Bioassessment of Roseville Run Watershed
Clarke Co, Virginia

Final Report

Submitted to

Office of Planning
County of Clarke
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Introduction and Literature Review

Roseville Run in Clarke County, Virginia is the subject of a watershed restoration project to mitigate nonpoint source pollution impacts in an agricultural landscape. Fecal coliform bacteria have been detected in 40% of the wells sampled in Clarke County in the past 10 years, with beef cattle having been identified as the primary source (Hagedorn 1999). Roseville Run is a major tributary to Spout Run, the county's only trout stream. To address these problems, the Clarke County Office of Natural Resources initiated a project to encourage construction of fences alongside Roseville Run from its origin to its confluence with Spout Run in order to exclude cattle and allow regrowth of riparian vegetation.

Excluding cattle from streams via the installation of fences along the stream reduces bank erosion and streambed disturbance which can hinder vegetative stability and increase sediment resuspension. However, there are questions as to the extent to which fencing allows for stream recovery and the time period over which any recovery will occur. In addition, fencing alone may not result in restoration of water quality and physical habitat if other Best Management Practices (BMPs), such as off-stream watering tanks, are not also utilized. There are also issues regarding the optimal characteristics of stream buffers, such as the distance between the fence and the stream bank and the type of vegetation (i.e. woody versus herbaceous) which should be present in the buffer zone between the stream and the fence. Given that stream fencing has significant costs, information on how to maximize its effectiveness in protecting water quality is valuable to natural resource managers in areas where animal grazing is an important land use.

Cattle with unrestricted access to streams may have deleterious or undesirable impacts on stream biota in several ways. Suspended sediment levels may be enhanced through erosion directly from the banks and/or from adjacent pasture. Suspended sediments may interfere with respiration and feeding of stream invertebrates (Lemly 1982) and fish (Gardner 1981). Deposited fine sediments may provide a poor substrate for many invertebrates and eliminate fish nesting areas. Enhanced levels of nutrients such as nitrogen and phosphorus reach these streams from manure deposited directly in the stream and/or on the adjacent pasture. Although less important in flowing waters than in lakes and ponds, nitrogen and phosphorus can stimulate the growth of nuisance algae which can alter stream food webs. Manure can also be a source of ammonia, which can be toxic to fish and benthic macroinvertebrates at high pH. The grazing and trampling action of cattle prevents the establishment of woody vegetation, eliminating the shading effect of trees. As a result, water temperatures may increase. Temperature is a critical factor controlling the life cycles of many aquatic organisms, and elevated stream temperatures can result in the elimination of cold-water animals such as stonefly nymphs and trout (Vannote and Sweeney 1980).

Knowing the potential for livestock with unrestricted access to streams to impact freshwater organisms, it should not be surprising to find that many studies to date indicate substantial degradation of the fauna of streams in watersheds with substantial land used as cattle pasture. A study in the piedmont region of Maryland found that the lack of fencing around

stream channels, along with a lack of other BMPs, resulted in sediment and nutrient pollution from dairy operations (Shirmohammadi et al. 1997).

This study was designed to use benthic invertebrates and physical stream habitat to assess stream conditions and monitor the response to riparian zone fencing. The overall objective of the study is to provide county resource managers with information on the effectiveness of fencing as a best management practice (BMP) in improving water quality in Clarke County.

Study Sites

Sites were selected to determine the status of Roseville Run and its major tributary, Westbrook Run, to ascertain the effectiveness of livestock fencing as a means for improving stream quality. Ideally, in a study attempting to determine the degree to which a stream or streams have been impacted by non-point source pollution, a reference station located in a relatively undisturbed watershed is selected in order to obtain information on the biological condition of a stream which is minimally impacted by human activities, but which shares the same natural influences as the study streams (e.g., stream order, climate, geology, etc.). An attempt was made to locate such a reference stream for this study, but examination of appropriate 7.5 minute scale topographic maps of the surrounding area did not reveal any such streams. As with the Page Brook study, a site on Page Brook at Rt. 617 was used as the reference site (Jones et al. 2002). Two sites on Roseville Run and two on Westbrook Run were sampled consistently during the years 1998 and 1999 (Figure 1). Table 1 indicates the names, location, and sampling dates at each station.

Methods

A modification of EPA Rapid Bioassessment Protocol (RBP) II was used as the basic tool for macroinvertebrate bioassessment (Plafkin et al. 1989). RBP II utilizes semiquantitative field collections in riffle/run and leaf litter habitats to determine the values of eight metrics which characterize the status of the benthic macroinvertebrate community. The protocol allows for the modification of metrics and the use of alternative metrics depending on regional conditions. Previous work has indicated that the scrapers/filter collector metric was very variable and not particularly indicative of degraded conditions (Jones and Kelso 1994). Furthermore, the occurrence of these two groups was sporadic in our samples. Thus, we deleted this metric. We used Sorensen's index for community similarity. The ratio shredders/total number could not be used as coarse particulate organic matter (CPOM) was not available at many sites. The seven metrics that we utilized in this study are shown in Table 2.

Macroinvertebrate communities were sampled at each site using a 44 cm x 22 cm kick net. The 0.5 mm mesh net was held to the bottom facing upstream and the substrate was disturbed for 1 m directly upstream from the net for one minute. Larger stones were also wiped clean manually when deemed necessary. Contents of the net were placed in a shallow pan. The net was inspected to remove adhering animals. Large stones and leaves were rinsed and

discarded. Obvious animals were picked directly into the sample jar. The remaining sample was collected by pouring the contents of the pan through a 0.5 mm sieve. This material was also transferred to the sample jar. The sample was preserved with formalin. Samples were collected from two locations at each station, a rapidly flowing riffle and a less rapid run, and composited into a single jar.

In the lab samples were rinsed with tap water through a 0.5 mm sieve to remove formalin and placed into a 35 cm x 40 cm pan marked with 5 cm x 5 cm squares. The pan was then shaken to distribute the sample evenly over the entire surface of the pan. Using a random number table, squares were selected for organism removal until a target number of 200 organisms was achieved. The pan was also scanned for large and/or rare taxa which were added to the picked subsample. All organisms were picked from the selected squares. Obvious large and unusual specimens were also added to the picked sample. The remaining sample was returned to the sample jar and represerved with alcohol/glycerine. Samples containing less than 100 animals were reported, but RBP metrics were not calculated. The selected organisms were sorted into ethanol-glycerine, identified to family and enumerated. Oligochaetes were not identified to family and were counted as a single taxon in all calculations. Taxonomic references included Merritt and Cummins (1996), McCafferty (1983), and Pennak (1978).

Macroinvertebrate rating was calculated following the guidance of the EPA bioassessment manual. In order to determine the values of certain metrics, it was necessary to assign biotic index values to each family (Hilsenhoff 1982). Since an external reference site unimpacted by agricultural activity with similar natural watershed characteristics was not available for sampling, the sampling event (i.e. station/date combination) in the Spout Run watershed which most consistently had scores on each metric ranking at or near the top of all samples was selected as the reference sample. As stated above this site was Page Brook at Rt. 617 (Jones et al. 2002). The raw scores of all samples were then expressed relative to the score of the reference sample. Metric scoring criteria used were those cited for RBP II (Fig. 6.3-4, Plafkin et al. 1989). EPT/Isopods was scored using the same criteria as EPT/Chironomids. Criteria for Sorenson's Index were: 0 for values less than 0.55, 3 for values between 0.55 and 0.75, and 6 for values greater than 0.75.

Relationships among sites were also explored using box plots created using SYSTAT for Windows. For a given category of samples a box plot depicts the spread of the middle half of the values as a box. A horizontal line within the box denotes the median. Whiskers (bracketed lines) extend to the edges of the data. Outliers are denoted by circles.

Habitat assessment was conducted using the methods outlined in the EPA bioassessment documents. The original RBP habitat protocol was used for Spring 1998 (Plafkin et al. 1989), but the revised protocol (Barbour et al. 1999) was used on the three later dates. At each site the Physical Characterization/Water Quality and Habitat Assessment (High Gradient) Field Data Sheets were filled out, normally during the macroinvertebrate sampling. This information was used to construct a rating based on the criteria in the habitat assessment portion of the document.

Results

Macroinvertebrates

A total of 7,810 macrobenthic invertebrates were identified and enumerated in 16 samples. Isopods (aquatic sowbugs) of the family Asellidae were the most abundant group comprising over 70% of all specimens. The midge family Chironomidae was the second most abundant with about 14% of all individuals followed by the caddisfly family Hydropsychidae at 4.5%. Other groups comprising over 1% of macrobenthos included the insect families Simulidae (blackflies) and Elmidae (riffle beetles), the oligochaetes (aquatic worms), and the planarians (flatworms). Number of individuals of each macroinvertebrate family found in each sample are contained in Appendix A. Relative abundance of each taxa is found in Appendix B.

Box plots were used to examine trends among sampling times by pooling data from all stations. The major non-insect taxa (Figure 2) included isopods (Asellidae), crayfish (Cambaridae), aquatic worms (Oligochaeta), and flatworms (Planariidae). Isopods were a dominant group at all sampling times with median contributions of over 50% of total individuals in the sample on all dates. Crayfish were generally rare, but were more abundant in the Fall 1999 sample especially at RR-M where 20 were collected. Oligochaetes were consistently found in small numbers, never exceeding 9% of the total and medians were generally about 2% of total. Flatworms were found in many samples, but were especially common in Fall 1999 at WB-WF when they made up slightly more than half of the total individuals.

Dominant insect taxa (Figure 3) were two-winged flies (Diptera), caddisflies (Trichoptera), beetles (Coleoptera), and mayflies (Ephemeroptera). Diptera were an important part of the community at most stations in the spring sample collections with median abundances of near 20% of total individuals. Diptera were generally less abundant in the fall except at WB-SF in 1998. Very few dipterans were observed in Fall 1999. Tripchoptera were well represented at all sites in Spring 1998 and at both SF stations (RR-SF and WB-SF) in Fall 1998 and Spring 1999. They were rare in Fall 1999. Coleoptera were consistently represented with median values of about 5% at all sample periods. Ephemeroptera were sporadic in occurrence.

Spatial trends were also examined using box plots. Roseville Run was represented by two stations: RR-M, an upstream site, and RR-SF, a downstream site. Likewise, Westbrook Run, the main tributary of Roseville Run, was also represented by two stations: WB-WF, an upstream site, and WB-SF, a downstream site. Isopods were always dominant at the Roseville Run sites with median values of 70-80% of total organisms (Figure 4). In Westbrook Run, the upstream site was strongly dominated by isopods, but at the downstream site isopods were much lower except on the last sampling date, Fall 1999. As noted above crayfish were sporadic except for the Fall 1999 RR-M sample. Oligochaetes were generally less abundant at the upstream sites than the downstream ones. Insect taxa consistently exhibited higher median abundance at WB-SF (Figure 5). Coleoptera and Trichoptera were generally higher at RR-SF than at the two upstream sites.

A stacked bar plot of average relative abundance of the major taxa showed that WB-SF, the lower site on Westbrook Run, had a much more even distribution of the major taxa than did any other site (Figure 6). At this site, isopods were only about 30% and Diptera, Coleoptera, and Trichoptera were 10-30% each. This contrasted with the other sites where isopods were over 60% of the total individuals. While never abundant, mayflies were more commonly found at WB-SF than at the other sites. RR-SF, the lower site on Roseville Run, showed a bit more diversity in these groups than did the two upstream sites.

Metrics exhibited some trends through time (Figure 7). Taxa richness generally decreased through the period with median going from about 13 to about 7. Family biotic index showed a slight increase as did percent dominance. Part of this was due to the decline in the benthic community at WB-SF in the last sample. However, the median value for the aggregate Biological Condition Index (BCI) score showed little change over time remaining near 10 which was about 25% of the reference values.

The spatial pattern in metrics was fairly clear (Figure 8). Individual metric scores for WB-SF, the lower site on Westbrook Run, consistently indicated a healthier community. For example, taxa richness, EPT index, and EPT/isopod abundance were higher while FBI and percent dominance were lower at WB-SF than at the other sites. This resulted in a aggregate BCI score median at WB-SF of about 25, about 60% of the reference value. RR-SF was slightly higher (median about 30% of reference) than the two upstream sites (10-20% of reference). Using the RBP II impairment class criteria (Plafkin et al. 1989) and the median BCI scores, WB-SF and RR-SF would be rated Moderately Impaired and the two upstream sites would be rated Severely Impaired.

Table 3 shows the metric values, metric scores, aggregate BCI, and impairment class for each sample collected in the study. Over the first three sampling dates, a very clear spatial pattern was evident. The lower station on Westbrook Run, WB-SF was much less impaired than the other three sites. It had a BCI score as high as 78.6 which represented Not Impaired conditions. However, on the final sampling date WB-SF showed impairment similar to that observed at the other sites.

Habitat

Results of habitat analysis using the standard EPA habitat protocol are shown in Tables 4-8. Pasture was the dominant surrounding land use resulting in local erosion varying from slight to heavy. Clear evidence of nonpoint sources was observed in the form of cattle activity in and along the stream (Table 4). Roseville Run and Westbrook Run are small streams varying in width from 1 to 4 m and in depth from 7 to 47 cm. Maximum velocities were 0.14 to 0.5 m/sec. Canopy cover was lacking over most of the stream with the most shading observed at the lower Roseville Run site, RR-SF. Riparian vegetation was mostly grasses.

Water quality measurements indicated that Roseville Run had high alkalinity, substantial conductivity, and above neutral pH as expected for a stream in the carbonate section of the Shenandoah Valley (Table 5). Dissolved oxygen was always adequate to support aquatic life, ranging from 7.4 to 12.6 mg/L. Highest values were observed in spring 1999 when values greatly exceeded 100% saturation due to intense photosynthesis of filamentous algae present. Water odors and oils were not present. Water was generally slightly turbid. Water was exceptionally turbid at WB-SF on the final sampling date. This was correlated with a decline in the benthic community at WB-SF on this date suggesting an increase in cattle activity or other erosive conditions in the area.

Sediment odors were normal on most dates and no sediment oils were observed (Table 6). Deposits of sand and silt were observed on a number of occasions. Cobble and gravel made up a majority of substrates at all stations in 1998 while in 1999 perceived substrate percentages had shifted to sand and silt.

The quantitative habitat assessment index changed during the study (Table 7). In spring 1998 the original Plafkin et al. (1989) index was used. Starting in fall 1998, the switch was made to the revised index procedure given in Barbour et al. (1999). In general habitat index values were about 50% of possible maximum score indicating substantial habitat degradation. The one exception was the 73% score found at WB-SF in spring of 1998.

Discussion

The results of this study indicate that the two upstream sites surveyed in the Roseville Run watershed consistently had a high degree of impairment. The two sites that were lower in their respective watersheds (both at Saratoga Farms) were typically moderately impaired. The Westbrook Run site at Saratoga Farms (WB-SF) was the least impacted site on 3 of 4 dates. In fact on each of the first 3 sampling dates, WB-SF scored much higher on the Biological Condition Index (BCI) than did the other three sites and on one date scored in the Not Impaired range. The Roseville Run site at Saratoga Farms (RR-SF) was highly impaired on the first sample date, but scored in the low end of moderately impaired on the remaining sample dates.

The habitat evaluation indicated that nonpoint sources in the form of livestock grazing were present at all stations, but were perhaps somewhat greater at the two upstream sites. The only site with much canopy cover was RR-SF which was the second best station in terms of BCI. Water quality measures did not reveal any differences between sites, but these were generally take at low flow. Sediment parameters showed little difference among stations. The EPA quantitative habitat assessment generally resulted in little difference among stations. However, on the first sample date, WB-SF which had the highest BCI score, also scored much higher on habitat than the other three sites.

While efforts were made to encourage landowners to construct fencing along streams in the Roseville Run watershed, the only fencing actually installed during the course of the study

was on Roseville Run just above U.S. Rt. 340. Thus, it is not surprising that the benthic community was moderately to highly impaired throughout the study area. The slight improvement in the benthic community at RR-SF may have been influenced by the fencing installed upstream on U.S. Rt 340. However, the change was very small. The higher quality found in the benthic community at WB-SF cannot be attributed to the installation of fencing since none was in place in Westbrook Run during the course of this study. It may be, however, that cattle activity was light in this area during the first 18 months of the study.

Most of the BCI scores observed in the Roseville Run were similar to those observed at unmitigated sites in the Page Brook watershed (Jones et al. 2002). These two groups of sites were also similar in overwhelming dominance of isopods. The higher scores observed on three dates at WB-SF were typical of those found at the sites in Page Brook that had fencing installed.

Conclusions

The Roseville Run watershed is a landscape whose vegetative cover has been extensively modified for agriculture. Like Page Brook, the stream community is seriously degraded in areas where cattle continue to have access. Very little of the stream bank is protected by fencing. One station on Westbrook Run exhibited a fair diversity of organisms and only moderately degraded conditions for the first three sampling dates. However, on the final sampling date the biological community at this site became degraded. The results of this study continue to suggest that in the absence of mitigation, stream communities in this landscape will suffer moderate to high impairment.

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Table 1.
Sample Locations
Roseville Run Study

Sample ID	Location	Spr'98	Fall'98	Spr'99	Fall'99
RR-M	Roseville Run, midway down	X	X	X	X
RR-SF	Roseville Run at Saratoga Farms	X	X	X	X
WB-WF	Westbrook Run, upstream	X	X	X	X
WB-SF	Westbrook Run at Saratoga Farms	X	X	X	X

Table 2
Metrics Used in the Roseville Run Study

Taxa Richness (TR)	-the number of taxa found in a given sample (high values indicate good water quality and habitat)
Family Biotic Index (FBI)	-the average tolerance value of individuals in a sample (low values indicate good water quality and habitat)
EPT/Chironomid Abundance (ept/chir, e/c)	-the number of individuals belonging to the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) divided by the number of individuals belonging to the Dipteran family Chironomidae (midges) (high values indicate good water quality and habitat)
Percent Dominance (% dom, %d)	-the percentage of individuals in a sample represented by the most abundant taxon (low values indicate good water quality and habitat)
EPT Index (EPT I)	-the number of taxa (in this case families) found in a sample belonging to the orders Ephemeroptera, Plecoptera, and Trichoptera (high values indicate good water quality and habitat)
EPT/Isopod abundance (ept/iso, e/i)	-the number of individuals belonging to the insect orders Ephemeroptera, Plecoptera, and Trichoptera divided by the number of individuals belonging to the crustacean order Isopoda (high values indicate good water quality and habitat).
Sorensen's Index of Community Similarity (Sor)	-a measure of who closely the family composition of a sample matches that of the reference sample (high values indicate good water quality and habitat).

Table 3
Metrics and Biological Condition Index Calculation
Roseville Run

		Metric Value ----->							Metric % of Ref ----->							Metric Score -->							Total	BCI (%)	Impair-
Station	Date	TaxaR	FBI	ept/chi	%DO	EPT	EPT/iso	Soren	TaxaR	FBI	ept/chi	%DO	EPT	EPT/iso	Soren	TaxaR	FBI	ept/	%D	E	EP	Sor	BCI	of Ref	ment
RR-M	28-May-9	12	7.13	0.312	63.72	4	0.125	0.694	54.5	79.7	7.3	63.7	57.1	9.7	0.694	3	3	0	0	0	0	3	9	21.4	SEV
RR-SF	27-May-9	14	6.90	0.429	58.20	3	0.139	0.723	63.6	82.3	10.0	58.2	42.9	10.8	0.723	3	3	0	0	0	0	3	9	21.4	SEV
WB-WF	27-May-9	11	7.52	0.919	74.04	4	0.020	0.778	50.0	75.5	21.5	74.0	57.1	1.5	0.778	3	3	0	0	0	0	6	12	28.6	MOD
WB-SF	27-May-9	16	5.21	1.214	30.69	3	2.125	0.731	72.7	109.	28.4	30.7	42.9	164.7	0.731	3	6	3	3	0	6	3	24	57.1	MOD
RR-M	19-Oct-98	7	7.97	0.200	96.82	1	0.002	0.708		71.3	4.7	96.8	14.3	0.1	0.708	0	3	0	0	0	0	3	6	14.3	SEV
RR-SF	19-Oct-98	9	6.75	3.200	63.28	2	0.249	0.800	40.9	84.2	74.8	63.3	28.6	19.3	0.800	3	3	3	0	0	0	6	15	35.7	MOD
WB-WF	19-Oct-98	8	7.81	0.667	88.55	1	0.003	0.605	36.4	72.7	15.6	88.5	14.3	0.2	0.605	0	3	0	0	0	0	3	6	14.3	SEV
WB-SF	19-Oct-98	15	5.30	1.250	26.57	6	2.195	0.760	68.2	107.	29.2	26.6	85.7	170.2	0.760	3	6	3	6	3	6	6	33	78.6	NOT
RR-M	11-Jun-99	7	7.29	0.065	63.43	2	0.029	0.585	31.8	77.9	1.5	63.4	28.6	2.3	0.585	0	3	0	0	0	0	3	6	14.3	SEV
RR-SF	11-Jun-99	12	7.37	1.812	79.84	3	0.094	0.578	54.5	77.0	42.3	79.8	42.9	7.3	0.578	3	3	3	0	0	0	3	12	28.6	MOD
WB-WF	11-Jun-99	5	7.85	0.333	93.98	1	0.010	0.364	22.7	72.4	7.8	94.0	14.3	0.8	0.364	0	3	0	0	0	0	0	3	7.1	SEV
WB-SF	11-Jun-99	12	5.34	0.448	43.94	6	3.900	0.783	54.5	106.	10.5	43.9	85.7	302.3	0.783	3	6	0	3	3	6	6	27	64.3	MOD
RR-M	29-Oct-99	8	7.91	2.000	91.37	2	0.006	0.667	36.4	71.8	46.7	91.4	28.6	0.5	0.667	0	3	3	0	0	0	3	9	21.4	SEV
RR-SF	02-Nov-99	12	7.66	3.000	80.00	1	0.018	0.851	54.5	74.1	70.1	80.0	14.3	1.4	0.851	3	3	3	0	0	0	6	15	35.7	MOD
WB-WF	29-Oct-99	5	7.60	0.182	55.23	1	0.032	0.698	22.7	74.7	4.2	55.2	14.3	2.5	0.698	0	3	0	0	0	0	3	6	14.3	SEV
WB-SF	02-Nov-99	6	7.71	10+	91.53	1	0.003	0.683	27.3	73.7	100+	91.5	14.3	0.2	0.683	0	3	6	0	0	0	3	12	28.6	MOD

Impairment categories: NOT = non-impaired, MOD = moderately impaired, SEV = severely impaired

Table 4
Habitat Evaluation. General Information
Roseville Run Study

Station	Date	Land Use	Local Erosion	Local NPS Sources	Stream Width (m)	Stream Depth (cm) Riffle	Run	Pool	High Water Mark (cm)	Max Velocity (m/sec)	Dam	Channel-ized	Canopy Cover	Riparian Veg
RR-M	27-May-98	Pasture	moderate	obvious	1	13	12	27	20	--	N	N	Open	--
RR-SF	28-May-98	Pasture	slight	some	2	8	10	38	90	--	N	N	MostlyShade	--
WB-WF	27-May-98	Pasture	moderate	some	2	10	12	47	--	--	N	N	Open	--
WB-SF	27-May-98	Pasture	slight	some	4	10	25	45	100	--	N	N	Open	--
RR-M	19-Oct-98	Pasture	--	obvious	0.8		12*		--	--	N	N	--	grass
RR-SF	19-Oct-98	--	--	--	2		10*		--	--	N	N	MostlyShade	grass/tree
WB-WF	19-Oct-98	Pasture	moderate	obvious	2		.07*		--	--	N	N	Open	grass
WB-SF	19-Oct-98	Pasture	--	obvious	4		.22*		--	--	N	N	Open	grass
RR-M	----	--	--	--	--		--		--	--	--	--	--	--
RR-SF	11-Jun-99	--	--	--	--		--		--	--	--	--	--	--
WB-WF	11-Jun-99	--	--	--	2.5		10		--	--	--	--	Open	--
WB-SF	11-Jun-99	Pasture	moderate	obvious	4		40		--	--	--	--	Open	grass
RR-M	29-Oct-99	Pasture	--	obvious	2.1		--		--	0.14	N	N	Open	grass
RR-SF	02-Nov-99	Pasture	heavy	obvious	--		--		--	0.14	--	--	MostlyShade	grass/tree
WB-WF	29-Oct-99	Pasture	--	--	--		15*		--	0.50	Y	--	Open	grass
WB-SF	02-Nov-99	Pasture	--	obvious	1.5		--		--	0.29	N	N	Open	grass

data sheet lost for RR-M in spring of 1999
-- indicates that data is not available for this parameter
* average depth of reach

Table 5
Habitat Evaluation. Water Quality.
Roseville Run

Station	Date	Temp (°C)	DO (mg/L)	DO (% sat)	pH	Alkalinity ($mgCaCO_3/L$)	Conductivity (umho@25)	Water Odors	Surface Oils	Turbidity
RR-M	28-May-98	15.7	8.25	84	--	--	390	none	none	clear
RR-SF	27-May-98	16.0	9.16	94	--	--	455	none	none	slightly turbid
WB-WF	27-May-98	18.5	13.22	143	--	--	430	none	none	slightly turbid
WB-SF	27-May-98	16.5	9.38	97	--	--	420	none	none	slightly turbid
RR-M	19-Oct-98	14.4	7.96	48	7.7	180	455	none	none	slightly turbid
RR-SF	19-Oct-98	15.5	10.63	106	7.7	173	707	none	none	slightly turbid
WB-WF	19-Oct-98	18.4	8.55	91	7.9	140	462	--	none	slightly turbid
WB-SF	19-Oct-98	15.4	10.11	102	7.9	153	344	none	none	clear
RR-M	--	--	--	--	--	--	--	--	--	--
RR-SF	11-Jun-99	21.1	11.92	134	8.09	--	678	--	--	--
WB-WF	11-Jun-99	25.5	12.60	154	8.06	--	416	none	none	clear
WB-SF	11-Jun-99	22.0	--	--	8.72	--	460	--	--	--
RR-M	29-Oct-99	15.9	8.29	84	7.98	--	543	none	none	clear
RR-SF	02-Nov-99	14.6	7.40	73	7.86	--	530	none	none	slightly turbid
WB-WF	29-Oct-99	15.9	11.98	122	8.11	--	458	none	none	clear
WB-SF	02-Nov-99	14.4	7.50	74	7.69	--	464	none	none	turbid

data sheet lost for RR-M in spring of 1999
-- indicates that data is not available for this parameter

Table 6
Habitat Evaluation. Substrate
Roseville Run

Station	Date	Sediment Odors	Sediment Oils	Sediment Deposits	Black Stones	Percent of Total Bedrock	Boulder	Cobble	Gravel	Sand	Silt	Clay
RR-M	28-May-98	normal	absent	sand, silt	no	0	2	16	16	33	33	0
RR-SF	27-May-98	normal	absent	sand	--	6	6	6	27	38	17	0
WB-WF	27-May-98	normal	absent	--	--	--	--	--	--	--	--	--
WB-SF	27-May-98	normal	absent	sand	--	5	15	30	10	30	10	0
RR-M	19-Oct-98	mild sulfur	absent	silt	--	0	4	12	30	5	49	0
RR-SF	19-Oct-98	normal	absent	--	--	0	2	13	40	0	45	0
WB-WF	19-Oct-98	none	absent	silt	--	0	5	20	60	0	15	0
WB-SF	19-Oct-98	normal	absent	silt	no	0	5	20	25	0	50	0
RR-M	----*	--	--	--	--	--	--	--	--	--	--	--
RR-SF	11-Jun-99	--	--	--	--	--	--	--	--	--	--	--
WB-WF	11-Jun-99	normal	absent	--	--	0	0	2	20	30	48	0
WB-SF	11-Jun-99	normal	absent	--	--	0	2	2	6	6	84	0
RR-M	29-Oct-99	normal	absent	silt	yes	5	0	11	0	11	73	0
RR-SF	02-Nov-99	normal	absent	none	--	0	2	2	7	30	59	0
WB-WF	29-Oct-99	manure	absent	none	no	0	0	1	0	30	69	0
WB-SF	02-Nov-99	normal	absent	none	--	0	0	3	3	31	63	0

data sheet lost for RR-M in spring of 1999
-- indicates that data is not available for this parameter

Table 7
Habitat Evaluation. EPA Quantitative Habitat Scoring.
Roseville Run

STATION	Date	Substrate & Cover	Embedded-ness	Flow	Channel Alteration	Scour & Deposition	Pool/riffle	Bank Stability	Bank Vegetation	Stream Cover		Overall Score	% of possible
RR-M	27-May-98	6	13	8	10	6	6	4	7	4		64	47.4
RR-SF	28-May-98	5	6	11	7	12	6	5	9	3		64	47.4
WB-WF	27-May-98	8	13	16	9	8	12	4	7	4		81	60.0
WB-SF	27-May-98	18	18	13	12	13	8	7	7	3		99	73.3
STATION	Date	Substrate & Cover	Embedded-ness	Vel/Dep Regime	Sediment Deposition	Channel Flow Status	Channel Alteration	Frequency of Riffles/Bends	Bank Stability	Vegetative Protection	Riparian Zone Width	Overall Score	% of possible
RR-M	19-Oct-98	7	10	8	9	18	14	14	12	12	6	110	55.0
RR-SF	19-Oct-98	11	9	14	9	13	17	13	10	12	6	114	57.0
WB-WF	19-Oct-98	14	12	10	11	14	14	16	10	8	6	115	57.5
WB-SF	19-Oct-98	12	10	9	6	11	15	15	8	7	6	99	49.5
RR-M	----	--	--	--	--	--	--	--	--	--	--	--	--
RR-SF	11-Jun-99	--	--	--	--	--	--	--	--	--	--	--	--
WB-WF	11-Jun-99	12	12	11	10	18	14	16	9	6	6	114	57.0
WB-SF	11-Jun-99	10	11	6	3	17	15	15	6	8	6	97	48.5
RR-M	29-Oct-99	9	16	14	7	20	12	14	11	6	8	117	58.5
RR-SF	02-Nov-99	5	10	13	6	20	20	11	4	10	4	103	51.5
WB-WF	29-Oct-99	11	11	11	10	20	12	15	4	10	6	200	100.0
WB-SF	02-Nov-99	9	12	8	3	20	16	8	3	9	2	90	45.0

data sheet lost for RR-M in spring of 1999
-- indicates that data is not available for this parameter
Scoring changed starting fall 1998, switch to newer protocol (Barbour et al.)

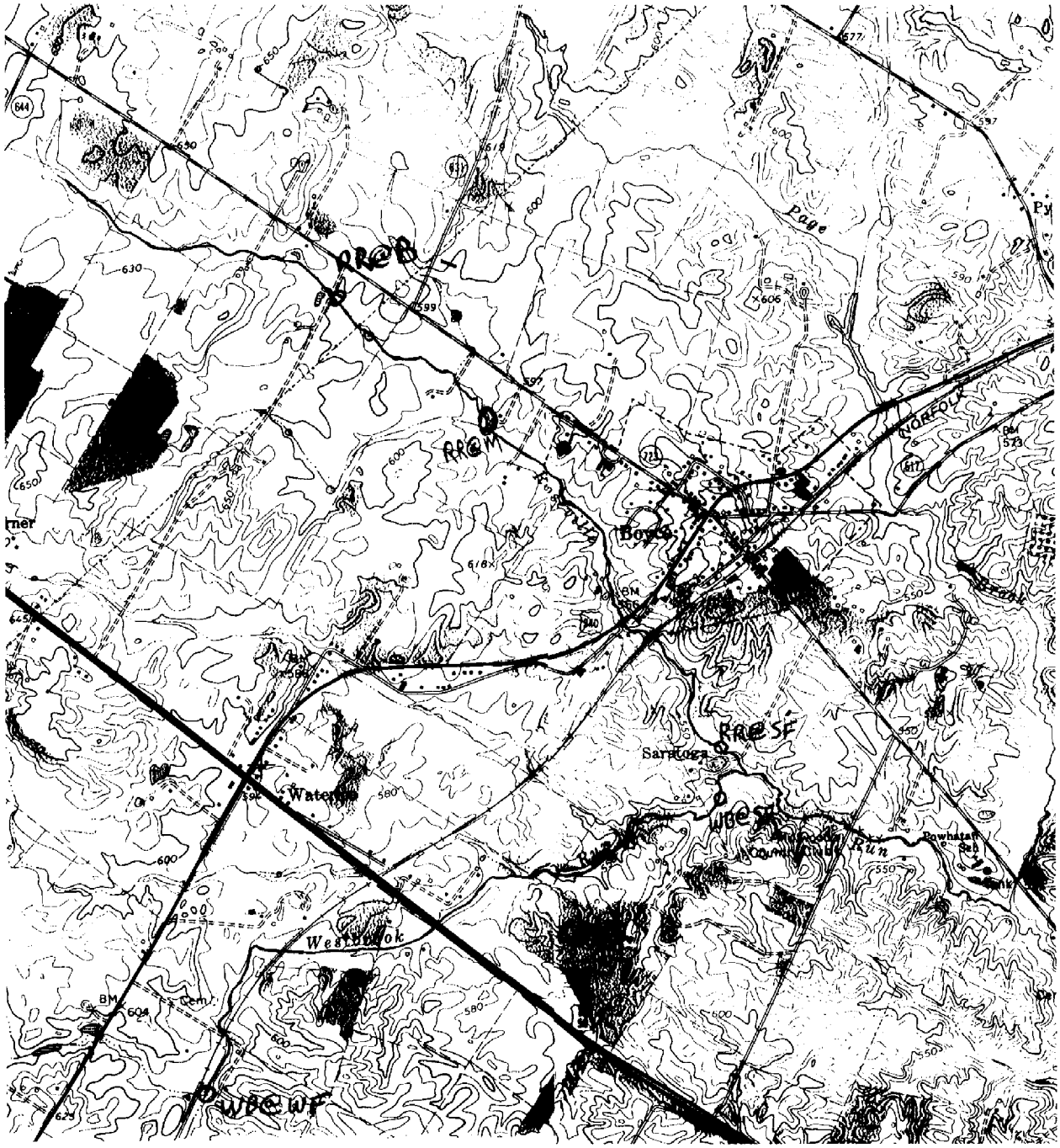

Figure 1. Map of the Study Area showing sampling sites.

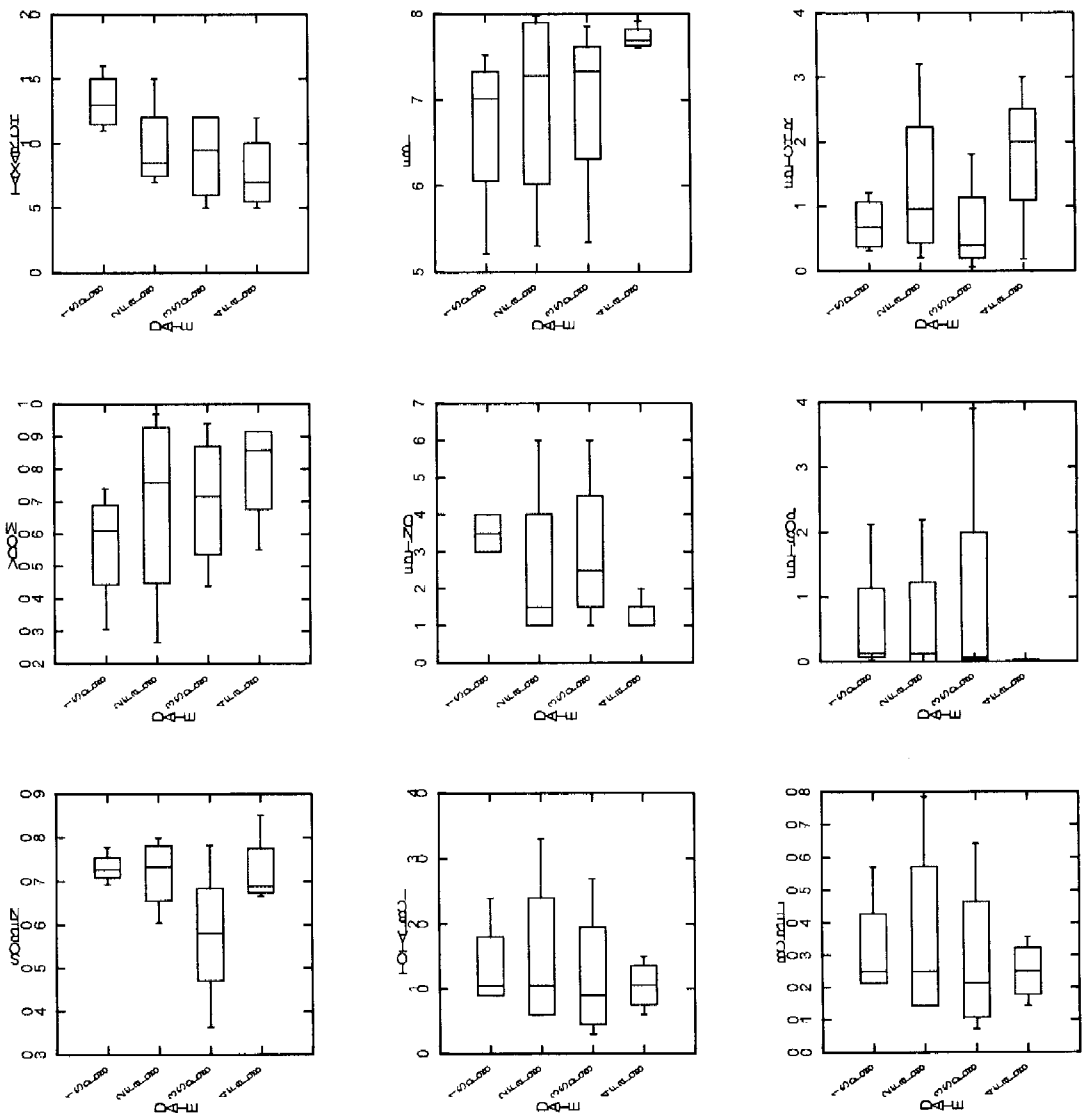

Figure 7. Metric values. Trends by sampling time pooling data from all sites. TAXARICH=taxa richness, FBI=family biotic index, EPTCHIR=EPT/Chironomid abundance, VDOM=percent dominance, EPTIND=EPT index, EPTISOP=EPT/Isopod abundance, SOREN=Sorensen's index of community similarity, TOTALBCI=Biological Condition Index Score (out of 42), BCIREL=BCI as a percent of reference BCI.

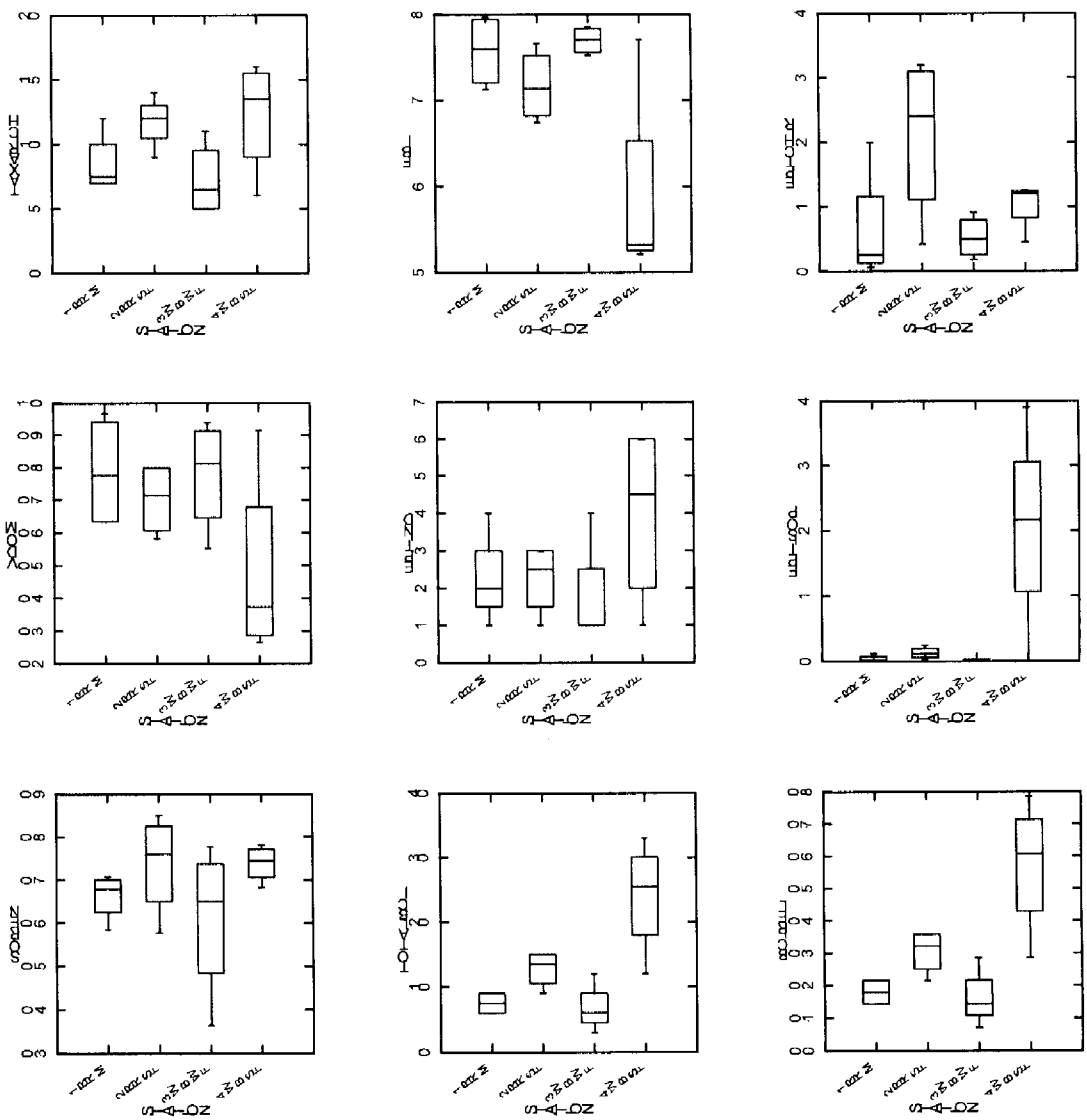

Figure 8. Metric values. Trends by sample site pooling data from all times. TAXARICH=taxa richness, FBI=family biotic index, EPTCHIR=EPT/Chironomid abundance, VDOM=percent dominance, EPTIND=EPT index, EPTISOP=EPT/Isopod abundance, SOREN=Sorensen's index of community similarity, TOTALBCI=Biological Condition Index Score (out of 42), BCIREL=BCI as a percent of reference BCI.

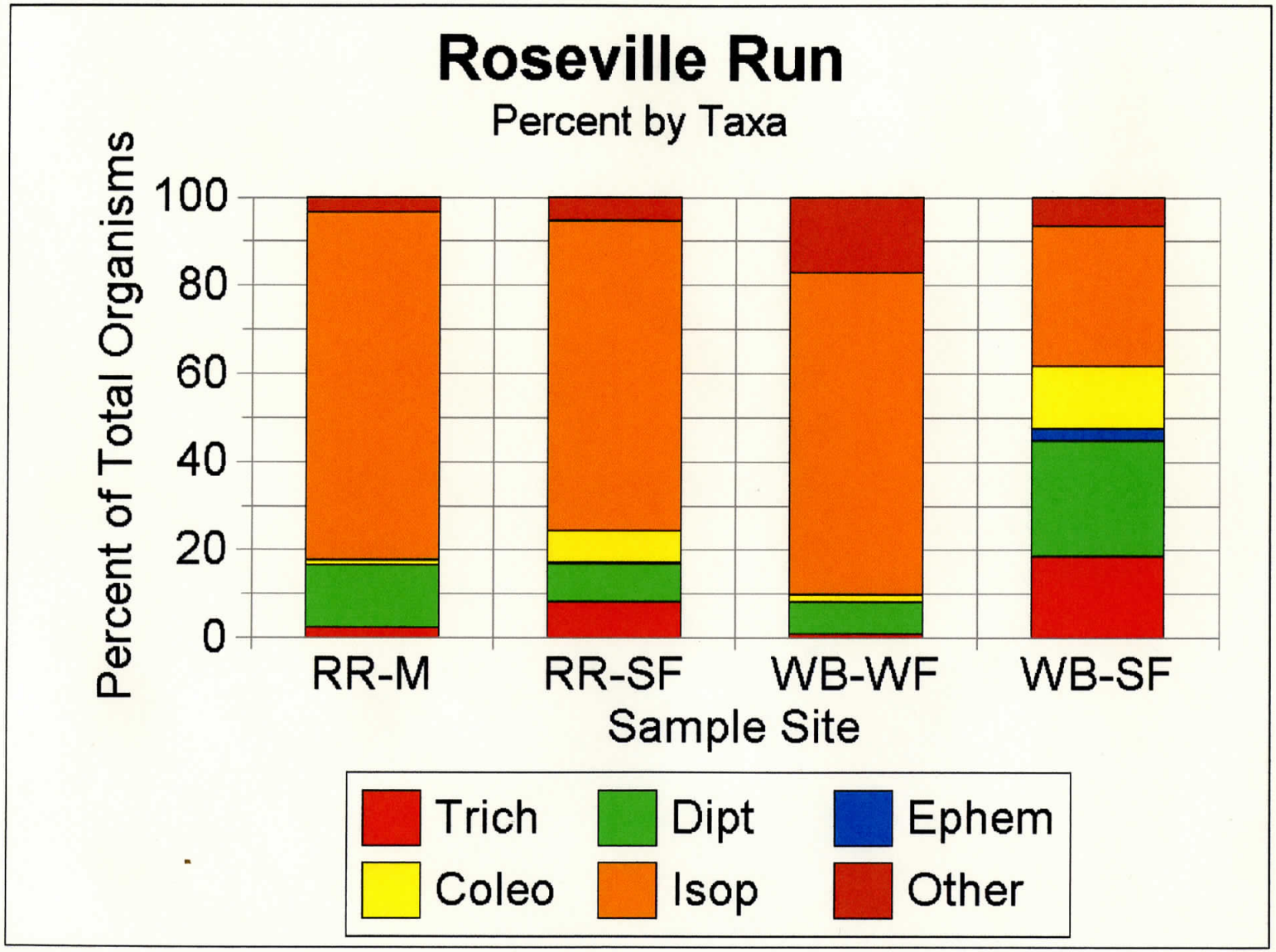

Figure 6. Relative abundance by major taxa for each sample site in Roseville Run watershed. Average over all sampling times.

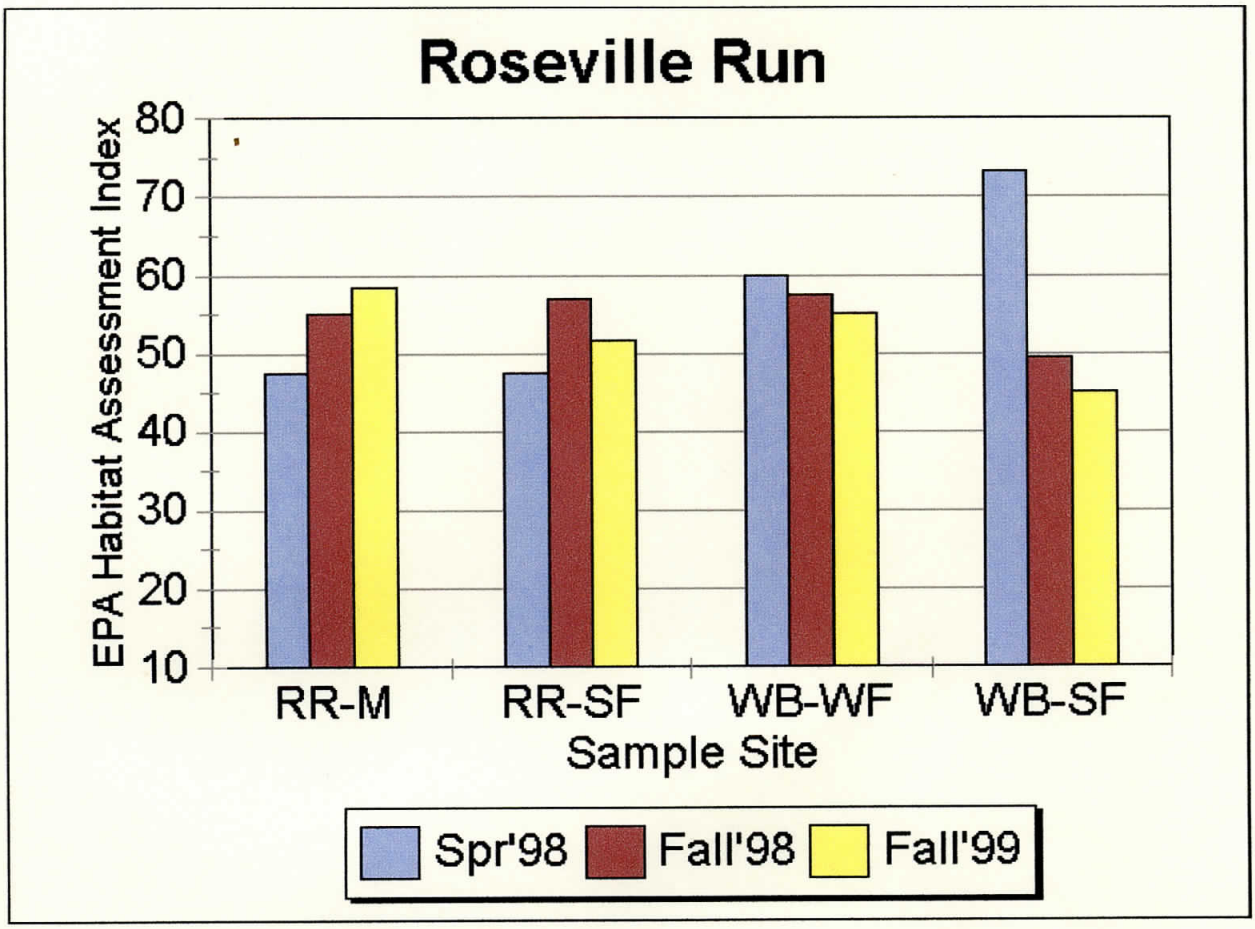

Figure 10. EPA Habitat Assessment Index. Percent of possible.

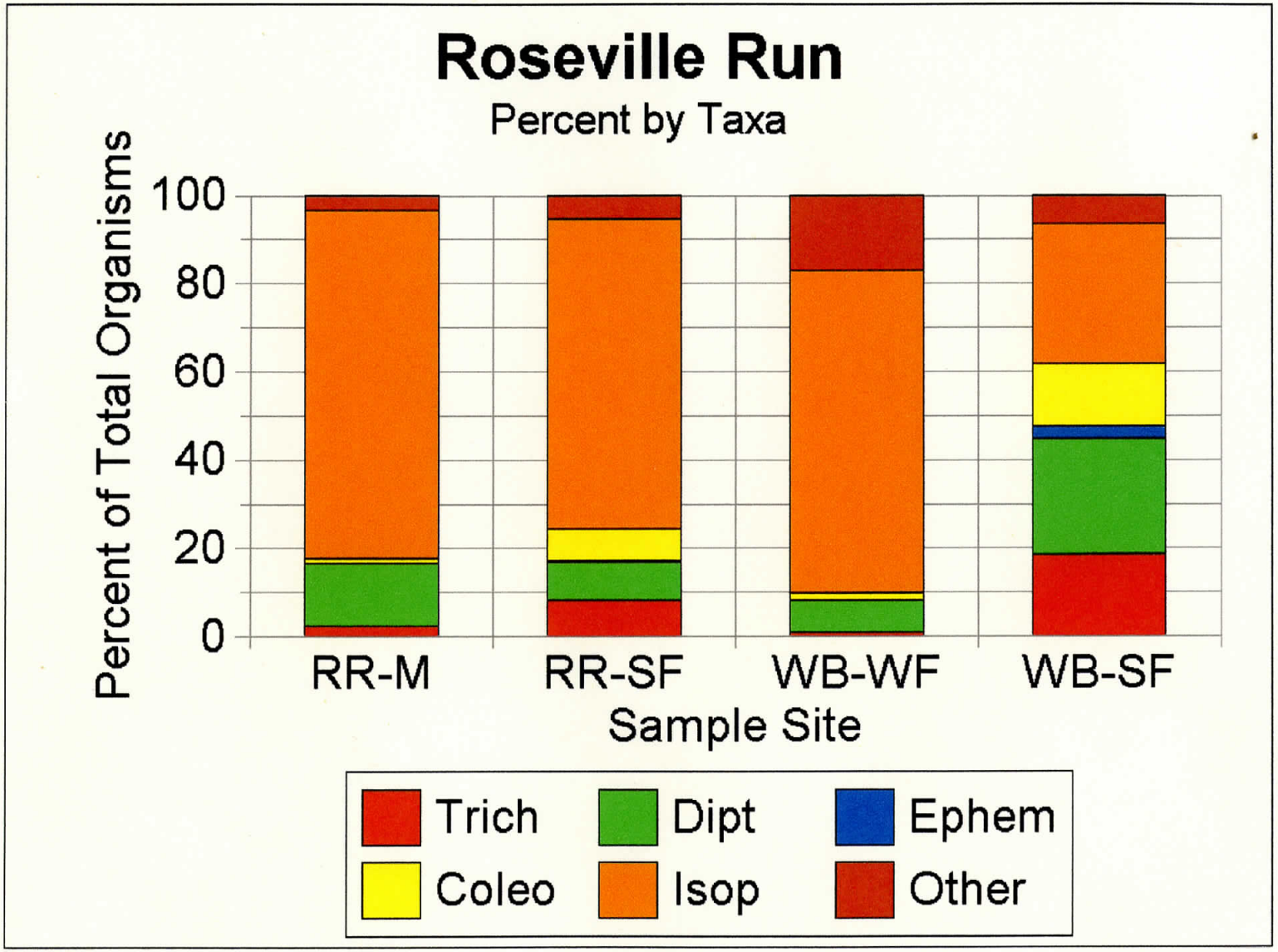

Figure 6. Relative abundance by major taxa. Average over all sampling dates.

ROSEVILLE RUN - RAW DATA TOTALS
QUANT DATA + SCANS

No. of Squares Counted	Station	FBI Ratings--> Date	TRICHOPTERA imm Trich	4 Hydropsyc	6 Polycentrc	3 Philopotar	4 Hydroptilic	Glossoma	PLECOPTERA 1 Perlidae	imm. Plec	DIPTERA 6 Ceratopog	6 Simulidae	6 Chironomi	3 Tipulidae
2	RR-M(con	28-May-98	2	43			8					6	173	
2	RR-SF(co	27-May-98		29			5					9	84	1
3	WB-WF(c	27-May-98	1	20			12					406	37	
3	WB-SF	27-May-98		93		7			2			1	84	3
1	RR-M	19-Oct-98		1								1	5	
1	RR-SF	19-Oct-98		44		4							15	9
1	WB-WF	19-Oct-98		2									3	1
2	WB-SF	19-Oct-98		67	2	8	1			1	3	4	72	
1	RR-M	11-Jun-99		1						3		1	62	
1	RR-SF	11-Jun-99	2	26								3	16	
1	WB-WF	11-Jun-99					2						6	
1	WB-SF	11-Jun-99		20		2	2						87	
1	RR-M	29-Oct-99		1									1	
4	RR-SF	02-Nov-99		3								1	1	1
7	WB-WF	29-Oct-99						2					11	
1	WB-SF	02-Nov-99		1										
			5	351	2	21	30	2	2	4	3	432	657	15

ROSEVILLE RUN - RA
QUANT DATA + SCAN

No. of Squares Counted	Station	FBI Ratings-Date	EPHEMEROPTERA 6 Empididae	Sciomyzid	u.k./imm E	4 Baetidae	4 Heptageni	7 Siphloneu	ODONATA 5 Calipteryg	3 Aeshnidae	COLEOPTERA 4 Elmidae	4 Psephenic	Haliplidae	Dytiscidae
2	RR-M(con	28-May-98			1						5		1	
2	RR-SF(co	27-May-98			2				2	1	30	1	4	
3	WB-WF(c	27-May-98			1						11	1		
3	WB-SF	27-May-98								2	41	2		
1	RR-M	19-Oct-98												
1	RR-SF	19-Oct-98								1	21			
1	WB-WF	19-Oct-98									29		2	
2	WB-SF	19-Oct-98	5				11				38			
1	RR-M	11-Jun-99									4			
1	RR-SF	11-Jun-99		1	1				1		23		3	1
1	WB-WF	11-Jun-99									3			
1	WB-SF	11-Jun-99			3	4		8			43		1	
1	RR-M	29-Oct-99			1						6		1	
4	RR-SF	02-Nov-99									9		5	
7	WB-WF	29-Oct-99									2			
1	WB-SF	02-Nov-99									21		3	
			5	1	9	4	11	8	3	4	286	4	20	1

ROSEVILLE RUN - RA
QUANT DATA + SCAN

No. of Squares Counted	Station	FBI Ratings- Date	CRUSTACEA 4 Gammaric	8 Asellidae	OTHER Cambarid	Gastropod	Oligochae	Planariida	Nematoda	TOTAL
2	RR-M(con	28-May-98		432		1	4	2		678
2	RR-SF(co	27-May-98		259	1		17			445
3	WB-WF(c	27-May-98		1743			14	108		2354
3	WB-SF	27-May-98	1	48	1	1	13	3	1	303
1	RR-M	19-Oct-98		517	2		6	2		534
1	RR-SF	19-Oct-98		193		1		17		305
1	WB-WF	19-Oct-98		688			20	32		777
2	WB-SF	19-Oct-98		41	1		9	8		271
1	RR-M	11-Jun-99		137			8			216
1	RR-SF	11-Jun-99		309				1		387
1	WB-WF	11-Jun-99		203	2					216
1	WB-SF	11-Jun-99		10			16	2		198
1	RR-M	29-Oct-99		339	20		2			371
4	RR-SF	02-Nov-99	1	164	1	1	14	4		205
7	WB-WF	29-Oct-99		62				95		172
1	WB-SF	02-Nov-99	5	346	2					378
			7	5491	30	4	123	274	1	7810

Metrics

ROSEVILLE RUN - ~~RAW DATA TOTALS~~
QUANT DATA

Squares Counted	Station	Date	Taxa Richness	FBI	ept/chir	%DOM	EPT Index	EPT/isop	Sorensen	Taxa Richness	FBI	ept/chir
			Raw Metrics									
2	RR-M(con	28-May-98	12	7.13	0.312	63.72%	4	0.125	0.6939	54.55	79.69	7.29
2	RR-SF(co	27-May-98	10	6.93	0.429	58.86%	3	0.139	0.7234	45.45	81.96	10.01
3	WB-WF(c	27-May-98	11	7.52	0.919	74.04%	4	0.020	0.7778	50.00	75.49	21.47
3	WB-SF	27-May-98	15	5.24	1.202	31.10%	3	2.104	0.7308	68.18	108.36	28.09
1	RR-M	19-Oct-98	7	7.97	0.200	96.82%	1	0.002	0.7083	31.82	71.27	4.67
1	RR-SF	19-Oct-98	7	6.88	3.200	65.42%	2	0.249	0.8	31.82	82.55	74.77
1	WB-WF	19-Oct-98	8	7.81	0.667	88.66%	1	0.003	0.6047	36.36	72.70	15.58
2	WB-SF	19-Oct-98	15	5.30	1.250	26.57%	6	2.195	0.76	68.18	107.14	29.21
1	RR-M	11-Jun-99	7	7.29	0.065	63.43%	2	0.029	0.5854	31.82	77.94	1.51
1	RR-SF	11-Jun-99	12	7.37	1.813	79.84%	3	0.094	0.5778	54.55	77.04	42.35
1	WB-WF	11-Jun-99	5	7.85	0.333	93.98%	1	0.010	0.3636	22.73	72.35	7.79
1	WB-SF	11-Jun-99	12	5.34	0.448	43.94%	6	3.900	0.7826	54.55	106.35	10.47
1	RR-M	29-Oct-99	8	7.91	2.000	91.37%	2	0.006	0.6667	36.36	71.78	46.73
4	RR-SF	02-Nov-99	12	7.66	3.000	80.00%	1	0.018	0.8511	54.55	74.14	70.09
7	WB-WF	29-Oct-99	5	7.60	0.182	55.23%	1	0.032	0.6977	22.73	74.74	4.25
1	WB-SF	02-Nov-99	6	7.71	ERR	91.53%	1	0.003	0.6829	27.27	73.67	ERR

using raw data
PB@617-F97 ref

ROSEVILLE RUN - RA
QUANT DATA

Squares Counted	Station	Date	% of Ref %DOM	EPT Index	EPT/isop	Sorensen	Taxa Richness	FBI	ept/chir	Score %DOM	EPT Index	EPT/isop
2	RR-M(con	28-May-98	63.72	57.14	9.69	0.6939	3	3	0	0	0	0
2	RR-SF(co	27-May-98	58.86	42.86	10.77	0.7234	3	3	0	0	0	0
3	WB-WF(c	27-May-98	74.04	57.14	1.51	0.7778	3	3	0	0	0	0
3	WB-SF	27-May-98	31.10	42.86	163.11	0.7308	3	6	3	3	0	6
1	RR-M	19-Oct-98	96.82	14.29	0.15	0.7083	0	3	0	0	0	0
1	RR-SF	19-Oct-98	65.42	28.57	19.28	0.8	0	3	3	0	0	0
1	WB-WF	19-Oct-98	88.66	14.29	0.23	0.6047	0	3	0	0	0	0
2	WB-SF	19-Oct-98	26.57	85.71	170.16	0.76	3	6	3	6	3	6
1	RR-M	11-Jun-99	63.43	28.57	2.26	0.5854	0	3	0	0	0	0
1	RR-SF	11-Jun-99	79.84	42.86	7.28	0.5778	3	3	3	0	0	0
1	WB-WF	11-Jun-99	93.98	14.29	0.76	0.3636	0	3	0	0	0	0
1	WB-SF	11-Jun-99	43.94	85.71	302.33	0.7826	3	6	0	3	3	6
1	RR-M	29-Oct-99	91.37	28.57	0.46	0.6667	0	3	3	0	0	0
4	RR-SF	02-Nov-99	80.00	14.29	1.42	0.8511	3	3	3	0	0	0
7	WB-WF	29-Oct-99	55.23	14.29	2.50	0.6977	0	3	0	0	0	0
1	WB-SF	02-Nov-99	91.53	14.29	0.22	0.6829	0	3	6	0	0	0

ROSEVILLE RUN - RA
QUANT DATA

Squares Counted	Station	Date	Sorensen	Total BCI	BCI (%)	
2	RR-M(con	28-May-98	3	9	21.43%	SI
2	RR-SF(co	27-May-98	3	9	21.43%	SI
3	WB-WF(c	27-May-98	6	12	28.57%	MI
3	WB-SF	27-May-98	3	24	57.14%	MI
1	RR-M	19-Oct-98	3	6	14.29%	SI
1	RR-SF	19-Oct-98	6	12	28.57%	MI
1	WB-WF	19-Oct-98	3	6	14.29%	SI
2	WB-SF	19-Oct-98	6	33	78.57%	NOT
1	RR-M	11-Jun-99	3	6	14.29%	SI
1	RR-SF	11-Jun-99	3	12	28.57%	MI
1	WB-WF	11-Jun-99	0	3	7.14%	SI
1	WB-SF	11-Jun-99	6	27	64.29%	MI
1	RR-M	29-Oct-99	3	9	21.43%	SI
4	RR-SF	02-Nov-99	6	15	35.71%	MI
7	WB-WF	29-Oct-99	3	6	14.29%	SI
1	WB-SF	02-Nov-99	3	12	28.57%	MI

ROSEVILLE RUN - RAW DATA TO TOTALS
QUANT DATA

No. of			TRICHOPTERA						PLECOPTERA	DIPTERA				
Squares		FBI Ratings-->		4	6	3	4		1			6	6	6	3
Counted	Station	Date	imm Trich	Hydropsyc	Polycentrc	Philopotar	Hydroptilic	Glossoma	Perlidae	imm. Plec	Ceratopog	Simulidae	Chironomi	Tipulidae	
2	RR-M(con	28-May-98	2	43			8					6	173		
2	RR-SF(co	27-May-98		29			5					9	84		
3	WB-WF(c	27-May-98	1	20			12					406	37		
3	WB-SF	27-May-98		93		7			1			1	84	1	
1	RR-M	19-Oct-98		1								1	5		
1	RR-SF	19-Oct-98		44		4							15		
1	WB-WF	19-Oct-98		2									3	1	
2	WB-SF	19-Oct-98		67	2	8	1			1	3	4	72		
1	RR-M	11-Jun-99		1						3		1	62		
1	RR-SF	11-Jun-99	2	26								3	16		
1	WB-WF	11-Jun-99					2						6		
1	WB-SF	11-Jun-99		20		2	2						87		
1	RR-M	29-Oct-99		1									1		
4	RR-SF	02-Nov-99		3								1	1	1	
7	WB-WF	29-Oct-99						2					11		
1	WB-SF	02-Nov-99		1											
			5	351	2	21	30	2	1	4	3	432	657	3	

ROSEVILLE RUN - RA
QUANT DATA

No. of Squares Counted	Station	FBI Ratings-Date	EPHEMEROPTERA						ODONATA		COLEOPTERA			
			6				4	4	7	5	3	4	4	
			Empididae	Sciomyzid	u.k./imm	Epl	Baetidae	Heptageni	Siphloneu	Calipteryg	Aeshnidae	Elmidae	Psephenic	Haliplidae
2	RR-M(con	28-May-98				1						5		1
2	RR-SF(co	27-May-98				2						30	1	4
3	WB-WF(c	27-May-98				1						11	1	
3	WB-SF	27-May-98									2	41	2	
1	RR-M	19-Oct-98												
1	RR-SF	19-Oct-98										21		
1	WB-WF	19-Oct-98										29		2
2	WB-SF	19-Oct-98	5					11				38		
1	RR-M	11-Jun-99										4		
1	RR-SF	11-Jun-99		1		1				1		23		3
1	WB-WF	11-Jun-99										3		
1	WB-SF	11-Jun-99				3	4		8			43		1
1	RR-M	29-Oct-99				1						6		1
4	RR-SF	02-Nov-99										9		5
7	WB-WF	29-Oct-99										2		
1	WB-SF	02-Nov-99										21		3
			5	1		9	4	11	8	1	2	286	4	20

ROSEVILLE RUN - RA
QUANT DATA

No. of Squares Counted	Station	FBI Ratings- Date	CRUSTACEA Dytiscidae	4 Gammaric	8 Asellidae	OTHER Cambarid	Gastropod	Oligochae	Planariida	Nematoda	TOTAL
2	RR-M(con	28-May-98			432		1	4	2		678
2	RR-SF(co	27-May-98			259			17			440
3	WB-WF(c	27-May-98			1743			14	108		2354
3	WB-SF	27-May-98		1	48		1	13	3	1	299
1	RR-M	19-Oct-98			517	2		6	2		534
1	RR-SF	19-Oct-98			193		1		17		295
1	WB-WF	19-Oct-98			688			19	32		776
2	WB-SF	19-Oct-98			41	1		9	8		271
1	RR-M	11-Jun-99			137			8			216
1	RR-SF	11-Jun-99	1		309				1		387
1	WB-WF	11-Jun-99			203	2					216
1	WB-SF	11-Jun-99			10			16	2		198
1	RR-M	29-Oct-99			339	20		2			371
4	RR-SF	02-Nov-99		1	164	1	1	14	4		205
7	WB-WF	29-Oct-99			62				95		172
1	WB-SF	02-Nov-99		5	346	2					378
			1	7	5491	28	4	122	274	1	7790

METRICS

ROSEVILLE RUN - ~~RAW DATA TOTALS~~
~~QUANT DATA + SCANS~~ OK

Squares Counted	Station	Date	Taxa Richness	FBI	ept/chir	Raw Metrics %DOM	EPT Index	EPT/isop	Sorensen	Taxa Richness	FBI	ept/chir
2	RR-M(con	28-May-98	12	7.13	0.312	63.72%	4	0.125	0.6939	54.55	79.69	7.29
2	RR-SF(co	27-May-98	14	6.90	0.429	58.20%	3	0.139	0.7234	63.64	82.29	10.01
3	WB-WF(c	27-May-98	11	7.52	0.919	74.04%	4	0.020	0.7778	50.00	75.49	21.47
3	WB-SF	27-May-98	16	5.21	1.214	30.69%	3	2.125	0.7308	72.73	108.99	28.37
1	RR-M	19-Oct-98	7	7.97	0.200	96.82%	1	0.002	0.7083	31.82	71.27	4.67
1	RR-SF	19-Oct-98	9	6.75	3.200	63.28%	2	0.249	0.8	40.91	84.20	74.77
1	WB-WF	19-Oct-98	8	7.81	0.667	88.55%	1	0.003	0.6047	36.36	72.70	15.58
2	WB-SF	19-Oct-98	15	5.30	1.250	26.57%	6	2.195	0.76	68.18	107.14	29.21
1	RR-M	11-Jun-99	7	7.29	0.065	63.43%	2	0.029	0.5854	31.82	77.94	1.51
1	RR-SF	11-Jun-99	12	7.37	1.813	79.84%	3	0.094	0.5778	54.55	77.04	42.35
1	WB-WF	11-Jun-99	5	7.85	0.333	93.98%	1	0.010	0.3636	22.73	72.35	7.79
1	WB-SF	11-Jun-99	12	5.34	0.448	43.94%	6	3.900	0.7826	54.55	106.35	10.47
1	RR-M	29-Oct-99	8	7.91	2.000	91.37%	2	0.006	0.6667	36.36	71.78	46.73
4	RR-SF	02-Nov-99	12	7.66	3.000	80.00%	1	0.018	0.8511	54.55	74.14	70.09
7	WB-WF	29-Oct-99	5	7.60	0.182	55.23%	1	0.032	0.6977	22.73	74.74	4.25
1	WB-SF	02-Nov-99	6	7.71	ERR	91.53%	1	0.003	0.6829	27.27	73.67	ERR

using raw data
PB@617-F97 ref

ROSEVILLE RUN - RA
QUANT DATA + SCAN

Squares Counted	Station	Date	% of Ref %DOM	EPT Index	EPT/isop	Sorensen	Taxa Richness	FBI	ept/chir	Score %DOM	EPT Index	EPT/isop	Sorensen
2	RR-M(con	28-May-98	63.72	57.14	9.69	0.6939	3	3	0	0	0	0	3
2	RR-SF(co	27-May-98	58.20	42.86	10.77	0.7234	3	3	0	0	0	0	3
3	WB-WF(c	27-May-98	74.04	57.14	1.51	0.7778	3	3	0	0	0	0	6
3	WB-SF	27-May-98	30.69	42.86	164.73	0.7308	3	6	3	3	0	6	3
1	RR-M	19-Oct-98	96.82	14.29	0.15	0.7083	0	3	0	0	0	0	3
1	RR-SF	19-Oct-98	63.28	28.57	19.28	0.8	3	3	3	0	0	0	6
1	WB-WF	19-Oct-98	88.55	14.29	0.23	0.6047	0	3	0	0	0	0	3
2	WB-SF	19-Oct-98	26.57	85.71	170.16	0.76	3	6	3	6	3	6	6
1	RR-M	11-Jun-99	63.43	28.57	2.26	0.5854	0	3	0	0	0	0	3
1	RR-SF	11-Jun-99	79.84	42.86	7.28	0.5778	3	3	3	0	0	0	3
1	WB-WF	11-Jun-99	93.98	14.29	0.76	0.3636	0	3	0	0	0	0	0
1	WB-SF	11-Jun-99	43.94	85.71	302.33	0.7826	3	6	0	3	3	6	6
1	RR-M	29-Oct-99	91.37	28.57	0.46	0.6667	0	3	3	0	0	0	3
4	RR-SF	02-Nov-99	80.00	14.29	1.42	0.8511	3	3	3	0	0	0	6
7	WB-WF	29-Oct-99	55.23	14.29	2.50	0.6977	0	3	0	0	0	0	3
1	WB-SF	02-Nov-99	91.53	14.29	0.22	0.6829	0	3	6	0	0	0	3

ROSEVILLE RUN - RA
QUANT DATA + SCAN

Squares Counted	Station	Date	Total BCI	BCI (%)	
2	RR-M(con	28-May-98	9	21.43%	HIGH
2	RR-SF(co	27-May-98	9	21.43%	HIGH
3	WB-WF(c	27-May-98	12	28.57%	MOD
3	WB-SF	27-May-98	24	57.14%	MOD
1	RR-M	19-Oct-98	6	14.29%	HIGH
1	RR-SF	19-Oct-98	15	35.71%	MOD
1	WB-WF	19-Oct-98	6	14.29%	HIGH
2	WB-SF	19-Oct-98	33	78.57%	NOT
1	RR-M	11-Jun-99	6	14.29%	HIGH
1	RR-SF	11-Jun-99	12	28.57%	MOD
1	WB-WF	11-Jun-99	3	7.14%	HIGH
1	WB-SF	11-Jun-99	27	64.29%	MOD
1	RR-M	29-Oct-99	9	21.43%	HIGH
4	RR-SF	02-Nov-99	15	35.71%	MOD
7	WB-WF	29-Oct-99	6	14.29%	HIGH
1	WB-SF	02-Nov-99	12	28.57%	MOD

Page Brook + Roseville Run

PB@ 6/7
Fall '97

Reference Conditions

Taxa Richness	~~27~~ 22
FBI	~~3.57~~ 5.68
EPT/Chir	~~3.17~~ 4.28
EPT Index	~~#~~ 7
% Dom	—
Soren	—
EPT/Isopods	1.29

1 Leptophebiadae
2 Vellidae
3 Coxidae
1 Isotomidae
1 Hydracarina
6 Pelecypods

Clarke County Projects

Metric Criteria used most from Pflafkin et al.

	Scoring Criteria		
Metric	6	3	0
Taxa Richness	>80%	40-80%	<40%
FBI	>85%	50-85%	<50%
EPT/Chir	>75%	25-75%	<25%
% Dominant Fam	<30%	30-50%	>50%
EPT Index	>90%	70-90%	<70%
EPT/Isopods	>75%	25-75%	<25%
Sorensen's	>0.75	0.25-0.75	<0.25