An Ecological Assessment of the

Youghiogheny River Watershed

WEST VIRGINIA

Watershed Assessment Program

An Ecological Assessment of the Youghiogheny River Watershed within West Virginia - 1996

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prepared by

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Summary

Historically, little has been documented about streams in the Youghiogheny River watershed within West Virginia. Fortunately it was one of the five watersheds selected for assessment during the first year of sampling under the newly organized Watershed Assessment Program (WAP) of the West Virginia Division of Environmental Protection's (DEP) Office of Water Resources (OWR). In July 1996, field teams from the WAP obtained data on the Youghiogheny River watershed. Of the 27 named streams located within the watershed, 22 were sampled. One unnamed stream was visited as well. Stony Run was partially filled in by construction of I-68, therefore, it was not sampled. Benthic, bacterial and physico-chemical samples were collected, primarily from near the streams' mouths. Instream and near stream habitats were assessed at most sample sites.

No sites were identified as having severely impaired biological conditions or poor habitat conditions when compared to reference stations. However, benthic community metric scores from several sites indicated poor biological diversity and unbalanced communities. This may have been due, in part, to less than optimal habitat conditions. Many sites had moderate to high levels of sedimentation. The high levels of sedimentation may have been due to a combination of low gradients (a natural phenomenon in much of this watershed) and soil erosion from farms and residential areas.

Seven sites exhibited fecal coliform bacteria concentrations greater than the criterion for applicable stream uses. Laurel Run's pH, and concentrations of iron, aluminum and manganese violated applicable criteria due to acid mine drainage.

Currently, the water quality criteria for public and industrial supply uses do not apply to streams in the Youghiogheny Watershed. The Environmental Quality Board (EQB) promulgated these use exclusions, but research by the EQB staff has found no reasons for them. Whether these water use exclusions are appropriate for this watershed and other questions were in need of answering. This assessment answered some of these questions.

The top two priority actions suggested by the DEP are:

- Recommend the EQB remove current use exclusions from Youghiogheny waters.
- Encourage further assessments of the five streams with biological condition scores below 50% of their respective reference sites to determine the causes and sources of impairment.

Acknowledgements

The primary author of this report is Douglas Wood. Without the assistance of many other individuals, however, compilation of this document would not have been possible. Jeffrey Bailey, Michael Nowlin, Michael Puckett and Michael Whitman collected the samples and assessed the sites. Marshall University students, Eric Wilhelm and Andrea Henry, under the guidance of Dr. Donald Tarter and Jeffrey Bailey, processed the benthos samples. Jeffrey Bailey, Janice Smithson, Alvan Gale and Douglas Wood identified the macroinvertebrates. Charles Surbaugh stored the raw data in the computer file. John Wirts and Jeffrey Bailey generated the tables and figures. George Constantz, working in parallel on another watershed report, bounced ideas to the primary author. Michael Arcuri and Patrick Campbell, along with the individuals already mentioned, provided useful comments while reviewing the report. Environmental Inspector Don Cathell gave insight into potential pollution sources in the watershed. Niles Primrose, of the Maryland Department of Natural Resources, provided a wealth of data from an ongoing, long-term monitoring effort in the Maryland portion of the watershed. Tom Oldham, of the West Virginia Division of Natural Resources, provided information on fish sampling and, particularly, on the Cheat Minnow. WV DEP's Technical Applications and Geographic Information Systems, (TAGIS) assisted with preparation of all maps. Finishing touches were applied to the report by James Hudson. Matt Thompson from WV DEP's Public Information Office provided layout services for this report.

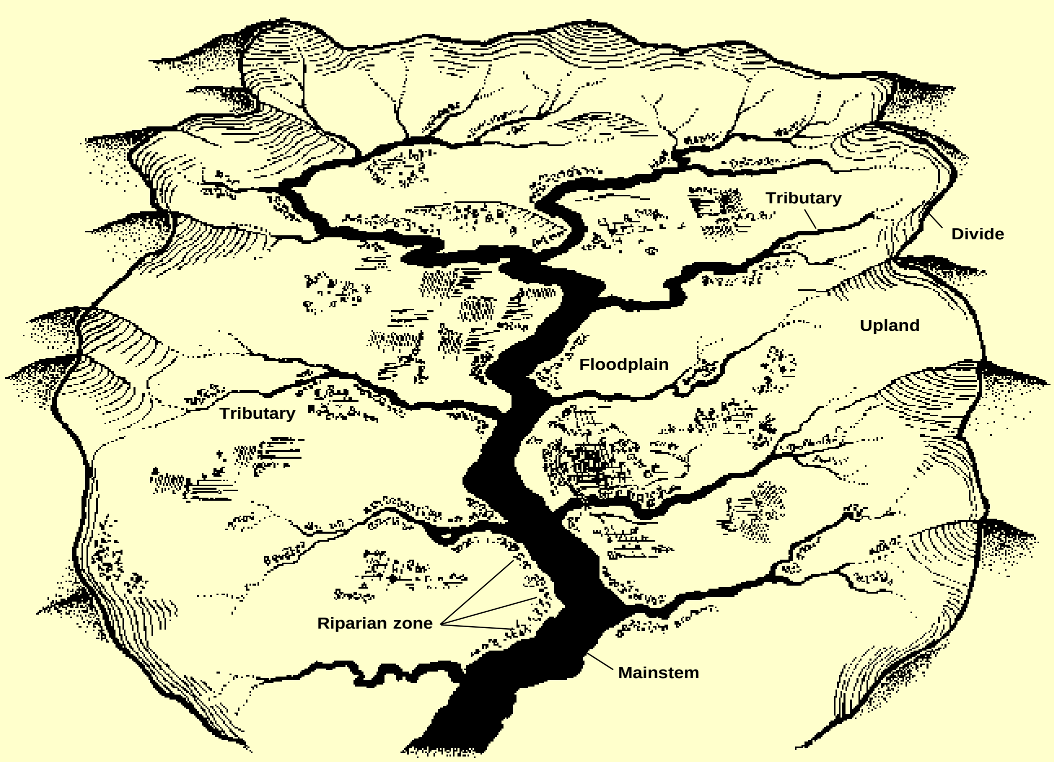
Watersheds and their Assessment

In 1959, the West Virginia Legislature created the State Water Commission, predecessor of the Office of Water Resources (OWR). The OWR has since been charged with balancing the human needs of economic development and water consumption with the restoration and maintenance of water quality in the state's waters.

At the federal level, the U.S. Congress enacted the Clean Water Act of 1972 (the Act) plus its subsequent amendments to restore the quality of our nation's waters. For 25 years, the Act's National Pollutant Discharge Elimination System (NPDES) has caused reductions in pollutants piped to surface waters. There is broad consensus that, because NPDES permits have reduced the amount of contaminants in point sources, the water quality of our nation's streams has improved significantly.

Under the federal law, each state was given the option of managing NPDES permits within its borders or leaving the federal government in that role. When West Virginia assumed primacy over NPDES permits in 1982, the state's Water Resources Board [combined with the Air Pollution Control Board in 1994 to become the Environmental Quality Board (EQB)] began developing water quality criteria for

Figure 1



Sarah B. Lauterbach

A Generalized Watershed

In several dictionaries, the first definition of "watershed" is the divide between adjoining water drainage areas. This report, though, uses an alternate definition, namely "all the land surface from which water drains to a specific point". For example, the Youghiogheny River watershed, detailed in this report, includes the part of Preston County that sheds surface water to Youghiogheny River.

each kind of use designated for the state's waters (see box). The WV Division of Environmental Protection's (DEP) water protection activities are guided by these water quality criteria and the EQB's anti-degradation policy, which charges the OWR with maintaining surface waters at sufficient quality to support existing uses, whether or not the uses are specifically designated by the EQB.

Water Quality Criteria

The levels of water quality parameters or stream conditions that are required to be maintained by the Code of State Regulations, Title 46, Series 1 (Requirements Governing Water Quality Standards - AKA the Water Quality Standards).

Even with significant progress, by the early 1990s many streams still did not support their designated uses. Consequently, environmental managers began examining pollutants flushing off the landscape from a broad array of sources. Recognizing the negative impacts of these Non-Point Sources (NPS) of pollution, which do not originate at clearly identifiable pipes or other outlets, was a conceptual step that served as a catalyst for today's holistic watershed approach to improving water quality.

Designated Uses

For each water body, those uses specified in the Water Quality Standards, whether or not those uses are being attained. Unless otherwise designated by the rules, all waters of the State are designated for:

- the propagation and maintenance of fish and other aquatic life, and
- water contact recreation.

Other types of designated uses include:

- public water supply,
- agriculture and wildlife uses, and
- industrial uses

A variety of watershed projects are currently being implemented by several DEP units, including the Watershed Assessment Program (the Program). Located within the OWR, the Program's scientists are charged with evaluating the health of West Virginia's watersheds. The Program is guided, in part, by the Interagency Watershed Management Steering Committee (see sidebar below).

The Program uses the U.S. Geological Survey's (USGS) scheme of hydrologic units to divide the state into 32 watersheds (see map, Figure 2). Some of these watershed units are entire stream basins bounded by natural hydrologic divides (e.g., Upper Guyandotte River watershed). Two other types of watershed units were devised for manageability: (1) clusters of small tributaries that drain directly into a larger mainstem stream (e.g., Potomac River direct drains watershed) and (2) the West Virginia parts of interstate basins (e.g., Tug Fork watershed). A goal of the Program is to assess each watershed unit every 5 years, an interval coinciding with the reissuance of National Pollutant Discharge Elimination System (NPDES) permits.

The Interagency Watershed Management Steering Committee

consists of representatives from each agency which participates in the Watershed Management Framework. Its function is to coordinate the operations of the existing water quality programs and activities within West Virginia to better achieve shared water resource management goals and objectives. The Watershed Basin Coordinator serves as the day to day contact for the committee. The responsibilities of this position are to organize and facilitate the Steering Committee meetings, maintain the watershed management schedule, assist with public outreach, and to be the primary contact for watershed management related issues.

A watershed can be envisioned as an aquatic "tree", a system of upwardly branching, successively smaller streams. An ideal watershed assessment would document changes in the quantity and quality of water flowing down every stream, at all water levels, in all seasons, from headwater reaches to

the exit point of the watershed. Land uses throughout the watershed would also be quantified. Obviously this approach would require more time and resources than are available to any agency.

General Watershed Assessment Strategy

The Program, therefore, assesses the health of a watershed by evaluating the health of as many of its streams as possible, as close to their mouths as possible. An exception to this general strategy is the strategy developed specifically for comparing watersheds to one another. This special sampling strategy is detailed in the section titled “Special Watersheds Assessment Strategy.” The general sampling strategy can be broken into several steps:

- The names of streams within the watershed are retrieved from the United States Environmental Protection Agency’s (EPA) Water Body System database.
- A list of streams is developed that contains several sub-lists, including:

1. Severely impaired streams,
2. Moderately impaired streams,
3. Slightly impaired streams,
4. Unimpaired streams,
5. Unassessed streams, and
6. Streams of particular concern to citizens or permit writers.

- Assessment teams visit as many streams listed as possible and sample as close to the streams' mouths as allowed by road access and sample site suitability. Longer streams may also be sampled at additional sites further upstream. In general if a stream is 15 to 30 miles (25 to 50 km) long, two sites are sampled. If a stream is 30 to 50 miles (50 to 89 km) long, three sites are sampled. If a stream is 50 to 100 miles (80 to 160 km) long, four sites are sampled. If a stream is longer than 100 miles (160 km), five sites are sampled. If inaccessible or unsuitable sites are dropped from the list, they are replaced with previously determined alternate sites.

The Program has scheduled the study of each watershed for a specific year of a 5-year cycle. Advantages of this pre-set timetable include: (a) synchronizing study dates with permit cycles, (b) facilitating the addition of stakeholders to the information gathering process, (c) insuring assessment of all watersheds, (d) improving the OWR's ability to plan and (e) buffering the assessment process against domination by special interests.

In broad terms, OWR evaluates the streams and the Interagency Watershed Management Steering Committee sets priorities in each watershed in 5 phases:

Phase 1 - For an initial cursory view, assessment teams measure or estimate about 50 indicator parameters in as many of each watershed's streams as possible.

Phase 2 - Combining older information, new Phase 1 data and stakeholders' reports, the Program produces a list of streams of concern.

Phase 3 - From the list of streams of concern, the Interagency Watershed Management Steering Committee develops a smaller list of priority streams for more detailed study.

Phase 4 - Depending on the situation, Program teams or outside teams (e.g., USGS or consultants) intensively study the priority streams.

Phase 5 - The Office of Water Resources issues recommendations for improvement; develops total

maximum daily loads, if applicable (see box); and, makes data available to any interested party such as local watershed associations, educators, consultants, and citizen monitoring teams.

This document, which reports Phase 1 findings, has been prepared for a wide variety of users, including elected officials, environmental consultants, educators and natural resources managers.

Total Maximum Daily Load and the 303(d) List

The term "total maximum daily load" (TMDL) originated in the federal Clean Water Act, which requires that degraded streams be restored to their designated uses.

Every two years, a list of water quality limited streams [called the 303(d) list after the Clean Water Act section number wherein the list is described] is prepared. Prior to adding a stream to the list, technology-based pollution controls must have been implemented or the conclusion must have been reached that even after implementing such controls the stream would not support its designated uses. West Virginia's 303(d) list includes streams affected by a number of stressors including mine drainage, acid rain, metals and siltation.

Mathematically, a TMDL is the sum of the allocations of a particular pollutant (from point and nonpoint sources) into a particular stream, plus a margin of safety. Restoration of a 303(d) stream begins by calculating a TMDL, which involves several steps:

- define when a water quality problem is occurring, the critical condition, (e.g., at base flow, during the hottest part of the day or throughout the winter ski season),
- calculate how much of a particular contaminant must be reduced in a stream in order to meet the appropriate water quality criterion,
- calculate the total maximum daily load from flow values during the problem period and the concentration allowed by the criterion,
- divide the total load allocation between point and nonpoint sources (e.g., 70% point and 30% nonpoint) and
- recommend pollution reduction controls to meet designated uses (e.g., install best management practices, reduce permit limits or prohibit discharges during problem periods). A TMDL cannot be approved, unless the proposed controls are reasonable and implementable.

The Program was designed in part to determine whether a stream belongs on the 303(d) list. In some cases, this determination can be made readily, for example, a stream degraded by acid mine drainage (AMD). However, the determination is more difficult to make for most streams because of a lack of data or data that are conflicting, of questionable quality or too old. Any stream which would not support its designated uses, even after technology-based controls were applied, would be a candidate for listing.

The Program's Phase 1 screening process provides information for making decisions on listing. A broader interagency process, the West Virginia Watershed Management Approach, enables diverse stakeholders to collectively decide which streams should be studied more intensively.

Special Watershed Assessment Strategy

Comparing Watersheds

EPA and other federal agencies have been interested in the relative conditions of the nation's waters since the Clean Water Act of 1972 mandated they prioritize water quality restoration efforts. Within West Virginia, several state agencies have an interest in prioritizing such efforts as well. The general sampling strategy is useful for comparing watersheds, but it was designed with other purposes in mind and will not pass the rigors of statistical tests that must be applied in a scientifically-sound, comparative study.

After the 1996 sampling season the Program developed a special sampling strategy to provide statistically valid data about the tested parameters for each watershed, highlighted in a few steps:

- 30-45 stream locations are selected randomly from an EPA database.
- Personnel from the Program, Environmental Enforcement and other groups reconnoiter the locations to secure landowner approval for sampling.
- Sampling teams visit the sites and sample in the manner described under the general assessment strategy.
- Special statistical analyses allow comparisons between watersheds.

Since the Youghiogheny River Watershed was sampled prior to development of the special sampling strategy, it cannot be compared in the same manner to other watersheds.

The U.S. Geological Survey has developed a **Hydrologic Unit Code (HUC)** used to identify watersheds throughout the United States. These numbers have replaced the older "map code" system of identifying watersheds.

HUC numbers consist of eight digits. The first two indicate the region the watershed is located in. West Virginia watersheds are located in one of two regions: 02 (Mid-Atlantic) is used to designate those watersheds which drain to the Atlantic Ocean. 05 is used to designate those streams which flow to the Gulf of Mexico via the Ohio River.

The next two digits indicate the subregion. All streams which flow into the Ohio at its beginnings in Pittsburgh are in sub-region 02. Those watersheds which flow into the Ohio between Pittsburgh and the mouth of the Kanawha at Point Pleasant are in sub-region 03. The Kanawha River watershed is sub-region 05. The Mud River and Big Sandy/Tug Fork watersheds are sub-region 07. Twelvepole Creek and the scattering of creeks between Point Pleasant and the mouth of Mud River are sub-region 09.

For the Mid-Atlantic Region the Potomac River drainage is sub-region 07. The James River watershed (in Pendleton and Monroe Counties) is sub-region 08. The remaining four digits indicate the accounting and catalog units for the individual watersheds.

The Youghiogheny River Watershed

The portion of the Youghiogheny River watershed (USGS HUC # 05020006) (see sidebar) within West Virginia (see Figure 2) covers approximately 80 square miles (207 sq km) in Preston County. Lying in the Allegheny Plateau Physiographic Province, the watershed is bounded on the east by the Eastern Continental Divide. Therefore, the

Youghiogheny waters drain toward the Gulf of Mexico while their eastern neighbor, the North Branch of Potomac River watershed, drains toward the Atlantic Ocean. Within West Virginia, the watershed is bounded on the north, west and south by the Cheat River watershed, and on the east by the Maryland border. Through the remainder of this report, the West Virginia portion of the Youghiogheny River watershed will be referred to as "the watershed".

Approximately the northern third of the watershed and a small fraction at the extreme southern end lies in the Central Appalachians Ecoregion. The remainder of the watershed is in the Central Appalachian Ridges & Valleys Ecoregion (Omernik 1992). In this watershed, the latter ecoregion is transposed upon a geosynclinal basin, the Mt. Carmel Syncline, with the watershed formed by high ridges of older rocks and the lower elevations covered with younger strata (Cardwell 1968). The climate of both ecoregions is marked by cool summers, cold winters and relatively high annual average precipitation. The Brandonville climatological station, just west of the northern portion of the watershed, receives average annual precipitation of 47 inches. The Rowlesburg climatological station, just west of the southern portion of the watershed, receives average annual precipitation of 55 inches. Preston County receives an average range of 50 inches to 130 inches of snowfall (National Weather Service personal communication). The watershed is punctuated by high, rounded mountains, but most second and higher order streams flow sluggishly through broad, low gradient valleys. A list of named streams in the watershed is found in Appendix B.

A significant wetland, Cranesville Swamp, is located on the West Virginia-Maryland Border within the watershed. The wetland is located in the zone of transition between the aforementioned bioregions. Called "Pine Swamp" locally and on the Cranesville USGS 7.5' topographic map, this wetland hosts the southernmost stand of tamarack (i.e. eastern larch or *Larix laricina)* in the eastern United States (Mansueti 1958). The saw-whet owl *(Aegolius acadicus*; a rare breeder in West Virginia) nests here (Sargent 1997). Several boreal insect species, including a few with aquatic life stages, have their southernmost known locations at the wetland. The Nature Conservancy's West Virginia and Maryland Chapters cooperatively manage a portion of the wetland. The remainder is owned and managed by private individuals.

A rare fish, the "Cheat minnow" *(Rhinicthys bowersi),* has been found in North Branch of Snowy Creek (Goodfellow 1984). Currently this fish's taxonomic status is being debated.

Two privately-operated recreational reservoirs, Terra Alta Lake and Alpine Lake (also known as “Hulls Lake”), are located in the vicinity of the town of Terra Alta. Terra Alta Lake lies on North Branch of Snowy Creek and Alpine Lake lies on Wardwell Run. Another privately-operated recreational reservoir, Silver Lake, lends its name to a community located near the head of Youghiogheny River.

A small amount of coal lies within the West Virginia portion of the watershed. Some of it has been mined, especially in the vicinity of Laurel Run of Snowy Creek. Most of the land is a patchwork of woodlots and pastures with some cropland, especially hay and buckwheat.

Wetlands are areas where water is the primary factor controlling the environment and the related plant and animal life. Most wetlands are dominated by plants which can tolerate frequent saturation. West Virginia has lacustrine wetlands (associated with lakes), riverine wetlands (associated with rivers) and palustrine wetlands which include bogs, marshes, and swamps. Two additional types of wetlands, marine and estuarine are coastal wetlands and are not found in West Virginia.

Terra Alta is the largest community in the watershed with approximately 2000 residents. Hopemont State Hospital is located just east of the town. The same sewage treatment plant serves both the community and the hospital. The town of Terra Alta and an association called Alpine Lake Property Owners are the only two entities that hold non-mining National Pollutant Discharge Elimination System (NPDES) permits issued by the OWR.

Youghiogheny River, Snowy Creek and Rhine Creek are considered high quality streams by the West Virginia Division of Natural Resources as detailed in their 1986 publication *West Virginia High Quality Streams.*

No streams in the watershed were present on the 1996 West Virginia 303(d) Stream List. This list includes streams that do not support their designated uses and are not expected to do so even with the application of best available industrial pollution control technology and/or secondary municipal wastewater treatment technology.

It is noteworthy that the Environmental Quality Board (EQB) has excluded public and industrial water supply from the list of designated uses applicable to Youghiogheny River tributaries. All other water use categories apply. The reasons for these exclusions are uncertain, but a preliminary investigation of the Water Resources Board’s (the predecessor of the EQB) records has revealed the likelihood of a simple mistake. The 1967 Requirements Governing Water Quality Standards and the 1998 Requirements Governing Water Quality Standards (see reference) explain that the only uses applicable to the Youghiogheny waters in West Virginia are public water supply and treated wastes transport and assimilation. It appears likely that former designated uses are now use exclusions because of a mistake in rewriting the regulations. At the EQB’s office, no record of discussion of changes in uses for the watershed’s streams has been found.

Assessment Methods in the Youghiogheny River Watershed

The Youghiogheny River watershed was visited July 8 & 9, 1996 by two assessment teams of two individuals each. Sample sites are listed in Appendix B. Most streams named on 7.5' topographic maps were sampled. The Ned Run watershed lies mostly in Maryland with its mouth being located in the midst of Pine Swamp. Therefore, it was considered inaccessible by the visiting sampling team. Two streams with no name shown on the topographical maps were visited. One of these is locally called Nottken Run. No samples were collected from Nottken Run, nor from the unnamed tributary to Snowy Creek since neither had flowing water near the selected sampling sites during the visits. However, the sampling team did partially assess the habitats. Streams without surface flow and other unnamed streams were not sampled. Also, Stony Run was, mistakenly, determined unsampleable. A revisit in 1998 found that in could likely have been sampled.

Each team collected benthic macroinvertebrate samples at each site following Rapid Bioassessment Protocol II (RBP II) (Plafkin, et. al. 1989), except as noted in the following paragraphs. Most samples were collected through use of a half-meter wide rectangular frame net. A 1-foot-wide D-frame net was used if the stream was too small to accommodate the larger net or if the Mid-Atlantic Coastal Stream sampling technique (MACS) was applied (Maxted, 1993). From each stream with appropriate riffle habitat, a sample was collected from riffles using the riffle-kick technique (Plafkin, et. al. 1989). Streams with a predominance of glide/pool habitat were sampled using the MACS protocol. Both sampling techniques are described in greater detail in Appendix A.

TABLE 1

YOUGHIOGHENY RIVER WATERSHED SAMPLING SITE SUMMARY

Named streams	27
Sites visited	23
Streams visited	22
Named, not visited	5
Unnamed, visited	2
Habitat assessed	21
Water Quality sampled	20
Benthos sampled	19

The teams collected riffle-kick samples from 11 streams and full MACS samples from 6 streams. Two streams were sampled only partially via the MACS technique. The Youghiogheny River mainstem sampling was begun via the MACS procedure. However, only 3 of 20 required net jabs were performed before a landowner, who shared a common boundary with a more complaisant landowner, advised the team to leave. The Laurel Run site received only a partial MACS sampling because the team followed a protocol adopted by The Program whereby streams with low pH readings and high conductivities receive a few cursory net jabs to determine if benthos are present. If no benthos are found, a full MACS sampling procedure is not carried out. The initial test sampling of Laurel Run failed to produce any organisms.

The benthic samples were delivered to Marshall University where students of Dr. Donald Tarter, Professor of Aquatic Biology, prepared them for identification by Office of Water Resources personnel. The 100-count subsample preparation technique (Plafkin, et. al. 1989) was used.

The Program staff classified sites according to average widths of the 100 meter assessed stream reaches. Class-I sites have average widths greater than 0 meters, but equal to or less than 3 meters. Class-II are greater than 3 meters, but equal to or less than 10 meters. Class-III are greater than 10 meters wide. The 6 fully MACS sampled sites were all Class-I sites. However, for reasons cited in the "Findings from benthological sampling" section, the Pine Swamp site was considered noncomparable to the other 5 sites. The riffle-kick sampled sites fell into Classes-I and -II. Only 3 of the 11 riffle sites were Class-I sites.

The reasoning behind this classification system is explained in the following discussion. Typically, aquatic communities at stream sites of vastly different sizes are not considered comparable to one another. This basic tenet is adhered to by most aquatic biologists because data generated from numerous studies have shown it to be true. The reasons for this fact are many, but collectively they can be identified as differences in number and character of ecological niches among various sizes of streams. Therefore, in order to make comparisons among stream sites, it is necessary to classify them in some fashion. The underlying premise in all such classification schemes is that fewer uncontrolled variables are operating upon the studied communities within each class than between each class. Biologists have more confidence in conclusions drawn from intrclass comparisons than from interclass compari-

sons. A few studies have been carried out to test this reasoning (e.g.: Anonymous 1997 and Stribling et.al. 1993). These studies point out that the reasoning may be flawed if applied too narrowly. Results show that as long as instream habitats are similar, watershed size and stream width may not be relevant variables influencing benthic macroinvertebrate communities. If applied over longer reaches, the reasoning is sound, because there is usually a greater variety of ecological niches in large rivers than in small streams. However, when samples are collected from only one type of habitat (in this instance, riffle/run), stream size may have no influence at all.

Even as this report is being prepared, such considerations are being researched, pondered and debated. Rather than change the format of this report, the Program staff decided to use the stream width classification system devised before they were made aware of the studies referenced in the previous paragraph.

Along with the macroinvertebrate sample, a fecal coliform bacteria sample was collected from each site. EPA sampling guidelines limit the field holding time for such samples to 6 hours. However, due to distance to laboratories, personnel limitations and time constraints, 24 hours was the limit used during this sampling effort. All bacteria samples were packed in wet ice until delivered to the laboratory. The Charleston laboratory of CT&E Environmental Services and the Philippi facility of Coal Operators Analytical Laboratory performed the analyses via the methods identified in Appendix A.

Immediately determined at each sampling site were the physico-chemical parameters of dissolved oxygen, temperature, pH and conductivity. Standard operating procedure required that sites with pH readings below 4.0 standard units and relatively high conductivity (equal to or greater than 200 µmhos/cm) be visually checked (from a precursory kick sample) for the presence of benthos. If none were seen, no benthological sample was to be collected. Sites with pH readings below 6.0 and conductivities equal to or greater than 200 µmhos/cm were to be sampled for alkalinity, acidity, sulfate, iron, aluminum and manganese. The flow was also to be measured at these sites. As mentioned previously, only one site met the aforementioned conditions of low pH and high conductivity; Laurel Run (MY-3) of Snowy Creek. However, no flow measurement was made since the team found the stream to be too deep. CT&E Environmental Services performed the analyses for the physico-chemical parameters not determined in the field.

An 8-page Stream Assessment Form (see Appendix A) was filled out at each site visited with only two exceptions; Browning Run and Stony Run. At each sampled site, a 100-meter section of stream and the land in its immediate vicinity were qualitatively evaluated for instream and streamside habitat conditions. The team that visited Browning Run determined it to be too small to sample and did not fill out a form. The same team determined that what was once the West Virginia portion of Stony Run had been partially covered with a head-of-valley fill zone from construction of Interstate 68. Therefore, they decided, there was no stream to sample and assess the habitat on. In 1998, a revisit found that their determination was only partially correct and a sample likely could have been collected from a portion of Stony Run upstream of the valley fill zone.

Statistical evaluation of the benthological data was performed using several widely accepted biometrics (benthic community metrics). All the sampling and evaluation methods, as well as materials used in sampling, are described in greater detail in Appendix A.

Findings

Findings from Benthological Sampling and Habitat Assessments

Summaries of the results of benthic sampling are found in Figures 3, 4 and 5. Note that the Laurel Run site is not included on any figures. As described in the *"Assessment Methods in the Youghiogheny River Watershed"* section, the sampling team conducted a test sampling to determine the need for a full sampling procedure. During the test, no benthos were found, so the team did not complete a full sampling procedure.

Pine Run (not to be confused with Pine Swamp) was selected as the reference site for the 3 Class-I riffle-kick sites. Figure 3 shows how the other sites compared to Pine Run. No sites fell within the lower left quadrant, the poorest rating possible. South Branch of Laurel Run and Buffalo Run fell within the biological condition range considered moderately impaired relative to the reference station. The biological condition score of Buffalo Run was below 50% of the reference site. Buffalo Run's habitat condition rating placed it in the suboptimal category, while South Branch of Laurel Run was considered marginal.

Wolf Creek, a site outside of the watershed, was chosen as the reference stream for comparison with the 8 Class-II riffle-kick sites. This site is located in a sub-watershed with geological strata and a climate similar to the Rhine Creek sub-watershed. The two sub-watersheds share a common divide and are located within the same ecoregion. A disjunct site was selected as the reference site because Rhine Creek, which was originally selected as the reference site, had a habitat rating lower than 3 other Class-II riffle-kick sites in the watershed. The Wolf Creek site, sampled in the Cheat River watershed survey on July 24, 1996, was also a Class-II riffle-kick site and its habitat rating was similar to those of the 3 sites mentioned above. Therefore, it was considered appropriate for a reference site. Precedent for selecting reference sites outside of the focal watershed is discussed in Hughes, et. al. (1986) and Barbour, et. al. (1996).

The biological conditions of Little Laurel Run, Snowy Creek, and Wardwell Run were all less than 50% of the reference site's. Along with North Branch of Snowy Creek and Maple Run, these 3 sites fell within the moderately impaired biological condition category. Since the habitat conditions of Snowy Creek, North Branch of Snowy Creek and Wardwell Run were very similar to that of the reference site, the reasons for their moderate impairment may have been associated with poorer water quality (see "Explanation of the Findings" section below).

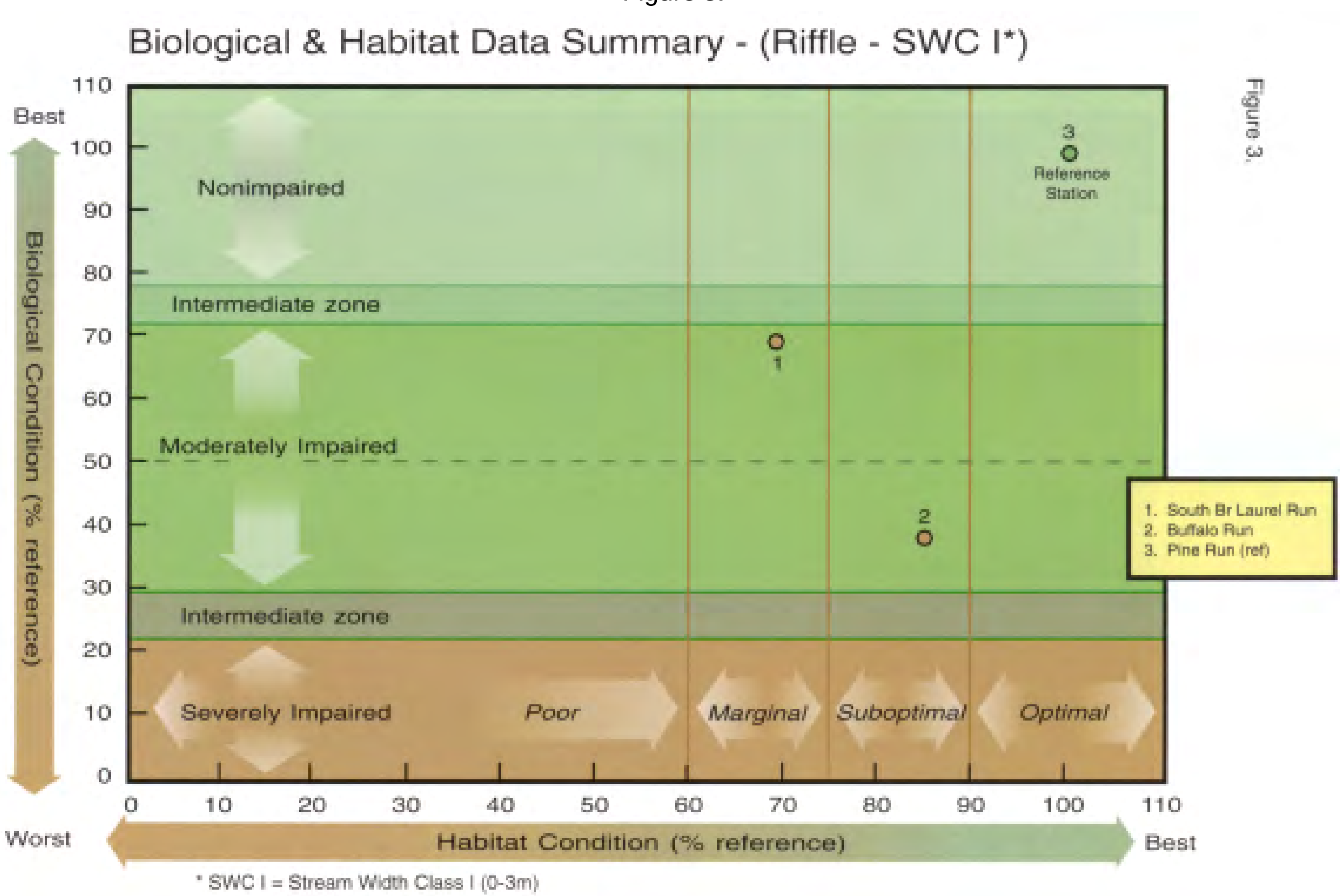
Of the 8 sites sampled with the MACS technique, the following 3 were considered noncomparable to the other 5: Youghiogheny River, Laurel Run and Pine Swamp.

Youghio-gheny River was considered noncomparable because only 3 of 20 required net jabs were made and because it was too large. This low number of jabs undoubtedly misrepresented the actual conditions at the site. Laurel Run did not have a full sampling procedure conducted on it. Pine Swamp had no perceptible flow, even though it was full of water. In general swamp habitats are not considered comparable to flowing stream habitats.

Figure 5 shows the plots of relative scores for the 5 comparable MACS-sampled streams. Hoyes Run was selected as the reference station for the glide/pool habitat sites. Although Hayes Run's habitat score was in the marginal category, its biological condition score was in the nonimpaired category. As with the riffle habitat sites, none of the glide/pool sites were rated as being severely impaired biologically or as having poor habitat conditions. Tankiln Run had the lowest scores for both biological (less than 50% of the reference) and habitat conditions (marginal).

Pine Swamp was considered not comparable with the other sites sampled. The unique habitat at this site, probably requires application of different benthic sampling and analytical techniques than those employed for either riffle/run or glide/pool stream habitats. In addition to the benthic organisms collected from Pine Swamp, between 200 and 300 bullhead catfish young were incidentally captured. These fish were removed from the sample in the laboratory before it was processed.

Figure 3.



Biological & Habitat Data Summary - (Riffle - SWC II*)

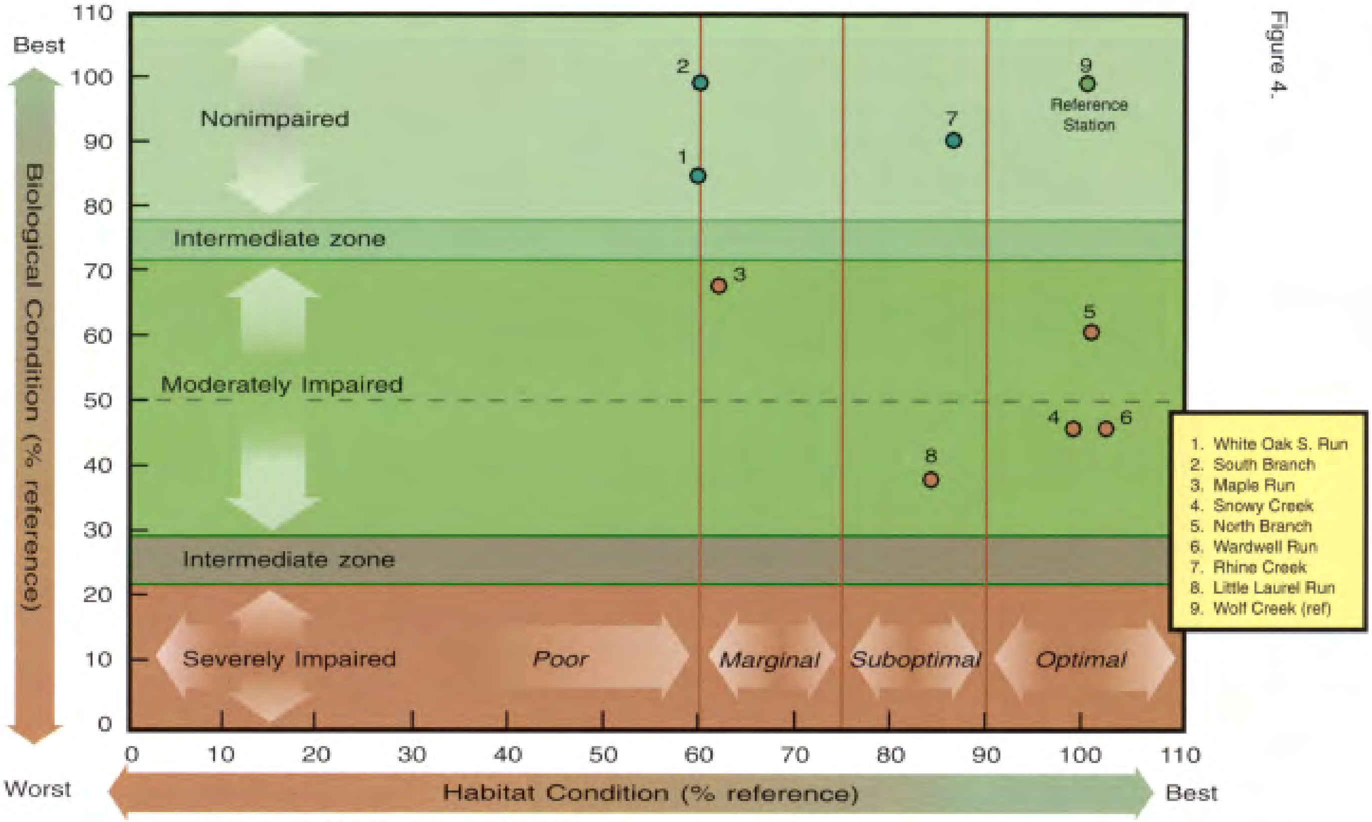


Figure 4.

* SWC II = Stream Width Class II (3-10m)

Biological & Habitat Data Summary - MACS*

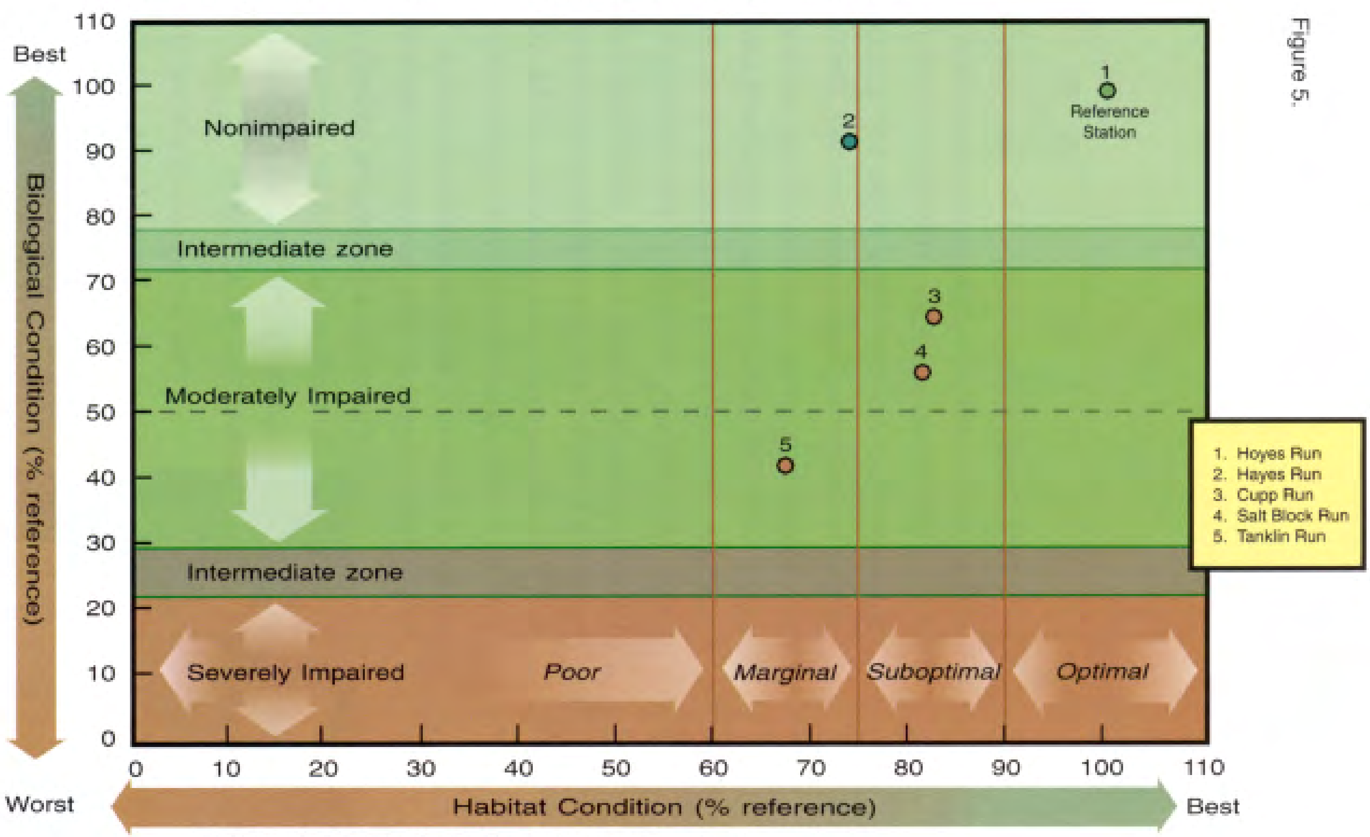


Figure 5.

* MACs = Mid-Atlantic Coastal Stream Sampling Technique

Findings from Bacteriological and Physico-chemical Sampling

Table 2 shows the results of bacteria analyses listed in descending order of concentration. The Water Quality Standards promulgated by the EQB state that for primary contact recreation the fecal coliform bacteria (FC) content is not to exceed 400 colonies/100 milliliters (ml) in more than 10% of all samples taken during a month. Seven sites produced inviolate samples. Since only one sample was collected from each of the sites during the sampling month, any result greater than 400 colonies/100 ml is considered a violation of the criterion. Rhine Creek had the highest count of FC bacteria, 5,500 colonies/100ml. Maple Run, Youghiogheny River and South Branch of Snowy Creek exhibited the next highest concentrations of bacteria with, respectively, 3,200, 2,600 and 1,000 colonies per 100 ml. The other sites with samples exceeding the criterion were Buffalo Run, South Branch of Laurel Run and Pine Run, all with less than 1,000 colonies/100ml.

Table 3 gives the results of the physico-chemical sampling performed at all the sites sampled. Pine Swamp produced a violation of the applicable dissolved oxygen criterion for aquatic life support, which states that oxygen concentration shall be no less than 5.0 milligrams per liter (mg/l). The oxygen concentration of the sample was 3.58 mg/l.

TABLE 2

Fecal coliform bacteria & turbidity

SITE	FC *	TURB
Rhine Creek	**5500**	M
Maple Run	**3200**	T
Youghiogheny River	**2600**	T
S. Branch Snowy Creek	**1000**	T
Buffalo Run	**948**	S
S. Branch Laurel Run	**760**	S
Pine Run	**600**	C
Browning Run	354	NR
Salt Block Run	330	NR
Tankiln Run	231	C
Hayes Run	226	C
Little Laurel Run	200	C
Cupp Run	160	C
Wardwell Run	136	S
Hoyes Run	130	C
Pine Swamp	120	NR
Snowy Creek	103	S
White Oak Spring Run	84	S
N. Branch Snowy Creek	42	S
Laurel Run	0	T

FC * = reported in colonies/100ml
Shaded numbers represent violations of water quality standards.

TURBIDITY LEGEND:
O=opaque, T=turbid, M=moderately turbid, S=slightly turbid, C=clear, NR=not reported.

Table 3.

Physico-chemical Characteristics of Stream Water

Name of sampling site	Date	Temp	pH	Dissolved Oxygen	Conductivity
		°C	Std. units	mg/l	µmhos/cm
RIFFLE - KICK S.W.C.I					
PINE RUN (REF)	09-Jul-96	15.57	7.94	7.67	61
S. BR. LAUREL RUN	08-Jul-96	17.80	7.40	8.10	61
BUFFALO RUN	08-Jul-96	18.40	6.30	8.20	43
RIFFLE - KICK S.W.C.II					
RHINE CREEK	09-Jul-96	18.74	7.74	7.34	93
SOUTH BRANCH	09-Jul-96	22.00	7.27	7.36	62
WHITE OAK SPRING RUN	08-Jul-96	15.73	7.38	8.22	59
MAPLE RUN	09-Jul-96	21.13	7.49	8.46	107
WARDWELL RUN	08-Jul-96	23.36	7.08	5.51	142
NORTH BRANCH	08-Jul-96	23.02	8.13	7.68	103
SNOWY CREEK	08-Jul-96	24.12	7.05	6.80	143
LITTLE LAUREL RUN	09-Jul-96	19.81	7.45	7.29	47
NOTTKEN RUN	09-Jul-96	ND	ND	ND	ND
U.N.T. OF SNOWY CREEK	08-Jul-96	ND	ND	ND	ND
WOLF CREEK (REF)*	24 Jul 96	15.30	ND	9.20	65
MACS					
HOYES RUN (REF)	09-Jul-96	17.00	6.97	8.38	35
HAYES RUN	08-Jul-96	15.16	6.74	8.81	35
CUPP RUN	09-Jul-96	16.60	7.30	8.10	46
SALT BLOCK RUN	09-Jul-96	16.30	7.50	8.40	81
TANKILN RUN	08-Jul-96	18.90	6.70	7.70	33
BROWNING RUN	08-Jul-96	21.10	6.92	6.98	48
NONCOMPARABLE					
LAUREL RUN	09-Jul-96	18.13	***3.47***	5.36	540
PINE SWAMP	09-Jul-96	25.30	6.61	***3.58***	77
YOUGHIOGHENY RIVER	09-Jul-96	20.57	7.36	8.34	93

Bold italic numbers in shaded cells represent violations of water quality standards.
ND = Not determined.
* Wolf Creek, the Reference site, is outside the watershed and was sampled at a different time.
(REF) = Reference site.

Laurel Run was severely impaired by acid mine drainage (Table 4). The pH of 3.47 and the conductivity of 540 µmhos/cm were, respectively, the lowest and highest of all the sites. The metals exceeded all applicable water quality criteria established by the EQB. The pH of 3.47 is far below the water quality criterion of no less than 6.0 standard units. As can be seen from Table 3, no other site produced a pH in violation of the criterion. The pH range for the other sites was between 6.30 and 8.13.

Table 4

Laurel Run was severely impaired by acid mine drainage	
pH	3.47 std. units*
Conductivity	540 µmhos/cm
Acidity	120 mg/l
Alkalinity	0 mg/l
Sulfate	190 mg/l
Iron	21 mg/l*
Aluminum	8.9 mg/l*
Manganese	1.5 mg/l

** indicates a violation of EQB criterion*

No benthic macroinvertebrates were found in a test sampling at this site.

Explanation of the Findings

Overall, the biometrics scores (Table 5) indicate balanced, relatively diverse benthic communities. Several streams had significant amounts of glide/pool habitat and, therefore, less than optimal amounts of riffles. Table 6 illustrates the physical habitat assessment scores for each site rated. The range of possible scores for each category is from 0 to 20, with 0 representing the worst possible condition and 20 the best. For the 11 assessed sites with predominantly riffle habitat, the average stream velocity score/depth regime was 12. This is on the low end of the sub-optimal range, indicating the absence of the fast-shallow regime. Sluggish streams hold more sediment for longer periods than swift streams.

Table 5.

Community Metric Scores for Benthic Macroinvertebrates

Name	Taxa richness	FBI	EPT index	% Dominant family	Scrapers/ filterers	EPT/ chironomids	CLI
RIFFLE - KICK S.W.C. I							
PINE RUN (REF)	18	3.00	13	42.4	0.40	0.76	-
SOUTH BRANCH LAUREL RUN	17	4.10	8	28.3	0.25	0.40	0.59
BUFFALO RUN	9	3.70	4	64.4	0.00	0.08	1.22
RIFFLE - KICK S.W.C. II							
RHINE CREEK	16	4.90	11	24.6	0.24	0.25	0.38
SOUTH BRANCH	15	4.10	10	35.6	0.25	0.56	0.60
WHITE OAK SPRING RUN	12	3.90	7	24.5	0.88	0.70	0.58
MAPLE RUN	15	5.50	7	39.4	0.49	0.09	0.60
WARDWELL RUN	13	5.80	5	36.1	0.21	0.10	0.85
NORTH BRANCH	13	4.50	7	61.7	0.12	0.78	0.85
SNOWY CREEK	9	5.70	3	59.1	0.21	0.33	1.33
LITTLE LAUREL RUN	8	3.30	3	66.0	0.00	0.30	1.63
WOLF CREEK (REF)	17	3.70	10	37.4	0.14	0.50	-
MACS							
HOYES RUN (REF)	20	4.20	13	17.2	0.33	0.72	-
HAYES RUN	25	3.60	16	19.7	0.26	0.53	0.24
CUPP RUN	14	3.20	8	23.2	1.00	0.29	0.71
SALT BLOCK RUN	14	4.00	9	66.7	1.00	0.64	0.79
TANKLIN RUN	16	3.30	8	43.6	0.00	0.38	0.63
NONCOMPARABLE							
PINE SWAMP	7	7.90	1	90.9	0.00	1.00	-

Taxa Richness - total number of taxa
Family Biotic Index - based on the organic pollution tolerance of families. Modified version of a system developed by William L. Hilsenhoff for benthic arthropods in Wisconsin.
EPT Index - Summarizes taxa richness within the insect orders ephemmeroptera, plecoptera and trichoptera, generally considered pollution sensitive. Decreases with decreasing water quality.
% Dominant Family - Number of individuals belonging to the most dominant family divided by the total number of organisms found. In general, increasing percentages indicate increasing environmental stressors (decreasing water quality).
Scraper/filterers - Ratio of Scrapers and Filterers. Based on functional feeding group designations for insect families. Decreasing ratios generally indicate increasing organic enrichment.
EPT/chironomids - Ratio of Ephemeroptera, Plecoptera, Trichoptera to Chironomidae abundance. Measures community balance. Decreasing ratios may indicate increasing organic enrichment or heavy metals concentration.
CLI - Community Loss Index - Measures the loss of taxa between a reference station and the station of comparision. Range is from zero to infinity. Increasing values indicate increasing dissimilarity between two stations.

Table 6

Rapid Physical Habitat Assessment

Name	Cover	Substrate	Embed	Velocity	Alter	Sediment	Riffles	Flow	Bank	Bankveg	Graze	Ripveg	Total
RIFFLE - KICK S.W.C.I													
PINE RUN (REF)	13	16	9	15	16	8	15	18	19	19	20	20	190
S. BR. LAUREL RUN	5	9	1	9	15	6	8	16	14	15	17	15	130
BUFFALO RUN	10	9	9	10	16	9	16	18	17	16	18	12	160
RIFFLE - KICK S.W.C.II													
RHINE CREEK	16	18	7	17	16	6	17	16	18	19	10	3	163
SOUTH BRANCH	2	3	7	5	16	8	1	19	19	19	13	2	114
WHITE OAK SPRING RUN	8	5	3	9	16	4	5	15	8	7	15	18	113
MAPLE RUN	6	8	7	10	15	10	8	15	15	14	7	3	117
WARDWELL RUN	15	16	19	16	16	19	16	18	19	16	13	10	193
NORTH BRANCH	18	17	10	16	17	11	16	18	15	16	17	19	190
SNOWY CREEK	17	17	12	19	15	15	11	17	17	16	16	15	187
LITTLE LAUREL RUN	15	3	10	5	19	12	3	6	16	15	16	14	158
NOTTKEN RUN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
U.N.T. OF SNOWY CREEK	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WOLF CREEK (REF)	15	16	18	15	16	16	16	17	13	14	18	15	189
MACS													
HOYES RUN (REF)	19	19	11	5	15	14	16	19	19	19	19	19	194
HAYES RUN	11	8	13	6	13	11	4	18	16	18	14	11	143
CUPP RUN	13	15	10	3	18	15	1	16	16	16	19	19	161
SALT BLOCK RUN	18	18	10	6	15	11	5	17	18	18	15	6	157
TANKILN RUN	12	11	8	7	5	11	10	19	18	18	5	7	131
BROWNING RUN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NONCOMPARABLE													
LAUREL RUN	1	1	7	14	16	1	14	16	15	15	14	5	119
PINE SWAMP	9	20	15	10	20	18	6	19	17	19	20	20	193
YOUGHIOGHENY RIVER	6	7	10	3	15	6	16	16	13	16	6	1	115

ND = Not determined. Range: 0 = Worst, 20 = Best.

Cover = instream cover; Substrate = epifaunal substrate; Embed = embeddedness; Velocity = velocity/depth regimes; Alter = channel alteration; Sediment = sediment deposition; Riffles = riffle frequency; Flow = channel flow status; Banks = bank condition; Bankveg = bank vegetative protection; Graze = grazing or other disruptive pressure; Ripveg = riparian vegetation zone width (least buffered side).

Many valleys supported cattle farms, where the predominant vegetation was a mixture of grasses. In such valleys, mature forests were rare alongside stream banks. Sediment from eroding farmlands may have contributed to producing the poorer benthic communities. Sediment fills interstitial spaces (i.e. spaces between gravels, cobbles and boulders) resulting in a loss of surface area available for macroinvertebrate

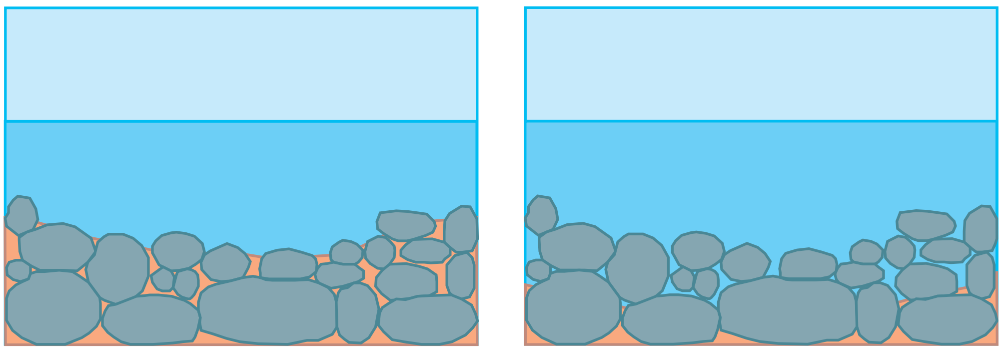
colonization. Also, during high water events, the scour of moving sediment may damage benthos, and/or increase benthos drift.

Average values for the different categories can be calculated for the 19 sites assessed for habitat. The average for the sediment deposition category was only 10, with the highest possible score of 20 representing the least deposition. If Pine Swamp is not considered and the sites are subdivided into predominantly riffle/run or glide/pool habitat types the average scores were, respectively, 10 and 9.

Another category that reflects sediment load is embeddedness. The average embeddedness value was only 9, with 20 representing the least amount of embeddedness. Without Pine Swamp, the average for glide/pool sites was only 10 and only 8 for riffle/run sites. All of these averages fall within the marginal range, indicating marginal benthic habitat conditions for those particular categories.

Figure 1.

Illustration of embeddedness. The view on the left is heavily embedded with sand and silt.



Heavily Embedded *Lightly Embedded*

Notice the different amounts of interstitial space (the space between rocks and gravel).

Despite these low habitat score averages, many of the sites produced benthic macroinvertebrate samples with relatively high diversities. Low gradient is a natural characteristic of several streams in the Youghiogheny River watershed. This characteristic is chiefly responsible for the predominance of glide/pool habitat in several of the watershed's streams. The highest numbers of taxa were found in two of the streams with a predominance of glide/pool habitat (i.e., 25 at Hayes Run and 20 at Hoyes Run). However, it should be noted that at these two sites, a variety of habitats were sampled. At Hayes Run, 10 riffles and 10 snags were sampled with a D-net. Hoyes Run had three habitats sampled. D-net sweeps were taken at 12 snags, 4 undercut banks and 4 aquatic macrophyte beds. By sampling more than one habitat type, the samplers may have increased the taxa richness values over those that might have been obtained from only one habitat type, even if that one type had been a riffle. While this flexibility in the selection of sample habitats is acceptable protocol for comparing one glide/pool site with another, it is considered a hindrance in comparing glide/pool habitats with riffle/run habitats.

A stream assessment form was filled out for each of 21 sites. Of these sites, 9 had pastures nearby, 3 had row crops, 3 had hay fields and 2 had cattle access places. Residential disturbances nearby included houses at 7 sites and lawns at 5. There were very few industrial or recreational disturbances noted and the bulk of those were listed as roads or bridges and culverts. Only 1 site, Snowy Creek, was noted as having evidence of a stream management activity. In this case the activity was channelization.

Of the 8 Class-II riffle-kick sites, Rhine Creek had the second highest percentage rating (South

Branch of Snowy Creek had the highest rating) of the reference stream's biological condition, yet its bacteria sample produced the highest count detected during the study. No sewage smells or anaerobic odors were detected in either the water or the sediment. There are two small communities and several cattle farms within the Rhine Creek valley, but no agricultural activities were noted in the immediate vicinity of the sample site.

The Class-1 riffle-kick reference site, Pine Run, also produced a bacteria count in violation of the criterion. It appears that FC bacteria concentration was not positively correlated with biological condition. A conversation with the local Environmental Enforcement inspector led to the conclusion that high bacteria counts on six of the seven streams that produced violations of the criterion were most likely due to livestock excrement. The local Health Department sanitarian indicated that residences in the village of Eglon and other habitations along an unnamed tributary of Maple Run, do not have appropriate sewage disposal systems. The sanitarian also advised that two dairy farms are located near Eglon. These dwellings and the dairy farms should be considered potential sources of the elevated bacteria concentration found on Maple Run.

Note from Table 2 that the 4 samples with bacteria counts of 1000/100ml or greater were rated as moderately turbid or turbid. Of the 7 samples exceeding the water quality criterion for bacteria, only 1 was rated as clear. Of the remaining 13 sites sampled for FC bacteria, 9 were assigned a turbidity rating (Pine Swamp's color was described as "tea, tannin", but no turbidity rating was given.). Of these 9 sites, 5 were rated as clear, but only acid-impacted Laurel Run, was considered more than slightly turbid. *Although the method of rating turbidity is subjective, the results reflect what more objective, past experiences have borne out. If there are continual or frequent inputs of FC bacteria into a waterbody, then events resulting in initial sediment input or resuspension of bottom sediment will likely produce higher bacteria counts than during times when the water is clear.* Streams that receive nonpoint source runoff from pastures and concentrated livestock staging areas often have high concentrations of bacteria associated with eroding soil during periods of high flows. For long periods, these bacteria remain viable, attached to sediment particles. When flows increase or when stream beds are disturbed, bacteria as well as sediment are resuspended.

The average conductivity value for the Class-II riffle-kick sites was 94 µmhos/cm. All 3 Class-II riffle-kick sites with habitat scores comparable to the reference site had conductivities above the average: Snowy Creek, North Branch of Snowy Creek and Wardwell Run had, respectively, 143, 103 and 142 µmhos/cm (Table 3). Even though these sites had optimal habitats, they supported moderately impaired benthic communities. Another Class-II riffle-kick site with moderately impaired benthos, Maple Run, also had a conductivity (107 µmhos/cm) above the average. Only 1 Class-II riffle-kick site in the moderately impaired category, Little Laurel Run, exhibited a conductivity (47 µmhos/cm) below the average for the watershed. The Class-II riffle-kick sites that scored as nonimpaired biologically exhibited conductivities below the average. These conductivities are the only noticeable differences in physico-chemical characteristics that may provide clues to why the streams fell into two different biological condition categories.

Snowy Creek receives a discharge from the Terra Alta sewage treatment plant (STP) that is often poorly treated due to collection system infiltration/inflow (I/I) problems. The sampling team noted that the water and sediment at the sampling site smelled like sewage. A plan is being formulated by the town and the DEP to upgrade the collection system. The Alpine Lake recreational area STP also has I/I problems. This STP discharges into Wardwell Run below the reservoir outlet and upstream of the sampling site. The sediment at the Maple Run site had a sewage smell. The site also had surface foam, garbage, cattle excrement and access to livestock. Only one other site was noted as having livestock access, the unnamed tributary to Snowy Creek, which was dry. The three aforementioned streams produced the highest Family Biotic Index values (See Table 5; Maple Run 5.50, Snowy Creek 5.70 and Wardwell Run 5.80), indicating the likelihood of substantial organic pollution (Hilsenhoff 1988).

There is a massive gob (mining refuse) pile at an old mine complex within the Laurel Run sub-watershed. Surface mines also are located within the sub-watershed. The coals in the Allegheny Formation of rock strata drained by Laurel Run include the Clarion and Kittaning coal seams. Another seam, the Winifrede coal of the Pottsville Group, is found within this geosynclinal basin as well. These coals and their overburdens are notorious for producing acid mine drainage. Less than 1 air mile (1.61 km) west of the head of Laurel Run, just over Brushy Knobs, South Branch of Snowy Creek drains a limestone valley. Likewise, just to the south, over Shaffer Mountain, Rhine Creek drains a limestone valley. There are almost no minable coals within the watersheds of either of these neighbor streams. It seems ironic that through a quirk of nature and subsequent human activity, streams so close to one another had vastly different biological conditions: the Rhine Creek and South Branch Snowy Creek sites had nonimpaired biological conditions, while Laurel Run produced no benthos, indicating it was greatly impaired.

In Little Laurel Run, the undersides of all rocks were red and the water had foam on its surface. These conditions, often seen in streams heavily laden with metals, may be clues to this site's moderately impaired benthic community. Precipitated iron hydroxide presents a reddish hue, while dissolved aluminum carried over riffles often forms persistent foam. The pH (7.45) was relatively high and the conductivity (47 µmhos/cm) was relatively low, but this does not rule out mine drainage. Not all such drainage is acidic and sometimes, acid may be readily buffered, leaving only elevated metal concentrations as clues of the pollutant source. The Little Laurel Run sub-watershed lies on the same rock strata and in the same geosynclinal basin as AMD-impacted Laurel Run. These three indicators (i.e., red rocks, foam and location in the same coal producing formation as Laurel Run) make it likely that Little Laurel Run receives coal mine drainage as well. A subsequent investigation of the watershed in 1998 found that this is the case.

Although Pine Swamp produced a violation of the dissolved oxygen criterion for aquatic life support, the relatively low concentration (3.58 mg/l) is not considered unusual in a swamp. The EQB has not promulgated a wetlands dissolved oxygen criterion distinct from that for warm water fishery streams and small, non-fishable streams.

Implications

The Youghiogheny River mainstem should be sampled again at a site where the sampling team is welcome. The biological condition of the mainstem is not known in the West Virginia portion of the watershed since a full benthological sampling could not be performed during the 2-day survey. Maryland researchers have over 10 years of quantitative data from the mainstem. Some of the sampling has been performed near the West Virginia-Maryland border. In the Maryland research, data from the mainstem near the border at Crellin, Maryland, compares well to the selected reference stream, South Branch of Bear Creek (Primrose April 9, 1997, personal communication).

An interstate effort should commence to determine the feasibility of minimizing current acid mine drainage impacts to Youghiogheny River and its impacted tributaries. Data gathered during this survey indicate that Laurel Run of Snowy Creek may contribute a significant acid load to the mainstem. Other AMD sources exist in Maryland and Pennsylvania.

Laurel Run of Snowy Creek has water quality problems attributable to abandoned coal mines. In light of the severe benthological impairment and the violations of water quality standards Laurel Run has been added to the 1998 303(d) list.

The five streams with biological condition scores below 50% of their respective reference sites (i.e., Little Laurel Run, Wardwell Run, Snowy Creek, Buffalo Run and Tankiln Run) should be investigated further to determine the causes and sources of the negative impacts upon their biota. Snowy Creek is of particular concern since it has been considered a high quality stream in the past.

Little Laurel Run should be investigated further to determine the extent of mine drainage impacts. As explained in the "Explanation of the findings" section, several clues existed during the sampling effort that hinted at such impacts and these clues were supported by the finding of an investigation in 1998.

Future proposals for coal mining in the watershed should be scrutinized closely because of the high potential for acid mine drainage.

The Youghiogheny River watershed streams in West Virginia should be designated by the EQB as supporting public water supply uses and, perhaps, industrial water supply uses as well. Inquiries of EQB members and staff, past and present, into the reasons for the exclusions has yielded no answers. The DEP should encourage the EQB to recommend to the Legislature that the exclusions be removed from the rules governing water quality standards.

Table 7

Suggested Action List

1. Recommend that EQB remove current use exclusions from Youghiogheny waters.
2. Develop TMDL for Laurel Run.
3. Determine source(s) of impact on biota of Little Laurel Run, Wardwell Run, Snowy Creek, Buffalo Run and Tankiln Run, and take appropriate restoration actions.
4. With Maryland, coordinate conservation efforts in Youghiogheny River watershed upstream of Friendsville, MD.
5. Nurture formation of an interstate watershed association.
6. Continue effort to eliminate I/I into Terra Alta's sewage collection system.
7. Encourage establishment of riparian buffer zones in pastured and residential valleys.
8. Cooperate with The Nature Conservancy, WV DNR, Maryland agencies and landowners to conserve Pine Swamp.
9. Scrutinize proposed mining to ensure no production of acid drainage during or after mining.
10. Assist in the study of the effects of filling headwater streams on downstream reaches.

Human-induced erosion in the watershed exacerbates benthos survival difficulties inherent in slow-moving streams. Establishment of forested riparian buffer zones between farm fields and streams could help mitigate some of the problems associated with sediment runoff (e.g. high embeddedness values and elevated fecal coliform bacteria concentrations). Likewise, better control of cattle access to streams could be beneficial to the aquatic systems.

Infiltration/Inflow problems in the Terra Alta sewage collection system are being scrutinized by town and state authorities. Minimizing these problems should proceed as rapidly as possible to reduce the potential health risk posed by occasional discharges of incompletely treated sewage into Snowy Creek.

Many years ago, several anglers convinced the former West Virginia Department of Natural Resources to consider stocking trout in Rhine Creek. Subsequent testing led the agency to place Rhine Creek on a regular stocking schedule. Perhaps Rhine Creek anglers could become a nucleus for a watershed association. A service organization, such as Ruritan International, may be interested in forming an association to work toward conserving and enhancing the water quality of the watershed. This would benefit the streams, the Office of Water Resources and other agencies working to improve the water quality there.

Six sites within the watershed stand out as having relatively high water quality as reflected in the benthological samples. Hoyes Run, Hayes Run, South Branch of Snowy Creek, Rhine Creek, White Oak Spring Run and Pine Run should be considered for special protection status to prevent degradation. At the very least, a list of benthologically outstanding streams should be compiled (perhaps an addendum to the former Department of Natural Resources' High Quality Streams List) for use by permitting and enforcement agencies. Such a list would help those agencies prioritize their efforts.

Three of the six sites with high water quality are on streams that drain into Pine Swamp (i.e., Hoyes Run, Hayes Run and White Oak Spring Run). Pine Swamp is a significant wetland worthy of special conservation efforts. The states of West Virginia and Maryland should assist their respective chapters of The Nature Conservancy and other private landowners in conserving this unique resource. By attempting to maintain the high quality of the three sites mentioned and to improve the quality of Cupp Run and Tankiln Run, state agencies can insure the long-term health of this important natural heritage site.

Additional Resources

The watershed movement in West Virginia includes a wide variety of federal, state and non-governmental organizations that are available to help improve the health of the streams in a watershed. Several agencies are participants in the West Virginia Watershed Management Framework and/or the West Virginia Watershed Network.

A Watershed Basin Coordinator has been employed to coordinate the activities of the agencies which participate in the West Virginia Watershed Management Framework. An important part of this process is public participation The Basin Coordinator may be contacted at 1-304-558-2108.

In addition the DEP's Stream Partners Program coordinator, available at 1-800-556-8181, serves as a resource for emerging watershed associations. The Stream Partners Program helps groups organize, form partnerships, decide on projects, and find the technical and financial resources they need.

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Appendix A: Assessment Methods

Given its charge and resources, the Program has chosen a specific combination of physical, chemical and biological indicator variables to evaluate stream health.

The stream side and instream habitats, and the benthic macroinvertebrates are the foci of the site's ecological assessment. Benthic macroinvertebrates are bottom-dwelling animals that do not have backbones. This excludes fishes, salamanders, tadpoles, etc. Habitat evaluations are important to the assessment because they reflect the physical conditions that support the benthic community. The benthic community is crucial because it reflects environmental conditions for an extended period prior to the site visit. Other parameters, like dissolved oxygen concentration, are complementary, but may not reflect recent fluctuations in environmental conditions. A release of a contaminant which flowed through the reach a week ago, for example, would be reflected by the impaired benthos, but might not be revealed in a water sample.

A site's fecal coliform bacteria concentration indicates the likelihood of a public health threat; higher concentrations are associated with greater concerns for public health through direct contact with the water. Fecal coliform bacteria are important indicators of contamination due to fecal material found in sewage, livestock waste and wildlife excrement.

Physico-chemical constituents are selected to help determine what types of stressors may be operating on the benthic community. They may also give clues about the sources of those stressors. A list of physico-chemical constituents typically analyzed for is found in Table B-1 on the next page.

Table A-1

Constituent Table

All numbered references to analytical methods are from either *EPA: Methods for Chemical Analysis of Water and Wastes; March 1983* unless otherwise noted.

Parameter	Minimum Detection Limit or Instrument Accuracy	Analytical Method	Maximum Holding Time
Acidity	5 mg/l	305.1	14 days
Alkalinity	5 mg/l	310.1	14 days
Sulfate	5 mg/l	375.4	28 days
Iron	200 µg/l	200.7	6 months
Aluminum	100 µg/l	200.7	6 months
Manganese	10 µg/l	200.7	6 months
Fecal Coliform Bacteria	Not Applicable	9222 D[1]	24 hours[2]
Conductance	1% of range[3]	Hydrolab™	Instant
pH	± 0.2 units[3]	Hydrolab™	Instant
Temperature	± 0.15 °C[3]	Hydrolab™	Instant
Dissolved Oxygen	± 0.2 mg/l[3]	Hydrolab™	Instant
Total Phosphorus	0.02 mg/l	4500-PE[1]	28 days
Nitrite+Nitrate-N	0.5 mg/l	353.3	28 days
Ammonia-N	0.5 mg/l	350.2	28 days
Unionized Amm-N	0.5 mg/l	350.2	28 days
Suspended Solids	5 mg/l	160.2	28 days
Chloride	1 mg/l	325.2	28 days

[1] *Standard Methods For The Examination Of Water And Wastewater, 18th Edition*, 1992.
[2] U. S. EPA guidelines limit the holding time for these samples to 6 hours. Due to laboratory location, personnel limitations and time constraints, 24 hours was the limit utilized during this sampling effort.
[3] Explanations of and variations in these accuracies are noted in Hydrolab Corporation's *Reporter ™ Water Quality Multiprobe Operating Manual,* May 1995, Application Note #109.

Assessment Protocols

The assessment protocols described below are detailed to a greater degree in the Program's Standard Operating Procedures (Anonymous, undated working document) manual. This manual is available to interested persons.

Physico-chemical sampling:

Water quality sample collection, handling and analysis methods generally follow procedures approved by the U.S. EPA and detailed in the documents noted in the reference section. The only frequent exception is the holding time for Fecal Coliform Bacteria, which is explained in note 2 of Table B-1. Field blanks for metals and nutrients are prepared weekly by each sampling team if metals and nutrients are being analyzed from the sampling sites visited during the week. The primary purpose of this procedure is to check for contamination of preservatives, containers and sample water during sampling and transporting. A secondary purpose is to check the precision of analytical procedures.

Field analyses for pH, temperature, dissolved oxygen and conductivity are performed utilizing a Hydrolab™ Scout™ and Multiprobe™ assembly. The manufacturer's calibration guidelines are followed with minimal variation except that the instruments are gener-ally not calibrated at the end of each sampling run.

In some instances, stream flow is measured. Usually this is done only in streams negatively impacted by mine drainage. A current meter is used across a stream transect and the discharge is calculated with the sum-of-partial-discharges method.

Physico-chemical data analyses:

Since the sites are sampled only once, potential uses of statistical analyses per site are quite limited. Generally, only simple statistics (e.g., mean, median and percentage) are generated from each watershed's data set. Although limited in application, these simple statistics may give insight into potential causes and sources of impairment.

Evaluation of habitat and the sampling site environment:

Following a specific protocol, summarized in the Program's Stream Assessment Form, assessment teams, usually composed of 2 people each, visit sites within the watershed and assess conditions at the sites. Each assessment consists of a 100-meter reach of stream and its stream side environment. The latitude and longitude of each site is recorded by a Global Positioning System (GPS) instrument or obtained from a topographic map should the GPS unit fail. The total habitat score from the two-page Rapid Habitat Assessment portion of the form is utilized in the data analysis step described under "Integration of biological, habitat and water quality data."

Benthic macroinvertebrate sampling:

Macroinvertebrate samples are collected via several techniques, depending upon the stream type and the water level. In streams having plenty of riffle/run habitat, a modified version of Rapid Bioassessment Protocol II (Plafkin, et. al. 1989) is used for sampling the benthos. In such streams of appropriate size, a modified kick-net (Surber-on-a-stick) is used to catch organisms dislodged by the sampler through kicking the substrate and rubbing the larger rocks. In very small riffle/run streams that will not accommodate the Surber-on-a-stick, a D-frame net is used to collect dislodged organisms. In streams that are too small to accommodate a D-frame net, rocks are picked clean of organisms by hand. This last technique provides only qualitative data that cannot be compared to the data generated from the other, net-assisted sampling procedures.

In streams dominated by glide/pool habitats, a D-frame net is used in a slightly modified version of a procedure developed for Mid-Atlantic Coastal Streams (Maxted 1993). Referred to as the MACS technique, this procedure consists mostly of sampling a variety of habitats (aquatic plants, woody debris, overhanging stream banks, etc) through sweeping motions of the net.

After the collection step, the organisms are preserved and the sample is sent to the Marshall University Biology Department for subsampling. The 100-organism subsample technique was used in 1996 and 1997. (Plafkin, et. al. 1989). The 200-organism sub-sample technique has been used since 1998. The subsampled organisms are returned to Program biologists who identify them to the family taxon and count them. The completed samples are kept preserved for future reference and for identification to lower taxa if necessary. In 1996, the initial year of the Program, Safe-fix™ and formalin were used as preservatives. During the 1997 sampling season, the switch was made from formalin to ethanol. Safe-fix™ is no longer used. Since 1997, ethanol has been the standard fixative.

Appropriate biological collection permits are obtained before each sampling season from the WV Division of Natural Resources (DNR). Fishes inadvertently collected are preserved and donated to the DNR fish laboratory. Salamanders collected are preserved and donated to the Marshall University Biological Museum.

Biological data analyses:

Widely accepted biological metrics and indices are calculated to aid in interpreting the benthological data. These tools are described in detail in Plafkin, et. al. 1989 and briefly described below:

Taxa richness - Total number of families. Generally decreases with decreasing water quality, habitat diversity and habitat suitability.

Modified family biotic index - Based on organic pollution tolerance of families. Tolerance values range from 0 to 10, increasing with decreasing water quality. Developed by William L. Hilsenhoff for benthic arthropods in Wisconsin (Hilsenhoff 1988).

Ratio of scraper and filtering collectors - Reflects the riffle/run community food base. Based on Functional Feeding Group designations for insect families (Merritt and Cummins 1984). Decreasing ratios generally indicate increasing organic enrichment (decreasing water quality).

Ratio of Ephemeroptera, Plecoptera and Trichoptera (EPT) to Chironomidae abundance - Measures community balance. Decreasing ratios generally indicate increasing organic enrichment or heavy metals concentration (decreasing water quality).

Percent contribution of dominant family - Number of individuals belonging to the dominant family divided by the total number of organisms found. Measures community balance. Increasing percentages generally indicate increasing environmental stressors (decreasing water quality).

EPT index - Summarizes taxa richness within the insect orders generally considered pollution sensitive (mayflies, stoneflies and caddiflies. Decreases with decreasing water quality.

Community loss index - Measures the loss of taxa between a reference station and the station of comparison. Range is from 0 to infinity. Increasing values indicate increasing dissimilarity between the two stations.

Integration of biological, habitat and water quality data:

Each site's biological metrics and indices, and rapid habitat assessment score (see "Evaluation of habitat and the sampling site environment") are compared with those of a reference site. The reference site has optimal habitat and no obvious impairments in water quality. The biological condition and habitat condition are expressed as percentages of the reference site, which is assigned values of 100%. These percentages are graphically plotted to indicate the degree of impairment relative to the reference site.

The physico-chemical data and field notes are referred to when interpreting the results of the plot. These data and observations are useful in determining causes and sources of impairment.

Appendix B

Table 8.

Sampling Site Location Descriptions

Sampling Site Name	Code	Location	Habitat Assess	Benth. Sample	Comments
Youghiogheny River	MY	Rt108/1 near final exit WV.	X	X	Only 3 jabs(MACS)
Laurel Run direct drain	MY-8	The one near Buffalo Run.			Not visited.
North Branch Laurel Run	MY-12	Only extreme headwater in WV			Not visited.
South Branch Laurel Run	MY-11	In MD near Blue Goose Rd.	X	X	
Stony Run	MY-10	Along I-68 near state line.			Not sampled.
Buffalo Run	MY-9	Rt12/2 near state line.	X	X	
White Rock Glade	MY-7				Not visited.
Salt Block Run	MY-6	Rt9 near state line.	X	X	
Muddy Creek	MY-1	Located entirely in Maryland			Not visited.
White Oak Spring Run	MY-1-A	Rt47/4 near headwater.	X	X	
Hoyes Run	MY-1-B	Rt47/4 near mouth.	X	X	Ref site(MACS)
Cupps Run	MY-1-A-1	Rt47/4 near mouth.	X	X	
Nottken Run	MY-1-B.5	Rt42 or 36 N of Terra Alta.	X		Ephemeral.
Browning Run	MY-1-C	Along Rt49 at mouth.			Too small.
Pine Swamp	MY-1-F	Near state line.	X	X	Swamp habitat.
Hayes Run	MY-1-D	Along Rt47/1 near mouth.	X	X	
Tankiln Run	MY-1-E	Perhaps at Rt47/1 bridge.	X	X	
Ned Run	MY-1-F-1	Located mostly in Maryland.			Inaccessible.
Snowy Creek	MY-2	Rt98 near Corinth.	X	X	
Laurel Run of Snowy Ck.	MY-3	Along Rt94/1 near state line	X	X	pH, cond
Little Laurel Run	MY-3-A	Along Rt94/1 near mouth.	X	X	
Unnamed trib. Snowy Ck.	MY-2-.5A	Rt7 near mouth.	X		Ephemeral.
North Branch Snowy Ck.	MY-2-A	Along Rt46 near Hopemont.	X	X	
Wardwell Run	MY-2-A-1	Rt46 near mouth.	X	X	
South Branch Snowy Ck.	MY-2-B	Rt94 0.5mi upstream of mouth	X	X	
Pine Run	MY-2-B-1	Along Rt90 near mouth.	X	X	Ref site(SWC 1).
Rhine Creek	MY-4	Rt108 1mi upstream of mouth.	X	X	
Maple Run	MY-5	Rt24/1 1mi upstream of mouth	X	X	

MACS = Mid-Atlantic coastal streams sampling technique.
SWC 1 = Stream width class 1 of the riffle-kick sampled streams.

Benthological Statistics and Habitat Data

Table 9.

Stream Sampling Stations

Stream name	A-N code	lat°	lat'	lat"	lon°	lon'	lon"	County
RIFFLE - KICK								
PINE RUN (REF)	WVMY-2-B-1	39	24	33.08	79	31	53.89	PRESTON
S. BR. LAUREL RUN	WVMY-11	39	40	58.51	79	28	23.20	GARRETT, MD
BUFFALO RUN	WVMY-9	39	37	59.47	79	28	55.46	PRESTON
RHINE CREEK	WVMY-4	39	19	52.62	79	30	33.54	PRESTON
SOUTH BRANCH	WVMY-2-B	39	25	38.55	79	31	16.73	PRESTON
WHITE OAK SPRING RUN	WVMY-1-A	39	29	59.51	79	29	25.89	PRESTON
MAPLE RUN	WVMY-5	39	17	53.00	79	29	27.59	PRESTON
WARDWELL RUN	WVMY-2-A-1	39	27	3.32	79	30	32.27	PRESTON
NORTH BRANCH	WVMY-2-A	39	26	38.99	79	30	44.67	PRESTON
SNOWY CREEK	WVMY-2	39	25	11.75	79	29	38.83	PRESTON
LITTLE LAUREL RUN	WVMY-3-A	39	23	10.48	79	29	54.55	PRESTON
NOTTKEN RUN	WVMY-1-B.5	39	31	19.77	79	30	22.08	PRESTON
U.N.T. OF SNOWY CREEK	WVMY-2-.5A	39	26	9.60	79	30	25.00	PRESTON
WOLF CREEK (REF)	WVMC-36-{00}	39	17	33.00	79	38	7.00	PRESTON
MACS								
HOYES RUN (REF)	WVMY-1-B	39	30	53.93	79	29	2.85	
PRESTON								
HAYES RUN	WVMY-1-D	39	31	55.29	79	29	15.60	PRESTON
CUPP RUN	WVMY-1-A-1	39	30	17.85	79	29	14.18	PRESTON
SALT BLOCK RUN	WVMY-6	39	34	10.80	79	29	6.40	
PRESTON								
TANKILN RUN	WVMY-1-E	39	32	18.56	79	29	25.80	PRESTON
BROWNING RUN	WVMY-1-C	39	31	37.89	79	28	52.85	PRESTON
NONCOMPARABLE								
LAUREL RUN	WVMY-3	39	23	7.83	79	29	17.80	PRESTON
PINE SWAMP	WVMY-1-F	39	32	21.09	79	28	43.74	PRESTON
YOUGHIOGHENY RIVER	WVMY	39	20	48.74	79	29	15.03	PRESTON

Table 10.

Stream Reach (100 meters) Characteristics. Numerical Units are in meters

Name	Date width	Stream depth	Riffle depth	Run depth	Pool pollution	Erosion	N.P.S
RIFFLE - KICK							
PINE RUN (REF)	09-Jul-96	2.00	0.10	0.20	0.20	S	NOE
S. BR. LAUREL RUN	08-Jul-96	2.00	0.10	0.20	NP	S	POT
BUFFALO RUN	08-Jul-96	2.00	0.10	0.20	NP	S	OBV
RHINE CREEK	09-Jul-96	7.00	0.10	0.30	0.30	M	POT
SOUTH BRANCH	09-Jul-96	6.00	0.20	0.50	1.00	N	POT
WHITE OAK SPRING RUN	08-Jul-96	4.00	0.10	0.20	0.20	M	NOE
MAPLE RUN	09-Jul-96	9.00	0.10	0.50	1.00	S	OBV
WARDWELL RUN	08-Jul-96	4.50	0.10	0.20	0.20	N	NOE
NORTH BRANCH	08-Jul-96	8.00	0.10	0.25	ND	N	NOE
SNOWY CREEK	08-Jul-96	10.00	0.10	0.30	1.00	N	POT
LITTLE LAUREL RUN	09-Jul-96	4.00	0.10	0.20	0.20	S	POT
NOTTKEN RUN	09-Jul-96	1.00*	ND	ND	ND	N	NOE
U.N.T. OF SNOWY CREEK	08-Jul-96	1.00*	ND	ND	ND	N	POT
WOLF CREEK (REF)	24Jul96	9.50	0.20	0.40	0.60	M	POT
MACS							
HOYES RUN (REF)	09-Jul-96	1.00	NP	0.20	0.25	S	OBV
HAYES RUN	08-Jul-96	ND	ND	ND	ND	S	OBV
CUPP RUN	09-Jul-96	1.00	0.10	0.20	0.30	S	OBV
SALT BLOCK RUN	09-Jul-96	1.00	0.10	0.20	0.40	S	OBV
TANKILN RUN	08-Jul-96	1.00	0.10	0.30	NP	NR	NR
BROWNING RUN	08-Jul-96	0.50	ND	ND	ND	NR	NR
NONCOMPARABLE							
LAUREL RUN	09-Jul-96	7.00	NP	1.50	2.00	H	OBV
PINE SWAMP	09-Jul-96	3.00	NP	0.00	1.00	S	POT
YOUGHIOGHENY RIVER	09-Jul-96	13.00	NP	0.50	1.00	H	OBV

* = Dry width.
ND = Not determined.
NP = Not present at site.
NR = Not recorded.

Erosion key:
S = slight,
M = moderate,
H = heavy.

N.P.S. (Non-point Source) Pollution key;
NOE = no evidence,
POT = potential sources,
OBV = obvious sources

Table 11.

Stream Reach (100 meters) Disturbances and Activities - RESIDENTIAL

Name	date	residences	lawns dock	boat	construction	pipe drain	road culvert	bridge
RIFFLE - KICK								
PINE RUN (REF)	09-Jul-96						X	X
S. BR. LAUREL RUN	08-Jul-96	X				X	X	
BUFFALO RUN	08-Jul-96							
RHINE CREEK	09-Jul-96	X	X			X	X	X
SOUTH BRANCH	09-Jul-96						X	X
WHITE OAK SPRING RUN	08-Jul-96						X	X
MAPLE RUN	09-Jul-96	X	X				X	X
WARDWELL RUN	08-Jul-96	X	X				X	X
NORTH BRANCH	08-Jul-96							
SNOWY CREEK	08-Jul-96					X	X	X
LITTLE LAUREL RUN	09-Jul-96						X	
NOTTKEN RUN	09-Jul-96	X	X					
U.N.T. OF SNOWY CREEK	08-Jul-96						X	X
WOLF CREEK (REF)	24 Jul 96	X						
MACS								
HOYES RUN (REF)	09-Jul-96							
HAYES RUN	08-Jul-96							
CUPP RUN	09-Jul-96							
SALT BLOCK RUN	09-Jul-96							
TANKILN RUN	08-Jul-96	X	X					
BROWNING RUN	08-Jul-96							
NONCOMPARABLE								
LAUREL RUN	09-Jul-96					X	X	
PINE SWAMP	09-Jul-96							
YOUGHIOGHENY RIVER	09-Jul-96	X					X	X

Table 12.

Stream Reach (100 meters) Disturbances and Activities - RECREATIONAL

Name	Parks camp	Parking lot	Boat dock	Swim-ming	Fish-ing	Pipes, drains	Foot trails	ATV, horse, bike trails	Road	Bridge
RIFFLE - KICK										
PINE RUN (REF)										
S. BR. LAUREL RUN										
BUFFALO RUN										
RHINE CREEK										
SOUTH BRANCH										
WHITE OAK SPRING RUN										
MAPLE RUN										
WARDWELL RUN										
NORTH BRANCH										
SNOWY CREEK										
LITTLE LAUREL RUN										
NOTTKEN RUN										
U.N.T. OF SNOWY CR.										
WOLF CREEK (REF)										
MACS										
HOYES RUN (REF)										
HAYES RUN									X	
CUPP RUN										
SALT BLOCK RUN										
TANKILN RUN		X						X	X	X
BROWNING RUN										
NONCOMPARABLE										
LAUREL RUN										
PINE SWAMP										
YOUGHIOGHENY RIVER										

Table 13.

100m Stream Reach Disturbances & Activities - AGRICULTURAL

Name	Row crops	Pas-ture	Hay	Orchard	Poultry	Cattle	Irrig-ation	Pipe-drain	Farm road	Bridge-culvert
RIFFLE-KICK										
PINE RUN (REF)		X								
S. BR. LAUREL RUN										
BUFFALO RUN										
RHINE CREEK										
SOUTH BRANCH		X								
WHITE OAK SPRING RUN		X								
MAPLE RUN	X					X				
WARDWELL RUN										
NORTH BRANCH										
SNOWY CREEK										
LITTLE LAUREL RUN										
NOTTKEN RUN		X								
U.N.T. OF SNOWY CR.	X	X	X			X				
WOLF CREEK (REF)										
MACS										
HOYES RUN (REF)										
HAYES RUN										
CUPP RUN										
SALT BLOCK RUN		X							X	X
TANKILN RUN		X						X	X	X
BROWNING RUN										
NONCOMPARABLE										
LAUREL RUN										
PINE SWAMP		X	X							
YOUGHIOGHENY RIVER	X	X	X							

Table 14.

Stream Reach (100 meters) Disturbances and Activities - INDUSTRIAL

Name	Industry plant	Surface mine	Deep prep	Coal	Quarry	Oil-Gas wells	Power plant	Logging
RIFFLE - KICK								
PINE RUN (REF)								
S. BR. LAUREL RUN		X						
BUFFALO RUN								
RHINE CREEK								
SOUTH BRANCH								
WHITE OAK SPRING RUN								X
MAPLE RUN								
WARDWELL RUN								
NORTH BRANCH								
SNOWY CREEK								
LITTLE LAUREL RUN								
NOTTKEN RUN								
U.N.T. OF SNOWY CREEK								
WOLF CREEK (REF)								
MACS								
HOYES RUN (REF)								
HAYES RUN								
CUPP RUN								
SALT BLOCK RUN								
TANKILN RUN								
BROWNING RUN								
NONCOMPARABLE								
LAUREL RUN								
PINE SWAMP								
YOUGHIOGHENY RIVER								

Table 14 (continued).

Stream Reach (100 meters) Disturbances and Activities - INDUSTRIAL

Name	Sawmill	Sanitary landfill	Waste water treatment	Public water treatment	Pipe-drain	Parking lot	Road	Bridge
RIFFLE - KICK								
PINE RUN (REF)								
S. BR. LAUREL RUN								
BUFFALO RUN							X	X
RHINE CREEK								
SOUTH BRANCH								
WHITE OAK SPRING RUN								
MAPLE RUN								
WARDWELL RUN								
NORTH BRANCH								
SNOWY CREEK								
LITTLE LAUREL RUN								
NOTTKEN RUN								
U.N.T. OF SNOWY CREEK								X
WOLF CREEK (REF)								
MACS								
HOYES RUN (REF)							X	X
HAYES RUN								
CUPP RUN							X	X
SALT BLOCK RUN								
TANKILN RUN								
BROWNING RUN								
NONCOMPARABLE								
LAUREL RUN								
PINE SWAMP								
YOUGHIOGHENY RIVER								

Table 15.

Stream Reach (100 meters) Disturbances and Activities - MANAGEMENT

Name	Liming	Rip-rap stabilization	Dredging	Channelized	Fill	Dams
RIFFLE - KICK						
PINE RUN (REF)						
S. BR. LAUREL RUN						
BUFFALO RUN						
RHINE CREEK						
SOUTH BRANCH						
WHITE OAK SPRING RUN						
MAPLE RUN						
WARDWELL RUN						
NORTH BRANCH						
SNOWY CREEK				X		
LITTLE LAUREL RUN						
NOTTKEN RUN						
U.N.T. OF SNOWY CREEK						
WOLF CREEK (REF)						
MACS						
HOYES RUN (REF)						
HAYES RUN						
CUPP RUN						
SALT BLOCK RUN						
TANKILN RUN						
BROWNING RUN						
NONCOMPARABLE						
LAUREL RUN						
PINE SWAMP						
YOUGHIOGHENY RIVER						

Table 16.

Sampling Site Stream Bank/Riparian Zone Measures - CANOPY (>5m high).

	Left				Right			
Name width	**zone type**	**veg trees**	**big trees**	**small width**	**zone type**	**veg trees**	**big trees**	**big**
RIFFLE - KICK								
PINE RUN (REF)	12.0	M	2	4	12.0	M	3	4
S. BR. LAUREL RUN	17.0	D	1	3	10.0	D	1	3
BUFFALO RUN	14.0	M	2	2	14.0	M	2	2
RHINE CREEK	3.0	M	2	1	10.0	D	1	3
SOUTH BRANCH	3.0	D	0	0	3.0	D	0	0
WHITE OAK SPRING RUN	12.0	M	1	3	12.0	M	1	2
MAPLE RUN	5.0	D	0	2	5.0	D	0	2
WARDWELL RUN	12.0	M	2	4	8.0	M	0	1
NORTH BRANCH	10.0	M	3	2	10.0	M	3	2
SNOWY CREEK	8.0	D	2	3	8.0	D	2	3
LITTLE LAUREL RUN	12.0	M	2	4	12.0	M	3	4
NOTTKEN RUN	1.0	D	0	0	1.0	D	0	0
U.N.T. OF SNOWY CREEK	ND	ND	ND	ND	ND	ND	ND	ND
WOLF CREEK (REF)	18.0	D	3	3	15.0	D	4	2
MACS								
HOYES RUN (REF)	18.0	M	2	2	18.0	M	2	2
HAYES RUN	ND	ND	ND	ND	ND	ND	ND	ND
CUPP RUN	18.0	D	1	2	18.0	M	3	2
SALT BLOCK RUN	5.0	D	0	1	5.0	D	0	1
TANKILN RUN	0.0	N	0	0	0.0	M	2	0
BROWNING RUN	ND	ND	ND	ND	ND	ND	ND	ND
NONCOMPARABLE								
LAUREL RUN	10.0	D	1	2	4.0	D	1	2
PINE SWAMP	18.0	N	0	0	18.0	N	0	0
YOUGHIOGHENY RIVER	3.0	D	0	1	5.0	D	2	1

Values represent % surface area covered by vegetation's greatest horizontal dimension:

0 = absent, 1 = 0-10%, 2 = 10-40%, 3 = 40-75%, 4 = >75%.

Big trees = > 0.3 m diameter at breast height. Small trees = < 0.3 m d.b.h.

Zone width is in meters.

ND = Not determined.

Vegetation type key: D = deciduous, C = coniferous, M = mixed, N = none.

Table 17.

Sampling Site Stream Bank/Riparian Zone Measures - UNDERSTORY (0.5-5m high).

Name	Left			Right		
	Veg type	Shrub saplings	Non-woody herbs	Veg type	Shrubs saplings	Non-woody herbs
RIFFLE - KICK						
PINE RUN (REF)	M	3	1	M	3	1
S. BR. LAUREL RUN	D	4	4	D	4	1
BUFFALO RUN	M	4	1	M	4	1
RHINE CREEK	M	1	1	D	2	2
SOUTH BRANCH	D	3	2	D	3	2
WHITE OAK SPRING RUN	M	3	1	M	2	1
MAPLE RUN	D	2	2	D	2	2
WARDWELL RUN	M	3	1	M	2	2
NORTH BRANCH	M	1	2	M	2	1
SNOWY CREEK	D	4	3	D	4	3
LITTLE LAUREL RUN	M	4	1	M	2	1
NOTTKEN RUN	D	2	1	D	2	1
U.N.T. OF SNOWY CREEK	D	0	2	D	0	2
WOLF CREEK (REF)	D	2	2	D	1	2
MACS						
HOYES RUN (REF)	M	4	4	M	4	4
HAYES RUN	M	2	4	M	2	4
CUPP RUN	M	3	4	M	3	4
SALT BLOCK RUN	D	3	4	D	3	4
TANKILN RUN	M	0	3	M	1	2
BROWNING RUN	ND	ND	ND	ND	ND	ND
NONCOMPARABLE						
LAUREL RUN	D	2	2	D	2	2
PINE SWAMP	D	0	4	D	0	4
YOUGHIOGHENY RIVER	D	3	1	D	3	1

Values represent % surface area covered by greatest horizontal dimension of vegetation:
0 = absent, 1 = 0-10%, 2 = 10-40%, 3 = 40-75%, 4 = >75%.
ND = Not determined.
Vegetation type key: D = deciduous, C = coniferous, M = mixed, N = none.

Table 18.

Sampling Site Stream Bank/Riparian Zone Measures - GROUND COVER (<0.5m high).

Name shrubs	Left			Right			
	Woody herbs, seedlings	**Non-woody soil grasses ferns, etc.**	**Bare shrubs**	**Woody herbs, seedlings**	**Non-woody soil grasses ferns, etc.**	**Bare shade**	**Stream**
RIFFLE - KICK							
PINE RUN (REF)	3	4	1	3	4	1	4
S. BR. LAUREL RUN	1	4	0	1	4	0	4
BUFFALO RUN	1	4	1	1	4	1	4
RHINE CREEK	2	2	2	3	3	2	3
SOUTH BRANCH	2	3	1	2	3	1	1
WHITE OAK SPRING RUN	2	2	3	3	4	3	4
MAPLE RUN	3	3	1	3	3	1	2
WARDWELL RUN	2	2	1	2	4	2	3
NORTH BRANCH	3	4	2	2	3	3	2
SNOWY CREEK	2	2	2	2	2	2	3
LITTLE LAUREL RUN	2	4	2	2	4	2	4
NOTTKEN RUN	2	4	1	2	4	1	1
U.N.T. OF SNOWY CREEK	1	4	1	1	4	1	1
WOLF CREEK (REF)	2	3	2	2	4	2	3
MACS							
HOYES RUN (REF)	1	4	0	1	4	0	4
HAYES RUN	1	4	0	1	4	0	4
CUPP RUN	2	4	1	1	4	1	4
SALT BLOCK RUN	0	4	0	0	4	1	3
TANKILN RUN	0	4	0	1	4	0	1
BROWNING RUN	ND	ND	ND	ND	ND	ND	ND
NONCOMPARABLE							
LAUREL RUN	4	4	1	4	4	1	1
PINE SWAMP	0	4	0	0	4	0	1
YOUGHIOGHENY RIVER	2	1	1	2	1	3	2

Values represent % surface area covered by greatest horizontal dimension of vegetation:
0 = absent, 1 = 0-10%, 2 = 10-40%, 3 = 40-75%, 4 = >75%.
ND = Not determined.

Table 19.

Physical Characterization - SUBSTRATE COMPOSITION.

name	% bedrock	% boulder	% cobble	% gravel	% sand	% silt	% clay
RIFFLE - KICK							
PINE RUN (REF)	0	10	30	20	20	20	0
S. BR. LAUREL RUN	10	10	5	0	65	10	0
BUFFALO RUN	15	10	10	5	50	10	0
RHINE CREEK	0	20	25	15	20	20	0
SOUTH BRANCH	0	10	15	20	20	35	0
WHITE OAK SPRING RUN	0	3	2	15	10	70	0
MAPLE RUN	0	15	30	15	10	30	0
WARDWELL RUN	0	70	20	5	2	3	0
NORTH BRANCH	0	25	25	10	15	25	0
SNOWY CREEK	0	20	20	15	15	20	0
LITTLE LAUREL RUN	0	35	10	20	20	15	0
NOTTKEN RUN	0	0	10	30	30	30	0
U.N.T. OF SNOWY CREEK	0	0	10	40	40	10	0
WOLF CREEK (REF)	5	15	50	30	0	0	0
MACS							
HOYES RUN (REF)	0	10	5	0	65	15	5
HAYES RUN	5	5	15	15	45	10	5
CUPP RUN	0	0	5	30	55	10	0
SALT BLOCK RUN	0	15	0	10	60	10	5
TANKILN RUN	0	0	10	20	50	15	5
BROWNING RUN	ND	ND	ND	ND	ND	ND	ND
NONCOMPARABLE							
LAUREL RUN	0	0	5	5	5	85	0
PINE SWAMP	0	0	0	0	40	40	20
YOUGHIOGHENY RIVER	0	20	2	3	15	60	0

Values represent % stream substrate surface area covered.

ND = Not determined.

Table 20.

Physical Characterization - SEDIMENT ODORS

Name	Normal	Sewage	Petroleum	Chemical	Anaerobic	None
RIFFLE - KICK						
PINE RUN (REF)	X					
S. BR. LAUREL RUN						X
BUFFALO RUN						X
RHINE CREEK	X					
SOUTH BRANCH	X					
WHITE OAK SPRING RUN	X					
MAPLE RUN		X			X	
WARDWELL RUN	X					
NORTH BRANCH	X					
SNOWY CREEK		X			X	
LITTLE LAUREL RUN	X					
NOTTKEN RUN	X					
U.N.T. OF SNOWY CREEK	X					
WOLF CREEK (REF)						X
MACS						
HOYES RUN (REF)						X
HAYES RUN						X
CUPP RUN						
SALT BLOCK RUN						X
TANKILN RUN					X	
BROWNING RUN						
NONCOMPARABLE						
LAUREL RUN	X					
PINE SWAMP					X	
YOUGHIOGHENY RIVER	X					

Table 21.

Physical Characterization - SEDIMENT OILS

Name	Absent	Slight	Moderate	Profuse
RIFFLE - KICK				
PINE RUN (REF)	X			
S. BR. LAUREL RUN	ND			
BUFFALO RUN	X			
RHINE CREEK	X			
SOUTH BRANCH	X			
WHITE OAK SPRING RUN	X			
MAPLE RUN	X			
WARDWELL RUN	X			
NORTH BRANCH	X			
SNOWY CREEK	X			
LITTLE LAUREL RUN	X			
NOTTKEN RUN	X			
U.N.T. OF SNOWY CREEK	X			
WOLF CREEK (REF)	X			
MACS				
HOYES RUN (REF)	X			
HAYES RUN	X			
CUPP RUN	X			
SALT BLOCK RUN	X			
TANKILN RUN	ND			
BROWNING RUN	ND			
NONCOMPARABLE				
LAUREL RUN	X			
PINE SWAMP	X			
YOUGHIOGHENY RIVER	X			

ND = Not determined.

Table 22.

Physical Characterization - SEDIMENT DEPOSITS

Name	sludge	saw -dust	paper fiber	sand	relic shell	marl	silt	lime fines	metal hydroxides	other deposits
RIFFLE - KICK										
PINE RUN (REF)				X			X			
S. BR. LAUREL RUN				X			X			Clay >5%
BUFFALO RUN				X			X			Clay >5%
RHINE CREEK				X			X			Heavily Embedded
SOUTH BRANCH				X			X			
WHITE OAK SPRING RUN				X			X			Heavy silt
MAPLE RUN				X			X			
WARDWELL RUN				X			X			
NORTH BRANCH				X			X			
SNOWY CREEK				X			X			
LITTLE LAUREL RUN				X			X			See Note*
NOTTKEN RUN				X			X			
U.N.T. OF SNOWY CREEK				X			X			
WOLF CREEK (REF)										
MACS										
HOYES RUN (REF)				X			X			Heavy Clay
HAYES RUN				X			X			Clay
CUPP RUN				X			X			Clay <5%
SALT BLOCK RUN				X			X			5% Clay
TANKILN RUN				X			X			Heavy Clay
BROWNING RUN	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
NONCOMPARABLE										
LAUREL RUN				X			X			Heavy Sediment
PINE SWAMP				X						
YOUGHIOGHENY RIVER				X			X			Heavy Sediment

ND = Not determined.

* A note on the assessment form indicated that the underside of all rocks were red.

Table 23.

Water Quality - WATER ODORS

Name	Normal	Sewage	Petroleum	Chemical	Anaerobic	None	Other
RIFFLE - KICK							
PINE RUN (REF)	X						
S. BR. LAUREL RUN						X	
BUFFALO RUN						X	
RHINE CREEK	X						
SOUTH BRANCH	X						
WHITE OAK SPRING RUN	X						
MAPLE RUN	X						
WARDWELL RUN	X						
NORTH BRANCH	X						
SNOWY CREEK		X			X		
LITTLE LAUREL RUN	X						
NOTTKEN RUN							
U.N.T. OF SNOWY CREEK							
WOLF CREEK (REF)						X	
MACS							
HOYES RUN (REF)						X	
HAYES RUN	X						
CUPP RUN						X	
SALT BLOCK RUN							
TANKILN RUN					X		
BROWNING RUN							
NONCOMPARABLE							
LAUREL RUN	X						
PINE SWAMP					X		
YOUGHIOGHENY RIVER	X						

Table 24.

Water Quality - SURFACE OILS

Name	Date	Slick	Sheen	Globs	Flecks	No
RIFFLE - KICK						
PINE RUN (REF)	09-Jul-96					X
S. BR. LAUREL RUN	08-Jul-96					X
BUFFALO RUN	08-Jul-96					X
RHINE CREEK	09-Jul-96					X
SOUTH BRANCH	09-Jul-96					X
WHITE OAK SPRING RUN	08-Jul-96					X
MAPLE RUN	09-Jul-96					X
WARDWELL RUN	08-Jul-96					X
NORTH BRANCH	08-Jul-96					X
SNOWY CREEK	08-Jul-96					X
LITTLE LAUREL RUN	09-Jul-96					X
NOTTKEN RUN	09-Jul-96					
U.N.T. OF SNOWY CREEK	08-Jul-96					
WOLF CREEK (REF)	24 Jul 96					X
MACS						
HOYES RUN (REF)	09-Jul-96					X
HAYES RUN	08-Jul-96					X
CUPP RUN	09-Jul-96					X
SALT BLOCK RUN	09-Jul-96					
TANKILN RUN	08-Jul-96					X
BROWNING RUN	08-Jul-96					ND
NONCOMPARABLE						
LAUREL RUN	09-Jul-96					X
PINE SWAMP	09-Jul-96					
YOUGHIOGHENY RIVER	09-Jul-96					X

ND = Not determined.

Table 25.

Benthic Macroinvertebrates.

Stream name	Date	Family	Count
BUFFALO RUN	08-Jul-96	Oligochaeta	14
BUFFALO RUN	08-Jul-96	Ephemerellidae	1
BUFFALO RUN	08-Jul-96	Hydropsychidae	7
BUFFALO RUN	08-Jul-96	Capniidae	76
BUFFALO RUN	08-Jul-96	Nemouridae	1
BUFFALO RUN	08-Jul-96	Cordulegastridae	1
BUFFALO RUN	08-Jul-96	Chironomidae	1
BUFFALO RUN	08-Jul-96	Tipulidae	1
BUFFALO RUN	08-Jul-96	Simuliidae	16
CUPP RUN	09-Jul-96	Oligochaeta	3
CUPP RUN	09-Jul-96	Baetidae	3
CUPP RUN	09-Jul-96	Heptageniidae	4
CUPP RUN	09-Jul-96	Leptophlebiidae	21
CUPP RUN	09-Jul-96	Limnephilidae	1
CUPP RUN	09-Jul-96	Lepidostomatidae	23
CUPP RUN	09-Jul-96	Odontoceridae	4
CUPP RUN	09-Jul-96	Capniidae	29
CUPP RUN	09-Jul-96	Peltoperlidae	7
CUPP RUN	09-Jul-96	Elmidae	3
CUPP RUN	09-Jul-96	Dryopidae	1
CUPP RUN	09-Jul-96	Chironomidae	20
CUPP RUN	09-Jul-96	Tipulidae	5
CUPP RUN	09-Jul-96	Tabanidae	1
HAYES RUN	08-Jul-96	Oligochaeta	1
HAYES RUN	08-Jul-96	Sphaeriidae	1
HAYES RUN	08-Jul-96	Cambaridae	2
HAYES RUN	08-Jul-96	Asellidae	1
HAYES RUN	08-Jul-96	Baetidae	6
HAYES RUN	08-Jul-96	Ephemeridae	1
HAYES RUN	08-Jul-96	Heptageniidae	2
HAYES RUN	08-Jul-96	Leptophlebiidae	5
HAYES RUN	08-Jul-96	Hydropsychidae	1
HAYES RUN	08-Jul-96	Philopotamidae	23
HAYES RUN	08-Jul-96	Rhyacophilidae	1
HAYES RUN	08-Jul-96	Limnephilidae	2
HAYES RUN	08-Jul-96	Odontoceridae	4
HAYES RUN	08-Jul-96	Leptoceridae	13
HAYES RUN	08-Jul-96	Pteronarcyidae	1
HAYES RUN	08-Jul-96	Chloroperlidae	1
HAYES RUN	08-Jul-96	Capniidae	16
HAYES RUN	08-Jul-96	Perlodidae	7
HAYES RUN	08-Jul-96	Peltoperlidae	4
HAYES RUN	08-Jul-96	Nemouridae	3
HAYES RUN	08-Jul-96	Aeshnidae	1
HAYES RUN	08-Jul-96	Elmidae	3
HAYES RUN	08-Jul-96	Chironomidae	14
HAYES RUN	08-Jul-96	Tipulidae	3
HAYES RUN	08-Jul-96	Simuliidae	1
HOYES RUN	09-Jul-96	Oligochaeta	16
HOYES RUN	09-Jul-96	Baetidae	1
HOYES RUN	09-Jul-96	Ephemeridae	1
HOYES RUN	09-Jul-96	Heptageniidae	4
HOYES RUN	09-Jul-96	Hydropsychidae	7
HOYES RUN	09-Jul-96	Rhyacophilidae	3
HOYES RUN	09-Jul-96	Limnephilidae	6
HOYES RUN	09-Jul-96	Lepidostomatidae	15
HOYES RUN	09-Jul-96	Odontoceridae	1
HOYES RUN	09-Jul-96	Capniidae	8
HOYES RUN	09-Jul-96	Perlidae	1
HOYES RUN	09-Jul-96	Perlodidae	5
HOYES RUN	09-Jul-96	Peltoperlidae	2
HOYES RUN	09-Jul-96	Nemouridae	3
HOYES RUN	09-Jul-96	Cordulegastridae	2
HOYES RUN	09-Jul-96	Hydrophilidae	2
HOYES RUN	09-Jul-96	Chironomidae	5
HOYES RUN	09-Jul-96	Tipulidae	7
HOYES RUN	09-Jul-96	Simuliidae	3
HOYES RUN	09-Jul-96	Tabanidae	1
LITTLE LAUREL RUN	08-Jul-96	Gammaridae	2
LITTLE LAUREL RUN	08-Jul-96	Baetidae	2
LITTLE LAUREL RUN	08-Jul-96	Hydropsychidae	5
LITTLE LAUREL RUN	08-Jul-96	Capniidae	68
LITTLE LAUREL RUN	08-Jul-96	Gomphidae	1
LITTLE LAUREL RUN	08-Jul-96	Chironomidae	7
LITTLE LAUREL RUN	08-Jul-96	Simuliidae	17
MAPLE RUN	09-Jul-96	Oligochaeta	7
MAPLE RUN	09-Jul-96	Baetidae	21
MAPLE RUN	09-Jul-96	Heptageniidae	2
MAPLE RUN	09-Jul-96	Isonychiidae	1
MAPLE RUN	09-Jul-96	Hydropsychidae	6
MAPLE RUN	09-Jul-96	Philopotamidae	14
MAPLE RUN	09-Jul-96	Chloroperlidae	5
MAPLE RUN	09-Jul-96	Capniidae	2
MAPLE RUN	09-Jul-96	Elmidae	3
MAPLE RUN	09-Jul-96	Psephenidae	28
MAPLE RUN	09-Jul-96	Corydalidae	1
MAPLE RUN	09-Jul-96	Chironomidae	71
MAPLE RUN	09-Jul-96	Tipulidae	2
MAPLE RUN	09-Jul-96	Simuliidae	14
MAPLE RUN	09-Jul-96	Ceratopogonidae	1
NORTH BRANCH	08-Jul-96	Nemertea	1
NORTH BRANCH	08-Jul-96	Baetidae	15
NORTH BRANCH	08-Jul-96	Heptageniidae	7
NORTH BRANCH	08-Jul-96	Isonychiidae	2
NORTH BRANCH	08-Jul-96	Hydropsychidae	82
NORTH BRANCH	08-Jul-96	Glossosomatidae	1
NORTH BRANCH	08-Jul-96	Psycomyiidae	4
NORTH BRANCH	08-Jul-96	Peltoperlidae	8
NORTH BRANCH	08-Jul-96	Elmidae	3
NORTH BRANCH	08-Jul-96	Corydalidae	5
NORTH BRANCH	08-Jul-96	Chironomidae	2
NORTH BRANCH	08-Jul-96	Tipulidae	2
NORTH BRANCH	08-Jul-96	Ceratopogonidae	1
PINE RUN	09-Jul-96	Oligochaeta	2
PINE RUN	09-Jul-96	Baetidae	8
PINE RUN	09-Jul-96	Ephemerellidae	2
PINE RUN	09-Jul-96	Hydropsychidae	8
PINE RUN	09-Jul-96	Philopotamidae	1
PINE RUN	09-Jul-96	Rhyacophilidae	2
PINE RUN	09-Jul-96	Glossosomatidae	1
PINE RUN	09-Jul-96	Pteronarcyidae	1
PINE RUN	09-Jul-96	Chloroperlidae	2
PINE RUN	09-Jul-96	Capniidae	6
PINE RUN	09-Jul-96	Perlidae	1
PINE RUN	09-Jul-96	Perlodidae	5
PINE RUN	09-Jul-96	Peltoperlidae	39
PINE RUN	09-Jul-96	Nemouridae	2
PINE RUN	09-Jul-96	Elmidae	5
PINE RUN	09-Jul-96	Chironomidae	4
PINE RUN	09-Jul-96	Tipulidae	2
PINE RUN	09-Jul-96	Empididae	1
PINE SWAMP	09-Jul-96	Sphaeriidae	10
PINE SWAMP	09-Jul-96	Talitridae	159
PINE SWAMP	09-Jul-96	Baetidae	1
PINE SWAMP	09-Jul-96	Aeshnidae	2
PINE SWAMP	09-Jul-96	Dytiscidae	1

Stream name	Date	Family	Count
PINE SWAMP	09-Jul-96	Noteridae	1
PINE SWAMP	09-Jul-96	Tabanidae	1
RHINE CREEK	09-Jul-96	Oligochaeta	1
RHINE CREEK	09-Jul-96	Gammaridae	1
RHINE CREEK	09-Jul-96	Baetidae	26
RHINE CREEK	09-Jul-96	Ephemerellidae	1
RHINE CREEK	09-Jul-96	Heptageniidae	3
RHINE CREEK	09-Jul-96	Leptophlebiidae	11
RHINE CREEK	09-Jul-96	Hydropsychidae	29
RHINE CREEK	09-Jul-96	Philopotamidae	5
RHINE CREEK	09-Jul-96	Capniidae	5
RHINE CREEK	09-Jul-96	Perlidae	2
RHINE CREEK	09-Jul-96	Peltoperlidae	2
RHINE CREEK	09-Jul-96	Elmidae	8
RHINE CREEK	09-Jul-96	Chironomidae	33
RHINE CREEK	09-Jul-96	Tipulidae	5
SALT BLOCK RUN	09-Jul-96	Gammaridae	66
SALT BLOCK RUN	09-Jul-96	Baetidae	7
SALT BLOCK RUN	09-Jul-96	Heptageniidae	3
SALT BLOCK RUN	09-Jul-96	Leptophlebiidae	1
SALT BLOCK RUN	09-Jul-96	Limnephilidae	1
SALT BLOCK RUN	09-Jul-96	Odontoceridae	3
SALT BLOCK RUN	09-Jul-96	Lepidostomatidae	1
SALT BLOCK RUN	09-Jul-96	Capniidae	1
SALT BLOCK RUN	09-Jul-96	Peltoperlidae	6
SALT BLOCK RUN	09-Jul-96	Nemouridae	1
SALT BLOCK RUN	09-Jul-96	Aeshnidae	1
SALT BLOCK RUN	09-Jul-96	Curculionidae	1
SALT BLOCK RUN	09-Jul-96	Chironomidae	5
SALT BLOCK RUN	09-Jul-96	Tabanidae	2
SNOWY CREEK	08-Jul-96	Oligochaeta	15
SNOWY CREEK	08-Jul-96	Baetidae	3
SNOWY CREEK	08-Jul-96	Leptophlebiidae	1
SNOWY CREEK	08-Jul-96	Hydropsychidae	65
SNOWY CREEK	08-Jul-96	Elmidae	17
SNOWY CREEK	08-Jul-96	Gyrinidae	1
SNOWY CREEK	08-Jul-96	Sialidae	1
SNOWY CREEK	08-Jul-96	Chironomidae	6
SNOWY CREEK	08-Jul-96	Tipulidae	1
SOUTH BRANCH	09-Jul-96	Cambaridae	2
SOUTH BRANCH	09-Jul-96	Baetidae	16
SOUTH BRANCH	09-Jul-96	Ephemerellidae	1
SOUTH BRANCH	09-Jul-96	Heptageniidae	10
SOUTH BRANCH	09-Jul-96	Isonychiidae	22
SOUTH BRANCH	09-Jul-96	Leptophlebiidae	5
SOUTH BRANCH	09-Jul-96	Psycomyiidae	1
SOUTH BRANCH	09-Jul-96	Pteronarcyidae	1
SOUTH BRANCH	09-Jul-96	Capniidae	2
SOUTH BRANCH	09-Jul-96	Peltoperlidae	5
SOUTH BRANCH	09-Jul-96	Elmidae	6
SOUTH BRANCH	09-Jul-96	Corydalidae	1
SOUTH BRANCH	09-Jul-96	Chironomidae	8
SOUTH BRANCH	09-Jul-96	Tipulidae	5
S. BRANCH LAUREL RUN	08-Jul-96	Oligochaeta	7
S. BRANCH LAUREL RUN	08-Jul-96	Sphaeriidae	2
S. BRANCH LAUREL RUN	08-Jul-96	Cambaridae	3
S. BRANCH LAUREL RUN	08-Jul-96	Asellidae	2
S. BRANCH LAUREL RUN	08-Jul-96	Baetidae	2
S. BRANCH LAUREL RUN	08-Jul-96	Heptageniidae	1
S. BRANCH LAUREL RUN	08-Jul-96	Leptophlebiidae	1
S. BRANCH LAUREL RUN	08-Jul-96	Hydropsychidae	1
S. BRANCH LAUREL RUN	08-Jul-96	Lepidostomatidae	3
S. BRANCH LAUREL RUN	08-Jul-96	Chloroperlidae	1
S. BRANCH LAUREL RUN	08-Jul-96	Capniidae	19

Stream name	Date	Family	Count
S. BRANCH LAUREL RUN	08-Jul-96	Perlodidae	10
S. BRANCH LAUREL RUN	08-Jul-96	Cordulegastridae	3
S. BRANCH LAUREL RUN	08-Jul-96	Dytiscidae	1
S. BRANCH LAUREL RUN	08-Jul-96	Chironomidae	12
S. BRANCH LAUREL RUN	08-Jul-96	Tipulidae	30
S. BRANCH LAUREL RUN	08-Jul-96	Tabanidae	8
TANKILN RUN	08-Jul-96	Sphaeriidae	2
TANKILN RUN	08-Jul-96	Cambaridae	3
TANKILN RUN	08-Jul-96	Asellidae	2
TANKILN RUN	08-Jul-96	Baetidae	5
TANKILN RUN	08-Jul-96	Ephemeridae	3
TANKILN RUN	08-Jul-96	Ephemerellidae	2
TANKILN RUN	08-Jul-96	Limnephilidae	1
TANKILN RUN	08-Jul-96	Lepidostomatidae	8
TANKILN RUN	08-Jul-96	Capniidae	51
TANKILN RUN	08-Jul-96	Peltoperlidae	2
TANKILN RUN	08-Jul-96	Nemouridae	3
TANKILN RUN	08-Jul-96	Curculionidae	1
TANKILN RUN	08-Jul-96	Dytiscidae	1
TANKILN RUN	08-Jul-96	Chironomidae	13
TANKILN RUN	08-Jul-96	Tipulidae	15
TANKILN RUN	08-Jul-96	Simuliidae	5
WARDWELL RUN	08-Jul-96	Oligochaeta	7
WARDWELL RUN	08-Jul-96	Asellidae	2
WARDWELL RUN	08-Jul-96	Gammaridae	10
WARDWELL RUN	08-Jul-96	Heptageniidae	3
WARDWELL RUN	08-Jul-96	Leptophlebiidae	1
WARDWELL RUN	08-Jul-96	Hydropsychidae	37
WARDWELL RUN	08-Jul-96	Capniidae	4
WARDWELL RUN	08-Jul-96	Peltoperlidae	1
WARDWELL RUN	08-Jul-96	Elmidae	7
WARDWELL RUN	08-Jul-96	Corydalidae	1
WARDWELL RUN	08-Jul-96	Chironomidae	43
WARDWELL RUN	08-Jul-96	Tipulidae	2
WARDWELL RUN	08-Jul-96	Simuliidae	1
WHITE OAK SPRING RUN	08-Jul-96	Empididae	14
WHITE OAK SPRING RUN	08-Jul-96	Baetidae	1
WHITE OAK SPRING RUN	08-Jul-96	Hydropsychidae	1
WHITE OAK SPRING RUN	08-Jul-96	Rhyacophilidae	1
WHITE OAK SPRING RUN	08-Jul-96	Chloroperlidae	4
WHITE OAK SPRING RUN	08-Jul-96	Capniidae	20
WHITE OAK SPRING RUN	08-Jul-96	Perlodidae	7
WHITE OAK SPRING RUN	08-Jul-96	Peltoperlidae	26
WHITE OAK SPRING RUN	08-Jul-96	Elmidae	21
WHITE OAK SPRING RUN	08-Jul-96	Chironomidae	3
WHITE OAK SPRING RUN	08-Jul-96	Tipulidae	6
WHITE OAK SPRING RUN	08-Jul-96	Simuliidae	2
WOLF RUN	24 Jul 96	Heptageniidae	5
WOLF RUN	24 Jul 96	Baetidae	10
WOLF RUN	24 Jul 96	Leptophlebiidae	1
WOLF RUN	24 Jul 96	Hydropsychidae	46
WOLF RUN	24 Jul 96	Philopotamidae	1
WOLF RUN	24 Jul 96	Peltoperlidae	7
WOLF RUN	24 Jul 96	Pteronarcyidae	1
WOLF RUN	24 Jul 96	Perlidae	12
WOLF RUN	24 Jul 96	Chloroperlidae	17
WOLF RUN	24 Jul 96	Capniidae/Leuctridae	5
WOLF RUN	24 Jul 96	Aeshnidae	1
WOLF RUN	24 Jul 96	Psephenidae	1
WOLF RUN	24 Jul 96	Elmidae	2
WOLF RUN	24 Jul 96	Corydalidae	1
WOLF RUN	24 Jul 96	Chironomidae	10
WOLF RUN	24 Jul 96	Tipulidae	2
WOLF RUN	24 Jul 96	Simulidae	1

Table 26.

Relative Frequency of Macroinvertebrate Taxa

Taxa	Number of streams	Total number of organisms
Chironomidae	17	258
Baetidae	15	117
Capniidae	14	307
Tipulidae	15	87
Hydropsychidae	12	249
Peltoperlidae	11	102
Elmidae	11	77
Heptageniidae	10	39
Oligochaeta	10	73
Leptophlebiidae	8	46
Simuliidae	8	59
Perlodidae	6	35
Nemouridae	6	13
Chloroperlidae	5	13
Ephemerellidae	5	7
Lepidostomatidae	5	50
Limnephilidae	5	11
Tabanidae	5	13
Asellidae	4	7
Cambaridae	5	11
Corydalidae	4	8
Gammaridae	4	79
Odontoceridae	4	12
Philopotamidae	4	43

Taxa	Number of streams	Total number of organisms
Rhyacophilidae	4	7
Sphaeriidae	4	15
Aeshnidae	3	4
Cordulegastridae	3	6
Dytiscidae	3	3
Ephemeridae	3	5
Isonychiidae	3	25
Perlidae	3	4
Pteronarcyidae	3	3
Ceratopogonidae	2	2
Curculionidae	2	2
Empididae	2	15
Glossosomatidae	2	2
Psycomyiidae	2	5
Dryopidae	1	1
Gomphidae	1	1
Gyrinidae	1	1
Hydrophilidae	1	2
Leptoceridae	1	13
Nemertea	1	1
Noteridae	1	1
Psephenidae	1	28
Sialidae	1	1
Talitridae	1	159

Appendix C. Glossary

303(d) list -a list of streams that are water quality limited and not expected to meet water quality criteria even after applying technology-based controls. Required by the Clean Water Act and named for the section of the Act in which it appears.

acidity -the capacity of water to donate protons. The abbreviation pH (see def.) refers to intensity of acidity. Higher acidtites are more corrosive and harmful to aquatic life.

acid mine drainage (AMD) -acidic water discharged from an active or abandoned mine.

alkalinity -measures water's buffering capacity, or resistance to acidification; often expressed as the concentration of carbonate and bicarbonate.

aluminum -a potentially toxic metallic element often found in mine drainage; when oxidized forms a white precipitate called "white boy".

benthic macroinvertebrates -invertebrate (without a backbone) animals that are large enough to be collected with a 595 µm mesh screen and that live on the substrate of a water body.

benthic organisms, or benthos - organisms that live on or near the substrate (bottom or material attached to the bottom) of a water body, e.g., algae, mayfly larvae, darters.

buffer -a dissolved substance that maintains a solution's original pH by neutralizing added acid.

canopy -The layer of vegetation that is more than 5 meters from the ground; see understory and ground cover.

citizens monitoring team -a group of people that periodically check the ecological health of their local streams.

conductivity (conductance) -the capacity of water to conduct an electrical current, higher conductivities indicate higher concentrations of ions.

designated uses -the uses specified in the state water quality standards for each water body or segment (e.g., fish propagation and industrial water supply).

discharge -liquid flowing from a point source or, the volume of water flowing down a stream per unit of time, typically recorded as cfs (cubic feet / second).

discharge permit -a legal document issued by a government regulatory agency specifying the kinds and amounts of pollutants a person or group may discharge into a water body; often called NPDES permit.

dissolved oxygen -describes the amount of molecular oxygen dissolved in water.

Division of Environmental Protection (DEP) -a unit in the executive branch of West Virginia's state government charged with enforcing environmental laws and monitoring environmental quality.

ecoregion -a land area with relative homogeneity in ecosystems that, under nonimpaired conditions, contain habitats which should support similar communities of animals (specifically, benthic macroinvertebrates).

ecosystem -the complex of a community and its environment functioning as an ecological unit in nature. A not easily defined aggregation of biotic and abiotic components that are interconnected through various trophic pathways, and that interact systematically in the transfer of nutrients and energy.

effluent -liquid flowing from a point source (e.g., pipe or collection pond).

Environmental Protection Agency (EPA) -a unit in the executive branch of the federal government charged with enforcing environmental laws.

Environmental Quality Board (EQB) -a standing group, whose members are appointed by the governor, that promulgates water quality criteria and judges appeals for relief from water quality regulations.

ephemeral -a stream that carries surface water during only part of the year; a stream that occasionally dries up.

eutrophic -a condition of a lake or stream which has higher than normal levels of nutrients, contributing to excessive plant growth. Usually eutrophic waters are seasonally deficient in oxygen. Consequently more food and cover is provided to some benthic macroinvertebrates than would be provided otherwise.

f**ecal coliform bacteria** -a group of single-celled organisms common in the alimentary tracts of some birds and all mammals, including man; indicates fecal pollution and the potential presence of human pathogens.

ground cover -vegetation that forms the lowest layer in a plant community defined as less than 0.5 meters high for this assessment) .

impaired -(1) according to the water quality standards, a stream that does not fully support 1 or more of its designated uses; (2) as used in this assessment report, a benthic macroinvertebrate community with metric scores substantially worse than those of an appropriate reference site.

iron -a metallic element, often found in mine drainage, that is potentially harmful to aquatic life. When oxidized, it forms an orange precipitate called “yellow boy” that can clog fish and macroinvertebrate gills.

lacustrine - of or having to do with a lake or lakes.

macroinvertebrates - organisms without a backbone which are large enough to be seen with the naked eye.

MACS -Mid-Atlantic Coastal Streams -macrobenthic sampling methodology used in streams with very low gradient that lack riffle habitat suitable for The Program’s preferred procedure (see Appendix B).

manganese -a metallic element, often found in mine drainage, that is potentially harmful to aquatic life.

MD - Maryland.

metrics -statistical tools used by ecologists to evaluate biological communities (see Appendix B).

National Pollutant Discharge Elimination System (NPDES) -a government permitting activity created by section 402 of the federal Clean Water Act of 1972 to control all discharges of pollutants from point sources. In West Virginia this activity is conducted by the Office of Water Resources.

nonimpaired -(1) according to the water quality standard, a stream that fully supports all of its designated uses: (2) as used in this assessment report, a benthic community with metric scores comparable to those of an appropriate reference site.

nonpoint source (NPS) pollution -contaminants that run off a broad landscape area (e.g., plowed field, parking lot, dirt road) and enter a receiving water body.

Office of Water Resources (OWR) -a unit within the DEP that manages a variety of regulatory and voluntary activities to enhance and protect West Virginia's surface and ground waters.

Oligotrophic - a stream, lake or pond which is poor in nutrients.

Palustrine - of or having to do with a marsh, swamp or bog.

pH -indicates the concentration of hydrogen ions; a measure of the intensity of acidity of a liquid. Represented on a scale of 0-14, a pH of 1 describes the strongest acid, 14 represents the strongest base, and 7 is neutral. Aquatic life cannot tolerate either extreme.

point source -a specific, discernible site (e.g., pipe, ditch, container) locatable on a map as a point, from which pollution discharges into a water body.

RBP - Rapid Bioassessment Protocol.

reference site -a stream reach that represents an area's (watershed or ecoregion) least impacted condition; used for comparison with other sites within that area. Site must meet the agency's minimum degradation criteria (Appedix D).

SCA -Soil Conservation Agency

sewage treatment plant or STP - an facility which removes human sewage from water. It may be a waste water treatment plant (WWTP), a package plant, or a Publicly Owned Treatment Works (POTW).

stakeholder -a person or group with a vested interest in a watershed, e.g., landowner, businessperson, angler.

STORET -STOrage and RETrieval of U.S. waterways parametric data -a system maintained by EPA and used by OWR to store and analyze water quality data.

total maximum daily load (TMDL) -the total amount of a particular pollutant that can enter a water body and not cause a water quality standards violation.

turbidity -the extent to which light passes through water, indicating its clarity; indirect measure of suspended sediment.

understory -the layer of vegetation that form a forest's middle layer (defined as 0.5 to 5 meters high for this assessment).

USGS -United States Geological Survey.

water-contact recreation -the type of designated use in which a person (e.g., angler, swimmer, boater) comes in contact with the stream's water.

watershed -a geographic area from which water drains to a particular point.

Watershed Approach Steering Committee -a task force of federal (e.g., U.S. EPA, USGS) and state (e.g., DEP, SCA) officers that recommends streams for intense, detailed study.

Watershed Assessment Program (the Program) -a group of scientists within the OWR charged with evaluating and reporting on the ecological health of West Virginia's watersheds.

watershed association -a group of diverse stakeholders working via a consensus process to improve water quality in their local streams.

Watershed Network -an informal coaliton of federal, state, multi-state, and non-governmental groups cooperating to support local watershed associations.