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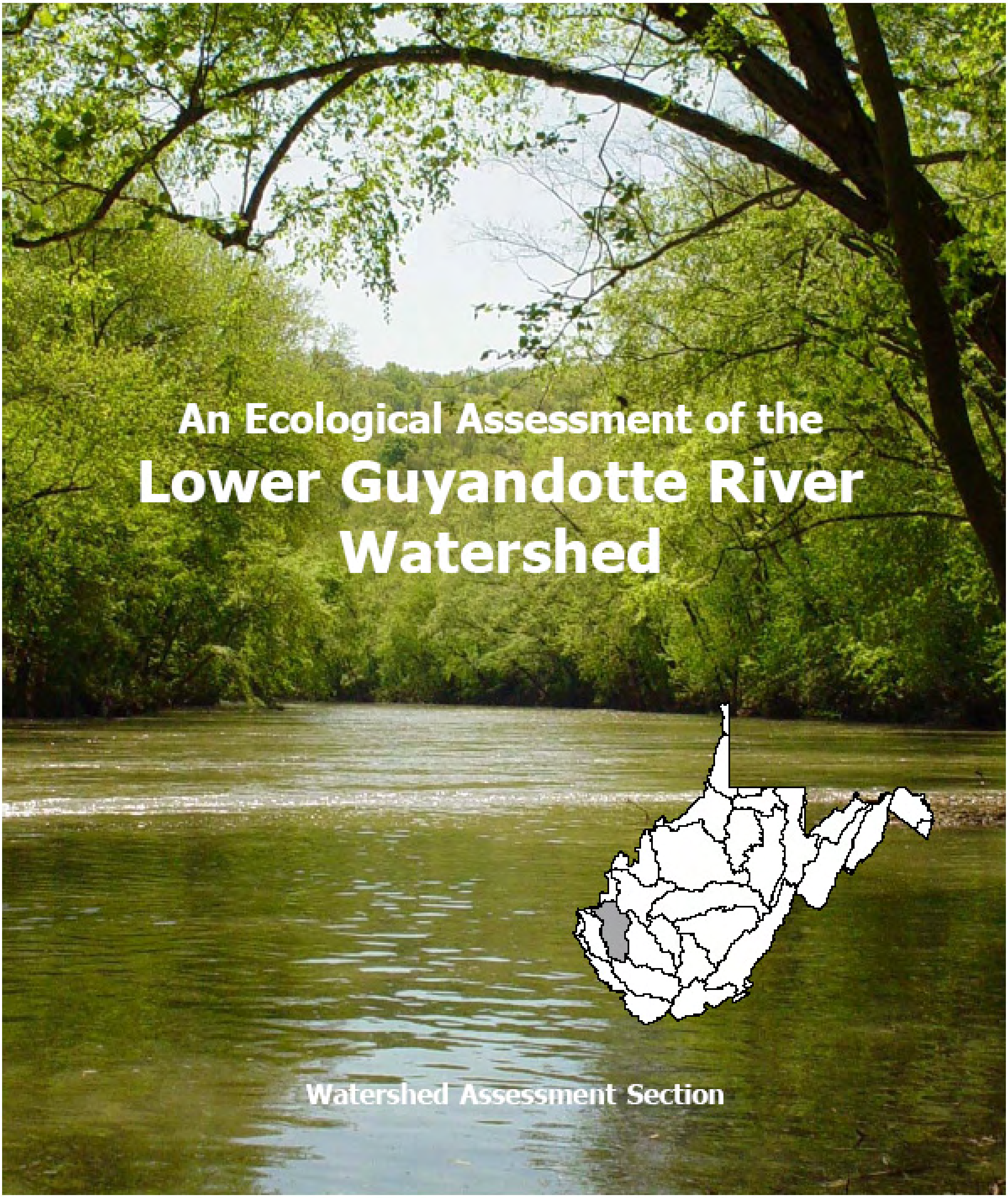

An Ecological Assessment of the Lower Guyandotte River Watershed

Watershed Assessment Section

Lower Guyandotte River Watershed

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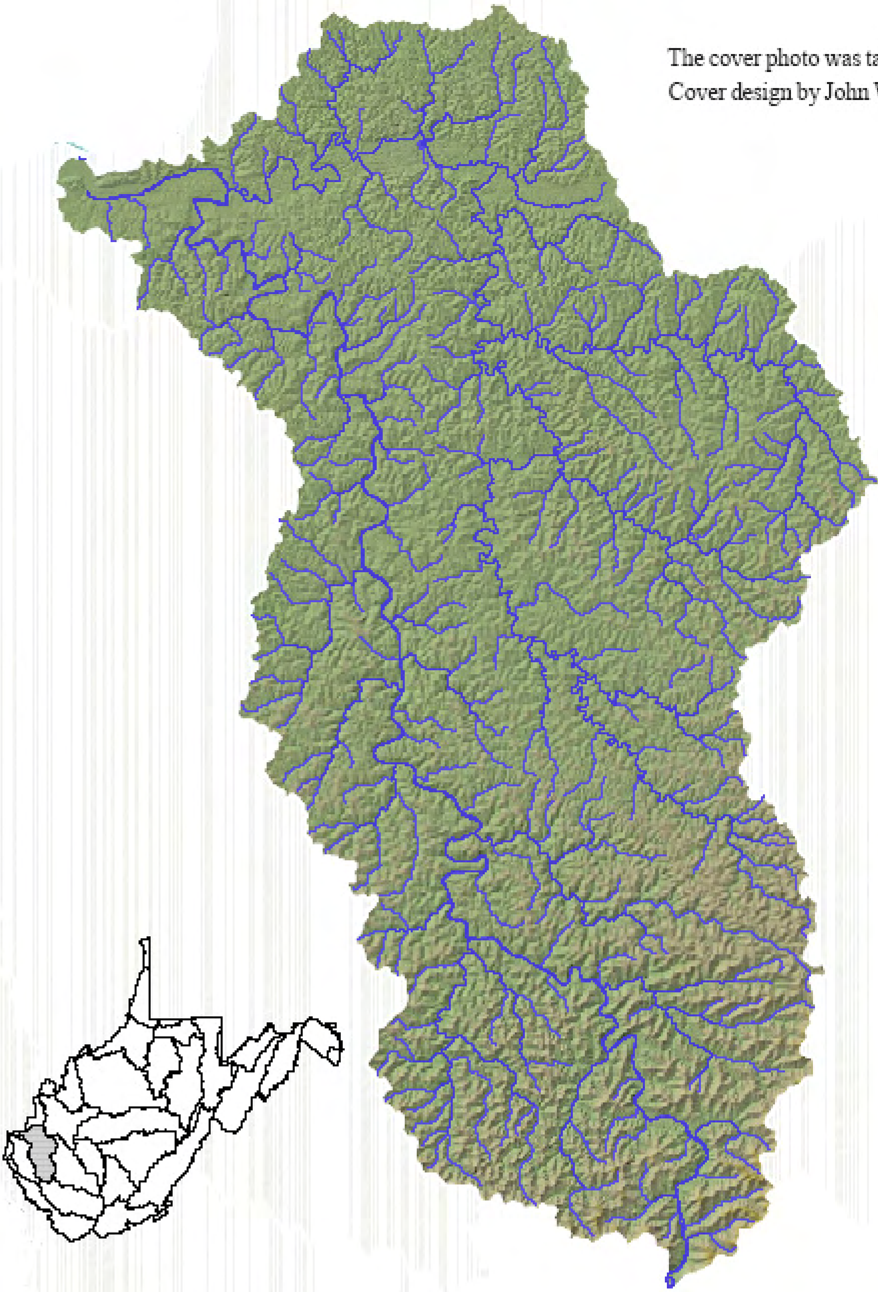

An Ecological Assessment of the Lower Guyandotte River Watershed

Report number - 05070102 - May 2004

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Summary

In 1998, during the months of May and June, assessment teams of the West Virginia Watershed Assessment Section visited 129 sites within the Lower Guyandotte River watershed. Benthic macroinvertebrate samples were collected at 119 of these sites and water quality samples were collected at 128 sites. This assessment report is based upon the data generated from this effort.

The surface areas of a majority of the sub-watersheds sampled during this study were covered mostly by forest. All but 2 of the sampled sites drain areas that were more than 70 % forested during the sampling period. The bottomlands of the lowermost portion of the watershed had undergone extensive urban development since Interstate Highway 64 was developed along the bed of ancient Teays Lake between the communities of Nitro and Huntington. The southern third of the watershed is underlain with minable coals. There were mines operating during the sampling period, and there was evidence of numerous inactive mines in the region. One site produced evidence that current mining activity negatively impacted Mud River. Other sites gave evidence that older mine drainage negatively impacted benthic communities therein.

At some sites, poor habitat conditions were considered possible causes of impairment. Two sites with substrates covered heavily by sediment drained areas that had 47.21 % and 13.83 % coverage by urban land, the highest percentages in this land use category of all the sites sampled. These sub-watersheds had the lowest percentage area coverage by forest as well. These 2 sites also produced the lowest West Virginia Stream Condition Index (WVSCI) benthological scores in the Mud River sub-watershed. From this information, it appears that the poor showing of *Tanyard Branch* (OGM-1.5) and *Indian Fork* (OGM-12), may have been due in large part to poor habitat that may have resulted from urbanization.

In the portion of the Guyandotte River watershed that excludes the Mud River sub-watershed, the 2 sites with the poorest WVSCI scores were negatively impacted, at least in part, by mine drainage. *Perrys Branch* (OG-49-E-1) and an *unnamed tributary of Big Creek* (OG-49-C.1) also had poor water quality and other evidence indicating severe impairment by mine drainage. A few streams were added to sampling lists by team members suspecting mine drainage impacts. The evidence gathered at these sites indicates there were more streams impacted by mine drainage within the watershed than were previously known.

Several sites produced benthic samples indicating impairment, but few clues about the causes or sources of impairment. No fewer than 25 of the comparably sampled sites fell in this category and are therefore recommended for further study. Also recommended for further study are the Guyandotte River and Mud River main stems, because they were not adequately sampled during this effort to allow the Watershed Assessment Section to assess their overall condition.

Acknowledgements

Funding for this watershed assessment was provided by the U.S. Environmental Protection Agency's 319 and 104(b)(3) programs and by the West Virginia Department of Environmental Protection.

Jeffrey Bailey, Perry Casto, Alvan Gale, Karen Maes, Christina Moore, Mike Puckett, Charles Surbaugh (retired since), John Wirts, and Doug Wood collected samples and assessed sampling sites. Karen Maes and Christina Moore processed some of the benthic macroinvertebrate samples, but most were processed by Marshall University students under the supervision of Dr. Donald Tarter and Jeffrey Bailey. Jeffrey Bailey, Janice Smithson, and John Wirts identified the macroinvertebrates. Karen Maes, Christina Moore, and Charles Surbaugh entered the raw data into the database. John Wirts, Doug Wood, and Kim Smith created tables and figures. Michael Arcuri, Patrick Campbell, Judith Lyons, Steve Young, and John Wirts reviewed various drafts of this report. Doug Wood interpreted the results and is the primary author of this report.

Watersheds And Their Assessment

In 1959, the West Virginia Legislature created the State Water Commission, which was the predecessor of the Division of Water Resources, and later, the Division of Water and Waste Management (DWWM). The DWWM, like its predecessor agencies, is charged with balancing the state's 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 and subsequent amendments in order to restore the quality of our nation's waters. For more than 25 years, the Act's National Pollutant Discharge Elimination System (NPDES) has caused reductions in pollutants discharged from point sources to surface waters. There is broad agreement that implementation of the NPDES permit system has reduced the amount of contaminants in point source discharges, and this reduction has resulted in significant improvement in the water quality of many of our nation's streams.

Under the federal law, each state was given the option of managing NPDES permits within its borders or deferring that management role to the federal government. When West Virginia assumed primacy over NPDES permits in 1982, the state's Water Resources Board - renamed the Environmental Quality Board (EQB) in 1994 - began developing water quality criteria for each kind of use designated for the state's waters (see box on this page). In addition, the WV Department of Environmental Protection's (DEP) water protection activities are guided by the EQB's anti-degradation policy, which charges the DWWM with maintaining surface waters at sufficient quality to support existing uses, regardless of whether or not the uses are specifically designated by the EQB.

Even with significant progress, by the early 1990s many streams still did not support their designated uses. Consequently, environmental managers began to examine pollutants flushing off of the landscape from a broad array of sources. Recognition of the negative impacts of these nonpoint sources (NPS) of pollution, was a conceptual step that served as a catalyst for today's holistic watershed approach to improving water quality.

Several DEP units, including the Watershed Assessment Section, are currently implementing a variety of watershed projects. Located within the DWWM, the Section's scientists are charged with evaluating the health of West Virginia's watersheds. The

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

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.

Watershed Assessment Section is guided, in part, by the Interagency Watershed Management Steering Committee (see box on this page).

The Watershed Assessment Section uses the U.S. Geological Survey's (USGS) scheme of hydrologic units to divide the state into 32 watersheds. Some of these watersheds are entire stream basins with natural hydrologic divides (e.g., Gauley River watershed). Three 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); (2) the West Virginia portions of interstate basins (e.g., Tug Fork watershed); and (3) divisions of large watersheds (e.g., Upper and Lower Kanawha River watersheds).

A goal of the Watershed Assessment Section is to assess each watershed unit every 5 years, an interval coinciding with the reissue of NPDES permits within each assessed watershed.

THE INTERAGENCY WATERSHED MANAGEMENT STEERING COMMITTEE consists of representatives from each agency that 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 Coordinator's responsibilities are to organize and facilitate the steering committee meetings, to maintain the watershed management schedule, to assist with public outreach, and to be the primary contact for watershed management related issues.

General Watershed Assessment Strategy

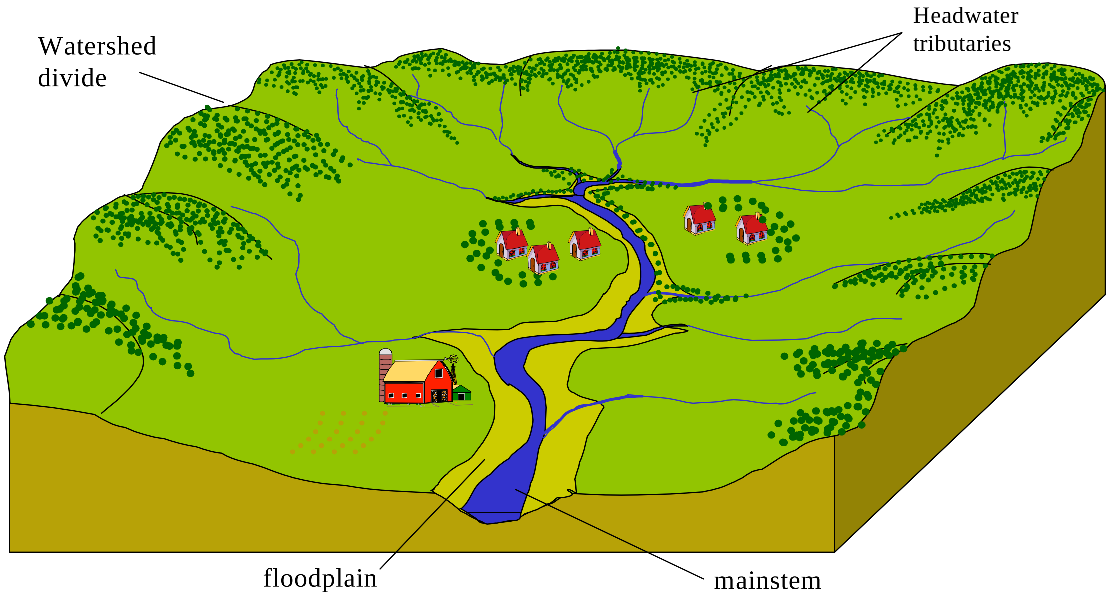
A watershed may be envisioned as an aquatic tree, that is, a network of upwardly branching, successively smaller streams (See Figure 1). An ideal assessment of a watershed would be one that documented changes in the quantity and quality of water flowing down every stream, at all water levels, in all seasons, from headwater reaches to the downstream boundary of the watershed. Land uses throughout the watershed would also be quantified. However, this approach would require more time and resources than are available.

The Watershed Assessment Section assesses the health of a watershed by evaluating the aquatic integrity of as many streams as possible near their mouths. The general sampling strategy can be broken into several steps:

- The names of streams within the watershed are retrieved from the U.S. Environmental Protection Agency's (EPA) Waterbody System database.

- A list of streams is developed that consists of several sub-lists, including:
  1. Severely impaired streams,

Figure 1. A Generalized Watershed



In this report, "watershed" refers to all of the land that drains to a certain point on a river. In the case of the Lower Guyandotte River watershed, it includes all the land (about 740 square miles) drained by the river between the cities of Logan and Huntington.

2. Slightly or moderately impaired streams,
3. Unimpaired streams,
4. Unassessed streams, and
5. Streams of particular concern to citizens.

- Assessment teams visit as many listed streams as possible and sample as close to the streams' mouths as allowed by road access and sample site suitability.

Long streams may be sampled at additional sites further upstream. In general if a stream is 15 to 30 miles (25-50 km) long, 2 sites are sampled; 30-50 miles (50-89 km) long, 3 sites are sampled; 50-100 miles (80-160 km) long, 4 sites are sampled or; longer than 100 miles (160 km), 5 sites are sampled. If inaccessible or unsuitable sites are dropped from the list, they are replaced with previously determined alternate sites.

An exception to this general investigative strategy is the sampling methodology developed to produce statistically valid summaries that allow the comparison of watersheds to one another. This methodology is detailed in the Watershed Assessment Section titled “Probabilistic or Random Sampling.”

The Watershed Assessment Section has scheduled the assessment of each watershed during a specific year of a 5-year cycle. Advantages of this preset timetable include: (1) synchronizing study dates with permit cycles, (2) facilitating stakeholder input in the information gathering process, (3) insuring assessment of all watersheds, and (4) improving the DWWM’s ability to plan.

In a broad sense, the DWWM’s Watershed Assessment Section evaluates streams while the Interagency Watershed Management Steering Committee (see box on page 8) sets priorities in each watershed.

This document, which reports an ecological assessment of 1 watershed, has been prepared for a wide variety of users, including elected officials, environmental consultants, educators, watershed associations, and natural resources managers.

Probabilistic (Random) Sampling

The nonrandom sampling component of the watershed assessment process is very useful in targeting problem sites, potential reference sites, and little known streams. However, the data generated from nonrandom sampling have limited usefulness in making statistical comparisons between watersheds.

In 1997, in order to improve the evaluation process, the Watershed Assessment Section began to incorporate random sampling into the watershed assessment strategy. The sample sites are randomly selected by computer and may require an assessment at any point along the length of the stream. Random sampling allows researchers to make statistically valid inferences about stream conditions within each watershed. Randomization also improves comparisons between watersheds. EPA personnel provide computer-generated locations for about 40 random sites within each watershed. Because there are many more miles of first-order and second-order headwater streams than there are of higher ordered streams, stream miles are statistically weighted so that an adequate number of larger stream sites are selected by the computer.

Section field crews visit the sites and verify locations with Global Positioning System (GPS) units. If a site is wadeable and has riffle/run habitat, it is assessed using the same protocols as those used at nonrandom sites with the addition of extra water quality constituents to the analysis list.

The results of random sampling are reported herein mixed with nonrandom data. The DEP, with support from the EPA, will report the results of statewide random sampling at a later date.

TOTAL MAXIMUM DAILY LOAD AND THE 303(d) LIST - The term "total maximum daily load" (TMDL) originates in the federal Clean Water Act, which requires that degraded streams be restored to support their designated uses.

Every 2 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. In a case of severe impairment, it is relatively easy to determine that a stream should be placed on the 303(d) list. However, the determination is more difficult to make for most streams due to a lack of data or data that are conflicting, of questionable quality, or too old. Any stream that would not support its designated uses, even after technology-based pollution controls were applied, would be considered for inclusion on the list. West Virginia's 303(d) list includes streams affected by a number of stressors including mine drainage, acid deposition, 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) list stream begins by calculating a TMDL, which involves several steps:

- Define when a water quality problem is occurring (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 able to be implemented.

Watershed Assessment Methods

In 1989, the EPA published a document titled *Rapid Bioassessment Protocols for Use in Streams and Rivers - Benthic Macroinvertebrates and Fish* (Plafkin et al. 1989). This document was intended to provide water quality monitoring programs, such as the Section's Watershed Assessment Program, with a practical technical reference for conducting cost-effective biological assessments of flowing waters.

Originally, the Rapid Bioassessment Protocols (RBPs) were intended to be inexpensive screening tools to determine if a stream was supporting a designated aquatic life use. However, the current consensus is that the RBPs also can be applied to other program areas, such as:

- Characterizing the existence and severity of use impairment
- Helping to identify sources and causes of impairments in watershed studies
- Evaluating the effectiveness of control actions
- Supporting use-attainability studies
- Characterizing regional biological components.

The diversity of applications provided by the RBPs was the primary reason they were adopted by the Watershed Assessment Section for use in assessing watersheds. In 1999, the EPA published a second edition of the RBP manual (Barbour, et. al.,1999). Before this publication date, a draft revision was circulated among the states and the Watershed Assessment Section was able to incorporate many of the recommended changes to protocol prior to the 1998 sampling season. Because the vast majority of stream miles in the state have riffle/run habitat, the "Single Habitat Approach" was the benthic collection method adopted by the Watershed Assessment Section.

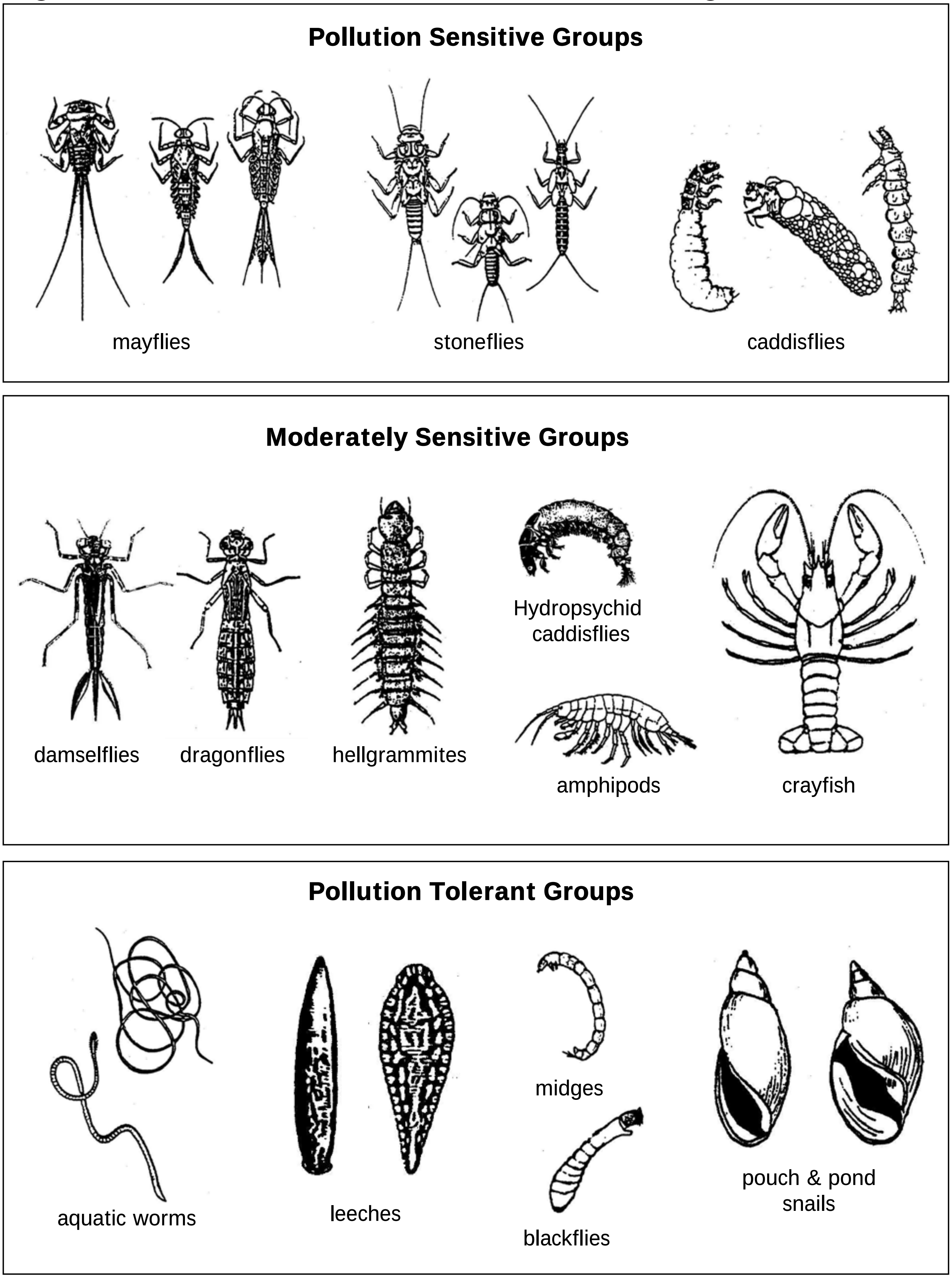
The following sections summarize the procedures used to assess the streams in this watershed. A more detailed description of assessment procedures is found in the Watershed Assessment Section's *Standard Operating Procedures* manual.

Biological Monitoring — Benthic Macroinvertebrates

Benthic macroinvertebrates are small animals that live on the bottoms of streams, rivers, and lakes. Insects comprise the largest diversity of these animals and include mayflies, stoneflies, caddisflies, beetles, midges, crane flies, dragonflies, and others. Snails, mussels, aquatic worms, and crayfish also are members of the benthic macroinvertebrate community. Benthic macroinvertebrates are important in the processing and cycling of nutrients, and are major food sources for fish and other aquatic animals. In general, a clean stream has a diverse array of benthic organisms that occupy a variety of ecological niches. Polluted streams generally have a lower diversity and often are devoid of pollution sensitive species. Figure 2 shows several of the most common macroinvertebrate organisms found in West Virginia's streams.

Benthic macroinvertebrate data have been used for several decades as tools for conducting

Figure 2. Common Benthic Macroinvertebrate Organisms



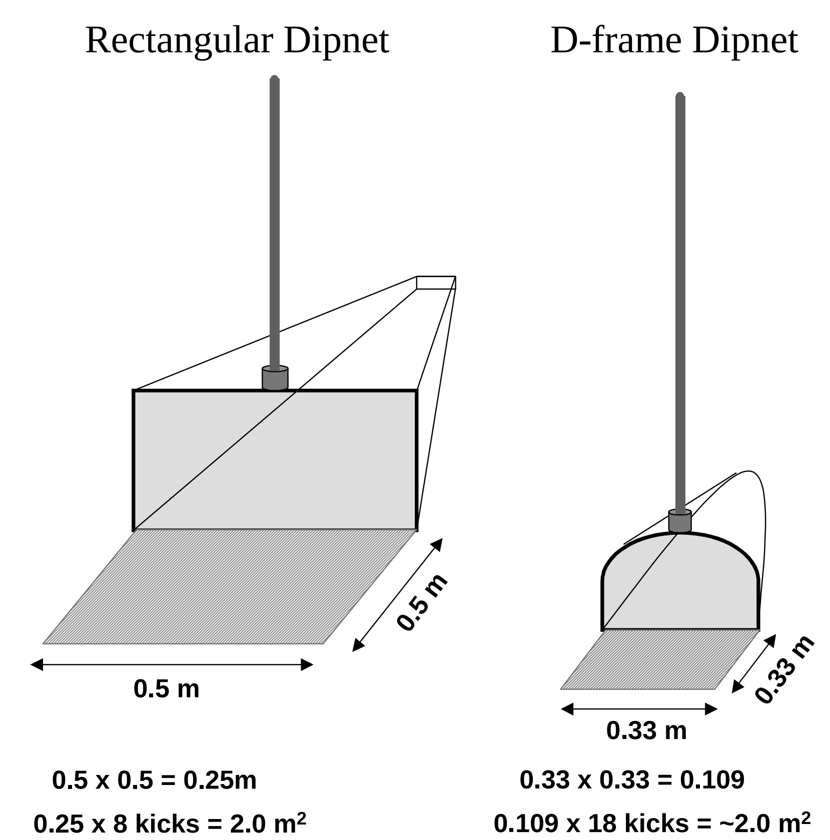
ecological assessments of streams. Many federal, state, and private organizations use this group of animals as part of their biological monitoring programs and the advantages are myriad. The most recognized benefit is that benthic macroinvertebrate communities reflect overall ecological integrity (i.e., chemical, physical, and biological integrity). They provide a holistic measure of environmental conditions by integrating responses to stresses over time, and the public better understands them (as opposed to chemical conditions) as measures of environmental health (Plafkin et al. 1989).

Benthic macroinvertebrates can be collected using several techniques. The Watershed Assessment Section used the EPA's RBP II with some modifications. The 2-man kick net used in the original RBP was replaced with a kick net modified for use by 1 person. In streams having adequate riffle/run habitat, the Watershed Assessment Section used a rectangular dipnet to capture organisms dislodged by kicking the stream bottom substrate and by brushing large rocks and sticks. In streams too small to accommodate the rectangular dipnet, a smaller net called a D-frame was used to collect dislodged organisms (See Figure 3). Riffle/run streams with low flow that did not have enough water to sample with either net were sampled using a procedure called hand picking. This procedure involved picking and washing stream substrate materials in a bucket of water. Field crews attempted to sample 2 square meters of stream substrate (an area equal to 8 kicks with a rectangular net and 18 with a D-frame net) regardless of the device or technique employed.

The D-frame net was also used to collect macroinvertebrates in slow flowing (glide/pool dominated) streams that did not have sufficient riffle/run habitat. Macroinvertebrate sampling in glide/pool streams was accomplished using a procedure developed for use in Mid-Atlantic state coastal plain streams (the MACS technique) but applied to slow-moving streams in West Virginia.

Benthic samples were preserved and delivered to the Department of Biological Sciences at Marshall University for processing. Processing involved removing a 200-organism subsample from the composite sample following RBP II protocols. The subsample was returned to

Figure 3. Benthos Collection Nets



Section biologists who counted and identified the specimens to the family level or the lowest possible level of classification. The samples were kept for future reference and for identification to lower taxonomic levels if necessary.

Fish specimens inadvertently collected during macroinvertebrate sampling were transferred to the West Virginia Department of Natural Resources (DNR) office in Elkins where they became part of the permanent fish collection. Salamanders inadvertently collected were donated to the Marshall University Biological Museum in care of Dr. Tom Pauley.

The Section's primary goal in collecting macroinvertebrate data was to determine the biological conditions of the selected stream assessment sites. Determining the biological condition of each site involved calculating and summarizing 6 community metrics based upon the benthic macroinvertebrate data. The following benthic community metrics were used for each assessment site:

Benthic Community Metrics

Metrics are calculations that numerically describe the benthic communities of streams. Some metrics are simple summations such as Taxa Richness; a measure of the total number of different kinds of organisms in a sample.

Other metrics are more complex such as Hilsenhoff's Biotic Index, which incorporates the pollution tolerance values of collected organisms to provide a number that assesses organic pollution in streams.

The Watershed Assessment Section currently uses 6 metrics to determine the integrity of benthic macroinvertebrate communities. The use of several metrics, instead of only 1 or 2, provides greater assurance that valid assessments of integrity are made.

Richness Metrics

1. Total Taxa - measures the total number of different macroinvertebrate taxa collected in the sample. In general, the total number of taxa increases with improving water quality.

2. EPT Index - measures the total number of distinct taxa within the generally pollution sensitive orders *Ephemeroptera* (mayflies), *Plecoptera* (stoneflies), and *Trichoptera* (caddisflies). In general, this index increases with improving water quality.

Community Composition Metrics

3. Percent Contribution of 2 Dominant Taxa - measures the abundance of the 2 numerically dominant taxa relative to the total number of organisms in the sample. Generally, this index decreases with improving water quality.

4. Percent EPT - measures the relative abundance of mayfly, stonefly, and caddisfly individuals to the total number of organisms in the sample. In general, this index increases with improving water quality.

5. Percent *Chironomidae* - measures the abundance of chironomid (midge) individuals relative to the total number of individuals in the sample. Generally, chironomids are considered tolerant of

many pollutants. This metric generally decreases in value with improving water quality.

Tolerance/Intolerance Metric

6. HBI (Hilsenhoff's Biotic Index - modified) - summarizes tolerances of the benthic community to organic pollution. Tolerance values range from 0 to 10 and generally decrease with improving water quality.

Of the many metrics available, these 6 metrics were used because (1) they provide the best discrimination between impaired and unimpaired sites, (2) they represent different community attributes, and (3) they minimize redundancy.

West Virginia Stream Condition Index

The 6 benthic community metrics were combined into a single index, the West Virginia Stream Condition Index (WVSCI). The WVSCI was developed by Tetra Tech Inc. (Gerritsen et. al. 2000) using the DEP's watershed assessment data and the EPA's Environmental Monitoring and Assessment Program data collected from riffle/run habitats in wadeable streams.

The WVSCI score is determined by calculating the average of the standardized score of each metric. The standardized score for each metric is determined by comparing an individual metric value to the "best standard value." This value represents either the 95^{th} or 5^{th} percentile (depending on whether the metric registers high or low for healthy streams) of all sites sampled via comparable methods. In general terms, all metrics values are converted to a standard, 0 to 100 (worst to best) scale. An average of the 6 standardized metric scores is calculated for each benthic sample site resulting in a final index score that ranges from 0 to 100.

In order to interpret the WVSCI score, the Watershed Assessment Section needed to establish reference conditions (see box on page 17). In a few previous assessments, the Watershed Assessment Section used either a single least-impaired site or a set of sites categorized by both stream width and ecoregional location as the reference conditions. However, it soon became clear that it is difficult to identify a single reference site that has both (1) minimal impairment and (2) the type of biological community that provides defensible conclusions about the impairment of assessed sites.

As a result of this revelation, the Watershed Assessment Section began defining reference conditions by using a collection of sites that met predetermined minimum impairment criteria. A site's suitability as a reference site was established by comparing the site's habitat and physicochemical data to a list of minimum degradation criteria or "reference site" criteria. Assessment sites that met all of the minimum criteria were given reference site status. The Watershed Assessment Section developed the minimum degradation criteria with the assumption that sites meeting these criteria would provide a reasonable approximation of least disturbed conditions.

Originally, the Watershed Assessment Section was using a set of reference sites limited to the watershed being studied. Subsequent research showed that a single reference set for wadeable streams is sufficient for statewide assessments (Tetra Tech, 2000). The researchers found that partitioning streams into ecoregions did not significantly improve the accuracy of assessments. The Watershed Assessment Section began using 107 reference sites to describe reference conditions. The reference conditions were then used to establish a threshold for biological impairment. These reference conditions can be used statewide, in all wadeable streams, and throughout the established sampling period of April through October.

The 5th percentile of the range of WVSCI scores for all the reference sites was selected as the impairment threshold. For the 107 reference sites used in this study, the 5th percentile score is 68. Initially, a site that received a WVSCI score equal to or less than 68 was considered impaired. However, because the final WVSCI score can be affected by a number of factors (collector, microhabitat variables, subsampling, etc.) the Watershed Assessment Section sampled 26 sites in duplicate to determine the precision of the scoring. Following an analysis of the duplicate data, the Watershed Assessment Section determined the precision estimate to be 7.4 WVSCI points. The Watershed Assessment Section then subtracted 7.4 points from the impaired threshold of 68 and generated what is termed the gray zone that ranges from >60.6 to 68.0. If a non-reference site has a WVSCI score within the "gray zone", a single kick sample is considered insufficient for classifying it as impaired. If a site produces a WVSCI score equal to or less than 60.6, the Watershed Assessment Section is confident that the site was truly biologically impaired during the assessment period based on the single benthic macroinvertebrate sample. Accordingly, sites receiving the lowest WVSCI scores are the most impaired.

Reference Conditions

Reference conditions describe the characteristics of waterbody segments least-impaired by human activities, and are used to define attainable biological and habitat conditions. Selection of reference sites depends on an evaluation of the physicochemical and habitat data collected during each site's assessment.

These data must meet minimum degradation criteria established by the Watershed Assessment Section before a site can be given reference site status. In general, the following parameters are examined: dissolved oxygen, pH, conductivity, fecal coliform bacteria, violations of water quality standards, nonpoint sources of pollution, benthic substrate, channel alteration, sediment deposition, streambank vegetation, riparian zone vegetation, overall habitat condition, human disturbances, point sources of pollution, and land use.

The information from sites that meet the defined criteria is used to establish reference conditions. Benthic macroinvertebrate data from each assessment site can then be compared to the reference conditions to produce a WVSCI score.

The impairment categories developed within the WVSCI are important tools the Watershed Assessment Section uses in making management decisions and in allocating limited resources to the streams that need them most. For the purposes of this report, the Watershed Assessment Section considered impaired sites and sites with WVSCI scores in the gray zone to be in need of further investigation and/or corrective action.

The WVSCI has proven itself as a useful and cost effective tool for assessing the health of the streams of West Virginia. However, like all biological assessment tools, it has its relative strengths and weaknesses. In some situations it is less applicable than in others. For most categories of streams found within West Virginia it appears to be a very reliable mechanism for measuring relative benthic community condition.

One shortfall seems to be its weakness in distinguishing differences in benthic community conditions between streams impacted by acidic deposition (rain, snow, fog, etc.) and unimpaired streams. Many atmospherically acidified streams have produced high WVSCI scores as long as there were no other sources of pollution present. Aquatic entomologists can often readily distinguish between benthic communities from deposition-impacted streams and unimpaired, non-acidified streams. Such clues as taxa composition and total numbers of organisms reveal the differences to the trained eye. Although the WVSCI also depends upon these clues, a family-level index is not sensitive enough to distinguish between the communities in the 2 categories of streams. This weakness in the WVSCI may also be partially due to its relative insensitivity to differences in total numbers of organisms collected. Often, acid deposition impacted sample sites do not produce enough individuals to require subsampling in the laboratory. The limitations of the current WVSCI are expected to diminish as genus-level and species-level indices are developed. These refinements of the WVSCI are expected to improve its sensitivity to benthic community changes brought about by problems like acid deposition.

The WVSCI is a helpful tool in assessing small watershed streams, but influences such as seasonal no-flow conditions and difficulty using consistent sampling methodologies, may result in low WVSCI scores that would indicate “impairment” in circumstances that are entirely natural. For this reason, it is imperative for assessment teams to record information adequate to determine the comparability of benthic collections.

Fecal Coliform Bacteria

Numerous disease-causing organisms may accompany fecal coliform bacteria, which is released to the environment in feces. Therefore, the presence of such bacteria in a water sample indicates the potential presence of human pathogens.

A fecal coliform bacteria sample was collected at each assessment site. EPA sampling guidelines limit the field holding time for such samples to 6 hours. Due to the distance to laboratories, personnel limitations, and time constraints, a 24-hour limit was utilized during this sampling effort. All bacteria samples were packed in wet ice until delivered to the laboratory for analysis.

Physicochemical Sampling

Physicochemical samples were collected at each site to help determine what types of stressors, if

Table 1. Water Quality Parameters

All numbered references to analytical methods are from *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	1 mg/L	305.1	14 days
Alkalinity	1 mg/L	310.1	14 days
Sulfate	5 mg/L	375.4	28 days
Iron	50 µg/L	200.7	6 months
Aluminum	50 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	0.05 mg/L	353.2	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 accuracy's are noted in Hydrolab Corporation's Reporter ™ Water Quality Multiprobe Operating Manual, May 1995, Application Note #109.

any, were negatively impacting each benthic macroinvertebrate community. The physicochemical data were helpful in providing clues about the sources of stressors.

Field analyses for pH, temperature, dissolved oxygen, and conductivity were performed. The manufacturer's calibration guidelines for each measurement instrument were followed with minimal variation.

Samples were collected at many sites for analysis of specific water quality constituents. A list of these constituents, preservation procedures, and analytical methods is included in Table 1.

In areas where mine drainage was present, assessment teams collected water samples for the analyses of aluminum (Al), iron (Fe), and manganese (Mn). In a few cases, samples were analyzed for hot acidity (mg/L), alkalinity (mg/L), and sulfate (mg/L). If excess nutrients were suspected, total phosphorus, nitrate-nitrite nitrogen, and ammonia were included in the analyses.

Assessment teams measured stream flow in cubic feet per second (cfs) when field readings indicated there was mine drainage impacting the stream. A current meter was used across a stream transect and the discharge was calculated with the sum-of-partial-discharges method.

The collection, handling, and analysis of water samples generally followed procedures approved by the EPA. Field blanks for water sample constituents were prepared on a regular basis by each assessment team. The primary purpose of collecting field blanks was to check for contamination of preservatives, containers, and sample water during sampling and transportation. A secondary purpose was to check the precision of analytical procedures.

Habitat Assessment

An 8-page Stream Assessment Form was completed at each site. A 100 meter section of stream and the land in its immediate vicinity were qualitatively evaluated for instream and streamside habitat conditions. Each assessment team recorded the location of each site, utilizing a GPS unit when possible, and recorded detailed travel directions so future researchers might return to the same site. The assessed stream section was sketched. The team recorded physical stream measurements, erosion potential, possible point and nonpoint sources of pollution, and any anthropogenic activities and disturbances. It also recorded observations about the substrate, water, and riparian zone.

An important part of each assessment was the completion of a 2-page Rapid Habitat Assessment form (from EPA's RBP manual by Barbour et. al. 1999), which produced a numerical score of the habitat conditions most likely to affect aquatic life. The information from this form provided insight into which macroinvertebrate taxa might be expected at the sample site. Information on physical impairments to the stream habitat encountered during the assessment also was provided on the form. The following 10 parameters were evaluated:

- Epifaunal substrate/fish cover
- Embeddedness
- Velocity/Depth regimes
- Channel alteration
- Sediment deposition
- Riffle frequency
- Channel flow status
- Bank stability
- Bank vegetative protection
- Width of undisturbed vegetation zone

A Rapid Habitat Assessment data set is valuable because it provides a means of comparing sites to one another. Each parameter on the assessment form was given a score ranging from 0 to 20. Table 2 describes the categories that are used to rate each parameter. The 10 individual scores for each parameter were added together and this sum was the final habitat condition score for each assessment site (maximum possible = 200).

Table 2. Scoring For Rapid Habitat Assessment

Optimal (score 16-20)	Habitat quality meets natural expectations.
Suboptimal (score 11-15)	Habitat quality less than desirable but satisfies expectations in most areas.
Marginal (score 6-10)	Habitat quality has a moderate level of degradation; severe degradation at frequent intervals.
Poor (score 0-5)	Habitat is substantially altered; severe degradation.

Although all the habitat parameters measure important aspects of stream habitat, some affect the benthic community more than others; *Embeddedness* and *sediment deposition* are 2 such parameters. Both of these parameters are measurements of the percentage of substrate affected by small particle deposits. Heavy deposits of small particles (silt and sand), especially in the spaces between cobbles and boulders in riffle/run habitats, restrict populations of benthic organisms. See Figure 4 for an illustration of substrate embeddedness.

Another important habitat parameter is the *riparian buffer zone width*. The condition of the land next to a stream has a direct and important affect on the instream conditions (see Figure 5). An intact riparian zone, (i.e., one with a combination of mature trees, saplings, and ground cover), serves as a buffer to pollutants entering a stream from runoff, controls erosion, and provides habitat and appropriate nutrient input into the stream.

Data Interpretation

When all of the aforementioned sets of data (i.e., biological, habitat, and physicochemical) are

Figure 4. Illustration of embeddedness

The view on the left is heavily embedded with sand and silt. Notice the different amounts of interstitial space (the space between the rocks and gravel).

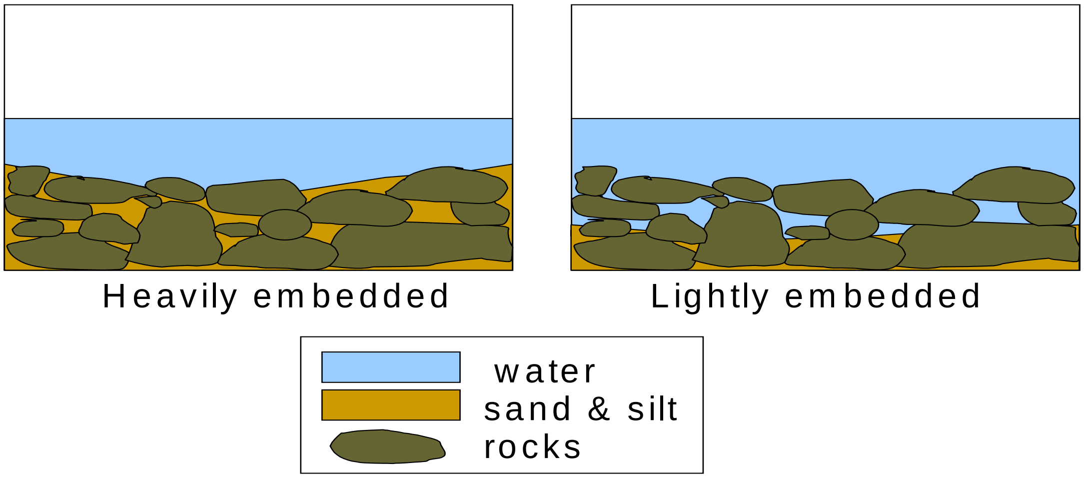
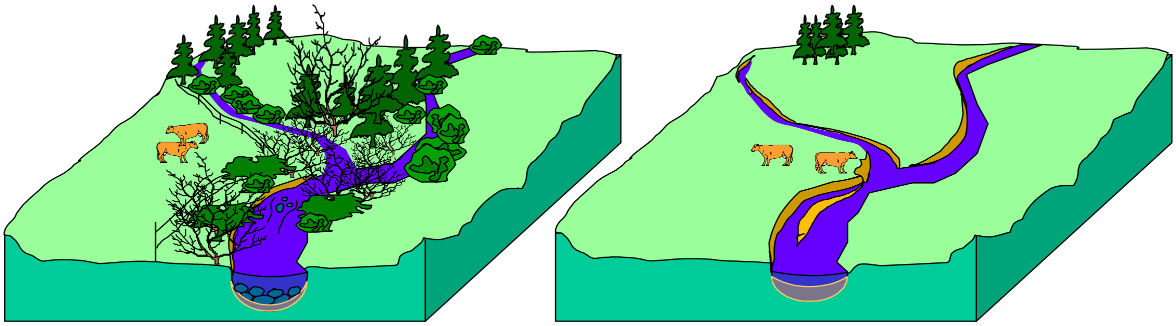


Figure 5. Stream with and without riparian buffer zone



compiled, they must be interpreted by experienced scientists in order to make them useful for purposes set forth in various legislative rules regarding water quality. One of the interpretive tools, the WVSCI, has already been explained. Visual tools, such as graphs and tables, can aid the scientist-interpreter in the translation of these data to the interested citizen. In the following sections, 2 visual aids will be used often to help in understanding the general biological condition of the sampled sites; the sub-watershed general information table and the RBP habitat vs. WVSCI X-Y graph. The sub-watersheds are smaller units of the larger watershed considered in this study. All watersheds within the United

Figure 6. Example Sub-watershed

Table ??. EXAMPLE Sub-watershed.				
Stream Name	ANCode	RBP	WVSCI	Fecal
Back Creek	WVP-6	155	72.65	***570***
Back Creek	WVP-6-{2.6}	170	61.33	210
Back Creek	WVP-6-{13.8}	158	49.99	340
Tilhance Ck	WVP-6-A-{3.2}	162	80.54	170
Higgins Run	WVP-6-A-1-{2.2}	***58***	NC52.68	320

Violation of water quality criterion: emboldened & italicized numbers.

WVSCI score in the gray zone: light gray row.

WVSCI score indicates impairment: dark gray row.

Poor RBP habitat score: emboldened & italicized numbers.

"NC" indicates the WVSCI is not comparable due to different sampling procedure.

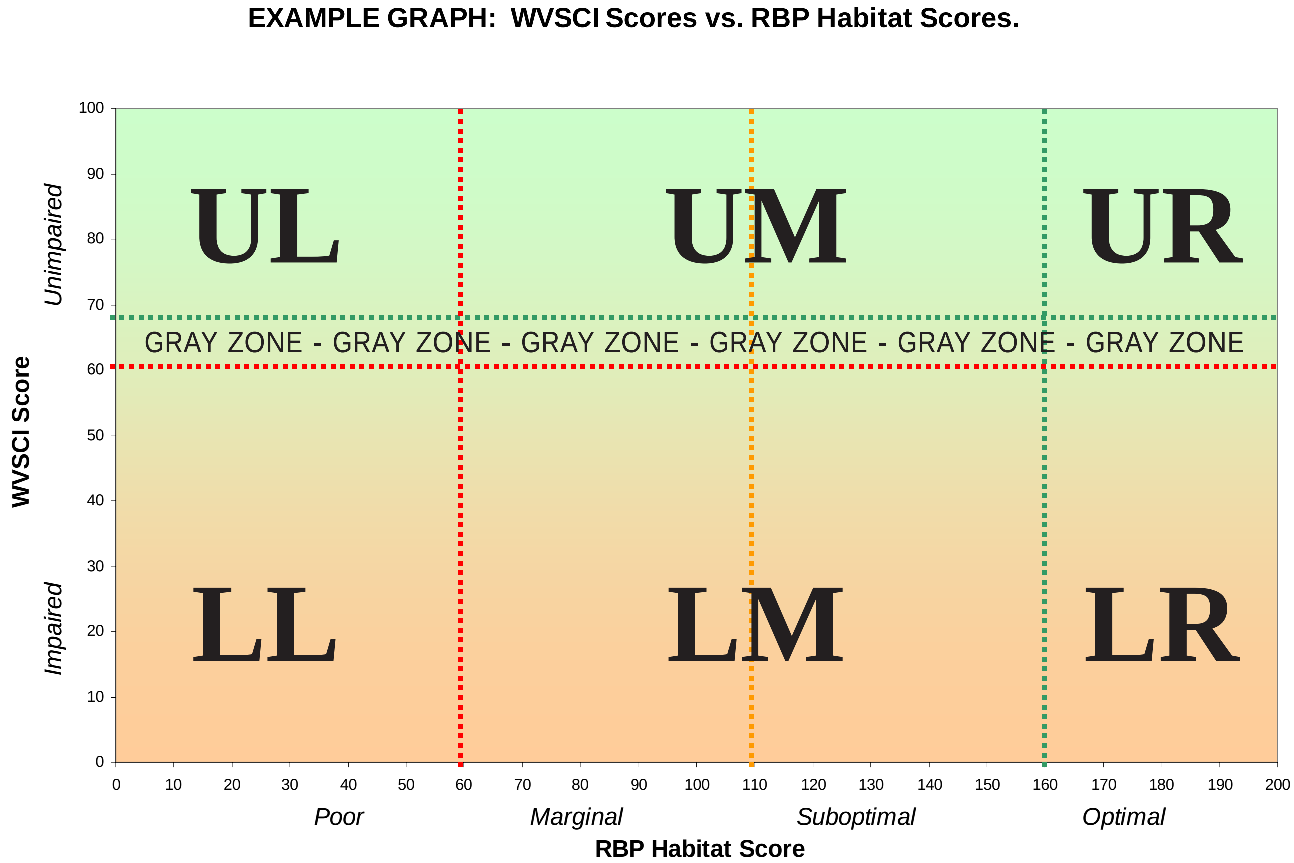
States and its territories have been categorized into a Hydrologic Unit Code System (HUCS) by the USGS. Each sub-watershed discussed herein is identified by an 8-digit numeric HUCS code.

Each sub-watershed table (see Figure 6) provides a quick reference to the stream sites sampled in a particular sub-watershed during the assessment survey. The stream name and the alpha-numeric code (AN code) for each site are given. Each AN code provides a little information about the sampling site location relative to the watershed mainstem stream. For instance, *Higgins Run* has been assigned the AN code **WVP-6-A-1-{2.2}**. The "**WV**" tells us the site has been designated by the state of **W**est **V**irginia and the "**P**" indicates it is within the **P**otomac River Direct Drains watershed. The alternating series of numbers and letters that follow indicate the stream is a tributary of a tributary of a tributary of *Potomac River*. Each number and letter corresponds to another branching of the stream. Generally, these numbers and letters refer to the branching sequence as a person travels upstream. While traveling up *Potomac River*, the **6**th named tributary we encounter is *Back Creek*. If we turn up *Back Creek*, the first (the letter "**A**" is the first letter in the Roman alphabet) named tributary we encounter is *Tilhance Branch*. Up *Tilhance Branch*, the **1**st named tributary we encounter is *Higgins Run*. At milepoint **2.2** on *Higgins Run* we find the sampling site. The coding system is not exact, so occasionally strange code particles like ".1B" and "A.5" show up. Usually, the absence of a bracketed milepoint suffix indicates the sample site is at or very near the mouth of the stream. Within each table, the upstream sequence of tributaries is usually ordered from top to bottom.

Also included in each general information table are the WVSCI score, the RBP habitat score, and the fecal coliform concentration of each sample site. The example table (Figure 6) deciphers the information provided by various font and color schemes.

An example RBP habitat vs. WVSCI X-Y graph is shown in Figure 7. On the X-axis, the dividing lines between the RBP habitat score ranges are shown in colored, dotted lines. Poor total habitat scores fall below 60. Marginal scores include 60 through 109.9. Total RBP habitat scores from 110 through 159.9 are considered suboptimal, while those equal to or above 160 are optimal. On

Figure 7. Example X-Y Graph.



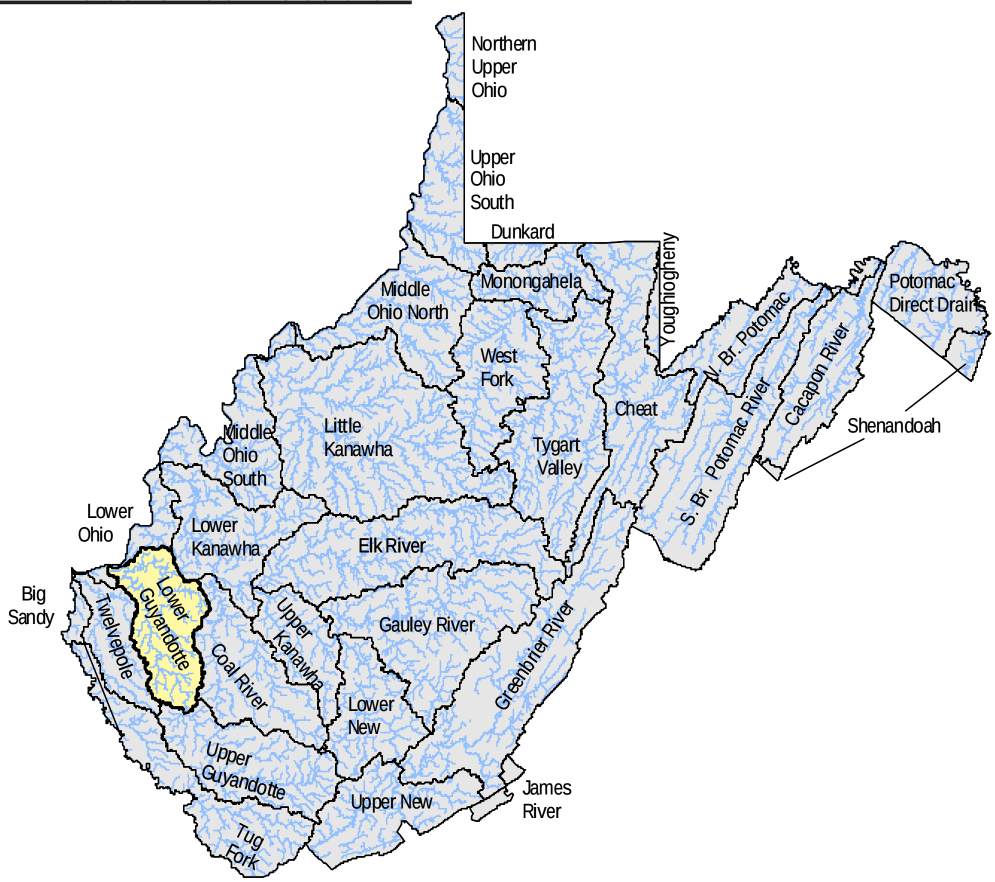
the Y-axis, the WVSCI score ranges are similarly delineated. Each sample site's paired score is represented by a mark on the graph, usually a large dot. Sites with dots in the upper right (UR) region of the graph generally have water quality and habitat conducive to producing diverse benthic macroinvertebrate communities. Dots that lie in the lower left (LL) portion of the graph represent sites with benthic communities that are almost certainly impaired by poor habitat along with other possible causes. Benthic communities at the sites represented by dots in the lower right (LR) sextant often are those that reside in high quality habitat, but are impaired by poor water quality. Sites that fall in all other sextants of the graph require more in-depth analysis to understand community condition and/or potential causes of impairment.

As mentioned previously, each site represented in the "gray zone" is one in which the benthic macroinvertebrate community may have been slightly impaired, but the single kick sample was considered insufficient evidence for classifying it as such.

The Lower Guyandotte River Watershed

The Lower Guyandotte River watershed consists of approximately the downstream (northern) half of the entire Guyandotte River watershed. All waters draining into Guyandotte River downstream of the mouth of Island Creek (in the community of Logan) are included in the Lower Guyandotte River watershed. The Island Creek sub-watershed (OG-65) is not included within this watershed. The section of the Guyandotte River mainstem that flows through this watershed extends from the mouth (at the Ohio floodplain village of Guyandotte) upstream to the community of Logan (nestled among the steep mountains of the Cumberland Plateau). The Lower Guyandotte Watershed is located within Logan, Lincoln, Putnam, Cabell and Mason Counties. The only significantly sized public lands within the watershed are Upper Mud River Wildlife Management Area/Flood Control Project, Big Ugly Wildlife Management Area, and Chief Logan State Park.

Figure 8. Watershed Location



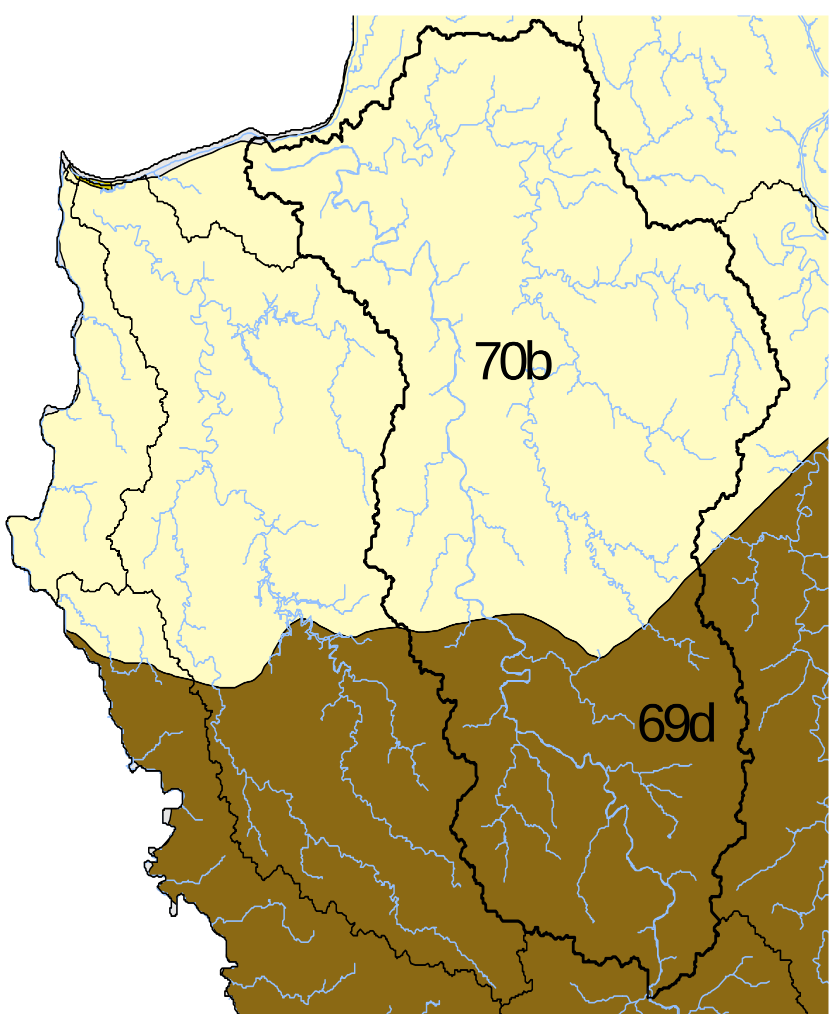
The watershed is located within 2 level III ecoregions as identified by the EPA classification system (Omernik, et. al. 1992). Approximately the northern two thirds are located within the Western

Allegheny Plateau level III ecoregion and, more particularly, within the Monongahela Transition Zone level IV sub-ecoregion (70b on Figure 9). Moving from downstream up, the surface rocks encountered are classified by geologists as belonging to the Monongahela Group, the Conemaugh Group and the Allegheny Formation. These consist of cyclical sequences of sandstones, siltstones, shales, thin limestones and thin coals.

The southern third of the watershed lies in the Cumberland Mountains level IV sub-ecoregion of the Central Appalachians level III ecoregion. The Cumberland Mountains sub-ecoregion (69d on Figure 9) is characterized by steep, razor-backed ridges with a preponderance of coarse-grained sandstones along with shales, siltstones and coal deposits. The strata underlying this portion of the watershed belong to the Kanawha formation. The streams are prone to flash-flooding and have numerous riffles. Streams generally have higher gradients than in the Monongahela Transition Zone. Substrates have significant quantities of sand eroded from the coarse-grained sandstones that predominate in the sub-ecoregion.

The Monongahela Transition Zone sub-ecoregion has less steep hillsides, broader ridge tops, fewer coal strata and coarse-grained sandstone layers, and a preponderance of fine-grained sandstones, siltstones, and lighter-colored shales. Third order and higher streams in this sub-ecoregion generally have lower gradients and lower riffle frequencies than those in the Cumberland Mountains sub-ecoregion. Most of this sub-ecoregion's streams are well-buffered against acid inputs. However, the preponderance of shales have produced soils with high clay components that do not drain well. Erosion is a significant problem in this portion of the watershed. This is particularly noticeable in the Mud River sub-watershed where farming is a predominant land use.

Figure 9. Watershed Ecoregions



The watershed is subject to the effects of both continental polar air masses and maritime tropical air masses. The worst floods are those brought on by tropical storms, including hurricanes, that penetrate across the Allegheny and Cumberland Mountains and move in a northerly direction. Such storms dump rain upon the headwaters first and continue pouring as they move in the same direction that the mainstem Guyandotte River drains. The R. D. Bailey Reservoir in the Upper Guyandotte River watershed has alleviated much of the flooding associated with major storm systems. The watershed experiences relatively mild winters (compared to northeastern West Virginia), generally receiving more rain than snow. Prevailing wind in summer is from the southwest.

Compilers of 18th century maps and journals referred to the river as “Guiandot,” “Kyandot,” “Kiandot” and variant spellings. It was sometimes identified as “Great Guiandot River” to distinguish it from “Little Guiandot River,” today’s Guyandotte Creek. Many writers have attributed this name to a mispronunciation or misspelling of the Indian Nation known today as “Wyandotte.” This is possible, but not likely. A map in the manuscript collection of General Thomas Gage (housed in the William Clements Library at the University of Michigan) and titled “A Draft of The Ohio from An Indian Account” (presumably drawn in 1755), identifies the river as “Kayendode” (Schwartz 1994:30). Other place names on the map appear to be in an Iroquoian language. The exact origin of the name may never be known.

John Hale wrote that the Delaware Indians called the stream “Seconee,” signifying “Narrow Bottom.” If true, the Delawares were speaking of the river some miles upstream of its mouth, for the lower 15 miles or so flow through the broad alluvial bed of the ancient Teays Lake making the bottoms quite wide.

This watershed, along with the Upper Guyandotte River, the Big Sandy River, the Tug Fork and the Levisa Fork watersheds, remained relatively undeveloped by expanding American industry and agriculture even into the first part of the 19th century. Before American General “Mad Anthony” Wayne’s army defeated Shawnee Blue Jacket’s combined Amerindian forces at Fallen Timbers in 1794, war parties continued hitting settlements in southwestern Virginia in a vain attempt to retake former territory. The ancient war trails up Kanawha Valley and through eastern Kentucky were too crowded with Virginians and Kentuckians to allow safe passage for aboriginal warriors, but the Guyandotte River, Tug Fork, and Levisa Fork valleys remained unsettled enough to allow war parties to pass relatively undetected. During the Napoleonic Wars in Europe, several nations’ armies demanded bear skins for warm winter wear and decorative clothing, like the tall bear skin hats of British soldiers. In a 3 year period (1805-1807), some 8,000 bear hides were shipped from these watersheds to New York merchants, like John Jacob Astor for the European markets (Hale, 1931).

The first major negative impact to the watershed came in the late 1800s with the timber industry. Local entrepreneurs like Anderson “Devil Anse” Hatfield, as well as corporations based in Cincinnati, New York, Philadelphia, and Richmond, financed the felling of forests at a dizzying pace (Waller, 1988). Prone to flash floods due to the steepness of the watershed’s slopes, Guyandotte River was scoured and choked with mud like never before in human history. It is likely that during this era mussel beds were obliterated under tons of sediment and fish populations plummeted.

Soon after the few decades of timbering severely degraded Guyandotte River, came the advent of the modern era of coal mining. Construction of a branch line of the C&O railroad ensured that coal could be readily shipped to national and international markets from the watershed. In the early part of the 20th century, a large increase in human population occurred as immigrants from southern states and other countries poured into the region to find work in the mines. This had a dual negative impact on the water quality of the watershed's streams. Metal-laden mine water and untreated or improperly treated sewage from coal camps and towns degraded some streams severely. In the 1950s and 1960s, strip mining was instituted in the watershed as coal companies attempted to maximize earnings by decreasing the total number of payroll employees while increasing coal production per employee. Newer technologies (primarily improved explosives and larger earth-moving machines) made this transformation in the mining industry possible.

In the 1960s, West Virginia passed some of the most stringent regulations in the nation governing surface mining, but the environmental damage wrought by this technique was still great (Caudill 1962, Dix 1988, Lee 1969, Savage 1990, and Williams 1976). A desire nationwide to minimize this damage was the driving force behind passage of federal legislation to institute better surface mining practices. Today, the hotly-debated practice of mountain-top removal and valley fill mining has buried several headwater stream segments in the watershed under megatons of rock fill. Within West Virginia, in the 17 year period between 1985 and 2001, 214.01 miles of stream were buried under valley fills (U.S. Army Corps of Engineers et. al. 2003:IV.B-2). This number includes neither the many miles of intermittent and ephemeral water courses that were buried during the same period, nor the water courses buried previous to this period by surface mining practices. Water emanating from these fills is chemically different from that in unmined watersheds and it supports biological communities that score lower on the WVSCI than those from unmined watersheds (Green, et. al. 2000). Sediment and coal fines continue to wash into streams from abandoned mines, and spills of these waste materials from active mines still occur. In recent years, federal courts required the Office of Surface Mining and the state of West Virginia to regulate mountain-top removal mining more stringently. As a result of this federal action, the West Virginia legislature now requires mining companies to construct valley fills from the toe upwards, instead of allowing the usual practice of shoving spoil from the working face over the slope. However, the current rules still do not prevent the burial of certain types of watercourses.

The regrowth of steep mountain forests in the watershed allowed many streams to recover from the initial degradation of the timbering boom. However, some streams are now severely damaged by mine drainage and may take hundreds of years or longer to recover. Under current regulations, some headwater streams will be buried under mining waste. Proponents of the controversial mountain-top removal mining technique say it is the only economically feasible way to take the remaining coal from the steep mountains of southwestern West Virginia. Eastern coal mining companies are competing with western companies like those operating in the Powder River basin of Wyoming, where coal is removed from beneath level land surfaces and there are relatively few surface water quality impacts during or after mining. Proponents of earlier mining techniques say that coal can be mined in the east in a more economically sustainable and environmentally friendly manner. Environmental and cultural issues of mountain-top removal mining continue to be studied and debated, while the permits for such mining practices continue to be issued.

Natural gas extraction is a major industry in the Lower Guyandotte River watershed area.

Numerous gas wells, pipelines and the roads that serve them contribute sediment to streams already burdened with too much sediment from urbanization, coal mining, road maintenance, and farming. Timbering roads and skid trails also increase sediment loads in the watershed's streams. Best management practices utilized by both the gas and timbering industries are designed to minimize erosion, but renegade loggers and gas well developers can cause major sediment problems. Even the best managed sites contribute some sediment to local streams, so that areas of extensive logging or gas extraction sometimes have sediment-choked streams.

Huntington, Barboursville, Milton and Logan are the largest incorporated communities lying at least partly in the watershed. The portion of the watershed between Huntington, Barboursville and Milton is heavily urbanized and suburbanized. Extensive housing and industrial development on the poorly drained soils of the ancient Teays Lake bottom have led to major degradation of the streams draining this portion of the watershed. Some communities are treating sewage at new or upgraded treatment plants, thanks in large part to federally funded programs instituted in the 1970s. Consequently, water quality has improved in a few areas, but many of the watersheds' communities remain inadequately sewered.

Almost nothing is known about the Guyandotte River freshwater mussel assemblage. It is likely that these creatures have suffered the same fate as their kin in other streams in the region. Sediment and other pollution, caused primarily by expansion of the coal industry, impacted mussel assemblages in the Big Sandy River drainage basin, which is very similar to the Guyandotte River basin. In a U.S. Fish & Wildlife Service report on mussels of the Big Sandy basin it was noted that there was a lack of interest by the scientific community in the mussel fauna of the basin. This indifference was attributed to "the apparent poor water quality of these rivers (i.e., high turbidity and high suspended solids, siltation, domestic waste) and the general unattractive nature of the streams in the basin." (Tolin and Schettig, 1984:2). The same could be said about the Guyandotte River basin.

The Mud River mussel assemblage was surveyed in 1984 by the former Division of Water Resources. Thirty-four sites produced only 11 species of mussels native to North America. Mud River's close proximity to the Ohio River leads malacologists to expect 20+ species. Extensive agriculture over the past 2 centuries has introduced vast quantities of sediment into the Mud River mainstem. In recent decades, housing construction between the river's mouth and Milton has bled more sediment into the river. The mussel population in Mud River is probably a mere "shell" of its former self. The warmwater fishery of Mud River has suffered from the severe sedimentation also. Improved sewage treatment, stricter enforcement of mining regulations in the last 30 years, and the construction of R.D. Bailey Reservoir on upper Guyandotte River have contributed to an improvement in that river's recreation fishery, but it may never recover to its pre-mining condition.

The West Virginia Division of Natural Resources included several streams within the Lower Guyandotte River watershed on its 2001 list of high quality streams (WVDNR, 2001). These streams are listed in Table 3. Streams are placed on this list if they meet either of 2 criteria: (1) they contain native trout populations or are stocked with trout, and (2) they are warmwater streams over 5 miles long with desirable fish populations utilized by the public.

The state's presumptive list of waters of special concern includes those shown in Table 4 in the

Lower Guyandotte River watershed. Explicit anti-degradation protection is given waters of special concern, also known as Tier 2.5 waters. Tier 2.5 waters are those with naturally reproducing trout populations, those utilized by the DEP as reference streams, or those determined to have biological scores indicating high water quality. Such streams are protected from human activities that would reduce their pollutant assimilation capacities by more than 10 %.

Table 3. WVDNR High quality streams.

Stream name	AN Code
Guyandotte River	WVO-4
Fourmile Creek	WVOG-27
Tenmile Creek	WVOG-32
Fourteenmile Creek	WVOG-34
Big Ugly Creek	WVOG-38
Harts Creek	WVOG-44
Big Creek	WVOG-49
Mud River	WVOG-2
Trace Fork	WVOGM-20
Middle Fork	WVOGM-25

Table 4. Special waters.

Stream name	AN Code
Horseshoe Br	WVOG-29-C
Plum Branch	WVOG-32-F
Steer Fork	WVOG-34-E
Little Ugly Ck	WVOG-37
Big Ugly Creek	WVOG-38
Pigeonroost Ck	WVOG-38-A
Laurel Creek	WVOG-38-D
Buffalo Creek	WVOG-61
Left Fk/Mill Ck	WVOGM-8-B

Assessment Results

General Overview

Of the 129 stream sites visited, 57 are located within the Mud River sub-watershed, the largest sub-watershed tributary to the Lower Guyandotte River watershed. Of the total sites visited, 111 were sampled for benthos using the riffle/run kick sampling technique, and thus are comparable to one another and to the set of reference streams. Only 8 were sampled using the noncomparable MACS technique and only 10 sites had no benthic sample collected at all. Therefore, approximately 86 % of the sites visited are benthologically compared in the following pages. Although the 8 MACS-sampled sites could not be compared with the others, the data generated from these samples are useful nonetheless. Of the 129 stream sites visited, 128 were sampled for water quality constituents and 122 had their habitats assessed using the 2-page rapid habitat assessment form. The graphic comparisons of the 111 riffle/run kick-sampled sites are shown in Figures 10-13.

Table 5: Sampling Summary	
Named streams	431
Sites visited	129
Habitat assessment sites	122
Water quality sampling sites	128
Comparable benthic collection sites	111
MACS-sampled sites	8

The Guyandotte River mainstem was included on the 1998 303(d) list of waterbodies with impaired water quality (see box on page 11) due to violations of certain water quality standards by aluminum and iron concentrations found in samples collected during sampling efforts other than the one reported on herein. The mainstem was sampled from only 1 location during the effort reported upon.

Six tributary streams in the Lower Guyandotte River watershed were placed on the 1998 303(d) list of impaired streams. One of these, Pats Branch (OG-0.5), was included on the primary list. The reasons for listing were violations of the water quality standards for copper and fluoride. The remaining 5 of these tributaries were included on the sub-list of mine-drainage impaired streams. Pats Branch was not sampled during this study, although it was the subject of more intensive sampling during a separate sampling effort. The other 303(d) streams were sampled during the study effort reported herein.

Benthic Macroinvertebrates

Within the entire watershed, 69 of the 111 (~ 62 %) benthologically comparable sites scored above 68.00 on the WVSCI. These sites are considered benthically unimpaired. Sites scoring 60.60 or below, and therefore considered biologically impaired, numbered 31 (~ 28 %). Scoring within the “gray zone” on the WVSCI (i.e., between 68.00 and 60.61, inclusive), 11 sites produced samples that were potentially impaired, but these single samples were not enough to ascertain their actual statuses without additional information.

Fig. 10. Lwr. Guyandotte (Excluding Mud R.) WVSCI vs. RBP Habitat.

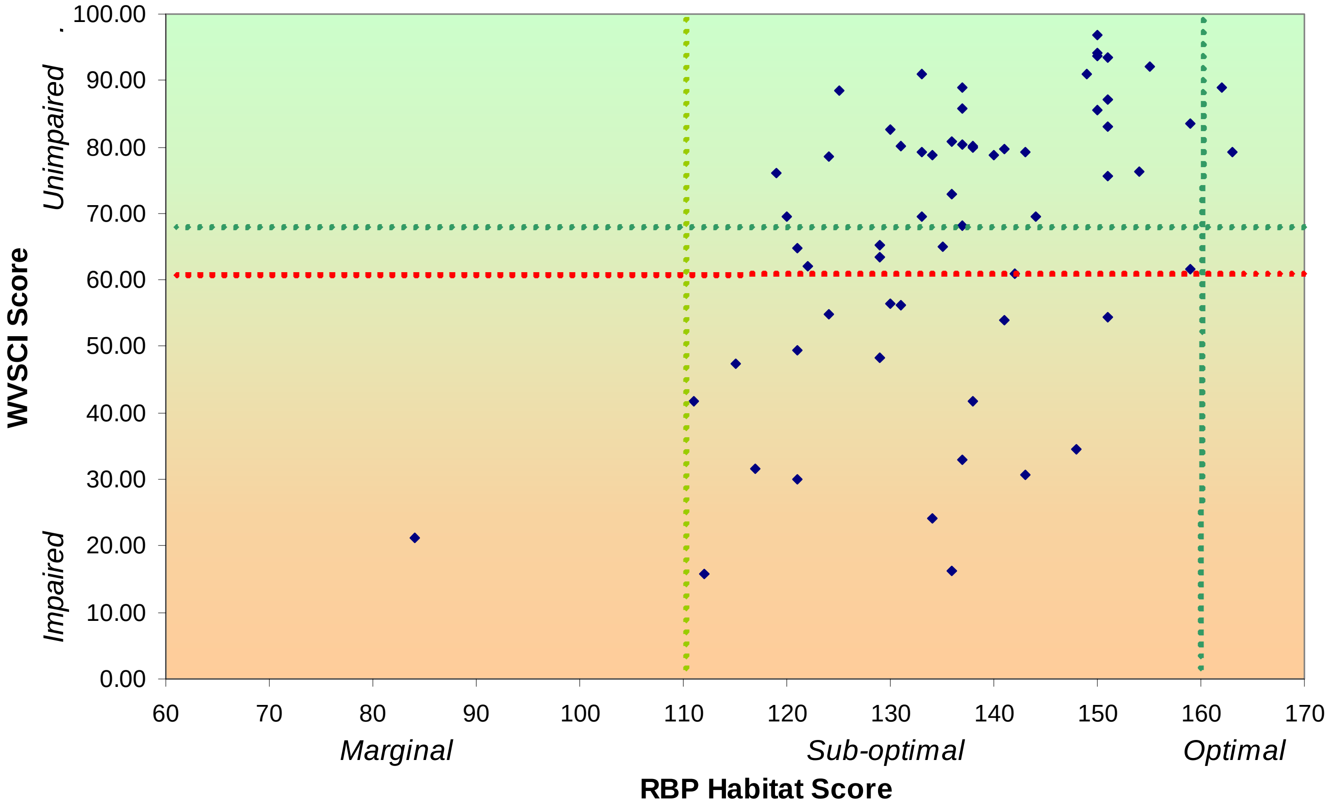


Fig. 10-A. Mud River Sub-Watershed WVSCI vs. RBP Habitat.

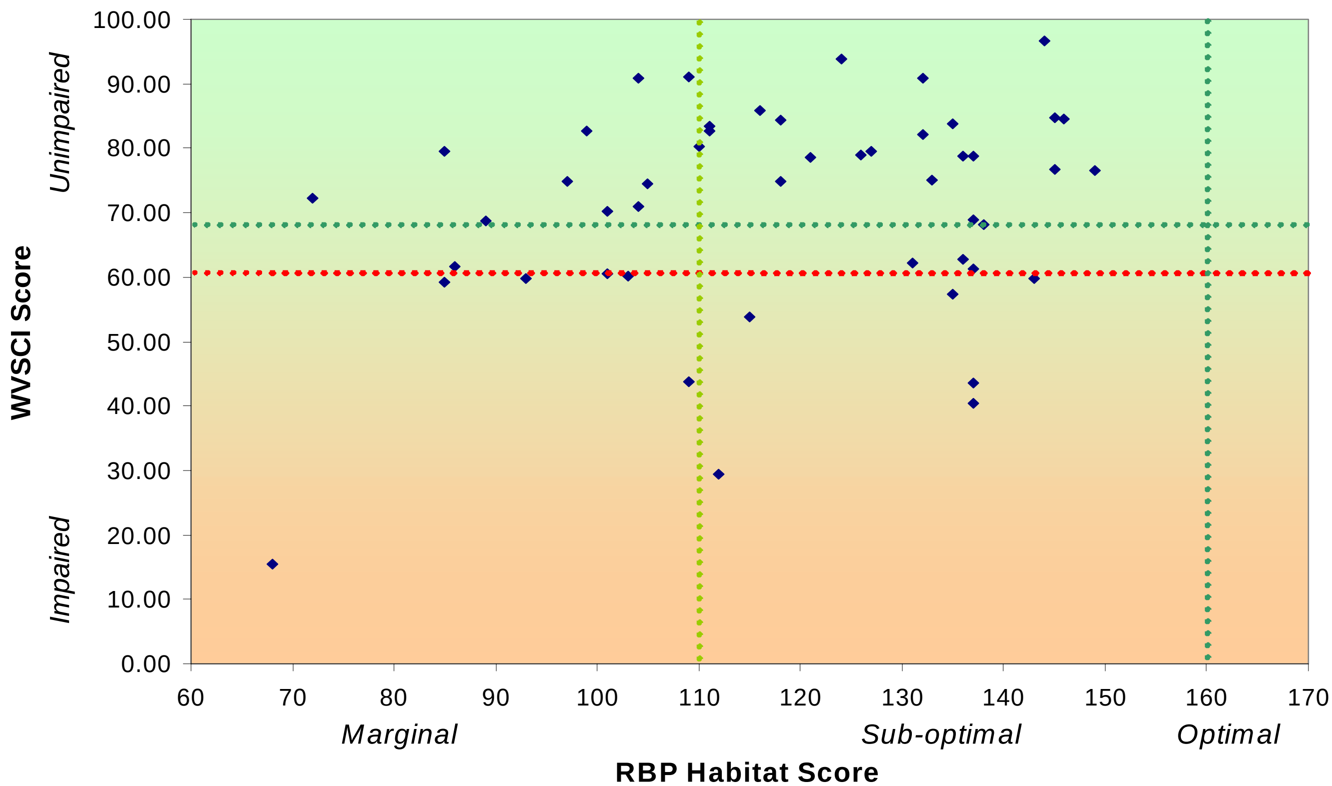


Fig. 11. Upper Mud River WVSCI Scores vs. RBP Habitat Scores.

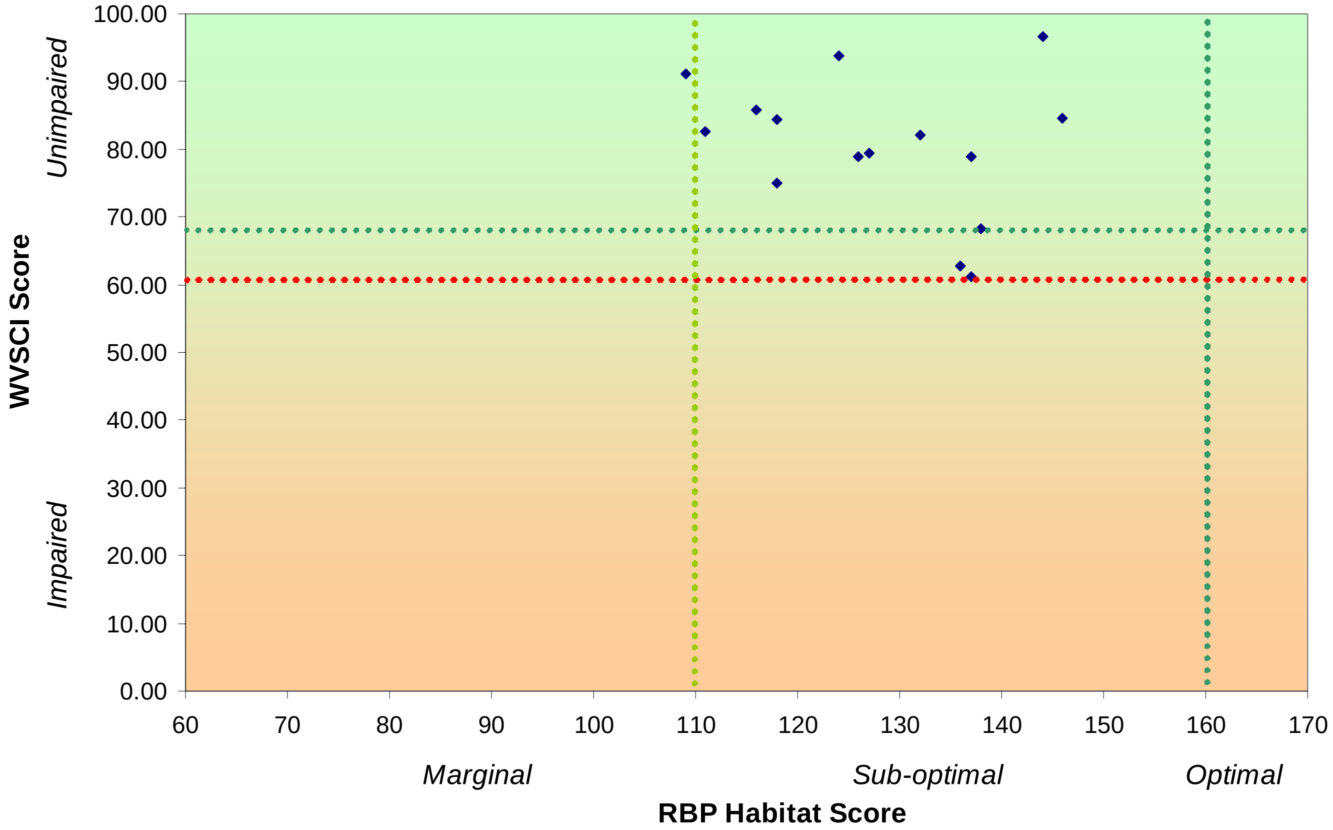


Fig. 12. Lower Mud River WVSCI Scores vs. RBP Habitat Scores.

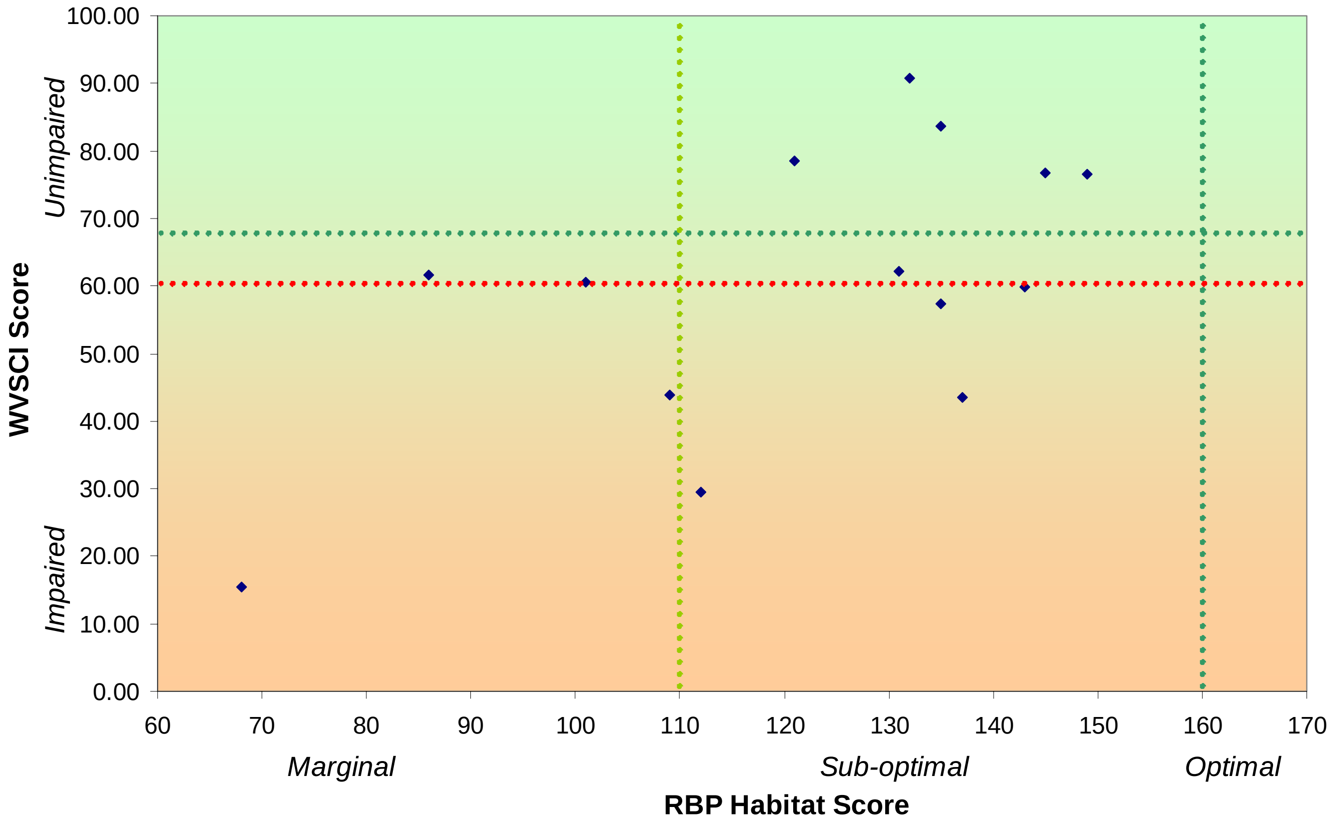
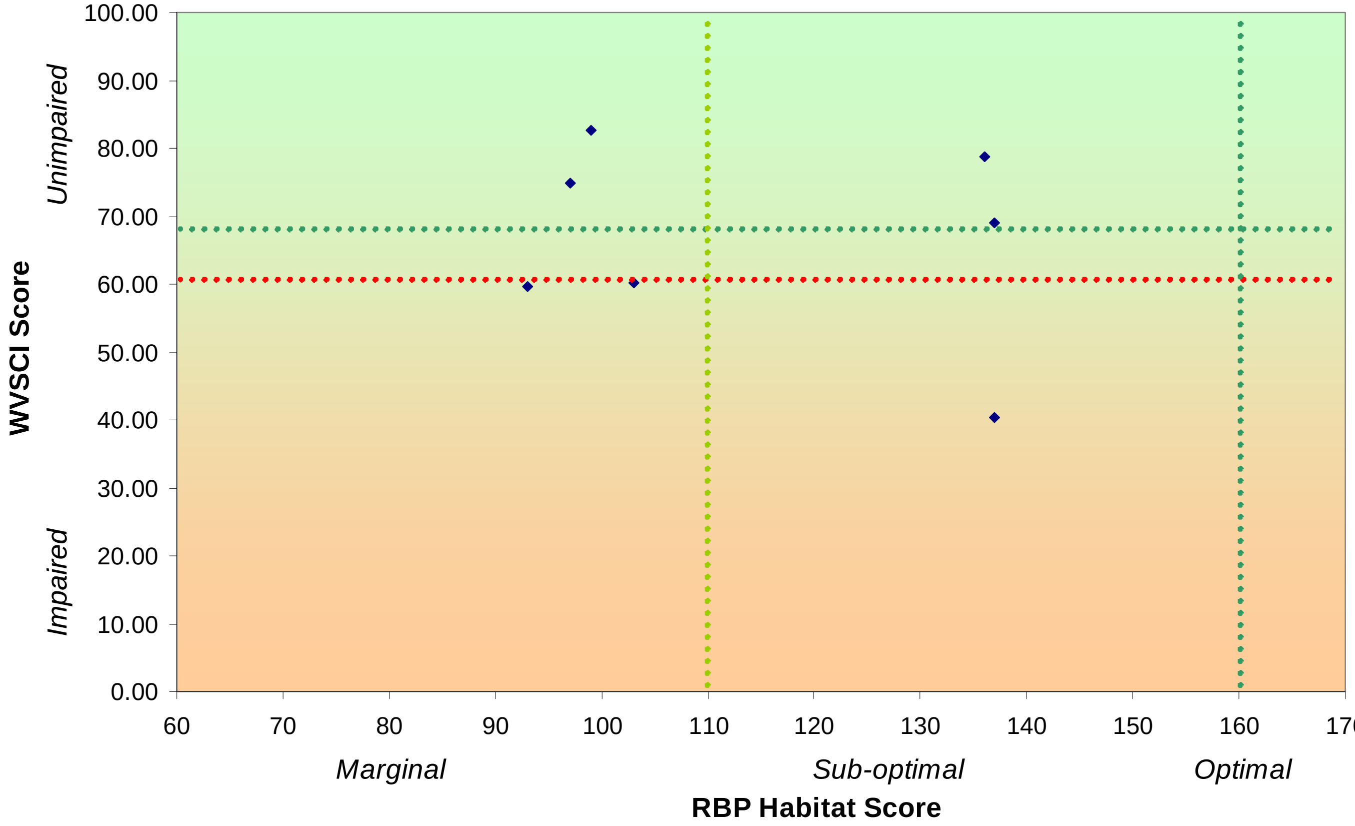


Figure 13. Middle Fork Mud River WVSCI vs. RBP Habitat.



Fecal Coliform Bacteria

Bacteria results are presented in Table A-7 in Appendix A. A majority of samples (77 of 125 or ~ 62 %) produced bacteria values above the 400/100mL water quality standard for contact recreation. Only 48 of 125 (~ 38 %) samples met the standard. Of the 77 samples above 400/100mL, 51 produced values of 1,000/100mL or more, 38 were 2,000/100mL or higher, and 6 were 10,000/100mL or higher. These values indicate a preponderance of fecal coliform bacteria sources within the watershed.

Physicochemical Water Quality

Various water quality constituents were analyzed for at almost all of the sites visited. The results of these analyses are presented in Tables A-7, A-8, & A-9 in Appendix A. Only 6 samples had pH values below the standard of 6.0 for aquatic life support. However, at least 1 of these samples came from a stream not originally included on the site list, but suspected by the sampling team to have mine drainage. It is uncertain how many other streams within the watershed are negatively impacted by mine drainage. Since most of the sampling sites were located near the mouths of selected streams, it is likely that some headwater areas receiving mine discharges remain improperly assessed.

Only 5 samples had conductivities greater than 500 µmhos/cm. Metals water quality standards violations numbered 14 for aluminum and 1 for iron. No violations of manganese and copper standards were detected. A few of the sites that had aluminum violations scored quite well on the WVSCI. *Lukey Fork* (OGM-50) scored 96.57 on the WVSCI and yet was in violation of the aluminum standard. The sampling team noted the stream was slightly turbid, perhaps due to a vehicle traveling up the streambed/roadway just prior to the team's arrival there. The *Kelleys Creek* (OGM-20-I-1-{1.5}) sample also violated the aluminum standard, yet it scored 72.31 on the WVSCI. The total suspended solids concentration was 165 mg/L. These examples show that a single sample violation of a water quality standard should not be the sole criterion used for placing a stream segment on the 303(d) list. In both of these cases, it is likely that suspended solids contributed significantly to the total aluminum concentrations detected.

Physical Habitat

There was no clear correlation between habitat scores and WVSCI scores.

The mean scores for most RBP Habitat parameters were in the suboptimal category with the exceptions of sediment deposition (marginal) and width of undisturbed vegetation zone (marginal). Results of the RBP Habitat Assessment are shown in Table A-11 in Appendix A. Also found in the Appendix, are the results of other habitat notations listed in Tables A-2, A-3, & A-4.

Only 2 total RBP habitat scores fell within the optimal range (≥160). No sites scored within the poor range (<60). The great majority of sites (78 %) scored within the suboptimal range (110-159).

Only 24 % scored within the marginal range (60-109). This relatively tight distribution of habitat scores within the Lower Guyandotte River watershed may have been due in part to the division of the entire Guyandotte River watershed into upper and lower portions, leaving the higher mountain streams within the upper portion and the slower, meandering streams of the lower elevations within the lower portion. When the Upper Guyandotte River watershed was sampled in A.D. 2000, 6 % of the sites produced RBP habitat scores within the optimal range.

The Mud River sub-watershed produced 83 % of the scores in the marginal range. No large tributary watershed with the same meandering, low-gradient, sediment-laden characteristics of Mud River exists within the Upper Guyandotte River watershed. Indeed, the larger tributary watersheds of the upper watershed consist primarily of swift, high-gradient, riffle-rich streams.

As stated previously, the average sediment deposition score over all the sites fell within the marginal category. The average embeddedness score was very low within the suboptimal range. A half a point lower and it would have fallen into the marginal category.

The Arcview land use database (1993 multi-resolution land characteristics coverage, or MRLC, in the watershed characterization modeling system, or WCMS) indicates that all but 3 of the sites sampled within the watershed had greater than 70 % of their surface drainage basins covered by forest. The 3 areas that had less than 70 % coverage by forest were those above *Tanyard Branch* (OGM-1.5, with 32.59 %), *Indian Fork* (OGM-12, with 49.07 %) and an *unnamed tributary of Trace Creek* (OG-14-D-{0.4}, with 61.35 %). The percentages of urban land coverage at all but 2 sites were below 4 %. Those 2 sites were *Tanyard Branch* (47.21 %) and *Indian Fork* (13.83 %).

Results And Discussions By Sub-watershed

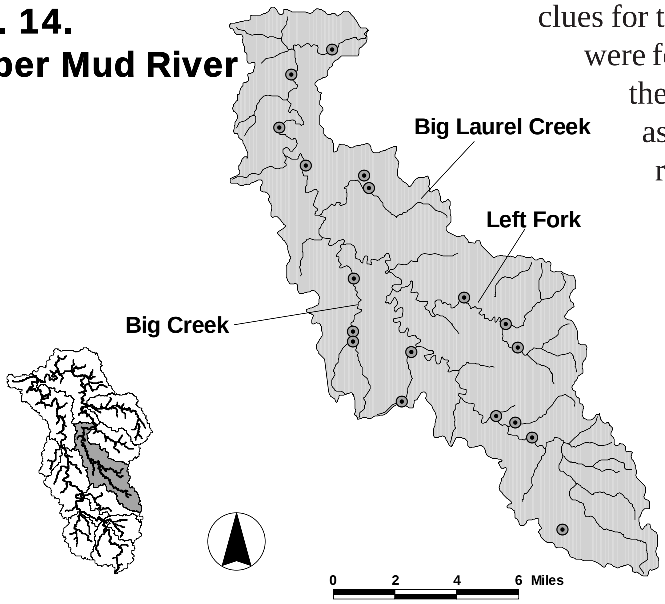
The following discussions focus on the biologically impaired streams and those with scores that indicate further data collection is warranted to determine whether or not they should be considered impaired. Known causes and sources of impairment are presented, and probable causes and sources are discussed. A few non-benthically sampled sites are discussed also. The discussions are grouped into sub-watersheds. The maps show sample site locations. The tables present a few results from each of the sites within each sub-watershed. See the example table (Figure 6).

Upper Mud River sites

Approximately the northern two thirds of this sub-watershed lie within the Monongahela Transition Zone sub-ecoregion. The southern third is within the Cumberland Mountains sub-ecoregion.

All but 2 of the comparably sampled Upper Mud River benthic sites produced WVSCI scores above 68.00 (i.e., within the unimpaired zone). Only *Left Fork of Mud River* 10.2 miles upstream of its mouth (OGM-39-{10.2}) and *Mud River mainstem* (OG-2-{77.2}) fell within the “gray zone”. No

Fig. 14.
Upper Mud River



clues for the relatively lower score at the Left Fork site were forthcoming in either the habitat assessment or the water quality analysis, but the mainstem site assessment produced clues. The field team recorded "Problems (1) Heavy sediment load (2) Conductivity high + pH high due to current mining activities upstream." Field readings were 8.27 for pH and 1,024 µmhos/cm for conductivity. Laboratory analyses further supported this statement, finding a sulfate concentration of 430 mg/L and a nitrate+nitrite concentration of 2.16 mg/L.

Two sites in this tributary sub-watershed produced the highest WVSCI scores within the Mud River sub-watershed. *Lukey Fork* and *Dry Fork* scored 96.57 and 93.77, respectively. Both of these sites had relatively high percentages of cobble in the sampled substrates (60 % & 50 %, respectively). One other site, *Upton Branch*, also scored above 90.00.

Lukey Fork was noted as being a potential reference site, but it was not selected in the final analysis, probably due to the dirt road that runs parallel to it or the aluminum water quality standard violation it produced. However, it was obviously one of the higher quality streams sampled during this study and it should be protected.

Two benthic sites were sampled using the MACS protocol, and therefore are not considered comparable to the other sites. One of these, *Mud River* (OG-2-{48.7}), produced a WVSCI score of 72.15 and was, therefore, likely to have had a relatively diverse, healthy benthic community within its glide/pool habitat. The other, *Mud River* (OG-2-{47.0}), scored only 63.53 on the WVSCI. Other

Table 6. Upper Mud River

Stream Name	ANCode	WVSCI	RBP	Fecal
Mud River	WVOG-2-(47.0)	NC63.53	120	***10000***
Mud River	WVOG-2-(48.7)	NC72.15	126	***600***
Mud River	WVOG-2-(77.2)	63.36	136	50
Sandlick Br	WVOGM-31	78.93	126	***1500***
Dry Fork	WVOGM-33-B	93.77	124	***610***
Big Branch	WVOGM-33-C	85.83	116	400
Big Creek	WVOGM-35-(1.8)	74.93	118	380
Big Creek	WVOGM-35-(4.1)	82.65	111	66
Laurel Fork	WVOGM-35-E	79.52	127	***3800***
Left Fk/Mud R	WVOGM-39	84.39	118	***5200***
Left Fk/Mud R	WVOGM-39-(10.2)	61.58	137	***2900***
Sycamore Fk	WVOGM-39-G	68.18	138	***5000***
Upton Branch	WVOGM-40.3-(0.0)	84.54	146	***930***
Upton Branch	WVOGM-40.3-(2.2)	91.14	109	***430***
Stonecoal Br	WVOGM-43	78.81	137	***1200***
Berry Branch	WVOGM-44-(0.2)	82.15	132	55
Lukey Fork	WVOGM-50	96.57	144	72

than fecal coliform bacteria, no other pollutants were detected at these sites.

Fecal coliform bacteria standard violations were detected at 64 % of the sub-watershed sampling sites. Clearly identified sources were not found at any of the sites and only 3 sites had notations indicating potential sources of bacteria.

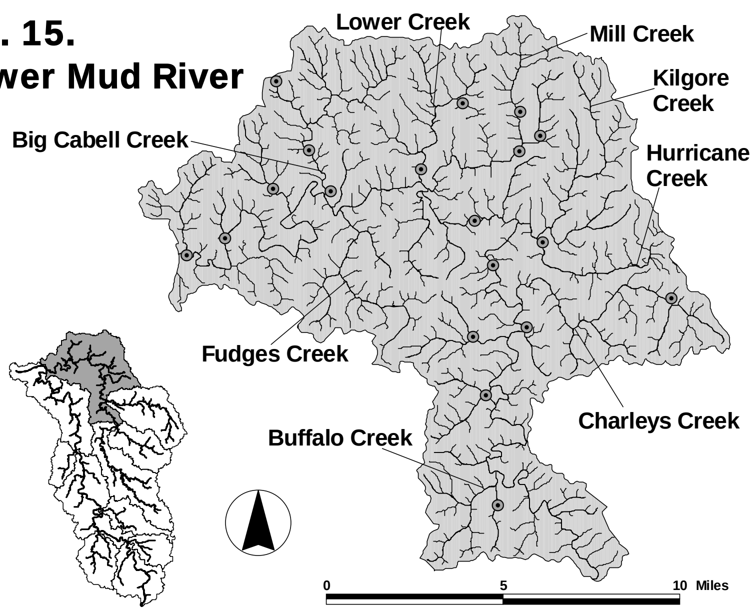
Although these data indicate that *Mud River's* DNR high quality status may have been adequately protected, the data from the Lower Mud River sub-watershed (see below) indicate that further investigation into the mainstem's status is warranted.

Lower Mud River Sites

The Monongahela Transition Zone sub-ecoregion covers the entire Lower Mud River sub-watershed. As stated previously, this sub-ecoregion is distinctly different from the Cumberland Mountains sub-ecoregion that covers the southern third of the Lower Guyandotte River watershed. Soils with high clay components are prevalent and the larger streams have relatively low gradients and lower riffle frequencies. Stream substrates tend to have high percentages of silt. These generalizations are borne out in the Mud River sub-watershed.

The riffle/run-sampled Lower Mud River sites did not fare as well on the WVSCI as did the upper sites. Only 5 produced values within the unimpaired range, while 6 scored within the impaired range. Three sites produced scores within the "gray zone."

Fig. 15. Lower Mud River



Tanyard Branch produced the lowest WVSCI score (15.50) of all comparably sampled sites within the entire Lower Guyandotte River watershed. One probable reason for this low score was the poor habitat quality found there. The bulk of the sampled substrate was silt (49 %) with sand comprising most of the remainder (40 %). The epifaunal substrate habitat parameter scored only 3 as did the sediment deposition category. The embeddedness category also scored in the poor range. Indeed, the overall habitat score was only 68, the lowest of all riffle/run sites comparably sampled. The fecal coliform bacteria concentration was 12,000 colonies per 100 mL, indicating a problematic level of sewage or animal waste.

The MRLC database indicates that the surface drainage area of the *Tanyard Branch* site was 47.21 % urban and only 32.59 % forested. These are, respectively, the highest and lowest percentages in these categories for all of the sites sampled. Indeed, all but 3 sites had greater than 70 % of their watershed areas covered with forest. When consideration is given to the relatively high percentage of urban land above the *Tanyard Branch* sample site, it is no surprise that some habitat parameters scored poorly and that the bacteria concentration was high.

Indian Fork also scored quite low on the WVSCI. This site received a marginal and a poor score, respectively, on the embeddedness and sediment deposition habitat categories. Also noted were the presence of livestock access and the odor of sewage in the water, although the bacteria concentration was only 150 colonies/100 mL. Like *Tanyard Branch*, *Indian Fork* had a relatively low percentage of surface area covered by forest, 49.07 %. Urban land covered 13.83 % of the drainage basin, the second highest percentage of all the sites sampled.

Little Cabell Creek, *Mud River* at OG-2-{3.6}, *Right Fork of Mill Creek*, and *Straight Fork*, all produced impaired benthological samples. A local landowner advised the samplers that *Little Cabell Creek* flowed out of its bank 2 days prior to the sampling date due to violent thunderstorms. This flash flood could have negatively impacted the benthic community by scouring the substrate and disrupting the benthic community. The habitat assessment forms and the water quality analyses gave no clear clues for the impairment at the *Mud River*, *Right Fork of Mill Creek*, and *Straight Fork* sites.

Table 7. Lower Mud River

Stream Name	ANCode	WVSCI	RBP	Fecal
Mud River	WVOG-2-(3.6)	43.58	137	***610***
Mud River	WVOG-2-(18.8)		110	150
Mud River	WVOG-2-(25.5)		99	200
Tanyard Br	WVOGM-1.5	15.50	68	***12000***
Little Cabell Ck	WVOGM-3-(0.9)	43.84	109	***1000***
Big Cabell Ck	WVOGM-4-(0.2)	NC42.90	93	***1000***
Big Cabell Ck	WVOGM-4-(2.0)	NC75.05	110	***610***
Lower Creek	WVOGM-7-(0.4)	61.59	86	***540***
Tony Branch	WVOGM-7-B-1	83.75	135	***460***
Mill Creek	WVOGM-8-(4.0)	76.58	149	***520***
Left Fk/Mill Ck	WVOGM-8-B	76.78	145	84
Right Fk/Mill Ck	WVOGM-8-C	57.33	135	***2800***
Indian Fork	WVOGM-12	29.45	112	150
Brush Creek	WVOGM-13	62.19	131	***1400***
Charley Creek	WVOGM-14-(7.2)	60.52	101	***880***
Fallen Fork	WVOGM-16-A	90.84	132	140
Trace Creek	WVOGM-19	78.51	121	130
Straight Fork	WVOGM-22-A-(0.7)	59.86	143	350

The “gray zone” sites are *Charley Creek*, *Lower Creek*, and *Brush Creek*. *Charley Creek* scored poorly on the embeddedness and sediment deposition habitat categories. The total score (101) was within the marginal range.

Lower Creek scored even lower (86) than Charley Creek in the rapid habitat assessment. Notations included: “-banks (both) are completely riprapped left bank also has a lot of mud mixed in- -reach is very much channelized -almost no habitat.” Another notation about *Lower Creek* provides another clue to the possible reason for its WVSCI score: “Reach is affected by backwater from the Mud [River] - water was backed up till last night.”

The *Brush Creek* site’s habitat assessment form provided no clear clues about the sources of its impairment.

Only 1 site within the *Lower Mud River* sub-watershed produced a WVSCI score above 90.00; *Fallen Fork*. A high percentage of cobble (60 %) in the sampled substrate and habitat scores for embeddedness and sediment deposition above the poor range, probably helped to support the diverse benthic community found there.

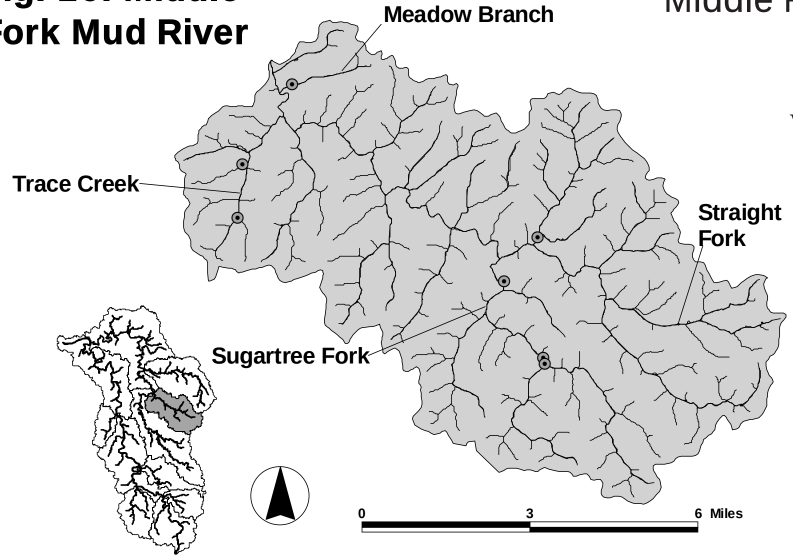
The 2 *Big Cabell Creek* sites (OGM-4-{0.2} & OGM-4-{2.0}) were sampled using the MACS protocol and are therefore, not comparable to the other sites in this tributary sub-watershed. No water quality data indicated pollution, other than fecal coliform bacteria, at these locations. Indeed, the site 2 miles upstream of the mouth scored within the unimpaired range of the WVSCI. It is likely this site supported a diverse benthic community in its glide/pool habitat.

Two *Mud River* sites, OG-2-{18.8} and OG-2-{25.5}, were not benthically-sampled. The water quality at these sites was minimally sampled for field parameters and bacteria. None of the water quality constituents provided evidence of impairment.

Of the total number of sub-watershed bacteria samples, 61 % were in violation of the bacteria water quality standard, but none of these had clearly identifiable sources indicated on the assessment forms. Only 4 had potential sources identified.

The relatively low WVSCI score of the only benthically-sampled *Mud River* mainstem site and the relatively poor showing of several tributary sites indicate that this portion of the mainstem should be further investigated to determine if its DNR high quality status is adequately protected.

Fig. 16. Middle Fork Mud River



Middle Fork Of Mud River Sites

This sub-watershed lies entirely within the Monongahela Transition Zone sub-ecoregion. See pertinent notes on this sub-ecoregion in the section titled “The Lower Guyandotte River Watershed”.

Of the 7 sites benthically-sampled in the *Middle Fork of Mud River* sub-watershed, 3 produced “impaired” WVSCI scores and the remainder harbored unimpaired benthological communities. *Meadow Branch* scored only 40.41 on the WVSCI. *Valley Fork*, which scored only 59.73, experienced a "thunderstorm-& recent flooding," according to the sampling team. *Sugartree Fork* (OGM-25-I) near its mouth also experienced a thunderstorm. However, the site located 3 miles upstream (OGM-25-I-{3.0}) also experienced a thunderstorm and it produced a WVSCI score of 74.85. In conclusion, no clear evidence of the causes of impairment for these 3 sites is forthcoming from the current information.

Table 8. Middle Fork Of Mud River				
Stream Name	ANCode	WVSCI	RBP	Fecal
Meadow Br	WVOGM-25-A	40.41	137	***520***
Trace Creek	WVOGM-25-B-(2.3)	68.96	137	***3800***
Tincture Fork	WVOGM-25-B-1	78.70	136	160
Valley Fork	WVOGM-25-H-1	59.73	93	***8000***
Sugartree Fk	WVOGM-25-I	60.18	103	***3200***
Sugartree Fk	WVOGM-25-I-(3.0)	74.85	97	***550***
Sand Fork	WVOGM-25-I-4	82.71	99	***3500***

Of the 7 fecal coliform bacteria samples collected, 6 were in violation of the water quality standard. No sources were positively identified, but 3 sites had notes indicating potential sources, like residential drain pipes or pasture.

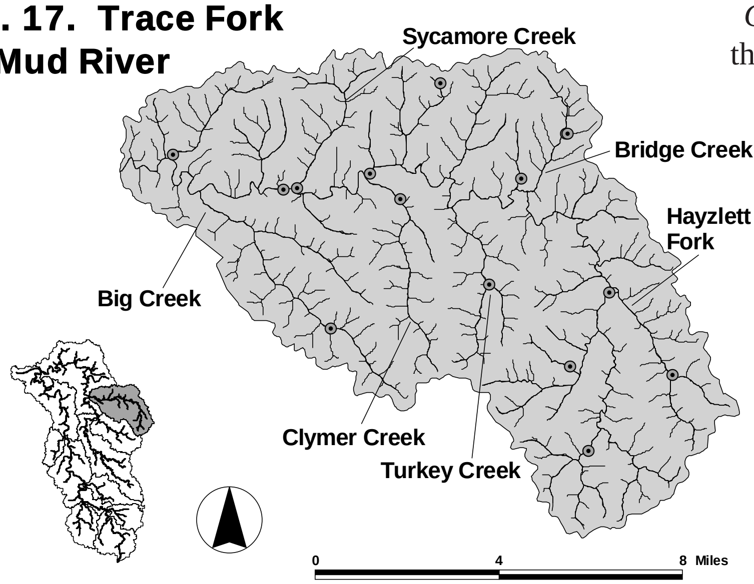
The *Middle Fork* mainstem was not sampled. Therefore, these data provide few clues whether or not current protection levels were maintaining the stream's DNR high quality status.

Trace Fork Of Mud River Sites

Like the Middle Fork of Mud River sub-watershed, the Trace Fork sub-watershed lies entirely within the Monongahela Transition Zone sub-ecoregion. Only 1 site, *Clymer Creek*, was sampled with the MACS technique, so the other 13 benthologically-sampled sites can be compared with one another. Of these 13 comparable sites, 11 produced WVSCI scores above 68.00 and were therefore, considered unimpaired. *Flint Hollow* scored above 90.00. As with other high-scoring sites in the Mud River sub-watershed, *Flint Hollow's* sampled substrate consisted of a relatively high percentage of larger particles, i.e. 15 % boulder and 40 % cobble. Also, the embeddedness and sediment deposition habitat assessment categories scored above the poor range.

The 2 sites considered benthically impaired are *Coon Creek* and *Trace Fork* (OGM-20-{21.2}) 21.2 miles upstream of its mouth. Both sites appeared to have substrates with significant amounts of easily suspended sediments of small particle size. *Coon Creek's* sampled substrate consisted of 30 % gravel and 40 % sand with the 20 % silt component surpassing the percentages of both boulder and cobble (only 5 % each). The sampled habitat of the upper *Trace Fork* site consisted of no boulder and only 20 % cobble, with the bulk in gravel and sand (35 % & 30 % respectively). The upper *Trace Fork* site also scored poorly in the sediment deposition category of the rapid habitat assessment. No other clues about the causes of impairment for these sites is forthcoming from the assessment forms and the laboratory analyses.

Fig. 17. Trace Fork of Mud River



Clymer Creek, the site sampled with the MACS protocol, had a fecal coliform bacteria concentration (909 colonies/100 mL) in violation of the water quality standard. Because this site scored within the unimpaired range of the WVSCI, it is likely the site supported a diverse benthic community in its glide/pool habitat

Flint Hollow was the only site that produced a WVSCI score above 90.00.

Sycamore Creek was sampled minimally. A bacteria sample was collected and field water quality parameters were determined, but no benthic sample was collected and no habitat assessment was performed. Only the fecal coliform bacteria concentration (940 colonies/100 mL) violated water quality standards.

In the Trace Fork watershed, 53 % of the fecal coliform bacteria samples were in violation of the water quality standard. No sources were positively identified and only 2 sites had potential sources (pasture) identified.

These results indicate that at least a few places within the sub-watershed had some problems contributing to degraded benthic communities. However, at least some portions of the mainstem appeared to be fitting of their status on the DNR's high quality streams list.

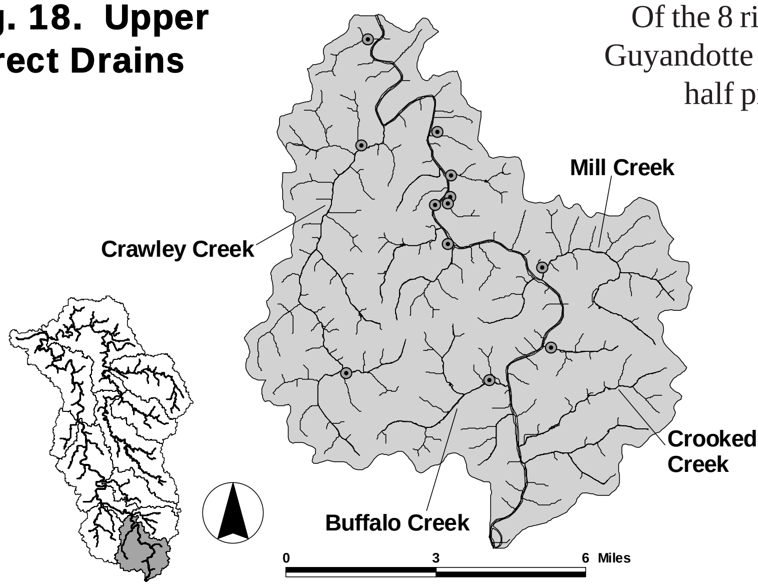
Table 9. Trace Fork Of Mud River

Stream Name	ANCode	WVSCI	RBP	Fecal
Trace Fork	WVOGM-20-(21.2)	59.14	85	***1100***
Trace Fork	WVOGM-20-(6.4)	71.04	104	160
Coon Creek	WVOGM-20-A	53.85	115	220
Big Creek	WVOGM-20-D-(4.6)	68.79	89	***4100***
Sycamore Ck	WVOGM-20-F			***940***
Clymer Creek	WVOGM-20-H	NC73.60	72	***909***
Kelleys Creek	WVOGM-20-I-1-(1.5)	72.31	72	***1100***
Nelson Hollow	WVOGM-20-K-(0.1)	83.48	111	340
Lefthand Fork	WVOGM-20-K-1	84.77	145	***1200***
Martin Run	WVOGM-20-L	79.48	85	360
Bridge Creek	WVOGM-20-M-(1.8)	74.44	105	***550***
Flint Hollow	WVOGM-20-M-1	90.89	104	300
Donley Fk/Hayslett Fk	WVOGM-20-R-2	80.31	110	171
Joes Creek	WVOGM-20-T-(3.5)	70.17	101	***6300***
Rockhouse Branch	WVOGM-20-V	75.08	133	220

Upper Guyandotte River Direct Drains Sites

The Cumberland Mountains sub-ecoregion contains this sub-watershed entirely. As noted previously, this sub-ecoregion is characterized by steep, razor-backed ridges, predominated by coarse-grained sandstones. The streams, including even the larger ones, have numerous riffles.

Fig. 18. Upper Direct Drains



Of the 8 riffle/run sampled sites in the Upper Guyandotte River Direct Drains sub-watershed, half produced benthic samples considered impaired on the WVSCI and half were considered unimpaired. *South Fork of Crawley Creek* scored only 31.54 and at least some of the reasons for its poor score were revealed by the assessment. The conductivity was 1,195 µmhos/cm and this was likely due to the highway construction fill area and surface mine that formed the headwater immediately above this site. To quote the sampler, "The headwaters of this stream have a large, 'reclaimed' contour strip mine and a huge valley fill from Corridor G construction."

Table 10. Upper Direct Drains				
Stream Name	ANCode	WVSCI	RBP	Fecal
Guyandotte River	WVO-4-(76.3)			***2100***
Lily Branch	WVOG-50	76.37	154	52
Fowler Branch	WVOG-51.5	41.85	111	***2000***
Canoe Fork	WVOG-51-B	69.64	133	***4200***
South Fk/Crawley Ck	WVOG-51-G.5	31.54	117	150
Godby Branch	WVOG-53	32.97	137	20
Mill Creek	WVOG-59	56.14	131	***3800***
Big Branch	WVOG-60	90.96	133	240
Buffalo Creek	WVOG-61	80.05	131	150

Godby Branch scored 32.97. The assessment produced evidence to support this stream's inclusion on the 303(d) mine drainage list. The pH was only 4.6 and the conductivity was 527 µmhos/cm. The aluminum concentration of 4.65 mg/L was a violation of the water quality standards. Coal fines, metal hydroxides and coal refuse were present.

Fowler Branch's total habitat score of 111 placed it high in the marginal range so it appears that mine drainage may have had a greater negative impact on the benthic community than did habitat. The WVSCI score was only 41.85. Conductivity was 527 µmhos/cm and notations regarding sampled substrate indicate; "Much of the material appears to be coal refuse & red-dog."

The *Mill Creek* site also was considered benthologically impaired, but no clear clues about potential causes are provided by the water quality analysis or the habitat assessment.

One site, *Big Branch*, scored higher than 90.00 on the WVSCI. The watershed assessment form is notated; "Bugs looked good. Maybe potential reference further up stream beyond last residence."

Although the *Buffalo Creek* mainstem site scored 80.05 on the WVSCI, the entire 3.14 mile stream is included on the 1998 303(d) mine drainage sub-list. A few notes on the assessment form give clues that *Buffalo Creek* may have had mine drainage. Indeed, historically the stream was negatively impacted by old mines and refuse areas near its headwater in Chief Logan State Park. However, an abandoned mine land reclamation project seems to have improved the water quality in *Buffalo Creek* and, consequently, the benthic community may have improved. This stream should be further assessed to determine if all or part of it can be removed from the 303(d) list.

Three sites, *Guyandotte River* (O-4-{76.3}), *Chafin Branch*, and *Toney Branch* (called Bentley Branch locally), were not benthically-sampled. No water quality constituents from the *Guyandotte River* site indicated violations of water quality standards. The same was true of Toney Branch. However, *Chafin Branch* was definitely negatively impacted by mine drainage. It exhibited a pH of 4.0 and a conductivity of 538 µmhos/cm.

Nearly half (44 %) of the fecal coliform bacteria samples were in violation of the standard. No sampled sites had clearly identifiable sources and only 2 had potential sources noted on their assessment forms.

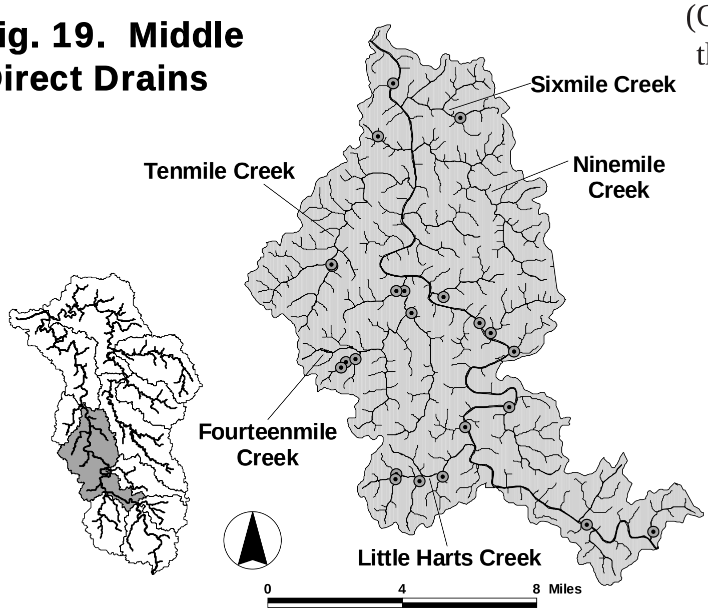
There are not enough data to determine whether or not *Guyandotte River* in this sub-watershed was meeting the expectations of the DNR's high quality streams list.

Middle Guyandotte River Direct Drains Sites

Approximately the southern half of this sub-watershed lies within the Cumberland Mountains sub-ecoregion. The Monongahela Transition Zone sub-ecoregion covers the northern half.

Of the 18 benthically-sampled sites in the Middle Guyandotte River Direct Drains sub-watershed, 5 scored below 60.60 on the WVSCI and therefore, were considered impaired. *Dry Branch* (OG-41) scored only 24.12, but few clues for this poor rating were forthcoming from the assessment. One note mentioned "rocks covered w/ dead fil.[filamentous] algae & periphyton." The sampling team also noted that heavy precipitation had occurred within the past 24 hours. The dead algae may have been due to a dry spell just before heavy rainfall runoff covered the channel again.

Fig. 19. Middle Direct Drains



Laurel Fork, *Aarons Creek*, *Short Bend*, and *Lick Branch* scored within the 50's on the WVSCI. *Short Bend's* assessment form provides a few clues about possible reasons for its poor benthic score. Gray water was noted as were sawdust and feed grain on the substrate. The fecal coliform bacteria concentration was quite high at 20,000 colonies/ 100 mL.

The sampled substrate at the *Laurel Fork* site consisted of 80 % gravel and only 10 % cobble. Only 15 % cobble covered the sampled substrate at the *Lick Branch* site. The bulk of the sampled area (45 %) was covered in gravel, with sand covering another 30 %. These relatively high percentages of small substrate materials at these sites reflect less than optimal conditions for most riffle-dwelling benthic macroinvertebrates. No other clear clues for the poor WVSCI scores at *Laurel Fork* and *Lick Branch* were provided by either the water quality data or the assessment form.

The *Aarons Creek* site's assessment form provided no indisputable evidence of potential causes of benthic impairment. Neither did the water quality constituents provide any clues.

The 3 "gray zone" sites, *Hamilton Creek*, *Sand Creek*, and *East Fork of Fourteenmile Creek*, produced no certain clues about the potential causes of impairment.

Limestone Branch is on the 1998 303(d) mine drainage sub-list and indeed, the pH of 5.6 and the aluminum concentration of 0.903 mg/L were in violation of water quality standards. However, the WVSCI score was 69.56. Notes on the assessment form indicate that the source of poor water quality is a mine discharge only 0.2 mile upstream of the sampling site, which is approximately 0.2 mile upstream of the mouth. By performing a preliminary kick sample and making water quality field tests immediately above this discharge, the sampling team determined there was no negative impact upstream of the discharge. The team's conclusion is that only the lowest 0.4 mile of *Limestone Branch* should be retained on the 303(d) list. The upper 1.38 miles should be removed from the list.

Plum Branch was selected as a reference site now included in the statewide reference site database. Another site, *Horseshoe Branch*, scored 93.59 on the WVSCI, but trash in the stream and other considerations kept it from being considered as a reference stream. However, it appears possible that above the sampled reach, *Horseshoe Branch* may support a potential reference site.

There were 11 samples (61 %) collected that were in violation of the water quality standard for fecal coliform bacteria. Three of

Table 11. Middle Direct Drains

Stream Name	ANCode	WVSCI	RBP	Fecal
Horseshoe Branch	WVOG-29-C	93.59	150	30
Stout Creek	WVOG-30-(1.2)	79.34	143	***3300***
Plum Branch	WVOG-32-F	87.20	151	32
Fourteenmile Creek	WVOG-34	72.96	136	***2000***
Lick Branch	WVOG-34-A	56.39	130	***1300***
East Fk/Fourteenmile Ck	WVOG-34-B	65.00	135	***2200***
Nelson Fork	WVOG-34-E-1	88.88	137	***6000***
Nelson Fork	WVOG-34-E-1-(0.8)	79.27	163	6
Aarons Creek	WVOG-35	54.43	151	***5600***
Hamilton Creek	WVOG-36	61.51	159	***1200***
Little Ugly Creek	WVOG-37	89.01	162	28
Sand Creek	WVOG-40	64.69	121	380
Dry Branch	WVOG-41	24.12	134	***4200***
Short Bend	WVOG-42-A	54.79	124	***20000***
Laurel Fork	WVOG-42-C-(0.2)	54.03	141	***6400***
Mudlick Branch	WVOG-42-D	80.84	136	***3200***
Gartin Fork	WVOG-42-E	80.21	138	230
Limestone Branch	WVOG-48	69.56	144	44

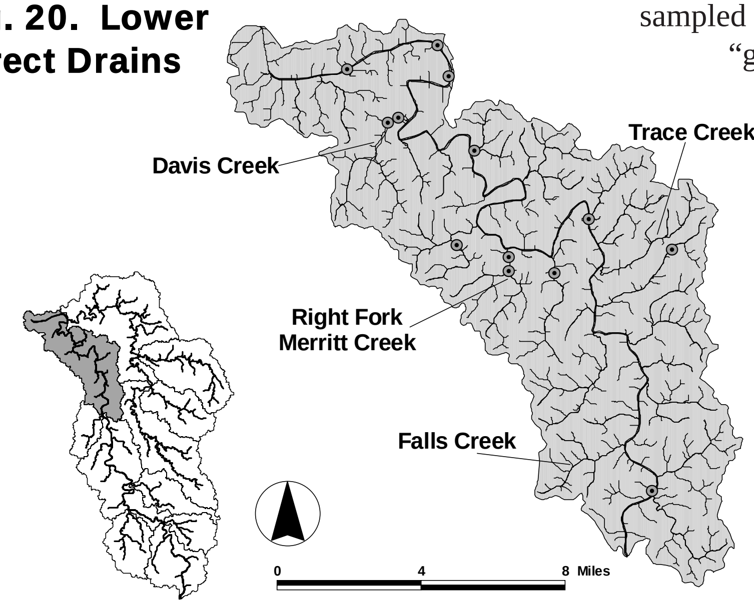
these had potential sources noted on their assessment forms; for example, dog pen, chicken yard, pasture, livestock access and drainage pipes near residences. Only the *Short Bend* site had an obvious source identified, a gray water discharge from a trailer within the reach.

These data do not include information on the *Guyandotte River* mainstem. Therefore, it is difficult to assess the river's actual status in relation to its status on the DNR high quality streams list.

Lower Guyandotte River Direct Drains Sites

This sub-watershed lies entirely within the Monongahela Transition Zone sub-ecoregion. Of the 9 sites benthologically-sampled, 2 were sampled by the MACS procedure, and consequently are not comparable with the other 7 sites. Of the comparably sampled riffle/run sites, 1 scored within the "gray zone" on the WVSCI and the others scored in the impaired range. The impaired sites shared 1 feature, all had 85 % or greater coverage of their sampled substrates by gravel or smaller particles. A predominance of gravel, sand or smaller particles usually causes developmental instability in an aquatic community and often leads to decreased diversity and abundance. Some scored poorly or marginally in the embeddedness or sediment deposition habitat categories. There were few other clues indicating potential causes of benthological impairment at these sites.

Fig. 20. Lower Direct Drains



Upper Heath Creek scored within the "gray zone" and it had a slightly higher percentage of its sampled substrate covered with particles the size of cobbles or larger (20 % cobble & 5 % bedrock).

Other than bacteria, no water quality constituents indicated pollution problems on either *Mill Creek* or the *unnamed tributary of Trace Creek*, the 2 MACS-sampled sites.

Approximately 77 % of fecal coliform bacteria

Table 12. Lower Direct Drains

Stream Name	ANCode	WVSCI	RBP	Fecal
Davis Creek	WVOG-3	21.13	84	330
Edens Branch	WVOG-3-0.5A	48.23	129	210
Mill Creek	WVOG-6-(0.1)	NC27.02	100	***1900***
Upper Heath Creek	WVOG-9-A-(0.3)	60.96	142	***3300***
Merritt Creek	WVOG-10	30.79	143	***3000***
Right Fk/Merritt Ck	WVOG-10-A	34.54	148	***900***
Smith Creek	WVOG-11	41.75	138	***2000***
UNT/Trace Creek	WVOG-14-D-(0.4)	NC43.46	99	***6400***
Staley Branch	WVOG-23.5	30.07	121	***5000***

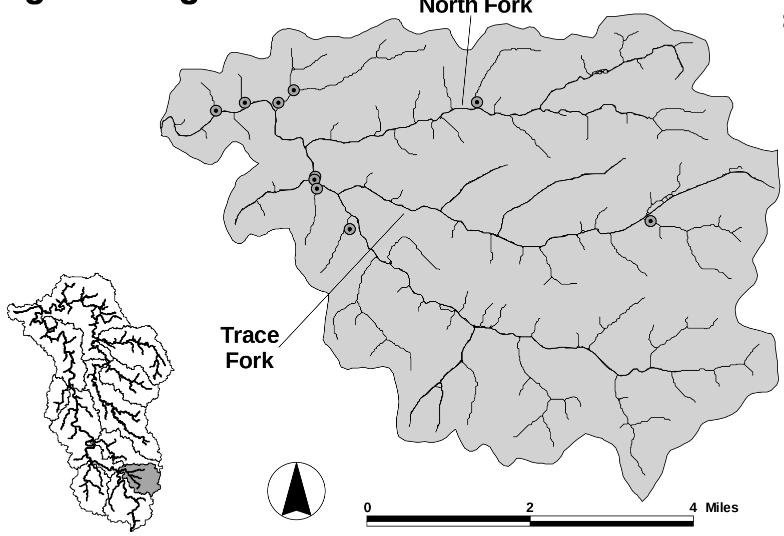
samples collected from this watershed violated the water quality standard. Only 1 assessment form gave clues to potential sources of bacteria.

These data do not include information on the *Guyandotte River* mainstem. Therefore, it is difficult to assess the river's actual status in relation to its status on the DNR high quality streams list.

Big Creek Sites

The Cumberland Mountains sub-ecoregion contains the entire Big Creek sub-watershed. For pertinent notes on this sub-ecoregion, see the section titled "The Lower Guyandotte River Watershed".

Fig. 21. Big Creek



Within the Big Creek sub-watershed, 8 sites were sampled for benthos. Of the 8 sites, only 2 produced samples with WVSCI scores above 68.00. *Dog Fork* and *Chapman Branch* were considered unimpaired.

Two sites, *North Branch of Ed Stone Branch* and *Big Creek*, scored in the WVSCI "gray zone." The remaining 4 sites produced samples that fell within the "impaired" range. An *unnamed tributary of Big Creek* and *Perrys Branch* were severely impaired by mine drainage. Both had pH values that violated the water quality standard, both had aluminum standard violations and both produced net acidities. Notes on the watershed assessment form indicated that both of these streams were probably impacted by mine drainage.

The other 2 sites impaired benthically produced samples with aluminum standard violations, but no other clearly mining-related water quality problems. The WVSCI scores of the *Ed Stone Branch* and *Vickers Branch* sites were 47.50 and 49.35, respectively. Local residents advised the sampling team that the old Banco mine was the cause of problems on Ed Stone Branch. According to notes penned by the sampling team, only the lower 0.1 mile

Table 13. Big Creek

Stream Name	ANCode	WVSCI	RBP	Fecal
Thomas Hollow	WVOG-49-0.3A			4
Big Creek	WVOG-49-(3.3)	63.36	129	***860***
Ed Stone Branch	WVOG-49-A	47.50	115	***420***
North Br/Ed Stone Br	WVOG-49-A-1	62.17	122	***3000***
Chapman Branch	WVOG-49-B-1	78.89	140	***3200***
Vickers Branch	WVOG-49-C	49.35	121	***800***
UNT/Big Creek	WVOG-49-C.1	15.79	112	16
Dog Fork	WVOG-49-D-2	83.14	151	***900***
Perrys Branch	WVOG-49-E-1	16.17	136	20

of *Vickers Branch* was negatively impacted by mine drainage. The source was a mountainside mine that only discharges in spring to the first south side hollow upstream of the mouth of *Vickers Branch*. A local resident advised, “when old mines dry up in summer, stream becomes normal color - orange color dissipates & fish come up into the stream.”

As stated earlier, the sites on *North Branch of Ed Stone Branch* and *Big Creek* scored in the “gray zone.” At the *North Branch* site, violations of the aluminum and iron standards indicated there was probably a mining source further up. Indeed, the sampling team noted “Old, abandoned mine drains into stream ~ 0.1 mi. u.s. on East side” of *North Branch*. Other sources of pollution at this site include straight pipe residential gray water discharges and yard waste dumping. A note reads, “Significant amount (10 %) of substrate in kicked area was grass.”

The *Big Creek* site’s assessment form gave few clues about the causes of biological impairment, although 80 % of the sampled substrate area consisted of gravel or smaller particle sizes.

Thomas Hollow (OG-49-0.3A) was selected for sampling by the field team because of suspected mine drainage impacts. The sample exhibited a net acidity and the pH was 5.0. It should be considered for addition to the 303(d) list. *Squirrel Hollow* (OG-49-.1A) was sampled because of the same suspicion, but its water quality proved that it was no longer receiving mine drainage from old mines shown on the topographic map. A local resident informed the team that the 4 old mines were sealed 6 years prior and most of the water from the mines was then draining into *Limestone Branch*.

Approximately 66 % of the fecal coliform bacteria samples violated the standard. Only 2 of the 6 sites with violations had clues about the sources of these violations. Only *North Branch of Ed Stone Branch* had a readily discernible source - gray water discharges from residences.

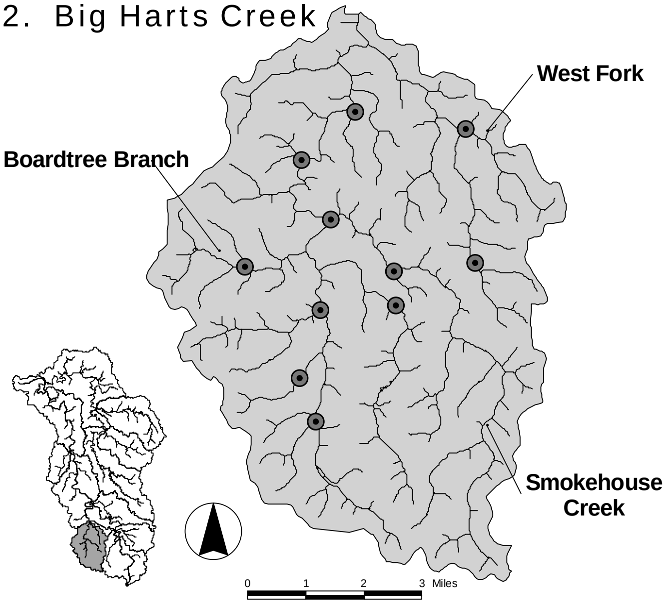
Although *Big Creek* was listed on the DNR high quality streams list, it and several tributaries were quite degraded during this study. As noted previously, the criteria for inclusion of warmwater streams, like *Big Creek*, on this list are that they be 5 miles or longer, and that they support a public fishery. No benthological data are utilized in determining high quality stream status on the DNR list. Further research could determine whether or not activities ongoing during the assessment period were contributing to the benthological community degradation or if the degradation was due primarily to abandoned mines.

Big Harts Creek Sites

Like the Big Creek sub-watershed, the Big Harts Creek sub-watershed lies within the Cumberland Mountains sub-ecoregion. All 11 of the benthologically-sampled sites in the Big Harts Creek sub-watershed produced WVSCI scores above 68.00 and therefore, were considered unimpaired. Other than fecal coliform bacteria, no water quality constituents indicated problems at any of these sites. *Big Harts Creek* mainstem was not sampled.

Sites with WVSCI scores above 90.00 were *Hoover Fork*, *Wolfpen Branch*, and *Henderson*

Fig. 22. Big Harts Creek



Branch. Of these streams, *Wolfpen Branch* appeared to have potential reference sites just a short way upstream of the sample site. The site was located at the dead end of a driveway and just above the yard was a cattle pen, but above the cattle pen appeared to be only forest.

Approximately 81 % of the samples violated the fecal coliform bacteria water quality standard. Only 3 of the 11 sample sites provided clear clues about potential sources of bacteria contamination and only 1 site had at least 1 source positively identified. The Hugh Dingess Elementary School sewage treatment plant was located approximately 50 meters upstream of the upper terminus of the assessed reach. A sludge bank was seen hugging the right bank 25-30 meters below the plant. This problem was reported to the DEP's Environmental Enforcement Program.

Although *Big Harts Creek* mainstem was not sampled benthically, the data generated from its tributaries indicate that it likely was of relatively high quality and, therefore deserving of the DNR's high quality stream status. However, further investigation is warranted before making this determination.

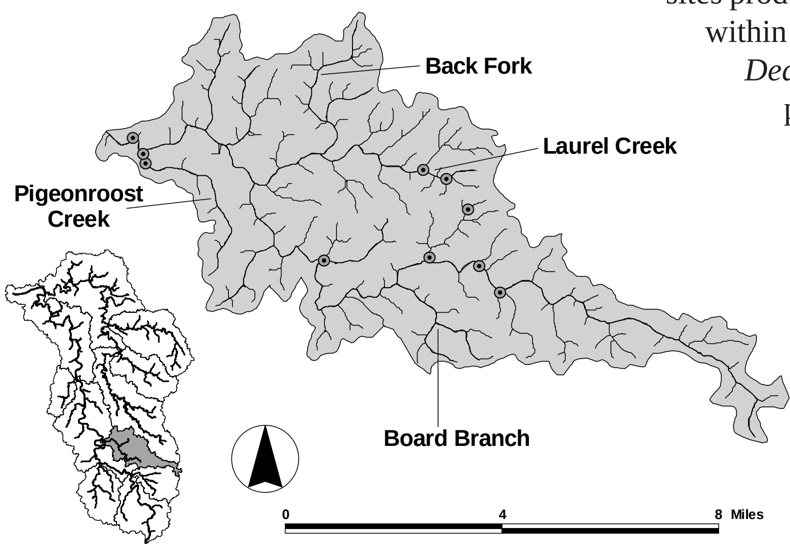
Table 14. Big Harts Creek

Stream Name	ANCode	WVSCI	RBP	Fecal
Workman Fork	WVOG-44-A.5	80.00	138	***12000***
Marsh Fork	WVOG-44-A-2-(2.8)	69.52	120	***5300***
Caney Branch	WVOG-44-C.3	78.82	134	***3300***
Thompson Br	WVOG-44-C.7	88.56	125	***38000***
Smokehouse Fk	WVOG-44-E	68.20	137	***60000***
Wolfpen Branch	WVOG-44-E-0.5	92.18	155	36
Adams Branch	WVOG-44-F-1	85.55	150	82
Buck Fork	WVOG-44-G-(1.9)	78.56	124	***830***
Hoover Fork	WVOG-44-H	94.17	150	***1400***
Henderson Br	WVOG-44-I	90.99	149	***420***
Bulwork Branch	WVOG-44-K	83.58	159	***1200***

Big Ugly Creek Sites

Almost all of the Big Ugly Creek sub-watershed lies within the Cumberland Mountains sub-ecoregion. Of the 9 benthically-sampled sites within the Big Ugly Creek tributary sub-watershed, only *Big Ugly Creek* near its mouth was considered not comparable because it was sampled via the MACS protocol. No water quality parameters indicated pollution problems at this site. Even though it was sampled with the MACS procedure, the site produced a WVSCI score considered in the unimpaired range. Although only 11 total taxa were found in the subsample, more than half of these were EPT taxa.

Fig. 23. Big Ugly Creek



All but 1 of the remaining benthically-sampled sites produced samples with WVSCI scores within the unimpaired range. However, *Little Deadening Creek's* WVSCI score (65.18) placed it at the upper end of the "gray zone." No clear clues about this site's potential impairment were forthcoming from the assessment process.

The 2 *Laurel Creek* sites, OG-38-D-{3.9} and OG-38-D-{4.5}, were selected as reference sites. They both scored over 90.00 on the WVSCI.

Table 15. Big Ugly Creek

Stream Name	ANCode	WVSCI	RBP	Fecal
Big Ugly Creek	WVOG-38-(0.8)	NC66.82	117	110
Big Ugly Creek	WVOG-38-(11.6)	79.59	141	160
Pigeonroost Creek	WVOG-38-A	75.55	151	83
Laurel Creek	WVOG-38-D-(3.9)	96.94	150	44
Laurel Creek	WVOG-38-D-(4.5)	93.39	151	33
Sulphur Creek	WVOG-38-G	82.58	130	50
Lefthand Creek	WVOG-38-K	79.31	133	***800***
Little Deadening Ck	WVOG-38-K.7	65.18	129	***500***
Pigeonroost Fork	WVOG-38-K-5	85.84	137	160

Only 2 of the 9 fecal coliform bacteria samples violated the water quality standard. One of the sites, *Lefthand Creek*, provided clues about potential sources - pipes draining a school building.

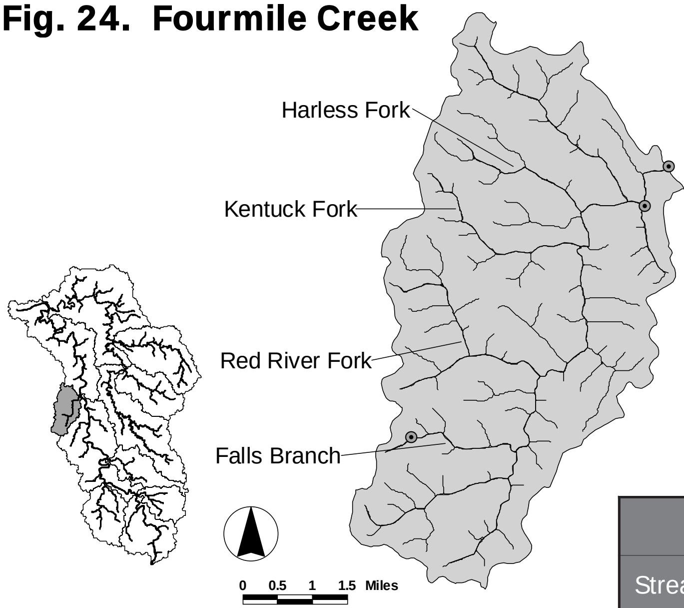
These data indicate that *Big Ugly Creek's* DNR high quality stream status was being adequately protected at the time of this study.

Fourmile Creek Sites

The Monongahela Transition Zone sub-ecoregion contains the entire Fourmile Creek sub-watershed. Only 2 sites were sampled benthically in this tributary sub-watershed. Both of these, *Falls Branch* and *Lowgap Branch*, scored within the unimpaired range of the WVSCI. The *Fourmile Creek mainstem* (OG-27) was not sampled for benthos. Although a site near the mouth was visited and found to be too deep and silted to sample, no attempt was made to find a suitable sampling site further upstream. Very few water quality constituents were sampled for, and those constituents that were analyzed gave no evidence of degradation.

Two of the 3 sites had bacteria samples in violation of the water quality standards and only 1 of these provided clues about a potential source, a pasture upstream of the sampled reach.

Fig. 24. Fourmile Creek



These few data are not enough to make conclusive statements about the validity of *Fourmile Creek's* inclusion on the DNR high quality streams list.

Table 16. Fourmile Creek				
Stream Name	ANCode	WVSCI	RBP	Fecal
Fourmile Ck	WVOG-27		104	70
Lowgap Br	WVOG-27-A	76.04	119	***740***
Falls Branch	WVOG-27-H-(1.8)	80.38	137	***420***

Implications

Table 17 is a list of sites that had water quality or other indicators of coal mining impacts during the assessment. These sites were discussed in detail in the pertinent sub-watershed sections of this report. Highlights of those discussions are presented below.

An abandoned mine land reclamation project may have improved *Buffalo Creek* (OG-61) significantly. The WVSCI score of 80.07 from the sample collected near the stream's mouth indicates improvement. Although the sample was in violation of the aluminum water quality standard, its other water quality constituents were not clearly indicative of mine drainage. The stream was included on the 1998 and 2002 303(d) lists for mine drainage, but it should be studied further to determine if the entire 3.14 miles should be retained on future lists. This study should include sampling for dissolved metals as well as total metals. Perhaps all or part of *Buffalo Creek* can be removed from the list.

Table 17. Sites Impacted By Coal Mining	
Stream Name	ANCode
Limestone Branch*+	WVOG-48
Thomas Hollow*	WVOG-49-0.3A
Ed Stone Branch*+	WVOG-49-A
North Br/Ed Stone Br*+	WVOG-49-A-1
Vickers Branch*	WVOG-49-C
UNT/Big Creek*	WVOG-49-C.1
Perrys Branch*	WVOG-49-E-1
Fowler Branch*	WVOG-51.5
Godby Branch*+	WVOG-53
Chafin Branch	WVOG-53.4

* Included on 2002 303(d) list.
\+ Included on 2002 303(d) list with mine drainage implicated.

The other 4 tributary streams on the 1998 303(d) list (*Limestone Branch, Ed Stone Branch, North Branch of Ed Stone Branch*, and *Godby Branch*) should be retained, but only part of *Limestone Branch* needs to be kept on the list. The water quality of the lowermost 0.4 mile of *Limestone Branch* was found to be negatively impacted by mine drainage, but upstream of this point the stream appeared to be unimpacted. *Ed Stone Branch* and *Godby Branch* also are characterized by having very small surface drainage areas of 2 square miles or less each. Due to low or no surface flows in drought years, very small streams are difficult to sample utilizing the comparable RBP riffle/run methods.

Other mine drainage impacted streams included on the 2002 303(d) list are the *unnamed tributary of Big Creek*, *Perrys Branch*, *Fowler Branch*, and *Vickers Branch*. However, the reason given for inclusion on the list was "unknown". It is likely that only the lowermost 0.1 mile of *Vickers Branch* suffers from mine drainage impacts. These streams also drain very small surface areas of 2 square miles or less each and therefore may be difficult to sample benthically during drought.

Chafin Branch and *Thomas Hollow* should be sampled further to determine if they should be included on future 303(d) lists due to mine drainage.

South Fork of Crawley Creek (OG-51-G.5) was included on the 2002 303(d) list because the WVSCI score was only 31.54. The cause of aquatic life impairment was identified as "unknown". However, the assessment reported herein indicated that the impairment may have been due to habitat and water quality degradation caused by highway construction and surface mining. TMDL sampling in the future should identify the cause(s) if aquatic life is still impaired during that sampling effort.

Figure 25.

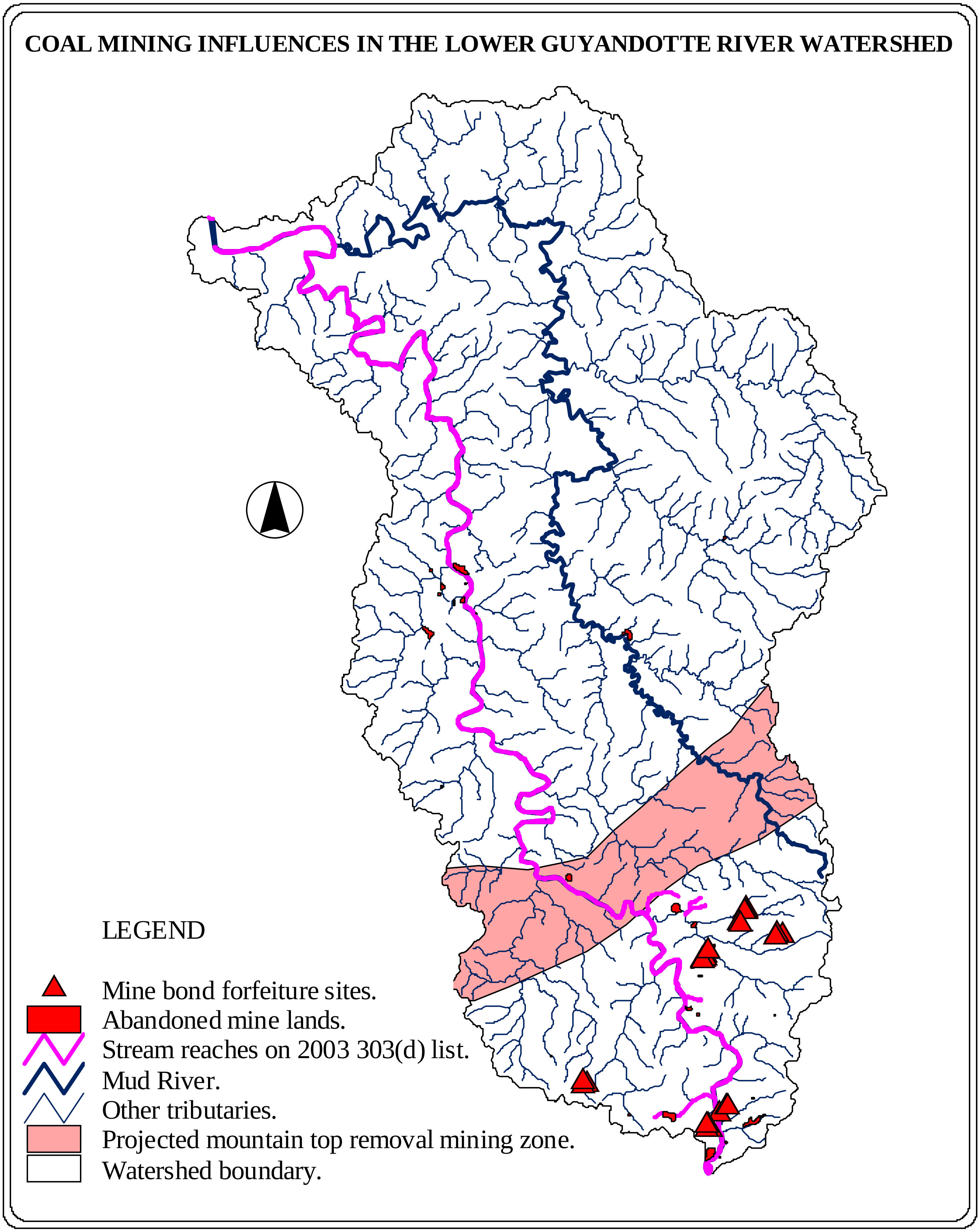
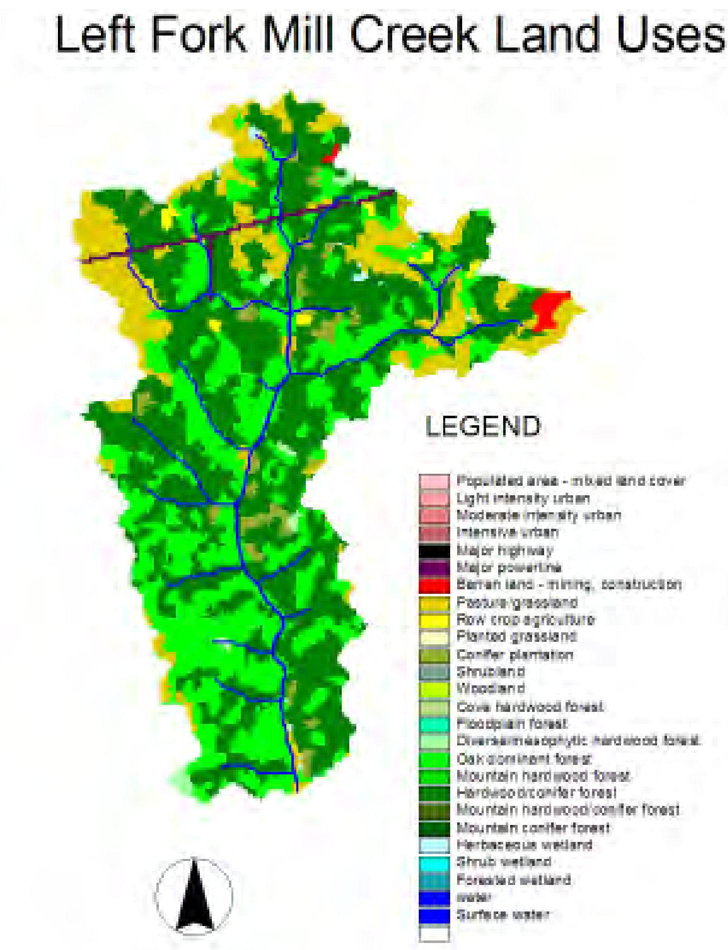
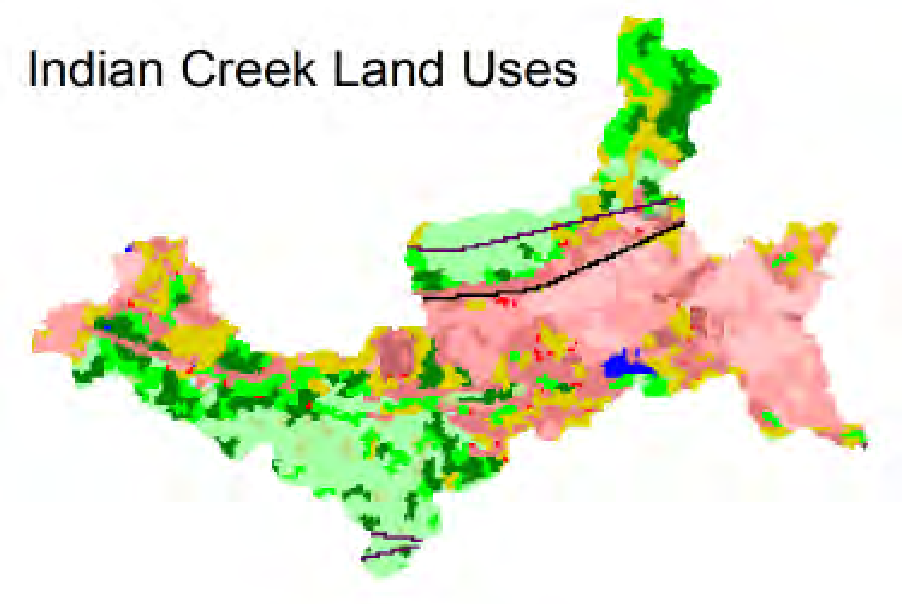

COAL MINING INFLUENCES IN THE LOWER GUYANDOTTE RIVER WATERSHED
LEGEND
Mine bond forfeiture sites.
Abandoned mine lands.
Stream reaches on 2003 303(d) list.
Mud River.
Other tributaries.
Projected mountain top removal mining zone.
Watershed boundary.

Figure 26.





As indicated in the discussion of the Upper Mud River sub-watershed, active mining is suspected as the source of water quality impairments found at *Mud River* (OG-2-{77.2}). The Division of Mining and Reclamation was notified.

The greatest concentration of mining related impairments was in the uppermost portion of the watershed. At least 1 sampling team found mine-drainage impacted streams in the upper watershed that were not included on the team's sampling list. Some of the mining related problems seem to have been seasonal phenomena. A more thorough investigation of the upper watershed is warranted in spring, when groundwater and stream levels are elevated.

Tanyard Branch (OGM-1.5) should be investigated further to determine if more suitable riffle/run habitat exists for sampling purposes. If no suitable habitat is found, then further investigation should target the sources of sediment to the stream. If better habitat exists, it should be sampled to determine whether or not the very low WVSCI score obtained during this study was due primarily to poor habitat quality at the sampled site.

Numerous studies have shown that urban lands produce negative impacts on stream water quality and biota (Schueler 1994, Basnyat et. al. 1999, and Dunne & Leopold 1978). Both *Tanyard Branch* and

Indian Fork (OGM-12) should be investigated to determine if the relatively high percentages of drainage basin surface coverage by urban and other non-forested lands contributed to their low WVSCI and habitat scores. *Indian Fork* was included on the 2002 303(d) list, while *Tanyard Branch* was not. A comparison of the maps shown in Figure 26 readily shows the differences in land use between *Indian Fork* and *Left Fork of Mill Creek*, 2 similar sized sub-watersheds within the Lower Mud River sub-watershed. As stated previously, the *Indian Fork* watershed had 13.60 % urban land coverage and 48.67 % forest land coverage. On the other hand, *Left Fork of Mill Creek* was largely forested with 88.37 % coverage and only 0.02 % urban coverage. The difference in the WVSCI scores is 47.33, with the *Indian Fork* site in the impaired range and the *Left Fork of Mill Creek* site in the unimpaired range. Indeed, *Left Fork* produced the fourth highest score in the Lower Mud River sub-watershed, while *Indian Fork* produced the second lowest score. It is likely that the lower RBP habitat score at the *Indian Creek* site resulted largely from the effects of urbanization above the site.

Three riffle/run-sampled sites that scored in the WVSCI "gray zone" and were probably being benthologically impaired, are; *North Branch of Ed Stone Branch* (OG-49-A-1) due to old mining, *Mud River* (OG-2-{77.2}) due to active mining, and *Lower Creek* (OGM-7-{0.4}) due to habitat degradation. The first 2 streams were added to the 2002 303(d) list and will be sampled further to determine if their aquatic life uses are indeed impaired. *Lower Creek* was not included on the list, because habitat degradation is not a valid reason for including streams on such lists. The other 9 riffle/run-sampled "gray zone" sites (*East Fork of Fourteenmile Creek, Little Deadening Creek, Sand Creek, Big Creek, Hamilton Creek, Upper Heath Creek, Brush Creek, Left Fork of Mud River,* and *Charley Creek*) produced no clear clues about causes of degradation, so further investigation is warranted.

The stream sites listed in Table 18 showed benthological impairments, but the assessments provided few clues about reasons for those impairments. Portions of these streams were included on the proposed 2002 303(d) list of waterbodies with biological impairment. Note that 50 % of these streams drain very small watershed areas. Since 1998 was a year marked by continuing drought, low or zero flow conditions experienced previous to the time of sampling may have contributed to degradation of the benthic communities in some of these streams.

Two stream sites showing biological impairment during this assessment, while providing no clues to causes of impairment, were not included on the proposed 2002 303(d) list. These questionable streams are *Edens*

Table 18. Sites with uncertain reasons for low WVSCI scores.

Stream name	AN Code	Drains <2 mi.^{2}
Mill Creek	WVOG-59	
Lick Br/Fourteenmile Ck	WVOG-34-A	X
Short Bend Fork	WVOG-42-A	X
Aarons Creek	WVOG-35	X
Laurel Fk/Little Harts Ck	WVOG-42-C-(0.2)	X
Smith Creek	WVOG-11	
Right Fk/Merritt Ck	WVOG-10-A	X
South Fk/Crawley Ck	WVOG-51-G.5	X
Merritt Creek	WVOG-10	
Dry Run	WVOG-41	X
Davis Creek	WVOG-3	
Unnamed Trib/Big Ck	WVOG-49-C.1	X
Straight Fork	WVOGM-22-A-(0.7)	X
Sugartree Fork	WVOGM-25-I	
Valley Fork	WVOGM-25-H-1	
Trace Fork	WVOGM-20-(21.2)	
Right Fk/Mill Ck	WVOGM-8-C	X
Coon Creek	WVOGM-20-A	
Little Cabell Creek	WVOGM-	
Mud River	WVOGM-2-(3.6)	
Meadow Branch	WVOGM-25-A	X
Indian Fork	WVOGM-12	

Branch (OG-3-0.5A) and *Staley Branch* (OG-23.5). These streams drain very small watershed areas of 2 square miles or less.

Most of the streams draining very small watershed areas produced WVSCI scores indicating benthological impairment. Some of these streams had obvious causes potentially contributing to the low scores (e.g., habitat degradation in *Tanyard Branch* and mine drainage in *Godby Branch*). However, assessments performed at over half of these sampling sites provided no clues to causes of the impairments. Further investigation of this phenomenon is warranted to determine how drought affects benthological communities in small watershed area streams and how low flow conditions affect sampling proficiency.

Several benthically unimpaired sites (as determined by the WVSCI) had total RBP habitat scores in the suboptimal range. In the Lower Guyandotte River watershed, it appears that suboptimal may be the best that can be expected due to natural and anthropomorphic reasons. The unimpaired sites that scored in the upper half (135-159) of the suboptimal RBP habitat range (110-159) are listed in Table 19.

Three of the sites listed in Table 19 (*Laurel Creek* at mile point 4.5, *Limestone Branch*, and *Lukey Fork*) produced samples that violated the aluminum water quality standard. All of *Limestone Branch* was included on the 2002 303(d) list due to mine drainage, but only the lowest 0.4 mile appeared to be negatively impacted by mining. Portions of these 23 streams may represent the best in this watershed during the sampling period. If future investigation supports this hypothesis, then they are worthy of special consideration by agencies concerned with stream restoration. Further research should include sampling streams for dissolved metals as well as total metals to determine whether the more biologically harmful dissolved forms are present in concentrations considered damaging.

Table 19. Sites with unimpaired benthos and the highest RBP habitat scores.

Stream Name	ANCode	WVSCI	RBP
Falls Branch	WVOG-27-H-(1.8)	80.38	137
Horseshoe Br	WVOG-29-C	93.59	150
Stout Creek	WVOG-30-(1.2)	79.34	143
Plum Branch	WVOG-32-F	87.20	151
Fourteenmile Ck	WVOG-34	72.96	136
Nelson Fork	WVOG-34-E-1	88.88	137
Big Ugly Creek	WVOG-38-(11.6)	79.59	141
Pigeonroost Ck	WVOG-38-A	75.55	151
Laurel Creek	WVOG-38-D-(3.9)	96.94	150
Laurel Creek	WVOG-38-D-(4.5)	93.39	151
Pigeonroost Fk	WVOG-38-K-5	85.84	137
Mudlick Branch	WVOG-42-D	80.84	136
Gartin Fork	WVOG-42-E	80.21	138
Workman Fork	WVOG-44-A.5	80.00	138
Smokehouse Fk	WVOG-44-E	68.20	137
Wolfpen Branch	WVOG-44-E-0.5	92.18	155
Adams Branch	WVOG-44-F-1	85.55	150
Hoover Fork	WVOG-44-H	94.17	150
Henderson Br	WVOG-44-I	90.99	149
Bulwork Branch	WVOG-44-K	83.58	159
Limestone Br	WVOG-48	69.56	144
Chapman Br	WVOG-49-B-1	78.89	140
Dog Fork	WVOG-49-D-2	83.14	151
Lily Branch	WVOG-50	76.37	154
Tony Branch	WVOGM-7-B-1	83.75	135
Mill Creek	WVOGM-8-(4.0)	76.58	149
Lefthand Fork	WVOGM-20-K-1	84.77	145
Trace Creek	WVOGM-25-B	68.96	137
Tincture Fork	WVOGM-25-B-1	78.70	136
Sycamore Fork	WVOGM-39-G	68.18	138
Upton Branch	WVOGM-40.3-(0.0)	84.54	146
Stonecoal Br	WVOGM-43	78.81	137
Lukey Fork	WVOGM-50	96.57	144

The *Guyandotte River* and *Mud River* mainstems were not sampled adequately to determine the condition of their benthological communities. Several riffle/run sites should be sampled in a future study in order to better understand the biological condition of the 2 rivers.

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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 definition below) refers to degree of acidity. Higher acidities 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 it forms a white precipitate called "white boy".

ArcView - a brand of Geographic Information System computer software.

benthic macroinvertebrates - small animals without backbones yet still visible to the naked eye, that live on the bottom (the substrate) of a water body and are large enough to be collected with a 595 micron mesh screen. Examples include insects, snails, and worms.

benthic organisms, or benthos - organisms that live on or near the substrate (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.

cfs - cubic feet per second, a measurement unit of stream discharge.

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.

CR - County Route.

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

designated uses -the uses specified in the state water quality standards for each water body or segment (e.g., fish propagation or 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 per 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 (DO) - the amount of molecular oxygen dissolved in water, normally expressed in mg/L.

DNR - Division of Natural Resources. A unit of the executive branch of West Virginia state government charged with protecting and regulating the use of wildlife, fish and their habitats.

DWWM - Division of Water and Waste Management. 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.

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

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.

EPA - Environmental Protection Agency (see definition above).

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

EQB - Environmental Quality Board (see definition above).

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

fecal 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.

GIS - Geographic Information System. Computer programs that allow for the integration and manipulation of spatially anchored data.

GPS - Geographic Positioning System.

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

impaired -as used in this assessment report, a benthic macroinvertebrate community with metric scores substantially worse than those of an appropriate reference site. The total WVSCI score is equal to or less than 60.6.

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.

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

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

metrics -statistical tools used by ecologists to evaluate biological communities

MRLC - 1993 **M**ulti-**R**esolution **L**and **C**haracteristics coverage in the WCMS.

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 Division of Water Resources.

N/C - not comparable.

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.

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. Relatively quick methods of comparatively assessing biological communities.

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.

SCA -Soil Conservation Agency.

Section - The Watershed Assessment Section of the WV Division of Water Resources.

SPOT image - a geographic information system coverage layer that mimics black and white satellite imagery.

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

STORET -**STO**rage and **RET**rieval of U.S. waterways parametric data -a system maintained by EPA and used by DWWM to store and analyze water quality data.

sub-watershed - a smaller drainage area within a watershed.

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).

unimpaired -as used in this assessment report, a benthic community with metric scores similar to those of an appropriate reference site. Total WVSCI score greater than 68.0.

UNT -unnamed tributary.

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. Environmental Protection Agency, U.S. Geological Survey) and state (e.g., Division of Environmental Protection, Soil Conservation Agency) officers that recommends streams for intense, detailed study.

Watershed Assessment Section -a group of scientists within the DWWM 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 coalition of federal, state, multi-state, and nongovernmental groups cooperating to support local watershed associations.

WCMS - **W**atershed **C**haracterization and **M**odeling **S**ystem, an ArcView-based GIS program developed by the Natural Resource Analysis Center of West Virginia University.

APPENDIX A - DATA TABLES

Table A-1. Sites Sampled.

Stream Name	Stream Code	Date	Latitude			Longitude			County
Guyandotte River	WVO-4-{76.3}	5/20/1998	37	56	52	82	1	11	Logan
Mud River	WVOG-2-{3.6}	5/29/1998	38	25	21.48	82	16	15.56	Cabell
Mud River	WVOG-2-{18.8}	5/14/1998	38	25	52	82	8	27	Cabell
Mud River	WVOG-2-{25.5}	5/14/1998	38	23	16	82	6	46.5	Cabell
Mud River	WVOG-2-{47}	5/28/1998	38	16	30.95	82	5	54.03	Lincoln
Mud River	WVOG-2-{48.7}	5/28/1998	38	15	48.4	82	7	21.1	Lincoln
Mud River	WVOG-2-{77.2}	5/18/1998	38	5	39	81	58	37	Lincoln
Tanyard Branch	WVOGM-1.5	5/18/1998	38	24	56	82	17	26	Cabell
Little Cabell Creek	WVOGM-3-{0.9}	5/26/1998	38	26	35.59	82	14	45.63	Cabell
Big Cabell Creek	WVOGM-4-{0.2}	5/29/1998	38	26	32.93	82	12	58.18	Cabell
Big Cabell Creek	WVOGM-4-{2}	5/26/1998	38	27	32.54	82	13	38.74	Cabell
Lower Creek	WVOGM-7-{0.4}	5/26/1998	38	27	6.69	82	10	8.79	Cabell
Tony Branch	WVOGM-7-B-1	5/3/1998	38	28	46	82	8	53	Cabell
Mill Creek	WVOGM-8-{4}	5/3/1998	38	27	36	82	7	5	Cabell
Left Fork/Mill Creek	WVOGM-8-B	5/3/1998	38	28	34	82	7	3.5	Cabell
Right Fork/Mill Creek	WVOGM-8-C	5/26/1998	38	27	58	82	6	26	Cabell
Indian Fork	WVOGM-12	5/15/1998	38	25	21	82	6	19	Cabell
Brush Creek	WVOGM-13	5/15/1998	38	24	46	82	7	52	Cabell
Charley Creek	WVOGM-14-{7.2}	5/29/1998	38	24	1.12	82	2	15.93	Putnam
Fallen Fork	WVOGM-16-A	5/4/1998	38	23	1.33	82	8	27.1	Cabell
Trace Creek	WVOGM-19	5/4/1998	38	21	35	82	8	2	Cabell
Trace Fork	WVOGM-20-{6.4}	6/9/1998	38	20	10.66	82	2	45.14	Lincoln
Trace Fork	WVOGM-20-{21.2}	5/29/1998	38	18	17	81	54	53.68	Lincoln
Coon Creek	WVOGM-20-A	5/4/1998	38	20	49.29	82	5	25.56	Lincoln
Big Creek	WVOGM-20-D-{4.6}	5/28/1998	38	17	32.8	82	1	35.43	Putnam
Sycamore Creek	WVOGM-20-F	6/9/1998	38	20	13	82	2	26	Putnam
Clymer Creek	WVOGM-20-H	5/27/1998	38	20	1.39	81	59	56.42	Putnam
Kelleys Creek/Trace Fork	WVOGM-20-I-1-{1.5}	5/28/1998	38	22	13.6	81	59	0.9	Putnam
Martin Run	WVOGM-20-L	5/6/1998	38	20	26.42	81	57	2.32	Putnam
Nelson Hollow	WVOGM-20-K-{0.1}	5/4/1998	38	20	30.06	82	0	40.32	Putnam
Lefthand Fork	WVOGM-20-K-1	5/7/1998	38	18	24.81	81	57	47.08	Putnam
Bridge Creek	WVOGM-20-M-{1.8}	5/27/1998	38	21	18.01	81	55	59.07	Putnam
Flint Hollow	WVOGM-20-M-1	5/6/1998	38	21	18	81	55	56	Putnam
Donley Fork/Hayslett Fork	WVOGM-20-R-2	5/27/1998	38	16	44.14	81	53	21.35	Lincoln
Joes Creek	WVOGM-20-T-{3.5}	5/28/1998	38	15	16.96	81	55	21.35	Lincoln
Rockhouse Branch	WVOGM-20-V	5/7/1998	38	16	53.18	81	55	49.04	Lincoln
Straight Fork	WVOGM-22-A-{0.7}	5/4/1998	38	18	51.78	82	7	37.45	Lincoln
Meadow Branch	WVOGM-25-A	5/6/1998	38	16	42.69	82	4	12.52	Lincoln
Trace Creek	WVOGM-25-B-{2.3}	5/28/1998	38	14	37.52	82	5	14.99	Lincoln
Tincture Fork	WVOGM-25-B-1	5/6/1998	38	15	26.96	82	5	10	Lincoln
Valley Fork	WVOGM-25-H-1	5/26/1998	38	14	22.49	81	59	20.4	Lincoln
Sugartree Fork	WVOGM-25-I	5/26/1998	38	13	41	82	0	0	Lincoln
Sugartree Fork	WVOGM-25-I-{3}	5/26/1998	38	12	30.39	81	59	12.38	Lincoln
Sand Fork	WVOGM-25-I-4	5/26/1998	38	12	24.8	81	59	10.66	Lincoln
Sandlick Branch	WVOGM-31	5/21/1998	38	13	14.68	82	6	48.06	Lincoln
Dry Fork	WVOGM-33-B	5/21/1998	38	12	59.72	82	4	43.83	Lincoln
Big Branch		5/28/1998	38	12	37.77	82	4	32.19	Lincoln
Big Creek	WVOGM-35-{1.8}	5/21/1998	38	10	4.75	82	5	3.1	Lincoln

Table A-1. Sites Sampled (continued).

Stream Name	Stream Code	Date	Latitude			Longitude			County
Big Creek	WVOGM-35-{4.1}	5/19/1998	38	8	35.79	82	5	2.54	Lincoln
Laurel Fork	WVOGM-35-E	5/28/1998	38	8	17.95	82	5	2.44	Lincoln
Left Fork/Mud River	WVOGM-39	5/27/1998	38	9	34.08	82	1	5.96	Lincoln
Left Fork/Mud River	WVOGM-39-{10.2}	5/27/1998	38	8	11.43	81	59	9.43	Lincoln
Sycamore Fork	WVOGM-39-G	5/27/1998	38	8	50.19	81	59	36.78	Lincoln
Upton Branch	WVOGM-40.3-{0}	5/19/1998	38	8	1.98	82	2	57.77	Lincoln
Upton Branch	WVOGM-40.3-{2.2}	5/19/1998	38	6	37.92	82	3	16.98	Lincoln
Stonecoal Branch	WVOGM-43	5/18/1998	38	6	15.7	81	59	55.34	Lincoln
Berry Branch	WVOGM-44-{0.2}	5/19/1998	38	6	4.75	81	59	13.99	Lincoln
Lukey Fork	WVOGM-50	5/18/1998	38	3	4.39	81	57	30.91	Boone
Davis Creek	WVOG-3	5/18/1998	38	23	46.5	82	19	21	Cabell
Edens Branch	WVOG-3-0.5A	5/18/1998	38	23	38.5	82	19	40	Cabell
Mill Creek	WVOG-6-{0.1}	5/18/1998	38	22	59.71	82	17	0.37	Cabell
Upper Heath Creek	WVOG-9-A-{0.3}	5/21/1998	38	20	42.74	82	17	29.86	Cabell
Merritt Creek	WVOG-10	5/21/1998	38	20	26	82	15	54	Cabell
Right Fork/Merritt Creek	WVOG-10-A	5/21/1998	38	20	6	82	15	54	Cabell
Smith Creek	WVOG-11	5/12/1998	38	20	4	82	14	30	Cabell
UNT/Trace Creek	WVOG-14-D-{0.4}	5/12/1998	38	20	40	82	10	53	Cabell
Staley Branch	WVOG-23.5	5/22/1998	38	14	49	82	11	24	Lincoln
Fourmile Creek	WVOG-27	5/22/1998	38	13	12	82	12	10	Lincoln
Lowgap Branch	WVOG-27-A	5/22/1998	38	12	43	82	12	32.5	Lincoln
Falls Branch	WVOG-27-H-{1.8}	5/27/1998	38	9	47.66	82	16	10.9	Lincoln
Horseshoe Branch	WVOG-29-C	5/13/1998	38	11	15	82	9	8	Lincoln
Stout Creek	WVOG-30-{1.2}	5/13/1998	38	10	45.03	82	11	49.7	Lincoln
Plum Branch	WVOG-32-F	5/27/1998	38	7	22.73	82	13	15.89	Lincoln
Fourteenmile Creek	WVOG-34	5/6/1998	38	6	46	82	10	54	Lincoln
Lick Branch	WVOG-34-A	5/6/1998	38	6	45.1	82	11	9.72	Lincoln
East Fork/Fourteenmile Creek	WVOG-34-B	5/6/1998	38	6	11	82	10	39.5	Lincoln
Nelson Fork	WVOG-34-E-1	5/6/1998	38	4	58.97	82	12	28.97	Lincoln
Nelson Fork	WVOG-34-E-1-{0.8}	5/11/1998	38	4	45.5	82	12	56	Lincoln
Aarons Creek	WVOG-35	5/11/1998	38	6	37	82	9	37	Lincoln
Hamilton Creek	WVOG-36	5/11/1998	38	5	42	82	8	4	Lincoln
Little Ugly Creek	WVOG-37	5/11/1998	38	5	14	82	7	17	Lincoln
Big Ugly Creek	WVOG-38-{0.8}	5/19/1998	38	4	51.73	82	7	6.9	Lincoln
Big Ugly Creek	WVOG-38-{11.6}	5/19/1998	38	2	51.77	82	0	1.71	Lincoln
Pigeonroost Creek	WVOG-38-A	5/19/1998	38	4	36	82	6	54	Lincoln
Laurel Creek	WVOG-38-D-{3.9}	5/18/1998	38	4	24	82	1	12	Lincoln
Laurel Creek	WVOG-38-D-{4.5}	5/18/1998	38	4	15.76	82	0	43.24	Lincoln
Sulphur Creek	WVOG-38-G	5/19/1998	38	2	56	82	3	12	Lincoln
Lefthand Creek	WVOG-38-K	5/19/1998	38	3	0	82	1	3	Lincoln
Little Deadening Creek	WVOG-38-K.7	5/19/1998	38	2	27	81	59	36	Lincoln
Pigeonroost Fork	WVOG-38-K-5	5/19/1998	38	3	46.5	82	0	17	Lincoln
Sand Creek	WVOG-40	5/11/1998	38	3	47.79	82	7	25.08	Lincoln
Dry Branch	WVOG-41	5/11/1998	38	3	15.8	82	8	51.03	Lincoln
Short Bend	WVOG-42-A	5/11/1998	38	1	58	82	9	34	Lincoln
Laurel Fork	WVOG-42-C-{0.2}	5/11/1998	38	1	50.17	82	10	19.05	Lincoln
Mudlick Branch	WVOG-42-D	5/11/1998	38	2	0.9	82	11	5.3	Lincoln
Gartin Fork	WVOG-42-E	5/11/1998	38	1	53	82	11	6	Lincoln

Table A-1. Sites Sampled (continued).

Stream Name	Stream Code	Date	Latitude			Longitude			County
Workman Fork	WVOG-44-A.5	5/20/1998	38	0	1.11	82	5	49.82	Logan
Marsh Fork	WVOG-44-A-2-{2.8}	5/20/1998	37	58	1.2	82	5	37.17	Logan
Caney Branch	WVOG-44-C.3	5/14/1998	38	0	15	82	7	55	Lincoln
Thompson Branch	WVOG-44-C.7	5/14/1998	37	59	32	82	8	55	Lincoln
Smokehouse Fork	WVOG-44-E	5/14/1998	37	58	39	82	8	22	Logan
Wolfpen Branch	WVOG-44-E-0.5	5/4/1998	37	57	53	82	7	9	Logan
Adams Branch	WVOG-44-F-1	5/4/1998	37	57	55.5	82	9	58.25	Logan
Buck Fork	WVOG-44-G-{1.9}	5/14/1998	37	57	22.54	82	7	6.45	Logan
Hoover Fork	WVOG-44-H	5/4/1998	37	57	17.4	82	8	31.62	Logan
Henderson Branch	WVOG-44-I	5/4/1998	37	56	16	82	8	54	Logan
Bulwark Branch	WVOG-44-K	5/4/1998	37	55	37.23	82	8	35.86	Logan
Limestone Branch	WVOG-48	5/6/1998	38	0	36.89	82	2	40.27	Logan
Squirrel Branch	WVOG-49-0.1A	5/6/1998	38	0	27	82	1	44	Logan
Thomas Hollow	WVOG-49-0.3A	5/6/1998	38	0	32.04	82	1	21.02	Logan
Big Creek	WVOG-49-{3.3}	5/20/1998	37	59	45.34	82	0	23.54	Logan
Ed Stone Branch	WVOG-49-A	5/5/1998	38	0	32.33	82	0	53.66	Logan
North Branch/Ed Stone Branch	WVOG-49-A-1	5/5/1998	38	0	40.76	82	0	41.59	Logan
Chapman Branch	WVOG-49-B-1	5/5/1998	38	0	34.5	81	58	13	Logan
Vickers Branch	WVOG-49-C	5/5/1998	37	59	43.58	82	0	23.77	Logan
UNT/Big Creek	WVOG-49-C.1	5/6/1998	37	59	38	82	0	22	Logan
Dog Fork	WVOG-49-D-2	5/5/1998	37	59	19	81	55	52	Boone
Perrys Branch	WVOG-49-E-1	5/6/1998	37	59	12	81	59	55	Logan
Lily Branch	WVOG-50	5/6/1998	37	59	44	82	2	42	Logan
Fowler Branch	WVOG-51.5	5/13/1998	37	58	7.76	82	1	9.42	Logan
Canoe Fork	WVOG-51-B	5/6/1998	37	57	52.97	82	2	49.16	Logan
South Fork/Crawley Creek	WVOG-51-G.5	5/13/1998	37	53	55.5	82	3	6	Logan
Godby Branch	WVOG-53	5/13/1998	37	57	23	82	0	51	Logan
Chafin Branch	WVOG-53.4	5/13/1998	37	57	0	82	0	51	Logan
Toney Branch	WVOG-53.5	5/13/1998	37	56	54	82	0	54	Logan
Mill Creek	WVOG-59	5/13/1998	37	55	48	81	58	49	Logan
Big Branch	WVOG-60	5/13/1998	37	54	24.5	81	58	36	Logan
Buffalo Creek	WVOG-61	5/13/1998	37	53	49.61	81	59	57.21	Logan

Table A-2. Physical characteristics of 100 meter stream reach.

Stream Code	Stream Width (m)	Riffle Depth (m)	Run Depth (m)	Pool Depth (m)
WVO-4-{76.3}	30	0.8	1.5	2
WVOG-2-{3.6}	20	0.2	0.5	
WVOG-2-{18.8}	25			
WVOG-2-{25.5}	30			
WVOG-2-{47}	11.3		1	1
WVOG-2-{48.7}	12.3			1
WVOG-2-{77.2}	11.3	0.18	0.4	1
WVOGM-1.5	1	0.01	0.03	0.25
WVOGM-3-{0.9}	4.9	0.1	0.25	0.4
WVOGM-4-{0.2}	9.7			1
WVOGM-4-{2}	3.6	0.1	0.2	0.4
WVOGM-7-{0.4}	5.1	0.1	0.2	0.35
WVOGM-7-B-1	1.7	0.05	0.1	0.6
WVOGM-8-{4}	9.1	0.1	0.2	1
WVOGM-8-B	5.5	0.05	0.1	0.5
WVOGM-8-C	4.1	0.05	0.15	0.25
WVOGM-12	3.7	0.08	0.5	1
WVOGM-13	1.1	0.01	0.06	0.08
WVOGM-14-{7.2}	2.3	0.1	0.5	1
WVOGM-16-A	1.5	0.1	0.2	
WVOGM-19	3.8	0.1	0.35	0.4
WVOGM-20-{6.4}	12.3	0.1	0.3	0.6
WVOGM-20-{21.2}	4	0.15	0.5	1
WVOGM-20-A	3.6	0.18	0.48	
WVOGM-20-D-{4.6}	2.2	0.05	0.1	0.5
WVOGM-20-H	3	0.1	0.6	1
WVOGM-20-I-1-{1.5}	0.5	0.02	0.01	0.03
WVOGM-20-L	1.3	0.08	0.2	0.32
WVOGM-20-K-{0.1}	1.4	0.15	0.52	0.6
WVOGM-20-K-1	1.8	0.1	0.2	0.5
WVOGM-20-M-{1.8}	4.3	0.03	0.1	0.25
WVOGM-20-M-1	1.2	0.05	0.15	
WVOGM-20-R-2	1	0.05	0.1	0.4
WVOGM-20-T-{3.5}	6	0.04	0.2	0.5
WVOGM-20-V	2	0.08	0.15	0.4
WVOGM-22-A-{0.7}	1.8	0.1	0.14	0.4
WVOGM-25-A	2.4	0.1	0.15	0.2
WVOGM-25-B-{2.3}	2.3	0.05	0.1	0.4
WVOGM-25-B-1	1.3	0.05	0.2	0.4
WVOGM-25-H-1	2.7	0.09	0.25	0.3
WVOGM-25-I	5.9	0.15	0.3	0.5
WVOGM-25-I-{3}	4	0.15	0.3	0.4
WVOGM-25-I-4	1.9	0.08	0.15	0.3
WVOGM-31	1.5	0.04	0.13	0.3
WVOGM-33-B	2.1	0.05	0.08	0.1
WVOGM-33-C	2.1	0.03	0.06	0.2
WVOGM-35-{1.8}	3.6	0.15	0.1	0.39
WVOGM-35-{4.1}	1.6	0.05	0.1	0.4

Table A-2. Physical characteristics of 100 M stream reach (cont.).

Stream Code	Stream Width (m)	Riffle Depth (m)	Run Depth (m)	Pool Depth (m)
WVOGM-35-E	2.4	0.05	0.1	0.15
WVOGM-39	4.5	0.08	0.4	0.7
WVOGM-39-{10.2}	2.6	0.08	0.15	0.5
WVOGM-39-G	4	0.05	0.15	0.3
WVOGM-40.3-{0}	1.5	0.1	0.1	0.6
WVOGM-40.3-{2.2}	1.4	0.05	0.1	0.18
WVOGM-43	1.4	0.05	0.1	0.42
WVOGM-44-{0.2}	1.4	0.05	0.07	0.25
WVOGM-50	1.1	0.05	0.1	0.29
WVOG-3	3.2	0.01	0.08	0.6
WVOG-3-0.5A	1.5	0.03	0.05	0.2
WVOG-6-{0.1}	1.9	0.1	0.6	
WVOG-9-A-{0.3}	3	0.05	0.1	
WVOG-10	4.5	0.05	0.1	1
WVOG-10-A	1.7	0.05	0.1	0.6
WVOG-11	4.1	0.05	0.1	0.6
WVOG-14-D-{0.4}	1.6		0.05	0.5
WVOG-23.5	0.9	0.03	0.05	0.3
WVOG-27	10			1
WVOG-27-A	1.8	0.03	0.12	0.5
WVOG-27-H-{1.8}	0.9	0.05		0.1
WVOG-29-C	1.8	0.05	0.1	0.25
WVOG-30-{1.2}	1.7	0.05	0.1	0.2
WVOG-32-F	3.5	0.1	0.1	0.13
WVOG-34	10	0.1	0.7	0.7
WVOG-34-A	3.6	0.05	0.1	
WVOG-34-B	3.5	0.1	0.2	0.6
WVOG-34-E-1	1.7	0.08	0.1	
WVOG-34-E-1-{0.8}	2.3	0.05	0.1	0.5
WVOG-35	2.6	0.05	0.2	0.3
WVOG-36	3.9	0.1	0.2	0.5
WVOG-37	2.6	0.1	0.15	
WVOG-38-{0.8}	11.4	0.15	0.25	0.4
WVOG-38-{11.6}	5.5	0.1	0.2	0.3
WVOG-38-A	2.2	0.1	0.15	0.3
WVOG-38-D-{3.9}	2.1	0.12	0.2	0.28
WVOG-38-D-{4.5}	1.6	0.05	0.1	0.35
WVOG-38-G	3.6	0.1	0.2	0.3
WVOG-38-K	3.1	0.1	0.15	0.2
WVOG-38-K.7	0.6	0.05		0.2
WVOG-38-K-5	0.5	0.05		0.3
WVOG-40	4.8	0.15	0.2	
WVOG-41	2.3	0.15	0.2	
WVOG-42-A	1.7	0.1	0.2	0.3
WVOG-42-C-{0.2}	1.9	0.1	0.15	0.35
WVOG-42-D	1.7	0.1	0.2	0.2
WVOG-42-E	2.5	0.1	0.15	0.3
WVOG-44-A.5	2	0.05	0.1	

Table A-2. Physical characteristics of 100 M stream reach (cont.).

Stream Code	Stream Width (m)	Riffle Depth (m)	Run Depth (m)	Pool Depth (m)
WVOG-44-A-2-{2.8}	1.7	0.05	0.1	0.2
WVOG-44-C.3	1.7	0.05	0.15	0.2
WVOG-44-C.7	1.3	0.05	0.15	0.2
WVOG-44-E	5.7	0.1	0.25	0.4
WVOG-44-E-0.5	2.7	0.2		
WVOG-44-F-1	1.5	0.15	0.2	
WVOG-44-G-{1.9}	2.7	0.1	0.15	0.2
WVOG-44-H	2.7	0.3	0.4	0.5
WVOG-44-I	2.7	0.25	0.3	
WVOG-44-K	3	0.25	0.4	0.6
WVOG-48	2.5	0.2	0.4	
WVOG-49-{3.3}	7.3	0.1	0.2	
WVOG-49-A	3.5	0.2	0.3	
WVOG-49-A-1	1.5	0.2	0.2	
WVOG-49-B-1	2.6	0.2	0.2	
WVOG-49-C	1.7	0.2	0.2	
WVOG-49-C.1	1	0.15	0.2	
WVOG-49-D-2	3.1	0.15	0.3	0.7
WVOG-49-E-1	1.7	0.1	0.2	
WVOG-50	3.3	0.1	0.2	0.3
WVOG-51.5	1.2	0.07	0.1	
WVOG-51-B	1.4	0.1	0.25	
WVOG-51-G.5	2.4	0.1	0.25	
WVOG-53	2.5	0.1	0.2	
WVOG-59	7.5	0.1	0.2	0.2
WVOG-60	2.2		0.1	0.15
WVOG-61	5.9	0.15	0.2	0.25

Table A-3. Observed Sediment Characteristics.

Stream Code	Sediment odors	Sediment oils	Sediment deposits
WVO-4-{76.3}	normal	absent	sand,silt
WVOG-2-{3.6}	normal	absent	sand,silt
WVOG-2-{18.8}	normal	absent	
WVOG-2-{25.5}	normal	absent	
WVOG-2-{47}	anaerobic	absent	sand,silt
WVOG-2-{48.7}	normal		sand,silt
WVOG-2-{77.2}	anaerobic	absent	sand,silt
WVOGM-1.5	none	absent	sand,silt
WVOGM-3-{0.9}	normal	absent	sand,silt
WVOGM-4-{0.2}	normal	absent	sand,silt,clay
WVOGM-4-{2}	normal	absent	sand,silt
WVOGM-7-{0.4}	normal	absent	sand,silt
WVOGM-7-B-1	normal	absent	sand,silt
WVOGM-8-{4}	normal	absent	sand,silt,clay
WVOGM-8-B	normal	absent	sand,silt,clay
WVOGM-8-C	normal	slight	sand,silt,metal hydroxides
WVOGM-12	sewage	absent	silt
WVOGM-13	none	absent	sand
WVOGM-14-{7.2}	normal	absent	sand,silt
WVOGM-16-A	normal	absent	sand,silt
WVOGM-19	normal	absent	sand,silt
WVOGM-20-{6.4}	normal	absent	sand,silt
WVOGM-20-{21.2}	normal	absent	sand,silt,clay
WVOGM-20-A	normal	absent	sand,silt
WVOGM-20-D-{4.6	normal	absent	sand,silt
WVOGM-20-H	normal	absent	sand,silt,clay
WVOGM-20-I-1-{1.	normal	absent	sand,silt
WVOGM-20-L	none	absent	sand,silt,clay
WVOGM-20-K-{0.1	normal	absent	sand,silt
WVOGM-20-K-1	none	absent	sand
WVOGM-20-M-{1.8	normal,anaerobic	absent	sand,silt
WVOGM-20-M-1	none	absent	sand,silt
WVOGM-20-R-2	normal	absent	sand,silt
WVOGM-20-T-{3.5	normal	absent	sand,silt
WVOGM-20-V	normal	absent	sand,silt
WVOGM-22-A-{0.7	normal	absent	sand,silt
WVOGM-25-A	normal	absent	sand,silt
WVOGM-25-B-{2.3	normal	absent	sand,silt
WVOGM-25-B-1	normal	absent	sand,silt
WVOGM-25-H-1	normal	absent	sand,silt
WVOGM-25-I	normal	absent	sand,silt
WVOGM-25-I-{3}	normal	absent	sand,silt
WVOGM-25-I-4	normal	absent	sand,silt
WVOGM-31	normal	absent	sand,silt
WVOGM-33-B	normal	absent	sand,silt
WVOGM-33-C	normal	absent	sand,silt
WVOGM-35-{1.8}	normal	absent	sand,silt
WVOGM-35-{4.1}	normal	absent	sand,silt

Table A-3. Observed Sediment Characteristics (continued).

Stream Code	Sediment odors	Sediment oils	Sediment deposits
WVOGM-35-E	normal	absent	sand,silt
WVOGM-39	normal	absent	sand,silt
WVOGM-39-{10.2}	normal	absent	sand,silt
WVOGM-39-G	normal	absent	sand,silt
WVOGM-40.3-{0}	normal	absent	sand
WVOGM-40.3-{2.2}	normal	moderate	sand,silt
WVOGM-43	normal	absent	sand,silt
WVOGM-44-{0.2}	normal	absent	sand,silt
WVOGM-50	normal	absent	sand,silt
WVOG-3	none	absent	silt
WVOG-3-0.5A	normal	absent	sand,silt
WVOG-6-{0.1}	sewage	absent	sand,silt
WVOG-9-A-{0.3}	normal	absent	sand,silt
WVOG-10	normal	absent	sand,silt
WVOG-10-A	normal	absent	sand,silt
WVOG-11	normal	absent	sand,silt,metal hydroxides
WVOG-14-D-{0.4}	normal	absent	sand,silt
WVOG-23.5	anaerobic	absent	sand,silt
WVOG-27	anaerobic	absent	silt
WVOG-27-A	none	absent	silt
WVOG-27-H-{1.8}	normal	absent	sand,silt
WVOG-29-C	normal	absent	sand,silt
WVOG-30-{1.2}	normal	absent	sand,silt
WVOG-32-F	normal	absent	sand,silt
WVOG-34	normal	absent	sand,silt
WVOG-34-A	normal	absent	sand,silt
WVOG-34-B	normal	absent	sand,silt
WVOG-34-E-1	normal	absent	sand,silt
WVOG-34-E-1-{0.8	normal	absent	sand,silt
WVOG-35	normal	absent	sand,silt
WVOG-36	normal	absent	sand,silt
WVOG-37	normal	absent	sand,silt
WVOG-38-{0.8}	normal	absent	sand,silt,coal pieces
WVOG-38-{11.6}	normal	absent	sand,silt
WVOG-38-A	normal	absent	sand,silt
WVOG-38-D-{3.9}	normal	absent	sand
WVOG-38-D-{4.5}	normal	absent	sand,silt
WVOG-38-G	normal	absent	sand,silt
WVOG-38-K	normal	absent	sand,silt
WVOG-38-K.7	normal	absent	sand,silt
WVOG-38-K-5	normal	absent	sand,silt
WVOG-40	normal,anaerobic	absent	sand,silt
WVOG-41	normal	absent	sand,silt,metal hydroxides
WVOG-42-A	normal	absent	sawdust,sand,silt
WVOG-42-C-{0.2}	normal	absent	sand,silt
WVOG-42-D	normal	absent	sand,silt
WVOG-42-E	normal	absent	sand,silt
WVOG-44-A.5	normal	absent	sand,silt

Table A-3. Observed Sediment Characteristics (continued).

Stream Code	Sediment odors	Sediment oils	Sediment deposits
WVOG-44-A-2-{2.8}	normal	absent	sand,silt
WVOG-44-C.3	normal	absent	sand,silt
WVOG-44-C.7	normal	absent	sand,silt
WVOG-44-E	sewage	absent	sand,silt,metal hydroxides
WVOG-44-E-0.5	normal	absent	sand
WVOG-44-F-1	normal	slight	sand,silt
WVOG-44-G-{1.9}	normal	slight	sand,silt,metal hydroxides
WVOG-44-H	normal	absent	sand
WVOG-44-I	normal	absent	sand
WVOG-44-K	normal	absent	sand
WVOG-48	petroleum	moderate	sand,metal hydroxides
WVOG-49-{3.3}	normal	absent	sand,silt
WVOG-49-A	normal	absent	sand
WVOG-49-A-1	normal	absent	sand,silt,grass clippings
WVOG-49-B-1	none	absent	sand,silt
WVOG-49-C	normal	absent	sand,metal hydroxides
WVOG-49-C.1	normal	slight	sand,silt
WVOG-49-D-2	normal	absent	sand,silt
WVOG-49-E-1	normal	absent	sand,metal hydroxides
WVOG-50	normal	absent	sand,silt
WVOG-51.5	normal	absent	sand,silt
WVOG-51-B	normal	absent	sand,silt
WVOG-51-G.5	normal	absent	sand,silt
WVOG-53	metallic	absent	sand,silt,metal hydroxides
WVOG-59	b.g. alage	absent	sand,silt
WVOG-60	normal	absent	sand,silt
WVOG-61	metallic	absent	sand,silt,metal hydroxides

Table A-4. Substrate composition in benthic collection area.

Stream Code	% bedrock	% boulder	% cobble	% gravel	% sand	% silt	% clay
WVOG-2-{3.6}	0	0	20	65	15	0	0
WVOG-2-{77.2}	10	5	50	15	15	5	0
WVOGM-1.5	0	0	1	10	40	49	0
WVOGM-3-{0.9}	0	0	60	30	9	1	0
WVOGM-4-{0.2}	0	0	0	0	75	15	10
WVOGM-4-{2}	0	0	0	10	80	10	0
WVOGM-7-{0.4}	0	0	30	50	16	4	0
WVOGM-7-B-1	0	0	20	50	30	0	0
WVOGM-8-{4}	0	0	0	40	50	5	5
WVOGM-8-B	0	0	5	40	45	5	5
WVOGM-8-C	0	0	40	40	15	5	0
WVOGM-12	0	0	20	35	35	10	0
WVOGM-13	0	0	30	40	30	0	0
WVOGM-14-{7.2}	0	0	10	30	30	20	10
WVOGM-16-A	0	2	60	20	15	3	0
WVOGM-19	0	0	20	30	40	10	0
WVOGM-20-{6.4}	0	0	20	65	10	5	0
WVOGM-20-{21.2}	0	0	20	35	30	10	5
WVOGM-20-A	0	5	5	30	40	20	0
WVOGM-20-D-{4.6}	0	0	30	40	20	10	0
WVOGM-20-I-1-{1.5}	0	0	0	45	35	15	5
WVOGM-20-L	0	10	30	30	30	0	0
WVOGM-20-K-{0.1}	0	10	50	25	10	5	0
WVOGM-20-K-1	0	10	50	25	15	0	0
WVOGM-20-M-{1.8}	0	0	15	25	40	10	10
WVOGM-20-M-1	0	15	40	20	25	0	0
WVOGM-20-R-2	0	0	25	40	20	10	5
WVOGM-20-T-{3.5}	0	0	30	40	20	10	0
WVOGM-20-V	0	10	50	25	10	5	0
WVOGM-22-A-{0.7}	0	2	50	15	30	3	0
WVOGM-25-A	0	0	10	35	50	5	0
WVOGM-25-B-{2.3}	0	0	40	50	10	0	0
WVOGM-25-B-1	0	0	40	30	25	5	0
WVOGM-25-H-1	0	0	15	35	50	0	0
WVOGM-25-I	0	0	0	45	50	5	0
WVOGM-25-I-{3}	0	5	25	30	40	0	0
WVOGM-25-I-4	0	0	5	45	50	0	0
WVOGM-31	0	0	30	55	2	13	0
WVOGM-33-B	5	5	50	30	5	5	0
WVOGM-33-C	0	0	20	65	15	0	0
WVOGM-35-{1.8}	0	0	60	20	15	5	0
WVOGM-35-{4.1}	0	0	40	30	30	0	0
WVOGM-35-E	0	0	30	50	20	0	0
WVOGM-39	0	5	30	60	5	0	0
WVOGM-39-{10.2}	0	5	35	45	15	0	0
WVOGM-39-G	0	0	15	70	15	0	0

Table A-4. Substrate composition in benthic collection area (continued).

Stream Code	% bedrock	% boulder	% cobble	% gravel	% sand	% silt	% clayh
WVOGM-40.3-{0}	0	10	40	30	10	10	0
WVOGM-40.3-{2.2}	0	0	10	20	60	10	0
WVOGM-43	5	5	40	30	15	5	0
WVOGM-44-{0.2}	0	0	40	30	20	10	0
WVOGM-50	0	2	60	25	5	8	0
WVOG-3	0	0	5	40	30	15	0
WVOG-3-0.5A	0	0	15	30	45	10	0
WVOG-6-{0.1}	0	0	0	10	45	45	0
WVOG-9-A-{0.3}	5	0	20	50	20	5	0
WVOG-10	0	0	5	70	20	5	0
WVOG-10-A	0	0	15	65	15	5	0
WVOG-11	0	0	15	30	40	10	5
WVOG-23.5	0	0	5	40	40	15	0
WVOG-27	0	5	0	0	0	95	0
WVOG-27-A	0	0	50	25	20	5	0
WVOG-27-H-{1.8}	0	0	15	60	20	5	0
WVOG-29-C	0	5	30	40	20	5	0
WVOG-30-{1.2}	0	5	30	40	20	5	0
WVOG-32-F	0	0	45	40	15	0	0
WVOG-34	0	0	15	35	45	5	0
WVOG-34-A	0	0	15	45	30	10	0
WVOG-34-B	0	0	25	35	35	5	0
WVOG-34-E-1	0	5	55	20	15	5	0
WVOG-34-E-1-{0.8}	0	0	35	30	30	5	0
WVOG-35	0	0	35	45	20	0	0
WVOG-36	0	5	35	35	20	5	0
WVOG-37	0	10	45	30	15	0	0
WVOG-38-{0.8}	0	0	5	5	80	10	0
WVOG-38-{11.6}	0	5	30	35	25	5	0
WVOG-38-A	0	0	15	40	40	5	0
WVOG-38-D-{3.9}	0	25	60	10	3	2	0
WVOG-38-D-{4.5}	0	15	60	15	5	5	0
WVOG-38-G	0	0	40	30	25	5	0
WVOG-38-K	0	5	20	40	30	5	0
WVOG-38-K.7	0	0	25	45	25	5	0
WVOG-38-K-5	0	0	15	35	45	5	0
WVOG-40	0	0	40	40	20	0	0
WVOG-41	0	10	70	20	0	0	0
WVOG-42-A	0	5	20	75	0	0	0
WVOG-42-C-{0.2}	0	0	10	80	10	0	0
WVOG-42-D	0	0	70	30	0	0	0
WVOG-42-E	5	0	65	10	20	0	0
WVOG-44-A.5	0	0	40	25	25	10	0
WVOG-44-A-2-{2.8}	0	0	35	15	25	25	0
WVOG-44-C.3	0	0	30	55	15	0	0
WVOG-44-C.7	0	0	40	50	10	0	0

Table A-4. Substrate composition in benthic collection area (continued).

Stream Code	% bedrock	% boulder	% cobble	% gravel	% sand	% silt	% clay
WVOG-44-E	0	0	30	45	25	0	0
WVOG-44-E-0.5	0	0	45	40	15	0	0
WVOG-44-F-1	0	0	40	49	10	1	0
WVOG-44-G-{1.9}	0	10	45	35	10	0	0
WVOG-44-H	0	0	10	65	25	0	0
WVOG-44-I	0	10	40	30	20	0	0
WVOG-44-K	0	0	30	45	25	0	0
WVOG-48	0	0	30	45	25	0	0
WVOG-49-{3.3}	0	0	20	30	30	20	0
WVOG-49-A	0	0	20	70	10	0	0
WVOG-49-A-1	0	0	45	45	10	0	0
WVOG-49-B-1	0	5	45	40	10	0	0
WVOG-49-C	0	0	35	55	10	0	0
WVOG-49-C.1	0	0	20	70	10	0	0
WVOG-49-D-2	0	0	35	50	15	0	0
WVOG-49-E-1	0	0	55	35	10	0	0
WVOG-50	0	10	50	30	10	0	0
WVOG-51.5	0	0	25	58	15	2	0
WVOG-51-B	0	10	20	50	20	0	0
WVOG-51-G.5	0	15	55	25	5	0	0
WVOG-53	0	0	50	40	10	0	0
WVOG-59	0	10	50	35	5	0	0
WVOG-60	0	0	50	45	5	0	0
WVOG-61	0	0	45	45	10	0	0

Table A-5. Macrobenthic community metrics and WVSCI scores.

Stream Code	Total Taxa	EPT taxa	% EPT	% 2 dom	% chiros	HBI	WVSCI
WVOG-2-{3.6}	10	5	19.46	71.35	46.49	5.89	43.58
WVOG-2-{47}	11	6	54.69	56.25	20.31	4.61	63.53
WVOG-2-{48.7}	17	9	49.08	47.24	26.38	4.65	72.15
WVOG-2-{77.2}	16	8	41.80	63.52	32.38	4.91	62.81
WVOGM-1.5	5	0	0.00	97.91	74.87	6.94	15.50
WVOGM-3-{0.9}	10	5	25.62	71.88	60.00	5.21	43.84
WVOGM-4-{0.2}	10	3	40.59	85.15	46.53	5.17	42.90
WVOGM-4-{2}	18	8	70.19	57.69	16.67	4.38	75.05
WVOGM-7-{0.4}	17	8	41.99	64.09	40.33	5.14	61.59
WVOGM-7-B-1	20	11	70.05	50.76	14.21	3.89	83.75
WVOGM-8-{4}	16	10	42.71	43.72	14.57	3.69	76.58
WVOGM-8-B	12	8	69.41	50.00	3.53	3.42	76.78
WVOGM-8-C	13	6	42.53	66.67	33.33	4.82	57.33
WVOGM-12	7	3	4.76	88.10	57.14	6.02	29.45
WVOGM-13	18	9	26.58	71.20	6.33	6.22	62.19
WVOGM-14-{7.2}	10	5	36.93	51.70	21.59	4.01	60.52
WVOGM-16-A	23	15	80.00	50.51	10.51	3.68	90.84
WVOGM-19	16	10	66.50	54.19	10.34	3.89	78.51
WVOGM-20-{6.4}	17	7	60.17	55.93	18.22	4.51	71.04
WVOGM-20-{21.2}	13	6	38.86	56.57	37.71	4.57	59.14
WVOGM-20-A	7	4	39.39	54.55	30.30	4.61	53.85
WVOGM-20-D-{4.6}	15	7	44.12	59.66	11.76	3.55	68.79
WVOGM-20-H	20	8	50.00	48.36	15.57	5.20	73.60
WVOGM-20-I-1-{1.5}	17	8	44.00	47.43	8.57	4.91	72.31
WVOGM-20-L	15	9	88.56	63.18	5.97	3.65	79.48
WVOGM-20-K-{0.1}	12	9	81.76	40.00	10.59	2.69	83.48
WVOGM-20-K-1	17	10	88.15	57.49	3.48	3.37	84.77
WVOGM-20-M-{1.8}	17	8	50.24	56.10	4.88	3.74	74.44
WVOGM-20-M-1	18	12	97.38	52.43	0.37	2.96	90.89
WVOGM-20-R-2	20	9	56.40	40.76	20.85	3.82	80.31
WVOGM-20-T-{3.5}	13	7	50.00	42.68	19.51	4.18	70.17
WVOGM-20-V	14	9	95.91	77.73	0.45	3.93	75.08
WVOGM-22-A-{0.7}	18	9	31.47	62.55	54.18	5.08	59.86
WVOGM-25-A	13	5	9.42	79.06	63.87	5.26	40.41
WVOGM-25-B-{2.3}	16	7	35.53	45.18	23.68	3.92	68.96
WVOGM-25-B-1	15	9	78.61	53.48	13.90	3.72	78.70
WVOGM-25-H-1	15	10	15.90	78.97	16.41	4.32	59.73
WVOGM-25-I	9	5	62.50	78.75	5.00	4.00	60.18
WVOGM-25-I-{3}	17	9	51.44	57.69	9.13	3.71	74.85
WVOGM-25-I-4	16	10	70.29	47.83	4.35	3.54	82.71
WVOGM-31	17	10	51.50	51.07	8.58	3.30	78.93
WVOGM-33-B	20	11	87.64	40.45	2.81	2.97	93.77
WVOGM-33-C	21	11	62.43	39.31	16.76	3.83	85.83
WVOGM-35-{1.8}	14	8	68.72	57.95	7.18	3.65	74.93
WVOGM-35-{4.1}	16	8	79.75	50.21	0.84	3.13	82.65
WVOGM-35-E	19	12	40.98	52.20	13.17	3.50	79.52
WVOGM-39	20	10	59.72	38.86	12.32	3.73	84.39
WVOGM-39-{10.2}	11	6	39.81	60.80	15.12	4.27	61.19

Table A-5. Macrobenthic community metrics and WVSCI scores(cont.)

Stream Code	Total Taxa	EPT taxa	% EPT	% 2 dom	% chiros	HBI	WVSCI
WVOGM-39-G	15	9	48.95	55.26	31.58	4.39	68.18
WVOGM-40.3-{0}	21	10	71.65	53.09	6.19	3.76	84.54
WVOGM-40.3-{2.2}	24	11	66.67	40.40	7.58	2.72	91.14
WVOGM-43	14	8	91.44	63.81	2.72	3.27	78.81
WVOGM-44-{0.2}	17	9	78.64	54.85	4.37	3.42	82.15
WVOGM-50	23	14	84.15	45.90	2.73	2.61	96.57
WVOG-3	5	2	7.84	93.14	87.25	5.86	21.13
WVOG-3-0.5A	10	5	35.34	86.75	7.23	6.28	48.23
WVOG-6-{0.1}	6	2	10.20	85.71	73.47	5.69	27.02
WVOG-9-A-{0.3}	14	8	44.53	61.13	38.06	5.15	60.96
WVOG-10	8	4	10.59	86.47	74.71	5.68	30.79
WVOG-10-A	13	7	11.06	92.68	87.38	5.76	34.54
WVOG-11	11	4	13.89	69.84	57.14	5.38	41.75
WVOG-14-D-{0.4}	15	1	26.29	66.86	40.57	6.89	43.46
WVOG-23.5	8	3	5.12	82.79	63.26	6.27	30.07
WVOG-27-A	20	9	55.34	47.57	26.70	4.39	76.04
WVOG-27-H-{1.8}	13	8	92.65	57.84	3.43	2.89	80.38
WVOG-29-C	24	13	83.82	50.21	4.56	3.26	93.59
WVOG-30-{1.2}	16	8	87.37	64.14	3.03	3.49	79.34
WVOG-32-F	18	12	74.01	52.42	7.49	2.89	87.20
WVOG-34	13	7	78.33	53.33	12.22	4.58	72.96
WVOG-34-A	7	3	82.74	84.26	14.72	4.17	56.39
WVOG-34-B	19	9	31.11	59.44	33.89	5.00	65.00
WVOG-34-E-1	20	12	76.50	50.50	5.50	3.40	88.88
WVOG-34-E-1-{0.8}	15	9	48.00	33.71	5.71	3.46	79.27
WVOG-35	10	5	44.00	65.14	34.86	4.71	54.43
WVOG-36	8	4	94.05	86.90	3.57	3.87	61.51
WVOG-37	19	13	88.83	62.01	3.91	3.36	89.01
WVOG-38-{0.8}	11	6	47.67	52.33	9.30	3.86	66.82
WVOG-38-{11.6}	19	10	79.08	69.39	6.12	3.98	79.59
WVOG-38-A	13	8	79.78	62.36	3.93	3.67	75.55
WVOG-38-D-{3.9}	24	15	80.00	38.57	1.43	3.05	96.94
WVOG-38-D-{4.5}	21	13	70.59	34.31	6.86	3.27	93.39
WVOG-38-G	16	11	91.71	69.43	2.59	3.33	82.58
WVOG-38-K	16	10	87.96	71.20	4.19	3.77	79.31
WVOG-38-K.7	11	7	81.50	80.00	17.00	4.12	65.18
WVOG-38-K-5	19	8	66.67	34.55	1.21	3.16	85.84
WVOG-40	10	7	77.42	76.34	15.05	4.24	64.69
WVOG-41	8	3	6.59	92.81	89.82	5.86	24.12
WVOG-42-A	8	4	62.71	68.36	34.46	4.51	54.79
WVOG-42-C-{0.2}	13	7	43.39	69.84	49.74	5.31	54.03
WVOG-42-D	19	10	59.30	47.72	12.63	3.86	80.84
WVOG-42-E	16	11	60.00	40.00	16.36	4.39	80.21
WVOG-44-A.5	16	10	74.14	52.30	13.22	3.87	80.00
WVOG-44-A-2-{2.8}	13	8	77.88	73.73	14.29	4.07	69.52
WVOG-44-C.3	20	9	68.32	55.45	16.34	4.08	78.82
WVOG-44-C.7	18	11	84.65	48.02	3.47	3.42	88.56
WVOG-44-E	15	9	47.06	51.34	28.34	4.93	68.20

Table A-5. Macrobenthic community metrics and WVSCI scores(cont.)

Stream Code	Total Taxa	EPT taxa	% EPT	% 2 dom	% chiros	HBI	WVSCI
WVOG-44-E-0.5	18	13	87.43	49.71	1.14	3.11	92.18
WVOG-44-F-1	19	10	91.21	65.57	4.03	2.80	85.55
WVOG-44-G-{1.9}	16	10	53.80	41.14	15.82	3.94	78.56
WVOG-44-H	24	15	73.86	35.23	8.52	3.40	94.17
WVOG-44-I	20	12	72.96	32.08	8.81	3.48	90.99
WVOG-44-K	18	10	82.35	57.52	7.19	3.47	83.58
WVOG-48	13	5	41.67	31.25	14.58	3.62	69.56
WVOG-49-{3.3}	15	8	30.46	62.44	19.29	4.51	63.36
WVOG-49-A	6	2	21.43	57.14	28.57	4.29	47.50
WVOG-49-A-1	9	4	66.67	64.29	4.76	4.62	62.17
WVOG-49-B-1	12	7	84.71	43.95	8.28	3.54	78.89
WVOG-49-C	6	2	46.67	76.67	13.33	4.40	49.35
WVOG-49-C.1	4	2	1.83	98.78	97.56	5.96	15.79
WVOG-49-D-2	17	9	82.67	47.52	11.39	3.65	83.14
WVOG-49-E-1	6	1	1.04	97.93	96.89	5.98	16.17
WVOG-50	13	8	84.73	63.05	3.45	3.67	76.37
WVOG-51.5	8	1	38.81	82.09	43.28	4.28	41.85
WVOG-51-B	13	8	65.84	55.90	30.43	3.91	69.64
WVOG-51-G.5	7	2	4.52	93.79	42.94	4.90	31.54
WVOG-53	12	4	11.28	87.22	81.95	5.48	32.97
WVOG-59	18	7	28.30	64.15	49.06	5.53	56.14
WVOG-60	17	11	88.44	37.69	5.53	3.40	90.96
WVOG-61	13	7	90.68	57.76	0.62	2.52	80.05

Table A-6. Benthic macroinvertebrates identified.

AN Code	Taxon	Count
WVOG-2-{3.6}	Simuliidae	46
WVOG-2-{3.6}	Sphaeriidae	8
WVOG-2-{3.6}	Perlidae	1
WVOG-2-{3.6}	Oligochaeta	5
WVOG-2-{3.6}	Hydropsychidae	29
WVOG-2-{3.6}	Heptageniidae	4
WVOG-2-{3.6}	Elmidae	4
WVOG-2-{3.6}	Chloroperlidae	1
WVOG-2-{3.6}	Chironomidae	86
WVOG-2-{3.6}	Baetidae	1
WVOG-2-{47}	Chironomidae	13
WVOG-2-{47}	Simuliidae	5
WVOG-2-{47}	Perlidae	3
WVOG-2-{47}	Hydropsychidae	3
WVOG-2-{47}	Heptageniidae	1
WVOG-2-{47}	Ephemerellidae	1
WVOG-2-{47}	Aeshnidae	3
WVOG-2-{47}	Corduliidae	1
WVOG-2-{47}	Caenidae	4
WVOG-2-{47}	Baetidae	23
WVOG-2-{47}	Elmidae	7
WVOG-2-{48.7}	Gomphidae	2
WVOG-2-{48.7}	Aeshnidae	5
WVOG-2-{48.7}	Baetidae	34
WVOG-2-{48.7}	Caenidae	14
WVOG-2-{48.7}	Cambaridae	2
WVOG-2-{48.7}	Capniidae/Leuctri	1
WVOG-2-{48.7}	Chironomidae	43
WVOG-2-{48.7}	Elmidae	15
WVOG-2-{48.7}	Ephemerellidae	6
WVOG-2-{48.7}	Heptageniidae	4
WVOG-2-{48.7}	Hydropsychidae	4
WVOG-2-{48.7}	Leptophlebiidae	2
WVOG-2-{48.7}	Oligochaeta	1
WVOG-2-{48.7}	Perlidae	14
WVOG-2-{48.7}	Polycentropodidae	1
WVOG-2-{48.7}	Sialidae	2
WVOG-2-{48.7}	Simuliidae	13
WVOG-2-{77.2}	Gomphidae	1
WVOG-2-{77.2}	Simuliidae	7
WVOG-2-{77.2}	Chironomidae	79
WVOG-2-{77.2}	Capniidae/Leuctri	2
WVOG-2-{77.2}	Aeshnidae	1
WVOG-2-{77.2}	Cambaridae	1
WVOG-2-{77.2}	Empididae	1
WVOG-2-{77.2}	Baetidae	12
WVOG-2-{77.2}	Ephemerellidae	2
WVOG-2-{77.2}	Philopotamidae	1
WVOG-2-{77.2}	Elmidae	49
WVOG-2-{77.2}	Perlidae	2
WVOG-2-{77.2}	Peltoperlidae	1
WVOG-2-{77.2}	Nemouridae	6
WVOG-2-{77.2}	Hydropsychidae	76
WVOG-2-{77.2}	Corydalidae	3
WVOGM-1.5	Planorbidae	1
WVOGM-1.5	Oligochaeta	44
WVOGM-1.5	Chironomidae	143
WVOGM-1.5	Sphaeriidae	2
WVOGM-1.5	Helophoridae	1
WVOGM-3-{0.9}	Chironomidae	96
WVOGM-3-{0.9}	Tipulidae	1
WVOGM-3-{0.9}	Capniidae/Leuctri	2
WVOGM-3-{0.9}	Baetidae	10
WVOGM-3-{0.9}	Cambaridae	1
WVOGM-3-{0.9}	Perlidae	2
WVOGM-3-{0.9}	Hydropsychidae	13
WVOGM-3-{0.9}	Heptageniidae	14
WVOGM-3-{0.9}	Psephenidae	2
WVOGM-3-{0.9}	Elmidae	19
WVOGM-4-{0.2}	Ephemerellidae	1
WVOGM-4-{0.2}	Gyrinidae	1
WVOGM-4-{0.2}	Caenidae	3
WVOGM-4-{0.2}	Cambaridae	2
WVOGM-4-{0.2}	Chironomidae	94
WVOGM-4-{0.2}	Corduliidae	1
WVOGM-4-{0.2}	Culicidae	9
WVOGM-4-{0.2}	Dytiscidae	2
WVOGM-4-{0.2}	Elmidae	11
WVOGM-4-{0.2}	Baetidae	78
WVOGM-4-{2}	Heptageniidae	7
WVOGM-4-{2}	Leptophlebiidae	14
WVOGM-4-{2}	Nemertea	1
WVOGM-4-{2}	Nemouridae	1
WVOGM-4-{2}	Perlidae	28
WVOGM-4-{2}	Chironomidae	52
WVOGM-4-{2}	Aeshnidae	9
WVOGM-4-{2}	Asellidae	9
WVOGM-4-{2}	Baetidae	128
WVOGM-4-{2}	Simuliidae	1

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOGM-4-{2}	Cambaridae	6
WVOGM-4-{2}	Hydropsychidae	12
WVOGM-4-{2}	Corydalidae	1
WVOGM-4-{2}	Lampyridae	1
WVOGM-4-{2}	Dryopidae	2
WVOGM-4-{2}	Elmidae	11
WVOGM-4-{2}	Ephemerellidae	3
WVOGM-4-{2}	Caenidae	26
WVOGM-7-{0.4}	Tipulidae	8
WVOGM-7-{0.4}	Elmidae	12
WVOGM-7-{0.4}	Perlodidae	2
WVOGM-7-{0.4}	Corbiculidae	1
WVOGM-7-{0.4}	Sialidae	1
WVOGM-7-{0.4}	Perlidae	8
WVOGM-7-{0.4}	Asellidae	2
WVOGM-7-{0.4}	Baetidae	4
WVOGM-7-{0.4}	Caenidae	5
WVOGM-7-{0.4}	Cambaridae	3
WVOGM-7-{0.4}	Chironomidae	73
WVOGM-7-{0.4}	Culicidae	1
WVOGM-7-{0.4}	Ephemerellidae	1
WVOGM-7-{0.4}	Heptageniidae	12
WVOGM-7-{0.4}	Hydropsychidae	43
WVOGM-7-{0.4}	Oligochaeta	4
WVOGM-7-{0.4}	Capniidae/Leuctri	1
WVOGM-7-B-1	Asellidae	14
WVOGM-7-B-1	Gomphidae	1
WVOGM-7-B-1	Capniidae/Leuctri	7
WVOGM-7-B-1	Baetidae	7
WVOGM-7-B-1	Caenidae	1
WVOGM-7-B-1	Cambaridae	1
WVOGM-7-B-1	Chironomidae	28
WVOGM-7-B-1	Chloroperlidae	1
WVOGM-7-B-1	Ephydridae	1
WVOGM-7-B-1	Heptageniidae	72
WVOGM-7-B-1	Hydropsychidae	1
WVOGM-7-B-1	Leptophlebiidae	2
WVOGM-7-B-1	Nemouridae	16
WVOGM-7-B-1	Oligochaeta	2
WVOGM-7-B-1	Perlidae	27
WVOGM-7-B-1	Perlodidae	3
WVOGM-7-B-1	Philopotamidae	1
WVOGM-7-B-1	Psephenidae	2
WVOGM-7-B-1	Tipulidae	5
WVOGM-7-B-1	Elmidae	5

AN Code	Taxon	Count
WVOGM-8-{4}	Elmidae	22
WVOGM-8-{4}	Chloroperlidae	11
WVOGM-8-{4}	Baetidae	25
WVOGM-8-{4}	Caenidae	5
WVOGM-8-{4}	Cambaridae	1
WVOGM-8-{4}	Capniidae/Leuctri	3
WVOGM-8-{4}	Ceratopogonidae	3
WVOGM-8-{4}	Heptageniidae	19
WVOGM-8-{4}	Chironomidae	29
WVOGM-8-{4}	Tipulidae	58
WVOGM-8-{4}	Ephemerellidae	4
WVOGM-8-{4}	Hydropsychidae	1
WVOGM-8-{4}	Isonychiidae	2
WVOGM-8-{4}	Nemouridae	5
WVOGM-8-{4}	Oligochaeta	1
WVOGM-8-{4}	Perlidae	10
WVOGM-8-B	Nemouridae	2
WVOGM-8-B	Baetidae	58
WVOGM-8-B	Capniidae/Leuctri	6
WVOGM-8-B	Chironomidae	6
WVOGM-8-B	Chloroperlidae	10
WVOGM-8-B	Elmidae	19
WVOGM-8-B	Ephemerellidae	3
WVOGM-8-B	Heptageniidae	27
WVOGM-8-B	Perlidae	5
WVOGM-8-B	Psephenidae	1
WVOGM-8-B	Tipulidae	26
WVOGM-8-B	Perlodidae	7
WVOGM-8-C	Capniidae/Leuctri	1
WVOGM-8-C	Tipulidae	6
WVOGM-8-C	Asellidae	1
WVOGM-8-C	Cambaridae	2
WVOGM-8-C	Psephenidae	3
WVOGM-8-C	Baetidae	3
WVOGM-8-C	Tabanidae	2
WVOGM-8-C	Perlidae	10
WVOGM-8-C	Hydropsychidae	58
WVOGM-8-C	Heptageniidae	1
WVOGM-8-C	Elmidae	28
WVOGM-8-C	Chloroperlidae	1
WVOGM-8-C	Chironomidae	58
WVOGM-12	Simuliidae	52
WVOGM-12	Baetidae	2
WVOGM-12	Capniidae/Leuctri	5
WVOGM-12	Chironomidae	96

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOGM-12	Elmidae	2
WVOGM-12	Leptophlebiidae	1
WVOGM-12	Oligochaeta	10
WVOGM-13	Psephenidae	2
WVOGM-13	Leptophlebiidae	9
WVOGM-13	Asellidae	194
WVOGM-13	Baetidae	7
WVOGM-13	Cambaridae	1
WVOGM-13	Capniidae/Leuctri	18
WVOGM-13	Chironomidae	20
WVOGM-13	Ephemerellidae	1
WVOGM-13	Gammaridae	5
WVOGM-13	Gomphidae	1
WVOGM-13	Hydropsychidae	1
WVOGM-13	Nemouridae	10
WVOGM-13	Perlidae	6
WVOGM-13	Tipulidae	1
WVOGM-13	Chloroperlidae	1
WVOGM-13	Elmidae	7
WVOGM-13	Heptageniidae	31
WVOGM-13	Corydalidae	1
WVOGM-14-{7.2}	Elmidae	53
WVOGM-14-{7.2}	Tipulidae	16
WVOGM-14-{7.2}	Baetidae	25
WVOGM-14-{7.2}	Gomphidae	1
WVOGM-14-{7.2}	Caenidae	1
WVOGM-14-{7.2}	Simuliidae	3
WVOGM-14-{7.2}	Perlidae	26
WVOGM-14-{7.2}	Hydropsychidae	12
WVOGM-14-{7.2}	Heptageniidae	1
WVOGM-14-{7.2}	Chironomidae	38
WVOGM-16-A	Ephemerellidae	15
WVOGM-16-A	Philopotamidae	1
WVOGM-16-A	Cambaridae	4
WVOGM-16-A	Veliidae	1
WVOGM-16-A	Tipulidae	2
WVOGM-16-A	Taeniopterygidae	1
WVOGM-16-A	Rhyacophilidae	1
WVOGM-16-A	Psephenidae	1
WVOGM-16-A	Elmidae	13
WVOGM-16-A	Caenidae	2
WVOGM-16-A	Baetidae	110
WVOGM-16-A	Asellidae	5
WVOGM-16-A	Capniidae/Leuctri	3
WVOGM-16-A	Chironomidae	31
WVOGM-16-A	Heptageniidae	16
WVOGM-16-A	Chloroperlidae	6
WVOGM-16-A	Perlodidae	16
WVOGM-16-A	Gomphidae	2
WVOGM-16-A	Hydropsychidae	7
WVOGM-16-A	Hydroptilidae	4
WVOGM-16-A	Leptophlebiidae	13
WVOGM-16-A	Nemouridae	39
WVOGM-16-A	Perlidae	2
WVOGM-19	Perlidae	16
WVOGM-19	Tipulidae	28
WVOGM-19	Perlodidae	2
WVOGM-19	Ameletidae	1
WVOGM-19	Caenidae	1
WVOGM-19	Baetidae	82
WVOGM-19	Oligochaeta	8
WVOGM-19	Asellidae	3
WVOGM-19	Capniidae/Leuctri	5
WVOGM-19	Chironomidae	21
WVOGM-19	Chloroperlidae	1
WVOGM-19	Elmidae	7
WVOGM-19	Ephemerellidae	14
WVOGM-19	Gomphidae	1
WVOGM-19	Heptageniidae	8
WVOGM-19	Nemouridae	5
WVOGM-20-{6.4}	Tipulidae	2
WVOGM-20-{6.4}	Corbiculidae	1
WVOGM-20-{6.4}	Macroveliidae	2
WVOGM-20-{6.4}	Isonychiidae	13
WVOGM-20-{6.4}	Hydroptilidae	1
WVOGM-20-{6.4}	Hydropsychidae	89
WVOGM-20-{6.4}	Heptageniidae	8
WVOGM-20-{6.4}	Elmidae	27
WVOGM-20-{6.4}	Oligochaeta	3
WVOGM-20-{6.4}	Chloroperlidae	1
WVOGM-20-{6.4}	Chironomidae	43
WVOGM-20-{6.4}	Cambaridae	2
WVOGM-20-{6.4}	Baetidae	1
WVOGM-20-{6.4}	Simuliidae	12
WVOGM-20-{6.4}	Veliidae	1
WVOGM-20-{6.4}	Perlidae	29
WVOGM-20-{6.4}	Asellidae	1
WVOGM-20-{21.2}	Elmidae	28
WVOGM-20-{21.2}	Asellidae	3
WVOGM-20-{21.2}	Heptageniidae	5

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOGM-20-{21.2}	Psephenidae	3
WVOGM-20-{21.2}	Gomphidae	1
WVOGM-20-{21.2}	Chironomidae	66
WVOGM-20-{21.2}	Ceratopogonidae	1
WVOGM-20-{21.2}	Capniidae/Leuctri	2
WVOGM-20-{21.2}	Cambaridae	5
WVOGM-20-{21.2}	Baetidae	33
WVOGM-20-{21.2}	Hydropsychidae	7
WVOGM-20-{21.2}	Perlidae	19
WVOGM-20-{21.2}	Caenidae	2
WVOGM-20-A	Tipulidae	8
WVOGM-20-A	Ephemerellidae	2
WVOGM-20-A	Chironomidae	10
WVOGM-20-A	Caenidae	2
WVOGM-20-A	Baetidae	8
WVOGM-20-A	Asellidae	2
WVOGM-20-A	Ameletidae	1
WVOGM-20-D-{4.6}	Hydropsychidae	26
WVOGM-20-D-{4.6}	Tabanidae	1
WVOGM-20-D-{4.6}	Tipulidae	6
WVOGM-20-D-{4.6}	Chironomidae	28
WVOGM-20-D-{4.6}	Asellidae	2
WVOGM-20-D-{4.6}	Baetidae	12
WVOGM-20-D-{4.6}	Perlidae	61
WVOGM-20-D-{4.6}	Ceratopogonidae	1
WVOGM-20-D-{4.6}	Psephenidae	13
WVOGM-20-D-{4.6}	Dryopidae	1
WVOGM-20-D-{4.6}	Elmidae	81
WVOGM-20-D-{4.6}	Ephemerellidae	1
WVOGM-20-D-{4.6}	Heptageniidae	1
WVOGM-20-D-{4.6}	Leptophlebiidae	1
WVOGM-20-D-{4.6}	Capniidae/Leuctri	3
WVOGM-20-H	Caenidae	12
WVOGM-20-H	Leptophlebiidae	3
WVOGM-20-H	Sialidae	2
WVOGM-20-H	Perlidae	1
WVOGM-20-H	Nemouridae	1
WVOGM-20-H	Libellulidae	3
WVOGM-20-H	Chironomidae	19
WVOGM-20-H	Aeshnidae	10
WVOGM-20-H	Asellidae	1
WVOGM-20-H	Baetidae	40
WVOGM-20-H	Cambaridae	2
WVOGM-20-H	Calopterygidae	1
WVOGM-20-H	Hydropsychidae	1
WVOGM-20-H	Coenagrionidae	2
WVOGM-20-H	Culicidae	16
WVOGM-20-H	Dixidae	1
WVOGM-20-H	Elmidae	2
WVOGM-20-H	Ephemerellidae	2
WVOGM-20-H	Heptageniidae	1
WVOGM-20-H	Hydrophilidae	2
WVOGM-20-I-1-{1.5}	Ephemerellidae	1
WVOGM-20-I-1-{1.5}	Veliidae	3
WVOGM-20-I-1-{1.5}	Tipulidae	4
WVOGM-20-I-1-{1.5}	Tabanidae	3
WVOGM-20-I-1-{1.5}	Leptophlebiidae	8
WVOGM-20-I-1-{1.5}	Asellidae	36
WVOGM-20-I-1-{1.5}	Baetidae	13
WVOGM-20-I-1-{1.5}	Cambaridae	5
WVOGM-20-I-1-{1.5}	Capniidae/Leuctri	5
WVOGM-20-I-1-{1.5}	Chironomidae	15
WVOGM-20-I-1-{1.5}	Dryopidae	1
WVOGM-20-I-1-{1.5}	Elmidae	30
WVOGM-20-I-1-{1.5}	Heptageniidae	47
WVOGM-20-I-1-{1.5}	Nemouridae	1
WVOGM-20-I-1-{1.5}	Oligochaeta	1
WVOGM-20-I-1-{1.5}	Perlidae	1
WVOGM-20-I-1-{1.5}	Polycentropodidae	1
WVOGM-20-L	Oligochaeta	2
WVOGM-20-L	Psephenidae	3
WVOGM-20-L	Tipulidae	1
WVOGM-20-L	Perlidae	11
WVOGM-20-L	Nemouridae	10
WVOGM-20-L	Leptophlebiidae	9
WVOGM-20-L	Heptageniidae	97
WVOGM-20-L	Ephemerellidae	4
WVOGM-20-L	Elmidae	3
WVOGM-20-L	Chironomidae	12
WVOGM-20-L	Capniidae/Leuctri	14
WVOGM-20-L	Caenidae	2
WVOGM-20-L	Baetidae	30
WVOGM-20-L	Asellidae	2
WVOGM-20-L	Perlodidae	1
WVOGM-20-K-{0.1}	Perlodidae	3
WVOGM-20-K-{0.1}	Dytiscidae	1
WVOGM-20-K-{0.1}	Elmidae	12
WVOGM-20-K-{0.1}	Baetidae	28
WVOGM-20-K-{0.1}	Caenidae	1
WVOGM-20-K-{0.1}	Ephemerellidae	2

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOGM-20-K-{0.1}	Chironomidae	18
WVOGM-20-K-{0.1}	Perlidae	35
WVOGM-20-K-{0.1}	Heptageniidae	8
WVOGM-20-K-{0.1}	Leptophlebiidae	4
WVOGM-20-K-{0.1}	Nemouridae	33
WVOGM-20-K-{0.1}	Capniidae/Leuctri	25
WVOGM-20-K-1	Oligochaeta	1
WVOGM-20-K-1	Perlidae	16
WVOGM-20-K-1	Psephenidae	13
WVOGM-20-K-1	Heptageniidae	23
WVOGM-20-K-1	Nemouridae	20
WVOGM-20-K-1	Leptophlebiidae	22
WVOGM-20-K-1	Isonychiidae	1
WVOGM-20-K-1	Hydroptilidae	1
WVOGM-20-K-1	Tipulidae	2
WVOGM-20-K-1	Cambaridae	1
WVOGM-20-K-1	Ephemerellidae	5
WVOGM-20-K-1	Capniidae/Leuctri	18
WVOGM-20-K-1	Chironomidae	10
WVOGM-20-K-1	Chloroperlidae	5
WVOGM-20-K-1	Elmidae	6
WVOGM-20-K-1	Empididae	1
WVOGM-20-K-1	Baetidae	142
WVOGM-20-M-{1.8}	Dryopidae	1
WVOGM-20-M-{1.8}	Heptageniidae	17
WVOGM-20-M-{1.8}	Psephenidae	2
WVOGM-20-M-{1.8}	Perlidae	19
WVOGM-20-M-{1.8}	Oligochaeta	1
WVOGM-20-M-{1.8}	Leptophlebiidae	2
WVOGM-20-M-{1.8}	Isonychiidae	11
WVOGM-20-M-{1.8}	Hydropsychidae	11
WVOGM-20-M-{1.8}	Baetidae	39
WVOGM-20-M-{1.8}	Tipulidae	6
WVOGM-20-M-{1.8}	Chironomidae	10
WVOGM-20-M-{1.8}	Ceratopogonidae	1
WVOGM-20-M-{1.8}	Capniidae/Leuctri	3
WVOGM-20-M-{1.8}	Cambaridae	3
WVOGM-20-M-{1.8}	Caenidae	1
WVOGM-20-M-{1.8}	Elmidae	76
WVOGM-20-M-{1.8}	Gomphidae	2
WVOGM-20-M-1	Heptageniidae	39
WVOGM-20-M-1	Leptophlebiidae	13
WVOGM-20-M-1	Nemouridae	47
WVOGM-20-M-1	Perlidae	3
WVOGM-20-M-1	Perlodidae	1

AN Code	Taxon	Count
WVOGM-20-M-1	Psephenidae	2
WVOGM-20-M-1	Tipulidae	1
WVOGM-20-M-1	Glossosomatidae	1
WVOGM-20-M-1	Rhyacophilidae	1
WVOGM-20-M-1	Ameletidae	4
WVOGM-20-M-1	Empididae	1
WVOGM-20-M-1	Chloroperlidae	13
WVOGM-20-M-1	Chironomidae	1
WVOGM-20-M-1	Capniidae/Leuctri	24
WVOGM-20-M-1	Cambaridae	1
WVOGM-20-M-1	Baetidae	93
WVOGM-20-M-1	Ephemerellidae	21
WVOGM-20-M-1	Asellidae	1
WVOGM-20-R-2	Heptageniidae	27
WVOGM-20-R-2	Hydrophilidae	1
WVOGM-20-R-2	Hydropsychidae	4
WVOGM-20-R-2	Isonychiidae	1
WVOGM-20-R-2	Leptophlebiidae	11
WVOGM-20-R-2	Tipulidae	5
WVOGM-20-R-2	Oligochaeta	1
WVOGM-20-R-2	Nemouridae	3
WVOGM-20-R-2	Gomphidae	1
WVOGM-20-R-2	Psephenidae	2
WVOGM-20-R-2	Baetidae	23
WVOGM-20-R-2	Perlidae	42
WVOGM-20-R-2	Asellidae	10
WVOGM-20-R-2	Cambaridae	5
WVOGM-20-R-2	Capniidae/Leuctri	7
WVOGM-20-R-2	Chironomidae	44
WVOGM-20-R-2	Corydalidae	1
WVOGM-20-R-2	Dryopidae	2
WVOGM-20-R-2	Elmidae	20
WVOGM-20-R-2	Ephemerellidae	1
WVOGM-20-T-{3.5}	Chironomidae	32
WVOGM-20-T-{3.5}	Heptageniidae	5
WVOGM-20-T-{3.5}	Tipulidae	3
WVOGM-20-T-{3.5}	Rhyacophilidae	1
WVOGM-20-T-{3.5}	Psephenidae	6
WVOGM-20-T-{3.5}	Perlidae	15
WVOGM-20-T-{3.5}	Hydropsychidae	27
WVOGM-20-T-{3.5}	Gomphidae	2
WVOGM-20-T-{3.5}	Chloroperlidae	1
WVOGM-20-T-{3.5}	Capniidae/Leuctri	3
WVOGM-20-T-{3.5}	Baetidae	30
WVOGM-20-T-{3.5}	Asellidae	1
WVOGM-20-T-{3.5}	Elmidae	38

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOGM-20-V	Hydropsychidae	8
WVOGM-20-V	Capniidae/Leuctri	1
WVOGM-20-V	Perlodidae	3
WVOGM-20-V	Perlidae	1
WVOGM-20-V	Simuliidae	1
WVOGM-20-V	Oligochaeta	3
WVOGM-20-V	Nemouridae	11
WVOGM-20-V	Elmidae	3
WVOGM-20-V	Chironomidae	1
WVOGM-20-V	Heptageniidae	49
WVOGM-20-V	Cambaridae	1
WVOGM-20-V	Caenidae	1
WVOGM-20-V	Baetidae	122
WVOGM-20-V	Ephemerellidae	15
WVOGM-22-A-{0.7}	Heptageniidae	19
WVOGM-22-A-{0.7}	Gomphidae	1
WVOGM-22-A-{0.7}	Ephemerellidae	5
WVOGM-22-A-{0.7}	Empididae	1
WVOGM-22-A-{0.7}	Hydropsychidae	1
WVOGM-22-A-{0.7}	Chloroperlidae	2
WVOGM-22-A-{0.7}	Tipulidae	5
WVOGM-22-A-{0.7}	Chironomidae	136
WVOGM-22-A-{0.7}	Elmidae	21
WVOGM-22-A-{0.7}	Leptophlebiidae	5
WVOGM-22-A-{0.7}	Nemouridae	15
WVOGM-22-A-{0.7}	Psephenidae	3
WVOGM-22-A-{0.7}	Ceratopogonidae	1
WVOGM-22-A-{0.7}	Capniidae/Leuctri	5
WVOGM-22-A-{0.7}	Caenidae	15
WVOGM-22-A-{0.7}	Baetidae	12
WVOGM-22-A-{0.7}	Asellidae	1
WVOGM-22-A-{0.7}	Oligochaeta	3
WVOGM-25-A	Lymnaeidae	1
WVOGM-25-A	Asellidae	7
WVOGM-25-A	Caenidae	1
WVOGM-25-A	Capniidae/Leuctri	2
WVOGM-25-A	Ceratopogonidae	1
WVOGM-25-A	Chironomidae	122
WVOGM-25-A	Dryopidae	1
WVOGM-25-A	Ephemerellidae	12
WVOGM-25-A	Nemouridae	1
WVOGM-25-A	Physidae	2
WVOGM-25-A	Tipulidae	29
WVOGM-25-A	Tricorythidae	2
WVOGM-25-A	Elmidae	10
WVOGM-25-B-{2.3}	Hirudinidae	1
WVOGM-25-B-{2.3}	Leptophlebiidae	4
WVOGM-25-B-{2.3}	Tipulidae	9
WVOGM-25-B-{2.3}	Psephenidae	26
WVOGM-25-B-{2.3}	Perlidae	30
WVOGM-25-B-{2.3}	Nemouridae	1
WVOGM-25-B-{2.3}	Hydropsychidae	15
WVOGM-25-B-{2.3}	Baetidae	5
WVOGM-25-B-{2.3}	Heptageniidae	10
WVOGM-25-B-{2.3}	Gomphidae	1
WVOGM-25-B-{2.3}	Elmidae	49
WVOGM-25-B-{2.3}	Corydalidae	1
WVOGM-25-B-{2.3}	Chironomidae	54
WVOGM-25-B-{2.3}	Capniidae/Leuctri	16
WVOGM-25-B-{2.3}	Cambaridae	5
WVOGM-25-B-{2.3}	Oligochaeta	1
WVOGM-25-B-1	Leptophlebiidae	2
WVOGM-25-B-1	Heptageniidae	74
WVOGM-25-B-1	Tipulidae	3
WVOGM-25-B-1	Rhyacophilidae	1
WVOGM-25-B-1	Perlodidae	2
WVOGM-25-B-1	Perlidae	12
WVOGM-25-B-1	Nemouridae	3
WVOGM-25-B-1	Calopterygidae	1
WVOGM-25-B-1	Ephemerellidae	23
WVOGM-25-B-1	Oligochaeta	6
WVOGM-25-B-1	Baetidae	9
WVOGM-25-B-1	Cambaridae	2
WVOGM-25-B-1	Capniidae/Leuctri	21
WVOGM-25-B-1	Chironomidae	26
WVOGM-25-B-1	Elmidae	2
WVOGM-25-H-1	Psephenidae	1
WVOGM-25-H-1	Chloroperlidae	1
WVOGM-25-H-1	Tipulidae	7
WVOGM-25-H-1	Peltoperlidae	1
WVOGM-25-H-1	Oligochaeta	2
WVOGM-25-H-1	Nemouridae	2
WVOGM-25-H-1	Leptophlebiidae	1
WVOGM-25-H-1	Perlidae	1
WVOGM-25-H-1	Hydropsychidae	13
WVOGM-25-H-1	Elmidae	122
WVOGM-25-H-1	Chironomidae	32
WVOGM-25-H-1	Capniidae/Leuctri	3
WVOGM-25-H-1	Caenidae	1
WVOGM-25-H-1	Baetidae	6
WVOGM-25-H-1	Heptageniidae	2

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOGM-25-I	Elmidae	24
WVOGM-25-I	Baetidae	39
WVOGM-25-I	Psephenidae	1
WVOGM-25-I	Perlidae	1
WVOGM-25-I	Heptageniidae	8
WVOGM-25-I	Chloroperlidae	1
WVOGM-25-I	Chironomidae	4
WVOGM-25-I	Capniidae/Leuctri	1
WVOGM-25-I	Curculionidae	1
WVOGM-25-I-{3}	Heptageniidae	8
WVOGM-25-I-{3}	Simuliidae	2
WVOGM-25-I-{3}	Psephenidae	3
WVOGM-25-I-{3}	Perlidae	14
WVOGM-25-I-{3}	Nemouridae	2
WVOGM-25-I-{3}	Leptophlebiidae	3
WVOGM-25-I-{3}	Hydropsychidae	9
WVOGM-25-I-{3}	Tipulidae	2
WVOGM-25-I-{3}	Baetidae	48
WVOGM-25-I-{3}	Isonychiidae	6
WVOGM-25-I-{3}	Asellidae	1
WVOGM-25-I-{3}	Gomphidae	1
WVOGM-25-I-{3}	Capniidae/Leuctri	16
WVOGM-25-I-{3}	Chironomidae	19
WVOGM-25-I-{3}	Corydalidae	1
WVOGM-25-I-{3}	Elmidae	72
WVOGM-25-I-{3}	Ephemerellidae	1
WVOGM-25-I-4	Hydropsychidae	7
WVOGM-25-I-4	Perlodidae	2
WVOGM-25-I-4	Tipulidae	10
WVOGM-25-I-4	Perlidae	6
WVOGM-25-I-4	Oligochaeta	3
WVOGM-25-I-4	Nemouridae	5
WVOGM-25-I-4	Isonychiidae	10
WVOGM-25-I-4	Psephenidae	1
WVOGM-25-I-4	Elmidae	20
WVOGM-25-I-4	Dryopidae	1
WVOGM-25-I-4	Chloroperlidae	2
WVOGM-25-I-4	Chironomidae	6
WVOGM-25-I-4	Capniidae/Leuctri	12
WVOGM-25-I-4	Baetidae	46
WVOGM-25-I-4	Heptageniidae	6
WVOGM-25-I-4	Caenidae	1
WVOGM-31	Perlidae	39
WVOGM-31	Hydropsychidae	1
WVOGM-31	Leptophlebiidae	7
WVOGM-31	Nemouridae	23
WVOGM-31	Oligochaeta	3
WVOGM-31	Perlodidae	4
WVOGM-31	Heptageniidae	18
WVOGM-31	Tipulidae	2
WVOGM-31	Gomphidae	2
WVOGM-31	Baetidae	15
WVOGM-31	Cambaridae	2
WVOGM-31	Psephenidae	4
WVOGM-31	Capniidae/Leuctri	10
WVOGM-31	Chironomidae	20
WVOGM-31	Chloroperlidae	1
WVOGM-31	Elmidae	80
WVOGM-31	Ephemerellidae	2
WVOGM-33-B	Simuliidae	1
WVOGM-33-B	Hydropsychidae	4
WVOGM-33-B	Psephenidae	3
WVOGM-33-B	Perlodidae	1
WVOGM-33-B	Perlidae	40
WVOGM-33-B	Nemouridae	3
WVOGM-33-B	Limnephilidae	1
WVOGM-33-B	Leptophlebiidae	3
WVOGM-33-B	Isonychiidae	1
WVOGM-33-B	Tipulidae	2
WVOGM-33-B	Baetidae	31
WVOGM-33-B	Gomphidae	2
WVOGM-33-B	Gerridae	1
WVOGM-33-B	Ephemerellidae	26
WVOGM-33-B	Elmidae	5
WVOGM-33-B	Chironomidae	5
WVOGM-33-B	Ceratopogonidae	2
WVOGM-33-B	Capniidae/Leuctri	14
WVOGM-33-B	Cambaridae	1
WVOGM-33-B	Heptageniidae	32
WVOGM-33-C	Limnephilidae	1
WVOGM-33-C	Nemouridae	5
WVOGM-33-C	Oligochaeta	1
WVOGM-33-C	Oligoneuriidae	1
WVOGM-33-C	Perlidae	10
WVOGM-33-C	Psephenidae	6
WVOGM-33-C	Simuliidae	1
WVOGM-33-C	Leptophlebiidae	5
WVOGM-33-C	Tipulidae	17
WVOGM-33-C	Elmidae	6
WVOGM-33-C	Tabanidae	1

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOGM-33-C	Cambaridae	1
WVOGM-33-C	Baetidae	35
WVOGM-33-C	Ephemerellidae	8
WVOGM-33-C	Corydalidae	2
WVOGM-33-C	Chloroperlidae	1
WVOGM-33-C	Chironomidae	29
WVOGM-33-C	Ceratopogonidae	1
WVOGM-33-C	Capniidae/Leuctri	8
WVOGM-33-C	Hydropsychidae	1
WVOGM-33-C	Heptageniidae	33
WVOGM-35-{1.8}	Simuliidae	13
WVOGM-35-{1.8}	Hydropsychidae	1
WVOGM-35-{1.8}	Psephenidae	1
WVOGM-35-{1.8}	Isonychiidae	7
WVOGM-35-{1.8}	Nemouridae	1
WVOGM-35-{1.8}	Perlidae	29
WVOGM-35-{1.8}	Heptageniidae	3
WVOGM-35-{1.8}	Chironomidae	14
WVOGM-35-{1.8}	Elmidae	29
WVOGM-35-{1.8}	Capniidae/Leuctri	5
WVOGM-35-{1.8}	Cambaridae	1
WVOGM-35-{1.8}	Baetidae	84
WVOGM-35-{1.8}	Ephemerellidae	4
WVOGM-35-{1.8}	Gomphidae	3
WVOGM-35-{4.1}	Isonychiidae	15
WVOGM-35-{4.1}	Veliidae	1
WVOGM-35-{4.1}	Tipulidae	2
WVOGM-35-{4.1}	Simuliidae	8
WVOGM-35-{4.1}	Psephenidae	1
WVOGM-35-{4.1}	Perlodidae	5
WVOGM-35-{4.1}	Nemouridae	24
WVOGM-35-{4.1}	Heptageniidae	2
WVOGM-35-{4.1}	Aeshnidae	1
WVOGM-35-{4.1}	Ephemerellidae	13
WVOGM-35-{4.1}	Elmidae	29
WVOGM-35-{4.1}	Chironomidae	2
WVOGM-35-{4.1}	Capniidae/Leuctri	20
WVOGM-35-{4.1}	Baetidae	90
WVOGM-35-{4.1}	Gomphidae	4
WVOGM-35-{4.1}	Perlidae	20
WVOGM-35-E	Heptageniidae	6
WVOGM-35-E	Hydropsychidae	5
WVOGM-35-E	Leptophlebiidae	1
WVOGM-35-E	Tipulidae	1
WVOGM-35-E	Nemouridae	2
WVOGM-35-E	Philopotamidae	4
WVOGM-35-E	Perlodidae	1
WVOGM-35-E	Gomphidae	4
WVOGM-35-E	Baetidae	19
WVOGM-35-E	Perlidae	12
WVOGM-35-E	Elmidae	80
WVOGM-35-E	Dryopidae	2
WVOGM-35-E	Corydalidae	1
WVOGM-35-E	Chloroperlidae	1
WVOGM-35-E	Capniidae/Leuctri	20
WVOGM-35-E	Ameletidae	10
WVOGM-35-E	Aeshnidae	6
WVOGM-35-E	Ephemerellidae	3
WVOGM-35-E	Chironomidae	27
WVOGM-39	Heptageniidae	7
WVOGM-39	Hydropsychidae	17
WVOGM-39	Isonychiidae	11
WVOGM-39	Tipulidae	2
WVOGM-39	Lepidostomatidae	1
WVOGM-39	Simuliidae	6
WVOGM-39	Nemouridae	4
WVOGM-39	Oligochaeta	3
WVOGM-39	Psephenidae	2
WVOGM-39	Capniidae/Leuctri	16
WVOGM-39	Perlidae	24
WVOGM-39	Ephemerellidae	4
WVOGM-39	Elmidae	41
WVOGM-39	Chironomidae	26
WVOGM-39	Cambaridae	1
WVOGM-39	Caenidae	1
WVOGM-39	Baetidae	41
WVOGM-39	Aeshnidae	2
WVOGM-39	Gomphidae	1
WVOGM-39	Dryopidae	1
WVOGM-39-{10.2}	Capniidae/Leuctri	13
WVOGM-39-{10.2}	Psephenidae	4
WVOGM-39-{10.2}	Perlidae	4
WVOGM-39-{10.2}	Isonychiidae	4
WVOGM-39-{10.2}	Hydropsychidae	50
WVOGM-39-{10.2}	Elmidae	140
WVOGM-39-{10.2}	Corydalidae	1
WVOGM-39-{10.2}	Chironomidae	49
WVOGM-39-{10.2}	Cambaridae	1
WVOGM-39-{10.2}	Baetidae	57
WVOGM-39-{10.2}	Chloroperlidae	1

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOGM-39-G	Heptageniidae	5
WVOGM-39-G	Perlidae	4
WVOGM-39-G	Simuliidae	7
WVOGM-39-G	Oligochaeta	1
WVOGM-39-G	Leptophlebiidae	4
WVOGM-39-G	Isonychiidae	3
WVOGM-39-G	Hydropsychidae	13
WVOGM-39-G	Elmidae	19
WVOGM-39-G	Chironomidae	60
WVOGM-39-G	Capniidae/Leuctri	15
WVOGM-39-G	Cambaridae	1
WVOGM-39-G	Caenidae	1
WVOGM-39-G	Baetidae	45
WVOGM-39-G	Tipulidae	9
WVOGM-39-G	Ephemerellidae	3
WVOGM-40.3-{0}	Tabanidae	1
WVOGM-40.3-{0}	Isonychiidae	1
WVOGM-40.3-{0}	Nemouridae	6
WVOGM-40.3-{0}	Oligochaeta	4
WVOGM-40.3-{0}	Perlidae	3
WVOGM-40.3-{0}	Perlodidae	2
WVOGM-40.3-{0}	Simuliidae	2
WVOGM-40.3-{0}	Hydropsychidae	1
WVOGM-40.3-{0}	Tipulidae	6
WVOGM-40.3-{0}	Psephenidae	4
WVOGM-40.3-{0}	Cambaridae	2
WVOGM-40.3-{0}	Nematoda	1
WVOGM-40.3-{0}	Heptageniidae	4
WVOGM-40.3-{0}	Baetiscidae	3
WVOGM-40.3-{0}	Capniidae/Leuctri	16
WVOGM-40.3-{0}	Chironomidae	12
WVOGM-40.3-{0}	Corydalidae	1
WVOGM-40.3-{0}	Dytiscidae	1
WVOGM-40.3-{0}	Elmidae	21
WVOGM-40.3-{0}	Ephemerellidae	22
WVOGM-40.3-{0}	Baetidae	81
WVOGM-40.3-{2.2}	Ephemeridae	5
WVOGM-40.3-{2.2}	Leptophlebiidae	21
WVOGM-40.3-{2.2}	Gomphidae	4
WVOGM-40.3-{2.2}	Heptageniidae	1
WVOGM-40.3-{2.2}	Isonychiidae	1
WVOGM-40.3-{2.2}	Lepidostomatidae	1
WVOGM-40.3-{2.2}	Nemouridae	11
WVOGM-40.3-{2.2}	Psephenidae	1
WVOGM-40.3-{2.2}	Simuliidae	1
WVOGM-40.3-{2.2}	Tipulidae	15
WVOGM-40.3-{2.2}	Limnephilidae	1
WVOGM-40.3-{2.2}	Veliidae	1
WVOGM-40.3-{2.2}	Perlidae	9
WVOGM-40.3-{2.2}	Aeshnidae	1
WVOGM-40.3-{2.2}	Baetidae	17
WVOGM-40.3-{2.2}	Capniidae/Leuctri	59
WVOGM-40.3-{2.2}	Ephemerellidae	6
WVOGM-40.3-{2.2}	Chironomidae	15
WVOGM-40.3-{2.2}	Corduliidae	3
WVOGM-40.3-{2.2}	Corydalidae	2
WVOGM-40.3-{2.2}	Dryopidae	1
WVOGM-40.3-{2.2}	Elmidae	17
WVOGM-40.3-{2.2}	Empididae	1
WVOGM-40.3-{2.2}	Cambaridae	4
WVOGM-43	Tipulidae	2
WVOGM-43	Ephemeridae	1
WVOGM-43	Rhyacophilidae	1
WVOGM-43	Psephenidae	1
WVOGM-43	Nemouridae	16
WVOGM-43	Leptophlebiidae	4
WVOGM-43	Heptageniidae	15
WVOGM-43	Ephemerellidae	34
WVOGM-43	Elmidae	7
WVOGM-43	Chironomidae	7
WVOGM-43	Simuliidae	3
WVOGM-43	Cambaridae	2
WVOGM-43	Baetidae	121
WVOGM-43	Capniidae/Leuctri	43
WVOGM-44-{0.2}	Psephenidae	3
WVOGM-44-{0.2}	Nemouridae	13
WVOGM-44-{0.2}	Dytiscidae	2
WVOGM-44-{0.2}	Hydropsychidae	1
WVOGM-44-{0.2}	Leptophlebiidae	2
WVOGM-44-{0.2}	Heptageniidae	5
WVOGM-44-{0.2}	Gomphidae	3
WVOGM-44-{0.2}	Perlidae	3
WVOGM-44-{0.2}	Elmidae	13
WVOGM-44-{0.2}	Chironomidae	9
WVOGM-44-{0.2}	Capniidae/Leuctri	24
WVOGM-44-{0.2}	Cambaridae	5
WVOGM-44-{0.2}	Baetidae	86
WVOGM-44-{0.2}	Tipulidae	7
WVOGM-44-{0.2}	Simuliidae	2
WVOGM-44-{0.2}	Perlodidae	1
WVOGM-44-{0.2}	Ephemerellidae	27

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOGM-50	Leptophlebiidae	2
WVOGM-50	Veliidae	2
WVOGM-50	Gomphidae	1
WVOGM-50	Heptageniidae	5
WVOGM-50	Hydropsychidae	4
WVOGM-50	Lepidostomatidae	1
WVOGM-50	Tipulidae	16
WVOGM-50	Ephemerellidae	11
WVOGM-50	Nemouridae	36
WVOGM-50	Dryopidae	1
WVOGM-50	Elmidae	1
WVOGM-50	Baetidae	35
WVOGM-50	Chloroperlidae	1
WVOGM-50	Corydalidae	1
WVOGM-50	Capniidae/Leuctri	48
WVOGM-50	Empididae	1
WVOGM-50	Tabanidae	1
WVOGM-50	Rhyacophilidae	1
WVOGM-50	Polycentropodidae	1
WVOGM-50	Perlodidae	4
WVOGM-50	Perlidae	4
WVOGM-50	Peltoperlidae	1
WVOGM-50	Chironomidae	5
WVOG-3	Elmidae	4
WVOG-3	Caenidae	2
WVOG-3	Heptageniidae	6
WVOG-3	Chironomidae	89
WVOG-3	Oligochaeta	1
WVOG-3-0.5A	Capniidae/Leuctri	5
WVOG-3-0.5A	Leptophlebiidae	2
WVOG-3-0.5A	Gammaridae	1
WVOG-3-0.5A	Ephemeridae	78
WVOG-3-0.5A	Veliidae	1
WVOG-3-0.5A	Chironomidae	18
WVOG-3-0.5A	Baetidae	1
WVOG-3-0.5A	Asellidae	138
WVOG-3-0.5A	Nemouridae	2
WVOG-3-0.5A	Elmidae	3
WVOG-6-{0.1}	Chironomidae	36
WVOG-6-{0.1}	Heptageniidae	2
WVOG-6-{0.1}	Elmidae	6
WVOG-6-{0.1}	Calopterygidae	1
WVOG-6-{0.1}	Caenidae	3
WVOG-6-{0.1}	Helophoridae	1
WVOG-9-A-{0.3}	Simuliidae	9
WVOG-9-A-{0.3}	Asellidae	7
WVOG-9-A-{0.3}	Baetidae	10
WVOG-9-A-{0.3}	Caenidae	2
WVOG-9-A-{0.3}	Capniidae/Leuctri	3
WVOG-9-A-{0.3}	Ceratopogonidae	2
WVOG-9-A-{0.3}	Chironomidae	94
WVOG-9-A-{0.3}	Elmidae	24
WVOG-9-A-{0.3}	Heptageniidae	33
WVOG-9-A-{0.3}	Hydropsychidae	57
WVOG-9-A-{0.3}	Leptophlebiidae	3
WVOG-9-A-{0.3}	Perlidae	1
WVOG-9-A-{0.3}	Veliidae	1
WVOG-9-A-{0.3}	Nemouridae	1
WVOG-10	Baetidae	1
WVOG-10	Chironomidae	127
WVOG-10	Caenidae	8
WVOG-10	Cambaridae	1
WVOG-10	Elmidae	20
WVOG-10	Hydropsychidae	8
WVOG-10	Psephenidae	4
WVOG-10	Ephemerellidae	1
WVOG-10-A	Leptophlebiidae	3
WVOG-10-A	Asellidae	2
WVOG-10-A	Baetidae	34
WVOG-10-A	Capniidae/Leuctri	2
WVOG-10-A	Chironomidae	561
WVOG-10-A	Elmidae	4
WVOG-10-A	Ephemerellidae	1
WVOG-10-A	Hydropsychidae	15
WVOG-10-A	Nemouridae	4
WVOG-10-A	Psephenidae	1
WVOG-10-A	Simuliidae	2
WVOG-10-A	Tipulidae	1
WVOG-10-A	Heptageniidae	12
WVOG-11	Chironomidae	144
WVOG-11	Tipulidae	5
WVOG-11	Psephenidae	22
WVOG-11	Oligochaeta	4
WVOG-11	Isonychiidae	1
WVOG-11	Hydropsychidae	1
WVOG-11	Elmidae	32
WVOG-11	Simuliidae	3
WVOG-11	Caenidae	3
WVOG-11	Asellidae	7
WVOG-11	Heptageniidae	30

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOG-14-D-{0.4}	Oligochaeta	3
WVOG-14-D-{0.4}	Caenidae	46
WVOG-14-D-{0.4}	Veliidae	1
WVOG-14-D-{0.4}	Tipulidae	2
WVOG-14-D-{0.4}	Tabanidae	2
WVOG-14-D-{0.4}	Stratiomyidae	1
WVOG-14-D-{0.4}	Sciomyzidae	1
WVOG-14-D-{0.4}	Dixidae	1
WVOG-14-D-{0.4}	Coenagrionidae	35
WVOG-14-D-{0.4}	Chironomidae	71
WVOG-14-D-{0.4}	Ceratopogonidae	1
WVOG-14-D-{0.4}	Cambaridae	1
WVOG-14-D-{0.4}	Calopterygidae	3
WVOG-14-D-{0.4}	Asellidae	1
WVOG-14-D-{0.4}	Simuliidae	6
WVOG-23.5	Capniidae/Leuctri	2
WVOG-23.5	Perlidae	2
WVOG-23.5	Tipulidae	1
WVOG-23.5	Simuliidae	42
WVOG-23.5	Oligochaeta	23
WVOG-23.5	Heptageniidae	7
WVOG-23.5	Chironomidae	136
WVOG-23.5	Gerridae	2
WVOG-27-A	Hydropsychidae	11
WVOG-27-A	Baetidae	43
WVOG-27-A	Tipulidae	1
WVOG-27-A	Simuliidae	1
WVOG-27-A	Psephenidae	2
WVOG-27-A	Perlodidae	1
WVOG-27-A	Perlidae	9
WVOG-27-A	Oligochaeta	9
WVOG-27-A	Nemouridae	7
WVOG-27-A	Leptophlebiidae	2
WVOG-27-A	Caenidae	1
WVOG-27-A	Cambaridae	4
WVOG-27-A	Veliidae	1
WVOG-27-A	Heptageniidae	19
WVOG-27-A	Capniidae/Leuctri	21
WVOG-27-A	Ceratopogonidae	1
WVOG-27-A	Chironomidae	55
WVOG-27-A	Dytiscidae	4
WVOG-27-A	Elmidae	13
WVOG-27-A	Gomphidae	1
WVOG-27-H-{1.8}	Tipulidae	3

AN Code	Taxon	Count
WVOG-27-H-{1.8}	Perlidae	6
WVOG-27-H-{1.8}	Nemouridae	5
WVOG-27-H-{1.8}	Leptophlebiidae	65
WVOG-27-H-{1.8}	Isonychiidae	1
WVOG-27-H-{1.8}	Hydropsychidae	4
WVOG-27-H-{1.8}	Elmidae	1
WVOG-27-H-{1.8}	Dixidae	1
WVOG-27-H-{1.8}	Chironomidae	7
WVOG-27-H-{1.8}	Capniidae/Leuctri	25
WVOG-27-H-{1.8}	Aeshnidae	3
WVOG-27-H-{1.8}	Baetidae	30
WVOG-27-H-{1.8}	Heptageniidae	53
WVOG-29-C	Simuliidae	1
WVOG-29-C	Hydropsychidae	3
WVOG-29-C	Leptophlebiidae	8
WVOG-29-C	Nemouridae	4
WVOG-29-C	Oligochaeta	1
WVOG-29-C	Perlodidae	3
WVOG-29-C	Philopotamidae	3
WVOG-29-C	Psephenidae	3
WVOG-29-C	Heptageniidae	11
WVOG-29-C	Tipulidae	5
WVOG-29-C	Veliidae	1
WVOG-29-C	Polycentropodidae	3
WVOG-29-C	Baetidae	79
WVOG-29-C	Lepidostomatidae	1
WVOG-29-C	Asellidae	1
WVOG-29-C	Gomphidae	2
WVOG-29-C	Cambaridae	1
WVOG-29-C	Capniidae/Leuctri	42
WVOG-29-C	Ceratopogonidae	1
WVOG-29-C	Chironomidae	11
WVOG-29-C	Elmidae	12
WVOG-29-C	Ephemerellidae	41
WVOG-29-C	Glossosomatidae	3
WVOG-29-C	Ameletidae	1
WVOG-30-{1.2}	Heptageniidae	18
WVOG-30-{1.2}	Leptophlebiidae	5
WVOG-30-{1.2}	Veliidae	1
WVOG-30-{1.2}	Tipulidae	12
WVOG-30-{1.2}	Simuliidae	1
WVOG-30-{1.2}	Psephenidae	1
WVOG-30-{1.2}	Nemouridae	1
WVOG-30-{1.2}	Capniidae/Leuctri	20
WVOG-30-{1.2}	Cambaridae	1
WVOG-30-{1.2}	Chironomidae	6

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOG-30-{1.2}	Elmidae	1
WVOG-30-{1.2}	Perlidae	1
WVOG-30-{1.2}	Ephemerellidae	25
WVOG-30-{1.2}	Baetidae	102
WVOG-30-{1.2}	Glossosomatidae	1
WVOG-30-{1.2}	Gomphidae	2
WVOG-32-F	Leptophlebiidae	3
WVOG-32-F	Hydropsychidae	14
WVOG-32-F	Tipulidae	9
WVOG-32-F	Psephenidae	9
WVOG-32-F	Polycentropodidae	1
WVOG-32-F	Perlodidae	5
WVOG-32-F	Nemouridae	2
WVOG-32-F	Isonychiidae	2
WVOG-32-F	Chironomidae	17
WVOG-32-F	Perlidae	4
WVOG-32-F	Heptageniidae	3
WVOG-32-F	Capniidae/Leuctri	79
WVOG-32-F	Chloroperlidae	1
WVOG-32-F	Elmidae	21
WVOG-32-F	Aeshnidae	1
WVOG-32-F	Ephemerellidae	14
WVOG-32-F	Gomphidae	2
WVOG-32-F	Baetidae	40
WVOG-34	Tipulidae	9
WVOG-34	Caenidae	38
WVOG-34	Heptageniidae	1
WVOG-34	Psephenidae	1
WVOG-34	Oligochaeta	2
WVOG-34	Leptophlebiidae	1
WVOG-34	Lampyridae	1
WVOG-34	Ephemerellidae	49
WVOG-34	Elmidae	4
WVOG-34	Capniidae/Leuctri	1
WVOG-34	Baetiscidae	4
WVOG-34	Baetidae	47
WVOG-34	Chironomidae	22
WVOG-34-A	Gomphidae	1
WVOG-34-A	Psephenidae	1
WVOG-34-A	Heptageniidae	2
WVOG-34-A	Elmidae	3
WVOG-34-A	Chironomidae	29
WVOG-34-A	Baetidae	137
WVOG-34-A	Ephemerellidae	24
WVOG-34-B	Heptageniidae	1
WVOG-34-B	Baetidae	6
WVOG-34-B	Tipulidae	6
WVOG-34-B	Simuliidae	1
WVOG-34-B	Psephenidae	5
WVOG-34-B	Physidae	1
WVOG-34-B	Perlodidae	1
WVOG-34-B	Nemouridae	3
WVOG-34-B	Ephemeridae	1
WVOG-34-B	Caenidae	26
WVOG-34-B	Oligochaeta	1
WVOG-34-B	Baetiscidae	1
WVOG-34-B	Ephemerellidae	15
WVOG-34-B	Capniidae/Leuctri	2
WVOG-34-B	Ceratopogonidae	1
WVOG-34-B	Chironomidae	61
WVOG-34-B	Corydalidae	1
WVOG-34-B	Dryopidae	1
WVOG-34-B	Elmidae	46
WVOG-34-E-1	Heptageniidae	15
WVOG-34-E-1	Cambaridae	1
WVOG-34-E-1	Philopotamidae	1
WVOG-34-E-1	Tipulidae	10
WVOG-34-E-1	Perlidae	1
WVOG-34-E-1	Peltoperlidae	1
WVOG-34-E-1	Nemouridae	4
WVOG-34-E-1	Leptophlebiidae	17
WVOG-34-E-1	Hydropsychidae	6
WVOG-34-E-1	Psephenidae	1
WVOG-34-E-1	Capniidae/Leuctri	3
WVOG-34-E-1	Chironomidae	11
WVOG-34-E-1	Baetidae	28
WVOG-34-E-1	Gomphidae	3
WVOG-34-E-1	Chloroperlidae	3
WVOG-34-E-1	Corydalidae	1
WVOG-34-E-1	Dryopidae	2
WVOG-34-E-1	Elmidae	18
WVOG-34-E-1	Ephemerellidae	73
WVOG-34-E-1	Ephemeridae	1
WVOG-34-E-1-{0.8}	Nemouridae	1
WVOG-34-E-1-{0.8}	Tipulidae	30
WVOG-34-E-1-{0.8}	Psephenidae	18
WVOG-34-E-1-{0.8}	Perlidae	3
WVOG-34-E-1-{0.8}	Leptophlebiidae	25
WVOG-34-E-1-{0.8}	Hydropsychidae	9
WVOG-34-E-1-{0.8}	Heptageniidae	2

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOG-34-E-1-{0.8}	Elmidae	29
WVOG-34-E-1-{0.8}	Chloroperlidae	3
WVOG-34-E-1-{0.8}	Baetidae	27
WVOG-34-E-1-{0.8}	Chironomidae	10
WVOG-34-E-1-{0.8}	Polycentropodidae	4
WVOG-34-E-1-{0.8}	Capniidae/Leuctri	10
WVOG-34-E-1-{0.8}	Cambaridae	1
WVOG-34-E-1-{0.8}	Gomphidae	3
WVOG-35	Elmidae	16
WVOG-35	Tipulidae	1
WVOG-35	Simuliidae	4
WVOG-35	Rhyacophilidae	1
WVOG-35	Psephenidae	16
WVOG-35	Peltoperlidae	1
WVOG-35	Ephemeridae	20
WVOG-35	Chironomidae	61
WVOG-35	Baetidae	53
WVOG-35	Hydropsychidae	2
WVOG-36	Gomphidae	1
WVOG-36	Nemouridae	11
WVOG-36	Psephenidae	1
WVOG-36	Heptageniidae	1
WVOG-36	Elmidae	2
WVOG-36	Baetidae	135
WVOG-36	Chironomidae	6
WVOG-36	Ephemerellidae	11
WVOG-37	Isonychiidae	1
WVOG-37	Tipulidae	2
WVOG-37	Simuliidae	1
WVOG-37	Rhyacophilidae	3
WVOG-37	Philopotamidae	8
WVOG-37	Perlodidae	1
WVOG-37	Perlidae	1
WVOG-37	Nemouridae	3
WVOG-37	Baetidae	65
WVOG-37	Leptophlebiidae	1
WVOG-37	Hydropsychidae	6
WVOG-37	Heptageniidae	1
WVOG-37	Ephemerellidae	46
WVOG-37	Elmidae	7
WVOG-37	Dryopidae	2
WVOG-37	Chironomidae	7
WVOG-37	Capniidae/Leuctri	19
WVOG-37	Cambaridae	1
WVOG-37	Limnephilidae	4
WVOG-38-{0.8}	Ephemerellidae	10
WVOG-38-{0.8}	Chironomidae	8
WVOG-38-{0.8}	Veliidae	1
WVOG-38-{0.8}	Perlidae	9
WVOG-38-{0.8}	Heptageniidae	7
WVOG-38-{0.8}	Aeshnidae	1
WVOG-38-{0.8}	Elmidae	34
WVOG-38-{0.8}	Caenidae	2
WVOG-38-{0.8}	Baetiscidae	2
WVOG-38-{0.8}	Baetidae	11
WVOG-38-{0.8}	Corbiculidae	1
WVOG-38-{11.6}	Ephemerellidae	7
WVOG-38-{11.6}	Taeniopterygidae	1
WVOG-38-{11.6}	Psephenidae	1
WVOG-38-{11.6}	Nemouridae	3
WVOG-38-{11.6}	Nemertea	1
WVOG-38-{11.6}	Isonychiidae	2
WVOG-38-{11.6}	Hydropsychidae	9
WVOG-38-{11.6}	Heptageniidae	7
WVOG-38-{11.6}	Ephemeridae	1
WVOG-38-{11.6}	Capniidae/Leuctri	7
WVOG-38-{11.6}	Gomphidae	1
WVOG-38-{11.6}	Baetiscidae	1
WVOG-38-{11.6}	Tipulidae	3
WVOG-38-{11.6}	Ceratopogonidae	2
WVOG-38-{11.6}	Chironomidae	12
WVOG-38-{11.6}	Corydalidae	1
WVOG-38-{11.6}	Elmidae	19
WVOG-38-{11.6}	Empididae	1
WVOG-38-{11.6}	Baetidae	117
WVOG-38-A	Isonychiidae	3
WVOG-38-A	Taeniopterygidae	2
WVOG-38-A	Tipulidae	5
WVOG-38-A	Simuliidae	20
WVOG-38-A	Perlodidae	1
WVOG-38-A	Nemouridae	16
WVOG-38-A	Elmidae	2
WVOG-38-A	Chloroperlidae	2
WVOG-38-A	Chironomidae	7
WVOG-38-A	Capniidae/Leuctri	16
WVOG-38-A	Baetidae	91
WVOG-38-A	Ephemerellidae	11
WVOG-38-A	Cambaridae	2
WVOG-38-D-{3.9}	Rhyacophilidae	2

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOG-38-D-{3.9}	Leptophlebiidae	4
WVOG-38-D-{3.9}	Nemouridae	12
WVOG-38-D-{3.9}	Peltoperlidae	1
WVOG-38-D-{3.9}	Tipulidae	6
WVOG-38-D-{3.9}	Perlidae	2
WVOG-38-D-{3.9}	Lepidostomatidae	1
WVOG-38-D-{3.9}	Perlodidae	4
WVOG-38-D-{3.9}	Polycentropodidae	1
WVOG-38-D-{3.9}	Simuliidae	4
WVOG-38-D-{3.9}	Chloroperlidae	1
WVOG-38-D-{3.9}	Philopotamidae	5
WVOG-38-D-{3.9}	Aeshnidae	1
WVOG-38-D-{3.9}	Hydropsychidae	5
WVOG-38-D-{3.9}	Baetidae	40
WVOG-38-D-{3.9}	Cambaridae	3
WVOG-38-D-{3.9}	Capniidae/Leuctri	37
WVOG-38-D-{3.9}	Chironomidae	3
WVOG-38-D-{3.9}	Ephemerellidae	41
WVOG-38-D-{3.9}	Gerridae	1
WVOG-38-D-{3.9}	Gomphidae	4
WVOG-38-D-{3.9}	Heptageniidae	12
WVOG-38-D-{3.9}	Dryopidae	2
WVOG-38-D-{3.9}	Elmidae	18
WVOG-38-D-{4.5}	Tipulidae	18
WVOG-38-D-{4.5}	Hydropsychidae	14
WVOG-38-D-{4.5}	Lepidostomatidae	1
WVOG-38-D-{4.5}	Leptophlebiidae	23
WVOG-38-D-{4.5}	Nemouridae	4
WVOG-38-D-{4.5}	Perlidae	4
WVOG-38-D-{4.5}	Perlodidae	4
WVOG-38-D-{4.5}	Simuliidae	1
WVOG-38-D-{4.5}	Heptageniidae	3
WVOG-38-D-{4.5}	Dryopidae	1
WVOG-38-D-{4.5}	Philopotamidae	6
WVOG-38-D-{4.5}	Cambaridae	1
WVOG-38-D-{4.5}	Aeshnidae	2
WVOG-38-D-{4.5}	Ephemerellidae	13
WVOG-38-D-{4.5}	Brachycentridae	1
WVOG-38-D-{4.5}	Ephemeridae	1
WVOG-38-D-{4.5}	Capniidae/Leuctri	26
WVOG-38-D-{4.5}	Ceratopogonidae	1
WVOG-38-D-{4.5}	Chironomidae	14
WVOG-38-D-{4.5}	Elmidae	22
WVOG-38-D-{4.5}	Baetidae	44
WVOG-38-G	Nemouridae	2
WVOG-38-G	Simuliidae	1
WVOG-38-G	Philopotamidae	4
WVOG-38-G	Isonychiidae	1
WVOG-38-G	Perlidae	1
WVOG-38-G	Tipulidae	5
WVOG-38-G	Leptophlebiidae	5
WVOG-38-G	Baetidae	103
WVOG-38-G	Heptageniidae	1
WVOG-38-G	Perlodidae	2
WVOG-38-G	Capniidae/Leuctri	26
WVOG-38-G	Ceratopogonidae	1
WVOG-38-G	Chironomidae	5
WVOG-38-G	Chloroperlidae	1
WVOG-38-G	Elmidae	4
WVOG-38-G	Ephemerellidae	31
WVOG-38-K	Psephenidae	2
WVOG-38-K	Hydropsychidae	6
WVOG-38-K	Perlodidae	6
WVOG-38-K	Perlidae	1
WVOG-38-K	Nemouridae	6
WVOG-38-K	Leptophlebiidae	1
WVOG-38-K	Isonychiidae	1
WVOG-38-K	Tipulidae	2
WVOG-38-K	Gomphidae	1
WVOG-38-K	Ephemerellidae	22
WVOG-38-K	Empididae	1
WVOG-38-K	Elmidae	9
WVOG-38-K	Chironomidae	8
WVOG-38-K	Capniidae/Leuctri	4
WVOG-38-K	Baetidae	114
WVOG-38-K	Heptageniidae	7
WVOG-38-K.7	Hydropsychidae	2
WVOG-38-K.7	Perlodidae	7
WVOG-38-K.7	Baetidae	126
WVOG-38-K.7	Leptophlebiidae	2
WVOG-38-K.7	Heptageniidae	4
WVOG-38-K.7	Ephemerellidae	14
WVOG-38-K.7	Dytiscidae	1
WVOG-38-K.7	Chironomidae	34
WVOG-38-K.7	Cambaridae	1
WVOG-38-K.7	Gomphidae	1
WVOG-38-K.7	Nemouridae	8
WVOG-38-K-5	Cambaridae	5
WVOG-38-K-5	Lepidostomatidae	1
WVOG-38-K-5	Hydropsychidae	20
WVOG-38-K-5	Gomphidae	2

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOG-38-K-5	Ephemerellidae	14
WVOG-38-K-5	Elmidae	13
WVOG-38-K-5	Dryopidae	5
WVOG-38-K-5	Corydalidae	1
WVOG-38-K-5	Capniidae/Leuctri	34
WVOG-38-K-5	Baetidae	23
WVOG-38-K-5	Aeshnidae	1
WVOG-38-K-5	Leptophlebiidae	14
WVOG-38-K-5	Dixidae	1
WVOG-38-K-5	Perlodidae	2
WVOG-38-K-5	Simuliidae	2
WVOG-38-K-5	Tabanidae	3
WVOG-38-K-5	Tipulidae	20
WVOG-38-K-5	Chironomidae	2
WVOG-38-K-5	Perlidae	2
WVOG-40	Elmidae	5
WVOG-40	Tipulidae	2
WVOG-40	Taeniopterygidae	1
WVOG-40	Lepidostomatidae	1
WVOG-40	Heptageniidae	1
WVOG-40	Ephemerellidae	8
WVOG-40	Chironomidae	14
WVOG-40	Caenidae	3
WVOG-40	Baetidae	57
WVOG-40	Ephemeridae	1
WVOG-41	Oligochaeta	2
WVOG-41	Ephemerellidae	5
WVOG-41	Tipulidae	2
WVOG-41	Psychodidae	1
WVOG-41	Ephydridae	1
WVOG-41	Baetidae	4
WVOG-41	Chironomidae	150
WVOG-41	Nemouridae	2
WVOG-42-A	Oligochaeta	2
WVOG-42-A	Tricorythidae	1
WVOG-42-A	Psephenidae	1
WVOG-42-A	Nemouridae	5
WVOG-42-A	Ephemerellidae	45
WVOG-42-A	Chironomidae	61
WVOG-42-A	Baetidae	60
WVOG-42-A	Psychodidae	2
WVOG-42-C-{0.2}	Elmidae	4
WVOG-42-C-{0.2}	Nemouridae	3
WVOG-42-C-{0.2}	Psephenidae	4
WVOG-42-C-{0.2}	Hydropsychidae	1
WVOG-42-C-{0.2}	Heptageniidae	2
WVOG-42-C-{0.2}	Ephemerellidae	11
WVOG-42-C-{0.2}	Chironomidae	94
WVOG-42-C-{0.2}	Ceratopogonidae	2
WVOG-42-C-{0.2}	Capniidae/Leuctri	1
WVOG-42-C-{0.2}	Caenidae	26
WVOG-42-C-{0.2}	Aeshnidae	1
WVOG-42-C-{0.2}	Baetidae	38
WVOG-42-C-{0.2}	Tipulidae	2
WVOG-42-D	Heptageniidae	7
WVOG-42-D	Hydropsychidae	2
WVOG-42-D	Leptophlebiidae	33
WVOG-42-D	Nemouridae	7
WVOG-42-D	Oligochaeta	1
WVOG-42-D	Gomphidae	4
WVOG-42-D	Psephenidae	38
WVOG-42-D	Philopotamidae	2
WVOG-42-D	Perlidae	3
WVOG-42-D	Baetidae	98
WVOG-42-D	Empididae	2
WVOG-42-D	Elmidae	13
WVOG-42-D	Dryopidae	2
WVOG-42-D	Chironomidae	36
WVOG-42-D	Capniidae/Leuctri	3
WVOG-42-D	Cambaridae	2
WVOG-42-D	Caenidae	2
WVOG-42-D	Ephemerellidae	12
WVOG-42-D	Tipulidae	18
WVOG-42-E	Hydropsychidae	5
WVOG-42-E	Leptophlebiidae	2
WVOG-42-E	Nemouridae	3
WVOG-42-E	Perlidae	2
WVOG-42-E	Perlodidae	2
WVOG-42-E	Tipulidae	17
WVOG-42-E	Ephemerellidae	11
WVOG-42-E	Psephenidae	8
WVOG-42-E	Heptageniidae	7
WVOG-42-E	Ephemeridae	2
WVOG-42-E	Elmidae	13
WVOG-42-E	Chironomidae	27
WVOG-42-E	Capniidae/Leuctri	4
WVOG-42-E	Caenidae	22
WVOG-42-E	Baetidae	39
WVOG-42-E	Gomphidae	1

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOG-44-A.5	Hydropsychidae	15
WVOG-44-A.5	Perlodidae	1
WVOG-44-A.5	Psephenidae	9
WVOG-44-A.5	Perlidae	3
WVOG-44-A.5	Nemouridae	5
WVOG-44-A.5	Leptophlebiidae	3
WVOG-44-A.5	Isonychiidae	3
WVOG-44-A.5	Gomphidae	3
WVOG-44-A.5	Ephemerellidae	27
WVOG-44-A.5	Elmidae	8
WVOG-44-A.5	Chironomidae	23
WVOG-44-A.5	Capniidae/Leuctri	7
WVOG-44-A.5	Baetidae	64
WVOG-44-A.5	Cambaridae	1
WVOG-44-A.5	Tipulidae	1
WVOG-44-A.5	Heptageniidae	1
WVOG-44-A-2-{2.8}	Hydropsychidae	2
WVOG-44-A-2-{2.8}	Tipulidae	4
WVOG-44-A-2-{2.8}	Psephenidae	4
WVOG-44-A-2-{2.8}	Perlodidae	1
WVOG-44-A-2-{2.8}	Oligochaeta	2
WVOG-44-A-2-{2.8}	Leptophlebiidae	2
WVOG-44-A-2-{2.8}	Heptageniidae	10
WVOG-44-A-2-{2.8}	Ephemerellidae	1
WVOG-44-A-2-{2.8}	Elmidae	7
WVOG-44-A-2-{2.8}	Chironomidae	31
WVOG-44-A-2-{2.8}	Capniidae/Leuctri	1
WVOG-44-A-2-{2.8}	Nemouridae	23
WVOG-44-A-2-{2.8}	Baetidae	129
WVOG-44-C.3	Veliidae	1
WVOG-44-C.3	Nemouridae	1
WVOG-44-C.3	Oligochaeta	1
WVOG-44-C.3	Perlodidae	2
WVOG-44-C.3	Psephenidae	14
WVOG-44-C.3	Rhyacophilidae	1
WVOG-44-C.3	Tipulidae	5
WVOG-44-C.3	Cambaridae	5
WVOG-44-C.3	Leptophlebiidae	7
WVOG-44-C.3	Sphaeriidae	1
WVOG-44-C.3	Baetidae	79
WVOG-44-C.3	Chironomidae	33
WVOG-44-C.3	Aeshnidae	1
WVOG-44-C.3	Heptageniidae	7
WVOG-44-C.3	Capniidae/Leuctri	3
WVOG-44-C.3	Corydalidae	1
WVOG-44-C.3	Curculionidae	1
WVOG-44-C.3	Elmidae	1
WVOG-44-C.3	Ephemerellidae	30
WVOG-44-C.3	Ephemeridae	8
WVOG-44-C.7	Ephemerellidae	35
WVOG-44-C.7	Peltoperlidae	3
WVOG-44-C.7	Oligochaeta	1
WVOG-44-C.7	Nemouridae	5
WVOG-44-C.7	Leptophlebiidae	6
WVOG-44-C.7	Lepidostomatidae	1
WVOG-44-C.7	Psephenidae	5
WVOG-44-C.7	Gomphidae	1
WVOG-44-C.7	Perlodidae	5
WVOG-44-C.7	Aeshnidae	1
WVOG-44-C.7	Heptageniidae	34
WVOG-44-C.7	Ameletidae	3
WVOG-44-C.7	Baetidae	62
WVOG-44-C.7	Cambaridae	4
WVOG-44-C.7	Capniidae/Leuctri	16
WVOG-44-C.7	Chironomidae	7
WVOG-44-C.7	Chloroperlidae	1
WVOG-44-C.7	Elmidae	12
WVOG-44-E	Ephemerellidae	2
WVOG-44-E	Isonychiidae	2
WVOG-44-E	Tipulidae	6
WVOG-44-E	Psephenidae	5
WVOG-44-E	Nemouridae	1
WVOG-44-E	Leptophlebiidae	1
WVOG-44-E	Lampyridae	1
WVOG-44-E	Caenidae	30
WVOG-44-E	Heptageniidae	7
WVOG-44-E	Baetidae	43
WVOG-44-E	Gomphidae	1
WVOG-44-E	Capniidae/Leuctri	1
WVOG-44-E	Chironomidae	53
WVOG-44-E	Chloroperlidae	1
WVOG-44-E	Elmidae	33
WVOG-44-E-0.5	Ameletidae	1
WVOG-44-E-0.5	Lepidostomatidae	1
WVOG-44-E-0.5	Tipulidae	6
WVOG-44-E-0.5	Philopotamidae	1
WVOG-44-E-0.5	Perlodidae	5
WVOG-44-E-0.5	Peltoperlidae	1
WVOG-44-E-0.5	Nemouridae	10
WVOG-44-E-0.5	Leptophlebiidae	7
WVOG-44-E-0.5	Psephenidae	1

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOG-44-E-0.5	Heptageniidae	3
WVOG-44-E-0.5	Gomphidae	1
WVOG-44-E-0.5	Ephemerellidae	35
WVOG-44-E-0.5	Elmidae	12
WVOG-44-E-0.5	Chloroperlidae	2
WVOG-44-E-0.5	Chironomidae	2
WVOG-44-E-0.5	Baetidae	52
WVOG-44-E-0.5	Hydropsychidae	12
WVOG-44-E-0.5	Capniidae/Leuctri	23
WVOG-44-F-1	Gomphidae	2
WVOG-44-F-1	Heptageniidae	3
WVOG-44-F-1	Hydropsychidae	10
WVOG-44-F-1	Tipulidae	3
WVOG-44-F-1	Oligochaeta	1
WVOG-44-F-1	Nemouridae	135
WVOG-44-F-1	Perlodidae	2
WVOG-44-F-1	Psephenidae	1
WVOG-44-F-1	Philopotamidae	19
WVOG-44-F-1	Baetidae	44
WVOG-44-F-1	Peltoperlidae	1
WVOG-44-F-1	Calopterygidae	1
WVOG-44-F-1	Cambaridae	2
WVOG-44-F-1	Capniidae/Leuctri	16
WVOG-44-F-1	Chironomidae	11
WVOG-44-F-1	Chloroperlidae	2
WVOG-44-F-1	Elmidae	2
WVOG-44-F-1	Empididae	1
WVOG-44-F-1	Ephemerellidae	17
WVOG-44-G-{1.9}	Ephemerellidae	25
WVOG-44-G-{1.9}	Gomphidae	4
WVOG-44-G-{1.9}	Tipulidae	5
WVOG-44-G-{1.9}	Psephenidae	5
WVOG-44-G-{1.9}	Perlodidae	3
WVOG-44-G-{1.9}	Perlidae	1
WVOG-44-G-{1.9}	Peltoperlidae	4
WVOG-44-G-{1.9}	Nemouridae	1
WVOG-44-G-{1.9}	Ameletidae	2
WVOG-44-G-{1.9}	Elmidae	32
WVOG-44-G-{1.9}	Corydalidae	2
WVOG-44-G-{1.9}	Chironomidae	25
WVOG-44-G-{1.9}	Capniidae/Leuctri	4
WVOG-44-G-{1.9}	Caenidae	4
WVOG-44-G-{1.9}	Baetidae	33
WVOG-44-G-{1.9}	Heptageniidae	8
WVOG-44-H	Leptophlebiidae	4
WVOG-44-H	Nemouridae	13
WVOG-44-H	Oligochaeta	1
WVOG-44-H	Perlidae	4
WVOG-44-H	Perlodidae	2
WVOG-44-H	Polycentropodidae	1
WVOG-44-H	Psephenidae	9
WVOG-44-H	Tipulidae	9
WVOG-44-H	Psychodidae	1
WVOG-44-H	Isonychiidae	2
WVOG-44-H	Rhyacophilidae	1
WVOG-44-H	Caenidae	6
WVOG-44-H	Heptageniidae	7
WVOG-44-H	Taeniopterygidae	1
WVOG-44-H	Baetiscidae	1
WVOG-44-H	Baetidae	32
WVOG-44-H	Calopterygidae	1
WVOG-44-H	Capniidae/Leuctri	24
WVOG-44-H	Chironomidae	15
WVOG-44-H	Coenagrionidae	1
WVOG-44-H	Elmidae	8
WVOG-44-H	Ephemerellidae	30
WVOG-44-H	Ephemeridae	2
WVOG-44-H	Gomphidae	1
WVOG-44-I	Nemouridae	19
WVOG-44-I	Heptageniidae	26
WVOG-44-I	Tipulidae	1
WVOG-44-I	Psephenidae	18
WVOG-44-I	Perlidae	3
WVOG-44-I	Leptophlebiidae	3
WVOG-44-I	Isonychiidae	2
WVOG-44-I	Hydropsychidae	16
WVOG-44-I	Veliidae	1
WVOG-44-I	Baetidae	3
WVOG-44-I	Ephemeridae	1
WVOG-44-I	Ephemerellidae	25
WVOG-44-I	Empididae	1
WVOG-44-I	Elmidae	5
WVOG-44-I	Corydalidae	2
WVOG-44-I	Chloroperlidae	1
WVOG-44-I	Chironomidae	14
WVOG-44-I	Capniidae/Leuctri	12
WVOG-44-I	Perlodidae	5
WVOG-44-I	Gomphidae	1
WVOG-44-K	Hydropsychidae	8
WVOG-44-K	Leptophlebiidae	1
WVOG-44-K	Nemouridae	16

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOG-44-K	Perlidae	1
WVOG-44-K	Perlodidae	1
WVOG-44-K	Heptageniidae	2
WVOG-44-K	Tipulidae	5
WVOG-44-K	Corydalidae	2
WVOG-44-K	Psephenidae	1
WVOG-44-K	Gomphidae	1
WVOG-44-K	Ephemerellidae	43
WVOG-44-K	Elmidae	5
WVOG-44-K	Chironomidae	11
WVOG-44-K	Capniidae/Leuctri	8
WVOG-44-K	Cambaridae	1
WVOG-44-K	Baetidae	45
WVOG-44-K	Ameletidae	1
WVOG-44-K	Empididae	1
WVOG-48	Hydrophilidae	1
WVOG-48	Sialidae	1
WVOG-48	Rhyacophilidae	1
WVOG-48	Psychodidae	1
WVOG-48	Oligochaeta	1
WVOG-48	Nemouridae	7
WVOG-48	Elmidae	7
WVOG-48	Corydalidae	2
WVOG-48	Chironomidae	7
WVOG-48	Capniidae/Leuctri	6
WVOG-48	Baetidae	3
WVOG-48	Tipulidae	8
WVOG-48	Ephemerellidae	3
WVOG-49-{3.3}	Oligochaeta	6
WVOG-49-{3.3}	Chironomidae	38
WVOG-49-{3.3}	Elmidae	85
WVOG-49-{3.3}	Ephemerellidae	10
WVOG-49-{3.3}	Gomphidae	1
WVOG-49-{3.3}	Heptageniidae	12
WVOG-49-{3.3}	Hydropsychidae	1
WVOG-49-{3.3}	Nemouridae	3
WVOG-49-{3.3}	Caenidae	2
WVOG-49-{3.3}	Perlidae	1
WVOG-49-{3.3}	Psephenidae	4
WVOG-49-{3.3}	Simuliidae	2
WVOG-49-{3.3}	Isonychiidae	2
WVOG-49-{3.3}	Corydalidae	1
WVOG-49-{3.3}	Baetidae	29
WVOG-49-A	Tipulidae	2
WVOG-49-A	Capniidae/Leuctri	1

AN Code	Taxon	Count
WVOG-49-A	Chironomidae	4
WVOG-49-A	Dryopidae	1
WVOG-49-A	Elmidae	4
WVOG-49-A	Baetidae	2
WVOG-49-A-1	Oligochaeta	2
WVOG-49-A-1	Baetidae	1
WVOG-49-A-1	Capniidae/Leuctri	3
WVOG-49-A-1	Elmidae	6
WVOG-49-A-1	Chironomidae	2
WVOG-49-A-1	Tipulidae	3
WVOG-49-A-1	Ephemerellidae	3
WVOG-49-A-1	Hydropsychidae	21
WVOG-49-A-1	Asellidae	1
WVOG-49-B-1	Tipulidae	4
WVOG-49-B-1	Nemouridae	30
WVOG-49-B-1	Leptophlebiidae	4
WVOG-49-B-1	Lepidostomatidae	1
WVOG-49-B-1	Hydropsychidae	3
WVOG-49-B-1	Heptageniidae	29
WVOG-49-B-1	Ephemerellidae	27
WVOG-49-B-1	Elmidae	5
WVOG-49-B-1	Chironomidae	13
WVOG-49-B-1	Baetidae	39
WVOG-49-B-1	Psephenidae	1
WVOG-49-B-1	Cambaridae	1
WVOG-49-C	Tricorythidae	1
WVOG-49-C	Tipulidae	10
WVOG-49-C	Hydropsychidae	13
WVOG-49-C	Gammaridae	1
WVOG-49-C	Corydalidae	1
WVOG-49-C	Chironomidae	4
WVOG-49-C.1	Chironomidae	160
WVOG-49-C.1	Ceratopogonidae	1
WVOG-49-C.1	Capniidae/Leuctri	1
WVOG-49-C.1	Hydropsychidae	2
WVOG-49-D-2	Capniidae/Leuctri	3
WVOG-49-D-2	Elmidae	3
WVOG-49-D-2	Cambaridae	1
WVOG-49-D-2	Ephemerellidae	54
WVOG-49-D-2	Heptageniidae	29
WVOG-49-D-2	Hydropsychidae	1
WVOG-49-D-2	Leptophlebiidae	4
WVOG-49-D-2	Nemouridae	31

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOG-49-D-2	Oligochaeta	3
WVOG-49-D-2	Perlidae	2
WVOG-49-D-2	Perlodidae	1
WVOG-49-D-2	Psephenidae	2
WVOG-49-D-2	Stratiomyidae	1
WVOG-49-D-2	Tipulidae	1
WVOG-49-D-2	Chironomidae	23
WVOG-49-D-2	Ceratopogonidae	1
WVOG-49-D-2	Baetidae	42
WVOG-49-E-1	Chironomidae	187
WVOG-49-E-1	Ceratopogonidae	1
WVOG-49-E-1	Capniidae/Leuctri	2
WVOG-49-E-1	Asellidae	1
WVOG-49-E-1	Oligochaeta	1
WVOG-49-E-1	Empididae	1
WVOG-50	Chironomidae	7
WVOG-50	Baetidae	91
WVOG-50	Capniidae/Leuctri	7
WVOG-50	Psephenidae	2
WVOG-50	Perlodidae	1
WVOG-50	Peltoperlidae	2
WVOG-50	Oligochaeta	4
WVOG-50	Nemouridae	15
WVOG-50	Leptophlebiidae	6
WVOG-50	Heptageniidae	13
WVOG-50	Ephemerellidae	37
WVOG-50	Elmidae	16
WVOG-50	Cambaridae	2
WVOG-51.5	Ephydridae	1
WVOG-51.5	Nemouridae	26
WVOG-51.5	Chironomidae	29
WVOG-51.5	Ceratopogonidae	1
WVOG-51.5	Cambaridae	3
WVOG-51.5	Asellidae	1
WVOG-51.5	Tipulidae	5
WVOG-51.5	Oligochaeta	1
WVOG-51-B	Rhyacophilidae	1
WVOG-51-B	Perlodidae	4
WVOG-51-B	Capniidae/Leuctri	1
WVOG-51-B	Chironomidae	49
WVOG-51-B	Culicidae	1
WVOG-51-B	Dolichopodidae	1
WVOG-51-B	Dytiscidae	1
WVOG-51-B	Elmidae	3
WVOG-51-B	Ephemerellidae	12
WVOG-51-B	Heptageniidae	15
WVOG-51-B	Leptophlebiidae	4
WVOG-51-B	Nemouridae	41
WVOG-51-B	Baetidae	28
WVOG-51-G.5	Aeshnidae	1
WVOG-51-G.5	Stratiomyidae	1
WVOG-51-G.5	Psephenidae	1
WVOG-51-G.5	Hydroptilidae	3
WVOG-51-G.5	Hydropsychidae	5
WVOG-51-G.5	Chironomidae	76
WVOG-51-G.5	Elmidae	90
WVOG-53	Empididae	1
WVOG-53	Aeshnidae	1
WVOG-53	Tipulidae	2
WVOG-53	Rhyacophilidae	1
WVOG-53	Psychodidae	2
WVOG-53	Nemouridae	7
WVOG-53	Corydalidae	1
WVOG-53	Chloroperlidae	1
WVOG-53	Chironomidae	109
WVOG-53	Ceratopogonidae	1
WVOG-53	Asellidae	1
WVOG-53	Capniidae/Leuctri	6
WVOG-59	Ephemerellidae	5
WVOG-59	Tipulidae	1
WVOG-59	Psephenidae	1
WVOG-59	Oligochaeta	1
WVOG-59	Nemouridae	1
WVOG-59	Hydropsychidae	2
WVOG-59	Heptageniidae	3
WVOG-59	Gomphidae	1
WVOG-59	Elmidae	12
WVOG-59	Corydalidae	2
WVOG-59	Coenagrionidae	1
WVOG-59	Chironomidae	52
WVOG-59	Capniidae/Leuctri	2
WVOG-59	Cambaridae	2
WVOG-59	Caenidae	16
WVOG-59	Asellidae	2
WVOG-59	Empididae	1
WVOG-59	Leptophlebiidae	1
WVOG-60	Heptageniidae	37
WVOG-60	Tipulidae	4

Table A-6. Benthic macroinvertebrates identified (continued).

AN Code	Taxon	Count
WVOG-60	Simuliidae	1
WVOG-60	Rhyacophilidae	2
WVOG-60	Psephenidae	5
WVOG-60	Philopotamidae	28
WVOG-60	Nemouridae	19
WVOG-60	Limnephilidae	1
WVOG-60	Ephemeridae	1
WVOG-60	Ephemerellidae	26
WVOG-60	Empididae	1
WVOG-60	Corydalidae	1
WVOG-60	Chironomidae	11
WVOG-60	Capniidae/Leuctri	13
WVOG-60	Baetidae	38
WVOG-60	Hydropsychidae	6
WVOG-60	Leptophlebiidae	5
WVOG-61	Capniidae/Leuctri	59
WVOG-61	Psephenidae	5
WVOG-61	Perlodidae	1
WVOG-61	Nemouridae	34
WVOG-61	Hydropsychidae	9
WVOG-61	Heptageniidae	17
WVOG-61	Ephemerellidae	7
WVOG-61	Empididae	1
WVOG-61	Elmidae	6
WVOG-61	Chironomidae	1
WVOG-61	Cambaridae	1
WVOG-61	Baetidae	19
WVOG-61	Corydalidae	1

Table A-7. Water quality parameters measured in the field, and fecal coliform bacteria.

Stream Code	Temp (^oC)	pH	DO (mg/L)	Conductivity umhos	Fecal Coliform Bacteria colonies/ 100 mL
WVO-4-{76.3}	20.8	7.6	8.1	387	2100
WVOG-2-{3.6}	19.8	7.2	8.4	175	610
WVOG-2-{18.8}	17.2	7	8.4	189	150
WVOG-2-{25.5}	17.2	6.9	8.3	197	200
WVOG-2-{47}	19.6	7	7.6	257	10000
WVOG-2-{48.7}	17	6.9	7.7	247	600
WVOG-2-{77.2}	20.5	8.3	10.4	1024	50
WVOGM-1.5	17.3	7.4	5.9	487	12000
WVOGM-3-{0.9}	17.2	7.4	9.1	184	1000
WVOGM-4-{0.2}	19.4	7	6.2	200	1000
WVOGM-4-{2}	18	7.4	8.8	170	610
WVOGM-7-{0.4}	19.4	7.4	8.7	186	540
WVOGM-7-B-1	14.3	8.1	9.2	170	460
WVOGM-8-{4}	14.9	7.8	8.5	129	520
WVOGM-8-B	15.1	7.8	8.6	122	84
WVOGM-8-C	21.3	7.7	8.9	191	2800
WVOGM-12	19.9	7.3	7.1	271	150
WVOGM-13	17.9	7.3	9.4	260	1400
WVOGM-14-{7.2}	18.5	7.5	6.9	213	880
WVOGM-16-A	11	7.3	10.6	121	140
WVOGM-19	12.2	7.3	10.2	125	130
WVOGM-20-{6.4}	15.7	7.4	7	183	160
WVOGM-20-{21.2}	18.9	7.4	6.8	171	1100
WVOGM-20-A	15.2	7.2	10	92	220
WVOGM-20-D-{4.6}	20.1	7.6	8.3	182	4100
WVOGM-20-F	15.5	7.3	6.4	172	940
WVOGM-20-H	17.8	7.2	7.4	156	909
WVOGM-20-I-1-{1.5}	17.7	7.5	7.7	221	1100
WVOGM-20-L	11.3	7.2	10.5	100	360
WVOGM-20-K-{0.1}	16.7	7.4	9.7	96	340
WVOGM-20-K-1	12.6	7.1	9.8	91	1200
WVOGM-20-M-{1.8}	17.3	7.4	7.8	152	550
WVOGM-20-M-1	12.3	7.1	10.4	102	300
WVOGM-20-R-2	16.9	7.4	7.2	167	171
WVOGM-20-T-{3.5}	17.1	7.4	7.6	154	6300
WVOGM-20-V	13.1	7.2	9.9	94	220
WVOGM-22-A-{0.7}	14.3	7.3	10.2	116	350
WVOGM-25-A	15	7.3	10.3	103	520
WVOGM-25-B-{2.3}	21.3	7.4	8.5	170	3800
WVOGM-25-B-1	17.9	7.2	9.3	119	160
WVOGM-25-H-1	17.9	6.8	8.3	150	8000
WVOGM-25-I	19.6	6.5	8.1	108	3200
WVOGM-25-I-{3}	20.2	6.6	8.1	95	550
WVOGM-25-I-4	21.3	6.5	8.2	87	3500
WVOGM-31	18.3	7.6	8.5	180	1500

Table A-7. Water quality parameters measured in the field, and fecal coliform bacteria (continued).

Stream Code	Temp (^oC)	pH	DO (mg/L)	Conductivity umhos	Fecal Coliform Bacteria colonies/ 100 mL
WVOGM-33-B	18.5	7.6	8.8	120	610
WVOGM-33-C	20.7	7.1	8.2	94	400
WVOGM-35-{1.8}	20.1	7.2	8.2	60	380
WVOGM-35-{4.1}	22.8	7.2	8.4	53	66
WVOGM-35-E	21.8	6.8	8.2	70	3800
WVOGM-39	18.3	6.7	8	91	5200
WVOGM-39-{10.2}	17.7	7.1	8.8	112	2900
WVOGM-39-G	17.4	6.8	8.9	74	5000
WVOGM-40.3-{0}	15.2	7.4	9.5	64	930
WVOGM-40.3-{2.2}	16.8	7.2	8.2	42	430
WVOGM-43	17.5	6.9	8.1	41	1200
WVOGM-44-{0.2}	15.1	7.5	9.5	77	55
WVOGM-50	17.2	7.1	8.8	47	72
WVOG-3	21.1	7.7	10.1	380	330
WVOG-3-0.5A	23.1	7.6	7.2	346	210
WVOG-9-A-{0.3}	21	7.6	8	312	3300
WVOG-10	20.4	7.4	6.8	270	3000
WVOG-10-A	21.8	7.6	7.9	251	900
WVOG-11	13.6	7	10.4	232	2000
WVOG-14-D-{0.4}	16.5	7	8.7	225	6400
WVOG-23.5	17.1	7	5.7	266	5000
WVOG-27	18.7	7	7.7	224	70
WVOG-27-A	17.4	7	7.8	146	740
WVOG-27-H-{1.8}	16.9	7.2	8.1	123	420
WVOG-29-C	16.7	6.9	8.8	80	30
WVOG-30-{1.2}	18.9	6.8	8.6	74	3300
WVOG-32-F	17.3	7.3	9	98	32
WVOG-34	16	7.4	8.6	83	2000
WVOG-34-A	16.1	7.4	8.5	71	1300
WVOG-34-B	14	7.4	8.9	92	2200
WVOG-34-E-1	12.4	7.4	9.4	71	6000
WVOG-34-E-1-{0.8}	12.8	7	9.6	69	6
WVOG-35	13	7.5	9.7	89	5600
WVOG-36	12.7	7.7	9.7	70	1200
WVOG-37	12.4	7.8	10	62	28
WVOG-38-{0.8}	21	7	7.9	82	110
WVOG-38-{11.6}	19.7	7	8.5	103	160
WVOG-38-A	17.9	6.9	8.5	42	83
WVOG-38-D-{3.9}	13.2	7.1	10	37	44
WVOG-38-D-{4.5}	14.3	7	9.9	38	33
WVOG-38-G	18.3	7	8.5	44	50
WVOG-38-K	17.3	6.9	8.9	63	800
WVOG-38-K.7	15.6	7.3	8.5	52	500
WVOG-38-K-5	18	7	7.8	45	160
WVOG-40	13.4	7.8	9.3	44	380

Table A-7. Water quality parameters measured in the field, and fecal coliform bacteria (continued).

Stream Code	Temp (°C)	pH	DO (mg/L)	Conductivity umhos	Fecal Coliform Bacteria colonies/ 100 mL
WVOG-41	13.4	7.8	9.2	101	4200
WVOG-42-A	13.1	7.7	9.1	73	20000
WVOG-42-C-{0.2}	13.2	7.6	9.1	96	6400
WVOG-42-D	13.1	7.7	9.3	62	3200
WVOG-42-E	12.9	7.7	9	55	230
WVOG-44-A.5	19.5	7.1	8.7	148	12000
WVOG-44-A-2-{2.8}	17.8	7.3	8.3	151	5300
WVOG-44-C.3	14.8	8	8.6	61	3300
WVOG-44-C.7	16.9	7.6	8.7	88	38000
WVOG-44-E	19.6	7.8	8.6	139	60000
WVOG-44-E-0.5	11.6	6.6	10.5	54	36
WVOG-44-F-1	14.3	7.2	9.9	259	82
WVOG-44-G-{1.9}	19.6	7.7	8.7	121	830
WVOG-44-H	13.8	6.8	10	54	1400
WVOG-44-I	13.8	6.8	10.2	58	420
WVOG-44-K	13.2	6.8	10.2	55	1200
WVOG-48	14.8	5.6	9.6	118	44
WVOG-49-0.3A	13.7	5	9.4	74	4
WVOG-49-{3.3}	23.2	7	7.7	410	860
WVOG-49-A	13.3	6.5	10	114	420
WVOG-49-A-1	12.3	6.5	10.2	76	3000
WVOG-49-B-1	11.8	6.7	10.3	67	3200
WVOG-49-C	14.3	6.1	9.4	291	800
WVOG-49-C.1	11.6	4.6	10.1	270	16
WVOG-49-D-2	11.4	6.8	10.2	81	900
WVOG-49-E-1	11.9	4.9	9.8	302	20
WVOG-50	15.2	6.1	9.4	57	52
WVOG-51.5	13.4	7.3	9	527	2000
WVOG-51-B	14.8	6.4	9.6	81	4200
WVOG-51-G.5	21.5	8	8.3	1195	150
WVOG-53	16.2	4.6	8.3	527	20
WVOG-59	18.1	8.3	8.7	165	3800
WVOG-6-{0.1}	19.4	7.4	7.7	237	1900
WVOG-60	17.1	7.6	8.6	109	240
WVOG-61	17.6	7.7	8.4	395	150

Table A-8. Additional water quality parameters taken from a subset of all streams sampled.

Stream Code	Hot acidity (mg/L)	Alkalinity (mg/L)	Sulfate (mg/L)	Total Al (mg/L)	Total Fe (mg/L)	Total Mn (mg/L)
WVO-4-{76.3}	<1	72.7	100	0.239	0.535	0.0792
WVOG-2-{3.6}	<1	41.2	33	0.355	1.16	0.094
WVOG-2-{47}	<1	33.4	74	0.275	0.633	0.115
WVOG-2-{48.7}	<1	31.2	66	0.21	0.526	0.116
WVOG-2-{77.2}	<1	106	430	0.52	0.17	0.15
WVOGM-3-{0.9}	<1	65.8	24	0.567	0.681	0.0345
WVOGM-4-{0.2}	<1	77.0	17	0.237	1.13	0.372
WVOGM-4-{2}	<1	67.9	18	0.374	0.761	0.113
WVOGM-7-{0.4}	<1	74.6	17	0.302	0.661	0.103
WVOGM-8-B	<1	40.0	14	0.318	0.549	0.0451
WVOGM-14-{7.2}	<1	79.5	16	0.119	0.308	0.0753
WVOGM-20-{6.4}	<1	71.8	12	0.0864	0.885	0.219
WVOGM-20-{21.2}	<1	58.6	14	0.219	0.912	0.169
WVOGM-20-D-{4.6}	<1	58	24	0.56	0.31	0.02
WVOGM-20-I-1-{1.5}	<1	66	31	0.76	0.51	0.04
WVOGM-20-K-{0.1}	<1	30	18	1	0.29	0.026
WVOGM-20-M-{1.8}	<1	46	19	0.74	0.46	0.028
WVOGM-20-T-{3.5}	<1	48	16	0.58	0.28	0.02
WVOGM-22-A-{0.7}	<1	24	25	1.1	0.72	0.035
WVOGM-25-B-{2.3}	<1	55.3	28	0.197	0.25	0.01
WVOGM-25-I-{3}	<1	29.7	16	0.147	0.725	0.118
WVOGM-35-{1.8}	<1	13	15	0.67	0.34	0.022
WVOGM-35-{4.1}	<1	14.2	10	0.05	0.314	0.0323
WVOGM-39-{10.2}	<1	36.7	11	0.112	0.332	0.0346
WVOGM-40.3-{2.2}	<1	10.1	10	0.0899	0.386	0.066
WVOGM-44-{0.2}	<1	15.5	11	0.05	0.233	0.0579
WVOGM-50	<1	9	13	0.99	0.28	0.02
WVOG-6-{0.1}	<1	91.7	27	0.354	1.03	0.531
WVOG-9-A-{0.3}	<1	97.0	47	0.0849	0.174	0.0512
WVOG-14-D-{0.4}	<1	67.8	32	0.237	0.527	0.191
WVOG-27-H-{1.8}	<1	43.1	17	0.248	0.54	0.0343
WVOG-30-{1.2}	<1	14.5	13	0.139	0.26	0.0268
WVOG-32-F	<1	15.4	11	0.05	0.11	0.01
WVOG-34-E-1-{0.8}	1.79	11.7	14	0.116	0.192	0.01
WVOG-38-{0.8}	<1	19.3	11	0.141	0.438	0.0338
WVOG-38-{11.6}	<1	25.6	13	0.0701	0.184	0.0199
WVOG-38-A	<1	9.90	8	0.0686	0.211	0.0288
WVOG-38-D-{3.9}	<1	5	10	0.57	0.14	0.02
WVOG-38-D-{4.5}	<1	6	11	0.81	0.14	0.02
WVOG-42-C-{0.2}	<1	22.1	12	0.0667	0.252	0.0493
WVOG-44-A-2-{2.8}	<1	50.7	15	0.707	1.44	0.0811
WVOG-44-G-{1.9}	<1	21.3	16	0.0546	0.256	0.031
WVOG-48	2.7	7.8	48	0.903	0.92	0.174
WVOG-49-0.3A	9.7	4.4	27	0.583	0.296	0.128
WVOG-49-{3.3}	<1	40.7	110	0.575	0.561	0.322

Table A-8. Additional water quality parameters taken from a subset of all streams sampled (continued).

Stream Code	Hot acidity (mg/L)	Alkalinity (mg/L)	Sulfate (mg/L)	Total Al (mg/L)	Total Fe (mg/L)	Total Mn (mg/L)
WVOG-49-A	2.2	9.7	40	0.868	0.761	0.112
WVOG-49-A-1	5.2	11.0	23	1.52	1.64	0.0975
WVOG-49-C	5.2	9.2	100	1.45	0.814	0.261
WVOG-49-C.1	30.2	3.4	98	3.755	0.32	0.5
WVOG-49-E-1	17.7	3.1	110	2.405	0.434	0.541
WVOG-51.5	<1	8.40	240	1.56	0.681	0.611
WVOG-51-G.5	<1	172	470	0.44	0.957	0.258
WVOG-53	37.4	3.60	180	4.65	0.636	0.726
WVOG-6-{0.1}	<1	91.7	27	0.354	1.03	0.531
WVOG-61	<1	15.1	160	0.821	1.21	0.375

Table A-9. Additional water quality parameters taken from a subset of all streams sampled.

Stream Code	Total Phos (mg/L)	NH3-N (mg/L)	NO2-NO3-N (mg/L)	TSS (mg/L)	Chloride (mg/L)	Ca-Tot (mg/L)	Mg (mg/L)
WVO-4-{76.3}	0.0267	<0.5	0.409				13.700
WVOG-2-{3.6}	0.0806	<0.5	0.393		3.41	18.800	6.000
WVOG-2-{47}	<0.02	<0.5	0.528		2.35	19.500	14.500
WVOG-2-{48.7}	<0.02	<0.5	0.500		2.04	18.100	13.300
WVOG-2-{77.2}	<0.02	<0.5	2.16		3.6	89	57
WVOGM-3-{0.9}	0.0379	<0.5	0.325		2.69	23.900	5.190
WVOGM-4-{0.2}	0.0492	<0.5	0.167		3.02	25.700	5.350
WVOGM-4-{2}	<0.02	<0.5	0.203		2.52	22.300	4.680
WVOGM-7-{0.4}	0.0290	<0.5	0.138		3.01	24.400	5.170
WVOGM-8-{4}	0.029		0.123				
WVOGM-8-B	0.024	<0.5	0.081		1.98	13.100	3.180
WVOGM-14-{7.2}	0.0290	<0.5	0.174	<5	4.70	25.100	6.240
WVOGM-20-{6.4}	<0.02	<0.5	0.186		5.29	21.500	4.670
WVOGM-20-{21.2}	0.0267	<0.5	0.246	<5	4.08	20.100	4.300
WVOGM-20-D-{4.6}	0.08	<0.5	0.09		1	18	3.4
WVOGM-20-I-1-{1.5}	0.14	<0.5	0.05		1	19	5.2
WVOGM-20-L	0.04		<0.05				
WVOGM-20-K-{0.1}	0.04	<1	<0.05		4	13	3.4
WVOGM-20-M-{1.8}	0.02	<0.5	0.08		3	14	3.1
WVOGM-20-T-{3.5}	0.02	<0.5	0.09		3	15	2.9
WVOGM-22-A-{0.7}	0.04	<1	0.13		3	15	3.3
WVOGM-25-B-{2.3}	<0.02	<0.5	0.312		1.99	15.200	4.410
WVOGM-25-I-{3}	<0.02	<0.5	0.118		1.51	11.100	3.040
WVOGM-31	<0.02		0.09				
WVOGM-35-{1.8}	<0.02	<0.5	0.07		<1	6.5	1.8
WVOGM-35-{4.1}	<0.02	<0.5	0.102		1.01	4.600	2.220
WVOGM-39-{10.2}	<0.02	<0.5	0.286		4.52	10.100	3.750
WVOGM-40.3-{2.2}	<0.02	<0.5	0.127		<1	3.160	2.020
WVOGM-43	<0.02		<0.05				
WVOGM-44-{0.2}	<0.02	<0.5	0.121		1.31	4.930	2.720
WVOGM-50	<0.02	<0.50	<0.05		2	5.6	2.4
WVOG-6-{0.1}	0.060	<0.5	0.267		6.75	30.100	7.810
WVOG-9-A-{0.3}	0.0672	<0.5	0.287				8.530
WVOG-14-D-{0.4}	0.0806	<0.5	0.369		6.54	23.860	5.056
WVOG-27-H-{1.8}	0.0379	<0.5	0.264		2.28	14.500	3.820
WVOG-30-{1.2}	<0.02	<0.5	0.105		1.42	5.160	2.440
WVOG-32-F	<0.02	<0.5	0.195		11.6	6.740	3.170
WVOG-34-E-1-{0.8}	0.045	<0.5	0.103		1.25	4.370	2.280
WVOG-38-{0.8}	<0.02	<0.5	0.101		3.61	6.230	3.040
WVOG-38-{11.6}	<0.02	<0.5	0.140		4.86	8.040	3.630
WVOG-38-A	<0.02	<0.5	0.083		<1	2.650	2.060
WVOG-38-D-{3.9}	<0.02	<0.5	<0.05		2.6	3.9	1.7
WVOG-38-D-{4.5}	<0.02	<0.5	0.19		2	4.3	1.9
WVOG-42-C-{0.2}	0.0222	<0.5	0.191				3.027
WVOG-44-A-2-{2.8}	0.103	<0.5	0.262				4.420
WVOG-44-G-{1.9}	<0.02	<0.5	0.188		10.8	7.300	3.470
WVOG-49-{3.3}	0.0582	<0.5	0.291				14.800

Table A-10. Additional water quality parameters taken from a subset of all streams sampled.

Stream Code	Cr (mg/L)	Cu (mg/L)	Pb-Tot (mg/L)	Zn (mg/L)
WVO-4-{76.3}		<0.005	<0.0050	<0.020
WVOG-2-{3.6}		<0.0050		<0.020
WVOG-2-{47}		0.0059		0.0330
WVOG-2-{48.7}		0.0052		<0.020
WVOG-2-{77.2}		<0.01		0.027
WVOGM-3-{0.9}		0.0066		<0.020
WVOGM-4-{0.2}		<0.0050		<0.020
WVOGM-4-{2}		<0.0050		<0.020
WVOGM-7-{0.4}		<0.0050		<0.020
WVOGM-8-B		<0.0050		<0.020
WVOGM-14-{7.2}	<0.0050	<0.0050		<0.020
WVOGM-20-{6.4}		<0.005		<0.020
WVOGM-20-{21.2}	<0.0050	<0.0050		0.0345
WVOGM-20-D-{4.6	<0.002	<0.01		<0.01
WVOGM-20-I-1-{1.	<0.002	<0.01		<0.01
WVOGM-20-K-{0.1		<0.01		<0.01
WVOGM-20-M-{1.8	<0.002	<0.01		<0.01
WVOGM-20-T-{3.5	<0.002	<0.01		<0.01
WVOGM-22-A-{0.7		<0.01		<0.01
WVOGM-25-B-{2.3		0.0061		0.0493
WVOGM-25-I-{3}		<0.0050		0.0289
WVOGM-35-{1.8}		<0.01		0.026
WVOGM-35-{4.1}		<0.0050		<0.020
WVOGM-39-{10.2}		0.0052		0.0363
WVOGM-40.3-{2.2}		<0.0050		<0.020
WVOGM-44-{0.2}		<0.0050		<0.020
WVOGM-50		<0.01		0.057
WVOG-9-A-{0.3}		<0.005		<0.020
WVOG-14-D-{0.4}		<0.005		<0.020
WVOG-27-H-{1.8}		0.0083		0.0248
WVOG-30-{1.2}		<0.0050		<0.020
WVOG-32-F		0.0053		<0.020
WVOG-34-E-1-{0.8		<0.0050		<0.020
WVOG-38-{0.8}		<0.0050		0.0224
WVOG-38-{11.6}		<0.005		0.020
WVOG-38-A		<0.0050		<0.020
WVOG-38-D-{3.9}		<0.01		0.03
WVOG-38-D-{4.5}		<0.01		0.038
WVOG-42-C-{0.2}		<0.0050		<0.020
WVOG-44-A-2-{2.8		0.0053		<0.020
WVOG-44-G-{1.9}		<0.005		<0.020
WVOG-49-{3.3}		<0.0050	<0.0050	0.0251
WVOG-6-{0.1}		<0.0050		<0.020

Table A-11. Rapid Habitat Assessment Scores.

Stream Code	cover	embed	velocity	alteration	sediment	riffle freq.	flow	bank stab.	bank veg	rip veg	**Total**
WVOG-2-{3.6}	16	14	18	18	12	10	17	9	9	14	**137**
WVOG-2-{18.8}	15	16	14	12	17	7	15	3	5	6	**110**
WVOG-2-{25.5}	15	11	14	13	10	6	12	5	10	3	**99**
WVOG-2-{47}	16	13	13	18	10	7	18	11	10	4	**120**
WVOG-2-{48.7}	15	13	15	17	9	7	17	10	14	9	**126**
WVOG-2-{77.2}	18	7	16	15	7	15	16	16	13	13	**136**
WVOGM-1.5	3	5	8	17	3	2	4	5	5	16	**68**
WVOGM-3-{0.9}	11	11	12	13	7	16	14	11	12	2	**109**
WVOGM-4-{0.2}	12	7	11	17	2	7	19	8	7	3	**93**
WVOGM-4-{2}	10	12	16	18	7	11	15	8	7	6	**110**
WVOGM-7-{0.4}	2	7	8	3	7	16	18	16	7	2	**86**
WVOGM-7-B-1	14	13	14	13	12	16	16	13	13	11	**135**
WVOGM-8-{4}	16	12	15	16	13	14	16	12	18	17	**149**
WVOGM-8-B	11	11	12	20	12	15	16	14	16	18	**145**
WVOGM-8-C	12	12	10	18	13	18	16	16	18	2	**135**
WVOGM-12	11	6	17	12	5	10	16	11	14	10	**112**
WVOGM-13	16	13	10	13	15	16	18	14	16	0	**131**
WVOGM-14-{7.2}	6	5	13	18	5	8	13	8	14	11	**101**
WVOGM-16-A	17	15	10	14	14	17	19	13	8	5	**132**
WVOGM-19	12	10	11	14	8	14	16	15	11	10	**121**
WVOGM-20-{6.4}	9	8	12	15	5	8	17	9	10	11	**104**
WVOGM-20-{21.2}	8	8	16	7	5	7	15	8	7	4	**85**
WVOGM-20-A	10	9	12	13	8	13	17	14	10	9	**115**
WVOGM-20-D-{4.6}	6	7	11	11	5	16	8	8	13	4	**89**
WVOGM-20-H	7	7	11	11	6	5	12	4	5	4	**72**
WVOGM-20-I-1-{1.5}	8	8	8	6	8	16	7	4	4	3	**72**
WVOGM-20-L	9	9	7	9	9	14	16	4	6	2	**85**
WVOGM-20-K-{0.1}	16	9	16	11	9	17	18	9	4	2	**111**
WVOGM-20-K-1	18	13	18	15	11	16	16	17	17	4	**145**
WVOGM-20-M-{1.8}	6	8	8	14	7	16	8	17	11	10	**105**
WVOGM-20-M-1	13	11	9	7	9	16	13	13	9	4	**104**
WVOGM-20-R-2	10	10	9	14	9	12	8	14	14	10	**110**
WVOGM-20-T-{3.5}	10	8	11	15	6	11	10	12	8	10	**101**
WVOGM-20-V	17	11	10	15	11	18	18	16	10	7	**133**
WVOGM-22-A-{0.7}	18	14	10	16	13	17	19	14	12	10	**143**
WVOGM-25-A	13	8	10	16	9	17	17	16	16	15	**137**
WVOGM-25-B-{2.3}	17	12	10	16	13	18	15	16	14	6	**137**
WVOGM-25-B-1	17	11	10	12	11	18	17	16	13	11	**136**
WVOGM-25-H-1	7	9	10	15	5	9	13	10	12	3	**93**
WVOGM-25-I	9	7	16	18	7	13	11	8	7	7	**103**
WVOGM-25-I-{3}	7	7	16	16	4	7	14	11	12	3	**97**
WVOGM-25-I-4	6	7	10	17	7	17	11	10	11	3	**99**
WVOGM-31	15	10	10	14	9	17	12	13	14	12	**126**
WVOGM-33-B	18	11	10	12	11	18	16	16	8	4	**124**
WVOGM-33-C	11	10	9	18	7	17	10	17	13	4	**116**

Table A-11. Rapid Habitat Assessment Scores (continued).

Stream Code	cover	embed	velocity	alteration	sediment	riffle freq.	flow	bank stab.	bank veg	rip veg	**Total**
WVOGM-35-{1.8}	10	9	13	17	6	8	12	16	16	11	**118**
WVOGM-35-{4.1}	8	8	9	13	5	13	10	15	14	16	**111**
WVOGM-35-E	14	15	10	16	10	17	16	13	13	3	**127**
WVOGM-39	14	10	19	12	10	16	14	10	10	3	**118**
WVOGM-39-{10.2}	15	11	14	18	8	17	16	9	11	18	**137**
WVOGM-39-G	11	13	17	13	13	17	13	12	16	13	**138**
WVOGM-40.3-{0}	15	10	13	19	10	16	10	17	18	18	**146**
WVOGM-40.3-{2.2}	7	5	8	16	5	16	8	13	14	17	**109**
WVOGM-43	15	12	10	14	11	18	12	18	15	12	**137**
WVOGM-44-{0.2}	17	11	10	15	10	18	15	15	11	10	**132**
WVOGM-50	17	11	10	17	10	17	15	14	17	16	**144**
WVOG-3	6	3	15	13	9	8	12	4	10	4	**84**
WVOG-3-0.5A	13	16	10	15	13	16	11	13	16	6	**129**
WVOG-6-{0.1}	11	6	12	18	8	17	12	2	3	11	**100**
WVOG-9-A-{0.3}	13	11	8	18	13	16	15	18	16	14	**142**
WVOG-10	15	11	14	13	14	15	15	16	17	13	**143**
WVOG-10-A	16	11	14	19	12	15	14	15	15	15	**148**
WVOG-11	18	16	17	13	11	17	13	12	14	7	**138**
WVOG-14-D-{0.4}	13	14	7	12	16	8	17	6	3	3	**99**
WVOG-23.5	13	12	9	18	10	16	11	3	11	18	**121**
WVOG-27	6	6	14	16	8	4	15	6	16	13	**104**
WVOG-27-A	16	7	16	17	7	16	11	8	16	5	**119**
WVOG-27-H-{1.8}	10	14	9	17	13	16	8	14	18	18	**137**
WVOG-29-C	14	13	9	18	14	18	14	18	18	14	**150**
WVOG-30-{1.2}	16	15	10	11	16	17	16	19	16	7	**143**
WVOG-32-F	14	15	13	17	14	17	15	15	16	15	**151**
WVOG-34	14	11	20	12	12	15	16	9	16	11	**136**
WVOG-34-A	11	13	9	11	16	17	18	16	12	7	**130**
WVOG-34-B	13	14	19	11	15	16	18	17	10	2	**135**
WVOG-34-E-1	14	17	10	12	18	19	19	15	7	6	**137**
WVOG-34-E-1-{0.8}	16	15	14	16	17	18	17	17	17	16	**163**
WVOG-35	15	15	10	16	12	17	17	16	16	17	**151**
WVOG-36	16	15	16	16	15	17	16	14	17	17	**159**
WVOG-37	16	13	14	17	14	18	18	19	18	15	**162**
WVOG-38-{0.8}	9	9	8	19	4	9	16	16	8	19	**117**
WVOG-38-{11.6}	14	13	10	18	11	18	15	15	14	13	**141**
WVOG-38-A	15	13	10	19	14	18	15	14	15	18	**151**
WVOG-38-D-{3.9}	17	12	14	16	11	17	15	16	16	16	**150**
WVOG-38-D-{4.5}	18	11	13	16	10	18	17	15	17	16	**151**
WVOG-38-G	13	11	10	15	12	18	14	11	11	15	**130**
WVOG-38-K	13	12	10	14	13	17	16	17	13	8	**133**
WVOG-38-K.7	11	12	8	15	13	17	14	18	18	3	**129**
WVOG-38-K-5	13	12	9	19	12	17	11	16	17	11	**137**
WVOG-40	10	11	10	16	8	16	19	11	12	8	**121**
WVOG-41	13	12	10	13	12	18	19	14	17	6	**134**

Table A-11. Rapid Habitat Assessment Scores (continued).

Stream Code	cover	embed	velocity	alteration	sediment	riffle freq.	flow	bank stab.	bank veg	rip veg	**Total**
WVOG-42-A	14	13	13	12	12	18	18	13	7	4	**124**
WVOG-42-C-{0.2}	15	12	14	15	12	18	19	13	16	7	**141**
WVOG-42-D	16	15	10	15	14	18	16	15	15	2	**136**
WVOG-42-E	12	13	10	12	13	17	16	18	16	11	**138**
WVOG-44-A.5	14	13	10	14	13	16	16	16	15	11	**138**
WVOG-44-A-2-{2.8}	13	12	9	9	12	18	13	16	15	3	**120**
WVOG-44-C.3	13	14	10	12	13	18	15	15	15	9	**134**
WVOG-44-C.7	13	13	10	11	13	18	16	12	14	5	**125**
WVOG-44-E	14	13	15	16	13	17	16	15	13	5	**137**
WVOG-44-E-0.5	15	17	10	16	14	20	20	16	17	10	**155**
WVOG-44-F-1	14	13	14	18	14	17	17	18	18	7	**150**
WVOG-44-G-{1.9}	11	12	10	10	12	17	18	16	12	6	**124**
WVOG-44-H	13	14	15	12	15	17	19	17	18	10	**150**
WVOG-44-I	17	15	10	14	13	18	19	14	17	12	**149**
WVOG-44-K	16	15	14	18	13	18	17	18	16	14	**159**
WVOG-48	14	13	13	12	14	19	20	17	16	6	**144**
WVOG-49-{3.3}	11	11	10	14	13	18	16	17	15	4	**129**
WVOG-49-A	9	11	5	13	15	17	18	15	10	2	**115**
WVOG-49-A-1	10	16	5	12	16	19	20	11	11	2	**122**
WVOG-49-B-1	14	11	5	11	15	19	20	16	18	11	**140**
WVOG-49-C	6	12	5	13	18	19	19	17	9	3	**121**
WVOG-49-C.1	7	12	5	11	15	17	19	18	6	2	**112**
WVOG-49-D-2	17	12	16	16	14	19	18	17	11	11	**151**
WVOG-49-E-1	9	15	5	12	14	19	16	11	14	11	**136**
WVOG-50	17	17	18	14	12	18	17	15	15	11	**154**
WVOG-51.5	7	9	5	9	11	19	17	18	13	3	**111**
WVOG-51-B	9	13	9	12	12	18	18	17	18	7	**133**
WVOG-51-G.5	12	8	10	5	16	18	15	19	12	2	**117**
WVOG-53	12	13	10	18	10	18	13	9	16	17	**137**
WVOG-59	11	10	10	15	10	18	12	13	17	15	**131**
WVOG-6-{0.1}	11	6	12	18	8	17	12	2	3	11	**100**
WVOG-60	14	13	10	13	10	18	14	17	17	7	**133**
WVOG-61	10	10	10	11	13	18	18	16	14	11	**131**

Categories scored 0-20, total possible score = 200.

cover = epifaunal substrate & available fish cover.
embed = embeddedness.
velocity = # of velocity/depth regimes.
alteration = channel alteration (human-induced).
sediment = sediment deposition.

riffle freq. = riffle frequency.
flow = channel flow status.
bank stab. = bank stability.
bank veg = bank vegetative protection.
rip veg = width of undisturbed vegetative zone.

West Virginia
Department of Environmental Protection,

Division of Water and Waste Management

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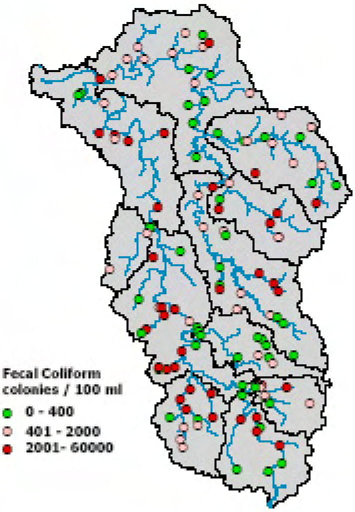
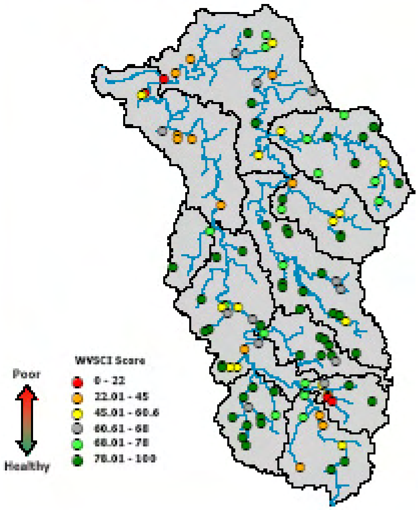
Department of Environmental Protection, Division of Water and Waste Management

This report summarizes data collected in the Lower Guyandottte River Watershed by the Watershed Assessment Section in 1998. It includes:

Water quality information from 128 sites,



Biological health information (benthic macroinvertebrates) from 111 samples,



And physical habitat and landuse pattern information that helps identify and explain impairments affecting the streams of West Virginia's Lower Guyandotte River Watershed.

Watershed Assessment Section