**An Assessment of the Potential Influence of Physical Habitat, Pyrethroids, and Metals on Benthic Communities in a Residential Stream in California in 2008**

**Final Report**

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# GENERAL INFORMATION

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# 1.0 EXECUTIVE SUMMARY

This 2008 study was designed to characterize benthic communities (macroinvertebrates) and physical habitat in a residential stream (Pleasant Grove Creek) in California. Concurrent water quality evaluations, physical sediment parameters, pyrethroids, and bulk metals {including simultaneously extracted metals (SEM) and acid volatile sulfides (AVS) ratios} were also measured. The relationship of various benthic metrics to physical habitat metrics, pyrethroids, and metals was evaluated. The 2008 data sets were combined with similar data sets collected from the same stream during 2006 and 2007 for further analysis. Combining the data sets over a three year period increased the statistical power for determining any significant relationships between benthic metrics and the various stressors.

Based on 10 instream and riparian physical habitat metrics, total physical habitat scores in Pleasant Grove Creek ranged from 57 to 138 (maximum possible total score is 200). Most of the physical habitat metrics were highly variable among the 27 Pleasant Grove Creek sites. In general, total physical habitat scores in this residential stream were considered to be poor.

Approximately 21,000 individual macroinvertebrates were picked and identified from 153 taxa collected from 27 Pleasant Grove Creek sites in 2008. The six most abundant taxa – Unidentified Immature *Tubificidae* (Oligochaetes), *Paratanytarsus* sp. (Chironomids), *Hyalella* sp. (amphipods), *Physa* sp. (snails), *Dugesia tigrina* (Planariidae) and *Dero digitata* (Naididae) – comprised approximately 44% of the individuals collected. These six taxa are generally considered tolerant to moderately tolerant (e.g., *Dugesia tigrina*) of environmental stressors. Pollution sensitive species such as Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), i.e. EPT taxa, were generally rare at most sites. However, it is noteworthy that the third most dominant species collected in this stream (*Hyalella* sp.) is extremely sensitive to pyrethroids.

Sediment samples were collected from fine-grained sediments at the sites in order to provide information on expected greater potential pyrethroid concentrations. Ranges of pyrethroid concentrations (ng/g dry weight) normalized to 1% TOC in Pleasant Grove Creek in 2008 were as follows: bifenthrin (0.47 – 25.84); fenpropathrin ( < 0.18); lambda-cyhalothrin (0.02 – 1.05); permethrin (0.10 – 7.3); cyfluthrin (0.023 – 4.7); cypermethrin (0.114 – 9.6); esfenvalerate (0.021 – 0.825) and deltamethrin (0.038 – 1.4). Toxic units (TU) calculations were determined for each by dividing the 1% TOC normalized concentration by the *Hyalella* LC50 concentration (a species highly sensitive to pyrethroids) that was also 1% TOC normalized. TU concentrations exceeding 1.0 were considered potentially toxic. The TU approach indicated that bifenthrin concentrations at approximately half of the sites were potentially toxic to *Hyalella* while cypermethrin concentrations at two sites were potentially toxic to *Hyalella*. The sum of pyrethroid TUs indicated that approximately half the sites sampled were predicted to be toxic due to pyrethroids based on the use of a pyrethroid-sensitive amphipod (*Hyalella azteca*).

For each bulk metal analyzed (except lead) at the 27 2008 sites, there was at least one sample that exceeded a sediment Threshold Effect Level (TEL) for freshwater. The number of TEL exceedences for various metals by site were arsenic (1 site), cadmium (2 sites), chromium (3 sites), copper (6 sites), mercury (1 site), nickel (6 sites) and zinc (6 sites). On a site specific level, the following was reported: (1) one site with six TEL exceedances; (2) one site with five TEL exceedances; (3) one site with four TEL exceedances and (4) three sites with one TEL exceedance. The SEM/AVS data suggests that at least seven of the twenty-seven sites have ratios greater than one with at least one co-occurring metal exceeding a TEL. Therefore, toxicity due to metals would be predicted at these sites.

In general, the relationships observed in the regression analyses of the benthic metrics versus pyrethroids and metals for the larger, three-year data set were not as strong as those observed for the 2008 data set alone. In contrast to the results of the regressions focusing on the toxicants, the significant relationships between benthic metrics versus habitat metrics were observed to be more numerous and stronger in the stepwise regression analyses on the three-year data set than those on 2008 alone. The habitat metric, velocity-depth regimes, exhibited the most significant relationships with benthic metrics in the three-year data set. The benthic metrics indicative of nonstressed communities (*Ephemeroptera taxa, EPT taxa, EPT Index, Collectors/Filterers*) were directly related to this metric, while those indicative of stressed communities (*Tolerance Value and % Tolerant taxa*) were inversely related to it.

The effects of habitat metrics tended to dominate when analysis of benthic metrics versus all environmental variables was conducted. For the larger three-year data set, it was noted that the effects of pyrethroids disappeared and those of metals did not persist in subsequent model confirmation analyses. The canonical correlation analyses underscored the findings of the regression-based analyses (and confirmation models) on the full environmental data set as the following was reported: (1) healthier, nonstressed benthic communities characterized by more *Ephemeroptera taxa*, *EPT taxa*, a higher *EPT index* and greater *Taxonomic richness* tended to be found in certain habitat conditions that were characterized by coarser sediments and higher scores for the habitat metrics *Velocity depth regimes, Epifaunal substrate/available cover, Sediment deposition,* and *Embeddedness*; and (2) more stressed communities that were characterized by lower values for the above benthic metrics, plus greater *Tolerance values*, more *Tolerant taxa* and higher *% Grazers* tended to be associated with finer sediments and lower scores for these key habitat metrics.

These findings indicate that assessments of the effects of toxicants on benthic communities should: (1) take into account potentially confounding effects of physical habitat conditions and (2) involve an appropriately large number of samples to provide adequate power and a more accurate picture of true relationships, thereby avoiding reporting of potentially misleading conclusions. Results from three years of bioassessment and stressor data from Pleasant Grove Creek demonstrated that habitat metrics (primarily velocity depth regimes) dominated in their effects on benthic communities while pyrethroids did not display significant relationships.

# 2.0 INTRODUCTION

Watershed urbanization is widespread and constantly increasing throughout the United States (Wang and Lyons, 2003). Conversion of rural lands to urban lands is driven by a combination of population growth, net movement of people from rural to urban/residential zones, and increased rates of land use per capita (Wang and Lyons, 2003). Urban land in the United States has more than tripled from 8,065 square miles in 1950 to 27,838 square miles in 1990 (Wang and Lyons, 2003). Most of this increase is caused by "urban sprawl" as people move from higher density downtown zones to newly built lower density suburbs surrounding the central city. Grimm *et a*l. (2000) reported that urbanization resulted in a major negative impact on aquatic ecosystems. Large areas of impervious surfaces and high levels of hydraulic connection of impervious surfaces to streams, through stormwater pipes or drains, are two characteristics of the urban environment that can lead to major negative impacts on urban/residential streams (Walsh *et al*. 2005). These two characteristics of urban streams cause decreased levels of evapotranspiration and infiltration and rapid delivery of water to these lotic environments. Karr and Chu (1999) reported that human activities in the urban environment can degrade aquatic ecosystems by altering one or more of the following principal groups of attributes: water or sediment quality; habitat structure; flow regime; energy source (food); or biotic interactions. Other investigators reported that urbanization specifically leads to fundamental changes in the hydrologic, hydraulic, erosional, and depositional characteristics of fluvial systems causing increased channel instability (Rhoades, 1995). In the western United States, urbanization was reported to produce lower Index of Biotic Integrity (IBI) scores than activities such as logging and larger cities were reported to have lower IBI scores than smaller cities (Kleindl, 1995; Fore et al., 1996; Karr, 1998). Expanded population growth in many urban and residential areas in states such as California is therefore a potential stressor to aquatic ecosystems that merits an investigation of the various multiple stressors that can exist and potentially contribute.

Bioassessment, a quantitative survey of physical habitat and biological communities of a water body, is a well established approach for determining the ecological condition of stream and river systems (Yoder and Rankin, 1995; Karr and Chu, 1999; Barbour *et al*., 1996; Wright *et al*., 2000; Bailey *et al.*, 2004). Assessments of benthic invertebrate assemblages and physical habitat (bioassessments) have been conducted in wadeable streams in California's Central Valley for a number of years (Bacey, 2005; Brown and May, 2004; Hall and Killen, 2001; Hall and Killen, 2002; Hall and Killen, 2003; Hall and Killen, 2004; Hall and Killen, 2005a; Hall and Killen, 2005b; Hall *et al.* in press; Jim Harrington, California Department of Fish and Game, personal communication; Tetra Tech, 2003). In the fall of 2007 a reference site expert panel was formed to develop a network of reference sites in California that can be used to interpret bioassessment data in the context of impairment (Peter Ode, California Department of Fish and Game, personal communication). To date, most of the bioassessments conducted in California have occurred in rural areas with minimal data available for urban streams (Hall and Killen, 2001; Bacey and Spurlock, 2007; Hall *et al*., in press; Peter Ode, California Department of Fish and Game, personal communication). Bioassessments provide a useful approach for integrating effects from physical, chemical, and biological stressors on aquatic organisms. The underpinnings of bioassessments are that the structure and function of an aquatic biological community can provide critical information about the quality of the surface water. Bioassessments are valuable for determining the status of aquatic biological communities across large spatial scales and land use types (agricultural and urban). Information on the status of resident biological communities is particularly useful for determining impaired water bodies, developing Total Maximum Daily Loads (TMDLs), and measuring success of voluntary or regulatory actions. Bioassessments serve monitoring needs through three primary functions: (1) screening or initial assessment of conditions; (2) characterization of impairment and diagnosis; and (3) trend monitoring to evaluate improvements from mitigation practices or further degradation. In addition, bioassessments also provide a direct means of measuring compliance with the goal of biotic integrity stipulated under the Clean Water Act because assemblages of aquatic organisms (i.e., macroinvertebrates) are comprised of taxa that are differentially responsive to different environmental stressors.

In recent years, pyrethroid insecticides - replacements for the organophosphates used for structural pest control, landscape maintenance and residential home and garden use – were reported at potentially toxic concentrations in both an urban (Kirker Creek) and a residential (Pleasant Grove Creek) stream in California (Weston *et al.*, 2005a; Weston *et al*., 2005b; Amweg *et al*., 2006). The toxicity assessment of pyrethroids in these two streams was based on sediment toxicity test results with a single species, the amphipod *Hyalella azteca*, which is highly sensitive to pyrethroids in laboratory-based clean water toxicity tests. Uncertainty exists when using only one species – particularly a highly sensitive one - as a benthic barometer for suggesting impairment of general ecosystem health. By contrast, bioassessments that include assessing the entire benthic assemblage in concert with physical habitat assessments, as described above, are a preferred approach for determining the ecological status of these streams. In addition, the assumption that pyrethroids are the only stressor in urban waterbodies is questionable as other investigators have reported that chemical stressors such as metals (Crunkilton et al. 1997; Pettigrove and Hoffman, 2003a) and polycyclic aromatic hydrocarbons (PAHs) (Pettigrove and Hoffman, 2003b) may also be present at concentrations that are potentially toxic to aquatic life. Recent studies in both an urban and residential stream in California have demonstrated that physical habitat limitations, and not chemical stressors such as pyrethroids and metals, are the primary stressor impacting resident benthic communities (Hall *et al*., in press).

The primary goal of this study, as reported below, was to characterize benthic communities (bioassessments) and physical habitat in a residential creek (Pleasant Grove Creek) in Roseville, California in the spring of 2008. Basic water quality parameters, eight specific pyrethroids, Total Organic Carbon (TOC), grain size, and bulk metals {including simultaneously extracted metals (SEM) and acid volatile sulfides (AVS)} were evaluated in sediment at each stream site in concert with the bioassessments. The relationship between various benthic community metrics (i.e., species richness, abundance) and physical habitat metrics, pyrethroids, and metals were evaluated for the 2008 data set. In addition, the 2008 data set was combined with similar data sets collected in 2006 and 2007 in this creek to determine the relationships between benthic metrics and the various stressors. Combining the data sets for the three year period increases the statistical power for determining significant relationships. Benthic community data was interpreted in the context of biological expectations for this residential stream.

# 3.0 MATERIALS AND METHODS

## 3.1 Site Selection

A total of 27 sites were sampled in Pleasant Grove Creek and its tributaries (South Branch and Kaseberg Creek) in late spring of 2008 (Figure 1; see Table 1 for site coordinates). Pleasant Grove Creek, located in Roseville, California, is characterized by numerous contiguous subdivisions of single family homes less than 10 years old. There is no industry in the area and sparse commercial development and agriculture. The distance from the upstream to downstream site was approximately 12 miles in the mainstem of Pleasant Grove Creek. The distance from the upstream to downstream site in South Branch was approximately 5 miles while the distance from the upstream to downstream site in Kaseberg Creek was approximately 6 miles. Twenty-one of the 27 sites sampled (sites lacking an "a" designation) were the same sites sampled for bioassessment studies in 2006 and 2007. These 21 sites were also sampled by Weston *et al.* 2005a during their pyrethroid study in 2004. The new sites added (PGC 8a, PGC 9a, PGC 11a, PGC 16a, PGC 17a and PGC 22a) were considered as surrogate mainstem sites for the stagnant backwater sites with the same number designation (i.e., PGC 8, PGC 9) sampled in previous years.

## 3.2 Physical Habitat Assessments

Physical habitat was evaluated at each site concurrently with benthic collections, water quality evaluations, sediment parameters, pyrethroids, and metals. The physical habitat evaluation methods followed protocols described in Harrington and Born (2000). The physical habitat metrics used for this study were based on nationally standardized protocols described in Barbour *et al.* (1999). A total of 10 continuous metrics scored on a 0-20 scale were evaluated (Appendix 1). Other non-continuous metrics including percent canopy, percent gradient, and substrate composition were also measured as reported in Appendix 1.

## 3.3 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates were collected in late spring of 2008 from three replicate samples at all 27 sample sites. The sampling procedures were conducted in accordance with methods described in Harrington and Born (2000). Within each of these sample reaches, a riffle was located (if possible) for the collection of benthic macroinvertebrates. Only Pleasant Grove Creek sites PGC2, PGC4, PGC5, and PGC10 were sampled using the riffle method (see non-riffle method described below for other sites). A tape measure was placed along the riffle and potential sampling transects were located at each meter interval of the tape. Using a random numbers table, three transects were randomly selected for sampling from among those available within the riffle. Benthic samples were taken using a standard D-net with 0.5 mm mesh starting with the most downstream portion of the riffle. A 1x2 foot section of the riffle immediately upstream of the net was disturbed to a depth of 4-6 inches to dislodge benthic macroinvertebrates for collection. Large rocks and woody debris were scrubbed and leaves were examined to dislodge organisms clinging to these substrates. Within each of the randomly chosen transects, three replicate samples were collected to reflect the structure and complexity of the habitat within the transect. If habitat complexity was lacking, samples were taken near the side margins and thalweg (deepest path) of the transect and the procedures described above were followed. All samples were preserved in 95% ethanol.

Due to the physical nature of this residential stream, it was often difficult to locate a substantial number of riffles to sample. In numerous cases, there was only a single section of riffle available within a selected reach to sample and in most instances there were no riffles present. In cases where riffles were lacking, alternative sampling methods for non-riffle areas were used as outlined in Harrington and Born (2000). All sites except PGC2, PGC4, PGC5 and PGC10 were sampled using the non-riffle method. This involved sampling the best available 1x2 foot sections of habitat throughout the reach using the same procedures described above. Nine 1x2 foot sections were randomly selected for sampling (i.e, stratified random sampling). Groups of three 1x2 foot sections were composited for each replicate for a total of three replicates per site.

## 3.4 Taxonomy of Benthic Macroinvertebrates

The goal of this study was to identify all benthic samples to the species level if possible. For taxa such as oligochaetes and chironomids, family and genus level, respectively, were often the lowest level of identification possible.

Benthic macroinvertebrate subsampling (resulting in a maximum of 300 individuals) and identifications were supervised by Angie Montalvo of California's Department of Fish and Game (CDFG) in Rancho Cordova, California. The benthic macroinvertebrate samples were subsampled and sorted by personnel at the CDFG Laboratory located at Chico State University. Level 3 identifications (species level identifications) followed protocols outlined in Harrington and Born (2000). Mr. Dan Pickard of CDFG conducted the taxonomic identifications. Slide preparations and mounting for species such as midges and oligochaetes followed protocols from the United States Geological Survey National Quality Control Laboratory described in Moulton *et al.* 2000.

## 3.5 Water Quality and Sediment Measurements

The following water quality parameters were measured at each stream site using procedures described in Kazyak (1997): temperature, pH, salinity, specific conductivity, dissolved oxygen, and turbidity (Table 1).

Grain size (Plumb, 1981) and TOC (U. S. EPA, 2004) were measured on sediment samples collected from each site. Depositional areas - areas most likely to contain hydrophobic pesticides such as pyrethroids - were specifically sampled at each site and three to five sediment samples from depositional areas were composited for the final sample. A stainless steel spoon (similar to a scoop) was used to collect the top 2-3 cm of sediment from each site. Approximately one liter of sediment was collected from each site for grain size and TOC determinations as well as pyrethroids and metals. All sampling equipment was cleaned between sites using nitric acid, ethanol and distilled water. Sediment samples were stored in a cooler on ice in the field and later transferred to a refrigerator before shipment to the Applied Marine Sciences Laboratory in League City, Texas for grain size and TOC analysis.

## 3.6 Pyrethroid Analysis

The pyrethroids bifenthrin, cypermethrin, cyfluthrin, deltamethrin, esfenvalerate, fenpropathrin, lambda-cyhalothrin and permethrin residues were extracted from sediment by shaking with methanol/water mixture and hexane for one hour. The sample was centrifuged and an aliquot of the upper hexane layer evaporated to dryness and re-dissolved in a small volume of hexane. The hexane sample was then subjected to a silica solid phase extraction (SPE) procedure prior to residue determination by gas chromatography with mass selective detection using negative ion chemical ionisation (GC-MS/NICI). The limit of quantitation (LOQ) of the method was 0.12 – 0.97 ng/g dry weight (mean = 0.24 ng/g dry weight) for bifenthrin, cypermethrin, cyfluthrin, deltamethrin, esfenvalerate, fenpropathrin, lambda-cyhalothrin and 1.2 to 9.7 ng/g dry weight (mean = 2.4 ng/g dry weight) for permethrin (see Robinson, 2005 for details).

## 3.7 Bulk Metals and SEM/AVS Analysis

The following bulk metals with existing Threshold Effects Levels (TELs), conservative protective benchmarks, as described by Buchman (1999) were measured on composited sediment samples for each site as previously described using EPA method 6020m: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni) and zinc (Zn). The method detection limit (MDL) for these seven metals was 0.025 μg/g dry weight. Mercury (Hg) was also measured on all sediment samples using EPA method 245.7m. The MDL for mercury was 0.01 μg/g dry weight.

Simultaneously extracted metals (SEM) analysis was conducted for Ni, Cu, Zn, Cd, Pb, and Hg using EPA method 200.8m. The MDLs (μmol/dry g) for these SEMs were as follows: Ni (0.0033), Cu (0.0062), Zn (0.0015), Cd (0.0018), Pb (0.0002) and Hg (0.00005). Acid volatile sulfides (AVS) were evaluated on sediment samples from each site using procedures described by Plumb (1981). SEM/AVS ratios were then developed for each site to provide insight on the bioavailability of these metals in sediment. The principle of SEM/AVS is based on the observation that there are some components in sediment that bind certain metals such that they are no longer available and therefore not toxic to benthic organisms (DiToro *et al*. 1990, 1992). Sulfides in sediments have the ability to bind with divalent metals such as cadmium, copper, lead, mercury, nickel and zinc and may render these metals unavailable to the extent sulfides are available. Sediments from the study sites were therefore analyzed for the amount of SEM and for the amount of freely available divalent metals as simultaneously extractable metals (SEM). Assuming that sulfides would bind with metals on a 1:1 molar basis, dividing SEM by the amount of AVS would suggest that these metals are available when the ratio is greater than 1.

## 3.8 Statistical Analysis

A description of the various statistical methods used for data analysis that includes questions addressed, statistical approaches for addressing questions, results and caveats is presented in Figure 2. Data for the 14 key benthic metrics were averaged across the three transects sampled for each site in Pleasant Grove Creek. These data were merged with data sets of habitat metrics, sediment concentrations of metals, and sediment pyrethoid concentrations for each site. The sediment concentration data for each pyrethroid were converted to toxicity units by standardizing them to 1% TOC and dividing by LC50 values that were also standardized to 1% TOC. Metals in sediment concentrations were also standardized to their relative toxicities by dividing the dry weight concentrations of each metal by their respective Thresholds Effects Levels (TEL) values.

The potential associations between the benthic metrics and the toxicity units for pyrethroids and metals were explored by a series of regression techniques. Prior to this analysis, all data were unit deviate standardized to place all dependent and independent variables on the same relative scales, as well as to produce more normal distributions. Univariate general linear model (GLM) regressions were conducted for each creek to determine whether there were indications of significant relationships ($\alpha$=0.01) between benthic metrics and specific pyrethroids and specific metals (SAS Institute, 2002). The various steps used in the statistical approach are described below.

1. A series of stepwise multiple regressions were conducted to determine potential relationships between the benthic metrics and pyrethroids (in toxicity units), metals (metals to TEL ratios), and habitat metrics (SAS Institute, 2002). Stepwise regressions were conducted separately for each of these three groups of independent variables, as well as with all variables combined into the same model. Each of these analyses was conducted on data collected from Pleasant Grove Creek in 2008 alone, as well as for data collected from the Creek from 2006, 2007 and 2008 combined. Six sites (Sites 8a, 9a, 11a, 16a, 17a, and 22a) were sampled in 2008 that were not sampled in 2006 or 2007, so these sites were omitted from the analyses of the three-year data set.

2. A second series of stepwise regressions were conducted for the benthic metrics versus principal components of the environmental data (pyrethroids, metals, and habitat metrics) that were produced by a principal components analysis (PCA) with an orthogonal rotation (*Proc Factor*, principal components method with a "varimax" rotation; SAS Institute, 2002). The second set of analyses was used to confirm the results of the first, due to concerns over multicollinearity between the independent variables, a common characteristic of environmental data sets.

3. A pair of complementary multivariate models was also conducted: Model 1 was designed to take the effects of the toxicants on the benthic metrics into account before the effects of the habitat metrics were assessed; and Model 2 was designed to take the effects of the habitat metrics on the benthic metrics into account before the effects of potential toxicants (pyrethroids TUs or metals to TELs) were assessed. In Model 1,

the principal components from the PCA on environmental data that were most highly "loaded" by the toxicants (i.e. those PCs identified by salient factor loadings of pyrethroids and/or metals) were forced into regression models (SAS Institute, 2002) to remove their potential effects and the residuals were re-analyzed by the two stepwise regression series: the benthic metrics versus the habitat metrics; and the benthic metrics versus the habitat Principal Components (i.e., PCs associated with the habitat metrics). In the Model 2 analyses, the effects of the PCs that were most highly loaded by the habitat metrics were removed in a similar manner prior to re-assessing the effects of the toxicants by the two regression series: the benthic metrics versus the pyrethroids and metals metrics; and the benthic metrics versus the PCs associated with pyrethroids and/or metals. In each case, if the significant relationships between the benthic and the environmental variables were observed to persist from the results of the original stepwise regression series to the results from Models 1 or 2, they were considered more significant and less confounded by the effects of other environmental variables. These analyses were conducted on the data sets from 2008 alone and from the three-year (2006-2008) data set combined.

4. The final series of multivariate analyses involved canonical correlation analyses of the benthic data versus the environmental data (SAS Institute, 2002). For the 2008 data set, the canonical correlation analyses were conducted on the PCs from a PCA of the benthic metrics data versus the PCs for the environmental data, because the number of samples collected in a single year was less than the total number of variables to be analyzed, thus there were insufficient degrees of freedom to permit analysis of the full suite of variables. For the three-year data set, canonical correlation analyses were conducted both on the PCs and on the benthic metrics versus the environmental variables.

# 4.0 RESULTS AND DISCUSSION

## 4.1 Physical Habitat

Based on 10 instream and riparian physical habitat metrics (Table 2), total physical habitat scores in Pleasant Grove Creek ranged from 57 to 138 (maximum possible total score is 200). Most habitat metrics were highly variable among Pleasant Grove Creek sites.

Other descriptive physical habitat metrics that were not scored on a 0-20 scale are presented in Table 3. These metrics are not scored on a 0-20 scale because some are bimodal (too much or too little canopy can be advantageous) and others are just descriptive. Mean flow ranged from 0.01 to 0.21 m/s for sites where flow measurements could be made. Percent canopy ranged from 0 to 92%. Gradient was consistent at all sites (1%) except PGC6 (1.5%). The % fines ranged from 0 to 100%.

## 4.2 Benthic Macroinvertebrates

Approximately 21,000 individual macroinvertebrates were picked and subsequently identified from 153 taxa collected from 27 Pleasant Grove Creek sites in 2008 (Table 4 and Appendix 2). The six most abundant taxa – Unidentified Immature *Tubificidae* (Oligochaetes), *Paratanytarsus* sp. (Chironomids), *Hyalella* sp. (amphipods), *Physa* sp. (snails), *Dugesia tigrina* (Planariidae) and *Dero digitata* (Naididae) - comprised approximately 44% of the individuals collected (Table 4). These six taxa are generally considered tolerant to moderately tolerant (i.e., *Dugesia tigrina*) of environmental stressors (Harrington and Born, 2000; Stribling et al., 1998). Pollution sensitive taxa such as Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), i.e. EPT taxa, were generally rare at most sites. However, it is noteworthy that the third most dominant species collected (*Hyalella* sp.) is extremely sensitive to pyrethroids as reported by Giddings (2006).

Total taxa richness – a metric that increases in non-stressed environments - ranged from 21 at PGC 11 to 62 at PGC5 (Table 5). The % dominant taxa – a metric that increases with disturbance – was reported to be greater at PGC 11 (61.2%) and lower at PGC 6 (11.8%). Tolerance value – a metric that increases with disturbance – was found to range from 5.3 at PGC 11 to 9.27 at PCG 16. Percent tolerant taxa (taxa that are dominant in stressed environments) were reported to range from 21% at PGC 6 to 61% at PGC 19. Percent collectors/gatherers – a feeding guild that is dominant in stressed environments - were reported to range from 29% at PGC11 to 92% at PGC22. Percent collectors/filterers – a feeding guild that is dominant in stressed environments – was reported to range from 0% at PGC 11, PGC 16, and PGC 22 to 28% at PGC 5 and PGC 9a. The total abundance metric (a metric that increases in non-stressed environments) was reported to range from 2,179 at PGC17 to 23,828 at PGC 18.

## 4.3 Water Quality and Sediment Parameters

With the exception of salinity (0.1 – 0.3 ppt), all water quality parameters in Pleasant Grove Creek were highly variable in 2008 (Table 1). Ranges of water quality conditions across the 27 sites were as follows: temperature (14.8 – 26.6 C), specific conductivity (85 - 582 uS), pH (6.79 - 9.44), dissolved oxygen (1.64 to 14.58 mg/L), and turbidity (1.57 – 51.9 NTU). Dissolved oxygen values less than 5.0 mg/L, concentrations reported by Lee and Lee-Jones (2000) to be stressful to aquatic life, were reported at nine sites.

Percent TOC in Pleasant Grove Creek sediment ranged from 0.3 to 10.24 % with a mean value of 2.7% (Table 6). The percent sand across sites ranged from 3.77 to 83.9% with a mean value of 55.8%. Mean percent values for % gravel, % silt and % clay were as follows 0.88%, 26.4%, and 16.9%, respectively.

## 4.4 Pyrethroids

Ranges of pyrethroid concentrations (ng/g dry weight) in Table 7 normalized to 1% TOC in Pleasant Grove Creek in 2008 were as follows: bifenthrin (0.47 – 25.84); fenpropathrin ( < 0.18); lambda-cyhalothrin ( 0.02 – 1.05); permethrin (0.10 – 7.3); cyfluthrin (0.023 – 4.7); cypermethrin (0.114 – 9.6); esfenvalerate (0.021 – 0.825) and deltamethrin (0.038 – 1.4). Highest concentrations of pyrethroids (1% TOC normalized) in descending order from sediment samples in Pleasant Grove Creek were reported for bifenthrin, cypermethrin, permethrin, cyfluthrin, deltamethrin, lambda-cyhalothrin, esfenvalerate and fenpropathrin.

Toxic units (TU) calculations were determined for each pyrethroid by dividing the 1% TOC normalized concentration by the *Hyalella* LC50 concentration (a species highly sensitive to pyrethroids) that was also 1% TOC normalized (Table 8). TU concentrations exceeding 1.0 were considered potentially toxic. The TU approach indicated that bifenthrin concentrations at approximately half of the sites were potentially toxic while cypermethrin concentrations at two sites were potentially toxic. The sum of TUs indicated that 15 of the 27 sites were predicted to be toxic due to pyrethroids. A ranking of total TUs for all Pleasant Grove Creek sites indicated that potential pyrethroid toxicity was greater at PGC 15 and PGC 16.

## 4.5 Bulk Metals and SEM/AVS

For each bulk metal (except lead) in Table 9 there was at least one sample that exceeded a sediment Threshold Effect Level (TEL) for freshwater (Buchman, 1999). TELs are conservative highly protective biological benchmarks. The number of TEL exceedences for various metals by site were arsenic (1 site), cadmium (2 sites), chromium (3 sites), copper (6 sites), mercury (1 site), nickel (6 sites) and zinc (6 sites). On a site specific level, the following was reported: (1) one site with six TEL exceedances (PGC 22), (2) one site with five TEL exceedances (PGC 15) and (3) one site with four TEL exceedances (PGC 16).

The SEM/AVS data suggest that at least seven of the twenty-seven sites have ratios greater than one with at least one co-occurring metal exceeding a TEL (Table 10). Therefore, metals were bioavailable and potentially toxic at the following sites: PGC 4, PGC 12, PGC 14, PGC 15, PGC 16, PGC 22, and PGC 16a.

## 4.6 Relationship of Benthic Metrics to all Stressors

Interpretation of the relationships of benthic metrics to environmental stressors requires an understanding of how different benthic metrics are expected to respond to impairment. In the statistical analyses presented below, the expected response of the various benthic metrics to impairment is as follows:

| Benthic Metric | Response to Impairment |
|---|---|
| Taxonomic Richness | Decrease |
| % Dominant Taxon | Increase |
| Emphemeroptera Taxa | Decrease |

| | |
|---|---|
| EPT Taxa | Decrease |
| EPT Index (%) | Decrease |
| Shannon Diversity | Decrease |
| Tolerance Value | Increase |
| % Tolerant Taxa | Increase |
| % Collectors/Filterers | Increase |
| % Collectors/Gatherers | Increase |
| % Grazers | Variable |
| % Predators | Variable |
| % Shredders | Decrease |
| Abundance | Decrease |

For additional details on benthic metrics and response to impairment (stressors) see Appendix 1.

### 4.6.1 Benthic Metrics vs. Pyrethroids

The results of the GLM regressions that explored the relationships between the benthic metrics and individual pyrethroids in the 2008 data set alone from Pleasant Grove Creek are presented in Table 11. The benthic metric *Taxonomic richness* was inversely related to bifenthrin, lambda-cyhalothrin, permethrin, cyfluthrin, deltamethrin, and Total TUs. *Ephemeroptera taxa* and *EPT taxa* were inversely related to cyfluthrin, deltamethrin, and Total TUs. *Percent Collectors/Filterers* was inversely related to bifenthrin and Total TUs. On the other hand, *% Predators* was directly related to bifenthrin, lambda-cyhalothrin, cyfluthrin, and Total TUs. The metric *% Dominant taxon* was directly related to bifenthrin.

The results of the GLM regressions on the 2006-2008 data set combined are presented in Table 12. Compared to the results of the analyses on the 2008 data set alone, there were fewer significant relationships, and lower $R^2$ values displayed in the analyses of this larger data set. However, some of the same relationships were significant: *Ephemeroptera taxa* was inversely related to cypermethrin and Total TUs; and the *EPT Taxa* was inversely related to cypermethrin, bifenthrin, and Total TUs. On the other hand, *% Tolerant taxa* was directly related to all pyrethroids except permethrin.

The results from the stepwise multiple regression analyses also indicated that there were more significant relationships between the benthic metric and pyrethroids in the sediments in the 2008 data set alone (Table 13a) compared to the three-year data set combined (Table 13b). *Taxonomic richness* and *%Collectors/Filterers* were inversely related to bifenthrin, while *Ephemeroptera taxa* and *EPT taxa* were inversely related to cyfluthrin in the 2008 data set (Table 13a). *Percent Dominant taxon* was directly related to bifenthrin. For the 2006-2008 data set, *Ephemeroptera taxa* was inversely related to cypermethrin, *EPT taxa* was inversely related to Total TUs, and *% Tolerant taxa* was directly related to cypermethrin (Table 13b).

### 4.6.2 Benthic Metrics vs. Metals

The results of the GLM regressions of the benthic metrics versus metals to TELs for the 2008 data set alone are shown in Table 14. *Taxonomic richness* was inversely related to cadmium to TEL and zinc to TEL. *Percent Collectors/Filterers* was inversely related to arsenic to TEL, cadmium to TEL, mercury to TEL and zinc to TEL. On the other hand, *% Collectors/Gatherers* was directly related to mercury to TEL and *% Grazers* were directly related to copper to TEL.

The results of the GLM regressions for the three-year data set are presented in Table 15. There were a number of modest ($R^2$<0.20) inverse relationships between benthic metrics and metals: *Taxonomic richness* was inversely related to cadmium to TEL; *Ephemeroptera taxa* was inversely related to mercury to TEL and zinc to TEL; *EPT taxa* was inversely related to arsenic to TEL, mercury to TEL, and zinc to TEL; and *% Collectors/Filterers* was inversely related to chromium to TEL and nickel to TEL. There were also a number of direct relationships between benthic metrics and metals: *Tolerance Value* was directly related to mercury to TEL and zinc to TEL; *% Tolerant taxa* was directly related to all metals except for copper to TEL; and *% Grazers* was directly related to arsenic to TEL, copper to TEL and Total metals to TELs.

Table 16 presents the results of the stepwise regressions on benthic metrics versus metals in the two data sets. In the 2008 data set analyses (Table 16a), *Taxonomic richness* and *% Collectors/Filterers* were both inversely related to cadmium to TEL. *Percent Collectors/Gatherers* was directly related to mercury to TEL and *% Grazers* was directly related to copper to TEL.

In the stepwise regressions of the 2006-2008 combined data set, there were more significant relationships between benthic metrics and metals (Table 16b). *Taxonomic richness* displayed a direct relationship to lead to TEL, while it was inversely related to cadmium to TEL. *Ephemeroptera taxa* and *EPT taxa* were both inversely related to zinc to TEL, while *Tolerance value* and *% Tolerant taxa* were both directly related to zinc to TEL. *Percent Collectors/Filterers* was inversely related to chromium to TEL and *% Grazers* was directly related to arsenic to TEL.

### 4.6.3 Benthic Metrics vs. Habitat Metrics

Table 17 presents the results of the stepwise regressions of benthic metrics versus habitat metrics. In the analyses of the 2008 data set (Table 17a) *Ephermeroptera taxa* and *EPT taxa* both had direct relationships with *% Gravel*. *EPT index* had an inverse relationship with *Bank stability*. *Tolerance value* and *% Tolerance taxa*, two indicators of stressed communities, both had inverse relationships with *Velocity depth regimes*, while the latter benthic metric was also inversely related to *Riparian vegetative zone*. The *% Collectors/gatherers* also displayed inverse relationships with *Velocity depth regimes*. *Percent Predators* was inversely related to *Channel alteration* and directly related to *Bank stability*.

The results of the stepwise regressions on the three-year data set displayed a number of significant relationships between benthic metrics and habitat metrics (Table 17b). *Velocity depth regimes* displayed the most significant and strongest ($R^2$ values ranging from 0.3 to 0.5) relationships with benthic metrics. This habitat metric was directly related to *Ephemeroptera taxa, EPT taxa, EPT index* and *% Collectors/Filterers*; while it was inversely related to *Tolerance value* and *% Tolerant taxa*. *Ephemeroptera taxa* and *EPT taxa* were also directly related to *Riparian vegetative zone*, while *% Tolerant taxa* was inversely related to this habitat metric. *Taxonomic richness* was directly related to *% Gravel*. *Shannon Diversity* was inversely related to *Vegetative protection*, while *% Grazers* was directly related to it. *Percent Grazers* was also directly related to *% Fines*. *Percent Collectors/Gatherers* was inversely related to *Epifaunal substrate/available cover*, and *% Predators* was inversely related to *Channel alteration*.

### 4.6.4 Benthic Metrics vs. Pyrethroids, Metals and Habitat Metrics

The results of the stepwise regressions for benthic metrics versus all of the environmental variables from 2008 are presented in Table 18a, column a.1. *Taxonomic richness* and *% Collectors/Filterers* were inversely related to bifenthrin TUs, while *% Dominant taxon* and *% Predators* were directly related to it. The relationships for *Taxonomic richness, % Collectors/Filterers, and % Predators* persisted in the Model 2 confirmation analyses (i.e., when the PCs for habitat metrics were statistically taken into account), but the one between *% Dominant taxon* and bifenthrin TUs, which was weaker (i.e., it had a lower $R^2$ value), did not. *Percent Collectors/Filterers* was also inversely related to copper to TEL and directly related to *Embeddedness*, although these relationships did not persist in the Model 1 and Model 2 confirmation analyses. *Percent Predators* was also directly correlated to *Velocity depth regimes* and *Bank stability*, and these relationships persisted in the Model 1 confirmation analysis. *Ephemeroptera taxa* and *EPT taxa* both displayed direct relationships with *% Gravel* and inverse relationships with cyfluthrin. These relationships persisted in the Model 1 and Model 2 confirmations. *EPT taxa* also displayed an inverse relationship to *Vegetative protection*, but this relationship was fairly weak ($R^2$ =0.11) and did not persist in the Model 1 confirmation analysis. Finally, *EPT index* was inversely related to *Bank stability*, a relationship that persisted in the Model 1 confirmation.

The results of stepwise regression analyses of the benthic metrics versus the environmental PCs from the 2008 data set (Table 18a, column a.2) tended to confirm the relationships observed for the analyses of the benthic metrics versus individual environmental variables. *Taxonomic richness* and *EPT taxa* were inversely related to PC2, the environmental principal component that was directly related to all of the pyrethroids to TUs, while *% Predators* was directly related to PC2. All of these relationships persisted in the Model 2 confirmations. *Ephemeroptera taxa* and *EPT taxa* were directly related to PC3, the principal component that was loaded on by most of the habitat metrics (i.e. negatively loaded on by *% Fines;* and positively loaded by *% Gravel, Velocity depth regimes, Epifaunal substrate/available cover, Embeddedness, and Sediment deposition*), while *Tolerance value, % Tolerant taxa*, and *% Collectors/Gatherers* were inversely related to it. All of these relationships persisted in the Model 1 confirmation analyses. *Percent Grazers* was directly related to PC5, the environmental principal component that was positively loaded on by *Vegetative protection*, *Canopy* and *Sediment deposition*.

In contrast to the results from the analyses of the 2008 data set alone (Table 18a), the results from stepwise regressions of the three-year data set combined (Table 18b) did not display significant relationships between benthic metrics and pyrethroids. Rather, the significant relationships tended to be those between the benthic metrics and the habitat metrics, particularly *Velocity depth regimes*. A few benthic metrics displayed significant relationships with metals: *Taxonomic richness* was directly related to lead to TEL combined with an inverse relationship with cadmium to TEL; *% Dominant taxon* displayed significant relationships to the same metals, but the direction of the relationships were reversed (i.e., inverse relationship with lead to TEL and direct relationship with cadmium to TEL); *% Tolerant taxa* was directly related to cadmium to TEL and arsenic to TEL; *% Grazers* was directly related to arsenic to TEL. However, all of these relationships between benthic metrics and toxicity-standardized metals were quite weak ($R^2 \leq 0.12$) and did not persist in the Model 2 confirmation analyses. Conversely, stronger relationships ($R^2 \geq 0.27$) were observed between a number of benthic metrics and the habitat metric *Velocity depth regimes*. *Ephemeroptera taxa*, *EPT taxa*, *EPT index*, and *% Collectors/Filterers* displayed direct relationships to *Velocity depth regimes*; while *Tolerance value*, *% Tolerant taxa,* and *% Collectors/Gatherers* were all inversely related to this habitat metric. All of these relationships persisted in the Model 1 confirmation analyses. There were other significant, but somewhat weaker relationships between benthic metrics and habitat metrics: *Taxonomic richness* was directly related to *% Gravel; Ephemeroptera taxa* was directly related to *Riparian buffer zone*, while *% Tolerant taxa* was inversely related to it; *Shannon Diversity* was inversely related to *Vegetative protection*; and *% Predators* was inversely related to *Channel alteration*. Despite the weaker relationships (lower $R^2$ values), all of these relationships, except the one between *Ephemeroptera taxa* and *Riparian buffer zone,* persisted in the Model 1 confirmation analyses.

The results of the stepwise analyses of benthic metrics versus environmental PCs are presented in Table 18b (column b.2). A number of benthic metrics displayed significant relationships to PC3, the principal component that was related to most of the habitat metrics (the PC that was positively loaded by *% Gravel, Sediment deposition, Embeddedness, Velocity depth regimes,* and *Epifaunal substrate/available cover;* and negatively loaded by *% Fines*). The benthic metrics *Taxonomic richness, Ephemeroptera taxa, EPT taxa,* and *% Collectors/Filterers* were directly related to PC3, while *Tolerance value, % Tolerant taxa,* and *% Collectors/Gatherers* were inversely related to PC3. All of these relationships persisted in the Model 1 confirmation analyses. Other, somewhat weaker relationships between benthic metrics and other environmental PCs were observed: *EPT taxa* was inversely related to PC6 (the PC that was positively associated with *Bank stability* and *Vegetative protection*), while *% Tolerant taxa* was directly related to this PC; *% Tolerant taxa* and *% Predators* were both inversely related to PC4 (the PC that was positively associated with *Riparian vegetative zone*, *Channel alteration*, and *Frequency of riffles/bends*); and % Tolerant taxa was also directly related to PC2 (the PC that was positively associated with most metal to TELs). All of these relationships persisted in the confirmation analyses.

Canonical correlation analysis provides a visual presentation and a statistical test of the relationships between PCs for benthic metrics and PCs for environmental variables. Figure 3 presents the relationships between the benthic metric PCs (BENPCs) and the environmental PCs for the 2008 data set. BENPC1 (which was negatively loaded by *Tolerant taxa* and *Tolerance value* and positively loaded by *EPT index, Ephemeroptera taxa* and *EPT taxa*) and BENPC2 (which was positively loaded by *Collectors/Filterers, Taxonomic richness* and negatively loaded by *% Predators*) were both positively correlated with the benthic canonical variate. PC3 (negatively loaded by *% Fines;* and positively loaded by *% Gravel, Velocity depth regimes, Epifaunal substrate/available cover, Embeddedness,* and *Sediment deposition*) was directly correlated with the canonical variate for the environmental PCs, while PC2 (positively loaded on by TUs for all pyrethroids) was inversely correlated to this canonical variate. The benthic canonical variate was strongly and significantly related to the environmental variate ($R^2$=0.75). Thus, benthic communities characterized by a higher *EPT index*, more *Ephemeroptera taxa*, more *EPT taxa*, higher *% Collectors/Filterers*, and higher *Taxonomic richness,* but lower *Tolerant taxa* and *Tolerance values* tended to be found in habitats characterized by less *% Fines* and more *% Gravels* in the sediments, higher *Velocity depth regimes*, *Epifaunal substrate/available cover*, *Embeddedness*, and *Sediment deposition;* as well as lower concentrations of pyrethroids . On the other hand, more stressed communities exhibiting lower *EPT index, Ephemeroptera taxa, EPT taxa,* and *% Collectors/Filterers*, but higher representation by *Tolerant taxa* and higher *Tolerance values* were associated with the opposite habitat conditions.

The results of the canonical correlation analyses of the BENPCs versus environmental PCs for the three-year data set are presented in Figure 4. There were significant and relatively strong relationship ($R^2$=0.52) between the canonical variate for the benthic PC, that was most strongly correlated to BENPC1 (positively loaded by *EPT taxa, EPT index, Ephemeroptera taxa*, and negatively loaded by *Tolerant taxa,* and *Tolerant value*), and the canonical variate for the environmental PCs, that was most strongly and positively correlated with PC3 (positively loaded on by *% Gravel, Sediment deposition, Embeddedness, Velocity depth regimes,* and *Epifaunal substrate/available cover* and negatively loaded on by *% Fines*). The environmental PCs associated with pyrethroids or metals were not strongly correlated with the relationship between the two canonical variates. Thus, the canonical correlation analysis of the 2006-2008 data set suggests that benthic communities with more *EPT taxa* and *Ephemeroptera taxa* and a higher *EPT index*, but lower representation by *Tolerant taxa* and lower *Tolerance values* tended to be associated with habitats that had coarser sediments (more gravel, less fines), plus higher scores for the habitat metrics *Sediment deposition, Embeddedness, Velocity depth regimes,* and *Epifaunal substrate/available cover.*

Since the three-year data set had significantly more samples (degrees of freedom) than the 2008 data set alone, a second canonical correlation analysis was conducted directly on the benthic metrics versus the environmental variables (Figure 5). The results of this analyses tended to confirm the canonical analyses on the principal components, except more metrics or variables were selected as having strong correlations with the canonical variates and the relationships between the benthic and environmental variates were highly significant and very strong ($R^2$=0.90). The benthic metrics that were positively correlated with the benthic metric were *EPT Index, Ephemeroptera taxa, EPT taxa, % Collectors/Filterers,* and *Taxonomic richness*, while *Tolerance value, Tolerant taxa,* and *% Grazers* were negatively correlated with it. The environmental variables that were positively correlated with the environmental variate were *Velocity depth regimes, Epifaunal substrate/available cover, Sediment deposition, Embeddedness,* and *Channel flow.* Thus, as with the previous analyses, it appears that benthic communities that have higher *EPT Index* values, more *Ephemeroptera taxa*, more *EPT taxa*, more *Collectors/Filterers,* and greater *Taxonomic richness* appear to be associated with habitats with higher scores for the habitat metrics *Velocity depth regimes, Epifaunal substrate/available cover, Sediment deposition, Embeddedness.* Conversely, more stressed benthic communities that are characterized as having greater *Tolerance values*, more *Tolerant taxa* and relatively higher *% Grazers* tended to be associated with habitats with lower scores for these habitat metrics. Pyrethroids and metals did not show strong associations with this relationship.

## 5.0 SUMMARY

Physical habitat conditions at Pleasant Grove Creek sites were highly variable but generally very poor for most sites. The benthic communities were generally diverse at most sites as 153 total taxa were collected in this stream in the late spring of 2008. The most abundant taxa in this stream (i.e., oligochaetes, chironomids, amphipods, snails, Planariidae) were tolerant to moderately tolerant of environmental stressors. Pyrethroid measurements in sediment indicated that bifenthrin at approximately half the sites and cypermethrin concentrations at two sites were potentially toxic based on a TU approach using an amphipod (*Hyalella*) that is extremely sensitive to pyrethroids. The sum of TUs for all pyrethroids indicated that approximately half the sites were predicted to be potentially toxic due to pyrethroids. Approximately 1/3 of the sites were predicted to be toxic based on the presence of metals (SEM/AVS ratio > 1 and co-occurring metal exceeding a TEL).

Overall, the relationships observed in the regression analyses of the benthic metrics versus toxicants for the larger, three-year combined data set were not as strong as those observed for the 2008 data set. The univariate regressions for the 2008 data alone suggested that there were significant relationships between certain benthic metrics and certain toxicity normalized pyrethroids. *Taxonomic richness, Ephemeroptera taxa, EPT taxa,* and *% Collectors/Filterers* appeared to be inversely related to many of the pyrethroids. Conversely, *% Dominant taxa* and *% Predators* displayed direct relationships to pyrethroids. The regressions of the benthic metrics versus pyrethroids for the three-year data set combined displayed fewer relationships. *Ephermeroptera taxa* and *EPT Index* were inversely related to certain pyrethroids (e.g. cypermethrin and Total TUs), while *% Tolerant taxa* was directly related to almost all of the pyrethroids. The univariate regressions of the benthic metrics versus toxicity standardized metals for the 2008 data set alone suggested that *Taxonomic richness* and *% Collectors/Filterers* were inversely related to certain metals (e.g. cadmium and zinc), while *% Collectors/Gatherers* and *% Grazers* were directly related to individual metals (mercury and copper, respectively). The univariate regressions of benthic metrics versus metals for the 2006-2008 combined data set produced more numerous, but weaker relationships. As with the pyrethroid analyses, the benthic metrics indicative of nonstressed communities (e.g., *Taxonomic richness, Ephemeroptera taxa, EPT taxa)* were inversely related to certain metals.

Conversely, *% Tolerant taxa* and, to a lesser extent, *Tolerance Value* and *% Grazers* were directly related to certain metals.

In contrast to the results of the regressions focusing on the toxicants, the significant relationships between benthic metrics versus habitat metrics were observed to be more numerous and stronger in the stepwise regression analyses on three-year data set than those on 2008 alone. The habitat metric *Velocity depth regimes* had the most relationships with benthic metrics in the three-year data set. The benthic metrics indicative of nonstressed communities (*Ephemeroptera taxa, EPT taxa, EPT Index*) were directly related to this metric, while those indicative of stressed communities (*Tolerance Value* and *% Tolerant taxa*) were inversely related to it. For the analyses of benthic metrics versus all environmental variables, the effects of habitat metrics tended to dominate. In fact, for the larger three-year data set, the effects of pyrethroids disappeared and those of metals did not persist in the Model 2 confirmation analyses. The canonical correlation analyses underscored the findings of the regression-based analyses (and confirmation models) on the full environmental data set: healthier, nonstressed benthic communities characterized by more *Ephemeroptera taxa and EPT taxa*, a higher *EPT index* and greater *Taxonomic richness* tended to be found in certain habitat conditions that were characterized by coarser sediments and higher scores for the habitat metrics *Velocity depth regimes, Epifaunal substrate/available cover, Sediment deposition,* and *Embeddedness*; while more stressed communities that were characterized by lower values for these benthic metrics, plus greater *Tolerance values*, more *Tolerant taxa* and higher *% Grazers* tended to be associated with finer sediments and lower scores for these key habitat metrics.

These findings indicate that assessments of the effects of toxicants on benthic communities should take into account potentially confounding effects of physical habitat conditions and should involve a reasonably large number of samples to provide adequate power and a more accurate picture of true relationships. Conversely, univariate regressions of individual groups of toxicants that involve relatively few samples may produce misleading findings.

## 5.0 CONCLUSIONS

The conclusions from this study are as follows:

- Results from three years of bioassessment and stressor (physical habitat, metals and pyrethroids) data for Pleasant Grove Creek demonstrated that habitat metrics (primarily velocity depth regimes) dominated in their effects on benthic communities.
- Based on three years of data for Pleasant Grove Creek, pyrethroids did not display significant relationships with benthic communities.
- It is critical to use multiple years of benthic community and stressor data to identify true significant relationships because using small data sets from only a single year of sampling may produce misleading findings.

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# TABLES SECTION

**TABLE 1** **Sample site names, coordinates and water quality parameters measured during May 2008 in Pleasant Grove Creek (PGC).**

| Site | Latitude | Longitude | Water Temperature (C) | Specific Conductivity . S) | pH | Dissolved Oxygen (mg/L) | Salinity (ppt) | Turbidity (NTU) |
|---|---|---|---|---|---|---|---|---|
| PGC 1 | 38.80584 | 121.30369 | 23.9 | 582 | 8.14 | 9.02 | 0.3 | 3.42 |
| PGC 2 | 38.80235 | 121.3295 | 18.0 | 449 | 7.86 | 7.55 | 0.3 | 2.19 |
| PGC 3 | 38.80143 | 121.33968 | 14.8 | 382 | 8.14 | 7.82 | 0.2 | 3.59 |
| PGC 4 | 38.79484 | 121.35876 | 17.0 | 438 | 7.95 | 7.22 | 0.3 | 2.48 |
| PGC 5 | 38.81219 | 121.42471 | 19.6 | 474 | 8.13 | 9.87 | 0.3 | 10.4 |
| PGC 6 | 38.81289 | 121.45128 | 20.0 | 478 | 8.52 | 12.19 | 0.3 | 5.24 |
| PGC 7 | 38.80861 | 121.49616 | 15.9 | 85 | 8.02 | 9.29 | 0.1 | 12.9 |
| PGC 8 | 38.80276 | 121.33842 | 15.5 | 120 | 7.26 | 6.47 | 0.1 | 3.70 |
| PGC 9 | 38.80407 | 121.32832 | 17.1 | 379 | 7.12 | 3.28 | 0.2 | 51.9 |
| PGC 10 | 38.78382 | 121.35748 | 16.7 | 211 | 7.67 | 8.24 | 0.1 | 8.92 |
| PGC 11 | 38.77529 | 121.34203 | 21.6 | 175 | 6.79 | 1.64 | 0.1 | 1.57 |
| PGC 12 | 38.76652 | 121.33944 | 22.4 | 149 | 9.04 | 14.58 | 0.1 | 5.26 |
| PGC 14 | 38.76482 | 121.32569 | 17.1 | 154 | 7.03 | 2.99 | 0.1 | 7.39 |
| PGC 15 | 38.76415 | 121.32280 | 26.6 | 201 | 9.44 | 8.16 | 0.1 | 5.29 |
| PGC 16 | 38.76321 | 121.34216 | 18.1 | 178 | 7.37 | 5.63 | 0.1 | 5.23 |
| PGC 17 | 38.75906 | 121.33251 | 23.0 | 143 | 7.15 | 9.52 | 0.1 | 1.77 |
| PGC 18 | 38.79470 | 121.34605 | 17.6 | 201 | 7.09 | 4.04 | 0.1 | 1.88 |
| PGC 19 | 38.79047 | 121.33415 | 16.4 | 112 | 7.10 | 4.14 | 0.1 | 3.39 |
| PGC 20 | 38.77000 | 121.31350 | 24.2 | 292 | 7.52 | 11.25 | 0.1 | 5.68 |
| PGC 21 | 38.76932 | 121.29945 | 19.2 | 211 | 7.39 | 5.94 | 0.1 | 2.63 |
| PGC 22 | 38.76616 | 121.28350 | 17.5 | 165 | 7.13 | 4.09 | 0.1 | 6.58 |
| PGC 8a | 38.79840 | 121.34814 | 17.4 | 408 | 8.01 | 7.48 | 0.2 | 2.39 |
| PGC 9a | 38.80143 | 121.33532 | 18.4 | 449 | 7.95 | 7.51 | 0.2 | 3.13 |
| PGC 11a | 38.78078 | 121.35410 | 16.1 | 257 | 7.48 | 5.74 | 0.1 | 4.55 |
| PGC 16a | 38.77330 | 121.34972 | 19.3 | 145 | 7.09 | 3.43 | 0.1 | 6.49 |
| PGC 17a | 38.76762 | 121.34657 | 15.0 | 495 | 7.32 | 2.40 | 0.3 | 14.2 |
| PGC 22a | 38.77015 | 121.30671 | 23.8 | 286 | 7.40 | 3.77 | 0.1 | 5.8 |

**TABLE 2** **Scoring of individual physical habitat metrics (0-20 scale) and final habitat score (maximum of 200) for sites in Pleasant Grove Creek (PGC) sampled in May 2008.**

| Site | Epi Subs | Embedd | Veloc Depth Divers | Sedim Depos | Chan Flow Status | Chan Alt | Freq Bends Riffles | Left Bank Stab | Right Bank Stab | L Bank Veget. Protect | R Bank Veget. Protect | L Bank Ripar Zone | R Bank Ripar Zone | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PGC 1 | 3 | 0 | 1 | 7 | 19 | 16 | 3 | 8 | 8 | 6 | 6 | 7 | 5 | 89 |
| PGC 2 | 11 | 10 | 13 | 11 | 13 | 12 | 10 | 5 | 5 | 6 | 4 | 4 | 3 | 107 |
| PGC 3 | 13 | 3 | 6 | 11 | 15 | 12 | 11 | 8 | 5 | 9 | 7 | 8 | 6 | 114 |
| PGC 4 | 10 | 3 | 6 | 6 | 8 | 16 | 13 | 4 | 5 | 7 | 6 | 6 | 7 | 97 |
| PGC 5 | 14 | 14 | 12 | 8 | 20 | 16 | 4 | 8 | 8 | 9 | 9 | 8 | 8 | 138 |
| PGC 6 | 6 | 1 | 14 | 3 | 9 | 16 | 16 | 2 | 2 | 2 | 2 | 5 | 5 | 83 |
| PGC 7 | 10 | 0 | 6 | 8 | 20 | 13 | 5 | 6 | 8 | 6 | 9 | 3 | 7 | 101 |
| PGC 8 | 9 | 2 | 4 | 14 | 16 | 19 | 15 | 5 | 5 | 9 | 9 | 5 | 5 | 117 |
| PGC 9 | 1 | 0 | 0 | 2 | 14 | 19 | 10 | 7 | 8 | 9 | 9 | 8 | 8 | 95 |
| PGC 10 | 6 | 16 | 1 | 5 | 4 | 13 | 1 | 8 | 8 | 6 | 6 | 3 | 3 | 80 |
| PGC 11 | 6 | 14 | 20 | 11 | 16 | 6 | 0 | 9 | 9 | 6 | 6 | 0 | 0 | 103 |
| PGC 12 | 3 | 0 | 3 | 4 | 11 | 18 | 8 | 7 | 7 | 6 | 6 | 6 | 6 | 85 |
| PGC 14 | 4 | 3 | 2 | 14 | 15 | 8 | 2 | 6 | 6 | 6 | 7 | 1 | 5 | 79 |
| PGC 15 | 5 | 0 | 1 | 2 | 15 | 11 | 2 | 8 | 8 | 6 | 3 | 6 | 3 | 70 |
| PGC 16 | 0 | 0 | 0 | 0 | 3 | 11 | 1 | 8 | 8 | 6 | 6 | 6 | 8 | 57 |
| PGC 17 | 5 | 0 | 1 | 3 | 16 | 15 | 3 | 9 | 9 | 4 | 3 | 5 | 2 | 75 |
| PGC 18 | 13 | 5 | 6 | 12 | 11 | 16 | 16 | 9 | 8 | 8 | 8 | 8 | 6 | 126 |
| PGC 19 | 13 | 10 | 0 | 11 | 11 | 11 | 3 | 6 | 6 | 8 | 7 | 3 | 3 | 92 |
| PGC 20 | 11 | 5 | 6 | 6 | 16 | 16 | 9 | 8 | 3 | 7 | 6 | 6 | 4 | 103 |
| PGC 21 | 17 | 12 | 1 | 12 | 14 | 10 | 8 | 2 | 2 | 8 | 4 | 3 | 3 | 96 |
| PGC 22 | 0 | 0 | 0 | 0 | 0 | 16 | 10 | 9 | 9 | 8 | 6 | 8 | 5 | 71 |

TABLE 2. – Continued.

| Site | Epi Subs | Embedd | Veloc Depth Divers | Sedim Depos | Chan Flow Status | Chan Alt | Freq Bends Riffles | Left Bank Stab | Right Bank Stab | L Bank Veget. Protect | R Bank Veget. Protect | L Bank Ripar Zone | R Bank Ripar Zone | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PGC 8a | 6 | 1 | 0 | 6 | 19 | 16 | 1 | 5 | 5 | 9 | 7 | 7 | 5 | 87 |
| PGC 9a | 8 | 9 | 6 | 10 | 15 | 16 | 10 | 4 | 4 | 7 | 7 | 6 | 4 | 106 |
| PGC 11a | 10 | 6 | 6 | 10 | 13 | 17 | 10 | 6 | 7 | 8 | 8 | 2 | 5 | 108 |
| PGC 16a | 11 | 2 | 7 | 6 | 16 | 6 | 6 | 6 | 6 | 8 | 8 | 3 | 7 | 93 |
| PGC 17a | 5 | 7 | 0 | 6 | 4 | 13 | 3 | 9 | 9 | 7 | 7 | 2 | 2 | 74 |
| PGC 22a | 7 | 6 | 6 | 11 | 18 | 16 | 8 | 7 | 3 | 7 | 5 | 5 | 4 | 103 |

**TABLE 3** **Physical habitat characteristics for 2008 Pleasant Grove Creek (PGC) sites that were not scored on a 0 - 20 scale.**

| Site | Mean Flow m/s | Ave. Width m | Ave. Depth cm | Canopy Cover % | Gradient % | Fines % | Gravel % | Cobble % | Boulder % | Bedrock % |
|---|---|---|---|---|---|---|---|---|---|---|
| PGC 1 | 0 | >12 | >100 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| PGC 2 | 0.07 | 2 | 10 | 62 | 1 | 30 | 60 | 10 | 0 | 0 |
| PGC 3 | 0.15 | 1.5 | 15 | 48 | 1 | 60 | 40 | 0 | 0 | 0 |
| PGC 4 | 0.01 | 5 | 14 | 71 | 1 | 70 | 30 | 0 | 0 | 0 |
| PGC 5 | 0.07 | 15 | 37 | 35 | 1 | 15 | 40 | 40 | 5 | 0 |
| PGC 6 | 0.21 | 5 | 17 | 10 | 1.5 | 90 | 10 | 0 | 0 | 0 |
| PGC 7 | 0.01 | 15 | 70 | 0 | 1 | 70 | 0 | 0 | 0 | 30[a] |
| PGC 8 | 0.03 | 0.5 | 19 | 90 | 1 | 90 | 10 | 0 | 0 | 0 |
| PGC 9 | 0 | 1.5 | 50 | 63 | 1 | 100 | 0 | 0 | 0 | 0 |
| PGC 10 | 0.01 | 1 | 13 | 4 | 1 | 70 | 10 | 20 | 0 | 0 |
| PGC 11 | 0.01 | 0.9 | 19 | 0 | 1 | 60 | 20 | 20 | 0 | 0 |
| PGC 12 | 0.04 | 1 | 11 | 40 | 1 | 100 | 0 | 0 | 0 | 0 |
| PGC 14 | 0.03 | 1 | 22 | 72 | 1 | 90 | 8 | 2 | 0 | 0 |
| PGC 15 | 0.01 | 3 | 32 | 0 | 1 | 100 | 0 | 0 | 0 | 0 |
| PGC 16 | 0 | 3 | 5 | 9 | 1 | 100 | 0 | 0 | 0 | 0 |
| PGC 17 | 0 | 1 | 40 | 9 | 1 | 90 | 10 | 0 | 0 | 0 |
| PGC 18 | 0.01 | 1 | 16 | 92 | 1 | 35 | 60 | 5 | 0 | 0 |
| PGC 19 | 0 | 1.5 | 13 | 58 | 1 | 75 | 10 | 10 | 5 | 0 |
| PGC 20 | 0.01 | 3 | 40 | 27 | 1 | 80 | 20 | 0 | 0 | 0 |
| PGC 21 | 0 | 2 | 35 | 63 | 1 | 40 | 20 | 20 | 20 | 0 |
| PGC 22 | 0 | 0.3 | 3 | 65 | 1 | 100 | 0 | 0 | 0 | 0 |
| PGC 8a | 0.01 | >18 | >100 | 41 | 1 | 100 | 0 | 0 | 0 | 0 |
| PGC 9a | 0.01 | 4.5 | 23 | 45 | 1 | 70 | 20 | 0 | 0 | 10[a] |
| PGC 11a | 0.02 | 3.5 | 50 | 51 | 1 | 90 | 10 | 0 | 0 | 0 |
| PGC 16a | 0 | 3 | 60 | 40 | 1 | 90 | 10 | 0 | 0 | 0 |
| PGC 17a | 0 | 1 | 30 | 52 | 1 | 100 | 0 | 0 | 0 | 0 |
| PGC 22a | 0 | 5 | 62 | 50 | 1 | 65 | 35 | 0 | 0 | 0 |

[a] clay hardpan

## TABLE 4 Total and taxon abundance for benthic macroinvertebrates in Pleasant Grove Creek.

| Lowest Taxa | Higher Taxa | Total N | Total % | Cumulative % |
|---|---|---|---|---|
| Unid. Imm. Tubificidae | Tubificidae | 2326 | 10.925 | 10.925 |
| Paratanytarsus sp. | Chironomidae | 1723 | 8.093 | 19.017 |
| Hyalella sp. | Hyalellidae | 1679 | 7.886 | 26.903 |
| Physa sp. | Physidae | 1515 | 7.116 | 34.019 |
| Dugesia tigrina | Planariidae | 1164 | 5.467 | 39.486 |
| Dero digitata | Naididae | 920 | 4.321 | 43.807 |
| Psectrotanypus sp. | Chironomidae | 896 | 4.208 | 48.016 |
| Chironomus sp. | Chironomidae | 858 | 4.030 | 52.045 |
| Rheocricotopus sp. | Chironomidae | 602 | 2.827 | 54.873 |
| Nais communis/ variabilis | Naididae | 551 | 2.588 | 57.461 |
| Oxyethira sp. | Hydroptilidae | 520 | 2.442 | 59.903 |
| Cyprididae | Podocopida | 515 | 2.419 | 62.322 |
| Slavina appendiculata | Naididae | 453 | 2.128 | 64.450 |
| Tubificidae w hair cht. | Tubificidae | 451 | 2.118 | 66.568 |
| Tanytarsus sp. | Chironomidae | 389 | 1.827 | 68.395 |
| Sphaerium sp. | Sphaeriidae | 387 | 1.818 | 70.213 |
| Ophidonais serpentina | Naididae | 367 | 1.724 | 71.936 |
| Cricotopus sp. | Chironomidae | 332 | 1.559 | 73.496 |
| Helisoma sp. | Planorbidae | 330 | 1.550 | 75.046 |
| Menetus opercularis | Planorbidae | 315 | 1.479 | 76.525 |
| Chironominae | Chironomidae | 283 | 1.329 | 77.854 |
| Simulium sp. | Simuliidae | 281 | 1.320 | 79.174 |
| Stylaria lacustris | Naididae | 232 | 1.090 | 80.264 |
| Chaetogaster diaphanus | Naididae | 222 | 1.043 | 81.307 |
| Aulodrilus pigueti | Tubificidae | 202 | 0.949 | 82.255 |
| Dicrotendipes sp. | Chironomidae | 201 | 0.944 | 83.199 |
| Paratendipes sp. | Chironomidae | 179 | 0.841 | 84.040 |
| Pisidium sp. | Sphaeriidae | 173 | 0.813 | 84.853 |
| Lumbriculus variegata | Lumbriculidae | 167 | 0.784 | 85.637 |
| Corynoneura sp. | Chironomidae | 166 | 0.780 | 86.417 |
| Fallceon quilleri | Baetidae | 164 | 0.770 | 87.187 |
| Haemonais waldvogeli | Naididae | 152 | 0.714 | 87.901 |
| Stempellina sp. | Chironomidae | 147 | 0.690 | 88.591 |
| Coenagrionidae | Odonata | 131 | 0.615 | 89.207 |
| Eukiefferiella sp. | Chironomidae | 126 | 0.592 | 89.799 |
| Polypedilum sp. | Chironomidae | 112 | 0.526 | 90.325 |
| Cryptochironomus sp. | Chironomidae | 106 | 0.498 | 90.822 |
| Tricorythodes sp. | Leptohyphidae | 103 | 0.484 | 91.306 |
| Gammarus sp. | Amphipoda | 98 | 0.460 | 91.766 |
| Tanypodinae | Chironomidae | 90 | 0.423 | 92.189 |
| Anax junius | Odonata | 87 | 0.409 | 92.598 |
| Cricotopus bicinctus grp | Chironomidae | 69 | 0.324 | 92.922 |
| Hydra sp. | Hydridae | 65 | 0.305 | 93.227 |
| Limnodrilus hoffmeisteri | Tubificidae | 63 | 0.296 | 93.523 |
| Liodessus obscurellus | Dytiscidae | 63 | 0.296 | 93.819 |
| Chironomini | Chironomidae | 61 | 0.287 | 94.105 |
| Psectrocladius sp. | Chironomidae | 60 | 0.282 | 94.387 |
| Baetis tricaudatus | Baetidae | 59 | 0.277 | 94.664 |
| Enchytraeidae | Oligochaeta | 56 | 0.263 | 94.927 |
| Phaenopsectra sp. | Chironomidae | 56 | 0.263 | 95.190 |
| Hydropsyche sp. | Hydropsychidae | 54 | 0.254 | 95.444 |

TABLE 4. – continued.

| Lowest Taxa | Higher Taxa | Total N | Total % | Cumulative % |
|---|---|---|---|---|
| Lymnaea sp. | Lymnaeidae | 52 | 0.244 | 95.688 |
| Caenis latipennis | Caenidae | 50 | 0.235 | 95.923 |
| Limnophyes sp. | Chironomidae | 50 | 0.235 | 96.158 |
| Orthocladiinae | Chironomidae | 46 | 0.216 | 96.374 |
| Prostoma sp. | Tertastemmatidae | 35 | 0.164 | 96.538 |
| Dero borellii | Naididae | 34 | 0.160 | 96.698 |
| Tanytarsini | Chironomidae | 32 | 0.150 | 96.848 |
| Probezzia sp. | Ceratopogonidae | 31 | 0.146 | 96.994 |
| Thienemanniella sp. | Chironomidae | 26 | 0.122 | 97.116 |
| Gyraulus sp. | Planorbidae | 25 | 0.117 | 97.234 |
| Lumbricina | Oligochaeta | 25 | 0.117 | 97.351 |
| Helobdella stagnalis | Glossiphoniidae | 24 | 0.113 | 97.464 |
| Tipula sp. | Tipulidae | 24 | 0.113 | 97.576 |
| Culicoides sp. | Ceratopogonidae | 21 | 0.099 | 97.675 |
| Orthocladius complex | Chironomidae | 21 | 0.099 | 97.774 |
| Cladopelma sp. | Chironomidae | 20 | 0.094 | 97.868 |
| Tanypus sp. | Chironomidae | 20 | 0.094 | 97.962 |
| Sciomyzidae | Diptera | 19 | 0.089 | 98.051 |
| Ablabesmyia sp. | Chironomidae | 18 | 0.085 | 98.135 |
| Corixidae | Hemiptera | 18 | 0.085 | 98.220 |
| Ferrissia sp. | Ancylidae | 18 | 0.085 | 98.304 |
| Eucorethra underwoodi | Chaoboridae | 17 | 0.080 | 98.384 |
| Chironomidae | Chironomidae | 16 | 0.075 | 98.459 |
| Corbicula sp. | Corbiculidae | 16 | 0.075 | 98.535 |
| Pentaneura sp. | Chironomidae | 16 | 0.075 | 98.610 |
| Ceratopogonidae | Diptera | 15 | 0.070 | 98.680 |
| Bezzia/ Palpomyia | Ceratopogonidae | 14 | 0.066 | 98.746 |
| Corisella decolor | Corixidae | 14 | 0.066 | 98.812 |
| Procambarus clarkii | Cambaridae | 14 | 0.066 | 98.877 |
| Cladotanytarsus sp. | Chironomidae | 12 | 0.056 | 98.934 |
| Rheotanytarsus sp. | Chironomidae | 12 | 0.056 | 98.990 |
| Cryptotendipes sp. | Chironomidae | 11 | 0.052 | 99.042 |
| Hydropsyche californica | Hydropsychidae | 11 | 0.052 | 99.094 |
| Nanocladius sp. | Chironomidae | 11 | 0.052 | 99.145 |
| Limnesia sp. | Limnesiidae | 9 | 0.042 | 99.187 |
| Mooreobdella microstoma | Erpobdellidae | 9 | 0.042 | 99.230 |
| Pristina leidyi | Naididae | 9 | 0.042 | 99.272 |
| Cricotopus trifascia group | Chironomidae | 8 | 0.038 | 99.310 |
| Psychoda sp. | Psychodidae | 8 | 0.038 | 99.347 |
| Baetis sp. | Baetidae | 7 | 0.033 | 99.380 |
| Procladius sp. | Chironomidae | 6 | 0.028 | 99.408 |
| Ephydridae | Ephydridae | 5 | 0.023 | 99.432 |
| Helobdella triserialis | Glossiphoniidae | 5 | 0.023 | 99.455 |
| Libellula sp. | Libellulidae | 5 | 0.023 | 99.479 |
| Limonia sp. | Tipulidae | 5 | 0.023 | 99.502 |
| Argia sp. | Coenagrionidae | 4 | 0.019 | 99.521 |
| Brundiniella sp. | Chironomidae | 4 | 0.019 | 99.540 |
| Muscidae | Muscidae | 4 | 0.019 | 99.558 |
| Sphaeromias sp. | Ceratopogonidae | 4 | 0.019 | 99.577 |
| Brachycera | Diptera | 3 | 0.014 | 99.591 |
| Centroptilum sp. | Baetidae | 3 | 0.014 | 99.605 |

TABLE 4. – continued.

| Lowest Taxa | Higher Taxa | Total N | Total % | Cumulative % |
|---|---|---|---|---|
| Ceratopogon sp. | Ceratopogonidae | 3 | 0.014 | 99.620 |
| Dytiscidae | Coleoptera | 3 | 0.014 | 99.634 |
| Hydroptila sp. | Hydroptilidae | 3 | 0.014 | 99.648 |
| Laccophilus mexicanus | Dytiscidae | 3 | 0.014 | 99.662 |
| Mooreobdella tetragon | Erpobdellidae | 3 | 0.014 | 99.676 |
| Paracladopelma sp. | Chironomidae | 3 | 0.014 | 99.690 |
| Sigara vallis | Corixidae | 3 | 0.014 | 99.704 |
| Torrenticola sp. | Torrenticolidae | 3 | 0.014 | 99.718 |
| Tropisternus sp. | Hydrophilidae | 3 | 0.014 | 99.732 |
| Alotanypus sp. | Chironomidae | 2 | 0.009 | 99.742 |
| Erpobdellidae | Arhynchobdellida | 2 | 0.009 | 99.751 |
| Glyptotendipes sp. | Chironomidae | 2 | 0.009 | 99.760 |
| Hydraena sp. | Hydraenidae | 2 | 0.009 | 99.770 |
| Hydrellia sp. | Ephydridae | 2 | 0.009 | 99.779 |
| Hydropsychidae | Trichoptera | 2 | 0.009 | 99.789 |
| Ischnura sp. | Coenagrionidae | 2 | 0.009 | 99.798 |
| Macropelopiini | Chironomidae | 2 | 0.009 | 99.807 |
| Parachironomus sp. | Chironomidae | 2 | 0.009 | 99.817 |
| Paraphaenocladius sp. | Chironomidae | 2 | 0.009 | 99.826 |
| Psychodidae | Chironomidae | 2 | 0.009 | 99.836 |
| Stempellinella sp. | Chironomidae | 2 | 0.009 | 99.845 |
| Synorthocladius sp. | Chironomidae | 2 | 0.009 | 99.854 |
| Trombidiformes | Arachnida | 2 | 0.009 | 99.864 |
| Tropisternus lateralis | Hydrophilidae | 2 | 0.009 | 99.873 |
| Agabus lutosus | Dytiscidae | 1 | 0.005 | 99.878 |
| Arrenurus sp. | Arrenuridae | 1 | 0.005 | 99.883 |
| Baetidae | Ephemeroptera | 1 | 0.005 | 99.887 |
| Culex sp. | Culicidae | 1 | 0.005 | 99.892 |
| Cymbiodyta sp. | Hydrophilidae | 1 | 0.005 | 99.897 |
| Diamesa sp. | Chironomidae | 1 | 0.005 | 99.901 |
| Helophorus sp. | Helophoridae | 1 | 0.005 | 99.906 |
| Hydrobius fuscipes | Hydrophilidae | 1 | 0.005 | 99.911 |
| Hydrophilus sp. | Hydrophilidae | 1 | 0.005 | 99.915 |
| Laccophilus sp. | Dytiscidae | 1 | 0.005 | 99.920 |
| Libellulidae | Odonata | 1 | 0.005 | 99.925 |
| Microtendipes pedellus grp | Chironomidae | 1 | 0.005 | 99.930 |
| Mideopsis sp. | Mideopsidae | 1 | 0.005 | 99.934 |
| Pachydiplax longipennis | Libellulidae | 1 | 0.005 | 99.939 |
| Parakiefferiella sp. | Chironomidae | 1 | 0.005 | 99.944 |
| Parametriocnemus sp. | Chironomidae | 1 | 0.005 | 99.948 |
| Paranais litoralis | Naididae | 1 | 0.005 | 99.953 |
| Pericoma/ Telmatoscopus | Psychodidae | 1 | 0.005 | 99.958 |
| Piona sp. | Pionidae | 1 | 0.005 | 99.962 |
| Progomphus borealis | Odonata | 1 | 0.005 | 99.967 |
| Sanfilippodytes terminalis | Dytiscidae | 1 | 0.005 | 99.972 |
| Setacera sp. | Ephydridae | 1 | 0.005 | 99.977 |
| Sperchon sp. | Sperchontidae | 1 | 0.005 | 99.981 |
| Stenochironomus sp. | Chironomidae | 1 | 0.005 | 99.986 |
| Thienemannimyia group | Chironomidae | 1 | 0.005 | 99.991 |
| Trichocorixa calva | Corixidae | 1 | 0.005 | 99.995 |
| Zavrelimyia/ Paramerina | Chironomidae | 1 | 0.005 | 100.000 |
| | | 21291 | | |

**TABLE 5** **Benthic metrics by site for the 27 Pleasant Grove Creek sites.**

| Site | PGC 1 | PGC 2 | PGC 3 | PGC 4 | PGC 5 | PGC 6 | PGC 7 | PGC 8 | PGC 9 | PGC 10 | PGC 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Taxonomic Richness | 40 | 50 | 54 | 58 | 62 | 48 | 51 | 33 | 25 | 42 | 21 |
| Percent Dominant Taxon | 41.5 | 15.3 | 26.7 | 16 | 16.6 | 11.8 | 18.8 | 37.9 | 22.3 | 15.7 | 61.2 |
| Number Ephemeroptera Taxa | 1 | 5 | 3 | 3 | 4 | 3 | 1 | 0 | 0 | 0 | 0 |
| Number Plecoptera Taxa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Number Trichoptera Taxa | 1 | 3 | 2 | 2 | 2 | 3 | 2 | 1 | 0 | 1 | 0 |
| EPT Taxa | 2 | 8 | 5 | 5 | 6 | 6 | 3 | 1 | 0 | 1 | 0 |
| EPT Index (%) | 1 | 27 | 4 | 11 | 10 | 23 | 2 | 1 | 0 | 0 | 0 |
| Sensitive EPT Index (%) | 1 | 12 | 1 | 6 | 8 | 2 | 1 | 1 | 0 | 0 | 0 |
| Shannon Diversity | 2.33 | 3.07 | 3 | 3.16 | 3.35 | 3.04 | 2.87 | 2.19 | 2.49 | 2.99 | 1.39 |
| Tolerance Value | 7.59 | 6 | 6.38 | 6.52 | 6.42 | 6.14 | 7.09 | 7.52 | 8.23 | 7.2 | 5.3 |
| Percent Intolerant Taxa (0-2) | 0 | 4 | 4 | 2 | 2 | 2 | 5 | 0 | 0 | 0 | 0 |
| Percent Tolerant Taxa (8-10) | 39 | 28 | 35 | 38 | 31 | 21 | 44 | 45 | 42 | 59 | 41 |
| Percent Baetidae | 0 | 9 | 2 | 4 | 2 | 9 | 0 | 0 | 0 | 0 | 0 |
| Percent Chironomidae | 19 | 50 | 72 | 33 | 45 | 36 | 31 | 59 | 32 | 51 | 6 |
| Percent Hydropsychidae | 0 | 5 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Percent Collectors Gatherers | 71 | 40 | 45 | 44 | 46 | 64 | 60 | 75 | 77 | 61 | 29 |
| Percent Collector-Filterers | 9 | 16 | 15 | 22 | 28 | 16 | 24 | 4 | 1 | 23 | 0 |
| Percent Scrapers | 15 | 9 | 5 | 8 | 3 | 3 | 4 | 8 | 3 | 7 | 0 |
| Percent Predators | 4 | 8 | 3 | 8 | 10 | 2 | 7 | 2 | 19 | 3 | 62 |
| Percent Shredders | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Abundance (#/sample) | 17232 | 5354 | 19929 | 7371 | 6072 | 7244 | 9263 | 9025 | 7044 | 11336 | 4436 |

TABLE 5. - continued.

| Site | PGC 12 | PGC 14 | PGC 15 | PGC 16 | PGC 17 | PGC 18 | PGC 19 | PGC 20 | PGC 21 | PGC 22 |
|---|---|---|---|---|---|---|---|---|---|---|
| Taxonomic Richness | 36 | 27 | 26 | 23 | 30 | 25 | 37 | 31 | 36 | 30 |
| Percent Dominant Taxon | 22.3 | 17.4 | 29.4 | 31.8 | 20.6 | 30.1 | 15.2 | 31 | 51.5 | 27.6 |
| Number Ephemeroptera Taxa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Number Plecoptera Taxa | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Number Trichoptera Taxa | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| EPT Taxa | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| EPT Index (%) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Sensitive EPT Index (%) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Shannon Diversity | 2.63 | 2.61 | 2.15 | 1.88 | 252 | 1.92 | 2.95 | 2.13 | 2.19 | 2.22 |
| Tolerance Value | 7.74 | 7.37 | 7.48 | 9.27 | 8.48 | 6.61 | 7.79 | 7.51 | 7.41 | 8.26 |
| Percent Intolerant Taxa (0-2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent Tolerant Taxa (8-10) | 45 | 56 | 53 | 50 | 50 | 41 | 61 | 52 | 52 | 54 |
| Percent Baetidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent Chironomidae | 46 | 10 | 2 | 25 | 38 | 26 | 51 | 33 | 75 | 10 |
| Percent Hydropsychidae | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent Collectors Gatherers | 77 | 71 | 74 | 73 | 50 | 68 | 56 | 37 | 77 | 92 |
| Percent Collector-Filterers | 5 | 1 | 5 | 0 | 8 | 0 | 17 | 21 | 5 | 0 |
| Percent Scrapers | 10 | 7 | 0 | 2 | 7 | 4 | 35 | 10 | 25 | 3 |
| Percent Predators | 9 | 22 | 20 | 23 | 23 | 21 | 10 | 7 | 5 | 2 |
| Percent Shredders | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Abundance (#/sample) | 13990 | 6505 | 6246 | 10026 | 2179 | 23828 | 5623 | 10201 | 12647 | 2212 |

TABLE 5. - continued.

| Site | PGC 8a | PGC 9a | PGC 11a | PGC 16a | PGC 17a | PGC 22a |
|---|---|---|---|---|---|---|
| Taxonomic Richness | 48 | 47 | 38 | 38 | 36 | 41 |
| Percent Dominant Taxon | 12.6 | 23.2 | 20.7 | 13.5 | 20.4 | 21.9 |
| Number Ephemeroptera Taxa | 1 | 4 | 0 | 0 | 0 | 0 |
| Number Plecoptera Taxa | 0 | 0 | 0 | 0 | 0 | 0 |
| Number Trichoptera Taxa | 1 | 1 | 0 | 0 | 0 | 1 |
| EPT Taxa | 2 | 5 | 0 | 0 | 0 | 1 |
| EPT Index (%) | 16 | 15 | 0 | 0 | 0 | 0 |
| Sensitive EPT Index (%) | 13 | 13 | 0 | 0 | 0 | 0 |
| Shannon Diversity | 3.24 | 2.98 | 2.64 | 2.94 | 2.65 | 2.63 |
| Tolerance Value | 5.98 | 6.16 | 7.74 | 7.8 | 7.92 | 7.57 |
| Percent Intolerant Taxa (0-2) | 5 | 7 | 0 | 0 | 0 | 0 |
| Percent Tolerant Taxa (8-10) | 40 | 29 | 44 | 47 | 57 | 43 |
| Percent Baetidae | 0 | 1 | 0 | 0 | 0 | 0 |
| Percent Chironomidae | 42 | 53 | 63 | 56 | 74 | 21 |
| Percent Hydropsychidae | 0 | 0 | 0 | 0 | 0 | 0 |
| Percent Collectors Gatherers | 57 | 41 | 77 | 71 | 59 | 45 |
| Percent Collector-Filterers | 10 | 28 | 12 | 10 | 18 | 14 |
| Percent Scrapers | 12 | 9 | 9 | 14 | 6 | 30 |
| Percent Predators | 5 | 7 | 2 | 8 | 18 | 17 |
| Percent Shredders | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Abundance (#/sample) | 5280 | 6623 | 6129 | 3367 | 10203 | 5233 |

**TABLE 6 TOC and grain size values for Pleasant Grove Creek (PGC) sites for 2008.**

| Site | % TOC | % Sand | % Gravel | % Silt | % Clay |
|---|---|---|---|---|---|
| PGC 1 | 1.88 | 55.76 | 0.34 | 22.52 | 21.38 |
| PGC 2 | 0.42 | 59.63 | 2 | 22.15 | 16.22 |
| PGC 3 | 0.89 | 57.09 | 0.24 | 24.7 | 17.97 |
| PGC 4 | 1.59 | 52.19 | 0.22 | 28.91 | 18.69 |
| PGC 5 | 2.27 | 48.81 | 0 | 30.04 | 21.16 |
| PGC 6 | 1.68 | 60.65 | 0.72 | 22.1 | 16.53 |
| PGC 7 | 1.82 | 58.81 | 0 | 27.27 | 13.93 |
| PGC 8 | 2.19 | 53.1 | 0.3 | 29.96 | 16.64 |
| PGC 9 | 1.33 | 55.21 | 1.03 | 27.28 | 16.48 |
| PGC 10 | 1.35 | 75.03 | 0 | 13.74 | 11.23 |
| PGC 11 | 5.28 | 57.23 | 0.45 | 29.77 | 12.55 |
| PGC 12 | 3.51 | 35.7 | 0.46 | 38.53 | 25.32 |
| PGC 14 | 3.98 | 66.31 | 1.94 | 20.33 | 11.42 |
| PGC 15 | 10.24 | 29.74 | 0 | 46.2 | 24.06 |
| PGC 16 | 7.15 | 3.77 | 0 | 59.89 | 36.33 |
| PGC 17 | 3.1 | 47.66 | 0 | 32.74 | 19.61 |
| PGC 18 | 2.56 | 69.26 | 0.22 | 17.98 | 12.53 |
| PGC 19 | 0.91 | 62.22 | 1.42 | 24.65 | 11.72 |
| PGC 20 | 1.23 | 72.4 | 1.45 | 15.7 | 10.46 |
| PGC 21 | 1.06 | 83.96 | 7.77 | 4.86 | 3.42 |
| PGC 22 | 10.07 | 5.81 | 0.11 | 52.58 | 41.5 |
| PGC 8A | 1.5 | 67.07 | 0.93 | 17.32 | 14.69 |
| PGC 9A | 0.3 | 74.87 | 2.54 | 11.89 | 10.7 |
| PGC 11A | 0.66 | 64.82 | 0.65 | 20.69 | 13.83 |
| PGC 16A | 1.72 | 42.44 | 0.23 | 38.75 | 18.58 |
| PGC 17A | 2.65 | 71.63 | 0.69 | 17.04 | 10.65 |
| PGC 22A | 1.6 | 74.09 | 0.27 | 14.28 | 11.36 |
| Mean | 2.701 | 55.750 | 0.888 | 26.366 | 16.999 |

**TABLE 7** **Pyrethroid concentrations (ng/g dry weight) from Pleasant Grove Creek (PGC) sites including 1% TOC normalized values by site in 2008. Non-detected values for Fenpropathrin (noted by an *) were assigned a value of one half the detection limit.**

| Sample ID | % TOC | Bifenthrin Ng/g | Bifenthrin ng/g TOC | Bifenthrin @ 1% TOC | Fenpropathrin ng/g | Fenpropathrin ng/g TOC | Fenpropathrin @ 1% TOC | Lambda-cyhal. ng/g | Lambda-cyhal. ng/g TOC | Lambda-cyhal. @ 1% TOC |
|---|---|---|---|---|---|---|---|---|---|---|
| PGC 1 | 1.88 | 1.23 | 65.58 | 0.66 | *0.13 | 0.13 | 0.07 | 0.04 | 2.21 | 0.02 |
| PGC 2 | 0.42 | 0.68 | 162.28 | 1.62 | *0.08 | 0.08 | 0.18 | 0.02 | 4.48 | 0.04 |
| PGC 3 | 0.89 | 4.97 | 558.97 | 5.59 | *0.09 | 0.09 | 0.10 | 0.07 | 7.73 | 0.08 |
| PGC 4 | 1.59 | 2.21 | 139.12 | 1.39 | *0.11 | 0.11 | 0.07 | 0.10 | 6.57 | 0.07 |
| PGC 5 | 2.27 | 2.21 | 97.25 | 0.97 | *0.20 | 0.20 | 0.09 | 0.15 | 6.42 | 0.06 |
| PGC 6 | 1.68 | 0.80 | 47.44 | 0.47 | *0.15 | 0.15 | 0.09 | 0.08 | 4.81 | 0.05 |
| PGC 7 | 1.82 | 1.03 | 56.56 | 0.57 | *0.11 | 0.11 | 0.06 | 0.24 | 13.12 | 0.13 |
| PGC 8 | 2.19 | 35.51 | 1621.32 | 16.21 | 0.02 | 0.02 | 0.01 | 0.44 | 20.30 | 0.20 |
| PGC 9 | 1.33 | 13.95 | 1048.98 | 10.49 | *0.09 | 0.09 | 0.06 | 0.18 | 13.51 | 0.14 |
| PGC 10 | 1.35 | 10.36 | 767.54 | 7.68 | 0.01 | 0.01 | 0.01 | 0.41 | 30.19 | 0.30 |
| PGC 11 | 5.28 | 111.78 | 2116.98 | 21.17 | 0.04 | 0.04 | 0.01 | 4.50 | 85.29 | 0.85 |
| PGC 12 | 3.51 | 9.03 | 257.35 | 2.57 | 0.03 | 0.03 | 0.01 | 0.25 | 7.12 | 0.07 |
| PGC 14 | 3.98 | 57.72 | 1450.38 | 14.50 | 0.10 | 0.10 | 0.02 | 2.18 | 54.86 | 0.55 |
| PGC 15 | 10.24 | 194.63 | 1900.68 | 19.01 | 0.31 | 0.31 | 0.03 | 10.77 | 105.22 | 1.05 |
| PGC 16 | 7.15 | 184.76 | 2583.99 | 25.84 | 0.11 | 0.11 | 0.02 | 5.15 | 72.06 | 0.72 |
| PGC 17 | 3.10 | 27.87 | 899.00 | 8.99 | 0.02 | 0.02 | 0.01 | 1.15 | 37.18 | 0.37 |
| PGC 18 | 2.56 | 15.69 | 613.02 | 6.13 | 0.01 | 0.01 | 0.00 | 0.20 | 7.92 | 0.08 |
| PGC 19 | 0.91 | 7.77 | 854.05 | 8.54 | *0.10 | 0.10 | 0.11 | 0.14 | 15.09 | 0.15 |
| PGC 20 | 1.23 | 2.88 | 234.54 | 2.35 | 0.02 | 0.02 | 0.01 | 1.03 | 83.42 | 0.83 |
| PGC 21 | 1.06 | 7.54 | 710.89 | 7.11 | 0.02 | 0.02 | 0.02 | 0.16 | 15.53 | 0.16 |
| PGC 22 | 10.07 | 10.91 | 108.30 | 1.08 | 0.03 | 0.03 | 0.00 | 0.29 | 2.87 | 0.03 |
| PGC 8A | 1.50 | 1.86 | 123.97 | 1.24 | *0.09 | 0.09 | 0.06 | 0.07 | 4.37 | 0.04 |
| PGC 9A | 0.30 | 0.17 | 57.74 | 0.58 | 0.003 | 0.00 | 0.01 | 0.01 | 4.63 | 0.05 |
| PGC 11A | 0.66 | 1.11 | 167.92 | 1.68 | *0.08 | 0.08 | 0.11 | 0.03 | 5.29 | 0.05 |
| PGC 16A | 1.72 | 3.81 | 221.45 | 2.21 | 0.01 | 0.01 | 0.01 | 0.17 | 9.60 | 0.10 |
| PGC 17A | 2.65 | 3.48 | 131.33 | 1.31 | 0.03 | 0.03 | 0.01 | 0.16 | 5.98 | 0.06 |
| PGC 22A | 1.60 | 17.05 | 1065.62 | 10.66 | 0.02 | 0.02 | 0.01 | 0.39 | 24.33 | 0.24 |

TABLE 7. – continued.

| Sample ID | % TOC | Permethrin ng/g | Permethrin ng/g TOC | Permethrin @ 1% TOC | Cyfluthrin ng/g | Cyfluthrin ng/g TOC | Cyfluthrin @ 1% TOC | Cypermethrin ng/g | Cypermethrin ng/g TOC | Cypermethrin @ 1% TOC |
|---|---|---|---|---|---|---|---|---|---|---|
| PGC 1 | 1.88 | 0.175 | 9.309 | 0.093 | 0.192 | 10.205 | 0.102 | 0.215 | 11.436 | 0.114 |
| PGC 2 | 0.42 | 0.109 | 25.952 | 0.260 | 0.104 | 24.706 | 0.247 | 0.068 | 16.286 | 0.163 |
| PGC 3 | 0.89 | 0.890 | 100.000 | 1.000 | 0.394 | 44.244 | 0.442 | 0.339 | 38.083 | 0.381 |
| PGC 4 | 1.59 | 0.261 | 16.415 | 0.164 | 0.343 | 21.556 | 0.216 | 0.357 | 22.460 | 0.225 |
| PGC 5 | 2.27 | 0.273 | 12.026 | 0.120 | 0.173 | 7.624 | 0.076 | 0.695 | 30.598 | 0.306 |
| PGC 6 | 1.68 | 0.168 | 10.000 | 0.100 | 0.156 | 9.266 | 0.093 | 0.193 | 11.491 | 0.115 |
| PGC 7 | 1.82 | 0.205 | 11.264 | 0.113 | 0.043 | 2.341 | 0.023 | 0.239 | 13.136 | 0.131 |
| PGC 8 | 2.19 | 4.422 | 201.922 | 2.019 | 3.102 | 141.660 | 1.417 | 2.268 | 103.564 | 1.036 |
| PGC 9 | 1.33 | 1.495 | 112.396 | 1.124 | 1.764 | 132.652 | 1.327 | 1.035 | 77.811 | 0.778 |
| PGC 10 | 1.35 | 1.704 | 126.238 | 1.262 | 3.028 | 224.307 | 2.243 | 12.989 | 962.175 | 9.622 |
| PGC 11 | 5.28 | 15.166 | 287.242 | 2.872 | 13.684 | 259.169 | 2.592 | 13.572 | 257.053 | 2.571 |
| PGC 12 | 3.51 | 2.067 | 58.891 | 0.589 | 1.918 | 54.642 | 0.546 | 1.015 | 28.922 | 0.289 |
| PGC 14 | 3.98 | 11.792 | 296.275 | 2.963 | 11.823 | 297.049 | 2.970 | 10.130 | 254.527 | 2.545 |
| PGC 15 | 10.24 | 71.832 | 701.488 | 7.015 | 48.258 | 471.270 | 4.713 | 57.563 | 562.134 | 5.621 |
| PGC 16 | 7.15 | 51.837 | 724.987 | 7.250 | 17.631 | 246.592 | 2.466 | 10.940 | 153.009 | 1.530 |
| PGC 17 | 3.10 | 10.926 | 352.449 | 3.524 | 5.864 | 189.163 | 1.892 | 6.444 | 207.884 | 2.079 |
| PGC 18 | 2.56 | 2.140 | 83.607 | 0.836 | 2.415 | 94.319 | 0.943 | 4.418 | 172.563 | 1.726 |
| PGC 19 | 0.91 | 0.942 | 103.516 | 1.035 | 0.461 | 50.667 | 0.507 | 0.449 | 49.353 | 0.494 |
| PGC 20 | 1.23 | 1.644 | 133.631 | 1.336 | 1.226 | 99.645 | 0.996 | 1.010 | 82.083 | 0.821 |
| PGC 21 | 1.06 | 2.204 | 207.961 | 2.080 | 1.773 | 167.272 | 1.673 | 0.824 | 77.768 | 0.778 |
| PGC 22 | 10.07 | 5.370 | 53.322 | 0.533 | 2.761 | 27.416 | 0.274 | 4.870 | 48.361 | 0.484 |
| PGC 8A | 1.50 | 0.317 | 21.133 | 0.211 | 0.527 | 35.101 | 0.351 | 0.329 | 21.949 | 0.219 |
| PGC 9A | 0.30 | 0.705 | 235.000 | 2.350 | 0.070 | 23.333 | 0.233 | 0.070 | 23.333 | 0.233 |
| PGC 11A | 0.66 | 0.095 | 14.318 | 0.143 | 1.122 | 170.013 | 1.700 | 0.512 | 77.628 | 0.776 |
| PGC 16A | 1.72 | 0.823 | 47.849 | 0.478 | 1.333 | 77.519 | 0.775 | 2.729 | 158.668 | 1.587 |
| PGC 17A | 2.65 | 0.663 | 25.019 | 0.250 | 0.322 | 12.139 | 0.121 | 0.538 | 20.312 | 0.203 |
| PGC 22A | 1.60 | 3.786 | 236.650 | 2.367 | 4.197 | 262.294 | 2.623 | 2.494 | 155.886 | 1.559 |

TABLE 7. – continued.

| Sample ID | % TOC | Esfenvalerate ng/g | Esfenvalerate ng/g TOC | Esfenvalerate @ 1% TOC | Deltamethrin ng/g | Deltamethrin ng/g TOC | Deltamethrin @ 1% TOC |
|---|---|---|---|---|---|---|---|
| PGC 1 | 1.88 | 0.066 | 3.532 | 0.035 | 0.294 | 15.619 | 0.156 |
| PGC 2 | 0.42 | 0.019 | 4.595 | 0.046 | 0.075 | 17.857 | 0.179 |
| PGC 3 | 0.89 | 0.072 | 8.101 | 0.081 | 0.155 | 17.426 | 0.174 |
| PGC 4 | 1.59 | 0.066 | 4.176 | 0.042 | 0.184 | 11.582 | 0.116 |
| PGC 5 | 2.27 | 0.193 | 8.504 | 0.085 | 0.195 | 8.590 | 0.086 |
| PGC 6 | 1.68 | 0.067 | 3.958 | 0.040 | 0.150 | 8.929 | 0.089 |
| PGC 7 | 1.82 | 0.072 | 3.973 | 0.040 | 0.105 | 5.769 | 0.058 |
| PGC 8 | 2.19 | 0.347 | 15.850 | 0.158 | 1.239 | 56.591 | 0.566 |
| PGC 9 | 1.33 | 0.095 | 7.120 | 0.071 | 0.425 | 31.991 | 0.320 |
| PGC 10 | 1.35 | 0.099 | 7.363 | 0.074 | 0.969 | 71.779 | 0.718 |
| PGC 11 | 5.28 | 1.138 | 21.550 | 0.215 | 3.840 | 72.726 | 0.727 |
| PGC 12 | 3.51 | 0.235 | 6.685 | 0.067 | 0.767 | 21.858 | 0.219 |
| PGC 14 | 3.98 | 1.248 | 31.360 | 0.314 | 3.548 | 89.137 | 0.891 |
| PGC 15 | 10.24 | 8.444 | 82.461 | 0.825 | 14.436 | 140.980 | 1.410 |
| PGC 16 | 7.15 | 1.823 | 25.495 | 0.255 | 6.706 | 93.789 | 0.938 |
| PGC 17 | 3.10 | 0.440 | 14.198 | 0.142 | 3.621 | 116.791 | 1.168 |
| PGC 18 | 2.56 | 0.145 | 5.650 | 0.056 | 0.406 | 15.857 | 0.159 |
| PGC 19 | 0.91 | 0.082 | 9.022 | 0.090 | 0.321 | 35.285 | 0.353 |
| PGC 20 | 1.23 | 0.082 | 6.683 | 0.067 | 0.706 | 57.434 | 0.574 |
| PGC 21 | 1.06 | 0.085 | 8.028 | 0.080 | 0.695 | 65.562 | 0.656 |
| PGC 22 | 10.07 | 0.383 | 3.801 | 0.038 | 0.384 | 3.814 | 0.038 |
| PGC 8A | 1.50 | 0.031 | 2.067 | 0.021 | 0.160 | 10.665 | 0.107 |
| PGC 9A | 0.30 | 0.014 | 4.500 | 0.045 | 0.070 | 23.333 | 0.233 |
| PGC 11A | 0.66 | 0.031 | 4.636 | 0.046 | 0.335 | 50.745 | 0.507 |
| PGC 16A | 1.72 | 0.148 | 8.604 | 0.086 | 1.904 | 110.707 | 1.107 |
| PGC 17A | 2.65 | 0.159 | 5.987 | 0.060 | 0.227 | 8.580 | 0.086 |
| PGC 22A | 1.60 | 0.299 | 18.671 | 0.187 | 1.398 | 87.379 | 0.874 |

**TABLE 8 Toxic units (TU) calculations for pyrethroids (1% TOC normalized) by site for Pleasant Grove Creek (PGC) sites in 2008. The sum of TUs by site and ranking by all sites is also included. Toxic units > 1.0 are in bold type.**

| Sample ID | % TOC | Bifen TU | Fen TU | Lam-cy TU | Perm TU | Cyflu TU | Cyper TU | Esfen TU | Delt TU | Sum TU | Rank Stream |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PGC 1 | 1.88 | 0.126 | NA | 0.005 | 0.001 | 0.009 | 0.030 | 0.002 | 0.020 | 0.193 | 25 |
| PGC 2 | 0.42 | 0.312 | NA | 0.010 | 0.002 | 0.023 | 0.043 | 0.003 | 0.023 | 0.416 | 18 |
| PGC 3 | 0.89 | **1.075** | NA | 0.017 | 0.009 | 0.041 | 0.100 | 0.005 | 0.022 | **1.270** | 13 |
| PGC 4 | 1.59 | 0.268 | NA | 0.015 | 0.002 | 0.020 | 0.059 | 0.003 | 0.015 | 0.380 | 19 |
| PGC 5 | 2.27 | 0.187 | NA | 0.014 | 0.001 | 0.007 | 0.081 | 0.006 | 0.011 | 0.306 | 23 |
| PGC 6 | 1.68 | 0.091 | NA | 0.011 | 0.001 | 0.009 | 0.030 | 0.003 | 0.011 | 0.156 | 27 |
| PGC 7 | 1.82 | 0.109 | NA | 0.029 | 0.001 | 0.002 | 0.035 | 0.003 | 0.007 | 0.186 | 26 |
| PGC 8 | 2.19 | **3.118** | NA | 0.045 | 0.019 | 0.131 | 0.273 | 0.010 | 0.072 | **3.667** | 6 |
| PGC 9 | 1.33 | **2.017** | NA | 0.030 | 0.010 | 0.123 | 0.205 | 0.005 | 0.040 | **2.430** | 9 |
| PGC 10 | 1.35 | **1.476** | NA | 0.067 | 0.012 | 0.208 | **2.532** | 0.005 | 0.091 | **4.390** | 4 |
| PGC 11 | 5.28 | **4.071** | NA | 0.190 | 0.027 | 0.240 | 0.676 | 0.014 | 0.092 | **5.310** | 3 |
| PGC 12 | 3.51 | 0.495 | NA | 0.016 | 0.005 | 0.051 | 0.076 | 0.004 | 0.028 | 0.675 | 17 |
| PGC 14 | 3.98 | **2.789** | NA | 0.122 | 0.027 | 0.275 | 0.670 | 0.020 | 0.113 | **4.017** | 5 |
| PGC 15 | 10.24 | **3.655** | NA | 0.234 | 0.065 | 0.436 | **1.479** | 0.054 | 0.178 | **6.102** | 1 |
| PGC 16 | 7.15 | **4.969** | NA | 0.160 | 0.067 | 0.228 | 0.403 | 0.017 | 0.119 | **5.963** | 2 |
| PGC 17 | 3.10 | **1.729** | NA | 0.083 | 0.033 | 0.175 | 0.547 | 0.009 | 0.148 | **2.723** | 8 |
| PGC 18 | 2.56 | **1.179** | NA | 0.018 | 0.008 | 0.087 | 0.454 | 0.004 | 0.020 | **1.769** | 12 |
| PGC 19 | 0.91 | **1.642** | NA | 0.034 | 0.010 | 0.047 | 0.130 | 0.006 | 0.045 | **1.913** | 10 |
| PGC 20 | 1.23 | 0.451 | NA | 0.185 | 0.012 | 0.092 | 0.216 | 0.004 | 0.073 | **1.034** | 15 |
| PGC 21 | 1.06 | **1.367** | NA | 0.035 | 0.019 | 0.155 | 0.205 | 0.005 | 0.083 | **1.869** | 11 |
| PGC 22 | 10.07 | 0.208 | NA | 0.006 | 0.005 | 0.025 | 0.127 | 0.002 | 0.005 | 0.380 | 20 |
| PGC 8A | 1.50 | 0.238 | NA | 0.010 | 0.002 | 0.033 | 0.058 | 0.001 | 0.014 | 0.355 | 21 |
| PGC 9A | 0.30 | 0.111 | NA | 0.010 | 0.022 | 0.022 | 0.061 | 0.003 | 0.030 | 0.259 | 24 |
| PGC 11A | 0.66 | 0.323 | NA | 0.012 | 0.001 | 0.157 | 0.204 | 0.003 | 0.064 | 0.765 | 16 |
| PGC 16A | 1.72 | 0.426 | NA | 0.021 | 0.004 | 0.072 | 0.418 | 0.006 | 0.140 | **1.087** | 14 |
| PGC 17A | 2.65 | 0.253 | NA | 0.013 | 0.002 | 0.011 | 0.053 | 0.004 | 0.011 | 0.348 | 22 |
| PGC 22A | 1.60 | **2.049** | NA | 0.054 | 0.022 | 0.243 | 0.410 | 0.012 | 0.111 | **2.901** | 7 |

**TABLE 9** **Bulk metals concentrations in sediment (μg/g dw) for the 2008 Pleasant Grove Creek (PGC) sites. Metals concentrations exceeding Threshold Effects Levels (TELs) are in bold.**

| Site | As | Cd | Cr | Cu | Pb | Hg | Ni | Zn |
|---|---|---|---|---|---|---|---|---|
| PGC01 | 1.39 | 0.091 | 17.2 | 16.06 | 7.78 | 0.020 | 10.46 | 59.5 |
| PGC02 | 1.56 | 0.048 | 21.7 | 13.94 | 5.04 | 0.010 | 16.83 | 34.5 |
| PGC03 | 1.69 | 0.064 | 21.1 | 16.68 | 6.05 | 0.020 | 14.15 | 47.5 |
| PGC04 | 2.59 | 0.092 | 30.6 | 23.20 | 7.32 | 0.020 | **26.51** | 56.8 |
| PGC05 | 1.09 | 0.123 | 21.9 | 23.70 | 17.96 | 0.030 | 12.99 | 91.5 |
| PGC06 | 1.07 | 0.081 | 21.9 | 14.83 | 6.92 | 0.020 | 13.60 | 70.1 |
| PGC07 | 1.30 | 0.098 | 21.7 | 20.70 | 8.20 | 0.040 | 13.41 | 54.0 |
| PGC08 | 2.59 | 0.134 | 26.7 | 30.65 | 8.82 | 0.050 | 16.07 | 90.5 |
| PGC09 | 2.17 | 0.070 | 20.3 | 18.25 | 6.60 | 0.020 | 13.75 | 58.1 |
| PGC10 | 1.64 | 0.082 | 18.8 | 32.72 | 5.37 | 0.030 | 12.05 | 83.0 |
| PGC11 | 3.95 | 0.470 | 33.4 | **74.86** | 12.72 | 0.070 | **26.42** | **240.9** |
| PGC12 | 3.06 | 0.268 | 29.6 | 25.69 | 9.17 | 0.050 | **19.22** | **180.4** |
| PGC14 | 2.16 | 0.286 | 21.9 | **42.47** | 9.31 | 0.060 | 15.74 | **189.7** |
| PGC15 | 4.64 | **0.815** | **42.3** | **125.90** | 23.45 | 0.150 | **34.37** | **580.9** |
| PGC16 | 5.00 | 0.383 | **48.0** | **82.33** | 14.52 | 0.080 | **33.39** | **275.0** |
| PGC17 | 1.21 | 0.084 | 12.5 | 28.84 | 4.69 | 0.020 | 7.47 | 99.2 |
| PGC18 | 1.33 | 0.087 | 17.6 | **171.50** | 6.08 | 0.030 | 9.88 | 86.6 |
| PGC19 | 1.94 | 0.062 | 20.5 | 16.49 | 6.21 | 0.020 | 12.29 | 48.2 |
| PGC20 | 2.36 | 0.092 | 19.7 | 16.04 | 14.64 | 0.030 | 10.68 | 59.4 |
| PGC21 | 1.18 | 0.050 | 11.7 | 11.41 | 3.13 | 0.020 | 5.55 | 35.4 |
| PGC22 | **8.88** | **0.622** | **54.3** | **813.80** | 24.20 | **0.210** | 36.30 | **503.6** |
| PGC 8a | 1.15 | 0.070 | 17.5 | 13.94 | 6.09 | 0.020 | 11.18 | 44.5 |
| PGC 9a | 1.10 | 0.031 | 13.0 | 9.60 | 4.63 | 0.010 | 8.77 | 21.2 |
| PGC 11a | 1.39 | 0.050 | 14.5 | 13.55 | 6.18 | 0.070 | 8.93 | 36.7 |
| PGC 16a | 2.57 | 0.091 | 25.3 | 22.85 | 7.22 | 0.030 | **18.74** | 83.1 |
| PGC 17a | 1.21 | 0.084 | 12.5 | 28.84 | 4.69 | 0.020 | 7.47 | 99.2 |
| PGC 22a | 2.18 | 0.086 | 20.2 | 16.55 | 9.11 | 0.020 | 9.59 | 54.0 |
| **TEL** | **5.900** | **0.596** | **37.300** | **35.700** | **35.000** | **0.174** | **18.000** | **123.100** |

**TABLE 10 Concentrations of acid volatile sulfide (AVS), simultaneously extracted metals (SEM), and the SEM/AVS ratio in sediment from the 2008 Pleasant Grove Creek sites.**

| | (concentrations in μmole/g dry weight) | | | | | | | Total | SEM/ |
|---|---|---|---|---|---|---|---|---|---|
| Station | AVS | Ni | Cu | Zn | Cd | Pb | Hg | SEM | AVS[a] |
| PGC 1 | 3.485 | 0.044 | 0.010 | 0.475 | ND | 0.019 | NA | 0.019 | 0.157 |
| PGC 2 | 0.085 | 0.072 | 0.060 | 0.202 | ND | 0.009 | NA | 0.009 | **4.021** |
| PGC 3 | 0.182 | 0.051 | 0.074 | 0.362 | ND | 0.013 | NA | 0.013 | **2.746** |
| PGC 4 | 0.147 | 0.111 | 0.094 | 0.412 | ND | 0.015 | NA | 0.015 | **4.302** |
| PGC 5 | 1.751 | 0.039 | 0.042 | 0.911 | ND | 0.041 | NA | 0.041 | 0.590 |
| PGC 6 | 5.724 | 0.039 | 0.008 | 0.733 | ND | 0.017 | NA | 0.017 | 0.139 |
| PGC 7 | 1.057 | 0.045 | 0.038 | 0.507 | ND | 0.019 | NA | 0.019 | 0.575 |
| PGC 8 | 2.029 | 0.067 | 0.040 | 0.815 | ND | 0.016 | NA | 0.016 | 0.462 |
| PGC 9 | 2.544 | 0.047 | 0.008 | 0.385 | ND | 0.011 | NA | 0.011 | 0.177 |
| PGC 10 | 0.719 | 0.037 | 0.124 | 0.854 | ND | 0.012 | NA | 0.012 | **1.429** |
| PGC 11 | 2.605 | 0.089 | 0.097 | 2.211 | 0.002 | 0.025 | NA | 0.027 | 0.930 |
| PGC 12 | 0.895 | 0.071 | 0.096 | 1.554 | ND | 0.024 | NA | 0.024 | **1.948** |
| PGC 14 | 0.058 | 0.053 | 0.063 | 1.994 | ND | 0.020 | NA | 0.020 | **36.851** |
| PGC 15 | 1.795 | 0.149 | 0.164 | 6.440 | 0.004 | 0.055 | NA | 0.058 | **3.794** |
| PGC 16 | 1.156 | 0.114 | 0.224 | 2.675 | 0.002 | 0.039 | NA | 0.041 | **2.643** |
| PGC 17 | 0.709 | 0.053 | 0.103 | 1.244 | ND | 0.021 | NA | 0.021 | **2.005** |
| PGC 18 | 1.703 | 0.029 | 0.052 | 0.817 | ND | 0.010 | NA | 0.010 | 0.533 |
| PGC 19 | 0.144 | 0.040 | 0.053 | 0.368 | ND | 0.010 | NA | 0.010 | **3.273** |
| PGC 20 | 0.499 | 0.043 | 0.059 | 0.480 | ND | 0.019 | NA | 0.019 | **1.205** |
| PGC 21 | 1.004 | 0.024 | 0.022 | 0.371 | ND | 0.007 | NA | 0.007 | 0.422 |
| PGC 22 | 0.724 | 0.153 | 3.153 | 6.037 | 0.004 | 0.067 | NA | 0.071 | **13.005** |
| PGC 8a | 0.112 | 0.048 | 0.056 | 0.360 | ND | 0.010 | NA | 0.010 | **4.233** |
| PGC 9a | 0.031 | 0.043 | 0.035 | 0.105 | ND | 0.007 | NA | 0.007 | **6.203** |
| PGC 11a | 0.072 | 0.036 | 0.060 | 0.287 | ND | 0.015 | NA | 0.015 | **5.525** |
| PGC 16a | 0.502 | 0.049 | 0.086 | 0.681 | ND | 0.014 | NA | 0.014 | **1.651** |
| PGC 17a | 2.731 | 0.029 | ND | 1.218 | ND | 0.009 | NA | 0.009 | 0.460 |
| PGC 22a | 0.923 | 0.041 | 0.021 | 0.492 | ND | 0.018 | NA | 0.018 | 0.620 |

[a]Bold SEM/AVS ratios >1 suggest metals are bioavailable and may be toxic.

**TABLE 11 Results of univariate linear regression models of benthic metrics versus pyrethroids in sediments (standardized to toxic units by dividing TOC-standardized concentrations by $LC_{50}$ values for the pyrethroids) in Pleasant Grove Creek in 2008, indicating type of the relationships (+ = direct; - = inverse) and $R^2$ values for significant relationships ($\alpha$=0.01; NS=not significant).**

| | Total TUs | | Bifenthrin | | Lambda-cyhal. | | Permethrin | |
|---|---|---|---|---|---|---|---|---|
| Benthic Metrics | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ |
| Taxonomic Richness | - | 0.41 | - | 0.43 | - | 0.34 | - | 0.31 |
| % Dominant Taxon | NS | | + | 0.22 | NS | | NS | |
| Ephemeroptera Taxa | - | 0.23 | NS | | NS | | NS | |
| EPT Taxa | - | 0.23 | NS | | NS | | NS | |
| EPT Index (%) | NS | | NS | | NS | | NS | |
| Shannon Diversity | NS | | NS | | NS | | NS | |
| Tolerance Value | NS | | NS | | NS | | NS | |
| % Tolerant Taxa (8-10) | NS | | NS | | NS | | NS | |
| % Collectors/Filterers | - | 0.24 | - | 0.34 | NS | | NS | |
| % Collectors/Gatherers | NS | | NS | | NS | | NS | |
| % Grazers | NS | | NS | | NS | | NS | |
| % Predators | + | 0.35 | + | 0.41 | + | 0.36 | NS | |
| % Shredders | NS | | NS | | NS | | NS | |
| Abundance (#/sample) | NS | | NS | | NS | | NS | |

TABLE 11. - Continued.

| | Cyfluthrin | | Cypermethrin | | Esfenvalerate | | Deltamethrin | |
|---|---|---|---|---|---|---|---|---|
| Benthic Metrics | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ |
| Taxonomic Richness | - | 0.37 | NS | | NS | | - | 0.29 |
| % Dominant Taxon | NS | | NS | | NS | | NS | |
| Ephemeroptera Taxa | - | 0.25 | NS | | NS | | - | 0.24 |
| EPT Taxa | - | 0.26 | NS | | NS | | - | 0.23 |
| EPT Index (%) | NS | | NS | | NS | | NS | |
| Shannon Diversity | NS | | NS | | NS | | NS | |
| Tolerance Value | NS | | NS | | NS | | NS | |
| % Tolerant Taxa (8-10) | NS | | NS | | NS | | NS | |
| % Collectors/Filterers | NS | | NS | | NS | | NS | |
| % Collectors/Gatherers | NS | | NS | | NS | | NS | |
| % Grazers | NS | | NS | | NS | | NS | |
| % Predators | + | 0.24 | NS | | NS | | NS | |
| % Shredders | NS | | NS | | NS | | NS | |
| Abundance (#/sample) | NS | | NS | | NS | | NS | |

**TABLE 12 Results of univariate linear regression models of benthic metrics versus pyrethroids in sediments (standardized to toxic units by dividing TOC-standardized concentrations by $LC_{50}$ values for the pyrethroids) in Pleasant Grove Creek in 2006-2008, indicating type of the relationships (+ = direct; - = inverse) and $R^2$ values for significant relationships ($\alpha$=0.01; NS=not significant).**

| | Total TUs | | Bifenthrin | | Lambda-cyhal. | | Permethrin | |
|---|---|---|---|---|---|---|---|---|
| Benthic Metrics | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ |
| Taxonomic Richness | NS | | NS | | NS | | NS | |
| % Dominant Taxon | NS | | NS | | NS | | NS | |
| Ephemeroptera Taxa | - | 0.09 | NS | | NS | | NS | |
| EPT Taxa | - | 0.12 | - | 0.11 | NS | | NS | |
| EPT Index (%) | NS | | NS | | NS | | NS | |
| Shannon Diversity | NS | | NS | | NS | | NS | |
| Tolerance Value | NS | | NS | | NS | | NS | |
| % Tolerant Taxa (8-10) | + | 0.22 | + | 0.20 | + | 0.15 | NS | |
| % Collectors/Filterers | NS | | NS | | NS | | NS | |
| % Collectors/Gatherers | NS | | NS | | NS | | NS | |
| % Grazers | NS | | NS | | NS | | NS | |
| % Predators | NS | | NS | | NS | | NS | |
| % Shredders | NS | | NS | | NS | | NS | |
| Abundance (#/sample) | NS | | NS | | NS | | NS | |

TABLE 12. - Continued.

| Benthic Metrics | Cyfluthrin | | Cypermethrin | | Esfenvalerate | | Deltamethrin | |
|---|---|---|---|---|---|---|---|---|
| | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ |
| Taxonomic Richness | NS | | NS | | NS | | NS | |
| % Dominant Taxon | NS | | NS | | NS | | NS | |
| Ephemeroptera Taxa | NS | | - | 0.10 | NS | | NS | |
| EPT Taxa | NS | | - | 0.11 | NS | | NS | |
| EPT Index (%) | NS | | NS | | NS | | NS | |
| Shannon Diversity | NS | | NS | | NS | | NS | |
| Tolerance Value | NS | | NS | | NS | | NS | |
| % Tolerant Taxa (8-10) | + | 0.15 | + | 0.23 | + | 0.14 | + | 0.17 |
| % Collectors/Filterers | NS | | NS | | NS | | NS | |
| % Collectors/Gatherers | NS | | NS | | NS | | NS | |
| % Grazers (None Found) | NS | | NS | | NS | | NS | |
| % Predators | NS | | NS | | NS | | NS | |
| % Shredders | NS | | NS | | NS | | NS | |
| Abundance (#/sample) | NS | | NS | | NS | | NS | |

**TABLE 13 Results of stepwise multiple linear regression models of benthic metrics versus toxicity units for pyrethroids for: a) Pleasant Grove Creek in 2008; b) Pleasant Grove Creek in 2006-2008. Only variables that were significant at $\alpha$=0.01 were included in the models (NS= not significant). The direction of the relationship for each significant variable is indicated (+ = direct; - = inverse), as is the contributed $R^2$ values.**

a) Models for benthic metrics versus toxicity units for pyrethroids for Pleasant Grove Creek in 2008.

| Benthic Metrics | Prob. | $R^2$ | Significant Variables ($R^2$) |
|---|---|---|---|
| Taxonomic Richness | <0.001 | 0.43 | -Bifenthrin (0.43) |
| % Dominant Taxon | 0.01 | 0.22 | +Bifenthrin (0.22) |
| Ephemeroptera Taxa | 0.007 | 0.25 | -Cyfluthrin (0.25) |
| EPT Taxa | 0.007 | 0.26 | -Cyfluthrin (0.26) |
| EPT Index (%) | NS | | |
| Shannon Diversity | NS | | |
| Tolerance Value | NS | | |
| % Tolerant Taxa (8-10) | NS | | |
| % Collectors/Filterers | <0.001 | 0.34 | -Bifenthrin (0.34) |
| % Collectors/Gatherers | NS | | |
| % Grazers | NS | | |
| % Predators | <0.001 | 0.41 | +Bifenthrin (0.41) |
| % Shredders | NS | | |
| Abundance (#/sample) | NS | | |

TABLE 13. - Continued.

b) Models for benthic metrics versus toxicity units for pyrethroids for Pleasant Grove Creek in 2006-2008.

| Benthic Metrics | Prob. | $R^2$ | Significant Variables ($R^2$) |
|---|---|---|---|
| Taxonomic Richness | NS | | |
| % Dominant Taxon | NS | | |
| Ephemeroptera Taxa | 0.01 | 0.09 | -Cyfluthrin (0.10) |
| EPT Taxa | 0.006 | 0.11 | -Total TUs (0.12) |
| EPT Index (%) | NS | | |
| Shannon Diversity | NS | | |
| Tolerance Value | NS | | |
| % Tolerant Taxa (8-10) | <0.001 | 0.22 | +Cyfluthrin (0.23) |
| % Collectors/Filterers | NS | | |
| % Collectors/Gatherers | NS | | |
| % Grazers | NS | | |
| % Predators | NS | | |
| % Shredders | NS | | |
| Abundance (#/sample) | NS | | |

**TABLE 14** **Results of univariate linear regression models of benthic metrics versus metals in sediments (standardized to toxic units by dividing by TEL values for the metals) in Pleasant Grove Creek in 2008, indicating type of the relationships (+ = direct; - = inverse) and $R^2$ values for significant relationships ($\alpha$=0.01; NS=not significant).**

| | Total Metals to TELs | | As to TEL | | Cd to TEL | | Cr to TEL | |
|---|---|---|---|---|---|---|---|---|
| Benthic Metrics | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ |
| Taxonomic Richness | NS | | NS | | - | 0.25 | NS | |
| % Dominant Taxon | NS | | NS | | NS | | NS | |
| Ephemeroptera Taxa | NS | | NS | | NS | | NS | |
| EPT Taxa | NS | | NS | | NS | | NS | |
| EPT Index (%) | NS | | NS | | NS | | NS | |
| Shannon Diversity | NS | | NS | | NS | | NS | |
| Tolerance Value | NS | | NS | | NS | | NS | |
| % Tolerant Taxa (8-10) | NS | | NS | | NS | | NS | |
| % Collectors/Filterers | NS | | - | 0.25 | - | 0.25 | NS | |
| % Collectors/Gatherers | NS | | NS | | NS | | NS | |
| % Grazers | NS | | NS | | NS | | NS | |
| % Predators | NS | | NS | | NS | | NS | |
| % Shredders | NS | | NS | | NS | | NS | |
| Abundance (#/sample) | NS | | NS | | NS | | NS | |

TABLE 14. - Continued.

| Benthic Metrics | Cu to TEL | | Pb to TEL | | Hg to TEL | | Ni to TEL | | Zn to TEL | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ |
| Taxonomic Richness | NS | | NS | | NS | | NS | | - | 0.24 |
| % Dominant Taxon | NS | | NS | | NS | | NS | | NS | |
| Ephemeroptera Taxa | NS | | NS | | NS | | NS | | NS | |
| EPT Taxa | NS | | NS | | NS | | NS | | NS | |
| EPT Index (%) | NS | | NS | | NS | | NS | | NS | |
| Shannon Diversity | NS | | NS | | NS | | NS | | NS | |
| Tolerance Value | NS | | NS | | NS | | NS | | NS | |
| % Tolerant Taxa (8-10) | NS | | NS | | NS | | NS | | NS | |
| % Collectors/Filterers | NS | | NS | | - | 0.22 | NS | | - | 0.24 |
| % Collectors/Gatherers | NS | | NS | | + | 0.25 | NS | | NS | |
| % Grazers | + | 0.23 | NS | | NS | | NS | | NS | |
| % Predators | NS | | NS | | NS | | NS | | NS | |
| % Shredders | NS | | NS | | NS | | NS | | NS | |
| Abundance (#/sample) | NS | | NS | | NS | | NS | | NS | |

**TABLE 15** **Results of univariate linear regression models of benthic metrics versus metals in sediments (standardized to toxic units by dividing by TEL values for the metals) in Pleasant Grove Creek in 2006-2008, indicating type of the relationships (+ = direct; - = inverse) and $R^2$ values for significant relationships ($\alpha$=0.01; NS=not significant).**

| | Total Metals to TELs | | As to TEL | | Cd to TEL | | Cr to TEL | |
|---|---|---|---|---|---|---|---|---|
| Benthic Metrics | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ |
| Taxonomic Richness | NS | | NS | | - | 0.13 | NS | |
| % Dominant Taxon | NS | | NS | | NS | | NS | |
| Ephemeroptera Taxa | NS | | NS | | NS | | NS | |
| EPT Taxa | NS | | - | 0.10 | NS | | NS | |
| EPT Index (%) | NS | | NS | | NS | | NS | |
| Shannon Diversity | NS | | NS | | NS | | NS | |
| Tolerance Value | NS | | NS | | NS | | NS | |
| % Tolerant Taxa (8-10) | + | 0.15 | + | 0.16 | + | 0.25 | + | 0.16 |
| % Collectors/Filterers | NS | | NS | | NS | | - | 0.10 |
| % Collectors/Gatherers | NS | | NS | | NS | | NS | |
| % Grazers | + | 0.13 | + | 0.14 | NS | | NS | |
| % Predators | NS | | NS | | NS | | NS | |
| % Shredders | NS | | NS | | NS | | NS | |
| Abundance (#/sample) | NS | | NS | | NS | | NS | |

TABLE 15. - Continued.

| Benthic Metrics | Cu to TEL | | Pb to TEL | | Hg to TEL | | Ni to TEL | | Zn to TEL | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ | Rel. | $R^2$ |
| Taxonomic Richness | NS | | NS | | NS | | NS | | NS | |
| % Dominant Taxon | NS | | NS | | NS | | NS | | NS | |
| Ephemeroptera Taxa | NS | | NS | | - | 0.12 | NS | | - | 0.12 |
| EPT Taxa | NS | | NS | | - | 0.16 | NS | | - | 0.16 |
| EPT Index (%) | NS | | NS | | NS | | NS | | NS | |
| Shannon Diversity | NS | | NS | | NS | | NS | | NS | |
| Tolerance Value | NS | | NS | | + | 0.13 | NS | | + | 0.13 |
| % Tolerant Taxa (8-10) | NS | | + | 0.17 | + | 0.28 | + | 0.16 | + | 0.28 |
| % Collectors/Filterers | NS | | NS | | NS | | - | 0.10 | NS | |
| % Collectors/Gatherers | NS | | NS | | NS | | NS | | NS | |
| % Grazers | + | 0.14 | NS | | NS | | NS | | NS | |
| % Predators | NS | | NS | | NS | | NS | | NS | |
| % Shredders | NS | | NS | | NS | | NS | | NS | |
| Abundance (#/sample) | NS | | NS | | NS | | NS | | NS | |

**TABLE 16 Results of stepwise multiple linear regression models of benthic metrics versus metals in sediments (standardized to toxic units by dividing by TEL values for the metals) for: a) Pleasant Grove Creek in 2008; b) Pleasant Grove Creek in 2006-2008. Only variables that were significant at $\alpha$=0.01 were included in the models (NS= not significant). The direction of the relationship for each significant variable is indicated (+ = direct; - = inverse), as is the contributed $R^2$ values.**

a) Models for benthic metrics versus metals to TEL ratios for Pleasant Grove Creek in 2008.

| Benthic Metrics | Prob. | $R^2$ | Significant Variables ($R^2$) |
|---|---|---|---|
| Taxonomic Richness | 0.009 | 0.25 | -Cadmium (0.25) |
| % Dominant Taxon | NS | | |
| Ephemeroptera Taxa | NS | | |
| EPT Taxa | NS | | |
| EPT Index (%) | NS | | |
| Shannon Diversity | NS | | |
| Tolerance Value | NS | | |
| % Tolerant Taxa (8-10) | NS | | |
| % Collectors/Filterers | 0.008 | 0.25 | -Cadmium (0.25) |
| % Collectors/Gatherers | 0.007 | 0.25 | +Mercury (0.25) |
| % Grazers | 0.01 | 0.23 | +Copper (0.23) |
| % Predators | NS | | |
| % Shredders | NS | | |
| Abundance (#/sample) | NS | | |

TABLE 16. - Continued.

b) Models for benthic metrics versus metals to TEL ratios for Pleasant Grove Creek in 2006-2008.

| Benthic Metrics | Prob. | $R^2$ | Significant Variables ($R^2$) |
|---|---|---|---|
| Taxonomic Richness | <0.001 | 0.30 | +Lead to TEL (0.17), -Cadmium to TEL (0.13) |
| % Dominant Taxon | NS | | |
| Ephemeroptera Taxa | 0.003 | 0.12 | -Zinc to TEL (0.12) |
| EPT Taxa | <0.001 | 0.16 | - Zinc to TEL (0.16) |
| EPT Index (%) | NS | | |
| Shannon Diversity | NS | | |
| Tolerance Value | 0.003 | 0.13 | + Zinc to TEL (0.13) |
| % Tolerant Taxa (8-10) | <0.001 | 0.28 | + Zinc to TEL (0.28) |
| % Collectors/Filterers | 0.005 | 0.10 | -Chromium (0.10) |
| % Collectors/Gatherers | NS | | |
| % Grazers | 0.002 | 0.14 | +Arsenic (0.14) |
| % Predators | NS | | |
| % Shredders | NS | | |
| Abundance (#/sample) | NS | | |

**TABLE 17** **Results of stepwise multiple linear regression models of benthic metrics versus habitat metrics for: a) Pleasant Grove Creek in 2008; b) Pleasant Grove Creek in 2006-2008. Only variables that were significant at $\alpha$=0.01 were included in the models (NS= not significant). The direction of the relationship for each significant variable is indicated (+ = direct; - = inverse), as is the contributed $R^2$ values.**

a) Models for benthic metrics versus habitat metrics for Pleasant Grove Creek in 2008.

| Benthic Metrics | Prob. | $R^2$ | Significant Variables ($R^2$) |
|---|---|---|---|
| Taxonomic Richness | NS | | |
| % Dominant Taxon | NS | | |
| Ephemeroptera Taxa | 0.004 | 0.29 | +% Gravel (0.29) |
| EPT Taxa | 0.005 | 0.28 | +% Gravel (0.28) |
| EPT Index (%) | 0.004 | 0.29 | -Bank stability (0.29) |
| Shannon Diversity | NS | | |
| Tolerance Value | <0.001 | 0.51 | -Velocity depth regimes (0.51) |
| % Tolerant Taxa (8-10) | <0.001 | 0.68 | -Velocity depth regimes (0.43), - Riparian vegetative zone (0.25) |
| % Collectors/Filterers | NS | | |
| % Collectors/Gatherers | 0.002 | 0.33 | -Velocity depth regimes (0.33) |
| % Grazers | NS | | |
| % Predators | <0.001 | 0.39 | -Channel alteration (0.22), +Bank stability (0.17) |
| % Shredders | NS | | |
| Abundance (#/sample) | NS | | |

TABLE 17. - Continued.

b) Models for benthic metrics versus habitat metrics for Pleasant Grove Creek in 2006-2008.

| Benthic Metrics | Prob. | $R^2$ | Significant Variables ($R^2$) |
|---|---|---|---|
| Taxonomic Richness | 0.002 | 0.15 | +% Gravel (0.15) |
| % Dominant Taxon | NS | | |
| Ephemeroptera Taxa | <0.001 | 0.43 | +Velocity depth regimes (0.37), +Riparian vegetative zone (0.06) |
| EPT Taxa | <0.001 | 0.47 | +Velocity depth regimes (0.42), +Riparian vegetative zone (0.05) |
| EPT Index (%) | <0.001 | 0.42 | +Velocity depth regimes (0.42) |
| Shannon Diversity | 0.008 | 0.10 | -Vegetative protection (0.10) |
| Tolerance Value | <0.001 | 0.45 | - Velocity depth regimes (0.45) |
| % Tolerant Taxa (8-10) | <0.001 | 0.60 | -Velocity depth regimes (0.51), - Riparian vegetative zone (0.09) |
| % Collectors/Filterers | <0.001 | 0.27 | +Velocity depth regimes (0.27) |
| % Collectors/Gatherers | 0.002 | 0.16 | -Epifaunal substrate/available cover (0.16) |
| % Grazers | 0.001 | 0.21 | +Vegetative protection (0.11) , +% Fines (0.10) |
| % Predators | 0.002 | 0.15 | -Channel alteration (0.15) |
| % Shredders | NS | | |
| Abundance (#/sample) | NS | | |

**TABLE 18** **Results of stepwise multiple linear regression models for: a)1. Pleasant Grove Creek benthic metrics versus toxicity units for pyrethroids, habitat metrics, and metals to TEL ratios for 2008; and a)2. Pleasant Grove Creek benthic metrics versus principal components of the environmental data for 2008; b)1. Pleasant Grove Creek benthic metrics versus toxicity units for pyrethroids, habitat metrics, and metals to TEL ratios for 2006-2008; and b)2. Pleasant Grove Creek benthic metrics versus principal components of the environmental data for 2006-2008. Only variables that were significant at α=0.01 were included in the models. The direction of the relationship for each significant variable is indicated (+ = direct; - = inverse), as is the contributed $R^2$ value.**

a) Regression models for Pleasant Grove Creek in 2008.

| Benthic Metrics | a.1. Significant Environmental Variables ($R^2$) | a.2. Significant Environmental Principal Components* |
|---|---|---|
| Taxonomic Richness | -Bifenthrin*** (0.43) | -PC2*** (0.28) |
| % Dominant Taxon | +Bifenthrin (0.22) | |
| Ephemeroptera Taxa | +% Gravel** (0.29), -Cyfluthrin*** (0.18) | +PC3** (0.23) |
| EPT Taxa | +% Gravel** (0.28), -Cyfluthrin*** (0.19), -Vegetative protection (0.11) | +PC3** (0.23), -PC2*** (0.14) |
| EPT Index (%) | -Bank stability** (0.29) | |
| Shannon Diversity | | |
| Tolerance Value | -Velocity depth regimes** (0.51) | -PC3** (0.38) |
| % Tolerant Taxa (8-10) | -Velocity depth regimes** (0.43), -Riparian buffer zone** (0.25), +Lead to TEL (0.10) | -PC3** (0.16) |

* The environmental variables with the largest loadings for the environmental principal components (proportion of variance explained by PCs are in parentheses) are: PC1 (0.37) = +Arsenic to TEL, +Chromium to TEL, +Mercury to TEL, +Nickel to TEL, +Lead to TEL, +Zinc to TEL, +Cadmium to TEL , and +Copper to TEL; PC2 (0.17) = +TUs for all pyrethroids; PC3 (0.12) = -% Fines, +% Gravel, +Velocity depth regimes, +Epifaunal substrate/available cover, +Embeddedness, and +Sediment deposition; PC4 (0.07) = +Riparian vegetative zone, and +Channel flow status; PC5 (0.06) = +Vegetative protection, +Canopy, and +Sediment dept regimes; PC6 (0.05) = +Bank stability, and +Frequency of riffles/bends.

** Variables that remained significant after the toxin principal components (PC1and PC2) were forced into the stepwise regressions prior to the testing of the habitat variables (see text for details).

*** Variables that remained significant after the habitat principal components (PC3, PC4, PC5, and PC6) were forced into the stepwise regressions prior to the testing of the toxic variables (see text for details).

TABLE 18. - Continued.

a) Regression models for Pleasant Grove Creek in 2008 continued.

| Benthic Metrics | a.1. Significant Variables ($R^2$) | a.2. Principal Components |
|---|---|---|
| % Collectors/Filterers | -Bifenthrin$^{***}$(0.34), +Embeddedness (0.15), -Copper to TEL (0.10) | |
| % Collectors/Gatherers | -Velocity depth regimes$^{**}$(0.33), +Mercury to TEL$^{***}$(0.17) | -PC3$^{**}$(0.28) |
| % Grazers | +Copper to TEL$^{***}$(0.23), +Sediment depth regimes (0.17) | +PC5$^{**}$(0.24) |
| % Predators | +Bifenthrin$^{***}$(0.41), +Velocity depth regimes$^{**}$(0.15), +Bank stability$^{**}$(0.14) | +PC2$^{***}$(0.19) |
| % Shredders | | |
| Abundance (#/sample) | | |

TABLE 18. - Continued.

b) Regression models for Pleasant Grove Creek in 2006-2008.

| Benthic Metrics | b.1. Significant Variables ($R^2$) | b.2. Principal Components* |
|---|---|---|
| Taxonomic Richness | +% Gravel** (0.17), +Lead to TEL (0.11), -Cadmium to TEL (0.08) | +PC3** (0.10) |
| % Dominant Taxon | -Lead to TEL (0.11), +Cadmium to TEL (0.07) | |
| Ephemeroptera Taxa | +Velocity depth regimes** (0.37), +Riparian buffer zone (0.06) | +PC3** (0.17) |
| EPT Taxa | +Velocity depth regimes** (0.42) | +PC3** (0.20), -PC6** (0.08) |
| EPT Index (%) | +Velocity depth regimes** (0.42) | +PC3** (0.13) |
| Shannon Diversity | -Vegetative protection** (0.10) | |
| Tolerance Value | -Velocity depth regimes** (0.45) | -PC3** (0.26) |
| % Tolerant Taxa (8-10) | -Velocity depth regimes** (0.51), +Cadmium to TEL (0.11), -Riparian buffer zone** (0.09), +Arsenic to TEL (0.03) | -PC3** (0.17), -PC4** (0.10), +PC6** (0.08), +PC2*** (0.07) |
| % Collectors/Filterers | +Velocity depth regimes** (0.27) | +PC3** (0.11) |
| % Collectors/Gatherers | - Velocity depth regimes** (0.14) | -PC3** (0.09) |
| % Grazers | +As to TEL (0.12) | |
| % Predators | -Channel alteration** (0.13) | -PC4** (0.09) |
| % Shredders | | |
| Abundance (#/sample) | | |

* The environmental variables with the largest loadings for the environmental principal components (proportion of variance explained by PCs are in parentheses) are: PC1 (0.35) = +TUs for all pyrethroids; PC2 (0.13) = +Chromium to TEL, +Nickel to TEL, +Zinc to TEL, +Mercury to TEL, +Lead to TEL, and +Arsenic to TEL; PC3 (0.11) = +% Gravel, +Sediment deposition, +Embeddedness, -% Fines, +Velocity depth regimes, and +Epifaunal substrate/available cover;
PC4 (0.08) = +Riparian vegetative zone, +Channel alteration, and +Frequency of riffles/bends; PC5 (0.06) = +Copper to TEL, +Cadmium to TEL, +Lead to TEL, and +Mercury to TEL; PC6 (0.05) = +Bank stability and +Vegetative protection.

** Variables that remained significant after the toxic principal components (PC1, PC2, and PC5) were forced into the stepwise regressions prior to the testing of the habitat variables (see text for details).

*** Variables that remained significant after the habitat principal components (PC3, PC4, and PC6) were forced into the stepwise regressions prior to the testing of the toxic variables (see text for details).

# FIGURES SECTION

**FIGURE 1 2008 Pleasant Grove Creek (PGC) sample sites.**

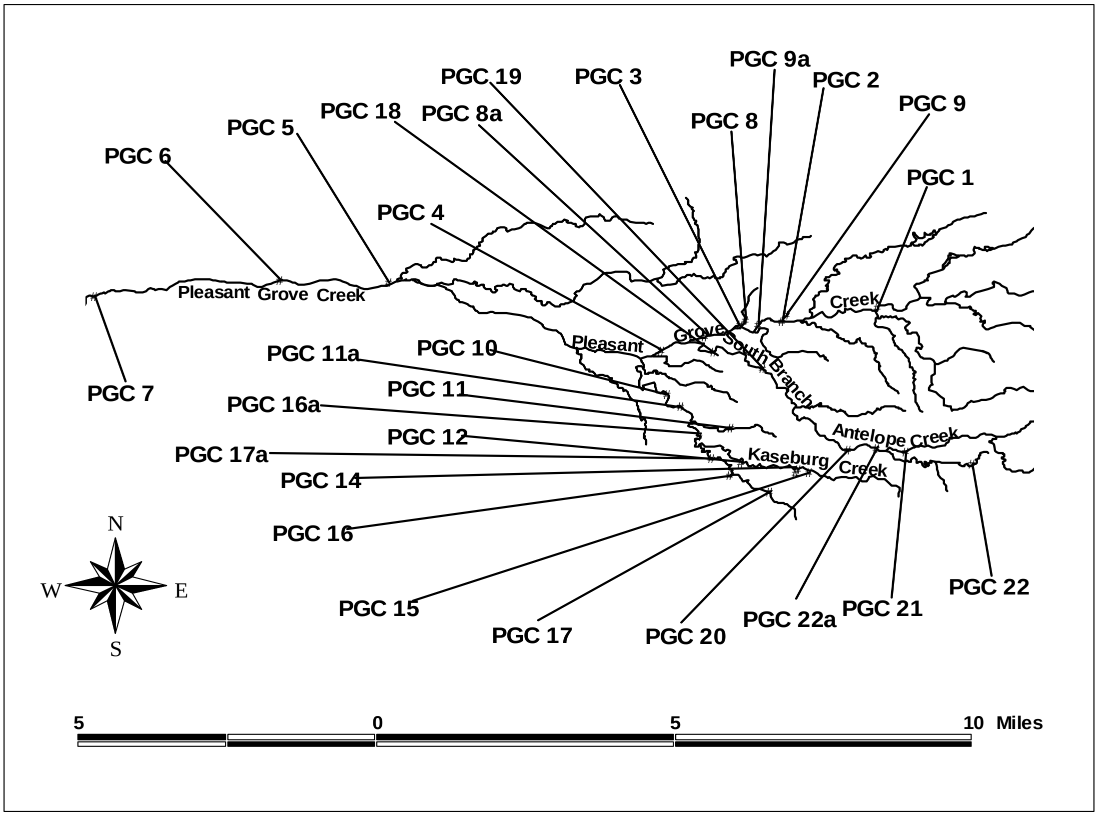
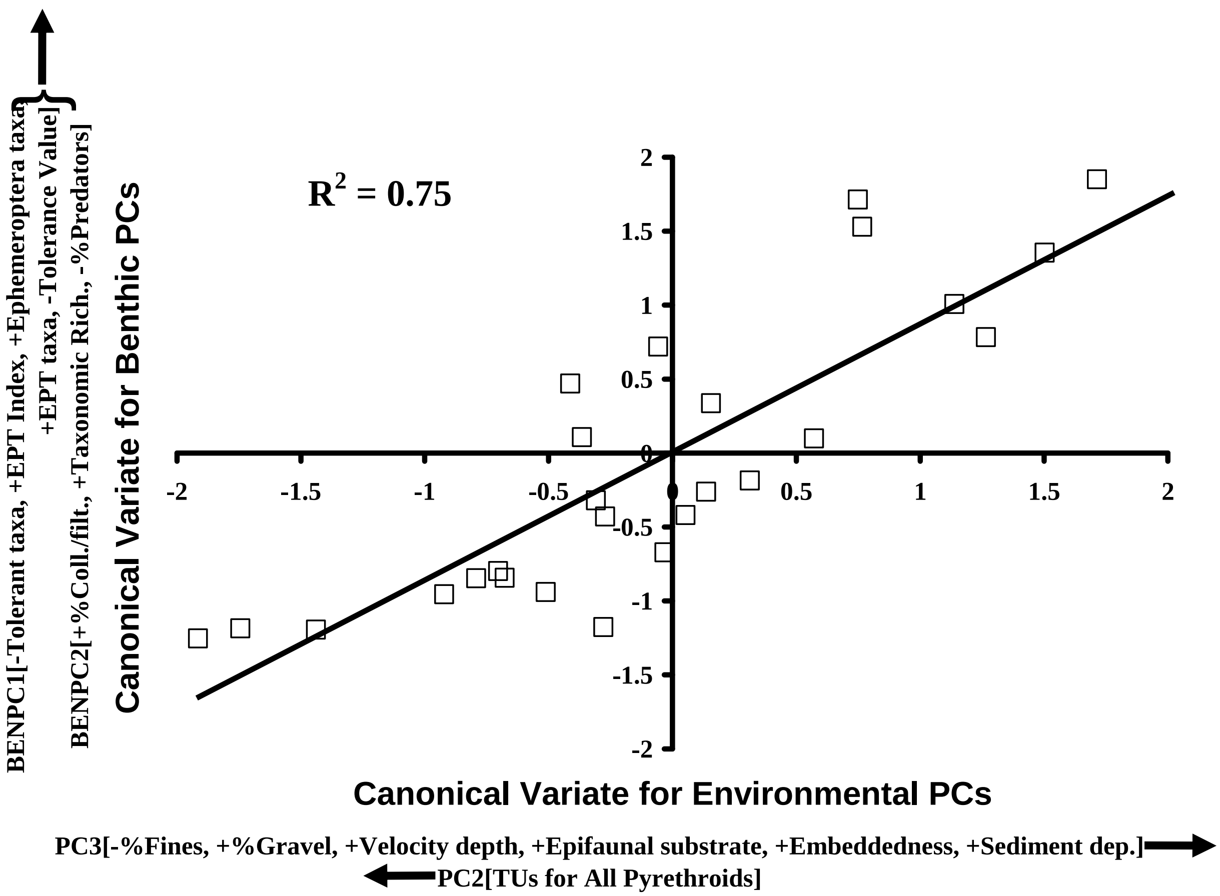


**FIGURE 2 Flow chart summarizing complementary statistical approaches.**

| Set | Question | Statistical Analyses | Results | Caveats |
| --- | --- | --- | --- | --- |
| I | Are there significant relationships between individual benthic metrics and individual pyrethroids & metals? | Univariate linear regressions of single benthic metrics versus single toxicants. | Suggests the **individual** toxicants that may have significant effects on **individual** benthic metrics. (Exploratory) | a) Effects of combinations of toxicants not determined.<br>b) Relationships of benthic metrics with toxicants may be confounded by effects of correlated environmental variables. |
| II | Are there significant relationships between individual benthic metrics and combinations of pyrethroids, metals and habitat metrics? | Stepwise multiple regressions of single benthic metrics versus pyrethroids, metals and habitat metrics. | Suggests the **combinations** of toxicants and habitat metrics that may have strongest effects on **individual** benthic metrics.<br>▪ Addresses caveat Ia).<br>▪ Addresses caveat Ib). | a) Multicollinearity between independent variables may obscure some of the relationships with benthic metrics and affect statistical tests. |
| III | Are there significant relationships between individual benthic metrics and PCs for pyrethroids, metals and habitat metrics? | Multiple regressions of single benthic metrics versus PCs of pyrethroids, metals and habitat metrics.<br>▪ Model 1 confirms habitat effects.<br>▪ Model 2 confirms toxicant effects. | Identifies and confirms the **combinations** of key toxicants and habitat metrics that may have significant effects on **individual** benthic metrics.<br>▪ Addresses caveat IIa).<br>Confirmation of key relationships. | a) The relationships are between individual benthic metrics and combinations of key independent variables. |
| IV | Are there significant relationships between **sets** of key benthic metrics and **sets** of key independent variables? | Canonical correlation analysis of benthic versus habitat and toxicant PCs. | Identifies and confirms the **sets** of key toxicants and habitat metrics that appear to be the most responsible for effects on **sets** of key benthic metrics. | . |

**FIGURE 3** **Results of the canonical correlation analysis of benthic biological versus environmental data for Pleasant Grove Creek in 2008: canonical variate for principal components of benthic metrics[*] versus the canonical variate for principal components of environmental data[**] (pyrethroids to TUs, metals to TELs, and habitat metrics). The principal components that were most highly correlated with the canonical variates are shown, along with the direction of their relationships (shown by arrows). The metrics in brackets are those that were those that were most highly loaded on these principal components.**

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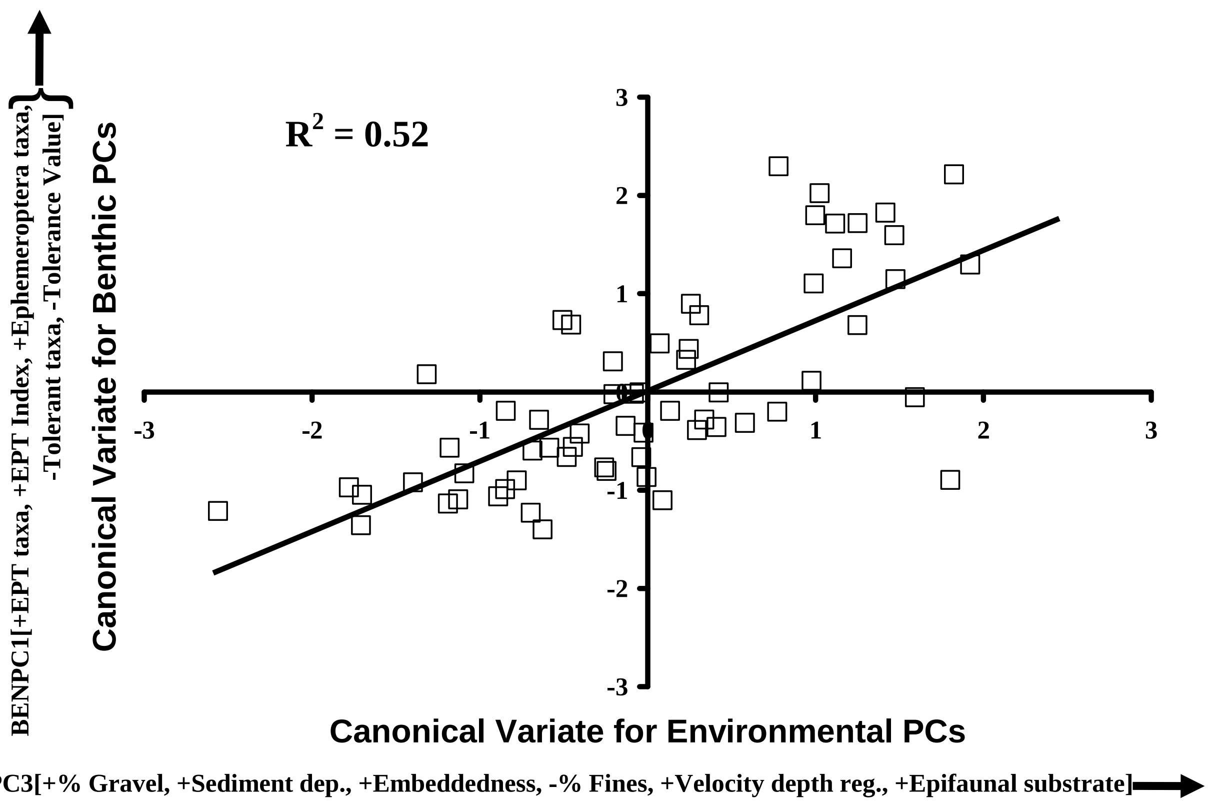
[*] The benthic metrics with the largest loadings for the benthic principal components that were correlated with the benthic canonical variate (proportion of variance of explained by PCs are in parentheses) are: BENPC1 (0.45) = -Tolerant taxa, +EPT index, +Ephemeroptera taxa, +EPT taxa, and -Tolerance value; BENPC2 (0.15) = +% Collectors/Filterers, +Taxonomic Richness, and -%Predators.

[**] The environmental variables with the largest loadings for the environmental principal components that were correlated with the environmental canonical variate (proportion of variance of explained by PCs are in parentheses) are: PC2 (0.17) = +TUs for all pyrethroids; and PC3 (0.12) = -% Fines, +% Gravel, +Velocity depth regimes, +Epifaunal substrate/available cover, +Embeddedness, and +Sediment deposition (see also Table 18a footnote).

**FIGURE 4** **Results of the canonical correlation analysis of biological versus environmental data for Pleasant Grove Creek in 2006-2008: canonical variate for principal components of benthic metrics* versus the canonical variate for principal components of environmental data** (pyrethroids to TUs, metals to TELs, and habitat metrics). The principal components that were most highly correlated with the canonical variates are shown, along with the direction of their relationships (shown by arrows). The metrics in brackets are those that were those that were most highly loaded on these principal components.**

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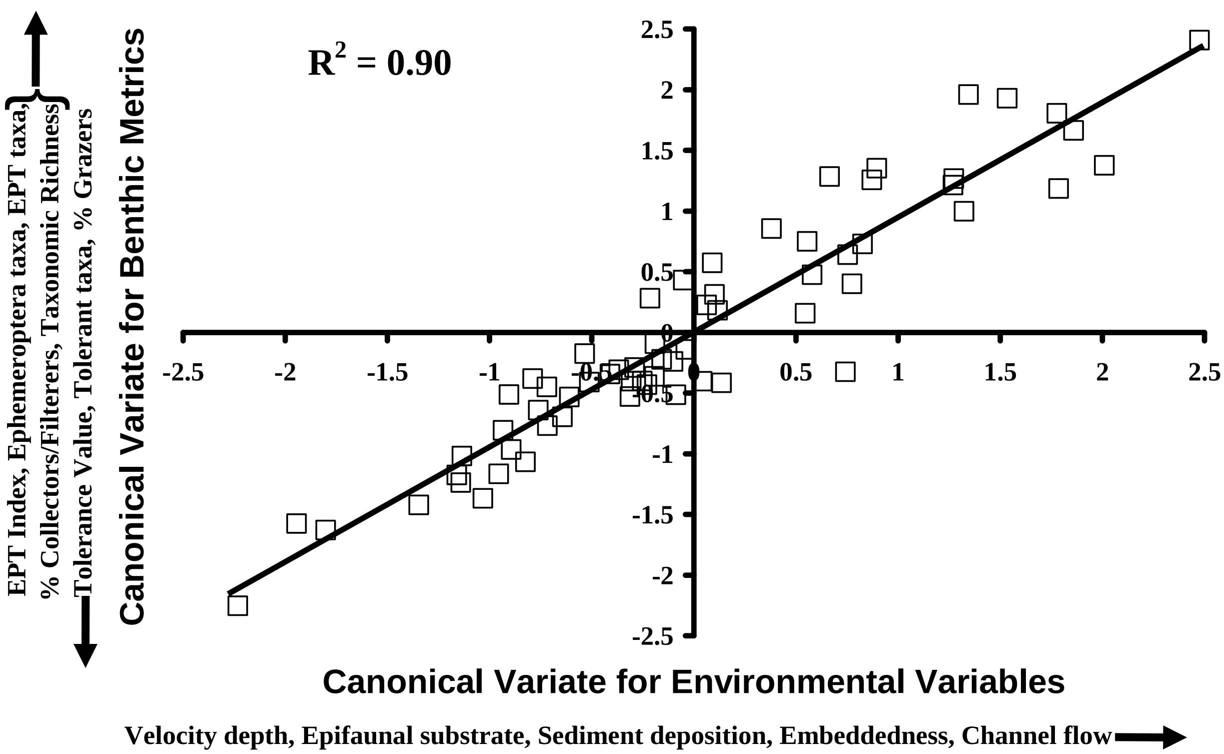
* The benthic metrics with the largest loadings for the benthic principal component that was correlated with the benthic canonical variate (the proportion of variance explained by the PC is in parentheses) are: BENPC1 (0.36) = +EPT taxa, +EPT index, +Ephemeroptera taxa, -Tolerant taxa, and -Tolerance value.

** The environmental variables with the largest loadings for the environmental principal components that were correlated with the environmental canonical variate (the proportion of variance explained by PCs are in parentheses) are: PC3 (0.11) = +% Gravel, +Sediment deposition, +Embeddedness, -% Fines, +Velocity depth regimes, and +Epifaunal substrate/available cover (see also Table 18b footnote).

**FIGURE 5** **Results of the canonical correlation analysis of benthic metrics versus environmental data (pyrethroids to TUs, metals to TELs, and habitat metrics) for Pleasant Grove Creek in 2006-2008. The metrics or variables that were most highly correlated with the canonical variates are shown in the sequence of the magnitude of correlations, along with the direction of their relationships (shown by arrows).**



# APPENDICES SECTION

**APPENDIX 1 California bioassessment worksheets including specific descriptions of the various physical habitat metrics.**

# CALIFORNIA BIOASSESSMENT WORKSHEET

WATERSHED/ STREAM: ____________________ DATE/ TIME: ____________________

COMPANY/ AGENCY: ____________________ SAMPLE ID #: ____________________

SITE DESCRIPTION: ________________________________________

**SAMPLING CREW**

______________________
______________________
______________________

**SITE INFORMATION**

GPS Coordinates
- Latitude: ________
- Longitude: ________

Elevation: ________
Ecoregion: ________
*COMMENTS*:

______________________
______________________
______________________
______________________
______________________

**CHEMICAL CHARACTERISTICS**

Water Temperature: ________
Specific Conductance: ________
pH: ________
Dissolved Oxygen: ________

**Bioassessment Laboratory Information:**

______________________
______________________
______________________
______________________
______________________

**SEND A COPY OF THIS FORM TO:**
DFG/ WPCL
2005 Nimbus Road
Rancho Cordova, CA 95670
(916) 358-2858
*website:* www.dfg.ca.gov/cabw/cabwhome.html

**RIFFLE/ REACH CHARACTERISTICS**

**Point Source Sampling Design**

Riffle Length: ____
- Transect 1: ____
- Transect 2: ____
- Transect 3: ____

*(record Physical/ Habitat Characteristcs in Riffle 1 column)*

**Non-Point Source Sampling Design**

Reach Length: ____
Physical Habitat Quality Score: ____

**Physical/ Habitat Characteristics**

| | Riffle 1 | Riffle 2 | Riffle 3 |
|---|---|---|---|
| Riffle Length: | | | |
| Transect Location: | | | |
| Avg. Riffle Width: | | | |
| Avg. Riffle Depth: | | | |
| Riffle Velocity: | | | |
| % Canopy Cover: | | | |
| Substrate Complexity: | | | |
| Embeddedness: | | | |
| Substrate Composition: | | | |
| Fines (<0.1"): | | | |
| Gravel (0.1-2"): | | | |
| Cobble (2-10"): | | | |
| Boulder (>10"): | | | |
| Bedrock (solid): | | | |
| Substrate Consolidation: | | | |
| Percent Gradient: | | | |

# CALIFORNIA STREAM BIOASSESSMENT PROCEDURE
## CHAIN OF CUSTODY (COC) RECORD

Project Name: ______________________ Date/ Time: ________________

Watershed Name: ______________________ Boiassessment Lab: ______________

| Sample Number | Lab Number | Sample Date | Sample Description |
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| Sampled by:<br>(sign and date) | Relinquished by:<br>(sign and date) | Received by:<br>(sign and date) |
| Received by:<br>(sign and date) | Received by:<br>(sign and date) | Received by:<br>(sign and date) |

Address of Sampler:

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Address of Project Advisor:

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## BIOLOGICAL METRICS USED TO DESCRIBE BENTHIC MACROINVERTEBRATE (BMI) SAMPLES COLLECTED FOLLOWING THE CALIFORNIA STREAM BIOASSESSMENT PROCEDURE (CSBP)

| Biological Metrics | Description | Response to Impairment |
|---|---|---|
| **Richness Measures** | | |
| Taxa Richness | Total number of individual taxa | decrease |
| EPT Taxa | Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders | decrease |
| Ephemeroptera Taxa | Number of mayfly taxa (genus or species) | decrease |
| Plecoptera Taxa | Number of stonefly taxa (genus or species) | decrease |
| Trichoptera Taxa | Number of caddisfly taxa (genus or species) | decrease |
| **Composition Measures** | | |
| EPT Index | Percent composition of mayfly, stonefly and caddisfly larvae | decrease |
| Sensitive EPT Index | Percent composition of mayfly, stonefly and caddisfly larvae with Tolerance Values of 0 through 3 | decrease |
| Shannon Diversity Index | General measure of sample diversity that incorporates richness and evenness (Shannon and Weaver 1963) | decrease |
| **Tolerance/Intolerance Measures** | | |
| Tolerance Value | Value between 0 and 10 weighted for abundance of individuals designated as pollution tolerant (higher values) and intolerant (lower values) | increase |
| Percent Intolerant Organisms | Percent of organisms in sample that are highly intolerant to impairment as indicated by a tolerance value of 0, 1 or 2 | decrease |
| Percent Tolerant Organisms | Percent of organisms in sample that are highly tolerant to impairment as indicated by a tolerance value of 8, 9 or 10 | increase |
| Percent Hydropsychidae | Percent of organisms in the caddisfly family Hydropsychidae | increase |
| Percent Baetidae | Percent of organisms in the mayfly family Baetidae | increase |
| Percent Dominant Taxa | Percent composition of the single most abundant taxon | increase |
| **Functional Feeding Groups** | | |
| Percent Collectors | Percent of macrobenthos that collect or gather fine particulate matter | increase |
| Percent Filterers | Percent of macrobenthos that filter fine particulate matter | increase |
| Percent Scrapers (Grazers) | Percent of macrobenthos that graze upon periphyton | variable |
| Percent Predators | Percent of macrobenthos that feed on other organisms | variable |
| Percent Shredders | Percent of macrobenthos that shreds coarse particulate matter | decrease |

# PHYSICAL HABITAT QUALITY
## (California Stream Bioassessment Procedure)

WATERSHED/ STREAM: ______________________

DATE/ TIME: ______________________

COMPANY/ AGENCY: ______________________

SAMPLE ID NUMBER: ______________________

SITE DESCRIPTION: ______________________

**Circle the appropriate score for all 20 habitat parameters. Record the total score on the front page of the CBW.**

Parameters to be evaluated within the sampling reach

| HABITAT PARAMETER | CONDITION CATEGORY | | | |
|---|---|---|---|---|
| | **OPTIMAL** | **SUBOPTIMAL** | **MARGINAL** | **POOR** |
| **1. Epifaunal Substrate/ Available Cover** | Greater than 70% (50% for low gradient streams) of substrate favorable for epifaunal colonization and fish cover; most favorable is a mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient). | 40-70% (30-50% for low gradient streams) mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% (10-30% for low gradient streams) mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% (10% for low gradient streams) stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **2. Embeddedness** | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **3. Velocity/ Depth Regimes**<br>*(deep<0.5 m, slow<0.3 m/s)* | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **4. Sediment Deposition** | Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **5. Channel Flow Status** | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

Parameters to be evaluated in an area longer than the sampling reach

| HABITAT PARAMETER | CONDITION CATEGORY | | | |
|---|---|---|---|---|
| | **OPTIMAL** | **SUBOPTIMAL** | **MARGINAL** | **POOR** |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability** (score each bank) Note: determine left of right side by facing downstream | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) Note: determine left or right side by facing downstream. | More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities haveimpacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |

## APPENDIX 2 Number of lowest identified taxa by transect and combined transects including tolerance values (TV) and feeding guilds (FFG) for Pleasant Grove Creek sites.

Tolerance values for taxa range from 1 to 10 with 10 being the most tolerant value. Feeding guilds are defined as follows:
CG = collector-gatherer; CF = collector-filterer; SC = scraper;
SH = shredder; P = predator; MH = macrophyte herbivore;
OM = omnivore; PA = parasite; XY = Xylophage.

PGC 1

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Hyalella sp. | 176 | Hyalella sp. | 88 | Hyalella sp. | 104 | Hyalella sp. | 8 | CG | 368 |
| Physa sp. | 42 | Paratanytarsus sp. | 49 | Physa sp. | 40 | Physa sp. | 8 | SC | 122 |
| Paratanytarsus sp. | 12 | Physa sp. | 40 | Cyprididae | 37 | Paratanytarsus sp. | 6 | CF | 74 |
| Chironominae | 11 | Cyprididae | 21 | Unid. Imm. Tubifricidae | 26 | Cyprididae | 8 | CG | 65 |
| Stylaria lacustris | 11 | Gammarus sp. | 16 | Gammarus sp. | 15 | Gammarus sp. | 6 | CG | 32 |
| Oxyethira sp. | 7 | Ophidonais serpentina | 10 | Aulodrilus pigueti | 15 | Unid. Imm. Tubifricidae | 10 | CG | 28 |
| Cyprididae | 7 | Aulodrilus pigueti | 10 | Paratanytarsus sp. | 13 | Aulodrilus pigueti | -- | CG | 25 |
| Slavina appendiculata | 5 | Cladopelma sp. | 9 | Corynoneura sp. | 6 | Stylaria lacustris | -- | CG | 14 |
| Coenagrionidae | 4 | Tanytarsini | 6 | Limnesia sp. | 5 | Ophidonais serpentina | -- | -- | 13 |
| Orthocladiinae | 3 | Tanypodinae | 6 | Ablabesmyia sp. | 4 | Chironominae | 6 | CG | 11 |
| Cricotopus sp. | 3 | Tanypus sp. | 4 | Tanypus sp. | 4 | Slavina appendiculata | -- | CG | 10 |
| Culicoides sp. | 1 | Dicrotendipes sp. | 3 | Slavina appendiculata | 4 | Corynoneura sp. | 7 | CG | 10 |
| Chironomidae | 1 | Corynoneura sp. | 3 | Chironomini | 3 | Tanypus sp. | 10 | P | 9 |
| Microtendipes pedellus grp | 1 | Chironomus sp. | 2 | Polypedilum sp. | 3 | Oxyethira sp. | 3 | PH | 9 |
| Corynoneura sp. | 1 | Paratanytarsus sp. (pupae) | 2 | Orthocladiinae | 3 | Cladopelma sp. | 7 | CG | 9 |
| Ablabesmyia sp. | 1 | Orthocladiinae | 2 | Ophidonais serpentina | 3 | Orthocladiinae | 5 | CG | 8 |
| Tanypus sp. | 1 | Ablabesmyia sp. | 2 | Dicrotendipes sp. | 2 | Limnesia sp. | 5 | P | 8 |
| Setacera sp. | 1 | Procambarus clarkii | 2 | Nais communis/ variabilis | 2 | Ablabesmyia sp. | 8 | CG | 7 |
| Caenis latipennis | 1 | Limnesia sp. | 2 | Dero digitata | 2 | Tanytarsini | 6 | CG | 6 |
| Gammarus sp. | 1 | Apedilum sp. | 1 | Stylaria lacustris | 2 | Tanypodinae | 7 | P | 6 |
| Procambarus clarkia | 1 | Micropsectra sp. | 1 | Chironomus sp. | 1 | Dicrotendipes sp. | 8 | CG | 5 |
| Limnesia sp. | 1 | Tanytarsus sp. | 1 | Corixidae | 1 | Coenagrionidae | -- | P | 5 |
| Unid. Imm. Tubifricidae | 1 | Caenis latipennis | 1 | Anax junius | 1 | Procambarus clarkii | 8 | SH | 3 |
| Gyraulus sp. | 1 | Oxyethira sp. | 1 | Coenagrionidae | 1 | Polypedilum sp. | 6 | CG | 3 |
| | 294 | Arrenurus sp. | 1 | Oxyethira sp. | 1 | Cricotopus sp. | 7 | CG | 3 |
| | | Torrenticola sp. | 1 | Helobdella stagnalis | 1 | Chironomus sp. | 10 | CG | 3 |
| | | Lumbriculus variegata | 1 | Tubificidae w hair cht. | 1 | Chironomini | 6 | CG | 3 |
| | | Slavina appendiculata | 1 | Pisidium sp. | 1 | Tubificidae w hair cht. | 5 | CG | 2 |
| | | Stylaria lacustris | 1 | | 301 | Pisidium sp. | 8 | CF | 2 |

PGC 1. – continued.

| | |
|---|---|
| Unid. Imm. Tubifricidae | 1 |
| Tubificidae w hair cht. | 1 |
| Pisidium sp. | 1 |
| Gyraulus sp. | 1 |
| | 291 |

| | | | |
|---|---|---|---|
| Paratanytarsus sp. (pupae) | -- | -- | 2 |
| Nais communis/ variabilis | -- | CG | 2 |
| Gyraulus sp. | 8 | SC | 2 |
| Dero digitata | -- | CG | 2 |
| Caenis latipennis | 7 | CG | 2 |
| Torrenticola sp. | 5 | P | 1 |
| Tanytarsus sp. | 6 | CF | 1 |
| Setacera sp. | 6 | SH | 1 |
| Microtendipes pedellus grp | 6 | CF | 1 |
| Micropsectra sp. | 7 | CG | 1 |
| Lumbriculus variegata | -- | CG | 1 |
| Helobdella stagnalis | 6 | PA | 1 |
| Culicoides sp. | 6 | P | 1 |
| Corixidae | 10 | P | 1 |
| Chironomidae | 6 | CG | 1 |
| Arrenurus sp. | 5 | P | 1 |
| Apedilum sp. | 6 | CG | 1 |
| Anax junius | -- | P | 1 |
| | | | 886 |

PGC 2

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Paratanytarsus sp. | 62 | Oxyethira sp. | 60 | Rheocricotopus sp. | 69 | Rheocricotopus sp. | 6 | OM | 134 |
| Micropsectra sp. | 48 | Rheocricotopus sp. | 57 | Unid. Imm. Tubifricidae | 40 | Oxyethira sp. | 3 | PH | 109 |
| Oxyethira sp. | 33 | Baetis tricaudatus | 29 | Baetis tricaudatus | 30 | Micropsectra sp. | 7 | CG | 78 |
| Physa sp. | 21 | Micropsectra sp. | 23 | Hydropsyche sp. | 25 | Paratanytarsus sp. | 6 | CF | 62 |
| Gammarus sp. | 14 | Simulium sp. | 22 | Dugesia tigrina | 23 | Baetis tricaudatus | 6 | CG | 59 |
| Cryptochironomus sp. | 13 | Corynoneura sp. | 16 | Oxyethira sp. | 16 | Unid. Imm. Tubifricidae | 10 | CG | 56 |
| Dicrotendipes sp. | 8 | Eukiefferiella sp. | 13 | Fallceon quilleri | 12 | Hydropsyche sp. | 4 | CF | 37 |
| Rheocricotopus sp. | 8 | Cryptochironomus sp. | 12 | Eukiefferiella sp. | 11 | Cryptochironomus sp. | 8 | P | 35 |
| Corynoneura sp. | 8 | Unid. Imm. Tubifricidae | 12 | Simulium sp. | 11 | Simulium sp. | 6 | CF | 34 |
| Hyalella sp. | 8 | Hydropsyche sp. | 11 | Cryptochironomus sp. | 10 | Corynoneura sp. | 7 | CG | 34 |
| Stempellina sp. | 7 | Fallceon quilleri | 6 | Corynoneura sp. | 10 | Dugesia tigrina | 4 | P | 29 |
| Polypedilum sp. | 6 | Dugesia tigrina | 6 | Micropsectra sp. | 7 | Eukiefferiella sp. | 8 | OM | 25 |
| Nanocladius sp. | 5 | Rheocricotopus sp. (pupae) | 3 | Rheocricotopus sp. (pupae) | 4 | Physa sp. | 8 | SC | 21 |
| Unid. Imm. Tubifricidae | 4 | Cyprididae | 3 | Baetis sp. | 4 | Gammarus sp. | 6 | CG | 18 |
| Tanytarsus sp. | 3 | Tubificidae w hair cht. | 3 | Thienemanniella sp. | 3 | Fallceon quilleri | 4 | CG | 18 |
| Cricotopus sp. | 3 | Corynoneura sp. (pupae) | 2 | Corynoneura sp. (pupae) | 3 | Stempellina sp. | 2 | CG | 8 |
| Limonia sp. | 3 | Nais communis/ variabilis | 2 | Hydropsyche californica | 3 | Rheocricotopus sp. (pupae) | -- | -- | 8 |
| Helisoma sp. | 3 | Stempellina sp. | 1 | Gammarus sp. | 3 | Polypedilum sp. | 6 | CG | 8 |
| Bezzia/ Palpomyia | 2 | Orthocladius complex | 1 | Polypedilum sp. | 2 | Hyalella sp. | 8 | CG | 8 |
| Phaenopsectra sp. | 2 | Cricotopus sp. | 1 | Hydropsychidae | 2 | Dicrotendipes sp. | 8 | CG | 8 |
| Orthocladius complex | 2 | Eukiefferiella sp. (pupae) | 1 | Nais communis/ variabilis | 2 | Thienemanniella sp. | 6 | CG | 6 |
| Thienemanniella sp. | 2 | Thienemanniella sp. | 1 | Cricotopus sp. | 1 | Nanocladius sp. | 3 | CG | 5 |
| Ablabesmyia sp. | 2 | Pentaneura sp. | 1 | Eukiefferiella sp. (pupae) | 1 | Nais communis/ variabilis | -- | CG | 5 |
| Caenis latipennis | 2 | Gammarus sp. | 1 | Pentaneura sp. | 1 | Cricotopus sp. | 7 | CG | 5 |
| Lumbricina | 2 | Lumbricina | 1 | Pentaneura sp. (pupae) | 1 | Corynoneura sp. | -- | -- | 5 |
| Hydrobius fuscipes (adults) | 1 | Stylaria lacustris | 1 | Muscidae | 1 | Baetis sp. | 5 | CG | 5 |
| Probezzia sp. | 1 | | 289 | Lumbricina | 1 | Tubificidae w hair cht. | 5 | CG | 4 |
| Sphaeromias sp. | 1 | | | Menetus opercularis | 1 | Lumbricina | -- | CG | 4 |
| Stempellina sp. (pupae) | 1 | | | | 297 | Hydropsyche californica | 4 | CF | 4 |
| Eukiefferiella sp. | 1 | | | | | Tanytarsus sp. | 6 | CF | 3 |

PGC 2. – continued.

| | |
|---|---|
| Limnophyes sp. | 1 |
| Cricotopus bicinctus grp | 1 |
| Eukiefferiella sp. (pupae) | 1 |
| Rheocricotopus sp. (pupae) | 1 |
| Simulium sp. | 1 |
| Baetis sp. | 1 |
| Tricorythodes sp. | 1 |
| Hydropsyche sp. | 1 |
| Hydropsyche californica | 1 |
| Procambarus clarkia | 1 |
| Nais communis/ variabilis | 1 |
| Ophidonais serpentine | 1 |
| Tubificidae w hair cht. | 1 |
| Corbicula sp. | 1 |
| Ferrissia sp. | 1 |
| | 291 |

| | | | |
|---|---|---|---|
| Orthocladius complex | 6 | CG | 3 |
| Limonia sp. | 6 | SH | 3 |
| Helisoma sp. | 6 | SC | 3 |
| Eukiefferiella sp. (pupae) | -- | -- | 3 |
| Cyprididae | 8 | CG | 3 |
| Phaenopsectra sp. | 7 | SC | 2 |
| Pentaneura sp. | 6 | P | 2 |
| Hydropsychidae | 4 | CF | 2 |
| Caenis latipennis | 7 | CG | 2 |
| Bezzia/ Palpomyia | 6 | P | 2 |
| Ablabesmyia sp. | 8 | CG | 2 |
| Tricorythodes sp. | 4 | CG | 1 |
| Stylaria lacustris | -- | CG | 1 |
| Stempellina sp. (pupae) | -- | -- | 1 |
| Sphaeromias sp. | 6 | P | 1 |
| Procambarus clarkii | 8 | SH | 1 |
| Probezzia sp. | 6 | P | 1 |
| Pentaneura sp. (pupae) | -- | -- | 1 |
| Ophidonais serpentina | -- | -- | 1 |
| Muscidae | 6 | P | 1 |
| Menetus opercularis | 6 | SC | 1 |
| Limnophyes sp. | 8 | CG | 1 |
| Hydrobius fuscipes (adults) | 8 | CG | 1 |
| Ferrissia sp. | 6 | SC | 1 |
| Cricotopus bicinctus grp | 7 | CG | 1 |
| Corbicula sp. | 8 | CF | 1 |
| | | | 877 |

PGC 3

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Micropsectra sp. | 59 | Rheocricotopus sp. | 135 | Rheocricotopus sp. | 94 | Rheocricotopus sp. | 6 | OM | 233 |
| Paratendipes sp. | 36 | Simulium sp. | 40 | Nais communis/ variabilis | 42 | Micropsectra sp. | 7 | CG | 111 |
| Chironomini | 24 | Micropsectra sp. | 29 | Simulium sp. | 28 | Simulium sp. | 6 | CF | 68 |
| Tanytarsus sp. | 20 | Eukiefferiella sp. | 15 | Eukiefferiella sp. | 23 | Nais communis/ variabilis | -- | CG | 46 |
| Unid. Imm. Tubifricidae | 15 | Ophidonais serpentina | 10 | Micropsectra sp. | 23 | Eukiefferiella sp. | 8 | OM | 38 |
| Phaenopsectra sp. | 13 | Fallceon quilleri | 9 | Paratanytarsus sp. | 11 | Paratendipes sp. | 8 | CG | 36 |
| Paratanytarsus sp. | 12 | Rheocricotopus sp. (pupae) | 9 | Corynoneura sp. | 9 | Paratanytarsus sp. | 6 | CF | 27 |
| Dero digitata | 10 | Polypedilum sp. | 7 | Polypedilum sp. | 9 | Chironomini | 6 | CG | 24 |
| Stempellina sp. | 10 | Orthocladiinae | 5 | Corynoneura sp. (pupae) | 8 | Ophidonais serpentina | -- | -- | 22 |
| Dicrotendipes sp. | 9 | Nais communis/ variabilis | 4 | Rheocricotopus sp. (pupae) | 5 | Tanytarsus sp. | 6 | CF | 21 |
| Ophidonais serpentine | 8 | Orthocladiinae (pupae) | 4 | Fallceon quilleri | 4 | Unid. Imm. Tubifricidae | 10 | CG | 17 |
| Tubificidae w hair cht. | 7 | Paratanytarsus sp. | 4 | Ophidonais serpentina | 4 | Polypedilum sp. | 6 | CG | 16 |
| Probezzia sp. | 5 | Chironominae | 3 | Tipula sp. | 4 | Phaenopsectra sp. | 7 | SC | 15 |
| Chironomus sp. | 4 | Corynoneura sp. | 3 | Baetis sp. | 3 | Rheocricotopus sp. (pupae) | -- | -- | 14 |
| Oxyethira sp. | 4 | Cryptochironomus sp. | 3 | Cryptochironomus sp. | 3 | Fallceon quilleri | 4 | CG | 13 |
| Pristina leidyi | 4 | Oxyethira sp. | 3 | Thienemanniella sp. | 3 | Corynoneura sp. | 7 | CG | 13 |
| Rheocricotopus sp. | 4 | Pentaneura sp. | 3 | Oxyethira sp. | 2 | Stempellina sp. | 2 | CG | 12 |
| Aulodrilus pigueti | 3 | Hydropsyche sp. | 2 | Phaenopsectra sp. | 2 | Dicrotendipes sp. | 8 | CG | 10 |
| Micropsectra sp. (pupae) | 2 | Tanytarsini | 2 | Physa sp. | 2 | Dero digitata | -- | CG | 10 |
| Polypedilum sp. (pupae) | 2 | Apedilum sp. | 1 | Stempellina sp. | 2 | Oxyethira sp. | 3 | PH | 9 |
| Procambarus clarkia | 2 | Baetis sp. | 1 | Unid. Imm. Tubifricidae | 2 | Corynoneura sp. (pupae) | -- | -- | 8 |
| Slavina appendiculata | 2 | Ceratopogonidae (pupae) | 1 | Apedilum sp. | 1 | Tubificidae w hair cht. | 5 | CG | 7 |
| Stempellina sp. (pupae) | 2 | Physa sp. | 1 | Coenagrionidae | 1 | Cryptochironomus sp. | 8 | P | 7 |
| Tricorythodes sp. | 2 | Pisidium sp. | 1 | Corbicula sp. | 1 | Probezzia sp. | 6 | P | 6 |
| Ablabesmyia sp. | 1 | Rheotanytarsus sp. | 1 | Cricotopus bicinctus grp (pupae) | 1 | Orthocladiinae | 5 | CG | 6 |
| Argia sp. | 1 | Stylaria lacustris | 1 | Cyprididae | 1 | Tipula sp. | 4 | OM | 4 |
| Coenagrionidae | 1 | | 297 | Dicrotendipes sp. | 1 | Thienemanniella sp. | 6 | CG | 4 |
| Corynoneura sp. | 1 | | | Enchytraeidae | 1 | Pristina leidyi | -- | CG | 4 |
| Cryptochironomus sp. | 1 | | | Eukiefferiella sp. (pupae) | 1 | Pentaneura sp. | 6 | P | 4 |
| Cryptotendipes sp. | 1 | | | Hydra sp. | 1 | Orthocladiinae (pupae) | -- | -- | 4 |

PGC 3. – continued.

| | |
|---|---|
| Hydropsyche sp. | 1 |
| Orthocladiinae | 1 |
| Paraphaenocladius sp. | 1 |
| Prostoma sp. | 1 |
| Stenochironomus sp. | 1 |
| Thienemanniella sp. | 1 |
| | 271 |

| | |
|---|---|
| Liodessus obscurellus (adults) | 1 |
| Menetus opercularis | 1 |
| Micropsectra sp. (pupae) | 1 |
| Paratanytarsus sp. (pupae) | 1 |
| Pentaneura sp. | 1 |
| Polypedilum sp. (pupae) | 1 |
| Probezzia sp. | 1 |
| Prostoma sp. | 1 |
| Slavina appendiculata | 1 |
| Sperchon sp. | 1 |
| Stempellinella sp. | 1 |
| Stylaria lacustris | 1 |
| Tanytarsus sp. | 1 |
| | 305 |

| | | | |
|---|---|---|---|
| Chironomus sp. | 10 | CG | 4 |
| Baetis sp. | 5 | CG | 4 |
| Slavina appendiculata | -- | CG | 3 |
| Polypedilum sp. (pupae) | -- | -- | 3 |
| Physa sp. | 8 | SC | 3 |
| Micropsectra sp. | -- | -- | 3 |
| Hydropsyche sp. | 4 | CF | 3 |
| Chironominae | 6 | CG | 3 |
| Aulodrilus pigueti | -- | CG | 3 |
| Tricorythodes sp. | 4 | CG | 2 |
| Tanytarsini | 6 | CG | 2 |
| Stylaria lacustris | -- | CG | 2 |
| Stempellina sp. (pupae) | -- | -- | 2 |
| Prostoma sp. | 8 | P | 2 |
| Procambarus clarkii | 8 | SH | 2 |
| Coenagrionidae | -- | P | 2 |
| Apedilum sp. | 6 | CG | 2 |
| Stenochironomus sp. | 5 | CG | 1 |
| Stempellinella sp. | 4 | CF | 1 |
| Sperchon sp. | 8 | P | 1 |
| Rheotanytarsus sp. | 6 | CF | 1 |
| Pisidium sp. | 8 | CF | 1 |
| Paratanytarsus sp. (pupae) | -- | -- | 1 |
| Paraphaenocladius sp. | 4 | CG | 1 |
| Menetus opercularis | 6 | SC | 1 |
| Liodessus obscurellus (adults) | 5 | P | 1 |
| Hydra sp. | 5 | P | 1 |
| Eukiefferiella sp. (pupae) | -- | -- | 1 |
| Enchytraeidae | 10 | CG | 1 |
| Cyprididae | 8 | CG | 1 |
| Cryptotendipes sp. | 6 | CG | 1 |
| Cricotopus bicinctus grp (pupae) | -- | -- | 1 |
| Corbicula sp. | 8 | CF | 1 |
| Ceratopogonidae (pupae) | -- | -- | 1 |
| Argia sp. | 7 | P | 1 |
| Ablabesmyia sp. | 8 | CG | 1 |
| | | | 873 |

PGC 4

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Simulium sp. | 110 | Hyalella sp. | 59 | Rheocricotopus sp. | 30 | Simulium sp. | 6 | CF | 142 |
| Rheocricotopus sp. | 32 | Micropsectra sp. | 43 | Unid. Imm. Tubifricidae | 30 | Hyalella sp. | 8 | CG | 89 |
| Physa sp. | 22 | Paratanytarsus sp. | 29 | Simulium sp. | 26 | Rheocricotopus sp. | 6 | OM | 73 |
| Fallceon quilleri | 19 | Nais communis/ variabilis | 23 | Oxyethira sp. | 25 | Micropsectra sp. | 7 | CG | 70 |
| Micropsectra sp. | 15 | Oxyethira sp. | 22 | Physa sp. | 24 | Physa sp. | 8 | SC | 66 |
| Corynoneura sp. | 12 | Physa sp. | 20 | Hyalella sp. | 19 | Oxyethira sp. | 3 | PH | 56 |
| Hyalella sp. | 11 | Stylaria lacustris | 14 | Hydra sp. | 13 | Unid. Imm. Tubifricidae | 10 | CG | 47 |
| Unid. Imm. Tubifricidae | 11 | Rheocricotopus sp. | 11 | Fallceon quilleri | 12 | Paratanytarsus sp. | 6 | CF | 37 |
| Eukiefferiella sp. | 10 | Simulium sp. | 6 | Micropsectra sp. | 12 | Nais communis/ variabilis | -- | CG | 34 |
| Cryptochironomus sp. | 9 | Unid. Imm. Tubifricidae | 6 | Cryptochironomus sp. | 11 | Fallceon quilleri | 4 | CG | 32 |
| Oxyethira sp. | 9 | Ophidonais serpentina | 5 | Nais communis/ variabilis | 9 | Cryptochironomus sp. | 8 | P | 23 |
| Paratanytarsus sp. | 6 | Cricotopus bicinctus grp | 4 | Ophidonais serpentina | 7 | Hydra sp. | 5 | P | 18 |
| Thienemanniella sp. | 5 | Hydra sp. | 4 | Eukiefferiella sp. | 6 | Stylaria lacustris | -- | CG | 17 |
| Tricorythodes sp. | 5 | Probezzia sp. | 4 | Lumbriculus variegata | 6 | Eukiefferiella sp. | 8 | OM | 17 |
| Stempellina sp. | 4 | Cryptochironomus sp. | 3 | Polypedilum sp. | 5 | Ophidonais serpentina | -- | -- | 13 |
| Cyprididae | 2 | Cyprididae | 3 | Eukiefferiella sp. (pupae) | 4 | Corynoneura sp. | 7 | CG | 13 |
| Lumbricina | 2 | Menetus opercularis | 3 | Helisoma sp. | 4 | Tricorythodes sp. | 4 | CG | 11 |
| Nais communis/ variabilis | 2 | Slavina appendiculata | 3 | Corbicula sp. | 3 | Thienemanniella sp. | 6 | CG | 8 |
| Stylaria lacustris | 2 | Tricorythodes sp. | 3 | Cricotopus bicinctus grp | 3 | Cricotopus bicinctus grp | 7 | CG | 8 |
| Tanytarsus sp. | 2 | Tubificidae w hair cht. | 3 | Pentaneura sp. | 3 | Slavina appendiculata | -- | CG | 6 |
| Agabus lutosus (adults) | 1 | Chaetogaster diaphanus | 2 | Slavina appendiculata | 3 | Menetus opercularis | 6 | SC | 6 |
| Baetis sp. | 1 | Cricotopus sp. | 2 | Tricorythodes sp. | 3 | Lumbriculus variegata | -- | CG | 6 |
| Corynoneura sp. (pupae) | 1 | Ablabesmyia sp. | 1 | Cryptochironomus sp. (pupae) | 2 | Helisoma sp. | 6 | SC | 6 |
| Cricotopus bicinctus grp | 1 | Apedilum sp. | 1 | Dugesia tigrina | 2 | Tubificidae w hair cht. | 5 | CG | 5 |
| Cricotopus bicinctus grp (pupae) | 1 | Baetis sp. | 1 | Menetus opercularis | 2 | Stempellina sp. | 2 | CG | 5 |
| Cricotopus sp. | 1 | Bezzia/ Palpomyia | 1 | Paratanytarsus sp. | 2 | Probezzia sp. | 6 | P | 5 |
| Helisoma sp. | 1 | Corynoneura sp. | 1 | Pentaneura sp. (pupae) | 2 | Polypedilum sp. | 6 | CG | 5 |
| Hydra sp. | 1 | Eukiefferiella sp. | 1 | Thienemanniella sp. | 2 | Cyprididae | 8 | CG | 5 |
| Liodessus obscurellus (adults) | 1 | Fallceon quilleri | 1 | Torrenticola sp. | 2 | Tanytarsus sp. | 6 | CF | 4 |
| Menetus opercularis | 1 | Gyraulus sp. | 1 | Tubificidae w hair cht. | 2 | Pentaneura sp. | 6 | P | 4 |
| Ophidonais serpentine | 1 | Helisoma sp. | 1 | Ablabesmyia sp. | 1 | Eukiefferiella sp. (pupae) | -- | -- | 4 |
| Pentaneura sp. | 1 | Hydraena sp. (adults) | 1 | Ceratopogonidae (pupae) | 1 | Lumbricina | -- | CG | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Progomphus borealis | 1 | Libellula sp. | 1 | Corynoneura sp. (pupae) | 1 | Cricotopus sp. | 7 | CG | 3 |
| PGC 4. – continued.<br>Rheocricotopus sp. (pupae) | 1 | Micropsectra sp. (pupae) | 1 | Dicrotendipes sp. | 1 | Corbicula sp. | 8 | CF | 3 |
| | 304 | Paratanytarsus sp. (pupae) | 1 | Enchytraeidae | 1 | Torrenticola sp. | 5 | P | 2 |
| | | Paratendipes sp. | 1 | Ferrissia sp. | 1 | Rheocricotopus sp. (pupae) | -- | -- | 2 |
| | | Phaenopsectra sp. | 1 | Hydroptila sp. | 1 | Phaenopsectra sp. | 7 | SC | 2 |
| | | Pisidium sp. | 1 | Ischnura sp. | 1 | Pentaneura sp. (pupae) | -- | -- | 2 |
| | | Prostoma sp. | 1 | Limnodrilus hoffmeisteri | 1 | Paratanytarsus sp. (pupae) | -- | -- | 2 |
| | | Stempellina sp. | 1 | Liodessus obscurellus (adults) | 1 | Micropsectra sp. (pupae) | -- | -- | 2 |
| | | Tanytarsus sp. | 1 | Lumbricina | 1 | Liodessus obscurellus (adults) | 5 | P | 2 |
| | | Thienemanniella sp. | 1 | Micropsectra sp. (pupae) | 1 | Dugesia tigrina | 4 | P | 2 |
| | | | 292 | Paranais litoralis | 1 | Cryptochironomus sp. (pupae) | -- | -- | 2 |
| | | | | Paratanytarsus sp. (pupae) | 1 | Corynoneura sp. (pupae) | -- | -- | 2 |
| | | | | Phaenopsectra sp. | 1 | Chaetogaster diaphanus | -- | -- | 2 |
| | | | | Pristina leidyi | 1 | Baetis sp. | 5 | CG | 2 |
| | | | | Probezzia sp. | 1 | Ablabesmyia sp. | 8 | CG | 2 |
| | | | | Rheocricotopus sp. (pupae) | 1 | Prostoma sp. | 8 | P | 1 |
| | | | | Stylaria lacustris | 1 | Progomphus borealis | 4 | P | 1 |
| | | | | Tanytarsus sp. | 1 | Pristina leidyi | -- | CG | 1 |
| | | | | | 294 | Pisidium sp. | 8 | CF | 1 |
| | | | | | | Paratendipes sp. | 8 | CG | 1 |
| | | | | | | Paranais litoralis | -- | CG | 1 |
| | | | | | | Limnodrilus hoffmeisteri | -- | CG | 1 |
| | | | | | | Libellula sp. | 9 | P | 1 |
| | | | | | | Ischnura sp. | 9 | P | 1 |
| | | | | | | Hydroptila sp. | 6 | PH | 1 |
| | | | | | | Hydraena sp. (adults) | 5 | SC | 1 |
| | | | | | | Gyraulus sp. | 8 | SC | 1 |
| | | | | | | Ferrissia sp. | 6 | SC | 1 |
| | | | | | | Enchytraeidae | 10 | CG | 1 |
| | | | | | | Dicrotendipes sp. | 8 | CG | 1 |
| | | | | | | Cricotopus bicinctus grp (pupae) | -- | -- | 1 |
| | | | | | | Ceratopogonidae (pupae) | -- | -- | 1 |
| | | | | | | Bezzia/ Palpomyia | 6 | P | 1 |
| | | | | | | Apedilum sp. | 6 | CG | 1 |
| | | | | | | Agabus lutosus (adults) | -- | P | 1 |
| | | | | | | | | | 890 |

PGC 5

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Paratanytarsus sp. | 58 | Hyalella sp. | 35 | Paratanytarsus sp. | 51 | Paratanytarsus sp. | 6 | CF | 144 |
| Chironomus sp. | 27 | Paratanytarsus sp. | 35 | Hyalella sp. | 37 | Hyalella sp. | 8 | CG | 73 |
| Gammarus sp. | 27 | Oxyethira sp. | 31 | Oxyethira sp. | 31 | Oxyethira sp. | 3 | PH | 65 |
| Rheocricotopus sp. | 21 | Tanytarsus sp. | 29 | Stylaria lacustris | 27 | Tanytarsus sp. | 6 | CF | 56 |
| Unid. Imm. Tubifricidae | 15 | Ophidonais serpentina | 24 | Dero digitata | 23 | Ophidonais serpentina | -- | -- | 45 |
| Dero digitata | 14 | Coenagrionidae | 22 | Ophidonais serpentina | 19 | Stylaria lacustris | -- | CG | 38 |
| Simulium sp. | 13 | Physa sp. | 16 | Tanytarsus sp. | 18 | Coenagrionidae | -- | P | 38 |
| Coenagrionidae | 9 | Stylaria lacustris | 10 | Slavina appendiculata | 10 | Dero digitata | -- | CG | 37 |
| Cricotopus sp. | 9 | Micropsectra sp. | 9 | Cricotopus bicinctus group | 8 | Rheocricotopus sp. | 6 | OM | 28 |
| Fallceon quilleri | 9 | Cricotopus bicinctus group | 8 | Coenagrionidae | 7 | Gammarus sp. | 6 | CG | 28 |
| Tanytarsus sp. | 9 | Dugesia tigrina | 8 | Polypedilum sp. | 6 | Chironomus sp. | 10 | CG | 28 |
| Cladopelma sp. | 8 | Rheocricotopus sp. | 7 | Unid. Imm. Tubifricidae | 6 | Unid. Imm. Tubifricidae | 10 | CG | 26 |
| Dicrotendipes sp. | 8 | Nais communis/ variabilis | 5 | Chironominae | 5 | Physa sp. | 8 | SC | 19 |
| Micropsectra sp. | 6 | Unid. Imm. Tubifricidae | 5 | Dugesia tigrina | 5 | Cricotopus bicinctus group | 7 | CG | 17 |
| Polypedilum sp. | 4 | Menetus opercularis | 4 | Haemonais waldvogeli | 4 | Micropsectra sp. | 7 | CG | 16 |
| Rheotanytarsus sp. | 4 | Cricotopus sp. | 3 | Rheotanytarsus sp. | 4 | Dugesia tigrina | 4 | P | 16 |
| Cricotopus sp. (pupae) | 3 | Dicrotendipes sp. | 3 | Cyprididae | 3 | Simulium sp. | 6 | CF | 15 |
| Dugesia tigrina | 3 | Fallceon quilleri | 3 | Tanypodinae | 3 | Polypedilum sp. | 6 | CG | 13 |
| Ferrissia sp. | 3 | Paratanytarsus sp. (pupae) | 3 | Ablabesmyia sp. | 1 | Fallceon quilleri | 4 | CG | 13 |
| Oxyethira sp. | 3 | Polypedilum sp. | 3 | Aulodrilus pigueti | 1 | Cricotopus sp. | 7 | CG | 13 |
| Phaenopsectra sp. | 3 | Ablabesmyia sp. | 2 | Caenis latipennis | 1 | Dicrotendipes sp. | 8 | CG | 12 |
| Tanypus sp. | 3 | Centroptilum sp. | 2 | Ceratopogonidae (pupae) | 1 | Slavina appendiculata | -- | CG | 11 |
| Haemonais waldvogeli | 2 | Liodessus obscurellus (adults) | 2 | Corynoneura sp. | 1 | Rheotanytarsus sp. | 6 | CF | 10 |
| Liodessus obscurellus (adults) | 2 | Probezzia sp. | 2 | Cricotopus sp. | 1 | Cladopelma sp. | 7 | CG | 8 |
| Ophidonais serpentine | 2 | Procambarus clarkii | 2 | Cricotopus sp. (pupae) | 1 | Haemonais waldvogeli | -- | CG | 6 |
| Pentaneura sp. | 2 | Rheotanytarsus sp. | 2 | Cryptotendipes sp. (pupae) | 1 | Tanypus sp. | 10 | P | 5 |
| Physa sp. | 2 | Simulium sp. | 2 | Dicrotendipes sp. | 1 | Phaenopsectra sp. | 7 | SC | 5 |
| Procambarus clarkia | 2 | Tanypus sp. | 2 | Fallceon quilleri | 1 | Paratanytarsus sp. (pupae) | -- | -- | 5 |
| Tricorythodes sp. | 2 | Bezzia/ Palpomyia | 1 | Limnodrilus hoffmeisteri | 1 | Nais communis/ variabilis | -- | CG | 5 |
| Corixidae | 1 | Brachycera (pupae) | 1 | Menetus opercularis | 1 | Menetus opercularis | 6 | SC | 5 |
| Corynoneura sp. | 1 | Ceratopogonidae (pupae) | 1 | Micropsectra sp. | 1 | Chironominae | 6 | CG | 5 |
| Cricotopus bicinctus group | 1 | Chironomini | 1 | Paratanytarsus sp. (pupae) | 1 | Procambarus clarkii | 8 | SH | 4 |
| Cyprididae | 1 | Chironomus sp. | 1 | Phaenopsectra sp. | 1 | Liodessus obscurellus (adults) | 5 | P | 4 |
| Enchytraeidae | 1 | Cryptotendipes sp. | 1 | Physa sp. | 1 | Cyprididae | 8 | CG | 4 |

| | |
|---|---|
| Hyalella sp. | 1 |
| Paratanytarsus sp. (pupae) | 1 |
| Pisidium sp. | 1 |
| Probezzia sp. | 1 |
| Slavina appendiculata | 1 |
| Stylaria lacustris | 1 |
| Thienemanniella sp. | 1 |
| | 285 |

| | |
|---|---|
| Eucorethra underwoodi | 1 |
| Gammarus sp. | 1 |
| Helisoma sp. | 1 |
| Hydroptila sp. | 1 |
| Ischnura sp. | 1 |
| Nanocladius sp. | 1 |
| Orthocladius complex | 1 |
| Phaenopsectra sp. | 1 |
| Psectrotanypus sp. | 1 |
| Sphaeromias sp. | 1 |
| Tropisternus sp. | 1 |
| Tubificidae w hair cht. | 1 |
| | 297 |

| | |
|---|---|
| Pisidium sp. | 1 |
| Procladius sp. | 1 |
| Psectrocladius sp. | 1 |
| Tanypodinae (pupae) | 1 |
| Tanytarsini (pupae) | 1 |
| | 288 |

| | | | |
|---|---|---|---|
| Cricotopus sp. (pupae) | -- | -- | 4 |
| Tanypodinae | 7 | P | 3 |
| Probezzia sp. | 6 | P | 3 |
| Ferrissia sp. | 6 | SC | 3 |
| Ablabesmyia sp. | 8 | CG | 3 |
| Tricorythodes sp. | 4 | CG | 2 |
| Pisidium sp. | 8 | CF | 2 |
| Pentaneura sp. | 6 | P | 2 |
| Corynoneura sp. | 7 | CG | 2 |
| Ceratopogonidae (pupae) | -- | -- | 2 |
| Centroptilum sp. | 2 | CG | 2 |
| Tubificidae w hair cht. | 5 | CG | 1 |
| Tropisternus sp. | 5 | P | 1 |
| Thienemanniella sp. | 6 | CG | 1 |
| Tanytarsini (pupae) | -- | -- | 1 |
| Tanypodinae (pupae) | -- | -- | 1 |
| Sphaeromias sp. | 6 | P | 1 |
| Psectrotanypus sp. | 10 | P | 1 |
| Psectrocladius sp. | 8 | CG | 1 |
| Procladius sp. | 9 | P | 1 |
| Orthocladius complex | 6 | CG | 1 |
| Nanocladius sp. | 3 | CG | 1 |
| Limnodrilus hoffmeisteri | -- | CG | 1 |
| Ischnura sp. | 9 | P | 1 |
| Hydroptila sp. | 6 | PH | 1 |
| Helisoma sp. | 6 | SC | 1 |
| Eucorethra underwoodi | -- | P | 1 |
| Enchytraeidae | 10 | CG | 1 |
| Cryptotendipes sp. | 6 | CG | 1 |
| Cryptotendipes sp. (pupae) | -- | -- | 1 |
| Corixidae | 10 | P | 1 |
| Chironomini | 6 | CG | 1 |
| Caenis latipennis | 7 | CG | 1 |
| Brachycera (pupae) | -- | -- | 1 |
| Bezzia/ Palpomyia | 6 | P | 1 |
| Aulodrilus pigueti | -- | CG | 1 |
| | | | 870 |

PGC 6

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Fallceon quilleri | 53 | Hyalella sp. | 69 | Nais communis/ variabilis | 70 | Nais communis/ variabilis | -- | CG | 105 |
| Tricorythodes sp. | 43 | Paratanytarsus sp. | 47 | Rheocricotopus sp. | 39 | Hyalella sp. | 8 | CG | 92 |
| Cricotopus bicinctus group | 33 | Physa sp. | 47 | Tricorythodes sp. | 35 | Paratanytarsus sp. | 6 | CF | 87 |
| Nais communis/ variabilis | 28 | Cricotopus sp. | 16 | Fallceon quilleri | 26 | Tricorythodes sp. | 4 | CG | 83 |
| Paratanytarsus sp. | 22 | Oxyethira sp. | 14 | Ophidonais serpentina | 18 | Fallceon quilleri | 4 | CG | 80 |
| Rheocricotopus sp. | 21 | Stylaria lacustris | 14 | Paratanytarsus sp. | 18 | Rheocricotopus sp. | 6 | OM | 60 |
| Hyalella sp. | 16 | Unid. Imm. Tubifricidae | 14 | Hydropsyche sp. | 11 | Physa sp. | 8 | SC | 60 |
| Cricotopus sp. | 15 | Corynoneura sp. | 11 | Cricotopus sp. | 10 | Cricotopus sp. | 7 | CG | 41 |
| Eukiefferiella sp. | 15 | Nais communis/ variabilis | 7 | Simulium sp. | 10 | Cricotopus bicinctus group | 7 | CG | 33 |
| Simulium sp. | 11 | Liodessus obscurellus (adults) | 5 | Micropsectra sp. | 9 | Ophidonais serpentina | -- | -- | 28 |
| Ophidonais serpentine | 10 | Tanytarsini | 5 | Eukiefferiella sp. | 8 | Eukiefferiella sp. | 8 | OM | 23 |
| Cricotopus trifascia group | 8 | Tricorythodes sp. | 5 | Hyalella sp. | 7 | Simulium sp. | 6 | CF | 21 |
| Physa sp. | 6 | Dicrotendipes sp. | 4 | Hydropsyche californica | 7 | Oxyethira sp. | 3 | PH | 18 |
| Psectrocladius sp. | 4 | Cyprididae | 3 | Physa sp. | 7 | Unid. Imm. Tubifricidae | 10 | CG | 15 |
| Hydropsyche sp. | 3 | Tanytarsus sp. | 3 | Orthocladiinae | 4 | Stylaria lacustris | -- | CG | 14 |
| Dicrotendipes sp. | 2 | Coenagrionidae | 2 | Orthocladius complex | 4 | Hydropsyche sp. | 4 | CF | 14 |
| Gammarus sp. | 2 | Limnodrilus hoffmeisteri | 2 | Chironominae | 3 | Corynoneura sp. | 7 | CG | 12 |
| Liodessus obscurellus (adults) | 2 | Polypedilum sp. | 2 | Orthocladiinae (pupae) | 3 | Micropsectra sp. | 7 | CG | 9 |
| Paracladopelma sp. | 2 | Tropisternus lateralis (adults) | 2 | Oxyethira sp. | 3 | Cricotopus trifascia group | 7 | CG | 8 |
| Corynoneura sp. | 1 | Apedilum sp. | 1 | Cladotanytarsus sp. | 2 | Liodessus obscurellus (adults) | 5 | P | 7 |
| Ferrissia sp. | 1 | Baetidae | 1 | Cricotopus sp. (pupae) | 1 | Hydropsyche californica | 4 | CF | 7 |
| Helisoma sp. | 1 | Chironomini | 1 | Cymbiodyta sp. (adults) | 1 | Dicrotendipes sp. | 8 | CG | 7 |
| Oxyethira sp. | 1 | Fallceon quilleri | 1 | Dicrotendipes sp. | 1 | Tanytarsini | 6 | CG | 5 |
| Synorthocladius sp. | 1 | Limnophyes sp. | 1 | Gammarus sp. | 1 | Orthocladiinae | 5 | CG | 5 |
| Thienemanniella sp. | 1 | Mooreobdella microstoma | 1 | Laccophilus mexicanus (adults) | 1 | Psectrocladius sp. | 8 | CG | 4 |
| Thienemannimyia group | 1 | Orthocladiinae | 1 | Paracladopelma sp. | 1 | Orthocladius complex | 6 | CG | 4 |
| | 303 | Sciomyzidae | 1 | Rheotanytarsus sp. | 1 | Tanytarsus sp. | 6 | CF | 3 |
| | | Sphaeromias sp. | 1 | Unid. Imm. Tubifricidae | 1 | Paracladopelma sp. | 7 | -- | 3 |
| | | Synorthocladius sp. | 1 | | 302 | Orthocladiinae (pupae) | -- | -- | 3 |
| | | Tubificidae w hair cht. | 1 | | | Gammarus sp. | 6 | CG | 3 |
| | | | 283 | | | Cyprididae | 8 | CG | 3 |
| | | | | | | Chironominae | 6 | CG | 3 |

| | | | |
|---|---|---|---|
| Tropisternus lateralis (adults) | 5 | CG | 2 |
| Synorthocladius sp. | 2 | CG | 2 |
| Polypedilum sp. | 6 | CG | 2 |
| Limnodrilus hoffmeisteri | -- | CG | 2 |
| Coenagrionidae | -- | P | 2 |
| Cladotanytarsus sp. | 7 | CG | 2 |
| Tubificidae w hair cht. | 5 | CG | 1 |
| Thienemannimyia group | 6 | P | 1 |
| Thienemanniella sp. | 6 | CG | 1 |
| Sphaeromias sp. | 6 | P | 1 |
| Sciomyzidae | 6 | P | 1 |
| Rheotanytarsus sp. | 6 | CF | 1 |
| Mooreobdella microstoma | 8 | P | 1 |
| Limnophyes sp. | 8 | CG | 1 |
| Laccophilus mexicanus (adults) | -- | P | 1 |
| Helisoma sp. | 6 | SC | 1 |
| Ferrissia sp. | 6 | SC | 1 |
| Cymbiodyta sp. (adults) | 5 | CG | 1 |
| Cricotopus sp. (pupae) | -- | -- | 1 |
| Chironomini | 6 | CG | 1 |
| Baetidae | 4 | CG | 1 |
| Apedilum sp. | 6 | CG | 1 |
| | | | 888 |

PGC 7

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Dero digitata | 70 | Paratanytarsus sp. | 68 | Ophidonais serpentina | 67 | Paratanytarsus sp. | 6 | CF | 165 |
| Ophidonais serpentine | 69 | Unid. Imm. Tubifricidae | 36 | Paratanytarsus sp. | 65 | Ophidonais serpentina | -- | -- | 153 |
| Paratanytarsus sp. | 32 | Hyalella sp. | 28 | Nais communis/ variabilis | 48 | Dero digitata | -- | CG | 94 |
| Hyalella sp. | 21 | Dero digitata | 24 | Hyalella sp. | 25 | Hyalella sp. | 8 | CG | 74 |
| Unid. Imm. Tubifricidae | 15 | Cricotopus sp. | 22 | Stylaria lacustris | 24 | Unid. Imm. Tubifricidae | 10 | CG | 53 |
| Caenis latipennis | 8 | Ophidonais serpentina | 17 | Physa sp. | 16 | Nais communis/ variabilis | -- | CG | 48 |
| Cryptotendipes sp. | 6 | Stylaria lacustris | 13 | Cricotopus sp. | 14 | Stylaria lacustris | -- | CG | 41 |
| Polypedilum sp. | 6 | Corisella decolor | 12 | Cyprididae | 8 | Cricotopus sp. | 7 | CG | 40 |
| Dicrotendipes sp. | 5 | Corixidae | 7 | Menetus opercularis | 7 | Physa sp. | 8 | SC | 26 |
| Paratanytarsus sp. (pupae) | 5 | Physa sp. | 7 | Corixidae | 5 | Corisella decolor | 8 | P | 14 |
| Stempellina sp. | 5 | Gammarus sp. | 5 | Dicrotendipes sp. | 4 | Menetus opercularis | 6 | SC | 13 |
| Cricotopus sp. | 4 | Oxyethira sp. | 4 | Liodessus obscurellus (adults) | 3 | Corixidae | 10 | P | 12 |
| Menetus opercularis | 4 | Corynoneura sp. | 3 | Slavina appendiculata | 3 | Cyprididae | 8 | CG | 10 |
| Stylaria lacustris | 4 | Lymnaea sp. | 3 | Corisella decolor | 2 | Dicrotendipes sp. | 8 | CG | 9 |
| Tanytarsus sp. | 4 | Ceratopogonidae (pupae) | 2 | Cricotopus sp. (pupae) | 2 | Polypedilum sp. | 6 | CG | 8 |
| Cladotanytarsus sp. (pupae) | 3 | Menetus opercularis | 2 | Polypedilum sp. | 2 | Gammarus sp. | 6 | CG | 8 |
| Gammarus sp. | 3 | Procladius sp. (pupae) | 2 | Unid. Imm. Tubifricidae | 2 | Caenis latipennis | 7 | CG | 8 |
| Physa sp. | 3 | Sigara vallis | 2 | Ceratopogon sp. | 1 | Paratanytarsus sp. (pupae) | -- | -- | 7 |
| Tubificidae w hair cht. | 3 | Tubificidae w hair cht. | 2 | Ceratopogonidae (pupae) | 1 | Cryptotendipes sp. | 6 | CG | 6 |
| Ablabesmyia sp. | 2 | Bezzia/ Palpomyia | 1 | Coenagrionidae | 1 | Tubificidae w hair cht. | 5 | CG | 5 |
| Ceratopogonidae (pupae) | 2 | Chaetogaster diaphanus | 1 | Corynoneura sp. | 1 | Tanytarsus sp. | 6 | CF | 5 |
| Cladotanytarsus sp. | 2 | Coenagrionidae | 1 | Gyraulus sp. | 1 | Stempellina sp. | 2 | CG | 5 |
| Cyprididae | 2 | Dytiscidae (larvae) | 1 | Lymnaea sp. | 1 | Slavina appendiculata | -- | CG | 5 |
| Enchytraeidae | 2 | Enchytraeidae | 1 | Nanocladius sp. | 1 | Oxyethira sp. | 3 | PH | 5 |
| Limnodrilus hoffmeisteri | 2 | Liodessus obscurellus (adults) | 1 | Oxyethira sp. | 1 | Lymnaea sp. | 7 | SC | 5 |
| Cryptotendipes sp. (pupae) | 1 | Liodessus obscurellus (larvae) | 1 | Paratanytarsus sp. (pupae) | 1 | Ceratopogonidae (pupae) | -- | -- | 5 |
| Glyptotendipes sp. | 1 | Mideopsis sp. | 1 | Phaenopsectra sp. | 1 | Liodessus obscurellus (adults) | 5 | P | 4 |
| Hydroptila sp. | 1 | Nanocladius sp. | 1 | Procladius sp. | 1 | Corynoneura sp. | 7 | CG | 4 |
| Limnophyes sp. | 1 | Parakiefferiella sp. (pupae) | 1 | Sciomyzidae | 1 | Enchytraeidae | 10 | CG | 3 |
| Lymnaea sp. | 1 | Paratanytarsus sp. (pupae) | 1 | Tanytarsus sp. | 1 | Cladotanytarsus sp. (pupae) | -- | -- | 3 |
| Parachironomus sp. | 1 | Procambarus clarkii | 1 | | 310 | Sigara vallis | 8 | P | 2 |

PGC 7. – continued.

| | |
|---|---|
| Phaenopsectra sp. | 1 |
| Procladius sp. | 1 |
| Prostoma sp. | 1 |
| Slavina appendiculata | 1 |
| Stempellina sp. (pupae) | 1 |
| | 293 |

| | |
|---|---|
| Sciomyzidae | 1 |
| Slavina appendiculata | 1 |
| Trichocorixa calva | 1 |
| Tropisternus sp. (larvae) | 1 |
| | 275 |

| | | | |
|---|---|---|---|
| Sciomyzidae | 6 | P | 2 |
| Procladius sp. | 9 | P | 2 |
| Procladius sp. (pupae) | -- | -- | 2 |
| Phaenopsectra sp. | 7 | SC | 2 |
| Nanocladius sp. | 3 | CG | 2 |
| Limnodrilus hoffmeisteri | -- | CG | 2 |
| Cricotopus sp. (pupae) | -- | -- | 2 |
| Coenagrionidae | -- | P | 2 |
| Cladotanytarsus sp. | 7 | CG | 2 |
| Ablabesmyia sp. | 8 | CG | 2 |
| Tropisternus sp. (larvae) | 5 | P | 1 |
| Trichocorixa calva | 8 | P | 1 |
| Stempellina sp. (pupae) | -- | -- | 1 |
| Prostoma sp. | 8 | P | 1 |
| Procambarus clarkii | 8 | SH | 1 |
| Parakiefferiella sp. (pupae) | -- | -- | 1 |
| Parachironomus sp. | 10 | P | 1 |
| Mideopsis sp. | 5 | P | 1 |
| Liodessus obscurellus (larvae) | 5 | P | 1 |
| Limnophyes sp. | 8 | CG | 1 |
| Hydroptila sp. | 6 | PH | 1 |
| Gyraulus sp. | 8 | SC | 1 |
| Glyptotendipes sp. | 10 | SH | 1 |
| Dytiscidae (larvae) | 5 | P | 1 |
| Cryptotendipes sp. (pupae) | -- | -- | 1 |
| Chaetogaster diaphanus | -- | -- | 1 |
| Ceratopogon sp. | 6 | P | 1 |
| Bezzia/ Palpomyia | 6 | P | 1 |
| | | | 878 |

PGC 8

| Taxon | T1 | Taxon | T2 | Taxon | T3 |
|---|---|---|---|---|---|
| Hyalella sp. | 171 | Micropsectra sp. | 195 | Micropsectra sp. | 89 |
| Micropsectra sp. | 59 | Physa sp. | 31 | Physa sp. | 74 |
| Menetus opercularis | 14 | Dero digitata | 13 | Chironomus sp. | 68 |
| Dicrotendipes sp. | 9 | Lymnaea sp. | 10 | Tanytarsus sp. | 24 |
| Paratanytarsus sp. | 8 | Chironominae (pupae) | 9 | Paratendipes sp. | 13 |
| Apedilum sp. | 5 | Limnophyes sp. | 7 | Lymnaea sp. | 9 |
| Physa sp. | 5 | Prostoma sp. | 7 | Oxyethira sp. | 9 |
| Cyprididae | 4 | Rheocricotopus sp. | 7 | Psectrotanypus sp. | 3 |
| Paratendipes sp. | 4 | Chironomus sp. | 4 | Unid. Imm. Tubifricidae | 3 |
| Chironominae | 3 | Lumbricina | 3 | Limnophyes sp. | 2 |
| Chironomus sp. | 3 | Tipula sp. | 2 | Lumbriculus variegata | 2 |
| Helisoma sp. | 2 | Unid. Imm. Tubifricidae | 2 | Prostoma sp. | 2 |
| Macropelopiini | 2 | Lumbriculus variegata | 1 | Cricotopus sp. | 1 |
| Psectrotanypus sp. | 2 | Muscidae | 1 | Cyprididae | 1 |
| Tanypodinae | 2 | Orthocladiinae (pupae) | 1 | Dicrotendipes sp. | 1 |
| Tanytarsus sp. | 2 | Paratendipes sp. | 1 | Eukiefferiella sp. | 1 |
| Alotanypus sp. | 1 | Pisidium sp. | 1 | Helobdella triserialis | 1 |
| Cricotopus sp. | 1 | Sciomyzidae | 1 | Limonia sp. | 1 |
| Limnophyes sp. | 1 | | 296 | Muscidae | 1 |
| Lymnaea sp. | 1 | | | Tipula sp. | 1 |
| Orthocladiinae | 1 | | | | 306 |
| Orthocladius complex | 1 | | | | |
| Oxyethira sp. | 1 | | | | |
| Phaenopsectra sp. | 1 | | | | |
| | 303 | | | | |

| Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|
| Micropsectra sp. | 7 | CG | 343 |
| Hyalella sp. | 8 | CG | 171 |
| Physa sp. | 8 | SC | 110 |
| Chironomus sp. | 10 | CG | 75 |
| Tanytarsus sp. | 6 | CF | 26 |
| Lymnaea sp. | 7 | SC | 20 |
| Paratendipes sp. | 8 | CG | 18 |
| Menetus opercularis | 6 | SC | 14 |
| Dero digitata | -- | CG | 13 |
| Oxyethira sp. | 3 | PH | 10 |
| Limnophyes sp. | 8 | CG | 10 |
| Dicrotendipes sp. | 8 | CG | 10 |
| Prostoma sp. | 8 | P | 9 |
| Chironominae (pupae) | -- | -- | 9 |
| Paratanytarsus sp. | 6 | CF | 8 |
| Rheocricotopus sp. | 6 | OM | 7 |
| Unid. Imm. Tubifricidae | 10 | CG | 5 |
| Psectrotanypus sp. | 10 | P | 5 |
| Cyprididae | 8 | CG | 5 |
| Apedilum sp. | 6 | CG | 5 |
| Tipula sp. | 4 | OM | 3 |
| Lumbriculus variegata | -- | CG | 3 |
| Lumbricina | -- | CG | 3 |
| Chironominae | 6 | CG | 3 |
| Tanypodinae | 7 | P | 2 |
| Muscidae | 6 | P | 2 |
| Macropelopiini | -- | -- | 2 |
| Helisoma sp. | 6 | SC | 2 |
| Cricotopus sp. | 7 | CG | 2 |
| Sciomyzidae | 6 | P | 1 |
| Pisidium sp. | 8 | CF | 1 |
| Phaenopsectra sp. | 7 | SC | 1 |

PGC 8. – continued.

| | | | |
|---|---|---|---|
| Orthocladius complex | 6 | CG | 1 |
| Orthocladiinae (pupae) | -- | -- | 1 |
| Orthocladiinae | 5 | CG | 1 |
| Limonia sp. | 6 | SH | 1 |
| Helobdella triserialis | -- | PA | 1 |
| Eukiefferiella sp. | 8 | OM | 1 |
| Alotanypus sp. | 7 | P | 1 |
| | | | 905 |

PGC 9

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Chaetogaster diaphanous | 83 | Chaetogaster diaphanus | 114 | Unid. Imm. Tubifricidae | 119 | Unid. Imm. Tubifricidae | 10 | CG | 198 |
| Unid. Imm. Tubifricidae | 67 | Chironomus sp. | 29 | Micropsectra sp. | 39 | Chaetogaster diaphanus | -- | -- | 197 |
| Micropsectra sp. | 32 | Micropsectra sp. | 28 | Aulodrilus pigueti | 30 | Micropsectra sp. | 7 | CG | 99 |
| Psectrotanypus sp. | 32 | Dugesia tigrina | 27 | Psectrocladius sp. | 22 | Psectrotanypus sp. | 10 | P | 57 |
| Dugesia tigrina | 16 | Psectrotanypus sp. | 25 | Tubificidae w hair cht. | 22 | Aulodrilus pigueti | -- | CG | 53 |
| Chironomus sp. | 14 | Aulodrilus pigueti | 23 | Enchytraeidae | 11 | Chironomus sp. | 10 | CG | 51 |
| Slavina appendiculata | 13 | Menetus opercularis | 14 | Tanypodinae | 11 | Dugesia tigrina | 4 | P | 43 |
| Culicoides sp. | 6 | Unid. Imm. Tubifricidae | 12 | Chironomus sp. | 8 | Tubificidae w hair cht. | 5 | CG | 25 |
| Limnodrilus hoffmeisteri | 6 | Chironominae (pupae) | 8 | Apedilum sp. | 6 | Psectrocladius sp. | 8 | CG | 22 |
| Menetus opercularis | 6 | Brundiniella sp. (pupae) | 3 | Culicoides sp. | 6 | Menetus opercularis | 6 | SC | 22 |
| Micropsectra sp. (pupae) | 6 | Culicoides sp. | 2 | Chironominae | 5 | Slavina appendiculata | -- | CG | 16 |
| Dero digitata | 4 | Cyprididae | 2 | Cyprididae | 5 | Culicoides sp. | 6 | P | 14 |
| Tanytarsus sp. | 2 | Dicrotendipes sp. | 2 | Chironominae (pupae) | 3 | Enchytraeidae | 10 | CG | 13 |
| Coenagrionidae | 1 | Enchytraeidae | 2 | Dero digitata | 3 | Tanypodinae | 7 | P | 11 |
| Eukiefferiella sp. | 1 | Slavina appendiculata | 2 | Dicrotendipes sp. | 2 | Chironominae (pupae) | -- | -- | 11 |
| Tubificidae w hair cht. | 1 | Tubificidae w hair cht. | 2 | Menetus opercularis | 2 | Dero digitata | -- | CG | 7 |
| | 290 | Paratanytarsus sp. | 1 | Paratanytarsus sp. | 2 | Cyprididae | 8 | CG | 7 |
| | | Sciomyzidae | 1 | Cricotopus sp. | 1 | Micropsectra sp. (pupae) | -- | -- | 6 |
| | | | 297 | Sciomyzidae | 1 | Limnodrilus hoffmeisteri | -- | CG | 6 |
| | | | | Slavina appendiculata | 1 | Apedilum sp. | 6 | CG | 6 |
| | | | | Tanypodinae (pupae) | 1 | Chironominae | 6 | CG | 5 |
| | | | | | 300 | Dicrotendipes sp. | 8 | CG | 4 |
| | | | | | | Paratanytarsus sp. | 6 | CF | 3 |
| | | | | | | Brundiniella sp. (pupae) | -- | -- | 3 |
| | | | | | | Tanytarsus sp. | 6 | CF | 2 |
| | | | | | | Sciomyzidae | 6 | P | 2 |
| | | | | | | Tanypodinae (pupae) | -- | -- | 1 |
| | | | | | | Eukiefferiella sp. | 8 | OM | 1 |
| | | | | | | Cricotopus sp. | 7 | CG | 1 |
| | | | | | | Coenagrionidae | -- | P | 1 |
| | | | | | | | | | 887 |

PGC 10

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Unid. Imm. Tubifricidae | 75 | Paratanytarsus sp. | 56 | Cyprididae | 73 | Paratanytarsus sp. | 6 | CF | 139 |
| Paratanytarsus sp. | 56 | Cricotopus sp. | 35 | Helisoma sp. | 49 | Unid. Imm. Tubifricidae | 10 | CG | 107 |
| Cricotopus sp. | 21 | Unid. Imm. Tubifricidae | 27 | Paratanytarsus sp. | 27 | Cyprididae | 8 | CG | 91 |
| Tanytarsus sp. | 19 | Tanytarsus sp. | 23 | Cricotopus sp. | 25 | Cricotopus sp. | 7 | CG | 81 |
| Chironomus sp. | 14 | Micropsectra sp. | 20 | Tanytarsus sp. | 14 | Helisoma sp. | 6 | SC | 66 |
| Chironominae | 13 | Nais communis/ variabilis | 18 | Chironomini | 13 | Tanytarsus sp. | 6 | CF | 56 |
| Physa sp. | 13 | Helisoma sp. | 16 | Physa sp. | 12 | Micropsectra sp. | 7 | CG | 39 |
| Cyprididae | 11 | Chironomus sp. | 12 | Micropsectra sp. | 10 | Physa sp. | 8 | SC | 36 |
| Apedilum sp. | 9 | Chironominae | 11 | Tanytarsini | 9 | Chironomus sp. | 10 | CG | 34 |
| Micropsectra sp. | 9 | Physa sp. | 11 | Apedilum sp. | 8 | Chironominae | 6 | CG | 24 |
| Lumbriculus variegate | 7 | Tubificidae w hair cht. | 11 | Chironomus sp. | 8 | Nais communis/ variabilis | -- | CG | 23 |
| Paratanytarsus sp. (pupae) | 6 | Lumbriculus variegata | 10 | Slavina appendiculata | 7 | Apedilum sp. | 6 | CG | 23 |
| Dero digitata | 5 | Cyprididae | 7 | Nais communis/ variabilis | 5 | Lumbriculus variegata | -- | CG | 18 |
| Liodessus obscurellus (adult) | 5 | Apedilum sp. | 6 | Unid. Imm. Tubifricidae | 5 | Tubificidae w hair cht. | 5 | CG | 16 |
| Lymnaea sp. | 5 | Chironominae (pupae) | 5 | Dicrotendipes sp. | 4 | Slavina appendiculata | -- | CG | 14 |
| Tubificidae w hair cht. | 5 | Slavina appendiculata | 5 | Hyalella sp. | 3 | Chironomini | 6 | CG | 13 |
| Apedilum sp. (pupae) | 3 | Menetus opercularis | 4 | Liodessus obscurellus (adult) | 3 | Paratanytarsus sp. (pupae) | -- | -- | 10 |
| Chironominae (pupae) | 2 | Paratanytarsus sp. (pupae) | 4 | Orthocladiinae | 3 | Liodessus obscurellus (adults) | 5 | P | 10 |
| Cricotopus sp. (pupae) | 2 | Stylaria lacustris | 3 | Laccophilus mexicanus (adult) | 2 | Tanytarsini | 6 | CG | 9 |
| Hyalella sp. | 2 | Liodessus obscurellus (adult) | 2 | Ophidonais serpentina | 2 | Lymnaea sp. | 7 | SC | 7 |
| Libellula sp. | 2 | Lumbricina | 2 | Brachycera (pupae) | 1 | Chironominae (pupae) | -- | -- | 7 |
| Slavina appendiculata | 2 | Mooreobdella microstoma | 2 | Chaetogaster diaphanus | 1 | Dicrotendipes sp. | 8 | CG | 6 |
| Brachycera (pupae) | 1 | Coenagrionidae | 1 | Corixidae | 1 | Menetus opercularis | 6 | SC | 5 |
| Corynoneura sp. | 1 | Cricotopus sp. (pupae) | 1 | Corynoneura sp. | 1 | Hyalella sp. | 8 | CG | 5 |
| Dicrotendipes sp. | 1 | Dicrotendipes sp. | 1 | Culex sp. | 1 | Dero digitata | -- | CG | 5 |
| Helisoma sp. | 1 | Limnophyes sp. | 1 | Eucorethra underwoodi | 1 | Stylaria lacustris | -- | CG | 4 |

PGC 10. – continued.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Mooreobdella tetragon | 1 | Lymnaea sp. | 1 | Libellulidae | 1 | Orthocladiinae | 5 | CG | 3 |
| Sigara vallis | 1 | Paratendipes sp. | 1 | Lumbriculus variegata | 1 | Cricotopus sp. (pupae) | -- | -- | 3 |
| | 292 | Psectrotanypus sp. | 1 | Lymnaea sp. | 1 | Apedilum sp. (pupae) | -- | -- | 3 |
| | | Tanypodinae | 1 | Menetus opercularis | 1 | Ophidonais serpentina | -- | -- | 2 |
| | | Tropisternus sp. (larvae) | 1 | Oxyethira sp. | 1 | Mooreobdella microstoma | 8 | P | 2 |
| | | | 299 | Sanfilippodytes terminalis (adults) | 1 | Lumbricina | -- | CG | 2 |
| | | | | Stylaria lacustris | 1 | Libellula sp. | 9 | P | 2 |
| | | | | | 295 | Laccophilus mexicanus (adult) | -- | P | 2 |
| | | | | | | Corynoneura sp. | 7 | CG | 2 |
| | | | | | | Brachycera (pupae) | -- | -- | 2 |
| | | | | | | Tropisternus sp. (larvae) | 5 | P | 1 |
| | | | | | | Tanypodinae | 7 | P | 1 |
| | | | | | | Sigara vallis | 8 | P | 1 |
| | | | | | | Sanfilippodytes terminalis (adults) | -- | P | 1 |
| | | | | | | Psectrotanypus sp. | 10 | P | 1 |
| | | | | | | Paratendipes sp. | 8 | CG | 1 |
| | | | | | | Oxyethira sp. | 3 | PH | 1 |
| | | | | | | Mooreobdella tetragon | 8 | P | 1 |
| | | | | | | Limnophyes sp. | 8 | CG | 1 |
| | | | | | | Libellulidae | 9 | P | 1 |
| | | | | | | Eucorethra underwoodi | -- | P | 1 |
| | | | | | | Culex sp. | 8 | CG | 1 |
| | | | | | | Corixidae | 10 | P | 1 |
| | | | | | | Coenagrionidae | -- | P | 1 |
| | | | | | | Chaetogaster diaphanus | -- | -- | 1 |
| | | | | | | | | | 886 |

PGC 11

| Taxon | T1 | Taxon | T2 | Taxon | T3 |
|---|---|---|---|---|---|
| Dugesia tigrina | 152 | Dugesia tigrina | 191 | Dugesia tigrina | 194 |
| Micropsectra sp. | 44 | Helisoma sp. | 55 | Unid. Imm. Tubifricidae | 43 |
| Slavina appendiculata | 33 | Unid. Imm. Tubifricidae | 42 | Lumbriculus variegata | 23 |
| Unid. Imm. Tubifricidae | 26 | Slavina appendiculata | 6 | Helisoma sp. | 21 |
| Lumbriculus variegate | 6 | Micropsectra sp. | 4 | Slavina appendiculata | 8 |
| Cyprididae | 3 | Lumbriculus variegata | 2 | Dero digitata | 2 |
| Prostoma sp. | 3 | Tubificidae w hair cht. | 2 | Tubificidae w hair cht. | 2 |
| Chironomus sp. | 2 | Apedilum sp. | 1 | Lymnaea sp. | 1 |
| Apedilum sp. | 1 | Dero digitata | 1 | Prostoma sp. | 1 |
| Hyalella sp. | 1 | Dicrotendipes sp. | 1 | | 295 |
| Hydra sp. | 1 | Ephydridae (pupae) | 1 | | |
| Limonia sp. | 1 | Limnodrilus hoffmeisteri | 1 | | |
| Pisidium sp. | 1 | Liodessus obscurellus (adult) | 1 | | |
| | 274 | | 308 | | |

| Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|
| Dugesia tigrina | 4 | P | 537 |
| Unid. Imm. Tubifricidae | 10 | CG | 111 |
| Helisoma sp. | 6 | SC | 76 |
| Micropsectra sp. | 7 | CG | 48 |
| Slavina appendiculata | -- | CG | 47 |
| Lumbriculus variegata | -- | CG | 31 |
| Tubificidae w hair cht. | 5 | CG | 4 |
| Prostoma sp. | 8 | P | 4 |
| Dero digitata | -- | CG | 3 |
| Cyprididae | 8 | CG | 3 |
| Chironomus sp. | 10 | CG | 2 |
| Apedilum sp. | 6 | CG | 2 |
| Pisidium sp. | 8 | CF | 1 |
| Lymnaea sp. | 7 | SC | 1 |
| Liodessus obscurellus (adult) | 5 | P | 1 |
| Limonia sp. | 6 | SH | 1 |
| Limnodrilus hoffmeisteri | -- | CG | 1 |
| Hydra sp. | 5 | P | 1 |
| Hyalella sp. | 8 | CG | 1 |
| Ephydridae (pupae) | -- | -- | 1 |
| Dicrotendipes sp. | 8 | CG | 1 |
| | | | 877 |

PGC 12

| Taxon | T1 | Taxon | T2 | Taxon | T3 |
|---|---|---|---|---|---|
| Psectrotanypus sp. | 47 | Micropsectra sp. | 105 | Nais communis/ variabilis | 140 |
| Unid. Imm. Tubifricidae | 34 | Dero digitata | 55 | Micropsectra sp. | 80 |
| Aulodrilus pigueti | 27 | Aulodrilus pigueti | 33 | Paratanytarsus sp. | 17 |
| Cricotopus sp. | 20 | Unid. Imm. Tubifricidae | 27 | Unid. Imm. Tubifricidae | 17 |
| Dero digitata | 19 | Psectrotanypus sp. | 20 | Rheocricotopus sp. | 15 |
| Paratanytarsus sp. | 19 | Physa sp. | 10 | Hydra sp. | 8 |
| Chironomus sp. | 18 | Chironomus sp. | 9 | Cricotopus sp. | 5 |
| Cyprididae | 18 | Paratanytarsus sp. | 9 | Physa sp. | 4 |
| Physa sp. | 17 | Lumbriculus variegata | 7 | Psectrotanypus sp. | 4 |
| Tubificidae w hair cht. | 15 | Menetus opercularis | 6 | Hyalella sp. | 2 |
| Micropsectra sp. | 13 | Tubificidae w hair cht. | 5 | Chaetogaster diaphanus | 1 |
| Menetus opercularis | 7 | Cricotopus sp. | 3 | Chironomus sp. | 1 |
| Hyalella sp. | 6 | Chaetogaster diaphanus | 2 | Cricotopus bicinctus group | 1 |
| Helisoma sp. | 5 | Helisoma sp. | 2 | Cyprididae | 1 |
| Cricotopus sp. (pupae) | 3 | Hyalella sp. | 1 | Dicrotendipes sp. | 1 |
| Psectrocladius sp. | 3 | Micropsectra sp. (pupae) | 1 | Helisoma sp. | 1 |
| Apedilum sp. | 2 | Mooreobdella microstoma | 1 | Lumbriculus variegata | 1 |
| Limnophyes sp. | 2 | Polypedilum sp. (pupae) | 1 | Lymnaea sp. | 1 |
| Liodessus obscurellus (adult) | 2 | Tanytarsus sp. | 1 | Menetus opercularis | 1 |
| Coenagrionidae | 1 | | 298 | Paratendipes sp. | 1 |
| Limnophyes sp. (pupae) | 1 | | | Polypedilum sp. | 1 |
| Polypedilum sp. | 1 | | | Pristina leidyi | 1 |
| Procambarus clarkia | 1 | | | Tanytarsus sp. | 1 |
| Sciomyzidae | 1 | | | | 305 |
| Tanytarsus sp. | 1 | | | | |
| Thienemanniella sp. | 1 | | | | |
| Tipula sp. | 1 | | | | |
| | 285 | | | | |

| Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|
| Micropsectra sp. | 7 | CG | 198 |
| Nais communis/ variabilis | -- | CG | 140 |
| Unid. Imm. Tubifricidae | 10 | CG | 78 |
| Dero digitata | -- | CG | 74 |
| Psectrotanypus sp. | 10 | P | 71 |
| Aulodrilus pigueti | -- | CG | 60 |
| Paratanytarsus sp. | 6 | CF | 45 |
| Physa sp. | 8 | SC | 31 |
| Cricotopus sp. | 7 | CG | 28 |
| Chironomus sp. | 10 | CG | 28 |
| Tubificidae w hair cht. | 5 | CG | 20 |
| Cyprididae | 8 | CG | 19 |
| Rheocricotopus sp. | 6 | OM | 15 |
| Menetus opercularis | 6 | SC | 14 |
| Hyalella sp. | 8 | CG | 9 |
| Lumbriculus variegata | -- | CG | 8 |
| Hydra sp. | 5 | P | 8 |
| Helisoma sp. | 6 | SC | 8 |
| Tanytarsus sp. | 6 | CF | 3 |
| Psectrocladius sp. | 8 | CG | 3 |
| Cricotopus sp. (pupae) | -- | -- | 3 |
| Chaetogaster diaphanus | -- | -- | 3 |
| Polypedilum sp. | 6 | CG | 2 |
| Liodessus obscurellus (adult) | 5 | P | 2 |
| Limnophyes sp. | 8 | CG | 2 |
| Apedilum sp. | 6 | CG | 2 |
| Tipula sp. | 4 | OM | 1 |
| Thienemanniella sp. | 6 | CG | 1 |
| Sciomyzidae | 6 | P | 1 |
| Procambarus clarkii | 8 | SH | 1 |
| Pristina leidyi | -- | CG | 1 |
| Polypedilum sp. (pupae) | -- | -- | 1 |
| Paratendipes sp. | 8 | CG | 1 |

PGC 12. – continued.

| | | | |
|---|---|---|---|
| Mooreobdella microstoma | 8 | P | 1 |
| Micropsectra sp. (pupae) | -- | -- | 1 |
| Lymnaea sp. | 7 | SC | 1 |
| Limnophyes sp. (pupae) | -- | -- | 1 |
| Dicrotendipes sp. | 8 | CG | 1 |
| Cricotopus bicinctus group | 7 | CG | 1 |
| Coenagrionidae | -- | P | 1 |
| | | | 888 |

PGC 14

| Taxon | T1 | Taxon | T2 | Taxon | T3 |
|---|---|---|---|---|---|
| Unid. Imm. Tubifricidae | 93 | Unid. Imm. Tubifricidae | 97 | Dero digitata | 72 |
| Dugesia tigrina | 67 | Dero digitata | 55 | Haemonais waldvogeli | 65 |
| Menetus opercularis | 20 | Dugesia tigrina | 44 | Dugesia tigrina | 44 |
| Chironomus sp. | 18 | Tubificidae w hair cht. | 24 | Menetus opercularis | 28 |
| Enchytraeidae | 16 | Chironomus sp. | 14 | Unid. Imm. Tubifricidae | 25 |
| Limnodrilus hoffmeisteri | 16 | Haemonais waldvogeli | 14 | Lumbriculus variegata | 12 |
| Tubificidae w hair cht. | 15 | Aulodrilus pigueti | 9 | Hydra sp. | 10 |
| Psectrotanypus sp. | 13 | Chaetogaster diaphanus | 8 | Chironomus sp. | 9 |
| Hydra sp. | 7 | Menetus opercularis | 7 | Tubificidae w hair cht. | 9 |
| Chironomini | 5 | Micropsectra sp. | 4 | Aulodrilus pigueti | 6 |
| Aulodrilus pigueti | 4 | Chironominae | 3 | Psectrotanypus sp. | 5 |
| Dero digitata | 4 | Hyalella sp. | 3 | Chironomidae | 4 |
| Micropsectra sp. | 4 | Psectrotanypus sp. | 2 | Slavina appendiculata | 4 |
| Pisidium sp. | 4 | Helisoma sp. | 1 | Enchytraeidae | 3 |
| Slavina appendiculata | 3 | Lumbriculus variegata | 1 | Chaetogaster diaphanus | 2 |
| Helisoma sp. | 2 | Pristina leidyi | 1 | Micropsectra sp. | 2 |
| Lumbriculus variegate | 2 | Slavina appendiculata | 1 | Physa sp. | 2 |
| Nais communis/ variabilis | 2 | Tipula sp. | 1 | Tanytarsini | 2 |
| Dicrotendipes sp. | 1 | | 289 | Dero borellii | 1 |
| Haemonais waldvogeli | 1 | | | Helobdella stagnalis | 1 |
| | 297 | | | Paratanytarsus sp. | 1 |
| | | | | | 307 |

| Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|
| Unid. Imm. Tubifricidae | 10 | CG | 215 |
| Dugesia tigrina | 4 | P | 155 |
| Dero digitata | -- | CG | 131 |
| Haemonais waldvogeli | -- | CG | 80 |
| Menetus opercularis | 6 | SC | 55 |
| Tubificidae w hair cht. | 5 | CG | 48 |
| Chironomus sp. | 10 | CG | 41 |
| Psectrotanypus sp. | 10 | P | 20 |
| Enchytraeidae | 10 | CG | 19 |
| Aulodrilus pigueti | -- | CG | 19 |
| Hydra sp. | 5 | P | 17 |
| Limnodrilus hoffmeisteri | -- | CG | 16 |
| Lumbriculus variegata | -- | CG | 15 |
| Micropsectra sp. | 7 | CG | 10 |
| Chaetogaster diaphanus | -- | -- | 10 |
| Slavina appendiculata | -- | CG | 8 |
| Chironomini | 6 | CG | 5 |
| Pisidium sp. | 8 | CF | 4 |
| Chironomidae | 6 | CG | 4 |
| Hyalella sp. | 8 | CG | 3 |
| Helisoma sp. | 6 | SC | 3 |
| Chironominae | 6 | CG | 3 |
| Tanytarsini | 6 | CG | 2 |
| Physa sp. | 8 | SC | 2 |
| Nais communis/ variabilis | -- | CG | 2 |
| Tipula sp. | 4 | OM | 1 |
| Pristina leidyi | -- | CG | 1 |
| Paratanytarsus sp. | 6 | CF | 1 |
| Helobdella stagnalis | 6 | PA | 1 |
| Dicrotendipes sp. | 8 | CG | 1 |
| Dero borellii | 10 | CG | 1 |
| | | | 893 |

PGC 15

| Taxon | T1 | Taxon | T2 | Taxon | T3 |
|---|---|---|---|---|---|
| Unid. Imm. Tubifricidae | 88 | Unid. Imm. Tubifricidae | 110 | Dugesia tigrina | 79 |
| Dugesia tigrina | 54 | Dero digitata | 45 | Unid. Imm. Tubifricidae | 62 |
| Tubificidae w hair cht. | 43 | Dugesia tigrina | 35 | Dero digitata | 45 |
| Dero digitata | 31 | Slavina appendiculata | 25 | Slavina appendiculata | 36 |
| Slavina appendiculata | 28 | Haemonais waldvogeli | 19 | Pisidium sp. | 32 |
| Limnodrilus hoffmeisteri | 15 | Tubificidae w hair cht. | 15 | Haemonais waldvogeli | 15 |
| Haemonais waldvogeli | 11 | Pisidium sp. | 12 | Dero borellii | 6 |
| Dero borellii | 7 | Dero borellii | 9 | Aulodrilus pigueti | 4 |
| Dicrotendipes sp. | 5 | Aulodrilus pigueti | 8 | Tubificidae w hair cht. | 4 |
| Enchytraeidae | 3 | Limnodrilus hoffmeisteri | 7 | Dicrotendipes sp. | 3 |
| Coenagrionidae | 2 | Dicrotendipes sp. | 3 | Erpobdellidae | 2 |
| Cricotopus sp. | 2 | Chaetogaster diaphanus | 2 | Ferrissia sp. | 1 |
| Liodessus obscurellus (adult) | 2 | Coenagrionidae | 2 | Limnodrilus hoffmeisteri | 1 |
| Chironominae | 1 | Menetus opercularis | 2 | Limnophyes sp. | 1 |
| Cyprididae | 1 | Helobdella stagnalis | 1 | Psectrotanypus sp. | 1 |
| Ephydridae | 1 | | 295 | | 292 |
| Helisoma sp. | 1 | | | | |
| Mooreobdella microstoma | 1 | | | | |
| Pisidium sp. | 1 | | | | |
| Psectrotanypus sp. | 1 | | | | |
| | 298 | | | | |

| Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|
| Unid. Imm. Tubifricidae | 10 | CG | 260 |
| Dugesia tigrina | 4 | P | 168 |
| Dero digitata | -- | CG | 121 |
| Slavina appendiculata | -- | CG | 89 |
| Tubificidae w hair cht. | 5 | CG | 62 |
| Pisidium sp. | 8 | CF | 45 |
| Haemonais waldvogeli | -- | CG | 45 |
| Limnodrilus hoffmeisteri | -- | CG | 23 |
| Dero borellii | 10 | CG | 22 |
| Aulodrilus pigueti | -- | CG | 12 |
| Dicrotendipes sp. | 8 | CG | 11 |
| Coenagrionidae | -- | P | 4 |
| Enchytraeidae | 10 | CG | 3 |
| Psectrotanypus sp. | 10 | P | 2 |
| Menetus opercularis | 6 | SC | 2 |
| Liodessus obscurellus (adult) | 5 | P | 2 |
| Erpobdellidae | 8 | P | 2 |
| Cricotopus sp. | 7 | CG | 2 |
| Chaetogaster diaphanus | -- | -- | 2 |
| Mooreobdella microstoma | 8 | P | 1 |
| Limnophyes sp. | 8 | CG | 1 |
| Helobdella stagnalis | 6 | PA | 1 |
| Helisoma sp. | 6 | SC | 1 |
| Ferrissia sp. | 6 | SC | 1 |
| Ephydridae | 6 | -- | 1 |
| Cyprididae | 8 | CG | 1 |
| Chironominae | 6 | CG | 1 |
| | | | 885 |

PGC 16

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Psectrotanypus sp. | 111 | Unid. Imm. Tubifricidae | 69 | Unid. Imm. Tubifricidae | 211 | Unid. Imm. Tubifricidae | 10 | CG | 282 |
| Slavina appendiculata | 109 | Dero digitata | 65 | Psectrotanypus sp. | 62 | Psectrotanypus sp. | 10 | P | 202 |
| Dero digitata | 39 | Tubificidae w hair cht. | 54 | Dero digitata | 12 | Slavina appendiculata | -- | CG | 144 |
| Chironomus sp. | 13 | Slavina appendiculata | 35 | Tubificidae w hair cht. | 8 | Dero digitata | -- | CG | 116 |
| Physa sp. | 6 | Psectrotanypus sp. | 29 | Haemonais waldvogeli | 2 | Tubificidae w hair cht. | 5 | CG | 62 |
| Psychoda sp. | 4 | Helobdella stagnalis | 19 | Cricotopus sp. | 1 | Helobdella stagnalis | 6 | PA | 21 |
| Hyalella sp. | 2 | Limnodrilus hoffmeisteri | 6 | Cyprididae | 1 | Chironomus sp. | 10 | CG | 14 |
| Psychodidae | 2 | Helobdella triserialis | 4 | Helobdella stagnalis | 1 | Psychoda sp. | 10 | CG | 8 |
| Unid. Imm. Tubifricidae | 2 | Haemonais waldvogeli | 3 | Psychoda sp. | 1 | Physa sp. | 8 | SC | 7 |
| Helisoma sp. | 1 | Psychoda sp. | 3 | | 299 | Limnodrilus hoffmeisteri | -- | CG | 6 |
| Helobdella stagnalis | 1 | Chironomus sp. | 1 | | | Haemonais waldvogeli | -- | CG | 5 |
| Ophidonais serpentine | 1 | Cricotopus sp. | 1 | | | Helobdella triserialis | -- | PA | 4 |
| Orthocladius complex | 1 | Lumbricina | 1 | | | Psychodidae | -- | CG | 2 |
| | 292 | Micropsectra sp. | 1 | | | Hyalella sp. | 8 | CG | 2 |
| | | Mooreobdella microstoma | 1 | | | Cricotopus sp. | 7 | CG | 2 |
| | | Pericoma/ Telmatoscopus | 1 | | | Tipula sp. | 4 | OM | 1 |
| | | Physa sp. | 1 | | | Pericoma/ Telmatoscopus | 4 | CG | 1 |
| | | Tipula sp. | 1 | | | Orthocladius complex | 6 | CG | 1 |
| | | | 295 | | | Ophidonais serpentina | -- | -- | 1 |
| | | | | | | Mooreobdella microstoma | 8 | P | 1 |
| | | | | | | Micropsectra sp. | 7 | CG | 1 |
| | | | | | | Lumbricina | -- | CG | 1 |
| | | | | | | Helisoma sp. | 6 | SC | 1 |
| | | | | | | Cyprididae | 8 | CG | 1 |
| | | | | | | | | | 886 |

PGC 17

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Unid. Imm. Tubifricidae | 95 | Psectrotanypus sp. | 69 | Physa sp. | 82 | Unid. Imm. Tubifricidae | 10 | CG | 172 |
| Psectrotanypus sp. | 73 | Physa sp. | 41 | Unid. Imm. Tubifricidae | 51 | Psectrotanypus sp. | 10 | P | 142 |
| Cricotopus sp. | 33 | Tanypodinae | 35 | Pisidium sp. | 41 | Physa sp. | 8 | SC | 142 |
| Physa sp. | 19 | Micropsectra sp. | 32 | Slavina appendiculata | 23 | Micropsectra sp. | 7 | CG | 62 |
| Paratanytarsus sp. | 14 | Unid. Imm. Tubifricidae | 26 | Micropsectra sp. | 21 | Pisidium sp. | 8 | CF | 48 |
| Micropsectra sp. | 9 | Dero digitata | 15 | Cyprididae | 17 | Tanypodinae | 7 | P | 35 |
| Chironomus sp. | 8 | Slavina appendiculata | 12 | Tubificidae w hair cht. | 9 | Slavina appendiculata | -- | CG | 35 |
| Dero digitata | 8 | Tubificidae w hair cht. | 7 | Dero digitata | 8 | Cricotopus sp. | 7 | CG | 35 |
| Dero borellii | 7 | Pisidium sp. | 6 | Helisoma sp. | 8 | Dero digitata | -- | CG | 31 |
| Cyprididae | 4 | Helisoma sp. | 5 | Liodessus obscurellus (adult) | 4 | Cyprididae | 8 | CG | 24 |
| Lumbricina | 4 | Paratanytarsus sp. | 5 | Enchytraeidae | 2 | Paratanytarsus sp. | 6 | CF | 20 |
| Tanypodinae (pupae) | 2 | Liodessus obscurellus (adult) | 4 | Limnophyes sp. | 2 | Tubificidae w hair cht. | 5 | CG | 16 |
| Helisoma sp. | 1 | Cyprididae | 3 | Haemonais waldvogeli | 1 | Helisoma sp. | 6 | SC | 14 |
| Hyalella sp. | 1 | Limnodrilus hoffmeisteri | 3 | Laccophilus sp. (adult) | 1 | Chironomus sp. | 10 | CG | 10 |
| Limnophyes sp. | 1 | Lumbriculus variegata | 3 | Lymnaea sp. | 1 | Liodessus obscurellus (adult) | 5 | P | 9 |
| Liodessus obscurellus (adult) | 1 | Chironomus sp. | 2 | Nais communis/ variabilis | 1 | Dero borellii | 10 | CG | 7 |
| Muscidae | 1 | Cricotopus sp. | 2 | Paratanytarsus sp. | 1 | Lumbricina | -- | CG | 4 |
| Oxyethira sp. | 1 | Orthocladius complex | 2 | | 273 | Limnophyes sp. | 8 | CG | 4 |
| Paratanytarsus sp. (pupae) | 1 | Dicrotendipes sp. | 1 | | | Lumbriculus variegata | -- | CG | 3 |
| Pisidium sp. | 1 | Limnophyes sp. | 1 | | | Limnodrilus hoffmeisteri | -- | CG | 3 |
| Tanytarsini (pupae) | 1 | Stylaria lacustris | 1 | | | Tanytarsini (pupae) | -- | -- | 2 |
| | 285 | Tanytarsini | 1 | | | Tanypodinae (pupae) | -- | -- | 2 |
| | | Tanytarsini (pupae) | 1 | | | Orthocladius complex | 6 | CG | 2 |
| | | | 277 | | | Enchytraeidae | 10 | CG | 2 |
| | | | | | | Tanytarsini | 6 | CG | 1 |
| | | | | | | Stylaria lacustris | -- | CG | 1 |
| | | | | | | Paratanytarsus sp. (pupae) | -- | -- | 1 |
| | | | | | | Oxyethira sp. | 3 | PH | 1 |
| | | | | | | Nais communis/ variabilis | -- | CG | 1 |
| | | | | | | Muscidae | 6 | P | 1 |

PGC 17. – continued.

| | | | |
|---|---|---|---|
| Lymnaea sp. | 7 | SC | 1 |
| Laccophilus sp. (adult) | 5 | P | 1 |
| Hyalella sp. | 8 | CG | 1 |
| Haemonais waldvogeli | -- | CG | 1 |
| Dicrotendipes sp. | 8 | CG | 1 |
| | | | 835 |

PGC 18

| Taxon | T1 | Taxon | T2 | Taxon | T3 |
|---|---|---|---|---|---|
| Sphaerium sp. | 141 | Micropsectra sp. | 117 | Sphaerium sp. | 88 |
| Micropsectra sp. | 38 | Dugesia tigrina | 73 | Dugesia tigrina | 69 |
| Dugesia tigrina | 36 | Sphaerium sp. | 35 | Micropsectra sp. | 66 |
| Cyprididae | 26 | Menetus opercularis | 16 | Helisoma sp. | 49 |
| Slavina appendiculata | 11 | Slavina appendiculata | 16 | Menetus opercularis | 13 |
| Helisoma sp. | 7 | Helisoma sp. | 8 | Cyprididae | 3 |
| Menetus opercularis | 6 | Tubificidae w hair cht. | 6 | Tubificidae w hair cht. | 2 |
| Nais communis | 6 | Unid. Imm. Tubifricidae | 5 | Chironomus sp. | 1 |
| Ophidonais serpentine | 4 | Lumbriculus variegata | 3 | Lumbriculus variegata | 1 |
| Tubificidae w hair cht. | 4 | Cyprididae | 2 | Nais communis/ variabilis | 1 |
| Chironomus sp. | 3 | Sciomyzidae | 2 | Unid. Imm. Tubifricidae | 1 |
| Hyalella sp. | 3 | Chironomus sp. | 1 | | 294 |
| Unid. Imm. Tubifricidae | 3 | Hydra sp. | 1 | | |
| Alotanypus sp. | 1 | Lumbricina | 1 | | |
| Cricotopus sp. | 1 | Nais communis/ variabilis | 1 | | |
| Enchytraeidae | 1 | Paraphaenocladius sp. | 1 | | |
| Lumbriculus variegate | 1 | Pristina leidyi | 1 | | |
| Mooreobdella microstoma | 1 | | 289 | | |
| Piona sp. | 1 | | | | |
| | 294 | | | | |

| Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|
| Sphaerium sp. | 8 | CG | 264 |
| Micropsectra sp. | 7 | CG | 221 |
| Dugesia tigrina | 4 | P | 178 |
| Helisoma sp. | 6 | SC | 64 |
| Menetus opercularis | 6 | SC | 35 |
| Cyprididae | 8 | CG | 31 |
| Slavina appendiculata | -- | CG | 27 |
| Tubificidae w hair cht. | 5 | CG | 12 |
| Unid. Imm. Tubifricidae | 10 | CG | 9 |
| Nais communis | -- | CG | 6 |
| Lumbriculus variegata | -- | CG | 5 |
| Chironomus sp. | 10 | CG | 5 |
| Ophidonais serpentina | -- | -- | 4 |
| Hyalella sp. | 8 | CG | 3 |
| Sciomyzidae | 6 | P | 2 |
| Nais communis/ variabilis | -- | CG | 2 |
| Pristina leidyi | -- | CG | 1 |
| Piona sp. | -- | P | 1 |
| Paraphaenocladius sp. | 4 | CG | 1 |
| Mooreobdella microstoma | 8 | P | 1 |
| Lumbricina | -- | CG | 1 |
| Hydra sp. | 5 | P | 1 |
| Enchytraeidae | 10 | CG | 1 |
| Cricotopus sp. | 7 | CG | 1 |
| Alotanypus sp. | 7 | P | 1 |
| | | | 877 |

PGC 19

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Physa sp. | 88 | Micropsectra sp. | 49 | Dero digitata | 59 | Physa sp. | 8 | SC | 134 |
| Chironomus sp. | 42 | Chironomus sp. | 47 | Paratanytarsus sp. | 45 | Chironomus sp. | 10 | CG | 107 |
| Psectrotanypus sp. | 30 | Psectrotanypus sp. | 35 | Tanytarsus sp. | 36 | Dero digitata | -- | CG | 78 |
| Micropsectra sp. | 28 | Physa sp. | 29 | Stylaria lacustris | 25 | Micropsectra sp. | 7 | CG | 77 |
| Tanytarsus sp. | 11 | Pisidium sp. | 26 | Chironominae | 21 | Tanytarsus sp. | 6 | CF | 67 |
| Unid. Imm. Tubifricidae | 10 | Unid. Imm. Tubifricidae | 22 | Chironomus sp. | 18 | Psectrotanypus sp. | 10 | P | 65 |
| Nais communis/ variabilis | 9 | Tanytarsus sp. | 20 | Physa sp. | 17 | Paratanytarsus sp. | 6 | CF | 54 |
| Paratanytarsus sp. | 8 | Dero digitata | 19 | Tubificidae w hair cht. | 15 | Unid. Imm. Tubifricidae | 10 | CG | 46 |
| Tubificidae w hair cht. | 8 | Chironominae | 14 | Unid. Imm. Tubifricidae | 14 | Chironominae | 6 | CG | 35 |
| Helisoma sp. | 7 | Aulodrilus pigueti | 4 | Dugesia tigrina | 11 | Stylaria lacustris | -- | CG | 28 |
| Dicrotendipes sp. | 6 | Tubificidae w hair cht. | 4 | Cyprididae | 10 | Pisidium sp. | 8 | CF | 28 |
| Corynoneura sp. | 5 | Cyprididae | 3 | Cricotopus sp. | 5 | Tubificidae w hair cht. | 5 | CG | 27 |
| Lumbriculus variegate | 4 | Dugesia tigrina | 3 | Hyalella sp. | 5 | Dugesia tigrina | 4 | P | 14 |
| Menetus opercularis | 4 | Lumbriculus variegata | 3 | Slavina appendiculata | 5 | Cyprididae | 8 | CG | 13 |
| Hyalella sp. | 3 | Orthocladiinae | 3 | Tanypodinae | 4 | Slavina appendiculata | -- | CG | 11 |
| Polypedilum sp. | 3 | Slavina appendiculata | 3 | Paratanytarsus sp. (pupae) | 3 | Nais communis/ variabilis | -- | CG | 9 |
| Slavina appendiculata | 3 | Chaetogaster diaphanus | 2 | Prostoma sp. | 3 | Hyalella sp. | 8 | CG | 8 |
| Apedilum sp. | 2 | Stylaria lacustris | 2 | Psectrocladius sp. | 3 | Helisoma sp. | 6 | SC | 8 |
| Cricotopus sp. | 2 | Apedilum sp. | 1 | Dicrotendipes sp. | 1 | Dicrotendipes sp. | 8 | CG | 8 |
| Micropsectra sp. (pupae) | 2 | Corynoneura sp. | 1 | Enchytraeidae | 1 | Lumbriculus variegata | -- | CG | 7 |
| Pisidium sp. | 2 | Dicrotendipes sp. | 1 | Eucorethra underwoodi | 1 | Cricotopus sp. | 7 | CG | 7 |
| Chironomus sp. (pupae) | 1 | Ferrissia sp. | 1 | Haemonais waldvogeli | 1 | Corynoneura sp. | 7 | CG | 6 |
| Corbicula sp. | 1 | Helisoma sp. | 1 | | 303 | Menetus opercularis | 6 | SC | 5 |
| Cricotopus bicinctus grp (pupae) | 1 | Limnophyes sp. | 1 | | | Tanypodinae | 7 | P | 4 |
| Dicrotendipes sp. (pupae) | 1 | Menetus opercularis | 1 | | | Aulodrilus pigueti | -- | CG | 4 |
| Enchytraeidae | 1 | Paratanytarsus sp. | 1 | | | Psectrocladius sp. | 8 | CG | 3 |
| Paratendipes sp. | 1 | Paratendipes sp. | 1 | | | Prostoma sp. | 8 | P | 3 |
| Stylaria lacustris | 1 | | 297 | | | Polypedilum sp. | 6 | CG | 3 |
| | 284 | | | | | Paratanytarsus sp. (pupae) | -- | -- | 3 |
| | | | | | | Orthocladiinae | 5 | CG | 3 |
| | | | | | | Apedilum sp. | 6 | CG | 3 |
| | | | | | | Paratendipes sp. | 8 | CG | 2 |
| | | | | | | Micropsectra sp. (pupae) | -- | -- | 2 |

PGC 19. – continued.

| | | | |
|---|---|---|---|
| Enchytraeidae | 10 | CG | 2 |
| Chaetogaster diaphanus | -- | -- | 2 |
| Limnophyes sp. | 8 | CG | 1 |
| Haemonais waldvogeli | -- | CG | 1 |
| Ferrissia sp. | 6 | SC | 1 |
| Eucorethra underwoodi | -- | P | 1 |
| Dicrotendipes sp. (pupae) | -- | -- | 1 |
| Cricotopus bicinctus grp (pupae) | -- | -- | 1 |
| Corbicula sp. | 8 | CF | 1 |
| Chironomus sp. (pupae) | -- | -- | 1 |
| | | | 884 |

PGC 20

| Taxon | T1 |
|---|---|
| Paratanytarsus sp. | 101 |
| Hyalella sp. | 63 |
| Dero digitata | 29 |
| Physa sp. | 28 |
| Psectrotanypus sp. | 18 |
| Dicrotendipes sp. | 7 |
| Ophidonais serpentine | 7 |
| Tubificidae w hair cht. | 6 |
| Chironomus sp. | 5 |
| Corynoneura sp. | 4 |
| Polypedilum sp. | 4 |
| Unid. Imm. Tubifricidae | 4 |
| Coenagrionidae | 3 |
| Cyprididae | 3 |
| Stylaria lacustris | 3 |
| Chironomini (pupae) | 1 |
| Cricotopus sp. | 1 |
| Dicrotendipes sp. (pupae) | 1 |
| Eucorethra underwoodi | 1 |
| Gyraulus sp. | 1 |
| Helisoma sp. | 1 |
| Oxyethira sp. | 1 |
| Paratanytarsus sp. (pupae) | 1 |
| Sciomyzidae | 1 |
| | 294 |

| Taxon | T2 |
|---|---|
| Hyalella sp. | 76 |
| Paratanytarsus sp. | 62 |
| Physa sp. | 49 |
| Psectrotanypus sp. | 25 |
| Dero digitata | 23 |
| Cricotopus sp. | 12 |
| Unid. Imm. Tubifricidae | 7 |
| Polypedilum sp. | 5 |
| Tubificidae w hair cht. | 5 |
| Corynoneura sp. | 4 |
| Dicrotendipes sp. | 3 |
| Chironomus sp. | 2 |
| Coenagrionidae | 2 |
| Cyprididae | 2 |
| Dugesia tigrina | 2 |
| Dytiscidae (larvae) | 2 |
| Helisoma sp. | 2 |
| Hydrellia sp. | 2 |
| Chaetogaster diaphanus | 1 |
| Culicoides sp. | 1 |
| Liodessus obscurellus (adult) | 1 |
| Liodessus obscurellus (larvae) | 1 |
| Menetus opercularis | 1 |
| Parachironomus sp. | 1 |
| Paratanytarsus sp. (pupae) | 1 |
| Psectrocladius sp. | 1 |
| | 293 |

| Taxon | T3 |
|---|---|
| Physa sp. | 195 |
| Hyalella sp. | 36 |
| Paratanytarsus sp. | 21 |
| Helisoma sp. | 11 |
| Cricotopus sp. | 8 |
| Dero digitata | 4 |
| Psectrotanypus sp. | 4 |
| Liodessus obscurellus (adult) | 3 |
| Gyraulus sp. | 2 |
| Unid. Imm. Tubifricidae | 2 |
| Corynoneura sp. | 1 |
| Cyprididae | 1 |
| Hydrophilus sp. (adult) | 1 |
| Menetus opercularis | 1 |
| Sphaerium sp. | 1 |
| | 291 |

| Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|
| Physa sp. | 8 | SC | 272 |
| Paratanytarsus sp. | 6 | CF | 184 |
| Hyalella sp. | 8 | CG | 175 |
| Dero digitata | -- | CG | 56 |
| Psectrotanypus sp. | 10 | P | 47 |
| Cricotopus sp. | 7 | CG | 21 |
| Helisoma sp. | 6 | SC | 14 |
| Unid. Imm. Tubifricidae | 10 | CG | 13 |
| Tubificidae w hair cht. | 5 | CG | 11 |
| Dicrotendipes sp. | 8 | CG | 10 |
| Polypedilum sp. | 6 | CG | 9 |
| Corynoneura sp. | 7 | CG | 9 |
| Ophidonais serpentina | -- | -- | 7 |
| Chironomus sp. | 10 | CG | 7 |
| Cyprididae | 8 | CG | 6 |
| Coenagrionidae | -- | P | 5 |
| Liodessus obscurellus (adult) | 5 | P | 4 |
| Stylaria lacustris | -- | CG | 3 |
| Gyraulus sp. | 8 | SC | 3 |
| Paratanytarsus sp. (pupae) | -- | -- | 2 |
| Menetus opercularis | 6 | SC | 2 |
| Hydrellia sp. | 6 | SH | 2 |
| Dytiscidae (larvae) | 5 | P | 2 |
| Dugesia tigrina | 4 | P | 2 |
| Sphaerium sp. | 8 | CG | 1 |
| Sciomyzidae | 6 | P | 1 |
| Psectrocladius sp. | 8 | CG | 1 |
| Parachironomus sp. | 10 | P | 1 |
| Oxyethira sp. | 3 | PH | 1 |

PGC 20. – continued.

| | | | |
|---|---|---|---|
| Liodessus obscurellus (larvae) | 5 | P | 1 |
| Hydrophilus sp. (adult) | 5 | CG | 1 |
| Eucorethra underwoodi | -- | P | 1 |
| Dicrotendipes sp. (pupae) | -- | -- | 1 |
| Culicoides sp. | 6 | P | 1 |
| Chironomini (pupae) | -- | -- | 1 |
| Chaetogaster diaphanous | -- | -- | 1 |
| | | | 878 |

PGC 21

| Taxon | T1 |
|---|---|
| Micropsectra sp. | 137 |
| Physa sp. | 65 |
| Chironomus sp. | 28 |
| Prostoma sp. | 11 |
| Oxyethira sp. | 9 |
| Pisidium sp. | 9 |
| Lymnaea sp. | 7 |
| Rheocricotopus sp. | 7 |
| Unid. Imm. Tubifricidae | 6 |
| Paratendipes sp. | 5 |
| Helisoma sp. | 4 |
| Apedilum sp. | 3 |
| Chironominae | 3 |
| Chironominae (pupae) | 3 |
| Tanytarsus sp. | 2 |
| Cladotanytarsus sp. | 1 |
| Cyprididae | 1 |
| Dero digitata | 1 |
| Mooreobdella microstoma | 1 |
| Mooreobdella tetragon | 1 |
| Rheocricotopus sp. (pupae) | 1 |
| Thienemanniella sp. | 1 |
| Tipula sp. | 1 |
| | 307 |

| Taxon | T2 |
|---|---|
| Micropsectra sp. | 234 |
| Unid. Imm. Tubifricidae | 16 |
| Eukiefferiella sp. | 12 |
| Paratendipes sp. | 8 |
| Nais communis/ variabilis | 7 |
| Dugesia tigrina | 5 |
| Limnophyes sp. | 4 |
| Chironominae | 3 |
| Stylaria lacustris | 3 |
| Chironomidae (pupae) | 2 |
| Helisoma sp. | 2 |
| Chironomidae | 1 |
| Dicrotendipes sp. | 1 |
| Lymnaea sp. | 1 |
| Tanypodinae | 1 |
| Tanytarsini | 1 |
| | 301 |

| Taxon | T3 |
|---|---|
| Micropsectra sp. | 100 |
| Paratendipes sp. | 34 |
| Psectrotanypus sp. | 29 |
| Tanytarsus sp. | 23 |
| Dero digitata | 21 |
| Chironomus sp. | 15 |
| Slavina appendiculata | 14 |
| Unid. Imm. Tubifricidae | 14 |
| Stylaria lacustris | 9 |
| Micropsectra sp. (pupae) | 8 |
| Paratanytarsus sp. | 7 |
| Dicrotendipes sp. | 6 |
| Helisoma sp. | 6 |
| Tubificidae w hair cht. | 6 |
| Sphaerium sp. | 4 |
| Sciomyzidae | 2 |
| Apedilum sp. | 1 |
| Cladotanytarsus sp. (pupae) | 1 |
| Enchytraeidae | 1 |
| Haemonais waldvogeli | 1 |
| Hyalella sp. | 1 |
| Limnophyes sp. | 1 |
| Lymnaea sp. | 1 |
| Paratanytarsus sp. (pupae) | 1 |
| Physa sp. | 1 |
| | 307 |

| Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|
| Micropsectra sp. | 7 | CG | 471 |
| Physa sp. | 8 | SC | 66 |
| Paratendipes sp. | 8 | CG | 47 |
| Chironomus sp. | 10 | CG | 43 |
| Unid. Imm. Tubifricidae | 10 | CG | 36 |
| Psectrotanypus sp. | 10 | P | 29 |
| Tanytarsus sp. | 6 | CF | 25 |
| Dero digitata | -- | CG | 22 |
| Slavina appendiculata | -- | CG | 14 |
| Stylaria lacustris | -- | CG | 12 |
| Helisoma sp. | 6 | SC | 12 |
| Eukiefferiella sp. | 8 | OM | 12 |
| Prostoma sp. | 8 | P | 11 |
| Pisidium sp. | 8 | CF | 9 |
| Oxyethira sp. | 3 | PH | 9 |
| Lymnaea sp. | 7 | SC | 9 |
| Micropsectra sp. (pupae) | -- | -- | 8 |
| Rheocricotopus sp. | 6 | OM | 7 |
| Paratanytarsus sp. | 6 | CF | 7 |
| Nais communis/ variabilis | -- | CG | 7 |
| Dicrotendipes sp. | 8 | CG | 7 |
| Tubificidae w hair cht. | 5 | CG | 6 |
| Chironominae | 6 | CG | 6 |
| Limnophyes sp. | 8 | CG | 5 |
| Dugesia tigrina | 4 | P | 5 |
| Sphaerium sp. | 8 | CG | 4 |
| Apedilum sp. | 6 | CG | 4 |
| Chironominae (pupae) | -- | -- | 3 |
| Sciomyzidae | 6 | P | 2 |
| Chironomidae (pupae) | -- | -- | 2 |
| Tipula sp. | 4 | OM | 1 |
| Thienemanniella sp. | 6 | CG | 1 |

PGC 21. – continued.

| | | | |
|---|---|---|---|
| Tanytarsini | 6 | CG | 1 |
| Tanypodinae | 7 | P | 1 |
| Rheocricotopus sp. (pupae) | -- | -- | 1 |
| Paratanytarsus sp. (pupae) | -- | -- | 1 |
| Mooreobdella tetragon | 8 | P | 1 |
| Mooreobdella microstoma | 8 | P | 1 |
| Hyalella sp. | 8 | CG | 1 |
| Haemonais waldvogeli | -- | CG | 1 |
| Enchytraeidae | 10 | CG | 1 |
| Cyprididae | 8 | CG | 1 |
| Cladotanytarsus sp. | 7 | CG | 1 |
| Cladotanytarsus sp. (pupae) | -- | -- | 1 |
| Chironomidae | 6 | CG | 1 |
| | | | 915 |

PGC 22

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Sphaerium sp. | 103 | Unid. Imm. Tubifricidae | 163 | Cyprididae | 70 | Unid. Imm. Tubifricidae | 10 | CG | 231 |
| Cyprididae | 102 | Tubificidae w hair cht. | 46 | Unid. Imm. Tubifricidae | 66 | Cyprididae | 8 | CG | 204 |
| Micropsectra sp. | 41 | Cyprididae | 32 | Lumbriculus variegata | 54 | Sphaerium sp. | 8 | CG | 103 |
| Lumbriculus variegate | 8 | Limnophyes sp. | 8 | Aulodrilus pigueti | 22 | Lumbriculus variegata | -- | CG | 65 |
| Orthocladius complex | 5 | Nais communis/ variabilis | 5 | Physa sp. | 16 | Micropsectra sp. | 7 | CG | 51 |
| Psectrotanypus sp. | 5 | Physa sp. | 4 | Micropsectra sp. | 9 | Tubificidae w hair cht. | 5 | CG | 47 |
| Tipula sp. | 4 | Aulodrilus pigueti | 3 | Tipula sp. | 8 | Aulodrilus pigueti | -- | CG | 25 |
| Chironomini | 3 | Lumbriculus variegata | 3 | Nais communis/ variabilis | 5 | Physa sp. | 8 | SC | 22 |
| Gyraulus sp. | 2 | Enchytraeidae | 2 | Psectrotanypus sp. | 4 | Tipula sp. | 4 | OM | 12 |
| Helisoma sp. | 2 | Argia sp. | 1 | Lymnaea sp. | 3 | Nais communis/ variabilis | -- | CG | 10 |
| Physa sp. | 2 | Lymnaea sp. | 1 | Tanytarsini | 3 | Psectrotanypus sp. | 10 | P | 9 |
| Unid. Imm. Tubifricidae | 2 | Micropsectra sp. | 1 | Ephydridae | 2 | Limnophyes sp. | 8 | CG | 9 |
| Corynoneura sp. | 1 | Parametriocnemus sp. | 1 | Pisidium sp. | 2 | Orthocladius complex | 6 | CG | 5 |
| Dicrotendipes sp. | 1 | Prostoma sp. | 1 | Prostoma sp. | 2 | Lymnaea sp. | 7 | SC | 5 |
| Lymnaea sp. | 1 | Sciomyzidae | 1 | Sciomyzidae | 2 | Tanytarsini | 6 | CG | 3 |
| Menetus opercularis | 1 | | 272 | Argia sp. | 1 | Sciomyzidae | 6 | P | 3 |
| Mooreobdella microstoma | 1 | | | Diamesa sp. | 1 | Prostoma sp. | 8 | P | 3 |
| Pisidium sp. | 1 | | | Limnophyes sp. | 1 | Pisidium sp. | 8 | CF | 3 |
| | 285 | | | Lumbricina | 1 | Chironomini | 6 | CG | 3 |
| | | | | Mooreobdella tetragon | 1 | Helisoma sp. | 6 | SC | 2 |
| | | | | Tubificidae w hair cht. | 1 | Gyraulus sp. | 8 | SC | 2 |
| | | | | | 274 | Ephydridae | 6 | -- | 2 |
| | | | | | | Enchytraeidae | 10 | CG | 2 |
| | | | | | | Argia sp. | 7 | P | 2 |
| | | | | | | Parametriocnemus sp. | 5 | CG | 1 |
| | | | | | | Mooreobdella tetragon | 8 | P | 1 |
| | | | | | | Mooreobdella microstoma | 8 | P | 1 |
| | | | | | | Menetus opercularis | 6 | SC | 1 |
| | | | | | | Lumbricina | -- | CG | 1 |
| | | | | | | Dicrotendipes sp. | 8 | CG | 1 |
| | | | | | | Diamesa sp. | 5 | CG | 1 |
| | | | | | | Corynoneura sp. | 7 | CG | 1 |
| | | | | | | | | | 831 |

PGC 8a

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Hyalella sp. | 43 | Stempellina sp. | 43 | Micropsectra sp. | 37 | Oxyethira sp. | 3 | PH | 109 |
| Oxyethira sp. | 43 | Oxyethira sp. | 34 | Oxyethira sp. | 32 | Stempellina sp. | 2 | CG | 84 |
| Dicrotendipes sp. | 26 | Physa sp. | 34 | Stempellina sp. | 29 | Hyalella sp. | 8 | CG | 82 |
| Physa sp. | 23 | Hyalella sp. | 28 | Nais communis/ variabilis | 19 | Physa sp. | 8 | SC | 75 |
| Paratanytarsus sp. | 18 | Dero digitata | 18 | Ophidonais serpentina | 19 | Micropsectra sp. | 7 | CG | 49 |
| Nais communis/ variabilis | 15 | Paratanytarsus sp. | 15 | Physa sp. | 18 | Paratanytarsus sp. | 6 | CF | 40 |
| Chironominae | 13 | Tanytarsus sp. | 14 | Caenis latipennis | 14 | Dicrotendipes sp. | 8 | CG | 37 |
| Stempellina sp. | 12 | Caenis latipennis | 11 | Tanytarsus sp. | 13 | Nais communis/ variabilis | -- | CG | 34 |
| Limnophyes sp. | 10 | Ophidonais serpentina | 11 | Hyalella sp. | 11 | Tanytarsus sp. | 6 | CF | 32 |
| Psectrocladius sp. | 10 | Micropsectra sp. | 9 | Menetus opercularis | 11 | Ophidonais serpentina | -- | -- | 32 |
| Stylaria lacustris | 9 | Unid. Imm. Tubifricidae | 8 | Unid. Imm. Tubifricidae | 11 | Caenis latipennis | 7 | CG | 29 |
| Corynoneura sp. | 8 | Polypedilum sp. | 7 | Paratanytarsus sp. | 7 | Unid. Imm. Tubifricidae | 10 | CG | 20 |
| Phaenopsectra sp. | 8 | Dicrotendipes sp. | 6 | Phaenopsectra sp. | 7 | Phaenopsectra sp. | 7 | SC | 18 |
| Polypedilum sp. | 7 | Menetus opercularis | 6 | Dicrotendipes sp. | 5 | Menetus opercularis | 6 | SC | 18 |
| Orthocladiinae | 6 | Paratanytarsus sp. (pupae) | 5 | Psectrocladius sp. | 5 | Dero digitata | -- | CG | 18 |
| Tanytarsus sp. | 5 | Probezzia sp. | 5 | Probezzia sp. | 4 | Psectrocladius sp. | 8 | CG | 17 |
| Apedilum sp. | 4 | Slavina appendiculata | 4 | Tubificidae w hair cht. | 4 | Polypedilum sp. | 6 | CG | 16 |
| Caenis latipennis | 4 | Tubificidae w hair cht. | 4 | Bezzia/ Palpomyia | 3 | Chironominae | 6 | CG | 14 |
| Ceratopogonidae (pupae) | 4 | Chironomus sp. | 3 | Ferrissia sp. | 3 | Probezzia sp. | 6 | P | 11 |
| Micropsectra sp. | 3 | Cryptochironomus sp. | 3 | Stempellina sp. (pupae) | 3 | Limnophyes sp. | 8 | CG | 11 |
| Orthocladiinae (pupae) | 3 | Eucorethra underwoodi | 3 | Cricotopus sp. | 2 | Tubificidae w hair cht. | 5 | CG | 10 |
| Paratanytarsus sp. (pupae) | 3 | Gyraulus sp. | 3 | Helisoma sp. | 2 | Stylaria lacustris | -- | CG | 9 |
| Cyprididae | 2 | Lumbriculus variegata | 3 | Liodessus obscurellus (adult) | 2 | Paratanytarsus sp. (pupae) | -- | -- | 9 |
| Helisoma sp. | 2 | Phaenopsectra sp. | 3 | Lymnaea sp. | 2 | Corynoneura sp. | 7 | CG | 8 |
| Ophidonais serpentine | 2 | Ceratopogon sp. | 2 | Polypedilum sp. | 2 | Orthocladiinae | 5 | CG | 6 |
| Probezzia sp. | 2 | Helisoma sp. | 2 | Cladotanytarsus sp. (pupae) | 1 | Helisoma sp. | 6 | SC | 6 |
| Tubificidae w hair cht. | 2 | Liodessus obscurellus (adult) | 2 | Culicoides sp. | 1 | Slavina appendiculata | -- | CG | 5 |
| Corixidae | 1 | Orthocladiinae (pupae) | 2 | Paratanytarsus sp. (pupae) | 1 | Orthocladiinae (pupae) | -- | -- | 5 |

PGC 8a. – continued.

| | |
|---|---|
| Eucorethra underwoodi | 1 |
| Menetus opercularis | 1 |
| Pachydiplax longipennis | 1 |
| Simulium sp. | 1 |
| Slavina appendiculata | 1 |
| Stempellinella sp. | 1 |
| Unid. Imm. Tubifricidae | 1 |
| | 295 |

| | |
|---|---|
| Psectrocladius sp. | 2 |
| Chironominae | 1 |
| Chironomus sp. (pupae) | 1 |
| Corbicula sp. | 1 |
| Corixidae | 1 |
| Culicoides sp. | 1 |
| Ferrissia sp. | 1 |
| Limnophyes sp. | 1 |
| Pisidium sp. | 1 |
| Psectrotanypus sp. | 1 |
| | 299 |

| | |
|---|---|
| Pisidium sp. | 1 |
| Polypedilum sp. (pupae) | 1 |
| Pristina leidyi | 1 |
| Sphaeromias sp. | 1 |
| | 272 |

| | | | |
|---|---|---|---|
| Liodessus obscurellus (adult) | 5 | P | 4 |
| Ferrissia sp. | 6 | SC | 4 |
| Eucorethra underwoodi | -- | P | 4 |
| Ceratopogonidae (pupae) | -- | -- | 4 |
| Apedilum sp. | 6 | CG | 4 |
| Stempellina sp. (pupae) | -- | -- | 3 |
| Lumbriculus variegata | -- | CG | 3 |
| Gyraulus sp. | 8 | SC | 3 |
| Cryptochironomus sp. | 8 | P | 3 |
| Chironomus sp. | 10 | CG | 3 |
| Bezzia/ Palpomyia | 6 | P | 3 |
| Pisidium sp. | 8 | CF | 2 |
| Lymnaea sp. | 7 | SC | 2 |
| Cyprididae | 8 | CG | 2 |
| Culicoides sp. | 6 | P | 2 |
| Cricotopus sp. | 7 | CG | 2 |
| Corixidae | 10 | P | 2 |
| Ceratopogon sp. | 6 | P | 2 |
| Stempellinella sp. | 4 | CF | 1 |
| Sphaeromias sp. | 6 | P | 1 |
| Simulium sp. | 6 | CF | 1 |
| Psectrotanypus sp. | 10 | P | 1 |
| Pristina leidyi | -- | CG | 1 |
| Polypedilum sp. (pupae) | -- | -- | 1 |
| Pachydiplax longipennis | 9 | P | 1 |
| Corbicula sp. | 8 | CF | 1 |
| Cladotanytarsus sp. (pupae) | -- | -- | 1 |
| Chironomus sp. (pupae) | -- | -- | 1 |
| | | | 866 |

PGC 9a

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Paratanytarsus sp. | 71 | Paratanytarsus sp. | 92 | Paratanytarsus sp. | 41 | Paratanytarsus sp. | 6 | CF | 204 |
| Ophidonais serpentina | 26 | Oxyethira sp. | 73 | Unid. Imm. Tubifricidae | 41 | Oxyethira sp. | 3 | PH | 115 |
| Hyalella sp. | 21 | Micropsectra sp. | 31 | Micropsectra sp. | 38 | Micropsectra sp. | 7 | CG | 86 |
| Tanytarsus sp. | 20 | Physa sp. | 25 | Cryptochironomus sp. | 29 | Unid. Imm. Tubifricidae | 10 | CG | 58 |
| Oxyethira sp. | 19 | Stylaria lacustris | 14 | Oxyethira sp. | 23 | Physa sp. | 8 | SC | 48 |
| Micropsectra sp. | 17 | Nais communis/ variabilis | 11 | Rheocricotopus sp. | 15 | Hyalella sp. | 8 | CG | 33 |
| Unid. Imm. Tubifricidae | 17 | Hyalella sp. | 6 | Stempellina sp. | 14 | Cryptochironomus sp. | 8 | P | 32 |
| Menetus opercularis | 11 | Menetus opercularis | 6 | Physa sp. | 12 | Ophidonais serpentina | -- | -- | 28 |
| Physa sp. | 11 | Rheocricotopus sp. | 5 | Polypedilum sp. | 11 | Stempellina sp. | 2 | CG | 22 |
| Dicrotendipes sp. | 10 | Dicrotendipes sp. | 4 | Corbicula sp. | 9 | Menetus opercularis | 6 | SC | 22 |
| Stempellina sp. | 7 | Fallceon quilleri | 3 | Caenis latipennis | 8 | Tanytarsus sp. | 6 | CF | 20 |
| Dugesia tigrina | 5 | Gammarus sp. | 3 | Hyalella sp. | 6 | Rheocricotopus sp. | 6 | OM | 20 |
| Tubificidae w hair cht. | 5 | Thienemanniella sp. | 3 | Chironominae | 5 | Stylaria lacustris | -- | CG | 15 |
| Apedilum sp. | 4 | Cricotopus bicinctus grp | 2 | Fallceon quilleri | 5 | Dicrotendipes sp. | 8 | CG | 15 |
| Paratanytarsus sp. (pupae) | 4 | Dugesia tigrina | 2 | Menetus opercularis | 5 | Nais communis/ variabilis | -- | CG | 13 |
| Probezzia sp. | 4 | Micropsectra sp. (pupae) | 2 | Gammarus sp. | 4 | Polypedilum sp. | 6 | CG | 12 |
| Cricotopus sp. | 3 | Nanocladius sp. | 2 | Apedilum sp. | 3 | Gammarus sp. | 6 | CG | 9 |
| Stempellina sp. (pupae) | 3 | Ophidonais serpentina | 2 | Lumbricina | 3 | Corbicula sp. | 8 | CF | 9 |
| Bezzia/ Palpomyia | 2 | Tricorythodes sp. | 2 | Bezzia/ Palpomyia | 2 | Fallceon quilleri | 4 | CG | 8 |
| Cricotopus bicinctus grp | 2 | Apedilum sp. | 1 | Chironomidae (pupae) | 2 | Caenis latipennis | 7 | CG | 8 |
| Cryptochironomus sp. | 2 | Argia sp. | 1 | Chironominae (pupae) | 2 | Apedilum sp. | 6 | CG | 8 |
| Cryptochironomus sp. (pupae) | 2 | Centroptilum sp. | 1 | Corynoneura sp. | 2 | Tubificidae w hair cht. | 5 | CG | 7 |
| Gammarus sp. | 2 | Chironomini | 1 | Cricotopus sp. | 2 | Dugesia tigrina | 4 | P | 7 |
| Nais communis/ variabilis | 2 | Coenagrionidae | 1 | Tricorythodes sp. | 2 | Chironomini | 6 | CG | 6 |
| Ablabesmyia sp. | 1 | Corynoneura sp. | 1 | Tubificidae w hair cht. | 2 | Cricotopus sp. | 7 | CG | 5 |
| Ceratopogonidae | 1 | Cricotopus bicinctus grp (pupae) | 1 | Ceratopogonidae | 1 | Tricorythodes sp. | 4 | CG | 4 |
| Coenagrionidae | 1 | Cryptochironomus sp. | 1 | Coenagrionidae | 1 | Stempellina sp. (pupae) | -- | -- | 4 |
| Corynoneura sp. | 1 | Libellula sp. | 1 | Cyprididae | 1 | Probezzia sp. | 6 | P | 4 |
| Culicoides sp. | 1 | Liodessus obscurellus (adult) | 1 | Dicrotendipes sp. | 1 | Paratanytarsus sp. (pupae) | -- | -- | 4 |
| Cyprididae | 1 | Pentaneura sp. | 1 | Eukiefferiella sp. | 1 | Micropsectra sp. (pupae) | -- | -- | 4 |
| Liodessus obscurellus (adult) | 1 | Stempellina sp. | 1 | Micropsectra sp. (pupae) | 1 | Cricotopus bicinctus grp | 7 | CG | 4 |
| Lumbriculus variegata | 1 | Thienemanniella sp. (pupae) | 1 | Orthocladiinae | 1 | Corynoneura sp. | 7 | CG | 4 |
| Micropsectra sp. (pupae) | 1 | | 301 | Orthocladius complex | 1 | Bezzia/ Palpomyia | 6 | P | 4 |

PGC 9a. continued.

| | |
|---|---|
| Nanocladius sp. | 1 |
| Polypedilum sp. | 1 |
| Procambarus clarkii | 1 |
| Stylaria lacustris | 1 |
| | 283 |

| | |
|---|---|
| Phaenopsectra sp. | 1 |
| Stempellina sp. (pupae) | 1 |
| Zavrelimyia/ Paramerina | 1 |
| | 297 |

| | | | |
|---|---|---|---|
| Thienemanniella sp. | 6 | CG | 3 |
| Nanocladius sp. | 3 | CG | 3 |
| Lumbricina | -- | CG | 3 |
| Coenagrionidae | -- | P | 3 |
| Chironomidae (pupae) | -- | -- | 2 |
| Chironominae (pupae) | -- | -- | 2 |
| Liodessus obscurellus (adult) | 5 | P | 2 |
| Cyprididae | 8 | CG | 2 |
| Cryptochironomus sp. (pupae) | -- | -- | 2 |
| Ceratopogonidae (pupae) | -- | -- | 2 |
| Zavrelimyia/ Paramerina | 7 | P | 1 |
| Thienemanniella sp. (pupae) | -- | -- | 1 |
| Procambarus clarkii | 8 | SH | 1 |
| Phaenopsectra sp. | 7 | SC | 1 |
| Pentaneura sp. | 6 | P | 1 |
| Orthocladius complex | 6 | CG | 1 |
| Orthocladiinae | 5 | CG | 1 |
| Lumbriculus variegata | -- | CG | 1 |
| Libellula sp. | 9 | P | 1 |
| Eukiefferiella sp. | 8 | OM | 1 |
| Culicoides sp. | 6 | P | 1 |
| Cricotopus bicinctus grp (pupae) | -- | -- | 1 |
| Centroptilum sp. | 2 | CG | 1 |
| Argia sp. | 7 | P | 1 |
| Ablabesmyia sp. | 8 | CG | 1 |
| | | | 881 |

PGC 11a

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Chironomus sp. | 89 | Micropsectra sp. | 66 | Micropsectra sp. | 85 | Micropsectra sp. | 7 | CG | 186 |
| Hyalella sp. | 72 | Paratanytarsus sp. | 47 | Hyalella sp. | 55 | Hyalella sp. | 8 | CG | 146 |
| Micropsectra sp. | 35 | Nais communis/ variabilis | 40 | Unid. Imm. Tubifricidae | 35 | Chironomus sp. | 10 | CG | 137 |
| Chironomini | 21 | Chironomus sp. | 37 | Paratanytarsus sp. | 30 | Paratanytarsus sp. | 6 | CF | 95 |
| Paratanytarsus sp. | 18 | Hyalella sp. | 19 | Physa sp. | 20 | Unid. Imm. Tubifricidae | 10 | CG | 50 |
| Physa sp. | 11 | Paratendipes sp. | 13 | Chironomus sp. | 11 | Nais communis/ variabilis | -- | CG | 44 |
| Helisoma sp. | 8 | Unid. Imm. Tubifricidae | 13 | Psectrotanypus sp. | 11 | Physa sp. | 8 | SC | 37 |
| Menetus opercularis | 4 | Chironominae | 10 | Dicrotendipes sp. | 8 | Chironominae | 6 | CG | 31 |
| Nais communis/ variabilis | 4 | Corynoneura sp. | 9 | Dero digitata | 7 | Psectrotanypus sp. | 10 | P | 15 |
| Cricotopus sp. | 3 | Cricotopus sp. | 8 | Menetus opercularis | 7 | Paratendipes sp. | 8 | CG | 15 |
| Orthocladius complex | 3 | Phaenopsectra sp. | 6 | Apedilum sp. | 6 | Helisoma sp. | 6 | SC | 15 |
| Apedilum sp. | 2 | Physa sp. | 6 | Tanytarsus sp. | 6 | Dicrotendipes sp. | 8 | CG | 13 |
| Corynoneura sp. | 2 | Dicrotendipes sp. | 3 | Helisoma sp. | 5 | Menetus opercularis | 6 | SC | 12 |
| Dicrotendipes sp. | 2 | Paratanytarsus sp. (pupae) | 3 | Paratanytarsus sp. (pupae) | 4 | Cricotopus sp. | 7 | CG | 11 |
| Ferrissia sp. | 2 | Sciomyzidae | 3 | Tubificidae w hair cht. | 4 | Corynoneura sp. | 7 | CG | 11 |
| Psectrotanypus sp. | 2 | Apedilum sp. | 2 | Chironominae (pupae) | 3 | Apedilum sp. | 6 | CG | 10 |
| Unid. Imm. Tubifricidae | 2 | Chironomidae (pupae) | 2 | Lumbricina | 3 | Phaenopsectra sp. | 7 | SC | 8 |
| Cyprididae | 1 | Enchytraeidae | 2 | Paratendipes sp. | 2 | Tanytarsus sp. | 6 | CF | 7 |
| Glyptotendipes sp. | 1 | Helisoma sp. | 2 | Phaenopsectra sp. | 2 | Paratanytarsus sp. (pupae) | -- | -- | 7 |
| Hydra sp. | 1 | Psectrotanypus sp. | 2 | Polypedilum sp. | 2 | Dero digitata | -- | CG | 7 |
| Sphaerium sp. | 1 | Ablabesmyia sp. | 1 | Sphaerium sp. | 2 | Chironominae (pupae) | -- | -- | 4 |
| | 284 | Chironominae (pupae) | 1 | Cricotopus bicinctus grp | 1 | Tubificidae w hair cht. | 5 | CG | 4 |
| | | Haemonais waldvogeli | 1 | Cryptochironomus sp. | 1 | Sphaerium sp. | 8 | CG | 3 |
| | | Hydraena sp. (adult) | 1 | Ferrissia sp. | 1 | Sciomyzidae | 6 | P | 3 |
| | | Lumbriculus variegata | 1 | Haemonais waldvogeli | 1 | Orthocladius complex | 6 | CG | 3 |
| | | Menetus opercularis | 1 | Limnophyes sp. | 1 | Lumbricina | -- | CG | 3 |
| | | Tanytarsus sp. | 1 | Stylaria lacustris | 1 | Ferrissia sp. | 6 | SC | 3 |
| | | Tipula sp. | 1 | | 314 | Polypedilum sp. | 6 | CG | 2 |
| | | | 301 | | | Haemonais waldvogeli | -- | CG | 2 |
| | | | | | | Enchytraeidae | 10 | CG | 2 |

PGC 11a. – continued.

| | | | |
|---|---|---|---|
| Chironomidae | -- | -- | 2 |
| Tipula sp. | 4 | OM | 1 |
| Stylaria lacustris | -- | CG | 1 |
| Lumbriculus variegata | -- | CG | 1 |
| Limnophyes sp. | 8 | CG | 1 |
| Hydraena sp. (adult) | 5 | SC | 1 |
| Hydra sp. | 5 | P | 1 |
| Glyptotendipes sp. | 10 | SH | 1 |
| Cyprididae | 8 | CG | 1 |
| Cryptochironomus sp. | 8 | P | 1 |
| Cricotopus bicinctus grp | 7 | CG | 1 |
| Ablabesmyia sp. | 8 | CG | 1 |
| | | | 899 |

PGC 16a

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Hyalella sp. | 90 | Chironomus sp. | 55 | Chironomus sp. | 49 | Chironomus sp. | 10 | CG | 118 |
| Paratendipes sp. | 38 | Unid. Imm. Tubifricidae | 42 | Chironominae | 41 | Hyalella sp. | 8 | CG | 103 |
| Physa sp. | 30 | Tubificidae w hair cht. | 33 | Tanytarsus sp. | 34 | Chironominae | 6 | CG | 89 |
| Chironominae | 27 | Physa sp. | 31 | Psectrotanypus sp. | 30 | Unid. Imm. Tubifricidae | 10 | CG | 63 |
| Unid. Imm. Tubifricidae | 18 | Chironominae | 21 | Paratanytarsus sp. | 27 | Physa sp. | 8 | SC | 63 |
| Chironomus sp. | 14 | Psectrotanypus sp. | 13 | Dero digitata | 24 | Paratendipes sp. | 8 | CG | 57 |
| Menetus opercularis | 10 | Dero digitata | 12 | Paratendipes sp. | 15 | Psectrotanypus sp. | 10 | P | 47 |
| Dero digitata | 9 | Menetus opercularis | 11 | Micropsectra sp. | 11 | Dero digitata | -- | CG | 45 |
| Corynoneura sp. | 6 | Micropsectra sp. | 10 | Hyalella sp. | 8 | Tanytarsus sp. | 6 | CF | 43 |
| Psectrocladius sp. | 6 | Paratanytarsus sp. | 10 | Corynoneura sp. | 6 | Unid. Imm. Tubifricidae | 5 | CG | 40 |
| Tanytarsus sp. | 6 | Tanypodinae | 9 | Stylaria lacustris | 6 | Paratanytarsus sp. | 6 | CF | 37 |
| Cricotopus sp. | 5 | Hyalella sp. | 5 | Menetus opercularis | 4 | Menetus opercularis | 6 | SC | 25 |
| Nais communis/ variabilis | 5 | Corynoneura sp. | 4 | Nais communis/ variabilis | 4 | Micropsectra sp. | 7 | CG | 23 |
| Liodessus obscurellus (adult) | 4 | Paratendipes sp. | 4 | Tanypodinae | 4 | Corynoneura sp. | 7 | CG | 16 |
| Psectrotanypus sp. | 4 | Chironomus sp. (pupae) | 3 | Tubificidae w hair cht. | 4 | Tanypodinae | 7 | P | 13 |
| Stylaria lacustris | 3 | Enchytraeidae | 3 | Chironominae (pupae) | 3 | Cricotopus sp. | 7 | CG | 10 |
| Tubificidae w hair cht. | 3 | Psectrocladius sp. | 3 | Cricotopus sp. | 3 | Stylaria lacustris | -- | CG | 9 |
| Chironomidae (pupae) | 2 | Slavina appendiculata | 3 | Unid. Imm. Tubifricidae | 3 | Psectrocladius sp. | 8 | CG | 9 |
| Micropsectra sp. | 2 | Tanytarsus sp. | 3 | Cladopelma sp. | 2 | Nais communis/ variabilis | -- | CG | 9 |
| Paratanytarsus sp. (pupae) | 2 | Cricotopus sp. | 2 | Dicrotendipes sp. | 2 | Slavina appendiculata | -- | CG | 6 |
| Apedilum sp. | 1 | Apedilum sp. | 1 | Ferrissia sp. | 2 | Liodessus obscurellus (adult) | 5 | P | 4 |
| Chaetogaster diaphanus | 1 | Bezzia/ Palpomyia | 1 | Physa sp. | 2 | Chironominae (pupae) | -- | -- | 4 |
| Cricotopus sp. (pupae) | 1 | Chironominae (pupae) | 1 | Slavina appendiculata | 2 | Paratanytarsus sp. (pupae) | -- | -- | 3 |
| Dicrotendipes sp. | 1 | Cyprididae | 1 | Cryptochironomus sp. | 1 | Enchytraeidae | 10 | CG | 3 |
| Pisidium sp. | 1 | Limnodrilus hoffmeisteri | 1 | Cryptotendipes sp. | 1 | Dicrotendipes sp. | 8 | CG | 3 |
| Probezzia sp. | 1 | Lymnaea sp. | 1 | Helisoma sp. | 1 | Chironomus sp. (pupae) | -- | -- | 3 |
| Psectrotanypus sp. (pupae) | 1 | Paratanytarsus sp. (pupae) | 1 | Hydra sp. | 1 | Polypedilum sp. | 6 | CG | 2 |
| Slavina appendiculata | 1 | Phaenopsectra sp. | 1 | Polypedilum sp. | 1 | Ferrissia sp. | 6 | SC | 2 |
| | 292 | Polypedilum sp. | 1 | Tanytarsus sp. (pupae) | 1 | Cladopelma sp. | 7 | CG | 2 |
| | | Procladius sp. | 1 | | 292 | Chironomidae (pupae) | -- | -- | 2 |
| | | | 287 | | | Apedilum sp. | 6 | CG | 2 |
| | | | | | | Tanytarsus sp. (pupae) | -- | -- | 1 |
| | | | | | | Psectrotanypus sp. (pupae) | -- | -- | 1 |

PGC 16a. – continued.

| | | | |
|---|---|---|---|
| Procladius sp. | 9 | P | 1 |
| Probezzia sp. | 6 | P | 1 |
| Pisidium sp. | 8 | CF | 1 |
| Phaenopsectra sp. | 7 | SC | 1 |
| Lymnaea sp. | 7 | SC | 1 |
| Limnodrilus hoffmeisteri | -- | CG | 1 |
| Hydra sp. | 5 | P | 1 |
| Helisoma sp. | 6 | SC | 1 |
| Cyprididae | 8 | CG | 1 |
| Cryptotendipes sp. | 6 | CG | 1 |
| Cryptochironomus sp. | 8 | P | 1 |
| Cricotopus sp. (pupae) | -- | -- | 1 |
| Chaetogaster diaphanus | -- | -- | 1 |
| Bezzia/ Palpomyia | 6 | P | 1 |
| | | | 871 |

PGC 17a

| Taxon | T1 |
|---|---|
| Psectrotanypus sp. | 118 |
| Chironomus sp. | 98 |
| Hyalella sp. | 18 |
| Micropsectra sp. | 18 |
| Helisoma sp. | 12 |
| Cyprididae | 6 |
| Tanypus sp. | 6 |
| Pisidium sp. | 5 |
| Unid. Imm. Tubifricidae | 4 |
| Menetus opercularis | 3 |
| Physa sp. | 3 |
| Culicoides sp. | 1 |
| Dicrotendipes sp. | 1 |
| Limnesia sp. | 1 |
| Tanytarsus sp. | 1 |
| Trombidiformes | 1 |
| Tubificidae w hair cht. | 1 |
| | 297 |

| Taxon | T2 |
|---|---|
| Paratanytarsus sp. | 77 |
| Micropsectra sp. | 62 |
| Chironomus sp. | 25 |
| Hyalella sp. | 21 |
| Pisidium sp. | 19 |
| Helisoma sp. | 11 |
| Tanypodinae | 10 |
| Chironominae | 9 |
| Haemonais waldvogeli | 8 |
| Dero digitata | 7 |
| Psectrotanypus sp. | 7 |
| Dicrotendipes sp. | 6 |
| Paratanytarsus sp. (pupae) | 5 |
| Tanytarsus sp. | 4 |
| Chironomidae (pupae) | 2 |
| Corynoneura sp. | 2 |
| Menetus opercularis | 2 |
| Physa sp. | 2 |
| Apedilum sp. | 1 |
| Chaetogaster diaphanus | 1 |
| Chironominae (pupae) | 1 |
| Chironomus sp. (pupae) | 1 |
| Cladopelma sp. | 1 |
| Cricotopus sp. | 1 |
| Cyprididae | 1 |
| Ephydridae (pupae) | 1 |
| Hydra sp. | 1 |
| Nais communis/ variabilis | 1 |
| Paratendipes sp. | 1 |
| Phaenopsectra sp. | 1 |
| Procambarus clarkii | 1 |
| Tubificidae w hair cht. | 1 |
| | 293 |

| Taxon | T3 |
|---|---|
| Micropsectra sp. | 99 |
| Dero digitata | 36 |
| Paratanytarsus sp. | 28 |
| Tubificidae w hair cht. | 14 |
| Unid. Imm. Tubifricidae | 12 |
| Chironomus sp. | 11 |
| Hyalella sp. | 11 |
| Micropsectra sp. (pupae) | 11 |
| Psectrotanypus sp. | 10 |
| Menetus opercularis | 9 |
| Tanytarsus sp. | 9 |
| Apedilum sp. | 8 |
| Paratanytarsus sp. (pupae) | 5 |
| Physa sp. | 5 |
| Corynoneura sp. | 4 |
| Cricotopus sp. | 3 |
| Helisoma sp. | 2 |
| Stylaria lacustris | 2 |
| Cladotanytarsus sp. (pupae) | 1 |
| Coenagrionidae | 1 |
| Corixidae | 1 |
| Dicrotendipes sp. | 1 |
| Dicrotendipes sp. (pupae) | 1 |
| Enchytraeidae | 1 |
| Limnophyes sp. | 1 |
| Pisidium sp. | 1 |
| Psectrotanypus sp. (pupae) | 1 |
| | 288 |

| Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|
| Micropsectra sp. | 7 | CG | 179 |
| Psectrotanypus sp. | 10 | P | 135 |
| Chironomus sp. | 10 | CG | 134 |
| Paratanytarsus sp. | 6 | CF | 105 |
| Hyalella sp. | 8 | CG | 50 |
| Dero digitata | -- | CG | 43 |
| Pisidium sp. | 8 | CF | 25 |
| Helisoma sp. | 6 | SC | 25 |
| Tubificidae w hair cht. | 5 | CG | 16 |
| Unid. Imm. Tubifricidae | 10 | CG | 16 |
| Tanytarsus sp. | 6 | CF | 14 |
| Menetus opercularis | 6 | SC | 14 |
| Micropsectra sp. (pupae) | -- | -- | 11 |
| Tanypodinae | 7 | P | 10 |
| Physa sp. | 8 | SC | 10 |
| Paratanytarsus sp. (pupae) | -- | -- | 10 |
| Chironominae | 6 | CG | 9 |
| Apedilum sp. | 6 | CG | 9 |
| Haemonais waldvogeli | -- | CG | 8 |
| Dicrotendipes sp. | 8 | CG | 8 |
| Cyprididae | 8 | CG | 7 |
| Tanypus sp. | 10 | P | 6 |
| Corynoneura sp. | 7 | CG | 6 |
| Cricotopus sp. | 7 | CG | 4 |
| Stylaria lacustris | -- | CG | 2 |
| Chironomidae (pupae) | -- | -- | 2 |
| Trombidiformes | 5 | P | 1 |
| Psectrotanypus sp. (pupae) | -- | -- | 1 |
| Procambarus clarkii | 8 | SH | 1 |
| Phaenopsectra sp. | 7 | SC | 1 |
| Paratendipes sp. | 8 | CG | 1 |
| Nais communis/ variabilis | -- | CG | 1 |
| Limnophyes sp. | 8 | CG | 1 |

PGC 17a. – continued.

| | | | |
|---|---|---|---|
| Limnesia sp. | 5 | P | 1 |
| Hydra sp. | 5 | P | 1 |
| Ephydridae (pupae) | -- | -- | 1 |
| Enchytraeidae | 10 | CG | 1 |
| Dicrotendipes sp. (pupae) | -- | -- | 1 |
| Culicoides sp. | 6 | P | 1 |
| Corixidae | 10 | P | 1 |
| Coenagrionidae | -- | P | 1 |
| Cladotanytarsus sp. (pupae) | -- | -- | 1 |
| Cladopelma sp. | 7 | CG | 1 |
| Chironomus sp. (pupae) | -- | -- | 1 |
| Chironominae (pupae) | -- | -- | 1 |
| Chaetogaster diaphanus | -- | -- | 1 |
| | | | 878 |

PGC 22a

| Taxon | T1 | Taxon | T2 | Taxon | T3 | Taxon | Tolerance Value | Feeding Guild | Total |
|---|---|---|---|---|---|---|---|---|---|
| Hyalella sp. | 121 | Hyalella sp. | 61 | Unid. Imm. Tubifricidae | 71 | Hyalella sp. | 8 | CG | 182 |
| Physa sp. | 66 | Paratanytarsus sp. | 46 | Coenagrionidae | 64 | Physa sp. | 8 | SC | 143 |
| Paratanytarsus sp. | 40 | Physa sp. | 33 | Physa sp. | 44 | Paratanytarsus sp. | 6 | CF | 118 |
| Menetus opercularis | 15 | Menetus opercularis | 27 | Paratanytarsus sp. | 32 | Unid. Imm. Tubifricidae | 10 | CG | 74 |
| Gyraulus sp. | 7 | Stylaria lacustris | 21 | Tubificidae w hair cht. | 26 | Coenagrionidae | -- | P | 66 |
| Psectrotanypus sp. | 7 | Psectrotanypus sp. | 20 | Hyalella sp. | 10 | Psectrotanypus sp. | 10 | P | 45 |
| Dugesia tigrina | 5 | Hydra sp. | 16 | Psectrotanypus sp. | 8 | Menetus opercularis | 6 | SC | 43 |
| Nais communis/ variabilis | 5 | Ophidonais serpentina | 13 | Eucorethra underwoodi | 6 | Tubificidae w hair cht. | 5 | CG | 33 |
| Chironomus sp. | 4 | Sphaerium sp. | 8 | Ophidonais serpentina | 5 | Stylaria lacustris | -- | CG | 21 |
| Cyprididae | 3 | Dero digitata | 7 | Polypedilum sp. | 5 | Ophidonais serpentina | -- | -- | 18 |
| Dicrotendipes sp. | 3 | Dicrotendipes sp. | 6 | Dero borellii | 4 | Hydra sp. | 5 | P | 16 |
| Haemonais waldvogeli | 3 | Gyraulus sp. | 6 | Liodessus obscurellus (adult) | 4 | Gyraulus sp. | 8 | SC | 13 |
| Sphaerium sp. | 3 | Chironomus sp. | 4 | Chironomini | 3 | Sphaerium sp. | 8 | CG | 12 |
| Tubificidae w hair cht. | 3 | Tubificidae w hair cht. | 4 | Cyprididae | 2 | Eucorethra underwoodi | -- | P | 9 |
| Oxyethira sp. | 2 | Dugesia tigrina | 3 | Brundiniella sp. (pupae) | 1 | Dicrotendipes sp. | 8 | CG | 9 |
| Chironomini | 1 | Eucorethra underwoodi | 3 | Culicoides sp. | 1 | Dugesia tigrina | 4 | P | 8 |
| Cricotopus sp. | 1 | Coenagrionidae | 2 | Limnodrilus hoffmeisteri | 1 | Chironomus sp. | 10 | CG | 8 |
| Helophorus sp. (larvae) | 1 | Slavina appendiculata | 2 | Liodessus obscurellus (larvae) | 1 | Dero digitata | -- | CG | 7 |
| Polypedilum sp. | 1 | Unid. Imm. Tubifricidae | 2 | Menetus opercularis | 1 | Polypedilum sp. | 6 | CG | 6 |
| Prostoma sp. | 1 | Bezzia/ Palpomyia | 1 | Oxyethira sp. | 1 | Nais communis/ variabilis | -- | CG | 5 |
| Unid. Imm. Tubifricidae | 1 | Chaetogaster diaphanus | 1 | Sciomyzidae | 1 | Cyprididae | 8 | CG | 5 |
| | 293 | Cladotanytarsus sp. | 1 | Sphaerium sp. | 1 | Liodessus obscurellus (adult) | 5 | P | 4 |
| | | Enchytraeidae | 1 | | 292 | Dero borellii | 10 | CG | 4 |
| | | Ferrissia sp. | 1 | | | Chironomini | 6 | CG | 4 |
| | | Helisoma sp. | 1 | | | Oxyethira sp. | 3 | PH | 3 |
| | | Libellula sp. | 1 | | | Haemonais waldvogeli | -- | CG | 3 |
| | | Trombidiformes | 1 | | | Slavina appendiculata | -- | CG | 2 |
| | | | 292 | | | Trombidiformes | 5 | P | 1 |
| | | | | | | Sciomyzidae | 6 | P | 1 |

PGC 22a. – continued.

| | | | |
|---|---|---|---|
| Prostoma sp. | 8 | P | 1 |
| Liodessus obscurellus (larvae) | 5 | P | 1 |
| Limnodrilus hoffmeisteri | -- | CG | 1 |
| Libellula sp. | 9 | P | 1 |
| Helophorus sp. (larvae) | -- | SH | 1 |
| Helisoma sp. | 6 | SC | 1 |
| Ferrissia sp. | 6 | SC | 1 |
| Enchytraeidae | 10 | CG | 1 |
| Culicoides sp. | 6 | P | 1 |
| Cricotopus sp. | 7 | CG | 1 |
| Cladotanytarsus sp. | 7 | CG | 1 |
| Chaetogaster diaphanus | -- | -- | 1 |
| Brundiniella sp. (pupae) | -- | -- | 1 |
| Bezzia/ Palpomyia | 6 | P | 1 |
| | | | 877 |