Summary Report

Benthic Macroinvertebrate Biomonitoring/Surveys Blue River, Colorado

2021

Prepared for:

The Blue River Watershed Group
and Trout Unlimited

Prepared by:

David E. Rees
Timberline Aquatics, Inc.
4219 Table Mountain Place, Suite A
Fort Collins, Colorado 80526

25 June 2022

Summary Report

Benthic Macroinvertebrate Biomonitoring/Surveys Blue River, Colorado

2021

Prepared for:

The Blue River Watershed Group and Trout Unlimited

Prepared by:

David E. Rees
Timberline Aquatics, Inc.
4219 Table Mountain Place, Suite A
Fort Collins, Colorado 80526

25 June 2022

Table of Contents

List of Tables

List of Figures

Introduction

In order to fully assess the effects of human influences on aquatic environments, it is often necessary to monitor physical, chemical, and biological components of aquatic ecosystems. Fortunately, benthic macroinvertebrate communities represent a valuable tool as biological indicators of water quality and aquatic conditions (Plafkin et al. 1989, Barbour et al. 1999, Paul et al. 2005, Merritt et al. 2008). The structure and function of a benthic macroinvertebrate assemblage is expected to be representative of the existing aquatic conditions and regional ecological pressures. Individual taxa typically have specific adaptations to their environment and therefore exhibit a wide range of sensitivities to environmental disturbances or pollution.

River impoundments are one of the most influential anthropogenic modifications known to affect free-flowing riverine ecosystems worldwide (Grill et al. 2019). Numerous studies have shown how the construction of dams and reservoirs can significantly modify the downstream abiotic and biotic components of free-flowing rivers and streams (Ward and Stanford 1979, Caissie 2006, Olden and Naiman 2010, Poff and Zimmerman 2010, Ellis and Jones 2013, Wang et al. 2018). The natural temperature and flow regime are considered major influences on the biology and ecology of riverine ecosystems, and temperature is considered particularly important for providing cues that structure the life histories of many aquatic macroinvertebrates (Ward and Stanford 1982, Armitage 1984, Ward and Stanford 1987, Olden and Naiman 2010). Releases from reservoirs have been known to modify temperature and flow regimes for many kilometers downstream (Ward and Stanford 1979, Krajenbrink et al. 2022). Typically, deep releases (hypolimnetic or cold) from thermally stratified reservoirs will increase winter water temperatures (Gore 1977, Ward and Stanford 1979, Dickerson et al. 2012), decrease summer temperatures (Lehmkuhl 1972, Ward and Stanford 1979, Vinson 2001), and increase diel constancy of thermal events (Armitage 1984). Alternatively, surface releases (epilimnetic or warm) from thermally stratified reservoirs can elevate summer water temperatures and delay vernal warming and autumnal cooling downstream (Fraley 1979, Ward and Stanford 1979, Petts 1984). Abrupt releases, either deep or surface, from dams can also be detrimental to aquatic biota, particularly when they cause sudden changes in water temperatures. These types of releases have been shown to produce a shock effect, potentially reducing diversity and abundance of benthic macroinvertebrates with a narrow range of thermal tolerances (Olden and Naiman 2010, Carolli et al. 2011, McLaren et al. 2019).

Colorado, like much of the western U.S., is well-known for its numerous impoundments on rivers and streams of various sizes. Several detailed studies document the downstream impacts of regulated Colorado rivers on benthic macroinvertebrate communities (Stanford and Ward 1984, Zimmerman and Ward 1984, Rader and Ward 1988, Voelz and Ward 1991, Collier et al. 1996). These studies support the concept that changes in flow patterns and riverine thermal regimes below dams can clearly impact the structure and function of macroinvertebrate communities for many kilometers downstream. Previous studies on the Blue River below Dillon Reservoir by Voelz and Ward (1989, 1990) determined that a sequential gradient in macroinvertebrate community recovery occurred within the first 20 km below the impoundment. The recovery was mostly attributed to the return of a more natural thermal regime. Other probable variables influencing macroinvertebrate community distributional patterns included a shift in food resources, from filamentous algae below the dam to diatoms and detritus farther downstream. In summary, downstream effects of impoundments can be characterized as causing a reduction in macroinvertebrate community structure and function that continues until the natural thermal and flow regimes can be ameliorated and restored.

Study Area

During seasonal monitoring (spring, summer, and fall) in 2021, a total of ten (10) stations were sampled to evaluate the health of benthic macroinvertebrate communities in the Blue River (Table 1, Figure 1). Sampling sites included two locations upstream from Dillon Reservoir and eight locations downstream from Dillon Reservoir, between Dillon Dam and Green Mountain Reservoir. Study sites were generally selected to assess potential impacts and recovery from regulated flows and the altered thermal regime downstream from Dillon Dam. All study sites were previously monitored during 2020, except for site BRaFG which was added in 2021 to provide an assessment of seasonal conditions in the Blue River within the Town of Breckenridge (Figure 1). Sampling locations between Dillon Dam and Green Mountain Reservoir were strategically positioned in areas where there was historical data and/or potential influences to the temperature and flow regime from tributaries.

Table 1. Coordinates and elevations of sample sites on Blue River in 2021.

	Latitude	Longitude	Elevation (m)
BRaFG	39.49379	-106.04548	2898
UBR	39.56651	-106.04884	2773
Blue 5	39.62601	-106.06658	2684
DRD	39.63651	-106.07419	2675
Blue 3	39.65595	-106.07685	2647
D 5	39.70545	-106.11062	2596
Blue 2	39.72713	-106.1321	2574
Blue 1	39.74336	-106.13196	2558
SCR	39.78217	-106.16035	2502
BRC	39.8217	-106.20584	2443

Figure 1. Map of study sites used for Blue River benthic macroinvertebrate biomonitoring in 2021.

Methods

The purpose of this biomonitoring study was to assess seasonal variability in benthic macroinvertebrate communities at specific locations along the Blue River where releases from Dillon Reservoir and/or other anthropogenic stressors (e.g., urban runoff, etc.) may be influencing the health of aquatic life. The objective of this study required that three (3) quantitative replicate Hess samples were taken from similar habitat at each study site. Several biotic analysis tools (metrics) were utilized in this study to account for different types of responses to various stressors. This approach was designed to identify the spatial distribution of disturbances as well as any seasonal variability.

Three replicate, quantitative samples were collected from ten study sites on the Blue River during April, August, and October (spring, summer, and fall) of 2021. All samples were collected from similar riffle habitat to provide benthic macroinvertebrate data that was representative and comparable throughout the study area. Substrate within each sample was thoroughly agitated and individual rocks were scrubbed by hand to dislodge benthic organisms. All macroinvertebrates were rinsed into sample jars and preserved in 80% ethanol solution. Each sample jar was labeled with date, sampling location, and sample ID number on the outside and inside of each container. All samples were transported to the lab at Timberline Aquatics, Inc. where benthic macroinvertebrates were sorted, identified, and enumerated. The sorting and identification process was conducted for each entire sample to avoid any potential problems or controversy associated with subsampling.

The sorting process involved separating macroinvertebrates from debris in each sample. All macroinvertebrates were removed from each sample and placed into vials containing coarse taxonomic groups. Benthic macroinvertebrates were then identified to a taxonomic level consistent with the Operational Taxonomic Unit (OTU) established by the Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment (CDPHE). This level of identification was typically genus or species for mayflies, stoneflies, caddisflies, and many dipterans. Members of the family Chironomidae were also identified to the genus level. Specimens were identified using a variety of taxonomic keys including Ward et al. (2002) and Merritt et al. (2008). As part of the quality control protocols at Timberline Aquatics, Inc., all sorted macroinvertebrate samples were checked by a qualified taxonomist, and 10% of identifications were checked for accuracy at Colorado State University.

Population densities and species lists were developed for each sampling event during 2021 and a variety analysis tools were used to provide information regarding aquatic conditions. All macroinvertebrate data were analyzed using the MMI v4 and an additional assortment of individual metrics. The following section provides a brief description of each tool that was used to assess the health of aquatic communities in this study.

Multi-Metric Index (MMI v4)

In the fall of 2010, the WQCD developed a Multi-Metric Index (MMI) to assist in the evaluation of benthic macroinvertebrate data from across the State of Colorado (Colorado Department of Public Health and Environment 2010). In 2017, the MMI was recalibrated and updated to produce a new analysis tool (the MMI v4) that relies on specific methods and protocols for sample processing and analysis (Colorado Department of Public Health and Environment 2017). This most recent version of the MMI provides a single index score based on eight equally weighted metrics. This score is then assessed along a threshold gradient correlated to overall aquatic health which determines the "aquatic life use designation' for a sampling location. The MMI v4 was applied to quantitative benthic macroinvertebrate data collected from the Blue River in 2021 using the guidelines established in the WQCD Listing Methodology, 2020 Listing Cycle (Colorado Department of Public Health and Environment 2019).

The group of metrics used in MMI v4 calculations depends on the sampling location and corresponding Biotype (Mountains, Transitional, or Plains). In the Blue River study area, the nine most upstream study sites were located in Biotype 2 (Mountains), while site BRC was located within Biotype 1 (the Transition Zone), which includes lower mountain areas in the State of Colorado. Each of the individual metrics used in the analysis produces a score that is adjusted to a scale from 1 to 100 based on the range of metric values found at "reference sites". In Biotype 1, these metrics include: EPT Taxa, % Non-Insect Individuals, % EPT Individuals (no Baetidae), % Coleoptera Individuals, % Intolerant Taxa, % Increaser Individuals (Mid-Elevation), Clinger Taxa, and Predator/Shredder Taxa. In Biotype 2, these metrics include: EPT Taxa, % EPT Individuals (no Baetidae), Clinger Taxa, Total Taxa, Intolerant Taxa, % Increasers (Mountains), Predator Taxa, and % Scraper Individuals. A detailed description of the component metrics and methods used to calculate MMI v4 scores can be found in the *Aquatic Life Use Attainment: Methodology to Determine Use Attainment for Rivers and Streams, Policy 10-1* and Appendix D of the *Section 303(d) Listing Methodology 2020 Listing Cycle* (Colorado Department of Public Health and Environment 2017 and 2019). The MMI v4 was developed using macroinvertebrate data that was mostly collected during the late summer or fall; therefore, it is expected to be most accurate when applied during those seasons. Thresholds for the MMI v4 in Biotypes 1 and 2 are as follows:

Biotype	Attainment Threshold	Impairment Threshold
Transitional (Biotype 1)	45.2	33.7
Mountains (Biotype 2)	47.5	39.8

MMI v4 scores that fall between the thresholds for attainment and impairment (the 'Grey Zone') require further evaluation using additional metrics to determine an aquatic life use designation. The additional metrics include Shannon Diversity (Diversity) and the Hilsenhoff Biotic Index (HBI). The specific thresholds for the auxiliary metrics in Biotypes 1 and 2 are listed below, followed by descriptions of each metric:

Biotype	HBI	Diversity
Transitional (Biotype 1)	5.8	2.1
Mountains (Biotype 2)	4.9	3.2

Shannon Diversity (Diversity): Diversity was used as an auxiliary metric for the MMI v4 and as an independent metric in this study to evaluate changes in macroinvertebrate community structure by providing a measure of community balance. In unpolluted waters, Diversity values typically range from near 3.0 to 4.0. In polluted waters, this value is generally less than 1.0 (Ward et al. 2002).

Hilsenhoff Biotic Index (HBI): The HBI is another auxiliary metric used for the MMI v4; however, it is also valuable as an independent metric and has been widely used and/or recommended in numerous regional biomonitoring studies (Paul et al. 2005). Most of the value from this metric lies in the detection of organic pollution, but it is also used to evaluate aquatic conditions in a variety of other circumstances. The HBI was originally developed using macroinvertebrate taxa from streams in Wisconsin; therefore, it may require regional modifications (Hilsenhoff 1988). Tolerance values for taxa occurring in this study area were taken from a list provided by the CDPHE, which was derived from a variety of regional sources. Although HBI values may naturally vary across regions, a comparison of the values produced within the same river system should provide information regarding locations impacted by nutrient-enrichment and/or other aquatic disturbances. Values for the HBI range from 0.0 to 10.0 and increase as water quality decreases.

Additional Metrics Used in this Study

In addition to the MMI v4 and associated auxiliary metrics, several other individual metrics were applied in the analysis of macroinvertebrate data from sites in the Blue River study area in order to provide a more thorough evaluation of macroinvertebrate community structure and function. The following section provides a description of each individual metric used in this study:

Richness measures:

Total EPT (Ephemeroptera Plecoptera Trichoptera) Taxa: The effectiveness of this metric is based on the assumption that the orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are generally more sensitive to pollution/perturbations than other benthic macroinvertebrate orders (Lenat 1988). The Total EPT Taxa metric is currently an important and widely used metric in many regions of the United States (Barbour et al. 1999). The Total EPT Taxa value is simply given as the total number of distinguishable taxa in the orders Ephemeroptera, Plecoptera, and

Trichoptera found at each sampling location. For the purpose of this study, each major component (insect order) used in this metric was reviewed separately in addition to the Total EPT Taxa value. Results from this metric are expected to naturally vary among river systems, but this tool can be an excellent indicator of disturbances within a specific drainage. The Total EPT Taxa value is expected to decrease in response to a variety of stressors including nutrient-enrichment (Wang et al. 2007).

Taxa Richness: The Taxa Richness (or Total Taxa) metric is reported as the total number of identifiable taxa collected from each sampling location. Total Taxa has become one of the most widely used metrics to evaluate stream health, as it provides a general indication of community health and stability (Courtemanch 1996). Taxa Richness values are expected to decrease with increased perturbations to the aquatic environment (Resh and Jackson 1993).

Clinger Taxa: This metric requires the reorganization of macroinvertebrates into groups based on their habits or modes of locomotion. The number of Clinger Taxa includes those macroinvertebrates which are adapted to attach to relatively clean benthic substrate. Perturbations such as excessive sedimentation, rapid changes in discharge, or excessive algal growth can cause a reduction in this metric value (Hughes and Brossett 2009).

***Composition measures*:**

Percent Clingers: This metric relies on the assumption that proportion of benthic macroinvertebrates with specific habitat adaptations will respond negatively to unnatural alterations in their preferred habitat. The above list of perturbations (sedimentation, rapid changes in discharge, and excessive algal growth) can not only reduce the richness of clinger taxa, but these types of impacts should cause a decline in the proportion of these specialized macroinvertebrates.

Percent Shredders and Scrapers: Shredders and Scrapers are often considered sensitive to disturbances because they are specialized feeders (Barbour et al. 1999). Consequently, these sensitive feeding groups are expected to be well-represented in healthy streams. Much of the value in this type of analysis comes from a comparison of sites within a specific study area.

Percent Chironomidae: The midge family Chironomidae is generally considered to be fairly tolerant of environmental stress compared to other aquatic insect families (Plafkin et al. 1989). The Percent Chironomidae metric relies on the assumption that the relative proportion of representatives from this family will increase with increasing stress or pollution. Streams that are undisturbed often have a relatively even distribution of Ephemeroptera, Plecoptera, Trichoptera, and Chironomidae (Mandaville 2002); while the family Chironomidae often dominates (75% or more of the macroinvertebrate density) at sites degraded by metals or other pollutants (Barton and Metcalf-Smith 1992). Most species in the family

Chironomidae tend to have a relatively short life-cycle which enables them to continually re-colonize unstable or polluted habitats, making their abundance a relatively reliable indicator of certain types of environmental stress (Lenat 1983).

Percent EPT: As previously stated, most taxa in the orders Ephemeroptera, Plecoptera, and Trichoptera are expected to be sensitive to environmental perturbations or pollution. Therefore, the percentage of individuals from EPT orders provides a measure of benthic macroinvertebrates (at each sampling location) that are expected to be sensitive to anthropogenic stressors or pollution. A decrease in the Percent EPT value suggests that the benthic macroinvertebrate community consists of a higher proportion of tolerant taxa.

***Abundance measures*:**

Density: Macroinvertebrate abundance (Density) was reported as the mean number of macroinvertebrates per m^2 found at each study site. The Density metric provides a means of measuring and comparing standing crop at each site. This metric can be useful when comparing food-web components among sites or when paired with dry weight information to evaluate changes in biomass throughout the study area.

Biomass: Biomass was reported as the mean dry weight of benthic macroinvertebrates per m^2 at each site. Biomass values were obtained by drying macroinvertebrates from each sample in a scientific drying oven at 100° C for 24 hours or until all water content had evaporated (no decrease in weight could be detected). Biomass values provide production-related information in terms of weight of macroinvertebrates produced at each site. Density and Biomass values offered a means of measuring standing crop, which provided an indication of productivity for the macroinvertebrate portion of the food web at each sampling location.

***Trophic measures*:**

Functional Feeding Groups: Most of the previously described metrics use macroinvertebrate information that is based on community structure; however, macroinvertebrate taxa were also separated into functional guilds based on methods of food acquisition to provide a measure of ecological function. All specimens were categorized according to feeding strategy to determine the relative proportion of various groups. Some representation of each feeding group usually indicates healthy aquatic conditions; however, it is normal for certain groups (such as collector-gatherers) to be more abundant than others (Ward et al. 2002). Scrapers and shredders are often considered sensitive to disturbance because they are specialized feeders (Barbour et al. 1999). Consequently, an assortment of feeding groups (including the most sensitive groups) is expected to be observed at healthy study sites in Colorado streams. Much of the value in this type of analysis comes from the comparison of sites within a specific drainage. Changes in the proportion of functional feeding groups can provide insight into various types of stress in river systems (Ward et al. 2002).

Results/Discussion

Quantitative benthic macroinvertebrate samples were collected from ten (10) study sites on the Blue River during the spring (24 April), summer (12 August), and fall (25 October) of 2021 to evaluate the health (structure and function) of benthic communities in this study area. After samples were collected, they were transported to the lab at Timberline Aquatics, Inc. where specimens were sorted, identified, and enumerated (Appendix A; Tables A1-A10, Appendix B; Tables B1-B10, Appendix C; Tables C1-C10). The previously described metrics and analysis tools (including the MMI v4) were used to provide a comprehensive assessment of macroinvertebrate community health in the Blue River.

In general, results from 2021 demonstrated a wide range of macroinvertebrate community parameters throughout the study area; however, several aspects of community structure and function followed patterns that were similar to those observed during seasonal sampling in 2020. The presence of Dillon Reservoir (and other potential anthropogenic stressors) appeared to have a continuous and substantial influence on macroinvertebrate community health at specific locations within the study area. Overall, a fairly predictable pattern of stress and recovery in this study area tended to persist not only among seasons, but also between years (2020 and 2021).

The MMI v4

A comprehensive evaluation of benthic macroinvertebrate community health was provided by the MMI v4 for 10 study sites on the Blue River during three seasons (spring, summer, and fall) in 2021. Changes in macroinvertebrate community structure and function from upstream to downstream were demonstrated by the MMI v4 and individual (component) metrics used in MMI v4 calculations (Tables 2-4). A comparison of MMI v4 scores among study sites indicated that some locations tended to maintain relatively stable macroinvertebrate communities regardless of the season; however, the benthic communities at other sites exhibited greater seasonal variability.

Study sites on the Blue River were distributed between two Biotypes in the State of Colorado (based on State classifications). The nine most upstream study sites were located in mountain habitat (Biotype 2), while the remaining study site (BRC) was located in a transitional area (Biotype 1) between the mountains and plains. In order to correctly utilize the MMI v4, all specimens were identified to the Operational Taxonomic Unit (OTU) that was established by the WQCD. For each Biotype, the MMI v4 was calculated using the appropriate set of component metrics, and final scores were evaluated using the corresponding thresholds for ‘attainment’ and ‘impairment’. While it is not always appropriate to compare MMI v4 scores between Biotypes, some of the component metrics (or individual metrics in the following section) provided an opportunity to make comparisons throughout the study area.

Spring 2021

During the spring (24 April) of 2021, the MMI v4 and associated component metrics generated scores that varied considerably throughout the study area (Table 2). The two sampling locations upstream from Dillon Reservoir (BRaFG and UBR) produced widely contrasting scores, while downstream from the reservoir, there was a clear pattern of impact followed by recovery. Site BRaFG was originally established in the spring of 2021 (creating a new upstream boundary for the study area), and the MMI v4 score of 32.7 indicated that this location was 'impaired' for aquatic life use (Table 2). Possible stressors at this location included (but were not limited to) flow manipulations (dewatering) and urban runoff associated with the Town of Breckenridge. Farther downstream (immediately upstream from Dillon Reservoir), an MMI v4 score of 60.8 implied that there was a considerable improvement in aquatic conditions at site UBR.

Downstream from Dillon Reservoir, results from the MMI v4 showed a distinct pattern of relatively severe stress (starting at site Blue 5) followed by gradual improvements in a downstream direction (Table 2, Figure 2). Scores from the MMI v4 (in Biotype 2) ranged from 14.9 at site Blue 5 to 70.2 at site SCR. Farther downstream, site BRC (the only site located in Biotype 1) generated a relatively high MMI v4 score of 72.3. Components for the MMI v4 suggested that much of the stress to aquatic life downstream from Dillon Reservoir could be attributed to the loss of sensitive and specialized macroinvertebrates (based on the EPT Taxa, % EPT Individuals [no Baetidae], and % Scraper Individuals scores). As the richness and relative abundance of sensitive and specialized individuals increased in a downstream direction, MMI v4 scores responded by showing consistent improvements in macroinvertebrate community health. A similar pattern of stress and recovery was also observed in the spring of 2020 (Figure 2).

In the spring of 2021, four study sites (BRaFG, Blue 5, DRD, and Blue 3) generated MMI v4 scores that were below the 'impairment' threshold. Only site D 5 produced an MMI v4 score in the 'Grey Zone' (the range of scores between the 'attainment' and 'impairment' thresholds), and the auxiliary metrics (Diversity and HBI) indicated that this location was in 'attainment' for aquatic life use (Table 2). Results from the MMI v4 (and auxiliary metrics) suggested that much of the stress to benthic macroinvertebrate communities downstream from Dillon Reservoir was likely associated with the alterations to the natural temperature and flow regimes (reservoir operations) and possibly other anthropogenic activities in densely populated areas.

Summer 2021

In order to evaluate the health of aquatic communities during the summer months, benthic macroinvertebrates were collected on 12 August, 2021 at the same ten study sites that were sampled during the spring season. Results from the MMI v4 (and component metrics) indicated that stress to aquatic life had become more wide-spread during the summer, resulting in scores that indicated 'impairment' at seven of the ten sampling sites (Table 3). Both of the study sites upstream from Dillon Reservoir (BRaFG and UBR) generated MMI v4 scores that were below the 'impairment' threshold, and five sites downstream from Dillon Dam were also considered ‘impaired’ (Table 3). The greatest impact to aquatic life was observed at site Blue 5, followed by slight recovery in a downstream direction to site Blue 3; however, a second decline in MMI v4 scores was observed at site D 5, which was followed by gradual improvements in a downstream direction (Figure 3). The MMI v4 scores in Biotype 2 ranged from 12.9 at site Blue 5 to 52.6 at site SCR, with site SCR generating the only MMI v4 score above the ‘attainment’ threshold (Table 3). The single sampling location in Biotype 1 (site BRC) produced a relatively high MMI v4 score (69.0) that was well-above the ‘attainment’ threshold during the summer of 2021.

During the August sampling event, detectable impacts to aquatic life upstream from Dillon Reservoir could mostly be attributed to a reduction in the proportion of sensitive and specialized individuals (based on % EPT Individuals [no Baetidae] and % Scraper Individuals, respectively). Downstream from the impoundment, there was a similar reduction in the proportion of sensitive and specialized individuals and an increase in the proportion of taxa that are resistant to environmental stressors or pollution (% Increasers, Mountain Trn). Auxiliary metrics indicated that community balance (Diversity) was disrupted at the same sampling locations that received poor MMI v4 scores downstream from the reservoir, and the HBI and TIV detected high proportions of nutrient-tolerant and sediment-tolerant individuals (respectively) at sites Blue 2 and Blue 1 (Table 3).

While the influence of releases from Dillon Reservoir continued to be the most likely source of stress to macroinvertebrate communities during the summer, the severity and longitudinal distribution of measurable impacts downstream from Dillon Dam appeared to be greater during this season (Figure 3). It is possible that brief periods of relatively warm surface-water spilling from Dillon Reservoir may have had an additional negative impact on macroinvertebrate communities that had adapted to cold-water releases during the summer months. Furthermore, there may be other sources of anthropogenic stress (e.g., urban runoff, etc.) having a negative influence on benthic macroinvertebrates in this portion of study area.

Fall 2021

Benthic macroinvertebrate sampling continued on 25 October, 2021 at the same ten study sites that were sampled during the spring and summer. Results from the MMI v4 (and associated metrics) generally suggested that spatial patterns of stress and recovery were similar to the patterns observed during the spring of 2021 (Tables 2 and 4). Scores generated by the MMI v4 in Biotype 2 ranged from 15.8 (site Blue 5) to 72.8 (site SCR), while the single sampling site in Biotype 1 (BRC) generated a relatively high score of 73.7 (Table 4). Upstream from Dillon Reservoir, site BRaFG produced an MMI v4 score (36.3) indicating ‘impairment’, while approximately 10 miles downstream, site UBR generated a score (54.6) that showed improvements in most community parameters. Much of the stress at site BRaFG was caused by relatively high numbers of tolerant individuals compared to lower proportions of sensitive and specialized taxa.

Downstream from Dillon Reservoir, the component metrics that detected the greatest stress included: % EPT Individuals (no Baetidae), % Increasers (Mountains), and % Scraper Individuals (Table 4). These metrics suggested that macroinvertebrate communities immediately downstream from the impoundment consisted of high proportions of tolerant taxa that were less specialized in their habits and habitat requirements. Many of the scores from MMI v4 component metrics improved rapidly downstream from site DRD, eventually leading to considerably higher MMI v4 scores in the downstream portion of the study area (Table 4; Figure 4). Results from the fall (and spring) suggested that macroinvertebrate community health was rapidly improving in a relatively short distance downstream from Dillon Dam and the Town of Silverthorne. During the fall of 2021, MMI v4 scores also showed a pattern of impact and recovery that was similar the pattern observed in the fall of 2020 (Figure 4).

A review of results provided by auxiliary metrics (HBI and Diversity) during all seasons in 2021 was used to determine the status of MMI v4 scores that were in the 'Grey Zone' (site D 5 in the spring and fall, and site Blue 3 in the summer), and to assist in the evaluation of macroinvertebrate data throughout the study area (Tables 2-4; Figures 5-6). In 2021, the majority of HBI values remained below the threshold set by the WQCD indicating that most sites supported low proportions of nutrient-tolerant individuals (Figure 5). The only two exceedances in HBI values were found at sites Blue 2 and Blue 1 during the summer season (Table 3). Overall, results from the HBI exhibited some spatial and seasonal variability, but most values suggested that nutrient-enrichment was an unlikely source of stress throughout most of the study area in 2021 (Figure 5).

Diversity values were also calculated (as part of the MMI v4 tool) using macroinvertebrate data from all three seasons in 2021. Although many Diversity values were below the State's threshold (3.2), these scores were never responsible for 'impairment' designations when study sites generated MMI v4 scores in the 'Grey Zone'. Overall, low Diversity values were frequently detected at study sites that produced MMI v4 scores below the 'impairment' threshold (Figure 6). This suggested that macroinvertebrate community balance, like many other measures of community health, was a good indicator of stress caused by reservoir operations, and the balance among macroinvertebrate taxa generally improved with distance downstream from Dillon Dam.

In summary, flow reductions and urban runoff associated with the Town of Breckenridge were likely responsible for 'impairment' designations at site BRaFG, while alterations from the natural flow and temperature regime were likely responsible for much of the stress leading to 'impairment' designations downstream from Dillon Reservoir. Seasonal and spatial variability in the pattern of recovery (with respect to distance downstream from the reservoir) suggested that factors such as surface-water releases, input from tributaries, and possibly other sources of anthropogenic stress (urban runoff) may have had various influences on the health and recovery of benthic macroinvertebrate communities at different times during the year. The following section provides a review of additional individual metrics that were used to assist in the assessment of macroinvertebrate community health (structure and function) in 2021.

Table 2. MMI v4 scores from composited replicate Hess samples collected from ten study sites on the Blue River on 24 April 2021. Scores indicating 'impairment' are provided in red.

Metric	BRaFG	UBR	Blue 5	DRD	Blue 3	D 5	Blue 2	Blue 1	SCR	BRC
	Biotype 2									Biotype 1
EPT Taxa	57.5	86.2	21.6	28.7	64.7	79.0	86.2	86.2	100.0	62.5
% EPT individuals, no Baetidae	46.0	70.4	2.6	8.8	23.8	42.8	58.3	66.3	78.5	94.3
Clinger Taxa	30.0	50.0	5.0	10.0	35.0	45.0	60.0	50.0	75.0	81.7
Total Taxa	42.9	57.1	28.6	33.3	42.9	52.4	64.3	50.0	73.8	--
Intolerant Taxa	38.1	57.1	19.0	23.8	42.9	57.1	61.9	57.1	71.4	--
% Increasers, Mountain Trn	6.4	54.6	2.4	9.7	24.4	26.3	34.1	66.0	45.4	--
Predator Taxa	38.5	38.5	30.8	38.5	23.1	38.5	69.2	53.8	53.8	--
% Scraper Individuals	2.0	72.3	9.4	10.1	23.8	27.5	43.5	100.0	63.7	--
% Non-Insect Individuals	--	--	--	--	--	--	--	--	--	87.3
% Coleoptera Individuals	--	--	--	--	--	--	--	--	--	13.4
% Intolerant Taxa	--	--	--	--	--	--	--	--	--	62.7
% Increasers, Mid-Elevation	--	--	--	--	--	--	--	--	--	90.6
Predator/Shredder taxa	--	--	--	--	--	--	--	--	--	85.7
MMI Score	**32.7**	**60.8**	**14.9**	**20.4**	**35.1**	**46.1**	**59.7**	**66.2**	**70.2**	**72.3**
Auxiliary Metrics										
Shannon Diversity	2.54	3.00	2.35	1.54	2.23	3.27	3.61	2.68	3.89	4.01
HBI	2.66	3.15	4.60	4.67	4.31	3.50	3.08	3.46	2.62	2.54
TIV (Sediment Region 1)	3.35	3.55	5.48	4.59	4.33	4.64	4.06	3.77	3.70	NA

Table 3. MMI v4 scores from composited replicate Hess samples collected from ten study sites on the Blue River on 12 August 2021. Scores indicating 'impairment' are provided in red.

Metric	BRaFG	UBR	Blue 5	DRD	Blue 3	D 5	Blue 2	Blue 1	SCR	BRC
	Biotype 2									Biotype 1
EPT Taxa	49.2	35.7	22.3	44.7	58.1	35.7	40.2	53.6	62.6	62.5
% EPT individuals, no Baetidae	9.1	20.4	1.7	4.3	25.8	28.7	5.6	6.3	43.7	67.6
Clinger Taxa	45.0	35.0	15.0	50.0	60.0	40.0	30.0	50.0	65	67.3
Total Taxa	61.9	50.0	26.2	47.6	57.1	45.2	52.4	59.5	81	--
Intolerant Taxa	47.6	38.1	28.6	52.4	61.9	52.4	57.1	57.1	81	--
% Increasers, Mountain Trn	14.9	19.2	0.9	5.6	38.1	6.3	4.8	6.1	19	--
Predator Taxa	53.8	30.8	7.7	23.1	23.1	15.4	46.2	30.8	61.5	--
% Scraper Individuals	9.8	12.7	0.7	10.7	6.8	6.2	4.3	3.3	6.8	--
% Non-Insect Individuals	--	--	--	--	--	--	--	--	--	97.8
% Coleoptera Individuals	--	--	--	--	--	--	--	--	--	8.1
% Intolerant Taxa	--	--	--	--	--	--	--	--	--	84.6
% Increasers, Mid-Elevation	--	--	--	--	--	--	--	--	--	100.0
Predator/Shredder taxa	--	--	--	--	--	--	--	--	--	64.3
MMI Score	**36.4**	**30.2**	**12.9**	**29.8**	**41.4**	**28.7**	**30.1**	**33.4**	**52.6**	**69.0**
Auxiliary Metrics										
Shannon Diversity	3.80	3.62	1.41	2.37	3.56	2.90	1.55	1.60	3.98	3.76
HBI	4.03	4.38	4.68	4.83	3.80	4.48	5.70	5.69	3.36	3.01
TIV (Sediment Region 1)	4.87	4.77	4.50	4.88	4.84	5.38	6.71	6.54	4.87	NA

Table 4. MMI v4 scores from composited replicate Hess samples collected from ten study sites on the Blue River on 25 October 2021. Scores indicating 'impairment' are provided in red.

Metric	BRaFG	UBR	Blue 5	DRD	Blue 3	D 5	Blue 2	Blue 1	SCR	BRC
	Biotype 2									Biotype 1
EPT Taxa	36.7	44.9	16.3	20.4	40.8	44.9	61.2	65.3	65.3	70.8
% EPT individuals, no Baetidae	47.1	65.4	0.8	4.7	40.2	38.3	52.7	61.6	91.6	75.6
Clinger Taxa	35.0	45.0	20.0	15.0	50.0	45.0	70.0	60.0	75	81.7
Total Taxa	57.1	45.2	38.1	38.1	47.6	54.8	66.7	66.7	81	--
Intolerant Taxa	42.9	52.4	23.8	28.6	52.4	61.9	76.2	76.2	85.7	--
% Increasers, Mountain Trn	20.0	69.2	0.9	6.5	17.7	28.6	48.8	48.0	34.1	--
Predator Taxa	38.5	38.5	23.1	15.4	30.8	30.8	69.2	61.5	84.6	--
% Scraper Individuals	13.2	76.3	3.0	5.3	4.1	23.4	59.7	68.4	64.9	--
% Non-Insect Individuals	--	--	--	--	--	--	--	--	--	98.5
% Coleoptera Individuals	--	--	--	--	--	--	--	--	--	12.4
% Intolerant Taxa	--	--	--	--	--	--	--	--	--	93.7
% Increasers, Mid-Elevation	--	--	--	--	--	--	--	--	--	100.0
Predator/Shredder taxa	--	--	--	--	--	--	--	--	--	57.1
MMI Score	**36.3**	**54.6**	**15.8**	**16.8**	**35.5**	**41.0**	**63.1**	**63.5**	**72.8**	**73.7**
Auxiliary Metrics										
Shannon Diversity	3.23	3.25	2.24	2.05	2.89	3.50	3.96	3.40	3.72	3.42
HBI	2.91	3.46	4.81	4.33	3.30	3.08	3.33	3.32	2.34	3.18
TIV (Sediment Region 1)	4.08	3.70	5.16	4.32	4.08	4.79	4.87	4.10	3.62	NA

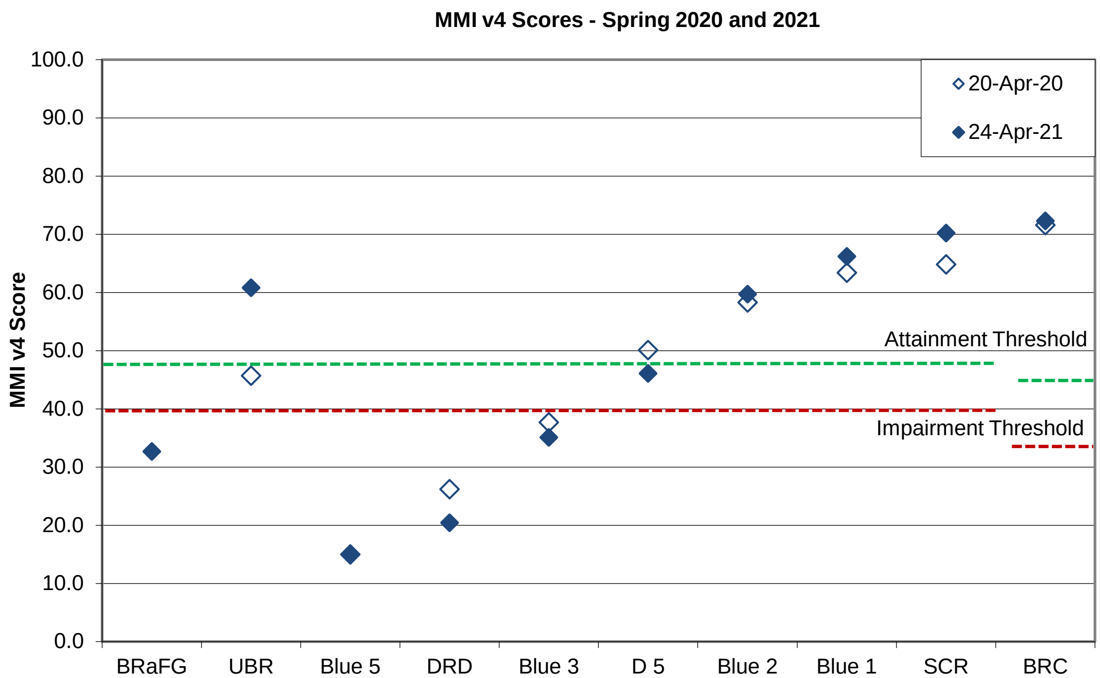


Figure 2. MMI v4 scores from composited quantitative (Hess) samples at study sites on the Blue River during April 2020 and 2021.

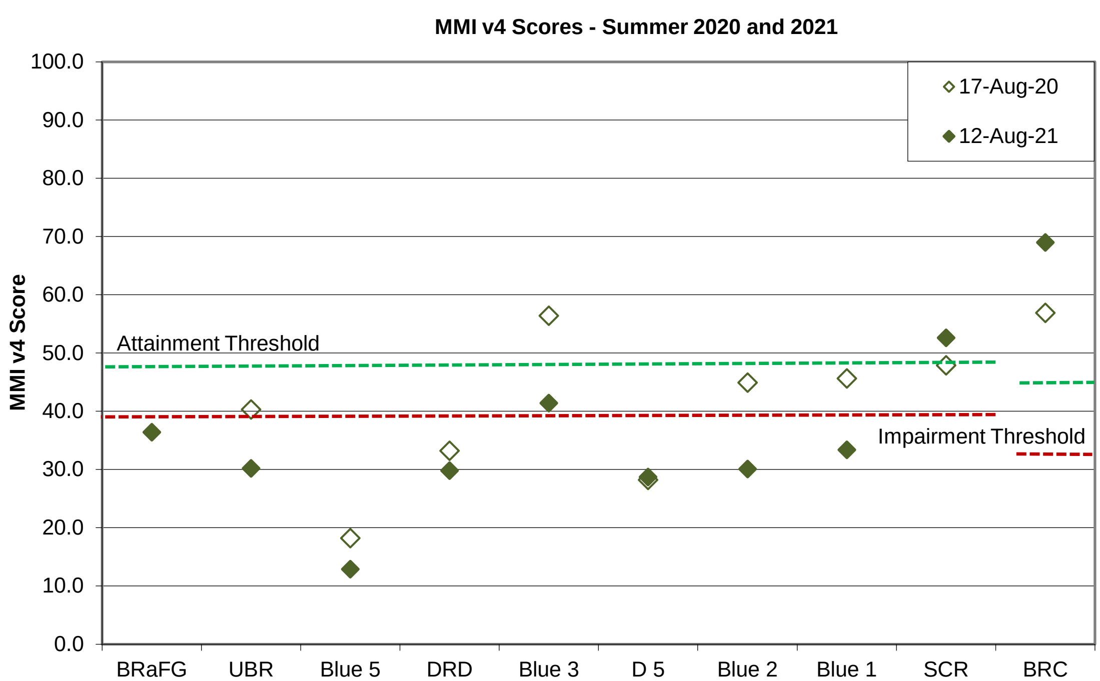


Figure 3. MMI v4 scores from composited quantitative (Hess) samples at study sites on the Blue River during August 2020 and 2021.

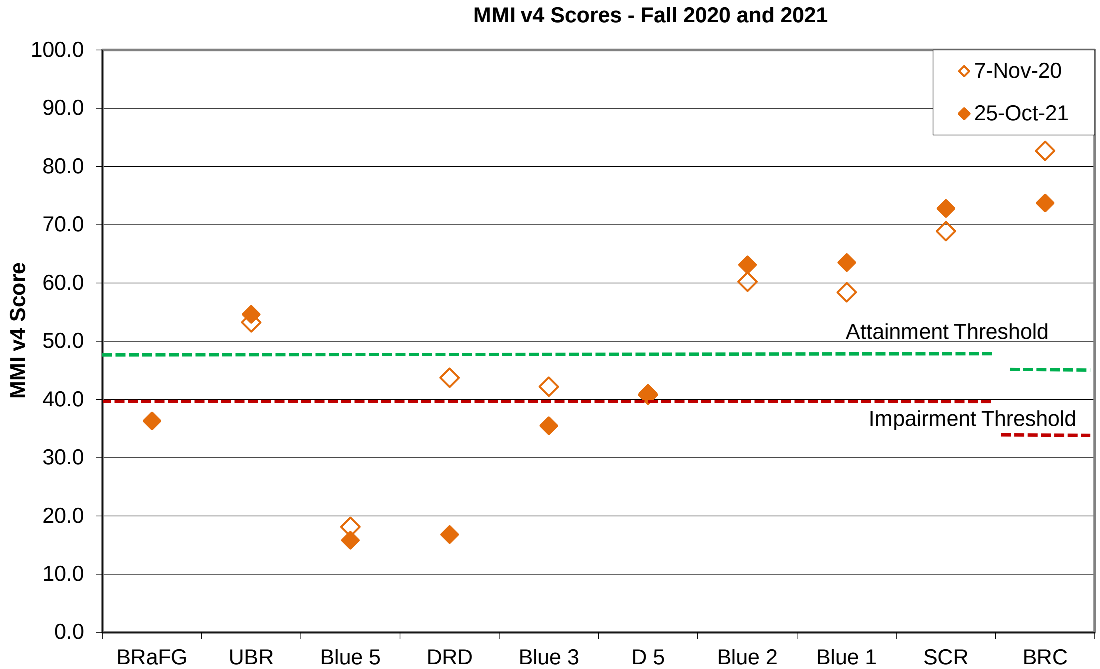


Figure 4. MMI v4 scores from composited quantitative (Hess) samples at study sites on the Blue River during November 2020 and October 2021.

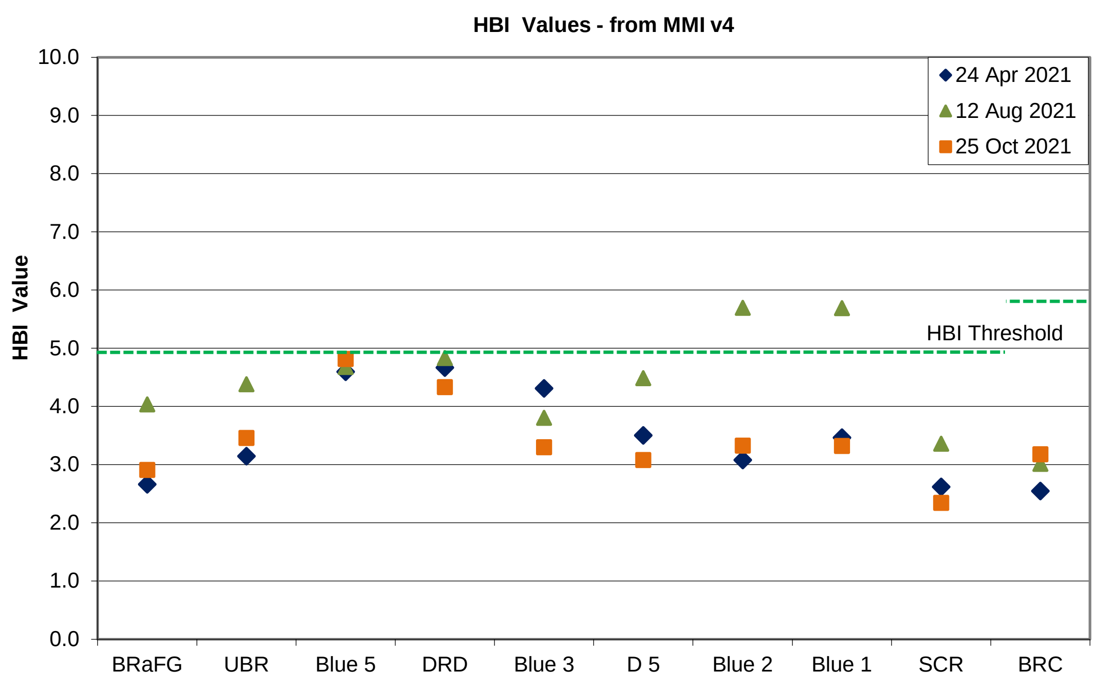


Figure 5. HBI values from composited quantitative (Hess) samples at study sites on the Blue River during April, August and October 2021.

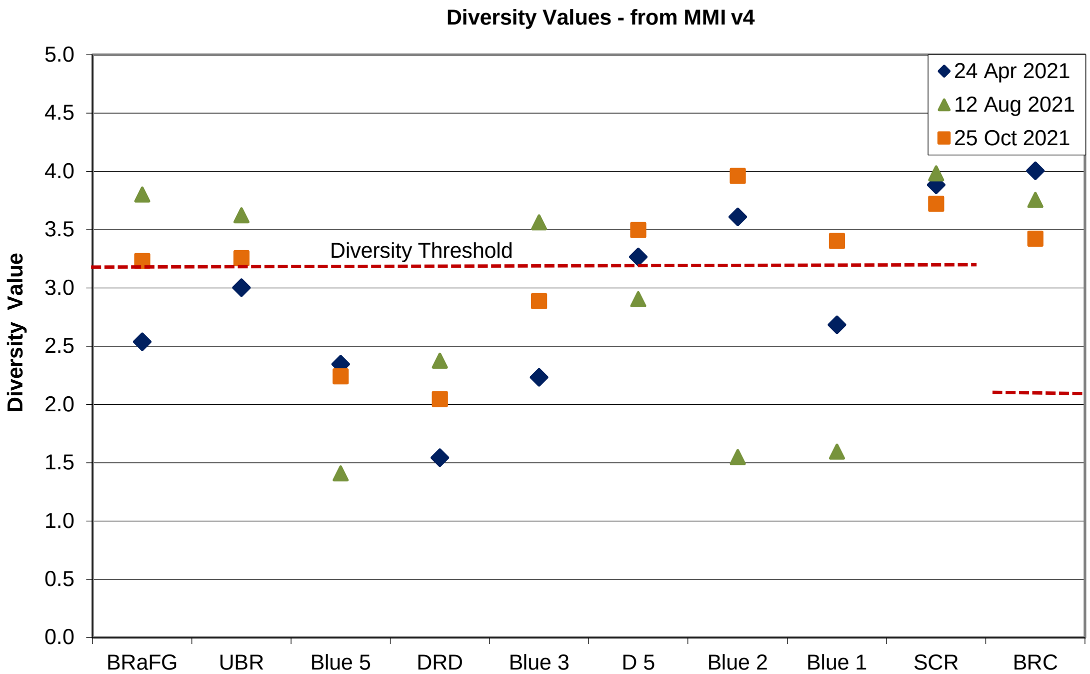


Figure 6. Shannon Diversity values from composited quantitative (Hess) samples at study sites on the Blue River during April, August and October 2021.

Table 5. Aquatic life use designations based on MMI v4 scores from quantitative (Hess) samples at sites in the Blue River study area, 2021.

Aquatic Life Use Designations in 2021 based on MMI (v4)			
Site	**Spring 2021**	**Summer 2021**	**Fall 2021**
BRaFG	Impairment	Impairment	Impairment
UBR	Attainment	Impairment	Attainment
Blue 5	Impairment	Impairment	Impairment
DRD	Impairment	Impairment	Impairment
Blue 3	Impairment	Attainment	Impairment
D 5	Attainment	Impairment	Attainment
Blue 2	Attainment	Impairment	Attainment
Blue 1	Attainment	Impairment	Attainment
SCR	Attainment	Attainment	Attainment
BRC	Attainment	Attainment	Attainment

Additional Evaluation (Individual Metrics)

In the previous section, results from the MMI v4 (and associated metrics) were based on a subset of specimens (approximately 300) from composited Hess samples. This rarefication process is built into the MMI v4 program to ensure that a consistent allocation of data can be compared when using different sampling techniques throughout the State of Colorado. It should be noted that some bias may occur during this rarefication process, and inevitably some taxa may be excluded or poorly represented. Therefore, the following analysis was conducted using all specimens from each quantitative sample (Tables 6-11).

Spring 2021

In the spring (24 April) of 2021, most of the individual metrics indicated that there were stream reaches both upstream and downstream from Dillon Reservoir showing evidence of stress and recovery (Tables 6 and 7). Upstream from the reservoir, there was evidence of moderate to severe impacts to the macroinvertebrate community at site BRaFG; however, considerable improvements were detected farther downstream at site UBR. Impacts to community structure at site BRaFG could be generally characterized as a reduction in taxa richness and abundance. Individual metrics that provided indications of this type of stress included: Total EPT Taxa, Taxa Richness, Total Density, and Total Dry Weight (Tables 6 and 7). These types of impacts are known to occur in response to a variety of stressors including urban runoff and flow diversions. Site BRaFG is located within the Town of Breckenridge and dewatering has been reported near this location. Farther downstream (but still upstream from Dillon Reservoir), there were improvements in all of the above-mentioned metrics (Tables 6 and 7), indicating that the macroinvertebrate community had become more diverse and stable at site UBR.

Immediately downstream from Dillon Dam, individual metrics detected impacts to macroinvertebrate community structure and function that could probably be attributed to hypolimnetic releases from Dillon Reservoir. Specific impacts at sites Blue 5 and DRD were mostly related to reductions in the richness and abundance of some of the most environmentally sensitive insect taxa (EPT Taxa). The Total EPT Taxa value, which includes mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera), was the lowest in the study area at sites Blue 5 (and DRD), and while site Blue 5 supported a high percentage of Ephemeroptera (46.29%), all of these individuals were the tolerant baetid, *Baetis tricaudatus* (Tables 6 and 7; Appendix A, Table A3). Generally, stoneflies and caddisflies are considered among the most sensitive groups of aquatic insects in regulated streams. A review of individual metric results showed that stoneflies and caddisflies comprised less than 3.0% of the macroinvertebrate community at sites Blue 5 and DRD, and members of the important net-spinning caddisfly (Hydropsychidae) were completely absent (Tables 6 and 7). Despite detectable impacts to aquatic life near Dillon Dam, most metrics suggested that stress to macroinvertebrate communities was ameliorated with distance in a downstream direction (Tables 6 and 7). The improvements observed in the lower portion of the study area may have been enhanced by select taxa drifting and recolonizing downstream from several tributaries along the Blue River.

Table 6. Individual metrics and comparative values for quantitative benthic macroinvertebrate samples collected from the Blue River, 24 April 2021.

Metric	BRaFG	UBR	Blue 5	DRD	Blue 3	D 5	Blue 2	Blue 1	SCR	BRC
# Ephemeroptera Taxa	2	4	1	2	3	3	5	4	6	6
# Plecoptera Taxa	4	4	2	2	6	5	6	5	4	3
# Trichoptera Taxa	2	4	1	0	2	5	6	4	7	7
Total EPT Taxa	**8**	**12**	**4**	**4**	**11**	**13**	**17**	**13**	**17**	**16**
Taxa Richness	**18**	**24**	**16**	**14**	**25**	**27**	**35**	**26**	**35**	**36**
Clinger Taxa	**10**	**13**	**5**	**6**	**12**	**15**	**19**	**15**	**20**	**20**
Hydropsychidae Density (estimated #/m²)	**0**	**171**	**0**	**0**	**39**	**252**	**353**	**97**	**202**	**35**
% Clingers	**63.22%**	**60.88%**	**1.28%**	**5.42%**	**17.51%**	**28.81%**	**36.70%**	**50.30%**	**59.34%**	**77.70%**
% Shredders and Scrapers	**2.01%**	**30.73%**	**0.13%**	**4.29%**	**10.80%**	**9.20%**	**32.28%**	**45.30%**	**36.43%**	**41.94%**
% Chironomidae	**16.67%**	**8.25%**	**45.01%**	**17.83%**	**18.97%**	**50.70%**	**39.86%**	**14.24%**	**18.92%**	**13.25%**

Table 7. Additional metrics and comparative values for quantitative benthic macroinvertebrate samples collected on the Blue River, 24 April 2021.

Metric	BRaFG	UBR	Blue 5	DRD	Blue 3	D 5	Blue 2	Blue 1	SCR	BRC
% Ephemeroptera individuals	0.57%	57.61%	46.29%	78.56%	70.69%	24.65%	27.37%	74.85%	38.90%	49.67%
% Plecoptera individuals	2.59%	6.12%	1.53%	2.48%	6.81%	9.73%	7.00%	2.42%	2.23%	1.77%
% Trichoptera individuals	33.62%	19.49%	0.13%	0.00%	1.63%	13.46%	21.58%	7.12%	33.49%	22.08%
Percent EPT	**36.78%**	**83.21%**	**47.95%**	**81.04%**	**79.13%**	**47.85%**	**55.96%**	**84.39%**	**74.62%**	**73.51%**
Ephemeroptera (estimated #/m²)	8	1,572	1,404	1,349	3,021	1,974	2,184	1,917	1,285	875
Plecoptera (estimated #/m²)	36	169	47	43	292	781	560	64	75	32
Trichoptera (estimated #/m²)	454	532	4	0	71	1,080	1,724	183	1,107	390
Other (estimated #/m²)	857	465	1,581	329	896	4,181	3,518	404	844	474
Total Density (estimated #/m²)	**1,355**	**2,738**	**3,036**	**1,721**	**4,280**	**8,016**	**7,986**	**2,568**	**3,311**	**1,771**
Total Dry Wt (estimated g/m²)	**0.2756**	**1.4578**	**0.3318**	**0.2624**	**0.6833**	**4.0217**	**3.8884**	**1.3876**	**2.5806**	**1.2752**

Summer 2021

Benthic macroinvertebrate sampling and analysis continued in the summer (12 August) of 2021 to provide a seasonal perspective on longitudinal patterns of macroinvertebrate community structure and function in the Blue River. The most likely sources of stress during the summer months included urban runoff (near the Towns of Breckenridge and Silverthorne), hypolimnetic releases from Dillon Reservoir, and rapid increases in water temperature from surface water spilling into the Blue River. Individual metrics generally detected low to moderate levels of stress upstream from Dillon Reservoir (sites BRaFG and UBR), and a more extensive area of low to moderate stress at sampling locations downstream from Dillon Dam (Tables 8 and 9).

During the summer season, individual metrics were often inconsistent in their interpretation of macroinvertebrate community health. While most of the individual metrics continued to detect negative impacts at the same study sites that were stressed during the spring season, metrics that measure community richness (Total EPT Taxa, Taxa Richness, and Clinger Taxa) suggested there were improvements at site BRaFG, and rapid improvements at many of the sampling locations downstream from site Blue 5 (Table 8). Interestingly, an increase in the richness of sensitive and specialized taxa was not always supported by improvements in the proportion of sensitive and specialized taxa, and the combination of individual metric values suggested that macroinvertebrate communities may not be reaching optimal structure and function in the Blue River until the lower boundary of the study area (Tables 8 and 9).

Upstream from Dillon Reservoir, the Total EPT Taxa, Taxa Richness, and Clinger Taxa metrics showed improvements at site BRaFG when compared to results from the spring sampling event; however, each of these metrics demonstrated a decline farther downstream at site UBR. Alternatively, the Hydropsychidae Density, Percent Shredders and Scrapers, Percent EPT, and densities of sensitive taxa (Ephemeroptera, Plecoptera, and Trichoptera) all showed improvement at site UBR (Tables 8 and 9). In summary, individual metrics detected a greater number of sensitive taxa at site BRaFG; however, higher densities and greater proportions of sensitive taxa were found at site UBR. Although individual metrics detected substantial changes in community composition between sites BRaFG and UBR, both sites appeared to be moderately stressed.

Most of the applied metrics agreed that the macroinvertebrate community was highly stressed immediately downstream from Dillon Dam during the summer of 2021; however, the interpretation of community health and distance downstream to recovery differed between individual metrics (Tables 8 and 9). Metrics that consistently identified site Blue 5 as the most stressed site in the study area included: Total EPT Taxa, Taxa Richness, Clinger Taxa, Percent Clingers, Percent Shredders and Scrapers, Total Density, and Total Dry Weight (Tables 8 and 9). Individual metrics that measure richness parameters (Total EPT Taxa, Taxa Richness, and Clinger Taxa) showed rapid improvements in a downstream direction while metrics that measure proportion or abundances of sensitive individuals were more variable. For example, the Percent EPT value was the highest in the study area at site Blue 5 and decreased in a downstream direction to site Blue 2 (Table 9). This metric was highly influenced by the abundance of *Baetis tricaudatus* (Appendix B, Table B3), a species of mayfly known to be tolerant to alterations in temperature and flow. Results from the summer of 2021 suggest that the number of sensitive taxa improved rapidly downstream from Dillon Dam; however, the aquatic conditions did not support greater proportions of sensitive taxa for many miles downstream.

Table 8. Individual metrics and comparative values for quantitative benthic macroinvertebrate samples collected from the Blue River, 12 August 2021.

Metric	BRaFG	UBR	Blue 5	DRD	Blue 3	D 5	Blue 2	Blue 1	SCR	BRC
# Ephemeroptera Taxa	7	4	2	5	8	4	8	8	7	4
# Plecoptera Taxa	4	3	1	3	5	3	3	3	4	4
# Trichoptera Taxa	4	2	2	3	2	4	4	5	6	8
Total EPT Taxa	**15**	**9**	**5**	**11**	**15**	**11**	**15**	**16**	**17**	**16**
Taxa Richness	**33**	**24**	**11**	**22**	**29**	**27**	**33**	**37**	**40**	**33**
Clinger Taxa	**16**	**11**	**3**	**11**	**14**	**13**	**15**	**16**	**17**	**16**
Hydropsychidae Density (estimated #/m^2)	**8**	**54**	**4**	**4**	**39**	**147**	**178**	**120**	**155**	**136**
% Clingers	**32.95%**	**29.84%**	**4.52%**	**14.60%**	**40.60%**	**51.63%**	**83.23%**	**81.47%**	**40.59%**	**69.34%**
% Shredders and Scrapers	**3.68%**	**5.74%**	**0.00%**	**2.72%**	**4.87%**	**0.27%**	**1.17%**	**2.18%**	**6.72%**	**33.41%**
% Chironomidae	**31.18%**	**30.16%**	**12.56%**	**17.57%**	**27.49%**	**27.00%**	**10.48%**	**9.14%**	**47.47%**	**15.79%**

Table 9. Additional metrics and comparative values for quantitative benthic macroinvertebrate samples collected on the Blue River, 12 August 2021.

Metric	BRaFG	UBR	Blue 5	DRD	Blue 3	D 5	Blue 2	Blue 1	SCR	BRC
% Ephemeroptera individuals	30.16%	44.10%	77.64%	63.12%	33.06%	19.42%	5.39%	8.02%	9.54%	12.36%
% Plecoptera individuals	1.39%	2.46%	0.75%	1.98%	8.93%	2.15%	1.49%	2.76%	3.34%	5.03%
% Trichoptera individuals	2.66%	8.03%	0.50%	0.74%	9.05%	20.46%	1.84%	1.67%	30.75%	45.08%
Percent EPT	**34.22%**	**54.59%**	**78.89%**	**65.84%**	**51.04%**	**42.03%**	**8.73%**	**12.44%**	**43.62%**	**62.47%**
Ephemeroptera (estimated #/m²)	925	1,045	1,198	990	1,108	3,122	1,038	860	712	211
Plecoptera (estimated #/m²)	44	60	12	32	300	346	288	296	250	86
Trichoptera (estimated #/m²)	82	191	8	12	303	3,289	354	181	2,291	767
Other (estimated #/m²)	2,019	1,081	329	541	1,641	9,321	17,521	9,365	4,203	642
Total Density (estimated #/m²)	**3,070**	**2,377**	**1,547**	**1,575**	**3,352**	**16,078**	**19,201**	**10,702**	**7,456**	**1,706**
Total Dry Wt (estimated g/m²)	**0.8450**	**1.0302**	**0.1535**	**0.1992**	**0.5155**	**2.0349**	**2.2066**	**1.8969**	**1.2244**	**1.4217**

Fall 2021

Seasonal benthic macroinvertebrate monitoring continued on the Blue River during the fall (25 October) of 2021 using the same individual metrics that were applied during previous seasonal (spring and summer) sampling events. Results from data analysis were used to assess changes in macroinvertebrate community health and ultimately provide insight into the overall ecological integrity of the Blue River during the fall season. A review of the results from individual metrics indicated that stressed aquatic communities existed both upstream from Dillon Reservoir (site BRaFG) and downstream from the reservoir (sites Blue 5, DRD, and Blue 3); however, most metrics also detected strong recovery gradients of macroinvertebrate structure and function downstream from the locations with the greatest stress (Tables 10 and 11).

Upstream from Dillon Reservoir, many of the individual metrics detected moderate levels of stress at site BRaFG, followed by improvements in community parameters farther downstream at site UBR (Tables 10 and 11). Overall, the benthic macroinvertebrate community at site BRaFG could be characterized as supporting relatively low densities of individuals with few sensitive or specialized taxa. A comparison of the Total EPT Taxa value (9) to the Taxa Richness value (24) suggested that less than half (38%) of the taxa at site BRaFG were considered sensitive to anthropogenic disturbances, and the Percent Shredders and Scrapers metric indicted that only about 5.0% of the community displayed specialized feeding strategies (Table 10). Farther downstream at site UBR, a comparison of the Total EPT Taxa value (12) to the Taxa Richness value (23) indicated that approximately 52% of the taxa were sensitive to anthropogenic stressors, and the Percent Shredders and Scrapers value increased to 35.25% (Table 10). Additionally, the Total Density value improved in a downstream direction from 1,402 individuals/m^2 at site BRaFG to 2,374 individuals/m^2 at site UBR (Table 11).

Downstream from Dillon Reservoir, most of the individual metrics demonstrated a longitudinal pattern of stress and recovery that was similar to the pattern observed during previous seasonal sampling events. Moderate to severe impacts were detected within several miles of Dillon Dam, but rapid improvements in macroinvertebrate community health were observed downstream from the dam and the Town of Silverthorne. During October of 2021, the majority of individual metrics suggested that the macroinvertebrate communities at sites Blue 5 and DRD were the most stressed in the study area, while much of the recovery in community parameters occurred between sites DRD and Blue 2 (Tables 10 and 11). The summation of the most sensitive macroinvertebrate taxa, EPT Taxa, ranged from a low of only four taxa at site Blue 5 to a high of 20 EPT Taxa at sites Blue 1 and SCR (Table 10). Only one species of Hydropsychid caddisfly (*Arctopsyche grandis*) was found at site Blue 5 and the density of this species was estimated at 4 individuals/m^2 (Appendix C, Table C3). At the farthest downstream site in the study area (site BRC) the density of Hydropsychid caddisflies had improved to 403 individuals/m^2 (Table 10). Similarly, the Total Density estimate for all benthic macroinvertebrates was lowest at site DRD (832 individuals/m^2); however, abundances improved rapidly downstream and remained relatively high from site D 5 to site BRC (Table 11). In general, sites Blue 2, Blue 1, SCR, and BRC exhibited good community health and produced relatively high values from the following metrics: Total EPT Taxa, Taxa Richness, Clinger Taxa, Percent Shredders and Scrapers, and Total Density (Tables 10 and 11). Again, it is likely that the repopulation of sensitive taxa in the lower reaches of this study area reflected faunal contributions from the numerous tributaries along the Blue River.

Table 10. Individual metrics and comparative values for quantitative benthic macroinvertebrate samples collected from the Blue River, 25 October 2021.

Metric	BRaFG	UBR	Blue 5	DRD	Blue 3	D 5	Blue 2	Blue 1	SCR	BRC
# Ephemeroptera Taxa	3	3	3	2	5	4	5	7	6	7
# Plecoptera Taxa	4	6	0	2	4	4	7	8	5	5
# Trichoptera Taxa	2	3	1	1	2	5	6	5	9	7
Total EPT Taxa	**9**	**12**	**4**	**5**	**11**	**13**	**18**	**20**	**20**	**19**
Taxa Richness	**24**	**23**	**16**	**16**	**23**	**30**	**33**	**34**	**42**	**31**
Clinger Taxa	**12**	**14**	**6**	**4**	**13**	**14**	**19**	**16**	**21**	**19**
Hydropsychidae Density (estimated #/m²)	**12**	**97**	**4**	**0**	**78**	**120**	**140**	**66**	**155**	**403**
% Clingers	**49.30%**	**66.39%**	**24.17%**	**4.23%**	**42.34%**	**39.07%**	**40.42%**	**35.68%**	**55.70%**	**87.60%**
% Shredders and Scrapers	**5.01%**	**35.25%**	**0.33%**	**1.88%**	**2.46%**	**8.41%**	**28.57%**	**44.42%**	**43.41%**	**33.26%**
% Chironomidae	**10.58%**	**1.64%**	**15.23%**	**9.39%**	**12.29%**	**29.44%**	**32.56%**	**20.71%**	**15.04%**	**4.28%**

Table 11. Additional metrics and comparative values for quantitative benthic macroinvertebrate samples collected on the Blue River, 25 October 2021.

Metric	BRaFG	UBR	Blue 5	DRD	Blue 3	D 5	Blue 2	Blue 1	SCR	BRC
% Ephemeroptera individuals	22.28%	52.13%	51.99%	72.30%	38.94%	28.41%	43.41%	53.24%	21.42%	11.09%
% Plecoptera individuals	9.19%	5.41%	0.00%	3.29%	3.97%	3.46%	4.21%	3.56%	2.26%	4.50%
% Trichoptera individuals	27.30%	12.30%	0.33%	0.47%	29.30%	21.03%	9.63%	15.61%	51.50%	44.13%
Percent EPT	**58.77%**	**69.84%**	**52.32%**	**76.06%**	**72.21%**	**52.90%**	**57.25%**	**72.41%**	**75.18%**	**59.71%**
Ephemeroptera (estimated #/m²)	311	1,234	609	598	800	1,180	1,521	2,553	1,030	393
Plecoptera (estimated #/m²)	130	131	0	28	83	145	150	173	110	160
Trichoptera (estimated #/m²)	381	292	4	4	602	874	339	749	2,472	1,562
Other (estimated #/m²)	580	717	563	202	575	1,961	1,503	1,327	1,199	1,428
Total Density (estimated #/m²)	**1,402**	**2,374**	**1,176**	**832**	**2,060**	**4,160**	**3,513**	**4,802**	**4,811**	**3,543**
Total Dry Wt (estimated g/m²)	**0.2488**	**0.5372**	**0.1434**	**0.1074**	**0.5523**	**1.3291**	**1.1942**	**0.6899**	**2.2798**	**1.1143**

General Observations - 2021

When comparing results from select metrics during all three sampling periods, 24 April (Spring), 12 August (Summer), and 25 October (Fall) of 2021, there were certain longitudinal changes in macroinvertebrate community structure and function that appeared to remain relatively similar regardless of the season (Figures 7-14). Several individual metrics that consistently detected stress immediately downstream from Dillon Dam included the Total EPT Taxa, Taxa Richness, Clinger Taxa, and Percent Shredders and Scrapers metrics. Despite the detection of stress near Dillon Dam, each of these metrics also showed evidence of a general recovery gradient in a downstream direction (Figures 7-10). This pattern of impact and recovery is typical and expected downstream from hypolimnetic release reservoirs. The Total EPT Taxa and Taxa Richness values appeared to be consistently reduced at sites Blue 5 and DRD (the sites in closest proximity to the dam), but values from these metrics increased substantially farther downstream at site Blue 2 during all seasons (Figures 7 and 8). During each season, the lowest Clinger Taxa value (less than 7) was also found at either site Blue 5 or DRD; however, this metric typically showed rapid improvements with values consistently exceeding 15 at study sites downstream from site Blue 1 (Figure 9). While many of the macroinvertebrates that are classified as Clinger Taxa may be adversely affected by an unnatural thermal regime, these taxa are also typically sensitive to rapid changes in discharge (associated with regulated streams) because they are typically poor swimmers.

The seasonal spatial patterns produced by the Percent Shredders and Scrapers metric were slightly different than those produced by metrics that measure community richness parameters (Figure 10). Results from 2021 suggested that specialized feeding guilds (Shredders and Scrapers) were poorly represented during all seasons at site BRaFG and the study sites immediately downstream from Dillon Reservoir; however, both feeding groups showed a capacity for recovery (which was greatest during the spring and fall seasons) (Figure 10). The specific impacts affecting these specialized feeding groups at site BRaFG are unknown; however, the coarse particulate organic material from the adjacent riparian habitat (that provides a food resource for shredders) is expected to be poorly represented immediately downstream from reservoirs. Improvements in percent composition of Shredders and Scrapers in a downstream direction could likely be attributed to improvements in periphyton community composition and/or increased riparian habitat along the length of the Blue River and its tributaries.

While most metrics detected a pattern of impact followed by recovery downstream of Dillon Reservoir, other individual metrics such as Percent EPT, Total Density, Total Dry Weight, and Mean Dry Weight exhibited greater variability among sampling locations and seasons (Figures 11-14). The Percent EPT metric produced relatively high values during all seasons at study sites immediately downstream from Dillon Reservoir, and the lowest values from this metric were found at sites Blue 2 and Blue 1 during the summer season (Figure 11). The inability of the Percent EPT metric to detect stress downstream from Dillon Dam was mostly due to high densities of the relatively tolerant mayfly, *Baetis tricaudatus*. This species is known to be one of the few mayflies that can survive and flourish in habitats with altered temperature and flow regimes. During all seasons in

2021, *Baetis tricaudatus* accounted for more than 96% of the individuals that were included in Percent EPT values at site Blue 5 (Appendix A-C; Tables A3, B3, and C3). Farther downstream, the low Percent EPT values observed at sites Blue 2 and Blue 1 in August were not caused by a reduction in the number of EPT individuals, but rather an increase in the abundance of black flies of the genus *Simulium* sp. During the summer, black flies accounted for more than 76% of the total density of macroinvertebrates collected at sites Blue 2 and Blue 1 (Appendix B; Tables B7 and B8). Black flies are collector-filterers, and increased densities indicate a probable increase in the abundance of fine particulate organic matter at these two sampling locations during the summer of 2021.

Measures of total macroinvertebrate density, total dry weight, and mean dry weight of individuals (number/m^2, g/m^2, and mg/individual, respectively) generally detected the greatest stress in the study area immediately downstream from Dillon Dam; however, the recovery gradient was variable (depending on the season) and often occurred in the middle or downstream reaches of the study area (Figures 12-14). Interestingly, the Mean Dry Weight metric indicated that individual macroinvertebrate body size generally increased downstream from site DRD, except during the summer when low Mean Dry Weight values continued to site SCR (Figure 14). Farther downstream at site BRC, the average dry weight of individual specimens was up to 8.4 times greater than those found at site Blue 5 (depending on the season). These results suggested that the feeding habits and energy dynamics of fish below Dillon Dam were potentially limited by the small body size (and biomass) of the available benthic macroinvertebrates, and the spatial impact of these conditions varied by season in 2021.

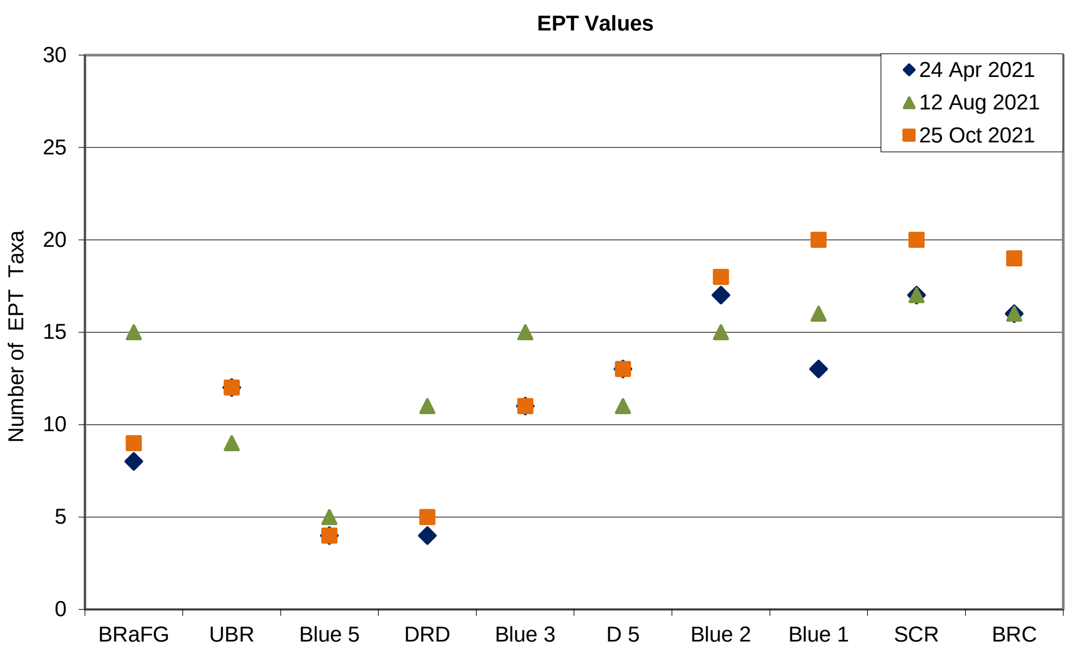


Figure 7. Total EPT Taxa values from spring, summer, and fall sampling on the Blue River during 2021.

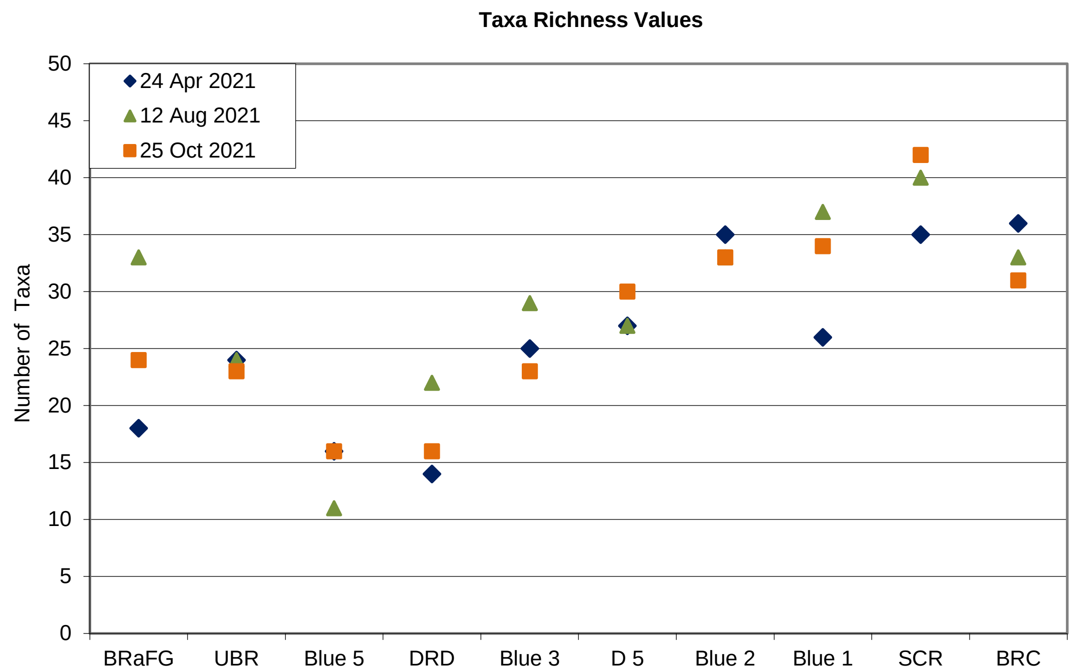


Figure 8. Taxa Richness values from spring, summer, and fall sampling on the Blue River during 2021.

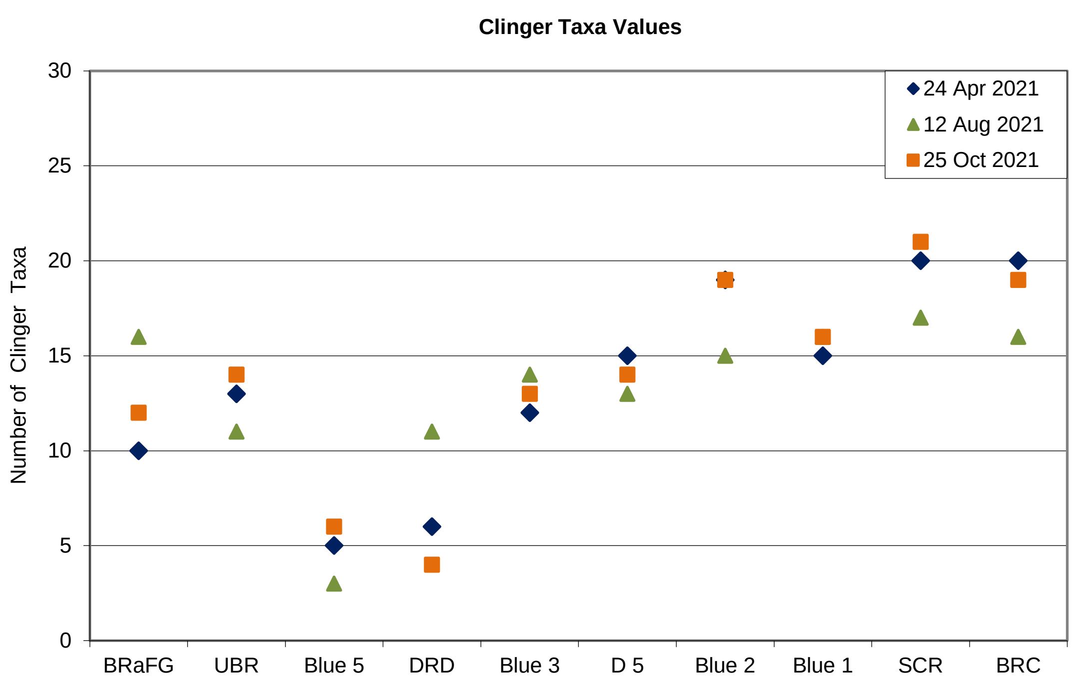


Figure 9. Clinger Taxa values from spring, summer, and fall sampling on the Blue River during 2021.

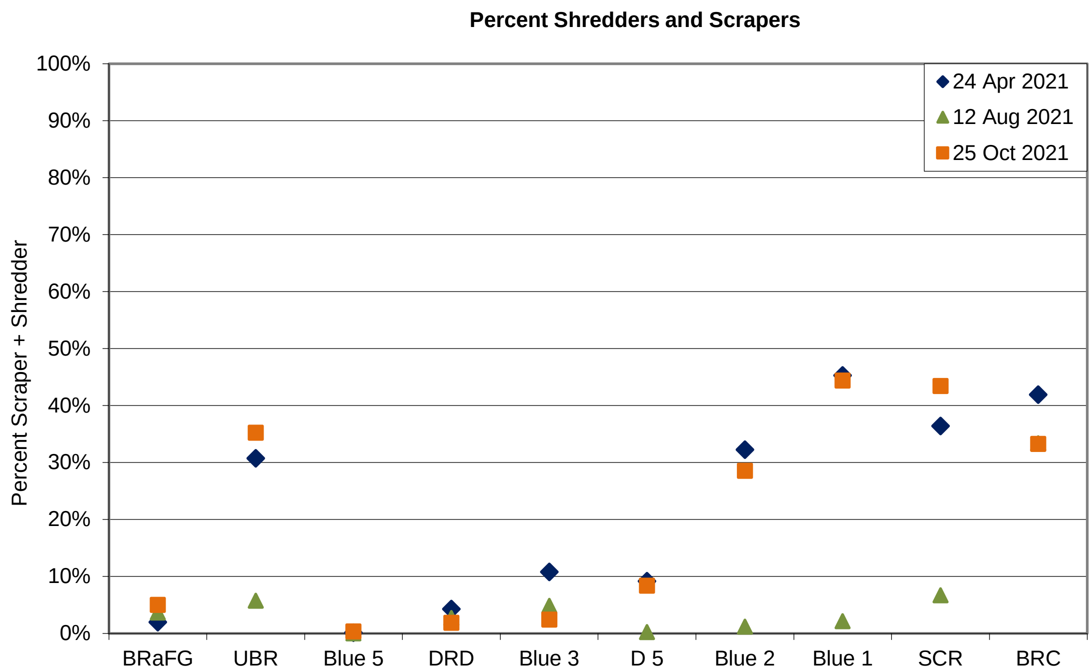


Figure 10. Percent Shredders and Scrapers from spring, summer, and fall sampling on the Blue River during 2021.

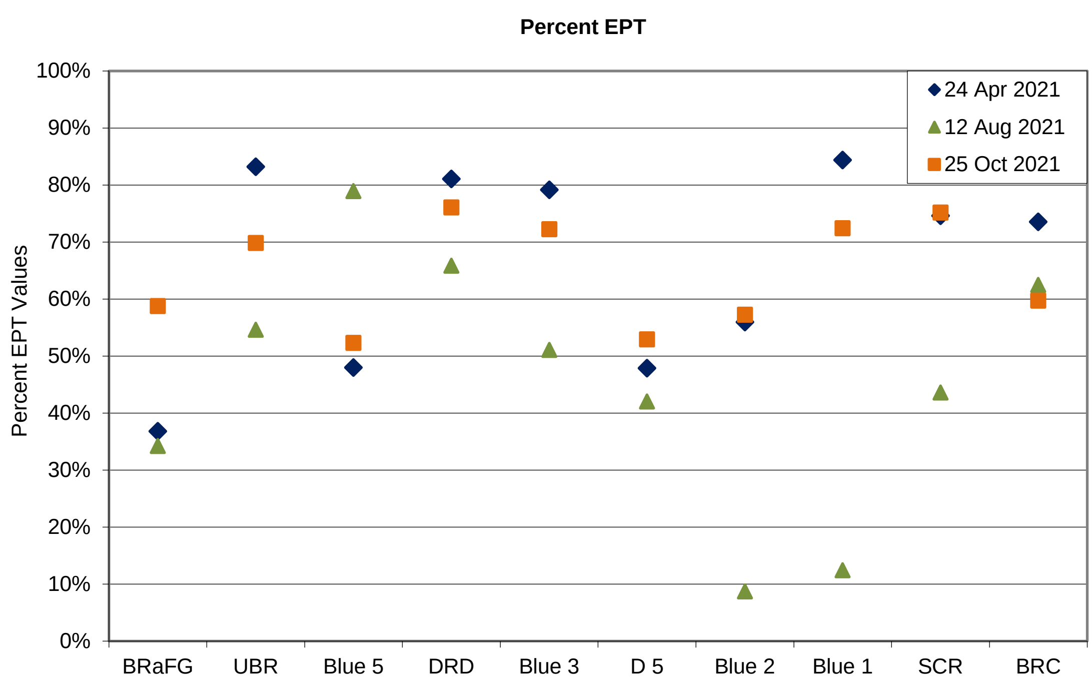


Figure 11. Percent EPT values from spring, summer and fall sampling on the Blue River during 2021.

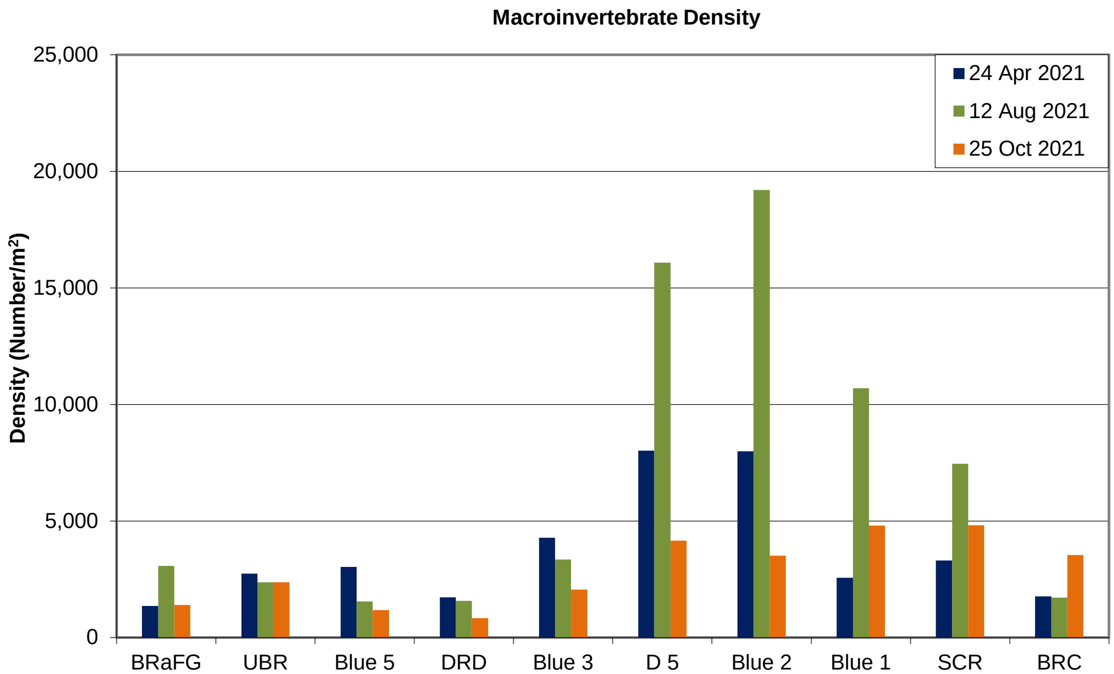


Figure 12. Estimated Total Density values (number/m^2) from spring, summer and fall sampling on the Blue River, 2021.

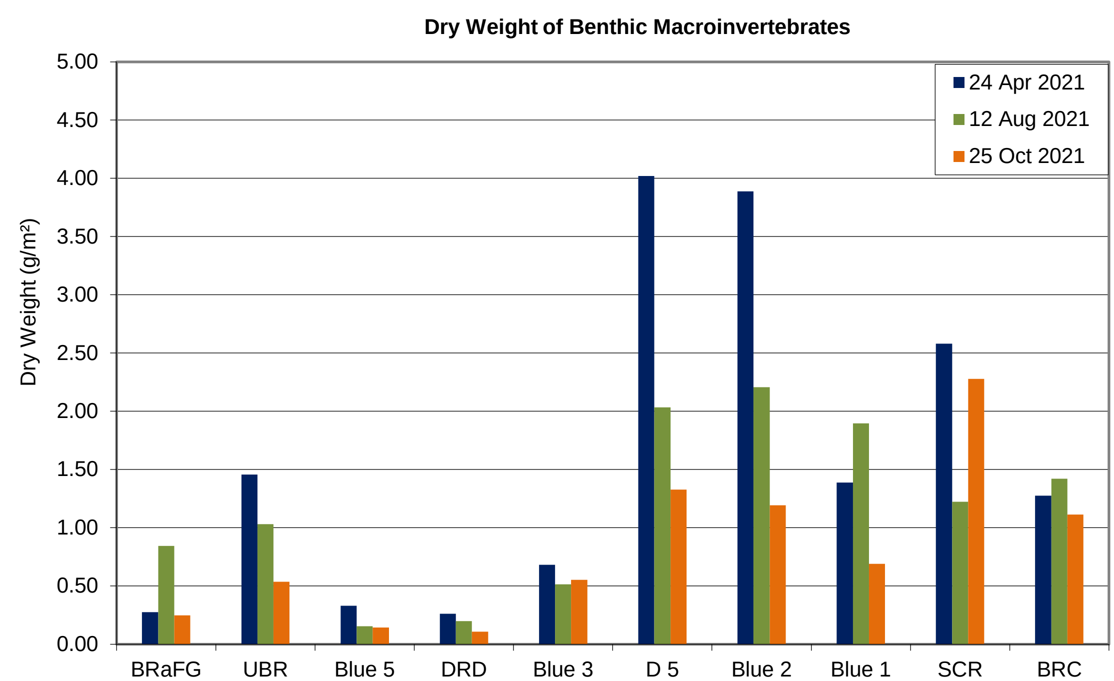


Figure 13. Estimated Total Dry Weight (g/m^2) of benthic macroinvertebrates during spring, summer, and fall sampling on the Blue River, 2021.

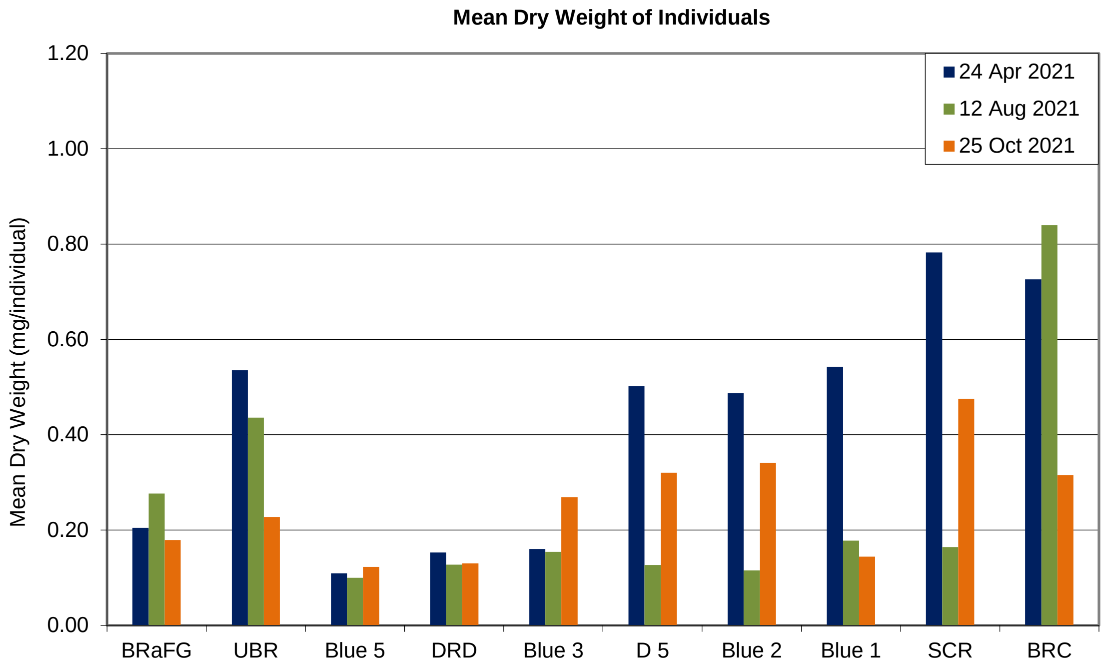


Figure 14. Mean dry weight (mg/individual) for benthic macroinvertebrate specimens during spring, summer, and fall of 2021.

Functional Feeding Groups

In order to provide an evaluation of ecological function during each season, benthic macroinvertebrate taxa were categorized into functional feeding groups (based on their method of food acquisition) and the percent composition of each group was compared among study sites (Tables 12-14; Figures 15-17). In healthy streams, all feeding groups should be adequately represented; however, it is common for certain groups (collector-gatherers) to be slightly dominant. Upstream from Dillon Reservoir, sites BRaFG and UBR supported a more balanced distribution among feeding groups in the spring and fall seasons; however, during both of these seasons, the higher proportion of scrapers at site UBR was an indication of better aquatic conditions (Figures 15-17). During the summer, both of these study sites were dominated by the most tolerant feeding group (collector-gatherers) and sensitive groups were poorly represented. Downstream from Dillon Reservoir, collector-gatherers were consistently abundant (and often dominated) at the three study sites below Dillon Dam (Blue 5, DRD, and Blue 3), while the most sensitive feeding groups (shredders and scrapers) were either absent or poorly represented (Tables 12-14). Farther downstream, there was evidence of recovery in the proportions of various feeding guilds (including shredders and scrapers); however, the rate of longitudinal recovery appeared to be dependent on the season (Figures 15-17). The availability of diverse and stable food resources in the downstream portion of the study area could likely be attributed to influences from tributaries and the return to a more natural thermal regime. The results from the analysis of functional feeding groups generally supported the findings from other metrics and analysis tools used in this study.

Table 12. Relative abundance of functional feeding groups on 24 April 2021 at sampling locations in the Blue River study area.

Site	Functional Feeding Group					
	Collector-Gatherer	Collector-Filterer	Shredder	Scraper	Predator	Omnivore
BRaFG	18.39%	32.76%	1.72%	0.29%	14.37%	32.47%
UBR	38.69%	21.05%	1.28%	29.45%	6.12%	3.41%
Blue 5	91.30%	0.38%	0.00%	0.13%	2.30%	5.88%
DRD	86.46%	0.23%	0.45%	3.84%	8.58%	0.45%
Blue 3	81.85%	1.63%	1.91%	8.89%	5.26%	0.45%
D 5	67.75%	12.83%	0.68%	8.52%	9.78%	0.44%
Blue 2	49.64%	8.31%	13.32%	18.96%	8.17%	1.60%
Blue 1	46.97%	4.39%	2.73%	42.58%	3.03%	0.30%
SCR	34.20%	23.85%	10.11%	26.32%	3.41%	2.12%
BRC	32.89%	11.92%	4.64%	37.31%	13.25%	0.00%

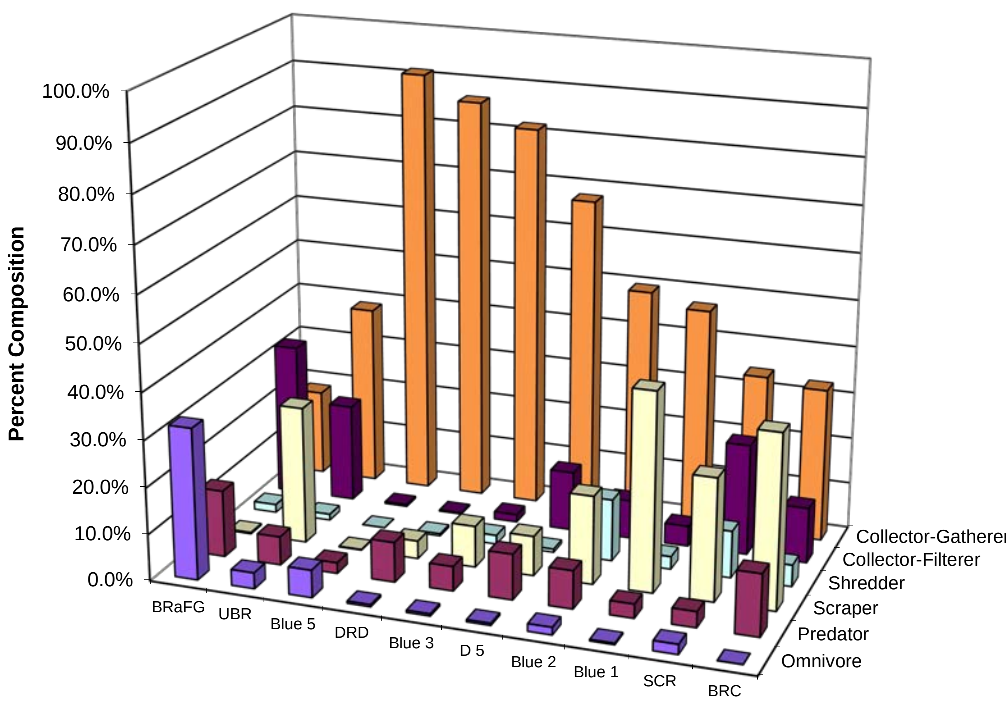


Figure 15. Functional feeding group composition for study sites in the Blue River study area, 24 April 2021.

Table 13. Relative abundance of functional feeding groups on 12 August 2021 at sampling locations in the Blue River study area.

Site	Functional Feeding Group					
	Collector-Gatherer	Collector-Filterer	Shredder	Scraper	Predator	Omnivore
BRaFG	63.88%	11.79%	0.25%	3.42%	4.94%	15.72%
UBR	80.16%	8.36%	0.33%	5.41%	3.11%	2.62%
Blue 5	90.20%	4.52%	0.00%	0.00%	0.75%	4.52%
DRD	80.69%	8.17%	0.25%	2.48%	1.73%	6.68%
Blue 3	72.74%	9.51%	1.16%	3.71%	8.12%	4.76%
D 5	48.11%	48.47%	0.05%	0.22%	2.44%	0.72%
Blue 2	15.66%	80.97%	0.36%	0.81%	1.96%	0.24%
Blue 1	16.32%	78.02%	0.44%	1.74%	3.08%	0.40%
SCR	51.54%	34.29%	4.38%	2.34%	5.58%	1.88%
BRC	26.77%	32.72%	2.97%	30.43%	6.18%	0.92%

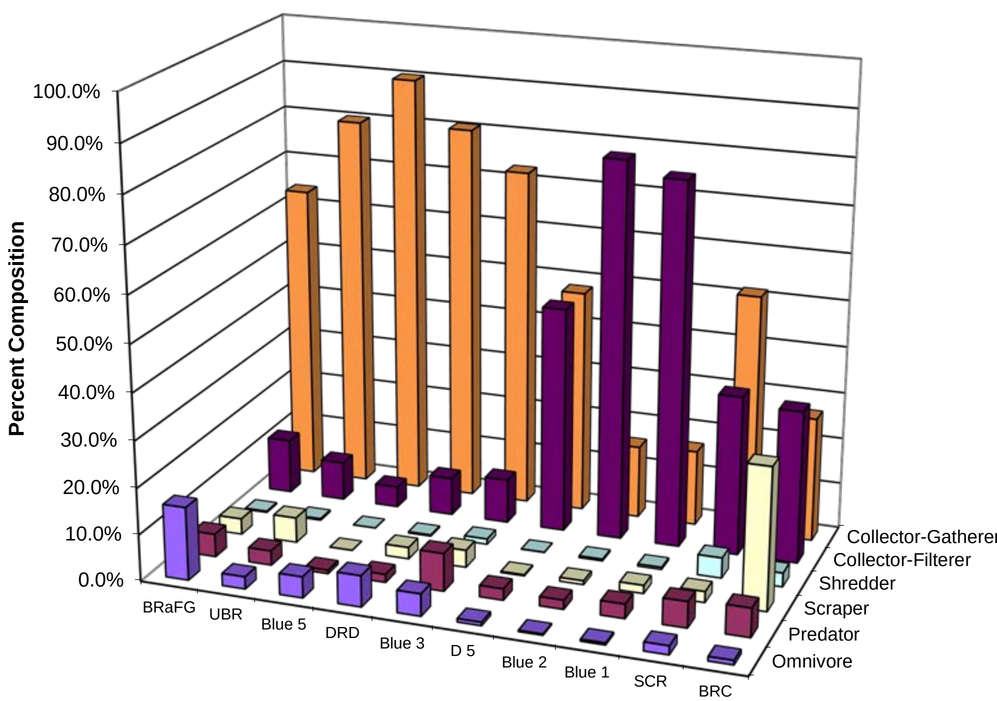


Figure 16. Functional feeding group composition for study sites in the Blue River study area, 12 August 2021.

Table 14. Relative abundance of functional feeding groups on 25 October 2021 at sampling locations in the Blue River study area.

Site	Functional Feeding Group					
	Collector-Gatherer	Collector-Filterer	Shredder	Scraper	Predator	Omnivore
BRaFG	37.88%	27.58%	1.95%	3.06%	11.70%	17.83%
UBR	42.62%	12.13%	1.15%	34.10%	5.08%	4.92%
Blue 5	68.21%	22.85%	0.00%	0.33%	0.66%	7.95%
DRD	82.63%	1.88%	1.41%	0.47%	2.82%	10.80%
Blue 3	58.41%	29.87%	1.32%	1.13%	4.54%	4.73%
D 5	62.52%	19.35%	0.65%	7.76%	3.83%	5.89%
Blue 2	56.59%	7.75%	4.21%	24.36%	5.09%	1.99%
Blue 1	47.33%	2.59%	15.45%	28.96%	3.16%	2.51%
SCR	20.61%	27.81%	20.86%	22.55%	5.58%	2.59%
BRC	13.39%	46.10%	3.07%	30.19%	6.92%	0.33%

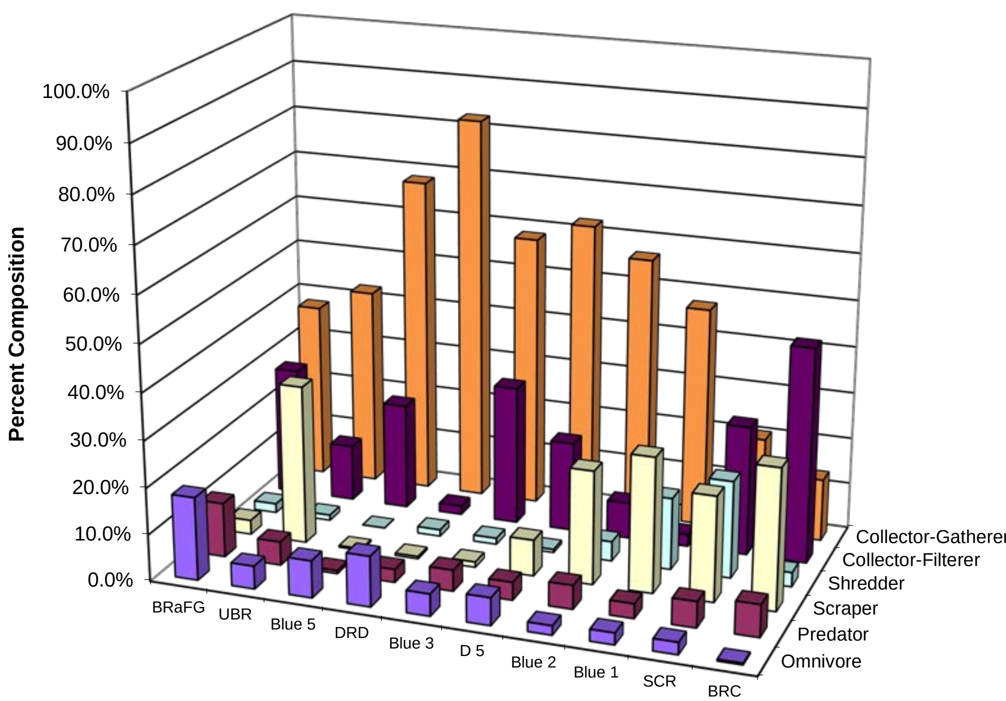


Figure 17. Functional feeding group composition for study sites in the Blue River study area, 25 October 2021.

Conclusions

In conclusion, the 2021 study of macroinvertebrate community structure and function in the Blue River indicated: 1) study sites upstream from Dillon Reservoir (BRaFG and UBR) should not be considered 'reference sites' because both locations showed evidence of moderate to severe stress (at least seasonally) during 2021, 2) the most upstream study site (BRaFG) and the two study sites immediately downstream from Dillon Reservoir (Blue 5 and DRD) were consistently considered 'impaired' based on MMI v4 scores, and these results were supported by several additional analysis tools, 3) below Dillon Dam, macroinvertebrate community parameters generally improved in a downstream direction, although the rate of recovery exhibited some seasonal variability, and 4) the hypolimnetic releases from Dillon Reservoir represented a relatively consistent source of stress; however, the distance to recovery may have been influenced by a variety of factors including: abrupt changes in water temperature (surface spills from the reservoir), urban runoff (from roads and development near the Town of Silverthorne), and the benefits from certain tributaries that are relatively unimpacted by anthropogenic stressors.

A fairly predictable recovery gradient of macroinvertebrate structure and function occurred downstream from Dillon Reservoir from site Blue 5 to site BRC during 2021. The biotic and abiotic factors that collectively influence the health of macroinvertebrate communities in this stream segment remain poorly understood. It is likely that the hypolimnetic releases from the reservoir alter the rivers natural thermal and flow regimes and negatively impact benthic macroinvertebrate community structure and function, while the numerous tributaries ameliorate the natural thermal and flow regimes in the downstream portion of the study area. Research has shown that changes in the thermal regime and timing, magnitude, and frequency of low and high flows can affect the abundance and diversity of macroinvertebrate communities (Ward and Stanford 1979, Stanford and Ward 2001). It is recommended that additional physical, chemical, and biological factors be measured to ascertain how they may impact various longitudinal macroinvertebrate community patterns. Additional study sites may also be needed on tributaries to accurately assess the contributions from these supplementary water sources.

The results from seasonal biomonitoring in 2021 were similar to the results from seasonal biomonitoring in 2020. Both studies indicated that the stretch of the Blue River directly below the impoundment supported stressed macroinvertebrate communities; although, there was a fairly predictable longitudinal pattern of improvements in macroinvertebrate structure and function with distance downstream. During both years, negative impacts were more extensive (spatially) during the summer season. While urban runoff could have been a source of additional stress during the summer months, it is also possible that abrupt increases in water temperatures following surface spills from Dillon Reservoir could have caused additional stress and increased the distance downstream to recovery. During both years (2020 and 2021) there were also reductions in Total Density and Total Dry Weight of benthic macroinvertebrates in the Blue River below Dillon Reservoir that may impose food-web limitations on fish populations. Additional research may be needed to determine if the results from these seasonal benthic macroinvertebrate assessments can be extrapolated to other years and other seasons.

Literature Cited

Armitage, P. D. 1984. Environmental changes induced by stream regulation and their effect on lotic macroinvertebrate macroinvertebrate communities. Pp. 139-165. *In*: Regulated Rivers, Lillehammer, A. and S. J. Saltveit (eds.) Oslo University Press, Oslo, Norway.

Barbour, M. T., J. Gerritsen, B. D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: Periphyton, benthic macroinvertebrates and fish, second edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Barton, D.R. and J.L. Metcalfe-Smith. 1992. A comparison of sampling techniques and summary indices for assessment of water quality in Yamaska River, Quebec, based on benthic macroinvertebrates. Environmental Monitoring and Assessment 21: 225-244.

Caissie, D. 2006. The thermal regime of rivers: A review. Freshwater Biology 51: 1389-1406.

Carolli, M., M. C. Bruno, A. Siviglia and B. Maiolini. 2011. Responses of benthic invertebrates to abrupt changes of temperature in flume simulations. River Research and Applications 28: 698-691.

Collier, M., R. H. Webb, and J. C. Schmidt. 1996. Dams and rivers: A primer on downstream effects of dams. U.S. Geological Survey 1126.

Colorado Department of Public Health and Environment. 2010. Aquatic life use attainment: Methodology to determine use attainment for rivers and streams. Policy Statement 2010-1.

Colorado Department of Public Health and Environment. 2017. Aquatic life use attainment: Methodology to determine use attainment for rivers and streams. Policy Statement 10-1.

Colorado Department of Public Health and Environment. 2019. Section 303(d) Listing Methodology 2020 Listing Cycle.

Courtemanch, D.L. 1996. Commentary on the Subsampling Procedures Used for Rapid Bioassessments. Journal of the North American Benthological Society 15: 381-385.

Dickerson, N. E., J. L. Carrivick, and L. E. Brown. 2012. Flow regulation alters alpine river thermal regimes. Journal of Hydrology 464-465, 505-516.

Ellis, L. E. and N. E. Jones. 2013. Longitudinal trends in regulated river: A review and synthesis within the context of the serial discontinuity concept. Environmental Review. NRC Research Press. Pp. 136-148.

Fraley, J. J. 1979. Effects of elevated stream temperatures below a shallow reservoir on cold-water macroinvertebrate fauna. Pp. 257-272. *In*: The Ecology of Regulated Streams. Ward, J. V. and J. A. Stanford (eds.). Plenum Press, New York, New York.

Gore, J. A. 1977. Reservoir manipulations and benthic macroinvertebrates in a prairie river. Hydrobiologia 55: 113-123.

Grill, G., B. Lehner, M. Thieme, B. Geenen, D. Tickner, F. Antonelli, and C. Zarfl. 2019. Mapping the world's free flowing rivers. Nature 569: 215-221.

Hilsenhoff, W. L. 1988. Rapid field assessment of organic pollution with a family level biotic index. Journal of the North American Benthological Society 7(1): 65-68.

Hughes, D.L. and M.O. Brossett. 2009. Rapid Bioassessment of Stream Health. CRC Press, Taylor & Francis Group. Boca Raton, FL.

Krajenbrink, H. J., J. C. White, M. J. Dunbar, and P. J. Wood. 2022. Macroinvertebrate and diatom community responses to thermal alterations below water supply reservoirs. River Research Applications 38: 595-612.

Lehmkuhl, D. M. 1972. Change in thermal regime as a cause of reduction of benthic fauna downstream of a reservoir. Journal of the Fisheries Board of Canada 29: 1329-1332

Lenat, D.R. 1983. Chironomid Taxa Richness: Natural Variation and Use in Pollution Assessment. Freshwater Invertebrate Biology 2: 192-198.

Lenat, D.R. 1988. Water quality assessment of streams using a qualitative collection method for benthic macroinvertebrates. Journal of the North American Benthological Society 7: 222-33.

Mandaville, S.M. 2002. Benthic macroinvertebrates in freshwaters-taxa tolerance values, metrics, and protocols. Project H-1. Soil and Water Conservation Society of Metro Halifax,.xviii. 48. Pp., Appendices A-B 120pp.

McLaren, J. S., T. V. Royer, R. W. Van Kirk, and M. L. Muradian. 2019. Management and limnology interact to drive water temperature patterns in a Middle Rockies river-reservoir system. JAWRA Journal of the American Water Resources Association 55: 1323-1334.

Merritt, R. W., K. W. Cummins, and M. B. Berg. 2008. An Introduction to the Aquatic Insects of North America. Fourth Edition, Kendall/Hunt. Dubuque, Iowa.

Olden, J. D. and R. J. Naiman. 2010. Incorporating thermal regimes into environmental flow assessments: Modify dam operations to restore freshwater ecosystem integrity. Freshwater Biology 55: 86-107.

Paul, M. J., J. Gerritsen, C. Hawkins, and E. Leppo. 2005. Draft. Development of biological assessment tools for Colorado. Colorado Department of Public Health and Environment, Water Quality Control Division – Monitoring Unit. Denver, Colorado.

Petts, G. E. 1984. Impounded rivers: Perspectives for ecological management. John Wiley and Sons, New York, New York. 326 pp.

Plafkin, J. L., M. T. Barbour, K. D. Porter, S. K. Gross, and R. M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. EPA/444/4-89/001.

Poff, N. L. J. K. H. Zimmerman. 2010. Ecological responses to altered flow regimes: A literature review to inform the science and management of environmental flows. Freshwater Biology 55: 194-205.

Rader, R. B. and J. V. Ward. 1988. Influence of regulation on environmental conditions and macroinvertebrate community in the upper Colorado River. Regulated Rivers 2:597-628.

Resh, V.H. and J.K. Jackson. 1993. Rapid assessment approaches in biomonitoring using benthic macroinvertebrates. In Rosenberg, D.M, V.H. Resh. (Editors). Freshwater Biomonitoring and Benthic Macroinvertebrates. Chapman & Hall, New York: 195-223.

Stanford, J. A. and J. V. Ward. 1984. The effects of regulation on the limnology of the Gunnison River: A North American case history. Pp. 467-480. *In* Regulated Rivers. Lillehammer, A. and S. J. Salveit (eds.) Oslo University Press, Oslo, Norway.

Stanford, J. A. and J. V. Ward. 2001. Revisiting the Serial Discontinuity Concept. Regulated Rivers: Research and Management 17: 303-310.

Vinson, M. R. 2001. Long-term dynamics of an invertebrate assemblage downstream from a large dam. Ecological Applications 11: 711-730.

Voelz, N. J. and J. V. Ward. 1989. Biotic and abiotic gradients in a regulated high elevation Rocky Mountain river. Regulated Rivers 3: 143-152.

Voelz, N. J. and J. V. Ward. 1990. Macroinvertebrate responses along a complex regulated stream environmental gradient. Regulated Rivers: Research and Management 5:365-374.

Voelz, N. J. and J. V. Ward. 1991. Biotic responses along the recovery gradient of a regulated stream. Canadian Journal of Fisheries and Aquatic Sciences 48: 2477-2490.

Wang, L., D. M. Robertson, and P. J. Garrison. 2007. Linkages between nutrients and assemblages of macroinvertebrates and fish in wadeable streams: implication to nutrient criteria development. Environmental Management 39: 194-212.

Wang, F., S. C. Maberly, B. Wang and X. Liang. 2018. Effects of dams on riverine biogeochemical cycling and ecology. Inland Waters 8: 130-140.

Ward, J. V. and J. A. Stanford. 1979. Ecological factors controlling stream zoobenthos with emphasis on thermal modification of regulated streams. Pp. 35-56. *In*: The Ecology of Regulated Streams. Ward, J. V. and J. A. Stanford (eds.). Plenum Press, New York, New York.

Ward, J. V. and J. A. Stanford. 1982. Thermal responses in the evolutionary ecology of aquatic insects. Annual Review of Entomology 27: 97-117.

Ward, J. V. and J. A. Stanford. 1987. The ecology of regulated streams: Past accomplishments and directions for future research. Pp. 391-409. *In*: Regulated Streams Advances in Ecology. Craig, J. F. and J. B. Kemper (eds.) Plenum Press, New York, New York.

Ward, J. V., B. C. Kondratieff, and R. E. Zuellig. 2002. An Illustrated Guide to the Mountain Stream Insects of Colorado. Second Edition. University Press of Colorado. Boulder, Colorado.

Zimmerman, H. J. and J. V. Ward. 1984. A survey of regulated streams in the Rocky Mountains of Colorado, U.S.A. Pp. 251-262. *In* Regulated rivers. Lillehammer, A. and S. J. Salveit (eds.) Oslo University Press, Oslo, Norway.

Appendix A

Benthic Macroinvertebrate Data – Spring 2021

Table A1. Macroinvertebrate data collected from site BRaFG on 24 April 2021.

Blue River				
BRaFG		Sample		
24 April 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Baetis tricaudatus		1		**4**
Diphetor hageni				
Drunella doddsii				
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.				
Epeorus longimanus	1			**4**
Plecoptera				
Chloroperlidae			1	**4**
Sweltsa sp.				
Prostoia besametsa			1	**4**
Zapada oregonensis				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla fulva				
Kogotus modestus		2	4	**24**
Megarcys signata			1	**4**
Trichoptera				
Brachycentrus americanus		16	98	**442**
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis				
Hydropsyche cockerelli				
Hydropsyche oslari				
Lepidostoma sp.				
Hesperophylax sp.			3	**12**
Rhyacophila coloradensis				
Rhyacophila sibirica				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.			2	**8**
Cricotopus/*Orthocladius* sp.			1	**4**
Diamesa sp.				
Eukiefferiella sp.		2		**8**
Hydrobaenus sp.				
Micropsectra/Tanytarsus sp.				
Microtendipes sp.				
Pagastia sp.			5	**20**
Parametriocnemus sp.				
Polypedilum sp.				
Rheocricotopus sp.	1	15	32	**187**
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.				

Table A1. cont. Macroinvertebrate data collected from site BRaFG on 24 April 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Wiedemannia sp.				
Simulium sp.				
Antocha sp.				
Hexatoma sp.				
Coleoptera				
Heterlimnius corpulentus	1	1	4	**24**
Optioservus sp.				
Zaitzevia parvula				
Miscellaneous (Non-insects)				
Lebertia sp.		6	20	**101**
Sperchon sp.	1	4	11	**63**
Torrenticola sp.				
Caecidotea sp.				
Polycelis coronata	4	41	68	**438**
Enchytraeidae		1		**4**
Totals	**8**	**89**	**251**	**1355**
Shannon Weaver Diversity				**2.54**
Calculated Evenness				**0.608**
EPT				**8**
% EPT				**36.78%**
Density				**1,355**
% Non-Insect				**44.83%**
% Shredder/Scraper				**2.01%**
Taxa Richness				**18**
# Ephemeroptera Taxa				**2**
# Plecoptera Taxa				**4**
# Trichoptera Taxa				**2**
% Ephemeroptera individuals				**0.57%**
% Plectopera individuals				**2.59%**
% Trichoptera individuals				**33.62%**
Percent Chironomidae				**16.67%**
Percent Tolerant Organisms				**12.93%**
# Intolerant Taxa				**8**

Table A2. Macroinvertebrate data collected from site UBR on 24 April 2021.

Blue River				
UBR		Sample		
24 April 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Baetis tricaudatus	32	70	93	**756**
Diphetor hageni	2	1		**12**
Drunella doddsii				
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.	3	2	2	**28**
Epeorus longimanus	53	70	77	**776**
Plecoptera				
Chloroperlidae				
Sweltsa sp.	16	3	5	**94**
Prostoia besametsa	2	1	5	**32**
Zapada oregonensis				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla fulva		1	1	**8**
Kogotus modestus	3	2	4	**35**
Megarcys signata				
Trichoptera				
Brachycentrus americanus	21	31	38	**349**
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis	8	7	29	**171**
Hydropsyche cockerelli				
Hydropsyche oslari				
Lepidostoma sp.	1			**4**
Hesperophylax sp.				
Rhyacophila coloradensis		1	1	**8**
Rhyacophila sibirica				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/*Orthocladius* sp.	3	3	2	**32**
Diamesa sp.				
Eukiefferiella sp.	1		4	**20**
Hydrobaenus sp.				
Micropsectra/Tanytarsus sp.		1	3	**16**
Microtendipes sp.				
Pagastia sp.			1	**4**
Parametriocnemus sp.				
Polypedilum sp.				
Rheocricotopus sp.	13	16	3	**125**
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.	2	3	3	**32**

Table A2. cont. Macroinvertebrate data collected from site UBR on 24 April 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Wiedemannia sp.				
Simulium sp.	1		13	**55**
Antocha sp.			3	**12**
Hexatoma sp.				
Coleoptera				
Heterlimnius corpulentus	7	1	3	**43**
Optioservus sp.				
Zaitzevia parvula				
Miscellaneous (Non-insects)				
Lebertia sp.	1	2	3	**24**
Sperchon sp.				
Torrenticola sp.				
Caecidotea sp.				
Polycelis coronata	4	16	4	**94**
Enchytraeidae	1		1	**8**
Totals	**174**	**231**	**298**	**2738**
Shannon Weaver Diversity				**3.09**
Calculated Evenness				**0.673**
EPT				**12**
% EPT				**83.21%**
Density				**2,738**
% Non-Insect				**4.55%**
% Shredder/Scraper				**30.73%**
Taxa Richness				**24**
# Ephemeroptera Taxa				**4**
# Plecoptera Taxa				**4**
# Trichoptera Taxa				**4**
% Ephemeroptera individuals				**57.61%**
% Plectopera individuals				**6.12%**
% Trichoptera individuals				**19.49%**
Percent Chironomidae				**8.25%**
Percent Tolerant Organisms				**2.42%**
# Intolerant Taxa				**12**

Table A3. Macroinvertebrate data collected from site Blue 5 on 24 April 2021.

Blue River				
Blue 5		Sample		
24 April 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Baetis tricaudatus	100	59	203	**1404**
Diphetor hageni				
Drunella doddsii				
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.				
Epeorus longimanus				
Plecoptera				
Chloroperlidae	1			**4**
Sweltsa sp.	4	2	5	**43**
Prostoia besametsa				
Zapada oregonensis				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla fulva				
Kogotus modestus				
Megarcys signata				
Trichoptera				
Brachycentrus americanus			1	**4**
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis				
Hydropsyche cockerelli				
Hydropsyche oslari				
Lepidostoma sp.				
Hesperophylax sp.				
Rhyacophila coloradensis				
Rhyacophila sibirica				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	63	48	52	**632**
Diamesa sp.	3	3	11	**66**
Eukiefferiella sp.	12	1	8	**82**
Hydrobaenus sp.			1	**4**
Micropsectra/Tanytarsus sp.	1			**4**
Microtendipes sp.				
Pagastia sp.	13	17	19	**190**
Parametriocnemus sp.				
Polypedilum sp.				
Rheocricotopus sp.				
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.	22	18	60	**388**

Table A3. cont. Macroinvertebrate data collected from site Blue 5 on 24 April 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Wiedemannia sp.				
Simulium sp.			2	**8**
Antocha sp.				
Hexatoma sp.				
Coleoptera				
Heterlimnius corpulentus				
Optioservus sp.				
Zaitzevia parvula				
Miscellaneous (Non-insects)				
Lebertia sp.	1	1		**8**
Sperchon sp.	1	1	2	**16**
Torrenticola sp.				
Caecidotea sp.	1			**4**
Polycelis coronata	14	14	18	**179**
Enchytraeidae				
Totals	**236**	**164**	**382**	**3036**
Shannon Weaver Diversity				**2.35**
Calculated Evenness				**0.587**
EPT				**4**
% EPT				**47.95%**
Density				**3,036**
% Non-Insect				**6.78%**
% Shredder/Scraper				**0.13%**
Taxa Richness				**16**
# Ephemeroptera Taxa				**1**
# Plecoptera Taxa				**2**
# Trichoptera Taxa				**1**
% Ephemeroptera individuals				**46.29%**
% Plectopera individuals				**1.53%**
% Trichoptera individuals				**0.13%**
Percent Chironomidae				**45.01%**
Percent Tolerant Organisms				**3.84%**
# Intolerant Taxa				**5**

Table A4. Macroinvertebrate data collected from site DRD on 24 April 2021.

Blue River				
DRD		Sample		
24 April 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Baetis tricaudatus	53	97	181	**1283**
Diphetor hageni				
Drunella doddsii				
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.				
Epeorus longimanus	5	6	6	**66**
Plecoptera				
Chloroperlidae				
Sweltsa sp.	5	1	3	**35**
Prostoia besametsa			2	**8**
Zapada oregonensis				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla fulva				
Kogotus modestus				
Megarcys signata				
Trichoptera				
Brachycentrus americanus				
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis				
Hydropsyche cockerelli				
Hydropsyche oslari				
Lepidostoma sp.				
Hesperophylax sp.				
Rhyacophila coloradensis				
Rhyacophila sibirica				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	6	26		**125**
Diamesa sp.		3		**12**
Eukiefferiella sp.		2		**8**
Hydrobaenus sp.				
Micropsectra/Tanytarsus sp.				
Microtendipes sp.				
Pagastia sp.	3	3	7	**51**
Parametriocnemus sp.				
Polypedilum sp.				
Rheocricotopus sp.	2			**8**
Synorthocladius sp.				
Thienemannimyia genus group		27		**105**
Tvetenia sp.				

Table A4. cont. Macroinvertebrate data collected from site DRD on 24 April 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Wiedemannia sp.				
Simulium sp.		1		**4**
Antocha sp.				
Hexatoma sp.				
Coleoptera				
Heterlimnius corpulentus				
Optioservus sp.				
Zaitzevia parvula				
Miscellaneous (Non-insects)				
Lebertia sp.	1			**4**
Sperchon sp.	1			**4**
Torrenticola sp.				
Caecidotea sp.				
Polycelis coronata	1	1		**8**
Enchytraeidae				
Totals	**77**	**167**	**199**	**1721**
Shannon Weaver Diversity				**1.53**
Calculated Evenness				**0.401**
EPT				**4**
% EPT				**81.04%**
Density				**1,721**
% Non-Insect				**0.90%**
% Shredder/Scraper				**4.29%**
Taxa Richness				**14**
# Ephemeroptera Taxa				**2**
# Plecoptera Taxa				**2**
# Trichoptera Taxa				**0**
% Ephemeroptera individuals				**78.56%**
% Plectopera individuals				**2.48%**
% Trichoptera individuals				**0.00%**
Percent Chironomidae				**17.83%**
Percent Tolerant Organisms				**0.90%**
# Intolerant Taxa				**5**

Table A5. Macroinvertebrate data collected from site Blue 3 on 24 April 2021.

Blue River				
Blue 3		Sample		
24 April 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Baetis tricaudatus	176	76	431	**2648**
Diphetor hageni				
Drunella doddsii				
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.	4		1	**20**
Epeorus longimanus	25	6	60	**353**
Plecoptera				
Chloroperlidae				
Sweltsa sp.	22	11	18	**198**
Prostoia besametsa	1	4	15	**78**
Zapada oregonensis			1	**4**
Claassenia sabulosa				
Cultus sp.		1		**4**
Diura knowltoni				
Isoperla fulva			1	**4**
Kogotus modestus				
Megarcys signata	1			**4**
Trichoptera				
Brachycentrus americanus				
Brachycentrus occidentalis	3	1	4	**32**
Glossosoma sp.				
Arctopsyche grandis	1	1	8	**39**
Hydropsyche cockerelli				
Hydropsyche oslari				
Lepidostoma sp.				
Hesperophylax sp.				
Rhyacophila coloradensis				
Rhyacophila sibirica				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	43	36	35	**442**
Diamesa sp.	1	2		**12**
Eukiefferiella sp.	2		2	**16**
Hydrobaenus sp.	2			**8**
Micropsectra/Tanytarsus sp.			1	**4**
Microtendipes sp.				
Pagastia sp.	3	1	7	**43**
Parametriocnemus sp.				
Polypedilum sp.				
Rheocricotopus sp.	12	1	29	**163**
Synorthocladius sp.	1		1	**8**
Thienemannimyia genus group				
Tvetenia sp.	2	2	26	**117**

Table A5. cont. Macroinvertebrate data collected from site Blue 3 on 24 April 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Wiedemannia sp.				
Simulium sp.				
Antocha sp.				
Hexatoma sp.				
Coleoptera				
Heterlimnius corpulentus	1	5	4	**39**
Optioservus sp.				
Zaitzevia parvula				
Miscellaneous (Non-insects)				
Lebertia sp.	1	1		**8**
Sperchon sp.		2		**8**
Torrenticola sp.				
Caecidotea sp.				
Polycelis coronata		4	1	**20**
Enchytraeidae	2			**8**
Totals	**303**	**154**	**645**	**4280**
Shannon Weaver Diversity				**2.19**
Calculated Evenness				**0.471**
EPT				**11**
% EPT				**79.13%**
Density				**4,280**
% Non-Insect				**1.00%**
% Shredder/Scraper				**10.80%**
Taxa Richness				**25**
# Ephemeroptera Taxa				**3**
# Plecoptera Taxa				**6**
# Trichoptera Taxa				**2**
% Ephemeroptera individuals				**70.69%**
% Plectopera individuals				**6.81%**
% Trichoptera individuals				**1.63%**
Percent Chironomidae				**18.97%**
Percent Tolerant Organisms				**1.18%**
# Intolerant Taxa				**12**

Table A6. Macroinvertebrate data collected from site D 5 on 24 April 2021.

Blue River				
D 5		Sample		
24 April 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Baetis tricaudatus	107	170	62	**1314**
Diphetor hageni				
Drunella doddsii				
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.	6	8	2	**63**
Epeorus longimanus	69	51	34	**597**
Plecoptera				
Chloroperlidae			1	**4**
Sweltsa sp.	38	89	63	**737**
Prostoia besametsa	1	1	3	**20**
Zapada oregonensis				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla fulva	1	3		**16**
Kogotus modestus				
Megarcys signata		1		**4**
Trichoptera				
Brachycentrus americanus				
Brachycentrus occidentalis	94	61	45	**776**
Glossosoma sp.	4	1		**20**
Arctopsyche grandis	18	24	23	**252**
Hydropsyche cockerelli				
Hydropsyche oslari				
Lepidostoma sp.	2	3	2	**28**
Hesperophylax sp.				
Rhyacophila coloradensis	1			**4**
Rhyacophila sibirica				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	133	260	219	**2373**
Diamesa sp.	38	74	43	**601**
Eukiefferiella sp.	16	40	19	**291**
Hydrobaenus sp.		1		**4**
Micropsectra/Tanytarsus sp.	9	13	10	**125**
Microtendipes sp.				
Pagastia sp.	8	13	3	**94**
Parametriocnemus sp.				
Polypedilum sp.		2		**8**
Rheocricotopus sp.	37	48	37	**473**
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.	12	8	4	**94**

Table A6. cont. Macroinvertebrate data collected from site D 5 on 24 April 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Wiedemannia sp.				
Simulium sp.				
Antocha sp.	2	5	2	**35**
Hexatoma sp.				
Coleoptera				
Heterlimnius corpulentus	1	5	1	**28**
Optioservus sp.				
Zaitzevia parvula				
Miscellaneous (Non-insects)				
Lebertia sp.	3		1	**16**
Sperchon sp.		1		**4**
Torrenticola sp.				
Caecidotea sp.				
Polycelis coronata	1	3	5	**35**
Enchytraeidae				
Totals	**601**	**885**	**579**	**8016**
Shannon Weaver Diversity				**3.26**
Calculated Evenness				**0.685**
EPT				**13**
% EPT				**47.85%**
Density				**8,016**
% Non-Insect				**0.68%**
% Shredder/Scraper				**9.20%**
Taxa Richness				**27**
# Ephemeroptera Taxa				**3**
# Plecoptera Taxa				**5**
# Trichoptera Taxa				**5**
% Ephemeroptera individuals				**24.65%**
% Plectopera individuals				**9.73%**
% Trichoptera individuals				**13.46%**
Percent Chironomidae				**50.70%**
Percent Tolerant Organisms				**5.47%**
# Intolerant Taxa				**14**

Table A7. Macroinvertebrate data collected from site Blue 2 on 24 April 2021.

Blue River				
Blue 2		Sample		
24 April 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Baetis tricaudatus	64	45	70	**694**
Diphetor hageni				
Drunella doddsii	2			**8**
Drunella grandis	1	1	3	**20**
Ephemerella dorothea infrequens				
Cinygmula sp.	5	7	18	**117**
Epeorus longimanus	125	97	125	**1345**
Plecoptera				
Chloroperlidae	1			**4**
Sweltsa sp.	7	61	59	**493**
Prostoia besametsa				
Zapada oregonensis	1	1		**8**
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni	1			**4**
Isoperla fulva	2	3	5	**39**
Kogotus modestus				
Megarcys signata	1	1	1	**12**
Trichoptera				
Brachycentrus americanus	1	2	2	**20**
Brachycentrus occidentalis	37	20	15	**280**
Glossosoma sp.			5	**20**
Arctopsyche grandis	32	31	28	**353**
Hydropsyche cockerelli				
Hydropsyche oslari				
Lepidostoma sp.	39	76	155	**1047**
Hesperophylax sp.				
Rhyacophila coloradensis				
Rhyacophila sibirica	1			**4**
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/*Orthocladius* sp.	234	87	98	**1625**
Diamesa sp.	75	29	54	**613**
Eukiefferiella sp.	9	31	22	**241**
Hydrobaenus sp.				
Micropsectra/Tanytarsus sp.	2	7	16	**97**
Microtendipes sp.				
Pagastia sp.	1	5	4	**39**
Parametriocnemus sp.			1	**4**
Polypedilum sp.		1	1	**8**
Rheocricotopus sp.	22	29	82	**516**
Synorthocladius sp.				
Thienemannimyia genus group		1		**4**
Tvetenia sp.	3	4	2	**35**

Table A7. cont. Macroinvertebrate data collected from site Blue 2 on 24 April 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.			1	**4**
Wiedemannia sp.				
Simulium sp.	2		1	**12**
Antocha sp.	1	1	2	**16**
Hexatoma sp.		1	2	**12**
Coleoptera				
Heterlimnius corpulentus	2	6	13	**82**
Optioservus sp.				
Zaitzevia parvula				
Miscellaneous (Non-insects)				
Lebertia sp.	2	2	8	**47**
Sperchon sp.		4	5	**35**
Torrenticola sp.				
Caecidotea sp.				
Polycelis coronata	1	2	30	**128**
Enchytraeidae				
Totals	**674**	**555**	**828**	**7986**
Shannon Weaver Diversity				**3.60**
Calculated Evenness				**0.702**
EPT				**17**
% EPT				**55.96%**
Density				**7,986**
% Non-Insect				**2.63%**
% Shredder/Scraper				**32.28%**
Taxa Richness				**35**
# Ephemeroptera Taxa				**5**
# Plecoptera Taxa				**6**
# Trichoptera Taxa				**6**
% Ephemeroptera individuals				**27.37%**
% Plectopera individuals				**7.00%**
% Trichoptera individuals				**21.58%**
Percent Chironomidae				**39.86%**
Percent Tolerant Organisms				**5.25%**
# Intolerant Taxa				**19**

Table A8. Macroinvertebrate data collected from site Blue 1 on 24 April 2021.

Blue River				
Blue 1		Sample		
24 April 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Baetis tricaudatus	34	45	135	**830**
Diphetor hageni				
Drunella doddsii				
Drunella grandis	1	1	1	**12**
Ephemerella dorothea infrequens				
Cinygmula sp.	5	11	13	**113**
Epeorus longimanus	74	69	105	**962**
Plecoptera				
Chloroperlidae	1			**4**
Sweltsa sp.	5	2		**28**
Prostoia besametsa				
Zapada oregonensis				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni		1		**4**
Isoperla fulva	1	4	1	**24**
Kogotus modestus				
Megarcys signata	1			**4**
Trichoptera				
Brachycentrus americanus				
Brachycentrus occidentalis	1	1	1	**12**
Glossosoma sp.				
Arctopsyche grandis		9	16	**97**
Hydropsyche cockerelli				
Hydropsyche oslari				
Lepidostoma sp.	10	2	6	**70**
Hesperophylax sp.				
Rhyacophila coloradensis			1	**4**
Rhyacophila sibirica				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	6	7	11	**94**
Diamesa sp.	11	10	17	**148**
Eukiefferiella sp.	5	4	9	**70**
Hydrobaenus sp.				
Micropsectra/Tanytarsus sp.		2		**8**
Microtendipes sp.				
Pagastia sp.	1		2	**12**
Parametriocnemus sp.				
Polypedilum sp.				
Rheocricotopus sp.	6	2		**32**
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.		1		**4**

Table A8. cont. Macroinvertebrate data collected from site Blue 1 on 24 April 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.		1		**4**
Wiedemannia sp.				
Simulium sp.		1		**4**
Antocha sp.				
Hexatoma sp.				
Coleoptera				
Heterlimnius corpulentus			2	**8**
Optioservus sp.				
Zaitzevia parvula				
Miscellaneous (Non-insects)				
Lebertia sp.			2	**8**
Sperchon sp.	1			**4**
Torrenticola sp.				
Caecidotea sp.				
Polycelis coronata		2		**8**
Enchytraeidae				
Totals	**163**	**175**	**322**	**2568**
Shannon Weaver Diversity				**2.66**
Calculated Evenness				**0.566**
EPT				**13**
% EPT				**84.39%**
Density				**2,568**
% Non-Insect				**0.76%**
% Shredder/Scraper				**45.30%**
Taxa Richness				**26**
# Ephemeroptera Taxa				**4**
# Plecoptera Taxa				**5**
# Trichoptera Taxa				**4**
% Ephemeroptera individuals				**74.85%**
% Plectopera individuals				**2.42%**
% Trichoptera individuals				**7.12%**
Percent Chironomidae				**14.24%**
Percent Tolerant Organisms				**3.48%**
# Intolerant Taxa				**13**

Table A9. Macroinvertebrate data collected from site SCR on 24 April 2021.

Blue River				
SCR		Sample		
24 April 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Baetis tricaudatus	25	58	17	**388**
Diphetor hageni		4	5	**35**
Drunella doddsii				
Drunella grandis	12	8	7	**105**
Ephemerella dorothea infrequens	1			**4**
Cinygmula sp.	1	4	23	**109**
Epeorus longimanus	41	49	76	**644**
Plecoptera				
Chloroperlidae	1			**4**
Sweltsa sp.		1	8	**35**
Prostoia besametsa		3		**12**
Zapada oregonensis				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla fulva		3	3	**24**
Kogotus modestus				
Megarcys signata				
Trichoptera				
Brachycentrus americanus	6		2	**32**
Brachycentrus occidentalis	91	27	24	**551**
Glossosoma sp.		1		**4**
Arctopsyche grandis	27	17	7	**198**
Hydropsyche cockerelli				
Hydropsyche oslari	1			**4**
Lepidostoma sp.	26	4	51	**314**
Hesperophylax sp.				
Rhyacophila coloradensis			1	**4**
Rhyacophila sibirica				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/*Orthocladius* sp.	8	20	3	**121**
Diamesa sp.	7	7	4	**70**
Eukiefferiella sp.	4	13	4	**82**
Hydrobaenus sp.				
Micropsectra/Tanytarsus sp.	4	4	2	**39**
Microtendipes sp.				
Pagastia sp.	4	21	10	**136**
Parametriocnemus sp.		2		**8**
Polypedilum sp.		2		**8**
Rheocricotopus sp.		13	26	**152**
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.		2	1	**12**

Table A9. cont. Macroinvertebrate data collected from site SCR on 24 April 2021.

Other Diptera				
Atherix pachypus		4	2	**24**
Chelifera/Neoplasta sp.				
Wiedemannia sp.		1		**4**
Simulium sp.		1		**4**
Antocha sp.	1	7	3	**43**
Hexatoma sp.				
Coleoptera				
Heterlimnius corpulentus	5	5	1	**43**
Optioservus sp.	1	1		**8**
Zaitzevia parvula				
Miscellaneous (Non-insects)				
Lebertia sp.	1			**4**
Sperchon sp.	1	2	1	**16**
Torrenticola sp.				
Caecidotea sp.				
Polycelis coronata	8	5	5	**70**
Enchytraeidae				
Totals	**276**	**289**	**286**	**3311**
Shannon Weaver Diversity				**3.86**
Calculated Evenness				**0.753**
EPT				**17**
% EPT				**74.62%**
Density				**3,311**
% Non-Insect				**2.70%**
% Shredder/Scraper				**36.43%**
Taxa Richness				**35**
# Ephemeroptera Taxa				**6**
# Plecoptera Taxa				**4**
# Trichoptera Taxa				**7**
% Ephemeroptera individuals				**38.90%**
% Plectopera individuals				**2.23%**
% Trichoptera individuals				**33.49%**
Percent Chironomidae				**18.92%**
Percent Tolerant Organisms				**4.23%**
# Intolerant Taxa				**17**

Table A10. Macroinvertebrate data collected from site BRC on 24 April 2021.

Blue River				
BRC		Sample		
24 April 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Baetis tricaudatus	1	4	4	**35**
Diphetor hageni		3	6	**35**
Drunella doddsii				
Drunella grandis	10	10	10	**117**
Ephemerella dorothea infrequens	19	36	25	**311**
Cinygmula sp.		2	2	**16**
Epeorus longimanus	12	46	35	**361**
Plecoptera				
Chloroperlidae	1			**4**
Sweltsa sp.			1	**4**
Prostoia besametsa				
Zapada oregonensis				
Claassenia sabulosa	1	3	2	**24**
Cultus sp.				
Diura knowltoni				
Isoperla fulva				
Kogotus modestus				
Megarcys signata				
Trichoptera				
Brachycentrus americanus		1	1	**8**
Brachycentrus occidentalis	8	20	13	**159**
Glossosoma sp.	12	13	2	**105**
Arctopsyche grandis		4	4	**32**
Hydropsyche cockerelli			1	**4**
Hydropsyche oslari				
Lepidostoma sp.	3	2	15	**78**
Hesperophylax sp.				
Rhyacophila coloradensis				
Rhyacophila sibirica				
Oligophlebodes sp.		1		**4**
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/*Orthocladius* sp.		6	1	**28**
Diamesa sp.		1		**4**
Eukiefferiella sp.	3	1		**16**
Hydrobaenus sp.				
Micropsectra/Tanytarsus sp.	1	8	6	**59**
Microtendipes sp.	2			**8**
Pagastia sp.		3	1	**16**
Parametriocnemus sp.	1			**4**
Polypedilum sp.	1			**4**
Rheocricotopus sp.	1		5	**24**
Synorthocladius sp.				
Thienemannimyia genus group	2	4	10	**63**
Tvetenia sp.		3		**12**

Table A10. cont. Macroinvertebrate data collected from site BRC on 24 April 2021.

Other Diptera				
Atherix pachypus			1	**4**
Chelifera/Neoplasta sp.	3		5	**32**
Wiedemannia sp.			1	**4**
Simulium sp.				
Antocha sp.				
Hexatoma sp.				
Coleoptera				
Heterlimnius corpulentus	3	2	4	**35**
Optioservus sp.	5	2	7	**55**
Zaitzevia parvula		1		**4**
Miscellaneous (Non-insects)				
Lebertia sp.	1		9	**39**
Sperchon sp.	12		3	**59**
Torrenticola sp.			1	**4**
Caecidotea sp.				
Polycelis coronata				
Enchytraeidae				
Totals	**102**	**176**	**175**	**1771**
Shannon Weaver Diversity				**4.01**
Calculated Evenness				**0.776**
EPT				**16**
% EPT				**73.51%**
Density				**1,771**
% Non-Insect				**5.74%**
% Shredder/Scraper				**41.94%**
Taxa Richness				**36**
# Ephemeroptera Taxa				**6**
# Plecoptera Taxa				**3**
# Trichoptera Taxa				**7**
% Ephemeroptera individuals				**49.67%**
% Plectopera individuals				**1.77%**
% Trichoptera individuals				**22.08%**
Percent Chironomidae				**13.25%**
Percent Tolerant Organisms				**9.93%**
# Intolerant Taxa				**14**

Appendix B

Benthic Macroinvertebrate Data – Summer 2021

Table B1. Macroinvertebrate data collected from site BRaFG on 12 August 2021.

Blue River				
BRaFG		Sample		
12 August 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.		1	2	**12**
Baetis flavistriga	64	17	15	**373**
Baetis tricaudatus	23	44	48	**446**
Diphetor hageni	1		1	**8**
Drunella coloradensis		1		**4**
Drunella grandis				
Serratella tibialis				
Cinygmula sp.		1		**4**
Epeorus deceptivus	4	7	9	**78**
Epeorus longimanus				
Rhithrogena sp.				
Plecoptera				
Suwallia sp.		4		**16**
Sweltsa sp.				
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa				
Perlodidae	2	1	1	**16**
Isoperla sp.				
Isoperla fulva				
Kogotus modestus	2			**8**
Megarcys signata			1	**4**
Skwala americana				
Trichoptera				
Brachycentrus americanus	5	6	6	**66**
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis	1		1	**8**
Hydropsyche cockerelli				
Hydroptila sp.				
Lepidostoma sp.				
Limnephilidae			1	**4**
Rhyacophila coloradensis		1		**4**
Diptera				
Chironomidae				
Brillia sp.				
Cardiocladius sp.				
Corynoneura sp.				
Cricotopus/Orthocladius sp.	7	40	5	**202**
Eukiefferiella sp.		5	1	**24**
Hydrobaenus sp.	4			**16**
Krenosmittia sp.				
Micropsectra/Tanytarsus sp.	6	7	3	**63**
Microtendipes sp.				
Nanocladius sp.			1	**4**
Pagastia sp.	6	10	11	**105**
Parametriocnemus sp.				
Polypedilum sp.				
Rheocricotopus sp.	45	18	4	**260**
Stempellinella sp.				
Synorthocladius sp.	1			**4**
Thienemannimyia genus group				
Tvetenia sp.	22	32	18	**280**

Table B1. cont. Macroinvertebrate data collected from site BRaFG on 12 August 2021.

Other Diptera				
Atherix pachypus				
Bibiocephala grandis				
Ceratopogoninae				
Deuterophlebia coloradensis				
Chelifera/Neoplasta sp.				
Clinocera sp.				
Lispoides aequifrons	1			**4**
Simulium sp.	8	45	21	**287**
Hexatoma sp.				
Tipula sp.			1	**4**
Coleoptera				
Heterlimnius corpulentus	16	18	5	**152**
Optioservus sp.	1			**4**
Miscellaneous (Non-insects)				
Hygrobates sp.				
Lebertia sp.	8	8	1	**66**
Sperchon sp.	3	1	5	**35**
Polycelis coronata	68	38	18	**481**
Lymnaeidae				
Enchytraeidae	2	4	1	**28**
Naididae				
Nematoda				
Totals	**300**	**309**	**180**	**3070**
Shannon Weaver Diversity				**3.78**
Calculated Evenness				**0.749**
EPT				**15**
% EPT				**34.22%**
Density				**3,070**
% Non-Insect				**19.90%**
% Shredder/Scraper				**3.68%**
Taxa Richness				**33**
# Ephemeroptera Taxa				**7**
# Plecoptera Taxa				**4**
# Trichoptera Taxa				**4**
% Ephemeroptera individuals				**30.16%**
% Plectopera individuals				**1.39%**
% Trichoptera individuals				**2.66%**
Percent Chironomidae				**31.18%**
Percent Tolerant Organisms				**7.48%**
# Intolerant Taxa				**13**

Table B2. Macroinvertebrate data collected from site UBR on 12 August 2021.

Blue River				
UBR		Sample		
12 August 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	12	9	10	**121**
Baetis flavistriga	5	4	3	**47**
Baetis tricaudatus	71	54	68	**749**
Diphetor hageni				
Drunella coloradensis				
Drunella grandis				
Serratella tibialis				
Cinygmula sp.				
Epeorus deceptivus				
Epeorus longimanus	6	5	22	**128**
Rhithrogena sp.				
Plecoptera				
Suwallia sp.			7	**28**
Sweltsa sp.				
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa				
Perlodidae	5	2		**28**
Isoperla sp.			1	**4**
Isoperla fulva				
Kogotus modestus				
Megarcys signata				
Skwala americana				
Trichoptera				
Brachycentrus americanus	14	4	17	**136**
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis	7	2	5	**55**
Hydropsyche cockerelli				
Hydroptila sp.				
Lepidostoma sp.				
Limnephilidae				
Rhyacophila coloradensis				
Diptera				
Chironomidae				
Brillia sp.				
Cardiocladius sp.				
Corynoneura sp.				
Cricotopus/Orthocladius sp.	17	21	14	**202**
Eukiefferiella sp.	1		3	**16**
Hydrobaenus sp.				
Krenosmittia sp.				
Micropsectra/Tanytarsus sp.	9	5	23	**144**
Microtendipes sp.				
Nanocladius sp.				
Pagastia sp.	2	2	18	**86**
Parametriocnemus sp.				
Polypedilum sp.			1	**4**
Rheocricotopus sp.	8	8	24	**156**
Stempellinella sp.				
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.	3	10	15	**109**

Table B2. cont. Macroinvertebrate data collected from site UBR on 12 August 2021.

Other Diptera				
Atherix pachypus				
Bibiocephala grandis				
Ceratopogoninae				
Deuterophlebia coloradensis				
Chelifera/Neoplasta sp.				
Clinocera sp.				
Lispoides aequifrons				
Simulium sp.	2			**8**
Hexatoma sp.				
Tipula sp.			1	**4**
Coleoptera				
Heterlimnius corpulentus	6	6	27	**152**
Optioservus sp.				
Miscellaneous (Non-insects)				
Hygrobates sp.				
Lebertia sp.		2		**8**
Sperchon sp.	2			**8**
Polycelis coronata	4	2	10	**63**
Lymnaeidae				
Enchytraeidae	2		27	**113**
Naididae	1		1	**8**
Nematoda				
Totals	**177**	**136**	**297**	**2377**
Shannon Weaver Diversity				**3.58**
Calculated Evenness				**0.780**
EPT				**9**
% EPT				**54.59%**
Density				**2,377**
% Non-Insect				**8.36%**
% Shredder/Scraper				**5.74%**
Taxa Richness				**24**
# Ephemeroptera Taxa				**4**
# Plecoptera Taxa				**3**
# Trichoptera Taxa				**2**
% Ephemeroptera individuals				**44.10%**
% Plectopera individuals				**2.46%**
% Trichoptera individuals				**8.03%**
Percent Chironomidae				**30.16%**
Percent Tolerant Organisms				**12.46%**
# Intolerant Taxa				**8**

Table B3. Macroinvertebrate data collected from site Blue 5 on 12 August 2021.

Blue River				
Blue 5		Sample		
12 August 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.		1	1	**8**
Baetis flavistriga				
Baetis tricaudatus	147	60	100	**1190**
Diphetor hageni				
Drunella coloradensis				
Drunella grandis				
Serratella tibialis				
Cinygmula sp.				
Epeorus deceptivus				
Epeorus longimanus				
Rhithrogena sp.				
Plecoptera				
Suwallia sp.				
Sweltsa sp.	3			**12**
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa				
Perlodidae				
Isoperla sp.				
Isoperla fulva				
Kogotus modestus				
Megarcys signata				
Skwala americana				
Trichoptera				
Brachycentrus americanus	1			**4**
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis			1	**4**
Hydropsyche cockerelli				
Hydroptila sp.				
Lepidostoma sp.				
Limnephilidae				
Rhyacophila coloradensis				
Diptera				
Chironomidae				
Brillia sp.				
Cardiocladius sp.				
Corynoneura sp.				
Cricotopus/Orthocladius sp.				
Eukiefferiella sp.			1	**4**
Hydrobaenus sp.				
Krenosmittia sp.				
Micropsectra/Tanytarsus sp.	9	1	4	**55**
Microtendipes sp.				
Nanocladius sp.				
Pagastia sp.	10	6	7	**90**
Parametriocnemus sp.				
Polypedilum sp.				
Rheocricotopus sp.				
Stempellinella sp.				
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.	7	1	4	**47**

Table B3. cont. Macroinvertebrate data collected from site Blue 5 on 12 August 2021.

Other Diptera				
Atherix pachypus				
Bibiocephala grandis				
Ceratopogoninae				
Deuterophlebia coloradensis				
Chelifera/Neoplasta sp.				
Clinocera sp.				
Lispoides aequifrons				
Simulium sp.	7	4	5	**63**
Hexatoma sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus				
Optioservus sp.				
Miscellaneous (Non-insects)				
Hygrobates sp.				
Lebertia sp.				
Sperchon sp.				
Polycelis coronata	8	3	7	**70**
Lymnaeidae				
Enchytraeidae				
Naididae				
Nematoda				
Totals	**192**	**76**	**130**	**1547**
Shannon Weaver Diversity				**1.39**
Calculated Evenness				**0.403**
EPT				**5**
% EPT				**78.89%**
Density				**1,547**
% Non-Insect				**4.52%**
% Shredder/Scraper				**0.00%**
Taxa Richness				**11**
# Ephemeroptera Taxa				**2**
# Plecoptera Taxa				**1**
# Trichoptera Taxa				**2**
% Ephemeroptera individuals				**77.64%**
% Plectopera individuals				**0.75%**
% Trichoptera individuals				**0.50%**
Percent Chironomidae				**12.56%**
Percent Tolerant Organisms				**3.77%**
# Intolerant Taxa				**5**

Table B4. Macroinvertebrate data collected from site DRD on 12 August 2021.

Blue River				
DRD		Sample		
12 August 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	2		8	**39**
Baetis flavistriga				
Baetis tricaudatus	42	101	93	**915**
Diphetor hageni				
Drunella coloradensis		2	1	**12**
Drunella grandis				
Serratella tibialis				
Cinygmula sp.				
Epeorus deceptivus	1	2	2	**20**
Epeorus longimanus	1			**4**
Rhithrogena sp.				
Plecoptera				
Suwallia sp.		3	2	**20**
Sweltsa sp.				
Zapada cinctipes				
Zapada oregonensis group		1		**4**
Claassenia sabulosa				
Perlodidae				
Isoperla sp.				
Isoperla fulva				
Kogotus modestus				
Megarcys signata			2	**8**
Skwala americana				
Trichoptera				
Brachycentrus americanus		1		**4**
Brachycentrus occidentalis			1	**4**
Glossosoma sp.				
Arctopsyche grandis			1	**4**
Hydropsyche cockerelli				
Hydroptila sp.				
Lepidostoma sp.				
Limnephilidae				
Rhyacophila coloradensis				
Diptera				
Chironomidae				
Brillia sp.				
Cardiocladius sp.				
Corynoneura sp.				
Cricotopus/Orthocladius sp.		1		**4**
Eukiefferiella sp.	3	12	1	**63**
Hydrobaenus sp.		1		**4**
Krenosmittia sp.				
Micropsectra/Tanytarsus sp.	6	6	4	**63**
Microtendipes sp.				
Nanocladius sp.				
Pagastia sp.	1	5	2	**32**
Parametriocnemus sp.				
Polypedilum sp.				
Rheocricotopus sp.		1	1	**8**
Stempellinella sp.				
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.	3	23	1	**105**

Table B4. cont. Macroinvertebrate data collected from site DRD on 12 August 2021.

Other Diptera				
Atherix pachypus				
Bibiocephala grandis				
Ceratopogoninae				
Deuterophlebia coloradensis				
Chelifera/Neoplasta sp.				
Clinocera sp.				
Lispoides aequifrons				
Simulium sp.	5	23	2	**117**
Hexatoma sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	3	2	3	**32**
Optioservus sp.				
Miscellaneous (Non-insects)				
Hygrobates sp.				
Lebertia sp.				
Sperchon sp.				
Polycelis coronata	8	16	3	**105**
Lymnaeidae				
Enchytraeidae				
Naididae	1		1	**8**
Nematoda				
Totals	**76**	**200**	**128**	**1575**
Shannon Weaver Diversity				**2.45**
Calculated Evenness				**0.550**
EPT				**11**
% EPT				**65.84%**
Density				**1,575**
% Non-Insect				**7.18%**
% Shredder/Scraper				**2.72%**
Taxa Richness				**22**
# Ephemeroptera Taxa				**5**
# Plecoptera Taxa				**3**
# Trichoptera Taxa				**3**
% Ephemeroptera individuals				**63.12%**
% Plectopera individuals				**1.98%**
% Trichoptera individuals				**0.74%**
Percent Chironomidae				**17.57%**
Percent Tolerant Organisms				**8.66%**
# Intolerant Taxa				**11**

Table B5. Macroinvertebrate data collected from site Blue 3 on 12 August 2021.

Blue River				
Blue 3		Sample		
12 August 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	11	8	11	**117**
Baetis flavistriga				
Baetis tricaudatus	97	49	64	**814**
Diphetor hageni				
Drunella coloradensis	2	1	1	**16**
Drunella grandis		1		**4**
Serratella tibialis	3	2	8	**51**
Cinygmula sp.	1	2	1	**16**
Epeorus deceptivus	6	7	1	**55**
Epeorus longimanus	5	4		**35**
Rhithrogena sp.				
Plecoptera				
Suwallia sp.	16	8	10	**132**
Sweltsa sp.	6	3	24	**128**
Zapada cinctipes			1	**4**
Zapada oregonensis group	4	1	3	**32**
Claassenia sabulosa				
Perlodidae	1			**4**
Isoperla sp.				
Isoperla fulva				
Kogotus modestus				
Megarcys signata				
Skwala americana				
Trichoptera				
Brachycentrus americanus				
Brachycentrus occidentalis	7	14	47	**264**
Glossosoma sp.				
Arctopsyche grandis	8	2		**39**
Hydropsyche cockerelli				
Hydroptila sp.				
Lepidostoma sp.				
Limnephilidae				
Rhyacophila coloradensis				
Diptera				
Chironomidae				
Brillia sp.		1		**4**
Cardiocladius sp.				
Corynoneura sp.				
Cricotopus/Orthocladius sp.	14		24	**148**
Eukiefferiella sp.			2	**8**
Hydrobaenus sp.				
Krenosmittia sp.				
Micropsectra/Tanytarsus sp.	32	5	38	**291**
Microtendipes sp.				
Nanocladius sp.				
Pagastia sp.	7		48	**214**
Parametriocnemus sp.	1			**4**
Polypedilum sp.				
Rheocricotopus sp.	26	4	21	**198**
Stempellinella sp.				
Synorthocladius sp.				
Thienemannimyia genus group			1	**4**
Tvetenia sp.	8		5	**51**

Table B5. cont. Macroinvertebrate data collected from site Blue 3 on 12 August 2021.

Other Diptera				
Atherix pachypus				
Bibiocephala grandis				
Ceratopogoninae				
Deuterophlebia coloradensis				
Chelifera/Neoplasta sp.				
Clinocera sp.				
Lispoides aequifrons				
Simulium sp.		3	1	**16**
Hexatoma sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	28	27	81	**528**
Optioservus sp.				
Miscellaneous (Non-insects)				
Hygrobates sp.		1		**4**
Lebertia sp.				
Sperchon sp.				
Polycelis coronata	14	3	24	**159**
Lymnaeidae				
Enchytraeidae		3		**12**
Naididae				
Nematoda				
Totals	**297**	**149**	**416**	**3352**
Shannon Weaver Diversity				**3.67**
Calculated Evenness				**0.755**
EPT				**15**
% EPT				**51.04%**
Density				**3,352**
% Non-Insect				**5.22%**
% Shredder/Scraper				**4.87%**
Taxa Richness				**29**
# Ephemeroptera Taxa				**8**
# Plecoptera Taxa				**5**
# Trichoptera Taxa				**2**
% Ephemeroptera individuals				**33.06%**
% Plectopera individuals				**8.93%**
% Trichoptera individuals				**9.05%**
Percent Chironomidae				**27.49%**
Percent Tolerant Organisms				**9.40%**
# Intolerant Taxa				**14**

Table B6. Macroinvertebrate data collected from site D 5 on 12 August 2021.

Blue River				
D 5		Sample		
12 August 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	49	35	36	**466**
Baetis flavistriga				
Baetis tricaudatus	310	254	117	**2640**
Diphetor hageni				
Drunella coloradensis				
Drunella grandis	1	2		**12**
Serratella tibialis				
Cinygmula sp.				
Epeorus deceptivus				
Epeorus longimanus	1			**4**
Rhithrogena sp.				
Plecoptera				
Suwallia sp.		2	1	**12**
Sweltsa sp.	36	16	33	**330**
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa				
Perlodidae	1			**4**
Isoperla sp.				
Isoperla fulva				
Kogotus modestus				
Megarcys signata				
Skwala americana				
Trichoptera				
Brachycentrus americanus				
Brachycentrus occidentalis	568	148	88	**3117**
Glossosoma sp.	1	1	2	**16**
Arctopsyche grandis	19	17	2	**148**
Hydropsyche cockerelli				
Hydroptila sp.				
Lepidostoma sp.	1		1	**8**
Limnephilidae				
Rhyacophila coloradensis				
Diptera				
Chironomidae				
Brillia sp.				
Cardiocladius sp.				
Corynoneura sp.	1			**4**
Cricotopus/Orthocladius sp.	11	9	5	**97**
Eukiefferiella sp.	17	10	4	**121**
Hydrobaenus sp.				
Krenosmittia sp.				
Micropsectra/Tanytarsus sp.	346	154	325	**3198**
Microtendipes sp.				
Nanocladius sp.				
Pagastia sp.	81	46	38	**640**
Parametriocnemus sp.				
Polypedilum sp.				
Rheocricotopus sp.	24	5	4	**128**
Stempellinella sp.				
Synorthocladius sp.	2	5	1	**32**
Thienemannimyia genus group	1	4	1	**24**
Tvetenia sp.	14	10	1	**97**

Table B6. cont. Macroinvertebrate data collected from site D 5 on 12 August 2021.

Other Diptera				
Atherix pachypus				
Bibiocephala grandis			1	**4**
Ceratopogoninae				
Deuterophlebia coloradensis				
Chelifera/Neoplasta sp.				
Clinocera sp.				
Lispoides aequifrons				
Simulium sp.	882	127	158	**4524**
Hexatoma sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	39	15	25	**307**
Optioservus sp.				
Miscellaneous (Non-insects)				
Hygrobates sp.				
Lebertia sp.	4			**16**
Sperchon sp.		2		**8**
Polycelis coronata	14	6	10	**117**
Lymnaeidae				
Enchytraeidae				
Naididae			1	**4**
Nematoda				
Totals	**2423**	**868**	**854**	**16078**
Shannon Weaver Diversity				**2.82**
Calculated Evenness				**0.594**
EPT				**11**
% EPT				**42.03%**
Density				**16,078**
% Non-Insect				**0.89%**
% Shredder/Scraper				**0.27%**
Taxa Richness				**27**
# Ephemeroptera Taxa				**4**
# Plecoptera Taxa				**3**
# Trichoptera Taxa				**4**
% Ephemeroptera individuals				**19.42%**
% Plectopera individuals				**2.15%**
% Trichoptera individuals				**20.46%**
Percent Chironomidae				**27.00%**
Percent Tolerant Organisms				**20.84%**
# Intolerant Taxa				**13**

Table B7. Macroinvertebrate data collected from site Blue 2 on 12 August 2021.

Blue River				
Blue 2		Sample		
12 August 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	15	15	15	**175**
Baetis flavistriga		2	1	**12**
Baetis tricaudatus	66	60	51	**687**
Diphetor hageni				
Drunella coloradensis			1	**4**
Drunella grandis	5	2	2	**35**
Serratella tibialis	1		1	**8**
Cinygmula sp.				
Epeorus deceptivus	3	8	2	**51**
Epeorus longimanus	8	4	5	**66**
Rhithrogena sp.				
Plecoptera				
Suwallia sp.	1			**4**
Sweltsa sp.	16	19	36	**276**
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa				
Perlodidae				
Isoperla sp.				
Isoperla fulva				
Kogotus modestus				
Megarcys signata				
Skwala americana	1		1	**8**
Trichoptera				
Brachycentrus americanus			3	**12**
Brachycentrus occidentalis	4	6	15	**97**
Glossosoma sp.				
Arctopsyche grandis	18	14	14	**179**
Hydropsyche cockerelli				
Hydroptila sp.				
Lepidostoma sp.	2	4	11	**66**
Limnephilidae				
Rhyacophila coloradensis				
Diptera				
Chironomidae				
Brillia sp.				
Cardiocladius sp.	4	3	2	**35**
Corynoneura sp.				
Cricotopus/Orthocladius sp.	12	8	15	**136**
Eukiefferiella sp.	16	12	4	**125**
Hydrobaenus sp.				
Krenosmittia sp.				
Micropsectra/Tanytarsus sp.	120	62	131	**1214**
Microtendipes sp.				
Nanocladius sp.				
Pagastia sp.	15	12	23	**194**
Parametriocnemus sp.		3		**12**
Polypedilum sp.			1	**4**
Rheocricotopus sp.	3	5	8	**63**
Stempellinella sp.				
Synorthocladius sp.	2	2	3	**28**
Thienemannimyia genus group	1	3	1	**20**
Tvetenia sp.	17	6	25	**187**

Table B7. cont. Macroinvertebrate data collected from site Blue 2 on 12 August 2021.

Other Diptera				
Atherix pachypus				
Bibiocephala grandis				
Ceratopogoninae				
Deuterophlebia coloradensis				
Chelifera/Neoplasta sp.				
Clinocera sp.			1	**4**
Lispoides aequifrons				
Simulium sp.	437	2036	1461	**15249**
Hexatoma sp.			1	**4**
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	10	13	21	**171**
Optioservus sp.				
Miscellaneous (Non-insects)				
Hygrobates sp.				
Lebertia sp.	2		3	**20**
Sperchon sp.	1	1		**8**
Polycelis coronata	7	4	1	**47**
Lymnaeidae				
Enchytraeidae				
Naididae				
Nematoda				
Totals	**787**	**2304**	**1859**	**19201**
Shannon Weaver Diversity				**1.47**
Calculated Evenness				**0.291**
EPT				**15**
% EPT				**8.73%**
Density				**19,201**
% Non-Insect				**0.38%**
% Shredder/Scraper				**1.17%**
Taxa Richness				**33**
# Ephemeroptera Taxa				**8**
# Plecoptera Taxa				**3**
# Trichoptera Taxa				**4**
% Ephemeroptera individuals				**5.39%**
% Plectopera individuals				**1.49%**
% Trichoptera individuals				**1.84%**
Percent Chironomidae				**10.48%**
Percent Tolerant Organisms				**7.11%**
# Intolerant Taxa				**16**

Table B8. Macroinvertebrate data collected from site Blue 1 on 12 August 2021.

Blue River				
Blue 1		Sample		
12 August 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	14	4	13	**121**
Baetis flavistriga	6	1	6	**51**
Baetis tricaudatus	54	29	55	**535**
Diphetor hageni	1			**4**
Drunella coloradensis				
Drunella grandis				
Serratella tibialis	2	1		**12**
Cinygmula sp.				
Epeorus deceptivus	1	1		**8**
Epeorus longimanus	13	8	9	**117**
Rhithrogena sp.			3	**12**
Plecoptera				
Suwallia sp.				
Sweltsa sp.	29	20	21	**272**
Zapada cinctipes	2	1		**12**
Zapada oregonensis group				
Claassenia sabulosa				
Perlodidae	1		2	**12**
Isoperla sp.				
Isoperla fulva				
Kogotus modestus				
Megarcys signata				
Skwala americana				
Trichoptera				
Brachycentrus americanus	1		1	**8**
Brachycentrus occidentalis	2			**8**
Glossosoma sp.		2	1	**12**
Arctopsyche grandis	19	4	8	**121**
Hydropsyche cockerelli				
Hydroptila sp.				
Lepidostoma sp.	5		3	**32**
Limnephilidae				
Rhyacophila coloradensis				
Diptera				
Chironomidae				
Brillia sp.				
Cardiocladius sp.	4		1	**20**
Corynoneura sp.				
Cricotopus/Orthocladius sp.	4		10	**55**
Eukiefferiella sp.	5	2	3	**39**
Hydrobaenus sp.				
Krenosmittia sp.				
Micropsectra/Tanytarsus sp.	55	37	75	**648**
Microtendipes sp.				
Nanocladius sp.				
Pagastia sp.	5	2		**28**
Parametriocnemus sp.				
Polypedilum sp.		1		**4**
Rheocricotopus sp.	13	2	7	**86**
Stempellinella sp.				
Synorthocladius sp.	1			**4**
Thienemannimyia genus group	1			**4**
Tvetenia sp.	17	4	3	**94**

Table B8. cont. Macroinvertebrate data collected from site Blue 1 on 12 August 2021.

Other Diptera				
Atherix pachypus		1		**4**
Bibiocephala grandis			1	**4**
Ceratopogoninae	2			**8**
Deuterophlebia coloradensis	3	2	1	**24**
Chelifera/Neoplasta sp.	1		1	**8**
Clinocera sp.				
Lispoides aequifrons				
Simulium sp.	1279	185	652	**8202**
Hexatoma sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	9	5	5	**74**
Optioservus sp.	2			**8**
Miscellaneous (Non-insects)				
Hygrobates sp.				
Lebertia sp.				
Sperchon sp.		1		**4**
Polycelis coronata	5	3	3	**43**
Lymnaeidae	1			**4**
Enchytraeidae				
Naididae				
Nematoda				
Totals	**1557**	**316**	**884**	**10702**
Shannon Weaver Diversity				**1.62**
Calculated Evenness				**0.311**
EPT				**16**
% EPT				**12.44%**
Density				**10,702**
% Non-Insect				**0.47%**
% Shredder/Scraper				**2.18%**
Taxa Richness				**37**
# Ephemeroptera Taxa				**8**
# Plecoptera Taxa				**3**
# Trichoptera Taxa				**5**
% Ephemeroptera individuals				**8.02%**
% Plectopera individuals				**2.76%**
% Trichoptera individuals				**1.67%**
Percent Chironomidae				**9.14%**
Percent Tolerant Organisms				**6.49%**
# Intolerant Taxa				**18**

Table B9. Macroinvertebrate data collected from site SCR on 12 August 2021.

Blue River				
SCR		Sample		
12 August 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	6	9	10	**97**
Baetis flavistriga	3	1		**16**
Baetis tricaudatus	30	50	20	**388**
Diphetor hageni	5	4	4	**51**
Drunella coloradensis				
Drunella grandis	11	16	12	**152**
Serratella tibialis				
Cinygmula sp.			1	**4**
Epeorus deceptivus				
Epeorus longimanus	1			**4**
Rhithrogena sp.				
Plecoptera				
Suwallia sp.				
Sweltsa sp.	19	20	11	**194**
Zapada cinctipes			1	**4**
Zapada oregonensis group				
Claassenia sabulosa				
Perlodidae				
Isoperla sp.			8	**32**
Isoperla fulva				
Kogotus modestus				
Megarcys signata				
Skwala americana	2	1	2	**20**
Trichoptera				
Brachycentrus americanus	2	12	2	**63**
Brachycentrus occidentalis	114	162	181	**1772**
Glossosoma sp.	2	1		**12**
Arctopsyche grandis	3	11	26	**156**
Hydropsyche cockerelli				
Hydroptila sp.				
Lepidostoma sp.	35	16	21	**280**
Limnephilidae				
Rhyacophila coloradensis		2		**8**
Diptera				
Chironomidae				
Brillia sp.				
Cardiocladius sp.				
Corynoneura sp.		1		**4**
Cricotopus/Orthocladius sp.	77	104	117	**1156**
Eukiefferiella sp.	4	4	1	**35**
Hydrobaenus sp.				
Krenosmittia sp.				
Micropsectra/Tanytarsus sp.	36	94	105	**911**
Microtendipes sp.	7	1		**32**
Nanocladius sp.				
Pagastia sp.	16	18	11	**175**
Parametriocnemus sp.	5	20	4	**113**
Polypedilum sp.		6	5	**43**
Rheocricotopus sp.	12	34	27	**283**
Stempellinella sp.	28	40	29	**376**
Synorthocladius sp.	8	15	5	**109**
Thienemannimyia genus group	7	9	12	**109**
Tvetenia sp.	8	10	31	**190**

Table B9. cont. Macroinvertebrate data collected from site SCR on 12 August 2021.

Other Diptera				
Atherix pachypus		1	1	**8**
Bibiocephala grandis				
Ceratopogoninae				
Deuterophlebia coloradensis				
Chelifera/Neoplasta sp.		2	1	**12**
Clinocera sp.				
Lispoides aequifrons				
Simulium sp.	5	10	25	**156**
Hexatoma sp.		1		**4**
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	27	31	19	**299**
Optioservus sp.		1		**4**
Miscellaneous (Non-insects)				
Hygrobates sp.				
Lebertia sp.	3		1	**16**
Sperchon sp.	2	1	1	**16**
Polycelis coronata	13	5	18	**140**
Lymnaeidae				
Enchytraeidae		2	1	**12**
Naididae				
Nematoda				
Totals	**491**	**715**	**713**	**7456**
Shannon Weaver Diversity				**3.90**
Calculated Evenness				**0.732**
EPT				**17**
% EPT				**43.62%**
Density				**7,456**
% Non-Insect				**2.45%**
% Shredder/Scraper				**6.72%**
Taxa Richness				**40**
# Ephemeroptera Taxa				**7**
# Plecoptera Taxa				**4**
# Trichoptera Taxa				**6**
% Ephemeroptera individuals				**9.54%**
% Plectopera individuals				**3.34%**
% Trichoptera individuals				**30.75%**
Percent Chironomidae				**47.47%**
Percent Tolerant Organisms				**13.34%**
# Intolerant Taxa				**17**

Table B10. Macroinvertebrate data collected from site BRC on 12 August 2021.

Blue River				
BRC		Sample		
12 August 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	3		1	**16**
Baetis flavistriga				
Baetis tricaudatus	27	4	15	**179**
Diphetor hageni	1			**4**
Drunella coloradensis				
Drunella grandis	2	1		**12**
Serratella tibialis				
Cinygmula sp.				
Epeorus deceptivus				
Epeorus longimanus				
Rhithrogena sp.				
Plecoptera				
Suwallia sp.				
Sweltsa sp.	1	2	6	**35**
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa	7	2	1	**39**
Perlodidae				
Isoperla sp.				
Isoperla fulva	1			**4**
Kogotus modestus				
Megarcys signata				
Skwala americana	2			**8**
Trichoptera				
Brachycentrus americanus	1			**4**
Brachycentrus occidentalis	14		11	**97**
Glossosoma sp.	71	24	27	**473**
Arctopsyche grandis	16	5	3	**94**
Hydropsyche cockerelli	6	3	2	**43**
Hydroptila sp.	4	1		**20**
Lepidostoma sp.	6	1	1	**32**
Limnephilidae				
Rhyacophila coloradensis	1			**4**
Diptera				
Chironomidae				
Brillia sp.				
Cardiocladius sp.				
Corynoneura sp.				
Cricotopus/Orthocladius sp.	9	3		**47**
Eukiefferiella sp.	2	2		**16**
Hydrobaenus sp.				
Krenosmittia sp.			2	**8**
Micropsectra/Tanytarsus sp.	6	2	4	**47**
Microtendipes sp.				
Nanocladius sp.				
Pagastia sp.	5	3	3	**43**
Parametriocnemus sp.				
Polypedilum sp.	4		1	**20**
Rheocricotopus sp.			8	**32**
Stempellinella sp.	4	1	4	**35**
Synorthocladius sp.	2		1	**12**
Thienemannimyia genus group	1			**4**
Tvetenia sp.	2			**8**

Table B10. cont. Macroinvertebrate data collected from site BRC on 12 August 2021.

Other Diptera				
Atherix pachypus				
Bibiocephala grandis				
Ceratopogoninae				
Deuterophlebia coloradensis				
Chelifera/Neoplasta sp.				
Clinocera sp.				
Lispoides aequifrons				
Simulium sp.	39	30	4	**283**
Hexatoma sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	5	1	6	**47**
Optioservus sp.	2	1		**12**
Miscellaneous (Non-insects)				
Hygrobates sp.				
Lebertia sp.				
Sperchon sp.	2			**8**
Polycelis coronata	3		1	**16**
Lymnaeidae				
Enchytraeidae				
Naididae				
Nematoda	1			**4**
Totals	**250**	**86**	**101**	**1706**
Shannon Weaver Diversity				**3.76**
Calculated Evenness				**0.745**
EPT				**16**
% EPT				**62.47%**
Density				**1,706**
% Non-Insect				**1.60%**
% Shredder/Scraper				**33.41%**
Taxa Richness				**33**
# Ephemeroptera Taxa				**4**
# Plecoptera Taxa				**4**
# Trichoptera Taxa				**8**
% Ephemeroptera individuals				**12.36%**
% Plectopera individuals				**5.03%**
% Trichoptera individuals				**45.08%**
Percent Chironomidae				**15.79%**
Percent Tolerant Organisms				**4.12%**
# Intolerant Taxa				**15**

Appendix C

Benthic Macroinvertebrate Data – Fall 2021

Table C1. Macroinvertebrate data collected from site BRaFG on 25 October 2021.

Blue River				
BRaFG		Sample		
25 October 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.				
Baetis tricaudatus	6	35	33	**287**
Diphetor hageni		3		**12**
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.				
Epeorus sp.	2	1		**12**
Epeorus longimanus				
Rhithrogena sp.				
Plecoptera				
Capnia sp.				
Chloroperlidae				
Sweltsa sp.				
Prostoia besametsa		1		**4**
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla sp.	2	11	9	**86**
Isoperla fulva				
Megarcys signata		1	1	**8**
Skwala americana				
Taenionema sp.		3	5	**32**
Trichoptera				
Brachycentrus americanus	2	73	20	**369**
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis	2	1		**12**
Hydropsyche cockerelli				
Lepidostoma sp.				
Rhyacophila brunnea				
Rhyacophila coloradensis				
Rhyacophila sibirica group				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.		3	3	**24**
Cricotopus/*Orthocladius* sp.	1	1		**8**
Diamesa sp.				
Eukiefferiella sp.	1	5	4	**39**
Heterotrissocladius sp.				
Micropsectra/Tanytarsus sp.		3	2	**20**
Microtendipes sp.				
Pagastia sp.	2	12		**55**
Parametriocnemus sp.				
Polypedilum sp.				
Pseudorthocladius sp.				
Rheocricotopus sp.				
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.	1			**4**

Table C1. cont. Macroinvertebrate data collected from site BRaFG on 25 October 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Pericoma sp.		1		**4**
Simulium sp.		1		**4**
Antocha sp.				
Hesperoconopa sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	4	14	6	**94**
Optioservus sp.				
Miscellaneous (Non-insects)				
Atractides sp.		1		**4**
Lebertia sp.	2	8	3	**51**
Protzia sp.				
Sperchon sp.		3	1	**16**
Pisidium sp.				
Polycelis coronata	3	43	18	**249**
Enchytraeidae				
Lumbricidae		1		**4**
Naididae		1		**4**
Nematoda				
Totals	**28**	**226**	**105**	**1402**
Shannon Weaver Diversity				**3.23**
Calculated Evenness				**0.704**
EPT				**9**
% EPT				**58.77%**
Density				**1,402**
% Non-Insect				**23.40%**
% Shredder/Scraper				**5.01%**
Taxa Richness				**24**
# Ephemeroptera Taxa				**3**
# Plecoptera Taxa				**4**
# Trichoptera Taxa				**2**
% Ephemeroptera individuals				**22.28%**
% Plectopera individuals				**9.19%**
% Trichoptera individuals				**27.30%**
Percent Chironomidae				**10.58%**
Percent Tolerant Organisms				**9.75%**
# Intolerant Taxa				**9**

Table C2. Macroinvertebrate data collected from site UBR on 25 October 2021.

Blue River				
UBR		Sample		
25 October 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.				
Baetis tricaudatus	23	32	56	**431**
Diphetor hageni				
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.	9	11	8	**109**
Epeorus sp.				
Epeorus longimanus	39	50	90	**694**
Rhithrogena sp.				
Plecoptera				
Capnia sp.				
Chloroperlidae				
Sweltsa sp.	4	1		**20**
Prostoia besametsa	3	4		**28**
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni	1			**4**
Isoperla sp.	2	2	2	**24**
Isoperla fulva	5	2	5	**47**
Megarcys signata				
Skwala americana	1		1	**8**
Taenionema sp.				
Trichoptera				
Brachycentrus americanus	18	13	17	**187**
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis	12	7	6	**97**
Hydropsyche cockerelli				
Lepidostoma sp.				
Rhyacophila brunnea	1		1	**8**
Rhyacophila coloradensis				
Rhyacophila sibirica group				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	1	1	4	**24**
Diamesa sp.				
Eukiefferiella sp.		1		**4**
Heterotrissocladius sp.		1		**4**
Micropsectra/Tanytarsus sp.		1		**4**
Microtendipes sp.				
Pagastia sp.		1		**4**
Parametriocnemus sp.				
Polypedilum sp.				
Pseudorthocladius sp.				
Rheocricotopus sp.				
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.				

Table C2. cont. Macroinvertebrate data collected from site UBR on 25 October 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Pericoma sp.				
Simulium sp.			1	**4**
Antocha sp.	10	7	2	**74**
Hesperoconopa sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	35	18	18	**276**
Optioservus sp.				
Miscellaneous (Non-insects)				
Atractides sp.				
Lebertia sp.	3	1		**16**
Protzia sp.				
Sperchon sp.				
Pisidium sp.				
Polycelis coronata	7	13	10	**117**
Enchytraeidae	27	18	4	**190**
Lumbricidae				
Naididae				
Nematoda				
Totals	**201**	**184**	**225**	**2374**
Shannon Weaver Diversity				**3.24**
Calculated Evenness				**0.716**
EPT				**12**
% EPT				**69.84%**
Density				**2,374**
% Non-Insect				**13.61%**
% Shredder/Scraper				**35.25%**
Taxa Richness				**23**
# Ephemeroptera Taxa				**3**
# Plecoptera Taxa				**6**
# Trichoptera Taxa				**3**
% Ephemeroptera individuals				**52.13%**
% Plectopera individuals				**5.41%**
% Trichoptera individuals				**12.30%**
Percent Chironomidae				**1.64%**
Percent Tolerant Organisms				**9.02%**
# Intolerant Taxa				**14**

Table C3. Macroinvertebrate data collected from site Blue 5 on 25 October 2021.

Blue River				
Blue 5		Sample		
25 October 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.		2		**8**
Baetis tricaudatus	75	25	54	**597**
Diphetor hageni				
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.				
Epeorus sp.	1			**4**
Epeorus longimanus				
Rhithrogena sp.				
Plecoptera				
Capnia sp.				
Chloroperlidae				
Sweltsa sp.				
Prostoia besametsa				
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla sp.				
Isoperla fulva				
Megarcys signata				
Skwala americana				
Taenionema sp.				
Trichoptera				
Brachycentrus americanus				
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis			1	**4**
Hydropsyche cockerelli				
Lepidostoma sp.				
Rhyacophila brunnea				
Rhyacophila coloradensis				
Rhyacophila sibirica group				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	3		2	**20**
Diamesa sp.		1	1	**8**
Eukiefferiella sp.	2		1	**12**
Heterotrissocladius sp.				
Micropsectra/Tanytarsus sp.	1		1	**8**
Microtendipes sp.				
Pagastia sp.	7	1	4	**47**
Parametriocnemus sp.				
Polypedilum sp.				
Pseudorthocladius sp.				
Rheocricotopus sp.				
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.	17	2	3	**86**

Table C3. cont. Macroinvertebrate data collected from site Blue 5 on 25 October 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Pericoma sp.				
Simulium sp.	35	5	28	**264**
Antocha sp.				
Hesperoconopa sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus		1		**4**
Optioservus sp.				
Miscellaneous (Non-insects)				
Atractides sp.				
Lebertia sp.	1			**4**
Protzia sp.				
Sperchon sp.	1			**4**
Pisidium sp.				
Polycelis coronata	10	8	6	**94**
Enchytraeidae	2		1	**12**
Lumbricidae				
Naididae				
Nematoda				
Totals	**155**	**45**	**102**	**1176**
Shannon Weaver Diversity				**2.24**
Calculated Evenness				**0.560**
EPT				**4**
% EPT				**52.32%**
Density				**1,176**
% Non-Insect				**9.60%**
% Shredder/Scraper				**0.33%**
Taxa Richness				**16**
# Ephemeroptera Taxa				**3**
# Plecoptera Taxa				**0**
# Trichoptera Taxa				**1**
% Ephemeroptera individuals				**51.99%**
% Plectopera individuals				**0.00%**
% Trichoptera individuals				**0.33%**
Percent Chironomidae				**15.23%**
Percent Tolerant Organisms				**3.31%**
# Intolerant Taxa				**4**

Table C4. Macroinvertebrate data collected from site DRD on 25 October 2021.

Blue River				
DRD		Sample		
25 October 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	5	8	3	**63**
Baetis tricaudatus	58	46	34	**535**
Diphetor hageni				
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.				
Epeorus sp.				
Epeorus longimanus				
Rhithrogena sp.				
Plecoptera				
Capnia sp.				
Chloroperlidae				
Sweltsa sp.	3	1	2	**24**
Prostoia besametsa				
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla sp.				
Isoperla fulva				
Megarcys signata				
Skwala americana				
Taenionema sp.	1			**4**
Trichoptera				
Brachycentrus americanus	1			**4**
Brachycentrus occidentalis				
Glossosoma sp.				
Arctopsyche grandis				
Hydropsyche cockerelli				
Lepidostoma sp.				
Rhyacophila brunnea				
Rhyacophila coloradensis				
Rhyacophila sibirica group				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.	3			**12**
Cricotopus/*Orthocladius* sp.	4		1	**20**
Diamesa sp.		1		**4**
Eukiefferiella sp.	3		1	**16**
Heterotrissocladius sp.				
Micropsectra/Tanytarsus sp.	1		1	**8**
Microtendipes sp.				
Pagastia sp.			1	**4**
Parametriocnemus sp.				
Polypedilum sp.				
Pseudorthocladius sp.				
Rheocricotopus sp.				
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.	2		2	**16**

Table C4. cont. Macroinvertebrate data collected from site DRD on 25 October 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Pericoma sp.				
Simulium sp.	2		1	**12**
Antocha sp.				
Hesperoconopa sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	1	2	1	**16**
Optioservus sp.				
Miscellaneous (Non-insects)				
Atractides sp.				
Lebertia sp.				
Protzia sp.				
Sperchon sp.				
Pisidium sp.				
Polycelis coronata	9	10	4	**90**
Enchytraeidae				
Lumbricidae				
Naididae	1			**4**
Nematoda				
Totals	**94**	**68**	**51**	**832**
Shannon Weaver Diversity				**2.05**
Calculated Evenness				**0.512**
EPT				**5**
% EPT				**76.06%**
Density				**832**
% Non-Insect				**11.27%**
% Shredder/Scraper				**1.88%**
Taxa Richness				**16**
# Ephemeroptera Taxa				**2**
# Plecoptera Taxa				**2**
# Trichoptera Taxa				**1**
% Ephemeroptera individuals				**72.30%**
% Plectopera individuals				**3.29%**
% Trichoptera individuals				**0.47%**
Percent Chironomidae				**9.39%**
Percent Tolerant Organisms				**3.29%**
# Intolerant Taxa				**5**

Table C5. Macroinvertebrate data collected from site Blue 3 on 25 October 2021.

Blue River				
Blue 3		Sample		
25 October 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	1	10	2	**51**
Baetis tricaudatus	40	98	49	**725**
Diphetor hageni				
Drunella grandis		2	2	**16**
Ephemerella dorothea infrequens				
Cinygmula sp.			1	**4**
Epeorus sp.			1	**4**
Epeorus longimanus				
Rhithrogena sp.				
Plecoptera				
Capnia sp.				
Chloroperlidae				
Sweltsa sp.		7	2	**35**
Prostoia besametsa			1	**4**
Zapada cinctipes				
Zapada oregonensis group	3	3		**24**
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla sp.				
Isoperla fulva	2	2	1	**20**
Megarcys signata				
Skwala americana				
Taenionema sp.				
Trichoptera				
Brachycentrus americanus				
Brachycentrus occidentalis	18	82	35	**524**
Glossosoma sp.				
Arctopsyche grandis	4	10	6	**78**
Hydropsyche cockerelli				
Lepidostoma sp.				
Rhyacophila brunnea				
Rhyacophila coloradensis				
Rhyacophila sibirica group				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	4	4	15	**90**
Diamesa sp.				
Eukiefferiella sp.	1		5	**24**
Heterotrissocladius sp.				
Micropsectra/Tanytarsus sp.	1	3	1	**20**
Microtendipes sp.				
Pagastia sp.	1	3	14	**70**
Parametriocnemus sp.				
Polypedilum sp.				
Pseudorthocladius sp.				
Rheocricotopus sp.				
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.	4	7	2	**51**

Table C5. cont. Macroinvertebrate data collected from site Blue 3 on 25 October 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Pericoma sp.				
Simulium sp.	3			**12**
Antocha sp.		1		**4**
Hesperoconopa sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	3	16	24	**167**
Optioservus sp.				
Miscellaneous (Non-insects)				
Atractides sp.				
Lebertia sp.		5	2	**28**
Protzia sp.			1	**4**
Sperchon sp.		1	1	**8**
Pisidium sp.				
Polycelis coronata	1	17	7	**97**
Enchytraeidae				
Lumbricidae				
Naididae				
Nematoda				
Totals	**86**	**271**	**172**	**2060**
Shannon Weaver Diversity				**3.01**
Calculated Evenness				**0.665**
EPT				**11**
% EPT				**72.21%**
Density				**2,060**
% Non-Insect				**6.62%**
% Shredder/Scraper				**2.46%**
Taxa Richness				**23**
# Ephemeroptera Taxa				**5**
# Plecoptera Taxa				**4**
# Trichoptera Taxa				**2**
% Ephemeroptera individuals				**38.94%**
% Plectopera individuals				**3.97%**
% Trichoptera individuals				**29.30%**
Percent Chironomidae				**12.29%**
Percent Tolerant Organisms				**3.97%**
# Intolerant Taxa				**11**

Table C6. Macroinvertebrate data collected from site D 5 on 25 October 2021.

Blue River				
D 5		Sample		
25 October 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.		1		**4**
Baetis tricaudatus	40	85	113	**923**
Diphetor hageni				
Drunella grandis				
Ephemerella dorothea infrequens				
Cinygmula sp.	16	13	24	**206**
Epeorus sp.				
Epeorus longimanus		7	5	**47**
Rhithrogena sp.				
Plecoptera				
Capnia sp.				
Chloroperlidae				
Sweltsa sp.	20	8	3	**121**
Prostoia besametsa			1	**4**
Zapada cinctipes		1		**4**
Zapada oregonensis group				
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla sp.				
Isoperla fulva	1	1	2	**16**
Megarcys signata				
Skwala americana				
Taenionema sp.				
Trichoptera				
Brachycentrus americanus			1	**4**
Brachycentrus occidentalis	33	84	56	**671**
Glossosoma sp.		15	3	**70**
Arctopsyche grandis		16	15	**121**
Hydropsyche cockerelli				
Lepidostoma sp.	1	1		**8**
Rhyacophila brunnea				
Rhyacophila coloradensis				
Rhyacophila sibirica group				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	17	39	61	**454**
Diamesa sp.	7	6	14	**105**
Eukiefferiella sp.	9	6	23	**148**
Heterotrissocladius sp.				
Micropsectra/Tanytarsus sp.	7			**28**
Microtendipes sp.				
Pagastia sp.	14	42	63	**462**
Parametriocnemus sp.		1		**4**
Polypedilum sp.	2	1		**12**
Pseudorthocladius sp.				
Rheocricotopus sp.	1			**4**
Synorthocladius sp.	1		1	**8**
Thienemannimyia genus group				
Tvetenia sp.				

Table C6. cont. Macroinvertebrate data collected from site D 5 on 25 October 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.		1		**4**
Pericoma sp.				
Simulium sp.			2	**8**
Antocha sp.	1	6	7	**55**
Hesperoconopa sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	47	36	21	**404**
Optioservus sp.				
Miscellaneous (Non-insects)				
Atractides sp.				
Lebertia sp.	1		2	**12**
Protzia sp.	1			**4**
Sperchon sp.				
Pisidium sp.				
Polycelis coronata	30	26	7	**245**
Enchytraeidae				
Lumbricidae				
Naididae				
Nematoda		1		**4**
Totals	**249**	**397**	**424**	**4160**
Shannon Weaver Diversity				**3.51**
Calculated Evenness				**0.715**
EPT				**13**
% EPT				**52.90%**
Density				**4,160**
% Non-Insect				**6.36%**
% Shredder/Scraper				**8.41%**
Taxa Richness				**30**
# Ephemeroptera Taxa				**4**
# Plecoptera Taxa				**4**
# Trichoptera Taxa				**5**
% Ephemeroptera individuals				**28.41%**
% Plectopera individuals				**3.46%**
% Trichoptera individuals				**21.03%**
Percent Chironomidae				**29.44%**
Percent Tolerant Organisms				**4.58%**
# Intolerant Taxa				**14**

Table C7. Macroinvertebrate data collected from site Blue 2 on 25 October 2021.

Blue River				
Blue 2		Sample		
25 October 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.				
Baetis tricaudatus	46	91	42	**694**
Diphetor hageni	1			**4**
Drunella grandis	10	4	5	**74**
Ephemerella dorothea infrequens				
Cinygmula sp.	22	71	6	**384**
Epeorus sp.				
Epeorus longimanus	27	35	32	**365**
Rhithrogena sp.				
Plecoptera				
Capnia sp.				
Chloroperlidae				
Sweltsa sp.	9	10	1	**78**
Prostoia besametsa				
Zapada cinctipes	1			**4**
Zapada oregonensis group	1		5	**24**
Claassenia sabulosa				
Cultus sp.	1			**4**
Diura knowltoni				
Isoperla sp.				
Isoperla fulva	2	3	2	**28**
Megarcys signata				
Skwala americana		1		**4**
Taenionema sp.	1		1	**8**
Trichoptera				
Brachycentrus americanus		1		**4**
Brachycentrus occidentalis	4	14	7	**97**
Glossosoma sp.		3	1	**16**
Arctopsyche grandis	15	14	7	**140**
Hydropsyche cockerelli				
Lepidostoma sp.	1	11	8	**78**
Rhyacophila brunnea				
Rhyacophila coloradensis				
Rhyacophila sibirica group				
Oligophlebodes sp.			1	**4**
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/*Orthocladius* sp.	17	35	37	**345**
Diamesa sp.	7	18	15	**156**
Eukiefferiella sp.	20	26	12	**225**
Heterotrissocladius sp.				
Micropsectra/Tanytarsus sp.	4	1		**20**
Microtendipes sp.		1		**4**
Pagastia sp.	23	53	12	**342**
Parametriocnemus sp.				
Polypedilum sp.	4	6	1	**43**
Pseudorthocladius sp.				
Rheocricotopus sp.				
Synorthocladius sp.				
Thienemannimyia genus group	2			**8**
Tvetenia sp.				

Table C7. cont. Macroinvertebrate data collected from site Blue 2 on 25 October 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.				
Pericoma sp.				
Simulium sp.	1	2	4	**28**
Antocha sp.	2	3		**20**
Hesperoconopa sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	16	18	12	**179**
Optioservus sp.	1			**4**
Miscellaneous (Non-insects)				
Atractides sp.				
Lebertia sp.	2	8	1	**43**
Protzia sp.				
Sperchon sp.	2	2		**16**
Pisidium sp.				
Polycelis coronata	7	8	3	**70**
Enchytraeidae				
Lumbricidae				
Naididae				
Nematoda				
Totals	**249**	**439**	**215**	**3513**
Shannon Weaver Diversity				**3.87**
Calculated Evenness				**0.768**
EPT				**18**
% EPT				**57.25%**
Density				**3,513**
% Non-Insect				**3.65%**
% Shredder/Scraper				**28.57%**
Taxa Richness				**33**
# Ephemeroptera Taxa				**5**
# Plecoptera Taxa				**7**
# Trichoptera Taxa				**6**
% Ephemeroptera individuals				**43.41%**
% Plectopera individuals				**4.21%**
% Trichoptera individuals				**9.63%**
Percent Chironomidae				**32.56%**
Percent Tolerant Organisms				**8.64%**
# Intolerant Taxa				**18**

Table C8. Macroinvertebrate data collected from site Blue 1 on 25 October 2021.

Blue River				
Blue 1		Sample		
25 October 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.	1		1	**8**
Baetis tricaudatus	62	149	83	**1140**
Diphetor hageni	2	1	1	**16**
Drunella grandis		2		**8**
Ephemerella dorothea infrequens				
Cinygmula sp.	46	69	68	**710**
Epeorus sp.				
Epeorus longimanus	54	69	48	**663**
Rhithrogena sp.	2			**8**
Plecoptera				
Capnia sp.		1		**4**
Chloroperlidae	2			**8**
Sweltsa sp.	9	6	10	**97**
Prostoia besametsa	1	4		**20**
Zapada cinctipes	2		3	**20**
Zapada oregonensis group	2			**8**
Claassenia sabulosa				
Cultus sp.				
Diura knowltoni				
Isoperla sp.				
Isoperla fulva		2		**8**
Megarcys signata				
Skwala americana		1	1	**8**
Taenionema sp.				
Trichoptera				
Brachycentrus americanus			1	**4**
Brachycentrus occidentalis		2	1	**12**
Glossosoma sp.				
Arctopsyche grandis	4	5	8	**66**
Hydropsyche cockerelli				
Lepidostoma sp.	22	87	62	**663**
Rhyacophila brunnea				
Rhyacophila coloradensis	1			**4**
Rhyacophila sibirica group				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	30	69	50	**578**
Diamesa sp.	12	13	14	**152**
Eukiefferiella sp.	10	14	9	**128**
Heterotrissocladius sp.				
Micropsectra/Tanytarsus sp.		1	1	**8**
Microtendipes sp.				
Pagastia sp.	4	20	2	**101**
Parametriocnemus sp.				
Polypedilum sp.	3	4		**28**
Pseudorthocladius sp.				
Rheocricotopus sp.				
Synorthocladius sp.				
Thienemannimyia genus group				
Tvetenia sp.				

Table C8. cont. Macroinvertebrate data collected from site Blue 1 on 25 October 2021.

Other Diptera				
Atherix pachypus			2	**8**
Chelifera/Neoplasta sp.				
Pericoma sp.				
Simulium sp.	8	1	1	**39**
Antocha sp.		1		**4**
Hesperoconopa sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	14	7	14	**136**
Optioservus sp.				
Miscellaneous (Non-insects)				
Atractides sp.				
Lebertia sp.		1	3	**16**
Protzia sp.				
Sperchon sp.				
Pisidium sp.		1		**4**
Polycelis coronata	16	11	4	**121**
Enchytraeidae				
Lumbricidae				
Naididae				
Nematoda	1			**4**
Totals	**308**	**541**	**387**	**4802**
Shannon Weaver Diversity				**3.37**
Calculated Evenness				**0.663**
EPT				**20**
% EPT				**72.41%**
Density				**4,802**
% Non-Insect				**2.99%**
% Shredder/Scraper				**44.42%**
Taxa Richness				**34**
# Ephemeroptera Taxa				**7**
# Plecoptera Taxa				**8**
# Trichoptera Taxa				**5**
% Ephemeroptera individuals				**53.24%**
% Plectopera individuals				**3.56%**
% Trichoptera individuals				**15.61%**
Percent Chironomidae				**20.71%**
Percent Tolerant Organisms				**3.24%**
# Intolerant Taxa				**20**

Table C9. Macroinvertebrate data collected from site SCR on 25 October 2021.

Blue River				
SCR		Sample		
25 October 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.				
Baetis tricaudatus	11	8	11	**117**
Diphetor hageni	3	2	3	**32**
Drunella grandis	14	14	5	**128**
Ephemerella dorothea infrequens				
Cinygmula sp.	12	27	35	**287**
Epeorus sp.				
Epeorus longimanus	30	29	60	**462**
Rhithrogena sp.			1	**4**
Plecoptera				
Capnia sp.				
Chloroperlidae				
Sweltsa sp.	1	12	6	**74**
Prostoia besametsa				
Zapada cinctipes	1			**4**
Zapada oregonensis group				
Claassenia sabulosa				
Cultus sp.			1	**4**
Diura knowltoni				
Isoperla sp.				
Isoperla fulva	2		1	**12**
Megarcys signata				
Skwala americana	1	1	2	**16**
Taenionema sp.				
Trichoptera				
Brachycentrus americanus	3	3	1	**28**
Brachycentrus occidentalis	139	101	51	**1128**
Glossosoma sp.	24	14	12	**194**
Arctopsyche grandis	30	7	2	**152**
Hydropsyche cockerelli	1			**4**
Lepidostoma sp.	19	81	146	**954**
Rhyacophila brunnea				
Rhyacophila coloradensis		1		**4**
Rhyacophila sibirica group			1	**4**
Oligophlebodes sp.			1	**4**
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	9	1	7	**66**
Diamesa sp.				
Eukiefferiella sp.	93	11	6	**427**
Heterotrissocladius sp.				
Micropsectra/Tanytarsus sp.	2	1	1	**16**
Microtendipes sp.				
Pagastia sp.	24	4	4	**125**
Parametriocnemus sp.				
Polypedilum sp.	8	1	1	**39**
Pseudorthocladius sp.		1		**4**
Rheocricotopus sp.				
Synorthocladius sp.	1			**4**
Thienemannimyia genus group	3	1	2	**24**
Tvetenia sp.	4	1		**20**

Table C9. cont. Macroinvertebrate data collected from site SCR on 25 October 2021.

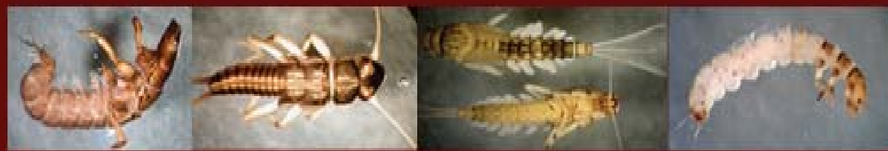
Other Diptera				
Atherix pachypus	3	6	10	**74**
Chelifera/Neoplasta sp.	3			**12**
Pericoma sp.				
Simulium sp.	3	2		**20**
Antocha sp.	7	1	1	**35**
Hesperoconopa sp.		1		**4**
Tipula sp.			1	**4**
Coleoptera				
Heterlimnius corpulentus	16	11	11	**148**
Optioservus sp.	1			**4**
Miscellaneous (Non-insects)				
Atractides sp.				
Lebertia sp.	1	2	4	**28**
Protzia sp.				
Sperchon sp.	2		1	**12**
Pisidium sp.	1			**4**
Polycelis coronata	14	13	5	**125**
Enchytraeidae				
Lumbricidae				
Naididae				
Nematoda		1		**4**
Totals	**486**	**358**	**393**	**4811**
Shannon Weaver Diversity				**3.72**
Calculated Evenness				**0.690**
EPT				**20**
% EPT				**75.18%**
Density				**4,811**
% Non-Insect				**3.56%**
% Shredder/Scraper				**43.41%**
Taxa Richness				**42**
# Ephemeroptera Taxa				**6**
# Plecoptera Taxa				**5**
# Trichoptera Taxa				**9**
% Ephemeroptera individuals				**21.42%**
% Plectopera individuals				**2.26%**
% Trichoptera individuals				**51.50%**
Percent Chironomidae				**15.04%**
Percent Tolerant Organisms				**10.11%**
# Intolerant Taxa				**23**

Table C10. Macroinvertebrate data collected from site BRC on 25 October 2021.

Blue River				
BRC		Sample		
25 October 2021	1	2	3	**Estimated #/m²**
Ephemeroptera				
Acentrella sp.				
Baetis tricaudatus	14	12	8	**132**
Diphetor hageni	2			**8**
Drunella grandis	7	2	1	**39**
Ephemerella dorothea infrequens	12	5	3	**78**
Cinygmula sp.	12	3	2	**66**
Epeorus sp.				
Epeorus longimanus	5	9	3	**66**
Rhithrogena sp.	1			**4**
Plecoptera				
Capnia sp.				
Chloroperlidae	1			**4**
Sweltsa sp.	3			**12**
Prostoia besametsa				
Zapada cinctipes				
Zapada oregonensis group				
Claassenia sabulosa	21		5	**101**
Cultus sp.		2		**8**
Diura knowltoni				
Isoperla sp.				
Isoperla fulva	4	2	3	**35**
Megarcys signata				
Skwala americana				
Taenionema sp.				
Trichoptera				
Brachycentrus americanus	6	8	8	**86**
Brachycentrus occidentalis	8	1	7	**63**
Glossosoma sp.	112	63	43	**845**
Arctopsyche grandis	4	11	13	**109**
Hydropsyche cockerelli	26	36	14	**295**
Lepidostoma sp.	20	6	2	**109**
Rhyacophila brunnea				
Rhyacophila coloradensis	3	5	6	**55**
Rhyacophila sibirica group				
Oligophlebodes sp.				
Diptera				
Chironomidae				
Brillia sp.				
Cricotopus/Orthocladius sp.	2	4	1	**28**
Diamesa sp.				
Eukiefferiella sp.	5	12	4	**82**
Heterotrissocladius sp.				
Micropsectra/Tanytarsus sp.	3			**12**
Microtendipes sp.				
Pagastia sp.		2		**8**
Parametriocnemus sp.				
Polypedilum sp.				
Pseudorthocladius sp.				
Rheocricotopus sp.				
Synorthocladius sp.				
Thienemannimyia genus group	4			**16**
Tvetenia sp.	1	1		**8**

Table C10. cont. Macroinvertebrate data collected from site BRC on 25 October 2021.

Other Diptera				
Atherix pachypus				
Chelifera/Neoplasta sp.	1	2	1	**16**
Pericoma sp.				
Simulium sp.	17	198	63	**1078**
Antocha sp.	1	1	3	**20**
Hesperoconopa sp.				
Tipula sp.				
Coleoptera				
Heterlimnius corpulentus	15	7	4	**101**
Optioservus sp.	3	7	2	**47**
Miscellaneous (Non-insects)				
Atractides sp.				
Lebertia sp.				
Protzia sp.				
Sperchon sp.				
Pisidium sp.				
Polycelis coronata			3	**12**
Enchytraeidae				
Lumbricidae				
Naididae				
Nematoda				
Totals	**313**	**399**	**199**	**3543**
Shannon Weaver Diversity				**3.44**
Calculated Evenness				**0.695**
EPT				**19**
% EPT				**59.71%**
Density				**3,543**
% Non-Insect				**0.33%**
% Shredder/Scraper				**33.26%**
Taxa Richness				**31**
# Ephemeroptera Taxa				**7**
# Plecoptera Taxa				**5**
# Trichoptera Taxa				**7**
% Ephemeroptera individuals				**11.09%**
% Plectopera individuals				**4.50%**
% Trichoptera individuals				**44.13%**
Percent Chironomidae				**4.28%**
Percent Tolerant Organisms				**2.63%**
# Intolerant Taxa				**18**



Timberline Aquatics, Inc.
4219 Table Mountain Place, Suite A
Fort Collins, Colorado 80526