Assessment of the Water Quality in the Quittapahilla Watershed Using Benthic Macroinvertebrates

Prepared for: Quittapahilla Watershed Association (QWA)

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Executive Summary
This study assessed water quality across six sites within the Quittapahilla watershed using benthic macroinvertebrates as biological indicators. Results indicate a gradient of conditions ranging from moderately good to poor, with Killinger Creek (K1) showing the greatest impairment and Quittapahilla Creek at Palmyra-Bellegrove Road (Q2) showing the best overall conditions. Findings suggest that localized impacts within tributaries play a significant role in shaping watershed health.

Objective
The objective of this study was to assess water quality across multiple sites within the Quittapahilla watershed by analyzing benthic macroinvertebrate communities. Because different macroinvertebrate taxa exhibit varying levels of tolerance to pollution, their presence and abundance provide an effective biological indicator of stream health. This study aimed to compare community composition among sites and evaluate overall watershed condition using standard biological indices.

Methods
Macroinvertebrate samples were collected from six sites within the Quittapahilla watershed, including both mainstem and tributary locations. Sampling locations included Quittapahilla Creek at Garfield Street (Q1; 40.332464, -76.471849), Quittapahilla Creek at Palmyra-Bellegrove Road (Q2; 40.342592, -76.563490), Snitz Creek at Walnut Street (S1; 40.331346, -76.460273), Beck Creek at Bricker Lane (BK1; 40.323999, -76.483927), Bachman Run at Louser Road (BM1; 40.317592, -76.516046), and Killinger Creek at Killinger Road (K1; 40.312635, -76.554315). Sampling was conducted during the 2025 field season.

A D-net was used to collect benthic macroinvertebrates from stream substrates at each site. Collected organisms were preserved in 70% isopropyl alcohol and stored in labeled sample jars corresponding to each site. In the laboratory, samples were sorted and organisms were identified to the family level using dissecting microscopes. Identification was performed by examining morphological characteristics such as body segmentation, appendages, and head structures using standard taxonomic keys.

Following identification, the number of individuals in each taxonomic group was recorded. These data were used to calculate biological indices including the Family Biotic Index (FBI), EPT richness, Shannon-Wiener diversity index, and overall species richness.

Results Summary
Macroinvertebrate communities differed across the six sampling sites, indicating variation in water quality throughout the watershed. Sites with a higher abundance of pollution-tolerant taxa showed elevated FBI values, suggesting poorer water quality conditions, while sites with greater representation of pollution-sensitive taxa, particularly EPT groups, indicated relatively better stream health. Differences in functional feeding groups were also observed, with some sites dominated by shredders and others by collectors, reflecting variation in organic matter inputs and nutrient availability. Overall, the results suggest moderate impacts to water quality across the watershed, likely influenced by surrounding agricultural and urban land use.

Site: Q1 – Quittapahilla Creek at Garfield Street

Site Q1 is located along the mainstem of Quittapahilla Creek at Garfield Street. As a primary channel site, it reflects cumulative impacts from upstream land use, including agricultural and urban inputs. This location is expected to exhibit a mix of pollution-tolerant and moderately sensitive macroinvertebrate taxa, providing insight into overall watershed conditions and baseline water quality within the main creek.

Family Name	Common Name	Feed Type	Tolerance Value	# of Individuals
Aeshnidae	Darner dragonflies	Predator	3	5
Asellidae	Water slaters (aquatic isopods)	Shredder	8	2
Chironomidae	Non-biting midges	Collector-gatherer	6	1
Ephemeroptera	Mayflies	Collector-gatherer	4	5
Gammaridae	Scuds (amphipods)	Shredder	4	4
Hydropsychidae	Net-spinning caddisflies	Collector-filterer	5	103
Limoniidae	Crane flies	Shredder	3	1
Oligochaeta	Aquatic worms	Collector-gatherer	8	5
Planariidae	Planarians	Predator	4	5
Simulidae	Black flies	Collector-filterer	6	1
Tipulidae	Crane flies	Shredder	4	3

Total Individuals: **135**
Species Richness: **11**
EPT Count: **108**
FBI: **5.03**
Shannon-Wiener Index (SWI): **0.93**

Site: Q2 – Quittapahilla Creek at Palmyra-Bellegrove Road

Site Q2 is located along the mainstem of Quittapahilla Creek at Palmyra-Bellegrove Road, downstream of Site Q1. As a downstream site, it reflects cumulative impacts from upstream land use, including agricultural and urban inputs, as well as potential changes in water quality as the stream progresses through the watershed. This location provides insight into how macroinvertebrate communities respond to increasing downstream influences and allows for comparison with upstream conditions to assess overall watershed health trends

Family Name	Common Name	Feed Type	Tolerance Value	# of Individuals
Asellidae	Water slaters	Shredder	8	1
Chironomidae	Non-biting midges	Collector-gatherer	6	25
Coenagrionidae	Damselflies	Predator	8	1
Corbiculidae	Clams	Collector-filterer	4	35
Elmidae adults	Riffle beetles (adults)	Scraper	5	5
Elmidae larvae	Riffle beetles (larvae)	Collector-gatherer	5	8
Gammaridae	Scuds (amphipods)	Shredder	4	399
Glossomatidae	Saddlecase caddisflies	Scraper	0	4
Hebridae	Velvet water bugs	Predator	8	2
Hirudinea	Leeches	Predator	8	8
Hydropsychidae	Net-spinning caddisflies	Collector-filterer	5	53
Limoniidae	Crane flies	Shredder	3	5
Oligochaeta	Aquatic worms	Collector-gatherer	8	11
Patellidae	True limpets	Scraper	6	1
Planariidae	Planarians	Predator	4	1
Planorbidae	Ramshorn snails	Scraper	6	11
Tipulidae	Crane flies	Shredder	4	1

Total Individuals: **571**
Species Richness: **17**
EPT Count: **57**
FBI: **4.37**
Shannon-Wiener Index: **1.24**

Site: S1 – Snitz Creek at Walnut Street

Site S1 is located along Snitz Creek at Walnut Street, a tributary of the Quittapahilla Creek. As a tributary site, it reflects more localized environmental conditions and inputs compared to mainstem locations. This site provides insight into how smaller stream systems contribute to overall watershed health and allows for comparison with both upstream and downstream conditions.

Family Name	Common Name	Feed Type	Tolerance Value	# of Individuals
Chironomidae	Non-biting midges	Collector-gatherer	6	28
Collembola	Springtails	Collector-gatherer	—	11
Elmidae adults	Riffle beetles (adults)	Scraper	5	8
Elmidae larvae	Riffle beetles (larvae)	Collector-gatherer	5	14
Gammaridae	Scuds (amphipods)	Shredder	4	17
Glossomatidae	Saddlecase caddisflies	Scraper	0	1
Hirudinea	Leeches	Predator	8	5
Hydropsychidae	Net-spinning caddisflies	Collector-filterer	5	83
Leptophlebiidae	Pronggill mayflies	Shredder	4	2
Planariidae	Planarians	Predator	4	5
Planorbidae	Ramshorn snails	Scraper	6	2
Psephenidae	Water penny beetles	Scraper	4	1

Total Individuals: **177**
Species Richness: **12**
EPT Count: **86**
FBI: **5.09**
Shannon-Wiener Index: **1.75**

Site: K1 – Killinger Creek at Killinger Road

Site K1 is located along Killinger Creek at Killinger Road, a tributary within the Quittapahilla watershed. As a smaller tributary site, it reflects more localized environmental conditions and inputs, including potential influences from surrounding land use and organic matter accumulation. This location provides insight into how tributary systems contribute to overall watershed health and allows for comparison with both upstream and mainstem sites.

Family Name	Common Name	Feed Type	Tolerance Value	# of Individuals
Asellidae	Water slaters	Shredder	8	884
Cambaridae	Crayfish	Shredder	6	3
Chironomidae	Non-biting midges	Collector-gatherer	6	10
Dytiscidae	Predaceous diving beetles	Predator	5	4
Elmidae adults	Riffle beetles (adults)	Scraper	5	15
Elmidae larvae	Riffle beetles (larvae)	Collector-gatherer	5	53
Ephemeroptera	Mayflies	Collector-gatherer	4	2
Gammaridae	Scuds (amphipods)	Shredder	4	254
Hirudinea	Leeches	Predator	8	3
Hydropsychidae	Net-spinning caddisflies	Collector-filterer	5	14
Lymnaeidae	Pond snails	Scraper	7	27
Oligochaeta	Aquatic worms	Collector-gatherer	8	4
Planorbidae	Ramshorn snails	Scraper	6	50
Simuliidae	Black flies	Collector-filterer	6	17

Total Individuals: **1,340**
Species Richness: **14**
EPT Count: **14**
FBI: **6.90**
Shannon-Wiener Index: **1.18**

Site: BK1 – Beck Creek at Bricker Lane

Site BK1 is located along Beck Creek at Bricker Lane, a tributary within the Quittapahilla watershed. As a tributary site, it reflects localized environmental conditions and inputs from surrounding land use, including potential influences from runoff and organic matter accumulation. This site provides insight into how smaller stream systems contribute to overall watershed health and allows for comparison with both mainstem and other tributary locations.

Family Name	Common Name	Feed Type	Tolerance Value	# of Individuals
Asellidae	Water slaters	Shredder	8	18
Cambaridae	Crayfish	Shredder	6	5
Chironomidae	Non-biting midges	Collector-gatherer	6	5
Coenagrionidae	Damselflies	Predator	8	1
Corixidae	Water boatmen	Collector-gatherer	8	8
Elmidae adults	Riffle beetles (adults)	Scraper	5	5
Ephemeroptera	Mayflies	Collector-gatherer	4	2
Gammaridae	Scuds (amphipods)	Shredder	4	115
Hydropsychidae	Net-spinning caddisflies	Collector-filterer	5	13
Leptophlebiidae	Pronggill mayflies	Shredder	4	2
Lymnaeidae	Pond snails	Scraper	7	16
Oligochaeta	Aquatic worms	Collector-gatherer	8	29
Simulidae	Black flies	Collector-filterer	6	2
Tipulidae	Crane flies	Shredder	4	3

Total Individuals: **225**
Species Richness: **14**
EPT Count: **15**
FBI: **5.40**
Shannon-Wiener Index: **1.75**

Site: BM1 – Bachman Run at Louser Road

Site BM1 is located along Bachman Run at Louser Road, a tributary within the Quittapahilla watershed. As a tributary site, it reflects localized environmental conditions and inputs from surrounding land use, including potential influences from runoff and organic matter accumulation. This location provides insight into how tributary systems contribute to overall watershed health and allows for comparison with both mainstem and other tributary sites.

Family Name	Common Name	Feed Type	Tolerance Value	# of Individuals
Asellidae	Water slaters	Shredder	8	6
Chironomidae	Non-biting midges	Collector-gatherer	6	27
Corbiculidae	Clams	Collector-filterer	4	4
Elmidae adults	Riffle beetles (adults)	Scraper	5	23
Elmidae larvae	Riffle beetles (larvae)	Collector-gatherer	5	60
Gammaridae	Scuds (amphipods)	Shredder	4	437
Hydropsychidae	Net-spinning caddisflies	Collector-filterer	5	70
Limoniidae	Crane flies	Shredder	3	5
Lymnaeidae	Pond snails	Scraper	7	78
Planariidae	Planarians	Predator	4	2
Tipulidae	Crane flies	Shredder	4	1

Total Individuals: **713**
Species Richness: **11**
EPT Count: **70**
FBI: **4.65**
Shannon-Wiener Index: **1.18**

Key Findings

Analysis of benthic macroinvertebrate communities across the Quittapahilla watershed revealed clear spatial variation in water quality and ecological condition. Biological indices, community composition, and functional feeding group distributions collectively indicate a gradient of environmental impact across the six sampling sites.

Water quality conditions ranged from moderately good to poor across the watershed. The lowest FBI value was observed at Q2 (4.37), indicating relatively good water quality, followed closely by BM1 (4.65). In contrast, K1 exhibited the highest FBI value (6.90). This site represents a priority area for further investigation due to its degraded biological condition and dominance of pollution-tolerant taxa. The remaining sites (Q1, S1, and BK1) showed moderate conditions, suggesting varying degrees of impact likely influenced by surrounding land use.

EPT richness varied substantially among sites and served as a strong indicator of water quality differences. Higher EPT counts at Q1 and S1 suggest the presence of more pollution-sensitive taxa and relatively better localized conditions. In contrast, K1 showed very low EPT representation, reinforcing evidence of degraded water quality. Moderate EPT presence at Q2 and BM1 supports their classification as comparatively healthier sites within the watershed.

Functional feeding group composition further highlighted differences in ecological processes across sites. Shredder dominance, particularly at K1 and BM1, indicates high inputs of coarse organic matter, likely from riparian vegetation or organic enrichment. Collector-dominated communities at Q1 and S1 suggest elevated fine particulate organic matter and potential nutrient enrichment. The widespread presence of collectors across multiple sites may reflect watershed-wide influences from agricultural and urban runoff. Observed patterns, particularly in tributary sites, suggest localized influences from surrounding land use, including agricultural runoff and organic enrichment.

A notable pattern across all sites was the relatively low abundance of predator taxa, suggesting reduced trophic complexity and potential ecological imbalance. This trend may indicate environmental stressors that limit higher trophic level organisms or simplify food web structure.

One of the most significant findings was the extreme dominance of pollution-tolerant taxa at K1, particularly Asellidae, which accounted for the majority of individuals at that site. This level of dominance indicates a highly disturbed system with reduced biodiversity and limited ecological resilience. In contrast, sites such as Q2 and BM1 exhibited greater balance in community composition, despite some dominance patterns, suggesting comparatively healthier conditions.

Overall, the Quittapahilla watershed exhibits a mix of moderately impacted and impaired conditions, with evidence of both localized stressors and broader watershed influences. Tributary sites showed greater variability, indicating that localized inputs play a significant role in shaping water quality. Mainstem sites, particularly Q2, reflect cumulative conditions and appear to maintain relatively improved ecological function compared to some tributaries.

Watershed-Level Comparison of Biological Metrics

The following table summarizes key biological metrics across all six sampling sites within the Quittapahilla watershed, including total macroinvertebrate abundance, species richness, EPT richness, Family Biotic Index (FBI), and Shannon-Wiener diversity index (SWI). These metrics provide a comparative overview of water quality and ecological condition across both mainstem and tributary locations. Lower FBI values and higher EPT richness generally indicate better water quality, while higher diversity values reflect greater ecological complexity. This summary allows for direct comparison among sites and highlights spatial trends in watershed health.

Site	Total Individuals	Richness	EPT	FBI	SWI	Water Quality
Q1	135	11	108	5.03	0.93	Moderate
Q2	571	17	57	4.37	1.24	Good
S1	177	12	86	5.09	1.75	Moderate
BK1	225	14	15	5.40	1.75	Moderate
BM1	713	11	70	4.65	1.18	Moderately Good
K1	1340	14	14	6.90	1.18	Poor

Suggested Next Steps

Based on the findings of this study, several actions may be beneficial for further understanding and improving water quality within the Quittapahilla watershed. Rotating sampling locations within each stream reach could provide a more representative assessment of macroinvertebrate communities and reduce site-specific bias. Expanding sampling to include a warm-weather period, particularly mid-summer, may also capture additional macroinvertebrate taxa associated with seasonal hatches, resulting in a more comprehensive evaluation of biodiversity.

Additionally, the development of a formal report or summary based on these findings could support public outreach efforts by increasing awareness of current water quality conditions and potential contributing factors. Communicating these results to the broader community may help highlight the influence of land use practices and encourage stewardship within the watershed.

Limitations

This study represents a single sampling period and may not capture seasonal variation in macroinvertebrate communities. Additionally, identification to the family level may limit resolution of ecological differences among taxa. Future sampling across multiple seasons could provide a more comprehensive assessment.

Overall, results indicate a clear gradient in water quality across the watershed, with localized impairment in tributary systems and relatively improved conditions in mainstem reaches.