



Biological and Water Quality Study of the Powell Creek (Auglaize River) Watershed

(HUC 04100007 11)

2013

Defiance and Putnam Counties, Ohio



Ohio EPA Technical Report EAS/2014-11-09

Division of Surface Water
November 10, 2014

Biological and Water Quality Study of the
Powell Creek (Auglaize River) Watershed
(HUC 04100007 11)
Defiance and Putnam Counties, Ohio
2013

Pre-Implementation Monitoring
Great Lakes Restoration Initiative
Grant # GL-00E01131-0
(State Grant # EPAFPOWL12)

November 10, 2014
Ohio EPA Technical Report EAS/2014-11-09

prepared by

Ohio Environmental Protection Agency
Division of Surface Water

Ecological Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125

and

Water Quality Unit
Northwest District Office
347 N. Dunbridge Rd.
Bowling Green, Ohio 43402

John Kasich, Governor
State of Ohio

Craig Butler, Director
Environmental Protection Agency

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	2
INTRODUCTION	3
SUMMARY AND CONCLUSIONS	4
METHODS	9
RESULTS	
Macroinvertebrate Community	10
Fish Community and Physical Habitat	14
Water Quality	17
REFERENCES	22
APPENDICES	
Appendix Table 1 – Invertebrate Community Index (ICI) metrics and scores for samples collected with quantitative methods from Powell Creek, 2013 and 2000.	A.1
Appendix Table 2 – Macroinvertebrate community data collected from sites in the Powell Creek watershed, 2013 and 2000.	A.2
Appendix Table 3 – Index of Biotic Integrity (IBI) metrics and scores for headwater site samples collected from the Powell Creek watershed, 2013 and 2000.	A.18
Appendix Table 4 – Index of Biotic Integrity (IBI) metrics and scores for wading site samples collected from the Powell Creek watershed, 2013 and 2000.	A.19
Appendix Table 5 – Fish community data collected from sites in the Powell Creek watershed, 2013 and 2000.	A.20
Appendix Table 6 – Water quality and field data collected from sites in the Powell Creek watershed, 2013.	A.35

ACKNOWLEDGEMENTS

The following individuals are acknowledged for their contribution to this report.

Stream sampling: Ben Rich, Holly Tucker, Mike Bolton, Jack Freda, Laura Hughes, Sarah Becker, Joshua Griffin, Chris Riddle, Ben Smith, and numerous 2013 summer interns

Data support: Dennis Mishne

Report preparation: Jeff DeShon

Report preparation support: Paul Gledhill, Ben Rich, Chuck McKnight, Chris Riddle

Reviewers: Dan Glomski, Holly Tucker, Russ Gibson, Rick Wilson

Copies of this report are available at:

http://www.epa.ohio.gov/dsw/document_index/psdindx.aspx

or by written or email request to:

Jeff DeShon

Ohio EPA, Division of Surface Water

Groveport Field Office

4675 Homer Ohio Lane

Groveport, Ohio 43125

jeffrey.deshon@epa.ohio.gov

INTRODUCTION

Dissolved Reactive Phosphorus (DRP) loadings into western Lake Erie from the Maumee River watershed are at record levels despite more than a decade of conservation programming (*e.g.*, the Conservation Reserve Enhancement Program) focused on Lake Erie. Nutrient enrichment has caused the return of blue-green algae blooms in Lake Erie at levels not previously observed since the 1960s. While the sources of phosphorus are numerous, the largest land use (84%) in the Powell Creek watershed is cultivated cropland. The Powell Creek Nutrient Reduction project is designed to demonstrate the environmental benefits of targeting limited cost-share funding for agricultural nutrient reduction practices into small geographical land areas to produce measurable reductions in nitrogen, phosphorus and sediment loadings. Ohio EPA, through the Division of Surface Water Nonpoint Source Program, is partnering with the Defiance County Soil & Water Conservation District, the Ohio Department of Natural Resources, Defiance County Health Department and local NRCS personnel to insure that this project is successfully implemented within the Powell Creek watershed.

Ohio EPA is partnering with the Defiance County SWCD by sub-granting funds to provide cost-share assistance to landowners and agricultural producers to complete nutrient management plans (NMPs) and to install nutrient reduction management practices as specifically identified in their NMPs as well as generally recommended in the Powell Creek TMDL. Besides these activities, more than 20 acres of wetlands will be restored under this project. Additionally, working in partnership with the Defiance County Health Department, ten failing home sewage treatment systems within the project area will be identified and cost-share assistance offered to landowners to repair and/or replace the failing systems. Activities will be conducted on a smaller scale within the project area in Putnam County. All of these activities will be implemented in harmony with a controlled drainage cost-share project that is being implemented in surrounding counties which is funded by the Ohio Department of Natural Resources.

During the 2013 field season (July through October) chemical, physical, and biological sampling was conducted at ten Defiance and Putnam county sites in the Powell Creek watershed (HUC 04100007 11) to assess and characterize baseline water resource conditions prior to full implementation of the Powell Creek Nutrient Reduction project. The watershed, which is comprised of three (3) HUC-12 subwatersheds (North Powell Creek, Upper Powell Creek and Lower Powell Creek), lies within the Auglaize River basin, a tributary of the Maumee River. The Powell Creek watershed is located in northwest Ohio, overlapping parts of Defiance, Putnam, Henry and Paulding counties and is comprised of approximately 63,000 acres (98 mi²) of which about 84% is in agricultural production. The overwhelming majority of the watershed area is in Defiance and Putnam counties, which is where activities under this project are concentrated. Other land uses within the Powell Creek watershed are forested cover (8.4%) and developed land, most of which is open space (7.1%) (National Land Data Set, 2006). Of collocated sites that Ohio EPA sampled in the watershed during a prior survey in 2000, only one North Powell Creek site met minimum Clean Water Act (CWA) water quality goals; other assessed sites located on named streams (Powell Creek, North Powell Creek, South Powell Creek, and Wagner Run) were in non-attainment of the designated Warmwater Habitat (WWH) aquatic life use or were recommended for other less than CWA goal uses (*i.e.*, Modified Warmwater Habitat or Limited Resource Water). High magnitude causes of aquatic life use impairment identified during the 2000 assessment included nutrients, sediment, organic substances and poor habitat quality. Primary impairment sources identified were run-off from agricultural fields and operations, channel modification and failing home sewage treatment systems (HSTS).

The current aquatic life use designation of Powell Creek and its primary tributaries, North Powell Creek, South Powell Creek, Wagner Run, and Hogback Run is unverified Warmwater Habitat (OAC 3745-1-11). Based on the limited sampling in 2000, the WWH use was confirmed and deemed appropriate for Powell

Creek, North Powell Creek, and South Powell Creek in the reaches sampled as part of this project. Wagner Run was recommended for the Modified Warmwater Habitat (MWH) use due to extensive channel modifications; no sampling was conducted in Hogback Run. However, as of the publication of this report, a use designation rulemaking had not yet been completed to incorporate these aquatic life use verifications and recommendations into the Ohio Water Quality Standards (WQS).

Specific objectives of the survey were to:

- Assess the present biological conditions in the Powell Creek watershed within the project area by evaluating fish and macroinvertebrate communities;
- Establish baseline conditions for future analysis of resource trends as the Powell Creek Nutrient Reduction project is fully implemented;
- Identify the relative concentrations and loadings of nutrients and other selected parameters in surface water;
- Assess physical habitat influences on stream biotic integrity;
- Determine beneficial use attainment status and recommend changes, if appropriate; and
- Confirm or revise causes and sources of beneficial use impairment as determined by earlier studies.

The entire watershed is located within the Huron-Erie Lake Plain (HELP) ecoregion and there is only one small permitted point source discharger present. The Continental WWTP discharges to an unnamed tributary of South Powell Creek which has a confluence at South Powell river mile (RM) 13.36. Stream samples, including sample type, drainage area and location information are listed in Table 1 and represented graphically in Figure 1.

SUMMARY AND CONCLUSIONS

Ohio EPA completed two electrofishing passes of fish community sampling and artificial and natural substrate collections of macroinvertebrate communities at the most downstream Powell Creek site in 2013. Either one-pass fish sampling (headwater sites) or two-pass fish sampling (wading sites) along with qualitative, natural substrate macroinvertebrate sampling were completed at nine additional Powell Creek watershed sites in 2013. All sites received a Qualitative Habitat Evaluation Index (QHEI) assessment and six grab samples for stream chemistry analyses during spring, summer, and fall, 2013. Continuous monitoring water quality sondes were deployed at three locations for one three-day period to evaluate diel measurements of field dissolved oxygen, pH, temperature, and conductivity. Sampling locations are detailed in Table 1 and graphically presented in Figure 1; aquatic life use attainment status is presented in Table 2. Summarized sample attributes from all biological, physical habitat, and chemical water quality sites are included as Tables 3-8. Other relevant data, including raw data, are tabulated in Appendix Tables 1-6.

Only the most downstream Powell Creek site at Boy Scout Rd. (RM 0.36) was in full attainment of the WWH aquatic life use designation; all other sites were in partial or non-attainment. Both fish and macroinvertebrate communities were performing at HELP ecoregional expectations at this sampling location, which was the only one of the ten sites in the watershed that was not influenced by severely limiting physical habitat conditions including poor channel morphology, heavy siltation, a preponderance of muck substrates, and low gradient, sluggish flow conditions. These physical habitat factors seemed to have the most influence on quality of biotas even though nutrient concentrations (*i.e.*, total phosphorus and nitrate+nitrite) were elevated above target levels at nearly all sampling locations. It appeared that excessive nutrients were not causing immediate, near field problems in the Powell Creek drainage and that much of the nutrient load is likely being exported to the lower Auglaize River and then on into the Maumee River. Consequently, it also seems unlikely that pending nutrient reduction demonstration projects in the adjacent uplands will result in full biological community

restoration that meets ecoregional expectations at Powell Creek watershed sites, though some measurable improvements (*i.e.*, a positive trajectory) in community structure and function should be attainable. The most tangible benefit of these projects will be to reduce loads of nutrients to downstream water bodies and, ultimately, lower, however slightly, the loads being delivered to the western basin of Lake Erie from the Maumee River.

Table 1. Sampling locations in the Powell Creek (Auglaize River) watershed study area, 2013. Type of sampling included fish community (F), macroinvertebrate community (M), physical habitat (H), stream chemistry (C), and water quality sonde (D).

Point of Record River Mile	Type of Sampling	Latitude	Longitude	Local Landmark (Station ID)	Watershed Size at Site (mi ²)
Powell Creek (04-110-000)					
6.39	F,M,H,C	41.202400	-84.338000	Holly Rd. (Defiance Co. Rd. 9) (P06G08)	85.0
0.36	F,M,H,C,D	41.252400	-84.376300	Boy Scout Rd. (P06G07)	97.0
Wagner Run (04-111-000)					
0.55	F,M,H,C	41.216100	-84.336600	St. Rt. 15 (P06G06)	3.4
North Powell Creek (04-112-000)					
7.40	F,M,H,C	41.171700	-84.285800	Highland Center Rd (Twp. Rd. 182) (204280)	30.7
0.10	F,M,H,C,D	41.195800	-84.331900	St. Rt. 15 (P06G05)	46.2
Hogback Run (04-113-000)					
0.10	M,C	41.194586	-84.311403	Hoffman Rd. (Twp. Rd. 7) (302193)	2.1
Trib. to North Powell Creek (RM 4.25) (04-112-001)					
0.75	F,M,H,C	41.191261	-84.285837	Highland Center Rd (Twp. Rd. 182) (302192)	4.3
Trib. to North Powell Creek (RM 6.00) (04-112-003)					
0.45	F,M,H,C	41.182530	-84.285898	Highland Center Rd (Twp. Rd. 182) (302191)	4.0
South Powell Creek (04-114-000)					
8.22	F,M,H,C	41.148900	-84.293100	Putnam Co. Rd. 22B (P06P06)	25.7
1.75	F,M,H,C,D	41.186700	-84.324500	Schubert Rd. (Defiance Co. Rd. 169) (P06G04)	35.2

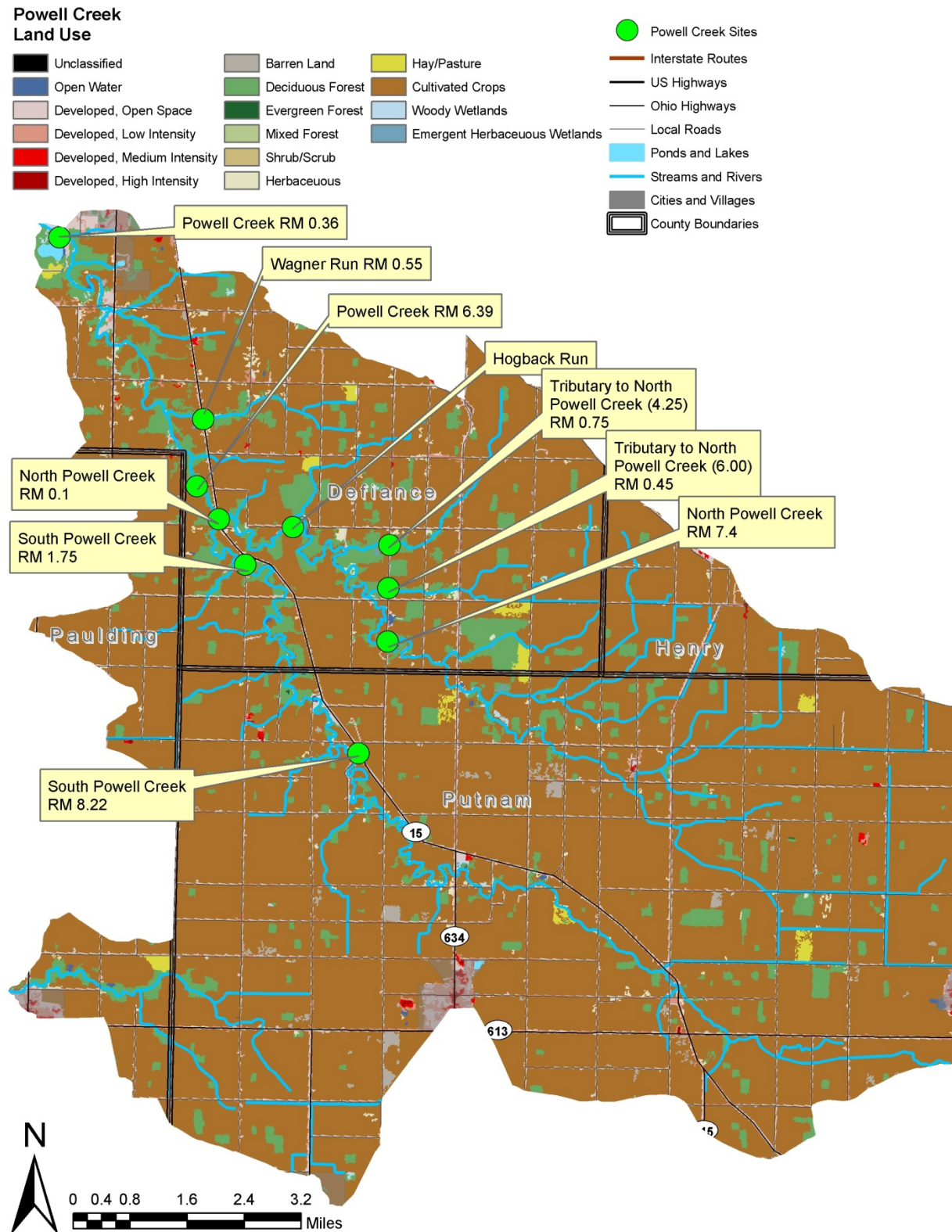
Table 2. Aquatic life use attainment status for sampling locations in the Powell Creek (Auglaize River) watershed study area, 2013. The Index of Biotic Integrity (IBI), Modified Index of well-being (MIwb), and Invertebrate Community Index (ICI) scores are based on the performance of the biological community. The Qualitative Habitat Evaluation Index (QHEI) is a measure of the ability of the physical habitat to support a biological community. Sampling locations were evaluated using Warmwater Habitat (WWH) aquatic life use biocriteria codified in the Ohio Water Quality Standards (OAC 3745-1-07, Table 7-15) for the Huron-Erie Lake Plain (HELP) ecoregion of Ohio. If biological impairment has occurred, the cause(s) and source(s) of the impairment, based on the weight of evidence of data, are noted.

Point of Record River Mile	Watershed Size (mi ²) Site Type	Aquatic Life Use Attainment Status	IBI	MIwb	ICI ^a	QHEI	Aquatic Life Use Impairment Cause(s) ----- Source(s)
Powell Creek (04-110-000) – WWH (Existing)							
6.39	85.0 Wading	Partial	34	8.0	F*	37.8 (Poor)	direct habitat alterations, siltation/sedimentation ----- channelization, non-irrigated crop production
0.36	97.0 Wading	Full	34	9.0	28 (MG ^{ns})	58.5 (Fair)	- ----- -
Wagner Run (04-111-000) – WWH (Existing)							
0.55	3.2 Headwater	Partial	32	-	LF*	36.0 (Poor)	direct habitat alterations, siltation/sedimentation ----- channelization, non-irrigated crop production
North Powell Creek (04-112-000) – WWH (Existing)							
7.40	30.7 Wading	Non	23*	5.3*	LF*	31.5 (Poor)	direct habitat alterations, siltation/sedimentation ----- channelization, non-irrigated crop production
0.10	46.2 Wading	Partial	33	7.0 ^{ns}	LF*	37.0 (Poor)	direct habitat alterations, siltation/sedimentation ----- channelization, non-irrigated crop production
Tributary to North Powell Creek (RM 4.25) (04-112-001) – Undesignated / WWH (Recommended)							
0.75	4.3 Headwater	Non	30	-	P*	45.5 (Fair)	direct habitat alterations, siltation/sedimentation ----- channelization, non-irrigated crop production
Tributary to North Powell Creek (RM 6.00) (04-112-003) – Undesignated / WWH (Recommended)							
0.45	4.0 Headwater	Non	26 ^{ns}	-	P*	37.0 (Poor)	direct habitat alterations, siltation/sedimentation ----- channelization, non-irrigated crop production
Hogback Run (04-113-000) – WWH (Existing)							
0.10 ^b	2.1 Headwater	-	-	-	P*	-	-
South Powell Creek (04-114-000) – WWH (Existing)							
8.22	25.7 Wading	Non	22*	6.1*	VP*	33.5 (Poor)	direct habitat alterations, siltation/sedimentation ----- channelization, non-irrigated crop production
1.75	35.2 Wading	Non	25*	6.2*	LF*	34.5 (Poor)	direct habitat alterations, siltation/sedimentation ----- channelization, non-irrigated crop production

BIOCRITERIA: Huron-Erie Lake Plain (HELP)				HABITAT		
INDEX - Site Type	WWH	EWB	MWH-C ^c	QHEI Score (<20 mi ² sites)	QHEI Score (>20 mi ² sites)	Quality
IBI: Headwater	28	50	20	≥70	≥75	Excellent
IBI: Wading	32	50	22	55-69	60-74	Good
MIwb: Wading	7.3	9.4	5.6	43-54	45-59	Fair
ICI	34	46	22	<43/<30	<45/<30	Poor/Very Poor

- a Narrative assessment used in lieu of ICI score based on qualitative sampling data when no quantitative data collected or when ICI score is invalidated (MG-marginally good, F-fair, LF-low fair, P-poor, VP-very poor).
- b Attainment status not determined as fish community sampling was not conducted and macroinvertebrates were sampled with only qualitative protocols.
- c Channel modified waterways in the HELP ecoregion.
- * Significant departure from ecoregion biocriterion (>4 IBI or ICI units and >0.5 MIwb units); poor and very poor results are underlined.
- ns Non-significant departure from biocriterion (≤4 IBI or ICI units and ≤0.5 MIwb units).

Figure 1. Sampling locations (biological, physical habitat, and stream chemistry) and current land uses in the Powell Creek (Auglaize River) watershed study area, 2013.



METHODS

All chemical, physical, and biological field, EPA laboratory, data processing, and data analysis methods and procedures adhere to those specified in the Surface Water Field Sampling Manual for Water Column Chemistry, Bacteria and Flows (Ohio Environmental Protection Agency 2013), Biological Criteria for the Protection of Aquatic Life, Volumes II - III (Ohio Environmental Protection Agency 1987b, 1989a, 1989b, 2014a, 2014b), The Qualitative Habitat Evaluation Index (QHEI); Rationale, Methods, and Application (Rankin 1989), and Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (Ohio Environmental Protection Agency 2006).

Determining Use Attainment

Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1). Assessing aquatic use attainment status involves a primary reliance on the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-15). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Three attainment status results are possible at each sampling location - full, partial, or non-attainment. Full attainment means that all of the applicable indices meet the biocriteria. Partial attainment means that one or more of the applicable indices fails to meet the biocriteria. Non-attainment means that none of the applicable indices meet the biocriteria or one of the organism groups reflects poor or very poor performance. An aquatic life use attainment table (Table 2) is constructed based on the sampling results and is arranged from upstream to downstream and includes the sampling locations indicated by river mile, the applicable biological indices, the use attainment status (*i.e.*, full, partial, or non-attainment), the Qualitative Habitat Evaluation Index (QHEI), and causes and sources if impairment is indicated. Biological results for sites in the Powell Creek (Auglaize River) watershed study area were compared to Warmwater Habitat (WWH) biocriteria established for the Huron-Erie Lake Plain (HELP) ecoregion of Ohio.

Macroinvertebrate Community Assessment

Macroinvertebrates were collected from artificial substrates and from natural habitats at one 2013 Powell Creek site near its confluence with the Auglaize River and from natural habitats only at the other Powell Creek watershed sites sampled in 2013 (Figure 1). The artificial substrate collection provided quantitative data and consisted of a composite sample of five modified Hester-Dendy multiple-plate samplers colonized for six weeks. The natural habitat sampling effort provided presence/absence data and consisted of an inventory of all observed macroinvertebrate taxa from natural habitats at each site with no attempt to quantify populations other than notations on the predominance of specific taxa or taxa groups within major macrohabitat types (*e.g.*, riffle, run, pool, margin). Discussion of macroinvertebrate field and laboratory procedures is detailed in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio Environmental Protection Agency 1989a, 2014b).

Fish Community Assessment

Fish were sampled with one pass each in 2013 at all Powell Creek headwater sites (< 20 mi² drainage) and with two passes each in 2013 at five of six wading sites (> 20 mi² drainage) using pulsed DC headwater or wading electrofishing methods (Figure 1). Fish were processed in the field which included identifying each individual to species, counting individuals at all sites, weighing individuals at wading sites, and recording any external abnormalities. Discussion of the fish community assessment

methodology used in this report is detailed in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio Environmental Protection Agency 1989a, 2014b).

Physical Habitat Assessment

Aquatic habitat at sites in the Powell Creek (Auglaize River) watershed study area was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989; Ohio Environmental Protection Agency 2006). Various attributes of the available habitat are scored based on their overall importance to the establishment of viable, diverse aquatic faunas. Evaluations of type and quality of substrate, amount of instream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and stream gradient are among the metrics used to evaluate the characteristics of a stream segment, not just the characteristics of a single sampling site. As such, individual sites may have much poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values higher than 60 are generally conducive to the establishment of warm water faunas while those which score in excess of 75 often typify habitat conditions which have the ability to support exceptional faunas. Habitat assessments using QHEI protocols were completed for each Powell Creek watershed fish sampling reach (Figure 1).

Chemical Water Quality

Six surface water chemistry grab samples were collected from nine of ten Powell Creek (Auglaize River) watershed sampling locations between April 25, 2013 and August 12, 2013 (Figure 1); five sampling visits were made to the Hogback Creek site. Stations were established in free-flowing sections of the streams and were primarily collected from bridge crossings. Benthic and sestonic chlorophyll samples were collected on August 15, 2013 from Powell Creek RM 0.36 and North Powell Creek RM 0.10 at each stream's most downstream sampling location. In addition, submersible continuous sondes were deployed from August 13-15, 2013, at Powell Creek RM 0.36, North Powell Creek RM 0.10, and South Powell Creek RM 1.75 to record hourly readings of four field water quality parameters: temperature, pH, dissolved oxygen, and conductivity. All water samples were collected either directly into appropriate containers or indirectly using a clean bucket, preserved and delivered to Ohio EPA's Environmental Services laboratory. Collected water was preserved using appropriate methods, as outlined in the Surface Water Field Sampling Manual for Water Column Chemistry, Bacteria and Flows (Ohio Environmental Protection Agency 2013).

RESULTS

Macroinvertebrate Community

Macroinvertebrate community sampling was conducted at ten sites in the Powell Creek watershed during 2013. Quantitative artificial substrate data were collected and an Invertebrate Community Index (ICI) score was determined for one 2013 Powell Creek site at river mile (RM) 0.36, the most downstream site; qualitative, natural substrate collections were made and relevant data attributes were calculated for all other Powell Creek watershed sampling locations. Results are summarized in Table 3 which also includes historical data collected from collocated Powell Creek watershed sites sampled in 2000. ICI metrics and scores for the most downstream Powell Creek site and raw data for all sites are attached as Appendix Tables 1 and 2. Sampling locations were evaluated using the Warmwater Habitat (WWH) aquatic life use narrative or the WWH biocriterion codified in the Ohio Administrative Code (OAC 3745-1-07, Table 7-15) for the HELP ecoregion.

Powell Creek at the mouth (RM 0.36) was dissimilar from other sites in that gravel and cobble substrates were present (Figure 2). It was also the only location that supported a macroinvertebrate assemblage

that approached WWH aquatic life use expectations, with a marginally good narrative evaluation. Flow was nearly interstitial but qualitative sampling yielded ten EPT taxa and four sensitive taxa. The remaining nine sites had no discernable current and muck or clay hardpan substrates were overlain by a thick layer of silt (Figure 3). Consequently, fair to very poor macroinvertebrate communities were present (Table 3). Pollution tolerant taxa made up at least half of the total taxa documented at each site. Powell Creek at RM 6.39 was the only location among the nine where sensitive taxa (2) were recorded. Collocated sampling locations within the study area generally reflected a slight lowering in macroinvertebrate community condition in 2013 versus 2000, likely due to marginally higher water levels encountered in the earlier survey. Due to the severe habitat limitations present and an inherent lack of energy in the watershed, which otherwise might enhance recovery potential, it is unlikely that habitat conditions will improve any time soon without significant intervention. Consequently, it also seems unlikely that pending nutrient reduction demonstration projects in the adjacent uplands will result in macroinvertebrate community restoration meeting ecoregional expectations, though some measurable improvements (*i.e.*, a positive trajectory) in community structure and function should be attainable.

Table 3. Summary of macroinvertebrate data collected by Ohio EPA from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Powell Creek (Auglaize River) watershed study area, 2013. Also included are historical data collected from collocated Powell Creek watershed sites during a 2000 survey. The applicable aquatic life use designation is Warmwater Habitat (WWH) for all sites.

River Mile PoR (ALP) ^a	Density (Number/ft ²)	Qual. Taxa	Pollution Sensitive Taxa	Pollution Tolerant Taxa	Qual. EPT ^b	ICI ^c	Narrative Evaluation
Powell Creek - 2013							
6.39	-	39	2	20	6	F*	Fair
0.36	27	33	4	11	10	28 (MG ^{ns})	Marginally Good
Powell Creek - 2000							
0.36 (0.30)	137	31	2	6	5	40	Good
Wagner Run - 2013							
0.55	-	28	0	19	3	LF*	Low Fair
Wagner Run - 2000							
0.55 (0.60)	-	16	0	10	2	F*	Fair
North Powell Creek - 2013							
7.40 (6.40)	-	34	0	23	4	LF*	Low Fair
0.10	-	43	0	30	4	LF*	Low Fair
North Powell Creek - 2000							
0.10 (0.10)	-	23	0	14	3	MG ^{ns}	Marginally Good
Tributary to North Powell Creek (RM 4.25) - 2013							
0.75	-	27	0	16	1	P*	Poor
Tributary to North Powell Creek (RM 6.00) - 2013							
0.45	-	22	0	17	1	P*	Poor
Hogback Run - 2013							
0.10	-	24	0	19	1	P*	Poor

South Powell Creek - 2013							
8.22 (6.70)	-	25	0	22	0	<u>VP</u> *	Very Poor
1.75 (2.95)	-	39	0	20	4	LF*	Low Fair
South Powell Creek - 2000							
8.22 (8.50)	-	26	0	16	3	F*	Fair
1.75 (1.80)	-	14		9	2	F*	Fair

Ecoregion Biocriterion: Huron-Erie Lake Plain (HELP)			
INDEX	WWH	EWB	MWH-C ^d
ICI	34	46	22

- a PoR: Point of Record-the river mile, usually a bridge crossing, that reflects the general, umbrella location of the sampling station.
ALP: Absolute Location Point-if used, the specific river mile where sampling occurred for the noted indicator.
ALP locations are often used when actual sampling deviates from the PoR sampling station river mile but the location is still considered representative of that station. If used, ALP river miles are recorded in Appendix Tables 1-2.
- b Qual. EPT=Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness, a measure of pollution sensitive organisms collected from natural substrates at the sampling location.
- c Narrative assessment used in lieu of ICI score based on qualitative sampling data when no quantitative data are collected or the ICI score is invalidated.
- d Channel modified waterways in the HELP ecoregion.
- * Significant departure from ecoregion biocriterion (>4 ICI units); poor and very poor results are underlined.
- ns Non-significant departure from biocriterion (≤4 ICI units).



Figure 2. Powell Creek at Boy Scout Rd. (RM 0.36) near the confluence with the Auglaize River, 2013.



Figure 3. Powell Creek upstream from Holly Rd. (Defiance Co. Rd. 9) at RM 6.39, 2013.

Fish Community and Physical Habitat

A total of 8,954 fish representing 44 species and 2 hybrids were collected from nine sites in the Powell Creek (Auglaize River) watershed study area during 2013. Results are summarized in Table 4 along with historical data collected from collocated sites in 2000; attributes of physical habitat at these sites, as scored by the QHEI for each fish zone, are tabulated in Table 5. IBI metrics and scores are presented in Appendix Tables 3 and 4 and relative numbers and species collected per location are presented in Appendix Table 5. Sampling locations were evaluated using Warmwater Habitat (WWH) biocriteria for fish community IBI and/or MLwb scores codified in the Ohio Administrative Code (OAC 3745-1-07, Table 7-15).

With the exception of the most downstream Powell Creek site, physical habitat in the study area ranged from fair to poor quality due to the extensive amount of channel modification and heavy silt deposition caused by the prevailing agricultural land use in the watershed. No riffles were encountered at any of the sampling locations throughout the study area. All six streams were low gradient and dominated by wetland-like muck and silt substrates (Figure 4). The most downstream site on Powell Creek at RM 0.36 deviated from this trend as it was dominated by bedrock substrates (Figure 2). This site resembled more of the coarser parent material found downstream in the Auglaize River. There was no change in habitat quality at similar sites between 2000 and 2013. Table 5 outlines these and other details about each of the 2000 and 2013 sampling locations.



Figure 4. South Powell Creek adjacent St. Rt. 15 near Mt. Zion Cemetery (RM 6.70), 2013.

Fish communities at sites in Powell Creek, Wagner Run, the two unnamed tributaries to North Powell Creek, and North Powell Creek at RM 0.10 met HELP ecoregional expectations and achieved the WWH aquatic life use biocriteria in 2013. Communities in South Powell Creek (RMs 8.22 and 1.75) and North Powell Creek (RM 7.40) did not meet WWH expectations. At the locations sampled, these two streams had limited available habitat to support a diverse fish community. Poor channel morphology, wetland-like substrates of silt and muck, and a lack of flow or riffles characterized these low gradient streams. Species tolerant of low dissolved oxygen and siltation, including fathead minnows (*Pimephales promelas*), bluntnose minnows (*Pimephales notatus*), and green sunfish (*Lepomis cyanellus*), dominated

fish communities in North and South Powell creeks. With the exception of the two South Powell Creek sites, where index scores were essentially unchanged, IBI and MIwb scores at 2013 sites were generally higher than those observed in 2000 at collocated sites.

Table 4. Fish community summaries based on pulsed D.C. headwater and wading electrofishing sampling conducted by Ohio EPA in the Powell Creek (Auglaize River) watershed study area, 2013. Also included are historical data collected from collocated Powell Creek watershed sites during a 2000 survey. The applicable aquatic life use designation is Warmwater Habitat (WWH) for all sites.

River Mile PoR (ALP) ^a	Site Type	Species (Total)	Species (Sensitive)	Relative Number ^b	QHEI	Index of Biotic Integrity	Modified Index of Well-being ^c	Narrative Evaluation
Powell Creek - 2013								
6.39 (6.40)	Wading	22	1	1357	37.8	34	8.0	Marginally Good/Good
0.36 (0.40)	Wading	38	8	2479	58.5	34	9.0	Marginally Good/Very Good
Powell Creek - 2000								
0.36 (0.40)	Wading	19	1	722	53.0	<u>26</u> [*]	8.0	Poor/Good
Wagner Run - 2013								
0.55 (0.60)	Headwater	14	0	1378	36.0	32	-	Fair
Wagner Run - 2000								
0.55 (0.60)	Headwater	13	0	692	37.0	26 ^{ns}	-	Poor
North Powell Creek - 2013								
7.40 (6.40)	Wading	13	0	473	31.5	<u>23</u> [*]	<u>5.3</u> [*]	Poor/Poor
0.10	Wading	24	1	1676	37.0	33	7.0 ^{ns}	Fair/Fair
North Powell Creek - 2000								
0.10	Wading	22	1	846	35.0	28 ^{ns}	7.0 ^{ns}	Fair/Fair
Tributary to North Powell Creek (RM 4.25) - 2013								
0.75 (0.80)	Headwater	13	0	614	45.5	30	-	Fair
Tributary to North Powell Creek (RM 6.00) - 2013								
0.45 (0.50)	Headwater	14	0	317	37.0	26 ^{ns}	-	Poor
South Powell Creek - 2013								
8.22 (6.70)	Wading	14	0	2529	33.5	<u>22</u> [*]	6.1 [*]	Poor/Fair
1.75 (2.95)	Wading	18	1	456	34.5	<u>25</u> [*]	6.2 [*]	Poor/Fair
South Powell Creek - 2000								
8.22 (8.20)	Wading	13	0	729	32.5	<u>22</u> [*]	5.9 [*]	Poor/Fair
1.75 (1.80)	Wading	15	0	158	43.0	<u>26</u> [*]	<u>5.1</u> [*]	Poor/Poor
Ecoregion Biocriteria: Huron-Erie Lake Plain (HELP)								
INDEX – Site Type				WWH	EWB	MWH-C ^d		
IBI: Headwater				28	50	20		
IBI: Wading				32	50	22		
MIwb: Wading				7.3	9.4	5.6		

a PoR: Point of Record-the river mile, usually a bridge crossing, that reflects the general, umbrella location of the sampling station.

ALP: Absolute Location Point-if used, the specific river mile where sampling occurred for the noted indicator.

ALP locations are often used when actual sampling deviates from the PoR sampling station river mile but the location is still considered representative of that station. If used, ALP river miles are recorded in Appendix Tables 3-5.

b Relative numbers are per 300 meters (headwater and wading methods).

c MIwb not applicable at sites with < 20 mi² drainage areas.

d Channel modified waterways in the HELP ecoregion.

* Significant departure from ecoregion biocriterion (>4 IBI units and >0.5 MIwb units); poor and very poor results are underlined.

ns Non-significant departure from ecoregion biocriterion (≤4 IBI units or ≤0.5 MIwb units).

Table 5. Qualitative Habitat Evaluation Index (QHEI) scores and physical attributes for sampling sites in the Powell Creek (Auglaize River) watershed study area, 2013, and for collocated sites assessed in 2000.

			MWH Attributes																																
			WWH Attributes										High Influence							Moderate Influence															
River Mile PoR (ALP) ^a	QHEI Score	Rating	No Channelization or Recovered Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max. Depth >40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/ No Cover	Max. Depth <40 cm (WD,HW sites)	Total High Influence Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total Moderate Influence Attributes	(MWH H.I.+1)/ (WWH+1) Ratio	(MWH M.I.+1)/ (WWH+1) Ratio		
			Key QHEI Components																																
			Powell Creek (04-110-000)																																
			Year: 2013																																
			6.39 (6.40)	37.8	Poor	■				■			■	3		◆			◆		2		●			●	●		●	●		●	7	0.75	2.00
			0.36 (0.40)	58.5	Fair	■				■	■		■	4							0		●			●			●	●		●	6	0.20	1.40
Powell Creek (04-110-000)																																			
Year: 2000																																			
0.36 (0.40)	53.0	Fair					■		■	■	3	◆				◆		2	●	●			●	●			●	●		●	7	0.75	2.00		
Wagner Run (04-111-000)																																			
Year: 2013																																			
0.55 (0.60)	36.0	Poor	■				■					2		◆			◆	◆	3		●			●			●	●	●		●	6	1.33	2.67	
Wagner Run (04-111-000)																																			
Year: 2000																																			
0.55 (0.60)	37.0	Poor					■					1					◆	◆	2	●	●			●			●	●	●		●	7	2.00	4.00	
North Powell Creek (04-112-000)																																			
Year: 2013																																			
7.40 (6.40)	31.5	Poor	■				■			■	3		◆			◆		2		●			●			●	●	●		●	6	0.75	1.75		
0.10	37.0	Poor	■				■			■	3		◆			◆		2		●			●			●	●	●		●	6	0.75	1.75		
North Powell Creek (04-112-000)																																			
Year: 2000																																			
0.10	35.0	Poor					■			■	2		◆			◆		2	●	●			●	●			●	●	●		●	8	1.33	3.00	
Tributary to North Powell Creek (RM 4.25) (04-112-001)																																			
Year: 2013																																			
0.75 (0.80)	45.5	Fair	■	■			■					3					◆	◆	2		●			●			●	●	●		●	6	0.75	2.00	
Tributary to North Powell Creek (RM 6.00) (04-112-003)																																			
Year: 2013																																			
0.45 (0.50)	37.0	Poor	■				■			■	3		◆			◆		2		●			●			●	●	●		●	6	0.75	1.75		
South Powell Creek (04-114-000)																																			
Year: 2013																																			
8.22 (6.70)	33.5	Poor	■							■	2		◆			◆		2		●			●	●			●	●		●	6	1.00	2.33		
1.75 (2.95)	34.5	Poor	■							■	2		◆			◆		2		●			●	●			●	●		●	6	1.00	2.33		
South Powell Creek (04-114-000)																																			
Year: 2000																																			
8.22 (8.20)	32.5	Poor					■			■			◆	◆		◆		3		●			●	●			●	●		●	6	1.33	2.33		
1.75 (1.80)	43.0	Poor					■			■				◆				1	●	●			●	●			●	●		●	7	1.00	2.67		

a PoR: Point of Record-the river mile, usually a bridge crossing, that reflects the general, umbrella location of the sampling station.

ALP: Absolute Location Point-if used, the specific river mile where sampling occurred for the noted indicator.

ALP locations are often used when actual sampling deviates from the PoR sampling station river mile but the location is still considered representative of that station.

Water Quality

Surface water grab samples were collected from the Powell Creek (Auglaize River) watershed study area at ten locations on six occasions between April 25 and August 12, 2013. Surface water samples were analyzed for nutrients including nitrate+nitrite, ammonia, TKN, total phosphorus, and orthophosphate. Additional parameter coverage included suspended and dissolved solids, alkalinity, chloride, sulfate, and field parameter measurements including dissolved oxygen, pH, conductivity, and temperature. Parameters that exceeded Ohio WQS criteria are reported in Table 6 and nutrient measurements that exceeded statewide targets are reported in Table 7; the full data set is compiled in Appendix Table 6.

During the course of six sampling events, dissolved oxygen (D.O.) measurements below the WWH aquatic life use average WQS criterion were observed a total of eleven times across seven of the ten sites (Table 6). Five measurements were also below the WWH aquatic life use minimum WQS criterion. The three sites that did not have any values below the WQS average criterion were those with the largest drainage areas ($>30 \text{ mi}^2$). In addition, exceedances of the average May temperature criterion (17.8°C) for streams in the Lake Erie basin occurred in May at eight of the ten sites (Table 6). Biological activity, water flow/turbulence, pollution, and stream temperature can influence the dissolved oxygen in streams. During summer months, flow is often decreased, pollutant sources are less diluted, water temperatures are higher, and biological activities are increased. In the Powell Creek watershed, conditions such as these likely contributed to the generally low D.O. levels and criterion exceedances.

The Powell Creek watershed is predominantly surrounded by agricultural land use. Elevated total phosphorus levels above statewide targets were observed at nine of the ten locations sampled in 2013. South Powell Creek had higher concentrations of total phosphorus (0.23 and 0.25 mg/l at the two sites), and likely were the contributing factor to an increase in geometric mean concentrations between the most downstream North Powell Creek and most upstream Powell Creek locations. Nitrate+nitrite geometric means in Powell Creek were above statewide targets at eight of the ten locations (Table 7, Figure 5). North Powell Creek had higher geometric mean concentrations of nitrate+nitrite, relative to South Powell Creek. The mixing of North Powell and South Powell creeks appears to reduce values at the upstream Powell Creek site; however, the geometric mean increases at the downstream site, leading to the conclusion that there are continued inputs downstream from the confluence. Nitrate+nitrite levels increased as additional nitrate+nitrite load entered the stream in excess of what could be assimilated by the biomass. Ammonia levels throughout the entire watershed did not exceed the Ohio WQS criteria at any of the locations sampled.

Submersible continuous sondes were deployed from August 13-15, 2013, at three sites in the Powell Creek watershed to record hourly readings of four field water quality parameters: temperature, pH, dissolved oxygen, and conductivity. Figure 6 shows the D.O. data range for a 24-hour period at the three sites. Table 8 shows summary data for the four parameters monitored at each sampling site. Since these parameters fluctuate in a diel fashion, these sites' summary data for three 24-hour periods are described. These are labeled A, B and C. The A period starts August 13 at 1500 hours and ends August 14 at 1400 hours. The B period begins August 14 at 400 hours and ends August 15 at 300 hours. Finally, the C period includes August 14 at 1500 hours through August 15 at 1400 hours. A D.O. exceedance of the minimum WQS criterion (red shaded cell in Table 8) was captured during this time period at South Powell Creek at Schubert Rd. (RM 1.75). No D.O. diel ranges were observed to indicate excessive nutrient enrichment. Both the North Powell Creek and South Powell Creek D.O. data were found to be sub-saturation throughout the survey. The sluggish stream flow and near complete canopy coverage of these sites, along with organic material loading from the agricultural watershed, combined to explain these results.

Table 6. Exceedances of Ohio Water Quality Standards criteria (OAC 3745-1) for parameters measured in the Powell Creek (Auglaize River) watershed study area, 2013.

Stream RM	Location	Parameter (value – mg/l unless noted)
Powell Creek		
6.39	Holly Rd.	temperature – 23.2°C ^a (May 20) dissolved oxygen – 4.46 ^b (June 6)
0.36	Boy Scout Rd.	temperature – 20.1°C ^a (May 20)
Wagner Run		
0.55	St. Rt. 15	temperature – 19.5°C ^a (May 20) dissolved oxygen – 4.09 ^b (August 12)
North Powell Creek		
7.40	Highland Center Rd.	temperature – 20.4°C ^a (May 20) dissolved oxygen – 2.8 ^c (May 20), 4.31 ^b (August 12)
0.10	St. Rt. 15	temperature – 22.5°C ^a (May 20)
Tributary to North Powell Creek (RM 6.00)		
0.45	Highland Center Rd.	dissolved oxygen – 2.72 ^c (May 20), 3.03 ^c (August 12)
Tributary to North Powell Creek (RM 4.25)		
0.75	Highland Center Rd.	dissolved oxygen – 4.75 ^b (May 20), 4.50 ^b (August 12)
Hogback Run		
0.1	Hoffman Rd.	temperature – 20.1°C ^a (May 20) dissolved oxygen – 3.39 ^c (July 30), 3.22 ^c (August 12)
South Powell Creek		
8.22	Co. Rd. 228	temperature – 24.0°C ^a (May 20) dissolved oxygen – 4.91 ^b (June 6)
1.75	Schubert Rd.	temperature – 22.5°C ^a (May 20)

a Exceedance of the average May temperature criterion (17.8°C) for streams in the Lake Erie basin.

b Exceedance of the outside mixing zone average dissolved oxygen criterion (5.0 mg/l) for WWH streams.

c Exceedance of the outside mixing zone minimum dissolved oxygen criterion (4.0 mg/l) for WWH streams.

Table 7. Seasonal geometric mean values (mg/l) for nutrients (nitrate+nitrite and total phosphorus) calculated from six grab samples collected at ten sites in the Powell Creek (Auglaize River) watershed study area, 2013. Yellow shaded values are above statewide recommended geometric mean targets (Ohio EPA, 1999)¹.

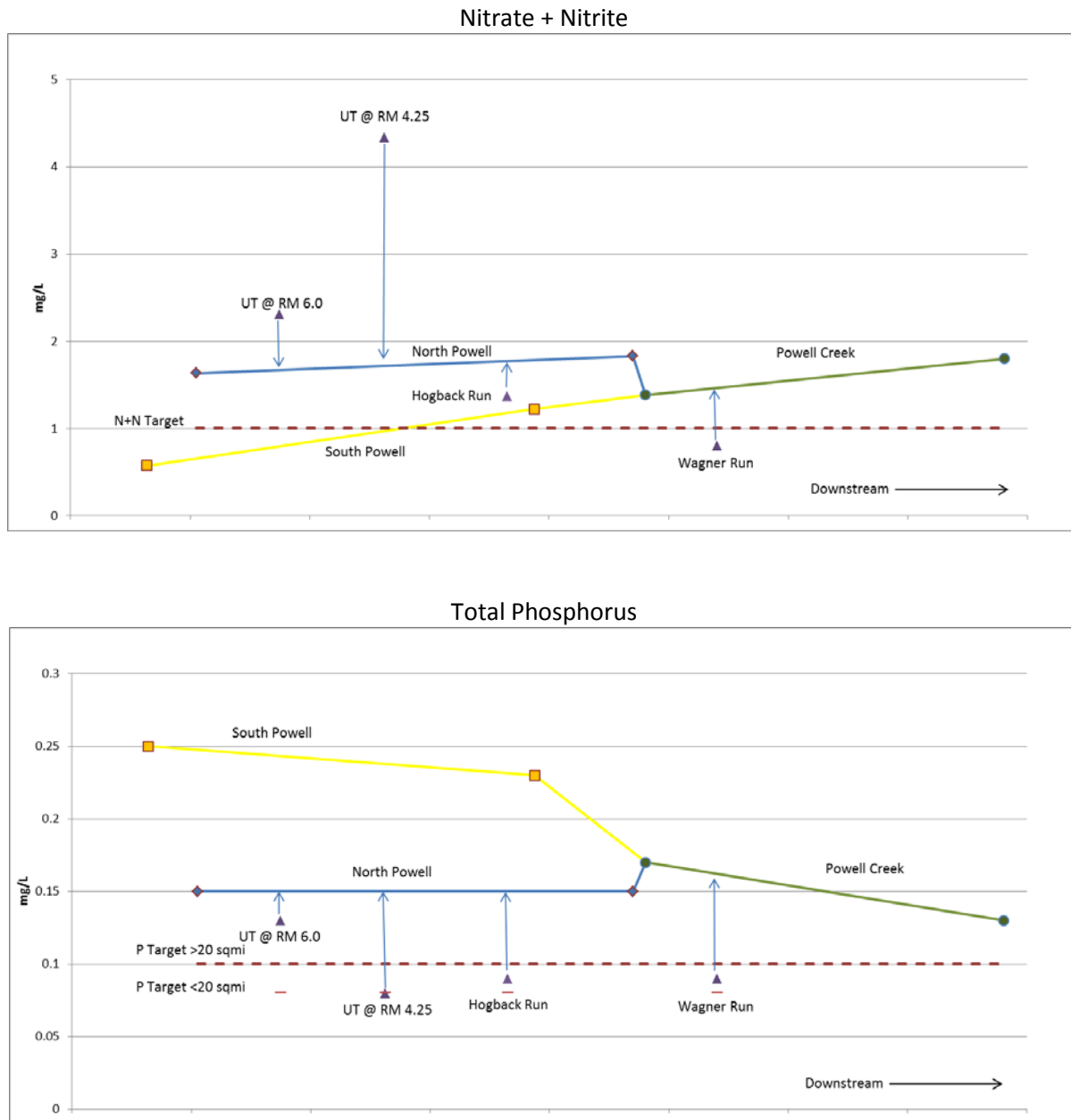
Stream RM	Location	Parameter (Geometric Mean [mg/l])
Powell Creek		
6.39 ^w	Holly Rd.	phosphorus (0.17), nitrate-nitrite (1.38)
0.36 ^w	Boy Scout Rd.	phosphorus (0.13), nitrate-nitrite (1.80)
Wagner Run		
0.55 ^h	St. Rt. 15	phosphorus (0.09), nitrate-nitrite (0.80)
North Powell Creek		
7.40 ^w	Highland Center Rd.	phosphorus (0.15), nitrate-nitrite (1.63)
0.10 ^w	St Rt 15	phosphorus (0.15), nitrate-nitrite (1.83)
Tributary to North Powell Creek (RM 6.00)		
0.45 ^h	Highland Center Rd.	phosphorus (0.13), nitrate-nitrite (2.31)
Tributary to North Powell Creek (RM 4.25)		
0.75 ^h	Highland Center Rd.	phosphorus (0.08), nitrate-nitrite (4.34)
Hogback Run		
0.10 ^h	Hoffman Rd.	phosphorus (0.09), nitrate-nitrite (1.37)
South Powell Creek		
8.22 ^w	Co. Rd. 228	phosphorus (0.25), nitrate-nitrite (0.57)
1.75 ^w	Schubert Rd.	phosphorus (0.23), nitrate-nitrite (1.22)

1 Target geometric means for total phosphorus are 0.08 mg/l (WWH) for headwater stream sites and 0.10 mg/l (WWH) for wading stream sites; target geometric means for nitrate+nitrite are 1.0 mg/l (WWH) for both headwater and wading stream sites.

w - wading stream site

h - headwater stream site

Figure 5. Plot of seasonal geometric mean values (mg/l) for nutrients (nitrate+nitrite, top, and total phosphorus, bottom) calculated from six grab samples collected at ten sites in the Powell Creek (Auglaize River) watershed study area, 2013.



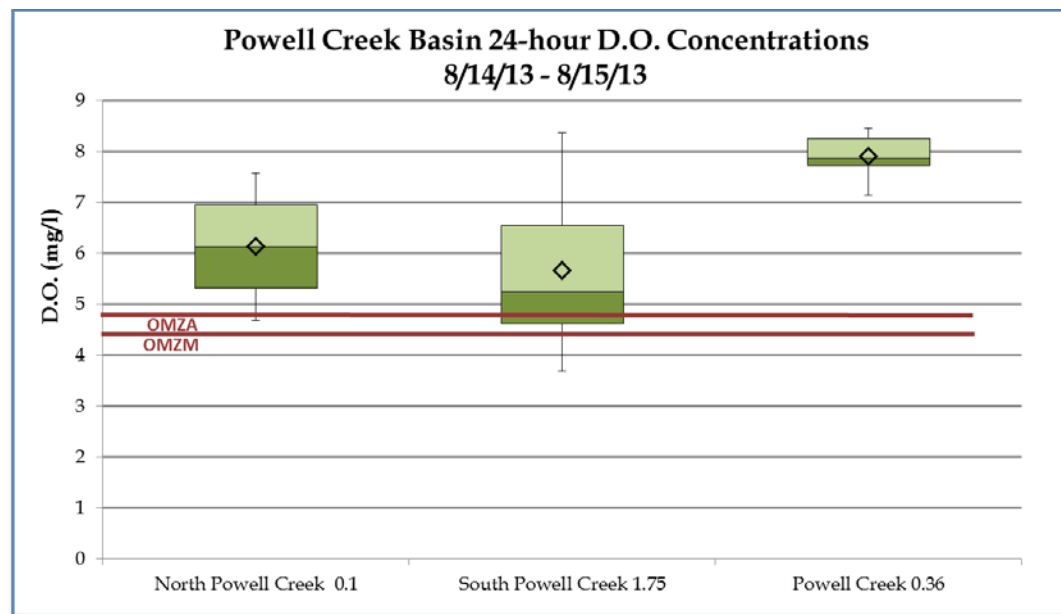


Figure 6. Plot of continuous dissolved oxygen monitored using water quality sondes with sensors tracking at three Powell Creek watershed sites, 2013..

Table 8. Summary of water quality parameters collected using water quality sondes with critical values identified for analysis and comparison to Ohio WQS criteria; data collected from three Powell Creek watershed sites, 2013.

Stream	River Mile	STORET		Temperature (C)				pH (SU)				Sp Conductivity (mS/cm)				Dissolved Oxygen (mg/l)			
				Min	Ave	Max	Range	Min	Ave	Max	Range	Min	Ave	Max	Range	Min	Ave	Max	Range
Dates sampled: Aug. 13 - Aug. 15, 2013																			
North Pow ell 0.1		P06G05	A	16.49	20.17	24.66	8.17	7.66	7.78	7.91	0.25	480	481	482	2	4.68	6.03	7.44	2.76
WWH			B	16.49	19.22	22.15	5.66	7.66	7.78	7.90	0.24	480	481	483	3	4.68	6.14	7.57	2.89
			C	15.64	18.95	22.15	6.51	7.68	7.78	7.90	0.22	481	483	487	6	5.33	6.32	7.57	2.24
South Pow ell 1.75		P06G04	A	17.83	20.76	24.49	6.66	7.52	7.65	7.83	0.31	573	575	577	4	3.68	5.67	8.51	4.83
WWH			B	17.83	19.38	21.28	3.45	7.52	7.64	7.81	0.29	573	575	577	4	3.68	5.66	8.36	4.68
			C	16.93	19.01	21.28	4.35	7.57	7.65	7.81	0.24	573	576	579	6	4.33	5.83	8.36	4.03
Pow ell Creek 0.36		P06G07	A	18.29	20.57	23.16	4.87	8.05	8.10	8.15	0.10	467	470	472	5	7.14	7.89	8.42	1.28
WWH			B	18.29	19.38	20.41	2.12	8.04	8.09	8.15	0.11	467	469	472	5	7.14	7.91	8.45	1.31
			C	17.51	19.02	20.41	2.90	8.03	8.10	8.23	0.20	462	467	472	10	7.73	8.27	9.21	1.48

REFERENCES

- Ohio Environmental Protection Agency. 2014a. 2014 updates to Biological Criteria for the Protection of Aquatic Life: Volume II and Volume II Addendum. User's manual for biological field assessment of Ohio surface waters. Division of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.
http://epa.ohio.gov/Portals/35/documents/BioCrit88_Vol2Updates2014.pdf
- _____. 2014b. 2014 updates to Biological Criteria for the Protection of Aquatic Life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.
http://epa.ohio.gov/Portals/35/documents/BioCrit88_Vol3Updates2014.pdf
- _____. 2013. Surface water field sampling manual for water column chemistry, bacteria and flows. Division of Surface Water, Columbus, Ohio.
http://epa.ohio.gov/Portals/35/documents/SW_SamplingManual.pdf
- _____. 2010. Ohio Lake Erie Phosphorus Task Force final report. Division of Surface Water, Columbus, Ohio.
http://www.epa.state.oh.us/portals/35/lakeerie/ptaskforce/Task_Force_Final_Report_April_2010.pdf
- _____. 2006. Methods for assessing habitat in flowing waters: Using the Qualitative Habitat Evaluation Index (QHEI). Ohio EPA Tech. Bull. EAS/2006-06-1. Division of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.
<http://epa.ohio.gov/portals/35/documents/QHEIManualJune2006.pdf>
- _____. 1999. Association between nutrients, habitat, and the aquatic biota in Ohio rivers and streams. Technical Bulletin MAS/1999-1-1. Division of Surface Water, Columbus, Ohio.
http://www.epa.state.oh.us/portals/35/documents/assoc_load.pdf
- _____. 1989a. Addendum to Biological criteria for the protection of aquatic life: Volume II. User's manual for biological field assessment of Ohio surface waters. Division of Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.
http://epa.ohio.gov/portals/35/documents/BioCrit88_Vol2Addendum.pdf
- _____. 1989b. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.
<http://epa.ohio.gov/portals/35/documents/Vol3.pdf>
- _____. 1987a. Biological criteria for the protection of aquatic life: Volume I. The role of biological data in water quality assessment. Division of Water Qual. Monit. & Assess., Surface Water Section, Columbus, Ohio.
<http://epa.ohio.gov/Portals/35/documents/Vol1.pdf>
- _____. 1987b. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Qual. Monit. & Assess., Surface Water Section, Columbus, Ohio.
<http://epa.ohio.gov/Portals/35/documents/Vol2.pdf>
- Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Ohio Environmental Protection Agency, Division of Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.
http://epa.ohio.gov/Portals/35/documents/QHEI_1989.pdf

APPENDICES

Appendix Table 1. Invertebrate Community Index (ICI) metrics and scores for samples collected with quantitative methods from Powell Creek, 2013 and 2000.

River Mile	Drainage Area (sq mi)	Number of				Percent:					Qual. EPT	Eco- region	ICI
		Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Mayflies	Caddis- flies	Tany- tarsini	Other Dipt/NI	Tolerant Organisms			
Powell Creek (04-110)													
Year: 2013													
0.36	97.0	15(2)	3(2)	0(0)	7(2)	43.3(6)	0.0(0)	0.0(0)	10.4(6)	0.7(6)	10(4)	1	28 (MG)
Year: 2000													
0.30	98.0	31(4)	7(4)	1(2)	19(4)	30.1(4)	20.0(6)	18.7(4)	30.1(4)	4.8(6)	5(2)	1	40

Appendix Table 2. Macroinvertebrate community data collected from sites in the Powell Creek watershed, 2013 and 2000.

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Powell Creek

Collection Date: 09/23/2013 River Code: 04-110 RM: 6.39

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
04664	<i>Helobdella stagnalis</i>	+			
04685	<i>Placobdella ornata</i>	+			
04935	<i>Erpobdella punctata punctata</i>	+			
04964	<i>Erpobdella microstoma</i>	+			
06201	<i>Hyalella azteca</i>	+			
11200	<i>Callibaetis sp</i>	+			
13400	<i>Stenacron sp</i>	+			
17200	<i>Caenis sp</i>	+			
18700	<i>Hexagenia sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
22300	<i>Argia sp</i>	+			
24107	<i>Nasiaeschna pentacantha</i>	+			
24900	<i>Gomphus sp</i>	+			
45400	<i>Trichocorixa sp</i>	+			
59300	<i>Mystacides sp</i>	+			
59410	<i>Nectopsyche diarina</i>	+			
60900	<i>Peltodytes sp</i>	+			
68708	<i>Dubiraphia vittata group</i>	+			
71900	<i>Tipula sp</i>	+			
72420	<i>Chaoborus sp</i>	+			
77120	<i>Ablabesmyia mallochi</i>	+			
78655	<i>Procladius (Holotanypus) sp</i>	+			
79020	<i>Tanytus neopunctipennis</i>	+			
82730	<i>Chironomus (C.) decorus group</i>	+			
82820	<i>Cryptochironomus sp</i>	+			
82885	<i>Cryptotendipes pseudotener</i>	+			
83002	<i>Dicrotendipes modestus</i>	+			
83051	<i>Dicrotendipes simpsoni</i>	+			
83158	<i>Endochironomus nigricans</i>	+			
83300	<i>Glyptotendipes (G.) sp</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84520	<i>Polypedilum (Tripodura) halterale group</i>	+			
84800	<i>Tribelos jucundum</i>	+			
85230	<i>Cladotanytarsus mancus group</i>	+			
85500	<i>Paratanytarsus sp</i>	+			
85800	<i>Tanytarsus sp</i>	+			
85840	<i>Tanytarsus sepp</i>	+			
98600	<i>Sphaerium sp</i>	+			
99001	<i>Unionidae</i>	+			

No. Quantitative Taxa: 0	Total Taxa: 39
No. Qualitative Taxa: 39	ICI: F
Number of Organisms: 0	Qual EPT: 6

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Powell Creek
 Boy Scout Rd.

Collection Date: 09/23/2013 River Code: 04-110 RM: 0.36

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	<i>Turbellaria</i>	+			
04964	<i>Erpobdella microstoma</i>	+			
08250	<i>Orconectes (Procericambarus) rusticus</i>	+			
11200	<i>Callibaetis sp</i>	+			
11670	<i>Procloeon viridoculare</i>	+			
13400	<i>Stenacron sp</i>	6 +			
13521	<i>Stenonema femoratum</i>	2 +			
17200	<i>Caenis sp</i>	50 +			
18700	<i>Hexagenia sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
22300	<i>Argia sp</i>	7 +			
45300	<i>Sigara sp</i>	+			
52200	<i>Cheumatopsyche sp</i>	+			
59300	<i>Mystacides sp</i>	+			
59520	<i>Oecetis cinerascens</i>	+			
59700	<i>Trienodes sp</i>	+			
68300	<i>Cyphon sp</i>	42			
68708	<i>Dubiraphia vittata group</i>	1 +			
69400	<i>Stenelmis sp</i>	12 +			
71900	<i>Tipula sp</i>	+			
72160	<i>Psychoda sp</i>	3			
72700	<i>Anopheles sp</i>	+			
78655	<i>Procladius (Holotanypus) sp</i>	+			
82710	<i>Chironomus (C.) sp</i>	1			
83300	<i>Glyptotendipes (G.) sp</i>	4 +			
83600	<i>Kiefferulus (K.) dux</i>	1			
84210	<i>Paratendipes albimanus</i> or <i>P. duplicatus</i>	1 +			
84300	<i>Phaenopsectra obediens group</i>	2			
84450	<i>Polypedilum (Uresipedilum) flavum</i>	+			
84800	<i>Tribelos jucundum</i>	1 +			
85800	<i>Tanytarsus sp</i>	+			
95100	<i>Physella sp</i>	+			
96120	<i>Menetus (Micromenetus) dilatatus</i>	+			
96900	<i>Ferrissia sp</i>	+			
96930	<i>Laevapex fuscus</i>	1 +			
98200	<i>Pisidium sp</i>	+			
98600	<i>Sphaerium sp</i>	+			
99180	<i>Strophitus undulatus undulatus</i>	+			

No. Quantitative Taxa: 15	Total Taxa: 38
No. Qualitative Taxa: 33	ICI: 28 MG
Number of Organisms: 134	Qual EPT: 10

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Powell Creek
Boy Scout Rd.

Collection Date: 08/31/2000 River Code: 04-110 RM: 0.30

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01320	<i>Hydra sp</i>	5	84540	<i>Polypedilum (Tripodura) scalaenum group</i>	3
02600	<i>Nematomorpha</i>	+	84750	<i>Stictochironomus sp</i>	+
03360	<i>Plumatella sp</i>	+	85201	<i>Cladotanytarsus species group A</i>	3
05900	<i>Lirceus sp</i>	+	85625	<i>Rheotanytarsus sp</i>	56 +
06201	<i>Hyalella azteca</i>	+	85821	<i>Tanytarsus glabrescens group sp 7</i>	69 +
08250	<i>Orconectes (Procericambarus) rusticus</i>	+	96900	<i>Ferrissia sp</i>	11 +
11001	<i>Baetidae</i>	2	98600	<i>Sphaerium sp</i>	+
12200	<i>Isonychia sp</i>	1			
12900	<i>Heptagenia sp</i>	7	No. Quantitative Taxa: 31		Total Taxa: 50
13000	<i>Leucrocuta sp</i>	42 +	No. Qualitative Taxa: 31		ICI: 40
13400	<i>Stenacron sp</i>	132 +	Number of Organisms: 685		Qual EPT: 5
13521	<i>Stenonema femoratum</i>	18 +			
13570	<i>Maccaffertium terminatum</i>	4			
17200	<i>Caenis sp</i>	+			
22300	<i>Argia sp</i>	7 +			
45300	<i>Sigara sp</i>	+			
47600	<i>Sialis sp</i>	+			
48220	<i>Chauliodes rastricornis</i>	+			
52200	<i>Cheumatopsyche sp</i>	137 +			
60900	<i>Peltodytes sp</i>	+			
68300	<i>Cyphon sp</i>	+			
68708	<i>Dubiraphia vittata group</i>	+			
68901	<i>Macronychus glabratus</i>	1			
69400	<i>Stenelmis sp</i>	+			
71100	<i>Hexatoma sp</i>	+			
71900	<i>Tipula sp</i>	+			
77120	<i>Ablabesmyia mallochi</i>	+			
77500	<i>Conchapelopia sp</i>	3 +			
77750	<i>Hayesomyia senata or Thienemannimyia norena</i>	9 +			
78450	<i>Nilotanypus fimbriatus</i>	15			
80370	<i>Corynoneura lobata</i>	66			
80410	<i>Cricotopus (C.) sp</i>	3			
81231	<i>Nanocladius (N.) crassicornus or N. (N.) "rectinervis"</i>	3			
81240	<i>Nanocladius (N.) distinctus</i>	16			
81270	<i>Nanocladius (N.) spiniplenus</i>	3			
82121	<i>Thienemanniella lobapodema</i>	4			
82141	<i>Thienemanniella xena</i>	15			
82820	<i>Cryptochironomus sp</i>	+			
83040	<i>Dicrotendipes neomodestus</i>	3			
83840	<i>Microtendipes pedellus group</i>	16 +			
84450	<i>Polypedilum (Uresipedilum) flavum</i>	25 +			
84460	<i>Polypedilum (P.) fallax group</i>	3			
84470	<i>Polypedilum (P.) illinoense</i>	3			

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Wagner Run

Collection Date: 08/13/2013 River Code: 04-111 RM: 0.55

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	<i>Oligochaeta</i>	+			
04964	<i>Erpobdella microstoma</i>	+			
05900	<i>Lirceus sp</i>	+			
06700	<i>Crangonyx sp</i>	+			
07875	<i>Cambarus (Tubericambarus) polychromatus</i>	+			
08250	<i>Orconectes (Procericambarus) rusticus</i>	+			
11200	<i>Callibaetis sp</i>	+			
13521	<i>Stenonema femoratum</i>	+			
17200	<i>Caenis sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
24107	<i>Nasiaeschna pentacantha</i>	+			
28500	<i>Libellula sp</i>	+			
45300	<i>Sigara sp</i>	+			
45400	<i>Trichocorixa sp</i>	+			
60900	<i>Peltodytes sp</i>	+			
63900	<i>Laccophilus sp</i>	+			
71300	<i>Limonia sp</i>	+			
77500	<i>Conchapelopia sp</i>	+			
83040	<i>Dicrotendipes neomodestus</i>	+			
83300	<i>Glyptotendipes (G.) sp</i>	+			
84210	<i>Paratendipes albimanus</i> or <i>P. duplicatus</i>	+			
84450	<i>Polypedilum (Uresipedilum) flavum</i>	+			
84520	<i>Polypedilum (Tripodura) halterale</i> group	+			
87400	<i>Stratiomys sp</i>	+			
95100	<i>Physella sp</i>	+			
96120	<i>Menetus (Micromenetus) dilatatus</i>	+			
96264	<i>Planorbella (Pierosoma) pilsbryi</i>	+			
98600	<i>Sphaerium sp</i>	+			

No. Quantitative Taxa: 0	Total Taxa: 28
No. Qualitative Taxa: 28	ICI: LF
Number of Organisms: 0	Qual EPT: 3

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Wagner Run
 St. Rt. 15

Collection Date: 07/19/2000 River Code: 04-111 RM: 0.60

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
05900	<i>Lirceus sp</i>	+			
08220	<i>Orconectes (Gremicambarus) immunis</i>	+			
13400	<i>Stenacron sp</i>	+			
13521	<i>Stenonema femoratum</i>	+			
27500	<i>Somatochlora sp</i>	+			
43205	<i>Nepa apiculata</i>	+			
45300	<i>Sigara sp</i>	+			
62200	<i>Copelatus sp</i>	+			
63300	<i>Hydroporini</i>	+			
66200	<i>Cymbiodyta sp</i>	+			
67800	<i>Tropisternus sp</i>	+			
77120	<i>Ablabesmyia mallochi</i>	+			
83840	<i>Microtendipes pedellus group</i>	+			
84750	<i>Stictochironomus sp</i>	+			
85840	<i>Tanytarsus sepp</i>	+			
96264	<i>Planorbella (Pierosoma) pilsbryi</i>	+			

No. Quantitative Taxa: 0	Total Taxa: 16
No. Qualitative Taxa: 16	ICI: F
Number of Organisms: 0	Qual EPT: 2

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: North Powell Creek

Collection Date: 09/23/2013 River Code: 04-112 RM: 6.40

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01320	<i>Hydra sp</i>	+			
01801	<i>Turbellaria</i>	+			
04664	<i>Helobdella stagnalis</i>	+			
04666	<i>Helobdella papillata</i>	+			
04964	<i>Erpobdella microstoma</i>	+			
08451	<i>Palaemonetes kadiakensis</i>	+			
11200	<i>Callibaetis sp</i>	+			
13521	<i>Stenonema femoratum</i>	+			
17200	<i>Caenis sp</i>	+			
18700	<i>Hexagenia sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
22300	<i>Argia sp</i>	+			
24107	<i>Nasiaeschna pentacantha</i>	+			
27500	<i>Somatochlora sp</i>	+			
45400	<i>Trichocorixa sp</i>	+			
45900	<i>Notonecta sp</i>	+			
72700	<i>Anopheles sp</i>	+			
77355	<i>Clinotanytus pinguis</i>	+			
78655	<i>Procladius (Holotanytus) sp</i>	+			
83002	<i>Dicrotendipes modestus</i>	+			
83051	<i>Dicrotendipes simpsoni</i>	+			
83158	<i>Endochironomus nigricans</i>	+			
83300	<i>Glyptotendipes (G.) sp</i>	+			
83600	<i>Kiefferulus (K.) dux</i>	+			
84315	<i>Phaenopsectra flavipes</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84520	<i>Polypedilum (Tripodura) halterale group</i>	+			
84800	<i>Tribelos jucundum</i>	+			
85800	<i>Tanytarsus sp</i>	+			
86100	<i>Chrysops sp</i>	+			
95100	<i>Physella sp</i>	+			
96120	<i>Menetus (Micromenetus) dilatatus</i>	+			
96264	<i>Planorbella (Pierosoma) pilsbryi</i>	+			
98600	<i>Sphaerium sp</i>	+			

No. Quantitative Taxa: 0	Total Taxa: 34
No. Qualitative Taxa: 34	ICI: LF
Number of Organisms: 0	Qual EPT: 4

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: North Powell Creek

Collection Date: 09/23/2013 River Code: 04-112 RM: 0.10

St. Rt. 15

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	<i>Turbellaria</i>	+			
03600	<i>Oligochaeta</i>	+			
04664	<i>Helobdella stagnalis</i>	+			
04666	<i>Helobdella papillata</i>	+			
04964	<i>Erpobdella microstoma</i>	+			
05800	<i>Caecidotea sp</i>	+			
08601	<i>Hydrachnidia</i>	+			
11200	<i>Callibaetis sp</i>	+			
13400	<i>Stenacron sp</i>	+			
17200	<i>Caenis sp</i>	+			
18700	<i>Hexagenia sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
22300	<i>Argia sp</i>	+			
24107	<i>Nasiaeschna pentacantha</i>	+			
28955	<i>Plathemis lydia</i>	+			
42700	<i>Belostoma sp</i>	+			
45300	<i>Sigara sp</i>	+			
48220	<i>Chauliodes rastricornis</i>	+			
60900	<i>Peltodytes sp</i>	+			
65800	<i>Berosus sp</i>	+			
67800	<i>Tropisternus sp</i>	+			
68300	<i>Cyphon sp</i>	+			
72420	<i>Chaoborus sp</i>	+			
72900	<i>Culex sp</i>	+			
77355	<i>Clinotanypus pinguis</i>	+			
78655	<i>Procladius (Holotanypus) sp</i>	+			
79020	<i>Tanypus neopunctipennis</i>	+			
82820	<i>Cryptochironomus sp</i>	+			
82885	<i>Cryptotendipes pseudotener</i>	+			
83002	<i>Dicrotendipes modestus</i>	+			
83040	<i>Dicrotendipes neomodestus</i>	+			
83051	<i>Dicrotendipes simpsoni</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84800	<i>Tribelos jucundum</i>	+			
85840	<i>Tanytarsus sepp</i>	+			
87601	<i>Dolichopodidae</i>	+			
95100	<i>Physella sp</i>	+			
96120	<i>Menetus (Micromenetus) dilatatus</i>	+			
96264	<i>Planorbella (Pierosoma) pilsbryi</i>	+			
96930	<i>Laevapex fuscus</i>	+			
98600	<i>Sphaerium sp</i>	+			
99100	<i>Pyganodon grandis</i>	+			
99740	<i>Toxolasma parvus</i>	+			

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: North Powell Creek
 St. Rt. 15

Collection Date: 07/19/2000 River Code: 04-112 RM: 0.10

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
05900	<i>Lirceus sp</i>	+			
08250	<i>Orconectes (Procericambarus) rusticus</i>	+			
13400	<i>Stenacron sp</i>	+			
18704	<i>Hexagenia atrocaudata</i>	+			
27500	<i>Somatochlora sp</i>	+			
45300	<i>Sigara sp</i>	+			
47600	<i>Sialis sp</i>	+			
52200	<i>Cheumatopsyche sp</i>	+			
60400	<i>Gyrinus sp</i>	+			
62200	<i>Copelatus sp</i>	+			
63300	<i>Hydroporini</i>	+			
66500	<i>Enochrus sp</i>	+			
67000	<i>Helophorus sp</i>	+			
67700	<i>Paracymus sp</i>	+			
68300	<i>Cyphon sp</i>	+			
78140	<i>Labrundinia pilosella</i>	+			
79100	<i>Thienemannimyia group</i>	+			
83051	<i>Dicrotendipes simpsoni</i>	+			
84520	<i>Polypedilum (Tripodura) halterale group</i>	+			
84700	<i>Stenochironomus sp</i>	+			
84800	<i>Tribelos jucundum</i>	+			
95100	<i>Physella sp</i>	+			
98600	<i>Sphaerium sp</i>	+			

No. Quantitative Taxa: 0	Total Taxa: 23
No. Qualitative Taxa: 23	ICI: MG
Number of Organisms: 0	Qual EPT: 3

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Hogback Run

Collection Date: 08/13/2013 River Code: 04-113 RM: 0.10

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	<i>Oligochaeta</i>	+			
04687	<i>Placobdella parasitica</i>	+			
04964	<i>Erpobdella microstoma</i>	+			
05900	<i>Lirceus sp</i>	+			
17200	<i>Caenis sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
23600	<i>Aeshna sp</i>	+			
45300	<i>Sigara sp</i>	+			
45400	<i>Trichocorixa sp</i>	+			
60900	<i>Peltodytes sp</i>	+			
63900	<i>Laccophilus sp</i>	+			
67800	<i>Tropisternus sp</i>	+			
72700	<i>Anopheles sp</i>	+			
77355	<i>Clinotanytus pinguis</i>	+			
78655	<i>Procladius (Holotanytus) sp</i>	+			
79020	<i>Tanytus neopunctipennis</i>	+			
82800	<i>Cladopelma sp</i>	+			
83410	<i>Harnischia curtilamellata</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84520	<i>Polypedilum (Tripodura) halterale group</i>	+			
85800	<i>Tanytarsus sp</i>	+			
86100	<i>Chrysops sp</i>	+			
95100	<i>Physella sp</i>	+			
96264	<i>Planorbella (Pierosoma) pilsbryi</i>	+			

No. Quantitative Taxa: 0	Total Taxa: 24
No. Qualitative Taxa: 24	ICI: P
Number of Organisms: 0	Qual EPT: 1

Macroinvertebrate Collection

Site: Trib. to N. Powell Creek (RM 4.25)

Collection Date: 08/13/2013 River Code: 04-112-001 RM: 0.75

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03360	<i>Plumatella sp</i>	+			
04685	<i>Placobdella ornata</i>	+			
05900	<i>Lirceus sp</i>	+			
07875	<i>Cambarus (Tubericambarus) polychromatus</i>	+			
08220	<i>Orconectes (Gremicambarus) immunis</i>	+			
08601	<i>Hydrachnidia</i>	+			
13521	<i>Stenonema femoratum</i>	+			
22001	<i>Coenagrionidae</i>	+			
22300	<i>Argia sp</i>	+			
23950	<i>Epiaeschna heros</i>	+			
60900	<i>Peltodytes sp</i>	+			
68300	<i>Cyphon sp</i>	+			
68708	<i>Dubiraphia vittata group</i>	+			
71300	<i>Limonia sp</i>	+			
72700	<i>Anopheles sp</i>	+			
72900	<i>Culex sp</i>	+			
77120	<i>Ablabesmyia mallochi</i>	+			
78655	<i>Procladius (Holotanypus) sp</i>	+			
82820	<i>Cryptochironomus sp</i>	+			
84210	<i>Paratendipes albimanus</i> or <i>P. duplicatus</i>	+			
84315	<i>Phaenopsectra flavipes</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84520	<i>Polypedilum (Tripodura) halterale group</i>	+			
84800	<i>Tribelos jucundum</i>	+			
95100	<i>Physella sp</i>	+			
98200	<i>Pisidium sp</i>	+			
98600	<i>Sphaerium sp</i>	+			

No. Quantitative Taxa: 0

Total Taxa: 27

No. Qualitative Taxa: 27

ICI: P

Number of Organisms: 0

Qual EPT: 1

Macroinvertebrate Collection

Site: Trib. to N. Powell Creek (RM 6.00)

Collection Date: 08/14/2013 River Code: 04-112-003 RM: 0.45

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	<i>Oligochaeta</i>	+			
04666	<i>Helobdella papillata</i>	+			
06201	<i>Hyalella azteca</i>	+			
17200	<i>Caenis sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
24107	<i>Nasiaeschna pentacantha</i>	+			
45300	<i>Sigara sp</i>	+			
60900	<i>Peltodytes sp</i>	+			
63300	<i>Hydroporini</i>	+			
64050	<i>Liodessus sp</i>	+			
68300	<i>Cyphon sp</i>	+			
72700	<i>Anopheles sp</i>	+			
78655	<i>Procladius (Holotanypus) sp</i>	+			
78702	<i>Psectrotanypus dyari</i>	+			
82730	<i>Chironomus (C.) decorus group</i>	+			
83002	<i>Dicrotendipes modestus</i>	+			
83051	<i>Dicrotendipes simpsoni</i>	+			
84520	<i>Polypedilum (Tripodura) halterale group</i>	+			
84800	<i>Tribelos jucundum</i>	+			
85500	<i>Paratanytarsus sp</i>	+			
85800	<i>Tanytarsus sp</i>	+			
95100	<i>Physella sp</i>	+			

No. Quantitative Taxa: 0 Total Taxa: 22

No. Qualitative Taxa: 22 ICI: P

Number of Organisms: 0 Qual EPT: 1

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: South Powell Creek

Collection Date: 09/23/2013 River Code: 04-114 RM: 6.70

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	<i>Oligochaeta</i>	+			
04664	<i>Helobdella stagnalis</i>	+			
04964	<i>Erpobdella microstoma</i>	+			
05800	<i>Caecidotea sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
22300	<i>Argia sp</i>	+			
24107	<i>Nasiaeschna pentacantha</i>	+			
28705	<i>Pachydiplax longipennis</i>	+			
28955	<i>Plathemis lydia</i>	+			
42700	<i>Belostoma sp</i>	+			
45100	<i>Palmarcorixa sp</i>	+			
45400	<i>Trichocorixa sp</i>	+			
45900	<i>Notonecta sp</i>	+			
77355	<i>Clinotanytus pinguis</i>	+			
78655	<i>Procladius (Holotanytus) sp</i>	+			
82730	<i>Chironomus (C.) decorus group</i>	+			
82800	<i>Cladopelma sp</i>	+			
83051	<i>Dicrotendipes simpsoni</i>	+			
83300	<i>Glyptotendipes (G.) sp</i>	+			
83600	<i>Kiefferulus (K.) dux</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84800	<i>Tribelos jucundum</i>	+			
95100	<i>Physella sp</i>	+			
96264	<i>Planorbella (Pierosoma) pilsbryi</i>	+			
98600	<i>Sphaerium sp</i>	+			

No. Quantitative Taxa: 0	Total Taxa: 25
No. Qualitative Taxa: 25	ICI: VP
Number of Organisms: 0	Qual EPT: 0

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: South Powell Creek

Collection Date: 09/23/2013 River Code: 04-114 RM: 2.95

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
00653	<i>Eunapius fragilis</i>	+			
01801	<i>Turbellaria</i>	+			
03040	<i>Fredericella sp</i>	+			
03600	<i>Oligochaeta</i>	+			
04664	<i>Helobdella stagnalis</i>	+			
04666	<i>Helobdella papillata</i>	+			
04685	<i>Placobdella ornata</i>	+			
04964	<i>Erpobdella microstoma</i>	+			
11200	<i>Callibaetis sp</i>	+			
13521	<i>Stenonema femoratum</i>	+			
17200	<i>Caenis sp</i>	+			
18700	<i>Hexagenia sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
22300	<i>Argia sp</i>	+			
24107	<i>Nasiaeschna pentacantha</i>	+			
27307	<i>Epitheca (Epicordulia) princeps</i>	+			
28500	<i>Libellula sp</i>	+			
28955	<i>Plathemis lydia</i>	+			
42700	<i>Belostoma sp</i>	+			
43570	<i>Neoplea sp</i>	+			
45900	<i>Notonecta sp</i>	+			
68708	<i>Dubiraphia vittata group</i>	+			
72420	<i>Chaoborus sp</i>	+			
72700	<i>Anopheles sp</i>	+			
78655	<i>Procladius (Holotanypus) sp</i>	+			
82730	<i>Chironomus (C.) decorus group</i>	+			
82885	<i>Cryptotendipes pseudotener</i>	+			
83003	<i>Dicrotendipes fumidus</i>	+			
83040	<i>Dicrotendipes neomodestus</i>	+			
83158	<i>Endochironomus nigricans</i>	+			
83600	<i>Kiefferulus (K.) dux</i>	+			
84300	<i>Phaenopsectra obediens group</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84888	<i>Xenochironomus xenolabis</i>	+			
85500	<i>Paratanytarsus sp</i>	+			
85800	<i>Tanytarsus sp</i>	+			
96120	<i>Menetus (Micromenetus) dilatatus</i>	+			
96900	<i>Ferrissia sp</i>	+			
99100	<i>Pyganodon grandis</i>	+			

No. Quantitative Taxa: 0	Total Taxa: 39
No. Qualitative Taxa: 39	ICI: LF
Number of Organisms: 0	Qual EPT: 4

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: South Powell Creek

Collection Date: 07/19/2000 River Code: 04-114 RM: 8.50

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03360	<i>Plumatella sp</i>	+			
04685	<i>Placobdella ornata</i>	+			
04964	<i>Erpobdella microstoma</i>	+			
05900	<i>Lirceus sp</i>	+			
08220	<i>Orconectes (Gremicambarus) immunis</i>	+			
08250	<i>Orconectes (Procericambarus) rusticus</i>	+			
11200	<i>Callibaetis sp</i>	+			
13400	<i>Stenacron sp</i>	+			
17200	<i>Caenis sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
24107	<i>Nasiaeschna pentacantha</i>	+			
45300	<i>Sigara sp</i>	+			
45400	<i>Trichocorixa sp</i>	+			
47600	<i>Sialis sp</i>	+			
60300	<i>Dineutus sp</i>	+			
60400	<i>Gyrinus sp</i>	+			
63300	<i>Hydroporini</i>	+			
77120	<i>Ablabesmyia mallochi</i>	+			
77750	<i>Hayesomyia senata</i> or <i>Thienemannimyia norena</i>	+			
78655	<i>Procladius (Holotanypus) sp</i>	+			
83051	<i>Dicrotendipes simpsoni</i>	+			
83300	<i>Glyptotendipes (G.) sp</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84700	<i>Stenochironomus sp</i>	+			
95100	<i>Physella sp</i>	+			
98600	<i>Sphaerium sp</i>	+			

No. Quantitative Taxa: 0 Total Taxa: 26

No. Qualitative Taxa: 26 ICI: F

Number of Organisms: 0 Qual EPT: 3

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: South Powell Creek
Schubert Rd.

Collection Date: 07/19/2000 River Code: 04-114 RM: 1.80

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
04935	<i>Erpobdella punctata punctata</i>	+			
08250	<i>Orconectes (Procericambarus) rusticus</i>	+			
13400	<i>Stenacron sp</i>	+			
18750	<i>Hexagenia limbata</i>	+			
22001	<i>Coenagrionidae</i>	+			
24107	<i>Nasiaeschna pentacantha</i>	+			
45400	<i>Trichocorixa sp</i>	+			
47600	<i>Sialis sp</i>	+			
63300	<i>Hydroporini</i>	+			
77120	<i>Ablabesmyia mallochi</i>	+			
83300	<i>Glyptotendipes (G.) sp</i>	+			
84790	<i>Tribelos fuscicorne</i>	+			
84800	<i>Tribelos jucundum</i>	+			
95100	<i>Physella sp</i>	+			

No. Quantitative Taxa: 0 Total Taxa: 14

No. Qualitative Taxa: 14 ICI: F

Number of Organisms: 0 Qual EPT: 2

Appendix Table 3. Index of Biotic Integrity (IBI) metrics and scores for headwater site samples collected from the Powell Creek watershed, 2013 and 2000.

River Mile	Type	Date	Drainage area (sq mi)	Number of						Percent of Individuals					Rel.No. minus tolerants /(0.3km)	IBI	
				Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni- vores	Pioneering fishes	Insect- ivores	DELT anomalies			
Wagner Run - (04-111)																	
Year: 2013																	
0.60	E	08/28/2013	3.3	13(5)	5(5)	0(1)	0(1)	2(3)	3(3)	88(1)	71(1)	86(1)	21(3)	0.0(5)	166(3)	32	
Year: 2000																	
0.60	E	07/25/2000	3.3	12(5)	6(5)	0(1)	0(1)	1(1)	1(1)	78(1)	43(1)	73(1)	6(1)	0.0(5)	150(3)	26	
Trib. to N. Powell Cr. (RM 6.00) - (04-112-003)																	
Year: 2013																	
0.50	E	08/28/2013	4.0	13(5)	5(3)	0(1)	0(1)	1(1)	1(1)	88(1)	47(1)	80(1)	46(5)	0.0(5)	37(1)	26	
Trib. to N. Powell Cr. (RM 4.25) - (04-112-001)																	
Year: 2013																	
0.80	E	08/28/2013	4.3	13(5)	6(5)	0(1)	0(1)	2(3)	2(1)	84(1)	47(1)	73(1)	37(5)	0.0(5)	100(1)	30	

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 4. Index of Biotic Integrity (IBI) metrics and scores for wading site samples collected from the Powell Creek watershed, 2013 and 2000.

River Mile	Type	Date	Drainage area (sq mi)	Number of					Percent of Individuals						Rel.No. minus tolerants /(0.3km)	IBI	Modified Iwb	
				Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Simple Lithophils	Tolerant fishes	Omni- vores	Top carnivores	Insect- ivores	DELT anomalies				
Powell Creek - (04110)																		
Year: 2013																		
6.40	E	08/21/2013	85	20(3)	3(3)	2(3)	0(1)	3(3)	2(1)	49(1)	30(3)	1.6(3)	68(5)	0.0(5)	688(3)	34	8.3	
6.40	E	09/24/2013	85	19(3)	4(5)	1(1)	0(1)	3(3)	3(1)	48(1)	20(3)	1.0(3)	77(5)	0.0(5)	716(3)	34	7.7	
0.40	D	08/21/2013	98	31(5)	4(5)	5(5)	1(1)	3(3)	2(1)	52(1)	56(1)	0.7(1)	41(3)	0.0(5)	1556(5)	36	9.6	
0.40	E	09/19/2013	98	28(5)	5(5)	1(1)	2(1)	4(3)	2(1)	54(1)	50(1)	0.6(1)	48(3)	0.0(5)	782(5)	32	8.5	
Year: 2000																		
0.40	D	07/25/2000	98	18(3)	3(3)	2(1)	0(1)	1(1)	1(1)	47(1)	37(1)	2.1(3)	58(5)	0.4(3)	381(3)	26	8.0	
North Powell Creek - (04112)																		
Year: 2013																		
6.40	E	08/28/2013	31	12(3)	2(3)	1(1)	0(1)	1(1)	1(1)	81(1)	48(1)	2.3(3)	48(3)	0.0(5)	114(1)	24	5.4	
6.40	E	09/19/2013	31	8(1)	1(1)	0(1)	0(1)	1(1)	0(1)	68(1)	41(1)	2.4(3)	57(5)	0.0(5)	106(1)	22	5.2	
0.10	E	08/27/2013	46	21(5)	4(5)	0(1)	0(1)	3(3)	3(1)	76(1)	33(3)	0.4(1)	60(5)	0.0(5)	538(3)	34	7.2	
0.10	E	09/24/2013	46	20(5)	4(5)	1(1)	0(1)	3(3)	2(1)	81(1)	37(1)	0.4(1)	60(5)	0.0(5)	200(3)	32	6.7	
Year: 2000																		
0.10	D	07/25/2000	50	19(3)	3(3)	1(1)	0(1)	3(3)	4(1)	80(1)	20(3)	0.5(1)	76(5)	0.2(5)	168(1)	28	7.0	
South Powell Creek - (04114)																		
Year: 2013																		
6.70	E	08/20/2013	28	12(3)	2(3)	0(1)	0(1)	1(1)	0(1)	97(1)	55(1)	0.2(1)	45(3)	0.1(5)	87(1)	22	6.1	
3.00	E	08/20/2013	34	16(3)	3(3)	1(1)	0(1)	2(1)	2(1)	59(1)	29(3)	0.3(1)	68(5)	0.0(5)	242(3)	28	7.3	
3.00	E	09/19/2013	34	11(3)	3(3)	0(1)	0(1)	1(1)	0(1)	81(1)	53(1)	0.0(1)	47(3)	0.0(5)	62(1)	22	5.2	
Year: 2000																		
8.20	D	10/11/2000	25	11(3)	3(3)	0(1)	0(1)	0(1)	0(1)	78(1)	57(1)	0.2(1)	43(3)	0.0(5)	158(1)	22	5.9	
1.80	D	10/11/2000	35	13(3)	3(3)	0(1)	0(1)	0(1)	0(1)	69(1)	23(3)	1.0(1)	75(5)	0.0(5)	50(1) *	26	5.1	

na - Qualitative data, Modified Iwb not applicable.

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 5. Fish community data collected from sites in the Powell Creek watershed, 2013 and 2000.

Species List

River Code: 04-110	Stream: Powell Creek	Sample Date: 2013
River Mile: 6.40	Location:	Date Range: 08/21/2013
Time Fished: 3455 sec	Drainage: 85.0 sq mi	Thru: 09/24/2013
Dist Fished: 0.30 km	Basin: Maumee River	No of Passes: 2
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
White Sucker	W	O	S	T	4	4.00	0.29	0.21	1.43	53.50
Spotted Sucker	R	I	S		1	1.00	0.07	0.16	1.07	160.00
Common Carp	G	O	M	T	4	4.00	0.29	2.53	16.94	632.50
Golden Shiner	N	I	M	T	3	3.00	0.22	0.01	0.07	3.67
Redfin Shiner	N	I	N		31	31.00	2.28	0.17	1.13	5.45
Spotfin Shiner	N	I	M		22	22.00	1.62	0.17	1.14	7.77
Fathead Minnow	N	O	C	T	35	35.00	2.58	0.05	0.34	1.47
Bluntnose Minnow	N	O	C	T	299	299.00	22.03	0.69	4.65	2.32
Channel Catfish	F		C		9	9.00	0.66	0.49	3.31	54.89
Yellow Bullhead		I	C	T	49	49.00	3.61	1.37	9.18	27.98
Black Bullhead		I	C	P	9	9.00	0.66	0.18	1.17	19.44
Tadpole Madtom		I	C		91	91.00	6.71	0.54	3.64	5.97
Blackstripe Topminnow		I	M		17	17.00	1.25	0.02	0.14	1.25
White Crappie	S	I	C		1	1.00	0.07	0.01	0.07	10.00
Largemouth Bass	F	C	C		18	18.00	1.33	0.07	0.48	4.00
Green Sunfish	S	I	C	T	261	261.00	19.23	5.72	38.32	21.93
Bluegill Sunfish	S	I	C	P	7	7.00	0.52	0.19	1.30	27.71
Orangespotted Sunfish	S	I	C		353	353.00	26.01	1.43	9.60	4.06
Blackside Darter	D	I	S		25	25.00	1.84	0.09	0.62	3.72
Logperch	D	I	S	M	3	3.00	0.22	0.04	0.28	14.00
Johnny Darter	D	I	C		114	114.00	8.40	0.11	0.75	0.99
Freshwater Drum			M	P	1	1.00	0.07	0.65	4.35	650.00
<i>Mile Total</i>					1,357	1,357.00		14.94		
<i>Number of Species</i>					22					
<i>Number of Hybrids</i>					0					

Species List

River Code: 04-110	Stream: Powell Creek	Sample Date: 2013
River Mile: 0.40	Location: Boy Scout Rd.	Date Range: 08/21/2013
Time Fished: 5794 sec	Drainage: 98.0 sq mi	Thru: 09/19/2013
Dist Fished: 0.35 km	Basin: Maumee River	Sampler Type: D E
	No of Passes: 2	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Gizzard Shad		O	M	456	370.00	14.93	2.58	15.11	6.89
Quillback	C	O	M	1	0.75	0.03	0.07	0.42	96.00
Shorthead Redhorse	R	I	S M	1	0.75	0.03	0.04	0.22	50.00
Northern Hog Sucker	R	I	S M	1	0.75	0.03	0.05	0.26	60.00
White Sucker	W	O	S T	1	0.75	0.03	0.01	0.05	12.00
Spotted Sucker	R	I	S	3	2.75	0.11	0.20	1.17	79.00
Common Carp	G	O	M T	5	4.00	0.16	0.46	2.68	121.20
Goldfish	G	O	M T	5	3.75	0.15	0.19	1.10	50.00
Golden Shiner	N	I	M T	1	0.75	0.03	0.00	0.01	3.00
Creek Chub	N	G	N T	38	31.00	1.25	0.23	1.34	7.39
Suckermouth Minnow	N	I	S	13	10.75	0.43	0.04	0.22	3.23
Emerald Shiner	N	I	M	14	10.50	0.42	0.05	0.26	4.29
Redfin Shiner	N	I	N	206	164.50	6.64	0.21	1.22	1.26
Striped Shiner	N	I	S	13	9.75	0.39	0.01	0.06	1.09
Spotfin Shiner	N	I	M	25	20.00	0.81	0.04	0.23	1.88
Sand Shiner	N	I	M M	48	38.00	1.53	0.06	0.35	1.58
Mimic Shiner	N	I	M I	4	4.00	0.16	0.00	0.02	1.00
Ghost Shiner	N	I	M	20	15.25	0.62	0.03	0.15	1.65
Fathead Minnow	N	O	C T	11	9.25	0.37	0.03	0.16	3.09
Bluntnose Minnow	N	O	C T	1,160	948.00	38.25	1.61	9.40	1.72
Central Stoneroller	N	H	N	1	1.00	0.04	0.00	0.01	2.00
Channel Catfish	F		C	24	18.25	0.74	1.29	7.55	71.50
Yellow Bullhead		I	C T	56	47.25	1.91	2.19	12.79	45.04
Flathead Catfish	F	P	C	2	2.00	0.08	0.18	1.07	91.00
Brindled Madtom		I	C I	3	2.75	0.11	0.03	0.20	12.00
Tadpole Madtom		I	C	26	21.75	0.88	0.12	0.71	5.73
Blackstripe Topminnow		I	M	8	7.75	0.31	0.01	0.05	1.13
Brook Silverside		I	M M	6	4.50	0.18	0.01	0.04	1.67
Black Crappie	S	I	C	1	1.00	0.04	0.01	0.04	6.00
Largemouth Bass	F	C	C	19	15.00	0.61	0.90	5.26	62.21
Green Sunfish	S	I	C T	316	265.25	10.70	4.31	25.23	16.83
Bluegill Sunfish	S	I	C P	104	81.00	3.27	0.48	2.81	6.04
Orangespotted Sunfish	S	I	C	196	163.75	6.61	0.74	4.33	4.60
Longear Sunfish	S	I	C M	110	94.25	3.80	0.52	3.03	5.55
Green Sf X Bluegill Sf				5	4.00	0.16	0.14	0.82	37.20
Blackside Darter	D	I	S	1	1.00	0.04	0.01	0.05	8.00
Logperch	D	I	S M	21	17.75	0.72	0.18	1.02	10.00
Johnny Darter	D	I	C	65	57.25	2.31	0.06	0.32	0.97
Fantail Darter	D	I	C	31	28.00	1.13	0.04	0.23	1.40
<i>Mile Total</i>				3,021	2,478.75		17.09		
<i>Number of Species</i>				38					
<i>Number of Hybrids</i>				1					

Species List

River Code: 04-110	Stream: Powell Creek	Sample Date: 2000
River Mile: 0.40	Location: Boy Scout Rd.	Date Range: 07/25/2000
Time Fished: 2242 sec	Drainage: 98.0 sq mi	
Dist Fished: 0.20 km	Basin: Maumee River	No of Passes: 1
		Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Golden Redhorse	R	I	S	M	3	4.50	0.62	0.12	0.21	27.00
Spotted Sucker	R	I	S		3	4.50	0.62	0.09	0.16	20.33
Common Carp	G	O	M	T	93	139.50	19.33	12.48	21.47	89.49
Redfin Shiner	N	I	N		15	22.50	3.12	0.04	0.06	1.54
Spotfin Shiner	N	I	M		27	40.50	5.61	0.06	0.11	1.52
Ghost Shiner	N	I	M		1	1.50	0.21	0.00	0.00	1.00
Fathead Minnow	N	O	C	T	5	7.50	1.04	0.02	0.03	2.00
Bluntnose Minnow	N	O	C	T	78	117.00	16.22	0.19	0.33	1.65
Channel Catfish	F		C		10	15.00	2.08	0.21	0.36	14.00
Yellow Bullhead		I	C	T	10	15.00	2.08	0.30	0.52	20.20
Flathead Catfish	F	P	C		2	3.00	0.42	40.50	69.65	13,500.00
Tadpole Madtom		I	C		3	4.50	0.62	0.03	0.06	7.00
Blackstripe Topminnow		I	M		1	1.50	0.21	0.01	0.01	3.00
Largemouth Bass	F	C	C		8	12.00	1.66	0.08	0.14	6.63
Green Sunfish	S	I	C	T	41	61.50	8.52	0.60	1.04	9.78
Bluegill Sunfish	S	I	C	P	37	55.50	7.69	0.46	0.78	8.19
Orangespotted Sunfish	S	I	C		139	208.50	28.90	0.67	1.15	3.20
Blackside Darter	D	I	S		1	1.50	0.21	0.01	0.01	5.00
Freshwater Drum			M	P	4	6.00	0.83	2.29	3.93	381.25
<i>Mile Total</i>					481	721.50		58.15		
<i>Number of Species</i>					19					
<i>Number of Hybrids</i>					0					

Species List

River Code: 04-111	Stream: Wagner Run	Sample Date: 2013
River Mile: 0.60	Location: St. Rt. 15	Date Range: 08/28/2013
Time Fished: 1333 sec	Drainage: 3.3 sq mi	
Dist Fished: 0.15 km	Basin: Maumee River	No of Passes: 1
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
White Sucker	W	O	S	T	16	32.00	2.32			
Goldfish	G	O	M	T	5	10.00	0.73			
Creek Chub	N	G	N	T	58	116.00	8.42			
Striped Shiner	N	I	S		1	2.00	0.15			
Spotfin Shiner	N	I	M		5	10.00	0.73			
Fathead Minnow	N	O	C	T	394	788.00	57.18			
Bluntnose Minnow	N	O	C	T	71	142.00	10.30			
Yellow Bullhead		I	C	T	25	50.00	3.63			
Blackstripe Topminnow		I	M		34	68.00	4.93			
Green Sunfish	S	I	C	T	37	74.00	5.37			
Bluegill Sunfish	S	I	C	P	1	2.00	0.15			
Orangespotted Sunfish	S	I	C		10	20.00	1.45			
Blackside Darter	D	I	S		1	2.00	0.15			
Johnny Darter	D	I	C		31	62.00	4.50			
<i>Mile Total</i>					689	1,378.00				
<i>Number of Species</i>					14					
<i>Number of Hybrids</i>					0					

Species List

River Code: 04-111	Stream: Wagner Run	Sample Date: 2000
River Mile: 0.60	Location: St. Rt. 15	Date Range: 07/25/2000
Time Fished: 2052 sec	Drainage: 3.3 sq mi	
Dist Fished: 0.15 km	Basin: Maumee River	No of Passes: 1
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
White Sucker	W	O	S	T	16	32.00	4.62	0.12	2.34	3.69
Common Carp	G	O	M	T	1	2.00	0.29	0.02	0.44	11.00
Golden Shiner	N	I	M	T	1	2.00	0.29	0.02	0.44	11.00
Creek Chub	N	G	N	T	116	232.00	33.53	2.61	51.72	11.25
Redfin Shiner	N	I	N		6	12.00	1.73	0.02	0.40	1.67
Fathead Minnow	N	O	C	T	19	38.00	5.49	0.06	1.23	1.63
Bluntnose Minnow	N	O	C	T	113	226.00	32.66	0.56	11.06	2.47
Central Stoneroller	N	H	N		6	12.00	1.73	0.08	1.63	6.83
Yellow Bullhead		I	C	T	3	6.00	0.87	1.26	25.02	210.33
Largemouth Bass	F	C	C		54	108.00	15.61	0.12	2.46	1.15
Green Sunfish	S	I	C	T	2	4.00	0.58	0.10	2.02	25.50
Bluegill Sunfish	S	I	C	P	5	10.00	1.45	0.04	0.83	4.20
Johnny Darter	D	I	C		4	8.00	1.16	0.02	0.40	2.50
<i>Mile Total</i>					346	692.00		5.04		
<i>Number of Species</i>					13					
<i>Number of Hybrids</i>					0					

Species List

River Code: 04-112	Stream: North Powell Creek	Sample Date: 2013
River Mile: 6.40	Location:	Date Range: 08/28/2013
Time Fished: 2294 sec	Drainage: 31.9 sq mi	Thru: 09/19/2013
Dist Fished: 0.30 km	Basin: Maumee River	Sampler Type: E
	No of Passes: 2	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
White Sucker	W	O	S	T	3	3.00	0.63	0.03	1.68	9.33
Goldfish	G	O	M	T	3	3.00	0.63	0.02	1.32	7.33
Golden Shiner	N	I	M	T	5	5.00	1.06	0.02	0.90	3.00
Fathead Minnow	N	O	C	T	109	109.00	23.04	0.15	8.83	1.35
Bluntnose Minnow	N	O	C	T	99	99.00	20.93	0.13	7.69	1.29
Common Carp X Goldfish	G	O		T	1	1.00	0.21	0.01	0.60	10.00
Yellow Bullhead		I	C	T	35	35.00	7.40	0.22	13.43	6.39
Tadpole Madtom		I	C		23	23.00	4.86	0.03	1.95	1.43
Blackstripe Topminnow		I	M		38	38.00	8.03	0.04	2.16	0.95
Largemouth Bass	F	C	C		11	11.00	2.33	0.05	3.00	4.55
Green Sunfish	S	I	C	T	108	108.00	22.83	0.83	50.03	7.71
Orangespotted Sunfish	S	I	C		2	2.00	0.42	0.03	1.80	15.00
Green Sf X Bluegill Sf					3	3.00	0.63	0.04	2.58	14.33
Yellow Perch			M		1	1.00	0.21	0.02	1.44	24.00
Johnny Darter	D	I	C		32	32.00	6.77	0.04	2.49	1.30
<i>Mile Total</i>					473	473.00		1.66		
<i>Number of Species</i>					13					
<i>Number of Hybrids</i>					2					

Species List

River Code: 04-112	Stream: North Powell Creek	Sample Date: 2013
River Mile: 0.10	Location: St. Rt. 15	Date Range: 08/27/2013
Time Fished: 3775 sec	Drainage: 46.2 sq mi	Thru: 09/24/2013
Dist Fished: 0.30 km	Basin: Maumee River	No of Passes: 2
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
White Sucker	W	O	S	T	1	1.00	0.06	0.14	0.65	139.00
Goldfish	G	O	M	T	2	2.00	0.12	0.12	0.57	61.50
Golden Shiner	N	I	M	T	50	50.00	2.98	0.22	1.01	4.32
Creek Chub	N	G	N	T	15	15.00	0.89	0.38	1.75	25.00
Suckermouth Minnow	N	I	S		1	1.00	0.06	0.00	0.01	3.00
Redfin Shiner	N	I	N		8	8.00	0.48	0.02	0.11	2.88
Striped Shiner	N	I	S		1	1.00	0.06	0.04	0.17	36.00
Spotfin Shiner	N	I	M		43	43.00	2.57	0.11	0.49	2.44
Fathead Minnow	N	O	C	T	41	41.00	2.45	0.10	0.47	2.44
Bluntnose Minnow	N	O	C	T	532	532.00	31.74	1.56	7.27	2.94
Central Stoneroller	N	H	N		71	71.00	4.24	0.13	0.62	1.89
Yellow Bullhead		I	C	T	114	114.00	6.80	5.11	23.79	44.82
Black Bullhead		I	C	P	23	23.00	1.37	0.83	3.86	36.02
Tadpole Madtom		I	C		30	30.00	1.79	0.26	1.22	8.70
Blackstripe Topminnow		I	M		5	5.00	0.30	0.01	0.03	1.20
White Crappie	S	I	C		3	3.00	0.18	0.01	0.07	4.67
Black Crappie	S	I	C		1	1.00	0.06	0.05	0.25	54.00
Largemouth Bass	F	C	C		6	6.00	0.36	0.04	0.19	6.67
Green Sunfish	S	I	C	T	552	552.00	32.94	11.59	53.96	20.99
Bluegill Sunfish	S	I	C	P	12	12.00	0.72	0.17	0.77	13.75
Orangespotted Sunfish	S	I	C		36	36.00	2.15	0.19	0.87	5.19
Blackside Darter	D	I	S		22	22.00	1.31	0.10	0.46	4.48
Logperch	D	I	S	M	17	17.00	1.01	0.21	0.97	12.29
Johnny Darter	D	I	C		90	90.00	5.37	0.10	0.46	1.09
<i>Mile Total</i>					1,676	1,676.00		21.48		
<i>Number of Species</i>					24					
<i>Number of Hybrids</i>					0					

Species List

River Code: 04-112	Stream: North Powell Creek	Sample Date: 2000
River Mile: 0.10	Location: St. Rt. 15	Date Range: 07/25/2000
Time Fished: 1350 sec	Drainage: 46.2 sq mi	
Dist Fished: 0.20 km	Basin: Maumee River	No of Passes: 1
		Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
White Sucker	W	O	S	T	17	25.50	3.01	1.82	6.99	71.41
Common Carp	G	O	M	T	2	3.00	0.35	0.11	0.42	36.50
Goldfish	G	O	M	T	1	1.50	0.18	0.01	0.03	5.00
Golden Shiner	N	I	M	T	21	31.50	3.72	0.14	0.53	4.33
Creek Chub	N	G	N	T	12	18.00	2.13	0.64	2.46	35.67
Suckermouth Minnow	N	I	S		1	1.50	0.18	0.00	0.01	1.00
Redfin Shiner	N	I	N		6	9.00	1.06	0.02	0.06	1.67
Spotfin Shiner	N	I	M		4	6.00	0.71	0.02	0.09	3.75
Fathead Minnow	N	O	C	T	24	36.00	4.26	0.05	0.19	1.39
Bluntnose Minnow	N	O	C	T	71	106.50	12.59	0.19	0.74	1.82
Yellow Bullhead		I	C	T	145	217.50	25.71	14.33	54.98	65.86
Black Bullhead		I	C	P	34	51.00	6.03	4.65	17.85	91.18
Tadpole Madtom		I	C		2	3.00	0.35	0.03	0.12	10.50
Blackstripe Topminnow		I	M		2	3.00	0.35	0.01	0.02	1.50
Largemouth Bass	F	C	C		3	4.50	0.53	0.02	0.09	5.33
Green Sunfish	S	I	C	T	159	238.50	28.19	3.23	12.38	13.52
Bluegill Sunfish	S	I	C	P	26	39.00	4.61	0.45	1.73	11.54
Orangespotted Sunfish	S	I	C		27	40.50	4.79	0.15	0.59	3.77
Green Sf X Bluegill Sf					4	6.00	0.71	0.17	0.64	28.00
Blackside Darter	D	I	S		1	1.50	0.18	0.01	0.02	4.00
Logperch	D	I	S	M	1	1.50	0.18	0.02	0.07	11.00
Johnny Darter	D	I	C		1	1.50	0.18	0.00	0.01	2.00
<i>Mile Total</i>					564	846.00		26.06		
<i>Number of Species</i>					21					
<i>Number of Hybrids</i>					1					

Species List

River Code: 04-112-001	Stream: Trib. to North Powell Creek (RM 4.25)	Sample Date: 2013
River Mile: 0.80	Location:	Date Range: 08/28/2013
Time Fished: 1800 sec	Drainage: 4.3 sq mi	
Dist Fished: 0.15 km	Basin: Maumee River	No of Passes: 1
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
White Sucker	W	O	S	T	54	108.00	17.59			
Creek Chub	N	G	N	T	34	68.00	11.07			
Redfin Shiner	N	I	N		2	4.00	0.65			
Silverjaw Minnow	N	I	M		3	6.00	0.98			
Fathead Minnow	N	O	C	T	61	122.00	19.87			
Bluntnose Minnow	N	O	C	T	29	58.00	9.45			
Central Stoneroller	N	H	N		17	34.00	5.54			
Yellow Bullhead		I	C	T	3	6.00	0.98			
Tadpole Madtom		I	C		2	4.00	0.65			
Blackstripe Topminnow		I	M		2	4.00	0.65			
Green Sunfish	S	I	C	T	76	152.00	24.76			
Blackside Darter	D	I	S		3	6.00	0.98			
Johnny Darter	D	I	C		21	42.00	6.84			
<i>Mile Total</i>					307	614.00				
<i>Number of Species</i>					13					
<i>Number of Hybrids</i>					0					

Species List

River Code: 04-112-003	Stream: Trib. to North Powell Creek (RM 6.00)	Sample Date: 2013
River Mile: 0.50	Location:	Date Range: 08/28/2013
Time Fished: 1298 sec	Drainage: 4.0 sq mi	
Dist Fished: 0.13 km	Basin: Maumee River	No of Passes: 1
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
White Sucker	W	O	S	T	1	2.31	0.76			
Goldfish	G	O	M	T	3	6.92	2.27			
Golden Shiner	N	I	M	T	6	13.85	4.55			
Creek Chub	N	G	N	T	5	11.54	3.79			
Redfin Shiner	N	I	N		1	2.31	0.76			
Fathead Minnow	N	O	C	T	49	113.08	37.12			
Bluntnose Minnow	N	O	C	T	9	20.77	6.82			
Yellow Bullhead		I	C	T	2	4.62	1.52			
Tadpole Madtom		I	C		4	9.23	3.03			
Blackstripe Topminnow		I	M		4	9.23	3.03			
Largemouth Bass	F	C	C		4	9.23	3.03			
Green Sunfish	S	I	C	T	41	94.62	31.06			
Orangespotted Sunfish	S	I	C		1	2.31	0.76			
Johnny Darter	D	I	C		2	4.62	1.52			
<i>Mile Total</i>					132	304.62				
<i>Number of Species</i>					14					
<i>Number of Hybrids</i>					0					

Species List

River Code: 04-114	Stream: South Powell Creek	Sample Date: 2013
River Mile: 6.70	Location:	Date Range: 08/20/2013
Time Fished: 1518 sec	Drainage: 28.1 sq mi	
Dist Fished: 0.10 km	Basin: Maumee River	No of Passes: 1
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Common Carp	G	O	M	T	13	39.00	1.54	1.80	10.37	46.15
Golden Shiner	N	I	M	T	141	423.00	16.73	1.43	8.26	3.39
Redfin Shiner	N	I	N		3	9.00	0.36	0.02	0.12	2.33
Fathead Minnow	N	O	C	T	414	1,242.00	49.11	1.85	10.67	1.49
Bluntnose Minnow	N	O	C	T	34	102.00	4.03	0.51	2.94	5.00
Common Carp X Goldfish	G	O		T	3	9.00	0.36	0.18	1.04	20.00
Yellow Bullhead		I	C	T	14	42.00	1.66	1.49	8.57	35.43
Black Bullhead		I	C	P	8	24.00	0.95	2.75	15.84	114.57
Tadpole Madtom		I	C		5	15.00	0.59	0.17	1.00	11.60
Blackstripe Topminnow		I	M		1	3.00	0.12	0.00	0.02	1.00
Largemouth Bass	F	C	C		2	6.00	0.24	0.03	0.17	5.00
Green Sunfish	S	I	C	T	195	585.00	23.13	6.91	39.82	11.81
Orangespotted Sunfish	S	I	C		6	18.00	0.71	0.18	1.04	10.00
Johnny Darter	D	I	C		4	12.00	0.47	0.02	0.14	2.00
<i>Mile Total</i>					843	2,529.00		17.36		
<i>Number of Species</i>					13					
<i>Number of Hybrids</i>					1					

Species List

River Code: 04-114	Stream: South Powell Creek	Sample Date: 2013
River Mile: 2.95	Location:	Date Range: 08/20/2013
Time Fished: 3463 sec	Drainage: 34.8 sq mi	Thru: 09/19/2013
Dist Fished: 0.30 km	Basin: Maumee River	No of Passes: 2
		Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
White Sucker	W	O	S	T	2	2.00	0.44	0.05	1.26	25.00
Common Carp	G	O	M	T	2	2.00	0.44	0.01	0.25	5.00
Golden Shiner	N	I	M	T	35	35.00	7.68	0.18	4.40	5.00
Creek Chub	N	G	N	T	4	4.00	0.88	0.08	2.01	20.00
Fathead Minnow	N	O	C	T	56	56.00	12.28	0.12	2.89	2.05
Bluntnose Minnow	N	O	C	T	108	108.00	23.68	0.40	10.03	3.69
Central Stoneroller	N	H	N		1	1.00	0.22	0.00	0.10	4.00
Common Carp X Goldfish	G	O		T	3	3.00	0.66	0.05	1.26	16.67
Yellow Bullhead		I	C	T	17	17.00	3.73	1.00	25.09	58.71
Brown Bullhead		I	C	T	1	1.00	0.22	0.04	0.98	39.00
Black Bullhead		I	C	P	2	2.00	0.44	0.15	3.77	75.00
Tadpole Madtom		I	C		4	4.00	0.88	0.04	1.01	10.00
Blackstripe Topminnow		I	M		3	3.00	0.66	0.01	0.13	1.67
Largemouth Bass	F	C	C		1	1.00	0.22	0.00	0.08	3.00
Green Sunfish	S	I	C	T	76	76.00	16.67	0.88	22.20	11.62
Bluegill Sunfish	S	I	C	P	17	17.00	3.73	0.29	7.18	16.78
Orangespotted Sunfish	S	I	C		97	97.00	21.27	0.60	15.19	6.23
Green Sf X Bluegill Sf					2	2.00	0.44	0.01	0.23	4.50
Logperch	D	I	S	M	3	3.00	0.66	0.05	1.13	15.00
Johnny Darter	D	I	C		22	22.00	4.82	0.03	0.83	1.50
<i>Mile Total</i>					456	456.00		3.98		
<i>Number of Species</i>					18					
<i>Number of Hybrids</i>					2					

Species List

River Code: 04-114	Stream: South Powell Creek	Sample Date: 2000
River Mile: 8.20	Location: Co. Rd. 22-B	Date Range: 10/11/2000
Time Fished: 1749 sec	Drainage: 25.0 sq mi	
Dist Fished: 0.20 km	Basin: Maumee River	No of Passes: 1
		Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Gizzard Shad		O	M		1	1.50	0.21	0.04	0.51	29.00
Common Carp	G	O	M	T	23	34.50	4.73	4.60	53.75	133.23
Goldfish	G	O	M	T	1	1.50	0.21	0.03	0.39	22.00
Golden Shiner	N	I	M	T	29	43.50	5.97	0.16	1.92	3.78
Fathead Minnow	N	O	C	T	251	376.50	51.65	0.73	8.56	1.94
Yellow Bullhead		I	C	T	4	6.00	0.82	0.43	5.05	72.00
Black Bullhead		I	C	P	15	22.50	3.09	1.39	16.28	61.87
Tadpole Madtom		I	C		5	7.50	1.03	0.08	0.88	10.00
Blackstripe Topminnow		I	M		9	13.50	1.85	0.01	0.14	0.89
Largemouth Bass	F	C	C		1	1.50	0.21	0.06	0.67	38.00
Green Sunfish	S	I	C	T	73	109.50	15.02	0.84	9.82	7.67
Bluegill Sunfish	S	I	C	P	1	1.50	0.21	0.02	0.25	14.00
Orangespotted Sunfish	S	I	C		73	109.50	15.02	0.15	1.78	1.39
<i>Mile Total</i>					486	729.00		8.55		
<i>Number of Species</i>					13					
<i>Number of Hybrids</i>					0					

Species List

River Code: 04-114	Stream: South Powell Creek	Sample Date: 2000
River Mile: 1.80	Location: Schubert Rd.	Date Range: 10/11/2000
Time Fished: 1915 sec	Drainage: 35.0 sq mi	
Dist Fished: 0.20 km	Basin: Maumee River	No of Passes: 1
		Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Common Carp	G	O	M	T	9	13.50	8.57	15.74	82.65	1,165.56
Goldfish	G	O	M	T	2	3.00	1.90	0.42	2.19	138.50
Golden Shiner	N	I	M	T	6	9.00	5.71	0.06	0.31	6.50
Creek Chub	N	G	N	T	1	1.50	0.95	0.00	0.02	2.00
Spotfin Shiner	N	I	M		2	3.00	1.90	0.03	0.16	10.00
Fathead Minnow	N	O	C	T	9	13.50	8.57	0.06	0.30	4.22
Bluntnose Minnow	N	O	C	T	4	6.00	3.81	0.02	0.09	3.00
Yellow Bullhead		I	C	T	18	27.00	17.14	1.22	6.38	45.00
Black Bullhead		I	C	P	8	12.00	7.62	0.77	4.04	64.14
Tadpole Madtom		I	C		1	1.50	0.95	0.04	0.18	23.00
Blackstripe Topminnow		I	M		1	1.50	0.95	0.00	0.01	1.00
Largemouth Bass	F	C	C		1	1.50	0.95	0.00	0.02	2.00
Green Sunfish	S	I	C	T	23	34.50	21.90	0.48	2.52	13.91
Bluegill Sunfish	S	I	C	P	8	12.00	7.62	0.13	0.66	10.50
Orangespotted Sunfish	S	I	C		12	18.00	11.43	0.09	0.47	5.00
<i>Mile Total</i>					105	157.50		19.04		
<i>Number of Species</i>					15					
<i>Number of Hybrids</i>					0					

Appendix Table 6. Water quality and field data collected from sites in the Powell Creek watershed, 2013.

		Stream Location: Powell Creek at Holly Rd. (CR9)						
		River Mile: 6.39		Station: P06G08				
PARAMETER	UNITS	04/25/13	05/20/13	06/06/13	06/19/13	07/30/13	08/12/13	
CBOD20	mg/L	7.6			6.2			
Total Dissolved Solids	mg/L	376	396	418	370	306	314	
Total Suspended Solids	mg/L	205	58	43	35	24	43	
Alkalinity	mg/L	82.8	214.0	89.6	174.0	171.0	191.0	
Ammonia	mg/L	0.204	<0.050	0.375	0.079	<0.050	<0.050	
COD	mg/L	42	28	42		27	28	
Chloride	mg/L	23.1	38.6	24.7	34.4	40.5	39.9	
Conductivity	umhos/cm		605	412		502	544	
Nitrate+nitrite	mg/L	8.82	0.52	10.40	7.97	0.36	<0.10	
Nitrite	mg/L	<0.020	0.039	0.414	0.113	<0.020	<0.020	
Orthophosphate, dissolved	mg/L	0.097	0.034	0.159	0.071	0.126	0.101	
Sulfate	mg/L	44.4	53.6	65.2	63.6	54.5	35.3	
TKN	mg/L	1.42	0.85	2.21	1.38	0.72	0.77	
Total Phosphorus	mg/L	0.263	0.100	0.284	0.107	0.198	0.164	
FIELD PARAMETERS								
Time	hhmmss	15:37:00	12:19:07	12:10:52	16:35:00	13:19:47	12:30:00	
Conductivity	uS/cm		626.0	341.7	574.0	448.5	529.0	
Conductivity @ 25C	uS/cm	326.0	649.0	392.9		491.6	536.0	
Dissolved Oxygen	mg/L	9.12	7.88	6.30	7.47	7.80	6.96	
Dissolved Oxygen	%	77.3	92.2	66.9	87.4	86.5	83.3	
pH	s.u.	7.39	7.87	7.42	7.70	7.83	7.96	
Temperature	°C	8.1	23.2	18.2	23.1	20.4	24.3	
Shaded values are exceedences of Ohio WQS criteria.								

		Stream Location: Powell Creek at Boy Scout Rd.						
		River Mile: 0.36		Station: P06G07				
PARAMETER	UNITS	04/25/13	05/20/13	06/06/13	06/19/13	07/30/13	08/12/13	
CBOD20	mg/L	7.7			6.2			
Total Dissolved Solids	mg/L	374	396	406	376	328	296	
Total Suspended Solids	mg/L	216	16	49	23	21	25	
Alkalinity	mg/L	94.6	209.0	84.1	161.0	167.0	179.0	
Ammonia	mg/L	0.130	<0.050	0.363	0.055	<0.050	<0.050	
COD	mg/L	32	28	49		25	21	
Chloride	mg/L	23.2	36.4	23.8	31.7	43.9	31.7	
Conductivity	umhos/cm		615	400		532	507	
Nitrate+nitrite	mg/L	8.74	0.79	11.40	14.20	0.61	<0.10	
Nitrite	mg/L	0.037	0.024	0.413	0.225	<0.020	<0.020	
Orthophosphate, dissolved	mg/L	0.080	<0.010	0.141	0.070	0.106	0.061	
Sulfate	mg/L	38.8	64.6	63.7	63.8	67.8	40.6	
TKN	mg/L	1.25	1.22	1.77	1.57	0.73	0.77	
Total Phosphorus	mg/L	0.241	0.055	0.273	0.076	0.154	0.095	
FIELD PARAMETERS								
Time	hhmmss	14:32:58	10:19:04	10:17:23	15:12:00	11:09:31	10:38:00	
Conductivity	uS/cm		598.0	332.8	597.0	457.7	456.2	
Conductivity @ 25C	uS/cm	343.0	659.0	383.1		520.0	496.5	
Dissolved Oxygen	mg/L	9.86	8.05	7.22	7.96	7.93	6.92	
Dissolved Oxygen	%	83.3	89.0	76.5	92.2	85.1	77.3	
pH	s.u.	7.50	8.05	7.61	7.88	8.06	7.98	
Temperature	°C	8.0	20.1	18.1	22.6	18.7	20.8	
Shaded values are exceedences of Ohio WQS criteria.								

Appendix Table 6. (continued)

		Stream Location: Wagner Run (at RM 5.19) at SR15						
		River Mile: 0.55		Station: P06G06				
PARAMETER	UNITS	04/25/13	05/20/13	06/06/13	06/19/13	07/30/13	08/12/13	
CBOD20	mg/L	7.3			5.1			
Total Dissolved Solids	mg/L	324	334	348	324	342	280	
Total Suspended Solids	mg/L	23	11	<5	5	24	17	
Alkalinity	mg/L	95.6	159.0	145.0	169.0	189.0	156.0	
Ammonia	mg/L	0.110	0.068	<0.050	<0.050	<0.050	0.131	
COD	mg/L	37	24	20		33	36	
Chloride	mg/L	18.6	41.5	27.2	28.3	38.9	28.9	
Conductivity	umhos/cm		519	539		527	435	
Nitrate+nitrite	mg/L	8.51	<0.10	9.38	5.73	<0.10	0.23	
Nitrite	mg/L	0.061	0.032	0.118	0.049	<0.020	0.021	
Orthophosphate, dissolved	mg/L	0.061	0.080	0.027	0.023	0.047	0.129	
Sulfate	mg/L	35.6	54.5	59.9	70.3	58.0	29.8	
TKN	mg/L	1.37	0.99	0.83	1.07	0.87	1.15	
Total Phosphorus	mg/L	0.139	0.059	0.045	0.044	0.109	0.227	
FIELD PARAMETERS								
Time	hhmmss	15:20:24	10:39:53	10:43:11	16:10:00	11:31:53	10:56:00	
Conductivity	uS/cm		497.3	425.0	525.0	460.7	390.9	
Conductivity @ 25C	uS/cm	340.7	555.0	514.0		516.0	428.0	
Dissolved Oxygen	mg/L	10.80	7.55	7.37	14.53	9.53	4.09	
Dissolved Oxygen	%	91.3	82.4	74.7	165.6	103.8	45.4	
pH	s.u.	7.46	7.71	7.73	8.65	8.08	7.62	
Temperature	°C	8.0	19.5	15.9	21.8	19.4	20.5	
Shaded values are exceedences of Ohio WQS criteria.								

		Stream Location: HOGBACK RUN @ HOFFMAN RD. (TWP. RD. 7)						
		River Mile: 0.10		Station: 302193				
PARAMETER	UNITS	05/20/13	06/06/13	06/19/14	07/30/13	08/12/13		
CBOD20	mg/L			5.2				
Total Dissolved Solids	mg/L	314	366	338	452	334		
Total Suspended Solids	mg/L	47	22	34	9	27		
Alkalinity	mg/L	163	123	170	295	223		
Ammonia	mg/L	0.173	0.077	0.067	0.575	0.180		
COD	mg/L	<20	<20		29	21		
Chloride	mg/L	23.9	26.6	27.1	45.4	28.9		
Conductivity	umhos/cm	507	513		709	582		
Nitrate+nitrite	mg/L	4.73	14.70	9.87	<0.10	0.14		
Nitrite	mg/L	0.213	0.111	0.035	<0.020	<0.020		
Orthophosphate, dissolved	mg/L	0.037	0.024	0.034	0.093	0.067		
Sulfate	mg/L	54.8	45.1	52.7	45.3	34.1		
TKN	mg/L	1.10	0.62	0.91	1.61	0.97		
Total Phosphorus	mg/L	0.079	0.045	0.066	0.173	0.161		
FIELD PARAMETERS								
Time	hhmmss	10:53:59	10:54:35	16:50:00	11:46:24	11:10:00		
Conductivity	uS/cm	491.5	403.5	539.0	595.0	521.0		
Conductivity @ 25C	uS/cm	543.0	488.5		694.0	567.0		
Dissolved Oxygen	mg/L	5.68	8.76	7.08	3.39	3.22		
Dissolved Oxygen	%	62.7	88.7	78.9	35.5	36.0		
pH	s.u.	7.63	7.87	7.77	7.67	7.56		
Temperature	°C	20.1	15.9	20.7	17.5	20.8		
Shaded values are exceedences of Ohio WQS criteria.								

Appendix Table 6. (continued)

		Stream Location: N. Powell Ck at Highland Center Rd. (TR 182)						
		River Mile: 7.40		Station: 204280				
PARAMETER	UNITS	04/25/13	05/20/13	06/06/13	06/19/13	07/30/13	08/12/13	
CBOD20	mg/L	8.3			5.4			
Total Dissolved Solids	mg/L	424	394	414	360	300	666	
Total Suspended Solids	mg/L	142	49	66	27	82	51	
Alkalinity	mg/L	81	232	168	216	171	142	
Ammonia	mg/L	0.269	0.075	0.359	0.069	0.295	0.481	
COD	mg/L	58	25	23		31	28	
Chloride	mg/L	22.1	33.7	25.7	26.1	20.6	34.6	
Conductivity	umhos/cm		617	597		465	960	
Nitrate+nitrite	mg/L	8.71	0.67	15.2	9.57	<0.10	0.44	
Nitrite	mg/L	<0.020	0.042	0.298	0.098	<0.020	0.055	
Orthophosphate, dissolved	mg/L	0.096	0.055	0.070	0.054	0.160	0.027	
Sulfate	mg/L	44.5	57.3	51.6	55.1	68.3	306	
TKN	mg/L	1.59	0.91	3.78	1.19	1.18	1.68	
Total Phosphorus	mg/L	0.290	0.125	0.129	0.092	0.320	0.091	
FIELD PARAMETERS								
Time	hhmmss	17:46:56	11:24:57	11:19:37	17:25:00	12:16:35	11:39:00	
Conductivity	uS/cm		607	490.1	614	405.7	898	
Conductivity @ 25C	uS/cm	311.5	665.0	570.0		451.7	940.0	
Dissolved Oxygen	mg/L	9.21	2.80	5.89	6.00	5.44	4.31	
Dissolved Oxygen	%	78.8	31.2	61.9	69.5	59.6	50.0	
pH	s.u.	7.36	7.43	7.64	7.67	7.60	7.52	
Temperature	°C	8.5	20.4	17.7	22.6	19.7	22.6	
Shaded values are exceedences of Ohio WQS criteria.								

		Stream Location: N. Powell Ck at SR 15						
		River Mile: 0.10		Station: P06G05				
PARAMETER	UNITS	04/25/13	05/20/13	06/06/13	06/19/13	07/30/13	08/12/13	
CBOD20	mg/L	8.7			5.3			
Total Dissolved Solids	mg/L	400	358	426	364	270	284	
Total Suspended Solids	mg/L	195	39	38	24	10	20	
Alkalinity	mg/L	76.5	211.0	120.0	178.0	163.0	178.0	
Ammonia	mg/L	0.293	0.061	0.228	0.096	<0.050	<0.050	
COD	mg/L	38	23	34		24	26	
Chloride	mg/L	23.7	32.0	23.0	23.9	21.2	21.2	
Conductivity	umhos/cm		571	520		417	481	
Nitrate+nitrite	mg/L	9.26	0.94	18.30	15.40	0.31	<0.10	
Nitrite	mg/L	<0.020	0.044	0.415	0.358	<0.020	<0.020	
Orthophosphate, dissolved	mg/L	0.097	0.019	0.092	0.066	0.111	0.083	
Sulfate	mg/L	45.6	51.4	48.5	53.1	46.0	38.4	
TKN	mg/L	1.36	0.91	1.74	1.48	0.72	0.76	
Total Phosphorus	mg/L	0.296	0.078	0.168	0.109	0.179	0.162	
FIELD PARAMETERS								
Time	hhmmss	16:44:10	12:08:42	12:01:28	13:20:00	13:08:47	12:22:00	
Conductivity	uS/cm		587.0	424.3	575.0	386.1	456.3	
Conductivity @ 25C	uS/cm	298.1	615.0	494.0		411.6	474.7	
Dissolved Oxygen	mg/L	9.11	6.23	6.20	5.53	7.59	6.13	
Dissolved Oxygen	%	77.2	72.3	65.1	61.7	86.5	71.5	
pH	s.u.	7.33	7.61	7.47	7.48	7.77	7.78	
Temperature	°C	8.1	22.7	17.6	20.7	21.8	23.0	
Shaded values are exceedences of Ohio WQS criteria.								

Appendix Table 6. (continued)

		Stream Location: UT to North Powell Ck at RN 4.25 at Highland Center Rd. (TR 182)						
		River Mile: 0.75		Station: 302192				
PARAMETER	UNITS	04/25/13	05/20/13	06/06/13	06/19/13	07/30/13	08/12/13	
CBOD20	mg/L	5			5.5			
Total Dissolved Solids	mg/L	360	326	410	336	390	354	
Total Suspended Solids	mg/L	13	47	14	26	28	46	
Alkalinity	mg/L	119	149	172	170	216	197	
Ammonia	mg/L	0.053	0.077	0.062	0.068	0.073	0.139	
COD	mg/L	21	<20	<20		24	<20	
Chloride	mg/L	24.2	46.7	42.7	36.5	48.7	50.8	
Conductivity	umhos/cm		539	657		610	608	
Nitrate+nitrite	mg/L	13.10	2.11	14.80	8.41	2.18	0.89	
Nitrite	mg/L	0.047	0.051	0.100	0.061	0.033	<0.020	
Orthophosphate, dissolved	mg/L	0.028	<0.010	0.016	0.020	0.131	0.092	
Sulfate	mg/L	36.7	59.0	54.7	60.4	52.4	46.2	
TKN	mg/L	1.41	0.80	0.69	0.84	0.93	0.85	
Total Phosphorus	mg/L	0.120	0.044	0.034	0.051	0.177	0.148	
FIELD PARAMETERS								
Time	hhmmss	17:25:41	11:10:55	11:05:01	17:05:00	11:59:28	11:20:00	
Conductivity	uS/cm		536	522	555	512	539	
Conductivity @ 25C	uS/cm	469.6	609.0	626.0		597.0	597.0	
Dissolved Oxygen	mg/L	11.53	4.75	8.03	6.74	5.10	4.50	
Dissolved Oxygen	%	101.8	50.9	82.0	74.1	53.5	49.5	
pH	s.u.	7.87	7.58	7.94	7.73	7.64	7.72	
Temperature	°C	9.8	18.7	16.3	19.9	17.6	19.9	
Shaded values are exceedences of Ohio WQS criteria.								

		Stream Location: UT to North Powell Ck at RM 6.00 at Highland Center Rd. (TR182)						
		River Mile: 0.45		Station: 302191				
PARAMETER	UNITS	04/25/13	05/20/13	06/06/13	06/19/13	07/30/13	08/12/13	
CBOD20	mg/L	5.5			5.5			
Total Dissolved Solids	mg/L	398	350	424	334	324	322	
Total Suspended Solids	mg/L	17	32	18	13	42	19	
Alkalinity	mg/L	89.8	163.0	170.0	149.0	207.0	180.0	
Ammonia	mg/L	0.143	0.597	0.100	0.107	0.562	1.360	
COD	mg/L	32	24	<20		30	25	
Chloride	mg/L	18.7	42.4	33.6	34.3	33.7	37.6	
Conductivity	umhos/cm		557	646		530	562	
Nitrate+nitrite	mg/L	12.90	0.58	16.00	7.56	0.54	0.31	
Nitrite	mg/L	0.053	0.073	0.131	0.084	0.064	0.053	
Orthophosphate, dissolved	mg/L	0.069	0.081	0.033	0.035	0.091	0.163	
Sulfate	mg/L	35.9	69.5	65.1	76.6	48.5	57.2	
TKN	mg/L	1.43	1.49	1.09	1.14	1.49	2.25	
Total Phosphorus	mg/L	0.175	0.142	0.055	0.075	0.155	0.271	
FIELD PARAMETERS								
Time	hhmmss	17:34:12	11:17:29	11:12:14	17:15:00	12:06:32	11:28:00	
Conductivity	uS/cm		510	513	558	458	504	
Conductivity @ 25C	uS/cm	368.6	594.0	617.0		519.0	549.0	
Dissolved Oxygen	mg/L	10.48	2.72	6.49	3.97	5.37	3.03	
Dissolved Oxygen	%	91.4	28.6	66.1	43.4	57.8	33.8	
pH	s.u.	7.55	7.39	7.72	7.43	7.61	7.57	
Temperature	°C	9.3	17.6	16.2	19.7	18.9	20.7	
Shaded values are exceedences of Ohio WQS criteria.								

Appendix Table 6. (continued)

		Stream Location: South Powell Creek at CR 22-B						
		River Mile: 8.22		Station: P06P06				
PARAMETER	UNITS	04/25/13	05/20/13	06/06/13	06/19/13	07/30/13	08/12/13	
CBOD20	mg/L	8.6			5.9			
Total Dissolved Solids	mg/L	480	554	408	356	320	404	
Total Suspended Solids	mg/L	246	61	22	7	<5	<5	
Alkalinity	mg/L	72.5	235.0	82.4	158.0	164.0	165.0	
Ammonia	mg/L	0.240	<0.050	0.407	0.099	<0.050	<0.050	
COD	mg/L	33	35	50		24	24	
Chloride	mg/L	35.3	79.3	28.6	45.5	49.9	71.6	
Conductivity	umhos/cm		856	421		534	709	
Nitrate+nitrite	mg/L	7.07	<0.10	8.15	4.82	<0.10	<0.10	
Nitrite	mg/L	0.103	0.045	0.442	0.165	<0.020	<0.020	
Orthophosphate, dissolved	mg/L	0.155	0.031	0.214	0.104	0.162	0.147	
Sulfate	mg/L	57.5	102.0	74.1	81.8	61.9	86.7	
TKN	mg/L	1.24	1.18	1.88	1.53	0.83	0.81	
Total Phosphorus	mg/L	0.552	0.171	0.383	0.172	0.209	0.178	
FIELD PARAMETERS								
Time	hhmmss	18:05:23	11:43:48	11:41:50	17:45:00	12:39:38		
Conductivity	uS/cm		910.0	350.4	591.0	468.5		
Conductivity @ 25C	uS/cm	305.4	927.0	401.9		522		
Dissolved Oxygen	mg/L	8.74	8.37	4.91	9.58	11.80		
Dissolved Oxygen	%	75.6	99.7	52.2	112.2	129.1		
pH	s.u.	7.30	7.69	7.36	7.77	8.27		
Temperature	°C	8.9	24.0	18.3	23.1	19.7		
Shaded values are exceedences of Ohio WQS criteria.								

		Stream Location: South Powell Creek at Schubert Rd. (CR169)						
		River Mile: 1.75		Station: P06G04				
PARAMETER	UNITS	04/25/13	05/20/13	06/06/13	06/19/13	07/30/13	08/12/13	
CBOD20	mg/L	7.4			6.0			
Total Dissolved Solids	mg/L	408	408	390	366	314	328	
Total Suspended Solids	mg/L	94	36	61	45	31	32	
Alkalinity	mg/L	102.0	229.0	82.6	173.0	164.0	200.0	
Ammonia	mg/L	0.142	<0.050	0.432	0.077	<0.050	<0.050	
COD	mg/L	38	32	46		27	25	
Chloride	mg/L	25.6	47.4	26.1	39.9	44.0	53.1	
Conductivity	umhos/cm		662	379		519	594	
Nitrate+nitrite	mg/L	9.15	0.63	8.50	4.70	0.28	<0.10	
Nitrite	mg/L	0.034	0.047	0.401	0.032	<0.020	<0.020	
Orthophosphate, dissolved	mg/L	0.110	0.078	0.175	0.080	0.145	0.134	
Sulfate	mg/L	46.6	62.2	71.6	67.2	55.7	37.6	
TKN	mg/L	1.27	1.03	1.82	1.46	0.78	0.80	
Total Phosphorus	mg/L	0.281	0.183	0.320	0.155	0.235	0.229	
FIELD PARAMETERS								
Time	hhmmss	15:54:20	11:59:03	11:53:47	12:15:00	12:54:58	12:11:00	
Conductivity	uS/cm		681.0	315.1	573.0	455.6	555.0	
Conductivity @ 25C	uS/cm	372.3	715.0	360.4		507.0	584.0	
Dissolved Oxygen	mg/L	8.89	5.28	5.15	5.45	6.60	6.08	
Dissolved Oxygen	%	76.0	61.2	54.9	61.1	72.3	70.2	
pH	s.u.	7.42	7.59	7.37	7.30	7.78	7.85	
Temperature	°C	8.5	22.5	18.4	20.8	19.7	22.4	
Shaded values are exceedences of Ohio WQS criteria.								