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Lake Erie Unit
Division of Surface Water

Biological and Water Quality Study of Furnace Run Watershed

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Ted Strickland, Governor
Chris Korleski, Director

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Furnace Run at RM 1.0. Photo by Dave Altfater

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Cover Photo: Everett Road Covered Bridge, Cuyahoga Valley National Park, Ohio.
Photo by Kelvin Rogers, Ohio EPA, Northeast District Office, Twinsburg, Ohio

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1.0 Project Summary

In 2006 the Ohio Environmental Protection Agency (Ohio EPA) conducted a biological and water quality survey of the Furnace Run watershed, a tributary of the Cuyahoga River. The purpose of this study was to provide an updated environmental status report of the area. This information will be used to appropriately assess the level of beneficial use impairment for aquatic life and fish habitat in this section of the Cuyahoga River Area of Concern (AOC).

Prior sample efforts by Ohio EPA in 1991 and 1996 indicated that this watershed is in full attainment of biological and water quality standards. However, a study conducted in 2003 by Metroparks Serving Summit County found that Rock Creek, a tributary to Furnace Run, was in non-attainment of fish and macroinvertebrate community aquatic life criteria. This was attributed to high dissolved solids levels resulting from slag leachate during and immediately following construction of the Interstate 80 interchange near this area in 2000-2001.

The Ohio EPA collected aquatic life community data, habitat information and water quality samples at seven sites within the Furnace Run watershed. Additional fish community data were collected at one site at the mouth of Furnace Run as part of a separate project. Figure 1 contains a map of the sampling area and collection sites.

Grab water samples were collected three times at the seven sites in the Furnace Run watershed using the protocols and procedures outlined Ohio EPA (2006). Field water quality data was collected at each site for conductivity, dissolved oxygen (D.O.) pH, and temperature.(Ohio EPA, 2006). General stream water quality parameters, including nutrients and total metals (including mercury) were analyzed at the Ohio EPA laboratory per the standard operating procedures in Ohio EPA (2001). A total of 26 samples, including those for quality control purposes, were analyzed.

The Ohio EPA collected fish community data from seven of the eight sites in the watershed (Figure 1). The fish sampling at each site was from zones, each between 150 and 200 meters in length. Two passes or collections were made during the survey at six of the sites; only one pass was completed at the site located at the mouth of Furnace Run (RM 0.20) as part of a separate project. Electro-fishing gear was utilized for fish collection. Fish were identified to species, counted, weighed (only at RM 0.2) and checked for deformities, eroded fins, lesions and external tumors (DELTs).

The macroinvertebrate communities at six Furnace Run sites and one Rock Creek site were sampled using qualitative (multi-habitat composite) and quantitative (artificial substrate) sampling protocols. Results are summarized in Table 3.

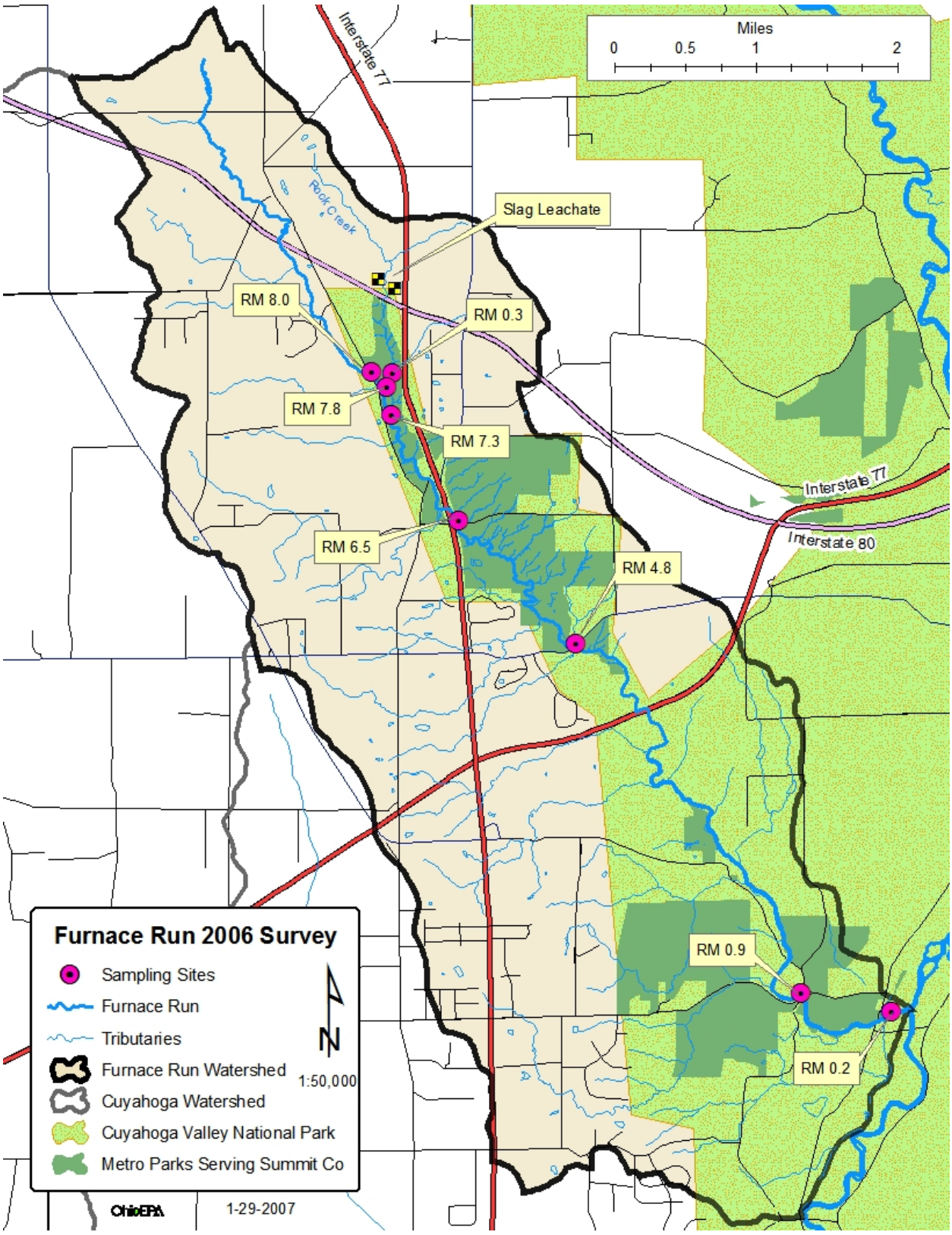

Figure 1. Furnace Run Watershed - 2006 Survey Sampling Locations

The artificial substrate samplers were originally placed in the stream on July 5-6, 2006. High flows from July storms resulted in the loss of most of the samplers. The samplers were reset on August 18, 2006. Later storms resulted in the loss of the samplers from the RM 4.8 and 0.9 sampling locations. Only qualitative samples were used to evaluate the macroinvertebrate community from these locations.

Qualitative Habitat Evaluation Indices (QHEI) data were collected at seven of the eight sites from zones approximately 150 meters in length. The site from which QHEI data were not collected was upstream of the Everett Road covered bridge (RM 0.9); qualitative macroinvertebrate data was the only aquatic life data collected at this site due to loss of the quantitative samplers. No fish community data were collected at this site due to the proximity of sampling conducted at RM 0.2.

All sampling methods, protocols, and procedures utilized during the biological survey were conducted in accordance with the Quality Assurance Project Plan (QAPP) dated March 2006 for the West Branch (Black River AOC) / Furnace Run (Cuyahoga River AOC) Assessment.

2.0 Background

In the 1987 amendment to the Great Lakes Water Quality Agreement the International Joint Commission identified the Cuyahoga River as one of 42 Great Lakes areas that were contributing to the degraded condition of the Great Lakes. Canada and the United States agreed to develop Remedial Action Plans or RAPs to restore the beneficial uses within these 42 Areas of Concern (AOCs). An AOC is one failing to meet objectives of the U.S.-Canada Great Lakes Water Quality Agreement. These AOCs are the State's most polluted and environmentally impacted rivers which empty into Lake Erie. Ohio's RAP program addresses the restoration of the beneficial uses in the Ohio AOCs.

There are four Areas of Concern (AOCs) in Ohio; Ashtabula River, Black River, Cuyahoga River and Maumee River. Ohio EPA is responsible for working with local stakeholders to ensure that RAPs are developed and implemented in these AOCs. The Ohio EPA is seeking to supplement stream habitat and fish community data in the Furnace Run subwatershed of the Cuyahoga River AOC in order to accurately determine the degree of beneficial use impairment for fish and macroinvertebrate communities and fish habitat within this watershed.

Furnace Run originates in Brecksville, Broadview Heights and Richfield in northern Summit and southern Cuyahoga counties in northeast Ohio. It flows approximately 10.4 miles southeast through Bath and Boston townships to meet the Cuyahoga River at river mile (RM) 33.08. It drains approximately 35 square miles of predominately suburban lands. A 2001 satellite land cover analysis determined that approximately 14 % of the watershed is considered urbanized with generally impervious surfaces (Figure 2). The remaining 86 % of the watershed is comprised primarily of wooded (47%), grass/agricultural (34%) shrub/scrub (7%) cover (Cuyahoga River RAP, 2004).

1991 and 1996 Ohio EPA surveys found Furnace Run to be in FULL Attainment of the current Warm Water Habitat (WWH) aquatic life use designation.

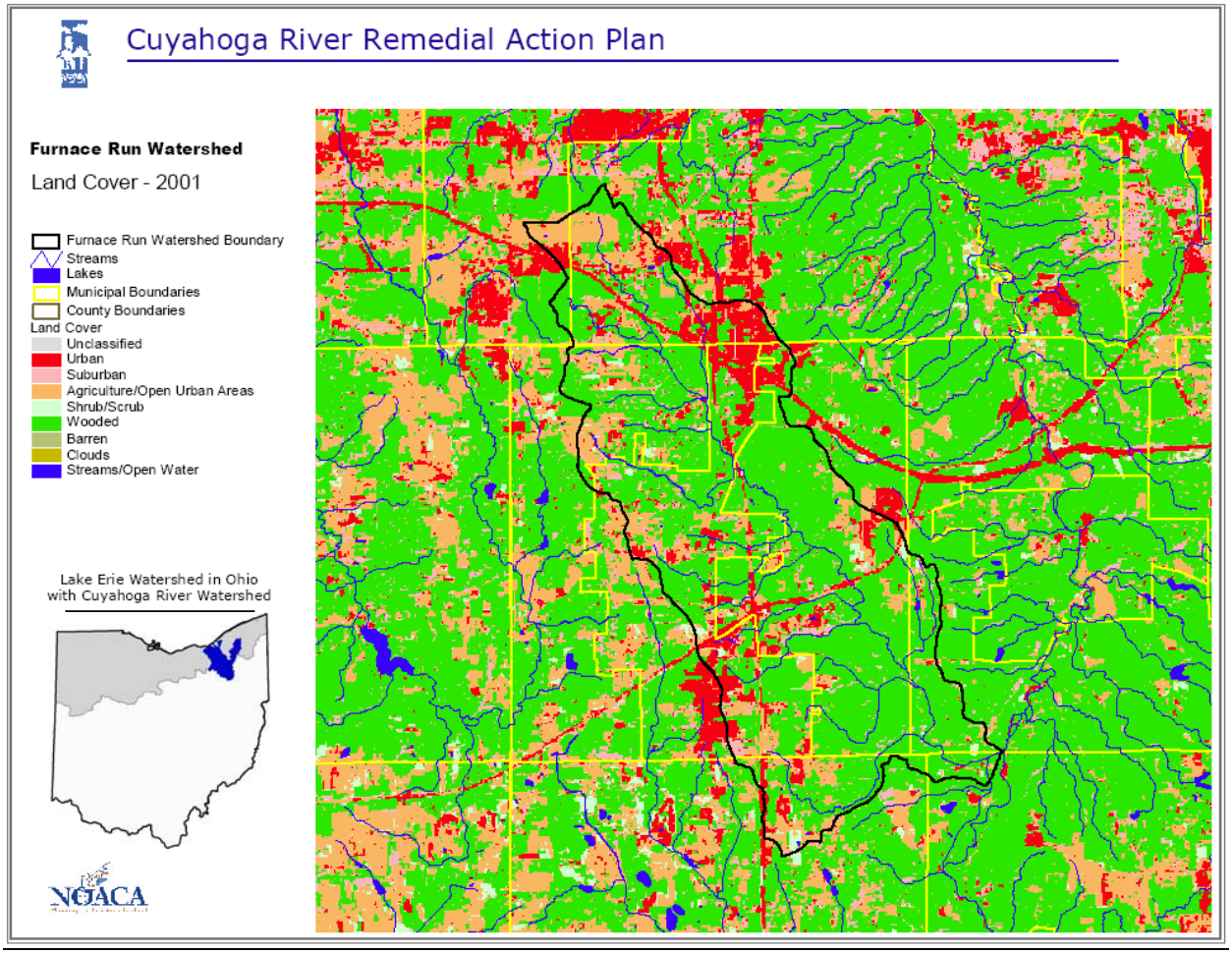

Figure 2. Land Cover map of Furnace Run watershed

Furnace Run Metro Park, operated by Metroparks Serving Summit County, is located within the Furnace Run watershed. It currently consists of seven tracts of land totaling approximately 870 acres in Richfield. The tracts are fragmented east-west by Interstate 77, State Route (SR) 21, and Brecksville Road, and north-south by Brush Road and State Route 303; however, two of the southernmost tracts, approximating 43 acres along Wheatley Road, are disjunct from the remainder of the park and ecologically separated by Interstate 271. Furnace Run Metro Park is contiguous with, and often considered part of, Cuyahoga Valley National Park (CVNP), which contains 30,000 acres of wetland and forest along the Cuyahoga River from Akron to Cleveland. Metro Parks is responsible for the management of these natural areas. In 2003 they contracted a natural resource management study to provide baseline ecological data and ensure continued protection of the resource (Metroparks Serving Summit County, 2004).

Furnace Run lies within the area covered by the Lower Cuyahoga River Total Maximum Daily Load (TMDL) report, which was approved by U.S. EPA on September 26, 2003. TMDLs identify and evaluate water quality problems in impaired water bodies and propose solutions to bring those waters into attainment. Because of earlier identification as being in FULL attainment with Ohio Water Quality Criteria it was not specifically included within the report.

3.0 Historical Data

The 2003 survey conducted by Enviroscience, Inc. for Metroparks Serving Summit County included aquatic life (fish and macroinvertebrate) analyses consistent with Ohio EPA protocol at five stream sites, including one in Rock Creek, a small tributary of Furnace Run. All of the Furnace Run sites were found to be in FULL Attainment with WWH, with two sites exhibiting a fishery community indicative of Exceptional Warm Water Habitat (EWH). Although habitat scores indicated that Rock Creek was also capable of supporting higher level aquatic life communities, it was not in attainment of WWH standards. Historical water quality problems originating from upstream of the site after the 1996 OEPA survey combined with channelized conditions immediately downstream of the site at that time may have limited Rock Creek's biological performance (Metroparks, 2004). See Table 1 for historical sampling results from Ohio EPA and Metroparks reports.

Rock Creek and Furnace Run have been impacted by slag leachate from construction of the Ohio Turnpike/Interstate 77 interchange in 2000. Two leachate sources and four sites within the Rock Creek/Furnace Run watershed have been monitored monthly for water quality by the Ohio Turnpike Commission (OTC) since 2001 (see Appendix 1). Test results from the two slag leachate sites indicate this material may have a significant negative impact on aquatic life; from June 2001 to June 2006 pH values have ranged from 6.2 - 13.5 S.U. Field measured dissolved oxygen and conductivity levels have ranged from 0.0 - 14.4 mg/l and 1230 - 48,800 umhos/cm (in 2004) respectively. Laboratory results for sulfate, COD and BOD5 have ranged from 60 - 3188 mg/l, 28 - 6900 mg/l and 5 - 2600 mg.l respectively.

Water quality samples collected by the OTC at the Rock Creek site (RM 0.4) indicate an increasing negative impact by this pollutant source over time. Conductivity values ranged from 924 – 2500 umhos/cm in 2001 and from 2720 – 7320 umhos/cm in 2006. This is well above the OEPA water quality standards for dissolved solids (1500umhos/cm Outside Mixing Zone Average). Sulfate values ranged from 45 – 140 mg/l in 2001 and from 91 – 259 mg/l in 2006.

Table 1. Aquatic life use attainment status in the Furnace Run watershed based on data collected from 1984 to 2003. Attainment status for lotic habitats are based on biocriteria for the Erie/Ontario Lake Plain ecoregion of Ohio (OAC 3745-1-07, Table 7-17). River Mile values for the Metroparks Study have been adjusted to correspond with OEPA sites.

RIVER MILE	IBI	Qualitative Invertebrate Taxa (Total/EPT)	ICI	QHEI	Attainment Status	Comments
Furnace Run						
8.00 MSSC, 2003	46	42/6	32[ns]	65.0	FULL	Between Townsend Rd. and restoration area
7.80 MSSC, 2003	52	38/5	26	62.25	PARTIAL	Within restoration area
7.30 MSSC, 2003	50	34/5	32[ns]	87.5	FULL	Dst. Rock Creek confluence
6.50 MSSC, 2003	46	27/5	14[1]	80.0	FULL[2]	Dst. Brush Road
4.80 MSSC, 2003	44	20/8	- [3]	73.5	FULL[4]	Dst. SR 303
0.90 OEPA, 1996	48	42/10	E*	70.0	FULL	Ust. Everett Road covered bridge
0.90 OEPA, 1991	46	-	E*	73.0	FULL	"
0.90 OEPA, 1988	-	-	E*	-	FULL[5]	"
0.20 OEPA, 1984	38	-	-	-	PARTIAL[6]	Ust. confluence with Cuyahoga River
Rock Creek						
0.40 MSSC, 2003	30	34/5	18	75.5	NON	Ust. Elm Grove bridge in Brushwood area
0.40 OEPA, 1996	48	-	-	-	FULL	"

* Narrative evaluation used in lieu of ICI (E=Excellent, VG=Very Good, G=Good, MG=Marginally Good, F=Fair; P=Poor)
ns – nonsignificant departure from ecoregional biocriteria for WWH or EWH (<4 IBI or ICI units; <0.5 MIwb units).
[1] Hester-Dendy (HD) samplers partially buried by sediment
[2] Based on IBI score only due to partial burial of the HD samplers
[3] HD samplers completely buried by sediment
[4] Based on IBI score only due to burial of the HD samplers
[5] Status based only on macroinvertebrate community
[6] Status based only on fish community

4.0 2006 OEPA Survey Results

4.1 Water Chemistry

Water sample results indicated no exceedences of water quality standards for any analyzed parameter. All sample analyses for chromium, copper, zinc, mercury, cadmium, lead and selenium levels were below detection limits. Total phosphorus levels ranged from below detection limits (< 0.010 mg/l) to 0.061 mg/l. Ammonia levels were all below detection limits (<0.050 mg/l).

No exceedences of water quality standards were found in the collected water samples. Biochemical Oxygen Demand (BOD) levels were below detection limits (<2.0 mg/l) in all samples. Total Suspended Solids (TSS) levels were generally below detection limits (<5.0 mg/l) in most samples, but ranged to 56 mg/l in one sample collected at the Everett Road site at RM 0.9. The elevated TSS level is attributed to rainfall for several days prior to the sampling event.

Elevated TDS and conductivity were found at the Rock Creek site, ranging up to 1420 mg/l and 2230 umho/cm respectively. Average TDSconductivity at the Rock Creek site was 1012 mg/l, which is below the Ohio EPA 1500 mg/l maximum standard Outside Mixing Zone Average (OMZA) for dissolved solids from point source discharges.

Field conductivity levels ranged from 468 – 2331 umhos/cm, with the highest levels found at the Rock Creek site. These corresponded to the laboratory analyses for this parameter. Total dissolved solids levels were generally below 600 mg/l but ranged from 272 to 1420 mg/l, again with the highest values found at the Rock Creek site. The elevated TDS and conductivity levels at the Rock Creek site are attributed to continuing slag leachate from the Ohio turnpike interchange construction upstream of this site.

4.2 Aquatic Life and Habitat

Fish and macroinvertebrate community (IBI, MIwb, ICI) and habitat (QHEI) values from this survey are presented in Table 2.

IBI scores ranged from 36 upstream of the Furnace Run confluence with the Cuyahoga River (RM 0.2) to 52 at RM 6.5. The IBI and MIwb scores at RM 0.2 were considered a nonsignifcant departure from the ecoregional biocriteria for Warmwater Habitat (WWH). The last survey conducted in 1984 by OEPA at RM 0.2 found an IBI score of 38.

Table 2. Aquatic life use attainment status in the Furnace Run watershed based on data collected from May to October 2006.

RIVER MILE Fish/Invert.	IBI	Modified MIwb	ICI	QHEI	Attainment Status	Comments
Furnace Run						
8.00	49	NA	34	72.5	FULL	Between Townsend Rd. and restoration area
7.80	48	NA	40	74.5	FULL	Within restoration area
7.30	45	NA	44	80.5	FULL	Dst. Rock Creek confluence
6.50	52	NA	44	83.0	FULL	Dst. Brush Road
4.80	42	NA	Fair*	71.5	PARTIAL	Dst. SR 303
0.20 / 0.90	36ns	7.8ns (Wading)	Fair*	66.0	PARTIAL	Ust. Everett Road covered bridge to ust. Confluence with Cuyahoga River
Rock Creek						
0.30	49	NA	26s	77.0	PARTIAL	Ust. Elm Grove bridge in Brushwood area

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP) (Ohio Administrative Code 3745-1-07, Table 7-15)		
INDEX – Site Type	WWH	EWH
IBI – Headwaters	40	50
IBI – Wading	38	50
Mod. Iwb – Wading	7.9	9.4
ICI	34	46

* – Narrative evaluation used in lieu of ICI

ns – nonsignificant departure from ecoregional biocriteria for WWH or EWH (<4 IBI or ICI units; <0.5 MIwb units).

s – significant departure from ecoregional biocriteria – non attainment with WWH use designation.

Results of the macroinvertebrate quantitative samples from Furnace Run ranged from marginally good at the RM 8.0 site to very good at the RM's 7.3 and 6.5 sites (Table 3). Qualitative samples from RM's 4.8 and 0.9/0.2 were evaluated as fair. These two sites were the only ones with a calculated drainage area greater than 10 square miles. The Rock Creek quantitative sample from RM 0.3 was evaluated as fair. Sites evaluated as fair were not in attainment of the WWH use designation. The drainage area for each of the sites with quantitative sampling results was less than ten square miles. Sites with drainage areas less than ten square miles are usually evaluated by qualitative samples only, because there is usually insufficient water depth and current velocities for reliable use of the artificial substrate samplers. The reference data from which the ICI scoring criteria were developed did not include small drainage area sites, so caution should be used in evaluating ICI scores from the Furnace Run and Rock Creek sites. The qualitative samples, collected when the quantitative samples were collected, were all evaluated as fair except the Furnace Run RM 6.5 site which was marginally good.

Historical data are available from the Furnace Run RM 0.9 site for trend analysis. Table 4 summarizes macroinvertebrate qualitative sampling results from 1988, 1996 and 2006. There has been a consistent decline in number of total taxa, number of sensitive taxa, and number of EPT taxa collected in qualitative samples from 1988 to 2006. Bank erosion is severe in some locations and the stream channel appears to be unstable with its course changing radically during most storm events. These impacts associated with high flows during storm events appear to be negatively impacting Furnace Run macroinvertebrate communities.

Table 3. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in Furnace Run and Rock Creek, 2006.

Stream/ River Mile	Density Number/ft^2	Total Taxa	Quantitative Taxa	Qualitative Taxa	Qualitative EPT[a]	ICI	Evaluation
Furnace Run							
8.0	219	47	38	18	6	34	Good[b]
7.8	366	44	32	28	7	40	Good[b]
7.3	308	47	36	21	8	44	Very Good[b]
6.5	211	55	42	32	11	44	Very Good[b]
4.8	--	--	--	19	7	--	Fair
0.9	--	--	--	20	8	--	Fair
Rock Creek							
0.3	77	44	32	29	6	26	Fair[b]

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP) (Ohio Administrative Code 3745-1-07, Table 7-17)		
INDEX	WWH	EWH
ICI	34	46

[a] EPT=total Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness, a measure of pollution sensitive organisms.
* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
[ns] Nonsignificant departure from biocriterion (≤4 ICI units).
[b] Evaluation based on quantitative sample. Qualitative sample results are a narrative evaluation of fair for all sites except RM 6.5 which was marginally good.

Table 4. Furnace Run RM 0.9 historical data from macroinvertebrate qualitative sampling.

Year	Qualitative Taxa	Cold Water Taxa	Sensitive Taxa	Qualitative EPT[a]	Evaluation
1988	53	2	19	16	Exceptional
1996	42	2	12	10	Exceptional
2006	20	0	10	8	Fair

QHEI scores from all sites averaged 75, which is above the restoration or delisting target of 60 for the Loss of Fish Habitat Beneficial Use Impairment (BUI) for the Cuyahoga River AOC (Ohio EPA Delisting Targets for Areas of Concern, 2005). A review of QHEI components (Appendix 6) reveals an increase in Total Modified Warm Water Habitat (MWH) attributes as you move downstream. No MWH attributes were observed at the upstream sites (RM 8.0, 7.8); one to three attributes were observed at RMs 7.3, 6.5, 4.8 and 0.9; and six attributes were found at the mouth of Furnace Run (RM 0.2). This trend may be indicative of or associated with storm impacts and increased urbanization in upstream areas, resulting in elevated erosion rates at the mouth.

5.0 Conclusions and Recommendations

The results of the aquatic life and habitat evaluations indicate that this watershed is in PARTIAL attainment with Ohio water quality criteria for the Warm Water Habitat Use Designation (Table 2). Although the fish community in both Rock Creek and Furnace Run are meeting the IBI criteria, the macroinvertebrate community is showing signs of impairment, particularly in the qualitative samples. Use of these qualitative samples to determine degree of attainment may be a better methodology for evaluation of sites with a drainage area less than 10 square miles.

PARTIAL attainment in the Rock Creek tributary to Furnace Run is due to low ICI scores attributed to historical impacts from upstream pollution sources. However, the increase in IBI and ICI scores at this site from a 2003 survey which found the stream to be in NON attainment indicates that this small tributary is improving or adjusting to the impacts from the slag leachate discharge from upstream sources, although water chemistry results indicate that these impacts are not diminishing with time.

The stream restoration area in the Furnace Run mainstem (RM 7.8) was completed in 1999. This project consisted of returning Furnace Run to its original watercourse after previously being diverted to Brushwood Lake. Restoration of this stream segment consisted of utilizing soil bioengineering techniques to improve riparian habitat. The 2003 survey conducted by Metroparks serving Summit County found this area to be in PARTIAL attainment with Ohio WQS for aquatic life, while the 2006 survey found the area to be in FULL attainment. This indicates that the restoration project has been a success in this stream segment.

The results of this survey indicate that the Furnace Run watershed meets the BUI Restoration Targets for Degradation of Fish Populations and Loss of Fish Habitat (Ohio EPA Delisting Targets for Areas of Concern, 2005). The aquatic macroinvertebrate data indicate that although the majority of the watershed meets the BUI restoration target for Degradation of Benthos, there appears to be continuing impact from slag leachate that affects Rock Creek.

Additionally, the physical habitat in Furnace Run sites at RM 6.5, 4.8, and 0.9 appeared to have been influenced by high flow events during 2006 and previous years. Significant bank erosion is occurring in lower Furnace Run based on visual observations of banks at sampling sites along with excessive amounts of silts/clays covering the stream bottom (Photo 1 and 2). The stream bottom at RM 4.8 was covered with gray silts which clearly appeared to have eroded from the stream banks.

Photo 1. Eroding streambank at RM 6.5
D. Altfater

Photo 2. Silt covered stream bottom
D. Altfater

Sites near the mouth of Furnace Run (RM 0.2 and 0.9) were observed to have been recently impacted from heavy rains and high rates of erosion (Photo 3 and 4). This may have contributed to a drop in ICI scores at these sites over previous years (Table 4).

Photo 3. Furnace Run DST Everett Road. Note heavy farm field erosion at far left.
K. Rogers

Photo 4. Mouth of Furnace Run. Note sediment plume into Cuyahoga River.
K. Rogers

The Furnace Run watershed should continue to be monitored on a regular basis to ensure that the restoration targets continue to be met and that the watershed remains in attainment with Ohio biological and water quality criteria. It is recommended that local political jurisdictions within the watershed implement riparian protection strategies and storm water management programs to maintain the current level of biological and water quality, as noted in the Lower Cuyahoga River Total Maximum Daily Loads (TMDL) Report (Ohio EPA, 2003). Communities within the Furnace Run watershed are also regulated under Ohio EPA Phase 2 Storm Water National Pollutant Discharge Elimination System System (NPDES) Permits which require the implementation and enforcement of these storm water management programs by early 2008.

References

Cuyahoga River Remedial Action Plan. 2004 Urbanization in the Cuyahoga Watershed, Guide #3.

Metroparks Serving Summit County. 2004 Natural Resource Management Study Furnace Run Metropark. Prepared by Enviroscience, Inc.

Ohio Environmental Protection Agency. 1999. Biological and Water Quality Study of the Cuyahoga River and Selected Tributaries. Available at: www.epa.state.oh.us/dsw/documents/cuyvol1.pdf

Ohio Environmental Protection Agency. 1994. Biological and Water Quality Study of the Cuyahoga River and Selected Tributaries. Ecological Assessment Section, Division of Surface Water.

Ohio Environmental Protection Agency. 2001. Manual of Laboratory Standard Operating Procedures: Volume I, II and III. Division of Environmental Services.

Ohio Environmental Protection Agency. 2003. Total Maximum Daily Loads for the Lower Cuyahoga River. Final Report. Division of Surface Water. Available at: www.epa.state.oh.us/dsw/tmdl/LowerCuyahogaFinalTMDL.html

Ohio Environmental Protection Agency. June, 2005. Delisting Targets for Ohio Areas of Concern. Lake Erie Unit, Division of Surface Water. Available at: http://www.epa.state.oh.us/dsw/rap/DelistingTargetsOhioAOC_Final_June20-2005.pdf

Ohio Environmental Protection Agency. 2006. Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices. Division of Surface Water and Environmental Services.