

# **STREAM WATER QUALITY MONITORING REPORT**

## **KENTUCKY WATERWAYS ALLIANCE UPPER HARRODS CREEK WATERSHED HENRY AND OLDHAM COUNTIES, KENTUCKY**

**Eco-Tech project LV 2014 020**



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**December 2014**





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## **1.0 INTRODUCTION**

Eco-Tech Consultants was contracted by Kentucky Waterways Alliance to collect data of sufficient quality and quantity to characterize existing water quality in the Upper Harrods Creek watershed. The data collected in this analysis satisfies requirements of Phase 1 Monitoring, as described in the Watershed Planning Guidebook for Kentucky Communities (KWA/KDOW 2010). Specifically, physical/chemical water quality, habitat and macroinvertebrate communities were assessed during this study. The results of this project will be used in the development of a watershed-based plan for Upper Harrods Creek watershed.

## **2.0 SITE CHARACTERIZATION AND HISTORY**

Harrods Creek is not meeting its designated use of primary contact recreation because of high levels of fecal coliform bacteria, an indicator of contamination with human or animal wastes and potential pathogens. Many of the communities, with the exception of La Grange, depend on package treatment systems or septic systems that may be contributing to fecal coliform contamination.

Harrods Creek has historically been impaired for its entire length for primary contact recreation due to fecal coliform, but was proposed to be delisted in 2012 (KDOW 2012). An organic enrichment TMDL for river miles 0.0 to 3.2 was approved in 1995. Lower sections of the watershed outside of the planning area have been sampled by the Kentucky Division of Water and the Louisville Metropolitan Sewer District several times since 1987; one site was sampled on Harrods Creek within this watershed planning area. These results will be provided in the watershed plan.

A watershed plan for the headwaters and immediate downstream areas (see Figures 2 and 3) will help local communities plan for the increased development and urbanization on the horizon and address existing water quality issues. In late 2013, KWA was approached by residents in the Harrods Creek Watershed interested in assessing, planning, and implementing measures to protect and, where necessary, restore Harrods Creek. Residents are so committed to these efforts they have raised and donated private funds to KWA to begin this work.

The project will produce a plan for Upper Harrods Creek to guide future best management practice (BMP) implementation, an active watershed team covering the watershed, and water quality sampling sufficient to initiate BMP implementation efforts for the watershed. KWA has organized a watershed group in the Upper Harrods Creek watershed and is conducting preliminary planning on watershed issues that may result in additional monitoring, planning, and BMP implementation in other sub-watersheds of Harrods Creek. For example, KWA received a 2014 Section 319(h) Nonpoint Source Implementation Grant to finalize the Darby Creek Watershed Plan written in June 2010 and begin implementation efforts.

### 3.0 MONITORING METHODS

Water quality monitoring was conducted in the Upper Harrods Creek watershed, which includes the Brush Fork, Ash Run, and Berry Creek tributaries (Figure 1). The study area comprises an area of approximately 43 mi<sup>2</sup>. The Upper Harrods Creek watershed followed the guidelines found in the Phase I Monitoring section of the Watershed Planning Guidebook for Kentucky Communities (KWA/KDOW 2010). This initial monitoring will help with the preliminary identification of water quality impairment and also prioritize sub-watersheds for further study and BMP implementation.

Six study sites were selected in consultation with the Kentucky Division of Water. Three monitoring sites were located on the Harrods Creek main stem and three sites were located on major tributaries to Harrods Creek including Berry Creek, Ash Run, and Brush Creek (Figures 1 and 2).

All six sites were sampled five times within a 30-day period starting on September 24, 2014. Sample dates included 9-24-2014, 9-29-2014, 10-03-2014, 10-20-2014 and 10-23-2014. The sampling completed on 10-03-2014 was a wet weather sampling event, while the other samples were completed during dry-weather base-flow conditions. A wet weather event is defined as a seven-day antecedent dry period (in which no more than 0.1 inch of precipitation occurs) followed by visible run-off conditions, such as sheet flow on impervious surfaces and visible surface flow in ephemeral channels. A dry weather event is defined as following a seven-day dry period, in which no more than 0.1 inch of precipitation occurs. Local precipitation was monitored at the Kentucky Mesonet Oldham County station LGRN ([http://www.kymesonet.org/live\\_data.html#LGRN](http://www.kymesonet.org/live_data.html#LGRN)).

On each sample date, grab samples were taken and preserved using sodium thiosulfate to determine *Escherichia coli* concentrations (i.e. colonies / 100mL) following KDOW standard operating procedures (DOWSOP03025; KDOW 2011a). During each sampling event, spot measurements of stream-water pH, dissolved oxygen, specific conductivity, and temperature were completed using KDOW standard operating procedures (DOWSOP03014; KDOW 2009a). Grab samples were also completed on three or four dates at each site for total nitrogen (TN), total phosphorus (TP) and total suspended solids (TSS) following KDOW standard operating procedures (DOWSOP03015; KDOW 2011d). Collection and analytical methods for each parameter are provided in Table 1. Water quality data at each site were compared to established action levels and/or benchmarks provided by the KDOW (Table 2). When water quality data were reported from the laboratory as being above or below the detection limits, the sample value was set to the detection limit for calculations.

Benthic macroinvertebrates samples were collected and habitat (RBP methods) was assessed at all six sites on September 29, 2014. Benthic macroinvertebrates sampling were completed following KDOW standard operating procedure DOWSOP03003 (KDOW, 2011c), and processed according to KDOW procedure DOWSOP03005 (KDOW 2009b). Briefly, benthic macroinvertebrates were sampled and processed according to Kentucky Division of Water standard methods including 300-pick riffle sample and multi-habitat samples. Organisms were identified to lowest practical level, typically genus. RBP habitat

assessments were completed using KDOW standard operating procedure DOWSOP03024 (KDOW 2011b).

A few deviations from our original Quality Assurance Project Plan were completed during this project. First, we were unable to get field pH measurements from all of our sites on the first and second sampling events due to a pH probe malfunction resulting in pH probe replacement. Also, while flow was evident at all sites during all sampling events, flow was too low to measure on all sampling occasions except for one using a flow meter. On one sample date spot measurements of stream velocity were completed at each site to confirm flow.

## 4.0 RESULTS

### 4.1 *Upper Harrods Creek Site #1 (UH1)*

Site UH1 is the most upstream site on the main stem of Harrods Creek (Figures 1 and 2). UH1 has a watershed area of 9.32mi<sup>2</sup> with 48% agricultural and 9% urban land use within the watershed based on the 2006 National Land Cover Dataset (NLCD). Stream temperature during our sampling period ranged from 11.4°C to 25.5°C, which is not an action-level violation. The pH ranged from 7.8 – 8.4 at UH1, which is not an action-level violation. The pH was not measured at site UH1 during the first sampling event due to probe malfunction. Specific conductivity ranged from 484 to 731 during the study, and was moderate on one sample date (9/29/2014) and was high on the last two dates (10/20/2014 and 10/23/2014) base on benchmarks provided by the KDOW. Dissolved O<sub>2</sub> ranged from 3.27 mg/L to 9.64 mg/L and was an action-level violation on one sample date (10/3/2014). The geometric mean of the five E. coli samples completed during this project was 187 colonies / 100ml, which is an action level violation. Single-sample E. coli samples were also above action levels on three sample dates (Table 3a). Total suspended solids was within the high category of the established benchmarks on 10-20-2014. Total phosphorus was in the moderate benchmark category on one sample occasion. Macroinvertebrate communities scored in the “Fair” category for the MBI (Table 4); habitat was also estimated to be “Fair”.

### 4.2 *Upper Harrods Creek Site #2 (UH2)*

Site UH2 is located on Berry Creek near the confluence with Harrods Creek (Figures 1 and 2). UH2 has a watershed area of 2.29mi<sup>2</sup> with 54% agricultural and 8% urban land use within the watershed based on the 2006 NLCD. Stream temperature during our sampling period ranged from 9.8°C to 20.2°C, which is not an action-level violation. The pH ranged from 7.7 – 8.3 at UH1, which is not an action-level violation. The pH of stream water at UH2 was measured in the lab instead of the field during the first sampling event due to probe malfunction. Specific conductivity ranged from 479 to 797 during the study, and was in the moderate benchmark category on one sample occasion and was in the high benchmark category on the last two sampling occasions. Dissolved O<sub>2</sub> ranged from 3.67 mg/L to 10.02 mg/L and was an action-level violation on the wet-weather sample date

(10/3/2014). The geometric mean of the five *E. coli* samples completed for UH2 was 168 colonies / 100ml, which is an action level violation. Single-sample *E. coli* samples were also above action levels on two sample dates (Table 3b). Total phosphorus was in the high benchmark category on two sample occasions. Habitat was estimated to be “Fair” (Table 6).

#### *4.3 Upper Harrods Creek Site #3 (UH3)*

Site UH3 is located on the main stem of Harrods Creek approximately 3 km downstream of UH1 (Figures 1 and 2). UH3 has a watershed area of 15.74mi<sup>2</sup> with 54% agricultural and 8% urban land use within the watershed based on the 2006 NLCD. Stream temperature during our sampling period ranged from 10.2°C to 18.2°C and pH ranged from 7.5 – 8.3 at UH3. The pH of stream water at UH3 was measured in the lab instead of the field during the first sampling event due to probe malfunction. Specific conductivity ranged from 458 µS/cm to 748 µS/cm and was in the high benchmark category on the last two sampling events. Dissolved O<sub>2</sub> ranged from 2.48 mg/L to 9.49 mg/L and was an action-level violation on the wet-weather sample date (10/3/2014). The geometric mean of the five *E. coli* samples completed during this project was 114 colonies / 100ml, which is not above the action level, but the single-sample *E. coli* colony estimates were above action levels on the wet-weather sampling event (10-3-2014). Total suspended solids was within the moderate benchmark category on 9/29/2014. Total phosphorus was also in the moderate benchmark category on two sampling occasions. Macroinvertebrate communities scored in the “Good” category for the MBI (Table 4); habitat was also estimated to be “Good” (Table 6).

#### *4.4 Upper Harrods Creek Site #4 (UH4)*

Site UH4 is located on Ash Run near the confluence with Harrods Creek (Figures 1 and 2). UH4 has a watershed area of 2.42mi<sup>2</sup> with 50% agricultural and 8% urban land use within the watershed based on the 2006 NLCD. Stream temperature during our sampling period ranged from 8.5°C to 18.7°C, and pH ranged from 8.1 – 8.5 at UH4. The pH of stream water at UH4 was not measured on the first two site visits due to a probe malfunction. Specific conductivity ranged from 620 µS/cm to 812 µS/cm, and was in the moderate benchmark category on one sample occasion and was in the high benchmark category on all other sampling occasions. Dissolved O<sub>2</sub> ranged from 3.00 mg/L to 10.92 mg/L and was an action-level violation on the wet-weather sample date (10/3/2014). The geometric mean of the five *E. coli* samples completed for UH2 was 76 colonies / 100ml, which is not an action level violation, but single-sample *E. coli* samples were also above action levels on two sample dates (Table 3d). Total phosphorus was in the moderate benchmark category on two sample occasions. Habitat was estimated to be “Good” (Table 6).

#### *4.5 Upper Harrods Creek Site #5 (UH5)*

Site UH5 is located on Brush Creek near the confluence with Harrods Creek (Figures 1 and 2). UH5 has a watershed area of 5.15mi<sup>2</sup> with 33% agricultural and 18% urban land use

within the watershed based on the 2006 NLCD. Stream temperature during our sampling period ranged from 9.2°C to 18.2°C, and pH ranged from 8.0 – 8.4 at UH5. The pH of stream water at UH5 was not measured on the first two site visits due to a probe malfunction. Specific conductivity ranged from 530  $\mu\text{S}/\text{cm}$  to 755  $\mu\text{S}/\text{cm}$ , and was in the moderate benchmark category on one sample occasion and was in the high benchmark category on two sampling occasions. Dissolved  $\text{O}_2$  ranged from 4.56 mg/L to 10.02 mg/L. The geometric mean of the five *E. coli* samples completed for UH5 was 160 colonies / 100ml, which is not an action level violation, but single-sample *E. coli* samples were above action levels during the wet-weather sampling event (Table 3e). Total phosphorus was in the high benchmark category on one sample occasions. Habitat was estimated to be “Fair” (Table 6).

#### 4.6 Upper Harrods Creek Site #6 (UH6)

Site UH6 is located on the main stem of Harrods Creek approximately 14 km downstream from site UH3 (Figures 1 and 2). UH6 has a watershed area of 37.14mi<sup>2</sup> with 47% agricultural and 9% urban land use within the watershed based on the 2006 NLCD. Stream temperature during our sampling period ranged from 9.3°C to 19.9°C, and pH ranged from 8.3 – 8.6 at UH6. The pH of stream water at UH6 was not measured on the first two site visits due to a probe malfunction. Specific conductivity ranged from 483  $\mu\text{S}/\text{cm}$  to 920  $\mu\text{S}/\text{cm}$ , and was in the high benchmark category on the last two sample occasions. Dissolved  $\text{O}_2$  ranged from 5.71 mg/L to 12.61 mg/L. The geometric mean of the five *E. coli* samples completed for UH2 was 32 colonies / 100ml, which is below the established action level. Total phosphorus was in the high benchmark category on one sample occasion and total nitrogen was in the moderate/high category on one sampling occasion. Macroinvertebrate communities scored in the “Good” category for the MBI (Table 4), habitat was also estimated to be “Good” (Table 6).

## 5.0 SUMMARY

All sites sampled in the upper Harrods Creek Watershed in this study violated established action levels or scored high in some KDOW benchmarks. Only site UH6 did not violate the action level for *E. coli* colony concentrations. These *E. coli* action-level violations were expected due to Harrods Creek’s historical impairment by fecal coliform bacteria (see section 2.0). Specific conductivity was moderate or high at all six sites during on at least two of the five sample dates. Sites UH5 and UH6 were the only two sites that did not have action-level violations for dissolved oxygen. Nutrients were in the moderate or high benchmark categories on at least one sample date at each sample site, which is common in watersheds with significant agricultural land use. Total suspended solids was in the moderate or high benchmark categories only at two sample sites (UH1 and UH3), and was only observed to be moderate or high on one sample date at each site. There were no action-level violations or moderate-high benchmark observations for stream temperature, pH, MBI, or RBP habitat scores at any of the six sample sites.



## 6.0 LITERATURE CITED

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## **TABLES**

Table 1. Analytical Method, Containers, Preservation, and Holding Times Requirements

Parameter	KDOW SOP or Standard Method Number	Containers (no., volume, type)	Preservation requirements (chemical, temp., light)	Maximum holding times
Dissolved Oxygen, concentration	DOWSOP03014	N/A	N/A	N/A
Dissolved Oxygen, % saturation	DOWSOP03014	N/A	N/A	N/A
Specific Conductance	DOWSOP03014	N/A	N/A	N/A
Water Temperature	DOWSOP03014	N/A	N/A	N/A
pH	DOWSOP03014	N/A	N/A	N/A
Flow	DOWSOP03019	N/A	N/A	N/A
Rapid Bioassessment Protocol	DOWSOP03024	N/A	N/A	N/A
Macroinvertebrate Bioassessment Index	DOWSOP030050	2 widemouth 1 liter glass or polyethylene sampling jars	95% ethanol in field; 70% in storage	5 years
Total Suspended Solids	SM 2540D 21st, 2005	Polyethylene or glass bottle, 1 liter	Cool to 4° C.	7 days
<i>Escherichia coli</i>	SM 9223 B 2004 MPN	Polyethylene bottle - Sodium thiosulfate sterile, 120 mL bottle with a 100 fill line	Cool to 4° C.	6 hrs
Phosphorus, Total as P	SM 4500-P b.5/E 21st 2005	Polyethylene or glass bottle, 1 liter	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<2	28 days
Nitrate-nitrite as N	SM 4110 B 21st 2005	Polyethylene or glass bottle, 1 liter	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<3	48 hours
Total Kjeldahl Nitrogen	SM 4500-N org/D 21st 2005	Polyethylene or glass bottle, 1 liter	Cool, 4°C, H <sub>2</sub> SO <sub>4</sub> to pH<4	28 days

Table 2. Action levels and benchmarks established for this study.

Parameter	Units	Action Levels and Benchmarks		
		Headwater	Wadeable	Wet Weather
Dissolved O <sub>2</sub>	mg / L	< 4.0	< 4.0	< 4.0
Sp. Conductance	µS / cm	Low: < 570 Mod: 570 - 640 High > 640	Low: < 570 Mod: 570 - 630 High > 630	> 630
Water Temp.	°C	> 31.7°C	> 31.7°C	> 31.7°C
pH	SU	< 6.0 or > 9.0	< 6.0 or > 9.0	< 6.0 or > 9.0
RBP Habitat	Category	Poor	Poor	N/A
MBI	Category	Poor or Very Poor	Poor or Very Poor	N/A
TSS	mg / L	Low: < 15 Mod: 15 - 24 High > 24	Low: < 11 Mod: 11 - 18 High > 18	> 80
<i>Escherichia coli</i>	colonies / 100 mL	Geometric mean > 130 or 20% or more of all samples > 240	Geometric mean > 130 or 20% or more of all samples > 240	Geometric mean > 130 or 20% or more of all samples > 240
Total Phosphorus	mg / L	Low: < 0.09 Mod: 0.09 - 0.12 High > 0.12	Low: < 0.15 Mod: 0.15 - 0.25 High > 0.25	> 0.50
Total Nitrogen	mg / L	Low: < 0.7 Mod: 0.7 - 1.0 High > 1.0	Low: < 1.1 Mod: 1.1 - 1.6 High > 1.6	> 5.0






N/A - not applicable

**Table 3. Summary Tables of Data Collected at Each Study Site in the Upper Harrod's Creek Watershed.**

Table 3a. Upper Harrods Creek Site #1 (UH1)												
Date	Temp (°C)	pH	Sp. Cond. (µS/cm)	DO (mg/L)	DO (%)	E-Coli (Col/100ml)	Nitrate (mg/L)	Nitrite (mg/L)	TN (mg/L)	TSS (mg/L)	TKN (mg/L)	TP (mg/L)
24-Sep-14	17.3	n/a	484	6.77	76.6	16	<0.2	<0.2	0.9	<6	0.5	0.05
29-Sep-14	25.5	8.4	590	7.21	95.4	249	<0.2	<0.2	0.8	<6	0.4	0.10
<b>3-Oct-14*</b>	<b>19.8</b>	<b>7.8</b>	<b>586</b>	<b>3.27</b>	<b>38.9</b>	<b>&gt;2420</b>	<b>&lt;0.2</b>	<b>&lt;0.2</b>	<b>0.9</b>	<b>&lt;6</b>	<b>0.5</b>	<b>0.15</b>
20-Oct-14	11.4	8.1	648	8.22	81.7	613	<0.2	<0.2	1.3	22	0.9	0.15
23-Oct-14	12.0	8.2	731	9.64	97.1	39						
Mean**	17.2	8.1	608	7.02	77.9	187			0.98		0.6	0.11
Std. Dev.**	5.8	0.3	91	2.37	23.5	8			0.22		0.2	0.05

Table 3b. Upper Harrods Creek Site #2 (UH2)												
Date	Temp (°C)	pH	Sp. Cond. (µS/cm)	DO (mg/L)	DO (%)	E-Coli (Col/100ml)	Nitrate (mg/L)	Nitrite (mg/L)	TN (mg/L)	TSS (mg/L)	TKN (mg/L)	TP (mg/L)
24-Sep-14	13.5	7.7	479	7.36	76.7	285	<0.2	<0.2	0.7	<6	0.3	0.03
29-Sep-14	20.2	7.7	636	4.31	51.7	19	<0.2	<0.2	0.8	<6	0.4	0.16
<b>3-Oct-14*</b>	<b>18.5</b>	<b>8.0</b>	<b>624</b>	<b>3.67</b>	<b>42.6</b>	<b>517</b>	<b>&lt;0.2</b>	<b>&lt;0.2</b>	<b>0.9</b>	<b>&lt;6</b>	<b>0.5</b>	<b>0.31</b>
20-Oct-14	10.8	8.3	675	9.19	90.1	217	<0.2	<0.2	0.9	<6	0.5	0.13
23-Oct-14	9.8	8.2	797	10.2	97.6	219						
Mean**	14.6	8.0	642	6.95	71.7	168			0.83		0.4	0.16
Std. Dev.**	4.6	0.3	114	2.89	23.9	4			0.10		0.1	0.12

\*October 3, 2014 sample event was a wet event; \*\*Mean and standard deviation for E-Coli are geometric






Color Key		
Benchmarks		Action level
	High	 Violation
	Unkown (Could be moderate or low)	
	Moderate	
	Unkown (Could be high or moderate)	

**Table 3 cont. Summary Tables of Data Collected at Each Study Site in the Upper Harrod's Creek Watershed.**

<b>Table 3c. Upper Harrods Creek Site #3 (UH3)</b>												
Date	Temp (°C)	pH	Sp. Cond. (µS/cm)	DO (mg/L)	DO (%)	E-Coli (Col/100ml)	Nitrate (mg/L)	Nitrite (mg/L)	TN (mg/L)	TSS (mg/L)	TKN (mg/L)	TP (mg/L)
24-Sep-14	14	7.5	458	7.12	75.1	116	<0.2	<0.2	0.7	<6	0.3	0.15
29-Sep-14	18.2	8.2	560	4.25	49.0	78	<0.2	<0.2	1.0	18	0.6	0.15
<b>3-Oct-14*</b>	<b>17.9</b>	<b>8.0</b>	<b>595</b>	<b>2.48</b>	<b>28.4</b>	<b>361</b>	<b>&lt;0.2</b>	<b>&lt;0.2</b>	<b>0.8</b>	<b>&lt;6</b>	<b>0.4</b>	<b>0.23</b>
20-Oct-14	11.4	8.3	665	8.88	88.3	110	<0.2	<0.2	1.0	<6	0.6	0.09
23-Oct-14	10.2	8.2	748	9.49	91.7	53						
Mean**	14.3	8.0	605	6.44	66.5	114			0.88		0.5	0.16
Std. Dev.**	3.7	0.3	109	3.01	27.1	2			0.15		0.2	0.06

<b>Table 3d. Upper Harrods Creek Site #4 (UH4)</b>												
Date	Temp (°C)	pH	Sp. Cond. (µS/cm)	DO (mg/L)	DO (%)	E-Coli (Col/100ml)	Nitrate (mg/L)	Nitrite (mg/L)	TN (mg/L)	TSS (mg/L)	TKN (mg/L)	TP (mg/L)
24-Sep-14	15.7	n/a	665	7.51	82.2	84						
29-Sep-14	18.2	n/a	620	4.11	47.4	1	<0.2	<0.2	1.1	<6	0.7	0.11
<b>3-Oct-14*</b>	<b>18.7</b>	<b>8.1</b>	<b>673</b>	<b>3.00</b>	<b>34.9</b>	<b>&gt;2420</b>	<b>&lt;0.2</b>	<b>&lt;0.2</b>	<b>1.0</b>	<b>&lt;6</b>	<b>0.6</b>	<b>0.31</b>
20-Oct-14	10.3	8.4	747	9.98	96.7	250	<0.2	<0.2	1.1	<6	0.7	0.12
23-Oct-14	8.5	8.5	812	10.92	101.3	50						
Mean**	14.3	8.3	703	7.10	72.5	76			1.07		0.7	0.18
Std. Dev.**	4.6	0.2	76	3.49	29.8	17			0.06		0.1	0.11

\*October 3, 2014 sample event was a wet event; \*\*Mean and standard deviation for E-Coli are geometric

<b>Color Key</b>		<b>Action level</b>	
<b>Benchmarks</b>			
	High		Unkown (Could be moderate or low)
	Moderate		Unkown (Could be high or moderate)
			Violation

**Table 3 cont. Summary Tables of Data Collected at Each Study Site in the Upper Harrod's Creek Watershed.**

Table 3e. Upper Harrods Creek Site #5 (UH5)												
Date	Temp (°C)	pH	Sp. Cond. (µS/cm)	DO (mg/L)	DO (%)	E-Coli (Col/100ml)	Nitrate (mg/L)	Nitrite (mg/L)	TN (mg/L)	TSS (mg/L)	TKN (mg/L)	TP (mg/L)
24-Sep-14	14.6	n/a	586	8.35	89.2	139						
29-Sep-14	17.3	n/a	530	6.81	77.1	51	<0.2	<0.2	0.7	<6	0.3	0.15
<b>3-Oct-14*</b>	<b>18.2</b>	<b>8.0</b>	<b>595</b>	<b>4.56</b>	<b>52.6</b>	<b>&gt;2420</b>	<b>&lt;0.2</b>	<b>&lt;0.2</b>	<b>0.7</b>	<b>6</b>	<b>0.3</b>	<b>0.13</b>
20-Oct-14	11.1	8.4	661	9.82	96.9	103	<0.2	<0.2	1.1	<6	0.7	0.05
23-Oct-14	9.2	8.4	755	10.02	94.5	59						
Mean**	14.1	8.3	625	7.91	82.1	160			0.83		0.4	0.11
Std. Dev.**	3.9	0.2	86	2.28	18.2	5			0.23		0.2	0.05

Table 3f. Upper Harrods Creek Site #6 (UH6)												
Date	Temp (°C)	pH	Sp. Cond. (µS/cm)	DO (mg/L)	DO (%)	E-Coli (Col/100ml)	Nitrate (mg/L)	Nitrite (mg/L)	TN (mg/L)	TSS (mg/L)	TKN (mg/L)	TP (mg/L)
24-Sep-14	18.6	n/a	483	8.90	103.4	4						
29-Sep-14	18.5	n/a	510	5.40	62.6	121	1.1	<0.2	1.7	<6	0.4	0.26
<b>3-Oct-14*</b>	<b>19.9</b>	<b>8.3</b>	<b>586</b>	<b>5.71</b>	<b>68.1</b>	<b>46</b>	<b>&lt;0.2</b>	<b>&lt;0.2</b>	<b>0.7</b>	<b>&lt;6</b>	<b>0.3</b>	<b>0.32</b>
20-Oct-14	11.7	8.6	637	10.62	106.3	47	<0.2	<0.2	1.2	10	0.8	0.08
23-Oct-14	9.3	8.6	920	12.61	119.2	34						
Mean**	15.6	8.5	627	8.65	91.9	32			1.20		0.5	0.22
Std. Dev.**	4.8	0.2	175	3.12	25.1	4			0.50		0.3	0.12

\*October 3, 2014 sample event was a wet event; \*\*Mean and standard deviation for E-Coli are geometric






Color Key		
Benchmarks		Action level
	High	 Violation
	Unkown (Could be moderate or low)	
	Moderate	
	Unkown (Could be high or moderate)	

Table 4. Macroinvertebrate metrics calculated for upper Harrods Creek mainstem sites on September 29, 2014.

<b>Metric</b>	<b>UH-1</b>	<b>UH-3</b>	<b>UH-6</b>
<b>Genus Richness</b>	28	27	28
<b>EPT Genus Richness</b>	7	7	10
<b>mHBI</b>	6.91	5.53	5.64
<b>m%EPT</b>	60.07	13.93	57.59
<b>%Chironomidae &amp; Oligochaeta</b>	16.61	22.14	17.93
<b>%Clinger</b>	14.13	77.86	71.38
<b>MBI</b>	<b>49.30</b>	<b>54.40</b>	<b>66.19</b>
<b>Narrative Rating</b>	<b>Fair</b>	<b>Good</b>	<b>Good</b>



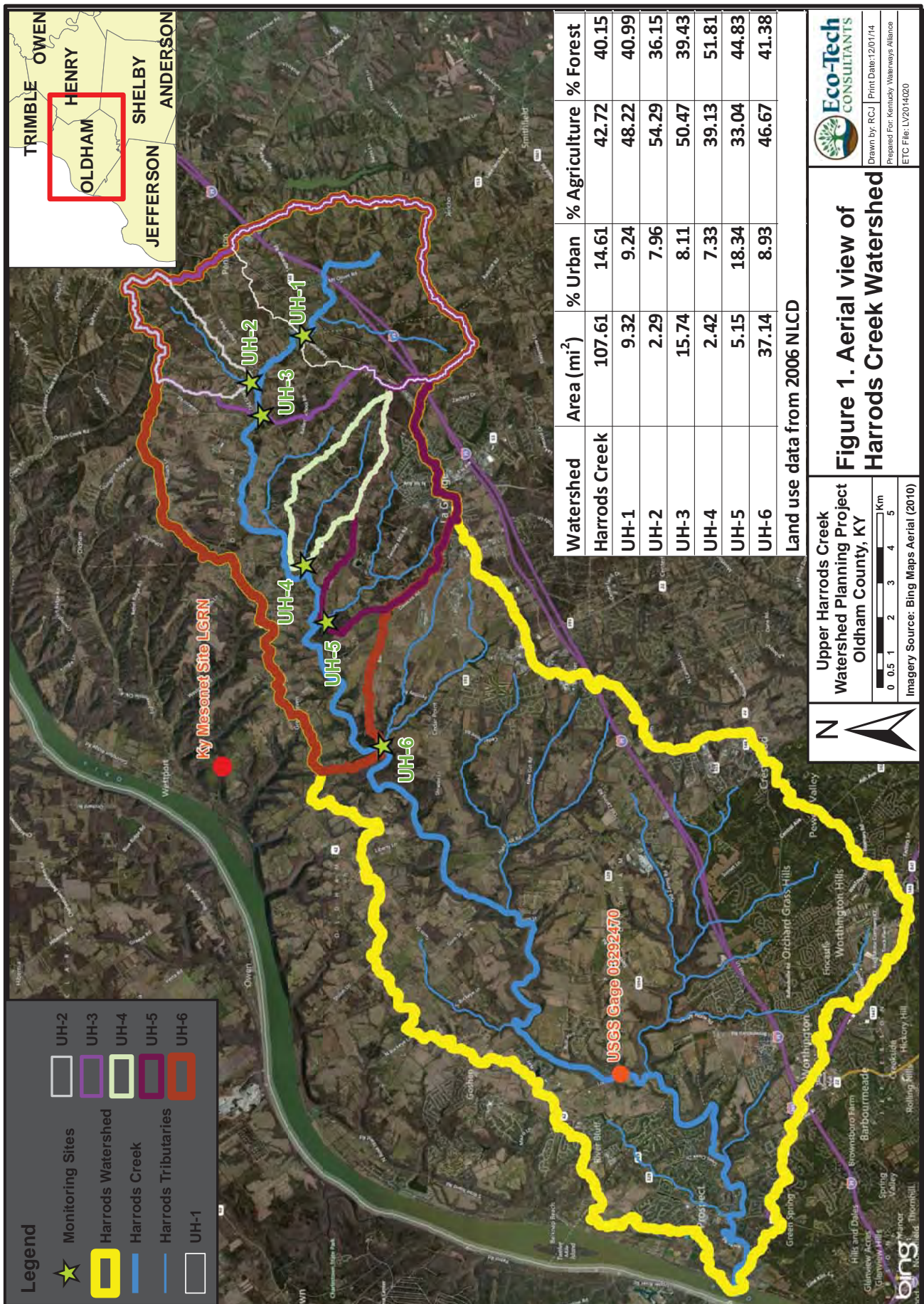
Table 5. Macroinvertebrate taxa identified from mainstem upper Harrods Creek Sites sampled on September 29, 2014.

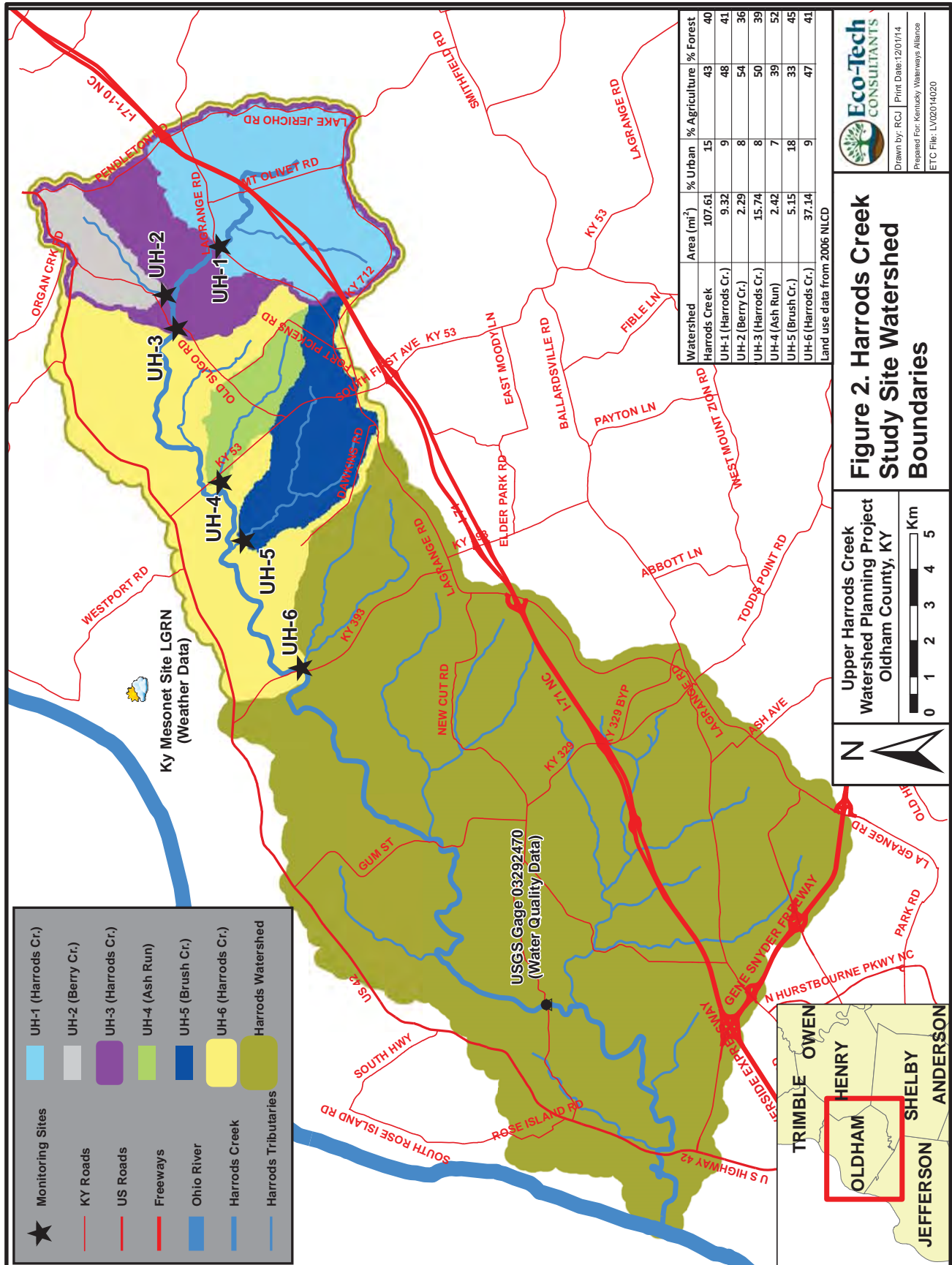
Taxon			Semi-Quant.			Multihabitat		
Order	Family	Final ID	UH1	UH3	UH6	UH1	UH3	UH6
Amphipoda	Gammaridae	<i>Gammarus</i> sp	1	2				1
Basommatophora	Physidae	<i>Physella</i> sp				1	1	1
Coleoptera	Elmidae	<i>Dubiraphia</i> sp	5					
Coleoptera	Elmidae	<i>Stenelmis</i> sp	29	159	30	1	1	
Coleoptera	Haliplidae	<i>Pelodytes</i> sp				1		
Coleoptera	Hydrophilidae	<i>Berosus</i> sp	9		1			
Coleoptera	Hydrophilidae	<i>Tropisternus</i> sp				1		
Coleoptera	Noteridae	<i>Hydrocanthus</i> sp				1		
Coleoptera	Psephenidae	<i>Psephenus herricki</i>			19	1	1	1
Decapoda	Cambaridae	<i>Orconectes juvenilis</i>		2	1			1
Diptera	Ceratopogonidae	<i>Ceratopogonidae</i> sp	3					
Diptera	Chironomidae	<i>Abalbesmyia</i> sp	13	10			1	
Diptera	Chironomidae	<i>Apedilum</i> sp		5				
Diptera	Chironomidae	<i>Cardiocladius</i> sp		4				
Diptera	Chironomidae	<i>Corynoneura</i> sp	1					
Diptera	Chironomidae	<i>Dicrotendipes</i> sp	26					
Diptera	Chironomidae	<i>Orthocladus</i> sp		9	21			1
Diptera	Chironomidae	<i>Polypedilum</i> sp		19	21		1	1
Diptera	Chironomidae	<i>Pseudochironomus</i> sp				1		1
Diptera	Chironomidae	Chironomidae sp (pupa)			2			
Diptera	Chironomidae	<i>Zavrelia</i> sp		10	8			1
Diptera	Simuliidae	<i>Prosimulium</i> sp		1	4			
Diptera	Tabanidae	<i>Chrysops</i> sp		2				
Diptera	Tipulidae	<i>Tipula</i> sp		1				
Ephemeroptera	Baetidae	<i>Baetis</i> sp	1		29		1	1
Ephemeroptera	Caenidae	<i>Caenis</i> sp	161	4	5	1		1
Ephemeroptera	Heptageniidae	<i>Stenacron</i> sp	2	3	9		1	1
Ephemeroptera	Heptageniidae	<i>Stenonema femoratum</i>	2	2	1	1	1	1
Ephemeroptera	Isonychiidae	<i>Isonychia</i> sp				1		
Haplotaxida	Tubificidae	Unid. Tubificid sp	7	5				
Hemiptera	Veliidae	<i>Microvelia</i> sp					1	
Isopoda	Asellidae	<i>Lirceus fontinalis</i>		5	6	1	1	1
Lymnophila	Planorbidae	<i>Helisoma</i> sp				1		
Megaloptera	Sialidae	<i>Sialis</i> sp	1		1			
Mesogastropoda	Pleuroceridae	<i>Elimia</i> sp	15	5		1	1	1
Odonata	Coenagrionidae	<i>Argia</i> sp			4			1
Odonata	Coenagrionidae	Coenagrionid sp	1	1	1	1	1	
Pelecypoda	Corbiculidae	<i>Corbicula fluminea</i>	2			1		1
Plecoptera	Chloroperlidae	Chloroperlidae sp		1				
Plecoptera	Perlidae	<i>Acroneuria</i> sp			1			
Trichoptera	Helicopsychidae	<i>Helicopsyche borealis</i>						1
Trichoptera	Hydropsychidae	<i>Cheumatopsyche</i> sp	1	29	100	1		1
Trichoptera	Hydropsychidae	<i>Hydropsyche</i> sp			15		1	
Trichoptera	Hydropsychidae	Hydropsychidae (pupa)	1					
Trichoptera	Leptoceridae	<i>Oecetis</i> sp	2					
Trichoptera	Philopotamidae	<i>Chimarra</i> sp			7			
Trichoptera	Polycentropodidae	<i>Cernotina</i> sp						1
Tricladida	Planariidae	<i>Dugesia</i> sp			4			1
		Copepoda sp		1				

Table 6. Rapid bioassessment protocol habitat parameters and total habitat score calculated for upper Harrods Creek mainstem sites on September 29, 2014.

<b>Metric</b>	<b>UH-1</b>	<b>UH-2</b>	<b>UH-3</b>	<b>UH-4</b>	<b>UH-5</b>	<b>UH-6</b>
<b>1. Epifaunal Substrate</b>	5	15	10	9	14	9
<b>2. Embeddedness</b>	14	16	13	18	17	14
<b>3. Velocity/Depth Regime</b>	14	15	13	12	15	13
<b>4. Sediment Deposition</b>	11	14	10	14	14	13
<b>5. Channel Flow Status</b>	12	11	10	10	13	15
<b>6. Channel Alteration</b>	15	17	18	19	19	15
<b>7. Frquency of Riffles</b>	16	17	16	17	18	16
<b>8. Bank Stability</b>	15	14	16	19	9	16
<b>9. Vegetative Protection</b>	16	18	18	19	17	16
<b>10. Riparian vegetative Zone Width</b>	8	17	19	20	14	17
<b>Total RBP Habitat Score</b>	<b>126</b>	<b>154</b>	<b>143</b>	<b>157</b>	<b>150</b>	<b>144</b>
<b>Narrative Rating</b>	<b>Fair</b>	<b>Fair</b>	<b>Good</b>	<b>Good</b>	<b>Fair</b>	<b>Good</b>

## FIGURES





## **PHOTOGRAPHS**



Photo 1. Upper Harrods Creek Site 1 (8/20/2014)



Photo 2. Upper Harrods Creek Site 1 (09/24/2014)



Photo 3. Upper Harrods Creek Site 1 (10/03/2014)



Photo 4. Upper Harrods Creek Site 2 – Berry Creek (08/20/2014)





Photo 5. Upper Harrods Creek Site 2 – Berry Creek (10/03/2014)



Photo 6. Upper Harrods Creek Site 2 – Berry Creek (10/20/2014)



Photo 7. Upper Harrods Creek Site 3 (09/24/2014)



Photo 8. Upper Harrods Creek Site 3 (10/20/2014)



Photo 9. Upper Harrods Creek Site 4 – Ash Run (09/24/2014)



Photo 10. Upper Harrods Creek Site 4 – Ash Run (09/24/2014)



Photo 11. Upper Harrods Creek Site 4 – Ash Run (10/03/2014)



Photo 12. Upper Harrods Creek Site 4 – Ash Run (10/20/2014)



Photo 13. Upper Harrods Creek Site 5 – Brush Creek (09/24/2014)



Photo 14. Upper Harrods Creek Site 5 – Brush Creek (09/24/2014)



Photo 15. Upper Harrods Creek Site 5 – Brush Creek (10/20/2014)



Photo 16. Upper Harrods Creek Site 6 (09/24/2014)

**PROVISIONAL USGS REAL-TIME GAGE DATA**  
**(USGS 03292470)**

