Meadow Run Water Quality and Bacteria Investigation
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A partnership between the Voinovich School for Leadership and Public Affairs at Ohio University and the Jackson County Health Department

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Study Purpose & Background

In January of 2007 a complaint was received by the Jackson County Health Department from a landowner, Mr. Greg Pugh, who lives adjacent to Meadow Run. The nature of the complaint involved flooding issues on the property, concern about pollutants in the creek, the potential of a human health hazard related to bacteria from untreated or poorly treated sewage, and odor generated from the stream around the property.

In February of 2007, Jackson County Health Department personnel, the Raccoon Creek Watershed Coordinator at Ohio University, and the Natural Resources Conservation Service (NRCS) area technician visited the landowner and surveyed the situation. During that site visit it was decided that there was a need for water quality data, specifically *E. Coli* and Fecal coliform counts in Meadow Run to determine the severity and source of the potentially untreated waste water.

A plan of action was developed that consists of an analysis *E. Coli* and fecal coliform sampling in Meadow Run funded by the Jackson County Health Department. The Raccoon Creek Watershed Coordinator, with assistance of a graduate associate at Ohio University's Voinovich School of Leadership and Public Affairs would prepare a sampling plan and conduct the stream sampling. A meeting on March 16th, 2007 was held between the two entities to develop a sampling plan and further refine study objectives and collaboration. In April of 2007, a study plan to address bacteria and water quality in Meadow Run was agreed upon. Sampling began on April 23rd, 2007.

Study Description

Meadow Run is a tributary to Little Raccoon Creek in Jackson County, Ohio (Map 1). Meadow Run is 4.6 miles long and flows southwest to northeast through the Village of Wellston. The Meadow Run watershed encompasses 10.7 square miles and has an average fall of 9.8 feet per mile. Upstream of the confluence with Little Raccoon Creek is a large wetland that is partially due to constriction by an abandoned railroad and beaver dams.

The goal of the Meadow Run bacteria study is to determine the concentration of the bacteria *E. Coli* and fecal coliform in samples of water collected from Meadow Run in Jackson County, Ohio and to determine if impairments to aquatic life and human health risks are present.

Major components and objectives of the study are summarized below:

1. Collect 25 grab samples and have a laboratory determine the concentration of *E. Coli* and fecal coliform in water samples from Meadow Run in May 2007; Five samples at five locations.

2. Collect field chemistry information such as pH, specific conductivity, dissolved oxygen (DO), and temperature from each sampling site; this data will aid in determining overall water quality.

3. Analyze and compare results with Ohio EPA water quality standards for surface waters of Ohio.

4. Compile data into final report and distribute to appropriate entities including: the Jackson County Health Department, Wellston City Council, Greg Pugh, and the Ohio EPA.

Background materials were assembled and site locations were established (Table 1, Map 2). Stream sampling sites were chosen based on previous studies of Meadow Run (OEPA 1996) and the nature of the landowner's complaint.

Table 1: 2007 Meadow Run Sampling Locations

Site (location code)	River Mile (RM)	Location/Notes
Mouth of Meadow Run (MR1)	0.1	Along abandoned RR bed just upstream of confluence with Little Raccoon Creek; Mead property leased to Dickerson et al.
Greg and Diana Pugh property (MR2)	0.5	Stream location behind Pugh residence
Cheatwood Road (MR3)	0.72	Downstream bridge
14th Street in Wellston (MR4)	1.5	At bridge crossing
SR 327 in Wellston (MR5)	2.1	Downstream bridge

The results of the investigation will be evaluated using Ohio EPA's general water quality criterion for recreational use designations that applies to all surface waters in the state. The criteria are set forth in Table 7-13 in Ohio Revised Code section 3745-1-07. This section establishes water quality criterion for both total fecal coliform and E. Coli bacteria levels (Figure 1) and dictate that at least one of the two must meet for each designation. These criteria apply during the recreation season which is defined as May 1st – October 15th.

Figure 1: Ohio EPA Primary and Secondary Contact Standards for Fecal Coliform and E. Coli Bacteria (Ohio Revised Code 3745-1-07)

Primary contact

Fecal coliform - geometric mean fecal coliform content (either MPN or MF), based on not less than five samples within a thirty-day period, shall not exceed 1,000 per 100 ml and fecal coliform content (either MPN or MF) shall not exceed 2,000 per 100 ml in more than ten per cent of the samples taken during any thirty-day period.

E. coli - geometric mean E. coli content (either MPN or MF), based on not less than five samples within a thirty-day period, shall not exceed 126 per 100 ml and E. coli content (either MPN or MF) shall not exceed 298 per 100 ml in more than ten per cent of the samples taken during any thirty-day period.

Secondary contact

Fecal coliform - shall not exceed 5,000 per 100 ml (either MPN or MF) in more than ten per cent of the samples taken during any thirty-day period.

E. coli - shall not exceed 576 per 100 ml in more than ten per cent of the samples taken during any thirty-day period.

Methodology

A Quality Assurance Project Plan (QAPP) was developed for this study which covers all sampling and data procedures/requirements (USEPA, 1996).

Field data collected at a stream location consists of dissolved oxygen (DO), pH, conductivity, temperature, and discharge (i.e. stream flow). Measurements of DO, pH, specific conductivity, and temperature are measured with a Hydrolab Quanta multi-meter HI98129. This data is collected during water sample collection. The probe or sonde is placed into the stream where flow exists (at least one foot per second for DO), and a reading is taken and recorded once the meter stabilizes.

Bacteria grab samples were collected directly into pre-cleaned and sterilized containers supplied by the laboratory and described in the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (OEPA 2003). The actual water sample was taken just below the surface, properly labeled, and transferred immediately to a cooler and stored on ice for preservation. Bacteria grab samples were collected on Wednesday afternoons and delivered to the Athens County Health Department by 7:30 a.m. (Thursday) the following day for pick up by the contracted lab, MASI Environmental Labs of Dublin, Ohio. Internal Ohio EPA sampling procedures require that samples be received by the laboratory within six hours of collection but since that was not possible on this project, samples were collected according to USEPA guidance when samples need to be shipped overnight to a laboratory for analysis the next day. All samples were

kept chilled in a cooler during transport and were placed in a refrigerator overnight. Holding times for sample analysis, according to USEPA protocol, is 30 hours maximum although 24 hours is recommended. Laboratory analysis for *E. Coli* and fecal coliform was conducted using EPA 1103.1 methods and standard method 92220 respectively. Four percent of bacteria samples had duplicate samples for quality control and assurance practices.

Field data was recorded in a notebook and entered into a database. Fecal coliform and *E. Coli* data were faxed by MASI Environmental Labs to the Jackson County Health Department on Friday following the sampling event. The Jackson County Health Department then faxed the data to the Raccoon Creek Watershed Coordinator at Ohio University for entry into a database and data analysis (Appendix A). Hard copies of all data, field and lab, were kept for data quality and assurance objectives.

Historical Meadow Run Data

Ohio EPA has previously studied the Meadow Run basin for water quality impairments which included data on toxic sediments, fish and macroinvertebrate communities, habitat, and chemical water quality (OEPA 1996). According to Ohio EPA, Meadow Run's Biological Use Designation is Warm Water Habitat (WWH) and all 5.1 river miles are in non-attainment of the designated use (Figure 1). Listed sources of impairment in 1996 included Pillsbury (General Mills currently), Wellston WWTP, and acid mine drainage (AMD). Causes of impairment included ammonia, Biological Oxygen Demand (BOD) in the water column, and dioxin and manganese in sediments. Ohio EPA also indicated that biological integrity of the lower reach of Meadow Run is chronically "heavily impacted" from organic enrichment with data collected in 1984, 1990, and 1995.

Surface water samples documented high levels of iron at RM 3.1, 2.23, 1.47, and 0.72. DO levels did not achieve the minimum WWH criterion at RM 0.72 (Cheatwood Road) and algal growth was substantial. Fecal coliform samples were collected three times during August to September of 1995. One violation of the Primary Contact Recreation (PCR) criterion occurred at RM 2.23 while all three fecal coliform samples at RM 0.72 violated the PCR criterion.

More recent water quality problems in Meadow Run were seen in August of 2006. The Wellston WWTP had mechanical problems which resulted in its inability to treat wastewater for a period of several weeks. As a result some untreated wastewater was discharged into Meadow Run which resulted in significant fish mortality, which was investigated by both Ohio EPA and the Ohio Department of Natural Resources Division of Wildlife. Water quality data collected by the Raccoon Creek Partnership showed DO levels of 0.5 mg/l on 8-16-06 and 0.45 mg/l on 8-22-06.

Results and Discussion

Water samples were collected at the five sites on Meadow Run (Table 1) on April 18th, April 25th, May 2nd, 9th, 16th, 23rd, and 30th of 2007. Field chemistry was collected on all dates except on May 23rd and bacteria samples were collected and analyzed for all five dates in May.

The purpose of the bacteria data was not to suggest recreational use designation, which is done by Ohio EPA but only to compare with already established statewide criterion. Fecal coliform results indicate that Meadow Run has concentrations below the Ohio EPA primary contact recreational use standards at any of the five sites sampled in Meadow Run but does exceed primary contact standards for E. *Coli* at four of the five sites (Figure 2). The four sites that do not meet primary contact statewide standards for *E. Coli* are river mile 0.2 (Pugh Residence), river mile 0.72 (Cheatwood Road), river mile 1.5 (14th Street bridge in Wellston), and river mile 2.1 (SR 327). *E. Coli* concentrations at river mile 0.72, 1.5, and 2.1 are extremely elevated. Meadow Run at the 14th street bridge (MR-04, RM 1.5) had the highest mean concentration of *E. Coli* at nearly eight times the statewide standard.

Additionally, there is clearly a trend that the upstream sites on Meadow Run have higher concentrations of *E. Coli* and fecal coliform than the lower reaches. The only site that does not exceed the state water quality standards for either *E. Coli* is at the confluence of Meadow Run (RM 0.1) with Little Raccoon Creek, which is downstream of a large wetland in Meadow Run. Residence time in the wetland is not known, but this data indicates that the wetland is providing significant buffering capacity to Little Raccoon Creek with regard to bacteria concentrations.

Over the five sample collection times in May there was considerable fluctuation in the concentration of bacteria at each site (Figure 3 & 4). For example, on May 16th and May 30th concentrations of fecal coliform and E. Coli were much greater than the other three dates for all five sites. In fact, MR-05 had concentrations of 9,100 and > 10,000 cfu/100 ml during the May 16th and May 30th sampling respectively. MR-03, MR-04, and MR-05 all had concentrations > than 9,000 cfu/100 ml during the May 16th sampling. Precipitation does appear to affect bacteria levels in Meadow Run because the samples collected on these two dates, May 16th and 30th, were after recent rainfall events where creek levels were slightly elevated.

Figure 2: 2007 Meadow Run *E. Coli* and Fecal Coliform Data by Site

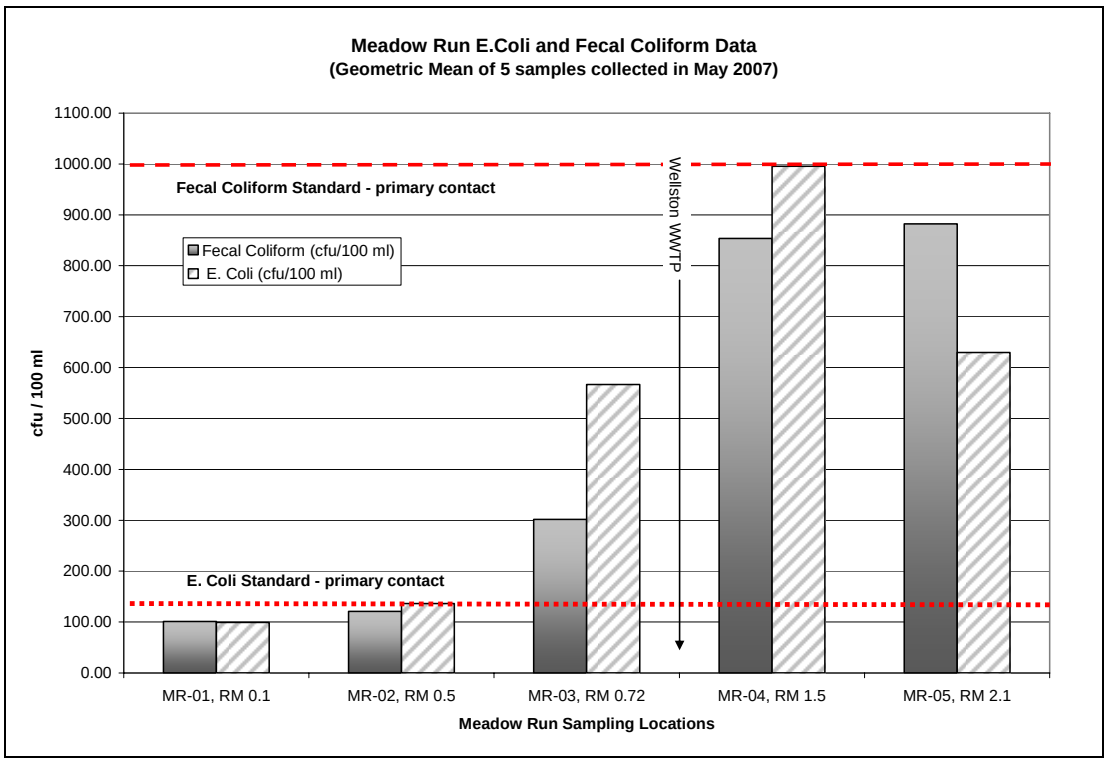


Figure 3: 2007 Fecal Coliform Data in Meadow Run by Sampling Date

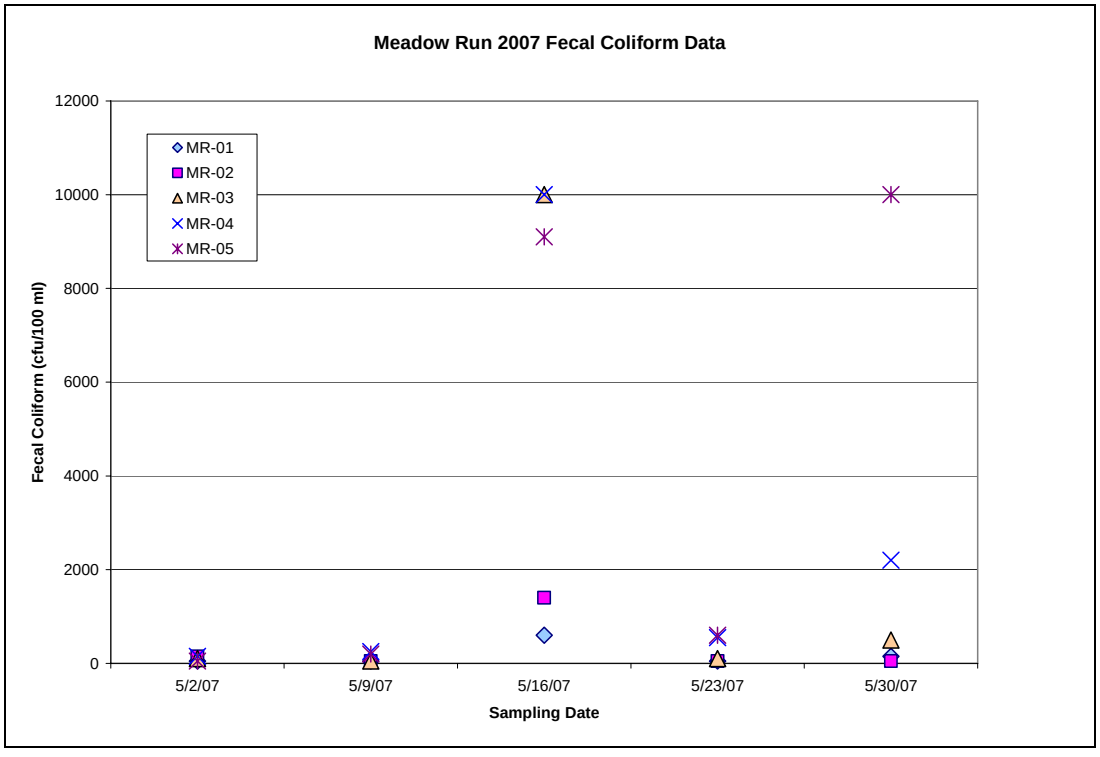
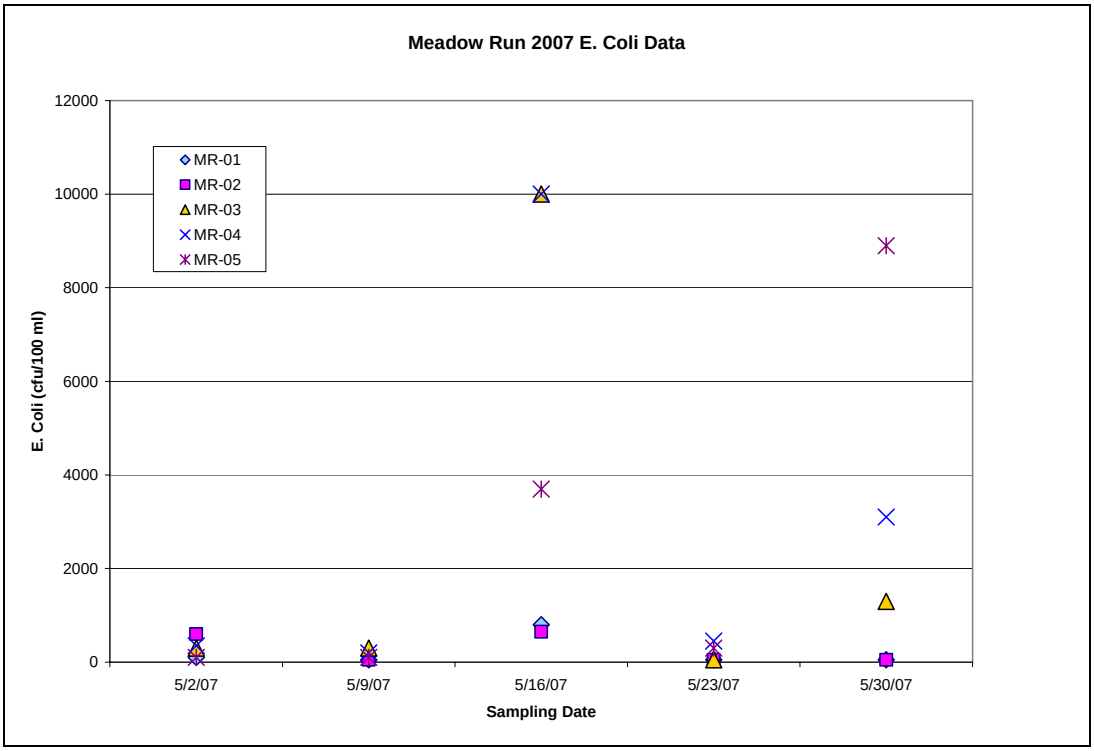


Figure 4: 2007 *E. Coli* Data in Meadow Run by Sampling Date



Water chemistry data collected during the same time period with a Hydrolab datasonde indicated that pH levels were not indicative of AMD levels. The lowest pH measurement was on May 16th at MR-05 (SR 327) of 6.79. The USEPA standard for pH for the protection of aquatic life is 6.5 – 9.0. All of the samples collected in Meadow Run in May of 2007 were within this range. This is in contrast to earlier Ohio EPA study that reported acid mine drainage as an impairment to Meadow Run. During the 2007 sampling large amounts of iron or aluminum flocculants were not visible which are usually associated with acid mine drainage impacted streams. Consistent with the data collected in this study the Little Raccoon Creek Acid Mine Drainage Abatement and Treatment (AMDAT) plan did not recognize Meadow Run as a priority for AMD treatment and abatement (Laverty, 2000).

Specific conductivity measurements ranged from 499 – 928 uS/cm. The lowest measurements were at the confluence of Meadow Run, which ranged from 499 – 523 uS/cm showing that specific conductivity is reduced in the wetland between RM 0.5 and RM 0.1.

Since the study period fell within the April 15th to June 15th fish spawning season, dissolved oxygen levels must equal or exceed 5 mg/l at all times (Ohio Revised Code 3745-1-32). All of the Meadow Run sites exceeded or equaled the OEPA standard of 5 mg/l except MR-03 (Cheatwood Rd, RM 0.72) on May 30th. The DO level at this site was 4.67 mg/l on May 30th.

Conclusions

It was apparent during this investigation that Meadow Run contains untreated or poorly treated sewage/wastewater by the odor and color of the stream water and high density of algae in many locations. Data collected during this investigation in Meadow Run documents high levels *E. Coli* bacteria that is a serious human health risk. At four of the five sampling locations *E. Coli* concentrations exceed water quality standards, and at three of these sites *E. Coli* concentrations are four to eight times the state water quality standards. The month of May was unusually dry in 2007 but both the May 16th and May 30th sampling were conducted after small precipitation events either the day before or the morning of sampling. This indicates that precipitation events trigger higher amounts of *E. Coli* and fecal coliform to enter the water column in Meadow Run. It should be noted that during the sampling event, children were seen playing in the stream that had *E. Coli* concentrations of over 10,000 cfu/100 ml. Potential sources of bacteria contamination include overflow from plugged wastewater pump stations, possible unsewered areas in Wellston or upstream of Wellston in the Meadow Run headwaters. Further investigation by the Raccoon Creek Partnership, Jackson County Health Department, the City of Wellston, and Ohio EPA is needed to determine the cause and source of the untreated wastewater entering Meadow Run, the true extent of its contamination, the risks to both public health and aquatic life, and to establish the necessary steps to remediate the problem.

References

Laverty, B. 2000. Acid Mine Drainage Abatement and Treatment (AMDAT) Plan for the Little Raccoon Creek Watershed, Jackson County, Ohio, 69 p.

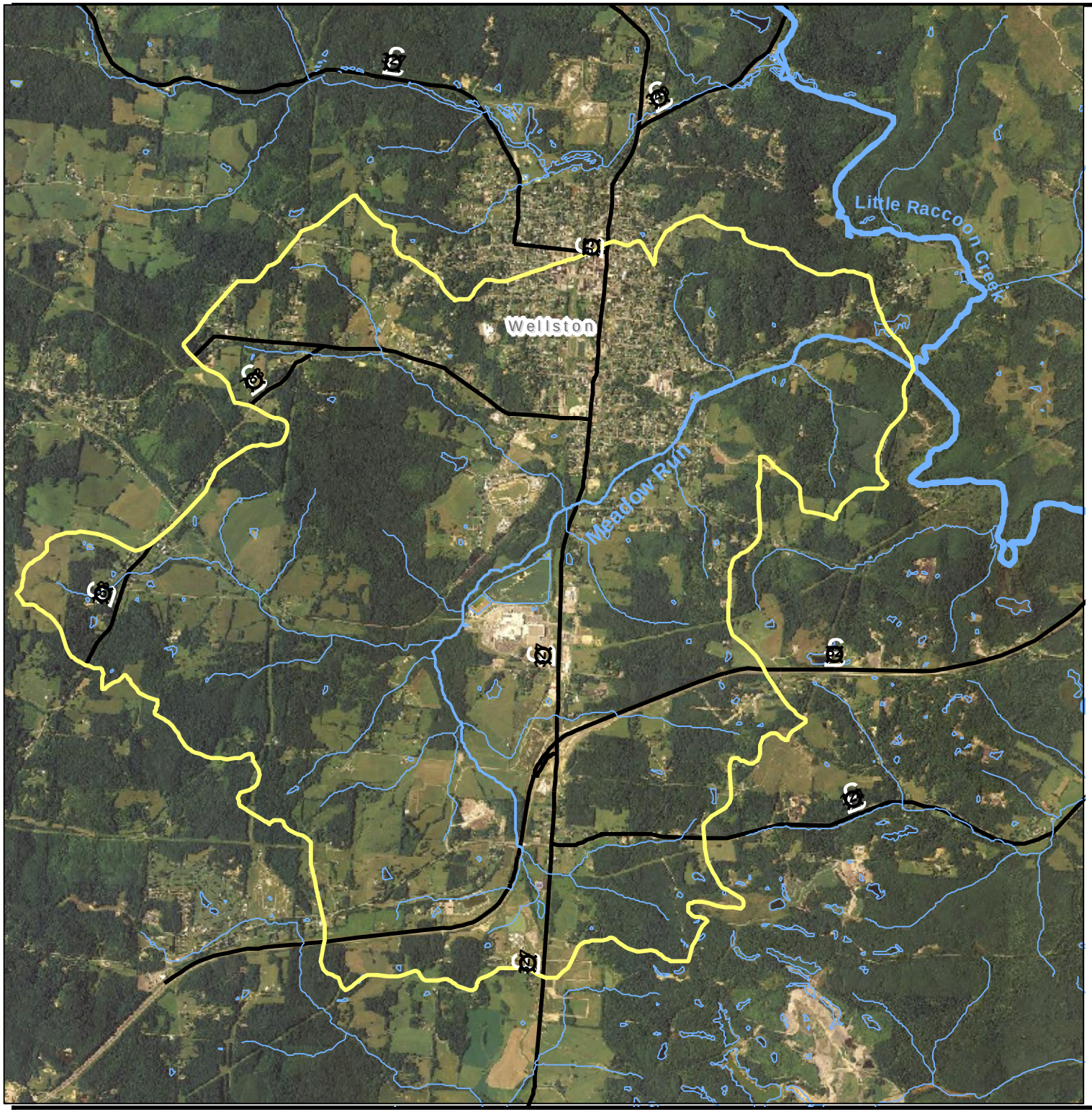
Ohio Environmental Protection Agency (OEPA), 1996. Biological and Water Quality Study of The Raccoon Creek Basin (1995). OEPA Technical Report Number MAS/1996-12-7. Columbus, OH.

Ohio Environmental Protection Agency (OEPA), 2003. Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices. Division of Surface Water.

United States Environmental Protection Agency (USEPA), 1996. The Volunteer Monitor's Guide to Quality Assurance Project Plans (QAPP). Publication EPA 841-B-96-003. Washington, D.C.

Appendix A: Meadow Run 2007 Water Quality Data

Site ID	River Mile	Location	Lab AR sample #	Date	Time (mil)	Total Coliform (100 ml)	E. Coli (100 ml)	Temp ©	Specific Conductivity (mS/cm)	DO (mg/l)	DO %	pH	North	West	Comments
MR-01	0.1	Along abandoned RR	102714	4/18/2007	16:40	positive	positive	17.33	0.391	12.25	129.9	7.1	39 06.907	082 30.280	
MR-02	0.5	Pugh residence	102715	4/18/2007	16:00	positive	positive	13.01	0.392	15.22	145.5	7.36	39 07.045	082 30.781	
MR-03	0.72	Cheatwood Road bridge	102713	4/18/2007	NA	positive	positive	12.65	0.393	11.95	110	7.53	39 06.935	082 30.924	
MR-04	1.5	14th street bridge	102712	4/18/2007	15:15	positive	positive	13.43	0.322	12.94	125	7.32	39 06.585	082 31.591	
MR-05	2.1	SR327 bridge, downstream	102711	4/18/2007	14:15	positive	positive	14.45	0.315	10.95	108.1	7.18	39 06.322	082 32.104	
MR-01	0.1	Along abandoned RR	102719	4/25/2007	14:48			19.07	0.452	10.39	113.6	7.16			
MR-02	0.5	Pugh residence	10720	4/25/2007	15:00			17.62	0.478	8.35	88.1	7.23			
MR-03	0.72	Cheatwood Road bridge	102718	4/25/2007	14:30			16.59	0.486	6.63	68.4	7.3			
MR-04	1.5	14th street bridge	102717	4/25/2007	14:18			16.19	0.446	9.26	94.2	7.36			
MR-05	2.1	SR327 bridge, downstream	102716	4/25/2007	14:10			18.67	0.445	10.25	109.7	7.2			
MR-01	0.1	Along abandoned RR	2609	5/2/2007	15:01	< 50	100	17.44	0.502	7.17	74.7	7.34			
MR-02	0.5	Pugh residence	2610	5/2/2007	15:16	150	600	18.57	0.558	5.94	62.3	7.31			
MR-03	0.72	Cheatwood Road bridge	2608	5/2/2007	14:48	100	300	18.5	0.557	5.45	58.7	7.42			
MR-04	1.5	14th street bridge	2607	5/2/2007	14:35	150	350	18	0.536	7.72	77.5	7.46			
MR-05	2.1	SR327 bridge, downstream	2606	5/2/2007	14:18	< 50	100	18.77	0.561	7.65	80.3	7.35			
MR-01	0.1	Along abandoned RR	2614	5/9/2007	14:05	<50	<50	22.67	0.499	8.15	95.6	7.2			
MR-02	0.5	Pugh residence	104720	5/9/2007	14:32	50	<50	18.2	0.666	8.9		7.39			
MR-03	0.72	Cheatwood Road bridge	2613	5/9/2007	13:57	50	300	16.91	0.677	5.7	58.5	7.45			
MR-04	1.5	14th street bridge	2612	5/9/2007	13:45	250	200	17.67	0.671	7.28	77.2	7.47			
MR-05	2.1	SR327 bridge, downstream	2611	5/9/2007	13:30	200	100	18.74	0.691	8.5	42.1	7.21			
MR-01	0.1	Along abandoned RR	4740	5/16/2007	15:30	600	800	20.54	0.553	7.49	83.5	7.27			
MR-02	0.5	Pugh residence	4741	5/16/2007	15:50	1400	650	19.5	0.792	7.06	77.7	7.28			
MR-03	0.72	Cheatwood Road bridge	4739	5/16/2007	15:19	>10,000	>10,000	18.72	0.754	5	53.5	7.32			
MR-04	1.5	14th street bridge	4738	5/16/2007	15:08	>10,000	>10,000	19.77	0.904	5.93	65.4	7.18			
MR-05	2.1	SR327 bridge, downstream	4737	5/16/2007	15:00	9100	3700	20.12	0.826	6.75	74.4	6.79			
MR-01	0.1	Along abandoned RR	4840	5/23/2007	13:39	<50	<50								
MR-02	0.5	Pugh residence	4841	5/23/2007	13:55	<50	50								
MR-03	0.72	Cheatwood Road bridge	4839	5/23/2007	13:34	100	50								
MR-04	1.5	14th street bridge	4838	5/23/2007	13:26	550	450								
MR-05	2.1	SR327 bridge, downstream	4837	5/23/2007	13:18	600	300								
MR-01	0.1	Along abandoned RR	7021	5/30/2007	13:20	150	50	23.23	0.521	7.54	88	7.71			
MR-02	0.5	Pugh residence	7022	5/30/2007	13:45	50	<50	21.6	0.791	6	67.3	7.76			
MR-02	0.5	Pugh residence	7023	5/30/2007	13:45	150	100								Duplicate
MR-03	0.72	Cheatwood Road bridge	7020	5/30/2007	13:11	500	1300	20.56	0.791	4.67	51.3	7.83			
MR-04	1.5	14th street bridge	7019	5/30/2007	13:00	2200	3100	21.33	0.928	6.44	72.5	7.76			
MR-05	2.1	SR327 bridge, downstream	7017	5/30/2007	12:42	>10,000	8900	21.31	0.853	8.1	90.1	7.58			
MR-05	2.1	SR327 bridge, downstream	7018	5/30/2007	12:42	9600	6400								Duplicate



Map 1: Meadow Run Watershed

0 0.25 0.5 1
Miles

Legend

- Little Raccoon Creek
- Meadow Run
- streams
- State Roads
- Meadow Run Boundary

Little Raccoon Creek Watershed

Map 2: Meadow Run Sampling Locations