

**Water Quality Monitoring of Pennsylvania Lake Erie Streams for Indications of
Non-Point Source Pollution**

**Report submitted to
The Pennsylvania Department of Environmental Protection
Coastal Zone Management Program**

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Abstract

A stream monitoring project was conducted at stream sites along Pennsylvania's Lake Erie shoreline. The City of Erie occupies the central location along this shoreline, and urbanization has spread out from the city both east and west. The shoreline length is approximately forty-five miles from the Ohio state line to the New York state line. Each of thirty sites was visited on five separate occasions, approximately a month apart, between May and October of 2005. On-site measurements were made and water samples were collected for laboratory analysis.

It was found that those stream sites that were most remote from urban areas had better water quality. A ranking was developed for those parameters measured which could have an impact on ecological integrity. The highest ranking stream sites were those on Six Mile Creek, Twenty Mile Creek, and Elk Creek, along with Scott Run (a small stream on the edge of the city).

The lowest ranking sites were those affected by urban development, and included Sixteen Mile Creek, which runs through the town of North East, PA, and Mill Creek, Cascade Creek, McDanel Run, and Walnut Creek, all of which are directly affected by the City of Erie and its surrounding urban area.

An examination of individual parameters and groups of parameters provided clues as to the type of non-point pollution influencing individual sites. These results could lead investigators to selected portions of impacted watersheds in order to specifically identify problem areas and activities. Remediation actions could then be developed using Best Management Practices to ameliorate the adverse impact on the watersheds and stream water quality.

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1. Background

In order to identify possible sources of non-point source pollution, the Department of Environmental Science and Engineering conducted a water quality monitoring program during the Spring, Summer, and Fall of 2005 of the streams flowing into Lake Erie along the Pennsylvania shoreline.

The streams flowing into Lake Erie along the Pennsylvania shoreline follow roughly parallel paths as they drain the relatively narrow Pennsylvania Lake Erie watershed. The lake level (approximately 570' above sea level) is approximately 60 to 100 feet lower than a narrow plateau created when the last glaciers retreated from this area about 12,000 years ago. Wave action over the last 12,000 years created a cliff-like bluff along the shoreline in this region. The streams along this shoreline flow northwest into the Lake, but the larger ones tend to flow southwest from their headwaters and then turn northwest as they cut their way through the Devonian shale bedrock of the region to discharge into the lake. The shale is easily eroded and each stream has to some degree created a ravine as it descends through the bluff to the lake level. These ravines are local foci for erosion and in some cases have resulted in steep unstable conditions for the unconsolidated material above the bedrock.

The watersheds along the Pennsylvania Lake Erie shoreline vary widely in their land use. The watersheds draining directly into Presque Isle Bay are mostly urban while, with some exceptions, the watersheds of streams draining directly into Lake Erie are mixed forest and agricultural fields. There is an ever increasing urban sprawl radiating out from the City of Erie as well as village-type population centers clustered at various locations.

An important feature along this shoreline is Presque Isle, a seven-mile recurved sand spit which projects into the Lake and forms Presque Isle Bay, the Erie Harbor. As the last glacier retreated from this area, it stalled at this approximate location and created a moraine across what is now Lake Erie. This moraine is now underwater, but it disturbs the littoral drift of sediments carried by currents from west to east along the southern shore of the lake. Deposition of sand at the former terminus of the moraine has led to the peninsula we call Presque Isle. The harbor formed by Presque Isle has been designated an Area of Concern in the Great Lakes by the United States Department of State in January 1991, because of the presence of contaminated sediments and high incidence of fish tumors. The most likely sources of contamination now found in the Bay are pollutants released from activities along the Bayfront, many of which have subsequently been controlled. Today, it is likely that there continues to be a release of sediment and contamination from the watershed to the Bay, and that this transport of sediment and associated contamination is likely to have a deleterious impact on the streams of the watershed as well as on the Bay itself.

Many of these streams support valuable sport fisheries. In addition, a stream's quality reflects the overall environmental quality of its watershed. Therefore, it is important to monitor the water quality of these streams in order to identify potential threats to these valuable resources and to develop protection and intervention strategies where necessary. These streams also provide the opportunity to study the relative

importance of urbanization and agriculture as determining factors influencing ecological quality and biodiversity.

2. Project Description

The objective of this project was to monitor water quality at selected sites (Figure 1) on the perennial streams entering Lake Erie along Pennsylvania's shoreline over a period from Spring to Fall, 2005, and to use that information to identify watersheds that might be non-point sources of pollution. Water quality parameters evaluated included *in situ* measurements of pH, temperature, conductivity, and dissolved oxygen. Water samples were collected and returned to the laboratory for the measurement of total coliforms and *E. coli*, total nitrogen (TN), total phosphorus (TP), turbidity, total organic carbon (TOC), and 5-day biochemical oxygen demand (BOD₅). These factors were selected to complement the data collected in the prior studies referred to above.

The presence of coliform bacteria, and *E. coli* in particular, is the most widely accepted indicator of fecal contamination in a stream. Fecal contamination containing coliform bacteria may come from any warm-blooded animal including farm animals, wildlife, and birds, and so does not always confirm the presence of untreated sewage. However, the presence of fecal coliform counts above health department standards can lead to the closing of bathing beaches and public warnings to avoid contact with contaminated water. Moreover, coliforms, high BOD, and high TOC are reliable indicators of organic pollution and are detrimental to the health of the streams and Lake Erie.

Nitrogen and phosphorus are the principal nutrients of concern related to eutrophication of Lake Erie. The typical sources of these nutrients are human and farm animal wastes and excessive fertilization of agricultural and residential properties. Nitrogen is occasionally regulated in the NPDES permits for point-source discharges of water to Lake Erie. Phosphorus is always regulated in new NPDES permits for water discharges to Lake Erie because it is believed to be the limiting nutrient for algal growth in the lake.

The work objectives for the project included the following elements.

- Monitoring of water quality during the spring through the fall of 2005 for 20 perennial streams which enter Lake Erie along the Pennsylvania shoreline, at a total of 30 locations on 20 streams;
- Analysis of results and preparation of a report for the Pennsylvania Department of Environmental Protection's Coastal Zone Management Program;
- Presentations by the Principle Investigator (PI) to at least two watershed groups, municipalities in the study area, and/or other interested groups on prior arrangement at no cost;
- Electronic publication of the findings to the public through Gannon University's Department of Environmental Science and Engineering website.

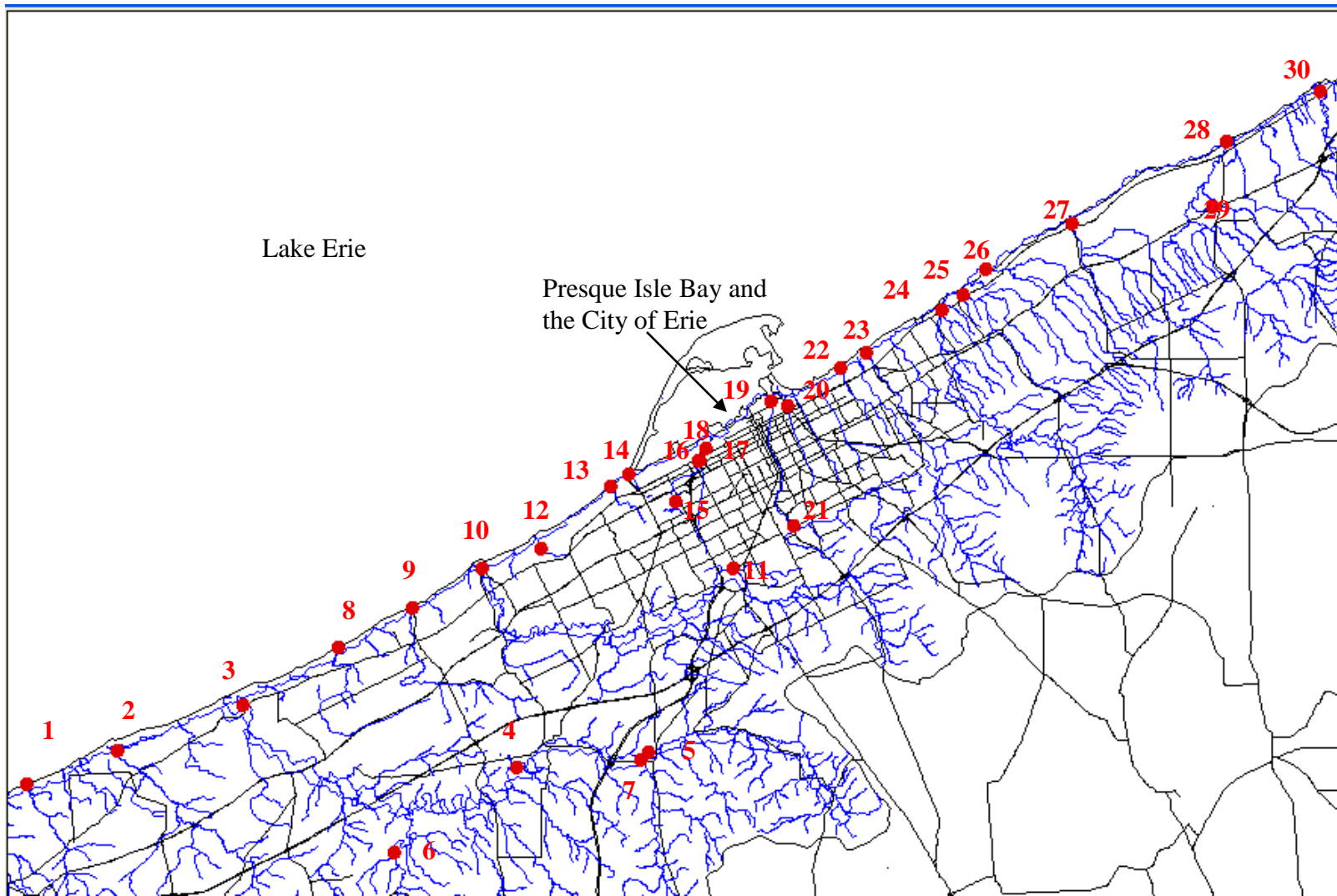


Figure 1. Map of Pennsylvania's northwest shoreline on Lake Erie illustrating the location of the stream monitoring sampling sites; numbers correspond to the site numbers listed in Table 1.

3. Methods

3.1 Work Plan

All sampling and sample analysis were in accordance with the USEPA's The Volunteer Monitor's Guide to Quality Assurance Project Plans (EPA 841 –B-96-003). Student workers were trained in proper data collection, sample collection, and field and laboratory documentation. All necessary equipment and supplies were assembled in accordance with the Guide. In addition to traditional data presentation techniques, use of a GIS format for the presentation of results using ArcView and the US EPA's BASINS system were used for the analysis and presentation of environmental data.

3.2 Site Selection

In determining site locations, sites were selected based on practical public access points to the streams. The locations were near the mouth for all streams and for the larger streams additional sites were identified within their drainage area, including named tributaries. Thus 30 sites were monitored throughout the course of the study. At each location field measurements were made and samples were collected for laboratory analysis. Locational information and site names are provided in Table 1.

3.3 Field Measurements and Sample Collection

On-site measurements of pH, dissolved oxygen (DO) and temperature were made at each site using Accumet portable pH and DO meters. Specific conductivity was measured with a Corning 311 portable conductivity meter and recorded in $\mu\text{S}/\text{cm}$. The surface velocity was taken at the thalweg of the stream with a hand-held velocity meter and recorded in ft/s, then converted to m/s.

Water samples were collected within each sample reach. Sample bottles were pre-washed using Alconox and rinsed with tap water. The bottles were then placed in a 0.1 N nitric acid bath for 24 hours and rinsed with distilled water. Water samples were collected in 1 L plastic bottles. All water samples were filled to the top so as to avoid air headspace in the bottle. All bottles were placed on ice for return to the laboratory. All samples were analyzed in duplicate except where noted.

3.4 Laboratory Measurements

3.4.1 Total Organic Carbon (TOC)

Total organic carbon was measured using unfiltered samples. TOC was measured in the sample by the non-purgeable organic carbon method using a Shimadzu 5050A Total Carbon Analyzer. Each sample was acidified with phosphoric acid to convert carbonate and bicarbonate ions to carbonic acid. The sample was then sparged with oxygen for 10 minutes, stripping carbonic acid (as carbon dioxide) from the sample (this may also remove volatile organics). Before and after each sample batch, a standard of known carbon content and a deionized-water blank were analyzed for quality control purposes.

Table 1. Site names and location information; listed approximately from west to east along the Lake Erie shoreline.

Site Number	Site Name	Latitude	Longitude
1	Raccoon Creek	41° 59' 19.49" N	80° 28' 50.52" W
2	Crooked Creek	42° 00' 08.48" N	80° 25' 53.49" W
3	Elk Creek 1	42° 01' 11.14" N	80° 21' 51.33" W
4	Elk Creek 2	41° 51' 39.19" N	80° 13' 00.17" W
5	Elk Creek 3	41° 59' 58.50" N	80° 08' 54.32" W
6	Little Elk Creek	41° 57' 37.61" N	80° 17' 01.30" W
7	Lamson ¹	41° 59' 47.22" N	80° 08' 59.45" W
8	Godfrey Run	42° 02' 33.49" N	80° 18' 46.22" W
9	Trout Run	42° 03' 30.56" N	80° 16' 21.45" W
10	Walnut Creek 1	42° 04' 27.16" N	80° 14' 10.49" W
11	Walnut Creek 2	42° 04' 22.28" N	80° 05' 58.76" W
12	Wilkins	42° 04' 55.91" N	80° 12' 12.45" W
13	Marshall	42° 06' 21.62" N	80° 09' 63.20" W
14	Scott Run	42° 06' 38.16" N	80° 09' 17.25" W
15	Cascade West Br 2	42° 05' 58.29" N	80° 07' 49.26" W
16	Cascade West Br 1	42° 06' 59.29" N	80° 07' 02.64" W
17	Cascade Main Br	42° 06' 57.16" N	80° 07' 01.48" W
18	Cascade Mouth	42° 07' 34.91" N	80° 06' 41.49" W
19	Mill Creek 1	42° 08' 22.75" N	80° 04' 41.92" W
20	Garrison Run ²	42° 08' 16.30" N	80° 04' 13.26" W
21	Mill Creek 2	42° 05' 28.98" N	80° 03' 27.19" W
22	McDanel Run	42° 09' 10.35" N	80° 02' 28.29" W
23	Four Mile Creek	42° 09' 30.79" N	80° 01' 39.25" W
24	Six Mile Creek	42° 10' 30.35" N	79° 59' 10.03" W
25	Seven Mile Creek	42° 10' 55.56" N	79° 58' 42.50" W
26	Eight Mile Creek	42° 11' 27.70" N	79° 57' 42.39" W
27	Twelve Mile Creek	42° 12' 32.19" N	79° 54' 54.56" W
28	Sixteen Mile Creek	42° 14' 25.50" N	79° 49' 53.57" W
29	Baker Creek ³	42° 12' 53.54" N	79° 50' 19.60" W
30	Twenty Mile Creek	42° 15' 37.46" N	79° 46' 47.35" W

¹ tributary to Elk Creek

² tributary to Mill Creek

³ tributary to Sixteen Mile Creek

Scott Run, Cascade Creek, and Mill Creek flow into Presque Isle Bay

3.4.2 5-Day Biochemical Oxygen Demand (BOD₅)

The BOD₅ was determined on single samples at each site using the five-day test procedure as described in Standard Method 5210B (APHA et al., 1998). Initial and final DO concentrations were measured using a YSI 52 Dissolved Oxygen Meter. Samples were incubated in a Hach BOD Incubator at 20° C in the dark for the test period. To insure quality control, a distilled-water blank was run with all batches.

3.4.3 Turbidity

Turbidity readings were made using an Orbecco-Hellige Digital Direct-Reading Turbidimeter. Results were expressed in nephelometric turbidity units (NTUs). The unit was zeroed and checked with a 40 NTU turbidity standard before every sample batch.

3.4.4 Bacterial Counts

The HACH m-Colibblue 24 system was used to quantify total coliforms and *E. coli*, using their pre-sterilized pipettes, dishes, broth, filter housings, and filter membranes. This system allows for the determination of both total coliforms and *E. coli* on the same membrane after incubation.

3.4.5 Total Nitrogen and Total Phosphorus

The HACH Test-n-Tube system was used for both Total Phosphorus and Total Nitrogen.

3.5 Data Analysis

For each parameter at each site, a mean value was calculated spanning the study period. Sites were ranked with 30 being the highest quality and 1 being the lowest quality. The rankings for all ecologically important parameters were summed for each site resulting in a ranked score by site where the highest quality composite score was 270 and the lowest quality score was 9. This ranking system permits a comparison among the studied streams, but does not correspond to any regulatory scheme.

Measured parameters were also grouped into four functional categories: physical factors, organic factors, bacteria, and nutrients. The categories and their member parameters are shown in

Table 2. Physical factors included water temperature and conductivity (pH and DO were excluded because all measurements were in the acceptable range). Organic factors included TOC and BOD₅. Organic pollution is typically associated with untreated or poorly treated wastewater discharged into streams, runoff from animal farming operations, and natural animal waste from wildlife. Associated with this category is typically bacterial pollution, which is more directly associated with manure and untreated sewage. Nutrients (nitrogen and phosphorus) are typically associated with excess fertilization of agricultural fields, golf courses, and residential areas. Nutrients are also associated with poorly treated animal waste. Summed rankings by category were calculated so that comparisons could be made on a category basis.

Table 2. Functional categories for grouping measured parameters and their member parameters.

Category	Included Parameters
Physical factors	temperature, conductivity
Organic factors	BOD ₅ , TOC
Bacteria	total coliforms, <i>E. coli</i>
Nutrients	total phosphorus, total nitrogen

4. Results and Discussion

Mean values over the five sampling periods at each site were calculated for each test and are presented in Table 3. Data values for each parameter at each sampling visit for every site are provided in the Appendix.

4.1 Individual Parameters

4.1.1 Temperature, Turbidity

Generally speaking, a low temperature is considered more desirable than a high temperature in streams. High temperatures result in lower dissolved oxygen levels and some aquatic organisms, particularly fish, require cold water to complete their life cycle. Over the study period (May 23 through October 5, 2005), the mean air temperature was 25.2°C with a maximum of 28.9°C and a minimum of 20.3°C. The mean stream water temperature showed slightly more variability with a mean temperature of 20.9°C, a maximum of 24.9°C at Little Elk Creek, and a minimum of 16.7°C at Godfrey Run.

There was a high degree of variability for turbidity over the five sampling periods. The maximum average value was 50.9 NTUs at Walnut I with a minimum average value of 1.1 NTUs at Six Mile. Turbidity results from sediment transport into the stream during storm events and the growth of floating algae in the stream water. High turbidity with low TOC would suggest that erosion is more likely than algal growth. However, because erosion is a storm-event related process, turbidity variation may simply be an artifact of the day on which the samples were collected. Therefore, this factor was omitted from the grouped parameter rankings.

4.1.2 Conductivity, pH

High conductivity is considered less desirable than low conductivity. Conductivity is the result of dissolved salts in the water, and this is usually related to erosion and sediment loss from the watershed. Conductivity showed more variation with a maximum value of 1,037 µS/cm and a minimum of 225 µS/cm at Elk 2. The mean average value for conductivity was 461 µS/cm.

Table 3. Field and laboratory data for all streams; mean of five measurements made between May and October, 2005.

	Air Temp (°C)	Water Temp (°C)	Stream Width (m)	Stream Depth (m)	Surface Velocity (m/s)	pH	DO	Conductivity (µS/cm)	BOD (mg/L)	Total Organic Carbon (mg/L)	Turbidity (ntu)	Total Nitrogen (mg/L)	Total Phosphate (mg/L)	Total Coliforms	E. coli
Raccoon	23.00	19.58	6.02	0.47	0.26	7.75	9.45	321	1.40	6.24	3.86	1.12	0.32	4,360	93
Crooked	23.08	19.74	11.43	0.12	0.38	7.72	9.59	306	1.37	4.39	2.54	1.39	0.27	6,426	4,080
Elk 1	23.14	22.28	15.67	0.20	0.53	7.80	10.57	377	1.35	4.11	1.66	1.66	0.39	5,382	4,013
Elk 2	22.60	21.36	21.07	0.27	0.28	7.50	10.93	225	2.11	7.26	16.61	1.32	0.46	8,875	5,020
Elk 3	26.24	21.94	8.13	0.17	0.36	7.42	7.82	255	1.54	5.09	2.54	0.81	0.27	3,494	238
Little Elk	26.24	24.92	7.10	0.14	0.22	7.82	10.30	247	1.75	5.58	1.20	0.94	0.23	42,568	71
Lamson	26.24	22.64	4.01	0.15	0.27	7.88	9.24	292	1.22	4.28	1.63	0.59	0.25	3,826	229
Godfrey	21.88	16.26	2.96	0.35	0.36	7.94	9.95	362	1.44	2.77	2.92	3.23	0.35	12,000	8,040
Trout	20.34	17.52	5.42	0.38	0.37	7.85	10.25	364	2.11	5.76	15.16	2.77	0.60	8,913	774
Walnut 1	20.76	20.30	13.40	0.36	0.37	7.92	9.88	456	1.52	6.19	50.90	1.44	0.55	8,623	4,580
Walnut 2	28.28	23.32	7.32	0.09	0.28	7.61	8.07	611	2.72	5.84	2.09	1.08	0.28	7,810	145
Wilkins	22.34	19.96	5.09	0.23	0.42	7.62	9.73	505	1.02	4.96	21.16	2.21	0.35	5,485	460
Marshall	26.11	17.94	3.41	0.12	0.26	8.06	10.43	613	0.86	4.03	1.21	2.47	0.28	11,830	4,010
Scott	26.11	17.32	2.40	0.20	0.15	7.95	9.31	773	0.93	4.92	6.20	1.50	0.27	3,718	15
Cascade W Br 1	25.89	18.94	2.71	0.28	0.27	7.91	10.14	1,037	0.82	3.91	2.76	2.56	0.27	10,400	4,080
Cascade W Br 2	28.94	18.14	4.47	0.16	0.22	7.21	8.63	981	2.76	3.18	1.35	4.21	0.50	15,050	162
Cascade Main Br	25.89	17.86	8.38	0.15	0.30	7.89	10.81	665	1.27	3.45	3.26	1.88	0.27	4,417	42
Cascade Mouth	25.11	20.88	7.03	0.45	0.16	8.07	9.55	795	1.17	4.54	1.36	2.62	0.27	6,016	60
Mill Creek 1	25.44	19.40	7.96	0.42		8.01	8.64	570	5.57	6.95	4.46	2.22	0.43	20,000	3,960
Garrison	24.78	21.00	4.11	0.10	0.33	7.65	8.20	484	1.56	5.46	3.40	2.40	0.38	9,618	390
Mill Creek 2	28.16	21.80	7.87	0.21	0.41	7.36	9.46	500	4.54	4.34	1.69	1.70	0.31	13,360	239
McDanel	25.00	21.48	4.77	0.04	0.23	8.15	10.03	555	1.78	6.91	2.22	2.85	0.32	9,750	50
Four Mile	25.88	22.60	8.57	0.09	0.30	8.18	9.30	406	3.26	4.60	1.42	1.00	0.21	5,529	90
Six Mile	26.00	23.58	12.01	0.44	0.13	8.40	8.58	273	0.73	4.38	1.07	0.49	0.26	11,330	17
Seven Mile	25.89	21.44	5.64	0.22	0.40	8.19	9.03	353	1.13	4.82	1.71	1.43	0.25	11,610	99
Eight Mile	26.22	22.82	8.00	0.18	0.38	8.16	9.45	327	1.01	5.70	4.19	0.91	0.27	11,840	4,200
Twelve Mile	26.80	22.34	6.10	0.28	0.95	8.27	8.90	294	2.51	3.57	1.18	2.54	0.25	5,910	70
Sixteen Mile	26.44	22.76	11.13	0.47	0.35	7.90	9.01	365	2.37	6.92	5.14	1.80	0.48	12,900	5,090
Baker	27.78	21.96	3.28	0.26	0.52	7.86	8.25	260	0.95	6.07	21.54	0.93	0.65	15,440	469
Twenty Mile	26.68	24.32	13.25	0.14	0.39	8.15	9.55	260	1.03	3.48	1.40	1.20	0.28	3,831	34
MEAN	25.24	20.88	7.62	0.24	0.34	7.78	9.44	461	1.79	4.99	6.26	1.78	0.34	10,010	1,694
STD DEV	2.17	2.23	4.29	0.13	0.15	0.28	0.82	216	1.10	1.21	10.23	0.87	0.12	7,400	2,281

The pH was fairly uniform for the sites throughout the sampling period. Average pH for all sampling sites was 7.78 with a maximum value of 8.40 at Six Mile and a minimum value of 7.21 at Cascade West 2. These values are all in the normal range for streams, and the variation is not of any significance. Thus, pH was not used for grouped parameter rankings.

4.1.3 DO, TOC, BOD₅

Dissolved oxygen (DO) averaged 9.44 mg/L, with a maximum of 10.93 mg/L at Elk 2 and a minimum 7.82 mg/L at Elk 3. These values are all in the acceptable range, and the variation has no real ecological significance.

Total organic carbon (TOC) ranged between 2.77 at Godfrey and 7.26 mg/L at Elk 2 and the average was 4.99 mg/L. This variation may have some significance as an indicator of organic pollution.

BOD₅ ranged from a low of 0.73 mg/L at Six Mile to a high of 5.57 mg/L at Mill Creek, with a mean value of 1.79 mg/L. Even the highest of these values is modest, and reassures us that there are probably no direct discharges of untreated sewage or manure directly into these streams. The variation may be of significance if it reinforces variation observed in other parameters (to be discussed later).

4.1.4 TP, TN

The average total phosphate (TP) concentration was 0.34 mg/L, with a maximum 0.65 mg/L at Baker Run and a minimum of 0.21 mg/L at Four Mile Creek. Total nitrogen (TN) averaged 1.78 mg/L with a maximum of 4.21 mg/L at Cascade Creek West Branch 2 and a minimum of 0.49 mg/L at Six Mile Creek. TP and TN are nutrients which stimulate algal growth and high levels of either are undesirable. They usually are the result of over-fertilization of fields and lawns, or are related to the discharge of poorly treated sewage.

4.1.5 Bacterial Counts

Observations of Total Coliforms showed a high degree of variability over the sampling period. Coliform counts are reported as colony forming units (CFUs) per 100 mL of sample. The maximum value of 42,568 CFUs /100 mL was found at Little Elk Creek, the minimum was 3,494 CFUs /100 mL at Elk Creek 3, and the average for all sampling sites was 10,010 CFUs /100 mL. A species within the total coliforms is *E. coli*, which also showed wide variability within a measured range of 15 CFUs/100 mL at Scott Run to 8,040 CFUs/100 mL at Godfrey Run, with an average of 1,694 CFUs/100 mL. Compared to total coliforms, *E. coli* are believed to be a more direct indication of warm-blooded animal waste because they are not known to naturally grow or reproduce outside of an intestinal tract.

4.2 Geographic Distribution of Water Quality

A ranking was created for each parameter of interest by comparing the mean scores for that factor among all the sites. To create the ranking, a score was assigned from 1 (lowest quality) to 30 (highest quality), and those scores were summed (Table 4).

Table 4. Ranking of stream sites for each parameter and consolidated rank score; higher score is higher quality; organized generally from west to east.

Site Name	Temp	Cond	BOD5	TOC	TN	TP	Tot Col	E. coli	Total Score
Raccoon	22	21	16	5	22	12	26	21	145
Crooked Creek	21	22	17	19	19	22	19	6	145
Elk 1	10	15	18	23	15	8	24	8	121
Elk 2	16	30	8	1	20	6	16	3	100
Elk 3	12	28	13	13	28	24	30	16	164
Little Elk	1	29	11	11	25	29	1	23	130
Lamson	7	24	20	22	29	26	28	17	173
Godfrey	30	18	15	30	2	10	7	1	113
Trout	28	17	9	9	4	2	15	11	95
Walnut I	19	13	14	6	17	3	17	4	93
Walnut 2	4	7	5	8	23	15	18	19	99
Wilkins	20	10	24	14	11	11	23	13	126
Marshall	26	6	28	24	8	17	9	9	127
Scott	29	4	27	15	16	20	29	30	170
Cascade W Br 2	25	2	4	29	1	4	4	18	87
Cascade W Br	24	1	29	25	6	23	12	7	127
Cascade Main Br	27	5	19	28	12	18	25	27	161
Cascade Mouth	18	3	21	18	5	19	20	25	129
Mill Creek 1	23	8	1	2	10	7	2	10	63
Garrison	17	12	12	12	9	9	14	14	99
Mill Creek 2	13	11	2	21	14	14	5	15	95
McDanel	14	9	10	4	3	13	13	26	92
Four Mile	8	14	3	17	24	30	22	22	140
Six Mile	3	25	30	20	30	25	11	29	173
Seven Mile	15	19	22	16	18	27	10	20	147
Eight Mile	5	20	25	10	27	21	8	5	121
Twelve Mile	9	23	6	26	7	28	21	24	144
Sixteen Mile	6	16	7	3	13	5	6	2	58
Baker	11	27	26	7	26	1	3	12	113
Twenty Mile	2	26	23	27	21	16	27	28	170

Another way to visualize this data is to categorize values using various colors to represent low through high values. This may provide easier interpretation of the data than by inspection of numerals. Figure 2 provides such a color-based representation, with darker colors representing lower quality values. The City of Erie occupies a central location along the shoreline, with decreasing degree of urbanization east and west.

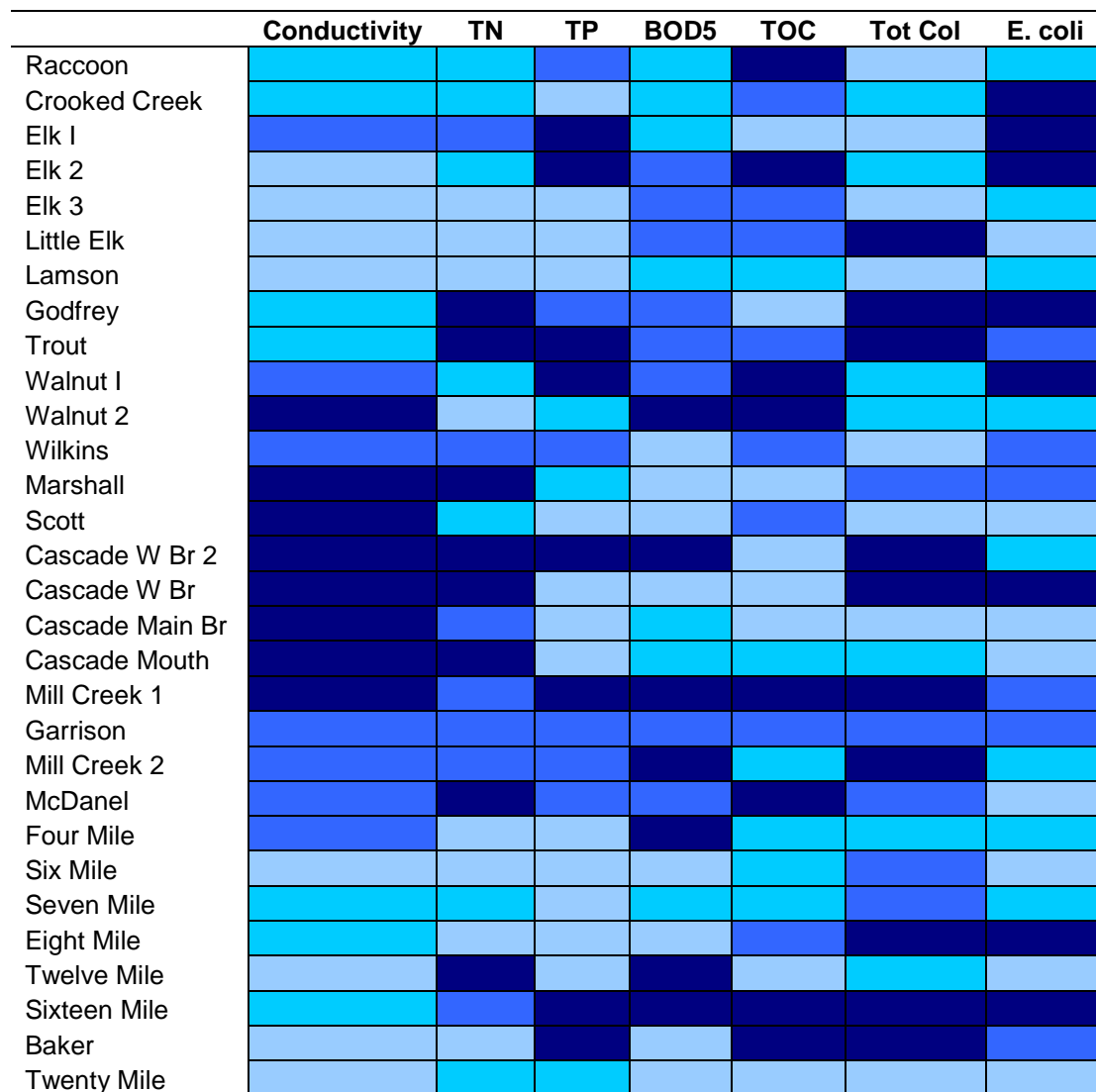


Figure 2. Color-based representation of mean parameter values for the stream sites; darker color represents a lower quality.

As can be seen in the figure, sites clustered in and around the City of Erie (Walnut Creek through Four Mile Creek) have the lowest quality values for conductivity and nitrogen, as well as scattered poor values for other factors. On the fringes of the urbanized central area, residential and agricultural activity is reflected in poor values for organic matter and bacteria. Scattered small urban centers both west and east of Erie are reflected in poor values for selected parameters.

4.3 Consolidated Water Quality Rankings

Streams were ranked according to total score. This is also helpful in identifying those stream sites with the highest water quality, which should be protected from degradation. This ranking is provided in Table 5.

Table 5. Sites ranked by total score; higher score is for higher quality; highest possible score is 300.

Site Name	Temp	Cond	BOD5	TOC	TN	TP	Tot Col	E. coli	Total Score
Six Mile	3	25	30	20	30	25	11	29	173
Lamson	7	24	20	22	29	26	28	17	173
Twenty Mile	2	26	23	27	21	16	27	28	170
Scott	29	4	27	15	16	20	29	30	170
Elk 3	12	28	13	13	28	24	30	16	164
Cascade Main Br	27	5	19	28	12	18	25	27	161
Seven Mile	15	19	22	16	18	27	10	20	147
Crooked Creek	21	22	17	19	19	22	19	6	145
Raccoon	22	21	16	5	22	12	26	21	145
Twelve Mile	9	23	6	26	7	28	21	24	144
Four Mile	8	14	3	17	24	30	22	22	140
Little Elk	1	29	11	11	25	29	1	23	130
Cascade Mouth	18	3	21	18	5	19	20	25	129
Marshall	26	6	28	24	8	17	9	9	127
Cascade W Br	24	1	29	25	6	23	12	7	127
Wilkins	20	10	24	14	11	11	23	13	126
Elk 1	10	15	18	23	15	8	24	8	121
Eight Mile	5	20	25	10	27	21	8	5	121
Godfrey	30	18	15	30	2	10	7	1	113
Baker	11	27	26	7	26	1	3	12	113
Elk 2	16	30	8	1	20	6	16	3	100
Walnut 2	4	7	5	8	23	15	18	19	99
Garrison	17	12	12	12	9	9	14	14	99
Mill Creek 2	13	11	2	21	14	14	5	15	95
Trout	28	17	9	9	4	2	15	11	95
Walnut 1	19	13	14	6	17	3	17	4	93
McDanel	14	9	10	4	3	13	13	26	92
Cascade W Br 2	25	2	4	29	1	4	4	18	87
Mill Creek 1	23	8	1	2	10	7	2	10	63
Sixteen Mile	6	16	7	3	13	5	6	2	58

It should be kept in mind that this ranking system gives equal weight to each parameter. This does not correspond with the ecological importance of each parameter. In addition, slight variation (resulting in ranking differences) may not be ecologically significant. Also, since some of these streams have much larger watersheds than others, discharging much more water than others, the relative importance of each stream is not recognized in this ranking approach.

4.4 Consolidated Ranking by Grouped Parameters

The stream sites are ranked in Table 6 by the four categories defined above, consisting of physical factors, nutrients, organics, and bacteria. It would be possible to

examine the status of every stream site, but in this report, we will only discuss those sites ranked at or near the bottom of Table 5 and those at the top.

4.4.1 The Worst Stream Sites

The lowest ranked site was at the mouth of Sixteen Mile Creek, which ranked at or near the bottom of all of the categories in Table 6. Sixteen Mile Creek's watershed includes the town of North East and extensive agricultural areas dominated by vineyards. This suggests that the Sixteen Mile watershed has non-point pollution sources of several types, including erosion, nutrient loss, and organic pollution including sewage-type material.

The second and seventh lowest ranked sites were those on Mill Creek in the City of Erie. This is the largest tributary to Presque Isle Bay, and it ranked near the bottom of every category of non-point source pollution. Mill Creek 1 is located at the mouth of the stream. Mill Creek 2, located above the so-called "Mill Creek Tube" would have scored better in every category compared to Mill Creek 1 except that the temperature was lower at MC1 compared to MC2. This is probably due to the Tube being underground and therefore resulting in a cooler temperature upon emergence, a misleading ecological indicator. The Tube is a buried twenty-eight foot diameter culvert which contains the stream in its lower portion. The Tube functions as a storm sewer, receiving storm sewer discharges from the highly urbanized city surfaces before opening into a concrete-lined channel adjacent to the Erie Wastewater Treatment Plant, and soon discharging into Presque Isle Bay. Clearly, Mill Creek, along with its tributary Garrison Run, is the primary source of non-point pollution discharged to Presque Isle Bay compared to the other sampled tributary streams (Cascade Creek and Scott Run).

The third worst site was on the Cascade Creek West Branch 2 in the City. This site is located in a highly industrial and commercial district with a large fraction of impervious surface. The site scored poorly due to high levels of nitrogen and phosphorus, along with moderately poor rankings for physical factors and bacterial counts.

The fourth worst site, McDanel Run, scored poorly in the rankings due to organic carbon and nutrients, particularly nitrogen. This small stream enters Lake Erie at Chautauqua Boulevard on the east side of Erie, with headwaters near McClelland Avenue above East 26th Street. Its upper reaches are contained in storm sewers and flows through an industrial and urban area. Except for the lower reach (about a quarter-mile in length) there is no riparian buffer zone. There is a natural waterfall at the mouth of the stream which would prevent upstream migration of fish from Lake Erie.

The mouth of Walnut Creek was fifth from the bottom of our overall ranking. Walnut Creek has the second largest watershed of the Pennsylvania Lake Erie streams, and drains a highly urbanized area occupied by the regional shopping mall and associated commercial activity along upper Peach Street. The Walnut Creek 2 site, located closer to the commercial area, scored higher than did the mouth, primarily because of a better ranking for nutrients and bacteria. Perhaps there are sources for nutrients and bacteria down stream of Walnut 2 which, when added to the pollution released high in the watershed, culminated in the lower sites overall lower ranking.

Table 6. Site rankings by grouped parameters; intermediate lines divide the 30 sites into three classes.

Site Name	Physical Factors	Site Name	Nutrient Factors	Site Name	Organic Factors	Site Name	Bacterial Factors
Godfrey	48	Six Mile	55	Cascade W Br	54	Scott	59
Elk 2	46	Lamson	55	Marshall	52	Twenty Mile	55
Trout	45	Little Elk	54	Six Mile	50	Cascade Main Br	52
Raccoon	43	Four Mile	54	Twenty Mile	50	Raccoon	47
Crooked Creek	43	Elk 3	52	Cascade Main Br	47	Elk 3	46
Elk 3	40	Eight Mile	48	Godfrey	45	Cascade Mouth	45
Baker	38	Seven Mile	45	Scott	42	Twelve Mile	45
Seven Mile	34	Crooked Creek	41	Lamson	42	Lamson	45
Scott	33	Walnut 2	38	Elk I	41	Four Mile	44
Walnut 1	32	Twenty Mile	37	Cascade Mouth	39	Six Mile	40
Marshall	32	Scott	36	Wilkins	38	McDanel	39
Cascade Main Br	32	Twelve Mile	35	Seven Mile	38	Walnut 2	37
Twelve Mile	32	Raccoon	34	Crooked Creek	36	Wilkins	36
Mill Creek 1	31	Cascade Main Br	30	Eight Mile	35	Elk I	32
Lamson	31	Cascade W Br	29	Cascade W Br 2	33	Seven Mile	30
Little Elk	30	Mill Creek 2	28	Baker	33	Garrison	28
Wilkins	30	Baker	27	Twelve Mile	32	Trout	26
Garrison	29	Elk 2	26	Elk 3	26	Crooked Creek	25
Six Mile	28	Marshall	25	Garrison	24	Little Elk	24
Twenty Mile	28	Cascade Mouth	24	Mill Creek 2	23	Cascade W Br 2	22
Cascade W Br 2	27	Elk I	23	Little Elk	22	Walnut I	21
Elk 1	25	Wilkins	22	Raccoon	21	Mill Creek 2	20
Cascade W Br	25	Walnut I	20	Walnut I	20	Elk 2	19
Eight Mile	25	Garrison	18	Four Mile	20	Cascade W Br	19
Mill Creek 2	24	Sixteen Mile	18	Trout	18	Marshall	18
McDanel	23	Mill Creek 1	17	McDanel	14	Baker	15
Four Mile	22	McDanel	16	Walnut 2	13	Eight Mile	13
Sixteen Mile	22	Godfrey	12	Sixteen Mile	10	Mill Creek 1	12
Cascade Mouth	21	Trout	6	Elk 2	9	Godfrey	8
Walnut 2	11	Cascade W Br 2	5	Mill Creek 1	3	Sixteen Mile	8

The Trout Run site had the sixth lowest ranking due mostly to poor rankings for nutrients and organics. There is said to be an extremely popular near-shore fishery for steelhead trout in Lake Erie just off the mouth of this stream. The Pennsylvania Fish and Boat Commission has a rather large trout hatchery facility in this watershed. It is not known whether discharge from the facility is in any way connected with the observed high levels of nutrients and organics, but the possibility does exist.

4.4.2 The Best Stream Sites

The best stream sites monitored were those on Six Mile Creek, Twenty Mile Creek and the upper sites on Elk Creek (Elk 3 and Lamson, a tributary to Elk), as well as Scott Run.

Six Mile Creek provides an excellent steelhead fishery in its lower reach. Its watershed is just under 20 miles² and is only partially developed with extensive open or forested areas. Agriculture and low density residential development is scattered throughout the watershed.

Twenty Mile Creek's watershed is mostly across the state line in New York, but the mouth of the stream is in Pennsylvania and is said to have a robust cold-water fishery.

Elk Creek has the largest watershed (101 square miles) in this study area. Its lower region is dominated by the development around Lake City and Girard Boros while its upper reaches consist of widely scattered agriculture in otherwise undeveloped forest and abandoned fields. Only 10 percent of the watershed is now classified by the Erie County Department of Planning as being "developed." This is arguably the most productive of all streams flowing directly into Lake Erie along the Pennsylvania shoreline. Elk Creek supports a diverse fish population including warmwater and coldwater species of fish. Natural reproduction of rainbow trout [steelhead] has been noted in some tributaries. The stream also supports a fair population of smallmouth bass in places. Many of these bass are rather small in size, and likely are the result of spawning of Lake Erie adult fish that run up from Lake Erie in the springtime during higher water levels. Channel catfish ascend the lower end of the stream for spawning purposes. Numerous species of "baitfish" inhabit the stream (Wellington, personal communication, 2005). On the other hand, there are small urban centers and discharges from treatment plants, mostly in the lower reaches. These urban centers and discharges may contribute to the lower water quality at the lower sites of Elk 1 and Elk 2.

Scott Run, a small stream discharging into the far west end of Presque Isle Bay ranked highly. This stream drains a small area in Millcreek Township on the edge of the city and scored well in all factors but conductivity. Much of this small watershed contains a forested area and a lightly-used recreational park. During storm events, high sediment loads have been observed in this stream. Our ranking system was inadequate to assess sediment transport and erosion, and so the ranking for Scott Run is a bit misleading. The stream drops dramatically within a short distance and has created a deep ravine at the bluff. It is easily observed that Scott Run has created high unstable stream banks and is a major source of sediment to Presque Isle Bay.

5. Conclusions and Recommendations

It is clear from this study and prior work done by these and other researchers along this shoreline that these streams vary from almost pristine condition to highly urbanized and stressed aquatic ecosystems. This study did not quantify the extent of channelization, stream bank instability, contaminated sediments, and other indicators of degraded stream conditions. However, the results of this study do reflect the general observation that streams flowing through areas which have been developed or manipulated have lower water quality than those flowing through undisturbed areas. As was shown dramatically in Figure 2, water quality in the urban center of this shoreline is negatively affected by urbanization.

It may be possible to restore the water quality of streams flowing through the City of Erie's metropolitan region, but it would be at great expense. Other streams are not so far gone. The results of this study suggest that there are scattered releases of non-point source pollution which could be identified and addressed through the use of so-called "best management practices" by agriculture and urban centers, if concerned citizens and their local governments are sufficiently aware and motivated to take action.

It should be clear to any careful observer that urban sprawl and development lead to degraded water quality, and that this poses a threat to the integrity of the aquatic ecosystems of these streams. The many streams along this coastline which still support healthy ecosystems deserve protection. Such protection can be afforded through intelligent land use decisions and a respect for the value and beauty of these beautiful natural resources.

6. Appendix

On the following pages are the detailed results of sampling visits and sample analysis, arranged in alphabetical order.

6.1 Baker Creek

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/9/2005	6/27/2005	7/20/2005	8/16/2005	9/26/2005					
Time	4:00 PM	11:05 PM	3:10 PM	2:05 PM	3:15 PM					
Heavy Rain Past 7 Days	No	No	Yes	Yes	Yes Storm (Heavy Rain)					
Weather Conditions	Sunny	Sunny	Sunny	Sunny						
Air Temp (C°)	33.3	31.1	28.3	25.6	20.6	27.8	5.0	28.3	33.3	20.6
Water Temp (C°)	22.5	21.6	23.6	22.6	19.5	22.0	1.5	22.5	23.6	19.5
Stream Width (m)	3.4	2.7	3.4	2.7	4.1	3.3	0.6	3.4	4.1	2.7
Stream Depth (m)	0.26	0.235	0.23	0.14	0.42	0.3	0.10	0.235	0.415	0.14
Surface Velocity (m/s)	0.4	0.3	0.4	0.3	1.3	0.5	0.4	0.4	1.3	0.3
pH	8.0	7.9	8.0	8.1	7.6	7.9	0.2	8.0	8.1	7.6
DO (mg/L)	7.4	7.5	7.2	9.0	10.2	8.2	1.3	7.5	10.2	7.2
Conductivity (µS/cm)	299	258	263	235	244	259.8	24.57	258	299	235
BOD (mg/L)	2.0	0.5	0.8	0.5	0.9	1.0	0.6	0.8	2.0	0.5
Turbidity (ntu)	2.6	88.7	9.9	2.9	3.60	21.5	37.66	3.6	88.7	2.6
Total Nitrogen (mg/L)	2.4	0.8	0.9	0	0.55	0.9	0.89	0.8	2.4	0
Total Phosphate (mg/L)	0.36	1.14	0.47	0.64	0.66	0.7	0.30	0.64	1.14	0.36
Total Organic Carbon (mg/L)	4.7	5.0	4.1	3.4	13.1	6.1	4.0	4.7	13.1	3.4
Total Coliform (col/100 mL)*	20000	18300	15500	3400	20000	15440	6977	18300	20000	3400
E. Coli (col/100mL)	93	250	250	0	1750	469	724	250	1750	0

*Coliform of 20000 is a designated limit, actual value may be greater

6.2 Cascade Creek Main Branch

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/31/2005	6/20/2005	7/13/2005	8/9/2005	9/7/2005					
Time	11:15AM	2:10 PM	11:55 PM	2:30 PM	1:45 PM					
Heavy Rain Past 7 Days	no	yes	No	No	Yes					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	20.6	22.8	31.1	28.9	26.1	25.9	4.3	26.1	31.1	20.6
Water Temp (C°)	13.7	17.5	17.8	21.1	19.2	17.9	2.7	17.8	21.1	13.7
Stream Width (m)	7.4	8.5	8.3	8.9	8.9	8.4	0.6	8.5	8.9	7.4
Stream Depth (m)	0.22	0.20	0.14	0.10	0.09	0.15	0.06	0.14	0.22	0.09
Surface Velocity (m/s)	0.2	0.2	0.4	0.4	0.3	0.3	0.1	0.3	0.4	0.2
pH	7.9	7.8	7.8	8.3	7.8	7.9	0.2	7.8	8.3	7.8
DO (mg/L)	11.0	11.0	10.2	10.8	11.1	10.8	0.4	11.0	11.1	10.2
Conductivity (µS/cm)	704	683	638	631	668	664.8	30.57	668	704	631
BOD (mg/L)	1.7	2.0	1.0	0.8	0.8	1.3	0.5	1.0	2.0	0.8
Turbidity (ntu)	4.1	3.9	3.1	2.4	2.80	3.3	0.72	3.1	4.1	2.4
Total Nitrogen (mg/L)	3.9	1.5	0.8	0.8	2.40	1.9	1.31	1.5	3.9	0.8
Total Phosphate (mg/L)	0.27	0.26	0.22	0.22	0.40	0.3	0.07	0.26	0.4	0.22
Total Organic Carbon (mg/L)	3.3	3.6	3.3	3.0	4.1	3.5	0.4	3.3	4.1	3.0
Total Coliform (col/100 mL)	37	700	3400	1650	16300	4417	6762	1650	16300	37
E. Coli	8	0	0	0	200	42	89	0	200	0

6.3 Cascade Creek Mouth

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/31/2005	6/21/2005	7/14/2005	8/9/2005	9/7/2005					
Time	11:24AM	1:05 PM	1:10 PM	2:50 PM	2:00 PM					
Heavy Rain Past 7 Days	no	yes	no	No	Yes					
Weather Conditions	Sunny	Sunny	Cover	Sunny	Sunny					
Air Temp (C°)	20.6	21.1	28.9	28.9	26.1	25.1	4.1	26.1	28.9	20.6
Water Temp (C°)	16.0	20.7	23.6	24.6	19.5	20.9	3.4	20.7	24.6	16.0
Stream Width (m)	5.9	7.1	6.2	8.8	7.2	7.0	1.1	7.1	8.8	5.9
Stream Depth (m)	0.22	0.50	0.42	0.33	0.80	0.45	0.22	0.42	0.80	0.22
Surface Velocity (m/s)	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.2	0.2	0.1
pH	8.2	8.1	8.1	8.0	8.0	8.1	0.1	8.1	8.2	8.0
DO (mg/L)	9.8	10.2	9.3	8.1	10.4	9.6	0.9	9.8	10.4	8.1
Conductivity (µS/cm)	850	863	726	753	782	794.8	59.88	782	863	726
BOD (mg/L)	1.2	1.4	2.2	0.4	0.7	1.2	0.7	1.2	2.2	0.4
Turbidity (ntu)	1.9	1.9	1.3	0.7	1.00	1.4	0.54	1.3	1.9	0.7
Total Nitrogen (mg/L)	4.9	2.6	2.5	1.1	2.00	2.6	1.41	2.5	4.9	1.1
Total Phosphate (mg/L)	0.26	0.25	0.27	0.28	0.31	0.3	0.02	0.27	0.31	0.25
Total Organic Carbon (mg/L)	3.3	3.9	8.2	3.4	3.9	4.5	2.1	3.9	8.2	3.3
Total Coliform (col/100 mL)	32	1150	9800	2850	16250	6016	6866	2850	16250	32
E. Coli	2	0	0	0	300	60	134	0	300	0

6.4 Cascade West Branch

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/31/2005	6/20/2005	7/13/2005	8/9/2005	9/7/2005					
Time	11:15AM	2:00 PM	11:45 PM	2:25 PM	1:30 PM					
Heavy Rain Past 7 Days	No	Yes	No	No	Yes					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (90 C°)	20.6	22.8	31.1	28.9	26.1	25.9	4.3	26.1	31.1	20.6
Water Temp (C°)	14.0	17.5	21.1	22.6	19.5	18.9	3.3	19.5	22.6	14.0
Stream Width (m)	3.2	2.6	2.6	2.6	2.6	2.7	0.3	2.6	3.2	2.6
Stream Depth (m)	0.34	0.35	0.24	0.29	0.19	0.28	0.07	0.29	0.35	0.19
Surface Velocity (m/s)	0.2	0.1	0.2	0.1	0.8	0.3	0.3	0.2	0.8	0.1
pH	7.9	7.8	7.9	8.3	7.9	7.9	0.2	7.9	8.3	7.8
DO (mg/L)	9.5	9.8	10.1	10.2	11.1	10.1	0.6	10.1	11.1	9.5
Conductivity (µS/cm)	1045	1054	1030	1036	1020	1037.0	13.15	1036	1054	1020
BOD (mg/L)	1.1	0.7	0.8	0.7	0.8	0.8	0.1	0.8	1.1	0.7
Turbidity (ntu)	6.3	2.4	1.6	1.5	2.00	2.8	2.01	2	6.3	1.5
Total Nitrogen (mg/L)	2.75	3.6	1.7	1.9	2.85	2.6	0.77	2.75	3.6	1.7
Total Phosphate (mg/L)	0.33	0.19	0.29	0.19	0.34	0.3	0.07	0.29	0.34	0.19
Total Organic Carbon (mg/L)	3.9	3.4	3.7	4.6	3.9	3.9	0.4	3.9	4.6	3.4
Total Coliform (col/100 mL)*	20000	2900	5200	12500	11400	10400	6724	11400	20000	2900
E. Coli**	20000	0	50	0	350	4080	8901	50	20000	0

*Coliform of 20000 is a designated limit, actual value may be greater

**E. coli of 200000 is a designated limit, actual value may be greater

6.5 Cascade West Branch 2

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/9/2005	6/28/2005	7/21/2005	8/18/2005	10/5/2005					
Time	2:05 AM	9:55 AM	2:00 PM	1:30 PM	2:20 PM					
Heavy Rain Past 7 Days	No	No	Yes	Yes	No					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	33.3	29.4	27.8	27.2	27.0	28.9	2.6	27.8	33.3	27.0
Water Temp (C°)	17.8	15.9	18.7	19.9	18.4	18.1	1.5	18.4	19.9	15.9
Stream Width (m)	3.9	6.1	4.9	3.6	3.8	4.5	1.0	3.9	6.1	3.6
Stream Depth (m)	0.11	0.49	0.02	0.105	0.05	0.2	0.19	0.105	0.49	0.02
Surface Velocity (m/s)	0.5	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.5	0.1
pH	7.3	7.1	7.2	7.5	7.1	7.2	0.2	7.2	7.5	7.1
DO (mg/L)	10.2	7.8	8.4	8.8	8.1	8.6	0.9	8.4	10.2	7.8
Conductivity (µS/cm)	1096	1071	995	750	992	980.8	136.93	995	1096	750
BOD (mg/L)	2.3	0.7	1.3	1.9	7.7	2.8	2.8	1.9	7.7	0.7
Turbidity (ntu)	2.34	1.3	1.2	0.9	1.00	1.3	0.58	1.2	2.34	0.9
Total Nitrogen (mg/L)	6.8	3.5	4.5	2.9	3.35	4.2	1.56	3.5	6.8	2.9
Total Phosphate (mg/L)	0.15	0.27	0.21	0.46	1.40	0.5	0.52	0.27	1.4	0.15
Total Organic Carbon (mg/L)	2.3	1.9	3.6	5.8	2.2	3.2	1.6	2.3	5.8	1.9
Total Coliform (col/100 mL)*	20000	8650	13450	20000	13150	15050	4902	13450	20000	8650
E. Coli (col/100mL)	8	350	100	150	200	162	127	150	350	8

*Coliform of 20000 is a designated limit, actual value may be greater

6.6 Crooked Creek

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/23/2005	6/15/2005	7/7/2005	8/4/2005	8/24/2005					
Time	2:25 PM	2:00 PM	10:40 AM	2:15 PM	1:40 PM					
Heavy Rain Past 7 Days	No	Yes	No	No	Yes					
Weather Conditions	Light Rain	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	12.1	23.3	23.9	32.8	23.3	23.1	7.3	23.3	32.8	12.1
Water Temp (C°)	12.4	21.4	19.7	24.1	21.1	19.7	4.4	21.1	24.1	12.4
Stream Width (m)	11.5	11.8	10.2	12.1	11.6	11.4	0.7	11.6	12.1	10.2
Stream Depth (m)	0.17	0.15	0.11	0.11	0.08	0.12	0.04	0.11	0.17	0.08
Surface Velocity (m/s)	0.3	0.2	0.6	0.5	0.2	0.4	0.2	0.3	0.6	0.2
pH	7.6	7.7	7.8	8.0	7.7	7.7	0.1	7.7	8.0	7.6
DO (mg/L)	10.3	9.0	9.6	9.0	10.1	9.6	0.6	9.6	10.3	9.0
Conductivity (µS/cm)	297	316	320	336	260	305.8	29.12	316	336	260
BOD (mg/L)	1.1	1.9	1.5	1.3	1.1	1.4	0.3	1.3	1.9	1.1
Turbidity (ntu)	1.82	3.1	2.9	3	1.90	2.5	0.63	2.9	3.1	1.82
Total Nitrogen (mg/L)	0.65	0.1	1.5	2.3	2.40	1.4	1.01	1.5	2.4	0.1
Total Phosphate (mg/L)	0.41	0.23	0.22	0.22	0.26	0.3	0.08	0.23	0.41	0.22
Total Organic Carbon (mg/L)	4.5	5.0	4.1	4.5	3.9	4.4	0.4	4.5	5.0	3.9
Total Coliform (col/100 mL)*	20000	2430	2850	1700	5150	6426	7697	2850	20000	1700
E. Coli**	20000	400	0	0	0	4080	8901	0	20000	0

*Coliform of 20000 is a designated limit, actual value may be greater

**E. coli of 200000 is a designated limit, actual value may be greater

6.7 Eight Mile

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/6/2005	6/23/2005	7/18/2005	8/15/2005	9/21/2005					
Time	1:48 PM	1:50 PM	2:25PM	10:50 PM	2:20 PM					
Heavy Rain Past 7 Days	No	Yes	Yes	Yes	No					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	27.2	23.9	32.2	22.2	25.6	26.2	3.8	25.6	32.2	22.2
Water Temp (C°)	23.3	24.2	25.0	21.5	20.1	22.8	2.0	23.3	25.0	20.1
Stream Width (m)	13.5	1.3	8.8	8.5	7.9	8.0	4.4	8.5	13.5	1.3
Stream Depth (m)	0.25	0.02	0.09	0.06	0.50	0.2	0.20	0.09	0.5	0.02
Surface Velocity (m/s)	0.2	0.3	0.4	0.7	0.2	0.4	0.2	0.3	0.7	0.2
pH	8.2	8.3	8.2	8.3	8.0	8.2	0.1	8.2	8.3	8.0
DO (mg/L)	8.1	10.9	8.3	9.9	10.0	9.4	1.2	9.9	10.9	8.1
Conductivity (µS/cm)	324	327	317	340	329	327.4	8.38	327	340	317
BOD (mg/L)	1.4	0.8	1.0	1.7	0.2	1.0	0.6	1.0	1.7	0.2
Turbidity (ntu)	2.9	1.8	12.8	1.5	1.95	4.2	4.84	1.95	12.8	1.5
Total Nitrogen (mg/L)	0.7	0.3	2.45	0.2	0.90	0.9	0.91	0.7	2.45	0.2
Total Phosphate (mg/L)	0.17	0.3	0.34	0.16	0.38	0.3	0.10	0.3	0.375	0.16
Total Organic Carbon (mg/L)	5.1	5.9	8.1	4.4	5.1	5.7	1.4	5.1	8.1	4.4
Total Coliform (col/100 mL)*	20000	3250	20000	3700	12250	11840	8267	12250	20000	3250
E. Coli (col/100mL)**	20000	0	750	0	250	4200	8838	250	20000	0

6.8 Elk 1

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/23/2005	6/15/2005	7/7/2005	8/4/2005	8/24/2005					
Time	2:50 PM	2:21 PM	11:00	2:35 PM	2:00 PM					
Heavy Rain Past 7 Days	No	Yes	No	No	Yes					
Weather Conditions	Light Rain	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	11.9	23.3	24.4	32.8	23.3	23.1	7.4	23.3	32.8	11.9
Water Temp (C°)	14.9	24.0	21.8	27.8	22.9	22.3	4.7	22.9	27.8	14.9
Stream Width (m)	18.5	11.3	10.1	9.3	29.3	15.7	8.4	11.3	29.3	9.3
Stream Depth (m)	0.26	0.25	0.18	0.12	0.18	0.20	0.06	0.18	0.26	0.12
Surface Velocity (m/s)	0.7	0.4	0.5	0.9	0.2	0.5	0.3	0.5	0.9	0.2
pH	7.7	7.8	7.6	8.3	7.9	7.8	0.3	7.8	8.3	7.6
DO (mg/L)	11.5	10.8	9.4	11.1	10.0	10.6	0.9	10.8	11.5	9.4
Conductivity (µS/cm)	300	404	390	400	390	376.8	43.37	390	404	300
BOD (mg/L)	1.2	2.1	1.0	1.3	1.2	1.3	0.4	1.2	2.1	1.0
Turbidity (ntu)	1.7	2.7	1.2	1.6	1.10	1.7	0.63	1.6	2.7	1.1
Total Nitrogen (mg/L)	0.8	0	2.4	1.8	3.30	1.7	1.30	1.8	3.3	0
Total Phosphate (mg/L)	0.62	0.33	0.17	0.29	0.52	0.4	0.18	0.33	0.62	0.17
Total Organic Carbon (mg/L)	3.9	4.3	4.2	4.3	3.9	4.1	0.2	4.2	4.3	3.9
Total Coliform (col/100 mL)*	20000	960	2600	750	2600	5382	8218	2600	20000	750
E. Coli**	20000	65	0	0	0	4013	8937			

*Coliform of 20000 is a designated limit, actual value may be greater

**E. coli of 200000 is a designated limit, actual value may be greater

6.9 Elk 2

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/24/2005	6/17/2005	7/11/2005	8/8/2005	8/31/2005					
Time	14:30	10:40 AM	1:50 PM	2:45 PM	1:05 PM					
Heavy Rain Past 7 Days	No	Yes	No	NO	Yes					
Weather Conditions	60% Cloud Cover	60% Cloud Cover	Sunny	Sunny	Steady Rain					
Air Temp (C°)	12.8	16.7	27.8	26.7	29.0	22.6	7.3	26.7	29.0	12.8
Water Temp (C°)	13.2	17.3	29.1	27.3	19.9	21.4	6.7	19.9	29.1	13.2
Stream Width (m)	37.2	19.3	12.7	15.1		21.1	11.1	17.2	37.2	12.7
Stream Depth (m)	0.31	0.20	0.27	0.15	0.43	0.27	0.11	0.27	0.43	0.15
Surface Velocity (m/s)	0.1	0.4	0.2	0.1	0.5	0.3	0.2	0.2	0.5	0.1
pH	7.8	7.8	8.6	8.7	6.9	7.5	0.7	7.8	8.7	6.9
DO (mg/L)	10.5	11.1	10.6	13.1	9.3	10.9	1.4	10.6	13.1	9.3
Conductivity (µS/cm)	248	242	316	301	20	225.4	119.27	248	316	20
BOD (mg/L)	1.1	3.4	1.8	1.7	2.5	2.1	0.9	1.8	3.4	1.1
Turbidity (ntu)	3.65	8.6	4	1.3	65.50	16.6	27.46	4	65.5	1.3
Total Nitrogen (mg/L)	0.1	2.9	0.9	0.6	2.10	1.3	1.15	0.9	2.9	0.1
Total Phosphate (mg/L)	0.41	0.34	0.2	0.21	1.15	0.5	0.39	0.34	1.15	0.2
TOC (mg/L)	4.3	8.3	5.4	5.4	12.9	7.3	3.5	5.4	12.9	4.3
Total Col (col/100 mL)*	25	20000	3250	1100	20000	8875	10222	3250	20000	25
E. Coli**	0	20000	0	0	5100	5020	8660	0	20000	0

*Coliform of 20000 is a designated limit, actual value may be greater

**E. coli of 200000 is a designated limit, actual value may be greater

6.10 Elk 3

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/13/2005	7/5/2005	8/3/2005	8/17/2005	9/28/2005					
Time	10:20 AM	1:15AM	11:55 AM	1:30 PM	12:45 PM					
Heavy Rain Past 7 Days	No	No	No	Yes	Yes					
Weather Conditions	Cover	Cloudy	Sunny	Sunny	Sunny					
Air Temp (C°)	31.7	23.9	31.7	25.6	18.3	26.2	5.7	25.6	31.7	18.3
Water Temp (C°)	23.4	24.4	23.5	23.1	15.3	21.9	3.7	23.4	24.4	15.3
Stream Width (m)	7.5	7.8	7.7	9.3	8.4	8.1	0.7	7.8	9.3	7.5
Stream Depth (m)	0.14	0.23	0.13	0.095	0.25	0.2	0.07	0.14	0.25	0.095
Surface Velocity (m/s)	0.8	0.3	0.2	0.1	0.5	0.4	0.3	0.3	0.8	0.1
pH	7.8	7.4	7.0	8.1	7.8	7.4	0.4	7.8	8.1	7.0
DO (mg/L)	6.9	7.3	7.1	7.9	10.0	7.8	1.3	7.3	10.0	6.9
Conductivity (µS/cm)	249	254	270	283	217	254.6	24.95	254	283	217
BOD (mg/L)	3.0	0.7	0.7	1.1	2.2	1.5	1.0	1.1	3.0	0.7
Turbidity (ntu)	4.5	2.1	0.14	3	2.95	2.5	1.59	2.95	4.5	0.14
Total Nitrogen (mg/L)	0.8	1	1.1	0.45	0.70	0.8	0.26	0.8	1.1	0.45
Total Phosphate (mg/L)	0.23	0.25	0.14	0.27	0.44	0.3	0.11	0.25	0.44	0.14
Total Organic Carbon (mg/L)	4.7	4.9	4.8	4.0	7.1	5.1	1.2	4.8	7.1	4.0
Total Coliform (col/100 mL)	1970	3750	1300	2950	7500	3494	2426	2950	7500	1300
E. Coli	390	0	0	150	650	238	280	150	650	0

6.11 Four Mile

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/1/2005	6/23/2005	7/18/2005	8/15/2005	9/14/2005					
Time	1:25PM	12:55 PM	1:30PM	9:50 PM	3:00 PM					
Heavy Rain Past 7 Days	No	Yes	Yes	Yes	Yes					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	23.3	23.9	32.2	22.2	27.8	25.9	4.1	23.9	32.2	22.2
Water Temp (C°)	20.9	21.3	24.8	21.9	24.1	22.6	1.7	21.9	24.8	20.9
Stream Width (m)	12.0	7.9	9.0	7.2	6.9	8.6	2.1	7.9	12.0	6.9
Stream Depth (m)	0.10	0.07	0.10	0.11	0.08	0.09	0.02	0.10	0.11	0.07
Surface Velocity (m/s)	0.3	0.3	0.6	0.2	0.1	0.3	0.2	0.3	0.6	0.1
pH	8.6	8.3	7.9	8.1	8.3	8.2	0.3	8.3	8.6	7.9
DO (mg/L)	8.3	11.4	8.3	8.7	9.8	9.3	1.3	8.7	11.4	8.3
Conductivity (µS/cm)	439	456	314	373	446	405.6	60.7	439	456	314
BOD (mg/L)	1.3	0.8	8.6	1.8	3.9	3.3	3.2	1.8	8.6	0.8
Turbidity (ntu)	0.9	0.7	3.2	1.1	1.20	1.4	1.01	1.1	3.2	0.7
Total Nitrogen (mg/L)	3.25	0.4	1.05	0.2	0.10	1.0	1.31	0.4	3.25	0.1
Total Phosphate (mg/L)	0.13	0.12	0.24	0.2	0.35	0.2	0.09	0.2	0.35	0.12
Total Organic Carbon (mg/L)	3.7	3.8	6.4	4.7	4.4	4.6	1.1	4.4	6.4	3.7
Total Coliform (col/100 mL)*	43	1100	20000	4700	1800	5529	8272	1800	20000	43
E. Coli	0	0	450	0	0	90	201	0	450	0

*Coliform of 20000 is a designated limit, actual value may be greater

6.12 Garrison Run

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/1/2005	6/21/2005	7/14/2005	8/11/2005	9/14/2005					
Time	12:00 PM	1:25 PM	1:50 PM	3:30 PM	2:10 PM					
Heavy Rain Past 7 Days	Yes	Yes	No	Yes	Yes					
Weather Conditions	Sunny	Sunny	Scattered Showers	Sunny	Sunny					
Air Temp (C°)	23.3	21.1	25.6	26.1	27.8	24.8	2.6	25.6	27.8	21.1
Water Temp (C°)	14.9	17.7	20.5	23.7	22.1	19.8	3.5	20.5	23.7	14.9
Stream Width (m)	4.9	4.3	3.7	4.3	4.1	4.3	0.4	4.3	4.9	3.7
Stream Depth (m)	0.06	0.05	0.11	0.15	0.15	0.10	0.05	0.11	0.15	0.05
Surface Velocity (m/s)	0.1	0.3	0.3	0.5	0.5	0.3	0.2	0.3	0.5	0.1
pH	8.2	7.6	7.8	7.9	7.3	7.7	0.3	7.8	8.2	7.3
DO (mg/L)	11.5	9.1	6.8	7.2	6.5	8.2	2.1	7.2	11.5	6.5
Conductivity (µS/cm)	512	552	484	402	472	484.4	55.40	484	552	402
BOD (mg/L)	2.4	1.4	0.8	1.1	2.2	1.6	0.7	1.4	2.4	0.8
Turbidity (ntu)	2.3	2.6	2	8.41	1.70	3.4	2.82	2.3	8.41	1.7
Total Nitrogen (mg/L)	5.4	1.4	1.4	1.1	2.70	2.4	1.79	1.4	5.4	1.1
Total Phosphate (mg/L)	0.25	0.34	0.3	0.5	0.49	0.4	0.11	0.34	0.5	0.25
Total Organic Carbon (mg/L)	5.0	5.0	5.4	5.4	6.3	5.5	0.5	5.4	6.3	5.0
Total Coliform (col/100 mL)*	42	2550	6550	20000	18950	9618	9300	6550	20000	42
E. Coli	0	0	100	450	1400	390	594	100	1400	0

*Coliform of 20000 is a designated limit, actual value may be greater

6.13 Godfrey

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/23/2005	6/17/2005	7/7/2005	8/4/2005	8/24/2005					
Time	3:07 PM	10:05 AM	11:25	3:05 PM	2:20 PM					
Heavy Rain Past 7 Days	No	Yes	No	No	Yes					
Weather Conditions	Light Rain	60% Cover	Sunny	Sunny	Sunny					
Air Temp (C°)	12.2	16.7	24.4	32.8	23.3	21.9	7.9	23.3	32.8	12.2
Water Temp (C°)	11.5	14.1	16.6	20.4	18.7	16.3	3.6	16.6	20.4	11.5
Stream Width (m)	3.0	3.0	3.0	3.0	3.0	3.0	0.0	3.0	3.0	3.0
Stream Depth (m)	0.25	0.36	0.36	0.34	0.42	0.35	0.06	0.36	0.42	0.25
Surface Velocity (m/s)	0.2	0.3	0.2	0.8	0.3	0.4	0.2	0.3	0.8	0.2
pH	7.7	7.9	7.9	8.4	8.1	7.9	0.3	7.9	8.4	7.7
DO (mg/L)	10.8	11.3	9.5	8.4	9.8	9.9	1.2	9.8	11.3	8.4
Conductivity (µS/cm)	348	374	369	379	341	362.2	16.72	369	379	341
BOD (mg/L)	1.7	3.4	0.9	0.7	0.6	1.4	1.2	0.9	3.4	0.6
Turbidity (ntu)	4.8	4.1	2.2	2.5	1.00	2.9	1.53	2.5	4.8	1
Total Nitrogen (mg/L)	0.95	4.2	2	4.6	4.40	3.2	1.65	4.2	4.6	0.95
Total Phosphate (mg/L)	0.73	0.27	0.21	0.2	0.36	0.4	0.22	0.27	0.73	0.2
Total Organic Carbon (mg/L)	3.2	3.1	2.8	2.3	2.4	2.8	0.4	2.8	3.2	2.3
Total Coliform (col/100 mL)*	20000	20000	5450	3650	10900	12000	7776	10900	20000	3650
E. Coli**	20000	20000	0	0	200	8040	10918	200	20000	0

*Coliform of 20000 is a designated limit, actual value may be greater

**E. coli of 200000 is a designated limit, actual value may be greater

6.14 Lamson

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/13/2005	7/5/2005	8/3/2005	8/17/2005	9/28/2005					
Time	10:00 AM	1:50 PM	11:35 PM	2:20 PM	1:05 PM					
Heavy Rain Past 7 Days	No	No	No	Yes	Yes					
Weather Conditions	40% Cover	Cloudy (very light rain)	Sunny	Sunny	Sunny					
Air Temp (C°)	31.7	23.9	31.7	25.6	18.3	26.2	5.7	25.6	31.7	18.3
Water Temp (C°)	22.3	24.2	23.7	25.9	17.1	22.6	3.4	23.7	25.9	17.1
Stream Width (m)	3.7	4.4	4.2	3.4	4.4	4.0	0.4	4.2	4.4	3.4
Stream Depth (m)	0.14	0.11	0.17	0.13	0.20	0.1	0.03	0.14	0.195	0.11
Surface Velocity (m/s)	0.9	0.0	0.1	0.2	0.2	0.3	0.3	0.2	0.9	0.0
pH	7.8	8.1	7.7	8.2	7.9	7.9	0.2	7.9	8.2	7.7
DO (mg/L)	7.3	9.8	9.7	9.0	10.4	9.2	1.2	9.7	10.4	7.3
Conductivity (µS/cm)	264	308	316	327	247	292.4	34.9	308	327	247
BOD (mg/L)	2.4	0.8	0.6	0.8	1.4	1.2	0.7	0.8	2.4	0.6
Turbidity (ntu)	2.2	1.4	1.8	1.2	1.55	1.6	0.39	1.55	2.2	1.2
Total Nitrogen (mg/L)	0.6	0.3	0.9	0.45	0.70	0.6	0.23	0.6	0.9	0.3
Total Phosphate (mg/L)	0.24	0.21	0.14	0.37	0.31	0.3	0.09	0.24	0.37	0.14
Total Organic Carbon (mg/L)	4.2	4.0	3.9	3.5	5.7	4.3	0.8	4.0	5.7	3.5
Total Coliform (col/100 mL)	3880	4400	1200	3850	5800	3826	1668	3880	5800	1200
E. Coli	795	0	0	300	50	229	340	50	795	0

6.15 Little Elk

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/13/2005	7/5/2005	8/3/2005	8/17/2005	9/28/2005					
Time	11:20 AM	2:15 PM	11:00 AM	1:30 PM	1:35 PM					
Heavy Rain Past 7 Days	No	No	No	Yes	Yes					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	31.7	23.9	31.7	25.6	18.3	26.2	5.7	25.6	31.7	18.3
Water Temp (C°)	25.6	25.7	25.5	31.1	16.7	24.9	5.2	25.6	31.1	16.7
Stream Width (m)	2.7	8.6	6.1	9.5	8.6	7.1	2.7	8.6	9.5	2.7
Stream Depth (m)	0.05	0.13	0.14	0.105	0.26	0.1	0.08	0.13	0.255	0.05
Surface Velocity (m/s)	0.3	0.1	0.2	0.2	0.3	0.2	0.1	0.2	0.3	0.1
pH	8.4	8.9	9.2	9.0	7.2	7.8	0.8	8.9	9.2	7.2
DO (mg/L)	8.5	10.4	12.3	10.9	9.4	10.3	1.5	10.4	12.3	8.5
Conductivity (µS/cm)	219	274	255	316	170	246.8	55.38	255	316	170
BOD (mg/L)	2.6	1.2	2.0	1.0	1.9	1.8	0.6	1.9	2.6	1.0
Turbidity (ntu)	1.2	1.1	1.2	1	1.50	1.2	0.19	1.2	1.5	1
Total Nitrogen (mg/L)	2	0.8	0.4	0.9	0.60	0.9	0.62	0.8	2	0.4
Total Phosphate (mg/L)	0.18	0.2	0.14	0.26	0.39	0.2	0.10	0.2	0.39	0.14
Total Organic Carbon (mg/L)	4.8	4.7	6.0	4.8	7.7	5.6	1.3	4.8	7.7	4.7
Total Coliform (col/100 mL)*	1290	200000	2350	5850	3350	42568	88023	3350	200000	1290
E. Coli	55	0	0	150	150	71	76	55	150	0

*Coliform of 20000 is a designated limit, actual value may be greater

6.16 Marshall

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/31/2005	6/20/2005	7/13/2005	8/7/2005	9/7/2005					
Time	10:20AM	1:20 PM	11:10 AM	1:43 PM	12:40 PM					
Heavy Rain Past 7 Days	no	yes	no	no	yes					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	20.6	22.8	32.2	28.9	26.1	26.1	4.7	26.1	32.2	20.6
Water Temp (C°)	13.7	16.7	19.4	21.5	18.4	17.9	2.9	18.4	21.5	13.7
Stream Width (m)	5.8	2.9	2.3	2.9	3.2	3.4	1.4	2.9	5.8	2.3
Stream Depth (m)	0.13	0.16	0.11	0.07	0.15	0.12	0.03	0.13	0.16	0.07
Surface Velocity (m/s)	0.2	0.4	0.1	0.3	0.3	0.3	0.1	0.3	0.4	0.1
pH	8.2	8.0	8.1	8.2	7.9	8.1	0.1	8.1	8.2	7.9
DO (mg/L)	11.4	11.3	9.9	9.7	9.9	10.4	0.8	9.9	11.4	9.7
Conductivity (µS/cm)	638	696	497	554	680	613.0	85.06	638	696	497
BOD (mg/L)	1.4	0.9	0.8	0.5	0.7	0.9	0.4	0.8	1.4	0.5
Turbidity (NTU)	2.35	1.1	1	0.8	0.80	1.2	0.65	1	2.35	0.8
Total Nitrogen (mg/L)	3.7	4.05	1.4	1.4	1.80	2.5	1.30	1.8	4.05	1.4
Total Phosphate (mg/L)	0.32	0.17	0.27	0.27	0.36	0.3	0.07	0.27	0.36	0.17
Total Organic Carbon (mg/L)	4.2	5.0	3.2	3.4	4.5	4.0	0.8	4.2	5.0	3.2
Total Coliform (col/100 mL)*	20000	3550	5200	15900	14500	11830	7123	14500	20000	3550
E. Coli**	20000	0	0	0	50	4010	8939	0	20000	0

*Coliform of 20000 is a designated limit, actual value may be greater

**E. coli of 200000 is a designated limit, actual value may be greater

6.17 McDanel Run

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/1/2005	6/21/2005	7/14/2005	8/11/2005	9/14/2005					
Time	1:05PM	2:15 PM	2:20 PM	4:00 PM	2:40 PM					
Heavy Rain Past 7 Days	Yes	Yes	No	Yes	Yes					
Weather Conditions	Sunny	Sunny	Light Rain	50% cloud cover	Sunny					
Air Temp (C°)	23.3	21.1	26.7	26.1	27.8	25.0	2.7	26.1	27.8	21.1
Water Temp (C°)	17.3	19.2	23.8	23.9	23.2	21.5	3.0	23.2	23.9	17.3
Stream Width (m)	5.5	6.3	2.8	4.3	5.0	4.8	1.3	5.0	6.3	2.8
Stream Depth (m)	0.07	0.06	0.02	0.03	0.04	0.0	0.02	0.035	0.07	0.02
Surface Velocity (m/s)	0.2	0.1	0.3	0.3	0.2	0.2	0.1	0.2	0.3	0.1
pH	8.7	7.9	8.1	8.3	8.1	8.2	0.3	8.1	8.7	7.9
DO (mg/L)	11.6	10.0	8.1	8.9	11.6	10.0	1.6	10.0	11.6	8.1
Conductivity (µS/cm)	674	590	505	488	517	554.8	77.17	517	674	488
BOD (mg/L)	2.7	1.6	1.5	1.3	2.0	1.8	0.6	1.6	2.7	1.3
Turbidity (ntu)	7.7	1.1	0.7	0.8	0.80	2.2	3.07	0.8	7.7	0.7
Total Nitrogen (mg/L)	4.85	2.4	2.45	1	3.55	2.9	1.44	2.45	4.85	1
Total Phosphate (mg/L)	0.52	0.27	0.27	0.23	0.29	0.3	0.12	0.27	0.52	0.23
Total OrganicCarbon (mg/L)	5.5	5.4	6.1	12.5	5.1	6.9	3.2	5.5	12.5	5.1
Total Coliform (col/100 mL)*	20000	7500	5600	8400	7250	9750	5819	7500	20000	5600
E. Coli	0	0	0	100	150	50	71	0	150	0

*Coliform of 20000 is a designated limit, actual value may be greater

6.18 Mill Creek

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/1/2005	6/21/2005	7/14/2005	8/11/2005	9/14/2005					
Time	12:45PM	1:55 PM	1:32 PM	3:10 PM	1:35 PM					
Heavy Rain Past 7 Days	Yes	Yes	No	Yes	Yes					
Weather Conditions	Sunny	Sunny	Scattered Showers	Sunny	Sunny					
Air Temp (C°)	23.3	21.1	28.9	26.1	27.8	25.4	3.2	26.1	28.9	21.1
Water Temp (C°)	14.1	17.7	21.5	23.1	20.6	19.4	3.6	20.6	23.1	14.1
Stream Width (m)	8.0	8.0	8.0	8.0	8.0	8.0	0.0	8.0	8.0	8.0
Stream Depth (m)			0.36	0.47	0.42	0.42	0.06	0.42	0.47	0.36
Surface Velocity (m/s)										
pH	8.3	8.0	7.9	8.4	7.8	8.0	0.2	8.0	8.4	7.8
DO (mg/L)	9.1	9.9	8.0	8.3	8.0	8.6	0.8	8.3	9.9	8.0
Conductivity (µS/cm)	596	580	580	514	580	570.0	32.06	580	596	514
BOD (mg/L)	2.9	8.8	9.1	3.8	3.3	5.6	3.1	3.8	9.1	2.9
Turbidity (ntu)	4	1.9	2.7	10.7	3.00	4.5	3.57	3	10.7	1.9
Total Nitrogen (mg/L)	0.85	3.7	2.25	1.2	3.10	2.2	1.21	2.25	3.7	0.85
Total Phosphate (mg/L)	0.29	0.4	0.46	0.46	0.52	0.4	0.09	0.46	0.52	0.29
Total Organic Carbon (mg/L)	4.9	5.7	9.4	7.7	7.1	7.0	1.7	7.1	9.4	4.9
Total Coliform (col/100 mL)*	20000	20000	20000	20000	20000	20000	0	20000	20000	20000
E. Coli	0	2400	1200	650	15550	3960	6539	1200	15550	0

*Coliform of 20000 is a designated limit, actual value may be greater

6.19 Mill Creek 2

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/8/2005	6/28/2005	7/21/2005	8/18/2005	10/5/2005					
Time	11:40 AM	10:25 AM	2:30 PM	2:00 PM	2:00 PM					
Heavy Rain Past 7 Days	No	No	Yes	Yes	No					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	28.3	31.1	27.2	27.2	27.0	28.2	1.7	27.2	31.1	27.0
Water Temp(C°)	20.9	22.1	24.0	23.3	18.7	21.8	2.1	22.1	24.0	18.7
Stream Width (m)	9.4	8.6	7.4	6.7	7.3	7.9	1.1	7.4	9.4	6.7
Stream Depth (m)	0.195	0.23	0.2	0.18	0.25	0.2	0.03	0.2	0.25	0.18
Surface Velocity (m/s)	0.2	0.3	0.6	0.4	0.6	0.4	0.2	0.4	0.6	0.2
pH	8.3	8.1	6.7	8.7	8.2	7.4	0.8	8.2	8.7	6.7
DO (mg/L)	7.9	9.2	9.1	10.6	10.5	9.5	1.1	9.2	10.6	7.9
Conductivity (µS/cm)	383	561	525	516	515	500.0	68.04	516	561	383
BOD (mg/L)	1.8	1.0	7.9	2.5	9.5	4.5	3.9	2.5	9.5	1.0
Turbidity (ntu)	1.3	1.2	3.5	1.2	1.25	1.7	1.01	1.25	3.5	1.2
Total Nitrogen (mg/L)	0	0.5	3.3	1.4	3.30	1.7	1.54	1.4	3.3	0
Total Phosphate (mg/L)	0.24	0.38	0.24	0.31	0.39	0.3	0.07	0.31	0.39	0.24
Total Organic Carbon (mg/L)	3.9	4.1	4.7	4.4	4.6	4.3	0.3	4.4	4.7	3.9
Total Coliform (col/100 mL)*	20000	9500	9200	8100	20000	13360	6084	9500	20000	8100
E. Coli	147	400	100	100	450	239	171	147	450	100

*Coliform of 20000 is a designated limit, actual value may be greater

6.20 Raccoon Creek

	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Sampling Date	5/23/2005	6/15/2005	7/7/2005	8/4/2005	8/24/2005					
Time	2:00 PM	1:35 PM	10:10 AM	1:35 PM	1:15 PM					
Heavy Rain Past 7 Days	No	Yes	No	No	Yes					
Weather Conditions	Showers	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	12.2	23.9	23.9	31.7	23.3	23.0	7.0	23.9	31.7	12.2
Water Temp (C°)	13.1	21.5	19.0	23.5	20.8	19.6	4.0	20.8	23.5	13.1
Stream Width (m)	6.5	7.4	6.4	5.1	4.7	6.0	1.1	6.4	7.4	4.7
Stream Depth (m)	0.50	0.46	0.56	0.42	0.41	0.47	0.06	0.46	0.56	0.41
Surface Velocity (m/s)	0.1	0.8		0.1	0.0	0.3	0.4	0.1	0.8	0.0
pH	7.5	7.6	7.7	8.2	8.0	7.7	0.3	7.7	8.2	7.5
DO (mg/L)	10.4	8.1	9.0	9.4	10.4	9.5	1.0	9.4	10.4	8.1
Conductivity (µS/cm)	271	324	357	358	297	321.4	37.91	324	358	271
BOD (mg/L)	1.6	2.2	1.3	1.0	0.8	1.4	0.6	1.3	2.2	0.8
Turbidity (ntu)	4.1	5.6	3.8	3.4	2.40	3.9	1.17	3.8	5.6	2.4
Total Nitrogen (mg/L)	0.9	0	0.8	3.3	0.60	1.1	1.27	0.8	3.3	0
Total Phosphate (mg/L)	0.54	0.25	0.21	0.33	0.26	0.3	0.13	0.26	0.54	0.21
Total Organic Carbon (mg/L)	6.3	6.6	5.6	6.7	6.0	6.2	0.4	6.3	6.7	5.6
Total Coliform (col/100 mL)*	20000	1190	5350	3600	7300	4360	7347	5350	20000	1190
E. Coli**	20000	220	0	0	150	93	8903	150	20000	0

*Coliform of 20000 is a designated limit, actual value may be greater

**E. coli of 200000 is a designated limit, actual value may be greater

6.21 Scott Run

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/31/2005	6/20/2005	7/13/2005	8/9/2005	9/7/2005					
Time	10:50AM	1:35 PM	11:25 AM	2:00 PM	1:10 PM					
Heavy Rain Past 7 Days	no	yes	No	No	Yes					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	20.6	22.8	32.2	28.9	26.1	26.1	4.7	26.1	32.2	20.6
Water Temp (C°)	13.1	16.6	17.6	19.9	19.4	17.3	2.7	17.6	19.9	13.1
Stream Width (m)	3.1	2.4	2.5	1.8	2.3	2.4	0.5	2.4	3.1	1.8
Stream Depth (m)	0.28	0.19	0.23	0.15	0.13	0.20	0.06	0.19	0.28	0.13
Surface Velocity (m/s)	0.1	0.2	0.0	0.2	0.2	0.2	0.1	0.2	0.2	0.0
pH	8.1	7.9	8.0	8.0	7.8	7.9	0.1	8.0	8.1	7.8
DO (mg/L)	9.5	9.9	9.1	8.4	9.7	9.3	0.6	9.5	9.9	8.4
Conductivity (µS/cm)	819	819	720	799	707	772.8	54.94	799	819	707
BOD (mg/L)	1.7	1.5	0.5	0.3	0.6	0.9	0.6	0.6	1.7	0.3
Turbidity (ntu)	8.5	3.4	3.1	2.2	13.80	6.2	4.91	3.4	13.8	2.2
Total Nitrogen (mg/L)	3.7	1.6	0.4	1	0.80	1.5	1.30	1	3.7	0.4
Total Phosphate (mg/L)	0.28	0.18	0.24	0.23	0.44	0.3	0.10	0.24	0.44	0.18
Total Organic Carbon (mg/L)	4.7	4.8	4.9	4.4	5.8	4.9	0.5	4.8	5.8	4.4
Total Coliform (col/100 mL)	90	4700	2750	7150	3900	3718	2592	3900	7150	90
E. Coli	27	0	50	0	0	15	23	0	50	0

6.22 Seven Mile

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/6/2005	6/23/2005	7/18/2005	8/15/2005	9/21/2005					
Time	1:25 PM	1:35 PM	2:10PM	10:30 AM	2:10 PM					
Heavy Rain Past 7 Days	No	Yes	Yes	Yes	No					
Weather Conditions	Sunny	Sunny	30% Cloud Cover	Sunny	Sunny					
Air Temp (C°)	26.1	23.9	32.2	22.2	25.1	25.9	3.8	25.1	32.2	22.2
Water Temp (C°)	22.6	19.7	24.3	20.7	19.9	21.4	2.0	20.7	24.3	19.7
Stream Width (m)	8.1	8.2	4.2	3.8	3.9	5.6	2.3	4.2	8.2	3.8
Stream Depth (m)	0.1	0.06	0.14	0.08	0.70	0.2	0.27	0.1	0.7	0.06
Surface Velocity (m/s)	0.5	0.4	0.4	0.3	0.4	0.4	0.1	0.4	0.5	0.3
pH	8.3	8.1	8.3	8.2	8.1	8.2	0.1	8.2	8.3	8.1
DO (mg/L)	8.2	10.1	7.9	9.4	9.6	9.0	1.0	9.4	10.1	7.9
Conductivity (µS/cm)	367	345	330	350	373	353.0	17.31	350	373	330
BOD (mg/L)	1.8	0.5	1.0	1.6	0.7	1.1	0.6	1.0	1.8	0.5
Turbidity (ntu)	2	0.9	2.9	0.9	1.85	1.7	0.84	1.85	2.9	0.9
Total Nitrogen (mg/L)	1.4	1.3	2.15	0.8	1.50	1.4	0.48	1.4	2.15	0.8
Total Phosphate (mg/L)	0.17	0.21	0.36	0.16	0.37	0.3	0.10	0.21	0.365	0.16
Total Organic Carbon (mg/L)	4.5	5.0	6.1	4.4	4.1	4.8	0.8	4.5	6.1	4.1
Total Coliform (col/100 mL)*	20000	6800	20000	3100	8150	11610	7879	8150	20000	3100
E. Coli (col/100 mL)	195	0	150	0	150	99	92	150	195	0

*Coliform of 20000 is a designated limit, actual value may be greater

6.23 Six Mile

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/6/2005	6/23/2005	7/18/2005	8/15/2005	9/21/2005					
Time	1:05	1:20 PM	1:50PM	10:10 AM	2:00 PM					
Heavy Rain Past 7 Days	No	Yes	Yes	Yes	No					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	26.1	23.9	32.2	22.2	25.6	26.0	3.8	25.6	32.2	22.2
Water Temp (C°)	25.2	22.6	25.9	21.5	22.7	23.6	1.9	22.7	25.9	21.5
Stream Width (m)	13.6	11.6	12.4	10.0	12.5	12.0	1.3	12.4	13.6	10.0
Stream Depth (m)	0.425	0.45	0.545	0.475	0.32	0.4	0.08	0.45	0.545	0.32
Surface Velocity (m/s)	0.2	0.0	0.0	0.1	0.3	0.1	0.1	0.1	0.3	0.0
pH	8.5	8.3	8.3	8.3	8.6	8.4	0.1	8.3	8.6	8.3
DO (mg/L)	7.4	8.9	7.7	9.3	9.7	8.6	1.0	8.9	9.7	7.4
Conductivity (µS/cm)	284	295	242	275	269	273.0	19.91	275	295	242
BOD (mg/L)	1.2	0.5	1.0	0.9	0.1	0.7	0.4	0.9	1.2	0.1
Turbidity (ntu)	1.4	0.6	1.9	0.7	0.75	1.1	0.56	0.75	1.9	0.6
Total Nitrogen (mg/L)	0.9	0.4	0.95	0.2	0.00	0.5	0.42	0.4	0.95	0
Total Phosphate (mg/L)	0.17	0.17	0.32	0.22	0.40	0.3	0.10	0.22	0.395	0.17
Total Organic Carbon (mg/L)	4.3	3.6	6.2	4.0	3.8	4.4	1.0	4.0	6.2	3.6
Total Coliform (col/100 mL)*	20000	19500	10100	1750	5300	11330	8240	10100	20000	1750
E. Coli (col/100mL)	85	0	0	0	0	17	38	0	85	0

*Coliform of 20000 is a designated limit, actual value may be greater

6.24 Sixteen Mile

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/8/2005	6/27/2005	7/20/2005	8/16/2005	9/26/2005					
Time	10:12 AM	10:15 AM	2:30 PM	1:20 PM	2:30 PM					
Heavy Rain Past 7 Days	No	No	Yes	Yes	Yes					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	(Heavy Rain)					
Air Temp (C°)	28.3	30.0	27.8	25.6	20.5	26.4	3.7	27.8	30.0	20.5
Water Temp (C°)	21.0	22.3	26.1	24.6	19.8	22.8	2.6	22.3	26.1	19.8
Stream Width (m)	11.3	11.7	11.4	10.1		11.1	0.7	11.4	11.7	10.1
Stream Depth (m)	0.64	0.56	0.375	0.405	0.38	0.5	0.12	0.405	0.64	0.375
Surface Velocity (m/s)	0.2	0.3	0.5	0.2	0.5	0.3	0.1	0.3	0.5	0.2
pH	8.1	8.0	8.2	8.4	7.5	7.9	0.4	8.1	8.4	7.5
DO (mg/L)	9.0	8.3	9.0	9.1	9.7	9.0	0.5	9.0	9.7	8.3
Conductivity (µS/cm)	345	420	401	408	250	364.8	70.35	401	420	250
BOD (mg/L)	3.5	1.4	1.5	3.8	1.6	2.4	1.2	1.6	3.8	1.4
Turbidity (ntu)	2.8	1	1.4	1	19.50	5.1	8.06	1.4	19.5	1
Total Nitrogen (mg/L)	0.6	1.2	1.6	1.3	4.30	1.8	1.44	1.3	4.3	0.6
Total Phosphate (mg/L)	0.39	0.43	0.32	0.36	0.88	0.5	0.23	0.39	0.88	0.32
Total Organic Carbon (mg/L)	7.9	5.0	4.9	5.5	11.2	6.9	2.7	5.5	11.2	4.9
Total Coliform (col/100 mL)*	20000	14400	6700	3400	20000	12900	7612	14400	20000	3400
E. Coli**	20000	150	200	0	5100	5090	8610	200	20000	0

*Coliform of 20000 is a designated limit, actual value may be greater

**E. coli of 200000 is a designated limit, actual value may be greater

6.25 Trout

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/24/2005	6/17/2005	7/11/2005	8/8/2005	8/31/2005					
Time	2:05 PM	10:20 AM	1:20 PM	2:25 PM	12:40 PM					
Heavy Rain Past 7 Days	No	Yes 60%	No	No	Yes					
Weather Conditions	60% Cloud Cover	Cloud Cover	Sunny	Sunny	Steady Rain					
Air Temp (C°)	10.5	16.7	27.8	26.7	20.0	20.3	7.2	20.0	27.8	10.5
Water Temp (C°)	11.3	15.9	20.0	20.6	19.8	17.5	3.9	19.8	20.6	11.3
Stream Width (m)	3.9	4.1	4.1	9.6	N/A	5.4	2.8	4.1	9.6	3.9
Stream Depth (m)	0.35	0.29	0.22	0.34	0.68	0.38	0.18	0.34	0.68	0.22
Surface Velocity (m/s)	0.3	0.2	0.2	0.5	0.7	0.4	0.2	0.3	0.7	0.2
pH	7.7	7.8	7.9	8.6	7.7	7.8	0.4	7.8	8.6	7.7
DO (mg/L)	11.2	11.2	9.5	10.2	9.2	10.2	0.9	10.2	11.2	9.2
Conductivity (µS/cm)	404	405	423	427	162	364.2	113.51	405	427	162
BOD (mg/L)	2.2	3.4	1.3	1.3	2.4	2.1	0.9	2.2	3.4	1.3
Turbidity (ntu)	3.6	5.8	1.4	1.6	63.40	15.2	27.03	3.6	63.4	1.4
Total Nitrogen (mg/L)	1.45	5.5	1.4	3.1	2.40	2.8	1.68	2.4	5.5	1.4
Total Phosphate (mg/L)	0.39	0.23	0.32	0.37	1.70	0.6	0.62	0.37	1.7	0.23
Total Organic Carbon (mg/L)	4.3	4.6	3.4	3.5	13.0	5.8	4.1	4.3	13.0	3.4
Total Coliform (col/100 mL)*	13	20000	2000	2550	20000	8913	10165	2550	20000	13
E. Coli	0	1020	0	0	2850	774	1242	0	2850	0

*Coliform of 20000 is a designated limit, actual value may be greater

6.26 Twelve Mile

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/6/2005	6/27/2005	7/20/2005	8/16/2005	9/21/2005					
Time	2:16 PM	9:55 AM	2:10 PM	1:00 PM	2:35 PM					
Heavy Rain Past 7 Days	No	No	Yes	Yes	No					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	26.1	30.0	26.7	25.6	25.6	26.8	1.8	26.1	30.0	25.6
Water Temp (C°)	23.1	20.3	25.0	22.1	21.2	22.3	1.8	22.1	25.0	20.3
Stream Width (m)	6.8	5.8	6.0	5.5	6.4	6.1	0.5	6.0	6.8	5.5
Stream Depth (m)	0.32	0.3	0.34	0.23	0.19	0.3	0.07	0.3	0.34	0.185
Surface Velocity (m/s)	3.4	0.2	0.5	0.4	0.3	1.0	1.4	0.4	3.4	0.2
pH	8.1	8.1	8.4	8.8	8.3	8.3	0.3	8.3	8.8	8.1
DO (mg/L)	8.3	8.5	8.7	9.4	9.7	8.9	0.6	8.7	9.7	8.3
Conductivity (µS/cm)	298	316	321	229	307	294.2	37.49	307	321	229
BOD (mg/L)	1.3	1.4	8.6	1.1	0.3	2.5	3.4	1.3	8.6	0.3
Turbidity (ntu)	1.5	1.3	0.8	0.7	1.60	1.2	0.41	1.3	1.6	0.7
Total Nitrogen (mg/L)	2.6	2.9	3.5	1.5	2.20	2.5	0.75	2.6	3.5	1.5
Total Phosphate (mg/L)	0.17	0.38	0.27	0.11	0.33	0.3	0.11	0.27	0.38	0.11
Total Organic Carbon (mg/L)	3.8	3.3	3.9	3.5	3.4	3.6	0.2	3.5	3.9	3.3
Total Coliform (col/100 mL)	198	11800	7500	3200	6850	5910	4418	6850	11800	198
E. Coli (col/100 mL)	98	50	50	0	150	70	57	50	150	0

6.27 Twenty Mile

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/8/2005	6/27/2005	7/20/2005	8/16/1995	9/26/2005					
Time	10:38 AM	10:35 AM	2:45 PM	1:40 PM	2:50 PM					
Heavy Rain Past 7 Days	No	No	Yes	Yes	Yes					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	(Heavy Rain)					
Air Temp (C°)	28.3	31.1	27.8	25.6	20.6	26.7	3.9	27.8	31.1	20.6
Water Temp (C°)	23.4	24.0	27.8	26.5	19.9	24.3	3.1	24.0	27.8	19.9
Stream Width (m)	14.5	12.7	15.3	12.6	11.3	13.3	1.6	12.7	15.3	11.3
Stream Depth (m)	0.14	0.17	0.16	0.05	0.20	0.1	0.06	0.16	0.2	0.05
Surface Velocity (m/s)	0.3	0.2	0.3	0.3	0.7	0.4	0.2	0.3	0.7	0.2
pH	8.2	8.0	8.6	8.6	7.8	8.2	0.3	8.2	8.6	7.8
DO (mg/L)	8.8	9.4	9.6	9.9	10.1	9.6	0.5	9.6	10.1	8.8
Conductivity (µS/cm)	255	265	267	259	255	260.2	5.59	259	267	255
BOD (mg/L)	1.1	1.5	0.8	0.7	1.0	1.0	0.3	1.0	1.5	0.7
Turbidity (ntu)	1	0.8	1	0.6	3.60	1.4	1.24	1	3.6	0.6
Total Nitrogen (mg/L)	2.5	0.1	1.7	0.2	1.50	1.2	1.03	1.5	2.5	0.1
Total Phosphate (mg/L)	0.17	0.41	0.22	0.19	0.41	0.3	0.12	0.22	0.41	0.17
Total Organic Carbon (mg/L)	3.2	3.0	3.5	3.3	4.4	3.5	0.5	3.3	4.4	3.0
Total Coliform (col/100 mL)	107	6100	1950	750	10250	3831	4279	1950	10250	107
E. Coli	22	0	50	0	100	34	42	22	100	0

6.28 Walnut 1

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/24/2005	6/17/2005	7/11/2005	8/8/2005	8/31/2005					
Time	3:05 PM	11:05 AM	2:25 PM	3:15 PM	1:30 PM					
Heavy Rain Past 7 Days	No	Yes	No	No	Yes					
	50%	60%								
	Cloud	Cloud								
Weather Conditions	Cover	Cover	Sunny	Sunny	Steady Rain					
Air Temp (C°)	12.8	16.5	27.8	26.7	20.0	20.8	6.5	20.0	27.8	12.8
Water Temp (C°)	12.8	16.9	25.9	25.2	20.7	20.3	5.6	20.7	25.9	12.8
Stream Width (m)	23.7	12.0	9.1	8.9	N/A	13.4	7.0	10.5	23.7	8.9
Stream Depth (m)	0.42	0.39	0.26	0.29	0.43	0.36	0.08	0.39	0.43	0.26
Surface Velocity (m/s)	0.2	0.5	0.1	0.2	0.9	0.4	0.3	0.2	0.9	0.1
pH	8.2	7.9	8.4	8.4	7.5	7.9	0.4	8.2	8.4	7.5
DO (mg/L)	10.9	11.0	8.8	9.0	9.7	9.9	1.0	9.7	11.0	8.8
Conductivity (µS/cm)	450	376	452	450	550	455.6	61.89	450	550	376
BOD (mg/L)	0.7	3.2	0.9	0.6	2.1	1.5	1.1	0.9	3.2	0.6
Turbidity (ntu)	1.4	8.2	0.9	1	243.00	50.9	107.43	1.4	243	0.9
Total Nitrogen (mg/L)	1.8	1.2	0.9	1.1	2.20	1.4	0.54	1.2	2.2	0.9
Total Phosphate (mg/L)	0.32	0.24	0.19	0.17	1.85	0.6	0.73	0.24	1.85	0.17
Total Organic Carbon (mg/L)	4.0	7.1	3.5	3.5	12.9	6.2	4.0	4.0	12.9	3.5
Total Coliform (col/mL)*	16	20000	1850	1250	20000	8623	10407	1850	20000	16
E. Coli**	0	20000	0	0	2900	4580	8711	0	20000	0

*Coliform of 20000 is a designated limit, actual value may be greater

**E. coli of 200000 is a designated limit, actual value may be greater

6.29 Walnut 2

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	6/8/2005	6/28/2005	7/21/2005	8/18/2005	10/5/2005					
Time	12:10 PM	10:50 AM	2:55 PM	2:50 PM	1:40 PM					
Heavy Rain Past 7 Days	No	No	Yes	Yes	No					
Weather Conditions	Sunny	Sunny	Sunny	Sunny	Sunny					
Air Temp (C°)	28.3	31.1	27.2	27.8	27	28.28	1.6574076	27.8	31.1	27
Water Temp (C°)	22.2	24.2	25.5	25.3	19.4	23.32	2.5528416	24.2	25.5	19.4
Stream Width (m)	6.408	8.169	7.224	7.1	7.68	7.3162	0.6594863	7.224	8.169	6.408
Stream Depth (m)	0.09	0.1	0.09	0.08	0.105	0.093	0.0097468	0.09	0.105	0.08
Surface Velocity (m/s)	0.27	0.107	0.335	0.366	0.314	0.2784	0.1019721	0.314	0.366	0.107
pH	7.76	7.42	7.36	7.95	7.94	7.61	0.2813894	7.76	7.95	7.36
DO (mg/L)	7.31	5.51	8.68	8.81	10.02	8.066	1.7214325	8.68	10.02	5.51
Conductivity (µS/cm)	701	755	536	587	475	610.8	115.68578	587	755	475
BOD (mg/L)	1.33	0.79	1.64	0.27	9.56	2.718	3.8604236	1.33	9.56	0.27
Turbidity (ntu)	2.1	2.2	2.6	1.3	2.25	2.09	0.4801042	2.2	2.6	1.3
Total Nitrogen (mg/L)	1.5	0.7	1.4	0.5	1.3	1.08	0.4494441	1.3	1.5	0.5
Total Phosphate (mg/L)	0.17	0.35	0.21	0.28	0.4	0.282	0.0952365	0.28	0.4	0.17
Total Organic Carbon (mg/L)	4.879	5.034	8.162	5.579	5.57	5.8448	1.3328303	5.57	8.162	4.879
Total Coliform (col/mL)	200	8600	18200	3250	8800	7810	6860.43	8600	18200	200
E. Coli	27	200	450	0	50	145.4	187.09837	50	450	0

6.30 Wilkins

Test	Session 1	Session 2	Session 3	Session 4	Session 5	Average	Standard Deviation	Median	Max	Min
Date	5/24/2005	6/20/2005	7/11/2005	8/8/2005	8/31/2005					
Time	3:45 PM	1:00 PM	2:45 PM	3:40 PM	2:10 PM					
Heavy Rain Past 7 Days	no	yes	No	No	Yes					
Cloud Cover	50%				Steady					
Weather Conditions		Sunny	Sunny	Sunny	Rain					
Air Temp (C°)	12.8	22.8	27.8	27.2	21.1	22.3	6.0	22.8	27.8	12.8
Water Temp (C°)	11.7	15.8	18.2	19.1	20.0	17.0	3.3	18.2	20.0	11.7
Stream Width (m)	5.8	3.8	5.3	4.6	5.9	5.1	0.9	5.3	5.9	3.8
Stream Depth (m)	0.16	0.13	0.50	0.11	0.24	0.23	0.16	0.16	0.50	0.11
Surface Velocity (m/s)	0.4	0.3	0.1	0.6	0.7	0.4	0.3	0.4	0.7	0.1
pH	8.4	8.0	8.2	8.0	7.1	7.6	0.5	8.0	8.4	7.1
DO (mg/L)	10.2	10.9	9.0	8.9	9.6	9.7	0.8	9.6	10.9	8.9
Conductivity (µS/cm)	517	607	642	639	120	505.0	221.08	607	642	120
BOD (mg/L)	1.6	0.8	0.6	0.4	1.7	1.0	0.6	0.8	1.7	0.4
Turbidity (ntu)	7.7	6	1.6	2	88.50	21.2	37.73	6	88.5	1.6
Total Nitrogen (mg/L)	1.45	5	0.5	0.4	3.70	2.2	2.05	1.45	5	0.4
Total Phosphate (mg/L)	0.22	0.23	0.22	0.25	0.82	0.3	0.26	0.23	0.82	0.22
Total Organic Carbon (mg/L)	5.4	3.3	2.7	2.7	10.7	5.0	3.4	3.3	10.7	2.7
Total Coliform (col/100 mL)*	24	2150	1950	3300	20000	5485	8199	2150	20000	24
E. Coli	0	50	0	0	2250	460	1001	0	2250	0

*Coliform of 20000 is a designated limit, actual value may be greater