Aquatic Enhancement
& Survey, Inc.

2016 Water Quality Sampling Report
Steuben County Lakes Council
Steuben County, Indiana

December 2, 2016

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Acknowledgements

I would like to thank the following for making possible the 2016 season sampling and the preparation of this report: Bob Glick, Bill Schmidt, Sue Myers, Pete Hippensteel and the membership of the Steuben County Lakes Council, the Anthony Wayne Council, Keith Chrysler, Dean Rosener, Mary Jo Fitzenrider and Anne Skinner of Clear Lake, Janel Meyer of the Steuben County Soil and Water Conservation District. Laboratory analysis for this work was performed by Sandhill Environmental, Angola Indiana and Environmental Laboratories Inc., Madison Indiana. Field work and report preparation was performed by Scott Banfield, Tyler Herrington, Mary Vandenberg, Jason Hofacker and Krystal Francess of Aquatic Enhancement & Survey, Inc.

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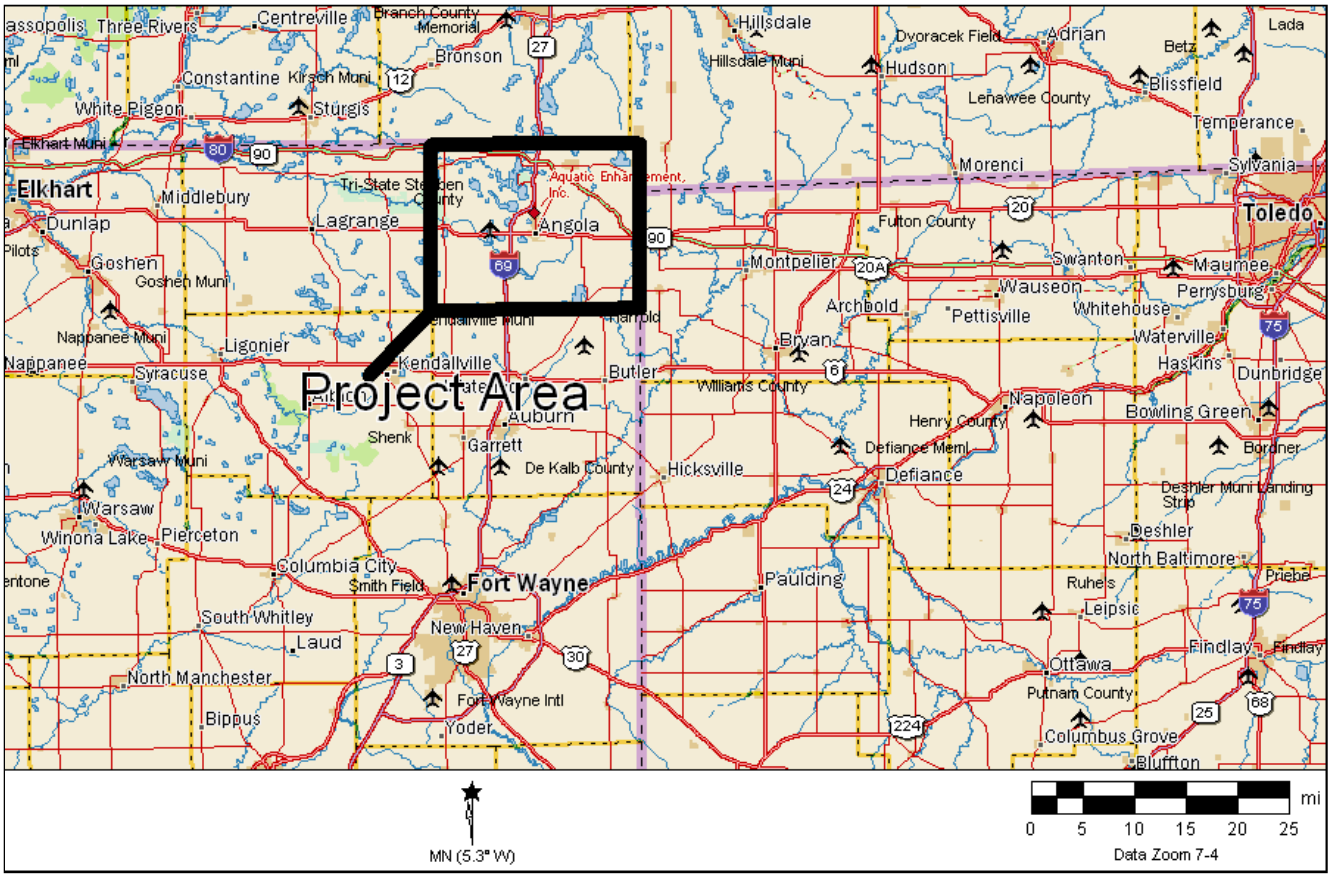

Figure 1 Project location map

1. Project Overview and Purpose:

This project was completed by Aquatic Enhancement & Survey, Inc. under contract with the Steuben County Lakes Council (SCLC), Angola/Trine MS4, and the Steuben County Soil and Water Conservation District. Also partnered with the SCLC in support of this work was the Steuben County Surveyor's Office, and the Clear Lake Township Land Conservancy. Basic water quality data and stream flow (discharge) measurements were collected from a total of 53 sites on several streams and lakes in Steuben County and LaGrange County, Indiana. The sampling reported in this work was completed in May, July, and August of 2016. Figure 2 (page 6) displays sampling locations and associated surface water features. For all sites measured parameters included total phosphorus, total suspended solids, pH, dissolved oxygen, temperature, specific conductance, and E-coli. A basic measurement of stream flow-rate (discharge) at each sampling site was taken when conditions permitted. For sites 1 through 16, 33, and 34 (May and July) sampling also included nitrate + nitrite, and total Kjehldahl nitrogen (TKN).

Total phosphorus, total suspended solids, and nitrogen parameter loading figures were calculated for certain sites at which these measurements were detectible and at which a flow measurement was taken. The purpose of the sampling was to gain a basic understanding of the fate and source of contaminants in these systems with a goal of directing future sampling or directing remediation of watershed point and non-point pollution sources. Table 1 provides a site key showing brief written descriptions of each numbered sampling site. Collected data and calculated loading rates are provided in tables 1-6.

2. Methods:

All samples collected were grab samples. Samples were placed on ice immediately after collection. All samples held overnight were refrigerated. Measurements for temperature, dissolved oxygen, and specific conductance were taken in the field using a meter. Measurements of pH were taken in the field using a meter or measured in the laboratory. Meters were calibrated at the beginning of each sampling day. Where possible, stream flows were calculated using measurements of the stream cross-sectional area and stream velocity. Stream flow cross-sectional area was calculated by measuring stream width using a tape measure and calculating average stream depth by measuring depth at multiple equidistant points using a measuring staff or tape measure. Quality Assurance Procedures and EPA method codes for laboratory analysis are available upon request.

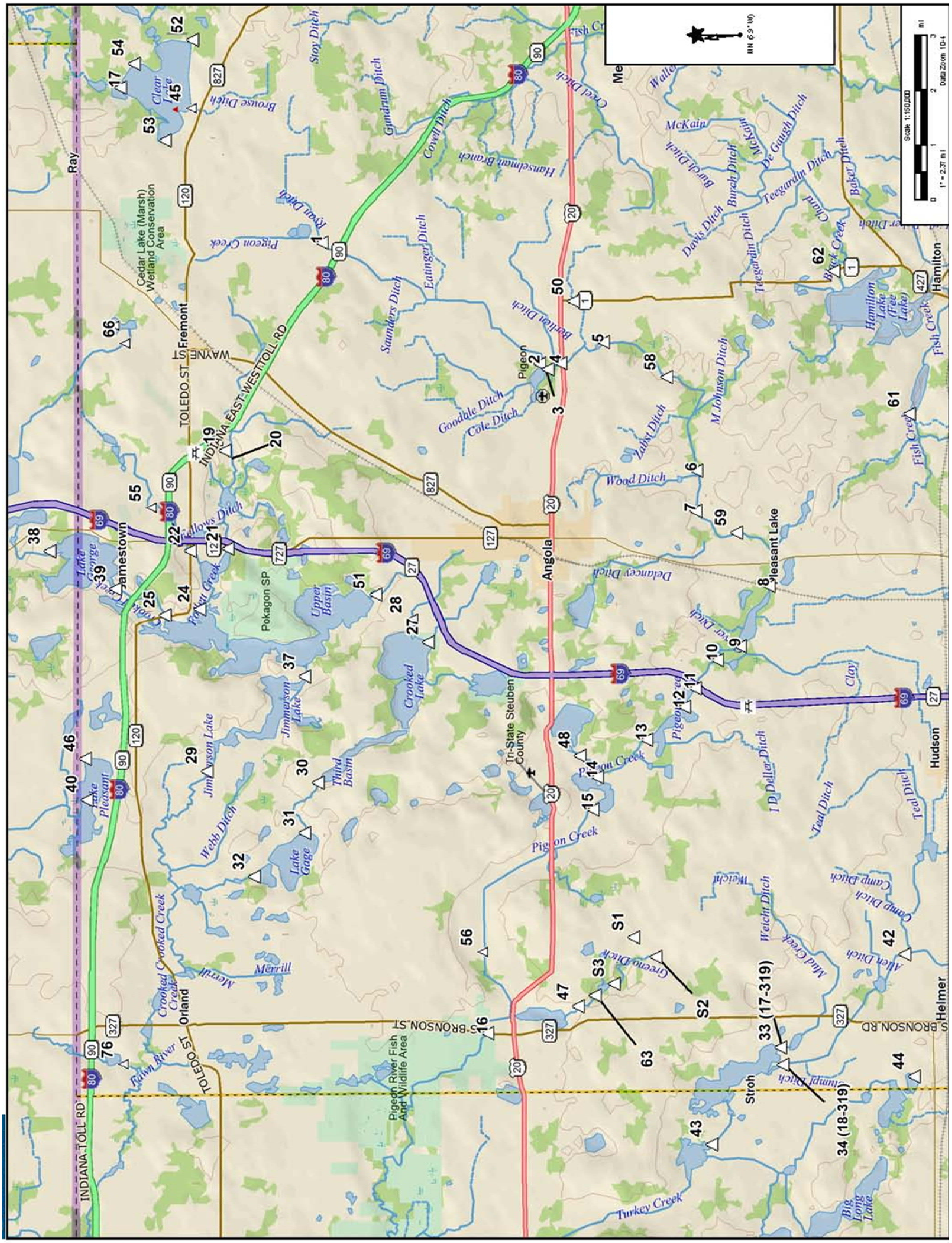

Figure 2 Sampling site map

Samp. Site	SCLC funded	At or near HUC 12 Outlet (10)	At or near HUC14 Outlet Site (13)	Steuben Surveyor Funding (6)	MS4 Funding (4 sites)	Pigeon 319 funded sites (16)	Clear Lake funding (2)	Included in 319 QAPP (18)	Location Description
1.	August		yes			yes		yes	Pigeon, East Ray Clark Road at culvert, below juncture with the Ryan Ditch.
2.	August					yes		yes	Pigeon Creek, Pigeon Lake Inlet.
3.	August					yes		yes	Pigeon Creek, Pigeon Lake Outlet.
4.	August	yes	yes			yes		yes	Pigeon, U.S. 20 Bridge, Below juncture with Berlien Ditch.
5.	August					yes		yes	Pigeon Creek, Metz Road.
6.		yes	yes		yes			yes	Pigeon Creek, Bill Deller Road.
7.					yes			yes	Pigeon Creek, Meridian Road.
8.	August					yes		yes	Pigeon Creek, Long Lake Inlet.
9.	August					yes		yes	Pigeon Creek, Long Lake Outlet.
10.	August	yes	yes			yes		yes	Pigeon Creek, Mud Lake Outlet just west of Long Lake, Johnson Ditch from Ashley.
11.	August					yes		yes	Pigeon Creek, Big Bower Lake Inlet.
12.	August					yes		yes	Pigeon Creek, Big Bower Lake Outlet/Golden Lake Inlet.
13.	August					yes		yes	Pigeon Creek, Golden Lake Outlet.
14.	August					yes		yes	Pigeon Creek, Hogback Lake Inlet.
15.	August	yes	yes			yes		yes	Pigeon Creek, Hogback Lake Outlet.
16.	August	yes*	yes*			yes		yes	Pigeon Creek at 327.
17.	yes		yes						Clear Lake Outlet.
19.	yes								Crane Marsh Outlet, (tributary to Marsh Lake).
21.	yes								Follet Creek, Little Otter Lake Inlet.
22.	yes								Walter's Lakes Drain (tributary to Big Otter Lake).
24.	yes								Follet Creek, Snow Lake Inlet.
25.	yes								Crooked Creek at 120 (Tributary to Snow Lake).
27.	yes								Carpenter Ditch (Tributary to Crooked Lake).
28.	yes								Palfreyman Ditch (Tributary to Crooked Lake).
29.	yes	yes*	yes*						Crooked Creek (Jimmerson outlet at Nevada Mills).
30.	yes								Concorde Creek (Outlet from Crooked Lake).
31.	yes								Concorde Creek (Inlet to Lake Gage).
32.	yes	yes*	yes*						Concorde Creek (Outlet from Lime Lake).
33.	(319 site 17) August					May/Jul			Dewitt Ditch (Tributary to Big Turkey Lake).
34.	(319 site 18) August					May/Jul			Turkey Creek (Tributary to Big Turkey Lake).
37.	yes								Crooked Creek (James Outlet, Jimmerson Inlet at 4 corners).
38.	yes								Lake George NE tributary (from Silver Lake).
39.	yes		yes						Crooked Creek (Lake George Outlet).
40.	yes								Lake Pleasant.
42.	yes	yes	yes						Turkey Ck at 700S east of 800W, below Little Turkey and Deetz Ditch juncture.
43.	yes	yes*	yes*						Big Turkey Outlet at 350S on curve north of Stroh or west of Turkey Lake Tavern.
44.	yes								Trib. To McClish Lake (east end).
45.	yes								Trib. To Clear Lake (Cyrus Brouse Ditch).
46.	yes								Trib. To Lake Pleasant (East End).
47.	yes								Trib. To West Otter (Between Arrowhead and Otter).
48.	yes								Trib. Between Silver and Hogback.
50.	yes								William Jack Ditch (at State Rd. 1).
51.	yes								Croxton Ditch (at West 275 North).
52.				yes					Clear Lake Trib. (Harry Teeters Ditch).
53.							yes		Clear Lake Trib. (Peter Smith Ditch).
54.							yes		Clear Lake Trib. (Alvin Patterson Ditch).
58.					yes				Pigeon Creek at Hanselman.
59.					yes				Pigeon Creek at 400 South.
61.				yes					Tributary to Ball Lake.
62.				yes					Black Creek, Tributary to Hamilton Lake.
63.	yes								Tributary just downstream of Arrowhead Lake.
64.				yes					Tributary to Arrowhead Lake at south end of Arrowhead Lake
65.	yes								Fish Creek at 427

Table 1 Descriptions of numbered sampling sites

Site	Date	E-coli (CFU or colonies/ 100 ml)	CFM	Total Phos. (ppm)	Total Phos. Loading (kg/day)	Nitrogen, Nitrate +Nitrite (ppm)	Nitrogen Loading (kg/day)	TKN (ppm)	TKN Loading (kg/day)	TSS (ppm)	TSS Loading (kg/day)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *
1	5/25/2016	118.3	414.21	0.022	0.37	3.24	54.73	0.87	14.70	3.7	62.50	9.46	7.72	18.2	828	
2	5/25/2016	115	561.82	0.023	0.53	3.2	73.32	0.78	17.87	3.2	73.32	9.84	8.01	19.9	782	
3	5/25/2016	6.7	562.30	0.024	0.55	5.11	117.18	0.88	20.18	4.4	100.90	8.82	8.31	23.4	710	
4	5/25/2016	36	1198.64	0.039	1.91	4.35	212.63	1	48.88	6.8	332.39	8.53	8.17	22.6	743	
5	5/25/2016	45	1053.86	0.029	1.25	4.2	180.50	1	42.98	4.6	197.70	8.09	8.11	22.0	761	
6	5/25/2016	168	2349.93	0.055	5.27	3.78	362.25	1.1	105.42	13	1245.82	7.29	8.06	23.2	740	
7	5/25/2016	82	3809.75	0.087	13.52	3.83	595.05	1.1	170.90	16	2485.83	7.34	8.07	22.8	838	
8	5/26/2016	39	3974.00	0.059	9.56	3.54	573.70	0.91	147.48	13	2106.82	7.25	7.94	21.0	841	
9	5/26/2016	10.2	2421.37	0.029	2.86	3.69	364.37	0.93	91.83	2	197.49	7.67	8.27	22.7	766	
10	5/26/2016	30.3	6218.11	0.034	8.62	4.86	1232.40	0.94	238.36	3.9	988.96	7.62	8.09	22.7	866	
11	5/26/2016	69.5	nd	0.022	nd	3.88	nd	0.96	nd	3.8	nd	7.65	8.13	22.0	771	
12	5/26/2016	33.5	4097.43	0.046	7.69	3.87	646.66	1	167.10	4.6	768.64	8.03	8.17	21.8	733	
13	5/26/2016	<2.5	nd	0.022	nd	4.47	nd	0.89	nd	1.7	nd	7.59	8.32	23.6	732	
14	5/26/2016	7.8	4645.76	0.06	11.37	4.02	761.62	1.1	208.40	5	947.29	7.51	8.25	22.9	735	
15	5/26/2016	<2.5	4865.49	0.021	4.17	3.45	684.54	0.94	186.51	4.2	833.36	8.07	8.33	23.3	699	
16	5/27/2016	52.4	5429.97	0.051	11.29	3.03	670.96	0.89	197.08	7.3	1616.50	9.35	8	20.6	687	
17	5/31/2016	2	nd	0.017	nd	nd	nd	nd	nd	1.1	nd	6.64	8.28	22.3	353.9	
19	5/31/2016	280.2	201.87	0.043	0.35	nd	nd	nd	nd	8.6	nd	7.00	8	17.4	875	
21	5/31/2016	124	512.24	0.019	0.40	nd	nd	nd	nd	2	nd	4.41	7.89	20.4	749	
22	5/31/2016	656.4	66.09	0.069	0.19	nd	nd	nd	nd	2.4	nd	6.26	7.76	16.1	797	
24	5/31/2016	22	nd	0.036	nd	nd	nd	nd	nd	16	nd	5.17	8.04	23.2	681	
25	5/31/2016	49.8	144.34	0.021	0.12	nd	nd	nd	nd	2.2	nd	5.66	7.81	21.8	503	
27	5/31/2016	109.2	45.96	0.058	0.11	nd	nd	nd	nd	5.1	nd	7.06	8.08	20.8	847	

Table 2 May data for sites 1 through 27. The notation "nd" denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8).

Site	Date	E-coli (CFU or colonies/ 100 ml)	CFM	Total Phos. (ppm)	Total Phos. Loading (kg/day)	Nitrogen, Nitrate +Nitrite (ppm)	Nitrogen Loading (kg/day)	TKN (ppm)	TKN Loading (kg/day)	TSS (ppm)	TSS Loading (kg/day)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *
28	5/31/2016	104	771.87	0.103	3.24	nd	nd	nd	nd	5.2	nd	6.41	7.96	19.6	597	
29	5/31/2016	22	1950.31	0.02	1.59	nd	nd	nd	nd	1.8	nd	6.01	7.98	25.0	558	
30	5/31/2016	146.6	560.65	0.037	0.85	nd	nd	nd	nd	4.2	nd	5.05	0.037	24.5	492.3	
31	5/31/2016	119.6	424.83	0.036	0.62	nd	nd	nd	nd	4.4	nd	6.20	8.08	23.9	491.7	
32	5/31/2016	8.2	nd	0.019	nd	nd	nd	nd	nd	6.7	nd	6.03	8.34	25.4	463.3	
33 (17-319)	5/27/2016	4	347.61	0.029	0.41	3.42	48.48	0.78	11.06	1.7	24.10	7.46	8.31	22.4	664	
34(18-319)	5/27/2016	149.8	1469.66	0.049	2.94	4.74	284.09	1.1	65.93	2.7	161.82	5.98	7.66	20.4	721	
17(sclc)	5/31/2016	2	nd	0.017	nd	nd	nd	nd	nd	1.1	nd	6.64	8.28	22.3	353.9	
37	5/31/2016	6.2	nd	0.014	nd	nd	nd	nd	nd	4.8	nd	6.92	8.28	22.7	562	
38	5/31/2016	118.2	216.25	0.013	0.11	nd	nd	nd	nd	1.3	nd	4.34	7.52	20.9	431.3	
39	5/31/2016	2	32.23	0.029	0.04	nd	nd	nd	nd	1.5	nd	6.91	8.46	23.3	391.4	
40	5/31/2016	<2.0	lake site	0.013	nd	nd	nd	nd	nd	2.1	nd	6.86	8.49	24.5	435.9	
42	5/27/2016	139.4	534.60	0.052	1.13	nd	nd	nd	nd	3.3	nd	6.62	7.91	20.5	710	
43	5/27/2016	172	4068.92	0.038	6.31	nd	nd	nd	nd	14	nd	6.59	8.26	23.0	629	
44	5/27/2016	80.8	58.63k	0.019	nd	nd	nd	nd	nd	2.7	nd	7.38	7.59	14.8	753	
45	5/31/2016	2599.4	nd	0.061	nd	nd	nd	nd	nd	8.2	nd	6.62	7.8	15.1	751	
46	5/31/2016	551	68.04	0.053	0.15	nd	nd	nd	nd	4.2	nd	9.23	7.84	18.6	682	
47	5/27/2016	279.2	nd	0.044	nd	nd	nd	nd	nd	3.6	nd	5.54	8.1	23.5	561	
48	5/31/2016	181.8	222.87	0.022	0.20	nd	nd	nd	nd	<1.0	nd	5.87	8.21	25.8	484	
50	5/25/2016	147	67.92	0.107	0.30	nd	nd	nd	nd	17	nd	7.16	7.92	23.5	780	
51	5/27/2016	167.2	54.45	0.023	0.05	nd	nd	nd	nd	1.7	nd	10.26	8.12	21.8	851	
52	5/31/2016	1454	5.59	0.278	0.06	nd	nd	nd	nd	18	nd	5.47	7.78	17.0	665	
53	5/31/2016	<2.0	5.59	0.047	0.01	nd	nd	nd	nd	3.2	nd	7.46	7.3	12.4	610	
54	5/31/2016	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
58	5/25/2016	36.7	1122.91	0.039	1.79	nd	nd	nd	nd	4.9	nd	8.64	8.28	23.0	753	
59	5/26/2016	181.8	3428.92	0.062	8.67	nd	nd	nd	nd	6.1	nd	7.78	8.02	21.0	853	
61	5/31/2016	688.2	94.89	0.117	0.45	nd	nd	nd	nd	7.8	nd	7.69	8.07	16.3	489.9	
62	5/31/2016	141.2	86.34	0.135	0.48	nd	nd	nd	nd	9.1	nd	7.69	8.07	18.2	653	
63	5/27/2016	397.8	nd	0.034	nd	nd	nd	nd	nd	1.4	nd	6.17	8.15	23.8	562	
64	5/27/2016	61	155.51	0.051	0.32	nd	nd	nd	nd	5	nd	6.95	8.13	22.1	588	
65	5/31/2016	150.8	937.97	0.149	5.70	nd	nd	nd	nd	24	nd	6.39	6.51	19.3	695	

Table 3 May data for sites 28 through 65. The notation "nd" denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8).

Site	Date	E-coli (CFU or colonies/ 100 ml)	CFM	Total Phos. (ppm)	Total Phos. Loading (kg/day)	Nitrogen, Nitrate +Nitrite (ppm)	Nitrogen Loading (kg/day)	TKN (ppm)	TKN Loading (kg/day)	TSS (ppm)	TSS Loading (kg/day)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *
1	07/25/16	832	228.76	0.022	0.21	1.23	11.47	0.55	5.13	6.6	61.57	966.00	7.83	23.4	903	
2	07/25/16	508.5	111.37	0.03	0.14	0.989	4.49	0.53	2.41	3.1	14.08	9.51	8.14	23.8	843	
3	07/25/16	37.5	562.49	0.015	0.34	6.08	139.47	0.99	22.71	5.6	128.46	7.85	8.47	28.9	716	
4	07/25/16	260	559.23	0.042	0.96	4.57	104.22	0.98	22.35	9.1	207.53	7.30	8.05	27.5	785	
5	07/25/16	26	344.84	0.01	0.14	4.22	59.35	0.94	13.22	2.1	29.53	7.79	8.33	28.7	803	
6	07/25/16	611.5	1609.76	0.039	2.56	3.28	215.32	0.85	55.80	4.7	308.54	8.43	8.33	28.4	782	
7	07/25/16	862.5	1178.05	0.073	3.51	3.98	191.21	1	48.04	8.9	427.57	6.96	8.13	27.7	1126	
8	07/25/16	657	489.02	0.047	0.94	3.43	68.40	0.83	16.55	7.2	143.59	7.14	8.1	26.1	988	
9	07/26/16	54.5	765.96	0.019	0.59	3.11	97.15	1	31.24	7.4	231.15	9.71	8.31	26.5	733	
10	07/26/16	157.5	1387.17	0.028	1.58	2.63	148.78	1.1	62.23	4.2	237.59	7.75	8.22	26.9	772	
11	07/26/16	177.5	nd	0.04	nd	2.72	nd	1	nd	7.7	nd	6.51	8.04	26.5	774	
12	07/26/16	37	1225.01	0.025	1.25	2.54	126.89	0.88	43.96	4.5	224.81	8.61	8.42	27.6	766	
13	07/26/16	42.5	nd	0.016	nd	2.69	nd	0.83	nd	4.2	nd	9.35	8.48	28.2	679	
14	07/26/16	86.5	1174.81	0.021	1.01	2.71	129.84	0.82	39.29	3.6	172.47	7.02	8.17	27.2	684	
15	07/26/16	<5.0	1748.73	0.018	1.28	1.95	139.06	1.1	78.45	4.5	320.92	7.96	8.47	29.0	643	
16	07/26/16	235.5	1266.96	0.015	0.78	1.81	93.52	0.66	34.10	2.2	113.67	7.06	8.05	23.7	658	
17	7/28/2016	131	nd	0.012	nd	nd	nd	nd	nd	2.8	nd	6.35	8.28	27.4	338	
20	7/27/2016	341.5	162.76	0.032	0.21	nd	nd	nd	nd	4.7	31.20	6.85	8.07	22.2	887	
21	7/27/2016	264.5	340.62	0.011	0.15	nd	nd	nd	nd	2	27.78	4.97	7.83	25.8	701	
22	7/27/2016	205	40.51	0.141	0.23	nd	nd	nd	nd	4.4	7.27	7.66	7.78	21.8	824	
24	7/27/2016	10	nd	0.011	nd	nd	nd	nd	nd	2	nd	7.45	8.38	29.5	643	
25	7/27/2016	1.3	345.62	<0.010	nd	nd	nd	nd	nd	1.3	18.32	6.02	7.77	29.2	424.7	
27	7/29/2016	377	0.23	0.089	0.00	nd	nd	nd	nd	7.6	0.07	6.94	7.49	23.8	1042	

Table 4 July data for sites 1 through 27. The notation "nd" denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8).

Site	Date	E-coli (CFU or colonies/ 100 ml)	CFM	Total Phos. (ppm)	Total Phos. Loading (kg/day)	Nitrogen, Nitrate +Nitrite (ppm)	Nitrogen Loading (kg/day)	TKN (ppm)	TKN Loading (kg/day)	TSS (ppm)	TSS Loading (kg/day)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *
28	7/29/2016	454.5	5.26	0.024	0.01	nd	nd	nd	nd	6.6	1.42	6.65	8.34	22.7	673	
29	7/29/2016	196.5	1530.24	0.105	6.55	nd	nd	nd	nd	2.2	137.29	6.16	8.21	27.6	514	
30	7/29/2016	123	nd	<0.010	nd	nd	nd	nd	nd	1.3	nd	4.22	8.1	27.3	454.7	
31	7/28/2016	281.5	36.31	0.011	0.02	nd	nd	nd	nd	2.8	4.15	6.88	7.49	23.1	556	
32	7/28/2016	832	95.44	0.012	0.05	nd	nd	nd	nd	2.3	8.95	5.7	8.16	29.1	444	
33 (17-319)	07/27/16	26	198.52	<0.010	nd	2.12	17.16	0.81	6.56	3.6	29.14	6.58	8.06	29.9	595	
34(18-319)	07/27/16	788	753.65	0.126	3.87	1.79	55.01	1.4	43.03	2.4	73.76	7.18	7.95	27.1	611	
37	7/29/2016	26	nd	<0.010	nd	nd	nd	nd	nd	1.7	nd	6.36	8.35	27.2	534	
38	7/27/2016	559.5	271.7	0.014	0.16	nd	nd	nd	nd	1.2	13.30	5.26	7.43	27.1	388.8	
39	7/27/2016	26	340.19	<0.010	nd	nd	nd	nd	nd	1.3	18.04	7.25	8.52	28.7	366.5	
40	7/28/2016	20.5	nd	<0.010	nd	nd	nd	nd	nd	3.3	nd	7.37	8.63	28.9	422.3	
42	7/28/2016	832	188.74	0.111	0.85	nd	nd	nd	nd	3.9	30.02	7.15	7.87	20.0	749	
43	7/28/2016	87.5	526.1	<0.010	nd	nd	nd	nd	nd	2.3	49.35	5.75	7.92	26.9	527	
44	7/28/2016	508.5	12.49	0.085	0.04	nd	nd	nd	nd	5	2.55	7.64	7.67	17.3	773	
45	7/27/2016	1,049	nd	0.06	nd	nd	nd	nd	nd	4.6	nd	6.94	7.71	18.5	869	
46	7/28/2016	224	23.66	<0.010	nd	nd	nd	nd	nd	3	2.89	7.81	7.52	15.6	690	
47	7/28/2016	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
48	7/27/2016	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
50	7/29/2016	803.5	nd	0.113	nd	nd	nd	nd	nd	16	nd	6.63	7.92	20.2	813	
51	7/29/2016	216	nd	<0.010	nd	nd	nd	nd	nd	1	nd	7.84	8.14	20.5	852	
52	7/27/2016	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
53	7/27/2016	<5.0	5.07	0.012	0.00	nd	nd	nd	nd	1.6	0.33	8.98	7.2	15.4	586	
54	7/27/2016	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
58	7/25/2016	325	322.58	0.029	0.38	nd	nd	nd	nd	6.2	81.56	8.21	8.34	27.5	785	
59	7/25/2016	629.5	661.83	0.059	1.59	nd	nd	nd	nd	5.8	156.54	6.68	8.08	26.9	1089	
61	7/29/2016	967.5	59.68	0.073	0.18	nd	nd	nd	nd	9.5	23.12	8.13	8.09	19.1	687	
62	7/29/2016	213	6.03	0.137	0.03	nd	nd	nd	nd	8.9	2.19	7.26	7.88	20.9	954	
63	7/28/2016	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
64	7/28/2016	302.5	8.04	<0.010	nd	nd	nd	nd	nd	8.8	2.89	6.12	8.07	23.0	672	
65	7/29/2016	605.5	361.58	0.14	2.06	nd	nd	nd	nd	16	235.93	6.92	8.26	22.8	716	

Table 5 July data for sites 28 through 65. The notation "nd" denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8).

Site	Date	E-coli (CFU or colonies/ 100 ml)	CFM	Total Phos. (ppm)	Total Phos. Loading (kg/day)	TSS (ppm)	TSS Loading (kg/day)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *
1	8/22/2016	269	234.6	0.045	0.43	15	143.51	9.49	8.07	17.8	839	
2	8/22/2016	418	272.39	0.011	0.12	2.4	26.66	9.44	8.12	20.0	830	
3	8/22/2016	15.5	865.26	0.013	0.46	6.6	232.89	8.46	8.4	25.2	666	
4	8/22/2016	94.5	969.59	0.036	1.42	10	395.41	7.44	7.99	23.2	687	
5	8/22/2016	73	447.79	0.044	0.80	6.7	122.35	6.7	7.89	24.4	718	
6	8/22/2016	454.5	441.05	0.028	0.50	4.3	77.34	7.24	8.23	23.4	713	
7	8/22/2016	442	775.38	0.066	2.09	7	221.34	7.43	8.27	22.8	921	
8	8/22/2016	441	1358.04	0.044	2.44	4.6	254.76	7.11	8.14	21.7	877	
9	8/23/2016	10	1026.26	0.033	1.38	15	627.78	8.55	8.55	23.3	735	
10	8/23/2016	49	1564.6	0.043	2.74	9.4	599.77	7.15	8.1	23.5	753	
11	8/23/2016	54.5	nd	0.027	nd	5.2	nd	6.23	8.04	23.6	745	
12	8/23/2016	5	1338.68	0.056	3.06	12	655.11	8.22	8.47	24.5	713	
13	8/23/2016	<5.0	nd	0.044	nd	9	nd	7.98	8.54	25.5	635	
14	8/23/2016	15.5	1659.38	0.026	1.76	4.4	297.75	5.92	8.06	24.4	638	
15	8/23/2016	5	2312.82	0.024	2.26	7.2	679.09	6.64	8.37	25.8	601	
16	8/24/2016	156.5	3242.70	0.02	2.64	4.7	621.53	7.14	8.17	20.9	626	
17	8/30/2016	15.5	nd	<0.010	nd	2.8	nd	6.93	8.22	24.4	340	
20	8/30/2016	101.5	244.12	0.03	0.30	2.8	27.88	6.38	8.09	21.7	896	
21	8/30/2016	741.5	391.56	<0.010	nd	<1.0	nd	4.96	7.87	24.4	705	
22	8/30/2016	137.5	62.19	0.053	0.13	2.2	5.58	6.24	7.72	20.7	745	
24	8/30/2016	20.5	nd	<0.010	nd	1.7	nd	7.92	8.45	26.5	629	
25	8/30/2016	60.5	898.65	<0.010	nd	<1.0	nd	4.47	7.58	24.7	384	
27	8/25/2016	618	30.88	0.124	0.16	30	37.78	7.11	7.98	21.4	595	

Table 6 August data for sites 1 through 27. The notation "nd" denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8).

Site	Date	E-coli (CFU or colonies/ 100 ml)	CFM	Total Phos. (ppm)	Total Phos. Loading (kg/day)	TSS (ppm)	TSS Loading (kg/day)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *
28	8/24/2016	371.5	26.23	0.141	0.15	17	18.18	7.91	7.75	24.3	631	
29	8/24/2016	36.5	2790.77	0.04	4.55	4.9	557.67	6.55	8.33	25.8	517	
30	8/30/2016	49	125.46	<0.010	nd	1.5	7.67	5.3	8.04	24.2	449	
31	8/30/2016	466.5	113.96	<0.010	nd	3	13.94	7.35	7.44	21.8	473	
32	8/30/2016	611.5	226.58	<0.010	nd	5.2	48.05	6.41	8.01	25.1	430	
33(17-319)	8/24/2016	37.5	305.47	0.022	0.27	3.8	47.34	6.64	7.82	23.2	577	
34(18-319)	8/24/2016	466.5	988.30	0.091	3.67	2.4	96.73	5.82	7.76	20.2	624	
37	8/30/2016	15	nd	<0.010	nd	1.8	nd	7.1	8.35	25.2	538	
38	8/30/2016	1,301.50	545.35	0.016	0.36	1.4	31.14	4.11	7.37	24.5	361	
39	8/30/2016	5	605.97	<0.010	nd	1	24.71	6	8.4	25.5	363	
40	8/30/2016	<5.0	nd	<0.010	nd	2.1	nd	6.58	8.45	26.2	429	
42	8/24/2016	576.5	nd	0.095	nd	3.2	nd	6.14	8.09	18.2	768	
43	8/24/2016	65.5	603.93	0.013	0.32	2.4	59.11	6.94	8.15	24.2	476.5	
44	8/24/2016	273	10.46	0.015	0.01	3.2	1.37	7.32	7.7	17.3	776	
45	8/25/2016	1,017.50	nd	0.042	nd	3.4	nd	6.55	7.74	9.2	881	
46	8/30/2016	146	20.77	<0.010	nd	1.5	1.27	6.27	7.53	16.2	692	
47	8/24/2016	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
48	8/24/2016	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
50	8/22/2016	379.5	3.82	0.142	0.02	4.2	0.65	7.86	7.92	19.9	758	
51	8/30/2016	269	75.55	0.03	0.09	1.7	5.24	8.24	7.85	17.5	716	
52	8/25/2016	1,824.50	4.54	0.322	0.06	50	9.26	6.29	7.72	21.8	859.00	
53	8/25/2016	179.5	5.74	0.017	0.00	1.8	0.42	8.04	7.24	16.4	627	
54	8/25/2016	240	nd	0.308	nd	2.6	nd	4.99	7.18	21.9	429.50	
58	8/22/2016	493.5	613.78	0.044	1.10	6.4	160.19	6.62	8.07	23.5	728	
59	8/22/2016	366.5	858.02	0.055	1.92	5.8	202.95	7.14	8.19	21.9	922	
61	8/25/2016	1,493.50	91.44	0.055	0.21	5	18.64	7.7	8.14	20.5	661	
62	8/25/2016	256	5.76	0.061	0.01	2.8	0.66	6.71	7.98	21	861	
63	8/24/2016	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
64	8/24/2016	698	1.89	0.121	0.01	6.8	0.52	7.63	8.16	21.1	675	
65	8/25/2016	645.5	440.42	0.01	0.18	3.90	70.05	7.15	8.32	22.60	738.00	

Table 7 August data for sites 28 through 65. The notation "nd" denotes that no data was collected or calculated due to a result below lab detection limits or the constraints of field conditions. Data shaded exceeds certain water quality standards selected from those provided by IDEM (see corresponding shaded standards in table 8).

Parameter	Target	Reference/other information
Temperature	Dependent on time of year and whether stream is designated as a cold water fishery	Indiana Administrative Code (IAC)
Dissolved Oxygen (DO)	Min: 4.0 mg/L Max: 12.0 mg/L	Indiana Administrative Code (IAC)
	Min: 6.0 mg/L in cold water fishery streams	Indiana Administrative Code (IAC)
	Min: 7.0 mg/L in spawning areas of cold water fishery streams	Indiana Administrative Code (IAC)
E. coli	Max: 235 CFU/ 100mL in a single sample,	Indiana Administrative Code (IAC)
	Max: Geometric Mean of 125 CFU/ 100mL from 5 equally spaced samples over a 30-day period	
Total Phosphorus	Max: 0.076 mg/L	U.S. EPA recommendation
	0.07 mg/L	Dividing line between mesotrophic and eutrophic streams (Dodd et al. 1998)
	Max: 0.08 mg/L	Ohio EPA recommendation to protect aquatic biotic integrity in WWH
	Max: 0.3 mg/L	IDEM draft TMDL target
Total Suspended Solids (TSS)	Max: 80.0 mg/L	Wawasee Area Conservancy Foundation recommendation to protect aquatic life in lake systems
	Max: 30.0 mg/L	IDEM draft TMDL target
	Range: 25.0-80.0 mg/L	Concentrations within this range reduce fish concentrations (Waters, 1995)
	Max: 40.0 mg/L	New Jersey criteria for warm water streams
	Max: 46.0 mg/L	Minnesota TMDL criteria for protection of fish/macroinvertebrate health
Turbidity	Max: 10.4 NTU	U.S. EPA recommendation

Table 8 Indiana Department of Environmental Quality Table of Water Quality Targets. Standards shaded on results tables correspond to standards shaded in this table.

3. Results: May Sampling

May sampling occurred at all 53 sites. May sampling results are listed in tables 2 and 3. Samples collected represented baseline flow conditions. Table 8 contains a variety of stream water quality targets provided by the Indiana Department of Environmental Management (IDEM) for comparison with the 2016 season data. Also provided for comparison is table 9 containing averages of stream data from the IDEM probabilistic data set. The data used to calculate these averages was collected from Indiana Streams within the St. Joseph River watershed from year 2000 to 2005. Most of the collection sites included in the 2016 data are also within the St. Joseph River watershed and therefore represent somewhat similar soil types, topography, and land uses. This allows some amount of judgment to be made as to whether the 2016 samples were "below average", "average" or "above average" in terms of Northern Indiana stream water quality. In May several sites did not conform to the standards listed in table 8. Six sites exceeded the E-coli standard of 235 and seven sites exceeded the total phosphorus standard of .076.

Parameter	IDEM Mean Stream Data
	St. Joseph Wtrshd 2000-2005
pH	n/d
D.O. (ppm)	7.14
Temp. (deg C)	19.91
Specific conductance umho/cm	764.19
Total Suspended Solids (ppm)	36
Total Phosphorus (ppm)	0.382
E-coli (CFU/100ml)/(MPN)	1895.58

Table 9 Average of IDEM-collected probabilistic Indiana stream data for the St Joseph River Watershed 2000-2005

4. Results: July Sampling

July sampling occurred at 48 sites. Five sites were not sampled due to a "low flow", or "no flow" condition. July sampling results are listed in tables 4 and 5. Samples collected represented baseline flow conditions. E-coli standards were exceeded at 23 of the 48 sites sampled. Total phosphorus standards were exceeded at 8 sites.

5. Results: August Sampling

August sampling occurred at 50 sites. Sampling results are listed in tables 6 and 7. Samples collected represented baseline flow conditions. E-coli standards were exceeded at 24 of the 50 sites sampled. Total phosphorus standards were exceeded at 8 of the sites.

6. Conclusions

A number of notable observations were made during the 2016 season sampling. E-coli measurements above the 235 CFU standard remained relatively common on Pigeon Creek with 15 of 54 sampling events (28%) returning results above 235. This was, however down slightly from 2015 when 35% of sampling events returning results above 235.

E-coli counts on the Upper Pigeon (sites 1-11 above Big Bower Lake) appeared to be less significant in 2016 than in 2015. Of 33 samplings, only 10 (30%) were above 235. In 2015 there were 16 (48%) above 235. In 2014 the figure was 34% and in 2013 it was 41%. The highest E-coli count recorded on the upper Pigeon reach was lower than in the past three years. A high count of 862 from site 7 occurred on July 25. In 2015 a count of 4950 was recorded from site 11 (Big Bower Lake inlet) collected on August 25. In 2014 the highest E-coli was 1435 from site 7 (Meridian Road) and in 2013 the highest was a measurement of 9300 colonies at site 1 (Ray Clark Rd.).

For total phosphorus on the upper Pigeon only 1 sampling (3%) exceeded a standard of .076 ppm. In 2015 a total of 3 samplings (9%) exceeded the standard. The relatively low phosphorus levels are to be expected with the 2015 and 2016 sampling representing baseline flow conditions. In 2014 sampling, which included rain events, 13 of 44 upper Pigeon samplings (30%) exceeded the standard. This was similar to the 2013 season when 27 of 88 sites (31%) exceeded that standard.

In 2016 no sites on Pigeon Creek exceeded the E-coli standard on all three sampling. In 2015 three sites had exceeded the standard on all three samplings. This occurred at Bill Deller Road, Meridian Road, and the Inlet to Long Lake.

The tributary to Ball Lake was well above the standard for E-coli during all three samplings, although levels were not as high as the count of 19,862.9 recorded in August of 2015. Supplemental sampling efforts by the Ball Lake residents to track potential pollution sources in that watershed are ongoing.

The SCLC has built an extensive body of local water quality data through this sampling program over several years. There are many ways to examine the statistical content of the data and glean information to assist in meeting the needs of local lake residents, government agencies, and land users. The SCLC is encouraged to continue to convey the water quality information through its website, meetings, and other outlets, fostering cooperative community water-quality improvement efforts and encouraging new input and ideas to direct future sampling.