



*Aquatic Enhancement
& Survey, Inc.*

**2012 Water Quality Sampling Report
Steuben County Lakes Council
Steuben County, Indiana**

November 11, 2012



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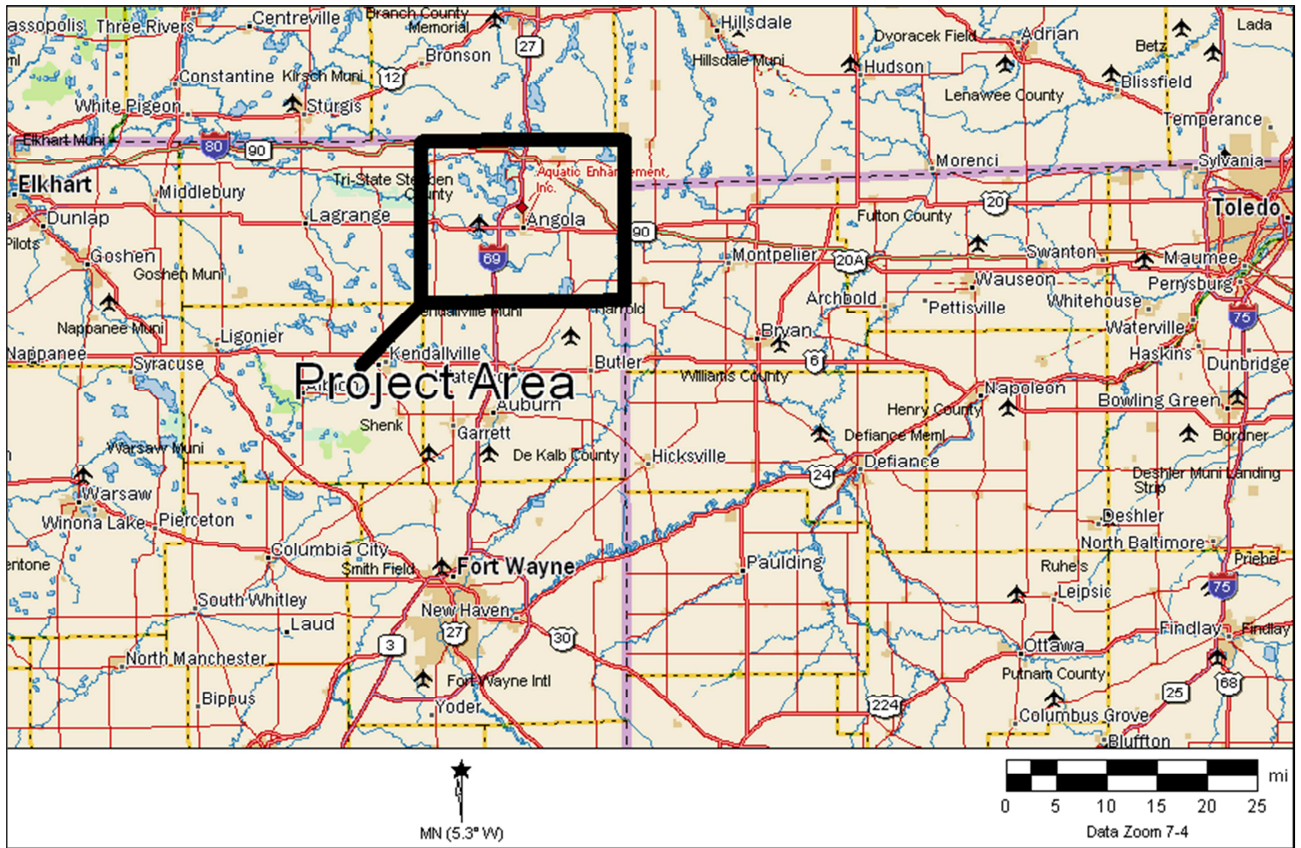


Figure 1 Project location map

1. Project Overview and Purpose:

This project was completed by Aquatic Enhancement & Survey, Inc. under contract with the Steuben County Lakes Council (SCLC), and Angola/Trine MS4. Also partnered with the SCLC in support of this work was the Steuben County Soil and Water Conservation District (SWCD) (working with the assistance of EPA 319 grant funding administered through the Indiana Department of Environmental Management), and the Steuben County Surveyor's Office. Basic water quality data and stream flow (discharge) measurements were collected from several streams and lakes in Steuben County, Indiana. One sampling site was located in LaGrange County Indiana and one was located in Branch County Michigan (See figure 1 above for general project area location). Sampling was completed in May through August of 2012. Figure 2 (page 6) displays sampling locations and associated surface water features. Measured parameters included total phosphorus, total suspended solids, pH, dissolved oxygen, temperature, specific conductance, E-coli, and a basic measurement of stream flow-rate (discharge) at each sampling site having measurable flow. Total phosphorus and total suspended solids loading figures were calculated for each site at which these measurements were detectable 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 one on page 8 provides a site key showing brief written descriptions of each numbered sampling site. Collected data and calculated loading rates are provided in tables 2-7 on pages 9 through 14.

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 and dissolved oxygen were taken in the field using a YSI 85 dissolved oxygen, temperature, conductivity, and salinity meter. Measurements of pH were taken in the field using an Oakton pH 6 Acorn series meter. Both 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 marked section of rope, tape measure, or laser rangefinder and calculating average stream depth by measuring depth at multiple equidistant points using a measuring staff, or tape measure. Laboratory analysis for all samples was completed by Sherry Laboratories, Inc., Fort Wayne, Indiana 46808. Quality Assurance Procedures and EPA method codes are available upon request.

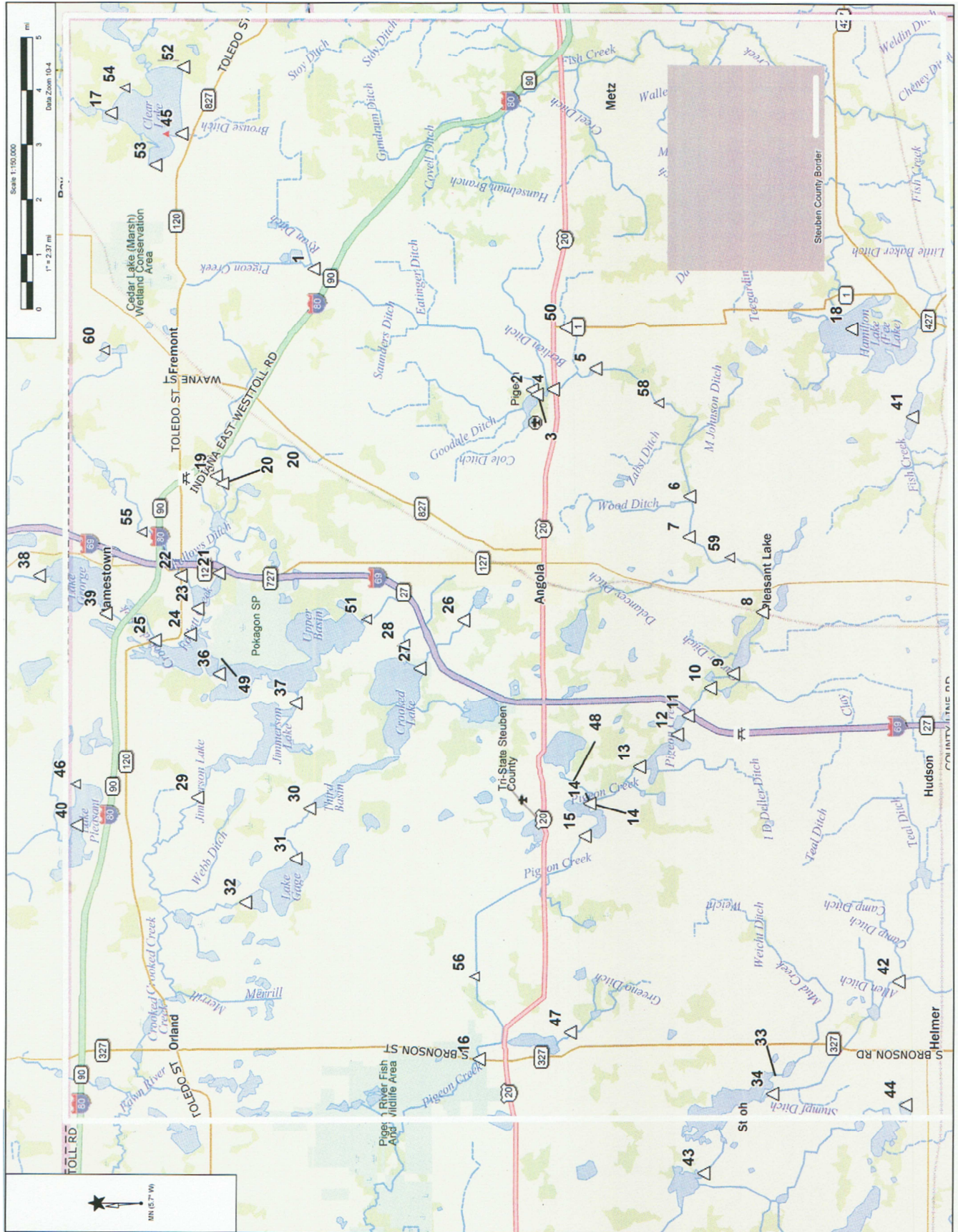


Figure 2 Sampling site map.

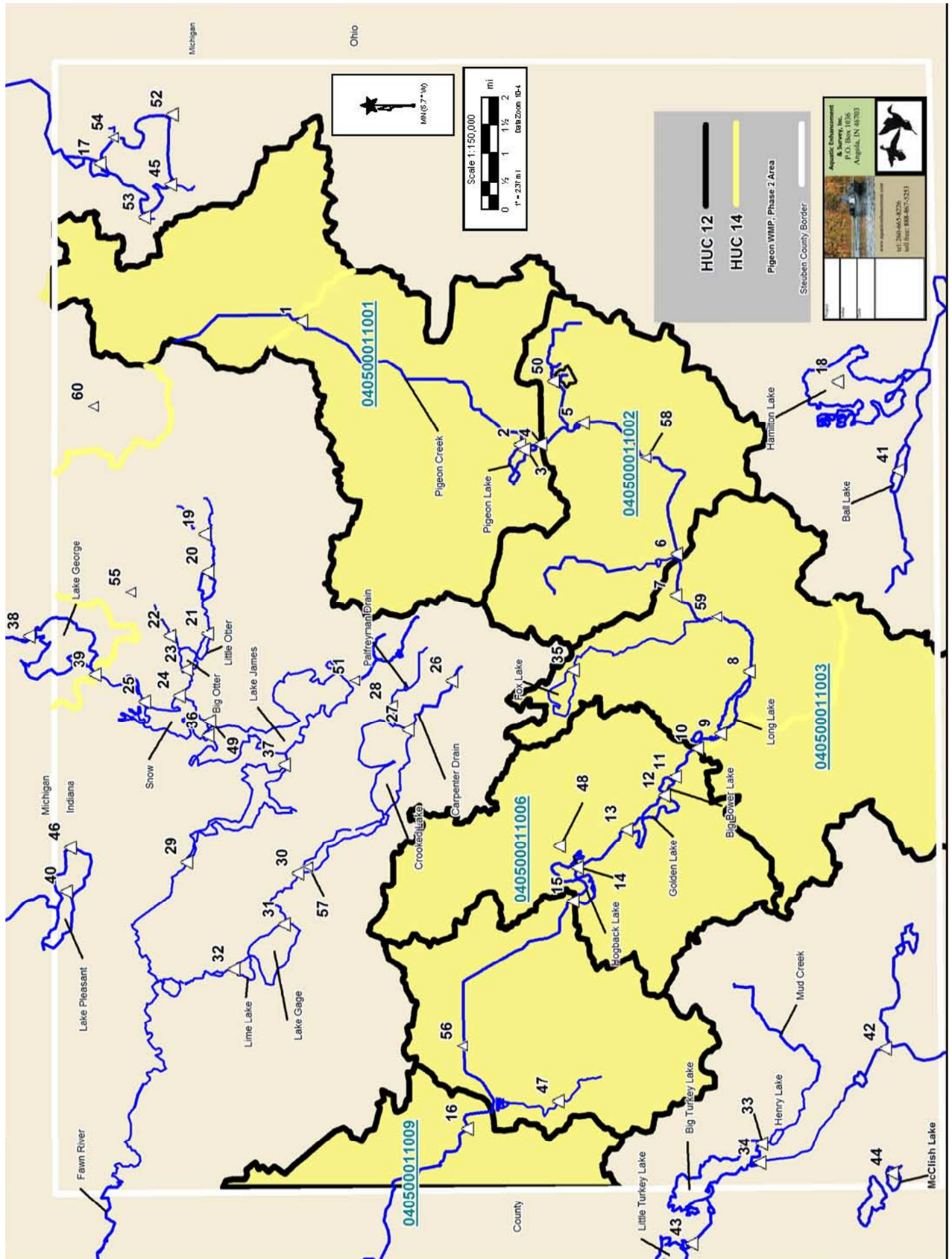


Figure 3. Sampling site map showing Pigeon HUC 12 and 14 subwatershed units.

Sampling Site	At or near HUC 12 Outlet (11)	At or near HUC14 Outlet Site (14)	Steuben County Surveyor Funding (13)	MS4 Funding (7 sites)	Pigeon 319 funded site (14)	Included in 319 QAPP	Location Description
1.		yes			yes	yes	Pigeon, East Ray Clark Road at culvert, below juncture with the Ryan Ditch
2.					yes	yes	Pigeon Creek, Pigeon Lake Inlet
3.					yes	yes	Pigeon Creek, Pigeon Lake Outlet
4.	yes	yes			yes	yes	Pigeon, U.S. 20 Bridge, Below juncture with Berlien Ditch
5.					yes	yes	Pigeon Creek, Metz Road
6.	yes	yes		yes		yes	Pigeon Creek, Bill Deller Road
7.				yes		yes	Pigeon Creek, Meridian Road
8.					yes	yes	Pigeon Creek, Long Lake Inlet
9.					yes	yes	Pigeon Creek, Long Lake Outlet
10.	yes	yes			yes	yes	Pigeon Creek, Mud Lake Outlet just west of Long Lake, Johnson Ditch from Ashley
11.					yes	yes	Pigeon Creek, Big Bower Lake Inlet
12.					yes	yes	Pigeon Creek, Big Bower Lake Outlet/Golden Lake Inlet
13.					yes	yes	Pigeon Creek, Golden Lake Outlet
14.					yes	yes	Pigeon Creek, Hogback Lake Inlet
15.	yes	yes			yes	yes	Pigeon Creek, Hogback Lake Outlet
16.	yes*	yes*			yes	yes	Pigeon Creek at 327
17.		yes					Clear Lake Outlet
18.	yes*	yes*	yes				Hamilton Lake
19.							Crane Marsh Outlet, (tributary to Marsh Lake)
20.			yes				Deller Ditch (Tributary to Marsh Lake)
21.							Follet Creek, Little Otter Lake Inlet
22.			yes				Walter's Lakes Drain (tributary to Big Otter Lake)
23.							Follet Creek, Big Otter Lake Outlet
24.							Follet Creek, Snow Lake Inlet
25.			yes				Crooked Creek at 120 (Tributary to Snow Lake)
26.				yes			Carpenter Ditch (outlet from Center Lake)
27.				yes			Carpenter Ditch (Tributary to Crooked Lake)
28.				yes			Palfreyman Ditch (Tributary to Crooked Lake)
29.	yes*	yes*					Crooked Creek (Jimmerson outlet at Nevada Mills)
30.							Concorde Creek (Outlet from Crooked Lake)
31.							Concorde Creek (Inlet to Lake Gage)
32.	yes*	yes*					Concorde Creek (Outlet from Lime Lake)
33.			yes				Dewitt Ditch (Tributary to Big Turkey Lake)
34.							Turkey Creek (Tributary to Big Turkey Lake)
35.	Discontinued in 2011						Fox Lake Outlet
36.	yes	yes					Crooked Creek (Snow Lake outlet, Inlet to James)
37.							Crooked Creek (James Outlet, Jimmerson Inlet at 4 corners)
38.							Lake George NE tributary (from Silver Lake)
39.		yes					Crooked Creek (Lake George Outlet)
40.							Lake Pleasant
41.			yes				Ball Lake
42.	yes	yes					Turkey Ck at 700S east of 800W, below Little Turkey and Deetz Ditch juncture
43.	yes*	yes*					Big Turkey Outlet at 350S on curve north of Stroh or west of Turkey Lake Tavern
44.							Trib. To McClish Lake (east end)
45.							Trib. To Clear Lake (Cyrus Brouse Ditch)
46.							Trib. To Lake Pleasant (East End)
47.							Trib. To West Otter (Between Arrowhead and Otter)
48.							Trib. Between Silver and Hogback
49.							Trib. To Snow Lake (Pokagon State Park)
50.							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)
55.			yes				Walter's Lake Drain at 660 North
56.			yes				Steuben Regional Waste District Effluent (Trib. to Pigeon)
57.	Discontinued in 2012						Crooked Lake Third Basin
58.				yes			Pigeon Creek at Hanselman
59.				yes			Pigeon Creek at 400 South
60.							Fish Lake (Fremont)

Table 1 Description of numbered sampling sites.

Site	Sampling Date	E-coli (CFU or colonies/100 ml)	Total Phos. (ppm)	Total Suspended Solids (ppm)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *	CFM discharge estimate	T.S.S. Loading estimate Kg/day	Phos. Loading estimate Kg/day
1	5/18/12	214	0.032	11	7.89	7.74	12.6	784		413.87	185.52	.54
2	5/18/12	214	0.033	9	9.17	7.95	14.5	768		442.80	162.40	.59
3	5/18/12	1.0	0.019	< 4	11.23	8.35	18.9	684		577.64	ND	.45
4.	5/18/12	73.3	0.049	16	8.92	8.12	18.4	705		1005.63	655.70	2.01
5.	5/18/12	60.2	0.038	8	8.05	8.08	18.8	722		919.87	299.89	1.42
6.	5/18/12	260	0.048	10	7.81	8.03	18.1	724		975.22	397.42	1.91
7.	5/18/12	186	0.080	20	7.95	8.02	18	854		2219.58	1809.05	7.24
8.	5/22/12	248	.083	21	7.74	7.68	16.7	841		1146.31	981.00	3.88
9.	5/22/12	14.8	0.038	9	11.85	8.14	20.9	730		2798.39	1026.36	4.33
10.	5/22/12	10.9	0.034	8	10.82	8.10	20.4	774		3005.58	979.86	4.16
11.	5/22/12	37.9	0.035	8	10.44	7.96	20.4	754		ND	ND	ND
12.	5/22/12	10.9	0.034	8	10.20	8.10	21.5	747		1823.76	594.57	2.53
13.	5/22/12	2.0	0.024	7	14.19	8.22	22.3	646		ND	ND	ND
14.	5/22/12	34.5	0.025	7	11.56	8.08	21.4	684		2684.02	765.65	2.73
15.	5/22/12	5.1	0.028	<2	12.46	7.90	22.1	661		2341.56	ND	2.67
16.	5/22/12	78.5	0.023	7	8.54	8.18	21.6	677		3753.22	1070.66	3.52
17.	5/11/12	<1.0	<0.040	< 4	9.25	8.17	18.1	353.3		457.37	BDL	BDL
18.	5/14/12	<1.0	0.020	<2	10.29	8.41	19.3	380		LS	LS	LS
19.	5/14/12	1.0	0.060	< 2	7.55	8.46	17.9	1,600		83.64	BDL	.20
20.	5/14/12	194	0.037	8	8.27	7.85	16.4	800		338.16	110.25	.51
21.	5/14/12	18.9	0.018	6	6.67	7.80	18.4	720		643.15	157.26	.47
22.	5/11/12	35.9	0.070	< 5	8.02	7.69	24	656		158.54	BDL	.45
23.	5/14/12	39.3	0.017	< 2	9.78	8.33	21.8	660		ND	ND	ND
24.	5/14/12	3.1	0.011	< 2	9.74	8.32	21.3	650		ND	ND	ND
25.	5/14/12	26.2	<0.010	<2	7.21	7.80	20.4	440		817.41	BDL	BDL

Table 2 Summary table of May sampling results, sites 1-25. BDL indicates data below lab detection limit, ND indicates no data collected at this site, LS indicates no data due to site being a lake sampling site, NMF indicates some flow but not measurable. NF indicates no flow noted. . Data shaded exceeds water quality standards selected from those provided by IDEM. (see corresponding shaded standards on table 8 page 15)

Sample Site	Sampling Date	E-coli (CFU or colonies/100 ml)	Total Phos. (ppm)	Total Suspended Solids (ppm)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *	CFM discharge estimate	T.S.S. Loading Kg/day	Phos. Loading Kg/day
26.	5/15/12	240	0.078	9	5.77	8.09	17.9	446.6		24.88	9.1	.08
27.	5/15/12	579	0.062	7	8.37	7.89	13.6	528		82.07	23.41	.21
28.	5/15/12	40.4	0.031	9	7.52	8.09	16.6	705		31.71	11.6	.04
29.	5/14/12	8.6	< 0.010	<2	7.94	7.98	21.1	540		3201.12	BDL	BDL
30.	5/15/12	143	0.024	8	7.84	8.31	18.5	467.5		211.57	68.97	.21
31.	5/15/12	47.1	0.027	9	7.75	8.02	19.4	485.7		300.74	110.30	.33
32.	5/15/12	8.6	< 0.010	<4	8.19	8.25	20.5	461.3		41.77	BDL	BDL
33.	5/16/12	44.8	0.024	7	8.43	7.92	19.1	660		NF	NF	NF
34.	5/16/12	62.0	0.050	<4	5.99	7.62	18.6	603		780.91	BDL	1.59
35.	Discontinued in 2011.											
36.	5/14/12	1.0	< 0.010	<2	9.86	8.38	21.6	540		ND	ND	ND
37.	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND
38.	5/11/12	48.8	< 0.040	<4	8.28	7.76	23	426.9		317.58	BDL	BDL
39.	5/11/12	9.8	< 0.040	<4	8.36	8.09	20.1	406.7		660.90	BDL	BDL
40.	5/14/12	1.0	< 0.010	<2	8.90	8.29	20.5	450		LS	LS	LS
41.	5/14/12	1.0	0.039	5	11.36	8.45	19.6	480		LS	LS	LS
42.	5/16/12	140	0.059	<4	7.55	7.72	18.5	593		460.80	BDL	.98
43.	5/16/12	44.1	0.021	4	8.60	8.16	21.2	593		1451.52	236.61	1.24
44.	5/16/12	9.8	0.018	<4	7.50	7.51	16.7	722		27.36	BDL	.02
45.	5/11/12	980	<0.040	5	9.35	7.61	15.8	707		27.80	5.67	BDL
46.	5/14/12	76.7	< 0.010	<2	11.74	7.85	18.1	640		46.49	BDL	BDL
47.	5/15/12	155	0.046	<4	6.84	7.93	18.6	553		85.28	BDL	.16
48.	5/15/12	35.3	0.012	<5	8.28	8.26	21.5	453.1		205.63	BDL	.10
49.	5/16/12	1.0	0.096	<5	8.80	7.82	15.6	4935		2.26	BDL	.01
50.	5/16/12	158	0.059	5	8.97	7.66	18.3	706		10.40	2.12	.03
51.	5/15/12	151	0.011	<5	9.03	8.25	11.0	822		67.14	BDL	.03
52.	5/11/12	201	0.132	5	7.61	7.67	19.5	610		26.44	5.39	.14
53.	5/11/12	< 1.0	<0.040	<4	6.40	7.11	13.4	649		5.36	BDL	BDL
54.	5/11/12	62.7	<0.040	<4	7.0	7.29	15.3	386.5		17.06	BDL	BDL
55.	5/11/12	19.9	0.059	5	6.92	7.37	20.2	464.6		81.65	16.64	.20
56.	5/16/12	< 1.0	0.253	<4	8.38	7.77	15.1	3214		23.49	BDL	.24
57.	Discontinued in 2012.											
58.	5/18/12	102	0.040	8	7.73	8.08	18.9	719		735.75	239.87	1.20
59.	5/18/12	145	0.084	23	7.84	8.00	18.3	841		1848.65	1732.73	6.33
60.	5/11/12	1.0	0.017	<2	9.13	8.38	22.4	403.4		LS	LS	LS

Table 3 Summary table of May sampling results, sites 26-60.

Sample Site	Sampling Date	E-coli (CFU or colonies/100 ml)	Total Phos. (ppm)	Total Suspended Solids (ppm)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *	CFM discharge estimate	T.S.S. Loading estimate Kg/day	Phos. Loading estimate Kg/day
1	7/19/12	1,990	0.098	57	7.0	7.78	22.9	724	*	236.20	548.66	.94
2	7/20/12	1,990	0.049	17	6.38	7.77	19.4	726	*	335.73	232.59	.67
3	7/20/12	69.7	0.028	9	6.96	8.02	22.4	616	*	427.37	156.75	.49
4.	7/20/12	196	0.055	9	4.15	7.62	23.8	653	*	467.78	171.57	1.04
5.	7/20/12	101	0.071	5	4.57	7.58	24.0	686	*	324.42	66.10	.94
6.	7/20/12	770	0.074	11	5.78	7.95	24.8	679	*	414.09	185.63	1.25
7.	7/7/12	727	0.164	39	6.41	7.82	23.7	900	*	955.74	1518.98	6.39
8.	7/20/12	727	0.103	16	6.99	7.83	23.9	881	*	901.09	587.54	3.78
9.	7/20/12	156	0.049	9	9.27	8.25	28	703	*	1783.74	654.22	3.56
10.	7/24/12	54.8	0.068	15	5.99	8.09	26.6	693		1255.17	767.26	3.48
11.	7/24/12	130	0.067	10	4.63	7.91	27.2	690		ND	ND	ND
12.	7/24/12	17.1	0.058	7	5.92	8.07	27.3	689		1150.99	328.34	2.72
13.	7/24/12	12.1	0.030	9	7.73	8.34	28.3	632		ND	ND	ND
14.	7/25/12	48.8	0.037	5	5.25	7.31	24.7	638		2162.46	440.62	3.26
15.	7/25/12	8.0	0.041	9	8.51	8.15	26.7	577		1390.80	510.10	2.32
16.	7/25/12	140	0.045	5	7.37	7.67	21.7	643		2391.90	487.37	4.39
17.	7/2/12	14.8	0.016	<4	6.56	8.26	27.3	339.9		NF	NF	NF
18.	7/3/12	<1.0	0.016	<2	7.49	7.38	28.3	346.5		LS	LS	LS
19.	7/23/12	21.3	0.205	26	5.54	7.65	25.2	1867		51.68	54.76	.43
20.	7/23/12	548	0.078	45	6.77	7.71	21.9	925		161.84	296.79	.51
21.	7/23/12	60.5	0.013	<4	3.04	7.33	25.3	716		208.40	BDL	.11
22.	7/3/12	770	0.049	<2	6.33	7.58	20.9	705		NMF	NMF	NMF
23.	7/23/12	8.5	<0.010	<4	6.26	7.96	27.5	7.41		ND	ND	ND
24.	7/23/12	48.7	0.012	<4	6.30	7.69	27.9	630		ND	ND	ND
25.	7/23/12	365	0.011	<4	6.77	7.52	23.5	677		NMF	NMF	NMF

Table 4. Summary table of July sampling results, sites 1-25. BDL indicates data below lab detection limit, ND indicates no data collected at this site, LS indicates no data due to site being a lake sampling site, NMF indicates some flow but not measurable. NF indicates no flow noted. . Data shaded exceeds water quality standards selected from those provided by IDEM. (see corresponding shaded standards on table 8 page 15)

Sample Site	Sampling Date	E-coli (CFU or colonies/100 ml)	Total Phos. (ppm)	Total Suspended Solids (ppm)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *	CFM discharge estimate	T.S.S. Loading Kg/day	Phos. Loading Kg/day
26.	7/2/12	517	0.070	<5	5.10	7.61	22.1	593		10.61	BDL	.03
27.	7/2/12	5,480	0.083	<4	5.42	7.96	23.9	616		2.49	BDL	.01
28.	7/2/12	1,990	0.106	10	4.33	7.63	26.4	702		24.19	9.86	.10
29.	7/23/12	6.3	0.016	<4	6.63	7.70	29.5	536		370.77	BDL	.24
30.	7/2/12	276	0.028	5	4.21	7.47	29.1	528		20.15	4.11	.02
31.	7/2/12	1,410	0.041	14	5.82	8.04	24.2	619		25.69	14.66	.04
32.	7/2/12	9.8	0.011	<4	4.83	8.07	30.1	467		6.89	BDL	<.01
33.	7/5/12	19.9	0.032	<4	8.25	7.86	29.4	531		17.82	BDL	.02
34.	7/5/12	1,120	0.105	<4	4.60	7.41	26.8	576		486.92	BDL	2.08
35.	Discontinued in 2011											
36.	7/23/12	4.1	<0.010	<4	6.56	7.96	27.5	525		ND	ND	ND
37.	7/23/12	144	<0.010	<4	6.60	7.84	27.3	520		NMF	NMF	NMF
38.	7/23/12	NF								NF	NF	NF
39.	7/23/12	NF								NF	NF	NF
40.	7/3/12	<1.0	0.011	<2	6.92	8.24	28.1	440.4		LS	LS	LS
41.	7/3/12	3.0	0.019	<2	7.22	8.04	27.9	420.3		LS	LS	LS
42.	7/5/12	687	0.105	5	5.88	7.44	25.3	659		292.70	59.64	1.25
43.	7/5/12	46.4	0.030	7	6.0	7.51	29.8	502		199.59	56.94	.24
44.	7/5/12	687	0.018	<4	7.49	7.59	23.8	721		10.22	BDL	.01
45.	7/2/12	7,700	0.052	8	7.12	7.75	18.7	856		9.05	2.95	.02
46.	7/3/12	152	0.011	<2	10.01	7.75	20.4	636		8.77	BDL	<.01
47.	7/5/12	NF	NF	NF	NF	NF	NF	NF		NF	NF	NF
48.	7/5/12	649	0.018	<4	5.60	7.33	27.8	421.4		8.16	BDL	.01
49.	7/24/12	24.1	0.683	<5	7.0	7.94	24.2	2485		3.34	BDL	.09
50.	7/23/12	1,120	0.115	5	5.71	7.22	20.9	790		NF	NF	NF
51.	7/5/12	727	0.015	<4	9.51	7.29	27.2	431		34.95	BDL	.02
52.	7/2/12	NF	NF	NF	NF	NF	NF	NF		NF	NF	NF
53.	7/2/12	2.0	0.059	<4	6.45	6.94	16.5	591		3.05	BDL	.01
54.	7/2/12	548	0.188	<5	4.20	7.05	23.3	417.7		NMF	NMF	NMF
55.	7/3/12	NMF	NMF	NMF	NMF	NMF	NMF	NMF		NMF	NMF	NMF
56.	7/5/12	3.1	0.463	<4	7.55	7.74	15.3	3145		60.53	BDL	1.14
57.	Discontinued in 2012											
58.	7/20/12	411	0.058	5	6.37	7.89	23.1	675	*	692.03	141.01	1.64
59.	7/20/12	816	0.137	25	6.02	7.81	23.6	921	*	1021.02	1040.22	5.7
60.	7/19/12	<1.0	0.020	<4	6.09	8.11	29.2	445.5	*	LS	LS	LS

Table 5. Summary table of July sampling results, sites 26-60, 2012.

Sample Site	Sampling Date	E-coli (CFU or colonies/100 ml)	Total Phos. (ppm)	Total Suspended Solids (ppm)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *	CFM discharge estimate	T.S.S. Loading estimate Kg/day	Phos. Loading estimate Kg/day
1	8/2/12	1,990	0.092	87	7.55	7.59	18.7	751		44.89	159.15	.17
2	8/2/12	649	0.019	4	8.05	7.66	20.3	754		247.34	40.32	.19
3	8/2/12	3.1	0.024	6	7.68	7.93	26.4	622		234.36	57.30	.23
4	8/2/12	126	0.044	5	5.14	7.54	24.8	674		296.48	60.41	.53
5	8/2/12	13.2	0.069	8	8.23	7.81	24.7	692		222.39	72.50	.63
6	8/2/12	1,300	0.074	15	6.43	7.84	23.8	690		226.56	138.49	.68
7	8/2/12	687	0.118	22	6.09	7.76	24.4	976		647.63	580.63	3.11
8	8/3/12	179	0.071	7	6.70	7.61	22.7	875		284.93	81.28	.82
9	8/3/12	16.1	0.039	8	12.27	8.31	27.4	683		1176.07	383.42	1.87
10	8/3/12	23.1	0.054	9	7.63	7.91	27.3	702		1133.55	415.75	2.49
11	8/3/12	64.4	0.055	5	6.24	7.73	26.8	703		ND	ND	ND
12	8/3/12	4.1/ D7.3	0.047	5	9.19	8.33	29.0	696		832.10	169.55	1.59
13	8/3/12	1.0/	0.028	8	11.34	8.40/D8.28	29.4	621		ND	ND	ND
14	8/6/12	48.7	0.037	4	4.50	7.37	23.6	620		969.75	158.08	1.46
15	8/6/12	28.5	0.034	7	7.08	7.95	26.9	576		1022.98	291.82	1.42
16	8/6/12	131	0.036	<4	7.20	7.59	20.5	660		2096.88	BDL	3.08
17	8/16/12	7.4	<0.020	2.04	6.83	8.29	24.2	343.5		NMF	NMF	NMF
18	8/16/12	<1.0	<0.020	1.20	7.12	8.53	24.2	341.5		LS	LS	LS
19	8/21/12	75	0.310	24.0	7.77	8.80	21.1	1740		81	79.22	
20	8/21/12	230	0.058	5.80-	7.53	8.16	17.2	920		5.92	1.40	
21	8/17/12	29	<0.020	<1.00	8.22	8.15	24.1	730		339.90	BDL	
22	8/17/12	150	0.040	3.26	7.13	7.98	25.2	808		3.56	.47	
23	8/17/12	10.3	<0.020	1.21	8.76	8.47	24.1	624		ND	ND	ND
24	8/17/12	30	<0.020	2.40	6.60	8.13	23.0	633		ND	ND	ND
25	8/14/12	NF	NF	NF	NF	NF	NF	NF	*	NF	NF	NF

Table 6. Summary table of August sampling results, sites 1-25. BDL indicates data below lab detection limit, ND indicates no data collected at this site, LS indicates no data due to site being a lake sampling site, NMF indicates some flow but not measureable. NF indicates no flow noted. . Data shaded exceeds water quality standards selected from those provided by IDEM. (see corresponding shaded standards on table 8 page 15)

Sample Site	Sampling Date	E-coli (CFU or colonies/100 ml)	Total Phos. (ppm)	Total Suspended Solids (ppm)	D.O.	pH	Temp (C)	Specific Conductance	Post rain event *	CFM discharge estimate	T.S.S. Loading Kg/day	Phos. Loading Kg/day
26.	8/14/12	570	0.074	1.00	5.36	7.60	17.5	696	*	2.54	.10	.01
27.	8/14/12	3670	0.077	1.21	7.05	8.02	18.2	477.8	*	19.07	.94	.06
28.	8/14/12	2900	0.069	9.68	5.38	7.66	19.4	314.8	*	267.57	105.55	.75
29.	8/21/12	20	<0.020	<1.00	6.47	8.08	27	541	*	115.86	BDL	BDL
30.	8/14/12	NF	NF	NF	NF	NF	NF	NF	*	NMF	NMF	NMF
31.	8/14/12	79	<0.020	1.40	7.49	8.31	17.7	638	*	56.40	3.22	BDL
32.	8/14/12	42	<0.020	1.00	5.46	8.08	21.3	441.2	*	2.63	.11	BDL
33.	8/14/12	25	0.027	3.84	5.42	7.79	22	559	*	NMF	NMF	NMF
34.	8/14/12	370	0.047	<1.00	7.09	7.99	20.4	580	*	NMF	NMF	NMF
35.	Discontinued in 2011											
36.	8/17/12	29	<0.020	1.41	7.46	8.43	23.9	534		ND	ND	ND
37.	8/17/12	16	8.46	2.20	8.00	8.46	23.6	512		NMF	NMF	NMF
38.	8/16/12	200	0.096	2.58	3.67	7.40	21.4	753		3.60	.38	.01
39.	8/16/12 NF	NF	NF	NF	NF	NF	NF	NF		NF	NF	NF
40.	8/15/12	35	<0.020	2.83	8.58	8.19	24.1	453.6		LS	LS	LS
41.	8/16/12	5.3	<0.020	2.00	9.31	8.67	24.3	399.4		LS	LS	LS
42.	8/14/12	320	0.066	1.40	6.44	7.85	20.2	639		112.21	6.40	.30
43.	8/14/12	250	0.026	3.64	6.94	8.19	24.1	461.1		338.00	50.14	.36
44.	8/14/12	220	0.022	5.60	6.65	7.85	22.8	736		7.87	1.80	.01
45.	8/16/12	330	0.040	8.20	6.30	7.72	17.8	888		11.92	3.98	.02
46.	8/15/12	33	<0.020	1.67	10.52	8.27	23.7	648		16.44	1.12	BDL
47.	8/14/12	330	0.157	2.00	6.28	8.09	20.5	437.7		27.75	2.26	.18
48.	8/14/12	74	<0.020	1.26	5.66	8.25	25.2	427.1		76.81	3.94	BDL
49.	8/21/12	5.9	0.323	<1.00	6.72	7.67	21.1	2764		2.14	BDL	.03
50.	8/2/12	411	0.134	<5	5.48	7.47	19.9	803		NMF	NMF	NMF
51.	8/16/12	1200	<0.020	1.63	7.19	8.00	20.0	632		100.36	6.67	BDL
52.	8/16/12 NF	NF	NF	NF	NF	NF	NF	NF		NF	NF	NF
53.	8/16/12	16	0.024	<1.00		7.24				2.01	BDL	<.01
54.	8/16/12	120	0.312	2.92		7.24				NMF	NMF	NMF
55.	8/17/12	4330	0.077	2.93		7.81				1.21	.14	<.01
56.	8/6/12	2.0	0.296	<5		7.83				38.06	BDL	.46
57.	Discontinued in 2012											
58.	8/2/12	649	0.047	<4		7.97				1223.42	BDL	2.34
59.	8/2/12	276	0.104	14		7.78				707.78	403.80	3.00
60.	8/16/12	5.8	<0.020	1.20		8.16				LS	LS	LS

Table 7. Summary table of August sampling results, sites 26-60

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 coldwater fishery streams	Indiana Administrative Code (IAC)
	Min: 7.0 mg/L in spawning areas of coldwater 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

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.

Stream and lake sampling was performed May 14 and May 22. Sampling results are listed in tables 2 and 3 (pages 9 and 10). Samples collected in May represented conditions of relatively low flow due to dry weather. Table 8, page 15 contains a variety of stream water quality targets provided by the Indiana Department of Environmental Management (IDEM) for comparison with the 2012 season data. Also provided for comparison is table 9 page 17 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 2012 SCLC 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 2012 SCLC samples were “below average”, “average” or “above average” in terms of Indiana stream water quality.

In May measurements of pH, dissolved oxygen and temperature were all within ranges normally expected ranges. The highest specific conductance (4935 umho/cm) was measured at the outlet of the Pokagon State Park treatment plant. This is typical of treatment effluents due to the nature of the treatment process. No sites showed total suspended solids above the IDEM standard of 30 ppm. A total phosphorus standard of .076 ppm was exceeded at 7 sites. No sites exceeded the IDEM probabilistic data measurement of .382 ppm. Only four sites exceeded the IDEM standard of 235 col/100 ml in May. None were above the IDEM probabilistic average of 1895.58 cfu/100 ml.

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
Tss Loading Kg/day	n/d
Total Phos. Loading Kg/day	n/d

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

4. Results: July Sampling.

Stream and lake sampling was performed between July 2 and July 25. Sampling results are listed in tables 4 and 5 (pages 12 and 13). Samples collected in July represented conditions of very low flow due to droughty weather. In July measurements of pH, and temperature were all within ranges normally expected under the prevailing climatic conditions. A lower than desired

dissolved oxygen level (3.04) was measured at Follet Creek where it enters Little Otter Lake. This is probably due to decomposition taking place in the marsh upstream of this area. The highest specific conductance (2485 umho/cm) was again measured at the outlet of the Pokagon State Park treatment plant. Only three sites showed total suspended solids above the IDEM standard of 30 ppm. A total phosphorus standard of .076 ppm was exceeded at 14 sites. Two sites exceeded the IDEM probabilistic data measurement of .382 ppm. A total of 22 sites exceeded the IDEM standard of 235 col/100 ml in May. Five were above the IDEM probabilistic average of 1895.58 cfu/100 ml.

5. Results: August Sampling.

Sampling in August occurred between the 2nd and the 14th of the month. Results are listed in tables 6 and 7 (pages 13 and 14). Samples collected in August generally represented conditions of low flow due to dry weather. In August measurements of pH, and temperature were all within ranges normally expected ranges for the prevailing climatic conditions. A lower than desired D.O. occurred at the NE tributary to Lake George. This has also occurred at this site in the past and may be a results of decomposition taking place in the marsh this tributary flows through. The highest specific conductance (2764 umho/cm) was measured at the outlet of the Pokagon State Park treatment plant. Only one site (Pigeon at Ray Clark) showed total suspended solids above the IDEM standard of 30 ppm. A total phosphorus standard of .076 ppm was exceeded at 13 sites. Only one site exceeded the IDEM probabilistic data measurement of .382 ppm. A total of 17 sites exceeded the IDEM standard of 235 col/100 ml in May. Four were above the IDEM probabilistic average of 1895.58 cfu/100 ml.

7. Conclusions

A number of water quality concerns were noted during the 2012 season sampling. Data collected from the northeast tributary to Lake George and Follet Creek at its' confluence with Little Otter Lake showed oxygen levels below the 4 ppm target listed in the IAC. This has occurred previously at both these locations and is probably due to decomposition taking place in the marshy areas just upstream of the sampling site. Additionally, significant amounts of emergent or floating vegetation growing in these marshes may have the effect of shading out submersed vegetation that releases oxygen into the water. While these oxygen levels have implications for organisms living in the streams, the low oxygen condition of these streams probably does not persist very far from the confluence of these streams with the lake before diffusion and mixing with oxygenated lake water eliminates it.

Carpenter and Palfreyman Ditches (tributaries to Crooked Lake) and sites on the upper Pigeon River remain points of focus for continuing improvement and investigation, primarily with regard to E-coli counts which may be altered through implementation of alternative land-use or waste disposal practices.