Appendix E: Water Quality Sampling Data

Water Chemistry

Site Name: BC #1 - Buck Creek at Stair Road
Site Number: 1

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	17	17	17	17	17	25	26	26	23	26	26
samples in exceedance (bolded)	N/A	N/A	0	0	10	N/A	15	6	21	15	7

Sonde Data

						Guage Based					
Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L2	TP mg-N/L22
8/28/12 11:10	19.13	0.595	8.06	8.45	8.9	1.5	**2149.6**	6.8	0.0419	0.0599	0.0599
9/11/12 13:59	17.29	0.709	9.37	7.7	7.6	0.0	**517.2**	1.5	**2.8555**	0.035	0.035
9/25/12 12:30	12.96	0.704	9.43	7.54	0		**410.6**	0.9	**3.2706**	0.0227	0.0227
10/11/12 14:04	11.23	0.711	9.7	7.71	0.5	0.0	172.3	1	**3.3038**	**0.089**	0.089
10/23/12 11:34	14.83	0.445	7.62	7.91	9.4	4.1	**727**	**35.7**	**1.5893**	**0.2489**	0.2489
11/6/12 13:51						0.4	47.1	5.6	**2.8386**	0.0434	0.0434
11/19/12 13:48						0.2	27.9	1.1		**0.5074**	**0.5074**
12/4/12 12:45						0.2	**461.1**	0.7	**2.7549**	**0.1483**	0.1483
12/18/2012 1:18	6.58	0.718	10.85	9.13	6.7	0.1	82	0.3	**3.0639**	0.0427	0.0427
1/3/2013 11:14						0.5	17.3	**32.4**		**0.6871**	**0.6871**
1/15/2013 11:16						23.2	**1299.7**	8.1		**0.4314**	**0.4314**
1/31/2013 11:34	2.33	0.614	11.89	8.2	66.9	43.3	**579.4**	**36.6**	**21.5838**	**1.0443**	**1.0443**
2/12/2013 13:53	4.3	0.727	10.5	8.33	**23.8**	12.9	42	4	**16.9725**	0.0626	0.0626
2/27/2013 11:16	2.23	0.558	12.77	8.34	**117**	63.9	**1046.2**	**74**	**26.187**	**0.128**	0.128
3/12/2013 10:15	3.93	0.687	10.13	8.59	55.5	25.8	114.5	9.6	**22.089**	**0.107**	0.107
3/26/13 10:37						4.2	42	4.7	**10.714**	0.009	0.009
4/9/2013 13:02	19.29	0.673	10.73	9.59	**16.8**	4.8	63.1	3	**10.225**	0.018	0.018
4/24/2013 10:36	7.46	0.355	8.91	6.74	**361**	133.4	**3255.4**	**226**	**12.0610**	**0.31**	**0.31**
5/7/2013 13:18	17.98	0.629	6.73	7.28	13.1	9.3	161.6	2.8	**11.661**	0.005	0.005
5/22/2013 14:02	18.74	0.663	4.39	7	12.5	6.2	193.5	3.6	**5.1680**	0.0530	0.0530
6/4/2013 11:28						22.7	**461.1**	5.3	**22.7010**	**0.1000**	0.1000
6/18/2013 11:18	19.59	0.711	8.09	7.34	**70.4**	7.2	**1986.3**	3.5	**15.4680**	**0.9130**	**0.9130**
7/2/2013 12:52	17.38	0.693	8.88	7.55	**19.4**	14.4	**866.4**	2.7	**8.172**	**0.0960**	0.0960
7/17/2013 12:33	21.69	0.693	8.23	7.49	6.4	1.8	**344.8**	8.1	0.082	0.042	0.042
7/30/2013 12:28						0.4	**866.4**	2.8	**4.125**	**0.365**	**0.365**
8/13/2013 11:11						0.2	**1986.3**	**59.5**	**3.03**	**0.254**	0.254

Site Name: SC #2 Sugar Creek at SR 25/Stair Road
Site Number: 2

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	18	18	18	18	18	25	26	26	23	26	26
samples in exceedance (bolded)	N/A	N/A	0	2	9	N/A	14	8	21	9	4

Sonde Data

Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Guage Based Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
8/28/12 11:20	20.43	0.514	8.01	8.31	**22**	3.9	**435.2**	5	0.0277	0.0258	0.0258
9/11/12 13:28	18.27	0.645	8.89	7.8	7.2	0.2	**325.5**	1.8	**1.4757**	0.0233	0.0233
9/25/12 12:16	13.28	0.555	9.2	7.61	0		**298.7**	1.2	**1.8577**	0.0143	0.0143
10/11/12 13:40	11.48	0.662	10.03	7.82	0.4	0.0	45.7	0.9	**2.061**	0.074	0.074
10/23/12 11:22	14.49	0.625	7.82	7.99	8.3	10.4	**547.5**	**27.3**	0.8524	**0.0815**	0.0815
11/6/12 13:29						1.1	67	0.4	**1.726**	**0.0872**	0.0872
11/19/12 13:29	7.97	0.687	12.9	8.62	4.1	0.5	13.1	1		**0.1479**	0.1479
12/4/12 12:24						0.6	62.4	1.6	**1.6129**	**0.0822**	0.0822
12/18/2012 13:01	6.58	0.698	11.14	**9.2**	2.8	0.1	84.2	0.6	**1.9244**	**0.8304**	**0.8304**
1/3/2013 11:05						1.3	25.6	1.1		0.0478	0.0478
1/15/2013 11:05						59.2	**344.8**	**23.4**		**0.4025**	**0.4025**
1/31/2013 11:24	2.45	0.476	11.12	8.11	**154**	109.2	**461.1**	**59.5**	**16.0346**	**0.3428**	**0.3428**
2/12/2013 13:25	4.46	0.698	10.13	8.29	**31.1**	32.9	38.8	**28**	**14.41**	0.0599	0.0599
2/27/2013 11:10	3.24	0.452	13.73	8.14	**147**	163.2	**435.2**	**96**	**18.933**	**0.585**	**0.585**
3/12/2013 10:10	4.4	0.614	10.65	8.5	**58.5**	65.8	**344.8**	11.5	**16.555**	0.062	0.062
3/26/2013 10:29						10.8	24.3	1.3	**7.091**	0.007	0.007
4/9/2013 13:36	21.74	0.647	9.39	**9.56**	**26.1**	12.2	37.9	3.3	**6.527**	0.029	0.029
4/24/2013 10:28	7.3	0.252	9.45	6.74	**711**	340.9	**1299.7**	**364**	**6.881**	**0.284**	0.284
5/7/2013 12:55	17.97	0.609	6.96	7.34	**13.9**	23.7	129.6	14.2	**7.532**	0.056	0.056
5/22/2013 13:36	20.54	0.649	4.38	7.02	6.2	15.8	133.4	6.1	**3.8070**	0.0240	0.0240
6/4/13 10:18						56.6	**461.1**	11.3	**16.7710**	0.0540	0.0540
6/18/2013 11:06	20.89	0.648	7.41	7.28	**51.4**	18.4	**575.4**	**22.5**	**12.5820**	0.0590	0.0590
7/2/2013 12:30	18.06	0.692	8.09	7.63	2.9	36.9	**387.3**	6.1	**6.344**	0.0180	0.0180
7/17/2013 12:09	24.59	0.682	8.07	7.65	8.3	4.6	**579.4**	3.3	**3.236**	0.053	0.053
7/30/2013 12:06						0.9	228.2	1.7	**2.304**	0.031	0.031
8/13/2013 10:59						0.7	**1413.6**	**21.6**	**1.512**	0.043	0.043

Site Name: DCD #3 - Deer Creek - downstream at Trail Head Park
Site Number: 3

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	18	18	18	18	18	26	26	26	24	26	26
samples in exceedance (bolded)	N/A	N/A	0	2	12	N/A	11	9	20	12	2

Sonde Data

Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Discharge cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
8/28/12 10:33	22.34	0.621	7.82	8.16	3.4	46	62.7	6.4	**1.101**	0.0309	0.0309
9/11/12 12:49	19.73	0.615	8.68	7.84	**11.1**	71	**387.3**	10.4	0.8651	0.0471	0.0471
9/25/12 11:52	13.61	0.658	9.27	7.73	0	26	51.2	2.1	**1.1328**	0.0384	0.0384
10/11/12 13:18	10.18	0.702	12.21	8.14	0	38	21.6	0.8	**1.0383**	0.0717	0.0717
10/23/12 10:56	14.28	0.661	7.44	8.09	**217**	115	**456.9**	**139.2**	0.6835	**0.1188**	0.1188
11/6/12 13:02						79	13.2	1.7	0.987	0.0293	0.0293
11/19/12 12:58	5.87	0.688	13.7	8.71	2.5	69	9.6	1.8		**0.3243**	**0.3243**
12/4/12 11:52						64	12.1	1.4	0.8806	**0.1518**	0.1518
12/18/2012 12:30	5.16	0.744	11.52	**9.28**	2.9	50	14.6	1.1	**1.2075**	**0.1289**	0.1289
1/3/2013 10:50						136	13.4	1.7		**0.3082**	**0.3082**
1/15/2013 10:47						1140	**517.2**	**102.5**	**8.7697**	**0.2772**	0.2772
1/31/2013 11:04	3.3	0.512	10.04	8.07	**200**	1460	**1299.7**	**134.1**	**11.1161**	**0.2748**	0.2748
2/12/2013 12:54	3.22	0.697	11.71	8.38	**24.7**	328	37.3	7	**8.8325**	0.045	0.045
2/27/2013 10:48	2.64	0.583	12.2	8.39	**111**	927	**648.8**	**80**	**10.835**	**0.266**	0.266
3/12/2013 9:41	4.47	0.39	10.94	8.47	**89.4**	776	209.8	**45.7**	**12.321**	**0.117**	0.117
3/26/2013 10:09						157	14.8	2	**5.456**	0.065	0.065
4/9/2013 12:05	16.65	0.648	8.75	**9.85**	**29.5**	195	77.6	8.4	**4.749**	0.035	0.035
4/24/2013 9:59	8.43	0.357	8.68	6.77	**534**	3170	**1986.3**	**329**	**6.18**	**0.151**	0.151
5/7/2013 12:16	17.03	0.631	7.27	7.14	**16.2**	268	73.3	4.3	**5.886**	0.044	0.044
5/22/2013 12:50	21.99	0.634	4.21	7.06	**23.9**	157	63.1	13.2	**5.7380**	0.0120	0.0120
6/4/2013 9:46						536	**365.4**	**30.8**	**12.6210**	**0.0910**	0.0910
6/18/2013 10:10	20.83	0.573	7.79	7.06	**70.6**	479	**325.5**	**35**	**8.2810**	**0.1730**	0.1730
7/2/2013 11:29	19.13	0.617	7.66	7.51	**27.5**	205	**547.5**	**19.3**	**5.597**	0.0790	0.0790
7/17/2013 11:37	25.97	0.669	7.71	7.52	7.7	100	**235.9**	9.3	**3.901**	0.062	0.062
7/30/2013 11:30						45	93.4	3.1	**1.845**	0.045	0.045
8/13/2013 10:24						60	**365.4**	7.3	**1.564**	0.08	0.08

Site Name: BR #4 - Bachelor Run at 350N
Site Number: 4

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	18	18	18	18	18	26	26	26	24	25	25
samples in exceedance (bolded)	N/A	N/A	18	2	11	N/A	9	7	22	10	5

Sonde Data

Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Guage Based Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
3/26/2013 9:50						19.9	157.6	7.3	**6.772**	0	0
4/9/2013 11:35	17.85	0.735	**10**	**9.19**	**37.4**	23.4	69.1	5.3	**6.167**	0.021	0.021
9/25/12 11:00	14.04	0.816	**9.92**	7.67	1.5	3.1	18.3	1.1	**1.3757**	0.0253	0.0253
9/11/12 12:01	22.11	0.76	**9.71**	7.87	4.1	8.5	18.5	4.1	0.4858	0.0295	0.0295
5/7/2013 11:37	17.29	0.686	**6.85**	7.09	**38.7**	33.9	128.3	12.2	**6.417**	0.032	0.032
8/28/12 10:03	21.92	0.708	**9.7**	8.26	4	5.5	19.9	7.3	**1.0945**	0.0406	0.0406
1/3/2013 10:30						16.3	80.9	1.5		0.0425	0.0425
10/11/12 12:35	12.49	0.782	**12.49**	8.06	3.1	4.6	6.3	**59.3**	**1.0821**	0.0463	0.0463
7/2/2013 10:53	18.02	0.786	**8.93**	7.49	**9.9**	25.1	**325.5**	4.1	**5.48**	0.0470	0.0470
7/30/2013 10:55						6.7	95.9	1.9	**1.93**	0.049	0.049
11/6/12 12:32						9.5	14.5	1.3	**1.2083**	0.0506	0.0506
2/12/2013 12:17	3.96	0.691	**11.02**	8.36	**23**	37.0	60.2	4.8	**11.2843**	0.052	0.052
7/17/2013 11:07	26.57	0.749	**9.4**	7.41	**13**	14.2	156.5	3.1	0.087	0.054	0.054
8/13/2013 10:03						7.2	218.7	4.7	**1.783**	0.058	0.058
5/22/2013 12:17	20.67	0.761	**4.46**	6.99	**12.8**	20.7	104.3	6.6	**4.0930**	0.0650	0.0650
10/23/12 10:21	15.32	0.631	**7.68**	7.88	1.4	13.5	**248.1**	5.8	**1.0255**	**0.094**	0.094
6/4/2013 9:27						64.4	**410.6**	**17.4**	**14.7890**	**0.0960**	0.0960
12/4/12 11:25						7.7	43.2	1.7	**1.3113**	**0.1572**	0.1572
6/18/2013 9:49	19.99	0.671	**7.98**	6.99	**64.7**	57.6	**410.6**	**23.5**	**10.2290**	**0.2040**	0.2040
1/15/2013 10:31						138.2	**387.3**	**36.5**	**14.8697**	**0.2105**	0.2105
4/24/2013 9:38	7.78	0.368	**8.78**	6.54	**526**	379.9	**2187.2**	**276**	**6.566**	**0.307**	**0.307**
1/31/2013 10:46	2.75	0.571	**10.44**	8	**150**	176.7	**1413.6**	**75.5**	**15.8638**	**0.3674**	**0.3674**
11/19/12 12:27	7.52	0.82	**13.19**	8.5	3.5	8.3	5.2	1.4		**0.4223**	**0.4223**
12/18/2012 12:03	6.26	0.86	**10.84**	**9.39**	3.9	5.8	8.5	1.6	**1.7114**	**0.505**	**0.505**
3/12/2013 9:26	3.97	0.683	**11.19**	8.5	**60.9**	93.3	**435.2**	13.4	**15.054**	**0.589**	**0.589**
2/27/2013 10:32	3.4	0.118	**11.2**	8.18	**109**	108.4	**1046.2**	**56.7**	**15.997**		

Site Name: PC #5 - Paint Creek at 450 N
Site Number: 5

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	18	18	18	18	18	26	25	25	23	25	25
samples in exceedance (bolded)	N/A	N/A	1	1	12	N/A	19	4	15	11	5

Sonde Data

Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Guage Based Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
2/27/2013 10:16	3.52	0.624	11.56	7.75	**67.1**	41.1	**325.5**	**30.2**	**15.968**	0.008	0.008
5/7/2013 11:06	15.01	0.698	6.87	6.64	**52.2**	13.0	56.5	2.3	**11.017**	0.011	0.011
3/26/2013 9:32						7.3	25.3	1.3	**8.071**	0.018	0.018
9/25/2012 10:28	12.18	0.692	7.02	7.33	6.8	1.2	**290.9**	3.9	0.8653	0.0195	0.0195
4/9/2013 11:03	15.14	0.672	9	8.84	**25.2**	9.0	**238.2**	4.8	**8.545**	0.02	0.02
7/30/2013 10:26						2.6	**1203.3**	0.5	**1.992**	0.026	0.026
7/2/2013 10:23	17.4	0.711	8.08	7.04	5.4	9.7	**866.4**	2	**11.329**	0.0280	0.0280
9/11/2012 11:15	17.25	0.681	6.04	7.34	**14.1**	3.3	**387.3**	3.2	0.2492	0.0297	0.0297
8/28/2012 9:44	20.4	0.556	**3.74**	7.69	**20.5**	2.1	**290.9**	**504**	0.0386	0.034	0.034
11/6/2012 12:03						3.7	**2149.6**	1.5	0.6164	0.0356	0.0356
5/22/2013 11:44	11.07	0.7	4.18	6.78	**10.9**	8.0	**387.3**	3.8	**6.1760**	0.0410	0.0410
6/4/2013 9:09						25.0	**344.1**	3	**17.9010**	0.0490	0.0490
6/18/2013 9:28	18.38	0.693	7.17	6.55	**39.4**	22.3	**770.1**	4.4	**17.0680**	0.0530	0.0530
7/17/2013 10:39	21.91	0.718	7.88	7.02	4.5	5.5	**980.4**	3.5	**8.129**	**0.086**	0.086
10/11/2012 12:01	8.92	0.697	7.91	7.52	**29**	1.8	**261.3**	2	1.0185	**0.1086**	0.1086
10/23/2012 9:47	14.66	0.668	4.58	7.56	3.6	5.2	**313**	6	1.0648	**0.1123**	0.1123
4/24/2013 9:18	7.01	0.313	8.23	6.2	**252**	144.2	**1119.9**	**96**	**10.1880**	**0.179**	0.179
12/4/2012 10:56						3.0	125.9	3.9	0.2525	**0.185**	0.185
3/12/2013 9:10	3.55	0.67	9.44	8.05	**49.1**	35.9	204.6	5.7	**14.13**	**0.195**	0.195
12/18/2012 11:39	5.18	0.739	9.18	**9.01**	5.9	2.2	**1046.2**	2	0.779	**0.3691**	**0.3691**
1/15/2013 10:17						53.6	**240.0**	8.3		**0.5716**	**0.5716**
2/12/2013 11:57	3.07	0.695	10.79	8.13	**17.8**	14.2	**275.5**	2.1	**12.048**	**0.7507**	**0.7507**
11/19/2012 11:55	5.66	0.732	10.43	8.12	7.8	3.2	79.8	1.8		**1.1769**	**1.1769**
1/31/2013 10:30	2.38	0.569	9.72	7.66	**50.1**	68.4	185.0	**17.2**	**15.4215**	**1.6923**	**1.6923**
1/3/2013 10:18						6.2					
8/13/2013 9:46						2.8	**1299.7**	2.7	**1.35**		0.18

Site Name: LDU #6 - Little Deer Creek - upstream at SR 29
Site Number: 6

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	18	17	17	17	17		23	22	21	22	22
samples in exceedance (bolded)	N/A	N/A	0	1	11	N/A	14	5	13	11	3

Sonde Data

Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Guage Based Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
5/7/2013 9:45	15.26	0.634	6.19	6.81	**71.5**	34.0	**290.9**	6.3	**7.532**	0.022	0.022
2/12/2013 10:47	1.9	0.729	10.6	8.34	**20.7**	37.6	167.4	3.3	**9.8291**	0.0409	0.0409
5/22/2013 11:06	20.36	0.637	4.27	6.74	**12.9**	20.7	**290.9**	4.5	**5.3820**	0.0410	0.0410
7/30/13 9:21						6.7	**365.4**	2.1	**1.696**	0.045	0.045
7/17/2013 9:25	24.71	0.615	6.38	7.21	2.3	14.2	**816.4**	3.6	0.097	0.051	0.051
8/28/2012 8:57	20.64	0.516	5.44	7.73	9.6	5.5	**648.8**	10	0.0581	0.0541	0.0541
9/11/2012 9:32	17.49	0.611	6.35	7.5	**17.4**	8.6	**410.6**	11.2	0.3583	0.0569	0.0569
11/6/2012 10:41						9.5	59.1	2.2	0.8561	0.0584	0.0584
6/4/2013 8:39						65.2	**365.4**	9.3	**14.2950**	0.0630	0.0630
4/9/2013 9:41	13.42	0.636	6.99	8.61	**30.7**	23.5	**727**	5.3	**6.016**	0.067	0.067
8/13/2013 9:13						7.0	**547.5**	4.4	**1.641**	0.074	0.074
2/27/2013 9:46	2.89	0.589	11.94	8.14	**101**	103.5	**613.1**	**68.3**	**13.645**	**0.097**	0.097
9/25/2012 9:20	12.52	0.625	7.79	7.65	**13.5**	3.0	178.2	9.6	0.5431	**0.0974**	0.0974
3/12/2013 8:36	3.77	0.633	9.84	8.35	**49.4**	94.5	98.8	10.2	**13.983**	**0.115**	0.115
6/18/2013 8:50	19.42	0.541	6.94	6.78	**57.6**	58.2	**488.4**	**24.5**	**9.4990**	**0.1420**	0.1420
10/11/2012 10:28	8.97	0.687	6.44	7.46	4.9	4.6	85.7	3.3	0.886	**0.1671**	0.1671
1/15/2013 9:44						142.1	151.5	**31.3**	**11.9633**	**0.207**	0.207
10/23/2012 9:12	13.95	0.657	6.9	7.77	3	13.2	**280.9**	5.7	0.4018	**0.2266**	0.2266
4/24/2013 8:44	7.42	0.324	8.89	6.54	**309**	368.6	**1732.9**	**159**	**6.8340**	**0.228**	0.228
12/4/2012 10:10	11.1					7.7	142.1	7.1	0.4927	**0.3494**	**0.3494**
11/19/2012 10:36	5.25	0.723	9.48	8.16	5.7	8.3	54.8	3.6		**0.354**	**0.354**
1/31/2013 9:46	2.79	0.584	11.59	8.1	**54.7**	180.7	**307.6**	**26.5**	**13.5842**	**1.4174**	**1.4174**
12/18/2012 10:29	4.16	0.733	8.57	**9.04**	4.4	5.8	70.6				
1/3/2013 9:54						15.8					
3/26/2013 9:00											
7/2/2013 9:20						25.5					

Site Name: LDD #7 - Little Deer Creek - downstream at 300 N
Site Number: 7

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	18	18	18	18	18	26	24	24	23	24	24
samples in exceedance (bolded)	N/A	N/A	0	1	12	N/A	13	10	16	11	2

Sonde Data

Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Guage Based Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
3/26/2013 9:23						27.8	14.5	5.3	**6.017**	0.002	0.002
5/7/2013 10:39	17.59	0.611	5.8	6.89	**61.8**	50.0	148.3	5.5	**6.711**	0.015	0.015
4/9/2013 10:36	16.6	0.639	7.94	8.88	**35.1**	34.5	**248.1**	7.9	**5.724**	0.019	0.019
5/22/2013 11:15	20.87	0.632	4.1	7.05	**11.4**	30.5	231.0	5	**4.8500**	0.0210	0.0210
7/2/2013 9:53	18.73	0.612	7.44	7.34	**10.8**	37.0	**648.8**	7.5	**7.636**	0.0450	0.0450
7/17/2013 10:32	24.32	0.649	6.71	7.23	4.5	20.9	**686.7**	6.4	**3.235**	0.047	0.047
8/28/2012 9:30	20.51	0.539	6.62	7.89	3.5	8.1	157.8	7.7	0.0522	0.0475	0.0475
2/12/2013 11:26	2.96	0.717	10.41	8.24	**22.2**	55.3	66.3	5.7	**8.9914**	0.052	0.052
7/30/2013 11:05						9.9	**365.4**	1.8	**1.585**	0.055	0.055
11/6/2012 11:39						14.0	135.4	**32**	0.5137	0.0586	0.0586
9/25/2012 10:20	13.47	0.666	8.77	7.67	2.3	4.4	**365.4**	2.9	0.3811	0.0704	0.0704
6/4/2013 9:01						95.8	**387.3**	**18.5**	**13.8430**	0.0740	0.0740
8/13/2013 9:37						10.6	**920.8**	6.3	**1.371**	0.075	0.075
9/11/2012 10:45	17.92	0.694	8.71	7.83	**10.9**	12.6	**517.2**	7.1	0.2627	**0.0827**	0.0827
3/12/2013 9:01	3.89	0.623	10.27	8.4	**64.8**	138.5	145.0	**16.9**	**13.5335**	**0.087**	0.087
10/23/2012 9:35	14.27	0.731	6.59	7.83	4.2	19.8	**360.9**	14.8	0.8028	**0.1157**	0.1157
10/11/2012 11:32	10.2	0.737	9.62	7.87	2.2	6.7	214.3	1.5	0.7352	**0.1274**	0.1274
6/18/2013 9:22	20.35	0.53	6.92	6.72	**79.4**	85.6	**410.6**	**34.3**	**9.1040**	**0.1320**	0.1320
2/27/2013 10:08	2.45	0.551	10.74	8.18	**142**	154.5	**435.2**	**111**	**8.69**	**0.18**	0.18
1/15/2013 10:08						207.3	214.3	**58**	**11.2502**	**0.1994**	0.1994
1/31/2013 10:19	2.93	0.548	10.22	7.97	**104**	264.0	**648.8**	**62**	**12.7755**	**0.2214**	0.2214
4/24/2013 9:08	8.07	0.304	8.65	6.61	**413**	552.7	**1986.3**	**238**	**5.0940**	**0.228**	0.228
11/19/2012 11:31	6.43	0.724	12.38	8.5	**24.3**	12.2	107.1	**442**		**0.4204**	**0.4204**
12/18/2012 11:17	5.46	0.764	9.71	**9.1**	5.2	8.5	161.6	**52.3**	0.7532	**1.4561**	**1.4561**
12/4/2012 10:45						11.3					
1/3/2013 10:12						23.7					

Site Name: MD #8 McCloskey Ditch
Site Number: 8

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	18	18	18	18	18	26	25	25	24	25	25
samples in exceedance (bolded)	N/A	N/A	1	0	9	N/A	16	4	18	11	2

Sonde Data

Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Guage Based Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
3/26/2013 9:13						8.4	48.0	1.6	**5.539**	0	0
5/22/2013 10:48	20.13	0.682	**3.68**	6.62	**11.5**	9.2	**461.1**	3.3	**4.0060**	0.0050	0.0050
5/7/2013 10:17	15.46	0.673	6.4	6.66	**62.8**	15.0	206.4	4.7	**6.277**	0.011	0.011
4/9/2013 10:10	16.68	0.669	7.73	8.61	**49**	10.4	**290.9**	8.3	**5.248**	0.018	0.018
9/25/2012 9:50	12.98	0.77	7.63	7.32	4.1	1.3	**290.9**	6.4	0.3683	0.0331	0.0331
7/30/2013 9:51						3.0	**435.2**	2.6	**1.685**	0.035	0.035
6/4/2013 8:50						28.8	**2419.6**	8.5	**12.4110**	0.0440	0.0440
9/11/2012 10:10	18.57	0.796	6.93	7.35	7.7	3.8	114.5	3.9	**1.9206**	0.0452	0.0452
2/27/2013 9:55	2.57	0.564	11.14	8.1	**140**	46.5	**1203.3**	**76**	**11.269**	0.046	0.046
8/28/2012 9:16	19.96	0.612	6.31	7.81	0	2.5	228.2	2.9	0.0459	0.0508	0.0508
7/2/2013 9:55	17.71	0.661	7.14	7.11	6.8	11.1	**727.0**	5.6	**4.989**	0.0530	0.0530
6/18/13 9:07	18.82	0.675	6.99	6.88	**42.5**	25.7	**1203.3**	12.2	**9.3250**	0.0630	0.0630
7/17/2013 10:02	23.01	0.7	6.86	7.12	4.8	6.3	**1046.2**	5.1	**2.89**	0.068	0.068
2/12/2013 11:03	3.4	0.733	10.04	8.07	**21.1**	16.6	**547.5**	3.9	**9.9278**	0.0735	0.0735
8/13/2013 9:26						3.2	**410.6**	4.4	**1.253**	**0.094**	0.094
11/6/2012 11:14						4.2	47.9	1.7	**1.4455**	**0.0941**	0.0941
10/23/2012 9:27	13.93	0.799	8.68	7.8	0	6.0	**579.4**	3.4	1.0855	**0.1162**	0.1162
1/15/2013 9:56						62.4	**980.4**	**20**	**10.8065**	**0.1283**	0.1283
10/11/2012 11:03	9.57	0.851	8.6	7.52	3.3	2.0	75.4	1.6	0.5969	**0.1345**	0.1345
4/24/2013 8:57	7.18	0.256	8.91	6.48	**427**	164.7	**1413.6**	**260**	**5.5520**	**0.209**	0.209
1/31/2013 10:00	2.67	0.568	10.46	7.83	**79.5**	79.9	**579.4**	**40.8**	**12.5231**	**0.2213**	0.2213
11/19/2012 11:07	6.9	0.78	12.42	8.33	4.8	3.7	38.4	2.6		**0.2342**	0.2342
3/12/2013 8:48	3.73	0.65	9.5	8.18	**56.1**	41.7	**410.6**	9.6	**12.812**	**0.288**	0.288
12/18/2012 10:56	5.46	0.789	9.94	9	5.3	2.6	37.9	1.3	0.5258	**0.3685**	**0.3685**
12/4/2012 10:30						3.4	48	1.4	0.2392	**0.7698**	**0.7698**
1/3/2013 10:04						7.0					

Site Name: SFD #9 - South Fork Deer Creek - downstream at 1125 S
Site Number 9

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	19	19	19	19	19	26	25	25	24	25	25
samples in exceedance (bolded)	N/A	N/A	1	1	13	N/A	17	9	20	16	2

Sonde Data

Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Guage Based Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
3/12/2013 8:17	4.29	0.598	10.04	8.25	**76.1**	102.2	**613.1**	**15.2**	**10.522**	0.014	0.014
5/7/2013 9:04	15.98	0.675	5.59	6.6	**82.1**	36.6	75.4	**17**	**4.255**	0.016	0.016
3/26/2013 8:45						20.4	**517.2**	4	**5.521**	0.026	0.026
4/9/2013 9:06	13.51	0.667	6.86	8.64	**13.2**	24.9	146.7	4.9	**4.652**	0.037	0.037
6/4/2013 8:22						70.8	**261.3**	**24.5**	**9.4100**	0.0430	0.0430
2/12/2013 10:08	2.5	0.669	10.01	8.23	**29.1**	40.5	151.5	7.8	**8.2371**	0.0598	0.0598
9/11/2012 9:19	18.86	0.507	7.42	7.32	**12.5**	9.5	**387.3**	6.4	0.2378	0.0694	0.0694
6/18/2013 8:30	20.63	0.507	6.37	6.62	**87.4**	63.3	**365.4**	**44**	**5.9710**	0.0710	0.0710
7/2/2013 9:00	18.79	0.644	6.54	7.22	**23.4**	27.5	**387.3**	13.2	**3.414**	0.0800	0.0800
8/28/2012 8:35	21.03	0.505	6.03	**5.97**	**21**	6.0	**1046.2**	**16**	0.0341	**0.0995**	0.0995
7/30/2013 8:50						7.3	**275.5**	3.6	**1.185**	**0.124**	0.124
12/18/2012 9:53	5.17	0.78	8.11	8.95	6.3	6.2	125.9	3	**1.8076**	**0.1241**	0.1241
9/25/2012 8:48	12.14	0.705	6.66	7.21	**12**	3.2	**488.4**	2.3	**1.3162**	**0.1262**	0.1262
4/24/2013 8:27	8.9	0.314	7.71	6.5	**354**	394.3	**1732.9**	**151**	**3.7670**	**0.13**	0.13
8/13/2013 8:37						7.5	**816.4**	6	**1.09**	**0.149**	0.149
11/6/2012 10:05						10.2	66.3	14.7	**1.5664**	**0.1888**	0.1888
5/22/2013 9:30	19.91	0.621	**3.68**	6.58	**26.5**	22.3	**461.1**	13.7	**6.5760**	**0.1910**	0.1910
11/19/12 10:11	5.18	0.732	9.35	8.09	3.7	8.9	77.1	1.3		**0.1944**	0.1944
7/17/2013 9:55	24.67	0.683	5.98	7.03	6.6	15.3	**435.2**	5.3	**1.7**	**0.196**	0.196
1/31/2013 9:25	3.17	0.492	9.92	7.83	**119**	197.1	**866.4**	**56**	**9.5078**	**0.2334**	0.2334
10/11/2012 11:42	8.25	0.738	6.79	7.39	2	4.9	103.9	1.2	**1.6393**	**0.2409**	0.2409
1/15/2013 9:25						155.6	**648.8**	**63.5**	**7.3972**	**0.2542**	0.2542
10/23/2012 8:50	13.93	0.696	5.92	7.74	1.8	13.9	**416**	3.8	0.5942	**0.2924**	0.2924
2/27/2013 9:24	2.57	0.598	10.87	8.19	**137**	109.8	**1119.9**	**79**	**6.82**	**0.308**	**0.308**
12/4/2012 9:48	10.8	0.748	6.17	8.91	2.1	8.3	104.6	3.7	0.6687	**0.3124**	**0.3124**
1/3/2013 9:38						17.0					

Site Name: DCM #10 - Deer Creek - midstream at SR 35
Site Number: 10

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	19	19	19	19	19	26	25	25	23	25	25
samples in exceedance (bolded)	N/A	N/A	0	0	12	N/A	19	8	13	16	4

Sonde Data

Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Guage Based Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
8/28/12 8:22	19.3	0.582	5.46	7.65	9.8	8.7	**686.7**	11	0.045	0.0568	0.0568
9/11/12 8:39	16.15	0.315	6.38	7.27	**12.1**	13.8	**248.9**	8.8	0.0281	**0.1024**	0.1024
9/25/12 8:19	12.08	0.685	7.9	7.49	7.1	4.7	178.2	5.4	0.0928	0.0424	0.0424
10/11/12 9:07	8.2	0.719	6.51	7.4	4.4	7.2	70.8	4	0.3537	**0.1606**	0.1606
10/23/12 8:42	14.27	0.654	6.89	7.79	**29.2**	20.2	**1011.2**	**26.7**	0.3196	**0.2267**	0.2267
11/6/12 9:37						14.9	141.4	2.5	0.842	0.0708	0.0708
11/19/12 9:41	4.8	0.731	9.47	8.15	5.9	13.0	48.7	3.5		**0.6394**	**0.6394**
12/4/12 9:36	11.46	0.73	6	8.5	2.7	12.1	91	4.4	-0.0198	**0.166**	0.166
12/18/2012 9:26	5.01	0.754	8.09	8.99	6.3	9.1	93.3	2.1	0.4871	**1.0107**	**1.0107**
1/3/2013 9:28						24.1					
1/15/2013 9:16						230.1	**517.2**	**61**		**0.2424**	0.2424
1/31/2013 9:14	3.45	0.485	10.26	7.83	**111**	286.6	**1299.7**	**59**	**9.8961**	**0.1965**	0.1965
2/12/2013 9:56	3.01	0.641	10.71	8.12	**27.6**	58.8	**517.2**	6.9	**9.4822**	0.0711	0.0711
2/27/13 9:15	2.9	0.467	10.54	7.94	**209**	157.5	**2419.6**	**141**	**9.488**	**0.261**	0.261
3/12/2013 8:07	3.93	0.555	9.48	8.08	**80.6**	149.7	**365.4**	**17.3**	**11.018**	**0.353**	**0.353**
3/26/2013 8:35						30.2	**260.3**	2.1	**5.742**	**0.461**	**0.461**
4/9/2013 8:46	11.48	0.549	6.72	8.36	**186**	36.2	**1413.6**	**82**	**7.215**	**0.125**	0.125
4/24/2013 8:18	7.66	0.203	8.2	6.36	**718**	567.6	**2909.3**	**365**	**4.1320**	**0.257**	0.257
5/7/13 8:40	15.81	0.595	5.62	6.48	**78.5**	53.2	**325.5**	4.7	**6.388**	0.026	0.026
5/22/2013 9:18	18.6	0.625	4.02	6.64	**12.6**	33.0	**325.5**	5.6	**6.9410**	0.0550	0.0550
6/4/2013 8:14						103.0	**461.1**	14.8	**11.4570**	0.0620	0.0620
6/18/2013 8:26	18.94	0.568	7.02	6.53	**68.2**	92.0	**727.0**	**22.5**	**7.6910**	**0.1330**	0.1330
7/2/2013 8:48	17.58	0.626	7.29	7.24	**24.6**	40.0	**770.1**	13	**8.243**	**0.0830**	0.0830
7/17/2013 8:41	22.44	0.671	6.45	7.09	0.9	22.3	**387.3**	3.6	**2.981**	0.051	0.051
7/30/2013 8:41						10.6	**275.5**	2.6	0.795	0.052	0.052
8/13/13 8:27						10.9	**727**	5.7	0.777	**0.095**	0.095

Site Name: SFU #11 - South Fork Deer Creek - upstream at Touby Road
Site Number: 11

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	19	19	19	19	19	26	26	26	23	26	26
samples in exceedance (bolded)	N/A	N/A	2	0	9	N/A	14	5	16	18	3

	Sonde Data					Guage Based					
Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
5/22/2013 7:51	18.12	0.604	**3.35**	6.72	**18**	8.0	**1203.3**	6	**7.8350**	0.0510	0.0510
6/4/2013 7:41						25.3	**344.8**	11.8	**10.5350**	0.0550	0.0550
9/25/2012 7:28	13.28	0.534	6.63	7.35	3	1.1	58.1	1.9	0.0844	0.0564	0.0564
3/26/2013 8:03						7.4	231	2.1	**6.467**	0.057	0.057
4/9/2013 7:43	11.88	0.622	6.13	8.31	**27.3**	8.6	166.4	3.3	**6.149**	0.06	0.06
8/28/2012 8:40	19.09	0.393	**3.93**	6.79	0	2.1	228.2	2.6	0.0504	0.0678	0.0678
2/12/2013 8:54	4.03	0.626	9.47	7.75	**33.8**	14.5	186	3.6	**8.7111**	0.0771	0.0771
11/6/2012 8:35						3.6	47.1	3.6	**2.9367**	0.0784	0.0784
9/11/2012 7:36	15.69	0.506	4.92	6.96	3.2	3.4	**272.3**	3	0.7655	**0.0834**	0.0834
7/2/2013 7:55	18.17	0.614	5.58	6.94	**11.2**	9.9	**613.1**	3	**3.809**	**0.0870**	0.0870
3/12/2013 7:32	3.79	0.038	8.88	7.7	6.4	36.8	**579.4**	7.8	**10.644**	**0.099**	0.099
7/17/2013 7:41	23.72	0.643	5.24	6.57	0.9	5.4	**488.4**	2.7	**1.481**	**0.101**	0.101
6/18/2013 7:46	20.05	0.425	5.54	6.04	**74**	22.4	**410.6**	**28.7**	**5.5680**	**0.1050**	0.1050
10/23/2012 7:57	14.48	0.678	6.22	7.79	4.2	4.7	**290.9**	6.2	**1.4728**	**0.1103**	0.1103
7/30/2013 7:48						2.6	**435.2**	5.3	0.174	**0.132**	0.132
12/18/2012 8:32	5.21	0.734	9.54	8.95	4.7	2.2	95.9	1.3	**2.1665**	**0.1548**	0.1548
8/13/2013 7:39						2.7	127.4	6.2	0.321	**0.173**	0.173
10/11/2012 7:54	6.71	0.568	6.83	7.38	7.6	1.7	**1986.3**	5.5	0.2348	**0.1948**	0.1948
5/7/2013 7:44	14.66	0.504	4.74	6	**106**	13.0	125.9	11.3	**5.47**	**0.208**	0.208
11/19/2012 8:40	4.77	0.719	11.06	8.14	3.9	3.2	62	2		**0.2123**	0.2123
4/24/2013 7:45	7.77	0.186	7.11	6.13	**502**	135.2	**5794.3**	**202**	**3.4650**	**0.248**	0.248
1/31/2013 8:38	4.63	0.356	9.75	7.62	**99.1**	70.8	**920.8**	**37**	**9.6995**	**0.2578**	0.2578
1/15/2013 8:45						57.0	**547.5**	**46.7**		**0.2607**	0.2607
1/3/2013 8:46						5.9	214.3	1.6		**0.3655**	**0.3655**
2/27/2013 8:41	3.14	0.435	**8.06**	7.45	**122**	37.1	**686.7**	**47.5**	**9.375**	**0.389**	**0.389**
12/4/2012 8:36	12.26	0.678	**7.32**	8.57	3.5	2.9	137.6	3.8	0.5191	**0.3947**	**0.3947**

Site Name: DCU #12 - Deer Creek - upstream at Elm St.
Site Number: 12

Exceedance Key

target	N/A	N/A	>4	6-9	9.89	N/A	235	15	1	0.08	0.3
number of samples	19	19	19	19	19		26	26	23	25	25
samples in exceedance (bolded)	N/A	N/A	1	0	13	N/A	22	11	13	13	4

Sonde Data

Date/Time (EST)	Temp C	SpC mS/cm	DO mG/L	pH	Turbidity NTU	Guage Based Flow cfs	E. coli cfu/100 mL	TSS mg/L	NO3+NO2 mg-N/L	TP mg-N/L	TP mg-N/L2
8/28/2012 8:01	18.87	0.699	5.08	6.99	**13.1**	5.5	**579.4**	**48.3**	0.0372	0.0532	0.0532
9/11/2012 8:09	15.86	0.622	5.59	7.12	**12.8**	8.7	**1553.1**	8.7	0.0927	0.0614	0.0614
9/25/2012 7:52	12.02	0.705	7.04	7.2	8	3.0	**1203.3**	3.7	0.1848	0.0354	0.0354
10/11/2012 8:31	6.86	0.723	6.61	7.32	5.3	4.3	**1046.2**	3.2			
10/23/2012 8:18	14.13	0.647	6.31	7.87	2.5	12.6	214.2	5.4	0.2245	**0.1634**	0.1634
11/6/2012 9:09						9.5	186	2.6	0.6881	**0.089**	0.089
11/19/12 9:11	4.23	0.719	9.71	8.12	**11.1**	8.3	**727**	2.4	0.0865	**0.6975**	**0.6975**
12/4/2012 9:04	11.99	0.729	5.64	8.42	6.1	7.7	**816.4**	5.2	-0.0485	**0.1229**	0.1229
12/18/2012 9:00	4.67	0.733	8.37	8.99	6.1	5.7	214.2	1.4	0.6435	**2.5953**	**2.5953**
1/3/2013 9:11						15.3	**387.3**	2.1		**0.1854**	0.1854
1/15/2013 9:00						146.1	**770.1**	**64**		**0.2399**	0.2399
1/31/2013 8:56	3.64	0.492	10.26	7.8	**101**	184.4	**2419.6**	**47.7**	**10.5161**	**0.7911**	**0.7911**
2/12/2013 9:24	2.46	0.652	10.05	8.08	**31.8**	37.8	**1732.9**	7.7	**10.2306**	**2.4033**	**2.4033**
2/27/2013 8:58	2.99	0.477	9.82	7.79	**202**	97.8	**1553.1**	**118**	**9.931**	**0.182**	0.182
3/12/2013 7:49	3.65	0.571	9.81	8.05	**82.3**	95.1	**461.1**	**17**	**11.522**	0.04	0.04
3/26/2013 8:19						19.2	167	3.4	**6.387**	**0.249**	0.249
4/9/2013 8:15	11.35	0.532	6.62	8.24	**149**	22.5	**1299.7**	**67**	**7.392**	**0.186**	0.186
4/24/2013 8:02	7.48	0.209	7.45	6.27	**642**	356.8	**3075.9**	**306**	**4.2120**	**0.233**	0.233
5/7/2013 8:11	14.52	0.581	5.59	6.47	**77.2**	33.8	**648.8**	5.5	**6.179**	0.016	0.016
5/22/2013 8:23	18.41	0.628	**3.61**	6.5	**12.9**	21.0	**517.2**	11	**6.7110**	0.0520	0.0520
6/4/2013 7:58						65.4	**579.4**	**18.2**	**11.6680**	0.0620	0.0620
6/18/2013 8:02	19.45	0.552	6.56	6.64	**66.5**	58.4	**1119.9**	**29.3**	**8.3000**	0.0770	0.0770
7/2/2013 8:28	17.63	0.643	6.96	7.15	**25.2**	25.4	**1299.7**	**16.6**	**7.972**	0.0690	0.0690
7/17/2013 8:09	22.53	0.682	6.09	6.96	8.3	14.1	**920.8**	9.3	**2.872**	0.06	0.06
7/30/2013 8:13						6.7	**980.4**	6.3	0.292	0.062	0.062
8/13/2013 8:07						6.9	**1413.6**	**87.7**	0.806	0.058	0.058

Fish

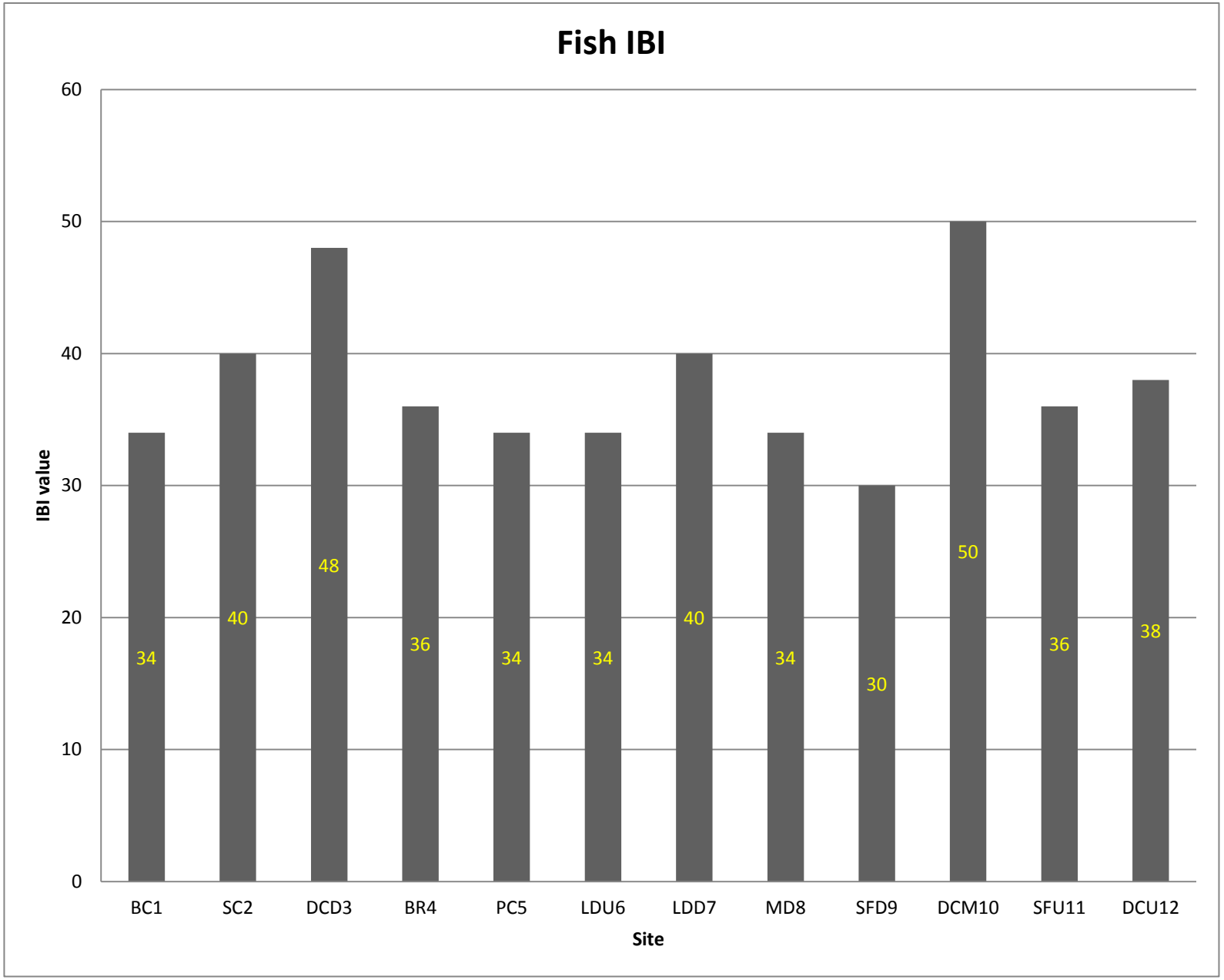
SITE	BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12
Bigeye Chub		3	107	2			29			1	2	7
Black Bullhead												
Blacknose Dace	8	10			24	1	1					6
Blackside darter		1	5				5				2	1
Blackstriped Topminnow		1	3			1	2	5	14	13	16	
Bluegill	13	55	30	1	36	64	58	74	88	58	124	32
Bluntnose Minnow	16	94	28	38	14	3	80	191		42	128	14
Quillback									2			
Brook Stickleback												
Brown Bullhead												
Central Mud Minnow												
Central Stoneroller	73	22	5	37	92	10	44	115		7	156	3
Common Carp										1		4
Creek Chub	127	131		1	29	42	19	128		4	33	22
Creek Chubsucker					21			14				
Emerald Shiner								1				
Fantail Darter				9	1	9	1			2		1
Fathead Minnow												
mimic shiner										2		
Gizzard Shad												
Goldfish												
Golden Redhorse			8				2	3	7	31		
Grass Pickerel								2				
Green Sunfish	5		7		29		4	15	31	5	2	3
Greenside Darter			5	3	1	5	14	4		11	6	7
Horneyhead Chub		2	4	28		18	11	1		5	2	14
Johnny Darter						2	5	8	5	10	35	17
Largemouth Bass										1		
logperch												
Longear Sunfish	4	13	67	8	1		3	21	7	9	10	12
Mississippi Silvery Minnow		37	78	1			62	46		16		34
Mottled Sculpin	131	15		29	18							
Northern Hog Sucker		1	9	4		1	10	2		1		5
Orangespot sunfish			2				3		18		11	7
Orangethroat Darter	3				16	2	4	10			9	1
Pumpkinseed	1	1	1				4	19		22		
Rainbow Darter	5		7	36		4	5	12		5	7	2

SITE	BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12
Redear Sunfish		2	5			1	5					
Redfin Shiner		2	1	1	33			6		7	2	
River Chub												
River Shiner		2	29									
Rock Bass			28	2		5	5	13	6	62		
Rosyface shiner		6	4	2		3	12			18	1	1
Sand Shiner		734	143	1			50	7		5	52	1
Silverjaw Minnow	1	21	2		11	2	11	1		2	36	
Smallmouth Bass	3	3	13	2			8	2		7		
steel color shiner											1	
Spotfin Shiner	42	76	3	15		5	5	1				1
Spotted Bass	1	1	4					5		5		1
Southern Redbellied Dace					16							
Spotted Sucker										1		
Stonecat Madtom		1	3	4		2						2
Striped Shiner	2	1	6		1	4	1	135		69	38	22
Suckermouth Minnow												
White Sucker	70	1			12		1	33	2	48	22	60
Yellow Bullhead	1				2		4		1		1	
Bluegill/Green Sunfish Hybrid												
Pumpkinseed/Green Sunfish Hybrid												
Bluegill/Pumpkinseed Hybrid									5			
Bluegill/Longear Sunfish Hybrid												
Longear/Green Hybrid												
white crappie									1			
Warmouth										1	3	10
Total Species	18	26	28	20	18	20	31	28	13	31	24	27
Number of individuals	506	1,236	607	224	357	184	468	874	187	471	699	290
time in seconds	3,460	2,016	2,433	2,082	2,771	2,413	3,387	4,281	3,845	4,309	2,031	2,815
Drainage area	11.18	28.56	298.77	35.91	13.81	35.43	52.93	15.92	38.75	56.34	13.74	35.77

SITE	BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12
Total species	18	26	28	20	18	20	31	28	13	31	24	27
#of Darters Madtoms												
Sculpin	4	FALSE	FALSE	FALSE	5	FALSE	FALSE	5	FALSE	FALSE	6	FALSE
# of darters	2	1	3	3	3	5	6	4	1	4	5	6
% Headwater species	27	2	0	17	17	5	0	0	0	0	0	2
# of sunfish	4	4	7	3	3	3	7	5	6	6	5	5
# of minnows sp								12	1	11	9	10
# of suckers	1	2	2	1	2	1	3	4	3	4	1	2
# if sensitive species	3	8	12	11	2	7	11	9	3	12	7	9
% of tolerant species	45	19	6	17	31	25	23	42	18	21	27	38
% omnivores	17	11	17	17	7	2	31	31	1	23	21	39
%insectivorus	41	75	72	50	48	55	46	39	84	54	49	39
% Pioneer								55	19	15	57	21
% Carnivores	1	0	7	2	0	3	3	3	3	16	0	4
CPUE	146	613	249	108	129	76	138	204	49	109	344	103
% Simple Lithophilic	17	4	40	19	15	7	25	28	5	37	11	47
%DELTS	0											

SITE	BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12
Ibi												
Total species scoring classification	5	5	5	3	5	3	5	5	1	5	5	5
#of Darters Madtoms Sculpin scoring classification	3	3	3	5	5	5	5	5	1	5	5	5
# of darters scoring classification	3	1	3	5	5	5	5	5	1	5	5	5
% Headwater species	0.27	2.02	0.00	16.96	16.53	5.43	0.43	0.00	0.00	0.42	0.00	2.41
# of sunfish scoring classification	5	5	5	3	3	3	5	5	5	5	3	3
score for % headwater	3	5	1	5	5	5	5	1	1	5	1	5
# of minnows sp scoring classification	5	5	5	5	5	5	5	5	1	5	5	5
# of suckers scoring classification	1	3	3	1	1	1	3	3	3	5	1	3
# of sensitive species scoring classification	3	3	5	5	1	3	5	5	1	5	5	3
% of tolerant individuals	45	19	6	17	31	25	23	42	18	21	27	38
% of tolerant scoring classifacation	3	1	1	1	1	1	1	1	1	1	1	1
% omnivores	5	5	5	5	5	5	3	3	5	5	5	3
%insectivorus	3	5	5	5	3	5	3	3	5	5	3	3
% Pioneer	3	5	5	3	1	3	3	1	5	5	1	5
% Carnivores	1	1	3	1	5	1	1	1	1	5	3	1
CPUE	146.24	613.1	249.49	107.6	128.8	76.25	138.2	204.2	48.63	109.31	344.2	103.02
CPUE scoring classification	3	5	3	1	3	1	1	3	1	1	5	1
% Simple Lithophilic	17.391	4.4498	40.198	19.2	14.85	6.522	24.57	27.57	4.813	36.518	11.16	47.2414
% Simple Lithophilic scoring classification	1	1	5	1	1	1	3	3	1	3	1	5
%DELTS	5	5	5	5	5	5	5	5	5	5	5	5
IBI Score	**34**	**40**	**48**	**36**	**34**	**34**	**40**	**34**	**30**	**50**	**36**	**38**

SITE	BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12



Macroinvertebrates

	SITES		BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12
Order	***Family***	***Genus***												
Acariformes	Hydrachnidia	Unknown		1			2						10	1
Amphipoda	Talitridae	Hyalella			10	3					8			
Amphipoda	Talitridae	Unknown						3						
Amphipoda	Unknown	Unknown						1	1	85	2		20	
Bivalvia	Unknown (larval)	Unknown				1		21						
Coleoptera	Dytiscidae	Matus	1											
Coleoptera	Elmidae	Dubiraphia- larvae			1		26	22	2	2	43	2	14	24
Coleoptera	Elmidae	Dubiraphia- adult											1	
Coleoptera	Elmidae	Macronychus						9						1
Coleoptera	Elmidae	Microcylloepus		2	1			9						
Coleoptera	Elmidae	Optioservus		2		1	1	136	2	1				1
Coleoptera	Elmidae	Stenelmis	2	12	2	21		187	2					3
Coleoptera	Haliplidae	Peltodytes		9			1	2		1			4	
Coleoptera	Haliplidae	Peltodytes-adult			1							1		
Coleoptera	Hydrophilidae	Berosus		10	1	1						1	5	
Coleoptera	Hydrophilidae	Hydrocus						2			2			
Coleoptera	Hydrophilidae	Hydrophilus	1					1						
Coleoptera	Lutrochidae	Lutrochus	1											
Coleoptera	Psephenidae	Psepherus						28						
Coleoptera	Scirtidae	Scirtes						1			6			2
Coleoptera	Scirtidae	Prionocyphon							2					
Diptera	Ceratopogonidae	Culicoides												
Diptera	Ceratopogonidae	Probezzia		1										
Diptera	Ceratopogonidae	Serromyia									2			
Diptera	Chironomidae	Ablabesmyia			7									
Diptera	Chironomidae	Chironominae					26					46		
Diptera	Chironomidae	Chironomini	113	23				67			2			1
Diptera	Chironomidae	Chironomus			3						9			1
Diptera	Chironomidae	Diamesinae	1	3				23			67			
Diptera	Chironomidae	Orthocladiinae	37	25				30						
Diptera	Chironomidae	Podonominae	5	2			17	25			11	26		
Diptera	Chironomidae	Prodiamesinae	4					20			3			
Diptera	Chironomidae	Tanypodinae	14	14			7	90			2	3		1
Diptera	Chironomidae	Tanytarsini	13	6				27				1		4
Diptera	Chironomidae	Unknown			81	40	1	14	52	155	8		46	168
Diptera	Culicidae	Anopheles									1			
Diptera	Dixidae	Dixa	1	1										

	SITES		BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12
Diptera	Empididae	Hemerodromia	11	5							1			
Diptera	Simulidae	Simulium						2	1					
Diptera	Syrphidae	Unknown	2											
Diptera	Tabanidae	Chrysops	4				1	6	1					1
Diptera	Tabanidae	Merycomyia	1											
Diptera	Tabanidae	Tabanus						5						2
Diptera	Tipulidae	Antocha	6	2		1			1					1
Diptera	Tipulidae	Dicranota		2										
Diptera	Tipulidae	Hexatoma						2						
Diptera	Tipulidae	Paradelphomyia	1					1						
Diptera	Tipulidae	Pedicia						1						
Diptera	Tipulidae	Tipula		2				1						
Ephemeroptera	Ameletidae	Ameletus		2				19						
Ephemeroptera	Baetidae	Acentrella						3						
Ephemeroptera	Baetidae	Acerpenna		1	3									2
Ephemeroptera	Baetidae	Baetis				19		13						1
Ephemeroptera	Baetidae	Callibaetis				1			7			2	11	
Ephemeroptera	Baetidae	Centroptilum							13	1			7	
Ephemeroptera	Baetidae	Diphetor hagen		1				1						
Ephemeroptera	Baetidae	Fallceon		2				5						
Ephemeroptera	Baetidae	Paracloeodes		1				13						
Ephemeroptera	Baetidae	Plauditis						1						
Ephemeroptera	Baetidae	Pseudocleon						1						
Ephemeroptera	Baetidae	Unknown	1	2			1	20			2			1
Ephemeroptera	Baetiscidae	Baetisca	1					1						
Ephemeroptera	Caeniidae	Caenis		11	20	1	37	337	40	25	18	12	93	26
Ephemeroptera	Ephemeridae	Ephemera						2						
Ephemeroptera	Heptageniidae	Epeorus						2						
Ephemeroptera	Heptageniidae	Heptagenia		5	4			14						
Ephemeroptera	Heptageniidae	Leucrocuta		1				3						
Ephemeroptera	Heptageniidae	Maccaffertium		9		3		251	18					1
Ephemeroptera	Heptageniidae	Nixe						4						1
Ephemeroptera	Heptageniidae	Stenacron						21						
Ephemeroptera	Heptageniidae	Stenonema femoratum		10	2	8		97						1
Ephemeroptera	Heptageniidae	Unknown	3	7			1	41						1
Ephemeroptera	Isonychiidae	Isonychia		4		1		31						
Ephemeroptera	Leptohyphidae	Tricorythodes		10	174	108		6	14					
Ephemeroptera	Leptophlebiidae	Paraleptophlebia			1			1	1					
Ephemeroptera	Polymitarcyidae	Ephoron						1						

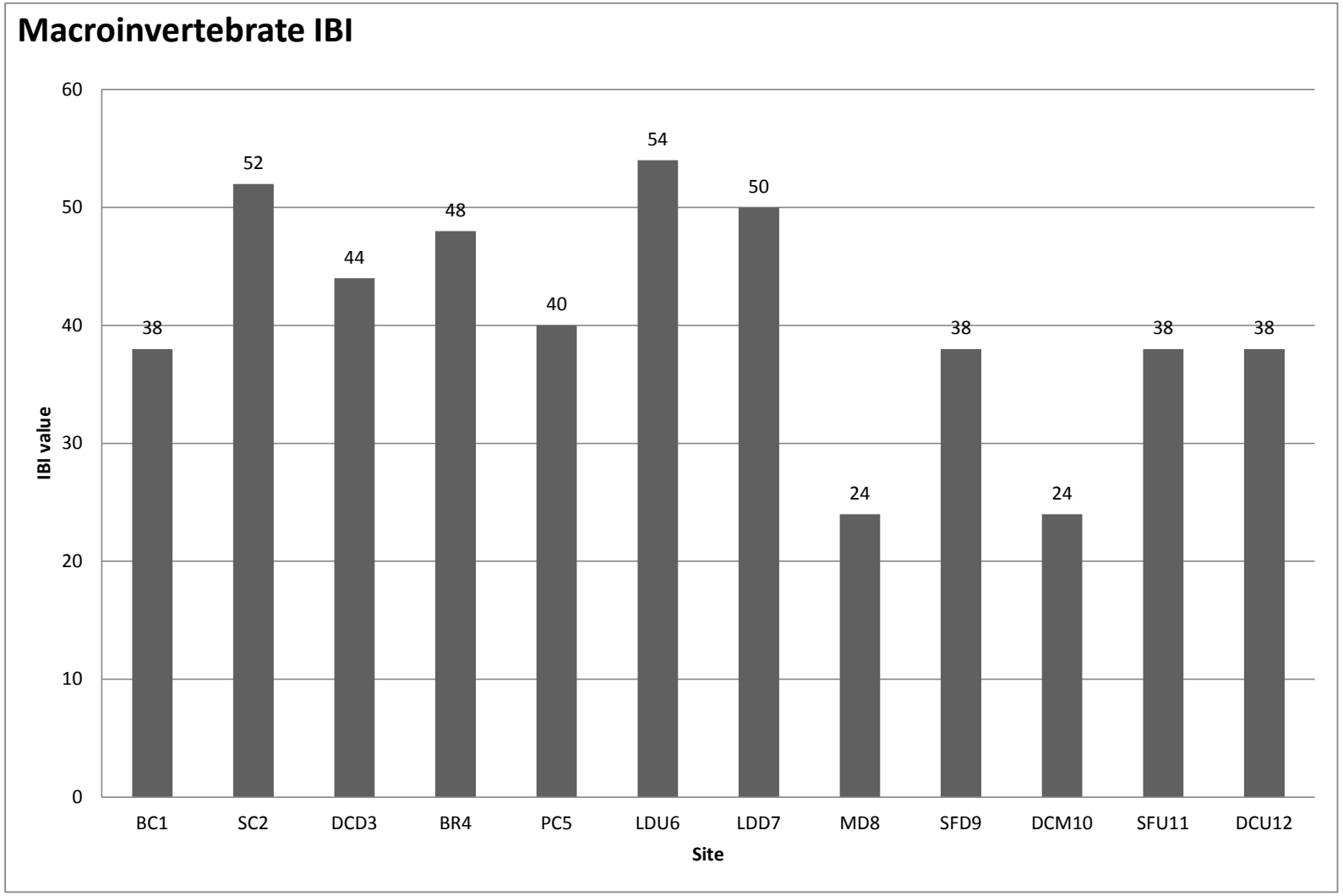
	SITES		BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12
Gastropoda	Ancylidae	Unknown		1			1		2				1	1
Gastropoda	Physa	Unknown	4	3	1	6	10	11	5				1	2
Gastropoda	Planorbidae	Unknown			3		4		1					2
Gastropoda	Sphaeriidae	Unknown					4					5	1	
Gastropoda	Valvatidae	Valvata									1			
Hemiptera	Corixidae	Corixinae						4			7			
Hemiptera	Corixidae	Trichocorixa						3						
Hemiptera	Corixidae	Unknown			1		91	1						
Hemiptera	Gerridae	Aquarius												1
Hemiptera	Gerridae	Limnoporus									1			
Hemiptera	Gerridae	Rheumatobates									1			
Hemiptera	Gerridae	Trepobates		1							14			
Hemiptera	Naucoridae	Pelocoris	1											
Hemiptera	Ochteridae	Ochterus						1						
Hemiptera	Saldidae	Unknown		1										
Hemiptera	Veliidae	Steinovelia								1				
Isopoda	Asellidae	Asellus	3	15		17								
Lepidoptera	Crambidae	Petrophila				1								
Lepidoptera	Neargyractis	Unknown		1										
Odonata	Calopterygidae	Calopteryx						1						
Odonata	Calopterygidae	Hetaerina				1								
Odonata	Coenagrionidae	Amphiagrion						10	3					
Odonata	Coenagrionidae	Argia		1				2			2		1	
Odonata	Coenagrionidae	Chromagrion			3	1								2
Odonata	Coenagrionidae	Coenagrion								5			24	
Odonata	Coenagrionidae	Enallagma								1	3			
Odonata	Coenagrionidae	Unknown					1	1			3			
Odonata	Libellulidae	Libellula								2				
Oligochaeta	Stylaria	Unknown			3									
Oligochaeta	Unknown	Unknown			18		7		8	35	1	45	12	48
Orthoptera	Acrididae	Eotettix	1											
Plecoptera	Capniidae	Allocapnia		5	8									
Plecoptera	Capniidae	Capnura		1										
Plecoptera	Capniidae	Unknown	2	93				5						
Plecoptera	Chloroperlidae	Alloperla		11										
Plecoptera	Chloroperlidae	Unknown						1						
Plecoptera	Leuctidae	Leuctra		20										
Plecoptera	Nemouridae	Nemoura			13									
Plecoptera	Nemouridae	Shipsa		1				2						

	SITES		BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12
Plecoptera	Nemouridae	Unknown		1				5						
Plecoptera	Perlodidae	Isoperla												
Plecoptera	Perlodidae	Unknown		2										
Plecoptera	Taeniopterygidae	Oemopteryx		5				2						
Plecoptera	Taeniopterygidae	Strophopteryx		8		2			21					
Plecoptera	Taeniopterygidae	Taeniopteryx						32						
Plecoptera	Taeniopterygidae	Unknown		8				7						
Plecoptera	Unknown	Unknown		4				11						
Trichoptera	Brachycentridae	Brachycentrus									1			
Trichoptera	Brachycentridae	Micrasema						1						
Trichoptera	Glossosomatidae	Agapetus	1											1
Trichoptera	Glossosomatidae	Protoptila							2					
Trichoptera	Helicopsychidae	Helicopsyche		1		11		48	20			3		
Trichoptera	Hydropsychidae	Ceratopsyche		3		1		13			1			
Trichoptera	Hydropsychidae	Cheumatopsyche	28	16		8		90	1					5
Trichoptera	Hydropsychidae	Hydropsyche	12	8	1			20	6					
Trichoptera	Hydropsychidae	Potamyia			1				2					
Trichoptera	Hydropsychidae	Unknown		1				2	1					
Trichoptera	Hydroptilidae	Hydroptila			1			1						
Trichoptera	Hydroptilidae	Mayatrichia						3						
Trichoptera	Hydroptilidae	Unknown						1						
Trichoptera	Leptoceridae	Mystacious						3						
Trichoptera	Leptoceridae	Oecetis						7						
Trichoptera	Leptoceridae	Setodes	1			1								
Trichoptera	Leptoceridae	Trianodes						1						
Trichoptera	Limnephilidae	Hydatophylax	3					5						
Trichoptera	Odontoceridae	Psilotreta						2						
Trichoptera	Philopotamidae	Chimarra	11	4		6		83	1					
Trichoptera	Philopotamidae	Dolophilodes		1										
Trichoptera	Phryganeidae	Agrypnia	1											
Trichoptera	Polycentropodidae	Cyrnellus		3					1					
Trichoptera	Polycentropodidae	Neureclipsis	1	1				10						
Trichoptera	Polycentropodidae	Polycentropus						4						
Trichoptera	Polycentropodidae	Unknown						2						
Turbellaria	Planariidae	Unknown			6	2			2					

SITES	BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12
Total	292	408	370	266	239	2019	233	314	222	147	251	307
Drainage Area	11.18	28.56	298.77	35.91	13.81	35.43	52.93	15.92	38.75	56.34	13.74	35.77
Total # Taxa	33	59	25	24	17	82	28	10	25	11	12	27
Total *# Indiv*	292	408	370	266	239	2019	233	314	222	147	251	307
Total EPT	12	35	11	13	3	50	15	2	4	3	3	10
Total Dipter Taxa	14	12	3	2	5	15	4	1	10	4	1	8
%Chiro	0.64	0.18	0.25	0.15	0.21	0.15	0.22	0.49	0.46	0.52	0.18	0.57
%NonInsect	0.02	0.05	0.11	0.11	0.12	0.02	0.08	0.38	0.05	0.34	0.18	0.18
%Intolerant	0.15	0.58	0.61	0.62	0.15	0.52	0.56	0.08	0.09	0.10	0.40	0.12
%Tolerant	0.03	0.05	0.10	0.10	0.08	0.01	0.07	0.41	0.14	0.31	0.23	0.17
%Predators	0.10	0.09	0.01	0.01	0.41	0.06	0.01	0.03	0.16	0.03	0.12	0.02
%Shred/Scraper	0.04	0.49	0.10	0.20	0.07	0.44	0.32	0.01	0.03	0.03	0.02	0.06
%C-F	0.23	0.12	0.01	0.06	0.02	0.14	0.06	0.00	0.01	0.04	0.00	0.03
% Sprawlers	0.24	0.50	0.59	0.52	0.15	0.34	0.47	0.09	0.09	0.10	0.37	0.10
# of Taxa	**3**	**5**	**3**	**3**	**1**	**5**	**3**	**1**	**3**	**1**	**1**	**3**
# Indiv	5	5	5	5	5	5	5	5	5	3	5	5
#EPT	**5**	**5**	**3**	**5**	**1**	**5**	**5**	**1**	**3**	**1**	**1**	**5**
%Chiro	**1**	**5**	**3**	**5**	**5**	**5**	**5**	**1**	**3**	**1**	**5**	**1**
%NonInsect	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**1**	**5**	**3**	**5**	**5**
Total Dipter Taxa	**5**	**3**	**1**	**1**	**1**	**5**	**1**	**1**	**3**	**1**	**1**	**3**
%Intolerant	**1**	**5**	**5**	**5**	**1**	**5**	**5**	**1**	**1**	**1**	**5**	**1**
%Tolerant	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**1**	**3**	**1**	**3**	**3**
%Predators	**1**	**1**	**1**	**1**	**5**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
%Shred/Scraper	**1**	**5**	**3**	**3**	**1**	**5**	**5**	**1**	**1**	**1**	**1**	**1**
%C-F	**1**	**3**	**5**	**5**	**5**	**3**	**5**	**5**	**5**	**5**	**5**	**5**
% Sprawlers	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
Total Score	38	52	44	48	40	54	50	24	38	24	38	38

Unimpaired	
Impaired	

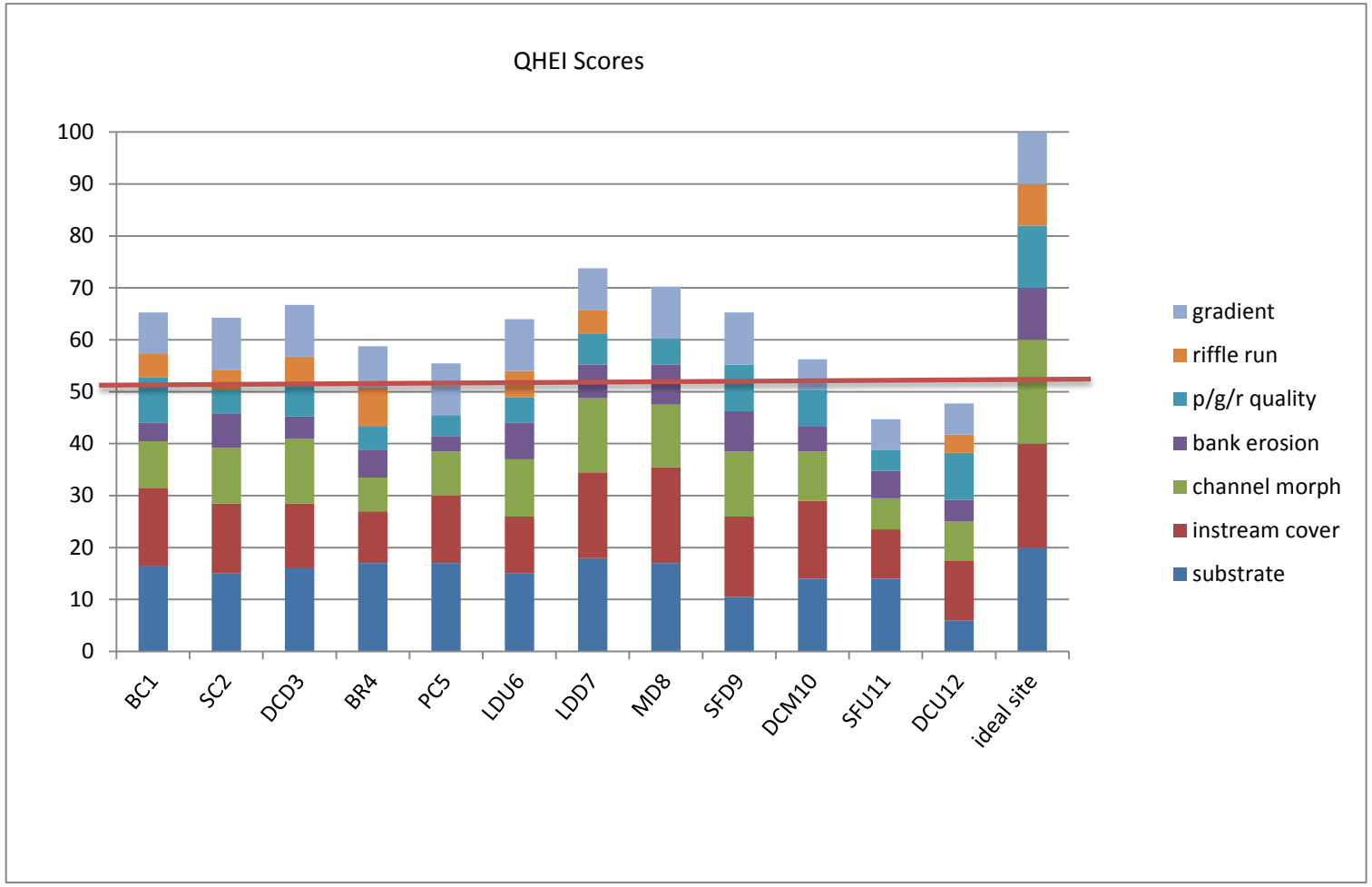
SITES	BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12



Habitat

SITES	BC1	SC2	DCD3	BR4	PC5	LDU6	LDD7	MD8	SFD9	DCM10	SFU11	DCU12	ideal site
substrate	16.5	15	16	17	17	15	18	17	10.5	14	14	6	20
instream cover	15	13.5	12.5	10	13	11	16.5	18.5	15.5	15	9.5	11.5	20
channel morph	9	10.75	12.5	6.5	8.5	11	14.25	12	12.5	9.5	6	7.5	20
bank erosion	3.5	6.5	4.25	5.25	3	7	6.5	7.75	7.75	4.75	5.25	4.25	10
p/g/r quality	8.75	4.5	6.5	4.5	4	5	6	5	9	7	4	9	12
riffle run	4.5	4	5	7.5	0	5	4.5	0	0	0	0	3.5	8
gradient	8	10	10	8	10	10	8	10	10	6	6	6	10
total	65.25	64.25	66.75	58.75	55.5	64	73.75	70.25	65.25	56.25	44.75	47.75	

data is averaged from two scorers



INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
We Protect Hoosiers and Our Environment.

Mitchell E. Daniels Jr.
Governor

Thomas W. Easterly
Commissioner

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July 18, 2012

Sara Peel, Director, Watershed Projects
Wabash River Enhancement Corporation
200 North 2nd Street
Lafayette, IN 47901

Dear Ms. Peel:

Re: QAPP Approval
FFY 2011 Section 319 Project
EDS# A305-2-22

This letter is to inform you that the Quality Assurance Project Plan (QAPP) for the *Deer Creek-Sugar Creek Watershed Project* has been approved by our office. The signature page is enclosed for your records.

Thank you for your interest in furthering Indiana's nonpoint source pollution goals by facilitating water quality monitoring efforts in your watershed. We appreciate your work and anticipate that much good will come from your efforts. Please remember to address quality assurance (QA) activities as required by the QAPP in the Quarterly Progress Reports for your project. If you have any questions or if we can be of further assistance, do not hesitate to contact your Watershed Specialist, Leanne Whitesell, at (317) 308-3119 or our QA Manager, Betty Ratcliff, at 317/308-3135.

Sincerely,

Bonny F. Elifritz

Bonny F. Elifritz, Chief
Watershed Planning and Restoration Section
Office of Water Quality

Enclosure

Cc: Jessica Fulgoni, Watershed Resource Specialist
Wabash River Enhancement Corporation

1.0 Title Page

Quality Assurance Project Plan

for

Deer Creek – Sugar Creek Watershed

ARN # 305-2-22

Prepared by:

Jessica Fulgoni, Watershed Resource Specialist
Sara Peel, Director of Watershed Projects
Wabash River Enhancement Corporation

Prepared for:

Indiana Department of Environmental Management
Office of Water Quality
Watershed Planning & Restoration Section
Final Draft
July 2012

Approved By:

Project Manager:	Sara Peel	7/10/12 Date
TLS QA Manager:	Betty Ratcliff	7/16/12 Date
WPR Section Chief:	Bonny R Elifritz	7/18/12 Date

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Table 1: Sampling Program
Table 2: Study Schedule
Table 3: Data Quality Objectives
Table 4: Sampling procedures
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Table 6: Quality Control Procedures
Table 7: Data quality procedures

3.3 Distribution List

Betty Ratcliff, IDEM NPS Quality Assurance Manager
Technical and Logistical Services Section
Indiana Department of Environmental Management
100 North Senate Avenue
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Indianapolis, IN 46204-2251

Leanne Whitesell, IDEM NPS Project Manager
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Indiana Department of Environmental Management
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Rhonda Hicks, Carroll County SWCD

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Delphi, IN 46923

Ron Turco, Project Director for Water Sampling
915 West State Street
West Lafayette, IN 47906

Megan Haas, Water Chemistry and Bacteria Technician
915 West State Street
West Lafayette, IN 47906

Reuben Goforth, Project Director for Biological Sampling
196 Marstellar Street
West Lafayette, IN 47907

Beth Bailey, Project Technician for Biological Sampling
196 Marstellar Street
West Lafayette, IN 47907

4.0 Project Task/or Organization

In general, the Director of Watershed Projects is responsible for overall implementation of the project. The Water Chemistry and Bacteria Technician reports to the Project Director for Water Sampling. The Project Technician for Biological Sampling reports to the Project Director for Biological Sampling who in turn coordinates with the Project Director for Water Sampling. The Project Director for Water Sampling coordinates with the Director of Watershed Projects, who shares data with the IDEM Quality Assurance Manager, IDEM Project Manager, and the project steering committee.

4.1 Key Personnel

Sara Peel, Director of Watershed Projects
Phone: 765-337-9100 Address: 200 N. 2nd Street Lafayette
E-mail: speel@lafayette.in.gov
Oversees the project and development of the watershed management plan

Rhonda Hicks, Sponsoring SWCD
Phone: 765-564-4480 x3 Address: 1523 North Highway 421, Ste #2, Delphi, IN 46923
E-mail: swcdcc@ffni.com
Coordinates with local volunteers and reviews collected data

Ron Turco, Project Director for Water Sampling, Water Chemistry and Bacteria QC Director
Phone: 765-494-8077 Address: 915 W. State St. West Lafayette, IN 47907
E-mail: rturco@purdue.edu
QC director for water chemistry, oversees project finances and water quality sampling, operates Purdue University's Soil Microbiology Lab

Megan Haas, Water Chemistry and Bacteria Technician

Phone: 765-494-8098 Address: 915 W. State St. West Lafayette, IN 47907
E-mail: mheller@purdue.edu
Will sample and analyze for water chemistry and bacteria parameters, technician at Purdue University's Soil Microbiology Lab

Reuben Goforth, Project Director for Biological Sampling and Habitat Evaluation
Phone: 765-494-0009 Address: 195 Marstellar Street West Lafayette
E-mail: rgoforth@purdue.edu
QC director for biological sampling, responsible for biological and habitat sampling implementation

Beth Bailey, Technician for Biological Sampling and Habitat Evaluation
Phone: 765-494-0009 Address: 195 Marstellar Street West Lafayette. Email: baileyej@purdue.edu.
Will sample and analyze all fish, macroinvertebrate, mussels, and habitat data

4.2 Project Organization Chart

The Project Director for Water Sampling is responsible for:
Oversight of the WCB Technician
Implementation of the QAPP
Water chemistry sampling
Review of water chemistry data entry to completeness and accuracy
Analysis of collected information

The Water Chemistry and Bacteria Technician is responsible for:
Water chemistry QAPP development
Collection of general watershed parameters
Geolocation of sampling sites
Water chemistry sampling
Data entry for water chemistry samples
Analysis of collected information

The Project Director for Biological Sampling is responsible for:
Oversight of field and laboratory technicians (to be identified at a later date)
Implementation of the QAPP
Biological community and physical habitat sampling
Review of biological and physical habitat data entry for completeness and accuracy
Analysis of collected information

The Director of Watershed Projects is responsible for:
QAPP development
Analysis of collected information
Volunteer monitor coordination

5.0 Special Training Needs/Certification & Qualifications

Special training is required to collect and analyze water chemistry and biological/habitat samples. All training will be provided for these activities by the Project

Directors for Water Sampling and Biological Sampling, respectively. Volunteer monitors will be trained in the Hoosier Riverwatch sample collection, analysis and reporting method prior to participating in Hoosier Riverwatch-based volunteer monitoring. Wabash Sampling Blitz volunteers will be instructed in sample collection and analysis procedures at the time of sampling.

6.0 Problem Definition/Background

6.1 Problem Statement

Water quality throughout the Deer Creek – Sugar Creek watershed is relatively poor.

6.2 Historical & Background Information

The area under study encompasses 240,203 acres or 345 square miles. This watershed includes all areas that drain into Deer Creek and Sugar Creek prior to joining the Wabash River in the southwest portion of the watershed. This area includes three 10-digit watersheds: Sugar Creek – Wabash River (HUC 0512010504; 62,978 acres), Deer Creek (HUC 0512010505; 131,140 acres), and South Fork Deer Creek (HUC 0512010506; 46,085 acres). The Deer Creek – Sugar Creek watershed is part of a larger, 8-digit Middle Wabash – Deer Watershed.

Impaired biotic communities, *E. coli*, PCBs, and mercury have been persistent problems in this portion of the Wabash River watershed. In 2008 and on the draft 2010, the IDEM 303(d) list included the following identified impairments for this watershed: Deer Creek, Paint Creek, Plank Ditch, Guckien Cohee Ditch, Buck Creek, Bachelor Run-Kuns Ditch, Sugar Creek, Little Sugar Creek, and unnamed tributaries for *E. coli*; Buck Creek and its tributaries for impaired biotic communities; Deer Creek and the Wabash River for PCBs in fish tissue; Wabash River for mercury in fish tissue. Because of these impairments, a water management plan is needed to get the levels of these four parameters within their Total Maximum Daily Load ranges

In 2008 and on the draft 2010, the IDEM 303(d) list included the following identified impairments for this watershed: Deer Creek, Paint Creek, Plank Ditch, Guckien Cohee Ditch, Buck Creek, Bachelor Run-Kuns Ditch, Sugar Creek, Little Sugar Creek, and unnamed tributaries for *E. coli*; Buck Creek and its tributaries for impaired biotic communities; Deer Creek and the Wabash River for PCBs in fish tissue; Wabash River for mercury in fish tissue. Because of these impairments, a water management plan is needed to get the levels of these four parameters within their Total Maximum Daily Load ranges.

7.0 Process Design

7.1 Study Site Description

The study area encompasses 240,203 acres or 345 square miles of land including portions of Carroll, Cass, Howard, Miami, and Tippecanoe counties.

8.0 Quality Objectives & Criteria for Measurement Data

8. 1 Goal Statements & Objective Statements

The objective of this study is to determine what water quality levels are currently normal for these watersheds throughout the year as well as identify sources of pollution that may be reduced through implementation of a watershed management plan. Chemical, biological, and physical conditions on the selected streams will be documented. The collection of this data will allow for the identification of problem areas, characterization of the watershed, implementation of the watershed management plan, and assessment of implementation success for tributaries to the Wabash River. Ultimately, this monitoring program is designed to show changes in water quality from the watershed management planning phase to the implementation phase. Collected data will be compared with data collected during development of the watershed management plan.

In summary, the goal of the water quality collection portion of this project is to determine the quality of water within the Deer Creek – Sugar Creek watershed and to establish whether a change in water quality can be displayed during the implementation phase(s) of this program. These goals will be achieved through the following actions:

Action 1: Field and laboratory water chemistry data collection at each site will include monitoring for nutrients (nitrogen, phosphorous), *E. coli*, total suspended solids, dissolved oxygen, conductivity, turbidity, temperature, and pH at all sites monitored. Nutrients, *E. coli* and total suspended solids will be determined in the laboratory using approved methods. Dissolved oxygen, conductivity, turbidity, temperature, and pH will be determined on site using either handheld or in-situ probes.

Action 2: Flow will be measured at each of the 12 sample sites using US Forest Service methods. Personnel will complete cross section measurements of velocity and depth.

Action 3: Fish communities will be sampled using an ETS backpack electroshocker at (12) twelve biological monitoring stations. Fish will be identified in the field. Fish will be measured for total length in millimeters (mm). Fish will be released following each sampling event. Fish will be reported by species and fish Index of Biotic Integrity (IBI) will be calculated according to the protocol developed for use by the Indiana Department of Natural Resources and Indiana Department of Environmental Management.

Action 4: Benthic macroinvertebrates (primarily aquatic insect larvae and nymphs) will be sampled at each site using a frame kick net (500 µm mesh) at the same (12) twelve biological monitoring stations. Macroinvertebrate samples will be preserved in the field using 90% ethanol. Preserved samples will be processed and individuals identified to the lowest practicable taxonomic level (i.e., Genus for most groups; Family for Chironomidae). Purdue staff will report macroinvertebrate data according to identifications to the lowest practicable taxonomic level, and we will also calculate a macroinvertebrate IBI (mIBI) using protocols developed for use by the Indiana Department of Environmental Management.

Action 5: Mussels will be sampled at each of the (12) twelve biological monitoring stations. Mussel communities will be analyzed using the mussel methodology used by the Indiana Department of Natural Resources.

Action 6: Stream habitat at each site will be evaluated using the Qualitative Habitat Evaluation Index (QHEI, Ohio Environmental Protection Agency, 2006).

Action 7: Volunteer monitors will collect standard Hoosier Riverwatch parameters at the (12) twelve biological monitoring sites. Volunteers will be trained prior to sampling and will submit quarterly collected data to the Watershed Coordinator and the Hoosier Riverwatch database.

Action 8: Volunteer monitors will collect field samples and conduct in-situ and field station monitoring at approximately 200 stream sites as part of the Wabash Sampling Blitz. Volunteers will be instructed in sample collection and analysis at the time of sampling.

Action 9: Current water quality data will be analyzed to allow for comparison with historical and previously collected data to provide baseline and post-implementation water quality condition information.

To achieve the goal of evaluating a change in water quality, standardized data collection methodology and analysis will be used at each of the sampling stations. Consistencies in methodology will ensure that sampling stations will be comparable to one another and between sampling periods allowing for the watershed group to determine which sites are degraded relative to one another and determine if a measurable change in water quality is present. Methodologies will follow those established and accepted by the scientific community and regulatory agencies (IDEM, Ohio EPA, and USEPA).

8.2 Study Site

Water samples will be collected at the sites detailed in Table 1 and displayed in Figure 1.

Table 1: Sampling Program (PC=Professional Chemistry; B=Biology)

Site Number	Stream Site	Latitude/Longitude	Parameters Sampled
1	Buck Creek at Stair Road, Tippecanoe County	40.4966, -86.8084	PC, B
2	Sugar Creek at SR 25/Stair Road, Tippecanoe County	40.5123, -86.7861	PC, B
3	Deer Creek at Trail Head Park, Carroll County	40.5871, -86.6659	PC, B
4	Bachelor Run at CR 350 N, Carroll County	40.5979, -86.5741	PC, B
5	Paint Creek at CR 450 N, Carroll County	40.6126, -86.4823	PC, B
6	Little Deer Creek at SR 29, Carroll County	40.5573, -86.3954	PC, B
7	Little Deer Creek at CR 300 N, Carroll County	40.5903, -86.4670	PC, B
8	McCloskey Ditch at CR 600 E, Carroll County	40.5972, -86.4112	PC, B
9	South Fork Deer Creek at CR 1225 S, Cass County	40.5882, -86.2142	PC, B
10	Deer Creek at SR 35, Cass County	40.6025, -86.2020	PC, B
11	South Fork Deer Creek at Touby Road, Howard County	40.5429, -86.0931	PC, B
12	Deer Creek at CR 300 E, Miami County	40.6023, -86.0134	PC, B

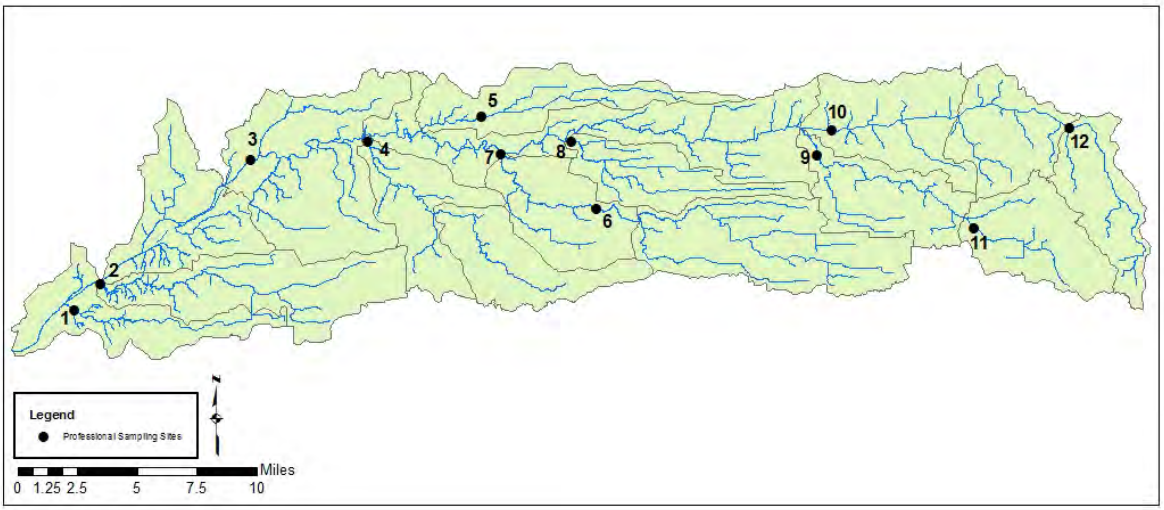


Figure 1: Map of water sampling sites located in the Deer Creek – Sugar Creek Watershed. (Numbers correspond to site numbers in Table 1)

8.3 Sampling Design

The sampling program includes professional water chemistry, volunteer water quality, and professional biological monitoring.

Professional Water Chemistry

A multi-tiered water chemistry monitoring plan will be implemented to establish a baseline for Deer Creek, Sugar Creek and their tributaries within the watershed. Water chemistry monitoring sites will be located on the Monitoring sites will be established throughout the watershed. Sites will be located on Bachelor Run, Buck Creek, Deer Creek, Little Deer Creek, McCloskey Ditch, Paint Creek, South Fork Deer Creek, and Sugar Creek. All sites are shown in Figure1.

Each site will be sampled on a biweekly basis for nutrients (nitrogen, phosphorous), *E. coli*, total suspended solids, flow, dissolved oxygen, conductivity, turbidity, temperature, and pH. Dissolved oxygen, conductivity, turbidity, temperature, and pH will be analyzed *in situ* with field equipment. Sampling will commence upon approval of the QAPP and continue for a period of one year. The minimum number of sampling events for the twelve sites will be 26 per year. Discharge will be calculated from velocity measurements one time at each sample site using approved USFS methods. The water chemistry sampling schedule is flexible enough to prevent sampling during inappropriate weather or when equipment is not working. Following each sampling event, all water chemistry samples will be transported to Purdue University's Soil Microbiology Lab for analysis.

Stream Flow

Stream flow will be monitored once at all of the water chemistry sites. Stream flow monitoring will follow USFS protocols. Discharge will be calculated based on velocity and depth measurements Drainage areas will be taken from Hoggatt (1975) and

confirmed using the watershed delineation tools in ArcInfo Geographic Information System (GIS).

Volunteer Monitoring
Volunteer monitoring will occur quarterly throughout the sampling period as detailed in Appendix A. Sampling will commence upon approval of QAPP through January 2016. Volunteer monitoring sites will correspond with sites shown in Figure 1. In total, twelve sites will be sampled by volunteer monitors using the Hoosier Riverwatch monitoring protocol.

Biological Monitoring
Biological samples will be collected annually from the water chemistry sites described above. Sample site locations are provided in Figure 1. Fish and macroinvertebrate samples will be collected annually in the first and last year of the agreement and mussels will be sampled once during the first year of the agreement. Physical habitat will be evaluated annually using the QHEI during the first and last year of the agreement. Biological samples will be taken on comparable dates each project year as possible given potential weather constraints. Fish and mussels will be identified on-site. Benthic macroinvertebrate samples will be preserved in 90% ethanol on-site, and the samples will be transported to Purdue University's Aquatic Ecology Lab (Department of Forestry and Natural Resources, Forestry Building Rm. 114) for processing and identification.

8.4 Study Timetable

Water chemistry and bacterial monitoring will commence upon approval of QAPP and will continue for one year. All sites will be sampled in the morning on the same day. At the field, metered measurements will be taken at that time. Samples will be transported immediately back to the lab and stored. E. coli will be set up that day and results will be read 24 hours later. Nutrients will be prepped for analysis and will be stored at 4°C for 28 days or frozen for up to 6 months. Batch samples stored at 4°Cwill be analyzed for nutrients 1-2 times per month. Frozen batch samples will be analyzed within a 6 month period Total suspended solids will be analyzed the same day.

Table 2: Study Schedule

Activity	Sample Schedule	Start Date	End Date
Water chemistry monitoring	Biweekly	Upon approval of QAPP	1 year from start date
Volunteer water quality monitoring	Quarterly	Upon approval of QAPP	February 13, 2015
Biological monitoring (fish and macroinvertebrates)	1st and last year of grant agreement	Upon approval of QAPP	January 31, 2016
Mussel monitoring	Once	Upon approval of QAPP	1 year from start date
Habitat assessment	1st and last year of grant agreement	Upon approval of QAPP	January 31, 2016
Flow	Once	Upon approval of QAPP	1 year from water chemistry start date

There are several potential constraints that may affect sampling and analysis. The first is weather. Should weather conditions make it dangerous for the technician to sample on the planned date,sampling will occur on the next available date after weather conditions have improved. Sampling will then continue as normal. Weather may also affect the ability of the technician to obtain water samples. In winter the streams and rivers may freeze over. Should this occur, an attempt to break the ice will be made. If the ice cannot be broken, or if it is too dangerous to do so, then sampling will not be done at that site for that sampling period. During the summer, there may be no-flow conditions in which an insufficient amount of water is not present for sampling. In this case sampling may be skipped. All conditions will be noted on field sheets. Other constraints that may occur include equiment unavailability or malfunction. If this occurs it will be dealt with in a timely manner and noted with the data.

Reports to IDEM will be made on a quarterly basis. A final report will be submitted at project's end.

9.0 Data Quality Indicators (*for Measurement Data)*

The project goals are to establish a baseline of water quality data by which change can be shown during the implementation phase and to obtain an overview of water quality in Deer Creek, Sugar Creek and their tributaries from which a watershed management plan can be developed. Like many projects, this project has financial, temporal, and other constraints. For example, water chemistry data will be collected from only six tributaries with the goal of establishing a baseline by which a change in water quality can be shown during the implementation phase(s). Biological and physical habitat data will be collected at twelve total sites; these twelve sites are the same as the ones to be sampled for water quality data. The sampling design will not provide data for every tributary within the watershed; rather the data will be representative of an agricultural and urban watershed. This will allow for the collection of more data per level of effort. Based on this, the general data quality objectives are to gather representative information on the ecosystem's health at the watershed scale, collect broad watershed scale data to make broad conclusions, and perform collection by accepted protocols to ensure the effort can be repeated in the future. The data quality objectives for

measurement of data are precision, accuracy, representativeness, comparability, and completeness.

9.1 Precision

Field Water Chemistry Parameters

Field equipment and instruments will be calibrated following manufacturer's guidelines before each sampling event. Field equipment will follow recommended usage by the equipment manufacturer. This will allow for high precision. Precision will be measured by calculating the Relative Percent Difference as follows:

$$RPD = \frac{(C - C') \times 100\%}{(C + C') / 2}$$

Where: C=the larger of the two values and C'=the smaller of the two values. An acceptable RPD value is 5%.

Laboratory Water Chemistry Parameters

One duplicate will be taken for every 20 samples taken. One duplicate will be taken in a sterilized plastic amber bottle while the second will be taken in a nutrient free glass amber bottle. Each sample will be taken back to the lab and analyzed for each appropriate parameter (plastic: E. coli, glass: nutrients and total suspended solids). For every 20 samples, one split sample will be analyzed for each parameter. In the event that more than 20 samples need to be taken during a sampling event, an appropriate number of duplicates and split samples will be analyzed so that 5% of samples are duplicates. Should lab data not meet the DQOs in this QAPP, the data will be reviewed by the Water Chemistry and Bacteria Technician and/or the Project Director for Water Quality Sampling and proper action taken.

For nutrients (nitrogen, phosphorus) and total suspended solids, RPD will be calculated as show above using both duplicates and split samples. RPD values should be less than 10%. For E. coli, a 95% confidence interval will be calculated for each site.

Blanks results should fall within 10% of the detection limit for each method.

Field Biological and Physical Habitat Parameters

No calibration is required for biological field sampling equipment and the QHEI is a metric-based protocol. Precision will be assurred by taking replicate samples at each site in time and space. Three replicate 100-m fish samples will be collected at each site on a quarterly basis. Six macroinvertebrate samples will be collected from riffle habitats using a D-net. Physical habitats will be evaluated on one occasion at each site, and the Project Director for Biological Sampling will conduct all of these evaluations for consistency.

Laboratory Biological Parameters

Precision in laboratory-processed macroinvertebrate samples will be assured by processing all six samples collected at each site on each sampling date.

Global Positioning System Parameters

Location coordinate data precision is expected to be high (Table 4).

9.2 Accuracy and or Bias

Field Water Chemistry Parameters

Accuracy for in-situ parameters (dissolved oxygen, conductivity, turbidty, temperature, and pH) will be maintained through proper calibration techniques as provided by the manufacturers of the sonde. These calibrations will take place as needed. Accuracy levels for each parameter measured can be found in Table 3.

Laboratory Water Chemistry Parameters

Accuracy will be maintained through adherance to the following protocols. Accuracy for analyical instruments will be maintained by proper instrument maintenance and following manufacturer's protocal. For each sampling trip, a field blank, trip blank, and lab blank will be analyzed for each parameter (E. coli, nutrients, total suspended solids). A field blank will ensure no contamination during sampling events in the field. A trip blank will ensure proper transportation techniques. A lab blank will ensure proper handling techniques in the lab. These blanks will be analyzed for all laboratory parameters: *E. coli*, total suspended solids, and nutrients (nitrate+nitrite-N, ammonia-N, and total phosphate). The day of sampling, a stock control will be made containing a known amount of nutrients. All samples to be analyzed for nutrients and the stock control will be stored in glass containers at 4°C. Samples will not be preserved with sulfuric acid because it causes interference with the analytical instruments. Any nutrient losses over the storage period will be accounted for with the stock control. At time of nutrient analysis, a matrix spike will be created from a sample chosen at random from the batches to be analyzed. A known amount of each nutrient will be added. Percent recovery will be calculated as follows:

$$\%R = [(A-B)x100]/C$$

Where A = the concentration of the spiked sample,
B = the concentration of the unspiked sample, and
C = the actual concentration of the spike added.

For each nutrient analysis, equipment blanks will be run. Check standards of high and low concentrations will be run A set of standards of known concentration for each nutrient will also be run during each analysis event. These standards will also be used to determine the percent bias. Percent bias will be calculated as follows:

$$\%B = [(x-T)x100]/T$$

Where x = the mean of the results of duplicate analyses of the standard and
T = the concentration of the standard.

Accuracy for all analysis will be maintained through use of blanks. Should a blank result be outside of the ±10% detection limit range, the sample will be considered contaminated for that parameter and appropriate corrective actions will be taken.

Field Biological and Physical Habitat Parameters

Accuracy in fish and mussel identification and enumeration will be assured through collection and maintenance of voucher specimens for each species collected at each

sampling site on each sampling date. Accuracy in habitat evaluations will be assured through consisent evaluations by the Project Directory for Biological Sampling.

Laboratory Biological Parameters
Accuracy in benthic macroinvertebrate identification and enumeration will be assured based on R. Merrit & K. Cummins. 1996. AQUATIC INSECTS OF NORTH AMERICA, 3rd Ed.)

Global Positioning System Parameters
Table 3 details accuracy for site geolocation.

9.3 Completeness

In the event that some catastrophic event (i.e. weather anomaly, chemical spill, etc) were to occur, the first action take would be to delay the sampling to a later time of the week in hopes that sampling could occur under more representative conditions. There is flexibility built into the project's schedule to allow sampling to occur during favorable conditions to preserve data quality.

Field and Laborary Water Chemistry Parameters
One hundred percent collection of field laboratory samples is expected. Sampling locations were field checked to ensure sampling access and proper hydrology is present at each site. However, climatic (frozen streams) or other changes may alter conditions in the watershed. Equipment malfunction or problems during sample collection and analysis could limit the amount of water chemistry data over the term of the project. 85% is an acceptable number because there will likely be events that will prevent sampling for a period of time such as frozen streams.
Valid data will be required from 85% of the scheduled sampling events per site. Completeness will be calculated as follows:

$$\% \text{ Completeness} = \frac{(\text{number of valid measurements obtained})}{(\text{number of measurements expected})} \times 100$$

$$85\% \text{ Completeness} = \frac{(\text{22 valid sampling events})}{(\text{26 expected sampling events})} \times 100$$

Biological and Habitat Parameters
One hundred percent collection of biological samples and physical habitat parameters is expected. Unpredictable and/or extended weather constraints may necessitate delayed sampling events on occasion. However, no issues with achieving 100% sampling for this portion of the project are anticipated.

Global Positioning System Parameters
The geolocation of sample sites is not dependent upon weather or other climatic situations (barring the loss of satellites). Since GPS data can be collected over the length of the project, 100% completeness should be achieved.

9.4 Representativeness

The project monitoring committee met prior to sample site selection to identify a representative agricultural and urban watershed along with a control for both. The selected water chemistry sites are considered representative of typical agricultural and urban conditions within the Deer Creek – Sugar Creek watershed. For biological sampling, sites are representative of the overall watershed and will provide information for prioritization purposes based on both small and large watershed drainage areas.

9.5 Comparability

Comparability will be maintained by adhering to the methods stated in this document at all times. These methods were developed from published sources, or from methods developed by USEPA, IDEM, USDA, or Ohio EPA.

9.6 Sensitivity

Methods for bacteria and water chemistry parameters are highly sensitive. Table 3 summarizes the sensitivites and detection limits for each parameter.

Table 3: Data Quality Objectives

Parameter	Precision	Accuracy	Completeness	Sensitivity	Detection Limit
Nitrate+Nitrite-N	RPD ≤ 10%	Maintained through use of blanks	C ≥ 85%	Measures out to 1/100th of mg	0.25mg-N/L
Total Phosphorus	RPD ≤ 10%	Maintained through use of blanks	C ≥ 85%	Measures out to 1/1000th of mg	0.0.01mg-P/L
E. coli	95% Confidence Interval	Maintained through use of blanks	C ≥ 85%	Measures out to 1/10th of cfu/mL	1 cfu/100mL
Total Suspended Solids	RPD ≤ 10%	Maintained through use of blanks	C ≥ 85%	Measures out to 1/10th of mg (as determined by analytical scale)	4mg/L
pH	RPD ≤ 5%	± 0.2 units	C ≥ 85%	Measures out to 1/100th of unit	0-14 units (detection range)
Turbidity	RPD ≤ 5%	± 2% of reading or ± 1 least significant digit; ± 3% of reading at 500 to 1000NTU	C ≥ 85%	Measures out to 1/10th of NTU	0-1000NTU (detection range)
Dissolved Oxygen	RPD ≤ 5%	% = 0 to 200% ± 2% of reading or 2% air saturation, whichever is greater. 200%-500% ±6% of reading	C ≥ 85%	Measures out to 1/100th of mg	0-50mg/L (detection range)
Temperature	RPD ≤ 5%	± 0.2^{o}C	C ≥ 85%	Measures out to 1/100th of ^{o}C	-5-+50°C (detection range)
Conductivity	RPD ≤ 5%	± 0.5% of reading or 0.001mS/cm, whichever is greater	C ≥ 85%	Measures out to 1/1000th to 1/10th of mS (dependent on range)	0-100mS/cm (detection range)
Blanks-chemistry and bacteria	±10% of Detection Limit of method	If blanks are positive, the sample will be considered contaminated and corrective actions will be taken	C ≥ 85%	N/A	N/A
Split Samples-E. coli	95% Confidence Interval	Maintained through use of blanks	C ≥ 85%	N/A	N/A
Split Samples Nutrients and TSS	RPD ≤ 10%	Maintained through use of blanks	C ≥ 85%	N/A	N/A

Matrix Spike-Nutrients	N/A-used to calculate accuracy	% Recovery ≥ 90%	C ≥ 85%	N/A	N/A
Fish	N/A	N/A	C=100%	N/A	N/A
Mussel	N/A	N/A	C=100%	N/A	N/A
Macroinvertebrates	N/A	N/A	C=100%	N/A	N/A
Habitat	N/A	N/A	C=100%	N/A	N/A
Volunteer Monitoring	See Appendix A	See Appendix A	See Appendix A		
Geolocation	N/A	<7 meters, 95% 2D RMS w/WAAS/EGNOS <3 meters, 95% 2d RMS	N/A	N/A	N/A

10.0 Non Direct (Secondary Data)

11.0 Monitoring Requirements

11.1 Monitoring Process Design

Identify parameters or indicators and link monitoring design to goals and objectives. Clearly describe if sample will be analyzed by volunteer method analysis or analytical laboratory analysis

11.2 Monitoring Methods

Water Chemistry Sampling

Measurements made in the field will be made using manufacturer's guidelines and procedures, and as detailed in Table 4. Measurements made in the field include temperature, dissolved oxygen, pH, turbidity, and conductivity. Field data will be recorded on the field sheet. See Appendix B.

Samples for nitrogen, phosphorus, E. coli, and total suspended solids will be obtained by grab sampling. At each site, each bottle will be given a unique identification number from a label list. This label will be placed on the bottle and recorded on the field sheet prior to sampling. At this time, weather conditions and any other items of interest will be recorded on the field sheet. Bottles obtained through grab samples will be securely attached to a swing sampler (Nasco). A swing sampler allows a bottle to be attached to a pole and swing so that collection of samples may be taken at any angle. In the tributaries, samples will be taken in the thalweg from below the water surface using the hand-dip method, as summarized by Myers and Wilde (2003). Lids will be taken off just before lowering the jar into the water and will be placed face up on the ground where they will not be contaminated. Upon jar retrieval, lids will immediately be placed back on the jar. Once all jars are filled for that site, they will be placed in a cooler with ice packs until arrival back at the lab. At this time, jars will be stored at 4°C until analysis can be performed.

Two 1-L bottles of water will be filled at each site. One sample container is a sterilized amber polypropylene bottle, the other is a nutrient-free glass amber bottle. The polypropylene bottle sample will be used for *E. coli* analysis while the glass bottle will be used for total suspended solids and nutrient analysis. All relevant equipment,

preparation, collection, holding times, and analysis can be found in Appendices B-I for each given analysis.

Equipment used for *E. coli* analysis will be washed with soapy water, triple rinsed with tap water, triple rinsed with distilled deionized water (DDW) and allowed to dry. Once dry, equipment will be sterilized. Equipment for total suspended solids will be washed in the same manner as *E. coli* equipment, but will not be sterilized. Equipment for nutrient analysis will be rinsed with tap water, placed in a 50% hydrochloric acid bath, soaked overnight, triple rinsed with DDW, and allowed to dry. This glassware will be kept separate from other glassware in the lab to minimize nutrient exposure between uses.

Table 4: Sampling Procedures

Parameter	Sample Matrix	Sampling Frequency	Sampling Method	Sample Container	Sample Volume	Holding Time
E. coli	Collected Water Sample	Biweekly	Surface water grab sample-Colilert analysis as used by IDEM	Sterile amber polypropylene	100mL	6 hours
Total Suspended Solids	Collected Water Sample	Biweekly	Surface water grab sample-ASTM analysis method	Nutrient-free amber glass	100mL-1000mL	24 hours
Nitrate+Nitrite-N	Collected Water Sample	Biweekly	Surface water grab sample-SEAL Analytical EPA-114-A analysis method	Nutrient-free amber glass	20mL	28 days if stored at 4°C, 6 months if frozen
Total Phosphorus	Collected Water Sample	Biweekly	Surface water grab sample-SEAL Analytical EPA-119-A analysis method	Nutrient-free amber glass	20mL	28 days if stored at 4°C, 6 months if frozen
Dissolved Oxygen	Field Water Sample	Biweekly	Hach Hydrolab Quanta Sonde	N/A	N/A	N/A
Conductivity	Field Water Sample	Biweekly	Hach Hydrolab Quanta Sonde	N/A	N/A	N/A
Turbidity	Field Water Sample	Biweekly	Hach Hydrolab Quanta Sonde	N/A	N/A	N/A
pH	Field Water Sample	Biweekly	Hach Hydrolab Quanta Sonde	N/A	N/A	N/A
Temperature	Field Water Sample	Biweekly	Hach Hydrolab Quanta Sonde	N/A	N/A	N/A
Fish	Stream Reach	2 times (1st and last year)	Backpack Electroshocker	N/A	N/A	<1hr
Macroinvertebrates	Stream Reach	2 times (1st and last year)	Surber Sampler	500mL Nalgene	100-500mL	Up to 90 days
Mussel	Stream Reach	1 time	Buckets and rakes	N/A	N/A	N/A

Habitat	Stream Reach	1 time	QHEI Published Protocol	N/A	N/A	N/A
Stream flow	Field Sample	1 time	Sounding weights, type AA current meter and digitizer	N/A	N/A	N/A
Geolocation	Field sampling	1 time	Magellan Explorist 300	N/A	N/A	N/A

Biological and Physical Habitat Sampling

Fish, mussels and benthic macroinvertebrate samples will be collected. Specifically, a backpack electroshocker (ETS) will be used to sample fish from three replicate 100-m reaches within each sample site. Fish will be identified, measured, and released following processing, and the fish data will be used to calculate fish-based biological integrity measures (e.g., species richness, % intolerant species, and fish IBI). Macroinvertebrate samples will be collected using a D-frame benthic net (Wildco) scooped through submerged vegetation, riffles and other cover. Macroinvertebrate samples will be placed in 90% ethanol (EtOH) in the field and then later picked and sorted in the laboratory. Individual macroinvertebrates will be identified to the lowest practicable taxonomic level under magnification (primarily to Genus; Chironomidae (midges) will be identified to sub-family only). Biological integrity measures will be calculated based on the macroinvertebrate samples (e.g., taxa richness, % intolerant taxa, Family Biotic Index (Hilsenhoff 1988), mIBI). Physical habitat will be evaluated by the Project Director for Biological Sampling using the QHEI (Ohio Environmental Protection Agency 2006). Fish IBI and mIBI will be calculated using established IDEM procedures by ecoregion.

Stream Flow

Stream flow will be calculated one time using methods based on USFS methodology (Appendix J).

11.3 Site Description

A map is included as Figure 2.

11.4 Field QC Activities

Calibration of field equipment will be performed in the lab before each samlping event. Should the equipment be out of range, it will be recalibrated according to the manufacturer's procedure. Standard calibration solutions will be used to calibrate field meters. Calibration checks of lab analytical equipment will be performed before each sample analysis according to methods found in Appendices B-I.

12.0 Analytical Requirements

12.1 Analytical Methods

See Table 5 for a summary of the analysis procedures. Appendices B-I detail analysis methods to be used in Purdue's Soil Microbiology Laboratory.

Table 5: Analytical Procedures

Parameter	Analytical Method	Performance Range	Units
E. coli	IDEXX Colilert test method-SM 9223B, APHA:Section 9223	1-2,419.2	MPN/100mL
Total Suspended Solids	ASTM D5907-03	4-20,000	mg/L
Nitrate+Nitrite-N	SEAL Analytical AQ2 Discrete Analyzer-EPA method 353.2	0.25-15	mg-N/L
Total Phosphorus	SEAL Analytical AQ2 Discrete Analyzer-EPA method 365.1	0.005-1.0	mg-P/L
Dissolved Oxygen	Hach Hydrolab Quanta; SM 4500 O G	0-500 (as a percent) or 0-50	% or mg/L
Conductivity	Hach Hydrolab Quanta;; SM 2510A	1-200	mS/cm
pH	Hach Hydrolab Quanta;; SM 4500 H+	0-14	Units
Temperature	Hach Hydrolab Quanta;; SM 2550 B (2)	-5 to 70	^{o}C
Turbidity	Hach Hydrolab Quanta;; SM 2540 B	0-1000	NTU

12.2 Analytical QC Activities

Quality control will be achieved by strict adherence to written protocol. Quality control procedures are stated in more detail in Section 9 and in each individual analysis method in Appendices B-I. Lab blanks, field blanks, trip blanks, stock controls, matrix spikes and standard solutions will all be used to ensure high quality data (Table 6). The Water Chemistry and Bacteria Technician will be trained in proper sample handling techniques and how to perform *E. coli* and nutrient analysis on analytical equipment. Any other persons who work for the WCM Technician for this project will be trained and made aware of the requirements of this QAPP.

All field biological sample labels and field data sheets will be initialed by Project Director for Biological Sampling or a qualified designee following his/her approval of the sampling and preservation methods used. In the field, the numbers of samples and measures collected for each sampling site will be recorded on the field form. The Project Director for Biological Sampling or qualified designee will initial the field form to confirm the number of samples collected.

Field form and laboratory form data will be digitized by the Project Director for Biological Sampling or a qualified designee. Project personnel will initial each data sheet after the data have been digitized. After all data have been digitized, project personnel will check all digitized data against the original data sheets. Project personnel will initial data sheets to indicate that the digitized data and data sheets are in agreement. Any errors will be recorded and corrected. The Project Director for Biological Sampling or designee will verify data quality by checking digitized data against original data sheets for every third data sheet.

Table 6: Quality Control Procedures

Quality Control Procedure	Field	Laboratory	Frequency

Field Blank	Yes	Yes	Once per 20 samples collected
Lab Blank	No	Yes	Once per 20 samples collected
Trip Blank	Yes	Yes	Once per 20 samples collected
Stock Control	No	Yes	Once per sampling event
Matrix Spike	No	Yes	Once per analysis event
Standards	No	Yes	Once per analysis event

DATA GENERATION & ACQUISITION

13.0 Sample Handling and Custody Requirements

Field water chemistry samples will be labeled with a unique identification code and logged into a field data sheet (see Appendix B). Field data sheets will include site identification, sampling date and time, sampler name, sample parameters, and field meter results. Samples will be directly taken to the lab and analyzed, or stored properly for later analysis. Before leaving the field, field sheets will be checked to make sure everything is complete, properly filled out, and legible. Samples will be logged into a laboratory log sheet (Appendix B) as they are analyzed by the sampler. It will also be noted on the sheet when samples are discarded. Both paper and electronic versions of these completed forms will be stored in the Purdue University Soil Microbiology Laboratory. Because all samples will remain in custody of the organization performing the sampling, no chain of custody documentation will be needed. Biological and physical habitat field data sheets will be checked over and then maintained in the Purdue University Aquatic Ecology Laboratory. Macroinvertebrate samples will be signed in when brought in from the field, and resulting data sheets will be signed upon completion of processinng for each field sample. Physical data sheets (fish, macroinvertebrate, mussel, and physical habitat) will also be signed once they have been entered into Excel spreadsheets.

14.0 Testing, Inspection Maintenance and Calibration

Calibration of field equipment will be performed in the lab before each samlping event. Should the equipment be out of range, it will be recalibrated according to the manufacturer's procedure. Standard calibration solutions will be used to calibrate field meters. Calibration checks of lab analytical equipment will be performed before each sample analysis according to methods found in Appendices B-I.

ASSESSMENTS/OVERSIGHT

15.0 Assessment/Oversight/Data Quality Assessment & Decision Rules

15.1 Data Quality Indicators

Precision and Accuracy/Bias

Precision and accuracy will be maintained by adherence to protocol as stated in Section 3. Data quality controls outlined in the sections above will be sufficient to meet the objectives of the study. Data quality assessments conducted by Purdue University's Soil Microbiology Lab will be sufficient to meet the objectives of the project. Laboratory analysis of precision and accuracy checks, including control levels for duplicate and replicate samples and field and laboratory blanks, will be kept on file in the laboratory. All laboratory data will be assessed by Purdue University's Soil Microbiology Lab to determine if data quality falls within the required precision levels. The lab will follow established protocols to determine if data is valid. Any data that is determined to not meet laboratory quality control guidelines will not be reported or used for prioritization of implementation activities. All QA/QC measure for each run of samples will be included in the lab's final data analysis and will be included in IDEM reports.

Field measurements and biological and habitat data will be accepted as valid provided no significant problems occur during calibration and sampling. Field water chemistry measurements will be repeated if precision failures are observed (RPD>5%). Data that does not meet precision goals will not be included in sample analysis and subwatershed prioritization. The accuracy of field measurements and biological and habitat data will not be quantified. However, the data will be acceptable provided that no significant problems occurred during equipment calibration or sampling. Sampling will be rescheduled if problems occur during equipment calibration. Field measurements will be repeated if difficulties occur during sampling.

Completeness

Completeness will be determined as stated in Section 3. Should completeness goals not be met, data collected will still be considered valid. If completeness goals are not met, the watershed coordinator will inform the IDEM Project Manager. At the end of the study, it will be determined whether data collected is representative of the watersheds under investigation.

15.2 Corrective Action

Should problems be revealed, corrective actions will be taken based on the problem that occurs. Some actions that may be taken include the following: resterilizing bottles, acid washing bottles or glassware and baking at 400C to remove all nutrients, checking chemials for proper storage and expiration dates, checking incubators for temperature control, checking equipment for malfunction and calibration.

18.2 Validation & Qualifiers

Results that do not meet DQI limits as defined in Section 9 will be flagged by the Technician at time of data entry and analysis.

18.3 Reconciliation with User Requirements

For Data Qualifiers and Flags where estimations are required, the raw result will be used as an estimation of the true result. The reported result will be marked as estimated (J). If no estimations are needed and the data meets all DQIs, the data will be marked as accepted (A).

Data Qualifiers and Flags

R: Rejected
J: Estimated.
Q: One or more of the QC checks or criteria was out of control.
H: The analysis for this parameter was performed out of the holding time. The results will be estimated or rejected on the basis listed below:
1) If the analysis was performed between the holding time and 1½ times the holding time the result will be estimated.
2) If the analysis was performed outside the 1½ times the holding time window the result will be rejected.

D: The Relative Percent Difference (RPD) for this parameter was above the acceptable control limits. The parameter will be considered estimated or rejected on the basis listed below:
1) If the RPD is between the established control limits and two times the established control limits then the sample will be estimated.
2) If the RPD is twice the established control limits then the sample will be rejected.

B: This parameter was found in field or lab blank. Whether the result is accepted, estimated, or rejected will be based upon the level of contamination listed below.
1) If the Sample result is greater than the reporting limit but less than five times the blank contamination the result will be rejected.
2) If the Sample result is between five and ten times the blank contamination the result will be estimated.
3) If the Sample result is less than the Reporting limit or greater than ten times the Blank contamination the result will be accepted.
4) If the Sample result is < 10 times the Reporting limit then the result will be flagged (J+) as estimated high. In other words it is usable but the result is probably biased high.

U: The result of the parameter is above the Method Detection Limit (MDL) but below the reporting limit and will be estimated.
L: The result of the parameter is below the detection limit and will be rejected. Any RPD calculated using this result will not be valid
A: Accepted

18.4 Modeling or Statistical Methods Used

Calculations and statistics required to measure these results against previously collected data in a paired watershed analysis will also be utilized.

19.0 Reports to Management, Documentation, Records

Field sheets will be inspected before leaving each sample site. RPD will be calculated once back in the lab and all data analyzed for that site. Calibration logs will be kept in a notebook in the lab.

Data review will be done by the WCM Technician. Raw data sheets will be reviewed prior to leaving sample site. Data will be entered into a spreadsheet or other similar program and reviewed at that time. The WCM Technician will review all data collected in the field. It will be reviewed for completeness. The Project Director for Water Sampling will also review field sheets and check data sheets for completeness against the field sheets.

19.1 Data Reporting

Data will be transmitted in a suitable format such as Microsoft Excel, Access or other compatable software. All raw data and data analysis results generated as part of this grant project will be submitted in an electronic format with the Final Report to the IDEM Project Manager or Quality Assurance Manager. The format will be compatible with the software currently used by IDEM. At a minimum, the file will contain the project name, sample name, site number, site description, date, time, sample matrix, results, units, detection limits, latitude, longitude, and quality control comments in addition to analytical results.

19.2 Data Management

Include databases, models, format (date, time, staff, parameters, units, methods, results), data qualifyers, QC samples, unique group number, sample numbers, site number, locational information, results, and data quality assessment level (shown below). Provide hard copy and electronic copy of QAPP to IDEM. The documentation should include: sample number, site number, latitude, logitude, medium, purpose for collection, method used to obtain latitude & logitude, date, time, parameter, units, results, analytical method, detection limit, data quality assessment level, qualifiers.

19.3 Quality Assurance Reports

Quality Assurance (QA) reports will be submitted to IDEM's Watershed Management Section every three months as part of the Quarterly Progress Report and/or Final Report. Any problems that are found with the data will be documented in the quarterly reports. Quality assurance reports will include any quality control problems encountered, the actions taken, and any effect these problems had on data.

20.0 References

Harrelson, Cheryl C; Rawlins, C. L.; Potyondy, John P. 1994. Stream channel reference sites: an illustrated guide to field technique. Chapter 10: Measuring Discharges. Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Hoggatt, R.E. 1975. Drainage areas of Indiana streams. Report prepared by the U.S. Geological Survey, in cooperation with the State of Indiana Department of Natural Resources.

IDEM. 2008. Indiana's 2008 303(d) List of Impaired Waters. Available at: http://www.in.gov/idem/4680.htm. Last accessed October 27, 2008.

Myers, D., and F. Wilde. 2003. Chapter A7 Biological Indicators, Techniques of Water-Resource Investigation Report No. 09-A7, 3rd edition, U.S. Geological Survey.

Runkel, R.L., Crawford, C.G., and Cohn, T.A., 2004, Load Estimator (LOADEST): A FORTRAN Program for Estimating Constituent Loads in Streams and Rivers**:** U.S. Geological Survey Techniques and Methods Book 4, Chapter A5, 69 p.

21.0 Appendices

Appendix A: Volunteer Monitoring QAPP

1. Hoosier Riverwatch Program

Hoosier Riverwatch is a program sponsored by the Indiana Department of Natural Resources (DNR). Participants are trained in workshops and provided basic chemical analysis kits and data forms. Hoosier Riverwatch sampling will be conducted as part of the education and outreach and monitoring portions of the current watershed management planning effort. Sampling will be completed only by trained volunteer monitors and will be coordinated by the volunteer coordinator. Sampling is planned to occur at the 12 biological monitoring sites throughout the target watershed no less than quarterly. Sampling is scheduled to begin upon approval of the QAPP and will continue on a quarterly basis through January 2016. Sampling at additional sites or more often than quarterly may occur depending upon requests and interest from the public.

Each sampling event will include all four Hoosier Riverwatch monitoring areas including: habitat evaluation, chemical monitoring, biological monitoring, and stream flow calculation. Sampling will follow the Hoosier Riverwatch sampling protocols and procedures as found in the handbook *Volunteer Stream Monitoring training Manual* (Hoosier Riverwatch, 2012). Chemical parameters will include: dissolved oxygen, pH, temperature, temperature change, orthophosphate, nitrate, nitrite, and turbidity. Biological oxygen demand and *E. coli* bacteria may be included as well.

Sampling will occur quarterly as possible by volunteer monitors and will be coordinated between sites as possible. Sampling will not occur on the same date and time as professional monitoring. Additionally, sampling will be independent of rain events with sampling to be rescheduled if unsafe, high flow conditions occur. All samples will be collected and analyzed by Hoosier Riverwatch volunteers at the site where collected using Hoosier Riverwatch methods. If biological oxygen demand and *E. coli* bacteria are collected, they will be analyzed on the date samples are collected by one volunteer monitor. Macroinvertebrate sampling will be randomly scheduled and should occur no less than once in the fall and once in the spring with the anticipation that monitoring will occur quarterly. All data will be entered into the Hoosier Riverwatch electronic database within one week of the monitoring session.

Volunteer Study Schedule

Summer 2012	Riverwatch volunteer coordination begins
Summer 2012	Sample sites and volunteers identified
Summer 2012	Hoosier Riverwatch volunteer training, if needed
QAPP Approval – Jan. 2016	Quarterly sampling occurs
QAPP Approval – Jan. 2016	Volunteer coordination continues

2. Hoosier Riverwatch Organization and Personnel

Personnel

Jessica Fulgoni, Wabash River Enhancement Corporation
200 N. 2nd Street
Lafayette, Indiana 47906
Phone: 269-377-5418 email: jfulgoni@lafayette.in.gov

Hoosier Riverwatch Project Organization

The volunteer coordinator is responsible for coordinating volunteer monitoring efforts within the Deer Creek – Sugar Creek watershed.

- The volunteer coordinator will lead implementation of the Hoosier Riverwatch volunteer monitoring program.
- The volunteer coordinator will rely on local Hoosier Riverwatch trainers, as possible, and/or will become trained to conduct Hoosier Riverwatch training.
- The volunteer coordinator and all volunteers will follow Hoosier Riverwatch procedures including entering data directly into the Hoosier Riverwatch database. The coordinator will include volunteer data in the final watershed management plan.
- Volunteers will be identified to conduct monitoring at primary sites which are anticipated to correspond with professional biological monitoring program sites. Volunteers may choose to monitor other sites and will provide copies of datasheets to the volunteer coordinator for record-keeping purposes.

3. Data Quality Objectives

Precision, Accuracy, and Completeness

Hoosier Riverwatch standards for quality assurance and quality control will be in effect for this monitoring program. Only data collected by trained Hoosier Riverwatch volunteers will be accepted. Data quality objectives are listed in Table 1. Precision, accuracy, and completeness goals will be met when volunteers do as follows:

- Collect the water samples as directed
- Rinse bottles and tubes with sample water before collecting the water sample and with distilled water after completing the test.
- Perform tests immediately after collecting the water sample unless directed otherwise.
- Calibrate, use, and maintain the testing equipment according to guidelines provided.
- Follow the specific directions of a testing protocol exactly as described.
- Repeat measurements to check for accuracy.
- Analyze duplicates for quality control.
- Minimize contamination of stock chemicals and testing equipment.
- Store kits away from heat and sunlight.
- Check expiration dates on chemicals and replace supplies as needed.
- Check to be sure results submitted via the Hoosier Riverwatch database are the same as those recorded on the data sheets.

Table 1. Date quality objectives.

Parameter	Precision	Accuracy	Completeness
Dissolved oxygen	1 duplicate sample per quarter	Test distilled water as a blank; add oxygen by blowing into water through a straw and check again	All sites sampled quarterly June 2009 through December 2010
Biological oxygen demand	1 duplicate sample per quarter	1 blank (distilled water)	All sites sampled quarterly June 2009 through December 2010
E. coli bacteria	3 samples (each 3-5 ml or less if after rainfall) One duplicate sample per quarter	1 blank (distilled water)	All sites sampled quarterly June 2009 through December 2010
pH	1 duplicate sample per quarter	1 neutral solution test	All sites sampled quarterly June 2009 through December 2010
Water temperature/ temperature change	2 readings averaged at testing sites; 2 readings averaged one mile upstream	Temperature will be taken at both sites not more than 2 hours apart.	All sites sampled quarterly June 2009 through December 2010
Orthophosphate	1 duplicate sample per quarter	1 blank (distilled water)	All sites sampled quarterly June 2009 through December 2010
Nitrate/nitrite	1 duplicate sample per quarter	1 blank (distilled water)	All sites sampled quarterly June 2009 through December 2010
Turbidity	3 readings at one testing site averaged. One duplicate sample per quarter	Samples must be taken in representative stream flow	All sites sampled quarterly June 2009 through December 2010
Benthic macroinvertebrates	3 samples from different locations in a 200 ft stream reach in a variety of habitats. One duplicate sample per quarter	3 minute kick seine technique or 20 dip net jabs at each location	Minimum of 2 monitoring events at each site (30 minutes collecting and identifying macroinvertebrates during each event)

Representativeness

Sampling is planned to occur at the biological monitoring sites to capture indicators from each of these subwatersheds. Results of these sites will be representative of general water quality within each subwatershed and will help to identify areas of concern.

Comparability

Results from this monitoring program will be comparable with results obtained by other Hoosier Riverwatch volunteers across the state. Some of the volunteer sites may correspond with professional monitoring sites as well and will be compared with results from these sites for accuracy.

Sensitivity

Sensitivity of field measurements will be the detection limits listed in Table 3.

4. Hoosier Riverwatch Sampling Procedures

Sampling procedures are described in the Hoosier Riverwatch program manual *Volunteer Stream Monitoring Training Manual* (Hoosier Riverwatch, 2012). Chemical parameters will be tested using the equipment provided by Hoosier Riverwatch. Although training of all volunteers is not yet complete, it is assumed that volunteers will utilize the following methodologies. Methods include: CHEMetrics phosphate and dissolved oxygen test kits, WaterWorks test strips for nitrate and pH, Coliscan Easygel by Microbiology Laboratories, Inc. for *E. coli* sampling, and a turbidity tube for turbidity measurements. Sampling procedures are detailed in Table 2. Habitat quality will be quantified using the Citizens Qualitative Habitat Evaluation Index (CQHEI). The macroinvertebrate community will be sampled using a kick seine or dip net technique as detailed in the Hoosier Riverwatch manual.

Table 2. Sampling procedures.

Parameter	Sample Matrix	Sampling Frequency	Sampling Method	Sample Container	Sample Volume	Holding Time
Dissolved oxygen	Rinse 25 ml collection container 3 times; collect sample water 3-5 inches below surface in thalweg	Quarterly 6/09-3/11	CHEMetrics Dissolved Oxygen kit K-7512	CHEMet ampoule	25 ml	N/A
Biological oxygen demand	Rinse black bottle collection container three times; collect water and cap bottle 3-5 inches below water surface in thalweg	Quarterly 6/09-3/11	CHEMetrics Dissolved Oxygen Kit K-7512	Black bottle and CHEMet ampoule	25 ml	N/A
E. coli bacteria	Use sterile pipettes to collect samples from main stream flow; put 3-5 ml of sample water in Easygel bottle immediately	Quarterly 6/09-3/11	Coliscan Easygel solution bottles from Micrology Labs.	Petri dishes from incubated at 35C for 24 hours	3-5 ml placed in each Petri dish	Samples will be plated within 8 hours
pH	Rinse collection container 3 times; collect sample water 3-5 inches below surface in thalweg	Quarterly 6/09-3/11	WaterWorks pH TestStrips #481104	Plastic cup	3 ounces	N/A ; Complete test within 2 minutes
Water temperature/ change	Take water temperature in thalweg at each site	Quarterly 6/09-3/11	Thermometer	N/A	N/A	N/A
Orthophosphate	Rinse 25 ml collection container three times; collect sample water 3-5 inches below surface in thalweg	Quarterly 6/09-3/11	CHEMetrics Phosphate Kit K-8510	CHEMet ampoules	25 ml	N/A ; Complete test within 5 minutes
Nitrate/nitrite	Rinse collection container three times; collect sample water 3-5 inches below surface in thalweg	Quarterly 6/09-3/11	WaterWorks Nitrate/Nitrite Test Strips #480009	Plastic cup	3 ounces	N/A ; Complete test within 2 minutes
Turbidity	Rinse tube with sample water. Collect	Quarterly 6/09-3/11	Riverwatch turbidity tube	Bucket and	Varies	N/A

	samle in bucket and pour into tube until the bottom symbol is not visible then release water until symbol appears. Convert to NTU using manual pg 52.		method (pg 51-52 Hoosier Riverwatch manual)	turbidity tube		
Flow	Single cross stream measurement	Quarterly 6/09-3/11	Riverwatch flow method	N/A	N/A	N/A
Benthic macroinvertebrates	3 samples collected at 3 sites in 200 ft reach	Quarterly 6/09-3/11	3 minute kick seine technique or 20 dip net jabs at each location in a variety of habitats	Minimum of 30 minutes spent collecting and identifying	N/A	N/A

5. Hoosier Riverwatch Custody Procedure

Most samples will not be transported to other locations, rather sampling will occur immediately followed by analysis by the sample collector. If biological oxygen demand and/or *E. coli* sample analyses are included as part of the sampling program, these analyses will be completed off-site by the volunteer coordinator. In this case, volunteers will deliver samples to the volunteer coordinator on ice and with collection times recorded on the sample containers. Chain of custody forms will be signed by the volunteer coordinator prior to accepting the *E. coli* or BOD sample(s). The volunteer coordinator will store the samples on ice until analysis can occur. All analyses will occur within the holding time.

6. Hoosier Riverwatch Calibration Procedures and Frequency

No equipment requires calibration.

7. Hoosier Riverwatch Sample Analysis Procedures

Water quality monitoring will follow the sample analysis procedures defined in the Hoosier Riverwater monitoring manual. Analytical procedures for the specific tests are noted in Table 3.

Table 3: Analytical procedures

Parameter	Analytical Method	Performance Range	Units
Dissolved oxygen	CHEMetrics DO Kit K-7512	Range: 5.4-14.2 mg/L; IN avg: 9.8 mg/L	mg/L
Biological Oxygen Demand	CHEMetrics DO Kit K-7512	Range: 0-6.3 mg/L; IN avg: 1.5 mg/L	mg/L
E. coli	Coliscan easygel solution bottles and Petri dishes	Range: 1-1157 col/100 mL; IN avg: 645 col/100 mL	Colonies/100 mL
pH	WaterWorks pH test strips #481104	Range: 7.2-8.8; IN avg: 8.0	pH units
Water temperature change	Thermometer	State standard: < 5 degrees change	Degrees
Orthophosphate	CHEMetrics phosphate kit K-8510	None	mg/L
Nitrate	WaterWorks nitrate/nitrite test strips #480009	Range: 0-36.08 mg/L; IN avg: 12.32 mg/L	mg/L
Turbidity	Turbidity tube	Range: 0-173 NTU; IN avg: 36 NTU	NTU
Macroinvertebrates	3 samples at 3 locations in 200 ft; 3 minute kick seine or 20 dip net jabs	Pollution Tolerance Index range: 0-23	PTI

8. Hoosier Riverwatch Quality Control Procedures

Volunteers will be trained and instructed to follow Hoosier Riverwatch procedures as defined in the monitoring manual. All but two of these tests are done in thefield (Table 4). The volunteer coordinator will assist volunteers with all test procedures and questions as they arise.

Table 4: Quality Control Procedures

Quality Control Procedure	Field (Yes/No)	Off Site (yes/no)	Frequency (minimum)
Dissolved oxygen	Yes	No	12 sites quarterly
Biological Oxygen Demand	No	Yes	12 sites quarterly
E. coli	No	Yes	12 sites quarterly
pH	Yes	No	12 sites quarterly
Water temperature change	Yes	No	12 sites quarterly
Orthophosphate	Yes	No	12 sites quarterly
Nitrate	Yes	No	12 sites quarterly
Turbidity	Yes	No	12 sites quarterly
Macroinvertebrates	Yes	No	12 sites quarterly

9. Hoosier Riverwatch Data Reduction, Analysis, Review, and Reporting

Results will be entered into the Hoosier Riverwatch database by the volunteer coordinator and trained Riverwatch volunteers. Sampling results will be submitted to IDEM 319 grant managers in access or excel including sample number, project name, site number, date, sample matrix, method, results, units, detection limit, latitude, longitude, and quality control comments. The volunteer coordinator will review and analyze the results and prepare a final report on monitoring activities as part of the grant project. This report will include complete results for each parameter tested.

10. Hoosier Riverwatch Performance and System Audits

All data worksheets will be kept on file by the volunteer coordinator and available for review by IDEM staff. All data will be reported online to the Hoosier Riverwatch

database which is open for public access. The volunteer coordinator will contact each volunteer during the monitoring timeframe to discuss any questions or problems. IDEM reserves the right to conduct external performance and/or system audits of any component of this study.

11. Hoosier Riverwatch Preventative Maintenance

After each use, the volunteer coordinator will check the equipment. Any missing or expired chemicals or damaged equipment will be replaced prior to the equipment's next use.

12. Hoosier Riverwatch Data Quality Assessment

The volunteer coordinator and volunteers together will review all data sheets before submitting results to Hoosier Riverwatch. Precision, accuracy, and completeness will be covered in this review process. If data is not within typical ranges or is incomplete, it will not be entered into the Hoosier Riverwatch database.

13. Hoosier Riverwatch Corrective Action

The volunteer coordinator will determine if corrections are needed to ensure the success of the monitoring program. If the coordinator feels that changes are needed to meet the program objectives, proposed changes will be submitted first to the IDEM project manager for approval prior to implementation. The coordinator will also be in contact with volunteers at least once quarterly. Additionally, all volunteers will be part of the monitoring subcommittee to ensure that the volunteers get the feedback necessary to make the monitoring program successful.

14. Hoosier Riverwatch Quality Assurance Reports

Quality Assurance reports will be submitted to IDEM's watershed management section as part of the quarterly progress reports and/or final report.

The QA report will include:

- Assessment of the data in terms of accuracy, precision, and completeness;
- Results of any performance audits performed during the quarter;
- Any significant quality control problems encountered and the recommended solutions;
- Discussion of whether the QA objectives are being met and the resulting impacts on decision-making; and
- Any limitations on the use of the data.

15. Hoosier Riverwatch References

Hoosier Riverwatch. 2012. Volunteer Stream Monitoring Training Manual. Indiana Department of Natural Resources, Indianapolis, Indiana.

Appendix B: Sample Log Sheets

Water Chemistry and Bacteria Monitoring of the Lafayette-West Lafayette Reach of the Wabash River Watershed

Purdue University Soil Microbiology Laboratory

Field Data sheet

Date/Time:

Site ID:

Collection made by:

Weather Conditions, Notes and Other Observations:

Field Blank Collected:

Trip Blank Collected:

Sample ID	Notes

Meter Results:

Dissolved Oxygen (mg/L)	
Conductivity (mS/cm)	
pH (units)	
Temperature (°C)	
Turbidity (NTU)	

Initials of person filling out form:

Water Chemistry and Bacteria Monitoring of the Lafayette-West Lafayette Reach of the Wabash River Watershed

Purdue University Soil Microbiology Laboratory

Lab Bench Sheet

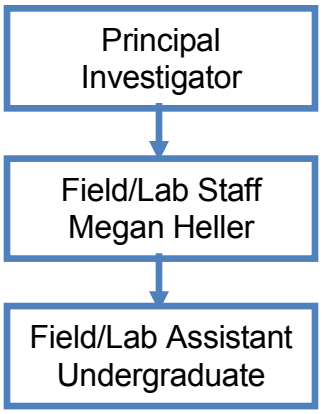
Date / Time In	Sample ID	Analysis Performed	Date / Time Out	Notes	Initials

Appendix C: Colilert Test Method Standard Operating Procedure

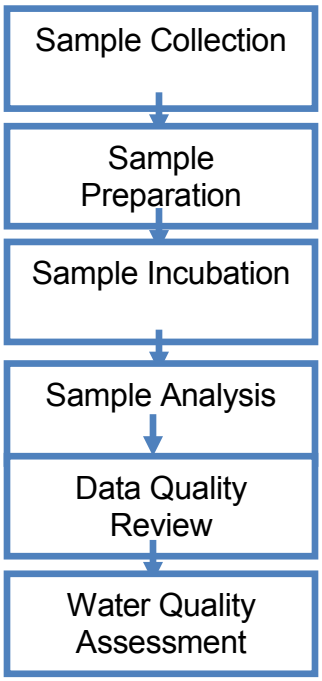
This method is modified from the Colilert Test Method provided by IDEM.

1. Scope and Application, Matrix
    a. Colilert is used for the simultaneous detection, specific identification, confirmation and quantification of total coliforms and *E. coli* in water.
    b. Colilert may be used for drinking water, pool water, surface water and bottled water, and it can be used as a pass or fail (presence/absence) test without Quanti-Trays or a quantification test using Quanti-Trays.
    c. Colilert may be performed in a fixed or mobile laboratory setting. The mobile laboratory setting requires a standard outside AC electrical outlet and/or and AC/DC power inverter powered by a DC battery or DC battery pack.
2. Summary of Method, Detection Limit
    a. Total coliforms and *E. coli* are specifically and simultaneously detected and identified at 1 MPN (Most Probable Number)/100mL (1 MPN/100mL is equivalent to 1 CFU/100mL) of sample in 24 hours or less by inoculating the reagent with the water sample and incubating it. Samples may be quantified using Quanti-Trays with a range of 1 MPN/100mL to 2419.2 MPN/100mL or 10 MPN/100mL to 24192 MPN/100mL if a 1:10 dilution is performed. No further sample manipulation or testing is necessary.
3. Comments
    a. Avoid prolonged exposure of Colilert to sunlight because it may cause a false positive in the sample.
    b. Shake sample thoroughly before inoculation with reagents
    c. Do not transfer colonies or cultures pre-grown in any enrichment media to Colilert, suppressant reagents may be overloaded by transferring heavy inocula of certain non-coliforms. This does not apply to dilute pure cultures used in controls.
    d. Do not pre-filter sample and place the membrane in Colilert.
    e. Do not dilute sample in buffered water for addition to Colilert; samples may be diluted with sterile laboratory pure water.
    f. Colilert training will be provided by the United States Geological Survey Ohio Water Microbiology Laboratory to the laboratory technician. Any other persons requiring training in the future will be taught by the laboratory technician. Training will consist of reading this document and field and laboratory demonstrations of the proper Colilert methods. The training is finalized by the trainee's demonstration of proficiency in the field and in a fixed and/or mobile laboratory by actual successful water sample collection and analysis under direct supervision of the trainer.

g. Water sample are collected according to a suitable method capable of meeting or exceeding the performance requirements of this test method. A log will be maintained in the laboratory to keep track of all samples.
h. Both electronic data if applicable and hardcopy data are accurately and continuously maintained, so all data fields are occupied. All data are readily available and saved for a minimum of 2 years. Electronic data are stored on a secure Purdue University hard drive. Hardcopy data are stored in the Purdue Agronomy Soil Microbiology Laboratory.
i. Any disposable material coming into contact with culture media is discarded in a special biohazard trash receptacle. These special biohazard trash receptacles are routinely picked up by Purdue Radiological and Environmental Management and are properly disposed of in accordance with applicable local, state and federal laws.
j. Roles and Personnel



k. Process



4. Equipment and Materials
    a. Incubator set at 35.0^{o}C +/- 0.5^{o}C
    b. Long wavelength ultraviolet lamp (365nm)
    c. Sterile, non-fluorescent container
    d. Thermometer
    e. IDEXX sealer with rubber template
    f. Sanitizer
    g. Paper towels
    h. Biohazard trash receptacle
    i. Sterile 10mL pipet with pipet pump or bulb
    j. Sterile deionized water
    k. Laboratory bench sheets and/or electronic equivalent
    l. Sterile gloves
5. Reagents, Cultures and Culture Media
    a. Colilert reagent packet (Snap Pack) for 100mL sample
    b. Procedural controls if applicable
6. Procedure
    a. Before starting any laboratory work, put on gloves and then sanitize self and all laboratory bench tops. For a mobile laboratory setting, plug in vehicle to an electrical outlet if at a hotel or similar location or turn on AC/DC power inverter if an electrical outlet is unavailable. Turn on incubator if not already on.
    b. Remove samples from cooler, place on bench and allow to warm
    c. Log samples into laboratory bench sheets and/or electronic equivalent using sample identification.
    d. If using sample container as culture flask for the presence/absence test, shake sample container approximately 20 times or about 30 seconds and adjust sample volume to 100mL if needed. If a separate container is required, then number container with lab number.
    e. Separate one Colilert Snap Pack from the strip taking care not to accidentally open the pack, or the adjacent one.
    f. Tap the Colilert reagent snap pack to ensure that all the powder is in the bottom of the pack.
    g. Snap open the pack at the score line at the top of the pack. Do not touch the top of the pack.
    h. Aseptically add the contents of the Colilert Snap Pack to the culture container (sample bottle), cap and seal; shake the container approximately 20 times or about 30 seconds to thoroughly mix the sample and reagent. Further dissolution will occur with incubation.
        i. If performing an MPN by Quanti-Tray:
        ii. Turn on the Quanti-Tray Sealer to preheat. Green light indicates ready status.

iii. Prepare a dilution if sample is excessively turbid (>50 NTU) or known to have high *E. coli* counts based on recent collection efforts. .
iv. Label all Quanti-Trays with the lab number and dilution if applicable.
v. Pour the sample or diluted sample containing the Colilert into the properly labeled Quanti-Tray.
vi. Press the Run button to seal the Quanti-Tray.

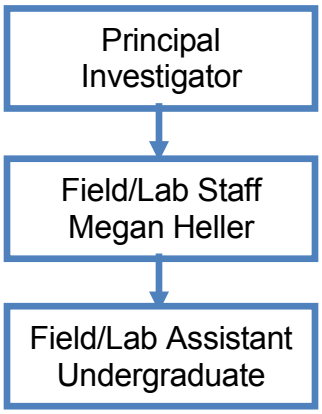
i. Incubate sample/reagent mixture at 35.0^{o}C +/- 0.5^{o}C for 24 hours.
j. Read the reaction at 24 hours. If yellow color is seen, check for fluorescence. Samples, which are indeterminate, may be incubated for an additional 4 hours for a total of 28 hours of incubation. Color should be uniform throughout the container. If not, mix by inversion before reading.

7. Interpretation
   a. Check yellow tests for fluorescence, which would indicate the presence of *E. coli.*
   b. For quantification, count the number of large yellow wells and small yellow wells that fluoresce for *E. coli.*
   c. Use the chart accompanying the Quanti-Tray containers or an approved adaptation of this chart to determine the results of MPN/100mL for *E. coli*. Record these values on laboratory bench sheet, lab notebook and/or electronic equivalent.
   d. If there is ever a question about this test method, then consults IDEXX.
8. Quality Control
   a. Procedural controls consist of:
      i. Blanks consisting of DDW will be run with each set of samples
9. References
   a. “Colilert Product Brochure,” IDEXX Laboratories, One IDEXX Drive, Westbrook Maine, 04092, 2002.
   b. “Colilert Test Method”, Indiana Department of Environmental Management, 100 N. Senate Ave, Indianapolis, Indiana, 46204, 2008.
   c. Standard Methods for the Examination of Water and Wastewater, 20th Edition, Natural Bathing Beaches, Method 9213 D., 1998.
   d. Standard Methods for the Examination of Water and Wastewater, 20th Edition, Enzyme Substrate Test, Method 9223 B., 1998.

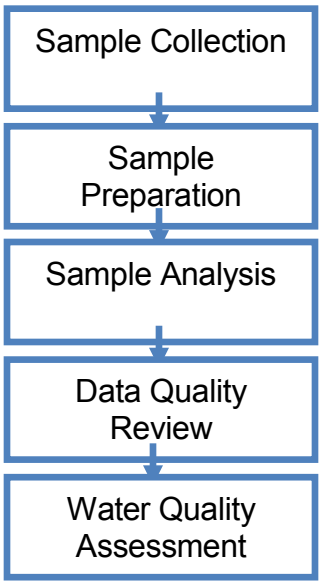
Appendix D: Total Suspended Solids Standard Operating Procedure

This method is modified from ASTM D5907 Standard Test Method for Filterable and Nonfilterable Matter in Water.

1. Scope and Application, Matrix
    a. This method may be used to determine the amount of non-filterable (total suspended solids – TSS) in water.
    b. This method may be used for drinking, surface and saline waters, domestic and industrial waste waters.
    c. This method may be performed in a laboratory setting.
2. Summary of Method, Detection Limit
    a. Suspended solids in a water sample of known volume are retained on a 1.5um filter of known weight. This filter is dried at 105°C and weighed. The difference in weight is equal to the amount of TSS. The range of detection for TSS is between 4 and 20,000 mg/L.
3. Comments
    a. This method is only meant to include particulates. Leaves, sticks, insects, fish, etc should be removed before analysis.
    b. Due to the nature of some materials, they may not be measured correctly. Such substances include glycerin and sulfuric acid which remain liquid at room temperature.
    c. Algae or very fine particles may increase the filter time by plugging the filter. This may affect the results.
    d. Water sample are collected according to a suitable method capable of meeting or exceeding the performance requirements of this test method. A log will be maintained in the laboratory to keep track of all samples.
    e. Both electronic data if applicable and hardcopy data are accurately and continuously maintained, so all data fields are occupied. All data are readily available and saved for a minimum of 2 years. Electronic data are stored on a secure Purdue University hard drive. Hardcopy data are stored in the Purdue Agronomy Soil Microbiology Laboratory.
    f. Roles and Personnel



g. Process



4. Equipment and Materials
    a. Laboratory bench sheets and/or electronic equivalent
    b. Glass fiber filters-binder free-Whatman 934-AH 1.5um or equivalent
    c. Membrane filter assembly
    d. Aluminum pan
    e. Drying oven set at 105°C
    f. Analytical balance capable of measuring to the nearest 0.1mg
5. Reagents, Cultures and Culture Media
    a. Distilled Deionized Water (DDW)
6. Procedure
    a. Prepare the glass fiber filters
        i. Place the filter on the assembly.
        ii. With the vacuum applied, rinse filter with three successive rinses. Each rinse should be equal to 3mL DDW per square centimeter of filterable surface area. For 35mm filterable area filters, use 30mL per wash.
        iii. Do not combine total volume into a single rinse. This is not as effective as three separate rinses.
        iv. Throw out the rinses once all water has been removed from the filter
        v. Carefully remove the filter with forceps and place in labeled aluminum pan
        vi. Place pan and filter in 105°C oven for one hour.
        vii. Once dry, pan and filter should only be handled with forceps, tongs, or lint-free gloves.
        viii. Remove from oven and place in a desiccator until completely cool.

ix. When cool, weigh pan and filter to the nearest 0.1mg just before use.

b. Determine proper sample volume
   i. For standard filters with 35mm filterable area, begin with 100mL of sample. If 2.5mg of dry solids is not caught by the filter, increase the volume until you get 2.5 – 200mg of dry matter. Do not exceed 200mg.
      1. If other size area filters or filter apparatus' are used, use a volume of sample equal to 10mL/cm^2 of filterable area.
   ii. If filtering time exceeds 5 minutes, follow Break-Point Determination steps below.
      1. Place filter on apparatus. Filter and time a known volume of sample.
      2. Repeat the above step with increasing volumes of sample until filtration rate rapidly drops off.
      3. Plot time on x-axis and volume on the y-axis. Choose the volume to filter based off of the time. This should be the time just before the rate drops off.
      4. If less than 2.5mg of is retained by the filter, a larger diameter filter may need to be used.
      5. If 20mL or less of sample is to be filtered, dilute sample in 100 – 1000mL of water. Do not pipet as the tip can act as a filter.

c. Assemble filter apparatus

d. Mix the sample well and pour into a graduated cylinder. Measure the volume. Pour this known volume into the filter assembly with suction applied until all liquid has passed through.

e. Wash the graduated cylinder, filter apparatus, and filter with three separate rinses of water. For 35mm filterable area filters, use about 20mL per wash. For other filters, use 2mL/cm^2 filterable area. Discard washed water when done.

f. Once the filter is dry, remove it using forceps and place in original pan.

g. Dry for at least 1 hour at 105°C or until constant weight is achieved.
   i. Constant weight is achieved when there is a 0.5mg difference or less between weight checks. A 4% difference may also be used, whichever is greater.

h. Once dry, place in a desiccator until cool. Weigh to the nearest 0.1mg.

7. Interpretation
   a. Calculate Total Suspended Solids as follows in mg/L:

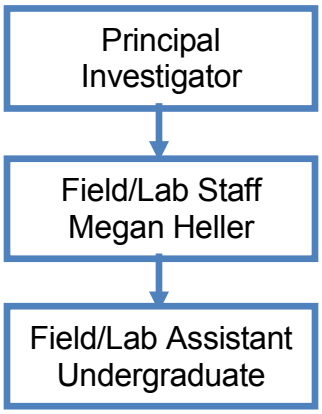
$$= \frac{\text{(mg of residue + filter) - mg of filter}}{\text{mL of sample filtered}} \times 1000$$

   b. Report values to the nearest milligram.
8. Quality Control
   a. Procedural controls consist of running one blank with each batch of samples.
   b. Each DDW blank will be taken through the same procedure stated above.
   c. Blanks may decrease in mass by about 0.2mg. If a weight increase or mass loss greater than 0.4mg occurs, samples in the batch will be rerun.
9. References
   a. ASTM International, Standard Test Method for Filterable and Nonfilterable Matter in Water, Method D5907 – 03, 2003.

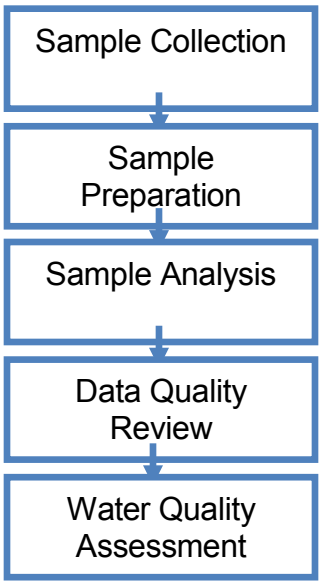
Appendix E: Nitrate-N + Nitrite-N Standard Operating Procedure

This method is modified from SEAL Analytical, Nitrate-N + Nitrite-N in Drinking and Surface Waters, and Domestic and Industrial Wastes.

1. Scope and Application, Matrix
    a. This method may be used to determine the amount of nitrate and nitrite ions in samples.
    b. This method may be used for drinking and surface water, and industrial and domestic wastes.
    c. This method may be performed in a laboratory setting.
2. Summary of Method, Detection Limit
    a. Copperized cadmium reduces nitrate to nitrite. Nitrite reacts with sulfanilamide, which, in the presence of a dilute phosphoric acid, combines with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a reddish purplish azo dye. This is measured spectrophotometrically. Detection limit for this method is 0.03mg N/L.
3. Comments
    a. Training will be provided by a technician experienced with using the SEAL Analytical machine.
    b. Samples should be filtered before analysis to remove turbidity.
    c. Samples should be analyzed as soon as possible after collection.
    d. If it is not possible to run samples after collection samples should be kept at 4°C for up to 28 days or frozen for up to 6 months.
    e. Water sample are collected according to a suitable method capable of meeting or exceeding the performance requirements of this test method. A log will be maintained in the laboratory to keep track of all samples.
    f. Both electronic data if applicable and hardcopy data are accurately and continuously maintained, so all data fields are occupied. All data are readily available and saved for a minimum of 2 years. Electronic data are stored on a secure Purdue University hard drive. Hardcopy data are stored in the Purdue Agronomy Soil Microbiology Laboratory.
    g. Roles and Personnel



h. Process



4. Equipment and Materials
    a. Laboratory bench sheets and/or electronic equivalent
    b. Analytical balance
    c. Properly prepared glassware
    d. SEAL Analytical machine
    e. Filters
5. Reagents
    a. Deionized Distilled Water (DDW)
    b. Dilute hydrochloric acid solution: 90 parts water with 10 parts HCl.
    c. Copper (II) Sulfate: Dissolve either 20g of copper (II) sulfate anhydrous or 31.3g copper (II) sulfate pentahydrate in about 800mL of DDW. Bring to 1L volume
    d. Triton X-100: First weigh 25g Triton X-100 (neat liquid) into a separate weigh boat. In a 250mL container, add about 200mL DDW and stir while slowly adding the Triton X-100. Dilute to 250mL volume once dissolved.
    e. Ammonium chloride buffer stock pH 8.5: Under a fume hood, dissolve 134.2g ammonium chloride and 1.2g ethylenediaminetetraacetic acid, disodium salt hydrate in about 800mL of DDW. Using a concentrated ammonium hydroxide solution (or 10% w/v sodium hydroxide), adjust pH to 8.5. Dilute to 1L with DDW.
        i. Because ACS grade ammonium chloride may contain nitrate contamination, an alternative to the buffer stock is as follows: Under a fume hood, carefully add 210mL concentrated hydrochloric acid, 164mL concentrated ammonium hydroxide and 1.2g ethylenediaminetetraacetic acid to about 500mL DDW. Adjust pH to 8.5 with concentrated ammonium hydroxide. Dilute to 1L with DDW.

f. Working buffer: Add 0.25mL of Triton X-100 solution to 100mL of ammonium chloride buffer and mix.
g. Sulfanilamide-NEDD reagent: To about 300mL of DDW, carefully add 10mL of concentrated phosphoric acid. To that add 7.5g sulfanilamide and 0.375g N-(1-naphthyl)-ethylenediamine dihydrochloride and dissolve. Before adding ammonium chloride buffer, test a small volume to make sure the solution does not turn pink. Add 156mL of buffer if test batch does not turn pink. Fill volume to 500mL with DDW. Store for 1 month at 4°C unless a pink color develops. Filter the reagent at time of use for best results.

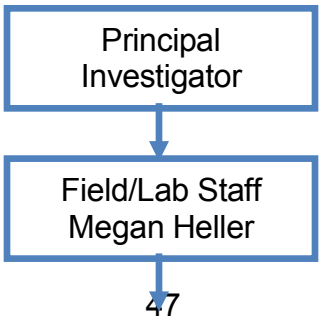
6. Procedure
   a. Preparation of Glassware
      i. All glassware should first be rinsed in the dilute HCl solution, and then rinsed with DDW. Glassware may be soaked overnight in a 50% HCl bath
      ii. Prepped equipment will be stored in an area where it will not be contaminated and should only be used for nutrient analysis
   b. Standard Preparation
      i. To prepare standard stock solutions:
         1. NITRATE-Stock Nitrate-N standard solution: Dry a sample of sodium nitrate at 105oC for at least 2 hours. Cool in desiccator. In about 350mL of DDW, dissolve 1.517g sodium nitrate. Bring to 500mL volume with DDW. This will yield 500mg NO_3-N/L.
         2. NITRITE-Stock Nitrite-N standard solution: Dry a sample of sodium nitrite in a desiccator for at least 4 hours. In about 800mL DDW dissolve 2.463g sodium nitrite. Bring to 1L volume. This solution can be stored in a dark bottle at 4°C. This will yield 500mg NO_2-N/L.
      ii. Intermediate standard solutions (ISS):
         1. NITRATE-Intermediate Nitrate-N stock standard solution: Dilute 3mL of Nitrate-N stock solution to 100mL volume with DDW. Store at 4°C and remake solution every 2 weeks. This will yield 15mg NO_3-N/L.
         2. NITRITE-Intermediate Nitrite-N stock standard solution: Dilute 3mL of Nitrite-N stock solution to 100mL volume with DDW. Remake this solution twice per week if needed that often. Otherwise, make fresh solution each time samples are run. This will yield 15mg NO_2-N/L.
      iii. Working standard solutions:
         1. The SEAL machine will dilute the ISSs to the appropriate concentrations to create a standard curve.
   c. Sample Preparation

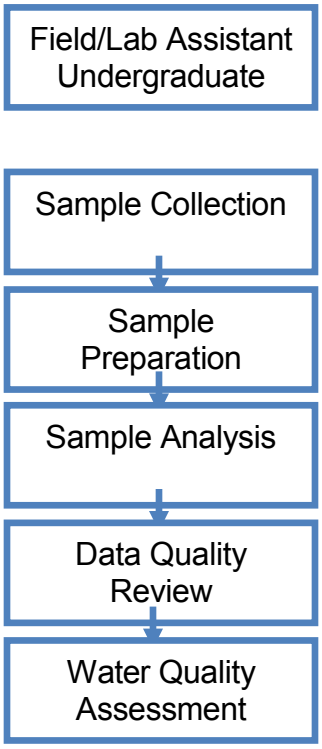
        i. If frozen, allow samples to completely thaw and gently invert to mix
        ii. Samples will be filtered through a glass fiber syringe filter
        iii. Place an amount of sample into a labeled reaction cup
    d. Analysis
        i. Place standards and samples in the autosampler tray
        ii. Set up the machine to run according to training.
7. Interpretation
    a. Data generated by the machine is in the format of mg N/L based on the standard curve.
8. Quality Control
    a. Blanks containing DDW will be run with every set of samples run on the machine.
9. References
    a. SEAL Analytical, Nitrate-N + Nitrite-N in Drinking and Surface Waters, and Domestic and Industrial Wastes, 2006.

Appendix F: Total Phosphorus Standard Operating Procedure

This method is modified from SEAL Analytical, Phosphorus-P, Total, in Drinking, Saline and Surface Waters, and Domestic and Industrial Wastes.

1. Scope and Application, Matrix
    b. This method may be used to determine the amount of total phosphorus in samples.
    c. This method may be used for drinking, surface and saline water, and industrial and domestic wastes
    d. This method may be performed in a laboratory setting.
2. Summary of Method, Detection Limit
    a. Forms of phosphorus are converted to orthophosphate by acid-persulfate digestion. Ammonium molybdate and antimony potassium tartrate react with orthophosphate to form an antimony phopho-molybdate complex. Ascorbic acid reduces this complex from which absorbance at 880nm is read. Detection limit for this method is 0.002mg P/L.
3. Comments
    a. Training will be provided by a technician experienced with using the SEAL Analytical machine.
    b. Samples should be filtered before analysis to remove turbidity.
    c. Samples should be run as soon as possible after collection.
    d. If it is not possible to run samples after collection samples should be kept at 4°C for up to 28 days or frozen for up to 6 months.
    e. Water sample are collected according to a suitable method capable of meeting or exceeding the performance requirements of this test method. A log will be maintained in the laboratory to keep track of all samples.
    f. Both electronic data if applicable and hardcopy data are accurately and continuously maintained, so all data fields are occupied. All data are readily available and saved for a minimum of 2 years. Electronic data are stored on a secure Purdue University hard drive. Hardcopy data are stored in the Purdue Agronomy Soil Microbiology Laboratory.
    g. Roles and Personnel





h. Process

4. Equipment and Materials
    a. Laboratory bench sheets and/or electronic equivalent
    b. Analytical balance
    c. Properly prepared glassware
    d. SEAL Analytical machine
    e. Filters
5. Reagents
    a. Deionized Distilled Water (DDW)
    b. Potassium dihydrogen orthophosphate (KH_2PO_4)
    c. Dilute hydrochloric acid solution: 90 parts water with 10 parts HCl
    d. Stock molybdate reagent-ammonium molybdate 4%: Dissolve 4g ammonium molybdate tetrahydrate in 100mL DDW by stirring at least 2 hours. Store solution in a plastic bottle at 4°C. If solution turns turbid or blue then throw out.
    e. Sulfuric acid 5N: Slowly add 70mL sulfuric acid to 400mL of DDW. Let cool and bring to 500mL volume
    f. Antimony potassium tartrate (Sb-K-tartrate): Dissolve 1.5g antimony potassium tartrate in 400mL DDW. Dilute to 500mL volume once dissolved. Store in an amber bottle at 4°C. Solution will keep for 1 month.
    g. Ascorbic acid: Dissolve 4g ascorbic acid in 100mL of DDW. Will keep for 1 week at 4°C. If the solution turns yellow, throw out.
    h. Working phosphate color reagent: In the orders given, add 40mL of 5N sulfuric acid, 20mL of 4% ammonium molybdate and swirl to

mix. Add 6mL of antimony potassium tartrate stock and swirl to mix. Fill to 100mL volume with DDW and mix. This solution can be stored for 2-3 weeks in a plastic bottle. If solution turns blue or turbid, discard.

i. Alkaline EDTA rinse: Dissolve 5g disodium EDTA dihydrate (Na_2EDTA) and 10g sodium hydroxide in 500mL DDW.

j. 11N sulfuric acid solution: Slowly add 155mL concentrated sulfuric acid to 300mL DDW. Once cool, dilute to 500mL.

k. Ammonia persulfate

6. Procedure

a. Preparation of Glassware

i. All glassware should first be rinsed in the dilute HCl solution, and then rinsed with DDW. Glassware may be soaked overnight in a 50% HCl bath.

ii. Prepped equipment will be stored in an area where it will not be contaminated and should only be used for nutrient analysis

b. Standard Preparation

i. To prepare standard stock solution:

1. Dry an amount of KH_2PO_4 at 105^oC and cool in a desiccator.
2. Weigh 2.197g of KH_2PO_4 into a 500mL volumetric flask. Bring to volume with DDW. This will give the solution 1000 mg/L Phosphorous.
3. This solution may be stored at 4^oC.

ii. To prepare Intermediate Standard Solution (ISS):

1. Add 1mL of standard stock solution to a 1L flask and bring to volume with DDW. This will yield 1.0mg P/L.
2. Digest this standard as stated below

iii. The SEAL will dilute the ISS to appropriate concentrations to make the standard curve.

c. Sample Preparation

i. Samples will be filtered through a glass fiber syringe filter

ii. For Phosphorus

1. Add 0.2mL of sulfuric acid solution to a 10mL sample
2. Add 0.08g ammonia persulfate to each sample
3. Steam autoclave samples for 30 minutes at 15psi.
4. Filter if sample is not clean
7. Run sample on SEAL

i. For Orthophosphate

1. Place an amount of sample into a labeled reaction cup
2. Run on seal

b. Analysis
    i. Place standards and samples in the autosampler tray
    ii. Set up the machine to run according to training.

8. Interpretation
    a. Data generated by the machine is in the format of mg P/L based on the standard curve.
9. Quality Control
    a. Blanks containing DDW will be run with every set of samples run on the machine.
10. References
    a. SEAL Analytical, Phosphorus-P, Total, in Drinking, Saline and Surface Waters, and Domestic and Industrial Wastes, 2005.
    b. O'Dell, J.W., 1993. "Determination of phosphorus by semi-automated colorimetry". EPA Method 365.1.

Appendix G: Hach Hydrolab Quanta Sonde Manual

YSI *incorporated*

6-Series
Multiparameter
Water Quality Sondes

User Manual

6-Series:
6600 V2
6600EDS V2
6920 V2
6820 V2
600 OMS V2
600XL
600XLM
600LS
600R
600QS

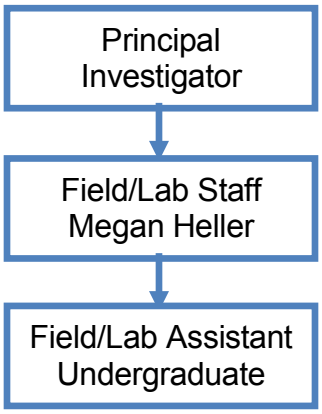
Appendix H: USFS Flow Monitoring Protocol

This method is modified from US Forest Service RM-242 Chapter 10.

1. Scope and Application, Matrix
    e. This method may be used to determine the discharge of a stream
    f. This method may be used for streams and rivers with a bridge
    g. This method may be performed in the field

11. Summary of Method, Detection Limit
    a. The stream cross section is divided up into verticals. Water velocity and depth is measured at each vertical. Measurements are used to calculate discharge

12. Comments
    a. Training will be provided by a technician experienced with this method
    b. Both electronic data if applicable and hardcopy data are accurately and continuously maintained, so all data fields are occupied. All data are readily available and saved for a minimum of 2 years. Electronic data are stored on a secure Purdue University hard drive. Hardcopy data are stored in the Purdue Agronomy Soil Microbiology Laboratory.
    c. Roles and Personnel



13. Equipment and Materials
    a. Sounding weights and reels
    b. Type AA current meter
    c. Digitizer
    d. Bridge board (if measuring from a bridge)

14. Reagents
    a. None needed

15. Procedure
    a. Equipment Assembly
        i. Place the adjustable foot on the bridge and extend out past the bridge rail. (You may use the roller that attaches to the

bottom of the bridge board so that it can be easily rolled along the bridge railing).

ii. Attach the removable handle to the sounding reel. Place the sounding reel on the mounting plate of bridge board. The suspension cable can be stretched out over the sheave at the end of 4 foot long boom. (Note: don't lower the cable before attaching the current meter and sounding weight. Caution: Sounding Reel Drag Brake should be locked at this moment.

iii. Attach the digitizer by using a rod mount on the side of adjustable foot (Figure 1E). A two-wire electrical cord with standard connector socket is used to connect the digitizer and sounding reel.

iv. Assembly type AA Current Meter (Figure 1C):

v. Assemble the tail piece: Slide the horizontal fin into vertical fin flanges until the curved locking recess aligns beneath the tab curve.

vi. Insert the fin assembly fully into the AA Current Meter and tighten the fin set screw. Move the balance weight as needed to balance the current meter.

vii. Insert stainless steel hanger bars into the hole of the sounding weight and use pin to thread into the bar through the hole in the weight.

viii. Insert the other side of stainless steel hanger bar to the hanger screw hole and use pin to thread into bar through the middle hole in the current meter.

ix. Insert the end of the sounding reel cable to the end of stainless steel hanger's hole. The electrical connection of the sounding reel is connected to the contact chamber cap of the current meter.

x. Gently lift the current meter and sounding weight and place over the bridge. The current meter and sounding weight are then suspended from the cable and are in position to be lowered into water below. Unlock the sounding reel drag brake and lower them into water.

b. Discharge Measurements

i. Stretch the tape measure across the channel width. Anchor it in place using cable ties, as necessary. Determine the approximate spacing of the verticals to provide about 20 subsections. The verticals should be spaced so that no subsection has more than 10 percent (ideally 5 percent) of the total discharge. The do not need to be evenly spaced.

ii. Move the bridge board to the first section. Record the horizontal distance (x) from the right bank for each place where you measure velocity on Table 1.

iii. Measure the water depth, $\boldsymbol{d_i}$, at this point:

iv. Lower the sounding reel until the weight is just touching the surface of the water. Record the last three digits of the counter in Table 1 (surface reading D1); this gives distance in 100ths of meters (i.e. 746 indicates 7.46 m).

v. Continue to lower the sounding weight until you can feel it hit the bottom of the river. Record the last three digits of the counter on Table 1 (bottom reading D2).

vi. The total depth $\boldsymbol{d_i}$ (meters) is (bottom reading (D2) – surface reading (D1))/100.

vii. Measure velocity at 0.2* $\boldsymbol{d_i}$ and 0.8* $\boldsymbol{d_i}$ and record on Table 2 the velocity reported by the current meter, $\boldsymbol{v_i}$. Follow the instruction for using the digitizer to measure velocity.

viii. Multiply the depth ($\boldsymbol{d_i}$)*.2 and subtract this from the bottom reading. This is the location of the first velocity reading ($\mathbf{v_{i,0.8}}$).

ix. Take the upper velocity reading. Multiply the depth ($\boldsymbol{d_i}$)*.6 and subtract this from the current reading $\boldsymbol{d_{i,.8}}$. This is the location of the second velocity reading ($\mathbf{v_{i,0.2}}$).

c. How to use the digitizer

i. Press the ON/SELECT button to turn on.

ii. Press ON/SELECT button to cycle through the type of meter used; choose “1-2: AA current meter/metric measurement”

iii. Press COUNT/STOP button to confirm your selection. From here, the selection will focus on the time settings.

iv. Press ON/SELECT button to cycle through the amount of time desired for counting. Use 40 seconds.

v. Press the COUNT/STOP to begin the counting process.

vi. When the timer has reached the timer limit, it will continue timing until the final signal is received.

vii. Press COUNT/STOP button to calculate and display VELOCITY.

16. Interpretation

a. Calculate the width of each section: $w_i = \left(x_{i+1} - x_{i-1}\right)/2$

b. Section average velocity: $v_i = \left(v_{i,0.2} + v_{i,0.8}\right)/2$

c. Calculate the discharge through section i: $q_i = \overline{v}_i \cdot d_i \cdot w_i$

d. Calculate stream discharge: $Q = \sum_{i=1}^{10} q_i$

17. Quality Control

18. References

a. Bowling, L. 2012. Environmental Hydrology Laboratory Manual. Purdue University.

b. Harrelson, Cheryl C; Rawlins, C. L.; Potyondy, John P. 1994. Stream channel reference sites: an illustrated guide to field

echnique. Chapter 10: Measuring Discharges. Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.