Creek. These SWWFs also represent important stakeholders in the protection and management of Big Walnut Creek.

5.0 WATER QUALITY ASSESSMENTS – EXISTING AND CURRENT

5.1 IDEM Data

A request was submitted to IDEM requesting both chemical and biological data that has been collected on the Big Walnut and Deer Creek Watersheds. Data was received from IDEM dating from 2002 to 2006. These sites were monitored on regular basis, but the frequency at which the site was monitored varies from site to site. Chemical and metal data was collected at four sites, fish data was collected at eight sites, and macroinvertebrate data at fifteen sites (Figure S). IDEM's Site 1 for chemical and metal data shows consistently high concentrations of nitrate. Site 1 also had high sediment concentrations. Site 1 is present in Subwatershed E. IDEM's Sites 3 and 4 for the chemical and metal data are the only sites reporting *E. coli* data from the collected data that we received from IDEM. These two sites were only sampled for *E. coli* during June of 2006 and show high *E. coli* concentrations. Site 3 is in Subwatershed D and Site 4 is in Subwatershed W. As noted in Section 4.1, twenty-nine segments of stream within the Big Walnut Watershed are listed for impairments according to the 303d list. Obviously, additional data was collected by IDEM to arrive at these listings; however, it was not made available to authors of this report as part of the data request.

5.2 Hoosier Riverwatch Data

Hoosier Riverwatch is a volunteer program run through IDNR Division of Fish and Wildlife. The purpose of the program is to increase public awareness of water quality throughout the State of Indiana by training volunteers to monitor the quality of local stream's water.

There has been little data regularly collected for the Big Walnut Creek Watershed (Eel 8-digit HUC). Available data dates from 2000 to 2007 and includes chemical, biological, habitat, and stream flow data. This data can be referenced in Table 7.

5.3 Current Data

Water quality monitoring was conducted within the watershed to identify nonpoint source pollution and critical areas. The sampling site locations covered the three primary counties, Boone, Hendricks, and Putnam. A number of these monitoring locations were located along streams segments that been identified as impaired. IDEM also conducted E. coli monitoring during five events (weekly) in October, 2007. Sample locations for monitoring associated with this plan, as well as IDEM's additional *E. coli* monitoring are shown on Figure T.

Current water quality monitoring conducted as part of this project consisted of chemical and macroinvertebrate sampling. Chemical sampling was conducted quarterly, beginning in May 2007 and macroinvertebrate sampling began in April 2007. Twenty-four sites within the watershed were sampled a total of six times for chemical parameters and twice for biological parameters. The water quality criteria analyzed included dissolved oxygen, biochemical oxygen demand, pH, total phosphate, nitrates, flow, total suspended solids, and *E. coli*. Collected samples of *E. coli* were cultured in the Commonwealth Biomonitoring laboratory for analysis.

Results of each water quality criteria sampled are displayed in Subsections 5.3.2 to 5.3.7 in Table format. The tables allow side by side comparison of a single criterion/parameter across all six sampling events. Several pollutants are shown as loads, rather than concentrations. This allows for a more accurate comparison of relative impacts in each subwatershed since flow is accounted for. Raw concentration data is included in Appendix E.

Loads for the pollutants were calculated as both an individual site average and as an overall watershed average. Averages were calculated using the first five samples. The sixth sample was not included as it was a part of the major storms that occurred in June and the data would skew the numbers. The average watershed nitrate load is 2162.03 tons/year. The average watershed total phosphorus load is 49.87 tons/year. The average watershed total suspended solids load is 3780.28 tons/year. The watershed average biochemical oxygen demand load is 3.24 tons/year.

E.coli averages were calculated as well, but not on a load basis. *E.coli* counts for the watershed average below the State single grab sample standard of 235 cfu/100mL at 212 cfu/100mL. This average is based upon the data collected for the project and not the data collected by IDEM for TMDL sampling. Even though the average is below the State standard many of the segments within the Big Walnut Creek Watershed are still impaired.

Monitoring of macroinvertebrates was performed twice (spring and fall) at all twenty-four sites within the watershed. The collected samples were analyzed using the State of Indiana's macroinvertebrate Index of Biotic Integrity (mIBI). A habitat assessment was also conducted at each site using the Qualitative Habitat Evaluation Index (QHEI) method set forth by the Ohio EPA. QHEI scores were used to aid in interpreting the mIBI scores.

Aquatic macroinvertebrates samples were collected using a dip net in riffle areas where the water current was 30cm/sec. Once samples were obtained they were preserved in the field with 70% isopropanol. A subsample of 100 organisms was prepared from each site by evenly distributing the organisms among randomly selected grids until 100 organisms had been selected from the entire sample. Each organism was then identified to the lowest possible taxon, typically genus or species. The results of the macroinvertebrate study were then analyzed by calculating metrics based on information about sensitivity of individual species to changes in environmental conditions.

A Quality Assurance Project Plan (QAPP) was developed and submitted to the State on April 2, 2007 and approved by IDEM on May 3, 2007 before monitoring activities began. Monitoring followed guidelines set forth in the approved QAPP.

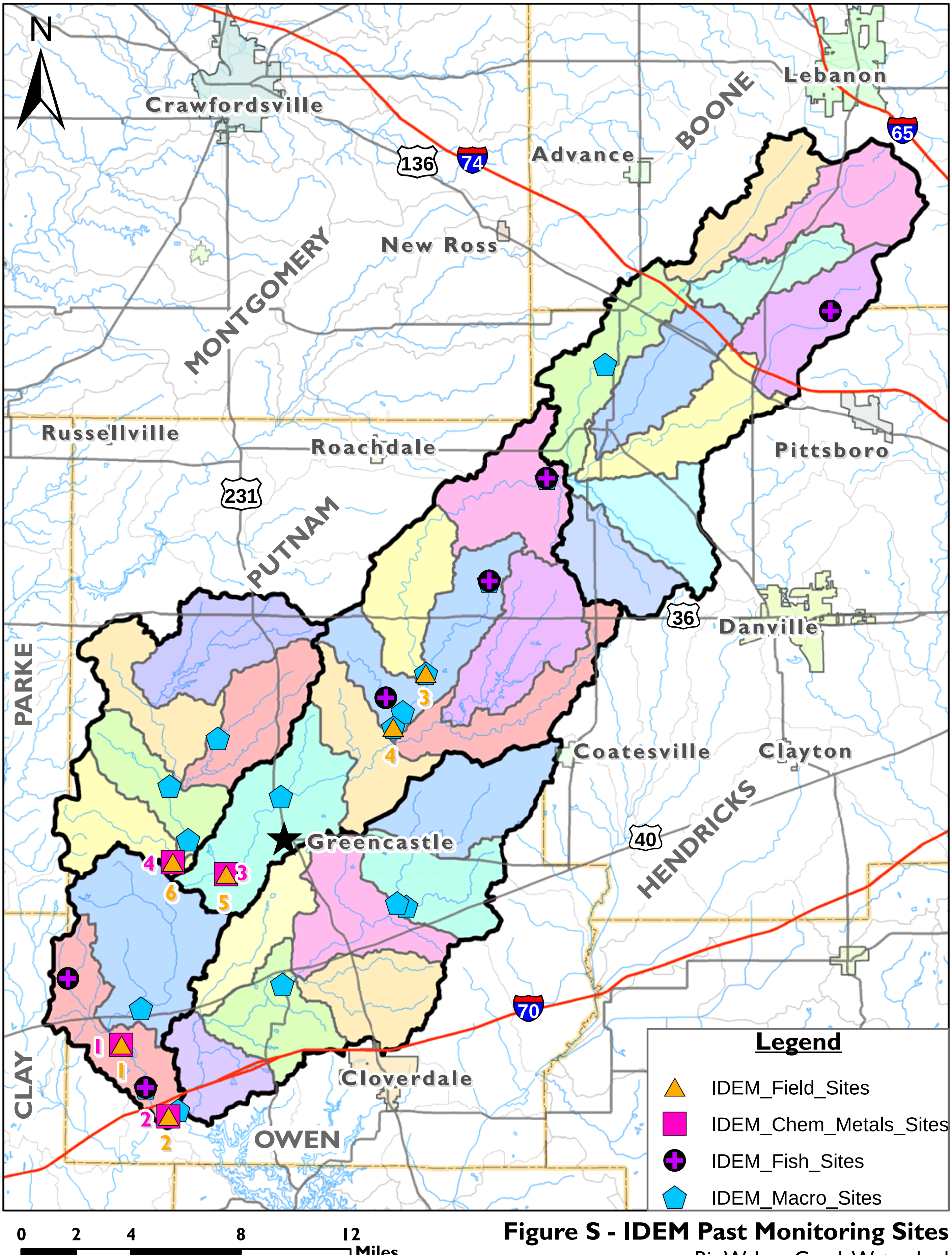

Figure S - IDEM Past Monitoring Sites

Big Walnut Creek Watershed

Boone, Clay, Hendricks, Parke, & Putnam Counties, Indiana

Table 7: Hoosier Riverwatch Data

Advanced Chemical Data

Site ID	Time	Date	Weather	Past Weather	Water Quality Score	DO (ppm)	DO (%Saturation)	pH	BOD 5(mg/L)	Temp Change (c)	Total Phosphate (mg/L)	Nitrate NO3 (mg/l)	Turbidity(NTU)	EColi
118	9:30AM	9/14/2000	Clear/Sunny	Clear/Sunny	73.55	11.5	110	8.57	2	-0.1	0.78	5.03	38	
118	9:15 AM	8/30/2001	Clear/Sunny	Clear/Sunny	80.31	8.33	92	8	1	0	0.65	2.75	42	
120	12:30p.m.	10/11/2000	Clear/Sunny	Clear/Sunny	76	12.5	98	7.83	2.5	0.52	0.6	4.05	58.33	
120	9:25	2/14/2002	Clear/Sunny	Clear/Sunny	76.08	14.67	101.33	8	5	0	0.57	2.83	57	
120	9:30am	9/2/2005	Clear/Sunny	Clear/Sunny	NA	9.87	102	8.33	1.67				28.01	
210	9:30 AM	4/5/2001	Clear/Sunny	Clear/Sunny	74.01	11	96	8	2.7	-0.5	0.68	6.5	60	
210	9:30 AM	9/10/2003	Clear/Sunny	Clear/Sunny	NA	8.6		7.87	4.67	0.2	0		44.33	
211	12:45 PM	4/5/2001	Clear/Sunny	Clear/Sunny	69.54	12.67	124.67	8	3	0.3	0.8	9.5	60	
417	9:30 AM	9/11/2004	Clear/Sunny	Clear/Sunny	NA	8	86	8		1		0	10	
696	10:30am	9/25/2004	Clear/Sunny	Clear/Sunny	62.9	4	42	6	4	-2	0	2	0	200
818	5:45 PM	8/31/2004	Clear/Sunny	Clear/Sunny	NA	0	90	9		-2		4.4	61	
889	1:00 PM	1/10/2004	Overcast	Clear/Sunny	NA	19	135	8.2		2			15.01	
889	9:00 AM	4/28/2006	Clear/Sunny	Overcast	N/A	10	85	6.5		1		22	15.01	
889	1:00 PM	9/17/2006	Overcast	Clear/Sunny	N/A	9.67	105		5.5	-0.5		8.8	15.01	
889	9:30 AM	5/4/2007	Overcast	Overcast	77.44	8.67	85	8.33	4.5	0		5.13	15.01	
1046	4:00 PM	5/29/2006	Clear/Sunny	Clear/Sunny	77.42	7	85	8.67	0	0		22	15.01	
1046	12:00 PM	9/16/2006	Clear/Sunny	Stormy	N/A	8	81		1	0		22	15.01	
1046	3:25 PM	3/27/2007	Clear/Sunny	Overcast	84.04	9	95	8	0	0		8.8	15.01	
1046	123:00 PM	5/31/2007	Overcast	Overcast	N/A	8	100	9				13.2	15.01	

Stream Flow Data

Site ID	Time	Date	Weather	Past Weather	Ave Depth(ft)	Ave Width(ft)	Ave Velocity (ft/sec)	n value	Discharge (cfs)
120	9:25am	2/14/2002	Clear/Sunny	Clear/Sunny	0.87	29.08	0.88	0.8	17.81
118	9:30	8/29/2002	Clear/Sunny	Clear/Sunny	0.89	24.33	2.73	0.9	53.2
696	7:00pm	10/22/2003	Clear/Sunny	Clear/Sunny	1.35	67.4	0.61	0.8	44.4
696	5:30pm	1/1/2003	Clear/Sunny	Clear/Sunny	1.31	70	0.6	0.8	44.02
696	10:00am	4/14/2004	Clear/Sunny	Overcast	1.68	64.48	1.18	0.8	102.26
818	5:45 PM	8/31/2004	Clear/Sunny	Clear/Sunny	0.92	7.5	0.2	0.9	1.24
696	10:30am	9/25/2004	Clear/Sunny	Clear/Sunny	1.08	57.67	0.44	0.8	21.92
889	1:00 PM	1/10/2004	Overcast	Clear/Sunny	0.8	42.67	0.95	0.9	29.19
120	9:30am	9/2/2005	Clear/Sunny	Clear/Sunny	1.18	33.37	0.56	0.8	17.64
889	9:00 AM	4/28/2006	Clear/Sunny	Overcast	1.31	68.33	1.82	0.8	130.33
1046	4:00 PM	5/29/2006	Clear/Sunny	Clear/Sunny	0.36	13.17	0.5	0.8	1.9
1046	12:00 PM	9/16/2006	Clear/Sunny	Stormy	0.23	5	0.22	0.8	0.2
1046	3:25 PM	3/27/2007	Clear/Sunny	Overcast	0.45	15.77	1.45	0.8	8.23
889	9:30 AM	5/4/2007	Overcast	Overcast	1.34	75.83	0.87	0.9	79.56
889	1:00 PM	9/17/2006	Overcast	Clear/Sunny	0.69	53.67	1.62	0.8	47.99

Table 7: Hoosier Riverwatch Data (cont)

Biological Data															
Site ID	Time	Date	Weather	Past Weather	Pollution Tollerance Score	Stonefly Larvae	Mayfly Larvae	Caddis Fly Larve	Dobsonfly Larvae	Riffle Beetle	Water Penny	Right handed Snail	Damsel Fly Nymph	Dragonfly Nymph	Sowbug
118	9:30 AM	9/14/2000	Clear/Sunny	Clear/Sunny	23		12	20		3		1		1	
118	9:15	8/30/2001	Clear/Sunny	Clear/Sunny	29		77	71	3	2				3	
118	12:30pm	8/29/2002	Clear/Sunny	Clear/Sunny	24		20	3		2			3	2	
120	12:30	10/11/2000	Clear/Sunny	Clear/Sunny	29		38	17		14		1	13	1	
120	09:25am	2/14/2002	Clear/Sunny	Clear/Sunny	18	4	22	17							
120	9:30am	9/2/2005	Clear/Sunny	Clear/Sunny	26		23	13		5	10		8	1	
210	9:30 AM	4/5/2001	Clear/Sunny	Clear/Sunny	30		25	31	8				1	2	4
210	9:30	9/10/2003	Clear/Sunny	Clear/Sunny	39	5	20	1	2	11		1	2	2	
211	12:45 PM	4/5/2001	Clear/Sunny	Clear/Sunny	29		20	12	1	3				1	
364	9:30	9/27/2001	Clear/Sunny	Clear/Sunny	23		108	84	9	1			2		
417	11:00 AM	6/30/2003	Clear/Sunny	Clear/Sunny	20		5		1		8	4			
696	7:00pm	10/22/2003	Clear/Sunny	Clear/Sunny	30		6	5		7	3	1	3	2	
696	10:00am	4/14/2004	Clear/Sunny	Overcast	26	5	4	2			2				
696	10:30am	9/25/2004	Clear/Sunny	Clear/Sunny	25		1	1			1	1			
818	5:45 PM	8/31/2004	Clear/Sunny	Clear/Sunny	18		2	1					3		
889	1:00 PM	10/21/2004	Overcast	Clear/Sunny	13		16	12					1		
889	9:00 AM	4/28/2006	Clear/Sunny	Overcast	27	1	78	44	3				2		
889	1:00 PM	9/17/2006	Overcast	Clear/Sunny	17	10	10	15							
889	9:30 AM	5/4/2007	Overcast	Overcast	30	31	33	3		2					
1046	4:00 PM	5/29/2006	Clear/Sunny	Clear/Sunny	24			8		1	5	20			
1046	12:00 PM	9/16/2006	Clear/Sunny	Stormy	20		5	8			5	several			
1046	123:00 PM	5/31/2007	Overcast	Overcast	17			10			2	5			
1046	3:25 PM	3/27/2007	Clear/Sunny	Overcast	25		1	15			11	20			5

Table 7: Hoosier Riverwatch Data (cont)

Habitat Data											
Site ID	Time	Date	Weather	Past Weather	I	II	III	IV	V	VI	CQHEI
118	9:30 AM	9/14/2000	Clear/Sunny	Clear/Sunny	15	8	15	9	12	10	69
120	12:30 p.m	10/11/2000	Clear/Sunny	Clear/Sunny	20	12	15	17	12	10	86
210	9:30 AM	4/5/2001	Clear/Sunny	Clear/Sunny	19	12	9	10	7	13	70
211	12:45 PM	4/5/2001	Clear/Sunny	Clear/Sunny	15	10	12	12	11	10	70
118	9:15am	8/30/2001	Clear/Sunny	Clear/Sunny	10	10	15	8	12	10	65
120	9:25	2/14/2002	Clear/Sunny	Clear/Sunny	15	14	12	12	12	13	78
364	9:30	9/27/2001	Clear/Sunny	Clear/Sunny	15	16	12	10	14	10	77
118	9:30 a.m.	8/29/2002	Clear/Sunny	Clear/Sunny	15	16	12	8	11	10	72
417	11:00 AM	6/30/2003	Clear/Sunny	Clear/Sunny	20	14	18	19	7	9	87
211	9:30	9/10/2003	Clear/Sunny	Clear/Sunny	24	6	12	12.5	11	12	77.5
696	7:00pm	10/23/2003	Clear/Sunny	Clear/Sunny	15	16	18	15	5	12	81
696	5:30pm	1/23/2004	Clear/Sunny	Clear/Sunny	15	16	15	17	10	10	83
696	10:00am	4/14/2004	Clear/Sunny	Overcast	15	18	15	14	12	15	89
818	5:45 PM	8/31/2004	Clear/Sunny	Clear/Sunny	0	10	14	14	9	6	53
696	10:30am	9/25/2004	Clear/Sunny	Clear/Sunny	15	18	15	14	8	11	81
818	2:30 PM	11/1/2004	Clear/Sunny	Clear/Sunny	0	8	8	14	7	6	43
120	9:30am	9/2/2005	Clear/Sunny	Clear/Sunny	20	10	15	16	13	10	84
889	9:00 AM	4/28/2006	Clear/Sunny	Overcast	17	14	16.5	17	9	11.5	85
1046	4:00 PM	5/29/2006	Clear/Sunny	Clear/Sunny	17	16	20	16.5	9	13	91.5
1046	3:25 PM	3/27/2007	Clear/Sunny	Overcast	13	16	20	14.5	10	10.5	84

Site ID	**Description**
118	Big Walnut Creek - Down stream of Houck Covered Bridge
120	Deer Creek - CR 375S bridge
210	Deweese Branch - Confluence with Deer Creek
211	Big Walnut Creek - Wildwood Bridge
364	Big Walnut Creek - Crowes Bridge
417	Deweese Branch - Limestone bottom creek flowing through wooded area with limestone outcroppings
696	Big Walnut Creek - McCloud Nature Park
818	Unnamed Tributary to Ramp Run - West CR 350N, Danville
889	Big Walnut Creek - Between Pine Bluff and Rolling Stone Covered Bridges
1046	Unnamed Tributary to Big Wanut Creek - Tributary to West Fork Big Walnut Creek

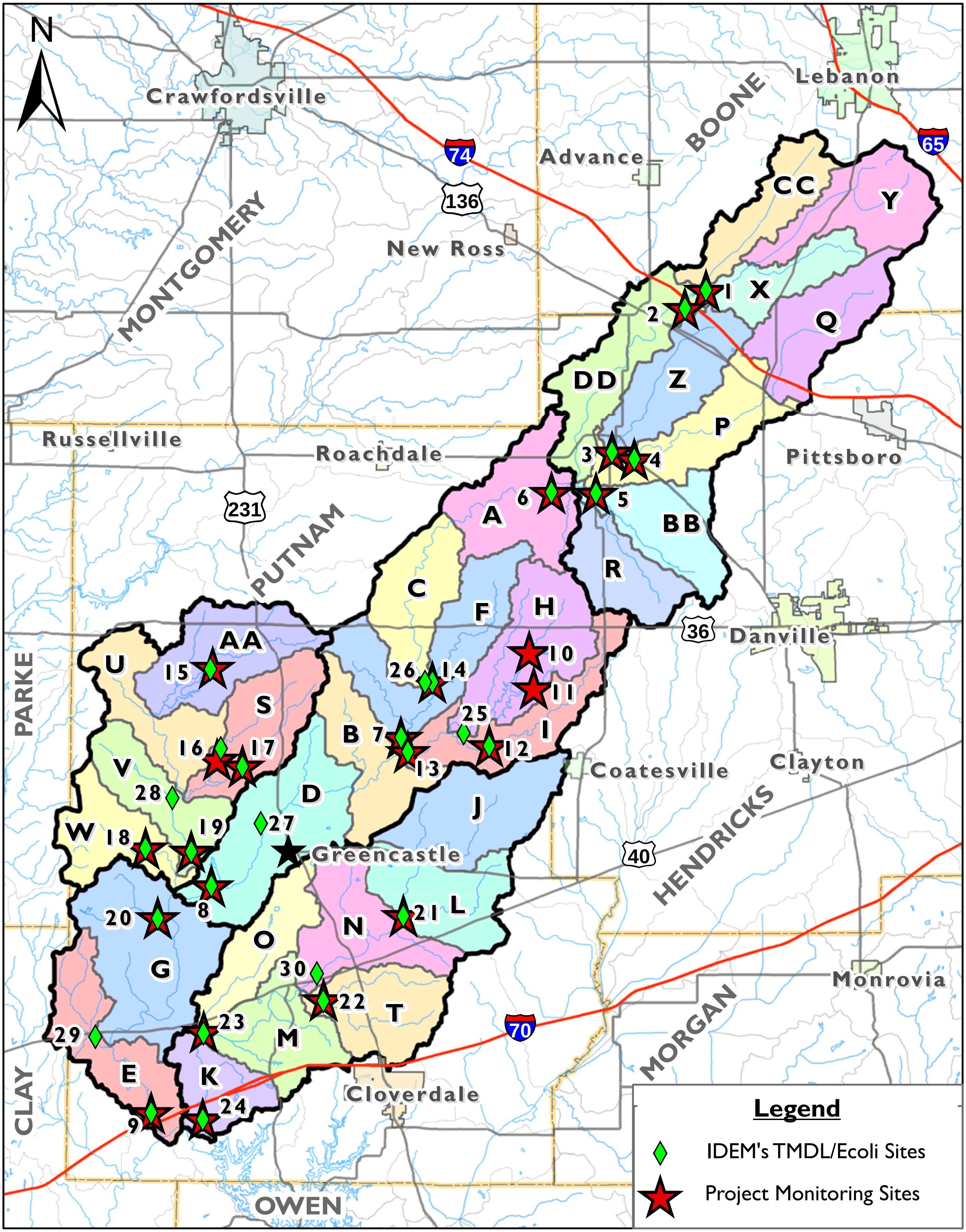

Figure T - Watershed Sampling Sites

Big Walnut Creek Watershed

Boone, Clay, Hendricks, Parke, & Putnam Counties, Indiana

5.3.1 Flow Measurements

Flow data were gathered from the USGS Gauge at Roachdale along Big Walnut Creek. Flow at this site is for a drainage area of 131 square miles. Flow at all other sites was extrapolated as a proportion of this flow. For example, if a sampling site has a drainage area of 13 square miles, the flow is ten percent of the flow at Roachdale. Changes in storm flows relative to base flow data can also demonstrate the 'flashiness' of the stream (i.e. its response to run-off events). Table 8 displays flow data for each sample site at each sample event.

Table 8: Flow Data

Flow Data (cfs) Flow data is calculated from USGS Roachdale Gauge						
	5/29/07	**7/11/07**	**8/28/07**	**1/8/08**	**4/10/08**	**6/4/08***
	Storm	Base	Base	Storm	Base	Storm
USGS Gauge Flow	42	8.5	6.5	35	100	7000
Site 1 - Watershed X, Y	7.1	1.4	1.1	6.0	17.0	1190.0
Site 2 - Watershed CC	3.4	0.7	0.5	2.8	8.0	560.0
Site 3 - Watershed Z	4.6	0.9	0.7	3.9	11.0	770.0
Site 4 - Watershed P, Q	8.0	1.6	1.2	6.7	19.0	1330.0
Site 5 - Watershed BB, R	7.6	1.5	1.2	6.3	18.0	1260.0
Site 6 - Watershed DD	38.2	7.7	5.9	31.9	91.0	6370.0
Site 7 - Watersheds A, C, F	46.6	9.4	7.2	38.9	111.0	7770.0
Site 8 - Watershed B, D	72.2	14.6	11.2	60.2	172.0	12040.0
Site 9 - Watershed E, G	107.5	21.8	16.6	89.6	256.0	17920.0
Site 10 - Watershed H	2.9	0.6	0.5	2.5	7.0	490.0
Site 11 - Watershed H	1.7	0.3	0.0	1.4	4.0	280.0
Site 12 - Watershed I	3.4	0.7	0.5	2.8	8.0	560.0
Site 13 - Watershed I	9.7	2.0	1.5	8.1	23.0	1610.0
Site 14 - Watershed F	3.4	0.7	0.5	2.8	8.0	560.0
Site 15 - Watershed AA	4.6	0.9	0.7	3.9	11.0	770.0
Site 16 - Watershed S	2.1	0.4	0.3	1.8	5.0	350.0
Site 17 - Watershed S	2.1	0.4	0.0	1.8	5.0	350.0
Site 18 - Watershed W	2.9	0.6	0.5	2.5	7.0	490.0
Site 19 - Watershed U, V	15.5	3.1	2.4	13.0	37.0	2590.0
Site 20 - Watershed G	2.5	0.5	0.4	2.1	6.0	420.0
Site 21 - Watershed L, J	6.7	1.4	1.0	5.6	16.0	1120.0
Site 22 - Watershed T	3.8	0.8	0.6	3.2	9.0	630.0
Site 23 - Watershed O	3.4	0.7	0.5	2.8	8.0	560.0
Site 24 - Watershed K, M, N	27.3	5.5	4.2	22.8	65.0	4550.0

*Approximately 1.5 inches of rain was received June 3-June 4, representing an above average storm event sampling.

5.3.2 Dissolved Oxygen (DO)

Dissolved oxygen is a measure of the amount of oxygen available in the water for fish, macroinvertebrates and other wildlife. When excessive nutrients from sources such as fertilizers and wastewaters enter the water, plants and algae will flourish. When excess aquatic plants and algae begin to decay or die they remove a significant amount of oxygen from the water which can often cause a fish kill or degraded conditions for other wildlife. Low DO levels often signal non-point source pollution problems. There are several factors that influence dissolved oxygen levels. They include: temperature, plant growth and photosynthesis, and amount of decaying organic matter.

Sites that displayed DO levels at or below the State water quality standard of 5 mg/L during each sampling event were highlighted to assist in the identification of consistent water quality concerns and the development of critical areas and watershed "hotspots."

Table 9: Dissolved Oxygen

Dissolved Oxygen (DO) mg/L						
	5/29/07	**7/11/07**	**8/28/07**	**1/8/08**	**4/10/08**	**6/4/08**
	Storm	Base	Base	Storm	Base	Storm
Site 1 - Watershed X, Y	8.1	7.3	6.7	9.5	10.5	7.0
Site 2 - Watershed CC	12	6.3	5.0	10.5	10.6	6.7
Site 3 - Watershed Z	9.1	8.4	9.4	10.5	11.9	7.8
Site 4 - Watershed P, Q	9.1	7.5	8.0	9.6	11.6	6.8
Site 5 - Watershed BB, R	8.6	5.7	6.4	10.0	10.5	8.0
Site 6 - Watershed DD	9.0	8.2	8.4	10.0	10.9	7.9
Site 7 - Watersheds A, C, F	8.7	6.8	7.0	9.8	10.6	8.0
Site 8 - Watershed B, D	11.1	8.6	7.8	12.4	11.9	8.1
Site 9 - Watershed E, G	9.7	8.1	8.2	12.8	11.7	9.7
Site 10 - Watershed H	6.7	7.8	7.5	9.8	10.7	8.2
Site 11 - Watershed H	8.1	5.0	3.6	9.9	10.2	8.1
Site 12 - Watershed I	8.9	4.2	4.4	8.1	10.5	8.2
Site 13 - Watershed I	8.0	8.4	4.7	9.4	10.2	7.9
Site 14 - Watershed F	10.6	8.2	7.3	9.8	10.5	8.4
Site 15 - Watershed AA	9.8	6.2	6.6	11.2	13.1	12.4
Site 16 - Watershed S	10.1	7.7	6.7	12.5	13.4	15.2
Site 17 - Watershed S	8.7	6.7	3.3	12.6	13.9	14.8
Site 18 - Watershed W	9.8	7.4	6.5	13.1	13.7	8.7
Site 19 - Watershed U, V	11.3	8.5	7.0	11.7	12.7	14.2
Site 20 - Watershed G	8.9	7.6	8.1	12.7	13.6	7.8
Site 21 - Watershed L, J	10.1	6.4	6.8	12.2	13.1	9.4
Site 22 - Watershed T	9	8.1	6.8	14.2	12.5	10.2
Site 23 - Watershed O	10.2	6.7	6.8	12.2	12.0	9.2
Site 24 - Watershed K, M, N	8.6	6.1	7.3	13.1	11.6	9.3

Percent saturation is the result of comparing the level of dissolved oxygen present in water to the total amount of dissolved oxygen that water is able to hold at a given temperature and pressure. Sites that displayed percent saturation values lower than 70% were highlighted to assist in identification of sites experiencing conditions stressful to aquatic life. Sites with percent saturation values higher than 115% were highlighted to assist in identification of sites likely experiencing algal bloom, as indicator of nutrient enrichment.

Table 10: Percent Saturation

Percent Saturation						
	5/29/07	**7/11/07**	**8/28/07**	**1/8/08**	**4/10/08**	**6/4/08**
	Storm	Base	Base	Storm	Base	Storm
Site 1 - Watershed X, Y	94.2	86.9	82.7	94.1	100.0	89.7
Site 2 - Watershed CC	148.2	73.3	61.7	104.0	98.2	82.7
Site 3 - Watershed Z	108.3	97.7	111.9	104.0	110.2	94.0
Site 4 - Watershed P, Q	105.8	89.3	85.2	93.2	104.4	84.0
Site 5 - Watershed BB, R	100.0	66.3	74.4	97.1	100.0	95.2
Site 6 - Watershed DD	104.7	98.8	101.2	99.0	101.0	94.1
Site 7 - Watersheds A, C, F	101.2	81.9	84.3	93.3	96.4	92.0
Site 8 - Watershed B, D	129.1	103.6	91.8	95.4	103.9	87.1
Site 9 - Watershed E, G	112.1	96.4	95.4	103.2	104.9	105.4
Site 10 - Watershed H	79.8	89.7	87.2	95.2	99.1	95.4
Site 11 - Watershed H	93.1	60.2	41.9	96.1	94.4	94.2
Site 12 - Watershed I	100.0	48.8	50.6	77.1	100.0	92.1
Site 13 - Watershed I	86.0	101.2	54.7	89.5	94.4	90.8
Site 14 - Watershed F	121.8	95.4	83.9	93.3	95.5	96.9
Site 15 - Watershed AA	112.6	77.0	80.6	103.7	111.7	129.2
Site 16 - Watershed S	112.2	89.5	75.3	105.9	110.7	156.7
Site 17 - Watershed S	103.6	77.0	39.3	101.6	115.7	152.6
Site 18 - Watershed W	119.7	84.1	72.2	104.8	116.1	90.2
Site 19 - Watershed U, V	132.9	101.2	79.6	91.4	108.3	147.2
Site 20 - Watershed G	97.8	86.4	92.1	105.0	115.3	80.8
Site 21 - Watershed L, J	114.8	74.0	77.3	109.4	114.4	101.1
Site 22 - Watershed T	96.8	92.1	77.3	127.4	105.9	110.9
Site 23 - Watershed O	117.2	74.4	75.6	105.2	101.7	101.1
Site 24 - Watershed K, M, N	96.6	74.5	83.0	109.1	101.0	101.1

5.3.3 Nitrate (NO3)

Nitrate is a form of nitrogen. Nitrogen is present in all living things and composes about 80% of the air we breathe. Nitrogen is a source of pollution to water when it becomes present in excessive amounts. Increased nitrogen leads to increased plant growth resulting in algal blooms in lakes and streams. Nitrate is a common inorganic nutrient found in commercial fertilizer, septic system waste, animal feed lot runoff, agricultural fertilizers, manure, industrial waste waters, and sanitary waste water including landfill leachate.

Sites that displayed the highest NO3 levels (upper third of the 24 sites, eight (8) sites) during each sampling event were highlighted to assist in the identification of consistent water quality concerns and the development of critical areas and watershed "hotspots." There is nothing scientific about the values highlighted, rather they represent a simple, relative comparison across sites to help determine rough trends.

Table 11: Nitrate

Nitrates (NO3) tons/year							
	5/29/07	**7/11/07**	**8/28/07**	**1/8/08**	**4/10/08**	**6/4/08**	**Average**
	Storm	Base	Base	Storm	Base	Storm	1st 5 events
Site 1 - Watershed X, Y	8.44	0.97	1.63	44.32	100.46	4453.78	31.16
Site 2 - Watershed CC	9.93	0.48	1.48	22.06	59.09	1544.34	18.51
Site 3 - Watershed Z	11.83	2.13	1.24	24.97	56.34	3185.21	19.30
Site 4 - Watershed P, Q	14.93	1.10	1.42	49.49	112.28	4584.77	35.84
Site 5 - Watershed BB, R	15.64	0.59	1.54	40.33	106.37	2357.88	32.89
Site 6 - Watershed DD	67.76	3.03	6.97	175.94	537.76	12547.79	158.29
Site 7 - Watersheds A, C, F	82.65	3.70	5.67	214.55	524.76	26784.70	166.27
Site 8 - Watershed B, D	135.19	15.82	14.34	260.88	338.81	22530.86	153.01
Site 9 - Watershed E, G	137.67	8.59	11.44	335.34	806.84	38829.20	259.98
Site 10 - Watershed H	2.03	0.12	0.34	7.39	19.30	1930.43	5.84
Site 11 - Watershed H	5.29	0.18	0.00	8.96	20.49	1323.72	1071.73
Site 12 - Watershed I	2.98	0.14	0.34	11.58	18.91	2095.89	6.79
Site 13 - Watershed I	24.74	1.18	1.48	35.10	72.49	3805.70	27.00
Site 14 - Watershed F	2.98	0.28	0.30	9.65	19.70	1930.43	6.58
Site 15 - Watershed AA	13.65	0.53	0.62	23.05	20.58	3033.53	11.69
Site 16 - Watershed S	7.24	0.24	0.24	8.86	24.62	827.33	8.24
Site 17 - Watershed S	4.96	0.35	0.00	10.28	32.99	758.38	9.72
Site 18 - Watershed W	4.05	0.47	0.34	5.42	10.34	1158.26	4.12
Site 19 - Watershed U, V	42.86	3.36	3.07	28.17	87.46	4081.48	32.98
Site 20 - Watershed G	2.98	0.25	0.20	1.45	4.14	537.76	1.80
Site 21 - Watershed L, J	12.58	0.55	0.98	22.06	55.16	3199.00	18.27
Site 22 - Watershed T	37.23	0.71	0.77	9.46	21.27	1799.44	13.89
Site 23 - Watershed O	8.60	0.41	0.49	6.07	9.46	882.48	5.01
Site 24 - Watershed K, M, N	94.11	4.33	4.14	78.60	134.44	7170.16	63.12
Overall (sum sites 1-24)	6074.03	49.03	59.04	1433.98	3194.06	151352.5	2162.03

5.3.4 Total Phosphorus (TP)

Phosphorus is an essential element for plant and animal life. It is a naturally occurring element found in rocks that is often mined for commercial fertilizer production. Aquatic life develops with low levels of phosphorus, but phosphorus becomes a problem in water quality when its presence becomes excessive. Excessive amounts of phosphorus can lead to problematic algal blooms causing depleted dissolve oxygen supplies and leading to eutrophication (aging/degradation) of lakes and other water bodies. Total Phosphorus includes inorganic and organic types of phosphorus. Increased phosphorus levels result from discharge of phosphorus-containing pollutants into surface waters. Sources of phosphorus include naturally occurring organic matter such as leaf litter, grass clipping and decaying plants and animals, as well as human and domestic animal waste and commercial and agricultural fertilizers.

Sites that displayed the highest TP levels (upper third of the 24 sites, eight (8) sites) during each sampling event were highlighted to assist in the identification of consistent water quality concerns and the development of critical areas and watershed "hotspots." There is nothing scientific about the values highlighted, rather they represent a simple, relative comparison across sites to help determine rough trends.

Table 12: Phosphorus

Total Phosphorus (TP) tons/year							
	5/29/07	**7/11/07**	**8/28/07**	**1/8/08**	**4/10/08**	**6/4/08**	**Average**
	Storm	Base	Base	Storm	Base	Storm	1st 5 events
Site 1 - Watershed X, Y	1.55	0.36	0.14	.24	0.5	468.82	0.56
Site 2 - Watershed CC	0.13	0.07	0.04	.11	0.39	523.97	0.15
Site 3 - Watershed Z	1.18	0.09	0.17	.12	0.98	606.71	0.51
Site 4 - Watershed P, Q	1.34	0.55	0.22	.40	2.99	681.17	1.10
Site 5 - Watershed BB, R	1.27	0.30	0.11	.37	1.06	1178.94	0.62
Site 6 - Watershed DD	16.19	2.43	1.10	1.57	4.48	2635.04	5.15
Site 7 - Watersheds A, C, F	11.02	0.74	1.13	1.92	8.75	3979.44	4.71
Site 8 - Watershed B, D	17.79	2.59	2.10	2.96	13.55	6166.34	7.80
Site 9 - Watershed E, G	42.36	5.15	4.25	4.41	32.78	10589.78	17.79
Site 10 - Watershed H	0.69	0.06	0.04	0.15	0.41	386.09	0.27
Site 11 - Watershed H	0.99	0.06	0.00	0.08	0.51	261.99	0.33
Site 12 - Watershed I	1.85	0.17	0.10	0.14	0.55	523.97	0.56
Site 13 - Watershed I	1.81	0.22	0.21	0.80	2.04	1427.14	1.02
Site 14 - Watershed F	0.10	0.08	0.16	0.17	0.55	286.81	0.21
Site 15 - Watershed AA	1.09	0.17	0.15	0.27	0.76	288.19	0.49
Site 16 - Watershed S	0.50	0.06	0.05	0.11	0.98	144.78	0.34
Site 17 - Watershed S	0.25	0.09	0.00	0.12	0.44	82.73	0.18
Site 18 - Watershed W	1.01	0.08	0.11	0.17	0.21	106.17	0.32
Site 19 - Watershed U, V	1.38	0.27	0.57	1.28	1.09	459.17	0.92
Site 20 - Watershed G	0.15	0.16	0.06	0.19	0.18	99.28	0.15
Site 21 - Watershed L, J	0.79	0.15	0.28	0.33	0.63	882.48	0.44
Site 22 - Watershed T	0.56	0.12	0.07	0.38	1.51	235.79	0.53
Site 23 - Watershed O	0.50	0.15	0.07	0.28	0.55	121.34	0.31
Site 24 - Watershed K, M, N	24.17	0.98	0.99	1.80	3.20	1075.52	5.43
Overall (sum sites 1-24)	124.67	15.1	12.12	18.37	79.09	33211.66	49.87

5.3.5 Total Suspended Solids (TSS)

Total Suspended Solids (TSS) are solid materials suspended in water and include such things as soil particles and industrial waste. TSS lower water quality by absorbing light resulting in warmer waters that have less ability to hold oxygen. Less light also decreases the amount of photosynthesis by plants and thus reduces the amount of oxygen produced by the plants. TSS can also have an impact on life by clogging fish gills, suffocating eggs and larvae, and obstructing habitats of microinvertebrates (aquatic insects).

Sites that displayed the highest TSS levels (upper third of the 24 sites, eight (8) sites) during each sampling event were highlighted to assist in the identification of consistent water quality concerns and the development of critical areas and watershed "hotspots." There is nothing scientific about the values highlighted, rather they represent a simple, relative comparison across sites to help determine rough trends.

Table 13: Total Suspended Solids

Total Suspended Solids (TSS) tons/year							
	5/29/07	**7/11/07**	**8/28/07**	**1/8/08**	**4/10/08**	**6/4/08**	**Average**
	Storm	Base	Base	Storm	Base	Storm	1st 5 events
Site 1 - Watershed X, Y	31.65	9.65	5.42	88.64	133.95	632904.90	53.86
Site 2 - Watershed CC	62.88	2.76	6.65	26.20	114.25	247094.90	42.55
Site 3 - Watershed Z	13.65	3.55	3.79	13.44	21.67	183528.63	11.22
Site 4 - Watershed P, Q	15.72	4.73	10.05	19.80	74.85	241027.84	25.03
Site 5 - Watershed BB, R	29.78	58.36	5.32	15.51	70.91	488950.06	35.98
Site 6 - Watershed DD	112.93	64.46	31.96	172.80	1971.80	1693951.36	470.79
Site 7 - Watersheds A, C, F	137.75	60.18	42.55	421.44	765.28	4101885.63	285.44
Site 8 - Watershed B, D	355.75	136.61	55.16	681.86	1863.45	10672514.03	618.57
Site 9 - Watershed E, G	794.23	203.98	130.80	970.73	5799.17	16555358.21	1579.78
Site 10 - Watershed H	169.40	2.95	0.98	1.23	34.47	162156.03	41.81
Site 11 - Watershed H	20.68	1.18	0.00	6.20	82.73	153882.76	22.16
Site 12 - Watershed I	16.55	6.20	3.20	5.52	48.85	616634.14	16.06
Site 13 - Watershed I	71.36	54.17	6.65	127.64	215.20	716740.67	95.00
Site 14 - Watershed F	4.96	8.27	2.71	5.52	35.46	516251.84	11.38
Site 15 - Watershed AA	4.55	12.41	10.69	21.13	124.59	517217.06	34.67
Site 16 - Watershed S	4.14	0.79	0.59	0.89	22.16	116515.17	5.71
Site 17 - Watershed S	5.17	3.15	0.00	1.77	22.16	121341.24	6.45
Site 18 - Watershed W	1.45	3.25	1.48	13.54	41.37	209451.54	12.22
Site 19 - Watershed U, V	22.96	32.06	23.64	76.82	127.55	1270360.10	56.61
Site 20 - Watershed G	1.24	0.98	0.20	3.10	11.82	121617.02	3.47
Site 21 - Watershed L, J	9.93	28.27	2.46	8.27	70.91	425797.46	23.97
Site 22 - Watershed T	78.18	21.27	4.14	9.46	84.21	174979.59	39.45
Site 23 - Watershed O	14.89	3.79	2.71	9.65	66.97	132372.27	19.60
Site 24 - Watershed K, M, N	416.77	151.68	95.14	134.74	544.16	3405828.12	268.50
Overall (sum sites 1-24)	2396.57	874.7	446.29	2835.90	12347.9	43478361	3780.28

5.3.6 Biochemical Oxygen Demand (BOD)

Biochemical Oxygen Demand (BOD) is a measure of the quantity of oxygen used by microorganisms (aerobic bacteria) in the oxidation (break-down) of organic matter. Streams with high quantities of plant growth and decay generally have high levels of biochemical oxygen levels. The higher the number, the more indicative the site is of higher pollution loads.

Sites that displayed the highest BOD levels (upper third of the 24 sites, eight (8) sites) during each sampling event were highlighted to assist in the identification of consistent water quality concerns and the development of critical areas and watershed "hotspots." There is nothing scientific about the values highlighted, rather they represent a simple, relative comparison across sites to help determine rough trends.

Table 14: Biochemical Oxygen Demand

Biochemical Oxygen Demand (BOD) tons/year							
	5/29/07	**7/11/07**	**8/28/07**	**1/8/08**	**4/10/08**	**6/4/08**	**Average**
	Storm	Base	Base	Storm	Base	Storm	1st 5 events
Site 1 - Watershed X, Y	12.66	4.00	3.25	4.73	10.05	3281.73	1.10
Site 2 - Watershed CC	3.97	1.03	1.77	3.86	3.15	3309.31	0.16
Site 3 - Watershed Z	6.83	1.51	1.65	6.53	4.33	6370.42	0.67
Site 4 - Watershed P, Q	12.58	3.47	3.55	7.92	14.97	7859.60	1.60
Site 5 - Watershed BB, R	13.40	4.58	3.43	9.93	19.50	8935.13	3.13
Site 6 - Watershed DD	56.47	15.93	17.43	47.13	134.44	20076.46	9.68
Site 7 - Watersheds A, C, F	82.65	18.52	19.86	53.64	10.93	33672.20	6.50
Site 8 - Watershed B, D	106.73	28.76	40.81	83.01	101.64	75893.43	12.03
Site 9 - Watershed E, G	158.85	47.24	49.05	158.85	25.21	84718.25	22.92
Site 10 - Watershed H	9.56	0.83	1.28	2.71	0.69	2895.64	0.62
Site 11 - Watershed H	4.30	3.01	0.00	1.52	1.18	1654.65	0.80
Site 12 - Watershed I	5.96	1.65	1.48	3.03	6.30	4191.79	1.07
Site 13 - Watershed I	12.37	5.52	5.76	15.16	49.84	13954.24	2.26
Site 14 - Watershed F	2.65	0.55	1.03	3.86	4.73	3088.69	0.24
Site 15 - Watershed AA	5.92	1.77	2.62	8.45	14.08	5157.00	0.91
Site 16 - Watershed S	2.48	0.16	0.68	2.30	2.95	2481.98	0.34
Site 17 - Watershed S	3.10	0.91	0.00	2.30	2.95	1654.65	0.23
Site 18 - Watershed W	4.63	0.24	1.03	3.45	6.20	2123.47	0.54
Site 19 - Watershed U, V	32.14	4.27	5.44	26.89	0.00	13264.84	1.69
Site 20 - Watershed G	3.97	0.30	0.95	2.48	0.00	1820.12	0.16
Site 21 - Watershed L, J	33.09	1.24	2.17	6.07	1.58	6618.61	1.19
Site 22 - Watershed T	7.07	0.08	1.60	4.41	2.66	2730.18	0.50
Site 23 - Watershed O	5.29	0.41	1.13	3.59	3.94	2868.07	0.39
Site 24 - Watershed K, M, N	53.78	4.88	11.17	31.44	0.37	5487.23	10.84
Overall (sum site 1-24)	10.02	1.47	1.76	1.39	1.55	314107.7	3.24

5.3.7 E. coli

E. coli is a specific species of fecal coliform bacteria, which are found in the feces of warm-blooded animals. *E. coli* enter our waters from combined sewer overflows (CSOs), failing septic systems, livestock in streams, agricultural feedlot runoff, wildlife, and urban runoff from domestic pet waste. Not all, but certain strains of *E. coli* can cause illness in humans. Those that are not pathogenic may occur with other intestinal pathogens and cause health problems.
Sites that displayed *E. coli* levels at or below the State water quality standard of 235 cfu/100mL during each sampling event were highlighted to assist in the identification of consistent water quality concerns and the development of critical areas and watershed "hotspots."

Table 15: *E. coli*

E. coli cfu/100mL							
	5/29/07	**7/11/07**	**8/28/07**	**1/8/08**	**4/10/08**	**6/4/08**	**Average**
	Storm	Base	Base	Storm	Base	Storm	1st 5 events
Site 1 - Watershed X, Y	218	494	441	262	182	2975	319.4
Site 2 - Watershed CC	87	117	170	103	67	1510	108.80
Site 3 - Watershed Z	281	247	226	136	136	1450	205.20
Site 4 - Watershed P, Q	155	514	103	164	120	5250	211.20
Site 5 - Watershed BB, R	174	190	376	152	546	3015	287.60
Site 6 - Watershed DD	175	131	181	205	155	1535	169.40
Site 7 - Watersheds A, C, F	124	72	137	80	91	5140	100.80
Site 8 - Watershed B, D	146	40	98	146	103	7205	106.60
Site 9 - Watershed E, G	64	74	112	48	61	6010	71.80
Site 10 - Watershed H	237	79	241	255	187	3075	199.80
Site 11 - Watershed H	822	2	889	421	106	2260	448.00
Site 12 - Watershed I	441	184	128	327	516	11250	319.20
Site 13 - Watershed I	48	155	65	210	52	10700	106.00
Site 14 - Watershed F	403	1353	285	187	208	2115	487.20
Site 15 - Watershed AA	110	223	125	75	120	6750	130.60
Site 16 - Watershed S	382	133	169	68	98	4450	170.00
Site 17 - Watershed S	269	117	31	243	399	775	211.80
Site 18 - Watershed W	152	123	295	228	112	6075	182.00
Site 19 - Watershed U, V	161	225	155	89	35	2010	133.00
Site 20 - Watershed G	902	483	83	327	38	210	366.60
Site 21 - Watershed L, J	228	209	256	47	87	1885	165.40
Site 22 - Watershed T	43	380	132	46	180	3035	156.20
Site 23 - Watershed O	230	290	310	122	103	13500	211.00
Site 24 - Watershed K, M, N	406	169	73	336	71	5555	211.00
Overall	260.75	250.17	211.71	178.21	157.21	107735	211.61

The Indiana Water Pollution Control Board (327 IAC 2-1-6 Section 6(d)) set forth water quality targets for *E. coli* for any one sample in a 30-day period. Concentrations for a one-time *E. coli* sample are not to exceed 235 cfu/100 ml. Data in Table 15 was collected as one sample in a 30-day period and concentrations are not to exceed 235cfu/mL. The Indiana Water Pollution Control Board also set forth water quality targets for *E. coli* that are not to exceed concentrations greater than 125 cfu/100 ml as a geometric mean based on no less than five samples spaced equally over a 30-day period (327 IAC 2-1-6 Section 6(d)). Table 16 shows *E. coli* data collected by IDEM using five samples equally spaced over 30-days. The geometric mean of these samples must not exceed 125 cfu/100mL concentration sampling. This data was collected by IDEM for the purpose of investigating if any currently listed segments could be removed from the 303d list. Several of the IDEM *E. coli* sample sites (22) overlapped the sample sites of this project. IDEM sample sites 17-30 all exceeded the State's geometric mean standard for *E. coli*.

Table 16: *E. coli* - IDEM

***E. coli* cfu/100mL – IDEM Sampling**						
	10/1/07	**10/9/07**	**10/15/07**	**10/22/07**	**10/29/07**	
	Week 1	Week 2	Week 3	Week 4	Week 5	GeoMean
Site 1 - Watershed X, Y	12	82	17.3	40.4	21.3	27.1
Site 2 - Watershed CC	72.7	77.6	13.2	38.2	6.3	28.2
Site 3 - Watershed Z	23.3	40.8	75.4	29.8	14.5	31.5
Site 4 - Watershed P, Q	16.6	29.2	78.4	38.2	50.4	37.4
Site 5 - Watershed BB, R	57.6	48.7	50.4	75.4	16	44.3
Site 6 - Watershed DD	365.4	25.9	6.3	108.6	81.3	55.5
Site 7 - Watersheds A, C, F	74.9	77.1	46.5	88.4	33.6	60.3
Site 8 - Watershed B, D	36.8	104.3	72.3	64.4	95.9	70.3
Site 9 - Watershed E, G	108.1	160.7	70.8	71.2	19.7	70.4
Site 12 - Watershed I	96	55.4	66.3	117.8	49.6	72.9
Site 13 - Watershed I	109.2	84.2	57.6	74.9	121.1	86.4
Site 14 - Watershed F	79.4	198.9	231	88.4	44.1	107.3
Site 15 - Watershed AA	238.2	149.7	261.3	146.7	16.7	117.9
Site 16 - Watershed S	167.4	209.8	172.3	82	58.1	123.6
Site 17 - Watershed S	2419.2	111.2	41.3	185	20.3	133.1
Site 18 - Watershed W	127.4	178.5	325.5	101.7	57.3	134.0
Site 19 - Watershed U, V	133.3	290.9	461.1	101.7	30.5	140.9
Site 20 - Watershed G	218.7	248.9	69.7	248.9	77.1	148.7
Site 21 - Watershed L, J	26.5	1553.1	82	22.8	980.4	149.8
Site 22 - Watershed T	307.6	285.1	95.8	222.4	101	180.0
Site 23 - Watershed O	613.1	275.5	325.5	135.4	26.2	181.1
Site 24 - Watershed K, M, N	686.7	143.9	290.9	172.3	66.3	201.0
Site 25 – Watershed H	290.9	156.5	313	410.6	121.1	234.5
Site 26 – Watershed C	137.4	816.4	325.5	218.7	106.7	243.3
Site 27 – Watershed D	248.1	365.4	579.4	224.7	77.1	246.5
Site 28 – Watershed V	1732.9	648.8	48	124.6	307.6	290.5
Site 29 – Watershed E	613.1	727	547.5	435.2	154.1	439.3
Site 30 – Watershed N	1119.9	410.6	1119.9	488.4	109.5	487.5

5.3.8 Other Parameters

In addition to the sampling of dissolved oxygen, nitrates, total phosphorus, total suspended solids, biochemical oxygen demand, and *E. coli,* other in-situ parameters such as pH, conductivity, and temperature readings were also taken at each sampling event.

pH is estimated by the concentration of H^+ ions present in a solution. Aquatic organisms are sensitive to pH, so it is therefore an important measurement of water quality. A range of 6.5 to 8.2 is best for most aquatic organisms. pH for Big Walnut Creek and its tributaries did not fall outside of this optimal range.

Conductivity is the ability of a solution to carry an electrical current. The presence of ions allows a current to be carried. Conductivity is higher in low or base flow conditions since water moves more slowly across soils and substrates that contain ions. Other ions also dissolve easier into slower moving water which increases conductivity levels.

Temperature is an important indicator of overall water quality. Temperature affects dissolved oxygen, photosynthesis, and metabolism of aquatic organisms. Aquatic life in Indiana streams are protected by the Indiana Administrative Code (IAC) (327 IAC 2-1-6). The code sets maximum water temperature limits in order to protect aquatic life for Indiana streams. For example, stream temperatures during the months of June, July, August, and September should not exceed 90°F (23.7°C) by more than 1% of the hours in a twelve month period. And at no time should a waters temperature exceed this same maximum limit by more than 3°F (1.7°C). Several of the sample sites were above the 90°F temperature during the time of sampling in the months of May, July, and August 2007, and June 2008. It is not know if the sites exceeded 90°F by more than 1% of the hours in 12 month period. One site did exceed the maximum limit of 90°F at any one time by 3°F.

5.3.9 Biological Data – Aquatic Macroinvertebrates

Biological data in the form of macroinvertebrate analysis was conducted twice as part of this project. Sampling efforts resulted in collecting 50 different macroinvertebrate genera during the spring collection and 65 genera during the fall collection. Dominant species collected during the spring and fall differed among the seasons. The spring dominant species included midges (Chironomidae), blackfly larvae (Simuliidae), and riffle beetles (primarily *Stenelmis*). Fall dominant species included caddisflies (Trichoptera), mayflies (Ephemeroptera) and midges (Chironomidae). The sediment-tolerant midge *Orthocladius obumbratus* was common amongst many of the sites at both spring and fall collections. An uncommon caddisfly (*Helicopsyche borealis*) was abundant during the fall collection sample at Miller Creek (Site 12).

Bioassessment of macroinvertebrates can indicate impairment of sites, while the organisms present at the site can indicate what type of impairment is present. Poor habitat quality can be one type of impairment that affects aquatic life. Figure 1a of the Aquatic Macroinvertebrate Report (Appendix F) shows the relationship between the mean Ohio EPA bioassessment score and QHEI habitat scores. The correlation between habitat and the bioassessment score should be within ten percent of the expected score in order to rule out low biological scores due to habitat impairments. If the biological score is low in the presence of good habitat, then water quality problems are suspected.

There are two sites that fall farthest from the expected scores. They are Limestone Creek (Site 22) and Jones Creek (Site 17). Both sites had good QHEI scores, but low biotic index scores. There was a low diversity of the organisms that were collected at these sites. Low diversity in the presence of good habitat indicates a water quality concern at these locations.

Due to an overall a lack of biotic integrity, four other sites are also of concern based on macroinvertebrate sampling. These are mainstem Sites 7 and 8, Site 10, and Site 24. In addition to these four sites, the headwaters of the watershed are also of interest since both biotic index and habitat scores are low. In this general location the macroinvertebrate analysis proves to be a limited diagnostic tool, since habitat impairments dictate low diversity, regardless of pollution levels. Therefore, we are uncertain, based on invertebrates, exactly how impaired the water quality may be due to pollution.

The Big Walnut Watershed has overall good to excellent habitat for aquatic life. The biggest concerns to habitat for aquatic life are lack of riparian vegetation and stream bank erosion. Nutrient enrichment also appears to be a problem in several locations based on the composition of species present. The complete Aquatic Macroinvertebrate Report can be referenced in Appendix F.

6.0 LAND USE

6.1 Land Use Composition by Subwatersheds

Land use in the Big Walnut Watershed is mostly rural or agricultural (Figure U1). Figures U2-U20 (Appendix A) show land use at a more usable scale for each priority 14-HUC subwatershed. The land use layer that was referenced was generated from the Central Indiana Water Resources Partnership (CIWRP) Pilot Studies by Indiana University-Purdue University Indianapolis Center for Earth and Environmental Science and Center for Urban Policy and the Environment (IUPUI-CEES and CUPE) (J. Wilson) 2003. The predominant land use is agriculture. Other major land use types within the watershed include forest and grasslands/suburban land. Residential/urban areas would compose a majority of the remaining land use. Table 17 defines acreage and percentages of each land use within the Big Walnut Watershed on an individual 14-HUC watershed level. For the most part, when looking at land use across the subwatersheds, percent of each subwatershed in a particular land use was considered more heavily than total acreage of a given land use. Since the water quality sampling strategy generally links water quality findings to a given subwatershed, it is more important to consider the land use characteristics of that subwatershed rather than total acreage when trying to understand the various land use influences.

6.1.1 Agricultural

With agriculture dominating the majority of the land use, many of the subwatersheds have similar acreages/percentages of such land use. Subwatersheds with greater than 70% of their acreage in active agricultural production include Subwatersheds J, P, Q, R, X, Y, Z, BB, and CC. Several of these subwatersheds are clustered in certain areas of the larger watershed. These areas can be generally described as the headwaters areas of Big Walnut Creek in Boone and Hendricks Counties, as well as the headwaters area of Deer Creek in Hendricks and Putnam County.

6.1.2 Forested

In general, forested land use increases in the southern portion of the watershed. Subwatersheds with the greatest percentages of forested land use include Subwatersheds C, E, G, K, M, V, and W. Most notable are Subwatersheds E and G (the most southern end of the mainstem of Big Walnut Creek and K (the most southern end of Deer Creek where Deer Creek enters Big Walnut Creek). The forested land use in these areas is clearly associated with steeper terrain and topography in this portion of the watershed. The local terrain and soils do not lend themselves to agricultural land use.