FLATROCK-HAW CREEK WATERSHED MANAGEMENT PLAN

Vision Statement: *Flatrock-Haw Creek Watershed: A pristine environment for the future*

Mission Statement: The Flatrock-Haw Creek Watershed Project will seek to promote stewardship of the natural resources in the watershed and conserve its agricultural heritage, while ensuring the sustainability of the area.

Table of Contents

1.0 Introduction ... 6
1.1 Brief History and Overview ... 6
1.2 Building Partnerships ... 7
2.0 Describing the Watershed ... 9
2.1 Topography ... 9
2.2 Hydrology ... 10
2.3 Physiography ... 12
2.4 Geology ... 12
2.4.1 Bedrock Geology ... 12
2.4.2 Surficial Geology ... 14
2.4.3 Watershed leaching potential and local climate ... 15
2.5 Soils, Wetlands and Native Vegetation ... 16
2.6 Threatened and Endangered Species ... 19
3.1 Natural History and Human Influence ... 21
3.2 Existing Landscape ... 21
3.3 Land Ownership ... 23
3.4 Point Source Discharge and Regulated Permits ... 24
3.5 Legal Drains ... 25
4.0 Investigation of Water Quality Issues and Benchmarks ... 27
4.1 Designated Use, Assessment, and Impairment ... 27
4.2.1 Agricultural Practices ... 28
4.2.2 Agricultural Practices: Livestock ... 31
4.2.3 Urban/Suburban/Impervious Surface and Population Density ... 32
4.3 Land Inventory, Visual Assessment and Spatial Research by Subwatershed 34
4.3.1 Subwatershed one-Town of Geneva-Flatrock River ... 34
4.3.2 Subwatershed two- Sidney Branch-Flatrock River ... 36
4.3.3 Subwatershed three- Big Slough ... 38
4.3.4 Subwatershed four-Haw Creek ... 39
4.3.5 Subwatershed five-Little Haw Creek-Haw Creek ... 41
4.3.6 Subwatershed six-Town of Northcliff-Flatrock River ... 42
4.4 Existing Data and Current Water Quality Sampling ... 44
4.4.1 Chemical and Pathogen Data ... 45
4.4.2 Physical Data and Stream Habitat ... 48
4.4.3 Biological Communities ... 48
5.0 Problem Statements, Prioritization, and Goals Development ... 49
5.1 Local Concerns ... 50
5.2 Problem Statements ... 50
5.2.1 Lack of education ... 50
5.2.2 Increased sedimentation ... 51
5.2.3 Biological Contamination ... 51
5.2.4 Chemical Runoff ... 51
5.2.5 Pesticides and other contaminants ... 51
5.2.6 Lack of recreation due to poor water quality ... 51
5.2.7 Biological Communities ... 51

5.2.8 Rate of water leaving Haw Creek Watershed 52
6.0 Identifying Critical Areas..... 54
6.1 Non-point Source Chemical Runoff 54
6.2 Biological Contamination..... 55
6.3 Sediment contamination..... 56
8.0 References..... 57
Appendix A: Project Committee Members 58
Appendix B: Watershed Survey 59
Appendix C: Concern card 61
Appendix D: NPDES Facilities 62

Figures

Figure 1.1 10 digit Flatrock-Haw Creek Watershed in relation to 8 digit Flatrock-Haw Basin 6
Figure 1.2 Organizational Structure 8
Figure 2.1-2 Slope in the Flatrock-Haw Creek Watershed 10
Figure 2.2-1 Subwatersheds in Flatrock-Haw Creek Watershed 11
Figure 2.3 Physiographic regions in Flatrock-Haw Creek Watershed 12
Figure 2.4.1 Bedrock geology of Flatrock-Haw Creek Watershed 13
Figure 2.4.2 Surficial Geology in the Flatrock-Haw Creek Watershed 14
Figure 2.4.3-2 Mean Columbus Climate based on thirty year average (1971-2000) 15
Figure 3.2 Current land use in the Flatrock-Haw Creek Watershed. 22
Figure 3.3 Land Ownership in Flatrock-Haw Creek Watershed 23
Figure 3.4 Location of NPDES outlets and CFOs in Flatrock-Haw Creek 25
Figure 3.5 Bartholomew County legal drains in Flatrock-Haw Creek 26
Figure 4.1 Segments in Flatrock-Haw Creek listed on the 2008 303(d) impaired water list 27
Figure 4.2.1-1 Bartholomew tillage practices for corn 29
Figure 4.2.1-2 Shelby tillage practices for corn 30
Figure 4.2.1-3 Bartholomew tillage practices for soybeans 30
Figure 4.2.1-4 Shelby tillage practices for soybeans 31
Figure 4.2.2 Livestock numbers by county and type over time 32
Figure 4.2.3 Population change in Columbus and surrounding commuting area 33
Figure 4.3 Six subwatersheds in Flatrock-Haw Creek 34
Figure 4.3.1 Subwatershed one in Flatrock-Haw Creek 35
Figure 4.3.3 Subwatershed three in Flatrock-Haw Creek 38
Figure 4.3.4 Subwatershed four in Flatrock-Haw Creek 40
Figure 4.3.5 Subwatershed five in Flatrock-Haw Creek 41
Figure 4.3.6 Subwatershed six in Flatrock-Haw Creek 43
Figure 4.4 Past and current potential monitoring sites in Flatrock-Haw Creek Watershed 44
Figure 6.1 Subwatersheds prioritized for NPS chemical runoff 54
Figure 6.2 Subwatersheds prioritized for biological contamination 55
Figure 6.3 Subwatersheds prioritized for sediment 56

Tables

Table 1.1 Watershed area relative to county boundaries 7
Table 2.2 Subwatersheds within the Flatrock-Haw Creek Watershed 11
Table 2.4.2 Surficial Geology in the Flatrock-Haw Creek Watershed 15
Table 2.5 Soil association characteristics in Flatrock-Haw Creek Watershed 17
Table 2.6 Threatened and Endangered Species 19
Table 3.2 Land use in Flatrock-Haw Creek Watershed 22
Table 3.4 NPDES outlets and CFOs status 24
Table 4.2 Specific land use of Flatrock-Haw Creek 28
Table 4.2.1-1 2007 Crop yields by county 28
Table 4.2.2 Livestock type and numbers by county 31
Table 4.3.1.1 Land use in subwatershed one 35
Table 4.3.1.2 Estimated contaminants in subwatershed one 36
Table 4.3.2.1 Land use in subwatershed two 37
Table 4.3.2.2 Estimated contaminants in subwatershed two 37
Table 4.3.3.1 Land use in subwatershed three 39
Table 4.3.3.2 Estimated contaminants in subwatershed three 39
Table 4.3.4.1 Land use in subwatershed four 40
Table 4.3.4.2 Estimated contaminants in subwatershed four 40
Table 4.3.5.1 Land use in subwatershed five 42
Table 4.3.5.2 Estimated contaminants in subwatershed five 42
Table 4.3.6.1 Land use in subwatershed six 43
Table 4.3.6.2 Estimated contaminants in subwatershed six 43
Table 4.4.1-1 Summary data for selected parameters, IDEM 45
Table 4.4.1-2 E. coli data from 2002 TMDL sites in smaller Flatrock-Haw Creek Watershed, IDEM 46
Table 4.4.1-3 Summary data for selected pesticides, 1997 IDEM data 47
Table 4.4.1-4 Summary data for selected parameters, Hoosier Riverwatch 48
Table 4.4.2 Citizens Qualitative Habitat Evaluation Index (CQHEI) averages for Flatrock-Haw Creek, Hoosier Riverwatch 48
Table 4.4.3-1 Index of Biotic Integrity 49
Table 4.4.3-2 Pollution Tollerance Index (PTI) averages for Flatrock-Haw Creek, Hoosier Riverwatch 49
Table 5.1 Concerns identified at the public meeting and steering committee 50
Table 5.2.1-1 Watershed results from the public meeting 51
Table 5.2.1-2 Additional watershed results from the public meeting 51
Table 5.2 Pollutants, potential sources, the impacts on use and associated problem statements 52

Introduction

1.1 Brief History and Overview

The 10 digit Flatrock-Haw Creek Watershed encompasses approximately 131 square miles (83,868 acres) in the 8 digit Flatrock-Haw Creek Basin (Figure 1.1). The majority of this acreage lies in Bartholomew County, with a portion of the watershed area lying in Shelby County (Table 1.1).

Figure 1.1 10 digit Flatrock-Haw Creek Watershed in relation to 8 digit Flatrock-Haw Basin

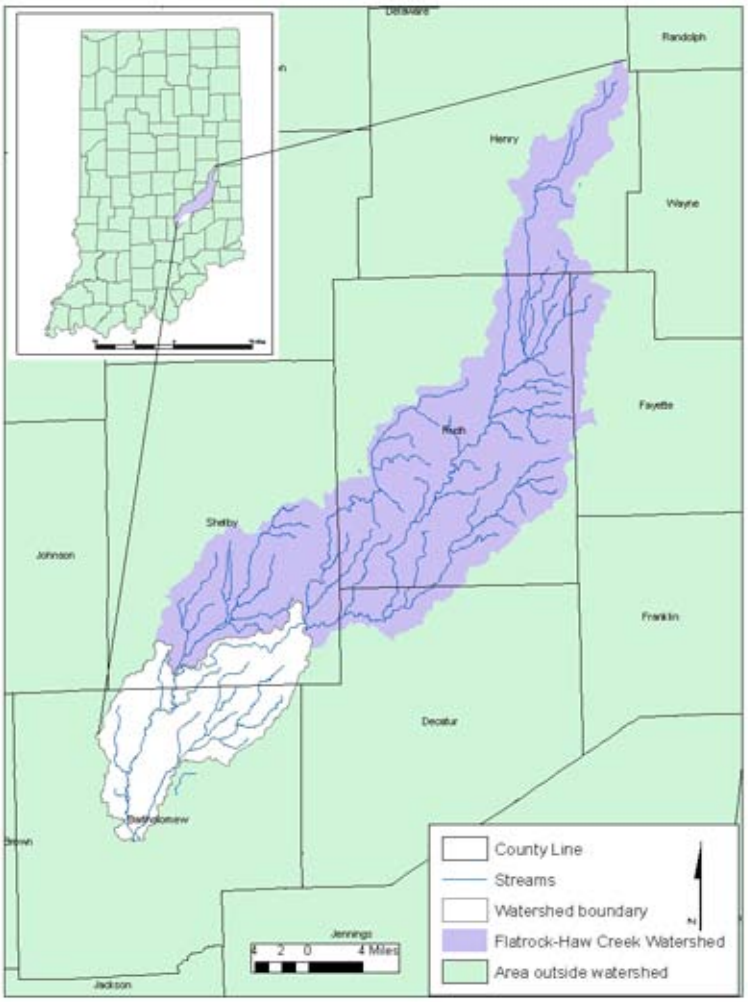


Table 1.1 Watershed area relative to county boundaries

County	Percentage of Watershed	Approximate acres in Watershed	Percent of County
Bartholomew	75%	62,901	24%
Shelby	25%	20,967	8%

The land use in the watershed is mostly agricultural (78%), and is characterized by corn and soybeans with some pasture operations. Livestock farms vary in size throughout the watershed from small family farm operations to larger confined feeding operations. Developed areas also make up a portion of the watershed, and are the next largest percentage of land use type in the watershed. The city of Columbus is almost entirely contained within this watershed and is the largest urban area in the watershed.

The mission of the Bartholomew County Soil and Water Conservation District (BCSWCD) is to provide assistance and education to help empower Bartholomew County residents to protect and preserve their natural resources. With the Flatrock-Haw Creek Watershed adjacent to the Clifty Creek Watershed the BCSWCD hopes to expand on the area residents' knowledge, continue to build partners in the area, and improve a larger section of their county.

Additionally, the Indiana Department of Environmental Management (IDEM) determined that several segments of the water bodies within the watershed did not meet recreational standards for E. coli. In turn, IDEM developed a Total Maximum Daily Load (TMDL) in August 2005 for the larger Flatrock-Haw Creek Basin for E. coli. That TMDL includes five (5) sample sites that fall within the smaller Flatrock-Haw Creek watershed boundary.

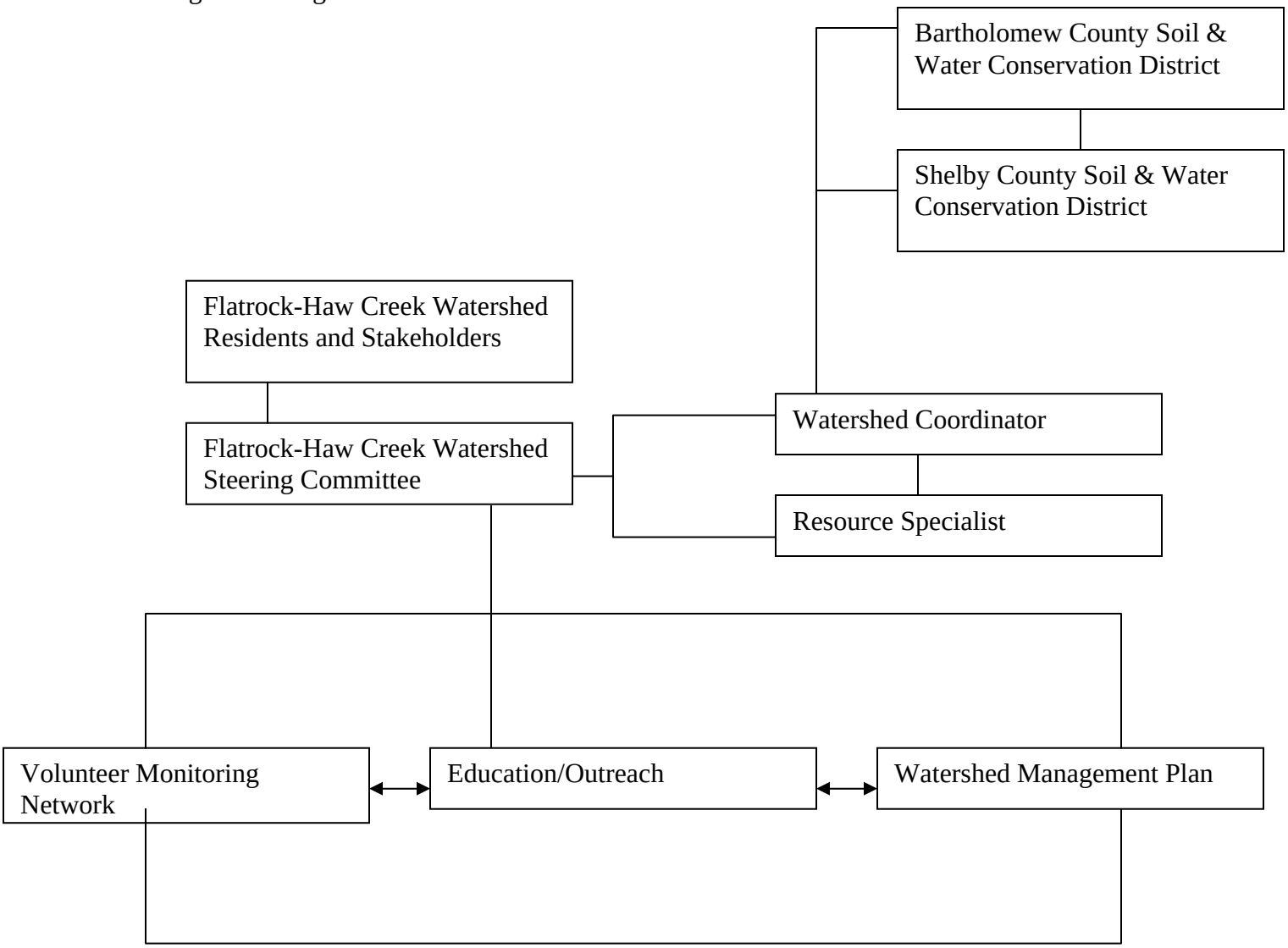
Based on the data available, the BCSWCD approached Shelby County SWCD (SCSWCD) for support in application of IDEM Section 319 grant. Funds were awarded to the BCSWCD in April 2008 to address the nonpoint source pollution issues in the Flatrock-Haw Creek Watershed.

1.2 Building Partnerships

Having moved toward the best needs and interests of the county, the Board and State agreed that project decisions and the direction of the watershed planning should be made by a representative local steering committee that is specific to the watershed project (Appendix A). Additionally, the Board decided to contract two full time positions to coordinate the details of the project and facilitate its progress (Figure 1.2). The project was introduced to residents through newspaper advertising, personal invitations, radio announcements, and a large scale public kickoff meeting. At the meeting an initial watershed survey (Appendix B) was passed out in addition to concern cards where residents could rank the resource concerns listed as they saw fit (Appendix C). The kickoff meeting hosted thirty five (35) individuals representing Bartholomew and Shelby

county residents. The purpose of the meeting was to introduce the project as well as seek interest from residents and landowners to form a locally led steering committee.

Figure 1.2 Organizational Structure



Response to the public meeting and personal invitations was noted, with eight individuals in attendance at the first steering committee meeting. Initial concerns were identified and discussion on the group's vision and mission statements, as well as the project logo occurred. Some of the initial concerns included a lack of education about water quality issues, stream cleanliness (sediment, nutrients, e.coli), and trash along the stream banks.

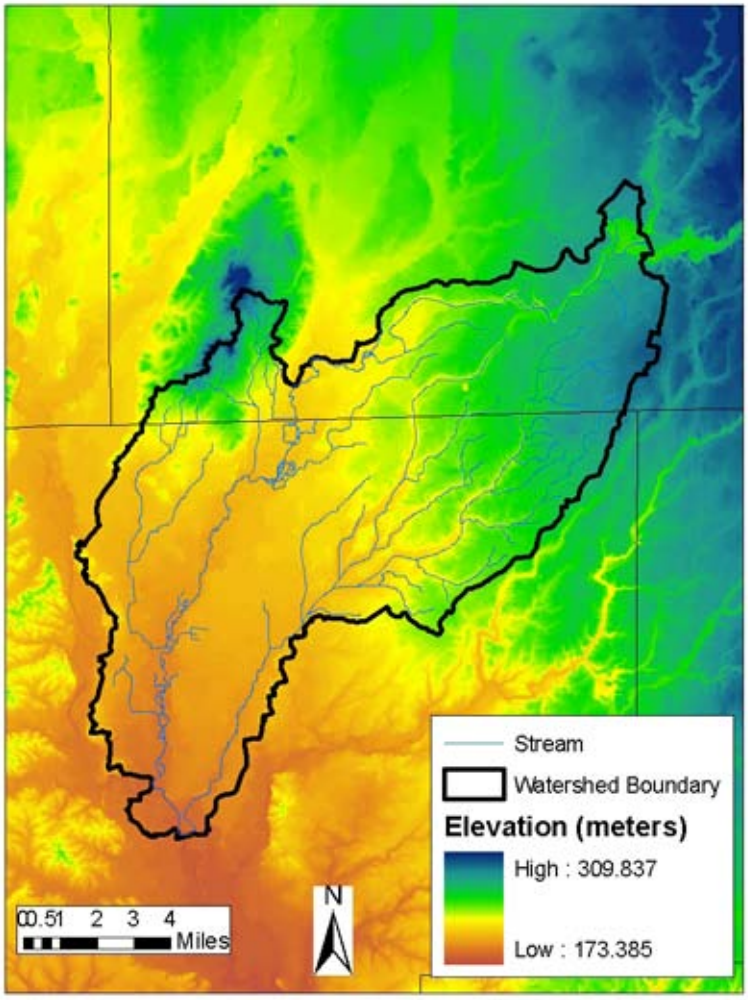
1.0 Describing the Watershed

This section includes maps displaying topography, hydrology, physiography, geology, soils, and wetlands of Flatrock-Haw Creek Watershed. Also included is information about the natural features and endangered species that could occur in the watershed.

2.1 Topography

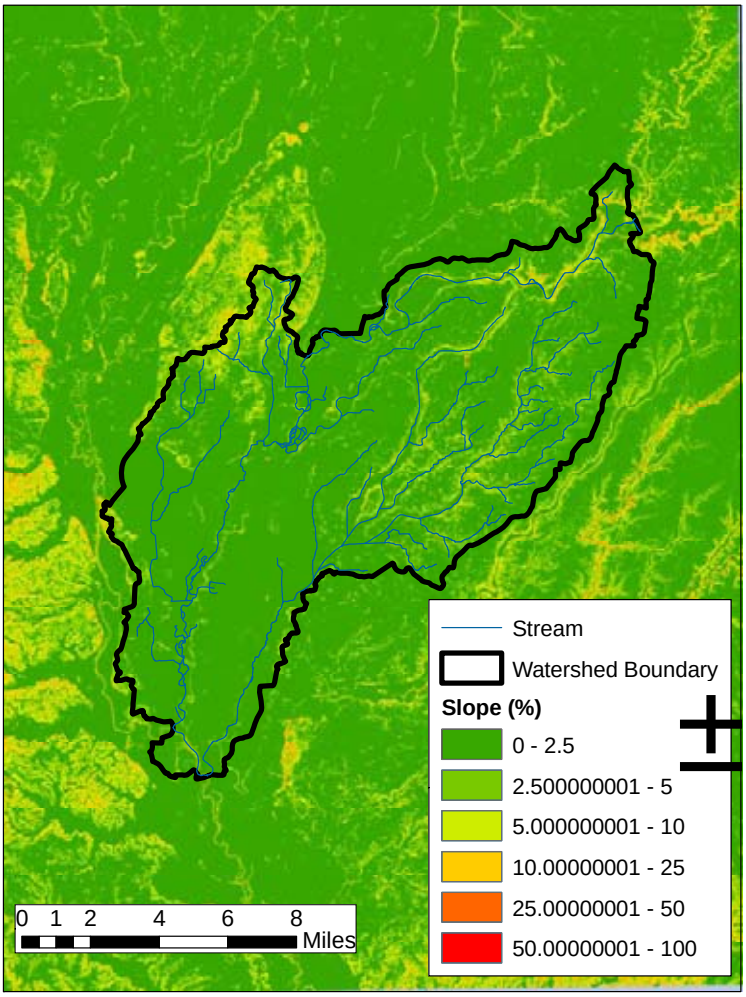
From the upper reaches of Flatrock-Haw Creek Watershed in Shelby County to where it drains into the East Fork of the White River just south of Columbus the elevation drops 90 meters (approximately 295 feet) (Figure 2.1-1).

Figure 2.1-1 Elevation of Flatrock-Haw Creek Watershed



The majority of the watershed has a slope of less than 5% (Figure 1.2-2), although there are areas along the stream systems where the slope increases. The areas where the steeper slopes have been observed are directly along the main sections of water bodies in the watershed.

Figure 2.1-2 Slope in the Flatrock-Haw Creek Watershed



2.2 Hydrology

A watershed is defined as a topographically delineated area that is drained by a stream or a network of streams. Watersheds are identified by scale and coded as such. Larger watersheds are identified by an eight (8) digit Hydrologic Unit Code (HUC). Slightly smaller watersheds are identified by a ten (10) digit HUC and subwatersheds within the ten digit watersheds are characterized by a twelve (12) digit HUC.

The Flatrock-Haw Creek Watershed is identified by a ten (10) digit HUC (0512020506), and is then subdivided into six (6) subwatersheds (Figure 2.2-1), which are denoted by twelve (12) digit HUCs (Table 2.2). In the Flatrock-Haw Creek Watershed two major water bodies flow into the East Fork White River near then outlet of the watershed, Flatrock River and Haw Creek. The major tributaries to Haw Creek include Tough Creek and Little Haw Creek. The watershed also includes a small portion of the Flatrock River. The tributaries to that portion of Flatrock River that fall within the watershed boundaries include Big Slough and Sidney Branch. Including all of the tributaries the watershed contains approximately 109 miles of stream. The streams in the watershed are less than one (1) percent of the total watershed area.

Figure 2.2-1 Subwatersheds in Flatrock-Haw Creek Watershed

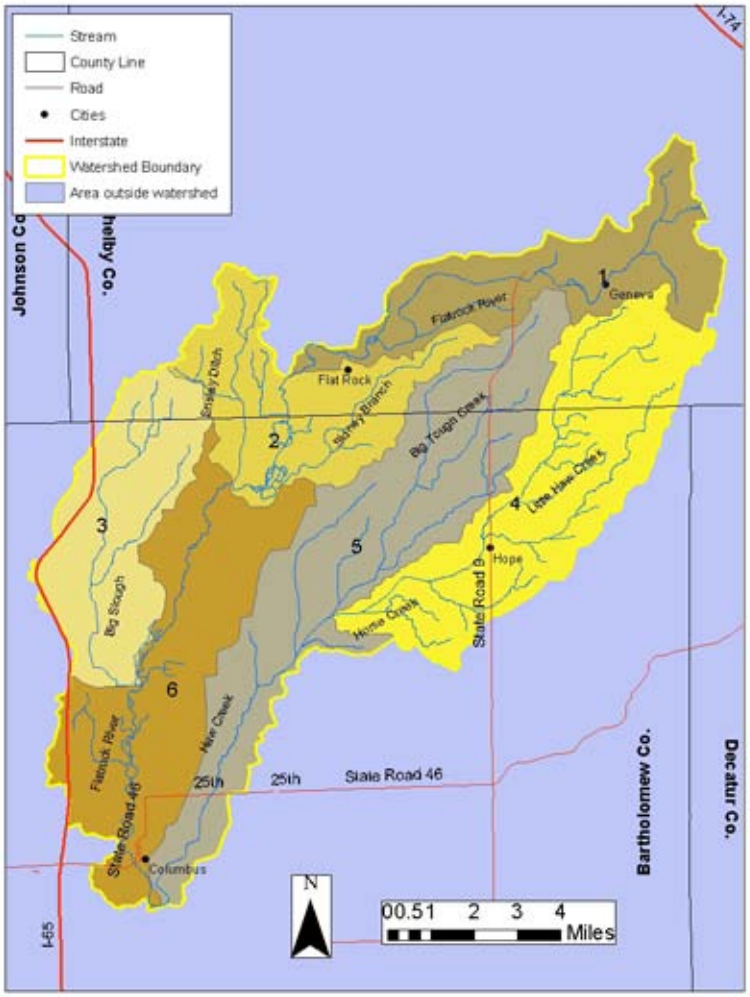


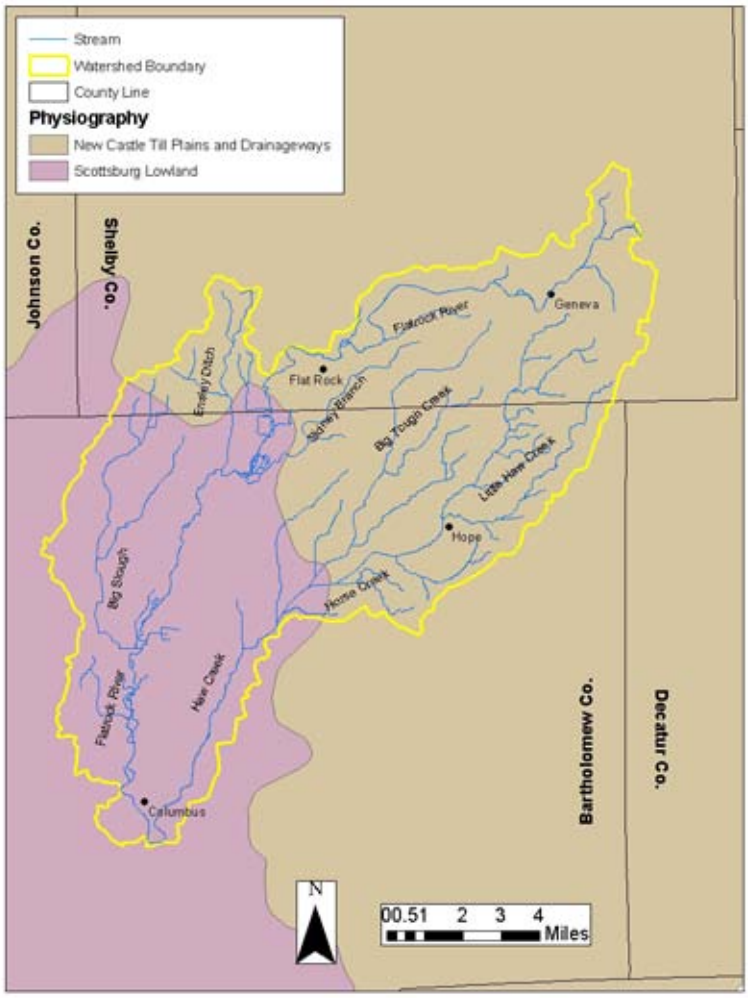
Table 2.2 Subwatersheds within the Flatrock-Haw Creek Watershed

Map ID	Subwatershed Name	Area (mi^2)	Acres	12 digit HUC
1	Town of Geneva-Flatrock River	16.72	10,708	051202050601
2	Sidney Branch-Flatrock River	16.7	10,693	051202050602
3	Big Slough	16.52	10,578	051202050603
4	Haw Creek	25.53	16,350	051202050604
5	Little Haw Creek-Haw Creek	31.09	19,910	051202050605
6	Town of Northcliff-Flatrock River	24.41	15,629	051202050606

2.3 Physiography

There are two physiographic regions that are found in the Flatrock-Haw Creek Watershed. These regions are the New Castle Till Plains and Drainageways and the Scottsburg Lowland (Figure 2.3). These two regions serve to divide the upper and lower halves of the watershed. The northern half of the watershed consists of New Castle Till Plain and Drainageways. This region is characterized by till plains formed from glacial deposits. These areas have a low relief with a crisscross pattern of tunnel valleys (Gray, 2000). The southern half of the watershed consists of Scottsburg Lowland. It is also characterized by a low relief, though one controlled by the underlying bedrock. The lowland was formed by shale erosion during the Devonian and early Mississippian ages (Meadows & Bair, 2000)

Figure 2.3 Physiographic regions in Flatrock-Haw Creek Watershed

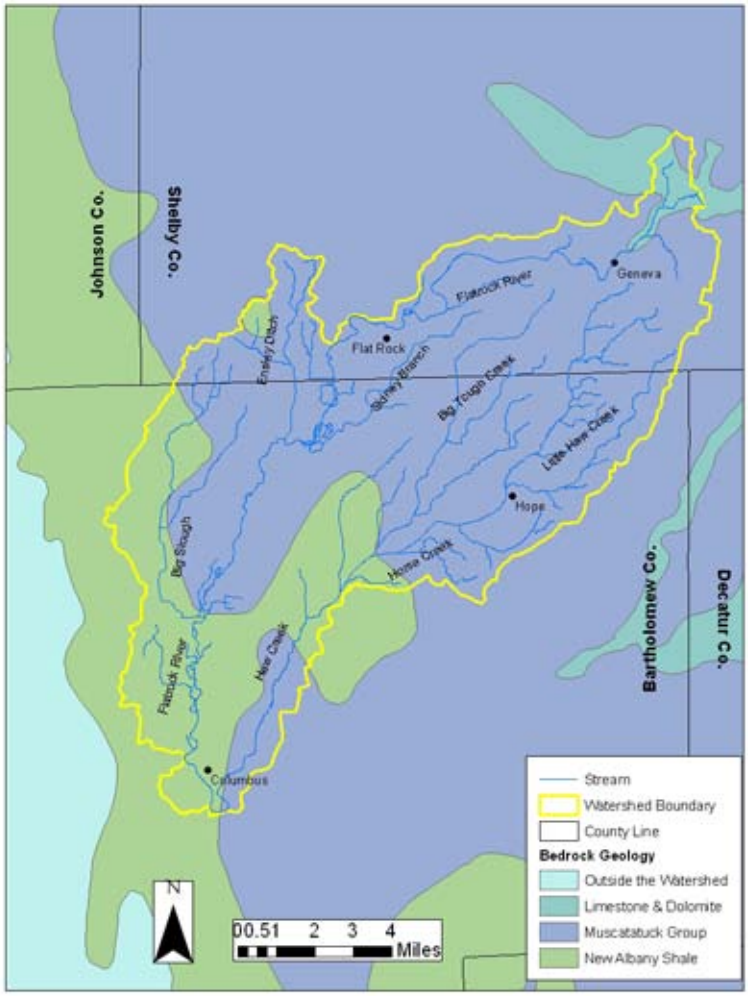


2.4 Geology

2.4.1 Bedrock Geology

Flatrock-Haw Creek Watershed consists of Muscatatuck Group, New Albany Shale, and a mix of Limestone and Dolomite geology (Figure 2.4.1). The Muscatatuck Group occurs in approximately three quarters of the watershed and is made up of dolomite and limestone. The New Albany Shale is found in the mid to lower regions of the watershed and consists of black and greenish-gray shale. Finally, the limestone/dolomite mix layer (Louisville Limestone, Brassfield Limestone, Salamonie Dolomite, and Cataract Formation) only occurs along the Flatrock River where it first enters the watershed. As long as there is enough overlying clays this bedrock geology has a low risk of surface to groundwater contamination (Maier, 2004).

Figure 2.4.1 Bedrock geology of Flatrock-Haw Creek Watershed



2.4.2 Surficial Geology

Alluvium constitutes the greater part of the area directly along the main stem of the streams that run through Flatrock-Haw Creek Watershed. Overall, the bulk of the northern half of the watershed is constituted of loam till and the southern half is dominated by undifferentiated outwash (Figure 2.4.2). Approximately ninety percent of the geology in the watershed dates back to the Wisconsinan Era or earlier, while the stream riparian areas are from the Holocene Era (Table 2.4.2). Areas where surficial contamination is likely to be highest is the areas where alluvium and outwash occur since these areas typically have less clay and silts deposited over them (Maier, 2004)

Figure 2.4.2 Surficial Geology in the Flatrock-Haw Creek Watershed

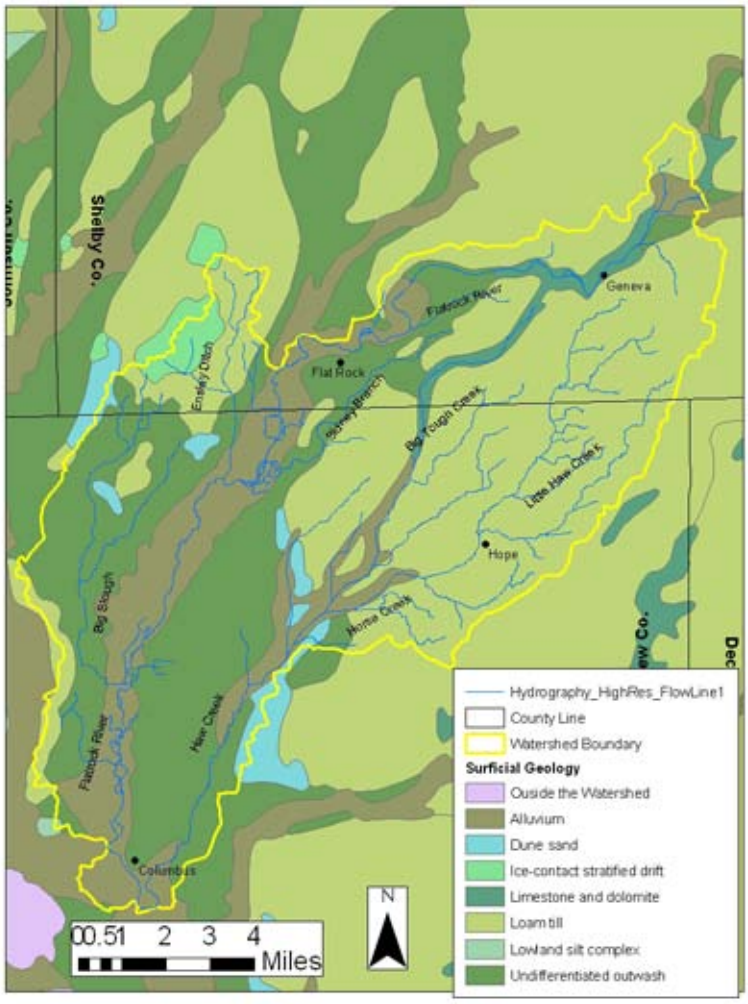


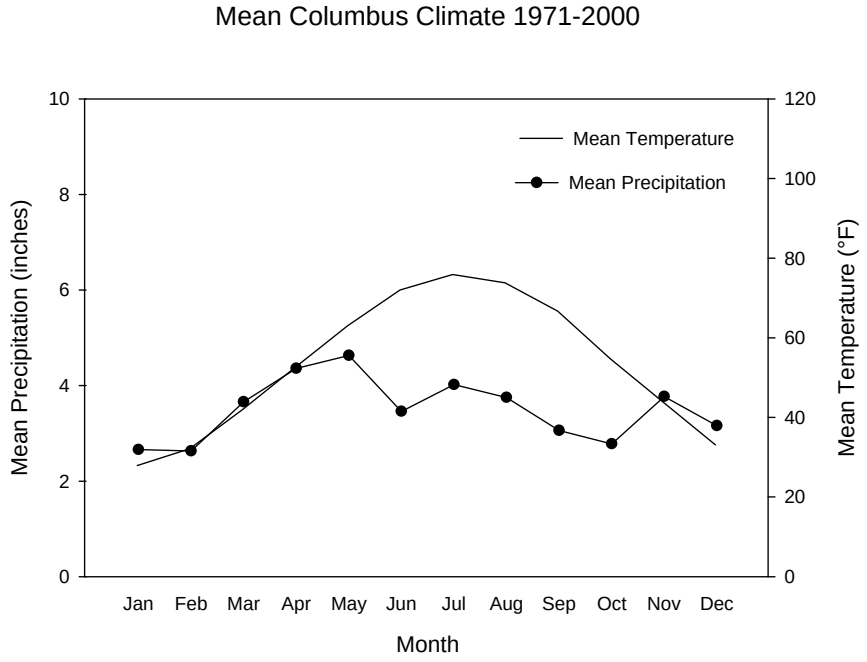
Table 2.4.2 Surficial Geology in the Flatrock-Haw Creek Watershed

Description	**Geologic Era**	**Deposition**	**% of Watershed**
Alluvium	Holocene	None	10
Dune Sand	Wisconsinian to Holocene	Aeolian	1.25
Ice-contact Stratified Drift	Pre-Wisconsinian	None	1.25
Limestone & Dolomite	Silurian & Devonian	None	2
Loam Till	Wisconsinian (Pleistocene)	Till (Huron-Erie Lobe)	42.5
Lowland Silt Complex	Wisconsinian (Pleistocene)	Relicit-surface	0.5
Undifferentiated Outwash	Wisconsinian (Pleistocene)	Outwash	42.5

2.4.3 Watershed leaching potential and local climate

Flatrock-Haw Creek Watershed has no karst within its boundaries, though portions of the watershed are more likely to have a higher leaching potential for pollutants to groundwater due to the surficial geology, particularly during large rain events. The geology where this is most likely to occur is areas of alluvium and outwash where there are little clay and silt deposits (Figure 2.4.2). As can be seen in Figure 2.4.3-2 (NCDC-NOAA, 2008) the highest average monthly precipitation events (Data based on 30 year average from 1971-2000 for the city of Columbus) occurs from May through August, indicating the portions of the year where the top half of the watershed is more likely to be susceptible to leaching. However, large rain events can happen year round.

Figure 2.4.3-2 Mean Columbus Climate based on thirty year average (1971-2000)



2.5 Soils, Wetlands and Native Vegetation

Soils

Since there are 133 different soil series that occur in Flatrock-Haw Creek Watershed, 9 different soil associations are reported in this management plan (Table 2.5, Figure 2.5.1). A soil association is an area with a distinctive proportional pattern of soils. It typically consists of one or more major soils and at least one minor soil and is named for the major soils. Soil associations are useful for general information about the soils in a region or when managing a watershed (USDA, 1991).

Figure 2.5.1 Soil Associations in Flatrock-Haw Creek Watershed

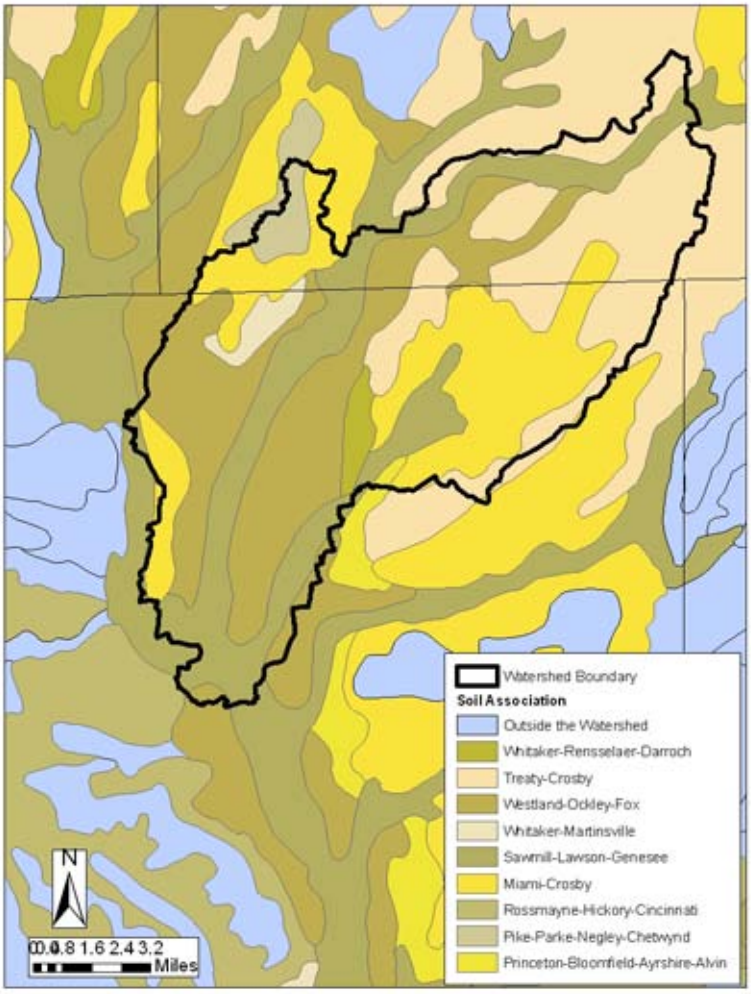


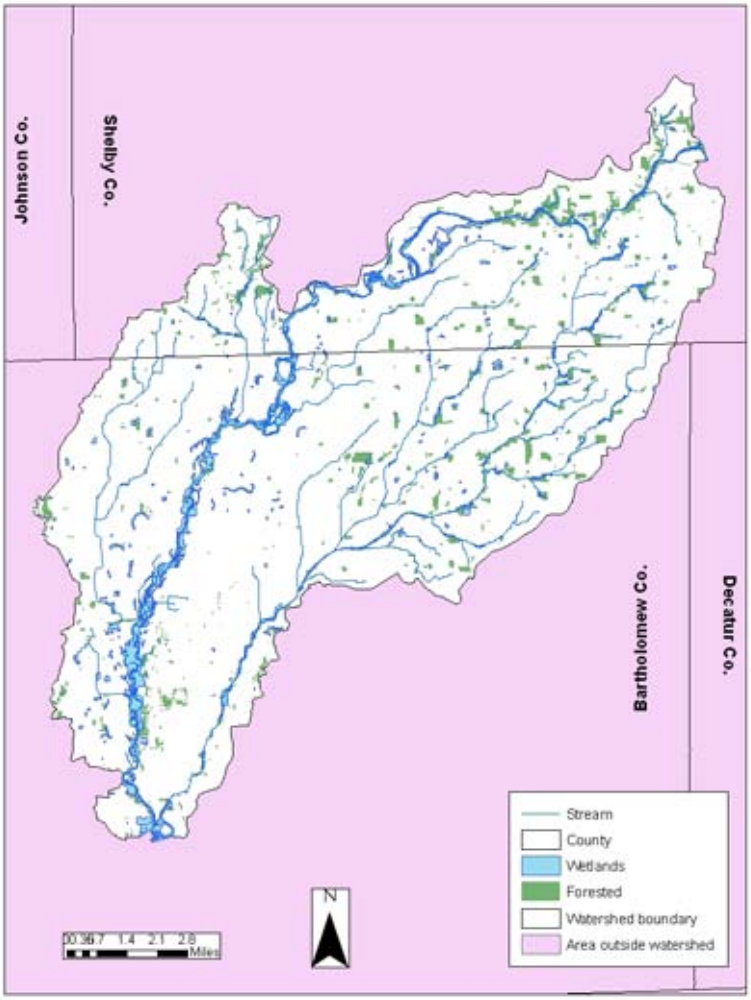
Table 2.5 Soil association characteristics in Flatrock-Haw Creek Watershed

Soil Association	% of Watershed	Characteristics	Native Vegetation
Miami-Crosby	22.0	Deep, well drained to somewhat poorly drained, medium textured, nearly level to strongly sloping soils on uplands.	Mixed hardwoods, water tolerant hardwoods
Pike-Parke-Negley-Chetwynd	1.94	Deep, well drained. Medium textured. Gently sloping to steep on uplands and terraces.	Mixed hardwoods
Princeton-Bloomfield-Ayrshire-Alvin	0.27	Deep, well drained and somewhat poorly drained. Moderately coarse textured and coarse textured. Nearly level to moderately sloping soils on uplands.	Mixed hardwoods
Rossmayne-Hickory-Cincinnati	0.002	Deep, moderately well drained. Medium textured and nearly level to steep slopes on terraces.	Mixed hardwoods
Sawmill-Lawson-Genesee	21.8	Deep, well drained to somewhat poorly drained. Nearly level to strongly sloping soils on uplands.	Mixed hardwoods
Treaty-Crosby	23.1	Somewhat poorly drained and very poorly drained soils. Nearly level. Formed in loess and glacial till on uplands.	Mixed hardwoods, water tolerant hardwoods
Westland-Ockley-Fox	27.6	Well drained, very poorly drained and somewhat poorly drained. Nearly level and gently sloping. Formed in glacial outwash on terraces and outwash plains.	Mixed hardwoods, water tolerant hardwoods
Whitaker-Martinsville	1.7	Deep, well drained and somewhat poorly drained. Medium textured and moderately coarse textured. Nearly level and gently sloping soils on terraces.	Mixed hardwoods
Whitaker-Rensselaer-Darroch	1.5	Deep, somewhat poorly drained to very poorly drained. Medium and moderately fine textured. Nearly level and gently sloping soils that formed in loess and in glacial till or outwash.	Mixed hardwoods, water tolerant hardwoods

Wetlands

Based on the National Wetland Inventory data wetlands in the watershed make up approximately 0.15% of the land use and forested areas consist of 8.0% of the land use. These areas are scattered and the majority of them lie along the stream bodies in the watershed (Figure 2.5.2). One aspect that determines the native vegetation that flourishes is the soil. Since there are over 130 soil series in the watershed they have been grouped into associations. Table 2.6 shows each soil association and the class of native vegetation typically found on that soil. The native vegetation seen in this area includes mixed hardwoods (e.g. oak, hickory, maple) and water tolerant hardwoods (e.g. tulip popular, sycamore, cottonwood).

Figure 2.6 Wetlands in Flatrock-Haw Creek Watershed



2.6 Threatened and Endangered Species

Out of the 595 endangered and threatened species in Indiana there are 48 that are known to be in either Bartholomew or Shelby counties. Of the 48 that potentially can be found in Flatrock-Haw Creek Watershed 20 of them are listed as state endangered and 18 are listed as state special concern. The rest are listed as threatened, rare or on a watch list for the future. Also, out of the 48 on the list there are only 5 that are also on the federal threatened and endangered list (4 endangered and 1 threatened).

Table 2.6 Threatened and Endangered Species

Common Name	State Rank	Federal Rank	Habitat	County
Vascular Plants				
Spreading	SE	**	Limestone creek banks	Bartholomew
Straw Sedge	ST	**	Open woods by ponds	Bartholomew
Illinois Hawthorn	SE	**	Well drained woods, fields and brushland	Bartholomew
Butternut	WL	**	Terraces and banks of streams	Bartholomew
Cattail Gay-Feather	ST	**	Prairies	Bartholomew
Small Sundrops	SR	**	Hard, white clay soil	Bartholomew
A Panic-grass	SE	**	Dry wooded slopes	Bartholomew
Gray beardtongue	SE	**	White oak slopes	Bartholomew
Smith's Bulrush	SE	**	Wet, sandy borders of lakes and sloughs	Bartholomew
Branching Bur-Reed	ST	**	Wet areas (not well known)	Bartholomew
Yellow Nodding Ladies'-Tresses	ST	**	Dry rocky roadcuts and old fields	Bartholomew
American Ginseng	WL	**	Well drained woods	Bartholomew
Mussels				
Eastern Fanshell Pearlymussel	SE	LE	Medium to large rivers in gravel riffles	Bartholomew
Northern Riffleshell	SE	LE	Medium to large rivers in gravel riffles	Shelby
Snuffbox	SE	**	Medium to large rivers in clear, gravel riffles	Bartholomew, Shelby
Wavyrayed Lampmussel	SSC	**	Medium-sized streams in gravel riffles	Bartholomew, Shelby
Kidneyshell	SSC	**	Medium to large rivers in gravel	Bartholomew, Shelby
Rabbitsfoot	SE	**	Medium to large rivers in mixed sand and gravel	Bartholomew, Shelby
Round Hickorynut	SSC	**	Medium-sized streams in sand and gravel in areas with moderate flow	Bartholomew
Clubshell	SE	LE	Medium to large rivers in gravel or mixed gravel and sand	Bartholomew, Shelby
Pyramid Pigtoe	SE	**	Medium to large rivers in sand or gravel in areas with a good current	Bartholomew
Salamander Mussel	SSC	**	Medium to large rivers on mud or gravel bars	Shelby
Purple Lilliput	SSC	**	Lakes and small to medium streams in gravel	Bartholomew, Shelby

Little Spectaclecase	SSC	**	Small to medium streams in sand or gravel	Bartholomew, Shelby
Reptiles				
Kirtland's Snake	SE	**	Wet, grassy areas along waterways (adaptable in urban settings)	Bartholomew
Birds				
Bachman's Sparrow	SXB	**	Dry, open woodlands	Bartholomew
Henslow's Sparrow	SE	**	Wet, shrubby fields and grasslands	Bartholomew
Great Blue Heron	*	**	Edge of water bodies	Bartholomew
Red-shouldered Hawk	SSC	**	Moist, mixed woodlands	Bartholomew
Sedge Wren	SE	**	Wet meadows and sedge marshes	Bartholomew
Peregrine Falcon	SE	No status	Open wetlands near cliffs	Bartholomew
Worm-Eating Warbler	SSC	**	Dense undergrowth on wooded slopes	Bartholomew
Black and White Warbler	SSC	**	Mixed woodlands	Bartholomew
Black-Crowned Night-Heron	SE	**	Edge of water bodies	Bartholomew
Barn Owl	SE	**	Open woodlands	Bartholomew
Bald Eagle	SE	LT, PDL	Large woods near water bodies	Bartholomew
Hooded Warbler	SSC	**	Small clearings with thick underbrush	Bartholomew
Mammals				
Bobcat	SSC	No status	Remote hilly forests	Bartholomew
Indiana Bat	SE	LE	Streams with deciduous forests	Bartholomew
Evening Bat	SE	**	Variety of habitats	Bartholomew
Northern River Otter	SSC	**	Medium to large streams and rivers	Shelby
Eastern Red Bat	SSC	**	Open spaces, along narrow streams and roads	Bartholomew
Hoary Bat	SSC	No status	Coniferous forests for roosting, open areas and lakes for feeding	Bartholomew
Little Brown Bat	SSC	No status	Near water, over winter in caves	Bartholomew
Northern Myotis	SSC	**	Forested hills and ridges, over winter in caves	Bartholomew
Eastern Pipistrelle	SSC	**	Edges of forests near streams, over winter in caves	Bartholomew
American Badger	SSC	**	Dry fields and pasture	Bartholomew, Shelby
Insects				
Turquoise Bluet	SR	**	Slow moving streams, ponds and lakes	Shelby

State: SX=state extirpated, SE=state endangered, ST=state threatened, SR=state rare, SSC=state special concern, WL=watch list, SG=state significant, *=not status but rarity warrants concern
Federal: LE=endangered, LT=threatened, LELT=different listings for specific ranges of species, PE=proposed endangered, PT=proposed threatened, E/SA=appearance similar to LE species, PDL=proposed for delisting, **= not listed; Indiana DNR, 2008.

3.0 Land Use

3.1 Natural History and Human Influence

The area was originally inhabited by a number of Indian tribes, with the Miami and the Delaware being the two main tribes of the region. By 1816 when Indiana became a state the area around Flatrock-Haw Creek Watershed was owned by the Delaware Indians, who had first moved into the area in the later part of the eighteenth century from eastern Ohio (Bartholomew County Historical Society, 1976). By way of the St. Mary's Treaty the Delaware's title to the land was extinguished in 1818 and white settlement began. The first settlers included General John Tipton, John Lindsey and Luke Bonesteel who came to the area in 1820 (Somerset Publishers, 1993).

The counties in which Flatrock-Haw Creek Watershed fall in include Bartholomew and Shelby and were both established in 1821. Bartholomew County was named for General Joseph Bartholomew while Shelby County was named for General Isaac Shelby.

The first railroad in Indiana was built in 1834 and part of it ran through the northern portion of Shelby County. A railroad was built from the Ohio River to Indianapolis, going through Columbus in 1843 (Bartholomew County Historical Society, 1976).

The watershed area is still approximately 78% agricultural but in the mid 1800's it was even more agriculturally oriented. The town of Columbus, currently the largest town that falls in the watershed boundary, was very rural in the mid 1850's. Upon moving to the area Reverend Dickey noted:

"*There were a few houses on Washington Street and on the street west of it, north of the railroad, but for several years after I became a citizen of this place, most of the ground north of the Madison railroad and east of Washington Street was under cultivation in a field or stood with forest trees on it"* (Bartholomew County Historical Society, 1976).

3.2 Existing Landscape

While population is continuously growing, the urban growth is only occurring within current established towns. The major towns that fall within the boundaries include Columbus (Pop. 39,690), Flat Rock (1,539), Taylorsville (Pop. 942), Clifford (Pop. 291), Hope (Pop. 2140), and Geneva (Pop. 1,368). There are also many other smaller towns that fall within the watershed boundary. The majority of the land use is agriculture, either pasture/hay or rotational cropland (Figure 3.2). Areas that are agricultural may include filter strips, riparian buffers, grass waterways, and wildlife habitat. Developed land makes up the next largest percentage of land use in the watershed (Table 3.2). Although 13.6% of the land is developed only 6% of this is urban/suburban of low to high intensity. The other portion is developed open space.

Figure 3.2 Current land use in the Flatrock-Haw Creek Watershed.

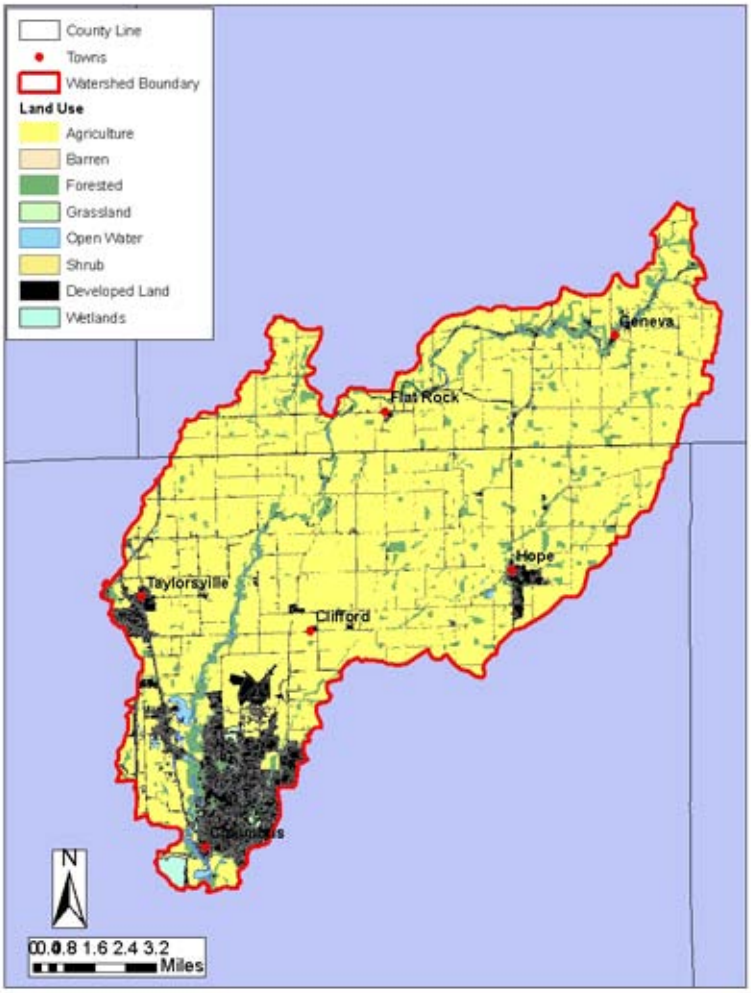


Table 3.2 Land use in Flatrock-Haw Creek Watershed

Land Use	% of Watershed
Open Water	0.75%
Developed Land	13.52%
Barren	0.001%
Forested	8.00%
Shrub	0.005%
Grassland	0.26%
Agriculture	77.27%
Wetlands	0.19%

Percentages derived from 1999 USGS land cover dataset

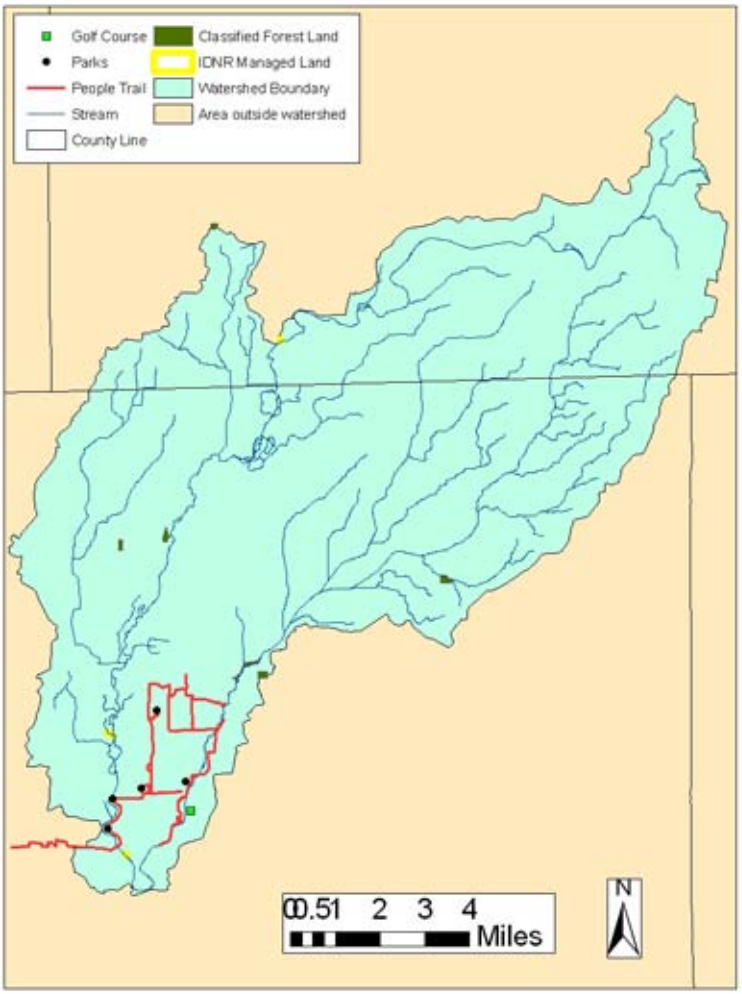
3.3 Land Ownership

Although there are no special areas or nationally owned forests in Flatrock-Haw Creek Watershed there are three areas that are maintained by the Indiana Department of Natural Resources (Indiana DNR). These areas are three public access river sites (Figure 3.3). The watershed also contains approximately 111 acres of classified forest. To be labeled as a classified forest an area must be entered into the program through Indiana DNR. The program defines a classified forest as:

"*Areas of 10 acres or more, supporting a growth of native or planted trees, which have been set aside for the production of timber and wildlife, the protection of watersheds, or the control of soil erosion. The owner of classified forest land does not relinquish ownership or control of his property and Division of Forestry does not become connected in any way with the ownership of the land.*"

Other land ownerships include local city parks and city trails (e.g. The People Trail) which are maintained by each town's park and recreation department. There are also 2 golf courses in the watershed Finally, the cities of Columbus and Hope have their major wellheads located within the watershed.

Figure 3.3 Land Ownership in Flatrock-Haw Creek Watershed



3.4 Point Source Discharge and Regulated Permits

Although the Flatrock-Haw Creek Watershed Project focuses largely on nonpoint source pollution there are regulated, point sources that also influence the water quality. Nonpoint source pollution is from a diffuse source, making it more difficult to pinpoint the contamination source(s). The planning process for the project is non-regulatory and is intended to improve the water quality in Flatrock-Haw Creek Watershed. Some ways in which the project will promote better water quality is through promotion of Best Management Practices (BMPs), community involvement, and widespread education about water quality issues. Point source pollution is from a defined source, such as a waste water treatment plant or industry, and is regulated through the National Pollution Discharge Elimination System (NPDES).

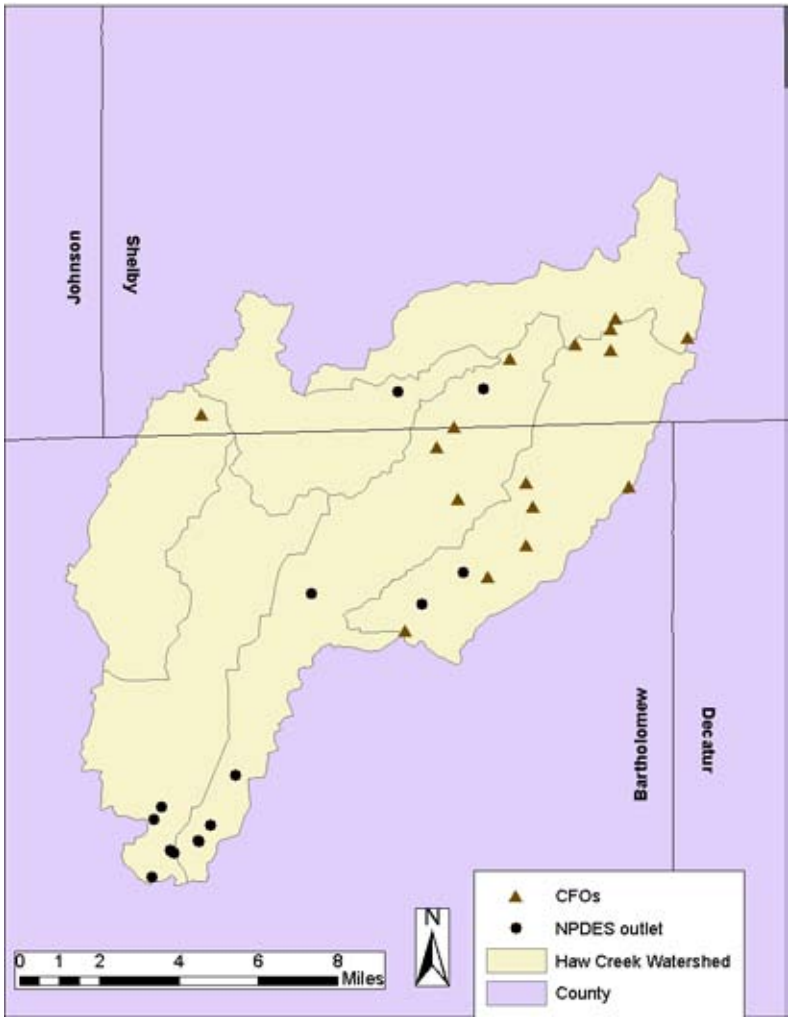
Contaminants leaving NPDES facilities are regularly self-monitored to ensure compliance of water quality standards established by the state of Indiana. These water quality reports are then reported to IDEM and available for public view. In 2007 Flatrock-Haw Creek Watershed had twelve (12) active and five (5) inactive permits in the watershed (Table 3.4, Figure 3.4) (Appendix D).

In addition to NPDES permits the state regulates confined feeding operations (CFOs). These operations are designated as CFOs based on livestock type and size of the operation. In 2006 there were seventeen (17) CFOs in Flatrock-Haw Creek Watershed (Table 3.4, Figure 3.4). Of the seventeen (17) CFOs, four (4) are registered CAFOs.

Table 3.4 NPDES outlets and CFOs status

County	NPDES outlets		Confined Feeding Operations		
	Active	Inactive	Active	Inactive	Voided
Bartholomew	10	5	7	1	1
Shelby	2	0	6	0	2

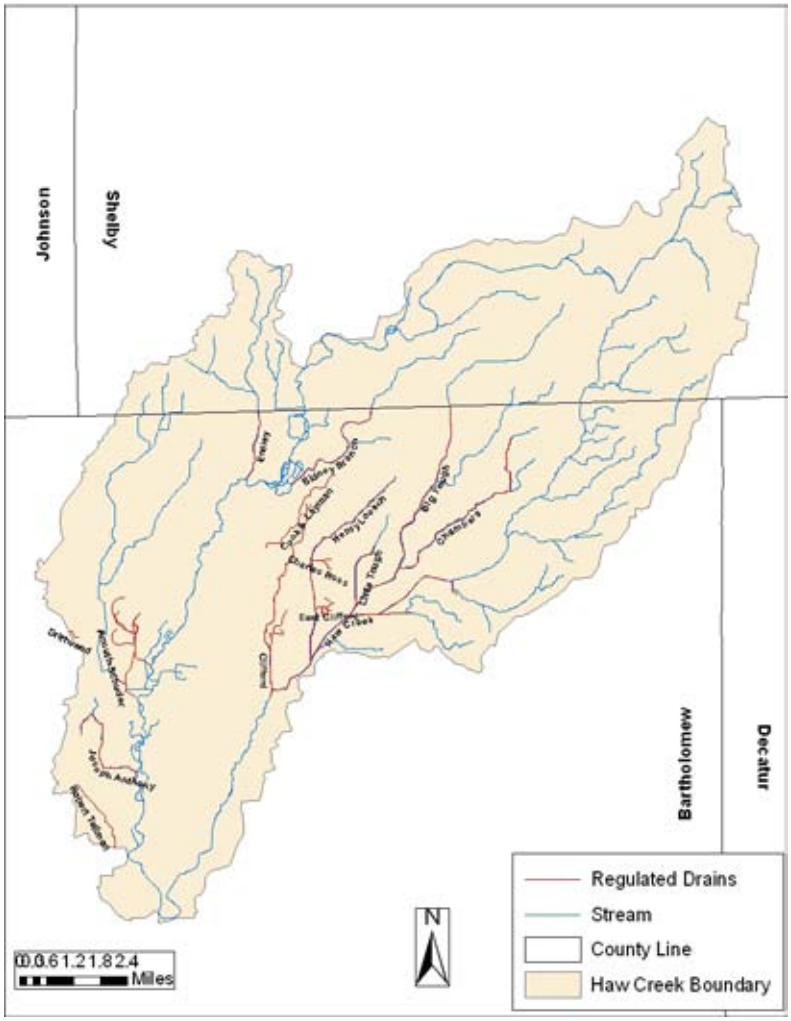
Figure 3.4 Location of NPDES outlets and CFOs in Flatrock-Haw Creek



3.5 Legal Drains

A legal drain is a regulated waterway that is engineered to move water from an area as quickly as possible. In addition to legal drains there is extensive tile drainage existing in both Bartholomew and Shelby counties that are unregulated. Majorly, legal drains are used to direct tile drainage and surface drainage away from fields and homes. Bartholomew County has an extensive legal drain system throughout the county with many of these drains located in Flatrock-Haw Creek Watershed. The legal drains in Bartholomew County that fall within the Flatrock-Haw Creek Watershed (Figure 3.5)include: Armuth-Schuder , Aaron Essex-Edward Lortz (Big Tough), Albert Reed-Elizabeth Stultz (Chambers), Charles Ross, Clifford Drain, Cook & Layman, Driftwood, East Clifford, Kate Ensley, Francis Overstreet (Haw Creek), Henry Loesch, Joseph Anthony, Marshall D. Lee (Little Tough), Robert Tellman, and Mary R. Glanton (Sidney Branch).

Figure 3.5 Bartholomew County legal drains in Flatrock-Haw Creek

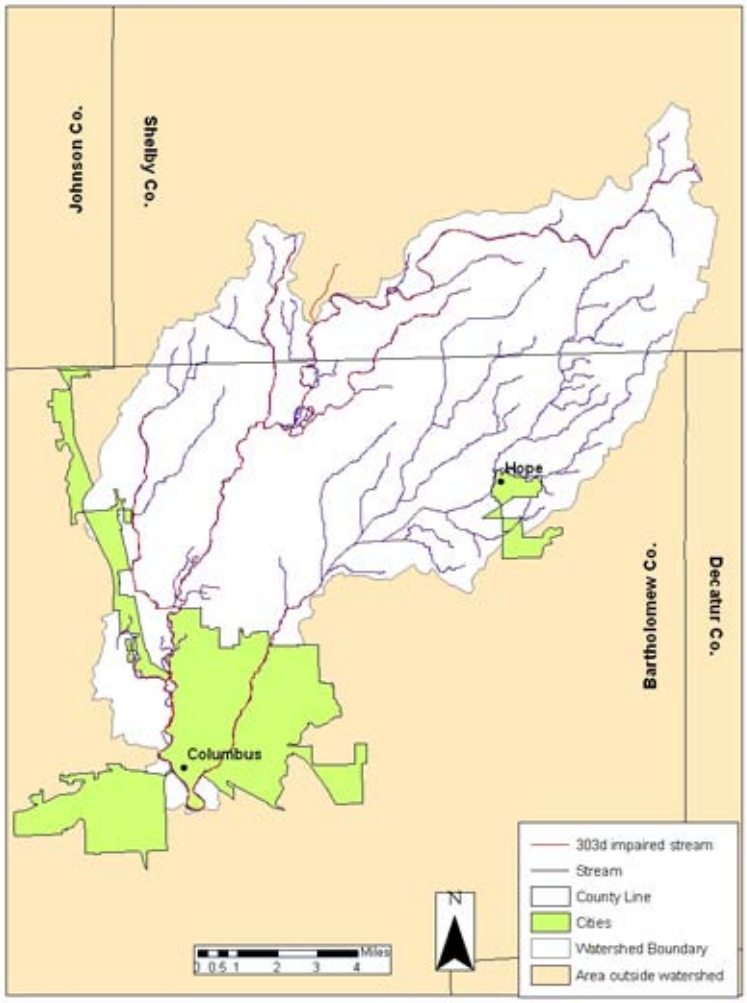


4.0 Investigation of Water Quality Issues and Benchmarks

4.1 Designated Use, Assessment, and Impairment

Since the Clean Water Act (1977) states are required to assess the quality of its water bodies to show compliance for state water quality standards. If a water body fails to meet the required standard it is listed on a 303(d) list created by the State regulating agency. In Indiana the Indiana Department of Environmental Management (IDEM) regulates the state's water bodies. These standards are set based on specific uses, which are aquatic life, human health (drinking), and recreation (swimming, fishing). If it is determined that water bodies in a watershed do not meet the water quality standards a Total Maximum Daily Load (TMDL) document is developed. In 2005 a TMDL for E. coli was developed for the larger Flatrock-Haw Creek Basin (HUC 05120205).

Figure 4.1 Segments in Flatrock-Haw Creek listed on the 2008 303(d) impaired water list



In 2008 twenty (20) segments of Flatrock-Haw Creek Watershed were listed on the 303(d) list for E. coli. These segments include the entire length of Flatrock River that is in the watershed, the lower portion of Haw Creek, Big Slough, Ensley Ditch, and Sidney Branch. This indicates that these segments do not meet state water quality standards for full body contact. These segments are currently listed in the 2005 TMDL that was developed for the larger Flatrock-Haw Creek Basin.

4.2 Land Inventory

Flatrock-Haw Creek Watershed drains approximately 84,000 acres which includes agricultural, urban/suburban, and industrial areas in two counties. Different land uses influence the water quality in the watershed. While most of the land is agricultural in use, the majority of the urban area of Columbus is encompassed in the watershed boundaries (See section 3 for details).

Table 4.2 Specific land use of Flatrock-Haw Creek

Land Use	% of Watershed	Category
Open water	0.75%	Water
Developed, open space	7.44%	Urban/Suburban
Developed, low intensity urban	3.84%	
Developed, medium intensity urban	1.49%	
Developed, high intensity urban	0.75%	
Barren	0.001%	Natural Vegetation
Deciduous forest	7.95%	
Evergreen forest	0.05%	
Mixed forest	0.002%	
Shrub	0.005%	
Grassland	0.26%	
Pasture/Hay	2.83%	Agriculture
Row crop	74.44%	
Woody wetlands	0.14%	Wetlands
Emergent herbaceous wetlands	0.05%	

Percentages from 1999 USGS land cover

4.2.1 Agricultural Practices

The majority of agricultural practices are row crop (corn, soybean) with the possibility of a cover crop during the winter months (Table 4.2.1-1). Typically, crops are grown on flatter or slightly rolling areas where steep areas are used for pasture or allowed to re-grow with natural vegetation.

Table 4.2.1-1 2007 Crop yields by county

County	**Corn**		**Soybeans**	
	Acres	**Yield (bushels)**	**Acres**	**Yield (bushels)**
Bartholomew	73,700	139	59,800	35
Shelby	106,700	128	87,400	37
	Wheat		**Hay**	
	Acres	**Yield (bushels)**	**Acres**	**Yield (tons)**
Bartholomew	4,500	60	4,000	2.17
Shelby	3,400	59	3,400	1.91

In no-till/strip-till systems a field is left undisturbed from harvest through planting with the exception of strips up to 1/3 of the row width. Planting or drilling is done using disc openers, coulters, row cleaners, in-row chisels or roto-tillers. In addition to no-till farmers can utilize mulch till, which is full width tillage where during one or more tillage trips the entire soil surface is disturbed prior to planting. In both conservation tillage practices residue cover greater than 30% is left. Reduced tillage is where during one or more tillage trips all of the soil surface is disturbed prior to planting, but there is a 15-30% residue cover left after planting. A final tillage practice used in the watershed is conventional tillage. With this method a farmer conducts full width tillage disturbing the entire soil surface before planting leaving less than a 15% residue cover after planting (CTIC, 2002).

While not used county wide there are areas in the counties that use no-till and mulch-till technology, which helps water quality by reducing soil erosion. Bartholomew County farms 48% of its corn acres using no-till practices. Conventional tillage is the next most common used practice with about 35% of the county using it. Mulch till and reduced till is used in small portions (Figure 4.2.1-1). Mulch till is the practice most commonly used for corn acres in Shelby County, with 51%. No-till practices make up about 38% of the tillage practice for corn, leaving only small portions that use reduced and conventional tillage (Figure 4.2.1-2). In Bartholomew County 73% of the soybean acres utilize no-till practices. Mulch till and conventional tillage is used about the same, 11% for each practice, while reduced tillage is used little for soybeans (Figure 4.2.1-3). Landowners in Shelby County have 95% of their soybean acres utilizing no-till practices with the rest of the fields spread between the other tillage practices (Figure 4.2.1-4). These values are based on the most recent data, but as can be seen in the figures below no-till practices have been gaining in use since 1990.

Figure 4.2.1-1 Bartholomew tillage practices for corn

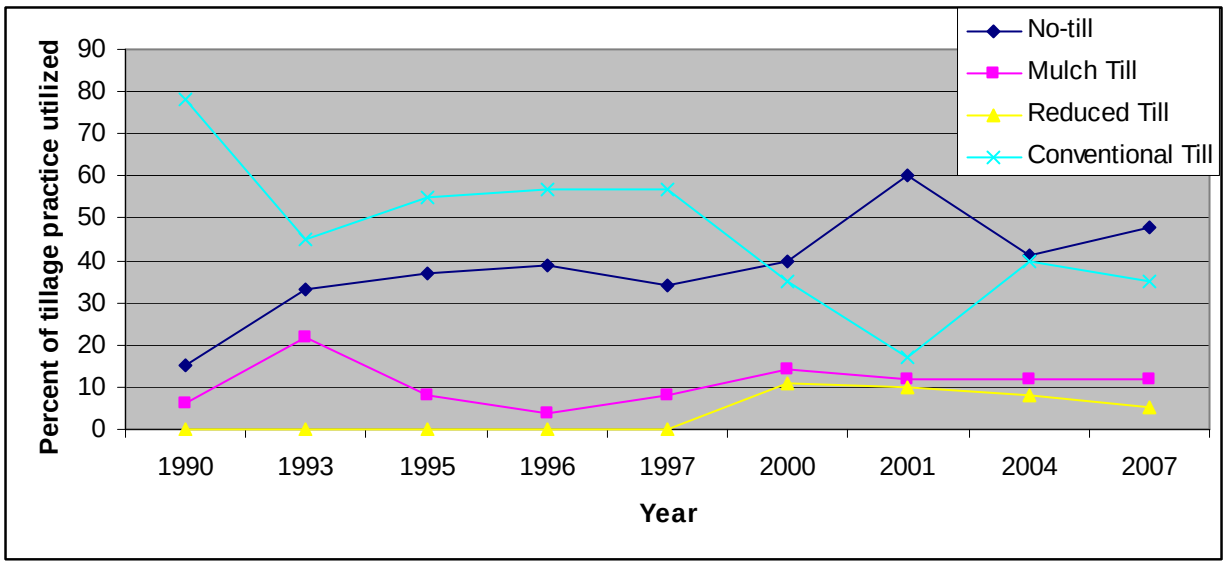


Figure 4.2.1-2 Shelby tillage practices for corn

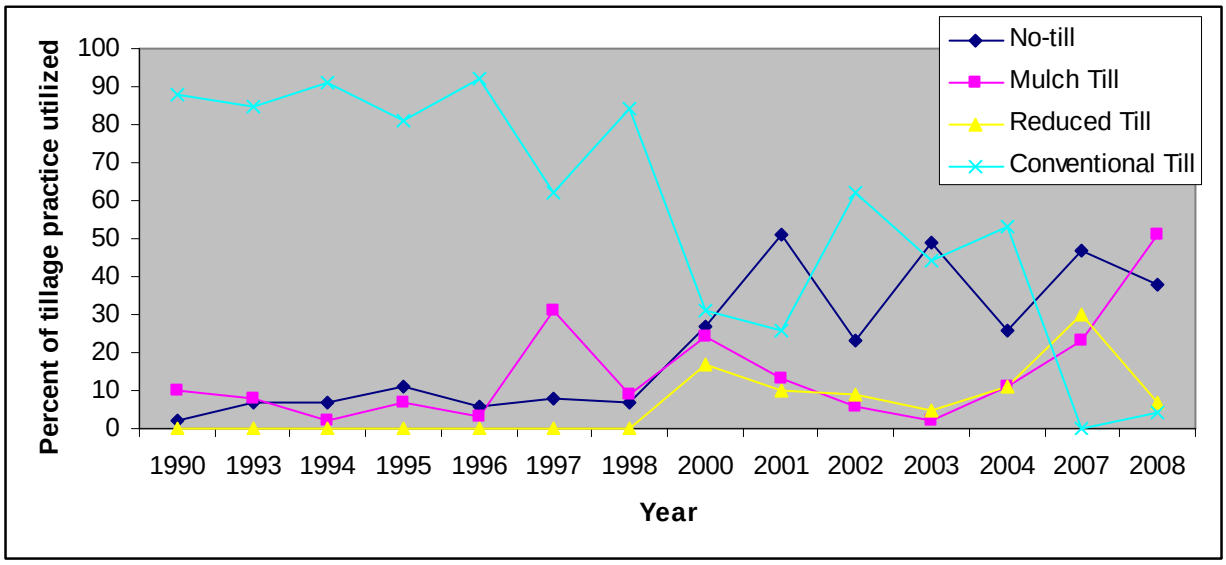


Figure 4.2.1-3 Bartholomew tillage practices for soybeans

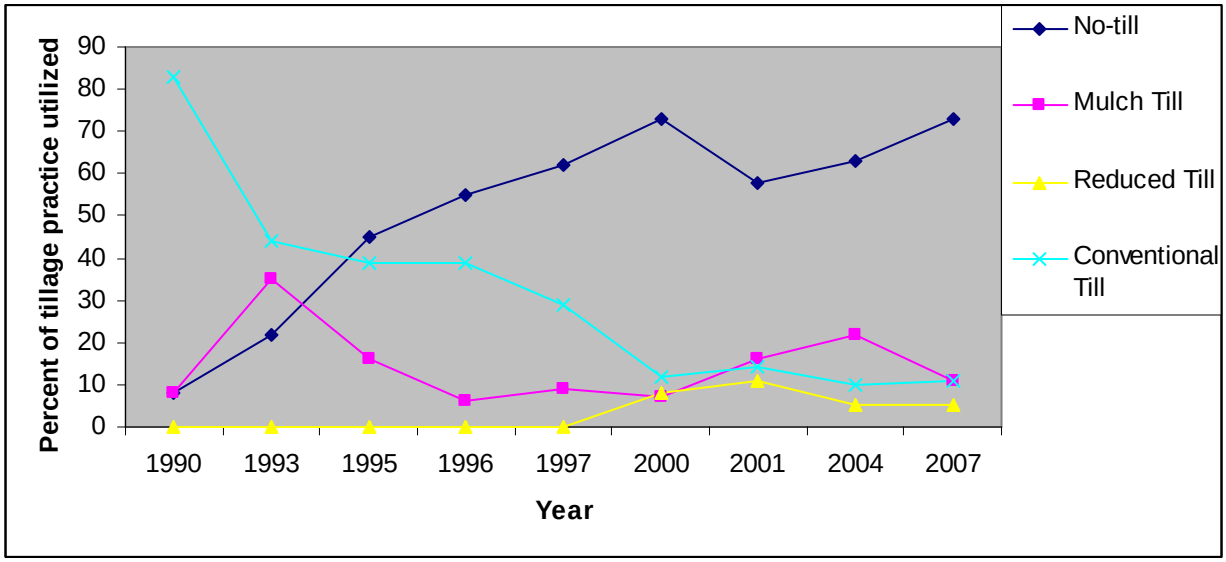
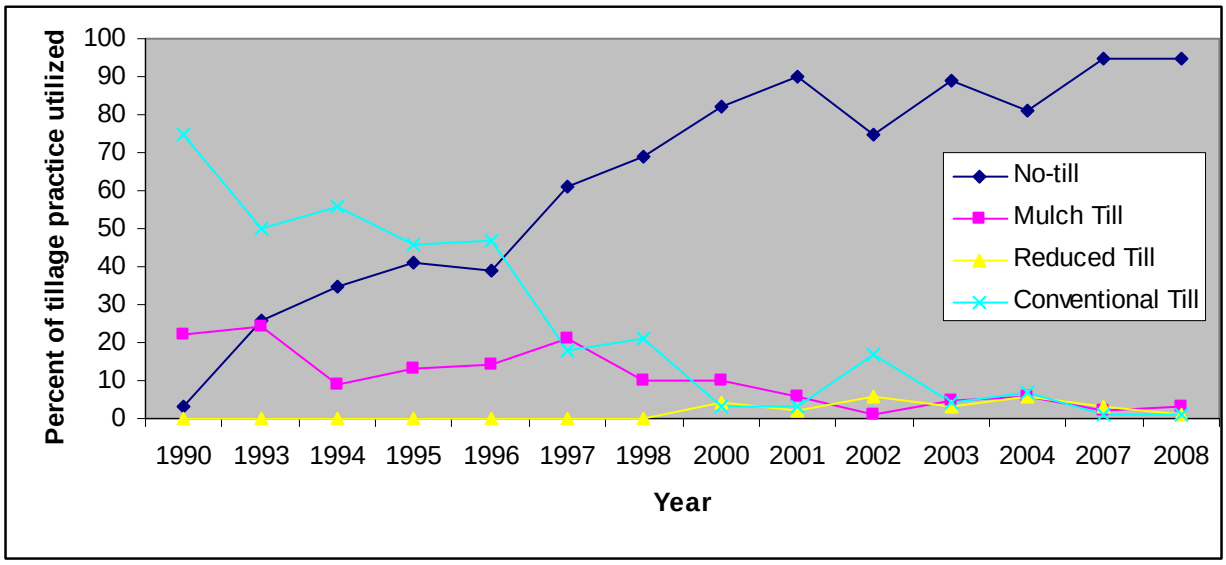


Figure 4.2.1-4 Shelby tillage practices for soybeans



4.2.2 Agricultural Practices: Livestock

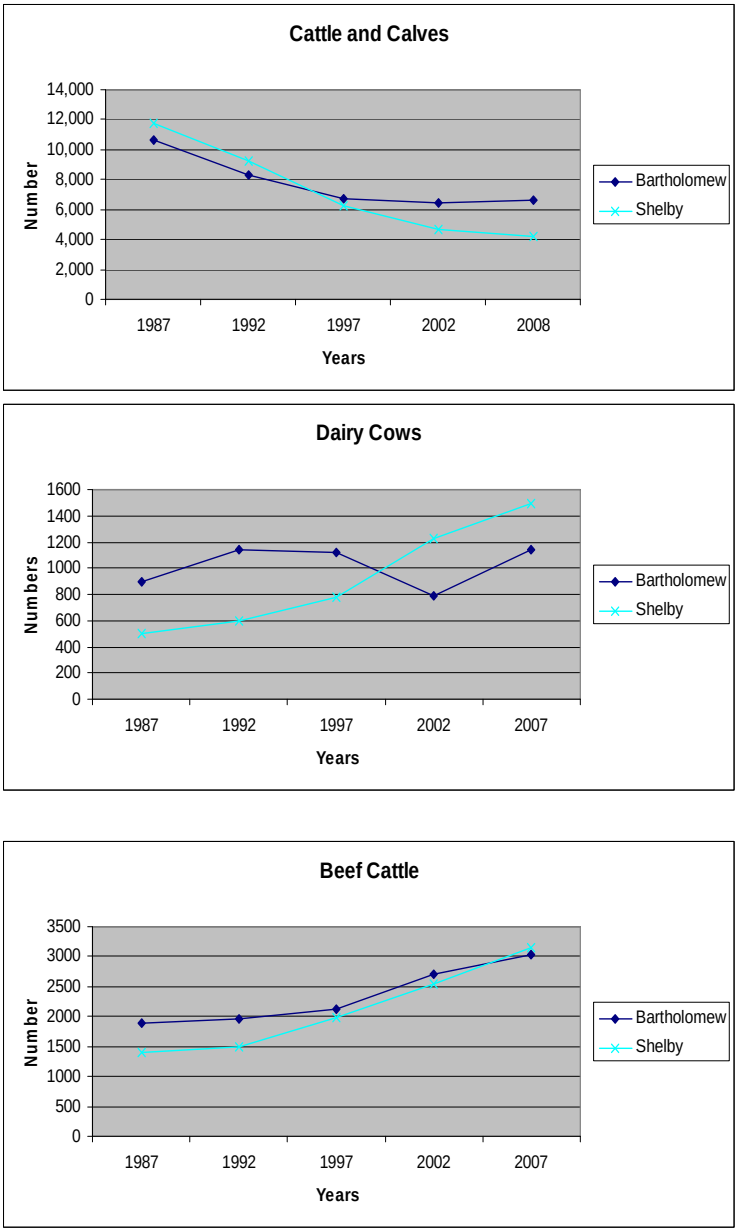
In addition to row crops there are a variety of livestock practices in the counties containing Flatrock-Haw Creek Watershed. In Table 4.2.2 livestock types that are found in Bartholomew and Shelby counties. Figure 4.2.2 also shows how the livestock numbers have changed over time. There are also areas in the watershed where livestock have unrestricted access to the stream, compounding existing water quality issues. Some BMPs that landowners can implement to help relieve these problems include fencing the stream off to livestock and creating an alternative water source for the animals.

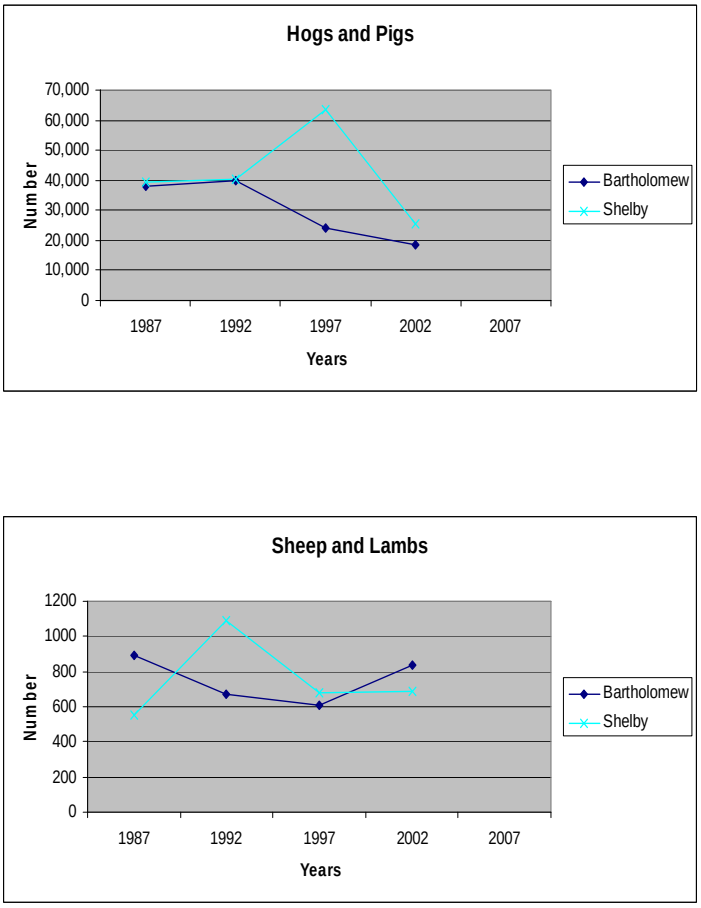
Table 4.2.2 Livestock type and numbers by county

County	Livestock Type	Numbers
Bartholomew	**Cattle and Calves**	6,600
	Beef Cows	2,000
	Milk Cows	900
	Hogs and Pigs	18,755
	Sheep and Lambs	837
Shelby	**Cattle and Calves**	4,200
	Beef Cows	1,300
	Milk Cows	600
	Hogs and Pigs	25,471
	Sheep and Lambs	685

- 2002 for all animal numbers except cattle, 2008 for cattle

Figure 4.2.2 Livestock numbers by county and type over time

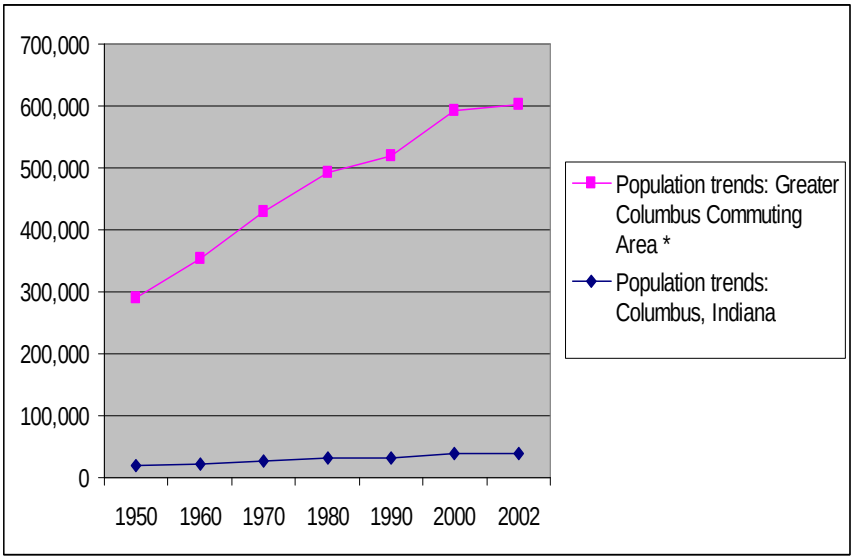




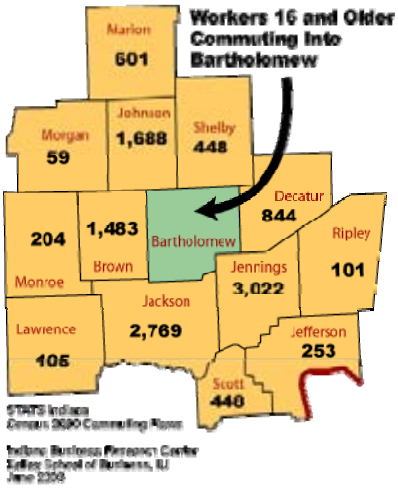
4.2.3 Urban/Suburban/Impervious Surface and Population Density

While Flatrock-Haw Creek Watershed is approximately 77% agricultural there are a few main urban/suburban areas that may also influence water quality. Although 13.5% is listed as developed only 6% of the land use is developed with low to high intensity (the other portion is developed open space). This developed open space is very likely to be roads and other impervious surfaces, which add to the runoff to the streams. Cities and towns in Flatrock-Haw Creek include Clifford, Columbus, Flatrock, Geneva, Hope, Old Saint Louis, Pleasure Valley, Saint Louis Crossing, and Taylorsville. Although the population growth in Columbus has been fairly consistent over the past fifty (50) years, the population that commutes into the Columbus area has steadily increased (Figure 4.2.3). In 2000 there were 12,334 people who live outside Bartholomew County and commute in for work in addition to the 30,010 Bartholomew County residents that work in Bartholomew County.

Figure 4.2.3 Population change in Columbus and surrounding commuting area



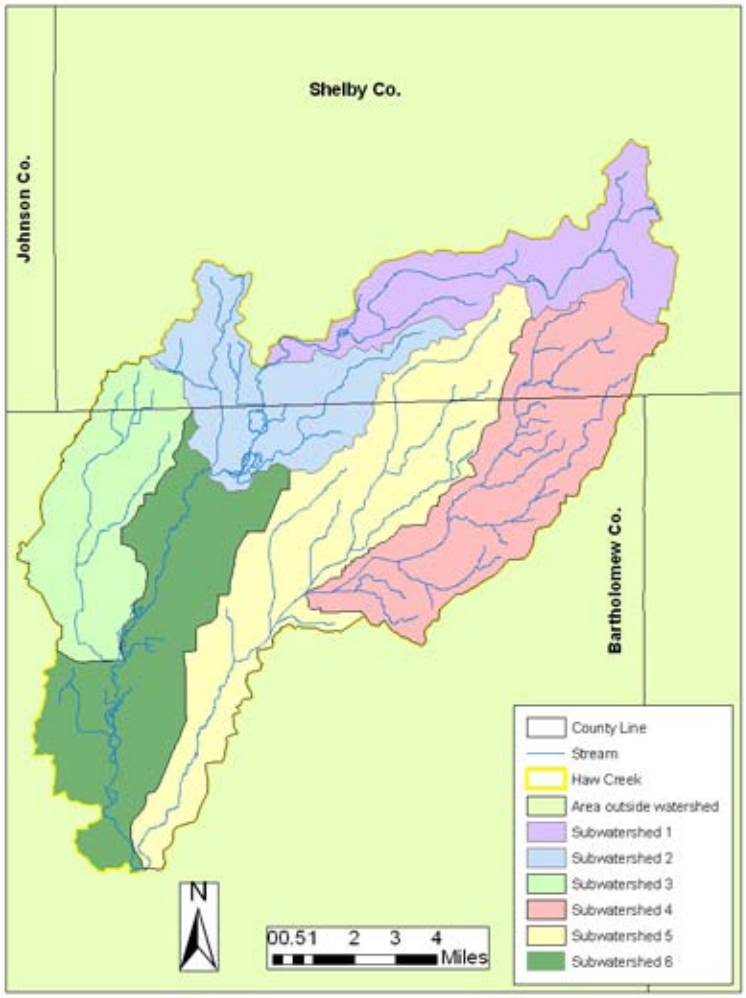
The Columbus commuting area includes Barthol
Brown, Decatur, Jackson, Jennings, Johnson, La
Monroe, Ripley, Scott and Shelby Counties (see
graphic)



4.3 Land Inventory, Visual Assessment and Spatial Research by Subwatershed

To help break up the watershed in more manageable areas the watershed has been divided into six (6) groups, the six (6) subwatersheds that make up the Flatrock-Haw Creek watershed (Figure 4.3)

Figure 4.3 Six subwatersheds in Flatrock-Haw Creek



4.3.1 Subwatershed one-Town of Geneva-Flatrock River

Subwatershed one contains a portion of Flatrock River as it first flows into Flatrock-Haw Creek Watershed (Figure 4.3.1). As subwatershed 1 is the northern most area of Flatrock-Haw Creek Watershed it is also the only subwatershed completely in Shelby County. The majority of land use in this subwatershed is row crop agriculture, although most of the areas directly along the stream are forested. There is little urban land use within this subwatershed (Table 4.3.1.1). The town of Geneva, population 1,368, does fall within the subwatershed boundary.

There are two (2) active confined feeding operations within this area, both of which are upstream of the project's water monitoring site that is in this subwatershed (Figure 4.3.1). In addition to these regulated sources, potential non-point source pollution sources include a small dairy farm and a few small horse farms where livestock have creek access, a large population of geese that overwinter in this area, many landowners that still use conventional tillage practices, and the area in and around Geneva that utilize septic systems. Current contaminants of concern estimates for subwatershed one are shown in Table 4.3.1.2. These were derived from L-THIA using land use.

IDEM has two sites that have past general chemistry water quality data (Section 4.4.1). One site is on 150W and was only sampled in 2002 but the other site (SR 252, near Flatrock) is a fixed site that has been monitored monthly since 1999 and is still in use. In addition there are two sites that were used in the 2002 Flatrock-Haw Creek Basin TMDL. These sites were on SR 9 and at the fixed station on SR 252 (Section 4.4.1). In addition to IDEM collected data there is one site that has been sampled by a Hoosier Riverwatch Volunteer (Flatrock behind 240 acre camp, Section 4.4.1).

Figure 4.3.1 Subwatershed one in Flatrock-Haw Creek

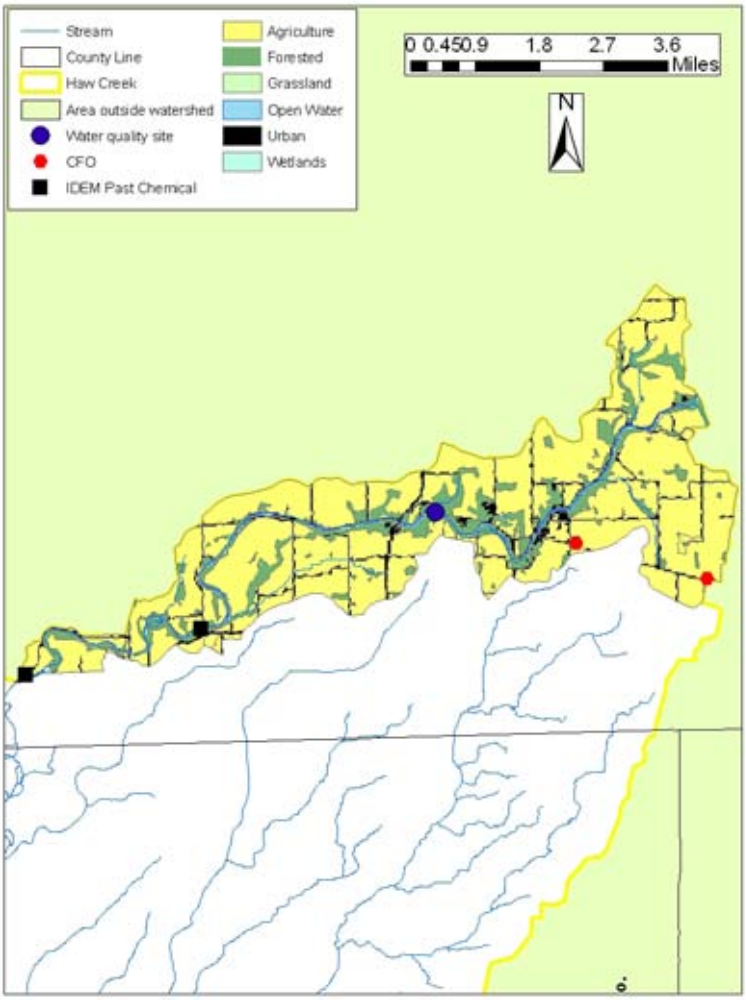


Table 4.3.1.1 Land use in subwatershed one

Land Use	% of Watershed
Water	0.37 %
Urban/Suburban/Developed open space	3.07 %
Forest	6.64 %
Grassland	0.05 %
Hay/Pasture	0.40 %
Row Crops	89.01 %
Wetlands	0.46 %

Table 4.3.1.2 Estimated contaminants in subwatershed one

Contaminant	Estimates
Nitrogen (lbs)	31,010
Phosphorus (lbs)	9,153
Suspended Sediment (lbs)	751,581
E.coli (millions of coliform)	845,057
BOD (lbs)	35,993

4.3.2 Subwatershed two- Sidney Branch-Flatrock River

Flatrock River continues through subwatershed two. The confluence of Sidney Branch, Flatrock River and Ensley's Ditch is near the base of the subwatershed (Figure 4.3.2). The upper portion of the subwatershed is in Shelby County while the lower portion falls in Bartholomew County. The majority of land use in this subwatershed is row crop agriculture. While the majority of the area along Flatrock River is forested the areas along Sidney Branch and Ensley's Ditch is row crop agriculture. There is also very little urban land use in subwatershed two (Table 4.3.2.1). Flat Rock, population 1,539, is the only concentration of houses in the subwatershed. There are no confined feeding operations within this area (Figure 4.3.2), although there is a NPDES regulated Ward's Stone Quarry within the subwatershed. Potential non-point pollution sources include stream bank erosion in the southern portion of the subwatershed, a public access site on State Road 252, septic systems around Flatrock, and use of conventional tillage in the river bottoms. Current contaminants of concern estimates for subwatershed two are shown in Table 4.3.2.2. These were derived from L-THIA using land use. IDEM has one site that is at top center of subwatershed two, SR 252 (Section 4.4.1). This data collected in 1997 is general water chemistry data.

Figure 4.3.2 Subwatershed two in Flatrock-Haw Creek

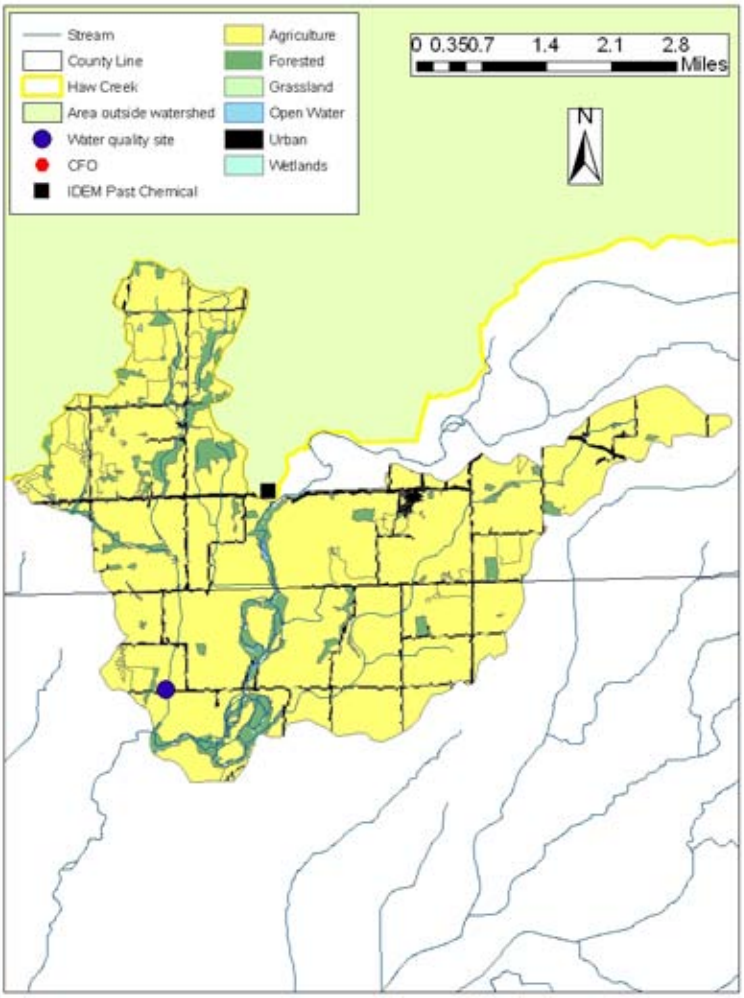


Table 4.3.2.1 Land use in subwatershed two

Land Use	% of Watershed
Water	0.08 %
Urban/Suburban/Developed open space	3.62 %
Forest	5.28 %
Grassland	0.04 %
Hay/Pasture	5.37 %
Row Crops	85.39 %
Wetlands	0.22 %

Table 4.3.2.2 Estimated contaminants in subwatershed two

Contaminant	Estimates
Nitrogen (lbs)	29,910
Phosphorus (lbs)	8,810
Suspended Sediment (lbs)	723,022
E.coli (millions of coliform)	816,147
BOD (lbs)	36,364

4.3.3 Subwatershed three- Big Slough

Subwatershed three contains Big Slough, from its start until it confluences with Flatrock River at the base of the subwatershed (Figure 4.3.3). A small portion of the subwatershed is in Shelby County, with the majority of the area in Bartholomew County. The majority of land use in this subwatershed is row crop agriculture. Urban land use makes up the next largest type (Table 4.3.3.1), as it contains portions of Columbus (population 39,690) and Taylorsville (population 942). There is one (1) active confined feeding operation within this area, upstream of the water monitoring site (Figure 4.3.3). Potential non-point source pollution sources include new construction areas near I65, bare soil exposure from tree removals, and the septic systems around Taylorsville. In addition, this area has sandy soil with a higher potential for nitrate leaching. Current contaminants of concern estimates for subwatershed three are shown in Table 4.3.3.2. These were derived from L-THIA using land use. The water monitoring site in this subwatershed is dry for a majority of the year and will only be used for sampling larger storm events. There are no sites within this area where water quality has been tested, most likely due to the lack of flow in the major water body in this subwatershed.

Figure 4.3.3 Subwatershed three in Flatrock-Haw Creek

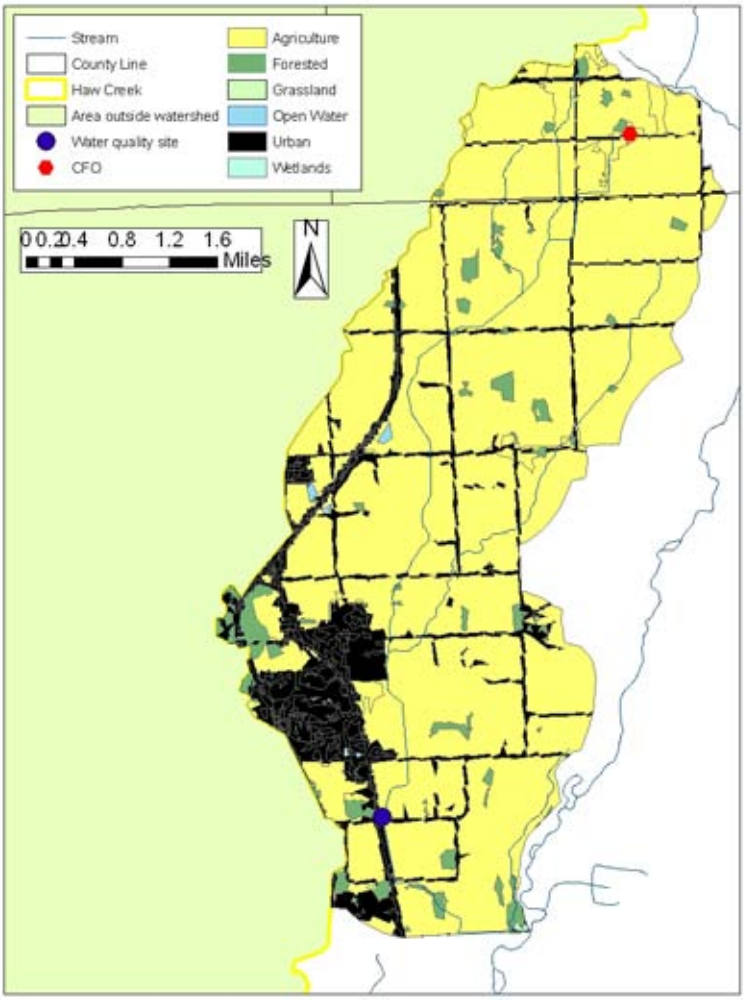


Table 4.3.3.1 Land use in subwatershed three

Land Use	% of Watershed
Water	0.11 %
Urban/Suburban/Developed open space	12.49 %
Forest	3.79 %
Grassland	0.05 %
Hay/Pasture	3.25 %
Row Crops	80.30 %
Wetlands	0.01 %

Table 4.3.3.2 Estimated contaminants in subwatershed three

Contaminant	Estimates
Nitrogen (lbs)	29,527
Phosphorus (lbs)	8,741
Suspended Sediment (lbs)	711,829
E.coli (millions of coliform)	846,281
BOD (lbs)	58,232

4.3.4 Subwatershed four-Haw Creek

Subwatershed four contains a portion of the headwaters of Haw Creek; including the tributaries of Little Haw Creek, Horse Creek, and Chickens Creek (Figure 4.3.4). The upper portion of the subwatershed is in Shelby County with the remainder in Bartholomew County. The majority of land use in this subwatershed is row crop agriculture, with some forested areas directly along the stream. There is also minor urban land use in subwatershed one four, although it does contain the town of Hope (population 2,140) (Table 4.3.4.1). The largest number of confined feeding operations falls in this subwatershed. There are eight (8) active confined feeding operations, one (1) inactive operation, and one (1) voided operation within the area, all of which are upstream of the water monitoring site (Figure 4.3.4). In addition to the regulated CFOs, there are old sewage lagoons, the Hope WWTP, and a wood products area that is NPDES regulated. Potential non-point source pollution sources include stream bank erosion upstream a lift station in Hope, a large dump site on 550N, and a large population of geese that overwinter at the WWTP in Hope. Finally, Hope well water is unable to be used for drinking due to high nitrate levels. Current contaminants of concern estimates for subwatershed four are shown in Table 4.3.4.2. These were derived from L-THIA using land use. IDEM and Hoosier Riverwatch do not currently have any sampling sites within this area so no past water quality data exists for the water bodies.

Figure 4.3.4 Subwatershed four in Flatrock-Haw Creek

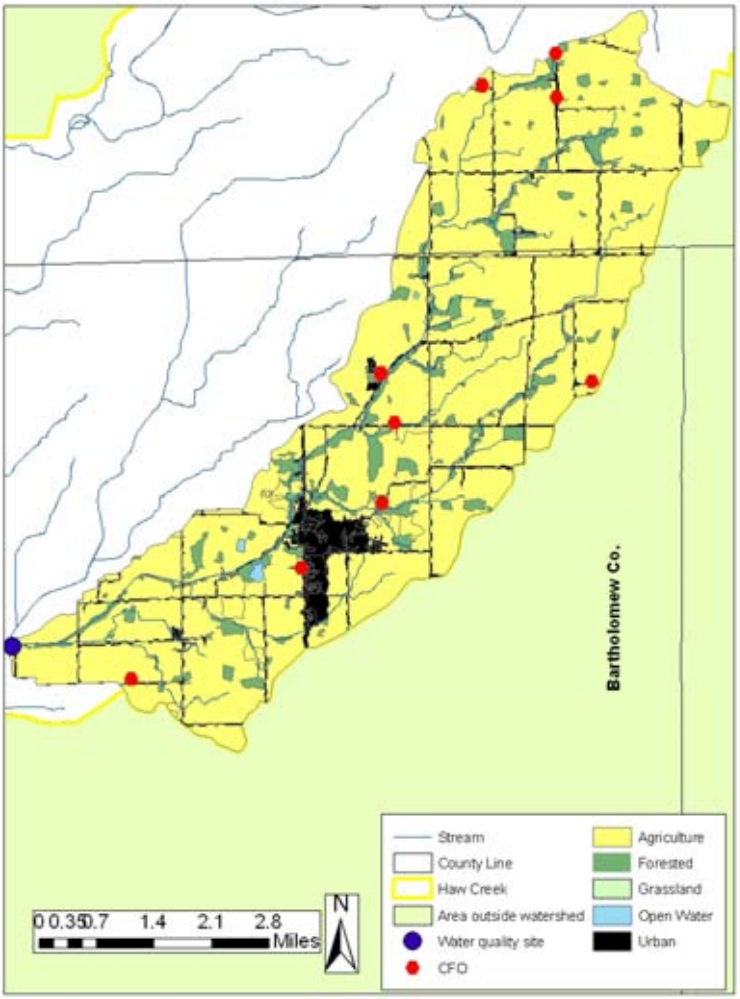


Table 4.3.4.1 Land use in subwatershed four

Land Use	% of Watershed
Water	0.11 %
Urban/Suburban/Developed open space	4.29 %
Forest	4.49 %
Grassland	0.02 %
Hay/Pasture	1.27 %
Row Crops	89.82 %
Wetlands	0.00 %

Table 4.3.4.2 Estimated contaminants in subwatershed four

Contaminant	Estimates
Nitrogen (lbs)	48,125
Phosphorus (lbs)	14,214
Suspended Sediment (lbs)	1,165,952
E.coli (millions of coliform)	1,319,673
BOD (lbs)	60,405

4.3.5 Subwatershed five-Little Haw Creek-Haw Creek

Subwatershed five contains the lower portion of Flatrock-Haw Creek along with several tributaries. These include Slash Loesch Ditch, Tough Creek, and Chambers Ditch (Figure 4.3.5). This subwatershed stretches nearly the length of Flatrock-Haw Creek Watershed, with the majority of it in Bartholomew County. At the base of this subwatershed is where Haw Creek flows into the East Fork of the White River. The majority of land use in this subwatershed is row crop agriculture, with very little of the areas directly along the stream forested. Urban land use make up the next largest portion, as it includes a large portion of Columbus (Table 4.3.5.1). There are four (4) confined feeding operations within this area, two of which are active and two have been voided (Figure 4.3.5). These operations are all in the upper portions of the subwatershed, two in each county. In addition, there are a Heritage Aggregates Stone Quarry, Cross Cliff Elementary, and Cummins, Inc that is NPDES permitted in subwatershed five. Potential non-point source pollution sources include horse access to the stream during the winter, construction along both US31 and 600N, conventional tillage use in river bottoms, septic system use around Clifford, and salt runoff from urban areas such as Columbus. Current contaminants of concern estimates for subwatershed five are shown in Table 4.3.5.2. These were derived from L-THIA using land use. IDEM has one site (SR 7) that has past general chemistry water quality data (Section 4.4.1). In addition this site was used in the 2002 Flatrock-Haw Creek Basin TMDL.

Figure 4.3.5 Subwatershed five in Flatrock-Haw Creek

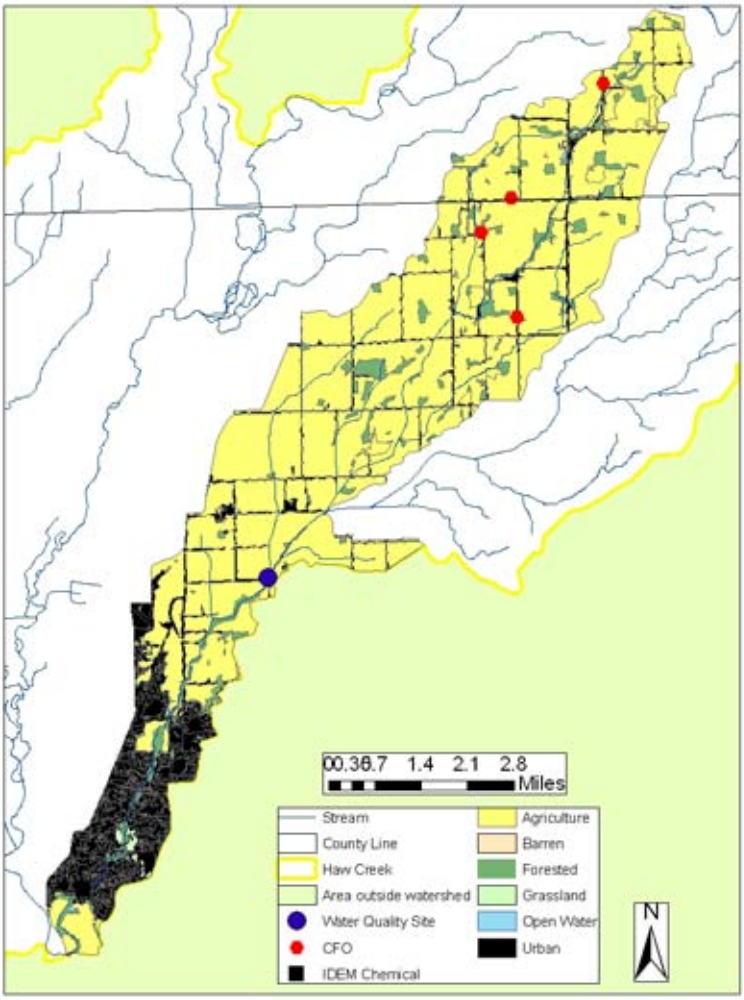


Table 4.3.5.1 Land use in subwatershed five

Land Use	% of Watershed
Water	0.27 %
Urban/Suburban/Developed open space	12.65 %
Barren	0.002
Forest	3.47 %
Grassland	0.21 %
Hay/Pasture	0.96 %
Row Crops	82.44 %
Wetlands	0.00 %

Table 4.3.5.2 Estimated contaminants in subwatershed five

Contaminant	Estimates
Nitrogen (lbs)	56,923
Phosphorus (lbs)	16,872
Suspended Sediment (lbs)	1,374,024
E.coli (millions of coliform)	1,632,136
BOD (lbs)	111,599

4.3.6 Subwatershed six-Town of Northcliff-Flatrock River

Subwatershed six contains the lower portion of Flatrock River (Figure 4.3.6). Near the base of this area is where Flatrock River dumps into the East Fork of the White River. This is the only subwatershed completely with Bartholomew County. While the majority of land use in this subwatershed is row crop agriculture it has the lowest amount of row crop land use of any subwatershed. This area also has the highest urban land use of all the subwatersheds, as it contains a large portion of Columbus (Table 4.3.6.1). There are no confined feeding operations within this area (Figure 4.3.6). NPDES regulated sources include three combined sewer overflows and a groundwater petro remediation site. Potential non-point source pollution sources include the airport, specialty crops that are planted that require extra chemicals, new construction sites, a public access point, septic systems in Armuth Acres, conventional tillage in river bottoms, an old landfill, and an old creosote plant. Current contaminants of concern estimates for subwatershed six are shown in Table 4.3.6.2. These were derived from L-THIA using land use.

While there is no plan for the project to monitor in this subwatershed data can be obtained from IDEM who has a fixed site near the base of the subwatershed. This site is one of three sites where general water chemistry has been monitored in the past (800N, SR 11, and SR 46 fixed station) (Section 4.4.1). There are also two sites that are monitored occasionally by Hoosier Riverwatch volunteer student groups (Mill Race and Noblitt Parks) The two sites listed in section 4.4.1 that show pesticide data are also within this subwatershed. In addition there are three sites that were used in the 2002 Flatrock-Haw Creek Basin TMDL. These sites include 800N, SR 11, and SR 31 at the USGS gage (Section 4.4.1).

Figure 4.3.6 Subwatershed six in Flatrock-Haw Creek

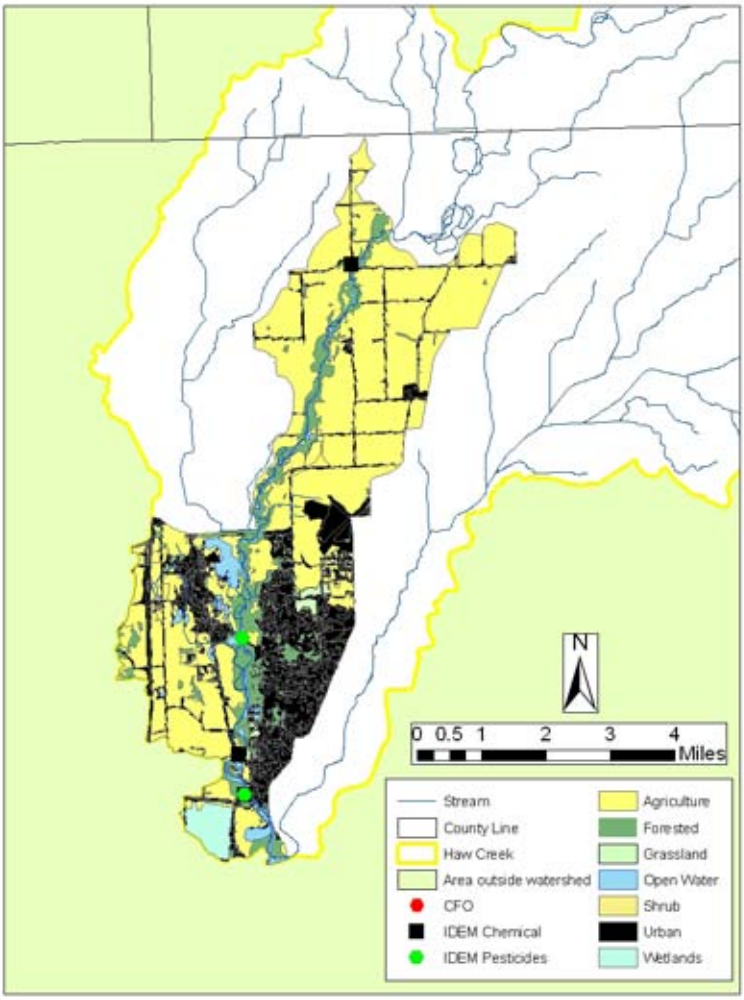


Table 4.3.6.1 Land use in subwatershed six

Land Use	% of Watershed
Water	1.64 %
Urban/Suburban/Developed open space	16.02 %
Forest	6.13 %
Shrub	0.01 %
Grassland	0.41 %
Hay/Pasture	1.39 %
Row Crops	74.35 %
Wetlands	0.05 %

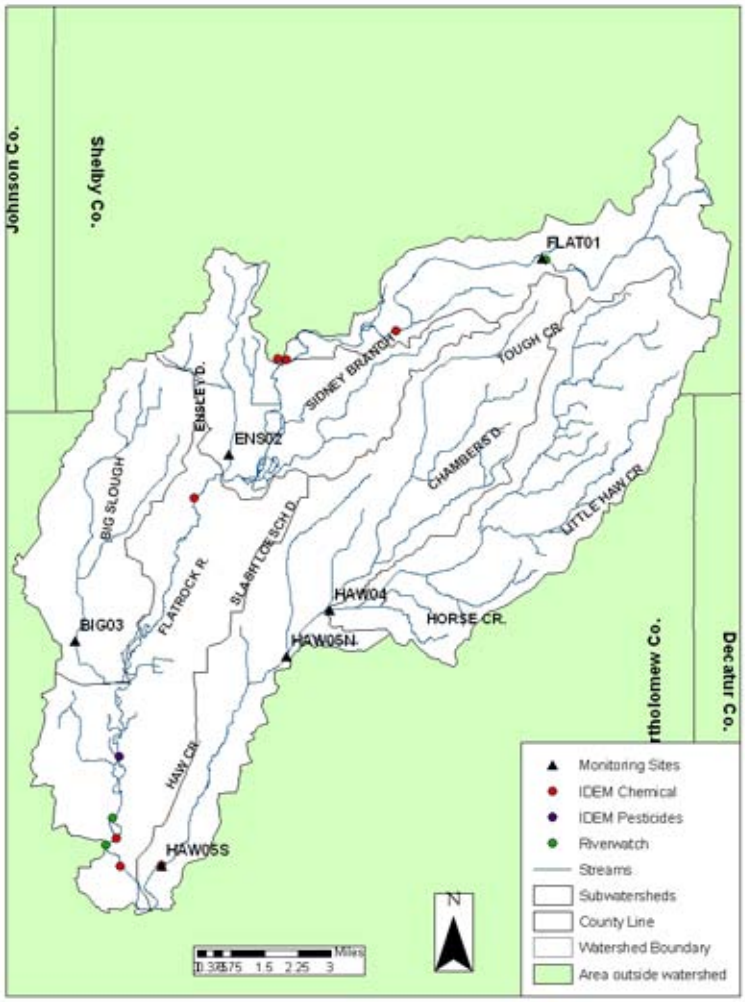
Table 4.3.6.2 Estimated contaminants in subwatershed six

Contaminant	Estimates
Nitrogen (lbs)	41,665
Phosphorus (lbs)	12,356
Suspended Sediment (lbs)	1,002,298
E.coli (millions of coliform)	1,220,882
BOD (lbs)	97,370

4.4 Existing Data and Current Water Quality Sampling

Indiana Department of Environmental Management (IDEM) has collected data throughout the watershed in addition to the study done to complete the TMDL for the larger Flatrock-Haw Creek Basin. In addition, there are three locations where Hoosier Riverwatch volunteers have collected the data in the past. Volunteer water samples at five sites will begin May 2009 and will monitor flow, chemistry, biology, and habitat of these areas. The collection and analysis will be done on a monthly basis in accordance with the Flatrock-Haw Creek Watershed Quality Assurance Project Plan (QAPP). Biological sampling will occur twice yearly in May and August. Data collection incorporates Hoosier Riverwatch methods for in-field sampling and laboratory analysis done by Columbus City Utilities laboratory. Figure 4.4 shows past data sites from IDEM and Hoosier Rivewatch as well as the potential water monitoring sites.

Figure 4.4 Past and current potential monitoring sites in Flatrock-Haw Creek Watershed



4.4.1 Chemical and Pathogen Data

The TMDL completed in 2002 by IDEM highlights the need for improvement of water bodies in the Flatrock-Haw Creek Basin. In the larger basin there were six (6) sites tested for E. coli that fall within the smaller Flatrock-Haw Creek Watershed. These samples showed spikes over 2400 cfu/100 mL and geometric means above the state standard for secondary contact at all but one (1) site. IDEM has also collected data at seven (7) sites for general water chemistry. Two of the sites are fixed data sites that are tested monthly. The other sites were sampled either in 1997 or 2002. Table 4.4.1-1 shows the general water chemistry data that IDEM has collected at those seven (7) sites.

Table 4.4.1-1 Summary data for selected parameters, IDEM

Location	Sample Number	Parameter	Median	Maximum	Minimum
CR 150 W (2002)	3	Ammonia (mg/L)	< 0.10	< 0.10	< 0.10
	3	Nitrate + Nitrite (mg/L)	2.70	6.00	0.08
	3	Total Phosphorus (mg/L)	0.08	0.12**	0.06
	3	TSS (mg/L)	11.00	19.00	8.00
CR 800 N (2002)	3	Ammonia (mg/L)	< 0.10	< 0.10	< 0.10
	3	Nitrate + Nitrite (mg/L)	2.50	3.50	1.20
	3	Total Phosphorus (mg/L)	0.07	0.07	0.03
	3	TSS (mg/L)	14.00	20.00	5.00
SR 11 (1997)	7	Nitrate + Nitrite (mg/L)	4.30	7.10	1.80
	7	Total Phosphorus (mg/L)	0.12**	0.31**	0.04
	7	TSS (mg/L)	26.00	109.00**	4.00
	3	E. coli (CFU/100 mL)	120.00	1800.00*	90.00
SR 252 (1997)	6	Nitrate + Nitrite (mg/L)	3.95	5.80	1.90
	6	Total Phosphorus (mg/L)	0.05	0.07	0.04
	6	TSS (mg/L)	9.00	29.00	4.00
	3	E. coli (CFU/100 mL)	310.00*	600.00*	130.00
SR 252, near Flat Rock (1999-2008)	114	Ammonia (mg/L)	< 0.10	< 0.10	< 0.10
	114	Nitrate + Nitrite (mg/L)	4.47	11.00*	0.10
	114	Total Phosphorus (mg/L)	0.05	0.51**	0.03
	114	TSS (mg/L)	9.00	280.00**	4.00
SR 46 (1991-2008)	211	Ammonia (mg/L)	0.10	0.30*	< 0.10
	218	Nitrate + Nitrite (mg/L)	3.20	6.60	1.00
	218	Total Phosphorus (mg/L)	0.08	0.52**	0.03
	217	TSS (mg/L)	13.00	408.00**	4.00
	89	E. coli (1991-1998) (CFU/100 mL)	100.00	5000.00*	10.00
SR 7 (1997)	6	Nitrate + Nitrite (mg/L)	2.80	4.40	0.67
	6	Total Phosphorus (mg/L)	0.07	0.09	0.03
	6	TSS (mg/L)	4.00	10.00	4.00
	3	E. coli (CFU/100 mL)	100.00	180.00	30.00

* Values that exceed Indiana Administrative Code standards for that parameter. E.coli standards are <235 cfu/100 mL. Nitrate + Nitrite standards are <10 mg/L for drinking water. Ammonia standards are <0.21 mg/L. ** Values that exceed IDEM draft TMDL target. Total phosphorus targets are <0.3 mg/L and Total Suspended Solids (TSS) targets are < 30 mg/L. (http://www.in.gov/idem/6242.htm)

Table 4.4.1-1 shows general chemistry for several sites sampled by IDEM. Table 4.4.1-2 focuses on E. coli data from the 2002 TMDL. The sites listed below in the table are the ones that fall within the Flatrock-Haw Creek Watershed.

Table 4.4.1-2 E. coli data from 2002 TMDL sites in smaller Flatrock-Haw Creek Watershed, IDEM

Site ID	Description	Sample Date	E. coli (CFU/100 mL)
WEF050-0013, Site 11	SR 9, Flatrock River, Shelby County	5/30/2002	310
		6/6/2002	> 2400
		6/13/2002	78
		6/20/2002	50
WEF050-0002, Site 12	SR 252 fixed station, Flatrock River, Shelby County	6/16/200	830
		7/27/2000	120
		5/31/2001	200
		5/30/2002	340
		6/6/2002	1700
		6/13/2002	820
		6/20/2002	240
		6/27/2002	440
		9/16/2002	153
		9/23/2002	48.8
		9/30/2002	54.6
		10/7/2002	52
		6/23/2004	290
		9/30/2004	93
WEF050-009, Site 13	CR 800 N, Flatrock River, Bartholomew County	5/30/2002	550
		6/6/2002	1600
		6/13/2002	460
		6/20/2002	87
		6/27/2002	460
WEF050-0001, Site 14	SR 31 USGS gage, Flatrock River, Bartholomew County	5/30/2002	580
		6/6/2002	340
		6/13/2002	210
		6/20/2002	17
WEF050-004, Site 15	SR 11, Flatrock River, Bartholomew County	6/4/1997	600
		7/10/1997	120
		9/17/1997	90
		5/30/2002	730
		6/6/2002	550
		6/13/2002	1300
		6/20/2002	70
		6/27/2002	> 2400
WEF060-002, Site 16	SR 7 Columbus, Haw Creek, Bartholomew County	5/30/1997	180
		7/16/1997	100
		9/19/1997	30
		7/31/2002	275
		8/7/2002	86
		8/15/2002	866
		8/21/2002	228
		8/28/2002	150

In addition to the water chemistry data IDEM also sampled for pesticides in 1997 at two sites in Flatrock-Haw Creek. Table 4.4.1-3 shows the pesticides that showed spikes or high values. Atrazine, a herbicide used when planting corn shows the highest spikes. At the two sites there were spikes of 38 and 44 ppb. The U.S. EPA drinking water standard for atrazine is 3 ppb.

Table 4.4.1-3 Summary data for selected pesticides, 1997 IDEM data

Location	Detections	Common Name	Trade Name	Class	Median	Maximum	Minir
Columbus, 2.6 Miles U/S from Mouth, 0.2 Miles NW of Columbus	15	Atrazine (ppb)	AAtrex, Atranex	Herbicide	1.10	38.00	
	15	Acetochlor (ppb)	Acenit, Guardian, Harness	Herbicide	0.10	9.80	
	15	Alachlor (ppb)	Lasso, Lariat, Crop Star	Herbicide	0.10	5.70	
	15	Clomazoe (ppb)	Several	Herbicide	0.10	1.00	
	15	Cyanazine (ppb)	Bladex, Fortrol, Payze	Herbicide	0.10	5.00	
	15	Dieldrin (ppb)	Several	Insecticide	<0.10	<0.10	
	15	Metolachlor (ppb)	Several	Herbicide	0.10	8.30	
	15	Metribuzin (ppb)	Several	Herbicide	0.10	0.30	
	15	Simazine (ppb)	Princep	Herbicide	0.07	0.30	
Columbus, Abutment of Abandoned Bridge, W End of 2nd St	17	Atrazine (ppb)	AAtrex, Atranex	Herbicide	0.90	44.00	
	17	Acetochlor (ppb)	Acenit, Guardian, Harness	Herbicide	0.10	11.00	
	17	Alachlor (ppb)	Lasso, Lariat, Crop Star	Herbicide	0.10	4.80	
	17	Clomazone (ppb)	Several	Herbicide	0.10	1.30	
	17	Cyanazine (ppb)	Bladex, Fortrol, Payze	Herbicide	0.10	4.50	
	17	Dieldrin (ppb)	Several	Insecticide	<0.10	<0.10	
	17	Metolachlor (ppb)	Several	Herbicide	0.20	13.00	
	17	Metribuzin (ppb)	Several	Herbicide	0.10	0.30	
	17	Simazine (ppb)	Princep	Herbicide	0.07	2.00	

There are three (3) sites where data has been collected by Hoosier Riverwatch volunteers. Table 4.4.1-4 shows this general water chemistry data as well as the number of samples taken at each site.

Table 4.4.1-4 Summary data for selected parameters, Hoosier Riverwatch

Location	Sample Number	Parameter	Median	Maximum	Minimum
Flatrock River, behind 240 acre camp (2001-2002)	1	E. coli (CFU/100 mL)	0.00	0.00	0.00
	3	pH	8.50	8.50	8.40
	1	BOD5 (mg/L)	4.00	4.00	4.00
	4	Water Temp.(C)	11.00	20.00	1.00
	4	Turbidity (NTU)	9.00	40.00**	5.00
Near Mill Race Park, Columbus (2001-2003)	10	Dissolved Oxygen (mg/L)	11.18	13.67*	7.30
	2	E. coli (CFU/100 mL)	100.00	100.00	100.00
	1	G. Coliforms (CFU/100 mL)	10.00	10.00	10.00
	10	pH	7.96	9.73	7.40
	10	BOD5 (mg/L)	2.85	4.33	0.30
	10	Water Temp.(C)	13.50	26.00	5.00
	10	Turbidity (NTU)	12.00**	18.00**	5.00
Noblitt Park, Columbus (1997-2008)	35	Dissolved Oxygen (mg/L)	9.60	12.67*	7.00
	20	E. coli (CFU/100 mL)	42.00	13333.00*	0.00
	17	G. Coliforms (CFU/100 mL)	1889.00	53334.00	10
	35	pH	7.90	9.37	6.67
	35	BOD5 (mg/L)	1.00	7.00	0.00
	35	Water Temp.(C)	16.00	22.00	6.00
	35	Turbidity (NTU)	15.01**	90.00**	5.00

* Values that exceed Indiana Administrative Code standards for that parameter. E.coli standards are <235 cfu/100 mL. Dissolved Oxygen standards are 4-12 mg/L. ** Values that exceed US EPS recommendation. Turbidity standards are < 10.4 NTU (http://www.in.gov/idem/6242.htm)

4.4.2 Physical Data and Stream Habitat

Another indication of a good stream is adequate habitat for the fish and macro invertebrates that occupy the water body. There are three (3) sites that have been analyzed for habitat by Hoosier Riverwatch volunteers (Table 4.4.2). A score over 100 is considered a high quality stream for habitat although anything above 60 is said to be conducive to warmwater fauna existence.

Table 4.4.2 Citizens Qualitative Habitat Evaluation Index (CQHEI) averages for Flatrock-Haw Creek, Hoosier Riverwatch

Site	Average CQHEI Score
Flatrock River, behind 240 acre camp (2001-2002)	90.75
Near Mill Race Park, Columbus (2000-2003)	71.83
Noblitt Park, Columbus (2001-2008)	78.34

4.4.3 Biological Communities

In addition to water chemistry conclusions can be drawn by the type and abundance of fish and macro invertebrates found in a stream. There are four sites that were sampled by IDEM for fish community studies. Three sites were on Flatrock River and one was on Haw Creek (Table 4.4.3-1). There are three (3) sites where macro invertebrates have been collected in the Flatrock-Haw Creek Watershed (Table 4.4.3-2). A score above 23 is rated as excellent and

anything between 17 and 22 is rated as good. The large flood in June 2008 in the watershed may have had a severe impact on macroinveterbrate populations. While this needs to be investigated further with sampling after the flood, the change in substrate and overall stream habitat could have an impact on the number and type of species found at these sites.

Table 4.4.3-1 Index of Biotic Integrity

Site	Year	Species found	IBI Score	Predominant fish species
Flatrock River, 150W, Shelby County	2002	29	56 (Excellent)	Bigeye chub, black redhorse, bluntnose minnow, golden redhorse, greenside darter, lonear sunfish, spotfin shiner
Flatrock River, 800N, Bartholomew County	2002	32	52 (Good)	Bigeye chub, bluntnose minnow, central stoneroller, longear sunfish, sand shiner, and spotfin shiner
Haw Creek, 690N, Bartholomew County	1997	11	32 (Poor)	Bluntnose minnow, creek chub, green sunfish, johnny darter, orange throat darter
Flatrock River, 850S, Shelby County	1997	16	32 (Poor)	Bluntnose minnow, longear sunfish, bluegill

Table 4.4.3-2 Pollution Tollerance Index (PTI) averages for Flatrock-Haw Creek, Hoosier Riverwatch

Site	**Average PTI Score**
Flatrock River, behind 240 acre camp (2001-2002)	37.50
Near Mill Race Park, Columbus (2000-2003)	18.80
Noblitt Park, Columbus (2001-2008)	17.40

5.0 Problem Statements, Prioritization, and Goals Development

Using the information gathered from the public meeting the steering committee acknowledged that nutrients, pesticides, E. coli, and sediment are the contaminants that are decreasing water quality in the watershed. Other concerns included trash/debris along the banks and other contaminants (oil, salt, etc.). A concern that indirectly leads to poor water quality is the lack of education about water quality issues in the local community. Finally, a concern was also listed for the rate of water leaving Flatrock-Haw Creek Watershed and the impact that has on stream bank and in-stream erosion.

5.1 Local Concerns

Near the beginning of the planning process the project held a public meeting where local stakeholders could come and voice their opinions on the water quality issues that are important to them. Stakeholders were given the following list of concerns and could add additional ones under the 'Other' section. They were asked to rank them on a 1 to 5 scale, with 1 as their highest priority and 5 as their lowest. The ranks were then averaged to get the values seen in Table 5.1 The steering committee agreed with the concerns and added the lack of water leaving Flatrock-Haw Creek, the lack of pervious surfaces in Columbus which can increase flooding, and maintaining and improving recreation (fishing, swimming, etc.).

Table 5.1 Concerns identified at the public meeting and steering committee

Concerns	Average Rank* (all people at public meeting)
Lack of education pertaining to water quality issues	3.57
Erosion (sedimentation)	2.45
Biological contamination (E. coli)	2.32
Chemical contamination (nutrients, pesticides)	2.41
Trash Debris along stream banks	2.89
Other (biological contaminants other than E.coli)	1.5 (only 2 people checked other)
Rate of water leaving Flatrock-Haw Creek Watershed	Added by committee
Lack of impervious surfaces in urban areas	Added by committee
Maintain/Improve Recreation (fishing, swimming)	Added by committee

**Ranked on a scale of 1 to 5, with 1 as the highest priority and 5 as the lowest priority*

5.2 Problem Statements

In order to address the local concerns raised by the stakeholders at the public meeting as well as themselves the steering committee created problem statements to address the concerns. The statements help to give a condensed version of the concerns along with what can be done to address the concerns. The problems described below indicate sources that are both point and nonpoint in nature, though the scope of the project will focus on the nonpoint sources as the point sources are better regulated.

5.2.1 Lack of education

Problem: *A lack of knowledge in the community about water quality issues and the potential sources may have lead to an increase in stream degradation.*

A survey was distributed at the public meeting to help assess the knowledge of the attending stakeholders (Appendix B). Some of the questions asked included define a watershed and identifying nonpoint source pollution. 67% of the survey respondents correctly identified a watershed while the rest of the respondents had a general idea of what a watershed is. Although many of those surveyed accurately defined a watershed there was few that correctly identified the nonpoint sources. Increasing awareness about water quality issues is important but if the stakeholders do not see how the issues affect their lives they may show less interest. To help determine interest levels survey respondents were also asked how water quality influenced their decisions, both on a personal and community level.

Table 5.2.1-1 Watershed results from the public meeting

Knowledge questions	Number Correct (%)	Incorrect (%)
Define a watershed	16 (67%)	8 (33%)
Identify nonpoint sources	5 (20%)	20 (80%)

Table 5.2.1-2 Additional watershed results from the public meeting

Opinion Questions	High	Medium	Low
Influence of water quality on personal decisions	15 (62.5%)	9 (37.5%)	0 (0%)
Influence of water quality on community decisions	22 (88%)	2 (8%)	1 (4%)

5.2.2 Increased sedimentation

Problem: *Sedimentation may be a significant problem in Flatrock-Haw Creek Watershed. This may result from overland runoff from agricultural, construction, and commercial industries. This may also result from in-stream and stream bank erosion potentially caused by the high rate of water leaving the stream, a lack of vegetation along the banks, and unrestricted livestock access.*

5.2.3 Biological Contamination

Problem: *Biological contamination occurs in the Flatrock-Haw Creek Watershed potentially due to overland runoff from feedlots, unrestricted livestock access to streams, wildlife, and failing septic systems. During high rain events a combined sewer overflow system can also cause contamination of biological pathogens.*

5.2.4 Chemical Runoff

Problem: *Overland and subsurface runoff from agricultural operations, golf courses, private homeowners' yards, and city parks can cause chemical contaminations of nutrients. Nutrient contamination can also occur with failing septic systems and from waste water treatment plants.*

5.2.5 Pesticides and other contaminants

Problem: *Pesticides, particularly atrazine is potentially an additional contaminant concern but the extent is unknown. Runoff from parking lots and leaching from personal dumps can lead to other chemical contamination including oils and salt.*

5.2.6 Lack of recreation due to poor water quality

Problem: *There may be a lack of recreation, particularly recreational fishing and swimming, due to degraded water quality or a lack of water during summer months. Increased sedimentation and chemical contaminants may have led to decreased fish habitat while biological pathogens have created hazards for swimming.*

5.2.7 Biological Communities

Problem: *There may be a decreased biological community in Flatrock-Haw Creek Watershed potentially due to a lack of quality habitat. A lack of quality habitat can be caused by excess nutrients, sediment and pesticides in the stream along with poor general water chemistry.*

5.2.8 Rate of water leaving Haw Creek Watershed

Problem: *A lack of pervious surfaces and an increased infrastructure in major urban areas such as Columbus may have created more flash events in the Flatrock-Haw Creek Watershed; which can add to in-stream erosion. The lack of education both on the local and state level has potentially led to restrictive government policies that compound the problem. The problem may also be compounded by the urban development of areas that are floodplains for water bodies.*

Table 5.2 Pollutants, potential sources, the impacts on use and associated problem statements.

Pollutant	Potential Sources		Impacts on Waterbody Uses	Problem Statement
	Nonpoint Sources	Point Sources		
Sediment	Agricultural Operations Stream Banks In-stream Erosion	Waste Water Treatment Plants Urban Storm water Systems	Indirect impacts to recreation fishing Impairs swimming/boating due to channel alteration Suspended sediment interrupts fish feeding and alters stream temperature	Sedimentation may be a significant problem in Flatrock-Haw Creek Watershed. This may result from overland runoff from agricultural, construction, and commercial industries. This may also result from in-stream and stream bank erosion potentially caused by the high rate of water leaving the stream, a lack of vegetation along the banks, and unrestricted livestock access.
Nutrients	Agricultural Fields Septic Systems Yards, Golf Courses Livestock Wildlife	Waste Water Treatment Plants Combined Sewer Overflows CAFOs Landfills	Excess algae growth in stream systems can cause problems with recreation Excess algae die off causes low dissolved oxygen in water	Overland and subsurface runoff from agricultural operations, golf courses, private homeowners' yards, and city parks can cause chemical contaminations of nutrients. Nutrient contamination can also occur with failing septic systems and from waste water treatment plants.
Pesticides	Agricultural Fields Yards, Golf		Indirect impacts to recreation fishing High levels have the potential to cause fish	Runoff from parking lots and leaching from personal dumps can lead to other chemical contamination

	Courses Parks Department		toxicity	including oils and salt. Pesticides, particularly atrazine, is potentially an additional contaminant concern but to what extent is unknown.
E. coli	Livestock Wildlife Septic Systems	Waste Water Treatment Plants Combined Sewer Overflows CAFOs	Human health risks, particularly with secondary contact Risk of illness to livestock that may use stream as primary drinking source	Biological contamination occurs in the Flatrock-Haw Creek Watershed potentially due to overland runoff from feedlots, unrestricted livestock access to streams, wildlife, and failing septic systems. During high rain events a combined sewer overflow system can also cause contamination of biological pathogens.
Other contaminants	Parking Lot Personal Dumps			Runoff from parking lots and leaching from personal dumps can lead to other chemical contamination including oils and salt. Pesticides, particularly atrazine is potentially an additional contaminant concern but to what extent is unknown.

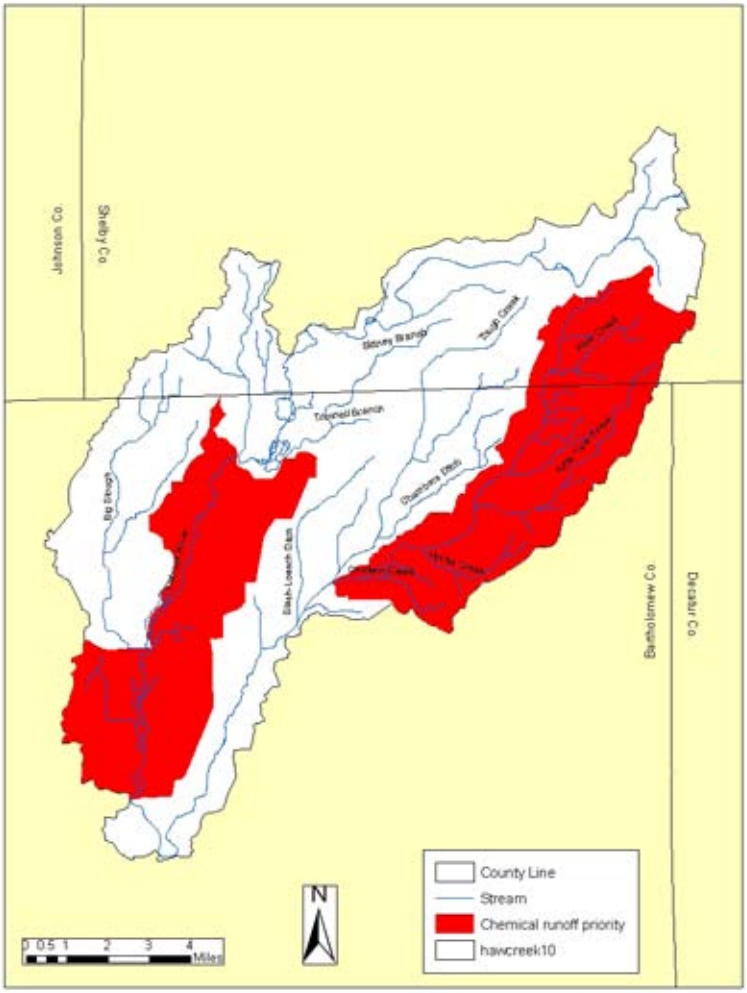
6.0 Identifying Critical Areas

The local steering committee has decided that while concerns occur watershed-wide the area of the watershed is broad. Consequently, the steering committee has used windshield surveys, information gathered from a technical and a public meeting, and local knowledge to identify areas of the watershed where efforts would show the most benefit in improving water quality. Utilizing 12 digit HUC boundaries, the committee prioritized areas for non-point source chemical runoff, biological contamination (E. coli), and sediment loading.

6.1 Non-point Source Chemical Runoff

Subwatersheds prioritized for non-point source chemical runoff include all of Haw Creek and a major portion of Town of Northcliff-Flatrock River (Figure 6.1). These two prioritized areas drain approximately 30,898 acres (37%) of the watershed. Areas encompass the headwaters of Haw Creek and all its initial tributaries before Tough Creek flows into it and the lower portion of Flatrock River. The Haw Creek subwatershed is noted for nitrate contamination to the wells and having areas where the soil has a high nitrate leaching potential. Town of Northcliff-Flatrock river has a lot of specialty crops where extra chemicals are applied as well as areas of sandy soils and irrigation systems, where leaching potential for chemical runoff is increased.

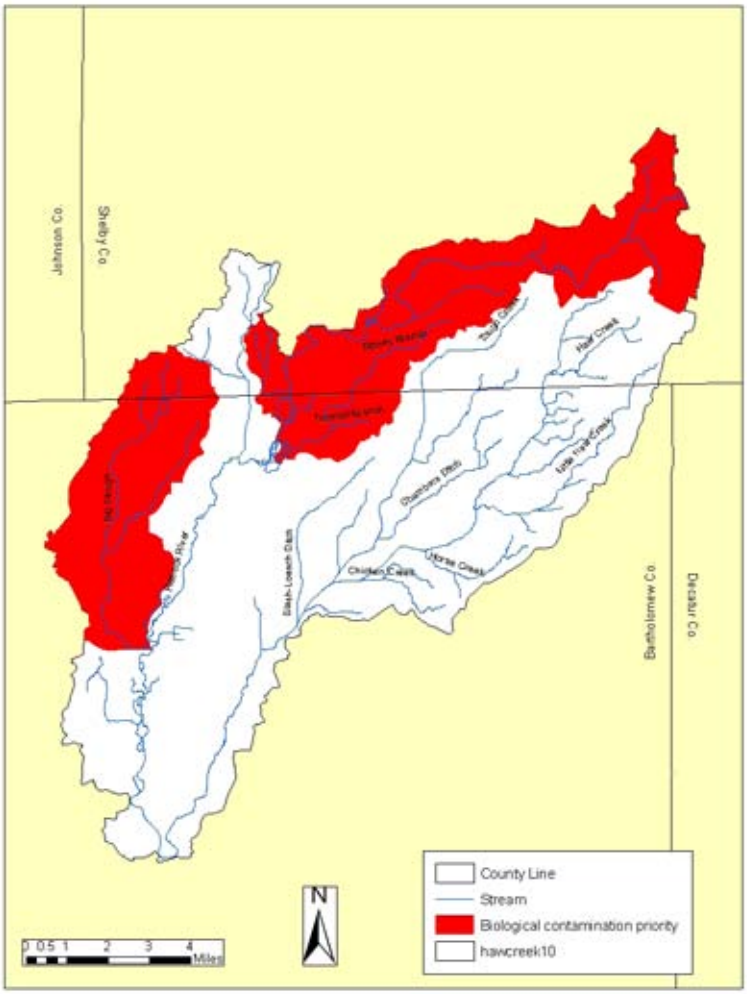
Figure 6.1 Subwatersheds prioritized for NPS chemical runoff



6.2 Biological Contamination

Subwatersheds prioritized for biological contamination is Big Slough, Town of Geneva-Flatrock River, and the eastern half of Sidney Branch-Flatrock River. Collectively, the areas prioritized drain approximately 27,814 acres (33%). Sources that have been noted in these areas that can contribute to biological contamination include small towns that utilize septic systems, multiple areas where animals have stream access, and a large population of geese that overwinter.

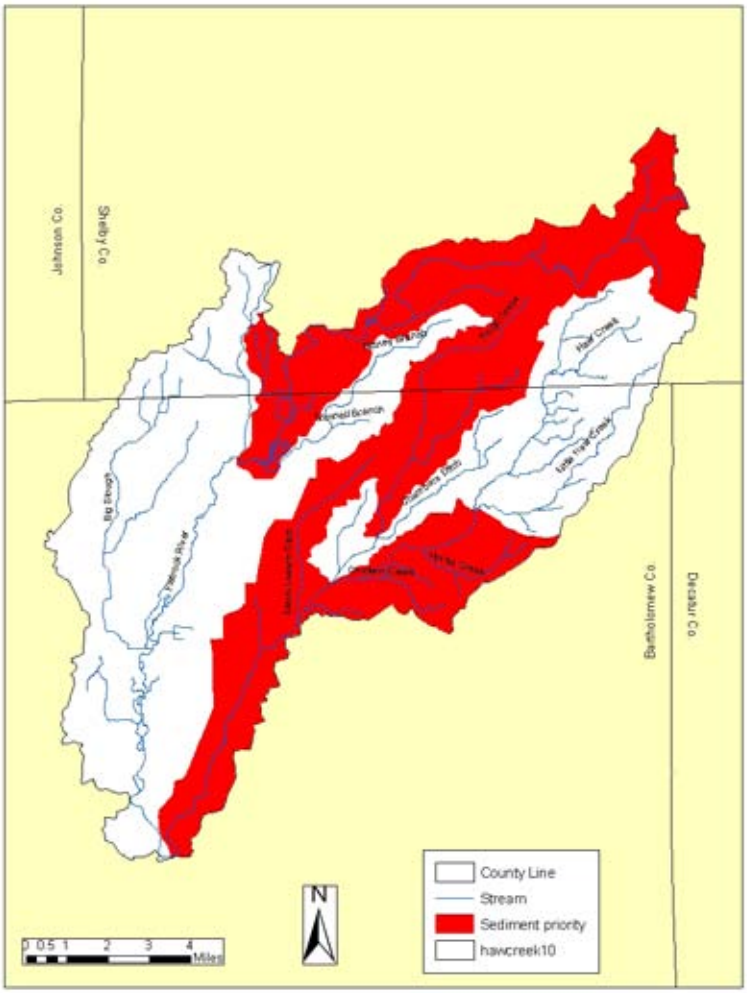
Figure 6.2 Subwatersheds prioritized for biological contamination



6.3 Sediment contamination

Subwatersheds prioritized for sediment include Town of Geneva-Flatrock River, the eastern half of Sidney Branch-Flatrock River, the lower half of Haw Creek, and a majority of Little Haw Creek-Haw Creek. Collectively, the areas prioritized for sediment include 35,937.5 acres (43%) of the watershed. There are many areas that are prioritized for sediment that are also prioritized for either non-point source chemical runoff or biological contamination due to multiple source concerns identified in certain areas. Sources for sediment in these areas include conventional tillage practices, areas of excessive stream bank erosion, animal stream access, and construction along US 31, 600 N, and outside Clifford.

Figure 6.3 Subwatersheds prioritized for sediment



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Appendix A: Project Committee Members

Steering Committee

Name	Affiliation
David Clouse	Hope City Utilities
Gary Dodd	Landowner/Farmer
Robert Finkel	Landowner/Farmer
Justin Gelfius	Landowner/Farmer
Jim Kelly	Lanowner
Janice Kroger	Landowner
Emilie Pannell	City of Columbus-Planning
Ronald Povinelli	Landowner
Fred Prazeau	Landowner
Colin Scheidt	Landowner
Ed Stone	Clifford Town Board/Fire Department
Elizabeth Trybula	Landowner

Appendix B: Watershed Survey

Bartholomew County Soil & Water Conservation District

Please take a few minutes to complete this short survey (both sides).
All returned surveys will be entered into a drawing for one of two Papa Deli's gift certificate, graciously donated by the Papa's Third Street Deli.

1.) Do you know what a watershed is?
   a. Absolutely, no doubt in my mind.
   b. I have a general idea.
   c. I have heard of a watershed, but couldn't tell you what it is.
   d. I have no idea

2.) Please briefly (in 1-3 sentences) describe your definition of a watershed.

3.) Please list any local rivers and/or streams you are familiar with.

4.) Please circle any and all items listed below that are potential sources of nonpoint pollution in rivers/streams:
   a. Residential lawn
   b. Agricultural field
   c. Industrial discharge
   d. Sewage treatment plant
   e. Roads/driveway/parking lot
   f. Golf course

5.) In general, do you think water quality in your area is improving, or do you think water quality is getting worse?
   a. Improving
   b. Getting worse.

6.) Are you familiar with Haw Creek?
   a. Yes
   b. No

7.) What do you think of the water quality in Haw Creek?
   a. The creek is clean.
   b. The creek could be better, but overall is clean.
   c. The creek is not clean, but is not terrible.
   d. The creek is not clean.
   e. I have no opinion on the subject.

8.) How important do you think overall water quality is for you and/or your family?
   a. Very important
   b. Somewhat important
   c. Not very important
   d. Not at all important

9.) On a scale of 1 to 10, with 1 being your lowest priority and 10 being your highest priority, where do you place water quality when making personal decisions?

1	2	3	4	5	6	7	8	9	10
lowest									highest

10.) On a scale of 1 to 10, with 1 being your lowest priority and 10 being your highest priority, where do you think water quality should be placed when making community decisions?

1	2	3	4	5	6	7	8	9	10
lowest									highest

Please include any additional comments regarding the subject of water quality in your county here:

NAME: _____

PHONE NUMBER (optional) _____

Appendix C: Concern card

Please rank these concerns based on your knowledge of the watershed. A ranking of one is what you feel to be the highest priority and 5 is the lowest priority.

____ Lack of education pertaining to water quality issues

____ Erosion (Sedimentation)

____ Biological contamination (E. coli)

____ Chemical contamination (Nutrients, Pesticides)

____ Trash/debris along stream banks

____ Other

_____
_____
_____

Please list below any areas you can specifically think there may be a problem. This can include excessive erosion along a stream, excess trash and debris along a stream bank, sensitive areas that may need protected (State parks, preserves, etc.), or any other areas where you have seen a large problem.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Appendix D: NPDES Facilities

Permit #	Permit Holder	County	Status
IN0049018	Bartholomew Co. Hospital	Bartholomew	Terminated
IN0004154	Columbus Filtration Plant #1	Bartholomew	Terminated
IN0032573	City of Columbus WWTP	Bartholomew	Effective
IN0004197	Cosco, Inc	Bartholomew	Terminated
IN0031551	Cross Cliff Elementary School	Bartholomew	Effective
IN0056448	Cummins Engine Co.	Bartholomew	Terminated
ING250075	Cummins Inc. Corp Ofc Bldg	Bartholomew	Effective
ING490083	Flat Rock Plant	Shelby	Effective
ING080039	Garden City Save Tobacco RD 6	Bartholomew	Effective
IN0045748	Hope Hardwoods Inc	Bartholomew	Effective
IN0021253	Hope WWTP	Bartholomew	Effective
IN0044300	Meshberger Stone Inc	Bartholomew	Terminated
IN0002046	Meshberger Stone, Flat Rock Quarry	Shelby	Terminated
ING490091	Ward Stone LLC Dinn Quarry	Shelby	Effective