# Describing the Watershed

## *2.1: Geography*

***This section provides a general description of commonly known location found in the watershed to provide the reader with knowledge of the location of its boundaries***

The Big Creek Watershed is located primarily in Posey county (64.6% of total area) with portions extending into Vanderburgh (26.1% of total area) and Gibson (8.3% of total area) Counties. It is entirely in Indiana. Several small communities exist on the edges and within the borders of the watershed including Cynthiana, Mt. Vernon, Poseyville, Darmstadt, and Wadesville. The location of the watershed and the communities in and around it are shown in *Figure 2.1-A: Communities and Places in the Big Creek Watershed.*

## *2.2: Sub-watersheds*

***Watersheds can be sub-divided into smaller drainages which are nested in the larger watershed. In this project the sub-watersheds are divided from an 11-digit or 10-digit watershed each having a unique 3 or 2 digit code added to the end. Sub-dividing the larger watershed is useful in prioritizing problem areas and this section details the location of the sub-watershed used in this project.***

The USGS has determined 16 smaller 14-digit and 12-digit sub-watersheds within the Big Creek Watershed. An overview of the location of the sixteen 14 digit and nine 12 digit sub-watersheds is shown in *figure 2.2-A: Big Creek Watershed 14 and 12 Digit Sub-watersheds.* In 2009, IDEM will begin using the 10 digit and 12 digit HUC's instead of the 11-digit and 14-digit HUC's in watershed planning and monitoring. The 12 digit sub-watersheds are shown below for reference, but the 14 digit sub-watersheds were used when analyzing and prioritizing the Big Creek Watershed during this study and will be used throughout the rest of the plan. *Table 2.2-A: Sub-watersheds* details the 14-digit HUC, geographic name, area (acres), sample points, and contribution to the entire Big Creek Watershed.

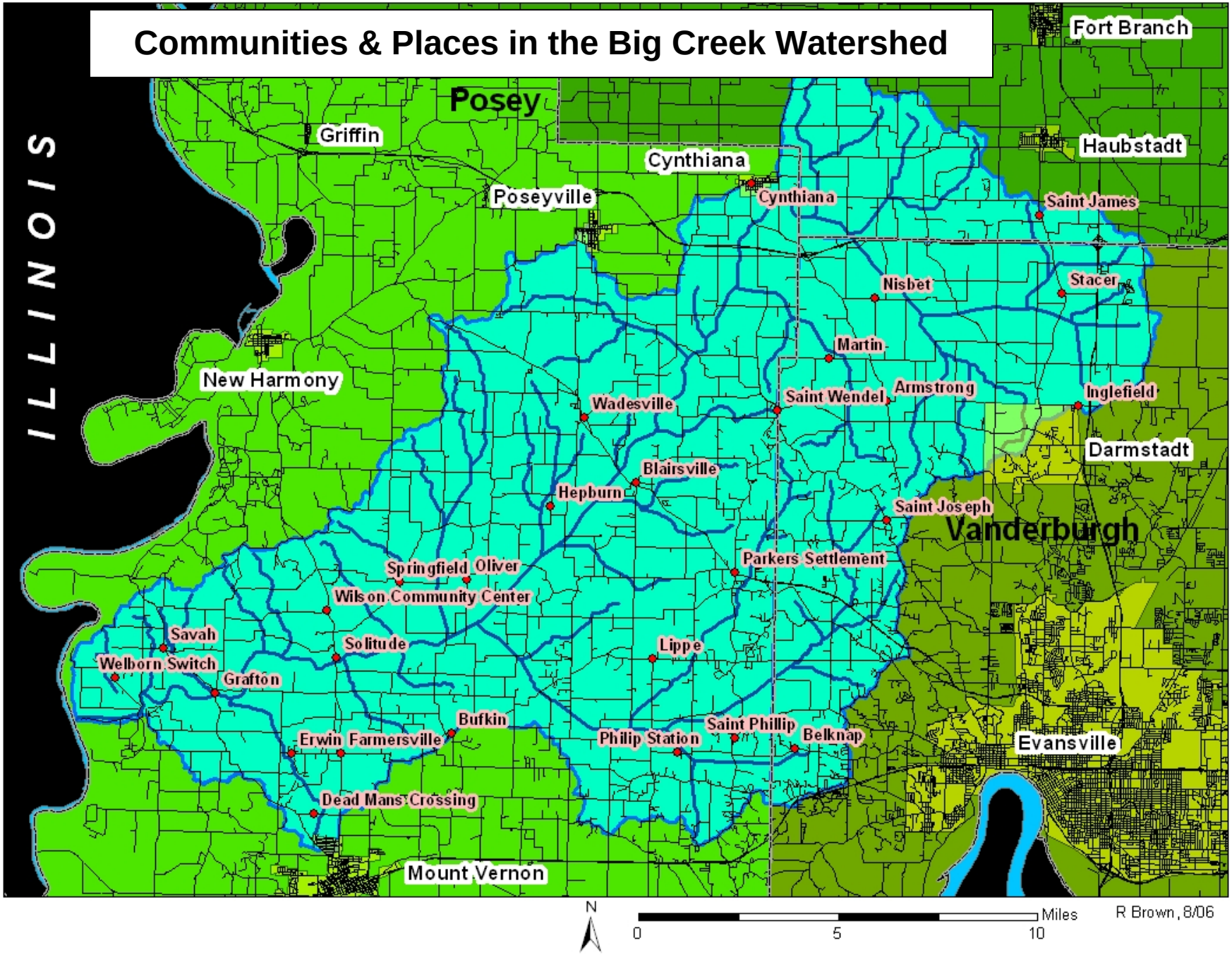


*Figure 2.1-A: Communities & Places in the Big Creek Watershed*

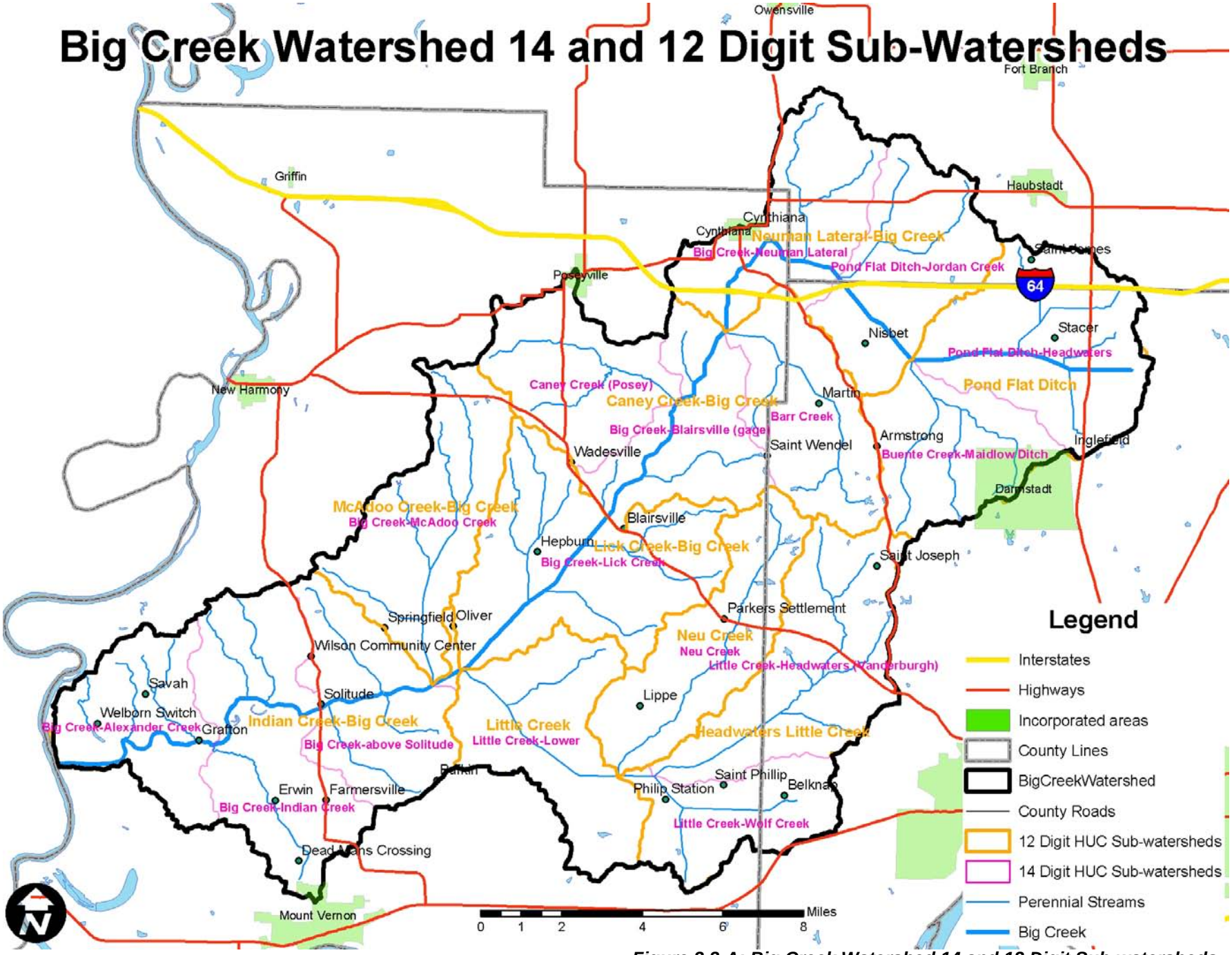


*Figure 2.2-A: Big Creek Watershed 14 and 12 Digit Sub-watersheds*

| HUC unit code | Geographic Name | Acres | Sample point # (s) | % of Big Creek Watershed |
|---|---|---|---|---|
| **05120113110010** | **Pond Flat Ditch – Headwaters** | **12547.8** | **34** | **7.7 %** |
| **05120113110020** | **Buente Creek – Maidlow Ditch** | **8186.3** | **33** | **5.0%** |
| **0512011311030** | **Pond Flat Ditch – Jordan Creek** | **10120.4** | **32** | **6.1%** |
| **05120113110040** | **Big Creek – Neuman Lateral** | **9831.4** | **31, 30, & 29** | **6.0%** |
| **05120113110050** | **Barr Creek** | **8998.7** | **28** | **5.5%** |
| **05120113110060** | **Caney Creek (Posey)** | **8587.4** | **26** | **5.2%** |
| **05120113110070** | **Big Creek – Blairsville (gage)** | **8306.6** | **27, 25, & 23** | **5.1%** |
| **05120113110080** | **Big Creek – Lick Creek** | **15548.2** | **24, 22, 21, 20, & 19** | **9.5%** |
| **05120113110090** | **Little Creek – Headwaters (Vanderburgh)** | **12639.4** | **18** | **7.7%** |
| **05120113110100** | **Little Creek – Wolf Creek** | **6815.1** | **17, 16** | **4.1%** |
| **05120113110110** | **Neu Creek** | **10052.1** | **15** | **6.1%** |
| **05120113110120** | **Little Creek – Lower** | **10545** | **14** | **6.4%** |
| **05120113110130** | **Big Creek – McAdoo Creek** | **11716.4** | **13, 12, & 11** | **7.1%** |
| **05120113110140** | **Big Creek – Above Solitude** | **9247.1** | **10, 9, & 8** | **5.6%** |
| **05120113110150** | **Big Creek – Indian Creek** | **12698.4** | **7, 6, & 5** | **7.7%** |
| **05120113110160** | **Big Creek – Alexander Creek** | **8129.7** | **4, 3, 2, & 1** | **5.0%** |

*Table 2.2-A: Sub-Watersheds*

## *2.3: Physical Description*

***This section describes the features that make this watershed unique. It is meant to give a broad context to the region and provide useful information on characteristics that lead to an area being naturally more or less prone to water quality problems***

### *2.3.1: Geologic History*

The majority of the watershed area falls into the region known as the driftless area, an area unaffected by the two more recent and better understood glacial advances of the Wisconsin and Illinoian stages. This driftess area is characterized by steeper slopes and consolidated subsurface materials though it was likely affected by glacial movements prior to the Illinoian stage (over 300,000 years ago). Evidence of the limits of the Illinoian glacial drift can still be seen in northern sections of the watershed. Towards the east, sediments left by the southward moving glaciers blocked northward flowing stream systems leaving behind a legacy of lakebed-formed soils. Along the northern margins of the watershed east of McAdoo creek, the flattened terraces and gentler sloping divide remain in contrast to the southeastern margins northwest of Evansville. *Figure 2.3.1-A: Glacial Features* shows the extent of the Illinoian glacial drift. The map indicates the limit of the glacial drift extending down to the northern limit of the watershed. Former glacial lakes along the drift margin would've been found in the Pond Flat Ditch-Headwater, Pond Flat Ditch-Jordan Creek, and Buente Creek-Maidlow Ditch Sub-Watersheds.

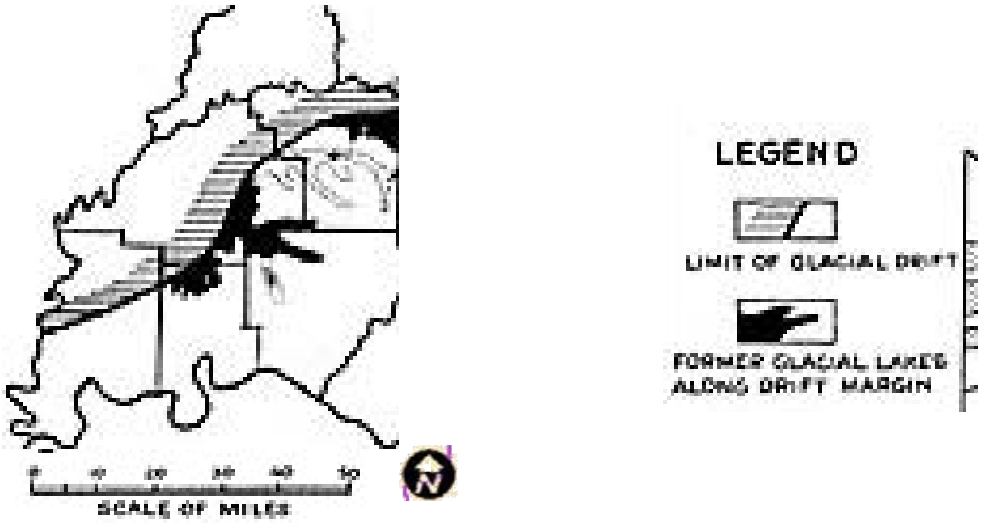


***Figure 2.3.1-A: Glacial Features***

### *2.3.2: Topography*

The watershed consists of mostly gentle to moderate slopes as well as flat floodplain areas along major streams and lakebed formations towards the northeast. Elevations range from 607 feet above sea level near the junction of St. Wendel Road and Island Road to 354 feet above sea level at the outlet of the Big Creek to the Wabash River. When viewed in 250 foot segments, slopes vary from almost zero to about 40%. *Figure 2.3.2-A: Big Creek Elevation and 100 year floodplain* depicts a generalized overview of the elevations found in the watershed.

*Figure 2.3.2-B: Big Creek Slope* depicts a generalized overview of the slopes found in the watershed. Both maps are based on the 2005 Indiana Statewide Orthophotography Project's Digital Elevation Models. Slope data has been generalized to 250 foot resolution. In the elevation diagram, the highest elevations are shown in purple to white with lower elevations appearing as deep red to brown, yellow, and the lowest teal. The extent of the 100-year storm event floodplain is shown in light blue. In the percent slopes diagram, the highest percent slopes or steepest areas are shown in red with more gently sloping areas appearing orange, yellow, light blue, and the flattest slopes appearing dark blue.

From the figures it is clear that the steepest slopes occur northwest of Evansville near Darmstadt and St. Wendel, at the headwaters of the Barr Creek, Neu Creek, and Little Creek. Steep slopes also border the Big Creek main channel in several places and are found on the northwest and southeast borders of the watershed. Flatter areas occur mostly along Big Creek downstream of Blairsville and also in the Big Creek – Indian Creek, Pond Flat Ditch – Headwaters, Buente Creek – Maidlow Ditch, Big Creek – Neuman Lateral, and Caney Creek Sub-watersheds.

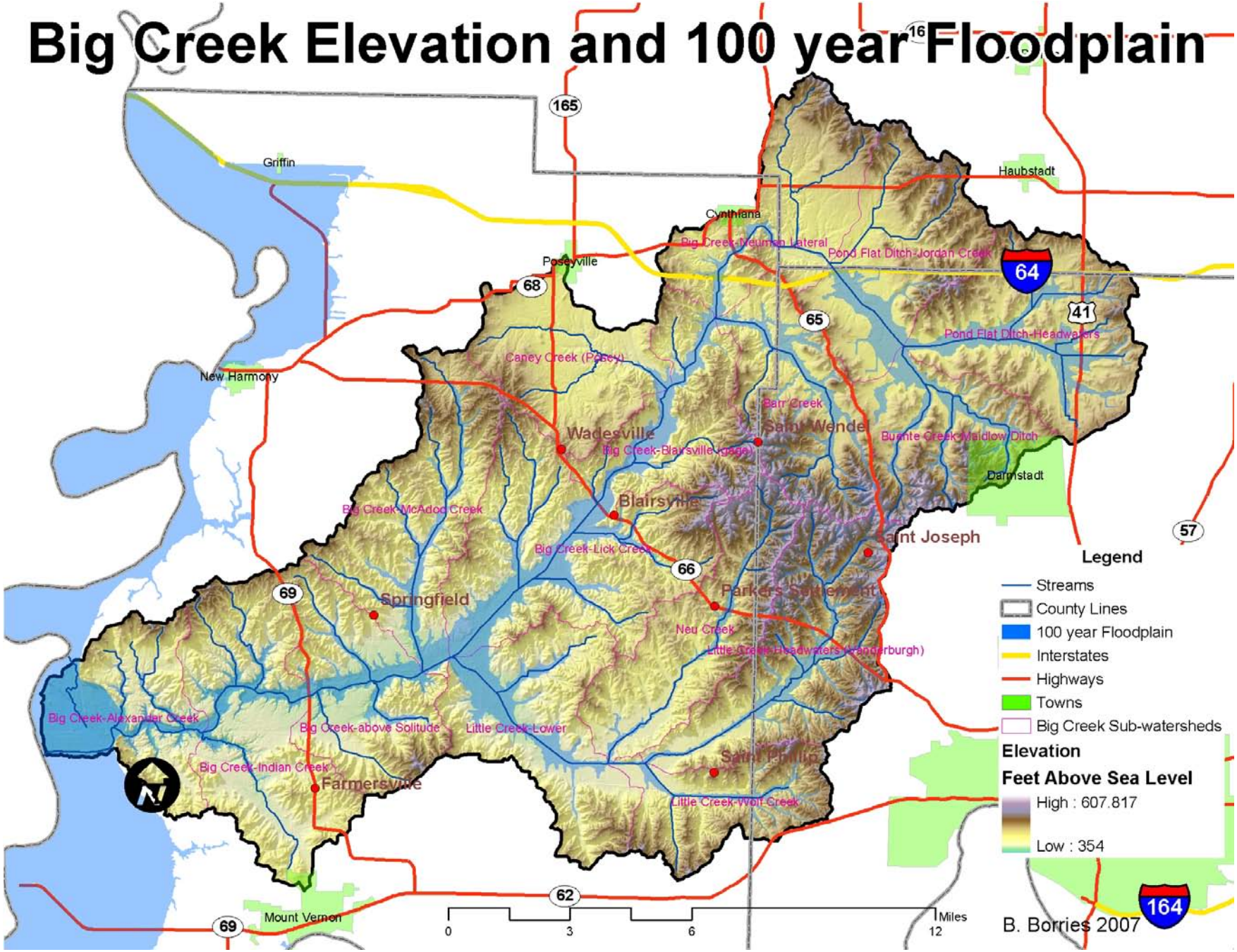


*Figure 2.3.2-: Big Creek Elevation and 100 year Floodplain*

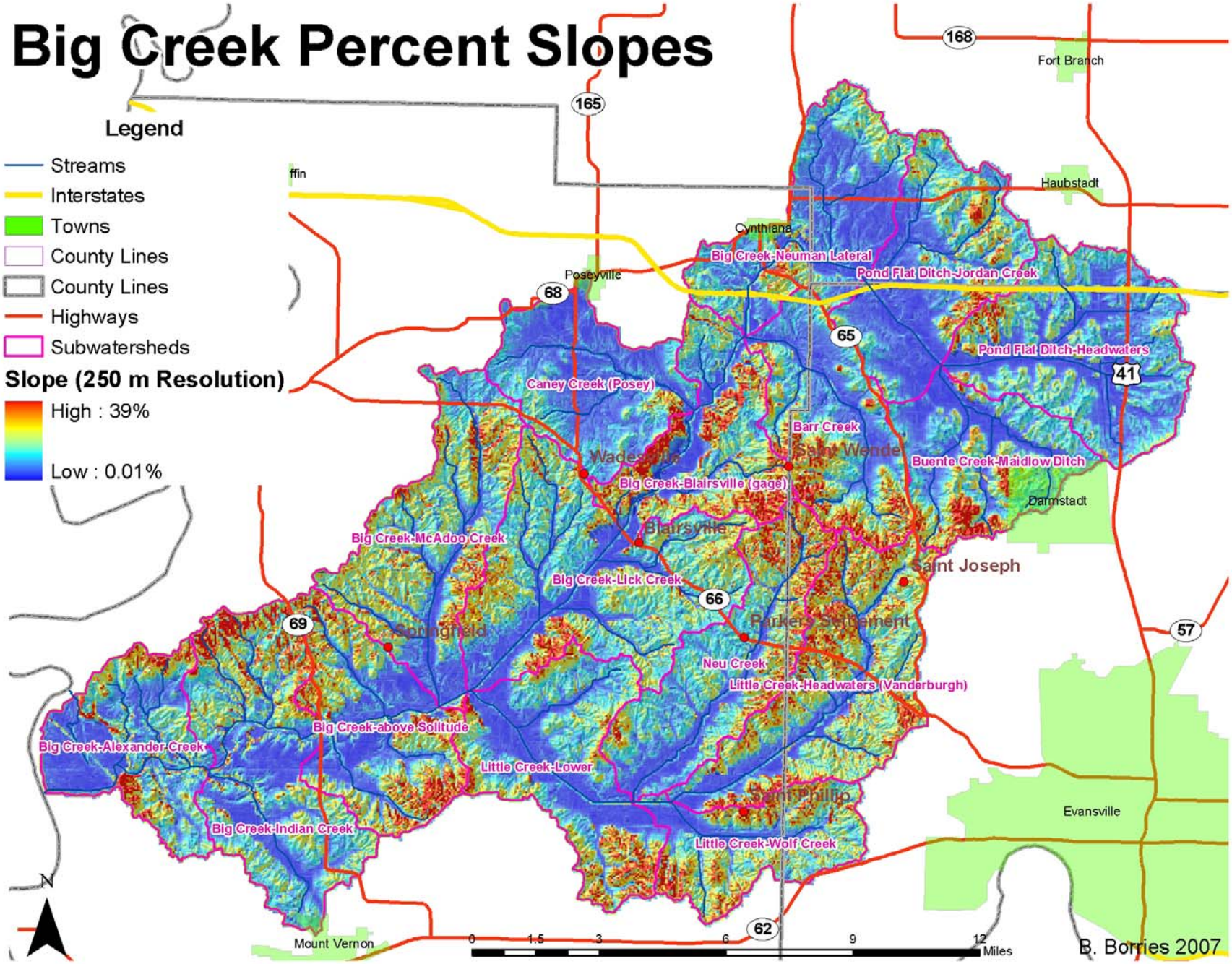


***Figure 2.3.2-B: Big Creek Percent Slopes***

Soils in the watershed are mostly silt-loams with varying amounts of clays and small amounts of sands. Most are windblown loess soils along with smaller amounts of glacial outwash, alluvial bottomland, and ridge-top soils. The NRCS has grouped soils into nine "soil associations." The locations of the associations are shown in *figure 2.3.3-A: Big Creek Watershed Soil Associations.* A short description of each follows the diagram. More detailed information about the soils can be found in the Soil Survey of Posey County, Indiana (available in text and digital format) published by the USDA NRCS in Cooperation with the Purdue University Agricultural Experiment Station.

**Hosmer Associations**

The Hosmer Association soils are "Deep, well-drained, nearly level to strongly sloping, medium-textured soils on uplands." Hosmer soils are on the tops and sides of ridges. Fragipan soil often exist reducing permeability at a depth of around 30 inches. Major water quality concerns with this association surround the difficulty in developing septic systems due to the low permeability and steep slopes in addition to increased erosion from the high volume of runoff.

**Petrolia-Nolan-Haymond**

The Petrolia-Nolan-Haymond Association soils are "Deep, nearly level, well drained, somewhat poorly drained, and poorly drained soils that have a silty subsoil or underlying material and that formed in alluvium. These soils are found along the Wabash River and are lower in elevation than the adjacent river terrace. Most are very level and are not subject to much erosion but water quality issues may arise when flooding occurs if septic systems or oil wells are present.

**Princeton-Bloomfield-Ayshire-Alvin**

The Princeton-Bloomfield-Ayshire-Alvin Association soils are "Deep, nearly level to steep, somewhat excessively drained and well drained soils that have a loamy and sandy subsoil and that formed in wind-deposited sediments." These areas are found near the Wabash river bluffs on ridgetops and side slopes. This association is rare in the watershed and is mostly woodlands. Where it is cropped it is subject to high levels of erosion because of its steepness.

**Reesville-Ragsdale**

The Reesville-Ragsdale Association soils are "Deep, nearly level, very poorly drained and somewhat poorly drained soils that have a silty subsoil and that formed in loess." This area is found on former glacial lakebeds and is mostly flat with swells and swales. Most has been drained by ditches and tile drains for cropping though a few areas remain with hardwoods. Water quality issues may arise in cases where septic systems and other sanitary facilities are installed in these soils due to severe drainage restrictions. Also, due to the presence of tile drains, water soluble pollutants such as nitrates are easily carried to water bodies without passing through vegetative buffers.

**Sylvan-Iona-Alford**

The Sylvan-Iona-Alford soils are “Deep, nearly level to very steep, well drained and moderately well drained soils that have a silty subsoil and that formed in loess.” This association occupies the majority of the watershed area. They are found in upland areas and are mainly used for crops. Some steeper areas are in woodlands and pastures. Erosion is the main water quality concern on steeper slopes where cropping occurs.

**Wilbur-Wakeland-Haymond**

Wilbur-Wakeland-Haymond soils are “Deep, nearly level, somewhat poorly drained soils that have silty underlying material and that formed in alluvium. These are bottomland soils that are found along major streams and smaller drainageways. They have a high water table and are mainly cropland. Tile and surface drains are prominent in these areas except where impractical. Undrained areas are mainly left wooded. Water quality issues may occur where septic systems are installed. Drained areas are also more likely to contribute pollutants that are soluble in water such as nitrates.

**Zanesville-Wellston-Gilpin**

Zanesville-Wellston-Gilpin soils are “moderately sloping to very steep medium textured soils on uplands.” The soils are mostly found on sides of drainageways and strongly sloping to very steep side slopes below ridgetops. A shallow fragipan layer and steep slopes may cause water quality problems when these areas are developed or cropped due to increased erosion risks from the high volumes of runoff.

**Zipp-Vincenness-Evansville**

Zipp-Vincennes-Evansville soils are “Deep nearly level, poorly drained and somewhat poorly drained soils that have a silty subsoil and that formed in silty sediments.” These soils have formed in former lake plain areas near the west-central area of the watershed between lower river terraces and higher upland areas. These soils have a high water table but are mostly drained from cropping. A few undrained areas are in woodlands. Water quality issues may arise when septic systems are installed due to wetness. Water soluble pollutants may also be an issue due to the presence of tile drains and high water table.

# Big Creek Watershed Soil Associations Based on NRCS Data

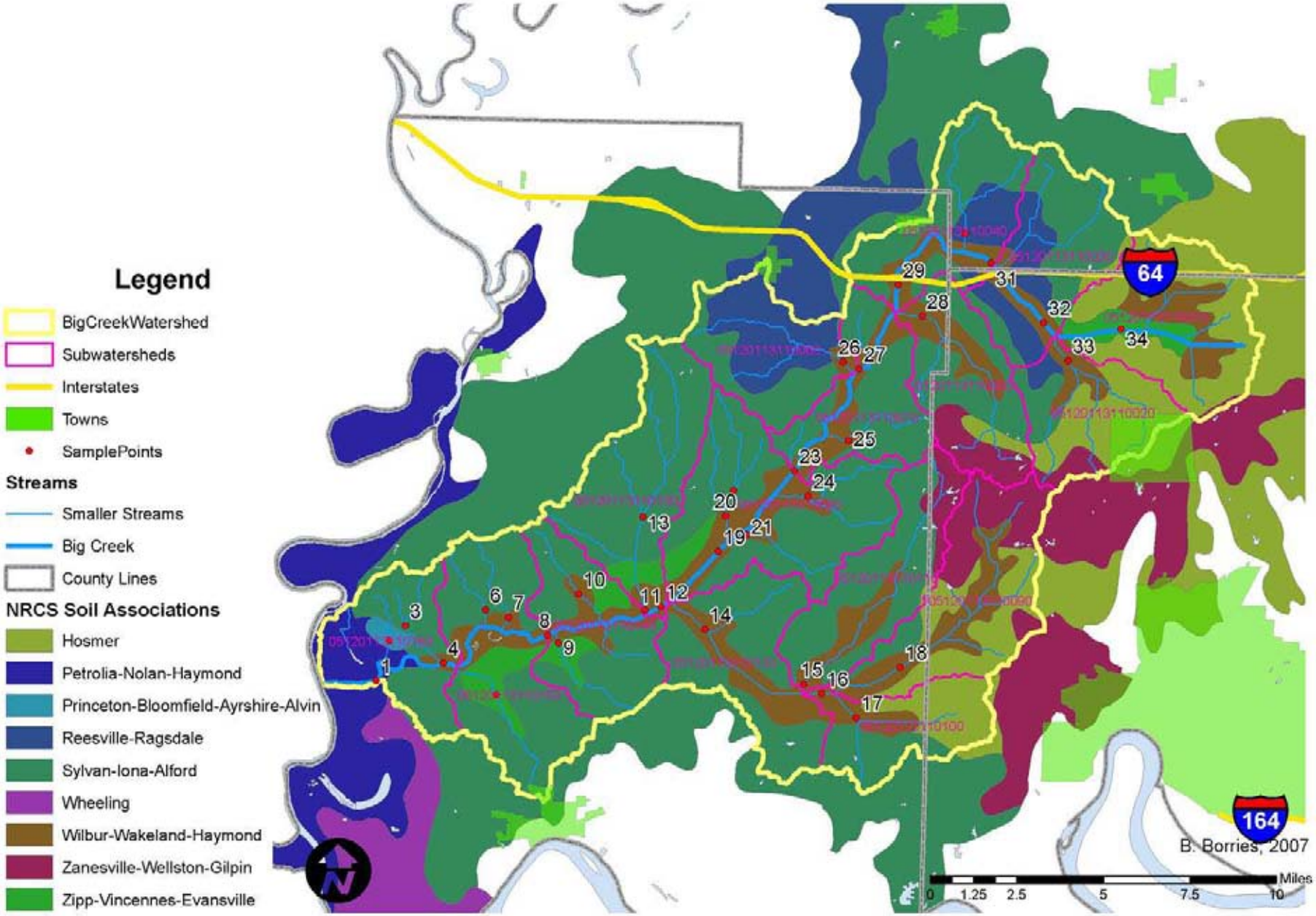


*Figure 2.3.3-A: Big Creek Watershed Soil Associations*

### *2.3.4: Hydrololgy*

The most prominent water body within the watershed is Big Creek which begins near Darmstadt and travels the course of the watershed before it enters the Wabash River northwest of Mt. Vernon. As the main channel within the drainage it has a number of tributaries such as Little Creek, Lick Creek, Barr Creek, and McAdoo Creek. *Figure 2.3.4-A: Big Creek Hydrography* shows the names and locations of all the perennial streams found in the Big Creek Watershed. Also shown are the intermittent streams displayed as a combination dotted and solid blue line, regulated drains illustrated with yellow, and waters of the state (defined as having a square mile or greater watershed) in green. Intermittent streams were digitized from aerial photographs and waters of the state were determined by the amount of land draining to each channel based on a flow accumulation model.

Several “legal drains” exist that are maintained by the local county surveyor’s offices. A few are artificial ditches, but most are modified natural channels. They are generally straightened or altered to follow property lines and have a 2:1 or 3:1 bank slope. Woody vegetation is controlled mechanically and with herbicides. Money to perform the maintenance is taken from a drainage assessment applied to all properties benefiting from the increased drainage. Straightening or otherwise altering natural channel shape can be harmful to the biological function of the channel by removing natural cover and other shape variations that provide refuge during both high and low flow events. Straightened streams also cause increased velocity and sustained discharges downstream though they provide extra drainage to the immediately adjacent land. The length in miles for each sub-watershed and the percentage of USGS perennial streams that are considered legal drains is shown in *Table 2.3.4-A: Legal Drains.*

The area of land draining to a stream and the length of a stream affect the regulations that are applied to a stream. The point at which a stream drains more than an one square mile or 640 acres of land is where it becomes a “water of the state.” From this point downstream, water and waterways become subject to regulation as to do upstream activities that affect the water at this point. In addition, streams that are more than ten miles in length are also subject to additional regulations when a project alters the floodway or area below the “Ordinary High Water Mark”

## Legal Drains

| Sub-watershed | Length of Regulated Drains (miles) | Length of Perennial Streams (miles) (Source: USGS) | % of Perennial Streams Regulated |
|---|---|---|---|
| **Pond Flat Ditch – Headwaters** | 10.74 | 14.93 | 55.86% |
| **Buente Creek – Maidlow Ditch** | 10.95 | 12.41 | 70.21% |
| **Pond Flat Ditch – Jordan Creek** | 5.00 | 10.28 | 25.73% |
| **Big Creek – Neuman Lateral** | 5.25 | 7.36 | 66.27% |
| **Barr Creek** | 5.88 | 10.59 | 55.53% |
| **Caney Creek (Posey)** | 0.43 | 8.50 | 5.10% |
| **Big Creek – Blairsville (gage)** | 7.62 | 11.94 | 56.83% |
| **Big Creek – Lick Creek** | 10.15 | 24.11 | 33.05% |
| **Little Creek – Headwaters (Vanderburgh)** | 3.07 | 16.85 | 18.22% |
| **Little Creek – Wolf Creek** | 1.70 | 6.73 | 25.34% |
| **Neu Creek** | 1.75 | 10.12 | 17.32% |
| **Little Creek – Lower** | 8.05 | 8.05 | 70.62% |
| **Big Creek – McAdoo Creek** | 1.64 | 17.79 | 7.04% |
| **Big Creek – Above Solitude** | 5.05 | 11.11 | 45.46% |
| **Big Creek – Indian Creek** | 3.75 | 13.16 | 28.54% |
| **Big Creek – Alexander Creek** | 4.94 | 14.10 | 35.05% |
| **Total** | 85.98 | 198.00 | 43.43% |

***Table 2.3.4-A: Legal Drains***

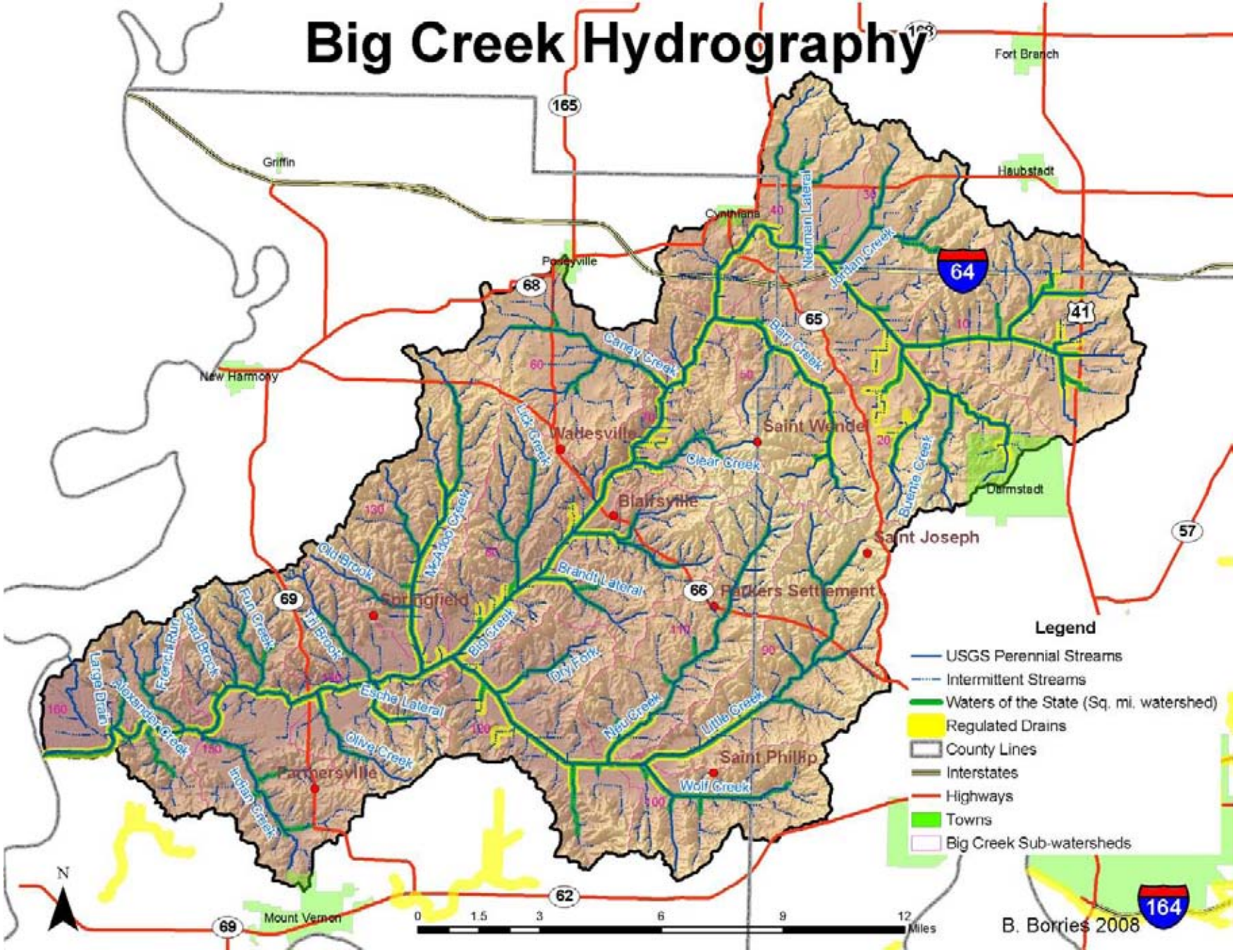


*Figure 2.3.4-A: Big Creek Hydrography*

The area has experienced several significant anthropologic hydrology changes since the settlement of the area by European. It is expected that considerably more wetland areas existed especially in the former lake plain areas in the Pond Flat-Headwaters, Buente Creek-Maidlow Ditch, Pond Flat-Jordan Creek, and Caney Creek Sub-watersheds. Soils in these areas are listed as hydric implying that they have distinctive characteristics that indicate they are saturated through much of the year. In these areas and other areas with saturated soils, tile drains are common and a network of artificial drainage ditches exist to minimize flooding. Many ditches have a small levee or berm at the top of the banks. Surface outlets are installed on some fields with backflow gates to keep water from backing up into fields during storm events. Other fields have surface inlets connected to pipe outlets located in the stream. The entire Big Creek main channel and much of the Little Creek main channel was also dredged and straightened during an Army Corps of Engineers project during the 1920s. Several cutoff oxbow lakes still remain near the main channel providing evidence of the Creek's historical sinuosity. All of these modifications to the hydrology combine to create a narrower floodplain, that for some smaller drainages creates a highly entrenched channel with a floodplain width not much smaller than the bankfull width. This typically results in general bank instability, less suspended sediment being trapped in floodplain areas, and more frequent flooding events in lower areas.

Small forested oxbow lakes are the only natural lakes in the watershed, but artificial lakes and ponds are common and gaining in popularity near new residential and commercial developments – especially near developments on hilltops and on ridges.

Cross-sections of the streams at each of the sample points were conducted during the study for stream flow measurements and can be found in the appendix. *Figure 2.3.4-C: Big Creek Elevations* shows a generalized slope of the Big Creek main channel from its headwaters (Pond Flat Ditch) to the outlet at the Wabash during the first round of monitoring. Elevations are based on the Indiana Digital Orthophotography Project's digital elevation models and field surveys. During this time the total elevation change from point 34 to point 1 was 62.8 feet over 30 miles, or about a 0.04% slope. The Creek's level at this time was affected by the high level of the Wabash River beginning at point 8. In *Figure 2.3.4-C*, bridge elevations assumed from the center of the road are shown as yellow triangles. Bottom elevation taken from field measurements are shown as blue diamonds with a line forming the generalized slope. Water levels measured from the bridges at the time the monitoring round was conducted are shown as purple squares with a line forming the generalized slope. Day 1 measurements were taken on 3/20/2007, day 2 measurements were taken on 3/22/2007, and day 3 measurements were taken on 3/23/2007.

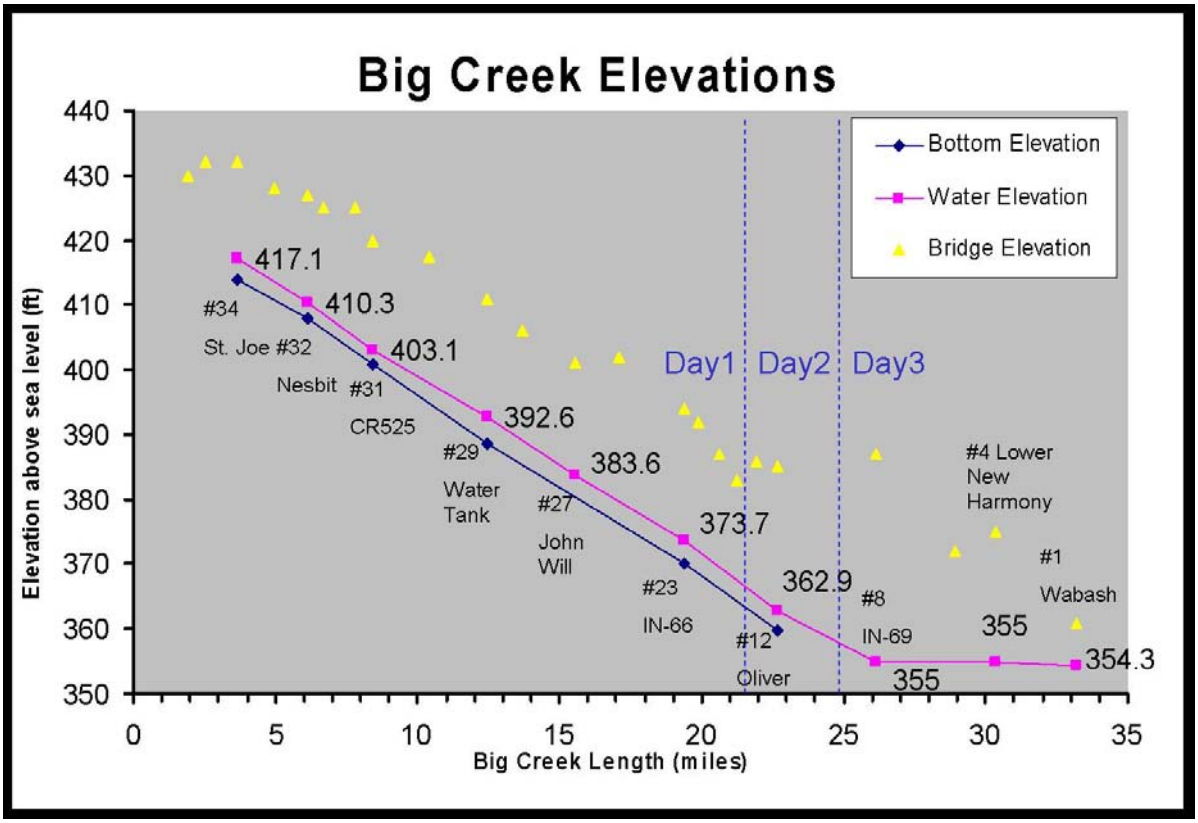


***Figure 2.3.4-C: Big Creek Elevations***

### *2.3.5: Natural History*

Prior to settlement by Europeans, Oak-Hickory forests dominated the Big Creek watershed landscape. Bottomland mixed-mesophytic forests consisting of a variety of Oaks, Bald Cypress, and Buttonbush and with a sparse understory, existed along the major streams and in the areas of little to no relief. Mussels were likely prevalent in gravel bottom sections of Big Creek, Little Creek, and the smaller tributaries. Many species reach the northern limit of their range in this region. The watershed falls entirely into the "Green River – Southern Wabash Lowlands" Ecoregion as defined by the EPA.

## *2.4: Landuse*

***This section gives a brief description of how the land is currently used in the watershed. It provides the reader with an understanding of current trends that may influence the watershed and planning process.***

### *2.4.1: Historic Land-use & Events*

### *2.4.2: Current Land-use*

Today the land is covered by much different vegetation and even substrates than before European settlement. Much of the land has been cleared for row crops and where forests remain, they are much different in character than they were 200 hundred years ago due to

selective harvesting and impacts to understory plant communities. Rivers and streams have undergone drastic hydrologic changes as described in *Section 2.3.4*. Woody debris is now cleared from many waterways and trees are removed from the riparian area causing warmer temperatures and less cover for fish and invertebrates.

*Figure 2.4.2-B: Big Creek Land Cover Totals* also derived from the GAP 1999 land cover study depicts the percentage of the watershed covered by each type. Row crops dominate with 72% followed by pasture & residential lawns with almost 13% and deciduous forests cover 11% of the watershed. Wetlands make up about 2% of the watershed being mostly wetland forests and open water bodies.

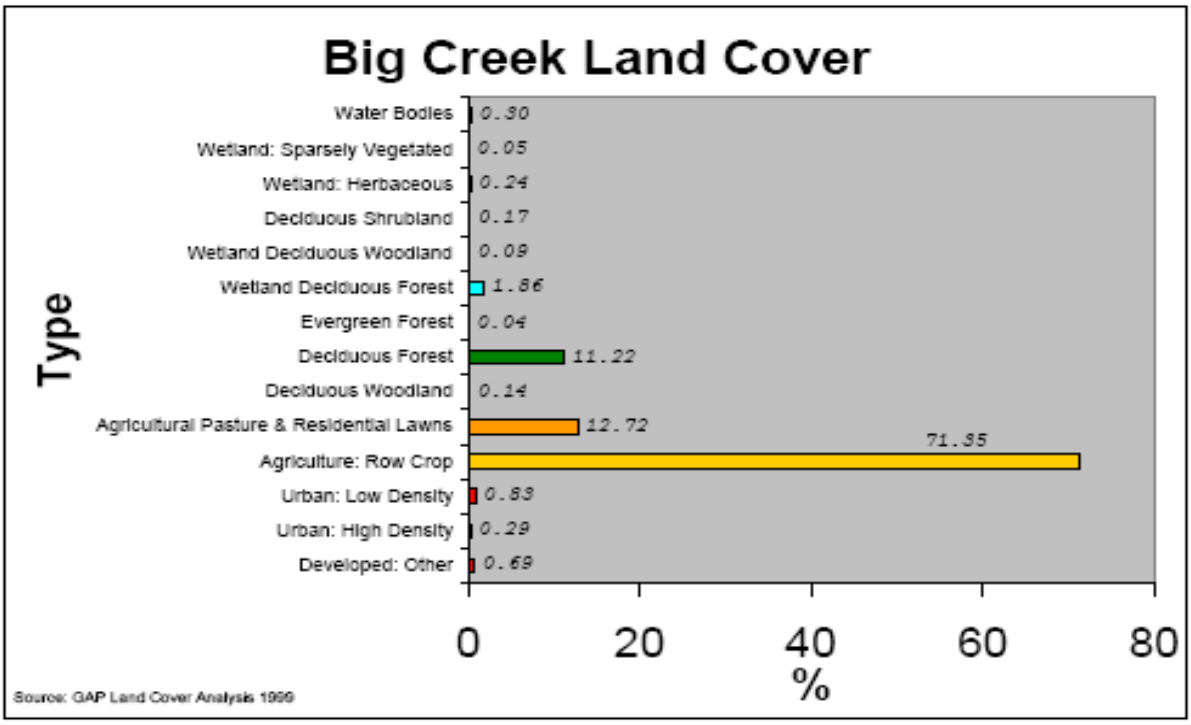


***Figure 2.4.2-A: Land Use from GAP Land Cover Analysis***

The current land uses present a number of challenges for land owners in trying to control the effects of the land use on water quality. *Figure 2.4.2-C: Land Use Hazards Based on Soil Associations* shows the location of land uses that may present hazards due to the water quality concerns associated with soil association on which they are located. The map follows the concerns associated with the soil groups as described in section 2.3.3. Areas depicted as nitrate and pathogen hazards due to septic systems (shown in purple) have a higher likelihood of contributing to concerns related to pathogens and nutrient loading and loss because of the properties of the soil. Areas depicted as nitrate hazards due to cropland (shown in olive) have a higher likelihood of contributing to concerns related to nutrient loading and loss and areas depicted as erosion hazards due to cropland (shown in brown) have a higher likelihood of contributing to concerns related to sediment loading and nutrient loading. The overall land uses are shown beneath the hazard areas depicted as follows: Developed: high intensity (red), Developed low intensity (orange), row crop (yellow), pasture (light green), woodlands (dark green), and lakes, reservoirs & wetlands (blue).

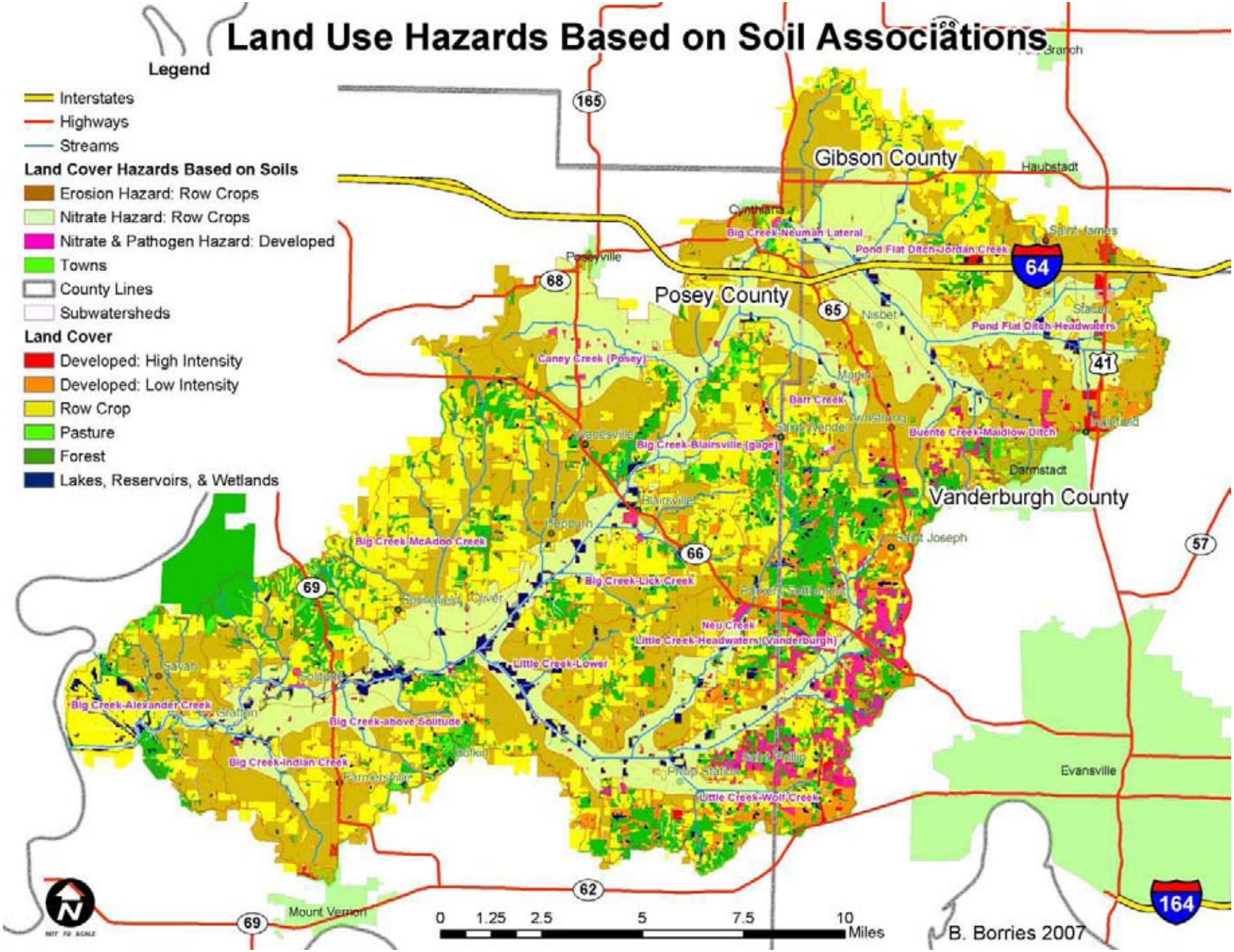


***Figure 2.4.2-C: Land Use Hazards Based on Soil Associations***

## Livestock Production

*Table 2.4.2-A: Livestock Production in the Big Creek Watershed* details the inventory of livestock in the watershed. The numbers are based on the 2002 National Agricultural Statistic Service Census study (NASS USDA 2007). Livestock numbers are important because high concentrations of manure from the animals can lead to water quality problems. The numbers were estimated by multiplying the inventory number for each county in the watershed by the percentage of the county the watershed covers.

### Cattle Numbers (Based on 2002 NASS Census)

| County | Number of Dairy Cows per County | Number of Beef Cows per County | Percent of County in Watershed | Estimated Number Beef Cows | Estimated Number Dairy Cows |
|---|---|---|---|---|---|
| Posey | 764 | 806 | 39.5% | 302 | 318 |
| Vanderburgh | 380 | 207 | * | 380 | 207 |
| Gibson | 878 | 1446 | 4.3% | 38 | 62 |
| Total | | | | 451 | 441 |

### Hog Numbers (Based on 2002 NASS Census)

| County | Number of Swine per County | Percent of County in Watershed | Estimated Number in Watershed |
|---|---|---|---|
| Posey | 21229 | 39.5% | 8386 |
| Vanderburgh | 3346 | * | 3346 |
| Gibson | 27463 | 4.3% | 1177 |
| Total | | | 10545 |

### Poultry Numbers (Based on 2002 NASS Census)

| County | Number of Layers per County | Percent of County in Watershed | Estimated Number in Watershed |
|---|---|---|---|
| Posey | 32 | 39.5 | 13 |
| Vanderburgh | 132 | * | 132 |
| Gibson | 364 | 4.3% | 16 |
| Total | | | 67 |

### Horse Numbers (Based on 2002 NASS Census)

| County | Number of Horses per County | Percent of County in Watershed | Estimated Number in Watershed |
|---|---|---|---|
| Posey | 950 | 39.5% | 375 |
| Vanderburgh | 1300 | 29.4% | 382 |
| Gibson | 980 | 4.3% | 42 |
| Total | | | 799 |

***Table 2.4.2-A: Livestock Production in the Big Creek Watershed***

**All permitted farms in the county located in Big Creek Watershed*

*Figure 2.4.2-D: Pastures and Livestock Facilities* shows the location of the farms that possess a Confined Feeding Operation permit issued by IDEM. Active permits are shown with a red thumbtack and voided or expired permits are shown with an X. Other feeding operations without a permit are shown with red dots. These are assumed to be smaller in size with animal numbers below the permit threshold. According to Indiana law, operations in which 300 cattle, 600 swine, or 30,000 fowl (turkeys, chickens or other poultry) are fed in a confined manner must obtain a CFO permit. This differs from an EPA Confined Animal Feeding Operation (CAFO) permit which has a higher animal threshold: 700-1000 cattle, 2,500-10,000 swine, and 30,000 to 125,000 fowl depending on breed and manure storage type. It is important to note that operations with permits may not actually possess animal numbers exceeding the permits threshold, but may just obtain the permit in case their operation grows. Also, operations exist where confined feeding occurs, but the animal numbers are not enough to require a permit. All three cattle, swine, and fowl CFO permitted operations exist in the watershed but no CAFO permitted operations are within its boundaries. *Table 2.4.2-B: CFOs by Sub-Watershed* indicates the number of operations found in each sub-watershed that have a CFO permit. Sub-watersheds with no permitted operations are not listed in the table.

**CFOs by Sub-Watershed**

| Sub-watershed | Number of Active Permitted Operations |
|---|---|
| Pond Flat Ditch – Headwaters | 1 |
| Pond Flat Ditch – Jordan Creek | 3 |
| Big Creek – Neuman Lateral | 2 |
| Barr's Creek | 1 |
| Caney Creek (Posey) | 2 |
| Little Creek – Lower | 1 |
| Big Creek – Indian Creek | 1 |

***Table 2.4.2-B: CFOs by Sub-Watershed***

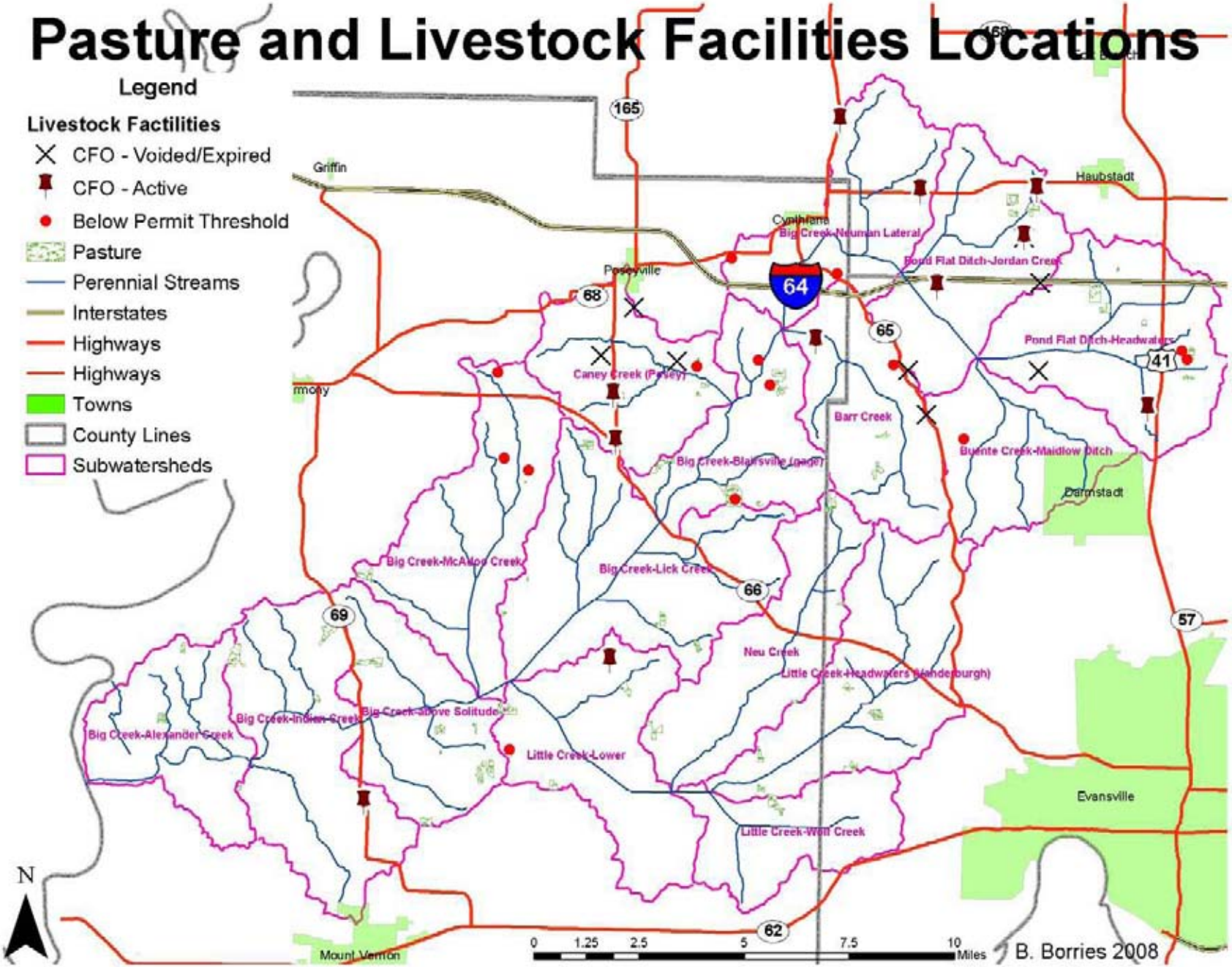


*Figure 2.4.2-D: Pasture and Livestock Facilities*

### *2.4.3: Population*

*Figure 2.4.3-A: Big Creek Population Density* shows the distribution of population throughout the watershed according to the 2000 census. Population totals for each census block were used to determine population density shown in number per square mile. Darker blocks indicate higher population density. In general, the highest concentrations of people are found in the southeastern section in Big Creek-Wolf Creek sub-watershed and in the small section of Mt. Vernon that overlaps the southern tip of the Big Creek-Indian Creek sub-watershed. Using the density determinations from the 2000 census data, the total estimated population of the watershed is 23,248.

The runoff curve number developed by the Soil Conservation Service can be used to estimate the amount of runoff generated by a storm (the amount of rain minus what infiltrates the soil). It estimates a higher amount of runoff for less permeable soils such as hydric soils and for land-uses, such as urban, that are likely to restrict the natural infiltration of the soil. On the other hand sandy soils and forests have a low curve number because more of the precipitation is likely to infiltrate into the soil. Population density in an area can have a significant impact on the amount of runoff. Higher population density usually means smaller lot sizes with more impervious areas. When areas of high population density are located on hydric soils, these effects are even more profound. *Figure 2.4.3-A: Big Creek Population Density* shows the locations of developed areas with hydric soils grouped into class C (high runoff) and class D (very high runoff). An average runoff amount based on the SCS curve number was created from land use and soils data for each sub-watershed and is shown in the map as green for "low", yellow for "medium", and red for "high." Population density is shown as green circles from white to black. Near white indicates the lowest density (0-50 per square mile) and black indicates the highest population density (greater than 1000 per square mile).

Additional challenges exist for controlling runoff and pollutants from areas with high population density, especially when high runoff soils are present. Increases in runoff lead to higher peak flow and stream bank erosion resulting in increased turbidity, suspended solids, and sedimentation. Loading of dissolved pollutants, such as nitrate, may also increase with the increase in runoff. The figure shows the most high runoff soils and the highest population density (with the exception of a small area in north Mt. Vernon) in the eastern section of the watershed. These area are found primarily in the Pond Flat Ditch – Headwaters, Buente Creek – Maidlow Ditch, Little Creek – Headwaters, and Little Creek – Wolf Creek Sub-watersheds.

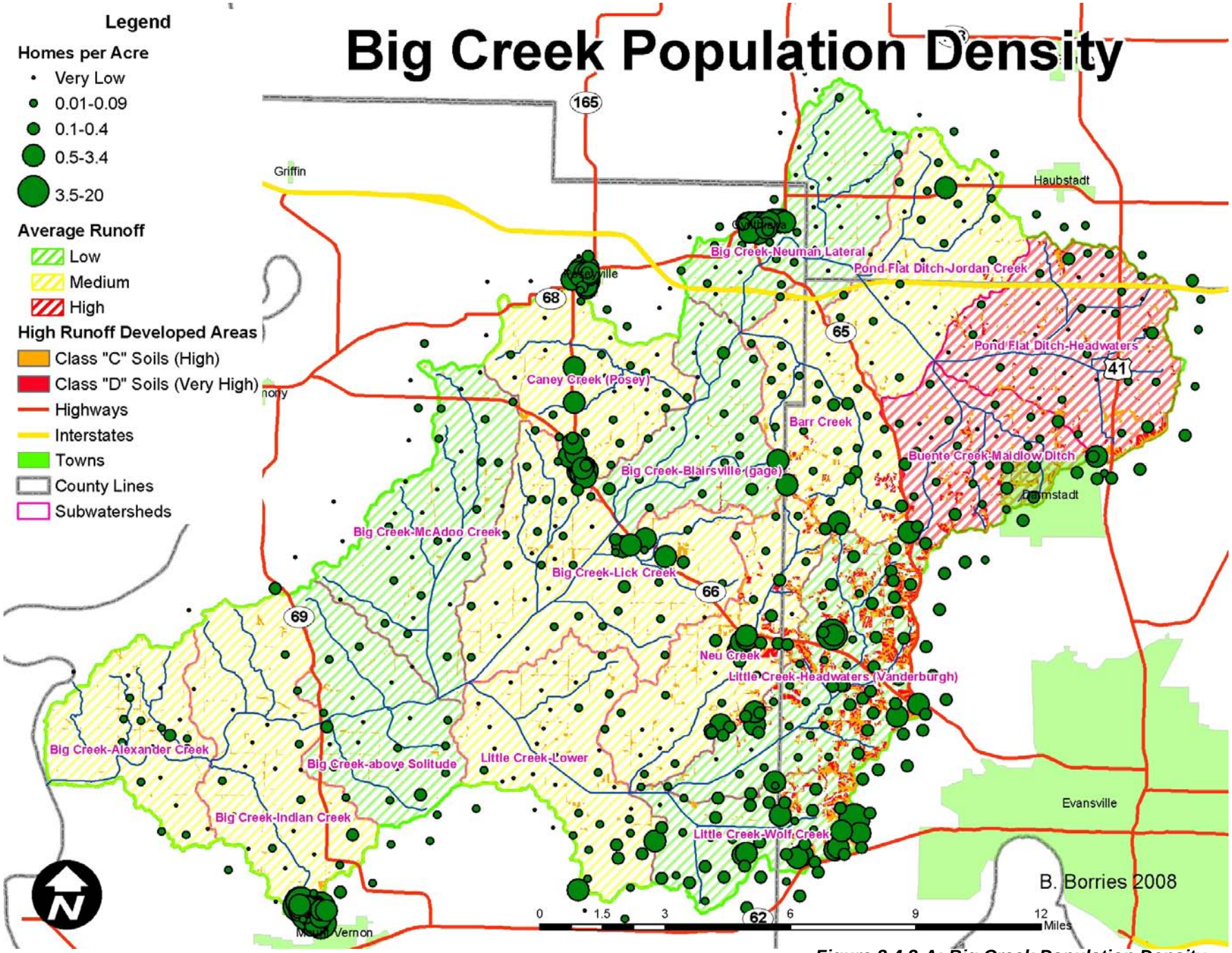


*Figure 2.4.3-A: Big Creek Population Density*

*Figure 2.4.3-B: Big Creek Population Change (1990 to 2000)* shows the current trend in population change throughout the watershed. The change is depicted as a percent change from 1990 to 2000 based on census data. The map shows areas with the highest percent increase in black with less dramatic increases in lighter shades of grey. Areas of no significant change are shown in white and areas with a decrease in population are shown in blue. The figure also shows the locations of high runoff soils that are currently in undeveloped areas. Class "C" (high runoff soils) area shown in orange and class "D" (very high runoff soils) area shown in red. These class "C" and "D" soils located in undeveloped areas can be considered areas that will cause the most significant impact if development occurs. The average amount of runoff for each sub-watershed determined from the runoff curve number calculated from soils and land use information is shown as red for high, yellow for medium, and green for low. The most significant increases in population are currently occurring in the southeastern section of the watershed near Evansville's Westside and in the area northeast of Darmstadt in the Pond Flat Ditch – Headwaters Sub-watershed.

If current changes continue, great challenges will exist in controlling the effects of increased development in the Pond Flat Ditch – Headwaters, Little Creek – Headwaters, and Little Creek – Wolf Creek sub-watersheds. These areas, to the north and west of Evansville, are experiencing the most growth and possess several qualities that make them difficult to develop while preserving water quality. High runoff soils are also common in these areas resulting in especially profound increases in runoff with increasing population densities. In addition, steep slopes exist making construction sites prone to erosion. Septic systems, the most common wastewater treatment method, are also prone to failure on high runoff soils. Other areas experiencing increases in population with significant amounts of high runoff soils include areas south and west of Wadesville in the Big Creek – McAdoo, Big Creek – Lick Creek, and Caney Creek Sub-watersheds.

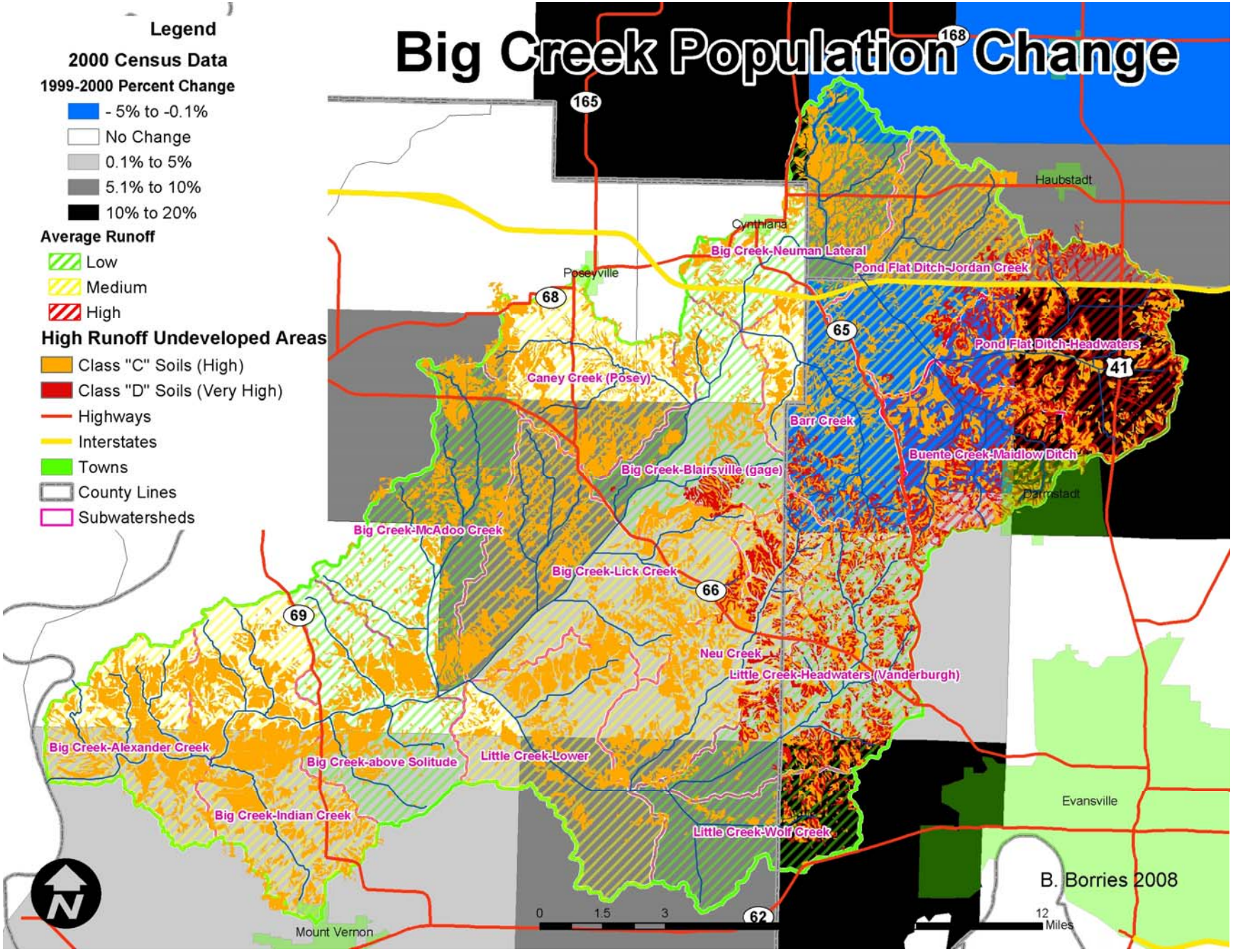


*Figure 2.4.3-B: Big Creek Population Change (1990 to 2000)*

### *2.4.4: Public Land Ownership*

Very little publicly owned or managed land exists in the watershed. The only parcel is a small corner of New Harmonie State Park that overlaps Big Creek – Indian Creek and Big Creek – Alexander Creek Sub-watersheds at the headwaters of French Run, Goad Brook, and Fun Creek. There are no trails open to the public in this part of the park. The section of the park that overlaps the watershed is about 630 acres and foreseeable management of the area is unlikely to have a significant effect on the watershed or the management plan. The location of the area is shown in *Figure 2.4.4-A: New Harmonie State Park Location* in green hatch.

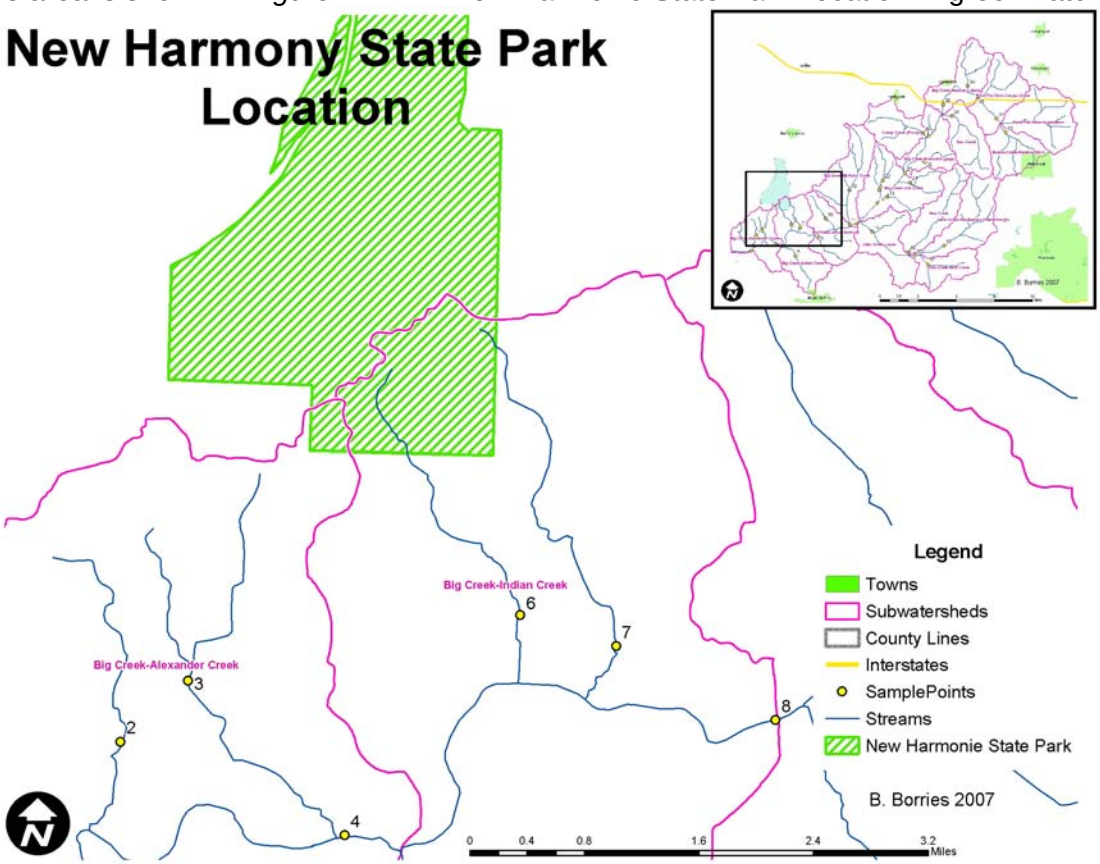


***Figure 2.4.4-A: New Harmonie State Park Location***

### *2.4.5: National Pollution Discharge Elimination System (NPDES) permits*

The National Pollution Discharge Elimination System (NPDES) was established in1987 to provide existing polluters with a step-by-step elimination of polluted discharges to surface waters. Permits are still issued today and operators must meet water quality criteria to maintain compliance. A small number of NPDES permits exist in the watershed. They include public-private sanitation systems, treatment water from a food processing facility, and a lift station near PPG Plastics. Their locations are shown in *Figure 2.4.5-A: National Pollution Discharge Elimination System Permit Locations*. Facilities are shown as a box with a small flag and pipe locations are shown as circles. All facility locations are linked to a nearby pipe.

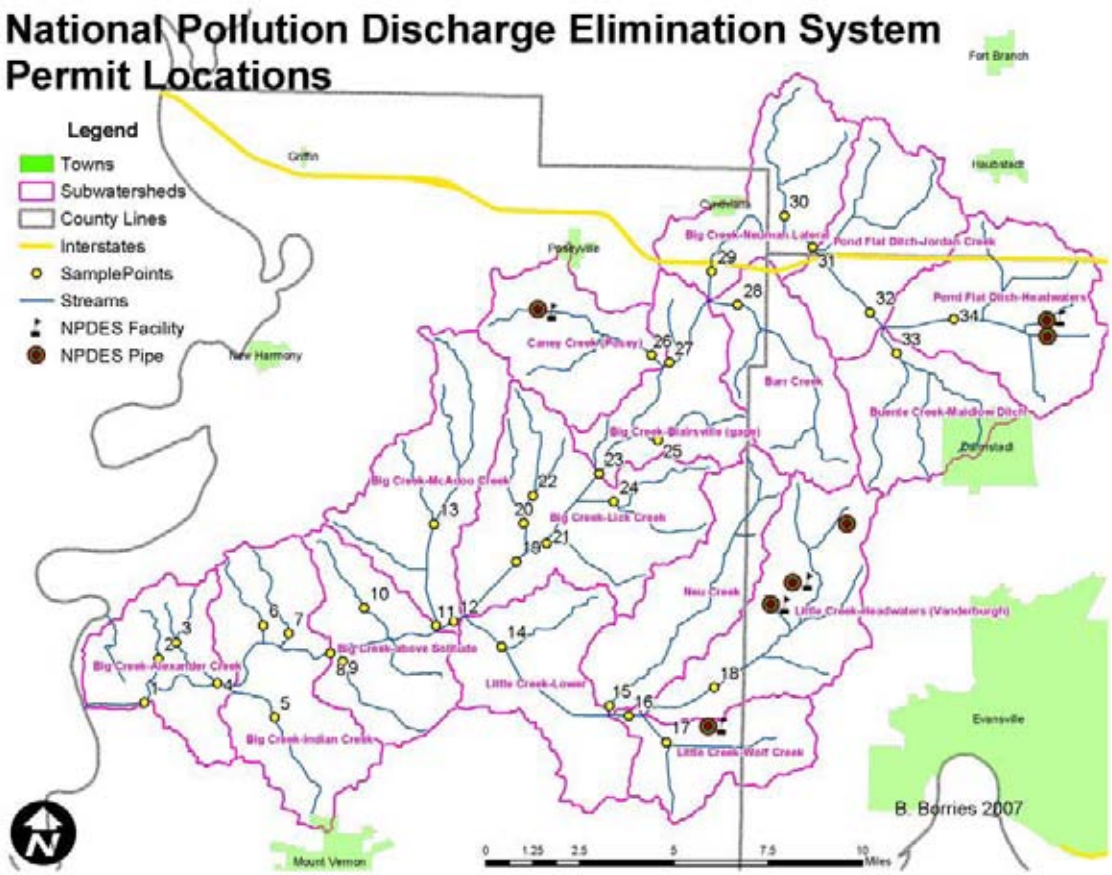


***Figure 2.4.5-A: National Pollution Discharge Elimination System Permit Locations***

## *2.4.6: Water Use*

There are no public surface water intakes within the Big Creek watershed and no known self-supplied surface water intakes. There are also no surface water intakes on the Wabash River downstream of the Big Creek outlet before its confluence with the Ohio River. There are many people that rely on groundwater that is affected by the Big Creek Watershed. Though the soils in the area contain subsurface clays that make penetration by contaminated runoff unlikely, groundwater pollution may occur because of oil production, septic systems, and infiltration of rain high in nitrates from fertilizers.

*Table 2.4.6-A: Estimated Groundwater Use* shows the estimated amount of groundwater and number of people using groundwater within the watershed and by each county. The data comes from the USGS Water Use estimates conducted in 2000. To obtain estimates for the watershed from the county level data the numbers were multiplied by the percent of the county that is made up by the watershed. Data for the population using groundwater was only available as a number that combined groundwater and surface water. This number would not reflect accurately the amount of groundwater used and so instead an average use in millions of gallons per day per thousand people was determined. The population figure in thousands of people was then determined using this number and the usage in millions of gallons per day. It is estimated that 1,860 people rely on 70,000 gallons/day through public supplies and 10,740 people rely on 740,000 gallons/day through self-supplied wells.

USGS Water Use Estimates (2000) by County

| County | Average Usage - Public Supply (Millions Gallons/Day per 1000 people) | County Usage - Groundwater - Public Supply (Millions Gallons/Day) | Estimated County Usage - Groundwater - Public Supply (1000s of People) | County Usage - Self Supplied (Millions Gallons/Day) | County Usage - Self Supplied (1000s of People) |
|---|---|---|---|---|---|
| Posey | 0.16 | 0.35 | 2.14 | 0.99 | 13.07 |
| Vanderburgh | n/a | 0 | 0 | 0.90 | 11.86 |
| Gibson | 0.07 | 1.68 | 23.70 | 0.40 | 5.27 |

Estimated Groundwater Use in Big Creek Watershed Based on USGS Data

| County | Percent of County in Watershed | Public Supply (Millions Gallons/Day) | Public Supply (1000s of People) | Self Supplied (Millions Gallons/Day) | Self Supplied (1000s of People) | Total (Millions Gallons/Day) | Total (1000s of People) |
|---|---|---|---|---|---|---|---|
| Posey | 39.5% | 0.06 | 0.84 | 0.39 | 5.16 | 0.46 | 6.01 |
| Vanderburgh | 29.4% | 0.00 | 0.00 | 0.26 | 3.49 | 0.26 | 3.49 |
| Gibson | 4.3% | 0.003 | 1.02 | 0.02 | 0.23 | 0.02 | 1.25 |
| **Total** | | **0.07** | **1.86** | **0.67** | **8.88** | **0.74** | **10.74** |

***Table 2.4.6-A: Estimated Groundwater Use***

### *2.4.7: Mining, Oil, & Gas*

Mineral resources can be found throughout the watershed, but only oil and some natural gas is utilized. Oil fields are shown in *Figure 2.4.7-A: Petroleum Field Locations* in pink. Oil wells are a common sight throughout these areas. Several fields also contain some natural gas and an underground field near Oliver is used by Vectren Energy Delivery to store natural gas for its customers.

Nearly half of Big Creek has significant oil resources below the ground and has the potential for both new contamination during drilling of new wells and rehabilitation of old wells or yet undiscovered contamination from historic well production. Some of this contamination has been discovered in the watershed and is detailed in chapter 3. Contamination may occur when high-salt groundwater is used to force oil out of deep oil fields seep into existing clean aquifers used for drinking water. Of particular importance in future protection measures are the areas where municipal drinking water is not available and a new line would be needed if the aquifer, currently used for drinking water is contaminated.

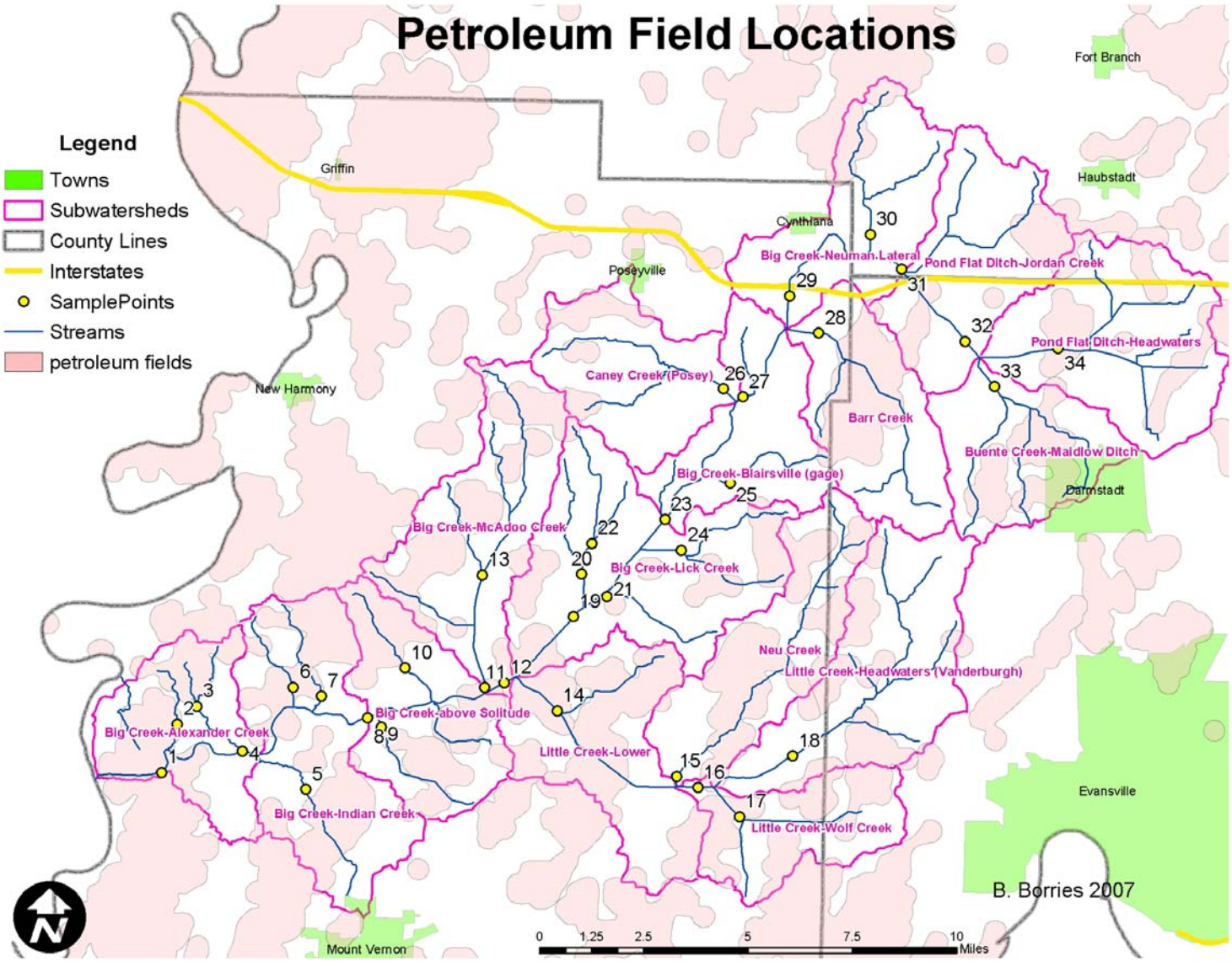


***Figure 2.4.7-A: Petroleum Field Locations***