**Harrods Creek Watershed Plan**
**Chapter 2: Exploring Your Watersheds**

## 2.1 Introduction

Chapter 2 focuses on existing information and local knowledge about the Harrods Creek Watershed. This information is critical to understanding the land and water uses in the watershed and their associated impacts on water quality. This chapter covers water resources, natural features, and human influences. Chapters 3 and 4 discuss water quality data that are being collected specifically for this project.

Harrods Creek starts in western Henry County and flows south and west through Oldham County and northeast through Jefferson County to the Ohio River (see Figure 1.1). This project focuses on the upper reaches of the creek, including its headwaters. The headwaters of a creek or river is where it begins, and its mouth is where it ends and flows into another body of water (see Figure 2.1). This project focuses on the upper portions of Harrods Creek only (Figure 2.2).

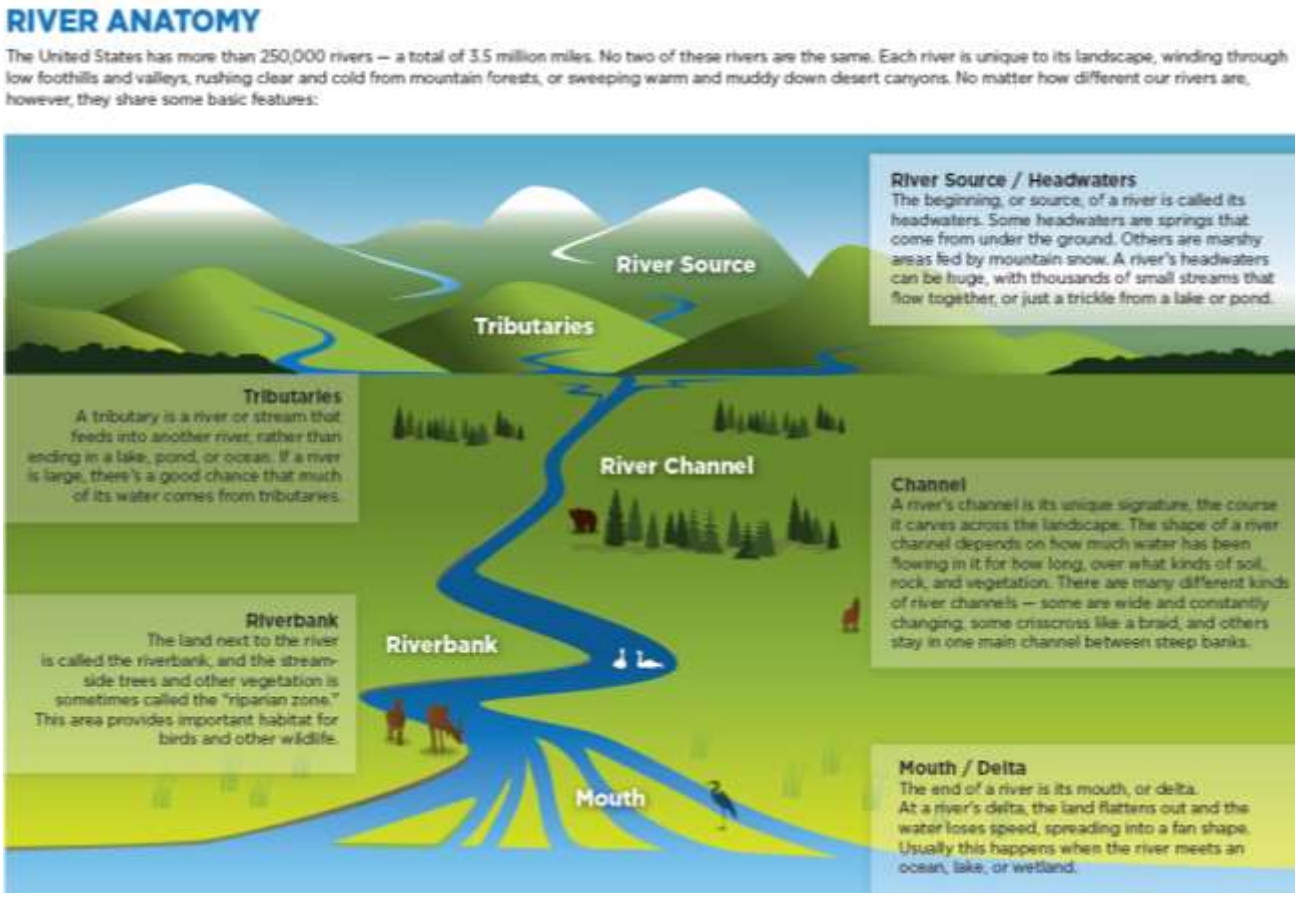


Figure 2.1: The anatomy of a river (American Rivers, 2015).

## 2.2 Water Resources

The Upper Harrods Creek Watershed, composed of the Headwaters Harrods Creek and most of the Brush Creek area, is the focus of this watershed plan (Figure 2.2). This includes the main stem of Harrods Creek as well as its direct tributaries.

This upper watershed area can be broken down into smaller parcels for ease of planning and information gathering (Table 2.1). The Harrods Creek Headwaters Watershed includes three sub-watersheds. The Brush Creek Watershed includes four sub-watersheds. Multiple "Harrods Creek" entries appear on Table 2.1 because they make up the main stem of the creek.

Table 2.1: Watershed Hydrologic Unit Codes and area.

| | Watershed Name | County | HUC-14 | Acres | Drainage Area (square miles) |
|---|---|---|---|---|---|
| Headwaters Harrods Creek | Harrods Creek | Henry and Oldham | 05140101200-010 | 7,829.61 | 12.23 |
| | Berry Creek | Oldham | 05140101200-020 | 1,517.74 | 2.37 |
| | Harrods Creek | Oldham | 05140101200-030 | 6,153.04 | 9.61 |
| Brush Creek | Ash Run | Oldham | 05140101200-040 | 1,552.35 | 2.42 |
| | Harrods Creek | Oldham | 05140101200-050 | 789.57 | 1.23 |
| | Brush Creek | Oldham | 05140101200-060 | 3,358.88 | 5.24 |
| | Harrods Creek | Oldham | 05140101200-070 | 2,524.26 | 3.94 |

These numeric codes are part of the Hydrologic Unit Code (HUC) system which is a standardized watershed classification system developed by the US Geologic Survey (USGS). HUC units are watersheds organized by size. Each of the seven sub-watersheds listed in Table 2.1 are HUC-14s. Other watersheds comparable in size will also have a 14-digit number; it is like an address for the watershed. Bigger watersheds have smaller HUC numbers. Ash Run is a HUC-14, and it is part of the larger Brush Creek Watershed which is a HUC-12. Brush Creek (051401010502) and the Headwaters of Harrods Creek (051401010501) are both HUC-12s, and the entire Harrods Creek Watershed from headwaters to mouth is a HUC-10 (0514010105). The Salt River Basin is a HUC-8.

The HUC numbers are used in gathering data about specific areas and to help identify and analyze pollution source information. It is helpful to break the watershed down into smaller pieces to help evaluate land uses and isolate sources of pollution.

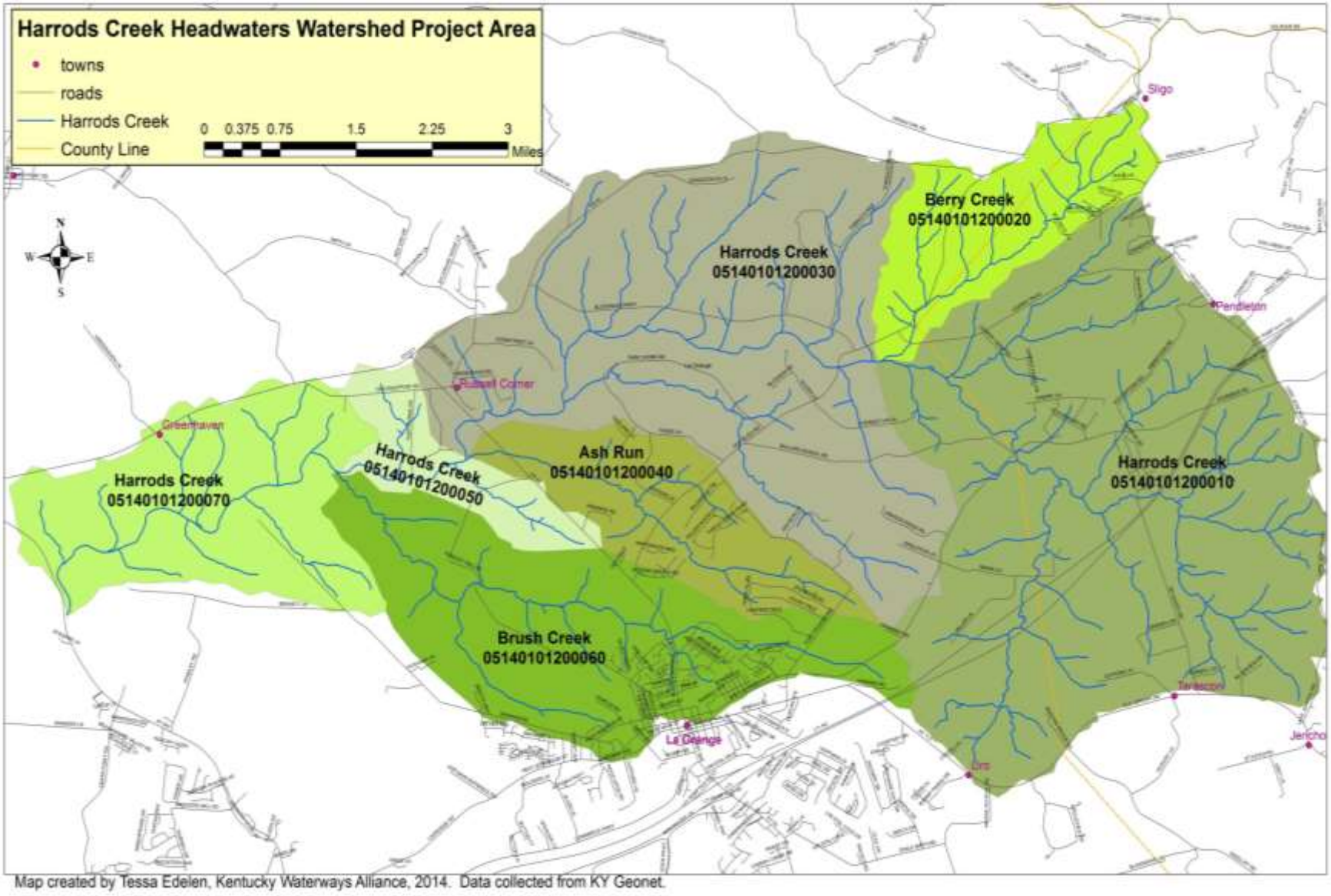



Figure 2.2: Upper Harrods Creek Watershed.

***Hydrology***

Hydrology is the study of water on the Earth. The hydrology of Harrods Creek includes where the creek flows (including surface water and ground water), how much water is in the creek, and the quality of the water. Other factors such as topography and precipitation also affect hydrology.

There are five major tributaries to Harrods Creek: South Fork Harrods Creek, Darby Creek, Cedar Creek, Brush Creek, and Ash Run. The upper watershed area includes Brush Creek and Ash Run. The general characteristics of the upper watershed area above HWY 393 are sloping to strongly sloping uplands with broad floodplains along the creek channels (OCEA Facilities Plan 2013, chapter 3). Stream slopes are moderate to flat, about 15 feet per mile from the headwaters to mile 15 above Darby Creek (Harrods Creek Total Maximum Daily Load for organic enrichment, KY Division of Water, 1995).

Stream flow (also called flow or discharge) measures the amount of water traveling through a stream in cubic feet per second (cfs). Stream flow data are useful because they indicate how much water is in a waterway and how fast that water is moving at a certain time and place. "Mean annual flow" is the average volume of water in a year to flow past a specific point. Typically, a downstream location will have a greater stream flow than an upstream location in the same body of water. This is because tributaries and precipitation add volume to the stream as it travels downstream toward the mouth.

The USGS has gaging stations that record these data year-round on many streams throughout the country. There is not a gage station in the project area. There is one nearby at USGS Gage Station 03292470, south of Goshen, KY (Figure 2.3). It is important to remember that the stream flow at USGS Gage Station 03292470 will be greater than points farther upstream.

Table 2.2 shows the measured average annual discharge at the USGS Gage Station 03292470 for years 2000 to 2013. Table 2.3 shows the peak stream flow for the same time period at the same gage station.

Water Year Summaries for 2012 and 2013 and much more information can be found at the USGS's website National Water Information System: http://waterdata.usgs.gov/nwis/

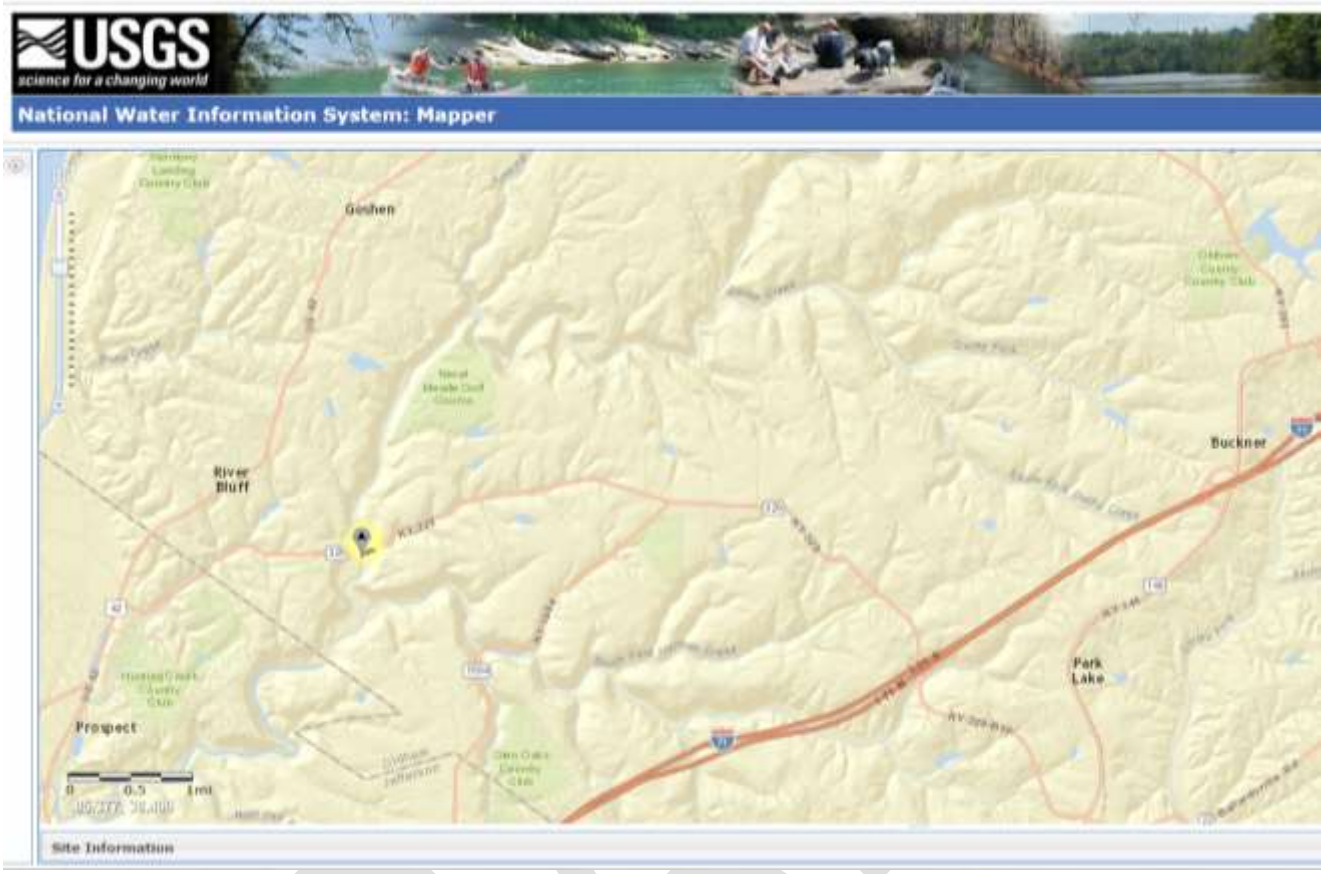



Figure 2.3: Location of USGS Gage Station 03292470 on Harrods Creek south of Goshen, KY.

Table 2.2: Average annual discharge at USGS Gage Station 03292470

| Water Year | Discharge, cubic feet per second |
|---|---|
| 2000 | 119.3 |
| 2001 | 75.2 |
| 2002 | 226.4 |
| 2003 | 172.6 |
| 2004 | 207.4 |
| 2005 | 145.3 |
| 2006 | 123.6 |
| 2007 | 84.4 |
| 2008 | 151.3 |
| 2009 | 88.2 |
| 2010 | 85.1 |
| 2011 | 156.4 |
| 2012 | 101.3 |
| 2013 | 84.7 |

Table 2.3: Peak Stream Flow (annual) at USGS Gage Station 03292470 (USGS, 2014)

| Water Year | Date | Gage Height (feet) | Stream flow (cfs) |
|---|---|---|---|
| 2000 | Feb. 18, 2000 | 14.76 | 16,500 |
| 2001 | Dec. 16, 2000 | 9.56 | 8,790 |
| 2002 | Mar. 26, 2002 | 9.73 | 9,060 |
| 2003 | Sep. 27, 2003 | 10.03 | 9,540 |
| 2004 | May 28, 2004 | 16.34 | 19,000 |
| 2005 | Jan. 03, 2005 | 10.44 | 10,100 |
| 2006 | Sep. 23, 2006 | 11.11 | 11,100 |
| 2007 | Jan. 15, 2007 | 7.03 | 2,510 |
| 2008 | Apr. 04, 2008 | 11.45 | 11,000 |
| 2009 | Aug. 04, 2009 | 10.77 | 9,310 |
| 2010 | May 02, 2010 | 9.10 | 5,670 |
| 2011 | Apr. 23, 2011 | 14.52 | 20,200 |
| 2012 | Dec. 05, 2011 | 9.73 | 6,830 |
| 2013 | Jan. 13, 2013 | 8.73 | 5,050 |

Table 2.4: Estimated flow for project area streams during low, mid, and high flow conditions (KY Watershed Viewer, 2015).

| | Stream Flow in cubic feet per second (cfs) | | | | |
|---|---|---|---|---|---|
| **Stream** | **Mean Annual Flow** | **Low Flow (7Q10)*** | **2-year flood** | **100-year flood** | **Watershed Size (sq. mi.)** |
| Harrods Creek (at mouth) | 126.5 | 0.3 | 7,269.6 | 19,600.2 | 108.14 |
| Harrods Creek (downstream of Brush Creek) | 43.8 | 0.0 | 3,549 | 10,070.8 | 3.94 |
| Brush Creek | 6.2 | 0.0 | 948.7 | 2,957.8 | 5.24 |
| Ash Run | 2.9 | 0.0 | 570.3 | 1,843.6 | 2.42 |
| Berry Creek | 2.8 | 0.0 | 551.3 | 1,786.6 | 2.37 |
| Harrods Creek (headwaters) | 14.5 | 0.0 | 1,681.7 | 5,033.2 | 12.23 |

* 7Q10 is the lowest 7-day average flow that occurs on average once every 10 years.

Various stream flow levels are estimated for all streams in Kentucky based on historical data from nearby gaging stations and can be viewed with the online mapping tool the Kentucky Watershed Viewer. The information in Table 2.4 shows the estimated flow for streams in the project area during low flow, mid flow, and high flow conditions. For flow-duration statistics to be reliable indicators of probable future conditions, a minimum of 10 years of record is typically used (Searcy, 1959).

Climate and Precipitation

The climate and precipitation of an area can have significant influence on a stream's characteristics. Like all of Kentucky, the Harrods Creek Watershed has a temperate climate with precipitation occurring year round (Table 2.5 and Figure 2.4). Oldham County, on average, gets 45 inches of rain per year, and there are 195 sunny days per year (US Weather Service, 2015).

Table 2.5: Yearly precipitation totals for La Grange, KY (KY Mesonet online database 2014).

| Yearly Precipitation Totals for La Grange, KY | |
|---|---|
| year | total (inches) |
| 2011 | 59.91 |
| 2012 | 40.61 |
| 2013 | 50.36 |
| 2014 | 49.16 |

Large rain events can greatly increase the volume of water in a creek and cause erosion. Erosion can lead to sediment (dirt) entering the stream. Too much dirt in the stream makes it difficult for aquatic organisms to thrive. Rain can also wash substances on the land like livestock manure, lawn and garden chemicals, airborne pollutants that have been deposited onto the ground, and anything else on the land into waterways where they become pollutants.

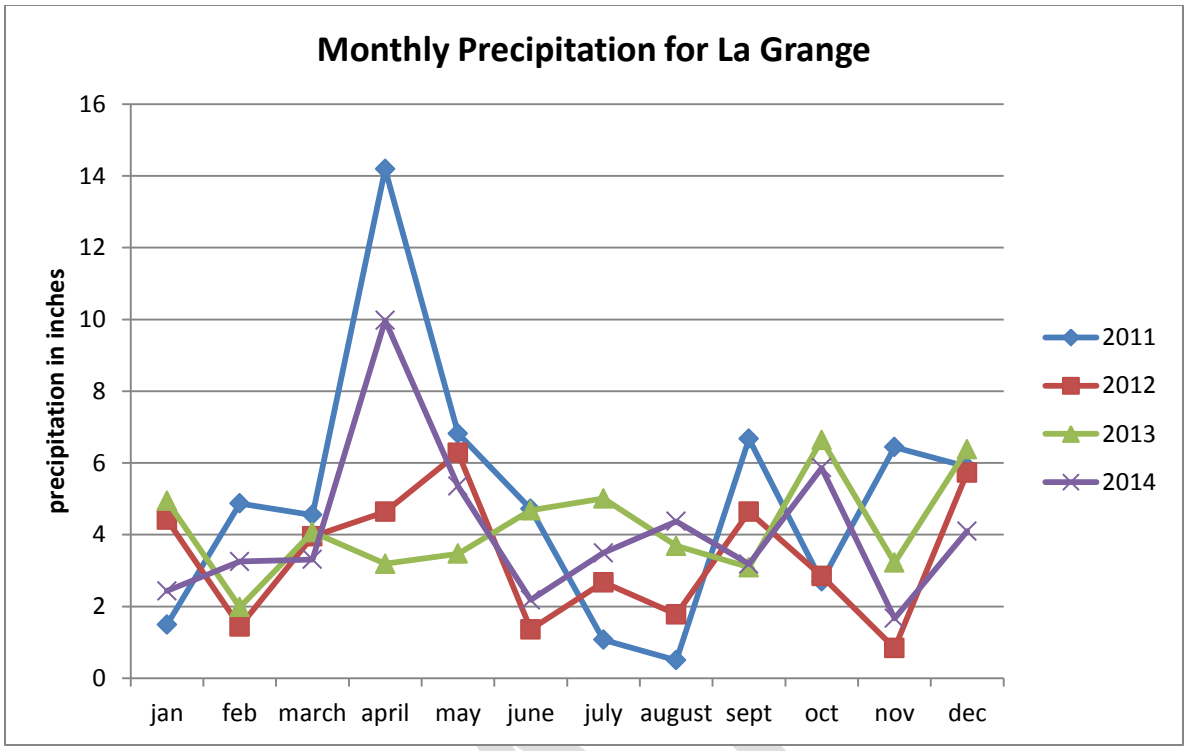


Figure 2.4: Annual precipitation 2011-2014 in Harrods Creek (KY Mesonet, 2015).

Wetlands

There are many different types of wetlands, from ones that are always wet with soggy soil to others that only hold water seasonally. Wetlands are important ecologically because they absorb water when rivers overflow and thereby help to mitigate flooding, provide valuable habitat to plants and animals, and cleanse water by filtering out nutrients and other pollutants.

The National Wetlands Inventory, a national database of wetland data operated by the National Fish and Wildlife Service, shows that there are many fresh water ponds in the project study area, but not a significant number of wetland features. According to the online mapping tool from the National Wetlands Inventory, the Headwaters and Brush Creek areas have approximately 40 wetland units making up 280 acres. These different units range from small seasonal marshes to a large farm pond almost 30 acres in size. Many of the wetland features fall into the category of "palustrine" which includes any inland wetland with no flowing water (National Wetlands Inventory online database, accessed November 2014).

## Groundwater-Surface Water Interaction

Nearly all surface water features (streams, lakes, reservoirs, and wetlands) interact with groundwater. These interactions are important to consider because a stream can get water from, or lose water to, the groundwater system. This exchange of water can impact the water quality and quantity of waterways. Withdrawal of water from streams can deplete groundwater or conversely, pumpage of groundwater can deplete water in streams, lakes, or wetlands. Similarly, pollution of surface water can degrade groundwater quality, and pollution of groundwater can degrade surface water. Effective watershed planning requires a clear understanding of linkages between groundwater and surface water (USGS 2014). Groundwater systems do not necessarily share the same watershed boundaries of surface waterways.
In many places in Kentucky, there are an abundance of caves, sinkholes, springs, and sinking streams which are considered karst features. A karst landscape is most often formed in limestone or dolomite (also known as dolostone). Dolomite and limestone are similar in many ways such as color, hardness, and industrial uses. Dolomite is slightly less soluble than limestone (www.usgs.gov).

Water in karst landscapes is highly vulnerable to pollution, since the connection between surface water and groundwater is more direct than in most other aquifer types. The underlying rock in this project area is dominated by limestone and dolomite, and there are numerous sinkholes and caves. The area is considered to have "moderate" karst potential (Figure 2.5). This means that there are karst features and the potential for more over time, but that there are not a significant number of major features such as caves, sinking streams, and springs.

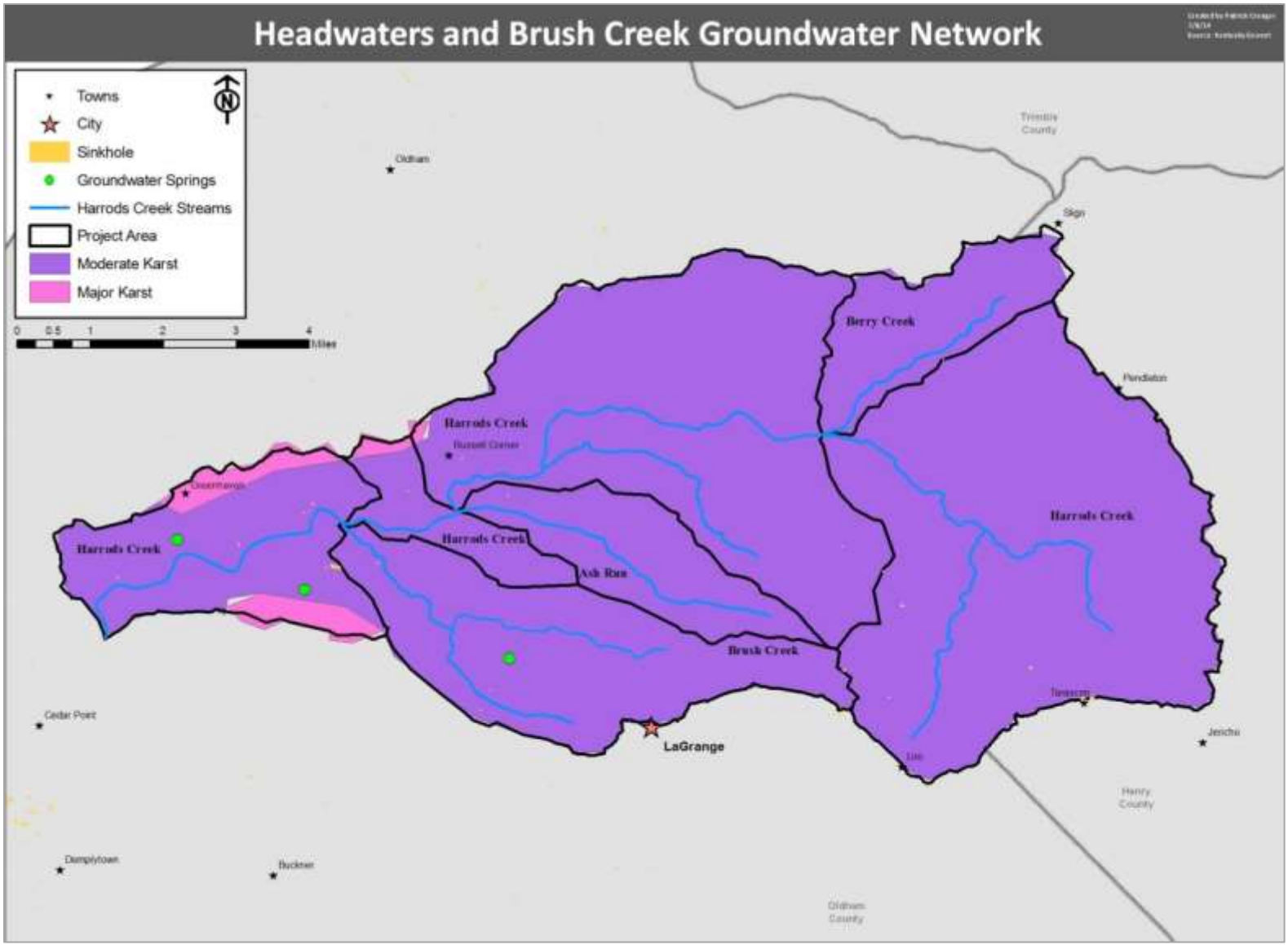


Figure 2.5: Groundwater and karst map of watershed study area.

***Flooding***

Flooding is a natural phenomenon. The area immediately surrounding a waterway (the "floodplain") is prone to flooding. When portions of floodplains are preserved in a natural, vegetated state, they provide many benefits including reduction in number and severity of floods, help handling stormwater runoff, and minimizing impacts of nonpoint source water pollution. By allowing floodwater to spread out across the floodplain and slow down, the sediments settle out, improving water quality. The natural vegetation of the floodplain filters out impurities and uses excess nutrients.

The floodplain along Harrods Creek is 100 to 500 feet wide, with floodplains along tributaries reported as 80 to 130 feet wide (OCEA Facility Plan, 2013).

Also affecting the rate and frequency of flooding is the amount of impervious surface in a community. An impervious surface is one that does not permit passage or infiltration of water, like concrete or rooftops. If a forest is converted into a shopping center, for example, all the rain that would have fallen on the trees and forest floor and either infiltrated into the soil or stayed on the site will now run off the roof and parking lot of the shopping center and into storm drains or directly to a stream. This can cause two problems. First, the runoff from a developed surface will pick up pollutants, such as oils and salts, and carry them to the stream. Second, impervious surfaces do not absorb water as does the porous forest floor, and as a result the runoff will enter the stream much faster. This swells the waterway downstream even more and carries pollutants from the land into the water. With more development and impervious surfaces, there is more and more run-off and flooding.

There is not a significant amount of urban development within the project area, but where it does exist, the size of the surrounding floodplains is a very important feature for mitigating floods when they occur (Figure 2.6). Most of the impervious surface within the project area is in the form of paved roads, parking lots, or buildings in La Grange (Figure 2.17).

Any future development will have an impact on surrounding streams and their flooding frequency, severity, and water quality.

Local information here about flooding in the watershed.

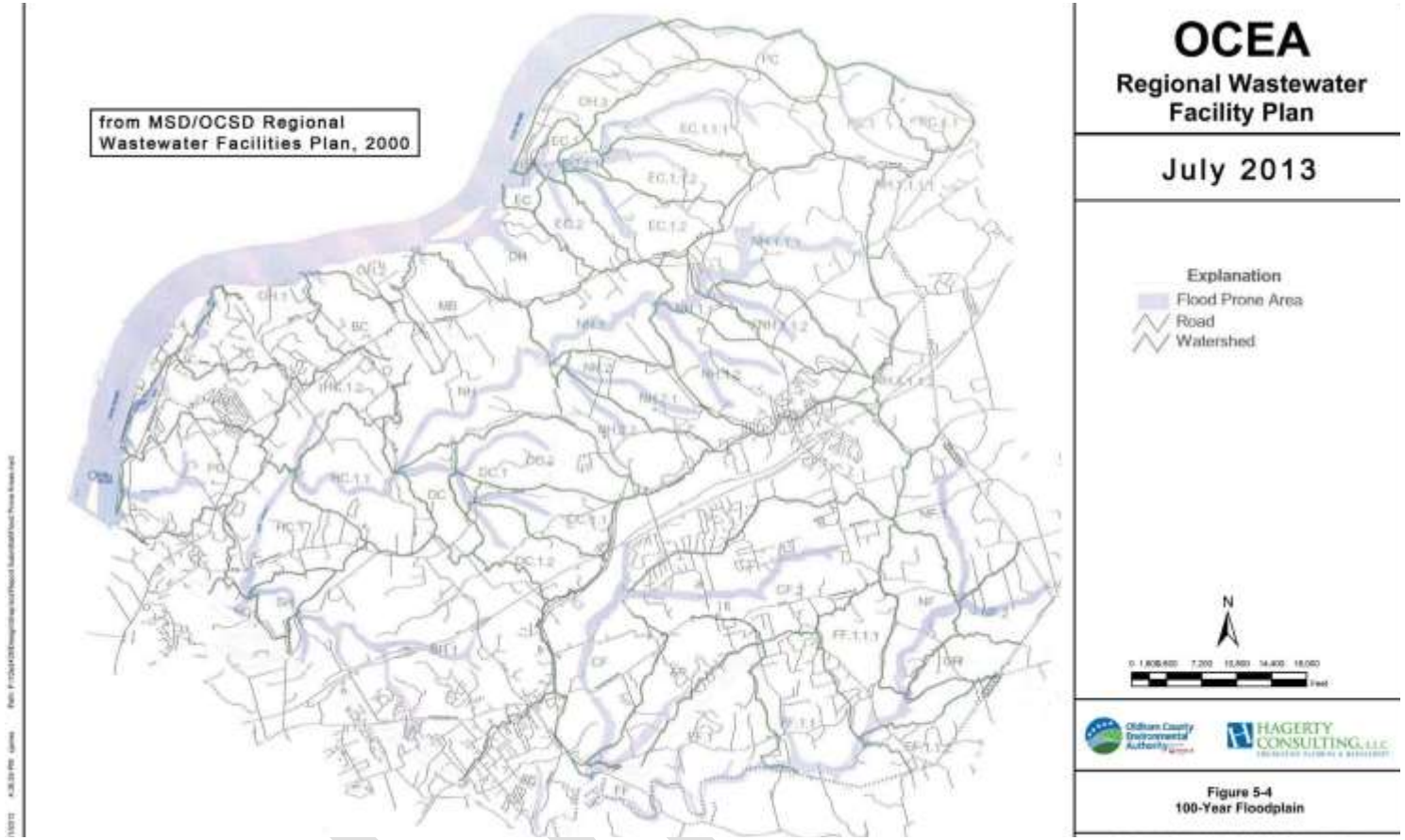



Figure 2.6: Floodplain in Oldham County.

Waiting on a better map

## Regulatory Status of Waterways

Harrods Creek has been assessed by the Kentucky Division of Water (KDOW), and it has been determined to be impaired. An impaired waterway, according to the Clean Water Act, is one that does not meet its designated uses, often due to a pollution issue. The creek was assessed in two different sections, on different dates. The mouth of the creek, river miles 0.0 to 3.2 that flow into the Ohio River in Jefferson County, was assessed in 2005. The rest of the creek, river miles 3.3 to 33, was assessed in 2011 (Table 2.6).

### Designated Uses

KDOW assigns designated uses to each assessed waterway. For each use, certain chemical, biological, or descriptive ("narrative") criteria apply to protect the stream so that its uses can safely continue. The criteria are used to determine whether a stream is impaired, and thus needs a watershed-based plan or Total Maximum Daily Load (TMDL) study. If a waterway does not meet water quality standards for its designated use, then it is considered impaired.

According to KDOW, all unassessed waters in Kentucky are labeled as "High Quality" waters. Waterways may have the following designated uses:

- primary contact recreation (PCR) like swimming or wading
- secondary contact recreation (SCR) like fishing or boating
- warm water aquatic habitat (WAH)
- cold water aquatic habitat (CAH)
- domestic water supply (WS)
- Outstanding State Resource Water (OSRW)

Fish Consumption is not a designated use, but it is recognized as an important human health indicator (per 401 KAR 10:031 Section 2) and has criteria to measure levels of pollutants.

### Impairment Status and TMDLs

Under section 303(d) of the Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop a Total Maximum Daily Load for these waters.

The phrase "Total Maximum Daily Load" or "TMDL" is used to refer to both a calculation and a report about impaired waterbodies and pollutants. As a calculation, a TMDL is the maximum

amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant.

By regulation, each pollutant causing a waterbody to be impaired or threatened is referred to as a waterbody/pollutant combination, and a TMDL is developed for each waterbody/pollutant combination. For example, if one waterbody is impaired or threatened by three pollutants, three TMDLs will be developed for the waterbody. However, in many cases, the phrase "TMDL" is used to describe a document that addresses several waterbody/pollutants combinations (i.e., several TMDLs exist in one TMDL document) (US EPA 2015).

As a written report, a TMDL includes detailed assessment information of site-specific impaired waters, watershed information, mathematical modeling, and the calculated number of a pollutant load.

Table 2.6: Harrods Creek Watershed Assessment Information (KDOW 2012).

| Waterbody Segment | County | WAH | PCR | SCR | FC | DWS | OSRW | Assess Date | Designated Uses |
|---|---|---|---|---|---|---|---|---|---|
| Harrods Creek 0.0 to 3.2 | Jefferson | 4A-NS | 5-PS | 2-FS | 3 | 3 | 3 | 12/1/2005 | WAH, FC, PCR, SCR |
| Harrods Creek 3.2 to 33.0 | Jefferson, Oldham, and Henry | 2-FS | 2-FS | 2-FS | 3 | 3 | 3 | 3/17/2011 | WAH, FC, PCR, SCR |

**NS = nonsupport, FS = full support, PS = partial support**

Reporting categories assigned to surface waters during assessment process: Category 1 - Attaining all designated uses. Category 2 - Attaining some designated uses; insufficient or no data available to determine if remaining uses are attained. Category 3 - Insufficient or no data and information are available to determine if any designated use is attained or impaired. Category 4 - Impaired or threatened for one or more designated uses but does not require development of a TMDL: A. TMDL has been completed. B. Pollution control requirements are reasonably expected to result in attainment of water quality standard in near future. C. Impairment is not caused by a pollutant. Category 5 - Impaired or threatened for one or more designated uses by a pollutant(s), and requires a TMDL.

Impaired waterways are recorded in an official report created by KDOW every two years, the *Integrated Report to Congress on the Condition of Water Resources in Kentucky* (2012 Integrated Report). It presents the quality of water in the assessed streams, lakes, and reservoirs of all major river basins of the state and includes the 303(d) list of impaired waterways. The list of impaired waters requiring a TMDL is called the 303(d) list and can be found in Volume 2 of the Integrated Report. The report is public information and may be accessed online or by contacting the Kentucky Division of Water offices. Each two year cycle focuses on a different river basin in Kentucky, but the report includes information on all the impaired waterways in the state.

Harrods Creek is listed as impaired in the 303(d) List of the 2012 Integrated Report to Congress and requires a TMDL study:

- Harrods Creek, river miles 0.0 to 3.2, Jefferson County
  Into Ohio River Segment Length: 3.2
  Impaired Use(s): Primary Contact Recreation Water (Partial Support)
  Pollutant(s): Fecal Coliform
  Suspected Sources: Highway/Road/Bridge Runoff (non-construction related); Municipal (urbanized high density area); package plant or other permitted small flow discharges.

- Harrods Creek, river miles 0.0 to 3.2, Jefferson County
  Into Ohio River Segment Length: 3.2
  Impaired Use(s): Warm Water Aquatic Habitat (Nonsupport)
  Pollutant(s): Nutrient/Eutrophication Biological Indicators
  Suspected Sources: Municipal (Urbanized high density area)

River miles 3.3 to 33 were previously listed as impaired for fecal coliform based on data collected by KDOW in 2004. This section was then de-listed after being reassessed in 2009. Data from 2009 indicated that the waterway did not have levels of fecal coliform exceeding state standards.

Because the upper portion of Harrods Creek is not currently listed as an impaired stream, no TMDL study has been completed or is currently planned. An Organic Enrichment TMDL study has been completed for the lower portion, river miles 0.0 to 3.2, of the creek.

Special Use Waters

Kentucky identifies certain Special Use Waters, which receive greater protection than other waterways. Special Use designations are made because of some exceptional quality of the water that needs protection or maintenance of current water quality. There are no

occurrences of Special Use Waters designations of Cold Water Aquatic Habitat, Exceptional Waters, Reference Reach Water, or Outstanding State Resource Water, State Wild River, State Wild and Scenic River, National Wild and Scenic River, or Federal Wild River in the Harrods Creek Watershed.

**Other Water Data**

Chapters 3 and 4 will explore water quality and habitat data collected specifically for this project. This section reviews existing data that may be helpful in the planning project.

Watershed Watch

The Salt River Watershed Watch is a volunteer organization that samples waterways all over the Salt River Basin for water quality and biology. The organization trains volunteers to collect data, supplies water testing kits, holds an annual conference to report data results, and serves to educate the community on important water quality issues. Typically, once trained, a volunteer may pick his or her site for the data collection three times a year. According to the Salt River Watershed Watch, there are several active volunteers in the Harrods Creek Watershed, but none in the project focus area. For more information, see the website: kywater.org/watch/salt.

Other watershed plans – There are at least three other watershed planning documents produced for the Harrods Creek Watershed in the past several years, all of them focusing on the lower stretches of the creek. A brief description of each is provided below:

- The Jefferson County Soil and Water Conservation District published a document on Harrods Creek in 1997 called "Harrods Creek… A reflection of us: a neighborly approach to improving water quality through watershed management." It focuses on nonpoint source pollution and what farmers and homeowners can do to improve water quality. It touches on preventing erosion from construction sites and responsible boat upkeep.

- The City of Prospect established the Harrods Creek Task Force in April 2000 to develop a strategy for the protection and enhancement of water quality in the watershed. The Task Force was composed of local officials, concerned citizens, MSD, University of Louisville, and local consulting firms. A report called "Harrods Creek Planning Meeting Report" was written by Nancy Stearns Theiss after several stakeholder meetings. The Task Force eventually morphed into the Parks Committee for Prospect.

- River Fields completed a study in 2004 with then intern Brooke Shireman. This study pulled together water quality data from several sources, historical and educational information, and future plans of entities like KY Infrastructure Authority, Metropolitan Sewer District, and the KY Division of Water.

## 2.3 Natural Features

The Harrods Creek Watershed is a picturesque place with rolling hills, beautiful farmland, and forested areas. What else do we want to say watershed team?

### Geology and Topography

In general geological terms, the Harrods Creek Watershed resides in the Outer Bluegrass physiographic region. This means that it the soils are mostly underlain by Saluda Dolomite and the Bardstown members of the Drakes Formation (Figure 2.7). Most of the exposed rocks in higher elevations are limestone or calcareous shale. Some of the ridgetops have 20-40 inch loess mantle of the residuum where Nicholson soils have formed. Along the Ohio, there is a narrow bank of deep mixed alluvium washed from the upper portions of the Ohio River. There are small bands of alluvial soils along Harrods Creek (Soil Survey of Oldham County, Kentucky).

The Drakes Formation is a rock type that is dominated by dolostone with shale as the secondary rock type. This geologic formation is from the Ordovician age. Dolostone is a carbonate sedimentary rock of which more than 50% by weight under the microscope consists of the mineral dolomite (USGS).

### Soils

Soils types are important to consider in watershed planning. Land use can be dictated by the type of soil. For example, Oldham County has a lot of agricultural land use, and the soil in most of the county is particularly suited to agricultural production (Figure 2.8).

The Harrods Creek Watershed is home to many soil types, but it is dominated by Beaseley and Nicholson soil types (personal communication with USFS Soil Scientist). Beasley Silt Loam soils are well drained soils that are important in agricultural production. They have a clayey residuum weathered from limestone and shale. Also, they belong to the hydrogroup C which is made of soils having a slow infiltration rate when thoroughly wet. Representative values for this soil type are: silt = 54.4%, sand = 27.1%, and clay = 18.5%.

Nicholson Silt Loam can also be found in abundance in the watershed, and it is also important in agricultural production. It is thin and fine-silty noncalcarous loess over clayey residuum weathered from limestone and shale. It also belongs to the well-drained hydrogroup C soils. Representative values for this soil types are: silt = 67.7%, sand = 11.3%, and clay = 21%.

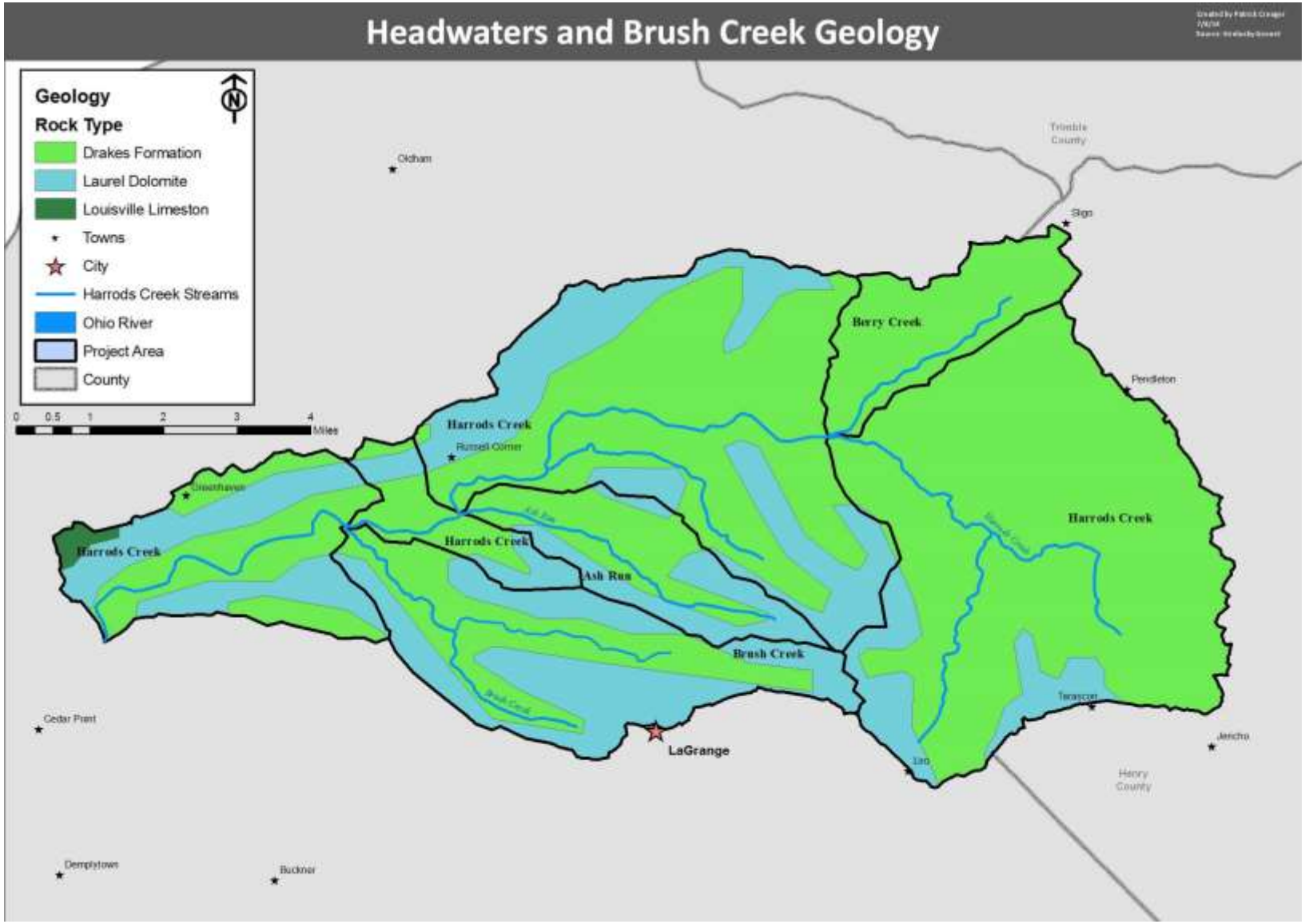


Figure 2.7: Generalized geology for Headwaters and Brush Creek.

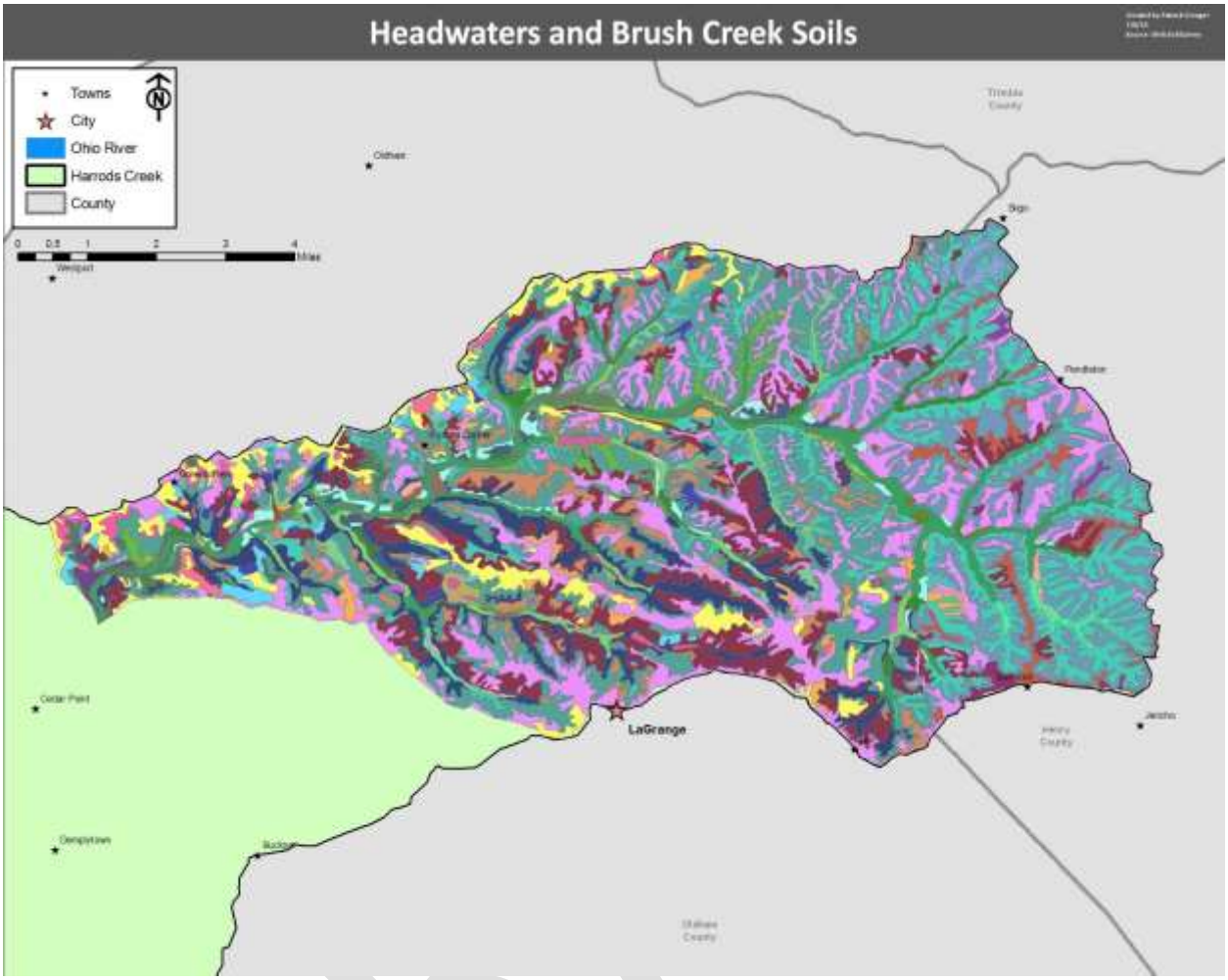
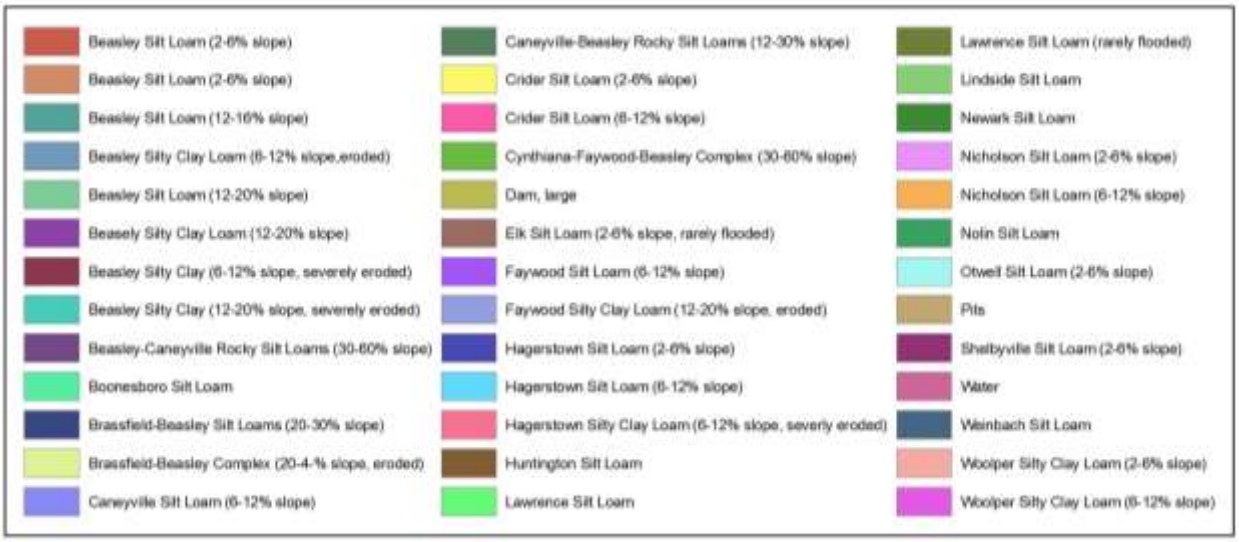



Figure 2.8: Soils of the Upper Harrods Creek Watershed.



## Ecoregion

Ecoregions are those areas that represent general similarity in ecological systems and in the type, quality, and quantity of environmental resources. They are typically broad-scale subdivisions based on terrain, rock type, and geologic structure and history. The Ecoregions of Kentucky project has described the state with a map and descriptions of all its ecoregions (Figure 2.9). More information can be found here: www.epa.gov/wed/pages/ecoregions The project also includes information such as climate, geology, soils, and land cover.

According to the EPA's Ecoregion map of Kentucky, the Harrods Creek Watershed is in the Outer Bluegrass area of the Interior Plateau Ecoregion of Kentucky, Ecoregion 71:

> The extensive plains of Ecoregion 71 are interrupted in places by dissected uplands, knobs, a few deeply incised master streams, and large areas of karst. Local relief and drainage density are less than in higher, cooler, and wetter Ecoregions to the east. Physiographic patterns strongly reflect geology. Ecoregion 71 is underlain by Mississippian-age through Ordovician-age limestone, calcareous shale, sandstone, siltstone, and shale. It is lithologically unlike the unconsolidated coastal plain sediments of Ecoregion 74 or the Pennsylvanian carboniferous sedimentary rocks that underlie most of Ecoregions 68, 69, 70, and 72. Soils have developed from residuum and not from glacial till deposits. Alfisols are common on limestone plains and support a potential natural vegetation of oak–hickory forest and bluestem prairie; both soils and potential natural vegetation contrast with Ultisols, Inceptisols, and mixed mesophytic forests of Ecoregions 68, 69, and 70. Stream morphology is highly variable and both high gradient streams with boulder or cobble substrates and low gradient streams with sand or gravel bottoms occur.

## Riparian/Streamside Vegetation

Streamside vegetation is often known as "riparian" vegetation. Trees, grasses, and shrubs along a stream bank are beneficial to the health of the stream in many ways. A riparian area or buffer can slow down the water running over land (rain or snow melt or human use like lawn watering) before it enters the creek. This allows the water to drop the sediment it carries and thus keep that sediment out of the stream. Similarly, a healthy riparian area can keep other pollutants out by serving as a physical buffer. Another important way a buffer can help is by providing shade. Shade along a creek makes the water temperature lower and generally better habitat for aquatic organisms. Also, plant roots stabilize the stream banks and reduce erosion, which is a major cause of stream sedimentation. In general, the entire project area is well vegetated with forested areas and riparian buffers (Figure 2.10). However, there may be areas that would benefit from a bigger or more robust riparian buffer.

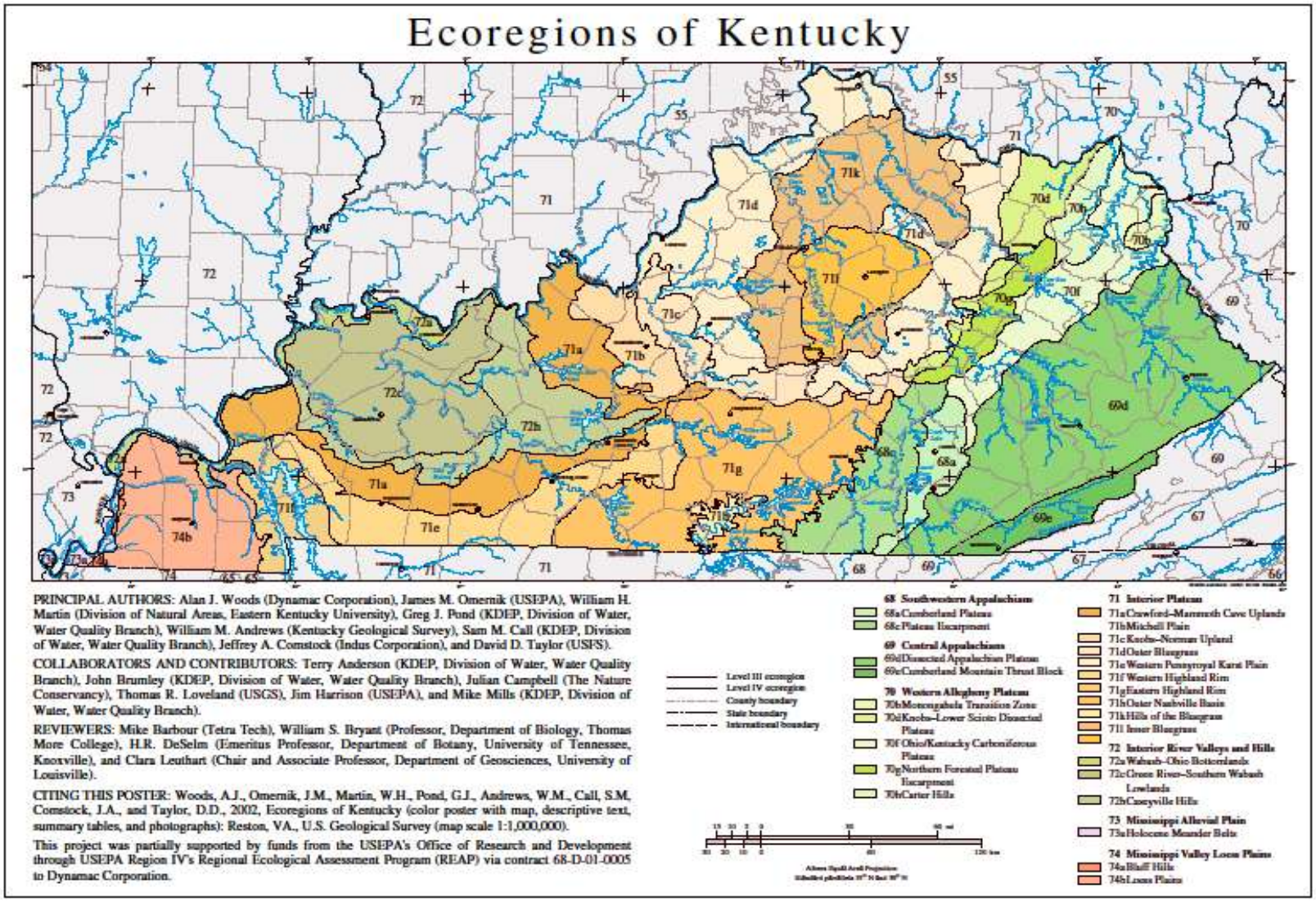



Figure 2.9: Ecoregions of Kentucky Map (Woods, A.J., Omernik, J.M., Martin, W.H., Pond, G.J., Andrews, W.M., Call, S.M, Comstock, J.A., and Taylor, D.D., 2002, Ecoregions of Kentucky).

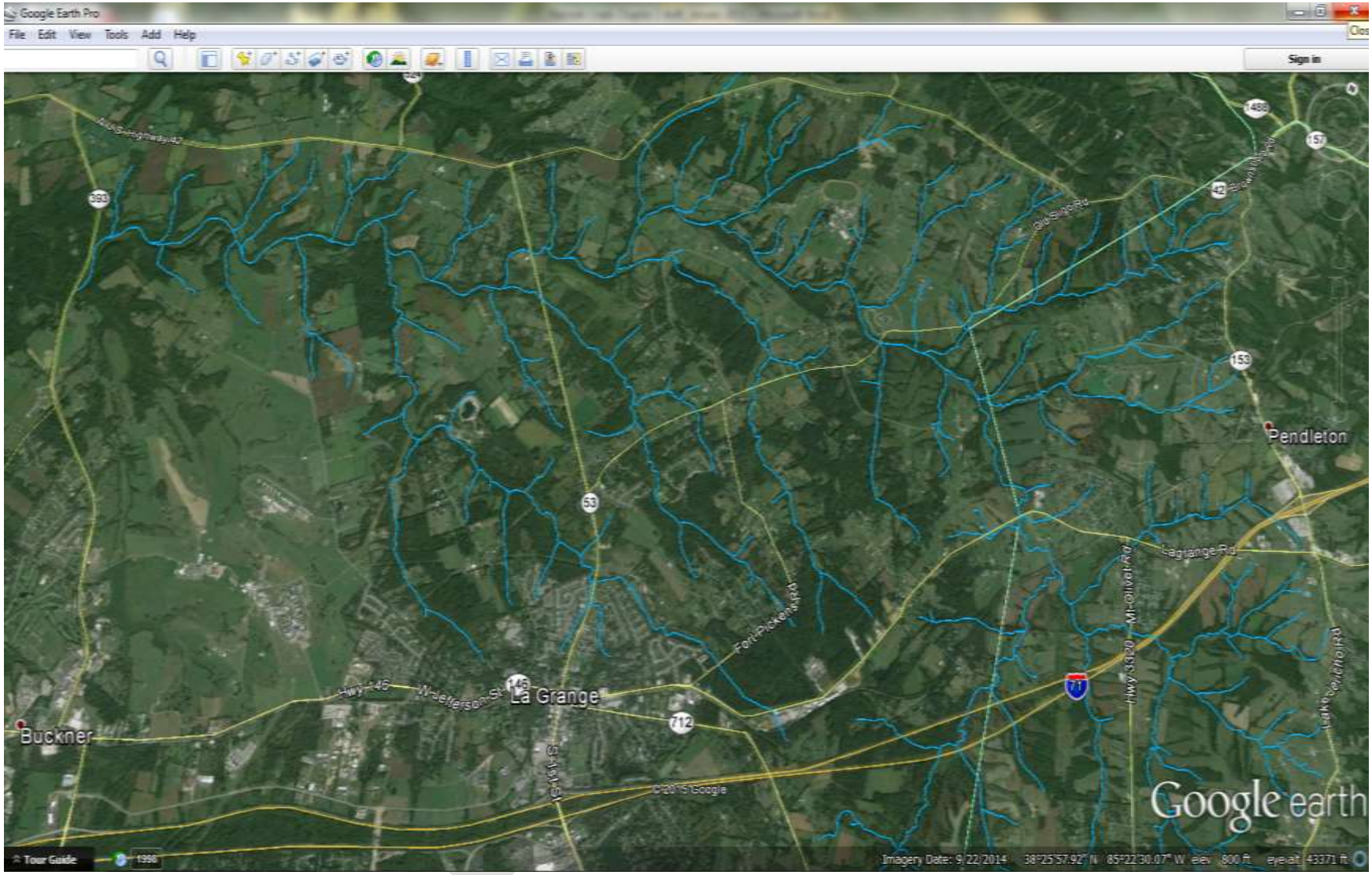


Figure 2.10: Google Earth image of the watershed illustrating vegetated areas.

**Rare and Exotic/Invasive Plants and Animals**

The Kentucky State Nature Preserves Commission works throughout the state on cataloguing threatened and endangered plants and animals. Table 2.7 and Figure 2.11 below display the species that correspond to Headwaters and Brush Creek areas. This report was created for the watershed project area by the Kentucky State Nature Preserves Commission and is specific to the watershed, not the counties at large.

Table 2.7: Locations of sensitive species in Upper Harrods Creek (KSNPC, 2014).

| Watershed Location | Species | Status |
|---|---|---|
| Headwaters Harrods Creek | *Myotis grisescens*<br>Gray Myotis Bat | Threatened |
| Brush Creek | *Ammodramus henslowii*<br>Henslow's Sparrow | Special Concern |
| Brush Creek | Doichonyx oryzivorus<br>Bobolink | Special Concern |

Status Designations of Kentucky State Nature Preserves Commission:
Endangered (E) = A taxon or natural community in danger of extirpation and/or extinction throughout all or a significant part of its range in Kentucky.

Threatened (T) = A taxon or natural community likely to become endangered within the foreseeable future throughout all or a significant part of its range in Kentucky.

Special Concern (S) = A taxon or natural community that should be monitored because (1) it exists in a limited geographic area in Kentucky, (2) it may become threatened or endangered due to modification or destruction of habitat, (3) certain characteristics or requirements make it especially vulnerable to specific pressures, (4) experienced researchers have identified other factors that may jeopardize it, or (5) it is thought to be rare or declining in KY, but insufficient information exists for assignment to the threatened or endangered status categories.

Figure 2.11: The Gray Myotis Bat, Henslow's Sparrow, and the Bobolink (USFWS, 2015).

## 2.4 Human Influences and Impacts

Humans greatly impact the environment. The following section covers some local impacts of water use in the project study area and the regulations in place to monitor these impacts.

**Water Use**

In Kentucky, the water withdrawal program, administered by KDOW, regulates all withdrawals of water greater than 10,000 gallons per day from any surface, spring, or groundwater source with the exception of water required for domestic purposes, agricultural withdrawals including irrigation, steam-powered electrical generated plants regulated by the Kentucky Public Service Commission, or injection underground as part of operation for the production of oil and gas. According to the Water Quantity Section of KDOW, there are no surface water withdrawal permits in the study area.

*Source Water Protection Plans, Wellhead Protection Program, Groundwater Protection Plans*

Source Water Protection Plans are required under the Safe Drinking Water Act to assess the quantity of water used in a public water system and formulate protection plans for source waters used by these systems. In the project area, there is a Source Water Protection area for Harrods Creek subwatershed HUC-05140101200-070 (Figure 2.12). This is the main stem of Harrods Creek, which flows to the Ohio River, a drinking water source for Louisville. This one section of Upper Harrods Creek is included in the Source Water Protection area because it is within the 25 mile distance from a drinking water source. Other parts of Upper Harrods Creek are not within that distance. There are no other municipalities in the project area with a Source Water Protection plan (personal communication with KDOW staff, 2015).

Wellhead Protection Plans are used to assist communities that rely on groundwater as their public water source. According to the Wellhead Protection Program of KDOW, there are no wellhead protection plans in the project area.

Groundwater Protection Plans (GPPs) are required for any facility or entity engaged in activities that have the potential to pollute groundwater. These activities include anything that could leach into the ground, including septic systems and pesticide storage. The law requires that these facilities have a GPP, but does not regularly monitor this requirement. GPPs are required to be recertified every three years and should be updated if activities are changed.

According to the Groundwater Branch of KDOW, there are at least three GPPs in the watershed area: Southern Petroleum and two Pilot Travel Centers. It is not known if there are other facilities in the project area that need a GPP. Because the GPP regulations are self-guided, it can be difficult to know if all facilities are in compliance.

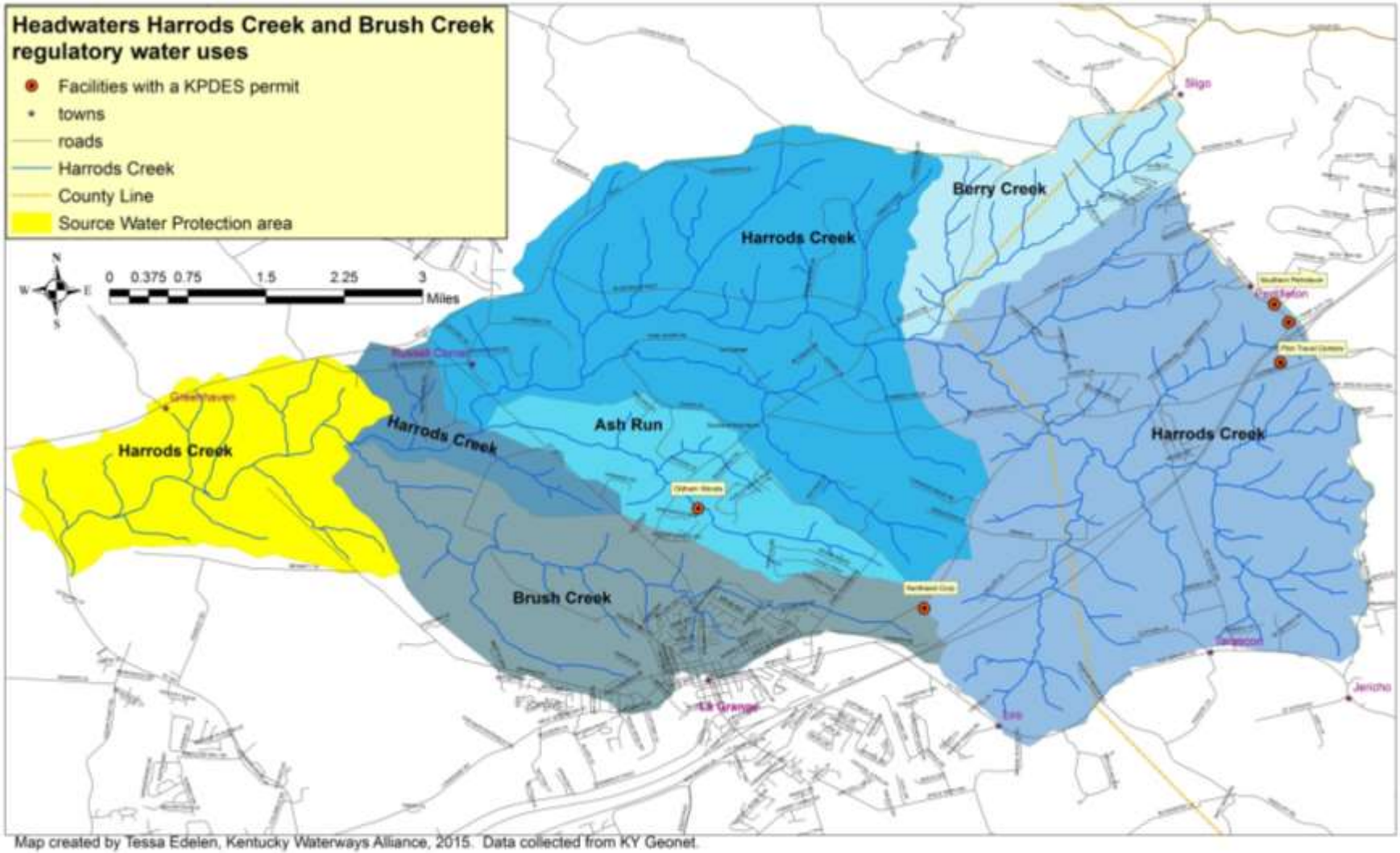



Figure 2.12: Source Water Protection Area and active KPDES permits in the Upper Harrods Creek Watershed.

*Permitted Discharges*

Point source pollution is pollution that has a known source, or discharge point, usually a pipe. Examples of point sources could include municipal and industrial facilities and wastewater plants that discharge directly into a stream. The point of discharge is called an outfall.

In Kentucky, point sources are required to have a permit through the Kentucky Pollutant Discharge Elimination System (KPDES). These permits allow specified levels of substances into waterways – permitted discharges. According to the EPA's ECHO website www.epa-echo.gov/echo/, there are five active permits in the project area (see Table 2.8 and Figure 2.12).

Facility discharge permits and data are public information. They are available through online sources like ECHO, the facility itself, or a Freedom of Information Act request to KDOW. Most facilities are required to file a monthly or quarterly report that details the contents of what was discharged, called a Discharge Monitoring Report. The facility's permit specifically states the limits of the pollutant(s) allowable. The Discharge Monitoring Report will show any discharge permit violations made at a facility, such as a discharge exceedance or a failure to report. Outfall pipes often discharges directly to a waterway. For example, the Pilot Travel Center's sanitary wastewater pipe discharges directly into the Headwaters of Harrods Creek.

For the most part, this watershed plan addresses nonpoint source pollution. However, it is necessary to understand all sources of pollution in a watershed to isolate nonpoint from point source pollution and to calculate accurate pollutant loads (see Chapter 4). Table 2.8 shows the KDPES permits in the project area. There are five active permits and three inactive permits. The number of permit violations is also listed. For more information, go to the EPA ECHO website and use the permit number to search for facility information.

Table 2.8: Permitted Discharges in the project area (ECHO 2015).

| Facility Name | Sub watershed | Permit Number | Expiration Date* | Permit/Facility Description | # Effluent Exceedances (3 yrs) |
|---|---|---|---|---|---|
| Pilot Travel Center | Headwaters Harrods Creek | KY0034011 | 12/31/2014 | Gas station and store with two discharge pipes: one sanitary wastewater and one stormwater (truck wash) | 12 (all from pipe 1) TSS, BOD, Nitrogen (ammonia) |
| Pilot Travel Center | Headwaters Harrods Creek | KY0104485 | 2/28/2018 | Travel Center - Stormwater | 5 *E. coli* and TSS |
| Southern Petroleum | Headwaters Harrods Creek | KY0110663 | 4/30/2018 | Bulk petroleum storage - stormwater | 0 |
| Northland Corp | Headwaters Harrods Creek | KY0098418 | 11/30/2017 | Lumber Company - Stormwater | 10 TSS, oil and grease |
| Oldham Woods Subdivision | Ash Run | KY0078026 | 7/31/2018 | Sanitary wastewater | 10 Nitrogen (ammonia), *E. coli*, DO, chlorine |
| La Grange Fire and Rescue Station | Brush Creek | KYR10E887 | Recently expired and inactive | General construction permit | 0 |
| Private sewer system | Brush Creek | KYR10E210 | Recently expired and inactive | General construction permit | 0 |
| Joe Clark Rock Quarry | Brush Creek | KY0098418 | Recently expired and inactive | Stormwater | 0 |

*If the CWA permit is past its expiration date, this normally means that the permitting authority has not yet issued a new permit. In these situations, the expired permit is often administratively extended and kept in effect until a new permit is issued. The three entries at the bottom of the table have expired permits, and according to their Discharge Monitoring Reports, they are inactive, indicating that they are no longer operational.

*Sewer and Septic*

In rural areas, it is common to have onsite wastewater systems instead of sewer lines and sewage treatment plants. There are two entities in Oldham County that work on wastewater issues: Oldham County Environmental Authority and La Grange Utilities Commission (Figures 2.13 and 2.14). Most of the project focus area is outside of a sewer service area, and it is assumed that most of the onsite systems are septic systems. Septic tanks and other types of onsite wastewater treatments (like lagoons or wetlands) are acceptable ways to treat sewage, if maintained properly. The Kentucky Onsite Wastewater Association recommends pumping out septic tanks every three to five years, depending on the number of people living in the home.

**Onsite Disposal – a brief history of Oldham County**

The La Grange Utilities Commission began serving the La Grange area with water and sewer lines in 1958. They created the first municipal sewage treatment plant in Oldham County. Today, there is one treatment facility that handles about 315 million gallons of waste water annually from about 2,700 customers in the La Grange area (La Grange Utilities Commission, 2015).

There was no municipal utility for the unincorporated areas for Oldham County until Oldham County Sewer District was established in 1996. Prior to that, the only sewage disposal options available were individual onsite systems, package plants designed for specific developments or MSD for developments adjacent to Jefferson County. Between 1970 and 2000, the population of Oldham County increased rapidly and septic systems multiplied in areas where new residences were constructed on small parcels. Septic tanks provide wastewater management for a significant percentage of customers in the planning area. Today, approximately 6,000 onsite sewage disposal systems are in use in Oldham County (OCEA Facility Plan, 2013).

There are areas in the county where the soils and geologic conditions are not ideal for wastewater treatment. This has led to some septic systems in the planning area to fail. Eliminating these systems may improve surface and ground water quality (OCEA Facility Plan, 2013).

**Existing Treatment Plants**

The existing publicly owned and private package plants in the OCEA Planning Area have been in-service for approximately 30 to 40 years. Many of these treatment processes used are old, require significant rehabilitation, and the processes will not be able to meet more stringent effluent standards. One of these privately operated package plants, Oldham Woods, is operating in the watershed project area (OCEA Facility Plan, 2013).

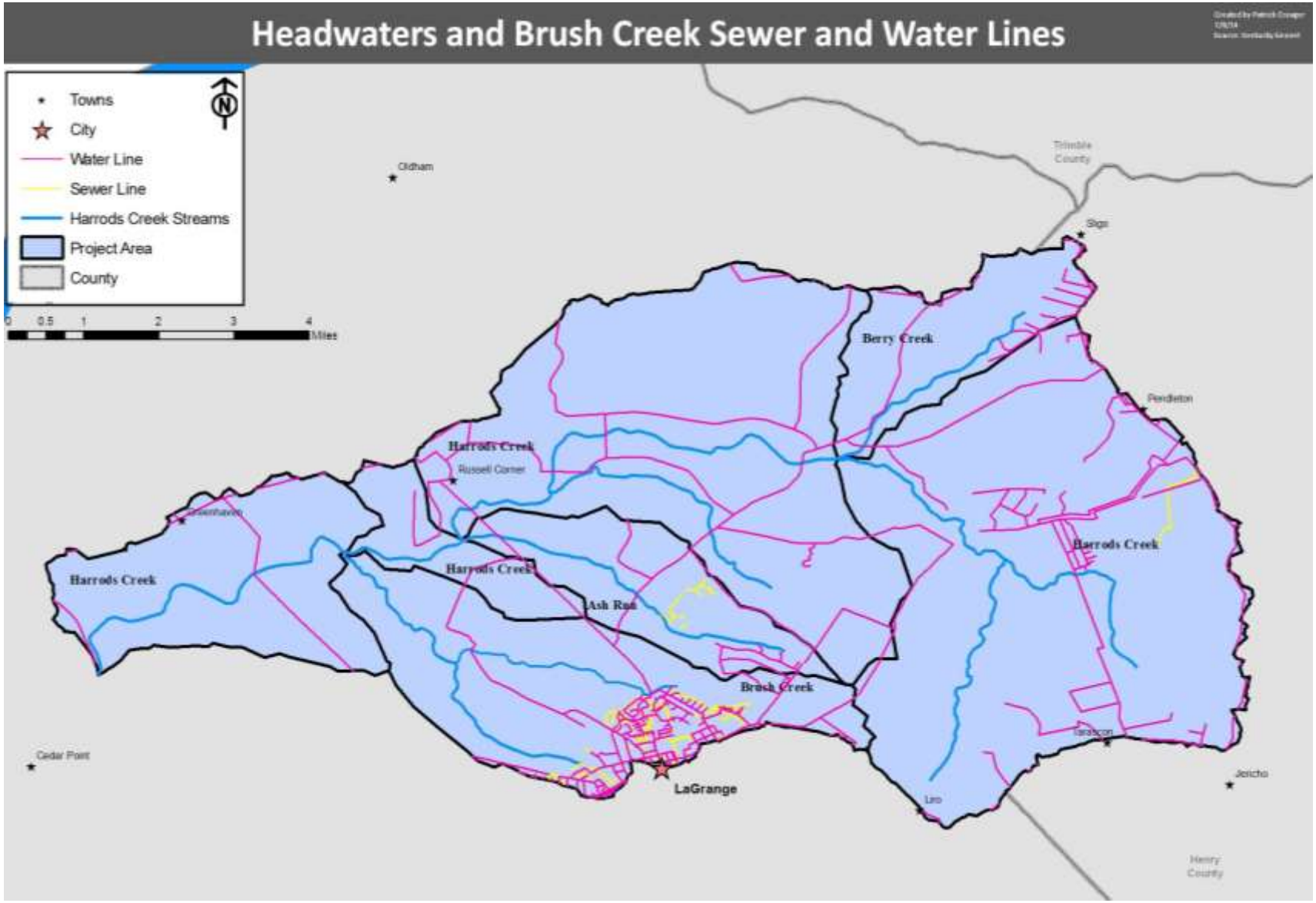


Figure 2.13: Sewer and water lines in the project area.

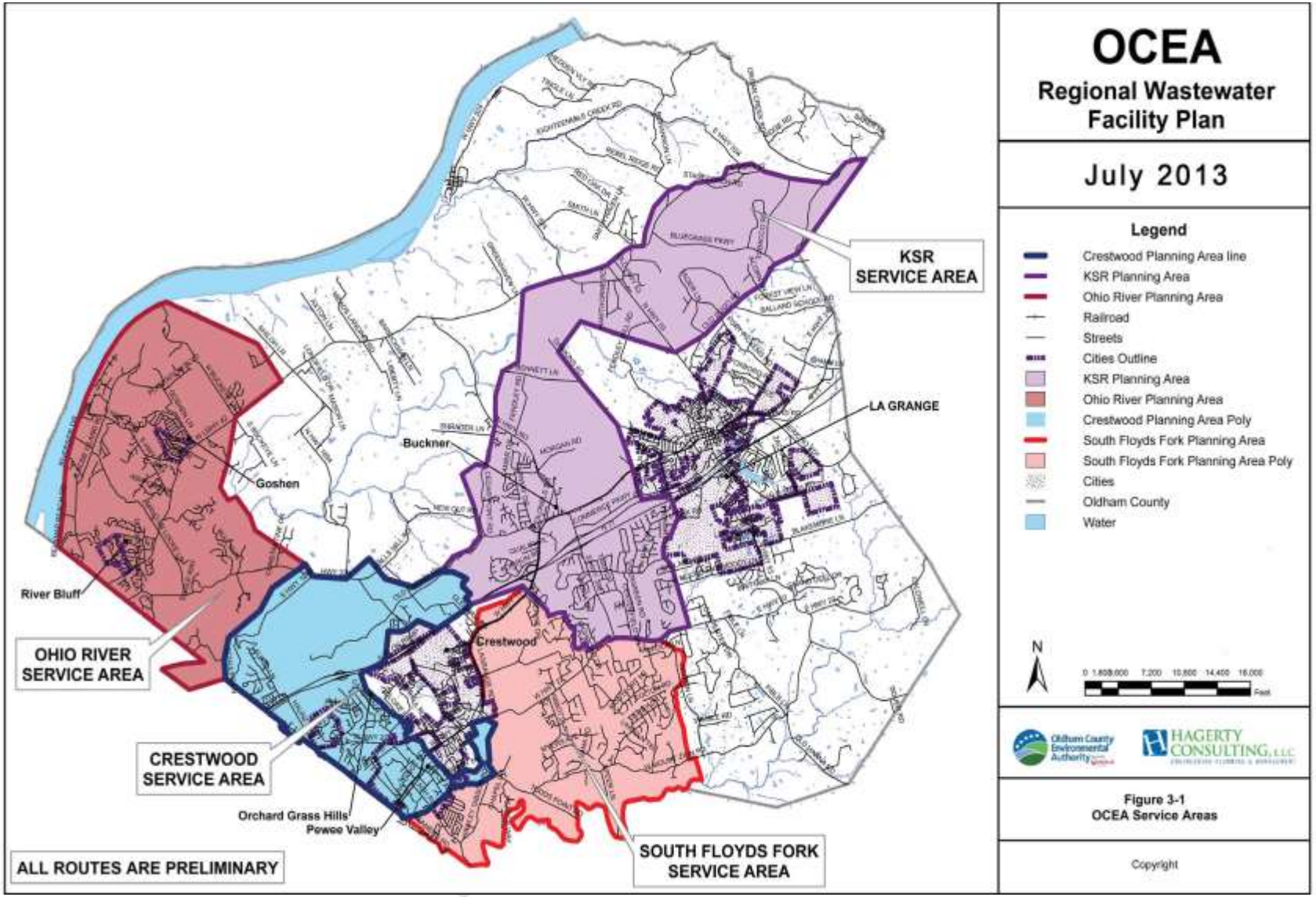


Figure 2.14: OCEA Regional Wastewater Facility Plan (OCEA, 2015).

## Land Use

Examining land use in a watershed can help illustrate the types of activities on the land that may be impacting water quality. The watershed has a lot of forested and pastured land with residential development concentrated around La Grange and along the roads (Figure 2.16). Forest tracts and vegetative buffers are typically good for instream water quality and aquatic habitat. Table 2.12 shows the distribution of land use and land cover types.

Table 2.12: Upper Harrods Creek Watershed Land Use (KY Geonet 2015).

| Land Use | Acres | Percent |
|---|---|---|
| Water | 142.35 | 0.60 |
| Developed | 2,090.18 | 8.61 |
| Barren | 47.45 | 0.20 |
| Forest | 9,686.92 | 40.83 |
| Shrub | 78.29 | 0.33 |
| Grassland/Herbaceous | 552.79 | 2.33 |
| Pasture/Hay | 10,161.41 | 42.83 |
| Cultivated Crops | 918.16 | 3.87 |
| Wetlands | 42.70 | 0.18 |
| **Total** | **23,720** | |

Overall, the watershed contains about 8% impervious surfaces (Figures 2.16 and 2.17). Impervious surfaces are those that do not allow rain or snow melt to infiltrate. When water does not sink into the ground, it runs off and has the potential to become runoff pollution, also called stormwater pollution (see Figure 2.15). As the watershed develops, stormwater pollution measures like green infrastructure and smart growth design may help avoid issues.

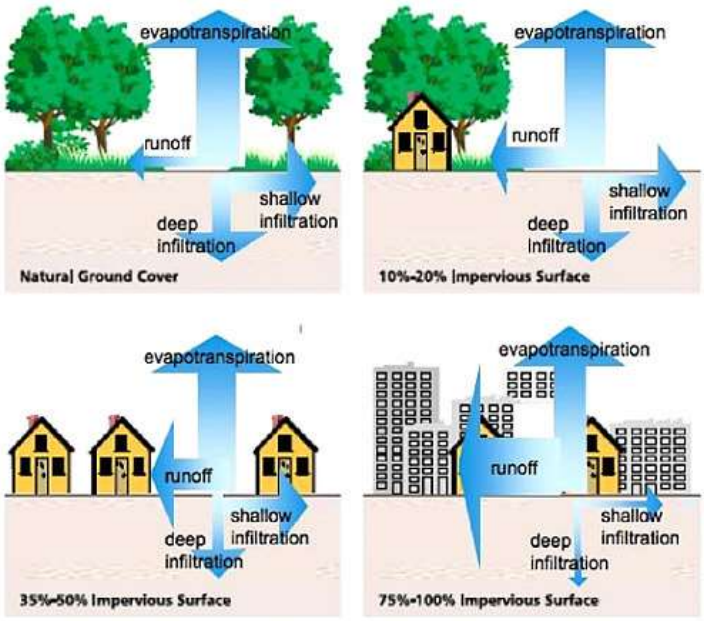



Figure 2.15: Diagram of the relationship between impervious surfaces and water infiltration.

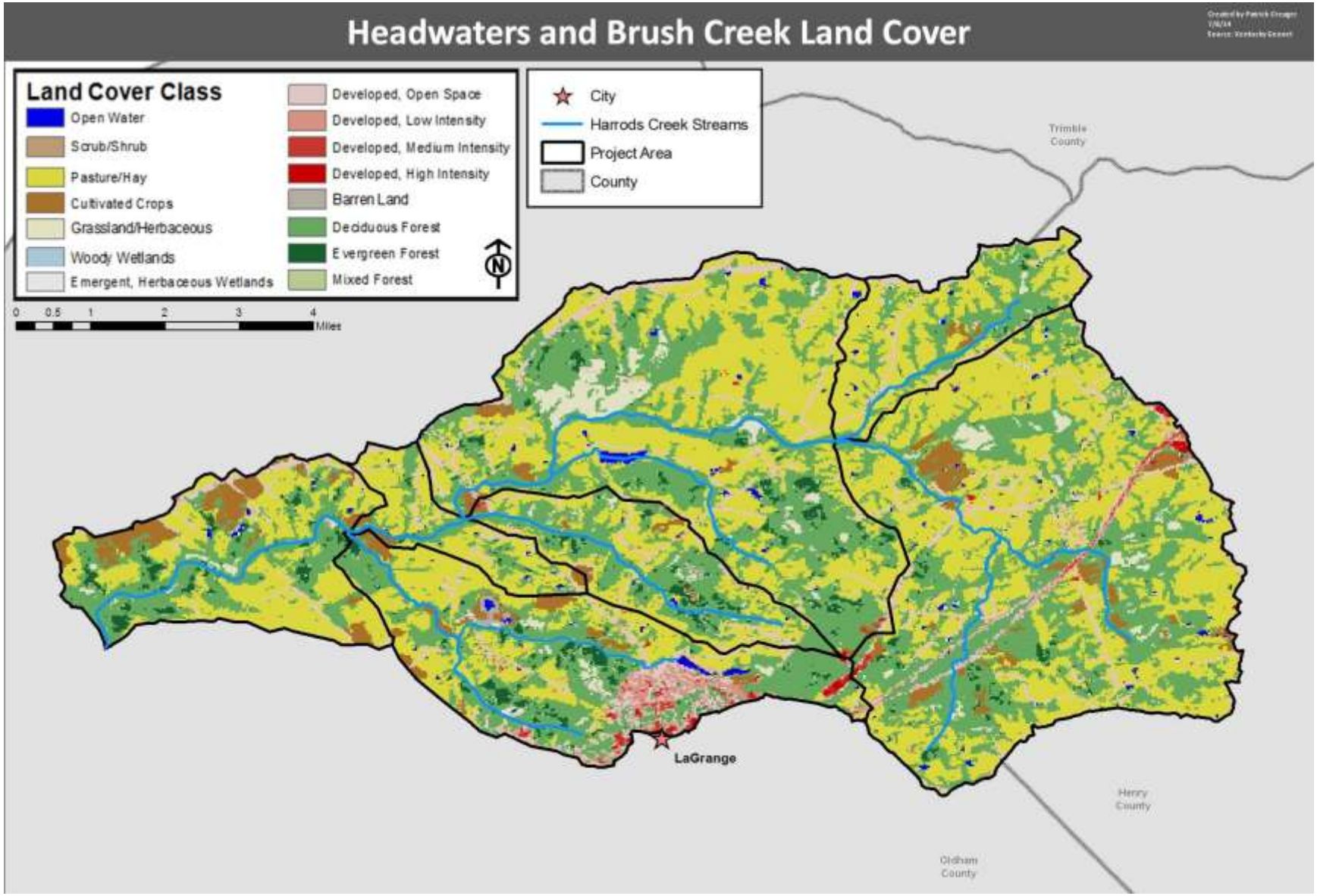



Figure 2.16: Land use coverages in the project area.

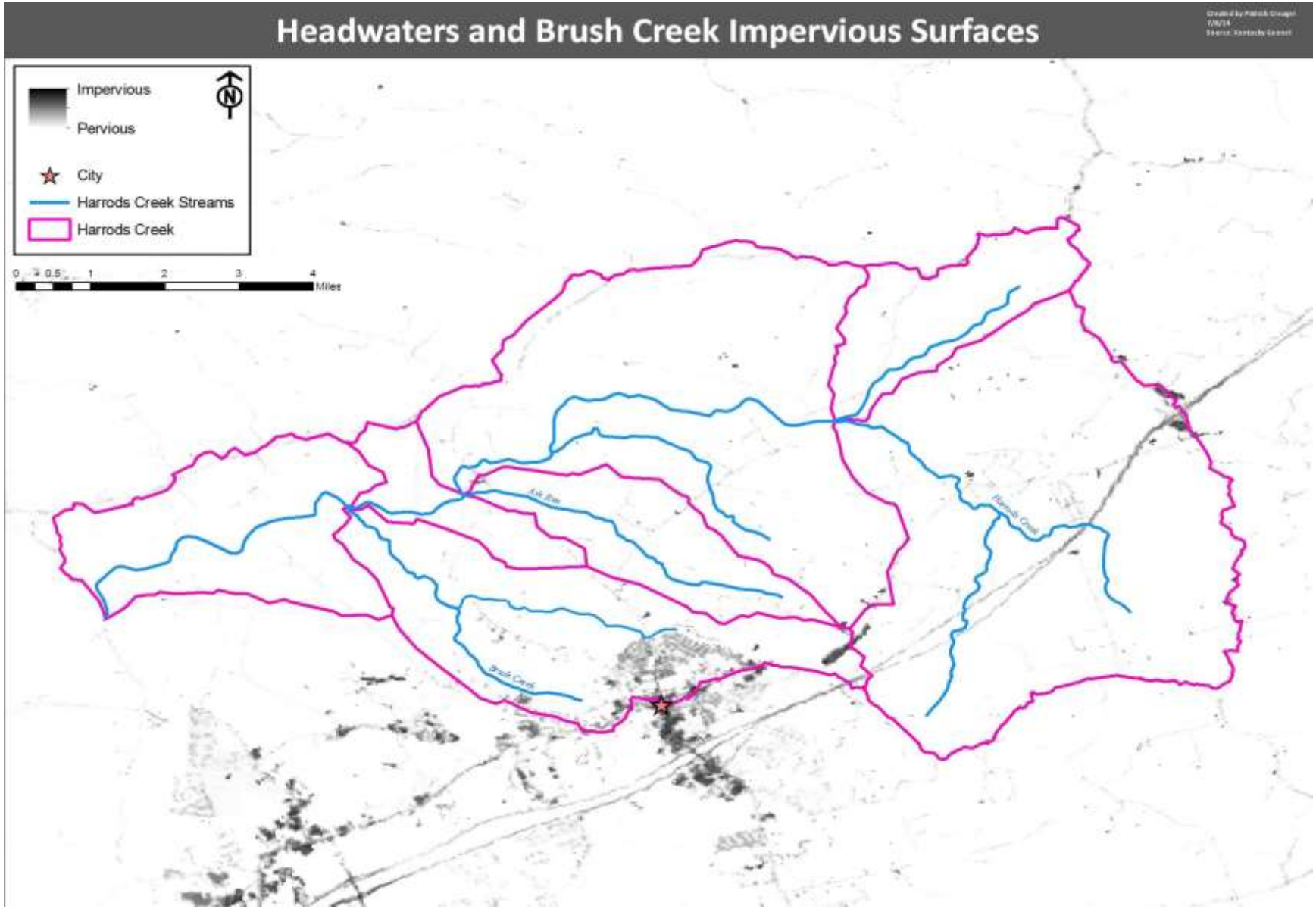


Figure 2.17: Impervious Surfaces in the project area.

**Other Water Disturbances**

*401 and 404 Permits*

Any person, firm, or agency (including federal, state, and local government agencies) planning to work in jurisdictional waters of the United States, or dump or place dredged or fill material in waters of the United States should contact the U.S. Army Corps of Engineers (USACE) office in your area and the Kentucky Division of Water, Water Quality Certification Section to obtain a permit. The 401 Water Quality Certification Program of the Kentucky Division of Water is the Commonwealth's review and authorization of selected federal license and permits (Kentucky Division of Water website water.ky.gov/permitting/Pages/KYWaterQualityCertProg.aspx).

Examples of federal licenses and permits subject to 401 certification include Clean Water Act 404 permits for discharge of dredged or fill material issued by the USACE, Federal Energy Regulatory Commission (FERC) hydropower licenses, and Rivers and Harbors Act 9 and 10 permits for activities that have a potential discharge in navigable waters issued by the USACE. A 401 certification from the Commonwealth of Kentucky also affirms that the discharge will not violate Kentucky's water quality standards (Kentucky Division of Water website water.ky.gov/permitting/Pages/KYWaterQualityCertProg.aspx).

Examples of activities that may require a certification from the Kentucky Division of Water, Water Quality Certification Section include:

- Placement of dredged or fill materials into waters of the state and/or wetlands
- Structural fill such as culverts and bridge supports
- Road and utility crossings
- Dredging, excavation, channel widening, or straightening
- Flooding, excavating, draining and/or filling a wetland
- Bank sloping; stabilization
- Stream channel relocation
- Water diversions
- Divert, obstruct or change the natural flow or bed of any waters of the state (e.g. debris removal, bank stabilization or culverting)
- Construct a barrier across a stream, channel, or watercourse that will create a reservoir: dams, weirs, dikes, levees or other similar structures (Kentucky Division of Water website water.ky.gov/permitting/Pages/KYWaterQualityCertProg.aspx).

A Freedom of Information Act request to the Louisville District Army Corps of Engineer for any 404 permits in Henry and Oldham Counties for the time period of January 1, 2010 to December 31, 2014 resulted in no permits within the project study area.

**Land Disturbances**

Activity on the land almost always impacts streams and rivers. Construction of new homes, buildings, and roads or other projects like quarries or low-head dams are just some examples.

Watershed Team – where in our project area are there low-head dams, new developments, quarries, or other land disturbances?

**Hazardous Material**

Information about sites that store or contain hazardous materials and/or waste is available through a number of programs administered by the KY Division of Waste Management. According to a phone call placed to the KY Division of Waste Management in January 2015, there are no known hazardous materials being stored in the project area (personal communication with an employee of the KY Division of Waste Management, 2015).

## 2.4 Demographics

The project area falls within the western portion of Henry County and the northeastern portion of Oldham County. It is a rural area with no incorporated cities entirely within the boundaries. The city of La Grange partially falls into the area, with the northern portion of the city making up the only area of moderate to dense population. There are several subdivisions and small, unincorporated towns in the area. The town of Pendleton, in Henry County, falls right on the project area's eastern border.

Harrods Creek Alliance – what else should we say about your demographics?

References coming soon.