ENVIRONMENT

INTRODUCTION

Environment is defined by Webster's Dictionary as "the circumstances, objects, or conditions by which one is surrounded" and "the complex of physical, chemical, and biotic factors (as climate, soil, and living things) that act upon an organism or an ecological community and ultimately determine its form and survival." These amenities also provide additional, less visible qualities, such as cleaner air, recreational areas, and wildlife habitat that are important to a community. Boone County's rural character attracts people to the county. Agricultural land, woodlands, scenic valleys, streams, and hillsides are significant environmental resources. Development has an effect on the physical and social environment of a community, and this can affect many of a community's unique characteristics or qualities that its residents feel are important. Therefore, development should preserve and promote an overall high quality of life while allowing an economic return. This quality, which attracts many new residents, is often replaced by the development built to accommodate them. This element is prepared from an environmental perspective and is to be used as one factor in determining the future land use of this plan. This element establishes the fact that environmental impacts should be addressed up front rather than allowed to accumulate and therefore require much more expenditure in the future.

PHYSICAL CHARACTERISTICS AND POTENTIAL IMPACTS

This section discusses the defining characteristics of Boone County's environment and how they may be impacted by development and the infrastructure (water, sewer, roads, etc.) necessary to support it. As Boone County's growth continues, issues such as water quality, air quality, noise and light pollution, stormwater, and decreased open space can combine to affect the quality of life. This section details potential impacts and how they may be mitigated.

GEOLOGY

The predominant bedrock of Boone County is interbedded shale and limestone with overlying alluvial and glacial deposits. Some of the deeper (about 1,000 feet) limestone layers can provide stone for mining. Of note, the Kope Formation of interbedded limestone and shale is poorly drained and prone to hillside slippage. The Cincinnati area is well known for landslides largely because of this formation. Kope is generally present at the surface along stream beds and lower portions of stream valley walls in Boone County. Kentucky Geological Survey maps show Kope prevalence in Big Bone Lick and southern portions of the county, as well as major hillsides in the western and northern parts of the county.

The Existing Land Use maps in this and prior Comprehensive Plans show that most gravel mining in Boone County has occurred along the Ohio riverfront. A few areas were mined years ago, and have been reclaimed or allowed to revert to natural vegetation. A dedicated study into how much minable gravel and sand remains in Boone County has not been conducted.

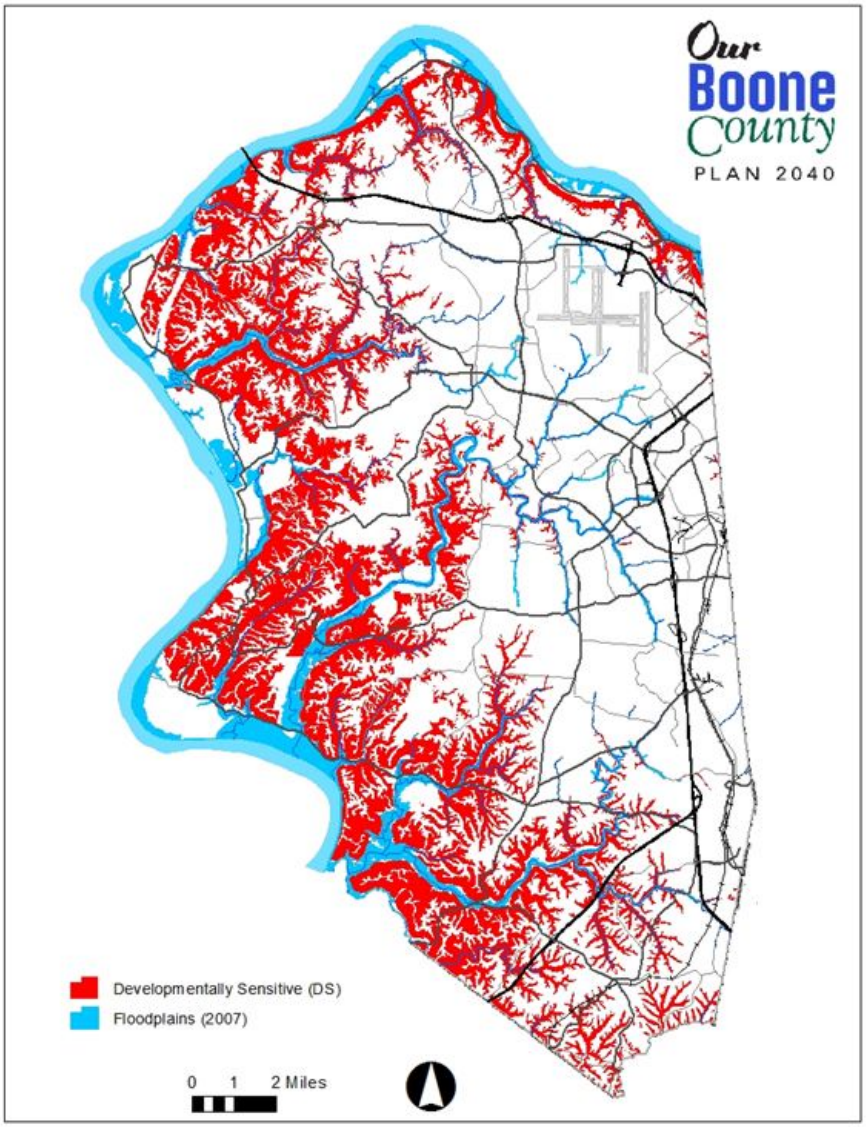
Soils

The *Soil Survey of Boone, Campbell, and Kenton Counties, Kentucky* (1973) remains the primary reference document for soils information in Boone County. Soils provide for agricultural production, affect drainage, flooding, permeability, slope stability, siltation, and development practices and costs.

Alluvial Soils - Alluvial soils include the remains of former stream beds and deposits of materials generated by erosion. They are found in designated flood zones of major rivers and along the banks of tributary streams. Alluvial soils are highly permeable, subject to high water tables, and usually connected with underground streams or aquifers. Alluvial soils are often highly erodible, serve as aquifer recharge areas, and should be addressed in development. Erosion control during and following development is therefore critical.

Permeability - Soil permeability is a measure of the rate and depth to which a soil absorbs water. Nearly half of the undeveloped land area in Boone County contains soils with poor permeability (0.63 inches per hour or lower). This land, located primarily in the southern and western areas of the county, has slopes of 20% or greater and is shown on **Figure 2.1** as Developmentally Sensitive (DS). Land with permeability of 0.63 to 2.00 inches per hour covers approximately 50% of the county and mostly has slopes under 20%. These areas are usually prime agricultural land or agricultural land of state-wide importance, and coincide with the parts of Boone County that are projected to develop within the 25 year planning horizon. Severely impermeable soils are found primarily along ridgelines where the bedrock is near the surface and in low-lying areas where the water table is high. Soils of poor permeability are subject to ponding and runoff. Nonporous surfaces of urban uses, on or adjacent to impermeable soils, can significantly increase the runoff volume, and aggravate ponding, erosion, and surface water pollution.

Figure 2.1 *- Developmentally Sensitive & 100-Year Floodplains*



Soils of poor permeability will not filter water or filter/absorb septic effluent or other pollutants. Conditions involving poor permeability and high water tables can result in pollutant spread into streams and ground water. Poorly drained soils are subject to frost action and settling which can crack foundations, fragment roads, displace utility lines, and generally damage or impair urban improvements. .

Depth to Seasonal High Water Table – The relationship between soils, water table and the underlying bedrock has implications for the mechanics of water filtration and ground water quality. A healthy system provides a naturally filtered water supply. In Boone County, extremely high water tables occur in only a small number of thin belts along the Ohio River and other scattered areas. Areas of moderate depth water tables are concentrated primarily on ridgelines in the County's northeastern uplands. Such areas are easily polluted by runoff from urban areas passing pollutants directly into ground water. Heavy storms can also bring the water table to the surface, causing ponding and flooding, a problem aggravated by urban uses. Depth to water table should always be addressed prior to development. Very shallow water table depths pose risks to development, and should not contain urban uses. High and moderate depths are more developable.

Strength of Soil - Soils vary considerably in compressive strength and stability and all soils have some limitation for urban uses, with soils on ridgelines, streambeds, sloping lands, and upper stream valleys the most notable. Rugged terrain in western and southwestern Boone County contains extensive areas of soils poorly suited to development. More moderate conditions prevail elsewhere in the county. All soil types are subject to erosion when ground cover is removed and will erode on moderate to steep slopes. Erosion control measures are vital to limit erosion during development.

Depth to Bedrock – In Boone County, shallow bedrock concentrations are found in:

- Northern areas of the county along steep hillsides overlooking the Ohio River
- Some stream beds
- Between Walton, Richwood and Beaverlick
- Many areas in the Gunpowder Creek and Woolper Creek valleys

Most of the land in the northeastern portion of the county, which includes the airport and most of the area within the City of Florence, does not contain this limitation for development. Shallow bedrock conditions increase trenching and other utility placement costs. Fill must sometimes be used to absorb storm runoff or provide pads for roadbeds, parking, and building foundations. While such actions are costly improvements, the resulting modifications are not environmentally hazardous. However, the occurrence of shallow bedrock depths and impermeable flat lands can lead to high water tables subject to flooding and/or groundwater contamination. Steep slopes with shallow bedrock depths, Kope geologic formations, and unstable soils without tree cover are landslide prone. When these situations exist, the land is minimally capable of supporting urban uses without serious environmental hazards.

Slope and Erosion - Erosion hazard is a combination of soil characteristics, absence of ground/tree cover, bedrock depth, and shallow surface drainage. Erosion from improperly modified slopes can disrupt natural drainage channels, pollute surface water runoff, and cause mudslides. The western and northern edges of Boone County are characterized by highly erodible steep slopes descending into stream valleys and bottom lands of small streams. Less steep upper slopes near ridgelines are moderately erodible, while ridgelines, plateaus, and large stream bed areas are free from significant erosion hazard. During development, sediment washing from sites can diminish water quality, impacting both water supply and recreation. Sediment that fills in drainage channels can aggravate flooding and cause more property damage. Requirements for the control of dust, noise, dirt on public right-of-ways, and erosion in public and private construction activity should be reviewed and revised where needed. In addition, the re-establishment of ground cover and reuse of resources such as removed trees for mulch, lumber, or firewood should be evaluated.

Agricultural Values - The USDA classifies soils for their agricultural suitability for field crops under normal conditions and considers prime agricultural land as important for the sustainability of a region (see Natural & Cultural Resources element). Agricultural lands provide much of the open space in a community and can create a character-defining visual identity for a community.

Across the nation, farmlands in metropolitan areas continue to be urbanized, partly because the qualities that make for desirable farm land (flat, well-drained, clear, etc.) coincide with those desired for urban development. Growing urban populations increase demand for agricultural productivity while also displacing it, at a time when desire for local food sources is rising. Future studies and visioning efforts should determine whether Boone County wants to retain its rural identity. If the agricultural lands should develop in a more urban manner, then standards should be established and incentives offered which attempt to preserve the unique character of these areas.

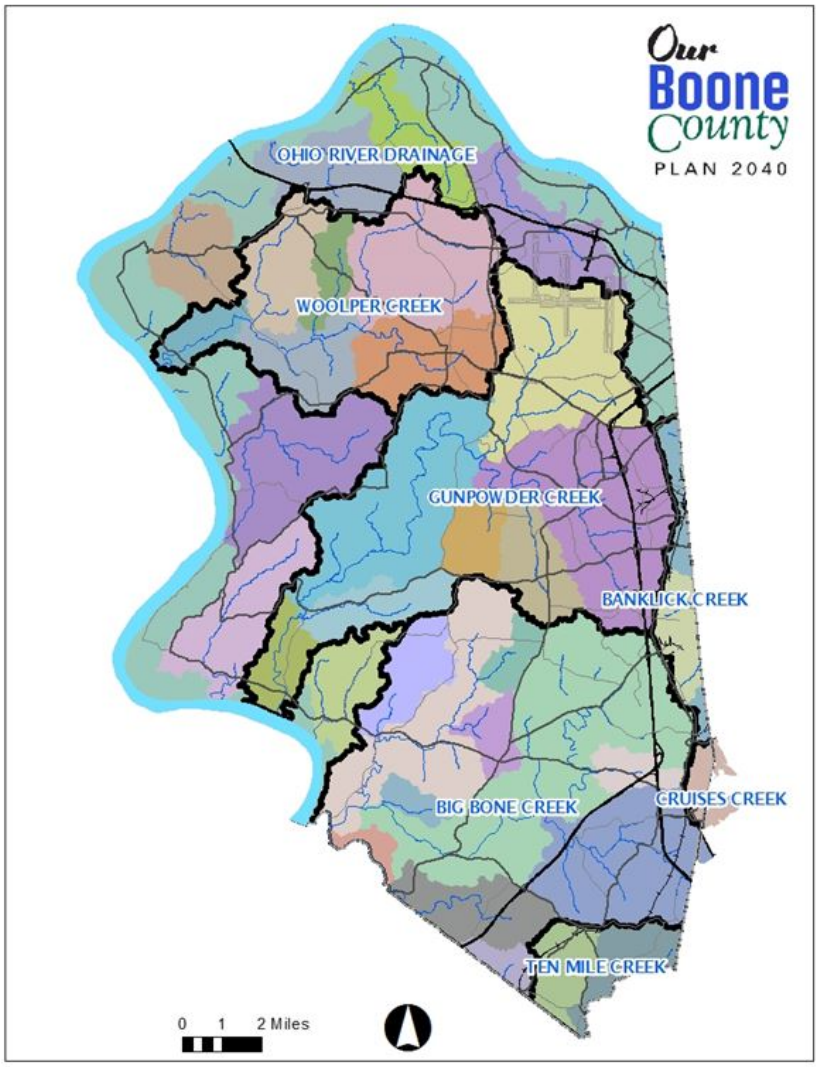
Topography – Boone County's unique glacial topography and steep forested hillsides offer astounding vistas, especially along the major stream valleys and 42 miles of Ohio River frontage. These natural vistas are an important amenity and a quality of life factor for residents of Boone County. Outstanding scenic areas include a series of cliffs along the Ohio River bordering the north edge of the county which affords dramatic views of the Ohio River and beyond. Notable man-made features such as individual historic homes/farm buildings and the towns of Burlington, Petersburg, Rabbit Hash, and Belleview/McVille also provide scenic amenities to the county.

Scenic areas identified by special study should be protected from insensitive development. Organizations such as The Hillside Trust endorse accepted design methodologies for development to minimize impact to hillsides and their scenic views. A study should be conducted to identify significant scenic areas and to outline measures to preserve or enhance these views. The Boone County GIS is an existing tool available to help with this task. If these areas are to develop, standards should be created which outline the procedures and methods necessary to protect and minimize negative impacts. Standards should also be developed for Developmentally Sensitive land, including procedures for how these areas may develop without creating an environmental hazard.

WATER

Stream Tributaries – Glaciation created a vast network of streams across Boone County. Major tributaries draining down to the Ohio River include Mud Lick, Big Bone Creek, Gunpowder Creek, Lick Run, Middle Creek, Woolper Creek, Sand Run, and Elijah's Creek. Also included are many smaller tributaries and intermittent streams. This natural drainage system provides an efficient storm water collection system and natural water supply. **Figure 2.2** shows the major watersheds so important to land use planning.

Figure 2.2 *- Major Watersheds and Stream Tributaries*



Along with loss of habitat, forests and farmland, impacts to water sources are among the most regularly documented in development density studies. Such studies often conclude that the compact development afforded by higher densities reduce the amount of impervious surface and have less impact. Development impacts to streams include runoff from urban and agricultural uses, which add suspended soil particles and chemicals, lower water quality, and increase water purification costs. Runoff from land uses sited close to a stream's natural drainage channel can contaminate a stream's purity, fill stream channels with sediment, cause flooding and erosion, and damage the aquatic and animal life balance. Such changes can also promote algae and bacteria development. Artificial storm drainage systems can be designed to handle stormwater runoff volumes and to contribute to groundwater recharge. However, such systems do not replace natural water filtering processes. Developments should look at a mix of artificial and natural stormwater mitigation measures and use structural solutions (e.g., detention basins, infiltration ditches & basins) with non-structural solutions such as natural vegetation buffers along streams. Maximum runoff limits, as established through specific drainage basin calculations, can also keep stream pollution levels within manageable limits and reduce flooding.
In Boone County, the effects of commercial and industrial development on stormwater conditions are well

documented. The potential cumulative stormwater runoff impacts from residential development cannot be overlooked. Even with required detention basins and other facilities controlling the rate of stormwater flow, the amount of stormwater reaching the county's creeks increases due to new impervious areas. Because of the difficulties in implementing public regional stormwater detention, additional studies such as those of the Banklick Creek, Gunpowder Creek and Woolper Creek watersheds should be encouraged. These studies suggest vegetation and buffer areas as one way to minimize storm runoff.

Aside from regional detention, Boone County has made improvements in the upper Gunpowder Creek watershed that help water flow downstream. Sanitation District Number 1 (SD1) now administers stormwater management throughout most of the developed areas of Northern Kentucky. Two notable exceptions are the cities of Florence and Walton, who plan to continue to operate their own systems. In the meantime, municipalities and counties continue to administer stormwater requirements and maintain public stormwater facilities for parts of the system.

Floodplains - **Figure 2.1** depicts the 100-year floodplain identified by FEMA, which correspond to areas flooded by the 1937 Flood. While the 1937 Flood was the highest recorded on the Ohio River, it is not the worst that could occur. Significant floods have also occurred in 1883, 1884, 1913, 1945, 1964, 1997, and 2018. U.S. Army Corps of Engineers studies of the Ohio River Basin indicate that critical combinations of storms and runoff can be anticipated in the future. Flood control structures do not alleviate all flood zone hazards; dams can increase high water levels upstream, alter the natural channel through which a flooding pattern would be expected, or alter the water table and underground drainage pattern serving local areas.

In Boone County, the lands designated as flood zones include primarily bottom lands along the Ohio River and its major tributaries. Minor tributaries flood more frequently as the percentage of impervious surface increases in each watershed. Portions of the upper Gunpowder, Woolper, Elijah's Creek, and Mud Lick watersheds frequently experience flooding. The most extensive flood zone area is the lower East Bend Bottom at the mouth of Gunpowder Creek. Spots of moderate flood hazard are found downstream from small dammed lakes scattered throughout the county.

Floodplains are not suitable for permanent urban uses. These areas must also be protected from adjacent urban improvements which may alter drainage patterns and volumes. SD1 has conducted watershed characterization reports in an attempt to quantify the impacts of impervious area on the condition of each stream. This information can be used for planning purposes. GIS can also be used to plan infrastructure and help in emergency efforts. The Boone County Building Department administers the National Flood Insurance Program (NFIP) locally, which enables communities to buy insurance protection from losses due to flooding and is an alternative to disaster assistance.

Water Quality - The Clean Water Act of 1977 includes goals, water quality standards, monitoring, controls, and strategies designed to meet the stated goal "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." By statute, Kentucky designates water uses; water quality criteria have also been established to protect the uses. Anti-degradation, including minimum goals for each water body, is a required component of these standards.

The Kentucky Agriculture Water Quality Act was passed in 1994 to bring Kentucky into compliance with Federal laws. The goal of the act is to protect surface and ground water from potential pollutants resulting from agriculture and forestry operations. The act did not establish any new water quality laws other than requiring that all agriculture and forestry operations of ten or more acres develop and implement a water quality plan by October 23, 2001. The Boone County Conservation District assists farmers with individual water quality plans, which include recommended best management practices (BMP) to keep pollutants from reaching our waterways. Landowners are required to install best management practices and also document their efforts to improve and protect the natural resources of the Commonwealth. By writing and carrying out a water quality plan, producers and landowners can be assured that they are helping to protect our water.

In 2007, Sanitation District Number 1 (SD1) entered into a Consent Decree with the US Environmental Protection Agency (USEPA) and the Kentucky Division of Water (KDOW) that utilizes an adaptive watershed management approach to address water quality in the streams of Northern Kentucky. This approach has been endorsed by USEPA as offering the greatest opportunity for identifying and prioritizing cost-effective and protective solutions to local government waste-water and storm water management obligations.

As part of this Consent Decree, SD1 delineated sixteen (16) major watersheds throughout Northern Kentucky for intensive study and developed a Watershed Characterization Report (WCR) for each of them. These reports provided a starting point for further investigation into individual watershed condition. SD1 also began a monitoring program to establish a baseline of current conditions of streams within each watershed. Monitoring included biological, water quality, hydrological, and hydromodification surveys at nearly 80 stations across Northern Kentucky. The results of these surveys are crucial to understanding the linkage between receiving stream quality and changes in watershed land cover/use at the local level. Preliminary results of these surveys indicate that: 1) the highest quality streams in NKY are in the lesser developed areas of western Boone County, 2) there is a direct relationship between stream quality and the amount of impervious surface within a watershed.

Section 303(d) of the Clean Water Act requires Kentucky to maintain a list of impaired waterways and ideally establish a Total Maximum Daily Load (TMDL) or a TMDL alternative for each of them. The TMDL is regulatory and includes strategies and controls. Since the initial 1998 report by the Kentucky Natural Resources and Environmental Protection Cabinet - Division of Water (KDOW), segments of several Boone County streams have appeared on the 303(d) List of Impaired Waterways. This list is updated every 2 years. The 2016 list includes segments of the following Boone County streams:

- Allen Fork
- Dry Creek
- Fowlers Creek
- Gunpowder Creek
- Long Branch
- McCoys Fork
- Middle Creek
- Riddles Run
- South Fork Gunpowder Creek
- Woolper Creek

Most of the pollution issues center around siltation, high nutrient levels, bacteria, and low dissolved oxygen, while Gunpowder Creek in particular includes industrial sources and urban runoff issues. Current and past lists of impaired streams is online at the Kentucky Division of Water's website.

KDOW monitors and collects data every 5 years. Data and reports, including the 2012 State Integrated 305b Report containing Boone County is available on KDOW's website. Parts of Ashby's Fork, Double Lick, Little South Fork, Garrison Creek and Second Creek are designated Exceptional Use Water (aka Reference Reach Streams). KDOW indicates that Gunpowder Creek and Elijah's Creek have been "severely impacted" by de-icing fluids used by the airport. The airport began implementing a glycol recovery and recycling system and an aeration system in 2004 to decrease permit violations. These creeks have been impacted by this pollution for many years and may require an extended period of time to recover.

The Phase II Stormwater Rule was finalized by the EPA 1999 and places certain requirements on municipal separate storm sewer systems (MS4s) related to outreach, illicit discharges, permitting, construction and post-construction stormwater management, and pollution prevention. SD1 implements the stormwater quality management program to comply with Phase II requirements for most of NKY, including designated areas in Boone County, with the exceptions of the City of Florence and City of Walton. In addition to the permit required stormwater programs, two watershed management plans for Boone County streams have been developed by the Boone County Conservation District and regional partners, which were funded by Section 319(h) Nonpoint Source

grants through the Kentucky Division of Water. The Gunpowder Creek Watershed Plan (2014) and the Woolper Creek Watershed Plan (2016) and other reports are available online on SD1's Documents and Forms page and Boone County Conservation District website. These projects are important because they enable strong citizen and land owner involvement, and are designed to protect public health, drinking water supplies, stewardship, property values, and recreation/tourism.

The Gunpowder Creek Watershed Initiative was completed in 2014 and was strongly engaged with the community throughout the planning process. The plan provides an inventory of the 58.2 square mile Gunpowder Creek watershed, results and analysis of extensive monitoring, and recommended Best Management Practices (BMPs). So far, two projects have been completed as a direct result of the plan, including: the YMCA Bankfull Wetland project, which restored 5-7 acres of wetland on Gunpowder Creek at YMCA Camp Ernst and removal of a circa 1950 low-head dam from Gunpowder Creek at Camp Michaels.

The Woolper Creek Watershed Initiative was completed in 2016 and featured the same level of community engagement as the Gunpowder project. The final report includes inventories, analysis and recommended BMPs for the 33-square mile Woolper Creek Watershed. Two projects have been completed using BMPs from the report, including a Bioretention Basin at the KY 18/237 Single Point Urban Interchange in Burlington and a water retention basin retrofit at the Toyota North American Parts Center of Kentucky.

Since its inception, the Northern Kentucky University Center for Environmental Restoration (NKU-CER) (formerly NKU Center for Applied Ecology) 'Stream and Wetland Restoration Program' has completed stream restoration projects at 8 sites in Boone County. These include:

- The former Split Rock Conservation Park
- Big Bone Lick State Park
- Adair Wildlife Management Area
- City of Florence World Of Golf Course, Boone Woods Park
- Sand Run
- Stream segment behind Burlington Elementary
- Big Bone Phase III Stream and Wetland Restoration Project

Boone County Fiscal Court has helped fund up to 1/3 of the assessment costs to extend sanitary sewer to existing subdivisions served by individual treatment plants. This type of activity should be encouraged. Public sewerage, artificial drainage systems, special road fills and foundation designs can also overcome some permeability limitations. Pump stations and the availability of sewer service could have a significant impact in western Boone County by enabling development at greater densities. The Public Facilities chapter explains this in greater detail and identifies some of the incremental effects of development within these areas. The rural character of western Boone County valued by residents may be at risk if development is not sensitive to environmental factors.

PLANT AND ANIMAL LIFE

According to the Kentucky Ecological Field Services Station, Boone County currently has 31 animal and 8 plant species listed as Endangered, Threatened, or Rare. The Endangered species includes 3 bat species, 10 bivalves and 1 plant – Running Buffalo Clover.

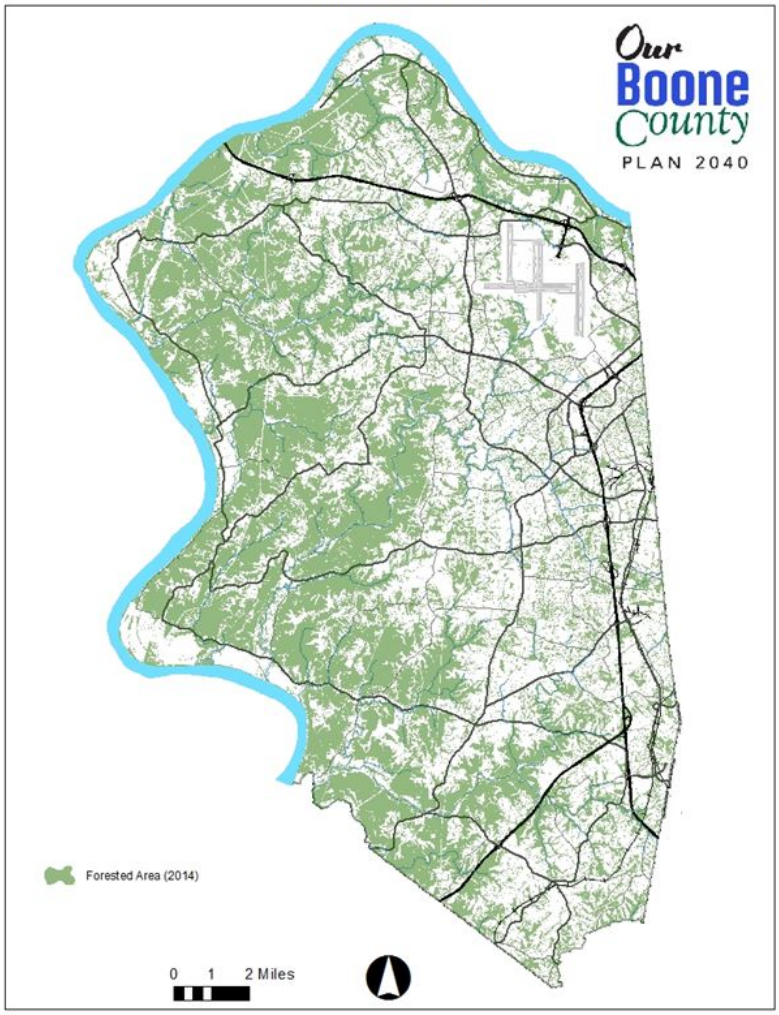
Wildlife Habitat - The USDA rates the potential of soils to accommodate three types of wildlife: wetland, woodland, and open land. Wetland wildlife requires soil conditions least capable of supporting urban uses. Woodland wildlife can exist within and adjacent to urban land uses, but is susceptible to habitat loss. Open land wildlife can be found within croplands, pasture and meadowlands, often adjacent to areas of urban use. Preservation of wildlife habitats is utilitarian but also has social value. Various species of wildlife perform ecological functions necessary to control bacteria, plant, and insect growth in natural drainage areas. Some

species of predator wildlife are required to control wildlife population cycles.

Habitat loss can result in animal control problems to residents and automobiles as displaced animals search for food and nesting areas. Woodland wildlife should be the primary concern in Boone County because of the extent of woodland habitat and its vulnerability to urban growth. Corresponding with the pattern of woodlands, woodland wildlife habitats appear predominantly in western Boone County, and diminish to small and isolated spots in the eastern/urbanized area.

Woodlands - Woodlands are significant natural resources and improve community quality of life by reducing noise, light, air pollution, and visual impacts between land uses. Tree roots also stabilize soils by reducing storm water volume and intensity, stabilize stream banks, and filter runoff before it reaches and pollutes streams. Woodland cover beautifies the landscape, diminishes the effects of strong winds, filters air pollutants, adds humidity, creates shade, and provides specialized wildlife habitats.

Figure 2.3 - *Woodlands*



Stream valleys in western and northern Boone County are heavily wooded, while the eastern uplands have limited and scattered forest cover. Protecting wooded areas in the less developed areas of the county as well as scattered vegetation remaining in urbanized areas and along major public roadways serves functional and visual purposes.

As of 2017 Boone County contained approximately 58,405 acres of woodlands (see **Figure 2.3**), a decrease of 232 acres from 2009, primarily resulting from development in eastern parts of the county. Approximately 32,564 of these acres lie on slopes over 20 percent. The remaining 25,841 acres of woodlands if located on slopes under 20 percent considered easier to develop. These woodlands coincide primarily with areas projected to experience growth over the 25 year planning horizon.

Studies of Boone County's forest canopy cover from the early 2000s (see **Figure 2.4**) analyzed relative quality of forest as three crown size classifications, large, medium, and small, which correspond generally to the age and maturity of the forest. **Table 2.1** shows the summary acreage statistics for the county. In 2002, 66% of the Boone County's forest cover was classified as small crown. Such a pattern results from either routine timber harvesting or agricultural fields being left fallow for 20+ years. The large crown forest areas comprised only 5% of the total forest and only 1.7% of Boone County's land cover, mainly on steep slopes and in stream corridors. Only 1% of the county's forest resources fell within incorporated boundaries. These studies examined in detail forest effects on air quality, stormwater management, floodplains, ground water recharge, erosion and steep slopes, and analyzed where existing forest canopy lies in relation to future land use and zoning. They describe benefits of tree canopies for offsetting the effects of impervious areas.

Figure 2.4 *–Forest Canopy Cover*

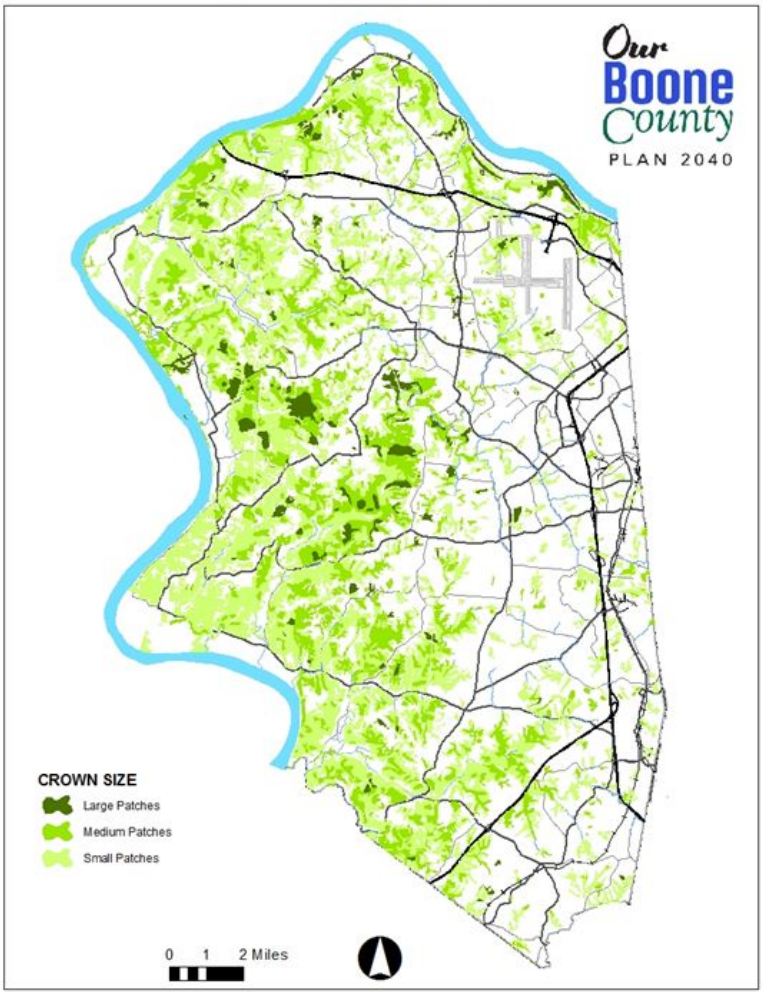


Table 2.1 - Boone County Canopy Forest Cover

	Area in acres	% of County
Boone County	164,469	
Large crown canopy	2,865	2%
Medium crown canopy	17,398	11%
Small crown canopy	39,132	24%
Total canopy cover	59,396	36%

Source: *Boone County Forest Canopy Cover Study, 2002*

Tree cover is directly related to environmental quality. Maintaining tree cover robust enough to function as green infrastructure reduces the need and expense of building infrastructure to manage air and water resources. Local agencies can use programs such as the CITYgreen GIS to calculate the environmental and economic values of the ecosystem services that trees provide. American Forests helps communities calculate the value of their trees so that leaders can make better decisions about integrating "green" into their urban infrastructure. Along these lines, an updated study of Boone County's forest cover should be conducted to track changes over the last 15 years.

Stormwater Runoff Reduction - Trees and soils function together to reduce stormwater runoff: trees by intercepting rainwater on leaves, branches, and trunks, where some of the intercepted water evaporates back into the atmosphere, and some soaks into the ground. Trees also slow storm flow, reducing the volume of water that a containment facility must store.

The Florence and Boone County Urban Forest Boards continue to implement urban forestry projects and have projects planned for the future. To date, the Urban Forest Boards have been effective on publically-owned land or right-of-way.

AIR QUALITY

Congress adopted the Clean Air Act Amendments (CAAA) in 1990 as an attempt to address air pollution problems in the nation. Six major pollutants are regulated by the CAAA (sulfur dioxide, nitrogen dioxide, lead, carbon monoxide, particulate matter, and ozone). In April of 2004 the U.S. Environmental Protection Agency (EPA) classified the greater Cincinnati metropolitan area as basic nonattainment under the 0.084 ozone standard. This area of nonattainment included Boone County. In 2008, the U.S. EPA completed its review of the national air quality standard for ozone and replaced the 0.084 parts per million with a new 0.075 parts per million standard.

Furthermore, in December of 2004 the EPA designated the greater Cincinnati area as nonattainment under the annual fine particulate matter (PM2.5) standard. The particulate matter is dangerous especially to children and elderly as well as people with respiratory problems due to them being more prone to infection. In 2011 the EPA announced that northern Kentucky, including Boone County, has been re-designated as a fine particulate matter attainment area.

In 2015, the American Lung Association reported that the Cincinnati-Wilmington-Maysville area (which includes Boone County) ranked 37 of 228 US metropolitan areas for high ozone days, 72 of 186 for 24-hour particle pollution and 20 of 184 for annual particle pollution. While the metro region experiences 40.7 fewer high ozone days/year compared to 1996 levels, the region still grades poorly, with Hamilton, Butler, Clermont and Campbell Counties all receiving Ozone Grades of F. Boone County's Ozone Grade of B is quite favorable by comparison and clearly benefits by being upwind of much of the Cincinnati metropolitan area. Within the County, the international airport and 33 miles of interstate highway contribute negatively to air quality.

TABLE 3.2 – Emissions Measurements; Northern Kentucky Counties

	2005	2008	2010	2015	2020
	Boone County				
VOC	4.33	4.00	3.92	3.17	2.96
CO	47.20	44.46	42.36	37.41	38.21
NO_x	10.27	8.53	7.42	4.63	3.45
	Campbell County				
VOC	2.52	2.29	2.21	1.74	1.55
CO	27.50	25.52	23.98	20.39	19.97
NO_x	5.98	4.88	4.21	2.54	1.81
	Kenton County				
VOC	4.32	3.85	3.65	2.85	2.56
CO	47.19	42.76	39.54	33.68	32.97
NO_x	10.39	8.37	6.91	4.23	3.01
	OKI KY Total				
VOC	11.17	10.14	9.78	7.79	7.09
CO	121.89	112.74	105.88	91.48	91.14
NO_x	26.64	21.78	18.54	11.40	8.27

Source: *OKI and Kentucky Division for Air Quality*

Boone County should continue to work with the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) which develops strategies, programs, and plans that aim to improve the air quality in the greater Cincinnati region. Among these are the 2040 Regional Transportation Plan and the OKI Regional Clean Air Program.

Studies of development density issues generally conclude that low density land uses generate longer trips, requiring people to travel farther between places of employment, schools, shopping, and recreation. Programs such as the Clean Air Act Amendments of 1990 (CAAA) and the Transportation Efficiency Act of the Twenty-first century (TEA 21) and its predecessors were created to limit the effect that increasing mobility has on air quality. The effect that low density development has on the transportation system and how it relates to these programs in Boone County and the region is explained in further detail in the Transportation Element.

According to OKI, vehicle emissions from transportation sources are projected to decrease as newer vehicles, meeting stricter federal emission standards, are incorporated into the fleet mix**. Table 3.2** compares different types of emission measurements in the three Northern Kentucky counties. VOC stands for Volatile Organic Compounds, CO stands for carbon compounds, and NOx stands for nitrogen compounds. New transportation facilities must undergo air quality analysis to attempt to forecast each facility's impact on future air quality. OKI generally performs this analysis in concert with federal agencies.

Air traffic at the Cincinnati-Northern Kentucky International Airport will continue to be a factor in the air quality of Boone County. The airport anticipates an increase in cargo and passenger traffic and will be addressing this issue in their Master Plan update.

CONSERVATION TOOLS

The Leadership In Energy and Environmental Design (LEED) Green Building Rating System is an independent certification program for developing high-performance, sustainable buildings. The LEED program awards levels of certification (Certified, Silver, Gold, Platinum) to buildings that meet standards in 5 categories: sustainable site

development, water savings, energy efficiency, materials selection, and indoor environmental quality. LEED standards can be applied to homes, commercial facilities and neighborhood development. Rating systems are available for new construction and major renovations as well as existing buildings.

At present, the US Green Buildings Council database lists over 109,000 certified LEED projects in the US. The database includes nearly 600 Kentucky projects, including dozens in the larger Northern Kentucky cities of Newport and Covington. In Boone County, projects which have attained basic LEED certification to date include: Thornwilde Elementary School (2014), L'Oreal Florence North Project (2015), and FTNK Hebron (2015). The PNC Bank Branch – Village Plaza in Florence (2007), Boone County Cooperative Extension building (2016), and Prologis Gateway International in Hebron (2016) have all achieved Silver certification. The only Gold level local LEED project listed is the Verst Group Logistics Warehouse Addition (2012) in Hebron.

In 2001/2002 the BCPC completed the 2002 Study of PDR and TDR for Boone County, Kentucky, which concluded that Purchase of Development Rights was a workable tool for Boone County at that time. However, land prices were high enough that PDR was not likely to be used at that time. The study also emphasized that PDR is only one of a number of tools designed to preserve open space and make farming viable. Some tools (PDR, Ag Districts, differential assessment for taxes) help make farming more lucrative. Others (zoning and Conservation Subdivision Design) encourage orderly and cost-effective growth by concentrating development near existing or planned infrastructure and affecting the physical design of development. Transfer of Development Rights was determined to not be appropriate for Boone County due to lack of public acceptance of higher density development in the urbanizing areas. There is a state-level Purchase of Agricultural Conservation Easement Program (PACE) in Kentucky. However, Boone County land is generally too expensive to make this program viable by itself. Some communities have used a designated tax or leveraged PACE funds with a local bond.

One tool which is actively used Boone County is the conservation easement. See Chapter 3: Natural & Cultural Resources for a discussion of the land trusts and related organizations that preserve land and other resources through conservation easements (or ownership) in Boone County. They include The Boone Conservancy, Hillside Trust, Cincinnati Preservation Association, Nature Conservancy and Kentucky Heritage Council.

CONCLUSIONS AND RECOMMENDATIONS

In Boone County, prime agricultural land, wooded hillsides, and stream corridors attract new residents, but can be easily impacted by new development. Special corridor studies should be conducted on a continuing basis to consider natural areas in Boone County for innovative development design, conservation, recreation, or preservation. Future development in the county should utilize environmentally sound design principles. Boone County needs to place a value on the mitigation of environmental impacts of development. Flooding caused by urban and suburban development is increasingly affecting both the major and minor tributaries. In the early 1990's relatively few creeks, such as Gunpowder and Elijah's Creeks experienced significant flooding, however, this Plan notes that many others now are partially affected, such as Sand Run, Woolper, Big Bone, and many smaller tributaries of the Gunpowder Creek watershed. Regional and local stormwater detention, erosion control and compliance must be addressed in more detail in local regulations. Soils in Boone County are generally not well suited for septic leach activity. Water line extensions must be carefully examined to determine the effect on water usage and resulting effect on septic performance. Stormwater regulations should be applicable to all types of development, and should be in effect before the undeveloped areas develop to prevent flooding, and costly stormwater control measures in the future.

A forecast of future development patterns will help anticipate changes to Boone County's environmental resources within the 25 year planning horizon. The Demographics and Economy chapters of Plan2040 identify areas in Boone County projected to experience rapid growth on short-term and longer range time frames. These chapters generally identify the type of land uses expected to develop and where. Considerations of future growth in Boone County should evaluate how to mitigate impacts of development within flood plains or areas of slopes over 20%, which are considered developmentally sensitive. Indirect environmental impacts can include extensions of public services, increased transportation distances, and greater consumption of natural resources

such as trees and oil.

Overall, land planning in Boone County should enable the higher density development on developable lands to reduce the pressure on developmentally sensitive areas. This is the most effective way to preserve environmental characteristics of rural Boone County, while reducing air pollution and making transit more feasible and effective. As Boone County's development continues, design will become increasingly important. Attention to water runoff, traffic congestion, and visual impacts will require more attention to mitigate the cumulative impacts of development on the environment.