The Hills Project

Department of Landscape Architecture
College of Agriculture
University of Kentucky
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NKAPC
Northern Kentucky Area Planning Commission

Building Codes Administration · Infrastructure Engineering · Current Planning · Link GIS Administration · Long-Range Planning

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Dr. Lee,

I want to express my appreciation to your 2007-2008 fifth year students for the collaborative work they did on our hillside study. I also want to congratulate them for earning ASLA's 2008 Community Service Award for their efforts. This recognition couldn't be focused on a more deserving or dedicated group of budding professionals.

As you know from our initial discussions, our goal in pursuing this study was to initiate a public dialog on hillside development. Our hope was that the students' enthusiasm and energy would help us engage our constituents to the extent that consensus might be achieved—a shortcoming of similar efforts in the past.

Your students presented thorough information in several interactive formats throughout the study and encouraged public input and feedback. They also sought input from all sectors of the community, facilitating conversations between the public, development community, preservation community, and local government representatives. While it's too soon to suggest that consensus was achieved or even begun, I have no problem stating that their efforts helped us bring all parties to the table and to start the process in a positive and constructive manner.

The Northern Kentucky Area Planning Commission is proud to have its name linked with the work of these students. We look forward to continuing the conversation your students began with our constituents.

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1.1 The Hills Project

The Hills Project was conducted by the University of Kentucky, Department of Landscape Architecture's Fifth Year Advanced Studio in cooperation with the Northern Kentucky Area Planning Commission during the Spring of 2008. The purpose of the Hills Project was to generate ideas, guidelines, and recommendations for both the development and preservation of Northern Kentucky's hillsides. The study specifically addressed the dilemma of whether hillsides should be used to maximize development opportunity or be left in a more natural vegetative state to serve ecological functions.

The study was completed over the course of four months and included three public meetings, at which stakeholder participation and survey activities were used to gather insight and ideas (fig. 1.1). The stakeholder input was crucial in driving conceptualization to influence guidelines and recommendations for the region.

The hillside dilemma was the common focus throughout the Hills Project. Information was gathered to inform and educate both the study team and general public about the breadth of issues related to hillside development and preservation. While hillsides were the primary focus, the scope of the study included planning and design recommendations on a comprehensive level. The original focal question was, "Should the hillsides be developed, preserved, or have a balance of both?" The comprehensive questions that evolved through research and interaction were, "What type of development and preservation is desired, where is it desired, why, and how can it be achieved?"

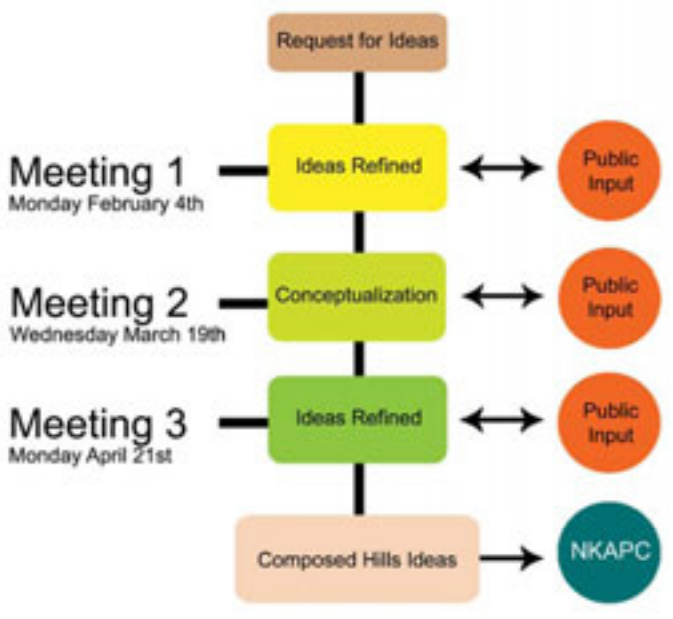


Figure 1.1 The Hills Project utilized a sequence of three public meetings to gather valuable stakeholder input and provide direction to the team's course of study.

In teaming with the Northern Kentucky Area Planning Commission, the focus of this study is for use within Kenton County. Recommendations for further action, as well as any reference to the *Comprehensive Plan Update 2006-2026* for Kenton County, speak to those elements which lie specifically within the boundaries of Kenton County. This overall study, however, included a comprehensive look at physical characteristics of the three county region of Northern Kentucky. Key components of hillside issues, such as geology, soils, and watersheds, are natural elements which occur throughout the region.

1.2 Project Goals

- Documenting and understanding the public's perceptions, particularly visual preference about landscape issues and values in Kenton County, Kentucky.
- Identifying critical and threatened hillside areas through physical inventory, analysis, and stakeholder input.
- Demonstrating and evaluating a variety of land use practices for hillsides and other areas.
- Developing a green landscape system.
- Identifying additional landscape and community assets that make this region a desirable place to live which will include land use planning and design recommendations.

1.3 Meeting One Snapshot - February 4, 2008

The presentation for Meeting One consisted of a holistic style inventory and analysis to ascertain the region's physical, economic, and demographic characteristics, as well as other variables affecting its growth and development (fig. 1.2). Public participation for Meeting One included the first background survey, the Landscape Value Survey, the Hillside Visual Preference Survey, and the Six Areas of Interest Exercise.

Figure 1.2 A wide variety of issues pertaining to inventory and analysis of the Northern Kentucky region were explored and presented at Meeting One.

1.4 Meeting Two Snapshot - March 19, 2008

The presentation for Meeting Two consisted of a broad conceptualization phase driven by results of the public participation session from the first meeting. In addition, public participation played a critical role for Meeting Two with activities including a second background survey, Landscape Typology Survey, Spatial Organization and Density Visual Preference Survey, and the continuation of the Six Areas of Intererst Exercise through plan drawings. Meeting Two explored a range of topics which will be referred to throughout this document. These topic areas also provide the basis for this document's overall organization. One can see in Figure 1.3 the topics presented at Meeting Two.

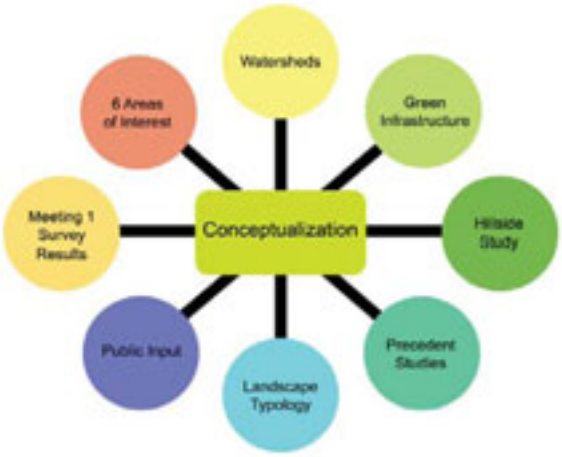


Figure 1.3 Topics covered at Meeting Two explored a wide range of possibilities for future growth and other potential regional planning considerations.

1.5 Meeting Three Snapshot - April 21, 2008

The presentation for Meeting Three recapped the progress from Meetings One and Two and discussed the future direction of the Hills Project. Main ideas generated through the Hills Project dialogue were refined and summarized as take home points for stakeholders (fig. 1.4). Public participation for Meeting Three included the third background survey and the continuation of the Six Areas of Interest Exercise through three-dimensional concept models.

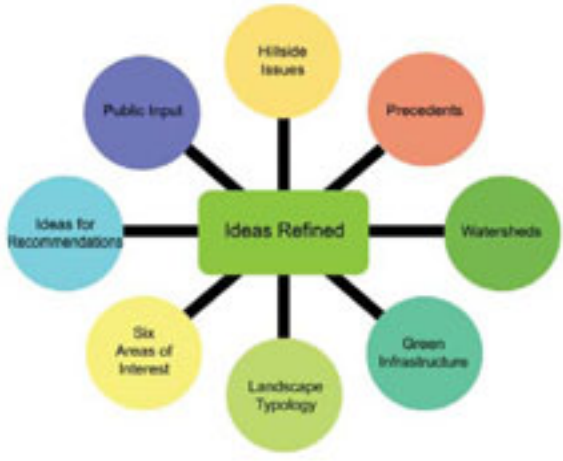


Figure 1.4 Topics presented at Meeting Three summarized the main points and suggested potential ideas for recommendations.

2.1 Historical Influences

In order to plan for the future one must first learn from the past. Northern Kentucky's development is a result of decades of change since its first settlement in 1788 (Cincinnati History Museum, 2004). Part of the Hills Project involved historical research on events that affected the population and economic growth of the region. More specifically, the research sought to pinpoint historical development that had direct impacts on population growth and density progression across the landscape. The analysis of population and density growth trends provided the Hills Project team with valuable knowledge of the region's historical development to assist in recommendations for future land use planning.

In 1788, settlers coming from the eastern seaboard founded Cincinnati along the banks of the Ohio River. Covington was established in 1814 along the opposite bank of the river from Cincinnati (City of Covington, 2002). The region's transportation system gradually experienced a shift from river travel to the railroad in the 1800s when the Pennsylvania Railroad System connected Northern Kentucky and Cincinnati, along with numerous out-of-state destinations (Pennsylvania Railroad System, 1917). Connections existed along major lines running to Pittsburgh, Chicago, and Philadelphia, with minor lines connecting to smaller cities like Louisville, Lexington, and Ashland, KY; ,Richmond and Seymour, IN; and Zanesville and Marietta, OH (Pennsylvania, 1917). In 1866, the Roebling Suspension Bridge connected Covington with Cincinnati. This bridge is one of the most notable sites in the region, designed by John A. Roebling, who later designed the Brooklyn Bridge (Mecklenborg, 1999).

By the early 1900s, Covington and Newport were the second and third largest cities in the state of Kentucky, and Cincinnati was the sixth largest city in the country, larger than St. Louis or Chicago (Mecklenborg, 1999). This was a testament to the rapid physical and economic growth in the region, and spurred the need for the currently named Cincinnati/Northern Kentucky International Airport in 1946 (Spencer, 2008).

Due to advancements in transportation, Northern Kentucky experienced explosive population growth around the airport and along interstate corridors. With the completion of Interstate 75 in 1962, new construction challenges began to occur in undeveloped areas. As population increased, growth spread onto the previously undeveloped hillsides and the issue of hillside construction became problematic. Examples such as the "cut in the hill" on Interstate 75 (fig. 2.1) provide evidence of the impact hillside development can impart on the region (refer to geology section of this chapter and Chapter 3. Hillside Issues, for more on this topic).

Figure 2.1 "The cut in the hill" on I-75, looking north toward Cincinnati. (Courtesy: Kenton County Library) This undated photo shows a historical condition on I-75.

The pressure to expand development into areas with unstable slopes and geology led to construction failures and environmental concerns. Development on sites with steep slopes or unstable geology is typically engineered in a manner that attempts to eliminate slope. Hillside removal creates a flat site with a large vertically cut face in the hill. These extreme cuts affect water runoff, soil stability, and landscape connectivity. For better or worse, unregulated excavation methods have permanently affected the landscape of Northern Kentucky.

2.2 Demographics

Demographic research of population and housing growth trends, accompanied with socio-economic data, helped the Hills Project team understand how and why Northern Kentucky evolved. Understanding demographic trends makes it possible to project future growth patterns through long-range comprehensive planning.

Looking at historical population growth records, it is evident that Kenton County has experienced a fluctuating rate of population growth throughout the decades (fig. 2.2). The largest increase in recent history was 15.8 percent in the 1960s. The completion of the interstate highways may have influenced the growth in the region. Population growth within the region is expected to continue into the future.

Percent Change in Population
Kenton County, Kentucky

Year	Population	% Increase
2000	151,464	6.6
1990	142,031	3.6
1980	137,058	5.9
1970	129,440	7.2
1960	120,700	15.8
1950	104,254	11.9
1940	93,139	-0.4
1930	93,534	27.3
1920	73,453	4.4
1910	70,355	10.6
1900	63,591	17.4
1890	54,161	23.1
1880	43,983	21.9
1870	36,096	41.7
1860	25,467	49.5
1850	17,038	

Figure 2.2 Kenton County population statistics. Data source: US Census Bureau and Comprehensive Plan Update 2006-2026

Comparing Kenton County to neighboring counties, census data reveals that Boone County (growth of 28,400 residents, 22.1%) experienced twice as much growth as Kenton County between 1990 and 2000. On the other hand, Campbell County grew only one-half as much (growth of 4,800 residents, 5.7%) as Kenton County over the same ten-year period.

Kenton County ranked 18th out of 120 counties in Kentucky for the highest growth rate in 2005 (US Census, 2000). The following diagrams (fig. 2.3) illustrate how development has pushed beyond the already utilized bottomlands and flat hilltops into the last remaining tracts of land located on the hillsides.

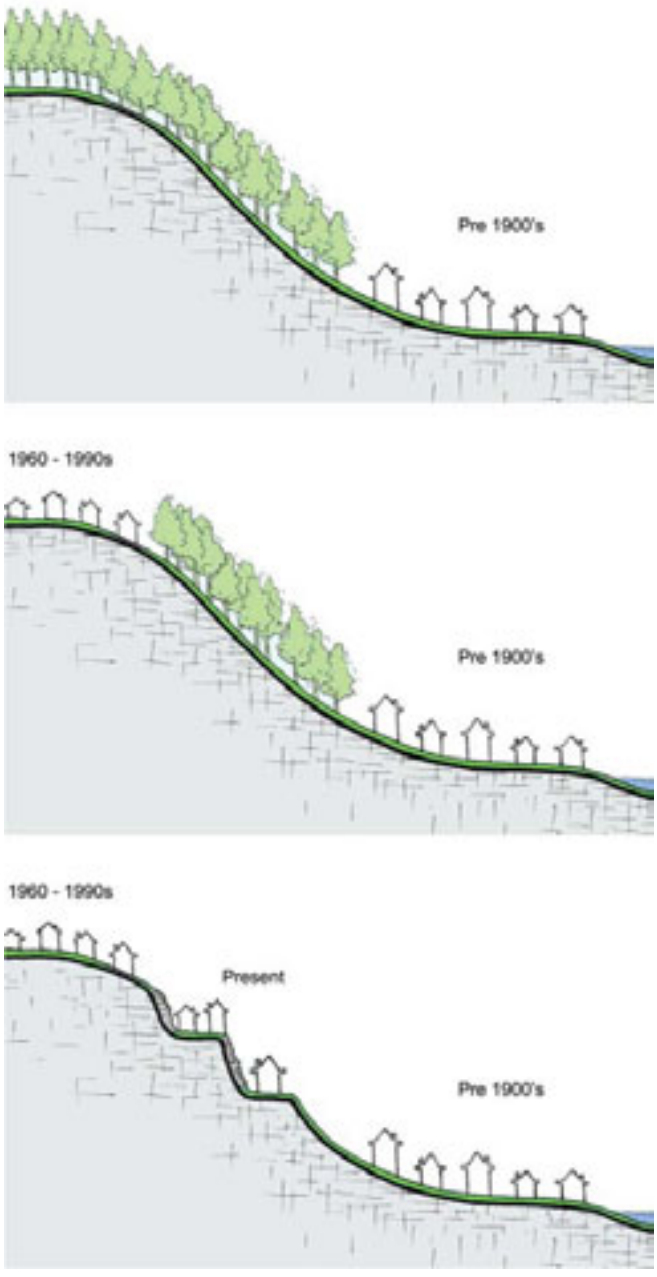


Figure 2.3 Abstract development patterns for typical hillsides in the Northern Kentucky area.

2.3 Hillside Development Pressure

With growth projected to increase by at least five percent over the next few years, the hillside development dilemma will become more pressing as the population seeks places to live, work, and play. The need for additional housing, places of work, and entertainment venues increases pressure on the remaining land considered Physically Restrictive Development Areas (PRDA) by the *Comprehensive Planning Update 2006-2026*. The Kenton County zoning ordinance characterizes PRDA as land with slopes 20 percent or greater (e.g., greater than 10 feet of elevation change over 50 feet of horizontal distance, or a change of greater than one story in building height over a distance of approximately five car lengths). It is important to note that the 2006 International Building Code by the International Code Council states, "The placement of buildings on or adjacent to slopes steeper than one unit vertical in three units horizontal (33.3-percent slope) shall conform to additional measures described in Sections 1805.3 (pg. 346-347)." Sites will be developed if a return on investment can be achieved, which is generally driven by the premium a buyer is willing to pay for the view. Currently, the only restraint for hillside development is economic and engineering feasibility.

2.4 Housing Trends

Just as population growth trends anticipate future growth, the Hills Project team used housing trends to estimate where and how much housing growth is expected to occur. Housing trends since 1940 indicate there are fewer people per home with fewer extended family members sharing the same home (US Census, 2000). This contributes to the rapid consumption of land for new single-family home construction. Building permit data indicates that single-family housing units comprise the majority of new home construction (Northern Kentucky Area Planning Commission, 2006).

The largest increase in housing unit growth within Kenton County occurred in the City of Independence, which experienced a 31 percent increase over the five years prior to 2005 (fig. 2.4). Trailing Independence at nearly half the rate was Ludlow, with a 14 percent increase in housing development. Both cities have a

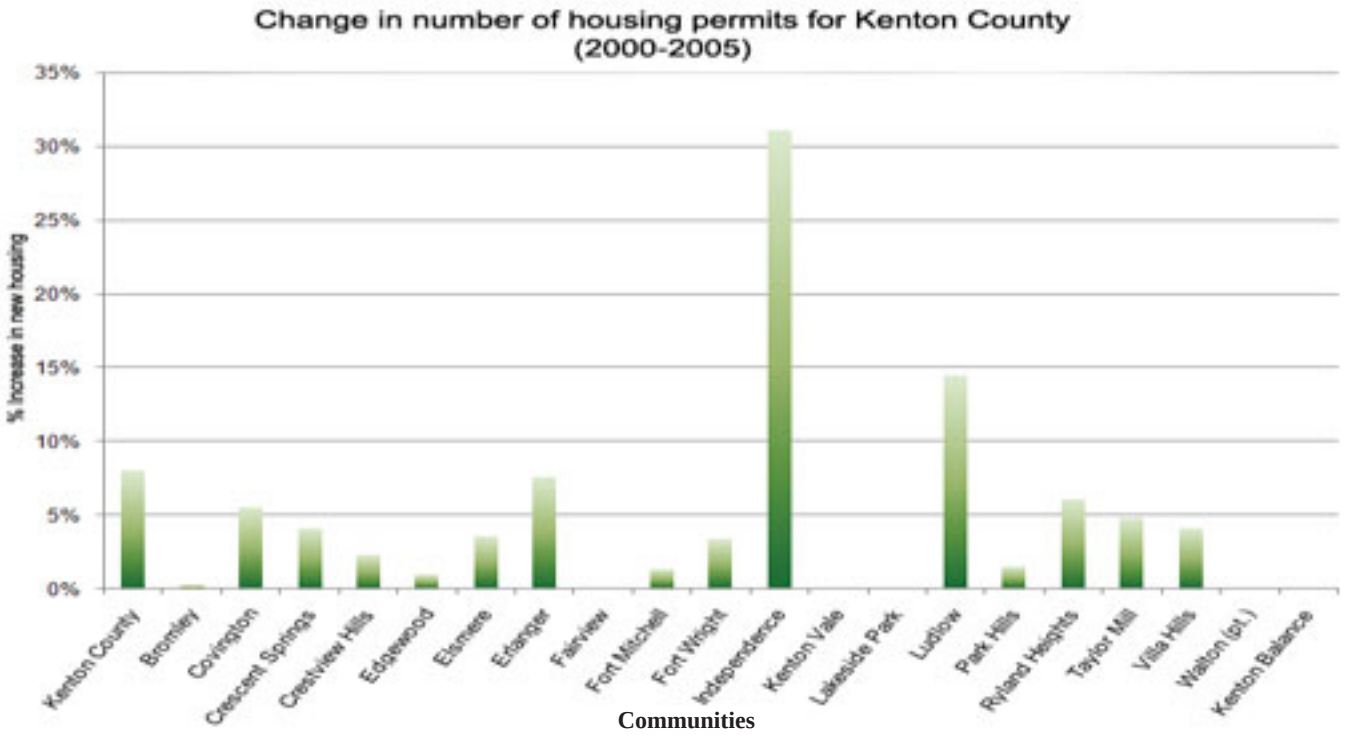


Figure 2.4 Change in the number of housing permits for Kenton County (2000 - 2005).

major portion of their land area designated as PRDA. The remaining areas of Kenton County exhibit lesser rates (<7%) of change in new housing development (NKAPC, 2006).

2.5 Places of Employment

Understanding stakeholder commutes to work helped the Hills Project team infer what may be necessary for the future in terms of transportation infrastructure. Employment patterns affect the distance and duration of travel commutes. Time of departure to work is an important factor that affects rush hour peaks when there is the greatest demand on the transportation system.

As of 2000, 40 percent of Kenton County's employed population worked within their home county, compared to 53 percent for Boone County and 35 percent for Campbell County (Kentucky State Data Center, 2007). Together, Ohio and Indiana employed the remaining 60 percent of Kenton County's workers, revealing that Kenton County is losing over half of its workforce daily to neighboring states. On the other hand, Boone County lost 22 percent and Campbell County lost 39 percent of their employed population to Ohio and Indiana. Workers who crossed county lines for employment, but only within the state of Kentucky, amounted to less than ten percent of the employed population (Kentucky State Data Center, 2007). This statistic may be due to a lack of infrastructural development in the region's urban centers, which may make it more difficult for businesses to relocate in these urban centers.

2.6 Density Progression

Landscape changes occurred in the Northern Kentucky area over the past half century because of the influx of population (6.6 percent increase between 1990 and 2000) into the region. These changes occurred especially in the areas directly south of Cincinnati such as Ludlow, Covington, and Villa Hills. For this reason, land use decisions become ever more critical to the infrastructure, schools, and services that can support the population. It is important to examine the region's density progression over time in order to understand and predict where it might occur in the future (Kelly & Becker, 2000). Figure 2.5 illustrates density progression within census tracts in Boone, Kenton, and Campbell counties from 1950 to 2000. This population growth reflects a mirror image of housing development throughout the county over the

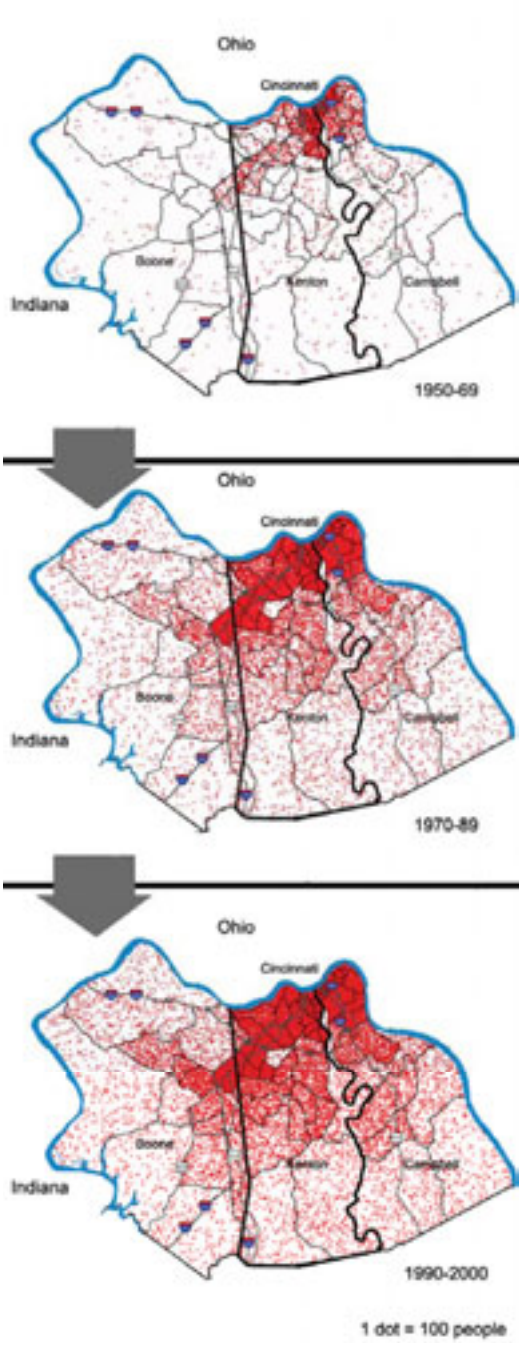


Figure 2.5 Maps depicting density progression between 1950-2000 in Northern Kentucky.

same period, and demonstrates population growth's effect on the landscape. Population trends are most recognizable during the 1970s after the development of Interstate 75 made it possible for people to live further away from the workplace and urbanized areas. This series of maps depicts population moving outward from the Covington area and south and west into Kenton County.

Kenton County continues to be a desirable place to live, and development pressure on hillsides and rural areas can be expected to increase in the future. Many of these sites provide less than ideal conditions for construction and pose additional threats and risks to the population and environment that call for new ideas and solutions. Hillside development in the region of Northern Kentucky is an increasingly debated issue as growth continues to demand additional infrastructure in the region (Rutledge, 2008). While some residents would like to see the forested hillside character preserved, other stakeholders see opportunities in urbanizing the hillsides. The Northern Kentucky landscape has a variety of values and meanings for stakeholders that need to be expressed and understood to assist in comprehensive land use planning as depicted in Figure 2.6.

2.7 Public Input Overview

A crucial part of the holistic inventory approach to the Hills Project was the communication of stakeholder input. The Hills Project team created several surveys and exercises for the public to help extract the ideas and opinions of the participating stakeholders while documenting the stakeholder's voice in the matter. Public input drove conceptualization and influenced recommendations throughout the dialogue of the Hills Project.

2.8 Landscape Value Survey

The Landscape Value Survey helped the research team understand how the participating stakeholders valued certain elements of the landscape. The team asked stakeholders the question, "For the future of Northern Kentucky, how do you value ___." Stakeholders then rated inserted landscape elements

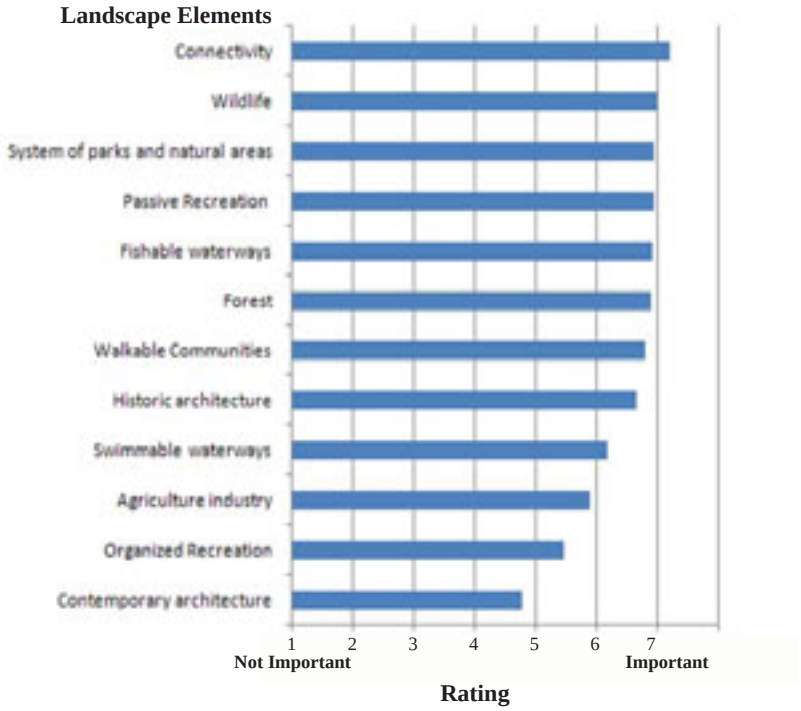


Figure 2.6 Landscape Value Survey results from Meeting One (56 participants).

(shown in fig. 2.6) on a scale of 1-7, with 1 meaning not important and 7 meaning important. Stakeholders submitted their responses with an electronic audience response system. The survey results are shown in Figure 2.6.

2.9 Hillside Visual Preference Survey

The Hillside Visual Preference Survey helped the team gain an understanding of stakeholder preferences related to hillside development. The overall approach was similar to that used by The Hillside Trust in "A Hillside Protection Strategy for Greater Cincinnati" (1991) where created images tested stakeholder preference; however, images for the Hills Project were created with different software and excluded architectural facades. The participants viewed images that simulated possible hillside development scenarios using a 3D modeling ecosystem generator program known as VUE 6 by E-ON software. The fifteen images of geometric volumes tested spatial organization, structure size, and placement on the hillside. The scenarios contained white geometric volumes instead of specific building facades to avoid architectural bias.

First, the Hillside Visual Preference Survey tested spatial organization by creating three different scenarios containing fifteen equal units of structure (fig. 2.7). The participants initially viewed all three images at one time, and then rated them as they appeared individually. Then the study tested structure size and hillside placement with the remaining twelve images, which were shown in a random sequence to all participants. The images displayed possible scenarios related to hillside development. The participants had eight seconds to view the image followed by a chance to respond using an audience response system. This was similar to the timing method used by Clay and Smidt (2004).

The results (fig. 2.7) indicate that in terms of spatial organization, stakeholders least preferred the dispersed organization, and preference increased as clustering increased. The results for structure size and hillside placement location show a general preference for smaller architectural massing and development located on top of the hill versus the bottom (Appendix 10.1). The undeveloped forested hillside received the highest score (6.34), and the lowest score (2.61) was for smaller architectural massing scattered across the hillside. Larger architectural massing was more acceptable on top of the hill rather than at the base of the hillside, and large horizontal architecture showed a higher approval rating than large vertical architecture.

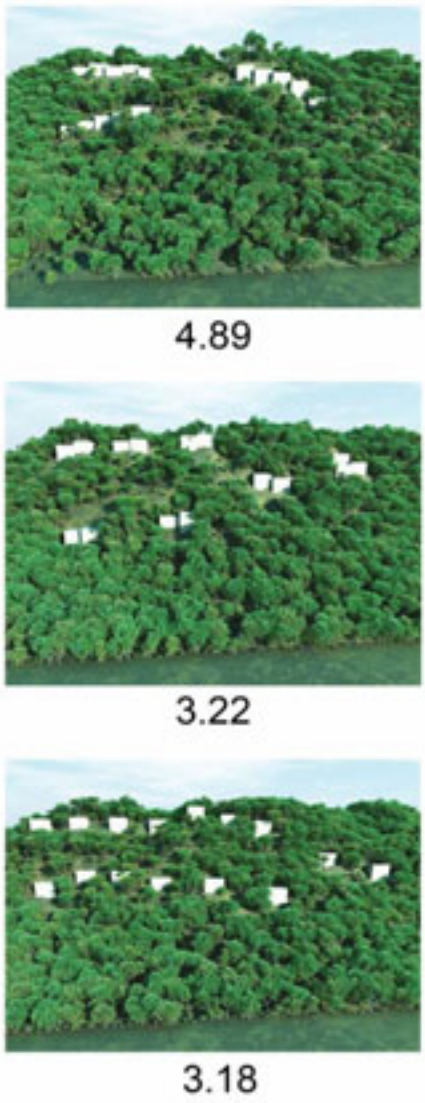


Figure 2.7 Hillside Visual Preference Survey - Spatial Organization results from Meeting One (56 participants). Scores indicate the average level of preference. The scale ranged from 1 (Dislike) to 7 (Like).

2.10 Physical Inventory Overview

The Hills Project's principal and distinguishing component is an inventory and analysis of the natural as well as the socioeconomic systems. Team members studied the physical landscape features of Kenton and the surrounding counties based on the following landscape characteristics: geology, soils, slopes, vegetation, watersheds and waterway health.

2.11 Geology

The inventory phase began with the geologic foundation of Boone, Kenton, and Campbell counties. The landscape's underlying geology significantly influences the type of soils, vegetation, topographic features, and building capabilities of a site. For example, areas having a subsurface material consisting of Kope formation (see Section 2.12) are very prone to landslides. For land use and development purposes in Northern Kentucky, areas with this type of underlying geology should be a substantial consideration in land use decisions. Figure 2.8 shows the occurrence of Kope formation in the tri-county area. In Kenton County, this formation characterizes 25 percent of the landscape.

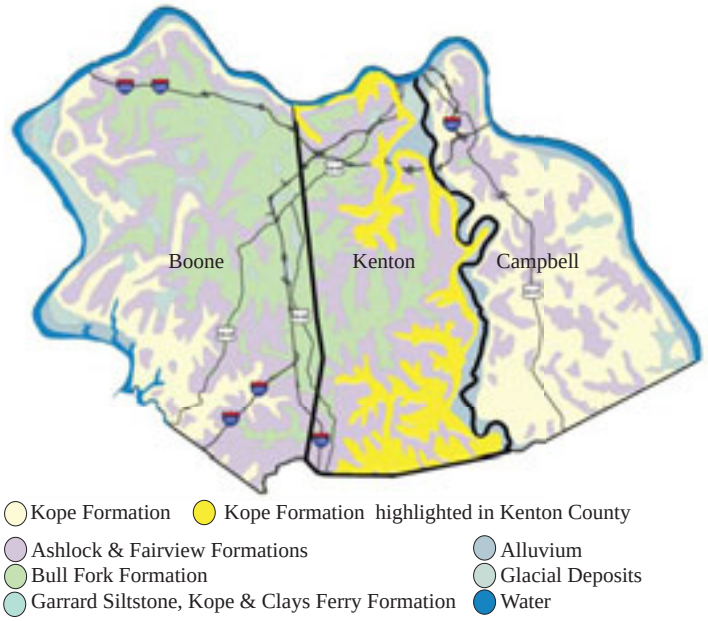


Figure 2.8 Kope formations throughout Kenton County in the context of the Northern Kentucky region.

2.12 Kope Formation

Kope is a clay-shale rich, flat-lying geologic formation that can reach over 200 feet thick in the Northern Kentucky region. In undisturbed conditions, the clay and shale help to maintain Kope stability; however, when development cuts increase the exposure of the particles to air and water, they begin to break down mineral size particles into clay. The materials found at the surface layer of a Kope formation have a heightened propensity to slide under these circumstances. Because the bedrock underlying Kope formations is significantly more stable, structures built on these conditions will often bypass through the Kope and anchor into the bedrock beneath (Agnello, 2005).

2.13 Soils

Soil inventory provides a wealth of knowledge about a landscape and determines opportunities and constraints that landscape architects must consider when generating land use ideas. This phase of the inventory utilized the *National Soil Survey* published by the U.S. Department of Agriculture's Natural Resource Conservation Service (USDA NRCS 2008). The survey rates soil limitations for a variety of land uses based on the number of limiting factors and associated costs and measures necessary to overcome them. For home, road, and small-scale commercial construction, the survey rated an overwhelming majority of the soils in Northern Kentucky as severely limited. However, soils rated as severely limited are not impossible for development. This rating indicates that land use decisions on these soils will be significantly impacted by some constraints of the landscape, with the understanding that some additional considerations and costs may be involved. Figure 2.9 illustrates the three levels of limitation provided by the survey.

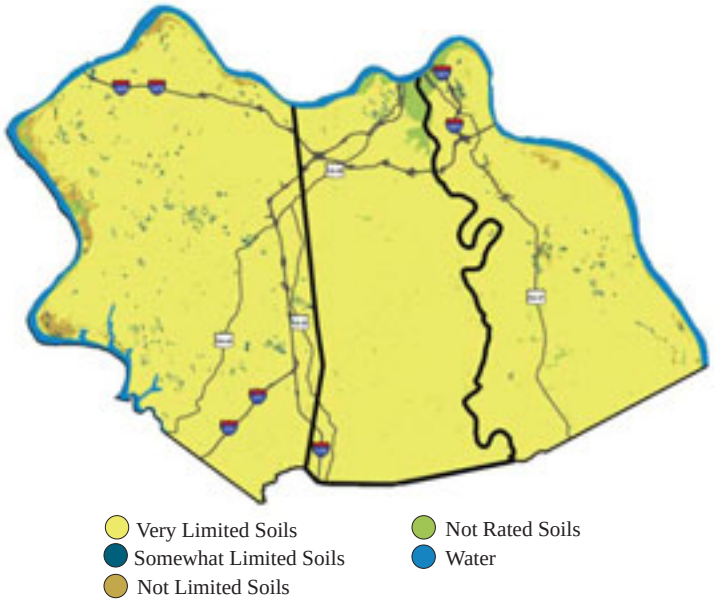


Figure 2.9 Soils throughout the Northern Kentucky region with an emphasis on Kenton County.

2.14 Slope

After collecting inventory of the geologic foundation of the region, the team proceeded to inventory the undulating form or slope of the landscape. Slope is the steepness or incline of an area, measured as a percentage. Slope maps help to understand the landscape on a number of levels. At a large scale, slope maps help to generate a three dimensional characterization of the area, and at a small scale, these maps indicate the opportunities and constraints of a

specific site. Figure 2.10 depicts a range of slopes in the tri-county area. Varying degrees of slope provide both limitations and opportunities for structures, vegetation types, and other land uses. Because the ultimate objective was to review the hillside area of Kenton County, the Hills Project team narrowed the area of focus to analyze the slope inventory for only Kenton County. Although focused on Kenton County, it is important to recognize slopes throughout the Northern Kentucky region.

The hillside area of Kenton County can be thought of as beginning at the northern edge along the Ohio River, turning south along the Licking River valley and continuing into neighboring counties. Because hillsides are integral to the landscape character of the Northern Kentucky region, they affect everyone living and working in the region.

Soils are a derivative of the bedrock over which they lie, and both the soils and the geology determine the stability of a slope. These three combined characteristics will affect the types of vegetation growing in an area, as well as the types of landscape development that may occur. In order to develop a thorough understanding of the landscape, one must not only consider the geology, soils, and slopes, but other landscape characteristics as well (discussed later in this study) because the landscape is a multi-faceted composite and each of these elements is fundamentally connected to one another.

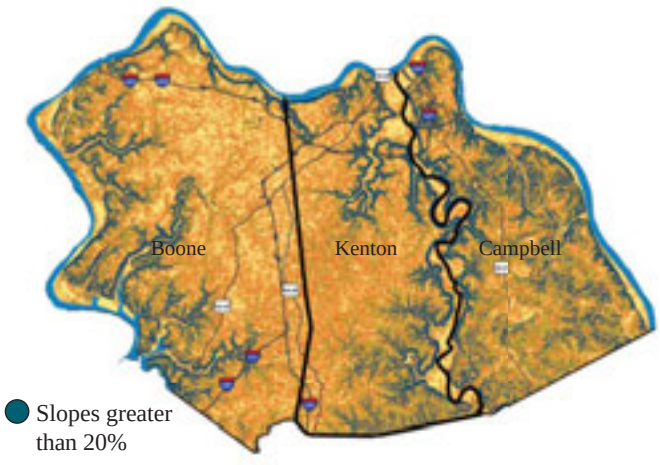


Figure 2.10 Slopes greater than 20% within the context of the Northern Kentucky region.
Data source: Kentucky Geography Network

2.15 Watersheds

Another aspect of the physical inventory involves the watersheds. While watersheds will be addressed more extensively in Chapter 8, it is important to introduce the concept at this time. Watersheds and water quality are inherently linked with geology, soils, and slope. Figure 2.11 is a digital elevation model of the Northern Kentucky area with prominent ridges indicated in red. Notice that the higher elevations form ridges connecting the entire Northern Kentucky region, thus determining the watershed boundaries. These watershed boundaries overlap political boundaries, indicating the need to consider maintaining watershed health from a regional perspective.

The Kentucky Division of Water has determined that many miles of waterways in the region do not meet designated standards for water quality (refer to fig. 8.1). Many of these waters are directly affected by the adjacent watershed's land use. As the landscape continues to urbanize, there is a greater likelihood of increasing water quality problems within Kenton County as well as the Northern Kentucky region.

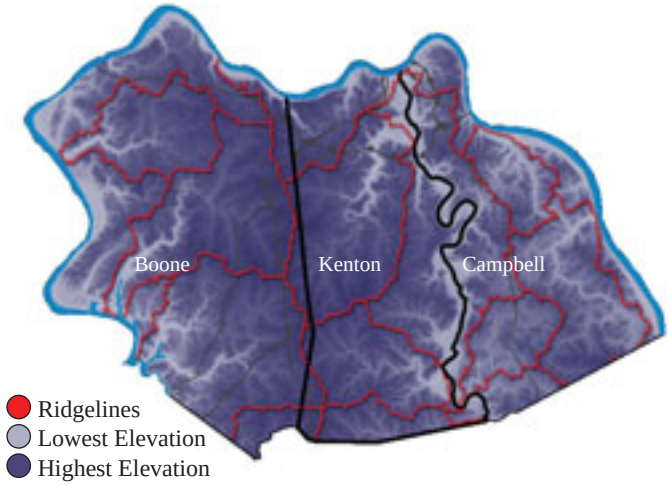


Figure 2.11 Digital elevation model showing ridgelines (in red) which determine watershed boundaries within the context of the Northern Kentucky region.
Data source: Kentucky Geography Network

3.1 Northern Kentucky Hillsides

This chapter will synthesize the constraints and opportunities of the Northern Kentucky region because many of these issues transcend the borders of Kenton County. In this chapter, many geological phenomenon are described and analyzed. Among these include many of the constraints for the structural development of hillsides such as: hillside slippage, soil erosion and landslides. This chapter will also describe the physical geology in the locations of previous landslides in order to recommend strategies to avoid such occurrences in the future and to help prevent economic loss through structural damages. When planners can recognize and understand the potential issues, they can better serve the community by avoiding development in areas prone to natural hazards, or at least be better prepared to deal with them in the long term. Finally, this chapter will describe various policy implications to foreshadow specific recommendations for communities to analyze and determine the most appropriate planning for the future of the Northern Kentucky region.

There are many challenges associated with developing hillsides (NKAPC, 2006). Among the challenges, Kenton County faces a propensity for landslides and infrastructural difficulties. Much of the remaining land for development in the County contains steep, heavily wooded hillsides which create construction challenges, but offer opportunities as well (NKAPC, 2006). The hillsides of Northern Kentucky are highly desirable for their scenic views of the Ohio and Licking Rivers as well as the Cincinnati skyline. The pressure to develop hillsides to take advantage of these views is an important planning consideration in the county (NKAPC, 2006). The balance between private property rights and the health, safety, and welfare of stakeholders is an essential consideration, as is the sustainability of the region. Developing the hillsides in Northern Kentucky include factors associated with economics, safety, and aesthetics. Therefore, one must look at the impact of development on the hillsides from multiple viewpoints. Some of the environmental consequences include increased soil erosion, stream siltation, and property damage (Spiker & Gori, 2003).

3.2 Landslides

To understand landslides and why they occur, it is first necessary to understand significant landslide terminology. A landslide describes many types of downhill earth movements. These range from rapidly moving catastrophic rock avalanches and debris flows in mountainous regions, to more slowly moving earth slides and other ground failures (Spiker & Gori, 2003). Landslides are the most widespread geologic hazards on Earth because they threaten lives and property, with an estimated 25 to 50 deaths and damage exceeding $2 billion annually (Spiker & Gori, 2003). Landslide losses are increasing in the United States as development expands under pressure from an increasing population (Spiker & Gori, 2003). Landslides are occurring in many parts of the United States, including the Northern Kentucky region.

The Northern Kentucky region exhibits evidence of land scarps and slides along the hillsides primarily caused by insufficient subsurface drainage issues (William Andrews, Jr., Kentucky Geological Survey (KGS), personal communication, 2008). Land scarps, along with trees sliding down the hillsides, are evidence that the land could require extra measures to develop or indicate an unsuitable place to urbanize. Most land scarps are due to insufficient subsurface drainage (fig. 3.1). Installing drainage tile throughout these areas may help, but may not cure the problem.

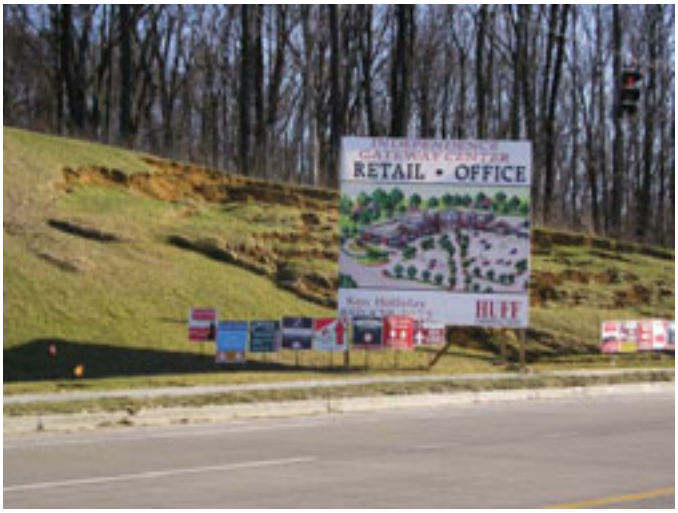


Figure 3.1 Land scarps near a recent Kenton County development project.

Landslides can occur naturally; however, human activity can contribute to land instability through modification of hillsides such as removal of vegetation and grading. These activities can lead to greater soil erosion (Andrews, 2007). For example, removal of vegetation may occur during development leaving the existing land susceptible to soil erosion and landslides. Vegetation provides hillsides with stability from the root structure of the plants. When these plants are removed, a degree of slope stability is removed (Andrews, 2007). Figure 3.2 shows a guide rail that required replacement due to soil erosion along Sleepy Hollow Road in Northern Kentucky.

Landslides also have an effect on a city's infrastructure and daily activities. School routes, transportation corridors, and residential developments may encounter noticeable problems on the hillsides within the Kenton County area (NKAPC, 2006). The example in Figure 3.3 shows a Campbell County residential development in which homes were condemned within 10 years of construction due to structural damage.

Road building and other forms of construction often exacerbate the landslide problem in hilly areas by altering the landscape and by increasing stormwater runoff (Spiker & Gori, 2003). According to the Kenton County Subdivision Regulations (NKAPC, 1978), the maximum percent slope for a road on which a school bus travels is 12 percent. Anectdotally during public meetings, the Hills team heard of subdivisions in Kenton County where children walk to the bottom of the hill to catch a bus for school because slopes on some residential streets exceed 12 percent. Some communities see this as a problem in terms of the children's safety, while others may consider it beneficial exercise. Understanding the opportunities and constraints is important when a value system is in play.

There are a number of roads prone to landslides within Kenton County and Northern Kentucky region including KY 8 between Ludlow and Anderson Ferry, KY 8 East of Dayton, and along Montague Road near Devou Park (Andrews, 2007). Figure 3.4 shows Montague Road, a residential area, where four

Figure 3.2 This guide rail along Sleepy Hollow Road shows signs of progressive downhill sliding.

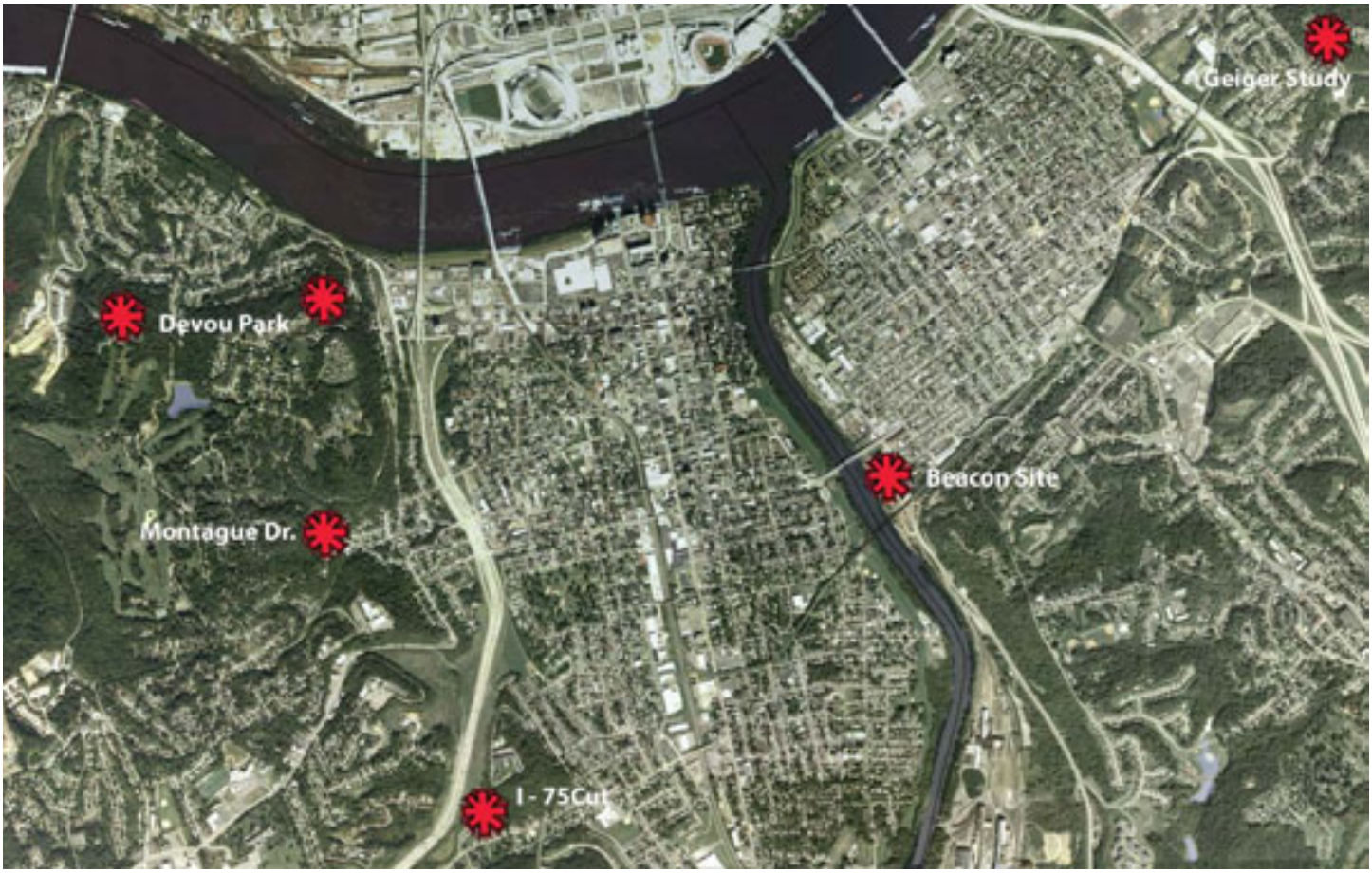
Figure 3.3 The dangers of poor hillside development; unstable slopes have compromised the foundations of several homes in Campbell County.

landslides have caused damage to infrastructure and the road. The first landslide occurred in 1990, with the most recent occurring in 2003. Laying asphalt on steep slopes can result in roads that need frequent repairs. The repair of roads, railroads, buildings and underground utilities costs thousands of dollars each year on average (Andrews, 2007). For example, roads in 11 counties of Greater Cincinnati contain fresh asphalt or concrete patches, irregular dips and rises, retaining walls leaning into the road, and/or sunken guide rails (Andrews, 2007).

Following the initial inventory overview and analysis phase, the Northern Kentucky region was further examined to identify specific areas where landslides had already caused environmental and economic impacts. The Kentucky Geological Survey and Dr. William Andrews were valuable resources in learning more about landslides in the Northern Kentucky region. Dr. Andrews recommended many useful readings including A Field Guide for Landslides in Northern Kentucky and Estimating Landslide Losses: Preliminary Results of a Seven-State Pilot Project. These resources helped to identify areas where landslides had occurred as of 2005 (fig. 3.5) in the Northern Kentucky region (Agnello, Maynard & Rockaway, 2005).

Figure 3.4 A landslide along Montague Road, near Devou Park in Kenton County.

Figure 3.5 Recent landslide locations in the hills surrounding downtown Covington, Kentucky.



Additionally, in Figure 3.6 the pink area indicates where the underlying Kope formation is located and the brown areas indicate the location of land considered to be Physically Restrictive Development Areas (PRDA). The PRDAs are characterized by at least a 20 percent slope and/or are subject to periodic flooding; the underlying Kope formation is characterized by flat-lying shale which poses an issue of structural limitations for development in this part of the county (NKAPC, 2006). The sites include: Devou Park, where Kope formation is found; the Montague Drive residential area where four separate landslides occurred as of 2003; the cut in I-75 in which Kope formation is exposed; the Beacon Industrial site along the Licking River; and the Geiger study near Woodlawn in the northern part of Campbell County (Agnello et al., 2005). PRDAs and Kope formation are both important factors that contribute to the potential for landslides because the majority of landslide events occurred in areas characterized by one, if not both, of these geologic features within the Northern Kentucky region (Agnello et al., 2005).

3.3 Factors Contributing to Landslides

After identifying where landslides occurred, the research team looked specifically at why they occurred. While there are many factors leading up to a landslide event the research team identified four major factors present in the Northern Kentucky region. The first major factor is the presence of the underlying Kope formation. Figure 3.7 shows the Kope formation along a Northern Kentucky road. Wire netting is used to catch the rubble from falling into the road.

Figure 3.6 Using the same study area as in figure 3.5, this map shows the location of Kope formation (pink overlay) and PRDA land (brown overlay).

Figure 3.7 Exposed Kope geology along a road-cut.

Kope formation erodes readily when exposed to air and water (Baum & Johnson, 1996). As a result, the colluvial materials found at the surface layer of the Kope formation have a high propensity to slide. Colluvial materials consist of loose bodies of sediment that have been deposited or built up at the bottom of a low grade slope or against a barrier on that slope and are transported by gravity (Baum & Johnson, 1996).

In addition to Kope formations, other underlying geology in this part of the state is partially responsible for landslide events. Materials that contribute to slope instability in addition to Kope and colluvium include Pate and Eden soils. Soils are classified according to slope and parent material, and some soil types add to the susceptibility of an area for landslides (Baum & Johnson, 1996). In addition, hillside soils may creep down a slope gradually, leading to failure during wet periods. Underlying geologic conditions result in visible land scarps throughout Kenton County (Baum & Johnson, 1996).

Residential developments and homeowners suffer when foundations are built on poorly suited soils, poor infrastructure, and/or poorly maintained erosion measures resulting in structural damage after just a few years. Figure 3.8(a-e) (on next page) shows a home in Campbell County that encountered hillside failure issues. The homes in this neighborhood are less than 10 years old and several were condemned due to structural problems. Site engineering practices may make it possible to build in these areas, but over time, such development may not be financially sustainable for the property owner and community.

A third contributing factor to landslides is slope. Within the Northern Kentucky area, hillsides slope gently near the valley floor and gradually become steeper as the elevation increases (Baum & Johnson, 1996). Slope analysis in ArcGIS based on the Shuttle Radar Topography Mission 2000 data for this area indicates that approximately 11.5 % of Kenton County has land sloping from 20–80%, with 16.5% of the land slopes between 12-19.9%. The remaining 72% percent of the county has less than 12% land slope. A 1% slope can be interpreted as the land rising 1 vertical foot across 100 horizontal feet. Figure 3.9 shows slopes of 20% or greater in the Northern Kentucky region.

If development on these hillsides is considered, one must look at possible sources for the resistance needed to prevent landslides. Tree roots, residual cohesion, soil suction, and roughness of the potential slip surfaces are possible sources to provide the additional sliding resistance needed to prevent landslides on the slopes as referenced by Baum and Johnson (1996). For a more in-depth explanation of these sources, refer to the U.S. Geological Survey bulletin by Baum and Johnson (1996).

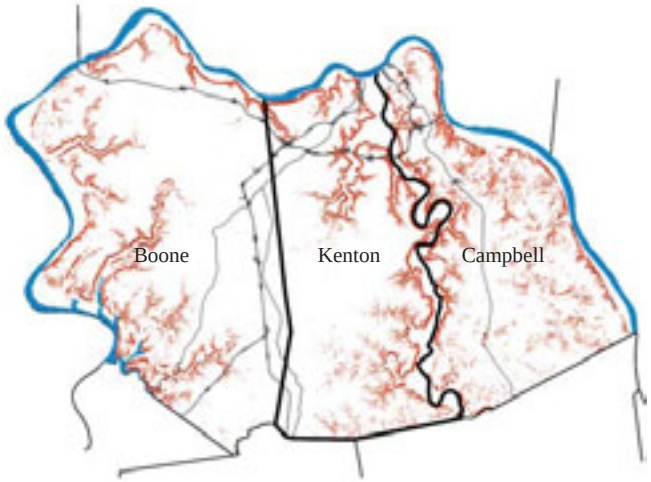


Figure 3.9 Land in the Northern Kentucky region with a slope greater than 20 percent is shown in red.
Data source: Kentucky Geography Network

Figure 3.8 (a-e) Structural damage to homes can occur from hillside failure issues as illustrated by photographs of this home located on Rocky View Dr. in Campbell County. The building permit for the house was issued in 1996; the house was condemned in 2004.

(a)

(b)

(c)

(e)

(d)

The last contributing factor to landslides is urban development, an increasing issue as development encroaches on the area's hillsides (Baum & Johnson, 1996). According to Baum and Johnson (1996), landslides became more common after 1960 as the population grew and improvements in technology made it possible to build in more challenging areas. Prior to that time, hillside areas served as natural barriers to urban development. As undeveloped level or gently sloping land became more scarce, urban development began to expand more and more into hillside areas (Baum & Johnson, 1996). Figure 3.10 shows The Views Condominiums, an example of hillside development in Northern Kentucky.

Figure 3.10 Hillside development in Northern Kentucky.

3.4 Landslide Susceptibility Map

Once the factors that contribute to hill slope failure have been identified, the logical next step is to determine where those conditions exist in the study area. After the occurrence of a mudslide in 1973, the City of Cincinnati recognized the need for a tool to help manage the landslide problem as related to existing and proposed highways. This prompted a landslide susceptibility study in 1980 by Sowers and Dalrymple, Consulting Engineers, who began creating a landslide susceptibility map (City of Cincinnati, 1980). Dr. John Rockaway of the Northern Kentucky University's Department of Geology, completed the landslide susceptibility map in 2002.

The process of generating the susceptibility map consisted primarily of compiling information presently available from a variety of sources, including topographic, geologic, and landcover maps; geologic and engineering literature; and databases maintained by governmental agencies. Black-and-white stereo photos paired with aerial photographs helped to identify existing and past landslides and to study land use, topography, and landforms (City of Cincinnati, 1980). The map was developed by assigning weighted factors to parameters determined during the study that related to hillside stability such as geology, slope, soil type, groundwater, and previous landslides. The city was divided into grids (in the range of 250 feet square) and a composite of all these parameters was generated for each area (City of Cincinnati, 1980). The landslide susceptibility map for Kenton County can be seen in Figure 3.11. This map also includes Boone and Campbell Counties for contextual purposes. Areas of low susceptibility to landslides are shown in light blue, while areas of high susceptibility are shown in red.

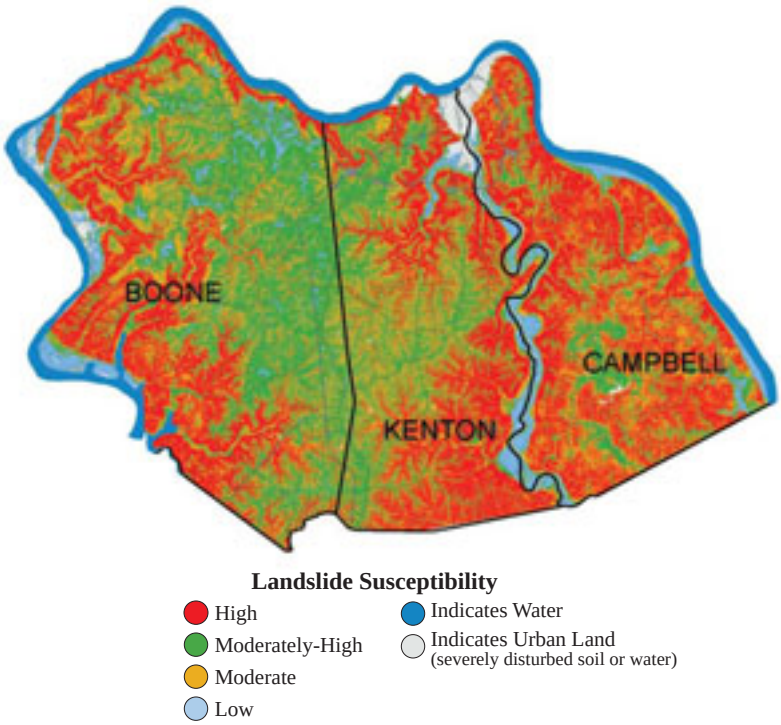


Figure 3.11 Landslide susceptibility for Northern Kentucky; areas shown in red indicate land with the highest potential for landslides.
Source: Northern Kentucky University, Department of Geology

3.5 Solutions

Landslides have the potential to cause a great amount of damage. Therefore, technical solutions were researched to assist in offering recommendations to help aid the prevention of future landslides. The Cincinnati area provides some possible technical solutions, as this region has underlying geology similar to that in Kenton County, and is facing some of the same challenges of hillside development (Andrews, 2007). One solution in Cincinnati utilizes walls designed to stop landslides along highways and residential sites. These have been shown to be successful in preventing landslides, but are also expensive. For example, pier walls require systematic maintenance which involves recurring costs, and eventually the wall will likely need to be replaced. Mount Adams provides another example of a structural wall (fig. 3.12). Shown is a specially designed retaining wall that cost about $30 million in the early 1980s and requires maintenance on a daily basis (Andrews, 2007). There are other technical solutions available for hillside mitigation depending on the particular region and conditions.

While technical solutions provide options for some sites, non-engineered solutions could provide similar effectiveness and require less maintenance and expense. Undisturbed vegetation acts as a natural erosion control and thus minimizes upkeep and expense. Adequate drainage is also critical for maintaining hillside stability; any activity, such as tree removal, can result in landslides by increasing the amount of water in an area which adds weight and higher pore pressure (Andrews, 2007). There are many approaches possible to minimize landslides but there is no one solution suitable for every site.

Figure 3.12 Retaining walls may be effective, but are costly and require continued maintenance.

Along with physical technical solutions, the Hillside study also explored the concept of policy alternatives. It is important to recognize that these policy alternatives are simply ideas to consider during further deliberation by community stakeholders. Ultimately the community needs to decide how to address and define the solutions appropriate for within Kenton County.

The first policy alternative concept examined the opportunities and constraints associated with the PRDAs shown in Figure 3.13. The mapped PRDAs coincide with the landslide susceptibility map in that the PRDAs and the areas rated highly susceptible to landslides overlap to create zones that could potentially be limited for development. Changing

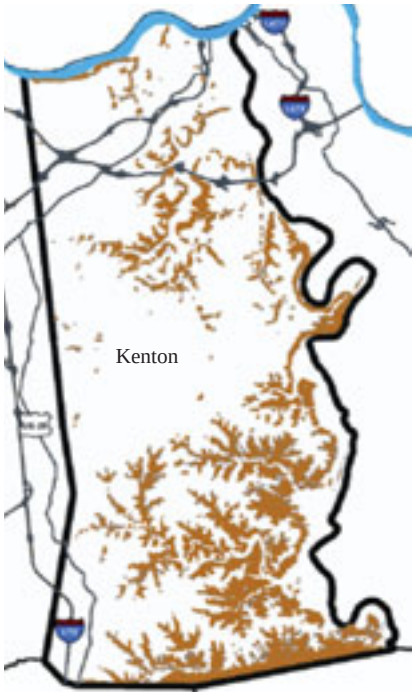


Figure 3.13 PRDA designated land for Kenton County, shown in brown.
Data source: Kentucky Geography Network

the development constraints in these areas could help prevent some challenges with construction and future hillside problems, especially in the areas where the Kope formation is present. Such development constraints also could help to conserve unsuitable development areas as green space. However, there is more work that needs to be done in the realm of policy changes and mapping techniques.

The Viewshed and Hillside Protection Overlay Zone or VP-O is an example of another policy alternative. This overlay zone was adopted in 2006 by the City of Covington, and is intended to protect and enhance Covington's unique natural heritage, as hillside areas are considered places of special character (Videkovich, 2008). Standards and guidelines that take into consideration the natural constraints of a site will result in a development that is sensitive to the environment; incorporates safeguards to maintain public health, safety, and general welfare; and minimize changes to the visual quality of the hillside (Videkovich, 2008). Figure 3.14 shows an example of the views that are considered important and worth protecting.

This overlay protection zone is ideal for the Northern Kentucky area and could potentially help with hillside development issues; however, a zoning map defining these areas does not yet exist. Under current policy, hillsides are not fully excluded from development. An area of future work would be to explore and/or modify the VP-O overlay of the City of Covington for use in others parts of Kenton County.

The hope is that guidelines such as these would assist in maintaining a level of balance in hillside development, and in preserving the beauty of the hillsides in this region for stakeholders. The use of GIS and field observations could be employedtoaccomplish the development of a conceptual map of a visual overlay.

Refer to Chapter 9 - Next Steps, for further discussion on potential policy approaches for addressing hillside development issues.

Figure 3.14 Hillside overlook atop Devou Park. Photograph: Northern Kentucy Area Planning Commission

4.1 What is a Precedent Study?

This chapter will focus on how researchers used past literature to develop new ideas to support an integration of hillside preservation and development techniques for the Northern Kentucky region. Preparation for new guidelines involved an analysis of case studies from different cities that have both hillside development and preservation issues similar to those in Northern Kentucky. "A case study is a well-documented and systematic examination of the process, decision-making, and outcomes of a project undertaken to inform future practice, policy, theory, and/or education" (Francis, 2001). The incorporation of a breadth of relevant literature addressing hillside issues regarding development and preservation supported research findings in the Hills Project. Learning from what others have previously accomplished or failed to accomplish is a potentially useful way of accumulating knowledge about guidelines and policy.

Ample hillside study data is available outside the realm of the Northern Kentucky region, and it is apparent that Kenton County is not alone when addressing hillside development issues. Robert Olshansky, Ph.D., is a Professor of Urban and Regional Planning at the University of California-Berkeley. He developed a study of 274 hillside plans and ordinances prepared by 190 different local governments. Precedent studies of these hillside areas, as well as Olshansky's article, "*Regulation of Hillside Development in the United States"* (1998), are good models for further hillside development guidelines.

The chosen precedent studies focused on nine jurisdictions in five states in order to pinpoint specific issues that directly relate to those in Kenton County. Guidelines written to address issues elsewhere may then serve to guide planners in Kenton County in an appropriate direction to develop and/or preserve the fragile hillsides in the region. These jurisdictions include Glendora, Pasadena, Los Angeles, and Los Gatos, CA; Colorado Springs, CO; Tucson, and Scottsdale, AZ; Pittsburgh, PA; and Cincinnati, OH. Each of these jurisdictions developed hillside guidelines to both preserve the natural character of the regional landscape and to encourage smart development using environmentally sensitive techniques so as not to harm the ecology or disturb the structural integrity of the earth below.

4.2 Methods for Collecting Data

There are a number of factors to consider when implementing hillside development and preservation strategies. Many of the model cities implemented regulation guidelines for reasons unique to their circumstances. Hillside development techniques vary according to each city's specific type of geology, soil, vegetation, climate, viewsheds, and community access. The team's research revealed that a city's most important reasons for implementation of hillside regulations were aesthetics, environmental issues, and potential hazards (Olshansky, 1998).

The initial step in the precedent study process was to gather case study data from each of the nine jurisdictions. Researchers then eliminated the irrelevant data by narrowing the development guidelines and standards only to include issues similar to those in Kenton County. "Standards are mandatory nondiscretionary regulations that must be followed [whereas] guidelines are discretionary. They are statements that present good ideas or recommendations on how to achieve the objectives established [by any hillside development document]" (Los Gatos, California, 2004).

Research for this study focused on Scottsdale, AZ, rather than the entire list of relevant metropolitan areas. Kenton County is a smaller part of the larger metropolitan area of Cincinnati, just as Scottsdale is a smaller component of the larger metropolitan area of Phoenix. The team's phone discussions with members of Scottsdale's city council revealed that it had a guideline implementation process most similar to that of Kenton County. Scottsdale required a comprehensive case study to formulate implementation strategies for hillside development to analyze the inventory data of this particular region properly. The *Citizen's Guide to Environmentally Sensitive Lands* (Scottsdale, Arizona, 2004) showed that Scottsdale closely resembled Kenton County in

physical restrictions such as steep slopes and sensitive lands. The Scottsdale city council drafted guidelines based on restrictive areas for development due to hazardous conditions. The county subsequently approved the necessary guidelines. Issues that most concerned local stakeholders in both Scottsdale and Kenton County were almost identical. Based on a comparison of Scottsdale's *Environmentally Sensitive Lands* ordinance document and the zoning ordinance documents for each of the cities within Kenton County, KY, both regions focused on aesthetics, geologic hazards, and community access.

As part of the discovery process, it was important to understand why these nine model jurisdictions needed to create hillside development guidelines. Olshansky identifies "aesthetics, natural phenomena geological hazards, health, safety, and general welfare" (Olshansky, 1998, p. 388) as issues most relevant to hillside development, and thus recognizes that it was necessary to highlight issues related to environmental, aesthetic, and/or potential hazards like landslides or floods. Based on Olshanksy's research, the Hills Project determined the most important factors for development and/or preservation were those that each of the jurisdictions of study recognizes as the common issues.

After analyzing case studies and taking inventory of legal documents from regions with similar concerns, reasons for implementation of hillside guidelines begin to emerge. Cities like Los Angeles created guidelines that do not serve as official regulations, "Rather they can help to guide proposals within the broad range of authorized designs so that projects will serve the public interest through rational, safe, and environmentally sound hillside development" (County of Los Angeles, California, 1979).

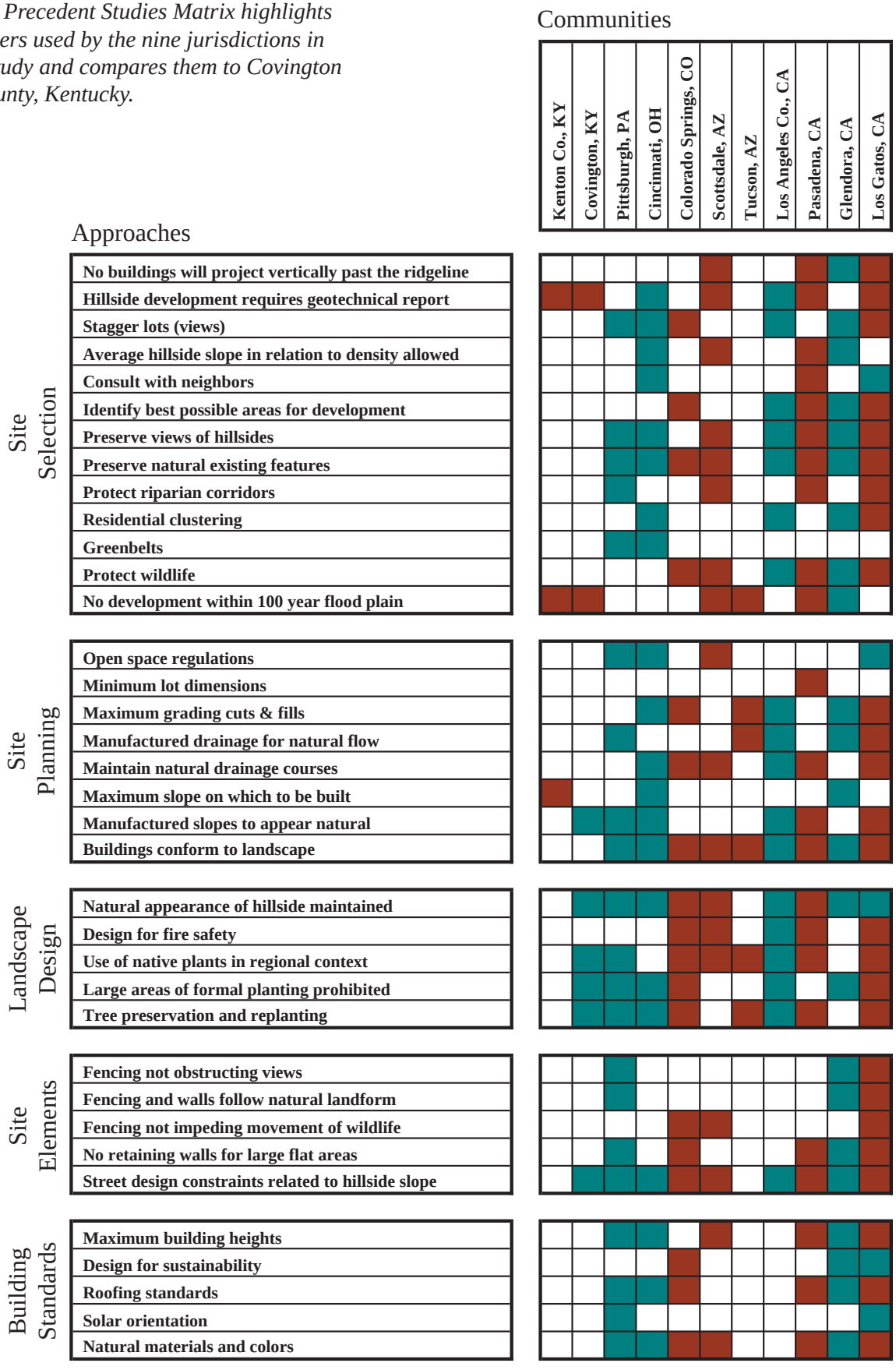
How people use land is of particular importance considering the negative ramifications of some hillside practices. Gathered geographic and statistical data help to aid in the decision process about what types of development are or are not appropriate for specific types of soils, geology, slopes, and ecosystems. Therefore, issues of sustainability, as well as the health, safety, and welfare of citizens, are critically important. Kenton County addresses these issues in its comprehensive plan as mandated by the Commonwealth of Kentucky in KRS 100 (Kentucky Revised Statutes). KRS 100 requires each county to establish a comprehensive plan that undergoes a revision every five years. This comprehensive plan can serve as a starting point for Kenton County as it drafts guidelines or regulations for hillside development. Other tools used to carry out land use visions for a city or county include zoning ordinances, subdivision regulations, or land use documents such as those shown in Figure 4.1.

4.3 Data Synthesis and Development of a Matrix

The comprehensive plan can guide a city or county in the development and implementation of zones to demarcate different land uses. These zones may then be broken down further into subdivisions in which each may establish their own development parameters. It is important to look at each of the precendent studies' techniques to understand the reasons for development guidelines. The Hills Project team outlined five broad categories of implementation techniques based on the Town of Los Gatos Hillside Development Standards and Guidelines: site selection, site planning, landscape design, site elements, and architectural regulations. The team used these techniques to form a matrix (Steiner et al., 2000) to determine each jurisdiction's frequency of use for each of the various strategies (fig. 4.2).

Figure 4.1 Zoning ordinances, subdivision regulations, and land use documents all guide precedent research.

Figure 4.2 The Precedent Studies Matrix highlights design paramaters used by the nine jurisdictions in the precedent study and compares them to Covington and Kenton County, Kentucky.



The highlighted boxes in the matrix show the frequency of each technique. The matrix also helps determine which techniques have the higher priority for implementation into a guidelines or standards document. The results of the matrix indicate "buildings must conform to landscape" is the only design guideline consistent to each of the jurisdictions of study. The Hills Project research showed that a city's hillside guidelines pertain to the specific issues of the area, so there are variances in the results of the study among different types of landscapes across the nine jurisdictions.

4.4 Ideas for Recommendations

Recommendations in the Hills Project for comprehensive hillside development guidelines evolved from the combined statistical analysis of the stakeholder input, case study data, and the data provided by the matrix. These recommendations may serve both the public as well as the professionals who will proceed with the future planning of the hillsides and the region as a whole. Because it is so important to create standards for hillside development, Kenton County could benefit by considering the guidelines adopted by the town of Los Gatos, CA. In their comprehensive document, Los Gatos considered a broad range of design goals and outlined a clear systematic guide for the design process. With Los Gatos as a model, Kenton County should develop a more comprehensive document for hillside development. This document should include a vision statement based on the stakeholder survey results that indicated the five guidelines (site selection, site planning, landscape design, site elements, and architectural regulations) that citizens rated as the most valuable to hillside development. These five guidelines should be a top priority for new design considerations in the county. In addition, the structure of the new document should include sections that focus on the design parameters listed in the matrix; specifically site selection, site planning, landscape design, site elements, and architectural regulations.

Stakeholder input should help determine what type of development would be acceptable. New guidelines for hillside development should focus on the research findings highlighted in the matrix. Kenton County should also take a closer look at those design guidelines that recurred frequently across the areas of research.

The research areas offer a better understanding of possible practices in terms of hillside planning. Kenton County should consider the guidelines adopted by these precedent examples to help guide comprehensive land use planning decisions.

5.1 Identifying the Areas

To begin the exploration of potential development ideas for Kenton County, the Hills team presented a wide range of ideas in order to gain stakeholder feedback on how future development should occur. Through this process, the team developed an understanding of stakeholder preferences which was critical to shaping the team's ideas for future recommendations.

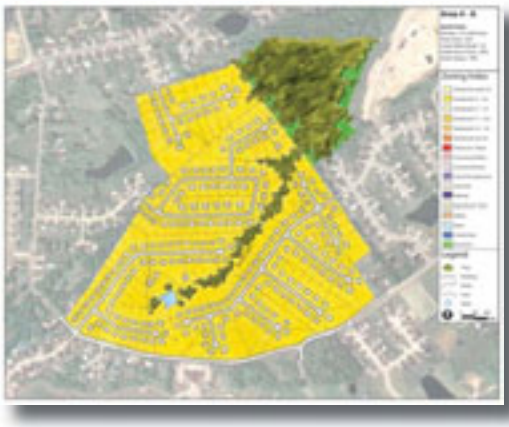
At the first of the three public meetings, stakeholders were asked to identify locations in the county they felt were important to focus on. This was accomplished through a sticker-map exercise, which asked participants to place yellow stickers on a large Kenton County aerial map of the places they would like to see changed and blue stickers on places they would like to see preserved (fig. 5.1). From the compiled sticker data, the team selected six locations for further development within the county: two urban areas, two suburban areas, and two rural areas (fig 5.2). For each of the six areas identified, the Hills Project team prepared four design concepts to represent potential future development scenarios (fig. 5.3). The purpose here was to represent a wide range of potential development possibilities and elicit feedback from the stakeholders concerning their likes and dislikes.

5.2 Gaining Stakeholder Input

In total, there were 24 designs, all of which were presented at Meeting Two (Appendix 10.2). The designs were accompanied by an aerial image of the site as identified at Meeting One, along with a map displaying any underlying Kope formation and PRDA land within the area. Participants were asked to evaluate each of the designs according to the approach taken as well as on the overall design,

Figure 5.1 Compiled Kenton County sticker-map from Meeting One participants.

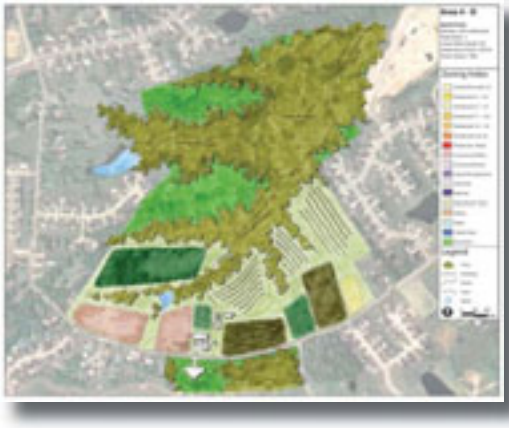
Figure 5.2 Six areas were chosen for development of design concepts.



Concept A
Higher density

Concept B
Lower density

Concept C
LEED-based



Concept D
Preservation

Figure 5.3 Four design concepts created for area 4.

filling out their responses on the provided worksheet (fig. 5.4). However, what the team did not reveal at Meeting Two was that each of the four designs (A, B, C, and D) for each site was based on the following underlying themes: (A) Higher density, (B) Lower density, (C) Leadership in Energy and Environmental Design [LEED]-based, and (D) Preservation. These four themes were used as idea generators by the design team and helped to create a consistent approach to design across the six areas. The purpose of this "blind" evaluation was to get an honest, unbiased response from stakeholders as to how they felt about each type of development. These themes were equally applied across all of the six areas and displayed in the same order (unlabeled) so that an accurate measure could be taken of the participant's response to each theme.

Figure 5.4 Participants during Meeting Two evaluating the preliminary design concepts.

5.3 Preliminary Stakeholder Reactions

After tabulating the results from the participant worksheets from Meeting Two, it was found that stakeholders most preferred the preservation-based theme (concept D) for all sites (fig. 5.5). These designs were created to leave as much of the site undeveloped as possible, and heavily emphasized the protection and/or restoration of sensitive natural areas. Rated second highest was the LEED-based theme (concept C); more specifically, this refers to LEED for Neighborhood Development, one of several programs created by the U.S. Green Building Council to promote more efficient and

sustainable forms of development. These concepts utilized principles of smart growth, new urbanism, and environmental responsibility in each design. Rated third was the lower-density theme (concept B), which applied development across the site at relatively low densities as according to the current zoning of each area. Rated the least preferred for all sites was the higher-density theme (concept A). However, for the two rural sites (areas 5 and 6 on fig. 5.2) the same overall hierarchy did not hold true. After preservation, the lower-density model received the second highest rating and the LEED-based model received the third highest rating. Perhaps these data reveal that stakeholders feel differently about land uses depending on where development is located in the county (rural vs. urban).

5.4 Interpretation of the Initial Results

While the team did gather valuable quantitative data from the participants at Meeting Two, this exercise was primarily an initial feedback session to give direction to the team. The designs presented at Meeting Two were essentially sketch ideas intended to elicit discussion about the impact of future development upon the hills and the surrounding landscape. Actual site-scale base maps were not used and would be beyond the purpose and scope of this project. That being said, stakeholders' qualitative responses were typically anecdotal, including comments about backyard slippage, excessive runoff from uphill areas, and structural movement in the foundations of homes. But overall, feedback from this 'pre-evaluation' activity illustrated that the participants are actually very perceptive judges about what is going on in the landscape. Without the thematic labels on each of the design concepts, stakeholders were able to grasp the underlying principles of each design in a consistent manner. The results are presented in Figure 5.5. In general, preservation of the county's lands was among the Meeting Two participants' top priorities, but if development were to occur, the question then becomes what kind of development is most suitable and where should it be located?

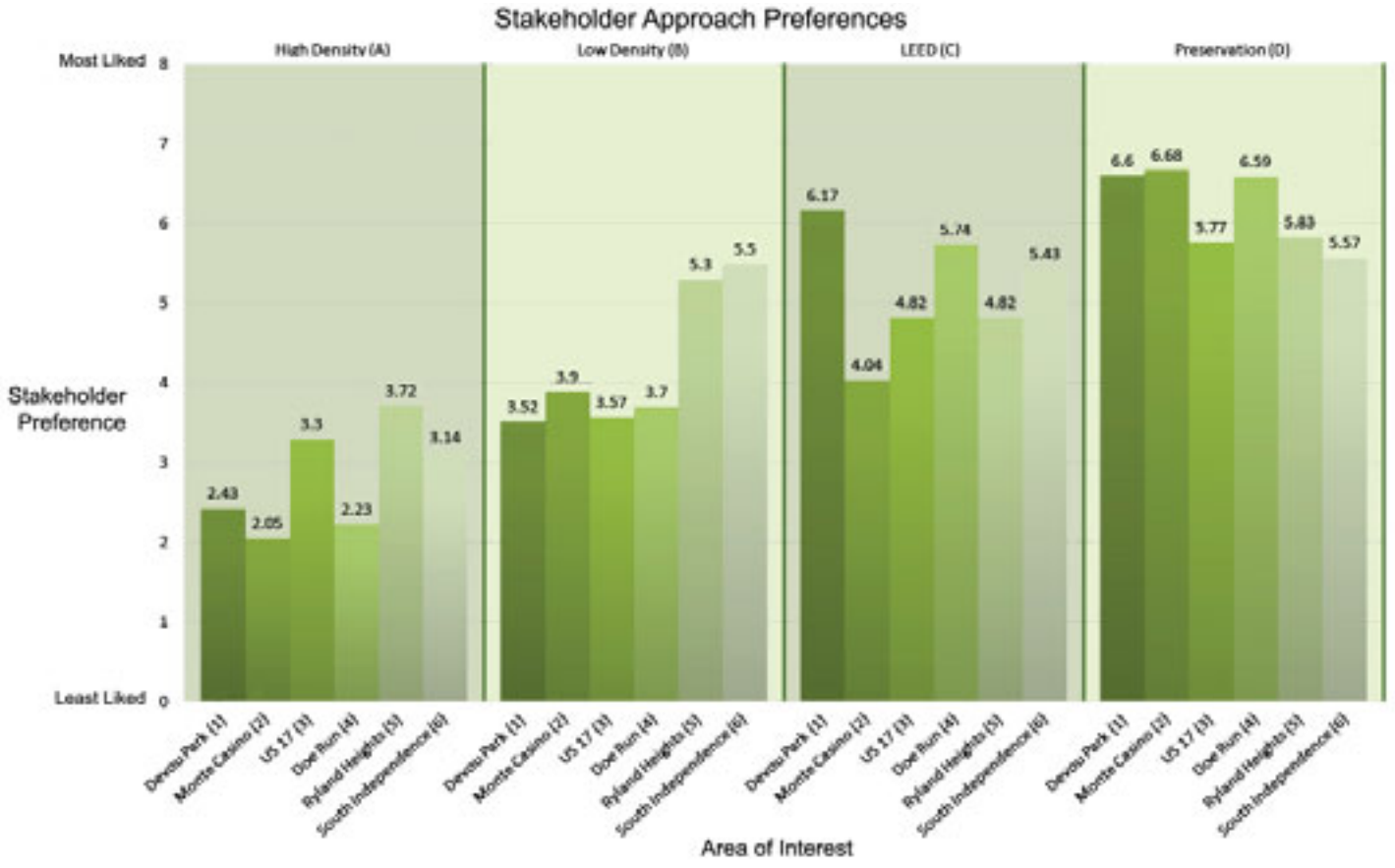


Figure 5.5 Results from preliminary evaluation completed at Meeting Two.

If development were to continue under the current trends and regulations, it could be argued that the most likely form to occur would very closely resemble that of the two lowest-rated designs. Based on the initial stakeholder input, it seems clear that stakeholders prefer a more intelligent approach to development through their preference toward LEED-based design strategies. However, there is currently no framework or incentive to provide smart growth opportunities in Kenton County or assist developers in achieving better designs.

5.5 Further Evaluation

While the stakeholder input gathered from Meeting Two was helpful, the team found it necessary to explore multiple evaluation frameworks for each of the design strategies. This approach allowed a quantitative analysis of each design across a wide range of perspectives, yielding a more comprehensive assessment of a given development.

LEED Rating System

The U.S. Green Building Council's LEED for Neighborhood Development (Pilot Version) rating system is used as a third-party assessment to verify that a development meets accepted high levels of environmentally responsible and sustainable development. Unlike other LEED products that focus primarily on green building practices, LEED for Neighborhood Development places emphasis on the design elements that bring buildings together into a neighborhood, and relates that neighborhood to its larger region and landscape (U.S. Green Building Council, 2007). The rating system is setup as a checklist of prerequisites and individual credits whereby a project's achievement of each credit contributes to the project's point total. Out of a possible 106 points, a project must earn at least 40 to become LEED certified. Additional points yield silver (50-59), gold (60-79) and platinum (80-106) certification status (fig. 5.6).

Figure 5.6 The LEED rating system is designed to certify exemplary development projects in terms of smart growth, new urbanism, and green building.
Image source: U.S Green Building Council
http://www.usgbc.org

Hasse Evaluation Method

Sprawl is a form of unchecked development extending out of the urbanized area and into the surrounding rural countryside. It is often associated with negative outcomes such as increased pollution, traffic congestion, loss of farmland, and loss of wildlife habitat (Hasse, 2004). The term smart growth, on the contrary, has been widely promoted to characterize compact patterns of development that do not embody the negative characteristics of sprawl (Hasse, 2004). In a sense, smart growth proclaims to be the antithesis of sprawl. However, it is often difficult to discuss the degree to which a particular development is actually sprawling or growing "smartly" due to the subjective nature of the two terms. It is for this reason that Hasse developed this evaluation method to provide a standardized means of objectively quantifying the characteristics of sprawl.

The Hasse evaluation method rates each concept based on a continuum between sprawl and smart growth (Hasse, 2004). Dr. John Hasse, Assistant Professor of Geography at Rowan University, published this method in *Landscape Journal* (2004) under the title, *"A Geospatial Approach to Measuring New Development Tracts for Characteristics of Sprawl."* The evaluation uses a set of geospatial indicators, such as average land consumption per unit, average impervious area per unit, and average distance to important community nodes, to analyze development tracts for characteristics of sprawl.

The team modified Hasse's approach and used nine geospatial indicators. The three geospatial indicators omitted from the study were regional planning inconsistency, land resource consumption, and growth trajectory. These were excluded from the evaluation for several reasons: the design concepts were too conceptual in nature to obtain the needed information, they did not have any measurable data for the category, or there was no measurable difference in data between the four concepts for a given site.

The team developed a set of numerical scales to quantify the data gathered from each indicator (Appendix 10.4). These scales allowed the team to accumulate a numerical score for each design concept. Positive scores meant that the development had more smart growth characteristics, while negative scores meant the development had more sprawling characteristics.

5.6 Evaluation Worksheet

After Meeting Two, stakeholder comments were incorporated into the designs and refined where possible. In preparation for the third stakeholder meeting, each of the 24 design concepts was evaluated by both the LEED for Neighborhood Development rating system and the modified Hasse evaluation method (fig. 5.7). Each concept was then rendered using a three-dimensional modeling program (VUE6 by E-ON software) to help better illustrate the potential impact of each design upon the Kenton County landscape. These concepts were displayed at Meeting Three in a public participation worksheet, which was printed on 24x24 inch photo paper and provided to each participant (fig. 5.8). The score for each evaluation method was displayed in the top right corner of each 3-D concept image, and buildings within each model were color-coded according to the Kenton County zoning map index for their associated land uses (fig. 5.9). The purpose of this worksheet was to see how stakeholder responses would change given the additional evaluation scores for comparison between designs and a more realistic representation of each potential site. Participants rated each concept on a scale ranging from 1 (dislike) to 7 (like).

5.7 Evaluation Worksheet Results

In general, the results from the Meeting Three public participation worksheet support the stakeholder

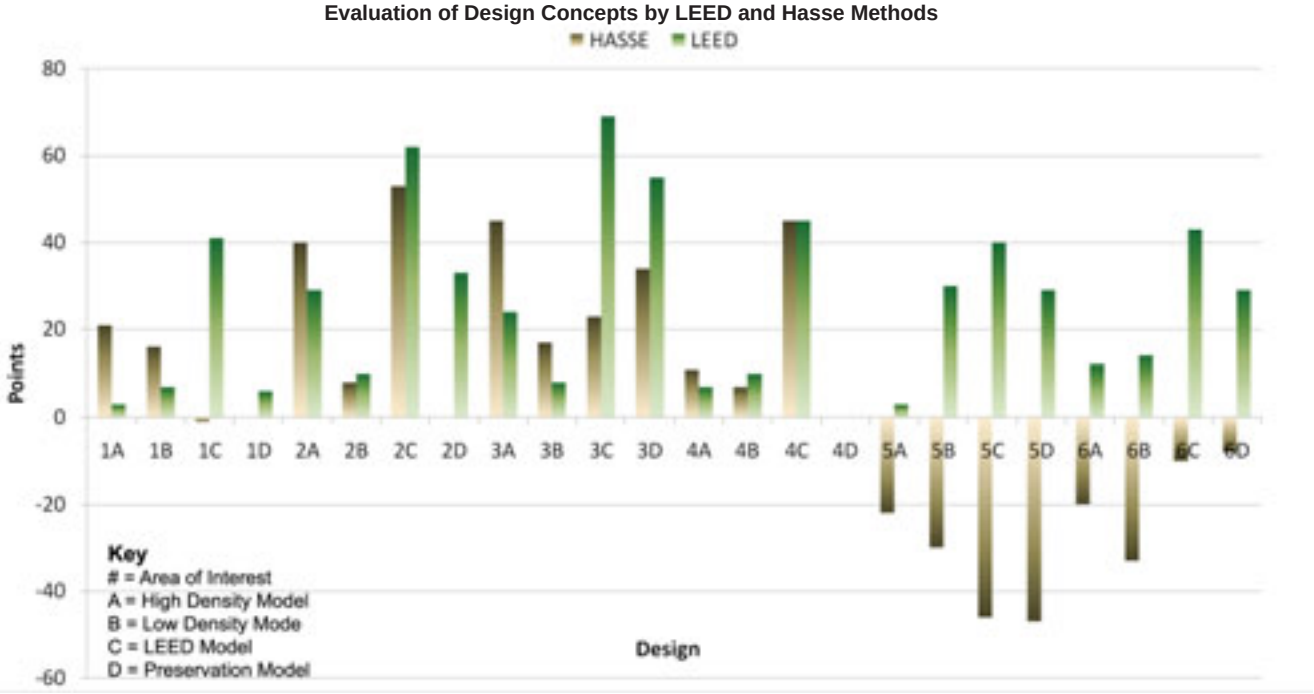
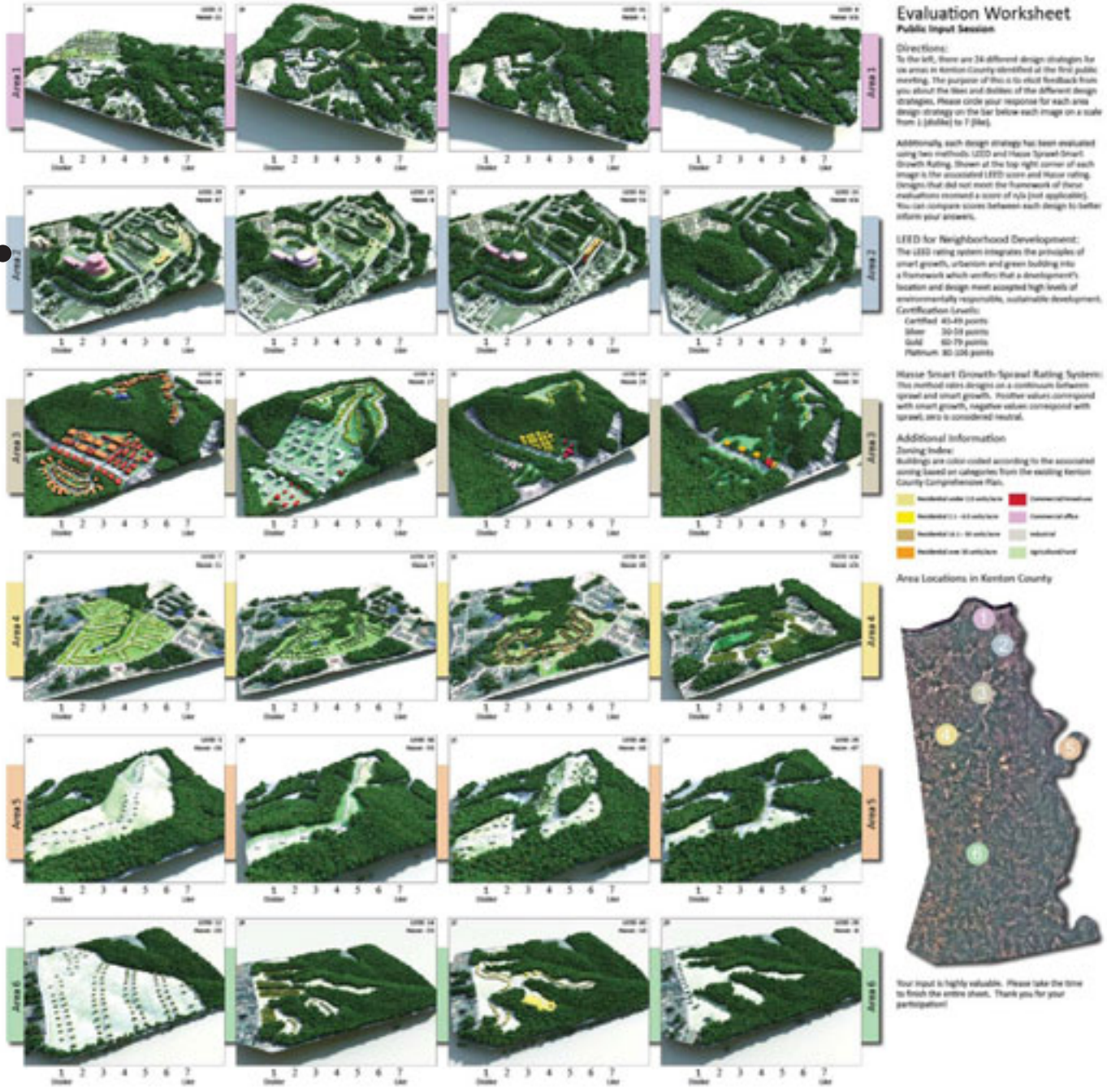


Figure 5.7 Results from Area of Interest Design Evaluations.

Figure 5.9 (left) Enlargement from worksheet of 3-D design concept (concept A, site 2) with evaluation scores and land use color coded to present a more realistic development model. A larger version of the worksheet can be found in Appendix 10.3.

Figure 5.8 (below) Public Participation Worksheet completed at Meeting Three. The worksheet included evaluation scores and asked participants to again rate each design concept for the six areas of interest.



responses from Meeting Two. Among the four themes (approaches) to each design, the preservation-based (D) concepts retained the highest rating, followed by the LEED-based (C) concepts. Once again, the two lowest-rated designs were the lower-density (B) and higher-density (A) concepts, with higher-density least preferred (fig. 5.10). The fact that the second stakeholder evaluation data closely matches that of the first evaluation suggests that the participants have responded in a consistent manner, helping to ensure the validity of the stakeholders' responses.

While these general trends are consistant with that of Meeting Two, a noted difference in stakeholder responses is that the level of preference between the LEED and preservation-based concepts had switched for sites 5 and 6. The LEED-based concepts were now rated higher than their respective preservation-based counterparts. While this change is somewhat minimal, perhaps it reflects an increasing preference among stakeholders for more conscientious growth forms, rather than opting for preservation-only concepts. A more detailed study of stakeholder preferences should be conducted to confirm the reasoning behind participants' choices on the worksheet as well as statistical significance.

A possible limitation of the data gathered from the Meeting Three worksheet is that despite the accompaniment of the LEED rating, Hasse score, and associated zoning index for each three-dimensional design concept, there is no measurable way for the team to study how, if at all, these additional evaluations and graphic representations affected stakeholder responses. Future studies would likely benefit from isolating each of these variables in order to accurately measure the participants' responses to each.

5.8 Ideas for Recommendations

The feedback generated from the design concepts shows that stakeholders generally favored preservation over development, but they were open to consideration of smart growth and LEED oriented developments. This is likely due to the guiding

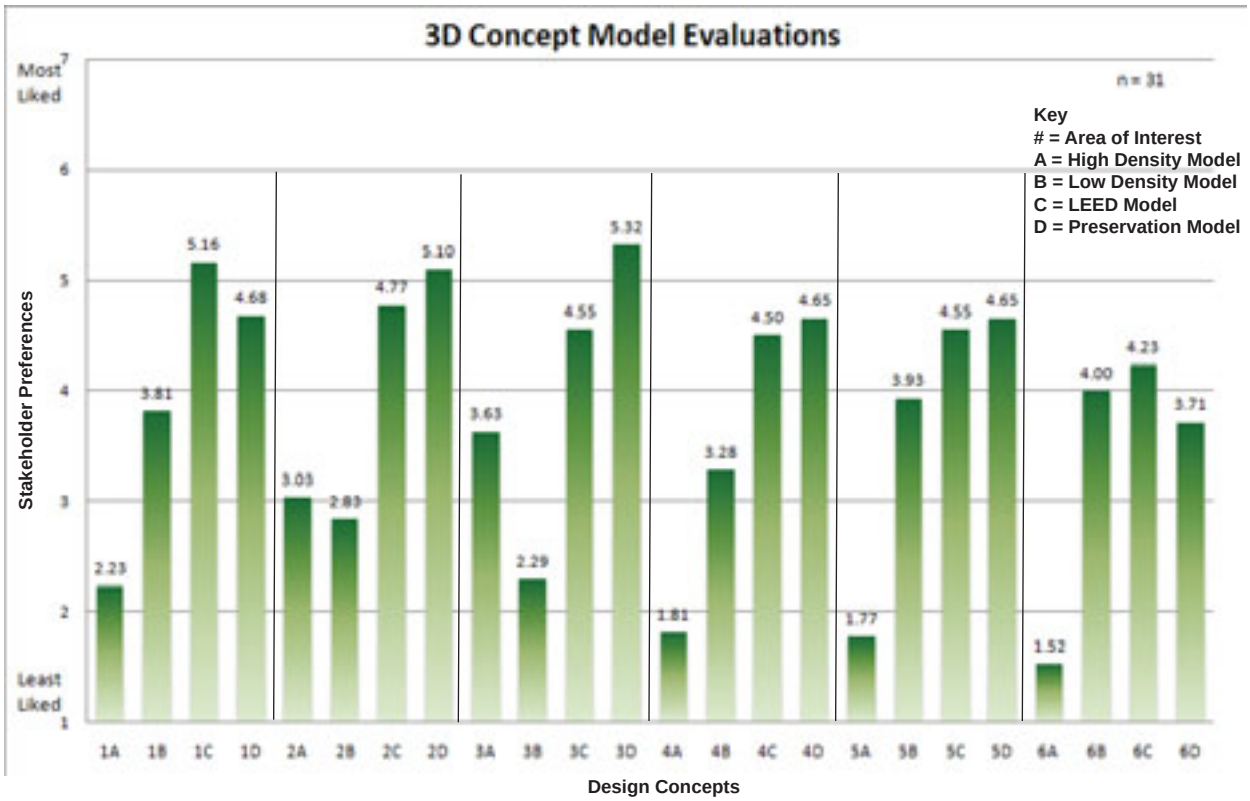


Figure 5.10 Stakeholder evaluations of 3-D concept models from Meeting Three.

principles of smart growth and LEED-oriented models that focused on site sensitive design, mixed-uses, compact development, preservation of valuable open space, and connectivity to the surrounding community. Realizing the stakeholders' preferences for design considerations such as these, a possible suggestion for all new development proposals would require an evaluation review of the proposed design using the LEED and/or Hasse frameworks. A benchmark could be used for an ideal community, requiring proposed development to meet standards in order to achieve the desired goal. In essence, each of these evaluation frameworks would rate the proposed developments and therefore allow the community to assess the appropriateness of a given development for future growth.

According to the Landscape Value Survey, a concern for agricultural preservation regarding the two rural sites was not preferred. During the first public meeting when stakeholders were asked, "What should be developed first among hillsides, flat forest land, or an agriculture field?" almost 3 out of 4 respondents chose an agriculture field. While these responses potentially were intended to preserve hillside lands, they may have inadvertently redirected development to rural areas. A possible remediation for this sprawl-promoting attitude would be to implement farmland and hillside preservation programs such as a purchase of development rights (PDR). This voluntary program allows landowners to sell only their development rights to a government/non-profit entity to hold in perpetuity while retaining title and all other rights to the land (American Farmland Trust, p.5). An effective example is the Lexington-Fayette Urban County Government's PDR program, established in 2000 as the first Agricultural Conservation Easement program by a local government in the Commonwealth of Kentucky (LFUCG, PDR, 2008). As of February 2008, the program has secured 182 properties totaling 20,789 acres (LFUCG, PDR, 2008). Additionally, Scott County implemented a PDR program in April 2008, presenting a case that this approach could be an emerging trend for communities wishing to protect their valuable lands.

To achieve a higher level of smart growth, the county should also consider infill development, which targets vacant or underutilized sites within already urbanized areas (fig. 5.11). This provides for a more efficient use of the county's valuable land resources. The stakeholder input survey showed that 42 out of 49 respondents would choose to revitalize an existing developed area over other options. While this land use decision is essentially an individual choice, infill development could nonetheless be encouraged through tax incentives that reward projects located on infill sites. This could be accomplished through a transfer of development rights (TDR) program. (See Section 9.2 Preservation Approaches for further details on TDR.) Essentially, this method would put the land into a conservation easement in trade for the rights to develop on infill sites. Additionally important is the need to map potential infill areas and consider the coordination of demolition efforts through city governments and private contractors.

Figure 5.11 The former Jillian's entertainment complex in dowtown Covington was a rehabilitation effort of the former Bavarian Brewery complex.

6.1 Rural to Urban Continuum

The six areas of interest delineated in the previous chapter are located within urban, suburban, and rural areas of Kenton County. Landscape typology is a way of characterizing a landscape based on a rural to urban continuum using density or other characteristics of the land. Interconnections within the landscape occur by different means, such as green infrastructure, watersheds, and hillsides, among other characteristics. Decisions made in rural areas may ultimately affect the urban areas within the landscape and vice versa.

If growth is considered inevitable, it is essential to determine where that growth is going to occur or should occur. Growth prevention in one area may lead to increased pressure to develop another area. For example, consider a balloon filled with air; if you squeeze one end of the balloon, the air inside shifts to the other end of the balloon. The air volume remains the same inside the balloon, but the pressure has displaced it to another area. Now think about each end of the balloon as a different landscape; as you squeeze development out of one area, pressure to develop is exerted on another area.

In *"Visualizing Density,"* Campoli and MacLean (2007) asked the question, "What characteristics make a certain area: urban, suburban, or rural?" In this study, the authors examined a variety of areas with similar densities but different development patterns and quantities of vegetation and open space. The authors deteremined these factors were ultimately the reasons why people perceived the landscape in the manner they did, rather than by density.

To better understand how the stakeholders perceive the rural, suburban and urban landscapes in the Hills Project study region, the Hills team conducted a Landscape Typology Survey. The goal of this exercise was not only to determine what were the stakeholders' typology perceptions, but also to discover which landscape elements they used to characterize the typologies.

Landscape Typology Survey

Similar to the method followed by Campoli and MacLean, the Hills Project team used aerial and birds-eye perspective photographs to illustrate a survey in which stakeholders were asked to express their preference regarding types of development patterns, amount of vegetation, types of structures, and building layouts for the three typology categories.

Photographs of rural and suburban landscapes were used from Kenton County, as well as from areas with similar densities in Stapleton, CO; Mariemont, OH; and Edinburg, NJ. Photographs of urban landscapes were used from Seattle, WA; New York City, NY; and Irvine, CA; but not from Kenton County due to the lack of high-density development.

Stakeholders viewed the photographs and were asked, "In what context would you place this area?" The context scale ranged from 1-8 with 1 and 2 being rural; 3 and 4 being exurban; 5 and 6 being suburban; and 7 and 8 being urban. In Figure 6.1 are examples of images from the Landscape Typology Survey. Figure 6.2 shows the mean results of the survey.

6.2 Spatial Organization & Density Visual Preferences

Visual Preference Survey

To produce the Spatial Organization and Density Visual Preference Survey, the team grouped the same photographs used in the typology survey into three categories based on the density or number of housing units per acre. Each density category was represented by pairs of photographs from three different areas, each exhibiting different development patterns and amounts of vegetation (fig. 6.3). The survey then asked the stakeholders the question, "Which pair of images is most visually pleasing?"

After the survey a small group discussion session took place and the stakeholders further explained their reasoning and the characteristics that influenced their rankings. Examples of the characteristics were high or low amounts of vegetation, the high and low amount and spacing of structures, and grid systems versus

Figure 6.1 Examples of photographs used in the Landscape Typology Survey to determine stakeholders' perceptions of the rural-urban continuum context. These photographs are of the same site during different seasons and from different points of view.
Photographs: maps.live.com

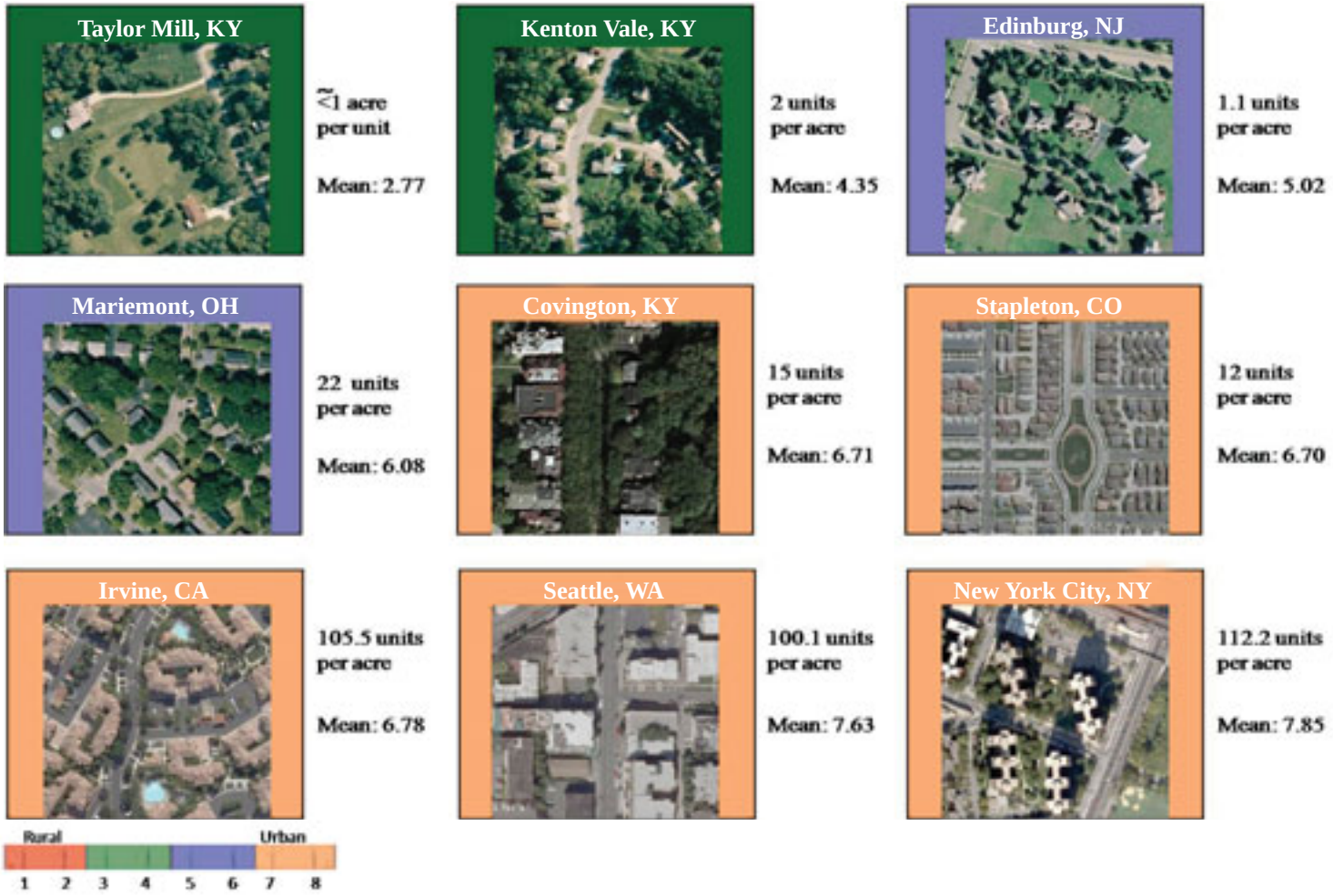


Figure 6.2 Landscape Typology Survey - Rural to Urban survey results - Mean. *Photographs: maps.live.com*

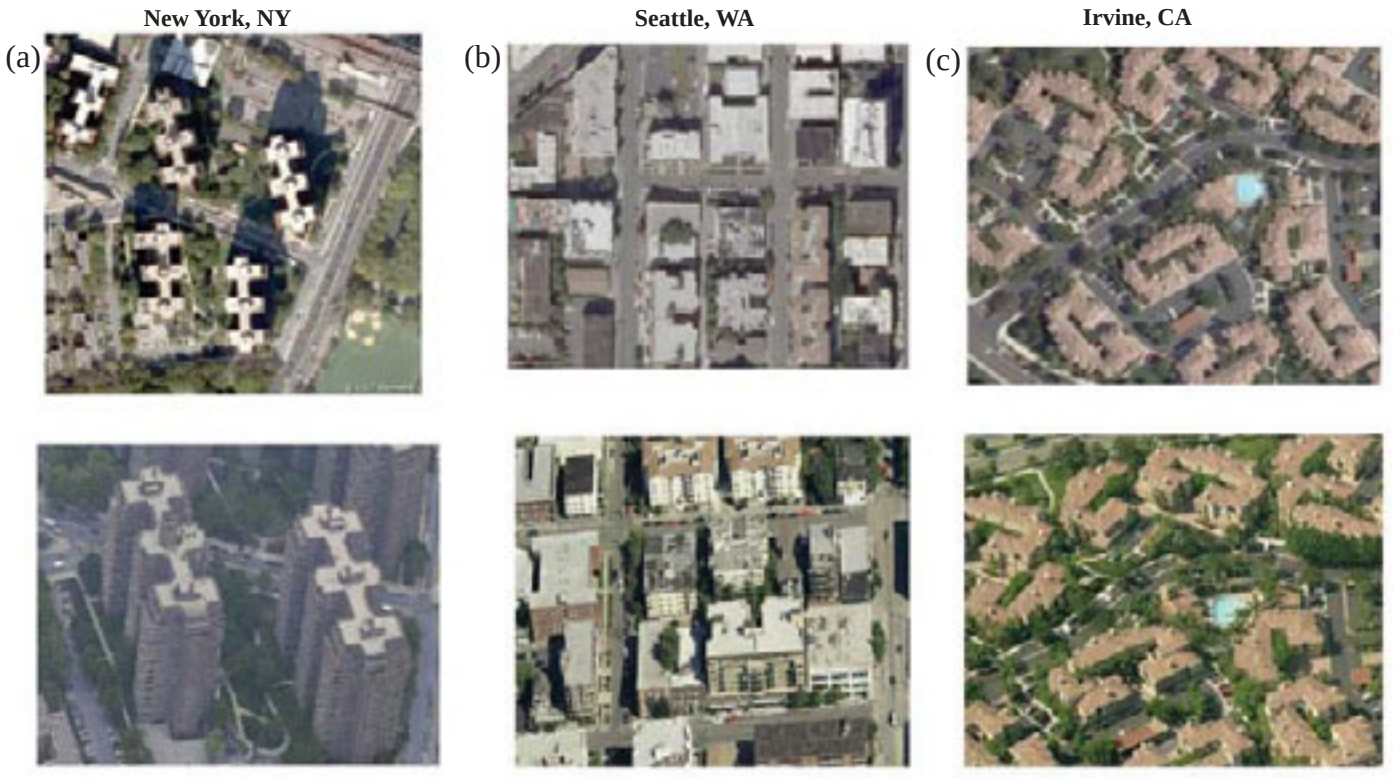


Figure 6.3 Example of "urban" paired photographs used in the Spatial Organization and Density Visual Preference Survey to determine stakeholders' preferences regarding density organization. Photographs: maps.live.com

free forming street systems. This information was useful to understand the stakeholder's perception of the landscape and to understand which characteristics they associated with certain landscape typologies.

Figures 6.4-6.6 show the results from the second part of the survey, which divided areas into three different categories based on density of housing units per acre. Mean scores reflected these results. The low-density category (fig. 6.4) of 0-11.1 units per acre consisted of Taylor Mill, KY; Kenton Vale, KY; and Edinburg, NJ. The stakeholders preferred the Taylor Mill, KY, area based on the high amount of vegetation and green space. Similarly, if there was more established vegetation, they would also likely enjoy Edinburg, NJ, because of the curvilinear street system and free-flowing sidewalks.

Within the medium density category (fig. 6.5) of 11.2-100 units per acre, the survey presented Stapleton, CO; Covington, KY; and Mariemont, OH. Stakeholders preferred Covington, KY, based on the high amount of vegetation and the balance between the built-environment and green space. Many stakeholders in Kenton County, as do people in many other places, have a negative perception of density. "Many people view density as a threat, believing that it leads to sinking property values, rising crime, and traffic congestion" (Campoli & MacLean, 2007, p. 11). Based on the results from the Spatial Organization and Density Visual Preference Survey, stakeholders of Kenton County liked certain forms produced by high density. According to Campoli and MacLean (p. 12), human perception of density is important to consider in design although units/acre may not be the way to measure density preference.

The high-density category (fig. 6.6) focused on Irvine, CA; Seattle, WA; and New York, NY. The stakeholders preferred Irvine, CA, based on the large amount of open space. The stakeholders also preferred the meandering sidewalks and curvilinear roads within the Irvine, CA, area. This is in keeping with Campoli and MacLean (p. 36) who found that

the form of a particular landscape element (i.e., building coverage, diversity of greenery, quality of public/private space) dictates whether a place feels cramped or spacious.

The results showed that the community would rather see a more organic free-form street system with building layouts spaced further apart within a higher urban density. Stakeholders also prefer more open green space between built structures. According to the survey, the Kenton County stakeholders did not disapprove or dislike high density but would rather see the density designed differently. The physical form of buildings and streets within the context of open space affects the perception of density.

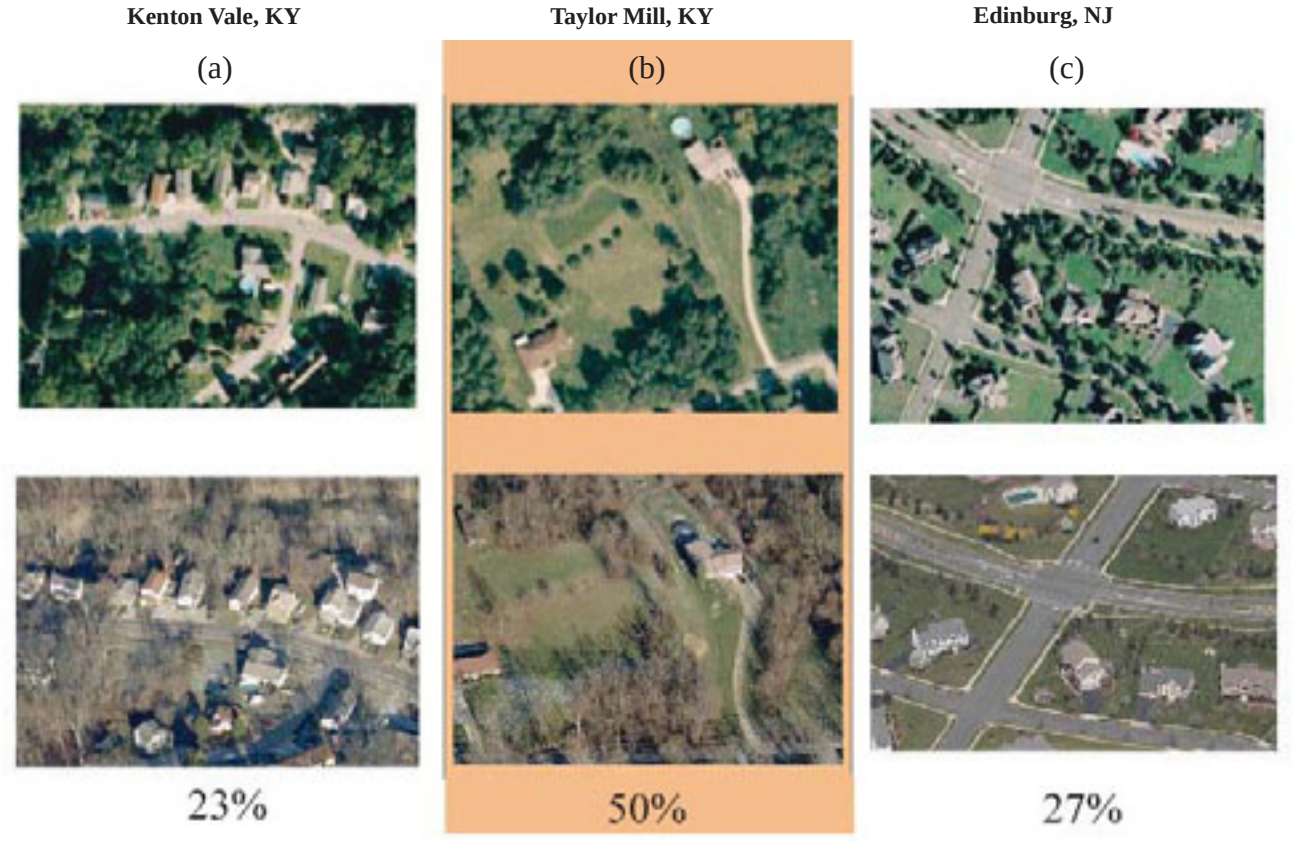


Figure 6.4 Spatial Organization rural preferences - Low Density. Photographs: maps.live.com

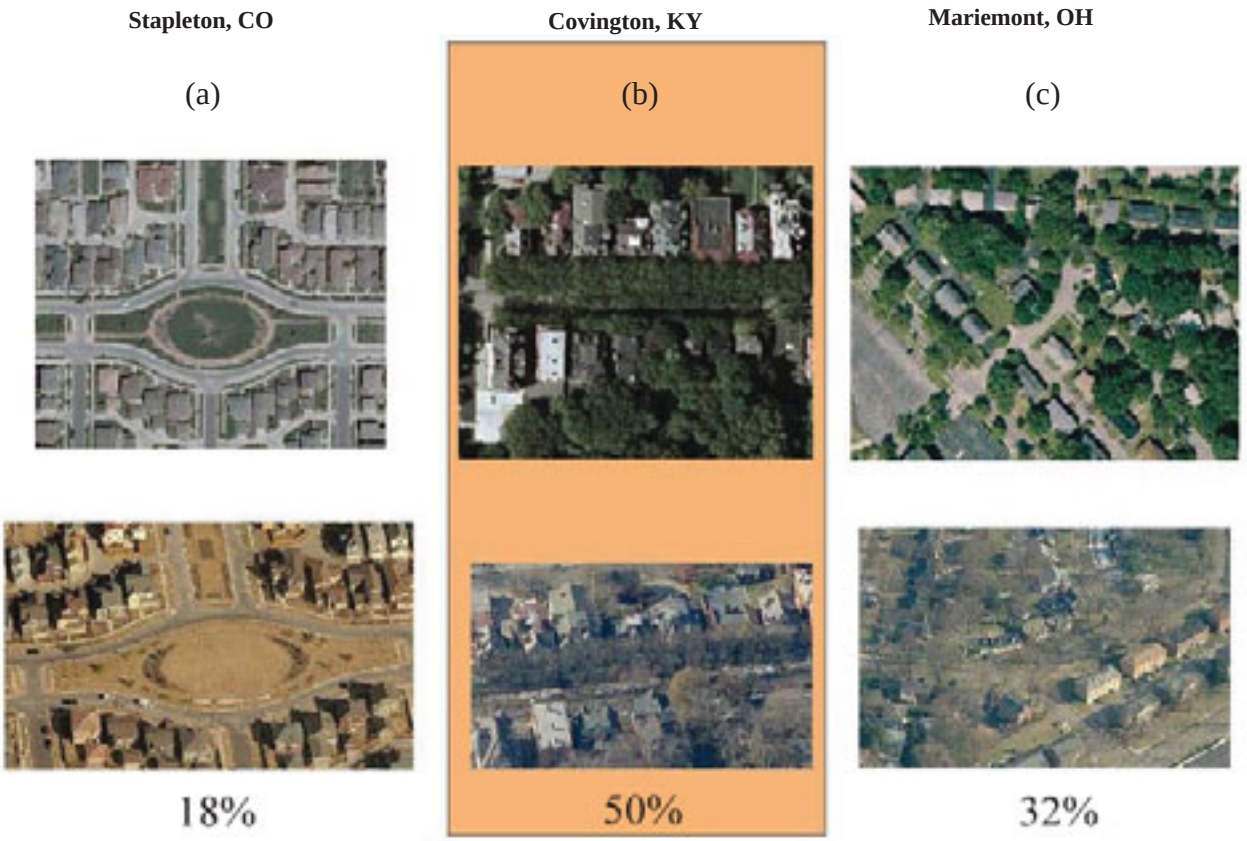


Figure 6.5 Spatial Organization suburban preferences - Medium Density. *Photographs: maps.live.com*

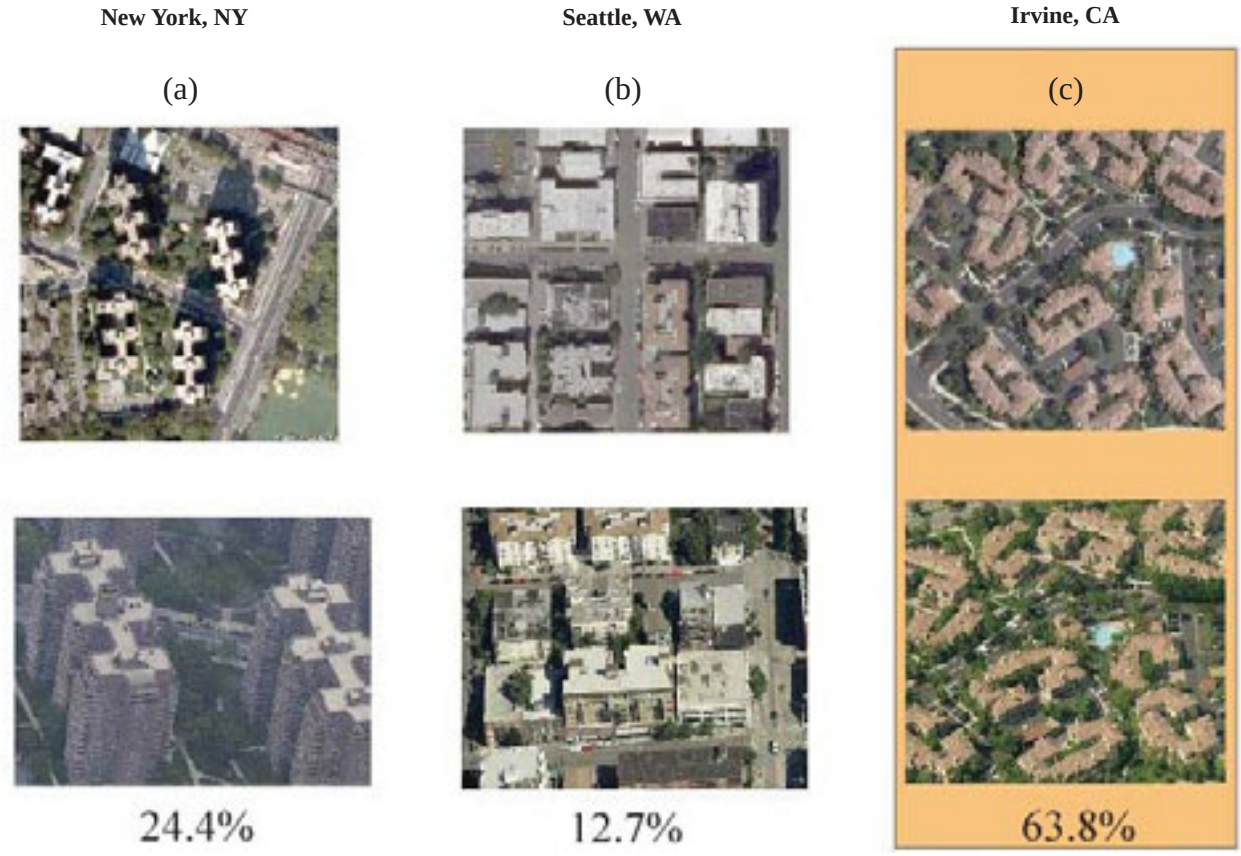


Figure 6.6 Spatial Organization urban preferences - High Density. *Photographs: maps.live.com*

6.3 Ideas for Recommendations

There are three primary ways to address the ideas presented in this chapter based on the limited data collected during this study. The first is to provide green space by developing up not out. The second is that sidewalks should meander and take on a form of their own, rather than be parallel to streets. The third is to use alternative structures to surface parking lots, such as a "tuck under" where parking is placed partially under a building (fig. 6.7), an internal structure where parking is placed to the interior of a development block (fig. 6.8), or a partial or completely underground structure to provide space for green areas or outdoor recreation (fig. 6.9).

Figure 6.7 An example of a "tuck under" parking lot (highlighted in red) where parking is placed partially under a building.
Photograph: maps.live.com

Figure 6.8 An example of an internal parking structure (highlighted in red) where parking is placed to the interior of a development block.
Photograph: maps.live.com

Figure 6.9 An example of a partial or completely underground parking structure (highlighted in red) to provide space for green areas.

7.1 What is Green Infrastructure?

The Environmental Protection Agency classifies green infrastructure as an "approach to wet weather management that is cost-effective, sustainable, and environmentally friendly." Green infrastructure protects ecologically sensitive areas so that communities can improve water quality while providing wildlife habitat and opportunities for outdoor recreation. It is a system that includes a network of connected parks, trails, sidewalks and boulevards, riparian corridors, farmland, woodland, undeveloped land and preserved hillsides (U.S. Environmental Protection Agency, 2008).

To achieve a desirable and convincing green landscape plan for Kenton County, it was essential to research other successful green infrastructure networks in the United States. The Hills Project team used a case study approach to compile information about existing systems. Noted urban landscape architect, Mark Francis, identifies Frederick Law Olmstead's Emerald Necklace in Boston, MA, as an excellent example of a park system that continues to provide a valuable asset to the city since its completion in 1896.

According to Francis, the significant elements to document in a case study include the time frame of the project's design and construction, its size, and the assets it provides to the surrounding area (Francis, 2001). Analysis of the Boston area, in addition to examples in Warren County, Louisville, and Lexington, KY, led to the development of a sound green landscape plan based on the needs and interests of Kenton County stakeholders. Figures 7.1 and 7.2 depict examples of the compiled information from case studies explored during the Hills Project.

7.2 Issues Facing Northern Kentucky

Kenton County is at a critical juncture as it plans for the ways in which the area will embrace its natural resources and open spaces to achieve the ideals set forth in Kenton County's *Comprehensive Plan Update 2006-2026*. The county's stakeholders have

Project Name:	Boston's Emerald Necklace Park System
Location:	Boston Common, Public Garden, Commonwealth Avn. Mall, Back Bay Fens, Riverway, Olmsted Park, Jamaica Pond, Arnold Arboretum, Franklin Park
Construction Completed:	1878 - 1896
Size:	1,100 acres comprised of nine parks, parkways, and waterways
Landscape Architect(s):	Fredrick Law Olmsted and Associates
Client/Developer	Boston Park Commisioners
Managed By:	Boston Park Dept.

Figure 7.1 Case study - Park System, Boston, MA

Project Name:	Louisville Park System
Location:	City of Louisville (Shawnee, Cherokee and Iroquis parks as well as Eastern, Western, and Algonquin Parkways
Construction Completed:	1891 - 1906
Size:	14,000 acres
Landscape Architect(s):	Fredrick Law Olmsted and sons
Client/Developer	City of Louisville
Managed By:	Louisville City Parks Department and Louisville Olmsted Parks conservancy

Figure 7.2 Case study - Metro Park System, Louisville, KY

expressed the desire for a strong green infrastructure system and believe that such a system can improve the quality of life. With the growing popularity of outdoor activities and passive recreation, along with the rapid increase in development, the desire to preserve existing open spaces is becoming a larger concern for U.S. residents (Kline, 2005).

Kenton County's *Comprehensive Plan Update 2006-2026* proposes to improve connectivity, implement green infrastructure systems, encourage watershed protection, introduce new building methods and techniques, and improve the quality of existing forested areas and open spaces. The goal for the Hills Project is to develop a starting point for Kenton County that will aid in establishing a permanent green infrastructure system that would place the county at the forefront of planning in Northern Kentucky. Thus, Kenton County will serve as an example for others to follow within the region, the state, and the nation.

7.3 Design Vocabulary

Greenways provide three significant benefits to a community; they protect ecologically significant natural systems, provide people with extensive recreational opportunities in metropolitan and rural

regions, and create a sense of place with significant historical heritage and cultural values (Fabos, 2004). An important aspect in developing a greenway system is to understand the associated design vocabulary in order to fully realize the value and extent of these benefits. It is important to involve stakeholders throughout the planning process and understand their perceptions of what a greenway is, since greenways often encompass both government and privately owned lands (Fabos, 2004). Greenways are site specific and vary from site to site, typically defying an exact definition. However, classifying greenway types can be a way in which to inform the user of when they have entered a greenway.

It is an objective of this project to develop a comprehensive design vocabulary for describing the uses and facilities of a multi-purpose greenway. A design vocabulary not only can assist in describing a greenway, but also aid in wayfinding as various classifications and terms can help tell someone where they are in a landscape. This vocabulary is universal in greenway planning and is influential in the process of developing the greenway design concept for Northern Kentucky. In *Greenways for America*, Charles Little (1990) gives more insight on how to start classifying greenway types. He describes four greenway types: urban riverside or waterfront greenways; recreational greenways; scenic and historic routes; and ecologically significant natural corridors (figs 7.3-7.6). The following descriptions and diagrams of greenways are taken from Little's *Greenways in America* (Little, pp.4-5).

As research continued for the greenway vocabulary, the need for describing existing parks in Kenton County became evident. Kenton County's *Comprehensive Plan Update 2006-2026* utilized

Figure 7.3
***Urban riverside or waterfront greenways** are created as part of a redevelopment program along neglected or run down city waterfronts, providing restoration and green space in a dense urban setting (Little, p. 4).*

Figure 7.4
***Recreational green-ways** feature a variety of paths and trails based on natural corridors, canals, abandoned rail beds and other rights-of-way, providing playing fields and open space (Little, p. 5).*

Figure 7.5
***Scenic and historic routes** usually exist along a road, highway, or sometimes a waterway, with an effort to provide pedestrian access along the route (Little, p. 5).*

Figure 7.6
***Ecologically significant natural corridors** exist along rivers, streams, and ridgelines to provide for wildlife migration and species interchange, nature study, and hiking (Little, p. 5).*

the National Park and Recreation Association's guidelines for parks and greenways to classify park types in the region. The following classifications were organized based on the size of the park, service area of the park, the size of population the park serves, and the types of features found within the park (figs. 7.7-7.10). These park types help one locate where they are in the region, as well as begin to aid in identifying what parks exist or need to be developed in the area.

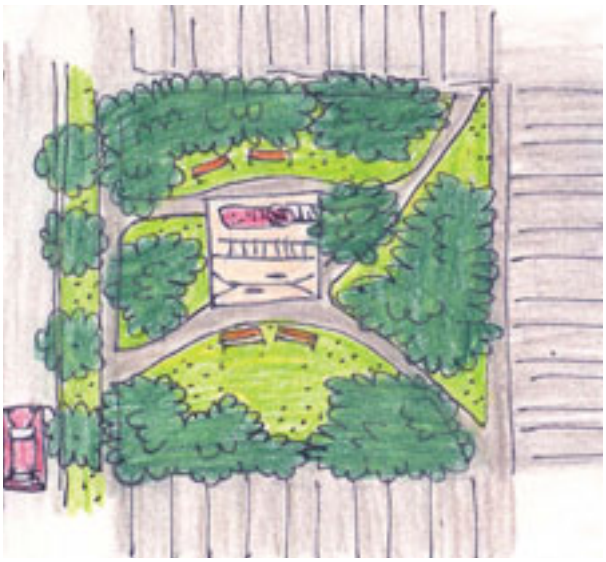


Figure 7.7 ***Mini parks*** *are approximately one acre in size and serve a 1/8 to a 1/2-mile radius, or half an acre per 1000 people. Typical features may include playgrounds, small multi-use areas and benches.*

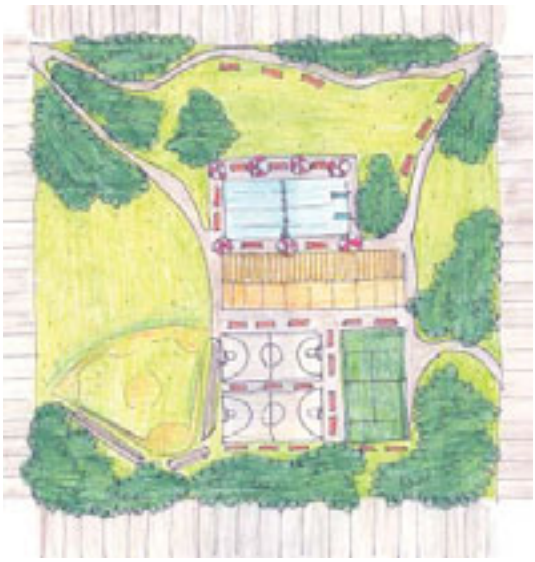


Figure 7.9 ***Community parks*** *are usually 25 to 50+ acres and serve a 1-2 miles radius, or 2.5 acres per 1000 people. Facilities include those of neighborhood parks along with swimming pools, sports complexes, community complexes, and possibly areas of natural quality.*

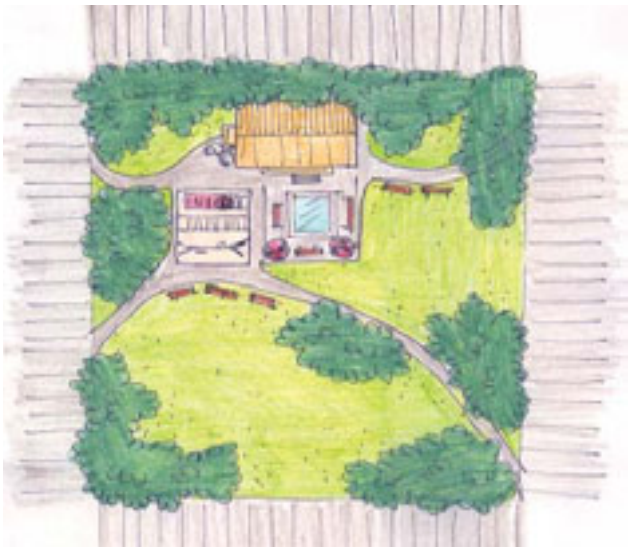


Figure 7.8 ***Neighborhood parks*** *are typically 5 to 15 acres and serve a 1/2 to 1-mile radius, or 2 acres per 1000 people. Facilities include playing fields, playground apparatus, small pools, neighborhood centers, drinking fountains, and restrooms.*

Figure 7.10 ***Linear parks*** *may vary in size according to landscape forms and necessity. They serve as connections to other parks in the region as well as provide locations for passive recreation.*

7.4 Benefits of Green Infrastructure

Greenways are especially important for a community because they "provide people with access to open spaces close to where they live, and link together the rural and urban spaces in the American landscape… threading through cities and countrysides like a giant circulation system" (Fabos, 2004) (fig. 7.11). The greenway concept proposed for Kenton County encompasses all of the desired benefits that the *Comprehensive Plan Update 2006-2026* puts forth as well as offers solutions to some of the key concerns facing the county. Greenways can benefit a community by providing recreation, preserving scenic views, fostering social equality, increasing property values, enhancing community amenities, and facilitating storm water management (Hellmund & Smith, 2006). The Hills Project team presented a variety of greenway types to the stakeholders during the public meetings in order to ascertain the most desirable types for the county.

According to Fabos (2004), there are three types of greenways: ecologically significant greenway corridors, recreational greenways, and greenways with historical and cultural values. Similar to other types of parks and natural areas, greenways can add to the landscape's aesthetic value by preserving views and habitats, such as those among the hillsides of Northern Kentucky (fig. 7.12). Greenways also have the potential to promote social justice and equality by providing accessible facilities for use by all people, regardless of age, social economic status, or physical ability (Hellmund & Smith, 2006).

Greenways are considered economic assets that may increase real estate values of adjacent properties. Though Kenton County lacks a study on the effects of green space on housing prices, one can assume that the county will follow the current national trend (fig. 7.13). Louisville Metro Parks states that property along park edges has been, and continues to be, of more value than property at a greater distance. "Since the creation of Waterfront Park more than $350 million has been invested in new housing, new attractions and new and expanded businesses in the area surrounding the park" (City of Louisville, 2006). A study by the Rocky Mountain Research Institute surveyed residents of Denver, CO, and found that the public had an increasing interest in greenways and trails and were willing to pay more for greenways to be in their neighborhood (American Trails, 2003). Another study near a park in Columbus, OH, determined that properties facing the park sold for between seven and twenty-three percent more than similar homes located a block away from the park (Weicher & Zerbst, 1973).

Figure 7.11 Bike and walking trails through residential neighborhoods provide connections to nature for the community. Photograph: maps.live.com

Figure 7.12 Scenery preservation is a specific concern for Kenton County.

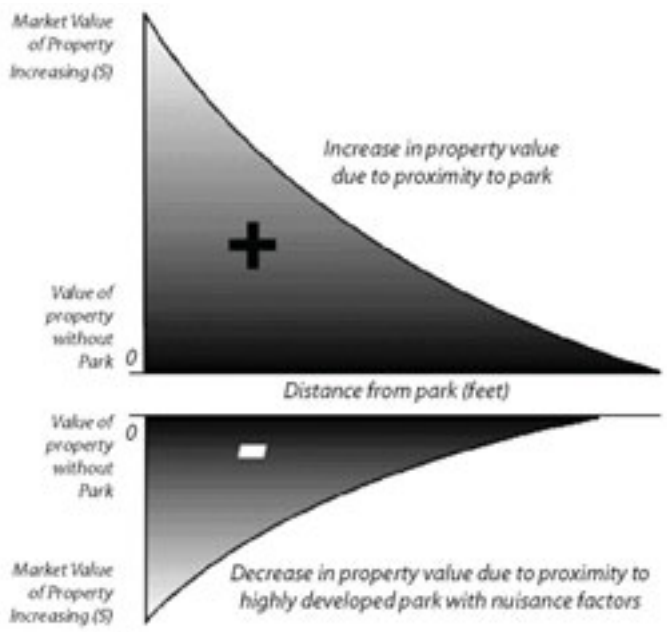


Figure 7.13 This chart illustrates how property values increase with the proximity to a greenway. Graphic source: National Park Service http://www.nps.gov/pwro/rtca/propval.htm#real

Greenways may also facilitate preservation of historical landmarks. Over a period of time, many roads, railroads, trails, canals, or other type of lines and corridors in the landscape may take on a role of historical significance, but might become threatened with destruction as development increases in an area. Incorporating historical landmark elements such as these within greenways may be an appropriate method of preserving them. Furthermore, the natural, historical, and cultural resources located along a greenway have the potential to serve an educational role and bring a sense of community to the region (Hellmund & Smith, 2006). Stones River Greenway in Murfreesboro, TN, is an excellent example of an historical greenway used to teach about the area's history as a Civil War battlefield (City of Murfreesboro, TN, 2008).

One of the most important benefits of a greenway is in the preservation of ecological environments. Greenways protect and enhance the natural environment by preserving woodlands and grasslands, thus providing protected areas and habitat for native species and wildlife. A green infrastructure system can also improve water quality through the establishment of riparian buffers along the banks of creeks, streams and rivers (fig. 7.14). Riparian areas also provide wildlife habitats and protect native plant species. They serve as natural filters for pollutants which would otherwise end up in the waterways (Hellmund & Smith, 2006).

Perhaps even more relevant for Kenton County and Northern Kentucky, is the costly property damage caused by annual flooding. Flooding in this area is frequently due to impacts associated with developed land. Greenways can help reduce the damage caused by floods by inhibiting or slowing storm water runoff (LFUCG, Greenways, 2008). Chapter Eight discusses the watershed atlas for Kenton County. The maps provided in this chapter illustrate where development is encroaching upon riparian areas.

7.5 Northern Kentucky's Need for Green Infrastructure

As land use trends across the United States continue to change, the threat of an increase in landscape fragmentation of the landscape remains (Ahern, 1995). It has become evident that recent trends toward green development diminish the effects of fragmentation and provide a more sustainable landscape condition (Fabos, 2004). The issues surrounding hillside

Figure 7.14 Riparian buffers along rivers and streams improve water quality as well as provide areas for the location of greenways. Photograph: maps.live.com

development in Kenton County are many; however, the impact this type of development has on the health, safety, and welfare of the region's citizens can be lessened with the implementation of green infrastructure.

There is a need for green infrastructure in Kenton County as well as in the Northern Kentucky region and was identified as an area of concern by the stakeholders during the three public meetings for this study. Data compiled for the comprehensive plan showed how Kenton County compared nationally in regard to open space dedicated to recreation. The information reveals that while currently there is an adequate amount of park and open space relative to the population of Kenton County, there is a need to plan for an increase in park and open space to accommodate the projected population growth. Furthermore, most of the park and open space currently utilized in Kenton County is categorized by the National Parks and Recreation Association as mini or community parks (NKAPC, 2006). The amount of natural areas dedicated to recreation is insufficient for the region's population, which is a concern indicated by stakeholders in the public survey taken as part of this research project.

Results from the public response survey conducted during Meeting One showed how stakeholders value quality of life elements related to connectivity, wildlife, passive recreation, fishable waterways, forestland, and a system of parks and natural areas in particular (refer back to fig. 2.6). It became evident through this survey that implementing greenways during the planning process in Kenton County as well as potentially in Northern Kentucky will not only provide the community with valuable benefits and an adequate amount of open space, but will also provide an avenue for calming the growing concerns about hillside development by protecting certain hillsides with green infrastructure.

7.6 Greenway Suitability Analysis

Government, private, and non-profit organizations have increasingly taken important roles in protecting millions of acres of land throughout the U.S. (Kazmierski, 2004). However, oftentimes they lack the resources and a clear process for identifying the most important areas to conserve (Kazmierski, 2004). For this reason, one of the major goals of this project was to provide a model to the NKAPC that would aid in identifying essential lands which would sustain natural resources while at the same time provide recreational opportunities for the region.

Recognizing the importance of the elements identified by stakeholders and observing the lack of natural landscapes dedicated to recreation as noted in the *Comprehensive Plan Update 2006-2026*, the design process for this study moved toward finding the most suitable areas for greenway development. The objective was to utilize the areas that best exhibit the landscape suitability analysis qualities most valued by stakeholders. For instance, based on stakeholder input, areas sought would strengthen connectivity, provide wildlife corridors, preserve forests, and improve water quality while providing natural areas for passive and active recreation.

To locate the essential land resources that would strengthen these components, a greenway suitability analysis was conducted using ESRI's ArcGIS ModelBuilder. The model was based on the Land Evaluation and Site Assessment (LESA) applications prepared for the U.S. Department of Agriculture's Natural Resources and Conservation Service by James R. Pease and Robert E. Coughlin. The capability and suitability systems described in this report identify opportunities and constraints for various land uses (Pease & Coughlin, 1996). In this case, a suitability analysis for greenways was performed for Kenton County as well as the Northern Kentucky region (fig. 7.15). Ten essential landscape elements for greenway development were rated by their importance using ArcGIS. Then the county was assessed within the context of the region to identify the areas most suitable for green infrastructure based on these elements.

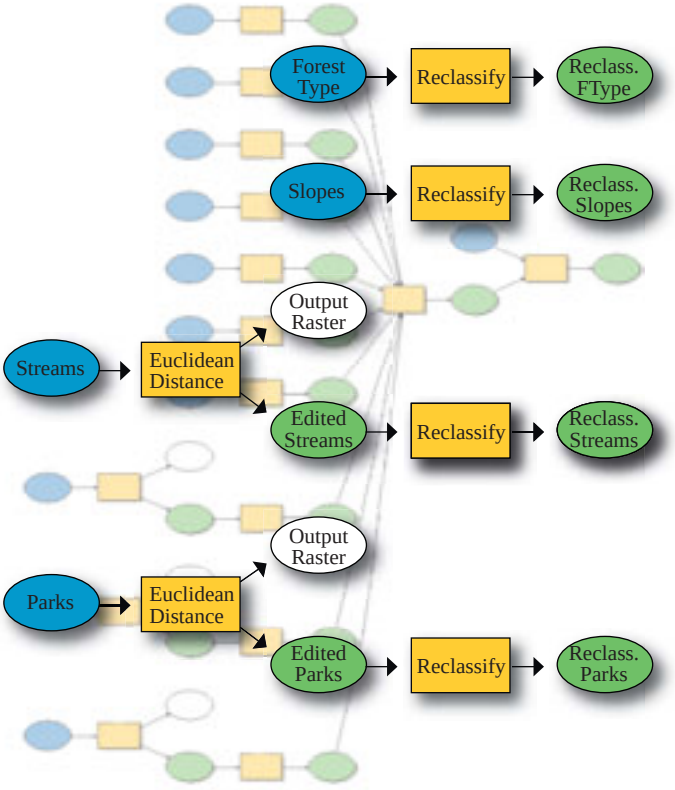


Figure 7.15 This model was generated with ESRI's ArcGIS ModelBuilder and represents the process and the ten landscape elements used to identify areas suitable for greenway development in Northern Kentucky.

Kenton County Green Landscape Plan Development

1.) On a scale of 1 to 10, rank these greenway benefits based on what you believe to be the most important benefit that a greenway has to offer.

	High Importance									Low Importance
Recreation	1	2	3	4	5	6	7	8	9	10
Historic Preservation	1	2	3	4	5	6	7	8	9	10
Storm water Management	1	2	3	4	5	6	7	8	9	10
Community Enhancement	1	2	3	4	5	6	7	8	9	10
Scenery Protection	1	2	3	4	5	6	7	8	9	10
Higher Property Values	1	2	3	4	5	6	7	8	9	10
Social Equity	1	2	3	4	5	6	7	8	9	10
Nature Conservation	1	2	3	4	5	6	7	8	9	10

2.) On a scale of 1 to 10, rank each landscape element based on the amount of influence it should have on determining suitable areas for greenway development.

	High Influence									Low Influence
Land cover	1	2	3	4	5	6	7	8	9	10
Slope %	1	2	3	4	5	6	7	8	9	10
Proximity to roads	1	2	3	4	5	6	7	8	9	10
Proximity to facilities	1	2	3	4	5	6	7	8	9	10
Existing parks	1	2	3	4	5	6	7	8	9	10
Proximity to parks	1	2	3	4	5	6	7	8	9	10
PRDA Land	1	2	3	4	5	6	7	8	9	10
Watershed Health	1	2	3	4	5	6	7	8	9	10
Forest Type	1	2	3	4	5	6	7	8	9	10
Proximity to streams	1	2	3	4	5	6	7	8	9	10
Proximity to wetlands	1	2	3	4	5	6	7	8	9	10

Figure 7.16 This survey was given to stakeholders at the beginning of Meeting Two in order to determine what the community perceived a greenway to be and what factors among the listed elements should be influential in determining suitable areas for greenway development.

The ten landscape elements were then mapped. The landscape elements are slope percentage; watershed health; PRDA land; land cover; forest type; and proximity to parks, roads, facilities, and streams. Although more landscape elements could have been used, these were believed to have the most impact on greenway development as well as represent the desires of the stakeholders.

In the LESA approach to suitability analysis, it is important to remember that in a democracy the people are the government and planning decisions should reflect the values and aspirations of its citizens (Pease & Coughlin, 1996). Staying consistent with the LESA approach, a second public response activity conducted during Meeting Two determined which factors among the ten elements were most valued by the stakeholders (fig. 7.16). The response activity also queried participants about what they perceived as a greenway and perceived as important benefits of a greenway. In order to elicit this information, three instructions were conveyed to the participants:

1. On a scale of 1 to 10, with one being the most, rank these greenway benefits based on what you believe to be the most important benefit a greenway has to offer.
2. Using the same scale, rank each landscape element based on the amount of influence it should have on determining suitable areas for greenway development.
3. For each of these elements, circle the factor that would be most suitable for greenway development.

Results indicated that the stakeholders felt a greenway could provide all of the benefits listed, with storm-water management and recreation as

the most important as indicated by lower scores for greenway benefits (fig. 7.17). Results from the survey also demonstrated that all of the factors in the suitability model were relevant and that watershed health, slope percentage, and land cover should have the most influence on determining greenway areas as indicated by lower scores for greenway suitability (fig. 7.18).

After assigning new values to the factors, and ranking the landscape elements accordingly, a comprehensive green landscape plan for Kenton County within the context of Northern Kentucky was produced. The map was then used as a friction surface to connect important nodes across the landscape and determine the most suitable areas for green corridors (fig. 7.19) (Miller, et al., 1998). Nodes that were selected included the six areas of interest described in Chapter 5, the population nodes in the region, major parks, and healthy streams. It is important to note that to accomplish a more comprehensive analysis for Northern Kentucky, additional nodes could be located. ArcGIS v. 9.2, a GIS program, was used to connect these nodes along the best possible path according to the suitability map. In other words, in determining the route from one node to the next, the path followed cells which were valued the most suitable for green development.

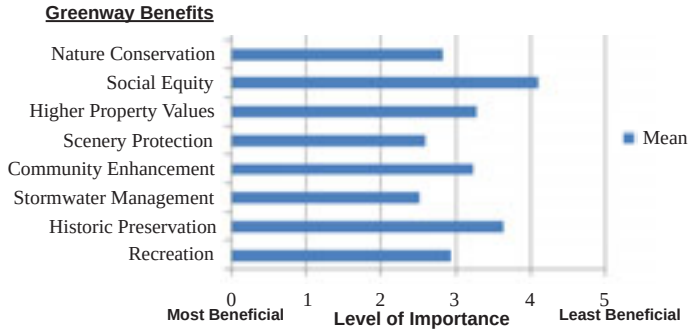


Figure 7.17 This graph illustrates the results from the survey conducted during Meeting Two. The majority of stakeholders indicated that stormwater management, scenery protection, and recreation are the three most important benefits a greenway can offer.

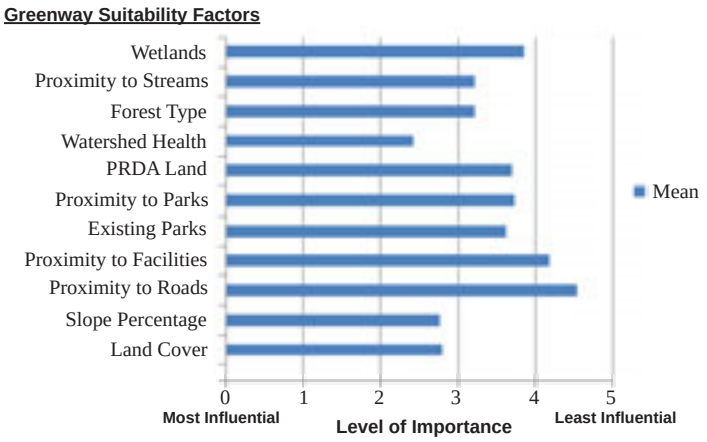


Figure 7.18 This graph shows the results from the survey conducted during Meeting Two. The stakeholders indicated that watershed health, slope percentage, and land cover should have the most influence on determining land area for greenway development.

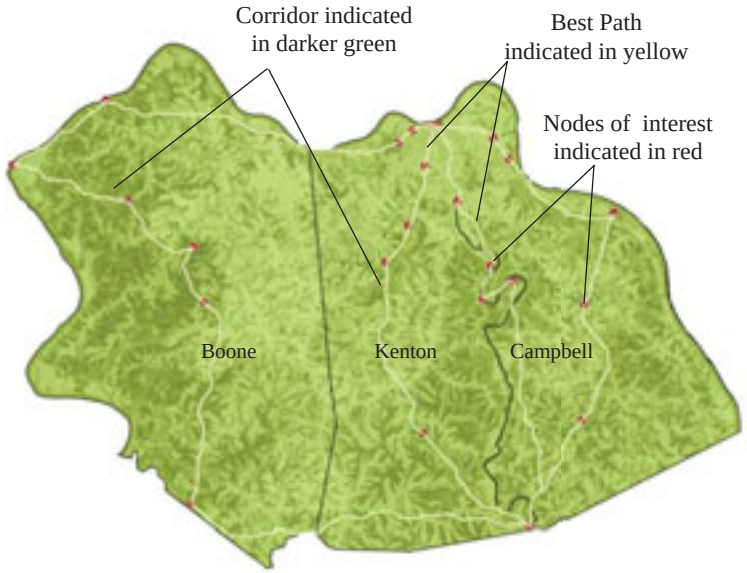


Figure 7.19 This map indicates areas that are most suitable for greenway development based on the ten landscape elements that were ranked through the public response survey. The corridor (darker green) follows the best path (i.e., the highest suitability) across the map based on multiple criteria.
Data source: Kentucky Geography Network

7.7 Biological Impacts of a Greenway

The results from Meeting Two were not the only tools used to assign new ratings to the factors within the landscape elements. Another tool utilized was information from *Conservation Thresholds for Land Use Planners* (Kennedy, Wilkinson, & Balch, 2003), a project of the Environmental Law Institute's State Biodiversity Program. Several key points are illustrated in this publication and relate to the suitability analysis and hillside dilemma affecting Kenton County and the Northern Kentucky region.

It is important for land use planners to take into account the impacts their decisions have on biological resources when considering the inevitability of land development (Kennedy et al., 2003). The spatial patterns that development takes will directly affect all aspects of biodiversity, "with the loss and fragmentation of habitats and ecosystems being the most significant threats" (Kennedy et al., 2003).

Based on this idea, the Environmental Law Institute presents a list of conservation guidelines from which the rankings for the factors within the landscape elements were taken for the suitability analysis. For instance, when considering forest type and riparian corridors it becomes important to recognize the "minimum sizes of habitat patches species need to survive as well as adequate size and placement of habitat corridors that would facilitate species movement" (Kennedy et al., 2003).

While it was not possible to incorporate all of the conservation thresholds within the Hills Project due to time constraints, it is recommended that planners follow the guidelines to ensure species persistence and biological sustainability.

7.8 Funding Green Infrastructure

Funding a greenway system throughout Kenton County is likely to be a challenging part of the green landscape development plan. In order to achieve this plan, the community must be fully committed to developing a greenway system (LFUCG, Greenways, 2008). The public meetings and Kenton County's *Comprehensive Plan Update 2006-2026* have shown that residents and officials are interested in such a movement in their county. Communities that have embraced such commitment and interest have typically found the financial support necessary to achieve their goal.

For many communities the most successful method of funding a greenway system is to pool private with local, state, and federal funding sources (LFUCG, Greenways, 2008). In order to implement the Kenton County greenways system successfully, the NKAPC will need to work in conjunction with several entities such as the parks and recreation department and grassroots organizations.

Several federal programs offer financial aid for projects intended to improve community infrastructure, transportation, housing, and recreation programs. The Transportation Equity Act for the 21st Century (TEA-21) is the primary source of federal funding for greenways. The U.S. Department of Housing and Urban Development offers financial grants to communities for neighborhood revitalization, economic development, and improvements to community facilities and services. Through the Community Development Block Grant Program, low and moderate income areas can receive funding for facilities and services as well.

The Land and Water Conservation Fund (LWCF) Grant is a federal funding source that has been used to establish parks and recreational opportunities in communities across the country. These funds help acquire additional lands for national parks, forests, and wildlife refuges. Congress, in past years, has appropriated LWCF funds for so-called "state-side" projects. Communities used these "state-side" LWCF grants to acquire and build a variety of park and recreational facilities, including trails and greenways. The U.S. Department of Agriculture and the Federal Emergency Management Agency offer a variety of funding programs that have the potential for use in developing greenways. Most of these federal government sources require local governments to match a certain dollar amount of the awarded grant (LFUCG, Greenways, 2008).

The Commonwealth of Kentucky offers many financial programs that can assist in the construction of a greenway system. The Kentucky Heritage Land Conservation Fund is the primary state funding source for acquiring lands in a natural state. The Kentucky Community Rivers and Streams Grant Program is another avenue by which Kenton County could seek funds for greenway development since the county has the Licking and the Ohio Rivers as county boundaries. This grant program promotes community and local government participation to restore, maintain, and enhance local and regional river resources and their accompanying watersheds, streams, and riparian areas (LFUCG, Greenways, 2008).

The Licking River is already the focus of several preservation efforts. One of these is the Kentucky Landowner Incentive Program which is designed to protect and enhance habitat for imperiled species in the state. The program provides landowners with the technical and financial support necessary to protect these species and their habitats (Kentucky State Nature Preserves Commission, 2008). Along with the Licking River, the Banklick Creek watershed has recently received $600,000 from the EPA and $400,000 from the Sanitation District #1 in order to improve the overall water quality in the watershed (NKAPC, 2008).

Local funding can also facilitate greenway development. For example, Cobb County, GA, voted to implement a one percent special local option sales tax to aid in the funding of transportation projects from which they diverted a portion to greenways. Over four years, Cobb County generated $3.8 million in sales tax revenues. Impact fees provide another option to develop a funding source. “Impact fees are payments required by local governments of new development for the purpose of providing new or expanded public capital facilities required to serve that development” (American Planning Association, 1997).

Bond referendums have achieved tremendous success for greenways in the nation. Charlotte-Mecklenburg, NC, used this method successfully to generate more than $15 million in four years. Aside from these alternatives, stakeholders should not overlook private funds as an option. Donations from the private sector or by sponsorship of sections of a greenway might provide the community with the opportunity for personal involvement in greenway development. With these suggestions and a determined effort, funding for a greenway system in Kenton County is certainly feasible.

The previous suggestions are just a few of the many options that are available for greenway development. The opportunities for financial support are available for any community in the nation; however, it takes time and effort to achieve. Certain methods or combination of methods may prove more effective for some communities than others.

The Hills Project team suggests that Kenton County take the time to fully weigh their options and make a decision that will best suit their needs. Based upon the results from all the public meetings, clearly the development of a green infrastructure has the support of the community.

7.9 Ideas for Recommendations

As the hillsides continue to be an issue for development or protection, they could be incorporated into a system of greenways which may potentially protect sensitive watersheds and physically restrictive development areas for future generations. Population projections and proposed developments indicate that the long-range plans for Kenton County may not provide an adequate amount of green space or linear parks to connect existing parks.

Input from stakeholders in the region suggests that park connections are of the highest concern, and indicates there is a surplus of mini parks but little to no existing linear connecting parks in Kenton County. Green infrastructure can address the need for preserving the hillsides and natural corridors, while ensuring open space and green connections to existing facilities for the future.

8.1 What is the Issue?

As "environmental sustainability" becomes one of the greatest buzz words of our time, watershed and water quality issues are rapidly gaining interest. Simultaneously, land use practices which are often insensitive to the many issues related to water quality are putting increasing levels of pressure on waterways and severely impacting the timeframe within which ecosystems can be expected to provide quality water. Looking at the landscape from a watershed and waterway health perspective offers an underutilized and undervalued report on the quality of land management decisions. In other words, water quality is a measure of land stewardship. By looking at land uses as indicators of watershed health it is possible to make future management decisions that will support higher water quality, and potentially reverse some of the damage already done.

8.2 Why Study Watersheds and Water Quality?

In the public response activity conducted during Meeting One, stakeholders indicated that fishable and swimmable waterways are very important in terms of what they value. On a scale of 1 – 7, with 1 indicating a landscape characteristic as Not Important and 7 indicating a landscape characteristic as Important, participants valued Fishable Waterways at a mean of 5.91, and Swimmable Waterways at 5.16. According to Kentucky Division of Water stream quality data, only a portion of Northern Kentucky's streams meet the criteria for uses such as these (fig. 8.1).

8.3. The Watershed Atlas

This study used an enhanced ArcGIS version of a watershed atlas based on work by Jones et al., (1997) and modified and tailored to Kentucky by Lee and Linebach (2008). The objective of the atlas is to provide an assessment of landscape characteristics that can help to explain why some waterways are limited for common waterway uses, and why some watersheds have maintained a landscape which supports higher levels of water quality.

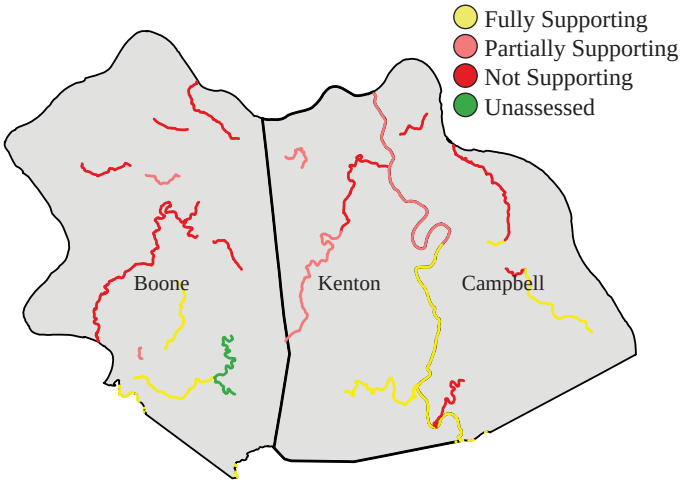


Figure 8.1 Kentucky Division of Water stream quality data shows few of the Northern Kentucky streams meet the standards for fishing and swimming.
Data source: Kentucky Geography Network

This study's research focused on the Hydrologic Unit Code (HUC) 14 watersheds of Kenton, Boone, and Campbell Counties. HUCs are the USGS's organization scheme for cataloging the watersheds across the United States from the largest scale drainage basins in the nation, down to the smallest scale watersheds (The National Atlas, 2007). Using publically available satellite imagery and spatial databases from the Kentucky Geography Network, the watersheds were characterized through evaluation of nineteen landscape based health indicators:

- Overall Development,
- Low Density Development,
- Impervious Cover
- Population Density
- Road Density
- Stream Density
- Road and Stream Intersections
- Roads in Riparian Zones
- Wetlands
- Agriculture in Riparian Zones
- Pasture and Hay on Slopes
- Crops on Slopes
- Forest Cover
- Forest in Riparian Zones
- Canopy Cover
- Interior Forest
- Outfalls and Package Outfalls
- Dams

The indicators were ranked by quintiles, distributing the watersheds among five quintiles from least likely to support healthy streams to most likely to support healthy streams.

8.4 What is a Watershed Health Indicator?

A watershed health indicator is a characteristic of the landscape known to contribute to waterway health or deterioration. Jones et al., (1997) in *A Watershed Atlas: An Ecological Assessment of the United States Mid-Atlantic Region*, relate the concept of watershed health indicators to that of economic indicators, a concept more widely understood.

"Economic indicators include the seasonally adjusted unemployment percentage and number of housing starts, both of which indicate overall economic condition. In these indicators, seasonal adjustment is made with a model, and most economists look at several indicators together instead of just one at a time. Similarly, watershed health indicators can be measurements of ecosystem components (such as the amount of forest) or processes (such as net primary productivity), and modeled adjustments can be used to help interpret the measurements in order to understand overall ecological conditions" (Jones et al., 1997, pp 4).

Impervious land cover is an example of a watershed health indicator used in this study. Impervious land cover is one of the more significant contributors to waterway degradation due to its impact on runoff during storm events. In general, 10% impervious cover in a watershed is a point at which water quality tends to decline.

Vegetation works to slow down the velocity of storm water runoff, as well as modify the hydrologic cycle in ways such as filtering pollutants. Often, when water travels across paved surfaces and rooftops, the water either enters the storm water collection system or enters directly back into waterways at high velocities, and without filtration of pollutants. Figure 8.2 illustrates the watershed quintiles for impervious land cover.

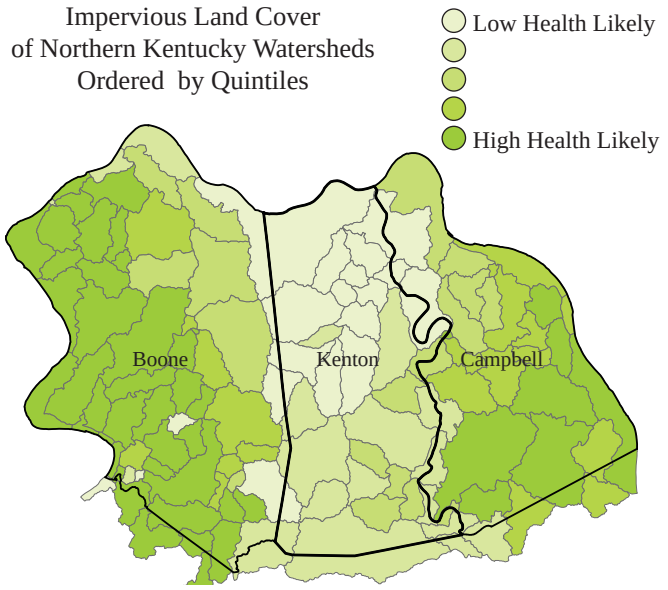


Figure 8.2 Northern Kentucky HUC14 watersheds impervious cover ordered by quintiles.
Data source: Kentucky Geography Network

8.5 How are Indicators Measured?

Several ArcGIS based techniques were used to calculate the indicators utilized in the atlas. Several were calculated via a process known as overlaying. The spatial data for Agriculture on Slopes, for example, were generated by overlaying land cover data (agriculture) and topographic data (slopes). The overlay process highlighted the intersection of agriculture with steep slopes. Another technique utilized is spatial filtering which can be thought of as a "sliding window" to calculate the occurrence of a particular indicator value as a small percentage of a larger map. An example of how this process was utilized by the atlas is in the determination of the occurrence of interior forest. Spatial filtering broke the pixilated, larger forest cover data into smaller grids, and counted the number of pixels within each smaller piece in which interior forest occurred (Jones et al., 1997).

8.6 What do the Indicators Tell Us?

The data for individual indicators were utilized to create two composite maps, indicating overall likeliness of watershed health for a total of 124 watersheds, 42 sharing territory with Kenton County. To characterize the condition of the watersheds on a comparative basis, these maps, like the individual indicator maps, were rated by quintile to divide the watersheds across five quintiles.

Figure 8.3 was created by counting the number of times a watershed ranked in the bottom quintile for watershed health for each watershed indicator, and Figure 8.4 shows the number of times a watershed ranked in the top quintile for watershed health. To determine the condition of the watersheds on a comparative basis, these maps, like the individual indicator maps, were placed by quintiles to divide the watersheds across five quintiles. This process identifies which watersheds likely had the most healthy overall land use practices, and which likely had the least healthy overall land use practices. A limitation of this approach is that it does not account explicitly for upstream conditions.

8.7 Watersheds Scoring Low for Health

Of the 42 watersheds in Kenton County alone, two scored among the lowest for watershed health, having rated in the bottom quintile 12 out of 19 times (fig. 8.3). Contributors to these low ratings are: Impervious Land Cover, Low Density Development, minimal Interior Forest, Population Density, as well as Agriculture and Roads occurring in Riparian Areas. Boone County included three watersheds (of six in the region) which never ranked in the bottom quintile for health; Kenton County includes two, and Campbell County, one (as noted in fig. 8.3).

8.8 Watersheds Scoring High for Health

Watersheds which were rated highest for health likeliness, 9 out of the 124 total watersheds in the region, occur in Boone County (fig. 8.4). Boone County also holds the majority of watersheds rating in the class just below the highest, with the majority of Kenton and Campbell Counties' watersheds occurring in the lowest two ranks. Boone County's high ratings are likely the result of fairly low levels of development and a high percentage of forest,

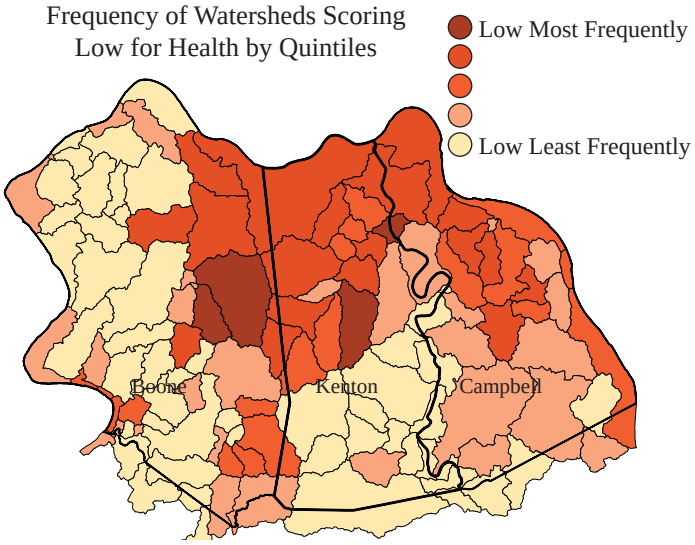


Figure 8.3 Watersheds rating in bottom quintiles most frequently, ordered by quintile; indicating lower overall health.
Data source: Kentucky Geography Network

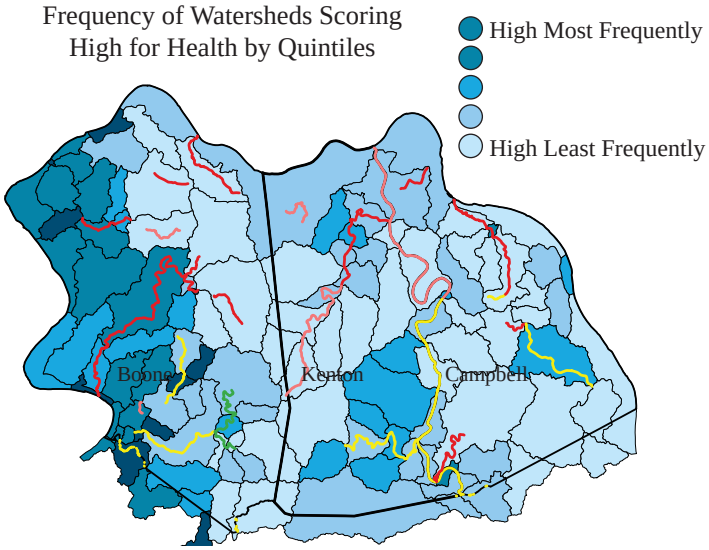


Figure 8.4 Watersheds rating in top quintiles most frequently, ordered by quintile; indicating higher overall health (includes Kentucky Division of Water stream quality data as refined in fig. 8.1).
Data source: Kentucky Geography Network

forest canopy and riparian forests. However, it is important to remember that Boone County has one of the highest levels of human population growth in the state in recent years. Figure 8.4 shows an overlay of the Kentucky Division of Water's stream quality data for overall use support. This map demonstrates how these watershed health indicators, at the scales of the individual watersheds as well as that of the bigger picture where all the watersheds are understood to be inherently linked, are determinants of the quality of the streams.

An overlay of the Kentucky Division of Water's data for streams supporting overall use (uses including fishing and swimming) demonstrates that watersheds which were ranked as most healthy include the streams which fully support overall use, while those which do not support overall use occurred in those watersheds ranked as least healthy, with some exceptions worth noting. For example, where the Licking River flows in Kenton County, through the highest quality watersheds in the area, the water quality supports all uses, but the quality degrades to only partially supporting use as the Licking begins to flow through the more developed areas of the county. Also note in Boone County, where Gunpowder Creek flows through the highest quality watersheds in the entire Northern Kentucky region, the stream is rated as not supporting overall use. At first glance, this may seem contradictory, but the headwaters of the stream are located in some of the lowest quality watersheds in the region. This stream provides an excellent example of how the land uses occurring upstream can significantly impact the quality of water downstream.

8.9 How did the Hills Project Use this Information?

The individual watershed indicators and composite watershed health maps were used in the development of the design proposals, and contributed to recommendations provided in the final stage of the study. However, in terms of environmentally conscious land use planning, the potential uses for a model such as this have not been fully realized. The watershed atlas offers a perspective that is relatively unfamiliar to land use planning efforts, and to the general public. But as water continues to escalate as a global issue and approaches such as Lee and Linebach's (2008) watershed atlas provide heightened insight into land use related contributions to water quality problems, the value and application opportunities of this form of analysis will become more widely recognized. Kenton, Boone, and Campbell Counties could be among those at the forefront of this movement, and have the opportunity to set a global precedent for ecological planning based on watersheds.

8.10 What Else can be Done with this Information?

Appendix 10.5 includes a map of each of the nineteen watershed health indicators. These maps can be used to understand why a particular watershed of interest scores high or low on the composite maps in Chapter 8. In the interest of improving or maintaining current watershed health rankings, these maps can be referenced when making land management decisions. For example, if a contributor to a watershed's low ranking is lack of riparian forest buffers, decisions could be made to extend the Greenway Infrastructure into this watershed. Another example for use is in the determination of areas of the county which can sustain further development. By referencing the All Development, Low Development, Impervious Land Cover, Roads in Riparian Areas, or Road/Stream Intersections data, decisions can be made based on which watersheds have reached limits on the degree of development that should occur within them, and those which may sustain further development, via a process of comparison and contrasting watershed characteristics. In addition, modifying existing development regulations based on watershed characteristics could be a starting point.

8.11 Comprehensive Watershed Protection Plan

As Kenton County and the Northern Kentucky area evaluate constraints and opportunities for future change, the protection of waterways will require improved management of existing conditions contributing to waterway degradation, and planning for potential stresses that may arise as the landscape

changes. A comprehensive watershed protection plan that addresses the future of development from a watershed based perspective for land use planning is critical. The development and implementation of necessary waterway protection ordinances will require that this atlas be maintained with up-to-date indicator data. These data, in conjunction with other resources provided by the Hills Project and the most up-to-date comprehensive plans, can be utilized to make predictions concerning potential land use change and implications for watershed and waterway quality (Butcher, 1999).

An example of potential use, from Jonathan Butcher's *Forecasting Future Land Use for Watershed Assessment*, is in the way the Watershed Atlas can help to address the following question:

"Given the expected rate of population growth and development within a watershed, and accompanying conversion of land use and land cover, what do we expect to happen to environmental resources under existing management measures and regulatory programs? Are these protections adequate, or are additional management strategies needed?" (Butcher, 1999, pp. 555)

In addition to maintenance of the atlas with up-to-date indicator data, maintaining a record of the changes occurring over time in the landscape as indicator data are updated will be a valuable resource for assessing the implications of future land use change. This, in combination with a build-out model similar to that described by Lathrop, Tulloch, and Hatfield (2006), can serve as a planning tool to determine potential impacts of future development scenarios on watershed integrity.

9.1 Next Steps Overview

As this region continues to grow, the focus will be on potential guidelines and recommendations to guide the future of the Northern Kentucky area. The challenges faced by planners and policy makers in managing urban growth and protecting open space in the 21st Century are daunting (Bengston, Fletcher & Nelson, 2004). According to Gerber & Phillips (2004), growth provides numerous benefits to a community. It stimulates the economy, creates jobs, generates tax revenues, provides housing and increases a city's prestige; but growth also imposes costs on the people who live near it. In recent years, some of the more unsightly consequences of growth have become more apparent.

Growth may also be seen as urban sprawl, which may be characterized as relatively low-density, noncontiguous, automobile dependent, residential and nonresidential development that consumes relatively large amounts of farmland and natural areas (Bengston et al., 2004). According to Bengston et al., (2004) policies have been implemented at the local, regional, state, and to a limited extent, national levels to help manage growth. There is a variety of research on policy approaches that could provide the next steps to address growth in the Northern Kentucky area. These strategies include: a differential tax incentive program, transfer of development rights program, purchase of development rights program, right of first refusal, insurance coverage policy, direct democracy, a land trust community and a fast track option for developers.

9.2 Preservation Approaches

Research throughout this study showed that stakeholders highly value the hillsides of the Northern Kentucky region. With development on the rise in this region, the health of the hillsides is at stake. One possible approach in helping to protect the hillsides may be a transfer of development rights (TDR) program. A TDR program moves development rights from an undesirable or unsuitable part of the region to an area where development is desired or better suited. A TDR program typically demarcates a sending area (one protected from development) and a receiving area (one where development will be allowed) (Brabec & Smith, 2002). With this definition, the hillsides of Kenton County represent the sending area and the receiving area may be represented by an area within a downtown or possibly an area that has underutilized infrastructure and that can manage an increase in density. TDR programs require careful determination of sending and receiving areas in order to guide development and increased density to specific places. A number of public policies underlie the TDR program, among them include a desire to control public costs associated with sprawl by channeling growth to existing population centers. Another public policy sets aside lands for agricultural purposes or in this case, the hillsides, to maintain rural open space and the rural character of the area (Brabec & Smith, 2002). The local government can facilitate logistics and the promotion of a TDR program.

A program similar to a TDR that works to accomplish the same goal is a purchase of development rights (PDR) program. A purchase or donation of development rights program typically uses public funds such as tax revenues, or municipal or state bonds to fund the purchase and retirement of development rights on agricultural land, or in this case, the hillsides (Brabec & Smith, 2002). Unlike a TDR program, a PDR program alone does not hold an inherent protection against land fragmentation. This tool is often cited as a drawback due to the costs involved. However, it does compensate the private landowner for providing public benefits, in this case the preservation of the hillsides. Therefore, the potential to avoid fragmentation is tied to the amount of public funding that is available for development rights purchase (Brabec & Smith, 2002) and the willingness of landowners to participate. The TDR program appeared to be more successful when agricultural land protection was evaluated (Brabec & Smith, 2002). Again, in this case it would be utilized to protect the hillsides where similar results are anticipated to occur.

With development encroaching on the visually desirable hills of Kenton County, the future is up to the stakeholders of this region. The benefits that the hills may provide to a community are numerous. A policy approach that gives a stronger voice to private landowners is through the formation of a special district. This approach could follow the model used for agricultural districts, but in this case would form hillside districts. Established in Kentucky in 1982, agricultural districts allow farmers to form special areas where commercial agriculture is encouraged and protected (American Farmland Trust, 2007). Implemented into the Northern Kentucky area, a similar approach for hillsides could encourage the preservation of the hillsides as part of the urban forest. This program is strictly voluntary, but has proven to have many benefits to farmers throughout Kentucky including: protection from annexation, mitigation from the impacts of state-funded projects on the conversion to non-farm use of nearby land, deferred payments of assessed costs for the extension of water lines across the property (as long as the land is not developed), priority registration in state conservation programs, and public hearings to protect landowners from eminent domain 'takings' (American Farmland Trust, 2007). A special district program seems to have very few negative aspects.

As the hills of Kenton County are such a desirable resource and an integral part of a healthy ecosystem, it is important to balance the protection and preservation of this resource with the development of these natural areas. Individual landowners, who want to preserve the land in its natural state, may donate their land to a non-profit community or a land trust. A land trust promotes voluntary private land conservation to benefit communities and natural systems (Land Trust Alliance, 2007). The goals of a land trust include: to dramatically expand land conservation (through tax incentives), to build strong land trusts, to defend the permanence of conservation easements, and to ensure that the work of land trusts is as strategically directed as possible (Land Trust Alliance, 2007). An example of a land trust is The Hillside Trust in Cincinnati, Ohio. The Hillside Trust's mission is to advocate the thoughtful use of hillsides through conservation and education. This program also actively works to help achieve a balance between the competing interests of development and conservation of the remaining hillside land (The Hillside Trust, 2007). The Hillside Trust accomplishes its mission through work in three broad program areas: research and education, land conservation, and advocacy of responsible land use (The Hillside Trust, 2007). Land trusts in general advocate for the importance of land conservation. The primary target for this advocacy may be the community landowners -- or even a small subset of those landowners (Land Trust Alliance, 2007).

As a land trust community, the Northern Kentucky area could acquire and own land in a non-profitable sense. Even those land trusts that have no interest in taking sides in general plans, zoning disputes, or other controversial issues have a basic responsibility to educate elected officials about what they are doing and why it is important to ensure that they will be allowed to continue to do it (Land Trust Alliance, 2007). Many land trusts go much further, cultivating the support of local officials and the public for legislation and referenda that create funding to purchase land or conservation easements. Some trusts go so far as to ask Congressional representatives to help them apply for federal grants to do the same (Land Trust Alliance, 2007). They view this as a simple extension of their work with landowners, and as a way of getting effective conservation to reach landowners who cannot afford to donate their often most valuable family asset. The Land Trust Alliance has expended a lot of resources to inform Congress about the tax benefits and funding that helps support land conservation (Land Trust Alliance, 2007). The Land Trust Alliance is unique in that although the government provides the funding, it does not own the land, which is a policy similar to The Hillside Trust.

9.3 Tax-based Approaches

The undeveloped hillsides are important because of their aesthetic value but are also an integral component of a dynamic ecosystem. Undeveloped hillsides provide a buffer to urban development and are a natural habitat for wildlife in the Northern Kentucky region. Property owners of these undeveloped hillsides provide multiple services to area stakeholders such

as aesthetic values and contributions to a healthy ecosystem, but compensation for their contributions is often non-existent. Property owners should be compensated for the benefits they provide.

An example of such compensation could be a hillside tax incentive program, similar to an agricultural tax incentive program. A differential tax incentive program, depending on how it is implemented, may be completely voluntary and an incentive to those landowners who participate. The benefit to participating landowners is a reduction in taxes; therefore, not punishing for development, but rather rewarding preservation. The level of participation in this type of incentive program could be used to indicate which areas may develop in the future. This hillside tax incentive program would be similar to a farmland preservation incentive program. For example, the participating landowners would join this program voluntarily, and as a result would receive a tax credit. These property owners would agree not to sell or develop their land for a certain length of time, and during this time would receive the tax credit. However, if the stakeholders decided to develop the land or had to sell it for some reason, they would forfeit the tax credit and have to pay back the taxes for the remainder of the time, as once agreed upon. This program would benefit the stakeholders who want to preserve their property on the hillsides.

Aesthetically, the views in Northern Kentucky are breathtaking. One approach to protecting hillsides involves purchase of development rights. As noted previously this approach can be expensive and result in fragmentation of land areas so preserved. A tax levy dedicated solely to generate funds for this purpose may be an option. It would likely have to be initiated with broad community awareness resulting from a campaign to educate the public. Most likely a referendum approach would be needed to ensure broad support from elected leadership. If the general public genuinely values the hillsides a positive outcome may be forthcoming from such an approach.

For further information on purchasing development rights see Section 5.8.

9.4 Governmental Approaches

The government has the responsibility to protect the health, safety, and welfare of the public. One aspect of this responsibility is property insurance. If a major landslide was to occur, property owners may or may not be covered by their insurance policy as there is such a wide range of variance within existing insurance policy terms. Therefore, a governmentally supplemented insurance policy for individuals dealing with the hillsides of Northern Kentucky could potentially provide a mechanism to limit or guide development. While insurance companies protect the policy holders, the potential liability that comes along with coverage of infrastructures on hillsides is enormous. Therefore, today, most insurance agencies will not cover property on hillsides because of liability reasons (NKAPC). If insurance companies do cover hillside property owners, they usually charge a higher premium to cover the risk. One approach would be to convene a hillside summit and include elected officials along with insurance industry experts, the lending industry, and local and national financial officials to better understand the liabilities concerning the hillsides.

Aside from the general public, many others show concern for the hills policy amendments. A concern of the region's developers is the length of the turn around time on the approval of projects. To a developer, time is money; and the length of the current review process may slow a project's completion. However, checks and balances are important to protect the health, safety and welfare of the public. A fast track approval process could be developed in collaboration with interested stakeholders that speeds approvals while maintaining high levels of environmental quality during construction.

9.5 Public-Policy Approaches

The public may represent the most influential voice for hillside mitigation. When a city council approves a development, but the public does not desire the development, it may bring conflict to a community. In the Northern Kentucky region there

are developers working with the public to expand and grow in a community-friendly way. There are also developers who buy and develop every available piece of land, regardless of what may be the best use of the property. In this instance, a more direct policy implication geared toward the public would be direct democracy.

Direct democracy is simply putting the public in charge and letting them decide what should be developed. Voter requirements provide a mechanism for groups such as environmental organizations to participate meaningfully in negotiations on the terms of development (Gerber & Phillips, 2004). According to Gerber and Phillips, voter requirements may fail to stop development, but property owners and developers can and do adapt to the constraints created by these direct democracy institutions. These voter requirement measures are attempts by slow-growth interests to shift the balance of power over land use decisions in their communities (Gerber & Phillips, 2004). The direct democracy process involves a list of land use regulations resulting in a 'growth machine' where property owners, developers, local businesses, and elected representatives all share strong incentives to promote desirable commercial and residential growth (Gerber & Phillips, 2004). Voter requirements force pro-development interests to interact with interest groups differently in the community. While they do not stop growth, they do appear to change the way government compensates current residents for bearing the costs of growth (Gerber & Phillips, 2004).

In a study done in San Diego and other California cities, the experience with voter requirements suggests that transferring some property rights to current residents can slow growth temporarily; however, over time, developers adapt to the new institutional environment created by voter requirements (Gerber & Phillips, 2004). As a result, voter requirements force developers to compensate precisely those interests that are most immediately and negatively affected by growth. These interests include current residents, especially those in immediately adjacent neighborhoods to new development (Gerber & Phillips, 2004). According to Bengston et al. (2004), participation by citizens and other stakeholders has often been identified as a vital element for success of growth management and open space protection efforts. The community needs meaningful, grassroots participation from the outset of the planning process and throughout implementation of plans if community goals and concerns are to be incorporated and local land-use plans are to have legitimacy (Bengston et al., 2004).

Over the course of this study, the research indicates that the public in Northern Kentucky is very interested in preserving the future of the hillsides. Public interest may be the first step to the implementation of another policy approach termed right-of-first refusal whereby two individuals come to a decision over a piece of land in a legitimate way. For example, stakeholder one owns property that stakeholder two (perhaps an individual, a land trust, or municipal entity acting on behalf of the public) is interested in acquiring either now or in the future. Under this approach, it is possible for stakeholder one, who now owns the land, to make an agreement with stakeholder two concerning the cost of the land. Stakeholder one will also determine the length of time that stakeholder two has to make a decision and work out financial obligations. After the predetermined length of time, if stakeholder two has taken no action or chooses not to purchase the land, stakeholder one may then offer it to another buyer. The concept of this policy implication is based on a prior agreement for the benefit of both parties.

9.6 Ideas for Recommendations

The phenomenon of sprawling urban development is one of the major forces driving environmental change in the U.S. (Lathrop, Tulloch & Hatfield, 2006). The rapid pace and broad scope of urbanization is testing the ability of land use planners and environmental resource managers to address the cumulative degradation of regional ecosystems and the resources and services that they provide (Lathrop et al., 2006). The wide variety of potential policy implications can assist stakeholders and local officials in determining the next steps to take. Another recommendation is to

incorporate an evaluation framework into local level policies. Regardless of the approach, an evaluation framework should be part of the process in order to judge if policies have been making a difference.

Examination of the implications of future change is critical to inform participants in the local and regional land use planning process before ill-advised and irreversible land use decisions occur (Lathrop et al., 2006). One way this can be accomplished is through the development of more complete build-out models. A build-out model can be used to examine the form of the fully developed landscape, while avoiding the uncertainty of predicting when the changes will occur (Lathrop et al., 2006). The build-out modeling approach is only valid where there is some concrete form of spatial planning that constrains the location and type of future development (Lathrop et al., 2006). The hillsides provide a spatial constraint, and thus the community should develop a build-out model of the hillsides to aid in future planning. The incorporation of a combination of guidelines and recommendations, an evaluation framework, and a complete build-out model are some of the more effective concepts that the NKAPC might pursue in determining the future uses of the hillsides in the Northern Kentucky region.

9.7 Conclusion

Throughout the course of the Hills Project, the stakeholders have shown strong interest, concern, and diversity of thought regarding the hillside dilemma. Some important elements in the debate are health safety and welfare, private property rights, the common pool resources, the tax base, water management, wildlife management, viewsheds, economic growth, and standard of living. The diversity of positions in this debate does not have to be a bad thing, and should be utilized to enhance a well rounded comprehensive planning approach.

A range of policy implications is possible and levels of compromise can be achieved. A dichotomy exists between private property rights and the health, safety, and welfare of the community as a whole. As the human population increases and natural resources are either consumed or degraded, the balance between them inevitably becomes more delicate. This balance can be addressed through voluntary programs, regulatory programs, or often a combination of both. Policy can also come about through the influencing forms of incentives and disincentives. To visualize this balancing process, the two concepts can be thought of as linear continuums (fig. 9.1).

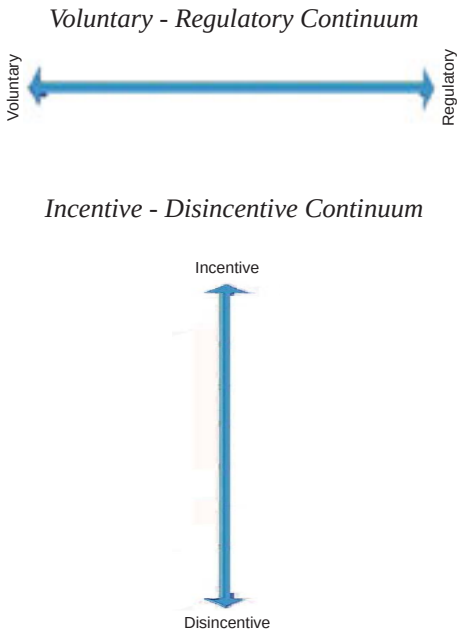


Figure 9.1 Graphic visualization of planning policy strategy implementation.

When the two continuums overlap and become the axes in a graph, as shown in Figure 9.2, they combine to create a series of quadrants that represent the possibilities of both continuums simultaneously. In other words, policy approaches can be placed in one of the four quadrants to describe the process by which they are implemented and put into practice. The graph depicts possible combinations of policy that may be adopted.

After implementing a chosen variety of policy implications, it would be beneficial to incorporate an evaluation framework into the local level policies. Regardless of the chosen policy approaches, the evaluation framework needs to be part of the process to judge if policies are achieving the intended outcomes. The best combination of policy is unique to an area or region and reflects stakeholder values, commitment, and culture.

The Hills Project team's strongest recommendation is for the stakeholders to continue this dialogue into the future and utilize this study as a foundation of research and ideas on which to develop policy to achieve their vision.

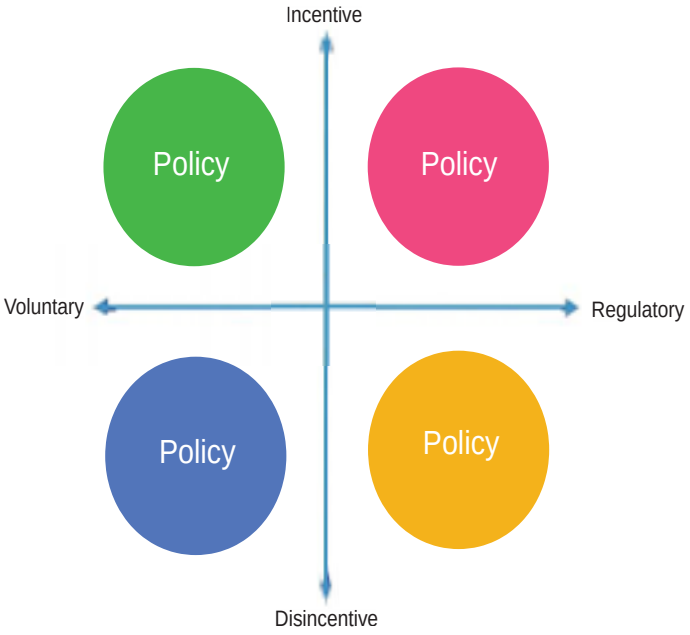


Figure 9.2 A combination of planning policy implementation strategies can be used to achieve the necessary balance between preservation and growth.

9.8 Take Home Points

The landscape will change; however, the what, where, why, and how can be influenced by stakeholders. Stakeholder input from the Hills Project's three public meetings has begun to reveal the answers to these important questions.

- The landscape is dynamic and interconnected in many ways with each piece affecting others. It is important to keep this in mind when deciding what to preserve and what to change.
- The process of involving all stakeholders is essential in the search for new solutions. This process can be challenging and frustrating when confrontation occurs, but it is the best way to achieve fairness and a well rounded approach to land use planning.
- A variety of policy options is available. It is important to learn from what others have done. Kenton County is not starting from scratch and is not the only area with this debate. Seek out the successes and failures of other locations before making major decisions.
- Establish an evaluation framework for policy to determine if it is working in positive ways. Policy can be dynamic; incorporate a level of flexibility into the system to account for unintended externalities.
- Integrate watersheds and greenways into land use planning. Stakeholder input and surveys have documented these issues as important to the community, and both can be tied to preserving the environment and improving the quality of life.
- Utilize this study as a research foundation for idea generation and a community wide dialogue that will continue into the future.

9.9 Tools for Future Planning

The Hills Project has provided a variety of tools and analytical information to assist in future planning efforts:

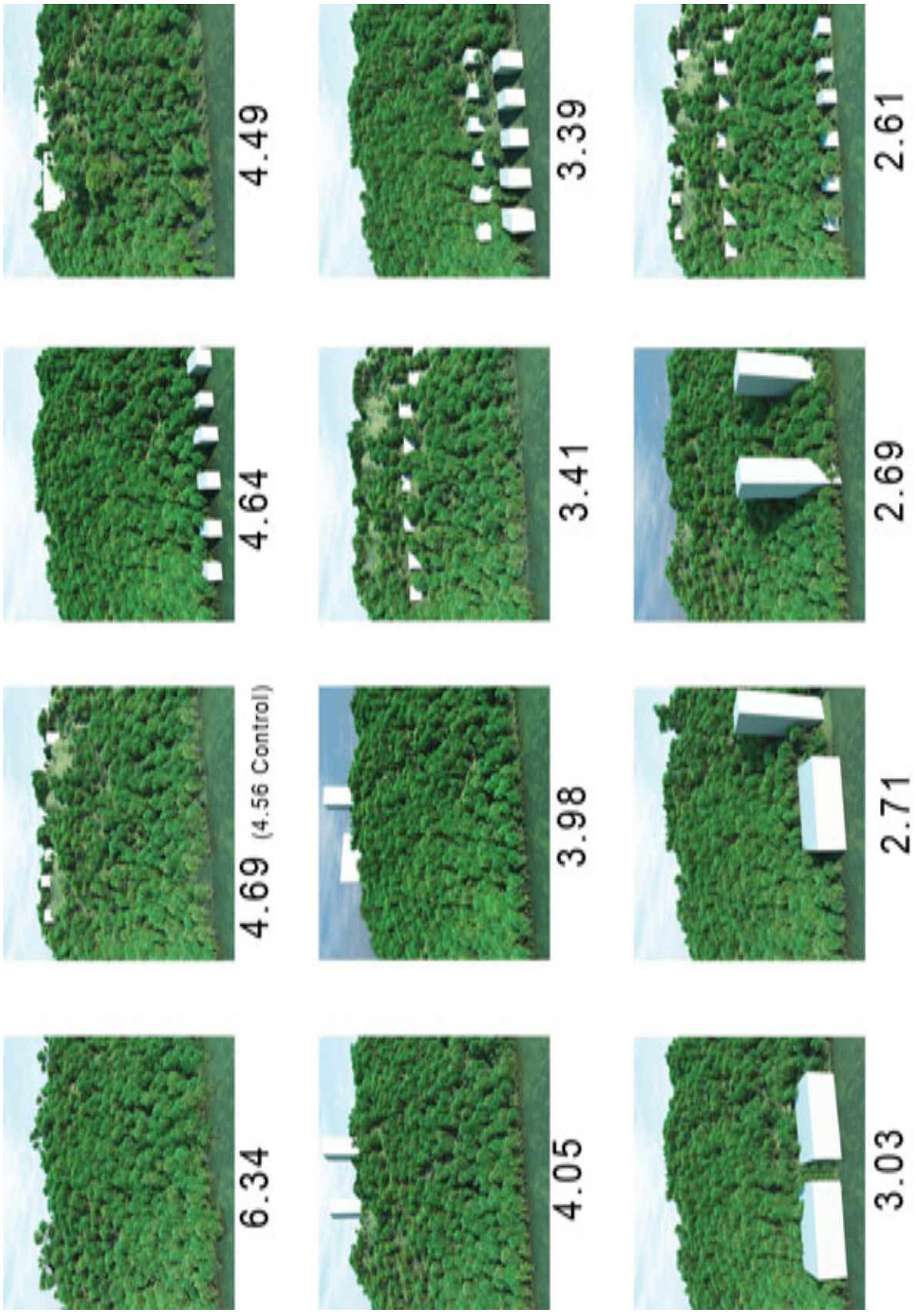
- A short list of precedent references.
- A series of map overlays showing slope, PRDA, Kope formation, and landslide potential.
- A watershed atlas to use as a tool to measure watershed health.
- A greenway suitability analysis map to help locate the best places for greenways.
- A community values database documenting the stakeholders' voice.

9.10 Afterward

The Hills Project would not have been possible without the overwhelming support of the community. We wish to thank all of the dedicated stakeholder participants for the experience and knowledge we gained throughout this project.

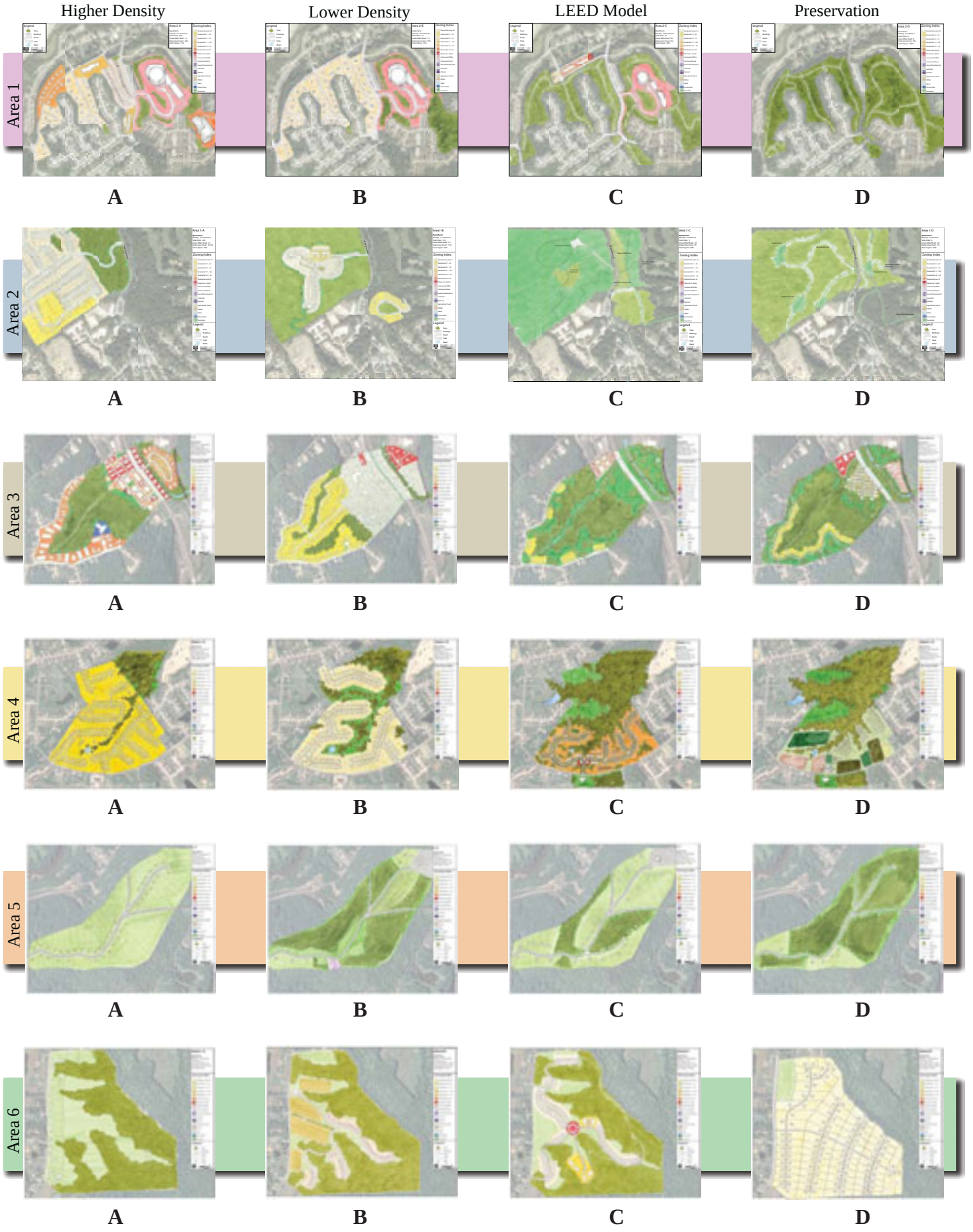
With our deepest appreciation,
2008 Advanced Landscape Architecture Studio
Department of Landscape Architecture
College of Agriculture
University of Kentucky

The following information is a combination of data gathered during the public input sessions of the Hills Project and other study materials used by the team.



Appendix 10.1 Hillside Visual Preference Study (Meeting One): Results for Structure Size and Location on the Hillside. A higher number indicates a higher preference.

Appendix 10.2 Six Areas of Interest Exercise (Meeting Two): 24 design concepts (four designs each for six areas).



Appendix 10.3 Evaluation Worksheet (Meeting Three): 24 three-dimensional renderings for the six areas as displayed on the public input worksheet.

Area 1

1 2 3 4 5 6 7
Dislike Like

1 2 3 4 5 6 7
Dislike Like

1 2 3 4 5 6 7
Dislike Like

1 2 3 4 5 6 7
Dislike Like

Area 1

Area 2

1 2 3 4 5 6 7
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Area 2

Area 3

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Area 3

Area 4

1 2 3 4 5 6 7
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1 2 3 4 5 6 7
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1 2 3 4 5 6 7
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Area 4

Area 5

1 2 3 4 5 6 7
Dislike Like

1 2 3 4 5 6 7
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1 2 3 4 5 6 7
Dislike Like

1 2 3 4 5 6 7
Dislike Like

Area 5

Area 6

1 2 3 4 5 6 7
Dislike Like

1 2 3 4 5 6 7
Dislike Like

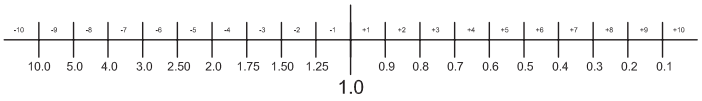
1 2 3 4 5 6 7
Dislike Like

1 2 3 4 5 6 7
Dislike Like

Area 6

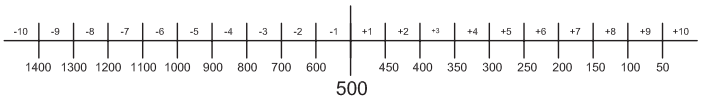
Appendix 10.4 Modified Hasse Evaluation Scales were developed by the team and used to rate the individual design concepts presented in Meeting Three.

Density Scale (Acres/unit)

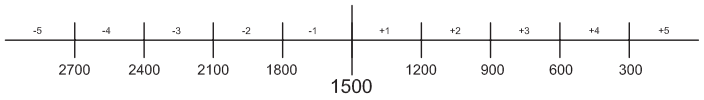


Cul de Sacs (No. per Housing Unit)

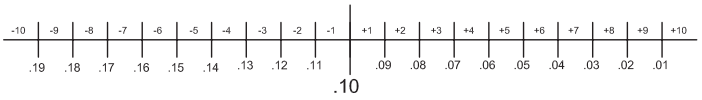
Leap Frog (Linear Feet)



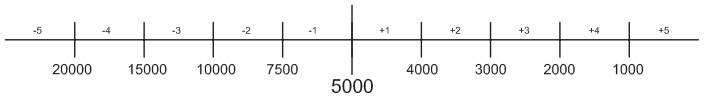
Transit (Distance in Linear Feet)



Impervious Space (Per Housing Unit)

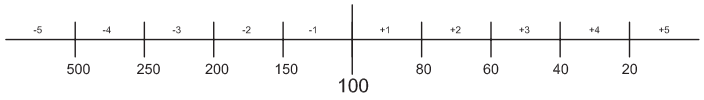


Community Nodes (Distance in Linear Feet)



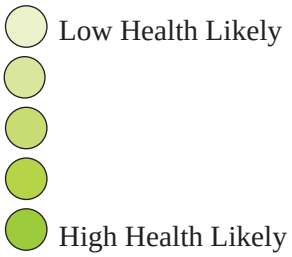
Land Uses (Bonus)

Road Length (Feet per Housing Unit)

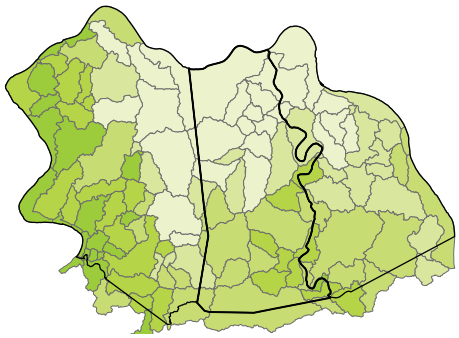


Highway Strip (Percent Development within 300')

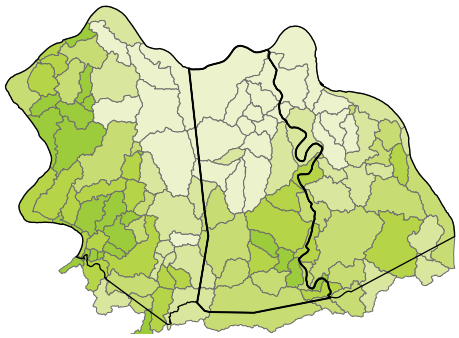
Appendix 10.5 Watershed Health Indicators used to generate composites shown in Chapter 8



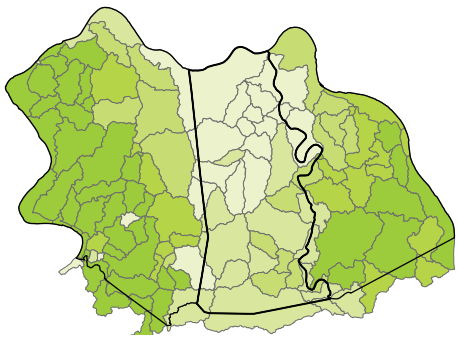
Key: Watersheds ordered by quintiles



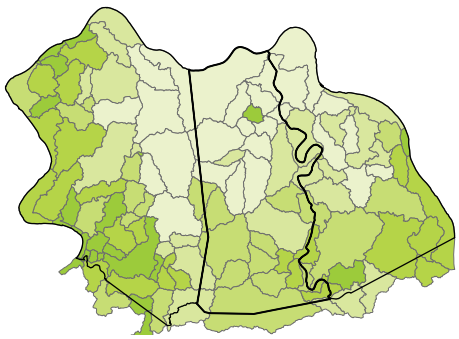
Overall Development



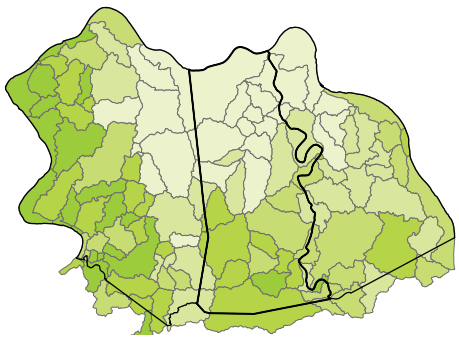
Low Density Development



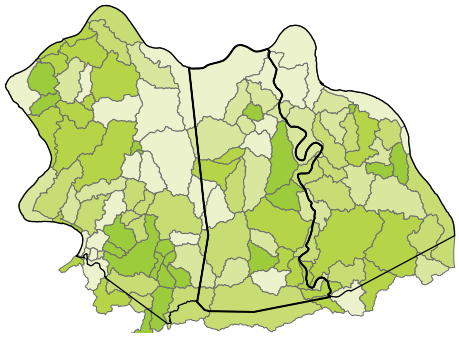
Impervious Cover



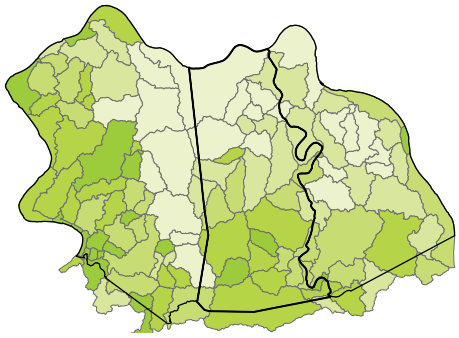
Population Density



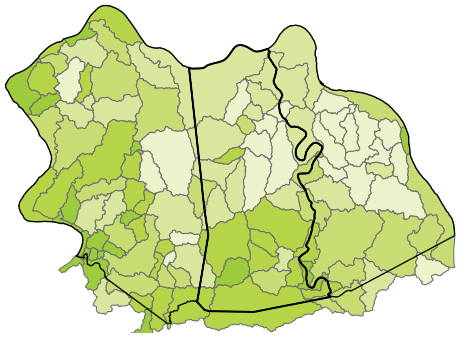
Road Density



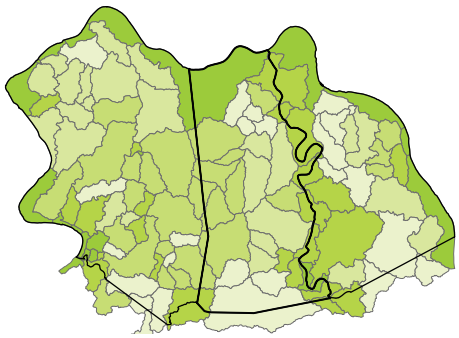
Stream Density



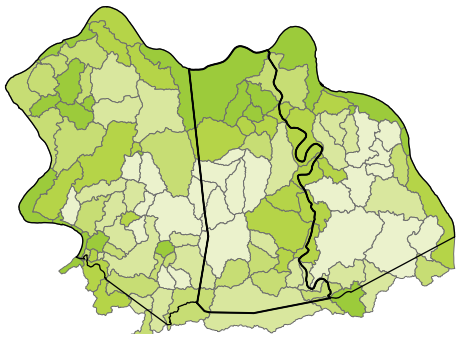
Road and Stream Intersections



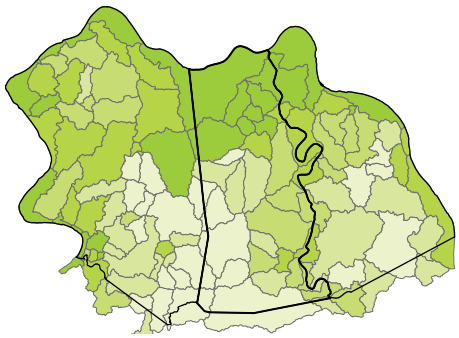
Roads in Riparian Zones



Wetlands

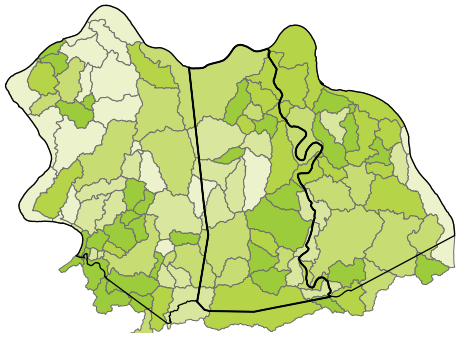


Agriculture in Riparian Zones

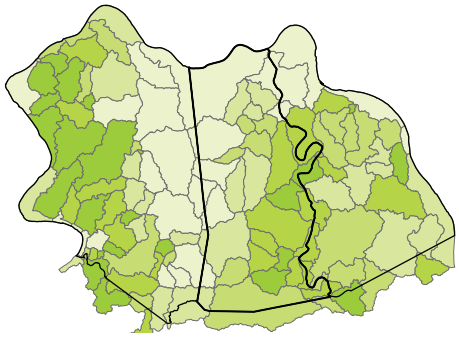


Pasture and Hay on Slopes

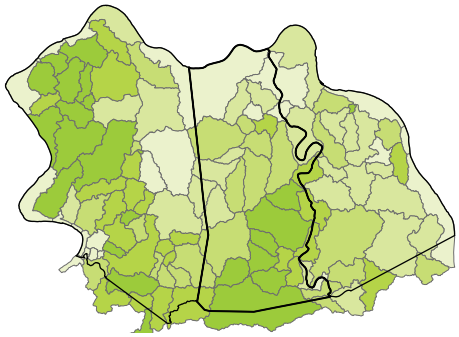
Appendix 10.5 Continued



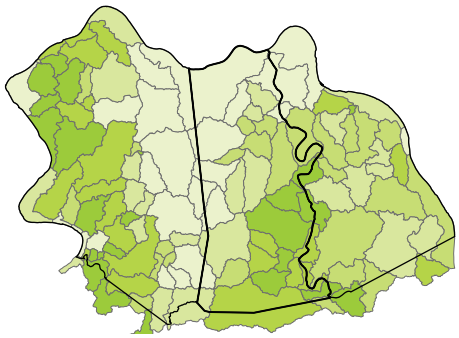
Crops on Slopes



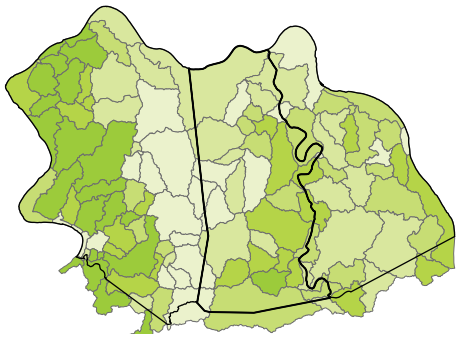
Forest Cover



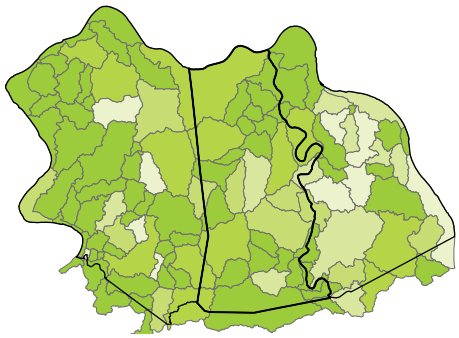
Forest in Riparian Zones



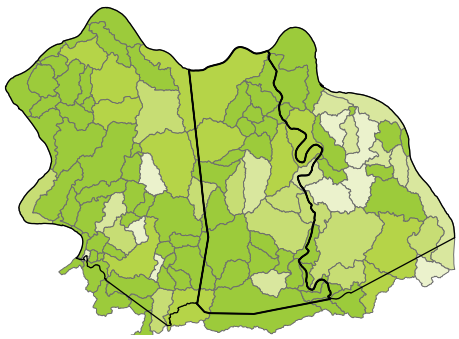
Canopy Cover



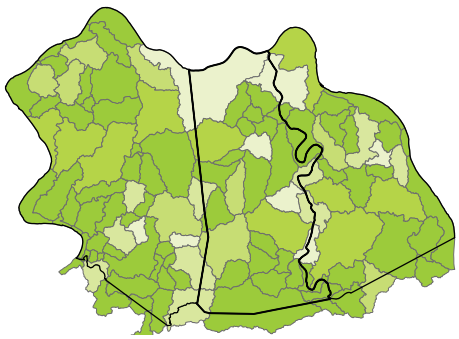
Interior Forest



Outfalls



Package Outfalls



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