

Section 1: Background



House Mountain and McAnnally Ridge define the landscape of Northeast Knox County.

Introduction

As the valleys of Knoxville-Knox County have been cleared for agriculture and development over the course of almost 300 years, the majority of remaining forested land exists mostly in hillside and ridgetop areas. Thus, the forested ridges have become a defining characteristic of our region's natural heritage. Not only do the ridges and hillsides embody the historical landscape, they are also a primary contributor to maintaining long term property values, clean air and water, and wildlife protection.

The Joint City/County Task Force on Ridge, Slope and Hillside Development and Protection was created by resolutions in March 2008 by both the Knoxville City Council and Knox County Commission. The impetus for the creation of this task force stemmed from recent developments on Chapman Ridge, which included the construction of a highly visible water tower. Other recent developments on ridge systems, which resulted in massive hillside scarring and significant forest loss, also contributed to the need to study, analyze and create recommendations for development and protection.

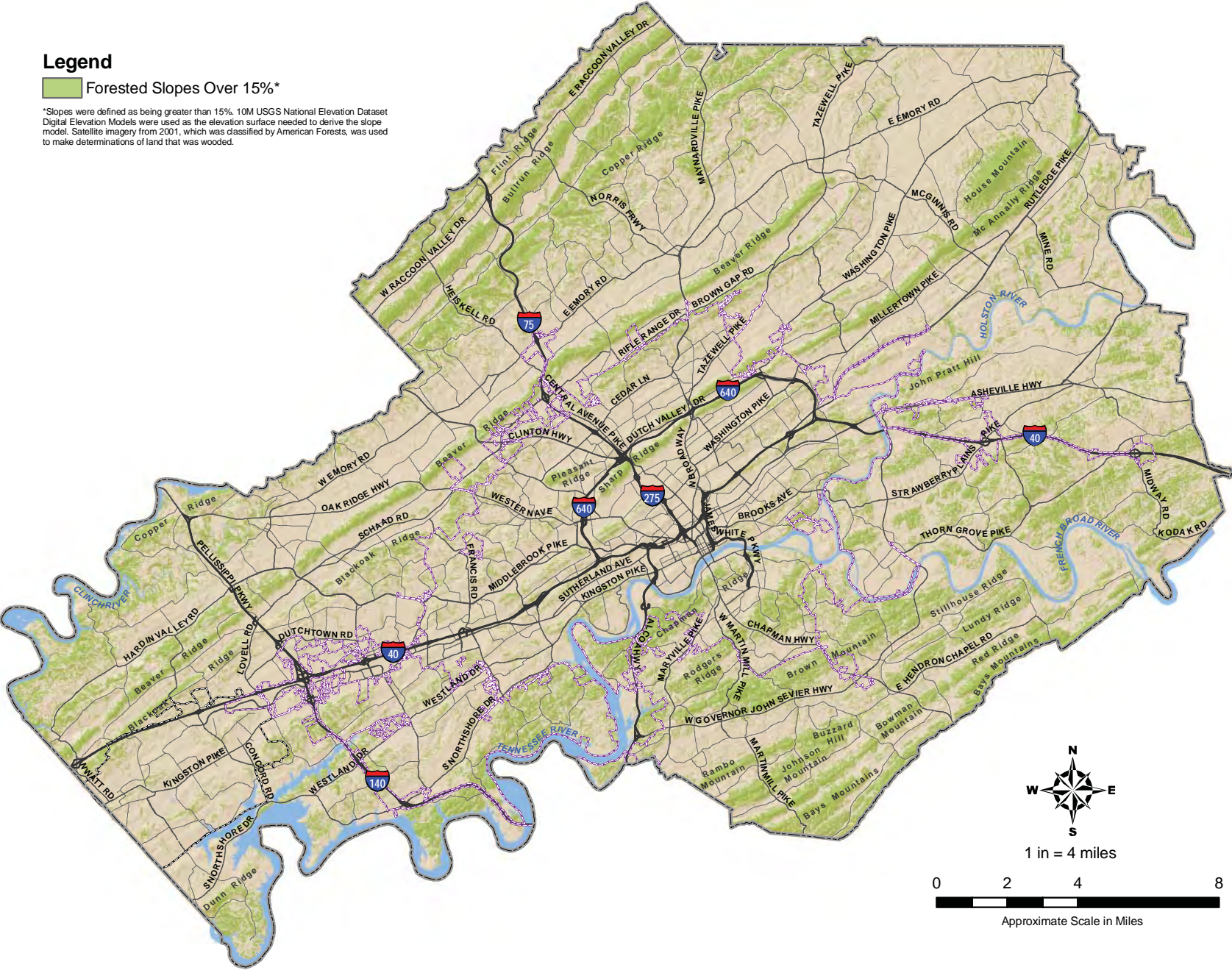
The task force is comprised of 29 citizens of Knoxville and Knox County representing a wide variety of interests and professions within the community; including builders and real estate professionals, landscape architects, engineers, city and county officials and professional staff, environmentalists, neighborhood advocates, attorneys and foresters. The Knoxville-Knox County Metropolitan Planning Commission was charged with providing technical analysis and facilitating the work of the task force. The first meeting was held in June 2008 and three subcommittees were formed to address issues related to land use, site design and public outreach. These subcommittees were designed to address various aspects of the development and planning process for hillside and ridgetop areas. In the past year, the task force and subcommittees have met approximately 50 times and have reviewed over 50 ordinances, reports and studies; on such topics as land disturbance, street design and parking, viewshed protection, slope restoration and reforestation, fire safety protection, water quality, and habitat protection.

Map 1: Forested Slopes

Legend

Forested Slopes Over 15%*

*Slopes were defined as being greater than 15%. 10M USGS National Elevation Dataset Digital Elevation Models were used as the elevation surface needed to derive the slope model. Satellite imagery from 2001, which was classified by American Forests, was used to make determinations of land that was wooded.



Characteristics of Ridges

FORESTED EXTENT

As of 2001, 50 to 60 percent of forested land was found in the hillside and ridgetop areas of Knoxville-Knox County. From 1989 to 1999 Knox County lost over 15,000 acres of forested land. The primary cause of forest loss in Knoxville-Knox County is conversion of agricultural land and speculative grading. Since 1999, 12,713 acres of agricultural land has been converted by rezoning. Forested hillside and ridgetop land is comprised primarily of cove hardwood, oak-hickory, and oak-pine forest community types. Oak-pine communities are often found on dry slopes, with chestnut oaks as the dominant species. On more moist slopes, the understory of the forest communities contain rhododendrons and mountain laurel. In areas with sandy soils over sandstone, virginia shortleaf and pine pitch stands occur.

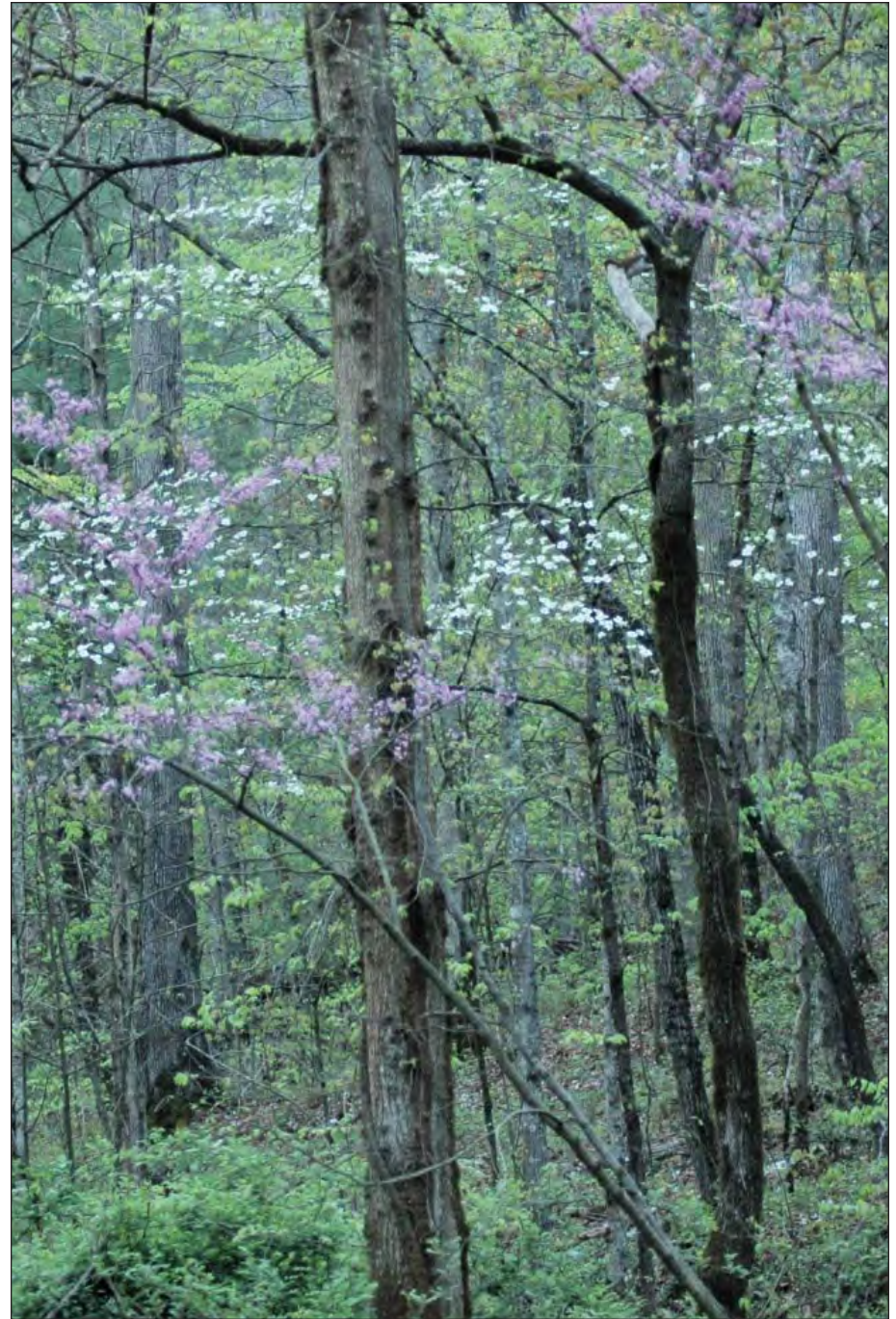
Forest Types in Knox County

The natural vegetation on Knox County's ridges are canopy and under-story trees associated with an oak-hickory forest. This is the most common type of forest in Tennessee, covering 72 percent of the state's forested areas. As the name suggests, a variety of oaks – red, white, chestnut and scarlet oaks – are found. Bitternut and shagbark hickories are also typical in these forests. Under-story trees include dogwood, red maple and sourwood. Oaks are particularly adaptable to the drier, south-facing ridges.

Cove hardwood or forests are also found in the rich hollows and lower portions of our ridges and mountains. Sugar maple, northern red oak and basswood commonly grow in the moist, fertile rich soils that are associated with this forest. These forests are typically found on north-facing slopes in the hollows of such places as Brown's Mountain and Copper Ridge.

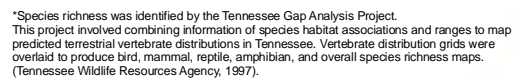
Many changes have occurred since 18th century settlement. Most of the county's forests were cut for agriculture or timber production in the past; however, soil was often left intact. In recent years, extensive clearing and grading has thwarted forest succession, that is, the new growth of plants and trees leading to the climax oak-hickory forest. When the soil is left intact, groundcover plants, like natural grasses, asters and goldenrod, can protect soil. In turn, this allows the growth of pine and regeneration of hardwoods, particularly when the roots and stumps are left behind.

In more recent time, some places, like Sharp's Ridge (above I-275) and Beaver Ridge (above Callahan Drive), have been sheared to the underlying bedrock. Pines have virtually been the only trees to come back in those locations. Fortunately, most of the oak-hickory forest has been conserved on Knox County ridges.



Typical forest community in Knox County

4 — The Knoxville Knox County Hillside and Ridgetop Protection Plan





Spotted Purple Butterfly
Credit: US National Fish & Wildlife Service

Threatened and endangered species are adversely affected by clear cutting and/or wholesale clearing of forested tracts. These large expanses of cleared land provide little protection for wildlife and major soil erosion concerns also threatening aquatic species in neighboring streams.

According to the Tennessee Gap Analysis Project, overall species richness is highest in the hillside and ridgetop areas of Knoxville and Knox County. These complex forest communities provide habitat for many native threatened and endangered species.



Wild Turkey in West Knoxville
Credit: Wade Franklin flickr.com

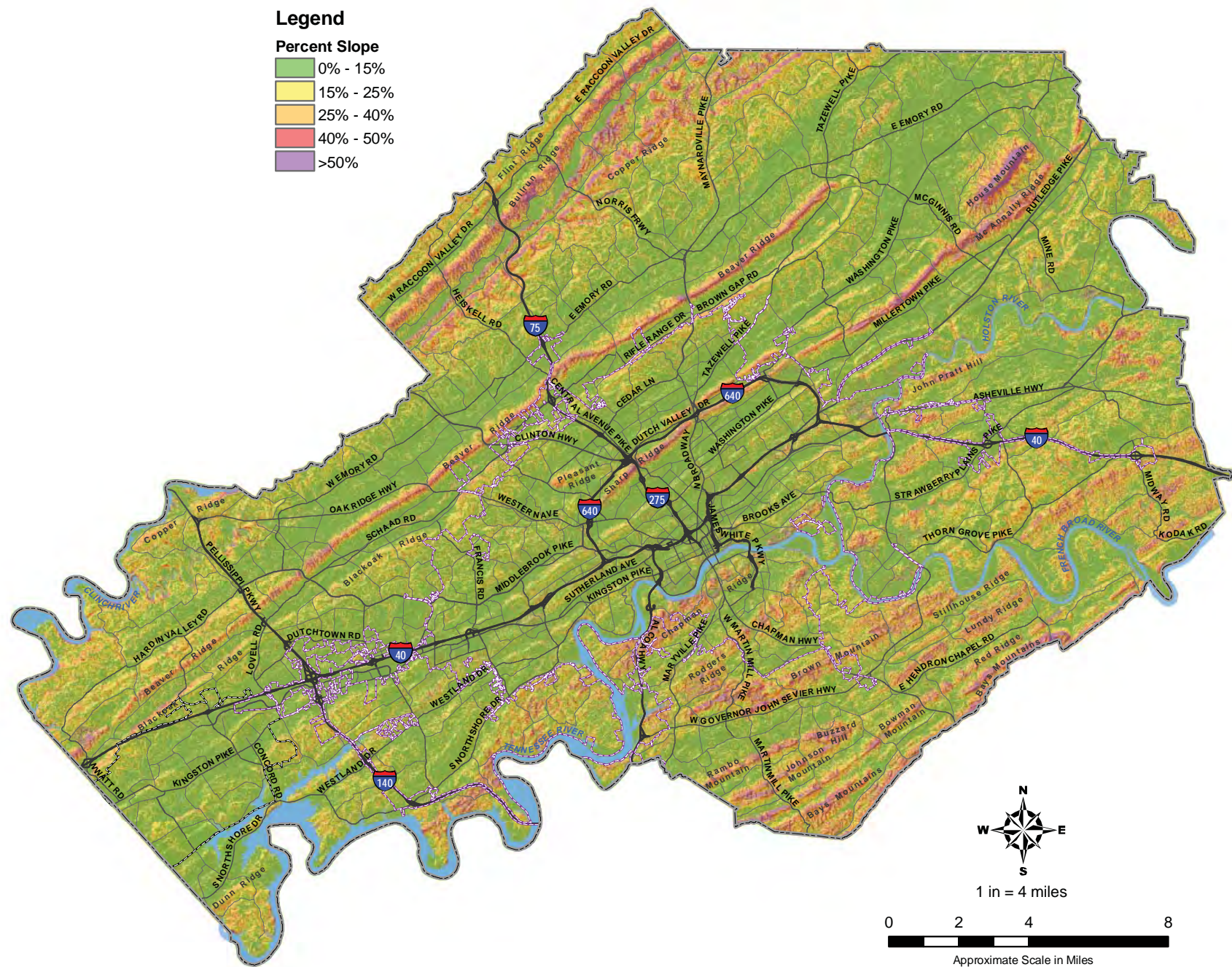
SLOPE

Generally, slopes in Knoxville-Knox County are measured as a percentage or as a ratio (rise/run). The terms slope and grade are often used interchangeably. As a point of reference regarding slopes, Walnut Street adjacent to the City-County building in downtown Knoxville has an approximately 23% grade or a 1:4.2 as a slope ratio. The majority of Knoxville and Knox County, approximately 67 percent, is sloped less than 15 percent. Land sloped 0-15 percent is found predominately within the valleys between ridge systems and in the lands near the rivers and reservoirs, while some areas sloped 0-15 percent are found on ridgetops.

Land that is sloped 0-15 percent in the valley generally does not pose many problems for development; however, ridgetop lands, while relatively flat, are often narrow and drain to areas with steep slopes and unstable soils. The following is a breakdown of slopes for Knoxville and Knox County. In evaluating slopes and building footprints, MPC staff and the task force noticed that the majority of development to date has remained in areas with slopes less than 25 percent. Policy recommendations regarding lands sloped greater than 15 percent has been integrated into the General Plan and Sector Plans since the 1990s and again in the Growth Policy Plan in 2000.

TABLE 1: COUNTYWIDE SLOPE CHARACTERISTICS		
<i>Percent Slope</i>	<i>Acres</i>	<i>Percent of County</i>
0 - 15	225,464	67.0
15 - 25	62,346	18.5
25 - 40	34,127	10.1
40 - 50	8,847	2.6
>50	5,797	1.7
Total	336,581	100.0

Map 3: Slope Classifications





Looking northwest, Beaver Ridge defines the communities of Karns, Powell and Halls.

GEOLOGICAL INFLUENCES ON THE FORM OF KNOX COUNTY'S RIDGES

Our ridges do not have uniform topography. Some are steeply angular. Some are more rounded. Being part of the Great Valley – the land between the Blue Ridge Mountains (that includes the Great Smoky Mountains) and the Cumberland Plateau— they are all oriented the same way, running from northeast to southwest, creating valleys that define communities like Halls, Powell and Gibbs.

Their bedrock has eroded over millions of years. Consequently, their geological foundations are varied. Different kinds of bedrock and geologic features, including faults, influence the shape of ridges. Typically, when sandstone is predominant, the ridges are narrow and distinctly defined. When other rock is present like shale, dolomite or limestone, ridges weather irregularly and have more varied topography. Another important factor in the shape of ridges is the inclination or “dip” of the rock layers. The shallower the dip, the broader and more asymmetric the ridge; the steeper the ridge, the steeper the dip.

In general terms, the types of ridges can be broken into three categories with their underlying geology being significant in their topographic form. The characteristics and implications of the features relative to conservation and development are summarized below.

“Knife-edge Ridges” Formed by Sandstone

Bull Run Ridge, Beaver Ridge, McAnnally Ridge, House Mountain and Bays Mountain (in Southeast Knox County—Bays Mountain in Northeast Knox County is underlain by limestone and dolomite) are prominent examples. Largely formed of sandstone, they are narrow and run for miles (with the exception of House Mountain), rapidly ascending from the surrounding valley floor.

Implications for Conservation and Development: Generally, developers have not looked to these knife-edged systems for development because their steep slopes (in excess of 25 %) present great difficulty for engineering roads and sound foundations. Almost all development has been undertaken on the lower, less steep slopes (those under 25 percent). Some very low density is occasionally seen on moderate slopes (15 to 25 percent). Rarely is there development on tops of these ridges; such development, particularly, with widespread tree clearing would be highly visible.

Asymmetrical Ridges Formed by Dolomite and Limestone

Black Oak Ridge and Copper Ridge are examples of asymmetrical ridges formed by dolomite and limestone. In these cases, the south face is generally less steep while the north face plummets to the floor of a valley. This is a result of the irregular weathering and erosion of the underlying bedrock. In addition, Knox group dolomite and limestone formations contain variable amounts of chert, which actually controls



Complexly shaped ridges, like Brown Mountain in south Knox County, vary widely in their form

the location of ridges. So, shallow-dipping layers of cherty dolomite will produce a wide expanse of ridge topography, like on Chestnut Ridge in the northwestern part of the county, with a steep northwest slope as the very cherty Copper Ridge Dolomite gives way to the limestone and shale that underlie the valley to the northwest. To the southeast of the very cherty Copper Ridge Dolomite is a valley of less resistant dolomite, and then another, usually narrower ridge underlain by more cherty dolomite. Then to the southeast of this ridge is another valley underlain by less cherty dolomite and limestone, and then another smaller, less prominent ridge underlain by moderately cherty dolomite. If the layering has a low dip, all of these ridges will be asymmetric; if the dip is steep, the ridges will be less asymmetric.

The gently rising south-facing slope is often used for residential subdivisions. For example, the houses of Fountain City, which are north of Merchants Road, were built on the dolomite formations.

Implications for Conservation and Development: Housing development on the south face and near the crest can be accomplished in an environmentally sensitive manner with conservation of woodlands. Development can also be inconspicuous as long as less steep locations are selected for buildings and clearing is limited. Generally, the very steep north faces of these ridges are areas that should be conserved.

Complexly Shaped Ridges

Formed by Sandstone, Shale and Limestone

Chapman Ridge and Brown's Mountain are prominent examples of complexly shaped ridges formed by sandstone, shale and limestone. Other well-known examples are in the lands surrounding Fort Loudoun Lake, like the rolling terrain of Lyon's Bend. They share a common characteristic: portions of their geologic formations have dissolved more readily over millions of years. In contrast to the knife-edged ridges, they are generally broad ridge systems that have a variety of features, including rounded knobs and steep hollows that are drained by small streams.

These ridges are substantially formed by sandstone but also contain layers of shale and limestone that are more subject to weathering processes, thus influencing the creation of hollows. Occasional gently sloped areas are interwoven into these broad ridges. In Knox County these ridges largely coincide with Chapman Ridge Sandstone, which is interspersed with shale, hematite (the iron oxide that gives it its red color, and limestone.

Implications for Conservation and Development: Many of the hollows and knobs are steeply sloping and are impractical for development. Occasionally level or gently sloping sites can be found and are suited to low density housing or clustered housing, which could be created with respect to steeper adjacent landscapes.



Soil slumping shown in the hillside area behind the playground demonstrates continued failure of the soil even after multiple attempts to stabilize the site.

Issues and Concerns

MASS WASTING (LANDSLIDES)

In 2003, improper clearing and grading during the construction of the Forest Ridge Apartments caused a landslide that destroyed an apartment building trapping and severely injuring an individual inside. The term landslide is often used interchangeably with mass wasting. Mass wasting is essentially the downward movement of earth materials. The two forms of mass wasting are classified as slope failures or sediment flows, the latter of which is often induced through the addition of water. They occur predominately in areas with steep slopes (such as slopes greater than 15 percent). They can be caused by both natural events (heavy rains, erosion, and earthquakes) and human-caused alterations to the land or a combination thereof. Generally, alterations to hillside and ridgetop land in Knoxville-Knox County are related to development activities and/or forestry practices. As slopes are cleared and graded, the likelihood of landslide events increase.

In evaluating soils and their capacity for development the Natural Resources Conservation Service (NRCS) Soil Survey for Knox County identifies soil types by slippage hazard. Soil slippage hazard is a measure of “the possibility that a mass

of soil will slip.” When vegetation is cleared, water saturates the soil and normal construction practices are applied (such as the application of heavy machinery) soil failure is more likely. Soil slippage hazard classes are identified as high (unstable), medium (moderately unstable) or low (slightly unstable to stable.)

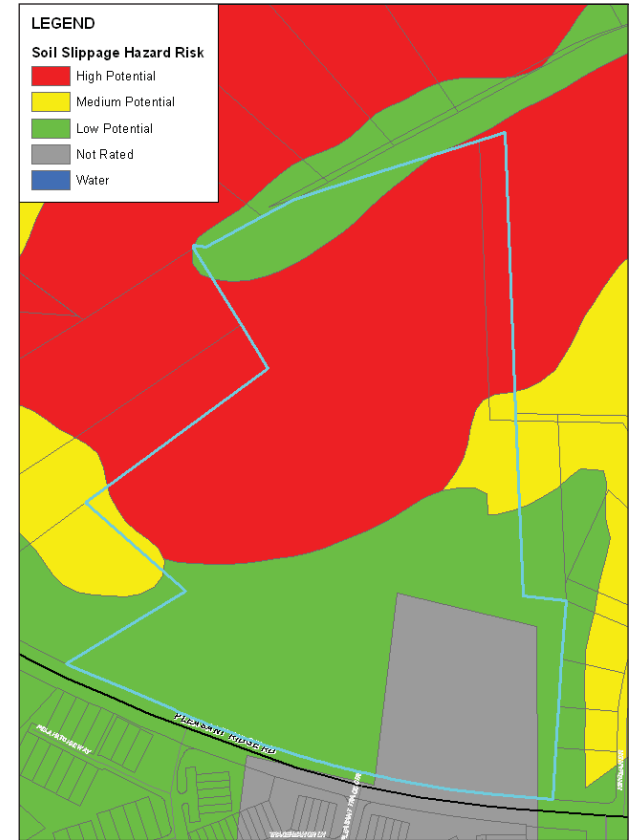
Classes are assigned based on observations of slope, mineral characteristics, strike and dip of bedrock geology, surface drainage patterns and occurrences of such features as slip scars and slumps. High slippage hazard soils are found predominately in steeply sloping hillside areas. (See also section 3.a on mass wasting for further discussion of landslide potential.)



A 1935 aerial image of the site shows the area in question as mostly forested.



A 2007 aerial image of the site shows the area in question has been heavily cleared and graded with little to no stabilization and signs of erosion.



High slip potential soils are dominate in the failure area.

In the past five years, a heavily cleared and graded site on a ridge on Pleasant Ridge Road behind a church-school has had several significant slope failures and sediment flows. Prior to disturbance the hillside had been forested as far back as 1935.

In evaluating soils, the NRCS soil survey map indicates the presence of high slip potential of soils in the failure area. Despite multiple efforts to stabilize the slope, the unstable soils have presented many difficulties for the property owners. As of spring 2009, a children's recreation area sits immediately adjacent to the slope still showing signs of imminent failure.



The above image was taken in September of 2008 during clearing and grading of phase III of the Wildwood Subdivision. Below: As of August 2009, the same area remained unstable. A portion of the hillside washed out closing a road in the neighborhood and causing water quality violations.

As of September 2008, Phase III of the Wildwood Subdivision off John Sevier Highway had received numerous water quality violations from both Knox County's Stormwater Engineering Department and the State of Tennessee's Department of Environment and Conservation. Encompassing both hillside and ridgetop lands on Brown Mountain, forested slopes ranging from 15 percent to greater than 50 percent were almost entirely cleared and graded with minimal erosion and sediment controls installed.

As of August of 2009, a massive sediment flow originating from a cleared and graded hillside had closed a road in the Wildwood Subdivision. Erosion and sediment control devices were also not functioning properly on the site and sediment spills over into an adjacent stream.



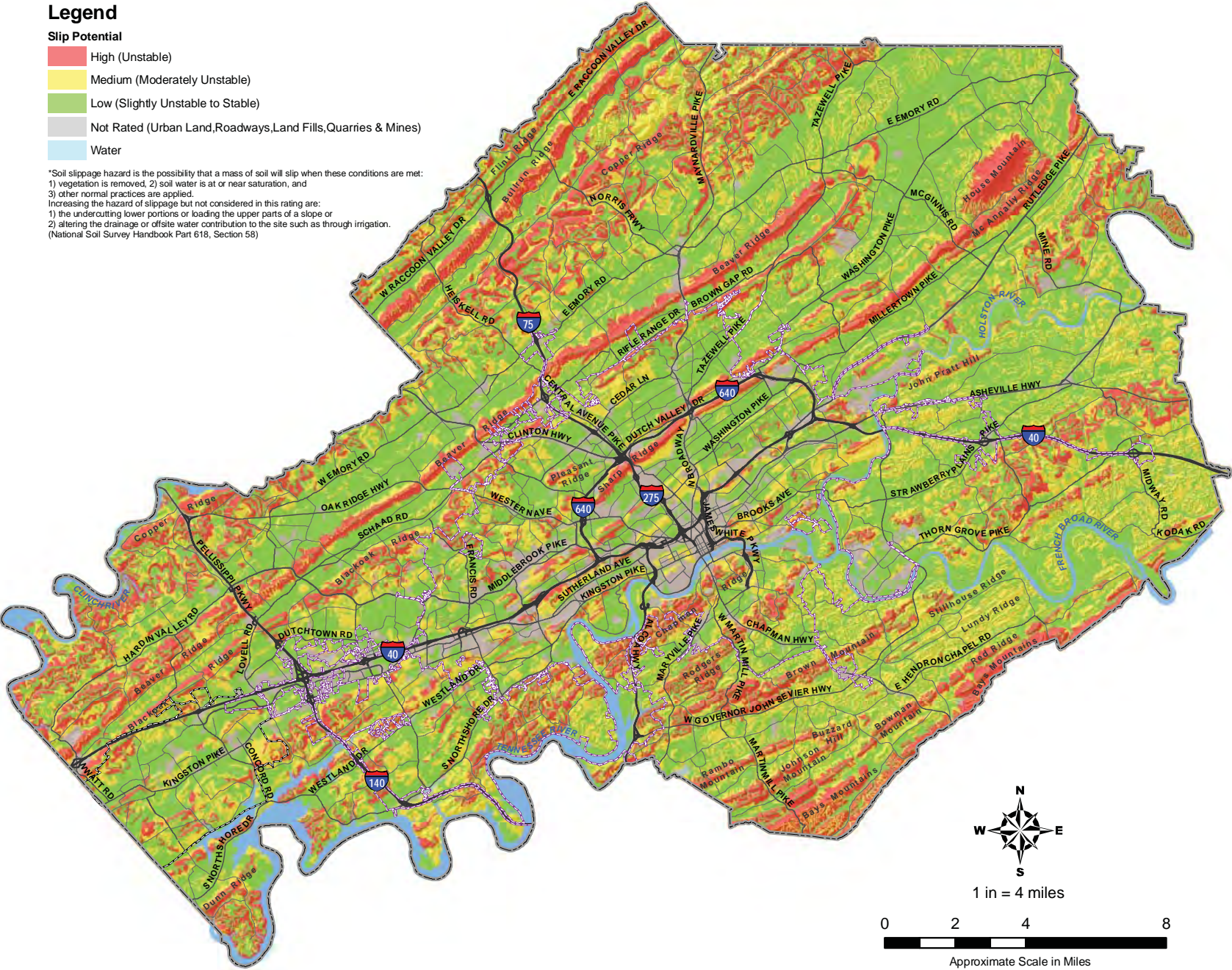
Map 4: Soil Slippage Potential

Legend

Slip Potential

- High (Unstable)
- Medium (Moderately Unstable)
- Low (Slightly Unstable to Stable)
- Not Rated (Urban Land,Roadways,Land Fills,Quarries & Mines)
- Water

*Soil slippage hazard is the possibility that a mass of soil will slip when these conditions are met:
1) vegetation is removed, 2) soil water is at or near saturation, and
3) other normal practices are applied.
Increasing the hazard of slippage but not considered in this rating are:
1) the undercutting lower portions or loading the upper parts of a slope or
2) altering the drainage or offsite water contribution to the site such as through irrigation.
(National Soil Survey Handbook Part 618, Section 58)





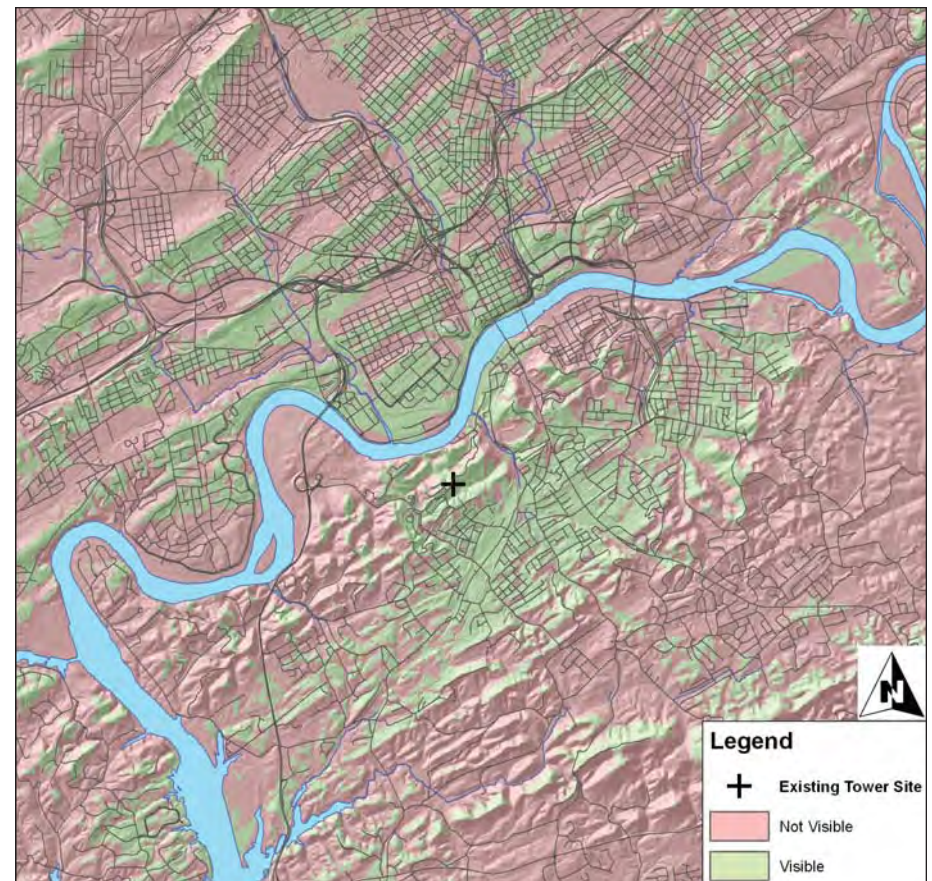
The water tower in South Knoxville sits 180 feet high obscuring scenic views of Chapman Ridge and the south Knoxville landscape. Below: Visibility Analysis of the South Knoxville Water Tower

HEIGHT OF STRUCTURES

When the South Knoxville water tower was erected on the view above Cherokee Trail on Chapman Ridge, many citizens were upset at the perceived lack of public review in the approval process of such a highly visible structure. In 2004, a multi-family residential development consisting of 143 units was approved on Cherokee Trail. During the review process, the need for a water tower was not indicated, simply stating that “public water and sewer utilities are available to serve the site.” However, by September of 2007 the need for water supply and pressure sufficient to provide sprinkled fire protection for the buildings was identified and MPC approved the use on review application for a water tower of approximately 180’ feet in height as applied for by the Woodlands of Knoxville, LLC.

The water tower was designed and constructed to meet the standards and requirements set forth by the Knoxville Utilities Board. The water tower is visible from many parts of downtown and along many arterials coming into the city.

The construction of wireless communication facilities (such as cell towers and radio antennas) along the ridge systems of Knoxville-Knox County has also been a concern for many citizens. In response to these complaints, MPC, the Knoxville City Council and the Knox County Commission approved a Wireless Communication Facilities Plan in 2002. However, the plan serves as more of a design guidance document than an enforceable set of standards because of the 1996 Telecommunications Act. This federal law protects private firms from more stringent local ordinances, however, there may be some measures adopted locally that could limiting the number of towers in the line of sight of scenic resources.





Cleared land that is not utilized for development often remains deforested with minimal revegetation through current regulations.

LACK OF REFORESTATION

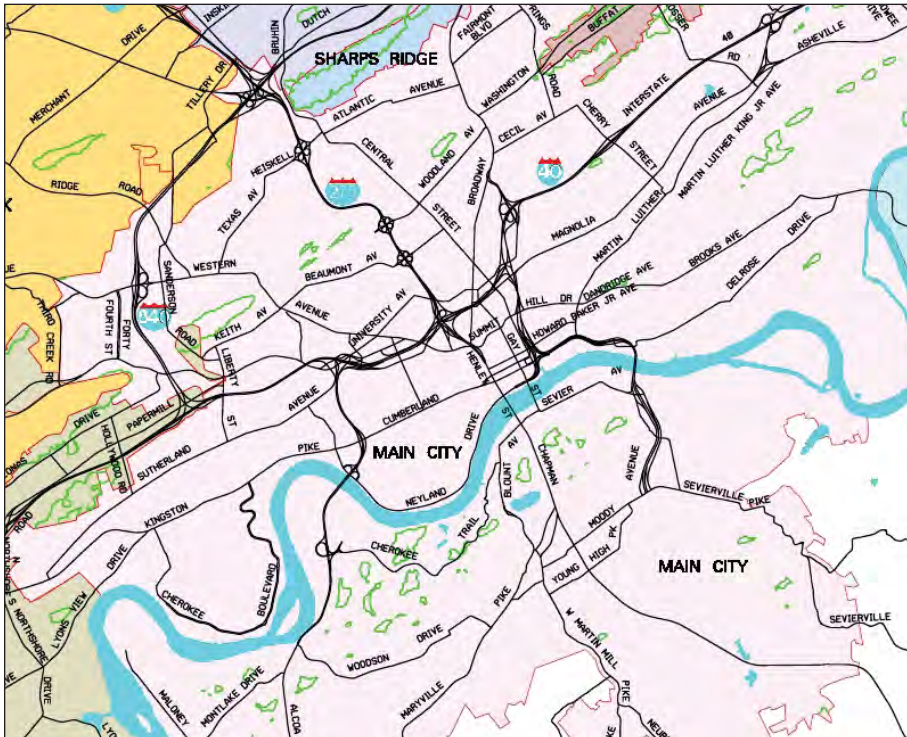
Since the majority of forested land is found in hillside and ridgetop areas, large swathes of clearing related to development and clearcutting related to forestry activities are often highly visible and related to extensive erosion and sediment control issues. Large scale clearing and grading in several hillside and ridgetop areas have raised concerns in the community related to both environmental and scenic resources.

Cleared land that is not utilized for development often remains deforested with minimal revegetation through current regulations. Grass matting is often used on steep slopes to minimize soil erosion, and trees are rarely replanted.

Existing regulations for clearing and grading pertain generally to erosion and sediment control. Knox County does not have a limitation on clearing or require reforestation of cleared undeveloped lands. The City of Knoxville requires that no more than 25% of land be cleared over a five year period on any one parcel when a building permit or subdivision approval has not been issued. When a building

permit or subdivision approval is required a minimum of six trees per acre shall remain unless cut and fill work is so extensive the trees cannot be saved. Large scale developments generally require extensive cut and fill work in areas with steep slopes.

Since 1935, the Agricultural Zoning Exemption Statute has maintained that zoning powers shall not limit or affect in any way or control the agricultural uses of land. The Tennessee Right to Farm Act, adopted in 1982, further protected farm and farming noting that neither could be a public or private nuisance. An opinion of the State Attorney General “declared that clear-cut tree harvesting was also outside the scope of the county’s power to regulate via zoning.” This opinion was based on court decisions in other states that prohibited local regulation of tree cutting operations. Particularly in times of economic downturn, cleared sites remain undeveloped and unreforested for decades. During which time, erosion and sedimentation issues continue for years on a site, degrading water quality of neighboring streams and groundwater.



LACK OF INFRASTRUCTURE

Construction of the water tower in 2007 was necessitated by additional condominium style development in the KUB service area for Chapman Ridge. The elevation of the area created several pockets where water pressure was inadequate to service shared-wall structures. Since that time, KUB and some utility districts of the Utilities Management Federation have been encouraged to complete mapping of their jurisdiction to demonstrate where service gaps currently exist. These areas tend to align heavily with the higher elevation points across Knoxville and Knox County.

Historically, these steeply sloped higher elevation areas have been largely undeveloped or developed at a very low density. Thus, roads in these areas tend to be inadequate to service large-scale denser developments. Steep road grades also raise concerns regarding emergency response in hillside and ridgetop areas. Problems related to fire safety protection has been a major concern in areas with similar topographical challenges such as Sevier County.

A task force member and forester for the State of Tennessee noted that there have been many instances of failure in emergency response equipment in areas with slopes very similar to those of Knox County.

Top Left: Increased wind speeds and the creation of a “fuel ladder” (as fire moves upslope the intensity is amplified through the burning of ground, mid and high level vegetation) destroyed five homes on Cove Mountain in Sevier County. The only local source of water, a well, was not sufficient to suppress the flames. Top Right: The transmission on this fire truck failed on a road grade of approximately 18 percent. Left: A draft KUB service area map denotes inadequate service in some hillside and ridgetop locations.



Sediment runoff across an uncovered lot can release as much as 30 tons of soil during a rain storm.

STORMWATER CONTROL AND WATER QUALITY

Sediment is the foremost pollutant in Knox County's waterways. Construction activities, particularly grading and cleared un-stabilized sites are major causes. The runoff that flows across an uncovered lot can release as much as 30 tons of soil during a rain storm. Sediment increases flooding, impacts public and private water supply, and destroys aquatic habitat. Runoff on cleared and graded steep slopes can be a particularly severe problem because of the increased velocity of downhill flow, resulting in greater potential for erosion. Hillside forest conservation is among the best strategies to avoid erosion problems. Trees intercept stormwater and reduce runoff. When rain falls the drops are deflected by leaves lessening the impact of the storm on underlying soils. Ground cover and roots hold the soils in place, also reducing susceptibility of erosion. Stormwater runoff rates from forested areas are the least of any landscape type, which helps to reduce flooding and serves as a filter of pollution.



An acre of trees removes about 2.6 tons of carbon each year; part of the formula to reduce air pollution.

AIR QUALITY

A healthy urban forest is part of the formula in reducing air pollution. Trees remove carbon dioxide, ozone and small air born particles that are released by vehicle and other fossil fuel burning processes. Carbon dioxide, which is another by-product of vehicle emissions, causes heat to build-up in our atmosphere. Trees reduce that effect because during photosynthesis, a tree transforms carbon dioxide into carbohydrates that are used by the trees in its growth and, in turn, releases oxygen. An acre of trees removes about 2.6 tons of carbon each year, or the equivalent of the carbon dioxide that is produced by an automobile driven about 26,000 miles per year.

Locally, the most serious air pollution problems are ozone and very small particulate matter. The U.S. Environmental Protection Agency has found that Knoxville-Knox County to be out of compliance in meeting acceptable standards for these two pollutants. Several environmental health problems, such as respiratory disease, result from high levels of these pollutants. Because a primary source is vehicle exhaust, various sanctions can be placed on local governments to improve air quality.

With most of our trees being located on ridges, there is a significant role that forest conservation plays in removing particulate pollution (those less than 10 microns) and ozone. The ozone problem is a "double-edged sword" because while trees can remove ozone to some degree, they are also harmed by high concentrations of ozone. This is a concern because recent studies indicate that ozone tends to singe tree leaves, reducing their ability to remove the overabundance of carbon dioxide in the lower atmosphere.



Over 40 percent of Knox County is in the rural designated area, which includes the 60 percent of the hillside and ridgetop areas.

Existing Plans and Policies

THE GROWTH PLAN FOR KNOXVILLE, KNOX COUNTY, AND FARRAGUT, TENNESSEE

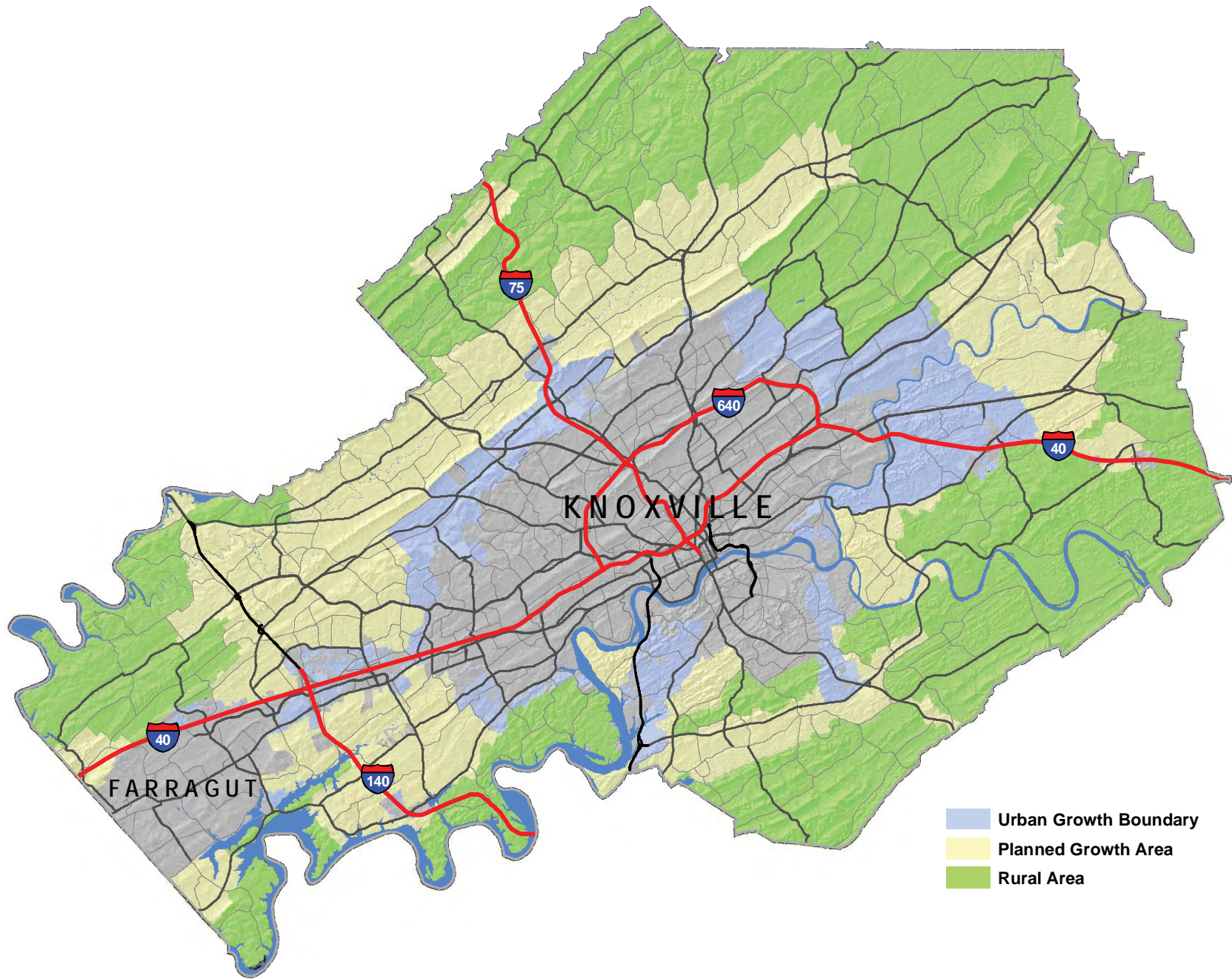
In 2001, Knoxville, Knox County, and the Town of Farragut agreed to and adopted the Growth Policy Plan. The document identifies specific areas for urban and suburban growth as well as a rural area, which under state law has to be set aside to:

- Identify territory that, over the next twenty (20) years, is to be preserved as agricultural lands, forests, recreational areas, wildlife management areas or for uses other than high density commercial, industrial or residential development;
- Reflect the county's duty to manage growth and natural resources in a manner which reasonably minimizes detrimental impact to agricultural lands, forests, recreational areas and wildlife management areas.

The adopted plan has policies relative to slope and density in the rural area:

- Rezoning on slopes of 25 % or more shall be limited to the following zoning districts: Open Space (OS), Estate (E) and Planned Residential (PR) at densities of one (1) dwelling unit per two or more acres.
- Rezonings on slopes of 15 to 25 % shall be limited to zoning districts which have a minimum one (1) acre lot size; Agriculture (A), Estate (E), Open Space (OS), and Planned Residential (PR) on lots of one (1) or more acres are appropriate.

Map 5: Knoxville, Knox County, and Farragut Growth Plan



The last part of the Growth Policy Plan includes several recommendations for ridge and forest protection:

- Incentives to encourage rural cluster development, whereby rural landscape features are preserved by allowing concentration of development on a relatively small part of a rural site. This could be based on a modified form of the existing Open Space (OS) zoning district.
- Local zoning ordinances should be revised to include overlay zones or site plan review provisions that would create and enforce environmentally sound standards for development on hillsides or other steeply sloping lands. Hillside protection ordinances (a) to limit the intensity of new development on hillsides, and (b) to preserve trees and ground cover as part of the development processes. These regulations are needed to manage forest resources during development, protect habitat, prevent erosion, preserve aesthetic resources, maintain water quality and avoid flooding.
- The local governments should work with state and federal biologists to identify where there are critical habitats for endangered species and develop local programs to set aside open space in those areas.

THE GENERAL PLAN

The 2033 General Plan, approved in December of 2003, presents broad, long range principles, concepts and policies that cover both Knoxville and Knox County over a 30-year timeframe. Throughout the plan reference is made to the need for the preservation and enhancement our ridges as part of the Agenda for Quality Growth. Several principles and concepts are mentioned that speak directly to hillside and ridgetop conservation.

- Natural features along transportation corridors, such as creeks and ridges, should be treated as resources to be conserved and enhanced rather than obstacles to be overcome or removed.
- A system of greenways should be established to protect environmentally sensitive areas to link neighborhoods to schools, parks and libraries and to define communities.
- Ridges should be preserved for wildlife and plant habitat as part of our respect and nurturing of Knoxville-Knox County's heritage areas.
- Create open space within new development by conserving naturally vegetated areas and putting new landscaping in place.

- Vegetated areas also filter pollutants and maintain cooler temperatures.
- Trees and natural areas enhance the character of neighborhoods and provide buffers from incompatible uses.
- Neighborhoods should be designed to respect and fit the natural terrain, preserving trees and open space.
- More density should be allowed in exchange for amenities such as quality landscaping and open space.

Under the action proposals for natural heritage preservation, several points relate explicitly to the work of the task force these include;

- Designate ridge, stream and river corridors as special areas with unique environmental and scenic values, identifying areas to conserve and the development opportunities that are consistent with the values.
- Create an Urban Forestry Plan for Knox County, to protect woodlands and plant trees, including the creation of a city-county tree board.
- Develop standards to rehabilitate hillsides and streams and to avoid disturbances of those assets in the future.

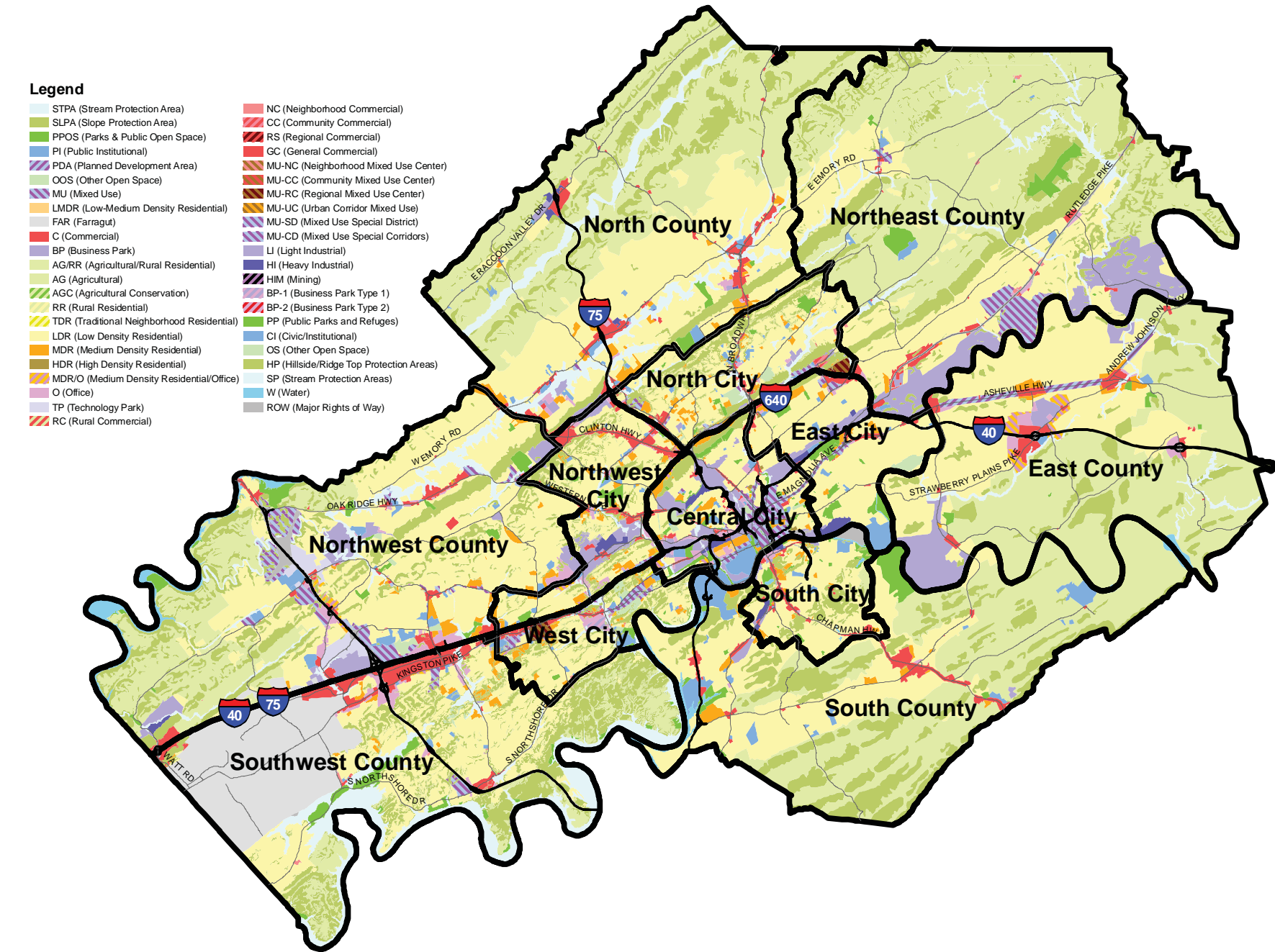
SECTOR PLANS

All sector plans identify areas for slope protection, see page 19. These include properties characterized by slopes in excess of 15 percent. However, the land use policies that deal with slope protection focus on their use as residential properties, rather than for a wider range of land uses. The following summarizes the basic policies for development in slope protection areas:

- Slopes 15 percent to 25 percent
Residential development at less than two dwelling units per acre
- Slopes 25 percent or greater
Residential at one dwelling per two acres

The policies also call for the protection of forested areas in association with steep slope areas and the use of planned development zones for further protection.

Map 6: MPC Planning Sectors



Existing Regulations

LAND CLEARING AND GRADING

State of Tennessee

The state of Tennessee's Tennessee Department of Environment and Conservation (TDEC) requires a National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP) and a Storm Water Pollution Prevention Plan (SWPPP) for land disturbing activities (for example, grubbing, excavation, grading, utilities and infrastructure installation) of at least one acre. This is filed as a Notice of Intent (NOI) permit with the state. Though this permitting process an applicant is required to identify the area of disturbance via a site plan and estimate of the total number of acres to be disturbed; however, there are no limitations on the amount of disturbance or the amount of existing tree and vegetation removal.

City of Knoxville

The city of Knoxville's Engineering Division also requires a Site Development Permit "prior to the beginning of any grading, clearing, excavating, filling or other disturbance of natural terrain." If a building permit or subdivision approval is not required, no more than 25 percent of the trees shall be removed over a five-year period on any parcel of non-exempt land without approval by the city horticulturalist. If a building permit or subdivision approval is required a minimum of six trees per acre shall be retained on site unless they cannot be retained because of other grading regulations, such as cut and fill slopes or road building minimum requirements.

Knox County

Knox County requires a grading permit prior to any land disturbing activity (clearing, grading, excavating, filling or other disturbance of natural terrain) of at least one acre or involves a larger common plan of development or sale that would disturb at least one acre. A bond, letter of credit, or cash deposit is required to adequately complete the drainage facilities and erosion control measures for stabilizing the site. However, there are no requirements for preserving a portion of trees, nor are there requirements for reforestation in the disturbed areas.

SUBDIVISION REGULATIONS

During the development process, the following minimum design standards must be adhered to in Knoxville and Knox County. These standards are set forth by the *Knoxville-Knox County Minimum Subdivision Regulations*, *City of Knoxville Zoning Ordinance*, *Knox County Zoning Ordinance*, *Knoxville Code of Ordinances* and *Knox County Code of Ordinances*. The following standards apply to both the city and county unless otherwise specified.

Streets and Roads

Local Streets

- Minimum pavement width of twenty-six feet, right-of-way width fifty feet.
- Maximum grade shall not exceed 12 percent. However, Knox County and the city of Knoxville Engineering may allow grades up to 15 percent.

Joint Permanent Easements (JPE)

- In the city of Knoxville a surveyor must certify the grade on the plat by way of a note. Grade of the JPE must be traversable with a maximum grade of 12 percent or less. A road profile may be necessary.

Driveways

- In the city of Knoxville all driveways shall be constructed to conform to the existing paved street grade, unless a different grade is approved by the Stormwater Engineering Division; driveways shall be laid to the lines and grades established by the director and subject to his inspection and approval. The site development permit review checklist calls for driveway grades of 12:1.
- In Knox County, there are no regulations regarding the grade of driveways.

Lot Drainage and Topography

- Lots shall not be excessively steep or contain excessive amounts of surface or near surface rock.
- Fill dirt shall not be placed upon sites which are to be used for drainfields.

Hillside Subdivisions

Hillside lands are defined as land proposed to be subdivided which has at least a 16 percent slope (an average difference in elevation of at least 16 feet in a horizontal distance of 100 feet. Any street frontage having a length of 300 feet or more shall be considered a hillside land area if the slope of 30 percent or more of its length equals or exceeds 16 percent. All provisions of these regulations as set forth herein shall apply to a "hillside land subdivision."

Street Design

When the average cross slope is between 26 and 40 percent:

- Pavement widths may be reduced to 20 feet.

When the average cross slope is greater than 40 percent:

- The minimum pavement width may be reduced to 16 feet for one-way traffic
- Right-of-way width can be reduced to 40 feet.
- Lots can front on only one side of the street.

Curb and Gutter

When street grades are 6 percent or less:

- Curb and gutter are required.

When street grades are 6 percent or greater:

- Six-inch vertical curb and gutters is required

Lots

When the average cross slope is between 26 and 40 percent:

- Average minimum lot areas for the entire subdivided area will be 25,000 square feet.
- Not less than 80 percent of the lots shall have a minimum area of 25,000 square feet.
- No lot shall have an area of less than 20,000 square feet.
- Minimum lot frontage is one hundred (100) feet.
- Cul-de-sac minimum frontage may be reduced to 50 feet.
- Minimum lot width is 100 feet.

When the average cross slope is greater than 40 percent:

- Average minimum lot areas for the entire subdivided area will be one acre.
- Not less than 80 percent of the lots shall have a minimum area of one acre.
- No lot shall have an area of less than 25,000 square feet.
- Minimum lot frontage is 140 feet
- Cul-de-sac minimum frontage may be reduced to 60 feet.
- Minimum lot width is 130 feet.

Note: Front setbacks are the same as what is required as per the city or county zoning ordinance for the underlying zoning.

Building Height

Most zones in the city and county have a 35 feet height limitation for buildings. Exemptions include telecommunication antennas (see commercial telecommunication facilities), power transmission towers, water tanks and with increased setbacks, churches, schools, hospitals and other public and semi-public buildings, may exceed the height limitations.

COMMERCIAL TELECOMMUNICATIONS FACILITIES

- Collocation of antennas and attachment to existing buildings are preferred regarding telecommunications towers. New construction should be a last resort option. Options to limit adverse impacts also include reduced heights for monopoles, camouflaging, and screening to minimize detrimental effects to the community.
- Administrative review is allowed if collocating or building an antenna on an existing structure that does not exceed more than 30 feet above the highest

point of the structure and with an antenna height.

- A Use on Review application is required if new construction is required.

In the *Wireless Communication Facilities Plan*, the following siting design guidance applies to ridges and mountains identified on the United States Geological Survey (USGS) quadrangle maps.

- Avoid skylining towers
- Use a backdrop to reduce visibility
- Locate towers below the ridgeline, not exceeding 30 feet above the ridge top tree line. Ridge top tree line is defined as the height of the tallest tree within 100 feet either side of the place where the tower exceeds the height of the ridgeline.

BUILDING PERMITS

The city of Knoxville and Knox County issue building permits to construct, enlarge, alter, repair or demolish a structure or to change the use of a building. Multi-family residential and commercial buildings require more detail in plan submission than single-family and two-family dwellings. The city of Knoxville and Knox County primarily use the standards of the most current version of the *International Building Code* and the *Residential Code*, as well as the various codes providing standards for fuel gas, plumbing, electrical, and mechanical. Generally, there are three inspections in the building permitting process (initial, rough-in and final) before a Certificate of Occupancy can be issued; however, a Certificate of Occupancy is not required for single-family residences or duplexes.

TREE PROTECTION

Knox County does not have a tree protection ordinance. However, the city of Knoxville has had a tree protection ordinance since 1992. In regard to clearing and grading the ordinance notes that where a building permit or subdivision approval has not been issued no more than 25 percent of the trees shall be cleared on any one parcel. For new land development and construction a minimum of six trees per acre shall be preserved unless because of cut and fill work such trees cannot be saved. The ordinance is administered by the city horticulturist. However, the definition of trees is limited to those that have a trunk six inches or more in diameter at one foot above the ground; or those of a horticultural variety or that are highly ornamental (e.g. dogwood, redbud, crabapple, sourwood, flowering cherry or peach, southern magnolia, or holly) and has a trunk diameter of three inches or more at one foot above the ground. When trees cannot be preserved because of cut and fill or do not exist on the site, they are required to be provided within 12 months of construction completion, at the rate of eight trees per acre, with at least one-half of the required number being species capable of attaining a height of 50 feet or more at maturity. Such trees shall have a minimum trunk diameter of two inches at six inches above ground at planting, unless of an ornamental variety, which shall have a minimum trunk diameter of one and one-fourth inches at six inches above ground at planting.

Typical Approaches: Model Ordinance and Guidelines

Many cities across the United States in areas with ridges and mountains have adopted protection ordinances because of the unique challenges their topography has for land development. In investigating their approaches, we limited our focus to cities in the Southeast. In late 2007, Sevier County commissioned a study to provide recommendations for protecting hillsides and ridges. This study provided a potential methodology for identifying scenic resource areas and then a second series of recommendations for site and design standards on slopes greater than 15 percent. The city of Gatlinburg utilized many of these recommendations as part of their recently adopted hillside ordinance. The city of Asheville has had a hillside ordinance since the 1980s, however, they recently updated their ordinance with more rigorous land disturbance and density limitations in areas with a natural average slope greater than 15 percent and above a defined elevation. In 2006, the city of Fayetteville, Arkansas adopted a hillside overlay district and best management practices for land development and lot development. In 2005, White County nestled in the north Georgia mountains adopted a hillside ordinance for areas with slopes greater than 25 percent, thus limiting land disturbance and requiring reforestation.

Many of the ordinances we reviewed had common approaches for reducing the impact of development on steep slopes and hillsides. These recommendations span a variety of standards and best management practices with the ultimate goal of limiting disturbance on hillside and ridgetop areas. Most ordinances call for narrower road standards, locating utilities under the streets or sidewalks, and reduced setbacks to limit disturbance in hillside and ridgetop areas. Heights of buildings and utility structures are also reduced to a height less than the average height of the tree canopy. Reductions in density for residential and limitations on building footprints for commercial are also commonly used to reduce disturbance. Overall standards for grading and clearing as it relates to the slope of the land are used in almost all ordinances reviewed. Geotechnical studies are called for in many ordinances when slopes are above 30 percent.

Economic Considerations

Beyond environmental benefits conservation of green space has many positive economic impacts for local communities. Natural open space areas, particularly forested areas, help reduce runoff and stormwater system demands. According to a 2002 study by American Forests, 744 million cubic feet of stormwater is retained by Knoxville and Knox County's urban forest area, saving \$1.48 billion dollars in infrastructure costs (estimated at \$2 per cubic foot). However, these areas are not necessarily protected or conserved. The study goes on to note that these same forested areas remove about 16.5 million pounds of pollutants (nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone, and particulate matter of 10 microns or less) from the air each year, a benefit worth \$41.2 million dollars annually.

Increased land and housing values for properties adjacent to or near conservation areas and passive parks (open/green space without ball fields, tennis courts and similar facilities) has been well documented across the country. National trends have demonstrated increases up to 20 percent in properties adjacent to passive parks. Another study in 2003 noted that within open space had greater positive effects on property values than any other land use. Linear parks, like Sequoyah Hills on Fort Loudoun Lake maximize increases in property values, in part, because of the large number of properties that abut or are near the park. In looking at these studies, staff sees potential value in creating some public or quasi-public hillside and ridgetop conservation areas, such as those mentioned in the recently adopted Knoxville-Knox County Park, Recreation and Greenways Plan. Included in this, is the soon-to-be-realized Urban Wilderness and Historic Corridor in south Knoxville.

Summary of Public Input

TASK FORCE AND SUBCOMMITTEE MEETINGS

The task force, along with the assistance of the Knoxville-Knox County Metropolitan Planning Commission and Leadership Knoxville held their first meeting on July 11, 2008. The meeting allowed the group to identify commonly held themes and issues, including:

- An abundance of trees and vegetation characterize much of Knox County.
- Limiting sprawl by clustering development can be beneficial.
- Maintaining clean air and water are basic needs.
- Greenway connectivity and walkable communities are needed.
- The beauty and ecology of forested ridge should be maintained.
- More appropriate hillside is needed development.
- Impact of roads and transportation infrastructure must be considered.

The following issues were identified as discussions points in creating hillside protection and development program:

- Both private property rights and public rights (such as protection of environmental quality) are important.
- Finding a balance between the benefits of preserving forested ridges and economic development is needed.
- A consistent way is needed to identify hillsides and ridgetops.
- Conservation programs are needed for some areas (for instance, what slopes are too steep for site development).
- Public outreach and education are needed during task force processes.
- Incentives should be created for hillside and ridgetop protection.
- Costs and benefits of implementing hillside protection programs are important.
- Impacts of ridgetop development on public infrastructure and environment are concerns.
- Future growth of the area and potential impact to hillsides and ridges must be considered.
- Implementation should be linked to the staffing capabilities, including manpower, for plan review and enforcement.
- Existing regulations, for example effects of zoning and subdivision regulations, must be considered.
- Land disturbance permit processes for city and county (tree clearing) should be examined.
- Amendments are needed to minimize impacts (for example, reduced road widths, setbacks, building heights, and grading maximums).
- Fire hazard and water supply issues for ridgetop development should be concerns.
- Density and clearing are concerns on hillsides and ridgetops.

- Water quality impacts and habitat protection are linked to hillside conservation.
- Urban forest resources and the need for reforestation are concerns.
- Other communities and their conservation programs should be studied.

Based on the issues, the task force established sub-committees to handle the many topics that would need to be addressed. The following sub-committees were formed based on expertise of task force members.

- Land Use and Permit Process
- Site Design and Restoration Standards
- Public Relations, Education and Recreation

Chairs were appointed for each of the sub-committees to facilitate the process and communication among group members. The sub-committees met 29 times over the course of 17 months to discuss the themes and issues that were most relevant to their specialties. The sub-committees reported back at the full task force meetings to gain consensus of issues and needed policy and code changes.

Meetings with task force co-chairs and sub-committee chairs and MPC staff were conducted four times to help keep the project work and consensus building process moving along efficiently. These meetings were held to help reduce research and work overlap between the sub-committees and decide which committee was best suited to research and discuss the various issues as they relate to hillsides and ridgetops.

To addresses specific topical areas, where additional expertise was needed, five additional meetings were held. These meetings addressed specifically utilities, fire protection, reforestation and slope restoration.

The full task force has met a total of seven times thus far. Before the meeting in July of 2008, a survey was sent to the members to gauge their views on the various issues and concerns related to hillsides and ridgetops and the possible policy solutions that have been used in other municipalities.

SURVEYS OF TASK FORCE MEMBERS

The first survey that task force members completed gauged the acceptability of various policy options and tools that could be used to protect the hillside and ridgetop areas of Knoxville and Knox County.

- Over 74 percent of the group strongly agreed that clearing limitations and modified engineering standards with a goal of minimizing grading are needed.
- 74 percent of the group also strongly agreed that reforestation standards and topsoil conservation were needed.
- 65 percent of the task force agreed that the regulations are needed and can be varied in response to the degree of slope (i.e. fewer houses on steeper slopes).

- 61 percent strongly agreed that there should be a prohibition of development on slopes greater than 40 percent.
- 57 percent strongly agreed that land uses in hillside and ridgetop areas should be regulated, with 26 percent agreeing.
- 74 percent of the group indicated that they would like to see the general form and environmental function of ridges be maintained while allowing for development, while 26 percent of the group would not want to see any manmade changes to hillsides, and 9 percent believe that changes to hillsides and ridges are the right an individual property owner (Note: over 100% due to respondent error).
- The area with the least amount of consensus was in regard to application of new regulations to existing single family lots. Many cities exempt existing single family lots.

A second survey was given to the task force in December of 2008 to address the potential policy solutions that had been discussed and evaluate their level of consensus.

- 96 percent of the survey respondents agree that Knoxville and Knox County needs a mapped hillside and ridge top area and 92 percent agree that within these areas there should be more rigorous development standards (including limitation on density, clearing and building height).
- 88 percent agree that these areas should require further review before rezoning, subdivision, clearing, grading and building activities commence.
- 88 percent agree that density and clearing should be graduated based on the percent slope and ridgetop status.
- 84 percent believe that if a conservation easement is utilized to protect steep slope and ridgetop areas of a property, a density bonus should be considered for the more level portions of the property.
- 83 percent agree that soil slippage is an important consideration in the hillside and ridgetop areas, as well as the conservation of forested areas.
- Again, in regard to exempting existing single family lots there was less consensus, however, there was more agreement that they should be only limited to clearing standard provisions.
- The respondents also agreed that development should be more restrictive as slopes increase, particularly in slopes 40 percent and above and on ridgetops.
- In regard to height of buildings 63 percent agreed that 35 feet is an acceptable

PUBLIC MEETINGS

While every task force meeting was sunshined and open to the public, task force members along with the assistance of MPC held 9 public meetings around Knoxville-Knox County during the months of July and August in 2009 to educate the public about the work of the task force and to gauge the acceptability of the proposed standards. During the public meetings task force co-chairs facilitated the meetings

and MPC staff presented on the challenges of developing on steeply sloped land and potential policy solutions. Attendees were surveyed on proposed policies for the hillside and ridgetop areas. The presentation and survey were also made available on the MPC website. More than 200 citizens attended the meetings and filled out the survey or responded to the survey on-line.

- 84 percent indicated that they strongly agree/agree with reductions in residential density and 69 percent strongly agree/agree with allowing a density increase in the more level portion of the property if an individual conserves hillside and ridgetop land.
- Over 90 percent agree that industrial and large scale commercial should be prohibited and that the size of apartment buildings should be limited in the hillside and ridgetop areas and large apartment complexes should be located at the base of the ridge (rather than on the ridge).
- Over 78 percent agree that building height should be limited 35 feet or three stories.
- 92 percent agree that clearing and grading should be prohibited without an approved development plan
- 92 percent agree that the steeper the slope the less clearing and grading should be allowed.
- 93 percent agree that there should be standards for borrow pits (soil mines), such as limiting their extent, identifying non-ridge alternative locations and requiring slope restoration and reforestation.
- 95 percent agree that there should be requisite standards for slope restoration and reforestation.
- 89 percent agree that some hillside and ridgetop areas should be identified for a donation/purchase program as part of the greenways/park system.

In addition to the survey responses, there were approximately 50 comments that were recorded at the public meetings. Summary of the eight areas of concern are outlined below.

ENVIRONMENTAL DEGRADATION:

Many citizens made observations about changes in Knox County's landscape that they felt should be addressed. These included such statements as "ridges have been shaved off, there were more trees in the 1970s."

FAILURE OF EXISTING REGULATIONS:

Some meeting participants pointed to shortcomings in the protection of water, scenic and forest resources. Such observations included lack of control in land clearing and grading, overly steep driveways, and erosion and sediment problems. Current bonding practices and were noted to be a potential shortcoming in assuring proper development practices. Shortcomings in enforcement were also noted.

STRENGTH OF GROWTH PLAN FOR KNOXVILLE, KNOX COUNTY, AND FARRAGUT:

A few citizens recognized that the development policies of the plan (for example, slope protection and residential density parameters) are important. Some people noted that the plan's Rural Area is also important in conserving agricultural and forest resources.

BALANCING DEVELOPMENT AND CONSERVATION:

Some citizens made comments to the effect that the solutions to hillside protection do not have to total preservation nor unrestricted development and reasonable approaches to accommodate responsible change is needed. Some citizens felt that individual single family house or lot owners would not likely be a problem.

NEGATIVE EFFECTS ON LAND VALUES WITH HILLSIDE REGULATION:

Some interests said they feared that land investments will be harmed by new regulations. A related concern was a hypothesis that if hillside regulations are put in place that there would be no more land for development.

ENVIRONMENTAL STEWARDSHIP:

Several people commented on the relationship of ridge protection to creek and river water quality, habitat protection (that it is not only people who can benefit from protection programs) and the scenic qualities of ridges in defining their communities (like Beaver Ridge).

RIDGES AS POTENTIAL PUBLIC OPEN SPACE RESOURCES:

A few citizens pointed to the possibility of creating a purchasing program to set aside ridges as part of an open space system. The work of the Legacy Park Foundation is a consideration in this regard.

NEW CODES AND ENFORCEMENT:

A few citizens said that model management practices of other cities and counties should be considered in developing the Knoxville-Knox County program. Many citizens pointed to the need for clarity in new or revised codes. Some citizens noted a need to be realistic in how codes can be administered, including the potential for additional enforcement personnel.

Implications from Current Regulations, Ordinance Reviews and Meetings

In reviewing the current Knoxville and Knox County regulations on clearing, grading and development on hillsides and ridgetops, the task force noted several shortcomings. Because of the particularly sensitivities of hillside and ridgetop lands, from environmental, economic and aesthetic perspectives, hillside clearing and development can have a more far reaching and long-lasting impact on the community than development on more level land areas. Wholesale clearing of land is currently allowed in the county with no requirements for reforestation, resulting in massive scarring on hillside lands. Task force consensus and responses from community meetings and surveys have shown that current policy regarding tree clearing in the county are both economically and environmentally unsustainable for maintaining property values, and clean air and water. Other communities around the United States have come to similar conclusions adopting grading and clearing standards specific to hillside and ridgetop lands, as demonstrated through the review of local ordinances.

Current limitations on hillside and ridgetop residential density has shortcomings. The existing general and sector plan policies work reasonably well when planned residential zoning is in place. However, some zone districts as Low Density Residential (RA) and General Residential (RB), which do require a site plan review, allow more density than a hillside site can sustain. The degradation to environmental resources has been a problem (see page 11 and the results of the Wildwood Subdivision). Additionally, there are occasional problems in assessing the need for water supply and fire hazard protection infrastructure; this should be calculated prior to setting densities, location and height of structures, and location of water tanks and towers (this was a basic problem in case of the South Knoxville water tower). It was the consensus of the task force and the participating community that more intense land uses, such as commercial and industrial uses and borrow pits, should be limited to more level land because of their environmental impacts and infrastructure demands.

During task force and community meetings, it became apparent that most people hold high regard for the rights of private property owners. Accordingly, their recommended advice in developing a plan revolved around a balance between conservation and development. Because of the overwhelming support to conserve the natural character of the hillsides and ridges in the community, the task force and majority of participants agree that the provision of incentives (for example, higher intensity development on more level portions of a site). These approaches and policy recommendations are addressed in the next component of this document: the policies and proposals of the Hillside and Ridgetop Plan.