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Hillside and Ridgetop Protection Plan

Prepared by the Knoxville Knox County Metropolitan Planning Commission
for the City-County Task Force on Ridge, Slope and Hillside Development & Protection

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Hillside and Ridgetop Protection Plan

This plan was adopted by:

Knoxville City Council on December 13, 2011
Knox County Commission on January 23, 2012

NOTE TO THE READER:
The following paragraph was added at the time of adoption by Knox County Commission.
This paragraph was not adopted by Knoxville City Council.

KNOX COUNTY AMENDMENT

NATURE OF PLAN AND LEGAL EFFECT

This plan and the principles, objectives, policies and guidelines included herein are advisory in nature and constitute non-binding recommendations for consideration in connection with development of steeply sloped areas. While this plan is being adopted as an amendment to the Knoxville-Knox County General Plan 2033, it is intended to provide background and supplemental information of an advisory nature and to serve as a guide to future MPC staff recommendations, but it is not intended to form an official part of the General Plan which would be binding on future land use decisions by County Commission, MPC, the County Board of Zoning Appeals pursuant to T.C.A. § 13-3-304. Any comparable provisions of the Knoxville-Knox County General Plan 2033 or any Sector Plan which relate to hillside and ridgetop protection shall also be considered advisory consistent with this plan.

Preface

The original version of this plan was prepared by the City-County Task Force on Ridge, Slope and Hillside Development and Protection following more than two years of work and public review and presented to the Knoxville-Knox County Metropolitan Planning Commission for consideration in September, 2010; revised and adopted by the Metropolitan Planning Commission in December 2010; and further revised and initiated as an amendment to the Knoxville-Knox County General Plan 2033 by the Knoxville City Council and Knox County Commission in November 2011.

With adoption of this Hillside and Ridgetop Protection Plan, the initial work of the City-County Task Force, the Metropolitan Planning Commission, Knoxville City Council and Knox County Commission comes to an end. These bodies have pursued a general policy of balancing conservation and development needs. The tone of that balance can be seen in Section 2, the plan section.

Before reading that section, take some time to review the background material, which provides an overview of hillside resources, and the shortcomings, as well as the positive aspects, of existing slope protection plans, codes and standards.

This plan sets forth the vision and primary means to be used to safely development steep slopes and ridgetops while minimizing offsite environmental damage; and it recognizes that implementation of these general objectives depends upon future adoption of ordinances and regulations by the legislative bodies of the City and County governments. The plan likewise recognizes that flexibility will be needed in applying these general goals and principles to specific proposals and site conditions on unique parcels of land, and leaves room for approval of sound engineering and creative solutions to meet these objectives.

The plan includes density and land disturbance guidelines which serve as a refinement of the existing policies of the General Plan. As such, a primary means to implement the plan are through the consideration of new zoning requests and development plan cases. You will also see that several steps are recommended for plan implementation. Some of these will require further public review, like the adoption of new hillside road standards and hillside and ridgetop land disturbance codes. The task force and MPC staff are willing to work with City and County staff for a second phase of work, including the drafting, review and refinement of new codes, standards, and regulations. These would likely include a conservation subdivision ordinance, hillside road standards, and stormwater regulations amendments regarding hillside land disturbance.

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Section 1: Background

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

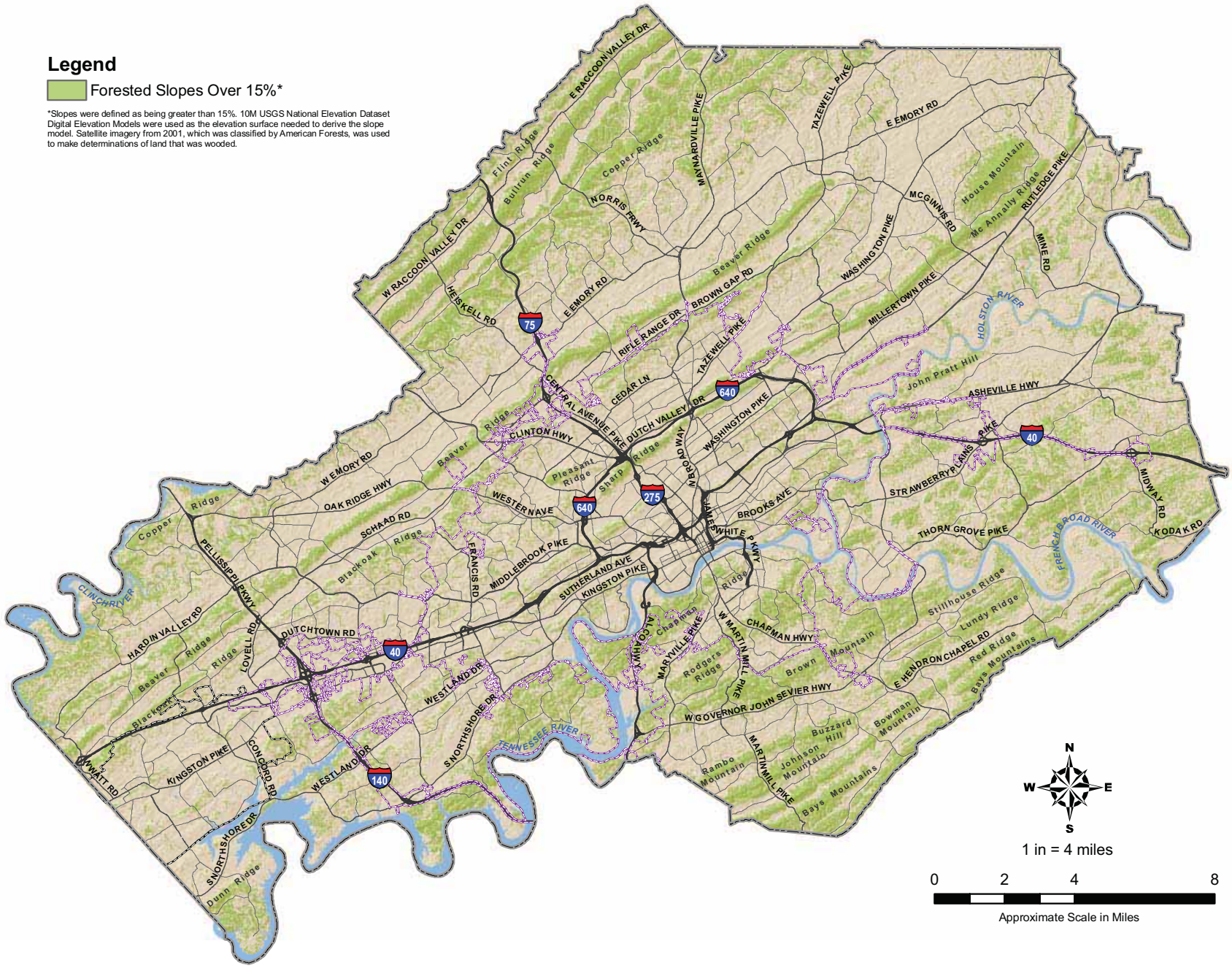
Introduction

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



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.[1] From 1989 to 1999 Knox County lost over 15,000 acres of forested land.[2] 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.[3] 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.[4] In areas with sandy soils over sandstone, virginia shortleaf and pine pitch stands occur.

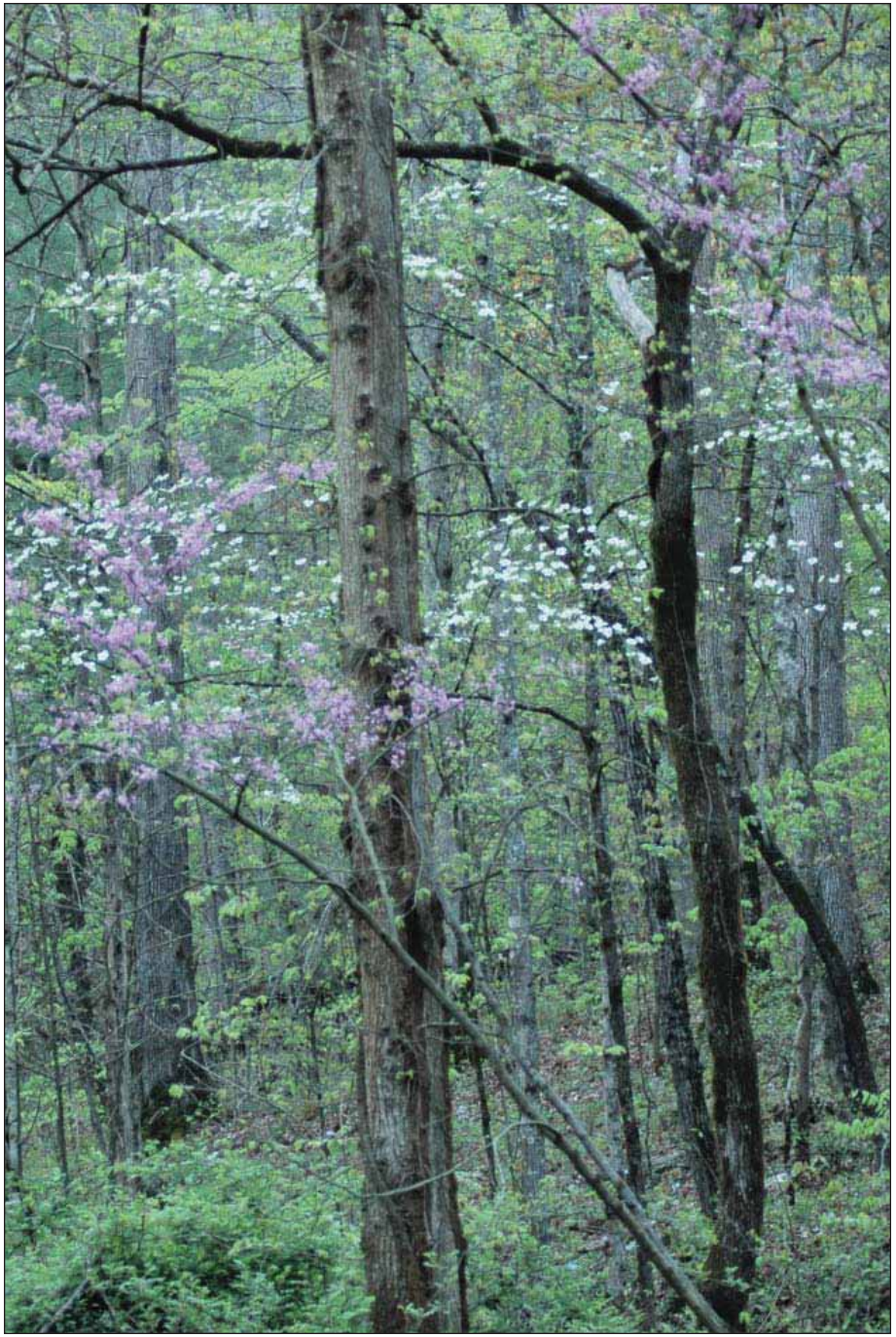
Forest Types in Knox County

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.

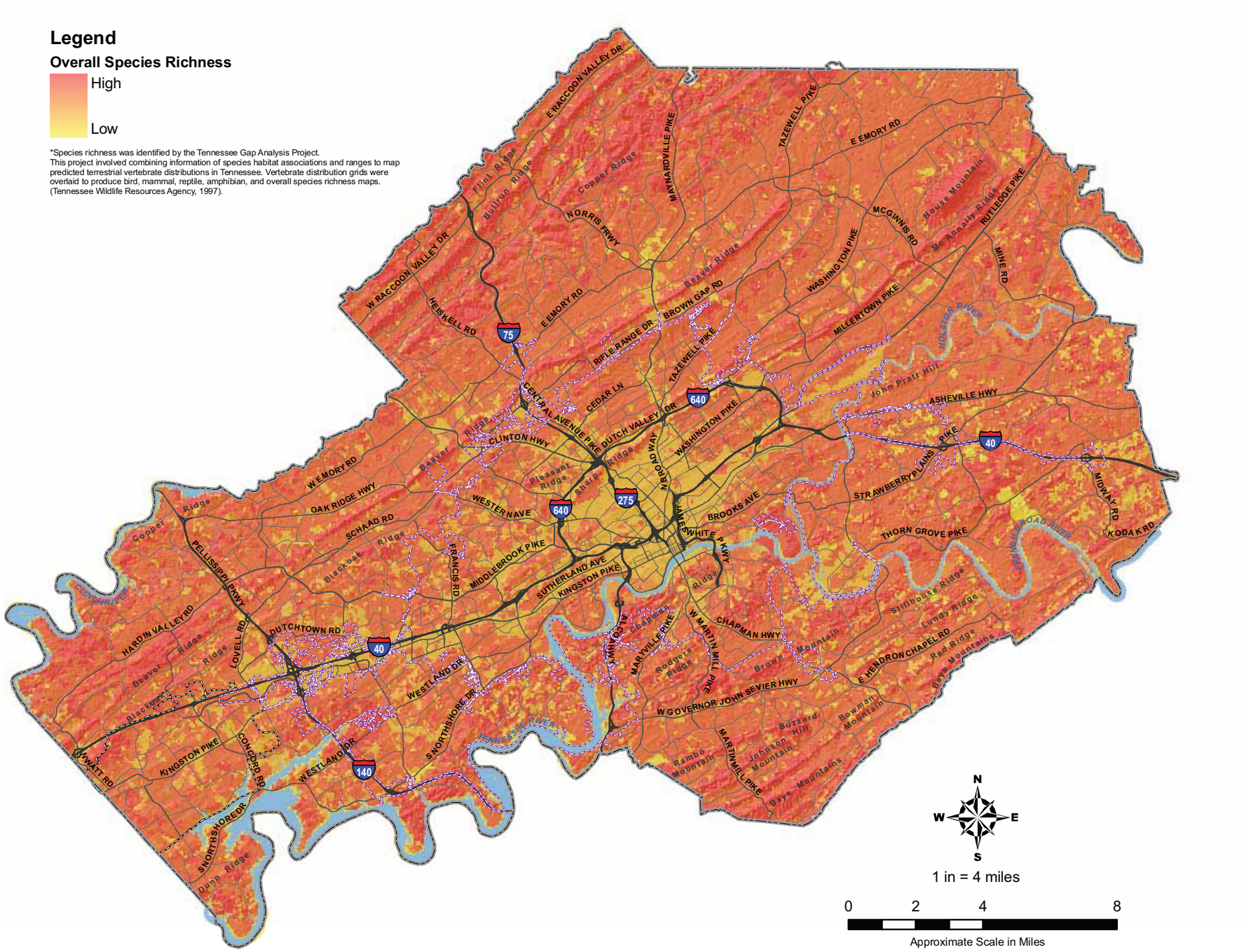
Many changes have occurred since 18th century settlement. Most of the county's forests were cut for agriculture or timber production in the past; however, soil was often left intact. In recent years, extensive clearing and grading has thwarted forest succession, that is, the new growth of plants and 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

Map 2: Species Richness



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

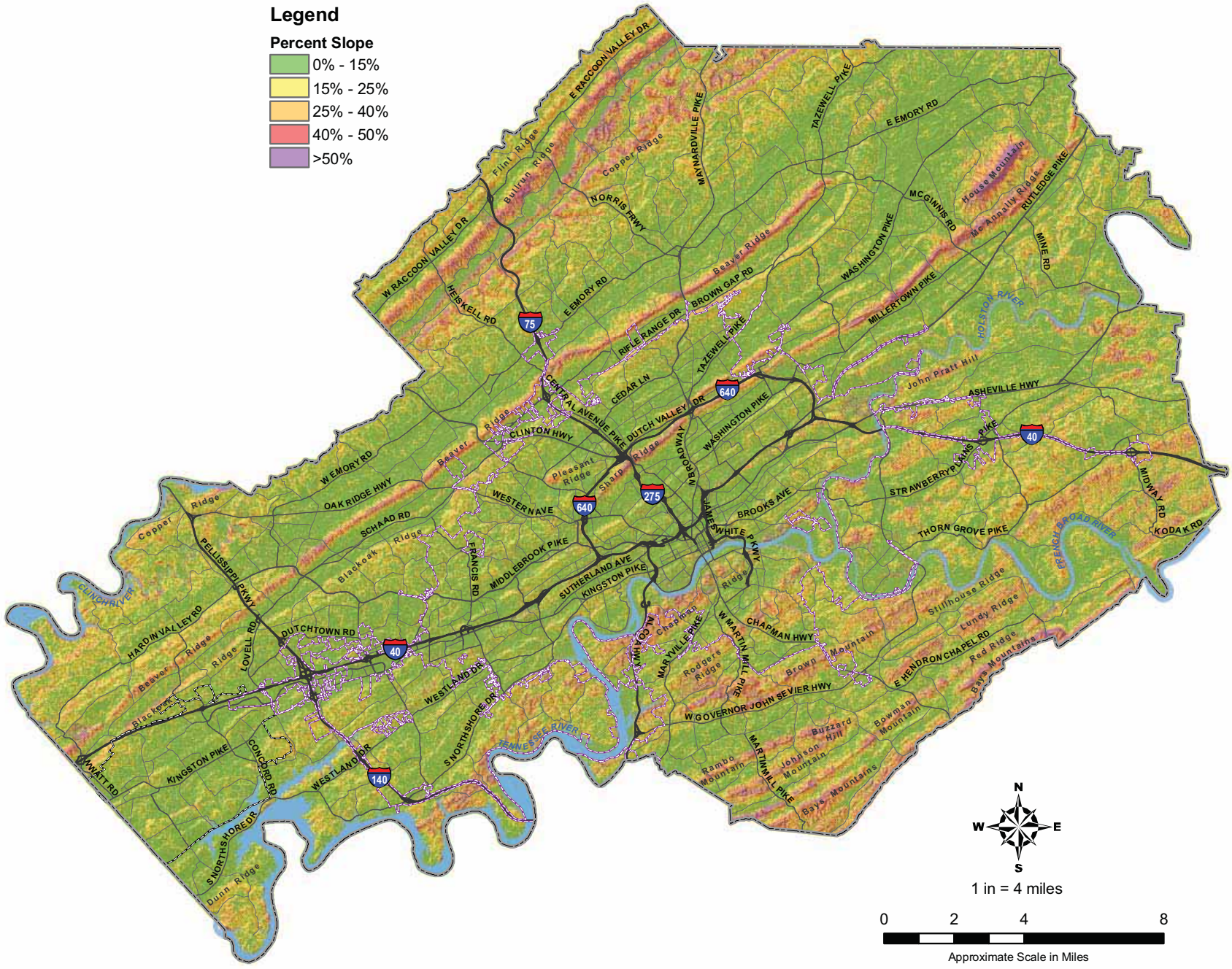
Generally, slopes in Knoxville-Knox County are measured as a percentage or as a ratio (rise/run). The terms slope and grade are often used interchangeably. As a point of reference regarding slopes, Walnut Street adjacent to the City-County building in downtown Knoxville has an approximately 23 percent 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

Percent Slope	*Acres*	*Percent of County*
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 percent) 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.[5] 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)

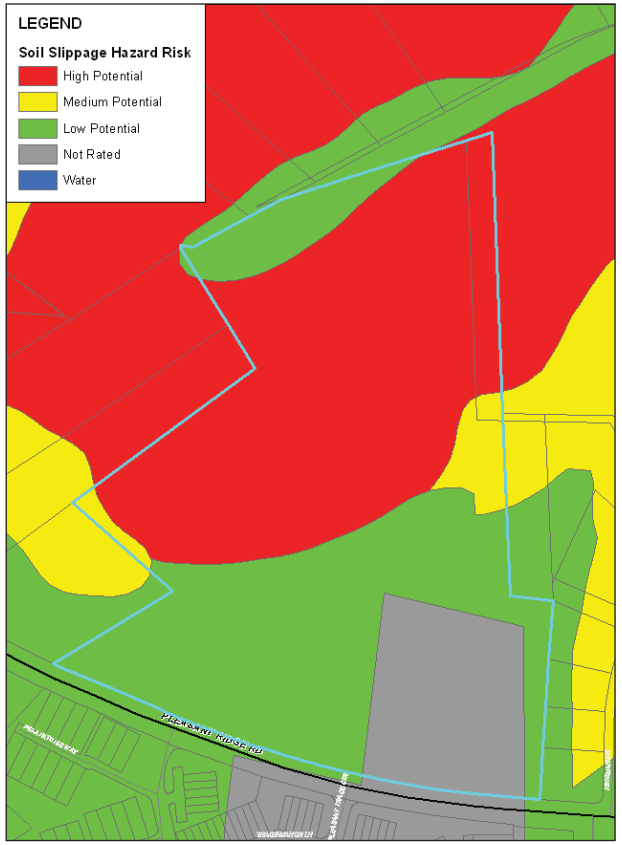
In 2003, improper clearing and grading during the construction of the Forest Ridge Apartments caused a landslide that destroyed an apartment building trapping and severely injuring an individual inside.[5] The term landslide is often used interchangeably with mass wasting. Mass wasting is essentially 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.

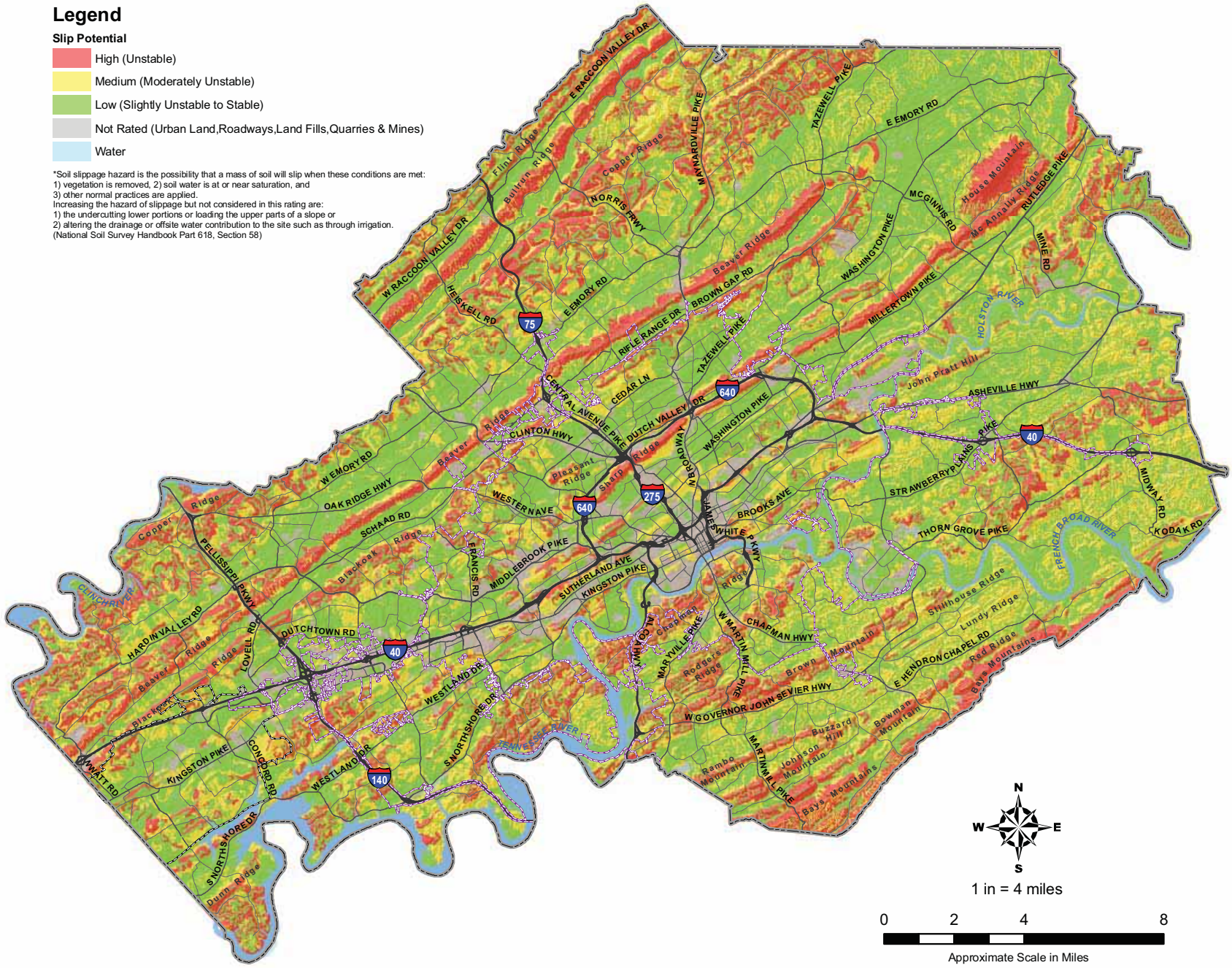
In evaluating soils, the NRCS soil survey map indicates the presence of high slip potential of soils in the failure area. Despite multiple efforts to stabilize the slope, the unstable soils have presented many difficulties for the property owners. As of spring 2009, a children's recreation area sits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



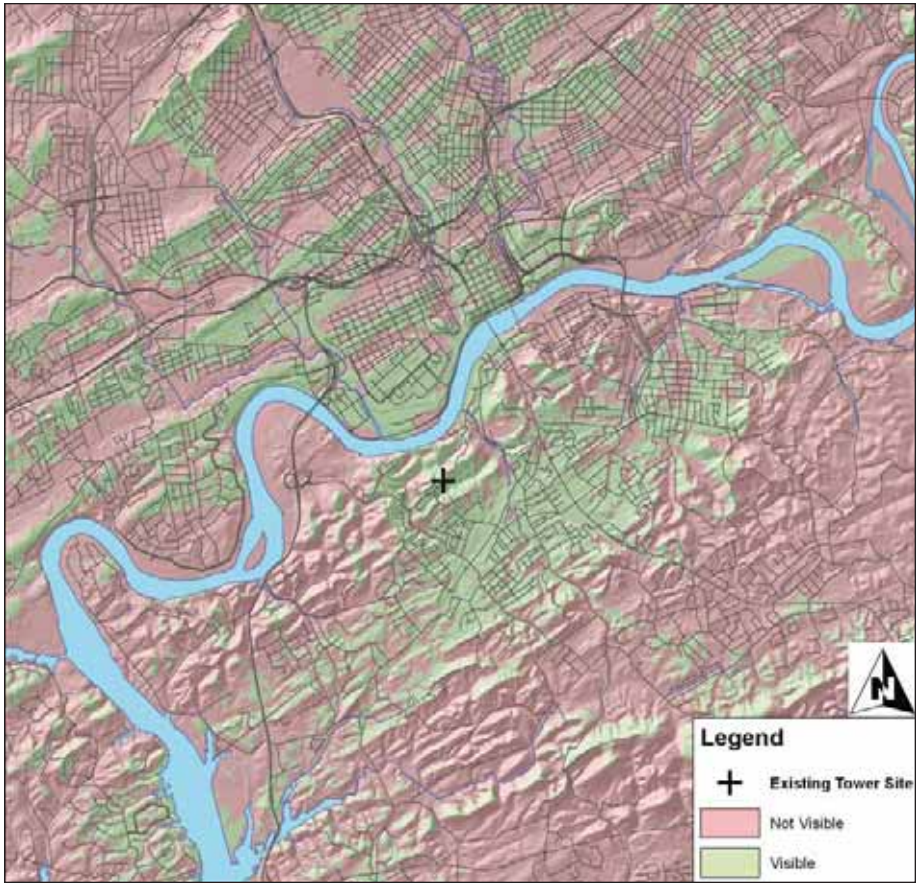
The water tower in South Knoxville sits 180 feet high obscuring scenic views of Chapman Ridge and the south Knoxville landscape. Below: *Visibility Analysis of the South Knoxville Water Tower*

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, student-oriented housing 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."[6] However, because an additional 500 residential units were proposed along Cherokee Trail, the need for water supply and pressure sufficient to provide sprinkled fire protection for the buildings was identified. 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 Tennessee Department of Environment and Conservation and local fire officials. 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 limit the number of towers in the line of sight of scenic resources.[7]



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

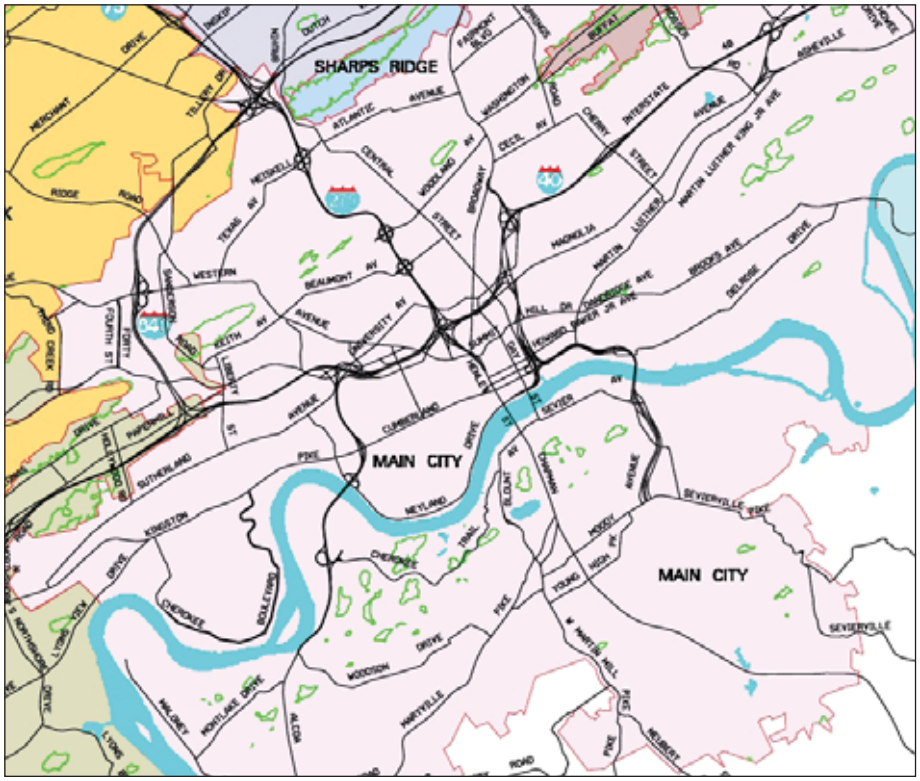
LACK OF REFORESTATION

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.[8] 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."[9] This opinion was based on court decisions in other states that prohibited local regulation of tree cutting operations. Particularly in times of economic downtown, 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 additional water supply and pressure were required to meet fire protection standards. Since that time, KUB has created maps that identify areas where water supply is not currently available to support development. 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 shows (see bright green outlines) where water supply is not currently available to support development 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 rail 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

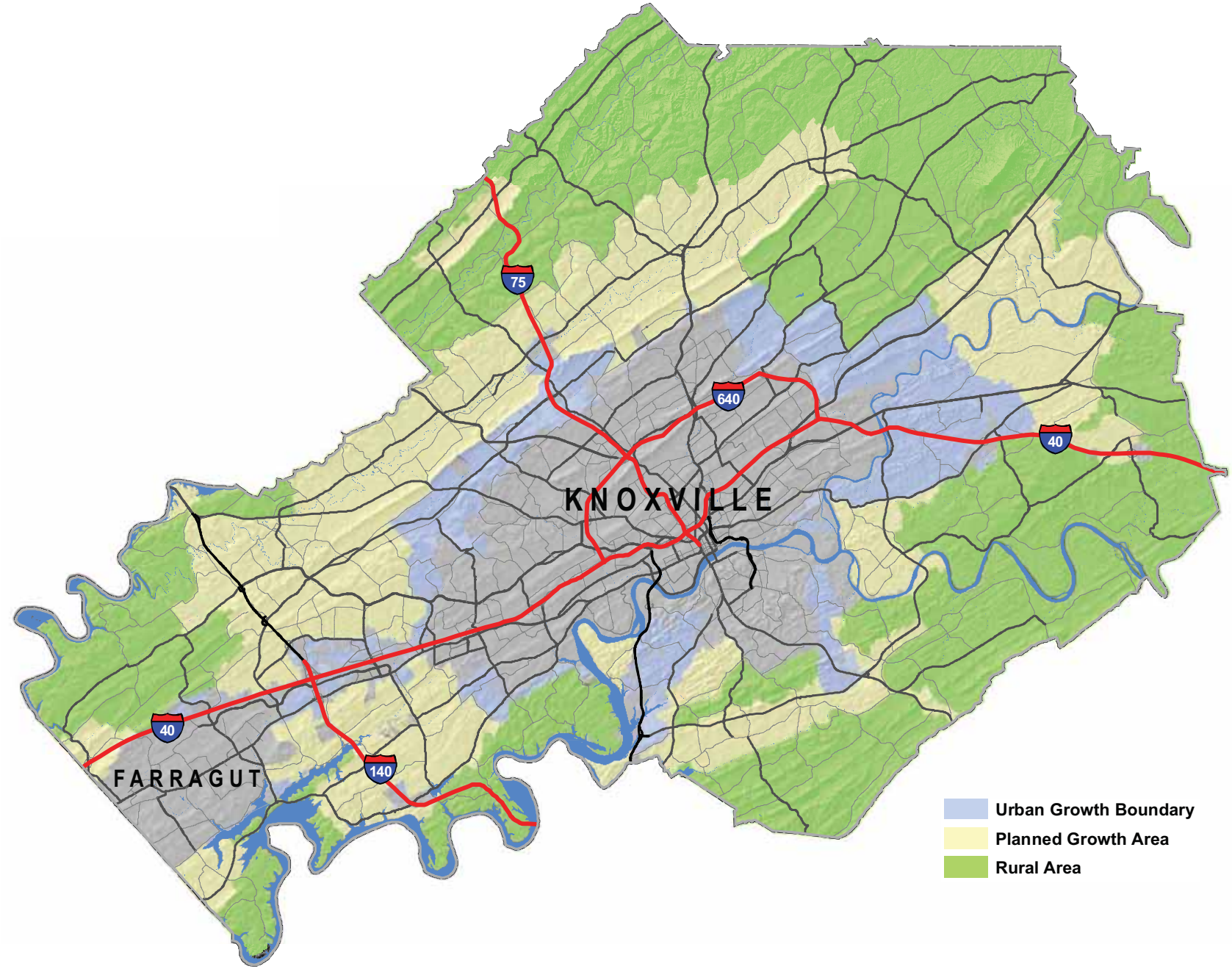
In 2001, Knoxville, Knox County, and the Town of Farragut agreed to and adopted the Growth Policy Plan. The document identifies specific areas for urban and suburban growth as well as a rural area, which under state law has to be set aside to:

- 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 percent 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 percent 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

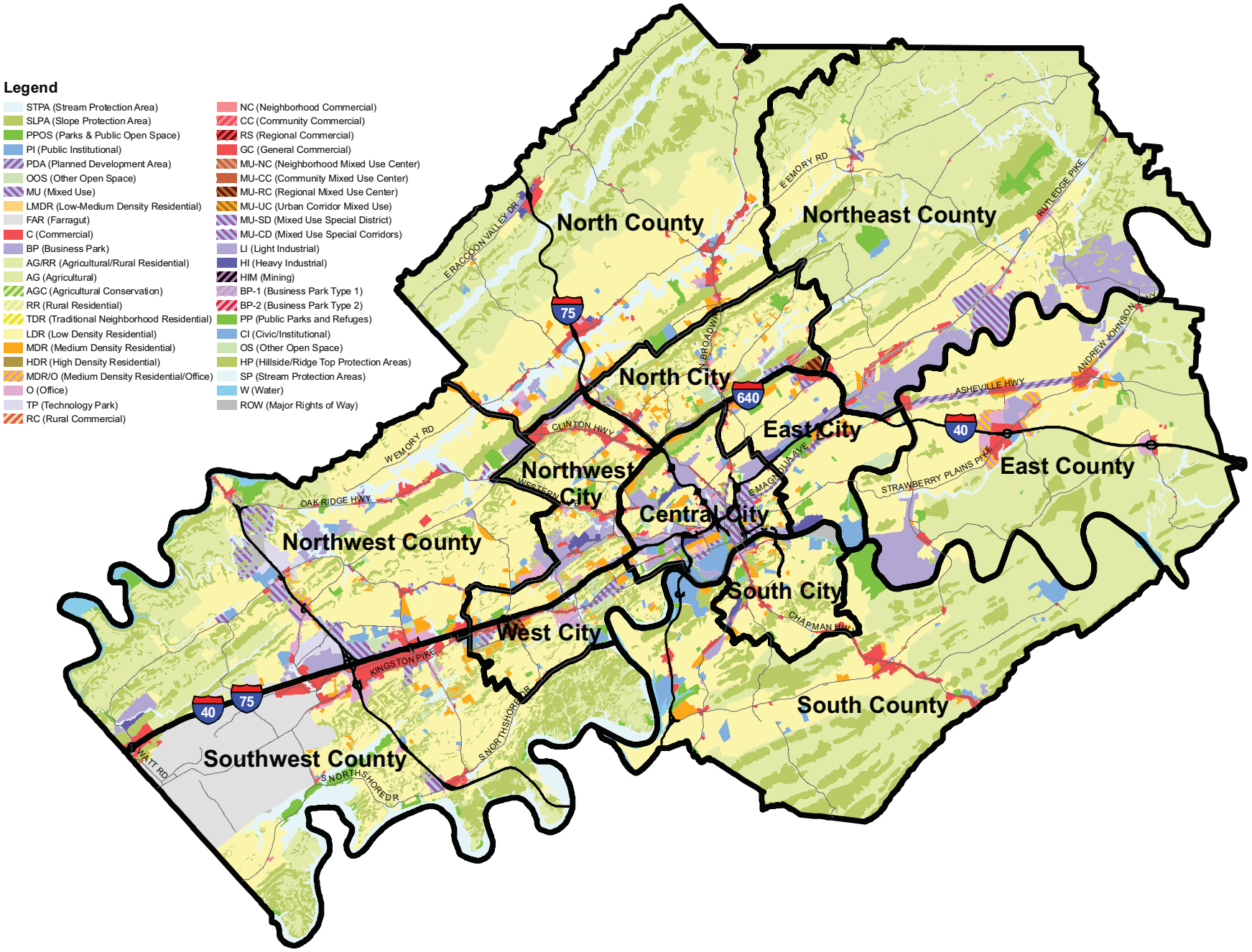
All sector plans identify areas for slope protection, see page 19.These include properties characterized by slopes in excess of 15 percent. However, the land use policies that deal with slope protection focus on their use as residential properties, rather than for a wider range of land uses. The following 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.[10] 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.[11]

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;[12] driveways shall be laid to the lines and grades established by the director and subject to his inspection and approval.[13] The site development permit review checklist calls for driveway grades of 12:1.[14]
- 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).[15] 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.[16]

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.[17] 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 a 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 and 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.

Endnotes

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13 Ibid. Appendix B, Section 23-48. Specifications for Driveways.

14 Ibid. Appendix A, Section E1. Site Development Permit Review Checklist, Streets and Sidewalks.

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16 Ibid.

17 Nicholls, Sarah and Crompton, John L. "The Impact of Greenways on Property Values: Evidence from Austin, Texas," Journal of Leisure Research, Vol. 37, No. 3, 2005. p. 321-341.

Section 2: The Plan

Virtually all the forest was destroyed in starting this west Knox County subdivision. Now it highly eroded and no houses were developed.

Guiding Principles, Objectives and Policies

The following points are the overarching themes that are presented in the remaining portions of the plan. Each of the principles, associated objectives and policies are reiterated in greater detail in the subsequent sections.

Conservation and restoration of forested ridges should be a component of environmental and economic sustainability in Knoxville and Knox County.

- In order to avoid water quality and quantity issues, including erosion and flooding, maintain the majority of steep forested slopes.
- To avoid further negative impacts to regional air quality, conserve and reforest steep slopes and ridgetops.
- Maintain a combination of private and public open spaces, where forests are kept largely intact, to foster wildlife and plant habitat protection.
- Recognizing that open space systems can enhance neighborhood and community property values, continue to set aside hillside woodlands in private development and create additional ridgetop natural areas.
- Limit development intensity and forest clearing in relation to steeper slopes and ridgetops; foster higher intensity development on flatter areas below ridges.

Conservation of McAnnally and other ridges near House Mountain could be part of regional open space system.

The health and safety of Knoxville and Knox County residents should be protected by avoiding high intensity hillside development.

- Guide development to areas where there is adequate water pressure for fire protection services.
- Revise standards for hillside road and driveway grades to better ensure emergency service access.
- Avoid development on slopes that are characterized by soils that have a high potential for landslides.
- Ensure that the early planning stage of hillside development includes a review of water service requirements, so that adjustments to density, height of building or other design elements can be considered to minimize the impacts of water facilities on the landscape.

Ridge conservation should be part of an open space system that reduces sprawl, maintains scenic resources and creates greenbelts around our communities.

- Maintain the Rural Area as identified in the Growth Policy Plan, conserving this predominant portion of our forested ridges, and direct development to the city of Knoxville, its Urban Growth Boundary and the county's Planned Growth Area.
- Limit building heights on hillsides and on ridgetops whereby housing and other uses blend with forest cover and natural slopes.
- Link ridge corridors as part of an open space system, building upon such corridors as the Urban Wilderness Trail.
- Continue to foster the work of the Legacy Parks Foundation and other land trusts in establishing ridge-oriented open space systems.
- Offer incentives to conserve hillsides and ridgetops, including increased intensities of land use on more level portions of a parcel.

Hillside and Ridgetop Protection Area

Knoxville-Knox County's General Plan and sector plans have identified steep slope protection areas since the 1990s. The significant use of those maps has been: (1) to depict areas that are appropriate for less intense uses, particularly residential uses, and (2) to enable the planning commission, city council and county commission to have a process to consider rezoning requests for hillside areas on a consistent basis. This process has been used to create "planned zoning districts," such as planned residential, so that an appropriate density can be determined and environmental constraints can be identified at the time of rezoning. Planned zoning districts also require site plan review so that a development and conservation plan, which depicts housing sites, roads and open spaces, can be established to conserve sensitive forested hillside areas.

The Hillside and Ridgetop Protection Plan map (see page 32) is proposed for much of the same purposes with the addition that flatter areas on the tops of ridges are included in the map. This is made possible on a systematic basis by advances in geographic information system (GIS) mapping that can identify those flat areas above a steep slope, including "ridgetops." This is significant because one of the overall objectives in creating the task force and this plan was to address ridgetop protection, including appropriate density, siting of structures, clearing and development standards.

The new Hillside and Ridgetop Protection Area is proposed to conserve natural terrain, water resources and scenic qualities associated with the ridges, while allowing development under certain circumstances. The map shows that there are diverse shapes to our ridges. Some have exceedingly steep hillsides, while others are lopsided, having a steep side and gently sloping side. These characteristics relate to underlying geological formations (see Background, pages 7 - 8). However, there is a common set of general development principles that can be used to conserve natural terrain:

- The steeper the slope, the lesser the amount of housing density and development intensity.
- The steeper the slope, the lesser the amount of land disturbance and a greater amount of conservation.
- The tops of ridges define the "crown" of Knox County's natural beauty and are worthy of conservation.

The plan maps and the policies are significant tools in minimizing negative impacts of construction on steep hillsides, including excessive deforestation, soil erosion, water quality degradation, landslides and loss of natural beauty.

Characteristics of the Hillside and Ridgetop Protection Area

The Hillside and Ridgetop Protection Area, also known as the Hillside Area, is characterized by slopes that are 15 percent and greater and at least five acres in size and flatter areas on ridges, including their summits. Within this area, most hillsides have a 15 to 40 percent slope while approximately 13 percent of the slopes are over 40 percent.

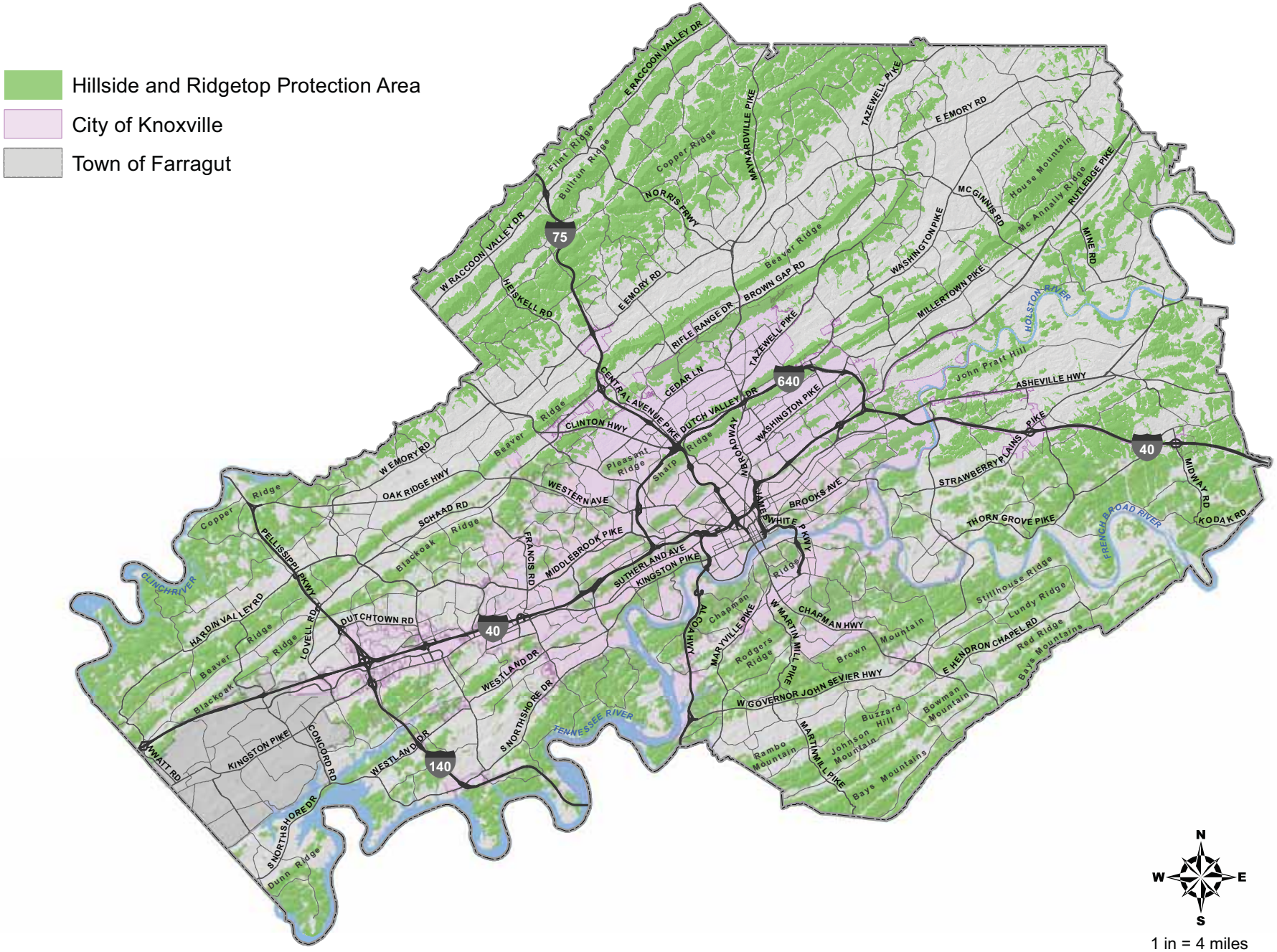
As slopes increase, the stability of soils generally decreases, thus the likelihood of soil failure is greater on steeper slopes, especially where more unstable soils are found (see Map 4: Soil Slippage Potential, page 12).

The Hillside and Ridgetop Protection Area also contains the vast majority of Knox County's forested resources, especially in the Rural Area (see Map 5: Knoxville, Knox County, and Farragut Growth Plan, page 18). Since these areas are mostly undisturbed, ridges are significant wildlife corridors. Species richness, as demonstrated through the work of the Tennessee Department of Wildlife and Fisheries, is also greater on ridges (see pages 4 and 5).

Table 2:
Proposed Hillside and Ridgetop Protection Area Acreage by Percent of Slope

Percent Slope	*Acres*	*Percent of Hillside and Ridgetop Protection Area*
0 - 15	38,024	29
15 - 25	43,424	33
25 - 40	33,034	25
40 or more	16,625	13
TOTAL	131,107	100

Map 7: Hillside and Ridgetop Protection Plan



1 in = 4 miles

Zoning and Development Policies

Zoning is the foundation for land use control in Knoxville and Knox County. Over the last two decades, MPC, the city council and county commission have made rezoning decisions based on the capability of land to sustain certain intensities of development, recognizing that steep slope and flooding conditions pose limitations. The zoning codes contain limitations on the height of building, which is 35 feet in the zoning districts that are currently within the Hillside and Ridgetop Protection Area. No changes are recommended to the building height limitation on steep slopes and ridgetops.

The Growth Policy Plan, General Plan and sector plans contain policies regarding recommended residential densities relative to the degree of slope. The following represents a refinement of those policies recognizing that there are significant geologic hazards and engineering constraints to development on the steepest slopes.

An example of two dwelling units per acre in the 15 to 25 percent slope group

LOW DENSITY AND RURAL RESIDENTIAL USES

Density and Land Disturbance Guidelines

As proposals for changes to the zoning map and development plans/concept plans are considered, the following factors are recommended to determine the overall allowable density for residential rezonings and the overall land disturbance allowable in new development or subdivisions for those portions of parcels that are within the Hillside and Ridgetop Protection Area. These factors should be codified as regulations in the future. The areas of the Growth Policy Plan referenced below are presented on page 18.

Table 3: Residential Density and Land Disturbance Guidelines
for Recommendations on Changes to the Zoning Map and Development Plan/ Concept Plan Review within the Hillside and Ridgetop Protection Area that is within the Urban Growth and the Planned Growth Area

Percent of Slope	*Recommended Maximum Density Factor**	*Recommended Maximum Land Disturbance Factor***
0 - 15	Knox County: 5 dua City of Knoxville: 6 dua	100%
15 - 25	2 dua	50%
25 - 40	0.5 dua	20%
40 or more	0.2 dua	10%
Ridgetops***	***	***

dua: dwelling units per acre

* These factors should be considered guidelines to determine an overall recommended residential density for requests for changes to the zoning map to planned residential (RP-1 in the city and PR in the county) zone districts that are considered by the Metropolitan Planning Commission prior to being considered by the appropriate legislative body. The resulting zone district development right would be considered a budget for dwelling units to be applied over the entire proposed development.

** Until such time as regulations are codified by the appropriate legislate body, these factors should be considered guidelines to determine an overall recommended land disturbance area for development plans and concept plans that are considered for approval by the Metropolitan Planning Commission. The overall land disturbance area would be considered a budget for land disturbance to be applied over the entire proposed development.

*** Ridgetops are generally the more level areas on the highest elevations of a ridge. Because the shapes of Knox County ridges are so varied (see pages 8 – 9), the ridgetop area should be determined on a case-by-case basis with each rezoning and related development proposal.

Density Bonus Provision

The density on the site may be raised in relation to the conservation of the steeper slopes and ridgetops that are part of a parcel. In cases relative to the Hillside and Ridgetop Protection Area, the planning commission may approve a density bonus of up to10 percent of the total units allowed in the base density when a conservation easement is placed on an undisturbed steep hillside or ridgetop portion of a parcel. An additional bonus density of 10 percent of that allowed by the base density may be approved when public access, such as a trail easement, is provided within the conservation easement. This bonus provision should be made available within a planned residential development and in a conservation subdivision.

An example of clustered housing on a modest slope in Black Mountain, North Carolina. This approach enabled the conservation of steep hillsides nearby. Note the small front yards and use of earth tone colors, chosen to help the houses blend with the natural terrain.

Density/Intensity Outside the Hillside Protection Area

The land below the Hillside and Ridgetop Protection Area, which contains more than 200,000 acres or about 60 percent of the county, would be suitable for those uses proposed by the General Plan and individual sector plans, and that are consistent with the Growth Policy Plan. As such, density and intensity would be regulated by those particular plans.

Some hillsides are very steep like the north face of Copper Ridge, which has slopes in excess of 50 percent. Very low density residential uses and minimal forest clearing are recommended on such slopes.

Clearing and Grading Provision

Hillside and ridgetop development necessitates careful consideration of the forest cover on various types of slopes. Loss of that cover may lead to erosion, water quality and geotechnical problems. The natural beauty of a ridge is also lost with wholesale destruction of hillsides. The clearing limits for rezoning cases, and subdivision and site plan review processes are shown in Table 3. In reviewing rezoning requests, concept and site plans, it may be necessary to note the steepest slopes of a parcel for conservation purposes. Clearing and grading should not be permitted until a development or clearing and grading plan has been approved.

This represents a good local example where clearing was limited around a ridgetop house, providing views for the owner and maintenance of the surrounding forest.

Pre-existing Vacant and New Lots

After a lot has been created, most purchasers will try to save trees as they build a house. Their goals are rational: shade, beauty and maintaining property value; numerous studies have shown that a wooded setting around a house adds 10 to 20 percent to the value of the lot.[1] In the Hillside and Ridgetop Protection Area, such conservation is particularly warranted so that neighboring property owners will not be adversely affected by greater runoff and loss of natural beauty. In the case of pre-existing vacant lots that are zoned for low density residential purposes, uses that are allowed under the current zoning should be permitted. The percentages of tree clearing, such as those for the slope groups in Table 3, should be used to avoid total lot clearing. Additionally, reduced building setbacks are recommended to avoid clearing and grading to minimize construction costs and the extent of cut and fill slopes (see page 37).

When new lots are created in a hillside subdivision, several options should be considered to conserve forested areas: (1) establishing clearing limitations on lots as part of the subdivision plat (this could be realized by a deed restriction); (2) setting aside a conservation easement on ridgetops and the steepest, forested portions of a lot; or (3) creating an administrative review process through building and planning officials to allow hillside home development and streamline the approval process.

Recommended Zoning

Planned residential zoning (PR, RP-1) is recommended for low density when parcels are in or partially within Hillside and Ridgetop Protection Areas.

MEDIUM DENSITY RESIDENTIAL AND OFFICE USES

Density and Use Intensity

The following provisions are recommended for decisions regarding medium density residential and office rezoning and site plan approvals that are within or partially within the Hillside and Ridgetop Protection Area. A parcel must be depicted on a sector plan for medium density or office uses, thus having reasonable locational characteristics in relation to adequate transportation and utility infrastructure.

When high density apartment or condominium uses are appropriate, the development should be constructed at the toe of a ridge.

- On slopes less than 15 percent, allow residential densities in the city up to 24 dwellings per acre and 12 dwellings per acre in the county, and office uses, when those areas are not on the top of a ridge.
- Allow consideration of medium density residential and office uses on slopes of 15 to 25 percent with certain provisions to reduce the amount of site disturbance: (1) smaller setbacks should be considered to avoid slope cuts, and (2) these uses should only be considered when the building footprint does not exceed 5,000 square feet per one acre when the slope is closer to 15 percent and graduating to one 5,000 square foot building footprint per two acres when the slope is closer to 25 percent. All new proposals for medium density and office uses should be subject to the approval of a use on review and site plan by the Metropolitan Planning Commission. Conservation measures and other incentives may be used to protect as much of the building site as possible (a summary of incentives is presented in Appendix H).

Clearing and Grading Provision

There are various techniques to avoid excessive clearing, including locations of medium density and office buildings on more level portions of a site (see above) and alternative parking layouts (see page 39). These provisions are outlined for medium density residential and office uses in the protection area to avoid various problems, including erosion and water quality degradation.

- On slopes of less than 15 percent within the protection area, site clearing and grading should be determined via site plan review, based on the size of more level area and its relation to other slope groups (for example, a quarter acre site within a large area of steep slopes (25 percent or more) would not be a good site for apartment development).
- In areas of 15 to 25 percent slopes, clearing should not exceed 50 percent of the area in that slope group (unless the Metropolitan Planning Commission approves a a development plan or creates a special district).
- On slopes greater than 25 percent, no clearing or grading should be permitted for medium density residential and office projects.
- Slopes that are created via grading (cut and fill slopes) and are adjacent to undisturbed slopes in the Hillside and Ridgetop Protection Area should be reforested. The Hillside Reforestation method is recommended (see page 41).

Recommended Zoning

Planned residential zoning (PR, RP-1) is recommended for medium density when a parcel is in or partially within the Hillside and Ridgetop Protection Area. A zone that requires site plan review is recommended for office development in the Hillside and Ridgetop Protection Area. A straightforward solution to accomplish this review is to amend the office park zoning districts to require use-on-review in the Hillside and Ridgetop Protection Area.

COMMERCIAL, INDUSTRIAL AND BORROW PIT USES

Use Restrictions

Commercial uses require attributes of reasonable location and terrain, particularly moderately level sites, and very good transportation and utility infrastructure.

- Commercial development should be allowed on land below the Hillside and Ridgetop Protection Area, when a parcel overlaps the protection area as long as the development proposal is consistent with the Growth Policy Plan and applicable elements of the Knoxville-Knox County General Plan.
- For commercial projects that extend into 15 to 25 percent slopes, slope restoration and reforestation of cut-and-fill areas should be accomplished to minimize the long term impact to water quality and lessen forest canopy loss in the hillside and ridgetop protection area.
- Industrial development is not recommended on hillsides that exceed 15 percent; this criteria has been used in various MPC industrial and business park site identification studies, such as those of 2002 and 2005.
- Borrow pit uses may only be allowed on slopes under 15 percent and should be restored via the Hillside Reforestation method (see page 43).

Recommended Zoning

Planned commercial zoning districts (PC, PC-1) should be used for commercial projects when parcels are in or partially within the Hillside and Ridgetop Protection Areas.

PLAN AMENDMENTS AND SPECIAL DISTRICTS FOR OFFICE AND COMMERCIAL USES

Other new office and commercial development may be considered in the Hillside and Ridgetop Protection Area under special circumstances. The following criteria should be considered in evaluating potential projects:

1. The area should be designated in the sector land use plan as office or commercial.
2. In some circumstances, a plan amendment will be necessary. Among the significant criteria that should be considered in making an amendment are:
    a. The type of ridge or hillside (see pages 7 and 8; narrow knife-edge ridges are generally not appropriate);
    b. The site's proximity to highways, freeways and transit;
    c. Traffic carrying capacity for those roads and streets providing access to the site; and
    d. The site's location in relation to the City, its Urban Growth Boundary, and the County's Planned Growth Area, especially areas that are particularly suitable as employment centers such as major highway intersections and freeway interchange areas.
3. In creating development plans for such sites, the design team should:
    a. Identify and conserve slopes over 25 percent;
    b. Use structured parking (preferably underground), especially for buildings taller than three stories, to reduce the area devoted to required off-street parking;
    c. Identify the measures to restore mature vegetation and forests that will be cleared due to construction; and
    d. Consider measures such as bio-infiltration, lower impact road design, reduced setbacks and other means available as incentives (see Appendix H).

All new proposals should be subject to the approval of a use on review and site plan by the Metropolitan Planning Commission.

OTHER CONSIDERATIONS

Retaining walls may be needed in various types of land development. Examples include providing a road without ripping out a large swath of sloping terrain in a residential development or fortifying a slope in more intensive development, avoiding cuts into steeper, natural hillsides. Determination of retaining wall height and safety measures (for example, fencing to avoid a person's fall) are subject to engineering staff review. Trees that would compromise the strength of walls should not be approved without engineering staff review.

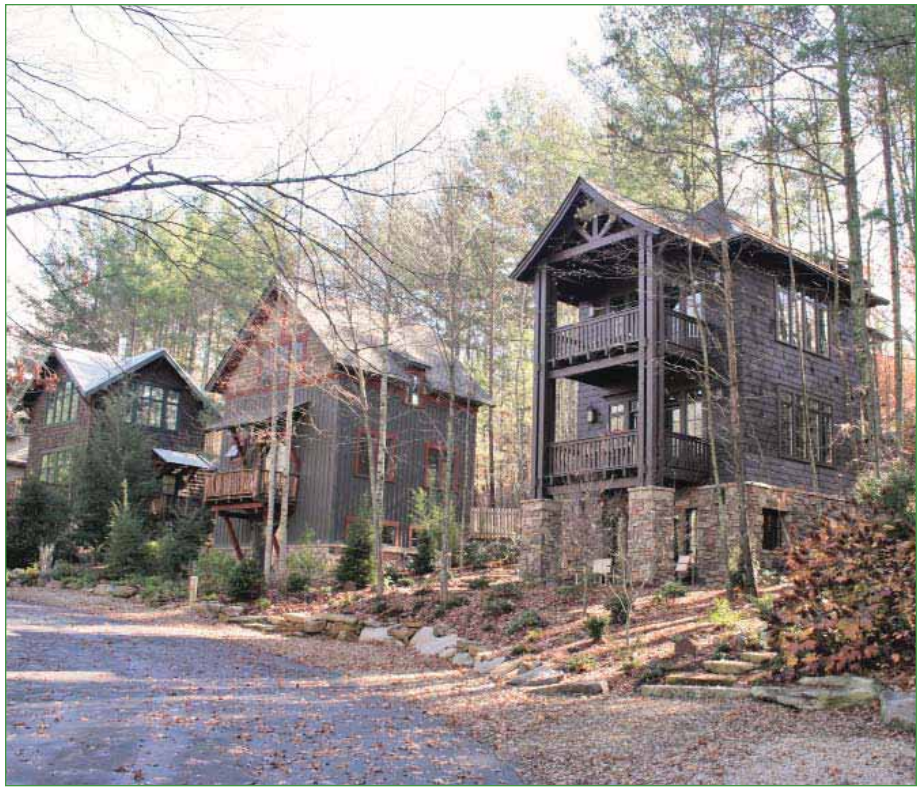
The Effect of the Hillside Policies

During the course of public input, some individuals observed that they felt that hillside areas are the only places left for future development. Staff analyzed the implications of the policies and has found that there is an array of opportunities to accommodate new development, both within and outside hillsides areas. This is summarized below and more fully explained in Appendix C.

MAXIMUM BUILDING HEIGHT

With few exceptions, such as near downtown and some office districts, the maximum building height of Knoxville's and Knox County's zoning regulations is 35 feet. This allows a three-story building. It is recommended that the maximum building height in the Hillside and Ridgetop Protection Area be 35 feet for all uses, as measured from the average natural grade of the proposed building footprint to the roofline (if a flat roof is used) or to the midpoint of the height of a pitched roof.

Water utilities, including tanks or towers, play a role in determining the acceptable height of buildings. Utility districts should be involved in the planning process to ascertain water pressure and related utility implications relative to height.

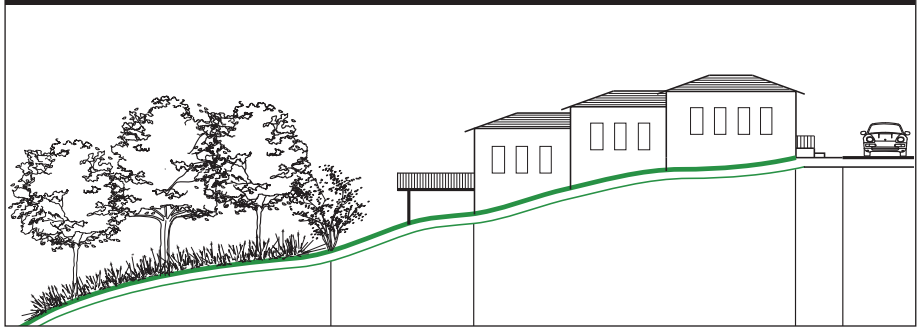


Existing zoning codes limit building heights to 35 feet. Hillside-oriented houses such as these are examples of structures that would meet the recommended 35 foot maximum height standard.

LOW AND RURAL RESIDENTIAL DENSITY DEVELOPMENT

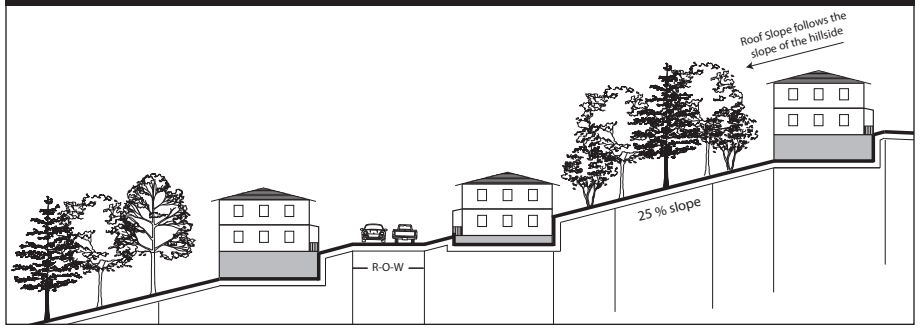
Detached and attached dwellings constitute the majority of uses that would be developed in the Hillside and Ridgetop Protection Area. The following design recommendations help achieve the goal of low impact development.

Figure 1: Example of Terrain Adaptive Architecture



- Terrain adaptive architecture is recommended. Structures should be built into the natural slope of the land to minimize cut and fill; pad grading (for example, preparation for a concrete building slab) should be avoided.
- Street pavement width should be minimized, and in some circumstances it may be reduced to 20 feet; in no case should it exceed 26 feet. Right-of-way width should not exceed 40 feet for 20 foot wide roads.
- Front yard setbacks may be reduced to limit overall site disturbance under some circumstances, such as when there is a fairly level space near the road and the back of the lot falls steeply downhill. These smaller setbacks may be approved via use-on-review or in exceptional cases of pre-existing lots, when a hardship is demonstrated.
- Rooflines should generally be designed to have a pitch that follows the natural slope; however, portions of the valley-facing facade can be accented by gables. Roofing material colors should be of earth tones (grays, greens, tans, and browns).

Figure 2: Example of Reduced Right-of-Way, Setbacks, and Adaptive Rooflines



- Lot orientation should be with the natural grade of the land. This will generally be a lateral orientation with a road running along the contours of a hillside. Additional lot width may be needed to accommodate driveway access.
- Residential building materials should be comprised of fire resistant material such as stone, brick or wood siding over a masonry foundation (see Firewise safety recommendations, page 48). Exterior material colors should be of earth tones such as grays, greens, tans, browns and natural wood.
- Tree preservation should be encouraged particularly on the rear of lots and near ridgetops to screen homes; at least 85 percent of trees within 100 feet of a ridgetop should be conserved.
- Homes should be clustered on more level land areas of the site, while areas with slopes 25 percent greater and ridgetops should be left undisturbed or developed at a very low density.
- Parking guidelines to minimize site disturbance include the following:

  For detached dwellings:

  On-street parking may be considered to meet off-street parking requirements on steep hillside sites, including bulb-outs with parking stalls running parallel to a road.

  Off-street parking options include:
  "Tucked-under garages" constructed within a house, minimize clearing and grading. Several designs are possible in placing a garage under a house: when the house is uphill and close to the right-of-way, a "tucked-under garage" can be a good solution; when access can be provided to the side of house a basement garage is another good solution.

  Parking pads near the right-of-way also offer a solution, especially on small lots, as long as sight distances are adequate where the pad meets the road.

  For attached dwellings, such as condominiums and duplexes, which are best sited on more level portions of a site, the following options are recommended:

  On-street parking may be considered, using bulb-outs with parking stalls running parallel to a road.

  Off-street parking under a structure is to be encouraged on hilly locations to reduce tree canopy removal.

This parking pad is an acceptable means to provide off-street parking in Asheville's low density hillside district to avoid the clearing that a conventional driveway would require.

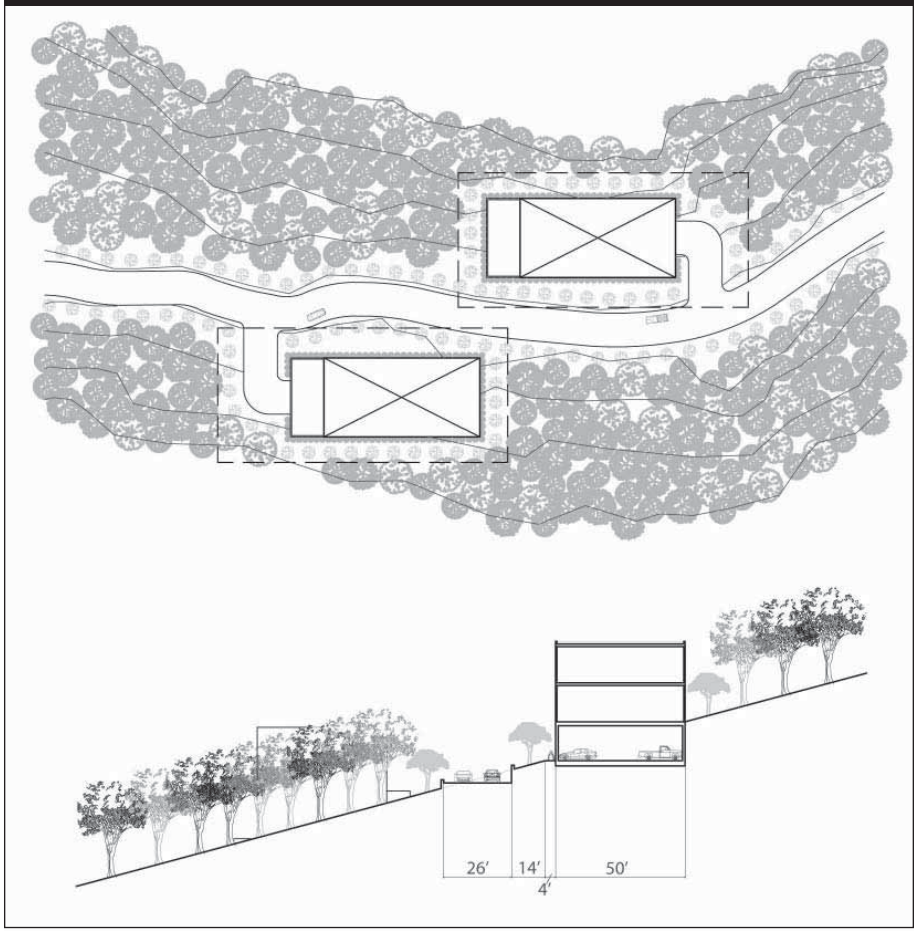
A local example of a "tucked under garage"

MEDIUM DENSITY RESIDENTIAL AND OFFICE DEVELOPMENT

Portions of the Hillside and Ridgetop Protection Area are characterized by moderate to steep slopes which present challenges for development in regard to public safety and environmental concerns. Under some circumstances, limited medium density housing or office development may be appropriate in area where transportation systems are very good and provisions for housing near jobs have been found to be a prudent land use policy (such as in the Tennessee Technology Corridor). In order to provide proper development guidance for such areas, the following recommendations should be considered in creating site plans:

- To reduce the amount of hillside site disturbance, development should be focused in more level areas below or on the less steep parts of the Hillside and Ridgetop Protection Area.
- Allow consideration of medium density residential and office uses on slopes of 15 to 25 percent with certain provisions to reduce the amount of site disturbance: (1) smaller setbacks should be considered to avoid slope cuts, and (2) these uses should only be considered when the building footprint does not exceed 5,000 square feet per one acre when the slope is closer to 15 percent and graduating to one 5,000 square foot building footprint per two acres when the slope is closer to 25 percent. All new proposals for medium density and office uses should be subject to the approval of a use on review and site plan by the Metropolitan Planning Commission. Conservation measures and other incentives may be used to protect as much of the building site as possible (a summary of incentives is presented in Appendix H).
- The maximum allowable height of a building should not exceed 35 feet, measured from the average natural grade of the building site.
- The criteria for the conservation of Hillside and Ridgetop Protection Areas focuses on the prevention of erosion and the preservation of trees and scenic views. As such, new development, including non-residential buildings, parking areas, artificial berms, and detention/retention ponds, should not be permitted on slopes in excess of 25 percent.
- Road and access should be accommodated with low-impact design, including narrower pavements and rights-of-way (these are further discussed on page 38).
- Under building parking structures, or terraced parking, should be used to preserve hillside and ridgetop protection areas.
- Shared parking and on-street parallel parking bays should be used where possible to minimize land disturbance, minimize impervious surface coverage, and preserve natural beauty.
- Maximum allowed parking for medium density and office density should be further examined to limit surface parking impacts; the suggested standards for office development is that the maximum parking should not exceed 2 spaces per 1,000 square feet of gross floor area.

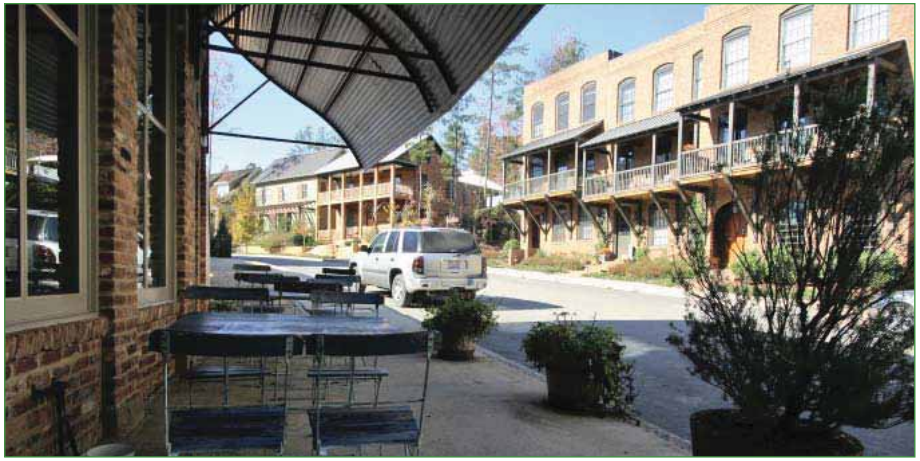
Figure 3: Example of Office Development on a Hillside with Underground Parking



COMMERCIAL AND INDUSTRIAL DEVELOPMENT

As noted previously, new commercial and industrial rezonings should not be permitted in the Hillside and Ridgetop Protection Area. However, pre-existing commercially zoned vacant property and new development on that land or on land adjoining the protection area should be considered in view of the following:

- Incentives should be explored to foster development totally outside of the Hillside and Ridgetop Protection Area. These should include consideration of a reduction in off-street parking, retail parking, shared parking, decreased setbacks and taller buildings on the level land.



In this mixed-use and commercial development the impact to the hilly terrain was limited by reducing the setbacks of the restaurant and condominiums (top) *and the wooded setting behind the commercial space and housing units was also saved* (bottom).

SUBDIVISION REGULATIONS

Development within the Hillside and Ridgetop Protection Area requires alternative design standards in order to protect public safety and environmentally sensitive areas. The current Minimum Subdivision Regulations address hillside development in a limited manner that is not consistently implemented. The Hillside and Ridgetop Task Force recommended that the current regulations be modified to foster safe and effective development with minimum land disturbance.

Infrastructure improvements for development, such as roads and utilities, contribute a significant amount to the total land disturbance of a site. Roads, for instance, in residential neighborhoods are typically 26 feet wide to accommodate on-street parking on both sides of the street while allowing for one continuous, uninterrupted travel lane. In the Hillside and Ridgetop Protection Area, it is anticipated that the intensity of development will be less than in other areas so more narrow streets (20 foot widths) can be acceptable as long as vehicles are not parked on streets. For fire protection needs, when a turn-around is required on a dead end street, roadways should meet all minimum design requirements of the city and county fire officials.

In level areas, underground utilities are typically located to the sides of roads because it is easier to maintain road surfaces when utility repairs are needed. Conventional, "flat land" subdivisions generally have 50 foot wide rights-of-way. However, when road widths are reduced and utilities are located under pavement, the right-of-way width can be reduced and still provide adequate space for utilities. This provides a secondary benefit of reducing the space between the street and the front property line, and reduces the need to clear and grade on steep slopes.

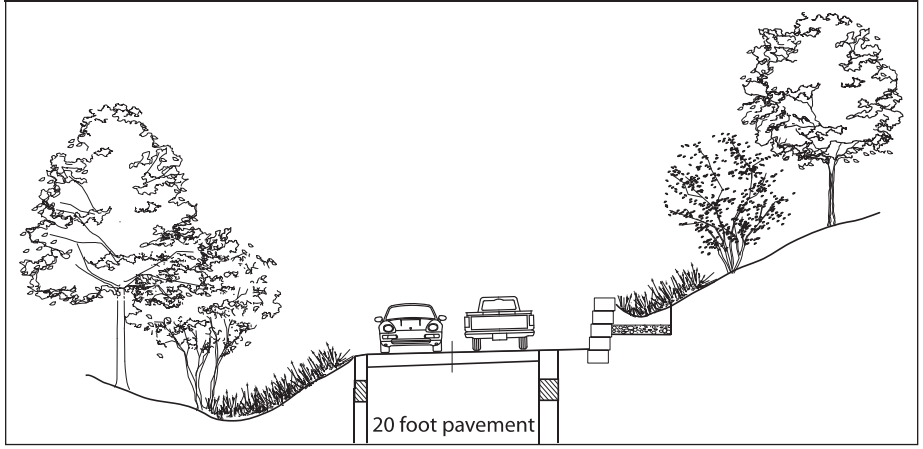
In the Hillside and Ridgetop Protection Area, it is proposed that utilities be placed under road surfaces when possible to reduce the amount of clearing and grading on extremely steep side slopes.[2] This is likely to be accomplished on a case-by-case basis because: (1) there are so many utility districts in Knox County, which operate independently and have different policies for utility placement, and (2) the city and county engineering departments may adopt different management practices for utility locations relative to road pavement.

Roadway Standards

In view of the input of the city and county engineering and public safety officials, the following hillside standards are recommended:

- Rights-of-Way = 40 feet
- Pavement Width = 20 feet (curb-to-curb; or edge-to-edge if stormwater drainage is provided by swales)
- Maximum Road Grade = City of Knoxville - 12 percent; Knox County - 15 percent
- Maximum Driveway Grade = 15 percent for both the city and county
- Turn-Arounds = In regard to turning radii, including hammerhead and cul-de-sac design, both the city and county follow the *American Association of State Highway and Transportation Officials* standards, and these are adequate for emergency vehicles. City fire officials follow *National Fire Protection Association 1141* standards. In general for a cul-de-sac, these standards require a right-of-way radius of 50 feet and a paved radius of 40 feet.

Figure 4: Example of Proposed Width for Hillside Road (20 Foot Pavement within a 40 Foot Right-of-way)



Setback and Lot Size Recommendations

The placement of structures on hillsides is very important when trying to limit the amount of disturbance. In order to provide the most flexibility, setbacks should be able to be reduced be to allow structures in the most appropriate location without encroaching into necessary setbacks for fire protection (some approaches are outlined on page 50). The hillside provisions of the subdivision regulations should be revised to offer greater flexibility in setbacks and larger lot size dimensions that are in keeping with this plan (that is, larger minimum-sized lots than the current 20,000 square feet on slopes that exceed 25 percent).

Proposed Conservation Subdivision Program

Conservation subdivisions are characterized by common open space, compact lots, less road pavement and, sometimes, clustered housing. The purpose of a conservation subdivision is to protect such resources as ridges and farmland while allowing the same housing density under zoning and subdivision regulations. A greater density, called a density bonus, may be offered to encourage conservation in residential development planning.

Open Space Program

The conservation subdivision open space requirement is to protect environmentally sensitive lands. It may also be used to provide recreation opportunities, including a density bonus when public access is provided. The open space requirements are based on the underlying zoning classification and will generally range from 40 to 60 percent of the parcel. The open space is required to be protected from development through a conservation easement.

Primary and Secondary Open Space Areas

The open space land should be determined by several factors; some are primary, others are secondary. Primary conservation areas should be included as open spaces because of environmental values and sensitivity to development, including slopes in excess of 25 percent and the floodplains along stream corridors. Secondary conservation areas are features that should be protected but are not as high a priority, such as forested 15 to 25 percent slopes and farmland.

Density Determination

Residential density will not be less than that allowed under conventional residential zone districts (such as the city's and county's low density residential zoning) or through the rezoning provisions of Planned Residential zoning. Essentially, the minimum lot size of the zone district is divided into the parcel size to determine the density that would be permitted without conservation provisions. Some cities and counties ask for a preliminary plan (sometimes referred to as a "yield plan"), showing the residential lot layout to determine the number of lots that could be created under convention zoning and subdivision codes. Thereafter, the designer can use the flexibility of the conservation subdivision provisions, including reduced lot size and narrower streets, to create a layout that sets aside the open spaces. Fire protection and water supply must also be considered, including the height of water tanks or towers in the area.

Density Bonus Provision

As noted in the zoning policy section (page 34), density may be increased in relation to the conservation of hillside and ridgetops up to 20 percent above the base zone density by setting aside conservation easements on steep forested slopes.

Open Space Management

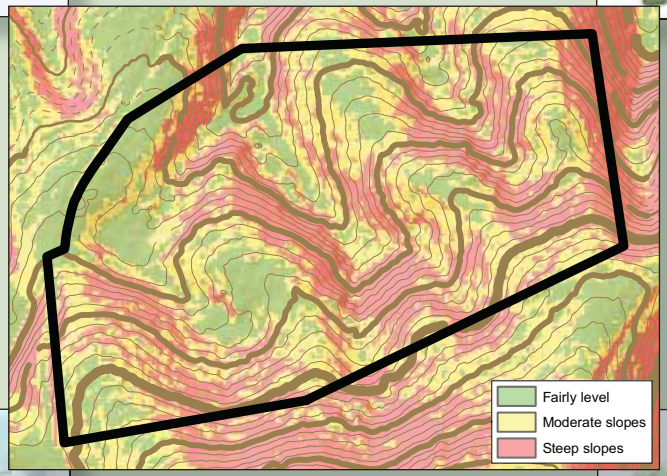
The management and permanent protection of open space is required to protect the resource from destruction or unscrupulous development. Restrictive mechanisms, including deed restrictions, conservation easements and transfer of ownership to a conservation organization or government, are typical approaches. The management of open space should be handled by the entity that has ownership, such as a neighborhood organization, conservation organization or city or county park department.

Applicable Zoning Districts

The conservation subdivision option should be available within most residential zoning districts. The potential hillside zoning overlay district and the county's agricultural zoning district are best suited to protect hillside and ridge resources; a density bonus should be considered to foster conservation. Pre-existing zoning, such as the Low Density Residential (RA) Zone, should also be considered when a developer desires to save such a resource as a hillside by reducing lot size and potentially clustered housing.

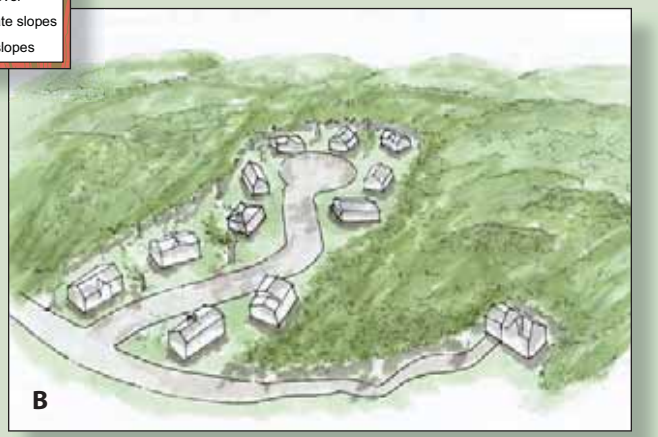
Figure 5: Hypothetical Hillside Development Example

EXISTING SITE TOPOGRAPHY:
Heavily forested, widely varied terrain



Scenario A:
CONVENTIONAL SUBDIVISION
The developer examined the topographic constraints of the site and originally proposed a plan for six large lots.

Scenario B:
CONSERVATION SUBDIVISION
Because the zoning allowed ten units on the site, the developer considered a conservation subdivision layout with clusterd housing, that would allow a 20 percent density bonus for preserving the surrounding hillside with a conservation easement.



REFORESTATION

Background

Hillside reforestation is a healing process when trees are planted on sites that were cleared and graded. Reforestation can also be a natural phenomenon when land is cleared for timber or development. An overview of the city's tree planting standards is presented on page 21. The county has no replanting provisions. Both local governments require soil stabilization, such as planting grass. That, however, does not re-establish a forest, and its associated benefits of habitat, beauty and greater water quality protection.

Clearing and grading on steep topography results in extreme landscape and hydrological changes. Some of the scars on Knox County's hillsides are so severe that the devastation cannot be easily remedied. As a result of extensive grading, soils are heavily compacted, limiting infiltration and increasing velocities of runoff. This places increased demands on stormwater infrastructure and limits the recharge of groundwater.

Knox County's existing forests are generally over a hundred years old. When lost, two generations of children will grow up during the 50 to 70 years that it will take a tree to reach maturity. Consequently, the emphasis in the Hillside and Ridgetop Protection Area should be to conserve trees for the benefit of current and future generations. This practice of good stewardship was recommended by citizens in creating this plan.

A Better Grading and Reforestation Practice

In view of the foregoing concerns, task force staff consulted with forestry professionals to identify better practices for slope stabilization and reforestation.[3] The most promising method is that of the Appalachian Regional Reforestation Initiative (ARRI), which a developed a six step process for grading and reforestation that should be added to the city's and county's engineering and stormwater best practices manuals. The practice is summarized below and is described in detail in Appendix D.

Description of the Recommended Practice

This is an approach to grading and tree planting where hillside forest cover is lost due to construction. It has been demonstrated to be an effective means to avoid soil compaction and difficulties in sustaining tree growth that is associated with conventional grading. The method, which relies on reuse of organic matter, top soil and rock, fosters significant stormwater infiltration and woodland regeneration. It has been tested in the Appalachian region by scientists from the University of Kentucky and Virginia Tech, and is now the standard practice in surface mine restoration. The steps include:

1. Topsoil and rock material from disturbed areas are saved on site at the beginning of a project to create a medium that is suitable for good tree growth and water infiltration.
2. Natural landforms should be mimicked in creating cut-and-fill areas. The majority of the backfill should be placed and compacted using standard engineering practices.
3. The final surface should be prepared by loosely distributing and lightly grading the topsoil and rock mixture, avoiding compaction of the upper few feet. That surface layer, which will form the forest's soil, should be a few feet deep.
4. For immediate erosion control, groundcover should be planted that is slow growing and tolerant of many soil conditions, such as red top and perennial rye grasses or legumes such as birdsfoot trefoil and white clover.
5. A combination of native trees should be selected that will grow rapidly, creating habitat and soil stability. These include oaks, black cherry, redbud and sugar maple; also see Appendix E).
6. The selected species should be planted as seedlings in the dormancy of winter.

This will be the typical appearance after grading -- loosely distributed rock and organic material.

The results of tree growth are significant as can be seen after three years.

Recommended Actions

The following steps are recommended in improving reforestation practices:

- The city and county should adopt the foregoing reclamation process as a slope restoration alternative in their best management practice manuals.
- Because this practice would be a new addition to the city's and county's engineering best management documents, a "test case" should be pursued, potentially offering an incentive (such as a grant) to create a benchmark for the costs and benefits of the method. Several "pilot" steps should be considered: (1) voluntary compliance by a developer to use the method with new construction; (2) use of the technique as a road or public facility project; or (3) a demonstration project in healing a previously cut slope.
- Another alternative method may be forthcoming. A student housing development will likely be created west of Edington Road in the next few years. As part of site plan approval several forested slopes were to be conserved; however, some cut slopes were approved with the understanding that they would be planted with native trees, using a method that has been tested in Athens-Clark County, Georgia. If successful on this Vestal-area site, that method may also be appropriate to adopt as a best management practice.

Cost Advantages

There are two potential cost benefits with the ARRI method: (1) less time than conventional soil compaction methods (that is, continually running a dozer back and forth to compact and smooth a slope); and (2) less stormwater runoff (water penetrates the rougher surface, with its rocks and un-compacted soils and organic debris) to reduce velocity of runoff and encourage infiltration, avoiding sedimentation, large detention basins and other infrastructure costs.

GRADING AND CLEARING

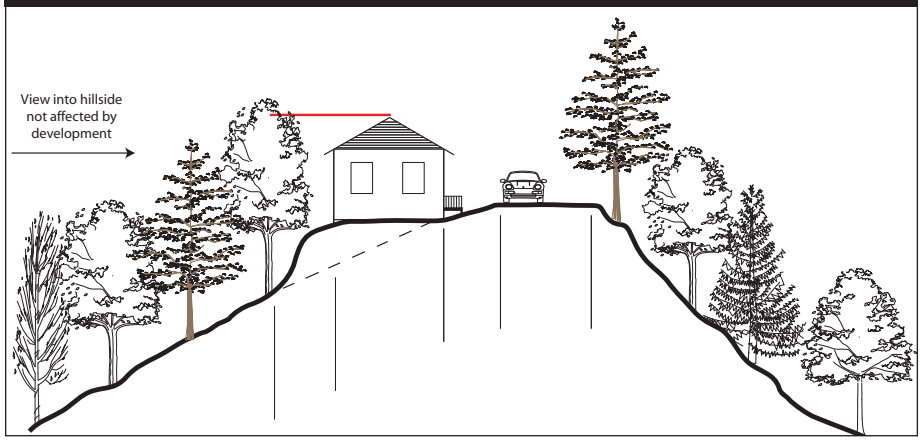
More attention to hillside grading and clearing will realize several goals of this plan: water resource and habitat protection along with public safety objectives such as keeping slopes intact, particularly those with unstable soils. Some land disturbing activities are currently regulated under stormwater permitting processes. Grading, especially as it relates to drainage and water quality, has been the principal concern requiring permitting. In the city, the permit is called a Site Development Permit; in the county, it is called a Grading Permit. Both permits require a plan showing the extent of the grading dimensions and how soil erosion and sedimentation will be mitigated. However, neither permit considers the removal of trees and other vegetation as part of the development plan review processes.

As of 2010, issuance of a grading permit in Knox County or a site development permit in the City of Knoxville require that a surety bond, cashier's check or letter of credit be provided to cover the performance bond costs for construction and grading. These relate to road construction, erosion prevention, sediment control and water quality buffers. The recent economic recession has contributed to several unfinished projects on steep slopes where a letter of credit was accepted as the means to address proper restoration and construction. However, several unfinished, eroding sites have resulted as the result of bankruptcies with no actual funds at local governments' disposal to see the project is properly completed. These sites continue to leach sediment into neighboring properties and water bodies. The restoration costs to local governments on these sites could result in hundreds of thousands to millions of dollars to return the land to a state that does not impact surrounding properties and waters.

The local governments have realized that there are shortcomings to the current bonding systems, especially letters of credit (largely worthless following a bankruptcy). Therefore, efforts to address this situation by the local governments are highly recommended.

Instead of working potential house sites into the hillside topography, the developer chose to clear the entire ridge, ultimately resulting in erosion problems. No lots have been developed.

Figure 6: Example of Preserving Tree Ridgeline with Residential Development



Land Disturbance Defined

Any activity that results in a change in existing soil, topography or vegetation, including development, clearing, grading and filling, is land disturbance. Under the proposed program, some clearing activities are not to be affected, including agricultural, and utility and emergency work to protect life, property and levels of public services.

Permitting for Land Disturbance

The following would be elements of a land disturbance permitting program:

General Requirements

When applying for building and development permits for property that is in the Hillside and Ridgetop Protection Area, applicants would depict grading and clearing areas with the amount of disturbance limited by the standards on page 31. This should apply to new subdivisions and pre-existing vacant lots. The total disturbance allowance can be used on any portion of the property within the Hillside and Ridgetop Protection Area, except on slopes over a 50 percent grade and on ridgetops. In those areas, total clearing should be limited so that the tree line on ridges remains undisturbed to the greatest extent practicable.

Disturbance Area Delineation

Hillside disturbance areas should be depicted on a site plan and marked in the field so that they can be verified by inspectors, and so that construction crews will know the limits of their operations. The disturbance limits should be marked with barrier fencing or other markings so that forest resources are not destroyed.

Geotechnical Analysis on Potential Landslide Areas

A geotechnical analysis is a review of the surface and subsurface characteristics of soils to determine the properties that are relevant to a project and any associated risks. Soils that are on steep slopes generally have a high slip potential when either the soils down slope or the soils in the hazard area are disturbed. In the Hillside and Ridgetop Area, geotechnical analysis should be required on slopes that are 40 percent or greater, or have soils that are considered to have a high slip potential, before any land disturbing activities can commence.

Reforestation and Landscaping

This is the process of re-establishing trees and ground cover within an area that has been disturbed. For small disturbance areas, like in and around parking areas and around buildings, a landscaping plan should be provided for planting native trees that will grow to provide shade, reduce runoff and improve the aesthetic appearance of the development. For large reforestation needs, such as extensive cut slopes, the Hillside Reforestation method depicted on pages 43-44 is an alternative that has merit and should be considered.

Ridgetops

A ridgetop is generally an area of 0 to 15 percent slopes at the pinnacle of a hillside. These areas will be delineated when a development plan is submitted for review (see the development guidelines, page 37). Tree line conservation is necessary in this area because of their prominence on a community's landscape; guidelines are provided on page 38. In some cases, new trees should be planted. A list of appropriate species is presented in Appendix E.

TIMBER CUTTING AND LOGGING

Forest clearing and grading for development purposes is a vastly different practice than growing and cutting timber as an agricultural endeavor. Under state law, zoning cannot limit agricultural practices, which include tree harvesting for lumber or other commodities. Two Tennessee zoning-related statutes are Title 13, Chapter 7, Section

114 (regarding county zoning powers), and Title 6, Chapter 54, Section 54 (regarding a city's zoning powers) cover this limitation. Statute 6-54-126 is illustrative:

"For any land that is used for agricultural purposes as of May 10, 1998, a municipality may not use its zoning power to interfere in any way with the use of such land for agricultural purposes as long as the land is used for agricultural purposes."

Additionally, under the Tennessee Right-to-Farm Act (Tennessee Statute 43-26-103), farmers are protected from nuisance suits when a farm operation is carried out in conformity with generally accepted agricultural practices.

Conserving and growing trees that will ultimately be used for lumber or related uses are agricultural purposes. Timber-producing practices can be regulated, however, by standards that assure that cutting and logging are carried out in a manner: (1) to conserve soil resources; (2) to foster forest regeneration follow timbering; and (3) to reduce impacts to public roads and adjacent properties.

Knoxville already has a development code, which is not part of the zoning ordinance, to provide guidance for timbering operations. The code limits the amount of clearing in a five year period and requires a site plan to depict the forest area that is to be cut. Owners of single family house lots are exempted from the ordinance. Knox County does not have a tree protection and timber production ordinance.
In urban and suburban areas, timbering can impact neighborhoods because of noise from machinery, issues with trucks entering highways, damage to roads, clean-up costs (when management is poor) and potential property value losses. In view of these concerns, both the city and county should adopt code changes to better regulate timber production and logging operations. The codes should address the following:

- Forest regeneration using the best management practices recognized by the state of Tennessee;
- Preparation of a timber cutting and future forest management plan reviewed by a professional forester;
- A time frame after cutting and logging to allow forest to grow. (In other words timbering should not be a precursor to development, merely for the purpose of cutting trees without an intent to further produce trees as agricultural products. This can be cross-referenced in subdivision regulations.);
- Exemptions from the tree cutting provisions for house lots of a certain size (such as under two acres) and for such emergency situations as ice and wind storms;
- A provision for protection of specimen trees (that is, trees of outstanding size that are determined by the forester who prepares the management plan to be noteworthy to this region).

Administration

ZONING AND PLANS REVIEW

Planned Zone Districts

When a zoning change is requested, such as agricultural to residential, planned residential zoning should be recommended by MPC staff and adopted by the legislative bodies. That has been the practice in following General Plan policies for a decade now and should be continued. Planned residential zoning requires site plan review, providing the opportunity to more fully consider the most appropriate natural locations for housing, open space conservation and infrastructure. Consequently, this type of zoning is a most appropriate means to balance private and public benefits.

Zoning Overlays and Plans Review for Permitting

In addition to policies related to rezoning decisions, an amendment to zoning or land development codes is recommended to address (1) consideration of a hillside and ridgetop overlay district, or (2) standardized review of parcel development via the building permit process. Overlay districts are used in many cities and counties, including Brentwood, Tennessee; Fayetteville, Arkansas; and Huntsville, Alabama. Standardized review is a procedure that has proved to be worthwhile in Asheville. One or the other method could be an effective way to address consistency in all hillside development approvals, including cost-saving measures, such as reduced setbacks, narrower roads, forest conservation and density. The proposed program for each alternative is outlined below.

Hillside Overlay Zoning District

An overlay district does not change the permitted residential uses of the "underlying" zone; however, it would establish additional review of housing density and location of development areas. An overlay would establish guidelines for new construction and a review process to assure that development and conservation are in better balance. The geographical basis for the overlay would be the Hillside and Ridgetop Protection Area. Zoning overlays have been used for years to assure that certain design standards are addressed. City or county officials are familiar with historic, downtown design and technology corridor overlay districts. Because an overlay district can be easily depicted on the zoning map, property owners, developers and development services staffs can readily see the overlay in relation to the underlying zone. The Knoxville Utilities Board sees an advantage in having an overlay as a "trigger" to assure that water supply and fire protection are always considered in initial stages of development planning.

Standard Review Under Building Permit Processes

Asheville has mastered this system, which is tied to their geographic information system and their building permit process. Essentially, an extension of the method to Knoxville and Knox County would work under the following scenario. Standards are adopted for intensity of use, clearing and road widths to reduce development impacts in relation to

degrees of hillside slopes. When a property owner decides to develop a large parcel or a single pre-existing lot, staff could use Knox County's Geographic Information System to identify whether or not the parcel is in or out of the Hillside and Ridgetop Protection Area. If the parcel is in the protection area, then standards must be met in preparing development plans, including the density and clearing standards that are identified on page 33. If a pre-existing vacant lot is found to be in the Hillside and Ridgetop Protection Area, density would not be regulated; however, the clearing standards (page 35), smaller setback standards (page 37), and parking alternatives (page 38) should apply for the benefit of the house builder.

Special Hillside Development Zoning Code

Some places, including Knoxville, have begun to create form-based zoning codes that address design issues, such as consistency in building location along a street, height, landscaping and road features. While these kinds of codes are typically used in urban settings such as South Waterfront, it is conceivable to create a special form-type code that would address hillside development issues, include provisions to create low profile architecture, small footprint buildings, house-like structures, and low impact roads. Variations in topography may prove to make this approach difficult and a more generalized approach using guidelines with site plan review may be more practical to administer.

Residential Uses in the Agricultural Zone

An amendment should be considered to the county's agricultural (A) zoning district to provide opportunities for hillside and ridgetop development review. Currently, one house can be built on a minimum one-acre in this zoning district. Under the current county agricultural zoning, tree conservation is not addressed on the residential lots. The agricultural zoning district should be amended to require use-on-review in permitting lots in the Hillside and Ridgetop Protection Area, using the following standards:

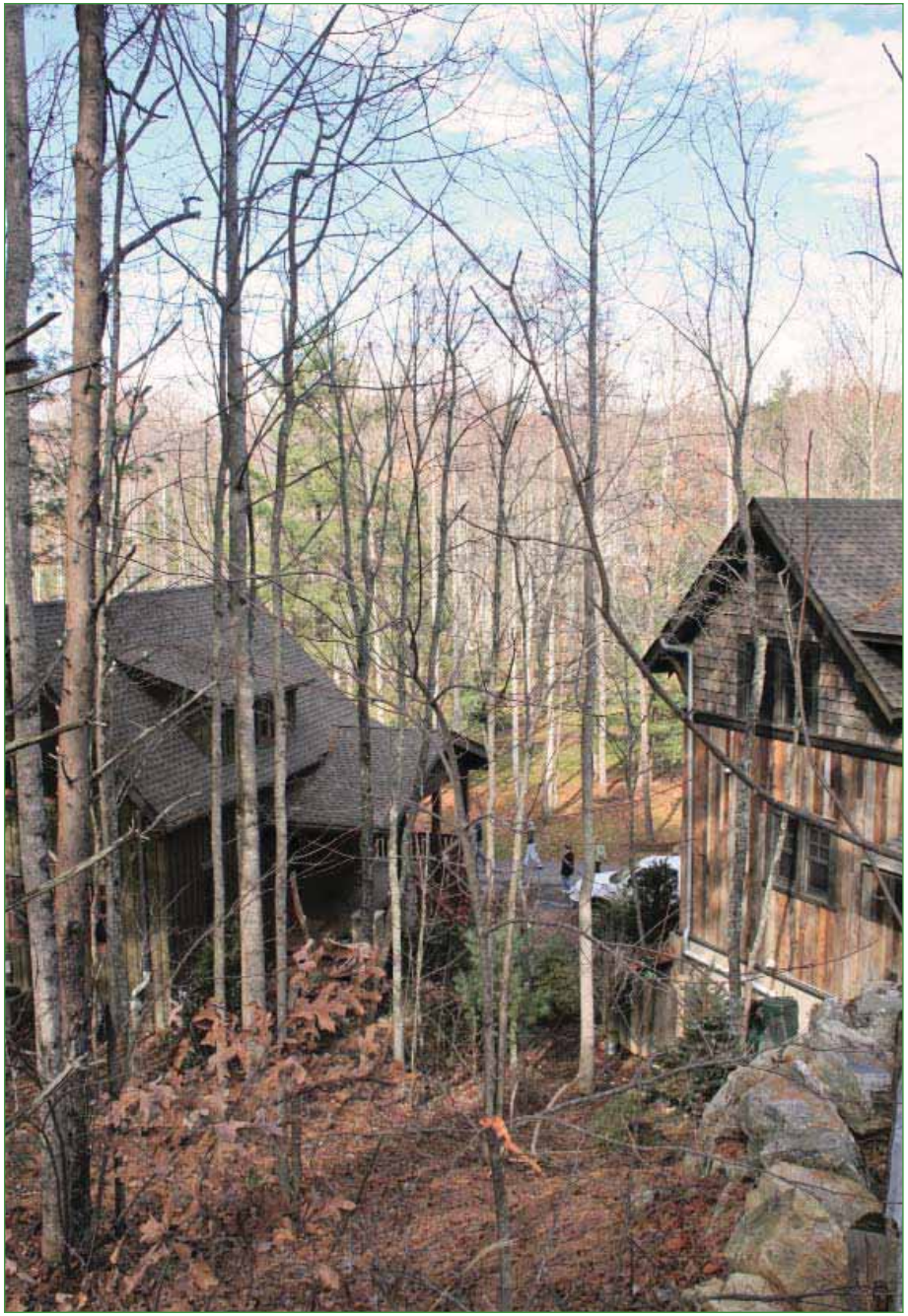
Table 4: Proposed Minimum Lot Size and Land Disturbance in the County's Agriculturally-Zoned Areas in the Hillside and Ridgetop Protection Area

Percent Slope	*Minimum Lot Size**	*Maximum Land Disturbance Factor***
0 - 15	1 acre	100%
15 - 25	1 acre	50%
25- 40	2 acres	20%
40 or more	5 acres	10%
Ridgetops***	***	***

*All minimum lot sizes must meet septic tank drain field requirements of Knox County Health Department; occasionally a larger size area may be required. Under state law a drain field may not be created on a slope greater than 50 percent

**These factors should be considered to determine an overall recommended land disturbance area for concept plans that are considered for approval by the Metropolitan Planning Commission. The overall land disturbance area would be considered a budget for land disturbance to be applied over the entire proposed development.

***Ridgetops are generally the more level areas on the highest elevations of a ridge. Because the shapes of Knox County ridges are so varied (see pages 8 - 9), the ridgetop area should be determined on a case-by-case basis with each concept plan proposal..



In this mountain community, houses were clustered in relatively close proximity on gently sloping sites (foreground) to converse steep forested hillsides (background).

Very large lot development, like the house on this north Knox County ridge, would conform to the recommended rural hillside standards.

Additionally, the proposed road width subdivision standards would apply in these areas, reducing development cost. Consideration should also be given to flexibility in setbacks. This would better assure slope protection and more effective fire protection.

Finally, the agricultural zone should be amended to allow clustered houses on agricultural-zoned property within or partly within the Hillside and Ridgetop Protection Area. This would allow attached and detached dwelling units on portions of a site in the Hillside and Ridgetop Protection Area that are below or part of 15 to 25 percent hillside slopes. In such cases, similar standards as those of the low density residential proposals should be used as long as septic or community-based wastewater systems can meet state and local engineering and health standards. The provision for these new rural lot size standards may become more necessary because community-based wastewater systems could provide the means for a developer to consider one acre lots on very steep slopes (greater than 25 percent), knowing that a septic drain field would not have to be placed on an individual parcel. Clearing and road construction on slopes greater than 40 percent is not advisable.

Staff Review and Inspections

Conventionally, the city and county engineering, public works and code administration staffs review road design, building structure, grading and stormwater plans. The city's Public Service Department personnel are responsible for timber clearing plans and replanting plans when clearing is approved for site development. The county has no similar review. When site plans are approved under use-on-review, city and county staffs do not inspect planting plans and MPC staff is not equipped to carry out field inspections. Consequently, there are short-comings in what is currently required by code or via plan approval.

Stormwater inspections offer a promising means to address some of these shortcomings in the future, especially in setting tree clearing limits because those inspectors are already visiting sites to examine stream buffers, site fencing and other management practices. Use of geographic information systems (including global position systems) may be instrumental in making field inspections easier. Still, city and county staffs have concerns regarding the means by which to carry out plan reviews and inspections. While Knoxville has the horticulturist position listed in its tree protection code, that position has not been funded for over 15 years.

Recommendation

The Task Force recommends that a greater level of review and inspection be carried out to assure that the principles of this plan be realized. This could include several options:

1. Additional city and county engineering and code staff or reallocation of existing staff to see that clearing limits are created in plans and on-site.

2. Funding a city forester and a county forester position are alternatives to improve the current system and administer a hillside and ridgetop protection program. Responsibilities would include: reviewing clearing and development limitations relative to codes (including hillside plan review); working with engineering and planning staff to assure

that road standards are being followed; reforestation plan review (checking that correct species and techniques are followed); and overseeing field inspections to assure that conservation and planting programs are implemented. As an alternative to two positions, a metropolitan forester position could be considered by funding and housing that position as part of the Metropolitan Planning Commission's activities.
3. Another alternative is to have the design professional (engineer or landscape architect) identify protection areas on site plans and certify that they have been marked and conserved on-site.

REVIEW OF SUBDIVISION PROPOSALS, LAND DISTURBANCE ACTIVITIES AND TIMBER REMOVAL OPERATIONS

Several changes are recommended to subdivision and related development codes. In order to reduce erosion, land disturbance and safety risks, alternatives should be created for hillside subdivisions whereby setbacks, lot size and road widths can be reduced to to conserve steeper slopes. A conservation subdivision provision (see example in Appendix F) should also be adopted. Land disturbance codes should be augmented to protect hillside forests. When forested slopes are cleared, the impact on water quality and flooding are significant because of poor percolation and runoff velocities that make erosion worse. Currently, the Knox County Stormwater Regulations call for a 50-foot undisturbed buffer. When slopes are as much as 25, 40 or 50 percent, as on many hillsides, wider buffers should be considered. As noted in the background section (pages 21-22), there are several shortcomings in land disturbance processes, particularly in tree clearing, that should be addressed for an effective ridge protection. Subdivision review, development permit, and stormwater review processes are appropriate for implementing the plan's conservation and development objectives. In summary, a wider stream buffer should be established when the Hillside and Ridgetop Protection Area is near a stream or river.

In the summer of 2010, the U.S. Department of Environmental Protection and, in turn, the Tennessee Department of Environmental Conservation, revised the requirements of the National Pollution Discharge Elimination System (NPDES) to better control runoff and water pollutants in all regions of the country. In Knox County, the new requirements will result in slightly wider stream buffer standards and limitations on land disturbance in relation to development phasing. The County Engineering Department is working with a committee to consider revisions to stormwater regulations that will place the county in compliance with the new NPDES standards. Stream buffering and erosion control are to be addressed in those revisions.

The county should also adopt a code to address reforestation of areas where trees are cut for timber production, which is an agricultural practice. The city and county should develop a review and approval process whereby a professional forester will approve timber clearing permits to address reforestation and the negative consequences of uncontrolled cutting and logging practices.

Bull Run Creek, like many streams in Knox County, is bordered by very steep slopes. The current required buffer would not protect the more expansive forested slope (see area of concern).

FIRE SUPPRESSION

When houses are constructed on steep hillsides and ridges, the danger of wildfires becomes more severe. Loss of hillside and ridgetop property is all too common during wild fires in this region, including nearby Sevier and Blount Counties. State and local fire officials recommend that homeowners take precautions to reduce potential fire disasters. These include the following proposed programs:

Fire Suppression Programs

Not all ridges are currently served with public water. Consequently, water lines and fire hydrants are not available. Private sources of water, such as wells, are the main alternative, especially in the rural, outlying portions of Knox County. While fire fighting services can be made available through the city of Knoxville, Rural Metro and community-based volunteer fire departments, the response time can be longer to reach hillside areas because of distance and access problems, resulting from steeper roads and driveways. While not required by existing building codes, private sprinkler systems are advisable to extinguish a house fire or, in severe cases, to "buy time" for a fire truck to arrive.[4] Property damage is far less with sprinkler systems because they are activated early on and less water is needed to extinguish a fire. In places that are not served by public water, home sprinkler systems can still be installed. Various manufacturers can provide the industry's standard (NFPA 13D system) with an attic or other storage tank. Such suppression can reduce insurance costs and is relatively inexpensive.

FireWise Program

Another fire preventive measure for hillside residential development is the "FireWise" program, which revolves around basic safety principles related to construction and landscape design. The greatest fire threat is the rapid uphill spread of fire, particularly under dry and windy conditions. Hillside houses in close proximity can be another problem. The "FireWise" program avoids such problems and contains several recommended measures:

House Construction

When choosing building materials, the primary goals are fuel and exposure reduction:

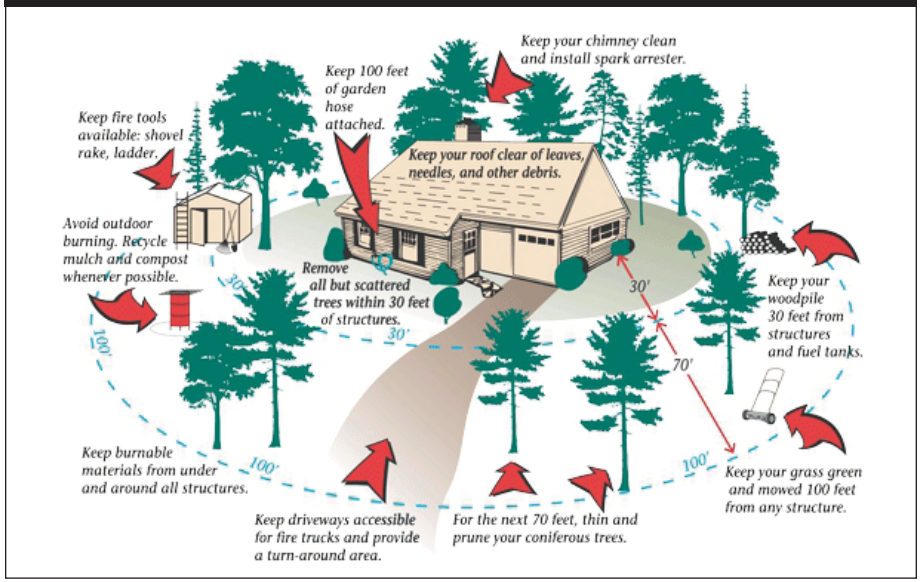
- ROOFS
  Fire resistant materials, such as most asphalt shingles, slate, clay tiles, metal, or cement, and concrete products should be used.
- WALLS
  Materials such as brick, stone, block, stucco and masonry are recommended. Though some materials will not burn, vinyl is not recommended as it can melt when exposed to high temperatures providing fire a direct path to interior walls. Wood siding above a masonry foundation is relatively fire resistant when it is not exposed to flammable vegetation, woodpiles and lattice.
- DECKS
  Wooden deck posts can serve as a ladder for fire to climb to the house. Masonry or other fire resistant materials are the recommended solution. Firewood and other flammables should not be stored under decks.
- CHIMNEY SPARK ARRESTORS
  Chimneys should have a spark arrestor installed to control flying embers.

Yard Landscaping and Tree Maintenance

The foremost objective is to maintain a "defensible space" around hillside houses. Trees, grasses and shrubs are the fuel for fires. Several prudent landscaping techniques can avoid wildfires that skip from plant to plant. This does not mean that clearing has to be widespread; however, certain measures can be used to limit the woody and grassy plants that can fuel a hillside fire.

- PLANT SELECTION
  All plants will burn if enough heat is generated in a fire. However, some species are better suited in resisting fire. Less flammable trees and plants include hardwoods, alders, hydrangea, crape myrtle and chokeberry. The flammable plants that should be avoided are closely spaced evergreens such as pines, cedars, junipers, hollies, spruces, firs and hemlocks. Other flammable trees and shrubs include magnolias, cypress, paper mulberry, rhododendron, laurel and azaleas. Grasses that go dormant can spread fire at ground level and should not be planted. Low growing shrubs should be chosen near houses to avoid situations where fire could reach siding and eaves.

Figure 7: FireWise "Defensibile Space" Fire Safety Principles



- TREE SPACING AND TRIMMING
  Closely-spaced trees and shrubs can result in the spread of fire. In general trees should not left to grow within 30 feet of a house. The crown of hardwood trees are not as great a fire threat as dense stands of evergreen trees. Evergreen trees should always have at least 20 feet between the tops. The lower limbs of closely spaced evergreens should be pruned to avoid having a fire climb into trees.
- PLANTING PATTERNS AND "HARDSCAPE"
  Planting trees and shrubs in widely separated spaces can reduce fire from spreading across a yard. Changes in the levels of a yard with stone or masonry retaining walls can also offer a firebreak. River rock and decorative gravel, especially around a house, is another effective fire prevention technique.

Recommendations

Two fire suppression methods are recommended:

- Residential fire sprinkler systems are highly recommended with new house development in the Hillside and Ridgetop Protection Area, particularly when no public water and hydrant facilities are available.
- Recommend that "FireWise" be a component of new hillside subdivisions, administered by a homeowners association to reduce the fire potential to individual houses and to protect neighboring properties in a collective manner. This can be accomplished through deed restrictions.

STRUCTURES ON HILLSIDES AND RIDGETOPS

Water towers and tanks are typically provided through a public utility, whose operations are defined under state law. Public utilities are not bound to comply with local zoning and related codes. Still, there are provisions which can be created for public review process in designing, locating and minimizing impacts of the facilities of public utility companies. These are outlined in this portion of the plan.

Communication towers, including cell phone, radio and television towers, are regulated through the Federal Communications Commission. While local governments and the Metropolitan Planning Commission have limited power to review and set design standards for cell phone towers, these tall structures are not subject to local prohibition.

A major emphasis of the task force's work has been on water supply facilities, including tanks, towers and the capacity of water lines to deliver fire protection and potable water services. Those issues are addressed below.

Water Tank, Tower and Supply

Public health and safety are foremost concerns in relation to water supply on slopes and hillsides, with fire protection and a sanitary source of water being key issues. Location and appearance of water towers and tanks are other concerns. All proposed water distribution systems must be created in accordance to the standards and approval by the appropriate utility jurisdiction and the Tennessee Department of Environment and Conservation.

Minimum General Requirements

The system must be designed, hydraulically analyzed, and installed to deliver required domestic water supplies, fire protection flows, and pressure requirements. Water quality standards must also be met.[5] The minimum water main size to provide water to fire hydrants should be verified with the appropriate utility jurisdiction and justified by hydraulic calculations with input from the appropriate fire protection agency. The system must be designed, stamped and submitted by a professional engineer licensed by the state of Tennessee.

Water Supply Implications

In view of the minimum general requirements, there are several implications for hillside development:

- SERVING SUBDIVISION LOTS WITH ADEQUATE DOMESTIC WATER SUPPLY AND FIRE PROTECTION
  Fire and health codes currently require that developments be served by adequate water line pressure and flow to support fire fighting purposes and to avoid contamination of drinking water, which can result when stagnant places could occur in the system. This is an issue because upper portions of subdivisions cannot always be served with adequate water pressure and flow. Additionally, to attain fire protection, hydrants have to be spaced at necessary intervals.[6] Certain high elevations in the county cannot be served by public water lines. Water pumps and booster stations are needed in such instances, especially with higher intensity land uses.
- SPRINKLER SYSTEMS WITHIN DWELLINGS AND OTHER BUILDINGS
  These systems are required for apartments and commercial structures Residential sprinkling systems cost about $1.50 per square foot; a cost that is occasionally a concern to a developer but is offset with better insurance rates because of safety benefits.

Proposed New Hillside Fire Protection Plans and Standards

Knoxville's and Knox County's fire officials and utility engineers agree on several principles that should be promoted in locating and designing water supply systems and creating development standards on hillsides. They are as follows:

- FUTURE WATER TANK AND TOWER LOCATIONS
  With such a large Rural Area (see map, page 18), there are limitations in serving the entire county with public water supplies. For economic reasons, not all ridgetop properties can be provided such public services (for example, private wells and sprinkler systems may be the only reasonable options). Still, there are certain points on some ridges that are advantageous locations for water tanks. The task force has worked with a few utility districts to identify such locations, but this needs to be further explored. To do so, the task force recommends that a consortium of all utility districts be formed to outline future potential locations of tanks and towers to serve developing urban and suburban areas. The Knoxville Utilities Board has already accomplished this analysis (see map, page 15).

  This process should be tied to the Urban Growth Boundary and Planned Growth Area of the Growth Policy Plan (see map, page 18) because those parts of Knox County are, by public policy, the places where growth is to be directed. This task can result in the creation of a county-wide, water supply sufficiency map that would identify where gravity-based water supply systems can and cannot be extended and, consequently, where the higher and lowest intensities of land development should be recommended. This will have implications for public policies relative to hillside protection and development, including land use and growth management plans.

  How such facilities are located is important not only for the reasons discussed above, but also to meet aesthetic concerns – maintaining the natural beauty of the region and reducing visual impacts on communities.

- SUBDIVISION ROAD AND DEVELOPMENT STANDARDS
  Several new code amendments are recommended to address excessive grades while providing access for fire fighting equipment, including minimum road width (20 feet within-the-pavement parking to be prohibited), maximum road grade (15 percent); maximum driveway grade (15 percent) and maximum building height (35 feet).

Designing and Locating Water Towers, Tanks and Reservoirs

Some utility districts and communities have developed basic principles to locate and design water supply facilities. Locally there are several good examples where principles, as those recommended below, have been applied. In north Knox County, Hallsdale-Powell Utility District has ground tanks on Copper Ridge. They are difficult to see because they are painted in earth tone colors and are set back from the ridge's crest. A similar design was used by West Knox Utility District to build its tank on Beaver Ridge above Schaad Road and the Knoxville Golf Course. The following principles are proposed to avoid the type of appearance of the now infamous south Knoxville water tower on the crest of Chapman Ridge.

- AVOID WATER TOWER LOCATIONS AT THE EDGE OF RIDGE CRESTS.
  A water tower near the edge of a prominent ridge would standout like a "sore thumb." As noted in the background report (see pages 7 - 8), there are several types of ridges in Knox County. The shape of a ridge is an important consideration when locating buildings and structures. "Knife-edged" ridges are prominent while "rounded" ridges, which are interspersed with hollows, are less so. When there are a series of rounded ridges, like those south of Chapman Ridge in south Knoxville, water towers could be sited on a knoll farther away from the first ridge line and not be conspicuous. In general, however, water towers are not an aesthetically pleasing solution in the proposed Hillside and Ridgetop Protection Area.
- BLEND WATER TANKS WITH THE NATURAL LANDSCAPE
  This is a far better aesthetic solution than building a water tower. The large-maturing, native trees of Knox County's oak-hickory forest grow to a height of 80 or more feet, offering natural camouflage for ground-mounted tanks. Water towers, such as that in south Knoxville, often exceed 150 feet. Tanks should always be the first possible solution to meet water supply needs.
- PAINT WATER TANKS IN EARTH-TONE COLORS.
  A common approach in some places is to paint water tanks and towers a "sky blue" color. That helps in the case of a water tower – we see this approach so often in various flat towns across America. However, when a tank is wedged into a hillside, an earth tone, like a shade of tan, should be used to provide camouflage.
- CONSERVE SURROUNDING TREES.
  Some clearing is necessary in erecting a tank. However, by keeping mature trees around the tank site, a natural screen is assured. Planting evergreens can supplement year-round screening of a water tank.

Water tanks, which rest on the ground and are surrounded by conserved woodlands, are an appropriate ridgetop utility design.

- CONSIDER DENSITY AND HEIGHT OF PLANNED DEVELOPMENT.
  In addition to the location of new development, density and height are significant in determining the type and location of the water supply facilities (tower or tank selection).

Public Review Proposals

The Knoxville Utilities Board has created a review process to more fully engage the public during the last year (this process is outlined on KUB's website). Such review opportunities should be extended to all community interests across Knox County. Public meeting options could include: (1) meetings, hosted by the utility district within potentially affected communities, or (2) a public hearing before the Metropolitan Planning Commission. Under State of Tennessee utility district statutes, districts are not obligated to abide by recommendations that are made by the planning commission or the local government. However, planning commission public meeting review could be the most transparent process and offers the means to consider a utility proposal in relation to the goals and policies of adopted community plans. Such a review process could be helpful, arriving at a more aesthetically pleasing project on hillside and ridges, especially in relation to the foregoing design principles (for example, location, color and tree conservation). Alternatively, rather than going through a change in state enabling legislation on planning commission duties, a memorandum of agreement among all utility districts to follow the foregoing design and location principles and a similar public review process could accomplish a similar purpose and be of overall public benefit.[7]

NATURAL AREAS AND RIDGE CONSERVATION CORRIDORS

Potential Conservation Programs

Knox County communities enjoy a naturally beautiful landscape, framed by forested ridges. Ridges define the edges of communities like Powell and Halls and are treasured by many residents. Ridge conservation corridors could be used to conserve natural settings for recreation including wildlife observation and walking trails. In one sense, these corridors could be part of a system of smaller Appalachian Trails. These conservation corridors are proposed to be part of a combination of public and privately-owned land and should be established through the following programs:

Hillside Conservation and Development Standards

Very low density residential development is already designated in most of the identified corridors and should be continued as one means to protect ridges (for example, one housing unit per two acres). Another option is clustered housing whereby incentives are provided to encourage developers to locate housing units on smaller lots at the toe of a slope or on more level terrain within a site (such increases in housing density could be made in exchange for a conservation easement).

Ridge Corridors and Trail Easement Acquisition

The work of the Legacy Parks Foundation is the model for this approach. Both private donations and public purchases should be considered. Tax advantages are available for donations and non-profit groups such as the foundation can assist in this option to create protected natural areas and walking trails.

Linkages between Ridge Conservation Corridors, and Natural and Wildlife Management Areas

Several proposals were outlined in the recently adopted Knoxville Knox County Park, Recreation and Greenway Plan. These include a proposed corridor along the top of McAnnally Ridge that would form a connection to House Mountain State Natural Area and a continuation of the Urban Wilderness and Historic Corridor. This corridor should be extended eastward to join the Civil War forts to Ijams Nature Center and William Hastie Park, and westward along Chapman Ridge.

Implementing Public and Quasi-Public Corridor Efforts

These options are available to implement and fund ridge corridor conservation efforts:

Legacy Parks Foundation

Legacy Parks Foundation is a public, tax-exempt organization founded in 2005 and is a part of the East Tennessee Foundation. Operated by an independent Board of Directors, it serves Knoxville and Knox County. Its mission is: "To enrich our quality of life by improving, preserving and growing parks, recreation and green space." Financial support for the program comes from grants, private donations, corporate contributions, gifts of property, and bequests. Coordination with the Foundation is a necessity in creating the future park system and publicly accessible ridge corridors.

Located in Ijams Nature Center, this is the type of trail that could be created in many areas of Knoxville and Knox County.

Corporate Sponsors/Naming Rights

A potential funding source is to work with corporations and businesses that would like to provide land, materials, and other resources for the creation of natural areas, trails, greenways and ridge conservation areas. Several prominent local examples include Clayton Homes' donation of a large open space on the Beaver Creek greenway, and the roles of the Pilot Corporation and Aslan Foundation in establishing the Urban Wilderness Corridor.

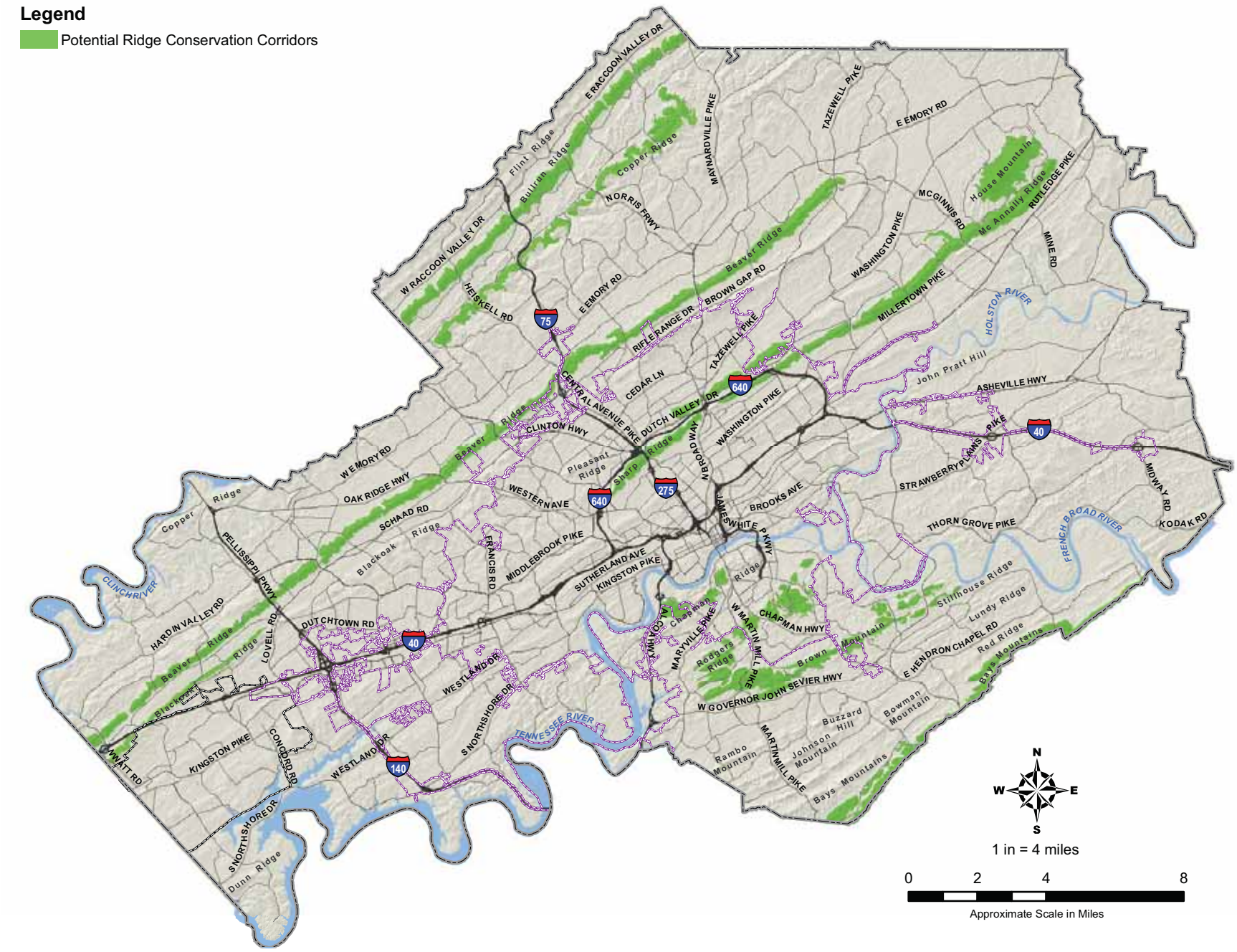
Real Estate Transfer Tax

The state currently uses a real estate transfer tax to acquire park land throughout Tennessee. Although this an extremely small portion of real estate transfer costs, the accumulative effect of thousands of transactions can be appreciable. It is recommended that Knoxville and Knox County officials work with state officials to amend the state law to direct a portion of the tax revenues, particularly those that collected in the county, for use in park and open space acquisition in Knox County.

Referenda for Open Space Funding

Provide opportunities through ballot measures or referenda that allow the public the opportunity to decide on creating new parks, greenways and open spaces. This should include bond issues and, potentially, the right for certain communities to establish their own park districts. A sales tax option is another consideration whereby a small portion of the sales tax is use for park and open space purchases. In Boulder, Colorado, for example, voters approved a local sales tax allocation of 0.4 percent in 1967 under which $116 million has been collected to establish 33,000 acres of greenways and foothill/mountain parks.

Map 8: Potential Ridge Conservation Corrridors



Endnotes

1 Menendez, Garry. "Saving Trees and Making Money in Residential Development," University of Tennessee Extension Service Bulletin #1766, 2005.

2 In Asheville's hillside areas, all utilities must be placed under a 20 foot-wide road to reduce cut slopes.

3 Victor Davis with the Office of Surface Mining and Dr. Jennifer Franklin with the University of Tennessee's Department of Forestry presented the restoration practices utilized for previously mined sites as part of the Appalachian Regional Reforestation Initiative to the task force, noting that these practices are also particularly well suited for disturbed soils related to development activities on hillsides.

4 This will usually require a storage tank in the attic or elsewhere on a property. Modern sprinkler systems have sensors related to fire location and limit the amount of water that is used to the room that has a fire.

5 The system may also have to be designed to include storage or pumping facilities, if necessary, to safely and reliably provide adequate domestic and fire flows and pressure at peak demands. For most water systems a satisfactory rule-of-thumb is to meet the needs of at least 24 hours of demand in elevated storage while maintaining required water quality standards.

6 The minimum standards for water lines (as of 2009) are 500 gallon per minute (gpm) flow and 20 pound per square inch flow; fire and utility officials are anticipating that a higher standard (1,000 gpm) is a better goal and may be forthcoming under state direction.

7 Utility districts have broad powers under state law and, generally, are not subject to city or county regulations. Under Tennessee Code Annotated, § 13-4-104, municipal planning commissions should be or can be reviewing public project plans by state or local agencies, including utilities. MPC is a regional planning commission, however, does not have such broad authority. Only state and state-funded projects are reviewed under the regional planning commission law and that review is by the Tennessee Department of Economic and Community Development, which may consider the work of the planning commission in its review. Consequently, consideration should be given to amending the state enabling statutes to allow regional planning commissions to have the same review authority pertaining to public project review as provided for municipal planning bodies. It would be advisable to have such review for areas within the city and in unincorporated areas. As such, the plans for the location and design of water towers and tanks could be reviewed in the course of an MPC meeting. As regards to areas outside the city of Knoxville, presently, there is no process for such referral for planning commission review in unincorporated areas. Again, a change in state law for referral of public projects within both city and county limits for regional planning commission review would assure that all interests can comment on locations and designs of facilities.

Section 3: Implementation and Action Steps

Implementation through action is an essential element and ultimate goal of every planning process. This section identifies how the principles, policies and recommendations of the Hillside and Ridgetop Protection Plan can be used during the course of development review; and serves to chart a path to fully implement the recommendations of the Plan, essentially becoming a "to-do" list for the decision-makers of Knoxville and Knox County for the next several years.

Action Step 1.

ADOPT THE PLAN AS AN ELEMENT OF THE KNOXVILLE-KNOX COUNTY GENERAL PLAN 2033

This plan should be adopted by the Knoxville City Council and the Knox County Commission as an element of the Knoxville-Knox County General Plan 2033, which serves as the regional general plan for the City of Knoxville and Knox County.

The purpose of the regional general plan, as authorized in state law at TCA 13-3-301 (Regional Plan), is to show through maps, charts, tables and other descriptive material, the planning commission's recommendations for the physical development of Knoxville and Knox County, in this case within the Hillside and Ridgetop Protection Area (HRPA).

This Hillside and Ridgetop Protection Plan is made, in accordance with TCA 13-3-302, for the general purpose of guiding and accomplishing a coordinated, efficient and economic development of Knoxville, Knox County and the HRPA, which will accommodate present and future needs and resources, promote the health, safety, prosperity and welfare of all of the citizens of Knoxville and Knox County, and promote efficiency and economy in the process of development. The plan guides the distribution of uses of land for habitation, recreation, forestry and conservation of resources, helps to create conditions favorable to transportation, health, safety, and civic activities, provides direction toward an efficient utilization and conservation of resources, and identifies area where there are currently inadequate services to adequately protect future development.

Adoption of the Hillside and Ridgetop Protection Plan as an element of the Knoxville-Knox County General Plan will (1) replace the existing Slope Protection Areas identified on each of the land use plans of the twelve sector plans with the HRPA; (2) provide guidance for decision makers in the approval of plan amendments, changes to the zoning map and development plans; and (3) provide recommendations for future codes and ordinances that can serve to implement the principles and policies of the plan.

Action Step 2.

FOLLOW THE RECOMMENDATIONS OF THE PLAN WHEN REVIEWING REQUESTS FOR AMENDMENTS TO LAND USE PLANS

The recommendations of this plan regarding future land use within the HRPA can be implemented when the planning commission, Knoxville City Council and the Knox County Commission consider requests from property owners within the HRPA to change the land use classifications of the General Plan.

The current land use plan classifications within the HRPA predominantly call for low to extremely low (rural) density residential land use. There is a very small fraction (less than 1 percent) of the area currently with land use plan classification and zoned for uses other than residential. This plan recommends continuation of this policy.

From time to time there is reason to revisit the land use plans for the city and county. This plan makes recommendations regarding requests to change the land use maps of the twelve sector plans with respect to land within the HRPA and decision makers should follow its guidance when making changes to future land use plans.

Within the constraints of other elements of the General Plan and the Knoxville-Farragut-Knox County Growth Policy Plan, the legislative bodies of Knoxville and Knox County, may, when warranted by exceptional character of the subject property or development in the surrounding area, reasonably deviate from the guidelines of this plan. The use of Special Districts, which meet the criteria identified in the plan, is recommended.

Action Step 3.

USE THE GUIDELINES FOUND IN THE PLAN FOR REVIEW OF REQUESTS TO CHANGE THE ZONING MAP

The guidelines provided in this plan regarding residential density and land disturbance provisions should be implemented when the planning commission, Knoxville City Council and the Knox County Commission consider requests from property owners within the HRPA to change the zoning map.

This plan provides guidelines for determining a density allowance, or budget, for requests to create planned residential zone districts, as well as criteria for the use of density bonuses as an incentive for setting aside land for conservation and making that land available to the public. In addition, the plan provides guidelines

for determining an overall land disturbance (clearing and grading) budget for development of the land. These factors should be considered as conditions of any change to the zoning map when approved by the legislative body.

Within the constraints of other elements of the General Plan and the Knoxville-Farragut-Knox County Growth Policy Plan, the legislative bodies of Knoxville and Knox County, may, when warranted by exceptional character of the subject property or development in the surrounding area, reasonably deviate from the guidelines of this plan.

Action Step 4.

USE THE GUIDELINES FOR REVIEW OF DEVELOPMENT PLANS AND CONCEPT PLANS

The guidelines presented in this plan should be implemented when the planning commission considers development plans as the second step of the planned development zoning process and concept plans as the first step in the subdivision process. The planning commission is provided flexibility by the City and County zoning ordinances to determine many of the dimensional and density regulations at the time of approval of the development plan within a planned development zone district. It is during this process when conditions of any zoning that reflect the recommendations and guidelines of the Plan may be implemented through development plan and concept plan approval by the planning commission.

The plan provides recommendations regarding a number of development standards which are meant to minimize or mitigate the impact of development on the hillsides and ridgetops. These include:

- Building height
- Minimum setback requirements, other than front and peripheral setbacks
- Density bonuses in accordance with any approved conditions to the zoning
- Fire suppression methods and programs such as FireWise
- Land disturbance limits
- Reforestation of disturbed land
- Treatment of utility facilities
- Variances from subdivision regulations such as:
  - Minimum right-of-way
  - Pavement width requirements
  - Maximum road grades
  - Maximum driveway grades
  - Turning radii and turn-around design

Action Step 5.

RECOMMENDATIONS FOR FUTURE REGULATIONS AND REQUIREMENTS THROUGH CHANGES TO CODES

Following the adoption of this plan, the City and County Zoning Ordinances and the City-County Subdivision Regulations should be reviewed for consistency with the principles and policies of the plan. A goal should be the establishment of set of development standards that reflect the recommendations of the plan and are applicable to all development within the HRPA, not just that development which is subject to planned development zoning. These recommendations will guide the City and County toward the creation of regulations that shape the design and placement of future development in a manner which minimizes its impact on the natural environment and mitigates any potentially damaging activity within the HRPA.

Recommendations for future amendments and additions to codes fall within three categories: (1) City and County Zoning Ordinances, (2) City-County Subdivision Regulations, and (3) City and County General Codes of Ordinances.

Zoning Ordinances

Changes to the zoning ordinances recommended by the plan to permit development consistent with the principles and policies of the plan include:

1. Building Height

Changes in the manner in which building height is measured should be considered, as should standards for additional height for structures that outside the boundaries of the HRPA but the overall development includes property within the HRPA.

2. Setbacks

Changes to allow the planning commission to determine appropriate front and peripheral setbacks within planned development zone districts and a general provision for flexible setbacks for development within any zone district in the HRPA should be considered.

3. Density Bonus Incentives

Provisions for density bonuses in any zone district within the HRPA subject to meeting the criteria of the plan should be considered.

4. Clearing and Grading Provisions

Provisions to limit clearing and grading until after site plan approval should be considered. Limits of clearing and grading within the HRPA should be considered so that they are applicable to all development regardless of zone district. These limitations should be related to and tied to any density provisions or bonuses that are considered.

5. Landscaping Requirements
For small disturbance areas, like those in and around parking areas and near buildings, landscaping requirements should be considered.

6. Reforestation Requirements
For large reforestation needs, such as cut slopes resulting from road or building construction, standards similar to those demonstrated in the Appalachian Regional Reforestation Initiative for the treatment and reforestation of disturbed land should be considered.

7. Parking Reduction Requirements
Provisions to reduce the required off-street parking requirement or a program to provide incentives for structured parking or parking beneath buildings should be considered.

Subdivision Regulations

Changes to the subdivision regulations recommended by the plan to permit development consistent with the principles and policies of the plan include:

1. Roadway Standards
Provisions for roadway standards applicable to development within the HRPA should be considered.

2. Setbacks and Building Placements
Provision for flexible setbacks for development within any zone district in the HRPA should be considered and coordinated with any changes to the zoning ordinances.

3. Conservation Subdivision Program
The conservation subdivision draft regulations shown in the appendix should be considered as the starting point for codification of these recommendations.

4. Land Disturbance Provisions
Approval of limits of land disturbance and methods of restoration as an element of the design plan approvals required by the subdivision regulations should be considered.

5. Conservation Easements and Connections to Trail Corridors
The property owner can, through the subdivision process, dedicate provisions for easements and connections in accordance with this plan and incentives created through the zoning ordinances.

General Code of Ordinances

Changes to the City and County Code of Ordinances could implement several of the proposed recommendation of the plan, including:

1. Timber Cutting and Logging
Timber producing practices should be regulated by standards that assure the conservation of soil resources, foster regeneration of forests and reduce impacts on roads and neighboring properties.

2. Land Disturbance Permit Program
Land disturbance resulting from development, as well as mineral and aggregate extraction practices, should be regulated by standards that assure the restoration of slopes and ground cover, while reducing impacts on storm water quality and quantity, roads and neighboring properties.

3. Bonding
The system of bonding against potential governmental costs of finishing development related projects should be revisited and strengthened to assure adequate funds to mitigate or complete projects that the developer is unable to complete.

Appendix A

ECONOMIC CONSIDERATIONS: LAND VALUES AND OPEN SPACE SYSTEMS

Land Values Associated with Hillside and Open Space Systems

Open space systems, which can include forested hillsides and ridges, generally refer to public or private lands that are conserved from development for various benefits including environmental, aesthetic, recreational and wildlife values. Some public and quasi-public open space systems have been created on ridges and others hillside resources will likely continue to be set aside to some degree, expanding upon the work of the Legacy Parks Foundation (see page 53). Existing open spaces include House Mountain, Seven Islands Wildlife Refuge, and the Urban Wilderness and Historic Corridor.

Public Open Space and Property Values

A review of various studies that analyze the impact of open space systems on surrounding property values shows positive impacts on land values.[1] The studies addressed different types of open space, level and hilly parks and such corridors as greenways. In looking at the studies, staff sees potential value in creating some public or quasi-public hillside and ridge top conservation areas.

The increased value of housing in relation to natural, passive parks is clear. Passive parks, which do not contain ball fields, tennis courts and similar facilities, have a positive relation to property values (see Table A-1). Texas A & M University research has shown that properties abutting passive parks have as much as a 20% increase in value.[2]

If selected hillside and ridge lines become part of a public or quasi-public open space system, the effect is typically more pronounced. Several studies indicate that to maximize increases in property values, open space systems should be linear because such corridors have longer perimeters that allow a larger number of properties to abut or be near open space. A local example of such a system is the linear park along Fort Loudoun Lake in Sequoyah Hills where property values are high both near and farther away from the park, owing in part, to the easy access to the open space.

Table A-1: Summary of Open Space Systems Effect on Property Values

Location	*Effect on Property Values*
Greenville, SC	• Home within 1500′ of any park = +6.5% • Homes within 1500′ of a small park = +8.5% • Homes 200′ to 1500′ of a medium to large park = +6%
Minneapolis, MN	• Average increase of $40,000 or a 20% increase in a home's value if adjacent to a park • Increase in home value up to 23% • Property values decrease 8.5% per every 1000′ from a greenway • On an average priced home ($188,142) property values increased $42,000 if the neighboring park was a "nature park"
Hocking County, NY	Property values decrease $500 per each 100′ the property is away from Watkins Glen State Park.
Hammond, NY	Property values decrease $72 per each 100′ the property is away from Keewaydin State Park
Portland, OR	• Property within 1500′ of park = $2,105 average increase in property value • Each additional open space acre = +$28.33 for each property • Home within 1500′ of a park with large natural open space area = increase $10,648 • Land size of park must exceed 258 acres to maximize the effect on property values
Indianapolis, IN	Homes near Monon Trail sell on the average 11% higher
Boulder, CO	Properties within 3,200′ of 3 greenways, values fall $4.20 for every foot a home is from the greenway
Austin, TX	Increase of 12.2% in the average value of all homes adjacent to the Barton Creek Greenbelt
Springfield, OH	Home values decrease $7.05 for each foot increase in distance from the Little Miami Trail
Apex, NC	Greenways (converted rails to trails project) added $5,000 to the price of adjacent homes
Seattle, WA	Homes near greenways hold values 6% higher
Coalition, NY	• 40′ distance from park accounted for 33% of the land value • 1000′ distance for 9% • 2500′ distance for 4.2% at
Front Royal, VA	A developer sold all 50 parcels in 4 months that neighbored a 7-mile stretch along the Big Blue Trail.
San Diego, CA	A developer saw a 25% increase in sales price when he cut back the development 15% and added natural open space.

Summary of Various Studies

Local Economic Benefits

Open space systems positively affect more than property values for the economic gain of a municipality. Other economic benefits include:

- Increased tax base in areas along open space parks and greenways
- Open space systems are a short term cost to municipalities following acquisitions
- Open spaces cost less to provide public service (the average cost of services in open space areas is $0.37 in comparison to $1.15 for residential areas)
- Increase in open space users' expenditures can reach into the hundreds of thousands of dollars (including expenditures in conjunction with use and foot ware, clothing and equipment).

Perceptions of how open space systems affect property values

Various studies have addressed perceptions on how property values are affected by open space. While most people saw no increase or decrease in property value, 20 to 40 percent (depending on which city was studied) believed that the presence of open space systems enhanced their property values. Two studies noted that after the open space systems were created, adjacent landowners felt that their perceptions of potential negative impacts were not as serious as they had anticipated.[3]

Studies specific to hillsides and ridge tops

Two case studies were found that reflect open space systems' effect on property values in hilly forests or ridge lines.

Grand Rapids, Michigan

Statistical studies of properties in Grand Rapids concluded that property in close proximity to urban forest preserves have an increase in value from $5,800 to $8,400. The increase in value accounts for 7% of a home's value and 19% to 35% of a lot's value.

Green Bay, Wisconsin

Empirical studies conclude that lots in the northwest suburbs of Green Bay near ridge trails sell for 26% more than lots farther away.

In the course of Task Force work, various cities and counties were consulted on their hillside and ridge protection programs. While most places have not carried out specific economic analysis, the experiences of administrators of their jurisdictions (see below) indicate that property values have increased or have not been affected by local protection measures.

Fayetteville, Arkansas

John Groddard, of the Fayetteville planning office, acknowledged that before the enactment of their hillside ordinance, there was quite a battle of arguments from landowners about the potential negative impacts of proposed hillside conservation policy. However, after the policy was passed and several years have gone by, no negative feedback or legal issues have resulted from the policy adoption.

Asheville, North Carolina

Shannon Tuch, assistant director of the Asheville planning office, stated that following the enactment of their hillside/ridge top protection ordinance, the general perception is that the ordinance has positively affected the value of land and properties near the protected areas.

Wilbraham, Massachusetts

Jon Pearsall, noted that since the Ridgeline and Hillside District in the Town of Wilbraham was implemented in 1990, there have been no perceived negative impacts upon property values. The Ridgeline and Hillside District was implemented after a company had cleared the slope of the hillside before going into bankruptcy. The slope was left denuded of vegetation for years. The residents welcomed the protection district as the natural views have been maintained which relate to the high market value of properties adjacent to hillsides and ridgelines.

Stowe, Vermont

Tom Jackman has perceived a large positive impact upon property values adjacent to the Ridgeline/Hillside Overlay District (RHOD) as it stopped highly visible development on hillsides and ridgelines, erosion and water quality problems.

Lyme, New Hampshire

The planning commission of Lyme has seen no negative impacts on property values since the adoption of their Steep Slopes Conservation District. The primary goal of the district is to conserve natural space that surrounds Lyme and maintains Lyme's unique town character.

Newberry, New Hampshire

Denise Walter has received no negative feedback after the implementation of Newberry's Skyline/Hillside Conservation Overlay District. Newberry's overlay district focuses on several area hills.

Endnotes

1. Nicholls, Sarah and Crompton, John L. The Impact of Greenways on Property Values: Evidence from Austin, Texas. Journal of Leisure Research. Vol. 37, No. 3. pp. 321-341. 2005.

2. Crompton, John L. Impact of Parks on Property Values: A Review of the Empirical Evidence. Journal of Leisure Research. Vol. 33, No. 1. pp.1-31. 2001.

3. Lindsey, Greg. Property Values, Recreation Values, and Urban Greenways. Journal of Park and Recreation Administration. Vol. 22, No. 3. Fall 2004, Lutzenhiser, Margot and Netusil, Noelwah. The Effect of Open Spaces on a Home's Sale Price. Reed College. Portland, OR.

Appendix B

OVERVIEW OF THE HILLSIDE AND RIDGETOP PROTECTION AREA MODEL

MPC's Geographic Information System (GIS) staff examined several topographic modeling techniques to identify steep hillsides and ridgetops. The purpose of the research was to determine a consistent means to identify those steeper portions of the Knoxville-Knox County's landscape where conservation and development could be brought into better balance.

Several places (such as Asheville and Gatlinburg) use a set elevation, above which their hillside and mountain top protection codes apply. Knox County's hillsides and ridgetops could not be mapped by a constant topographic elevation because of relatively constant decreases in the elevations of streams, rivers and ridges from northeast to west. GIS staff found that the City of Fayetteville, which adopted protection measures several years ago created a modeling technique that could, with adaptations, be used across Knox County. A description of the adaptation process follows.

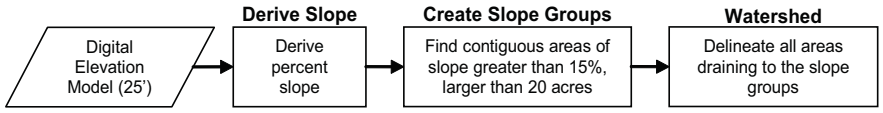
The City of Fayetteville Arkansas worked with the Center For Advanced Spatial Technologies at the University of Arkansas to develop a model which outline a hillside protection overlay. The output of the model serves as their overlay district. The only input to the model is a digital elevation model (DEM). Fayetteville used a 25 foot resolution DEM. That is, their elevation model, gridded the area within their city limits off in 25 foot by 25 foot cells. Higher resolution datasets within exist both in Fayetteville and in the Knox County Geographic Information System (GIS). However, for this type of modeling, a more a generalized set of data is appropriate as it smoothes small undulations and in the surface and helps to minimize the effect of small man made grades and cuts.

Initial Model Runs

Three major processes were used to delineate the overlay:

1. Derive the slopes
2. Identify "Slope Groups," which are defined as contiguous areas of slope over 15 percent that are larger than 20 acres.
3. Define the watershed of each slope group. This identifies all areas which are uphill of the slope group or all areas which drain to the slope group.

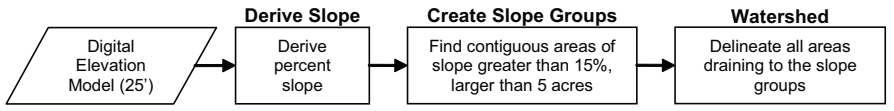
Figure B-1. Fayetteville Model



Model Revision 1

After several runs of the Fayetteville Model, MPC's GIS staff recommended several changes to help improve the consistency of the output. Generally, it was observed that Knox County's topography was more varied and complex than Fayetteville's and that a smaller slope group size was warranted. The slope group size was reduced to five acres and the model output was reevaluated.

Figure B-2. MPC Model Revision 1



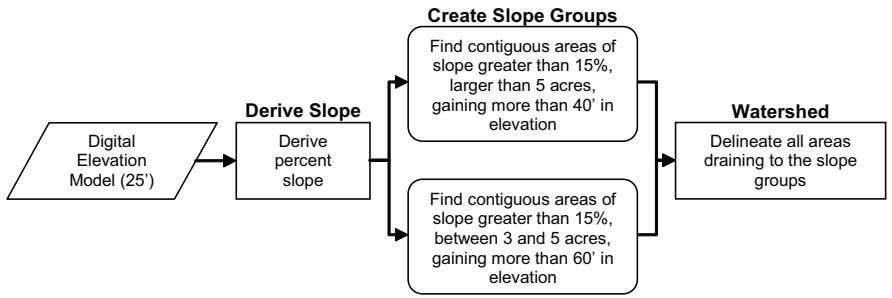
After the output was reviewed using 5 acre slope groups, three patterns emerged. First, the reduction of the slope group size threshold to under 5 acres improved the overall results. Second, some terrain was still not well defined using five acre threshold and that in some cases, lowering the slope group threshold even further would be desirable. Third, some undesirable slope groups were being included, some of which were over the 20 acre threshold. These slope groups included s teep river and stream banks which were long, thin bands of contiguous slope. Others groups were human-made terraces and cuts around features like large building pads and interstate related cut and fill.

Model Revision 2

A second model revision was created to address problems related to low elevation gain features. This version introduced the notion of elevation gain in evaluating the slope groups. In other words, the slope group or hill must be of a minimum height. Two rules would then govern which slope groups were included in the model:

1. Contiguous areas of slope greater than 15%, larger than 5 acres in size with an elevation gain greater than 40′
2. Contiguous areas of slope greater than 15%, between 3 and 5 acres in size with an elevation gain of at least 60′

Figure B-3. MPC Model Revision 2



Model Revision 3

The final revision of the model was created to address anomalies in slope groups such as interstate cuts, large stream banks and river bluffs. This revision inserted a manual slope group classification procedure that divided slope groups into two types: primary and secondary.

Secondary slope groups have one of the following characteristics:

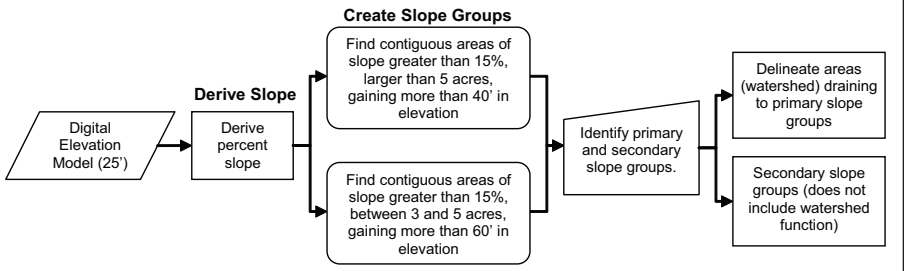
1. Low profile: Primarily encountered along rivers and streams. These are linear shaped portion of a slope group, longer than 500 feet, but with no portion of the spur gaining more than 40 feet.
2. Low profile connecting areas: These are areas greater than 500 feet in length connecting two larger slope group areas, also found along stream and river banks.
3. Low profile slope group: Primarily located along rivers and streams, these groups have an elevation gain more than 40 feet, but no portion of slope group gains more than 40 feet. Areas longer than 500 feet in length are considered secondary.
4. Human-created: Such slope groups are located in areas of significant human disturbance such as quarries, road cuts and areas of major grading.
5. Hydrologic Errors: Areas where a slope group crosses a stream bottom, small valley or minor depressions can cause watershed functions to inappropriately run uphill from the portion of slope group on the opposite side of the depression. Portions of these slope groups are removed.
6. River Bluffs: Slope group areas taller than 40 feet where the base of slope group is formed by a major river (Holston, French Broad, Tennessee or Clinch) and whose uphill area does not interact hydrologically with a slope group on an opposite hill or ridge face or whose slope group does not wrap continuously around to the ridge or hillside's opposite face.

All other slope groups not identified as secondary are considered primary.

Following the slope group classification, the final model output is generated. The final output is the sum of two components:

1. Primary slope groups and all areas which are uphill of the slope group (That is, areas which drain to the slope group).
2. Secondary slope groups (no watershed function is performed).

Figure B-4. MPC Model Revision 3



Appendix C

DEVELOPMENT IMPLICATIONS OF PROPOSED HILLSIDE AND RIDGETOP PROTECTION POLICIES

Introduction

The proposed Hillside and Ridgetop Protection Area is largely composed of moderate and steep slopes (those greater than a 15 percent grade) that rise to the ridge tops. That area is about one-third of Knoxville-Knox County's land resources.

The emphasis of Task Force work has been to find a balance between conservation and development. Steep slope residential density standards, which establish a policy of less density on steeper slopes, will continue to be recommended for rezoning cases. Those standards are:

Table C-1: Proposed Residential Density Standards

Slope Percentage	*Location*	*Density*
15 - 25	City, Urban and Planned Growth Areas	2 dwelling units per acre
25 - 40	City, Urban, Planned Growth and Rural Areas	1 dwelling unit per 2 acres
40 - 50	City, Urban, Planned Growth and Rural Areas	1 dwelling unit per 4 acres
50+	—	No development

The Basic Question

During the course of public input, some individuals observed that they felt that hillside areas are the only places left for future development. A county commissioner asked MPC staff to provide an assessment of the effect of the proposed policies on future land development. Consequently, staff analyzed the implications of the policies and has found that there is an array of opportunities to accommodate new development, both within and outside hillsides areas. The analysis is presented below.

Potential New Residential Development

Within the proposed Hillside and Ridge Top Protection Area, approximately 95 percent is intended for low intensity uses. These include agricultural (including forestry practices), rural residential and low density residential uses as depicted in the land use plans (adopted by MPC, City Council and County Commission).

There are approximately 82,000 acres of undeveloped land within the proposed Hillside and Ridgetop Protection Area. The Task Force has considered various scenarios for housing densities in that area with the basic principle being – the greater the slope, the less amount of housing density. In view of the proposed densities (see above and using 3 dwelling units per acre for slopes less than 15 percent), approximately 82,000 new dwelling units could be accommodated on the vacant land of the Hillside and Ridgetop Area. Those units could house about 205,000 residents. *Note: Using an average detached dwelling household size of 2.5 persons*.

Land Below the Hillside and Ridgetop Protection Area

There are about 70,000 acres of vacant land that is below the Hillside and Ridgetop Protection Area. (Farragut's land is not included in this number.) Current land use plans can be used to evaluate the potential office, commercial and residential development in that area, which is generally more level and extends from a roadway to the toe of a hillside. About 36,700 acres are in the Rural Area; if one-fourth of that area is developed for rural residential use, approximately 9,200 houses would be built, accommodating more than 23,000 people. *Note: Based on one acre lot sizes and 2.5 persons per household.*

There are almost 900 acres of vacant land for apartment development in the area, which could accommodate more than 12,000 new apartment units and could house approximately 20,000 people. In addition, there are approximately 3,000 vacant acres of land designated for office and mixed use (allowing a combination of office and medium density residential and sometimes retail uses). If one third of that land is developed for medium density residential uses, 14,000 dwelling units could be accommodated, housing over 23,000 residents. *Note: These figures are based on 1.7 people per medium density dwelling household and an average apartment density of 14 units per acre.*

There are about 22,700 vacant acres of land designated for low density residential uses, enough to accommodate more than 68,000 dwelling units and an estimated population of 170,000 in Knoxville-Knox County. *Note: An average housing density of 3 dwelling units per acre and an average household size of 2.5 persons were used in this estimate.*

Redevelopment of Rural Residential Parcels Outside the Hillside and Ridgetop Protection Area

Some rural residential uses (defined as an existing house on a two to ten acre parcel) will be redeveloped for higher intensity residential purposes. This is more likely along arterial road corridors or in growing urban or suburban areas, particularly when the value of the house is exceeded by potential value of new development. There are almost 9,000 acres of rural residential parcels in the City, its Urban Growth Boundary and the County's Planned Growth Area that are depicted for future low density residential or medium density purposes. More than 8,500 of the acres are depicted in sector plans for low density residential uses. If one-quarter of that land is redeveloped for low density residential uses (at four dwelling units per acre), there would be a net gain of 8,500 dwelling units on the level land outside the hillside area, enough units to accommodate 18,700 people. Almost 300 rural residential acres are depicted for medium density uses in sector plans. Redevelopment of one-fourth of those parcels would result in approximately 1,000 apartment or condominium units, enough to house over 1,700 people. *Note: At 14 dwelling units per acre and 1.7 persons per household*

Bottom Line on Housing for a Growing Population

existing vacant land proposed for housing within and outside the proposed Hillside and Ridgetop Protection Area is enough to construct approximately 185,000 dwelling units, enough housing for more than 435,000 people.

Redevelopment of a portion of the rural residential land proposed that is proposed for higher densities of housing in adopted plans would result in approximately 9,500 new dwelling units, enough housing for approximately 20,000 people.

Other Considerations

New Commercial Space

There are more that 1,900 vacant acres or rural residential uses that are proposed for commercial uses in adopted land use plans. That acreage can supply about 21 million square feet of new commercial space (or the equivalent of 175 new commercial centers). *Note: To provide a view of the extent of the opportunities, each of those centers could hypothetically contain a 60,000 square foot supermarket and an additional 60,000 square feet of shops and restaurants.*

Areas Not Considered with Significant Development Potential

Not all of the potential development and redevelopment opportunities in Knox County were examined in this overview. Other development opportunities include continued development in Farragut, mixed use development projects such as Northshore Town Center, and mixed use redevelopment projects, such as South Waterfront. All of which are substantial in adding housing, offices and retail space.

Appendix D

BEST MANAGEMENT PRACTICE: HILLSIDE RESTORATION

Cut Slope Stabilization and Reforestation

This is an approach to grading and tree planting on steep topography where forest cover is lost due to construction of buildings, structures and roads. It has been demonstrated to be an effective means for avoiding soil compaction and difficulties that can arise from trying to achieve tree growth on conventionally graded slopes. The method, which relies on reuse of organic matter, top soil, and rock fosters significant stormwater infiltration and woodland regeneration. It has been tested in the Appalachian region by scientists from the University of Kentucky and Virginia Tech, and is now the standard practice in surface mine site restoration.

Suitable Applications

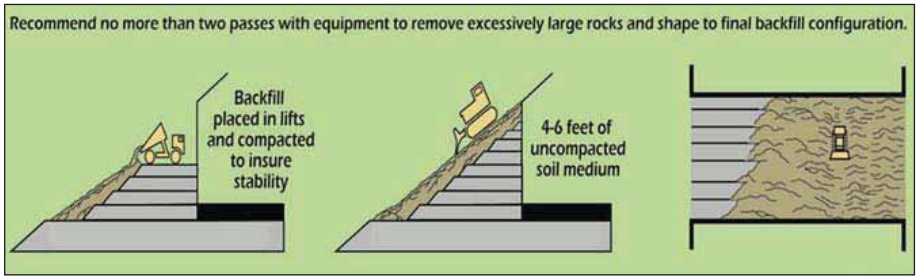
- This practice should be used in preparing a site for building construction that is at the edge of or within a hillside protection area, particularly in grading a natural slope of 15 percent or more.
- Road or facility construction at the toe of a forested slope may also be considered.

Proposed Hillside Forest Reclamation Process

Before clearing and grading a site, consider the following site priming practices to better support reforestation

Step 1.
Save topsoil and rock material from the disturbed areas of the site to create a rooting medium that is suitable for good tree growth. The medium should be comprised of topsoil and/or a topsoil and rock mixture and at a depth of 4 feet (lesser depths may be acceptable with compatible tree species).

Step 2.
Loosely grade (maximum of 2 passes with heavy grading equipment) the topsoil or topsoil and rock mixture established in step one to create a non-compacted growth medium. Trees will not survive in heavily compacted soils.



Step 3.
Mimic natural landforms when creating cut and fill areas, rather than heavily benched/terraced patterns. The majority of the backfill should be placed and compacted using standard engineering practices – but not as the final surface.

That surface layer ,which will form the forest's soil, should be at least four feet deep (lesser depths may be acceptable with compatible tree species) and only lightly graded (no more than 2 passes with equipment). Surface grading on longer and steeper slopes should be minimized, provided that doing so does not jeopardize stability.

To re-establish a healthy, native forest after disturbance, final grading must minimize surface compaction. This can be achieved by:

- dumping and leveling in separate operations,
- leveling with the lightest equipment available, using the fewest passes possible, and during dry conditions, and
- permanently removing all equipment from an area after leveling.

"Tracking in" operations (bulldozer treads creating depressions to trap seeds and water) actually compact the soil and hinder tree-growth, and should be avoided unless necessary for slope stability. Rubber tired equipment should not be used in final grading.

Step 4.
Use groundcovers that are compatible with growing trees. Groundcover for reforestation requires a balance between erosion control and competition for the light, water and space required by trees.

This can be achieved through the use of grasses and legumes that are slow growing, have sprawling growth forms and are tolerant of a wide range of soil conditions. Recommended mix examples include:

- Grasses - red top and perennial ryegrass
- Legumes – birdsfoot trefoil, white clover

This groundcover mix increases seedling survival and controls erosion in the long term as trees mature and the forest forms.

Step 5.
Plant two types of trees - early successional species for wildlife and soil stability, and native trees. The species should be mixed throughout the site, not planted in single-species blocks.

A mix of the following types of trees are recommended:

- Large maturing trees - oaks, black cherry, sugar maple, white ash and/or other native species (see the Tree Conservation and Planting Plan species list).
- Open site thriving trees – bristly locust, redbud, dogwood and crab apple (use those best suited for the area).

Step 6.
Use proper seedling care and tree planting techniques. Poor tree survival is often due to improper seedling handling or planting. Seedlings should never be allowed to dry out during storage and handling prior to planting, and should be kept dormant until planting.

Seedlings should be:

- Kept cool, but do not allow freezing
- Protected from direct sunlight
- Not exposed to high temperatures
- Planted in late winter to early spring
- Planted at a proper depth and firmly enough to ensure survival

Reputable and experienced tree planting crews are recommending for broad-scale operational tree planting.

Appendix E

BEST MANAGEMENT PRACTICE: RECOMMENDED TREES FOR STREETSCAPES, PARKING LOTS, YARDS AND REFORESTATION

The following tree species recommendations, which are organized by the size of the trees at maturity, have been adopted in several plans, including the Knoxville Knox County Tree Conservation and Planting Plan. The lists are also recommended by the Task Force on Ridge, Slope and Hillside Development and Protection, Tennessee Technology Corridor Development Authority and the Knoxville Tree Board, particularly to establish disease-tolerant, native trees for landscaping, water quality protection, habitat improvement and slope stabilization.

Suitable Applications

- Landscaping along streets and highways, including trees for median and sidewalk-related beautification and shading
- Selecting proper trees for use under or near overhead utility lines to avoid long term conflicts with the provision of electricity and related services
- Planting trees that will avoid conflicts with sight distance, such as a driver's ability to see vehicles and pedestrians at intersections
- Establishing native trees in reforestation and slope stabilization projects
- Providing developers, homeowners, and park, public works and horticulture officials with a list of trees that are suitable for parking lot and yard landscaping

LARGE TREE GROUP Mature Height More than 50'	Table E-1: LARGE TREE SPECIES RECOMMENDATIONS							
	Interchanges/ Grade Separations	Medians	Parking Lots or Similar 'Hardscape'	Near Sidewalks	Under Utility Lines	Visibility Concern Areas**	Yards	Hillside Reforestation ***
American Basswood (Linden)*	YES	YES	YES	YES	NO	YES	YES	YES
White Basswood (Linden)	YES	YES	YES	YES	NO	YES	YES	YES
American Beech*	YES	YES	NO[B]	NO[B]	NO	YES	YES	YES
European Beech	YES	YES	NO[B]	NO[B]	NO	YES	YES	YES
Blackgum*	YES	YES	NO	NO	NO	YES	YES	YES
Yellow Buckeye	YES	NO	NO	NO	NO	YES	YES	YES
Bald Cypress*	YES	YES	NO	NO	NO	YES	YES	NO
American Elm	YES	YES	YES[C]	YES[C]	NO	YES	YES	YES
Hackberry*	YES	YES	NO	NO	NO	YES	YES	YES
European Hornbeam	YES	YES	YES	NO	NO	NO	YES	NO
Ginkgo	YES	YES	NO[D]	NO	NO	YES	YES[E]	NO
Red Maple*	YES	YES	YES	YES	NO	YES	YES	YES
Sugar Maple*	YES	YES	YES	YES	NO	YES	YES	YES
Black Oak	YES	YES	NO	NO	NO	NO	YES	YES
Bur Oak	YES	YES	NO[B]	NO[B]	NO	YES	YES	YES
Chestnut Oak*	YES	YES	YES	YES	NO	YES	YES	YES
Chinkapin Oak*	YES	YES	NO[B]	NO[B]	NO	YES	YES	YES
English Oak	YES	YES	YES	YES	NO	YES	YES	NO
Northern Red Oak*	YES	YES	YES	YES	NO	YES	YES	YES
Post Oak	YES	YES	NO	NO	NO	NO	YES	YES
Sawtooth Oak	YES	YES	YES	YES	NO	YES	YES	NO
Scarlet Oak*	YES	YES	YES	YES	NO	YES	YES	YES
Shumard Oak*	YES	YES	YES	YES	NO	YES	YES	LIMITED
Southern Red Oak*	YES	YES	YES	YES	NO	YES	YES	LIMITED
White Oak*	YES	YES	YES	YES	NO	YES	YES	YES
Willow Oak*	YES	YES	YES	YES	NO	YES	YES	YES
Loblolly Pine*	YES	NO	NO	NO	NO	NO	YES	LIMITED
Pitch Pine	YES	YES[A]	NO	NO	NO	NO	YES	YES
Shortleaf Pine*	YES	YES[A]	NO	NO	NO	NO	YES	YES
White Pine*	YES	YES[A]	NO	NO	NO	NO	YES	YES
London Planetree/Sycamore*[F]	YES	YES	NO	NO	NO	YES	NO	NO
Tulip Poplar*	YES	YES	YES	YES	NO	YES	YES	LIMITED
Dawn Redwood	YES	YES[A]	NO	NO	NO	NO	YES	NO
Sweetgum*	YES	YES	NO[B]	NO[B]	NO	YES	YES	LIMITED
Black Cherry*	NO	NO	NO	NO	NO	NO	YES	YES
Virginia Pine*	NO	YES[A]	YES	NO	NO	NO	YES	YES
Laurel Oak	YES	YES	NO	YES	NO	NO	YES	NO
Winged Elm	YES	YES	YES	NO	NO	NO	YES	YES
Eastern Hemlock	NO	NO	NO	NO	NO	NO	YES	NO

A. If site does not obstruct visibility and median width is acceptable
B. Large nuts can cause difficulties under foot
C. If hybrid, disease-resistant variety is used
D. Because of slow-growing nature and 'stick-like' appearance
E. Male trees, only
F. Two different species; both can produce pollen, causing allergies

* Native to south central United States
**Tree placement and maintenance procedures should be respectful of sight distance
***Yes = well suited for shallow, poor soil quality on distrubed hillsides;
No = non natives, slow growth rate or riparian-oriented species;
Limited = better suited for good soil conditions and north-facing slopes

MEDIUM TREE GROUP Mature Height 30' - 50'	Table E-2: MEDIUM TREE SPECIES RECOMMENDATIONS							
	Interchanges/ Grade Separations	Medians	Parking Lots or Similar 'Hardscape'	Near Sidewalks	Under Utility Lines	Visibility Concern Areas**	Yards	Hillside Reforestation ***
Arborvitae*	YES	YES	YES	NO	NO	NO	YES	LIMITED
River Birch*	YES	YES	NO	NO	NO	YES	YES	NO
Catalpa*	YES	YES	NO	NO	NO	NO	YES	YES
Atlantic White Cedar	YES	YES[A]	YES[B]	NO	NO	NO	YES	NO
Deodar Cedar	YES	YES[A]	YES[B]	NO	NO	NO	YES	NO
YESEastern Red Cedar*	YES	YES[A]	YES[B]	NO	NO	NO	YES	YES
Kentucky Coffeetree	YES	YES	NO	NO	NO	YES	YES	YES
Amur Cork Tree	YES	YES	YES	YES	NO	YES	YES	NO
Cryptomeria	YES	YES	YES[B]	NO	NO	NO	YES	NO
Lace-bark Elm	YES	YES	YES	YES	NO	YES	YES	NO
Smooth Leaf Elm	YES	YES	YES	YES	NO	YES	YES	NO
Eastern Hemlock*	YES	YES[A]	YES[B]	NO	NO	NO	YES	NO
American Holly*	YES	YES	YES[B]	NO	NO	NO	YES	NO
Thornless Honeylocust	YES	YES	YES	YES	NO	YES	YES	YES
American Hornbeam*	YES	YES	YES	NO	NO	YES	YES	NO
Eastern Hophornbean*	YES	YES	YES	NO	NO	YES	YES	NO
Little-leaf Linden*	YES	YES	YES	YES	NO	YES	YES	NO
Silver Linden*	YES	YES	YES	YES	NO	YES	YES	NO
Black Locust*	YES	YES	YES	NO	NO	YES	YES	YES
Southern Magnolia*	YES	YES[A]	NO	YES	NO	NO	YES	NO
Sweetbay Magnolia*	YES	YES	YES[B]	YES	NO	NO	YES	NO
Hedge Maple	YES	YES	YES	YES	NO	YES	YES	NO
Trident Maple	YES	YES	YES	YES	NO	YES	YES	NO
Austrian Pine	YES	YES[A]	YES[B]	NO	NO	NO	YES	NO
Japanese Red Pine	YES	YES	YES	NO	NO	NO	YES	NO
Chinese Pistache	YES	YES	YES	YES	NO	YES	YES	NO
Sassafras*	YES	YES	NO	YES	NO	YES	YES	YES
Sourwood*	YES	YES	NO	YES	NO	YES	YES	LIMITED
Colorado Blue Spruce	YES	YES[A]	YES[B]	NO	NO	NO	YES	NO
White Spruce	YES	YES	YES[B]	NO	NO	NO	YES	NO
Weeping Willow[C]	YES	NO	NO	NO	NO	NO	YES	NO
Yellowwood*	YES	YES	YES	YES	NO	YES	YES	NO
Zelkova	YES	YES	YES	YES	NO	YES	YES	NO

A. Avoid planting where there are breaks in median for turning across travel lanes. Plant where a screen from on-coming car headlights is needed.
B. Use at edges of parking lots for border or buffering purposes. Do not use in islands or medians of parking lots.
C. Avoid near septic systems and similar problem areas.

* Native to south central United States
** Tree placement and maintenance procedures should be respectful of sight distance
*** Yes = well suited for shallow, poor soil quality on distrubed hillsides;
No = non natives, slow growth rate or riparian-oriented species;
Limited = better suited for good soil conditions and north-facing slopes

SMALL TREE GROUP Mature Height Less than 30'	Table E-3: SMALL TREE SPECIES RECOMMENDATIONS							
	Interchanges/ Grade Separations	Medians	Parking Lots or Similar 'Hardscape'	Near Sidewalks	Under Utility Lines	Visibility Concern Areas**	Yards	Hillside Reforestation ***
Blackhaw*	YES	YES	YES[A]	NO	YES	YES[B]	YES	LIMITED
Rusty Blackhaw*	YES	YES	YES[A]	NO	YES	YES[B]	YES	LIMITED
Red Buckeye*	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Carolina Buckthorn*	YES	YES	YES[A]	YES	YES	YES[B]	YES	LIMITED
Oriental Cherries	YES	YES	YES[A]	NO	YES	YES[B]	YES	YES
Carolina Cherrylaurel*	YES	YES	YES[A]	YES	YES	YES[B]	YES	LIMITED
Flowering Crabapple[C]	YES	YES	YES[A]	NO	YES	YES[B]	YES	LIMITED
Crepe Myrtle	YES	YES	YES[A]	YES	YES	YES[B]	YES	LIMITED
Flowering Dogwood*	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Kousa Dogwood*	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Pagoda Dogwood	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Autumn Flametree	YES	YES	YES[A]	YES	YES	YES[B]	YES	YES
American Fringetree*	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Chinese Fringetree	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Golden Raintree	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Cockspur Hawthorn	YES	YES	YES[A]	YES	YES	YES[B]	YES	LIMITED
Foster Holly	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Amur Maple	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Japanese Maple	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Pawpaw*	YES	YES	YES[A]	NO	YES	YES[B]	YES	LIMITED
Eastern Redbud*	YES	YES	YES[A]	YES	YES	YES[B]	YES	YES
Service Berry*	YES	YES	YES[A]	YES	YES	YES[B]	YES	LIMITED
Carolina Silverbell*	YES	YES	YES[A]	YES	YES	YES[B]	YES	LIMITED
European Smoketree	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
American Smoketree*	YES	YES	YES[A]	YES	YES	YES[B]	YES	YES
Sourwood*	YES	YES	YES[A]	YES	YES	YES[B]	YES	LIMITED
Mountain Stewartia	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Witch-hazel*	YES	YES	YES[A]	YES	YES	YES[B]	YES	NO
Southern Crabapple	YES	YES	YES[A]	NO	YES	YES[B]	YES	YES
Hawthorns[D]	YES	YES	YES[A]	NO	YES	YES[B]	YES	LIMITED

A. Should not be used for more than 25% of parking lot trees. Do not use in parking lot islands. May be used in parking lot medians

B. If properly trimmed. Some species will need to be pruned in their early years to allow space for pedestrian traffic; additional trimming may be needed.

C. Note that Flowering Crabapple and Red Cedar should not be planted near each other because of potential cedar apple rust disease.

D. Examples include Washington and Wintering Hawthorns

* Native to south central United States

** Tree placement and maintenance procedures should be respectful of sight distance

*** Yes = well suited for shallow, poor soil quality on distrubed hillsides;
No = non natives, slow growth rate or riparian-oriented species;
Limited = better suited for good soil conditions and north-facing slopes

Appendix F

MODEL CONSERVATION SUBDIVISION ORDINANCE

The following draft is the basis for a conservation subdivision ordinance that should be considered by Knox County interests. A similar ordinance will be prepared for the City of Knoxville. The elements of a conservation subdivision ordinance are discussed on pages 41-42.

Knox County Conservation Subdivision Ordinance

SECTION 1.1 PURPOSE

This regulation has been created to realize the following purposes:

A. To provide flexibility in design in agricultural and residential zoning districts to promote environmental resource conservation and efficient uses of the land.
B. To preserve in perpetuity unique or sensitive natural, historic and archaeological resources such as forested areas, steep slopes, ridgetops, prime farmlands, floodplains, wetlands, stream corridors, wildlife habitats, and places recognized on local, state and national registers of historic places.
C. To permit clustering of houses and structures on less environmentally sensitive areas.
D. To reduce the amount of infrastructure, including paved surfaces and utility easements, necessary for residential development.
E. To reduce erosion and sedimentation by minimizing land disturbance and removal of vegetation during residential development.
F. To promote interconnected open spaces throughout the community, particularly for wildlife and habitat protection.
G. To encourage street designs that reduce traffic speed and the amount of pavement.
H. To promote construction of convenient walking trails and bike paths both within the subdivision and connected to neighboring communities, businesses and community facilities to reduce reliance on automobiles, especially to provide subdivision residents the means to reach parks and schools.

SECTION 1.2 GENERAL REGULATIONS

A. **Applicability of Regulations.** The Conservation Subdivision option is available for zoning districts classified as Agricultural and Low Density Residential, including planned residential districts. Applicants shall comply with all other provisions of the zoning code and all other applicable laws, except those that are incompatible with the provisions contained herein.
B. **Ownership of Development Site.** The tract of land to be subdivided may be held in single and separate ownership or in multiple ownership. If held in multiple ownership, however, the site shall be developed according to a single plan with common authority and common responsibility.
C. **Housing Density Determination.** The allowable number of units in a Conservation Subdivision shall be determined using the Net Density Calculation or the Yield Plan method. Density bonuses may be allowed up to 20% over the Allowed Units per Acre. Qualifying bonuses are outlined in Section 1.2.C.3.
    1. **Net Density Calculation:**
    This calculation can only be used for zoning districts where a specified units per acre has been determined (for example, Planned Development zoning districts). Density is determined by multiplying the net acres on the site by the approved number of units per acre (plus the applicable density bonus). The net acres of a site is the total acres (gross acres) minus the acreage of the following:
        a. Floodways,
        b. Bodies of water over 5000 square feet of contiguous area,
        c. Wetlands that meet the definition of the Army Corps of Engineers pursuant to the Clean Water Act,
        d. The areas of slope over 50 percent,
        e. Cemeteries and burial grounds.
    2. **Yield Plan:**
    This method determines how many detached, single-dwelling unit lots could be developed on a site using zoning and subdivision standards required for the site under a conventional development scenario. The number of lots in this plan will determine the density in the conservation subdivision before any density bonuses are applied.
    The Yield Plan must be prepared as a conceptual layout plan in accordance with the standards of the Minimum Subdivision Regulations,

containing proposed lots, streets, right-of-way, and other pertinent features. Although it must be drawn to scale, it need not be based on a field survey. However, it must be a realistic layout reflecting a development pattern that could reasonably be expected to be implemented, taking into account the presence of wetlands, floodplains, steep slopes, existing easements or encumbrances and, if unsewered, the suitability of soils for subsurface sewage disposal.

3. **Density Bonus Provision:**
   Density bonuses are awarded when a development plan incorporates one or more of the following:
   a. 50% or more of the required open space is protected in perpetuity by a legal instrument pursuant to Section 1.4.G.1.a of the Conservation Subdivision Ordinance -- 10% bonus;
   b. Land that is dedicated for public purposes. The decision whether to accept an applicant's offer to dedicate lands for public usage within a proposed subdivision shall be at the discretion of the County, or with a conservation organization (such as a parks foundation) acceptable by the County to hold the land in perpetuity for public use. The density bonus will be determined by the Planning Commission, based on park needs determined through adopted plans for the area -- up to a 10% bonus ;
   c. The dedicated open space is 60% in all zones other than Agricultural, in which case 70% is required and a 10% bonus may be provided as determined by the planning commission, taking into account the size of the conserved farm land.

D. **Road Width and Design Provisions.** In order to reduce the impact of stormwater runoff, conserve natural features of the site and reduce monetary and energy costs associated with road development and maintenance, the following road design standards may be used in creating conservation subdivisions:
   1. Road pavement width (and on-street parking, Average Daily Traffic/ADT) requirements:
      a. 20 feet (no parking, <350 ADT)
      b. 20 to 22 feet (no parking, 350 to 1000ADT)
      c. 22 to 26 feet (parking on one side, <350ADT)
      d. 26 feet (parking on both sides, <350 ADT)
      e. 26 feet (one side, 350 to 1000 ADT);
   2. Rather than curb and gutter, grass-lined roadside swales may be used to handle storm water runoff when appropriate and approved by the County Engineering Department;
   3. Roads shall not traverse slopes greater than a 25 percent slope. If the applicant can demonstrate a hardship created by this requirement, the Planning Commission may approve such crossings.
   4. An ADA compliant sidewalk or walking path system shall be provided along streets within the subdivision. Linkages of the pedestrian system shall be made to pedestrian systems adjacent to the subdivision. Sidewalks shall be constructed of concrete, or asphalt (if separated from road pavement by four or more feet). Walking trails may be constructed of asphalt, crusher run or other approved material.

E. **Lot Width and Depth, Setbacks and Size Requirements.**
   1. The following two development approval options are available for properties with zoning that does not require development plan review. Properties with zoning that requires development plan review will use the same approval process as required by the zoning district:
      a. The zoning district lot size and setback and lot coverage requirement can be modified as shown in Table 3, however, lot sizes must be approved by the Health Department when using septic systems. Common areas may be considered outside the lots for wastewater systems.

Table 1

Zoning Classification	Lot Size	Setbacks	Lot Coverage
	Reduce Minimum Requirement by:		Increase Maximum to:
Agricultural	60%	50%	45%
Low Density Residential	30%	30%	45%

      b. A development plan can be created using the same development approval requirements as the Planned Development zoning districts where the dimensional standards will be determined as part of the development plan approved by the Planning Commission, County Board of Zoning Appeals and any other regulating authority (for example, Health Department).
   2. All new dwellings shall meet the following building setback requirements:
      a. From all external roads ROW: 100 feet
      b. From all other tract boundaries: 75 feet
      c. From all cropland or pasture land: 100 feet
   3. All new lots that are on private septic/sewer must be approved by the Knox County Health Department. Off site septic systems are acceptable in Conservation Subdivisions with the appropriate agencies.

F. **Height:** As required by the applicable zoning district.

G. **Tree Protection Areas.** Areas designated for tree protection that are located outside of the dedicated open space shall be indentified on the site plan. These areas shall include the critical root zone and greatest extent of the dripline for the trees included in the area to be protected.

H. **Off-Street Parking:** As required by the applicable zoning district. Credits may be approved for on-street parking, subject to approval by the Planning Commission.

SECTION 1.3 APPLICATION REQUIREMENTS

A. **Concept Plan.** In addition to the requirements of a Concept Plan (roads, lots, drainage, etc) in the Minimum Subdivision Regulations, the following information is required:
   1. Site Analysis Map. The purpose of this map is to ensure that the important site features have been adequately identified prior to the creation of the concept plan, and that the proposed open space will meet the requirements of this article. The site analysis map shall include the following features:
      a. Property boundaries;
      b. All streams, rivers, lakes, wetlands, flood plains, sinkholes and other hydrologic features;
      c. Topographic contours of no less than 4-foot intervals
      d. Hillside and ridgetop protection district boundary;
      e. General vegetation characteristics (forested areas, grasslands, etc);
      f. Primary and locally important farmland soils;
      g. Soils prone to slippage;
      h. Existing roads and structures;
      i. Potential connections with existing or proposed public greenways, parks and facilities;
      j. Wildlife habitats;
      k. Scenic views.
   2. Conservation Areas Map. All Primary and Secondary Conservation Areas labeled by type, as described in Section 1.4 of this Article;
   3. Open Space Map. The planned location of protected open space as required in Section 1.4.B.

B. **Design Plan.** In addition to the engineering design, construction drawing and related requirements of a Design Plan in the Minimum Subdivision Regulations, the following information is required:
   1. The designated open space.
   2. Tree protection area(s) located outside a dedicated open space.

C. **Final Plat.** In addition to the requirements of a Final Plat in the Subdivision Regulations, the following information is required:
   1. All areas designated as open space (lots and/or easements) must be labeled as open space.
   2. Plan for Management of Open Space and Operation of Common Facilities. An open space management plan, as described in Section 1.4.F, shall be prepared and submitted.
   3. Instrument of Permanent Protection. An instrument of permanent protection, such as a conservation easement or permanent restrictive covenant as described in Section 1.4, shall be placed on the open space and recorded prior to final plat certification for recording.

D. Other Requirements. The Applicant shall adhere to all applicable requirements of the underlying zoning and the subdivision regulations that are not in conflict with the Conservation Subdivision regulations.

SECTION 1.4 OPEN SPACE

A. **Definition.** Open space is the portion of the conservation subdivision that has been set aside for permanent protection. Activities within the open space are restricted in perpetuity through the use of an approved legal instrument. Yards shall not be counted as open space.

B. **Open Space Requirement.** The required open space may be more than the minimum if the acreage of Primary Conservation Areas is more than the minimum required.
   a. Low Density Residential Zones – The minimum restricted open space shall comprise at least 40% of the gross tract area when public sewer and water is provided.
   b. Agricultural Zones – The minimum restricted open space shall comprise at least 60% of the gross tract area.

C. **Standards to Determine Open Space.**
   1. Primary Conservation Areas - The following are required to be included within the open space, unless the applicant demonstrates that this provision would constitute an unusual hardship and be counter to the purposes of this article:
      a. The 100-year floodplain;
      b. Riparian zones of at least 75 foot width from the bank of all waterbodies regulated by the applicable stormwater ordinance of the County;
      c. Slopes above 25 percent of at least a 20,000 square foot contiguous area;
      d. Wetlands that meet the definition used by the Army Corps of Engineers pursuant to the Clean Water Act;
      e. Known populations of endangered or threatened species, or habitat for such species;
      f. Archaeological sites and Native American burial grounds.
   2. Secondary Conservation Areas - The following should be included within the open space to the maximum extent feasible:
      a. Historic sites on the local, state or national registers;
      b. Existing healthy, native forests of at least one acre of contiguous area;
      c. Individual existing healthy trees greater than 8 inches caliper, as measured from four and half (4.5) feet above the ground;
      d. Other significant natural features and scenic viewsheds such as ridge lines, peaks and rock outcroppings, particularly those that can be seen from public roads or places;
      e. Existing trails that connect the tract to neighboring areas;
      f. Prime and locally important farmland soils;

g. Slopes 15 percent or more of at least 1 acre in contiguous area;
h. Areas within a designated hillside and ridgetop area;
i. Wildlife habitats;
j. Sinkholes.

3. Above-ground utility rights-of-way and small areas of impervious surface may be included within the protected open space, but cannot be counted towards the 40% minimum area requirement (with the exception of historic structures and existing trails, which may be counted). Large areas of impervious surface shall be excluded from the open space.
4. The Planning Commission may require that at least 10% of the open space consist of land that is suitable for active recreation space such as playfields.
5. The open space should adjoin any neighboring areas of open space, other protected areas, and non-protected natural areas that would be candidates for inclusion as part of a future area of protected open space, such as adjacent steep slopes or prime farmlands.
6. The open space shall be directly accessible to the largest practicable number of lots within the subdivision. Non-adjoining lots shall be provided with safe, convenient access to the open space, such as a walking trail. Such access shall be provided outside of a driving lane.

D. **Permitted Uses of Open Space.**

1. Uses of open space may include the following:
   a. Conservation of natural, archeological or historical resources; or similar conservation-oriented areas;
   b. Walking or bicycle trails;
   c. Passive recreation areas, such as open fields;
   d. Active recreation areas, provided that they are limited to no more than 10% of the required open space and are not located within Primary Conservation Areas. Active recreation areas may include impervious surfaces. Active recreation areas in excess of this limit must be located outside of the protected open space.
   e. Agriculture, horticulture, silviculture or pasture uses, provided that all applicable stormwater best management practices are used to minimize environmental impacts, and such activities are not conducted within Primary Conservation Areas;
   f. Landscaped stormwater management facilities, community wastewater disposal systems and individual wastewater disposal systems located on soils particularly suited to such uses. Such facilities shall be located outside of Primary Conservation Areas;
   g. Easements for drainage, access, and underground utility lines;
   h. Wetlands and/or bioretention areas created as part of stormwater quality improvements with an operations and maintenance plan recorded with the deed as required by the applicable stormwater ordinance of the County;
   i. Other conservation-oriented uses that the Planning Commission determines to be compatible with the purposes of this ordinance.

E. **Prohibited Uses of Open Space.**

1. Golf course acreage;
2. Roads, parking lots and impervious surfaces, except as specifically authorized in the previous sections;
3. Impoundments such as retention and detention basins (does not include wetlands and bioretention areas as outlined in Section 1.4 D.1.h);

F. **Ownership and Management of Open Space.**

Ownership

1. All required open space shall be permanently restricted from future subdivision and development. Under no circumstances shall any development be permitted in the open space at any time, except for those uses listed in Section 1.4D.
2. Ownership of open space may be one or more of the following:
   a. Fee Simple Dedication to the County: The County may, but shall not be required to, accept a portion of the common facilities, provided that:
      i. There is no cost of acquisition to the County; and,
      ii. The County agrees to and has access to maintain such facilities.
   b. Condominium Association: Common facilities may be controlled through the use of condominium agreements. Such agreements shall be in accordance with relevant state law. All open land and common facilities shall be held as "common elements."
   c. Homeowner Association: Common facilities may be held in common ownership by a homeowner association subject to all of the following being met:
      i. Membership in the association shall be automatic (mandatory) for all purchases of dwelling units therein and their successors in title.
      ii. The association shall be responsible for maintenance and insurance of common facilities.
      iii. The bylaws shall confer legal authority on the association to place a lien on the real property of any member who falls delinquent in dues. Such shall be paid with the accrued interest before the lien may be lifted.
      iv. Written notice of any proposed transfer of common facilities by the association or the assumption of maintenance for common facilities must be given to all members of the association and to the County no less than thirty (30) days prior to such event.

d. Private Conservation Organization: An owner may transfer either fee simple title of the open space or easements of the open space to a private non-profit conservation organization provided that:
   i. The conservation organization is acceptable to the County and is a bona fide conservation organization intended to exist indefinitely;
   ii. The conveyance contains appropriate provisions for proper reverter or retransfer in the event that the organization becomes unwilling or unable to continue carrying out its functions;
   iii. The open space is permanently restricted from future development through a conservation easement and the County is given the ability to enforce these restrictions; and
   iv. A maintenance agreement acceptable to the County is established between the owner and the organization.

e. Dedication of Easements to the Local Government: The County may, but shall not be required to, accept easements for public use of any portion of the common land or facilities. In such cases, the facility remains in the ownership of the condominium association, homeowner association, or private conservation organization while the easements are held by the County. In addition, the following regulations shall apply:
   i. There shall be no cost of acquisition to the County.
   ii. Any such easements for public use shall be accessible to the residents of the County.
   iii. A satisfactory maintenance agreement shall be reached between the owner and the municipality.

Management

1. Unless otherwise agreed to by the County, the cost and responsibility of maintaining common facilities and open space shall be borne by the property owner, condominium association, homeowner association, or conservation organization.
2. The applicant shall submit and the Planning Commission shall approve a Plan for Management of Open Space and Operation of Common Facilities ("Plan") in accordance with the following requirements:
   a. The plan shall define ownership;
   b. The plan shall establish necessary regular and periodic operation and maintenance responsibilities for the various kinds of open space (for example: lawns, playing fields, woodlands, pastures, croplands, meadows, etc.);
   c. The plan shall estimate staffing needs, insurance requirements, and associated costs and define the means for funding the maintenance of the open space and operation of any common facilities on an ongoing basis. In addition, the plan shall include the means for funding long-term capital improvements as well as regular yearly operating and maintenance costs;
   d. At the County's discretion, the applicant may be required to escrow sufficient funds for the maintenance and operation costs of common facilities for up to one year; and
   e. Any changes to the management plan shall be approved by the County, and in the case of areas dedicated to a local government by County Commission, following a recommendation of County Park Board, or its successor.
3. In the event that the organization established to maintain the open space and the common facilities, or any successor organization thereto, fails to maintain all or any portion thereof in reasonable order and condition, the County may assume responsibility for maintenance and may enter the premises and take corrective action, including extended maintenance. The costs of such corrective action may be charged to the property owner, condominium association, homeowner association, conservation organization, or individual property owners who make up a condominium or homeowner association and may include administrative costs and penalties. Such costs shall become a lien on said properties.

G. **Legal Instrument for Permanent Protection.**

1. The open space shall be protected in perpetuity by a binding legal instrument that is recorded with the deed. The instrument shall be one of the following:
   a. A permanent conservation easement pursuant to section 170(h) of the Internal Revenue Code, as amended, in favor of either:
      i. A land trust or similar conservation-oriented non-profit organization with legal authority to accept such easements. The organization shall be bona fide and in perpetual existence and the conveyance instruments shall contain an appropriate provision for retransfer in the event the organization becomes unable to carry out its functions; or
      ii. A governmental entity with an interest in pursuing goals compatible with the purposes of this ordinance.
   b. A permanent restrictive covenant for conservation purposes in favor of a governmental entity.
   c. An equivalent legal tool that provides permanent protection, if approved by the County.
2. The instrument for permanent protection shall include clear restrictions on the use of the open space. These restrictions shall include all restrictions contained in this article, as well as any further restrictions the applicant chooses to place on the use of the open space.

DEFINITIONS

The definitions of the Knox County Zoning Ordinance and Knoxville – Knox County, Tennessee Minimum Subdivision Regulations shall apply, with the following additions.

Conservation Easement: A nonpossessory interest of a holder in real property imposing limitations or affirmative obligations on the owner of the servient estate, the owner's heirs, and assigns with respect to the use and management of the servient land, structures or features thereon, and/or activities conducted thereon, which limitations and affirmative obligations are intended to preserve, maintain or enhance the present condition, use or natural beauty of the land, the open-space value, the air or water quality, the agricultural, forest, recreational, geological, biological, historic, architectural, archeological, cultural or scenic resources of the servient estate and is recorded in the register's office of the county in which the easement is located.

Conservation Areas, Primary: Lands upon which primary resources are located in conservation subdivisions. All Primary Conservation Areas are required to be located within the Open Space.

Conservation Areas, Secondary: Lands containing secondary resources that are conserved as part of the Open Space.

Critical Root Zone: The minimum area beneath a tree that must be left undisturbed in order to reserve a sufficient root mass to give a tree a reasonable chance of survival. The critical root zone is typically represented by a concentric circle centering on the tree trunk with a radius equal in feet to one and a half (1.5) times the number of inches of the trunk diameter at four and a half (4.5) feet above the ground: (CRZ in ft = 1.5 x D in.).

Holder: ***a.*** A public body empowered to hold and interest in real property under the laws of the state or the United States; or ***b.*** a charitable corporation, charitable association, or charitable trust, the purposes or powers of which include retaining or protecting the natural, scenic, or open-space values of real property, assuring the availability of real property for agricultural, forest, recreational, or open-space use, protecting natural resources, maintaining or enhancing air or water quality, or preserving the historical, architectural, archeological, or cultural aspects of real property.

Open Space: A parcel or parcels of land and/or water, within a conservation subdivision, set aside for the protection of natural and cultural resources. Greenway land consists of Primary and Secondary Conservation Areas and is permanently restricted against further development.

Tree Protection Area: Areas where trees, or strands of trees, are to be preserved and protected during project development.

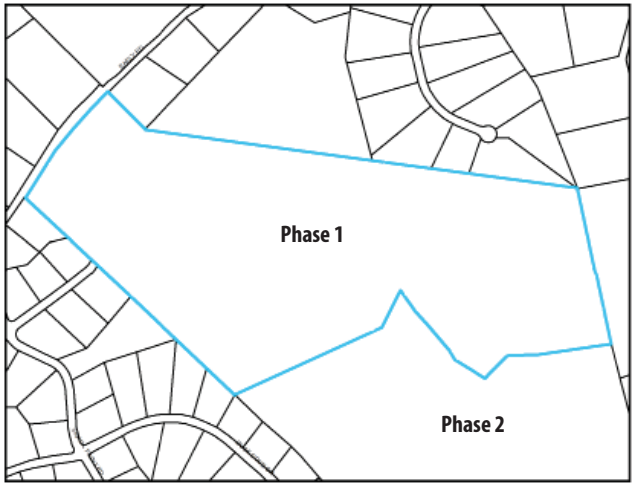
Appendix G

LAND DISTURBANCE CALCULATION

This example depicts the calculation method that would be used for future rezoning cases and use on review cases. The "Planned Zones" (for example, Planned Residential) would be recommended by MPC staff for any hillside-related case. Because the proposed development is to be considered via use on review (requiring site plan approval by MPC after both staff and public review), the rationality of the proposed clearing can be further considered in relation to the steepest forested slopes, water resources and similar concerns that may be inherent with specific sites.

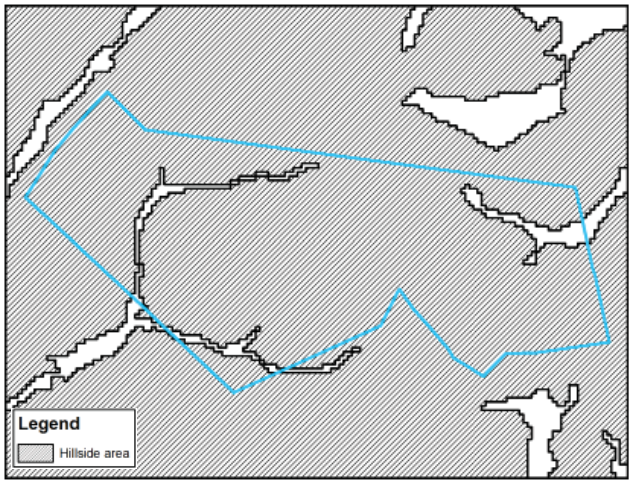
The following steps detail the process for determining how much land disturbance will be recommended in rezoning cases and for how land disturbance can be allocated throughout the site when drafting a site development plan within the Hillside and Ridgetop Protection Area.

Step 1: Determine site area.



The site area for development is not the entire parcel. In this case, the development has multiple phases. Only phase 1 will be reviewed for compliance with the land disturbance limitations since phase 2 will not be developed at this time.

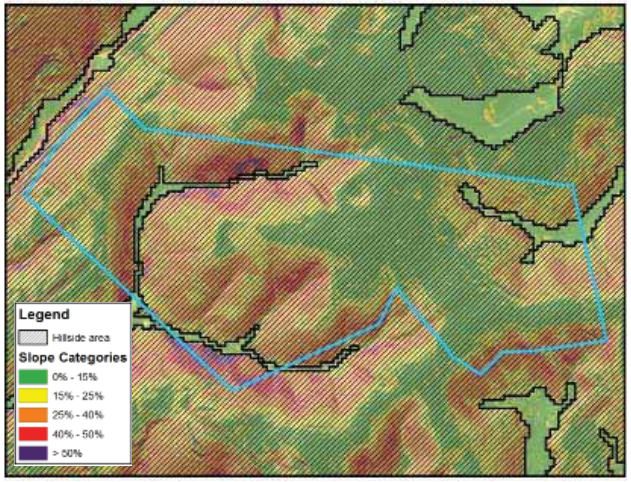
Step 2: Determine the Hillside and Ridgetop Protection Area within the designated development area.



This site is almost entirely within the Hillside and Ridgetop Protection Area. The site topology is that of a rolling hill with a relatively flat area on top. This site does not have an area that would be classified as a ridgetop.

The total acreage of the site is 82 acres, with 78 acres within the Hillside and Ridgetop Protection Area.

Step 3: Determine how many acres are in each slope category, within the Hillside and Ridgetop Protection Area.



Slope Category	Acres
0 - 15%	22.62
15% - 25%	22.47
25% - 40%	27.83
>40%	5.35

Step 4: Calculate land disturbance limitations.

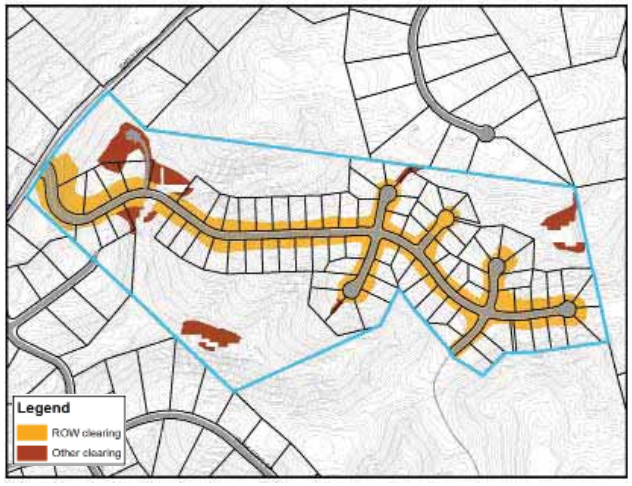
Land Disturbance Limitations within the Hillside & Ridgetop Protection Area			
Slope Category	**Disturbance Allocation**	**Acres**	**Allowed Disturbance**
0 - 15%	100%	22.62	22.62
15% - 25%	50%	22.47	11.24
25% - 40%	20%	27.83	5.57
>40%	10%	5.35	0.54
Ridgetop	15%	0	0
Total Acres of Disturbance Allowed			**39.98**

Each slope category has a certain disturbance allocation, as shown in the table. The acres in each slope category are multiplied by the disturbance allocation to give the allowed disturbance. The allowed disturbance for each slope category is added together to give the allowed disturbance for the entire site.

Of the 78 acres within the Hillside and Ridgetop Protection Area, 40 acres can be disturbed, as shown in the table.

While this disturbance could possibly be anywhere on the site, not being limited to certain slope groups, staff will consider such factors as very severe slopes to make recommendations regarding the most appropriate disturbance areas. Disturbance outside the Hillside and Ridgetop Protection Area does not count against the disturbance allowed.

Step 5: Determine a road and lot layout that minimizes land disturbance with the Hillside and Ridgetop Protection Area, and determine other disturbance needs within this area. (Example: detention ponds and utility installation)



In this example, the development density is 1 dwelling unit per acre.

- ROW clearing = 18.14 acres
- Other clearing = 3.37 acres

This leaves 18.47 acres that can be disturbed for other disturbance needs, like building houses on individual lots.

Note: This development has approximately 37 acres in open space.

Step 6: Determine how much land disturbance to allocate to each lot. On average, 32% of each lot can be disturbed outside of what was disturbed to install the infrastructure.

When determining the disturbance allowed per lot, the developer may want to take into consideration the size, topography, and previous disturbance on a lot.

For example:

During the installation of infrastructure, lot 1 had 94% disturbance and lot 2 had 15% disturbance.

The developer may want to allow lot 2 to disturb a high percentage of the lot, while allowing lot 1 to disturb a very low percentage.

Appendix H

SUMMARY OF DEVELOPMENT INCENTIVES

Reduced Setbacks and Peripheral Boundaries

In order to reduce slope cuts, provide:

1. Allowances for reduced front yard setbacks for hillside residential, and
2. Consideration of reduced peripheral setback in zones, such as planned commercial, that require use on review.

Means to implement the incentive: *Make an addition to supplementary regulations with references to specific zoning districts.*

Reduced Road and Right of Way Widths

In order to reduce hillside cuts and create cost savings, reduce:

1. Local road width standard in hillside protection area from 26 feet to 20 feet, and
2. Required right of way from 50 feet to 40 feet (this still allows utilities to either side of pavement).

Means to Implement the Incentive: *Make an additional provision in subdivision regulations and cross-reference in supplementary zoning regulations.*

Conservation Subdivision Ordinance

In order to set aside forested steep slopes and other natural areas, and provide the means to reduce development costs, develop conservation subdivision regulations that provide:

1. Allowances for smaller lots and reduced setbacks, enabling the establishment of the open space areas,
2. Allowances for reduced road widths, and opportunities for a density bonus, including a 10% bonus for conserving open space in perpetuity and up to an additional 10% bonus for land dedicated for public purposes.

Means to Implement the Incentive: *Adopt ordinance (see draft in Appendix F) with appropriate references in zoning and subdivision codes.*

Reduced Required Parking

In order to reduce hillside clearing and offer an opportunity for cost savings provide developers the opportunity to reduce parking areas, including:

1. Consideration of minimum and maximum standards, and
2. Reduction in parking stall size (county) from 200 square feet.

An example of a means to reduce parking requirements is a minimum and maximum option. (Derived from the *Tennessee Technology Corridor Development Authority Design Guidelines*, 2010).

Off-Street Parking Space Requirements*

Land Use	Minimum Number of Spaces Required	Maximum Number of Spaces Allowed
Restaurant	7.5 per 1000 sq. ft. of Gross Floor Area	15 per 1000 sq. ft. of Gross Floor Area
Office	3 per 1000 sq. ft. of Gross Floor Area	4.5 per 1000 sq. ft. of Gross Floor Area
Retail Establishments	3 per 1000 sq. ft. of Gross Floor Area	4.5 per 1000 sq. ft. of Gross Floor Area
Office Park, Multi-tenant Office Bldg.	2 per 1000 sq. ft. of Gross Floor Area	3.5 per 1000 sq. ft. of Gross Floor Area
Shopping Center	2 per 1000 sq. ft. of Gross Floor Area	3.5 per 1000 sq. ft. of Gross Floor Area
Research & Development Facility, Lab	2 per 1000 sq. ft. of Gross Floor Area	3.5 per 1000 sq. ft. of Gross Floor Area
All Other Non-Residential Uses	2 per 1000 sq. ft. of Gross Floor Area	3.5 per 1000 sq. ft. of Gross Floor Area
Warehousing, with Office Space	1 per 1000 sq. ft. of Gross Floor Area	1.5 per 1000 sq. ft. of Gross Floor Area
Industrial and Manufacturing	1 per 1000 sq. ft. of Gross Floor Area	1.5 per 1000 sq. ft. of Gross Floor Area
Hotel, Motel	1 per Room or Suite	1.5 per Room or Suite
Church or similar place of worship	1 per 4 seats in Main Worship Area	1 per 3 seats in Main Worship Area

** On-street parking spaces may be used to reduce either the minimum number required or the maximum number allowed for off-street parking spaces.*

Means to Implement the Incentive: *Make an addition to supplementary regulations.*

Appendix I

POINTS TO ADDRESS IN THE IMPLEMENTATION PHASE

The points presented in this appendix are a summary of the considerations that were proposed by Councilman Nick Della Volpe during the course of City Council-County Commission review. They may serve as a checklist in considering new codes and programs in the plan's implementation phase.

In developing future codes, standards and guidelines, the following should be taken into account:

- **Surety bond or other financial protection for the cost of ongoing maintenance of hydrology and soil stability control features and replanting of artificial slopes**
- **Code revisions to address mass grading before site plan approval and construction**
- **New subdivision standards to allow (by right) narrower hillside roads and to assure that road and driveway slopes meet emergency vehicle needs**
- **Guidelines for laying out roads and driveways with topography to reduce land disturbance**
- **Pervious surface standards (allowing water penetration) for residential lots of various sizes**
- **Standards to stabilize disturbed slopes, including geo-textiles and pervious engineered surfaces, with tree planting for long-term soil stabilization**
- **Review procedures to avoid exposure of acid soils, rock formations and high slip potential soils, and provisions for engineering approval**
- **Storm water system provisions to maintain post-construction flows with pre-construction flows**
- **Revised standards to foster less clearing for roadways, utilities and parking to reduce land disturbance to the maximum extent possible**
- **Guidelines for clearing that foster fire protection while retaining slope vegetation**
- **Provisions to avoid soil fill and grading on a site's conservation areas**
- **Ridgeline development standards to avoid tall buildings and maintain significant portions of surrounding forest canopies**
- **Guidelines for contour grading, building orientation running (parallel to slopes) and light shielding**
- **Consistency between National Pollution Discharge Elimination System and Tennessee Department of Environment and Conservation standards with minimum hillside protection provisions of the city and county**
- **Provisions for alternative compliance with hillside development provisions so that a sound proposal may be considered**
- **Workshops and seminars to discuss existing and proposed hillside protection programs and standards, including the potential engagement of University engineering, soil science and related personnel**

KNOXVILLE·KNOX COUNTY

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TENNESSEE