Town of Cary
Historic District Visioning Initiative

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Rationale

As development in the Triangle region continues, so does the impact to the rural landscape. Due to proximity to the Research Triangle Park, RDU International Airport, and the proposed I-540 Outer Loop, considerable development pressures are being placed on the western portions of the Town of Cary's planning jurisdiction. Two areas of specific concern are the Historic Districts of Green Level and Carpenter. Both of these communities are listed on the National Register of Historic Places and have significant historic architectural resources and scenic rural landscapes. The creation of the Historic District was a 'first step' in protecting the architectural resources, but currently the associated scenic landscapes remain unprotected.

Project Goals

The goals of this project are twofold:
1) To identify the visual extent of the landscapes associated with the historic architecture. The quantifying of the scenic resources will help guide an appropriate protection plan.
2) To develop a series of photo-realistic simulations that demonstrate conservation design techniques. These images will communicate conservation and scenic landscape issues to a diverse audience, from citizens to developers.

1) Identify Extent of Scenic Landscapes

A viewshed analysis was used to identify landscapes associated with the Green Level and Carpenter Historic Districts. A viewshed is defined as all the land area or terrain that can be seen from a particular point in the landscape. It can be related to the concept of "watershed" which is all the land area that drains to a particular point in the landscape. The most essential component of a useful information framework is a set of visual sensitivity maps. These maps not only identify which lands are visible from the roads within the historic districts, but also evaluate varying degrees of visual sensitivity, or potential visual impact. This could only be achieved through the development of new mapping approaches. Approaches based on direct observation or manual viewshed mapping techniques are time-consuming and expensive, of questionable accuracy, and limited to individual viewpoints or very small sets of viewpoints.

This report describes the approach of combining three-dimensional digital landscape models and computer simulations of multiple viewpoints along the roads in the historic districts.

Digital Landscape Models

The digital landscape model is the basis for the data used to generate the viewshed analysis. The digital landscape models employed in this project were derived from the Town of Cary's digital contour data (5 feet intervals) for Green Level and Carpenter. This data conversion process took 3 steps: (1) The contour data was cropped to the extent of the analysis area, and the extent of the model was defined as a rectangle that included land area with in one mile of the each historic district; (2) the contour data was converted to a Triangular Irregular Network (TIN) model; and (3) The TIN model was then converted to a raster Digital Elevation Model (DEM). The raster DEM represents the unvegetated land surface as a grid of elevation values spaced 20 feet apart. In effect, a digital elevation model is a rectilinear array (or raster) of uniformly sized cells, with each cell carrying a land elevation value; collectively these cells represent a continuous land surface.

Viewshed Mapping Procedures

The next step of the viewshed analysis (after preparing the terrain data) is developing viewpoints, from which the "view" is calculated using the digital elevation model. The primary way that the rural landscape is experienced is from viewpoints along the path of the roads. The paved roads running through the historic district were selected as the view positions in the DEM. An additional 500 feet of the roads were also selected at the entranceway edges of the historic districts because from these points you see into the historic district. The resulting digital files representing the path of the roads were subjected to a rasterizing process. These road raster cells would subsequently serve as the viewpoints used in mapping procedures. Each road viewpoint is placed 20 feet apart. The one exception to this was a cell selected near the front of the Green Level Baptist Church, which represented the congregation's view of the landscape as they entered and left the church.

The procedure for mapping visual sensitivity is a cumulative application of a viewshed-mapping algorithm. The viewshed-mapping algorithm identifies all model cells visible from, or to, a given cell (the viewpoint). This is accomplished by examining a large number of lines of sight constructed from the viewpoint cell to the model perimeter, testing each cell along each line of sight to determine whether it is obscured from the viewpoint by intervening cells. Such a map would be referred to as a single point model because the resulting map only took into account a single viewpoint. This procedure was used for the Green Level Baptist Church viewpoint. The single point model would show the area visible from that single point and may contain multiple polygons that represent the fragments of the landscape visible from that single point. To account for viewer height, 6 feet is added to the viewpoint cell in the elevation model.

Multiple point models contain more than one viewpoint and display the interaction of the viewpoints in the same manner. The interaction of these multiple viewpoints is referred to as visual sensitivity. The basic mapping algorithm assigns a score of one to visible cells while those not visible retain a score of zero. This procedure is repeated many times, once for each cell associated with the road, and scores in the surrounding cells are continually summed. When the procedure is complete (typically hundreds of applications of the viewshed mapping algorithm) the score in each model cell indicates the number of road cells from which it was found visible, and this is interpreted as the degree of exposure or visual sensitivity of each cell. The resulting map delineated areas that are visible from the viewpoints and can be classified so

as to use a different color or pattern to represent levels of how many view points have a "line of sight" to a particular point in the landscape. Typically a three-level classification of the landscape - high, medium, and low visual sensitivity - can be used to define important resource areas. The classification is based on the number of viewpoints that have a line of sight into areas of the landscape and does not take into account vegetation in the landscape. Vegetation changes very rapidly due to modern construction equipment, fire, insects, intense weather, and other human impacts and should not be used as control measure for protecting visual resources.

Viewshed Results

The multi-point viewshed map for the Carpenter area identifies land that can be seen from the viewpoints along the roads associated with the Carpenter Historic District. (Figure 1) The viewpoints include all road lengths that touch the historic district plus an additional 500 feet of road length beyond the historic district. The three shades of red indicate the visible land. The dark red areas indicate the land that is seen from the most view points while the light red is seen from the fewest amount of viewpoints. The blacked out areas in the top right corner of the image indicate that no data are available or represent areas outside of Cary's jurisdiction.

The single-point viewshed map for Green Level identifies land that can be seen from a single viewpoint in front of the Green Level Baptist Church. (Figure 2) The green area indicates the land that can be seen from the front of the Green Level Baptist Church.

The multi-point viewshed map for Green Level identifies land that can be seen from the viewpoints along the roads associated with the Green Level Historic District and from the single viewpoint in front of the Green Level Baptist Church. (Figure 3) The viewpoints include all road lengths that touch the historic district plus an additional 500 feet of road length beyond the historic district. The three shades of red indicate the visible land. The dark red areas indicate the land that is seen from the most viewpoints while the light red is seen from the fewest viewpoints.

2) Photo-Realistic Simulations

Aerial photographs were shot from a Cessna 172 aircraft. Nikon cameras with standard zoom lenses were used to shoot the aerial photos from an altitude of approximately 1,500 feet. Particular photos were selected by Town of Cary Planning Department staff in order to illustrate issues to be portrayed in the simulations. These slides were digitized with a slide scanner at approximately 200 pixels per inch for preparing the simulations. The digital images are the basis for the deliverables to the Town of Cary. The individual images are described below.

Carpenter Simulations

Carpenter - Aerial Photograph Overlay
An aerial photograph of the Carpenter community was used in a schematic overlay simulation. One image in this set indicates the boundary of the historic district and the contributing architecture structures (Figure 4). Other images indicate the Town's current land use and zoning patterns.

Carpenter - Aerial Photo Simulation
Conceptual designs for a conventional subdivision (Figure 5) and conservation subdivision (Figure 6) were developed. The site selected for these conceptual designs is critical to the character of Carpenter crossroads (Figure 7). The approach from the East and the South is

currently rural in character; the dominating landscape elements are the farm field and the forest field. The conventional design scenario develops the entire site and includes 120 single-family house on 12,000 square foot lots. The photo-simulation of this convention development (Figure 8) shows the significant scenic impact that would occur with this type of development. The conservation design scenario protects the farm field and forest edge by placing the development within the forested area. This scenario includes 84 single family house on 8,000 square foot lots and 68 multi family units. By clustering the development, this conservation design would keep approximately 40% of the site in open space, while minimizing the visual impact to the character of Carpenter. (Figure 9)

Carpenter Crossroads – Ground level 360 Degrees Photo Simulation
A 360-degree ground level photo simulation was developed for the Carpenter Crossroads. (Figures 10 and 11). This simulation shows a compatible redevelopment of the crossroad's commercial area. New commercial uses were visualized in vacant, existing structures. Improvements in infrastructure, such as sidewalks, planted medians, and a small plaza for community events were included in the simulation.

Green Level Simulations

Green Level - Aerial Photograph Overlay
An aerial photograph of the Green Level community (Figure 12) was used in a schematic overlay simulation. One image in this set indicates the boundary and the contributing structures of the historic district (Figure 13). The others images indicate the Town's current land use and zoning patterns.

Green Level - Aerial Photo Simulation
Three sites in the image were selected to show a complete build-out of the Green Level Historic District. Conceptual designs for a conventional subdivision (Figure 14), conservation subdivision (Figure 15), and village concept (Figure 16) were developed. The site developments are described as follows:

Conventional Subdivision Plan - Green Level
North West Parcel - 229 Single-family units on ½ acre lots
North East Parcel - 115 Single-family units on ½ acre lots
Southern Parcel - 31 Single-family units on ½ acre lots

Conservation Subdivision Plan - Green Level
North West Parcel - 98 Single-family units on ½ acre lots, 65 Single-family units on 10,000 acre lots, 116 Multi-family units
North East Parcel - 77 Single-family units on 10,000 sq. ft lots, 56 Multi-family units
Southern Parcel - 72 Single-family units on 7,500 sq. ft lots

Village Subdivision Plan (TDR) - Green Level
North East Parcel - 77 Single-family units on 10,000 sq. ft lots, 56 Multi-family units
Southern Parcel - 72 Single-family units on 7,500 sq. ft lots, 194 Multi-family units, 15,000 sq. ft of Commercial

The conventional simulation (Figure 17) shows houses and suburban streets directly fronting the scenic roads. This development pattern would be extremely impactive to the character and scenic quality of Green Level. The conservation simulation (Figure 18) places the majority of the development away from the road, tucked inside the forested areas. This development pattern

would have less visual impact to the character of Green Level. The simulation of the village concept (Figure 19) uses a technique referred to as “transfer of development rights” to cluster all the development from one site to another. In this image the development rights from the Northwest site were transferred to the southern site. The entire Northwest site would then be placed in conservation.

Farm Scene Simulation

Rural Farm Scene - Aerial Photo Simulation
Conceptual designs for a conventional subdivision (Figure 20) and conservation subdivision (Figure 21) were developed from an aerial photo of an existing farm scene (Figure 22). The conventional design scenario develops the entire site and includes 34 single-family houses on 2-acre lots. The photo-simulation of this conventional development (Figure 23) shows the significant scenic impact that would occur with this type of development. The conventional design scenario develops the entire site and includes 34 single-family houses on 1/3-acre lots. This simulation illustrates the preservation of rural open space to keep the farm scene intact. (Figure 24) Road realignment and development proximity scenarios were imaged to demonstrate varying degrees of impact.

Conclusions

The Design Research and Service Laboratory in the College of Design at North Carolina State University participated in several presentations of the prepared material in order to answer questions and facilitate communication with private landholders, members of the local community, developers, and other participants in the Town of Cary forums. From the verbal responses received, the participants indicated that the images did inform the community as to issues related to scenic development planning and conservation subdivision design. The viewshed information will be incorporated into the Open Space and Historic Resources Plan developed by the staff of the Town of Cary Planning Department.