ATTACHMENT B

Technical Methodology and Field Observation Report Town of Castle Rock Ridgeline Regulations February 25, 1999

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Introduction

7::-This_ roport beg!ns with a t:chni cal descriptioor of concepts imore on the computer implementation of the - skylmmg algorithm. Viewing platforms are discussed along with progrim parameters and data sources. A description of the different skyline and ridgeline areas shown on the O 1 cial Map follows. Finally, this report ends with some definitions that may prove useful for understanding sotjie of the more technical concepts.

Skylining

Intuitively, the skyline is the interface between land and sky. A structuije is skylined if it interrupts this land/sky interface. For the computer implementation, these intuitive ctincepts must be stated as precisely as possible. A technical description follows.

The skyline of an elevation profile (physical or terrain skyline) occurs $4\mathbf{f}$ location s if the elevation angle at s is the maximum for the profile. The elevation angle at s is the angle bijtween the horizontal and the line-of-sight to sand is called e_s . A structure of height h skylines (or is skylin d) at location i (with elevation zi) if the line-of-sight to z_j + h forms an elevation angle greater than e_s (Fi de 1). So in order to determine the skyline regions for a 35 foot structure (for example), it is first necessary to determine the physical skyline, then perform \hat{a} second pass to find areas where a structure would break the line-of-sight to the physical skyline.

Only visibility blocks from terrain were considered in this analysis. Sppcifically, vegetation screening and visibility obstructions caused by buildings or other structures were not cotjsidered.



Viewing Platforms

The viewing platforms were selected by the Ridgeline Protection Regulations Study Group (Group) and later •odified by the Planning Commission (Figure 2). A location at a high point just west of Butterfield Park was die only isolated viewing platform; all other platforms were located along roadways. For the roadways selected as viewing platforms, individual observation points were selected at 1/8 mile intervals. <u>A total of 232</u> observation points were used in the analysis.

It was decided by the Group that no special weighting should be applied to roadways. Consequently, an observation point along Gilbert Street is "worth" as much as an observation point along 125, even though 125 sees significantly more traffic.

Program Parameters

Computer code, using the skylining algorithm previously described, was used for the analyses that produced the Official Map. Several important parameters used by the program are presented in table 1. The viewing platform height is the observation height above local terrain. The buffer distance provides a region around the viewing location where structure skyline computations do not occur. This is because structures very close to the viewer almost always skyline. The maximum distance is the distance at which the structure skyline computations stop (the program "looks" to the edge of the terrain database in order to find the physical skyline).



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Flgure 2. Viewing Platforms

| Tahle 1 | Parameters | for Sk | vline | An4l | 2i2 |
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| Parameter | Value | | |
|--|---------------------|--|--|
| Sample spacing along roadways: | 0.125 miles | | |
| Observer height above local terrain: | 6 feet | | |
| Structure heights: | 25 feet and 35 feet | | |
| Maximum distance for recording skylined areas: | 4 miles | | |
| Buffer distance: | 0.25 miles | | |
| | | | |

Data Sources

The program requires two data files: a viewing platform file and an elevation database. Viewing platforms were originally selected from the U.S. Geological Survey (USGS) 1:1¢0,000 scale Digital Line Graph (DLG) database. The viewing platform locations were later modified to matctj roadway centerlines or right-of-ways from the Town parcel database. The elevation data file was obtained from the Town for regions in and adjacent to the incorporated area (5 foot contour equivalent). This elevation datrbase was augmented by the 1:24,000 scale USGS Digital 'Elevation Model (DEM - 20 foot contour equivale,t) for regions outside of the Town.

Skyline Area Breakdowns

For the Official Map. skyline computations were performed for buildin s of 25 foot and 35 foot height. Regions were broken down by the amount of skylining that occurred. Decifically, regions where structures (of 25 foot or 35 foot) skylined from 16 points or less are not shown. Reg ons where 35 foot structures (but not 25 foot structures) skylined from 17 to 64 points are shown in cyan and a ¢ indicated æ "Minor Skyline Areas" on the Map legend. Regions where 25 foot structures skylined from 17 toi 64 points are shown in yellow and are indicated as "Moderate Skyline Areas" on the Map legend. Regions where 25 foot structures skylined for 65 points or more are shown in red and are indicated as "Major Skyline veas" on the Map legend. Major and minor ridgelines (indicated by hatched patterns on the Map legend) we e determined by the Group on a field tour and are described below.

Major and Minor Ridgelines

,Some members of the Group expressed concern that there may be visue by significant ridgelines that were 'missed by the skyline analysis (minor ridgelines). Also, it was felt that some particularly sensitive skyline areas should be "upgraded" to the highest protection level (major ridge ines). To address these concerns, a field tour was undertaken to determine which ridgelines should be giver' the minor ridgeline or major ridgeline designation and included on the Official Map.

For this field trip, a physical ridgeline map was produced to show thos ridges that were visually significant, but not picked up by the skyline mapping. To determine the physical to field check, a watershed utility* was used - the assumption being that the "headwater" regions, filter was used to eliminate spurious single pixels from consideration. ¹Gelines how visually significant each ridgeline was, a viewshed analysis was run. Those ridges that were se n from 16 points or fewer (of the Group's selected viewing platforms) were removed from consideration! Similarly, those ridges that were already mapped by the skyline analysis, developed, or outside the Towrboundary were also discarded. Additionally, the Group named areas of interest that should be field ve ified. These areas were combined with the physical ridgeline map to determine ridgelines of interest (Figure 3 . It should be noted that the ridge regions delineated do not correspond to any particular elevation or dist ce below the ridge crest.

On November 20, 1998, the Group took this map into the field to viewr dgelines visible from Castle Rock first hand. The purpose of the field tour was to determine which ridge \cdot es would be included on the Official Map **as** well as in the regulations.

Each Group member was provided with a map of the Ridgelines of Inlrest (Figure 3). The Group followed he route specified on the field tour map (Figure 4). At each stop, the est and visually determined whether each should be included in the re Determining factors in the field included the visual prominence of a ri tion, or landforms obscured the view of a ridgeline. The Group also re from "Minor Skyline Areas" or "Moderate Skyline Areas" to "Major for inclusion on the Official Map were roughly outlined in the field. or ridgelines were digitized using the physical ridgeline map along with the field outlined regions. Consider ble interpretation was involved in this process.

Major ridgelines were predominantly regions that had significant exprIsion (at the minor or moderate skyline level) on the skyline map. In order to connect regions along a single geline that were discontinuous on the skyline map, the criterion of skylining at nine points or more at the 25 oot height was used. The lone exception to this rule was the prominent ridgeline north of Highway 86 in the Heritage Farm PD. At the request of the Planning Commission, the major ridgeline boundary was drawn to porrespond with the 17 point (at 25 foot height) skyline threshold.

At subsequent Group meetings, the Group validated the activities of th{ field tour by deciding to include the physical ridgelines determined in the field to be important for protectin. These ridgelines were included on the Official Map and in the regulations.

* The watershed utility in the GRASS (Geographic Resources Analysi Support System) GIS software packtge was used.

Definitions

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-:"'Viewing platform: A single point or series of points (for example, a ro31<1way) where the observer is located.

Line-of-sight: The line between an observer and a viewed object (also failed sight line).

Viewing ray: A straight line segment emanating from the observer to the edge of the study area.

Elevation profile: The projection of a viewing ray onto the elevation suirface. This results in a complex curve.

Digital Elevation Model (DEM): Digital representation of topography !This is usually implemented as a regularly-spaced matrix of values. (Imagine a checkerboard placed over thf landscape with an elevation tabulated at each checkerboard square center).