Land Use Analysis
and
Maps
for

The Escarpment Ordinance
in

Woodway, Texas

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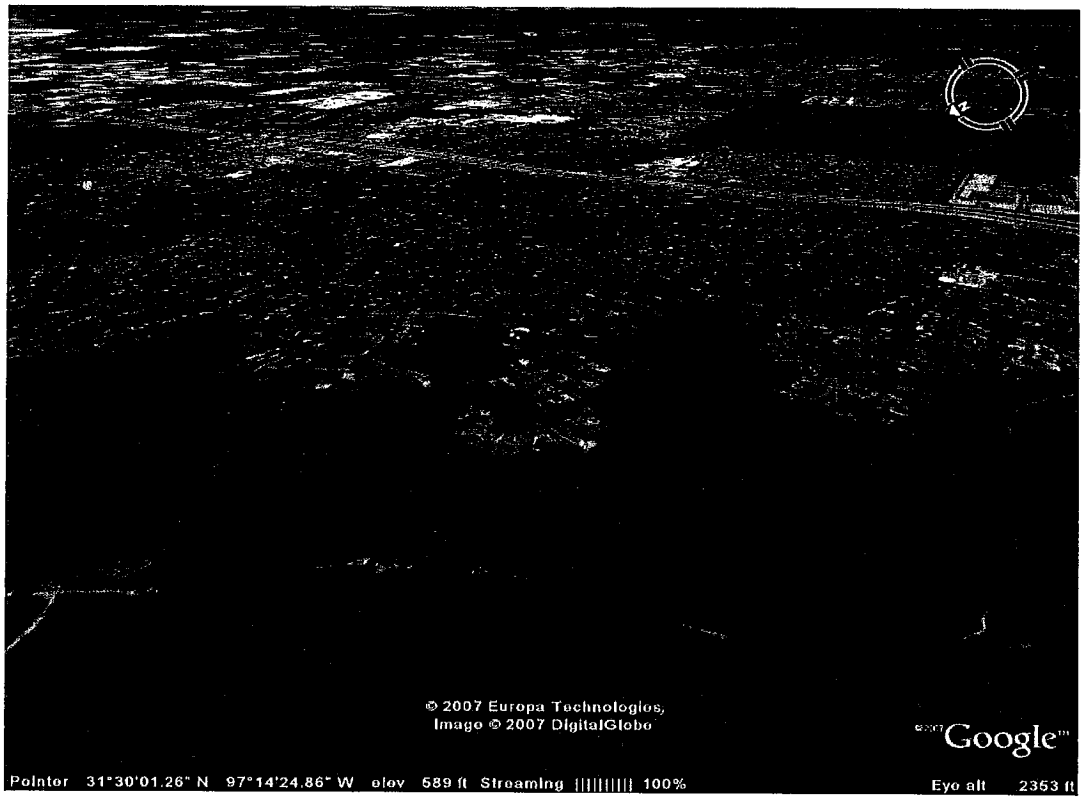

Introduction

All cities are impacted by the natural landscape upon which they are developed. The underlying geology affects topographic expression and soil development. Soils and topography along with climate affect vegetation and aesthetic appeal. These relationships are probably more significant in Woodway, Texas than in most cities. The geology underlying Woodway is comprised of alternating Cretaceous limestones and shales (Austin Chalk, South Bosque Shale, Lake Waco Formation and Pepper Shale). Differential erosion between the limestones and shales has produced a stair – stepped escarpment dissected by steep ravines which overlooks the Lake Waco reservoir. The naturally woody vegetation associated with the ravines and the excellent views provided by the escarpment make Woodway one of the most attractive community settings in Central Texas. However, the residual clay-rich soils of the shales are highly expansive and when they shrink and swell with changing moisture conditions, they affect structures and underground utilities. Perhaps

more importantly, the upper slope formed by the Austin Chalk overlying the upper South Bosque Shale (figure 1) is prone to slope failures in the form of slumps. Disturbance to natural conditions, even vegetation changes, can affect slope stability. In order to protect the high property values resulting from the unique natural setting in Woodway, Texas, it is important for construction and development to incorporate the best geoscience data available into design and management. The Escarpment Ordinance in the City of Woodway is one attempt to achieve this goal. This report provides maps with supporting data to help the application and enforcement of this ordinance.

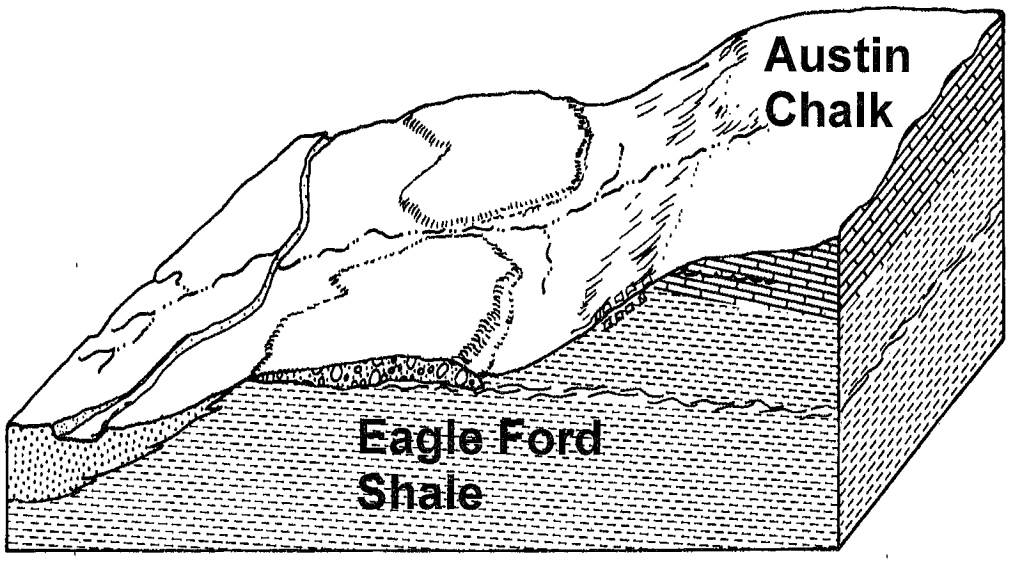

Figure 1. Geology of the Woodway Escarpment. Austin Chalk (a limestone) overlies the softer, expansive, Eagle Ford Shale; specifically the South Bosque formation in Woodway.

Methods

The basic methods in this study used the spatial technologies of Geographic Information Systems (GIS) coupled with field validation. GIS is a powerful media for "Best Management Planning" and allows analysis of data in areas where access was not practical, or even possible. For this project, we relied heavily on both vector and rasterized terrain data. The end result was the most accurate and map feasible with existing data.

Utilizing a digital elevation model (DEM) of the City of Woodway as a base we developed several map layers. These map layers included geology, topography, and slope. We digitized geologic data which contained the approximate position of the contact between the Austin Chalk and the South Bosque Shale. The geologic data included published data from the Geologic Atlas of Texas (BEG, 1990), the Environmental Atlas of McLennan County (Yelderman and Cervenka, 1992) and the Urban Geology of Greater Waco Part 1: Geology (Burket, 1965). These digital data were placed on maps with streets and parcel boundaries and then checked in the field by several people at different times. Field data checks were made at accessible points (streams, road cuts, etc) and coupled with reviews of geologic reports when possible.

The next step used the DEM to determine slopes greater than 6:1 to help identify the "terrain-indicated" escarpment zone and sensitive areas. The escarpment zone is defined in the ordinance as minimum of 45 feet above and 45 feet below the contact between the Austin Chalk and the South Bosque Shale. If the slope within these 90 feet is steeper than a 6:1 ratio of horizontal to vertical distance, then the escarpment zone continues above and below until the slope decreases to a more gentle ratio of greater than 6:1 horizontal to vertical distance. The escarpment zone as defined by the geology and the ordinance minimum distances was combined with the slope maps from the DEM and an escarpment zone map was constructed. Where slopes steeper than 6:1 continued along ravines but were not directly associated with the contact between the Austin Chalk and the South Bosque Shale, they were mapped as sensitive areas according to the ordinance and a line was drawn connecting the escarpment across the ravine.

Results

See map below, data files and website.

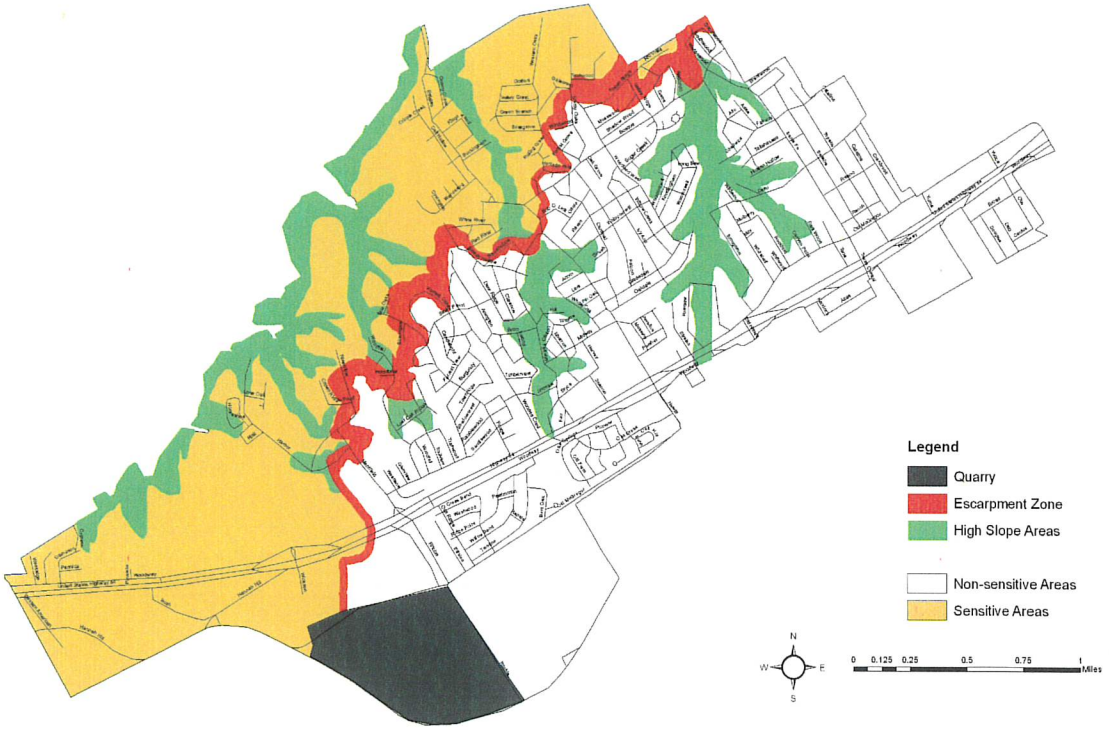

Figure 2. Escarpment Ordinance Map of Woodway, Texas showing the Escarpment Zone in red and the Sensitive Areas of Flat Shale in yellow, Steep Shale and Steep Chalk slopes in green. The dark grey area at the bottom of the map is the cement quarry and is too disturbed to have been accurately designated by the methods used in this study. Non-slope-sensitive chalk areas are not colored.

This map should be used as a planning document and a "guide." Building, construction and development should be based on site specific data which are the responsibility of the builder or developer and not the City of Woodway, the authors, or the publisher of this map. This map has been constructed with the best data readily available to the authors at the time of publication; however, there may be errors in the data bases and the technologies used to construct it which are beyond the control of the authors. If errors are discovered, the builder or developer should provide data to the City of Woodway to support the correction.

Conclusions

The Escarpment Ordinance map will allow builders, developers, city officials and homeowners to have a common source to begin making decisions. The Escarpment Ordinance map and associated report provide data that can be used to make better decisions regarding the design, development, construction and ordinance enforcement within the City of Woodway, Texas. However, the maps produced in this report are designed specifically to help guide construction and development in the city and to alert people to potential issues which need to be addressed for successful results, not to be used as the only data available. The following statement explains the escarpment zone map in context.

The methodology used in the construction of the map solves the problem of what scale should be used when determining the 6:1 slope ratio. The DEM data are the data that were used to determine the slope steepness for the Escarpment Zone and Sensitive Areas.

The area around the cement quarry proved to be beyond the practical application of the methods used in this study and was coded separately on the maps.

Recommendations

Further analysis using GIS may be warranted that includes the use of such data as soils, streams, watershed boundaries and other transportation networks. While the use of these types of data was not necessary for this particular project, analysis of these data may be helpful in the future and especially appropriate for on-line applications. The area around the cement quarry should be approached as a detailed study area using on-site data and perhaps a different GIS data base because of the scale needed to address the level of disturbance in this area.

The map could be improved with greater accuracy but this would require more field data form drill cores and field checks, better street and lot data and better topographic data from LIDAR. These improvements can be achieved with a data collection system that kept track of new field data generated by excavation and drilling or boreholes, obtaining better street and lot data from additional sources and by pursuing a grant that included obtaining LIDAR mapping data. Suggestions also include using student projects to gather data and continue to improve the on-line system.

Bibliography

Bureau of Economic Geology, 1990, Waco Sheet, Geologic Atlas of Texas.

Burket, J. M., 1965, Urban Geology of Greater Waco Part 1: Geology, Baylor Geological Studies, Bulletin No. 8, Baylor University, 45p.

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