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Spatial Analysis of Stream Buffer Setbacks for the Texas Hill Country

Project Proposal

Prepared by:

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1. Introduction

Water, an exceedingly important natural resource, is severely impacted by population growth and unregulated development. The persistent and mounting pressures of increased demand on local water resources significantly impacts the reserves and quality. Development, particularly construction, can lead to increased sedimentation and non-point source pollutants entering water systems. All of these strains can negatively affect water quality throughout the Hill Country Region of Texas. Therefore, it is important to have some type of regulation in relation to waterways in order to protect water resources as well as specialized riparian habitat. Implementation of stream setback buffer zones is one solution to help mitigate water resource degradation.

1.1. Summary

The Texas Hill Country Alliance (HCA) is a non-profit group working to develop a strategic and responsible regional growth plan that reflects their expertise and ideas of land stewardship. A major focus of the group has been their involvement in creating the *Regional Water Quality Protection Plan for the Barton Springs Segment of the Edwards Aquifer and Its Contributing Zone* (Naismith Engineering, Inc. 2005). This plan (RWQPP) is a comprehensive guide for the "protection of surface and ground water; outlining model ordinances and suggested development rules." The expectation for the future is to be able to apply the information presented in the document throughout the Texas Hill Country.

The specific task posed to PAKK was to "develop a full build-out land use map of the Texas Hill Country based on proposed rules established by the RWQPP." After speaking to members of HCA, it was decided that a commission of such magnitude should be developed in phases. These phases are multidimensional and will be addressed to greater extent within this proposal.

1.2. Purpose

The purpose of this project is to employ GIS capabilities for illustration and measurement of land area affected by stream buffer guidelines expressed in the RWQPP. The intended use of this data is to present stakeholders with a first order of protection through depiction of setback buffers around streams. The cartographic output provided by PAKK, in addition to data, analysis results, and information organized in this project, will be utilized by HCA and future GIS analysis teams in continuing to gather and aggregate stakeholder input. They will then be prepared to embark on a full build-out landuse map. The goal for this phase of the project is to construct a general overview map that will assist HCA in facilitating discussions of the many criteria to consider in urban and rural growth planning.

1.3.Scope

PAKK's primary focus will be the analysis and presentation of 600-foot stream buffers around previously recorded hydrography in the 17-county area defined as the Texas Hill Country. Based on these buffers, we will provide per county calculations of acreage amounts that are incongruous for well-planned sustainable development. The work product of the first phase of analysis will be a combination of maps and tables.

One particular challenge will be the creation of truly representative maps on a scale compatible with an executive overview level. The potential that there may need to be a map per county is high; each map would indicate stream buffers, identifying features and other details for discussion points. PAKK will spend time creating a cartographic base that will function as a platform allowing further criteria to be added such as critical environmental features (CEFs), impervious cover limits, and development planning elements. In regard to Web GIS, PAKK will focus on a 6-county region of interest to HCA including Hays, Comal, Blanco, Kendall, Bandera, and Medina.

2. Literature Review

Conscientious planned growth is vital for any area, whether it be as small as a university campus or as large as the Texas Hill Country. Resource scarcity is a fact of life in many parts of the world, and is becoming increasingly so here in Central Texas, especially in regard to water. Within the last 100 years, Texas has experienced several severe drought periods (The Handbook of Texas Online. 2008). Water is essential for the economy of the Texas Hill Country, with importance ranging from consumption and agricultural needs to tourism and energy production. The U. S. Environmental Protection Agency (2008) suggests that, "a watershed approach is the most effective framework to address today's water resource challenges. Watersheds supply drinking water, provide recreation and respite, and sustain life. More than $450 billion in food and fiber, manufactured goods, and tourism depends on clean water and healthy watersheds."

Communities throughout the U.S. are involved in studies and actively implementing plans to protect water resources and control pollution due to run-off. Kansas City, Missouri has developed and implemented a stream setback ordinance. The ordinance, which took several years to generate, was used as a key piece of knowledge for several of the city's ongoing challenges including development codes, environmental practices and wet weather programs. The project conducted a methodical study to evaluate and quantify riparian buffers and stream quality. This information was then used as a basis for low-impact development policies as well as other city based applications. Field observations and stream asset inventory maintain the idea that urbanization, agricultural practices, and loss of stream buffers are negatively impacting the overall stability and quality of streams throughout the city (Schulte et al. 2006). These findings further support the importance of riparian buffers for protecting stream quality (Schulte et al. 2006).

Many studies have been conducted on the analyses of stream setbacks. Non-point source pollution generates 65% of total inland surface water pollution including phosphorous, nitrogen, and pesticides, among others (Narumalani et al. 1997). Therefore, buffer zones for streams are necessary for even the most basic levels of development. Before reaching surface water, the buffer zones allow the pollutants to dissipate through, "infiltration, absorption, uptake, filtering, and deposition (Narumalani et al. 1997)." Studies suggest that buffer zones ranging from 3 to 200 meters are shown to be effective, and the buffers need to be constant across the entire study area. (Narumalani et al. 1997).

Much of the public is becoming aware of the importance of sustaining natural resources. With technology growing at an ever evolving rate, information readily reaches the public allowing community members to become better informed than ever. Public Participation GIS (PPGIS) is being utilized in relation to a wide array of issues ranging from neighborhood

development and revitalization to legislative actions to natural resources management. PPGIS typically involves people from different fields of expertise coming together to share knowledge in relation to the topic at hand. This information is translated into a GIS and used to influence and affect future activities.

In a time when government funding has decreased, many non-government organizations (NGOs) are taking it upon themselves to get involved in geospatial analyses to help influence decision making processes, particularly in local government, planning, and development. It has been found that, "…complicated contextual factors in which PPGIS is produced and implemented can constrain community organizations' PPGIS activities and limit the impact of their spatial analysis in decision-making processes that affect them (Ghose and Elwood 2003)."

Because the public generally lack knowledge and skills related to GIS and digital data, technical and analytical expertise and support are needed. Cooperation between multiple institutions, such as NGOs, non-profit groups, universities/colleges, government entities, etc. needs to transpire in order to fill this void, as PAKK hopes to do so with this current project. However, "…unequal power relations can differentially affect access to GIS and digital data, as well as control over the representations and analyses created with the technology (Ghose and Elwood 2003)." Therefore, "…key organizational factors (such as knowledge, stability, capacity, and leadership)…," can definitely impact interactions between entities (Ghose and Elwood 2003). Through being prepared and working cooperatively, many of these organizations can help shape future actions within their communities.

3. Proposal

3.1. Data

Table of Acquired Data Layers

File Name	Data Type	Description	Source
complete_hydrography	Shapefile	Major Rivers, Major Streams, Intermittent Streams, water bodies and Dams for 17 county area	Marston
Hill_County_Watersheds	Shapefile	Watershed areas ranging from 7,607 to 50,884 acres	Marston
Hca_dem	DEM	Digital Elevation Model of the 17 county area	HCA
City_limits	Shapefile	Useful for Location Reference/ Map clarity	HCA
cities	Shapefile	Useful for Location Reference/ Map clarity	HCA
HCA_area_lakes	Shapefile	Hydrology	HCA
HCA_counties	Shapefile	Useful for Location Reference/ Map clarity	HCA
major_aquifer_HCA	Shapefile	Hydrology	HCA
minor_hwy_HCA	Shapefile	Useful for Location Reference/ Map clarity	HCA
MUDs	Shapefile	Municipal Utility District	HCA
streams_HCA	Shapefile	Named Stream	HCA
2000_Block_Groups	Shapefile	Population Data	HCA

Other Data

Other Data may be required; expected sources are TNRIS, Texas Parks and Wildlife, CAPCOG, AACOP, HCA, county and city sources.

3.2. Methodology

To begin analyzing the amount of developable land within the 17-county area defined by HCA, PAKK will create maps detailing buffered hydrography features where development may be discouraged. We will be working with the entire study area; however, buffered areas are indistinguishable at the full 17-county extent view. To illustrate buffered area details at a more discernible scale, we will need to zoom in for a smaller scale view, creating maps of each county.

The amount of time spent processing GIS data should be reduced since we have several layers available for the 17-county study area, including complete hydrography, watershed boundaries, county boundaries, and many others. However, data layers required for land area analyses will require more attention as they are not all measured in known unit values. We will need to accurately compute the land area for affected layers, such as county boundaries and hydrography buffers.

According to the RWQPP (Naismith Engineering, Inc. 2005, p.70) required stream buffer sizes are outlined below:

Table 9 - Required Buffer Zone Widths (from Stream Centerline)

Contributing Area	*Width/Offset (feet, each side of centerline)*	*Total width (feet)*
32 to 120 Acres	*100*	*200*
120 to 300 Acres	*150*	*300*
300 to 640	*200*	*400*
Greater than 640 Acres	*300*	*600*

The watershed data provided to PAKK describes areas ranging in size from 7,607 to 50,884 acres. Due to the size of these contributing areas, we will be applying the broadest category of stream buffer. The 600 ft total buffer width will be generated from applying 300 ft. buffers from the centerline of features within the complete hydrography layer. A dissolve function will be employed in order to calculate the amount of acreage per county affected by these buffer setbacks. For location and identification purposes, the resulting maps will also display details such as main roadways, urban areas, population census tracts, and other information.

3.3 Implications

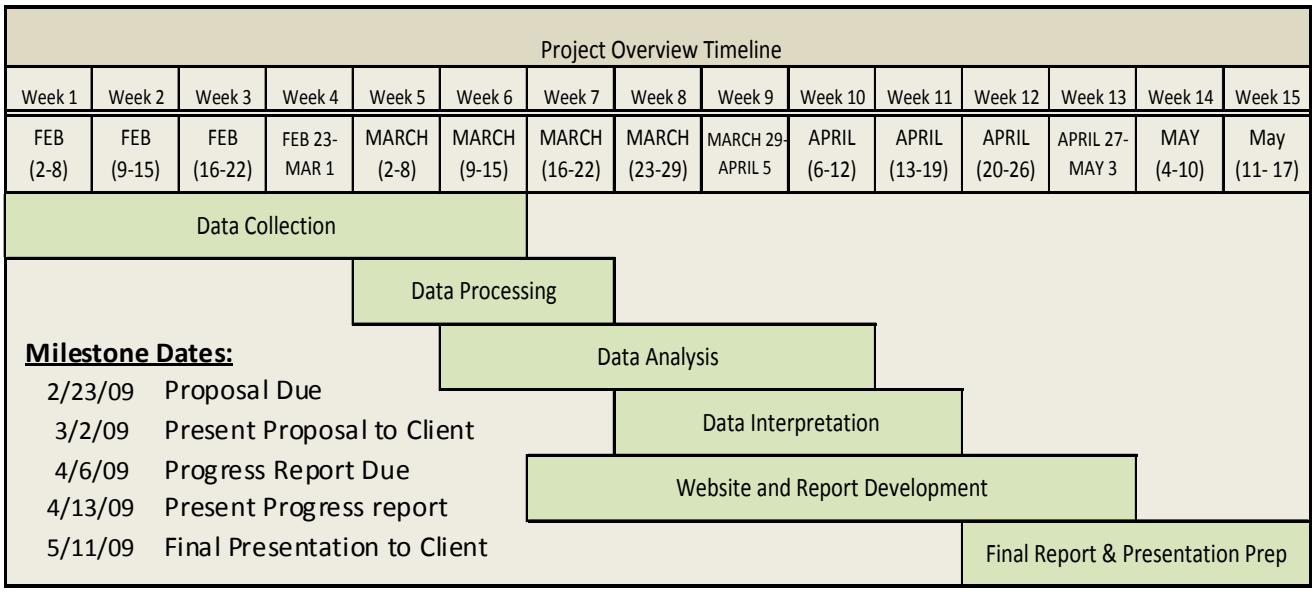
Once the amount of land sensitive to development is identified, the ensuing maps may aid in municipality implementation of guidelines set forth in the RWQPP. In the future, full-scale zoning and potential growth maps will supplement the buffer analyses and be utilized for zoning areas of more specificity, such as residential, commercial, and industrial development. While development may be allowed from 600-1000 ft. from a stream, the construction of an industrial pollution source at this proximity would be potentially hazardous to adjacent communities, as well as communities downstream.

PAKK hopes to offer HCA an opportunity to spatially view sensitive areas that can be protected during the projected population booms in the next 30-60 years. Many municipal areas are in close proximity to streams and rivers, so the analysis is needed not only as a starting point for a plan, but also to educate communities regarding their sensitive locations.

3.4 Budget

Item	Description	Estimated Hours	Hourly Rate	Total
Project Management	Coordination, scheduling, documentation & research	240	$60.00	$14,400.00
Data Collection	Collection, Categorization, Exploration, and Identification	40	$40.00	$1,600.00
Analysis/ Cartography	ArcGIS/ Web GIS Functionality	100	$65.00	$6,500.00
Layout/ Printing	Final Poster and Reports	90	$30.00	$2,700.00
Website Development	Creation and documentation of project deliverables	45	$40.00	$1,800.00
	Total Project Cost			$27,000.00

3.5 Timetable



3.6 Final Deliverables

The Hill Country Alliance will receive the following items:

- Detailed Final Report
- Poster highlighting our analyses and results
- Access to a website containing PAKK's project
- CD containing all of our data, metadata, proposal, progress report, final report, digital image of poster, and any related PowerPoint presentations. This CD will include a readme file containing instructions for accessing data and other information.

4. Conclusion

The final product of the project will assist HCA, other concerned citizens, and local advocacy groups in the future delineation and implementation of the RWQPP. The realization of such a plan in conjunction with other regulatory forces will serve to smooth the progress of a rapidly growing area in the protection and utilization of limited natural resources, particularly water.

This project will prove to be both challenging and informative for our group. We look forward to further exploration of the information. We would like to thank the former GEO 4427 classes that have produced much of the information we will be working with, as well as the members of HCA that have graciously allowed us to participate in such an important project.

5. Participation

Ms. Katherine Grobe – Project Manager

- Introduction
- Summary, Purpose, Scope
- Literature Review
- Methodology
- Participation
- References
- Editing
- Conclusion
- Layout/Printing
- Final Review
- Power Point

Ms. Phillicia Phillips – Assistant PM / Analyst

- Cover/ Title Page
- Introduction
- Summary, Purpose, Scope
- Literature Review
- Data List, Budget, Timetable
- Conclusion
- Participation
- Editing
- Final Review
- Layout/Printing
- Power Point

Mr. Amon Clack – Primary GIS Analyst

- Summary, Purpose, Scope
- Literature Review
- Methodology
- Implications
- Final Deliverables
- Final Review

Mr. Kyle Furtwangler – Web Designer / GIS Analyst

- Summary, Purpose, Scope
- Literature Review
- Budget
- Participation
- References
- Final Review

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