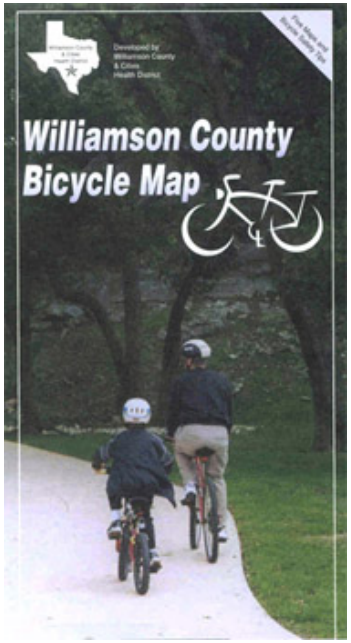


Promoting Exercise using GIS: The Williamson County Bicycle Map Project

By Paula Ferrigno, GIS / Data Coordinator

Abstract

Always seeking creative avenues to promote physical activity, the Williamson County & Cities Health District (WCCHD) utilized GIS technology to measure the safety of bikeable roads and created both a paper and web-based bicycle map. The presentation covers the goals for the project, design and implementation plans, and details on how the map was built using ArcView 3.2 and ARCIMS 3.1. The WCCHD is the local health department for a county of 250,000 residents in Central Texas. Attendees will learn how to duplicate this project with limited in-house resources.

Summary

Are you responsible for promoting physical activity for your organization? If so, this presentation is for you! The development of the Williamson County Bicycle Map demonstrates a creative and practical application of how GIS technology can be used to promote physical activity for a county population. For this project, staff utilized a set of criteria, developed by the Texas Transportation Institute at Texas A&M University, to physically evaluate county road conditions and calculate a suitability, or ease of use, score for roadways. With this data project staff developed a bicycle map for the county (available in print or on the web) that provides roadway information to bicyclists. The criteria can also be used to identify gaps in bicycle route networks and to plan bicycle improvements for roadways. The information, although created for Texas, is general enough to be used by any state. Also, learn from our experience how this bicycle map project led to new opportunities for partnerships and projects that have helped fund and market the map.

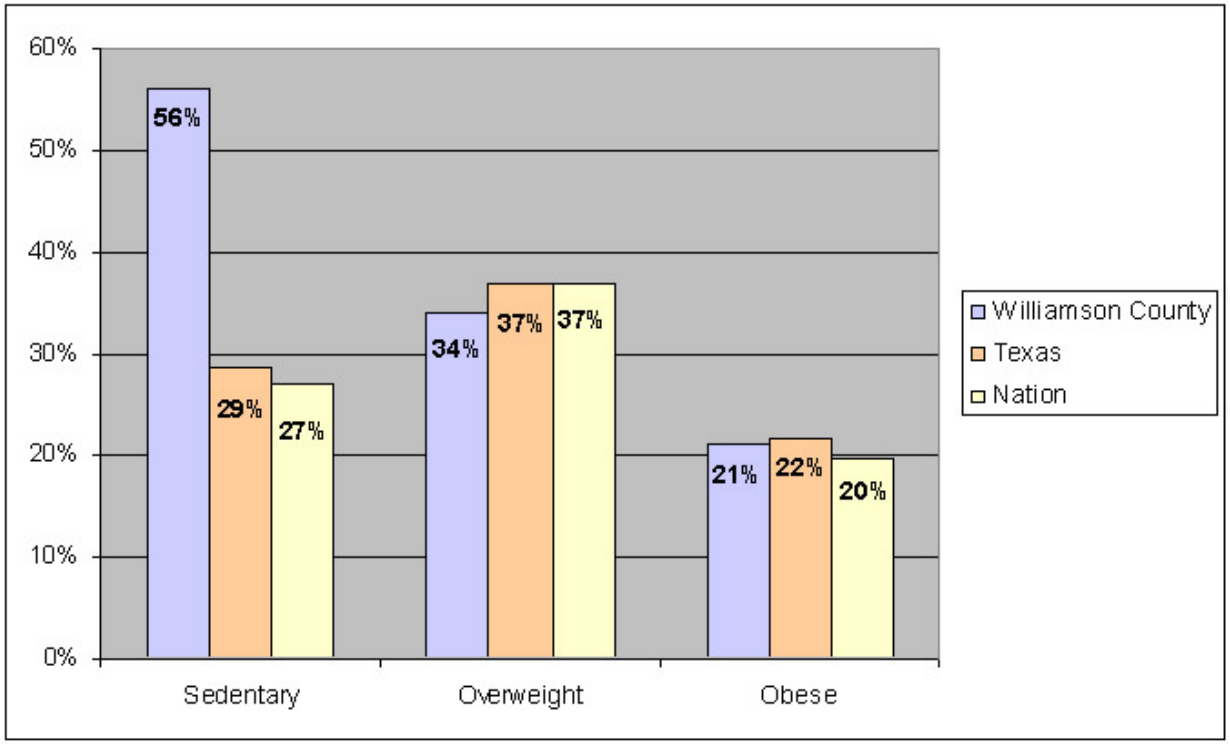
Background

The Williamson County & Cities Health District (WCCHD), located in central Texas, is the local public health department for a county of almost 300,000 residents over 1,124.3 square miles. While WCCHD provides many traditional public health services to residents, they are also responsible for promoting healthy living and healthy communities.

In 1999 WCCHD participated in a study called the Behavioral Risk Factor Surveillance Survey (BRFSS)[1]. The results showed that 56% of county residents were sedentary, 34% were overweight, and 21% were obese. Most alarming was that the rate of sedentary individuals was almost double that of Texas and the nation. In addition, vital statistic data showed that the most prevalent cause of death for county residents was cardiovascular disease. For such a young county (median age is 32 years), the combination of sedentary lifestyles and cardiovascular disease as the major cause of death raised concern for the future health of residents.

During this same time, WCCHD was granted nine AmeriCorps*VISTA positions for a period of three years (2000-2003) to work on the 2010 Healthy People objectives. These VISTA's were charged with the goal of reducing sedentary lifestyle in Williamson County, resulting in a number of projects that addressed physical activity for various segments of the population; one of the projects was a bicycle program. Two important components of the project are the Williamson County Bicycle Map and trail advocacy.

Behavioral Risk Factor Surveillance Survey (BRFSS)[1] Data, 1999



The Bicycle Suitability Criteria

Project staff began their work by researching existing methods for measuring roadway safety and suitability for bicyclist, and selected the *Bicycle Suitability Criteria for State Roadways in Texas*[2] as a guide for data collection.

The *Bicycle Suitability Criteria for State Roadways in Texas* report specifically addresses how to develop bicycle suitability, or ease of use, criteria for evaluating roads. The intended use of the suitability criteria developed by the researchers was for making a bicycle map that provides roadway information to bicyclists, but the authors note that the criteria can also be used to identify gaps or deficiencies in regional or intercity bicycle route networks, and to plan bicycle improvements for roadways. The information, although created for Texas, is general enough to be used by any state or local entity. For this project, the following types of roadways were selected to survey: city, county roads, farm-to-market roads / ranch roads, and state roads.

Many factors can be used when deciding how to grade a road. Recommended factors for this project include shoulder width; traffic volume (average daily traffic); vehicle speed (or posted speed limit); shoulder or pavement condition. Much of this information is available from state departments of transportation, county road departments, and city public work departments. For this project, traffic counts, shoulder widths, and speed limits were obtained from a combination of county, city, and state sources. Keep in mind that files acquired from these sources may contain inaccuracies or be out of date. For example, the traffic count data from the county hadn't been updated since 1997. This was a significant issue because of the recent population boom; Williamson County was one of the top ten fastest growing counties during the late 90's, increasing its population 79% by the year 2000. New roads were being built and older data files did not reflect this. The visual evaluation of the roadways helped with this problem, though, as confirmation of traffic counts, posted speed limits, and shoulder widths could be done in the field as well as identification of new roadways.

Suitability Factor	Value Range	Factor Score

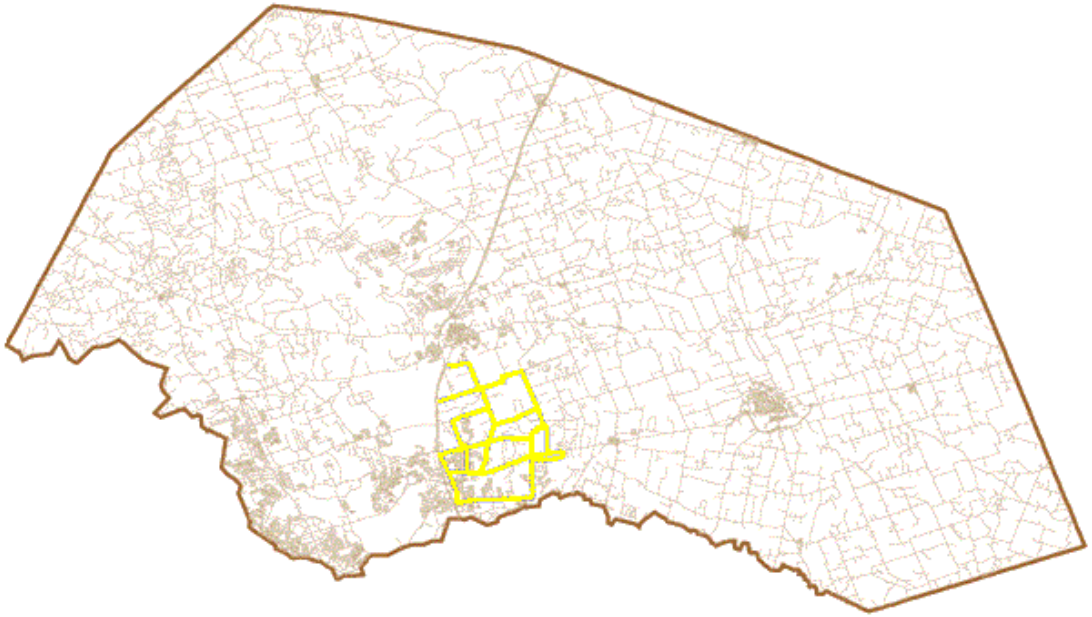
Shoulder Width [If no shoulder, Travel Lane width in brackets]	6 ft or greater [15 ft or greater]	2
	2 to 4 ft [12 to 14 ft]	0
	No shoulder [less than 12 feet]	-2
Traffic Volumes, ADT per lane (If ADT is unavailable, estimate the traffic by Light, Medium, or Heavy as indicated).	Less than 1,000 (Light)	2
	1,000 to 1,999 (Light to Medium)	1
	2,000 to 4,999 (Medium)	0
	5,000 to 9,999 (Medium to Heavy)	-1
	10,000 or greater (Heavy)	-2
Posted Speed Limit (or Average Vehicle Speed)	Less than 40 mph	2
	40 to 49 mph	1
	50 to 59 mph	0
	60to 69 mph	-1
	70 mph or greater	-2
Shoulder/Pavement Condition	Good	2
	Fair	0
	Poor	-2

Data Collection

Staff first viewed the basemap in ArcView to identify which roads to survey, and then created a spreadsheet to take out in the field. The themes used for the basemap were Census 2000 TIGER/Line shapefiles. Due to limited project resources, no electronic devices were available to use in the field so data collection was done the old fashioned way; pencil and paper. Supplies used for field data collection were the surveying spreadsheet, a measuring instrument (a measuring wheel or measuring tape), and a writing utensil. Once out in the field, staff typically broke down roadways by intersections; for example County Road 181 intersects three other roads; Lakeline Blvd, Bagdad Rd, and County Road 272. So, CR 181 would be scored from Lakeline to Bagdad, and from Bagdad to CR 272. With limited resources, this method provided some logic once data was entered back into the ArcView project. Obviously, a more efficient method would be to enter the data directly into the database while in the field through a device such as a PDA. Once the fieldwork was complete and factor scores were assigned, the data was entered in the road attribute table (additional fields were added to accommodate the new data) in ArcView. See Lessons Learned for more data collection tips. The total amount of time spent collecting data was

approximately 8 months with 1-2 staff.

Organize daily road data collection using basemap in ArcView.



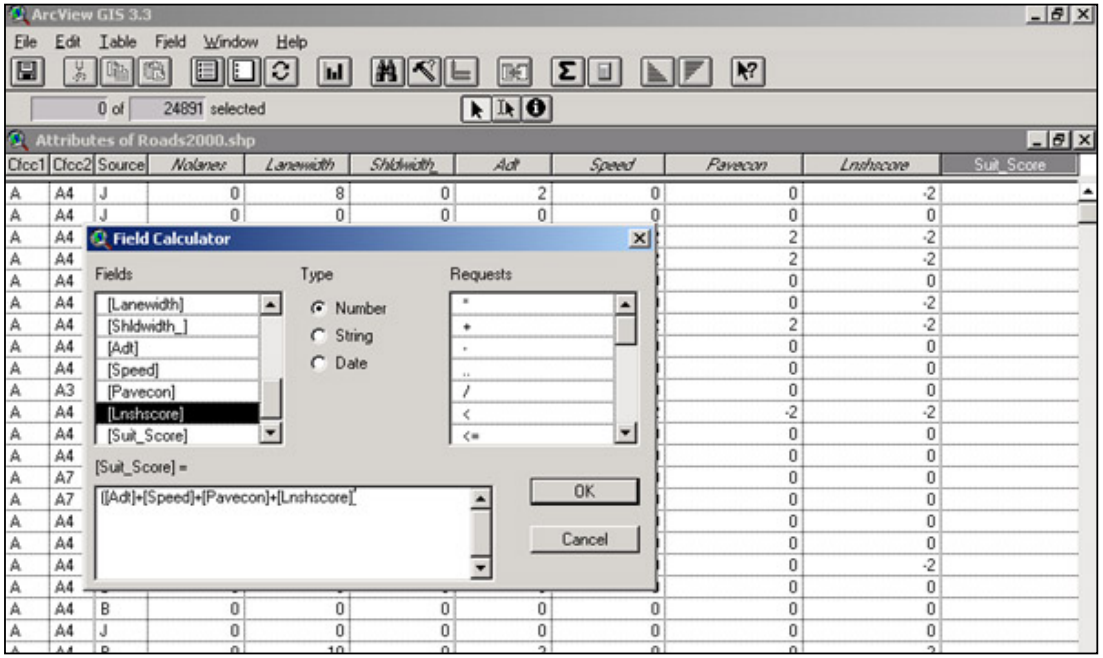
Sample spreadsheet used for field data collection

Road Name (Road to be surveyed)	From Road	To Road	Posted Speed Limit	Lane Width (ft)	Shoulder Width (ft)	Pavement Condition	Lane Count	Average Daily Traffic
Hutto								
CR 885	Between Hwy 79 & County Line							
Frameswitch								
CR 361	Between CR 101 & Carlos Parker							
CR 365	Between CR 101 & Carlos Parker							
CR 373	Between CR 365 & Hwy 79							
Taylor								
CR 401	Between Hwy 79 & CR 404							
Hoxie								
CR 422	Between CR 419 & CR 424							
Sandoval								
CR 427	Between Hwy 79 & CR 426							
Noack								
CR 432	Between Hwy 79 & CR 433							
Shiloh								
CR 442	Between FM 112 & County Line							
CR 440	Between County Line & FM 112							

Once the data was finished, the final bicycle suitability score was calculated in a new field called Suit_Score. This value is the result of combining all of the scoring factors into a single numerical score. The formula for the suitability score is:

Suitability Score = [ADT Factor Score + Speed Limit Factor Score + Pavement Condition Factor Score + Lane/Shoulder Width Factor Score]

Calculate the suitability score



Creating the Map in ArcView

The development of the map began by establishing the coloring scheme for the rated roadways. For the Williamson County bicycle map, the calculated suitability score determines the color of the road as follows:

Suitability Score	Road Color
Unrated	Gray
-1 or less	Red
0 to 2	Yellow
3 or greater	Green

Others conducting similar bicycle map projects may consider using a unique marking, such as a thick black line, to symbolize roads that are too dangerous to ride. Additional features were added to the map project (see below). Of the data obtained locally, the hike and bike trails were the most difficult to collect, mainly because it required contact and coordination with the individual local governments. Not all local governmental agencies utilize an in-house system to create park and trail plans, so several of the hike and bike trails had to be created from scratch for the project. In the end, staff was successful at obtaining the majority of existing, planned, and proposed hike and bike trail data.

Feature	Data Source
Cemeteries	Local source associated with the Historical Society
Water Features	Census 2002 TIGER/Line shapefiles

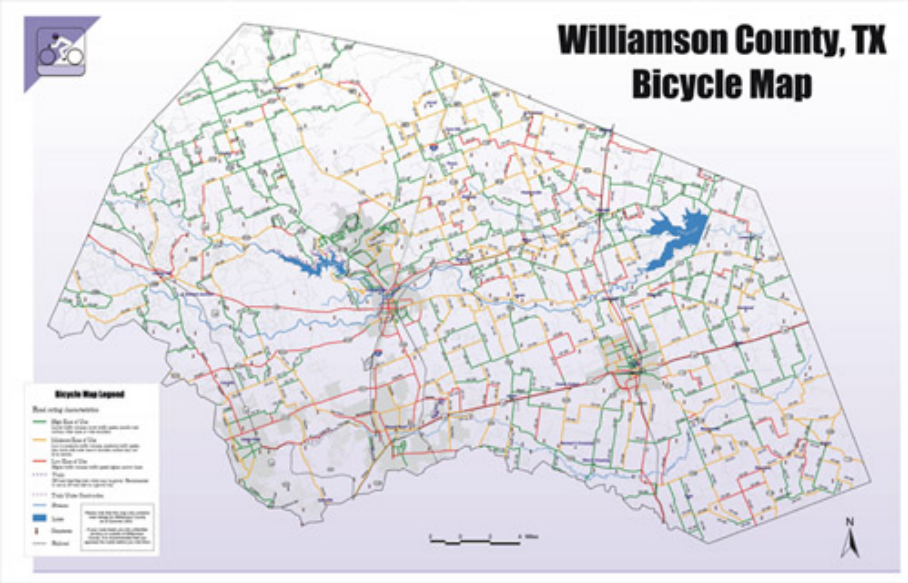
Railways	Census 2002 TIGER/Line shapefiles
Cities and Places	Census 2002 TIGER/Line shapefiles
Hike and Bike Trails	Local; City Park and Recreation Departments and Planning Departments

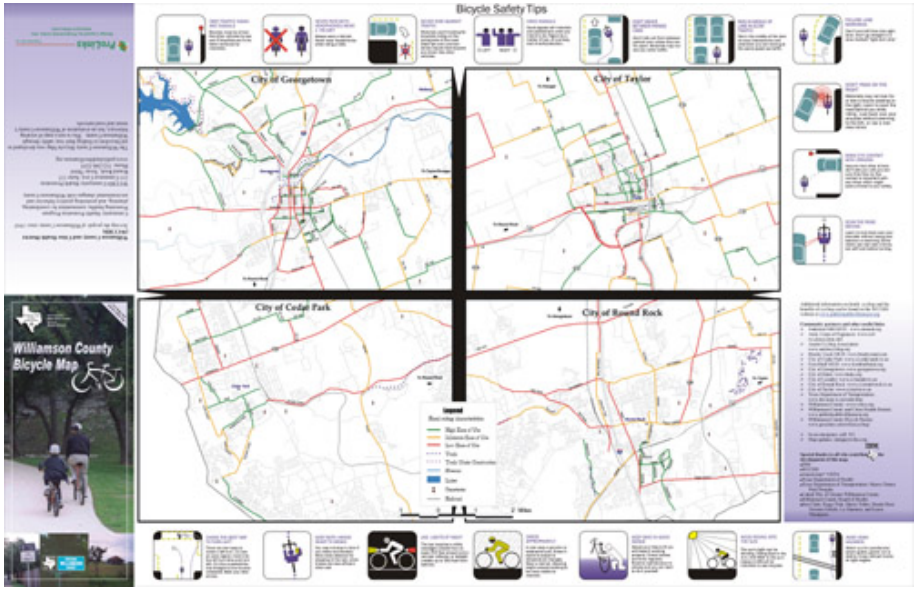
Production of Paper Map

Making a map may be an everyday task for many users of geographic information system software, but for a public health department cartography is not an everyday function. Fortunately, funding was provided for a map designer who was hired to do the final layout design of the bicycle map. Components that were created in-house and then sent to the designer included:

- ArcView project
- Cover art for front panel
- Bicycle safety tip graphics
- Legend design and wording
- Wording and logos for back panel

Approximately 1500 bicycle maps were first printed and distributed to recreation centers, chambers of commerce, YMCA, public libraries, parks & recreation departments, planning departments, and local bicycle shops. The maps ran out within a month, so another 5000 were printed and re-distributed.





Publishing the Bicycle Map on the Web

After the paper version of the Williamson County Bicycle Map was printed and distributed, the WCCHD began work to publish the map on the web. Internal resources available for this portion of the project were the ArcIMS 3.1 software, an internal web server, and one staff person. At the time, the main goal of offering the bicycle map in an interactive format on the web was to provide a way for the public to access local bicycling information while offering a "create your own route" feature, giving the user the ability to select and measure road segments to create and print a

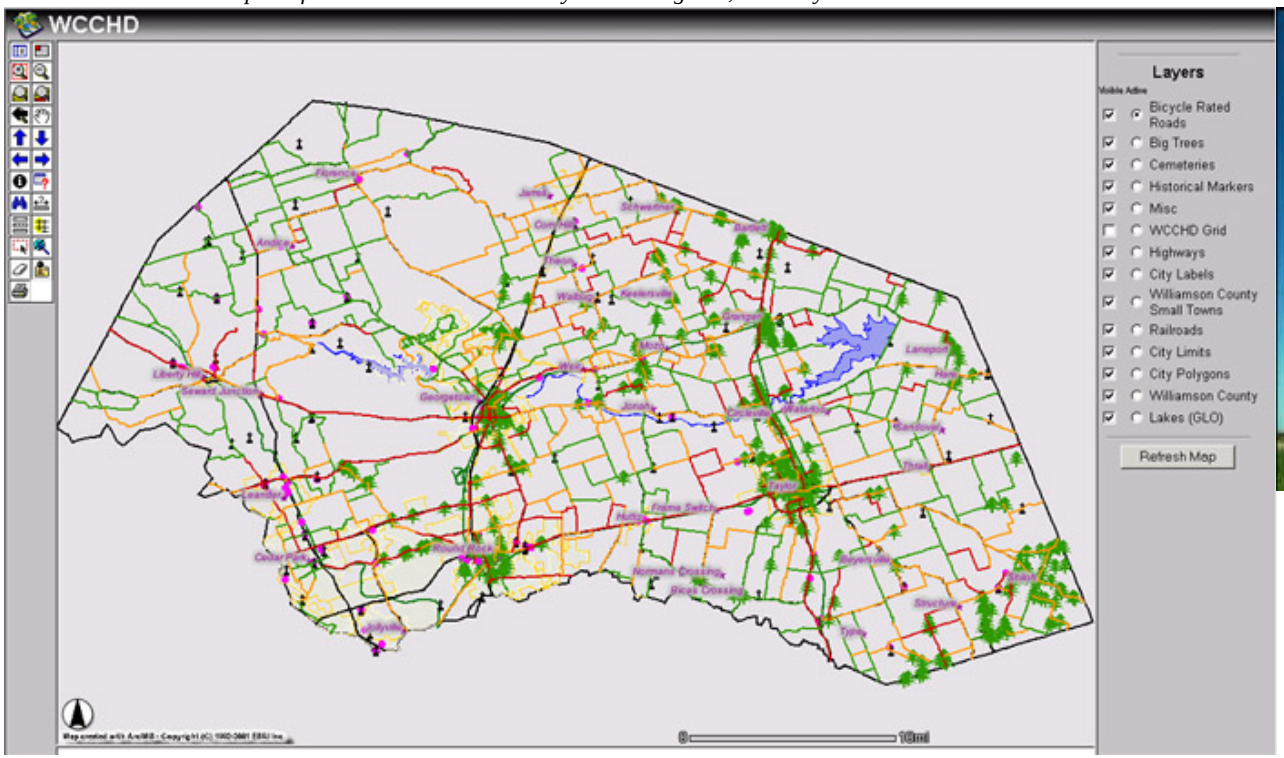
custom route. A web based product also gives the ability to keep features, such as roadways and trails, up to date as possible. The bicycle map began to evolve further after a new partnership was established with the Williamson County Commissioner's Court, and the idea of integrating bicycling and scenic destinations was born.

Incorporating Big Trees into the Bicycle Map

As the ArcIMS version of the bicycle map was in development, an opportunity was presented to WCCHD in the form of a partnership with the Williamson County Commissioner's Court. The Commissioner's Court had passed a resolution that would provide for the documentation and preservation of historical trees of 29 inches or more in diameter in Williamson County that fall within the right of way of county and state roads. The Commissioners were interested in making a map of scenic driving and bicycle routes to show off the historical trees once they were located and photographed. Since the WCCHD's bicycle map was already developed, they agreed to take on the project of documenting and photographing the historical trees and decided to include cemeteries and historical markers. This new turn for the project offers the potential for greater functionality than the scope of the paper map, as it incorporates the concept of 'destinations' with bicycling and is helping preserve part of the county's history. Plus, as the photographs of the trees, historical markers, and cemeteries are a huge draw to the public, they will make the web map even more robust and interesting.

Fortunately more funds were available to support this new part of the project, and data collection for the trees was done with better technology than with the road suitability score collection. A local consultant company[3] was hired to build custom processes for collecting and analyzing the data. With the use of handheld devices, uploaded with DOQQ images and a custom program to generate coordinates, staff collected the coordinates and descriptive information for the trees, cemeteries, and some historical markers (most historical marker coordinates were obtained from the Texas Historical Commission). A digital camera was used to photograph the trees, markers, and cemeteries. The trees and markers specifically coordinate with the roadways that are presented on the bicycle map. Then, data and photographs are uploaded into a master database. An ArcView project uses the data from the master database to create event themes for the trees, markers, and cemeteries. The shapefiles from the ArcView project are used for the ArcIMS bicycle map project . To date, staff has located over 700 historical trees and taken over 1000 photographs. The custom interface for the website, which will integrate all of the new features with the bicycle map, is currently under development.

Sample of Bicycle Map in ArcIMS including features of big trees, historical markers, and cemeteries. The photos to the right are samples of what viewers see when they select a big tree, cemetery or historical marker icon.



Historical Tree

Allison Cemetery in Williamson County, Texas

Lessons Learned

- Don't try to rate every single road; instead try to include routes that are in high demand, safer alternatives, and especially the safest or most dangerous roads.
- Clearly creating a bicycle suitability map is beneficial because it educates riders on which roads are safer to ride, but it can also help identify roadways that need improvements. This information can be very useful when trying to prioritize bike lane locations or when trying to apply for a grant to build a trail.
- If the Average Daily Traffic Count data is not available, eyeball the traffic level.
- Know the non-posted default speed limits. For example (in Texas), neighborhood road =30 mph; urban commercial road =30 mph; county road =30 mph; frontage road =55 mph; farm-to-market/ ranch-to-market =70 mph; highway numbered by Federal or State Government =70 mph.
- Create a committee with community representation from local cyclists. Involve them in all phases of the project; they can tell you which roadways are favorites, which ones to avoid and for what reasons.
- The use of a handheld device would greatly improve the field data collection process.

Acknowledgements:

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References:

1) The Behavioral Risk Factor Surveillance System (BRFSS) is the largest, continuously conducted, telephone health survey in the world. It enables the Center for Disease Control and Prevention

(CDC), state health departments, and other health agencies to monitor modifiable risk factors for chronic diseases and other leading causes of death. CDC developed standard core questionnaire for states to use to provide data that could be compared across states. The BRFSS, administered and supported by the Division of Adult and Community Health, National Center for Chronic Disease Prevention and Health Promotion, CDC, is an on-going data collection program.

2) Bicycle Suitability Criteria for State Roadways in Texas by Shawn M. Turner, C. Scott Shafer, and William P. Stewart of the Texas Transportation Institute at the Texas A&M University System. Research performed in cooperation with the Texas Department of Transportation. This report can be viewed at http://tti.tamu.edu/product/catalog/reports/3988-s.pdf.

3) ***wptc**:* training, web consulting and internet mapping; Austin, Texas www.wptc.com

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Author Information:

Paula C. Ferrigno
GIS / Data Coordinator 211 Commerce Blvd, Suite 113
Round Rock, Texas 78664
(512) 248-3281
pferrigno@wilco.org