THE UNIVERSITY OF TEXAS AT AUSTIN
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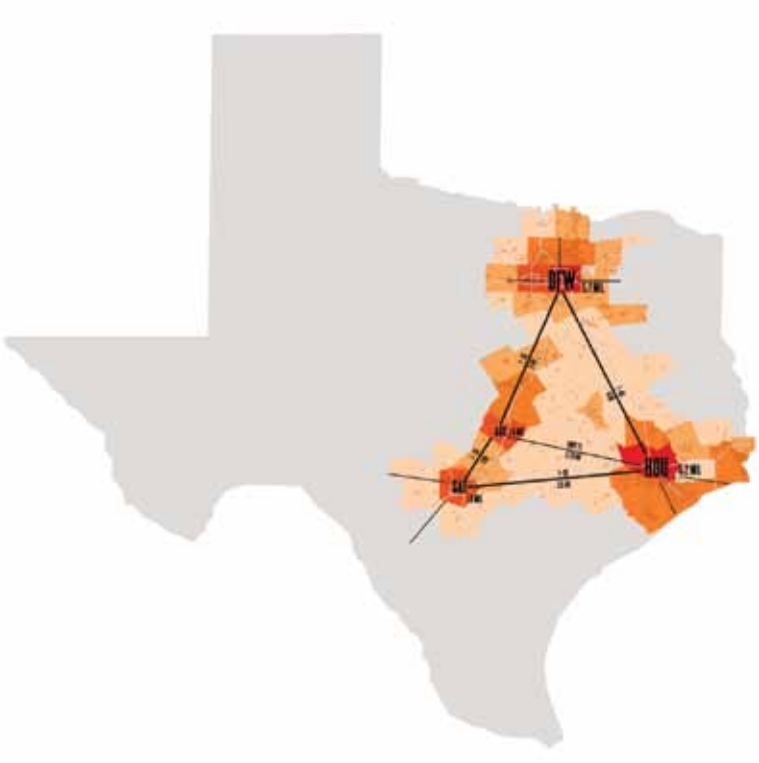
REINVENTING THE TEXAS TRIANGLE

Solutions for Growing Challenges



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REINVENTING THE TEXAS TRIANGLE

Solutions for Growing Challenges

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Cover image: The counties and major cities of the Texas Triangle, showing population density, major highways and travel time between cities. Created by Dean Almy, The University of Texas at Austin.

Introduction

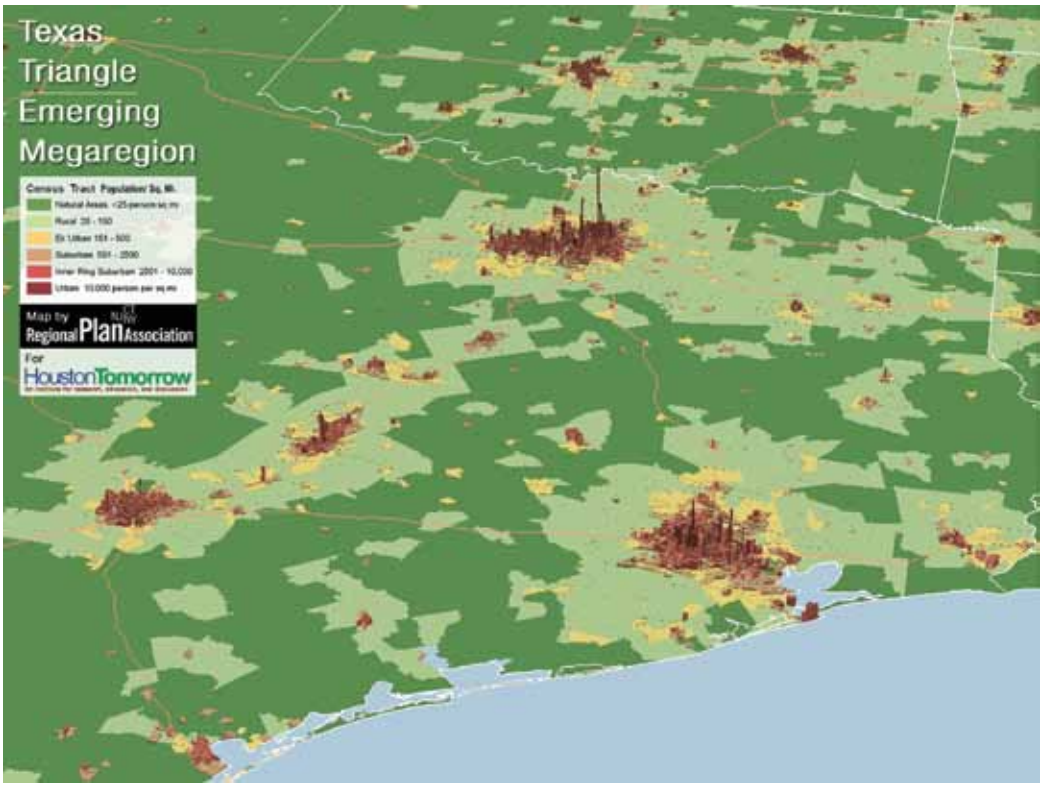
The Texas Triangle Megaregion is spatially delineated by the metropolitan areas of Dallas/Fort Worth, Austin, San Antonio and Houston, with a total land size of nearly 60,000 square miles and a total of 15 million inhabitants in the year 2000. An additional 10 million people are expected to inhabit this area in the next 40 years, a growth rate of more than 65 percent. This rapid growth presents several challenges to the State of Texas and the many communities in the megaregion.

By analyzing the urban areas of the Texas Triangle in terms of history, economic structure and major employment industries, and by identifying connections between the major cities, strategies for sustainable solutions to the region's challenges can be developed. The challenges the Texas Triangle faces require cooperation of the entire megaregion – they cannot be solved in isolation.

In order to manage the expected population growth, critical issues that must be addressed include: reducing suburban sprawl by identifying preferred growth areas, developing a new transportation network, ensuring the region's economic competitiveness and preserving significant natural resources as well as scenic landscapes.

This publication builds on data and findings from a team of faculty members and graduate students in the School of Architecture at The University of Texas at Austin. In Spring 2006, the team examined growth challenges facing the Texas Triangle from a megaregion perspective and explored spatial development strategies to coordinate local efforts for the purpose of strengthening the megaregion's competitiveness in a national and global context. These findings have been refined and developed further from 2006 to 2009 (Zhang, Steiner and Butler 2007).

In this publication, we look first at defining the Texas Triangle as a megaregion and provide some vital statistics. We next look at a history of the major urban areas of the Texas Triangle, some of the major industries that exist and some of the major challenges that the megaregion is facing. We discuss several strategies that need to be investigated in depth in order to link the megaregion and start to solve the challenges. Through awareness of challenges and strategic opportunities, the Texas Triangle Megaregion can successfully grow as we move towards the future.



A view of the Texas Triangle produced by RPA and Houston Tomorrow, showing population by census tract for cities around the region (Courtesy of Houston Tomorrow).

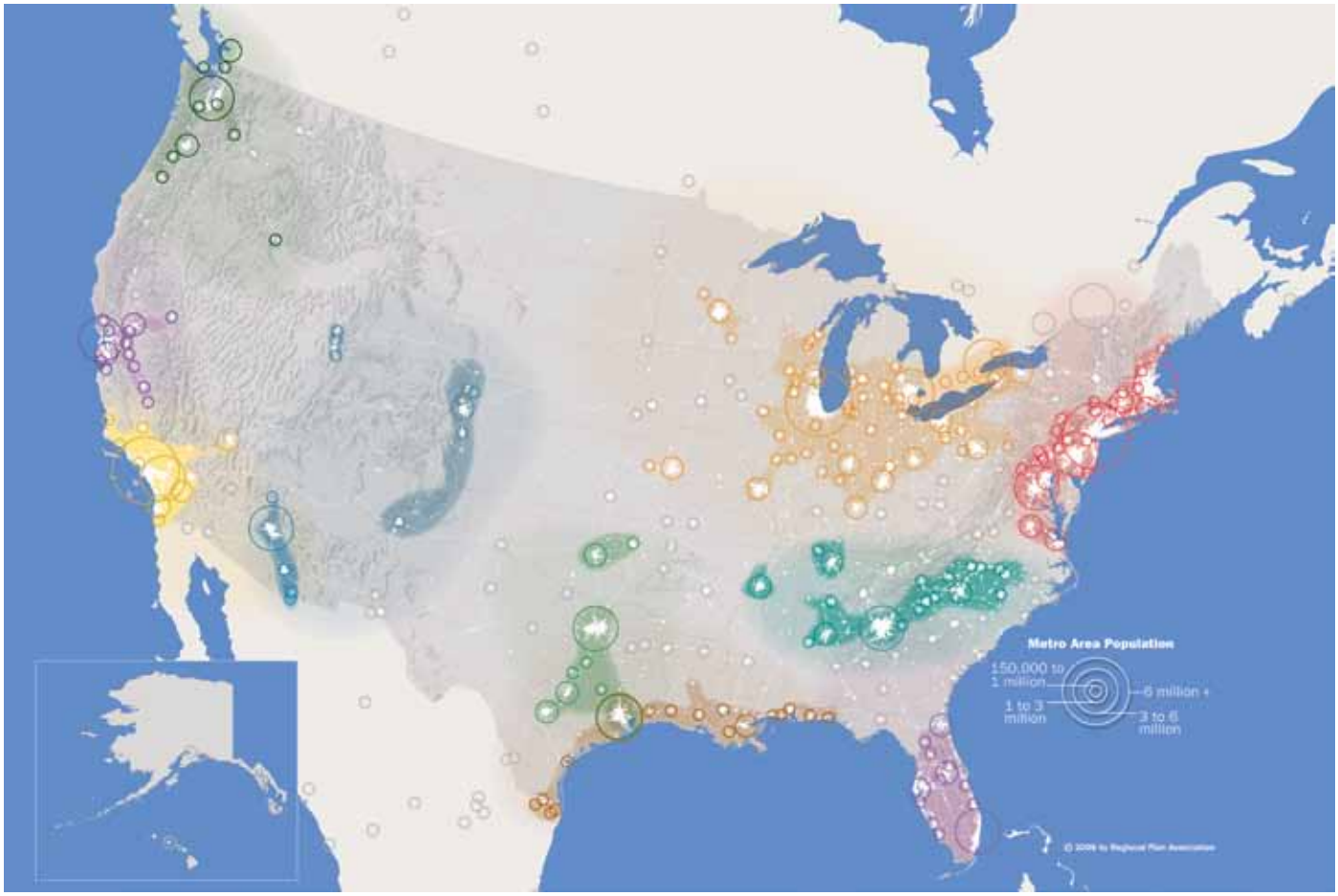


FIGURE 1
America 2050 defined megaregions in the United States (America 2050 2006).

The Texas Triangle
A Texas-Sized Megaregion

Economic globalization and postmodern urbanization in the 21st century are prompting a new geographical entity throughout the world - the megaregion. A megaregion consists of two or more metropolitan areas linked with interdependent environmental systems, a multimodal transportation infrastructure and complementary economies. Megaregions concentrate people, jobs and capital and play a decisive role in the increasingly competitive global economy. Observing this trend, the Regional Plan Association (RPA 2006) has advocated a megaregion approach – that is, spatial development at the megaregional level – as a useful scale for national planning. Megaregions can enhance metropolitan and city planning in the areas of economic development, infrastructure investments, environmental protection and rural and urban land uses. The megaregion approach offers provocative and visionary answers to growing problems such as congestion, development disparity and air pollution that are facing individual metropolitan areas or cities but are unlikely to be solved by each individually.

The Texas Triangle is one of the eleven emerging megaregions in the continental United States initially identified by

the University of Pennsylvania with RPA and the Lincoln Institute (Figure 1) (Carbonell and Yaro 2005). It geographically encompasses the metropolitan areas of Austin, Dallas, Fort Worth, Houston and San Antonio. Of the eleven megaregions, the Texas Triangle has invited probably the most discussion (Bright 2007). There are different versions of defining one or more megaregions in or around Texas, all which seem plausible.

Aside from the triangle version proposed by RPA, Lang and Dhavale proposed two corridor megaregions for Texas and its neighbors to the north and east (Figure 2). One is the Interstate 35 (I-35) Corridor stretching from San Antonio, Texas to Kansas City, Missouri. The other is the Gulf Coast stemming from Brownsville, Texas, to Mobile, Alabama along the Gulf of Mexico. A version of the "Texas Hinge" extending to Mexico also emerged during the 2006 Megaregion Workshop in Madrid, Spain (Zhang, Steiner and Butler 2007).

America 2050, a collaboration between the RPA, the Rockefeller Foundation and the University of Pennsylvania, delineates the Texas Triangle as a naturally conjoined urban megalopolis or megaregion. The triangle (especially along the I-35 corridor) represents a series of spatially conjoined urbanized areas that are anchored by three major metropolitan areas. The Houston metropolitan area links this corridor to the Gulf Coast and thereby to the state's primary economic base: oil and petroleum production and refining. The triangle is also contained entirely within the State of Texas and is a more coherent political entity.

FIGURE 2 Metropolitan Institute defined megaregions in the United States (Lang and Dhavale 2005).

Defining the Region

The Texas Triangle has three sides measuring 271, 198 and 241 miles in ground distance. These distances are quite far to navigate even with modern ground transportation and even in the Texas sense of "bigness." About 130 years ago, passenger and freight trains connected the major triangle cities with each other. It was the train connection that boosted the initial growth of the settlements. According to Barry Popik (2007), a New York City etymologist, the term "Texas Triangle" appeared as early as 1936 when the Missouri Pacific (MoPac) Railroad announced its new overnight services from St. Louis and Memphis to Dallas, Fort Worth, Houston, Austin and San Antonio. MoPac was one of the first railroads in the United States west of the Mississippi River. It operated passenger train services in the Southwest in the early part of the 20th century. "The Texas Triangle" was one of MoPac's premier named services, the "Sunshine Special" service. Today the Texas Triangle train service no longer operates. Only limited Amtrak connections exist and these trains are slow as freight is given preference over passengers on the rail lines. Three interstate highways (I-35, I-45 and I-10) have assumed the role of providing inter-city connections and delineating the triangle.

Sixty-six counties, including four metropolitan statistical area (MSA) clusters, comprise the Texas Triangle. The vital statistics of this area are summarized in Table 1.

TABLE 1
2000 statistics of the Texas Triangle Megaregion (US Census 2000)
*2003

Table 1. Texas Triangle Vital Statistics (2000)

	Texas Triangle (66 Counties)	Four MSA Clusters	State of Texas	United States
Area (Square Miles)	57,430	25,035	268,580	3,794,083
Pop. (1000s)	14,660	12,734	20,852	281,422
GDP ($million)		605,458*	722,832	9,749,104
% of US Total				
Area (Square Miles)	1.51%	0.66%	7.08%	100%
Pop (1000s)	5.21%	4.52%	7.41%	100%
GDP ($1000)		6.21%*	7.41%	100%

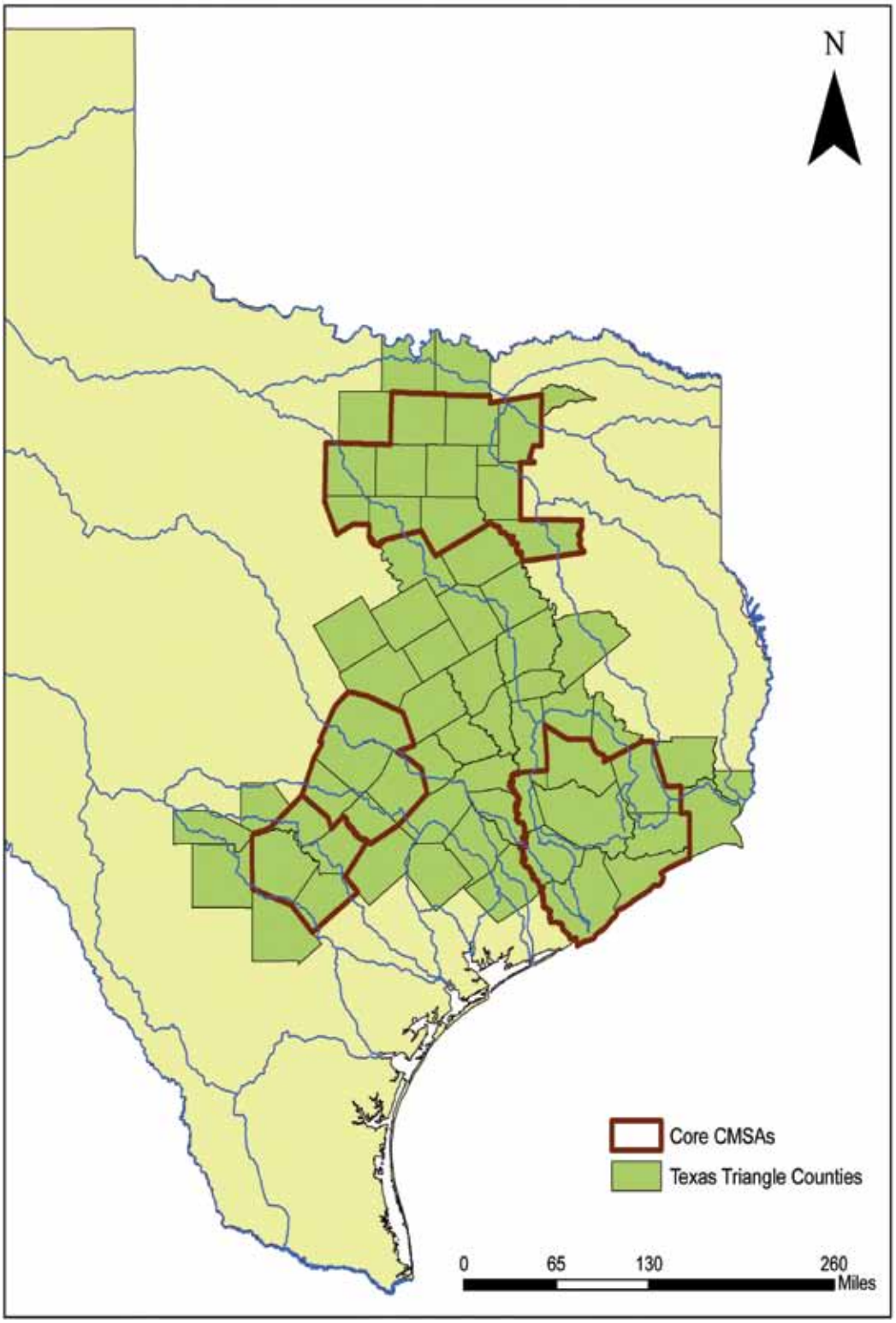


FIGURE 3 The Texas Triangle Megaregion consists of 66 counties. The consolidated metropolitan statistical areas (CMSAs) for San Antonio, Austin, Houston and Dallas/ Fort Worth are also shown (Map produced by authors with data from US Census 2000 and Texas Parks and Wildlife Department).

A Brief History of the Major Triangle Cities

Looking at the growth history of the Texas Triangle cities and metropolitan regions helps to explain the area as a megaregion. The history of each city is quite different but shows that they have grown to become complementary entities, each with a different economic strength. These strengths allow the cities to have their own identities and reduce competition throughout the region, although competition in some industries has occurred as the cities have diversified their economic base. Dallas and Houston started as distribution centers due to their transportation advantages, with Dallas as a land transportation hub in the inland and Houston as a water transportation hub on the coast. San Antonio and Fort Worth started as military posts, whereas Austin was created in a strategic place as a political-institutional establishment. There were some overlapping functions among them, especially in recent decades. Nevertheless, in the early days, their geographical separations made their relations more like isolated economic entities than competitors or co-producers.

Downtown San Antonio. One of the top tourist destinations in the United States, with nationally known attractions such as the Alamo and the River Walk.

SAN ANTONIO

The City of San Antonio (2007 city population 1,328,984; 2008 metropolitan population 2,031,445) is located in south central Texas. Spanish explorers founded San Antonio in 1718 as a supply depot for the missions in east Texas and Louisiana. In 1731, San Antonio gained the distinction of being Texas' first municipality, established as San Fernando de Bexar. The Mexican Revolution in 1812 marked the start of a very unstable political period for the San Antonio region. By 1846, San Antonio's population had dwindled to 800 people. However, after the State of Texas joined the Union, San Antonio emerged as a distribution hub for western migration. It increased in population to 3,488 by 1850 as many new settlers during the 19th century came from Germany. By 1860, San Antonio had become the largest city in Texas and it held this title until the early 20th century. The formation of the Galveston, Harrisburg and the San Antonio Rail System contributed significantly to San Antonio's prosperity at the time. Nevertheless, by 1930 Houston and Dallas had surpassed San Antonio in population.

During World War I, Fort Sam Houston became the largest military base in the United States. The military influence drastically changed San Antonio's economic landscape. The once agricultural distribution center of the west was transformed into America's training ground for its soldiers. During World War II, over a third of the total population of the city was comprised of military personnel. The population of the city actually doubled during World War II. San Antonio's dependency on the military as the main source of employment and chief economic driver characterized the region's social and economic climate. Being the oldest major city in Texas, San Antonio has more recently become one of the top tourist destinations in the United States. The tourist attractions include the River Walk, the Alamo, the Spanish missions and numerous golf courses.

HOUSTON

The City of Houston (2007 city population 2,208,180; 2008 metropolitan population 5,728,143) is located in southeastern Texas. The Allen brothers, Augustus Chapman Allen and John Kirby Allen, founded the Town of Houston on the Gulf coastal plain in 1836 and named the town after General Sam Houston. The Texas Congress designated Houston briefly as the capital of the Republic of Texas and incorporated the city on June 5, 1837. The accessibility of water transportation offered Houston strategic advantages. Before the Civil War, Houston was the most interior point with access to the Gulf of Mexico by water. Small river steamships operating on the Buffalo Bayou connected the oceangoing ships in Galveston with oxen-drawn wagons in the hinterland. At the turn of the 20th century, Houston's population reached 44,683. Major efforts began after the Civil War to dredge a better ship channel. In 1914 the Houston Ship Channel opened, making Houston a deepwater port, later to be ranked the second largest in the United States. By then, Houston had become a large commercial power, ranking first among Texas cities in terms of volumes of commerce and industry. Shipping was a staple industry in the local economy, especially during World War II. Houston's economy had changed dramatically since the discovery of oil at Spindletop. To ensure a safe distance from Gulf storms, oil companies built their refineries along the Houston Ship Channel. After the war, Houston utilized its natural supplies of salt, sulfur and natural gas to develop one of the two largest petrochemical concentrations in the United States. With this industry in place, Houston had become a world energy capital by 1970. Today, the Houston economy is still largely based on oil and gas-related industries, though the economy is rapidly expanding from its energy base.

Downtown Houston. The largest city in the State of Texas is also the largest city in the United States without zoning regulations.

Downtown Dallas. The Dallas Area Rapid Transit authority (DART) operates the state's first light rail system. Currently consisting of 45 miles of track, DART Rail is planned to double this system by 2014.

DALLAS

The City of Dallas (2007 city population 1,240,499; 2008 metropolitan population 4,226,003) is located along the Trinity River in northeast Texas. John Neely Bryant was the first American explorer to settle in the Dallas area in 1841. Rich soil and ample water made the area an ideal place to live. Initially a trading post by the Trinity River, Dallas as a county was officially formed on March 30, 1846, by order of the Texas State Legislature. Its role as an inland transportation hub was soon established since two Texas highways converged there. Providing services in dry goods and groceries stores, shoe and boot shops and drugstores, Dallas reached a population of about 800 by 1860. Expanding as a major rail center in the late 19th century, the city now covers 385 square miles. Dallas plays a leading role in the petroleum, telecommunications, computer technology, banking and transportation industries. Companies headquartered in the Dallas metropolitan area include: Exxon Mobil, 7-Eleven, Blockbuster, Mary Kay Cosmetics, Southwest Airlines, Comp USA, Texas Instruments and Zales Jewelry.

FORT WORTH

Fort Worth (2007 city population 681,818; 2008 metropolitan population 2,074,003) is located along the Trinity River, 32 miles west of Dallas. At the end of the Mexican-American War in 1849, Major Ripley S. Arnold founded Camp Worth at the Clear Fork and West Fork intersection of the Trinity River. The camp was officially named Fort Worth in honor of General William Jenkins Worth, a hero of the Mexican War. At war's end, the fort was relocated further west and settlers took the initial fort area and built department stores, a general store, a hotel, a doctor's office and a flour mill. Fort Worth also served as the western terminal on the way to California for overland mail service and a stagecoach line. Fort Worth, like Dallas, benefited from the natural resources the area had to offer. However, the Civil War caused shortages in money, food and water supply. Dallas/Fort Worth did not experience strong growth until the arrival of rail connections in the late 1870s. Evolving from its origins as a cattle drive terminus, Fort Worth retains its western character. The Stockyards Historic District, for example, preserves and recreates vestiges of the Chisholm Trail and the Texas and Pacific Railway.

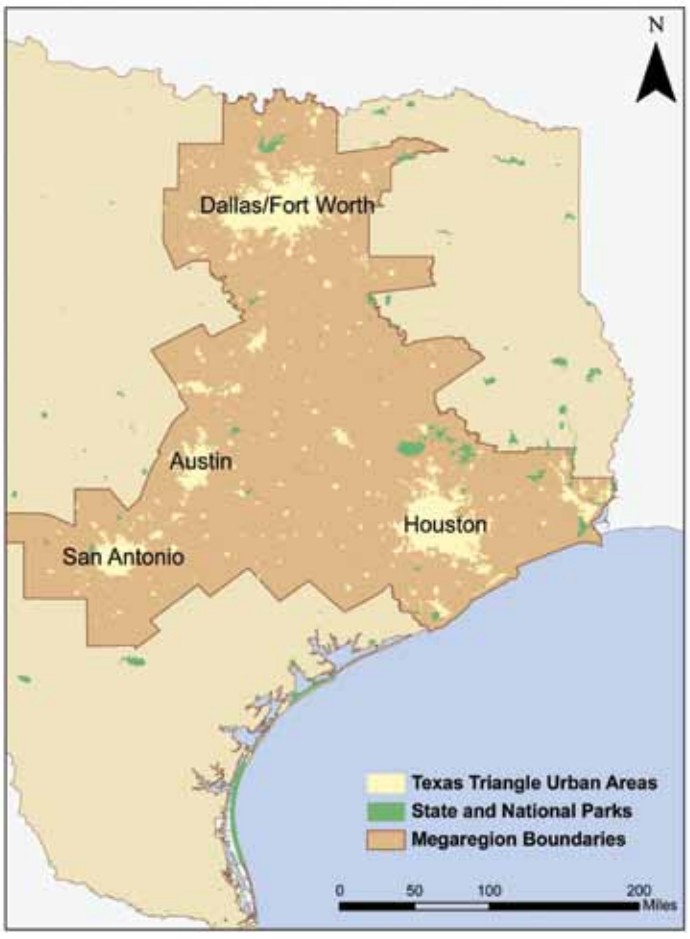


FIGURE 4 Urban areas of the Texas Triangle Megaregion (Map produced by authors with data from Texas General Land Office).

Downtown Fort Worth. This city is typically in the shadow of its larger neighbor, Dallas, but has established itself as a diverse manufacturing center and has continued to grow rapidly in population.

Downtown Austin. The downtown has seen a remarkable skyline change in recent years. The city, proud of its vast open space network, is now going vertical with several new condo complexes over 40 stories tall.

AUSTIN

The City of Austin (2007 population 743,074; 2008 metropolitan population 1,652,602) is located in east central Texas, where it straddles the Colorado River at the interface of the Edwards Plateau to the west and the fertile Blackland Prairie to the east. On a site used as a camp for Indian hunting parties, a group of Americans established the village of Waterloo which, in 1839, became Austin, the capital of the New Republic of Texas. Austin's first mayor, Edwin Waller, proposed a grid system for streets on the north bank of the Colorado River. This grid is aligned on a northeast tending ridge between two creek valleys. That configuration remains largely intact in the city's downtown. To the north of downtown, the grid shifts to a true north-south formation. Outside this core, streets ramble more organically across rolling hills and around water systems. After Texas became part of the United States in 1845, Austin became the permanent state capital. St. Edward's University was founded by Rev. Edward Sorin of the congregation of Holy Cross in 1878 and The University of Texas at Austin followed in 1882. Until the early 1970s, the city's economy was dominated by state government and higher education. Beginning in the late 19th century, a series of seven dams was constructed on the Colorado River for water supply, flood control and hydroelectric power. As a result, manufacturing expanded, the university expanded in size and the seeds for the computer technology industry were planted. Since the 1970s, the city has become an important center for computer technology (such as Texas Instruments, Dell, IBM, Motorola, Samsung and AMD), music (such as Willie Nelson and the Dixie Chicks) and, to some extent, television and film (such as Robert Rodriguez films and the Friday Night Lights television series). Barton Springs provides a popular year-round swimming pool with its constantly cool temperature and prolific discharge (32 million gallons/day). Its popularity laid the groundwork for a strong local environmental movement affecting city politics and its local, as well as national, identity. The Lady Bird Johnson Wildflower Center and other conservation organizations contribute to this "green" orientation. Meanwhile, the large academic, high-tech and student populations contribute both to continued technological innovation and a robust live music scene. Austin is also rapidly becoming a national leader in sustainable building and energy systems.

Industries and Economic Structure

The major metropolitan areas within the Texas Triangle (Dallas/Fort Worth, Austin, San Antonio and Houston) offer a very diverse industrial and economic structure for the megaregion. All four metro areas continue to play the strategic roles they have played in the past. For instance, Austin remains the place where state government jobs concentrate, whereas San Antonio's strength is still in the federal and military sectors along with a large tourist industry. Dallas/Fort Worth has a principal role as a distribution center in such sectors as trucking and warehousing, wholesale trade, air transportation, and transportation services. Houston remains strong in resource production, in both air and water transportation and oil related industries, such as oil and gas extraction, petroleum and coal products and chemicals and allied products.

While these cities each have industries that distinguish themselves from the others, there is also some competition of industries within the Texas Triangle. Austin and Dallas/Fort Worth are both home to similar high-tech industries, such as communications and electronics. Dallas/Fort Worth, Houston and San Antonio are all focused on oil and gas extraction. There is also competition in air transportation between Dallas/Fort Worth and Houston, with American Airlines and Southwest Airlines headquartered in the Dallas area and Continental Airlines headquartered in Houston. Between Austin and Houston, there is some competition in the industrial machinery and equipment sector. But despite all of this competition between the Texas Triangle metros, the cities do compliment each other in their economic roles.

Looking at location quotients (LQs) for the metro areas combined shows this complimentary relationship in many industries (Table 2). An LQ is the ratio of the share of an industry in the local economy to the share of that industry nationally. It shows whether the industry is an exporter or an importer for that local area. The higher the LQ, the more specialized the industry is in the local area compared to the rest of the country. When the four metros are combined, the export industries reduces to 16 LQs, compared to 54 when LQs are reported for the metros separately. The variance of LQs also decreases (Gilmer 2004a, 2004b). The decrease in the number of export industries and in the LQ variance indicate that many of the export industries serve the metros within the triangle and they support each other in performing economic functions.

TABLE 2 (OPPOSITE) The location quotients of selected industries in the Texas Triangle, by metro region and overall (Gilmer 2004a and 2004b).

Table 2. Location Quotients of Selected Export Industries in the Texas Triangle Metro Areas

Industry	Austin	Dallas/Fort Worth	Houston	San Antonio	Texas Triangle
Federal Civilian	-	-	-	1.84	-
Military	-	-	-	4.70	-
State Government	2.27	-	-	-	-
Local Government	-	-	-	1.16	-
Auto Dealers and Service Stations	-	-	-	1.28	-
Auto Repair, Services and Parking	-	-	-	1.19	-
Business Services	1.47	1.35	-	-	1.17
Chemicals and Allied Products	-	-	2.43	-	1.21
Communications	1.17	1.82	-	1.96	1.41
Depository and Non-depository Institutions	-	1.16	-	-	-
Eating and Drinking Places	-	-	-	1.35	-
Electric, Gas, Sanitary Services	-	-	3.69	3.13	2.15
Electronic and Other Electrical Equipment	3.32	2.47	-	-	1.54
Food Stores	-	-	-	1.29	-
General Building Contractors	-	-	-	1.16	-
General Merchandise Stores	-	-	-	1.19	-
Heavy Construction	-	-	3.03	1.18	1.73
Holding and Other Investment Offices	-	1.16	2.10	1.72	1.54
Home Furniture and Furnishings Stores	-	1.38	-	-	-
Industrial Machinery and Equipment	3.69	-	1.26	-	-
Insurance	-	1.16	-	2.35	-
Legal Services	-	-	1.34	-	-
Miscellaneous Manufacturing	-	-	-	1.18	-
Miscellaneous Repair Services	-	1.37	1.58	-	1.19
Miscellaneous Retail	-	-	-	1.18	-
Oil and Gas Extraction	-	4.82	13.81	1.30	7.49
Petroleum and Coal Products	-	-	4.97	-	2.22
Pipelines except Natural Gas	-	-	6.78	-	-
Private Households	-	-	-	1.28	-
Real Estate	-	1.54	1.27	-	1.31
Transportation by Air	-	2.49	1.40	-	1.71
Transportation Services	-	2.12	3.32	2.85	2.52
Trucking and Warehousing	-	1.17	-	-	-
Water Transportation	-	-	3.38	-	1.32
Wholesale Trade	2.08	1.47	-	-	1.31

Regional Challenges

The Texas Triangle Megaregion is expected to grow, as history suggests, by an additional 10 million people over the next 40+ years. This vast growth presents three key challenges. First, consumption pressure will be significant on land, water and other natural resources. It is projected that two of the five largest aquifers in the region will have less than 45 percent of their reservoirs remaining by 2050. Second, the region's population will become more diverse, with a large amount of international in-migration posing challenging demands for employment, education, health care and other services. A third challenge is mobility. National mobility studies show that all of the four metro areas in the Texas Triangle have been among the nation's top congested regions in the past two decades. It is an immense job to keep the people and goods moving within the region, across the Texas-Mexico border and along the North American Free Trade Agreement (NAFTA) corridor.

One great benefit of the Texas Triangle region is that it is entirely contained within the boundaries of a single state. As a result, policy changes necessary to encourage megaregional planning may be easier to implement. Currently, metropolitan planning organizations (MPOs) are responsible for transportation demand forecasting and planning for individual metropolitan areas. The scope of MPO's work typically does not go beyond their designated areas. While individual MPOs provide rather detailed pictures of their areas, forces of growth from the interactions among metropolitan areas and between the metro areas and their hinterlands are often not accounted for. A new brand of MPO, a *megaregion* planning organization, will need full support not only from the cities of the Texas Triangle but from the State of Texas in order to be successful.

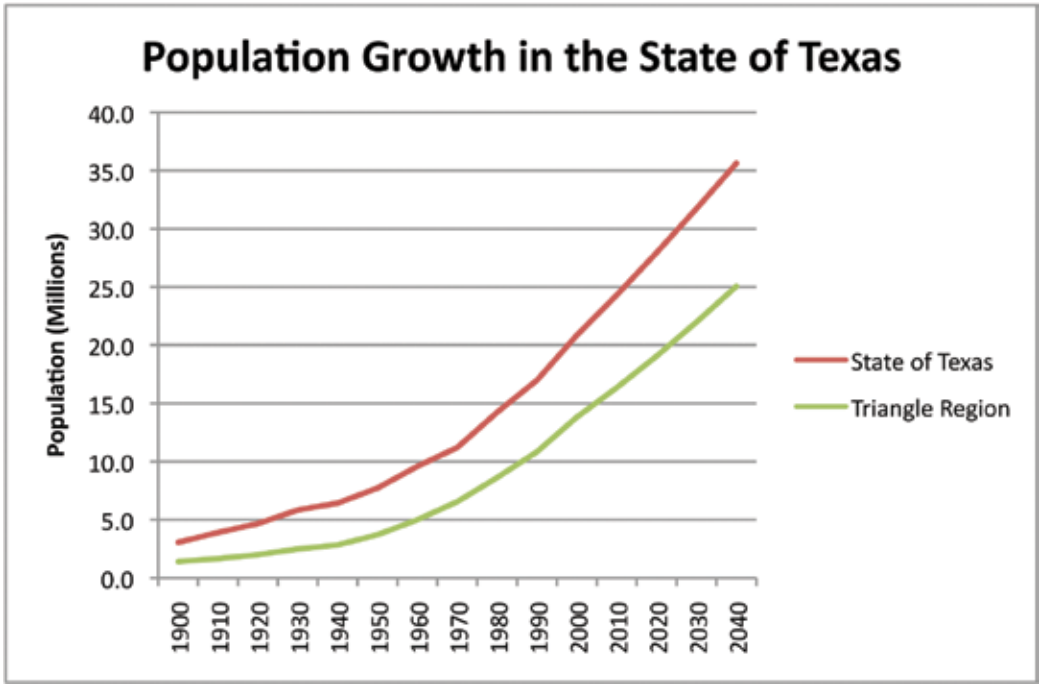


FIGURE 5
Actual and projected population growth in the Texas Triangle and the State of Texas (Texas Association of Counties, US Census).

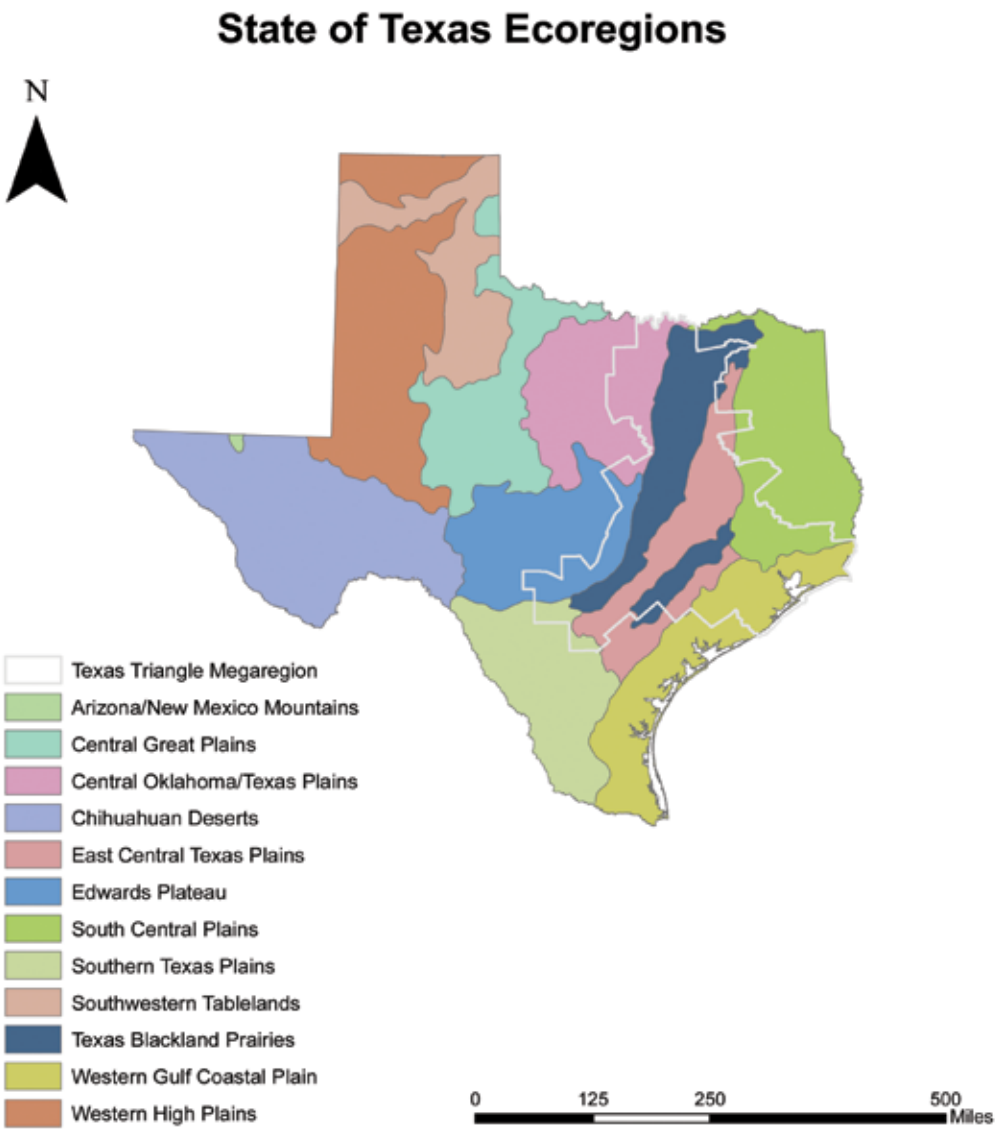


FIGURE 6 State of Texas ecoregions, as defined by the Environmental Protection Agency (Map produced by authors with data from the EPA).

GROWTH PRESSURES

While the population of the United States is projected to double between 2000 and 2100, the population of Texas is projected to increase by about 2.5 times (Nelson 2007). This rapid growth is putting enormous pressures not only on land development but on the natural resources of the state. Figure 4 shows the growth patterns of the Texas Triangle Megaregion compared to the entire State of Texas; clearly the 66 counties that comprise the Texas Triangle, out of 254 counties in the state, account for the majority of the state's population. The need for planning at the megaregional level, to direct the growth to preferred areas in order to reduce land consumption and environmental pressures, is clear. Suburban sprawl is a big issue in the State of Texas, which is not surprising due to having such a huge land area. In fact, the size of the city of Houston is equal to the land area of the cities of Boston, Denver, Las Vegas, Orlando, San Francisco and Philadelphia combined.

The State of Texas is fortunate to have an abundance of natural resources, including many critical resources being located within the Texas Triangle. The metros of Dallas, Austin and San Antonio are located in and along the interface between the Blackland Prairie and Edwards Plateau. The Blackland Prairie ecoregion is a highly fertile and

agriculturally productive province, comprised of fine textured clay soils and only small remnants of a formerly extensive natural prairie. There is still a considerable portion of agriculture land, although urban and industrial growth and development is a persistent challenge to the preservation of the region's intrinsic resources. The Edwards Plateau ecoregion is located south and west of Austin and San Antonio, characterized by hilly limestone terrain that is dissected by many spring-fed streams of tremendous ecological, recreational and aesthetic value. The Balcones Fault Zone and Escarpment provides a sharp delineation of the plateau ecoregion from the prairielands to the east. The native vegetative cover is diverse and largely evergreen, with juniper and live oak. Most of the region is used for livestock and wildlife management, including hunting. Together these resources and their associated amenities provide critical support to the economic stability of the metro areas. Water supplies are developed in the upstream regions immediately west and north of the metros. Agricultural, mining and other resource-based industries provide a base for many dozens of smaller communities located in between the metros. Increasingly, with improved transportation and telecommunication infrastructure, the interstitial zones between the metros are encountering intensive growth and development pressures.

The Houston metro and associated communities closer to the Gulf Coast are situated in the Gulf Coastal Plain ecoregion. The terrain is very flat and covered mainly in grassland, with forest or savannah-type vegetation in areas further inland. A very large proportion of the ecoregion is cropland. Urbanization and industrial development are the primary agents of change in land use in this region. The Houston metro's population, for example, is expected to grow beyond 8 million in the next 25 years. Figure 6 illustrates the locations of these ecoregions in the context of the Texas Triangle.

ECONOMIC LINKAGES AND DIVERSITY

Not only is the population of the Texas Triangle megaregion expected to grow, it is expected to become more diverse in racial composition. The Hispanic population of the region is nearly 30 percent, compared to less than 15 percent for the country as a whole (Figure 7). By 2040, the Hispanic population in Texas is projected to grow exponentially compared to the total population (Figure 8). Along with the diversity in race, the State of Texas also has a higher poverty concentration than the entire United States. Figure 9 shows the percent of families below the poverty level for the four MSA clusters compared to the nation as a whole.

Not only does the region need to pay attention to the typical challenges that come with population growth, such as infrastructure improvements, health care and education, but the racial diversity and associated poverty levels must also be addressed in order to ensure equality in the regional planning process.

Additionally the megaregion is still highly dependent on the oil and gas industry, and its leaders will need to find ways to increase the economic diversity of the region. The role of planning differs throughout the region, posing a challenge to an overarching megaregion planning organization form of government. Houston, for example, does not have zoning while Austin is generally regarded as a planning innovator.

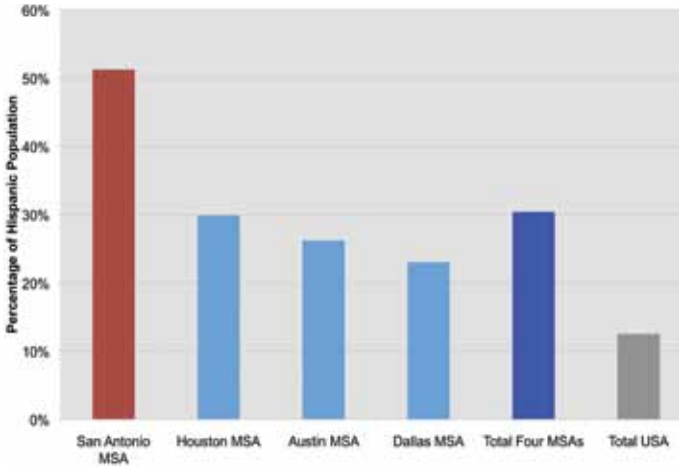


FIGURE 7
Percentage of Hispanic population by metropolitan statistical area (MSA), total for the Texas Triangle MSAs and total for the United States (Texas State Data Center, Census 2000).

FIGURE 8
Projected Hispanic population growth by 2040 for each MSA and the State of Texas compared to the total population growth for the same areas (Texas State Data Center using 2000-2002 migration scenario).

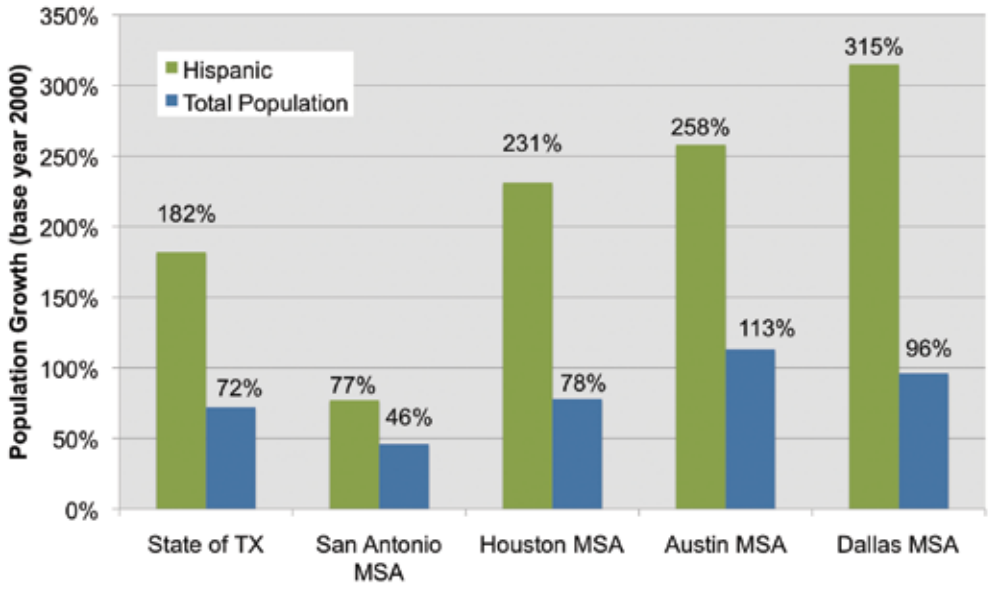
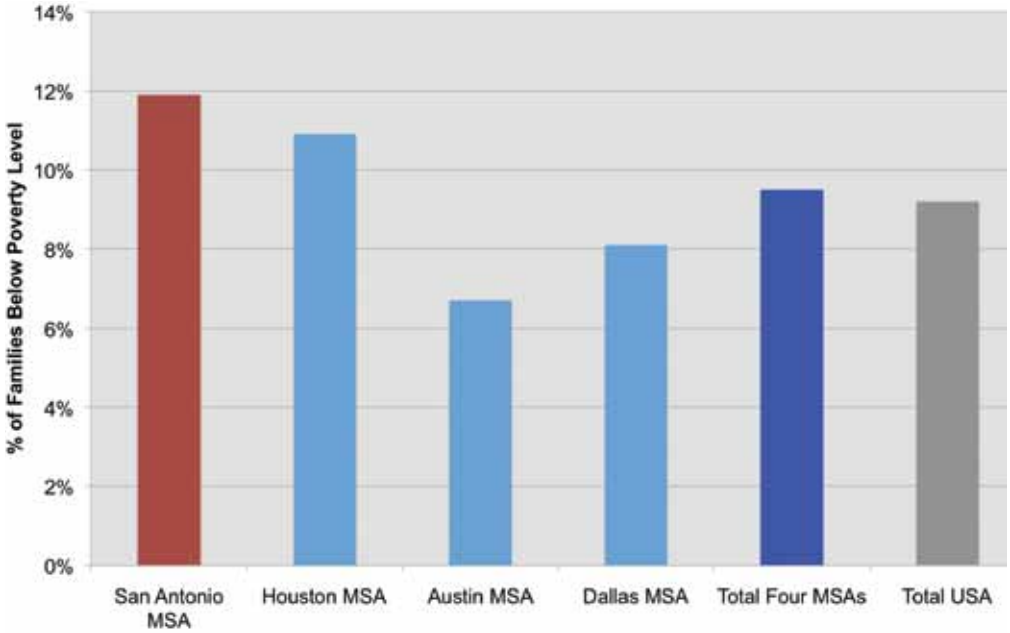


FIGURE 9 Percent of families below poverty level by MSA, total for the Texas Triangle MSAs and total for the United States (Census 2000).



TRANSPORTATION CONGESTION AND INFRASTRUCTURE

Another challenge is connectivity within the megaregion. Currently, the Texas Triangle is dominated by automobile, truck and air transportation systems. Development of late 20th century metropolitan regions was made possible by the construction of interstate highways, which are uniquely suited to serve urban regions stretching 30-80 miles across.

A related challenge concerns the restoration of infrastructure while building new projects for an expanding population. New roadways, bridges, parks, water and sewer lines, utility plants and wastewater treatment facilities will be needed for this first urban Texas century. This transformation has significant consequences for the people of the Texas Triangle. Social equity, cultural heritage, public safety and quality of life will be impacted.

Transit ridership studies from 2002 show clearly that bus transportation is the most heavily utilized form of transit in the Texas Triangle urban areas (Table 3). Figure 10 exhibits that, in general, the Texas Triangle urban areas also lag behind most other major cities in terms of transit trips. This shows that public transit enhancements are greatly needed within the Texas Triangle, not only to help reduce the current congestion but also to improve the links between the major cities of the region.

Table 3. Transit Ridership in the Largest Urbanized Areas (2002)

Urbanized Area	Pop. (2000)	Rank by Pop.	Motor Bus	Heavy Rail	Light Rail	Commuter Rail	Other
Dallas/Fort Worth/ Arlington	4,145,659	6	77.7%	-	17%	2.7%	2.6%
Houston	3,822,509	10	97.8%	-	-	-	2.2%
San Antonio	1,327,554	30	97.7%	-	-	-	2.3%
Austin	901,920	40	98.2%	-	-	-	1.8%
United States (Total Urbanized Area)	195,984,216	-	58.4%	29.8%	3.7%	4.6%	3.5%

TABLE 3 Transit ridership mode statistics in the largest urbanized areas in Texas (USDoT Bureau of Transportation Statistics 2002).

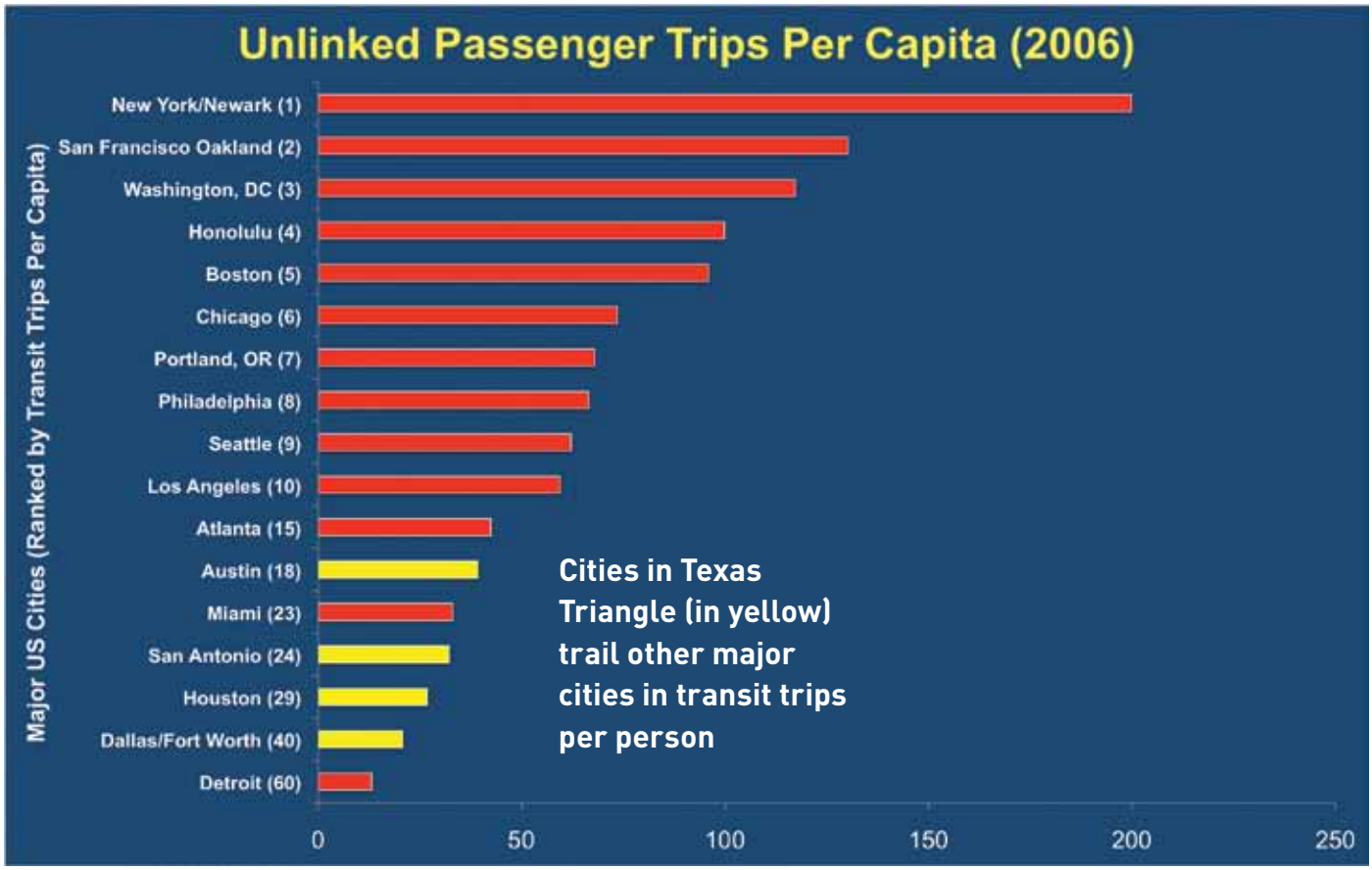


FIGURE 10
Unlinked passenger trips per capita for major US cities (National Transit Database 2006).

Strategies to Link the Megaregion

There are currently three different approaches to regional government operating within the Texas Triangle megaregion, offering a good starting point for a new megaregion planning organization. Envision Central Texas (ECT), with Austin as its major urban center, was created in 2002 and modeled after Envision Utah. Traffic congestion is the major problem in this region, and the ECT plan helped bring awareness to regional issues that resulted in the passage of a transit initiative that is funding a commuter rail line running from downtown Austin to the city of Leander to the northwest. Houston takes a more local approach to transportation and land-use issues, relying heavily on more business oriented organizations in conjunction with the Houston-Galveston Area Council which serves as the Houston area's MPO. These partnerships focus heavily on a traditional transportation process led by the MPO and implemented by corporate partners. A few smaller groups, such as Blueprint Houston and the Gulf Coast Institute, are working on smaller scales, but perhaps involving these groups in more regional issues will be a next step in the future. The Dallas/Fort Worth area, unlike the other metro regions in the triangle, is not dominated by one large city, which has brought negotiation and collaboration on regional issues to the forefront. The North Central Texas Council of Governments (NCTCOG) identified sustainable development as a regional goal in 1999 and set aside $30 million of federal funding for land-use and transportation oriented incentives, which have supported infrastructure investments for sustainable development projects. Similar to the work done in Central Texas, the Vision North Texas project is the regional visioning project in the Dallas-Fort Worth area, designed to raise awareness of the projected regional growth (Walz 2005). The existence of these three types of regional planning is encouraging, but they are currently working in isolation. In order to address the strategies described below, it is imperative that the MSA clusters work together to develop goals, strategies and policies for the Texas Triangle as a whole.

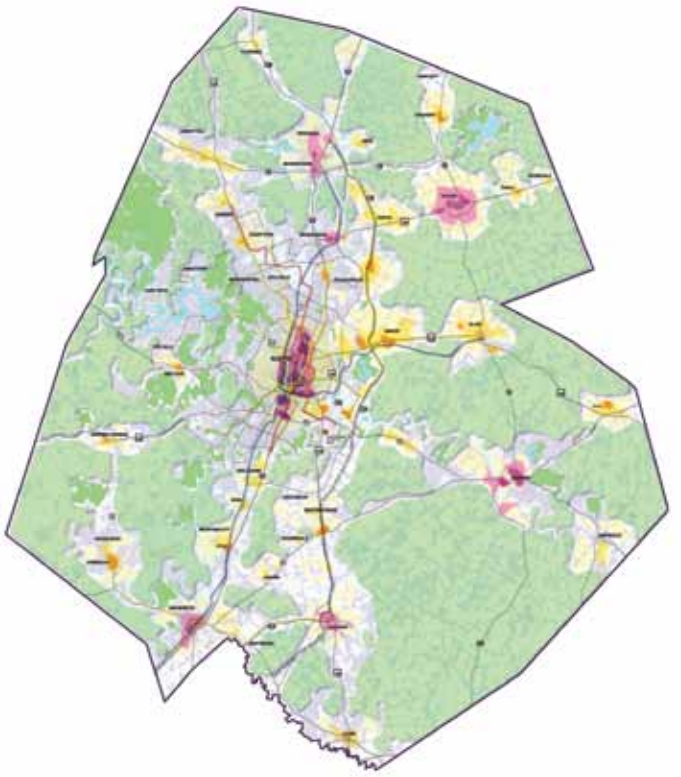


FIGURE 11
Envision Central Texas scenario for preferred growth, denoting urban centers in pink, town centers in yellow and open space preservation in green (Courtesy of Envision Central Texas 2003).

DEFINE AREAS OF PREFERRED GROWTH

In order to protect the natural resources of the area and reduce the amount of suburban sprawl, a strategy to direct growth in the region is needed. Sprawl is becoming a serious issue and will require strict policies to direct growth towards the preferred areas. ECT has defined these areas for the Austin MSA and cities within Bastrop, Hays, Caldwell, Travis and Williamson counties are utilizing the work done by ECT as a starting point when creating their visions for the future (Envision Central Texas 2009). Establishing this type of process for the entire Texas Triangle region can help all 66 counties work together to reduce sprawl, create appropriate density and protect natural resources.

CREATE A NEW TRANSPORTATION NETWORK

A megaregional approach for transportation planning in the Texas Triangle means that intercity travel between Dallas/Fort Worth, Houston, Austin and San Antonio becomes an intra-region movement. While individual MPOs provide rather detailed pictures of their areas, growth from the interactions among metropolitan areas and between metro areas is often not considered. A megaregional transportation plan should, therefore, integrate individual metropolitan transportation plans with consideration for the inter-city movement of people and goods. The State of Texas has the highest railroad mileage in the country but the rail system is currently used largely for freight. Texas also has an extensive highway system. The Trans Texas Corridor, proposed in 2002, would provide a network of multi-modal transportation corridors, extending over a distance of 4000 miles. The 1200-foot wide corridor would contain passenger lanes, truck lanes, freight rail, high speed rail, utility pipe lines and telecommunicaion lines. An update to this plan, by the Texas Department of Transportation, was unveiled in early 2009. It revised the original plan of prescriptive implementation across the state to individualized transportation projects that are tailored to regional needs (Texas Department of Transportation 2009).

Example of a high speed rail train.

FIGURE 12 Potential high speed rail corridors in the United States (Courtesy of the Federal Railroad Administration 2009).

Regardless of the direction the plans take, it is obvious that changes to the current transportation network are necessary. It will take the efforts of the entire state working together in order to provide funding for this project along with a plan that can effectively meet the growing transportation demands. Implementing new transportation modes is one way to improve some of the current transportation issues, including congestion and connectivity.

High speed rail is in discussion for regions throughout the country and Figure 12 shows the US Department of Transportation high speed rail corridors as of 2009. In Texas, the only currently defined corridor links Dallas to Austin and San Antonio, leaving Houston out of the connection within the state. In order to create a fully connected system within the Texas Triangle, high speed rail solutions must be brought to Houston as well. High speed rail in Texas is discussed further in the High Speed Rail Spotlight.

SPOTLIGHT: HIGH SPEED RAIL IN TEXAS

Transportation is a huge issue throughout the country, so it is no surprise that the State of Texas is also looking into alternatives to the highway networks that currently exist throughout the state. With the current congestion that is present on both the roads and in the air, a preferred alternative mode of travel is high speed rail.

A megaregion encompassing over 300 miles will require a new infrastructure - high speed rail (HSR). European and Asian nations have already built HSR systems, and the United States will need to do likewise. HSR should be integrated with expanded urban rail and goods movement. Within Texas, Dallas' leadership with urban rail is a positive step towards diversifying transportation, as are newer rail initiatives in Houston and Austin.

The current national plan (Figure 12) has linkages through all Texas Triangle cities, but San Antonio, Austin and Dallas/Fort Worth are on a north-south connection from Texas into Oklahoma and Arkansas, while Houston is on an east-west connection through Louisiana. An alternative to this plan, shown in Figure 13, was developed by a non-profit corporation, the Texas High Speed Rail and Transportation Corporation. This plan, also endorsed by the Texas Department of Transportation, creates the necessary HSR linkage between all the Triangle cities, and is one option of a plan that would best fit the Texas Triangle.

The federal economic stimulus plan, created in 2009, has allocated $8 billion for HSR for the entire country. This money, coupled with an additional $5 billion for HSR in the federal budget, is not enough for the entire country, but it is a step in the right direction. The Texas Triangle cities must work together to ensure that any funding for HSR in Texas is used to create an effective and intelligent system, linking all four of the metro areas.

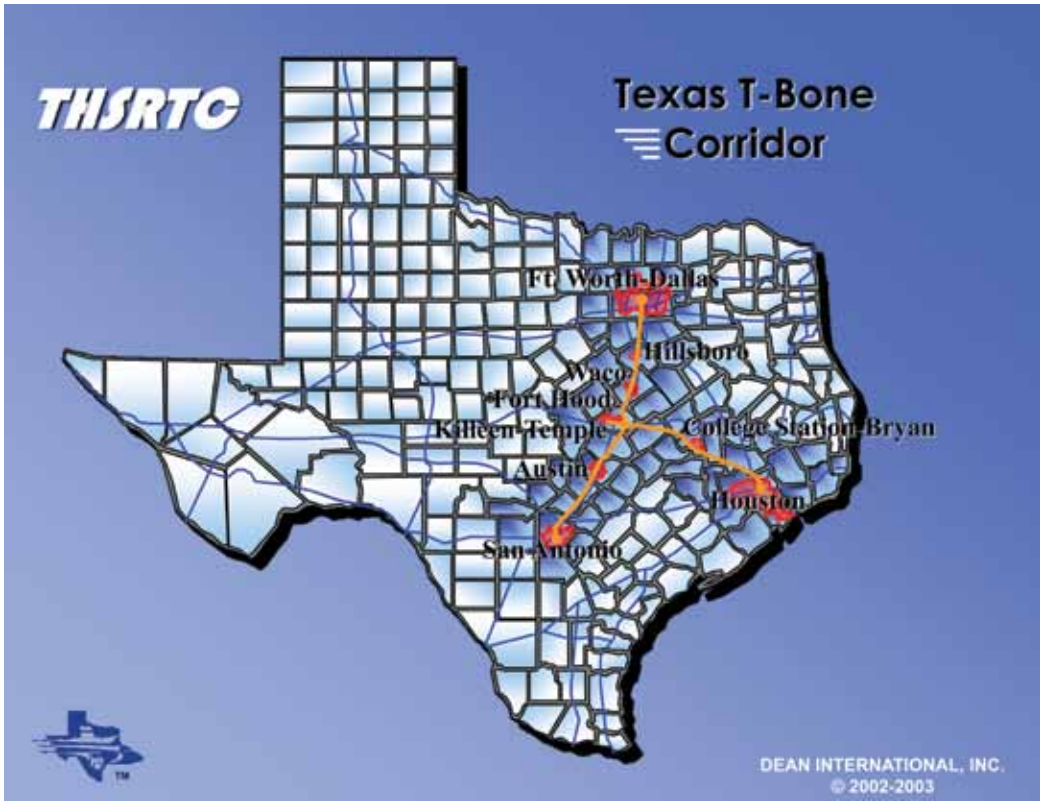


FIGURE 13
An alternative to the proposed high speed rail corridor in Texas, that links Houston to the other three metro areas (Courtesy of Dean International).

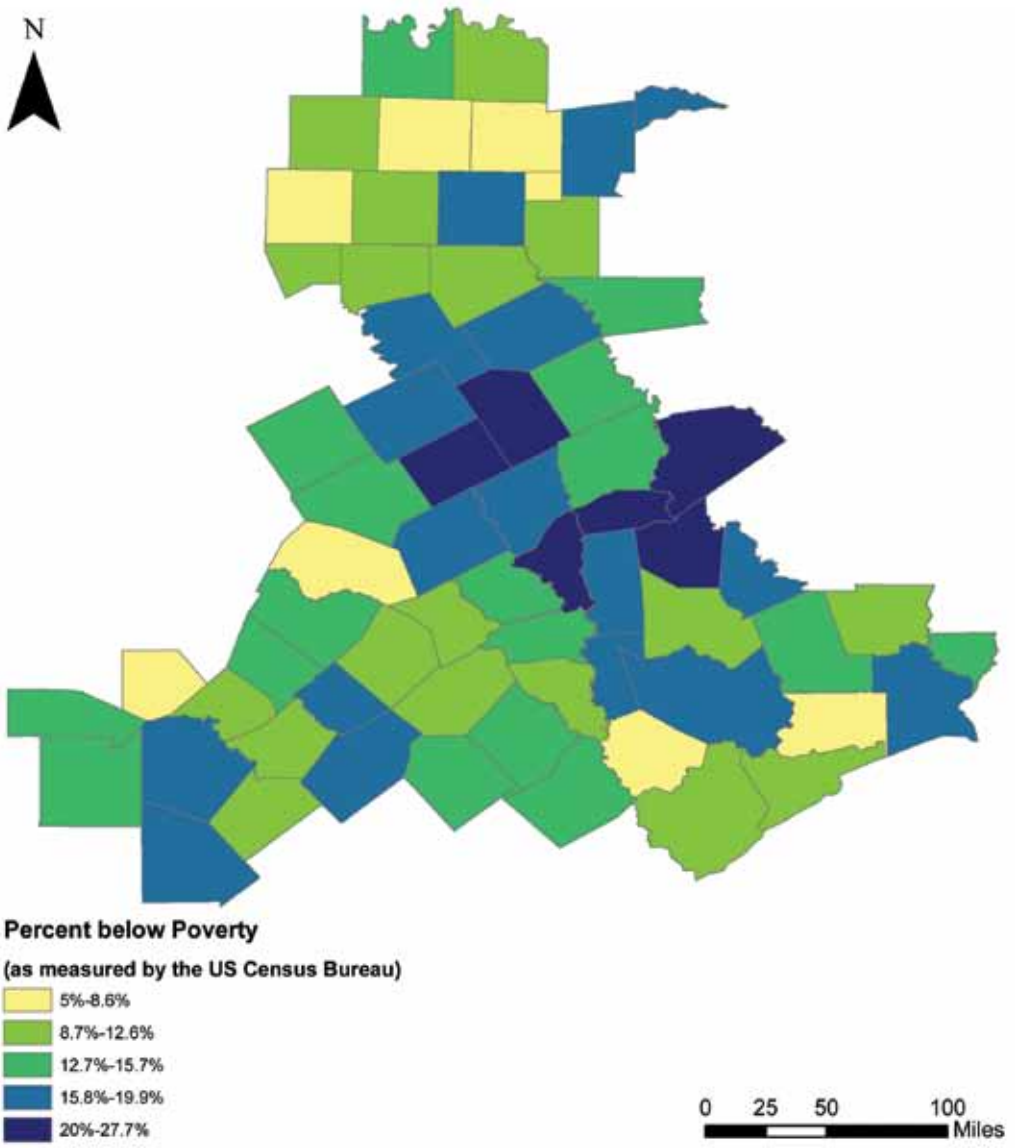


FIGURE 14
Percent of individuals below poverty in the Texas Triangle counties (Map produced by authors with data from Census 2000).

IMPROVE ECONOMIC COMPETITIVENESS

Addressing the issues of employment projections and housing supply will help keep the Texas Triangle competitive with the rest of the country. Additionally, the competitiveness within the region can be addressed through strengthening the economic linkages. Utilizing an enhanced intermodal transportation network will help address this issue. Encouraging alternative energy sources will lessen the region's dependency on the petrochemical industry, creating another layer of economic diversity.

The increasing population will likely highlight the income disparity of the region as well, and policies for more affordable housing options can make the Texas Triangle Megaregion a more attractive area of the country.

Figure 14 shows the condition of household income in the Texas Triangle Megaregion. Currently inclusionary zoning, which requires developers to make a percentage of housing units in new developments affordable to low income households, is prohibited in the State of Texas. Instead, affordable housing is an option that developers can choose if the city's incentives make it attractive to them. Regional policies that promote racial and economic integration and increased funding to acquire appropriate land for affordable housing developments can help mitigate gentrification and promote equity in housing throughout the Texas Triangle.

CONSERVE NATURAL RESOURCES

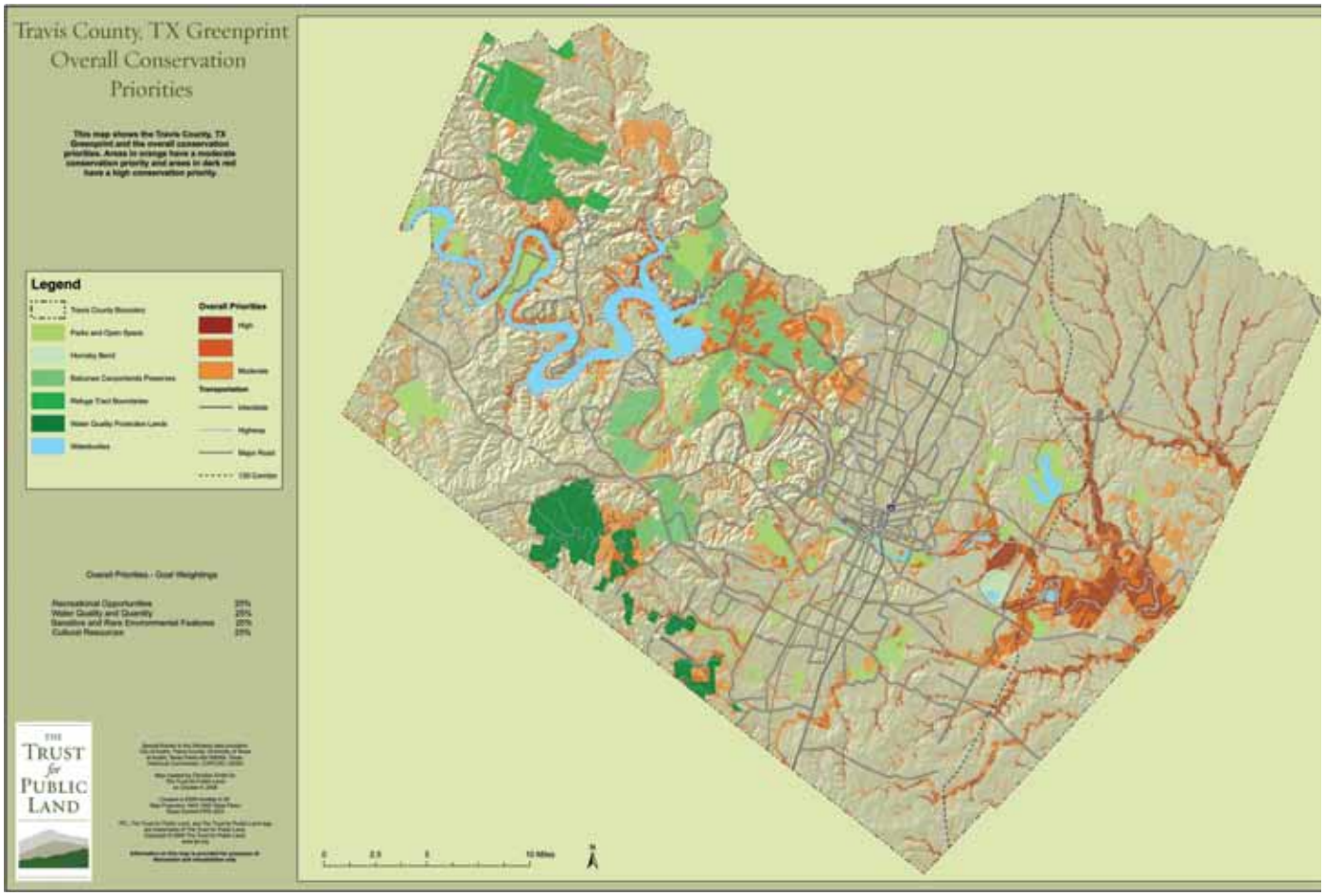
An increasing population within the Texas Triangle is already putting pressure on the many natural resources in the area. Threats to farmland and the water supply are serious concerns of suburban sprawl, and without a conservation plan in place the projected growth will only worsen this issue.

Growth strategies are critical in the effort to conserve the natural resources of the Blackland Prairie, Edwards Plateau and the Gulf Coast Plain. Directing growth away from these ecological areas and encouraging infill development needs to be discussed for the entire megaregion to ensure that the natural resources throughout the Texas Triangle are protected.

Several other strategies can help conserve the natural resources of the Texas Triangle Megaregion. Strict open space conservation policies, such as low-impact development, are necessary to help protect ecologically sensitive areas and habitats, develop recreational resources and protect hydrologically sensitive areas. Integrative water planning and management, through metro area collaboration for water supply planning, can help achieve aggressive water conservation and balance urban and in-stream flows. Additionally, greenfield development can be avoided by developing incentives and alternatives to sprawl through brownfield and infill redevelopment.

The Trust for Public Land is collaborating with counties throughout the state on greenprinting services, which uses geographic information systems (GIS) technology, demographic and geographic data and community input to assist community leaders in creating a conservation vision. The product is a map that highlights the lands that, if protected, could meet the community's conservation and growth management goals. Figure 15 shows a greenprint map for Travis County.

FIGURE 15
Travis County Greenprint map showing overall conservation priorities (Courtesy of Travis County Transportation and Natural Resources 2006).



SPOTLIGHT: WATER PLANNING IN TEXAS

Though the Texas Triangle Megaregion has a huge benefit in that it is completely within the boundaries of a single state, it is a huge challenge within the state to manage water resources. This is a current and pressing long term issue: how does Texas sustainably, equitably and efficiently manage the increased water demand that will undoubtedly arise with the projected increase in population?

Groundwater in Texas is considered private property and in order for metro areas to use this water they must purchase water rights from property owners. Surface water, on the other hand, is owned and controlled by the State of Texas. This presents a conflict between the state's ability to regulate and conserve water and the heavy reliance on ground water by each metro area. The major cities located within the Texas Triangle each have different perspectives on water conservation and usage. San Antonio relies heavily on the groundwater in the Edwards Aquifer for the water needs of the area's population and needs to find ways to reduce that dependence in order to preserve natural features and species. The Austin area has not felt the same pressures as San Antonio to reduce the consumption demand but has a great reliance on clean and abundant water for recreational use and endangered species that are connected to the Edwards Aquifer. The Dallas/Fort Worth area is facing extremely high population growth, higher than in the other metro areas, and also has the highest projected per capita water use rates in the state. Dallas/Fort Worth, like San Antonio, needs to find ways to reduce this demand. The Houston area must take into account the effect of water usage on Galveston Bay and the Gulf Coast to protect the existing habitats and maintain salinity balances between the San Jacinto River and Galveston Bay. The San Jacinto River also flows through the Houston Ship Channel, which has seen land surface subsidence due to excessive groundwater pumping in the past few decades. The groundwater/surface water struggle is another issue facing this megaregion (Texas Water Matters 2009).

Rebates for efficient appliances and fixtures, rebates for rainwater harvesting and increased outreach and education have been adopted by the City of Austin (City of Austin and LCRA 2008). San Antonio has had past success with aggressive water conservation strategies, reducing water use by 30 percent in 17 years (Texas Water Matters 2009). A conservation ordinance, passed in 2005, highlights requirements such as installation of drought-tolerant grasses in new developments, rain sensors on all in-ground sprinkler systems and regulation of charity car washes (San Antonio Water System 2009). Houston, which must focus on leaving enough water in rivers and estuaries in order to protect environmental flows and Dallas, which has had past success with water planning but is now the only major city in Texas that is projected to increase in per capita water use rather than decrease, can both look to the examples set by Austin and San Antonio in developing strategies and ordinances regarding water conservation. The creation of a megaregion planning organization can help unite strategies throughout the Texas Triangle.

FIGURE 16
Major aquifers across the State of Texas (Courtesy of Texas Water Development Board).

Moving Towards the Future

The implications of a megaregion approach for the Texas Triangle are profound for planning and policy making in general and for developing transportation infrastructure specifically. A critical starting point in formulating spatial development strategies for this megaregion is our future. We ought to have a vision for the future first, and then connect it with the past through the present. Some triangle metros, such as the Central Texas (the Austin Area) and North Texas (the Dallas/Fort Worth area), have embarked on ambitious visioning exercises. So should the Texas Triangle Megaregion. Several metros have also created rail systems, including Dallas, Houston and Austin. However, with the exception of Dallas/Fort Worth, intercity passenger rail systems are absent. To fully realize its potential, the Texas Triangle cities should be connected with passenger rail systems. Megaregional strategies require the cooperation of the entire Texas Triangle. Natural resource conservation is influenced by growth strategies; economic development is influenced by the transportation network; and the transportation network is influenced by growth strategies. These strategies are all interconnected, much like the region must be in order to address the challenges moving forward.

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