

5-5667-01-P3

Suitability Analysis Guidebook/Training Materials: Manual for Application of Suitability Analysis for a Selected Region in Texas

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Project 5-5667-01: Implementation of Accessible Land Use Modeling Tools for Texas Applications

AUGUST 31, 2010

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Performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration.

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Section I: Background and Application Process

1. Background

This Guidebook is prepared as part of Task 2 of implementation project 5-5667, which focuses on the development of a prototype application of the Suitability Analysis model using GIS for a selected region in Texas. It is organized into two sections. Section I provides a description of the study area and background information on data collection and analysis process. Section II introduces a prototype model with a step-by-step process to run it. Appendices to the Guidebook give additional details about each component of the model along with the required data and GIS tools to run the model, and results of each step.

2. Study Area

We selected the Austin Region for the development of a prototype application model using Suitability Analysis. The study region is comprised of three counties (Hays, Travis, and Williamson) out of the five counties that are within the Austin–Round Rock–San Marcos metropolitan area.

3. Process

As mentioned in the report, this model follows a four-step process.

- 1) Projection of Employment and Households
- 2) Calculation of Required Land
- 3) Suitability Analysis
- 4) Allocation of Employment and Households

Projection of Employment and Household

3.1.1 Data

Table 3.1 shows types of employment and household data with their sources collected for this study.

| Data Type | Year | Source |
|---------------------------------------|---------------------|--|
| Population and households | 2005 | U.S. Census Bureau |
| Population and households | 2014 projected | ESRI |
| Population | 2005-2040 projected | Texas State Data Center |
| Average parcel size for each land use | | CAPCOG data clearinghouse |
| Total employment projections | | Austin's Capital Area Metropolitan Planning Organization (CAMPO) |
| Employment (2 digit NAICS) | 2009 | Texas Comptroller Office |
| Employment Estimation (4 digit NAICS) | 2006 | Texas Workforce Commission |
| Employment Projection (4 digit NAICS) | 2016 | Texas Workforce Commission |
| Employment Estimation (2 digit NAICS) | 2008 | ESRI Business Analyst |
| Employment Projection (2 digit NAICS) | 2013 | ESRI Business Analyst |

Table 3.1: Data Types and Sources

After collecting required data for employment and household, this data was classified into different categories.

3.1.2 Employment Classification

For this study purpose, 17 categories of employment were developed based on the data collected from Texas Workforce Commission for 2006. This report consolidated 4-digit NAICS codes into the 2-digit NAICS categories.

Table 3.2 shows 2-digit NAICS employment categories with percentage of employees in each category for all three counties (Hays, Travis, and Williamson) for 2006. The purpose of showing employment categories in percentage is to break down total projected employment data from CAMPO into 2-digit NAICS categories for each projection year.

| Employment Categories Employment Percentage | | | centage |
|---|-------|--------|------------|
| | Hays | Travis | Williamson |
| Accommodation and Food Services | 7.80 | 8.30 | 7.80 |
| Administrative and Support and Waste Management and Remediation Services | 6.30 | 14.80 | 6.30 |
| Agriculture, Forestry, Fishing and Hunting | 0.80 | 0.10 | 0.80 |
| Arts, Entertainment, and Recreation | 1.50 | 1.90 | 1.50 |
| Construction | 15.30 | 10.6 | 15.30 |
| Educational Services | 47.50 | 37.40 | 47.50 |
| Finance and Insurance | 3.00 | 3.20 | 3.00 |
| Health Care and Social Assistance | 3.50 | 3.90 | 3.50 |
| Information | 0.00 | 0.60 | 0.00 |
| Manufacturing | 3.50 | 7.20 | 3.50 |
| Other Services (except Public Administration) | 1.60 | 1.60 | 1.60 |
| Professional, Scientific, and Technical Services | 1.70 | 3.60 | 1.70 |
| Real Estate and Rental and Leasing | 0.40 | 0.70 | 0.40 |
| Retail Trade | 6.90 | 4.90 | 6.90 |
| Transportation and Warehousing | 0.00 | 0.60 | 0.00 |
| Utilities | 0.3 | 0.00 | 0.3 |
| Wholesale Trade | 0.40 | 0.50 | 0.40 |
| Total | 100% | 100% | 100% |

Table 3.2: Employment Categories in Percentage

Average area per employee needs to be calculated to find out how much land would be required for projected employment. Average area per employee was calculated by dividing the existing area with the number of employees in every 2-digit NAICS category. Table 3.3 shows average area per employment in square foot for Hays County. Average area for Travis and Williamson County can be calculated similarly.

| Employment Categories | Number of Employment | Area (Sq.Ft) | Area per Employment (Sq.Ft) |
|---|-------------------------|-----------------|-----------------------------------|
| Accommodation and Food Services | 4,786 | 2,548,750 | 532.54 |
| Administrative and Support and Waste Management and Remediation Services | 587 | 776,250 | 1,322.40 |
| Agriculture, Forestry, Fishing and Hunting | 101 | 296,250 | 2,933.17 |
| Arts, Entertainment, and Recreation | 637 | 1,032,500 | 1,620.88 |
| Construction | 3,238 | 3,520,000 | 1,087.09 |
| Educational Services | 5,460 | 4,170,000 | 763.74 |
| Finance and Insurance | 753 | 940,000 | 1,248.34 |
| Health Care and Social Assistance | 3,537 | 3,395,000 | 959.85 |
| Information | 630 | 1,250,000 | 1,984.13 |
| Manufacturing | 3,413 | 3,562,500 | 1,007.14 |
| Other Services (except Public Administration) | 1,894 | 3,958,750 | 2,090.15 |
| Professional, Scientific, and Technical Services | 1,626 | 2,377,500 | 1,462.18 |
| Real Estate and Rental and Leasing | 1,215 | 3,133,750 | 2,579.22 |
| Retail Trade | 1,928 | 1,711,250 | 887.58 |
| Transportation and Warehousing | 665 | 1,088,750 | 1,637.22 |
| Utilities | 157 | 487,500 | 3,105.10 |
| Wholesale Trade | 1,810 | 3,157,500 | 1,744.48 |

Table 3.3: Average Area per Employment

Employment was categorized into basic and service sectors using the result of Location Quotient Technique. The following formula was used to calculate the number of basic sector employment for Hays County. The same formula can be used to calculate the number of basic sector employment for other counties or areas.

| | Hays County | | |
|---------------------------|---------------------|-------------------|------------------------------|
| | Employment | Total Hays County | |
| Basic Sector Employment = | Industry | Employment | X Toyac Employment Inductory |
| | Texas | Total Texas | × Texas Employment muustry |
| | Employment Industry | Employment | |

Table 3.4 shows basic and service sector employment in Hays County for the year 2005 and 2010.

| Employment Categories | 2005 | | 2010 | |
|---|-------|---------|-------|---------|
| | Basic | Service | Basic | Service |
| Accommodation and Food Services | 0 | 3,227 | 0 | 3,855 |
| Administrative and Support and Waste Management and Remediation Services | 0 | 2,625 | 0 | 3,189 |
| Agriculture, Forestry, Fishing and Hunting | 0 | 0 | 0 | 0 |
| Arts, Entertainment, and Recreation | 0 | 638 | 0 | 749 |
| Construction | 849 | 5,496 | 1,107 | 6,482 |
| Educational Services | 3,191 | 16,453 | 3,698 | 20,242 |
| Finance and Insurance | 0 | 1,247 | 0 | 1,445 |
| Health Care and Social Assistance | 0 | 1,458 | 0 | 1,772 |
| Information | 0 | 15 | 0 | 15 |
| Manufacturing | 22 | 1,443 | 95 | 1,613 |
| Other Services (except Public Administration) | 67 | 608 | 86 | 697 |
| Professional, Scientific, and Technical Services | 0 | 711 | 0 | 861 |
| Real Estate and Rental and Leasing | 0 | 181 | 0 | 209 |
| Retail Trade | 939 | 1,903 | 1,142 | 2,201 |
| Transportation and Warehousing | 0 | 0 | 0 | 0 |
| Utilities | 20 | 111 | 13 | 121 |
| Wholesale Trade | 0 | 145 | 0 | 162 |

Table 3.4: Basic and Service Employment in Hays County

3.1.3 Household Classification

The household (single family and multifamily) classification of the study area was categorized into three groups as shown in Table 3.5 based on household income level. Such categorization of household is required for input in TDM.

| Table 5.5. Household Categories | | |
|---|-----------------|--|
| Household Income Level (in U.S. Dollars) | Income Category | |
| <50,000 | Low Income | |
| 50,000 - 99,999 | Medium Income | |
| >100,000 | High Income | |

Table 3.5: Household Categories

Table 3.6 shows total number of households with income categories in Hays County for 2005 and 2010.

| Table 5.0: Households in Hays County | | | | | | | |
|--------------------------------------|--------|--------|--|--|--|--|--|
| Income Category | 2005 | 2010 | | | | | |
| Low Income | 24,197 | 25,430 | | | | | |
| Medium Income | 15,135 | 22,084 | | | | | |
| High Income | 8,160 | 14,851 | | | | | |
| Grand Total | 47,492 | 62,365 | | | | | |

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By adding the number of households with income categories of Hays, Travis, and Williamson County, we have the total number of households with income categories for the entire study area.

| Income Category | 2005 | 2010 | | | |
|-----------------|---------|---------|--|--|--|
| Low Income | 232,370 | 205,998 | | | |
| Medium Income | 176,815 | 225,196 | | | |
| High Income | 73,934 | 130,494 | | | |
| Grand Total | 483,119 | 561,687 | | | |

Table 3.7: Households of the Study Area

Required Land

Required land is the amount of land that is needed to accommodate future/projected employment and household. To calculate the future required land, we needed the average land area for each employment and household categories. This data was obtained from parcel data provided by CAPCOG.

3.1.4 Required Land for Employment

Table 3.8 shows the required land for both basic and service sector employment for the year 2010 for Hays County. To get the required land for basic and service sector employment: 1) find the difference between the number of employment for 2005 and 2010 for both basic and service sectors by using data from Table 3.4, and 2) multiply the difference with the average area per employment as shown in Table 3.3.

| Employment Categories | Growth 2 | 2005-2010 | Required Land (Sq.Ft) | | |
|--|----------|-----------|--------------------------|-----------|--|
| | Basic | Service | Basic | Service | |
| Accommodation and Food Services | 0 | 628 | 0 | 334,463 | |
| Administrative and Support and Waste Management and Remediation Services | 0 | 564 | 0 | 745,797 | |
| Agriculture, Forestry, Fishing and Hunting | 0 | 0 | 0 | 0 | |
| Arts, Entertainment, and Recreation | 0 | 111 | 0 | 179,990 | |
| Construction | 258 | 987 | 800,673 | 3,063,549 | |
| Educational Services | 507 | 3,789 | 387,004 | 2,893,702 | |
| Finance and Insurance | 0 | 198 | 0 | 247,284 | |
| Health Care and Social Assistance | 0 | 315 | 0 | 302,081 | |
| Information | 0 | 1 | 0 | 1,364 | |
| Manufacturing | 74 | 170 | 87,959 | 194,399 | |
| Other Services (except Public Administration) | 20 | 90 | 41,710 | 187,227 | |
| Professional, Scientific, and Technical Services | 0 | 150 | 0 | 219,377 | |
| Real Estate and Rental and Leasing | 0 | 28 | 0 | 72,177 | |
| Retail Trade | 202 | 297 | 223,750 | 327,560 | |
| Transportation and Warehousing | 0 | 0 | 0 | 0 | |
| Utilities | -7 | 10 | -6,101 | 8,692 | |
| Wholesale Trade | 0 | 17 | 0 | 16,173 | |

Table 3.8: Required Land for Employment in Hays County

Table 3.9 shows the total required land for basic and service sector employment of the entire study area. It was obtained by adding required land for basic and service sector employment of Hays, Travis, and Williamson County.

| Employment Categories | Required Land (Sq.Ft) | | | |
|--|------------------------------|------------|--|--|
| | Basic | Service | | |
| Accommodation and Food Services | 266,572 | 266,448 | | |
| Administrative and Support and Waste Management and Remediation Services | 1,580,969 | 5,451,375 | | |
| Agriculture, Forestry, Fishing and Hunting | | | | |
| Arts, Entertainment, and Recreation | 151,756 | 1,382,763 | | |
| Construction | 1,473,996 | 11,229,201 | | |
| Educational Services | 1,735,968 | 31,467,342 | | |
| Finance and Insurance | 0 | 1,145,659 | | |
| Health Care and Social Assistance | 0 | 2,347,173 | | |
| Information | -354,996 | 237,304 | | |
| Manufacturing | -859,341 | 841,043 | | |
| Other Services (except Public Administration) | 105,826 | 990,066 | | |
| Professional, Scientific, and Technical Services | 688,862 | 1,774,061 | | |
| Real Estate and Rental and Leasing | 0 | 658,817 | | |
| Retail Trade | 956,184 | 3,104,811 | | |
| Transportation and Warehousing | 0 | 56,919 | | |
| Utilities | -7,677 | 64,662 | | |
| Wholesale Trade | 85,208 | 308,845 | | |
| Grand Total | 5,823,329 | 63,726,487 | | |

Table 3.9: Required Land for Employment in the Study Area

3.1.5 Required Land for Household

Based on the result of the regression analysis (for census block groups data of the study area with variables: total number of low income, medium income and high income, sum of area of single family, sum of area of multifamily, and total count of single family), we derived a formula (Table 3.10) to calculate the required land for household. Table 3.11 shows the required land for household of the study area.

| Income Category | Area for | | | | | | |
|--------------------|-------------|---|---------|---|-----------|---|------------|
| Low | MF | | 2021.1 | | | - | 9378.4 |
| Income | SF | _ | 2234.4 | v | Change in | | 11836006.9 |
| Medium | MF | = | 1221.7 | Λ | Household | | 402759.4 |
| Income | SF | | 31167.2 | | | + | 4828423.1 |
| High | MF | | 888.6 | | | | 583922.5 |
| Income | SF | | 45120.5 | | | | 6300425.4 |

Table 3.10: Formula from Regression Analysis

| Income Category | 2005 | 2010 | Change | Required Land (Sq.Ft) | | |
|--------------------|---------|---------|---------|-----------------------|-------------|--|
| | | | | Single Family | Multifamily | |
| Low Income | 232,370 | 205,998 | -26,373 | -1,183,641,079 | -22,850,703 | |
| Medium Income | 176,815 | 225,196 | 48,381 | 621,940,250 | 97,773,923 | |
| High Income | 73,934 | 130,494 | 56,560 | 1,767,634,394 | 69,501,686 | |
| Grand Total | 483,119 | 561,687 | 78,568 | 1,205,933,565 | 144,424,906 | |

Table 3.11: Total Required Land

Note: Negative (-) sign indicates loss of projected household and required land.

Suitability Analysis

Suitability analysis is a 4-step process.

- 1. Selection of Suitability Factors
- 2. Selection of Land uses
- 3. Range of Buffer
- 4. Rating and Weighting

3.1.6 Selection of Suitability Factors

Suitability factors—both natural environmental and built environmental—need to be selected for suitability analysis. Selection of suitability factors is subjective and depends upon the purpose and the location of the study area. Table 3.12 shows the selected suitability factors for this study.

| Table 5.12. Selected Suitability Factors | | | | | |
|---|----------------------------|--|--|--|--|
| Natural Environmental | Built Environmental | | | | |
| Water Bodies | Highways | | | | |
| Wetlands | Intersections | | | | |
| Texas Ecological Assessment Protocol (TEAP) | Employment Centers | | | | |
| Karst (geological formations with aquifers, also a habitat for some endangered species) | Airports | | | | |
| | Existing Land use | | | | |

Table 3.12: Selected Suitability Factors

3.1.7 Selection of Land uses

Identifying land uses for the suitability analysis was based on employment and household categories. Selection of land uses is also subjective and depends upon the purpose and location of the study area. Table 3.13 shows the selected land uses for this study.

| Use Categories | Activities |
|--|---|
| Single-Family residential (SF) | |
| Multi-Family residential (MF) | |
| Basic Low Commercial (BLC) Service Low Commercial (SLC) | Offices, assisted living, day care, retail sales and services, restaurants, banks, nursery or greenhouse, grocery sales, pharmacies, fitness centers, dance and music academies, artist studio, colleges and universities, bed and breakfast. |
| Basic High Commercial (BHC) Service High Commercial (SHC) | Any use in Low Commercial plus bar, nightclub, entertainment venues, hospital, hotel, liquor store, office/warehouse, vehicle and equipment sales, leasing and repair, furniture sales, pet shop, wholesale activities. |
| Basic Light Industrial (BLI) Service Light Industrial (SLI) | Any use in HC plus commercial laundry, contractor storage yard, lumber yards, indoor manufacture, assembly and processing, mini-warehouse, RV, trailer and boat storage, SOB's, testing and research, warehouse and distribution, wholesale, wrecker impoundment. |
| Basic Heavy Industrial (BHI) Service Heavy Industrial (SHI) | Any use in LI plus outdoor manufacture, assembly and processing. |
| Open Space (OS) | City parks, pocket parks, community gardens, outdoor recreational areas, natural areas, environmentally sensitive areas, greenways |

3.1.8 Suitability Factors' Categories

Proximity/accessibility to the suitability factors was used to determine the location of future development. Proximity/accessibility was defined by buffer ranges around each factor. Buffer values are included in the rating table. Table 3.14 shows a range of buffers for the selected suitability factors.

| Factors | Analysis | Suitability Factors' Categories | | | |
|------------------------------|------------------------|---|--|--|--|
| Highway | Proximity | 50, 200, 500, 1000, 2000, 10000 feet | | | |
| Intersection | Accessibility | 0.5, 1, 2, 3 miles | | | |
| Employment Centers | Accessibility | 1000, 5000, 10000, 15000, 20000 feet | | | |
| Shopping Centers | Accessibility | 1000, 5000, 10000, 15000, 20000 feet | | | |
| Airport | Accessibility | 1000, 5000, 10000, 15000, 20000 feet | | | |
| Karst | Assignment Features | zone 1, zone 2, zone 3 | | | |
| Endangered Species Proximity | | 328, 984, 2296, 4921 feet | | | |
| Water Bodies | Proximity | 98, 328, 656, 3280 feet | | | |
| Wetlands | Proximity | 98, 328, 918, 3280 feet | | | |
| TEAP Assignment Raster | | 1, 10, 25, 50 (in percent of the total area) | | | |
| Existing Land use | Assignment | Vacant Lots and Tracts, Qualified Agricultural Land, Farm and Ranch Improvements (because we want to focus on undeveloped areas) | | | |

Table 3.14: Suitability Factors' Categories

3.1.9 Rating

Each of the suitability factors' categories was rated based on its suitability for each land use with a scale of -10 to 10. A sample rating table for the suitability factor "Highway" is shown in Table 3.15. Columns "Buffer_From" and "Buffer_To" show the range of buffers. Green columns show different land use categories by way of their ratings with respect to a range of buffers.

| | | | | | T | 0 | | | | | |
|-------------|-----------|-----|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Buffer_From | Buffer_To | MF | SF | BHC | BHI | BLC | SHC | SHI | SLC | SLI | OS |
| 0 | 50 | -10 | -10 | 10 | -5 | 10 | 10 | -5 | 10 | -4 | 2 |
| 50 | 200 | -5 | -7 | 10 | 0 | 10 | 10 | 0 | 10 | 0 | 4 |
| 200 | 500 | 0 | -3 | 7 | 2 | 5 | 8 | 4 | 5 | 3 | 1 |
| 500 | 1000 | 1 | 0 3 6 0 3 6 0 5 | | | | | 5 | 0 | | |
| 1000 | 2000 | 2 | 1 | 0 | 8 | -2 | 0 | 8 | -5 | 1 | 0 |
| 2000 | 10000 | 5 | 3 | -4 | -2 | -3 | -4 | -3 | -3 | -5 | -10 |

 Table 3.15: Sample Rating Table

For this study, rating tables for all the selected suitability factors were created in Microsoft Access as ".mdb" file, as shown in Figure 3.1.

| C | | Table To | ols | Rating : Da | atabase (Access 200 | 2 - 2003 file for | mat) (Read-Only) - N | licrosoft Access |
|-------------------------------|---------------------|----------------------|---------------------|----------------------|---|--------------------------------------|----------------------|------------------|
| Home Create Extern | nal Data Databa | se Tools Datash | eet | | | | | |
| View View View | Calibri B I U | * 11 * E | | Refrest | In New Σ To Save ♥ Sp X Delete - In M | otals 2↓ 5 pelling 2↓ fore + 2 | V Selection * | Find Sele |
| Views Clipboard 🕫 | | Font | TS R | ich Text | Records | | Sort & Filter | Find |
| Read-Only This database f | has been opened rea | d-only. You can only | change data in link | ed tables. To make d | design changes, save a | copy of the datab | ase. Save As | |
| Tables 🎄 | ID | - Buffer_From - | Buffer_To 🔹 | Distance_HV - | Field1 • | MF + | BHC - SI | F + BI |
| Acs_Air | | 1 0 | 50 | 50 | 50 | -10 | 10 | -10 |
| Acs Emp | | 2 50 | 200 | 200 | 200 | -5 | 10 | -7 |
| Acs Ints | | 3 200 | 500 | 500 | 500 | 0 | 7 | -3 |
| Are Sha | | 4 500 | 1000 | 1000 | 1000 | 1 | 3 | 0 |
| Acs_shp | | 5 1000 | 2000 | 2000 | 2000 | 2 | 0 | 1 |
| Dist_HW | | 6 2000 | 10000 | 10000 | 10000 | 5 | -4 | 3 |
| Karst | | | | | | | | |
| LU_Inv | | | | | | | | |
| Prox_ESp | | | | | | | | |
| Prox_Wat | | | | | | | | |
| Prox_Wet | | | | | | | | |
| TEAP | | | | | | | | |

Figure 3.1: Screenshot of Rating Table in Microsoft Office Access Note: Any land use that is rated "-11" is considered "null" and masked.

3.1.10 Weighting

For calculating each factor's weight, the AHP model was used. Therefore, all factors were compared with each other in a pair-wise comparison matrix, which is a measure to express the relative preference among the factors. Each factor was weighted expressing a judgment of the relative importance or preference of one factor against other as tabulated in .dbf format (shown in Figure 3.2).

| ID | Field12 | Field1 | Field2 | - Field3 | Field4 | Field5 | Field6 | Field7 | - Field8 | - Field9 | Field10 | Field11 |
|----|-----------------------------|----------------------------|----------------------------|----------|----------------------------|----------------------------|----------------------------|----------------------------|----------|----------|-----------------------------|-----------------------------|
| | 1 | Prox_Esp | Prox_Wat | Prox_Wet | TEAP | Karst | Acs_Air | Acs_Emp | Acs_Ints | Acs_Shp | Dist_HW | LU_Inv |
| | 2 Prox_Esp | 1 | | | | | | | | | | |
| | 3 Prox_Wat | 9 | 1 | | | | | | | | | |
| | 4 Prox_Wet | 7 | 0.5 | 1 | | | | | | | | |
| | 5 TEAP | 2 | 0.5 | 1 | 1 | | | | | | | |
| | 6 Karst | 2 | 0.5 | 3 | 2 | 1 | | | | | | |
| | 7 Acs_Air | 9 | 3 | 3 | 5 | 7 | 1 | | | | | |
| | 8 Acs_Emp | 9 | 7 | 3 | 2 | 5 | 0.25 | 1 | | | | |
| | 9 Acs_Ints | 9 | 4 | 3 | 3 | 7 | 0.5 | 5 | 1 | | | |
| | 10 Acs_Shp | 9 | 1 | 7 | 7 | 9 | 2 | 3 | 0.5 | 1 | | |
| | 11 Dist_HW | 9 | 3 | 7 | 5 | 7 | 0.5 | 3 | 4 | 3 | 1 | |
| | 12 LU Inv | 9 | 5 | 3 | 2 | 3 | 0.75 | 2 | 0.75 | 0.5 | 0.25 | 1 |

Figure 3.2: Screenshot of the AHP Weighting Table in Microsoft Office Access

The table was then entered in the AHP Extension to get weighting for all the land uses, as shown in Figure 3.3. AHP Extension can be downloaded from http://arcscripts.esri.com/details.asp?dbid=13764.

AHP 1.1 – Decision support tool for ArcGIS

| download contact author dow | nload help | | | | | |
|---|---|--|--|--|--|--|
| Author | Oswald Marinoni | | | | | |
| File Name | extAhp.zip | | | | | |
| Language | Visual Basic | | | | | |
| Last Modified | Feb 13 2009 | | | | | |
| Status of work | Public Domain | | | | | |
| Software | ArcGIS - ArcView | | | | | |
| File Size | 356.56 kb | | | | | |
| Downloads | 5083 | | | | | |
| report inappropriate content software products. Please alert t product. | ArcScripts is intended for the free exchange of scripts and tools related to ESRI he moderator if this script is a demo, trial-version, or an advertisement for a retail | | | | | |
| Summary | | | | | | |
| The provided extension performs a criteria weight determination according to the well known Analytic Hierarchy Process (AHP). Powerful tool for the creation of suitability maps (spatial planning, risk mapping and more)! Manual and some example files included. Limited to integer rasters. Allows up to 20 criteria. | | | | | | |
| A 'Spatial Analyst' extension is re | quired! | | | | | |

Figure 3.3: Screenshot of Download Page

3.1.10.1 Running the AHP Extension in ArcGIS

Steps:

- 1) Launch ArcGIS.
- 2) From the Tools Menu, choose Customize.
- 3) "Add from file" field (Figure 3.4).

| Categories: | Commands: | |
|---|---|-------------------------|
| 3D Analyst 3D View Adjustment Advanced Edit Tools ArcPad ArcScan Attribute transfer CAD Data Converters Data Frames Data Frames DataGraph Developer Samples | Edit Layer: AHP Color Dropper Color: Copy Cut DeveloperSamples_SelectTo Draw A Draw Text Drawing Tool: | |
| | Descriptio | Click on "Add from file |

Figure 3.4: Customize Option in the Tools Menu

4) Browse the extension "extahp.dll" and OK (Figure 3.5).

| oolbars: | Added Objects | | X |
|-------------|----------------|------|-------|
| Main Mer | | | W |
|] 3D Analy: | clsExtAhpRcCmd | | HD IE |
| Animation | | | - |
| Annotatio | | | lé(e |
| ArcPad | | | |
| ArcScan | | | set |
| COGO | | | |
| Cadastral | | | |
| Context M | | - | - |
| Data Fran | | OK | |
| | | 2.42 | |

Figure 3.5: Adding the AHP Extension

- 5) On the Commands tab, choose "Developer Samples" from "Categories."
- 6) Choose AHP from the "Commands" list box.
- 7) Drag AHP onto the ArcMap environment (Figure 3.6).

| oolbars Commands Uptions Show commands cor | ntaining: | |
|---|-----------|-------------|
| Categories: | | Commands: |
| Data Converters Data Frames Data View Context Menu DataGraph Developer Samples Dimensioning Distributed Geodatabase Edit Editor File Generic Constinue | | AHR |
| | | Description |

Figure 3.6: Adding AHP Toolbar

The ArcMap environment looks like this (Figure 3.7):



8) Click on the "AHP" and define the criteria (Figures 3.8 and 3.9). The number of criteria is restricted to a minimum of 2 and a maximum of 20.

| AHP - specify crit - Select criteria raster laye | teria - step 1 of 2 rs | | | | | X |
|---|--|---------------|---------------|-----------------------|------------------|---|
| Please select and the a | add raster layers to the list of raste | rs on the rig | pht hand side | . All rasters must be | integer rasters. | |
| Classified raster layers: (must be integer) | Reclass of slope Reclass of sand Reclass of peal | ·> <- | descriptor | layemame | | |
| | | | | Cancel | Next > | |

Figure 3.8: Defining Criteria (Factors) for Weighting

| AHP - specify crit | eria - step 1 of 2 | | | | |
|--|---------------------------------------|--------------|-------------------------|----------------------|------------|
| Select criteria raster layer | \$ | | | | |
| Please select and the a | dd raster layers to the list of raste | ers on the r | ight hand side. All ras | sters must be intege | r rasters. |
| Classified raster layers: | Reclass of sand | | descriptor | layername | |
| (must be integer) | Heclass of peat | | Reclass of slope | Reclass of slope | |
| | | -> | | | |
| | | <· | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | C | ancel | Next > |

Figure 3.9: Adding Description to the Criteria

9) After all criteria are defined, click *Next* to reach the screen shown in Figure 3.10.



Figure 3.10: Pair-wise Comparison in AHP

10) Put values in the matrix for all the factors and click Compute and Ok.

11) The result of the AHP for the selected suitability factors in the study is shown in Figure 3.11:

| 📕 AHP-Result.txt - | Notepad | | | | | | | | | | | X |
|---|--|---|--|---|---|---|--|--|---|---|---|---|
| File Edit Format Vie | ew Help | | | | | | | | | | | |
| acs_emp_rt05 acs_ints_rt05 acs_shp_rt05 prox_hwy_rt05 lu_inv_rt05 | acs_emp acs_int acs_shp prox_hw lu_inv_ | Lrt05 :s_rt05)_rt05 /y_rt05 _rt05 | | | | | | | | | | ^ |
| [Preference Mat prox_esp_rt05 prox_wat_rt05 prox_wat_rt05 teap_rt05 karst_rt05 acs_emp_rt05 acs_shp_rt05 acs_shp_rt05 prox_hwy_rt05 lu_inv_rt05 | :rix] ;p_rt05 1 9 7 2 2 9 9 9 9 9 9 9 9 9 9 9 | prox_wa 0.1111 0.5 0.5 0.5 7 4 1 3 5 | it_rt05 0.1429 2 1 3 3 3 7 7 7 3 | prox_we 0.5 2 1 2 5 2 3 7 5 2 2 2 2 2 2 2 2 2 2 2 2 2 | et_rt05 0.5 2 0.3333 0.5 1 7 5 7 9 7 3 | teap_rt 0.1111 0.3333 0.2 0.1429 1 0.25 0.5 2 0.5 0.5 0.75 | 05 0.1111 0.1429 0.3333 0.5 0.2 4 1 5 3 3 2 | karst_r 0.1111 0.25 0.3333 0.1429 2 0.2 1 0.5 4 0.75 | t05 0.1111 1 0.1429 0.1429 0.1111 0.5 0.3333 2 1 3 0.5 | acs_air 0.1111 0.3333 0.1429 0.1429 2 0.3333 0.25 0.3333 1 0.25 | _rt05 0.1111 0.2 0.3333 0.5 0.3333 1.3333 0.5 1.3333 2 4 1 | |
| [*****AHP resul [Efgenvalues] 12.7644 0.3183 -0.2275 -0.2275 -0.4143 0.0815 0.0815 -0.4521 -0.8283 | t5*****] | | | | | | | | | | | |

Figure 3.11: AHP Result

The AHP result was entered into the Weighting Toolset (see Section II, 4.1.5), as depicted in Figure 3.12.

| | 22 Suitability for Each Land-use 2010 | | | | | | × |
|-----|---|-------|--------------|---------|-----|----------|---|
| ir | nput_layer | | | | | | ^ |
| ſ | | | | | | 2 | |
| ſ | Raster | Field | | Weight | ~ | + | |
| | C:\Ali\TxDOT\ThirdRun\Result\2010\prox_esp_rt10 | SF | | 0.0113 | | - | |
| | C:\Ali\TxDOT\ThirdRun\Result\2010\prox_wat_rt10 | SF | | 0.0523 | | X | |
| | C:\Ali\TxDOT\ThirdRun\Result\2010\prox_wet_rt10 | SF | | 0.0303 | | <u> </u> | |
| | C:\Ali\TxDOT\ThirdRun\Result\2010\teap_rt10 | SF | | 0.0279 | | + | |
| | C:\Ali\TxDOT\ThirdRun\Result\2010\karst_rt10 | SF | | 0.0285 | | _ | |
| | C:\Ali\TxDOT\ThirdRun\Result\2010\acs_air_rt10 | SF | | 0.1651 | | | |
| | C:\Ali\TxDOT\ThirdRun\Result\2010\acs_emp_rt10 | SF | | 0.0846 | | + | |
| | C:\Ali\TxDOT\ThirdRun\Result\2010\acs_ints_rt10 | SF | | 0.1416 | | | |
| | C:\Ali\TxDOT\ThirdRun\Result\2010\acs_shp_rt10 | SF | | 0.1475 | ~ | | |
| | < | | | > | | | |
|) | Dutput Layer | | | | | | |
| | C:\Ali\TxDOT\ThirdRun\Result\2005\su_sf_05 | | | | | 2 | |
|) s | f_mask (optional) | | | | | | |
| [| C:\Ali\TxDOT\ThirdRun\Result\2005\sf_mask | | | | | 2 | |
| | | | | | | | Y |
| | | ок | Cancel Envir | onments | how | Help >> | |

Figure 3.12: Entering AHP Result into the Weighting Toolset

3.1.10.2 Mask

After rating and weighting, the next step was to mask the area that is not available for development. In this model, the process is called "Masking." The purpose of this process is to exclude water bodies, environmentally sensitive areas, and undevelopable land uses from allocation. This process ensures that allocation of projected employment and household will not take place in these masked areas.

Allocation of Employment and Households

Allocation of the projected employment and household into developable land (supply) is based on how much required land (demand) is needed to accommodate them. This process involves determining the order of allocation into the most suitable developable land in the region. LUM essentially allocates projected economy growth, represented by employment and household growth; the order for allocation is based on how an area developed according to the economic base theory. For this project the order of allocation was determined as:

> Basic Heavy Industrial (BHI) Basic High Commercial (BHC) Basic Light Industrial (BLI) Basic Low Commercial (BLC) Multi Family (MF) Single Family (SF) Open Space (OS) Service Heavy Industrial (SHI) Service High Commercial (SHC) Service Light Industrial (SLI) Service Low Commercial (SLC)

Section II: Prototype Model and Step-by-Step Process

Section II is intended to provide user friendly step-by-step guide to run the SA Model for similar types of applications.

4. Running the SA Model Toolbox in ArcGIS

The SA model application in ArcGIS was developed using Model Builder. The following are the steps performed to run the model:

- 1) Open ArcMap.
- 2) Open Arc Toolbox and add Toolbox (Figure 4.1).



Figure 4.1: Adding the Model Toolbox

3) Add the SA Model toolbox (Figure 4.2).



Figure 4.2: The Model in ArcToolbox

The prototype model is divided into three toolsets: *Rating, Weighting, and Allocation.*

Rating Toolset

The *Rating* toolset performs the straight-line distance analysis for the related suitability factors, assigns the rating tables (.mdb), and produces a raster layer, which includes the ratings for each land use in its attribute table.

4.1.1 Proximity

SA Model \longrightarrow Rating \longrightarrow Proximity

Proximity selects the first component *rating* to perform *buffering* and assigns *rating* values to the factors. The *Proximity* tool (Figure 4.3) produces a straight-line distance from the suitability factor and assigns rating value to these distances (*Buffer_From* and Buffer_To).



Figure 4.3: Example of Proximity Tool (Proximity to Highway)

4.1.2 Accessibility

SA Model \longrightarrow Rating \longrightarrow Accessibility

Select *Accessibility* tool (Figure 4.4) to perform the accessibility analysis. This tool produces distances based on the transportation network, the rating tables (.mdb), and a raster layer, which includes the ratings for each land use in its attribute table.



Figure 4.4: Example of Accessibility Tool (Accessibility to Airport)

4.1.3 Assignment

SA Model \longrightarrow Rating \longrightarrow Assignment

Select *Assignment* tool (Figure 4.5) to assign the rating table to unique categories of suitability factors such as land use, Karst Zone, and TEAP. This tool does not perform distance analysis. It produces a raster file.



Figure 4.5: Example of Assignment Tool (Land Use Rating Layer)

Weighting Toolset

The *Weighting* toolset assigns weights to all the suitability factors and generates a suitability map for each of the land use categories.

This tool has two sub-tools and performs two major tasks: 1) masking and 2) assigning weights. The two sub-tools are Mask for Each Land Use and Suitability for Each Land Use.

4.1.4 Mask for Each Land Use

The purpose of this sub-tool is to mask the area that cannot be developed for reasons such as wetlands, endangered species, etc. This sub-tool masks all the cells in each land use category that are rated "-11" for each suitability factor.

Steps: SA Model ----> Weighting ---> Mask for Each Land Use

- 1. Define the expression for each land use; for example, for Single Family Residential, put the expression as "SF" = -11.
- 2. Specify the name and location of the output mask layer.

- 3. Put raster datasets of all the selected suitability factors from the database. For example, for wetlands, put the raster file "prox_wet_rt10."
- 4. Click OK.

Similarly, we can perform masking for other land use categories, as shown in Figure 4.6.

| 7.3 | | | | |
|-----|-------------------------|--|---|---------|
| • | 🍃 Spatial A | Analyst Tools | 21 Mask for Each Land Use 2010 | |
| 1 | Spatial S | statistics Tools | | ^ |
| 1 2 | Tracking | Analyst Tools | Expression (optional) | _1 |
| - 9 | NOOLL | Model | "SF" = -11 | 泉 |
| 5 | - 1 0 1 H | Kaung 10 Decembri | Output Mask Layer | |
| | | 10 Proximity 10 Proximity to Endangerou | C:\Ali\TxDOT\ThirdRun\Result\Temp\RoundUp_Divi1 | 2 |
| | | 10 Proximity to Highway | prox wet rt10 | _ |
| | | 10 Proximity to Water Bodie | C:\Ali\TxDOT\ThirdRun\Result\2010\prox wet_rt10 | 2 |
| | | 10 Proximity to Wetlands | | |
| | | 11 Reduce Cell Size | CANTERPORT | 2 |
| | - - | 12 Accessibility | c./wii/t.eo/t/mildkun/kesui/2010/ji/ok_wat_1110 | _ |
| | | 12 Accessibility to Airport | prox_hwy_rt1U | ~ |
| | - P | 12 Accessibility to Employm | C:\Ali\TxDOT\ThirdRun\Result\2010\prox_hwy_rt10 | 2 |
| | ? | 12 Accessibility to Intersect | prox_esp_rt10 | |
| | | 12 Accessibility to proping 12 Accessibility to proping | C:\Ali\TxDOT\ThirdRun\Result\2010\prox_esp_rt10 | 2 |
| | | 13 Karst Zones Rating Lave | lu inv rt10 | |
| | | 13 Land Use Rating Laver | C:\Ali\TxDOT\ThirdRun\Result\2010\lu_inv_rt10 | 2 |
| | | 14 TEAP Rating Layer | karst rt10 | _ |
| E | 🗟 🔕 02 V | Veigting | C:\Ali\TxDOT\ThirdRun\Result\2010\karst_rt10 | 2 |
| | | 21 Mask for Each Land Use | arc do thi | |
| | | 21 Mask for Each Land Use | | <u></u> |
| | | 21 Mask for Each Land Use | C:(All) XDOI (Inirakun(Result(2010)acs_snp_rt10 | - |
| | - * | 21 Suitability for Each Land | acs_ints_rt10 | |
| | 2 | 21 Suitability for Each Land | C:\Ali\TxDOT\ThirdRun\Result\2010\acs_ints_rt10 | 2 |
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| | | 22 Suitability for Each Land | acs air rt10 | _ |
| | | 22 Suitability for Each Land | C:\Ali\TxDOT\ThirdRun\Result\2010\acs_air_rt10 | 2 |
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| | - 🕈 assi | gn | OK Cancel Environments << Hide | Help |
| | 🔍 🎗 suitz | ahilitv | | |
| | | | | |

Figure 4.6: Mask Tool for Each Land Use

Result: The white areas of the map are masked for Single Family (SF) development (Figure 4.7). This means SF development cannot be allocated in these areas.

| Luw : 3 | G Samplen Schemanics Trails Server Tools | 71 Line State (1 - 2017 | - | | 12 M. M. M. |
|---------|--|---|---|---|--|
| | Gostal Statistics Tools Tracking Analysit Tools | Expression (optional) | | - | |
| | - Co 01 Rabing | Charte & Mark Lawer | | - | |
| | 10 Proximity 10 Proximity to Endangerou | C:\All_T=DOT\TherBoarUresultiment_st_10 | | | A |
| | 10 Proximity to Water Bodie 10 Proximity to Water Bodie | C:(A)(T)COT)(ThedRun)(Result)2010(prox_wet_rc10 prink_web_rc10 | • | | |
| | 11 Reduce Cell Stav 12 Accessibility | C:VANTXDOT/ThirdRun/Result/2010/prox_wst_tt10 pms_hwy_rh10 | × | | |
| | 12 Accessibility to Airport 12 Accessibility to Employm 12 Accessibility to Intersect | C:\AW\TxDOT\ThirdRun\Result\2010[prox_hwv_rt10 prox_msp_rt10 | ٠ | 1 | and a start of the |
| | 12 Accessibility to Shoping 4 (3 Assignment Feature | CIVMITxDOTTThirdRuni/Result(2010/prox_esp_rt10 to the it10 | * | 1 | |
| | 13 Karst Zones Rating Laye 13 Land Use Rating Layer | C:(All(Tx00T)ThirdRun/Result(2010)/u_inv_rt10 karst_rt10 | * | | |
| | - S (12 Weighting > 21 Mask for Each Land Use | Ci/Al/DDOT/ThirdRun/Result/2010/karst_rt10 acs_shp_rt10 | * | | × |
| | 21 Mask for Each Land Use 21 Mask //w Each Land Use | C:/Ai/TxDOT/ThirdRun/Result/2010/acs_dip_r10 acs_nts_rt10 | • | | P 38 P 423 |
| | 21 Suitability for Each Land 21 Suitability for Each Land 21 Suitability for Each Land | C.(AllTxDOT)TrinRun/Renult(2010)acs_sits_rt10 acs_mmp_rt10 | - | | |
| | 21 Sutbity | C:(All/TxDiOT)TherdRun/Result(2010)acs_emp_rt10 | | 1 | Same Cart |

Figure 4.7: Result of the Mask Tool

4.1.5 Suitability for Each Land Use

This component of the Weighting tool uses AHP results (weight scores) for each land use to get the suitability layers.

Steps: SA Model \longrightarrow Weighting \longrightarrow Suitability for Each Land Use

- 1. Put raster files of all the suitability factors in the "input layer."
- 2. Select the land use under "Field;" here the selected land use is SF.
- 3. Use the weights that are generated by AHP (refer to section 2.3.5.1).
- 4. Specify the name and location of the "Output Layer."
- 5. Put the mask layer. For example, here the mask layer for SF is "sf_mask" (as shown in Figure 4.8).
- 6. Click OK.

| 22 Suitability for Each Land-use 2010 | | |
|--|----------------|-----------------------|
| input_layer | | A |
| 1 | | |
| Raster | Field | Weight 🔼 📥 |
| C:\Ali\TxDOT\ThirdRun\Result\2010\prox_esp_rt10 | SF | 0.0113 |
| C:\Ali\TxDOT\ThirdRun\Result\2010\prox_wat_rt10 C:\Ali\TxDOT\ThirdRun\Result\2010\prox_wat_rt10 | SF | 0.0523 |
| C:\Ali\TxDOT\ThirdRun\Result\2010\teap_rt10 | SF | 0.0279 |
| C:\Ali\TxDOT\ThirdRun\Result\2010\karst_rt10 | SF | 0.0285 |
| C:\Ali\TxDOT\ThirdRun\Result\2010\acs_air_rt10 C:\Ali\TxDOT\ThirdRun\Result\2010\acs_emp_rt10 | SE | 0.1651 |
| C:\Ali\TxDOT\ThirdRun\Result\2010\acs_ints_rt10 | SF | 0.1416 |
| C:\Ali\TxDOT\ThirdRun\Result\2010\acs_shp_rt10 | SF | 0.1475 |
| Output Layer | | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\su_sf_05 | | 🚔 |
| sf_mask (optional) | | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\sf_mask | | 🖻 |
| | | <u> </u> |
| | OK Cancel Envi | ronments Show Help >> |

Figure 4.8: Suitability for Each Land Use Tool

Allocation Toolset

The *Allocation* toolset combines the entire suitability map for all land use categories, allocates each land use into the most suitable location, and produces the composite allocation map. This tool has three sub-tools.

4.1.6 Combine the Suitability Layers

Select the *Combine the Suitability Layers 2010* to combine the entire suitability layers of each land use. This tool creates one composite raster layer that has the values of each land use in different fields in its attribute table.

Steps: SA Model — Allocation — Combine the Suitability Layers 2010



Figure 4.9: Combine the Suitability Layers Tool

4.1.7 Allocating

The *Allocating* toolset is used to allocate the required land (from section 2.2) on suitable land for each land use.

Steps: SA Model \longrightarrow Allocation \longrightarrow Allocating

Currently, the value of required land is set based on 2010 household and employment projections. However, this value can be adjusted for running different scenarios for employment and population growth.



Figure 4.10: Example of Allocation Tool (Allocating BHI)

4.1.8 Compare Scenarios

This tool compares results from two different scenarios/projections using the *Cut/Fill* function in Spatial Analyst Extension. The *Compare Scenarios* tool compares the 2005 to 2010 projections results of the study area based on two scenarios (with and without SH 130 and Ronald Reagan extension).

1) Put the composite suitability map of 2005 under "Scenario 1"

| ✓ Layers ✓ comb_sus_10 ✓ Value ✓ High : 13918 Low : 1 ✓ comb_sus_05 ✓ Value ✓ High : 13191 Low : 1 Compare_05-10 Value High : 28045 Low : 1 | X X Cartography Tools X X X </th <th>×</th> <th></th> <th></th> <th></th> | × | | | |
|---|---|-------------------|---|---|--|
| 33 Compare Scenarios Scenario 1 Comb_sus_05 Base Field 1 | 2 | | | | |
| LU Scenario 2 comb_sus_10 Base Field 2 LU compare_05-10 C:\All TYDOT\ThirdBup\Rest | illhommare 05-10 | न क्ष ान ख | * | T | |
| C:(Air(1xDO1) InirdKun(Kesi | OK Cancel Environments Show | Help >> | | | |

Figure 4.11: Adding Scenario 1 Result in Compare Scenarios Tool

- 2) Select the land use type of interest under "Base Field 1)."
- 3) Put the composite suitability map of 2010 under "Scenario 2."

| | | - | | | | |
|---------------------------|---|--------------|--------------|---|--|---------|
| ≝⁄ Layers | ArcToolbox | | | | | |
| Comb_sus_10 | 🗄 🧕 3D Analyst Tools | | | | | |
| Value | + Q Analysis Tools | | | | | |
| High : 13918 | Carcography Loois | | | | | |
| Low 1 | E Conversion Tools | | | | | |
| $\equiv \Box$ comb sus 05 | Data Interoperability Tools Data Management Tools | | | | | |
| Value | E Geocoding Tools | | | 10.0°C | | |
| High : 13191 | 🖅 👩 Geostatistical Analyst Tools | | | Sec. 1 | E Station Co. | |
| | 🖅 🚳 Linear Referencing Tools | | | - Gran | - 62 | this 1 |
| Low : 1 | 표 🚳 Mobile Tools | | | t main t | - 76 | - 585 B |
| 🖃 🔲 compare_05-10 | 🖅 🚳 Multidimension Tools | | | Plate | | -3 |
| Value | 🕑 💽 🥸 Network Analyst Tools | | | 100 B | 1. A. | and the |
| High : 28045 | 🗄 👰 Samples | | · · · · | | | and the |
| | E Schematics Tools | | | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | A STARLEY C | |
| LOW : 1 | 🗄 🥶 Server Tools | | 1 A A | and the second second | | / |
| | E Spatial Statistics Tools | | | A CARLER STOR | AND THE | |
| | Tracking Analyst Tools | | | | | 424 |
| | E TXDOT Model | | | S. A. The | A Sector Street | |
| 33 Compare Scenarios | | . 🗆 🗙 | | | | |
| Scenario 1 | | - | and a second | | A State of the second s | |
| comb_sus_05 | | - 🗃 | 1. al | | | |
| Base Field 1 | | | 1.4.4 | | | |
| LU | | * | 10 A. | 1 I In | | |
| Scenario 2 | | | | | -1 | |
| comb_sus_10 | | 2 🗃 | | 187 | | |
| Base Field 2 | | | A.6. | 1 ht | | |
| lu | | <u>·</u> | Sec. 1 | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | | |
| compare_05-10 | | | | | | |
| C:\Ali\TxDOT\ThirdRun\Res | ult\compare_05-10 | | j. | A CONTRACTOR OF | | |
| | | - | | - Long | | |
| | | | | TAL PL | | |
| | | - | | 985 | | |
| | OK Cancel Environments | Show Hein >> | | 200 | | |
| | Carlos Carlos | | | | | |

Figure 4.12: Adding Scenario 2 Result in Compare Scenario Tool

- 4) Select the land use type of interest related to step 2 under "Base Field 2)."
- 5) Specify the name and location of the result under "Compare _05-10)."

| STXDOT Model | 🕶 33 Compare Scenarios | | |
|---------------------------|--|----------------------------------|------|
| | 🔀 Scenario 1 | | |
| 31 Combine the Sui | comb_sus_05 | G | 2 |
| >> 31 Combine the Sui | Base Field 1 | | |
| 🍌 321 Allocating BHI | ω | | • |
| 🗠 322 Allocating BHC | Scenario 2 | | |
| >>> 323 Allocating BLI | comb_sus_10 | | 2 |
| > 324 Allocating BLC | Base Field 2 | | |
| 325 Allocating MF | LU | | • |
| 326 Allocating SF | 8 compare_05-10 | | |
| 328 Allocating SHI | C:\Ali\TxDOT\ThirdRun\Result\compare_05-10 | Ci Ci | 2 |
| >>> 329 Allocating SHC | | | |
| 🍡 32X Allocating SLI | | OK Cancel Environments Show Help | p >: |
| 👆 אלי 32XI Allocating SLC | | | |
| 🔁 33 Compare Scenar | os l | | |
| | | | |

Figure 4.13: Specifying Name and Location of Result

The following map shows the net gain/loss of the development due to scenario change. See *Cut/Fill* function explanation in the *ArcGIS Desktop Help*.



Figure 4.14: Net Gain/Loss of Development due to Scenario Change

4.1.9 TAZ

The *TAZ* Tool uses zonal statistical analysis to calculate the area of land allocated for each land use in each TAZ.

Steps: SA Model \longrightarrow Allocation \longrightarrow TAZ



This step should be repeated for each land use. The result is a TAZ shapefile that contains allocated land for all the land uses. To obtain employment and household density in TAZ, follow the steps below:

1) Open the attribute table of TAZ shape file and copy it to Excel.

| E 🗹 🌃 Copy | | | | Q | | | | | | | | PA | | | | | |
|------------|-------------------------------------|----|-------------|--------------|-------|-----|-----|-----|----------|-----------|--------|-----|--------|-----|-----|--|--|
| Attri | Remove | | | | | | | | | | | | | | . 0 | | |
| MTF, | Open Attribute Table | | INTPTLATOO | INTPTLONO | BHC | BHI | BLI | BLC | MF | SF | OS | SHI | SHC | SLI | SL | | |
| G632(| Joins and Relates | | | | 0 | 0 | 0 | 0 | 0 | 7168000 | 230400 | 0 | 0 | 0 | 2 | | |
| G632(| Second West Science | | | | 0 | 0 | 0 | 0 | 9651200 | 9472000 | 0 | 0 | 76800 | 0 | | | |
| G632(🏁 | Zoom to Layer | | | | 0 | 0 | 0 | 0 | 0 | 1331200 | 0 | 0 | 51200 | 0 | | | |
| G632(🔬 | | | | | 0 | 0 | 0 | 0 | 0 | 23372800 | 0 | 0 | 102400 | 0 | 41 | | |
| G632(| Vicible Scale Dance | | | | 0 | 0 | 0 | 0 | 2201600 | 117299200 | Ó | 0 | 230400 | 0 | | | |
| 9632(| Table Scale Kange | - | +29.8771852 | -097.9308258 | 51200 | 0 | 0 | 0 | 0 | 3891200 | 51200 | 0 | 51200 | 0 | | | |
| G632(| Use Symbol Levels | 1 | +30.1327153 | -098.1118477 | 0 | 0 | 0 | 0 | 0 | 450304000 | 0 | 0 | 0 | 0 | | | |
| G632(| | | +30.0465760 | -098.0554654 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 9632(| Pelection | | +30.0644337 | -097.8132682 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| G632(| Label Features | | +30.2224093 | -098.0998349 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| G632(| Facortoadaros | - | +30.2328574 | -098.0526262 | 0 | 0 | 0 | 0 | 0 | 644966400 | 0 | 0 | 0 | 0 | | | |
| G632(| Содуеть Баренско-Аптосовоп. | | +30.0812085 | -097.8159069 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| G632(| e le l'élèce | 13 | +30.0657968 | -097.8262303 | 0 | 0 | 0 | Û | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| G632(💣 | Convert Leatures to Graphics | 13 | +30.2580043 | -098.0459123 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | _ | | |
| G632(| Convert Symbology to Representation | | +29.8842902 | -097.9457957 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| G632(| Data | | +29.8821226 | -097.9278445 | 0 | 0 | 0 | 0 | 742400 | 1817600 | 0 | 0 | 0 | 0 | 1 | | |
| G632(| Fara | | +29.8846294 | -097.9387428 | 0 | 0 | 0 | 0 | 0 | 2636800 | 0 | 0 | 0 | 0 | _ | | |
| G632(| Save As Laver File | 1 | +29.8842587 | -097.9409685 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| G632(| - | | +29.8840069 | -097.9427626 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | _ | | |
| G632(| Properties | | +29.8826778 | -097.9365029 | 0 | 0 | 0 | 0 | 742400 | 486400 | 0 | 0 | 0 | 0 | | | |
| G632(| 12 | | +29.8830452 | -097.9135107 | 0 | 0 | 0 | 0 | 30515200 | 10214400 | 0 | 0 | 0 | 0 | 13 | | |
| G6320 | IS 115674 | 0 | +29.8821750 | -097.9484615 | 0 | 0 | 0 | 0 | 0 | 1356800 | 0 | 0 | 0 | 0 | | | |
| | | | | | | | | | | | | | | | | | |

Figure 4.16: TAZ Attribute Field

| Layers | ArcToolbox 3D Ana 3D Analys | « alyst Tools is Tools | | Q | | | | | A | 54 | 5 | | | | |
|-----------------------|-----------------------------------|------------------------------|-------------------|--------------|-------|-----|-----|-----|----------|-----------|--------|-----|--------|-----|----|
| Attributes of TAZ | | | | | | | | | | | | | | | |
| MTFCC00 FUNCSTAT00 | ALANDOO | AWATER00 | INTPTLAT00 | INTPTLON00 | BHC | BHI | BLI | BLC | MF | SF | OS | SHI | SHC | SLI | SI |
| W. Flach | 0 | 0 | | | 0 | 0 | 0 | 0 | 0 | 7168000 | 230400 | 0 | 0 | 0 | 2 |
| C Dooil | 0 | 0 | | | 0 | 0 | 0 | 0 | 9651200 | 9472000 | 0 | 0 | 76800 | 0 | |
| 🛂 Zoom To | 0 | 0 | | | 0 | 0 | 0 | 0 | 0 | 1331200 | 0 | 0 | 51200 | 0 | _ |
| ") Pan To | 0 | 0 | | | 0 | 0 | 0 | 0 | 0 | 23372800 | 0 | 0 | 102400 | 0 | 41 |
| Tolentify | 0 | 0 | | | 0 | 0 | 0 | 0 | 2201600 | 117299200 | 0 | 0 | 230400 | 0 | |
| Contra Att | 98196 | 0 | +29.8771852 | -097.9308258 | 51200 | 0 | 0 | 0 | 0 | 3891200 | 51200 | 0 | 51200 | 0 | |
| Select/Unselect | 9037461 | 0 | +30.132/153 | -098.11184/7 | U | U | U | 0 | U | 450304000 | U | 0 | U | U | |
| Zoom To Selected | 10656783 | 0 | +30.0465760 | -098.0554654 | U | U | U | U | U | U | U | 0 | U | U | |
| - | 40570400 | 0 | +30.0644337 | -097.0132002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Clear Selected | 11600409 | 0 | +30.2224093 | 030.0330349 | 0 | 0 | 0 | 0 | 0 | 644966400 | 0 | 0 | 0 | 0 | |
| Copy Selected | 2468950 | 0 | +30.0812085 | -097 8159069 | 0 | 0 | 0 | 0 | 0 | 044300400 | 0 | 0 | 0 | 0 | |
| C Dolote Selected | 1713983 | 0 | +30.0657968 | -097 8262303 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Sugaranana | 8009534 | 0 | +30 2580043 | -098 0459123 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Zoom To Highlighted | 129666 | 0 | +29.8842902 | -097.9457957 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Lipselect Highlighted | 639385 | 0 | +29.8821226 | -097.9278445 | 0 | 0 | 0 | 0 | 742400 | 1817600 | 0 | 0 | 0 | 0 | 13 |
| Stragournaging root | 77301 | 0 | +29.8846294 | -097.9387428 | 0 | 0 | 0 | 0 | 0 | 2636800 | 0 | 0 | 0 | 0 | |
| Reselect Highlighted | 31459 | 0 | +29.8842587 | -097.9409685 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| K Delete Highlighted | 58017 | 0 | +29.8840069 | -097.9427626 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| G6320 S | 39833 | 0 | +29.8826778 | -097.9365029 | 0 | 0 | 0 | 0 | 742400 | 486400 | 0 | 0 | 0 | 0 | |
| G6320 S | 533053 | 0 | +29.8830452 | -097.9135107 | 0 | 0 | 0 | 0 | 30515200 | 10214400 | 0 | 0 | 0 | 0 | 12 |
| G6320 S | 115674 | 0 | +29.8821750 | -097.9484615 | 0 | 0 | 0 | 0 | 0 | 1356800 | 0 | 0 | 0 | 0 | |
| | | | | | | | | | | | | | | | |

Figure 4.17: Select all the Fields in the Attribute Table and Copy to Microsoft Excel

- 2) Get the average square feet of land per employment and the average square feet of land per single family and multifamily household (this can be obtained from the existing average square feet per employment under the assumption that the region will continue to grow the same way. There are also other resources that may provide standard calculation of average area per employee.)
- 3) In Microsoft Excel, calculate total number of employment. For basic employment, divide the sum of the allocated land for basic employment by the average square feet of land per employment. For service employment, divide the sum of the allocated land for service employment by the average feet of land per employment.
- 4) Calculate the total number of households. For single family household, divide the total allocated land for single family by the average square feet of land per single family household. Similarly, for multifamily, divide the total allocated land for multifamily by the average square feet of land per multifamily.
- 5) Join the newly created Excel spreadsheet with the TAZ shape file.
| Eile Edit View Bookmarks Insert Selection Tools Window Help | |
|--|--|
| 🗅 😂 🖬 🚭 👗 🗈 🎕 🗙 🖙 🗠 🔶 1:547,660 | |
| × | Join Data |
| Image: Second secon | Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data. What do you want to join to this layer? Join attributes from a table 1. Choose the field in this layer that the join will be based on: TAZCE00 |
| - Mobile Tools | 2. Choose the table to join to this layer, or load the table from disk: |
| Attributes of TAZ1 | Sheet4\$ |
| FID Shape * STATEFP00 COUNTYFP00 TAZCE00 TAZIDFP0 | Show the attribute tables of layers in this list |
| 1 Polygon 48 209 681 48209681 | 3 Chapter the field in the table to have the join on |
| 2 Polygon 48 209 584 48209584 | 32662 0 0 0 0 0 0 0 |
| 3 Polygon 48 209 748 48209748 | ▼ 98349 0 0 0 0 0 0 0 |
| 5 Polygon 48 209 809 48209809 | TAZCE00 59059 0 0 0 0 0 0 0 0 |
| 6 Polygon 48 209 804 48209804 | Join Options |
| 7 Polygon 48 209 598 48209598 | Keep all records S9123 0 0 0 0 0 0 0 0 |
| 0 Pulyguil 40 209 710 40209710 | All records in the target table are shown in the resulting table. |
| 12 Dolugon 49 200 740 4020300 | Unmatched records will contain null values for all fields being |
| 21 Polygon 48 200 814 48209814 | appended into the target table from the join table. |
| 24 Polygon 48 209 699 48209699 | |
| 35 Polygon 48 209 903 48209903 | C Keep only matching records 71804 0 0 0 0 0 0 |
| 36 Polygon 48 209 916 48209916 | If a record in the target table doesn't have a match in the join 92348 0 0 0 0 0 0 0 |
| 41 Polygon 48 209 832 48209832 | table, that record is removed from the resulting target table. |
| 42 Polygon 48 209 578 48209578 | 71972 0 0 0 0 0 0 |
| 43 Polygon 48 209 833 48209833 | 39416 0 0 0 0 0 0 |
| 51 Polygon 48 209 836 48209836 | 39275 0 0 0 0 0 0 |
| 54 Polygon 48 209 816 48209816 | 71832 0 0 0 0 0 0 |
| 56 Polygon 48 209 591 48209591 | About Joining Data OK Cancel 45192 0 0 0 0 0 0 |
| 58 Polygon 48 209 844 48209844 | 31552 0 0 0 0 0 0 |
| | |
| Record: 14 4 1 1 1 Show: All Selected Reco | rds (0 out of 996 Selected) Options |

- Figure 4.18: Join the Excel Sheet with TAZ Shapefile
- 6) Add 3 new fields in the attribute table: a) field to calculate area in acre; b) field to calculate employment density per acre; c) field to calculate household density per acre.

| | | coll - | | | | | | | | | _ |
|---------|----------------|------------|-----------------------------|-------------|---------|------------|-------------------------------|-----|---------------------|---------|------------|
| | | | | | i | <u>×</u> | • | | . 1 . 2 | 3. 4. 5 | <u>ن</u> ا |
| 🖻 🗲 Lay | ers | | ArcToolbox | | | | | | | | |
| - 🗹 | TAZ1 | | 3D Analyst Tools | | 1 | 9 7 | Fin <u>d</u> & Replace | | | | |
| | | ± | Analysis Tools | | | | Select By Attributes | | | | |
| | TAZ | 1 1 | Cartography Tool | ls | | SQL | | - H | | | |
| | TAZ END Doot | | Conversion Tools | days was to | 6 | : | ⊆lear Selection | | 2 Select Add Field | | |
| | TAZ_EMP_Rast | erin 庄 🗄 | Data Interoperat | MICY LOOIS | [| :2 | Switch Selection | | 2. Select Add Fleid | | |
| | TAZ EMD | | Geogoding Tools | ic roois | 1 | = | Select All | L | | | |
| | compare 05-10 | | Geoclaticitical Application | elvet Toole | | | Soloce Di | _ | | Alt | |
| | compare_03-10 | | Geoscalistical Aria | a Tools | | | Add Eield | | - | THEFT | 2 |
| | | | | | | | Turn All Fields On | | | | |
| | | | | | | | | | | | کار |
| UM_EMP | NUM_MF | NUM_SF | NUM_HH | Ad | сге | Ý | Show Field Aliases | _ | DEN_S_EMP | DEN_EMP | ^ |
| 0 | 0 | | 0 0 | | 2633.4 | | Restore Default Column Widths | | 0 | | -3 |
| 0 | 0 | | 0 0 | | 510.3 | | | - | 0 | | - |
| 0 | 0 | | 0 0 | | 4836.1 | | Joins and Relates | | 0 | | - |
| 0 | 0 | | 0 0 | | 610.C | | Related Tables | • | 0 | | |
| 0 | 0 | | 0 0 | | 423.5 | | | - | 0 | | |
| 0 | 0 | | 0 0 | | 1979.0 | <u> 11</u> | Create <u>G</u> raph | | 0 | | |
| 0 | 0 | | 0 0 | | 32 | | Add Table to Layout | | 0 | | _ |
| 0 | 0 | | 0 0 | | 7.7 - | | | - | 0 | | _ |
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| 0 | 0 | 1. Righ | nt-click on O | ptions | 15 | | Export | | 0 | | - |
| 0 | 0 | U | | | 410.0 | | • | - | 0 | | |
| | | 4 | | | | | Appearance | | 101 | | 9 |
| I Show | r: All Selecte | d Reco | rds (0 out of 996 Sel | ected) | Hions 두 | · | | | | | |
| - | | | | | | _ | | _ | | | |

Figure 4.19: Add New Field to the TAZ Attribute Table

| Mattributes of TA21 Description SHC06 SL05 SL05 SL06 | <i>월</i> Laye ⊕ 🗹 👖 | rs AZ1 | | ArcToo + @ 3D + @ An | olbox Analyst To Ialysis Tools | ols | | | | | 1. | Right-cl | ick on the | field | | | |
|---|------------------------|------------|-------|----------------------------|--------------------------------------|-----|------------|-------------------|---------------|------------|----------|------------|--------------|--------------|--------|--------------------|----------------|
| OS805 SHI05 SHC05 SL05 SUM TAZCE00_1 NUM_BEMP NUM_MF NUM_SE NUM_H Acr In a 0 | 🗏 Attrib | utes of Ti | AZ1 | | | | | | | | | | | | | | |
| 0 0 0 0 0 0 0 0 16187.068164 46187.068164 2233 Sort Ascending 0 | 0505 | SHI05 | SHC05 | SLI05 | SLC05 | SUM | TAZCE00_1 | NUM_B_EMP | NUM_S_EMP | NUM_EMP | <u> </u> | NUM_MF | NUM_SF | NUM_HH | Acr | e 1 n 🔨 | I |
| 0 0 0 0 0 0 0 0 0 0 0 0 2233 Sott Dgscending 0 | 0 | 0 | 0 | 0 | 0 | 0 | 760 | 0 | 0 | | 0 | 0 | 16187.068184 | 16187.068184 | 2233. | Sort Asce | nding |
| 0 0 0 0 0 0 0 0 0 0 0 0 0 510 510 4 Adyanced Sorting 0 | 0 | 0 | 0 | 0 | 0 | 0 | 681 | 0 | 0 | | 0 | 0 | 0 | 0 | 2633. | F Sort Desc | ending |
| 0 0 0 0 748 0 | 0 | 0 | 0 | 0 | 0 | 0 | 584 | 0 | 0 | | 0 | 0 | 0 | 0 | 510. | | Cashing |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 748 | 0 | 0 | | Ο | 0 | 0 | 0 | 4836. | Z + Auvanceu | Sorung |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 697 | 0 | 0 | | 2 | Select C | alculate G | eometry | 2866. | Summarize | e |
| 0 0 0 0 0 0 0 0 122 2 gabous 0 0 0 0 0 0 0 0 0 1979. ■ field Calculate connetry 0 0 0 0 0 0 0 0 0 1979. ■ field Calculate connetry 0 0 0 0 0 0 0 0 0 1422.22222 23.34123 65.33728 88.671351 158 Galoute Gometry 0 0 0 0 0 0 0 0 0 7.7 Turn Field Off 0 0 0 0 0 0 0 0 7.7 Freeze/Unfreeze Column 0 0 0 0 0 0 0 0 1364.172336 959.11291 367.176817 1326.299727 131. Petete Field 0 0 0 0 0 0 0 0 0 48.772686 28.7798314 37.784841 39.749933 9.7202.0 | 0 | 0 | 0 | 0 | 0 | 0 | 809 | 0 | 0 | | 2. | beleet C | alculate O | conteny | 610. | S. Charlinson | |
| 0 0 0 0 0 0 0 0 1979. Eled Calculator 0 0 0 0 0 0 0 0 0 0 3 Eled Calculator 0 0 0 0 0 0 0 0 0 0 0 0 0 3 Eled Calculator 0 <t< td=""><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>804</td><td>0</td><td>0</td><td></td><td></td><td></td><td></td><td></td><td>423.</td><td>Z blausucs.</td><td></td></t<> | 0 | 0 | 0 | 0 | 0 | 0 | 804 | 0 | 0 | | | | | | 423. | Z blausucs. | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 698 | 0 | 0 | | 0 | 0 | 0 | 0 | 1979. | 📄 Field Calc | ulator |
| 0 0 0 0 100200 0 100200 0 1022222 142222222 23.34125 68.33726 68.37326 68.37326 1135 Scholled Guided Juni 0 0 0 0 0 999 0 0 0 97.48433 19. Turn Field Off 0 0 0 0 0 0 0 0 7. Freeze/Unfreeze Column 0 0 0 0 0 0 0 0 0 136.17233 136.172336 136.172336 959.11291 387.176817 1326.289727 131. Celete Field 0 0 0 0 0 0 0 0 0 48.77268 288.77817 1326.289727 131. Celete Field 0 0 0 0 0 0 0 0 48.77268 288.77817 1326.289727 131. Celete Field 0 0 0 0 0 0 0 0 48.77268 28.79493 39.823721 38.23721 | U | 0 | U | 0 | 4000000 | 0 | 718 | U | 1 400 000000 | 4 400 0000 | 0 | 00.0044.00 | 0 | 00.074.054 | 3. | Calculate | Coomotru |
| 0 0 0 0 0 94.7493 134.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.7493 14.74945 14.7493 14.7494 14.818733 9.7493 14.7494 14.818733 9.7493 14.7494 14.818733 9.7493 14.7796 28.77766 28.77766 28.77766 28.77766 28.77766 28.77766 28.77771 13.75771 13.75771 13.75771 9.7493 14.7796 9.777 9.7493 9.74933 9.8737721 9.7493 9.7493 9.74933 9.8737721 9.7493 9.74933 9.8737721 9.7493 9.74933 9.8737721 9.7493 9.74933 9.8737721 9.7493 9.74933 9.8737721 9.7493 9.74933 9.8737721 9. | | 0 | 0 | 0 | 1203200 | 0 | 708 | U | 1422.222222 | 1422.2222 | 222 | 23.334123 | 65.337228 | 88.671351 | 158 | | Geometry |
| 0 0 0 0 0 0 0 0 0 14 Freege/Unfreeze Column 0 0 0 0 0 0 0 0 14 Freege/Unfreeze Column 0 0 0 0 0 0 0 0 14 Freege/Unfreeze Column 0 0 0 0 0 0 0 0 0 1364172336 959.1121 367.176817 1326.289727 131 ¥ Delete Field 0 0 0 0 0 0 0 0 0 48.77266 48.77266 28. Properties 0 0 0 0 0 0 0 48.77266 48.77266 28. Properties 0 0 0 0 0 0 0 38.833119 198.569986 257.963104 37. Properties 0 0 0 0 0 0 0 38.833219 0 38.833219 38.83322 38.833219 38.83322 3 | - 0 | 0 | 0 | 0 | 0 | 0 | 912 | 0 | 0 | | 0 | 0 | 34.704333 | 94.704993 | 19. | Turn Field | Off |
| 0 | | 0 | 0 | 0 | 0 | 0 | 719 | 0 | 0 | | 0 | 0 | 0 | 0 | 14 | | |
| 0 | | 0 | 0 | 0 | 0 | 0 | 906 | 0 | 0 | | 0 | 23 33/123 | 17.48461 | 40.818733 | 14. | Free <u>z</u> e/Ur | htreeze Column |
| 0 | | 0 | 0 | 0 | 1638400 | 0 | 723 | 0 | 1364 172336 | 1364 1723 | 36 | 959 11291 | 367 176817 | 1326 289727 | 131 | X Delete Fie | ld |
| 0 0 0 0 911 0 0 68.393113 189.569396 257.963104 37 Propertjes 0 0 0 0 0 0 0 94.764933 94.764933 98.257.21 0 0 0 0 0 0 0 189.569396 189.569396 257.983104 37 Propertjes 0 0 0 0 0 0 0 0 189.569396 189.569396 257.983104 37 Propertjes 0 0 0 0 0 0 0 0 189.569396 129.569396 257.983104 37 Propertjes 0 0 0 0 0 0 0 189.569396 257.983104 39.2721 10.015.93937042 39.072042 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 9100.6823322 910.0823322 | | 0 | 0 | 0 | 0 | 0 | 720 | 0 | 0 | 100111120 | 0 | 0 | 48 77286 | 48,77286 | 28 | • (| |
| 0 0 0 0 0 908 0 0 0 94.784933 94.784993 98.23721 0 0 0 0 0 0 0 0 189.569966 129.569966 20.7403 0 0 0 0 0 0 0 3983.730425 398 | 0 | 0 | 0 | 0 | 0 | 0 | 911 | 0 | 0 | | 0 | 68.393119 | 189.569986 | 257.963104 | 37. | Properties | |
| 0 0 0 0 0 0 0 0 189.569966 189.569966 20.7403 0 0 0 0 0 68.2302 0 0 0 3963.73425 9100.682332 0 0 0 0 0 0 0 0 0 0.8.046249 0 8.046249 0 8.046249 0 8.046249 0 8.046249 0 8.046249 0 8.046249 0 8.046244 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2786.687103 0 <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>908</td> <td>0</td> <td>0</td> <td></td> <td>0</td> <td>0</td> <td>94.784993</td> <td>94.784993</td> <td>9)</td> <td>823721</td> <td>1</td> | 0 | 0 | 0 | 0 | 0 | 0 | 908 | 0 | 0 | | 0 | 0 | 94.784993 | 94.784993 | 9) | 823721 | 1 |
| 0 0 0 0 0 692 0 0 0 3983.730425 3983.730425 9100.682932 0 0 0 0 0 0 0 8.046249 0 8.046249 1066.171166 0 0 0 0 0 0 0 0 2786.687103 0 0 0 0 0 0 0 0 2786.687103 0 0 0 0 0 0 0 10015.920984 10015.920984 21530.580094 ¥ Record: H 0 Image: Control of the seconds (0 out of 996 Selected) Options ▼ Image: Control of the seconds (0 out of 996 Selected) Image: Control of the seconds (0 out of 996 Selected) Image: Control of the seconds (0 out of 996 Selected) Image: Control of the seconds (0 out of 996 Selected) Image: Control of the seconds (0 out of 996 Selected) Image: Control of the seconds (0 out of 996 Selected) Image: Control of the seconds (0 out of 996 Selected) Image: Control of the second sec | 0 | 0 | 0 | 0 | 0 | 0 | 704 | 0 | 0 | | 0 | 0 | 189.569986 | 189.569986 | 2 | 0.7403 | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 692 | 0 | 0 | | 0 | 0 | 3983.730425 | 3983.730425 | 9100. | 682932 | |
| 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 0 | 0 | 0 | 0 | 0 | 0 | 822 | 0 | 0 | | 0 | 8.046249 | 0 | 8.046249 | 1066.1 | 171166 | |
| 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | 0 | 0 | 0 | 0 | 0 | 0 | 814 | 0 | 0 | | 0 | 0 | 0 | 0 | 2786. | 687103 | |
| Record: 14 0 P 1 Show: All Selected Records (0 out of 996 Selected) Options | 0 | 0 | 0 | 0 | 0 | 0 | 693 | 0 | 0 | | 0 | 0 | 10015.920984 | 10015.920984 | 21530. | 580094 🛛 🗠 | |
| Record: 14 4 0 > H Show: All Selected Records (0 out of 996 Selected) Options + | < | | | | | | | | | | | | | | | > | |
| | Rec | ord: 🚺 🖣 | | I I I | Show: | All | Selected F | Records (0 out of | 996 Selected) | Opt | ions | • | | | | | |

Figure 4.20: Calculate Area in Acre

| 🔳 Altributes r | il Tit71 | | | |
|----------------|------------------|-------------|------------|--------------------|
| NUM_EMP | Field Calculator | | | IP Employment/acre |
| | Fields: | Type: | Functions: | 0 0 |
| | TAZCE00 1 | A d Roughan | Abs () | 0 0 |
| | NUM_B_EMP | | Atn () | 0 0 |
| - | NUM_S_EMP | C String | LOS() | 0 0 |
| - | NUM_EMP | C Date | Fix () | 0 0 |
| | NUM SF | | Int () | 0 0 |
| | NUM_HH | | Sin () | 0 0 |
| 100 C | Acre | | Sar () 🞽 | 0 0 |
| 1422.2222 | DEN S EMP | | | 23 9.000423 |
| _ | DEN_EMP | | * / 8 | 0 0 |
| - | DEN_HH | * | | 0 0 |
| - | DEN_EMP = | T Advanced | + - = | 0 0 |
| 1364 1725 | [NUM EMP]/[Acre] | | | 98 10.355198 |
| | | | Load | 0 0 |
| | | | Cours | 0 0 |
| | | | Javen | 0 0 |
| | | | Help | 0 0 |
| | | | | 0 0 |
| - | | | | 0 0 |
| _ | | | | 0 0 |
| | | | | 0 |

Figure 4.21: Calculate Employment Density in Field Calculator

Appendix A: Proximity Tool

Proximity in urban and transportation planning usually refers to the distance to facilities and services that affect allocation suitability and attractiveness. A popular research method to study the impact of proximity on land use is determining the *radial distance* or traditional circular buffer. The rating of attractiveness of locations within the buffer areas are determined by the environment and other locational effects these actors have on the site within a particular buffer distance.

Factors: Highway, Endangered Species, Water Bodies, Wetlands

Figures A1 through A9 and Tables A1 through A4 present information on these four factors.

| 😁 10 Proximity to Highway | |
|---|-------------|
| Input Layer | <u>_</u> |
| C:\Ali\TxDOT\ThirdRun\SHP\2030_Highway_2010.shp | - 🗃 |
| Output Rated Layer | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\prox_hwy_10 | - 🚘 |
| Selection Criteria (optional) | |
| "DRFT2_2030" = 'Freeway/Parkway' | - |
| Rating Table | |
| C:\Ali\TxDOT\ThirdRun\Rating.mdb\Dist_HW | - 🗃 |
| From value field | |
| Buffer_From | • |
| To value field | |
| Buffer_To | • |
| Buffer, To | - |
| Join Fields (optional) | <u> </u> |
| ₩ Buffer From | ~ |
| Buffer_To | |
| Distance_HW | |
| Field1 | |
| | _ |
| I I BHC | |
| | |
| | ~ |
| | > |
| Select All Unselect All Add | l Field |
| Output Join Field | |
| Rnuuer_10 | _ |
| OK Cancel Environments < | < Hide Help |

Highway

Figure A1: Proximity to Highway Tool

Input Layer: Select the highway shape file (2030_Highway_2010.shp) Output Rated Layer: Choose the location and name of the output file Selection Criteria: "DRFT2_2030" = 'Freeway/Parkway' OR "DRFT2_2030" = 'Major Arterial' (these are the major highways and roads in the study area) Rating Table: A rating table for highway in mdb format

From Value Field: It is the minimum value for buffer, so select "Buffer From." For Example, the model would consider 0 as the minimum value for highway distance of 0 to 50 feet from the land use type.

To Value Field: It is the maximum value for buffer, so select "Buffer To." For example, the model would consider 50 as the maximum value for highway distance of 0 to 50 feet from the land use type.

Output value field: Select "Buffer_to"

Join Fields (optional): It is optional but if needed you can select all or some of the fields to show them in the attribute table.

Output Join Field: Join the rating table with the result of the analysis to get the output. Here "Distance_HW" is a common field to join the rating table and the result of the analysis.

| | | | | | | | | - | | _ | - | | | | |
|----|--------------------|-----------|-------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| ID | Buffer_From | Buffer_To | Distance_HW | Field1 | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | OS |
| 1 | 0 | 50 | 50 | 50 | -10 | 10 | -10 | -5 | 10 | -4 | 10 | -5 | 10 | -4 | 2 |
| 2 | 50 | 200 | 200 | 200 | -5 | 10 | -7 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 4 |
| 3 | 200 | 500 | 500 | 500 | 0 | 7 | -3 | 2 | 5 | 3 | 8 | 4 | 5 | 3 | 1 |
| 4 | 500 | 1000 | 1000 | 1000 | 1 | 3 | 0 | 6 | 0 | 5 | 3 | 6 | 0 | 5 | 0 |
| 5 | 1000 | 2000 | 2000 | 2000 | 2 | 0 | 1 | 8 | -2 | -1 | 0 | 8 | -5 | -1 | 0 |
| 6 | 2000 | 10000 | 10000 | 10000 | 5 | -4 | 3 | -2 | -3 | -5 | -4 | -3 | -3 | -5 | -10 |

Table A1: Rating Table for Proximity to Highway



Figure A2: Result of Proximity to Highway Tool



Figure A3: Result (Zoomed In) of Proximity to Highway Tool

Endangered Species



Figure A4: Proximity to Endangered Species Tool

Input Layer: Shape file for endangered species (33nding.shp) Output Rated Layer: Choose the location and name of the output file Selection Criteria: Not required Rating Table: A rating table for endangered species in mdb format (Rating.mdb\Prox_Esp) **From Value Field**: It is the minimum value for buffer, so select "Buffer From." For Example, the model would consider 0 as the minimum value for Endangered Species from 0 to 100 meters.

To Value Field: It is the maximum value for buffer, so select "Buffer To." For example, the model would consider 100 as the maximum value for Endangered Species from 0 to 100 meters.

Output value field: Select "Buffer_to"

Join Fields (optional): It is optional but if needed you can select all or some of the fields to show them in the attribute table.

Output Join Field: Join the rating table with the result of the analysis to get the output. Here "Buffer_To" is the common field to join the rating table and the result of the proximity analysis.

| ID | Buffer_From | Buffer_To | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | OS |
|----|--------------------|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| 1 | 0 | 100 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | 5 |
| 2 | 100 | 300 | -5 | -8 | -1 | -11 | -7 | -8 | -8 | -11 | -7 | -8 | 10 |
| 3 | 300 | 700 | 2 | -5 | 5 | -11 | -3 | -6 | -5 | -11 | -3 | -6 | 4 |
| 4 | 700 | 1500 | 5 | 1 | 7 | -11 | 3 | -1 | 1 | -11 | 3 | -1 | 2 |

Table A2: Rating Table for Endangered Species



Figure A5: Result of Proximity to Endangered Species Tool

Water Bodies



Figure A6: Proximity to Water Bodies Tool

Input Layer: Select the shape file for water bodies (SAhydrogena.shp) Output Rated Layer: Choose the location and name of the output file Selection Criteria: "TYPE" = 'Major Stream' OR "TYPE" = 'Major River' OR "TYPE" = 'Stream, Water Body' OR "TYPE" = 'Water Body'

Rating Table: A rating table for water bodies in mdb format (Rating.mdb\Prox_Wat) **From Value Field**: It is the minimum value for buffer, so select "Buffer From." For Example, the model would consider 0 as the minimum value for water bodies from 0 to 30 meters.

To Value Field: It is the maximum value for buffer, so select "Buffer To." For example, the model would consider 30 as the maximum value for water bodies from 0 to 30 meters.

Output value field: Select "Buffer_to"

Join Fields (optional): It is optional but if needed you can select all or some of the fields to show them in the attribute table.

Output Join Field: Join the rating table with the result of the analysis to get the output. Here "Buffer_To" is the common field to join the rating table and the result of the analysis.

| ID | Buffer_From | Buffer_To | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | OS |
|----|--------------------|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| 1 | 0 | 30 | -10 | -11 | -10 | -11 | -11 | -11 | -11 | -11 | -10 | -11 | 2 |
| 2 | 30 | 100 | -5 | -7 | 5 | -11 | -5 | -11 | -5 | -11 | -3 | -11 | 5 |
| 3 | 100 | 200 | 2 | 0 | 7 | -7 | 1 | -5 | 2 | -5 | 3 | -3 | 7 |
| 4 | 200 | 1000 | 9 | 5 | 8 | 0 | 7 | 1 | 7 | 2 | 8 | 5 | 8 |

 Table A3: Rating Table for Water Bodies



Figure A7: Result of Proximity to Water Bodies Tool

Wetlands



Figure A8: Proximity to Wetlands Tool

Input Layer: Select the shape file for wetlands (edw_lulc_landcover.shp) Output Rated Layer: Choose the location and name of the output file Selection Criteria: "LABEL" = 'WOODY WETLAND'

Rating Table: A rating table for water bodies in mdb format (Rating.mdb\Prox_Wet) **From Value Field**: It is the minimum value for buffer, so select "Buffer From." For Example, the model would consider 0 as the minimum value for wetlands from 0 to 30 meters.

To Value Field: It is the maximum value for buffer, so select "Buffer To." For example, the model would consider 30 as the maximum value for wetlands from 0 to 30 meters. **Output value field**: Select "Buffer to"

Join Fields (optional): It is optional but if needed you can select all or some of the fields to show them in the attribute table.

Output Join Field: Join the rating table with the result of the analysis to get the output. Here "Buffer_To" is the common field to join the rating table and the result of the analysis.

| ID | Buffer_From | Buffer_To | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | OS |
|----|--------------------|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| 1 | 0 | 30 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | 2 |
| 2 | 30 | 100 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | 7 |
| 3 | 100 | 280 | 1 | -3 | 5 | -5 | -1 | -2 | -3 | -5 | -1 | -2 | 6 |
| 4 | 280 | 1000 | 8 | 3 | 10 | -1 | 7 | 0 | 3 | -1 | 7 | 0 | 3 |

Table A4: Rating Table for Wetlands



Figure A9: Result of Proximity to Wetland Tool

Appendix B: Accessibility Tool

Factors: Airport, Employment Centers, Intersection, Shopping Centers

Figures B1 through B8 and Tables B1 through B4 present information about these four factors.

Airport



Figure B1: Accessibility to Airport Tool

Network: It is the network of roads and highways for the study area. Select the existing transportation (roads, highways) network from the geodatabase

(2030_Highway_2010_ND.nd)

Intersection Layer: Shape file for airports (airfields_bts.shp)

Expression (optional): To specify the input layer if needed, here it is "FAC_TYPE" = 'AIRPORT'

Default break values (Measurement Units): Here the distance category is 1000, 5000, 10,000, 15,000, and 20,000 feet.

Rating Table: A rating table for intersection layer in .mdb format from the geodatabase (Rating.mdb\Acs_Air)

Output Join Field: Join the rating table with the result of the analysis to get the output. Here select "Category" because it is the common field to join the rating table and the result of the analysis.

Output Layer: Name and specify the location of the output. A raster file will be produced.

Impedance Attribute: Unit of measurement (feet, miles, etc).

| ID | Category | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | OS |
|----|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| 1 | 1000 | -10 | -5 | -10 | -3 | -4 | -5 | -5 | -10 | -5 | -10 | 0 |
| 2 | 5000 | -5 | -3 | -7 | -1 | -2 | -4 | -3 | -9 | -2 | -9 | 1 |
| 3 | 10000 | 0 | 0 | 0 | 1 | 2 | -3 | 0 | -8 | 0 | -8 | 4 |
| 4 | 15000 | 2 | 1 | 1 | 2 | 4 | 0 | 1 | 0 | 4 | 0 | 5 |
| 5 | 20000 | 3 | 2 | 5 | -1 | 6 | 3 | 2 | 0 | 6 | 2 | 7 |

Table B1: Rating Table for Airport



Figure B2: Result of Accessibility to Airport Tool

Employment Centers

| · · · · · | | | |
|--|--|---------|--------|
| 🗄 🧕 Spatial Analyst Tools | • 12 Accessibility to Employment Centers | | X |
| 🕀 👰 Spatial Statistics Tools | | | |
| 🛨 🧕 Tracking Analyst Tools | Network | | |
| E 🚳 TxDOT Model | C:\Ali\TxDOT\ThirdRun\SHP\2030 Highway 2010 ND.nd | | |
| E-S 01 Rating | Interceptions Lawer | | |
| 10 Proximity | | | |
| 10 Proximity to Endangerous Species | C:\Ali\TxDOT\FirstModel\SHP\emp_cntr.shp | | |
| >> 10 Proximity to Highway | Expression (optional) | | |
| 10 Proximity to Water Bodies | "NUMBER_EMP" >100 | | |
| 10 Proximity to Wetlands | Default break values (optional) | | |
| 11 Reduce Cell Size | | | |
| 12 Accessibility | Pating Table | | |
| 12 Accessibility to Airport | | | |
| 12 Accessibility to Employment Center: | C:(All(TXDOT(ThirdRun(Rating.mdb(Acs_Emp | | |
| 12 Accessibility to Intersection | Output Join Field | | |
| 12 Accessibility to Shoping Centers | Acs_Ints | - | |
| 13 Assignment Feature | Output Layer | _ | |
| 13 Karst Zones Rating Layer | C:\Ali\TxDOT\ThirdRun\Result\Temp\Reclass_SAPo2_CopyRasb | | |
| 13 Land Use Rating Layer | Impedance attribute | | |
| 24 TEAP Rating Layer | Feet | - | |
| E Solution Strength S | 1 | | \sim |
| 🖽 🕎 U3 Allocation | | | 1 |
| assign | OK Cancel Environments Show | Help >> | > |
| 🐘 🐷 suitability | | | |

Figure B3: Accessibility to Employment Centers Tool

Network: Select the existing transportation (roads, highways) network from the geodatabase (2030_Highway_2010_ND.nd)

Intersection Layer: Shape file for employment centers (emp_cntr.shp)

Expression (optional): To specify the input layer if needed, here it is "NUMBER_EMP" >100

Default break values (Measurement Units): Here the distance category is 1000, 5000, 10,000, 15,000, and 20,000 feet.

Rating Table: Rating table for intersection layer in .mdb format from the geodatabase (Rating.mdb\Acs_Emp)

Output Join Field: Join the rating table with the result of the analysis to get the output. Here select "Category" is the common field to join the rating table and the result of the analysis.

Output Layer: Specify the location and name of the output. A raster file will be produced.

Impedance Attribute: Unit of measurement (feet, miles, etc).

| ID | Category | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | OS |
|----|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| 1 | 1000 | -10 | 7 | -10 | -10 | 10 | -10 | 7 | -10 | 10 | -10 | 0 |
| 2 | 5000 | 0 | 8 | -2 | -7 | 8 | -5 | 8 | -7 | 8 | -5 | 2 |
| 3 | 10000 | 3 | 6 | 1 | -3 | 5 | -1 | 6 | -3 | 5 | -1 | 4 |
| 4 | 15000 | 2 | 1 | 3 | -1 | 0 | 0 | 1 | -1 | 0 | 0 | -1 |
| 5 | 20000 | -1 | 0 | -5 | 0 | -1 | 1 | 0 | 0 | -1 | 1 | -5 |

 Table B2: Rating Table for Employment Centers



Figure B4: Result of Accessibility to Employment Centers Tool

Intersection



Figure B5: Accessibility to Intersection Tool

Network: Select the existing transportation (roads, highways) network from the geodatabase (2030_Highway_2010_ND.nd)

Intersection Layer: Shape file for intersection (Intersection.shp)

Expression (optional): To specify the input layer if needed, here not needed.

Default break values (Measurement Units): mile for Intersection. Here the distance category is 0.5, 1, 2, and 3 miles

Rating Table: Rating table for intersection layer in .mdb format from the geodatabase (Rating.mdb\Acs_Ints)

Output Join Field: Join the rating table with the result of the analysis to get the output. Here select "Category" because it is the common field to join the rating table and the result of the analysis.

Output Layer: Specify the location and name of the output. A raster file will be produced.

Impedance Attribute: Unit of measurement (feet, miles, etc).

| ID | Category | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | OS |
|----|----------|----|-----|----|-----|-----|-----|-----|-----|-----|-----|----|
| 1 | 500 | -3 | -3 | -5 | -10 | -1 | -10 | -1 | -10 | -1 | -10 | -1 |
| 2 | 2000 | 1 | 0 | 0 | -6 | 5 | -5 | 0 | -6 | 5 | -5 | 1 |
| 3 | 5000 | 3 | 7 | 2 | -3 | 2 | -1 | 7 | -3 | 2 | -1 | 4 |
| 4 | 10000 | 2 | -1 | 5 | 1 | -7 | 1 | -2 | 1 | -7 | 1 | 0 |

Table B3: Rating Table for Intersection



Figure B6: Result of Accessibility to Intersection Tool

Shopping Centers



Figure B7: Accessibility to Shopping Centers Tool

Network: Select the existing transportation (roads, highways) network from the geodatabase (2030_Highway_2010_ND.nd)

Intersection Layer: Shape file for shopping centers (shp_cntr.shp)

Expression (optional): To specify the input layer if needed, here it is not needed. **Default break values** (Measurement Units): Here the distance category is 1000, 5000, 10,000, 15,000, and 20,000 feet.

Rating Table: Rating table for intersection layer in .mdb format from the geodatabase (Rating.mdb\Acs_Shp)

Output Join Field: Join the rating table with the result of the analysis to get the output. Here select "Category" t is the common field to join the rating table and the result of the analysis.

Output Layer: Specify the location and name of the output. A raster file will be produced.

Impedance Attribute: Unit of measurement (feet, miles, etc).

| ID | Category | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | OS |
|----|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|
| 1 | 1000 | -10 | 7 | -10 | -10 | 10 | -10 | 7 | -10 | 10 | -10 | 0 |
| 2 | 5000 | 0 | 8 | 0 | -7 | 8 | -5 | 8 | -7 | 8 | -5 | 3 |
| 3 | 10000 | 3 | 6 | 1 | -3 | 7 | -1 | 6 | -3 | 5 | -1 | 5 |
| 4 | 15000 | 0 | 1 | 0 | -1 | 0 | 0 | 1 | -1 | 0 | 0 | 0 |
| 5 | 20000 | -6 | 0 | -5 | 0 | -1 | 1 | 0 | 0 | -2 | 1 | -3 |

Table B4: Rating Table for Shopping Centers



Figure B8: Result of Accessibility to Shopping Centers Tool

Appendix C: Assignment Tool

Factors: Land Use, Karst, Texas Ecological Assessment Protocol (TEAP)

Figures C1 through C6 and Tables C1 through C3 present information about these three factors.

Land Use



Figure C1: Assignment Tool for Land Use

Input Layer: Select the shape file for land use (LU_2005.shp) Expression (optional): Not required Value Field: Specify the value field, here it is "LU_1Dig" Rating Table: Rating table of land use in mdb format (Rating.mdb\LU_Inv) Join Field: Join the rating table with the result of the analysis to get the output. Here the common join field is "LU_1Dig" lu_Inv_rt05: lu_inv_rt05 Join Fields (optional): It is optional but if needed you can select all or some of the fields to show them in the attribute table.

| ID | LU_Code | Category | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | LU_1Dig | OS |
|----|---------|--|-----|-----|---------|-----|-----|-----|-----|-----|-----|-----|---------|-----|
| 1 | A | Single Family Residential | -11 | -11 | - 11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | 1 | -11 |
| 2 | В | Multifamily Residential | -11 | -11 | - 11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | 2 | -11 |
| 3 | C | Vacant Lots and Tracts | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 3 | 10 |
| 4 | D | Qualified Agricultural Land | 0 | -5 | 5 | -5 | -5 | -5 | -5 | -7 | -2 | -5 | 4 | 10 |
| 5 | E | Farm and Ranch Improvements | 0 | -5 | 5 | -5 | -5 | -5 | -5 | -7 | -2 | -5 | 5 | 10 |
| 6 | F | Commercial | -11 | -11 | - 11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | 6 | -11 |
| 7 | G | Oil, Gas, and Other Minerals | -11 | -11 | - 11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | 7 | -11 |
| 8 | Н | Non business vehicles _tangible personal property | -11 | -11 | - 11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | 8 | -11 |
| 9 | J | Utilities | -11 | -11 | - 11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | 9 | -11 |
| 10 | M | Mobile Homes | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 |

Table C1: Rating Table for Existing Land Use



Figure C2: Result of Assignment of Land Use Tool

Karst

Input Layer: Select the shape file for Karst (KarstZones.shp)
Value Field: Specify the value field; here it is "Zone_"
Rating Table: Rating table of Karst in mdb format (Rating.mdb\Karst)
Join Field: Join the rating table with the result of the analysis to get the output. Here the common join field is "Code"
Karst_rt05: karst_rt05

Join Fields (optional): It is optional but if needed you can select all or some of the fields to show them in the attribute table.

| þ | 13 Karst Zones Rating Layer | |
|---|---|---|
| | Input Layer | ^ |
| | C:\Ali\TxDOT\FirstModel\SHP\KarstZones.shp | |
| | Value field | |
| | ZONE_ | |
| | Rating Table | |
| | C:\Ali\TxDOT\ThirdRun\Rating.mdb\Karst | |
| | Join Field | |
| | Code | |
| | karst_rt05 | |
| | C:\Ali\TxDOT\ThirdRun\Result\2005\karst_05 | |
| | Join Fields (optional) | |
| | Category Code MF BHC SF BHI BLC BLI SHC | |
| | Select All Unselect All Add Field | ~ |
| | OK Cancel Environments << Hide Help | > |

Figure C3: Assignment Tool for Karst

| | | | | | | Ка | irst | | | | | | | |
|----|----------|------|----|-----|----|-----|------|-----|-----|-----|-----|-----|-----|----|
| ID | Category | Code | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | ID1 | OS |
| 1 | Zone 1 | 1 | -8 | -10 | -3 | -10 | -10 | -10 | -10 | -10 | -10 | -10 | 1 | 8 |
| 2 | Zone 2 | 2 | -6 | -10 | -1 | -10 | -8 | -10 | -10 | -10 | -8 | -10 | 2 | 10 |
| 3 | Zone 3 | 3 | -2 | -7 | 2 | -10 | -4 | -7 | -7 | -10 | -4 | -7 | 3 | 6 |
| 4 | Zone 4 | 4 | 0 | -3 | 4 | -8 | -2 | -8 | -3 | -8 | -2 | -7 | 4 | 0 |



Figure C4: Result of Assignment of Karst Tool

TEAP

Composite: Select the composite layer for TEAP. It is one of the layers in TEAP dataset that includes the mean value of other of TEAP factors, which are diversity, rarity, and sustainability.

Teap_rt05: Specify the output raster layer, which include the rating for different land uses.

TEAP: A rating table of TEAP (Rating.mdb\TEAP)

From value field: "Category_From"

To value field: "Category_To"

Output value field: Specify the common field for joining the rating table to TEAP layer. **Output Join Field:** Specify the common field for joining the rating table to TEAP layer **Join Fields (optional):** Specify the field that needs to be included in final output layer, which are the rating for all the land uses.

| 14 TEAP Rating Layer | | | | |
|---|----|--------|--------------|--------------|
| composite | | | | 🗠 |
| C:\Ali\TxDOT\Sources\teap_report_data\composite | | | | 🖻 |
| teap_rt05 | | | | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\teap_05 | | | | 🗃 |
| TEAP | | | | |
| C:\Ali\TxDOT\ThirdRun\Rating.mdb\TEAP | | | | 🚘 |
| From value field | | | | |
| Category_From | | | | - |
| To value field | | | | |
| Category_To | | | | - |
| Output value field | | | | |
| Category_To | | | | – |
| Output Join Field | | | | |
| Category_To | | | | _ |
| | | | | |
| Category_From | | | | = |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | ~ |
| | | | | > |
| Select All Unselect All | | | | Add Field |
| | | | _ | |
| | | | | ~ |
| | ок | Cancel | Environments | << Hide Heln |
| | | Cancor | | |

Figure C5: Assignment Tool for TEAP

| | | | | | ****** | , 1 u.v. | | / | | | | | | | |
|------------|------|---|----------|-------------|--------|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|----|
| Category_F | romI | D | Category | Category_To | MF | BHC | SF | BHI | BLC | BLI | SHC | SHI | SLC | SLI | OS |
| 0 | | 1 | 1 | 1 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | -11 | 10 |
| 1 | | 2 | 10 | 10 | -2 | -6 | -1 | -8 | -4 | -6 | -6 | -8 | -4 | -6 | 10 |
| 10 | | 3 | 25 | 25 | 4 | -1 | 8 | -6 | 0 | -2 | -1 | -6 | 0 | -2 | 8 |
| 25 | 4 | 4 | 50 | 50 | 9 | 3 | 10 | -2 | 5 | 0 | 4 | -2 | 7 | 0 | 4 |
| 50 | 1 | 5 | 100 | 100 | 0 | 0 | 0 | 4 | 0 | 5 | 0 | 6 | 0 | 7 | 1 |

Table C3: Rating Table for TEAP



Figure C6: Result of Assignment of TEAP Tool

Appendix D: Allocation Toolset

Combination of all the rated and weighted maps is shown in Figures D1 through D24.

Combination for 2010

This process involves combining all the suitability layers of each land use for year 2010 and generating a composite suitability map.

| 31 Combine the Suitability Layers 2010 | |
|--|----------|
| Comb_5Us_10 | <u>^</u> |
| C:\Ali\TxDOT\ThirdRun\Result\2010\Comb_SA_10 | 2 |
| su_sli_10 | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\su_sli_10 | 2 |
| su_slc_10 | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\su_slc_10 | 2 |
| su_shi_10 | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\su_shi_10 | 2 |
| su_shc_10 | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\su_shc_10 | 2 |
| su_sf_10 | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\su_sf_10 | 2 |
| su os 10 | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\su_os_10 | |
| su_mt_10 | a |
| C:\Ali\TxDOT\ThirdRun\Result\2010\su_mt_10 | |
| su_bli_10 | a |
| C:(Ali) 1xDOT) ThirdRun(Result)2010(su_bli_10 | |
| su_bic_10 | 2 |
| C:(All(1xDO)(Inirakun(kesult)2010(su_bic_10 | |
| | ~~ |
| i C:(All(1xDO)()Inirakan(kesul(2010(sd_bni_10 | |
| | |
| C. (with you firm an and westing strated and the Transient Strategy and the Strategy and th | |
| OK Cancel Environments << Hi | de Help |

Figure D1: Allocation Tool to Combine Suitability Layers

Result

Darker area represents available land for development.



Figure D2: Result of Allocation Tool Showing Available Land for Development

Open Space

| ▶ 327 Allocating OS | |
|---|-------------------------------------|
| comb_sus_10 | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\comb_sus_10 | |
| value_field | |
| TIMES_SU_OS_1 | ▼ |
| new_field | |
| os | |
| req_area | 147200 |
| | 14/200 |
| | OK Cancel Environments << Hide Help |

Figure D3: Allocation Tool for Open Space



Figure D4: Allocated Open Space

Single Family (SF) 2010

| ► 326 Allocating SF | |
|---|------------------------|
| comb_sus_10 | × |
| C:\Ali\TxDOT\ThirdRun\Result\2010\comb_sus_10 | |
| value_field | |
| TIMES_SU_SF_2 | • |
| new_field | |
| SF | |
| req_area | |
| | 3756887363 |
| | OK Cancel Environments |

Figure D5: Allocation Tool for Single Family



Figure D6: Allocated Single Family

Multi Family (MF)

| 🐂 325 Allocating MF | |
|---|-------------------------------------|
| comb_sus_10 | A |
| C:\Ali\TxDOT\ThirdRun\Result\2010\comb_sus_10 | ≧ |
| value_field | |
| TIMES_SU_MF_2 | |
| new_field | |
| MF | |
| req_area | 57042047 |
| | 57042047 |
| | OK Cancel Environments << Hide Help |

Figure D7: Allocation Tool for Multi Family



Figure D8: Allocated Multi Family

Basic Heavy Industrial (BHI)

| 🐂 321 Allocating BHI | |
|--|-------------------------------------|
| comb_sus_10 C:\Ali\TxDOT\ThirdRun\Result\2010\comb_sus_10 | |
| value_field TIMES_SU_BHI2 | |
| new_field BHI | |
| req_area | 606978 |
| | OK Cancel Environments << Hide Help |

Figure D9: Allocation Tool for Basic Heavy Industrial



Figure D10: Allocated Basic Heavy Industrial

Basic Light Industrial (BLI)

| * 323 Allocating BLI | |
|----------------------|-------------------------------------|
| comb_sus_10 | @ |
| value_field | |
| TIMES_SU_BLI2 | v |
| BLI | |
| req_area | 0 |
| | OK Cancel Environments << Hide Help |

Figure D11: Allocation Tool for Basic Light Industrial



Figure D12: Allocated Basic Light Industrial

Service Heavy Industrial (SHI)

| 🕶 328 Allocating SHI | |
|---|-------------------------------------|
| comb_sus_10 | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\comb_sus_10 | |
| value_field | |
| TIMES_SU_SHI2 | ▼ |
| new_field | |
| SHI | |
| req_area | |
| | 11350782 |
| | OK Cancel Environments << Hide Help |

Figure D13: Allocation Tool for Service Heavy Industrial



Figure D14: Allocated Service Heavy Industrial

Service Light Industrial (SLI)

| 32X Allocating SLI | |
|---|-------------------------------------|
| comb_sus_10 | <u> </u> |
| C:\Ali\TxDOT\ThirdRun\Result\2010\comb_sus_10 | |
| value_field | |
| TIMES_SU_SLI2 | |
| new_field | |
| SLI | |
| req_area | |
| | 1078347 |
| | OK Cancel Environments << Hide Help |

Figure D15: Allocation Tool for Service Light Industrial



Figure D16: Allocated Service Light Industrial

Basic High Commercial (BHC)

| :omb_sus_10 | | | |
|---|--|--|---|
| C:\Ali\TxDOT\ThirdRun\Result\2010\comb_sus_10 | | | í |
| value_field | | | |
| TIMES_SU_BHC2 | | | - |
| new_field | | | |
| BHC | | | |
| eq_area | | | |

Figure D17: Allocation Tool for Basic High Commercial



Figure D18: Allocated Basic High Commercial

Basic Low Commercial (BLC)

| 324 Allocating BLC | |
|---|-------------------------------------|
| comb_sus_10 | A |
| C:\Ali\TxDOT\ThirdRun\Result\2010\comb_sus_10 | |
| value_field | |
| TIMES_SU_BLC2 | • |
| new_field | |
| BLC | |
| req_area | |
| | 606978 |
| | OK Cancel Environments << Hide Help |

Figure D19: Allocation Tool for Basic Low Commercial



Figure D20: Allocated Basic Low Commercial

Service High Commercial (SHC)

| * 329 Allocating SHC | | |
|--|-------------|--------------|
| comb_sus_10 C:\Ali\TxDOT\ThirdRun\Result\2010\comb_sus_10 | | < |
| value_field TIMES_SU_SHC2 | | - |
| new_field SHC | | |
| req_area | | 308845 |
| | OK Cancel I | Environments |

Figure D21: Allocation Tool for Service High Commercial



Figure D22: Allocated Service High Commercial

Service Low Commercial

| 32XI Allocating SLC | |
|---|-------------------------------------|
| comb_sus_10 | A |
| C:\Ali\TxDOT\ThirdRun\Result\2010\comb_sus_10 | 🖉 🖉 |
| value_field | |
| TIMES_SU_SLC2 | ▼ |
| new_field | |
| Jarc | |
| req_area | 15561382 |
| | OK Cancel Environments << Hide Help |

Figure D23: Allocation Tool for Service Low Commercial



Figure D24: Allocated Service Low Commercial
Appendix E: Suitability Tool

After we get total land available for development, we perform suitability analysis for each land use based on the weight. See Figures E1 through E5.

| 5 | suitability | | | | | |
|---------|--------------|-------|----|--------|--------------|-------------|
| • i | input_layer | | | | | - 🚅 |
| | Raster | Field | | Weight | | + |
| | | | | | | \times |
| | | | | | | 1 |
| | | | | | | |
| | < <u> </u> | | | | | × |
| • | output_layer | | | | | 2 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | ОК | Cancel | invironments | < Hide Help |

Figure E1: Suitability Tool

Suitability for 2005

Here, a raster file of each suitability factor for Single Family (SF) land use with assigned weight is entered.

| 22 Suitability for Each Land-use 20 | 005 | | | | | |
|--|-------|--------|--------------|---|-----------|---|
| input layer | | | | | | ^ |
| | | | | | 2 | |
| - | | | | | | |
| Raster | Field | Weight | | ~ | + | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\p | SF | 0.0113 | | | <u> </u> | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\p | SF | 0.0523 | | | × | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\p | SF | 0.0303 | | | | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\t | SF | 0.0279 | | | ↑ | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\k | SF | 0.0285 | | | · · | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\a | SF | 0.1651 | | _ | | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\a | SF | 0.0846 | | | • | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\a | SF | 0.1416 | | | | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\a | SF | 0.1475 | | | | |
| | | | | 2 | | |
| Output Layer | | | | | | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\su_sf_05 | | | | | 2 | |
| sf_mask (optional) | | | | | | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\sf_mas | k | | | | 2 | ~ |
| | | OK Car | Environments | | Hide Help | |

Figure E2: Suitability Tool for 2005



Figure E3: Result Suitability 2005

Suitability for 2010

| 22 Suitability for Each Land-use 20 | 10 | | | | | |
|---|-------|----|--------|--------------|----------|------------|
| input_layer | | | | | | |
| | | | | | | |
| Raster | Field | | Weight | | ~ | + |
| C:\Ali\TxDOT\ThirdRun\Result\2010\p | SF | | 0.0113 | | | <u> </u> |
| C:\Ali\TxDOT\ThirdRun\Result\2010\p | SF | 1 | 0.0523 | | | × |
| C:\Ali\TxDOT\ThirdRun\Result\2010\p | SF | 1 | 0.0303 | | | • <u>·</u> |
| C:\Ali\TxDOT\ThirdRun\Result\2010\t | SF | | 0.0279 | | | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\k | SF | | 0.0285 | | | - |
| C:\Ali\TxDOT\ThirdRun\Result\2010\a | SF | | 0.1651 | | | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\a | SF | | 0.0846 | | | + |
| C:\Ali\TxDOT\ThirdRun\Result\2010\a | SF | 1 | 0.1416 | | | |
| C:\Ali\TxDOT\ThirdRun\Result\2010\a | SF | | 0.1475 | | M | |
| < | | | | | > | |
| Output Layer | | | | | | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\su_sf_0 | 15 | | | | | 2 |
| sf_mask (optional) | | | | | | |
| C:\Ali\TxDOT\ThirdRun\Result\2005\sf_mask | < | | | | | 2 |
| | | | | | | |
| | | ок | Cancel | Environments | <<+ | Hide Help |

Figure E4: Result Suitability 2010



Figure E5: Result Suitability Single Family 2010