

Buildout Population Projections

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TABLE OF CONTENTS

Table of Contents	1
Figures and Tables	2
Executive Summary/Abstract	3
Section 1 Introduction	5
DFW Population Growth	6
Purpose	7
Objectives	7
Report Structure	8
Section 2 Overview	9
General Overview of Method	10
Issues.....	19
Benefits	21
Section 3 Municipal Application	22
Comprehensive Plans.....	22
Section 4 Regional Application	27
Collin County Mobility Plan.....	27
Regional Travel Demand Modeling.....	31
Section 5 Conclusion	37
Keeping the Future in Mind	37
Policy Implications	37
Implementation of Validating Travel Demand Model with Ultimate Buildout	38
Setting a Vision for the Future	39
Still Evolving	39
Bibliography	40
Appendix	42
TSZ Comparisons NCTCOG 2040 and Collin County Buildout Scenario	42

Figures and Tables

Figures

- Figure 1. DFW Regional Map | Page 5
- Figure 2. Buildout Projection vs. 2015 Population for City of Frisco | Page 8
- Figure 3. Traffic Survey Zones for DFW | Page 10
- Figure 4. Buildout Population Formula | Page 13
- Figure 5. Additional Formulas for Buildout Population | Page 13
- Figure 6. TSZ in DFW with Future Land Use Mapped Over Vacant Areas | Page 16
- Figure 7. Suitability Map Used to Determine Location of Future Population in City of Arlington | Page 24
- Figure 8. Master Thoroughfare Plan for McKinney | Page 25
- Figure 9. 2014 Update to Collin County Mobility Plan | Page 26
- Figure 10. Average Density in Collin County by Quadrant | Page 29
- Figure 11. Summary of Method for NCTCOG Demographic Forecasting | Page 31
- Figure 12. TSZ Map of Collin County | Page 33
- Figure 13. TSZ 3388 (Aerial and Future Land Use) | Page 34
- Figure 14. TSZ 3081 (Aerial and Future Land Use) | Page 35

Tables

- Table 1. General Guidelines for Density Assumptions | Page 15
- Table 2. Example of Buildout Population Calculations | Page 17
- Table 3. Buildout Population Calculations from City of Melissa | Page 22
- Table 4. Buildout Population Calculations from City of Frisco | Page 23
- Table 5. Buildout Scenario Comparison by Planning Area | Page 28
- Table 6. 2015 Unconstrained Buildout Projections | Page 28
- Table 7. Projections for TSZ 3388 | Page 34
- Table 8. Projections for TSZ 3081 | Page 35

EXECUTIVE SUMMARY/ABSTRACT

Buildout population projections are used by various municipalities and entities to project the ultimate population, or carrying capacity, of a specific area. There are many methods used to calculate buildout population. It is generally done by identifying the highest allowed uses in the vacant areas, based on the future land use plan, and calculating the maximum number of households and population. The maximum population in the vacant areas is then added to the existing population in that area to get the buildout population. Municipalities generally use these type of projections in comprehensive plans to set a vision for the future and to know what the carrying capacity is for their city. The projections are also used to help inform the planning efforts for infrastructure and other city services. In addition to setting a vision for the future, entities have also used buildout population projections for informing their travel demand modeling. The buildout population allows transportation planners to run a transportation model based on the maximum capacity. The result of the travel demand model will give the transportation planner a “worst case scenario” in regard to the transportation network that would be needed to support the maximum population. The buildout scenario can also be used in conjunction with the regional travel demand forecasting conducted by local MPOs. The buildout scenario can help the MPO to efficiently allocate population in the TSZs because the buildout scenario uses land use to project the capacity for each TSZ. While buildout population projections can be very beneficial in city planning, it also has many issues. The first major issue is the assumptions that have to be made by planners in terms of future densities and patterns of development. The second major issue is the lack of time projections associated with buildout projections. While it is helpful to know the carrying capacity of a city, it would be more beneficial to have an idea of the timeline to reach buildout. Overall, the process is

not formal and technical; however, if the weaknesses of the process are understood and taken into consideration, it can be used to set a long-range vision for the future and strategically plan.

SECTION 1 | INTRODUCTION

What is the purpose of this report?

According to the United States Census, “projections are estimates of the population for future dates. They illustrate plausible courses of future population change based on assumptions...” (“Population Estimates Terms and Definitions”, US Census). Population projections are widely-used by planners to help gain an understanding of the amount of people that will need to be served by the city in the future. In addition to planners, many other entities used population projections for similar reasons, like school districts and water districts/river authorities. Population projections can be done in variety of ways. The most common way of projecting population is the method used by the U.S Census Bureau and the State Demographers. The Texas State Demographer, emphasizes that “projections involve the use of certain assumptions about future events that may or may not occur.” Existing demographic patterns are used and “they may not accurately project the future populations of the State or of particular counties in the State.” The State Demographer uses three types of scenarios to projecting population. For all scenarios total population is projected by age, sex, and race/ethnicity. The three scenarios are ‘Zero Migration’ (only birth and death), ‘One-Half 2000-2010 Migration’ (50% of the growth rate of the last 10 years), and ‘2000-2010 Migration’ (100% of the growth rate from the last 10 years). All of these projections are linear and do not take land use into account (“Projections of the Population of Texas...” page 11). These population projections are released annually and many municipalities and entities utilize these to plan for the future. While these population projections are very helpful for planning for the future, they are just lines in a chart representing past growth trends. As a city grows, its land will continue to be developed and eventually the city will become landlocked and redevelopment will began to happen; therefore, growth will slow-down at some point in time. This is where buildout population projections

can help planners to cast a vision of the far future and calculate, or project, how many households the land in their municipality can hold at maximum capacity.

DFW Population Growth

The Dallas-Ft. Worth (DFW) region is used in this report because the region makes an excellent case study due to the amount of population growth that is occurring. The DFW region, shown in **Figure 1**, is the fourth largest metropolitan area in the United States. The North Central Texas Council of Governments (NCTCOG) projects the region to be over ten million people by 2040, which is an additional four million people. This growth will require more planning and more infrastructure. The DFW region is unique because the growth is unconstrained, unlike other metropolitan areas. The region is over 100 miles away from the other urban cores in Texas (Austin/San Antonio and Houston). The DFW region is also a prime example for suburban growth rings. DFW contains four rings of growth with more growth on the way. Population projections are essential for planning in a regional like DFW because of the city's needs to build new infrastructure and provide services to the future population. Even with unconstrained growth in the region, buildout population projections will help the cities understand the size of their future populations.

Figure 1. DFW Regional Map



Source: snipview.com

Purpose

The main purpose of this report is a documentation of buildout population projections and their practical applications. This is because there is a lack of documentation in textbooks and other publications about buildout population projections.

Secondary Purpose

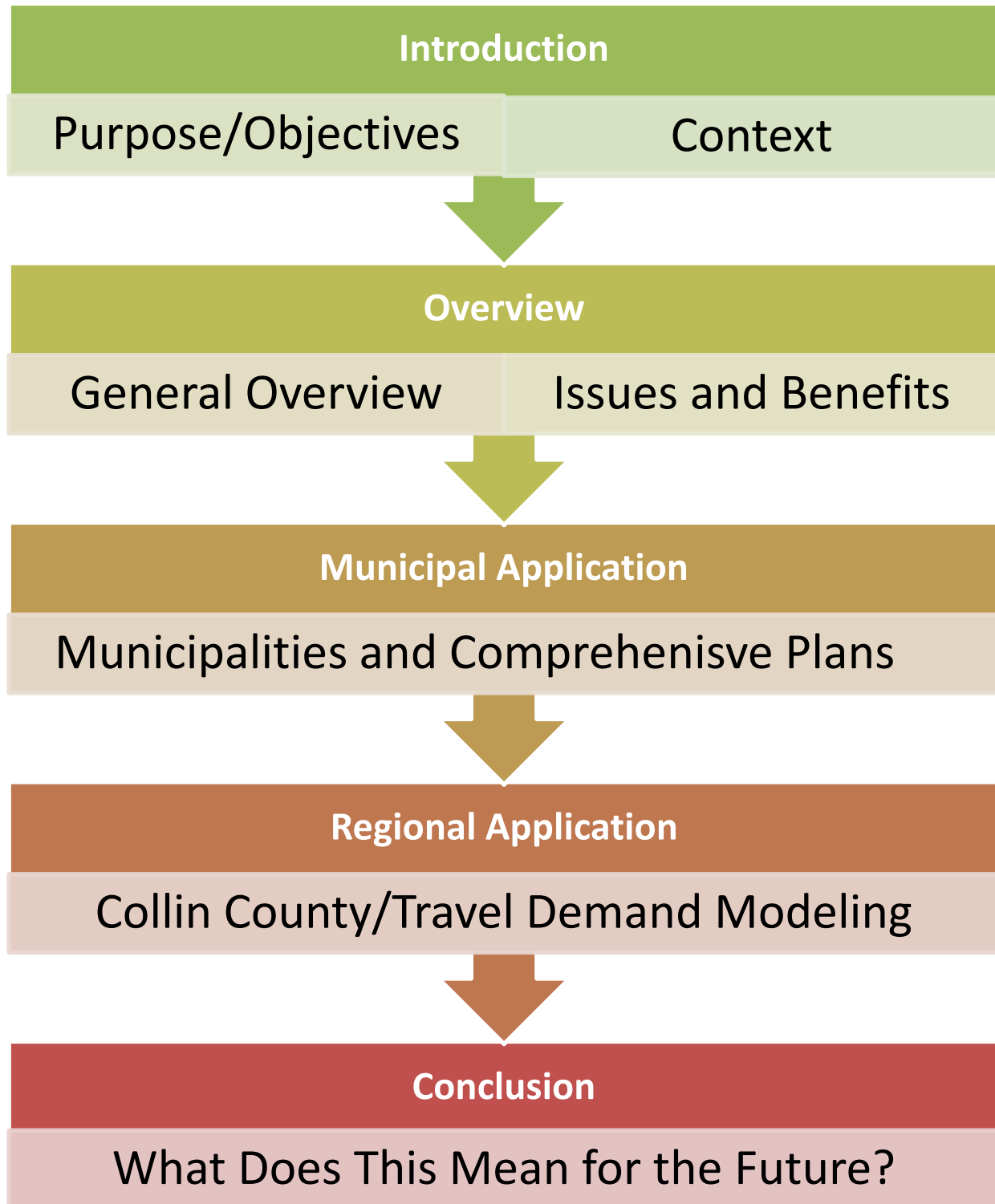
In developing the documentation of buildout population projections, a secondary purpose arose in regard to travel demand modeling. The secondary purpose will focus on the:

1. Application of buildout population projections used by Collin County; and
2. The implications that buildout population projections can have on demographic forecasting used by Metropolitan Planning Organizations (MPOs), which are ultimately used to model regional transportation patterns.

Objectives

The objectives of this report are:

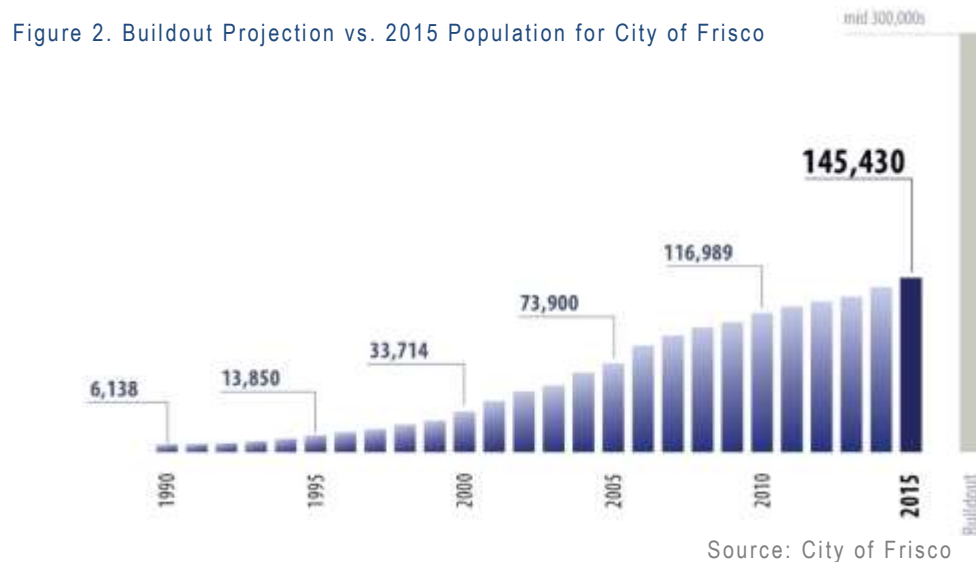
1. To inform the reader about what buildout population projections are,
2. To document the general method used,
3. To discuss the issues and benefits,
4. To explain the reasoning for Collin County's use of buildout population projections; and
5. To identify the need for buildout projections to be used in regional demographic forecasting.



SECTION 2 | OVERVIEW

What are buildout population projections?

Buildout projections are utilized to predict, or project, the maximum number of housing units that can be built inside a municipality’s jurisdiction and current zoning. Depending on the size of the municipality, the process can be tedious and time-consuming. The future land use maps and zoning maps are analyzed together to determine how much land is vacant, but has the possibility of being developed in the future. The analysis excludes land like wetlands, conservation areas, floodplain, parks, and steep topography because the likelihood of this type of land being developed is very low. Based on the municipality’s plans, planning and density assumptions are made for the vacant areas. Municipalities can reach a buildout population at any time, depending on the rate of construction, migration, and the amount of available land (“Summary Guide to Population Projections...”). Buildout projections are very loosely-defined and use by planners in a variety of ways. Since buildout projects are loosely defined and not documented in the form of a technical method, there are many issues and critiques that will be discussed later in this report; however, there are also a number of benefits and interesting approaches to buildout projections that will also be discussed. **Figure 2** is an example of projections from the City of Frisco.

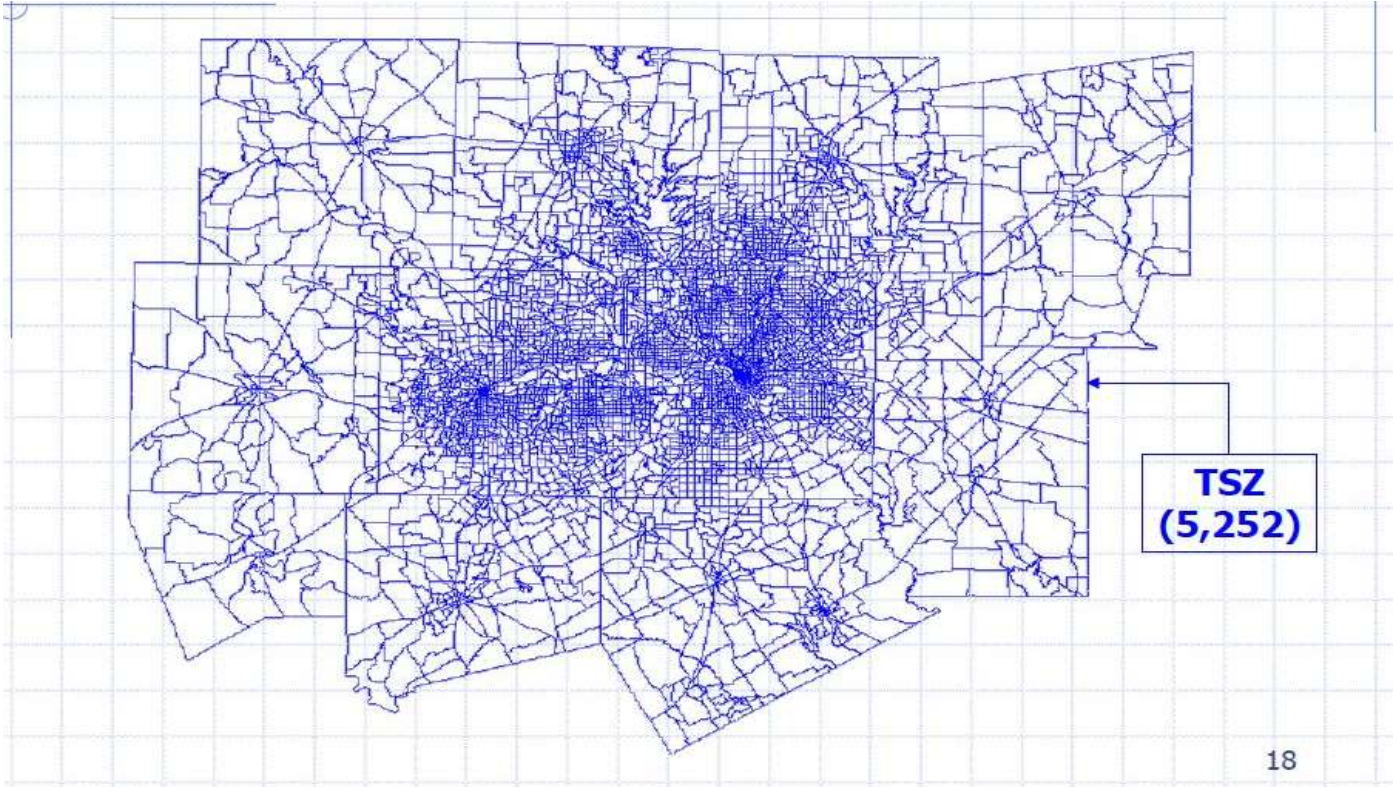


General Overview of Method

Study Area

The first step of this method is to define the study area that buildout projections are to be created for. This method can be applied to virtually any size area; however, the length of time required to complete the projections will increase as the study area gets larger. Generally, a shape file is set up in ArcGIS with a current aerial as a base map. It is recommended to divide the study area into smaller sections to allow the planner to drill down further into the projections. If the study area is not broken down, then the final data will only be applicable to the entire study area. If the study area is broken down into smaller sections, the data can be compiled for the specific sections within the study area. In addition, the existing population for each section, or study area, must be gathered. Depending on how the planner divides the study area, finding the existing population for the sections may be challenging. Many Metropolitan Planning Organizations (MPOs) use traffic survey zones (TSZs) in their transportation work. These TSZs are recommended for dividing up the study area. For most areas, the TSZ structure shape file for ArcGIS and existing populations for each TSZ are available for download online. **Figure 3** shows the TSZ structure for DFW, which is used by the North Central Texas Council of Governments (NCTCOG). It is important to use the most recent version of the TSZ structure and corresponding existing populations. This will save the planner a significant amount of time. The TSZs can then be added up to create buildout population projections for specific areas inside the study area (Harrison, 2013).

Figure 3. Traffic Survey Zones for DFW



Source: North Central Texas Council of Governments

Data Compilation

The next step is to gather data from study area. If the study area spans multiple municipalities, then data is needed from each municipality. Generally, the following items are needed:

- Comprehensive Plans
- Small Area Plans
- Future Land Use Plan (and the corresponding dwelling units per acre for each designation)
- Previous Population Projections
- Zoning Map

If a municipality does not have a comprehensive plan or small area plans, then general planning assumptions will need to be made for that area in order to project buildout population. At the very least, municipalities will have a zoning map – with exception of a few – and this map can be helpful in making planning assumptions for future development (Harrison, pg. 1, 2013).

Identify Vacant Land

The next step after the study area is defined and the necessary data is gathered is to identify the vacant land in the study area. An aerial base map should be used that matches the existing population used. For example, if the planner gathered the MPO TSZs and existing populations for 2012 then the 2012 aerial base map should be used. It is critical that the base map and existing population numbers are from the same year. The vacant land can then be identified and mapped in ArcGIS in the manner that best suits the planner. Generally, it is easiest to draw transparent polygons over the vacant areas. (Harrison, pg. 2, 2013).

Mapping the Future Land Use Plan(s)

After the vacant areas are mapped, the future land use plan(s) need to be mapped in the vacant areas. If more than one municipality is in the study area, a new set of universal future land use designations and colors needs to be created to ensure consistency, since each municipality generally uses different land use designations and colors. It is important the dwelling units per acre (DUA) were collected during the data compilation phase. This will assist the planner in creating new future land use designations. For example, the planner could establish that rural density single-family residential will be 0.5 to 1 DUA, low density single-family residential will be 1.5 to 3 DUA and urban density single-family residential will be 3.5 to 6 DUA. Then when looking each municipality's future land use plan, the planner can easily convert to the universal designations. Again, the universal designations are only needed if there are multiple municipalities in the study area. If the study area only spans over one municipality, then that municipality's future land use designations can be used (Harrison, pg. 2, 2013).

Calculating Buildout Projections

This part of the process is completely up to the planner performing the projections. Some planners have a preference to do all calculations by hand, while others like to do their calculations on the computer – typically in a Microsoft Excel document. The set-up of the Microsoft Excel document is also completely up to the planner performing the projections. There are basic formulas and guidelines for buildout population projections, but the set-up of the spreadsheet depends on the preferences of the planner. **Figure 4** and **Figure 5** are a general approaches to calculations. It is important to remember that if the study area spans more than one municipality, the information for each will need to be composed to form the final data for the entire study area. If the study area spans only one municipality, then the planner’s job will be easier (Harrison, pg. 2, 2013).

Figure 4. Buildout Population Formula

Existing Population + Maximum Population for Vacant Area = **Buildout Population**

The formula above is the simplest way to explain how to calculate buildout population. The way in which the planner applies and uses the formula to calculate the buildout population for the entire study area is up to their discretion; however it is important to note that this formula cannot just be applied across the board for the entire study area. Each future land use designation has a different dwelling units per acre (DUA) assigned to it, based on the municipality’s plans; therefore, each vacant area has to be calculated independently and added up at the end of the process to calculate the buildout population.

Figure 5. Additional Formulas for Buildout Population

Acres of Vacant Land x DUA from the Future Land Use Plan = **Max. Dwelling Units for Vacant Land**

(Max. Dwelling Units for Vacant Land x PPH*) x Occupancy Rate** = **Max. Population for Vacant Area**

*PPH = Persons per Household (Use the PPH from the US Census Bureau)

**Use the occupancy rate from the US Census Bureau

Unique Factors

It is important to make sure that the buildout population projections are as accurate as possible. There are many unique factors that can be added into the buildout population projections to help achieve accuracy.

Non-Residential Uses

Even though the buildout population projections are used to project the number of residents, non-residential factors still have to be taken into consideration. When mapping or identifying the vacant areas, it is important to note which vacant areas are designated for non-residential uses on the future land use plan(s). This is extremely important because the non-residential areas should not be factored into the buildout population projects.

Roadways

The formulas in **Figure 5** calculate the future population for the entire vacant area. As planners, we know that roadways, or right-of-way for future roadways, must be incorporated into the calculations. As a general rule of thumb, thirty percent of the acreage should be taken out to account for future roadway right-of-way (Harrison, pg. 2, 2013).

Environmental Factors

It is also important to take an environmental factors into account and remove that land area from the calculations. Floodplain, rivers, lakes, environmentally-sensitive areas, and endangered habitats are examples of environmental factors that should be taken into consideration.

Occupancy Rate and Persons per Household

The occupancy rate and persons per household for the planning area can be taken from the US Census to help predict the number of people that will be living in the future households.

Underutilized Property

Generally, buildout population projections only look at vacant land; however, adding in the analysis of underutilized property would help to make the buildout population projections more accurate. For example, certain areas might redevelop over time to a higher density or completely different uses. An aging commercial strip mall could be redeveloping to a primarily residential mixed use area. These types of considerations are critical to include in the buildout population projection calculations.

Vacant Areas without Future Land Use Plans

Some areas may not have plans; therefore, planning assumptions will have to be made. **Table 1** shows general planning assumptions and best practices for density (Harrison, pg. 2, 2013).

Table 1. General Guidelines for Density Assumptions

Single-Family Residential	Urban: 3.5 to 6 DUA
	Semi-Urban: 1 to 3.5 DUA
	Rural: 0.75 DUA and lower
Mixed Use	70% residential to 30% nonresidential
	80% residential to 20% nonresidential
Multi-Family	16 to 24 DUA
Medium Density Residential	8 to 12 DUA

Source: Freese and Nichols, Inc.

Figure 6 is a screenshot of a TSZ from DFW. The vacant areas were assigned a Future Land Use category based on the City’s future land use map. There are mixed use areas, single-family residential, commercial, and retail. **Table 2** is an outline of the calculation for the TSZ shown in **Figure 6**. There are 130 acres of vacant land that is assigned to single-family. According to the Future Land Use Plan, this single-family development will occur at 4 DUA. There is also an area of 25 vacant areas that is planned for high-density apartments at 24 DUA. Additionally, there is 241 vacant areas that was assigned to mixed use that will develop at a ratio of 20% residential to 80% non-residential. Before calculations can occur, 30% must be taken out of the acreages to account for roadway right-of-way.

Table 2. Example of Buildout Population Calculations

<p>Single-Family</p> <p>30% of 130 acres = 91</p> <p>91 x 4 DUA = <u>364 total new units</u></p>
<p>Multi-Family</p> <p>30% of 25 acres = 17.5</p> <p>17.5 x 24 DUA = <u>420 total new units</u></p>
<p>Mixed Use</p> <p>30% 241 acres =168.7</p> <p>168.7 x 20% = 33.7 residential acres</p> <p>33.7 acres x 24 DUA = <u>809 new units</u></p>
<p>Buildout Population for TSZ</p> <p>365 + 420 + 809 = <u>1,594 total new units</u></p> <p>1,594 new units x 94.3% occupancy rate = <u>1,498 total new households</u></p> <p>1,498 total households x 2.786 PPH = <u>4,174 total new population</u></p> <p>4,174 total new population + 6,162 existing population = <u>10,336 ultimate population</u></p>

Issues

Assumptions

One of the major issues and critiques of buildout population projections is the guess work that is required to produce the projections. A planner developing a buildout population scenario has to make assumptions about density in vacant areas that do not have plans. If the area does have plans, the planner is still making assumptions about the amount and general location of non-residential uses and right-of-way. As discussed in the overview section, a safe planning assumption is to take out 30% for roadways and right-of-way; however, planning practices are always changing and maybe different in the future. The push toward nodal development and reduced vehicle miles travelled might lessen the amount of roadway right-of-way needed for future development, or planning practices could swing in the opposite direction in the future to push for wider roadways. Generally, buildout projections are based on the future land use plans and the associated densities; however, comprehensive are evolving documents and are updated periodically. Since the comprehensive plans are always evolving, can buildout every truly be reach in a city or an area? Even a land-locked city with little to no vacant land will still have some population fluctuation based on migration and redevelopment. It is very hard to predict the redevelopment trends in a city, because it solely depends on the private market and the future trends. A built-out area in town will eventually age and become dilapidated, if it's not properly maintained over time. A planner conducting a buildout scenario cannot predict this situation and definitely cannot predict if a developer will redevelop at the same density or level the site and rebuild at a lower or higher density. The future is unknown and planners are only able to make assumptions based on the knowledge they have in the present time.

Lack of Time Projection

Another major issue and critique of buildout population projects is the lack of time projections associated with the scenario. While it is very helpful to see what the carrying capacity of a city or area could be, projecting a timeframe would better assist city leaders in planning for future infrastructure and services. If the city leaders have a general estimate of the time frame, the necessary infrastructure improvements can be scheduled in phases. This allows the City to still be proactive, while being cost-effective. It would be foolish for a city to build all the infrastructure necessary to support buildout, without knowing when the buildout may actually occur. To use a buildout projection for strategic planning efforts, a time frame needs to be incorporated to give the city leaders a better understanding of when buildout may be reached. Even projections of growth rates have assumptions and issues, but a future growth projections based on past trends would still allow for a better understanding of when buildout might be reached. Buildout projections with time projections attached to them would help to inform planning efforts in a number of areas, like water and wastewater service, emergency response service, library and public facilities services, school districts, water districts and river authorities, electrical and utility providers, and many more.

Solution

A compound annual growth rate (CAGR) of past growth could be calculated. The results could be projected linearly until the buildout population number is reached. To offer additional scenarios to account for guesswork and assumptions, linear projections could be done for percentages lower and higher than the CAGR. This still is not 100 percent accurate, but adds another layer to the buildout projections to help planners successfully and strategically plan for the future.

Benefits

Vision for the Future

Regardless of the issues, the main purpose and benefit of buildout projections is the vision for the future. Generally, it is a challenge to think and plan far in advance. Cities are busy with day-to-day current planning responsibilities, and it's easy to lose sight of the long-range picture. Having an estimate of how many people a city will ultimately have to plan for helps to establish that long-range vision and gives staff a number which can be easily understood. Buildout projections can set a long-range vision and help to inform planning efforts in a number of areas, like water and wastewater service, emergency response service, library and public facilities services, school districts, water districts and river authorities, and utility providers. However, as discussed in Section 4, it would be more beneficial to these entities if there were time projections attached to the buildout. It is beneficial to over plan than to under plan. Even with the technical issues and critiques that can arise in regard to buildout projections, the overall vision that it can cast is very helpful for strategic planning efforts. It is important that entities who conduct buildout population projects make it very clear that the projections are just estimates and they do not claim to know the actual carrying capacity of the city.

SECTION 3 | MUNICIPAL APPLICATION

How to municipalities use buildout population projections?

Comprehensive Plans

Generally cities do a form of buildout projections for their comprehensive plans. These type of buildout projections are sometimes referred to as ultimate population, or ultimate capacity. Once the future land use is completed or updated, the planner uses the vacant acreages and the associated densities to calculate the buildout population. This process is very similar to the methods outlined in Section 2; however, they are less time consuming because they are generally done using a simple chart that covers the data for the entire city. The data is not broken down into smaller sections. This type of ultimate capacity exercise is generally accompanied by a growth rate scenario table to show various growth trends. With this ultimate capacity and the growth rate scenarios, the reader of the comprehensive plan could estimate when the buildout might be reached in that particular city. Each city is unique and face different challenges; therefore, each city conducts buildout projections in a way that is best suited to the City. The following are examples of buildout projections used in municipal comprehensive plans from the DFW area. Generally cities give a brief summary of their method and state their findings. It is difficult to find the exact methods that a city used in calculating their buildout population.

City of Melissa

The City of Melissa updated their comprehensive plan in early 2015. The City used a buildout projection method, as shown in **Table 3**, based off the vacant areas from the future land use plan. Instead of using acres, the calculations took each vacant lot into consideration. This is easier to do in a city the size of Melissa, and would be much harder to accomplish in a larger city. Melissa’s buildout projections are also broken out by city

Table 3. Buildout Population Calculations from City of Melissa

Type of Lot	Vacant Acres or Number of Lots	Average DUA	Occupancy Rate	Persons Per Household	Estimated Future Population in
City Limits					
Estate Density	119	1	93.7%	3.35	374
Low Density	1,601	3.5	93.7%	3.35	17,589
Medium Density	59	8	93.7%	3.35	1,482
High Density	39	15	93.7%	3.35	1,836
Mixed Use*	150	20	93.7%	3.35	9,417
Vacant Platted Lots	281	-	93.7%	3.35	882
Future Population that can be Accommodated in the Existing City Limits					31,579
Current Population in the Existing City Limits					7,755
Capacity Population in the Existing City Limits					39,335
ETJ					
Estate Density	1,916	1	93.7%	3.35	6,014
Low Density	4,146	3.5	93.7%	3.35	45,549
Medium Density	2	8	93.7%	3.35	43
High Density	-	15	93.7%	3.35	-
Mixed Use*	431	20	93.7%	3.35	27,058
Vacant Platted Lots	-	-	93.7%	3.35	-
Future Population that can be Accommodated in the Existing ETJ					78,664
Current Population in the Existing ETJ					1,074
Capacity Population in the Existing ETJ					79,737
Total Planning Area					
Capacity in the Existing Planning Area					119,072

*Mixed Use assumes 20% of the acreage will be residential development.

Source: City of Melissa

limits and extraterritorial jurisdiction (ETJ) and then combined to form the entire planning area with a buildout projection of 119,072. The calculation chart does not look like it accounts for roadway and other right-of-way, but the plan revealed that the density was calculated to already include that consideration. The plan also notes that this method is simply an exercise to guide future planning efforts and that development occurs at market demand (“City of Melissa Future Land Use Plan” pg. 3.17). The method of buildout projection used in Melissa are suitable for a city that needs to have a future number to set a vision, but does not want the effort to be time consuming.

City of Frisco

The City of Frisco has a section within the Planning Department dedicated to demographics and population projections. This department updates the buildout projections on a regular basis. The projections, which are included in the 2015 update of the comprehensive plan and shown in **Table 4**, note that the method is for planning purposes only, and is to provide a maximum capacity analysis for infrastructure and services planning – as if every parcel was built-out to the maximum allowed density. The projections also note that the every parcel of land being built-out to the maximum allowed density is highly unlikely. The most recent buildout projection for Frisco is 363,500. Frisco updates their current population estimates every month based off the number of occupancy certificates; therefore, they are able to easily keep track of how close they are to buildout since their projections are based off the maximum number of housing units allowed in a vacant area. The plan also explains the need for non-residential uses to develop in vacant areas to support the residential uses (“City of Frisco Comprehensive Plan” pg. 114).

Table 4. Buildout Population Calculations from City of Frisco

Population Capacity			
Product Type	Baseline Base*	Future (High)	Build-Out (High)
Residents	176,830	198,010	374,840

Table A3.3: Population Capacity at Build-Out Highest Density Scenario

Housing Units				
Product Type	Baseline Base	Future (High)	Build-Out (High)	
Single Family	54,530	56,710	111,240	63%
Multi-Family	7,150		7,150	4%
Urban Living	7,400	51,100	58,500	33%
Total			176,890	

Table A3.4: Housing Unit Capacity at Build-Out Highest Density Scenario

*Baseline Base = Current development + projects under construction or in the pipeline.

Source: City of Frisco

City of Arlington

The City of Arlington is an example of a City that tailored buildout projections to produce a product that would best serve the needs of the City.

Arlington updated their comprehensive plan in March 2015. The plan is titled '99 Square Miles'.

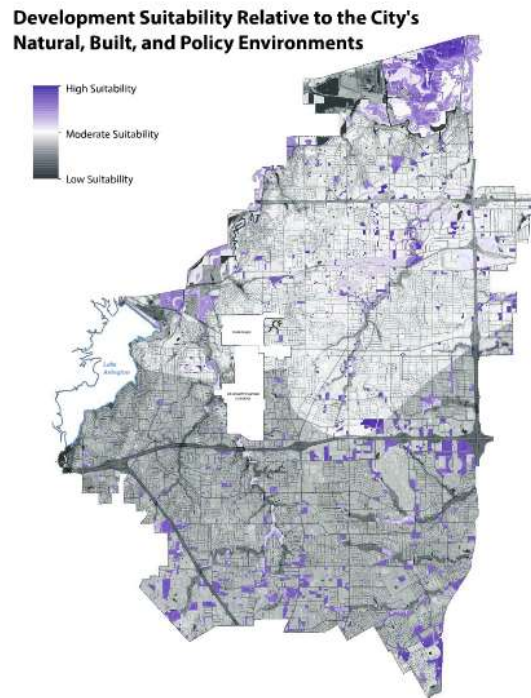
This plan incorporates a summary of the buildout projections completed by the planners. The method is called, 'carrying capacity analysis.'

Arlington is a land-locked city and noted in their summary that the traditional method for projecting buildout would not be as useful in their situation of redevelopment. This buildout projection was

completed in order to see where the City should focus their future development and redevelopment.

The method used three tiers of information: natural, built, and policy environments. There is less than ten percent of the City classified as vacant – approximately 6,128 acres. The vacant areas were analyzed in ArcGIS and each of the three factors was reviewed, ranked, and scored for each vacant area. The scores were averaged to create a single value to indicate the overall suitability of development. Based on this land use suitability analysis for the vacant areas, shown in **Figure 7**, the carrying capacity could then be projected. If an area was not suitable for development, then the area was not completely built-out in the model. At the end, Arlington predicts their buildout population is approximately 423,000 people and that might be reach a round the year 2023. This method of buildout projections is very thorough. Rather than just assuming that all land will be developed, the suitability analysis adds another layer of technical analysis to the projections ("99 Square Miles..." pg. 111).

Figure 7. Suitability Map Used to Determine Location of Future Population in City of Arlington

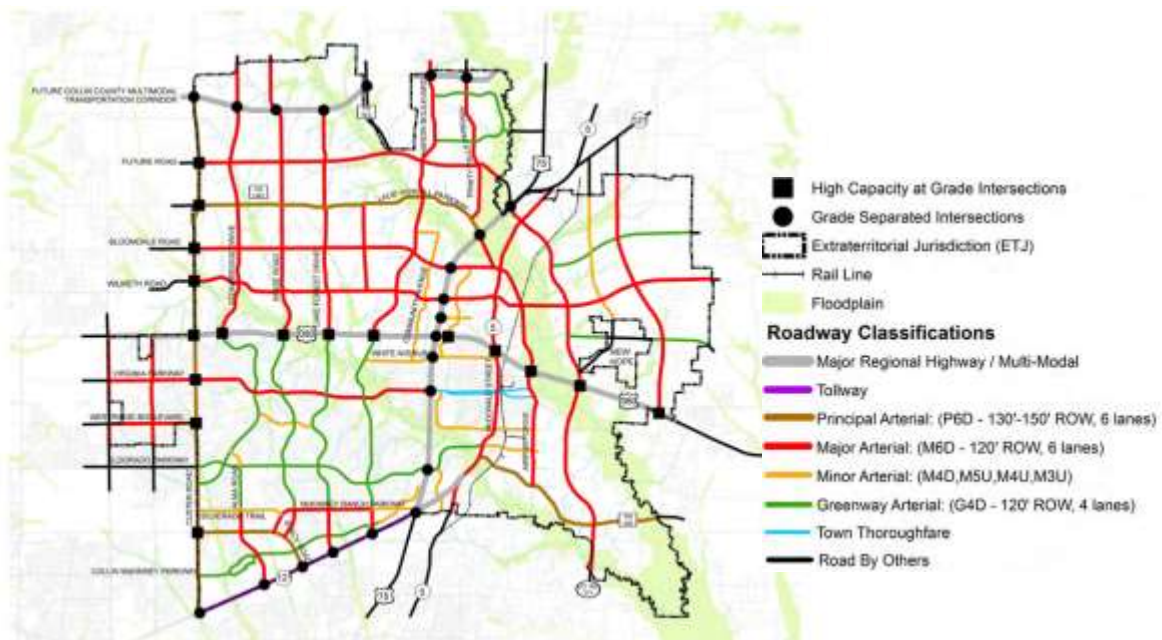


Source: City of Arlington

City of McKinney

The City of McKinney's comprehensive plan, created in 2004, identifies their use of buildout population projections to help with travel demand forecasting modeling. The City uses the TSZs from NCTCOG that are based on Census block geography, and then divided the TSZs into even smaller groups by arterial roadways locations and land use groupings. The City coded each TSZ with the existing population information. They ran their buildout calculations based on City databases, the future land use plan updates, and aerial photography. The new buildout numbers were added to the existing population to create the updated buildout scenario. The plan indicates that no time was connected with the buildout scenario. The City did produce other population projects with time frames to identify when buildout might be possible. The buildout scenario was used in the travel demand model to produce a master thoroughfare plan, shown in **Figure 8**. The City has updated their plan multiple times since 2004, and updates the buildout scenario to match the updated future land use plan and associated densities ("City of McKinney Comprehensive Plan" pg. 133).

Figure 8. Master Thoroughfare Plan for McKinney



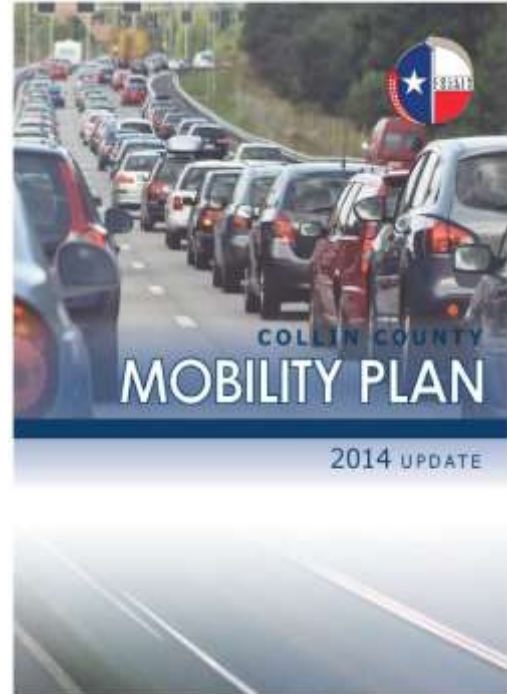
Source: City of McKinney

SECTION 4 | REGIONAL APPLICATION

Collin County Mobility Plan

Figure 9. 2014 Update to Collin County Mobility Plan

Collin County has used buildout population projections to inform their transportation planning and travel demand modeling. The County used the private consulting firm Jacobs to do their transportation plan and modeling, and also the subsequent updates. The 2014 update, shown in **Figure 9**, incorporated buildout population and employment projections. This buildout had many planning constraints to the model. For example, the political climate of the time wanted the east side of the County to stay rural, and thought that it would always stay rural. Therefore,



when the buildout was projected in 2013 for the 2014 plan update, the east side was not built-out to its full potential. In 2015, the County wanted to evaluate the buildout projection model by removing the constraints on the east side of the County. It is important to emphasize that this 2015 model has two critical assumptions: water and wastewater utilities can be extended to any portion of the County and roadway and other infrastructure will be built to accommodate the projected growth. Ultimately, Collin County uses the buildout population and employment projections for travel demand modeling. The projections for the 2015 unconstrained buildout scenario have been complete, but the travel demand modeling is still underway. The buildout projections are calculated down to the TSZ level, so that the data can be easily input into the transportation model to generate trips from each TSZ. The trip generation data will then produce the roadway network needed to support the amount of trips (“Collin County Mobility Plan” pg. 21-43).

An Innovative Tool

Collin County's goal is to be proactive, not reactive. The County is already experiencing a high rate of growth; and therefore, significant transportation issues. The County wants model the travel demand and infrastructure needed at ultimate buildout to allow the municipalities to see the unreal amount of roadways that will be needed to handle the future transportation network. Even though the buildout population may never be reached, Collin County will continue to grow and innovative solutions to traffic congestion are needed. Each time that Collin County runs a new scenario on their buildout population projections, the comprehensive plans that have been updated by the cities since the last projection update are reevaluated and added to the model. The new scenario for the vacant land without comprehensive plans is calculated and that projection is added to the updated comprehensive plan information for vacant areas to produce the new buildout projections ("Collin County Mobility Plan" pg. 21-43). Collin County has been able to set themselves apart as a progressive thinking County by initiating this buildout projection method. The eastern side of Collin County is very rural and undeveloped. Each set of County Commissioners generally have different ideas on how development will occur in that area. Even though market demand and private property owners can develop the land in the County as they wish, this buildout projections gives the County a planners a tool to present to the County Commissioners and help them to visualize how their desired development patterns will affect the transportation system at ultimate buildout. The County planners can also use the generally accepted scenario to plan the future roadways. Adjustments to the roadway network will need to be made as development occurs, but the buildout scenario allows the planners to coordinate with the cities to ensure that an adequate roadway network is prepared for future growth. This tool allows the County to be proactive, rather than reactive. It is better to plan for more roadways than not enough. Using the buildout projection method to developed different buildout scenarios, shown in **Table 5**, has allowed the County to "see into the future" and set a lofty vision for transportation solutions.

Results of Collin County Buildout Scenario (2013 Scenario vs. 2015 Scenario)

Table 5. Buildout Scenario Comparison by Planning Area

Planning Area	Constrained Scenario (2013)	Unconstrained Scenario (2015)	Change	% Change
Allen	94,781	110,365	15,584	16.44%
Celina	189,199	421,000	231,802	122.52%
Fairview	20,025	20,135	111	0.55%
Frisco	183,592	275,814	92,222	50.23%
McKinney	350,279	399,376	53,689	14.02%
Melissa	71,793	77,901	6,108	8.51%
Plano	284,656	301,168	16,512	5.80%
Princeton	78,304	106,943	28,639	36.57%
Weston	127,026	132,477	5,451	4.29%
Anna	146,017	285,736	139,720	95.69%
Blue Ridge	62,581	413,041	350,459	560.01%
Farmersville	106,002	371,188	265,186	250.17%
Josephine	6,338	22,763	16,425	259.15%
Lavon	20,715	41,779	21,064	101.68%
Nevada	11,770	56,767	44,997	382.30%
Royse City	40,906	87,084	46,178	112.89%
Rockwall	5,667	23,746	18,079	319.02%

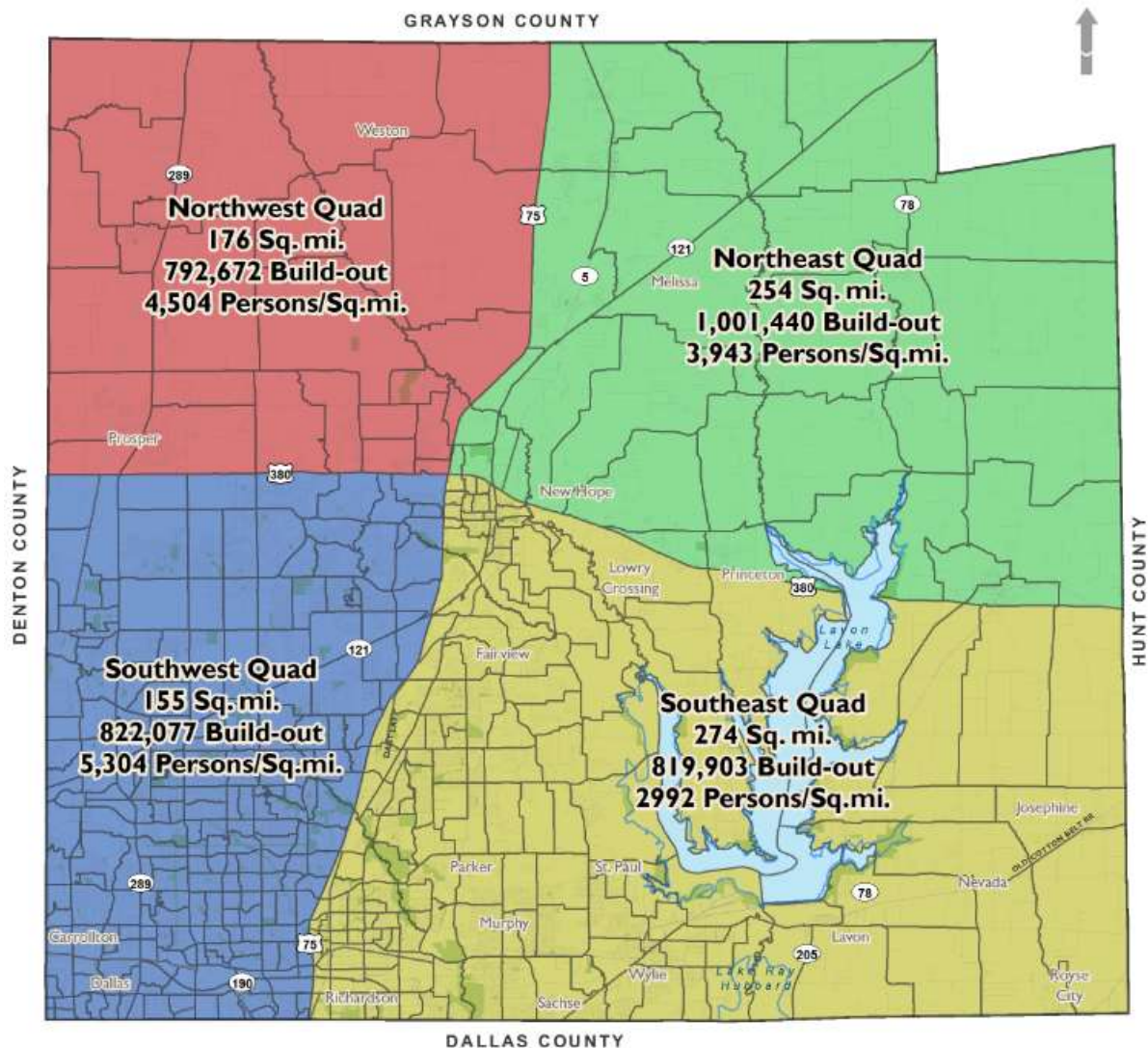
It is important to note that the Collin County method of buildout scenarios for both models combined the TSZ structure into planning areas to make the data easier to understand. Each TSZ was assigned to the city that had the most land area in the TSZ. It is important to note that the city names above are simply planning areas and not actual city limits.

Table 6. 2015 Unconstrained Buildout Projections

City Updates since 2013 scenario	445,526
+ East Side Assumptions from 2015 scenario	902,108
+ 2013 Unconstrained Scenario	2,088,456
= Buildout Population	3,436,090

The unconstrained buildout scenario, shown in **Table 6**, has a high shock-value and may seem impossible; however, when the densities are looked at in persons per square mile, the unconstrained buildout population becomes easier to understand. The unconstrained buildout scenario still keeps the west side of the County denser than the east and keeps the southeast quadrant, most rural parts of Collin County, as the least dense quadrant. **Figure 10** shows the average densities in the County by dividing the County into four quadrants, using US 380 and US 75 as the dividing lines. The best way to test buildout population projections is to compare the data to past trends for the study area.

Figure 10. Average Density in Collin County by Quadrant



Source: Collin County Mobility Plan

Regional Travel Demand Modeling

Vehicle trip projections allows municipalities to plan for future road capacity and connections by using the buildout projections to model the traffic (“Summary Guide to Population Projections... page 2). The transportation planners are able to utilize the information of the estimated number of households and residents by traffic survey zone to estimate where vehicle trips are happening; and from this, future roads and connections can be planned. According to the Federal Highway Administration (FHWA) a Traffic Survey Zone, herein referred to as TSZ, is a “basic geographic unit for inventorying demographic data and land use within a study area” (“Defining Traffic Analysis Zones”). The TSZs are used in the transportation model to allocate population and employment, which is the basis for trip generation. Many municipalities will plan for the future roadway network by modeling estimated projections at a certain timeframe. For example, a municipality can model the 2040 estimates to plan for their capital improvement projects for the next 20+ years; however, using the buildout projections for travel demand modeling allows a municipality to see what their ultimate future roadways network might look like. Because of this, leaders can be proactive instead of reactive. They will not immediately build the ultimate roadway network, but they can use it to better plan their infrastructure improvements and capital improvement programs.

How Are Buildout Projections a Benefit to Travel Demand Modeling?

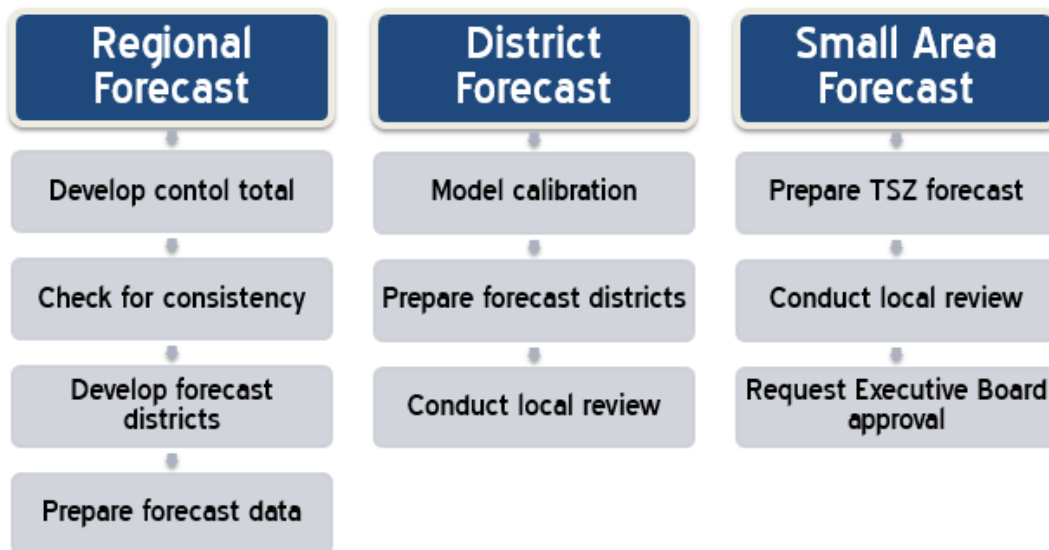
Buildout projections are a benefit to travel demand modeling because the projections can help to validate the allocation of the population in the TSZs. To help explain this benefit and provide a practical application, the Collin County unconstrained buildout scenario for Collin County will be used to validate the NCTCOG demographic forecasting for 2040. The Collin County scenario is being used because it is a recently complete buildout scenario for an entire county in the DFW region. It is important to note that these two methods are very different. Each method has benefits and issues, one is not better than other. The purpose of this analysis is to show the benefit of using buildout projections to validate the

allocation of population in the demographic forecasting, which is used to run a travel demand model for the DFW region. Using these tools in conjunction will help to refine the allocation of the population in the NCTCOG demographic forecasting; therefore, creating more efficient travel demand modeling.

Summary of NCTCOG Demographic Forecasting

The NCTCOG calls their population projections “demographic forecasting”. The demographic forecasting process is data-driven and analytical. The process is outlined in **Figure 11**. Stakeholder feedback is taken into consideration at the aggregate (district level) and disaggregate (traffic survey zone level) forecast stages. The NCTCOG uses a top-down method by using a projected control total, based on outside sources, for the 2040 population of the DFW region. The goal of the NCTCOG team is to take the control total (2040 population) and allocate the population within the various counties and cities, using TSZs. This demographic forecasting is then used to model the transportation network needed for the DFW region (North Central Texas 2040 Demographic Forecast”). The preliminary results of the forecasting are sent to cities and counties in the region, but many entities do not respond in a timely manner to NCTCOG or do not even look at the projection.

Figure 11. Summary of Method for NCTCOG Demographic Forecasting

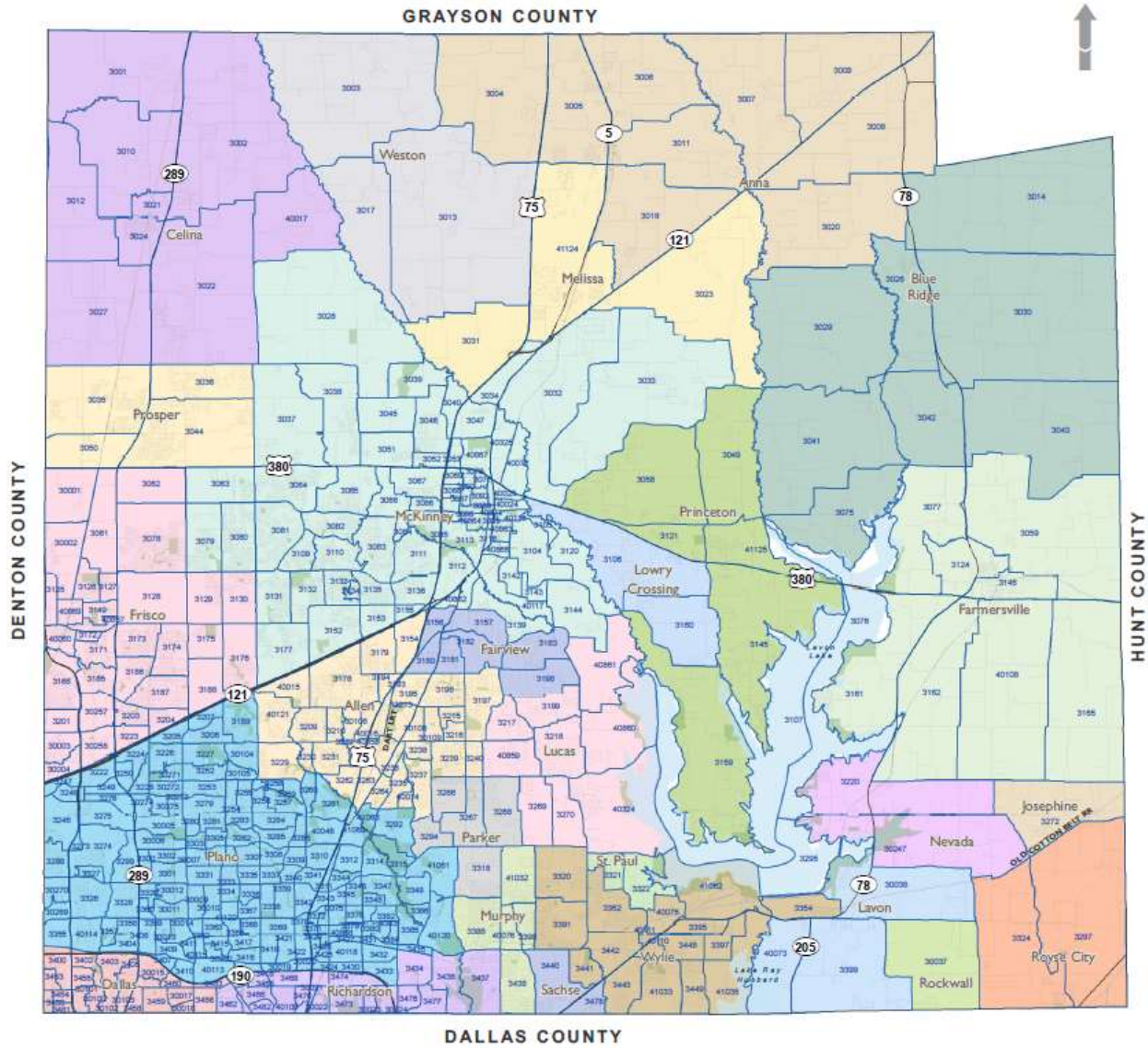


Validating Projections by TSZ

Again, it is important to note that the Collin County buildout projections and NCTCOG demographic forecasting cannot be compared side-by-side because it is an “apples and oranges” comparison. The buildout method is the ultimate buildout, while the NCTCOG demographic forecasting is the projection for the year 2040. However, when both projections are looked at by TSZ there are some issues that arise. Identifying these issues is the benefit of using both methods in conjunction and will be the tool to validating the population allocation in the TSZs for travel demand modeling.

There are many TSZs in the NCTCOG demographic forecasting where the 2040 projection is much higher than the buildout projection. The issue is not in the final demographic forecasting population total, but rather in the distribution of the population. Since the unconstrained buildout method for Collin County took City plans and land use into account to produce a carrying capacity, the NCTCOG 2040 projections should not be higher than the carrying capacity. If the projections in a TSZ are higher than the carrying capacity, then the travel demand modeling will actually be generating too many trips from those TSZs. Because of this issue, any NCTCOG TSZ with a higher 2040 population was examined. It is important to note that many of the TSZs could reach their buildout close to the year 2040, and many of the TSZs may actually be able to hold more people than the buildout method projected - due to the fact that we cannot accurately predict the exact land use capacity in the future. However, there are 202 TSZs where the 2040 NCTCOG demographic forecasting is higher than the buildout projections. TSZs with differences. To account for the issues and critiques discussed in Section 4, the TSZs with a difference of 5,000 or greater were examined further to help prove that using buildout projections in travel demand modeling would help to validate the model. There are 20 TSZs where NCTCOG is 5,000 or higher than the land use ultimate buildout. For examples, two are shown below and the rest are in the appendix of this report. **Figure 12** provides geographical reference for the TSZ examples in **Figure 13**, **Figure 14**, and in the **Appendix**.

Figure 12. TSZ Map of Collin County



COLLIN COUNTY MOBILITY PLAN - 2013 CITIES BY TSZ

- TSZ Boundary
- County Line
- Park
- Highways
- Railroad
- Water Body

Source: Collin County Mobility Plan



Figure 13. TSZ 3388 (Aerial and Future Land Use)



Table 7. Projections for TSZ 3388

2012 (existing shown in aerial)	5,802
NCTCOG 2040	15,217
Buildout Projection	6,385
Difference in 2040 and Buildout	8,832

The current residential areas shown in TSZ 3388 has approximately 5,802 people. The vacant areas shown in the Future Land Use plan is a small area of single-family residential (shown in yellow), a small area of medium-density residential (shown in orange), and areas of commercial/retail along the southern border of the TSZ (shown in red). Using best planning assumptions, it is hard to believe that 8,800 people will fit in the yellow and orange area when there is only 5,800 people currently in the entire TSZ. This TSZ is very low-density residential. It does not make sense that a very dense node with develop in the middle of the existing single-family residential areas. Even if the commercial areas were used for residential instead, it would be hard to accommodate an extra 8,800 people.

Figure 14. TSZ 3081 (Aerial and Future Land Use)



Table 8. Projections for TSZ 3081

2012 (existing shown in aerial)	8,741
NCTCOG 2040	17,185
Buildout Projection	9,060
Difference in 2040 and Buildout	8,125



The current residential areas in TSZ 3081 have approximately

8,741 people. This TSZ is almost built-out and has a small amount of vacant land. There is a small area of vacant land shown on the Future Land Use Plan for single-family residential (shown in yellow), and areas for commercial/retail (shown in red). Similar to TSZ 3388, it seems next to impossible that an extra 8,000 people will be living in the yellow area on the map. While there could be redevelopment, it is highly unlikely that an entire established single-family neighborhood will be wiped clean for higher density residential development.

SECTION 5 | CONCLUSION

How can this be used to plan better for the future?

Keeping the Future in Mind

It is important to keep the future trends in mind when developing buildout population projections.

Planners must stay up-to-date with developing trends to be prepared for the future. In today's world climate change and water are important factors in planning for the future. If planners only plan based on the current conditions, their plans will be sufficient to accommodate future growth. The carrying capacity of a city or an area is one example of keeping the future in mind.

Carrying Capacity

Carrying capacity is the amount of people that a city or an area can hold based on the available land area and resources. For example, if a city's buildout population is 100,000, but the local water authority's infrastructure can only serve 180,000, then 180,000 is the carrying capacity. It is important to add these factors into buildout populations to make the calculations as accurate as possible.

Policy Implications

Another factor to add to buildout populations to keep the future in mind are policy implications. For example, a city might not have enough vacant land to develop their city in accordance with the policies that are set in place. Cary, North Carolina experienced a similar situation. Their policies encouraged primarily single-family, large-lot homes. With the lack of vacant land, they could not reach their buildout population without adjusting their policies to include more mixed used/high density.

Implementation of Validating Travel Demand Model with Ultimate Buildout

The NCTCOG could adopt the practice of checking the demographic forecasting numbers against the buildout land use projections. This would allow the NCTCOG to see which TSZs are over projected and which are under projected. Since the NCTCOG projections are based off a control total, if population is moved from a TSZ it has to be reallocated somewhere else. Looking at the build out model would allow the NCTCOG to place the population from an overpopulated TSZ and reallocate that population in a TSZ that still has not reached the ultimate buildout. Since the demographic forecasting happens every five years, the ultimate buildout land use model should also be updated every five years to incorporate the latest comprehensive plan updates from the cities. To accurately model transportation and verify NCTCOG's demographic forecasting, it is critical that an ultimate buildout population is created for the entire NCTCOG region – not just certain counties. It is also important that an unconstrained (highest used based on City plans and planning assumptions) buildout model be used to ensure that population is not allocated in a TSZ that has reach its land use carrying capacity.

Regional Application

The task of developing an ultimate buildout population for the entire NCTCOG region is a large one; therefore, the task should be broken up and delegated. These datasets and numbers could be kept on the NCTCOG's online regional database. This would be beneficial data for the region. Each county and city can also use the ultimate buildout scenario to help inform any other planning efforts. It is critical for the NCTCOG to accurately distribute the population for demographic forecasting. The NCTCOG is the primary funding agencies for many cities. If the population is not accurately distributed, then the funds will be invested in the wrong areas through inaccurate traffic modeling and building of infrastructure. Each County could develop an ultimate buildout scenario using the method outlined in Section 4. The NCTCOG could help with funding for the extra staffing or hours that would be needed. Each County would turn over the numbers to the NCTCOG, who would be the keeper of the ultimate buildout model.

Every time a County updates the model, the updated numbers should be submitted to NCTCOG.

Another option is for the, the NCTCOG can partner with the City & Regional Planning program at the University of Texas at Arlington (UTA) to assist in the effort. Since the ultimate buildout land use scenario will only be updated every five years, the planning program at UTA could offer a semester long project studio class at the time of the update dedicated to assisting the NCTCOG in completing the ultimate buildout scenario for the entire NCTCOG region. A more viable option would be for the NCTCOG to document a buildout population projection method and distribute to all the cities in the region. The cities could then conduct these buildout projections annually. When the NCTCOG sends out their demographic forecasting for municipalities to double-check and confirm, the cities could use their buildout projections to check the distribution of the population. It is important for the NCTCOG to document the buildout population projection method so that all cities are using the same method.

Setting a Vision for the Future

Ultimately, buildout projections can be used to set a long-range vision for the future. Even with the issues and critiques discussed, the method is still beneficial but needs to be used with the issues in mind. While the buildout population projections that are used by various municipalities are all different, they were tailored to serve the needs of the City. This flexibility to tailor the buildout populations to the type of planning being performed by a City is an invaluable tool for long-range planning and setting a vision for the future.

Still Evolving

The widely-used method of buildout projections is still evolving. It is not formally documented in a concrete, technical manner; however, this loosely-defined planning exercise is a key tool in setting vision for the future that the public and city staff can understand. It should not be used as the only basis in planning for future infrastructure or services, but as a stepping stone to successful planning.

BIBLIOGRAPHY

The following sources were used in the development of this report.

- “99 Square Miles: A Vision for Arlington's Future”. (2015, March 17). Retrieved November 15, 2015, from <http://www.joomag.com/magazine/arlington-comprehensive-plan-update-adopted-3-17-2015/0879184001414527096?short>
- “2040 Demographic Forecast Presentation”. (2015, May 28). Retrieved August 25, 2015, from <http://rdc.nctcog.org/Members/ServiceGroup.aspx?id=5>
- “City of Frisco Comprehensive Plan”. (2015, August 4). Retrieved November 15, 2015, from <http://friscotexas.gov/departments/planningDevelopment/comprehensiveplanning/Documents/2015Plan/2015Plan.pdf>
- “City of McKinney Comprehensive Plan”. (2004, March 20). Retrieved November 10, 2015, from <https://www.mckinneytexas.org/DocumentCenter/View/4822>
- “City of Melissa Comprehensive Plan”. (2015, April 28). Retrieved November 15, 2015, from http://www.cityofmelissa.com/departments/development_and_neighborhood_services/COM_Comp_plan/index.html
- “City of Melissa Future Land Use Plan”. (2015, April 28). Retrieved November 15, 2015, from http://www.cityofmelissa.com/document/Chapter_3_Future_Land_Use_Plan.pdf
- “Collin County Mobility Plan”. (2014, August 1). Retrieved September 12, 2015, from http://www.co.collin.tx.us/mobility/Documents/mobility_plan/CCMobilityPlan082014.pdf
- Defining Traffic Analysis Zones. (n.d.). Retrieved November 18, 2015, from https://www.fhwa.dot.gov/planning/tmip/publications/other_reports/technical_synthesis_report/page01.cfm
- Harrison, D. (2013). Collin County Mobility Plan 2013 Update: Demographic and Land Use Forecasts, page 1-3
- “North Central Texas 2040 Demographic Forecast”. (n.d.). Retrieved September 10, 2015, from <http://www.nctcog.org/ris/demographics/forecast/Overview.pdf>
- “Population Estimates and Projections”. (n.d.). Retrieved November 15, 2015, from <http://friscotexas.gov/departments/planningDevelopment/comprehensiveplanning/Pages/Population.aspx>
- “Population Estimates Terms and Definitions”. (n.d.). Retrieved September 4, 2015, from <https://www.census.gov/popest/about/terms.html>
- “Projections of the Population of Texas and Counties in Texas by Age, Sex and Race/Ethnicity for 2010-

2050". (2014, November 1). Retrieved August 3, 2015, from
<http://osd.texas.gov/Data/TPEPP/Projections/Methodology.pdf>

"Summary Guide to Population Projections and Buildout Analysis". (n.d.). Retrieved September 15, 2015,
From http://www.orangecountygov.com/filestorage/124/1362/3210/Summary_Guide_to_Population_Projections_8-13-10.pdf

APPENDIX

TSZ Comparisons | NCTCOG 2040 and Collin County Buildout Scenario

TSZ 3318

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	1,511
NCTCOG 2040	21,574
Buildout Projection	4,238
Difference in 2040 and Buildout	17,336

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	3,849
NCTCOG 2040	23,576
Buildout Projection	7,611
Difference in 2040 and Buildout	15,965

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad

TSZ 3044

TSZ



TSZ with Future Land Use



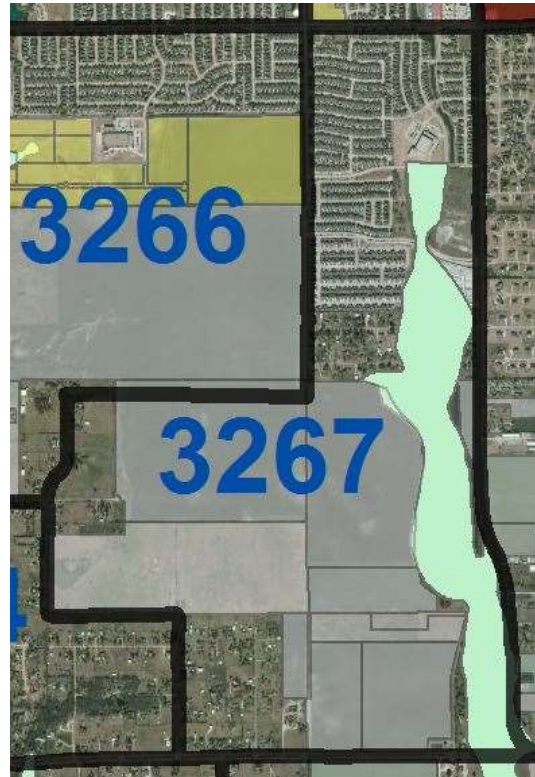
2012 (existing shown in aerial)	6,217
NCTCOG 2040	28,467
Buildout Projection	15,026
Difference in 2040 and Buildout	13,441

- Residential Rural (0.75 DUA)
 - Residential Semi-Urban (1.5 DUA)
 - Residential Urban (3.5 DUA)
 - Basic (Industrial)
 - Mixed Use Residential
 - Mixed Use Non-Residential
 - Retail
 - Service (Office, Commercial)
 - Public/Semi-Public
 - Parks & Open Space/Floodplain
 - Lake
- County Line
 - Park
 - Water Body
 - Railroad

TSZ



TSZ with Future Land Use



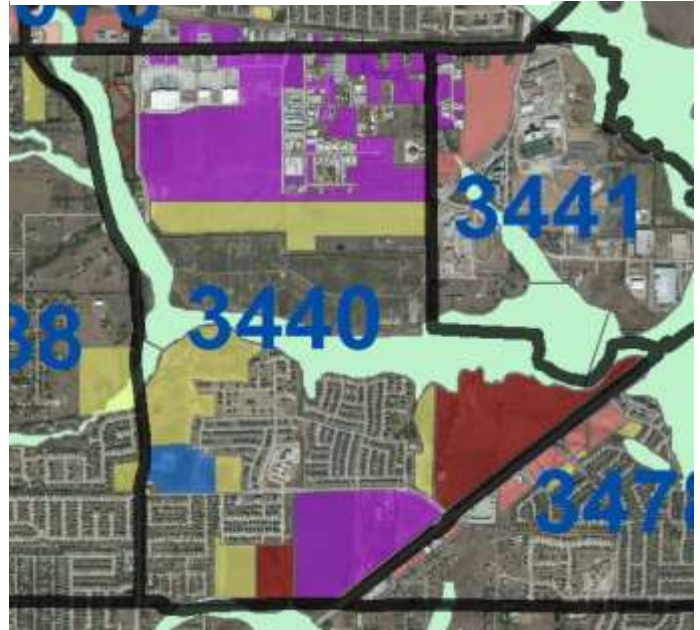
2012 (existing shown in aerial)	2,240
NCTCOG 2040	13,939
Buildout Projection	2,936
Difference in 2040 and Buildout	11,003

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
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- Railroad

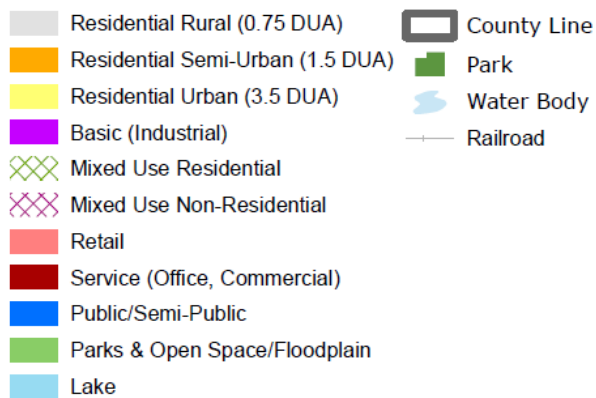
TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	1,846
NCTCOG 2040	15,215
Buildout Projection	4,246
Difference in 2040 and Buildout	10,969



TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	2,209
NCTCOG 2040	13,169
Buildout Projection	3,321
Difference in 2040 and Buildout	9,848

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	1,274
NCTCOG 2040	11,638
Buildout Projection	1,886
Difference in 2040 and Buildout	9,752

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
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- Railroad

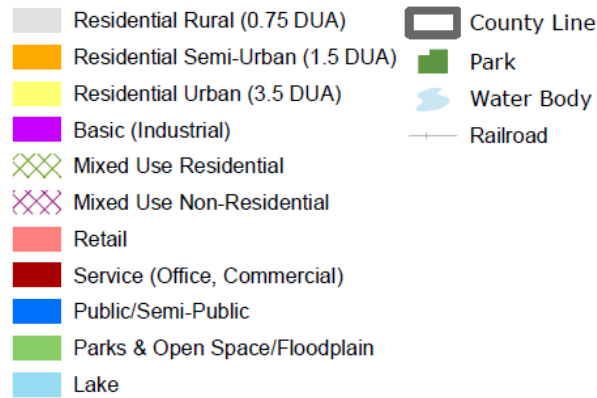
TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	7,116
NCTCOG 2040	18,013
Buildout Projection	8,564
Difference in 2040 and Buildout	9,449



TSZ 3035

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	2,368
NCTCOG 2040	22,811
Buildout Projection	13,698
Difference in 2040 and Buildout	9,113

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad

TSZ 3388

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	5,802
NCTCOG 2040	15,217
Buildout Projection	6,385
Difference in 2040 and Buildout	8,832

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad

TSZ 3036

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	1,841
NCTCOG 2040	11,420
Buildout Projection	3,092
Difference in 2040 and Buildout	8,328

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad

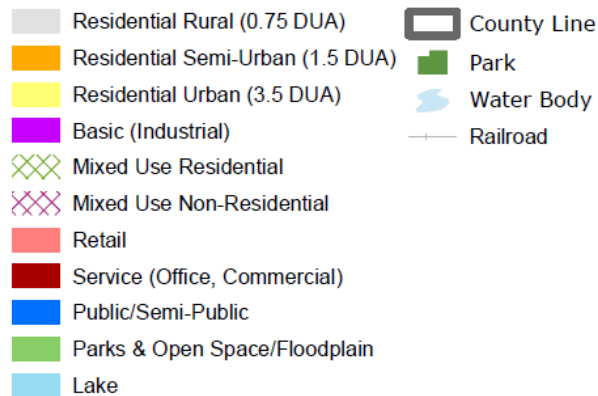
TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	633
NCTCOG 2040	10,983
Buildout Projection	2,768
Difference in 2040 and Buildout	8,215



TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	8,741
NCTCOG 2040	17,185
Buildout Projection	9,060
Difference in 2040 and Buildout	8,125

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad

TSZ 3320

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	3,120
NCTCOG 2040	15,389
Buildout Projection	7,756
Difference in 2040 and Buildout	7,633



TSZ 3391

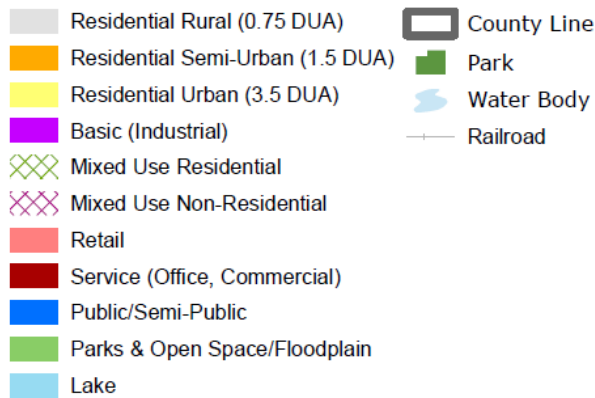
TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	7,090
NCTCOG 2040	16,630
Buildout Projection	9,304
Difference in 2040 and Buildout	7,326

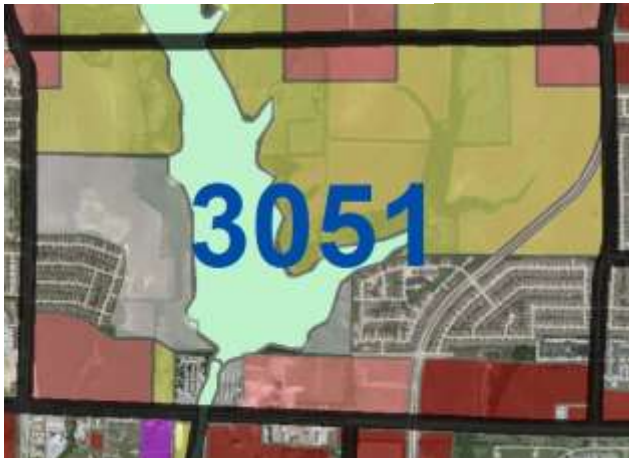


TSZ 3051

TSZ



TSZ with Future Land Use



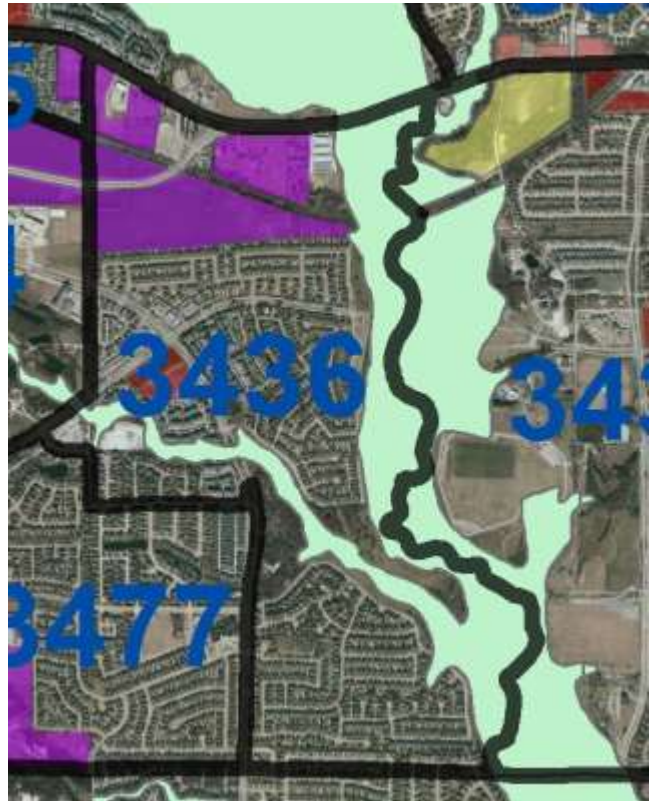
2012 (existing shown in aerial)	1,624
NCTCOG 2040	18,002
Buildout Projection	10,978
Difference in 2040 and Buildout	7,024

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	6,528
NCTCOG 2040	13,526
Buildout Projection	6,528
Difference in 2040 and Buildout	6,998

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
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- County Line
- Park
- Water Body
- Railroad

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	3,120
NCTCOG 2040	12,227
Buildout Projection	5,463
Difference in 2040 and Buildout	6,764

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	4,288
NCTCOG 2040	17,517
Buildout Projection	11,143
Difference in 2040 and Buildout	6,374

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad

TSZ 3437

TSZ



TSZ with Future Land Use



2012 (existing shown in aerial)	5,086
NCTCOG 2040	10,710
Buildout Projection	5,485
Difference in 2040 and Buildout	5,225

- Residential Rural (0.75 DUA)
- Residential Semi-Urban (1.5 DUA)
- Residential Urban (3.5 DUA)
- Basic (Industrial)
- Mixed Use Residential
- Mixed Use Non-Residential
- Retail
- Service (Office, Commercial)
- Public/Semi-Public
- Parks & Open Space/Floodplain
- Lake
- County Line
- Park
- Water Body
- Railroad