A NEAREST NEIGHBORING MATCH ANALYSIS OF THE PROXIMATE PRINCIPLE: THE RELATIONSHIP BETWEEN RESIDENTIAL PROPERTY VALUES AND PARKS IN ARLINGTON, TEXAS

by

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Abstract

A NEAREST NEIGHBORING MATCH

ANALYSIS OF THE PROXIMATE PRINCIPLE:

THE RELATIONSHIP BETWEEN RESIDENTIAL

PROPERTY VALUES AND PARKS

IN ARLINGTON, TEXAS

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The University of Texas at Arlington, 2017

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Most studies of this type use a hedonic value method of analysis while using spatial analysis primarily as a tool in the analysis. The nearest neighboring match analysis used in this study uses spatial analysis as the primary method of measurement. Housing stock from Arlington, Texas from 2015 – 2016 is used to determine whether this type of analysis is effective in measuring the existence of the proximate principle. It proved difficult to obtain a large enough study group when attempting to include multiple different structural attributes. Ultimately, it was shown that a much larger timeframe may be needed in order to make the nearest neighboring match analysis method viable.

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Definition of Key Terms

Proximate principle: The idea that properties near parks have higher property values based on a willingness by home buyers to pay larger amounts of money for this proximity (Crompton, 2005).

Protected Open Space: land that is considered permanent open space such as land that has had its development rights sold, or parks (Geoghegan, 2002).

Unprotected Open Space: privately owned, undeveloped land that could potentially be developed in the future, such as agricultural land or forested land (Geoghegan, 2002)

Hedonic Value Analysis: Analysis that identifies the implied prices of attributes revealed from prices of products and the characteristics associated with them (Rosen, 1974).

Nearest Neighbor Match Analysis: Analysis that identifies a home with proximity to a park, then matches it with other homes that are farther away, but have similar structural and neighborhood characteristics. (Metz, 2016).

Chapter 1

Introduction

1.1 Introduction

> In merging nature and culture the most successful cities combine such universal needs as maintaining or restoring contact with the cycles of nature, with specific, local characteristics. (Chappell 2007, Page 11-12)

Early park design in the United States was geared toward acquiring large tracts of land and attempting to either preserve a portion of the country side before it was developed, or to recreate the country side within the city. While conservation areas do still exist, different park types, and amenities have evolved. Park classifications can now be defined by the size of the space and the types of uses involved. While some parks are located inside commercial or civic developments, most are located adjacent to single family residences. These parks play a direct role in the value of the properties located in close proximity to them. This is known as the proximate principle, and is defined as follows:

> The premise that parks have a positive impact on proximate property values derives from the observation that people frequently are willing to pay a larger amount of money for a home located close to a park, than they are for a comparable home. In effect, this represents a 'capitalization' of park land into increased property values of proximate landowners. (Crompton 2005, page 203)

Most research on the proximate principle does indicate that parks have a positive impact on local residential property values. In addition, research has shown that disamenities, such as traffic congestion, do not have a great enough influence to sway the positive impacts greenspaces have on property values.

1.2 Statement of Problem

There are two existing studies in the region that have focused on the proximity to parks and open space. Peiser and Schwann (1993) studied the proximate principle within subdivisions that contained publicly used open space homes in Dallas/Fort Worth, and Miller (2001) studied homes that faced urban parks within the region. This study is being done to update the area of research within the Dallas/Arlington/Fort Worth region of

Texas.

The research methods typically used in this area of research have been statistically based using spatial analysis primarily as a tool. Hedonic Value analysis allows for the comparison of multiple characteristics to determine the end effect that park proximity has on the property value. With advances in geographic information systems, an updated study will show a more visual understanding of the principle.

1.3 Statement of Purpose

The intent of contribution for this paper is to assist in planning park locations, park sizes, and park types to serve both public and governmental interests. If a single type or size has a significantly greater effect on a certain density or demographic, the local government can begin to better estimate the growth or decline in tax rates when acquiring new land for a new park to be developed. The increased tax rates could factor in to the future development and maintenance of the new park (Blotzer and Netusil, 2000). In the case of the public, the study may help in the purchase of private property by providing better understanding of the additional value a park has on their home. It may also help to understand that if demographic shifts begin happening in the neighborhood, the home owner can identify whether these changes could have a positive or negative effect on the park's proximate properties.

1.4 Research Questions

Existing research regarding the proximate principle will be discussed in depth in the literature review, as well as the methodology used in these studies. The two studies conducted in the Dallas/Arlington/Fort Worth area of Texas will also be discussed in this review. This study will focus on the Dallas/Arlington/Fort Worth are using data that can acquired primarily from open data forums, with the exception of Multiple Listing Service information. The questions that will be explored within this study are:

1. Will the nearest neighbor match analysis show similar results as previous hedonic value analysis methods?

2. Does the effect of park on property values change depending on the size of the park or amenities that the park has to offer?
3. Do the impacts of the proximate principle change based on other value determinant characteristics?

1.5 Research Methods

The main contribution of this thesis is that it demonstrates the consistency of the proximate principle that has been proven in prior research. It will however, be taking an approach that has seldom been used, and not to this magnitude. The approach, or methodology, that will be used is the nearest neighboring match analysis. The previous study that used this analysis (Metz, 2016) used only three factors from the home characteristic subgroup to match neighboring properties within Census Block Groups. These factors were lot size, home size, and number of bathrooms. The initial analysis will determine whether a similar method of analysis shows the existence of the proximate principle in Arlington, Texas. It will focus on lot size, home size, number of bedrooms, number of bathrooms, number of parking spaces in a garage, and the existence of a swimming pool. If the existence of the proximate principle is shown, the analysis will continue into the second phase as described below.

The second phase will expand to compare different parks against other neighborhoods where home value determinants may be different (i.e. density, crime rates, proximity to retail and freeway access, income, demographic makeup, and school districts). This research methodology will use advances in computer programs and rating systems that are available to the average consumer. This study will use this information to combine the ideology of the hedonic value analysis method, with the accuracy of the nearest neighboring match analysis done by Metz (2016) by creating controls for the determinants typically used to determine the value of a home.

1.6 Summary

The introduction identifies the research questions for the following study. It also identifies the gaps in existing research that the following paper will attempt to fill, as well as the anticipated outcomes.

Chapter 2

The Literature on the Effect of Parks on Property Value

2.1 Introduction

Early park design in the United States was geared toward acquiring large tracts of land and attempting to either preserve a portion of the country side before it was developed, or to recreate the country side within the city (Cranz, 1982). As cities continue to grow, it is important to understand the fiscal effects open space has on residential property values.

To begin, open space can be broken down into two very broad categories, protected open space and developable open space. Permanent open space can increase the values of nearby land by as much as three times in comparison to nearby developable open space (Geoghgan, 2002). In Crompton's (2005) review of empirical evidence from the previous two decades, the existing research at the time showed that while a larger park may have a deeper reach into the local neighborhood, the impact of the proximate principle may be better felt if the land area were parceled out into smaller parks (Figure 2.1). This deeper reach could be attributed to the type of park itself, as the National Recreation and Park Association (Mertes, 1996) classified parks based on size and typical amenities offered. Based on Crompton's (2005) description of two park areas, the notion that a smaller park provides a higher premium (Anderson and West, 2006), and interpreting zone depths as 0-200 feet, 200-400 feet, and 400-600 feet into the adjacent neighborhood, the following table has been created. This table shows that when distributing the land area of a larger park into six smaller parks, the total land area related to each zone is much larger. The total land area of Zone A is approximately 246% larger with six smaller parks versus one larger park. In the case of Zone C, the land area increases by 337% with land distribution into six smaller parks.

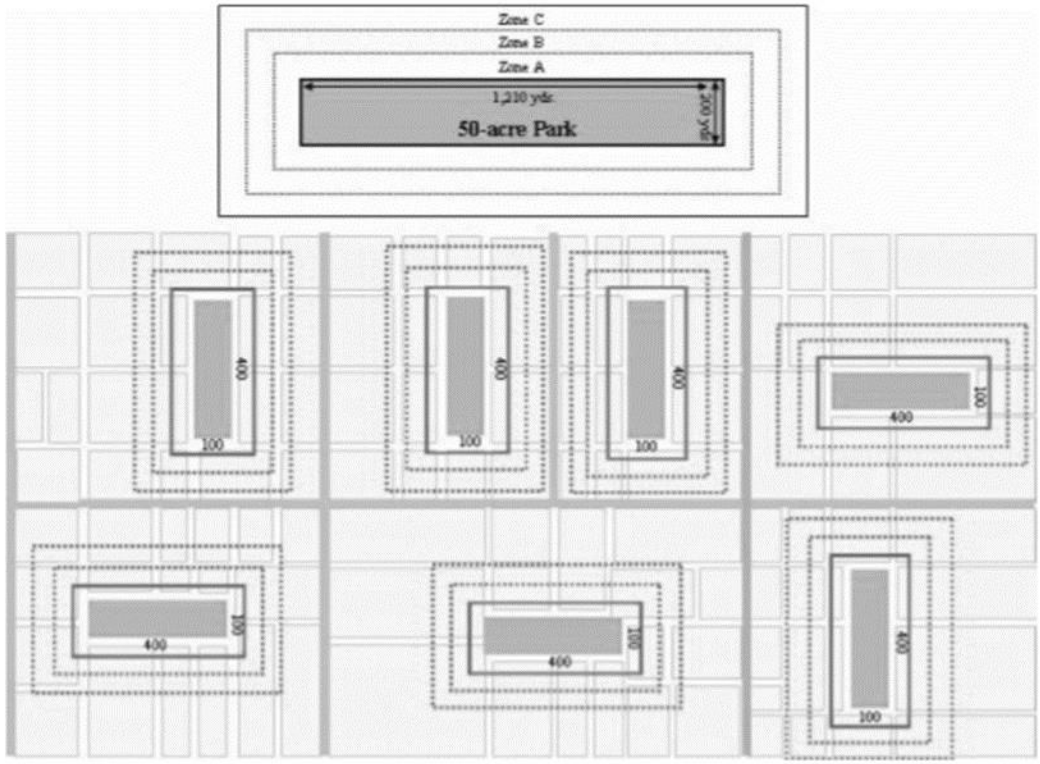


Figure 2-1 Illustration of the distribution of 50 acres of parkland into six smaller parks (Crompton, 2005)

	1 x 50-acre park	**6 x 8.3-acre parks**
	Affected square footage per zone	
Zone A	1,852,000 sq. ft.	4,560,000 sq. ft.
Zone B	2,172,000 sq. ft.	6,480,000 sq. ft.
Zone C	2,492,000 sq. ft.	8,400,000 sq. ft.

Table 2-1 Breakdown of land area based on Crompton's (2005) distribution of parkland

When considering the benefits of additional parks to local citizens and the impact on the local economy (Figure 2.2), it is imperative that local government agencies appreciate the indirect effects of parks, and the direct values that are felt by the citizen. These direct values are real estate values, production value, and natural system values.

The indirect values can include fiscal impacts for the consumer, expenditures from open space activity, employment, and tax revenues (Fausold and Lilieholm 1999).

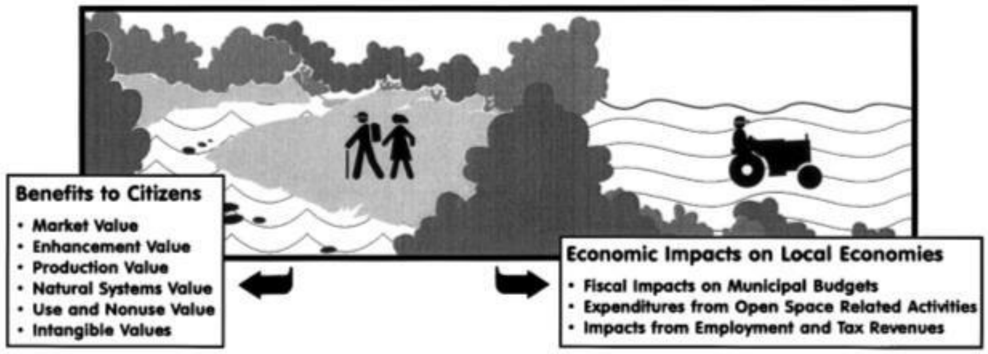


Figure 2-2: Open space values (Fausold and Lilieholm 1999)

Proximity and size aside, other factors pertaining to the open space itself are identified as playing additional roles in evaluating the proximate principle. The amount of open space near the lot (Bolitzer and Netusil, 2000) (Conway et al., 2010) (Metz, 2016), the type of open space (Cho et al., 2008) (Epsey and Owusu-Edusei, 2001) (Geoghegan, 2002) (Lutzenhiser and Netusill, 2001), and whether or not the land is unprotected or protected (Geoghegan, 2002) (Irwin and Bockastael, 2001) (Irwin, 2002) (Metz, 2016) all play additional roles in the overall value of this principle. The amenities the park offers also plays a role in this principle, as homes that face a recreation center can sell for less than those one block away (Weigher and Zerbst, 1973). The vegetation itself can also determine the effect of the principle, as a more uneven and diverse landscape is preferred in rural settings, while a more manicured landscape is favored in a more urban area (Cho et al., 2008).

The different property value determinants also play a role in how effective the proximate principle impact is. The amenity value of a neighborhood park can increase with increases in neighborhood density, income, and crime rates (Anderson and West, 2006). However, as the distance to the Central Business District increases, the premium value of parks can decrease (Anderson and West, 2006); however, in a polycentric urban development pattern, this impact can be insignificant (Chen and Jim, 2010).

Crompton (2001) describes three methods by which the effect of the proximate principle could be measured on greenways:

- When property has been retrofitted into open space, examine the home values before and after the construction to identify differences.
- Create a control by identifying properties with similar property value determinants, with the only difference being proximity to greenways. Match the properties remaining together to determine differences based on greenway proximity.
- The use of hedonic value analysis. Set control variables for property determinants including proximity to greenways. The distance decay approach is used to determine additional value to property as it moves closer to or farther away from greenways.

While his methods specifically mention greenways, the hedonic value approach has been the most consistently used method in measuring the effects of open spaces. The concern when using this method over a large metropolitan area such as Arlington; however, is that the different density levels and unobserved neighborhood characteristics may result in skewing either positively or negatively the effect open spaces have in smaller, more specific areas (Anderson et al., 2006). A nearest neighbor matching technique has been utilized in one instance along with a hedonic analysis of the same area. They both showed similar value premiums on proximate properties, but the nearest neighbor matching analysis only factored in limited number of housing attributes, and not other typical property value determinants (Metz, 2016).

2.2 Existing Studies and Key Themes

2.2.1 Introduction

A multitude of studies measuring the effect of open space on local property values have been conducted in the last three decades. These studies measure the actual difference in property values, giving the value a real figure rather than being a perceived notion. The results of these studies can be broken down into key themes that play roles in the additional value the proximate principle has on home values. For this discussion, they are as follows, proximity to open space, the type of open space, neighborhood characteristics, the amount of green space, and whether the land is protected or unprotected.

2.2.2 Proximity to Open Space

The belief that property located closer to a park is higher in value than property that is further away is termed the proximate principle (Crompton, 2001). Crompton (2001) examined nine existing studies of which eight were conducted using an attitude and opinion based survey method of homeowners and relative stakeholders. These surveys show that neither group believed that the proximity of an open space trail had a negative impact on the sale of a home. He further extrapolated that on average, between 20% and 40% of those surveyed believed that the open space trail would have a positive influence on the overall value and the salability of a home.

Within Crompton's (2001) examination is an interesting notion, many stakeholders felt that the existence of an open space trail held no impact on the value or resale of a home. Studies using economic valuation methods, such as hedonic value analysis, show this to be untrue. Open space located within 1,500 feet of a home can account for 1% up to 6.5% of the home's total value (Bolitzer and Netusil, 2000)

(Lutzenhiser and Netusill, 2001) (Epsey and Owusu-Edusei, 2001). Ham et al. (2015) found that homes within 1 mile of Pike National Forest in Colorado generate approximately $450 more in property taxes than those that are more than two miles away. The value of an average home increases with proximity to open space (Anderson and West, 2006) (Biao et al., 2012), and the father away a home is from an open space, the less the effect of the proximate principle is felt (Brander and Koetse 2011).

A study conducted in Columbus, Ohio illustrated that properties that fronted parks sold for approximately $1,130 more than those that were located a block farther away (Weigher and Zerbst, 1973). Miller (2001), studying homes facing urban parks in the Dallas/Fort Worth region of Texas, showed that the homes facing the park had on average a 22% higher value than those that were located at least one-half mile away. This is not the case for all subdivisions in Dallas, Texas; however, specifically those that have publicly usable open space homes. While values of the homes in the subdivisions are higher than average, the impact of the open space is not significant to the home's total value (Peiser and Schwann, 1993).

2.2.3 Types of Open Space

A very broad way to classify open space is to identify protected land versus unprotected, or developable, land. Geoghegan (2002) identifies protected open space as parks or land under conservation easements, and unprotected as farmland or other land that may have the potential for development. The model in that study the consumer was nearsighted, and would not understand that the unprotected land has the potential for development in the future, rather that they prefer more open space to less. The consumer, however, may not value the actual land itself, rather, the value comes from the fact that protected land will not become development (Irwin, 2002). Protected open space that is accessible by the public has been shown to have the highest impact on a home's value, and in staying with the proximate principle, this value decreases the farther away the home is from this open space (Metz, 2016).

Once the protection of the open space has been established, the different effects of smaller categories can be discussed. Lutzenhiser and Netusill, (2001) found that of four open space types in Portland, Oregon, natural park areas have the largest effect on property values, followed by golf courses, specialty parks, and urban parks. Focusing on more urbanized areas of the Twin Cities region of Minnesota, Anderson and West (2006) also found that specialty parks had a greater impact than neighborhood parks. Different open space types play a different role in value depending on their make-up and location within the city. Neighborhood park's value increases the closer you get to the Central Business District (Anderson and West, 2006), while natural forest areas are highly sought out in more rural settings (Cho et al., 2008). A study in Greenville, South Carolina, conducted from 1990-1999 showed that the highest effect of the proximate principle was due to proximity to small neighborhood parks (Epsey and Owusu-Edusei, 2001). This study also discussed the differences in how the park is maintained, as an unattractive medium park can have a negative effect that can reach up to 600 feet into the surrounding neighborhood.

2.2.4 Density

The amenity values of open space vary depending on the housing type (McCord et al., 2014). A parks value can reach up to three times higher in neighborhoods that are twice as dense as the average neighborhood (Anderson and West, 2006). This could be tied to the fact that the denser neighborhoods are typically located closer to the city's center. Less available green space in these areas can cause a higher value for open space (Brander and Koetse, 2011), while at the same time, open space holds a lower value in less dense neighborhoods (Biao et al., 2012). This is not always the case though, one study conducted in Shenzhen, China shows that the presence of multiple financial or social centers can lessen the significance of the Central Business District proximity (Chen and Jim, 2010).

2.2.5 Amount of Greenspace

Increases in the amount of greenspace within a certain distance of a home also have a positive influence of the home's value (Bolitzer and Netusil, 2000). The increase in the amount of greenspace is more impactful if the increase happens within a one-quarter mile radius of the home rather than within a one-mile radius (Metz, 2016). This can prove difficult to accomplish, as the amount of land area within the one-quarter mile radius is significantly less than the one-mile radius. The amount of landscaping in a neighborhood can also increase the value of a home depending on its type: tree coverage can increase premium values by 0.2% for each 1% in the increase of the amount of tree coverage (Rosies et al., 2002). An increase in the amount of greenspace by 1% within 200 to 300 feet of a home in Downtown Los Angeles, can increase the value of the home by 0.076% (Conway et al., 2010). Studies focusing on the amount of greenspace near a home could have a problematic issue, as they could value protected versus developable land at the same value.

2.3 Methodology

Most studies have used the third method described by Crompton (2001), the hedonic value analysis method (Anderson and West, 2006) (Biao et al., 2012) (Bolitzer and Netusil, 2000) (Chen and Jim, 2010) (Cho et al, 2008) (Cho et al., 2011) (Conway et al., 2010) (Epsey and Owusu-Edusei, 2001) (Geoghegan, 2002) (Ham et al., 2015) (Irwin and Bockastael, 2001) (Lutzenhiser and Netusill, 2001) (McCord et al., 2014) (McConnell and Walls, 2005) (Metz, 2016) (Weigher and Zerbst, 1973). This method uses Geographic Information Systems (GIS) as a tool to help geolocate addresses (Anderson and West, 2006), measure the amount of open space (Biao et al., 2012), or to measure Euclidian distances to the home's value determinants (Bolitzer and Netusil, 2000) and prepares the data for the ultimate hedonic value analysis.

Metz (2016) used a nearest neighboring match analysis to compare to the results of the hedonic value analysis conducted in the same area. This analysis does not use the linear distance measurement to open space or other determinants; rather, homes are matched based on number of bathrooms, home size, and lot size and compared based on park proximity. This method allows for 'better control for unobservable neighborhood characteristics.'

2.4 Summary

Park types, rather than size, have been studied (Lutzenhiser and Netusil, 2001) based on how manicured or natural the park is landscaped. With Crompton (2005) identifying the greater land area effect that six smaller parks have rather than one 50 acre park, identifying the proximate effect based on size is crucial. Another gap in the existing studies is the cross-referencing of park types to different neighborhood characteristics. Studies have shown that the affect the park type has differs depending on the proximity to the Central Business District (Anderson and West, 2006) (Cho et al., 2008). If open space holds a low value in less dense neighborhoods (Biao et al., 2012), should parks be planned in denser areas, while conservation areas at the outskirts? The final gap identified is in the methodology used by the majority of the studies. Previous research has proven that proximity to open space does play a role in the overall value of a home. How large or small, or whether it is positive or negative, can be measured by a number of different methods (Crompton, 2001). The most used method, hedonic value analysis, has shown the effect to be positive and even significant at times; nevertheless, identifying the type of park that has the greatest effect, or whether the effect differs based on the characteristics of the surrounding neighborhood can be difficult if using the nearest neighboring match analysis over a large area (Metz, 2016).

Chapter 3

Research Methodology

3.1 Introduction

This chapter describes the framework for the overall analysis used in this study. It begins by identifying the value determinants, or attributes, used in residential value analysis. Each attribute is broken into specific characteristics, if needed, or in order to acquire accurate data for the study. Once the data was acquired, it was compiled into a geodatabase to be used for analysis via ArcGIS 10.4.1.

The methodology is two phases. The first phase identifies the existence of the proximate principle and its extent in the City of Arlington, via the nearest neighbor match analysis. During this phase, certain parks have shown to play a differential effect on properties located close to them. The second phase identifies three parks, from two different park classifications, to determine the effect that park proximity has on the remaining value determining categories.

3.2 Scope

The scope of analysis for this research focuses on home sales from 2015 through 2016 within the city of Arlington, Texas.

3.3 Identifying Property Value Determinants

Previous studies have identified a series of attributes that influence local property values including structural, neighborhood, community, and locational attributes, as well as local amounts of crime. Each attribute is broken down into further characteristics as follows:

- Structural Attributes – Lot size, home size, number of bedrooms, bathrooms, garage parking spaces, and the presence of a swimming pool

- Neighborhood Attributes – Median age, median income level, and median age of structure
- Community Attributes – Local school district

The following table identifies the types of data that were acquired, the source used for acquisition, the date the data was retrieved or received, and the use within this study.

Data used in Geodatabase			
Type of Data	**Data Source**	**Date Retrieved**	**Use in Study**
Municipal Boundary	City of Arlington Open Data Portal	March 26, 2017	Shapefile
Tax Parcels	City of Arlington Open Data Portal	March 25, 2017	Shapefile
Park Properties	City of Arlington Open Data Portal	March 25, 2017	Shapefile
Parcel Land Use	City of Arlington Open Data Portal	March 27, 2017	Shapefile
Home Values and Structural Characteristics	Multiple Listing Service	March 18, 2017	Data
ACS Block Groups	United States Census Bureau	March 4, 2017	Shapefile and Metadata
School District Boundaries	United States Census Bureau	April 1, 2017	Shapefile

Table 3-1 Data used in Geodatabase construction

3.3.1 Structural Attributes

For this study, data was received from the Multiple Listing Service, via the City of Arlington. The data included property addresses, sales values, lot size, home size, number of bedrooms, number of bathrooms, number of garage spaces, and the presence of a swimming pool on the lot. A total of 8,046 homes were reported from January 2015 through December 2016. To eliminate outliers, such as foreclosures, the top and bottom five percent of sales were removed from the analysis. In an attempt to factor out human error for the entering of information into the MLS, the top and bottom three percent of the remaining sales were removed. This leaves the remaining study group at 6,906 home sales between the two years.

3.3.2 Neighborhood Attributes

Data related to the neighborhood attribute group was retrieved from the United States Census Bureau. The 2015 American Community Survey provides the most up to date information regarding existing demographics of the Census Block Groups during the study period.

3.3.3 Community Attributes

The largest factor in this group is the local school district. Different school districts provide different services and are ranked differently when comparing each other across the board. The city of Arlington has five school districts within its boundaries. These districts include Arlington ISD, Mansfield ISD, Kennedale ISD, HEB ISD, and Fort Worth ISD. Trying to analyze this factor as individual school ratings may prove to be difficult. The organization, GreatSchools.org has compiled a rating system for each state, and in Texas, the ratings are based on standardized test scores (Appendix A). In a study conducted in Connecticut, a hedonic value analysis showed that increases in test scores can lead to increases in property values (Clapp et al., 2008). However, in areas that allow for school choice, the probability of a parent choosing to purchase a home based on the nearest school is 6.5% lower than in areas that do not offer a choice (Ely and Teske, 2015). In 2013, Arlington Independent School District opened up the district so that students have the opportunity to transfer to any school of their choice within the district (Lenghi, 2013).

School District boundary information was retrieved via the United States Census Bureau. Upon a preliminary review of home sales, only Mansfield ISD and Arlington ISD be reviewed. The information used for this comparison are the standardized test scores for each school district, retrieved from the Texas Education Agency.

3.4 Methodology Used

The data was compiled into a geodatase for review with ArcGIS. Park parcels were categorized within the metadata provided within the shape file. These parcels (Image 3-1) were color coded for a more visual analysis. If classification information was missing in the shape file, the Arlington Park Finder maps (Appendix A) were used to identify parcels that may be separate, but are part of a larger park system. The park type parcel counts (Figure 3-1) are as follows:

- City Park (13)
- Community Park (11)
- Golf Courses (4)
- Linear Park (20)
- Natural Area (3)
- Neighborhood Park (39)
- Specialty Park (1)
- Not identified (3) (Arlington Park Finder, Appendix B)

Three park parcels were not identified within the data set, nor were they identified on the Arlington Park Finder map. These three were left as ‘not identified’ and only factors into the overall evaluation of the principle.

An address locator was created using the tax parcel layer retrieved from the Arlington open data portal as a single field locator to geolocate the sales values from 2015 to 2016 (Figure 3-2). Of the 6,908 home values remaining, approximately 4% were unable to be matched with existing locations, giving the final data set 6,653 home sales.

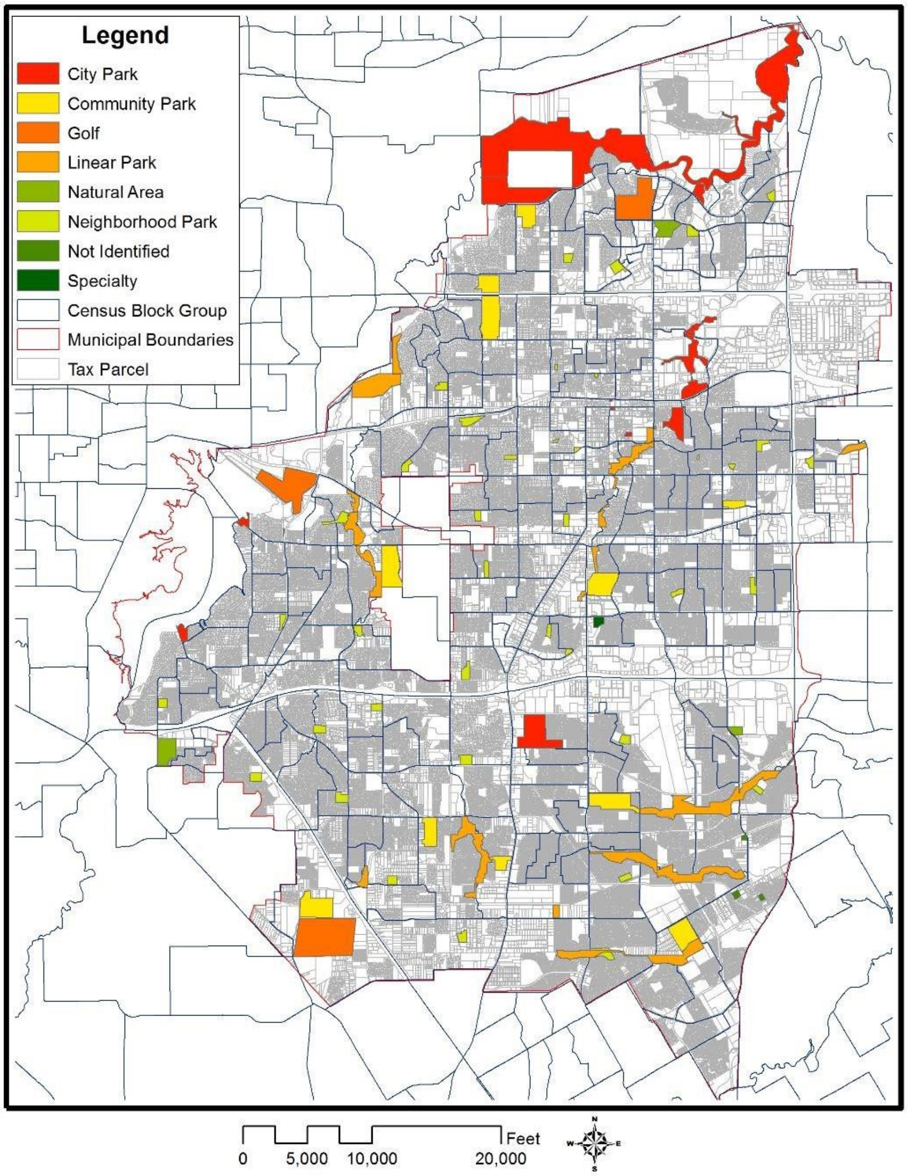


Figure 3-1 Park Classifications Map

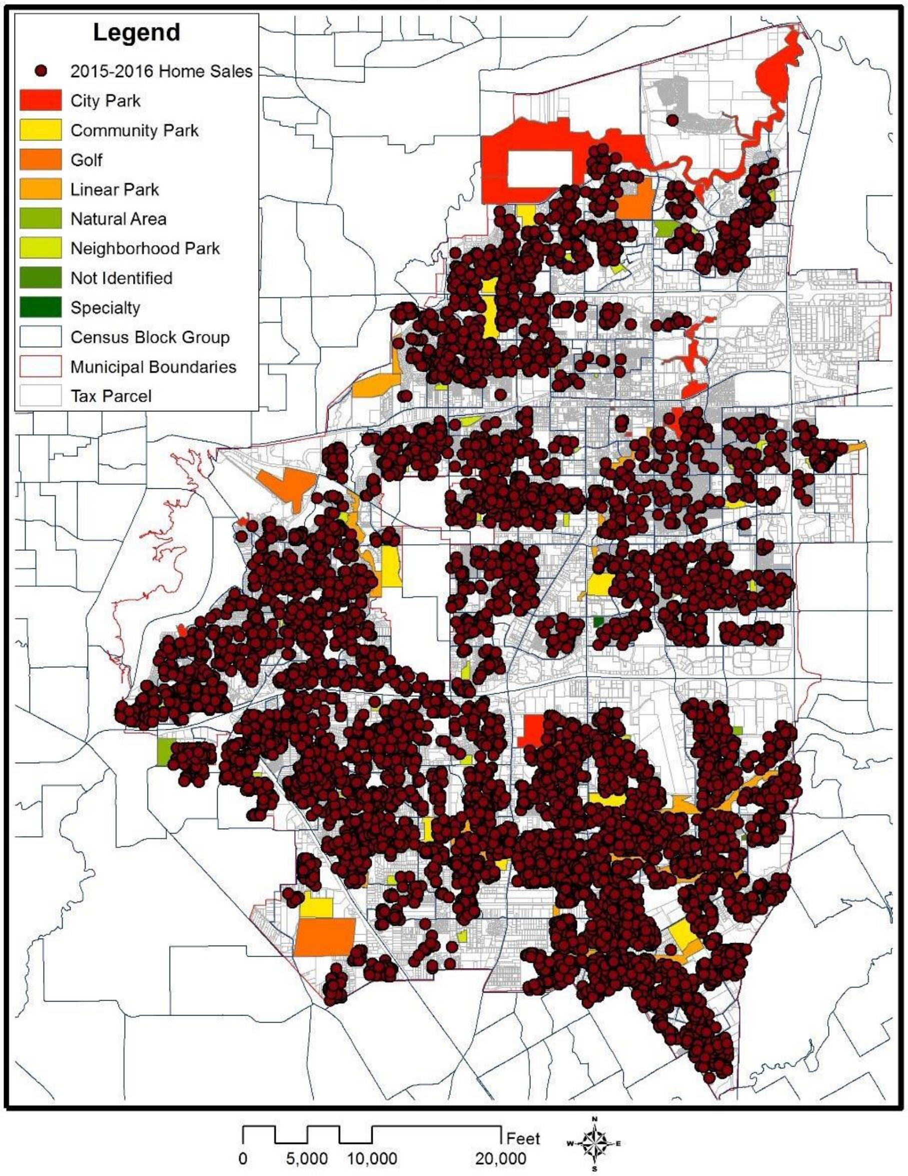


Figure 3-2 2015-2016 Homes Sales Map

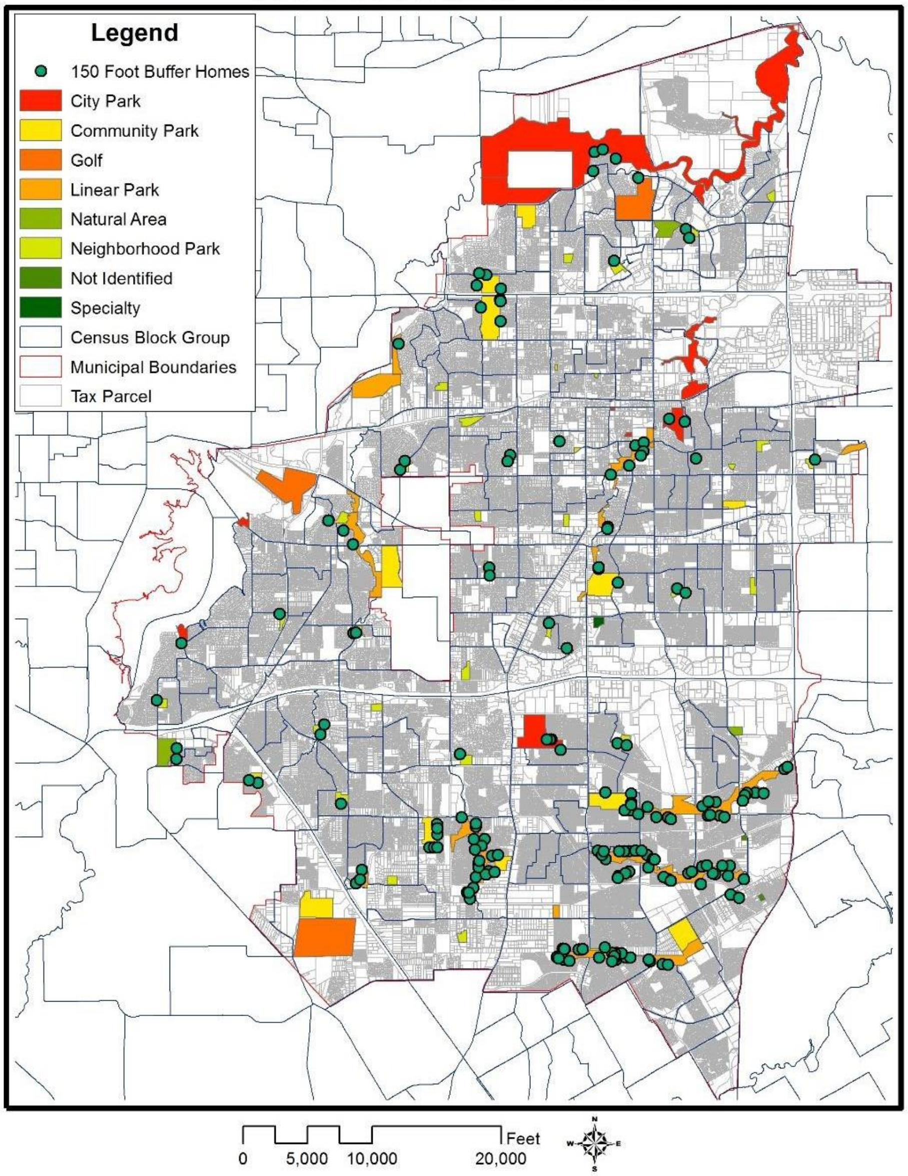


Figure 3-3 150-foot Buffer Homes Map

An initial buffer was created at 150 feet around each park parcel to identify homes sold within the closest proximity to all parks (Figure 3-3). This distance was chosen as the typical minimum property depth for residential properties in Arlington is 150 feet, and the typical local street right-of-way width is 50 feet. This allows the buffer to potentially capture both properties that back up to a park and ones that are located across a local street from a park.

Within this buffer are 188 homes. These homes were broken up by their number of bedrooms to identify the largest sample sizes (Table 3-2). With this breakdown, the two largest groups are three-bedroom and four-bedroom homes. These two groupings account for approximately 73% of the sample size.

Number of Bedrooms	Quantity	Average Square Footage	Minimum Square Footage	Maximum Square Footage
Two	1	1003.00	1003.00	1003.00
Three	96	1785.85	1089.00	2872.00
Four	80	2497.78	1223.00	3637.00
Five	9	3132.33	1951.00	4004.00
Six	2	3252.00	2518.00	3252.00

Table 3-2 Breakdown of Homes Based on Number of Bedrooms within 150-Foot Buffer

Additionally, the sales data was also broken into home sales by each year. This was also done to identify the bedroom count in each year of home sales. In 2015, of the homes sold, 59% were three-bedroom homes and 35% were four-bedroom homes (Figure 3-4). Additionally, in 2016, 61% of homes sold were three-bedroom homes and 34% were four-bedroom homes (Figure 3-5). This information indicates that the 51% of three-bedroom homes and 43% four-bedroom homes in the 150-foot buffer zone will provide a sizeable study group with additional numbers sold throughout the city.

A second buffer of 2,000 feet was created to identify three park classifications that have the largest concentration of home sales within their vicinity. For both the three-bedroom homes and four-bedroom homes those parks are as follows: neighborhood parks, linear parks, and community parks. These three park classifications allow for the best opportunity to determine whether the proximate principle is felt equally dependent on the other value determining factors.

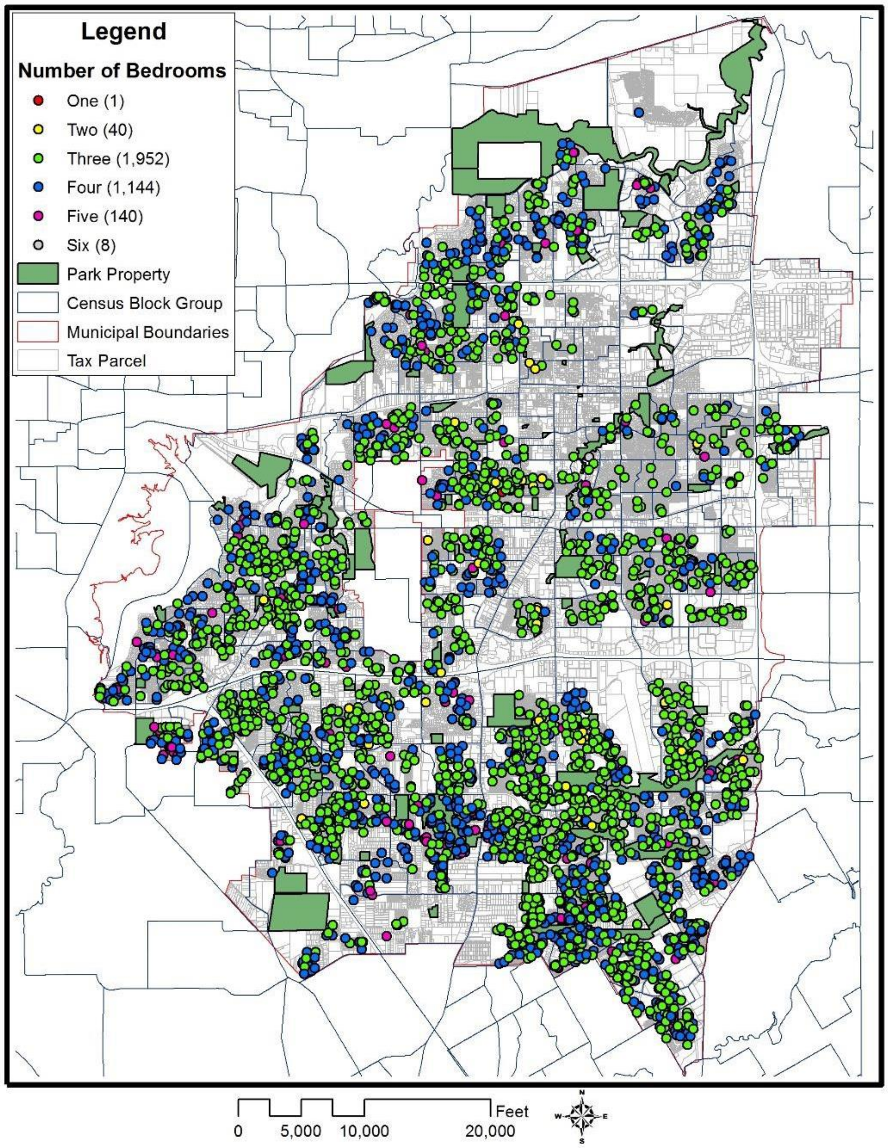


Figure 3-4 2015 Home Sales

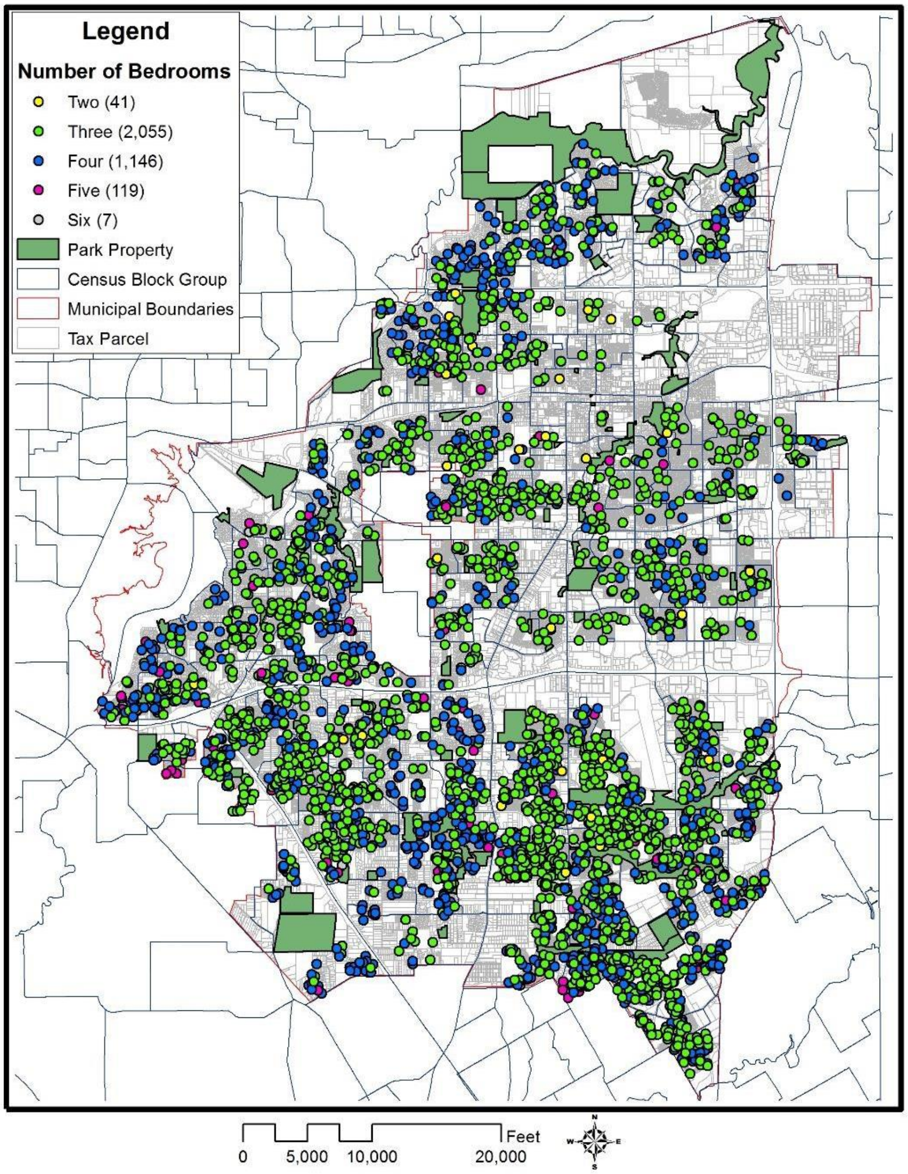


Figure 3-5 2016 Home Sales

3.5 Summary

The nearest neighboring match analysis methodology is being used to evaluate the proximate principle in the city of Arlington, and to provide a much more visual analysis of the principle. Additional correlation is provided to indicate whether the nearest neighboring match analysis is statistically significant. The findings are evaluated in the following chapter.

Chapter 4

Analysis

4.1 Introduction

An initial analysis of all park classifications was done to illustrate average home values adjacent to all park parcels throughout the entire city. The parks are then broken down into the classifications indicated in Chapter 3. The proximate principle is then measured for six of the classifications. The parcels indicated as not identified, and the one parcel indicated as specialty will be removed at this point in the analysis. Additionally, average home values within 2,000 feet of each park classification will be discussed.

As indicated in Chapter 3, certain park types have a larger concentration of homes when compared with the overall amount of homes sold during the study period. Neighborhood park types are broken into categories to determine differences in the median sales value and median price per square foot for both 2015 and 2016. Additionally, individual parks are identified and the average home values and price per square foot for three and four-bedroom homes will be analyzed based on the size of the park itself.

4.2 Proximate Principle for All Parks

Within the city of Arlington, 94 parcels were identified as being a park, or a portion of a park system. Figure 4-1 illustrates the trend of home values as the distance increases from a park within the 2,000-foot buffer. On average, the highest home values lie within the closest proximity to a park. This value represents both homes that back up to a park and homes that are across the street from a park.

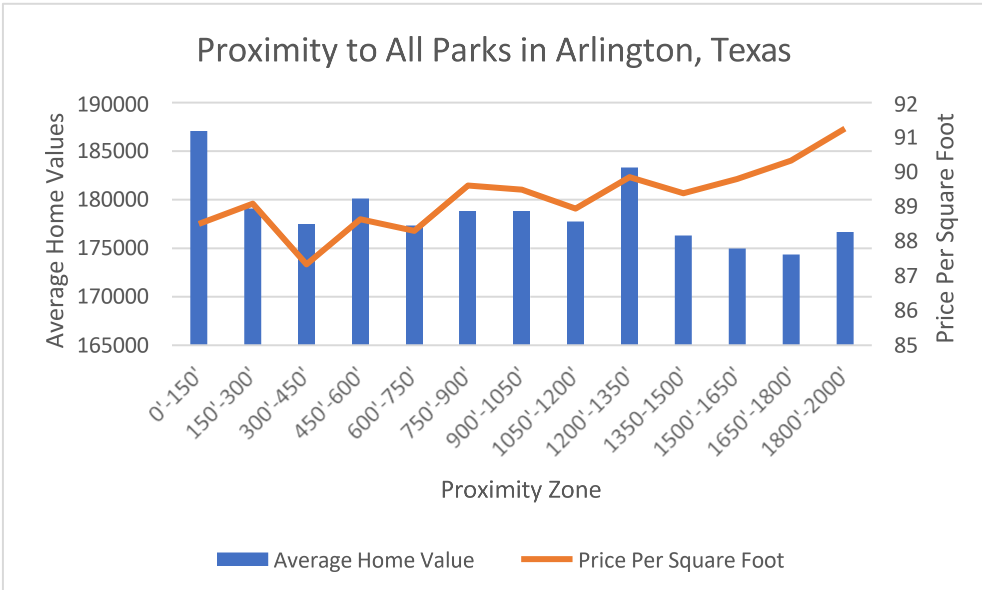


Figure 4-1 Average Home Values and Price Per Square Foot for 2,000 Foot Buffer

		Distance	**Sale_Price**
Distance	Pearson Correlation	1	0.54**
	Sig. (2-tailed)		0
	N	6653	6653
Sale_Price	Pearson Correlation	0.54**	1
	Sig. (2-tailed)	0	
	N	6653	6653

Table 4-1 Pearson's Correlation for Park Proximity

A Pearson's correlation analysis was conducted for all home sales throughout the study period, indicating that the proximity to a park plays a significant role in the home's value (Table 4-1). This significance; however, indicates that throughout the entire city, a home's value would increase as the distance to a park increases. Additional analysis within the 2,000-foot buffer will determine whether there are differences in the effect of each park classification.

4.3 Proximate Principle by Park Classification

As the initial mean analysis indicates, the value of homes appears to lessen the farther the lot is from a park. This could be skewed by the amount of homes sold within each of the proximity zones, as well as the homes that fall outside of the 2,000-foot buffer. Similar to the illustration and table provided in Chapter 2, each zone as it gets closer to the park, will be a smaller land area. These smaller land areas provide less and less opportunity to capture home sales. As table 4-2 indicates, the amount of home sales within each of the 150-foot buffer zones diminishes, or stays very similar to, the previous zone the closer they get to a park. The two exceptions to this can be seen in Figure 4-1, as the two highest average home values have two of the lowest concentrations of home sales compared to the that zones around it. One thing to note, is that the average price per square foot of a home increases as the linear distance to a park increases.

Proximity Zone	**Average Home Value**	**Price Per Square Foot**	**Quantity**
0'-150'	$187,057.13	$88.50	188
150'-300'	$179,103.60	$89.09	289
300'-450'	$177,511.36	$87.34	290
450'-600'	$180,116.45	$88.63	300
600'-750'	$177,324.77	$88.30	325
750'-900'	$178,831.56	$89.61	321
900'-1050'	$178,825.90	$89.49	368

Proximity Zone	Average Home Value	Price Per Square Foot	Quantity
1050'-1200'	$177,740.09	$88.94	353
1200'-1350'	$183,332.58	$89.85	313
1350-1500'	$176,311.13	$89.39	374
1500'-1650'	$174,998.37	$89.80	362
1650'-1800'	$174,338.38	$90.33	345
1800'-2000'	$176,676.96	$91.25	472
2000'-3000'	$177,252.04	$90.84	1692
3000'-4000'	$181,630.48	$90.18	471
4000'-5000'	$169,128.41	$88.01	63
5000'+	$211,572.23	$90.42	127
		Total	6653

Table 4-2 Average Home Values Based on Proximity Zones

The idea of the proximate principle is being shown on all park classifications; however, the correlation between distance from a park and property values are both negative and positive. Table 4-3 identifies the six park classifications, and the effect that distance has on the property values. City parks, Community parks, and Natural areas show a negative correlation, meaning that as the distance from a park increases, the value of the home decreases. Of these three, only two show this correlation to be statistically significant. On the other side of the spectrum Golf Courses, Linear parks, and Neighborhood parks show a positive correlation, meaning that an increase in distance from a park could mean an increase in the homes resale value. Again, of the three with positive correlations, only two show to be statistically significant.

Each park was given a 2,000-foot buffer to capture all home sales within the vicinity. Classifications that were assigned within the dataset, or from Arlington Park Finder were selected individually in ArcGIS and the homes surrounding them were selected. The data was pooled to identify median home values throughout each proximity zone, and for each classification. The two more passive park classifications,

Distance Effect on Property Value		
Park Classification	**Pearson's Correlation**	**Significance**
City Park	Negative	Not significant
Community Park	Negative	Significant
Golf Course	Positive	Significant
Linear Park	Positive	Significant
Natural Area	Negative	Significant
Neighborhood Park	Positive	Not Significant

Table 4-3 Pearson's Correlation Significance

golf courses and natural areas, show higher median home values compared to the remaining four classifications (Figure 4-2). Trendlines have also been included in Figure 4-2 to add some visual to this principle, as the two classifications also had the largest amount of fluctuation from proximity zone to proximity zone. These trends also match the correlations identified in Table 4-3. Table 4-4 provides the sales counts for each of the park classifications by proximity district.

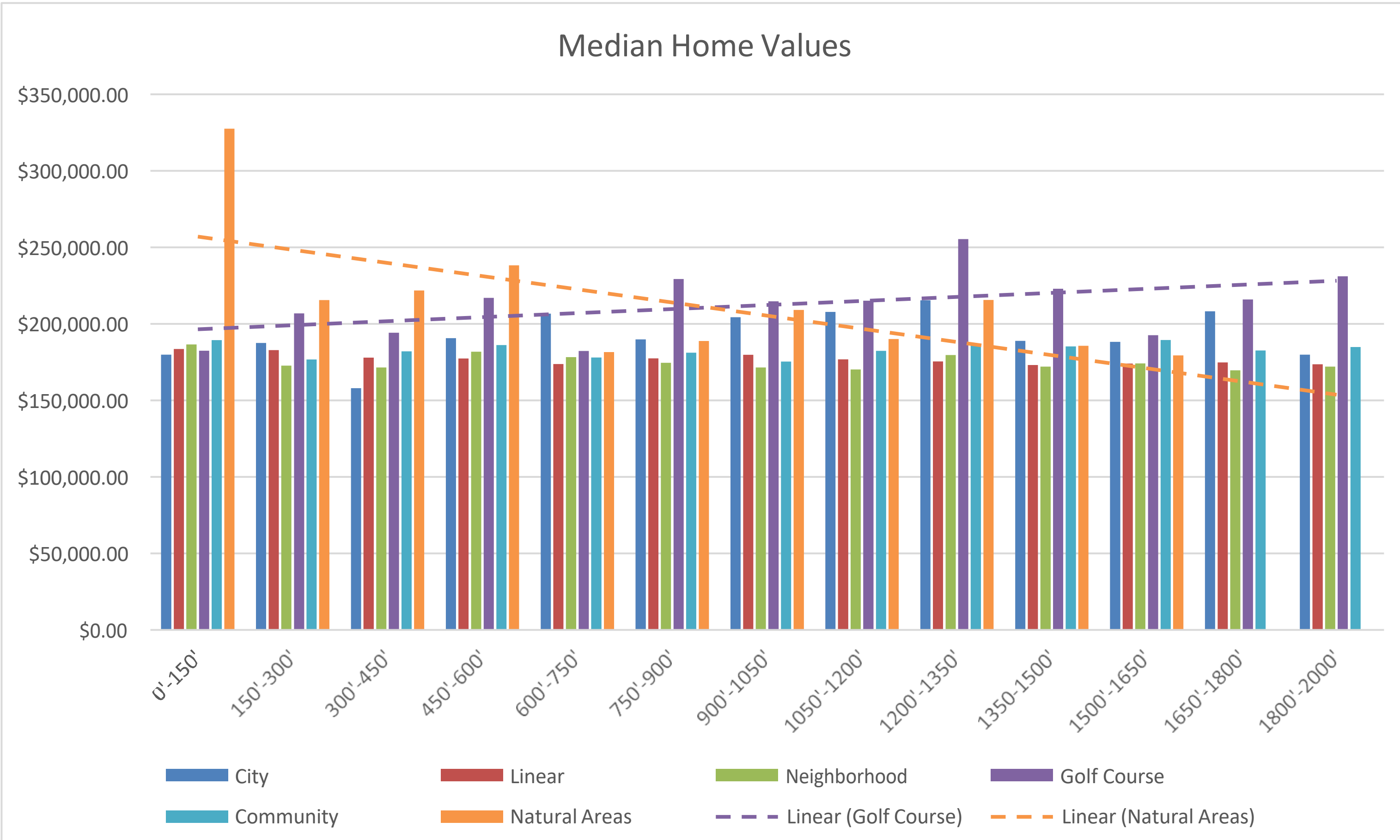


Figure 4-2 Median Home Values for all Proximity Zones and all Park Classifications

Number of Homes per Proximity Zone, Per Park Classification						
Proximity Zone	City	Linear	Neighborhood	Golf Course	Community	Natural Areas
0'-150'	11	104	43	2	26	2
150'-300'	16	131	89	5	51	2
300'-450'	19	130	89	9	54	5
450'-600'	20	113	127	3	49	13
600'-750'	25	141	134	9	53	2
750'-900'	25	158	123	7	53	16
900'-1050'	33	133	150	13	80	9
1050'-1200'	35	148	149	17	67	6
1200'-1350'	22	118	155	14	82	3
1350-1500'	28	137	187	19	88	12
1500'-1650'	29	119	209	16	85	6
1650'-1800'	33	126	205	28	93	0
1800'-2000'	35	185	306	28	142	0

Table 4-4 Number of Homes within Proximity Zones for all Parks

4.4 Nearest Neighboring Match Analysis

The intent of this research is to identify whether the nearest neighboring match analysis is a viable data analysis method for the existence of the proximate principle. Early attempts to create matches were difficult; however, the example listed below provided approximately 2.5% of the total population of sales. Figure 4-3 illustrates a small sample area illustrating matching locations. The factors for this example are:

- Three bedrooms
- Two bathrooms
- Two car garage
- No swimming pool
- A 7,200-square foot lot +/- 5%
- A 1,800-square foot home +/- 5%

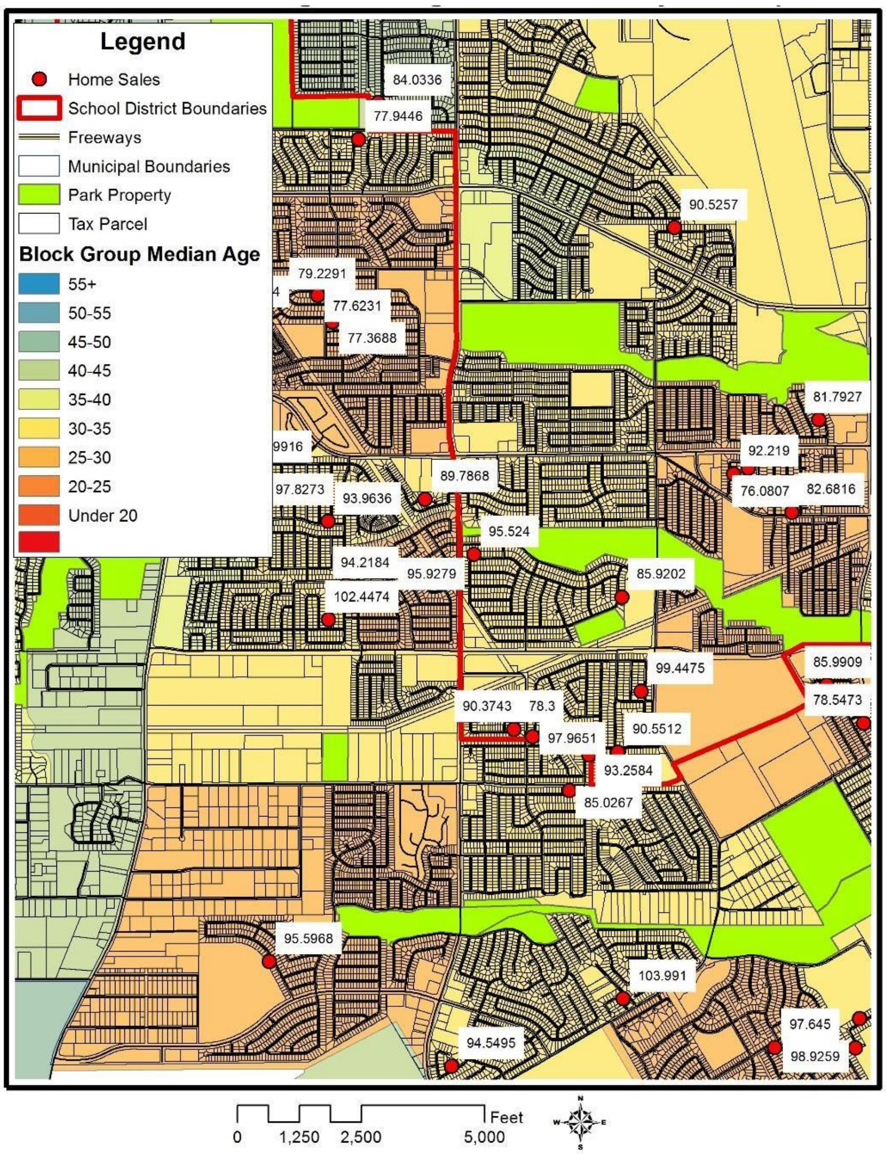


Figure 4-3 Nearest Neighboring Match Analysis Example

This query resulted in 172 homes being sold within the two years of the study. As illustrated in Figure 4-3, many of these homes are near each other, and provide a good study group.

Range	Average Home Value	Price Per Square Foot	Quantity
0'-200'	$159,133.33	$87.84	3
200'-400'	$158,210.00	$88.73	10
400'-600'	$182,500.00	$100.90	3
600-'800'	$149,061.25	$82.97	8
800'-1000'	$157,928.57	$88.22	7
1000'-1200'	$158,225.00	$89.43	8
1200'-1400'	$158,757.69	$89.00	13
1400'-1600'	$177,751.07	$98.96	14
1600'-1800'	$155,460.44	$86.91	9
1800'-2000'	$161,266.93	$90.53	14
2000'+	$162,899.54	$90.90	83

Table 4-5 Buffer Zone Values

Table 4-5 identifies the median home values within each of the 200-foot wide buffer zones. Approximately 48% of the study group falls outside of 2000 feet from a park which leaves 89 homes to study proximity. Figure 4-4 shows the median values for both sale price and price per square foot for all the zones. While both values show consistency with each other, there does not appear to be a visible trend with these values. Additionally, a t-test (Table 4-6) was run to determine any correlation between distance to a park and home value. While it does show a positive correlation, as distance increases from the park home values increase too, the correlation is not statistically significant.

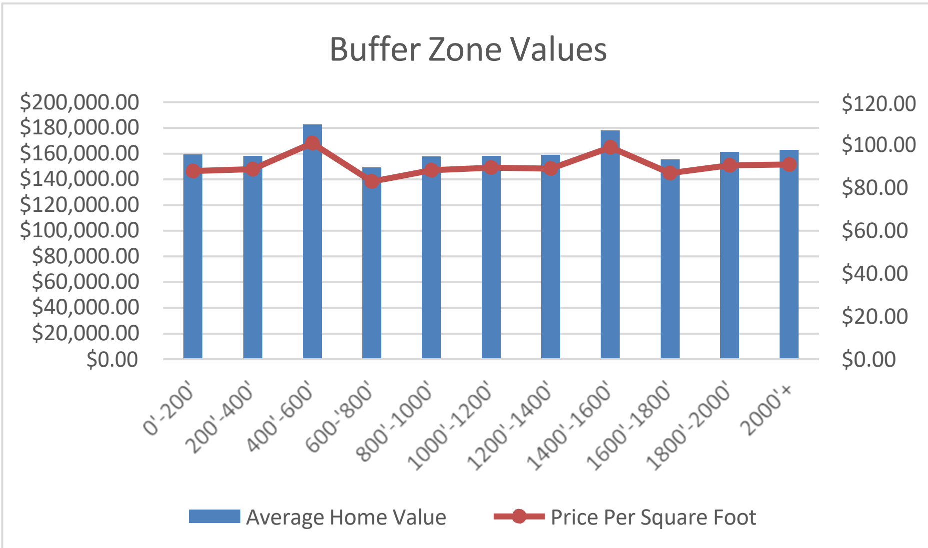


Figure 4-4 Buffer Zone Values

	Price_Sq_Ft	*Distance_to_park*
Mean	90.62290291	1958.286489
Variance	139.0114518	1131159.289
Observations	172	172
Pearson Correlation	0.012542133	
Hypothesized Mean Difference	0	
df	171	
t Stat	-23.03216124	
P(T<=t) one-tail	1.35046E-54	
t Critical one-tail	1.653813324	
P(T<=t) two-tail	2.70091E-54	
t Critical two-tail	1.973933954	

Table 4-6 Park Distance Correlation

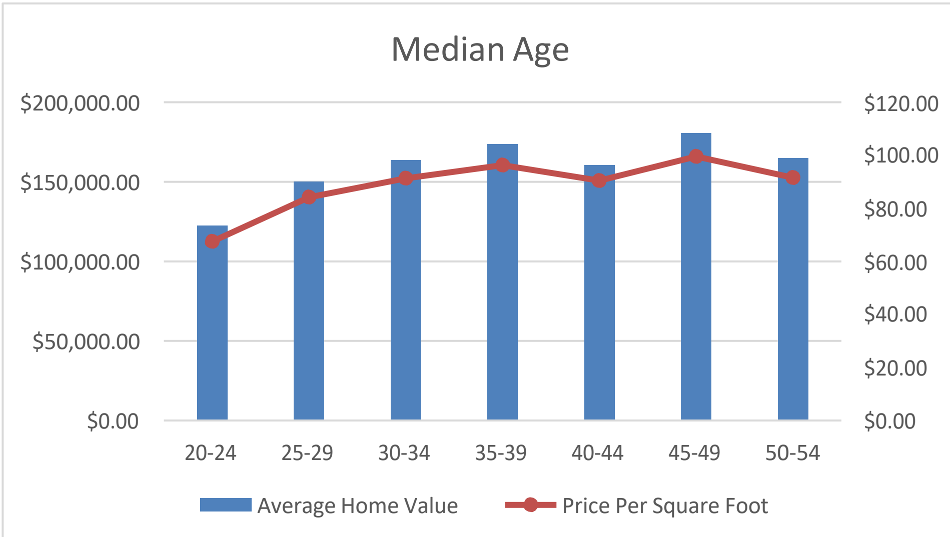


Figure 4-5 Median Age Determinant

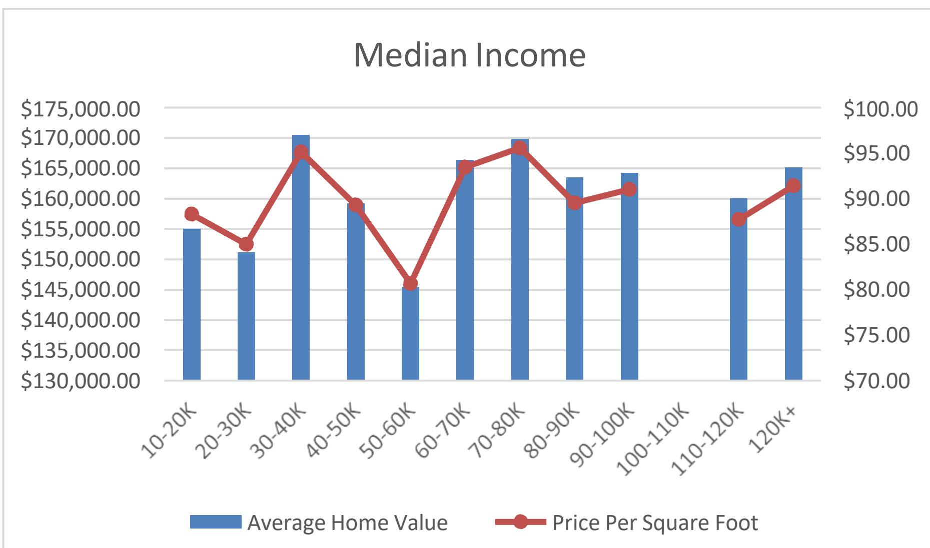


Figure 4-6 Median Income Determinant

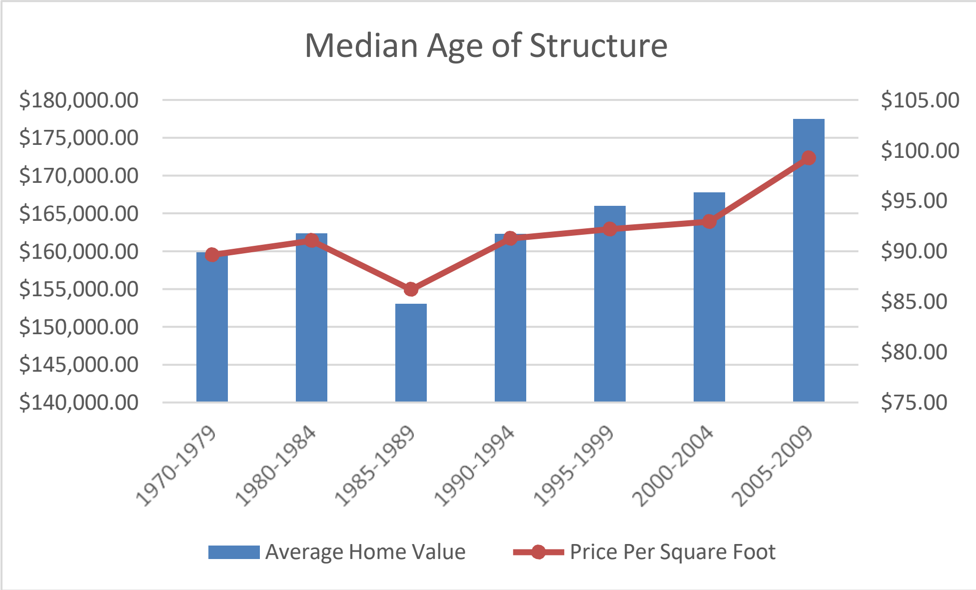


Figure 4-7 Median Age of Structure

Additional value determinants were also studied in this group. Figure 4-5 shows that a steady increase in home values based on the median age of the block group. Income (Figure 4-6) does not necessarily have the same effect. It shows that home values are fairly sporadic in relationship to median income. The average age of the structure (Figure 4-7) does show some trends that the older the age of the structure, the lower the value.

4.5 Developed versus Undeveloped versus Golf Courses

As Geoghegan (2002) identified the differences between protected and unprotected land, this research attempted to determine the differences within the protected land. For example, do natural areas affect home values the same as developed parks. Earlier in this chapter, it was identified that different classifications of park do affect home values differently, but how do developed parks overall affect home values (Table 4-7). Natural

Area parks tend to focus primarily on natural areas, but some do have more passive uses, such as hike and bike paths and trails (Appendix B).

Distance Effect on Property Value		
Park Classification	**Pearson's Correlation**	**Significance**
Undeveloped	Negative	Significant
Developed	Positive	Significant
Golf Course	Positive	Significant

Table 4-7 Pearson's Correlation Significance for Developed Type

Golf Courses have been separated from both developed and undeveloped park types. While the majority of the land lies in a very manicured, natural state, the activities that occur on these sites is lees passive than those that occur in natural areas. They also provide an increased source of vehicular traffic. While golf courses provide home values that are approximately 25% higher that developed parks, and 22% higher than undeveloped park types, these values diminish the closer a home is to the course.

Of the three park types, only undeveloped, or natural areas show a positive correlation for park proximity. This could be due to the less passive activities that occur at these facilities. It may also be due to the preservation of a natural view shed within the larger metropolitan area.

4.6 Neighborhood Parks Analysis

Neighborhood parks were chosen to be studied in further depth for their large concentration of homes sold in their vicinity, the sheer number of existing neighborhood parks in Arlington, and that they are spread throughout the entire community. This portion of the analysis focuses on the differences in effects that each park may have on its surrounding, local neighborhood. The average home value for all homes in Arlington that were sold during this time frame is approximately $179,000, with an approximate price per square foot at $90. The average three-bedroom home during this time frame sold for approximately $158,000 and $92.00 per square foot, and the average four-bedroom home sold for approximately $210,000 and $87.50 per square foot. Within a 2,000 foot buffer, 5 of the selected neighborhood parks three-bedroom homes mean values are above the city's average, and none of the selected parks have four-bedroom home mean values above the average

There does not appear to be any correlation between the amenities offered at each park and the effect the park has on the neighboring property's values. The only amenity that is common to either the positive or negative correlations of value is that the ability to fish may be associated with an increased home value the further away a home is from a park.

4.7 Summary

While the nearest neighboring match analysis does not show significant changes in value based on proximity, the lack of volume of lots to study did not appear to be enough to determine an accurate depiction of the proximate principle. The research does appear to indicate that the principle exists in some park classifications, both positively and negatively. Additionally, the analysis was not able to show any differences based on the range extending out greater than the identified 2,000 feet.

Chapter 5

Conclusion

5.1 Introduction

The attempt to use the nearest neighboring match analysis was unsuccessful at identifying the existence of the proximate principle on a broad scale throughout the city of Arlington. It also was not able to determine the existence of the principle within the smaller study group of 172 homes. The research could provide light on opportunities to increase its likelihood of a more successful study by having a larger pool of data to compare attributes to. It also provides insight into why the hedonic value analysis method is a more accurate measurement of the effect of park proximity.

5.2 What We Did Learn

Throughout the city of Arlington, it does appear that existence of a park can increase the value of a home with close proximity to them, but not all share this correlation. In fact, some of the park systems show that park proximity may negatively affect the value of the home itself. Even this is not the case with all parks of a same classification. The nine selected neighborhood parks were split with five having positive correlations and four having negative correlations.

In Chapter One, the author identified the following three research questions:

1. Will the nearest neighbor match analysis show similar results as previous hedonic value analysis methods?
2. Does the effect the park has on property values change depending on the size of the park or amenities that the park has to offer?
3. Do the impacts of the proximate principle change based on other value determinant characteristics?

While the data pool was small, it did show similar results to hedonic value analysis methods. These results are not as statistically significant based on the low number of homes with that many similar structural characteristics. Two final correlations were done using parks from the neighborhood park classification to determine the affect size had on the local home values. Both show that the size of the park has a positive correlation to home value. This indicates that in the case of neighborhood parks, the larger parks can increase the average value of the homes surrounding it. The last question is still unanswered. Since the nearest neighboring math analysis was not successful passed identifying passed structural characteristics of the home, the opportunity to separate by other value determining attributes was not studied.

5.3 Research Significance

While the original analysis did not work as expected, there may be opportunities to expand this type of analysis to make it more successful. Larger time frames would provide the opportunity to have a larger group of data to study. Consumer Price Index rates can be used to get all values on an even playing field, so that the prices can be compared. This larger pool of data provides more opportunity to create matches based on more structural characteristics other than just the number of bedrooms. Additionally, larger time frames would allow the use of multiple different groups of census data.

5.4 Future Research

The first opportunity for future research with the existing data would be to conduct a hedonic value analysis for all parks, each individual classification, and finally for each individual park itself. This information can be beneficial to future residential developments within the City of Arlington, as the understanding of proximity effect allows for better discussion about the density or housing type being proposed.

The second opportunity focuses on one park in particular. In Chapter One, three methods of valuation were discussed. The first method that Crompton (2001) identified was to focus on the value of space that has been retrofitted into a greenway, or park. Julia Burgen Park has recently begun development of trails and other amenities. This method would look at the values of homes in the area before the development of these amenities, and compare them to the values of homes sold after the park has been fully developed.

The third opportunity could be to turn the GIS database into an ongoing mapping system. Updating the sales values on a yearly basis and keeping up to date changes in demographics, crime, and other determining values could show how changes in one factor can change the value of a home.

5.5 Summary

This chapter outlines the findings based on the research questions identified in Chapter one, as well as identifies other key themes found throughout the research process. It also identifies ways to increase the likelihood of a more successful nearest neighboring math analysis research methodology, as well as recognizes opportunities for future research using existing, or similar data.

Appendix A

Great Schools Ratings

GreatSchools Ratings: Methodology Report

The GreatSchools Rating is a simple tool for parents to compare schools based on test scores and other available data, including student academic growth and college readiness. It is designed to be a starting point to help parents make baseline comparisons. We always advise parents to visit the school and consider other information on school performance and programs, as well as consider their child's and family's needs as part of the school selection process. The following report outlines how ratings are calculated and what metrics ratings are based on.

What goes into a GreatSchools Rating?

The GreatSchools Rating is an index of how well schools do on several measures of student success compared to all other students in the state. Historically, the GreatSchools rating has been based solely on how well students do on standardized tests compared to other students in the state. In a growing number of states where data are available, the GreatSchools rating incorporates information on multiple measures to give parents a more detailed picture of school performance. In these states, the GreatSchools Rating is comprised of three main components:

- *Test Scores*: The test score sub-rating examines how students at a school performed on standardized tests compared with other schools in the state. Specifically, this rating compares student proficiency rates for each grade and subject with all schools in the state.
- ***Student Growth***: The student growth sub-rating measures whether students at this school are making academic progress over time. Specifically, the sub-rating looks at how much progress individual students have made on reading and math assessments during the past year or more. This sub-rating is based on student growth models, which can vary from state to state.
- *College Readiness*: The college readiness sub-rating combines this high school's graduation rate with data about college entrance exams, both of which are indicators of how well schools are preparing students for success in college and beyond.

How is a GreatSchools Rating Calculated?

Each GreatSchools rating is on a 1-10 scale and is categorized as follows: 1-3 = "below average," 4-7 = "average," 8-10 = "above average." The overall rating for a school is a weighted combination of multiple sub-ratings. Sub-ratings are weighted equally, though actual weights depend on the amount of data available per school and what grades that school serves. For instance, the overall rating for a school serving grades K-5 would be 50% based on student achievement and 50% based on student growth. The rating for a high school with data for all three measures would be 33% based on student achievement, 33% student growth, and 33% college readiness. More details on the rating weights are provided below in Section IV.

Each sub-rating represents how a school compares to other schools in the state on each given measure. For each sub-rating, the bottom 10% of schools get a 1, the next 10% get a 2, on up to 10, which indicates the school's result is in the top 10%. More details on the calculation of each sub-rating are provided below.

The overall GreatSchools Rating is ***not*** a decile rating, however, because it is an average of multiple sub-ratings. For example, in order to get a rating of 1, a school would have to receive a 1 on all sub-ratings. As such, the distribution of the GreatSchools Rating in a given state looks more like a bell curve, with higher numbers of schools getting ratings in the "average" category, and fewer schools getting ratings in the "above average" or "below average" categories.

Section I: Student Achievement Sub-Rating

Calculating the Student Achievement Sub-Rating

First, we calculate a standardized proficiency rate for each school in a state. To do this, we convert the proficiency rate for each grade and subject tested with available data into standard units (mean = 0, standard deviation = 1). Then, we average all data available for a school, yielding an average standardized proficiency rate. We do this in order to prevent bias based on the grades a school serves. For instance, statewide proficiency rates can often be much lower for certain tested grades when compared with others, and schools serving these grades would be unfairly ranked lower than schools serving grades with higher statewide proficiency rates using a simple average without standardization.

We then sort standardized proficiency rates in a given state from low to high and converted into percentiles. The bottom decile (1^{st}-9^{th} percentiles) of schools receive a sub-rating of "1", the second decile (10-19^{th} percentile) receive a sub-rating of "2", and so on, with the top decile (90-99^{th} percentile) receiving a sub-rating of "10".

Test score sub-ratings are not calculated using data points (e.g., 3^{rd} grade math proficiency rates) with fewer than 10 students tested or the minimum reporting standard for that state, whichever is higher.

Breakdown of Testing Data used in Ratings by State

State	Included in Rating	Name of Test	Grades Tested	Subjects Tested
Alabama	Y	ACT Aspire, ACT PLAN	3-8, 10	ELA/Reading, Math, Science
Alaska	Y	SBA, HSGQE	3-10	ELA/Reading, Math, Science, Writing
Arizona	Y	AZMerit, AIMS	3-11	ELA/Reading, Math, Science
Arkansas	Y	ACTAAP	3-8, 11	ELA/Reading, Math, Science
California	Y	CAASPP, CST	3-8, 10-11	ELA/Reading, Math, Science
Colorado	Y	TCAP	3-10	ELA/Reading, Math, Science
Connecticut	Y	CMT	3-8, 10	ELA/Reading, Math, Science
Delaware	Y	DCAS	3-10	ELA/Reading, Math, Science, Social Science
District of Columbia	Y	DC-CAS	3-8, 10	ELA/Reading, Math, Science
Florida	Y	FCAT2	3-10	ELA/Reading, Math, Science
Georgia	Y	CRCT	3-8, 11	ELA/Reading, Math, Science, Social Science, Writing
Hawaii	Y	HAS	3-8, 10	ELA/Reading, Math
Idaho	Y	ISAT	3-10	ELA/Reading, Math, Science
Illinois	Y	PSAE	3-8	ELA/Reading, Math, Science
Indiana	Y	ISAT-Dell	3-8, 11	ELA/Reading, Math, Science, Social Science
Iowa	Y	IA Assessment	3-8, 11	ELA/Reading, Math, Science
Kansas	Y	KSA	3-8, 11-12	ELA/Reading, Math, Science, Social Science

Breakdown of Testing Data used in Ratings by State

State	Included in Rating	Name of Test	Grades Tested	Subjects Tested
Kentucky	Y	KCCT	3-8, 10-11	ELA/Reading, Math, Science, Social Science
Louisiana	Y	PARCC	3-8, HS	ELA/Reading, Math, Science, Social Science
Maine	Y	MEA, MHSA, NECAP	3-8, 11	ELA/Reading, Math, Science
Maryland	Y	MSA	3-8, 10	ELA/Reading, Math, Science
Massachusetts	Y	MCAS, MCAS STE	3-8, 10	ELA/Reading, Math, Science
Michigan	Y	MEAP	3-9, 11	ELA/Reading, Math, Science, Social Science
Minnesota	Y	MCA III	3-8, 10-11	ELA/Reading, Math, Science
Mississippi	Y	MCT 2, MST, SATP	3-8, 10	ELA/Reading, Math, Science, Social Science
Missouri	Y	MAP, MAP EOC	3-8, HS	ELA/Reading, Math, Science, Social Science
Montana	Y	MontCAS CRT	3-8, 10	ELA/Reading, Math, Science
Nebraska	Y	NESA	3-8, 11	ELA/Reading, Math, Science, Writing
Nevada	Y	CRT, HSPE	3-8, 11	ELA/Reading, Math, Science, Writing
New Hampshire	Y	NECAP	3-8, 11	ELA/Reading, Math, Writing
New Jersey	Y	NJ ASK, NJBCT	3-8, HS	ELA/Reading, Math, Science
New Mexico	Y	NMSBA	3-8, 10-11	ELA/Reading, Math, Science
New York	Y	NYTESTS, Regents	3-8, HS	ELA/Reading, Math, Science, Social Science
North Carolina	Y	EOC, EOG	3-8, 11	ELA/Reading, Math, Science
North Dakota	Y	NDSA	3-8, 11	ELA/Reading, Math
Ohio	Y	OAT, OGT	3-8, HS	ELA/Reading, Math, Science, Social Science, Writing
Oklahoma	Y	OCCT EOI	3-8, HS	ELA/Reading, Math, Science, Social Science, Writing
Oregon	Y	SBAC, OAKS	3-8, 11	ELA/Reading, Math, Science
Pennsylvania	Y	PSSA	3-8, 11	ELA/Reading, Math, Science
Rhode Island	Y	NECAP	3-8, 11	ELA/Reading, Math, Science, Writing
South Carolina	Y	PASS, HSAP, SC EOCEP	3-8, 10, HS	ELA/Reading, Math, Science, Social Science, Writing
South Dakota	Y	STEP	3-8, 11	ELA/Reading, Math
Tennessee	Y	GATEWAY, TCAP	3-8, HS	ELA/Reading, Math, Science
Texas	Y	STAAR	3-8, HS	ELA/Reading, Math, Science, Social Science, Writing
Utah	Y	CRT	3-11	ELA/Reading, Math, Science
Vermont	Y	SBAC, NECAP	3-8, 11	ELA/Reading, Math, Science
Virginia	Y	VAEOC, SOL	3-8, HS	ELA/Reading, Math, Science, Social Science, Writing
Washington	Y	SBAC, MSP, WA EOC	3-8, 10-11	ELA/Reading, Math, Science, Writing
West Virginia	Y	WESTEST	3-12	ELA/Reading, Math, Science, Social Science
Wisconsin	Y	WSAS	3-8, 10	ELA/Reading, Math, Science, Social Science
Wyoming	Y	PAWS	3-8, 11	ELA/Reading, Math, Science

Section II: Student Academic Growth Sub-Rating

Student growth models vary considerably by state, but attempt to answer the same basic question: how much academic progress are students making at a particular school? Specifically, how much academic progress are students making relative to similar students in the state. Different student growth models adjust for different student characteristics in order to ensure that growth comparisons are fair and accurate, but at a minimum all student growth models included in the GreatSchools rating account for prior student academic performance at the student level.

While student growth models vary across states, the same methodology is used to rate all types of continuous growth metrics (e.g., student growth percentiles, value-added scores, net growth, etc.). First, all growth metrics for an individual school are standardized (if not already in that format) and averaged across subjects and grades (when disaggregated across grades). Additionally, in order to improve the year-to-year reliability of growth measures, growth metrics are averaged across two years when data for past years is available and growth metrics do not already represent a multi-year average.

Next, similar to proficiency rates, growth metrics in a given state are sorted from low to high and converted into percentiles. Sub-ratings (1-10) are assigned for each decile, where the first decile (1-9th percentiles) receiving a "1", the second decile (10-19th percentile) receiving a "2", and so on until the top decile (90-99th percentile) which receives a "10".

Test score sub-ratings are not calculated using data points with fewer than 10 students tested or the minimum reporting standard for that state, whichever is higher.

Growth Models Used by State

State	Included in Rating	Growth Model Type	# of Years Averaged
Alabama			
Alaska			
Arizona			
Arkansas			
California			
Colorado	Y	Student Growth Percentile	2 years
Connecticut			
Delaware	Y	% Meeting Growth Targets	2 years
District of Columbia	Y	Student Growth Percentile	1 year
Florida	Y	Average Growth Score	1 year
Georgia			
Hawaii			
Idaho			
Illinois	Y	Average Growth Score	1 year
Indiana	Y	Student Growth Percentile	2 years

Growth Models Used by State

State	Included in Rating	Growth Model Type	# of Years Averaged
Iowa			
Kansas			
Kentucky	Y	% Meeting Growth Targets	2 years
Louisiana			
Maine			
Maryland			
Massachusetts	Y	Student Growth Percentile	2 years
Michigan	Y	Value Table (net growth)	Up to 3 years[1]
Minnesota			
Mississippi			
Missouri			
Montana			
Nebraska			
Nevada			
New Hampshire			
New Jersey	Y	Student Growth Percentile	2 years
New Mexico			
New York			
North Carolina			
North Dakota			
Ohio	Y	Value-Added	
Oklahoma			
Oregon			
Pennsylvania			
Rhode Island			
South Carolina			
South Dakota			
Tennessee			
Texas			
Utah			
Vermont			
Virginia			
Washington			
West Virginia			
Wisconsin	Y	Average Growth Score[2]	
Wyoming			

1. Michigan value table measures are reported as multi-year averages.
2. Value-added scores for schools in Milwaukee, both public and private, are calculated by the Value-Added Research Center (VARC)

Section III: College Readiness Sub-Rating

The college readiness sub-rating is determined by three metrics: (1) 4-year high school graduation rates, (2) performance on the ACT and/or SAT, and (3) participation rate on the ACT and/or SAT. If a state mandates participation on a college entrance exam, only performance for that exam is used as the college entrance exam component of the college readiness sub-rating. The overall college readiness sub-rating is the average of these two components—50% graduation rates and 50% college entrance exam performance (25% ACT/SAT scores) and participation (25% ACT/SAT % of students tested). If a school does not have sufficient data for one of these components, that component is not used in calculating the college readiness sub-rating. For instance, the college readiness rating for a high school that has information on college entrance exams but not graduation rates would be based solely on college entrance exams.

When calculating the college readiness sub-rating, each of the three metrics are sorted individually from low to high and converted into a percentile. These percentiles are weighted together, and the remaining percentile weighted average is assigned a rating where the first decile average ($1-9^{th}$ percentiles) receives a "1", the second decile ($10-19^{th}$ percentile) receives a "2", and so on until the top decile ($90-99^{th}$ percentile) which receives a "10".

College Readiness by State

			College Entrance Exams	
State	**Included in Rating**	**Graduation Rates Included**	**Participation Included**	**Name of Exam**
Alabama				
Alaska				
Arizona				
Arkansas				
California				
Colorado	Y	Y		ACT
Connecticut				
Delaware	Y	Y		SAT
District of Columbia[1]	Y	Y	Y	ACT/SAT
Florida	Y	Y	Y	SAT
Georgia				
Hawaii				
Idaho				
Illinois	Y	Y		ACT
Indiana	Y	Y	Y	ACT/SAT
Iowa				
Kansas				

College Readiness by State

State	Included in Rating	Graduation Rates Included	College Entrance Exams: Participation Included	College Entrance Exams: Name of Exam
Kentucky	Y	Y		
Louisiana				
Maine				
Maryland				
Massachusetts	Y	Y	Y	SAT
Michigan	Y	Y		
Minnesota				
Mississippi				
Missouri				
Montana				
Nebraska				
Nevada				
New Hampshire				
New Jersey	Y	Y	Y	ACT/SAT[2]
New Mexico				
New York				
North Carolina				
North Dakota				
Ohio	Y	Y	Y	ACT
Oklahoma				
Oregon				
Pennsylvania				
Rhode Island				
South Carolina				
South Dakota				
Tennessee				
Texas				
Utah				
Vermont				
Virginia				
Washington				
West Virginia				
Wisconsin[2]				
Wyoming				

1. The methodology for the District of Columbia (a GreatSchools local site) differs from the methodology outlined in this report (for more information, see: http://www.greatschools.org/catalog/pdf/New_Ratings_Methodology_DC.pdf)
2. SAT scores used for performance rating; ACT/SAT combined participation used for participation rating.

Section IV: Weighting for Overall Ratings

Overall ratings are calculated by averaging the raw percentiles of all available sub-ratings. Averaging raw percentiles instead of actual sub-ratings (1-10) reduces rounding error in the overall rating. The remaining percentile weighted average is assigned a rating where the first decile average (1-9th percentiles) receives a "1", the second decile (10-19th percentile) receives a "2", and so on until the top decile (90-99th percentile) which receives a "10". For high schools that also offer K-8 grades, two separate overall ratings are calculated—one for K-8 and one for 9-12—and the average of these two ratings serves as the overall rating. The figure below shows how the combining of sub-ratings into an overall rating vary based on what data is available and what grades a school serves:

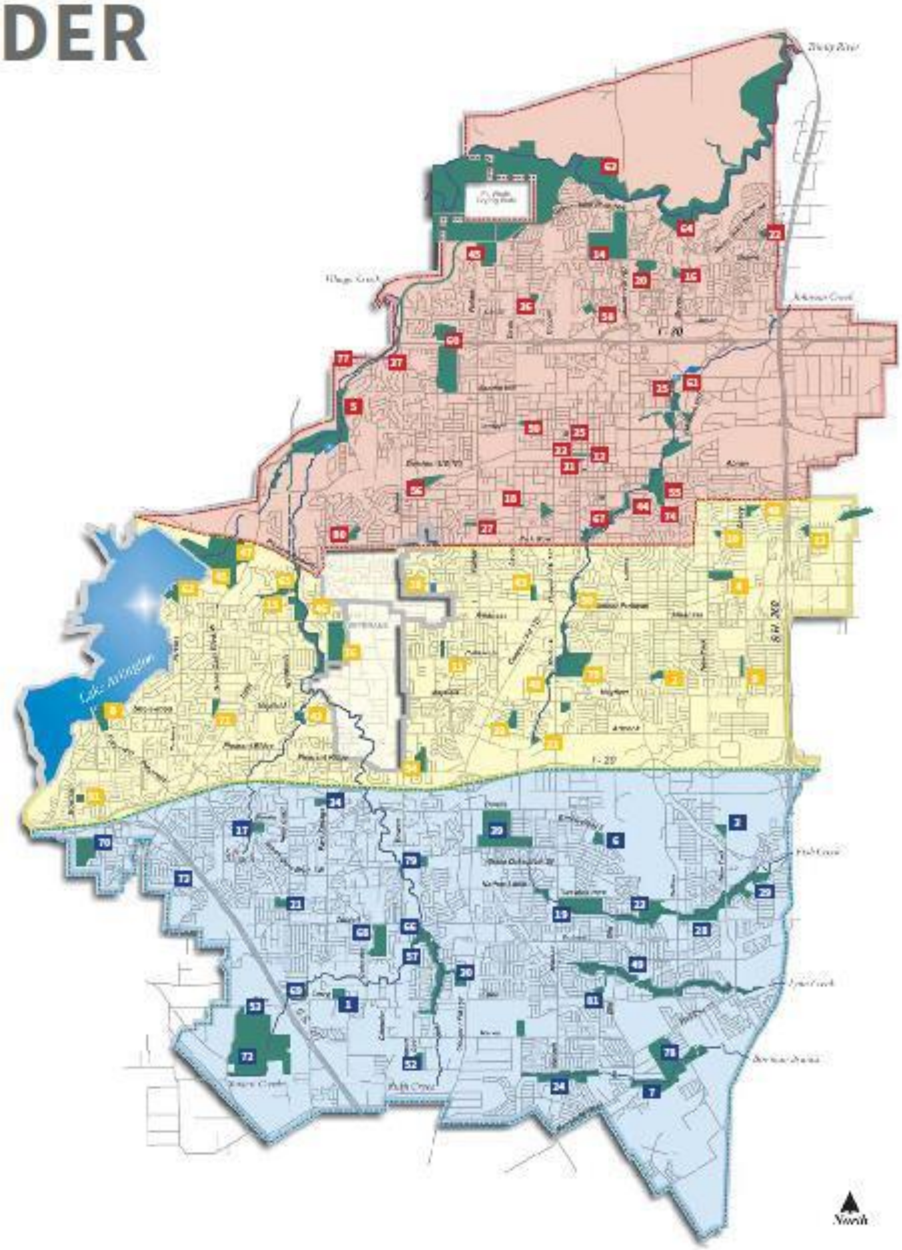
Weighting Scheme I: no student growth for high schools [1]					
	Elementary	Middle	High School	K-8	5-12/K12
Test Scores	50%	50%	50%	50%	50%
Growth	50%	50%	N/A	50%	25%
College Readiness	N/A	N/A	50%	N/A	25%
Weighting Scheme II: student growth for high schools [1]					
	Elementary	Middle	High School	K-8	5-12/K12
Test Scores	50%	50%	33%	50%	42%
Growth	50%	50%	33%	50%	42%
College Readiness	N/A	N/A	33%	N/A	16%

1. Student proficiency rates are required for all ratings. If growth and/or college readiness data is unavailable, weighting percentages are reapportioned to equal 100%.

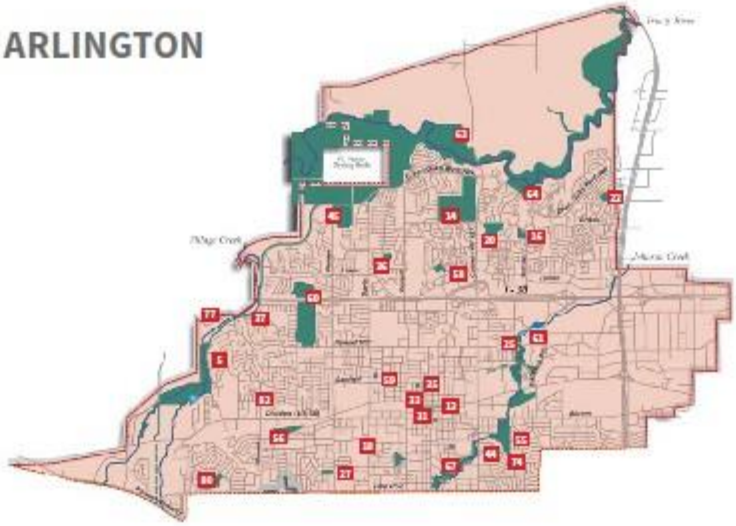
Appendix B

Park Finder

PARK **FINDER**



NORTH **ARLINGTON**



Park	#	Basketball	Bike/Hike Trails	Disc Golf	Dog Park	Equestrian Trails	Fishing	Fitness Course	Golf Course	Grill	Horseshoes	League Fields	Natural Area	Pavilion/Shelter	Picnic Area	Playground	Practice Fields	Public Art	Restrooms	Skateboarding	Soccer/League Fields	Splash Pad/Pool	Tennis	Volleyball
BOB FINDLAY LINEAR PARK	5		•				•						•											
CENTER STREET TRAIL CONNECTION	13		•																					
CHESTER W. DITTO GOLF COURSE	14								•				•					•	•					
CLARENCE THOMPSON PARK	16									•			•		•	•	•							
COLLEGE HILLS PARK	18	•													•	•	•							
CRYSTAL CANYON NATURAL AREA	20		•										•											
DIXON W. HOLMAN PARK	22		•							•			•		•	•								
DR. ROBERT CLUCK LINEAR PARK	25		•										•											
FIELDER PARK	27	•								•					•	•	•		•				•	
FOUNDERS PLAZA/LEVITT PAVILION	31													•	•			•						
GENE ALLEN PARK	33	•													•			•						
GEORGE STEVENS PARK	35									•				•	•	•								
GIBBONS PARK	36		•					•		•					•	•	•							
GREEN OAKS BLVD/RUSH-VILLAGE CREEK TRAIL	37		•										•											
JULIA BURGEN ON THE GREENWAY	44												•											
J.W. DUNLOP SPORTS CENTER	45									•		•	•	•	•	•	•		•		•			
MEADOWBROOK PARK & GOLF COURSE	55	•	•						•	•	•		•	•	•	•		•	•					
O.S. GRAY NATURAL AREA	56		•							•			•		•	•								
PARKWAY CENTRAL PARK	58									•				•	•	•		•						
PIRIE PARK	59									•					•	•								
RANDOL MILL PARK	60	•	•				•			•		•	•	•	•	•			•	•		•	•	
RICHARD GREENE LINEAR PARK	61		•										•		•			•						
RIVER LEGACY PARKS	63		•				•	•		•			•	•	•	•	•		•					
RIVER LEGACY PARKS - EAST	64		•							•			•		•	•	•							•
SENTER PARK	67											•			•									
VALLEY VIEW PARK	74									•				•	•	•								
VILLAGE CREEK HISTORICAL AREA	77		•				•			•			•		•		•							
WOODLAND WEST PARK	80	•								•					•	•			•			•	•	
HIGH OAK PARK	82		•					•		•			•	•	•	•								

CENTRAL **ARLINGTON**

Park	#	Basketball	Bike/Hike Trails	Disc Golf	Dog Park	Equestrian Trails	Fishing	Fitness Course	Golf Course	Grill	Horseshoes	League Fields	Nature Area	Pavilion/Shelter	Picnic Area	Playground	Practice Fields	Public Art	Restrooms	Skateboarding	Soccer League Fields	Splash Pad/Pool	Tennis	Volleyball
B.C. BARNES PARK	2		●							●				●	●	●	●							
BOB COOKE PARK	4	●	●							●					●	●	●		●				●	
BOWMAN SPRINGS PARK	8	●	●				●			●				●	●	●			●					
BRANTLEY HINSHAW PARK	9	●	●							●				●	●	●	●					●		
BURL L. WIKES PARK	10		●							●					●	●	●			●				
CALIFORNIA LANE PARK	11	●	●				●			●	●		●	●	●	●	●					●		
CARL KNOX, JR. PARK	12	●	●				●			●	●			●	●	●	●							
CLARENCE FOSTER PARK	15		●					●		●					●	●	●							
DUNCAN ROBINSON PARK	26									●					●	●	●							
GATEWAY PARK	32		●																					
H.A.D. DUNSWORTH PARK	38		●							●					●	●	●							
HELEN WESSLER PARK	40		●							●				●	●	●	●					●		
HEROS PARK	41																	●						
HOWARD MOORE PARK	42		●							●				●	●	●						●	●	
JAKE LANGSTON PARK	43		●							●			●		●	●								
KELLEY PARK	46		●										●		●									
LAKE ARLINGTON GOLF COURSE	47								●				●						●					
LAKES AT MATLOCK	48						●																	
MARROW BONE SPRING PARK	50		●										●											
MARTI VANRAVENSWAAY PARK	51		●							●			●		●	●	●							
MARY & JIMMIE HOOPER PARK	54	●	●				●			●			●	●	●	●	●							
RICHARD SIMPSON PARK	62						●			●				●	●				●					
RUSH CREEK LINEAR PARK - NORTH	65		●										●										●	
THORA HART PARK	71									●			●		●	●								
VANDERGRIFF PARK	75		●							●	●	●		●	●	●	●	●	●	●		●	●	
VETERANS PARK	76		●	●		●	●			●			●	●	●	●	●	●	●					

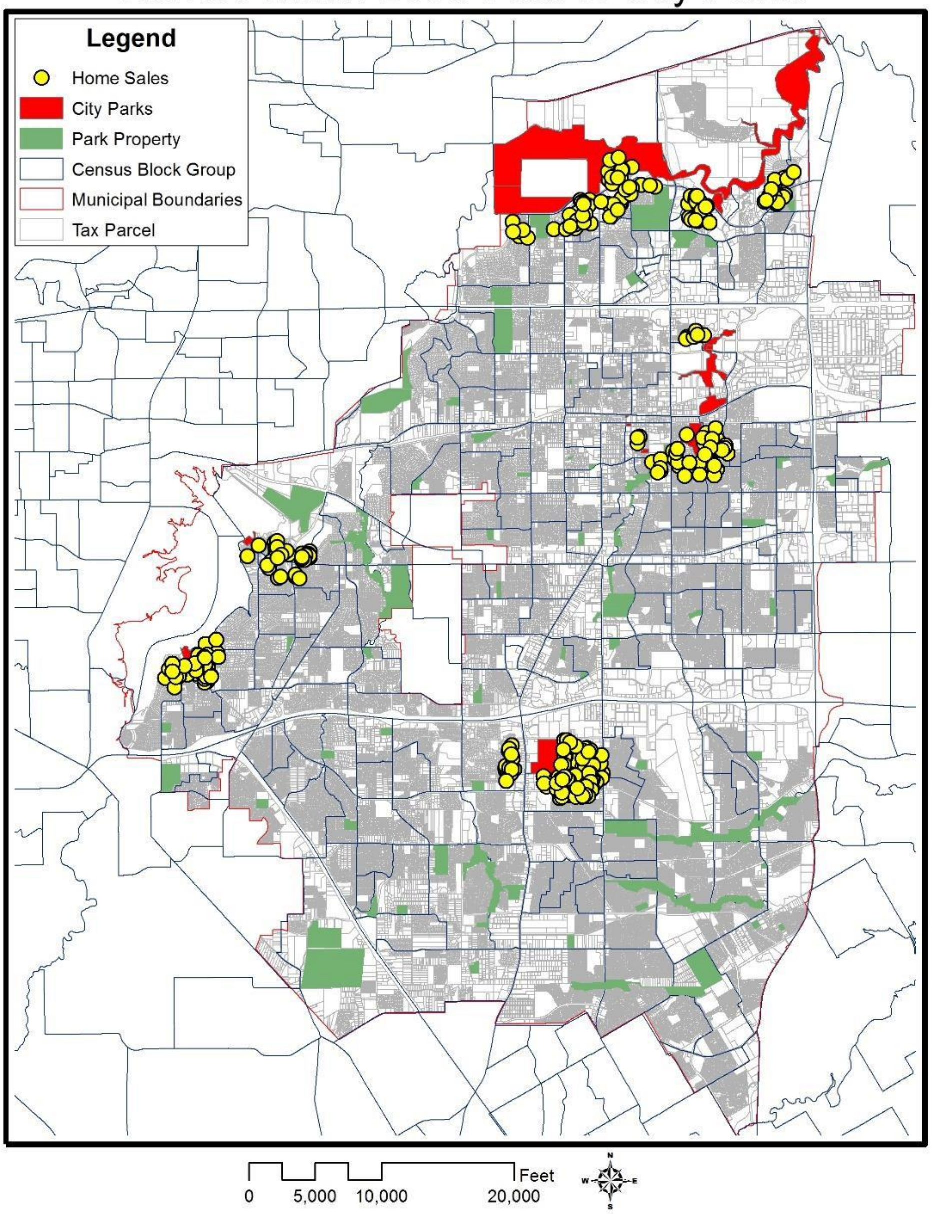
SOUTH **ARLINGTON**

Park	#	Basketball	Bike/Hike Trails	Disc Golf	Dog Park	Equestrian Trails	Fishing	Fitness Course	Golf Course	Grill	Horseshoes	League Fields	Natural Area	Pavilion/Shelter	Picnic Area	Playground	Practice Fields	Public Art	Restrooms	Skateboarding	Soccer League Fields	Splash Pad/Pool	Tennis	Volleyball
ALLEN SAXE PARK	1		●				●			●			●		●	●	●							
BLACKLAND PRAIRIE	3												●											
BOB MCFARLAND PARK	6	●	●							●			●	●	●	●								
BOWMAN BRANCH LINEAR PARK	7												●											
CLIFF NELSON PARK	17		●				●			●			●		●	●	●		●				●	
CRAVENS PARK	19	●	●				●			●		●	●	●	●	●			●				●	●
DEAVER PARK	21	●	●				●			●			●		●	●	●							
DON MISENHIMER PARK	24	●	●							●			●	●	●	●	●					●		●
FISH CREEK LINEAR PARK	28		●										●											
FISH CREEK NEIGHBORHOOD PARK	29	●	●					●		●			●	●	●	●	●							
F.J. "RED" KANE PARK	30	●	●				●			●			●		●	●	●		●					
GENE SCHRICKEL, JR. PARK	34		●				●			●			●	●	●	●	●							
HAROLD PATTERSON SPORTS CENTER	39									●		●		●	●				●		●			
LYNN CREEK LINEAR PARK	49		●										●											
MARTHA WALKER PARK	52												●		●									
MARTIN LUTHER KING JR. SPORTS CENTER	53		●							●		●	●	●	●	●			●					
O.W. FANNIN NATURAL AREA	57		●										●											
RUSH CREEK LINEAR PARK - SOUTH	66		●										●		●									
S.J. STOVALL PARK	68	●	●			●		●		●			●	●	●	●	●	●	●			●	●	●
SUBLETT CREEK LINEAR PARK	69		●										●		●									
SW NATURE PRESERVE	70												●											
TAILS N' TRAILS	23		●		●								●											
TIERRA VERDE GOLF CLUB	72												●						●					
TREEPOINT PARK	73		●					●		●			●		●	●	●							
WEBB COMMUNITY PARK	78	●	●				●			●			●	●	●	●	●		●		●			
WIMBLEDON PARK	79		●					●		●					●	●	●							
W.D. & ZETA WORKMAN PARK	81	●	●							●					●	●	●							

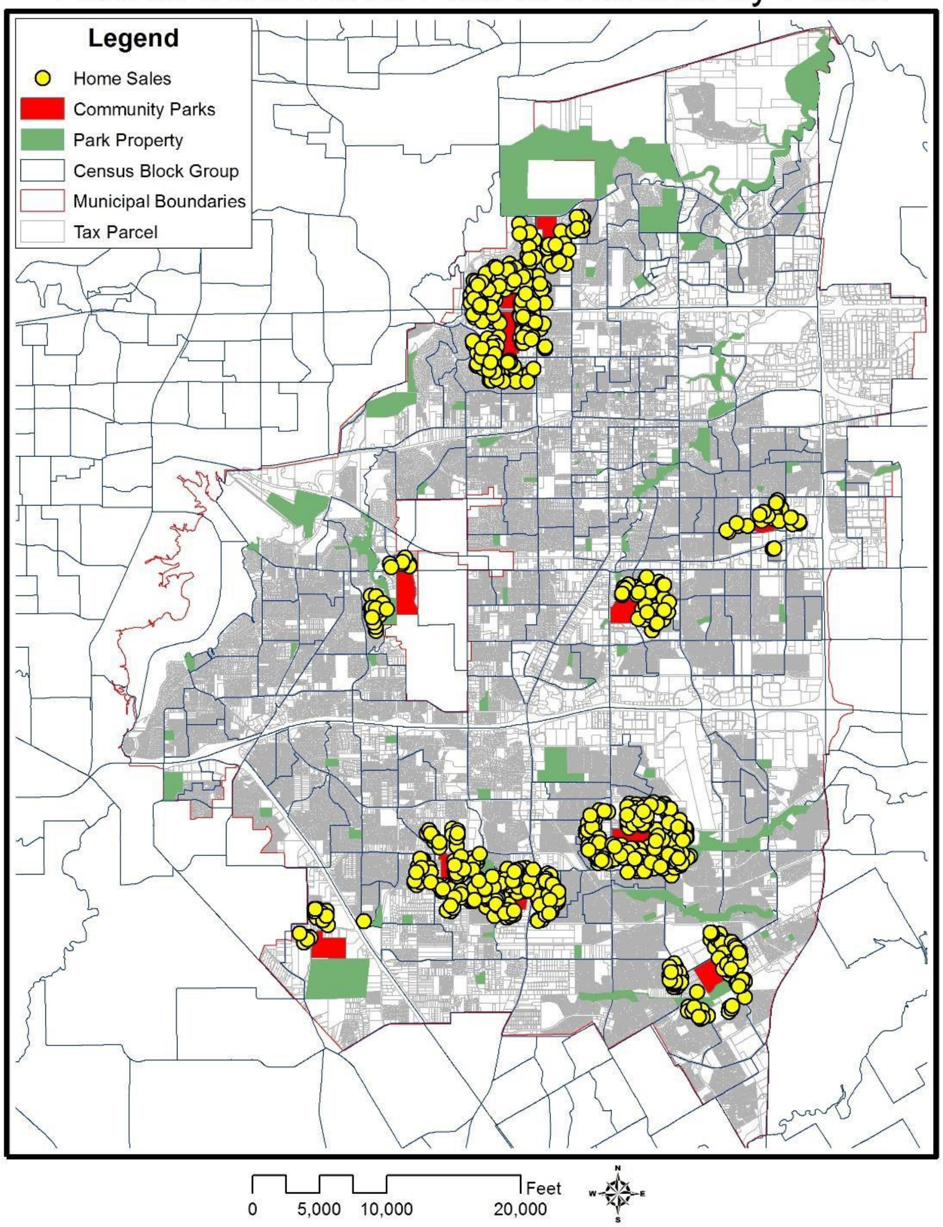
Appendix C

2,000 Foot Buffer Maps

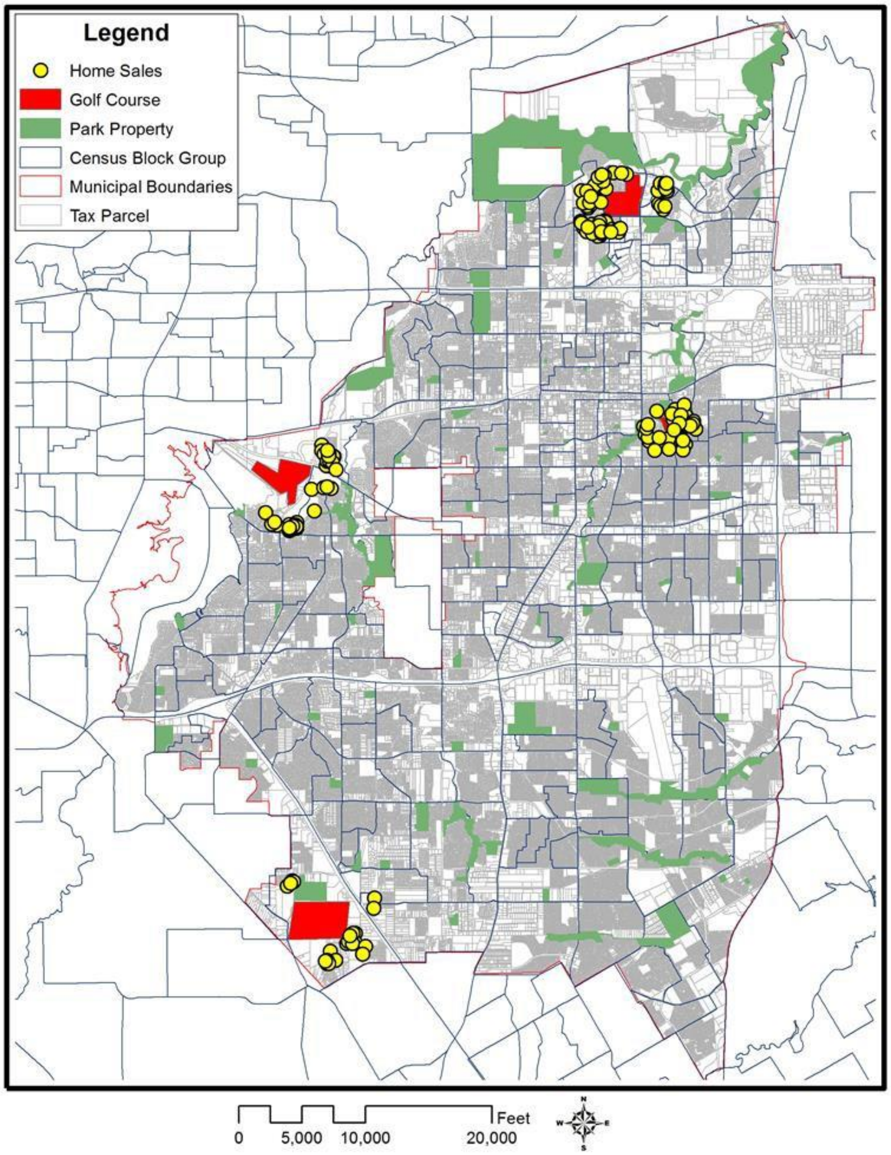
Homes within 2000 Feet of City Parks



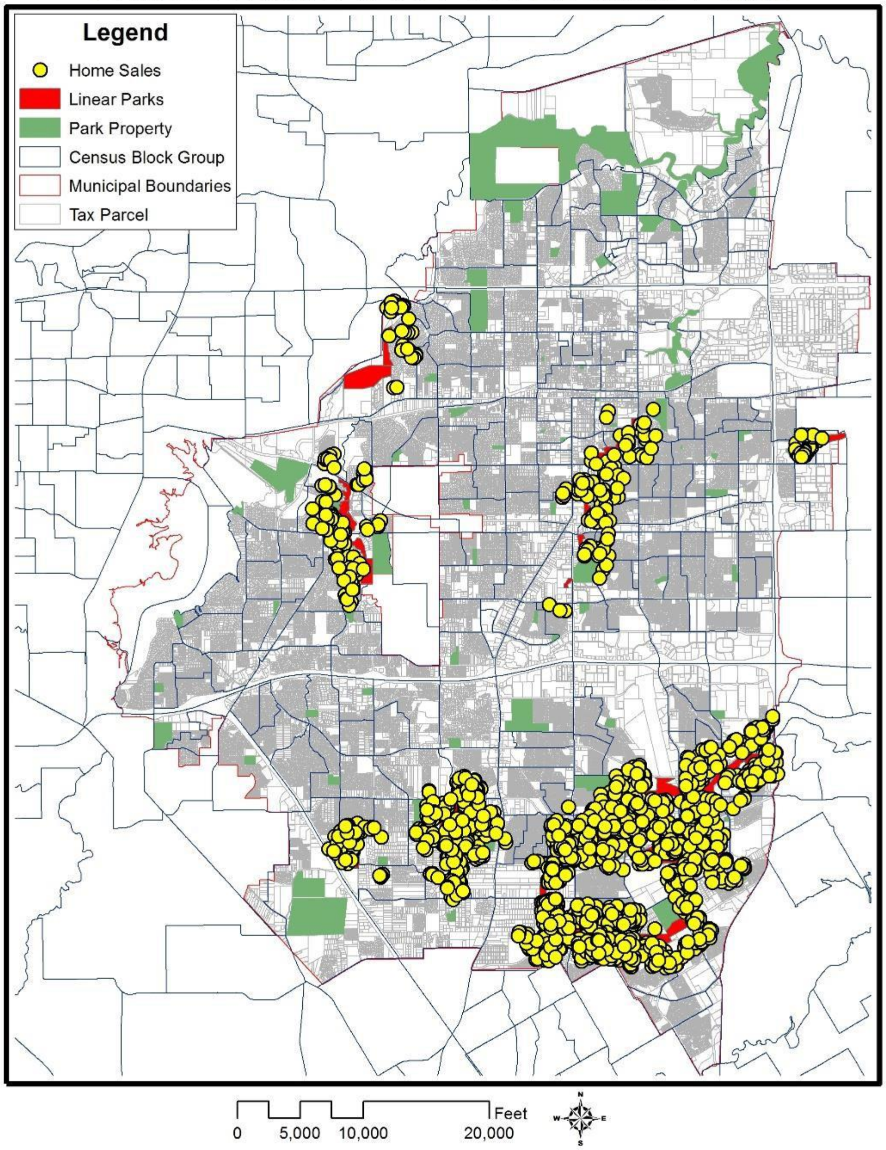
Homes within 2000 Feet of Community Parks



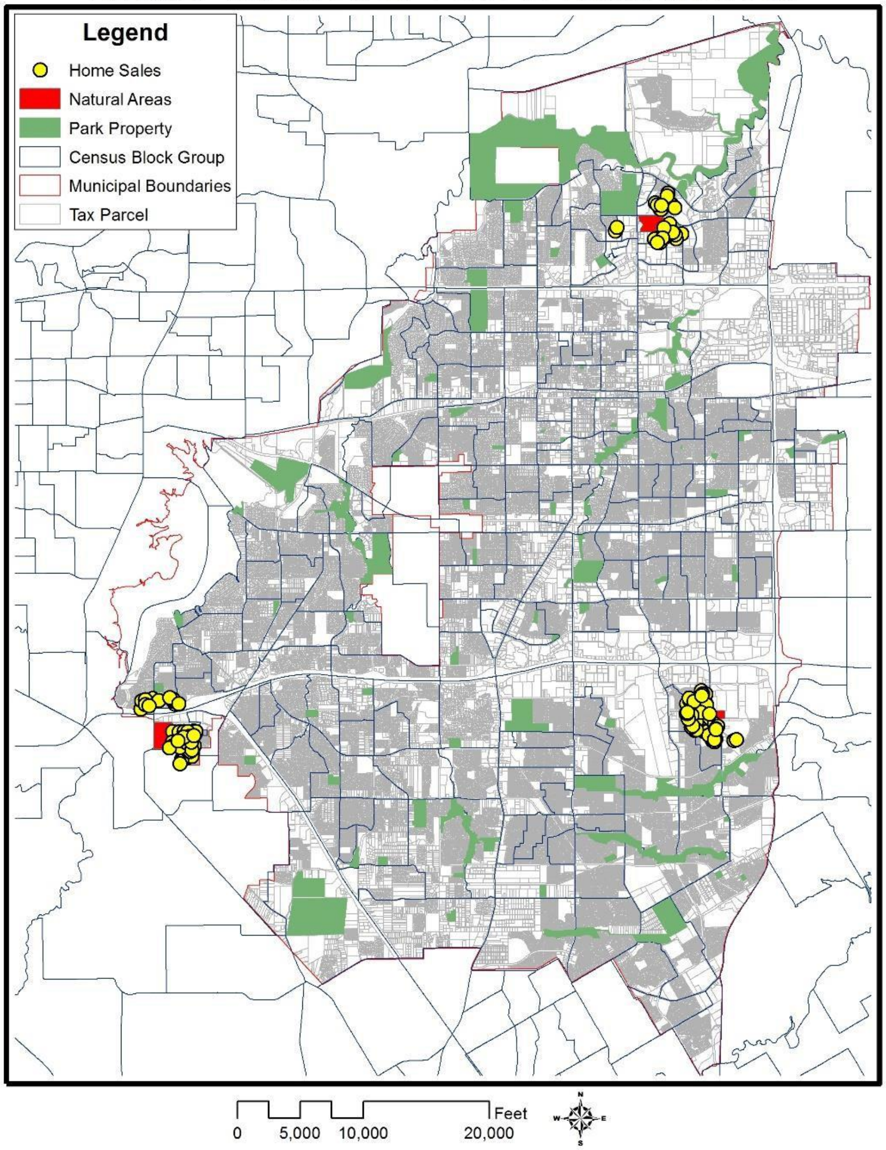
Homes within 2000 Feet of a Golf Course



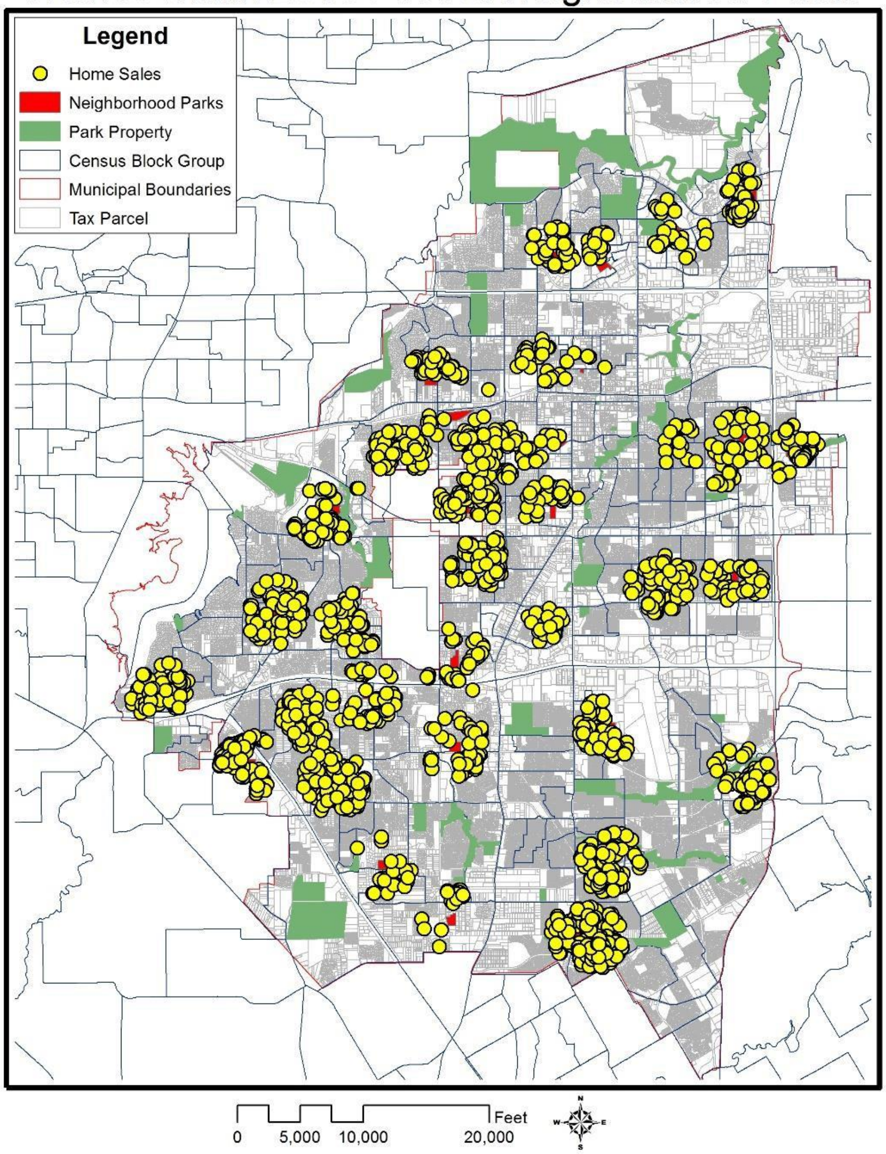
Homes within 2000 Feet of Linear Parks



Homes within 2000 Feet of Natural Areas



Homes within 2000 Feet of Neighborhood Parks



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Biographical Information

Bryan Isham grew up in a small town in west Texas with his parents Roy and Sharon, brother Josh, and sister Mindy. He enjoyed spending much of his time during the week being outside playing sports and riding bikes with his friends. Golf, fishing, and camping with his father and his brother was how he spent his weekends during the latter part of his youth. At this young age, he wanted to grow up to be a golf course designer.

After earning his Bachelor Degree in Landscape Architecture from Texas Tech University, Bryan moved to Arlington, Texas to search for a job and pursue a Master Degree in City and Regional Planning from the University of Texas at Arlington. His early desire to design golf courses had shifted to combine his two newfound interests, the landscape of a city and its relationships with the people living in it.

Bryan started his journey in City and Regional Planning in August of 2013 and graduated in May of 2017. He is currently employed with the City of Arlington, Community Development and Planning Department as a Senior Planner.