IMPACT OF LIGHT RAIL TRANSIT PROXIMITY ON SINGLE-FAMILY HOME VALUE APPRECIATION IN PORTLAND, OREGON 1998-2007

By

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To all those who work harder because they have to and to all those who still believe that this is a great country and are devoted to making it better

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LIST OF ABBREVIATIONS

APTA	American Public Transportation Association
BART	Bay Area Rapid Transit
BRT	Bus Rapid Transit
CBD	Central Business District
DART	Dallas Area Rapid Transit
EMV	Estimated Market Value
FHA	Federal Housing Administration
GIS	Geographic Information Systems
HOV	High Occupancy Vehicle
LOS	Level of Service
LRT	Light Rail Transit
LUTRAQ	Land-Use Transportation Air Quality
MARTA	Metropolitan Atlanta Regional Transit Authority
MAX	Metropolitan Area Express (Portland)
MBTA	Metropolitan Boston Transit Authority
MPO	Metropolitan Planning Organization
MSA	Metropolitan Statistical Area
ODOT	Oregon Department of Transportation
RLIS	Regional Land Information System
RMV	Real Market Value
SFR	Single Family Residential
SR	State Road

TCRP	Transit Cooperative Research Program
TOD	Transit-Oriented Development
UGB	Urban Growth Boundary
VMT	Vehicle Miles Traveled

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The mobility and accessibility offered by living in walkable proximity to transit cannot be understated. Enter, Portland, Oregon, the city that pioneered its Urban Growth Boundary (UGB) in 1979. The UGB in concert with Metro, the city's regional governing body has one of the highest per capita light rail uses in the United States(American Public Transportation Association, 2008). Currently three lines (soon to be four) and nearly forty stations serve this metro area (numbering two million people) connecting jobs, entertainment, and the necessities of life with residents.

Numerous studies examine the impact transit access has on property values as far back as the 1960s (Hess & Almeida, 2006). A large body of work exists on how just the preparation of planning a transit line can affect property values. This thesis examines the single family home real estate appreciation rates around five light rail stations throughout the region. The proximity to LRT should reflect in higher valuation of the land. The five stops are also categorized as low or high-income areas as well as having new, existing or no light rail access. This thesis examines via parcel data home value appreciation rate through 1997-2007 and compares the appreciation rates between single -family residential units in areas that are within a quarter-mile of a rail

station versus those who are not. It also examines appreciation rates in areas that have different light rail transit (LRT) scenarios (those areas with existing transit, those with new transit improvements, and those without transit). The benefits of having transit within a five-minute walk should be illustrated in higher single family residential units (SFR) values near those stations regardless of the income of the neighborhood's residents.

This study differs from previous work in that the actual appreciation will be compared in a dollar-per-square-foot format. Also departing from past studies is a comparison of home value appreciation rates in area with or without walkable transit access. What happens to home appreciation in single-family home areas with existing LRT versus areas that do not have light rail access? The empirical study ultimately contradicts the previous studies that areas with LRT access tend to be worth more, appreciate at a higher rate in Portland and vicinity than those that do not.

This research shows that proximity to the Central Business District has a stronger correlation to higher residential property values than light rail proximity. In the case studies it was found that a high-income area with no light rail access appreciated the most. A low-income area with no light rail access appreciated faster than a low-income area with access over the same ten-year period. Additional research could include examine areas that are an identical distance from downtown to determine the affect of proximity.

CHAPTER 1
INTRODUCTION

> Light rail, busways, and streetcar lines, like historic boulevards and main streets, are pedestrian friendly and serve as catalysts to the formation of mixed-use neighborhoods and centers. They do not form barriers within communities; in fact, they often unify a place by creating a focus and a common destination. Additionally, they form benign connections between communities; visitors without a car are always welcome to places trying to overcome the tyranny of parking lots and traffic congestion.
>
> --Peter Calthorpe, *The Regional City*

To quote Alex Marshall, author of the book, *How Cities Work, "*Cities and places are created by the methods we choose for moving people and goods and services from place to place…how we get around determines how we live… cities are born from their transportation systems—these systems drive the economy of a city and determine how people live" (Marshall, 2001). Marshall, while not a professional planner, decries the growth of suburban sprawl that has contributed to what he terms a "loss of place." (Marshall, 2001). He discusses how the loss of place has changed social interactions, i.e., quality of life in his hometown of Norfolk, Virginia. The loss of place, a common theme in Marshall's book is attributed to the advent of the automobile, but more so the advent of the highway. To undo the impact of the highway and the sprawl that it offers, returning to utilizing other forms of getting from point A to point B may be needed (Marshall, 2001). Light rail may be part of the solution to many of the problems of loss of place. Walking, bicycling and/or using light rail transit are all ways to conserve fossil fuel and lead to more sustainable future (Giuliano & Hanson, 2004).

Why Study Light Rail?

Why not? LRT is a popular form of transit that could lead to more sustainable, equitable cities (Giuliano & Hanson, 2004). LRT is a key motor for economic revitalization because it *can* reinforce the density of CBDs and provide transportation equity to citizens (Giuliano & Hanson,

2004). From conserving fossil fuels to promoting downtown businesses, there are many reasons to study LRT. A healthy LRT system can connect more people to jobs (Calthorpe & Fulton, 2001). According to Figure 1-1, heavy patronage of LRT leads to more mixed uses of land, larger residential densities, as well as more options of transport that do not use automobiles (Giuliano & Hanson, 2004). These developments tend to increase more LRT use (Figure 1-1). Public transit has an appeal to those who are concerned with transportation equity (Giuliano & Hanson, 2004).

Transportation equity is the availability of transport to those who do not own cars or for whatever reason cannot drive them (Calthorpe & Fulton, 2001). Older citizens and young people who lack autos are often excluded from employment in today's cities because the jobs are no longer in the Central Business Districts; they are often on the periphery (Calthorpe & Fulton, 2001). Many decades of decentralization has left the central city with a decreasing share of economic activity, but an increasing share of disadvantaged population (Pucher & Renne, 2003). Many of our nation's fast growing metropolitan areas are looking to light rail to solve these problems. Table 1-2 highlights the congestion rankings of cities and their corresponding new light rail track construction.

Table 1-2 also illustrates that cities are utilizing light rail to provide another form of transportation. Notice the difference between the miles of track constructed between the two modes. Much of the new construction is located in the Sunbelt, which is one of the, if not the fastest growing areas in the nation. The Sunbelt is defined as the region the south of the 37th or 38th parallels, north latitude (American Public Transportation Association, 2008). These cities are mid-size to large; the densities may not yet support commuter or heavy rail, but are likely to be as congested as any other large metro area. All have some form of rail transit; highlighted

areas are constructing new LRT tracks as of 2008 (Table 1-2). What is significant is that rapidly growing cities are looking more and more to LRT to fulfill their transit needs.

Light Rail Patronage Enforces a Sustainable City Core

Consider Alex Marshall, author of *How Cities Work*:

> To have a cohesive downtown, or even really older neighborhoods, a city has to have a cohesive system of mass transit, and has to make it dominant; urbanism is a result of pressure. It's about putting people, activities, and movement in a confined space. Only mass transit has the ability to raise the pressure to enough people per square inch (Marshall, 2001).

It is important for the country to rebuild and revitalize its core cities—to undo the sprawling patterns of the last fifty years. The health of our CBDs depends on multimodal transit and light rail is an increasingly popular mode of transit (Calthorpe & Fulton, 2001). The design of a city and its transportation options are intrinsically linked (Calthorpe & Fulton, 2001). Strong urban cores are reinforced because of their density (Marshall, 2001). The increased economic value derived from increased accessibility *should* lead to higher property values in our core areas, which can lead to revitalization of older suburbs (Marshall, 2001). An ideal scenario that illustrates this idea for city *X*: A LRT connects the underutilized downtown to the sprawling suburbs utilizing old railroad infrastructure. As auto-commute costs increase, transportation savings increase for employers and employees living near an LRT station. The metro area experiences a collective push to move back downtown. The downtown revitalizes, the desire to be closer to the CBD increases prices in the CBD. As jobs return to the CBD, and those closer-to-downtown older suburbs become attractive again, this will increase the municipal tax base as well as reduce a city's overall carbon blueprint by reinforcing density. If light rail use comprises more and more of our daily commute, we will be using less fossil fuels as LRT runs overwhelmingly on electricity (Marshall, 2001). The decreased dependency on fossil fuels makes LRT an attractive option for transit/ transportation planners.

Because most transit systems have the greatest impact on accessibility to downtown, compared to other areas of the region, the greatest impacts on development have been seen in downtown areas: "within downtowns, rail transit investments have stimulated redevelopment and brought life to once moribund commercial districts," concluded a 1995 report from the Transit Cooperative Research Program (Transportation Research Board, 2003). Vesalli (1996) found that public sector involvement, including land assembly, high-density zoning allowances, restrictions on parking, and financial incentives, played an important role in most successful examples of development around transit stations (Handy, 2005). There are many factors that contribute to successful, sustainable downtowns.

Land Use and Density + Light Rail Transit (LRT) = Sustainable, Successful Downtowns

A sustainable downtown can mean many things. For Alex Marshall it is a place to buy hardware or underwear without getting in a car (Marshall, 2001). By emphasizing LRT investment, a center city can rely less on fossil fuels and reduce its pollution from automobiles. However, a sustainable city core can also refer to a tight network of narrow walkable streets, an efficient LRT system that gets people where they need to go. Successful LRT requires a successful downtown. The hub of an LRT is typically centered in a city's core area.

A successful downtown is achieved through many factors-- perhaps the most important is a density of mixed uses. Mixed land uses can yield a number of transportation benefits: The more complementary land uses are mixed, (i.e., offices, shops, restaurants, banks), the more likely people are to walk and less likely to drive. With more mixed land uses, trips are potentially more spread out throughout the day and week, instead of clumped during the morning and evening peak periods (Halifax Regional, 2002). Several studies have concluded that land use mix is not as significant in influencing transit mode choice decisions in neighborhoods as density, although it is difficult to sort out the effects of land use mix because it is so strongly correlated to density

(Halifax Regional, 2002). Land use mix, however, is particularly significant for walking and biking modes, which are primary methods of accessing transit service. Because pedestrian and bike trips are typically shorter than transit or auto trips, the presence of a land-use mix within work-to-home trips is essential in ensuring accessibility to shopping, restaurants, recreation and less glamorous places like a hardware store.

To access shopping, recreation and restaurants, people need to have the ability to safely walk there once they leave their car, bus, or train. When urban planners discuss "walkability" they are referring to the ease of access to a particular destination by those on foot. Walkability is an important part of accessibility. In today's world, the transportation infrastructure meant to move cars efficiently (e.g., raised highways, triple left turns at intersections) could make walking three blocks an adventure. Many obstacles can prevent direct access on foot—these obstacles may not be readily apparent on a road map. An LRT system can add to what is considered "walkable" through its ease of use, reliability and interconnectedness. Perhaps the most basic factor in determining walkability of an area is the presence of sidewalks. It may be as simple as a wealth of pedestrian amenities including sidewalks combined with low road traffic speeds. If walkable access to LRT is desirable to the point the consumer is willing to pay more-- and the amenities easily accessed through such transit--than it is logical that the same property is attractive for a higher level of development (Diaz, 2001). Such trends often change the land uses naturally around stations. An existing low-density use such as Single-Family Residential (SFR) can be converted to a higher density use or another type altogether (Diaz, 2001). These developments are indicative of the rise of Transit-Oriented (TOD) and Mixed-Use Developments—based on the idea that many employers and employees will wish to capitalize on the transportation savings afforded by the land.

Light Rail is Popular

As an impetus for an increasingly popular urban form—TODs--LRT has been also increasing in popularity--if one considers new track mileage--it could be considered the most popular form of transit currently. Table 1-1 illustrates the popularity of LRT in this country by showing LRT construction as the largest percentage of total rail construction between 2002 and 2006. Table 1-1 shows that as a percentage—LRT is growing faster than other forms of rail transit—this speaks to the mode's popularity. Over the last few years more and more cities that have relied on other modes are also constructing or expanding their LRT systems. The perception is that LRT is safer, cleaner, and has a relatively low impact on the environment compared to heavier forms of rail (Transportation Research Board, 2002). Table 1-2 illustrates the cities that are constructing new LRT lines or are planning to; notice the cities in the table that are in bold type; these cities are located in the Sunbelt which is normally considered the region of the U.S located south of the 37th or 38th parallel north latitude (INRIX, 2006). Table 1-2 also highlights the INRIX congestion rating for these cities. These Sunbelt cities are growing and traffic congestion is a growing problem.

The aim for many transit planners is to relieve these same congested highways. It is argued that rail transit has more potential for attracting discretionary riders out of their cars than bus transit (Giuliano & Hanson, 2004). There are over thirty cities in the country that now employ some form of LRT. Many are experiencing increased ridership, and more sprawling cities such as Phoenix, Dallas, and Charlotte are planning to implement an LRT system or are enhancing an existing one. This is important because these areas are not part of the connected compact Northeast Corridor. They are Sunbelt cities, and are rapidly growing. As the next section will discuss the research question, it is important to remember that LRT is arguably the

most popular form of rail transit and will continue to be a central figure in transportation plans in this country for the foreseeable future.

Research Question

Now that the importance of examining LRT effects have began to be discussed, another theme of this study is the nature of land value. Unlike infrastructure, oil, or precious metals, land is a commodity that cannot be transported. It only has value because of where it is. It has been maintained that land value is determined by a bundle of factors, one of which is location (Alonso, Location and Land Use: Toward a General Theory of Land Rent, 1964). Early cities sprouted along transportation routes such as a road, a river or port. The location of the area made it more valuable due to the access the location provided (Alonso, Location and Land Use: Toward a General Theory of Land Rent, 1964). In the beginning of the 20th century, our fledgling cities experienced an intensification of residential densities because of technological limitations--since there were no automobiles, a city could only grow as quickly as it took to travel by foot, or horse (Marshall, 2001). Eventually technology improved, one form of transit begat another, and employees were able to live further and further away from jobs (Marshall, 2001). Our current situation is a result of technological development, and perhaps a lack of thoughtful planning for those who lack cars or seek an alternative.

We are now in a transition, due to many developments, where having access to a transit station is an option over the automobile congestion plaguing our cities**.** For the sake of this study, if this theory holds true, then residential areas near LRT *could* be experiencing larger property appreciation rates than comparable areas without transit. Or at the very least, they *would* significantly have a larger dollar-per-square-foot value as a whole than neighborhoods without LRT access. This leads to the question of what effect a *new* LRT station has on nearby residential areas that previously lacked LRT access? It would follow that areas that depend more

on transit (i.e., low-income and/or zero car households) could see the largest valuation compared to transit dependent areas that do not have LRT access. It also would follow that high income areas with LRT access may receive an extra valuation than those same high-income areas that lack LRT. These are relationships that this study will examine using Portland, Oregon, and its LRT system, Metro Area Express (MAX), as a case study. This study will also conduct separate scenarios that seek to isolate different LRT access levels to answer the following questions: What effect does LRT access have in a high income area versus a low income area with existing LRT transit? What effect does *new* LRT access have on a low-income area? How do these results compare with high and low-income areas that have *no* LRT access? These scenarios will be quantified in case study format and compared to each other. The independent variable will be 1997-2007 single-family residential values taxlot data provided by regional tax collectors. This study will hopefully illustrate a significant valuation benefit to neighborhoods that have LRT access.

As indicated within Table 1-2, some of our most congested cities are try to relieve that congestion through LRT expansion (Debrezion, Pels, & Rietveld, 2004). Table 1-2 identifies cities that have (constructed/are constructing) LRT and their congestion rankings. Rapidly growing metropolises have turned to LRT that may have lacked rail transit on any level before. LRT can help reinforce a city core and counteract sprawl (Calthorpe & Fulton, 2001). LRT is popular because it is more sustainable and less intrusive than the other forms of rail: heavy rail, commuter rail, rapid rail (included in "other rail") tend to be noisier and more expensive to construct that LRT (American Public Transportation Association, 2008). This is important because newer Sunbelt cities may lack the older rail infrastructure of older, northern cities (Marshall, 2001). To implement rail in these places may require new track, as older areas can

simply run new service on existing track. Examining the figures in Table 1-1, while all rail modes have had increases in their operating-cost-per-passenger mile, LRT has increased these costs at a slightly *lower* rate—perhaps pointing to a more sustainable form of transit for large to mid-size cities (Giuliano & Hanson, 2004). It is possible LRT may become cheaper over time, especially compared to rising fuel costs.

As to this chapter, its purpose is to provide the "Why?" for this study. The next chapter will identify background information that is necessary to understand the context of the study.

Could this desirability translate to higher property values around LRT stations? This thesis will examine the city of Portland, Oregon's single-family residential (SFR) parcels over a ten-year period to identify proximity to LRT's effect on home appreciation rates. Portland's population is just under two million inhabitants-- yet it leads the country in LRT passenger trips per capita (American Public Transportation Association, 2008). Although cities like Boston and San Francisco have larger total yearly ridership, the data shown in Tables 1-3 and 1-4 indicate that Portland is a leader is both passenger miles and passenger trips (Federal Transit Administration, 2002). Considering its size relative to other cities, Portland's reputation is that they rely on their light rail more than any other major metro area in the United States. The facts are as follows: per the Census Bureau's American Community Survey, Portland is the 23rd largest Metropolitan Statistical Area (MSA) (U.S Census Bureau, 2008). As shown in Tables 1-3 and 1-4, the area ranks fourth in passenger miles *and* fourth in passenger trips. In summary, LRT is a popular form of transit for many reasons. Transportation savings make a real difference and impetus in housing choices to many households in the country. Portland is a city that has embraced LRT like no major American metro-yet.

Table 1-1. Rail track miles by mode in the United States, 2002-2006

Year	Commuter Rail	Heavy Rail	Light Rail	Other Rail	Total
2002	7,267.1	2,179.2	1,113.6	29.7	10,589.5
2003	7,433.9	2,209.5	1,147.2	30.0	10,820.6
2004	7,284.1	2,209.5	1,321.2	30.3	10,845.1
2005	7,947.5	2,277.3	1,385.1	30.3	11,640.2
2006	8,016.7	2,277.3	1,463.8	38.3	11,796.1
Percent change, 2002-2006	10.3%	4.5%	31.4%	29.0%	10.2%

Source: American Public Transportation Association. (2008). *2008 Fact Book*.

Table 1-2. Light rail routes under construction and traffic congestion in select American cities as of 2006.

Location	Miles of Track	Congestion Ranking*
Charlotte, NC	9.6	27
Dallas, TX	16.0	4
Denver, CO	19.2	16
Los Angeles, CA	15.1	1
Oceanside, CA	23.7	15
Phoenix, AZ	64.3	13
Portland, OR	0.6	23
Salt Lake City, UT	0.8	50
San Francisco, CA	5.4	7
Seattle, WA	15.5	9
Tempe, AZ	20.0	13
TOTAL	190.2	

Source: American Public Transportation Association. (2008). *2008 Fact Book*.
Source: INRIX National Traffic Scorecard 2006. (2006)
*Oceanside (suburb of San Diego, CA) and Tempe (suburb of Phoenix, AZ) are considered part of the same city for their respective congestion rankings.

Table 1-3. Light rail transit agencies ranked by unlinked passenger trips, fiscal year 2006 (thousands)

Transit Agency/ Urbanized Area (Primary City)	Passenger Trips
Massachusetts Bay Transportation Authority (MBTA) Boston, MA	80,278
San Francisco Municipal Railway (MUNI) San Francisco, CA	43,678.8
Los Angeles County Metropolitan Transportation Authority (LACMTA) Los Angeles, CA	42,020.8
Tri-County Metropolitan Transportation District of Oregon (TriMet) Portland, OR	34,591.5
San Diego Trolley, Inc. (MTS) San Diego, CA	33,829.8
Southeastern Pennsylvania Transportation Authority (SEPTA) Philadelphia, PA	25,445.5
Dallas Area Rapid Transit (DART) Dallas, TX	18,581.1
Bi-State Development Agency (METRO) St. Louis, MO	16,573.9
New Jersey Transit Corporation (NJ TRANSIT) New York, NY	15,767.1
Utah Transit Authority (UTA) Salt Lake City, UT	15,203.7
Sacramento Regional Transit District (Sacramento RT) Sacramento, CA	14,452.1
Metropolitan Transit Authority of Harris County, Texas (Metro) Houston, TX	11,333.1
Denver Regional Transportation District (RTD) Denver, CO	11,277.9
Metro Transit Minneapolis, MN	8,957.9
Santa Clara Valley Transportation Authority (VTA) San Jose, CA	8,279.8
Port Authority of Allegheny County (Port Authority) Pittsburgh, PA	7,510.6
Maryland Transit Administration (MTA) Baltimore, MD	5,927.1
Niagara Frontier Transportation Authority (NFT Metro) Buffalo, NY	5,631.9
The Greater Cleveland Regional Transit Authority (GCRTA) Cleveland, OH	3,791.3
Memphis Area Transit Authority (MATA) Memphis, TN	959.3
Central Puget Sound Regional Transit Authority (ST) Seattle, WA	885.6
New Orleans Regional Transit Authority (NORTA) New Orleans, LA	605.9
Hillsborough Area Regional Transit Authority (HART) Tampa, FL	520.3
Charlotte Area Transit System (CATS) Charlotte, NC	175.3
Central Arkansas Transit Authority (CATA) Little Rock, AR	154.4
Kenosha Transit (KT) Kenosha, WI	52.9
Island Transit (IT) Galveston, TX	37

Source: Federal Transit Administration. (2007) National Transit Database.
Note: Data excludes transit agencies not reporting data to the National Transit Database.

Table 1-4. Light rail transit agencies ranked by passenger miles, fiscal year 2006 (thousands)

Transit Agency/ Urbanized Area (Primary City)	Passenger Miles
Los Angeles County Metropolitan Transportation Authority (LACMTA) Los Angeles, CA	302,183.5
Massachusetts Bay Transportation Authority (MBTA) Boston, MA	215,711
San Diego Trolley, Inc. (MTS) San Diego, CA	208,875.5
Tri-County Metropolitan Transportation District of Oregon (TriMet) Portland, OR	179,875.4
Dallas Area Rapid Transit (DART) Dallas, TX	136,797.1
Bi-State Development Agency (METRO) St. Louis, MO	119,769.5
San Francisco Municipal Railway (MUNI) San Francisco, CA	112,916.6
Utah Transit Authority (UTA) Salt Lake City, UT	86,039
Sacramento Regional Transit District (Sacramento RT) Sacramento, CA	78,181
New Jersey Transit Corporation (NJ TRANSIT) New York, NY	72,899.5
Southeastern Pennsylvania Transportation Authority (SEPTA) Philadelphia, PA	64,430.8
Denver Regional Transportation District (RTD) Denver, CO	59,137.1
Metro Transit Minneapolis, MN	52,584.6
Santa Clara Valley Transportation Authority (VTA) San Jose, CA	41,913.3
Maryland Transit Administration (MTA) Baltimore, MD	33,831.9
Port Authority of Allegheny County (Port Authority) Pittsburgh, PA	32,902.8
Metropolitan Transit Authority of Harris County, Texas (Metro) Houston, TX	27,517.6
The Greater Cleveland Regional Transit Authority (GCRTA) Cleveland, OH	22,147.1
Niagara Frontier Transportation Authority (NFT Metro) Buffalo, NY	13,867.3
Central Puget Sound Regional Transit Authority (ST) Seattle, WA	983
Memphis Area Transit Authority (MATA) Memphis, TN	919.6
Hillsborough Area Regional Transit Authority (HART) Tampa, FL	838.4
New Orleans Regional Transit Authority (NORTA) New Orleans, LA	763
Charlotte Area Transit System (CATS) Charlotte, NC	279.5
Central Arkansas Transit Authority (CATA) Little Rock, AR	249
Kenosha Transit (KT) Kenosha, WI	59.5
Island Transit (IT) Galveston, TX	47.6

Source: Federal Transit Administration. (2007) National Transit Database.
Note: Data excludes transit agencies not reporting data to the National Transit Database.

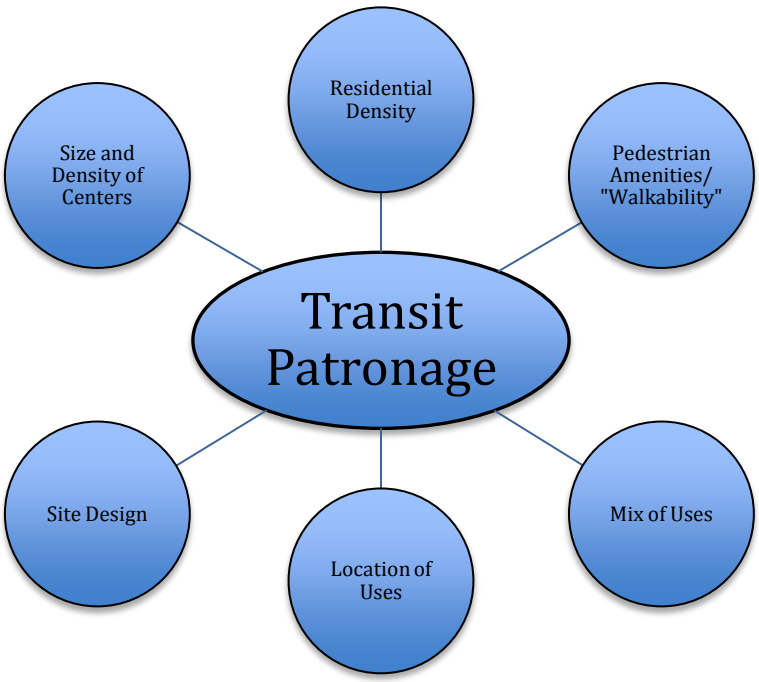

Figure 1-1. Relationship between land use and transit patronage

Source: Adapted from Halifax Regional Planning Paper, 2002

CHAPTER 2-
BACKGROUND INFORMATION

Modes of Transport

Before delving into any further research or literature on LRT, it is necessary to define what constitutes LRT. The American Public Transportation Association Fact Book (2008) defines light rail (streetcar, tramway, or trolley) as lightweight passenger rail cars operating singly (or in short, usually two-car, trains) on fixed rails in a right of way that is not separated from other traffic for much of the way. Light rail vehicles are typically driven electrically with power being drawn from an overhead electric line via a trolley or a pantograph. A light rail car (or streetcar, tram, or trolley car) usually operates much of its route on non-exclusive right-of-way. Sometimes older cars are refurbished (vintage trolley cars) or newer cars are built to look like older cars (heritage trolley cars) (American Public Transportation Association, 2008) Case in point: the New Orleans Streetcar has been termed "light rail" by some developers in an effort to make their developments look more appealing (Brown & Weiner, 2009).

For some, LRT *is* aesthetically appealing and characterized by lower speeds and lower capacity than metro systems or "heavy rail" (American Public Transportation Association, 2008). Newer systems tend to operate on private rights-of-way separate from city automobile traffic (American Public Transportation Association, 2008). Light rail may be defined to somewhat erroneously to include older streetcar systems (trolleys or tramways) that often run on city streets as well as modern light rail systems. Light rail systems can typically handle steeper inclines than heavy rail, and curves sharp enough to fit within street intersections. LRT is generally powered by electricity, usually by means of overhead wires, but sometimes by a live rail, also called third rail (a high voltage bar alongside the track), requiring safety measures and warnings to the public not to touch it. The type of technology used for the modern light rail

systems of today (the standard gauge, the electric wires over head connecting to the car, always over ground) are typically what people associate with LRT. Some examples of LRT systems include Portland's MAX, Dallas's DART, Minneapolis's Hiawatha Line and Charlotte's LYNX.

What is not LRT? Streetcars and trolleys that are not used over long distances, do not operate at fast speeds nor have a large number of riders compared to the other modes of rail transit are not LRT. The difference between streetcar/tram systems and LRT are difficult to ascertain because of a technology overlap. Some systems referred to as *light rail* are actually streetcar systems and vice versa. For example, Boston's light rail, MBTA's Green Line is a traditional trolley where the tracks and trains run along the streets and share space with road traffic. Stops tend to be frequent, and little effort is made to set up special stations. A true, modern light rail system like Portland's MAX are characterized as such because the trains are often separated from road traffic and run along their own right-of-way. Tracks are highly visible, and in some cases significant effort is expended to keep traffic away through the use of special signaling, and even grade crossings with gate arms. Many light rail systems — even fairly old ones — have a combination of the two, with both on-road and off-road sections. In some countries, only the latter is described as *light rail* (American Public Transportation Association, 2008). In those places, trams running on mixed right of way are not regarded as light rail, but considered distinctly as streetcars or trams. However, the requirement for saying that a rail line is "separated" can be quite minimal — sometimes just with concrete "buttons" to discourage automobile drivers from getting onto the tracks.

Heavy Rail

The subways that were utilized early in the 20th century are the predecessors to LRT. These systems were effective partly because of lack of space and the population density unique to New York's physical characteristics. Subways are referred to as heavy rail—other examples

include London's Underground, Chicago's Elevated Line, and Washington, D.C's Metro. These systems tend to travel at higher speeds and have larger carrying capacity than LRT. These systems differ from commuter rail in that they offer less service for commuters from suburbs and more on transport intra-city, instead of intercity. The American Public Transportation Fact Book 2008 defines heavy rail (metros, subways, rapid transit or rapid rail) as

> An electric railway with the capacity for a heavy volume of traffic. It is characterized by high speed and rapid acceleration passenger rail cars operating singly or in multi-car trains on fixed rails; separate rights-of-way from which all other vehicular and foot traffic are excluded; sophisticated signaling, and high platform loading. If the service were converted to full automation with no onboard personnel, the service would be considered an automated guide-way. A heavy rail car has motive capability, is driven by electric power taken from a third rail or (rarely, overhead wires), and is usually operated on exclusive right-of-way (American Public Transportation Association, 2008).

Commuter Rail

Suburban or commuter rail is somewhat harder to define than heavy rail. Amtrak's Northeast Corridor trains are an example of commuter rail in the United States. This train carries those who wish to travel intercity through the Northeast chain of cities. The American Public Transportation Fact Book 2008 defines commuter rail as

> An electric or diesel propelled railway for urban passenger train service consisting of local short distance operating between a central city and adjacent suburbs. Service must be operated on a regular basis by or under contract with a transit operator for the purpose of transporting passengers within urbanized areas and outlying areas (American Public Transportation Association, 2008).

An example of commuter rail is South Florida Regional Transportation Authority's Tri-Rail, a rail line that serves the metro areas of Miami-Fort Lauderdale and West Palm Beach. As with most rail transit, this system emphasizes quicker *headways* (time between running trains) during *peak periods* (generally during AM and PM commuter rush hours) (American Public Transportation Association, 2008).

Buses and Bus Rapid Transit (BRT)

The large majority of Americans take their transit trips on bus, not rail. As Figure 2-1 identifies, bus transit will always have its purpose. Being that it is not a fixed-way route gives it some advantages over LRT. Bus Rapid Transit (BRT) has been utilized around the world as a flexible, less-expensive alternative to LRT. BRT buses may have lower floors and can be very similar to LRT in appearance and function. Longer distance between stops, higher operating speeds and longer routes are all characteristics of BRT-- which can make it appealing as a LRT alternative (Jacobs Engineering, 2008). Table 2-1 identifies the capital cost per vehicle in having a dedicated lane for BRT, which is slightly lower than LRT's cost. The seated capacity of BRT is slightly lower. Even if the costs are lower--considering that BRT may be LRT's main competition for new expansion--it should be noted that there are limited studies on BRT's ability to stimulate property values. The many modes of transport that used fixed guideway systems (LRT, heavy and commuter rail) offer benefits that buses and BRT may not. While buses will always serve a major need, there is a desire by growing metros to establish passenger rail transit where there was none previously. BRT tends to offer a cheaper alternative to these cities as well.

The variety of modes of transport all rely on the same things (people, energy source) and all seek to produce the same result-to increase accessibility and mobility. In our larger metro areas these modes tend to work together to achieve the intended results. As mentioned before, there is some competition in areas between LRT and BRT because of the similar density requirements and the differing capital costs.

History of Transportation and Land Use

The following are necessary to understanding the history of transportation in America, particularly as it concerns urban and later suburban dwellers. The suburb, while not an American invention, was aided by the American expressway in the way the resulting land uses made land

value no longer tied to distance to the workplace. As our transit modes evolved, the need to live close to mobility was redefined. The home/ land values that accompanied access to mobility--be it streetcar, light rail or bus, have influenced the form and fashion of our cities. Before any mechanized transit, water bodies were early transit lines; their accessibility made their location desirable, especially in this country. The first large American towns were located on major bodies of water. As technology advanced moving inland became possible, and cheaper. Towns grew into cities and since the form of transport was predominantly by foot then the challenge was to keep everything close. However for many early city-dwellers needed to live close to where they worked, or access to transport**.** Thus**,** living near a transit stop was hardly a new concept. When the streetcar was invented in the late nineteenth century, there was a push to squeeze as many people as could fit near the lines; inadvertently creating the first TOD. Marshall notes that his hometown of Norfolk, Virginia, as many other cities that urbanized during the early 20th century, was predicated upon being near the streetcar line (Marshall, 2001). In time, horse drawn omnibuses were eventually replaced by the horse-drawn streetcar, which in turn, was replaced by the electric streetcar in the 1890s (Giuliano & Hanson, 2004). As the streetcar gained more prominence in the inner-workings of our cities, the land use surrounding the streetcar tended to create a market for land near the stations. In time, as each technological advancement replaced the preceding one, cities began to take up more and more land.

When serving the increasing urban population growth technological advancements in transportation made living "further out" more and more possible, if not desirable. When the first subways appeared in our country, it allowed the working man increased mobility due to its higher speeds; instead of living six blocks from his place of work he now might live a mile or so; the commuter was born. By the early-to-mid 20th century, in our larger cities, subways were

being utilized in combination with city buses and the streetcar (Giuliano & Hanson, 2004). The larger cities were then connected by rail.

During this time, our old industrial cities reached some of their highest populations—cities like Detroit, Cleveland, Buffalo and St. Louis--which is indicative of the density and the dependence on rail transit (Marshall, 2001). As the automobile began to increase in popularity, the old streetcars were disassembled in many places (Marshall, 2001). City buses would still carry on, but the new spirit of American freedom was the highway. The highway gave way to the expressway. These developments allowed workers to live ten miles or more away from their workplaces. The expressway then enabled increased accessibility by eliminating the slower drive on Main Street *on the way* to the job (Marshall, 2001). Transit by its very nature, does not utilize the highway. The auto-centered city now made pasture land that was never valuable before, extremely valuable. This highlights the nature of highways versus the nature of transit—whereas the highway tends to spread people out, transit pulls people in, similar to the spokes on a bicycle wheel.

Sprawl

By the 1950s and 1960s it was the desire of many Americans to escape the noisy, dirty, denseness of the city proper. The highways were designed to make auto use more efficient and decrease congestion. In 1955, President Dwight Eisenhower started the interstate highway system with national defense in mind. The idea behind the highway was moving people in cars quickly and efficiently. It enhanced suburban flight as now the worker could commute to his job in the CBD and return home to suburbia. An idea many people bought into this idea--whereas before they could live ten miles from work now they could live twenty or thirty. However the expressway construction carved up vibrant downtown neighborhoods. Bulldozing for

expressways along with urban renewal programs also encouraged bulldozing vibrant working-class neighborhoods, which displaced minorities, sometimes disproportionately.

Sprawl is characterized as low-density, automobile-centered development with a lack of grid-like connectivity in the street network (Marshall, 2001). Those types of circumstances have led to our current situation of sprawl and lack of vibrant city cores. The interstates prompted sprawl—but even President Eisenhower could not have to the foreseen the “Big Box” stores on appending six-lane suburban boulevards and accompanying subdivisions harboring cul-de sac after cul-de sac(Marshall, 2001). These are symptoms of urban sprawl; while convenient for auto use, these neighborhoods tend to be connected by pedestrian-unfriendly intersections that make walking, jogging, or bicycling anywhere dangerous (Marshall, 2001). Paradoxically, the most valuable land in a metro area could now be in area where previously there was no accessibility. As suburbia continued to expand further and further out, the interchanges of various expressways and beltways became the new downtown—that was where Americans worked, shopped and were entertained (Marshall, 2001).

For the typical American commuter, the congestion created by sprawl was bearable as long as transportation costs remained (namely gasoline) inexpensive. That changed after 9/11--but some people saw these problems coming; as early as the 1970’s many transportation professionals realized that adding another lane to an expressway might not solve the congestion problem (Calthorpe & Fulton, 2001). The transit agencies in our cities had suffered by then, with money being spent more on roads than transit (Calthorpe & Fulton, 2001). As more and more people drove cars transit in general became to be associated with poverty and crime. This attitude was signified in property studies in early-1990s Atlanta and Miami. In these areas, that attitude is reflected in lower than expected valuations in home prices The attitude toward transit by the late

20th century has changed--living near a transit stop was now in some areas seen as a detriment, instead of an asset. Towards the turn of the century governments began to re-emphasize public transit spending, but the local nature of government tended to prevent a comprehensive approach to the congestion problem (Calthorpe & Fulton, 2001). As we will see later, Portland was significantly ahead of many metrpolitan areas in transit investment.

Transit Taking Us Downtown

Planners and concerned policymakers are now speaking to a more concerned audience than twenty years ago. More and more cities are turning to LRT, to their neglected city cores in the hope of taking us back downtown. Regionalism would become more and more reflective of the new paradigm in transportation planning. The dilemma for policymakers stems from needing money to support both transit and highway, since the two often work in concert. All transit projects are not funded, and most transportation budgets are comprised of a majority highway construction and maintenance costs. A delicate highways-to-transit balancing budgeting job is necessary; many of us living in single family homes tend to use those same highways to access transit anyway.

Some Americans are looking to eliminate their dependence on automobiles entirely. Recently there has been a change in attitude supporting the return to city cores that have been underutilized for the majority of the last fifty years. These new downtowns may not be where people work as in the downtowns' heyday, but new developments and new densities are forming as Americans seek relief from un-walkable sprawl and high gasoline prices. Transportation costs now eat up a considerable chunk of household budgets (U.S Census Bureau, 2008). These developments have led policymakers, planners, and ordinary commuters to seek other forms of transportation. Such forms include HOV lanes, carpooling, walking, bicycling and increasingly public transit. BRT, Commuter rail, and LRT--are all forms of transit that have become favored

as Americans look to maximize the efficient use of their transportation dollar. Some commuters in our large metro areas have given up the two-hour commute in exchange for living near a transit stop. More new miles of track of LRT are being proposed than any other form of transit and many of these areas proposing LRT are in rapidly growing cities. Have we found that we no longer able to sustain a lack of transportation options, due to expensive gas, declining air quality and two hour commutes? One solution may very well be expanding our nations LRT and fostering connectivity with *all* transit modes.

While transit use has not greatly increased per capita, there are positive signs in the re-creation of TODs. The TOD seeks to make getting around without an automobile a major feature of living in that development—this is exemplified by sidewalks, bikeways, and most importantly walkable access to transit, which discussed earlier, is roughly a ¼ mile away in network distance. While this study examines SFR, the TODs (which are definitely not SFR) reflect the consumer's desire for a return to density, transport options and most of all a divorce from big box sprawl. The TODs values are reflected in this consumer desire. All of this is good news for landlords who own SFR near transit.

Home Valuation Tied to Bundle of Factors

Reiterating the research question, does having light rail access make a difference in single-family home value appreciation? There are many factors to say LRT access is the main impetus, given that houses appreciate in value for many reasons. The externalities are made up of a bundle of benefits. Factors such as number of bathrooms, added home improvements, the numbers of quality schools in the area are all hard to quantify. It is *more* likely given how well the LRT system performs. The logic stems from a well-utilized system; if LRT is making the population mobile without the automobile, walkable access to the station is desirable. If it is desirable to the point the consumer of housing is willing to pay more for increased accessibility,

than it is logical that the same property is attractive for a higher level of development (Diaz, 2001). If the property around a station is extremely desirable an existing low density use such as (Jackson, 2008). SFR can be converted to a higher density use or another type altogether (Diaz, 2001).

Trends in Home Appreciation

Home appreciation also reflects national economic trends. Property values are highly related to state, regional and neighborhood factors and trends. Among the nation's fastest growing metropolitan areas, a majority are located in the Sunbelt. Logically, single-family residential land appreciation reflects the desirability of the region in general. However, land values (and accompanying appreciation rates) can vary greatly from street to street. The cyclical regional and national trends in real estate such as the booms and busts of the 2000s can also effect home value appreciation.

As shown in Figure 3-2, the country experienced higher home appreciation rates in the 2003-2005 housing burst than any time in the previous ten years (National Association of Realtors, 2008). Figure 3-1 highlights regional trends: the robust Sunbelt population growth, and the appreciation of SFR values by 11.6 percent in 2004 and 12.4 percent in 2005 in the West. In the Northeast mean SFR values appreciated 11 percent in 2003, 11.7 percent in 2004, and 11.11 percent in 2005. Housing value growth in the U.S. as a whole was higher during these years than any other point since the late 1970s and the South, and the Midwest also posted strong numbers (National Association of Realtors, 2008). Figure 3-2 shows that home appreciation rates were steadily increasing throughout the United States right until the housing bubble burst in 2006 and 2007. As shown in Figure 3.2, the median sale price declined in each of these years. All regions saw a decline in the rate of appreciation by 2006, compared to the last three years (National Association of Realtors, 2008). By 2007, the mean national SFR housing value began to actually

depreciate, which followed another year of depreciation in 2008—something that had never happened before, since data was collected in 1968 (National Association of Realtors, 2008).

Concerning this ten-year study in Portland, it is important to recognize that the national housing value had grown as well. Portland echoed the national trends, but it remains to be seen whether or not LRT access can help home prices withstand the more volatile price fluctuations. Nevertheless, there are signs; the current housing depreciation is less acute in certain areas in Denver, Colorado. Homes near light-rail stations along the southeast line, which opened in November 2006, have increased by an average of nearly 4 percent over the past two years--but the rest of the Denver market declined an average of 7.5 percent (Jackson, 2008). According to the National Association of Realtors, mean housing values are higher in the West, then the Northeast, then the South and the Midwest being typically the least expensive. Interestingly the Northeast avoided the housing depreciation wave to the same extent that plagued the other regions, as well as the country on the whole.

In summary, the factors corresponding to home valuation are diversified; the price range can fluctuate so greatly in adjacent neighborhoods that access to transit may be a small reason X house is valued at X dollars. What is significant about the regional price fluctuations is the areas in the country (the Northeast) that "boomed" that were not as drastically affected by the "bust" as more auto-dependent regions (the South). The next section focuses on the different modes of transit and their particular effect on land as well as some factors that affect transit in general. While the South and West saw their home values fluctuate more during the recent home value decline, the Northeast's home values tended to decline at a lesser rate. The Northeast also is the most historically urban and dense area of our nation.

Density: Transit's Main Ingredient

Our old core cities, especially in the Northeast Corridor have blocks and blocks of TOD; though they are not referred to as such. They are remnants of the urban form of a city designed around a streetcar, one of the early forms of transit (Giuliano & Hanson, 2004). Density is probably the single most important factor, although density will not do it alone. The TCRP report recommends that instead of determining minimum density requirements for which transit service types are feasible, the relationship between density (as well as other aspects of land use form) and the cost at which transit service can be provided should instead be determined (Halifax Regional, 2002). This is because decisions about providing services are made in corridors and locations where land use characteristics, including density, types and mix of uses, are quite varied (Halifax Regional, 2002). Further, trip purpose also influences transit service type(Halifax Regional, 2002). In determining how land use form such as residential density and employment center size influences light rail and commuter rail transit demand and service cost, TCRP found that residential densities have more influence on light rail ridership and cost than on commuter rail (Halifax Regional, 2002). In turn, CBD employment density was found to be more important for supporting commuter rail ridership than light rail ridership (Halifax Regional, 2002). Thoughtful transportation planning, i.e., zoning for intense mixed uses around LRT stations is a good way of ensuring that it will. If light rail, in theory, drives up property value near a station, then the resulting increase values will result in highest and best use, which would increase density. As far as creating density, the regional picture must be taken into consideration. In Susan Hardy's discussion paper, *Smart growth and the Transportation-Land use connection: What does the research tell us?* She discusses the Knight and Trygg study which points to the necessity of the coordination of factors, "The evidence shows that transit can and often does influence where in the region growth occurs, but only given the right conditions and policies"

(Handy, 2005). The Knight and Trygg study explored the importance of four different factors in influencing the impact of transit on land use: local government land use policies, regional development trends and forces, availability of developable land, and the physical characteristics of the area (Knight & Trygg, 1977). They concluded that all of these factors influence the likelihood of development. There is a general logic and a history of the land-use transportation connection: the older the city, the more mature and diversified that city's transit options will be, generally speaking. The land value in these mature transit cities also tends to be high, matching the degree of use. Transit planning may differ in different areas depending on how strong the land-use transportation connection is. Generally, the mature transit city will have a high density.

Physical Constraints and Economic Concerns

While density is the main ingredient, other factors can either enhance or destroy the recipe. It is no coincidence that certain aspects of the land itself lend themselves easily to sprawl. The cities on either coast are limited in some aspect by mountains, bodies of water and other geographic features. Cities located on rolling expanses of flat terrain are not ideal in keeping density intact. Cities like Houston and Phoenix--some of the most sprawling congested cities exhibit similar characteristics. Kain discusses this in a study comparing ridership statistics of San Diego's trolley with While San Diego's smaller CBD tends to attract fewer ridership numbers but this disadvantage is offset by the area's favorable topography (Kain & Zvi, 1999). In contrast to Houston, which is built on an unbroken expanse, San Diego is hemmed in by the Pacific Ocean on one side and a steep mountain range on the other. As a result, a large fraction of San Diego's jobs and households are concentrated along North-South corridor along the bay and a large fraction of the remainder in a narrow East-West valley. Not surprisingly, the first and second lines of San Diego's light rail system were built in these corridors (Kain & Zvi, 1999). When transit technologies develop, they tend to accelerate the decline of older modes of

transport. Our present-day transportation modes will be discussed with an emphasis on the rail modes, especially LRT.

Portland exhibits the type of physical characteristics that induce a vibrant city core. These characteristics include physical features that serve as barriers to sprawling development: these include mountains, oceans and rivers- features that hem a city in. New York City wouldn't be New York without these prohibitive features—the same is true for San Francisco. These features are absent in cities like Phoenix, Orlando and Houston. Portland has no shortage of physical constraints on development—the city is divided by the Williamette River and by the Columbia River to the north. It is also bounded by a significant mountain range directly northwest of the CBD.

Consider Buffalo, New York. A recent study indicated that (despite the city's best efforts over a twenty year period) the light rail line has no significant effect on land use, employment or central city economic development (Banister & Berechman, 2000). The region's current economic picture and the region's current as well as forecasted population growth are crucial to LRT's success. If we define a successful LRT based on increased ridership, if LRT is going to bring back our CBDs then a population decline in total metropolitan area (people leaving *for* the suburbs and people leaving the suburbs altogether) is difficult to overcome. If there is chronic high unemployment, than an LRT can have all the accessibility in the world, but if jobs are leaving the area then an LRT will not help revitalize a CBD. Economic impacts are highly localized and tend to occur in fast-growing, heavily congested core areas (Giuliano & Hanson, 2004).

Portland has grown while Buffalo has shrunk. Portland's local economy is a diverse mix of high tech as well as traditional industries native to the Pacific Northwest. Portland also is

home to major employers such as Intel and Nike. Portland also, in terms of tonnage, is the third busiest port on the West Coast (Portland Business Alliance, 2005). Portland has historically had a lower unemployment rate than the national average but a significantly higher cost of living (Portland Business Alliance, 2005). Portland suffered an overall decline in population between 1950 and 1980, however not to the extent of Buffalo. The city seemed to be able to reinvent itself an attract people back to the core city—by 1990 the population had increased 19.4 percent from a decade earlier. By 2000, the population had grown by another twenty percent (U.S Census Bureau, 2008). Again, the local economic situation precludes any stand alone effects of LRT on home prices. LRT can help rejuvenate but is not likely to drive the engine of an economy entirely.

How Portland Changed

Portland was facing similar challenges in the 1970s and 1980s. In 1973 the state of Oregon adopted a series of state planning laws that led to the adoption of Portland's UGB provisionally in 1976 and finally in 1979 (Calthorpe & Fulton, 2001). The boundary was conceived primarily to protect farmlands from speculation and development (Calthorpe & Fulton, 2001). However, Portland at this time was still similar to any other metro area; the UGB boundary was so large that it took development nearly twenty years to reach it (Calthorpe & Fulton, 2001). A common misconception about the UGB is that it is a fixed boundary, when actually it is elastic—it must be adjusted periodically to provide enough land for twenty years of growth (Calthorpe & Fulton, 2001).

Metro, which began in 1979, finally began in 1992 to address the alternative transportation modes as a response to this sprawl (Calthorpe & Fulton, 2001). This effort was initiated by a new state Transportation Planning Rule that required cities with populations larger than 25,000 to revise their transportation plans to provide more emphasis on such modes,

requiring pedestrian friendly designs along transit lines and street connectivity in subdivisions (Calthorpe & Fulton, 2001). The MPOs in lieu of the Transportation Planning Rule had to adopt these plans that sought to decrease VMT per capita (Calthorpe & Fulton, 2001). It was a united front against auto-dependency – Metro was addressing VMT per capita in its Regional Urban Goals and Objectives, which called for a new regional plan (Calthorpe & Fulton, 2001). The plan would be known as Region 2040. Around the same time, a nonprofit environmental advocacy group called 1000 Friends of Oregon began its study of an alternative land-use transportation strategy (Bartholomew, 1997).

Land-Use Transportation Air Quality (LUTRAQ): The Stimulus for a Regional Approach

Echoing the "freeway revolts" of the 1950s and 1960s, the catalyst of today's Portland was the defeat of the Western Bypass Highway in 1988—another example of a concerned citizenry defeating a major highway plan (Bartholomew, 1997). The proposed bypass was an attempt to relieve congestion in Washington County, where rapid growth had been to that point. The political leaders of Washington County were solidly behind the proposed extension. This was a departure from the norm for the region, building more highways to alleviate traffic congestion. Comprised of citizens, activists and developers, Land-Use Transportation Air Quality (LUTRAQ) was born in a response to this proposed highway (Bartholomew, 1997). The group had to convince the state that their alternative land-use transit to not building the bypass could support the densities that the projections called for (Bartholomew, 1997). Workshops were held to persuade the public of the plan's feasibility. Instead of building more highways, LUTRAQ proposed alternatives that included more emphasis on pedestrian access to regional transit, and moderate density (Bartholomew, 1997). It was a very politically charged situation but in 1995, Oregon's Department of Transportation (ODOT) found the LUTRAQ alternative to be equal or superior to the bypass in virtually every category. This was followed in September

1995 with ODOT's official recommendation from the study process, calling for various smaller road improvements, but no bypass (Bartholomew, 1997). This defeat of a highway was significant because it was one of the few occasions that a land use-transportation alternative was taken seriously enough to defeat a new expressway (Bartholomew, 1997). LUTRAQ is significant because the voters made a conscientious decision to advocate transit options over expanding the highway system. This would set the stage for the LRT expansions that Portland would add every few years.

Whereas the political climate in Portland assisted in the area's regional approach to transportation, there are a bundle of factors that are tied in home valuation *and* increasing rail transit ridership. The factors tied to home valuation range from everything to location to number of bathrooms in the unit. Some of the factors tied to increasing transit ridership (which can signify a healthy downtown) include density and intensity of land use, the physical geography of the area, the economic trends of an area, but perhaps most importantly the attitudes of the area's citizens toward transit.

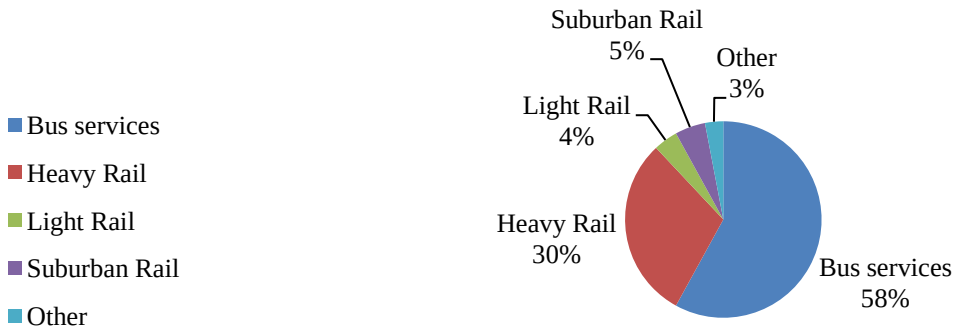

Figure 2-1. Percentage of transit trips in United States in 2000.

Source: *The Geography of Urban Transportation*, Third Edition, 2004.

Table 2-1. Cost and other selected characteristics for selected transit modes

Mode	Typical capital cost per vehicle (millions of dollars)	Annual operating cost per revenue mile	Seated capacity (passengers)	Average speed (MPH)	Maximum speed (MPH)
Light rail	3-25	Between $7-$15	150-300 per train/ 100 per streetcar	15-25	60
Heavy rail	20-250	Between $8-$10	60-80 per car plus standees	30	70
Commuter rail	5- 9	Between $11-$13	1,250 per train (depending on length)	30	90
Bus rapid transit	0.2-0.5 (shared lane) 8-25 (dedicated lane or guideway)	Between $6-$8	60-100 per bus	30	60

Source: *Florida Department of Transportation SEFCC Study*, (Jacobs Engineering, 2008)

CHAPTER 3
LITERATURE REVIEW

This literature review is divided in three sections. The first section discusses the theoretical framework established by Von Thunen in the mid 19th century and furthered by others in the latter part of the 20th. The second part discusses the previous studies of the effects of LRT on property values. The third section examines the myths and claims about LRT (Banister & Berechman, 2000). This thesis aims to quantify desirability in terms of housing appreciation rates. Land that offers increased alternative transportation options may have higher appreciation rates. Some urban planning studies examine how land use and transportation are connected, and in urban economics studies one may learn that accessibility and mobility affect location value. In real estate price studies, one learns that as a location becomes more attractive, as a result of certain characteristics, demand increases. This will result in increased price valuations as being close to a transport facility increases the accessibility of the property and thus the value of the transport facility is capitalized in the property value (Debrezion, Pels, & Rietveld, 2004). There are many factors or characteristics that determine how much a house worth, as access to transit is just one of many.

Theoretical Framework

Although in terms of total track mileage, light rail has a long way to go, the wave of rail transit future points towards light rail as opposed to other forms. In 2006, new light rail construction has most likely surpassed new commuter rail construction in the United States. More mid-size cities have planned light rail systems than commuter rail. Interestingly enough the cities that have new light rail routes are Sunbelt cities that have seen increased population growth in the last twenty years.

The motivation for living near LRT has been greater as transportation costs per household begin to rise. As gas prices increase, one motivation for living next to a LRT stop is the savings afforded by using transit compared to rising costs at the pump. For the consumer of land the choice could to move (for a variety of reasons) to an LRT stop interests economic geographers. *Location theory* is concerned with the where and why of economic activity. Johann Von Thunen, who in 1863, declared "for a given and of a given fertility, land value differentials are derived from the transportation savings afforded by the location of the land" as quoted in (Debrezion, Pels, & Rietveld, 2004). This is one of the first theories concerning the bundle of factors. Developing theoretical "rings" around the CBD, he theorized that the most important land uses would be centered in the central core. Von Thunen was primarily concerned with balancing land costs and transport costs. This theory may be illustrated in today's car-weary commuter--trading the ranch house in the suburbs for the more expensive town-home downtown.

Economist William Alonso conducted an important study in the 1960s improving Von Thunen's theory in "bid-rent" terms. The basic idea behind the bid-rent model is that every agent is prepared to pay a certain amount of money depending on the location of the land. This leads in equilibrium to a rent gradient that declines with distance from the CBD for sites that yield equal equity (Muth, 1969). In the early studies, a dominant factor explaining the difference between land (property) values was the accessibility as measured by the distance to the CBD and the associated transportation costs (Alonso, 1964). The money saved from not having to travel is what motivates the intense land uses found in our most dense city cores. The people who live in these areas often are able to perform many daily trips without using an automobile—for longer trips to work may be used by transit. Even longer trips may be used by a combination of different modes.

Von Thunen, Muth, and Alonso understood that transportation and land costs involve a trade-off. The one thing that all transit systems have in common is their attempt to improve one's accessibility and mobility. *Accessibility* refers to the number of opportunities called "activity sites available within a certain distance or travel time"(Giuliano & Hanson, 2004). Activity sites would include including employment, entertainment, recreation and the CBD. *Mobility* refers to the most efficient way to move people between different activity sites (Giuliano & Hanson, 2004). The goal of transportation planning has been to increase people's mobility (Giuliano & Hanson, 2004). Thus, *mobility* puts a high premium on collective modes of transport and the *accessibility* of places has a major impact upon their land values (and hence the use to which the land is put) and the location of a place within the transportation network determines its accessibility. Accessibility also includes the concept of attractiveness, the opportunities or activities that are located in a given place.

Thus in the long run, the transportation system (and the travel on it) shapes the land pattern (Giuliano & Hanson, 2004). Alex Marshall and others expressed the importance of this coordination. A way to measure the value of transit proximity, and moreover, success and health of a city is to examine its house value appreciation rates. If more people want to live in a place, that place becomes inherently more valuable, and the price of the land will increase over time. Based on new construction from recent years, LRT is quickly becoming the most popular form of rail transit. As mentioned earlier, a fixed-route service may be a better engine for realizing economic potential, more so than a highway or bus.

What is Walkability?

Much is made in this study on the benefits of walkability. A quarter-mile distance is theoretically the furthest distance people are willing to walk to transit as opposed to getting in their cars (Hess & Almeida, 2006). The terms *actual distance* and *network distance* are refer to

how long it takes to get somewhere (be it car or on foot)—network distance can be quite longer than actual (Hess & Almeida, 2006). In today's urban areas, earthen structures, landscaping, gated communities can make more difficult than it might appear on a map. Through these techniques many developers separate malls and other activity centers from the "face" of the street often make using an automobile necessary for what might have been a short walk. Also, actual accessibility could be lessened if one's residence (while being a quarter mile away satisfying the ¼ mile buffer) if to get to the stop busy intersections or freeway junctions between the person and the stop.

In previous studies, observers have noticed that inconsistent results and weak evidence of a land use- transport connection may be due to the complexity of metropolitan development and unpredictable travel patterns (Ryan, 1999). It was also found in the Parsons Brinckerhoff (PB) study that automobile access to stations has "limited appreciable effects on property values"(Parsons Brinckerhoff, 1999). Researchers have attempted to isolate the effects of access to transit in an effort to try to predict. This thesis seeks to correlate the two factors of access and home appreciation, and then compare these correlations to income and length of transit service.

Determining Value

Real Market Value (RMV) or Estimated Market Value (EMV) is the dollar amount that real estate professionals use to conduct property transactions (National Association of Realtors, 2009). Home appreciation rates fluctuate greatly in any given area due to the factors mentioned earlier. For the purposes of collecting taxes to support a county's infrastructure, there is a fragile balance in rapidly increasing property values—the more the house is worth; the more its owners have to pay in property taxes (Jackson, 2008).

A national trend in single-family home value growth welcomed the nation in the early to mid 2000s due to many factors, and as we have seen, desirable Sunbelt areas tend to populate

more robustly than their northern neighbors. As of 2008, however, there are coastal areas or Sunbelt areas that are depreciating in SFR value just as fiercely as they appreciated. Consider that in some regions, mean SFR value depreciated in back-to-back years, all American cities would do well to seek to eliminate any unnecessary detractors from the growing housing values.

Methods to Isolate LRT Impacts

Researchers use three approaches to separate out the effects on transit on land values; (1) matched pairs; (2) repeat sales analysis; and (3) hedonic price models (Cervero & Duncan, 2001). All of these methods implicitly assume that markets have fully captured information about the contamination and that stigma impacts are fully reflected in prices (Kilpatrick, 2005).

The first two approaches are the easiest but also the most problem-prone (Cervero & Duncan, 2001). Repeat sales extract value-trend changes immediately after a station implementation, thus isolating of the event itself and controlling for exogenous factors (Kilpatrick, 2005). Matched pairs determine whether the scores of the same participants in a study differ under different conditions. For instance, this sort of t-test could be used to determine if property values improve more after an implementation of a new light rail stop after taking a writing class than properties they did without a transit stop. In this study, the Parkrose/Sumner case study could be examined as far as what was the median home price before and after 2001 (when the LRT stop was implemented). Hedonic modeling or other mass appraisal techniques, preferred when large data sets are available, use data from both within and without an affected area and a dummy variable to capture the effect of stigma on value. When distance to a source of effect is a factor, then some sort of spatial analysis or distance function is included in the hedonic pricing model (Kilpatrick, 2005).

Gatzlaff and Smith (1993) used repeat sales data to examine the impact of the system on land values. They argued that a change in land value is a precursor to change in a land use, so is

a good measure of accessibility-related impacts. They conducted a series of repeated sales analysis, which compares the change in sales prices of a given property in successive sales. Repeated sales within station areas and outside station areas (1 square mile) and outside station areas were compared; there was no significant difference between groups (Gatzlaff & Smith, 1993). Pioneered by Bailey et al. (1963) this method estimates the effect of an exogenous amenity shock on home value by analyzing the change in a home's sale price over at least two transactions (Kent & Parilla, 2007). According to Kent, the repeat sales methodology "holds several advantages over a hedonic-based analysis. First of all housing price changes are grounded in real estate market transactions, which avoid the potential inaccuracy of third part assessors"(Kent & Parilla, 2007). This methodology seeks to eliminate the arbitrary nature of relying on an assessor's appraisal for property values. It is limited in that it only uses data from properties that were sold.

Hedonic price models introduce more rigorous controls, and are thus widely to be considered the best method available of ascribing benefits associated with factors like proximity to transportation facilities (Cambridge Systematics, Inc., 1999). Cervero and Duncan in their study of rail transit effects on commercial land values in Santa Clara County, California state that

> Hedonic price models apply the technique of multiple regressions to apportion real estate values to various explanatory variables, shedding light into the marginal contribution of factors like accessibility, land-use type and neighborhood quality to sales values. For purposes of gauging land-value benefits, a normative hedonic model is generally of the form:
>
> $$P_i = f\,(T, N, L\ C)$$
>
> Where:
> P_i equals the estimated price (per square foot) of parcel i.
> T is a vector that gauges proximity to transportation facilities.
> N is a vector of neighborhood characteristics (e.g., presence of mixed land uses; median housing income
> L is a vector of location and regional accessibility attributes (e.g., accessibility to jobs)
> C is a vector of controls (e.g., fixed-effect variables) - (Cervero & Duncan, 2001, p. 4)

Single-family residential was used in many studies due to the nature of residential land and accessibility. Location theory holds that home prices rise in synch with travel-time savings, thus to the degree transit expedites travel, properties near stations should sell for more. It is interesting to note that a 2002 study completed by Cervero and Duncan found that light rail conferred the greatest land value benefits to multi-family residential and commercial properties (Cervero & Duncan, 2002).

Nelson also found that rail's influence has been demonstrated more clearly for residential uses than for commercial ones (Parsons Brinckerhoff, 1999). Landis noted three reasons for this problem: (1) a lack of comprehensive and reliable data; (2) a smaller zone of impact that limits the number of observations; and (3) while housing values are determined in the market place, the values of individual corporate transactions may represent only the value of one pair of buyers and sellers (Landis, et al., 1995). It has been theorized that proximity to light rail *lines* could have negative effects on property; a study by Chen did not find any statistically significant nuisance effects (Parsons Brinckerhoff, 1999). Diaz maintains one of the more prominent ways that people understand the value of property is through the price or value of a home or in the rent they pay (Diaz, 2001). Another reason for examining SFR is that the number of real estate consumers (owners/renters) is greater than for other types of real estate (Diaz, 2001). All in all, the effects are more acutely felt in the residential sector (Diaz 2).

Previous Literature on LRT and Residential Property

The early studies done by Alonso and Muth were the predecessors of today's studies concerning LRT and home values. Studies began to appear in the late 1970s and 1980s. Previous research on light rail and residential property values suggests that light rail can have two opposing influences on property values: a positive accessibility effect and a negative nuisance effect (Garrett, 2004). The positive effects have been well covered throughout this thesis and the

nuisance effects include lighting, noise the closer the home is to the tracks (Garrett, 2004). However**,** the various studies that have examined LRT impacts on property values do not offer a consistent relationship. A list of similar studies is listed in Table 3-1. Referring to Figure 3-2, a graph of inflation-adjusted American housing values, the housing boom of the mid 2000s will be reflected in higher appreciation rates across the board regardless of how close the home is to an LRT stop (National Association of Realtors, 2009).

Numerous studies have been conducted on Portland, seemingly since its constructed light rail in 1986. One of the first studies was in 1988 when Al-Mosaind conducted a study done on Portland's East Burnside Line, focused his work on homes that were a quarter of a mile away from stops on the corridor. Al-Mosaind actually conducted two studies; the first used sales of homes that were located within a 1,000-meter width along the line but distinguished those that are within 500 meters of actual walking distance to a station; the second model used a distance measure to detect price gradient of homes within 500 meter actual walking distance. Al-Mosaind only examined houses that were sold in the study period- this could influence data--the study did not delve into how homes in or outside the buffer appreciated but Al Mosaind concluded that a net benefit indicated that the positive effects of accessibility are stronger than the nuisance effects.

Studies after the Al-Mosaind report have focused generally on the Eastside MAX now termed the Blue Line and have found that proximity yields positive effects on property values; Lewis-Workman and Brod in 1997 found that assessed property values increase $76 for every 100 feet closer within one station (Lewis-Workman & Brod, 1997). In 1998, Chen found that starting 100 meters away from a station property value decreased $32.20 per meter further (Chen, Rufolo, & Dueker, 1998). A year later, Dueker and Bianco using sales prices determined

"the median house value increase at a faster rate closer to stations" (Dueker & Bianco, 1999). They used distance to the station as a proxy of accessibility and distance to the line itself as a proxy for nuisance effects. They found that

> The real estate market has responded positively to LRT. The model estimates that a house that is valued at $82,800 (median price of housing in sample) at an LRT station would be valued at $80,500 a distance of 200 feet away, $78,554 a distance of 400 feet away, $76,961 a distance of 600 feet away, $75,721 a distance of 800 away and $74,835 (10% reduction) a distance of 1000 feet away from a rail station. This willingness to pay a premium for single-family housing having LRT access is a significant and positive land use benefit of the LRT investment (Dueker & Bianco, 1999).

Weinstein and Clower's Dallas study used median residential values and then examined the changes in property values near Dallas Light Rail between the years 1997 and 2001 (Weinstein & Clower, 2002). In Table 3-5, the median residential home value of 4,393 properties outside of a quarter-mile buffer zone appreciated 19.5% of their 1997 value compared to a 3,262 homes inside ¼ mile buffer zone increasing 32.1% over the same time period (Weinstein & Clower, 2002). Table 3-5 also shows that land zoned "Retail" (30.4% to 28.3%) and industrial parcels (21.5% to 13.0%) actually appreciated more in areas *without* access to rail transit in the same time period (Weinstein & Clower, 2002). This study categorized "Commercial" as "Retail" and "Office"—the "Office" parcels did appreciate more inside a quarter-mile buffer near light rail than those not within (24.7% to 11.5%)(Weinstein & Clower, 2002). Two things Weinstein and Clower's study suggests: DART rail is an amenity-enhancing service most keenly affecting the market values of properties where people live and where there are comparatively high concentrations of non-industrial jobs (Weinstein & Clower, 2002). It also implies that LRT may be more consistently beneficial to residential than other types of land.

LRT and Neighborhood Income

As mentioned earlier, the economic status of prospective transit neighborhoods may have an impact on LRT ridership and LRT-proximate property values. Researchers have found that proximity to a railway station is of higher value to low-income residential neighborhoods due to their heavier reliance on transit (Bowes & Ihlanfeldt, 2001). The dependency of a neighborhood's residents on transit may play a role is how valuable that transit is to that area's residents. This value may not translate to higher values in poorer neighborhoods, however. It would follow that a transit stop is more valued in neighborhoods that depend on them. For every foot closer to an LRT stop in an economically depressed area, it would make sense that those properties would be more valued. Not so. Hess and Almeida found that in Buffalo, New York, the proximity benefits were more acutely felt in high-income areas than low ones. The study on Buffalo found that within a half-mile radius of LRT station, property values were $2.31 greater for every foot closer to the station (Hess & Almeida, 2006). These results were promising but the overall picture in Buffalo is mixed. The study found that based on income level the effects of being close to LRT were varied. For three station neighborhoods that had below $20,000 median income the housing value decreased for every foot closer-- one station area neighborhood decreased by $42.31 for every foot closer (Hess & Almeida, 2006). In Buffalo, the conditions of this Rustbelt city (population decline, crime, economic downturn) overpowered the presence of a rail system (Banister & Berechman, 2000). Truly, the economic situation affecting a metro area has an effect on home appreciation regardless of the LRT access.

Implementation of a New Transit Station

Even though the economy holds sway over home values and home appreciation, it bears watching what the effect of the announcement, construction and general speculative anticipation of a light rail station can have on these same property values. Transit systems take shape in

several stages: route selection, site selection, clearance and displacement, construction, early operation, and mature operation. The timing of impact is to be fairly measured and this measurement used to determine financing for transit projects. Speculative activity may begin well before construction of a new system (Gatzlaff & Smith, 1993). However, research fails to explain the causality of an LRT station opening on property value (Kim, 2008) or basically it does not necessary follow that if land prices jump once a rail service begins that transit *caused* this appreciation (Cervero & Duncan, 2002). Spikes in land values could be attributable to other factors, like an upswing in the regional economy, improved highway conditions, or better schools (Cervero & Duncan, 2002). There is enough data to suggest that the implementation of a new light rail station could inflate the prices of nearby residential parcels in anticipation of increased accessibility.

The Hiawatha Line study (Minneapolis-St. Paul) conducted by Kent and Parilla examined the effect on SFR near seven of seventeen new light rail stations in 2004 in the city (Kent & Parilla, 2007). They compared EMVs from 2003-2006 to a comparison period spanning 1997-2000. Working with straight-line distance, they used a buffer system to classify parcels as being a half-mile, half-to-one mile, a mile, or two miles from a station stop (Kent & Parilla, 2007). The study found a similar appreciation rate inside and outside the half-mile buffer (Kent & Parilla, 2007). They found that after the stop (2003-2006) that the mean EMV of parcels within the half-mile buffer experience a significantly larger increase in mean EMV across all time periods (Kent & Parilla, 2007). The mean EMV within the half-mile buffer were consistently valued higher than outlying parcels. However when considering the percentage change in EMV, the parcels outside the half mile buffer appreciate significantly *more* than those within (Kent & Parilla, 2007). That suggests that the Hiawatha Line had no effect on EMV for homes close to

the light rail; higher income neighborhoods with more desirable amenities may explain the disparity.

Gatzlaff and Smith conducted a similar study in Miami in 1993. The study used sales of homes, known as repeat sales analysis, through tax records and only included homes that were sold between 1971 and 1990 near Miami's Metrorail, which differs from Portland's LRT in that it is commuter rail (Gatzlaff & Smith, 1993). This study also differs because it examined the effect of the implementation of a new station, whereas many studies tend to examine data after the fact. The study concluded that at best there was a limited positive effect on a new rail station in proximate residential areas. The study is significant in that the study used repeat sales analysis to highlight the differences of appreciation rates of homes in proximity to commuter rail stops and the median home price in Miami. Between 1978 and 1981, the study showed a "station index (average home) [appreciates] at a slightly faster [rate] than the county price index…and may be suggestive of an announcement effect" (Gatzlaff & Smith, 1993). In 1981, Gatzlaff identified "the appreciation of properties proximate Metrorail station locations is substantially below that of the MSA" (Gatzlaff & Smith, 1993). This implies that commuter rail transit could be a nuisance--that is have a negative effect on SFR property value-- and is often cited as one of the few studies to do so.

Negative Externalities Affect Property Value

As shown in Gatzlaff's 1981 research, there are potential "nuisance" factors that can drag down a home's value. Is the house near a busy highway or heavy industrial uses? Perhaps the home is a high crime area, or surrounded by abandoned homes? The negative externalities can lower home values or slow home appreciation rates for the same exact home – in a different area. Al-Mosaind delved into these negative externalities that include noise, increased pedestrian and automobile traffic near the station, attraction of undesirable groups to neighborhoods, and the

disruption and noise associated with the construction of such stations (Al-Mosaind, Dueker, & Strathman, 1993). Al-Mosaind concluded that "net positive impacts could be observed if the market viewed improved accessibility more as a benefit than a nuisance"(Al-Mosaind, Dueker, & Strathman, 1993). Diaz wrote a comprehensive paper that summarized twelve rail projects including both light and heavy rail in North America and found that some studies show that proximity to industrial uses or highway facilities may limit the extent to which property values are increased (Diaz, 2001).

In a study done on Atlanta, properties within a quarter of a mile from a rail station were found to sell for 19 percent less than properties beyond three miles from a station. However, properties that were between one and three miles from a station had a significantly higher value compared to those farther away. These results suggest that houses that are very close to stations are affected by negative externalities, but those at an intermediate distance are beyond the externality effects and benefit from the transportation access provided by the stations (Bowes & Ihlanfeldt, 2001). The researchers indicated "that [rail transit] affirms the possibility that rail stations may affect property values indirectly by increasing crime or retail activity within the neighborhood" (Bowes & Ihlanfeldt, 2001).

There are many reasons for the results--first of all, commuter rail is noisier and creates more pollution that light rail. The second, and perhaps more important, is that in Miami the Metrorail was not implemented in a centralized corridor and had no discernible developmental impact around the stations indicating the rail had little effect on accessibility (Gatzlaff & Smith, 1993). Cervero and Duncan found that land-value premiums only accrued to single-family housing units within a half -mile of rail stations on two corridors, and that they generally fell within half-mile ring of stations on other corridors (Cervero & Duncan, 2002). This study also

found that being near commuter-rail stops in the wealthier areas tended to depress multi-family real-estate prices. That same study found that multi-family housing in areas closer to the CBD accrued higher capitalization benefits (Cervero & Duncan, 2002). This same study found that depending on whether the units were for-sale or rental units there was a value-added of some $85,000 per condominium in the richer North County corridor—the same corridor that conferred negative effects on commercial parcels. These results were echoed in Nelson's 1992 commuter rail in Atlanta study (MARTA) study, using sales prices, he found that rail transit proximity increased in low-income neighborhoods but decreased in high-income neighborhoods (Nelson A. C., 1992). A MARTA study in by Bowes and Ihlanfeldt (2001) found that properties decreased by 19 percent within a quarter-mile compared to properties beyond three miles (Bowes & Ihlanfeldt, 2001).

LRT Effect on Commercial Properties

Studies on light rail systems effect on commercial properties are scarce (Cervero & Duncan, 2001). A study of the DART system compared differences in land values of loosely matched pairs of "comparable" retail and office properties near and not near LRT stations (Weinstein & Clower, 2002). The average percentage change in land values from 1994 to 1998 for retail and office properties near DART stops was 36.8 percent and 13.9 percent (Weinstein & Clower, 2002). Examining the same area, Weinberger, in 2000, conducted a study examining the relationship and found while properties within one-half mile to a station commanded a premium, properties that were one-quarter to one-half mile commanded an even higher premium (Weinberger, 2000). Seeking to improve on this work, Cervero and Duncan conducted a study on the effect of rail transit on commercial properties in Santa Clara County, California (Cervero & Duncan, 2001).Santa Clara County has both commuter and LRT in its system; both were examined. Using the quarter-mile distance settings, it was found that the capitalization benefits

near LRT were around per square foot, smaller than those associated with commuter rail in business districts (Cervero & Duncan, 2001). These findings also reinforce the effect transit has on more intense land uses as opposed to lower density uses such as SFR.

Conclusion of Previous Studies

In summary, Table 3-1 highlights some of the previous studies that have been conducted examining the effect LRT proximity on property values. The effect of LRT on property value is an inconsistent picture. While this thesis examines yearly home appreciation, fewer studies dealt with that aspect specifically. Referring to Table 3-5, the Dallas study that dealt with land value appreciation found that from 1997-2001 residential parcels within walking distance did appreciate more than the parcels that were outside the buffer.

Proximity to a LRT station can have an effect on property values, residential or commercial—be it positive or negative. Von Thunen, were he alive today, would point to the proximity as a methodto decrease transportation costs. Some studies indicating a contradiction to Von Thunen would point to the decreased desirability of living next to LRT due to the negative externalities (noise, pollution) of rail transport. Generally the literature found that the LRT correlation is strongest and most positive among residential parcels. Based on the literature, MFR has shown to have greater benefits than SFR. Other forms of rail transit also had positive effects on residential land as well. Although LRT's effect on commercial land was also a mixed picture, there were cases of a positive correlation as well. The implementation of a new LRT station may cause an unsustainable temporary spike in adjacent SFR values. A new resident may gladly pay extra for a home near LRT for increased accessibility to employment locations, entertainment, recreation, and other amenities. Because of increased accessibility to these places, landowners seeking to rent homes may bid up those properties and capitalize those benefits into the price of the property (Hess & Almeida, 2006).

For this study's purposes access to LRT does not actually guarantee land valuation appreciation just as building a LRT doesn't guarantee successful ridership. Both are dependent on a bundle of factors that are out of the realm of human control. The following section will highlight characteristics that attract LRT ridership: multimodal integration, intensity of land use, density of residential population, parking and auto dependence, area climate, as well as the area's physical and economic characteristics.

Attracting LRT Ridership

To maximize land valuation benefits of proximity to an LRT, the LRT must be utilized by the public it is intended to serve. Certain characteristics of a region can determine how utilized a city's LRT system will be. Those factors include multimodal integration, land use, land density, physical and economic characteristics, levels of transit service, area climate, and the public's perception towards transit in general. All these factors often are apparent in successful transit systems around the world. The assumption for this thesis is that the more riders on an LRT, the more likely homes are to benefit from increased values by being near an LRT. The following section seeks to clarify that LRT will not be successful by itself; it needs a few complimentary factors and/or situations to ensure highest possible patronage. The most important of these is density-- without density; it is unlikely that any LRT would be successful. The rest of this section reads much like a checklist for transportation planners who are inquiring about their LRT's systems lack of ridership. The purpose of this section is to underline the reasons for LRT's success stories, and they particularly apply to Portland, Oregon.

Multimodal Integration

It is apparent that no successful city transit system only relies on one form of transit. For a successful transit system, the many different forms of transit must be accessible and integrated (Calthorpe & Fulton, 2001). A transit center or hub is an area that has one or more accessible

connections to bus, BRT, commuter rail, light rail, heavy rail, air traffic, ferryboat, pedestrian and bicycle ways in a specific location. This would seem to indicate to lead to an increase in LRT use (as well every other mode) because the accessibility and mobility is enhanced (Kuby, Barranda, & Upchurch, 2004). With multimodal integration, pedestrian, bicycle, or bus trips are easily integrated and accessed from an LRT access point.

Intensity of Land Use Around Stations

Von Thunen's location theory established that all things being equal land values are derived from transportation savings the location of the land offers. Regardless of mode, the early economic geographers were correct when offering that the pull of the CBD would establish valuation based on distance from downtown. The most intense land use and highest densities in this country occur in New York City. A mix of residential and commercial land use is most desirable for the areas adjacent to an LRT station. Within compact urban regions, transit service in corridors that contain a variety of residential and non-residential activities will prove especially attractive and competitive (Parsons Brickenhoff Quade and Douglas, Cambridge Systematics, 1996). The ability to serve people's daily trips to work and home separate the LRT successes from the not so successful.

Density of Population around Stations

Density follows suit in the aspect that high density residential is optimum for TODs as well as high-density employment centers. Density could very well be the most important factor for transit success—the more trips made per mile the more the need for alternative forms of transport. Light rail needs density to succeed. Pushkarev and Zupan note that nine dwelling units/acre is the minimum residential density for a light rail system (Puhskarev & Zupan, 1982). The most successful transit systems are metropolitan areas with high density. Density and land use are intertwined because as density increases, land use intensifies. As land use intensifies,

there is potentially a need for a more intense form of rail transit. Pushkarev and Zupan recommended that if a LRT has five-minute peak headways then nine dwelling units per acre are required through a 25-100 square-mile corridor (Puhskarev& Zupan, 1982).

Generally density around LRT stops will be apparent because of the nature of utility maximization—this can be illustrated in the growth of multi-use TOD. The physical characteristics also can enable higher density of settlement as well as affect land values positively.

Parking

As mentioned earlier, auto access has limited capitalization effects on property values. However, park and ride access also enhances transit ridership by making stops more accessible (Litman, 2008b). Some may suspect auto use does not promote and in fact discourages transit ridership. Kuby noted in *Factors Influencing Light-Rail Boardings in the United States,* the two intermodal variables—number of bus connections and number of park-and-ride spaces—are both significant at the 0.001-level…[b]oth have positive b-coefficients that make a good deal of sense.

Each additional bus route intersecting with a station yields 123 weekday boardings, while each additional park-and-ride space nets 0.77 boardings"(Kuby, Barranda, & Upchurch, 2004). Parking is indeed a crucial issue for many who use a combination of auto and transit commuting, especially. The balance between too much and not enough parking, as well as whether to charge for parking in attempt to stimulate ridership numbers-- is a challenge for transportation/transit planners (Litman, 2008b). To summarize, park-and-ride lots can help increase ridership while removing people from their automobiles.

Levels of Service and Connectivity

A good transit system is typically characterized by good Level of Service grades. Level of Service (LOS) refers to how well transit serves the passenger's needs of length of service and

frequency of service. Examine Tables 3-2 and 3-3; these two aspects of transit length and frequency of service are designed with the passenger in mind. The more convenient the service is the higher the grade. Systems that do not run very often or very long typically may not capture potential ridership as well as systems who score high in these areas.

Connectivity refers to the ease as well as the number of connections between transit modes (Wilbur Smith Associates, et al., 2006). Connectivity is strengthened if the different transit modes schedules are coordinated (Wilbur Smith Associates, et al., 2006). For example if a home-to-work trip requires a bus to light rail transfer, then it requires the trip maker to coordinate the trip. To continue the example if the LRT has thirty minute headways, the rider needs the bus to arrive before the LRT departs. The schedule should provide some leeway—if the bus arrives at the same time the LRT departs then the rider does not have time to make the transfer. Shorter headways (less time between bus/rail arrivals) make the connectivity issue less important than say, hour-long headways where missing the train results in intolerable delays (Wilbur Smith Associates, et al., 2006). To conclude, the connectivity of transit systems requires schedule coordination--which is only possible if service runs on time (Wilbur Smith Associates, et al., 2006). Reliability matters--if the transit is repeatedly late and/or misses connections--riders will seek alternatives and likely return to their cars (Wilbur Smith Associates, et al., 2006).

However if the LRT does not connect people to where they need to go, then more frequent headways alone will not increase LRT ridership. Major destinations such as airports, employment centers, entertainment areas and riders homes should be connected, if not LRT ridership may suffer (Wilbur Smith Associates, et al., 2006). Does the LRT go where people need to go? Does it offer a reasonable choice to car or bus? A 1996 study used a cross-sectional regression analysis of station-level data to study land use characteristics that make a corridor

conducive to light rail (Parsons Brickenhoff Quade and Douglas, Cambridge Systematics, 1996). They combined data from 261 stations on 19 lines in 11 metropolitan areas, and their dependent variable, daily station boardings (Parsons Brickenhoff Quade and Douglas, Cambridge Systematics, 1996). They found that "In the future, as cities continue to evolve toward multiple centers, transit systems that link the CBD with sub regional employment centers will be especially cost-effective, offering opportunities for two-direction flows at all times of the day" (Parsons Brickenhoff Quade and Douglas, Cambridge Systematics, 1996). Portland's three (soon to be four) light rail lines connect major destinations in the area and exhibit a regional connectivity that services the suburbs (TriMet, 2008).

Area Climate

Transit ridership depends on many factors, some of which are beyond the realm of human control. An area's climate is another strong indicator of LRT ridership (Kuby, Barranda, & Upchurch, 2004). Perhaps the most important predictor of transit success is a temperate climate in which the rider feels comfortable waiting for transit. A 2002 study found that degree-days carried a negative coefficient of -1.52, meaning that more extreme temperatures discourage LRT ridership (Kuby, Barranda, & Upchurch, 2004). Cities blessed with temperate climates, such as San Diego, can expect up to 300 more boardings- per-station than average (Kuby, Barranda, & Upchurch, 2004). Cities like Buffalo, Cleveland and Salt Lake City which experience more extreme temperatures would see boardings at each station reduced by a similar amount (Kuby, Barranda, & Upchurch, 2004). Kuby also states that cities with extreme climates like Phoenix and Minneapolis "should not expect to match the ridership of more mild cities, where walking and waiting for transit is more comfortable…furthermore they should build covered waiting areas if they hope to mitigate this effect" (Kuby, Barranda, & Upchurch, 2004). Given the nature of the Sunbelt LRT expansion, planners would hopefully take notice of the preceding study. Is it

a coincidence, at least in this country, that warmer climate cities are also some of our most auto-dependent?

Auto Dependence

Cities that have large patronage of transit are more suitable for rail transit than auto centered cities such as Miami or Los Angeles (Mackett & Sutcliffe, 2003). A study conducted by Mackett indicated that Miami was particularly unsuitable for large transit patronage due to its auto-centered nature. Mackett constructed a table that highlighted factors conducive to a city having successful commuter rail ridership. Miami also scored low in terms of the collective public attitude towards public transit. American cities consistently scored lower than their counterparts in Canada and the United Kingdom (Mackett & Sutcliffe, 2003). In Cockerill and Stanley's (2002) meta-analysis on light rail's effect on property values, they found "[a]uthors of studies in both Miami and Dallas, where the effects of residential properties were actually negative, suggest that the "car culture" of these cities has limited public enthusiasm for light rail and thus dampened property value impacts" thus illustrating the correlation between car use and public perception of transit (Cockerill & Stanley, 2002).

Public Perception of Transit

In general, cities that have a positive image of public transport are more likely to patronize light rail than cities where the public perception of transit is of criminal activity (Mackett & Sutcliffe, 2003). The image of public transport, which is based on socioeconomic factors, such as adverse effects of the route alignment on a particular community can hinder that success of LRT (Mackett & Sutcliffe, 2003). The most important predictor of LRT ridership may be public willingness to use the transit system-- that willingness is a predictor and an outcome since the factors reciprocate ridership, and higher ridership paints a more positive picture of the transit system (Taylor & Fink, 2002).

The attitude of the city's populace can go a long way in determining a region's utilization of a transit system--a rapidly growing area can still have a virtually non-existent transit system. Auto centered cities such as Miami, Houston, and Atlanta may provide special challenges for transit providers (Mackett & Sutcliffe, 2003). These cities are known for their auto-centered nature and traffic congestion (INRIX, 2006). The Mackett study highlighted Miami's auto-centered nature—an attitude that lends itself toward a different collective public attitude toward transit, and perhaps living in close proximity to a transit station (Mackett & Sutcliffe, 2003).

While it is difficult to quantify the public attitude and transit ridership correlation, there have been studies on the characteristics of rail riders. A recent study of TOD dwellers found that rail riders are more physically active than non-riders (Brown & Weiner, 2009). The same study also revealed that rail riders walk more, use their cars less, and have a lower prevalence of obesity than non-riders (Brown & Weiner, 2009). There is a considerable amount of evidence supporting a theme of transit reinforcing transit patronage—as more people "buy in" to using transit the improved attitudes may spur expansion and system growth.

Conclusion

The previous section highlighted characteristics that attract LRT ridership: multimodal integration, intensity of land use, density of residential population, parking and auto dependence, area climate, as well as the area's public perception of transit. While these characteristics are enablers they do not alone guarantee successful LRT-- they tend to be present in areas with high transit use. If we examine our larger cities with mature, well utilized transit systems one likely finds a combination of these factors working together. Of course there is a great deal of debate about the actual benefits of light rail, as well as debates about the cost efficiency of transit in general. The next section discusses literature that refutes the aims and benefits of LRT. The following section an evaluation of LRT criticisms will highlight the arguments against LRT

expansions. A discussion on how Portland exhibits many of the LRT ridership attraction factors will explain why Portland was an ideal choice for the study.

Criticisms Made About LRT

This section presents arguments refuting the claims that LRT proponents make about LRT. Advocates of LRT will argue that LRT is safe, quiet, promotes economic development and most importantly counteract the negative externalities of auto-use (congestion, sprawl, pollution, reliance on fossil fuel). Critics of transit may use literature that equivocate transit expansions with negative externalities --higher crime and lower property values in order to defeat plans at the ballot box. These attitudes may be illustrated in referendum votes that vote against rail expansions (Mackett & Sutcliffe, 2003). City residents may not see the value of transit because it does not achieve projected ridership, economic benefits or is too costly. Critics have countered proponents' claims that LRT will automatically decrease congestion, reduce sprawl and increase density (O'Toole, 2004).

Roads, Like Transit, Are Not Free

Some critics of LRT contend that transit does not work; a repeated criticism is that it does not pay for itself (O'Toole, 2004). While most transit systems do not make money, some would argue that roads do not pay for themselves either (Litman, 2008a). To counter, some would argue a majority of transit is subsidized from taxes, just as other services like police, fire, and schools are. Given the thousands of public transportation agencies in the country, the consensus may be transit is a needed service that the taxpayer may rely on directly or indirectly (American Public Transportation Association, 2008).

Transit, and rail transit in particular, are often criticized because they do not pay for themselves; it is true that these systems are heavily subsidized by taxpayer money. The fare does not cover the full cost, just as the gallon of gas cost does not cover the full cost of driving. Do

we ever ask the road to pay for itself? The road is just as subsidized as transit, perhaps more so when referring to expressways that do not collect tolls.

Some critics advocate sacrificing multimodal accessibility for more highways (O'Toole, 2004). While many agree on the need for alternative modes of transport, Randall O'Toole supports less public expenditure for transit and more money for highways. The studies O'Toole offers tend to present data on how driving a car is less costly per passenger mile than LRT or bus (Holahan, 2008). This line of argument would assume we pay the full cost of driving. The costs of road maintenance, time lost to traffic congestion, and the costs of pollution are not included in the price per gallon-- costs that are absorbed by the taxpayers and the natural environment. Do we ask schools or courthouses to pay for themselves? The roads we drive on, with the exception of tolls roads are likely subsidized more so than transit.

In 2006, the State of Texas was actively pursuing a massive new transportation initiative called the Trans-Texas Corridor, which had toll highways as a major project component. As part of the project's analysis, the Texas DOT examined the issue of whether or not "free" roads pay for themselves. Their conclusion, shared in the newsletter *Keep Texas Moving* is that "no road pays for itself in gas taxes and fees" (Texas Department of Transportation, 2006). The newsletter cited State Highway 99 will cost $1 billion to build and maintain over its 40 year life cycle, but only generate $162 million in gas tax revenue during this same timeframe (Texas Department of Transportation, 2006). According to these calculations, it would take almost 250 years for State Highway 99 to generate enough gas tax revenue to pay for itself. This article severely weakens a favorite argument against transit subsidies.

Critics: LRT Does Not Decrease Congestion

It is still not clear if LRT decreases congestion**.** The studies show that light rail could actually *increase* congestion due to the delays that occur at LRT at-grade intersections (Litman,

2008a). Chandler and Noel did a simulation and found “the results of the simulated test scenarios indicate that the average additional delays from LRT crossings increase with increasing light rail crossing frequencies and increasing traffic volumes up to the roadway’s capacity-…as the road enters an over saturated condition, the average total delays continue to increase”(Chandler & Noel, 2004).

The Chandler article describes how LRT can actually *increase* congestion. The Chandler and Noel study also states that within a complex city roadway system, “that the change in delay is also dependent on the degree of coordination and preemption of traffic signals within the network (Chandler & Noel, 2004). If traffic signals are set to allow no conflicting phases to proceed during LRT crossings, an average travel time savings could result”(Chandler & Noel, 2004). These developments point to the possible benefits coordination between regional government and good transportation planning lending itself to an efficient LRT.

Does light rail use decrease congestion? By encouraging people to relocate downtown, it would follow that more destination options not requiring auto use are available to those same people. One could also contend that increased LRT use should get people out of their vehicles. Does light rail actually get people out of their cars? Dueker and Bianco (1999) indicated in a study comparing two corridors, bus and rail, that actually saw an increase toward more two-car households and a loss of zero and one-car households (Dueker & Bianco, 1999). Both shifts were detrimental to transit ridership and LRT "was not reversing the trend of increased auto availability in the inner portion of the study area"(Dueker & Bianco, 1999). This study compared the bus/rail modes within an inner portion of a corridor to bus/rail within the outer portion in terms of increasing zero and one-vehicle households. The reasoning stands that an increase in zero car households naturally lends itself to less congestion. The study showed that the bus

corridor showed an overall slight decrease in zero and one-vehicle households whereas the rail corridor showed a slight increase (Dueker & Bianco, 1999). The study results were promising; it indicated that multiple-vehicle ownership had stabilized in the outer corridors (Dueker & Bianco, 1999). While not entirely refuting the criticisms of LRT not decreasing auto dependence, the outer corridors had stabilized which indicates LRT's sprawl-reducing tendencies.

Criticism: LRT does not Reduce Sprawl nor Increase Density

Like the Knight and Trygg study, many planning experts agree that transit can influence the where and how development occurs. A more relevant thought is what types of development is occurring around LRT stations. Outlying stations can have the inadvertent affect of actually increasing sprawl (Handy, 2005). Handy asserts that transit systems impact development in two ways, just as highways do: by reducing transportation costs and by changing relative accessibilities (Handy, 2005). First, if a transit system reduces travel times, it may enable residents to live farther out, thereby increasing rather than decreasing sprawl (Handy, 2005). This idea would have merit if it were easily illustrated. However, most new light rail systems are designed to serve areas of existing development and may have little impact on travel times (Handy, 2005).This effect can help to increase ridership and may serve as a catalyst for redevelopment in selected areas.

Criticism: LRT Only Redistributes Growth, Not Create It

In addition, by reducing transportation costs, a transit system might increase overall development in the region, leading to a net gain for the region (though probably at the expense of some other region) – a "generative" impact (Handy, 2005). This finding implies that LRT while decreasing transportation costs does not actually decrease development, just redistribute it (Handy, 2005). This finding was echoed in a 1995 report from the TCRP concluded "urban rail transit investments rarely 'create' new growth, but more typically redistribute growth that would

have taken place without the investment (Huang, 1996). This is a potentially potent charge because many transit advocates argue that the economic benefits are one of the main reasons to continue to expand systems.

Redistributive theory, thus suggests that transit systems may have conflicting effects on development patterns, encouraging sprawl in some ways and acting as a counterforce to sprawl in others (Handy, 2005). In determining the net effect of transit, it is difficult to separate out the effect of transit from the other forces influencing the amount and location of development in a region. Despite this challenge, the impacts on development of transit systems-- particularly rail rapid transit systems and light rail have been evaluated and summarized by a number of researchers (Handy, 2005). Table 3-1 refers to major studies that occurred in the last few decades. Many of these systems rank among the more successful LRT systems and they might credit an increased regional vision in their long-range transportation plans.

Conclusion

The best-laid LRT expansion plan may not necessarily enhance an LRT ridership--land use, zoning, crime prevention are all things that must be compatible. The critics are often eager to repudiate any perceived benefit from LRT, no matter how many studies highlight there being a positive correlation. Garrett (2004) suggests that policymakers should consider why economic development is not taking place in a certain area:

> The general consensus from the academic literature and the findings presented in this report is that light rail is not a catalyst for economic development, but rather light rail can help guide economic development. Rather than relying solely on light rail to create economic development, city planners and officials should first address a key question: Why is economic development not occurring in a given area in the first place? Possible reasons include relatively high cost to business start-ups, unattractive locations (crime, poor infrastructure) and unnecessary zoning and regulations. Unless these barriers are lowered or removed, the long-run economic development objectives, with or without light rail will not be fully met.
>
> (Garrett, 2004)

As Garrett warns, each of these things must work in concert as LRT is not normally a big enough motor to spur development on its own. Cities that have recently put in an LRT tend to se slow ridership in their formative years (American Public Transportation Association, 2008). Critics of LRT have studies to enforce their claims that LRT does not reduce congestion, reduce sprawl or have any real effect on land use and/or land density. There are studies in the literature review that critics of LRT would cite as proving a lack of economic benefits that transit systems actually confer. The critics led by O'Toole also have presented data on how LRT is too costly and how roads are cheaper. What the critics of LRT fail to mention is that roads are just as if not more expensive and the associated costs (environment) may actually multiply costs in the future.

Generally the public's attitude toward and willingness to support transit has shown to be possibly just as important as density, physical and/or economic elements of a metropolitan area (Mackett & Sutcliffe, 2003). Still the economic valuation promise of LRT attracts new TOD plans, new construction and new opportunities for LRT expansion as evidenced by the studies of the last twenty years.

Table 3-1. Composite of studies: Effects of light rail proximity to property values

City, region(s) transit system, author(s)	Property value data source	Access measurement	Findings: effect of proximity to rail transit on property value or average home price
Dallas, Texas (DART) Weinstein and Clower, 2002	Assessed value (Dallas County Central Appraisal District)	Straight line distance to station, one-quarter mile from station, compared with properties located in the control group	Property value increased 32 percent near DART stations compared with 20 percent in control group areas not served by rail
Portland, Oregon (Eastside MAX) Chen et al., 1998	Sales prices (RLIS Lite and Metroscan)	Straight-line distance to station one km radius	Property value decreased $32.20 per meter further from station beginning at a distance of 100 meters from station
Portland, Oregon (Eastside MAX) Lewis-Workman and Brod, 1997	Assessed value (city property tax rolls)	Network distance to station, one mile radius	Property value increased $76 for every 100 feet closer (within a one-half to one mile radius) to three stations that were studied
Portland, Oregon (Eastside MAX) Al-Mosaind et al., 1993	Sales prices	Distance rings based on walking One km radius (Model 1) Network distance to station One-half km radius (Model 2)	Property values were $4.32 higher within the 500 meters than outside the 500 meter radius (Model 1) Property value decreased $2175 for every 100 meters further from station (Model 2)
Sacramento, California (Sacramento Light Rail) Landis et al., 1995	Sales prices (TRW-REDI data services)	Network distance to station All property transactions in the city	No statistically significant effect on home prices
San Jose, California (San Jose Light Rail) Landis et al., 1995	Sales prices (TRW-REDI data services	Network distance to station All property transactions in the city	Property value decreased $197 for every 100 meters closer to station Effect may be due to commercial and industrial uses

Adapted from Hess & Almeida: *Impact of Proximity to Light Rail Transit on Station-Area Property Values in Buffalo, New York*, 2006.

Table 3-2. Transit (fixed route) service frequency level of service measurements

LOS	Avg. Headway (min)	veh/h	Comments
A	<10	>6	Passengers do not need schedules
B	10-14	5-6	Frequent service, passengers consult schedules
C	15-20	3-4	Maximum desirable time to wait if bus/train missed
D	21-30	2	Service unattractive to choice riders
E	31-60	1	Service available during the hour
F	>60	<1	Service unattractive to all riders

Source: *Transit Capacity and Quality of Service Manual*, Second Edition, Transportation Research Board, Washington, DC, 2003.

Table 3-3. Transit (fixed route) hours of service level of service measurements

LOS	Hours of Service	Comments
A	19-24	Night or "owl" service provided
B	17-18	Late evening service provided
C	14-16	Early evening service provided
D	12-13	Daytime service provided
E	4-11	Peak hour service only or limited midday service
F	0-3	Very limited or no service

Source: *Transit Capacity and Quality of Service Manual*, Second Edition, Transportation Research Board, Washington, DC, 2003.

Table 3-4. Operating cost per mile by transit mode and cost increase of selected transit modes in the United States, 2000-2007.

Mode	Operating cost per mile, 2000	Operating cost per mile, 2007	Percentage increase
Light rail	$ 0.45	$ 0.60	33.3%
Bus	$ 0.59	$ 0.80	35.5%
Heavy rail	$ 0.28	$ 0.40	42.9%
Commuter rail	$ 0.29	$ 0.40	37.9%

Source: American Public Transportation Association. (2008). *2008 Fact Book.*

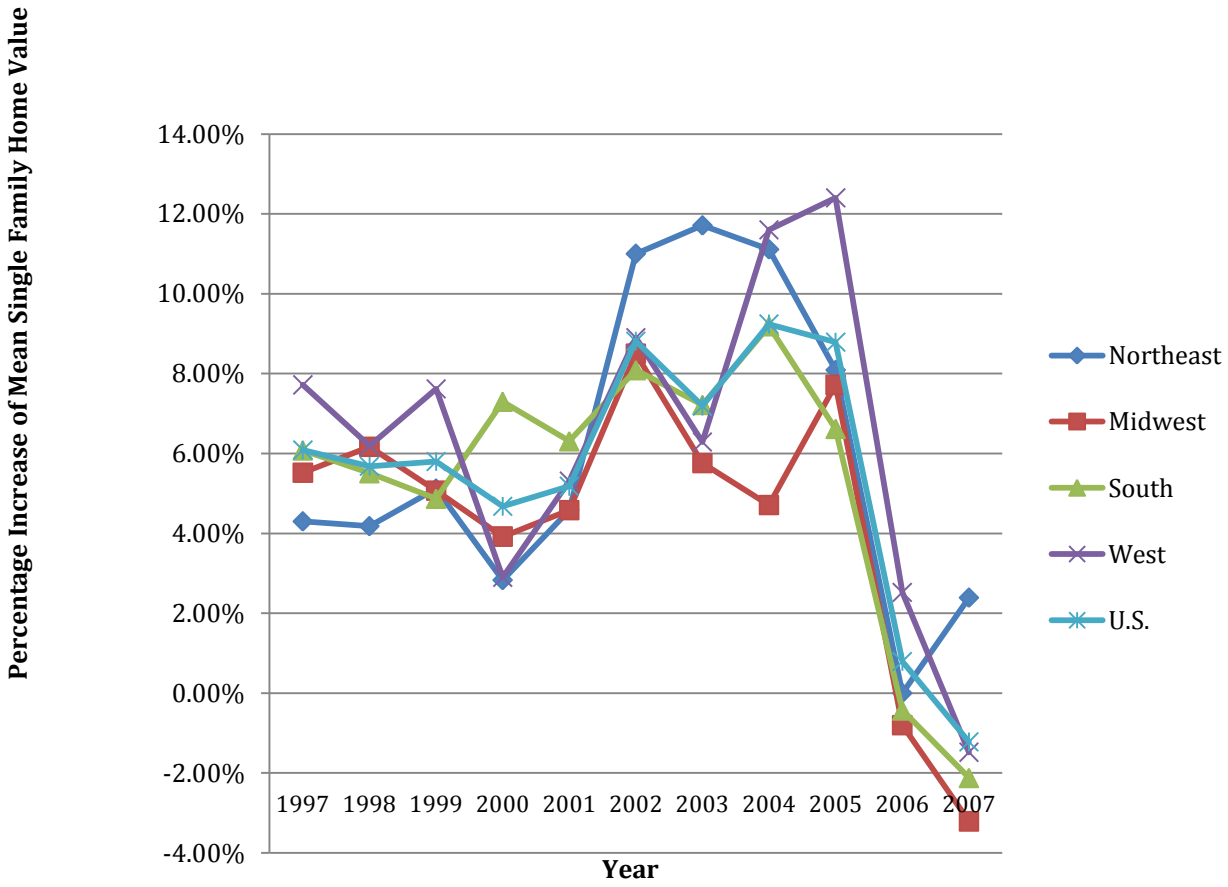

Figure 3-1. Percentage increase in mean sales price of existing single-family residential units in United States by region, 1997-2007.

Source: National Association of Realtors, 2008
Note: Data reflects U.S. and regional statistics for re-sale of existing homes and excludes new construction. Not seasonally adjusted for inflation.

Table 3-5. Rail route mileage and status of selected future rail projects in United States, 2006

Mode	Construction	Design	Open	Planning	Proposed	Total
Light rail	190.2	58.8	706.3	511.3	300.0	1,766.8
Commuter rail	126.7	118.1	4,265.7	969.3	885.6	6,365.4
Heavy rail	n/a	n/a	1,303.8	93.8	102.6	1,500.2

2008 Public Transportation Fact Book

Source: APTA *Transit Infrastructure Database*.

(a) Data as of September 2006.

Table 3-6. Land value appreciation by land type near light rail stops in Dallas, Texas, 1997-2001

	Residential	Retail	Office	Industrial
Inside ¼ mile buffer	**32.1%**	28.3%	24.7%	13.0%
Outside ¼ mile buffer	19.5%	30.4%	11.5%	21.5%

Source: Weinstein, B., and Clower, T. (2002) *An Assessment of the DART LRT on Taxable Property Valuations and Transit-Oriented Development*.

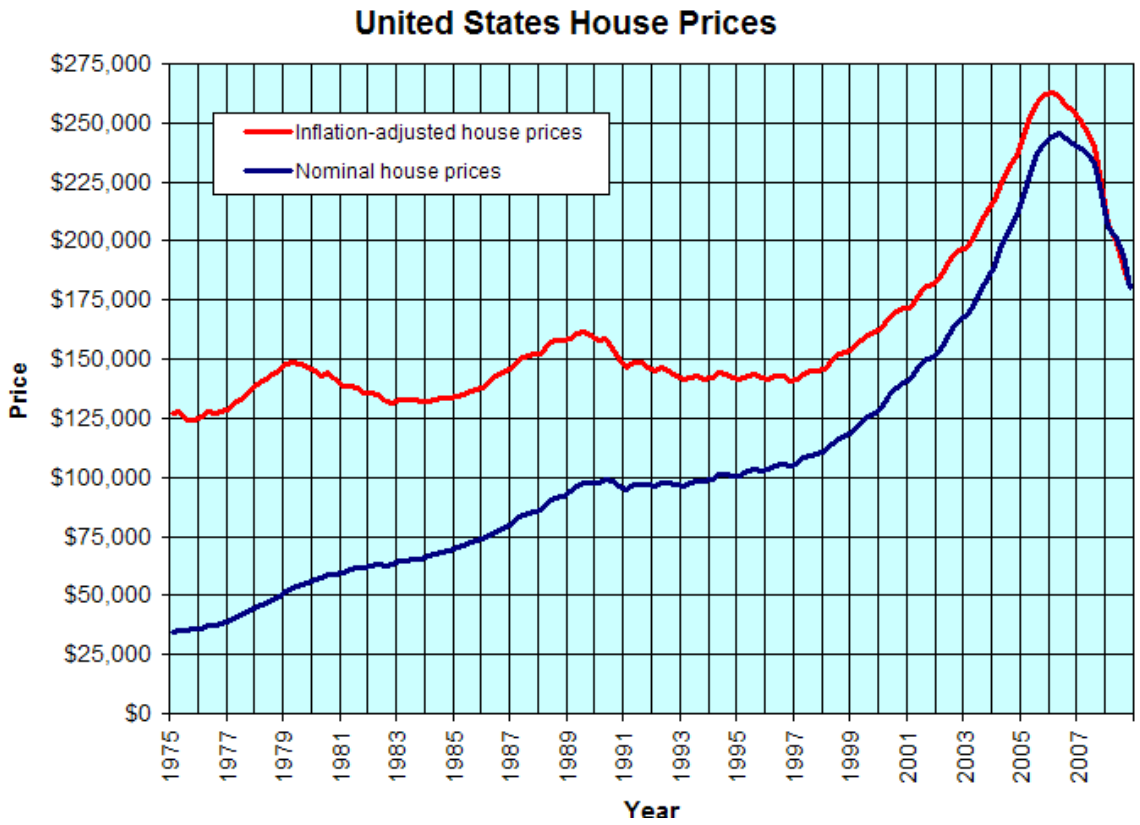

Figure 3-2. U.S Median Home Prices 1975-2009, (adjusted for inflation)

Source: National Association of Realtors, 2009.

CHAPTER 4
METHODOLOGY

The first chapter illustrated the benefits of LRT and why it is important, and the next chapter provided information on what LRT is and what it is not--as well as insight on factors that affect home prices. The third chapter reviews previous research on the land value-transit access correlation. This fourth chapter will examine the why and the how of the data collection process. It is important with any study of this nature to compare "apples to apples" which highlights our decisions to only examine SFR-detached, only examine properties that have been improved for the whole of the study years and to divide values by the square feet of the home.

This is an examination of Portland, Oregon --a city considered a planning success story--using a combination of collection and examination methodologies. The objective was to examine the ten year period set of RMV appreciation for SFR in different scenarios. Five neighborhoods were carefully chosen to reflect different LRT scenarios whose results (home appreciation) could be compared. The scenarios are existing LRT, new LRT, and no LRT compared in low-income versus high-income study areas.

Why Study Portland?

Urban planners have long known that a transportation system has a role in fostering growth and affecting the urban structure. Investments in improved transit are the subject of much debate among policymakers and planners, especially at the local level. Portland has an advantage over many other metro areas in this country because of the nature of its UGB. Portland's UGB contains would-be sprawl and may force would-be employment centers to consider locating near a LRT stop more so than say an Atlanta or a Los Angeles, comparatively. Portland's light rail follows many of the major arterials in the city as well as connections to the airport. Many metro areas lack the extensive network that Portland's Light Rail has which points

to the benefit of a regional body making transportation-land use decisions. Portland, Oregon's metropolitan area numbers around two million in population--the 23rd largest metropolitan area--but it ranks fourth in LRT use—right among larger metropolitan areas such as Boston, Los Angeles and San Francisco (American Public Transportation Association, 2008). This is noteworthy because Los Angeles and San Francisco are significantly larger and have more mature transit systems. These larger cities are part of a larger rail transit system that utilizes three or more forms of transit mentioned in this study--which is something Portland emulates.

Portland is an ideal city for LRT when examining the factors that stated earlier, some cities lack. Portland operates a downtown trolley and has links to commuter rail both which are integrated with TriMet (TriMet, 2008). These factors contribute to the city's multimodal integration. As of 2008, the most newly constructed form of rail transit in the country and when a mid-sized city ranks fourth in LRT trips it makes any Portland a logical choice for an examination of LRT-proximity and home appreciation correlation (American Public Transportation Association, 2008).

Portland is a relatively unique place for several reasons, all of them directly related to the success of the city's regional style government. The only elected regional government in this country, Portland's regional government, Metro, makes decisions concerning land use and transportation planning that is enforced across county jurisdictions (Marshall, 2001). The local governments in Multnomah, Clackamas and Washington counties have turned over land-use decisions to Metro; they decide what goes where (Marshall, 2001). They (Metro) answer directly to the governor of the state. Metro designed the light rail that is essential to the region. A central element of any regional design must be the balance between them, the ease of connections, and the appropriate land-use complement (Calthorpe & Fulton, 2001). Some policymakers think that

can only be achieved when the regional government has the power to make the decisions affect all jurisdictions within the region. A county or an MPO can make as many proposals and plans as its wants but if those plans are not in coordination with neighboring jurisdictions than its success will be hindered.

Why Examine Single-Family Residential (SFR)?

SFR was used in many previous studies due to the nature of residential land and accessibility. Location theory holds that home prices rise in synch with travel-time savings, thus to the degree transit expedites travel properties near stations should sell for more (Cervero, 1984). It is interesting to note that 2002 studies done by Cervero and Duncan found that light rail conferred the greatest land value benefits to multi-family residential and commercial properties. This is one justification for the research. However, Nelson in 1998 found that rail's influence has been demonstrated more clearly for residential uses than for commercial ones (Parsons Brinckerhoff, 1999). Landis noted three reasons for this problem: (1) a lack of comprehensive and reliable data; (2) a smaller zone of impact that limits the number of observations; and (3) while housing values are determined in the market place, the values of individual corporate transactions may represent only the value of one pair of buyers and sellers (Landis et. al., 1995). It has been theorized that proximity to rail *lines* could have negative effects on property (Gatzlaff & Smith, 1993); a study by Chen did not find any statistically significant nuisance effects (Chen, Rufolo, & Dueker, 1998). Diaz finds "one of the more prominent ways that people understand the value of property is through the price or value of a home or in the rent they pay"(Diaz, 2001). Another reason for examining SFR is that the number of real estate consumers (owners/renters) is greater than for other types of real estate"(Diaz, 2001). All in all, the effects are more acutely felt in the residential sector (Diaz, 2001). Thus the sample size is greater and the market price should be more responsive to changes.

The method chosen is a dollar-per-square-foot method that may present a clearer capitalization effect when comparing LRT scenarios. These studies are important to show a positive connection/economic capitalization benefit correlation of being close to a LRT stop in residential areas.

Dollar-per-Square-Foot Justification

In addition to evaluating percentage change in appreciation values over a ten-year period, this study uses a dollar-per-square-foot method that attempts to combine all SFR square footage to obtain a base dollar-per-square foot. Conversely, analyzing appreciation rates may not account for the different size of tax lots. By combining the sum of single- family home values and dividing them by the sum of square footage, perhaps a more accurate picture of land value before and after can be obtained. The dollar-per-square-foot method was used in Cervero and Duncan's 2001 study to analyze the capitalization effects in of LRT proximity in Santa Clara County (Cervero & Duncan, 2001). Property values are determined, appraised and assessed by various public agencies, namely the city/county property appraiser. Appraisers are licensed professionals who consider many different factors when evaluating a home; they are important to land value studies. Assessed, or taxable, values were used in the studies we examined.

Study Design

The data table looked like:

Address	ID number	Land Use	Rail Line	Square Foot	Case Area/ Name	1997 RMV	1998 RMV
123 Main Street	11223344	SFR	Blue Line	5000	Main Street Station	56000	57500

After these values were determined the particular LRT's stop total square footage is recorded, value F. Then the particular LRT stop's total composite RMV value was tabulated for

the years in question. For example, in 1998, the total Real market Value of all SFR parcels within a ¼ mile buffer of LRT case area C was valued at Y. This Y value is the composite 1998 SFR value of case area C. To be able to compare this number more easily, this potentially large number is divided by the total amount of square footage of case study C. This number equals the dollar-per-square foot value for stop C that year, value K.

Y = $15,000,000 (Total RMV of SFR parcels within case area C for year in question)
F = 1,000,000 (Total Square Footage within case area C for year in question)

$15,000,000/ 1,000,000 = $ 15 dollars (Value per square foot of total SFR parcels for year at stop C)

K = $15

This computation was made for every year 1997 and after, until 2007. The preceding year's dollar-per-square-foot value for each is area was then subtracted from the current year to determined yearly valuation change. These computations were done for every year in question. For example, if *L* is the 1998 per-square-foot value of all SFR parcels for stop C, then subtracting K from L would equal the per-square-foot valuation increase between 1997 and 1998 for stop C. This resulting number would then be divided into K to give the appreciation percentage rates found in the results.

For example say L= $16.50:

($16.50 - $15.00) = $1.50 = Per-square-foot Valuation increase

($1.50 / $15.00) = 10% appreciation rate for stop C between years 1997 and 1998.

The ten percent would represent the aggregate valuation rate of increase all SFR parcels in a ¼ mile buffer area near stop C. This number could then per compared to different stops as well as different time periods. Each year presented a different rate of appreciation. The fluctuating appreciation rates form the statistical basis for the findings later in the study. Again,

this study differs from other in that it examines the singe-family home appreciation value in different scenarios to see whether a long-term affect on property values and light rail proximity have some interdependent relationship. Many studies in this field of planning, as mentioned before, use hedonic and regression models to examine a distance/value relationship inside (or outside) a ¼ mile buffer. Some studies such as Al-Mosaind (1988) examine property values further out as far as two miles away from a LRT station (Al-Mosaind, Dueker, & Strathman, 1993). This study examines the difference in appreciation value percentage in different transit scenarios to see whether appreciation rates are indeed greater in areas within ¼ mile of a LRT station. The ¼ mile buffer (a five minute walk) used in this study is set in preceding studies as the greatest distance people are comfortable/willing to walk to access LRT (Kim, 2008).

A number of the studies mentioned use cross-sectional design with hedonic modeling and they examined various independent (explanatory) variables such as number of rooms and square feet and others to estimate probable property values (Kim 3). Cross-sectional research is a common way of examining how explanatory variables affect dependent variables (Kim 3). Cross studies which began in the latter part of the 20th century, have tended to use models to predict land value impacts given all things being equal (Kim, 2008). However, the most elaborate hedonic model cannot account for all factors (Kim, 2008). The literature does support the general contention that having access to light rail does improve residential values, sometimes improves commercial values and the effect upon industrial is relatively unstudied and unclear.

Case Studies/ LRT Scenarios

There are 44 stops on Portland's MAX. Some stops could not be analyzed due to data limitations on yearly home values. Certain stops were analyzed in this study based on 2007 real market home values in the surrounding area. Case study areas were chosen, based on a contrast between income levels as well as the amount of SFR parcels compared to commercial, industrial

or civic-use parcels. The five case study areas are broken down by income level: Hollywood/42nd Street which is a high income area with existing LRT, Martin Luther King Boulevard and Killingsworth Street which is also a high income area but lacks LRT. Three study areas are defined as low income; Polk and Smith Streets lack transit, the Parkrose/Sumner area has new transit, and East 172nd Street has existing LRT. The "new" designation for Parkrose/Sumner is a unique case to examine the before and after effect of LRT construction, something that has began to be examined.

To study the effect of the proximity of LRT stops on single-family home value appreciation in Portland, the RMV listed on the website www.portlandmaps.com were used. This data was collected by Metro, Portland's regional government, and distributed by RLIS, the regional land information authority. This information is free, although GIS data has a nominal charge. The following variables were collected from the website, and were recorded in accompanying data tables. Another important factor in choosing Portland is that their data is relatively accessible compared to other metros whose property value records are not as easily accessible or detailed. With the RLIS system, the different property parcel information is open for anyone to view.

This study differs from others in that it examines the single-family home appreciation value in different scenarios to see whether a long term affect on property values and light rail proximity have some interdependent relationship. Many studies in this field of planning, as mentioned before use hedonic and regression models to examine a distance/value relationship inside a ¼ mile buffer. Some studies such as Al-Mosaind 1988 study and others examine property values further out as far as two miles away from a light rail station (Al-Mosaind, Dueker, & Strathman, 1993). This study examines the difference in appreciation value

percentage in different transit scenarios to see whether appreciation rates are indeed greater in areas within ¼ mile of a light rail station. The ¼ mile buffer (a five minute walk) used in this study is set in preceding studies as the greatest distance people are comfortable/willing to walk to access LRT(Kim, 2008)

Data Elements

To study the effect of the proximity of LRT stops on single-family home value appreciation in Portland, the RMV listed on the website www.portlandmaps.com were used. This data was collected by Metro, Portland's regional government, and distributed by Regional Land Information System (RLIS), the regional land information authority. This information is free, although obtaining Geographical Information System (GIS) data requires a payment of a nominal fee. The variables in the study design were collected from the website, and were recorded in accompanying data tables. Another important factor in choosing Portland is that their data is relatively accessible compared to other metropolitan areas whose property value records are not as easily accessible or detailed. With the RLIS system, the different property parcel information is open for anyone to view for free.

The next step in the methodology is to identify all light rail stops in Portland that qualified for the parameters of the study. The exact location of the quarter-mile buffer (actual distance) was determined with GIS. GIS was used to join data values to a spatial location. This illustrated what parcels were ¼ mile away (actual distance) as well as which parcels were zoned commercial, industrial or public utility. Utilizing parcel GIS helped determined the buffer zones as they applied to the ¼ mile actual distance from LRT stations.

Unlike some of the previous studies, no dollar amounts in this study were adjusted for inflation. The dollar per square foot method was used as a way to easily compare the different LRT scenarios and as a way to compensate for different sized parcels. Per square foot also

captures the particular density of settlement in the case studies; larger parcels would not be at the same advantage had just property values been examined. The appreciation percentage was then determined from the previous year's dollar per square foot value. GIS was utilized to map all parcels located on/or within a quarter mile (actual distance) of a light rail station. The actual distance was determined via GIS. After parcels are identified via their property appraisal parcel number, real market values were recorded for ten years (1997-2007).

A distinctive aspect of the study is the comparison of SFR appreciation values in low-income and high-income areas per LRT scenario. How does one define a rich or poor area? This was done because there were limitations in the economic analysis provided by the U.S. Census based on zip codes--given that stops tended to have more than one zip code contained in a ¼ mile distance in any given direction. The Census was used to determine generally where lower income areas were, however home values tended to not be consistent with this method. It was thought that the areas chosen would be determined based on home values, per RLIS data. Scenarios in this study are defined as "Existing" LRT being area near an LRT stop built before 1997. "New" LRT is defined as an LRT stop built within 1997-2007, the time period of the study. "No LRT" is defined as an area that is not within a quarter-mile buffer of an LRT stop.

Data Exclusions

Which stops are to be chosen? The parameters of our study require a comparison of low-income and high-income neighborhoods. The stops adjacent to LRT were chosen particularly if (after analyzing the land use via GIS) there were a large amount of residential areas. Generally, stops with the more residential land uses within the ¼ mile buffers were more likely to be chosen, given all other things being equal. Many stops had civic buildings, hospitals, schools, parks and/or shopping centers adjacent to the stops. These areas around stops were avoided, due to lack of sample size these places provided and the lack of clear data. It should be noted that no

neighborhoods were used that were adjacent to the Yellow Line mainly because of time-data limitations; it was finished in 2004.

Since the data was available from 1997 to 2007, and the study examines SFR-detached values before and after a LRT stop is built, certain data was excluded. Only 1997-2007 data was readily accessible, no data before or after that time period was used. Also, only single-family residential parcels that have values for all the years between 1997 and 2007 were included. The following values were excluded-- any parcel housing that may have been built after 1997, and any parcel that does not have a ten-year set of values. This was done to eliminate data errors; new properties built since 1997 will be excluded. Attached housing was excluded due to accompanying fluctuation in square feet. Certain parcels, for various reasons, had no data on the website. Multifamily housing was excluded from this study because the lack of accurate living unit data. All commercial and industrial parcels were excluded due to data limitations. Also, as data was being collected there were parcels that had huge variations that could not be included—there were parcels that appreciated or depreciated by hundreds of thousands of dollars in consecutive years. These parcels could have been unimproved, and then improved (or vice versa) during the span of years in question. Regardless, these parcels were excluded.

Case Studies/ LRT Scenarios

There are 44 stops on Portland's MAX. Some stops could not be analyzed due to data limitations on yearly home values. Certain stops were analyzed in this study based on 2007 real market home values in the surrounding area. Case study areas were chosen, based on a contrast between income levels as well as the number of SFR parcels compared to commercial, industrial or civic-use parcels. The five case study areas are broken down by income level: Hollywood/42nd Street which is a high income area with existing LRT, Martin Luther King Boulevard and Killingsworth Street which is also a high income area but lacks LRT. Three study areas are

defined as low income; Polk and Smith Streets lack transit, the Parkrose/Sumner area has new transit, and East 172nd Street has existing LRT. The "new" designation for Parkrose/Sumner is a unique case to examine the before and after effect of LRT construction, something that has began to be examined.

Conclusion

To review, the data availability, LRT utilization and Portland's planning legacy were three major factors in selecting the city for examination. Using SFR, while in previous studies may not have reflected the greatest conferred economic valuation benefits, was the easiest to analyze. The ten-years of property values were then divided by the total number of square foot in each study area to give the whole area a composite value. This value could then be examined over time to ascertain valuation benefits more efficiently. Utilizing parcel GIS helped determined the buffer zones as they applied to the ¼ mile actual distance from LRT stations.

CHAPTER 5
CASE STUDIES/RESULTS

Portland's LRT system, referred to as the MAX, began service in 1996. This segment served primarily the Portland city core and east along U.S Highway 30. As the service grew, the west side of the line was completed in 1998, stretching all the way out to Hillsboro. As shown in Table 5-1, the Red Line travels from downtown to the Portland International Airport. In 2004, the Yellow Line was completed, running from downtown north along Interstate 5. As shown in Table 5-2, Portland's LRT starts early enough in the morning and ends late enough in the evening to serve most commuters that work different hours; as well as the 9am-5pm commuters. To enhance any study of LRT stations and their surrounding property values, the characteristics of the LRT lines and stations are shown in Table 5-1.

The Portland MSA has a population of over 2.2 million people between seven counties in northwestern Oregon and extreme southwestern Washington as shown in Figure XX (U.S Census Bureau, 2008). The 23rd largest MSA in the nation, Portland has the only directly elected Metropolitan Planning Organization (MPO) in the United States (Calthorpe & Fulton, 2001). Metro is responsible for land use planning and maintaining the UGB, managing TriMet which includes the MAX, some city parks, cemeteries, landfills, convention centers, city zoo and the region's GIS system (Calthorpe & Fulton, 2001). Metro's master plan for the region includes promoting mixed-use TOD's around LRT stops and multiple town centers that seek to be small-scale replications of the CBD. The political structure of Metro may help keep a regional balance with regards to development in various areas of the city. Other areas may promote growth in the suburbs at the expense of the city core. Other areas could be immobilized by county vs. county in- fighting with regards to land use decisions—these are precisely the issues Metro was set up to eliminate.

Case Studies

Nevertheless, Portland still has very different neighborhoods, with some rich and poor areas in the suburbs and core areas. The following chapter will give a snapshot of each neighborhood. The following five case studies are composed of three areas that within a quarter-mile of a LRT station and two areas that are not. At the same time, three of the five areas are low-income, while the other two are classified as high-income. The two areas that are classified as low income in this study are by no means poverty level; they just represent areas that are significantly below the Portland's metro area median household income of $48,288 (U.S Department of Housing and Urban Development, 2002).

Hollywood and 42nd Street, High-Income Area with Existing LRT

This area is 2.52 miles distance from the CBD, the closest out of all study areas. The Hollywood/42nd Street area is an older section of town that lies directly south of major retail destinations on the corner of Sandy Boulevard and Broadway. The 1999 median family income of this area was $59,288, significantly higher than the regional median (U.S Census Bureau, 2008). Table 5-3 shows that Hollywood/ 42nd has the second oldest housing stock (56.9 percent of housing built before 1939) and a smaller percentage of SFR-detached homes (U.S Census Bureau, 2008). This indicates a possibility that attached housing and MFR have developed over the years, indicating a density and intensity of land uses.

Figure 5-5 illustrates some aspects of the urban form of this area. The study area is cut in half by Interstate 84 as well as the MAX line. The northern half of this study area features moderate retail and office land with busy arterial intersections. The southern half of the study area is referred to as Laurelhurst neighborhood, and is separated from the retail by Interstate 84 and the MAX line. The SFR parcels are uniform typically right around 5,000 square feet. As

Figure 5-5, shows there is hardly any non-residential land use in the southern half of this study area.

This area also has twenty percent of its residents using transit (Table 5-3), which ranks highest of case studies. As Table 5-3 shows two LRT lines serve the Hollywood/42nd area, though at the station they share the same track—so residents enjoy more frequent service as well as access to more destinations than any other study area. The MAX station is also designated city "Transit Center" which *can* be defined as having stops/connections of more than one transit mode. As Figure 5-5 shows, bus transit serves this area quite well. . As Table 5-2 indicates, trains stop very frequently and as shown in Figure 5-1 the area's central location offers residents full accessibility to destinations.

East 172nd Street and Burnside Avenue, Low-Income Area with Existing LRT

Another station located on the MAX Blue Line, this station is 8.96 miles from the CBD, significantly farther away than any other case study area. The 1999 median family income of this area was $38,758--significantly lower than the regional median (U.S Census Bureau, 2008). This area is characterized by a less connecting pattern of streets, larger lots and newer housing—only 3.3 percent of the housing was built before 1939 (Table 5-3). As Figure 5-6 shows, there is some major retail on the major streets Burnside Avenue and Stark Avenue to the south. This area has many irregular sized lots and lacks a strict grid pattern of streets. This area lies on the border of east Portland and the suburb of Gresham. Burnside is a major corridor but it is only a two-lane road that is lined with trees and SFR with some MFR that are oriented clearly towards the street. The track is in the median that divides the road. There is not a large commercial to speak of—this is a very middle class residential area. The land use and intensity are not what they are, say, closer into town. There are no bike routes, but there is bus service on Burnside and Stark Avenues-- two east-west arterials. As shown in Table 5-3, the income and home values are

second lowest in the study, but 12.2 percent of the residents report using transit regularly (Table 5-3). More than half of the houses are SFR-detached. This area is served by the Blue Line, albeit the Blue Line extension, that began operations in 1998. This area does not have large amounts of commercial and maintains a rustic feel.

Martin Luther King Boulevard and Killingsworth Street, High-Income Area with No LRT

This neighborhood is filled with some inconsistencies. There are pockets of slightly dilapidated SFR units with stately old two story houses mixed in. The area also has a tight grid-like network of streets as well as uniform lot sizes. Street to street, there are different sizes of homes and presumably home values. This area in consistent in one aspect- these residential units are old. According to the Census Bureau, nearly ¾ of the area's housing stock was built before 1939. As to the median family income of $70,629 a year--easily the highest in the study--one could not tell from pictures (U.S Census Bureau, 2008). This is an area in flux, with a few new condominium-type apartments that are obviously new mixed with some homes that are not maintained. The overwhelmingly majority of the housing is SFR detached. The main thoroughfare is Martin Luther King Boulevard- this street is lined with older commercial units that appear to be underutilized. East of MLK is a predominantly African-American neighborhood, although with a city that is nearly eighty percent white, that statement does not hold the same effect as it would if referring to a Sunbelt or east coast city. This case study area is 2.72 miles from the CBD. Not served by LRT, and the nearest light rail line is the Yellow Line (opened in 2004) which is two miles away. This neighborhood lies outside the walking distance to LRT. Bus transit serves MLK Boulevard and Killingsworth and Alberta Streets. As shown in Table 5-3, this area ranked second in the study with 12.3 percent of the residents using transit regularly. Although not served by LRT, these residents utilize bus and are relatively close to downtown. While the housing stock is not overly impressive this area appreciates anyway—

which may point to the importance to being close to the CBD. With regards to property values and appreciation, this area may benefit economically through the age/size/ desirability of its housing stock.

Parkrose/ Sumner, Low-Income Area with New LRT

As Table 5-3 indicates, even with its new station, the residents of this area utilized transit less than the other areas. As Figure 5-4 will also indicate, the study sample may be influenced by the interchange carving the studied parcels in half. This station is 5.63 miles from the CBD and is served by the Red Line, which opened in 2001. Parkrose/ Sumner refers to the name for this station and the two neighborhoods Parkrose (to the east) and Sumner (to the west) that make up the area. As Figure 5-4 illustrates, this area is characterized by a major highway interchange (Interstate 205 and Columbia Boulevard) as well as an adjacent intersection of Sandy and Columbia Boulevards. This further highlights the high percentage of transportation infrastructure that exists in the study area. The LRT station itself is located in the median of Interstate 205 (Portland Freeway). To access the station riders use a flyover which is connected to a Park & Ride lot on the eastern side of the I-205 interchange on Sandy Boulevard. The Park & Ride lot is also served by buses that run along the mentioned arterials going to different parts of the city.

As shown in Table 5-3, the median family income is $46,580—which is close to the median regional income of $48,288 (U.S Census Bureau, 2008). The housing stock is newer with 11.4 percent of the stock built before 1939, but seemingly smaller in size than the other case study areas. Nearly seventy percent of the residential units are SFR-detached. Although there are plenty of bike lanes and major transit amenities, only 8.4 percent of study area residents use transit regularly.

North of the area are freight rail yards and other medium-industrial land uses that border the southern extent of the airport. This study area contains some air travel-type land uses, including major hotels directly east of the I-205 interchange. This area has some unimproved roads and some unimproved lots directly bordering the station area to the west. Noticeable are the lack of sidewalks on the residential side streets. The improved roads themselves lack drainage and shoulders. It appears that the interstate construction disabled what was once a tight network of streets, evidenced by the continuation of street names on either side of the interchange.

Polk Avenue and Smith Street, Low-Income Area with No LRT

This station is 5.92 miles from the CBD. This area has no access to LRT, although it is served by bus. North and east of downtown Portland; this area is somewhat isolated geographically from the rest of the city. The Polk and Smith case study area reported a median family income $38,452 even though nearly thirty percent of the homes were constructed before 1939 (U.S Census Bureau, 2008). The median income of this area was lowest of all study areas and nearly ten thousand dollars less than the regional median. Referring to the parcel map of the area, (Figure 5-2) this area is dominated by residential parcels, some 68 percent of them SFR-detached (U.S Census Bureau, 2008). As shown in Figure 5-2, Polk and Smith have uniform lot sizes, a strict grid pattern of streets and parks and schools are nearby. The neighborhood is typical middle class, much of the housing units are SFR-detached. The area also features bus service, prominent bike lanes and sidewalks.

There is a commercial corridor to the south of the study area on Lombard Street. Bus service runs along Fessenden Street, which is in the extreme north of the study area. Sidewalks are aplenty; bike lanes run through the study area along Central, Smith, Fessenden and Buchanan Streets. 9.2 percent of residents reported using transit (U.S Census Bureau, 2008). There are

more parks nearby in this area than the other areas, which may be indicative of the physical landscape that surrounds this area. Seemingly this area suffers from its relative isolation from downtown and its amenities to exhibit strong land values/ land appreciation.

The five study areas present scenarios that reflect today's urban centers. To recap, Hollywood/42nd is a high-income area that has had rail transit service since the 1980s. Close to downtown but separated from commercial and industrial uses, this area income-wise represents upper middle class-to-middle class America. Our high income, with no transit area, MLK/Killingsworth is located on a major arterial in an older section of town that is relatively close to the CBD. Overall, the income level suggests that the area is at least middle class. The area lacks LRT service in a ¼ mile radius but there is LRT a mile and a half away. This is an area in transition, possibly pushing out long-term residents and/or gentrifying due to relative proximity to the CBD.

Polk and Smith is farther away from the CBD, lacks LRT, and is lower income when compared to the other study areas. The area lacks even a moderate density of uses. It represents the typical middle class neighborhood in the older, outer suburb—old enough to have a grid pattern of street network but not older enough to capture the capitalization effects of older housing stock. East 172nd Street is also like Polk and Smith in that it is far away from downtown, but one difference- the area has been served by LRT since 1998. East 172nd probably echoes suburban life for many Americans—lack of prefect grid patterns in the street network, a commuter suburb. Parkrose and Sumner is a unique case study area because it has a major interchange in the middle of it. The area is low density and auto-centered in nature, with industrial uses nearby.

Results

As Table 5-3 indicates, the study areas appreciated rather inconsistently in the year before 2005. 1998 was a particularly slow year, with two areas showing negligible value growth. One stop, MLK/Killingsworth, grew 7.4 percent in 1998- that was greater than the 1998 regional home appreciation rate of 7.2-- the only study area better than the median (U.S Census Bureau, 2008). Table 5-3 shows that in 1999, the MLK/Killingsworth stop appreciated the fastest out of all study areas. All areas in 1999 exhibited a higher appreciation rate than the previous year. The regional home appreciation rate slowed in growth (U.S Census Bureau, 2008). All areas experienced a decline in appreciation rates from 1999 to 2000, which may have reflected regional or national economic trends. As the table indicates, the regional growth in home appreciation percentage rose 7.2 percent in 1998, 4.5 in 1999, and a slow 2.1 percent in 2000 (U.S Census Bureau, 2008). In 2001, four of the five case areas appreciated by a larger percentage than the year before. In 2002, the growth continued for the study areas. The Hollywood/42nd Street rose 7.9 percent more than it did it 2001, MLK/Killingsworth grew 6.2 percent more, Parkrose/Sumner 4.9 percent more, Polk and Smith 1.8 more, and East 172nd 0.7 more.

In 2003, Hollywood's home appreciation rate declined from 13.9 to 9.6—a difference of 4.3 percent. The regional average finally topped four percent in 2003, which foreshadowed the boom a few years later. As Table 5-5 shows, Polk and Smith maintained a steady growth rate right around seven percent. In 2004, Hollywood, MLK, Parkrose, grew significantly less than they did in 2003. Two low income areas, 172nd and Polk and Smith appreciated more in 2004 than in 2003—East 172nd actually grew by more than five percent—the highest increase for that study area in the years examined. In 2003, Parkrose/Sumner's appreciation rate spiked to 13.7 percent from the previous year. The Hollywood/42nd station still appreciated at a 9.6 percent

rate; its second best appreciation rate for this area up to that point. From 2003 to 2004, MLK/Killingsworth appreciated 18.6 percent--second only to Parkrose/Sumner. 2004 could be considered the year before the housing market exploded. By 2005, the boom was underway. Regionally, the average Portland home appreciated 9.1 percent—up from 4.6 in 2004.

In 2005 all areas appreciated in the study--Hollywood/42nd St. appreciated 4.2% more in 2005; MLK/Killingsworth 6.8 % more, Parkrose/Sumner 9.4 %, and Polk/Smith 2.7% and 172nd St. 2.4%. These last two areas grew much slower then when the entire area was booming, this may point to the distance from the CBD. 2006 offered much of the same; with all case study areas appreciating 10 percent or more, building on 2005's growth. Two low income areas, one with no LRT (Polk/ Smith) and with existing LRT (172nd) showed the highest appreciation growth yet. The two areas closest to the CBD showed the most robust growth: this study shows a boom in appreciation rates in the year 2005 and after. All case study areas experienced nearly double-digit growth rates or more in the years between 2005 and 2007. It can be said that the growth that the areas experienced were more related to the overall land valuation of the region that LRT station access.

The literature review mentions that the implementation of new station could lead to higher than normal appreciation or speculative rate in the years immediately after. It was hardly the case in this study. The Parkrose/Sumner area compared to the other areas appreciated the second lowest in both 2001 and 1998; in 2000, the year prior to implementation the area appreciated less than one percent.

The results are intended to show what happened in the market in these very different areas of the same metropolitan area. Two tables are used in the following discussion the first table examines yearly appreciation rates. The second table looks at the dollar-per-square-foot

value in 1997 and in 2007 and the ten years' total appreciation. The difference is that the former does not take into account how far the area has come overall. The first table seeks to only compare appreciation rates year-to-year. The results show that having an existing LRT ultimately does not guarantee an accelerated home appreciation. The results will also show that distance to the CBD is the greatest determinant of a home's value, as well as its ability to appreciate. However, a new LRT stop does seem to trigger an accelerated home value growth, but in this study, that acceleration was inconsistent. A few different stories emerge--the general trend of Portland in these ten years was a slow appreciation market that really slowed down around 2000. By 2003, the Portland market had accelerated and by 2005, a boom in appreciation was well underway, as was much of the nation.

Table 5-1. Characteristics for Portland light rail transit lines, 2008

MAX Line	Blue Line	Red Line	Yellow Line
Year opened	1986	2001	2004
Areas served	Hillsboro Beaverton Downtown Gresham	Beaverton Downtown Airport	Downtown Portland Expo Center
Stations	46	25	21
Station(s) Shared	22	22	12
Track Mileage	33	25.5	7.2
Transit Centers	9	6	1
Connections to other rail modes	2; Streetcar, Commuter rail	1; Streetcar	1; Streetcar

Source: TriMet System Information Map, 2008

Table 5-2. Case study transit stops and levels of service

Case study area	Frequency/ Level of service score	Hours of service/Level of service score	Served by which line?
Parkrose/Sumner	5-15 minutes /"B"	4:30am-Midnight/ "A"	Red
E 172nd Avenue	5-15 minutes /"B"	4:30am-Midnight/ "A"	Blue
Polk Avenue and Smith Street	n/a	n/a	n/a
MLK/Killingsworth*	n/a	n/a	n/a
Hollywood/42nd St.	5-15 minutes /"B"	4:30am-Midnight/ "A"	Blue/Red

Source: TriMet System Information Map, 2008

Table 5-3. Light rail transit scenario/case study area characteristics

Case Study	Type of LRT scenario	Median Family Income (1999 dollars)	Median Home Value (1999 dollars)	Percent of Housing Stock built before 1939	Percent using Public Transit (including taxicab)	Distance from CBD (miles)	Served by line(s)	Percent of housing units SFR detached
Hollywood @ 42nd Zip Code: 97232	High Income Area with Existing LRT Transit	$59,688	$233,400	56.9	20	2.52	Blue, Red	30.8
East 172nd Street Zip Code: 97233	Low Income Area with Existing LRT Transit	$38,758	$136,200	3.3	12.2	8.96	Blue	51.6
MLK Blvd @ Killingsworth Zip Code: 97212	High Income Area with No LRT Transit	$70,629	$232,900	73.9	12.3	2.72	None	72.1
Parkrose/ Sumner Zip Code: 97220	Low Income Area with New LRT Transit	$46,580	$135,200	11.4	8.4	5.63	Red	69.4
Polk Ave. @ Smith St. Zip Code: 97203	Low Income Area with No LRT Transit	$38,452	$121,200	29.6	9.2	5.92	None	68

Source: U.S Census Bureau, American Community Survey, 2006-2007.

Figure 5-1. Regional map of Portland, Oregon

Source: Regional Land Information System GIS.

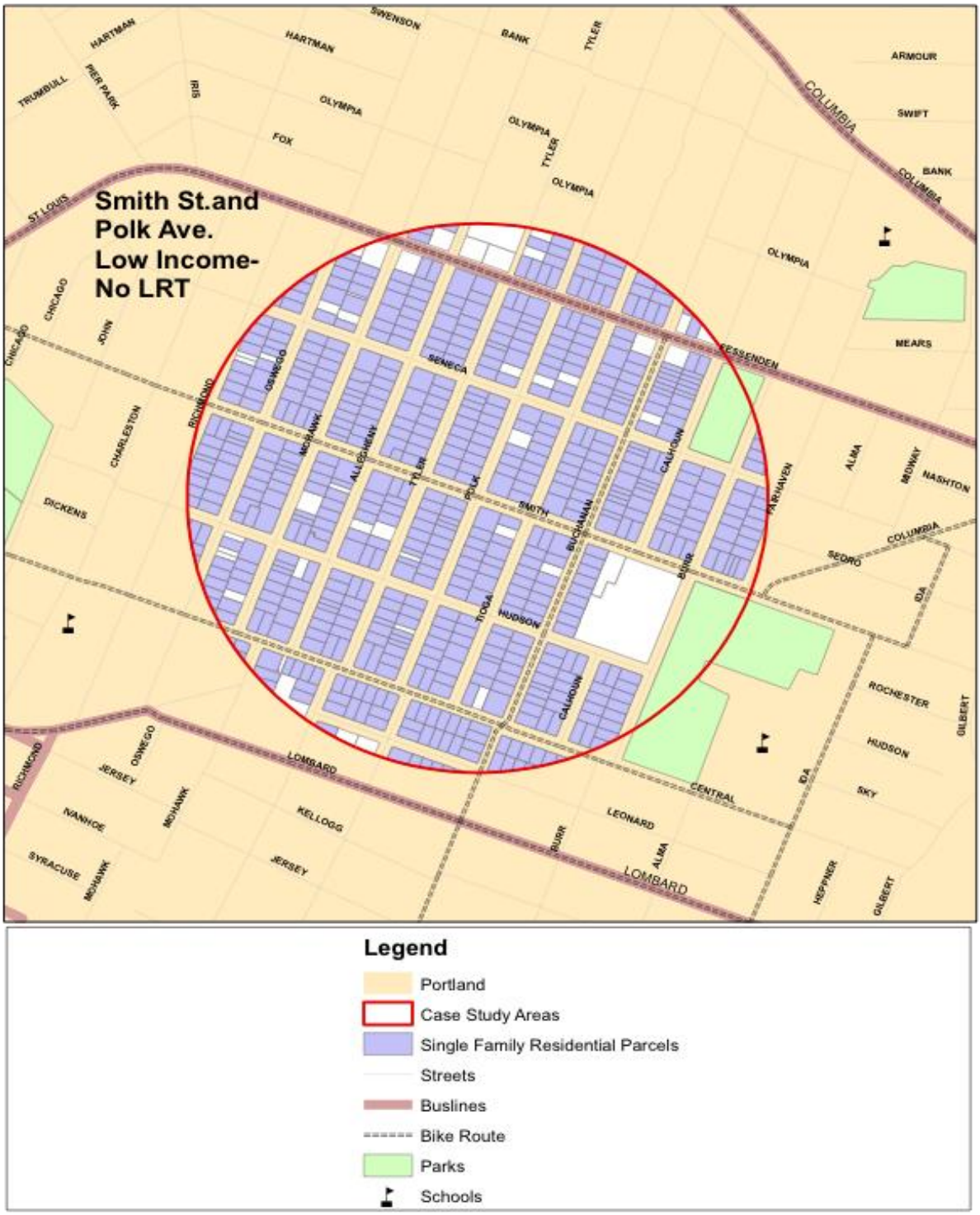

Figure 5-2. Parcel Map of Smith Street and Polk Avenue

Source: Regional Land Information System GIS.

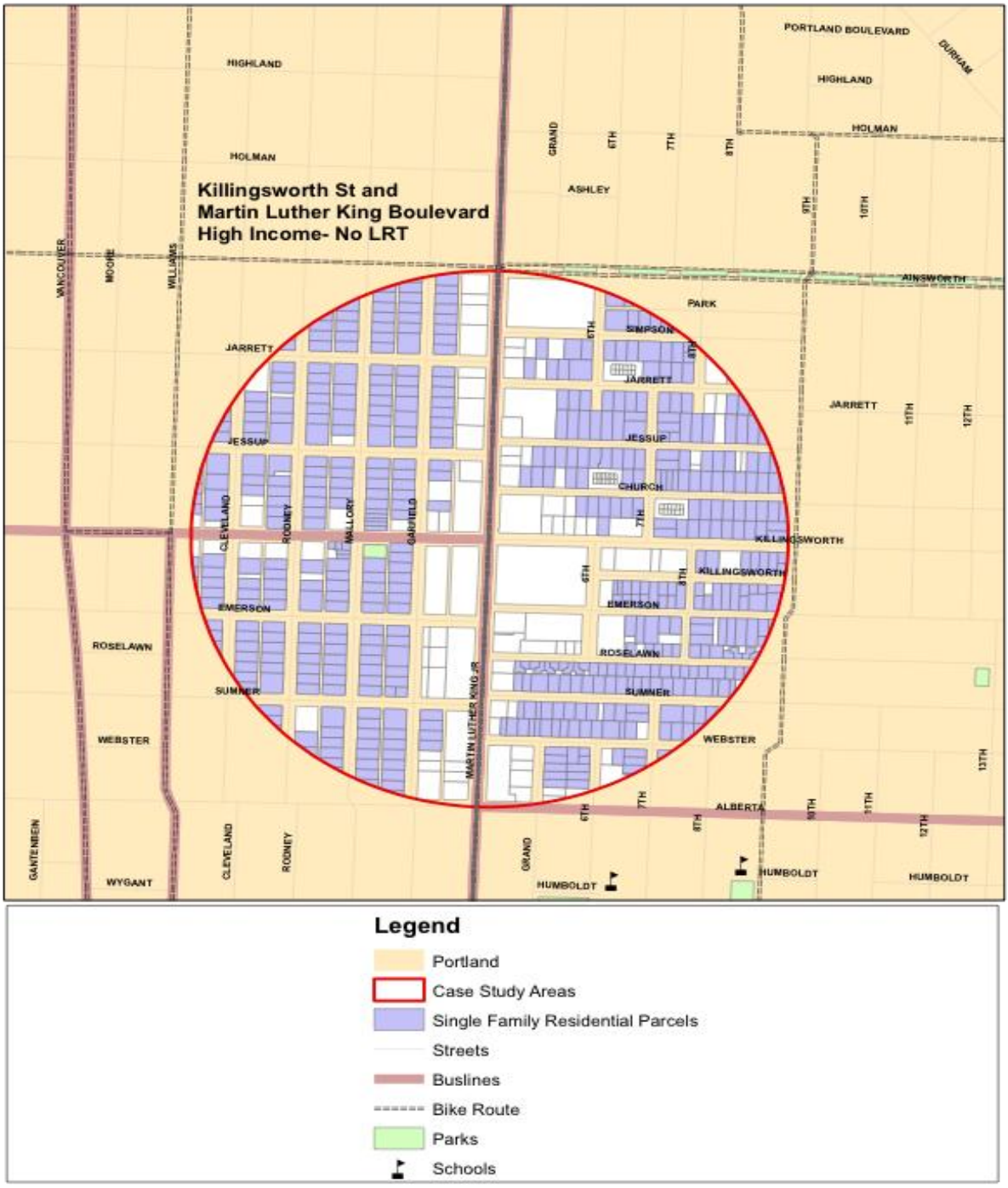

Figure 5-3. Parcel Map of Killingsworth Street /MLK Boulevard.

Source: Regional Land Information System GIS.

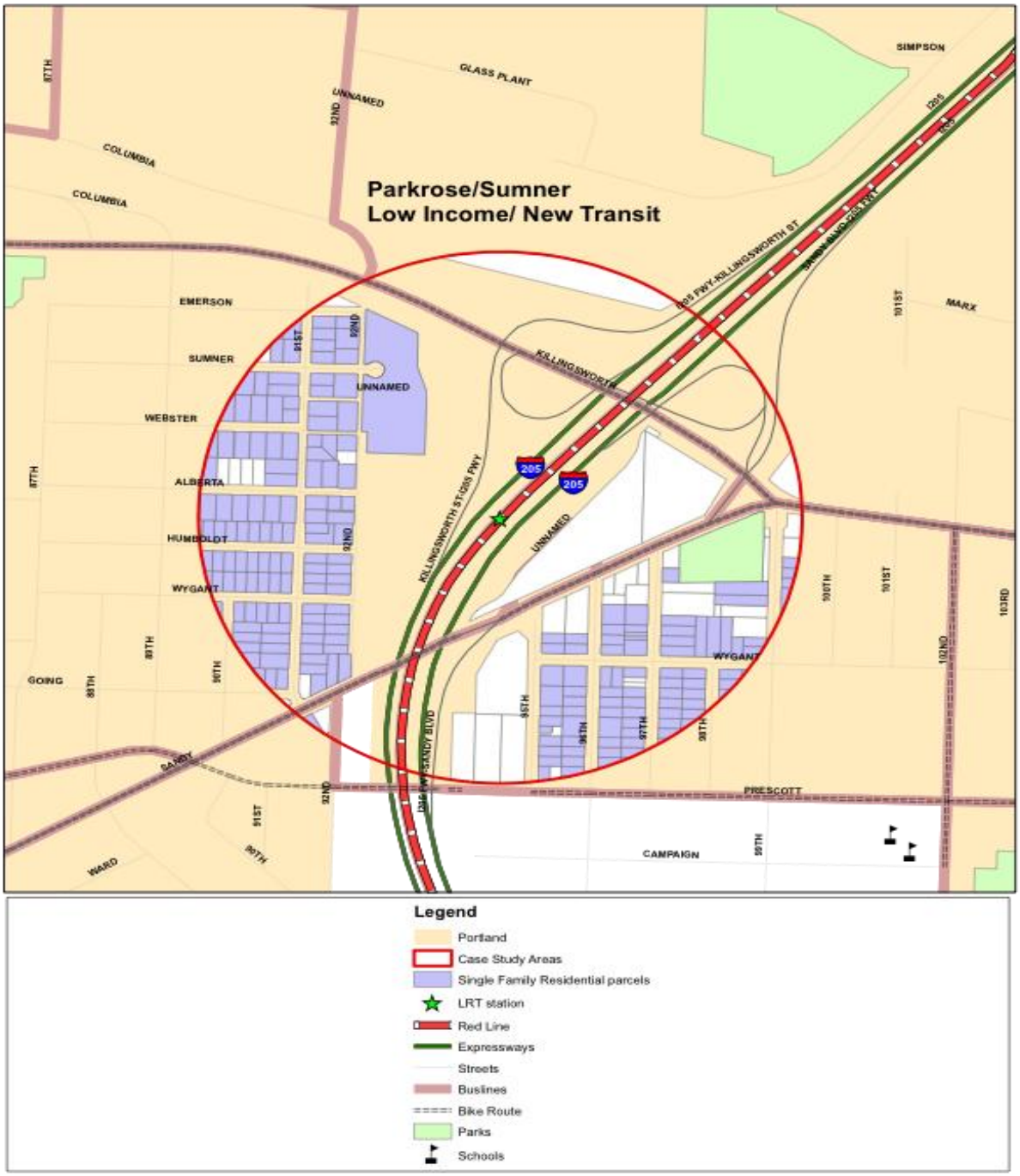

Figure 5-4. Parcel Map of Parkrose/Sumner Area

Source: Regional Land Information System GIS.

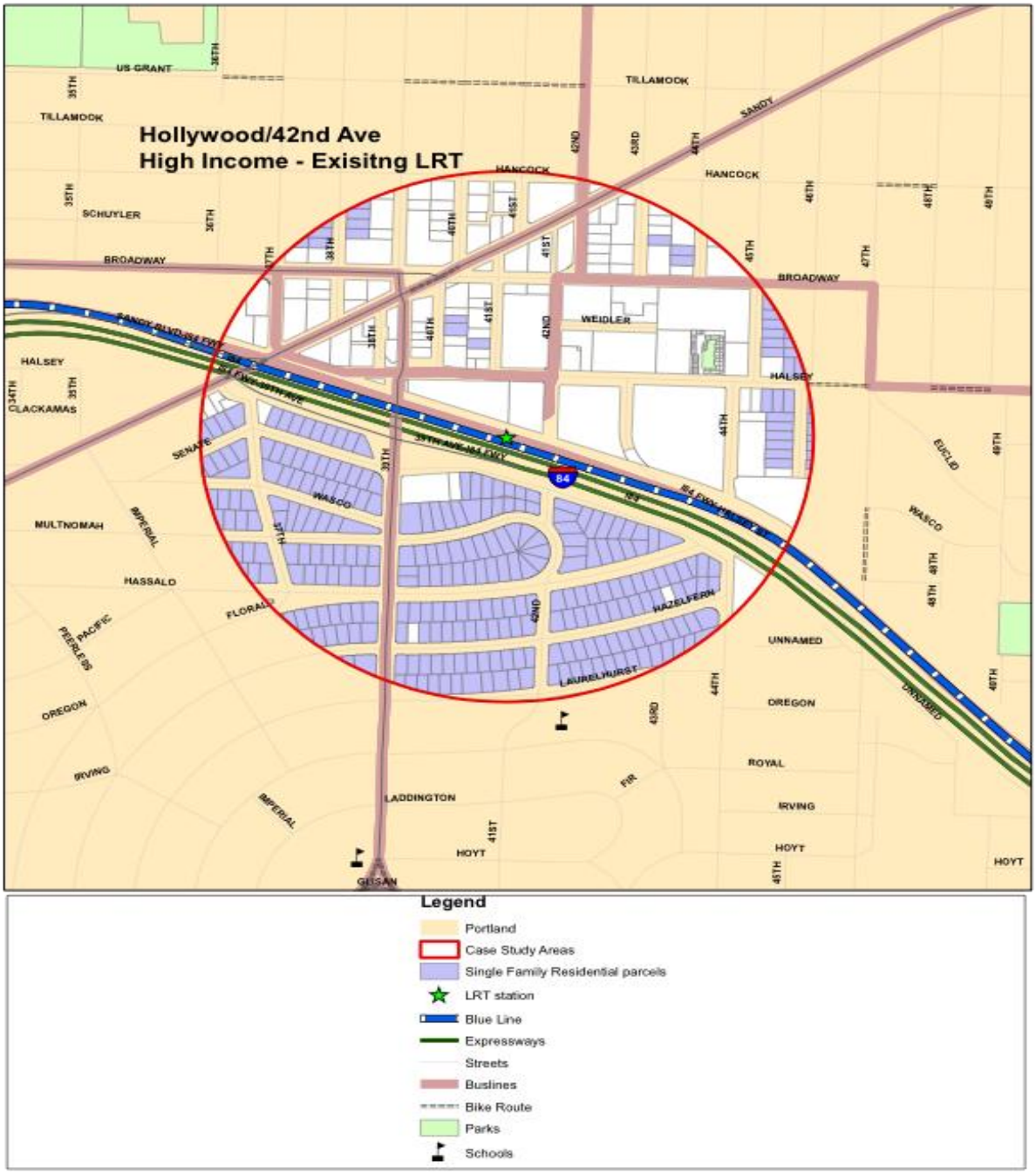

Figure 5-5. Parcel Map of Hollywood/42nd Street

Source: Regional Land Information System GIS

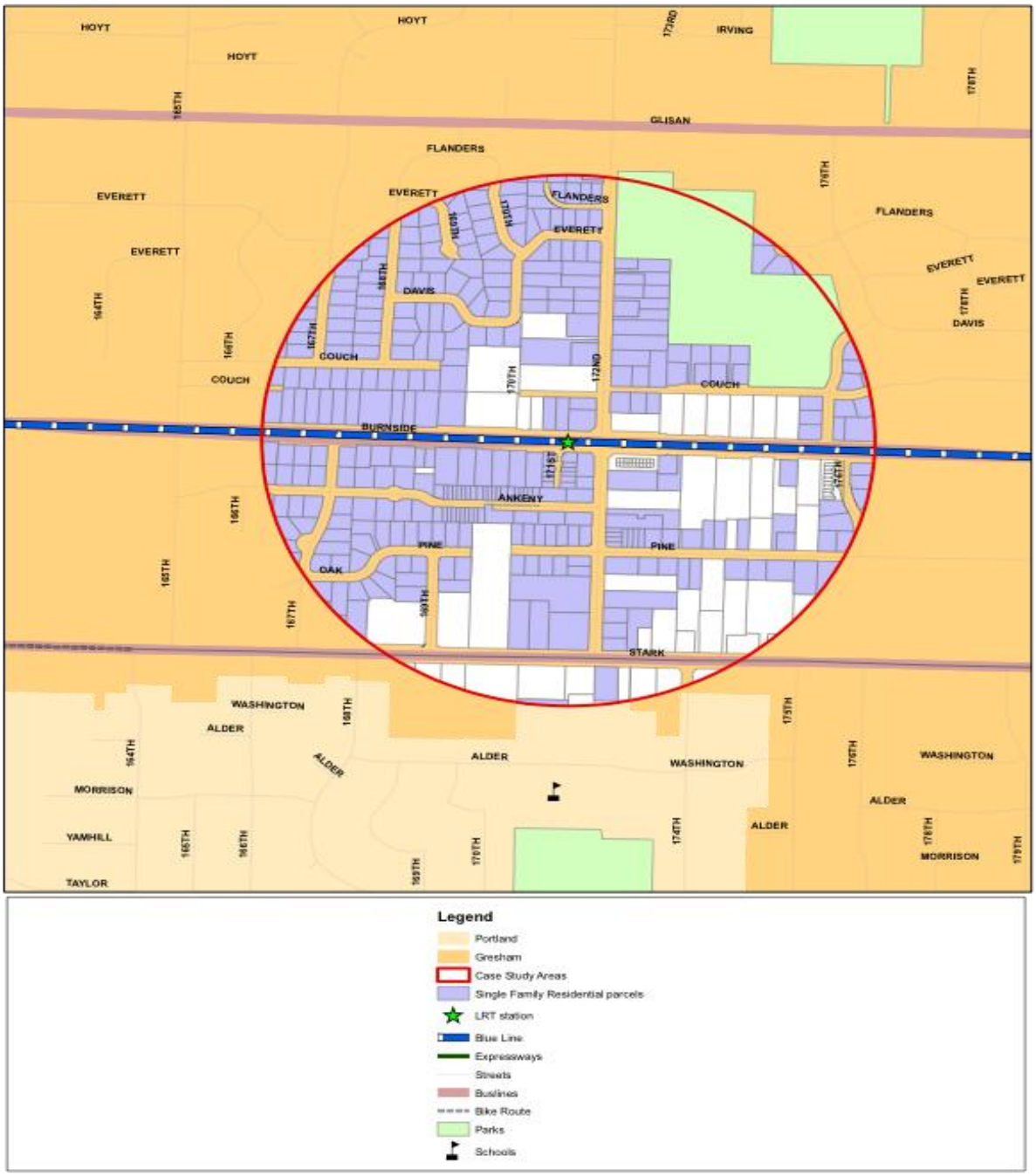

Figure 5-6. Parcel Map of East 172nd Ave

Source: Regional Land Information System GIS

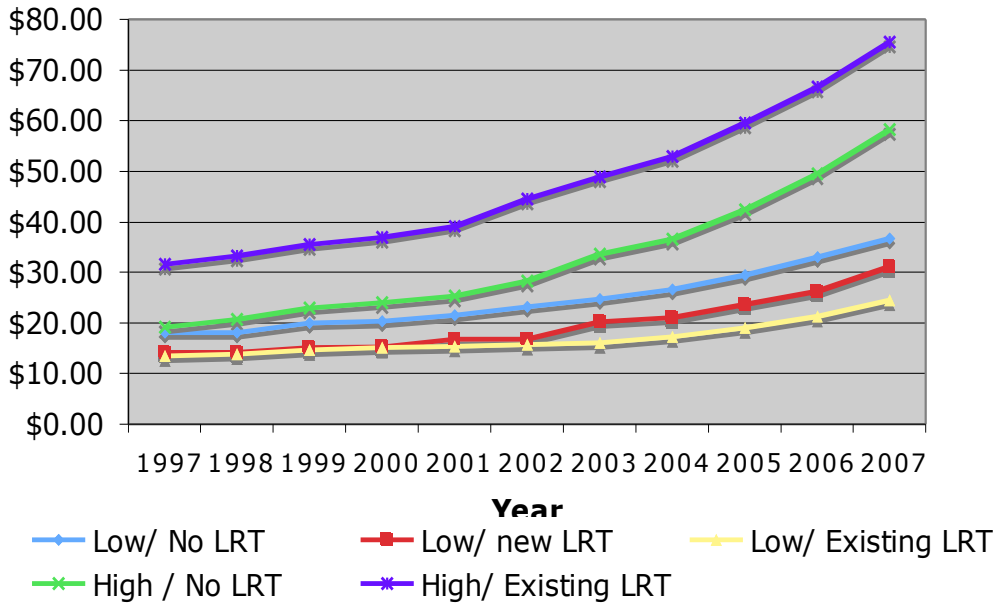

Figure 5-7. Results, Single-family residential parcels value in dollars per square foot, per light rail transit scenario in Portland, Oregon, 1997-2007

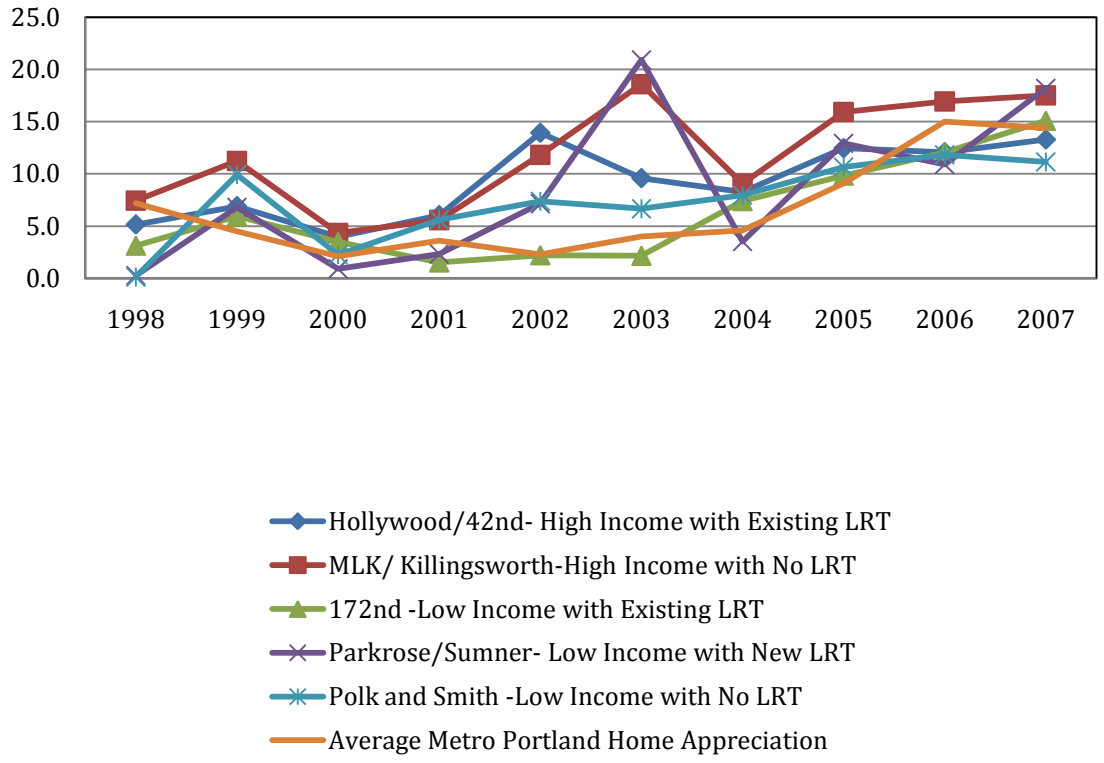

Figure 5-8. Single-family residential appreciation percentage rate per square foot in Portland, Oregon per findings

Table 5-4. Dollar-per-square-foot comparison, 1997 and 2007 per findings

Scenario	1997	2007	Total Appreciation (not adjusted for inflation)
Hollywood and 42nd: High - Income/Existing LRT	$31.58	$75.54	239%
Polk and Smith: Low-Income/No LRT	$18.10	$36.58	202%
E 172nd: Low-Income Existing LRT	$13.42	$24.47	182%
MLK/Killingsworth: High-Income/No LRT	$19.20	$58.24	303%
Parkrose/Sumner: Low-Income/New LRT	$14.15	$31.06	220%

Table 5-5. SFR appreciation percentage rate per square foot in Portland, Oregon, per findings

Case Area/ Scenario	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Per Sq. Ft. Total Increase 1998-2007
Hollywood/42nd: High-Income with existing LRT	5.2%	6.9	4.0	6.0	13.9	9.6	8.3	12.5	12.1	13.3	239%
MLK/ Killingsworth: High-Income with no LRT	7.4	11.2	4.3	5.6	11.8	18.6	9.1	15.9	16.9	17.5	303%
East 172nd Street: Low-Income with existing LRT	3.1	5.9	3.5	1.5	2.2	2.2	7.4	9.8	12.1	15.1	182%
Parkrose/Sumner: Low-Income with new LRT	0.3	6.8	0.9	2.3	7.2	20.9	3.5	12.9	10.9	18.2	220%
Polk and Smith: Low-Income with no LRT	0.1	9.9	2.3	5.6	7.4	6.7	8.0	10.7	11.8	11.1	202%
Average metro Portland home appreciation	7.2	4.5	2.1	3.6	2.3	4.0	4.6	9.1	15.0	14.4	n/a

CHAPTER 6
DISCUSSION

Analyzing five study areas revealed very different developments for each case study. This section will interpret those findings and relate them to the literature review. Based on the literature review, it was expected that the areas near LRT would appreciate more or at least equally with areas that lacked LRT access. The literature review was not consistently illustrating the higher values conferred upon residential land. There were studies reviewed that indicated that proximity to LRT could have a negative effect on property value. However it was found that there were several explanations possible for why a LRT scenario area did or did not appreciate. The individual station areas will be reviewed more in-depth in the next section.

Hollywood/42nd Street: Many Factors Add to Promising Results

The Hollywood/42nd station study area appreciated the second most out of all study areas. It benefits from many of the bundle of factors mentioned in the literature review; the area is closest to CBD, it has a more frequent LRT service, is closer to major retail, lacks negative externalities and has high transit ridership. Also, the area is directly located on a major interstate highway. In terms of the factors influencing ridership, Hollywood/42nd station area in a high-income area, has multimodal connections, a moderate density of land uses and a high density of surrounding population around the station. Only thirty percent of the SFR housing was detached which indicates a presence of multi-family uses (U.S Census Bureau, 2008). Accordingly, the station area has pedestrian amenities including sidewalks and a pedestrian crossover Interstate 84 to access the station. As demonstrated in the chapter previous, in terms of dollar per square foot the area was worth significantly more than the rest in 1997. Whereas MLK/ Killingsworth, the faster appreciator is still in the state of flux, Hollywood/42nd St. already had a sizeable head start in terms of dollars per square feet value.

Based on Von Thunen and Alonso's theories, Hollywood/42nd would probably appreciate reasonably well with or without LRT. The rent gradient from the Portland CBD to the periphery seemed to follow suit with Alonso's theory. As shown in results, the study areas were valued less the further away from downtown Portland. There are other reasons that might explain this as well--the frequency of service cannot be understated, the schools in the area, as well as highway access.

Hollywood/42nd may be more desirable because it is more accessible by more ways to more destinations. If MAX never existed, this area would still be located on Interstate 84. The added mobility of being able to walk safely to another form of transit that duplicates a limited access highway into downtown may just be worth paying that extra dollar for. People buying a home in this area may spend less on transportation as part of their household budget, which may leave more money for housing.

The next stop area Parkrose/Sumner does not benefit from the same location advantages that Hollywood/42nd does: Hollywood is a mature, walkable, close to downtown, high-income neighborhood easily accessed through the MAX lines. As shown in the results Hollywood/42nd never had a year when it did not appreciate by at least four percent. The property appreciation in this study area was consistent with the literature review. The idea that this area benefitted from highway access must be considered as well.

Parkrose/Sumner: New Station Yields Uneven Results

The most important aspect of Parkrose/Sumner study area was the implementation of a MAX station in 2001. This area is fragmented--Parkrose on one side of the interstate highway and the Sumner neighborhood on the other. Add to that fact that an interstate highway divides the neighborhood and this fragmentation frames any discussion on this study/area. Referring to the literature review, the Hiawatha Line in Minneapolis was a primary example, of land value

effects of implementation of new stations. The main difference is that was whole new LRT system with seven new stations—this is a new station as part of an existing line extension. The Hiawatha study, after the station construction, showed that homes *outside* the half-mile buffer appreciated significantly higher than those within.

The jury is still out on Parkrose/Sumner--all in all, the new LRT station may have had a positive effect on this study area, albeit a staggered amount of time after LRT station completion. For Parkrose/Sumner to post the highest yearly value SFR growth is likely not a coincidence. Time will tell whether the good showings of 2005 (second-most growth) and 2007 (18.2 percent appreciation-highest of all study areas for that year) were simply aberrations.

The Parkrose/Sumner area, compared to the other areas, appreciated the second lowest in both 2001 and 1998; in 2000, the year prior to implementation the area appreciated less than one percent. By 2001, all case study areas appreciated faster than in 2000, with the exception of East 172nd Street. Parkrose/Sumner, the only stop in the study served only by this new Red Line exclusively, did not fully experience a rapid growth until 2003. Parkrose/ Sumner home values spiked following the completion of an LRT station in 2001. This year marked the completion of the Red Line, which connected the system to Portland International Airport (PDX). It took time for the improvement to register -- in 2003 Parkrose/Sumner's appreciation rate spiked 21 percent from the previous year. The bigger picture of the study area is uneven at best.

In 2003, the Parkrose/Sumner houses appreciated 20.9 percent, which may lend credence to the LRT effect on single-family residential homes. However, it cannot be said for sure that LRT caused the value explosion, as in the very next year Parkrose/Sumner study area homes only appreciated 3.5 percent, which was well below other areas in that same year. By 2005, the appreciation rates were more in line with other areas in the study as well as the average in metro

as a whole. The 18.2 percent appreciation rate from 2006 to 2007 was the highest that year out of any area, which may mean that as a lower-income area Parkrose/Sumner and its new LRT was increasing the home values nearby. These healthy numbers help offset the

However, it is unclear. Parkrose/Sumner may still be adapting to its new transit investment and still suffers from its distance to the CBD. In Alonso's world this area would be in the intermediate with regards to the "rings"—not as close as MLK and Hollywood, but still closer to the CBD then Polk/Smith and East 172nd. The Parkrose/ Sumner study area lacks commercial uses (restaurants, grocers) to support the few hotels in the immediate area may provide clues as to the newness of the station as well as the highway. The development in this case study area seemed to have resulted from the interstate highway access rather than transit. This area lacks the diverse land uses and density of areas closer to the CBD. Recalling the literature review examples, this area is too close to industrial, rail lines and perhaps, four lane highways to be very desirable in a desirable city like Portland. The Parkrose/Sumner area lacks pedestrian amenities like sidewalks, the density and intensity of population and land use is less than say, Hollywood/42nd Street. Another difference is that the station being in the middle of a large limited access highway lacks connectivity and is harder to access for residents than other study areas-which further lowers the walkability. It is worth noting that the highway access may present a future boon for this area's land value prospects.

Polk and Smith: No Transit, Not Much Appreciation

Parkrose/ Sumner and Polk and Smith grew very similarly before 2001 when neither area had transit. They are both roughly six miles from the CBD. The two areas have gone in different directions since. Parkrose/Sumner got a new station while Polk and Smith ranked last in median family income, last in median home value even though the area has the third oldest housing stock (U.S Census Bureau, 2008). Perhaps the most compelling story Polk and Smith

tell is the overall health of the Portland CBD, that even as far away as six miles the area still out-performed the regional average seven out of ten years. Overall, Polk Street and Smith, a lower income area with no access to LRT, appreciated the least vigorously out of any case study area. Polk and Smith is farther away from the CBD, lacks LRT, and is lower income when compared to the other study areas. The area is mainly comprised of SFR with no commercial corridor and lack of other types of uses. Polk and Smith appreciated the least twice in 1998 and 2007. The area's best year in terms of growth was from 2005 to 2006, when the area's SFR appreciated in 11.8—the lowest of all stops that year.

When comparing value-per-square foot, Polk and Smith went from $18.10 a square foot to $36.58, which was better than the comparable area, East 172nd Street, an area that has long been served by LRT. Also interesting to note that the $18.10 per-square-foot 1997 value was the highest among all areas that are low-income and close to MLK's 1997 per-square-foot value of $19.20—this may indicate that a lack of LRT may have hindered the possible SFR appreciation in Polk and Smith. Referring to the Parkrose/Sumner stop, which was the new transit investment in a low-income area, really experienced a growth in appreciation rate after 2001—more so than the other stations. After the transit improvement the average appreciation rate for every "stop" was nearly 14% yearly; only the no LRT high-income case had a higher one. Parkrose/Sumner had appreciated at an average of 3.28 percent before the stop was implemented.

The Polk and Smith neighborhood appears to be typical middle class, with much of the housing units are SFR-detached. The area also features bus service, prominent bike lanes and sidewalks—in other words, a good candidate for LRT expansion. However, the area is isolated from the CBD, lacks office and retail land, and that probably plays a large role in the fact that the area performed less than the other areas. This area is close to the Williamette River actually

enforcing the isolation, thus proving that being restrained physically can have an adverse effect on home prices. This may contradict aspects of the literature review with regards to physical constraints enforcing higher values; although the area is near rivers, the area's distance to the CBD prevents the higher value capture. Also, this area lacks highway access. Perhaps if there was an interstate highway linking this area to the Vancouver area then the results would tell a different story. However, the most compelling reason for Polk and Smith's lack of value capture may be the waterfront industrial land uses that completely enclose the community on the north and the west. Heavy freight rail also encircles the area and connects more industrial land uses in extreme southwestern Vancouver, Washington area. Ironically the value perception of the community may be adversely related to the presence of heavy industrial rail.

Overall, Polk and Smith are located too far from the CBD to capitalize on accessibility's capitalization effects. If you lived here you likely had to have an automobile, and as only nine percent of residents reported using transit (U.S Census Bureau, 2008). The following study area East 172nd Street had the third highest percentage of people using transit (12.2%), on a stop that has been there since 1986—and still appreciated twenty percent less than Polk and Smith in the overall picture.

East 172nd Street: LRT Access Does Not Automatically Equate Appreciation

Looking at aerials, you would think this is a great example of a transit dependent neighborhood--there is great sidewalk connectivity, transit-oriented development near the station as well as a large park nearby. The area has been served by LRT since 1986, and it would follow that the case study area would appreciate at least as well as areas that were not served by transit. However, that was not the case-- East 172nd Street, which is located nine miles east of the CBD near the end of Portland proper and more into the city of Gresham, was valued significantly lower initially than the other case study areas. This area appreciated the fewest in the ten-year

period four times, including three years in a row, 2001-2003. In 2002, all study areas increased in appreciation--with the exception of the East 172nd Avenue station area.

The biggest detriment to 172nd's land value seems to be the lack intensity and density of land uses, and is too far away from the CBD to capture LRT-access effect. One would suspect that this stop is too far away for the CBD to have a trickle-down effect. It seems that even though this area is on a LRT stop for a while, the demand to live here is not like the other areas. In terms of dollar-per-square-foot value, East 172nd Street appreciated 182 percent in the years between 1998 and 2007, which also was the least out of any case study area. It is hard to pinpoint the reason that this area appreciated the least, given that this area has had time to grow around their LRT station. Noted earlier, this area was the furthest from the CBD, the main center of economic activity. It was also noted earlier that Portland has a significantly vibrant downtown for a city its size, it could be more important to be closer to the center city.

At first glance, the East 172nd stop disproved much of the motivations for research question presented in this study. But Von Thunen and Alonso would have recognized that East 172nd lies on the outer rings. The neighborhood has had time to grow around the station and it has not. It has an array of pedestrian amenities; it has dense multifamily units that speak to some intensity around stations. It has a transit utilizing populace, has good frequency and level of service—but in the end the lots are large which may hurt the area in terms of value per square foot. The major detriment: the area is nine miles from the CBD, and does not have much in the form of commercial uses. It also may suffer from lack of highway access, as Parkrose/Sumner and MLK study areas do. Perhaps this stop is a victim of the success of the CBD; in other areas this type of neighborhood typically has big box commercial nearby whereas in Portland people still shop and go downtown. Perhaps 172nd Street represents where we are headed—a world

where people value living downtown more than on the periphery. Portland's periphery may be really that—not like in other cities where downtown (jobs, restaurants, shopping) actually located *on* the periphery.

MLK Blvd. / Killingsworth Street- Proximity to Central Business District (CBD) reaps valuation benefits?

Conversely, the MLK/ Killingsworth area--much closer to the CBD, appreciates quite robustly in the dollar-per-square-foot ten-year study, and year-to-year, had the highest appreciation yearly rate five out of the ten years. The property parcels were typically more uniform than the areas further out from the CBD, reflecting possibly the density of streets in the area. Also, it should be noted that the MLK Blvd is a major arterial, whereas the other case study areas without transit do not have as major corridor. It should be presumed that upon examining the parcel map that many of the white parcels directly on MLK Blvd. are non-residential. Interesting to note is that this area is a historically African-American neighborhood-- to the extent that such areas tend to be undervalued this area has become revitalized when compared to other case study areas, as well as Portland as a whole. MLK/ Killingsworth has avoided the slumps in appreciation that hit the other study areas, and as noted earlier has had the highest appreciation year-to-year five times out of ten years.

When examining the results in the appreciation per-square foot the Martin Luther King and Killingsworth Street study area appreciated a robust 303 percent from 1997 to 2007 (Table 6-2). This 303 percent represents the highest appreciation per-square foot out of any case study area. Although this area is not served by LRT, it is exactly a mile away from the Yellow Line, which connects the CBD with the Expo Hall in North Portland. This area also represents the convergence of two arterial roads and these factors alone make it desirable location choice. However, how exactly does this area perform better than any other in this study? The proximity

to the CBD is matched by the Hollywood/42nd Avenue case area, but the Hollywood area is still worth $75.54 per square foot in 2007 compared to MLK/Killingsworth's $58.24.

The benefits of LRT access did not prevent from East 172nd Street/ Burnside Avenue from ranking last in terms of overall per-square-foot appreciation. This area and the Polk and Smith area were close in 1998 in SFR value per square foot, and while all case studies appreciated- East 172nd appreciated the slowest. East 172nd had by far the newest housing stock of the bunch and was by far the farthest away from downtown. East 172nd was not the lowest income area of the three areas defined as low income and was also not the lowest home value yet it still appreciated the least -add to that the fact that East 172nd residents reported using transit nearly tied for second in the whole study.

Home value and home appreciation depends on a bundle of factors, one of which is location and the amenities that location affords. Contrary to East 172nd, the MLK Blvd/ Killingworth study area lacked access to LRT. The area ended up appreciating more per square foot than any other study area—this again totally contradicts the research question. What MLK did have going for it was a higher income area, proximity to downtown and a *much* older housing stock. This case study illustrates how a strong LRT downtown core can indirectly bestow benefits to areas that lack direct access to LRT. While MLK/Killingsworth lacked the LRT proximity they still used transit, still used sidewalks and bicycles that took advantage of a "tight" grid network-- advantages that far away East 172nd did not or *could* not take.

Parkrose/Sumner was the lone case study that allowed a picture of before and after. The research question stated that the new station opening would cause a jump in the home appreciation percentage. This was true—the area enjoyed a study-high 21 percent per-square-foot appreciation in 2003. However, the station opened in 2001, another case study area without

transit appreciated by nearly as much that same year, and the national trend that year was also appreciating by great rates. The appreciation rate fell nearly seventeen percent the following year, so the validity of LRT access equaling home appreciation is at best weak. Perhaps it takes a year or so for the LRT effects to arrive in home values. Parkrose/Sumner being a low income area, with an abundance of non-friendly transit land uses (factories, multi-lane highways, large interstate interchanges and flyover station access) makes one suspect that this area simply needs more time to mature around its new stop. Still Parkrose/ Sumner faired third best in terms of total appreciation, so if one wishes to make that correlation there is hope.

Similar to previous studies, high income areas tended to fare better than low income areas wherever possible (Kent & Parilla, 2007). The national land boom made it difficult to separate what and what was not an LRT-induced appreciation. Hollywood and 42nd, while benefitting from LRT access may very well have appreciated just as greatly if they did not have an LRT station, given the 303 percent dollar-per-square-foot appreciation of MLK/Killingsworth.

The purpose of this study was to illustrate but not predict the correlation between LRT station proximity and higher home appreciation values. New LRT did seem to have a positive effect overall on the before-and-after valuation effect on the one case study, the Parkrose / Sumner area. This news is encouraging to the many metro areas expanding LRT systems currently. Among the factors that correlated to home appreciation, age of housing stock and distance to the CBD had the highest positive correlations to home appreciation in this study

To summarize, LRT access did not necessarily equate higher appreciation rates. The MLK/ Killingsworth parcels appreciated 303%, and while being close to the city's core the area lacked walkable access to LRT transit. This could be a result of the land being undervalued as people sought to move closer to downtown. This theory has some weight as the 172nd Street

stop area, while furthest from the CBD also appreciated the slowest at 182%. This would contradict any research that access to transit, alone, is the largest determining factor in housing appreciation rates. It is interesting is that the areas closer to the core have significantly higher home values to start with. It was more important that the study area be closer to downtown—though not necessarily older housing stock. It was found that higher-income neighborhoods performed well in the study regardless of whether or not they had transit. The unique factors of Portland may have influenced the study—based on the East 172nd Street stop—there may be a heightened benefit of living closer to the CBD. The suburbs in Portland do not have the same draw that they would in other places. The UGB is redefining what it means to be suburban in Portland. Portland has a large number of people that utilize the LRT. Since the lines all meet in the hub of downtown there is an added benefit to living closer to the CBD.

With the Martin Luther King/ Killingsworth Street area, the housing values belied what was seen on the aerial photographs. While to the eye, it appeared to be a neighborhood in transition, the housing appreciation rates clearly benefitted more from being three miles away from downtown more than they did not benefit from having LRT in a walkable distance.

The five scenarios offered very different pictures of what affected home appreciation and home values. It turns out, that multiple factors dictate home value; people are making trade offs. For example, people who may want larger homes or yards but cannot afford to live that close to the CBD may trade the higher transportation expenses of commuting. These same homes may not be expected to appreciate as quickly because less people are willing to do that compared to those who want “less” house and want to live closer to downtown.

CHAPTER 7
CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

The research question was answered, though not the expected answer. The research question sought to illustrate a clear pattern of LRT access improving SFR appreciation rates in a place where LRT is such an integral part of that's city's fabric. When factoring in the housing boom that was especially strong in Portland during the time of the study, it is clear that distance to the CBD is the strongest factor in home appreciation in this city.

The five scenarios offered very different pictures of what effect LRT had on home appreciation and home values. In areas that were high-income areas, LRT had a reinforcing effect on already high home values. In a high-income area that lacked LRT access, the home values still appreciated faster than any other case study. In a low-income area without LRT, that area still appreciated higher over a ten-year period than a similar area that had access.

Similar to previous studies, high-income areas tended to fare better than low-income areas wherever possible. The national land boom made it difficult to separate what and what was not an LRT-induced appreciation. Hollywood and 42nd Street while benefitting from LRT access may very well have appreciated just as greatly if they did not have a LRT station, given the 303 percent dollar-per-square-foot appreciation of MLK/Killingsworth.

The news was not all bad, however. In the older neighborhoods LRT access had a positive effect on SFR. New LRT did seem to have a positive effect overall on the before-and-after valuation effect on Parkrose/Sumner. This news is encouraging to the cities expanding LRT systems currently. Among the factors that correlated to home appreciation, age of housing stock and distance to the CBD had the highest positive correlations to home appreciation in this study.

There are many different strategies that could be utilized for further research in this area. While examining the ¼ mile distance, it would be beneficial to use network distance rather than actual distance. Network distance takes into account that commuters may be confined by sidewalks, fences, and landscaping. A more in-depth look at network distance may better capture the effects of proximity. Other research recommendations include analyzing the whole of residential parcels, including multi-family, attached housing—a more complete "appreciation effect" picture may be shown. Also, a study examining the appreciation rates of commercial and/or industrial zones would be beneficial for those interested in transit/transportation planning. Another opportunity for further study would be comparing appreciation rates in areas near LRT that exhibit very similar characteristics in age of housing accompanying street network, or lot sizes. These factors, if examined may be able to isolate the effects of LRT access more effectively.

One further recommendation for research would be to obtain data from a period of time when land values nationally were declining or appreciating slowly. This study examined property values during a boom and the beginning of a bust cycle. Perhaps if the study was conducted after the end of a bust, the near-LRT properties may be shown to recover quicker. How LRT-proximate home values resist a regional or national trend to depreciate could offer a concrete picture on the value added of an LRT station. A study of this nature could be conducted in an LRT city that is less susceptible to housing booms and busts. Another aspect that could be examined is the effect of crime or the *perception* of crime in terms of an area's home appreciation—could the perception of crime keep homes near stations from appreciating more?

The results of this study indicate that LRT does have a somewhat positive correlation on home appreciation but is hardly the predictor of home values or home appreciation. One of this

study's purposes was to highlight the economic benefits of LRT in a city that has wholeheartedly embraced the system. Another purpose was also to illustrate but not predict the correlation between LRT station proximity and higher home appreciation values. The research question was LRT would have conferred economic benefits on all areas with LRT compared to those without LRT access. Home appreciation was a gauge on such benefits. Home appreciation offered a benefit of being a percentage and number that could be compared over time rather simply. If LRT could create a location advantage anywhere, it would definitely be apparent in Portland, with its reputed citizens' planning IQ, multimodal integration and walkable blocks. Portland also has the most powerful regional land use government in the country.

It would be beneficial for cities across the country to imitate Portland's various successes in transit and transportation planning. A first step would be to end the county-by-county approach to land use and zoning decisions, a second step would be to initiate some sort of UGB to promote infill and density. These first two steps would be a great start to enabling a healthy LRT. In the future, an honest discussion informing the citizenry about the true cost of highways may be able to sway a city's populace into supporting more transit more forcefully. The end result should be safe, walkable downtowns that could signify the end of Marshall's loss of place. The social implications of transit should not be underestimated as we try to reverse this loss of place.

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BIOGRAPHICAL SKETCH

Stephen Thomas Anderson was born in Newark, New Jersey as the eldest of three children. His early years were spent in Northern New Jersey.From 1986 to 1989, he lived a life among cotton fields and hog farms and attended a rural school in Halifax, North Carolina. The contrast between urban and rural life would stay in his mind as a child-- indicated by his affection for and memorization of *Places Rated Almanac,* a book that ranked Metropolitan Statistical Areas in different categories such as transportation, economics and education. In 1990, his family moved to Florida, first Tallahassee for a year, and then Bradenton. A very different world than rural eastern North Carolina, it was hard at first to adapt to a system of sprawling, cookie-cutter suburbs. These subdivisions, he later realized tend to divide the neighbor from the neighborhood.

He graduated from Southeast High School in 1998, and studied Political Science for two years at Stetson University in DeLand, Florida. Transferring to the University of Florida in 2000, he chose to study History with a strong interest in American History. Graduating in 2003 with his bachelor's degree, he re-entered the University of Florida to pursue his master's degree in urban regional planning in 2006. He has interned for Tindale-Oliver & Associates, a transportation planning firm in Tampa, Florida as well as the St. Johns River Water Management District in Palatka, Florida. The need for all transit to become more utilized was realized in the summer of 2008 when commuting from Palatka to Gainesville (50 miles) every day when gas prices were four dollars. I am interested in urban places that work, vibrant streets, multimodal options, Geographical Information Systems (GIS), and other transit/ transportation planning issues. He currently works as a transportation planner/ GIS analyst at the South Florida Regional Transportation Authority in Pompano Beach. That agency manages Tri-Rail, the only commuter rail currently operating in the state. He hopes to help solve this area's addiction to the automobile through good transit/transportation planning.