Transit Oriented Development and the Valley Metro Rail

Master's Thesis Economic Geography

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Preface

Before you lies the master's thesis 'Transit Oriented Development and the Valley Metro Rail' which has been written to fulfil the graduation requirements of the Economic Geography master's degree at the University of Groningen. The research of this thesis has been conducted as part of the NEURUS program, for which I went to the United States in the winter semester of the 2018/2019 academic year. I decided to work on this research at the Arizona State University in Tempe, Arizona.

In the first place I would like to thank my supervisor, Mr. P. van Steen, for his excellent support and guidance during the process of this master's thesis. His critical but supportive feedback positively influenced the quality of this research.

I also wish to thank all of the respondents for the interviews, without their cooperation and willingness to take time out of their busy schedules it would not have been possible to conduct the qualitative part of this analysis.

Furthermore I would like to thank the faculty members of the School of Geographical Sciences & Urban Planning at the Arizona State University. Their willingness to help me explore my research topic has proven to be very useful, especially during the beginning of my stay in the United States.

Finally I am grateful for everyone that was in some way involved in supporting me during the full duration of both my bachelors and masters study at the University of Groningen. A special thanks goes out to my parents, my brother, my grandparents and all my friends. The submission of this thesis marks a final important step in my educational career. I am looking forward to what the future has to offer for me.

Daniël Hofman

Groningen, October 8, 2019

Abstract

Since the ending of the second world war there has been a migration flow towards a large area in the south of the United States, which causes cities like Phoenix, Arizona to grow rapidly in terms of population and land area. This rapid urban growth brought along problems concerning sustainability and suburbanisation. Light rail transit and Transit Oriented Development (TOD) are often used as instruments to combat problems of urban growth, accelerate land use changes and provide an economic impulse to certain areas. This research was done to analyse to which degree TOD is taking place or has taken place along the Valley Metro Rail system in Phoenix. Based on a mix of quantitative and qualitative research methods it can be concluded that TOD does occur to a certain degree along the Valley Metro Rail and that it will likely take place along future segments of the light rail system. However, there seems to be a mismatch between the results from a series of semi-structured interviews and a series of GIS analyses. Many of the interviewed stakeholders stated that there have been many strong positive effects of the light rail on TOD, whereas the quantitative research mainly shows that these effects have not yet taken place.

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Chapter 1: Introduction

1.1 Research background

During the mid-20th century processes of automation in factories and the increasing displacement of jobs to low-wage countries has led to the economic downfall of the region that was the epicentre of the American industrial sector. This area, known as the 'manufacturing belt' or 'rust belt' coincided with several states in the North-eastern part of the United States, such as Illinois, Indiana, Michigan, Ohio, Pennsylvania and New York. Some of the important cities, in which a large part of this manufacturing took place in the 20th century, were Detroit, Chicago and Pittsburgh.

Ever since the ending of the Second World War and the downfall of the 'Rust Belt' there has been a migration flow within the United States of America. This migration flow went from cold-weather regions in the Northeast (Rust Belt) towards the region that is often called the 'American Sunbelt'. This Sunbelt region stretches across the Southwest and Southeast of the United States. These warm-weather regions offered certain characteristics which made people decide to migrate towards the Sun Belt (Kahn, 2000). The Sun Belt has seen substantial growth of the population since mid-20th century from an inflow of people seeking a warmer and sunnier climate, growing economic opportunities and a surge in retiring baby boomers. The invention of the air conditioning has led to more comfortable summer conditions in the warmest regions in the Southern United States, and allowed more manufacturing and industry to locate in the Sun Belt (Kahn, 2000).

The large migration flow towards the Sun Belt has caused the populations of the cities to grow rapidly. By the middle of the 20th century the United States had fully embraced a consumption culture. Especially in the post-Second World War years, there came a fundamental shift. Instead of an urban identity anchored around industrial productivity, the new urban metropolis would be anchored around leisure and consumption (Nicolaides, 2003). Traditional downtowns and industrial districts were replaced by freeways, clusters of suburban homes, and low-rise, clean industrial parks. The new metropolitan form was not simply an industrial city grown bigger, but a wholly new urban form in its own right, with a unique structure and qualitative character. And a key aspect of that character was decentralization and urban sprawl (Nicolaides, 2003).

One of the reasons why the Sun Belt cities followed such a suburban and sprawled pattern is because the leaders and planners of many Sunbelt cities envisioned their cities as improving vastly upon the congested eastern city model, representing a kind of antithesis of the industrial city (Jackson, 1985; Nicolaides, 2003). Federal transportation policies during that period preferred investment in highways and roads rather than mass transit, thus facilitating suburban expansion of the cities in the Sun Belt region (Jackson, 1985). This federal focus on highways and roads combined with the rise of widespread automobile use enabled emergent cities to spatially disperse, transforming undeveloped land on the periphery, far from streetcar lines, into prime real estate. Cities that came of age after this point, as many Sunbelt cities did, felt the spatial impact of this new pattern of land conversion made possible by the automobile (Monkkonen, 1988). Therefore, in these Sun Belt cities there is often a lack of investment in fixed transit infrastructure. The Sun Belt cities are characterized by their over-reliance on sprawling, automobile-orientated development patterns, as is the case in the metropolitan area of Phoenix (Economist, 2017).

There is a contrast between the resource consumption of a city dweller living in a multi-unit building who walks to stores and commutes using mass transit, versus a suburb dweller living in a single family house who commutes by car. People who live in suburbs are more likely to impose larger environmental costs by degrading local air quality, increasing greenhouse gas production, and reducing

available open space (Kahn, 2000). Results of Kahn's (2000) study show that people who live in suburbs drive 31 percent more than their central city counterparts and consume more than twice as much land. The concerns that exist in relation to the suburban growth and processes of urban sprawl are captured in the following quote from a speech on strong communities in the United States, given by former US vice-president Al Gore in 1998:

"In the last 50 years, we've built flat, not tall: because land is cheaper the further out it lies, new office buildings, roads, and malls go up farther and farther out, lengthening commutes and adding to pollution. This outward stretch leaves a vacuum in the cities and suburbs which sucks away jobs, businesses, homes and hope; as people stop walking in downtown areas, the vacuum is filled up fast with crime, drugs, and danger'' (Gore, 1998)

One possible way that cities can trigger a countertrend against the car-dependency, urban sprawl, pollution and suburbanisation is by implementing a public transit system, such as light rail. Light rail transit is a mode of urban public rail transport. Investments in urban public transport are important to offer a real alternative to the car, since cars often cause high levels of congestion and emissions (Mulley et al., 2017). Supporters of light rail transit claim that it could help reshaping the form and quality of urban growth in cities. Light rail transit does so by simultaneously offering a solution to problems of urban sprawl and guiding urban revitalization (Atkinson-Palombo & Kuby, 2011). The availability of an integrated public transportation system has proven in some cases to be an important factor in reducing automobile dependence and providing more opportunity for physical exercise, such as walking or biking to work (Topalovic et al., 2012). Besides that, light rail systems are often implemented with the purpose to fight traffic congestion, generate economic development and accelerate land use changes (City of Phoenix, 2002).

Several light rail systems in the United States which have been operational for several decades, such as San Francisco Bay Area Rapid Transit (BART), Atlanta's Metropolitan Atlanta Rapid Transit Authority (MARTA) and the Washington Metropolitan Area Transit Authority (WMATA) that light rail transit overall can have a positive role in shaping metropolitan growth in larger regional contexts, but it also shows that the effects can be very localized (Cervero & Landis, 1997).

A complementary concept to these light rail systems is the concept of Transit Oriented Development (TOD). TOD often takes place along public transit systems in metropolitan areas. Cervero et al. (2004) state that TOD is a type of urban development, which focusses on maximizing the amount of business, residential and leisure space within walking distance of public transport (bus stops, train stations, light rail stops). In previous research on TOD this walking distance is often determined as 0.25 or 0.5 miles radius around a single transit station (Arrington, 2003; Atkinson-Palombo & Kuby, 2011; Credit, 2017). The concepts behind TOD are predicated upon creating built environments that service non-motorized and/or public transportation rather than the private automobile. Mixed land uses built at high density at the human-scale produce places that are conducive to walking, biking, bus and rail (Cervero and Kockelman, 1997). In doing so, TOD aims to increase public transport ridership by reducing the use of private cars and by promoting sustainable urban growth (Cervero et al., 2002). According to Boarnet and Compin (1999) TOD is generally accepted to take several years or even decades to unfold. Also the way in which TOD unfolds could be different for each individual station; case studies of individual station areas or projects have shown wide variations in the form of development at station areas (Dittmar and Ohland, 2004).

1.2 Area of study

The metropolitan area of Phoenix in Arizona is one of the fastest growing regions in the United States. The United States Census Bureau (2016) reported that the metropolitan area of Phoenix more than doubled in size in terms of population in the past 25 years. The area grew from 2.1 million people in 1991 to 4.7 million people in 2016. The Phoenix metropolitan area lies within Maricopa County which includes the city of Phoenix and several sub-cities like Tempe, Scottsdale, Glendale and Mesa (figure 1). In 2016 Maricopa county grew by 222 people per day on average, placing Phoenix amongst the fastest growing metropolitan areas in the United States (United States Census Bureau, 2016).

In the past few decades also the metropolitan area of Phoenix, Arizona in the Southwest of the United States experienced a vast growth of the residential population and the land area. These processes are accompanied by several problems of urban growth such as: traffic congestion, fragmented land use patterns, outward movement of economic activities from the downtown areas, and a lack of public transit (Talen, 2011; Keys et al., 2007). The Valley Metro light rail has been a way to combat these problems by providing a public transit system to the citizens of the metropolitan area of Phoenix. Some areas directly adjacent to the Valley Metro Rail experience certain effects that could be labelled as Transit Oriented Development (TOD).

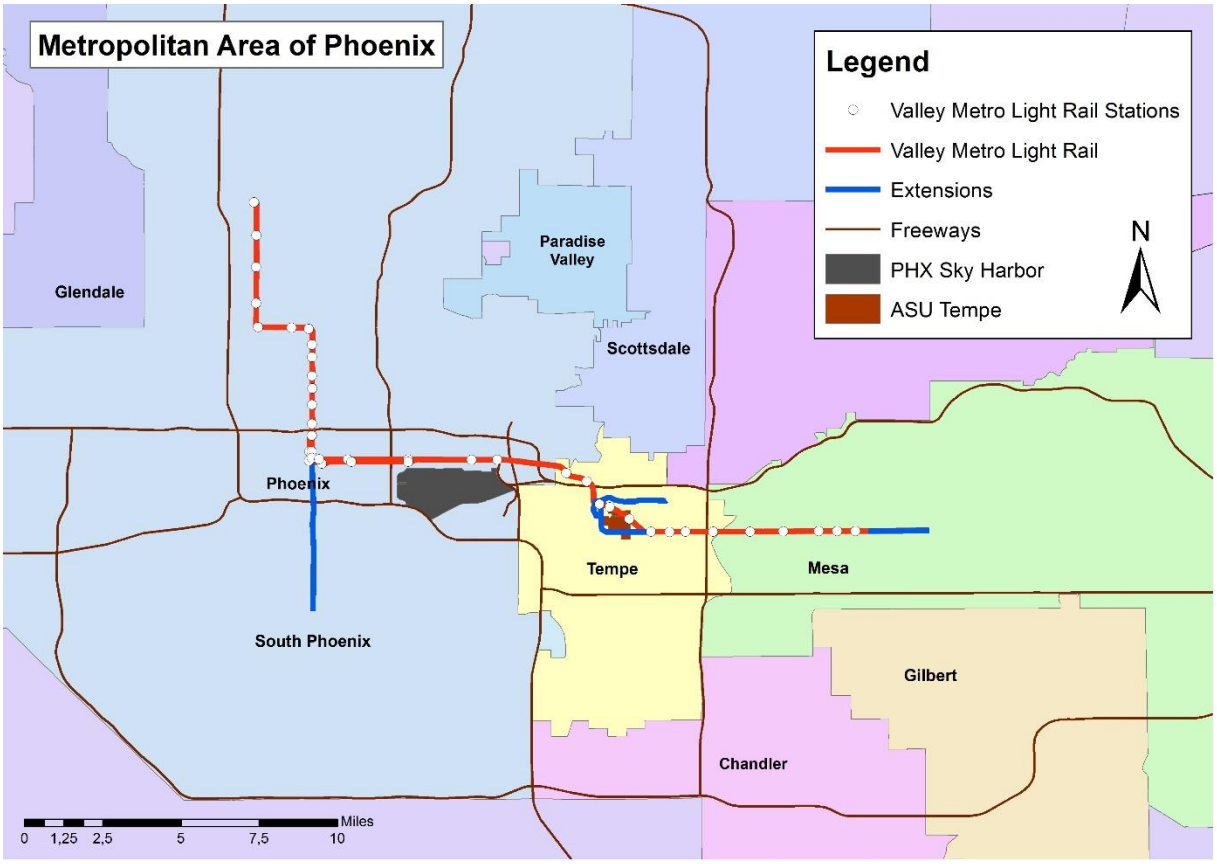

Figure 1. the Metropolitan area of Phoenix and the Valley Metro Rail. (source author)

The system passes along what is arguably the most attractive and competitive environment for public transit in the region (Golub et al., 2012). Traveling west, the line begins from just west of Downtown Mesa, making stops at Arizona State University's (ASU's) Tempe Campus with its more than forty thousand students, in Downtown Tempe, and at the Phoenix Sky Harbor International Airport before entering downtown Phoenix. In Phoenix, the line passes by major attractors, such as the new baseball

and basketball stadiums, convention centers, and ASU's downtown campus, as it turns north along the city's historical north–south spine, Central Avenue, heading toward north Phoenix neighborhoods.

At this moment, the Valley Metro Rail does not yet connect all the sub-cities in Phoenix to the light rail system. However, future extensions of the Valley Metro rail are planned. Can TOD be expected to also take place along those extensions, thus contributing to reducing the abovementioned urban growth problems?

1.3 Research goals and questions

The goal of this research is first, to analyse to which degree transit oriented development (TOD) is taking place or has taken place along the Valley Metro Rail in Phoenix, Arizona; and second, to predict to what degree TOD will take place in an area within the Phoenix metropolitan area where an extension of the light-rail infrastructure is foreseen.

The central question in this research is: Has the Valley Metro Rail (VMR) in the Phoenix metropolitan area generated or stimulated transit oriented development (TOD), and is TOD likely to happen along future extensions of the VMR?

In order to answer this central question the following set of sub-questions should be answered:

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

b. Is continued TOD likely to take place along these existing segments?

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

b. If so, to what degree and under what conditions can this TOD be expected?

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

1.4 Structure of the report

In Chapter two the theoretical framework of this research is provided. The context in which this research was performed is analysed in this chapter. This chapter includes a literature review of the key concepts and theories that are relevant to this research.

The third chapter, methodology, describes which research methods have been applied. In this chapter several choices that were made during the collection of data are explained. Furthermore attention is paid to the datasets, participants and ethics.

In chapters four through six several analyses are worked out. The results of the land use analysis (chapter 4), the property value analysis (chapter 5) and the employment analysis (chapter 6) are based on data that was retrieved from literature, in-depth interviews and GIS datasets.

In the seventh chapter conclusions are drawn from the results of these analyses in relation to the main research question and to the sub-questions of this research.

In chapter eight, a critical reflection is given on how the research was executed. This chapter points out where the research could have been improved in terms of data collection, theoretical framework and planning. Also a critical reflection on how the obtained data and conclusions of this research matches the theories and concepts that already existed on the topic.

Chapter 2: Theoretical Framework

2.1 Development of transit in American cities

Transit as a form of transportation has been a part of the American urban landscape since the horse-drawn streetcar was popularized in the mid 1800's. Since that time, transit has interacted differently with development and developers during different periods. But throughout transit's history, development has been a key component of its planning, success, and need (Carlton, 2009).

Electric streetcar systems evolved after the development of the electric traction motor in the 1890's. The higher speeds and extended range of electric streetcars relative to horse-drawn streetcars extended the practical uses of transit. The range of the electric streetcars was leveraged by real estate entrepreneurs to access easily developable open land on the periphery of cities (Fogelson, 1967; Carlton, 2009). Once transit put the land within reach of jobs, the entrepreneur-developer could build and sell housing. In this era, transit was acting as an enabler for real estate development.

The decline in transit's prominence was signalled by the rise of the car as a primary transportation mode through the early half of the twentieth century. Up until 1916, the United States were the world's leader in transit rail miles, streetcar ridership, and many other transit metrics. This was primarily motivated by the profits gathered by the real estate developers that installed these streetcar lines. But by 1945, after major disinvestment in transit infrastructure during the Second World War and the depression, the stage was set for the dominance of the automobile. Rail systems were dismantled and replaced by bus transit in most U.S. cities. As cars became more affordable, buses had minimal competitive advantage over the automobile with which they shared lanes. With the development of the Eisenhower Interstate System in 1956 and the promise of quick and easy vehicular access, the proverbial nail was put in transit's coffin (Carlton, 2009).

With the rise and dominance of the automobile came processes of suburbanisation. Baum-Snow (2007) stated that between 1950 and 1990, the aggregate population of central cities in the United States declined by 17 percent despite population growth of 72 percent in metropolitan areas as a whole. Suburbs epitomized the American Dream of home ownership, good schools, low crime, and a supportive family environment (Duany et al., 2000). During the same period the American economy was booming, which led to relatively high welfare. As household income grew, more households moved to the suburbs. Richer households were attracted to larger, newer suburban homes and were no longer willing to live in the central cities, because of concerns about crime and public school quality (Berry-Cullen and Levitt, 1999). An unintended consequence of suburban growth is greater resource consumption leading to greater environmental damage than if more households stayed in the city (Kahn, 2000).

2.2 The urban composition of the Phoenix metropolitan area

As mentioned in the introduction the metropolitan area of Phoenix is one of the fastest growing regions within the United States in terms of population. This increase in population has led to the fact that the land area of the Phoenix metropolitan area is also increasing rapidly. Between 1960 and 1990, the urbanized land area in metropolitan Phoenix grew 199 percent according to the Morrisson Institute for Public policy (2000). This rapid urban growth, which still takes place in Phoenix, features mostly low-density urban development that moves into surrounding agricultural and desert land (Keys et al., 2007).

Given the characteristics of urban growth of the city, Phoenix can be seen as a representative city of the American 'Sun belt.' The Sun Belt is a warm-weather region which stretches from the southwest to the southeast of the United States and covers states such as California, Arizona, New Mexico and Texas. Since the end of the Second World War, people tend to migrate within the United States from colder regions in the Midwest and the Northeast of the United States towards the Sun belt region in the south (Credit, 2017). Urban regions in the Sun Belt are, according to the Economist (2017) and Credit (2017) often urban regions in which there has not been a lot of investment in fixed transit infrastructure and where there is often a strong reliance on the use of automobiles. Phoenix is no exception to that.

Keys et al. (2007) mention that the metropolitan area of Phoenix was largely designed with the automobile owners in mind, especially in the period from 1970 until 2000. Phoenix therefore features mostly wide streets, expansive residential lots and quickly built commercial developments, besides having a large land area. The automobile provides the freedom for individuals to pick home locations at greater distances from their work. As a result, it has made the extent of the sprawl possible. Despite efforts to reduce automobile use in the area (e.g., high occupancy vehicle [HOV] lanes on freeways, the bus system, and the light rail system), the automobile remains the primary mode of transportation in the area (Keys et al., 2007; MAG 2006). Continued reliance on the automobile in urban areas is problematic because of traffic congestion and air pollution (Waits 2000).

Ross (2011) stated that Phoenix is recognized nowadays not only as one of the more sprawling, but also as one of the least sustainable metropolises in the United States. As the city's functions spread to sub-centers and lower density outlying municipalities, the loudest complaints have come from concerns over energy use (air conditioning and the use of automobiles), landscape degradation, and climate and weather (Ross 2011). Housing in the Phoenix metropolitan area mainly consists out of subdivisions of single-family houses, with the majority of new development located at an outwardly expanding urban fringe (Gober and Burns, 2002). Expansion of this nature has been enabled by half a century of transportation policies focused almost exclusively on the automobile (Gober, 2005). According to research done by Keys et al. (2007) the metropolitan area of Phoenix is indeed a rapidly growing, spatially expansive metropolitan area in the American West. For some, it exemplifies automobile-oriented urbanization mirrored in places such as Las Vegas, Albuquerque, and Salt Lake City. To others, Phoenix represents some of the direst problems facing urban growth: increasing water demands, billowing smog creation, and intensifying social isolation (Keys et al., 2007).

Gilham (2002) states that sprawling development characterised by highly dispersed, low-density housing or employment patterns leads to more frequent and longer trips requiring motorised vehicles (especially automobiles) and thus to more overall traffic congestion. In the case of the Phoenix metropolitan area it can be stated that traffic congestion levels as a result of excessive car use are relatively high (Keys et al., 2007; INTRIX, 2018). In addition to this, it is projected that over the next twenty years the population will increase almost 70 percent, regional transportation will rise nearly 80 percent, and congestion levels are expected to rise alongside them (MAG 2006).

Overall, this means that the situation in the Phoenix metropolitan area concerning transportation, built environment and urban development can be seen as rather 'unsustainable'. In addition, Keys et al. (2007) state that the dependency on the usage of automobiles will probably continue to be present. This has led to an increase in the demand for public transport in the Phoenix metropolitan area.

2.3 Transit revival

2.3.1 Introduction

During the “Great Society” movement of President Johnson’s first year in office in 1964, the Urban Mass Transit Act (UMTA) addressed funding inequities in the transportation system. In selling the original legislation to congress, President John F. Kennedy stated:

"To conserve and enhance values in existing urban areas is essential. But at least as important are steps to promote economic efficiency and livability in areas of future development. Our national welfare therefore requires the provision of good urban transportation, with the properly balanced use of private vehicles and modern mass transport to help shape as well as serve urban growth."

Public transport is touted worldwide not only for its ability to relieve traffic congestion, reduce energy consumption, and cleanse the air but also for its ability to support sustainable patterns of urban development (Cervero et al., 2017).

2.3.2 Light rail transit

In the past few years, there has been a growing concern about the viability of these traditional automobile- dependent suburbs which contain single-family houses on their individual lots, as is the case in the Phoenix metropolitan area (Atkinson-Palombo & Kuby, 2011). Ongoing concerns about the sustainability of the ongoing outward-oriented growth and the strong automobile-dependency brought a shift in the policies for transportation and land-use. One of these policies is that of light rail transit, which comes out of a series of initiatives at the local, regional, and state levels to promote urban infill and revitalize downtowns (MAG, 2003).

Light rail transit is a mode of urban public rail transport. Investments in urban public transport are important to offer a real alternative to the car, since cars often cause high levels of congestion and emissions (Mulley et al., 2017). Supporters of light rail transit claim that it could help reshaping the form and quality of urban growth in cities. Light rail transit does so by simultaneously offering a solution to problems of urban sprawl and guiding urban revitalization (Atkinson-Palombo & Kuby, 2011). The availability of an integrated public transportation system has proven in some cases to be an important factor in reducing automobile dependence and providing more opportunity for physical exercise, such as walking or biking to work (Topalovic et al., 2012). Besides that, light rail systems are often implemented with the purpose to fight traffic congestion, generate economic development and accelerate land use changes (City of Phoenix, 2002). According to Joshi et al. (2006) literature of transit accessibility on land-use change has, in general, supported the theory that higher accessibility to rail transit leads to higher land values around transit stops, which in turn results in higher densities of development. The case of the San Francisco Bay Area Rapid Transit (BART) shows that light rail transit overall can have a positive role in shaping metropolitan growth in larger regional contexts, but it also shows that the effects can be very localized (Cervero & Landis, 1997).

2.4 Valley Metro Rail in Phoenix

The light rail system in the Phoenix metropolitan area is called the 'Valley Metro Rail' and is operated by The Valley Metro Regional Public Transportation Authority, more popularly known as Valley Metro. Valley Metro is the authority that is responsible for public transit in and around the Phoenix metropolitan area. Valley Metro is the unified public brand of the regional transit system in the Phoenix metropolitan area. Valley Metro plans, develops and operates the bus, vanpool and light rail systems and alternative transportation programs for commuters, seniors and people with disabilities (Valley Metro, 2017). Valley Metro is the umbrella organization that is divided in Valley Metro Bus, which operates all the public bus transportation, and Valley Metro Rail, which is running all the light rail operations (Valley Metro, 2015). After accepting a referendum in 2004, construction of the Valley Metro Rail started in March 2005 and the structure became operational on December 27, 2008.

The system contains 38 stations that are designed by taking the desert sun and heat into account. As can be seen in the image below, the light rail connects the sub-cities of Tempe and Mesa to the city of Phoenix, as well as the airport and two campuses of the Arizona State University. Valley Metro Rail has helped transform the landscape across the metropolitan areas of Phoenix, Tempe and Mesa. Since construction of the starter line began in 2005, many new and adaptive re-use projects have been completed and others are in various stages of development (Valley Metro Rail, 2017).

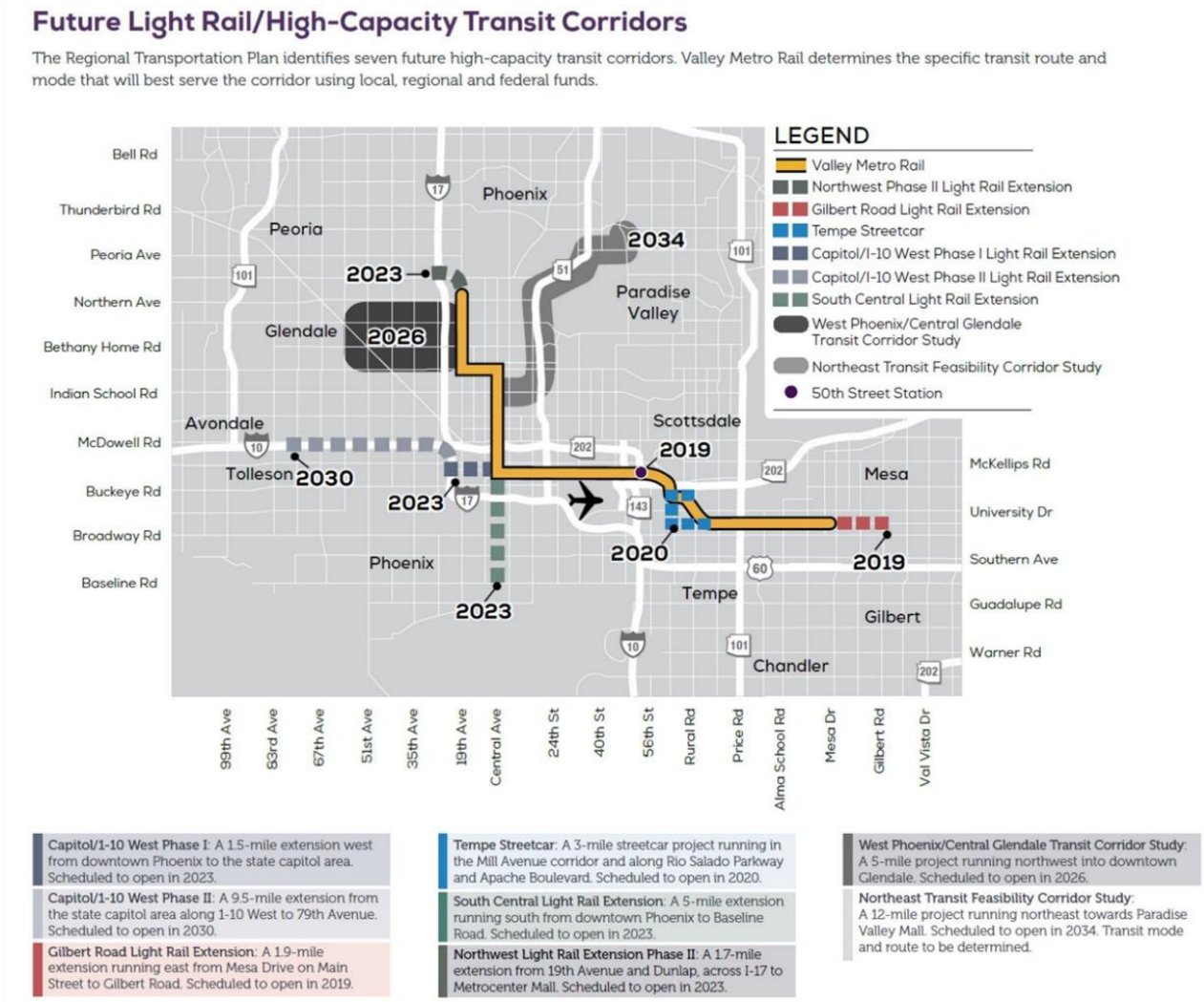

Figure 2: Existing and future light rail transit corridors (Source: Valley Metro, 2015)

In the time of the industrial era streetcars and rail played an important role in the development of the city of Phoenix. By the late 1800s, streetcars provided a significant part of the city's transportation needs, lasting until 1948. As in other cities throughout the United States, conversion to buses and decentralized, automobile-oriented planning led to a relative decline in the importance of public transit. From the 1950s until current times, the Phoenix metro area experienced rapid exurban and suburban growth (Gober 2005). In 1999, after nearly twenty years of debate over the development of high-capacity public transportation, several cities in Maricopa County created a proposal for the Central Phoenix/East Valley light rail project. Supporters of light rail transit development argued that it would stimulate and re-center growth and revitalize downtown Phoenix and the surrounding neighborhoods. Initial investment studies led to a National Environmental Protection Act (NEPA) environmental impact review process beginning in 1999, resulting in a final decision in 2003, with planning and design leading to construction beginning in 2005 (Golub et al., 2012). Regional and local funds contributed 57 percent of the $1.4 billion cost and the Valley Metro light rail opened for service on December 27, 2008. The line now passes through central and east Phoenix and connects with the neighboring cities of Tempe and Mesa to the east. The three cities together include more than half of the population of Maricopa County. As of today, there are 26.3 miles of track and 38 stations.

2.5 Transit Oriented Development

2.5.1 Introduction

Along public transit systems in metropolitan areas a type of development that often takes places is 'Transit Oriented Development' (TOD). TOD is a type of urban development, which focusses on maximizing the amount of business, residential and leisure space within walking distance of public transport (bus stops, train stations, light rail stops) (Cervero et al., 2004). In literature on TOD this walking distance is often expressed as 0.25 or 0.5 mile radius around a single transit station (Arrington, 2003; Atkinson-Palombo & Kuby, 2011; Credit, 2017). The ideas and concept that form the foundation of TOD are based upon creating built environments that discourage the use of the automobile, whilst at the same time promote walking and public transportation. According to Cervero and Kockelman (1997) TOD manifests itself in mixed land uses built at high density at the human-scale, in such a way that it produces places that are conducive to walking, biking, bus and rail. In doing so, TOD aims to increase public transport ridership by reducing the use of private cars and by promoting compact and sustainable urban growth (Cervero et al., 2002). Talen (2011) stresses that creating high density is an essential factor in creating and maintaining walkable, pedestrian-based access to needed services and neighborhood-based facilities, as well as a vibrant and diverse quality of life. According to Boarnet and Compin (1999) TOD is generally accepted to take several years or even decades to unfold. Also the way in which TOD unfolds could be different for each individual station; case studies of individual station areas or projects have shown wide variations in the form of development at station areas (Dittmar and Ohland, 2004).

TODs do not emerge around transit stations spontaneously. They are mostly the products of market forces and careful, strategic planning efforts to guide and nurture transit-supportive growth. Venables (2007) mentioned that the economic drivers of large-scale clustered development around train and busway stops are often pent-up market demands for growth in employment sectors that benefit from agglomeration and spatial clustering (e.g., knowledge-based industries and services). Employment gains in such fields as finance, law, real estate, and architectural design promote mid- and high-rise

development to facilitate face-to-face interactions, knowledge transfers, and deal-making (Venables, 2007).

TOD's growing popularity lies in part in its broad appeal. Cervero et al. (2017) mentioned that if there is any place on a city map where nearly everyone agrees that it makes sense to concentrate urban growth, it is in and around rail stations and major transit stops. Politicians, environmental advocates, real estate developers, and citizens relate to the idea that putting trip origins and destinations within walking distance of stations is beneficial environmentally, socially, and economically.

Yet for most transit corridors, TODs are more the exception than the rule. If the expansive surface parking lots (that some real estate developers have called "underperforming asphalt") and marginal neighborhoods found near many rail stops are any indication, going from the theory of TOD to real-world implementation is often an uphill struggle (Cervero et al., 2017).

2.5.2 New Urbanism and Sustainable Urbanism

TOD can be seen as an aspect of the urban design movement of 'New Urbanism'. New Urbanism is an urban design movement which promotes environmentally friendly habits by creating walkable neighborhoods containing a wide range of housing and job types. (Boeing et al., 2014). The concept of New Urbanism arose in the United States during the early 1980s. It has gradually influenced many aspects of urban planning, real estate development, and municipal land-use strategies. The ideas behind New Urbanism and the practices that pertain to New Urbanism, such as TOD, are strongly influenced urban design practices that were prominent until the rise of the automobile prior to the Second World War.

One movement that arose from the New Urbanism movement is that of Sustainable Urbanism. Sustainable Urbanism can be seen as a similar movement to New Urbanism, since it is based around bringing activities and land uses closer together, being more efficient in terms of infrastructure provision and transport energy use, increasing urban and suburban densities and promoting walkability. Talen (2011) states that sustainable urban form has walkable and connected streets, compact building forms, well-designed public spaces, diverse uses, mixed housing types. This closely relates to the concepts of New Urbanism and TOD. It can therefore be seen as a counter movement to previous generations of city building that promoted mainly car dependent subdivisions, segregated land use, superblock `projects', and physically disconnected housing (Talen, 2011). The places within the metropolitan area of Phoenix that have the potential to catalyze this sustainable urbanism are called 'nodes.' These nodes support sustainable urban form by providing public space around which buildings are organized. It is not a place where all shopping and social interaction necessarily occurs, nor does it need to be literally at the center of a population. Examples of these nodes can be urban core areas, shopping centers, as well as light rail station areas, which coincides closely with the concept of TOD (Talen, 2011).

2.5.3 TOD in the Phoenix metropolitan area

The Phoenix metropolitan area provides an interesting context for the concept of TOD since Phoenix characterizes as a large and rapid growing metropolitan area in terms of population and land area. In the year 2000, eight years ahead of the light rail becoming operational, the city of Phoenix strategically adopted overlay zoning to encourage TOD and to accelerate land-use change (City of Phoenix, 2002). This unprecedented policy sequencing means that TOD can take place in an early stage of the completion of a public transport system. According to Atkinson-Palombo & Kuby (2011) TOD can therefore also be defined as new construction that takes place in station areas after a light rail system

is approved but before it starts operating. Previous research has shown that since Phoenix's light rail line has been operational, neighbourhoods within walking distance of transit stations have experienced a substantial increase in new business start-ups in the knowledge, service and retail sectors when compared with automobile-accessible control areas (Credit, 2017). This is one of the indications that TOD does take place in the case of the Valley Metro light rail.

Due to the outward expansion of the Phoenix metropolitan area, and the subsequent departure of economic activity from the downtown core, city officials have instituted a variety of initiatives, such as light rail systems and the complementary TOD, in order to revitalize the downtown- and central areas. light rail is one of a series of initiatives at the local, regional, and state levels to promote urban infill and revitalize downtowns (MAG, 2003). Besides, these investments in urban public transport are important to offer a real alternative to the car, since cars cause high of congestion and have higher levels of emissions compared to many other modes of transportation, such as buses and light rail (Mulley et al., 2017). According to research done by Renne (2008) sprawl has created an extremely undesirable traffic situation in American cities, such as San Fransisco and Los Angeles, as well as other fast-sprawling cities in the United States. Cities and regions all over the USA, including the Bay Area, are rethinking the expansion of highways, as they often lead to induced travel demand for driving due to expanded low-density sprawl. To a certain extent, rail systems also induce new land development, although with the proper policies in place, these developments could be designed as TODs, which may lead to fewer vehicle trips, reduced emissions, and more sustainable outcomes compared with the conventional low-density sprawl model (Renne, 2008).

2.5.4 Characteristics of TOD

The ITDP (Institute for Transportation & Development Policy) is a nongovernment organization active on the global stage, devoted to advancing sustainable transportation and development. Over the years, ITDP has gained a reputation as an honest broker in representing the interests of cyclists, pedestrians, and transit users (Cervero et al., 2017). In 2017 the ITDP released the 3rd version of The TOD Standard, a case-based, illustrative document aimed at promoting TODs that are highly walkable and that effectively integrate station areas with their surroundings. A panel of TOD experts advised ITDP staff throughout the TOD Standard project. This document acts as a TOD guideline by offering the following eight key objectives that contribute to environmentally sustainable TOD (ITDP, 2017; Cervero et al., 2017).

- Walking: a public realm that is safe, complete, active, comfortable, and vibrant
- Cycling: a cycling network that is safe and complete, with ample and secure parking and storage
- Connectivity: walking and cycling routes that are short, direct, and varied, more so than driving routes.
- Transit service: high-quality transit that is accessible by foot.
- Mixed land uses: diverse and complementary land uses that shorten trip lengths.
- Density: residential and job densities sufficient to support high-quality transit.
- Compactness: developments that infill built-up areas and improve access to other transit hubs.
- Shifting: land devoted to off- and on-street parking and driveways is reduced.

TOD is a type of urban development, which focusses on maximizing the amount of business, residential and leisure space within walking distance of public transport stations (bus stops, train stations, light rail stops). TOD focuses compact growth around transit stops, thereby capitalizing on transit investments by bringing potential riders closer to transit facilities and increasing ridership (Arrington, 2003). Within the communities directly surrounding the transit stations, movement is aimed to be principally by foot. For travel out of the community, often too far to walk and not always easily bikable, transit becomes the preferred travel means. Transit stops thus serve as the conduit for connecting highly walkable, active urban districts and their hinterlands. In many ways, then, TOD can be seen as pedestrian-oriented development. Areas encompassed by walking distance (0,25 and/or 0,5 miles) are interlinked by high-quality, high-capacity public transit (Cervero et al., 2017). In order to reach compact types of development it is desirable that the block sizes in the neighborhoods surrounding the transit stations are small enough to provide a 'pedestrian-friendly' environment.

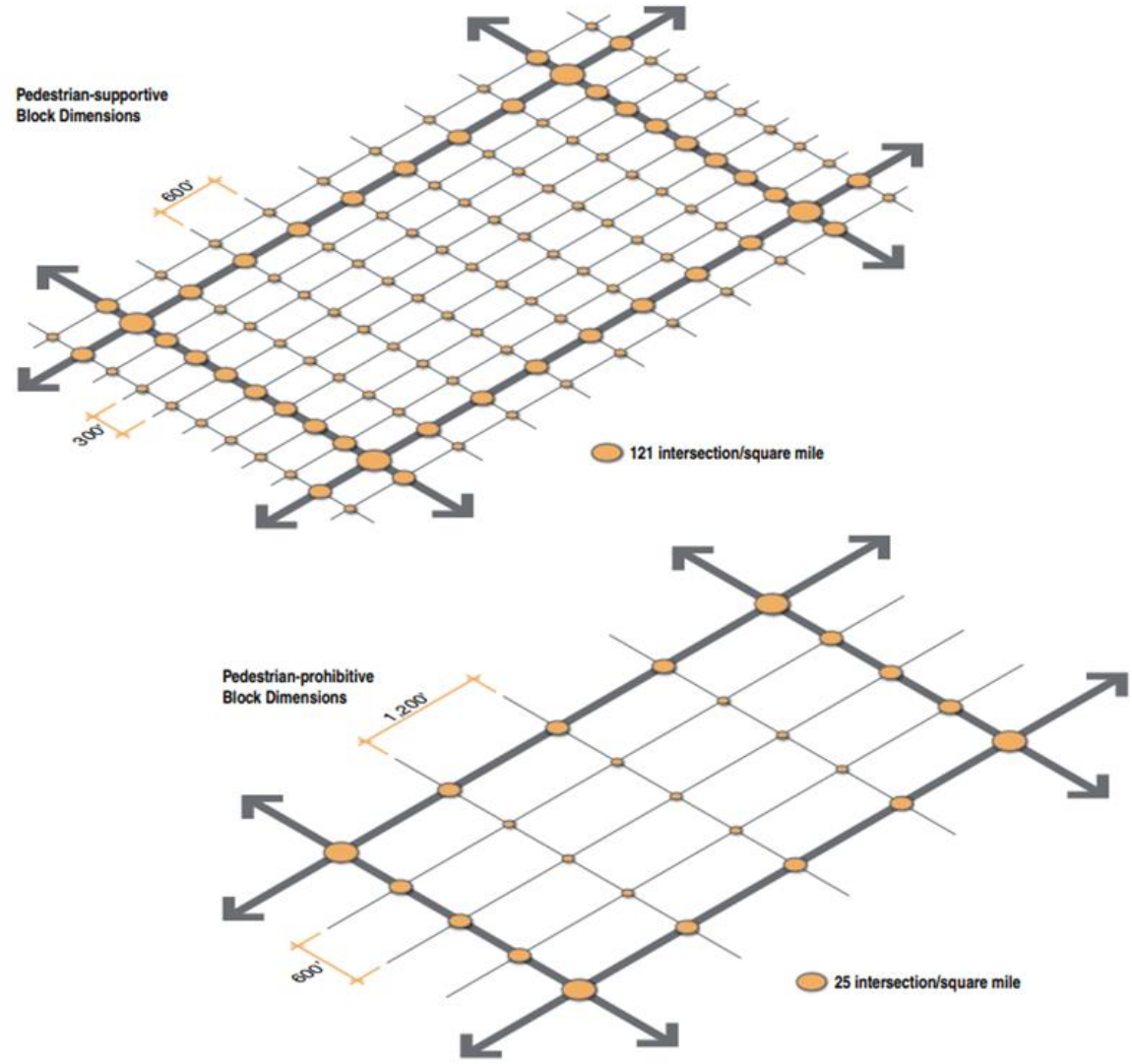

Figure 3. Options for scaling and designing blocks and road frontages. (Source: Pace, 2013.)

Access to transit is often impacted by the size of blocks. Large blocks limit opportunities for direct walking routes and create large segments of roadway that can be difficult to cross for pedestrians, as can be seen in figure 3. A compact street fabric is desirable in order to provide a walkable and pedestrian-friendly environment in which TOD could ideally take place.

2.5.5 Transit Adjacent Development

A relatively new distinction within literature on New Urbanism, smart growth and TOD has been proposed that describes the difference between a transit-adjacent development (TAD) and transit-oriented development (TOD) (Belzer and Autler 2002; Cervero et al. 2002; Dittmar & Ohland 2004). Both concepts refer to the area within a 10-min walk, or half-mile radius, around a major transit station. While a TOD describes a station-area precinct that is compact, mixed-use, and facilitates transit connectivity through urban design, a TAD is "physically near transit [but] fails to capitalize upon this proximity… [It] lacks any functional connectivity to transit – whether in terms of land-use composition, means of station access, or site design" (Cervero et al. 2002).

2.6 Operationalizing TOD

TOD has many characteristics, which makes the concept rather broad and difficult to measure directly. In this research, the focus will primarily lie on the effects TOD has on land use changes, changes in property values and changes in the employment structures. In this operationalization of the concept of TOD certain measurements that are relevant to this research will be displayed.

2.6.1 Land use

When it comes to land use structure, TODs are according to literature focusing on a high-density mix of commercial and residential land uses within walking distance of the transit stops (Cervero, 2004). According to the literature, 8 dwelling units per acre (approximately 5000 units per square mile and a gross density of 4,000 housing units within a half-mile of a station) is approximately the minimum density necessary to support transit ridership and to be qualified as TOD (Newman & Kenworthy, 2006). Thus, given the large investment to build rail infrastructure, it would only make sense that station areas should achieve such a density to generate transit trips, but zoning in many municipalities needs to be rewritten in order to allow for higher densities and mixed-use neighborhoods (Levine, 2006). Only 36% of all station areas achieved a density of 8 units per acre but if all stations were built out to this minimum density threshold, housing supply would only be able to accommodate 11% of the American population by 2050 (Renne, 2013). The availability of light rail transit (regardless of its actual use or impact on actual accessibility) can be used to justify zoning changes or overlay districts, which allow more intense development. Many cities allow or encourage more intense development near light rail stations and this can be a source of further changes in values. Talen (2011) states that land use density is an important dimension in realizing pedestrian-oriented urban forms, access to neighborhood-based facilities and services, as well as a vibrant and diverse quality of life. Also land use diversity is an essential factor for TOD. A mix of residential and commercial land uses that complement each other will promote the active use of neighborhood space at different times of the day.

2.6.2 Property value

Another important effect of TOD according to the literature is the influence it has on nearby property values. While the primary objective of public transportation investments is to improve urban mobility, they can also yield important economic benefits that are unevenly distributed. U.S. public transit agencies claim property development around rail stations as the most significant economic benefit of rail transit investments (Weinstein and Clower 2003). The desire by firms (and households) to be near important transportation infrastructure and the accessibility it brings, can put upward pressure on land and commercial property values and rents. Golub et al. (2012) add to this that several studies have shown that proximity to light rail transit stations positively affects property values and that these effects can possibly even appear before a system opens for operation.

Economic theory suggests that accessibility afforded by public transit can add to the amenities associated with adjacent activities. For example, residents who use the transit system may enjoy reduced travel time while businesses near a transit station can expect lower costs and agglomeration benefits. Thus, traditional location theory would predict that the cost benefits resulting from proximity to transit will be capitalized in the values associated with residential and commercial land uses (Joshi et al., 2006). Light-rail transit has enhanced residential property values by anywhere from 2 to 18 percent, and enhanced office, retail and industrial property values by 4 to 30 percent in various cities, including Portland, Sacramento, San Diego, and Santa Clara (Joshi et al., 2006).

Investments in public transport infrastructure, such as a new rail line, are capitalized totally or partially into nearby land and housing prices (Agostini & Palmucci, 2008). Theory holds that light rail transit might have two effects on residential property values. The first is that proximity to light rail stations might increase property values. The second is that proximity to light rail stations and tracks may decrease property values due to nuisance effects (traffic, noise, etc.). Generally, research shows that properties enjoy positive value impacts from proximity to light rail stations, though results vary based on the specific context and land-use type. Some studies also show no impacts. Most of the research uses hedonic regression or matched-pair– type approaches, which control for similar nearby properties as well as exogenous changes (Golub et al., 2012).

Portland, Oregon, showed property values increased with proximity to stations, up to 100 meters from light rail stations (Chen et al., 1998). Another study in Buffalo, New York, showed that in general, property within a ½ mile of rail stations is valued $2.31 higher (using straight-line distance) and $0.99 higher (using network distance) for every foot closer to a light rail station (Hess and Almeida 2007). A model looking at individual station effects in Buffalo revealed that the impacts are not equal throughout the system: value premiums for station proximity were greater in high-income neighborhoods than low-income neighborhoods. A study of light rail impacts on residential property values in St. Louis showed that proximity was valued at $14 per foot closer to the light rail station, for properties within about a quarter mile (Garret 2004). Atkinson-Palombo (2010) studied the effects of the light rail system in Phoenix and found that both proximity to the planned stations and a transit-oriented zoning overlay had a significant impact on prices for both condominiums and single-family homes in mixed-use neighborhoods.

In the literature, TOD's positive effects on property values and tax revenues are widely viewed as an economic benefit and are key to justifying the high cost of building rail transit infrastructure (Smith and Gihring, 2006).

Markets have penalized proximity to rail as a form of nuisance. For example, Landis et al. (1995) show that proximity to light rail in the case of the Santa Clara light rail had negative impacts on prices, while in the case of Sacramento and San Diego impacts were insignificant (though for San Diego, impacts were positive and significant within the central city). A later study in Santa Clara showed that home values responded positively to proximity, but condominiums did not (Cervero and Duncan 2002). Similarly, earlier studies of heavy rail in Atlanta (Nelson 1992) show that property values increased in low-income neighborhoods but decreased in high-income neighborhoods with increasing accessibility to Metropolitan Atlanta Rapid Transit Authority stations. The opposite result was found in Miami, Florida, where high- income neighborhoods benefited slightly from Miami Metro Rail but no such gains were found in low-income neighborhoods (Gatzlaff and Smith 1993).

2.6.3 Employment

A potential benefit of light rail transit investments is increasing density of both residential and commercial land uses within a close proximity of rail transit stations. Increases in densification are

associated with reduced urban sprawl, increased transit ridership, as well as more employment opportunities for transit dependent individuals (Bollinger & Ihlanfeldt, 1997).

On-going decentralization of firms in US metropolitan areas has led researchers to suggest that transport costs are becoming smaller relative to other production costs. High levels of mobility have made transport considerations less important in the firm's location decision. Firms once bound to certain locations because of the need to keep transport costs low, are now more free to choose locations based upon factors not related to transport costs (Ryan, 2005). Wheaton and Torto (1994) have found that worker amenities and other locational attributes which enhance the working environment for employees have become more influential in a firm's location decision. So it has become a larger priority for these companies to locate themselves close to these amenities.

According to Canales et al. (2019) the demand for transportation infrastructure is for a large part driven by the location and intensity of economic activity. It is therefore important to understand how changes in the distribution of these economic activities affect the transportation system. An important feature in this is that there are certain benefits associated with being close to important transportation infrastructure such as rail transit stations (e.g., increased foot traffic). This can have significant impacts on the accessibility to jobs for workers and commuting patterns (Canales et al., 2019). Research done by Fan et al. (2012). Adds to this that light rail has generated significant job accessibility benefits for workers. The results of their research showed that the benefits were significant for all workers, including low-, medium-, and high- wage workers, of several United States cities.

As modern economies have become increasingly service oriented, transportation costs that firms have to deal with have become more concerned with the movement of people. Light rail transit brings the opportunity to reduce the cost of moving workers and consumers (Canales et al., 2019). Furthermore, the increase in accessibility that rail transit offers can also attract service- and retail firms that seek locations that offer high volumes of (foot) traffic (Schuetz, 2015). Hence, the TOD investments are likely to spur economic activities in the areas surrounding the light rail stations and attract certain types of business to light rail station areas. Joshi et al. (2006) adds tot this that there is often a movement of jobs to new employment clusters along major transportation corridors, such as light rail systems.

Research conducted for the Transit Cooperative Research Program of the Federal Transit Administration in 1996 examined data on 19 light-rail transit systems and 47 commuter-rail systems and concluded that station boardings (transit usage) was positively correlated with both station area residential density and CBD employment density (Joshi et al., 2006).

Localized improvements to the infrastructure of public transit– such as building a light rail station that connects the station's neighbourhood with an employment centre (CBD or subcentre) -- will increase accessibility and decrease travel costs from that location and thereby increase land values, encouraging higher density development near the station (Anas 1995). Neighbourhoods around rail stations should therefore be relatively more attractive both to firms and households. Firms can potentially attract more consumers to convenient locations, particularly in industries such as retail, food service, entertainment and health care, and may offer lower wages to workers at that location. Households will be willing to pay higher rents/housing prices in exchange for lower transit costs (Schuetz et al., 2015). Therefore one could expect to see higher density of both residential and commercial development around rail stations. This means that light rail should also have a positive effect on the total employment density in the areas that the light rail system connects to. However, it must be stated that often the developers and employers are being reluctant to expand employment or construct buildings near a planned station up until a few years after operation (Schuetz et al., 2015).

2.7 Conceptual framework

The conceptual framework below (figure 4) shows the interconnectedness of the key theories and variables that form the basis of this research. In this research the mode of public transit that is being researched is that of light rail transit. The light rail system that operates in the Phoenix metropolitan area is called the Valley Metro Rail.

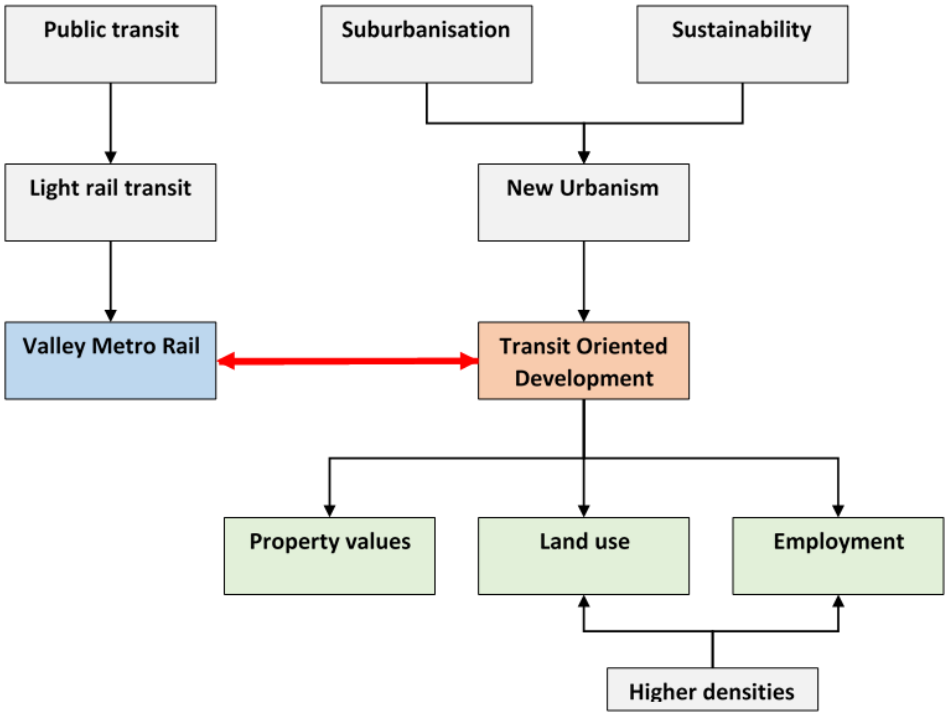

Figure 4: Conceptual model. (Source: author).

The metropolitan area of Phoenix, like many other cities in the United States has experienced processes of suburbanisation, due to the persistent population- and land area growth. The metropolitan area of Phoenix has some problems concerning sustainability, in part due to the processes of strong urban growth, car-dependency and suburbanisation.

New urbanism is an urban design movement that arose to combat problems concerning sustainability and suburbanisation. New urbanism aims to provide environmentally friendly and compact, walkable urban forms. The main concept in this research is that of TOD (orange box). TOD arose from new urbanism, as it aims to develop transit-oriented places in a way that it favours walking and public transit.

The concept of TOD has multiple characteristics, three of which are being further analysed in this research. These three characteristics are: land use, property value and employment, as can be seen in the model (green blocks). Especially regarding land use and employment it is important that developments take place in a way that it allows for high densities.

How the Valley Metro Rail and TOD influence each other is the main premise of this research, hence the red arrow.

Chapter 3: Methodology

3.1 Introduction

This chapter discusses the methodology of this research. In this chapter the choices that were made for the research methods will be explained. First a distinction will be given on the characteristics of the different possible research methods that are most often being used in academic research, mainly in social sciences; namely, qualitative and quantitative research methods. Subsequently the choice for these research methods will be substantiated. In this part an in-depth explanation of the choice for literature study and interviews will be provided. In this part also the choice for the different participants for the interviews will be elaborated upon. Second to last there will be provided an explanation on the way in which the qualitative and quantitative data is analysed. And lastly the ethics of the research will be elaborated upon.

3.2 Research methods

In scientific research, and certainly within the discipline of Geography and social sciences, two different ways of conducting research and collecting data are often distinguished. These two methods of data collection and scientific research are the qualitative one and the quantitative one. O'Leary (2014) states that these two categories of research methods are separate from each other, but that they can also be used together to strengthen the outcomes of the research. Integrating both qualitative and quantitative research methods is often called 'mixed method research.' In this research this type of mixed method research will be used.

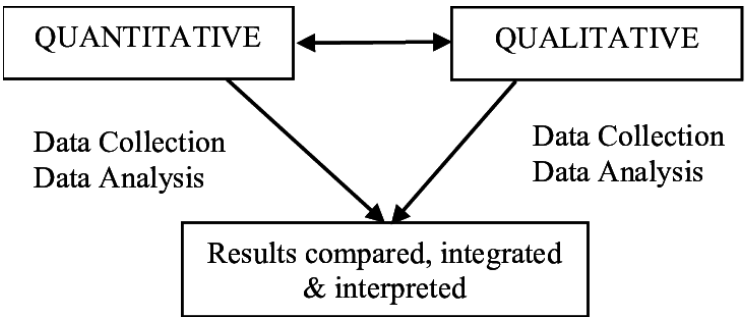

Figure 5: Visual diagram of the Mixed-Methods Concurrent Triangulation. (Source: Creswell & Plano Clark, 2007).

Given (2008) describes quantitative research as the systematic empirical investigation of observable phenomena via mathematical, statistical or computational techniques. The objective of quantitative research is to seek for quantitative relationships and to develop and employ mathematical models, theories, and hypotheses and link those to certain phenomena (Given, 2008). Quantitative methods focus on gathering facts and variables and often use statistic methods to verify or falsify hypotheses (O'Leary, 2014).

Qualitative research methods on the other hand, offer knowledge through exploring meaning and emotions, since human behaviour is often irrational, complex, messy, subjective and contradictory (Clifford et al., 2010). It is key in qualitative research to seek for the underlying meanings, arguments and explanations of certain phenomena, rather than expressing phenomena in quantitative relationships. Qualitative research methods include methods such as in-depth interviews, participant

observation and focus groups (Clifford et al.,2010). The downside of qualitative research is that the findings are often complex and in-depth, and can therefore not be used to make generalizations.

In regards to the research goals and research questions of this thesis, the combination of both quantitative and qualitative methods is viewed as the best possible procedure. After analysing the quantitative and qualitative data, the results that emerge from these two data analysis methods can be compared to each other and can together form an integrated set of results. By doing so the strengths of both research methods are being combined which will increase the validity and reliability of the results (Creswell & Plano Clark, 2007).

3.3 Qualitative data collection

3.3.1 Literature study

Literature study helps to give the researcher ideas, understanding, broadened perspective and will help legitimate the arguments of the researcher (Blaxter et al., 2006). Literature study is done in this research in order to gain knowledge and understanding of the topic. Through literature study, especially during the early stages of the research, I was able to define certain key concepts and terms that were essential to conducting this research. When researching the existing literature on the topic a collection of scientific resources, such as journal articles, books, webpages and policy documents were collected. This collection of mostly scientific resources served as the backbone for the theoretical framework of this research. The acquired knowledge through analysing these resources, has proven to be an essential and important prerequisite for conducting the several interviews.

3.3.2 Semi-structured interviews

One way of collecting scientific data through a qualitative way is that of the semi-structured interview. A semi-structured interview is a verbal exchange between the interviewee and the interviewer. The interviewer attempts to elicit information from the interviewee through asking questions. These questions are predetermined by the interviewer in an interview-guide (Clifford et al., 2010). Semi-structured interviews unfold however in a conventional manner in which the participants get the chance to bring up or explore issues they feel are relevant and important to the topic. Semi-structured interviews are self-conscious, orderly and partly-structured (Clifford et al., 2010).

In this research the choice has been made to formulate the questions on the interview-guide exactly the same as the secondary research questions of this research. In that way the answers that were that were given by the participants during the interviews were in direct relation to the goals and content of this research. During the interviews the interview-guide as shown below was brought and was used to make short notes in order to document the answers that the participants were giving.

Participant name, date, location: ……..

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

……
……
……

b. Is continued TOD likely to take place along these existing segments?

……
……
……

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

……
……
……

b. If so, to what degree and under what conditions can this TOD be expected?

……
……
……

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

……
……
……

3.3.3 Participants

One of the data collection instruments used in this research was to gather qualitative data through conducting semi-structured interviews. These interviews were held with several different people who were in some way related to- and were having experience related to the Phoenix Valley Metro light rail and the Transit Oriented Development that takes place in the Phoenix metropolitan area. The participants for these interviews were mostly found by searching online on relevant websites of certain institutions such as the city council of Tempe, Valley Metro, the Greater Phoenix Economical Council etc.

Before the intended participants for the semi-structured interviews were contacted, a series of three exploratory interviews were held with faculty members of the geography department of the ASU. These interviews happened all relatively short after arriving in Tempe, and were held with the following three faculty members:

Sara Meerow was the first faculty member of ASU with whom an explorative interview in relation to my research was held. Sara Meerow is an assistant professor at the ASU School of Geographical

Sciences and Urban Planning, where she has an expertise is in urban resilience and sustainability. Sara Meerow also acted as the direct coordinator of this thesis during the stay in the United States.

The second faculty member of the ASU School of Geographical Sciences and Urban Planning with whom an explorative interview was held was Ms. Deborah Salon, an assistant professor who has an expertise in transportation and policy.

The third faculty member of the ASU School of Geographical Sciences and Urban Planning with whom an explorative interview was held was Matthew Wigginton Conway, a PhD Student. The expertise of Matthew Wigginton Conway is in urban transportation, transportation demand modeling, and public transport.

Explorative Interviews	**Participant**	**Organisation**	**Expertise**
1 (01-10-2018) Tempe	Sara Meerow	Arizona State University	Assistant Professor at the School of Geographical Sciences & Urban Planning
2 (16-10-2018) Tempe	Deborah Salon	Arizona State University	Assistant Professor at the School of Geographical Sciences & Urban Planning
3 (02-11-2018) Tempe	Matthew Wigginton Conway	Arizona State University	PhD student at the School of Geographical Sciences & Urban Planning

After obtaining contact information of the actual intended participants for the semi-structured interviews, the emails with invitations to take part in such a semi-structured interview were sent. In reality it turned out to be rather difficult to get in touch with many of the intended candidates for the interviews. Many of the invitation-emails remained unanswered, even after sending reminder-emails to those intended interviewees after several weeks. Eventually it turned out to be very helpful to ask the interviewees that did answer the initial emails if they were willing to provide some email addresses or phone numbers of people in their networks. In that way, certain people that the interviewees thought were interesting and relevant people to include in this series of interviews, were brought in contact and were eventually interviewed. This resulted basically in a 'snowball sampling' of interviewees, in which one of the interviewee gives the researcher the name of at least one more potential interviewee. That interviewee, in turn, provides the name of at least one more potential interviewee, and so on (Kirchherr & Charles, 2018).

Eventually twelve participants were able to take part in this research, as shown in the table below. Out of the twelve participants, two were not able to actually participate in a semi-structured interview. These two participants (Elly Huizingh and Joshua Matthews) were however able and willing to give direct answers to the questions on the interview-guide. Therefore their provided information has been processed in the research. The other participants were willing to meet up and engage in an interview, which all lasted between 40 and 80 minutes.

Interviews	Participant	Organisation	Expertise
1 (29-11-2018) Tempe	Elly Huizing	Valley Realty	Manager of regional real estate agents
2 (03-12-2018) Tempe	Donald Cassano	Tempe City Council / Chamber of Commerce	Chairman of Transport and Public Relations Commission
3 (03-12-2018) Tempe	Maria Laughner	City of Tempe	Economic development program manager
4 (04-12-2018) Phoenix	Joshua Matthews	Valley Metro	Planner II, Capital and Service Development
5 (06-12-2018) Tempe	David Crummey	New Town Community Development Cooperation/ RAIL Mesa	Real Estate Development Manager / Board Chairman
6 (11-12-2018) Phoenix	Mitchell Allen	Greater Phoenix Economic Council	Senior vice president of Business Development department
7 (11-12-2018) Phoenix	Bryan Smith	Greater Phoenix Economic Council	Director of Business
8 (17-12-2018) Mesa	Jeff McVay	City of Mesa	Manager of Downtown Transformation
9 (10-01-2019) Tempe	Shannon Scutari	Scutari & Co., LLC	President of Scutari & Co., LLC and former Arizona Policy Advisor for Growth and Infrastructure
10 (10-01-2019) Tempe	Eric Iwersen	City of Tempe	Transit Manager and Senior Transportation Planner for the City of Tempe
11 (15-01-2019) Phoenix	Scott Smith	Valley Metro	CEO of Valley Metro / Former mayor of the city of Mesa
12 (22-01-2019) Tempe	Kate Borders	Downtown Tempe Authority	Executive Director

Valley Metro:

Valley Metro is the transit authority of the metropolitan area of Phoenix. Valley Metro is a membership organization, in which most services are separately funded and operated by individual cities and suburbs in the greater Phoenix region. The cities within the Phoenix metropolitan area have agreed to use Valley Metro as the overarching brand in order to streamline and unify the public transit services in the region.

Greater Phoenix Economic Council:

The Greater Phoenix Economic Council (GPEC) is a development organisation who actively works to attract quality businesses and advocate for the competitiveness of the Phoenix metropolitan area. As the regional economic development organization, GPEC works with 22-member communities, Maricopa County and more than 160 private investors to accomplish its mission, and serve as a strategic partner to companies across the world as they expand or relocate.

The City councils of Tempe and Mesa:
Tempe and Mesa are two neighbouring communities in the Phoenix metropolitan area who both connect to the city of Phoenix. Both Tempe and Mesa have their ow local city councils which are the legislative bodies that govern both cities.

Downtown Tempe Authority:
The Downtown Tempe Authority is a private, non-profit organization that works in partnership with the City of Tempe to increase the value of the Mill Avenue District through enhanced management and promotional services on behalf of DTC members and other downtown stakeholders.

New Town Community Development Cooperation:
The New Town organisation is a Tempe based development organisation of affordable housing. Besides that New Town is a provider of homebuyer education, homeownership counselling, credit counselling, financial coaching, financial literacy education

RAIL Mesa:
The Retail Arts Innovation and Livability (RAIL Mesa) is a nonprofit community development corporation along Mesa's light rail corridor. Its mission is to build and support quality development along the light rail corridor in a cohesive community-centred way.

Scutari & Co., LLC:
Ms. Scutari is a former attorney who has always focused on public policy. Has worked at the city of Tempe as their chief lobbyist, their government relations director where she pushed for light rail, bicycle infrastructure and transit. That's where she established her expertise. Afterwards governor Napolitano appointed Ms. Scutari as deputy director of the Arizona Department of Transportation where she helped create a public transportation division within the department. In 2011 she started her own company where she creates public private partnerships to get the funding and get the political and community support for large infrastructure projects, mainly rail-lines. Currently she is working with the city of Tempe and the private partners on the street car and transit oriented development around the street car. Ms. Scutari has been working with organizations that try to promote housing and land use along transit corridors.

3.4 Qualitative data analysis

3.4.1 Introduction

In the next section an explanation will be given on how the collected qualitative data will be analysed, so that eventually conclusions in relation to the research themes and problems can be drawn. The data that was obtained through conducting several semi-structured interviews with the participants has been processed in this research in order to provide conclusions on how TOD manifests itself along the Valley Metro Rail in the metropolitan area of Phoenix. In order for the researcher to draw conclusions from the obtained data, several steps need to be made. Guthrie (2010) describes three stages of qualitative data analysis:

1. Describe. When writing out the contents of the observation attention should be paid that the reporting is clear descriptive reporting. Irrelevant matters to the research problems and themes should be filtered out.

2. Classify. The material should be grouped in such a way that similarities and differences in data can be identified.

3. Interpret. The interpretation of the data should be presented separately. Key features that identify patterns should be picked out.

When analysing the obtained data from the interviews attention had been paid to Guthrie's (2010) three stages of qualitative data analysis, as presented above. In the next few segments there will be elaborated on how these different steps took place in this research. First of all transcribing has been used as a method to describe the relevant matters of the retrieved data. Secondly an explanation on how the obtained material was classified is given in the segment on 'coding.' And thirdly the interpretation of the data is further elaborated upon in the section of 'reporting results.'

3.4.2 Transcribing

In order to keep track of the important messages and discussions that take place during a semi-structured interview researches often record the audio of the interview. By recording the audio of the conversation between the interviewer and the interviewee, the interviewer can fully focus on the interaction with the interviewee. This can be very helpful, because it takes away the pressure of the interviewer about taking notes of the important messages the interviewee has to say (Valentine, 2005). In this research this method has been applied. During the interviews the audio was recorded and key notes were taken in direct relationship to the sub-research questions of this thesis. After the interviews took place the audio file was listened to and the content of the interview could be written down as a transcript. The number of interviews in this research was rather plentiful and the content of these interviews, which often took more than one hour, was not always relevant to the topic of this research. The choice has been made to not write a full transcript of each of the interviews in which the transcribing happened word for word. Instead the choice was made to basically write an extensive summary of each of the interviews of approximately 2-4 pages. The structure of these interview summaries per participant was, again in direct accordance with the interview-guide or, in this case, the research questions of this research. During the interviews with the participants the conversation often departed from the structure that was presented on the interview guide, hence the 'semi-structured' nature of the interview method. When transcribing the audio files of these interviews the contents of the interviews became structured again by placing certain answers under certain categories, namely the different research questions on the interview guide. In that way the outcomes of the interviews became directly categorized under the separate relevant research themes.

When writing the transcript summaries of the interviews strict attention was paid to categorize and organize the different outcomes of the interviews. This has basically eliminated the need of using coding software programs. All of the transcripts take over the exact form of the interview guide. All of the research questions of this research are presented, and under each of those questions the relevant answers given by the participants are written down. In that way the obtained qualitative data is already categorized in direct relation to the research questions.

In this research sticking close to the research questions when conducting the interviews has proven to be a very pragmatic way of sticking to the core themes of this research. Because of this the necessity of coding disappeared. All of the information and arguments that came out of the interviews were already arranged according to the research questions.

After the transcript summaries of the interviews were finalized and were classified in accordance to the research questions, the results could be reported. In the chapter on results the material and data obtained from the interviews is being interpreted for each of the research questions. Per research question or research theme the different arguments and opinions of the participants are being worked out. Arguments against and in favour of the research themes are being presented and interpreted. After this is done the different results will be synthesised.

3.5 Quantitative data collection

3.5.1 Distinguishing the urban area of Phoenix

With the use of ArcGIS software a series of maps were made in order to portray several of the effects that can be labelled as TOD. The effects of TOD are only observable in urban context, since it is about development that takes place in urbanized environments. Therefore the choice has been made to take only the data into the analyses that say something about these urban environments, rather than non-urbanised areas on the fringes of the metropolitan area.

The Phoenix metropolitan area in this analysis is defined as all the areas that have a population density of at least 100 people per square mile. The choice has been made to take only these areas into the analysis because this research attempts to analyze land use changes in an urban setting. As mentioned by the US Census Bureau (1990) in order for an area to be defined as 'urban' there has to be a minimum population density of 100 people per square mile. The metropolitan area of Phoenix consists out of multiple municipalities. Some of these municipalities which are located on the fringe of the metropolitan area can be seen as extended cities or incorporated places. These places often include large expanses of vacant or very sparsely populated territory (population density less than 100 people per square mile) that are essentially rural in character. In general, this situation results from extensive annexation of adjacent undeveloped territory (US Census Bureau, 1990). In order to leave these areas out of the analysis the areas with less than 100 people per square mile were dropped.

By clipping the datasets with the land area that can be labelled as urban, the rural areas that officially belong to the metropolitan area of Phoenix (or Maricopa County) were left out of the analysis. By doing this the changes that are expected to take place can be compared in a more consistent manner. The original MAG land use datasets, for example, showed extremely large plots of land that were located far outside the urban areas of the metropolitan area. These large plots of land were rural in character and were showing land use codes such as 'commercial high density' and 'mixed use.' For the purpose of this research these rural plots of land were left outside of the analysis of land use changes.

3.5.2 Land use data analysis

Two datasets were used to analyze changes from the existing land use structures, as of 2017, towards the expected future land uses. Both datasets on existing and future land use were obtained though the Maricopa Association of Governments (MAG). The Existing Land Use (2017) dataset was created by integrating GIS datasets from a variety of sources including the Maricopa County Assessor's Office, Arizona State Trust and Federal ownership (MAG, 2019). The dataset shows the composition of the different types of land uses that were present in the year 2017. The second dataset that was used in the analysis of land use changes was is Future Land Use dataset. This dataset was also created by the MAG. This dataset was created by overriding areas with developed and developable land uses (e.g. vacant, agriculture) with expected land uses prescribed within municipal developments and general plans. Depending on the municipality within the Phoenix metropolitan area, there are differences in the extent to which these future land uses will indeed take the proposed shape. In some of the municipal developments and plans there is more certainty that the future land uses will indeed take place. In other development plans the appointed future land use codes act more as a guideline, meaning that it is not 100 percent sure if the land use will indeed emerge in the future. In these cases the future land uses are merely a stated preference by the appropriate municipality and can in reality turn out differently. Conclusions that are being drawn from the future land use dataset should therefore be drawn with care. In the chapter of the land-use analysis, some examples will be

highlighted where the future land use codes will have a relative high chance of becoming reality, because the development plans are in far stages of approval, already approved or are already in the construction phase. When looking at indicators of TOD certain land use codes out of the two datasets seemed particularly relevant. These land use codes are 'mixed use', 'multifamily', 'commercial high density', 'single family high density', 'single family medium density' and 'single family low density.'

3.5.3 Property value analysis

The data that was used to perform the analysis is the 'Median Home Value' dataset that was composed by Zillow. The dataset shows the median home value per square feet at the zip code level in U.S. dollars. The dataset shows these median home values per month for each year for the past 23 years, with the most recent data that was used in this research being that of April 2019.

In the home value analysis the changes in the median home values of both the area surrounding the light rail and the area that is not surrounding the light rail are being compared to each other. A buffer of 0.5 miles was created around the existing light rail segment. The choice of the buffer being 0.5 miles has been made because that is the area where TOD generally takes place. Within a 0.5 mile radius around the light rail distances from- and towards the light rail are still considered walkable and on the pedestrian scale. So therefore TOD generally takes place within a 0,5 mile radius of public transit systems such as light rail (Atkinson-Palombo & Kuby, 2011; Credit, 2017). Within this corridor of 0.5 miles around the light rail the effects of TOD are expected to be best observable. Since the data on the median home values was only available on the zip code area level, the buffer of 0.5 miles around the light rail corridor does not overlap perfectly with these areas of measurement. Therefore, the choice was made to distinguish the zip code areas that, even for a small part, overlap with the 0.5 mile light rail buffer. These zip code areas were named 'zip code light rail' and the resulting zip code areas in the urban part of the Phoenix metropolitan area were named 'zip code no light rail.'

When making the maps the choice was made to portray the median home values for the month of June in the years 2000, 2004, 2006, 2008, 2011, 2015, 2018 and 2019. The same scale of for the median home values has been applied to all eight maps so that they could be more easily compared to each other. The lowest value of 50 was taken in order to show the lowest median home value (in 2000 and 2011) and the highest value of 410 was taken in order to show the highest median home value (in 2006 and 2019). The values in between these maximum and minimum value all fall in 6 equal median home value classifications.

3.5.4 Employment analysis

The dataset that has been used to perform the employment density analysis in this research comes from OnTheMap. OnTheMap, a web-based mapping and reporting application that shows where workers are employed and where they live. The data that is used in this application comes primarily from the U.S. census bureau and EHD Origin-Destination Employment Statistics (2002-2015) (OnTheMap, 2019). The data was extracted from OnTheMap and was then analysed and edited by the use of ArcGIS software in order to make maps of employment density. The data on the job locations of the workers in the Phoenix metropolitan area were firstly portrayed as points with employment values of the total number of jobs. Using ArcGIS a kernel density tool was used in order to create the employment density maps. The maps show the employment density in three different years. Data from the year 2004 was chosen, since that was the earliest year of data being available and since it shows the employment situation before the plans of the Valley Metro light rail were being approved. The second map of the employment density analysis shows the employment density in 2009. The year 2009

was chosen because it was right after the light rail becoming operational. And the final map of the employment density analysis shows the employment density of 2015, since that is the most recent available data and since it shows the data 6 years after the opening of the Valley Metro system. The same scale of the employment densities has been applied to all three maps so that they could be more easily compared to each other. All the values that are within the lower spectrum of the data (values lower than 28,5000) are portrayed in shades of green, whereas all the values that are within the higher spectrum of the data (values higher than 28,500) are portrayed in shades of orange and red.

3.6 Ethics

When making contact with the different participants attention was paid to ask the participants if they were willing to take part in a semi-structured interview in a polite and well-mannered way. In the first email that was sent to each of the participants the question was raised if it was acceptable that the interview would be sound-recorded. In addition to this question the statement was made that the audio-file that would come out of the interview would solely be used for the purposes of this research. In that way the participants were aware of how the actual interview would take shape. Confidentiality of participants was guaranteed at all times by the researcher. It is important that when conducting interviews the interviews take place in a location where the interviewee feels truly comfortable and safe (Clifford et al., 2010). Therefore, when planning the interview with the different participants it was made clear that the interviewee had complete control over the location in which the interview should take place. All but one interview took place at the office or workspace of the interviewee.

Chapter 4: Land use analysis

4.1 Introduction

In this section changes of land use structure in the station areas of the Valley Metro light rail are being analyzed. Two GIS datasets were used to analyze these land use changes, the 'existing land use' dataset and the 'future land use' dataset. The analysis in this chapter aims to distinguish significant changes in the land use structure of the urban metropolitan area of Phoenix. GIS software was used to find land use changes from the existing land use structures, as of 2017, towards the expected future land uses. The results from this analysis are subsequently synthesized with relevant results from the qualitative data analysis (semi-structured interviews) and the results from the literature review.

When looking at indicators of TOD that were mentioned in chapter 2, certain land use codes out of the two datasets seemed particularly relevant since they coincided with what theory suggests can be qualified as TOD. These land use codes of the datasets are 'mixed use', 'multifamily' and 'commercial high density'. The other land use codes in the datasets such as 'industrial', 'office' and 'educational' do not directly indicate levels of TOD and are therefore left out of the analysis.

Firstly, the land use of mixed use is the land use code that is most often mentioned as TOD by several academics who have done research on TOD (Cervero & Kockelman, 1997; Cervero et al., 2002). Therefore comparing changes of the percentages of mixed use development in the light rail corridor to the percentages outside the light rail corridor is very interesting. Again however, it must be stated that the future land use dataset brings no guarantee as to which these land uses will indeed take place in the future. They do however indicate the intentions and overall direction that planners, developers and city officials want to go.

Theory suggests that TOD is a type of development that is a mix of both commercial and residential land uses which must have a high density (Cervero & Kockelman, 1997; Keys et al., 2007). This high density in terms of housing land uses should, according to theory be no less than 8 dwelling units per acre or 5000 units per square mile in order to be qualified as TOD (Newman & Kenworthy, 2006). Therefore an increase in the land use code 'multifamily housing', as opposed to the 'single family housing' land use codes, of the existing land use dataset towards the future land use dataset, will indicate that TOD is increasing as well. Suburban multifamily housing is typically 20–30 units per acre, primarily rental property, and provides an existing and widespread model for bringing density into suburbia (Larco, 2009).

The land use code 'commercial high density' is also relevant for the land use analysis since it indicates that the density is relatively high and that the land use is commercial. This land use code can be seen as a relevant land use code with regards to TOD, since commercial land uses are part of the mix between the land use codes that form the basis for TOD.

4.2 Results semi-structured interviews

4.2.1 Walkability

In accordance with the existing literature on TOD (Atkinson Palombo & Kuby, 2011) many of the participants of the interviews mentioned the idea that TOD happens within a radius of a half mile or a quarter mile. This takes the premise of the developments being within walking distance of the light rail station into consideration. ''Within a half a mile around the stations is where you see most of the development taking place. Especially within a quarter of a mile radius is where you see the most growth.'' (Interviewee 9)

Not all the TOD that is taking place along the light rail is pedestrian-friendly. For TOD to be pedestrian-friendly it is important to have a fabric of the streets that supports that. This fabric of streets will allow for higher densities of certain land uses.

''So in many places we have to retrofit our street system to get a good feel because we built the city streets for the use of around at 35 miles per hour instead of 3 miles per hour. Downtown Mesa, Tempe and Phoenix are successful in this because they have pretty walkable grids. So unfortunately in many places even if there is a ''transit oriented development project'', it doesn't have a very powerful stimulating effect on the outside community because the rest of the walkable fabric of the roads isn't there. It becomes a building in isolation rather than a building that compliments the area that's already there.'' (Interviewee 5)

''We don't yet have or many communities that are actually walkable, So owning a car is often almost necessary […] So light rail has specifically helped those nodes that were already working on being a walkable community, such as downtown Phoenix and downtown Tempe.'' (Interviewee 5)

4.2.2 TOD occurrence

According to several interviewees economic development has occurred along the entirety of the 26-miles of light rail in the Phoenix metropolitan area. *''Based on tracking and research done by Valley Metro over 80% of this development has TOD characteristics […] These characteristics are that the development is high density, mixed-use, small set-backs, pedestrian scale, etc.'' (Interviewee 4)*

Valley Metro reports that in total, over $11 billion in development has occurred since the construction of the light rail began in 2005. This $11billion in development has occurred in areas of ½ mile around each of the Valley Metro stations. This includes over 25,000 new residential units (2,200 of which are affordable housing), over 4,000 new hotel rooms, and over 50,000,000 square feet of new development (Valley Metro, 2018; Interviewee 4). Some examples of significant Transit Oriented Developments that have occurred in the Phoenix metropolitan area include: Marina Heights and State Farm's headquarters, Hayden's Ferry, CityScape, the Phoenix Biomedical Campus, and the Downtown Phoenix ASU campus, among many other developments.

In downtown Phoenix TOD has increased tremendously according to several interviewees. *''Before the light rail there were a lot of vacant lots in the core of the city of Phoenix.'' (Interviewee 9)*

''Downtown Phoenix, 20 years ago was a ghost town. I mean there were people that work down there in the daytime, but no one lived down there. There were no residential towers, there wasn't really housing opportunity, there wasn't an ASU branch down there. […] And since light rail came it's been filling in and so now there's really good strong areas of downtown Phoenix'' (Interviewee 10)

Tempe started to adapt a more urban centric dense development pattern already before the light rail was planned. Since Tempe is a land-lock city, it basically had to step up and be developed more densely within the Tempe city limits. It was important to get a light rail connection in order to get a regional connection between Tempe and the other communities. So it could accommodate the urban growth that was already happening in the core area of Tempe. In Tempe a large number of building permits have happened along the light rail (Interviewee 3). Tempe really focusses on making their streets bikeable, walkable and transit accessible. Those areas around the light rail corridor is where development activity in the city is stronger than any other parts of the city. Those areas along the light rail are also showing the lowest vacancy rates. *''So whenever stuff's being built it's being occupied.''* (Interviewee 10). Development along Apache Blvd, in the eastern direction towards Mesa, however has taken a while longer than those other areas in Tempe. But development there is also starting to happen around the stations.

''We just got the light rail three years ago here in downtown Mesa, and we see a very significant growth in private investments. In the next year or two, when several of these projects, such as a 1500 dwelling units project, start construction and then several more start construction, there's going to be a lot of things going on. We will definitely see a great increase in construction.'' (Interviewee 8)

TOD does, however not take place along each light rail station at the same pace or to the same extent. For TOD to take place in certain areas of Mesa it took longer than in places like Tempe or Phoenix. A reason for this is that Mesa is located somewhat more to the fringe of the metropolitan area compared to Tempe and Phoenix, which are located more centrally in the metropolitan area.

''I mean as Tempe, our proximity to downtown Phoenix, the airport, and basically everything that there is to here, definitely helps speeding up growth and development here. And when it comes to Mesa, the further east you go, the further away you are from everything.'' (Interviewee 3)

Areas that have not seen a lot of TOD along the light rail include the area between Phoenix and Tempe (along Washington Street, between 7th Street and 38th Street), Camelback Road, and 19th Avenue. These areas tend to be more industrial, already built out, or have large quantities of existing (and in some places historic) single-family housing.

In general it can be stated that TOD has taken place along the Valley Metro light rail. There are however certain areas in which TOD took place to a much higher degree and there are places along the light rail where TOD takes place to a lesser degree. ''The development along the existing segments have been mixed; some areas have developed, however others have not met with much growth.'' (Interviewee 1) Most of the TOD that has occurred is focused in three areas according to several interviewees. These areas are distinguished by Interviewee 4 as the Central Avenue Corridor (Central Avenue, from Camelback Road to McDowell Road), Downtown Phoenix, and Downtown Tempe and the ASU Main Campus.

One thing that is very important to take into consideration is the following: A matter that came up in several interviews was that the light rail is not the only driving force behind development in several places along the light rail line. In Tempe the presence of the ASU campus provides a prosperous setting for development to take place near that campus. The fact that light rail is also present in downtown Tempe supposedly strengthens this setting for development to take place even further.

These other driving forces behind development can, however, not be seen secluded from the influence the light rail has had on these developments. Events such as ASU opening up campus in downtown Phoenix or the relocation of the Benedictine University to Mesa happen in conjunction with the developments of the actual light rail. The developments complement each other and act in synergy as a driving force behind development of apartments, restaurants, shops etc.

''You see, the funny thing is ASU has kind of been the driving force behind development as well on the light rail corridor. Not only in Tempe, but everywhere. Downtown Phoenix really kind of underwent a renaissance after ASU put the downtown Phoenix campus. Um, and downtown Mesa is now going to have some ASU facilities, which is driving further development there. So educational assets are also driving a lot of development along the light rail. They kind of work together with the presence of light rail.'' (Interviewee 7)

4.2.3 Continued TOD

Many interviewees stated that TOD will likely continue taking place along the existing segments. They stated that TOD has definitely not yet reached its maximum potential. Valley Metro has the expectation that the developments as a result of the light rail will not come to a stop in the Phoenix

metropolitan area. Valley Metro feels that the city is not even close to meeting the level of capacity and that there is still a lot of empty and developable land.

''There are a lot of places that could be better utilized with higher density developments when you have light rail […] When people and companies see the investment of light rail, it encourages them to be in that area, to invest.'' (Interviewee 11)

Several stations along the existing light rail line are starting to act as important nodes which attract activities and investment. In the direct area around these stations there has been an increase in the number of restaurants, shops, grocery stores, residences and single family houses. Some stations are more suitable to act as such nodes compared to other stations along the existing light rail.

The light rail segment between Mill Avenue and downtown Mesa has a lot of vacant land and has less developed areas. Some interviewees stated that they do not expect that much development will take place along this segment of the line. They stated that the billions of dollars of development almost exclusively takes place along the station areas which already act as nodes. The expectation is that the number of nodes will increase, but that often the planning isn't there to create nodes of TOD and that it cannot be at every light rail station to begin with.

''Tempe has gotten two pretty good nodes around ASU and downtown Phoenix has a series of nodes that are all sort of connected to each other. And so light rail fits well there […] But the area between Mill Avenue and downtown Mesa, is there going to be another node over there that's likely to develop in a transit oriented way? I think there are a too many vacant lots along that segment. And the billions of dollars of development almost exclusively takes place along these existing nodes.'' (Interviewee 5)

''I expect Tempe will just become even stronger of an urban experience and a place where you can do everything you need to do in a relatively compact area, for a large part thanks to light rail and TOD.'' (Interviewee 10)

A one mile portion of the original light rail opened in Mesa in December 2008. Then a section was opened in august 2015, which brought the light rail to downtown Mesa. After this extension connected the light rail to downtown Mesa a lot of developments have taken place. However, since the light rail is present in downtown Mesa for only 3 and a half years, a lot of the development has not fully taken place yet. The expectation is that continued TOD will definitely take place in this relatively new segment of the light rail.

''Since 2015 we are having a lot of TOD projects that we are either in some stage of approval, some stage of planning or in some cases under construction within the downtown Mesa square mile. Some of the projects have been finished, but not that many yet.'' (Interviewee 8)

4.2.4 Future extensions

Recently construction has started on the new Novus Innovation Corridor in Tempe. The Novus innovation corridor is a master development which is planned by ASU, and will take up an area of 330 acres. The development are is located just northeast of the ASU campus in Tempe, along the Rio Salado Parkway. The future street car extension of the light rail, that will become operational in 2021, will also find its route along the Rio Salado Parkway. The developments will all be mixed use development and will be geared towards the public, rather than towards students. The developments will mainly consist out of market rate housing, office complexes, hotels, shops and entertainment facilities. The executive director of the downtown Tempe authority mentioned the following about the recent Novus Corridor developments:

''The executives of the developments along the Novus Innovation Corridor are justifying their developments because of the extensions of the streetcar. They also think the other way around, that the streetcars are going to be needed to get people towards the developments.'' (Interviewee 12)

''I think wherever light rail goes, you're going to develop places where there'll be transit oriented development. It's just too natural. And I think governments have realized that they can give enough flexibility to developers that they can take advantage of the place when there is a presence of light rail.'' (Interviewee 11)

In the city of Mesa the light rail is planned to be extended two miles further eastward into a more suburban area. This extension will start where the previous Mesa light rail extension ended. The so called The Gilbert Road Extension will extend light rail on Main Street from Mesa Drive to Gilbert Road in Mesa. Besides that the city of Mesa is currently doing a study for an extension of the Tempe Streetcar Line so that will come and do a loop through Mesa's downtown. There is also a study about an extension of the light rail that goes down south to the community of Chandler.

Many interviewees have stated that the usage of light rail as an economic development tool and as a tool to accelerate land use changes has been proven to be very successful. Some interviewees however add to this that it has been successful only in limited areas. ''*Places where it is working are for example downtown Tempe and downtown Phoenix. And in places where it might work, the planning needs to be done ahead of time''* (Interviewee 5). And downtown Mesa has done that planning before the light rail extended to there. But in areas along the Gilbert road extension, the Dobson area and the South Phoenix extension that planning ahead of time is perhaps not happening sufficiently.

The two interviewees from GPEC stated that they felt that Phoenix has really done a great job of being progressive in the sense that they passed a one cent sales tax to help fund the extensions of the light rail. Proposition 305 that passed three years ago allowed for expansion of light rail. The first stage of that expansion took place last year. It was the northwest extension took the light rail to the Glendale border in Northwest side of the city of Phoenix. And from the same funding they are adding two more lines. One is the capital extension heading West on Washington Street and the other extension is the one to South Phoenix.

4.2.5 Requirements future TOD

It is important that zoning and planning regulations allow for types of development that are TOD, otherwise these types of development will not happening quickly. Phoenix and Tempe have adopted an overlay zoning policy which encourages and supports TOD's. Policy needs to match development in order to make land use changes. ''*And to reach this good leadership is needed''* (Interviewee 5).

''It is important that the public transportation is safe and effective, and that the TOD is supported by strong land uses policies and zoning codes that ensure the proper type of development is built.'' (Interviewee 4)

''For the downtown square mile of Mesa we adopted a form based code in 2012, that was in anticipation of the light rail and to helped us encourage the TOD development that we wanted. And that covers the majority of the downtown area and it also extends somewhat outward.'' (interviewee 8)

The planned light rail extension in Mesa will take place on Mesa's Main Street from Mesa Drive to Gilbert Road. Jeff McVay the manager of downtown transformation for the city of Mesa mentioned in the interview that the area of this extension is relatively suburbanized. He added that this area consists

mainly out of single family residential neighbourhoods and that therefore TOD will likely happen to a lesser extent.

"The area will not have the same amenities from an entertainment, retail kind of perspective. So no, I don't think TOD is going to happen at the same extent, but I do think that there are certain developable sites along that extension that have a lot of potential. So it might take longer because it's not as, not as urban of an area to start with.'' (Interviewee 8)

In this quote it becomes clear that for TOD to take place more successfully the surrounding environment should ideally be a more urbanised area with more amenities. Mariah Laughner, the economic development manager for the city of Tempe, adds to this that this can also be seen as an argument why a community like Glendale has chosen not to be connected to the light rail system. Besides the argument of the high costs of light rail, Glendale lacks the level of density that could help accommodate TOD along such a transit line. *''However, to my point, if they had built it, they would get the density because then you would create TOD.'' (Interviewee 3)*

Another thing that should be taken into consideration is that TOD does not take place instantly after construction of a light rail line is completed. *''When light rail construction was done in downtown Phoenix, the development didn't happen instantly''* (Interviewee 8). TOD is generally accepted to take several years or even decades to unfold. This is being supported by the views of several interviewees, as well as existing literature on TOD. *'' there wasn't this type of development going on in 2011 even. And the line had already been open for two years'' (Interviewee 9)*

4.3 Results GIS analysis

4.3.1 Mixed Use in Tempe and Mesa

When looking at downtown Tempe and Mesa as examples, drastic predicted changes in the mixed use land use code can be observed. As can be seen in figure 6 of appendix 2 the existing land use structure of Tempe shows that there are not yet many mixed use developments taking place along the light rail. When looking at figure 4 in appendix 2 it can be seen that basically the same can be said about Mesa. In the case of downtown Mesa and even the Gilbert Road extension there are no lots in the proximity of the light rail (or the segment of the Gilbert Road extension) that have a mixed use according to the existing land use data. In the case of Mesa this can be partly explained by the fact that a large segment of the existing light rail in Mesa has only been opened since 2015. Again, this is most likely due to the developers and employers being reluctant to expand employment or construct buildings near a planned station until a few years after operation (Schuetz et al., 2015).

In figures 5 and 7 of appendix 2 the future land use structures of the mixed use developments in Mesa and Tempe are portrayed. It can be observed that in Tempe there is a significant increase in the number of mixed use developments that are predicted to take place in the light rail station areas. Also in the areas surrounding the future Tempe Streetcar extension there can be seen a large increase in the amount of mixed use development. Along the proposed Street Car extension of the light rail in Tempe future mixed use land codes can be observed in the green area along the southern shore of Tempe Town Lake (figure 7 of appendix 2). When looking at the future land use data in Mesa (figure 5 of appendix 2) it can be observed that the number of lots with a mixed use code are expected to increase significantly as well. A very large proportion of the downtown square mile is expected to have a future land use code of mixed use. Also there will be some areas along the yet to be opened Gilbert Road Extension that are expected to change into mixed use development.

The data on existing and future land use suggests that the communities that are connected to the light rail are expected to change their land use codes into that of mixed use as a result of light rail being present or being planned. This is in accordance with what literature on TOD suggests. After all TOD is often described as high density mixed use developments that take place within walking distance (0,25 and 0,5 miles) of the light rail stations (Arrington, 2003; Atkinson-Palombo & Kuby, 2011). It must be stated however that some of these anticipated future land use codes might turn out different in reality.

4.3.2 Comparing percentages of land use

In figures 1, 2 and 3 of appendix 1 the tables are shown which give the number of square miles of each of these land use codes. The tables also show the percentage that the land areas of these land use codes represent in relation to the urban metropolitan area as well as a series of 0.25 and 0.5 buffers around the light rail segment, the light rail stations and the three extensions of the light rail system that are in the furthest phases of development.

Based on the percentages that are shown in figures 1, 2 and 3 of appendix 1, it can be observed that the majority of the analyzed land use codes do not really show significantly higher percentages within the light rail buffers compared to the areas outside of the light rail buffers.

The most striking result from this analysis is the expected growth of the 'mixed use' land use code. The total percentage of the mixed use land code changes from 0,0016% in the existing land use data set towards 3,43% in the future land use dataset. When looking at how this percentage of the total expected mixed use relates to the expected mixed use in the buffers around the light rail we see that around the light rail the expected percentage of mixed use is even higher. Within a buffer of 0.25 miles around the existing light rail corridor a percentage of 5,16 is expected to consist out of mixed use.

An interesting finding is that within 0.25 and 0.5 mile buffers around the planned extensions of the light rail there is a relatively lower percentage expected to be mixed use when compared to the rest of the urban metropolitan area. These percentages are 1,49 and 2,23 respectively.

However when looking at a 5 mile buffer around the light rail, as can be seen in the table (figure 1, 2 and 3 of appendix 1), a significant concentration of mixed use can be seen along the light rail. The percentage of mixed use within a 5 mile radius is only as high as 0,65.

4.4 Conclusion

Based on the content of the semi-structured interviews it can be stated that TOD, in terms of land use, has taken place to a certain extent along the existing segment of the Valley Metro Rail. Several developments have taken place along the light rail corridor which have had an impact on the land use structure. The expectations of the majority of the interviewees was that TOD is likely to also take place along the planned extensions of the light rail line.

Results from the GIS land use analysis are partly in agreement with the results from the qualitative part of this research. The GIS analysis suggests that along the majority of the light rail corridor (especially in downtown Tempe and Mesa) there will be an expected increase in mixed-use land use codes. In the future land use dataset more areas are zoned as mixed use, when compared to the dataset on existing land uses. This does however, not imply that these areas have changed or will change into mixed use. The other land use codes that were analysed in the GIS analysis, such as the commercial and single family housing land uses do not show significant changes compared to the areas outside of the light rail corridor.

Again, as mentioned above, it is important that the conclusions regarding future land use codes should be drawn with care. The MAG database on future land use codes is based on the general plans of the individual communities in the Phoenix metropolitan area. For some of the municipal developments and plans there is more certainty that the expected future land uses will indeed take place. In other development plans the appointed future land use codes act more as a guideline, meaning that it is not 100 percent sure if the land use codes will indeed be realised in the future. The fact that a parcel of land is coded as mixed use is an important prerequisite, but does not offer sufficient certainty that this land use code will indeed be realised. One way to determine whether or not a certain development is likely to take place is to look at what stage of development the plan is in. Some plans are merely in the stage of being recently proposed, others are already in stages of construction.

The TOD that has taken place has not been evenly distributed alongside the different segments of the light rail line. The billions of dollars of development mainly take place along the station areas that already act as nodes, such as downtown Phoenix and downtown Tempe. The expectation is that the number of nodes will increase, so that for example downtown Mesa will also act as a node, but that often the planning isn't there yet to create nodes of TOD.

It is therefore important for the future TOD developments that the municipal zoning-laws and codes allow for certain developments to take place that can be labelled as TOD. Based on several interviews these zoning laws and codes are being more and more implemented along existing segments, as well as future extension areas of the light rail.

Chapter 5: Property value analysis

5.1 Introduction

Several researchers have stated that light rail transit has a positive effect on property values and in turn lead to higher tax revenues. This positive effect the light rail transit and the accompanying TOD has on property values is often used to justify the choice for light rail and TOD (Bohman & Nilsson, 2016). The relative increase in accessibility provided by the new transit investment is the primary factor in increasing property values (Bohman & Nilsson, 2016).

Neighbourhoods around rail stations should be relatively more attractive both to firms and households. Firms can potentially attract more consumers to convenient locations, particularly in industries such as retail, food service, entertainment and health care, and may offer lower wages to workers at that location. Households will be willing to pay higher rents/housing prices in exchange for lower transit costs. Therefore it is expected to see higher density of both residential and commercial development around rail stations. Whether and how much land values increase near stations should depend on the extent of improved accessibility to the location; for instance, stations that link to larger and denser rail networks should have greater impacts on land values. Rail lines that simply replace existing bus transit service have little impact on accessibility, and hence should not influence land values. Station effects will likely be highly localized, within one-quarter to one-half mile of the stations, because most passengers access rail stations by walking (Schuetz et al., 2015).

5.2 Results semi-structured interviews

According to the interviewees of the semi-structured interviews the majority of property values along the light rail have increased since the opening of the light rail.

''When you look at evaluations of properties around the light rail you'll be able to see the increase of property values. There's certainly a multiplier effect there when you bring that in, because everything becomes just that much more valuable for certain developers at least.'' (Interviewee 6)

Two interviewees of GPEC mentioned that since the light rail opened, the property values in the station areas have gone up. Also they mentioned that new apartments and condos have opened, businesses have popped up, and the access to the universities has become better. Those are all seen as effects of the presence of the light rail. They stated that numerous studies have shown that TOD can promote economic development and increase nearby property values by improving transportation accessibility and offering a more liveable environment.

Several interviewees mentioned that in the relative short history of TOD planning along the light rail in the metropolitan area of Phoenix, there have been some unintended consequences. One of those consequences is that of gentrification. As a result of the light rail, developments are taking place which are increasing densities and are increasing the rental costs. So people are getting worried that certain areas along the light rail are not affordable to live anymore. In order to combat this negative side effect attention should be paid to insert affordable housing policies and plans. In this way there will be opportunities provided for working class people to be able to afford to live in these areas. This is important since working class people are often using the light rail. *''We have to be very careful and we have to do our best to have an overarching policy and code that helps to really address maintaining a percentage of our housing to be affordable.'' (Interviewee 10)*

5.3 Results GIS analysis

The data that was used to perform the analysis is the 'Median Home Value' dataset that was composed by Zillow. The dataset shows the median home value per square feet at the zip code level in U.S. dollars. The dataset shows these median home values per month for each year for the past 23 years, with the most recent data that was used in this research being that of April 2019.

In the home value analysis the changes in the median home values of both the area surrounding the light rail and the area that is not surrounding the light rail are being compared to each other. A buffer of 0.5 miles was created around the existing light rail segment. Within this corridor of 0.5 miles around the light rail the effects of TOD are expected to be best observable. Since the data on the median home values was only available on the zip code area level, the buffer of 0.5 miles around the light rail corridor does not overlap perfectly with these areas of measurement. Therefore, the choice was made to distinguish the zip code areas that, even for a small part, overlap with the 0.5 mile light rail buffer. These zip code areas were named 'zip code light rail' and the resulting zip code areas in the urban part of the Phoenix metropolitan area were named 'zip code no light rail.' The median home value per square feet in U.S. dollars of these two collections of zip code areas can be seen in the graph below (figure 6) and the table (figure 4 of appendix 1). When looking at the table in appendix 1 it can be seen in which periods the median home values were higher in the 'zip codes light rail' compared to 'zip codes no light rail' and vice versa. The darker shade of green shows the zip codes with the higher median home values, the lighter shade of green shows the zip codes where the median home values were lower. Overall, it can be seen that both the areas inside and outside the light rail corridor generally follow the same pattern in the period between 2000 and 2019.

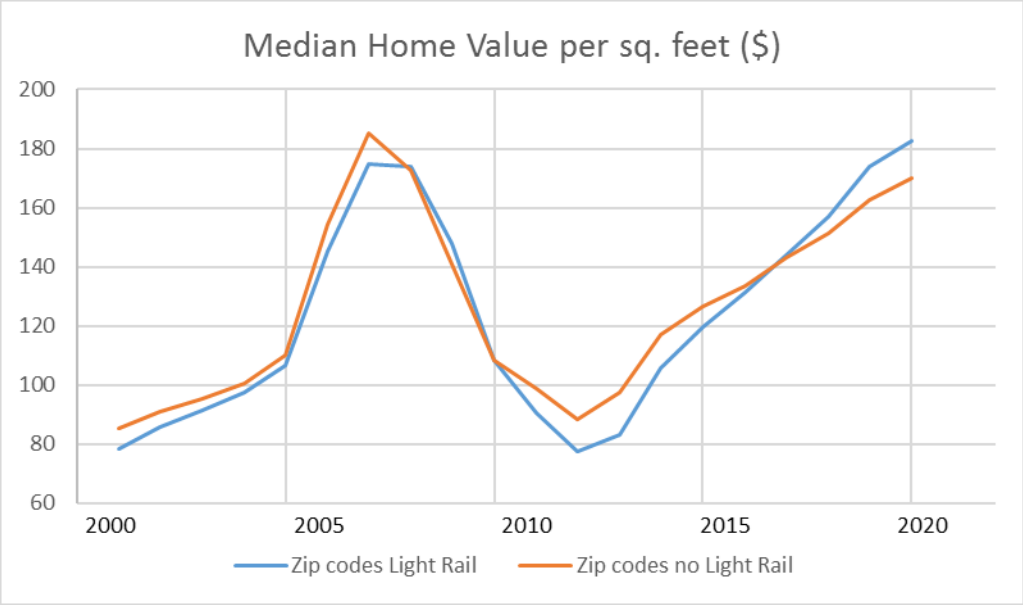

Figure 6: Graph of median home values in zipcodes with- and without light rail (Source: author).

In order to compare the developments of the median home values in a more detailed way the choice was made to look at two different time periods. The first time period that is distinguished in this research is the period of the development- and construction phases of the light rail. These phases took place between the years 2000 and 2008. The second time period that is distinguished in this research is the period between 2009 and 2019. This period is characterised by the Valley Metro light rail being operational, since the light rail opened on December 27th 2008, and the planning of the future extensions of the light rail system.

When making the maps the choice was made to portray the median home values for the month of June in the years 2000, 2004, 2006, 2008, 2011, 2015, 2018 and 2019. The same scale of for the median home values has been applied to all eight maps so that they could be more easily compared to each other. The lowest value of 50 was taken in order to show the lowest median home value (in 2000 and 2011) and the highest value of 410 was taken in order to show the highest median home value (in 2006 and 2019). The values in between these maximum and minimum value all fall in 6 equal median home value classifications.

Period 2000 - 2008

The first median home values that are taken into this analysis are those of the year 2000. In the year 2000 the first sales tax plan was approved by the Phoenix voters which was aimed to improve the overall transit situation with the formation of a new light rail system (Valley Metro, 2000).

In figure 8 of appendix 2 it can be seen that in June 2000 the median home values in the zip code areas that have an overlap with the 0.5 mile light rail corridor buffer are all within the range of 50 – 110 dollar per square feet. These zip code areas which have an average of 78,5 dollars per square feet, whereas the rest of the urban zip code areas have a slightly higher average median home value of 85,5 dollars per square feet. The median home values in the communities of Scottsdale and Paradise valley are the highest within the metropolitan area.

In June 2004, with the plans of the Valley metro light rail taking shape, it can be observed that the median home values in the zip code areas along the light rail corridor increase together with the home values of the zip code areas outside the light rail corridor. In figure 9 of appendix 2 it can be observed that the zip code areas in downtown Phoenix and downtown Tempe show relatively higher median home values than the majority of the rest of the zip code areas.

When construction on the light rail began in March 2005 the growth of the median home values coincidentally began to increase even more. In June 2006 it can be observed that the overall median home values in the Phoenix metropolitan area have increased stronger than the period between 2000 and 2005. It can be seen in the graph above (figure 6) that the overall median home values reach a peak height in the period between 2000 and 2008. In figure 10 of the appendix 2 it can be seen that the zip code areas in downtown Phoenix and Tempe are still relatively high compared to the other zip codes in the Phoenix metropolitan area.

When looking at June 2008 it can be seen that there has been a decrease in the median home values in the Phoenix metropolitan area. This sudden decrease of the home values could be explained by the financial crisis that began in 2007 when there emerged a crisis in the housing market, which in turn lead to an international banking crisis (Duchin et al., 2010).

Period 2009 – 2019

On December 27th 2008 the Valley Metro light rail became operational. However, in the period after opening, the median home values in both the light rail zip code area and the other zip code areas in the metropolitan area pf Phoenix kept on declining. Again, this could be explained by the financial crisis that took place around that period. Duchin et al. (2010) conclude in their research on the effect of the 2008 financial crisis on corporate investment, that corporate investment declined significantly following the onset of the crisis. This decline in investment might explain why the value of the homes in the Phoenix metropolitan area and specifically in the zip code areas along the light rail corridor have

declined as well. This period was characterized by developers not taking part in risky investments (Duchin et al., 2010).

After 2011 the median home values started to increase again, but still the median home values along the light rail corridor were lower than the other median home values in the metropolitan area up until the year 2016. After 2016 the median home values along the light rail corridor surpassed the median home values outside the light rail corridor. In the period between 2016 and 2019 it can be observed that the zip code areas in the light rail corridor have experienced a significantly higher growth of the median home values than the zip code areas outside the light rail corridor. As Boarnet and Compin (1999) mentioned in their research; the effects of TOD might not unfold within the first few years of opening of a light rail system. They add to this that in some in can even take decades for TOD to unfold. In the case of the Valley Metro it can be stated that these home value-effects of TOD did not really take place in the period of the initial plans, development, construction and opening of the light rail system. The effects took place when the light rail system had already been operational for a couple of years.

5.4 Conclusion

According to the interviewees of the semi-structured interviews the majority of property values along the light rail have increased since the opening of the light rail.

As a result of the increase in property values some areas along the light rail corridor have experienced gentrification and are expected to experience gentrification in the future as well. In order to combat the gentrification that is supposedly taking place to a certain extent, attention should be paid to adopt affordable housing policies and plans into the general development plans of the communities within the Phoenix metropolitan area. In this way there will be opportunities provided for working class people to be able to afford to live in these areas that are threatened by processes of gentrification. This is important since working class people are often using the light rail.

Based on the GIS median home value analysis it can be stated that in the period between 2000 and 2019 the median home values within- and outside the light rail corridor have developed rather in the same manner. Especially in the period before the financial crisis the median home values in the light rail corridor were not developing in a significantly different way compared to areas outside the light rail corridor.

However, since the year 2011 the median home values within the light rail corridor have grown in a slightly higher pace compared to the areas outside the light rail corridor. Around the year 2016 the median home values in the light rail corridor have surpassed the values of the areas outside the corridor, and are continuing to grow at a higher pace up until present times. This could coincide with what theory suggests on the matter. The home value-effects of TOD have not been taking place in the first few years of opening of the light rail system. Now that the Valley Metro Rail is operational for several years, finally the TOD effects, in the form of median home values, might be noticeable. It must be stated however that the period in which the median home-values in the light rail corridor are higher than the median home values outside the light rail corridor, is only a period of approximately 3 years. It could very well be possible that in the future the median home values change. Several more years need to pass by in order to state with more confidence that the median home value-effects of TOD have emerged. Perhaps the measure unit of the ‘median home value’ is too broad to fully grasp the effects of TOD that are taking place. Future research should therefore distinguish different types of home values, such as top tier and bottom tier as well as single family housing and multi-family housing for example.

Chapter 6: Employment analysis

6.1 Introduction

By implementing the Valley Metro light rail system the local and regional governments in the Phoenix metropolitan area have invested in a public transit infrastructure that connects some of the sub-cities within the Phoenix metropolitan area to each other as can be seen in figure 17 of appendix 2. Many of these cities act as employment centres. One of the premises of light rail transit is that it is a means to connect employment centres to each other and connecting employment centers to places of residence. Research done by Schuetz et al. (2015) focused on how light rail systems catalyse the development of high density, mixed-use housing and commercial activity within walking distance of rail stations. In their research Schuetz et al. (2015) also examine whether light rail can bring about changes in the number of jobs around the station areas.

6.2 Results semi-structured interviews

''Areas that have had high density of jobs have seen the biggest benefit of light rail […] places that are job-weak like Mesa, Apache Boulevard and 19th avenue have not seen the same level of investment.'' (Interviewee 5)

Based on the obtained data in this research it can be stated that downtown Mesa has truly transformed itself in the last five years as a result of the light rail extending to there. The main street in downtown Mesa used to be not so vibrant and not very thriving. *''And now you have all kinds of nice little things happening. People can easily walk around and visit shops, restaurants and entertainment, and that's also when you get TOD. You then get things like Benedictine University opening a campus there and just more businesses relocating to downtown Mesa.*'' (Interviewee 3)

''I think the success of our light rail system has been extreme. The numbers are really good. The businesses along the light rail corridor have seen a lot of growth.'' (Interviewee 3)

So because of the connection of the light rail to certain areas cause those areas to become more thriving and it transforms the area into a place where businesses wish to locate themselves. Several interviewees mentioned that the same thing has happened in downtown Phoenix when ASU decided to open up a 2nd campus there. Downtown Phoenix used to be rather deserted and lifeless before the light rail and the ASU campus located over there.

''And right now, where the campus is, there's a lot of activities going on and you see people all the time. […] you would not have that if it were not for the transit and the transit oriented development.'' (Interviewee 3)

According to Valley Metro one of the reasons that light rail is built is to attract urban development that is dense and pedestrian-friendly. *''Based on the current and past progressions, it would appear that TOD should follow the light rail extensions.'' (Interviewee 4)*

One of the planned extensions of the Valley Metro in one that will connect downtown Phoenix to South Phoenix. This new light rail line will operate from downtown Phoenix along Central Avenue and will have it's terminal at Baseline Road. There is, however, some opposition against this extension of the light rail system from several shop owners. These shop owners are afraid that their businesses are

going to be harmed with the opening of the light rail. Several interviewees have stated that this fear is rather unfounded. They state that previous openings of light rail segments in Phoenix, Tempe and Mesa have proven to have had a positive effect on the success of the surrounding businesses. *''Of course there is always some short term inconvenience during the construction phase''* (Interviewee 3). But Valley Metro is trying to help facilitate these opposing shop owners as much as possible. The overall expectations are positive, given the characteristics of South Phoenix and given the previous examples of light rail lines opening in the metropolitan area and how this has generated TOD. Several interviewees feel confident that TOD will happen along the South Central Phoenix extension and that the light rail will positively influence the business climate over there. *''At the end of the day the extension of the light rail is only going to help their business.''* (Interviewee 3)

Several interviewees stated that they felt positive that TOD can be seen as a way to combat the problem of bedroom communities. In the metropolitan area of Phoenix there are a lot of people who live in a certain community but commute to another community every day. *''There are a lot of bedroom communities in the metropolitan area. Gilbert is an example of such a bedroom community where let's say 90% of the people commute out.'' (Interviewee 6)* The city of Mesa is being praised as an example where TOD helps a community change from a bedroom community into a more thriving community where there are also jobs, rather than primarily residential areas.

''But light rail has done a great job of bringing business there. So now people are starting to commute towards Mesa from the outside. So when there is TOD and it's accessible to potential employees that's a good thing. It actually kind of counteracts the urban sprawl where everyone is kind of commuting into the central area and then going out.'' (Interviewee 6)

If future extensions will reach communities that are now disconnected, like Peoria, Chandler, Glendale etc. it will become more attractive to live and work in those places rather than people just living there. So more businesses opportunities and opportunities for people to work (besides retail) will occur in those places. We have seen this happen in Mesa.

6.3 Results GIS analysis

The dataset that has been used to perform the employment density analysis in this research comes from OnTheMap. OnTheMap is a web-based mapping and reporting application that shows where workers are employed and where they live. The data that is used in this application comes primarily from the U.S. census bureau and EHD Origin-Destination Employment Statistics (2002-2015) (OnTheMap, 2019). The data was extracted from OnTheMap and was then analysed and edited by the use of ArcGIS software in order to make maps of employment density. The data on the job locations of the workers in the Phoenix metropolitan area were firstly portrayed as points with employment values of the total number of jobs.

In the case of the Valley Metro Rail the employment centres that are connected by the Valley Metro light rail system have been certain areas in downtown Phoenix, uptown Phoenix, Tempe and Mesa. As can be seen in figure 16, 17 and 18 of appendix 2. These employment centres have shown a high concentration of employment density. The employment density maps depict this pattern; it can be observed that the light rail corridor connects the areas where employment density is the highest in terms of total jobs. When looking at the total amount of jobs, it can be observed that the highest concentration of employment is in the downtown area of Phoenix and to a lesser extent in Tempe and Mesa. It can also be observed that employment density of total jobs is relatively high in the community of Scottsdale, but that the light rail system has not yet connected to there.

Neighborhoods around rail stations should be relatively more attractive both to firms and households. Firms can potentially attract more consumers to convenient locations, particularly in industries such as retail, food service, entertainment and health care, and may offer lower wages to workers at that location. Households will be willing to pay higher rents/housing prices in exchange for lower transit costs (Schuetz et al., 2015). Therefore one could expect to see higher density of both residential and commercial development around rail stations. This means that light rail should also have a positive effect on the total employment density in the areas that the light rail system connects to.

However, based on the employment density data that is shown in figures 16, 17 and 18 there cannot be any significant increases in employment density observed in the areas that the light rail connects to. In this case the data is not yet in accordance with the theory or with outcomes of the qualitative part of this research. An explanation for this could be that in order for more significant changes of employment density to take place, more time needs to pass by indeed. The most recent data on employment density (figure 14 of appendix 2) shows that there have not been any significant increases in employment density after the light rail had been operational for 6 years. It could very well be that in order for these increases to fully take place more years, or even decades, needs to take place and that 6 years after becoming operational is just a too short amount of time.

6.4 Conclusion

According to the interviewees the effects of TOD, in terms of employment structure, have certainly taken place in the areas surrounding the light rail stations. Places that already had a relatively high density of employment, such as downtown Phoenix and downtown Tempe have experienced an increase in the number of businesses and jobs since the opening of the light rail.

However, when looking at the results from the GIS employment density analysis these increases in the number of jobs, that were mentioned by several interviewees, are less visible or not visible at all. The changes in employment density in the core areas surrounding the light rail have shown to be rather constant over the past years, instead of showing significant increases in the number of jobs. The supposed downtown Mesa transformation that was mentioned in some of the interviews is not visible at all in the GIS analysis.

This indicates that there is a mismatch between the obtained results from the qualitative and quantitative analyses of employment. A possible explanation for this could be that some of the interviewees were not completely objective in their views on the effects of the Valley Metro Rail and the accompanying TOD.

It must be stated however that the most recent employment density data that was used was that of the year 2015, which is only 6 years after the opening of the initial light rail line and is the exact same year when the downtown Mesa extension became operational. The employment effects of TOD could possibly not have taken place yet, since the effects of TOD often take several years to decades to fully unfold.

Also the data that was used showed the employment density of the total amount of jobs. Perhaps distinguishing the type of job would help provide a clearer view on the TOD employment effects. Perhaps showing the employment density changes over time of office- or retail jobs would show significant changes within the light rail corridor. Further research should focus on analysing employment changes per employment sector.

Chapter 7: Conclusion

7.1 TOD along the Valley Metro Rail

In this thesis a mix of qualitative and quantitative research methods were used to explore and analyse the effects of the concept of TOD that take place along the Valley Metro light Rail in the metropolitan area of Phoenix. Based on a literature review, a series of semi-structured interviews and a series of GIS analyses a moderate positive conception towards the effects of TOD in relation to the Valley Metro Rail and the Phoenix metropolitan area can be held.

In general the effects of TOD are visible or are becoming more and more visible along the current existing light rail line. The majority of the interviewees had positive attitudes and conceptions towards the Valley Metro Rail and the TOD that is taking place in the Phoenix metropolitan area. It became clear that since its opening in 2008 the Valley Metro Rail has had an influence on many developments that can be labelled as TOD. However, based on the quantitative part of this research not all of these supposed TOD effects of the light rail are yet visible. Several more years need to pass by for the long term effects of the Valley Metro Rail to become more visible.

7.2 3 analyses

From the interviews it became clear that several developments have taken place along the light rail corridor which have had an impact on the land use structure, and that these TOD developments are expected to continue to take place along the existing light rail lines, as well as along the planned extensions. The TOD that takes place and is expected to take place is predominantly located in the core areas along the light rail line, such as downtown Phoenix, Tempe and Mesa. future TOD developments should be allowed for by municipal zoning-laws and codes, since those are not yet always in place to support TOD.

The GIS analysis and the qualitative analyses suggest that along the majority of the light rail corridor (especially in downtown Tempe and Mesa) there can be a significant increase in mixed-use land use codes expected. However, the other land use codes that were analysed in the GIS analysis, such as single family housing and commercial land uses, do not show significant changes compared to the areas outside of the light rail corridor. The results from the qualitative part of the analysis and the quantitative part of the analysis seem to be not completely in line with each other.

It is important to note that the conclusions regarding future land use codes should be drawn with care. some areas in the future land use dataset are labelled as mixed use, this does not mean however that these areas will indeed become mixed use areas. These future land use codes are merely the expected or intended future land use codes. It is not completely certain that these land use codes will indeed be implemented in the future.

Not all of the anticipated effects of TOD have taken place yet. Based on GIS analyses it can be stated that the home value-effects of TOD have not been taking place in the first few years since the opening of the light rail system. Only in the most recent past few years a significant increase in median home values in the light rail corridor versus the areas outside the light rail corridor can be observed.

According to the interviewees the effects of TOD, in terms of employment structure, have certainly taken place in the areas surrounding the light rail stations. Places that already had a relatively high

density of employment, such as downtown Phoenix and downtown Tempe have experienced an increase in the number of businesses and jobs since the opening of the light rail.

However, when looking at the results from the GIS employment density analysis these increases in the number of jobs, that were mentioned by several interviewees, are less visible or not visible at all. The changes in employment density in the core areas surrounding the light rail have shown to be rather constant over the past years, instead of showing significant increases in the number of jobs. Here, again, the results from the qualitative- and quantitative parts of the analysis do not perfectly match.

7.3 Reflection

Many of the effects of TOD that are mentioned in existing literature on TOD have taken place or are taking place to a certain degree taking place along the Valley Metro Rail and can be expected along future segments of the Valley Metro Rail as well. However, in several occasions there is a strong mismatch between the results from the qualitative part and the quantitative part of this research.

On the one hand, the results from the semi-structured interviews are for a large part in accordance with the effect that TOD has as stated in the literature. The conceptions of the interviewees seem to be overly positive towards the effects of the light rail and TOD.

On the other hand, results from the quantitative part of this research show a different perspective. The GIS analyses do not show that the effects of TOD are taking place to the same extent that was suggested by the qualitative part of this research.

One possible explanation for this mismatch could be partly found in the fact that the quantitative data that was used in the analyses was not exactly perfect. The data that was used was imperfect or lacking to a certain extent. Firstly, the quantitative analyses that were performed were perhaps too broad to fully grasp and portray the effects of TOD in a sufficient manner. The analyses have simply not resulted in extremely concrete results. And secondly, there are external factors at play that partly influence the extent to which TOD takes place or not takes place. These external influences are for example: the financial crisis and ASU opening up a campus in downtown Phoenix. All in all it has proven to be difficult to research the effects of light rail and TOD in this context.

When looking at the property value analysis, the only variable that was used was that of the median home value of all the homes. Future research should therefore distinguish different types of home values, such as top tier and bottom tier as well as single family housing and multi-family housing for example. When looking at the employment analysis the data that was used was only available in the years 2004, 2009 and 2015. Perhaps more recent data would have shown some significant changes in the employment structure. Besides that, in the employment analysis the focused was only on the total amount of jobs. Perhaps distinguishing the type of job or the job sector would help provide a clearer view on the TOD employment effects. It is possible that employment density changes over time of office- or retail jobs would indeed show some significant changes within the light rail corridor. Further research should therefore focus on analysing employment changes per employment sector.

Another possible explanation for the mismatch could be found in the objectivity of the qualitative data. The data that was obtained through the series of semi-structured interviews has proven to be rather positive in relation to the Valley Metro Rail and TOD in the Phoenix metropolitan area. The results from the qualitative part of this research should therefore be treated with care. Many of the interviewees held overly positive attitudes towards the Valley Metro Rail and TOD. It seemed that often the

interviewees had a certain stake in relation to the light rail and TOD, and were therefore not completely objective.

As theory suggests, the effects of TOD often take several years, or sometimes even decades to fully unfold. So perhaps this is also the case with the Valley Metro Rail and TOD, and perhaps will the effects of TOD start to become more and more visible in the near future because of this time lag. Until now the quantitative data suggests that the time has not yet come for TOD to fully occur.

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Figure 1

Land area Total:			Land area Mixed Use:			Land area Multi Family:		
	sq. mile			sq. mile	percentage		sq. mile	percentage
Existing Land Use 2017:	**3185,521**		**Existing Land Use 2017:**	**0,05185**	**0,00163**	**Existing Land Use 2017:**	**54,3751**	**1,706945**
0.25mile station	57,87018		0.25mile station	0,039221	0,06777	0.25mile station	2,10128	3,631024
0.5mile station	72,55185		0.5mile station	0,039221	0,05406	0.5mile station	3,685169	5,079359
0.25 mile corridor	67,46938		0.25 mile corridor	0,039221	0,05813	0.25 mile corridor	2,968647	4,399991
0.5 mile corridor	77,75214		0.5 mile corridor	0,039221	0,05044	0.5 mile corridor	4,131478	5,313652
0.25 mile corridor ext	54,03438		0.25 mile corridor ext	0,020537	0,03801	0.25 mile corridor ext	0,947101	1,752775
0.5 mile corridor ext	60,32881		0.5 mile corridor ext	0,029796	0,04939	0.5 mile corridor ext	1,614893	2,676819
Land area Total:			Land area Mixed Use:			Land area Multi Family:		
	sq. mile			sq. mile	percentage		sq. mile	percentage
Future Land Use	**3158,087**		**Future Land Use**	**108,4063**	**3,43266**	**Future Land Use**	**65,84458**	**2,084952**
0.25mile station	57,87018		0.25mile station	3,085665	5,33205	0.25mile station	1,901409	3,285645
0.5mile station	72,55185		0.5mile station	3,743002	5,15907	0.5mile station	3,52082	4,852833
0.25 mile corridor	67,46938		0.25 mile corridor	3,479817	5,15762	0.25 mile corridor	2,851105	4,225776
0.5 mile corridor	77,75214		0.5 mile corridor	3,859918	4,96439	0.5 mile corridor	4,040977	5,197255
0.25 mile corridor ext	54,03438		0.25 mile corridor ext	0,807185	1,49384	0.25 mile corridor ext	0,878236	1,625328
0.5 mile corridor ext	60,32881		0.5 mile corridor ext	1,343939	2,22769	0.5 mile corridor ext	1,757633	2,913422
5 mile buffer Light Rail	442,2463		5 mile buffer Light Rail	2,88332	0,65197			

Figure 2

Land area Total:			Land area Commercial High:			Land area Single Fam. High Density :		
	sq. mile			sq. mile	percentage		sq. mile	percentage
Existing Land Use 2017:	**3185,521**		**Existing Land Use 2017:**	**15,40196**	**0,4835**	**Existing Land Use 2017:**	**350,1967**	**10,99339**
0.25mile station	57,87018		0.25mile station	0,279129	0,48234	0.25mile station	3,88306	6,709949
0.5mile station	72,55185		0.5mile station	0,315399	0,43472	0.5mile station	6,270937	8,643387
0.25 mile corridor	67,46938		0.25 mile corridor	0,299655	0,44413	0.25 mile corridor	4,941397	7,32391
0.5 mile corridor	77,75214		0.5 mile corridor	0,35518	0,45681	0.5 mile corridor	7,320694	9,415425
0.25 mile corridor ext	54,03438		0.25 mile corridor ext	0,188477	0,34881	0.25 mile corridor ext	2,983423	5,521343
0.5 mile corridor ext	60,32881		0.5 mile corridor ext	0,232684	0,38569	0.5 mile corridor ext	4,088119	6,776395
Land area Total:			Land area Commercial High:			Land area Single Fam. High Density :		
	sq. mile			sq. mile	percentage		sq. mile	percentage
Future Land Use	**3158,087**		**Future Land Use**	**29,3183**	**0,92836**	**Future Land Use**	**385,2055**	**12,19743**
0.25mile station	57,87018		0.25mile station	0,078534	0,13571	0.25mile station	3,968514	6,857614
0.5mile station	72,55185		0.5mile station	0,13489	0,18592	0.5mile station	6,738399	9,287702
0.25 mile corridor	67,46938		0.25 mile corridor	0,150371	0,22287	0.25 mile corridor	5,076097	7,523556
0.5 mile corridor	77,75214		0.5 mile corridor	0,225561	0,2901	0.5 mile corridor	7,489817	9,63294
0.25 mile corridor ext	54,03438		0.25 mile corridor ext	0,227361	0,42077	0.25 mile corridor ext	3,848246	7,121848
0.5 mile corridor ext	60,32881		0.5 mile corridor ext	0,268319	0,44476	0.5 mile corridor ext	4,714195	7,814168

Figure 3

Land area Total:			Land area Single Fam Medium Density:			Land area Single Fam Low Density:		
	sq. mile			sq. mile	percentage		sq. mile	percentage
Existing Land Use 2017:	**3185,521**		**Existing Land Use 2017:**	**117,5627**	**3,69053**	**Existing Land Use 2017:**	**140,4358**	**4,408566**
0.25mile station	57,87018		0.25mile station	0,736194	1,27215	0.25mile station	0	0
0.5mile station	72,55185		0.5mile station	1,881509	2,59333	0.5mile station	0,031308	0,043153
0.25 mile corridor	67,46938		0.25 mile corridor	1,677503	2,48632	0.25 mile corridor	0,003109	0,004608
0.5 mile corridor	77,75214		0.5 mile corridor	2,18948	2,81597	0.5 mile corridor	0,043353	0,055758
0.25 mile corridor ext	54,03438		0.25 mile corridor ext	0,86413	1,59922	0.25 mile corridor ext	0,067085	0,124152
0.5 mile corridor ext	60,32881		0.5 mile corridor ext	0,943457	1,56386	0.5 mile corridor ext	0,118188	0,195906
Land area Total:			Land area Single Fam Medium Density:			Land area Single Fam Low Density:		
	sq. mile			sq. mile	percentage		sq. mile	percentage
Future Land Use	**3158,087**		**Future Land Use**	**202,1657**	**6,40152**	**Future Land Use**	**259,8064**	**8,226704**
0.25mile station	57,87018		0.25mile station	0,717367	1,23961	0.25mile station	0	0
0.5mile station	72,55185		0.5mile station	1,9041	2,62447	0.5mile station	0,028258	0,038949
0.25 mile corridor	67,46938		0.25 mile corridor	1,597511	2,36776	0.25 mile corridor	0,000056	8,3E-05
0.5 mile corridor	77,75214		0.5 mile corridor	2,097851	2,69813	0.5 mile corridor	0,040303	0,051835
0.25 mile corridor ext	54,03438		0.25 mile corridor ext	0,84405	1,56206	0.25 mile corridor ext	0,067101	0,124182
0.5 mile corridor ext	60,32881		0.5 mile corridor ext	0,914952	1,51661	0.5 mile corridor ext	0,108539	0,179912

Median Home Value per square feet ($)		
Year - Month	Zip codes light rail	Zip codes no light rail
2000 - 06	78,5	85,5
2001 - 06	85,7	91
2002 - 06	91,6	95,5
2003 - 06	97,4	100,5
2004 - 06	106,6	110,3
2005 - 06	145,3	154,3
2006 - 06	174,6	185,1
2007 - 06	174,1	172,8
2008 - 06	147,8	140,9
2009 - 06	108,4	108,2
2010 - 06	90,4	98,7
2011 - 06	77,6	88,2
2012 - 06	83	97,7
2013 - 06	105,6	117,2
2014 - 06	119,8	126,8
2015 - 06	131,2	133,5
2016 - 06	143,9	143
2017 - 06	157	151,4
2018 - 06	174,1	162,8
2019 - 04	182,5	170,1

Figure 4

Appendix 2: GIS maps

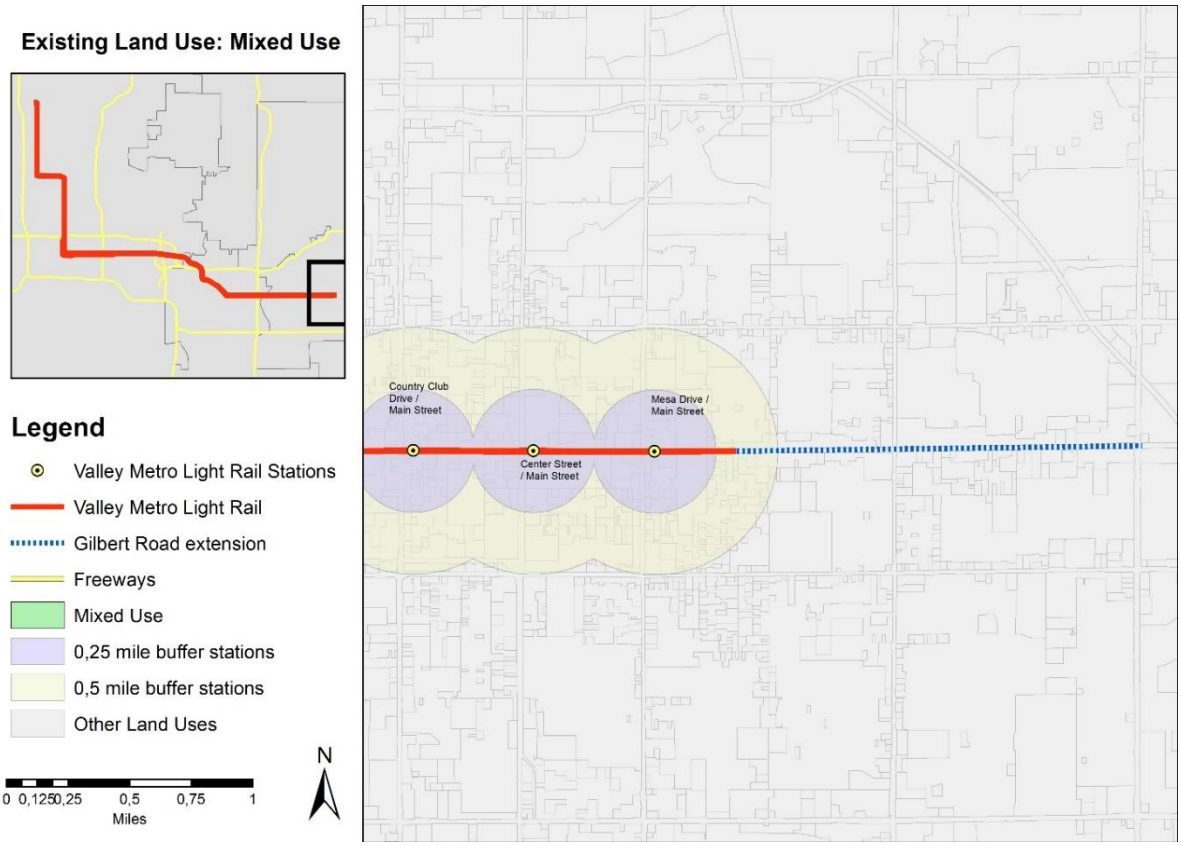

Figure 4: Mesa existing land use 2017

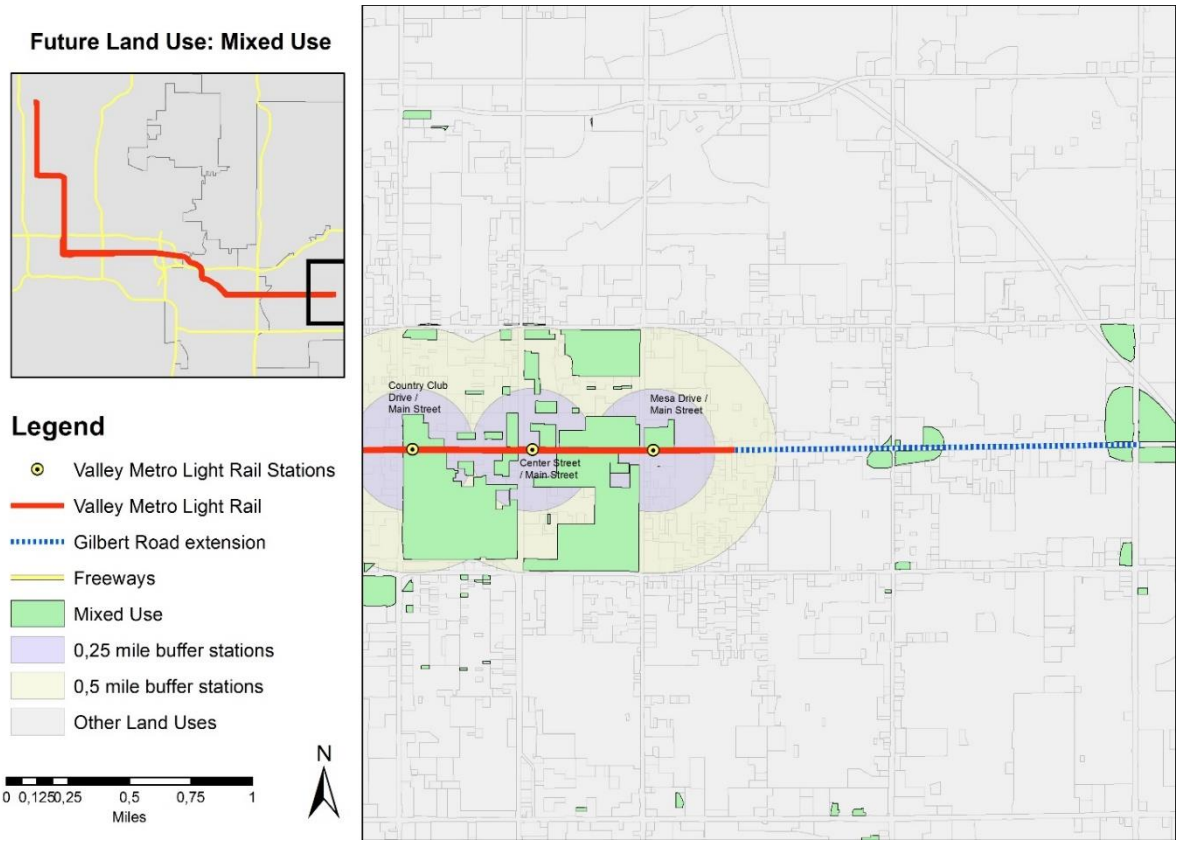

Figure 5: Mesa future land use

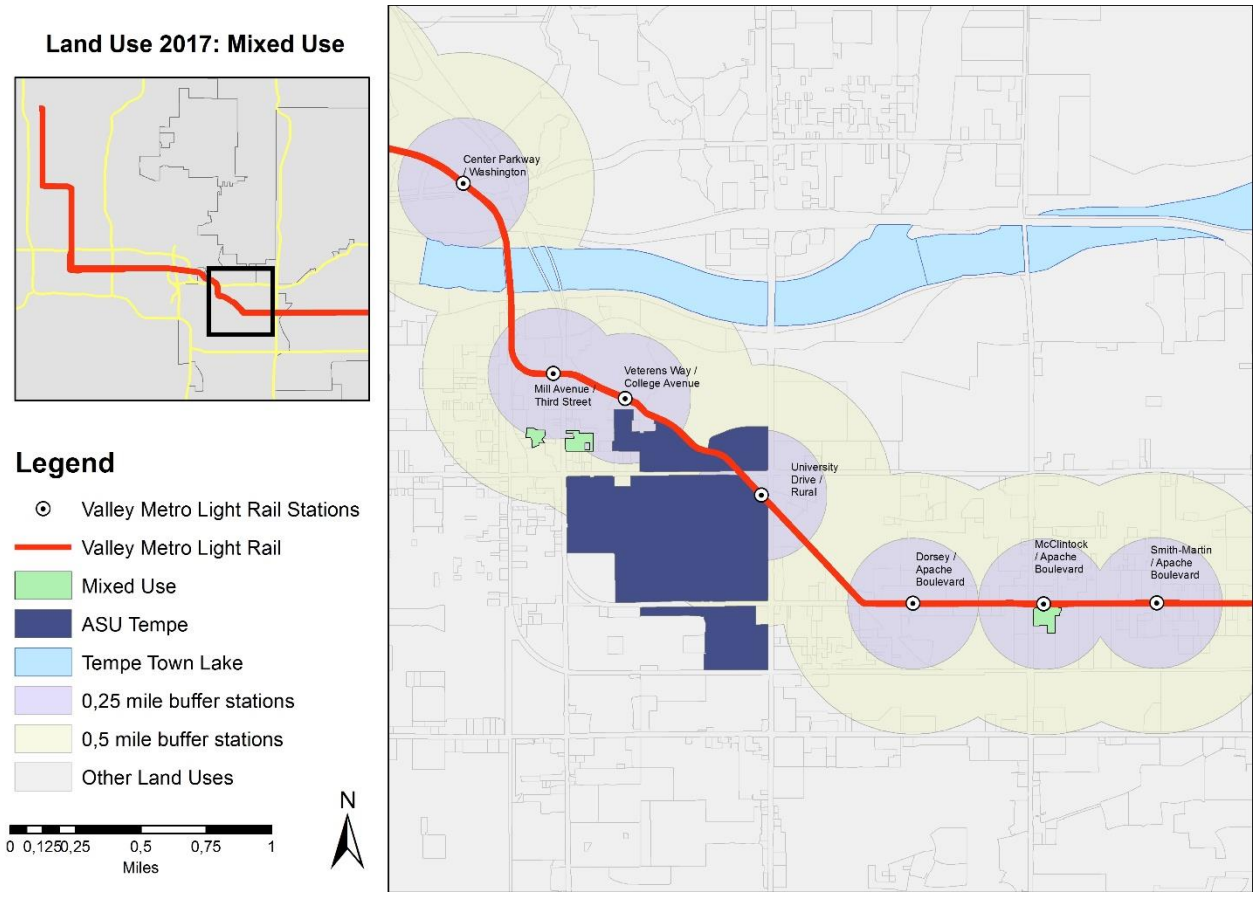

Figure 6: Tempe existing land use 2017

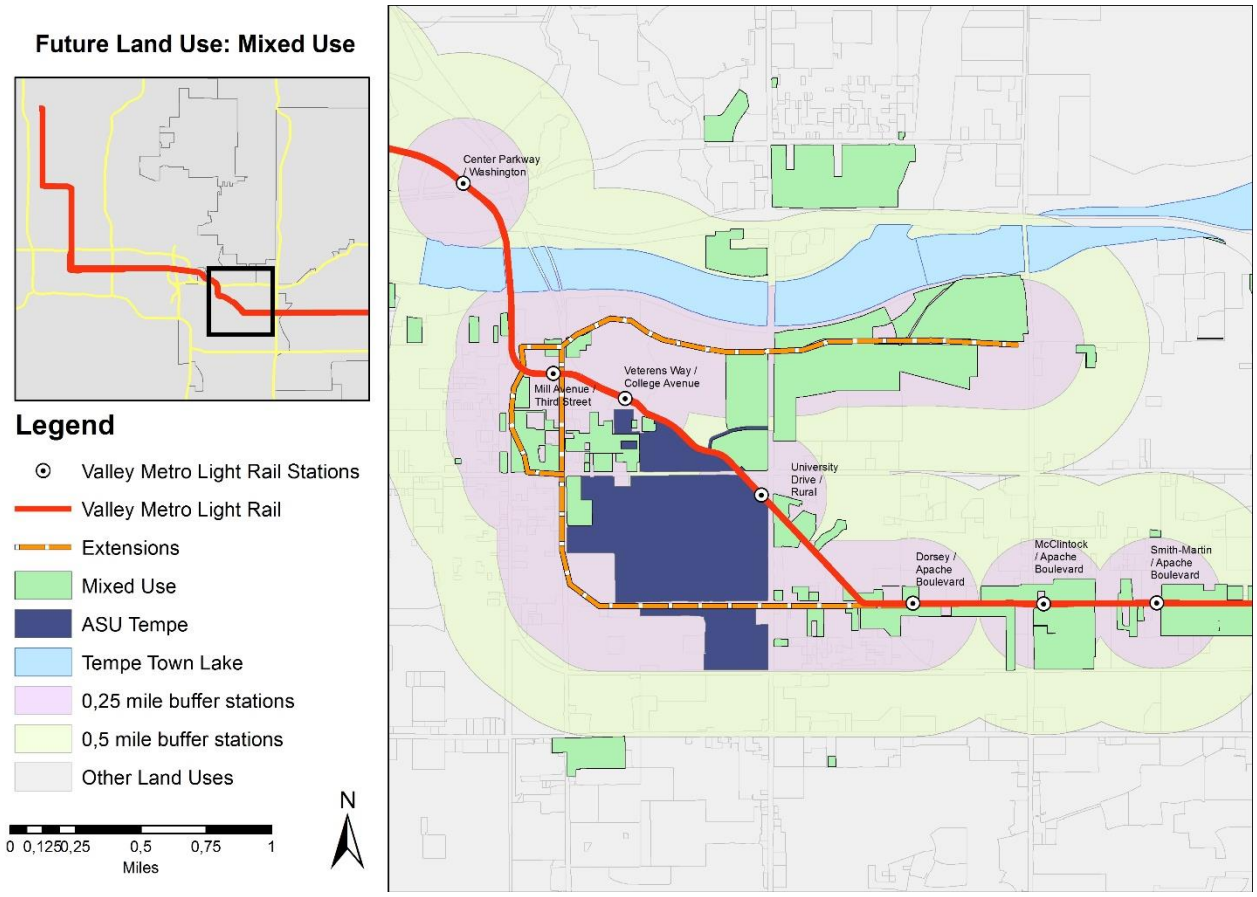

Figure 7: Tempe future land use

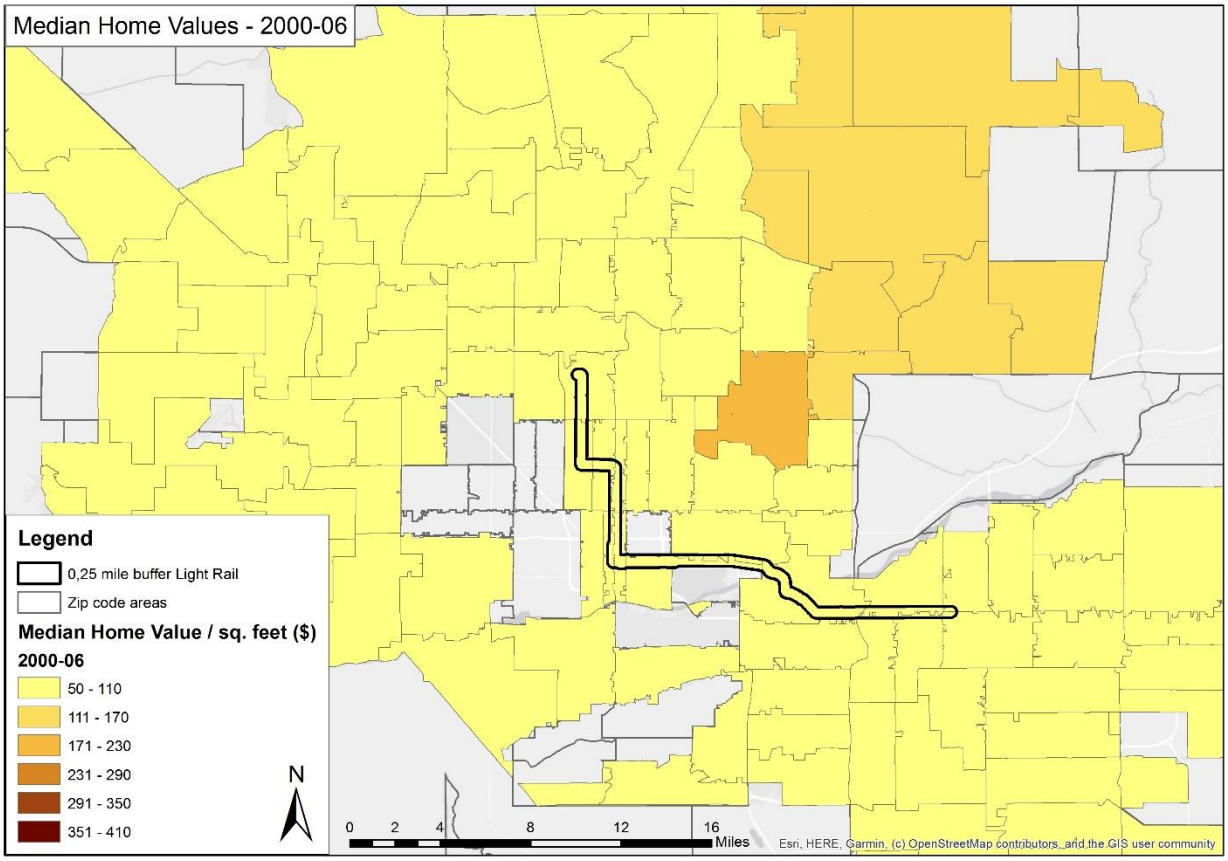

Figure 8

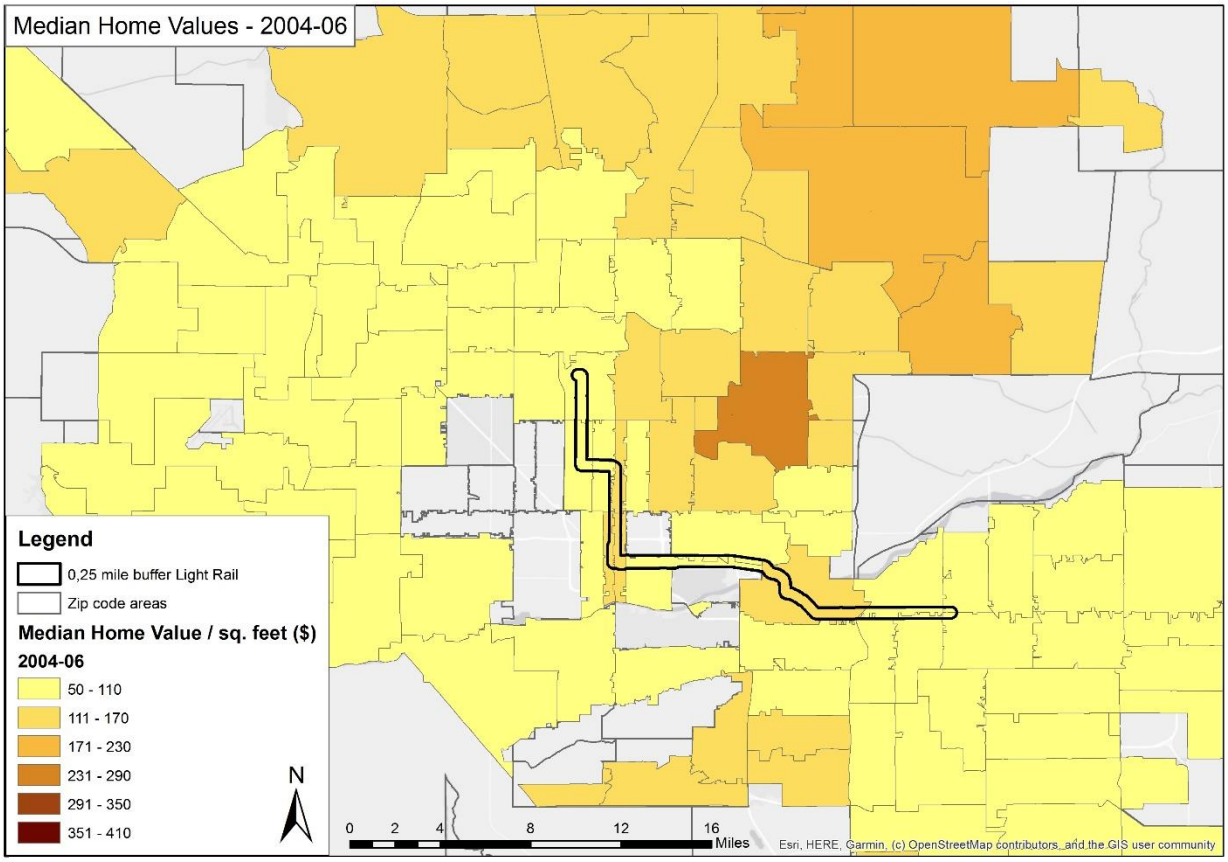

Figure 9

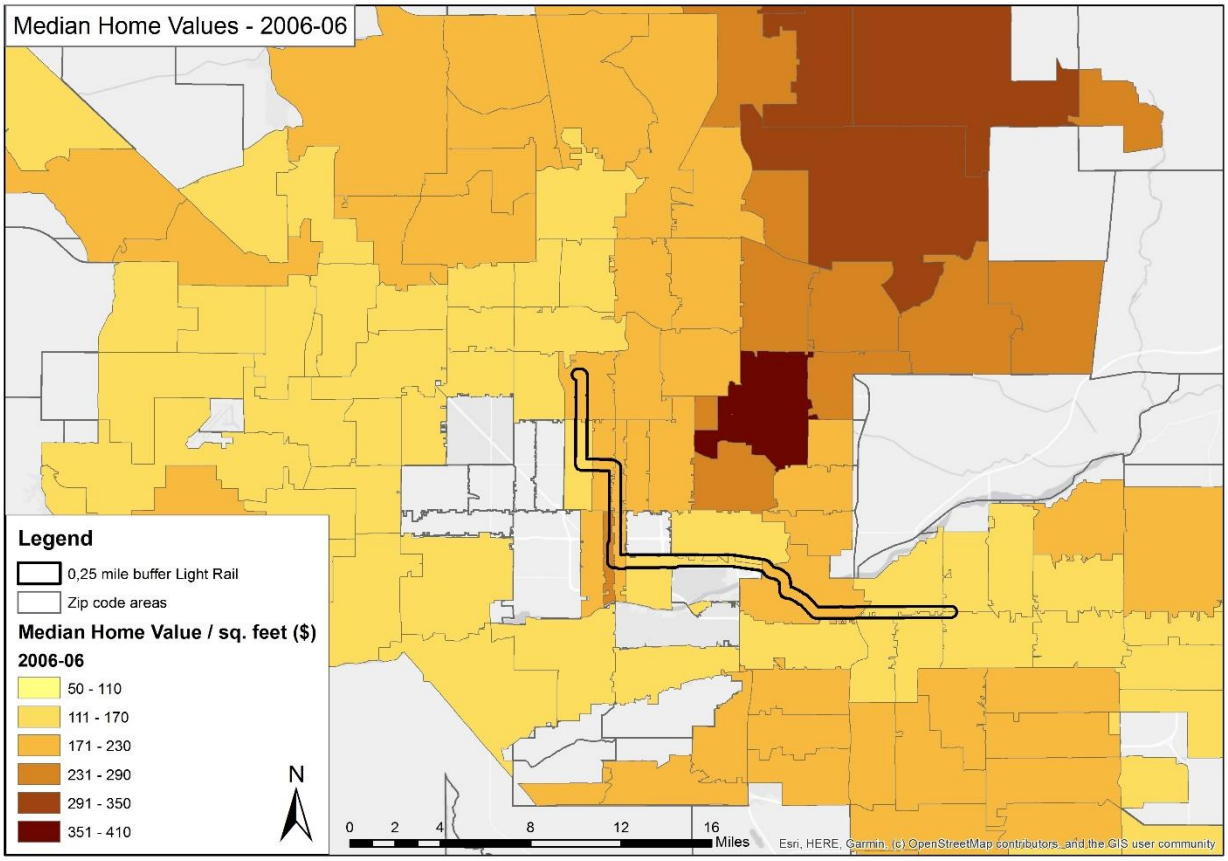

Figure 10

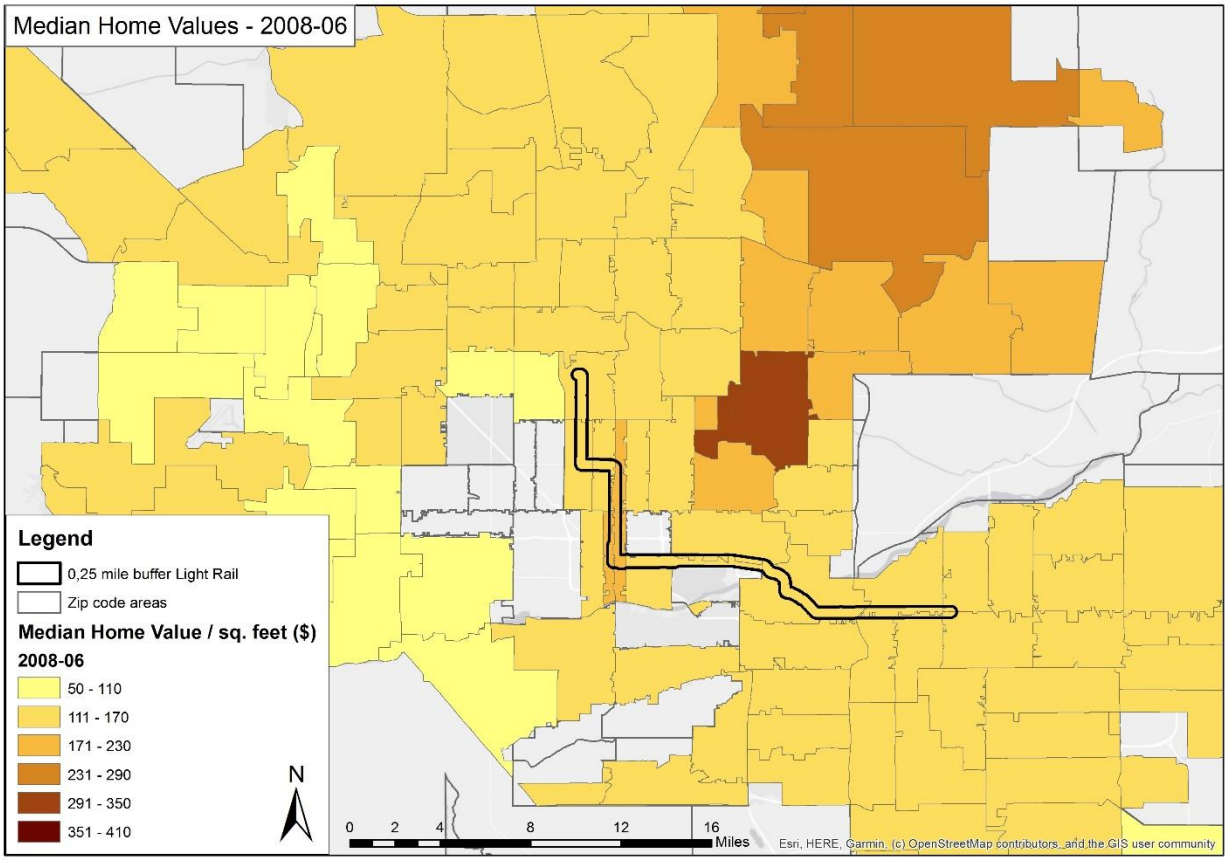

Figure 11

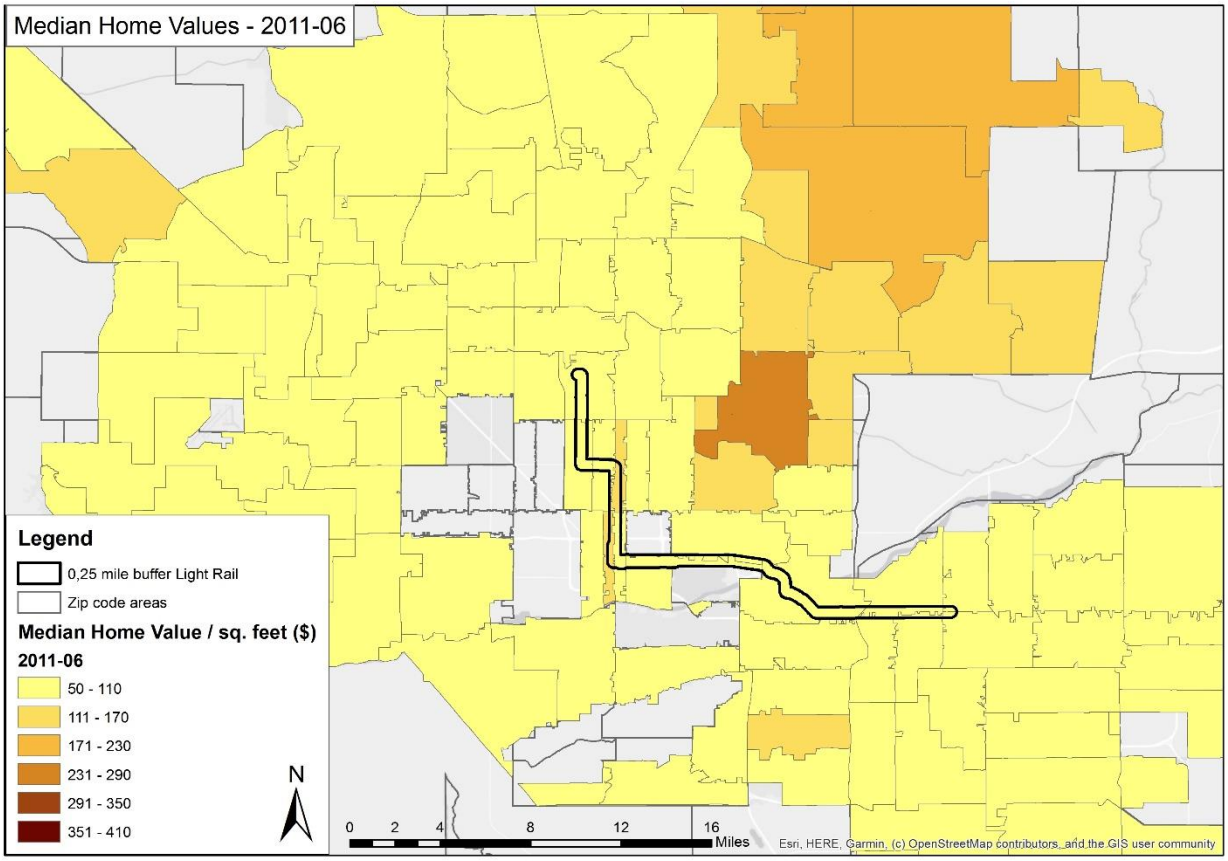

Figure 12

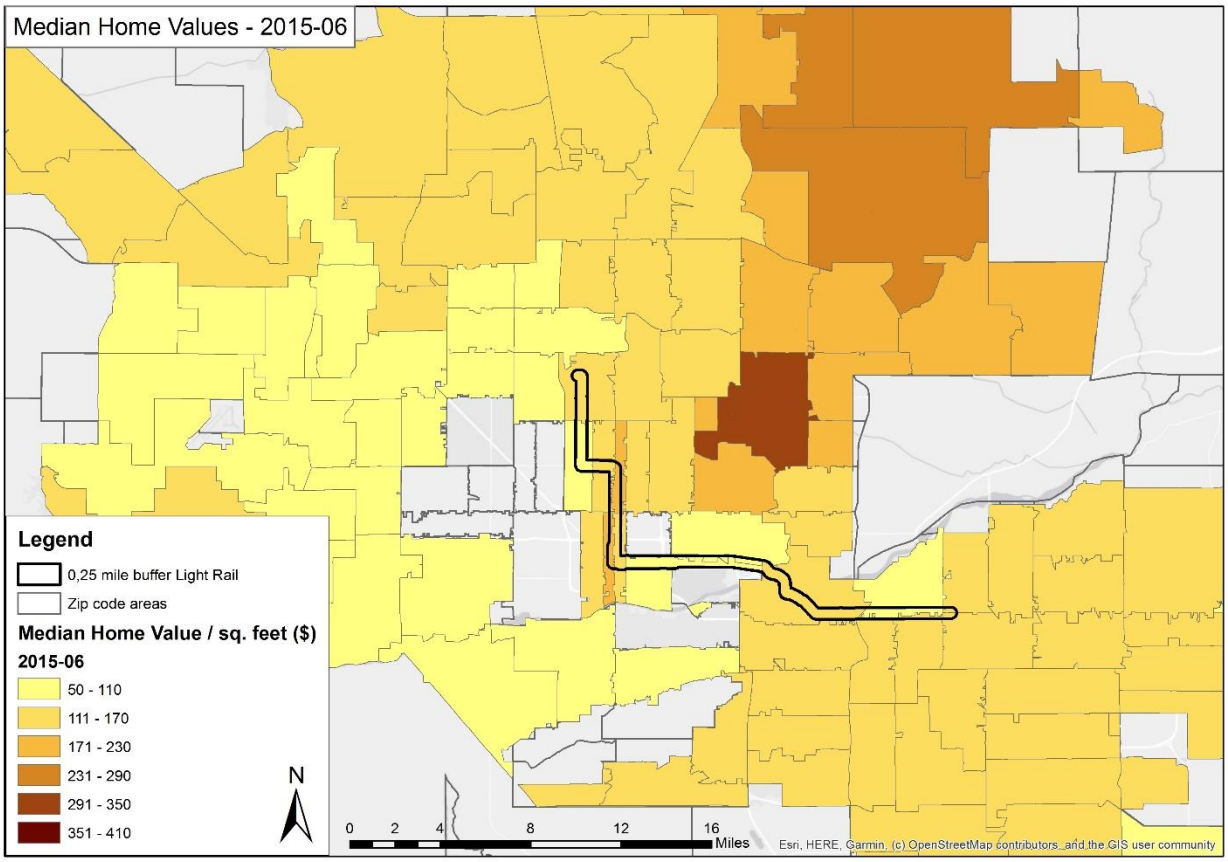

Figure 13

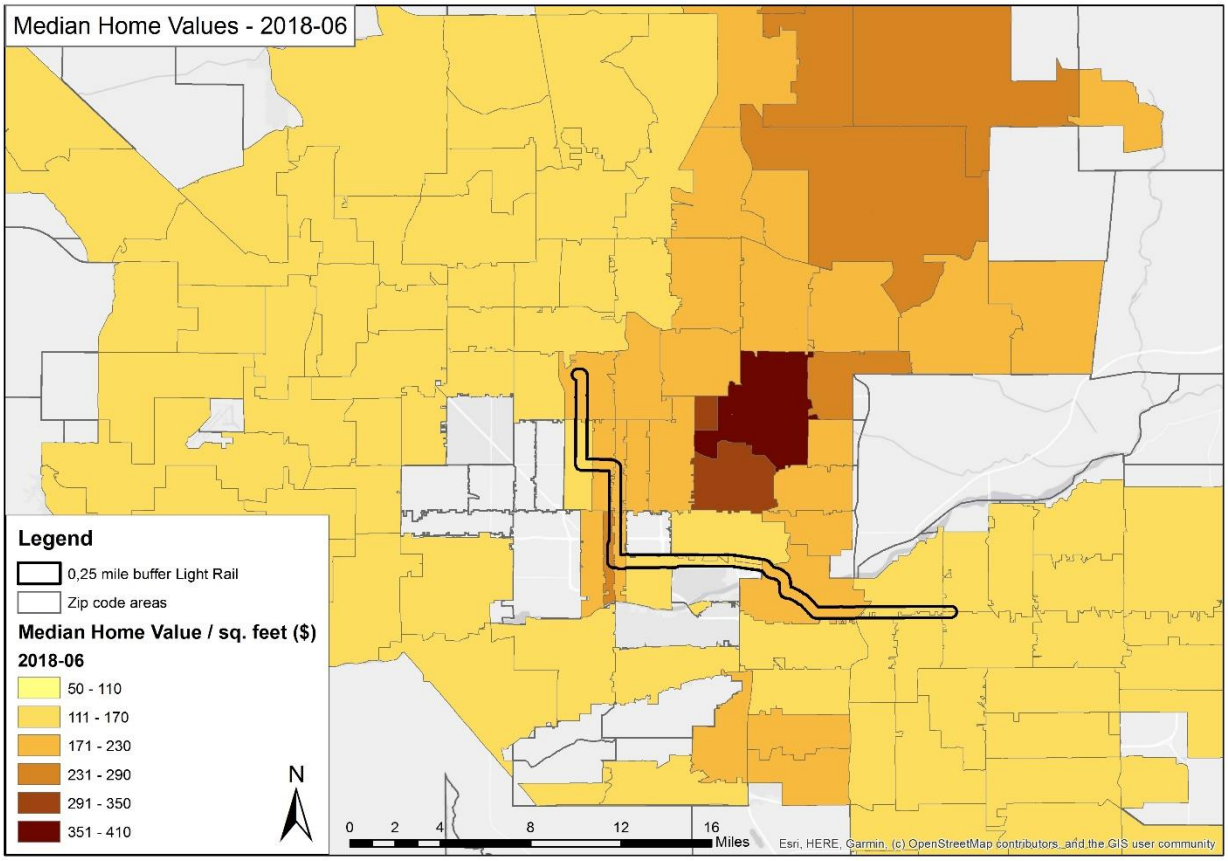

Figure 14

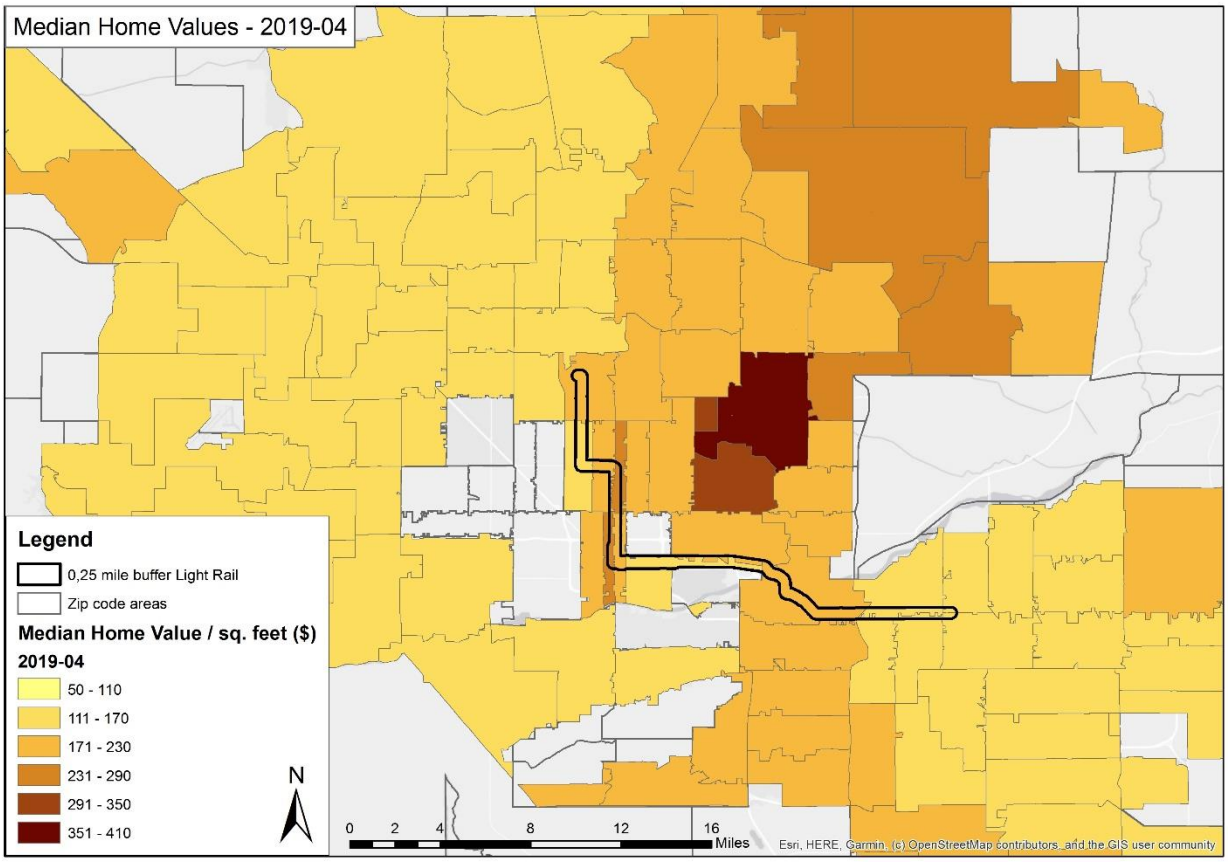

Figure 15

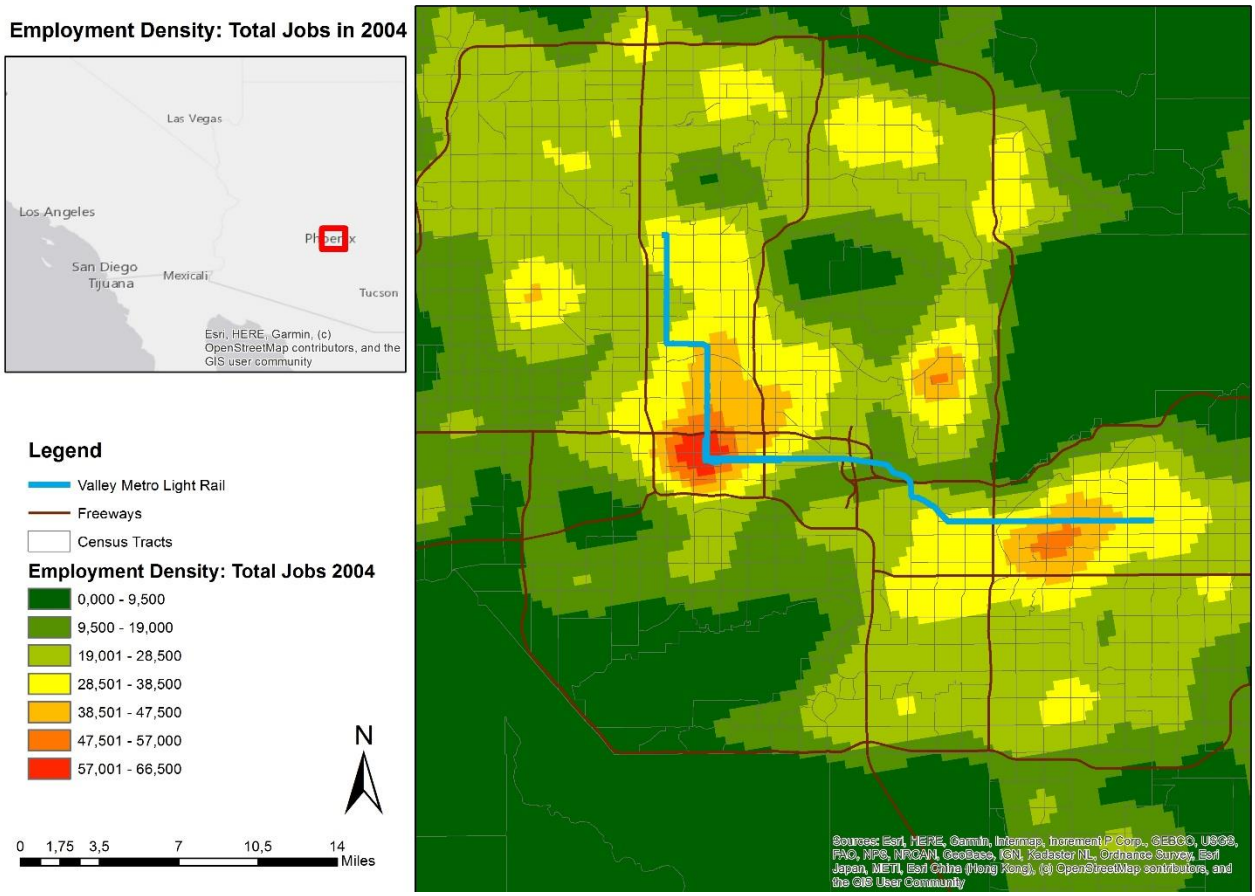

Figure 16

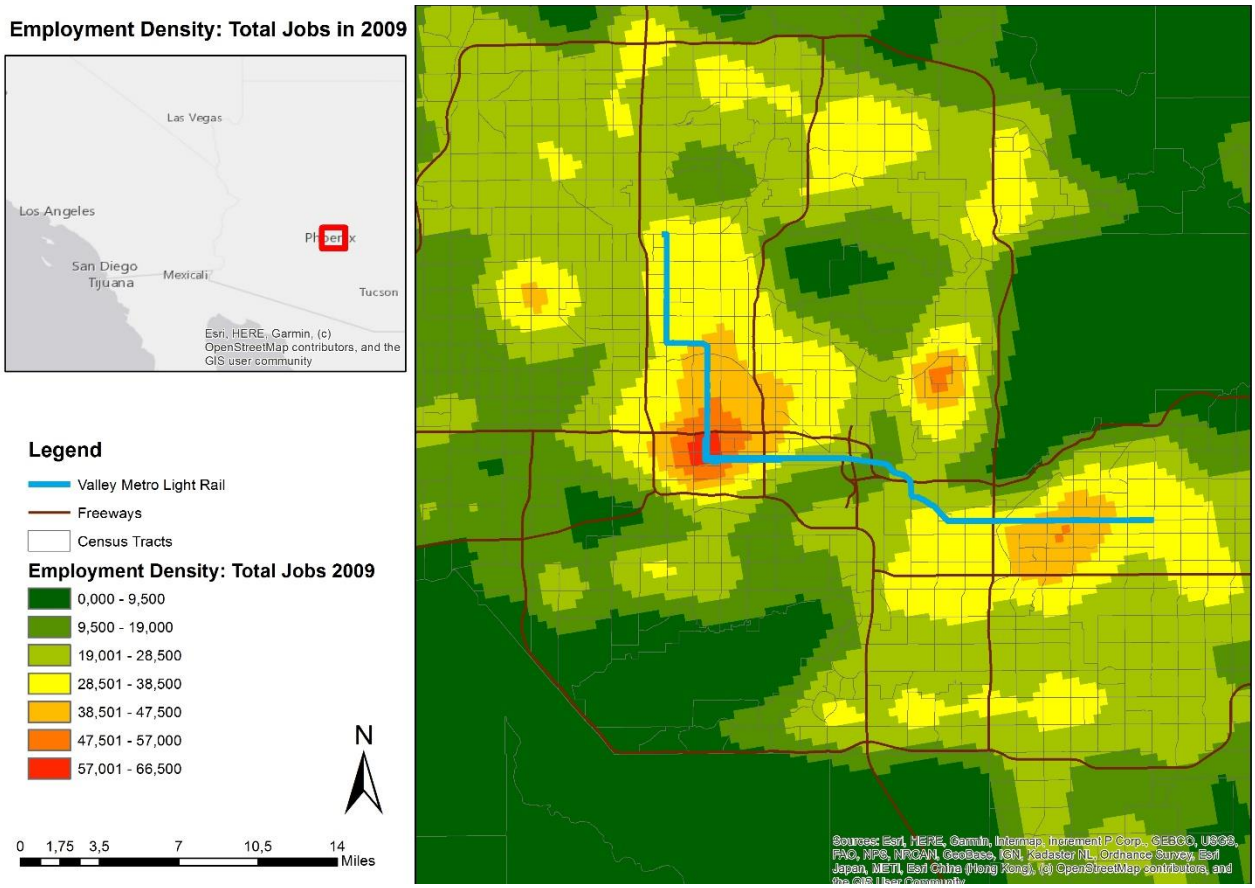

Figure 17

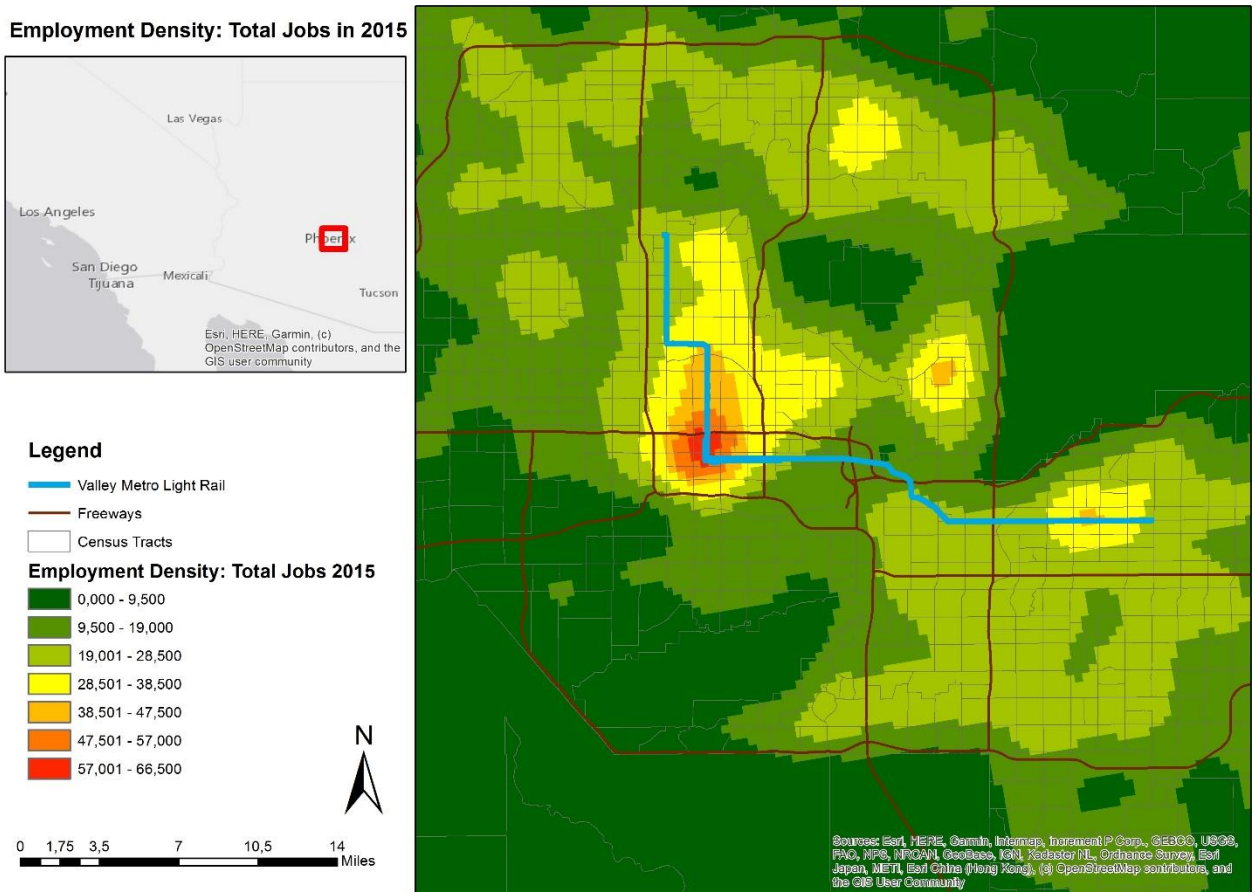
Employment Density: Total Jobs in 2015
Las Vegas
Los Angeles
Phoenix
San Diego
Tijuana
Mexicali
Tucson
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Legend
Valley Metro Light Rail
Freeways
Census Tracts
Employment Density: Total Jobs 2015
0,000 - 9,500
9,500 - 19,000
19,001 - 28,500
28,501 - 38,500
38,501 - 47,500
47,501 - 57,000
57,001 - 66,500
N
0 1,75 3,5 7 10,5 14
Miles
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Figure 18

Appendix 3: Interview guide

1] a. *To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?*

b. *Is continued TOD likely to take place along these existing segments?*

2] a. *Is TOD likely to happen along a future extension of the Valley Metro Rail?*

b. *If so, to what degree and under what conditions can this TOD be expected?*

3] *How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?*

Appendix 4: Transcript summary participant 1

Participant 1: Elly Huizing

29-11-2018, Phoenix.

Valley Realty: Manager of regional real estate agents

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

The development along the existing segments have been mixed; some areas have developed, however others have not met with much growth. Along the central corridor is where most of the development has been observed; and not so much, beyond.

b. Is continued TOD likely to take place along these existing segments?

It is still up in the air, as to which areas the TOD will be further developed. But I expect that TOD will take place along the majority of the areas where there is light rail .

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

The predictions of developments, are hard; given the developments up to this point. Certain station areas of future light rail extensions will definitely see an increase in development.

b. If so, to what degree and under what conditions can this TOD be expected?

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

The potential for commercial and boost the economy, will serve to strengthen the urban growth, while curtailing the negative side effects.

Appendix 5: Transcript summary participant 2

Participant 2: Donald Cassano

03-12-2018, Tempe.

I was on the city council of Tempe from ‘84 to ‘94. During that time we had attempted to redevelop Apache Boulevard many times and it never worked. You can change the median and landscaping and you can do think, but all those property owners did not want to change. They were afraid that they would lose customers and they didn't want to be taxed for it.

I worked as chairman of transport and public relations commission of the Chamber of Commerce in Tempe. And now I am finishing up my last 6-year term on the Tempe City Transportation Commission.

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

During the early years we went $1 billion in development along that rail line in Tempe alone. And of course having Tempe Town lake as another amenity, those two things really drew people and businesses to that area of Tempe. Now it's achieving what we had envisioned, but it is taking some years. Plans to open light rail were present many many years before it actually opened in 2008. Already in ’96 we came upon a lot of opposition to such a transit development. Some businesses were concerned that there would not be good access to their property anymore, since light rail would take up more space on the roads so that the number of lanes for the cars would decrease. And the push was to look at development that would enhance people to use light rail.

Light rail ridership has exceeded all expectations that we had in the beginning. It was very hyped in the beginning and ridership has been high all the way. There are however some concerns about safety on board and about the homeless people, but you have that on all the public transit systems in major cities.

I think people become afraid that there won't be any affordable housing. Some people cannot come and live in that area because of gentrification, and you know. that's a reality Tempe is facing. Many of these new apartments are not affordable for the average person I think.

b. Is continued TOD likely to take place along these existing segments?

The hope is with the street car is the same as that of light rail, it is to offer an alternative to the car so that large numbers of people can move without having to use the car over relative short distances. And the streetcar will connect to the existing light rail network, making it more extensive and convenient for people to make us of.

I believe that the current light rail and future extensions can provide things that people want to access closer to the Rail, such as certain amenities and services. And I think businesses are attracted to locating themselves in areas close to the light rail, especially if they're near where people are getting on and off.

I think this transit oriented design is going to be much more effective for those younger people because they aren't driving as much. They want to have a place where they can easily access and that's why

you see the development of apartments going where there are jobs and schools etc. and light rail is contributing to this tremendously.

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

Right now in Tempe there is a streetcar extension of the light rail being constructed. It will go along Mill avenue, make the turn to Apache boulevard and then there'll be a turn off to ash avenue. So there will be a loop so they can turn the trains around all the way over to the development area of State Farm and other developments along Rio Salado Parkway. There's also a push now to move it all the way into the Tempe marketplace development. And then further into Mesa. The city of Mesa has been the one that's pushing to get light rail to their community, and they are expanding the line more eastwards as well and are thinking about connecting their line further south to the downtown of Chandler. This will create business opportunities and you will see apartments and things like that being constructed in those areas.

b. If so, to what degree and under what conditions can this TOD be expected?

Development needs to be where people are connecting with their modes of transportation. And in the future public transit, such as light rail systems will continue to play an important role in this.

We would like to see that our current light rail system will become a more integrated network of multiple transit lines. But one of the biggest problems is the intergovernmental cooperation. And then also the funding, it always boils down in funding. Right now the current federal administration doesn't like transit and they don't like buses etc. they just don't care for trains. So it's real hard to get them to provide some revenue. And political change is every four or eight years. But you know, if enough people demand a change, a change will come. But like I said: people still really love their cars.

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

I think what it's done is it gets rid of blighted areas, because you have a new money coming in for new uses. But again, there's a balance, you're taking people away from low-income housing. We have seen that happening along Apache Boulevard, in the direction Mesa, where before the light rail there used to be a lot of old areas where there used to be trailer parks. They are gone now because the land has become too valuable. And a lot of that has to do with the light rail being there.

If we want to encourage fewer people drive cars, we need to look at having certain amenities and services connected to each other through light rail. So for example: if I can go to a light rail stop and I can leave my laundry at the dry cleaning and then on another stop there may be a small convenient store when I get off at night or I can easily reach entertainment centers with light rail. You know when we go into downtown Phoenix where you have the arenas, it's become an issue that people do not want to deal with parking anymore.

I think because of in America we still loved the car. We liked the convenience of the car, but different groups of people will embrace other modes of transport, such as light rail. And a group of people that wants to live the urban style of life do not really value owning a car that much. I heard a statistic earlier this year, when we were doing some lobbying work in Washington for our money for the streetcar extension, that 20% of the incoming freshman class this year has no driver's license. Ten / fifteen years ago 100% of the freshmen's would have a driver's license, because you need a driver's license, right? Well apparently not anymore.

Appendix 6: Transcript summary participant 3

Participant 3: Maria Laughner

03-12-2018, Tempe.

Economic development program manager for the city of Tempe. And I do economic development. One of our primary, um, competitive advantages over other cities here in the valley is that we have light rail from border to border. So as a landlocked city that we are, we pride ourselves on our accessibility and mass transit is very important to us.

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

TOD is a new concept. We've had buses for a long time, but um, light rail is new. I think it's been 10 years now since the light rail first opened. The greatest TOD opportunities right now are in downtown Phoenix, along central avenue. Once you go more up north in the direction of 19th street you will find that TOD is taking place to a lesser extent since that area is not as much developed when compared to downtown Phoenix.

So here in Tempe we are totally focused on transit oriented development because we are landlocked. So we're looking for densities we want to go up. We are working on this urban core master plan right now, which yet has to be approved.

So we're looking at different options for people to move that don't require cars. And also we have a traffic issue. So we're looking for ways to reduce traffic congestion. So we really see mass transit is the primary way to do that. So one way how to do that is that you create housing that is along transit corridors and nodes where people can easily access the public transit. We are aiming for high density mixed land use within a relative short distance from our transit nodes and light rail corridors.We see businesses relocating themselves in order to be closer to the light rail.

We closely cooperate with businesses, companies and property owners. We aim to help the with the different things that a company can do that makes them more competitive to the workforce in general and allows, allows them to fit better with their community. And what we're seeing is that now younger people, millennials, especially Gen z as they're called, they're not interested so much in driving. No, they just don't want to. And they will find another way to get there, whether it's biking or you know, light rail. So we want to explain companies that are looking to come in or that are already here what the city's plans are for where they currently are, especially if they are in an area that we know is going to transition. So we said, okay, this is what's happening in your area. This is what the city's doing. So here's where the public investment is, you know, we're investing in the street car or investing in bike lanes everywhere, you know, etcetera. Um, here are some things that we're doing to your, um, zoning map. So what we're trying to do is bring existing companies and property owners more, even more so than the companies along.

Downtown Mesa has transformed itself in the last five years as a result of the light rail extending to there. Main Street in Mesa used to be all like pawn shops and homelessness and you know, bad things, just bad. And now you have all kinds of nice little things happening. People can easily walk around and visit shops, restaurants and entertainment, and that's also when you get TOD. You then get things like Benedictine University opening a campus there, more businesses relocating to downtown Mesa. And so you get, more things happening in a place which used to be not so thriving at all. The same thing happened in downtown Phoenix when ASU decided to open up a 2nd campus there. The whole area

was very deserted and lifeless before that. And right now, where the campus is, there's a lot of activities going on and you see people all the time. Now it's always busy and there's a lot of life. you would not have that if it were not for the transit and the transit oriented development. You have to build where there are people. Yeah. And that's what we're trying to do here in Tempe. Yeah, Figure out where the people can be, and where they can be is going to be where there is light rail or some kind of transit.

Why communities like Glendale don't want light rail: Because it's expensive. Everything is driven by money. Yeah. It's expensive. Yeah. And quite honestly, they don't have enough density yet. So they thought it, it's like 20 years ahead of the time. However, to my point, if they had built it, they would get the density because then you would create TOD.

I mean, who talks about having light rail as an amenity? We do because our, our community sees it as such and people that are looking to come here also see it as such. The issue that we have then is traffic and affordable housing. Our real estate is the most expensive in Arizona.

b. Is continued TOD likely to take place along these existing segments?

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

When we look at downtown Phoenix, along their central avenue where the light rail is, shop owners were very afraid that their businesses were going to be harmed with the opening of the light rail. A lot of those businesses are thriving now. Real estate values along central avenue are outrageous now.

And now the people who own businesses along south central avenue, where one of the light rail extensions is planned, are trying to stop the extension from happening. Of course there is always some short term inconvenience in the construction phase. But Valley Metro is trying to help facilitate as much as possible. These shop owners who oppose against the light rail are rather short-sighted and do not really see the point, because at the end of the day the extension of the light rail is only going to help their business.

Absolutely. We're selling it like crazy. Yup. Every meeting that we have, that's what we're talking about. Our transit, because transit is very attractive. Not only that, I mean, now we're talking about what we think is attractive, but like

b. If so, to what degree and under what conditions can this TOD be expected?

Mesa has already experienced redevelopment. They have seen a lot of adaptive reuse where, you some old buildings are suddenly bought by people and they have a different use. Uh, the next level after that would be density, whereas where you get that TOD. I'm sure that it will happen along light rail, just the same way as our urban core master plan is planning for it the same way. In Mesa it just might take a little bit longer because they're further out. I mean as Tempe, our proximity to downtown Phoenix, the airport, and basically everything that there is to here, definitely helps speeding up growth and development here. And well, when it comes to Mesa.. the further east you go, the further away you are from everything.

I think the success of, of our light rail system has been extreme. The numbers are really good; the businesses along the corridor have seen a lot of growth. And we now we have an issue, at least in Tempe of affordable and workforce housing. Where can people live that's near where they work. And we don't have a lot of that because our land is expensive. So one of the next things we're working on is how do we get more attainable housing along the light rail. So you have people that can get places

and afford to live where they are and don't have to drive from the fringe into downtown. A more complex light rail network with several lines, as opposed to only one single light rail line, would help a lot with that. But because of politics and since Arizona is such a conservative state, it makes it hard to get anything done. But perhaps in 20 years there will be a second or maybe even a third line.

In places such as Surprise you'll have some more of this organic growth as opposed to relocation. What we have in Tempe is almost a hundred percent relocation and expansion. Theirs is more organic and development will take a lot longer than ours.

TOD will continue to take place because people will continue to come in the Phoenix population. And besides this the employment centres will grow and there will be more employment centres in the future.

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

Well, there, there are fewer cars. You have less congestion, less pollution. So that's pretty good

TOD can combat certain bedroom communities. If future extensions will reach communities that are now disconnected (like Peoria, Chandler, Glendale etc.) it will become more attractive to live and work in those places rather than people just living there. So more businesses opportunities and opportunities for people to work (besides retail). We have seen this happen in Mesa. The commitment to urban living is stronger than ever. People want to live where the action is going, not somewhere on the outskirts

Appendix 7: Transcript summary participant 4

Participant 4: Joshua Matthews

04-12-2018, Phoenix.

AICP Planner II, Capital and Service Development. Valley Metro

1a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

Economic development has occurred along the entirety of the 26-miles of light rail in the Phoenix metro area. Based on tracking and research that Valley Metro has published, over 80% of this development has TOD characteristics (high density, mixed-use, small set-backs, pedestrian scale, etc). In total, over $11 billion in development has occurred since 2005 (when light rail construction began) within Valley Metro station areas (1/2 mile buffer around each station). This includes over 25,000 new residential units (2,200 of which are affordable housing) , over 4,000 new hotel rooms, and over 50,000,000 square feet of new development.

Most of the TOD that has occurred is focused in three areas: the Central Avenue Corridor (Central Avenue, from Camelback Road to McDowell Road), Downtown Phoenix, and Downtown Tempe/ASU Main Campus. Some significant developments that have occurred include: Marina Heights (State Farm HQ), Hayden's Ferry, CityScape, the Phoenix Biomedical Campus, the and the Downtown Phoenix ASU campus, among many other developments which can be named TOD.

Areas that have not seen a lot of TOD along the light rail include the area between Phoenix and Tempe (along Washington Street, between 7th Street and 38th Street), Camelback Road, and 19th Avenue. These areas tend to be more industrial, already built out, or have large quantities of existing (and in some places historic) single-family housing.

1b. Is continued TOD likely to take place along these existing segments?

Based on the current markets and the developments that have been delivered over the past 3 years, it would appear that TOD should continue to be built along the light rail. The developments that have been built appear to be successful and are encouraging more development. Predicting the market it impossible though, so these expectations are just that. Valley Metro, along with our city partners, continue to support TOD and economic development along the light rail wherever possible.

2a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

One of the reasons that light rail is built is to attract urban development that is denser and more pedestrian-friendly. Based on the current market, it would appear that TOD should follow the light rail extensions. Valley Metro's first light rail extension, the Central Mesa Extension, is already seeing strong returns, in new developments, development proposals, and city-led RFPs for city-owned property. The Northwest Extension Phase I, which opened approximately 6 months after the Central Mesa Extension, has seen less development proposals. This may be based on where the two extensions were located, with the Central Mesa Extension bisecting downtown Mesa, while the Northwest Extension Phase I is located in a more suburban area of Phoenix.

2b. If so, to what degree and under what conditions can this TOD be expected?

Most of Valley Metro's light rail extensions predominantly serve areas outside of Downtown Phoenix, Tempe, or Mesa. Thus, the expectation is that development will more closely match the existing built environment of the areas that surround the extensions. This may include buildings that are 4-7 stories tall (as opposed to high-rises), smaller "middle housing" (condos, townhomes, etc.), and lower intensity development. Valley Metro and its member cities support all TOD that provides sustainable and affordable housing opportunities along the light rail line. One of the primary goals is to make it possible to live, work, and play without needing to own a vehicle.

3. How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

Although urban development and public transportation may attract undesirable side effects, such as increased visibility of homelessness and poor perceptions of safety, the benefits outweigh the risks. Communities have a responsibility to provide safe, affordable, and efficient transportation and housing options for all citizens. TOD and public transportation can work together to create a truly multi-modal, pedestrian oriented, and urban environment that is affordable for everyone. It is important that the public transportation is safe and effective, and that the TOD is supported by strong land uses policies and zoning codes that ensure the proper type of development is built. As TOD continues to be built and light rail is further developed, a critical mass of development and transportation options will occur that will lead to a unique, vibrant, and successful urban environment. As the provider of public transportation in the region, Valley Metro will do our part to continue connecting our communities and enhancing the lives of our riders.

Appendix 8: Transcript summary participant 5

Participant 5: David Crummey

06-12-2018, Tempe.

New Town Community Development Cooperation. We exists to expand affordable housing and Tempe in Chandler and other cities in the valley. Uh, we're also community land trust and a housing counseling agency. I have a background in urban planning. Outside of that I'm also the board chair of Rail Mesa, which is the Retail Arts Innovation and Livability, which is a nonprofit community development corporation along Mesa's light rail corridor. And our mission is to build and support quality development along the light rail corridor in a cohesive community centered way.

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

Light rail has been successful in the way that it moves people, faster than a bus. And that it provides an alternative to the car. Especially in this city. Well, light rail works best at a distance of 7 miles.

And as an economic development tool for getting low wage workers from place to place it has been successful in that.

We don't yet have or many communities that are actually walkable, So owning a car is often almost necessary. Living in Phoenix is isolating if you don't have access to a car, because the distances to visit friends for example are just too big.

So light rail has specifically helped those nodes that were already working on being a walkable community, such as downtown Phoenix and downtown Tempe.

Phoenix is walkable because of its history and because people really want downtown to be walkable over there. Tempe is walkable not because the people wanted that, but because of the students who have their classes, recreational activities and nightlife there, and they often don't have a car.

Mesa is housing poor, we don't have a lot of housing. We also don't have jobs. And so when it comes to employment centers, the major employment centers in downtown Mesa or the city of Mesa, one of the largest employers in the city. And then a whole bunch of people that employ less than a hundred people or less than 10 people or less than five people. Uh, and, and so what, what light rail did in Phoenix, in downtown Phoenix and in downtown Tempe, which was stimulate the one thing that was obviously needed: housing. In downtown Mesa housing is an obvious need, but it's not offset by the other obvious need of employment.

Areas that have had high density of jobs have seen the biggest benefit of light rail because it has the other missing component. In places that are job-weak like Mesa, Apache boulevard, 19th avenue have not seen the same level of investment.

Not all the TOD that is taking place is pedestrian-friendly. So the development has to be walkable oriented, has to be pedestrian or people oriented. Yeah. And you have to be able to have the fabric of the streets that supports that. So in many places we have to retrofit our street system to get a good feel because we built it around at 35 miles per hour instead of 3 miles per hour. Downtown Mesa, Tempe and Phoenix are successful in this because they have pretty walkable grids. So unfortunately in many places even if there is a ''transit oriented development project'', it doesn't have a very powerful stimulating effect on the outside community because the rest of the fabric isn't there. It becomes a

building in isolation rather than a building that compliments the area that's already there. Many of the developments that have taken place are these buildings and project that have so much parking spaces. Do they considered that transit oriented development or is it just a higher density car dependent development?

b. Is continued TOD likely to take place along these existing segments?

We'll start to see more nodes and, but the planning isn't there to create nodes of tod and it can't be at every light rail station to begin with. Tempe has gotten two pretty good nodes around ASU. Um, downtown Phoenix has a series of nodes that are all sort of connected to each other. And so light rail, yeah, fits well there. And then you get to would say camelback and central, more up north, and that sort of starting to feel like a node to, yeah, like there's, there's a lot of activity. You've got restaurants and shops and a grocery store and residences and single family houses. So that might be a node. Downtown Mesa, it might be a node, but between mill avenue and downtown Mesa, is there another node along light rail that's likely to develop in a transit oriented way? There are a lot of vacant lots. The 8 billion dollars of development almost exclusively takes place along these existing nodes.

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

There are many potential nodes that could develop here in south Phoenix because of its poverty, there are a lot of people who walk or take transit and people that maybe don't own a car. There are a lot of small businesses in South Phoenix.

Light rails great at seven miles. But it's bad at longer distances. Light rail is a very good technology to connect (relatively close by) nodes, but I don't believe that light rail is the best technology in connecting Mesa to Downtown Phoenix or connecting mesa to the airport. Because both the distance and the time that it takes to commute become too big.

So transit oriented development in the valley is very, um, we're trying to retrofit and change. We're trying to fix a poor system of transportation. We're trying to get people from point a to point B and light rail is doing an okay job with that. It's better than a bus. Yeah. Um, and then, and we don't want all those people to be in cars because then our roads won't work. And then as an economic development tool, it also has been very successful, but only in limited areas. Places where it's working: Tempe and downtown Phoenix. And in places where it's marginal, where it might work, the planning needs to be done ahead of time. Yeah. And downtown Mesa has done that planning. But in areas along the Gilbert road extension, the Dobson area and the South Phoenix extension that planning ahead of time is perhaps not happening sufficiently.

b. If so, to what degree and under what conditions can this TOD be expected?

It is important that zoning and planning regulation allow for types of development that are TOD, otherwise we will not see these types of development happening quickly. Phoenix and Tempe for example have overlay zoning, Mesa does not. Policy needs to match development in order to make land use changes. And of course this needs good leadership.

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

Appendix 9: Transcript summary participant 6

Participant 6: Mitchell Allen

11-12-2018, Phoenix.

Senior vice president of Business Development department - Greater Phoenix Economic Council.

Mitchell Allen's focus lies mainly on attracting industrial companies or any company that has to do with distribution and manufacturing. These 'clients' of the Greater Phoenix Economic Council are looking for ways to get people to their facility. A lot of the clients that are into the market who do not have a presence in Phoenix yet, are thinking about potentially expanding or relocating their business to greater Phoenix, how would their employees, the people that they're looking to hire, get to the facility?

Our whole focus is on attracting business and making that business case as to why a company should locate a integrator Phoenix versus a market like Denver or even Holland for that, for that matter.

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

A lot of our clients, especially the tech companies that Brian Smith is working with, are saying 'we've got a unique workforce, they are young and not all of them want to have to drive.' They want to be within walking distance of food, restaurants, different amenities as well as their work or within a short stop or two, uh, and can easily get around.

Phoenix is such an urban sprawl. Um, and we've kind of just continued to build outwards because we don't really have limits for the most part. But since there is no light rail system at the moment that connects to the outer edges of greater Phoenix, that means that TOD is also not happening over there.

but the reality is when you, when you talked to actual employers who have made the move to Phoenix, uh, anywhere between 70 and 80% of their employee base drives to work every day. And so it's not really as important, at least on the industrial side because a lot of these facilities tend to be more on the outskirts of town.

TOD was a big deal when the light rail came into to Phoenix and connected to Tempe and connected to Mesa. Mesa and Phoenix specifically continue to expand the line. Um, you know, ridership has, has grown year over year. Um, and unfortunately it displaces some businesses or causes harm to some businesses where the light rail construction is taking it takes place or had taken place. But you, you've seen values of properties go up, you've seen new apartments and condos, businesses pop up or multifamily sites pop up um, new restaurants, more access to the universities. Those are all effects of the presence of the light rail.

It is just during that period of construction, whether it's a year or two years can be painful for a restaurant or some sort of retail business. There is no way around that. But should those minor upsets cause you to stop what you're doing? I personally don't think so because if you look at the overall impact, the value overall of everything goes up. You have more people downtown. So because of more discretionary spending, there are more people downtown who are shopping and it just makes it more accessible.

b. Is continued TOD likely to take place along these existing segments?

Uh, yeah. So essentially, you know, at some point we, you know, we, there's only so much growing and so many car lanes you can add before you reach a limit. It is not realistic that the city will sprawl further without limits. We're already seeing kind of growth take place vertically, so more high rises. Um, you know, but then it becomes, well not all of those folks are going to own a car, you know

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

b. If so, to what degree and under what conditions can this TOD be expected?

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

Okay, so we are already seeing vertical growth take place in areas that have been more land lock. You see downtown Phoenix, you see a downtown Tempe, parts of Gilbert, parts of Chandler and Mesa. So for the communities that want more TOD and have a focus on that, I think it's going to be a positive thing.

There are a lot of bedroom communities. So like where I lived, Gilbert is a bedroom community a where let's say 90% of the people commute out. Mesa also used to be, or still kind of is a bedroom community. But light rail has done a great job of bringing business there. So now people are starting to commute inwards from outside of Mesa. So when there is TOD and it’s accessible to potential employees that’s a good thing. It actually kind of counteracts the urban sprawl where everyone's kind of commuting into the central area and then going out. Whereas some of the fringes, especially if you can get TOD there in a way that again, it has to be accessible. Um, you can start seeing a reverse commute's for people who are living further inside going the reverse direction.

Appendix 10: Transcript summary participant 7

Participant 7: Bryan Smith

11-12-2018, Phoenix.

Director of Business - Greater Phoenix Economic Council

Works together with Mitchell Allen and the rest of the development team on attracting business

to greater Phoenix. Brian Smiths' focus lies on software companies and start-ups.

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

Tempe has been probably the most aggressive in acquiring TOD on the light rail. But they've had some mixed results. I mean, um, the Mill Avenue/Rio Salado Avenue area is just huge for tech companies. It's the most walkable area in the region. They're adding the streetcar extension of the light rail there. The employment there is really just blown up. It's, it's the most economically productive the sub-market in the region. However, there's still a lot of vacancy in their ground-level retail. I mean the apartments are still filling up, but um, their retail, especially in the areas that are not close to the Mill Avenue and University area, you know, further east on Apache Blvd, there's a lot of vacancy there.

During construction, but even afterwards, light rail has not been good for retail and it has not necessarily contributed to a more walkable environment in those places that it's just passing by.

b. Is continued TOD likely to take place along these existing segments?

Phoenix has really done a great job of, um, being progressive in the sense that they, they passed a 1 cent sales tax to help fund, um, you know, an extension of the light rail. Proposition 305 that passed three years ago. And it allowed for expansion of light rail. The first stage of that took place last year. It was the northwest extension took the light rail all the way to the Glendale border in northwest side. And they're adding two more lines. One's the capital extension heading west on Washington in one is the south central

There is recognition that workforce is moving between these nodes (different cities within greater Phoenix). So, um, the fact that there is income coming to their communities and, uh, there are jobs going the other way. Uh, there's some pretty good cooperation between the cities that have the light rail.

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

b. If so, to what degree and under what conditions can this TOD be expected?

Communities like Glendale, Gilbert and Chandler are not connected mainly because of the high costs of light rail. It costs approximately 1 million dollars per mile. t's always going to be the most expensive option of infrastructure improvement.

You see, the funny thing is ASU has kind of been the driving force behind development as well on the light rail corridor. Not only in Tempe, but everywhere. Downtown Phoenix really kind of underwent a

renaissance after ASU put the downtown Phoenix campus. Um, and downtown Mesa is now going to have some ASU facilities, which is driving further development there. So educational assets are also driving a lot of development along the light rail. They kind of work together with the presence of light rail.

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

I've seen the tech workforce starting to live in those more walkable areas alongside the light rail Yeah. Um, you know, some of these companies have brought in transplants from some of those tier one markets, New York, DC, San Francisco, where they haven't needed a car. Um, so they're more accustomed to that lifestyle and don't really want to necessarily change. Um, so they've been more attracted to those areas where there are walkable amenities.

It's, yeah, it's really hard to say. I, I'm not sure how it will affect sprawl. Um, I think people definitely recognize that the access to amenities is higher on transit lines and to some part of the population that will continue to be a positive, but others that want more private space, will see that as a negative.

I think development will continue on the lines. And at some point development along the light rail will economically be the most viable option, rather than building on the fringes. Uh, I'm not sure what the tipping point will be there, but um, okay. But I do think that both patterns of development will continue.

I think the downside is, um, we are heavily invested in cars and now we're getting to the point 'and now what?', how do we this thing and now we have all this stuff built for cars whereas cars aren't the way forward. Maybe autonomous vehicles will change that, maybe not.

Appendix 11: Transcript summary participant 8

Participant 8: Jeff McVay

17-12-2018, Mesa.

Manager of downtown Mesa transformation/ the downtown redevelopment director. Mr. McVay led the city's effort to create the small area plan, which is essentially the downtown redevelopment plan. The boundary of that planning area included all of the light rail tracks and stations of the central Mesa extension. This extension goes out up to Gilbert road. So that is the extension that's under construction right now. So that is included in the downtown Mesa's developments efforts.

When the light rail first opened, Mesa only had a one mile portion of the light rail, from the Tempe border up to Sycamore station.

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

A one mile portion of the original light rail opened in Mesa in December 2008. Then a section was opened in august 2015, which brought the light rail to downtown Mesa and the next extension to Gilbert Road, which is the next two miles, will open in 2019.

Since 2015 we've had a lot of TOD projects that we are either in some stage of approval, some stage of planning or in some cases under construction within the downtown Mesa square mile. Some of the projects have been finished, but not that many yet. ASU is planning to open a facility here. A quarter to a half of all the projects that are currently under construction, being planned or have just become operational have a base or foundation in light rail.

Some of these projects are a combination of light rail being there and the fact that we have a reasonable cost of development that make it easier to pencil out some of these projects.

Before light rail, Mesa was basically a bedroom community with a relatively low employment ration. People would live in Mesa but work in places like Phoenix and Tempe. There's not a lot of nightlife that happens. Um, some people, some people say it's the low cost and rent, so that if you have a small business and you needed a place to start it up, this is a place you can afford to do it. So all those perceptions of the past that are starting to change over time now with, with the introduction of light rail and some of the accompanying new developments that are happening and some of the new businesses that would come in that, that perception, it's slow to change it, but it started to shift and people are starting to see something a little bit different. However, we aren't going to get rid of the perception of being a sleepy community quickly, these things need time. But the future is looking great with these new restaurants, breweries, shops, things that have come in that have helped us to start to move the needle. But I mean, the image of Mesa as a sleepy rather boring bedroom community is not going to drastically change until we have a significant number of new residential developments and a significant number of people living here that weren't living here before, before that will really change.

The downtown square mile of Mesa has the lowest residential density of all of the city of Mesa. And so once we get the residential density and the developments down here, to where it should be, that will change a lot of perceptions.

For the downtown square mile we adopted a form based code in 2012, that was in anticipation of the light rail and to help us encourage the TOD development that we wanted. And that covers the majority of the downtown area and it also extends somewhat outward. For the rest of the light rail alignment

on either side of our downtown. It's just our normal traditional Euclidean zoning, that you get anywhere. So we have made changes to the zoning over time to have, to build in tools that will allow us to get to more urban development and allowed TOD development. But we haven't gone through and done any overlays or created any kind of special zoning districts that will make it happen. Somebody has to actually choose to go that route in order for it to actually happen.

I actually have worked on a project myself where we were able to get our boards to deny the project for a car dealership. We got our board to deny it because it was on the light rail alignment at a hard corner that was going to have a station. So they let the policy work to that extent, but we have not gone through updating our zoning to reflect the needs and requirements of the light rail and TOD, except for zoning in our downtown core.

What has happened in downtown Phoenix in the last four or five years has been really incredible, especially going up central avenue, as you go north of the downtown you have the ASU campus there. Roosevelt row, third street and just all this stuff that's happening there has really been amazing. But what I recognized, and to some degree this works for Tempe as well, is that they've had these other influencers other than just light rail by themselves. When light rail construction was done in downtown Phoenix, the development didn't happen instantly. It took a number of years before you really started to see the action happening. And it was when ASU built their downtown campus when things really kicked off, so light rail cannot be seen as the only driving force behind development. The same goes for Tempe: they have always had ASU there, so they have always had some advantage when it comes to development. Mesa will be successful in its TOD efforts, it will just be different what everybody else does. Mesa serves a different niche. Tempe serves ASU and is a college town. Phoenix serves like the office core of the metropolitan area, they need to be the high rise district. And Mesa has a different niche that we're trying to fill in and that is more of the young professional to families. Um, so that what will be successful to us wouldn't be a success to Tempe or Phoenix.

In 2010 we as a city purposely went out to the private, not for profit universities in the Midwest and actively solicited to see whether they were interested in expanding and creating a footprint in Mesa. The one that wanted that was Benedictine University. And if you talk to them, they would tell you that one of the reasons they decided to move forward with the expanding their campus and having a footprint here was because of light rail and was because they could have a disperse campus then, instead of like ASU where everything is in one place.

b. Is continued TOD likely to take place along these existing segments?

We just got the light rail three years ago here in downtown, and we see a very significant growth in private investments here in downtown Mesa. In the next year or two, when several of these projects, such as a 1500 dwelling units project, start construction and then several more start construction, there's going to be a lot of things going on. We will definitely see a great increase in construction.

Once ASU opens their Mesa facilities in 2021, I anticipate that we're going to get a lot more light rail ridership from students. So there's going to be a lot of interconnection between the Tempe campus and these ASU buildings in Mesa. Just like there's a lot of connectivity between ASU in Tempe and the ASU campus in downtown Phoenix.

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

The future extension of the Mesa light rail will take place in a two mile section just east of the downtown area, in a more suburban area. So the existing pattern of development is that there's a lot of very large single family residential neighbourhoods. And the land that's available for redevelopment

really focuses on main street and the light rail corridor. Yeah. Um, so it won't have the same amenities from an entertainment, retail kind of perspective. No, I don't think TOD going to happen at the same extent, but I do think that there are certain developable sites along that extension that have a lot of potential. So it might take longer because it's not as, not as urban of an area to start with.

We're doing a study for an extension of the Tempe Streetcar Line that come will come into Mesa and do a loop through our downtown. There's also a study about an extension of the light rail that goes down to south to Chandler. Chandler really wants to have a light rail connection right now. Right now the transit ridership for the bus line that's there doesn't, show enough demand to be able to put in light rail, but they are going to continue to work and try and improve that until they can get light rail. I'm truly optimistic that what we're going to keep doing this and we're going to start creating those spurs and we're going to start creating those connector lines. The current light rail Line will end up becoming the backbone to a much larger system, and that's when we will really see TOD, because then the system will be able to really connect people. Because right now, as great as our light rail system is, it isn't a true system for commuters. The majority of people do not generally choose this as a commuter line because our freeways are just too efficient.

I think Glendale will be connected to the light rail system in the future. Glendale has way too many things, like the cardinal's stadium and the hockey arena all at all, that they have too much stuff out there to not connect at some point.

b. If so, to what degree and under what conditions can this TOD be expected?

Communities, such as Mesa need to be politically convinced to accept light rail, since in the beginning some city officials were against light rail.

It was important that the city of Mesa was included in the original plan, so that there would be three cities involved in the original plan for the Light rail. In this way the original proposal to the FTA (Federal Transit Administration) so that the light rail could be considered a regional system and then we could get the bigger grant.

The voters approved what was called proposition 400, which created a sales tax. So a percentage of the sales tax you pay on any purchase at the state is for proposition 400.Proposition 400 was all about transportation projects, but it included a good, a large chunk for transit and light rail. And so that's where our regional transit agency Valley Metro comes in. So every community has a portion of proposition 400 money that's devoted towards transit in their community. Proposition 400 expires somewhere in the 2020's and they are working on proposition 500 which will replace proposition 400. If they successfully get proposition 500 approved, I think our light rail system will become more and more interconnected and complex, which will in turn lead to more TOD. This will first happen in the city of Phoenix, because they are the biggest city, have the most funding and that's just simply where the action is.

TOD happens more quickly in an area that is urbanized, such as downtown Mesa, rather than areas that are more residential in nature, such as the future Mesa Light rail extension. For every TOD area, if it's going to be successful, it has to have at least some things that serve the neighbourhood. This doesn't necessarily have to be a restaurant district, but it might need to have a coffee shop, some stores or something like that.

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

People are choosing to live where they want to live based off of different things, it's not just where can I get a job? It's not moving to Arizona because it's sunny and beautiful. There has got be something else besides a nice climate and environment. So what does that really lead to? It leads to downtown's. How good your downtown is, is probably going to be one of the key indicators as to whether or not your city can be a success in the long term. Unless we get a core, a really good core down here, we are not going to be able to attract that economic activity to the entire city that's necessary for us to be successful long term. As a metropolitan are we are competing with Austin, Portland, Seattle, Denver, DC, all those places right now that people are migrating towards because they have a higher order of amenities that are available to us as residents. And really TOD and light rail, those bring the amenities. It's beyond just having a place to live. you got to have museums, you got to have arts, you've got to have all those things. And that's what TOD will bring us. But really just to me that is what is the deciding factor as to whether TOD is going to be successful in the long term.

Appendix 12: Transcript summary participant 9

Participant 9: Shannon Scutari

10-01-2019, Tempe.

Former attorney who has always focused on public policy. Has worked at the city of Tempe as their chief lobbyist, their government relations director where she pushed for light rail, bicycle infrastructure and transit. That's where she established her expertise. Afterwards governor Napolitano appointed Ms. Scutari as deputy director of the Arizona Department of Transportation where she helped create a public transportation division within the department. In 2011 she started her own company where she creates public private partnerships to get the funding and get the political and community support for large infrastructure projects, mainly rail-lines. Currently she is working with the city of Tempe and the private partners on the street car and transit oriented development around the street car. Ms. Scutari has been working with organizations that try to promote housing and land use along transit corridors.

What I do is I work on the front end with the businesses to help them contribute funding through the development agreements, so that they can actually have financial contribution from the private sector into the capital costs of the light rail itself.

I work with public and private partners to, um, create the developments around the light rail stations.

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

It's surpassed all of our expectations. it met our 20 year ridership goals within the first five years of operation. That's pretty impressive.

a lot of the pedestrian orientation and bicycling and things and the connection to the university was already happening before the light rail. But the light rail was a real critical piece to um, create a more cohesive connection around the stations

Tempe started that more urban centric dense development pattern. Since Tempe is a land-lock city, it basically had to step up and be develop more dense/ develop within the Tempe city limits. It was important to get a light rail connection in order to get a regional connection between Tempe and the other communities in a way that there was no dependence on the automobile anymore. So it could accommodate the urban growth that was already happening in the core area of Tempe. Development along Apache Blvd however has taken a while longer than those other areas in Tempe. But development there is starting to happen around the stations. The more dramatic increase in Transit Oriented Development has taken place in downtown Phoenix. Before the light rail there were a lot of vacant lots in the core of the city of Phoenix.

Mesa is starting to urbanize more their downtown. They didn't have a lot in the downtown area of Mesa. It didn't have a lot of foot traffic or a lot of energy within that area. The light rail has increased all of that and it's increased the city's investment in creating a more urban environment.

Within a half a mile around the stations is where you see most of the development taking place. Especially within a quarter of a mile radius is where you see the most growth.

However, commitment to development in the urban center, even if it's not around the station, has been a lot higher. There's a lot more, even between stations. Um, it's attracted a lot more growth. So it isn't just because it's around the light rail station. It's folks saying: we don't want to live in the outskirts anymore. We want to be more in an urban environment. That's also of importance here.

b. Is continued TOD likely to take place along these existing segments?

Yeah, so part of what spurred a lot of the development in these areas was a lot of our focus and in catalyzing the interest because there wasn't this type of development going on in 2011 even. And the line had already been open for two years. So it's a whole lot of it. During the recession there wasn't a lot of development going on and so what we did is we capitalized on that, created this fund and went to the developers

The recession created an opportunity, frankly I think for light rail and for the development, because there wasn't any development going on. And so it created an opportunity for people to start to be, they were forced to maybe look at other ways to develop real estate and there was some interest in some catalysts and we had some success with the ridership. So that was bringing people into the urban center, and developers liked that pattern because they want to know, well, let's develop around where the energy is and where the people are.

The light rail opened in December 2008 and we saw TOD taking off around the 2015 timeframe. And since then, and in the future TOD will continue to increase. I do believe however that the growth of TOD will level off, but there will remain a consistent commitment to this kind of development.

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

b. If so, to what degree and under what conditions can this TOD be expected?

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

t's, it gives us an alternative. Um, and people are choosing the alternative. It's difficult to maintain financially. Uh, the large amounts of infrastructure keep building out expensive to obviously create rail lines. But the more that people live in more balanced growth patterns, then it provides less of a need to own a car. And that can actually help financially families to save anywhere from 6,000 to $10,000 a year. And then that helps with housing and transportation costs.

Obviously greenhouse gas emissions and reductions in greenhouse gas emissions and things that tie into climate change issues and challenges.

It provides an alternative to having to use the automobile for everything. So there's other options than just the automobile. And so that minimizes some of the negative impacts of a continuous, um, sprawling pattern that's very car centric and one that's completely depending on the automobile.

There's also the piece of the actual time, your own personal time. Yeah. That if these compact development patterns are becoming the norm, then there's less time spent in the car and there's more time spent with our loved ones , there is more time spent with our employer, working, more free time, more recreating etcetera.

So it also balances out the opportunities for, you know, reducing congestion. You're reducing the amount of cars that are on the road.

It's also, like I said, changing preferences and actually that has created a real increase in a spike property values, which increases in the cost of housing, which provides inequities when it comes to affordability issues like that.

Appendix 13: Transcript summary participant 10

Participant 10: Eric Iwersen

10-01-2019, Tempe.

Transit Manager for the City of Tempe. In Tempe we pay for our service and we do all the route planning and handle the customization of our transit system in Tempe. But then we handed over to Valley Metro who, hires the drivers, ensures that buses and trains are on time and does the the day to day operations of it. Um, but we work really closely with Valley Metro and we worked really closely with our Economic Development Department. So we've been tracking how does development activity, specifically transit oriented development activity, how, how is the pace and the scale of the investment adjacent to our light rail versus suburban parts of the city or areas that are built really exclusive around the car?

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

One of the top complaints that we get from residents of Tempe is that traffic congestion is a problem, so that's why we're trying to move more people with public transportation and scooters and bikes etc.

the development activity around, um, our light rail line has been much more robust. It's been much stronger than other parts of the city. So development around mill avenue development around Apache Boulevard, Washington Boulevard, um, has all been much stronger, higher density etc.

In terms of ridership, relative to the size of the system, the Valley Metro light rail has been one of the top 15 most successful light rail lines of the country. And the development adjacent has been really strong too. And I would say it would have gone even faster and been more aggressive if we hadn't had a downturn. You know the recession that started in 2008, that really hampered development. But during the downturn, the development that took place all happened along the light rail line.

In Tempe, our greatest number of building permits have happened along the light rail and in those areas where we've done high capacity transit and made our streets more multimodal. So our streets that are bikeable, walkable and transit accessible, that's where we're seeing development activity in the city stronger than any other parts of the city. And then, um, that's also where we're showing our lowest vacancy rates. So stuff's being built and it's being occupied.

So Phoenix was the first to adopt TOD and they had, you know, looked at discouraging drive throughs and discouraging certain businesses. Um, and, and our tod does that as well. Um, discourages certain, you know, kind of more automobile related businesses, but,

not all parts of the, you know, of the 26 mile light rail that we have are equal. Um, even though the light rail is pretty equal, I mean it's the same basic, roughly the same speed and you know, it looks the same throughout the whole system. The geographic areas that it passes through are really widely varying. Um, I would say in general, Tempe I think has done the best at, um, you know, in our s six miles of light rail having pretty good distribution of tod along that whole six miles. Uh, Mesa has had, um, kind of spots, you know, certain spots that have had improvements. And then Phoenix has done really well in their downtown and then, well, kind of up and down central lab, but then like by the airport and as you get closer, you know, kind of between downtown Phoenix and downtown Tempe, there's a ton of available land to do redevelopment and tod and, and there's reasons in there.

I think it's, you know, it's not there. They're in between downtowns, there in between Tempe and Phoenix downtown. It's louder and there's a little bit, um, more challenging conditions there because of the airport. Um, you know, so like building housing, they're just has different, different, maybe less attractive, um, conditions

Yeah. Downtown Phoenix, 20 years ago was a ghost town. I mean there were people that work down there in the daytime and you'd see certain corners, certain areas that it was busy in the day time, but no one lived down there. There was no residential towers, there wasn't really housing opportunity, there wasn't an ASU branch down there. And it's pretty spread out for an urban core for a downtown. But they've added, I don't know, 15 residential towers. They added the baseball stadium about 16 years ago. Um, it's been filling in and so now there's really good strong areas of downtown Phoenix. Downtown Tempe is always had the highest density and most compact. And you know, Asu was the major, you know, reason for that for a long, long time.

b. Is continued TOD likely to take place along these existing segments?

In my opinion downtown Phoenix isn't a ghost town anymore, I think will only continue to get more rich with a diversity of jobs and development, entertainment and development and people.

In the past few years, since the light rail, to me, Tempe felt really active and vibrant, and I think it's only going to get better on that level in Tempe. I expect Tempe will just become even stronger of a, of an urban experience and a place where you can do everything you need to do in a relatively compact area, for a large part thanks to light rail and TOD.

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

we're talking about it now with the Streetcar Project that's under construction, extending the tod along the streetcar route. And I would say, um, that's also going well. However, now we have new issues. People have seen that one of the challenges or one of the, one of the unintended consequences of doing TOD and building the Streetcar Projects and having this higher density, um, there has been, um, an increase in the cost per, per square foot. So rental rates for folks have gotten more expensive and people get worried, um, about not being able to afford to live here.

pricing out people that have been here a long time, that's a concern. And that's that some people attribute the, you know, the growth and the success of the tod to, um, helping to create that, that gentrification or that, um, pricing out, um, issue. And with this new round of the tod expansion that we're looking at, we are also doing an affordable housing plan. Yeah. Um, and we're trying to address this issue of how do you maintain, um, affordability in addition to tod and, and success of these major rail projects.

I think light rail will definitely continue to grow and reach further parts of the valley and be successful. Right now plans are being made to extend the light rail from Mesa down south to the downtown of Chandler. And also other extensions are being planned, such as the south central Phoenix extension.

b. If so, to what degree and under what conditions can this TOD be expected?

so that's the, that's, we didn't really hear that 10 years ago and we were doing the tod. Now we're hearing that now that we have the experience of having done all these construction projects. So we have another layer in our tod now where we're trying to, you know, insert in affordable housing policies and plans to make sure that we're providing opportunities for, um, you know, working class people to be able to afford to live in the area. we have to be very careful and we have to do our best

to have, uh, an overarching policy and code that helps to really address maintaining a percentage of our housing to be affordable.

downtown Tempe end downtown Phoenix, those already, those are hubs. So they already had natural conditions.

Like, you know, there's movie theatres and there's restaurants and you know, there were small little markets now we're getting bigger market. So there were already goods and services and a kind of a way to live your life in that area. in those areas that are between the two downtowns. There isn't much there. I mean there isn't much in the way of like liveability and, and in those conditions that you know, people want to live with that's near there. And so, um, and you don't want to have to travel all the way to the downtowns to get it. So I think one of the things that we talk about with TOD is that, uh, we, um, what we refer to a station area planning and that we try to have, you know, if the light rail has stations every half a mile to a mile, we tried to think of, you know, maybe at every mile or every two miles that those stations are hubs and that you should have even more intense activity right at those hubs.

So you're creating almost a mini mini downtown or a node that might have a grocery store and I might have a couple of restaurants and maybe maybe a community center of some sort. And yes I that happening, I see that kind of emerging. For example right on the border between Tempe and Mesa. Also in north central Phoenix, you see, like as you get closer to camelback road or even kind of halfway, you see little pockets where there is a kind of a mini village or that node is sort of a mini downtown. So it basically has its own little goods and services node. People don't have to go to somewhere else. They don't have to take the light rail towards the downtown. They can get a lot of what they need to do in that node. Also these nodes will attract people from outside who stop at that certain light rail stop, since there is more activity going on over there.

So these light rail stations can be centers of an area, you know, they can be sort of like the town square in some ways of, of the area. Certainly if you build some other public space around it, um, and then you attract higher densities and you attract food, shops and other goods and services, you start to build that in and you're building that convenience and liveability for those areas.

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

I think when you really think about the growth in this region and, and long term sustainability of this region, you come to the conclusion that we have to invest in public transit and more significantly than we do now in order for us to succeed, um, and be a, be a economically sustainable, environmentally sustainable area with a high liveability. We have to invest in public transit more than we do now for us to make it. And so I think that, you know, I think that we're in, uh, in sort of an adolescent or a teenage phase of development and growth and transportation and culture in this region and that in order for us to get to the next level, we will soon start to realize that that public transportation and investments in major projects, rail projects are going to be critical for the success of the region.

TOD is really about having people live in and shop in and getting their groceries in a more compact area. And that they're doing those movements to get those goods and services through transit. And so they are polluting less hopefully by not driving a car, by having just a smaller footprint. The physical space they occupy, their house is not taking up 10,000 square feet of a parcel of land. They might be

in a building. And so through all through all those things, I think it's hopefully contributing to a less of a carbon footprint, less pollution, more sustainable use of our land and resources.

I always rode my bike to work and I still ride my bike to work or school. Um, but that was pretty rare for someone to do it like that. Now I think you can do that more easily, um, in parts of the region along the light rail line in those TOD areas. But now that people have the option to live such a ore sustainable lifestyle with biking, walkability, TOD etc. we see that people are actually doing it. Every time we build a building, it fills up. So obviously there's a demand. I know there's more people moving here too. Um, but hopefully that having that housing option, those, those options that are created, those lifestyle options that are created through tod is attracting people. And hopefully that's addressing a long term sustainability of the state and the region and our resources.

Appendix 14: Transcript summary participant 11

Participant 11: Scott Smith

15-01-2019, Phoenix.

CEO of Valley Metro Rail. Former mayor of Mesa.

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

When looking at the Valley Metro Quality of Life Report: The big number is $11 billion in a, in a real estate development, uh, within the corridor and a defined the corridor has been a half a mile on either side of the, of light rail. Now, in order to understand that, um, you really need to know a little bit of the history. Phoenix of course, is as many western cities in the U S was, was created by the car, the automobile. Yeah. And we're very much a sprawl city, uh, where, uh, you know, it had to have been a little bit surprising to you to know that everybody here has a car, drives a car. You really need a car to get where you want to go.

And if you don't have a car, you don't get around very well. And so that's how the city developed and uh, as many American cities it developed outward. So that meant that the inside, we call it the doughnut hole. Yeah. It's just like a donut. And our light rail basically runs through the, through the donut hell hole. These are areas that, uh, we're very vibrant. Back in the fifties and sixties, even in the 70s, downtown Mesa, downtown Tempe, even downtown Phoenix. And then as the community grew out, they were left behind. Yeah. And what light rail has done exactly. What's that? Do you think? Uh, because that's where, that's where the new development was. That's where the new malls were, that's where the new shopping is. There is no necessity for economic activities to take place in the core areas. Because with your car you could satisfy everything out in Chandler and East Mesa and, and the northwest part of the valley because development came out there, such as shopping and restaurants. Everything came to you and you didn't need to go downtown anymore. And so people left downtown. And what light rail was an attempt to do is to really re, uh, re-establish the city and fight the loss to revitalize it.

Mesa that hadn't had a building permit issued for a new home construction in 30 years. So no new homes have been built in downtown Mesa for 30 years. And then light rail came. Yeah. And since 2015, little over three years since light rail was expanded into depth through downtown Mesa, there's been over $400 million in either new construction, new projects approved or projects planned. So we went from zero to 400 million in three years, driven, almost completely by light rail.

Opening up the downtown Phoenix ASU campus happened at the same time when light rail opened. The two did not emerge in cooperation with each other, but it was definitely timed together, it was part of the integral thinking of both ASU and the city. they said, now's a great time to create this campus because we're right on light rail. We can connect Tempe with Phoenix and beyond.

Before light rail downtown Phoenix had a lot of empty lots. At five o'clock, it became dead. There were office buildings here, but there wasn't any entertainment. Nobody lived here. And so now what you see is, is you see a lot of people coming back to the city center, uh, and they're coming back and they're not driving their car every day. They may not even own a car, but they take transit, they take bicycles. So along with the light rail came also permanent residents to this area and more entertainment and more development.

We call that the sheep mentality: People wait for that first person to make the big investment and then they'll follow the herd. And that's what we have seen along the light rail. So light rail was the first big investment the government made. This is where government can be useful because they will take those investments. The government is patient money. They'll make those investments with the law because we don't need a financial return immediately. Then you have one or two bold investors who come in and they say, okay, let's give it a try. And once those come in and they're seeing successful, then other people follow, and that's what you're seeing happening along the light rail, especially in downtown Phoenix and in downtown Tempe. It hasn't quite happened totally in downtown Mesa, but it's getting there. But I would say if you really want to look and see the true long-term impact of light rail, you've already seen it in Phoenix and Tempe and starting to Mesa, come back in five years and you'll be amazed to how much has happened in just five years. Come back in 10 years and you won't recognize the place.

Our light rail is very long (26 miles) so there's no doubt that it's not a cure for everything. There are some areas that may not see development for five, ten years. People forget that real estate development takes a lot of time. And there is of course, and you even see this in the Netherlands, there's stretches of trains and transit that for whatever reason just isn't appealing. There are other issues with it. The surrounding, you know, maybe it's in an industrial area etc. And that's okay because you have a lot of opportunities elsewhere.

b. Is continued TOD likely to take place along these existing segments?

I don't think these developments as a result of the light rail will stop here in Phoenix, because we are not even close to meeting our level of capacity. there's still a lot of empty and developable land. There are a lot of places that could be better utilized with higher density developments when you have light rail.

When people and companies see that investment, when they see the light rail, it encourages them to be in that area, to invest.

I think you'll see many mid- and high rises like you already see now. I think you'll see a more urban type of environment with walkable restaurants as opposed to now. It's really a mix between the carryover from the suburban development and urban development. You'll see more of an urban development along light rail. It will become very walkable with the advent of the scooters and bikes. Um, you know, you don't even have to be next to a station anymore. That's the difference. People can walk out, get on a bird scooter, zip down to the station and leave their scooter there, get on light rail and be gone. That's going to have a huge impact on development because now you don't even have to be within walking distance of a station. You can probably be within a mile of a station instead of a quarter or a half mile. I think the scooters and the bicycles that you can just take and just drop, someone else will pick it up because their gps driven. I think those are going to have a huge impact on urban development, and they could potentially work very well with light rail.

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

In the future we will have at least two lines if not three to four. It will not expand a lot in the short term. And the main thing that will keep it from expanding quickly is money, it's just really expensive to build light rail. And I think that if it doesn't price itself out of the market, uh, I think politically it will become more bothersome.

I think wherever light rail goes, you're going to develop places where there'll be transit oriented development. It's just too natural. Yeah. Uh, and I think governments have realized that they can give

enough flexibility to developers that they can take advantage of the place when there is a presence of light rail.

b. If so, to what degree and under what conditions can this TOD be expected?

Some communities are voting light rail down, because there are too many conservative people elected in the council. We have a lot of people who, even though light rail has been proven to be a success, are still very much against it. Every measure that you ever come up with that shows that light rail and TOD have been a success. There will always be people who just don't like light rail, they don't like the investment. They don't like it. They don't ride it, they don't feel comfortable on it, and therefore it must be bad. They feel that it hurts their businesses, that it attracts the wrong kind of people. Now, none of these have been proven to be true across the board. It doesn't matter. You know, people, it's one of those issues and subjects that people get emotional about and they make up their mind. It's very difficult. Even with proper information, it's very difficult to change your mind.

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

So I guess the lesson is, is that we're going to have more people that want to live in urban areas, and there's no doubt we are becoming a more urbanized society around the world. More of us are moving into the center of cities and we're not creating new real estate to build new roadways. No. So you're going to have to figure out a way to transport large numbers of people over long distances and in a place like the Netherlands where you have an established rail network and you have established corridors that means that you are just adding capacity. If you have a place like Phoenix where you don't have those established corridors, you're going to have to figure out a way to find the place where you can transport large numbers of people. And that's where light rail and express buses and things like that come in. So I think it'll be there, uh, because the need to transport people will, will increase. Uh, and I think what it'll do is it'll still create this kind of development because as people get more congested, they want to live closer to what they do. Exactly, yeah and like you said, like the self-autonomous vehicles will not lower the congestion. So therefore a public transit system, like a light rail will stay relevant.

So I believe that the old idea of the American dream, you know, owning a car and having a nice house with the garden around it is changing. The younger generation values more to be closer to entertainment and amenities, they value sustainability more and are just simply enjoy living in an urbanized environment. So those things will change attitudes. Yeah. And I think that'll continue to support the long-term growth of light rail and will have a positive effect on TOD.

Appendix 15: Transcript summary participant 12

Participant 12: Kate Borders

22-01-2019, Tempe.

Director of the downtown Tempe Authority. Our organization funded by the property owners. We work closely with the government entities here. It's valley metro as well as our actual city government to work on these projects and how they can support the downtown growth.

1] a. To what degree has Transit Oriented Development (TOD) taken place along the existing segments of the Valley Metro Rail? – Where can TOD be observed, and where (almost) not?

Within the downtown of Tempe there are two light rail stations, one on Mill avenue and one near the Sun Devil stadium on Veterans road. All of the development around the station on Veterans road happened at the same time or after the light rail station was built. Also a lot of the big buildings you see along Tempe town lake, you know these major employers such as State Farm and all the apartment building, they are there partly because of the relatively close access to light rail. I do think however that there's always a bigger influence on the perceived need and use of something than the actual use of something. So I think a lot of corporations will decide they're going to relocate their headquarters here because light rail is an opportunity for their employees. Whether or not their employees ended up using light rail or not, the actual use is different from the asset that is then presented to the stakeholders. So often light rail is seen as a nice characteristic of the environment over here and that is often used as an argument for companies to relocate their business to this place, especially here in downtown Tempe. Just like Tempe town lake, the presence of light rail is kind of used as a marketing tool to lure in investments.

Absolutely, I think that we need to plan corridors appropriately based on connections to residential neighborhoods, connections to major assets. Take the library campus for example, and um, and there should be development around there. So different quarters become more dense. And obviously this is a policy decision too because the leadership of the city has to decide that they will allow development projects of certain heights and densities to occur in various places around downtown and not in other places. So they can create a TOD plan with the intention, which they're actually working on right now.

b. Is continued TOD likely to take place along these existing segments?

When we look at the streetcar extension, but also possibly other future extension in other parts of the metropolitan area, I absolutely feel that TOD will work in those places. I mean it, it doesn't matter in what city you work on such an extension, it has proven time and time again, that hard infrastructure, that rail infrastructure creates development more than any other infrastructure.

Right now there are conversations going to connecting the streetcar further east to the Tempe marketplace mall and also some extensions further into the neighborhoods. So then people could start to have shopping entertainment downtown all on one transit system. Okay. And ultimately that will, it will drive developments as well.

2] a. Is TOD likely to happen along a future extension of the Valley Metro Rail?

The Novus innovation corridor is a 330 acre master development planned by ASU, and it's basically from the campus more eastwards up until rural road. So it is the area to the east and more north of campus.Yeah, that's 330 acres. It's a lot of land. It's all mixed use development that's geared toward the public. It's not geared towards students, so it is not educational centers and it is not student housing. It's market rate housing, office complexes, hotels, entertainment, you know there's going to be almost like a little new main street over there that's going to have shops and boutiques and things like that. So that development, I think whichever way you look at it, they're thinking about doing the development and justifying it because of the extensions of the street car. They also think the other way around, that the streetcars are going to be needed to get people to the development. But these developments are happening kind of simultaneously. It is to be noted that ASU is a huge supporter of streetcar and wants that there for all of their current uses and their future proposed developments.

Currently a urban core master plan for the city of Tempe is being prepared. Part of which is a TOD study. Basically the plan strategizes density demand for most of Tempe. They suggest that transit routes should go more south, into the residential neighborhoods of Tempe. The plan is to incentivize development and transit along those routes. They're suggesting that transit should go there. They're not dictating what that transit should exactly look like, but this could of course be light rail. And then they're talking mainly about developments that should be approved and what those densities should look like, because our council struggles with height and density concerns.

b. If so, to what degree and under what conditions can this TOD be expected?

I certainly hope that one day the light rail network will expand more and more, an becomes a complex and more dense network. But of course have to rely on federal funding to do such extensions.

3] How will existing, continued and new TOD in the Phoenix metropolitan area contribute to reducing some of the observed negative side effects of the strong urban growth?

But when you look at the long term for a place like Tempe, when you add the street car components and then the streetcar extends, and the light rail continues to extend. And then now have a regional transit system. Yeah, it's all building upon the ultimate goal of being able to get people out of their vehicles. And that's where I think we're headed. So long term this is the right solution and it's sustainable. It's getting people comfortable with light rail and getting them on board literally and figuratively, um, over time

I definitely think the light rail system needs to be more complex ultimately. I mean we, I don't think we will ever be the same type of city that has eight different lines converging. Yeah, sure. But I mean, two to three of those converging lines would be doable, and I think then your citizens would start to take advantage of it more and you'd have sort of that flip and behaviors. I think that the development piece is key because there need to be things here. Um, also it's about inconvenience as much as it's about convenience. So the more that driving becomes inconvenient and parking becomes inconvenient, yeah then this option of light rail continues to become more interesting. And those challenges are definitely rising. So parking is hard in Tempe the traffic situation over here is bad. So those could be actually good ways to get people to change and become