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Transit Value-Added Monitoring System: Estimating Value-Added Outcomes Of Tucson's Streetcar

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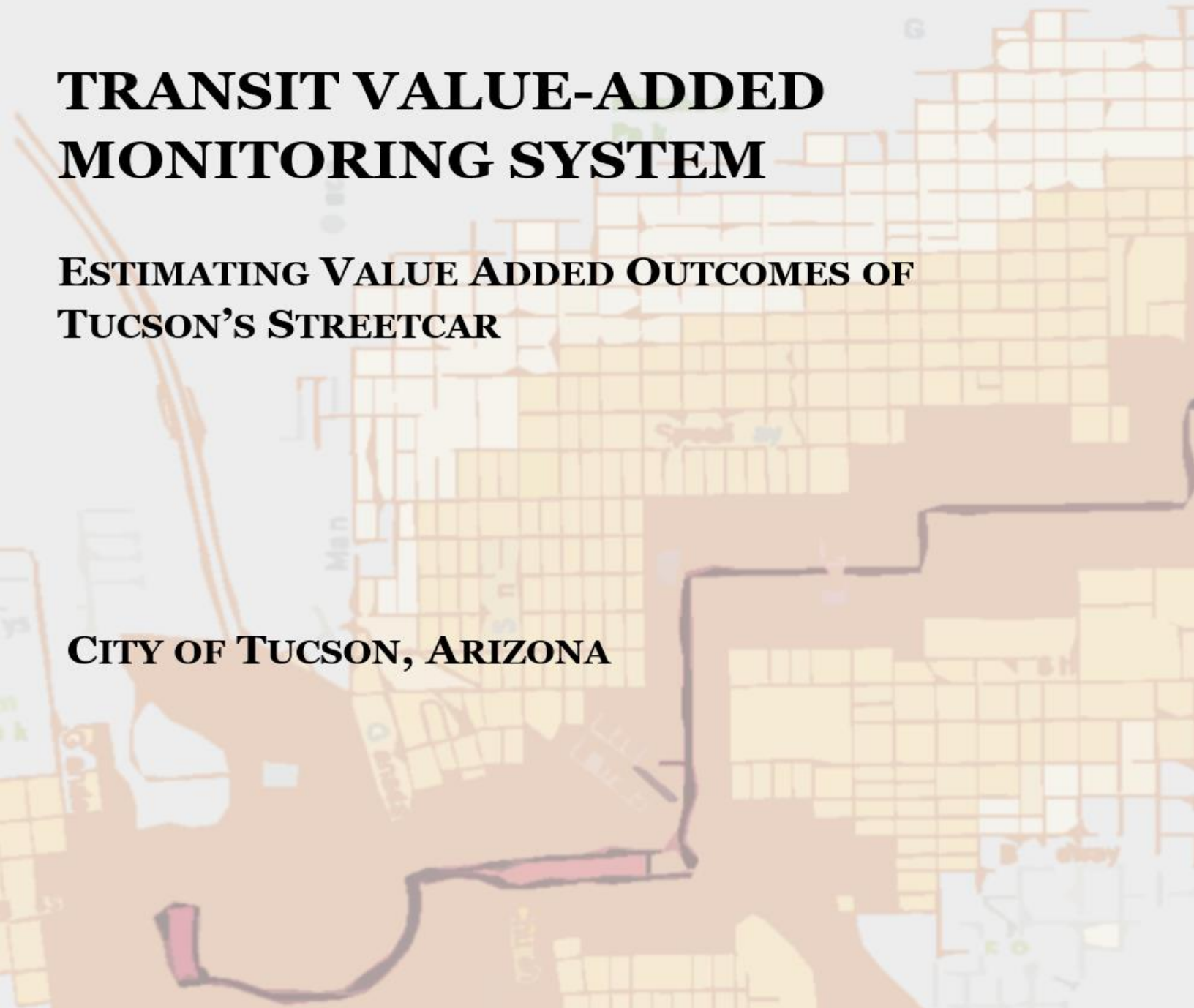
THE UNIVERSITY OF ARIZONA

TRANSIT VALUE-ADDED MONITORING SYSTEM

ESTIMATING VALUE ADDED OUTCOMES OF TUCSON'S STREETCAR



CITY OF TUCSON, ARIZONA

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16. Abstract

The City of Tucson operates Sun Link, which is a streetcar system. The full benefits of the streetcar to the city have not been cataloged. These include changes in jobs, people and households, changes in commuting mode choice, changes in wages and household income, and especially changes in the city's fiscal structure relating to property and sales taxes, and supplemental revenues. What is needed is a Transit Value-Added Monitoring System that can track changes along key economic, social, and fiscal dimensions. Such a system can help the city measure progress in achieving transit investment objectives. It can also help policymakers identify fiscal benefits, perhaps leading to more informed allocation of resources to help achieve transit-related policies.

This report creates a Transit Value-Added Monitoring System. It uses data available in the first quarter of 2024 to create spatial and data structures along the streetcar line, and then uses those data to report outcomes along numerous dimensions from the early 2010s before and shortly after streetcar service began, into the early 2020s during the pandemic and the early recovery years.

The area considered for value-added analysis is comprised of census blocks and block groups extending roughly one kilometer (about 0.63 mile) from streetcar transit stations and the track. For jobs and tax revenue analysis based on census blocks, the study area is equivalent to about 1.5% of the city's land area. For demographic analyses using census block group data, the 1-kilometer area is equivalent to about 1.8% of the city's land area.

The Transit Value-Added Monitoring System shows that between 2014 and the early 2020s, the streetcar corridor accounted for about half of the city's population and a third of its household growth, attracted about half of all new housing units in the city, gained a third of a billion dollars in household income after inflation, added hundreds of jobs with a quarter of a billion dollars in new wages, saw more than 40 percent of corridor residents commute to work via something other than the car, compared to 20 percent citywide, and increased real estate investment by $2.5 billion.

From a fiscal value-added perspective, annual new revenues generated within the streetcar corridor through FY 2023 came to more than $13 million. Capitalized at the local government tax-exempt borrowing rate, this revenue could service debt of nearly $400 million. Additional analysis shows that although property tax value-added revenue accounted for just 15% of total FY2023 revenues and just 9% of non-tax general fund revenues such as federal and state grants, local sales and state-shared income taxes accounted for 41% and 40% respectively of those tax revenues, while state-shared sales accounted for 34%. Value-added use taxes accounted for 62% of these revenues. Overall, the value-added revenue accounted for about 30% of the 1-kilometer streetcar corridor revenues in FY2023. Moreover, analysis shows that new tax revenues since 2019 have more than offset lost streetcar fares in constant dollar terms.

17. Key Words	18. Distribution Statement
Streetcar transit; Transit value-added; Transit economic development outcomes; Transit demographic outcomes; Transit commuting mode choice outcomes; Transit housing and tenure outcomes; Transit station policy; Transit station area planning; Transit post-pandemic planning; Transit waived fares; Transit fiscal value-added offsets waived fares.	No restrictions.

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Unclassified	Unclassified		Priceless

EXECUTIVE SUMMARY

The City of Tucson operates Sun Link, which is a streetcar system connecting the University of Arizona medical center to the main campus, the university and 4th Avenue commercial areas, downtown, the Mercado redevelopment area, and the convention center. Its 3.9-mile route includes 21 stations. Since opening in the middle of 2014, it has helped make this part of Tucson more attractive to people and businesses. Indeed, in 2022, ridership exceeded two million passengers, the highest ever, which occurred during the last full year of the COVID-19 pandemic.

However, the full benefits of the streetcar to the city have not been cataloged. These include changes in jobs, people and households, changes in commuting mode choice, changes in wages and household income, and especially changes in the city's fiscal structure relating to property and sales taxes, and supplemental revenues.

The city also anticipates expanding its fixed guideway transit service. Current plans call for a bus rapid transit system connecting downtown to Tucson Mall along Stone Avenue.

What is needed is a Transit Value-Added Monitoring System that can track changes along key economic, social, and fiscal dimensions. Such a system can help the city measure progress in achieving transit investment objectives. It can also help policymakers identify fiscal benefits, perhaps leading to more informed allocation of resources to help achieve transit-related policies.

This report creates such a Transit Value-Added Monitoring System. It uses data available in the first quarter of 2024 to create spatial and data structures along the streetcar line, and then uses those data to report outcomes along numerous dimensions from the early 2010s before and shortly after streetcar service began, into the early 2020s during the pandemic and the early recovery years.

The area considered for value-added analysis is comprised of census blocks and block groups extending roughly one kilometer (about 0.63 mile) from streetcar transit stations and the track. For jobs and tax revenue analysis based on census blocks, the study area is equivalent to about 1.5% of the city's land area. For demographic analyses using census block group data, the 1-kilometer area is equivalent to about 1.8% of the city's land area.

Exhibit E-1 shows that large to very large shares of change occurred on this very small area of land.

From a fiscal value-added perspective, annual new revenues generated within the streetcar corridor through FY 2023 came to more than $13 million, as shown in Exhibit E-2. Capitalized at the local government tax-exempt borrowing rate, this revenue could service debt of nearly $400 million.

Exhibit E-1
Selected Value-Added Outcomes, Tucson Streetcar Corridor, Before Operations Commenced to Early 2020s

Measure (1-kilometer unless noted)	Value-Added Metric	City Share
People and Jobs		
New People 2013-2022 (height of Covid)	3,124	29%
New Households 2013-2022 (height of Covid)	2,415	16%
Station-Track-Adjacent Block New Jobs 2015-2021	1,257	19%
Net New Jobs 2015-2021 (height of Covid)	365	5%
New Workers Living in Corridor 2013-2022	3,774	15%
Wages and Income		
Streetcar Value-Added Wages	$241,826,557	33%
Streetcar Value-Added Household Income	$176,850,948	7%
Property Value		
Streetcar Value-Added Total Property Value	$2,579,559,145	11%
Streetcar Value-Added Non-Exempt Property Value	$1,735,730,183	8%
Residential Units, Tenure		
New Residential Units, 2013-2022	2,253	24%
New Renters, 2013-2022	7,376	40%
Commute Mode to Work		
Share Not Using Autos/Trucks—Corridor	42%	
Share Not Using Autos/Trucks—City	19%	

Exhibit E-2
Streetcar Corridor Value-Added Fiscal Revenues FY2013-FY2023

Measure	Total Revenue FY 2023	Value-Added Revenue 2013-2023	Value-Added Share
Property Taxes	$5,177,487	$759,459	15%
Sales Taxes	$14,133,437	$5,772,093	41%
Use Taxes	$3,187,079	$1,971,159	62%
State-Shared Income Taxes	$4,633,069	$1,848,884	40%
State-Shared Sales/Auto Taxes	$4,814,751	$1,626,711	34%
Non-Tax General Fund Revenue	$11,450,774	$1,053,208	9%
Total Streetcar Revenue Value-Added	$43,396,597	$13,031,515	30%
Free Streetcar Fare Summary	**2023**	**Fares 2019**	**Net Taxes**
Net Tax Return from Free Fares*	$2,303,885	$801.055	$1,502,830

*This is the difference between new sales and property taxes gained between 2019 and 2023, $2,303,885 in 2023 dollars, and lost streetcar revenue based on 2019 fares, $801,055 in 2023 dollars, resulting in net tax revenues of $1,502,830.
See Chapter 9, Exhibit 8-1 footnotes for summary calculation details.

Exhibit E-2 also shows other trends. Although property tax value-added revenue accounted for just 15% of total FY2023 revenues and just 9% of non-tax general fund revenues such as federal and state grants, local sales and state-shared income taxes accounted for 41% and 40% respectively of those tax revenues, while state-shared sales accounted for 34%. Value-added use taxes accounted for 62% of these revenues. Overall, the value-added revenue accounted for about 30% of the 1-kilometer streetcar corridor revenues in FY2023.

Moreover, Exhibit E-2 shows that new tax revenues since 2019 have more than offset lost streetcar fares in constant dollar terms.

This report is a value-added analysis that focuses on only measurable employment (including wage), demographic (including household income), and fiscal revenue outcomes. It is not a statistical causal or association analysis that controls intervening factors. Nor is it an economic benefit/cost analysis or a fiscal analysis where revenues are compared to costs including opportunity costs. It assumes implicitly that most if not all these revenues are net of costs taxpayers would have paid anyway if growth had not occurred. Technically, the assumption is that marginal costs are nearly zero meaning that all marginal revenue is net of costs to the city. Future analyses can include cost considerations, explore revenue-cost relationships, and perhaps apply econometric and other parametric techniques.

The bottom line is that the streetcar corridor generates in the order of $13 million in new revenues annually for the city. As the corridor continues to add jobs, people, households, real estate investments, and taxable transactions, this figure will grow.

CONTENTS

INTRODUCTION

This report presents a reporting system to establish and then track the extent to which Tucson's streetcar adds value to the city along several dimensions such as:

Real estate investment
Jobs and wages
People and households including income
Property taxes
Sales taxes
Supplemental revenues

Tucson's streetcar, illustrated in Exhibit 1, was launched in 2014. Its route, shown in Exhibit 2, extends westbound from the University of Arizona medical school through campus and then along commercial corridors to downtown, terminating in the Mercado redevelopment area and then returning eastbound to the convention center and then back to the medical school.

Exhibit 1
Tucson's Streetcar
Source:
https://en.m.wikipedia.org/wiki/File:Tucson_sun_link_testing_phase_dec_24_2013.jpg

The streetcar route runs 3.9 miles (6.3 km) and includes 21 stops served by eight individual cars. It averages about 6,000 riders per day, totaling about two million passengers annually. It carries the nation's third highest volume of streetcar passengers, after Portland and Kansas City.[1] Since 2020, it has been free.

[1] From https://en.wikipedia.org/wiki/List_of_United_States_light_rail_systems sorted for streetcars.

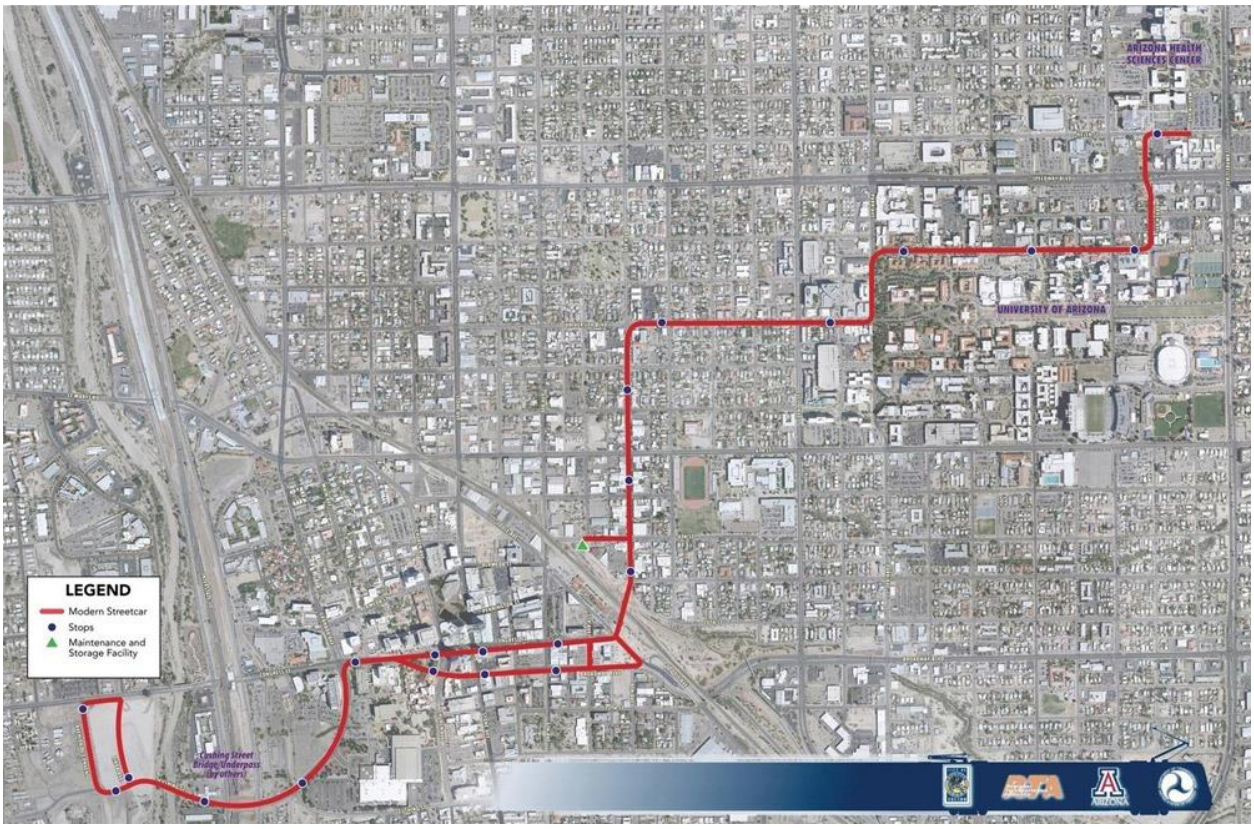

Exhibit 2
Tucson Streetcar route
Source: https://www.railwaypreservation.com/vintagetrolley/full-route.jpg

The streetcar was financed from local, regional, and federal sources, totaling about $300 million in current dollars. One of the purposes of the streetcar is to stimulate economic development along its route. As will be seen in Chapter 2, value-added real estate investments along the streetcar stations, tracks, and adjacent city blocks exceed $1.6 million while the figure within the half-mile (800 meter) circle the figure approaches $2.6 billion. Although there have been various estimates of streetcar economic development outcomes, they have not been consistent in their methodology or reporting. This report creates the ***Transit Value-Added Monitoring System*** for doing so. The methods used in this report can be applied to the proposed bus rapid transit (BRT) corridor connecting downtown with Tucson Mall along Stone Avenue.

The report is comprised of these seven chapters:

Chapter 1—Value-Added Concepts, Policy Context and Application presents key economic and policy purposes of value-added analysis and presents the Tucson context in terms of the streetcar alignment, the study area, and the tiers within it.

Chapter 2—Value-Added Employment and Wages Monitoring System provides a method that uses the Longitudinal Employment-Household Dynamics database to measure the change in jobs and wages along the streetcar corridor.

Chapter 3—Value-Added Demographic, Commuting, and Income Monitoring System employs methods to use the American Community Survey to measure the change in people, households by type and age, mean household income, and commuting mode choice to derive Value-Added outcomes.

Chapter 4—Value-Added Property Tax Monitoring System presents and applies a method for estimating property tax Value-Added annually.

Chapter 5—Value-Added Local Sales Tax Monitoring System presents and applies a method for estimating business privilege taxes, known popularly as sales taxes, as well as transient occupancy taxes, and the local hotel/motel surcharge tax.

Chapter 6—Value-Added Use Tax and State-Shared Revenue Value-Added Monitoring System includes use taxes and state-shared tax revenues.

Chapter 7—Value-Added Non-Tax General Fund Revenue Monitoring System includes proportionate share estimates of other general fund taxes and fees associated with development on the streetcar corridor.

Chapter 8— Post-Pandemic Streetcar Free Fares are Offset by Value-Added Tax Revenue shows that the free fare policy adopted in 2020 appears to generate new taxes that are sufficient to offset lot fare revenue.

Chapter 9—Maintaining the Value-Added Monitoring System outlines the process to update Value-Added outcomes annually for use by City County, City departments, and community stakeholders among others.

Once implemented and updated annually, Tucson's Transit Value-Added reporting system will be an important tool for monitoring transit outcomes as well as providing important economic development and demographic information for decision-makers.

To reiterate from the Executive Summary, this report is a value-added analysis that focuses on only measurable employment (including wage), demographic (including household income), and fiscal revenue outcomes. It is not a statistical causal or association analysis that controls for intervening factors. Nor is it an economic benefit/cost analysis or a fiscal analysis where revenues are compared to costs including opportunity costs. It assumes implicitly that most if not all these revenues are net of costs taxpayers would have paid anyway if growth had not occurred. Technically, the assumption is that marginal costs are nearly zero meaning that all marginal revenue is net of costs to the city. Future analyses can include benefit/cost considerations, explore revenue-cost relationships, and perhaps apply econometric and parametric techniques.

The report continues with Chapter 1 which frames Value-Added concepts and the policy context for application to Tucson.

CHAPTER 1
VALUE-ADDED CONCEPTS, POLICY CONTEXT, AND FRAMEWORK FOR TUCSON

This chapter reviews key value-added concepts and their role in policymaking. It then creates a framework for applying the concepts to Tucson's streetcar. The next four chapters operationalize the framework to create an annual reporting system to track outcomes associated with the streetcar.

Value-Added

Research shows that jobs and people are attracted to transit stations. They are also willing to pay more to be close to transit. If the market demand for development near transit stations is facilitated, the result would be higher real estate value leading to more property tax revenue. To the extent that new workers and households are also attracted to transit stations, other sources of revenue would also increase which in the case of Tucson would be the business privilege tax (otherwise known as a sales tax) and the public utility excise tax. If lodging facilities are attracted to transit stations, the City's transient occupancy tax and hotel/motel surcharge tax revenues would also increase.

Inasmuch as transit investments are expensive and can lead to unintended or undesired outcomes, the City could consider capturing Value-Added tax revenues to reinvest in new or expanded transit, finance transit debt, mitigate potential adverse outcomes, or make new investments into economic development or people. But how much is the Value-Added? Value-Added concepts are reviewed next. This is followed by subsections addressing measuring Value-Added, outlining a program to capture it, and identifying opportunities to invest Value-Added capture revenue.

Value-Added Conceptually

If someone owns a parcel of land and local government provides water, sewer, and road access, these government investments have added value to the parcel often at little or sometimes no cost to the owner. Likewise, adding transit next to or near the parcel also adds value. Of course, if the owner builds a home on the parcel, value is increased again. Finally, if the regional economic is robust and new development generates other new development through a multiplier effect, even more value is added.[2] These various forms of Value-Added are illustrated in Exhibit 1-1. Measuring Value-Added is addressed next.

[2] See https://www.stlouisfed.org/open-vault/2020/february/meet-multiplier-effect.

Exhibit 1-1
Value-Added Increments

Source: Arthur C. Nelson.

Measuring Value-Added

While Value-Added is conceptually simply, it can be elusive to measure. The key limitation is knowing the counter-factual; that is, would new development along transit corridors have occurred anyway? Most value-added studies simply report total new investment without respect to the counter factual.

Another approach to measuring Value-Added is the extent to which real estate values per square meter of land or building space vary with respect to transit station or Complete Street, proximity controlling for structural, socioeconomic, location, and other factors. These studies are common but are not conclusive; that is, in some situations, values per square meter rise with respect to proximity as expected based on theory but in other situations values fall reflecting externalities associated with proximity, and in other cases there is no discernable relationship between real estate value and proximity.

There is a third measurement option that is recommended for Tucson: net revenue accruing to local government. It is also a direct measure of the return to transit investments. Conceptually, it is the difference in new fiscal revenue generated by new development near transit or along Complete Streets and the additional cost to serve such development. For instance, if new fiscal revenue attributable to new development are $10 million per year but that new development costs an additional $1 million in public safety, city utilities, and other services per year, the net revenue is $9 million per year.

None of these approaches address the leveraged or multiplier effects of new development near transit. Multiplier effects can be estimated using a variety of standard techniques. A common, conservative multiplier is 1.0 which is added to the base investment which is 1.0. In the example above, all the numbers would simply be double; indeed, the typical range is 1.5 to 3.0.[3]

Moreover, none of these measures include social and environmental benefits. Most value-added studies overlook or underestimate these benefits, focusing only on measurable market value and tax benefits. What is missing is solid accounting of such benefits as improved job accessibility, reduced vehicle miles traveled with associated reductions in greenhouse gases and other harmful emissions, and so forth.[4] Exhibit 1-2 outlines many of these value-added benefits.[5]

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[3] Renee Haltom (2018), Fiscal Multiplier, Richmond VA: Richmond Fed, accessed April 20, 2024, from https://www.richmondfed.org/publications/research/econ_focus/2018/q4/jargon_alert.

[4] Adapted form See Todd Litman (2024), *Understanding Smart Growth Savings: Evaluating the Savings and Benefits of Compact Development*, available at https://www.vtpi.org/sg_save.pdf.

[5] Todd Litman (2024), Evaluating Public Transit Benefits and Costs: Best Practices Guidebook, available at https://www.vtpi.org/tranben.pdf. f

	Improved Transit Service	Increased Transit Travel	Reduced Automobile Travel	Transit-Oriented Development
Metric	Service Quality (speed, comfort, safety, etc.)	Transit Ridership (passenger-miles or mode share)	Mode Shifts or Automobile Travel Reductions	Portion of Development With TOD Design Features
Potential Benefits	• Improved convenience and comfort for existing users. • Equity benefits (since existing users tend to be disadvantaged). • Option value (the value of having an option for possible future use). • Improved operating efficiency (if service speed increases). • Improved security (reduced crime risk)	• Mobility benefits to new users. • Increased fare revenue. • Increased public fitness and health (by increasing walking and bicycling trips). • Increased security as more non-criminals ride transit and wait at stops and stations.	• Reduced traffic congestion. • Road and parking facility cost savings. • Consumer savings. • Reduced chauffeuring burdens. • Increased traffic safety. • Energy conservation. • Air and noise pollution reductions.	• Additional vehicle travel reductions ("leverage effects"). • Improved accessibility, particularly for non-drivers. • Community cohesion and reduced crime risk. • More efficient development (reduced infrastructure costs). • Farmland and habitat preservation.

Exhibit 1-2
Overlooked or understated benefits of transit station proximity that are not reflected in markets
Source: Adapted from Todd Litman, https://www.vtpi.org/tranben.pdf.

Value-Added Capture

In real estate, the property tax system automatically captures a share of the Value-Added. For instance, if a transit system is associated with $3 billion in Value-Added investment—however it is defined—and if the local property tax rate is 1% of market value (about the national average), the property tax system captures $30 million of the Value-Added annually. If the stream of revenues is capitalized at 3% reflecting the local government borrowing rate, the present value of the stream of value-added property tax revenues is $1 billion. This is a sizeable level of capture. This also excludes potential value capture from sales taxes or other taxes and fees.

The figure above is based only on the total investment. Suppose 90% of that would have occurred anyway so the increment (or marginal) Value-Added is $3 million annually, which would be $100 million when capitalized at the local government borrowing rate of 3%. This calculation logic can be extended to other taxes—notably sales taxes—and recurring fees new development pays (such as business licenses). That is the logic applied to chapters 2 and 3 relating to property and business transaction taxes.

How value-added capture can be spent is entertained next.

Value-Added Policy Context

Value-Added capture is often limited to special districts and used for investments that benefit properties in that district. This is the case with tax increment finance (TIF) districts. In these cases, all property taxes flowing to local government are frozen at the same amount in the base year through the end of the TIF period which is often 20 years. As property values increase, the increment in property taxes is used to finance improvements benefiting property within the district. This can include property acquisition and demolition, land assembly, infrastructure, construction of structures, and so forth. Incremental tax revenues are often used to retire bonds used for these and related purposes. After the TIF period, local governments receive all the property tax cash flow from all development that occurred in the meantime. This applies to other types of taxes such as sales taxes.

Special districts are limited in what they can do and how to be managed. Thus, many of the investment and mitigation objectives in using Value-Added capture may not be feasible. What follows is a value-added capture policy approach for Tucson.

High-Capacity Transit Corridor Value-Added Capture

Combining the value-added elements above, the following approach is recommended for consideration by Tucson.

The term “value-added revenues” is defined as total new tax and fee revenues flowing to the City generated from new development within any high-capacity transit corridor mapped by the City, such as the streetcar and the prospective Stone Avenue BRT route. Chapters 2 and 3 provide a method for calculating this.

Whether Arizona law allows value capture without creating special districts as authority to use these revenues has been addressed by Tucson legal counsel.[6] In effect, the City may be able to calculate the value-added tax revenues attributable to its high-capacity transit system and then budget those funds for a variety of legal purposes on an annual basis. This would be part of the City's discretionary use of general funds.

Mechanically, transit-associated value-added revenues could be calculated annually as the current fiscal revenue stream[7] from all sources generated from all development in high-capacity transit corridors. Once identified, the City may have discretion to use the funds for a variety of community reinvestment and development purposes, some of which are outlined below.

Costs are not considered in this application for several reasons:

> First, unless analysis shows otherwise, it is assumed that there is sufficient excess service capacity in existing facilities to accommodate new development. Thus, there is little or no marginal effect of new development on existing facilities.
>
> Second, impacts on utilities, such as water, sewer, power, gas, and so forth, are assumed to be mitigated by new revenue generated by new development.
>
> Third, like roads, capital costs incurred to build transit systems are considered sunk costs unless revenue is needed to finance debt.
>
> Fourth, social and environmental benefits offset much if not all of the costs, subject to further analysis.

Subject to City Council policymaking, value-added revenues may be used to support such initiatives as:

- Free transit fares.
- Below-market loans to expand housing supply.
- Targeted land acquisition, preparation, and construction of housing for households meeting certain criteria.
- Expansion of high-capacity systems elsewhere in the City.
- Infrastructure upgrades.
- Small business subsidies perhaps through property and sales tax abatements.
- Paying impact fees and connection fees for qualifying new development.
- Other allowable uses.

An overall policy perspective relating to the use of value-added revenue is advanced next.

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[6] See opinion prepared by Roi Lusk, Principal Assistant City Attorney, Office of the City Attorney, dated January 30, 2024.

[7] See https://www.tucsonaz.gov/files/sharedassets/public/v/1/bsd/documents/finance-documents/acfr-2021-2022.pdf for the full range of direct and indirect revenues.

Public Transit as a Public Good Elevating Quality of Life

Transportation does not pay its own way. That is, transportation systems in the US cost hundreds of billions of dollars more each year than is raised from motor fuel taxes, vehicle-based taxes and fees, farebox revenues and so forth.[8] Yet the economy and society depend on transportation for work, leisure, shopping, and personal services among others. While some may argue that unless transportation pays its own way, inefficiencies will arise, others can argue that some elements of transportation are public goods that ought to be paid for by society. This is especially the case with public transit. In this respect, studies chronicle the benefits of public transit in terms of:[9]

- Reduced congestion benefits;
- Increased economic development;
- Increased savings especially among lower income workers for whom automobile ownership can be prohibitive;
- Reduced transportation dependency;
- Reduced automobile injury or loss of life from automobile accidents;
- Reduced greenhouse gas emissions along with improved air quality;
- Improved public health as transit induces more walking;
- Improved health care access and outcomes;
- Reduced demand for more or wider highways often at considerable expense; and
- Enhanced community well-being among many others.

The economic benefits are especially important since improved productivity generates the very taxes and fees needed to help pay for transportation systems. For instance, in their location decision-making process, many companies prefer locating in places with robust transit systems.[10] But there is also an overlooked public service benefit as well: When lower income groups have improved mobility and access, it generates savings on government services and support programs.[11]

Studies also show that these benefits exceed costs. For instance, a national benefit/cost study of bus transit showed a B/C ratio of 2.60 meaning that for every dollar invested in bus transit, society gained $2.60 in benefits.[12] The bus transit B/C ratio for Arizona is

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[8] Chad Shirley (2023), Testimony on The Status of the Highway Trust Fund. Accessed April 22, 2024, from https://www.cbo.gov/publication/59667.

[9] Todd Litman (2024), *Evaluating Public Transit Benefits and Costs*, Victoria BC: Victoria Transport Policy Institute.

[10] American Public Transportation Association (2018), APTA, The Economic Cost of Failing to Modernize, accessed April 18, 2024, from https://www.apta.com/wp-content/uploads/Resources/resources/reportsandpublications/Documents/APTA-Economic-Cost-Failing-to-Modernize.pdf.

[11] Glen Weisbrod, Naomi Stein, Chandler Duncan, and Adam Blair (2017), *Practices for Evaluating the Economic Impacts and Benefits of Transit*, Washington DC: Transportation Research Board.

[12] Christopher E. Ferrell (2015). *The Benefits of Transit in the United States: A Review and Analysis of Benefit-Cost Studies*, San Jose CA: Mineta Transportation Institute, San Jose State University,

2.21. For streetcars, a study of the Kansas City system found a B/C ratio of 4.96[13] while the B/C ratio for the Cincinnati streetcar is estimated at up to 3.90.[14]

Another way to view benefit-cost is to compare transit outcomes with automobiles. Using this approach, one such study found that despite subsidies, rail transit benefits exceeded those of the personal occupancy vehicle (POV).[15]

Given these studies, social and economic efficiency arguments support such things as extensive transit systems and free fares. How this is paid for depends on public policies. Where aggregate improvement in society is the objective, public transit would be a public good financed from general taxes. After all, if aggregate benefits exceed costs, society is better off supporting public transit.

In the context of Tucson's streetcar, the value-added approach treats transit investment as a public good. New revenues associated with the streetcar need not be viewed as something to be captured and spent solely on the system itself, though that is clearly a policy option. An alternative perspective would treat streetcar costs as necessary to generate social, environmental, and economic benefits that exceed costs meaning that value-added revenue estimated in this report can be used to advance other initiatives, thereby making the city and its citizens even better off.

The last section in this chapter outlines a value-added analysis framework for Tucson.

Framework for Application to Tucson

The value-added analytic framework for Tucson is comprised of these five elements:

- Employment Value-Added (Chapter 2);
- Demographic, commuting, and household income Value-Added (Chapter 3).
- Property tax Value-Added (Chapter 4);
- Sales tax Value-Added (Chapter 5);
- Use tax and state-shared revenue Value-Added (Chapter 6); and
- Value-Added non-tax general fund revenue (Chapter 7).

Because Tucson has only one high-capacity transit corridor, presently, the analysis addresses only the streetcar. Its study area extends one mile from streetcar stations. Although transit station areas are commonly drawn at half-mile (about 800 meter) circles, studies published by this author show that transit station influence areas extend about one mile or more. Moreover, good planning and urban design can extend the range of a given half-mile circle to at least one kilometer if not towards one mile.[16] The

[13] WSP (2018), *Kansas City Riverfront Extension Benefit-Cost Analysis*, Kansas City MO: City of Kansas City.
[14] Mary Stagaman (nd), *An Assessment of the Cincinnati Streetcar Study*, Cincinnati OH: University of Cincinnati Center for the City.
[15] Nelson, A. C. (1997). PART 3: Society: Social Benefits of Transit: Case Study of Metropolitan Atlanta Rapid Transit Authority. *Transportation Research Record*, *1576*(1), 123-131. https://doi.org/10.3141/1576-16.
[16] See Brian Canepa (2007). Bursting the Bubble: Determining the Transit-Oriented Development's Walkable Limits. *Transportation Research Record*, *1992*(1), 28-34. https://doi.org/10.3141/1992-04.

smallest geographic unit of measure is the census block, which is essentially a city block or other block bounded by streets, landscape elements, or other features that demarcate a reasonably homogenous area of land. Subject to data collection constraints described in other chapters, the one mile study area is divided into these components:

- Census blocks encompassing or abutting stations → This is called the Station Tier.
- Other census blocks fronting the streetcar track → This is called the Track Tier.
- Census blocks adjacent to the Station and Track tiers → This is called the Adjacent Tier.
- Census blocks between the Adjacent Tier and one kilometer from stations → This is called the Kilometer Tier.
- Census blocks between the Kilometer Tier and one mile from stations → This is called the One Mile Tier.

Exhibit 1-3 illustrates these tiers while Exhibit 1-4 reports their land areas. Collectively, they comprise about 4.5% of the land area of the city. The area within the Kilometer Tier comprises about 1.5% of the city's land area while the area with the Adjacent Tier comprises about two-thirds of one half of one percent (0.66%) of the city's land area. Although this scheme is used for employment and tax Value-Added analysis, census data constraints require a differently configured study area (see Chapter 4).

The analyses presented below use 2014 as the base year. However, the analysis can be edited to show year-over-year changes such as the change in property taxes between one calendar year and the next. This may be useful as the economy continues to recover from the pandemic.

Note is made that the analysis of tax and fee revenues is based only on general fund revenues. Special purpose districts, dedicated revenues and other non-general fund accounts are not used. This allows decision-makers to focus on the potential discretionary uses of value-added streetcar corridor revenues. It is also assumed that value-added revenues are mostly net of incremental costs incurred to serve the needs of new development since 2014. Future analysis can focus on incremental costs needed to serve incremental development.

Finally, as will be shown below, the area roughly within one kilometer of streetcar stations is associated with the largest share of change among key variables. As such, policy implications focus on the area within the 1-kilometer distance band from streetcar stations.

Chapter 2 applies this framework to the employment tax Value-Added analysis.

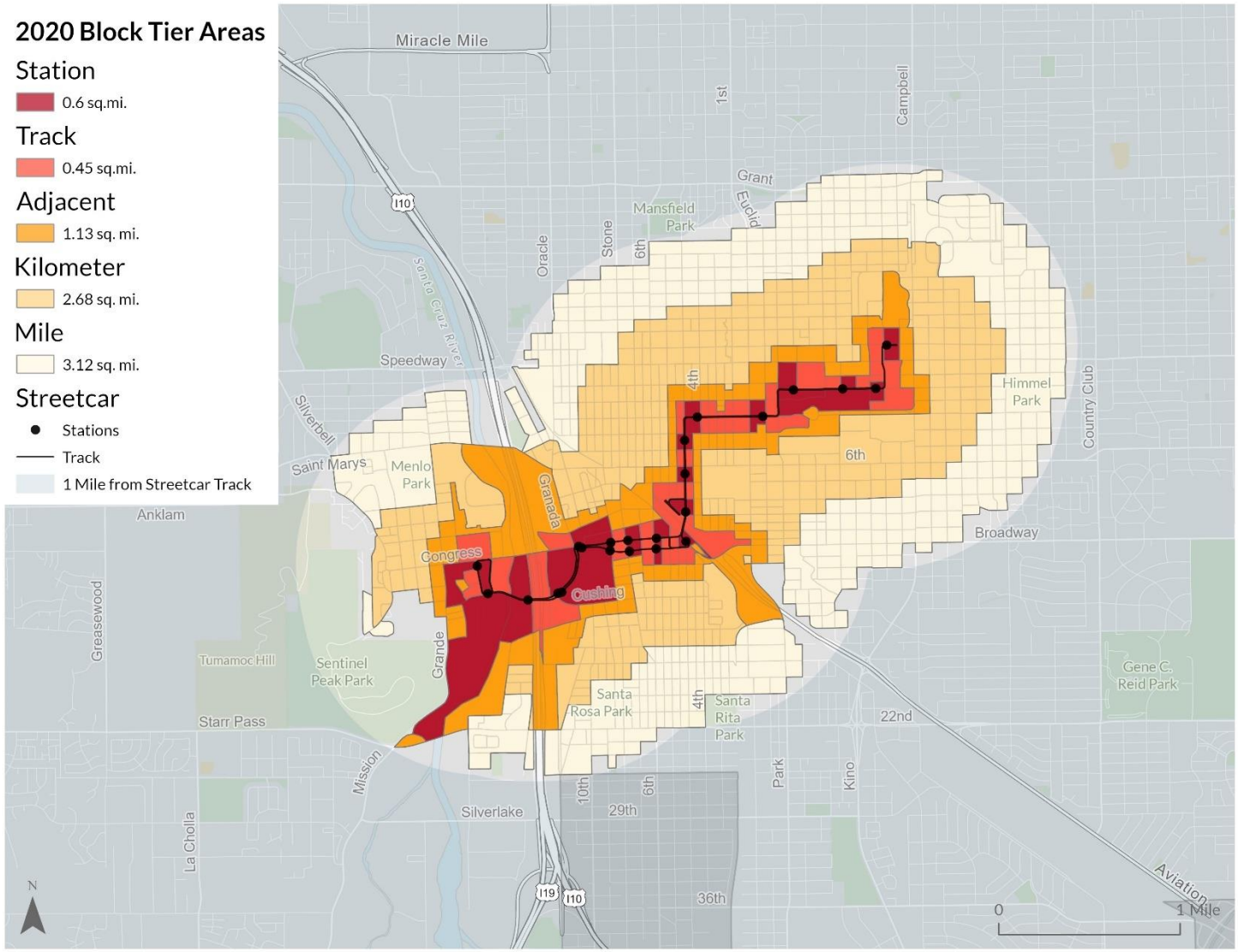

Exhibit 1-3
Streetcar Value-Added Study Area and Tiers
Source: Daniel Lawlor, City of Tucson

Exhibit 1-4
Land Area by Tier, 2020 Blocks

Tier	Census Block Acres	Share of City
Station Tier	385	0.18%
Track Tier	290	0.14%
Adjacent Tier	723	0.34%
Kilometer Tier	1,717	0.81%
Mile Tier	1,999	0.95%
Cumulative to Adjacent Tier	1,398	0.66%
Cumulative to Kilometer Tier	3,116	1.47%
Cumulative to Mile Tier	9,629	4.56%
City Balance	206,208	97.58%
City Total	211,323	100.00%

Source: Daniel Lawlor, City of Tucson
Figures may not sum up due to rounding.

TECHNICAL DOCUMENTATION ESTABLISHING THE STUDY AREA TIERS

2020 Census Blocks were the geographies used for LEHD WAC data and Assessor data.

Census block shapefiles were available at the state level. Therefore, census blocks intersecting Tucson's city limits were selected, resulting in a layer containing 7,675 blocks. The city limits were derived from the layer *WARD_COT*.

Additional fields related to distance from the streetcar were added to allow spatial analysis. This distance data consisted of tier classifications and measurements.

Blocks were separated into five tiers based on their location. These tier fields consisted of a general text field holding the name of the tier, "BLOCK_TIER," as well as binary numeric fields for each tier.

The method used to assign tiers is outlined below.

> Station: Blocks within 25 feet of streetcar stations
> Track: Blocks within 25 feet of streetcar track
> Adjacent: Blocks abutting the Station and Track tier blocks
> Kilometer: Blocks between the Adjacent tier and a 1-kilometer buffer around the streetcar track
> Mile: Blocks between the Kilometer tier and a 1-mile buffer around the streetcar

Fields containing distance measurements were also added. "FRONT_DOOR" field values are distance in feet from the nearest point along an edge of a census block polygon to the streetcar track. "CENTROID" field values are distance in feet from census block polygon centroids to the streetcar track.

The field "GEOID_NUM" was created because the original field identifying the census blocks, "GEOID20," was a text field, and a numeric field was required for joins.

CHAPTER 2
VALUE-ADDED EMPLOYMENT AND WAGES MONITORING SYSTEM

While tax and fee revenues are obvious value-added metrics, so are such metrics as change in jobs and people as they add wages and income to the area. This chapter addresses the change in jobs and wages along the streetcar corridor since 2015. The year 2015 is the base year because anomalies in the transition of the University of Arizona hospital to the Banner hospital system rendered health care employment data from before then to be incompatible with 2015 and beyond. The analysis includes two calculations:

- Change in Jobs by Economic Group
- Change in Aggregate Wages

Each is presented below with technical documentation provided in the appendix.

Change in Jobs by Economic Group

The Longitudinal Employer-Household Dynamics (LEHD) database is used to show change in jobs over time with respect to streetcar corridor tiers. Of the 20 2-digit economic sectors characterized by the North American Industrial Classification System (NAICS) reported in the LEHD, three are removed from analysis. Workers in the Agriculture, fishing, and forestry as well as the mining sectors are removed because there are no or very few jobs in those sectors along the corridor. (However, they are included in the analysis of workers by wage.) Workers in the construction sector are removed because jobs assigned to corridor based on the addresses of construction firms work elsewhere on job sites. Adding them would over-count the number of workers working in the corridor. The remaining 17 economic sectors are assigned to six broad economic groups that roughly reflect broad land use categories. An anomalous group includes the retail sector combined with the food service and lodging sector. The preference would be to combine food service with retail with lodging as a separate sector, but this is not the case. Although LEHD reports 3-digit figures that separate food service from lodging the problem is that some census blocks will suppress one or both 3-digit figures for confidentiality reasons. The six economic groups used for value-added analysis are shown in Exhibit 2-1.

Results are reported in Exhibit 2-2. All sectors except health care lost jobs in the streetcar corridor between 2015 and 2021. Following national trends, this was related to the COVID-19 pandemic that reduced jobs in most downtowns across the nation. The exception are health care jobs which are associated mostly with the Banner hospital. Overall, jobs were added within one kilometer of streetcar stations. Annual updates can track the extent and nature of recovery from the pandemic.

Exhibit 2-1
NAICS Economic Sectors Assigned to Employment Groups

NAICS Code	NAICS Sector Title and Economic Group Name
	Industrial
22	Utilities
31–33	Manufacturing
42	Wholesale Trade
48–49	Transportation and Warehousing
	Office
51	Information
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	Professional, Scientific, and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support, Waste Management, Remediation
81	Other Services (except Public Administration)
92	Public Administration
	Retail-Food-Lodging
44–45	Retail Trade
72	Accommodation and Food Services
	Education
61	Educational Services
	Health Care
62	Health Care and Social Assistance
	Arts-Entertainment-Recreation
71	Arts, Entertainment, and Recreation

Exhibit 2-2
Jobs and Change in Jobs by Streetcar Corridor Tier, 2015-2021

JOBS	2015						
Cumulative Tiers	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent	44,611	2,234	15,167	3,269	20,263	3,315	363
Kilometer	48,942	2,376	16,731	4,143	20,348	4,822	522
Mile	52,951	2,727	17,682	5,536	20,534	5,937	535
City Balance	189,892	31,551	58,848	50,228	11,679	35,385	2,201
City Total	242,843	34,278	76,530	55,764	32,213	41,322	2,736
Share of City							
Adjacent	18.4%	6.5%	19.8%	5.9%	62.9%	8.0%	13.3%
Kilometer	20.2%	6.9%	21.9%	7.4%	63.2%	11.7%	19.1%
Mile	21.8%	8.0%	23.1%	9.9%	63.7%	14.4%	19.6%
	2021						
Cumulative Tiers	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent	45,868	2,089	13,661	2,370	19,185	8,406	157
Kilometer	49,307	2,268	15,448	3,132	19,382	8,809	268
Mile	52,618	2,586	16,464	4,053	19,532	9,710	273
City Balance	197,016	38,378	61,581	44,834	11,743	38,854	1,626
City Total	249,634	40,964	78,045	48,887	31,275	48,564	1,899
Share of City							
Adjacent	18.4%	5.1%	17.5%	4.8%	61.3%	17.3%	8.3%
Kilometer	19.8%	5.5%	19.8%	6.4%	62.0%	18.1%	14.1%
Mile	21.1%	6.3%	21.1%	8.3%	62.5%	20.0%	14.4%

Exhibit 2-2
Jobs and Change in Jobs by Streetcar Corridor Tier, 2015-2021—continued

JOB CHANGE	2015-2021						
Cumulative Tier	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent	1,257	-145	-1,506	-899	-1,078	5,091	-206
Kilometer	365	-108	-1,283	-1,011	-966	3,987	-254
Mile	-333	-141	-1,218	-1,483	-1,002	3,773	-262
City Balance	7,124	6,827	2,733	-5,394	64	3,469	-575
City Total	6,791	6,686	1,515	-6,877	-938	7,242	-837
Share of City Change							
Track + Adjacent	18.51%	0.00%	0.00%	0.00%	0.00%	70.30%	0.00%
Kilometer	5.37%	0.00%	0.00%	0.00%	0.00%	55.05%	0.00%
Mile	0.00%	0.00%	0.00%	0.00%	0.00%	52.10%	0.00%

Note: For the period 2015-2021, because all tiers for all economic groups lost jobs, the "Share of City" percentages are null.
See the worksheet for explanation and calculation details.

Trends for individual economic groups within the 1-kilometer streetcar corridor are reported in Exhibit 2-3 and illustrated in Exhibit 2-4. Overall, jobs increased steadily until 2019, the year before the pandemic. Jobs fell by about 1,400 during the first pandemic year and by nearly the same during the second, in 2021. Yet, there were more jobs in the 1-kilometer streetcar corridor during the first full pandemic year than during the first full year of streetcar service.

Data reported in Exhibit 2-3 which are illustrated in Exhibit 2-4 can be used to gauge the nature of post-pandemic recovery going forward. For instance, although nearly 600 jobs were lost in the office group between 2019 and 2021, at 8% this was well below national downtown office trends.[17] The largest share of jobs lost were in the arts-entertainment-recreation economic group at nearly half. Yet that sector is also the smallest, by far. Jobs in the retail-lodging economic group fell by more than 1,000 or nearly a quarter. On the other hand, Tucson saw several new hotels open since the peak of the pandemic in 2021 with more in the pipeline. Overall, the downtown job market demonstrated remarkable resilience during Covid. It may be the case that all economic groups will recover fully by the middle 2020s leading to more jobs along the streetcar corridor.

The change in jobs is also reported for subareas. The city has established five streetcar subareas as shown in Exhibit 2-5. For the purposes of this report, four subareas are used for analysis as shown in Exhibit 2-6. The city's two university subareas—the university proper including the medical school and the "main gate" commercial area—are combined into a single University subarea. The area west of it to the railroad tracks which includes the 4th Avenue commercial corridor is called the West University subarea. The area between the railroad tracks and I-10 is called Centro instead of downtown because its footprint is much larger than what is commonly considered downtown. The area west of I-10 is called West Santa Cruz because it is mostly west of the Santa Cruz River. It is not called Mercado because there is another Mercado district elsewhere in the city and the Mercado redevelopment area is only a small part of this subarea.

Exhibit 2-7 distributes the change in jobs between 2015 and 2021 for the 1-kilometer streetcar corridor subarea among these four subareas. It also reports the change in jobs based on the tiers. Readers can study this exhibit to identify trends of interest to them. Overall trends show a large increase in jobs in the University subarea but a smaller loss in the West University subarea. Consistent with national trends where downtown offices and related businesses were closed during the pandemic, job losses were substantial in the Centro subarea. The West Santa Cruz subarea gained jobs attributed primarily to the Caterpillar project.

The next section addresses the change in jobs by wage group.

[17] Nationally, about 25% of office-based jobs were lost during the peak of the pandemic. This estimate is derived from https://www.bls.gov/opub/mlr/2021/article/covid-19-ends-longest-employment-expansion-in-ces-history.htm.

Exhibit 2-3
Annual Jobs by Economic Group within One Kilometer of Streetcar Stations, 2015-2021

Economic Group	2015	2016	2017	2018	2019	2020	2021	2015-2021	Change
Total	48,942	49,650	49,642	50,139	52,111	50,655	49,307	365	0.7%
Industrial	2,376	1,770	1,850	2,085	2,202	2,165	2,268	-108	-4.5%
Office	16,731	16,578	16,233	15,787	16,038	16,360	15,448	-1,283	-7.7%
Retail, Lodging	4,143	4,216	4,289	4,331	4,114	2,791	3,132	-1,011	-24.4%
Education	20,348	19,077	19,184	19,630	20,806	20,524	19,382	-966	-4.7%
Health	4,822	7,528	7,508	7,620	8,114	8,448	8,809	3,987	82.7%
Arts-Ent-Rec	522	481	578	686	837	367	268	-254	-48.7%

Source: Longitudinal Employment-Household Dynamics database, 2015-2021.

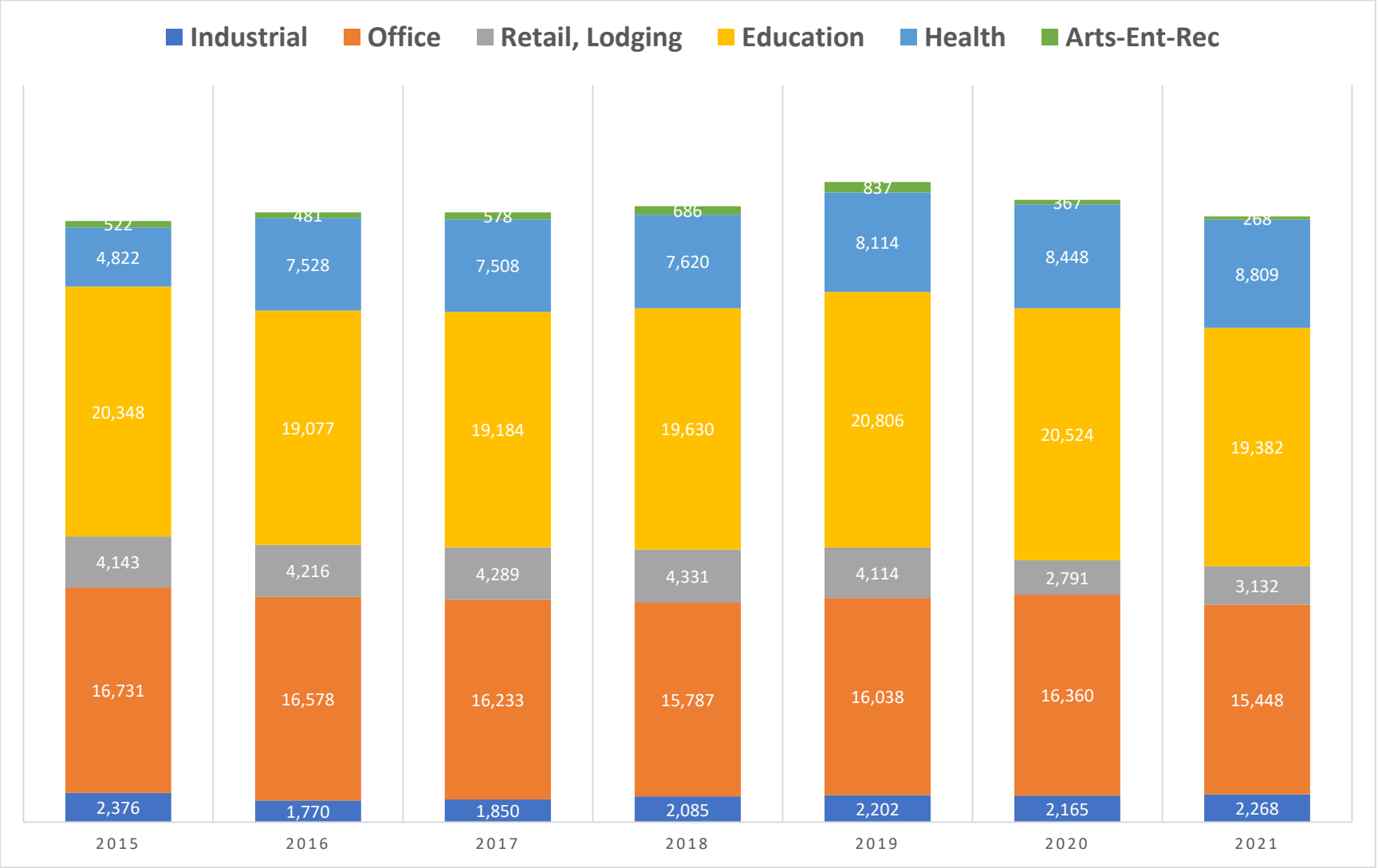

Exhibit 2-4
Annual Jobs by Economic Group in Tucson 1-Kilometer Streetcar Corridor, 2015-2021

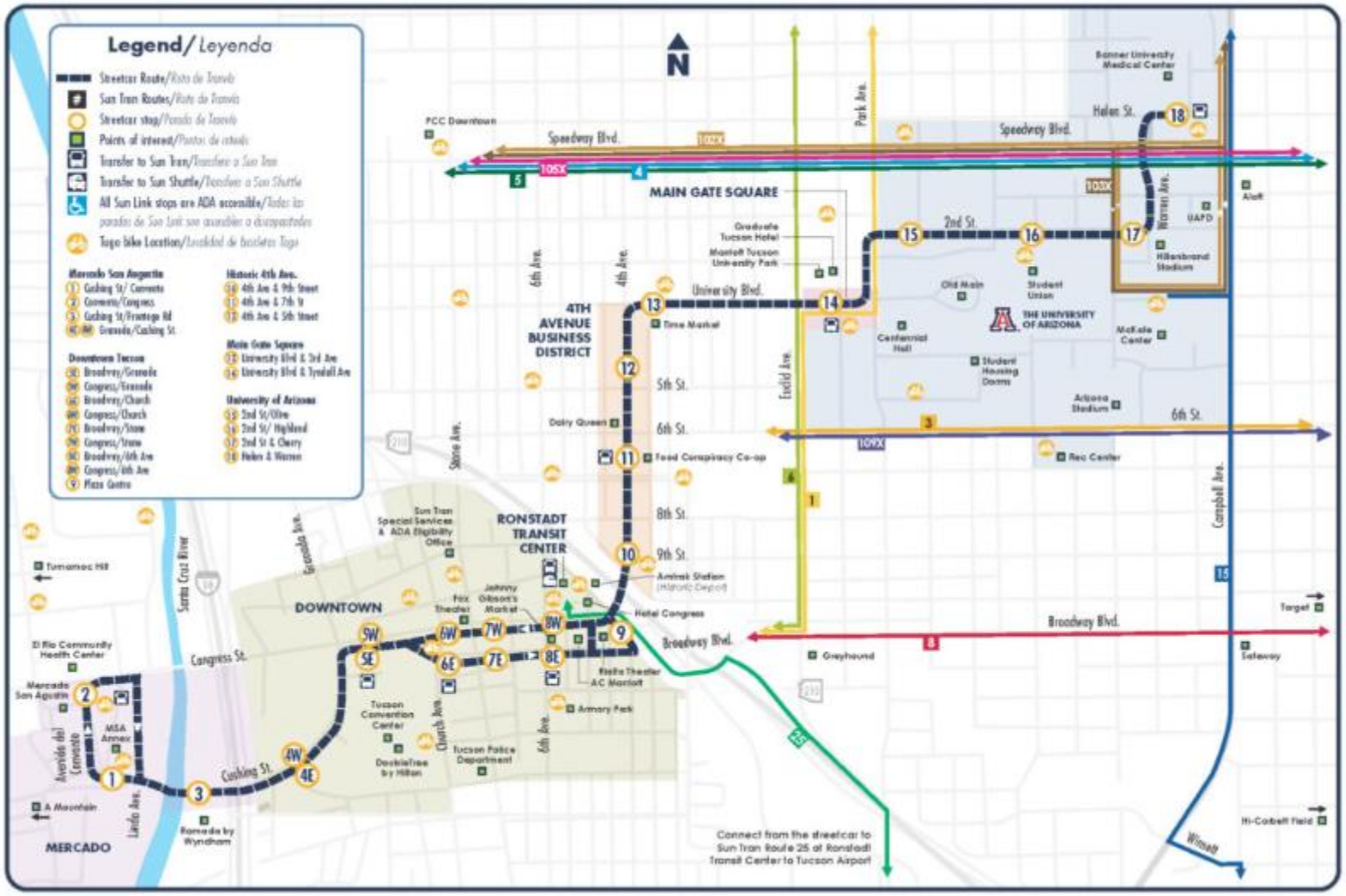

Exhibit 2-5
Streetcar subareas demarcated by Tucson.
Source: City of Tucson.

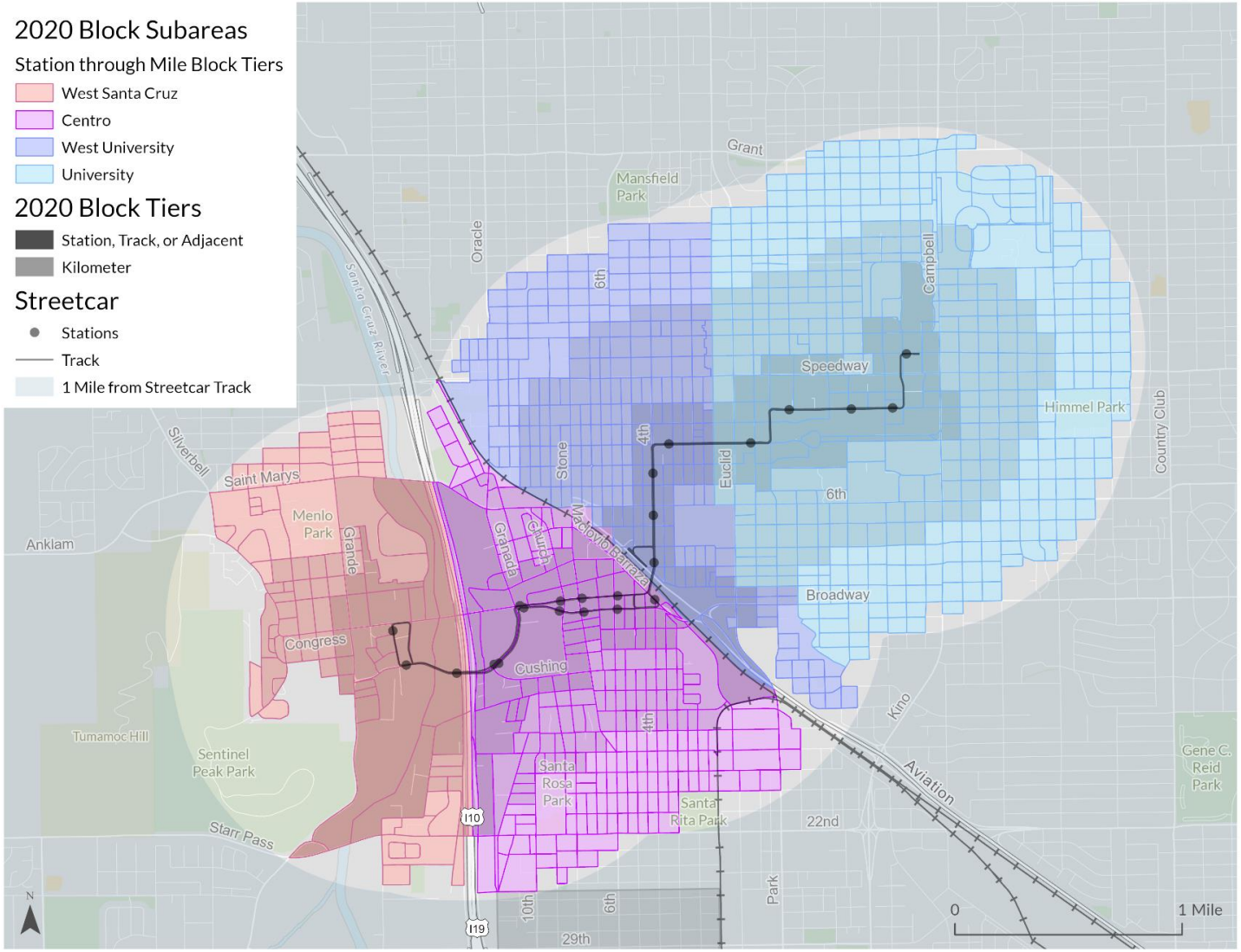

Exhibit 2-6
Streetcar Corridor Subareas using 2020 Census Blocks
Source: Daniel Lawlor, City of Tucson

Exhibit 2-7
Change in Jobs by Economic Group, Subarea and Tier, 2015-2021

Subarea, Tier	Industrial	Office	Retail, Lodging	Education	Health	Arts-Ent-Rec	Total
West Santa Cruz							
Station	431	(1)	79	0	4	0	513
Track	(49)	12	0	(54)	807	0	716
Adjacent	(38)	(38)	23	(12)	0	0	(65)
Station+Track+Adjacent	344	(27)	102	(66)	811	0	1,164
Kilometer	24	170	(55)	(1)	2	0	140
Cumulative Kilometer	368	143	47	(67)	813	0	1,304
Centro							
Station	(35)	(328)	87	(780)	(39)	(32)	(1,127)
Track	206	(80)	(445)	341	67	(126)	(37)
Adjacent	(672)	(1,221)	(88)	(44)	30	(67)	(2,062)
Station+Track+Adjacent	(501)	(1,629)	(446)	(483)	58	(225)	(3,226)
Kilometer	15	(5)	(56)	4	(734)	(75)	(851)
Cumulative Kilometer	(486)	(1,634)	(502)	(479)	(676)	(300)	(4,077)
West University							
Station	0	(11)	(203)	0	(4)	(1)	(219)
Track	4	(12)	(168)	0	0	0	(176)
Adjacent	(4)	66	(26)	(18)	(22)	9	5
Station+Track+Adjacent	0	43	(397)	(18)	(26)	8	(390)
Kilometer	(15)	(26)	209	119	(151)	20	156
Cumulative Kilometer	(15)	17	(188)	101	(177)	28	(234)
University							
Station	13	4	14	(511)	1	2	(477)
Track	(1)	13	3	0	(12)	9	12
Adjacent	0	90	(175)	0	4,259	0	4,174
Station+Track+Adjacent	12	107	(158)	(511)	4,248	11	3,709
Kilometer	13	84	(210)	(10)	(221)	7	(337)
Cumulative Kilometer	25	191	(368)	(521)	4,027	18	3,372

Exhibit 2-7
Change in Jobs by Economic Group, Subarea and Tier, 2015-2021—continued

Subarea, Tier	Industrial	Office	Retail, Lodging	Education	Health	Arts-Ent-Rec	Total
Total							
Station	409	(336)	(23)	(1,291)	(38)	(31)	(1,310)
Track	160	(67)	(610)	287	862	(117)	515
Adjacent	(714)	(1,103)	(266)	(74)	4,267	(58)	2,052
Station+Track+Adjacent	(145)	(1,506)	(899)	(1,078)	5,091	(206)	1,257
Kilometer	37	223	(112)	112	(1,104)	(48)	(892)
Cumulative Kilometer	(108)	(1,283)	(1,011)	(966)	3,987	(254)	365

Source: LEHD data assembled for 2015 and 2021.

Change in Aggregate Wages

Wages are reported by County Business Patterns (CBP) that are accessible through the American Community Survey (ACS) annually. While wages are reported for all of Pima County, theory posits and research show that locations in and near downtowns, and especially along transit corridors, have higher wages than suburban areas. Exhibit 2-8 shows how this study adjusts for the differences. It uses Denver County, Colorado, as the proxy for a downtown labor market relative to the rest of the counties comprising the Denver metropolitan area. The assumption is that as a small county that is the center of a large metropolitan area, Denver County attracts a higher proportion of higher wage jobs across most sectors than the balance of the metropolitan area. The wage ratio is thus a reasonable adjustment for downtown Tucson wages compared to the rest of the metropolitan area. Indeed, the adjustment is still an under-statement because Denver County's downtown is a small part of the whole county. Nonetheless, the ratios are reasonable. Exhibit 2-9 calculates the Pima County wages by economic sector and includes the downtown premium adjustment.

Exhibit 2-8
Adjustment for Downtown Wage Premium based on Denver, Colorado

Economic Sector	Denver Wages	Metro Wages Excluding Denver	Denver Ratio
Total for all sectors	$71,868	$65,780	1.09
Agriculture, forestry, fishing and hunting	$40,818	$49,768	0.82
Mining, quarrying, and oil and gas extraction	$155,716	$132,272	1.18
Utilities	$131,358	$123,135	1.07
Construction	$74,015	$73,261	1.01
Manufacturing	$76,519	$83,676	0.91
Wholesale trade	$83,881	$84,582	0.99
Retail trade	$37,089	$36,598	1.01
Transportation and warehousing	$62,266	$47,400	1.31
Information	$139,740	$123,484	1.13
Finance and insurance	$107,929	$87,814	1.23
Real estate and rental and leasing	$72,253	$63,801	1.13
Professional, scientific, and technical services	$111,489	$98,526	1.13
Management of companies and enterprises	$132,697	$115,277	1.15
Administrative and support, waste management	$49,204	$52,384	0.94
Educational services	$46,109	$43,216	1.07
Health care and social assistance	$62,242	$59,546	1.05
Arts, entertainment, and recreation	$71,311	$55,524	1.28
Accommodation and food services	$29,597	$26,431	1.12
Other services (except public administration)	$44,979	$43,371	1.04

Source: County Business Patters for Denver County and Denver MSA for 2021. Ratios are assumed to be constant over time and as such this table may not need to be updated although that is the option of the analyst.

Exhibit 2-9
Streetcar Corridor Wage Adjustment Factor

NAICS code	Meaning of NAICS Code	Year	Annual payroll ($1,000)	Number of employees	Average Wages per Worker per Year	Streetcar Corridor Factor
00	Total for all sectors	2021	15,717,391	312,775	$50,251	1.09
11	Agriculture, forestry, fishing and hunting	2021	7,227	219	$33,000	0.82
21	Mining, quarrying, and oil and gas extraction	2021	195,407	2,514	$77,728	1.18
22	Utilities	2021	206,761	2,068	$99,981	1.07
23	Construction	2021	1,239,799	21,593	$57,417	1.01
31-33	Manufacturing	2021	1,935,271	20,692	$93,527	0.91
42	Wholesale trade	2021	418,352	7,141	$58,585	0.99
44-45	Retail trade	2021	1,696,511	48,371	$35,073	1.01
48-49	Transportation and warehousing	2021	520,247	10,135	$51,332	1.31
51	Information	2021	499,202	5,645	$88,433	1.13
52	Finance and insurance	2021	1,031,319	13,152	$78,415	1.23
53	Real estate and rental and leasing	2021	289,772	6,253	$46,341	1.13
54	Professional, scientific, and technical services	2021	1,218,705	17,839	$68,317	1.13
55	Management of companies and enterprises	2021	223,240	3,757	$59,420	1.15
56	Administrative and support, waste management	2021	795,271	24,404	$32,588	0.94
61	Educational services	2021	322,680	7,385	$43,694	1.07
62	Health care and social assistance	2021	3,569,524	63,789	$55,958	1.05
71	Arts, entertainment, and recreation	2021	164,161	5,787	$28,367	1.28
72	Accommodation and food services	2021	913,535	38,476	$23,743	1.12
81	Other services (except public administration)	2021	469,494	13,534	$34,690	1.04
92	Public Administration				$53,441	1.07
99	Industries not classified	2021	913	21	$43,476	1.06

Source: County Business Patterns for Pima County, 2021.

Exhibit 2-10 reports aggregate wages for each of the streetcar tiers as well as the rest of the city and the city as a whole. The city's aggregate wages are calculated as the Pima County average wage for each economic sector times the number of jobs in the county, less the streetcar corridor jobs times the Pima County average age adjusted for the downtown premium (from Exhibit 2-8) times the number of streetcar corridor jobs. Notably, value-added wages in the 1-kilometer streetcar corridor accounted for nearly a third (32.9%) of the change in the city's value-added wages. This figure will be used in other chapters to help estimate value-added tax and other revenues.

Over the period 2015 to 2021, aggregate wages (in 2021$) increased by about $242 million in the 1-kilometer streetcar corridor. Indeed, it increased by more than that, in the amount of $275 million, in the innermost three geographies comprising blocks at the streetcar stations, other blocks adjacent to the track, and blocks adjacent to those. This is remarkable because the year 2021 was the peak of the pandemic and yet aggregate wages still rose. It is anticipated that Value-Added wages will grow as the economy recovers from the pandemic.

Exhibit 2-11 illustrates the pattern of change in aggregate wages spatially in the streetcar study area. For the most part, losses were more evident in the downtown core dominated by offices while gains were seen especially in the Mercado redevelopment area west of the Santa Cruz River.

Several tables presented below show templates for future updates relating to Value-Added employment. A technical appendix follows these tables describing data sources, collection, and database development features. This report includes a master Employment Value-Added Monitoring System excel workbook.

Chapter 3 presents value-added demographic, commuting, and household income changes associated with the streetcar corridor.

Exhibit 2-10
Change in Aggregate Wages for the Streetcar Corridor and City by Economic Group, 2015-2021

AGGREGATE WAGES	2015						
Cumulative Tiers	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent	$2,191,446,410	$211,903,014	$815,398,477	$82,974,859	$885,371,001	$185,501,765	$10,297,294
Kilometer	$2,402,302,122	$222,645,466	$899,974,846	$105,958,218	$889,084,988	$269,830,923	$14,807,680
Mile	$2,589,272,736	$248,529,160	$949,473,403	$146,657,224	$897,212,068	$332,224,427	$15,176,453
City Balance	$9,588,442,483	$2,499,622,031	$3,019,445,164	$1,516,552,703	$510,301,926	$1,980,084,446	$62,436,212
City Total	$12,177,715,219	$2,748,151,192	$3,968,918,567	$1,663,209,928	$1,407,513,993	$2,312,308,873	$77,612,666
Share of City							
Adjacent	18.0%	7.7%	20.5%	5.0%	62.9%	8.0%	13.3%
Kilometer	19.7%	8.1%	22.7%	6.4%	63.2%	11.7%	19.1%
Mile	21.3%	9.0%	23.9%	8.8%	63.7%	14.4%	19.6%
AGGREGATE WAGES	**2021**						
Cumulative Tiers	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent	$2,466,909,161	$203,406,524	$800,208,074	$66,741,428	$896,947,719	$493,904,743	$5,700,673
Kilometer	$2,644,128,679	$216,855,873	$903,731,087	$90,069,163	$906,157,972	$517,583,498	$9,731,085
Mile	$2,817,897,697	$239,340,591	$966,707,515	$118,243,253	$913,170,855	$570,522,848	$9,912,635
City Balance	$10,095,758,375	$2,958,972,741	$3,132,558,626	$1,359,876,101	$453,358,190	$2,147,036,034	$43,956,682
City Total	$12,913,656,073	$3,198,313,332	$4,099,266,141	$1,478,119,355	$1,366,529,045	$2,717,558,882	$53,869,317
Share of City							
Adjacent	19.1%	6.4%	19.5%	4.5%	65.6%	18.2%	10.6%
Kilometer	20.5%	6.8%	22.0%	6.1%	66.3%	19.0%	18.1%
Mile	21.8%	7.5%	23.6%	8.0%	66.8%	21.0%	18.4%

Source: From Employment Value-Added Monitoring System excel workbook.

Exhibit 2-10
Change in Aggregate Wages for the Streetcar Corridor and City by Economic Group, 2015-2021—continued

AGGREGATE WAGES	2015-2021						
Change 2015-2021	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent	$275,462,751	-$8,496,490	-$15,190,404	-$16,233,431	$11,576,718	$308,402,979	-$4,596,621
Kilometer	$241,826,557	-$5,789,593	$3,756,241	-$15,889,055	$17,072,984	$247,752,575	-$5,076,595
Mile	$228,624,961	-$9,188,569	$17,234,111	-$28,413,971	$15,958,787	$238,298,421	-$5,263,818
City Balance	$507,315,892	$459,350,709	$113,113,462	-$156,676,602	-$56,943,735	$166,951,588	-$18,479,530
City Total	$735,940,854	$450,162,140	$130,347,574	-$185,090,573	-$40,984,948	$405,250,009	-$23,743,348
Share of City							
Adjacent	37.43%	0.00%	0.00%	0.00%	0.00%	76.10%	0.00%
Kilometer	**32.86%**	0.00%	2.88%	0.00%	0.00%	61.14%	0.00%
Mile	31.07%	0.00%	13.22%	0.00%	0.00%	58.80%	0.00%

Source: From Employment Value-Added Monitoring System excel workbook.

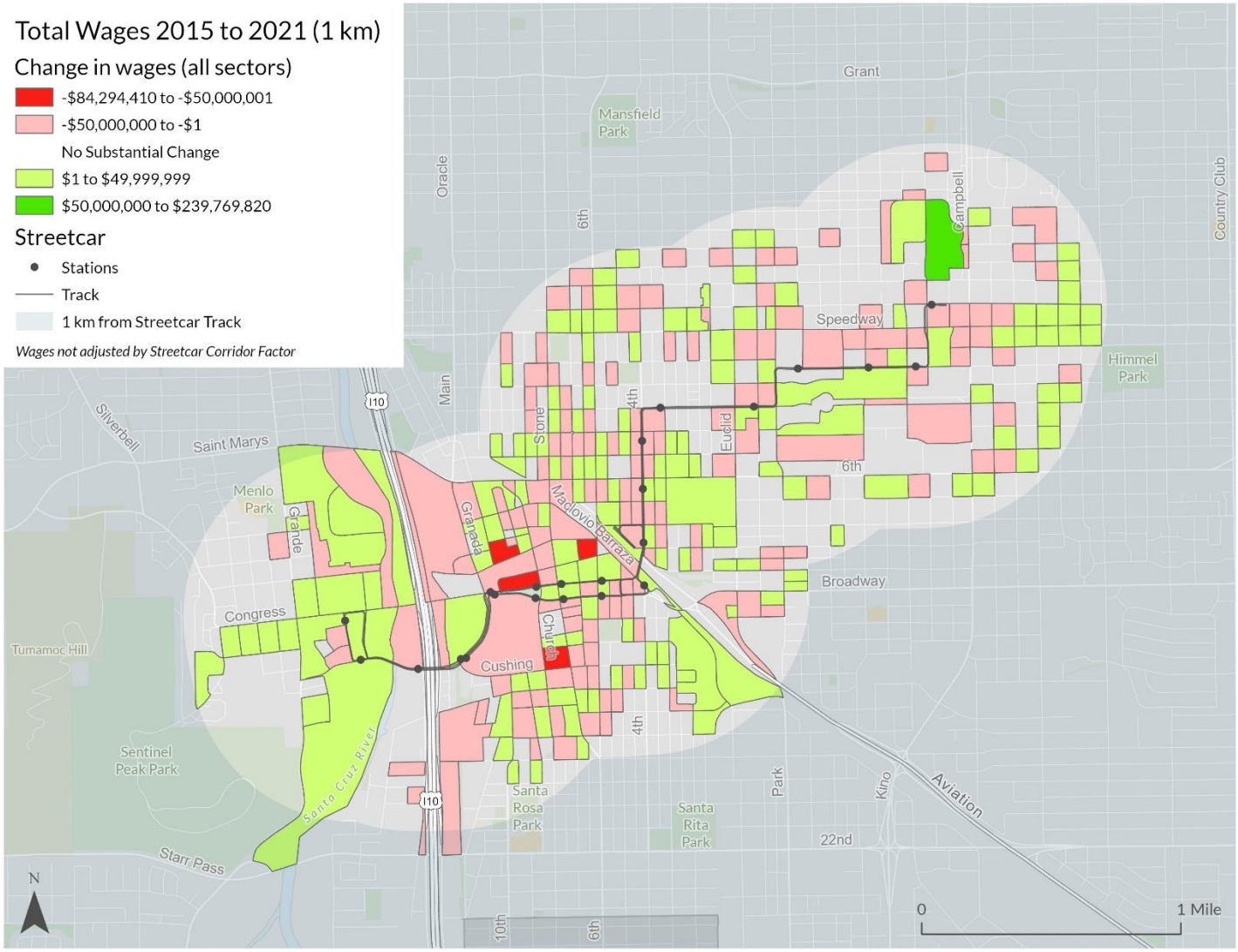

Exhibit 2-11
Difference in aggregate wages 2015 to 2021 based on all economic groups for the 1-kilometer tier
Source: Daniel Lawlor, City of Tucson.

Employment Value-Added Template A
Jobs and Change in Jobs by Streetcar Corridor Tier, 2015 to Future Year

JOBS	**2015**						
Cumulative Tiers	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent	44,611	2,234	15,167	3,269	20,263	3,315	363
Kilometer	48,942	2,376	16,731	4,143	20,348	4,822	522
Mile	52,951	2,727	17,682	5,536	20,534	5,937	535
City Balance	189,892	31,551	58,848	50,228	11,679	35,385	2,201
City Total	242,843	34,278	76,530	55,764	32,213	41,322	2,736
Share of City							
Adjacent	18.4%	6.5%	19.8%	5.9%	62.9%	8.0%	13.3%
Kilometer	20.2%	6.9%	21.9%	7.4%	63.2%	11.7%	19.1%
Mile	21.8%	8.0%	23.1%	9.9%	63.7%	14.4%	19.6%
	Future Year						
Cumulative Tiers	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent							
Kilometer							
Mile							
City Balance							
City Total							
Share of City							
Adjacent	%	%	%	%	%	%	%
Kilometer	%	%	%	%	%	%	%
Mile	%	%	%	%	%	%	%

Source: From Employment Value-Added Monitoring System excel workbook.

Employment Value-Added Template A
Jobs and Change in Jobs by Streetcar Corridor Tier, 2015 to Future Year—continued

JOB CHANGE	2015-						
Cumulative Tier	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent							
Kilometer							
Mile							
City Balance							
City Total							
Share of City Change							
Track + Adjacent	%	%	%	%	%	%	%
Kilometer	%	%	%	%	%	%	%
Mile	%	%	%	%	%	%	%

Source: From Employment Value-Added Monitoring System excel workbook.

Employment Value-Added Template B
Change in Jobs by Economic Group, Subarea and Tier, 2015-20xx

Subarea, Tier	Industrial	Office	Retail, Lodging	Education	Health	Arts-Ent-Rec	Total
West Santa Cruz							
Station							
Track							
Adjacent							
Station+Track+Adjacent							
Kilometer							
Cumulative Kilometer							
Centro							
Station							
Track							
Adjacent							
Station+Track+Adjacent							
Kilometer							
Cumulative Kilometer							
West University							
Station							
Track							
Adjacent							
Station+Track+Adjacent							
Kilometer							
Cumulative Kilometer							
University							
Station							
Track							
Adjacent							
Station+Track+Adjacent							
Kilometer							
Cumulative Kilometer							

Exhibit 2-7
Change in Jobs by Economic Group, Subarea and Tier, 2015-20xx—continued

Subarea, Tier	Industrial	Office	Retail, Lodging	Education	Health	Arts-Ent-Rec	Total
Total							
Station							
Track							
Adjacent							
Station+Track+Adjacent							
Kilometer							
Cumulative Kilometer							

Source: From Employment Value-Added Monitoring System excel workbook.

Employment Value-Added Template C
Change in Aggregate Wages for the Streetcar Corridor and City by Economic Group, 2015 to Future Year

AGGREGATE WAGES	2015						
Cumulative Tiers	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent	$2,191,446,410	$211,903,014	$815,398,477	$82,974,859	$885,371,001	$185,501,765	$10,297,294
Kilometer	$2,402,302,122	$222,645,466	$899,974,846	$105,958,218	$889,084,988	$269,830,923	$14,807,680
Mile	$2,589,272,736	$248,529,160	$949,473,403	$146,657,224	$897,212,068	$332,224,427	$15,176,453
City Balance	$9,588,442,483	$2,499,622,031	$3,019,445,164	$1,516,552,703	$510,301,926	$1,980,084,446	$62,436,212
City Total	$12,177,715,219	$2,748,151,192	$3,968,918,567	$1,663,209,928	$1,407,513,993	$2,312,308,873	$77,612,666
Share of City							
Adjacent	18.0%	7.7%	20.5%	5.0%	62.9%	8.0%	13.3%
Kilometer	19.7%	8.1%	22.7%	6.4%	63.2%	11.7%	19.1%
Mile	21.3%	9.0%	23.9%	8.8%	63.7%	14.4%	19.6%
AGGREGATE WAGES	**2021**						
Cumulative Tiers	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent							
Kilometer							
Mile							
City Balance							
City Total							
Share of City							
Adjacent	%	%	%	%	%	%	%
Kilometer	%	%	%	%	%	%	%
Mile	%	%	%	%	%	%	%

Source: From Employment Value-Added Monitoring System excel workbook.

Employment Value-Added Template C
Change in Aggregate Wages for the Streetcar Corridor and City by Economic Group, 2015 to Future Year—continued

AGGREGATE WAGES	2015-Future Year						
Change 2015-Future Year	**Total**	**Industrial**	**Office**	**Retail, Lodging**	**Education**	**Health**	**Arts-Ent-Rec**
Adjacent							
Kilometer							
Mile							
City Balance							
City Total							
Share of City							
Adjacent	37.43%	0.00%	0.00%	0.00%	0.00%	76.10%	0.00%
Kilometer	32.86%	0.00%	2.88%	0.00%	0.00%	61.14%	0.00%
Mile	31.07%	0.00%	13.22%	0.00%	0.00%	58.80%	0.00%

Source: From Employment Value-Added Monitoring System excel workbook.

TECHNICAL DOCUMENTATION

Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) of Workplace Area Characteristics (WAC)

The steps involved in creating the final LEHD WAC workbook and GIS layers for the years 2004 through 2021 are outlined below. LEHD WAC data represents the number of jobs of at the census block level and is broken into a number of age categories and NAICS job codes by type of work, such as Construction or Educational Services, NAICS codes 23 and 61 respectively.

1. Import LEHD tables (*az_wac_S000_JT00_2004.csv* through *az_wac_S000_JT00_2021.csv*) into the ArcGIS Pro project as standalone tables.
2. Join standalone tables to the 2020 census block layer with block tier classification and distance measurements, *COT_2020_CENSUS_BLOCKS_plus_DISTANCE*. Use the "GEOID_NUM" field from *COT_2020_CENSUS_BLOCKS_plus_DISTANCE* and the "w_geocode" field from the standalone table.
3. Export the joined features. This particular set of intermediate features had the following naming convention, with only the year changing. *COT_2020_CENSUS_BLOCKS_plus_DISTANCE_and_WAC_2004*. This step is not necessary, but running tools on features with joined tables can be problematic.
4. Run the *Table To Excel* conversion tool for the intermediate features.
5. In Excel, create a workbook that has a sheet for each intermediate feature along with a sheet containing the average annual wage for each NAICS job code. Within the sheet for each intermediate feature, create columns that will contain wage data for all age categories and job types. Use cell formulas referencing the wages sheet to calculate average annual wages for each feature across all age categories and job types. In this case, field names were changed from the difficult-to-decipher codes into descriptive names.
6. Run the *Excel To Table* tool to bring the tables with wages back into ArcGIS Pro. It is only necessary to import the "w_geocode" field along with the raw jobs totals and wage fields.
7. Join the tables with wages back to *COT_2020_CENSUS_BLOCKS_plus_DISTANCE*.
8. Export features into final layers, in this case with the naming convention *LEHD_WAGES_2004*, again with only the year changing.

It is important to note that the LEHD workbook had modifications and additions to reach its final form. First, the census blocks were sorted by block tier so that they were ordered from the Station Tier to the Mile Tier. Rows for block tier totals were then added to the bottom of each sheet, and these rows contained formulas summing the sorted records for each field by block tier.

The WAC data only contained values for census blocks where people were employed, so the total number of blocks where the "w_geocode" was not null provided a rough way

verify numbers across workbooks and layers. With numbers as large as those in the Total Wages column, rounding settings in excel can lead to differences.

LEHD WAC Data Verification Table		
Year	Join Matches (Total Census Blocks City-Wide)	Total Wages (Total Tiers)
2004	2,906	$2,624,251,673
2005	2,948	$2,799,517,854
2006	3,080	$1,843,574,794
2007	3,042	$2,551,142,014
2008	3,164	$2,359,282,777
2009	3,067	$2,894,808,420
2010	3,025	$2,837,633,565
2011	2,777	$2,586,266,147
2012	2,830	$2,620,032,287
2013	2,826	$2,298,668,449
2014	2,824	$2,945,384,021
2015	2,795	$2,615,598,558
2016	2,829	$2,640,977,244
2017	2,822	$2,642,268,597
2018	2,857	$2,656,730,534
2019	2,901	$2,764,856,918
2020	2,655	$2,725,991,622
2021	2,713	$2,666,900,296

CHAPTER 3
VALUE-ADDED DEMOGRAPHIC, COMMUTING, AND INCOME MONITORING SYSTEM

A key objective of transit is to attract people to move near transit stations as well as improve transportation options for current residents. This chapters uses the American Community Survey (ACS) to assess several demographic-based value-added outcomes.

The ACS provides annually updated demographic data at the block group level covering rolling 5-year periods. Block groups are comprised of 10 to 20 or so city blocks. The block group geography is organized as illustrated in Exhibit 3-1 based on 2010 block group geographies while Exhibit 3-2 reports the land area.[18] Analysis is provided for the following:

- Population total and for White/Non-White residents;
- Households by type;
- Householders by age;
- Residential units by type;
- Housing tenure (owner/renter);
- Commute mode; and
- Household income.

Analysis is reported for fewer tiers and larger geographic areas than other analyses because of census confidentiality and block group design constraints. The tiers are also spatially larger although the overall 1-mile study area is about the same. Finally, because Block group boundaries changed for the 2020 census a crosswalk procedure was used to create geographic comparability between the 2010 and 2020 censuses.

Three ACS periods are presented although only the first and last are compared. The first is the ACS 2009-2013 5-year sample. It is the baseline for comparison since data were collected for the years just before the streetcar was launched. The second is the ACS period covering the years from 2015 through 2019, which was just before the COVID-19 pandemic. Readers can compare changes between the first two periods. The last period is the most recent spanning the years of 2018 through 2022. This period includes the three years most impacted by the pandemic, 2020-2022. In effect, by comparing changes for periods just before the streetcar was launched to that including the peak pandemic years, a worst-case scenario is presented. It will not be until the 2027 5-year ACS sample that will be released in 2029 that the substantial pandemic's effects would have been worked through the economy.

The chapter proceeds with analyses of each of the topics noted above, with special reference to change in household income as a key value-added metric.

[18] Because the 2010 block group geographies are more compatible with this study than the 2020 boundaries, adjustments described below were made to achieve comparability. In addition, analysis excludes the area known locally a "A Mountain" as shown on Exhibit 3-2.

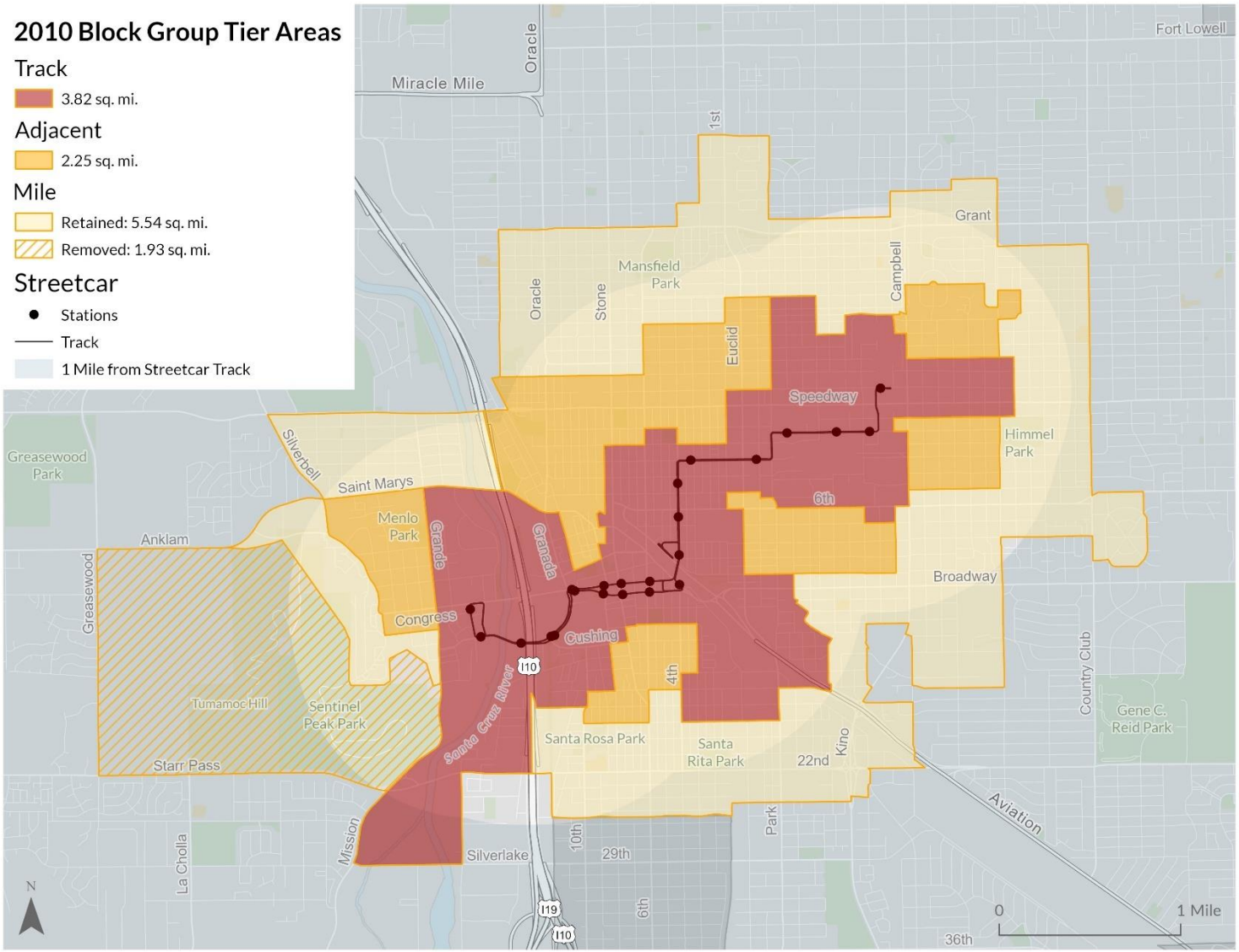

Exhibit 3-1
Streetcar Value-Added Study Area and Tiers Applied to the American Community Survey using 2010 Block Group Geographies
Note: The combination of the Track and Adjacent tiers is called the Kilometer tier for analytic purposes.
Source: Daniel Lawlor, City of Tucson

Exhibit 3-2
Land Area by Tier, 2010 Block Groups

Tier	Census Block Group Acres	Share of City
Track Tier	2,445	1.16%
Adjacent Tier	1,440	0.68%
Mile Tier	3,546	1.68%
Track + Adjacent Tiers = Kilometer Tier	3,885	1.84%
Cumulative to Mile Tier	7,340	3.52%
City Balance	203,893	96.48%
City Total	211,323	100.00%

Source: Daniel Lawlor, City of Tucson
Numbers may not sum up due to rounding.

Establishing Distance Tiers for 2010 Block Groups

Census Block Groups from 2010 are the geographies used for analysis of ACS demographic data.

Between the 2010 and 2020 decennial tabulations, block group geographies changed significantly within Tucson and our area of interest near the streetcar. 2010 was chosen for analysis because the geographies conformed better with 2020 block tiers. This necessitated the use of "crosswalks" to adjust post-2020 ACS data to 2010 block groups, which is covered in more detail in the section on ACS demographic data.

Block group shapefiles were available at the county level. Block groups intersecting the city limits were selected. Due to the size of block groups, especially in less populated places, some block groups sharing little more than a border with the city limits were removed, resulting in a layer containing 410 block groups.

Block groups were separated into three tiers based on their location. Tier fields consisted of a general text field holding the name of the tier, "BLOCK_TIER," as well as binary numeric fields for each tier.

The method used to assign tiers is outlined below.

> Track: Block groups within 50 feet of streetcar track
> Adjacent: Block groups between the Track tier and completely within a 1-mile buffer around the streetcar track
> Mile: Block groups beyond the Adjacent tier intersecting a 1-mile buffer around the streetcar

The Mile tier was further modified in two ways.

1. Block Groups were removed either because an insignificant portion was within the study area, or the block group was so large that it encompassed neighborhoods so far beyond the study area that to include it would have been misleading. The following block groups were removed from the tier.

    GEOIDFQ 1500000US040190023001
    GEOIDFQ 1500000US040190044074
    GEOIDFQ 1500000US040190012001
    GEOIDFQ 1500000US040190015001
    GEOIDFQ 1500000US040190018013
    GEOIDFQ 1500000US040199804001
    GEOIDFQ 1500000US040190025093

2. Block Group 1500000US040190044151 had its shape altered for areal calculations. The majority of the block group was taken up by A-Mountain and Tumamoc Hill and was reshaped to exclude those areas while retaining areas contributing to the demographic data.

In order to join ACS data, the “Geography” field, which concatenated "1500000US" and the existing GEOID10 field, was added.

What follows is analysis of demographic outcomes based on the list noted above for the entire 1-mile streetcar corridor study area (see Exhibit 3-1). As will be shown, the streetcar’s influence area extends mostly into the track and adjacent tiers and much less so into balance of the 1-mile study area. These two tiers combined will be called the 1-kilometeer tier, mindful that the actual distances range considerably around this threshold. Moreover, observations of data show that there are important differences in outcomes within the 1-kilometer tier based on location near the university, downtown, between the university and downtown, and the area west of the I-10 freeway. These differences are presented in the second part of this chapter. These subarea analyses will form the basis for future updates based on the templates outlined at the end of the chapter.

Population
The change in overall population along with change in White and non-White residents in each of the block group geographies is reported in Exhibit 3-3. White population is defined as white alone, not Hispanic or Latino while non-White is all other persons.

Overall population grew from the ACS period before streetcar service, 2009-2013, to the ACS 5-year survey year just before the pandemic, 2015-2029 for all three streetcar tiers—block groups encompassing the track, adjacent to those block groups, and from adjacent block groups to one mile away from streetcar stations. This was also the case with the non-White population. Although the White population also grew in the innermost tiers, it fell in between the adjacent and 1-mile tier—called simply the 1-mile tier for these purposes unless otherwise noted.

Trends are mixed between the periods just before and during the pandemic. While overall population grew in the 1-kilometer tier before the pandemic, it fell during the pandemic. In contrast, population fell between the 1-kilometer tier to one-mile tier before the pandemic but rose afterward.

However, as effects of the pandemic subside, longer term perspectives emerge. Overall trends emerge when comparing the period before streetcar service into the pandemic as both could be considered the nadir of long-term trends. Based on this approach, population grew across all tiers to the 1-kilometer tier but fell between that and the 1-mile tier. While the White population grew in the innermost tiers, it fell in the 1-mile tier and overall. The non-White population grew in the track and 1-mile tiers as well as overall.

Consider the context of the city where the White population is declining while the non-White population is growing. Even where the White population grew by 571 people in the 1-kilometer tier from before streetcar service into the pandemic, the non-White population grew by 2,552, absorbing 82% of the entire population change. Across all tiers out to one mile, the White population fell by 80 persons while the non-White population grew by nearly 2,800 people.

Change in households by type is considered next.

Exhibit 3-3
Change in Total, White, and Non-White Population by Streetcar Tier Before Streetcar Service and During the COVID-19 Pandemic

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City Change 2009-2013 to 2018-2022
Total Population						
Track	18,003	21,349	20,158	2,155	12.0%	19.6%
Adjacent	12,838	14,556	13,807	969	7.5%	8.8%
Kilometer	30,841	35,905	33,965	3,124	10.1%	28.5%
Mile	23,089	21,859	22,683	-406	-1.8%	Decline
Total Tiers	53,930	57,764	56,648	2,718	5.0%	24.8%
Balance	517,709	522,191	525,969	8,260	1.6%	75.2%
Total City	571,639	579,955	582,617	10,978	1.9%	
White Population						
Track	10,450	12,195	10,736	286	2.7%	Growth*
Adjacent	7,076	7,277	7,361	285	4.0%	Growth*
Kilometer	17,526	19,472	18,097	571	3.3%	Growth*
Mile	12,036	10,668	11,384	-652	-5.4%	Decline*
Total Tiers	29,562	30,140	29,482	-80	-0.3%	Decline*
Balance	240,982	229,817	223,203	(17,779)	-7.4%	Decline*
Total City	270,544	259,957	252,685	(17,859)	-6.6%	
Non-White Population						
Track	7,553	9,154	9,421	1,868	24.7%	6.5%
Adjacent	5,762	7,279	6,446	684	11.9%	2.4%
Kilometer	13,315	16,433	15,867	2,552	19.2%	8.8%
Mile	11,053	11,191	11,299	246	2.2%	0.9%
Total Tiers	24,368	27,624	27,166	2,798	11.5%	9.7%
Balance	276,727	292,374	302,766	26,039	9.4%	90.3%
Total City	301,095	319,998	329,933	28,838	9.6%	

Source: American Community Survey.
*Because the total city lost White population meaning ratios would be counter-intuitive, only the direction of change is indicated.

Households by Type
The change in households overall and by type are reported in Exhibit 3-4. Household types include households with and without children, single-person households, and multi-adult households without children ("multi-adult households").

The difference between population and household data is the households are a direct measure of occupied housing units where population includes those living in housing units or in such group quarters as dormitories, congregate care facilities, or jails. From the perspective of development, change in households is more important than change in population.

Exhibit 3-4 shows something remarkable. Between the period before streetcar service and during the pandemic, the cumulative change in households to 1-kilometer accounted for nearly 16% of the entire change in the city's households—on less than 2% of the city's urbanized land base. Even more remarkable is that the change in households among the block groups comprising the track tier—comprising just 1.16% of the city's urbanized land area—accounted for more than 9% of the change.

Not surprisingly, the number of households with children fell across all tiers but they also fell for the city. There is an important subtlety, however: While all streetcar tiers to 1-kilometer accounted for about 4% of the city's loss of households with children, this was less than those tiers' rate of household growth meaning that the streetcar tiers were more resilient in keeping households with children than the city.

These findings beg a particular question, nonetheless. Recent studies have shown that transit station areas attract substantial shares of regional growth among households with children. In some metropolitan areas, transit station areas have added households with children while their regions experienced a reduction in those households.[19] The policy implication for Tucson is that more might be done to attract and keep households with children near transit stations because that is indeed consistent with market demand.

Perhaps consistent with expectations, growth in single-person households within the 1-kilometer streetcar tier accounted for about 21% of the city's growth. Indeed, the track tier accounted for more than 16% of the entire city's growth among these households despite occupying 1.16% of the city's urbanized land. Trends were similar though less pronounced with respect to growth among multi-adult households.

Trends with respect to change in householders by age are considered next.

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[19] See Arthur C. Nelson and Robert Hibberd. Influence of Rail Transit on Development Patterns in the Mountain Mega-Region with a Surprise and Implications for Rail Transit and Land-Use Planning. *Transportation research record* 2675.4 (2021): 374–390.
See also Arthur C. Nelson and Robert Hibberd. Influence of Transit Station Proximity on Demographic Change Including Displacement and Gentrification with Implications for Transit and Land Use Planning After the COVID-19 Pandemic. *Transportation research record* 2677.1 (2023): 1721–1731.

Exhibit 3-4
Change in Households by Type by Streetcar Tier Before Streetcar Service and During the COVID-19 Pandemic

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City Change 2009-2013 to 2018-2022
Total Households						
Track	4,560	4,925	5,986	1,426	31.3%	9.3%
Adjacent	5,867	6,825	6,856	989	16.9%	6.5%
Kilometer	10,427	11,750	12,842	2,415	23.2%	15.8%
Mile	9,844	8,985	9,996	152	1.5%	1.0%
Total Tiers	20,271	20,735	22,838	2,567	12.7%	16.8%
Balance	201,079	206,996	213,804	12,725	6.3%	83.2%
Total City	221,350	227,731	236,642	15,292	6.9%	
Households with Children						
Track	602	469	463	(139)	-23.1%	2.1%
Adjacent	677	909	563	(114)	-16.8%	1.7%
Kilometer	1,279	1,378	1,026	(253)	-19.8%	3.9%
Mile	1,964	1,644	1,613	(351)	-17.9%	5.4%
Total Tiers	3,243	3,022	2,640	(603)	-18.6%	9.3%
Balance	61,082	60,452	55,192	(5,890)	-9.6%	90.7%
Total City	64,325	63,474	57,832	(6,493)	-10.1%	
Households without Children						
Track	3,958	4,456	5,522	1,564	39.5%	7.2%
Adjacent	5,190	5,916	6,293	1,103	21.2%	5.1%
Kilometer	9,148	10,372	11,815	2,667	29.2%	12.2%
Mile	7,880	7,341	8,383	503	6.4%	2.3%
Total Tiers	17,028	17,713	20,198	3,170	18.6%	14.6%
Balance	139,997	146,544	158,612	18,615	13.3%	85.4%
Total City	157,025	164,257	178,810	21,785	13.9%	

Exhibit 3-4
Change in Households by Type by Streetcar Tier Before Streetcar Service and During the COVID-19 Pandemic—continued

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City Change 2009-2013 to 2018-2022
Single-Person Households						
Track	2,209	2,517	3,068	859	38.9%	16.3%
Adjacent	2,955	2,963	3,199	244	8.3%	4.6%
Kilometer	5,164	5,480	6,267	1,103	21.4%	20.9%
Mile	3,790	3,268	4,100	310	8.2%	5.9%
Total Tiers	8,954	8,748	10,368	1,414	15.8%	26.8%
Balance	67,087	68,811	70,958	3,871	5.8%	73.2%
Total City	76,041	77,559	81,325	5,284	6.9%	
Multi-Adult Households						
Track	1,749	1,939	2,454	705	40.3%	4.3%
Adjacent	2,235	2,953	3,093	858	38.4%	5.2%
Kilometer	3,984	4,892	5,547	1,563	39.2%	9.5%
Mile	4,090	4,073	4,283	193	4.7%	1.2%
Total Tiers	8,074	8,965	9,830	1,756	21.8%	10.6%
Balance	72,910	77,733	87,654	14,744	20.2%	89.4%
Total City	80,984	86,698	97,484	16,500	20.4%	

Note: Total households, households with children, and single-person households with 2009-2013 and 2015-2019 are from ACS Table B11005 while those figures for 2018-2022 are from ACS Table B11012. All other figures are derived.
Source: American Community Survey

Householders by Age

Another way to appreciate the association between streetcar proximity of people is by assessing the change among householders by age. This is shown in Exhibit 3-5 with respect to householders who are under 25 years of age, those between 25 and 44 years of age and then between those who are 45 to 64 years of age, and finally those who are 65 years of age and older.

As a reminder, a household is comprised of one or more people occupying a residential unit and thus does not include those living in group quarters. However, a household includes multi-room apartments where each room is rented such as found near the University of Arizona campus with many hundreds near streetcar stations. The implications of this are evident in Exbibit 3-5. It shows that nearly a third of the city's change in householders under 25 years of age moved to the 1-kilometer tier during the study period.

In contrast, although all the other age categories added households, they were not as pronounced at the youngest age category. Yet changes are not trivial. The 1-kilometer tier accounted for more than 5% of the change in households aged group of 25 to 44 years of age while the next higher age accounted for about 3% the oldest groups.

Change in housing units by type is considered next followed by change housing tenure (owner, renter).

Exhibit 3-5
Change in Householders by Age by Streetcar Tier Before Streetcar Service and During the COVID-19 Pandemic

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City Change 2009-2013 to 2018-2022
Total Households						
Track	4,560	4,925	5,986	1,426	31.3%	9.3%
Adjacent	5,867	6,825	6,856	989	16.9%	6.5%
Kilometer	10,427	11,750	12,842	2,415	23.2%	15.8%
Mile	9,844	8,985	9,996	152	1.5%	1.0%
Total Tiers	20,271	20,735	22,838	2,567	12.7%	16.8%
Balance	201,079	206,996	213,804	12,725	6.3%	83.2%
Total City	221,350	227,731	236,642	15,292	6.9%	
Householders <25 Years of Age						
Track	1,355	1,727	2,232	877	64.7%	21.8%
Adjacent	1,556	1,739	1,984	428	27.5%	10.7%
Kilometer	2,911	3,466	4,216	1,305	44.8%	32.5%
Mile	1,820	1,631	1,682	-138	-7.6%	Decline
Total Tiers	4,731	5,097	5,899	1,168	24.7%	29.0%
Balance	15,121	15,239	17,974	2,853	18.9%	71.0%
Total City	19,852	20,336	23,873	4,021	20.3%	
Householders 25 to 44 Years of Age						
Track	777	1,477	1,611	834	107.4%	1.9%
Adjacent	865	2,544	2,453	1,588	183.6%	3.5%
Kilometer	1,642	4,021	4,064	2,422	147.5%	5.4%
Mile	1,442	2,534	3,195	1,753	121.6%	3.9%
Total Tiers	3,084	6,555	7,259	4,175	135.4%	9.3%
Balance	29,255	67,693	70,098	40,843	139.6%	90.7%
Total City	32,339	74,248	77,358	45,019	139.2%	

Exhibit 3-5
Change in Householders by Age by Streetcar Tier Before Streetcar Service and During the COVID-19 Pandemic—continued

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City Change 2009-2013 to 2018-2022
Householders 45 to 64 Years of Age						
Track	585	991	1,201	616	105.3%	1.4%
Adjacent	653	1,540	1,286	633	96.9%	1.4%
Kilometer	1,238	2,531	2,487	1,249	100.9%	2.8%
Mile	1,378	2,695	2,243	865	62.8%	2.0%
Total Tiers	2,616	5,226	4,730	2,114	80.8%	4.8%
Balance	28,052	71,743	70,067	42,015	149.8%	95.2%
Total City	30,668	76,969	74,797	44,129	143.9%	
Householders 65 Years of Age or Over						
Track	371	730	941	570	153.6%	1.4%
Adjacent	460	1,002	1,133	673	146.3%	1.7%
Kilometer	831	1,732	2,074	1,243	149.6%	3.1%
Mile	940	2,125	2,876	1,936	206.0%	4.9%
Total Tiers	1,771	3,857	4,950	3,179	179.5%	8.0%
Balance	19,096	52,321	55,664	36,568	191.5%	92.0%
Total City	20,867	56,178	60,615	39,748	190.5%	

Source: American Community Survey.

Housing Units by Type

Housing supply and especially supply by type is a key ingredient to achieving equitable transit-oriented development. This analysis addresses the total supply of housing units as opposed to only those that are occupied because ACS 5-year data do not include occupied units by type to the detail that it does for total units. Besides, the underlying concern is about total supply anyway.

The change in the total supply of housing units is reported in Exbibit 3-6. Categories include detached, townhouse, plex, and multi-family units. Detached and townhouse units are often intended for owner occupancy although large shares are rented. Plex units are 2-, 3-, and 4-unit structures commonly called duplexes, triplexes, and fourplexes where individual units are rented, though an owner may live in one and rent the others out. Multi-family structures include 5 or more units and can be rental apartments or condominiums.

Not surprisingly, considering its downtown location with expensive real estate, very few detached homes have been added to the inventory within the streetcar tiers cumulated to one mile during the study period. On the other hand, the track tier accounted for nearly 300 new detached units or about 4% of the city's total.

Surprisingly, the streetcar tiers to one mile accounted for nearly 88% of the 973 townhouses added to the city's inventory during the study period with the tiers to one kilometer accounting for about half of those. Either the local market demand for townhouses is soft relative to other western metropolitan areas or there are impediments to townhouse development that need to be overcome.

An even bigger surprise is the loss of plex units citywide and among the streetcar tiers. Plexes have long been considered a key source of housing that is affordable to a wide range of households. Yet, following national trends,[20] the city lost 357 of those units during the study period and 458 in the 1-mile tier meaning that 71 of such units were added elsewhere in the city, including just 21 in the 1-kilometer tier. The city's casita policy may help close the gap but more needs to be done to increase the supply of these units everywhere.

Finally, and not surprisingly given its central location, the 1-kilometer streetcar tier accounted for more than 70% of the change in multifamily units during the study period. A key reason is the addition of hundreds of student rental apartments between Speedway, Park, and Euclid. As that development winds down but demand continues to increase, the city may need to be more proactive in facilitating multifamily development among the streetcar tiers. Indeed, given that the rest of the city added fewer than 600 multifamily units, more efforts are needed to expand multifamily supply throughout the city.

Housing tenure trends are identified next.

[20] See Daniel Parolek with Arthur C. Nelson, 2020, *Missing Middle Housing*, Washington, DC: Island Press.

Exhibit 3-6
Change in Housing Units by Type by Streetcar Tier Before Streetcar Service and During the COVID-19 Pandemic

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City Change 2009-2013 to 2018-2022
Total Housing Units						
Track	5,580	5,970	6,981	1,401	25.1%	14.6%
Adjacent	7,008	8,007	7,860	852	12.2%	8.9%
Kilometer	12,588	13,977	14,841	2,253	17.9%	23.5%
Mile	11,006	10,362	11,261	255	2.3%	2.7%
Total Tiers	23,594	24,339	26,102	2,508	10.6%	26.1%
Balance	228,245	232,170	235,339	7,094	3.1%	73.9%
Total City	251,839	256,509	261,441	9,602	3.8%	
Detached Units						
Track	1,866	2,314	2,136	270	14.5%	4.1%
Adjacent	3,079	3,778	2,974	-105	-3.4%	-1.6%
Kilometer	4,945	6,092	5,110	165	3.3%	2.5%
Mile	6,629	6,313	6,635	6	0.1%	0.1%
Total Tiers	11,574	12,405	11,745	171	1.5%	2.6%
Balance	119,723	126,392	126,214	6,491	5.4%	97.4%
Total City	131,297	138,797	137,960	6,663	5.1%	
Townhouses						
Track	278	460	500	222	79.9%	22.8%
Adjacent	588	617	769	181	30.8%	18.6%
Kilometer	866	1,077	1,269	403	46.5%	41.4%
Mile	478	678	928	450	94.2%	46.3%
Total Tiers	1,344	1,755	2,198	854	63.5%	87.7%
Balance	17,788	11,877	17,908	120	0.7%	12.3%
Total City	19,132	13,632	20,105	973	5.1%	

Exhibit 3-6
Change in Households by Type by Streetcar Tier Before Streetcar Service and During the COVID-19 Pandemic—continued

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City Change 2009-2013 to 2018-2022
Plexes (2-, 3-, 4-Units)						
Track	971	776	1,025	54	5.6%	Growth*
Adjacent	1,112	1,024	1,079	-33	-3.0%	Decline*
Kilometer	2,083	1,800	2,104	21	1.0%	Growth*
Mile	1,474	1,294	1,025	-449	-30.5%	Decline*
Total Tiers	3,557	3,094	3,129	-428	-12.0%	Decline*
Balance	15,213	13,905	15,284	71	0.5%	Growth*
Total City	18,770	16,999	18,413	-357	-1.9%	
Multi-Family, 5 or More Units						
Track	2,373	2,379	3,304	931	39.2%	38.0%
Adjacent	2,229	2,405	3,025	796	35.7%	32.5%
Kilometer	4,602	4,784	6,329	1,727	37.5%	70.6%
Mile	2,120	1,645	2,286	166	7.8%	6.8%
Total Tiers	6,722	6,429	8,615	1,893	28.2%	77.4%
Balance	54,633	53,234	55,187	554	1.0%	22.6%
Total City	61,355	59,663	63,802	2,447	4.0%	

Source: American Community Surveys for 2013 and 2019.
*Because the total city lost plex units meaning ratios would be counter-intuitive, only the direction of change is indicated.

Housing Tenure

Housing tenure is the formal term for differentiating between owners and renters. Exhibit 3-7 shows the change in housing tenure for the streetcar tiers during the study period. The clearly notable trend is that whereas the 1-kilometer streetcar tier accounted for more than 40% of the change in the entire city's renters, it accounted for only slightly more than 1% of the change in owners. The key reason for the change in renters is the addition of hundreds of rental units serving students. It is assumed that the expansion of rental student housing has peaked and is unlikely to return to pre-pandemic construction levels.

A concern among policymakers is the inability of the condominium market to meet housing needs in this segment. There are two reasons for this. First, condo construction and owner-permanent financing is more expensive than conventional homes and townhouses. Second, construction defect laws and litigation steer condo builders away from the market. For some, a solution is to build condos but rent them first until the statute of limitations expires relating to construction defects. While a solution, it is not an efficient one to expand ownership opportunities to lower- and moderate-income housing segments.[21]

Trends in commuting modes are presented below.

[21] For a review of the issues and an outline of solutions, see https://www.urban.org/urban-wire/housing-market-needs-more-condos-why-are-so-few-being-built.

Exhibit 3-7
Change in Housing Tenure by Streetcar Tier Before Streetcar Service and During the COVID-19 Pandemic

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City Change 2009-2013 to 2018-2022
Total Occupied Units						
Track	4,560	4,925	5,986	1,426	31.3%	9.3%
Adjacent	5,867	6,825	6,856	989	16.9%	6.5%
Kilometer	10,427	11,750	12,842	2,415	23.2%	15.8%
Mile	9,844	8,985	9,996	152	1.5%	1.0%
Total Tiers	20,271	20,735	22,838	2,567	12.7%	16.8%
Balance	201,079	206,996	213,804	12,725	6.3%	83.2%
Total City	221,350	227,731	236,642	15,292	6.9%	
Owner-Occupied Units						
Track	1,077	1,082	1,177	100	9.3%	1.1%
Adjacent	1,974	1,980	1,970	-4	-0.2%	0.0%
Kilometer	3,051	3,062	3,147	96	3.1%	1.0%
Mile	4,004	3,523	4,180	176	4.4%	1.8%
Total Tiers	7,055	6,585	7,327	272	3.9%	2.9%
Balance	109,026	113,669	118,289	9,263	8.5%	97.1%
Total City	116,081	120,254	125,617	9,536	8.2%	
Renter-Occupied Units						
Track	3,483	3,843	4,808	1,325	38.0%	23.0%
Adjacent	3,893	4,845	4,886	993	25.5%	17.3%
Kilometer	7,376	8,688	9,694	2,318	31.4%	40.3%
Mile	5,840	5,462	5,816	-24	-0.4%	-0.4%
Total Tiers	13,216	14,150	15,511	2,295	17.4%	39.9%
Balance	92,053	93,327	95,515	3,462	3.8%	60.1%
Total City	105,269	107,477	111,026	5,757	5.5%	

Source: American Community Survey.

Commuting Mode

By expanding mobility options, fixed guideway transit systems such as streetcars influence mode choice in the journey or commute to work. But there is a caveat: the pandemic changed commuting behavior dramatically across the nation as workers shifted into social distancing mode and thus away from transit and working at home instead of an office or other workplaces.

There is another. Although Exhibit 3-8 reports commuting mode patterns for the streetcar corridor as well as the city for the study period, it does not report mode choice for other trip purposes. Indeed, about 80% of all trips are not related to the journey to work but rather to shopping, services, recreation, social visits, and so forth.[22]

Several trends are evident in Exhibit 3-8. First, the number of workers living within the 1-kilometer streetcar tier has increased by about 30% during the study period, or three times the city, accounting for about 15% of the entire city's change in workers. There is an important implication of this. Because 3,774 new workers were added to those already living in the streetcar corridor, more people who were living in the corridor but not working when the streetcar started service are now working. This is circumstantial evidence that the streetcar is associated with created jobs for residents that did not exist before.

Second, although the number of workers commuting via automobile/truck rose while commuting via transit and walking/biking fell, this seems clearly related to the pandemic. For instance, Exhibit 3-9 shows streetcar use in 2022 was the highest ever and was nearly three times higher than the peak of the pandemic in 2021. One reason for this is likely the free-fare policy of the city. The extent to which these numbers reflect those commuting to work via transit, or the role of free fares in sustaining it, will not be revealed meaningfully in the American Community Survey until data are released in the late 2020s. Nonetheless, trends can be followed annually.

Third, the share of workers working from home has increased substantially, also likely related to the pandemic. But a trend favoring the streetcar corridor is evident. Whereas working from home doubled during the study period for the city, it tripled in the streetcar corridor. People working from home who live along streetcar and other fixed guideway corridors enjoy multi-modal options without owning automobiles or using them less than those living elsewhere.[23] The extent to which this will be sustained post-pandemic will be revealed in future ACS releases. Moreover, data show that of the 3,774 workers added to the corridor during the study period, 1,374 or 36% used other than the automobile/truck mode to work.

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[22] This is inferred from Figure 5 of 2017 National Household Travel Survey, 2019,*Travel Behavior Trend Analysis of Workers and Non-Workers,* Washington DC: Federal Highway Administration, available form https://nhts.ornl.gov/assets/FHWA_NHTS_Report_3B_Final_021119.pdf.

[23] Arthur C. Nelson and Robert Hibberd. 2024. *Rail and Bus Rapid Transit as a Development Strategy.* Social Science Research Network, forthcoming.

Exhibit 3-8
Change in Commuting Mode by Streetcar Tier Before Streetcar Service and During the COVID-19 Pandemic

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City Change 2009-2013 to 2018-2022
Total Workers Living in Geographic Area						
Track	6,712	7,728	8,663	1,951	29.1%	7.5%
Adjacent	5,919	8,020	7,742	1,823	30.8%	7.0%
Kilometer	12,631	15,748	16,405	3,774	29.9%	14.5%
Mile	10,905	9,877	11,047	142	1.3%	0.5%
Total Tiers	23,536	25,625	27,453	3,917	16.6%	15.1%
Balance	221,162	234,581	243,252	22,090	10.0%	84.9%
Total City	244,698	260,206	270,705	26,007	10.6%	
Automobile/Truck including Carpooling						
Track	3,384	3,719	4,755	1,371	40.5%	10.8%
Adjacent	3,674	5,053	4,692	1,018	27.7%	8.0%
Kilometer	7,058	8,772	9,447	2,389	33.8%	18.8%
Mile	7,599	7,230	7,507	-92	-1.2%	-0.7%
Total Tiers	14,657	16,002	16,954	2,297	15.7%	18.1%
Balance	191,136	205,402	201,563	10,427	5.5%	81.9%
Total City	205,793	221,404	218,516	12,723	6.2%	
Transit						
Track	490	236	218	-272	-55.6%	4.8%
Adjacent	292	500	118	-174	-59.4%	3.0%
Kilometer	782	736	336	(446)	-57.0%	7.8%
Mile	676	488	268	-408	-60.3%	7.1%
Total Tiers	1,458	1,224	604	-854	-58.5%	14.9%
Balance	10,618	7,476	5,753	(4,865)	-45.8%	85.1%
Total City	12,076	8,700	6,357	(5,719)	-47.4%	
Biking/Walking						
Track	2,419	1,824	2,538	119	4.9%	-4.2%
Adjacent	1,582	1,368	1,418	-164	-10.4%	5.8%
Kilometer	4,001	3,192	3,956	(45)	-1.1%	1.6%
Mile	1,832	1,410	1,431	-401	-21.9%	14.2%
Total Tiers	5,833	4,602	5,386	-447	-7.7%	15.8%
Balance	8,819	14,560	6,440	(2,379)	-27.0%	84.2%
Total City	14,652	19,162	11,826	(2,826)	-19.3%	

Exhibit 3-8
Change in Commuting Mode by Streetcar Tier Before Streetcar Service and During the COVID-19 Pandemic—continued

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City Change 2009-2013 to 2018-2022
Work at Home						
Track	333	654	1,116	783	235.1%	3.8%
Adjacent	357	658	1,440	1,083	303.4%	5.3%
Kilometer	690	1,312	2,556	1,866	270.4%	9.2%
Mile	421	469	1,655	1,234	293.0%	6.0%
Total Tiers	1,111	1,781	4,210	3,099	279.0%	15.2%
Balance	8,675	10,455	25,967	17,292	199.3%	84.8%
Total City	9,786	12,236	30,177	20,391	208.4%	
All Other Modes						
Track	86	1,295	38	-48	-56.1%	-3.4%
Adjacent	14	441	74	60	427.2%	4.2%
Kilometer	100	1,736	112	12	12.0%	0.8%
Mile	377	280	187	-190	-50.4%	-13.2%
Total Tiers	477	2,016	298	-179	-37.4%	-12.4%
Balance	1,914	(3,312)	3,530	1,616	84.4%	112.4%
Total City	2,391	(1,296)	3,829	1,438	60.1%	
Other than Automobile/Truck						
Track	3,242	2,714	3,871	629	19.4%	5.3%
Adjacent	2,231	2,526	2,976	745	33.4%	6.3%
Kilometer	5,473	5,240	6,847	1,374	25.1%	11.6%
Mile	2,929	2,367	3,354	425	14.5%	3.6%
Total Tiers	8,402	7,607	10,201	1,799	21.4%	15.2%
Balance	28,112	32,491	38,160	10,048	35.7%	84.8%
Total City	36,514	40,098	48,360	11,846	32.4%	

Source: American Community Survey.

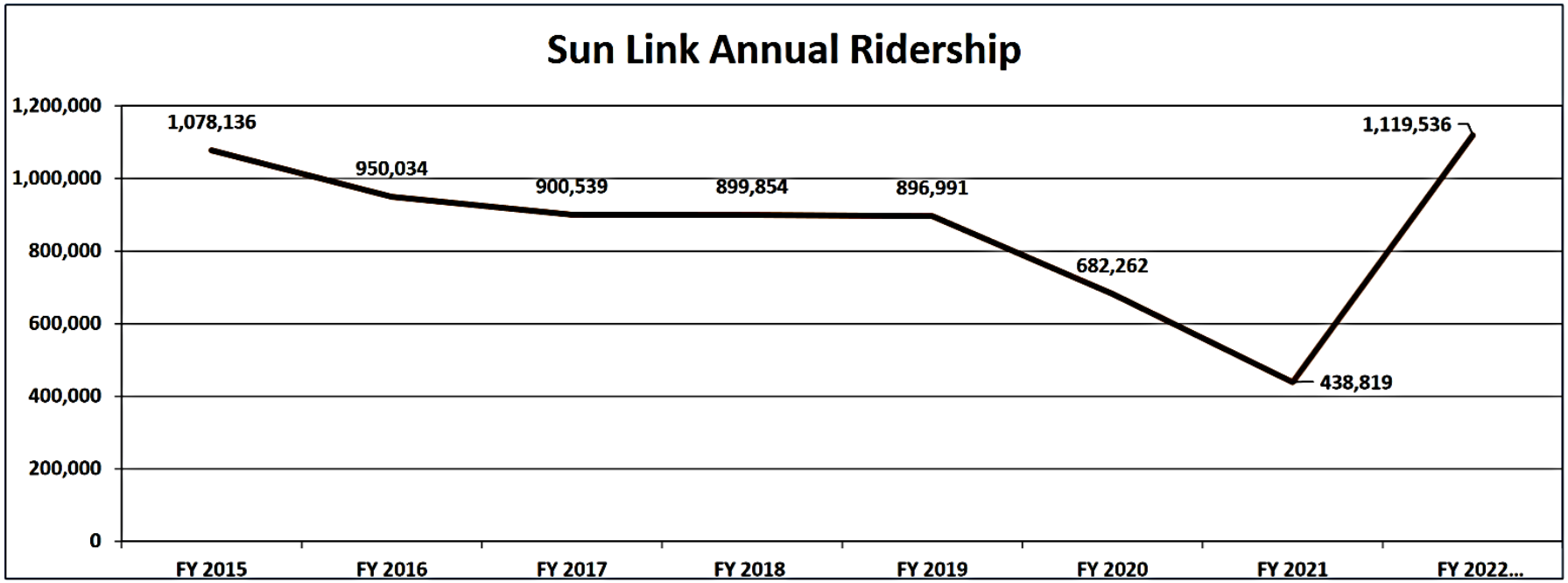


Exhibit 3-9
Annual Tucson streetcar ridership 2015 through 2022
Source: https://rtamobility.com/wp-content/docs/2022/06/RTACART-2022-05-26-Sun-Tran-Ridership-History-Presentation.pdf.

Finally, as Exhibit 3-10 shows, while fewer than 60% of the workers living in the 1-kilometer streetcar corridor commute to work via automobile/truck, that figure for the balance of the city was more than 80% during all time periods. In other words, streetcar corridor dependency on autos for the commute to work is about 30% less than that for the rest of the city. This may have implications for varying transportation impact fees with respect to fixed guideway transit station proximity.

The last discussion in this section addresses household income with value-added implications.

Exhibit 3-10
Ratio of Automobile/Truck Commutes to Workers in 1-Kilometer Streetcar Corridor Compared to City Balance

Measure	2009-2013	2015-2019	2018-2022
1-Kilometer Corridor			
Workers Living in Corridor	12,631	15,748	16,405
Auto/Truck Commuters	7,058	8,772	9,447
Percent Auto/Truck	56%	56%	58%
Rest of City			
Workers Living in Rest of City	232,067	244,458	254,300
Auto/Truck Commutes	198,735	212,632	209,069
Percent Auto/Truck	86%	87%	82%

Source: American Community Survey.

Household Income

While the foregoing analyses addressed Value-Added in demographic and commuting contexts, this analysis estimates the household income Value-Added during the study period.

Exhibit 3-11 reports the mean household income for the streetcar tiers and the city for each of the ACS periods. The figures have been inflated to 2022 dollars. Although median household income is used customarily to compare incomes across space and over time,[24] it cannot be used to estimate change in aggregate income and thus Value-Added which is the objective in this analysis.

Exhibit 3-11 also reports the total number of households for the tiers, the rest of the city, and the city. Multiplying mean household income by the number of households generates in 2022 dollars produces aggregate income for each spatial unit.

The difference between aggregate household income for the period 2018-2022 and that for 2009-2013 in 2022 dollars is an estimate of value-added household income for each of the streetcar tiers. For the 1-kilometer tier, the value-added household income is about $177 million (highlighted in Exhibit 3-11).

An overall summary concludes this chapter. The next three chapters estimate property tax, sales tax, and other value-added revenues associated with the streetcar corridor.

[24] Median household income is the income at which half the households earn more and half less. Mean household income is total income for all households divided by the number of households. Median household income is the usual preference for comparative analysis because it adjusts for outliers at the high and low end. For instance, if Bill Gates attends a meeting, everyone's average income goes up. The median metric adjusts for the Bill Gates effect. But median income cannot be used to estimate aggregate income which is the analytic objective in this report.

Exhibit 3-11
Mean and Aggregate Household Income Value-Added, 2009-13 to 2018-22

Tier	2009-2013	2015-2019	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022
Mean Household Income in 2022 Dollars					
Track	$55,726	$60,069	$54,247	($1,479)	-2.7%
Adjacent	$55,065	$52,585	$62,621	$7,555	13.7%
Kilometer	$55,354	$55,722	$58,717	$3,363	6.1%
Mile	$68,533	$55,492	$67,631	($902)	-1.3%
Total Tiers	$55,357	$55,725	$58,720	$3,363	6.1%
Balance	$65,528	$67,132	$73,034	$7,506	11.5%
Total City	$65,183	$66,084	$72,029	$6,846	10.5%
Households					
Track	4,560	4,925	5,986	$1,426	31.3%
Adjacent	5,867	6,825	6,856	$989	16.9%
Kilometer	10,427	11,750	12,842	$2,415	23.2%
Mile	9,844	11,750	12,842	$2,998	30.5%
Total Tiers	30,698	35,250	38,525	$7,827	25.5%
Balance	201,079	206,996	213,804	$12,725	6.3%
Total City	221,350	227,731	236,642	$15,292	6.9%
Aggregate Income in 2022 Dollars					
Track	$254,108,966	$295,837,740	$324,697,463	$70,588,497	27.8%
Adjacent	$323,068,061	$358,895,680	$429,330,512	$106,262,451	32.9%
Kilometer	$577,177,027	$654,733,420	$754,027,975	**$176,850,948**	30.6%
Mile	$674,643,050	$652,030,503	$868,492,565	$193,849,515	28.7%
Total Tiers	$1,828,997,104	$1,961,497,343	$2,376,548,515	$547,551,411	29.9%
Balance	$13,176,364,427	$13,895,986,610	$15,615,011,099	$2,438,646,672	18.5%
Total City	$14,428,184,504	$15,049,315,270	$17,045,106,918	$2,616,922,414	18.1%

Source: American Community Survey.

Demographic, Commuting, and Value-Added Household Income Summary
Despite being just 1.8% of Tucson's land area, during the study period that extends before streetcar service (2009-2013) and mostly into the pandemic (2018-2022), the 1-kilometer streetcar corridor accounted for:

- Nearly 30% of the city's new residents;
- About 16% of the city's new households including nearly a third of householders under 25 years of age;
- More than 70% of the city's new multi-family housing units;
- About 40% of the city's new renters;
- About 15% of the city's increase in workers;
- About 12% of the share of workers using other than automobiles and trucks in their commute; and
- More than $167 million in new household income added to the city.

1-KILOMETER SUBAREA ANALYSIS

For the most part, the foregoing analysis shows that the 1-kilometer tier, comprised of the track and adjacent tiers, accounts for the largest share of the change in outcomes within the 1-mile corridor. As such, future analysis can be simplified by focusing on just the 1-kilometer geographic units.

Moreover, refined analysis shows that the streetcar study area consists of four sub areas being:

- West Santa Cruz which is the area west of the I-10 freeway and Santa Cruz river;
- Centro which is comprised of downtown and the areas north and south of it between the West Santa Cruz subarea and the West University subarea;
- West University subarea between the Centro and University subareas; and
- University being the easternmost subarea.

Exhibit 3-12 illustrates these subareas. What follows are brief discussions of subarea findings for each of the demographic, commuting, and income measures comprising the ACS-based analysis.

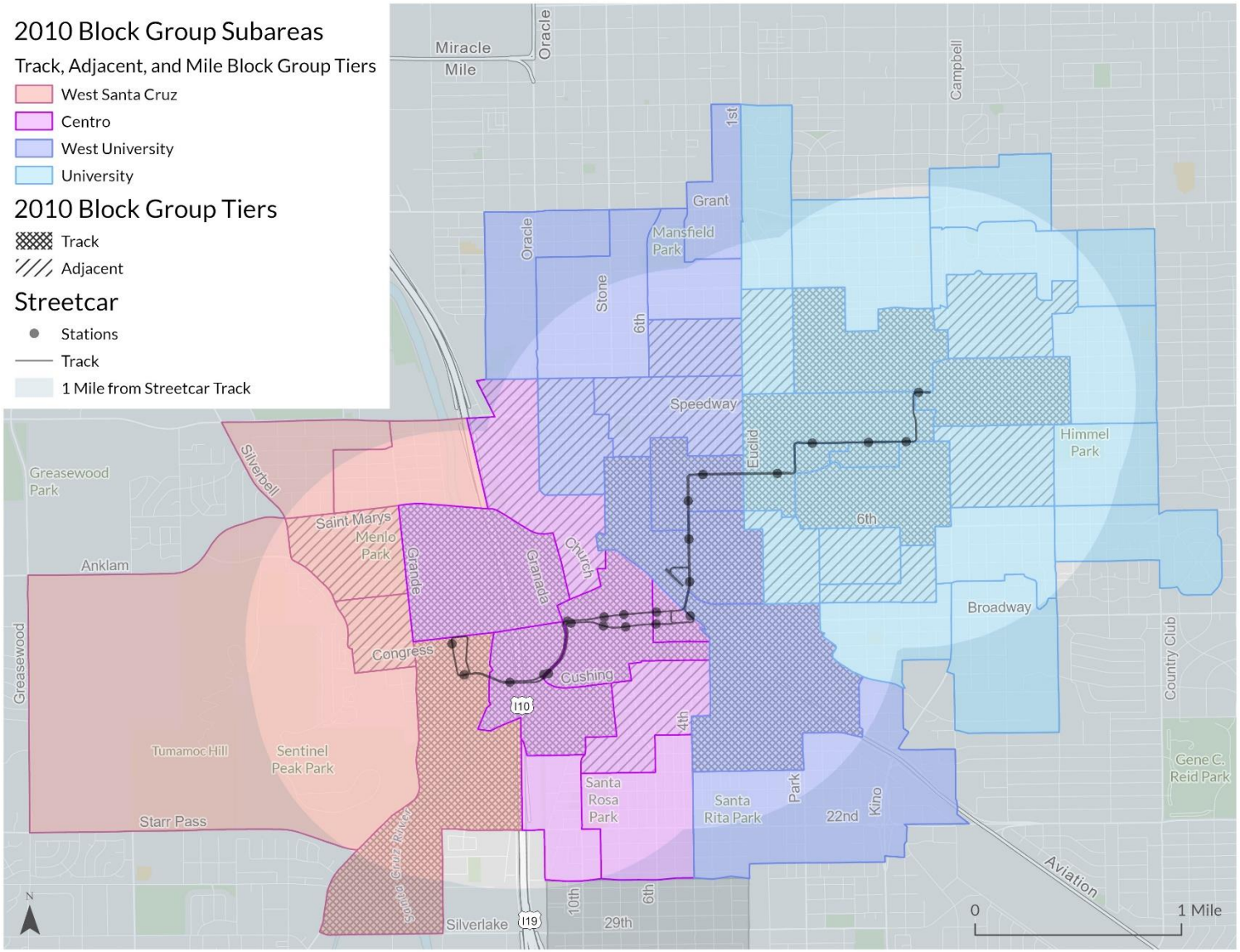


Exhibit 3-12
Streetcar Corridor Subareas using 2010 Census Block Groups
Source: Daniel Lawlor, City of Tucson

City, Corridor, and Subarea Population, Household Type, and Householder Age

Changes in subarea population, households, and householders by age for the 1-kilometer tier between the ACS survey of 2009-2013 and 2018-2022 are reported in Exhibits 3-13, 3-14, and 3-15, respectively.

Exhibit 3-13 shows gains in population and households, from most to least, occurred in the University, West University, and Centro subareas, respectively. The West Santa Cruz subarea lost a small number of residents. The 1-kilometer corridor accounted for nearly 30% of Tucson's growth, on less than 2% of the city's land based. At nearly 2,600 persons, the University subarea gained by far the largest number of new residents. Indeed, it accounted for more than 80% of the 1-kilometer corridor's growth.

An important observation is that although the city lost White residents, the 1-kilometer corridor gained such residents but mostly in the University subarea. This would seem attributable to growth in university students where a sizeable share are attracted to new housing opportunities built in recent years off-campus both near the university and in downtown in the Centro subarea.

Trends are more nuanced when considering change in households by type, as seen in Exhibit 3-14. All sub areas gained households with the University subarea accounted for about 40% of the 1-kilometer corridor change, again likely because of new off-campus student housing. It is important to note that off-campus student housing is not considered group quarters or dormitory housing but rather apartment housing. Each apartment unit counts as one household, based on census definitions, even if roommates are not related. Because students usually share living quarters, the University and West University subareas share of growth in single-person households lagged the Centro and West Santa Cruz subareas considerably.

It is interesting to note that it is entirely feasible for an area to lose population and yet gain households which is seen in the West Santa Cruz subarea. Indeed, this subarea was the only one that saw an increase in the number of households with children. Otherwise, following citywide trends, all other subareas saw a reduction in households with children.

Primarily because of the university, the University and West University subareas led the 1-kilometer corridor in adding householders under 25 years of age. The availability of student-oriented housing downtown also meant that Centro added such households. Indeed, the corridor accounted for about a third of the entire city's growth in these households. The West Santa Cruz subarea lost such households. While the 1-kilometer corridor has been adding younger households, it lags the city in the growth of householders aged 65 or more, accounting for only about 4% of the city's growth.

The change in housing units by type and tenure (owner/renter) in the 1-kilometer corridor by subarea is considered next.

Exhibit 3-13
Change in Population including White and Non-White for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022

City, Corridor, Subarea	2009-2013	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City, *Corridor* Change 2009-2013 to 2018-2022
Population					
City	571,639	582,617	10,978	1.9%	
Corridor	30,841	33,965	3,124	10.1%	28.5%
West Santa Cruz	4,807	4,796	(11)	-0.2%	*-0.4%*
Centro	4,927	5,259	332	6.7%	*10.6%*
West University	5,919	6,141	222	3.7%	*7.1%*
University	15,188	17,769	2,581	17.0%	*82.6%*
White					
City	270,544	252,685	(17,859)	-6.6%	
Corridor	17,526	18,098	572	3.3%	Growth
West Santa Cruz	1,474	1,364	(110)	-7.5%	*Decline*
Centro	1,989	2,174	185	9.3%	*Growth*
West University	3,776	3,206	(570)	-15.1%	*Decline*
University	10,287	11,354	1,067	10.4%	*Growth*
Non-White					
City	301,095	329,933	28,838	9.6%	
Corridor	13,315	15,867	2,552	19.2%	8.8%
West Santa Cruz	3,333	3,432	99	3.0%	*3.9%*
Centro	2,938	3,085	147	5.0%	*5.8%*
West University	2,143	2,935	792	37.0%	*31.0%*
University	4,901	6,415	1,514	30.9%	*59.3%*

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

Exhibit 3-14
Change in Households by Type for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022

City, Corridor, Subarea	2009-2013	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City, *Corridor* Change 2009-2013 to 2018-2022
Households					
City	221,350	236,642	15,292	6.9%	
Corridor	10,427	12,842	2,415	23.2%	15.8%
West Santa Cruz	1,161	1,495	334	28.7%	*13.8%*
Centro	2,546	3,301	755	29.7%	*31.3%*
West University	2,910	3,262	352	12.1%	*14.6%*
University	3,810	4,784	974	25.6%	*40.3%*
Households with Children					
City	64,325	57,832	(6,493)	-10.1%	
Corridor	1,279	1,027	(252)	-19.7%	Decline
West Santa Cruz	214	312	98	45.9%	*Growth*
Centro	417	244	(173)	-41.5%	*Decline*
West University	342	173	(169)	-49.4%	*Decline*
University	306	297	(9)	-2.8%	*Growth*
Households without Children					
City	157,025	178,810	21,785	13.9%	
Corridor	9,148	11,815	2,667	29.2%	12.2%
West Santa Cruz	947	1,182	235	24.8%	*8.8%*
Centro	2,129	3,057	928	43.6%	*34.8%*
West University	2,568	3,089	521	20.3%	*19.5%*
University	3,504	4,486	982	28.0%	*36.8%*
Single-Person Households					
City	76,041	81,438	5,397	7.1%	
Corridor	5,164	6,380	1,216	23.6%	22.5%
West Santa Cruz	433	719	286	66.1%	*23.5%*
Centro	1,316	2,154	838	63.7%	*68.9%*
West University	1,526	1,547	21	1.4%	*1.7%*
University	1,889	1,961	72	3.8%	*5.9%*

Exhibit 3-14
Change in Households by Type for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022—continued

City, Corridor, Subarea	2009-2013	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City, *Corridor* Change 2009-2013 to 2018-2022
Multi-Adult Households (no children)					
City	80,984	97,371	16,387	20.2%	
Corridor	3,984	5,435	1,451	36.4%	8.9%
West Santa Cruz	514	463	-51	-9.9%	*-3.5%*
Centro	813	903	90	11.1%	*6.2%*
West University	1,042	1,542	500	48.0%	*34.5%*
University	1,615	2,526	911	56.4%	*62.8%*

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

Exhibit 3-15
Change in Households by Householder Age for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022

City, Corridor, Subarea	2009-2013	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City, *Corridor* Change 2009-2013 to 2018-2022
Households					
City	221,350	236,642	15,292	6.9%	
Corridor	10,427	12,842	2,415	23.2%	15.8%
West Santa Cruz	1,161	1,495	334	28.7%	13.8%
Centro	2,546	3,301	755	29.7%	31.3%
West University	2,910	3,262	352	12.1%	14.6%
University	3,810	4,784	974	25.6%	40.3%
Householders <25 Years of Age					
City	19,852	23,873	4,021	20.3%	
Corridor	2,911	4,216	1,305	44.8%	32.5%
West Santa Cruz	73	68	(5)	-7.4%	-0.4%
Centro	380	719	339	89.3%	26.0%
West University	758	1,204	446	58.8%	34.2%
University	1,700	2,226	526	30.9%	40.3%
Householders 25-44 Years of Age					
City	74,538	77,358	2,820	3.8%	
Corridor	3,683	4,064	381	10.4%	13.5%
West Santa Cruz	323	574	251	77.8%	65.9%
Centro	952	1,166	214	22.5%	56.1%
West University	1,210	907	(303)	-25.0%	-79.4%
University	1,198	1,417	219	18.2%	57.3%
Householders 45-64 Years of Age					
City	80,339	74,797	(5,542)	-6.9%	
Corridor	2,389	2,487	98	4.1%	Growth
West Santa Cruz	429	380	(49)	-11.5%	-50.3%
Centro	624	790	166	26.5%	169.4%
West University	756	703	(53)	-7.0%	-53.9%
University	580	614	34	5.9%	34.8%

Exhibit 3-15
Change in Households by Householder Age for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022—continued

City, Corridor, Subarea	2009-2013	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City, *Corridor* Change 2009-2013 to 2018-2022
Householders 65 Years of Age and Over					
City	46,621	60,615	13,994	30.0%	
Corridor	1,444	2,074	630	43.6%	4.5%
West Santa Cruz	336	473	137	40.7%	21.7%
Centro	590	626	36	6.1%	5.7%
West University	186	448	262	140.8%	41.6%
University	332	527	195	58.9%	31.0%

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

City, Corridor, and Subarea Housing Units by Type and Tenure

The change in housing units by type for the city, the 1-kilomerter corridor, and sub areas is reported in Exhibit 3-16 while change in tenure is reported in Exhibit 3-17. Special reference is provided in Exhibit 3-16 with "middle housing".

The 1-kilometer corridor accounted for more than a quarter of the change in housing units in the city during the study period, despite occupying less than 2% of the city's land area. Not surprisingly given its density, the corridor added very few detached units overall with the West Santa Cruz and Centro subareas losing several hundred such units. One of the key trends revealed is that the number of plex units (structures comprised of 2, 3 and 4 units) fell citywide though grew slightly in the corridor as well as in the West Santa Cruz and West University subareas. Likewise, where the city lost units overall in structures comprised of 5 or more units, the 1-kilometer corridor gained several hundred such units.

In recent years, local housing and planning interests have focused on expanding the supply of middle housing.[25] Generally, this is moderate density housing where attached structures are three or fewer floors and thus do not need elevators based on most state building codes. As applied here, it is defined as attached and plex units, and units in structures of 5-19 units. Exhibit 3-16 shows that whereas the city overall lost middle housing units during the study period, the 1-kilometer gained such units as did all subareas, led by Centro, West Santa Cruz and University.

Consistent with its higher density and mixed-use composition and the presence of a major university, the 1-kilometer corridor accounted for about 40% of the change in the city's rental units and practically all the change in occupied units with 2,318 additional rental units compared to just 98 owner occupied units. Indeed, the Centro subarea lost such units overall.

The change in commute mode to work is presented next.

[25] See Dan Parolek with Arthur C. Nelson (2020), *Missing Middle Housing*, Island Press.

Exhibit 3-16
Change in Housing Units by Type for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022

City, Corridor, Subarea	2009-2013	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City, *Corridor* Change 2009-2013 to 2018-2022
Housing Units					
City	251,839	261,441	9,602	3.8%	
Corridor	12,588	14,841	2,253	17.9%	23.5%
West Santa Cruz	1,415	1,559	144	10.2%	*6.4%*
Centro	3,139	3,931	792	25.2%	*35.1%*
West University	3,441	3,879	438	12.7%	*19.4%*
University	4,593	5,473	880	19.2%	*39.0%*
Detached units					
City	131,297	137,960	6,663	5.1%	
Corridor	4,945	5,111	166	3.3%	2.5%
West Santa Cruz	629	541	(88)	-14.0%	*-53.1%*
Centro	1,034	844	(190)	-18.4%	*-114.8%*
West University	1,415	1,645	230	16.3%	*138.9%*
University	1,867	2,080	213	11.4%	*129.0%*
Townhouse units					
City	19,132	20,105	973	5.1%	
Corridor	866	1,269	403	46.6%	41.4%
West Santa Cruz	165	313	148	89.7%	*36.7%*
Centro	146	180	34	23.5%	*8.5%*
West University	327	159	(168)	-51.5%	*-41.8%*
University	228	617	389	170.8%	*96.6%*
Plex (2-, 3-, 4-) units					
City	18,770	18,413	(357)	-1.9%	
Corridor	2,083	2,104	21	1.0%	Growth
West Santa Cruz	119	205	86	72.2%	*Growth*
Centro	515	502	(13)	-2.5%	*Decline*
West University	596	761	165	27.7%	*Growth*
University	853	636	(217)	-25.5%	*Decline*

Exhibit 3-16
Change in Housing Units by Type for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022—continued

City, Corridor, Subarea	2009-2013	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City, *Corridor* Change 2009-2013 to 2018-2022
5-19 units					
City	30,990	29,974	(1,016)	-3.3%	
Corridor	1,362	2,096	734	53.9%	Growth
West Santa Cruz	164	242	78	47.6%	*Growth*
Centro	541	899	358	66.1%	*Growth*
West University	221	386	165	74.5%	*Growth*
University	436	569	133	30.5%	*Growth*
20 or more units					
City	30,365	33,828	3,463	11.4%	
Corridor	3,240	4,234	994	30.7%	28.7%
West Santa Cruz	308	239	(69)	-22.5%	*-7.0%*
Centro	880	1,499	619	70.4%	*62.3%*
West University	870	926	56	6.4%	*5.6%*
University	1,182	1,570	388	32.8%	*39.0%*
Other units					
City	21,285	21,162	(123)	-0.6%	
Corridor	92	28	(64)	-70.0%	Decline
West Santa Cruz	30	19	(11)	-36.5%	*Decline*
Centro	23	6	(17)	-74.0%	*Decline*
West University	12	3	(9)	-78.4%	*Decline*
University	27	0	(27)	-100.0%	*Decline*
Middle Housing units (Townhouse, Plex, 5-19 units)					
City	68,892	68,492	(400)	-0.6%	
Corridor	4,311	5,469	1,158	26.9%	Growth
West Santa Cruz	448	760	312	69.6%	*Growth*
Centro	1,202	1,581	379	31.5%	*Growth*
West University	1,144	1,306	162	14.1%	*Growth*
University	1,517	1,822	305	20.1%	*Growth*

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

Exhibit 3-17
Change in Housing Units by Tenure for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022

City, Corridor, Subarea	2009-2013	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2023	Share of City, *Corridor* Change 2009-2013 to 2018-2022
Households					
City	221,350	236,642	15,292	6.9%	
Corridor	10,427	12,842	2,415	23.2%	15.8%
West Santa Cruz	1,161	1,495	334	28.7%	*13.8%*
Centro	2,546	3,301	755	29.7%	*31.3%*
West University	2,910	3,262	352	12.1%	*14.6%*
University	3,810	4,784	974	25.6%	*40.3%*
Owner Households					
City	116,081	125,617	9,536	8.2%	
Corridor	3,051	3,147	96	3.2%	1.0%
West Santa Cruz	570	689	119	20.9%	*123.2%*
Centro	711	543	-168	-23.6%	*-173.9%*
West University	850	904	54	6.4%	*56.1%*
University	920	1,011	91	9.9%	*94.6%*
Renter Households					
City	105,269	111,026	5,757	5.5%	
Corridor	7,376	9,694	2,318	31.4%	40.3%
West Santa Cruz	591	806	215	36.3%	*9.3%*
Centro	1,835	2,758	923	50.3%	*39.8%*
West University	2,060	2,358	298	14.5%	*12.9%*
University	2,890	3,773	883	30.5%	*38.1%*

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

City, Corridor, and Subarea Workers and Commute Mode to Work

Exhibit 3-18 reports the change in workers and commute mode for the city, the 1-kilometer corridor, and subareas for the study period. Notably, the change in workers in the corridor accounted for about 15% of the change in works for the city overall. Not surprisingly. The University subarea accounted for more than 60% of the increase in workers during the study period.

Commute to work data that include 2020 through much of 2022 are skewed by the COVID-19 pandemic because of work location shutdowns, social distancing, and substantial increases in working from home. Thus, while commuting via the auto/truck mode increased, commuting via transit and walking/biking decreased. On the other hand, the rate of change in working from home in the 1-kilometer corridor was much larger than that for the city overall, and many times that for the West Santa Cruz and Centro subareas.

There are important reasons why working from home may be much more attractive within high-capacity transit corridors than elsewhere. First of all, these corridors offer many amenities within walking or short vehicle distances to shopping, restaurants, services, leisure and so forth. In contrast, working from home in isolated suburban settings can lead to “cabin fever” and reduced productivity. This is clearly an area in need of future research.

The other finding is that whereas outside the 1-kilometer corridor, commuting via other than auto/truck accounts for about a fifth of mode share, within the corridor it accounts for double that or more than 40%. One implication is that road impact fees, which are based on the volume of road use by autos/trucks associated with new development, might be reduced by up to 60% within the 1-kilometer corridor and even half within the University subarea.

The change in mean household income in the city, the 1-kilometer corridor, and the sub areas during the study period is reviewed next.

Exhibit 3-18
Change in Workers and Commute Mode to Work for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022

City, Corridor, Subarea	2009-2013	2018-2022	Change 2009-2013 to 2018-2022	Percent Change 2009-2013 to 2018-2022	Share of City, *Corridor* Change 2009-2013 to 2018-2022
Workers Living in Subarea					
City	244,698	270,705	26,007	10.6%	
Corridor	12,631	16,405	3,774	29.9%	14.5%
West Santa Cruz	857	1,451	594	69.3%	*15.7%*
Centro	2,752	2,889	137	5.0%	*3.6%*
West University	2,946	3,624	678	23.0%	*18.0%*
University	6,076	8,441	2,365	38.9%	*62.7%*
Auto/Truck Commute					
City	205,793	218,516	12,723	6.2%	
Corridor	7,058	9,447	2,389	33.8%	18.8%
West Santa Cruz	713	1,117	404	56.6%	*16.9%*
Centro	1,851	1,850	-1	-0.1%	*0.0%*
West University	1,816	2,458	642	35.4%	*26.9%*
University	2,678	4,022	1,344	50.2%	*56.3%*
Transit Commute					
City	8,691	6,357	-2,334	-26.9%	
Corridor	546	336	-210	-38.5%	Decline
West Santa Cruz	49	61	12	23.6%	*Growth*
Centro	245	121	-124	-50.8%	*Decline*
West University	124	104	-20	-16.4%	*Decline*
University	128	51	-77	-60.2%	*Decline*
Walk/Bike Commute					
City	14,652	11,826	-2,826	-19.3%	
Corridor	4,001	3,955	-46	-1.1%	Decline
West Santa Cruz	22	40	18	83.3%	*Growth*
Centro	444	316	-128	-28.7%	*Decline*
West University	822	493	-329	-40.0%	*Decline*
University	2,713	3,105	392	14.5%	*Growth*
Work at Home					
City	9,786	30,177	20,391	208.4%	
Corridor	690	2,506	1,816	263.2%	8.9%
West Santa Cruz	22	180	158	719.4%	*8.7%*
Centro	108	602	494	457.3%	*27.2%*
West University	163	510	347	213.0%	*19.1%*
University	397	1,214	817	205.7%	*45.0%*

Exhibit 3-18
Change in Workers and Commute Mode to Work for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022—continued

City, Corridor, Subarea	2009-2013	2018-2022	Percent Change 2009-2013 to 2018-2022		
Other Commute					
City	5,776	3,829	-1,947	-33.7%	
Corridor	336	112	-224	-66.8%	Decline
West Santa Cruz	51	3	-48	-93.3%	*Decline*
Centro	104	0	-104	-100.0%	*Decline*
West University	21	59	38	181.4%	*Growth*
University	160	49	-111	-69.4%	*Decline*
Non-Auto/Truck Commute					
City	38,905	52,189	13,284	34.1%	
Corridor	5,573	6,958	1,385	24.9%	10.4%
West Santa Cruz	144	334	190	132.1%	*13.7%*
Centro	901	1,039	138	15.3%	*10.0%*
West University	1,130	1,166	36	3.2%	*2.6%*
University	3,398	4,419	1,021	30.1%	*73.7%*
Non-Auto/Truck Commute Percent					
City	15.9%	19.3%	21.3%		
Corridor	44.1%	42.4%	-3.9%		
West Santa Cruz	16.8%	23.0%	37.1%		
Centro	32.7%	36.0%	9.9%		
West University	38.4%	32.2%	-16.1%		
University	55.9%	52.4%	-6.4%		

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

City, Corridor, and Subarea Mean Household Income

The final demographic element to consider is the change in mean household income during the study period for the city, the 1-kilometer transit corridor, and each of the four subareas. This is shown in Exhibit 3-19. The figures are in inflation-adjusted 2022 dollars.

There is one observation that stands out: while the mean household income of the city increased, it fell in the 1-kilometer corridor overall. Among the subareas, West Santa Cruz mean household income increased considerably, by 46%. This is attributable to the subarea having a very low base in 2009-2013 combined with substantial new residential development into the 2020s. On the other hand, mean household income in the University subarea fell, likely because of the influx of students occupying hundreds of new privately provided rental apartments near campus. The two other subareas saw increases in mean household income about on par with the city overall.

The key interest is the extent to which the 1-kilometer corridor and its subareas are associated with value-added household income. Exhibit 3-19 confirms this is the case. During the study period, the 1-kilometer corridor added about $177 million in household income led by nearly $67 million generated from the Centro subarea. The West Santa Cruz subarea gained proportionately more, about double, likely because of extensive redevelopment in the area during the study period. The University and West University subareas gained about $30 million each in Value-Added income.

Although value-added wages during the study period were larger, those wages are exported out of the corridor to where workers live and expend their income. The exception would be those wages spent in the corridor for lunches, after-work engagements, and perhaps some impulse shopping.

The following tables offer templates to update key value-added metrics annually as ACS data become available. This is followed by the technical documentation for acquiring and using the ACS 5-year sample data.

The next three chapters estimate the value-added property investment and property tax revenue (Chapter 4), sales tax revenue (Chapter 5), and other revenue (Chapter 6) associated with the 1-mile streetcar corridor.

Exhibit 3-19
Change in Mean Household and Aggregate Income for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022
[Figures in Inflation-Adjusted Dollars to Latest ACS Year]

City, Corridor, Subarea	2009-2013	2018-2022	Percent Change 2009-2013 to 2018-2022
Mean Household Income			
City	$65,183	$72,029	10.5%
Corridor	$55,354	$58,717	6.1%
West Santa Cruz	$46,587	$68,056	46.1%
Centro	$60,000	$66,601	11.0%
West University	$53,716	$57,986	7.9%
University	$56,172	$50,859	-9.5%
Households			
City	221,350	236,642	6.9%
Corridor	10,427	12,842	23.2%
West Santa Cruz	1,161	1,495	28.7%
Centro	2,546	3,301	29.7%
West University	2,910	3,262	12.1%
University	3,810	4,784	25.6%
Aggregate Household Income			**Value-Added**
City	$14,428,184,504	$17,045,106,918	$2,616,922,414
Corridor	$577,177,027	$754,027,975	$176,850,948
West Santa Cruz	$54,087,903	$101,712,662	$47,624,759
Centro	$152,759,283	$219,848,898	$67,089,615
West University	$156,313,886	$189,165,489	$32,851,603
University	$214,015,955	$243,300,927	$29,284,972

*Figures are in inflation-adjusted 2022 dollars.
Source: ACS 5-Year samples.

Demographic Value-Added Template A
Change in Population from 2009-2013 to 20xx-20xx

City, Corridor, Subarea	2009-2013	20xx-20xx	Change 2009-2013 to 20xx-20xx	Percent Change 2009-2013 to 20xx-20xx	Share of City, *Corridor* Change 2009-2013 to 20xx-20xx
Population					
City	571,639			%	
Corridor	30,841			%	%
West Santa Cruz	4,807			%	%
Centro	4,927			%	%
West University	5,919			%	%
University	15,188			%	%
White					
City	270,544			%	
Corridor	17,526			%	%
West Santa Cruz	1,474			%	%
Centro	1,989			%	%
West University	3,776			%	%
University	10,287			%	%
Non-White					
City	301,095			%	
Corridor	13,315			%	%
West Santa Cruz	3,333			%	%
Centro	2,938			%	%
West University	2,143			%	%
University	4,901			%	%

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

Demographic Value-Added Template B
Change in Households by Type from 2009-2013 to 20xx-20xx

City, Corridor, Subarea	2009-2013	2018-20xx	Change 2009-2013 to 20xx-20xx	Percent Change 2009-2013 to 20xx-20xx	Share of City, *Corridor* Change 2009-2013 to 20xx-20xx
Households					
City	221,350			%	
Corridor	10,427			%	%
West Santa Cruz	1,161			%	%
Centro	2,546			%	%
West University	2,910			%	%
University	3,810			%	%
Households with Children					
City	64,325			%	
Corridor	1,279			%	%
West Santa Cruz	214			%	%
Centro	417			%	%
West University	342			%	%
University	306			%	%
Households without Children					
City	157,025			%	
Corridor	9,148			%	%
West Santa Cruz	947			%	%
Centro	2,129			%	%
West University	2,568			%	%
University	3,504			%	%
Single-Person Households					
City	76,041			%	
Corridor	5,164			%	%
West Santa Cruz	433			%	%
Centro	1,316			%	%
West University	1,526			%	%
University	1,889			%	%

Exhibit 3-14
Change in Households by Type for the City, Streetcar Corridor, and Subareas, 2009-2013 to 2018-2022—continued

City, Corridor, Subarea	2009-2013	20xx-20xx	Change 2009-2013 to 20xx-20xx	Percent Change 2009-2013 to 20xx-20xx	Share of City, *Corridor* Change 2009-2013 to 20xx-20xx
Multi-Adult Households (no children)					
City	80,984			%	
Corridor	3,984			%	%
West Santa Cruz	514			%	%
Centro	813			%	%
West University	1,042			%	%
University	1,615			%	%

Source: ACS 5-Year samples.
Note: Total households, households with children, and single-person households with 2009-2013 and 2015-2019 are from ACS Table B11005 while those figures for 2018-2022 and after are from ACS Table B11012.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

Demographic Value-Added Template C
Change in Households by Householder Age from 2009-2013 to 20xx-20xx

City, Corridor, Subarea	2009-2013	20xx-20xx	Change 2009-2013 to 20xx-20xx	Percent Change 2009-2013 to 20xx-20xx	Share of City, *Corridor* Change 2009-2013 to 20xx-20xx
Households					
City	221,350			%	
Corridor	10,427			%	%
West Santa Cruz	1,161			%	%
Centro	2,546			%	%
West University	2,910			%	%
University	3,810			%	%
Householders <25 Years of Age					
City	19,852			%	
Corridor	2,911			%	%
West Santa Cruz	73			%	%
Centro	380			%	%
West University	758			%	%
University	1,700			%	%
Householders 25-44 Years of Age					
City	74,538			%	
Corridor	3,683			%	%
West Santa Cruz	323			%	%
Centro	952			%	%
West University	1,210			%	%
University	1,198			%	%
Householders 45-64 Years of Age					
City	80,339			%	
Corridor	2,389			%	%
West Santa Cruz	429			%	%
Centro	624			%	%
West University	756			%	%
University	580			%	%

Demographic Value-Added Template C
Change in Households by Householder Age from 2009-2013 to 20xx-20xx—continued

City, Corridor, Subarea	2009-2013	20xx-20xx	Change 2009-2013 to 20xx-20xx	Percent Change 2009-2013 to 20xx-20xx	Share of City, *Corridor* Change 2009-2013 to 20xx-20xx
Householders 65 Years of Age and Over					
City	46,621			%	
Corridor	1,444			%	%
West Santa Cruz	336			*%*	*%*
Centro	590			*%*	*%*
West University	186			*%*	*%*
University	332			*%*	*%*

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

Demographic Value-Added Template D
Change in Housing Units by Type from 2009-2013 to 20xx-20xx

City, Corridor, Subarea	2009-2013	20xx-20xx	Change 2009-2013 to 20xx-20xx	Percent Change 2009-2013 to 20xx-20xx	Share of City, *Corridor* Change 2009-2013 to 20xx-20xx
Housing Units					
City	251,839			%	
Corridor	12,588			%	%
West Santa Cruz	1,415			%	%
Centro	3,139			%	%
West University	3,441			%	%
University	4,593			%	%
Detached units					
City	131,297			%	
Corridor	4,945			%	%
West Santa Cruz	629			%	%
Centro	1,034			%	%
West University	1,415			%	%
University	1,867			%	%
Townhouse units					
City	19,132			%	
Corridor	866			%	%
West Santa Cruz	165			%	%
Centro	146			%	%
West University	327			%	%
University	228			%	%
Plex (2-, 3-, 4-) units					
City	18,770			%	
Corridor	2,083			%	%
West Santa Cruz	119			%	%
Centro	515			%	%
West University	596			%	%
University	853			%	%

Demographic Value-Added Template D
Change in Housing Units by Type from 2009-2013 to 20xx-20xx—continued

City, Corridor, Subarea	2009-2013	20xx-20xx	Change 2009-2013 to 20xx-20xx	Percent Change 2009-2013 to 20xx-20xx	Share of City, *Corridor* Change 2009-2013 to 20xx-20xx
5-19 units					
City	30,990			%	
Corridor	1,362			%	%
West Santa Cruz	164			%	%
Centro	541			%	%
West University	221			%	%
University	436			%	%
20 or more units					
City	30,365			%	
Corridor	3,240			%	%
West Santa Cruz	308			%	%
Centro	880			%	%
West University	870			%	%
University	1,182			%	%
Other units					
City	21,285			%	
Corridor	92			%	%
West Santa Cruz	30			%	%
Centro	23			%	%
West University	12			%	%
University	27			%	%
Middle Housing units (Townhouse, Plex, 5-19 units)					
City	68,892			%	
Corridor	4,311			%	%
West Santa Cruz	448			%	%
Centro	1,202			%	%
West University	1,144			%	%
University	1,517			%	%

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

Demographic Value-Added Template E
Change in Housing Tenure from 2009-2013 to 20xx-20xx

City, Corridor, Subarea	2009-2013	20xx-20xx	Change 2009-2013 to 20xx-20xx	Percent Change 2009-2013 to 20xx-20xx	Share of City, *Corridor* Change 2009-2013 to 20xx-20xx
Households					
City	221,350			%	
Corridor	10,427			%	%
West Santa Cruz	1,161			%	%
Centro	2,546			%	%
West University	2,910			%	%
University	3,810			%	%
Owner Households					
City	116,081			%	
Corridor	3,051			%	%
West Santa Cruz	570			%	%
Centro	711			%	%
West University	850			%	%
University	920			%	%
Renter Households					
City	105,269			%	
Corridor	7,376			%	%
West Santa Cruz	591			%	%
Centro	1,835			%	%
West University	2,060			%	%
University	2,890			%	%

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

Demographic Value-Added Template F
Change in Workers and Commuting Mode from 2009-2013 to 20xx-20xx

City, Corridor, Subarea	2009-2013	20xx-20xx	Change 2009-2013 to 20xx-20xx	Percent Change 2009-2013 to 20xx-20xx	Share of City, *Corridor* Change 2009-2013 to 20xx-20xx
Workers Living in Subarea					
City	244,698			%	
Corridor	12,631			%	%
West Santa Cruz	857			%	%
Centro	2,752			%	%
West University	2,946			%	%
University	6,076			%	%
Auto/Truck Commute					
City	205,793			%	
Corridor	7,058			%	%
West Santa Cruz	713			%	%
Centro	1,851			%	%
West University	1,816			%	%
University	2,678			%	%
Transit Commute					
City	8,691			%	
Corridor	546			%	%
West Santa Cruz	49			%	%
Centro	245			%	%
West University	124			%	%
University	128			%	%
Walk/Bike Commute					
City	14,652			%	
Corridor	4,001			%	%
West Santa Cruz	22			%	%
Centro	444			%	%
West University	822			%	%
University	2,713			%	%
Work at Home					
City	9,786			%	
Corridor	690			%	%
West Santa Cruz	22			%	%
Centro	108			%	%
West University	163			%	%
University	397			%	%

Demographic Value-Added Template F
Change in Workers and Commuting Mode from 2009-2013 to 20xx-20xx—continued

City, Corridor, Subarea	2009-2013	20xx-20xx	Change 2009-2013 to 20xx-20xx	Percent Change 2009-2013 to 20xx-20xx	Share of City, *Corridor* Change 2009-2013 to 20xx-20xx
Other Commute					
City	5,776			%	
Corridor	336			%	%
West Santa Cruz	51			%	%
Centro	104			%	%
West University	21			%	%
University	160			%	%
Non-Auto/Truck Commute					
City	38,905			%	
Corridor	5,573			%	%
West Santa Cruz	144			%	%
Centro	901			%	%
West University	1,130			%	%
University	3,398			%	%
Non-Auto/Truck Commute Percent					
City	15.9%	%	%		
Corridor	44.1%	%	%		
West Santa Cruz	16.8%	%	%		
Centro	32.7%	%	%		
West University	38.4%	%	%		
University	55.9%	%	%		

Source: ACS 5-Year samples.
Note: If City or Corridor change is negative, only ordinal directions of change are noted in the last column.

Demographic Value-Added Template G
Change in Mean Household and Aggregate Income for the City, Streetcar Corridor, and Subareas from 2009-2013 to 20xx-20xx
[Figures in Inflation-Adjusted Dollars to Latest ACS Year]

City, Corridor, Subarea	2009-2013 (in 20xx Dollars)	20xx-20xx (in 20xx Dollars)	Percent Change 2009-2013 to 20xx-20xx
Mean Household Income			
City	$65,183		%
Corridor	$55,731		%
West Santa Cruz	$41,657		%
Centro	$61,526		%
West University	$59,173		%
University	$47,844		%
Households			
City	221,350		%
Corridor	10,427		%
West Santa Cruz	1,161		%
Centro	2,546		%
West University	2,910		%
University	3,810		^
Aggregate Household Income			**Value-Added**
City	$14,428,184,504		
Corridor	$581,106,422		
West Santa Cruz	$48,363,388		
Centro	$156,645,081		
West University	$172,194,718		
University	$182,284,075		

Note: Current dollars will need to be changed to the most recent ACS used, adjusted for the consumer price index (CPI).
Source: ACS 5-Year samples.

American Community Survey (ACS) Data

Once block group geographies were established, relevant demographics tables were downloaded from data.census.gov. Each table contained "GEO_ID" field numbers that could be used to join to the block group layer with block groups tiered by distance, *Block_Groups_2010_Tiered*.

Raw census tables were brought into an excel workbook for each demographic category. These sheets were imported into ArcGIS Pro using the Excel To Table tool.

In order to join the 2010 block groups, which did not have a "GEOIDFQ" field, which would have been a direct match with the "Geography" field in the demographics tables, an additional "Geography" field was added to the 2010 block groups layer that concatenated "1500000US" and the "GEOID10" field.

The following 2010 block groups did not have a match with records in ACS tables from 2013 through 2019; 402 of 410 were joined. ACS tables from 2020 onward had 410 matches.

1500000US040194705001
1500000US040194105031
1500000US040190029031
1500000US040190027011
1500000US040194105021
1500000US040194105011
1500000US040194105032
1500000US040190027012

For the years 2013 to 2019, the process for creating geographically tiered demographics worksheets was fairly straightforward. Once the tables were brought into the ArcGIS project as a standalone table, they could be joined to *Block_Groups_2010_Tiered* on the "Geography" field, exported as a feature class, and then exported to a worksheet using the Table to Excel tool.

Census block groups changed their geographies significantly from the 2010 decennial to the 2020 decennial. As a result, geography "crosswalks" were needed for tables with data from after 2020. This relationship file was obtained from IPUMS, a project under the University of Minnesota that "provides census and survey data from around the world integrated across time and space" (IPUMS). The file used to convert data from 2020 block groups to 2010 block groups in the state of Arizona, *nhgis_bg2020_bg2010_04*, was downloaded. The crosswalk file contained interpolation weights that estimated the percentage of a given block group's characteristics (total population, households, etc.). The weights as described in the metadata for *nhgis_bg2020_bg2010_04* are listed below.

wt_pop: Interpolation weight, total population
(Expected proportion of source zone's population located in target zone)
wt_adult: Interpolation weight, persons age 18 and over
(Expected proportion of source zone's adult population located in target zone)
wt_fam: Interpolation weight, total families
(Expected proportion of source zone's families located in target zone)
wt_hh: Interpolation weight, total households
(Expected proportion of source zone's households located in target zone)
wt_hu: Interpolation weight, total housing units
(Expected proportion of source zone's housing units located in target zone)

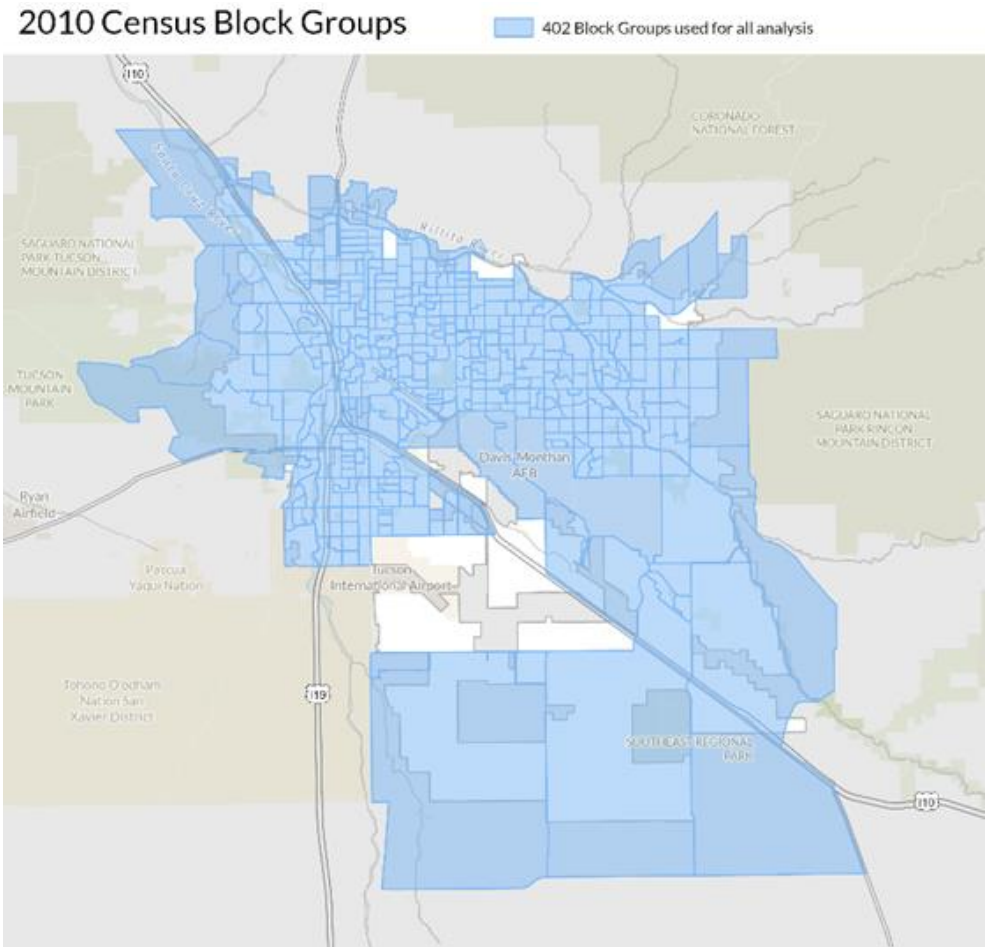
The general process for using the crosswalks is outlined below. Notes specific to each demographic table were taken because they sometimes required slightly different approaches. *

1. Download 2020 to 2010 NHGIS block group relationship table.
    a. Add text type version of the field “Geography” to facilitate joins.
2. Join modified NHGIS relationship table (*nhgis_bg2020_to_bg2010*) to 2020+ demographics tables (results in 974 features)
3. Create fields for estimated adjusted characteristics.
    a. For example, create a field for estimated, adjusted total population, “EST_TOTAL,” by multiplying the 2020 block group’s “TOTAL” field by wt_pop from NHGIS relationship table.
4. Join *Block_Groups_2010_Tiered* on the “Geography_2010” field (results in 591 matches)
5. Run the Summary Statistics tool to sum the relevant fields, for example the “EST_TOTAL” field described above, with the Case Field parameter as “2010_Geography.”
    a. This generates 411 records (one for all "NULL" values)
6. Join the resulting summary table back to *Block_Groups_2010_Tiered*
    a. 410 matches
7. Run the Table To Excel tool.

One final step for the post-2020 data involved removing the eight census block groups that did not join with any of the pre-2020 demographics tables to make comparisons more accurate. These additional block groups were not in the study area; they were all in the "BALANCE" tier. Thus, they only affected total population, households, or housing units. The general process was to select the 402 block groups that matched the pre-2020 data, then export that layer, run the Table To Excel tool, and add the sheet to final workbook for each category.

* While most of these notes are not worth including in this report, the most divergent process was Mean Household Income, which required two tables, B19025 and B11012. When combining intermediate tables *B19025_22* and *B11012_2022* (both of which were already joined to the NHGIS Crosswalk and already had a field added and calculated for adjusted household number and adjusted household aggregate income), summary

statistics needed to be run before joining to maintain correct numbers. Otherwise, the join duplicated values. Then the “Mean_Household_Income” field could be calculated as “!SUM_Adjusted_NUM_AGG_HH_INCOME! / !SUM_Total_HH_Adjusted!”



Post-2020 Data Layer Summary			
Map Name (ACS Table Name)	Full Total (410 Block Groups)	Adjusted Total (402 Block Groups)	NHGIS Weight
Hispanic_White_Non_White (B03002)	Total Population: 611,325	Total Population: 582,617	wt_pop
Household_Type (B09019)	Total Population: 611,325	Total Population: 582,617	wt_pop
Householder_Age (B19037)	Total Households (Householders): 246,530	Total Households (Householders): 236,642	wt_hh
Total_Units_in_Structure (B25024)	Total Household Units: 272,503	Total Household Units: 261,441	wt_hu
Occupied_Units_in_Structure_by_Tenure (B25032)	Total Households (Occupied Units): 246,530	Total Households (Occupied Units): 236,642	wt_hh
Persons_by_Units_in_Structure_by Tenure (B25033)	Portion of Total Population: 585,382	Portion of Total Population: 559,056	wt_pop
Mean_HH_Income (B19025 and B11012)	Total Households: 246,530 Total Mean HH Income: 69,789	Total Households: 236,642 Total Mean HH Income: 69,503	wt_hh
Vehicles_Available_By_Tenure (B25044)	Total Households (Occupied Units): 246,530	Total Households (Occupied Units): 236,642	wt_hh
Transportation_to_Work (B08301)	Total Workers: 282,147	Total Workers: 270,705	wt_pop
Households_byType_B11012	Total Households: 246,530	Total Households: 236,642	wt_hh

CHAPTER 4
VALUE-ADDED PROPERTY TAX MONITORING SYSTEM

As new development is attracted to transit stations it generates several types of revenue for the city, one of which is property taxes. Property taxes are a form of wealth tax in which those who own property are charged the tax. For owner-occupied homes and businesses including their business tenants, this is the case. However, for residential property it is the tenants who really pay the tax. The analysis of value-added property taxes is comprised of the following seven steps:

- Data Assembly
- Baseline and Current Year Selection and Basic Analysis
- Total and Non-Exempt Differentiation
- Non-Exempt Property Value Change Analysis
- Value-Added Property Tax Revenue
- Value-Added Property Tax Revenue by Subarea
- Maintaining the Database

The chapter concludes with a synthesis of property tax Value-Added metrics for the different corridor buffers and subareas based on the 1-kilometer buffer. Templates for future applications are also provided.

The first step in the process is aggregating assessor records into census blocks. Three kinds of data are collected:

- Land value,
- Improvement value; and
- Total value.

Unfortunately, the building area in square feet was not accessible when this report was prepared. Future versions of the value-added analysis may be able to add these data.

Land area data reveal important size relationships that are shown in Exhibit 2-4. For perspective, the total land area of all the Station, Track and Adjacent census blocks is only 723 acres which accounts for about two-thirds of one percent (0.66%) of the land area of all census blocks in the city. The land area cumulative to one kilometer is only 1,717 acres or just 1.47% of the city land area. The total study area cumulatively to one-mile totals 9,629 acres or 4.56% of the land area. Yet as will be shown below, the streetcar corridor accounts for many times more Value-Added than is proportionate to land area.

Total value is the key metric, however. Fair market value is collected, as opposed to assessed value. This allows for analysis of investment patterns near transit stations over time whether it is private firms or government tax-exempt. Data are further collected for broad property codes as shown in Exhibit 4-1.

Exhibit 4-1
Property Codes and Descriptors

All Property
00 - Vacant Land
01,02,08 - Single Family Residential
03 - Multi Family Residential
03,05,06 – Lodging
10 - Misc, Commercial
11-14 – Retail
15,16 - Office, banks
17 – Service Stations
18 - Vehicle sales, service
19 - Care facilities
20 – Restaurants
21 - Medical facilities
25 - Theaters, amusement
26 – Parking
27 - Clubs, lodges
28 - Incomplete structures
29 - Private schools
30,31,37,38 – Industrial
70 - Personal property
77 - Merchant, manufacturing
89 - Converted use
90-93 - Private, religious exempt
94-99 - Government exempt
All Other

Source: Assembled from State of Arizona Revenue Department.

Although property tax data are available for every year, this analysis starts with 2013 which is the year in which the streetcar was initiated. Although the market made investments near transit stations before the system started, and were thus attributable to its inevitability, some of those investments would not have been captured in the assessor records until 2013 or later.

Unlike other analyses presented in this report, adjustment to current dollars is not made. The reason is that structure value based on 2013 has depreciated since then. For instance, low-rise nonresidential structures—which dominate the building type along the corridor, depreciate over about 20 to 40 years. In 10 years, they will have lost a quarter to half of their value. Indeed, the rate of depreciation for many land uses is higher than inflation over the long term. Not all real estate loses value, however. Unless it is contaminated, land will gain value over time especially in central locations such as along streetcar corridors. Normally, depreciation even when offset in part by rising land values is at or below inflation in the long term[26] Without an economic analysis of each property in the study area, this report addresses depreciation in part by not inflating past investment to current dollars. The approach likely understates overall loss of real estate value attributable to depreciation which means the value-added analysis is conservative. There is a final consideration. In strong and growing markets, depreciation is offset through rehabilitation and even the reconstruction of structures. The current assessed value would therefore rise. In effect, reinvestment in these structures along the streetcar corridor are a form of value-added.

The result of this step is a reasonable calculation of change in property value between 2013 and the current year which in this analysis is 2023. Results are summarized in Exhibit 4-2. Exhibit 4-3 highlights trends. Two sets of data are reported. "Total Property Value" includes all real property including such tax-exempt property as government, religious, private schools, and clubs/lodges. Non-exempt property is all other for which property taxes are assessed. Between 2014 and 2023, the cumulative 1-kilometer tier more than doubled in assessed value reflecting substantial new investment in the corridor. Indeed, on land area comprising about 1.5% of the city's land area, the 1-kilometer corridor accounted for about 8% of the change in non-exempt property value. From economic and fiscal perspectives, the streetcar corridor generates many more times revenues than its land area relative to the city's land base, and as such they show efficient outcomes. Indeed, as efficiencies accumulate more investment is likely to follow. The City can facilitate this virtuous cycle by reinvesting some of its value-added revenue into this or other high-capacity transit corridors.

The next step estimates Value-Added property tax revenue. This is summarized in Exhibit 4-4. It apportions value-added non-exempt property value for selected tiers, including notably the 1-kilometer tier, to the total change citywide. It then multiplies that proportionality by the change in property taxes between 2013 and 2023 to estimate the property tax value-added attributable to the streetcar corridor. For the 1-kilometer corridor, property tax Value-Added is about $800,000 annually. This is despite a large reduction in the effective property tax rate from 0.180% of value to 0.128%.

[26] See Arthur C. Nelson (2013), *Real Estate Finance for Development*, Island Press.

Exhibit 4-2
Streetcar Transit Corridor Change in Total and Non-Exempt Property Value, 2013-2023

	Total Property Value			Non-Exempt Property Value		
Tier, Geographic Area	**2013**	**2023**	**Value-Added**	**2013**	**2023**	**Value-Added**
Station Tier	$391,353,603	$643,611,718	$252,258,115	$115,386,075	$186,474,271	$71,088,196
Track Tier	$352,796,917	$821,910,836	$469,113,919	$127,579,874	$450,178,380	$322,598,506
Adjacent Tier	$897,019,736	$1,813,207,431	$916,187,695	$249,586,094	$844,476,333	$594,890,239
Kilometer Tier	$1,547,119,500	$2,489,118,916	$941,999,416	$850,511,929	$1,597,665,171	$747,153,242
Mile Tier	$971,916,782	$1,677,754,928	$705,838,146	$856,726,229	$1,541,739,115	$685,012,886
Station-Track-Adjacent	$1,641,170,256	$3,278,729,985	$1,637,559,729	$492,552,043	$1,481,128,984	$988,576,941
Cumulative Kilometer	$3,188,289,756	$5,767,848,901	$2,579,559,145	$1,343,063,972	$3,078,794,155	$1,735,730,183
Cumulative Mile	$4,160,206,538	$7,445,603,829	$3,285,397,291	$2,199,790,201	$4,620,533,270	$2,420,743,069
City Balance	$25,882,318,511	$45,734,927,697	$19,852,609,186	$21,433,409,528	$41,348,639,778	$19,915,230,250
City Total	$30,042,525,049	$53,180,531,526	$23,138,006,477	$23,633,199,729	$45,969,173,048	$22,335,973,319

Source: Pima County Assessor.

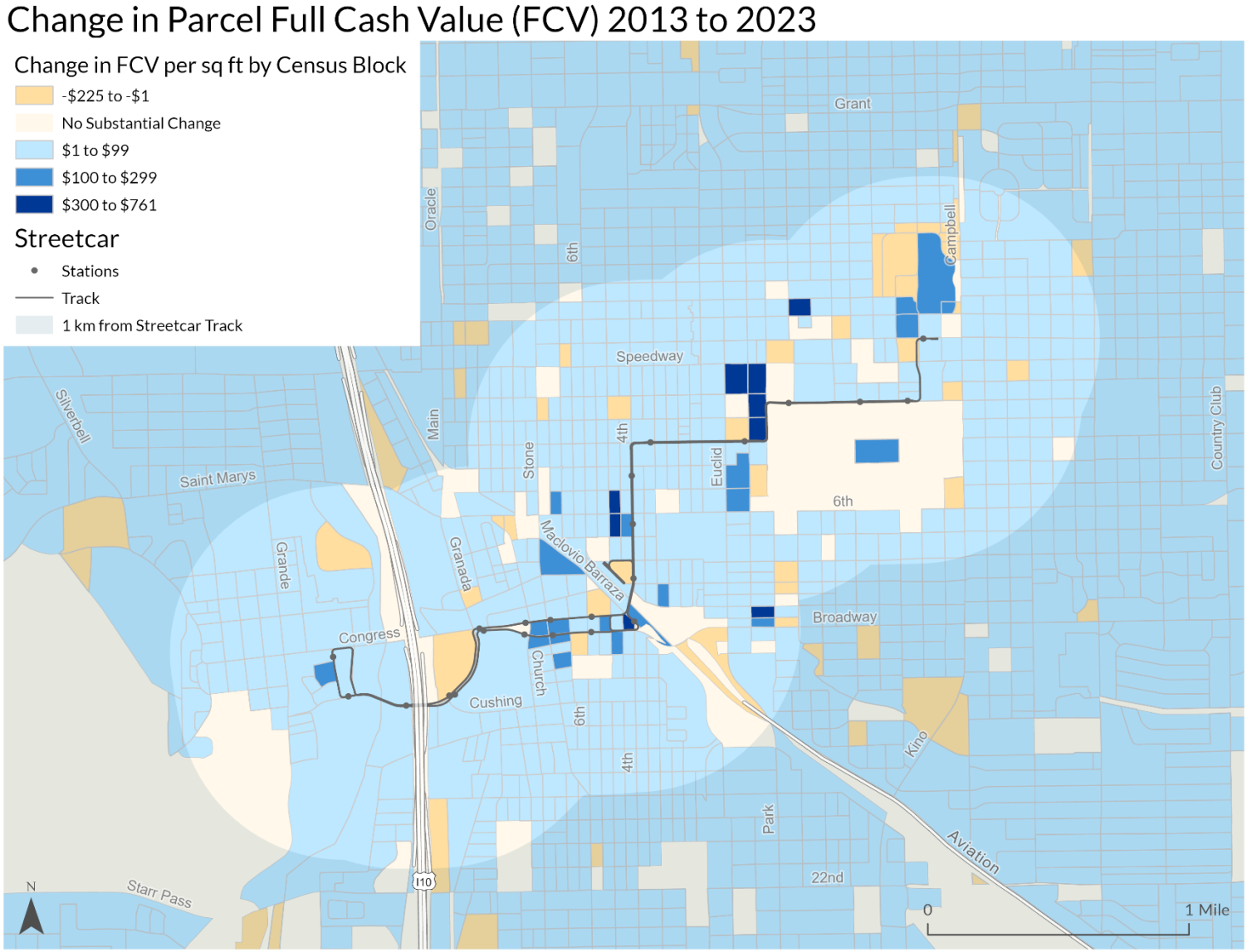


Exhibit 4-3
Change in Full Cash Value of Real Estate by Census Block. 2013-2023
Source: Assessor data with image by Daniel Lawlor.

Exhibit 4-4
Streetcar Transit Corridor Non-Exempt Property Tax Value-Added, 2013-2023

Cumulative Tier	Non-Exempt Value 2013	Non-Exempt Property Taxes 2013	CPI Adjustment for 2013 @ 1.31	Non-Exempt Value 2023	Property Taxes 2023	Value-Added Property Taxes	Value-Added Property Tax Share
Adjacent	$492,552,043	$888,208	$1,163,552	$1,481,128,984	$1,891,666	$728,114	38%
Kilometer	$1,343,063,972	$2,421,917	$3,172,711	$3,078,794,155	$3,932,170	$759,459	19%
Mile	$2,199,790,201	$3,966,831	$5,196,549	$4,620,533,270	$5,901,246	$704,697	12%
City Total Value-Added	$23,633,199,729			$45,969,173,048			
Property Taxes Received	$42,617,209			$58,710,840			
Effective Tax Rate	0.1803%			0.1277%			

Source: Property tax data 2014 from: https://www.tucsonaz.gov/files/sharedassets/public/v/1/city-services/business-services/documents/2015_tentative_budget.pdf
Property tax data 2023 from: https://www.tucsonaz.gov/files/sharedassets/public/v/1/bsd/documents/finance-documents/tentative-summary-schedule-estimated-revenue-and-expenditures-fy24-attachment_f.pdf

Exhibit 4-5 apportions property tax Value-Added to the subareas.

This chapter concludes with templates for reporting property tax related value-added outcomes associated with the streetcar corridor.

PROPERTY TAX VALUES ADDED TABLE TEMPLATES

With respect to property taxes, these three tables are recommended for annual value-added reporting:

> Property Tax Template A: Total Property Value Change, 2014-Current Year
>
> Property Tax Template A: Non-Exempt Property Value Change, 2013-Current Year
>
> Property Tax Template C: Estimated Property Tax Value-Added Current Year
>
> Property Tax Template D: Estimated Property Tax Value-Added Current Year by Subarea

All four templates are shown below.

The templates can also be edited to show year-over-year changes such as the change in property taxes between one calendar year and the next. This may be useful as the economy continues to recover from the pandemic.

Chapter 5 presents the sales tax value-added monitoring system.

Exhibit 4-5
1-Kilometer Streetcar Transit Corridor Non-Exempt Property Tax Value-Added, 2013-2023 by Subarea

Measure	2013	2023	Change	Percent Change
Assessed Value				
City Assessed Value	$30,042,525,049	$53,180,531,526	$23,138,006,477	77%
City Non-Exempt Value	$23,633,199,729	$45,969,173,048	$22,335,973,319	95%
Streetcar Assessed Value	$3,188,289,756	$5,767,848,901	$2,579,559,145	81%
Streetcar Non-Exempt Value	$1,343,063,972	$3,078,794,155	$1,735,730,183	129%
Selected Corridor Non-Exempt Land Use Values				
Office	$189,976,151	$228,457,225	$38,481,074	20%
Retail, Restaurant	$75,384,733	$122,458,664	$47,073,931	62%
Lodging	$54,271,513	$81,750,827	$27,479,314	51%
Industrial	$81,750,827	$38,592,191	-$43,158,636	-53%
Residential	$805,362,903	$2,298,364,050	$1,493,001,147	185%
Total Selected Value	$1,206,746,127	$2,769,622,957	$1,562,876,830	130%
Property Taxes				
Effective Rate	0.1803%	0.1277%	-0.0526%	-29%
Property Tax Revenue in 2023$	$3,172,711	$3,932,170	$759,459	24%

Note: Values in 2013 are not adjusted for inflation to offset depreciation. Property tax revenue is adjusted for inflation.

Property Tax Template A
Streetcar Transit Corridor Share of Total Change in Total Property Value, 2013 to Current Year

	Total Property Value			Non-Exempt Property Value		
Tier, Geographic Area	**2013**	**20xx**	**Value-Added**	**2013**	**20xx**	**Value-Added**
Station Tier	$423,840,753			$132,491,247		
Track Tier	$364,851,579			$129,694,132		
Adjacent Tier	$957,442,104			$283,976,759		
Kilometer Tier	$1,566,594,038			$885,295,394		
Mile Tier	$993,796,742			$877,457,976		
Station-Track-Adjacent	$1,746,134,436			$546,162,138		
Cumulative Kilometer	$3,312,728,474			$1,431,457,532		
Cumulative Mile	$4,306,525,216			$2,308,915,508		
City Balance	$27,769,418,807			$23,033,420,452		
City Total	$32,075,944,023			$25,342,335,960		

Source: Property tax data 2014 from: https://www.tucsonaz.gov/files/sharedassets/public/v/1/city-services/business-services/documents/2015_tentative_budget.pdf
Property tax data for future year from the same general source.

Property Tax Template B
1-Kilometer Streetcar Transit Corridor Non-Exempt Property Tax Value-Added, 2013-2023 by Subarea

Subarea	Total Assessed Value 2013	Non-Exempt Value 2013	Total Assessed Value 20xx	Non-Exempt Value 20xx
West Santa Cruz	$194,487,184	$144,453,107		
Centro	$907,297,337	$380,330,178		
West University	$425,563,452	$346,572,137		
University	$1,785,380,501	$560,102,110		
Streetcar Corridor Total	$3,312,728,474	$1,431,457,532		

Subarea	Total Assessed Value-Added, 2013-20xx	Non-Exempt Value-Added, 2013-20xx	Non-Exempt Value-Added Share	Value-Added Property Taxes
West Santa Cruz				
Centro				
West University				
University				
Streetcar Corridor Total				
City Total				
Property Tax Change				

TECHNICAL DOCUMENTATION

Assessor Data by Census Block Structure

The steps involved in creating the final Assessor data workbook and GIS layers for the years 2005, 2010, 2013, 2014, 2019, and 2023 are outlined below.

1. Find *paregion* polygons intersecting current City of Tucson city limits.
    a. City limits were derived from the layer *WARD_COT*

2. Run the Feature to Point tool on the selected *paregion* polygons. Parcels were ultimately assigned census block geographic ids based on the location of the resulting centroid, which was required to be within the parcel's polygon.

3. From the resulting points layer, select features within census blocks.
    a. The layer used initially was *COT_2020_CENSUS_BLOCKS_DISTANCE**, which was created according to the process outlined in the Census Blocks section of Establishing Distance Tiers for Census Blocks and Block Groups. This layer contained fields for the various block tiers used in analysis

4. Spatial Join selected *paregion* points to *COT_2020_CENSUS_BLOCKS_DISTANCE* (remove fields from *paregion* as needed to keep only relevant data)
    a. Important tool parameters:
        i. Target: *paregion* points layer
        ii. Join: *COT_2020_CBs_DISTANCE* (in subsequent steps, *COT_2020_CBs_DISTANCE_ASSESSOR*; details below)
        iii. Operation: One to one
        iv. Match: Within

5. Add fields for parcel use types and value estimates by use type**
    a. These were fields for the various categories of land use. In 2005 and 2010, coded values for land use were in the "USE" field, in 2013, 2014, 2019, and 2023, values were in the "PARCEL_USE" field.
    b. Fields for counts of each type of land use as well as land, improved, and total cash value per use type were created. For example, Single Family Residential, consisting of parcels with use types beginning with 01, 02, or 08, had a "SINGLE_FAMILY_RESIDENTIAL" field to hold a value of 1 or NULL, along with fields for estimated value, "SINGLE_FAM_RES_FCV" (land), "SINGLE_FAM_RES_IMP_FCV" (improved), and SINGLE_FAM_RES_TOTAL_FCV (land plus improved).

6. Calculate values for newly created fields.
    a. First, calculate the count field by selecting based on parcel use and batch updating the selected features to hold a 1. Continuing the single family residential example, the selection would be parcels with "USE" beginning with 01, 02, or 08.
    b. Then, calculate the values fields by multiplying the count field by the value field of interest. For example, "SINGLE_FAMILY_RESIDENTIAL" times "LANDFCV" to get "SINGLE_FAM_RES_FCV."
        i. In 2005 Data, there is no TOTALFCV field, this was calculated by adding LANDFCV and IMPFCV for each parcel. However, in 2010, there is a TOTALFCV field, but this field does not equal LANDFCV plus IMPFCV. For example, there are numerous single-family residences with 0 LANDFCV and 0 IMPFCV with TOTALFCVs of hundreds of thousands of dollars. Thus, for 2010, 2013, 2014, 2019, and 2023 the TOTALFCV field value was used, not the addition of LANDFCV and IMPFCV.

7. Use the Dissolve tool on the GEOID_NUM field, summing values for the various use type counts and values by census block.

8. Spatial Join the dissolved point features back to *COT_2020_CENSUS_BLOCKS_DISTANCE*.
    a. Important tool parameters
        i. Target: *COT_2020_CENSUS_BLOCKS_DISTANCE*
        ii. Join: Dissolved Points
        iii. Operation: One to One
        iv. Match: Intersect

9. Run the Table to Excel tool to bring the layer into the master workbook.

Depending on the year there were different numbers of parcels within the city's census blocks.

Paregion* points within *COT_2020_CENSUS_BLOCKS_DISTANCE	
Year	Features
2005	169,854
2010	179,976
2013	178,898
2014	187,707
2019	176,268
2023	178,586

Due to an error reading the Use Codes, Retail was defined as beginning with either 11 or 14, not 11 through 14. Thus, Use Codes beginning with 12, 13 were not included. Properties that could have been defined as Retail were defined as All Other. The difference between the partial (11 and 14) and full (11 through 14) retail counts for each year are listed below.

Year	Partial (11 and 14)	Full (11 through14)
2005	2,171	2,313
2010	2,148	2,373
2013	2,206	2,422
2014	2,265	2,497
2019	2,221	2,447
2023	2,209	2,395

* Initially *COT_2020_CENSUS_BLOCKS_DISTANCE* was used, but after adding USE type fields for counts and values, I created *COT_2020_CBs_DISTANCE_ASSESSOR* with those fields already in place so that I would not need to add them in subsequent iterations.
** Not required in subsequent iterations due to creation of COT_2020_CBs_DISTANCE_ASSESSOR

CHAPTER 5
VALUE-ADDED SALES TAX MONITORING SYSTEM

The term sales tax is applied broadly in this chapter. Technically, the city has three variations of the sales tax:

- Business transaction privilege tax (TPT);
- Transient occupancy tax (applied to hotel/motel visitors); and
- Hotel/motel surcharge tax.

For purposes of this study, these are collectively called "streetcar" sales taxes because they can be traced to the study. These are distinguished from "city" sales taxes presented in Chapter 6. To ensure confidentiality and because 20 unique geographic units are reported, the amounts of tax receipts from each of the individual sources is not reported.

The study period begins in calendar year 2013 which was the first full year before the streetcar began operating, with the end year being calendar year 2023 which is the most recent year for which data are available.

Sales tax rates have changed over the study period. The city's share of the TPT was 2.00% up through June 2017, rising to 2.50% from July 2017 through February 2018, and then to 2.60% since March 2018 which is slated to continue until June 2032. On the other hand, the transient occupancy has remained constant at 6.00% since July 2002. However, the hotel/motel room surtax rose from $1/room/night from June 2009 to $2/room/night from through Jun 2016 and $4/room/night since then. Inasmuch as this study estimates value-added outcomes to the streetcar, changes in tax rates are not relevant. If this were an economic or fiscal impact analysis, normalizing differences in revenue may be important.

It is also important to note that the city's share of sales taxes is exclusive of the special dedicated sales tax received by the Rio Nuevo Multipurpose Facilities District, also known as the Rio Nuevo Tax Increment Finance District. It receives an incremental amount of the state's TPT share paid by businesses operating within the district.

Exhibit 5-1 reports the streetcar sales taxes received in calendar year 2023 by tier and subarea based on the 1-kilometer corridor, the CPI-adjusted 2013 study area sales tax revenues, and value-added revenues. Spatial trends are illustrated in Exhibit 5-2. Analysis shows that the 1-kilometer corridor generates nearly $5.8 million more per year in 2023 than before the streetcar began operations in 2014. All subareas gained value-added sales taxes headed by the University subarea at $2.4 million, Centro at $2.1 million, West University at $0.6 million, and West Santa Cruz at $0.7 million.

The chapter includes a template for estimating streetcar sales tax Value-Added in future years. Other value-added tax revenue is estimated in Chapter 6.

Exhibit 5-1
Value-Added Study Area Sales Taxes, 2013-2023

Sales Taxes 2023

Tier	West Santa Cruz	Centro	West University	University	Total
Station	$411,809	$1,842,416	$524,245	$2,135,856	$4,914,326
Track	$9,653	$755,782	$614,627	$1,104,369	$2,484,430
Track + Station	$421,462	$2,598,198	$1,138,872	$3,240,225	$7,398,756
Adjacent	$103,624	$1,188,371	$416,445	$306,241	$2,014,681
Station+Track+Adjacent	$525,086	$3,786,568	$1,555,317	$3,546,466	$9,413,437
Kilometer	$718,362	$1,295,255	$948,155	$1,758,228	$4,720,000
Kilometer Cumulative	$1,243,448	$5,081,823	$2,503,472	$5,304,694	$14,133,437

Sales Taxes 2013 in 2023 Dollars

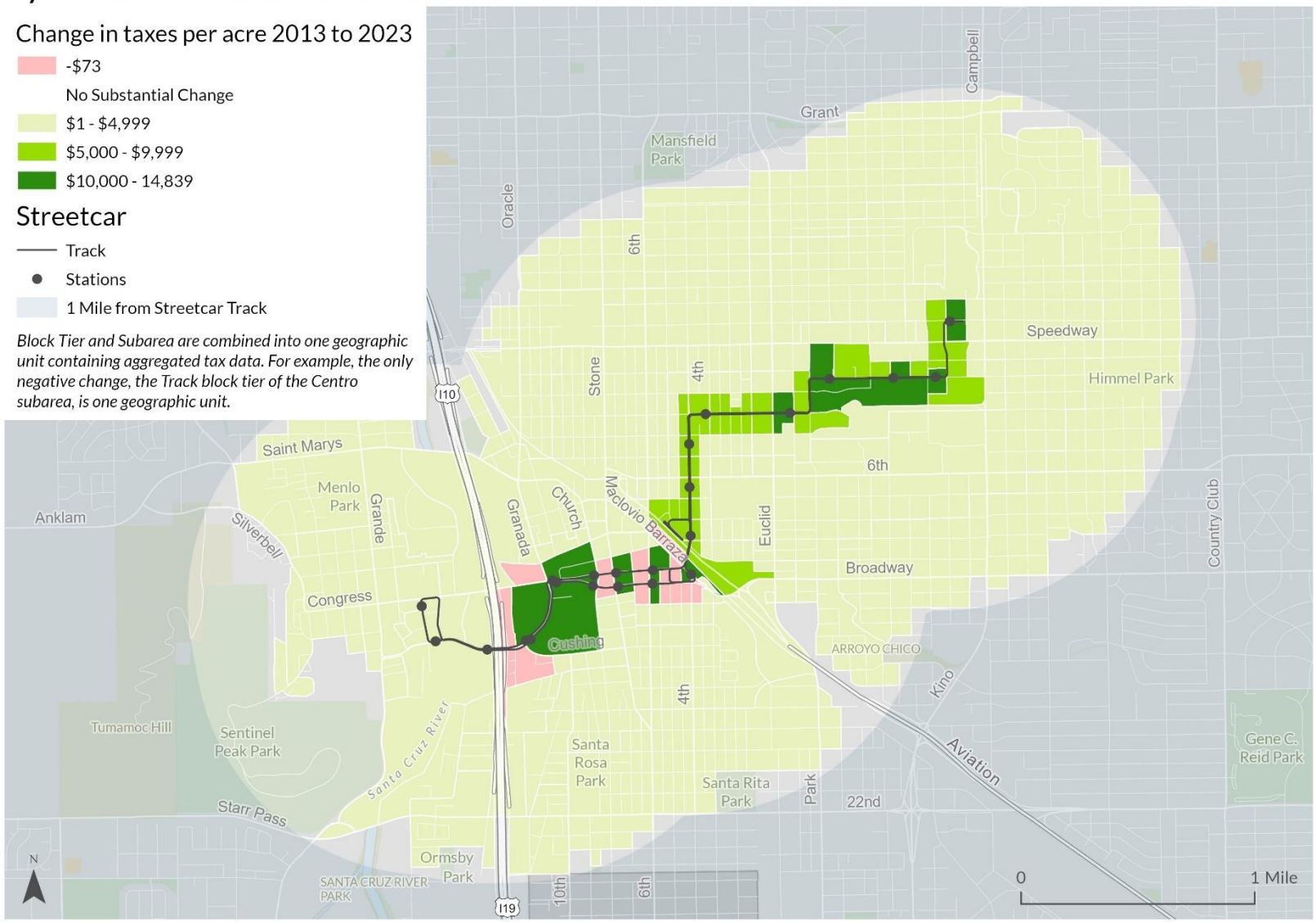
Tier	West Santa Cruz	Centro	West University	University	Total
Station	$163,180	$824,201	$471,595	$1,274,734	$2,733,710
Track	$373	$997,857	$346,020	$359,491	$1,703,741
Track + Station	$163,553	$1,822,058	$817,615	$1,634,225	$4,437,451
Adjacent	$74,031	$746,684	$396,546	$186,645	$1,403,906
Station+Track+Adjacent	$237,584	$2,568,742	$1,214,161	$1,820,869	$5,841,357
Kilometer	$340,375	$422,541	$692,386	$1,064,686	$2,519,987
Kilometer Cumulative	$577,959	$2,991,283	$1,906,547	$2,885,555	$8,361,344

Value-Added 2013-2023 in 2023 Dollars

Tier	West Santa Cruz	Centro	West University	University	Total
Station	$248,628	$1,018,215	$52,650	$861,123	$2,180,616
Track	$9,280	-$242,075	$268,607	$744,877	$780,689
Track + Station	$257,909	$776,140	$321,257	$1,606,000	$2,961,305
Adjacent	$29,593	$441,687	$19,899	$119,596	$610,775
Station+Track+Adjacent	$287,502	$1,217,826	$341,156	$1,725,596	$3,572,080
Kilometer	$377,986	$872,714	$255,770	$693,542	$2,200,012
Kilometer Cumulative	$665,489	$2,090,540	$596,926	$2,419,139	**$5,772,093**

Source: City of Tucson, IT Department.

Change in Sales Tax, Transient Occupancy Tax, and Hotel/Motel Surtax per Acre by Block Tier and Subarea 2013 to 2023



Source: Daniel Lawlor, City of Tucson.

Subarea Sales Tax Value-Added Template A
Value-Added Study Area Sales Taxes, 2013-20xx

Sales Taxes 2023

Tier	West Santa Cruz	Centro	West University	University	Total
Station	$388,399	$1,785,146	$488,556	$2,157,941	$4,820,042
Track	$14,919	$787,621	$669,357	$1,111,310	$2,583,207
Track + Station	$403,317	$2,572,767	$1,157,913	$3,269,251	$7,403,249
Adjacent	$104,014	$1,189,230	$426,171	$337,380	$2,056,795
Station+Track+Adjacent	$507,331	$3,761,997	$1,584,084	$3,606,632	$9,460,044
Kilometer	$689,304	$1,294,762	$990,424	$1,787,011	$4,761,501
Kilometer Cumulative	$1,196,635	$5,056,759	$2,574,508	$5,393,643	$14,221,545

Sales Taxes 2013 in 20xx Dollars

Tier	West Santa Cruz	Centro	West University	University	Total
Station					
Track					
Track + Station					
Adjacent					
Station+Track+Adjacent					
Kilometer					
Kilometer Cumulative					

Value-Added 2013-20xx in 20xx Dollars

Tier	West Santa Cruz	Centro	West University	University	Total
Station					
Track					
Track + Station					
Adjacent					
Station+Track+Adjacent					
Kilometer					
Kilometer Cumulative					

Geocoding and Enriching ADOR and TRMS Sales Tax Data Collected in the Vicinity of the Sun Link Modern Streetcar

Unaggregated sales tax data either collected by the City of Tucson or provided to the City is classified as Level 3, Restricted. Only authorized city employees are permitted to view and work with raw sales tax data.

Prior to FY 2017 the City of Tucson performed sales tax collection and kept records of collected taxes in the Tax Record Management System (TRMS). This data is now archived for regulatory and research purposes.

In January 2017, the Arizona Department of Revenue (ADOR) began collecting sales tax on behalf of the city. ADOR makes regular reports of collected taxes available to the city per agreement.

Both TRMS and ADOR tax data are available to authorized employees via the City of Tucson's Modern Data Warehouse (MDW).

The current contacts for additional information regarding City sales tax and this process are:

Name	Title	Email
Tom O'Dell	Finance Analyst	tom.odell@tucsonaz.gov
James McGinnis	Data Analyst	james.mcginnis@tucsonaz.gov

Process for Geocoding and Enriching Sales Tax Data

1. Data was queried from the MDW based on pre-defined business codes and the data was limited geographically to zip-codes surrounding Sun Link.

2. Additional queries aggregated the data by the unique addresses, stripping out dates and collection amounts. This provided a smaller data set to geocode.

3. These queries were made into tables in the MDW so that the data would be available in ArcGIS Pro.

4. The tables were brought into an ArcGIS Pro project and further geographically constrained using the pre-defined geometries described in Chapter One: Technical Documentation Establishing the Study Area Tiers. The constrained selections were then exported as feature classes.

5. The address data was geocoded using standard GIS processes.

6. The geocoded data was enriched with additional attributes related to distance from the streetcar and by district. This was accomplished by intersecting the points with the pre-defined polygons and applying the terms to the selected points via the calculate field function.

7. Using a python script in a notebook, the labeled data was joined back to the larger table containing collection dates and collected sales tax amounts and exported as a .csv file.

8. The .csv file was converted to an Excel document, stripped of any identifiable data related to the tax paying businesses, and then further aggregated to the month and year.

Process for Visualizing Sales Tax Data

1. A layer of Block Tier Areas and Subareas that could match the areas into which sales tax had been aggregated was created. This layer was based on *ALL_BLOCK_TIERS_with_SUBAREAS* and led to 20 features to which the sales tax for any given year could be added (five block tiers and four subareas, 5 x 4 = 20).
    a. Created an additional field, TIER_SUBAREA, that concatenated the tier and the subarea, for example, TIER_A_STATION Centro.
    b. Created additional fields to hold normalized sales tax: TAX_AREA_ACRES (acreage of each block tier subarea unit) and TAX_per_ACRE.

2. Steps taken to visualize data for a given fiscal year:
    a. Selected data for a given fiscal year and made a new table.
    b. Ran Summary Statistics
        i. Case Field: SC_Distance_Tier and Block_Subarea
    c. Added a TIER_SUBAREA field to this table by concatenating SC_Distance_Tier and Block_Subarea.
    d. Joined this table to ALL_BLOCK_TIERS_with_SUBAREAS on the TIER_SUBAREA field and exported.
    e. Calculated fields to find normalized tax revenue.

CHAPTER 6
USE TAX AND STATE-SHARED TAX REVENUE MONITORING SYSTEM

This chapter includes use taxes and state -shared tax revenue received by the city apportioned to the study area as an estimate of these value-added taxes. Taxes considered include:

- City use tax;
- State-shared income tax;
- State-shared sales tax; and
- State-shared auto sales tax.

City Use Tax

In 2023, the city collected about $15.6 million from a "use tax". It is a tax on goods that are used or stored in Tucson but not purchased in the city. Without a use tax, buyers are encouraged to shop where a city sales tax is not imposed. It thus removes the incentive to shop elsewhere to avoid paying the city sales tax. It is the same tax rate as the business privilege tax reviewed in Chapter 5.[27]

Because use tax data for the streetcar corridor are not available, they need to be estimated. Inasmuch as the tax applies to businesses, they are used to estimate the tax. It is also assumed that wages are a reasonable proxy to estimate use taxes. For reasons noted in Chapter 2, the case year for wages is 2015 while the end year is 2021. Exhibit 6-1 adjusts citywide and corridor wages to 2023 dollars. It also adjusts 2015 use taxes to 2023 dollars. Through a series of steps, it is estimated that the 1-kilometer corridor generated nearly $2.0 million in value-added use tax revenue.

State-Shared Income Tax Revenues

The state collects income taxes that it shares with local governments. About three quarters of the state's income taxes are generated from individuals with the balance from corporations. Exhibit 6-2 estimates the proportionate value-added share attributable to the 1-kilometer corridor based on the change in aggregate household income. It adjusts 2013 state-shared income tax collections to 2023 dollars. The value-added calculations are based on aggregate household income for 2013 and 2022 from the ACS 5-year sample. The analysis thus understates corridor household growth for reasons noted in Chapter 3, and as such they are conservative. This adds more than $1.8 million to the city's general fund.

[27] For details, see https://www.tucsonaz.gov/files/sharedassets/public/v/1/city-services/business-services/documents/use_tax_workshop_format_10_2011.pdf.

Exhibit 6-1
Value-Added Use Tax, 2015-2023

Measure ***Base Year***	**Metric**
2015 Use Taxes	$4,900,000
CPI Adjustment 2015 to 2023	1.28
CPI Adjusted Use Taxes 2023	$6,272,000
2015 City Wages in 2021$	$12,177,715,219
CPI Adjustment 2021 to 2023	1.12
2015 City Wages in 2023$	$13,639,041,045
Use Tax Proportion, 2015	0.0460%
2023 Use Taxes	$15,565,370
2021 City Wages	$12,913,656,073
2021 City Wages in 2023$	$14,463,294,802
Use Tax Proportion. 2023	0.1076%
2015 Corridor Wages in 2021$	$2,402,302,122
2015 Corridor Wages in 2023$	$2,690,578,377
2021 Corridor Wages	$2,644,128,679
2021 Corridor Wages in 2023$	$2,961,424,120
2015 Corridor Use Tax, 2023$	$1,215,919
2021 Corridor Use Tax, 2023$	$3,187,079
Use Tax Value-Added	**$1,971,159**

Sources: Aggregate wages from Employment Value-Added Monitoring System workbook. Use tax revenue for 2015 is from https://www.tucsonaz.gov/files/sharedassets/public/v/1/city-services/business-services/documents/tentative_adoption_2016.pdf while use tax revenue for 2023 is from https://www.tucsonaz.gov/files/sharedassets/public/v/1/bsd/documents/finance-documents/tentative-summary-schedule-estimated-revenue-and-expenditures-fy24-attachment_f.pdf.

Exhibit 6-2
Value-Added State-Shared Income Tax Revenue, 2013-2023

Measure	Metric
State-Shared Income Tax, FY 2013	$53,128,730
CPI Factor to 2023	1.31
Tax 2013 in 2023 Dollars	$69,598,636
2013 City Aggregate Income in 2023$	$14,428,184,504
State-Shared Income Tax Return	0.4824%
State-Shared Income Tax, FY 2023	$104,732,400
2023 City Aggregate Income	$17,045,106,918
State-Shared Income Tax Return	0.6144%
2013 Corridor Aggregate Income in 2023$	$577,177,027
2013 Corridor State-Shared Income Tax in 2023$	$2,784,185
2023 Corridor Aggregate Income	$754,027,975
2023 Corridor State-Shared Income Tax	$4,633,069
State-Shared Income Tax Value-Added	**$1,848,884**

Sources: Aggregate household income from Household Income Value-Added Monitoring System workbook. State-shared income tax revenue for 2013 is from https://www.tucsonaz.gov/files/sharedassets/public/v/1/city-services/business-services/documents/2014_tentative_budget.pdf while state-shared income tax revenue for 2023 is from https://www.tucsonaz.gov/files/sharedassets/public/v/1/bsd/documents/finance-documents/tentative-summary-schedule-estimated-revenue-and-expenditures-fy24-attachment_f.pdf.

State-Shared Sales and Auto Tax Revenues

The state collects sales tax and taxes on auto sales that it shares with local governments. Exhibit 6-3 estimates the proportionate value-added share attributable to the 1-kilometer corridor based on the change in aggregate household income. It adjusts 2013 state-shared sales and auto tax collections to 2023 dollars. The value-added calculations are based on aggregate household income for 2013 and 2022 from the ACS 5-year sample. As noted above, the analysis understates corridor household growth and as such they are conservative. State-shared sales/auto tax revenue apportioned to the 1-kilometer streetcar corridor adds more than $1.6 million to the city's general fund.

The chapter concludes with templates for future reporting as well as documentation for reference.

Exhibit 6-3
Value-Added State-Shared Sales and Auto Tax Revenue, 2013-2023

Measure	Metric
State-Shared Sales/Auto Tax, FY 2013	$60,835,220
CPI Factor to 2023	1.31
2013 State-Shared Sales/Auto Tax in 2023$	$79,694,138
2013 City Aggregate Income in 2023$	$14,428,184,504
State-Shared Sales/Auto Tax Return, 2013	0.5524%
State-Shared Sales/Auto Tax, FY 2023	$108,839,389
2023 City Aggregate Income	$17,045,106,918
State-Shared Sales/Auto Tax Return, 2023	0.6385%
2013 Corridor Aggregate Income in 2023$	$577,177,027
2013 Corridor State-Shared Income Tax in 2023$	$3,188,040
2023 Corridor Aggregate Income	$754,027,975
2023 Corridor State-Shared Income Tax	$4,814,751
State-Shared Sales/Auto Tax Value-Added	**$1,626,711**

Sources: Aggregate household income from Household Income Value-Added Monitoring System workbook. State-shared sales and auto tax revenue for 2013 is from https://www.tucsonaz.gov/files/sharedassets/public/v/1/city-services/business-services/documents/2014_tentative_budget.pdf while state-shared income tax revenue for 2023 is from https://www.tucsonaz.gov/files/sharedassets/public/v/1/bsd/documents/finance-documents/tentative-summary-schedule-estimated-revenue-and-expenditures-fy24-attachment_f.pdf.

Use and State-Shared Revenue Template A
Value-Added Use Tax, 2015-20xx

Measure	
Base Year	**Metric**
2015 Use Taxes	$4,900,000
CPI Adjustment 2015 to 20xx	
CPI Adjusted Use Taxes 20xx	
2015 City Wages in 2021$	$12,177,715,219
CPI Adjustment 2021 to 20xx	
2015 City Wages in 20xx$	
Use Tax Proportion, 2015	
20xx Use Taxes	
2021 City Wages	
2021 City Wages in 20xx$	
Use Tax Proportion. 20xx	
2015 Corridor Wages in 2021$	
2015 Corridor Wages in 20xx$	
2021 Corridor Wages	
2021 Corridor Wages in 20xx$	
2015 Corridor Use Tax, 20xx$	
2021 Corridor Use Tax, 20xx$	
Use Tax Value-Added	

Sources: Aggregate wages from Employment Value-Added Monitoring System workbook. Use tax revenue for 2015 is from https://www.tucsonaz.gov/files/sharedassets/public/v/1/city-services/business-services/documents/tentative_adoption_2016.pdf while use tax revenue for 20xx would come from the same source when such information becomes available.

Use and State-Shared Revenue Template B
Value-Added State-Shared Income Tax Revenue, 2014-20xx

Measure	Metric
State-Shared Income Tax, FY 2013	$53,128,730
CPI Factor to 20xx	
Tax 2013 in 20xx Dollars	
2013 City Aggregate Income in 20xx$	
State-Shared Income Tax Return	
State-Shared Income Tax, FY 20xx	
20xx City Aggregate Income	
State-Shared Income Tax Return	
2013 Corridor Aggregate Income in 20xx$	
2013 Corridor State-Shared Income Tax in 20xx$	
20xx Corridor Aggregate Income	
20xx Corridor State-Shared Income Tax	
State-Shared Income Tax Value-Added	

Sources: Aggregate household income from Household Income Value-Added Monitoring System workbook. State-shared income tax revenue for 2013 is from https://www.tucsonaz.gov/files/sharedassets/public/v/1/city-services/business-services/documents/2014_tentative_budget.pdf while state-shared income tax revenue for future years from the same source when such information becomes available.

Use and State-Shared Revenue Template C
Value-Added State-Shared Sales and Auto Tax Revenue, 2014-20xx

Measure	Metric
State-Shared Sales/Auto Tax, FY 2013	$60,835,220
CPI Factor to 20xx	
2013 State-Shared Sales/Auto Tax in 20xx$	
2013 City Aggregate Income in 20xx$	
State-Shared Sales/Auto Tax Return, 2013	
State-Shared Sales/Auto Tax, FY 20xx	
20xx City Aggregate Income	
State-Shared Sales/Auto Tax Return, 20xx	
2013 Corridor Aggregate Income in 20xx$	
2013 Corridor State-Shared Income Tax in 20xx$	
20xx Corridor Aggregate Income	
20xx Corridor State-Shared Income Tax	
State-Shared Sales/Auto Tax Value-Added	

Sources: Aggregate household income from Household Income Value-Added Monitoring System workbook. State-shared income tax revenue for 2013 is from https://www.tucsonaz.gov/files/sharedassets/public/v/1/city-services/business-services/documents/2014_tentative_budget.pdf while state-shared income tax revenue for future years from the same source when such information becomes available.

TECHNICAL DOCUMENTATION FOR STATE-SHARED TAX REVENUE MONITORING SYSTEM

Baseline 2013 figures are provided in City of Tucson Summary by Fund Type of Revenues Other Than Property Taxes Fiscal Year 2014 available at https://www.tucsonaz.gov/files/sharedassets/public/v/1/city-services/business-services/documents/2014_tentative_budget.pdf. Figures for General Fund actual revenues are used.

These figures are inflated to the analysis year using the Consumer Price Index online calculator available at https://data.bls.gov/cgi-bin/cpicalc.pl.

Future comparable figures from the same source are available each year from the same general link.

Future year actual revenues are subtracted from inflation-adjusted 2013 actual revenues. For the use tax, the difference is multiplied by the share of citywide change in aggregate wages attributable to the streetcar corridor based on the technique presented in Chapter 2. For the state-shared income and sales/auto taxes, the difference is multiplied by the share of citywide change in aggregate household income attributable to the streetcar corridor based on the technique presented in Chapter 3.

CHAPTER 7
VALUE-ADDED NON-TAX GENERAL FUND REVENUE VALUE-ADDED MONITORING SYSTEM

In addition to property and sales taxes, the city receives hundreds of millions of dollars each year from federal and state sources, as well as a variety of local fees, assessments, fines, interest, and so forth. These revenues flow into the general fund. This chapter estimates Value-Added contributions of the streetcar corridor from these non-tax revenue sources.

As a general proposition, these revenues are sensitive to changes in population. Indeed, many revenue sharing schemes are based on population only. Accordingly, as a general proposition, an increase or decrease in population can be reasonably associated with a directly proportionate increase or decrease in these non-tax revenues. Subject to refinement, the assumption is that changes in population along the streetcar corridor will be directly proportionate to changes in these revenues.

It is also assumed that because these funds flow into the general fund, there is some discretion in how they can affect the allocation of other general fund revenues. For instance, if new general fund revenues are earmarked for a specific program, other general fund revenues used for the same purpose that are not earmarked may be allocated for other purposes based on city council discretion.

Exhibit 7-1 identifies value-added non-tax revenues associated with streetcar corridor growth. In all cases, the actual FY 2023 revenues are apportioned into revenues per capita and then multiplied by the change in corridor population between the 2013 ACS 5-year survey (for the period 2009-2013) and the most recent ACS 5-year survey which in this case is 2022 for the period 2018-2022. The result is that the estimate is conservative since it likely understates the actual change in population from the earlier period. In this case, the analysis estimates that on a per capita basis of growth between 2009-2013 and 2018-2022, the 1-kilometer streetcar corridor accounts for about $1.1 million in new general fund revenues aggregated from all the sources listed in Exhibit 7-1.

The chapter concludes with technical documentation. Chapter 8 addresses the extent to which free fares along the streetcar corridor leads to increased ridership which leads to more economic development that translates into more tax revenues that can offset free fares.

Exhibit 7-1
Value-Added Non-Tax General Fund Revenues

		Cost/Capita Based on 2023 Population	Corridor Change
General Fund Revenues	**Actual FY 2023**	**547,239**	**3,124**
Local taxes			
Public Utility Tax	$27,750,150	$50.71	$158,416
Pawn Broker Second Hand Dealer	$200,520	$0.37	$1,145
Property Taxes - Prior Years	$250,000	$0.46	$1,427
Government Property Lease Excise Tax	$40,000	$0.07	$228
State Shared Revenues			
Smart & Safe Arizona	$3,000,000	$5.48	$17,126
Licenses and permits			
Utility Franchise Fees	$15,690,480	$28.67	$89,572
Permits/Inspection Fees	$10,359,360	$18.93	$59,138
Fire Permit and Inspection Fees	$891,970	$1.63	$5,092
Cable Television Licenses	$2,542,080	$4.65	$14,512
License Application Fees	$2,979,447	$5.44	$17,009
Animal License and Care Fees	$700,000	$1.28	$3,996
Liquor Licenses and Permits	$945,000	$1.73	$5,395
Litter Assessment Fee	$252,330	$0.46	$1,440
Alarm Permit Fee	$39,900	$0.07	$228
Telecom Licenses, Franchise Fee	$235,150	$0.43	$1,342
Dealer Trade Show License	$74,000	$0.14	$422
Misc Licenses, Permits and Fees	$30,410	$0.06	$174
Charges for Services			
Admin Charges to Enterprise Funds	$13,973,338	$25.53	$79,769
Business Services Department	$2,623	$0.00	$15
Human Resources	$24	$0.00	$0
City Attorney	$20,000	$0.04	$114
City Clerk	$4,653	$0.01	$27
Environmental & General Services	$21,413,870	$39.13	$122,244
General Government			
Parks and Recreation	$2,072,209	$3.79	$11,830
Planning & Development Services	$2,833,300	$5.18	$16,174
Public Defender	$70,920	$0.13	$405
Transportation & Mobility	$200,000	$0.37	$1,142
Tucson Fire	$11,901,300	$21.75	$67,940
Tucson Police	$1,287,100	$2.35	$7,348

Exhibit 7-1
Value-Added Non-Tax General Fund Revenues—continued

		Cost/Capita Based on 2023 Population	Corridor Change
General Fund Revenues	**Actual FY 2023**	**547,239**	**3,124**
Fines and forfeits			
City Attorney	$282,801	$0.52	$1,614
City Court	$4,008,420	$7.32	$22,883
Tucson Police	$1,505,250	$2.75	$8,593
Miscellaneous Fines	$17,710	$0.03	$101
Use of Money and Property			
Rentals and Leases	$230,200	$0.42	$1,314
Interest Earnings	$1,825,140	$3.34	$10,419
Community Development Block Grant Fund			
Community Development Block Grant	$13,324,430	$24.35	$76,065
Other Federal Grants Fund			
City Attorney	$164,760	$0.30	$941
City Court	$591,690	$1.08	$3,378
Housing & Community Development	$16,675,430	$30.47	$95,194
Planning & Development Services	$6,960	$0.01	$40
Parks and Recreation	$2,063,640	$3.77	$11,781
Transportation and Mobility	$666,780	$1.22	$3,806
Tucson Fire	$1,691,650	$3.09	$9,657
Tucson Police	$15,070,330	$27.54	$86,031
Tucson Water	$650,000	$1.19	$3,711
Non-Federal Grants Fund			
City Attorney	$251,442	$0.46	$1,435
City Manager	$70,568	$0.13	$403
Mayor and Council	$25,000	$0.05	$143
Housing & Community Development	$0	$0.00	$0
Public Safety Communications	$3,544,330	$6.48	$20,233
Tucson Fire	$22,080	$0.04	$126
Tucson Police	$2,044,420	$3.74	$11,671
Total Value-Added			**$1,053,208**

Source for FY 2023:
https://www.tucsonaz.gov/files/sharedassets/public/v/1/bsd/documents/finance-documents/schedules-a-g-to-resolution-23629.pdf

Value-Added Non-Tax General Fund Revenues Template

General Fund Revenues	Actual FY 20xx	Cost/Capita Based on 20xx Population	Corridor Change
		[Population]	*[Population]*
Local taxes			
Public Utility Tax			
Pawn Broker Second Hand Dealer			
Property Taxes - Prior Years			
Government Property Lease Excise Tax			
State Shared Revenues			
Smart & Safe Arizona			
Licenses and permits			
Utility Franchise Fees			
Permits/Inspection Fees			
Fire Permit and Inspection Fees			
Cable Television Licenses			
License Application Fees			
Animal License and Care Fees			
Liquor Licenses and Permits			
Litter Assessment Fee			
Alarm Permit Fee			
Telecom Licenses, Franchise Fee			
Dealer Trade Show License			
Misc Licenses, Permits and Fees			
Charges for Services			
Admin Charges to Enterprise Funds			
Business Services Department			
Human Resources			
City Attorney			
City Clerk			
Environmental & General Services			
General Government			
Parks and Recreation			
Planning & Development Services			
Public Defender			
Transportation & Mobility			
Tucson Fire			
Tucson Police			

Value-Added Non-Tax General Fund Revenues Template—continued

General Fund Revenues	Actual FY 20xx	Cost/Capita Based on 20xx Population	Corridor Change
		[Population]	*[Population]*
Fines and forfeits			
City Attorney			
City Court			
Tucson Police			
Miscellaneous Fines			
Use of Money and Property			
Rentals and Leases			
Interest Earnings			
Community Development Block Grant Fund			
Community Development Block Grant			
Other Federal Grants Fund			
City Attorney			
City Court			
Housing & Community Development			
Planning & Development Services			
Parks and Recreation			
Transportation and Mobility			
Tucson Fire			
Tucson Police			
Tucson Water			
Non-Federal Grants Fund			
City Attorney			
City Manager			
Mayor and Council			
Housing & Community Development			
Public Safety Communications			
Tucson Fire			
Tucson Police			
Total Value-Added			

Source for FY 2023:
https://www.tucsonaz.gov/files/sharedassets/public/v/1/bsd/documents/finance-documents/schedules-a-g-to-resolution-23629.pdf

SUMMARY PROCEDURES FOR VALUE-ADDED NON-TAX GENERAL FUND REVENUE ANALYSIS

Only figures are needed from the file "City of Tucson Summary by Fund Type of Revenues Other Than Property Taxes" for the relevant fiscal year. These figures would be divided by the city's population to create non-tax revenues per capita which is multiplied by the most recent ACS 5-year data available for new population.

CHAPTER 8
POST-PANDEMIC STREETCAR FREE FARES ARE OFFSET BY VALUE-ADDED TAX REVENUE

This chapter assesses the association between transit fares and value-added fiscal return. It takes advantage of the opportunity to conduct what is termed a "natural experiment" wherein outcomes are measured in relation to a significant change. In this case, it is the introduction of free fares in 2020 and the association with increased value-added tax revenues through 2023. While not a causal analysis, it associates increased fiscal benefits with the city's free fare policy adopted in 2020.

In 2019, before the COVID-19 pandemic, streetcar ridership was about 900,000, roughly consistent with ridership levels before then. The pandemic pushed ridership down by more than half, to about 440,000 riders in FY 2021.

Just before FY2021, in middle 2020, the city council waived all transit fares, using pandemic-related federal funds to cover some of the losses. Ridership rose to more than 1.1 million in FY2022, the highest ever, and then rose more than a third to more than 1.7 million in FY2023.

While the overall economic benefits of transit have been documented, [28] what has not been studied is the association between increased ridership and economic development and resulting fiscal benefits. That is addressed here.

First, consider the effects of transit fares on ridership. In economics, if the price of something goes up, its consumption usually falls. This is called the price elasticity of demand. Over time, consumption may return to prior levels but sometimes it does not. Thus, price effects can be short-term or long-term.

Research shows conclusively that transit fare elasticities vary by income, a phenomenon called income elasticity of demand.[29] Because many people who use transit have few or no transportation options often because of their incomes, transit fares are considered income inelastic among lower incomes. Even though some might reduce their use of transit in the short-term, in the long term, transit dependent riders will return to their pre-increase levels. It is an inequitable outcome, however, as those who can afford fare increases the least must pay them while reducing expenditures elsewhere such as for food, rent, health care, and so forth.

On the other hand, higher income riders who have mobility options will shift their mode away from transit to alternatives in the short term with many not returning to transit even in the long term.

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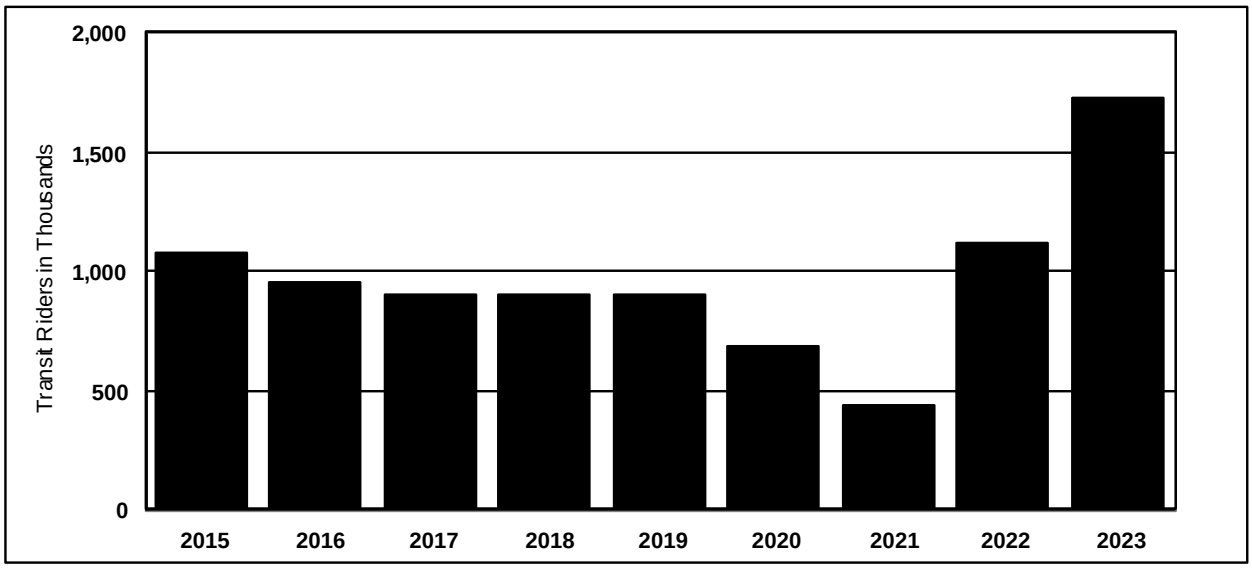
[28] See American Public Transportation Association, *Economic Impact of Public Transportation Investment,* https://www.apta.com/wp-content/uploads/APTA-Economic-Impact-Public-Transit-2020.pdf, and *Transit has a Net Economic Benefit*, https://transitmeansbusiness.metroplanning.org/benefits/transit-has-a-net-economic-benefit, and

[29] For a review of elasticities in the context of transit and ridership, see Todd Litman, *Understanding Transport Demands and Elasticities*, Victoria Transport Policy Institute, available at https://www.vtpi.org/elasticities.pdf.

Exhibit 8-1
Streetcar Ridership FY 2015 through FY 2023



Source: American Public Transportation Association annual ridership repots.

Increased fares thus have perverse economic and social equity outcomes. One outcome is that the incidence of paying for the increase falls onto those who can least afford it. But as higher income riders choose other options, ridership falls leading to the need for even higher fares, the cost of which would be borne by lower income and other transit-dependent riders. Only through subsidies can this vicious cycle be moderated.

In contrast, lowering fares to zero does many things including expanding opportunities for lower income riders to access more services, shopping and job opportunities, and adding higher income riders. Indeed, a study by Brough, Freedman, and Phillips[30] found that reducing transit fares to zero *doubles* ridership. This is precisely the outcome with respect to Tucson's streetcar.

As ridership increases, so does local economic development.[31] By implication, as increased ridership improves economic development, it should also improve local fiscal conditions. Unfortunately, no research substantiates this. Although more rigorous analysis is needed, what follows is an exploratory study into the association between increased ridership along the Tucson streetcar corridor and increased fiscal revenues. The study compares sales and property tax revenues received by the City in 2019, the year before the pandemic, and 2023. It thus bridges the pandemic period of 2020 through 2022.

Exhibit 8-2 presents the overall findings.

In 2019, fare revenue was about $800,000 adjusted for inflation. Because transit costs are mostly fixed, roughly the same whether ridership drops by half or doubles, this is the baseline figure used for analysis.

How much did the city gain in new streetcar corridor taxes? Free fares increase ridership, and more riders mean more spending. More riders plus other streetcar-induced outcomes are associated with $2.3 million more tax revenue in 2023 than in 2019, adjusted for inflation. This excludes all other revenues which are substantial and should be addressed in future analysis.

The bottom line is that the $800,000 in waived streetcar fares is associated with $2.3 million in new tax revenue for a net gain of $1.5 million. The annualized rate of return is 17.0%. Put differently, each $1.00 of waived fares is associated with $2.88 in new tax revenue.

[30] Rebecca Brough, Matthew Freedman, and David C. Phillips, 2023, Eliminating Fares to Expand Opportunities: Experimental Evidence on the Impacts of Free Public Transportation on Economic and Social Disparities, *American Economic Journal: Economic Policy*, available from https://www.aeaweb.org/articles?id=10.1257/pol.20230460.
[31] Neuwirth, Roanne, 1990, Economic impacts of transit on cities, *Transportation Research Record* 1274: 142-149.

Exhibit 8-2
Tax Return Analysis

Measure	Metric
Sales Taxes 2019[a]	$12,508,669
Sales Taxes 2023	$14,221,545
Change	$1,712,876
Property Value 2019[b]	$1,134,854,740
Property Value 2023	$1,597,665,171
Change	$462,810,431
Property Tax Rate	0.1277%
Property Tax Revenue	$591,009
Direct Tax Revenue	$2,303,885
Streetcar Fares 2019[c]	$801,055
Net Return	$1,502,830
Rate of Return	17.0%
Return Ratio: $1.00 =	$2.88

Notes

a Adjusted for 2023 dollars.

b No adjustment to 2023 dollars needed because depreciation offsets much of the difference. See chapter 4 for details.

c Streetcar fare revenue 2019 from https://www.suntran.com/wp-content/uploads/2021/07/ST-SL-SV-Annual-Report-19.pdf and adjusted for 2023 dollars.

Subject to more detailed analysis, free fares along the streetcar corridor leads to increased ridership which leads to more economic development that translates into more tax revenues that can offset free fares.

Unfortunately, the City has no audit system to track changes in fiscal revenues over time in the streetcar corridor. This is a problem because if decision-makers do not know the fiscal benefits of waived transit fares, they could make unwise decisions. For instance, if fares are reinstated, ridership will certainly fall as well as tax revenues. Losses could wipe out gains leaving the city worse off especially if ridership falls to pre-pandemic levels, as research suggests it would.

What is also known is that while lower-income and transit-depending riders will pay the fares because they have no choice, which is an equity problem, those with choices will shift to cars. That will reduce ridership and increase traffic and pollution.

To help the council make informed decisions, the value-added monitoring system can track revenues and compare them to foregone fare revenues. The city may find that free fares leverage new revenues that more than offset costs. But even if it comes close to breaking even, free fares advance the city's equity and environmental missions.

The report concludes with Chapter 9, which provides an overall summary of value-added outcomes and guidance for maintaining a transit Value-Added monitoring system.

CHAPTER 9
SUMMARY AND MAINTENANCE OF THE VALUE-ADDED MONITORING SYSTEM

This report creates a Transit Value-Added Monitoring System. It uses data available in the first quarter of 2024 to create spatial and data structures along the streetcar line, and then uses those data to report outcomes along numerous dimensions from the early 2010s before and shortly after streetcar service began, into the early 2020s during the pandemic and the early recovery years.

The area considered for value-added analysis is comprised of census block and block groups roughly one kilometer (about 0.63 mile) extending from streetcar transit stations and the track. For jobs and tax revenue analysis based on census blocks, the study area is equivalent to about 1.5% of the city's land area. For demographic analyses using census block group data, the 1-kilometer area is equivalent to about 1.8% of the city's land area.

Since service began in the middle of 2014, Tucson's streetcar system has added value to downtown and the city in several respects. Exhibit 9-1 shows that large to very large shares of change occurred on this very small area of land.

From a fiscal value-added perspective, annual new revenues generated within the streetcar corridor through FY 2023 came to more than $13 million annually, as shown in Exhibit 9-2. Capitalized at the local government tax-exempt borrowing rate, this revenue could service debt of about $400 million.

Exhibit E-2 also shows other trends. Although property tax value-added revenue accounted for just 15% of total FY2023 revenues and just 9% of non-tax general fund revenues such as federal and state grants, local sales and state-shared income taxes accounted for 41% and 40% respectively of those tax revenues, while state-shared sales accounted for 34%. Value-added use taxes (see chapter 6) accounted for 62% of these revenues. Overall, the value-added revenue accounted for about 30% of the 1-kilometer streetcar corridor revenues in FY2023.

Although this analysis includes only new revenue and not costs, it is assumed that most if not of these revenues are net of costs taxpayers would have paid anyway if growth had not occurred. Technically, the assumption is that because marginal costs are nearly zero, all marginal revenue is net of costs to the city. Future analysis can explore this assumption.

The bottom line is that the streetcar corridor generates in the order of $13 million in new revenues annually for the city. As the corridor continues to add jobs, people, households, real estate investments, and taxable transactions, this figure will grow.

Exhibit 9-1
Selected Value-Added Outcomes, Tucson Streetcar Corridor, Before Operations Commenced to Early 2020s

Measure (1-kilometer unless noted)	Value-Added Metric	City Share
People and Jobs		
New People 2013-2022 (height of Covid)	3,124	29%
New Households 2013-2022 (height of Covid)	2,415	16%
Station-Track-Adjacent Block New Jobs 2015-2021	1,257	19%
Net New Jobs 2015-2021 (height of Covid)	365	5%
New Workers Living in Corridor	3,774	15%
Wages and Income		
Streetcar Value-Added Wages	$241,826,557	33%
Streetcar Value-Added Household Income	$176,850,948	7%
Property Value		
Streetcar Value-Added Total Property Value	$2,579,559,145	11%
Streetcar Value-Added Non-Exempt Property Value	$1,735,730,183	8%
Residential Units, Tenure		
New Residential Units, 2013-2022	2,253	24%
New Renters, 2013-2022	7,376	40%
Commute Mode to Work		
Share Not Using Autos/Trucks--Corridor	42%	
Share Not Using Autos/Trucks—City	19%	

Exhibit 9-2
Streetcar 1-Kilometer Corridor Value-Added Fiscal Revenues Estimated for FY2023

Revenue Source	Total Revenue FY 2023	Value-Added 2013-2023	Value-Added Share
Property Taxes[a]	$5,177,487	$759,459	15%
Sales Taxes[b]	$14,133,437	$5,772,093	41%
Use Taxes[c]	$3,187,079	$1,971,159	62%
State-Shared Income Taxes[d]	$4,633,069	$1,848,884	40%
State-Shared Sales/Auto Taxes[e]	$4,814,751	$1,626,711	34%
Non-Tax General Fund Revenue[f]	$11,450,774	$1,053,208	9%
Total Streetcar Fiscal Value-Added	$43,396,597	$13,031,515	30%

Notes:

a Streetcar corridor difference between 2023 assessed value of non-exempt property and 2013 assessed value, divided by the citywide difference between 2023 assessed value and 2013 assessed value in 2023 dollars times actual FY 2023 property taxes received. (Inflation-adjusted 2013 property tax revenues to 2023 are used. See Chapter 4.)

b Difference between FY 2023 streetcar corridor sales taxes received (business transaction privilege tax, transient occupancy tax, hotel/motel surtax) and FY 2013 streetcar corridor sales taxes received in 2023 dollars.

c Streetcar corridor difference between 2021 aggregate LEHD-based wages adjusted for downtown premium and 2015 aggregate wages in 2021 dollars divided by difference between 2021 aggregate citywide wages and 2015 aggregate wages in 2021 dollars times actual FY 2023 use taxes received.

d Streetcar corridor difference between 2018-2022 aggregate ACS-based household income and 2009-2013 aggregate household income in 2022 dollars divided by difference between 2018-2022 aggregate citywide household income wages and 2009-2013 aggregate household income in 2022 dollars times actual FY 2023 state-shared income tax revenue received.

e Same process as footnote “d” but applied to actual FY 2023 state-shared sales/auto tax revenue received.

f Non-tax general fund revenue received during FY 2023 divided by total city population to estimate revenue per capita, times difference in streetcar corridor population between ACS 2018-2022 and 2009-2013 periods. (The estimate is lagged several years resulting in a conservative figure.)

As a reminder, this report is a value-added analysis that focuses on only measurable employment (including wage), demographic (including household income), and fiscal revenue outcomes. It is not a statistical causal or association analysis that controls for intervening factors. Nor is it an economic benefit/cost analysis or a fiscal analysis where revenues are compared to costs including opportunity costs. It assumes implicitly that most if not all these revenues are net of costs taxpayers would have paid anyway if growth had not occurred. Technically, the assumption is that marginal costs are nearly zero meaning that all marginal revenue is net of costs to the city. Future analyses can include cost considerations, explore revenue-cost relationships, and perhaps apply econometric and other parametric techniques.

As the value-added contributions to the city always change it is important to update the analysis at least once each year. This should be done during the budget-making process for the next fiscal year. The recommendation is to do so in the first quarter of each year, such as the first quarter of 2025 during the budget-making process for fiscal year 2026. Doing so will allow:

1. Updating LEHD data to 2022 which would have been released about the middle of 2024;

2. Updating ACS data to 2023 which would have been released in fall 2024;

3. Updating property and sales tax data through either the end of fiscal year 2024 for sales taxes or the end of calendar year 2024 for property taxes; and

4. Updating supplemental data based on actual FY 2024 data should be included in the annual audit released about the end of the calendar year, 2024.

Ideally, the updating process would be assembled by a responsible party although other officials will assemble confidential data as needed, especially for sales and related transaction-based taxes.

TECHNICAL APPENDIX
STREETCAR ECONOMIC IMPACT DATA TABLES

Table 1
United States Census Bureau: *LEHD Origin-Destination Employment Statistics (LODES)*

Official name of data set	az_wac_S000_JT00_2004 through az_wac_S000_JT00_2021
Year of publication and/or last update	4/3/2023
Author and/or owner	United States Census Bureau
URL or FTP address of the repository	https://lehd.ces.census.gov/data/#lodes
Description	Tables of Longitudinal Employer-Household Dynamics (LEHD) Origin-Destination Employment Statistics (LODES) of Workplace Area Characteristics (WAC) for the state of Arizona by 2020 Census Block.
Coordinate system	NA
Projection system	NAD 1983 HARN StatePlane Arizona Central FIPS 0202 (Feet Intl)
Spatial Resolution	NA

Table 2
United States Census Bureau: *CB2100CPB | County Business Patterns, including ZIP Code Business Patterns, by Legal Form of Organization and Employment Size Class for the U.S., States, and Selected Geographies: 2021*

Official name of data set	CBP2021.CB2100CBP-2024-03-15T173825.csv
Year of publication and/or last update	5/25/2023
Author and/or owner	United States Census Bureau
URL or FTP address of the repository	https://data.census.gov/table?g=050XX00US04019&y=2021&d=ECNSVY%20Business%20Patterns%20County%20Business%20Patterns
Description	From US Census Bureau: "Data Items and Other Identifying Records: This table contains data classified by Legal Form of Organization (CBP U.S. and state level only) and employment size category of the establishment. Industry Coverage: The data are shown at the 2- through 6- digit NAICS code levels for all sectors with published data, and for NAICS code 00 (Total for all sectors)."
Coordinate system	NA
Projection system	NAD 1983 HARN StatePlane Arizona Central FIPS 0202 (Feet Intl)
Spatial Resolution	NA

Table 3
United States Census Bureau: *tl_2023_04_tabblock20.shp*

Official name of data set	tl_2023_04_tabblock20.shp
Year of publication and/or last update	05/2023
Author and/or owner	United States Census Bureau
URL or FTP address of the repository	https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2023&layergroup=Blocks+%282020%29
Description	2020 Census Blocks From US Census Bureau: "Census Blocks are statistical areas bounded on all sides by visible features, such as streets, roads, streams, and railroad tracks, and/or by nonvisible boundaries such as city, town, township, and county limits, and short line-of-sight extensions of streets and roads."
Coordinate system	NAD 1983
Projection system	NA
Spatial Resolution	NA

Table 4
United States Census Bureau: *tl_2010_04019_bg10.shp*

Official name of data set	tl_2010_04019_bg10.shp
Year of publication and/or last update	05/2023
Author and/or owner	United States Census Bureau
URL or FTP address of the repository	https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2010&layergroup=Block+Groups
Description	2010 Census Block Groups From US Census Bureau: "Standard block groups are clusters of blocks within the same census tract that have the same first digit of their 4-character census block number (e.g., Blocks 3001, 3002, 3003 to 3999 in census tract 1210.02 belong to block group 3)."
Coordinate system	NAD 1983
Projection system	NA
Spatial Resolution	NA

Table 5
City of Tucson: *City of Tucson Ward Boundaries*

Official name of data set	WARD_COT
Year of publication and/or last update	05/13/2024
Author and/or owner	City of Tucson GIS
URL or FTP address of the repository	https://utility.arcgis.com/usrsvcs/servers/0657741d9e4a4289912330077707ad39/rest/services/PublicMaps/Boundaries/MapServer/15
Description	From the City of Tucson: "ward_cot displays the six city council districts in the City of Tucson. Ward area legal boundaries are based on Pima County voting precinct legal boundaries. Last updated September 19, 2023."
Coordinate system	NAD 1983 HARN
Projection system	NAD 1983 HARN StatePlane Arizona Central FIPS 0202 (Intl Feet)
Spatial Resolution	NA

Table 6
Pima County GIS: *Parcels – Regional*

Official name of data set	paregion_2005.shp through paregion_2023.shp
Year of publication and/or last update	05/13/2024
Author and/or owner	Pima County GIS
URL or FTP address of the repository	The current version of paregion is available at the address below, but the full set of archived versions was obtained from Pima County GIS after a request. https://gis.pima.gov/data/contents/metadet.cfm?name=paregion
Description	Parcels in Pima County From Pima County GIS: "paregion displays all tax parcels, common areas, and private roadway parcels in Pima County."
Coordinate system	NAD 1983 HPGN
Projection system	NA
Spatial Resolution	NA

Table 7
IPUMS National Historical Geographic Information System: *Geography Crosswalk*

Official name of data set	nhgis_bg2020_bg2010_04
Year of publication and/or last update	2021
Author and/or owner	IPUMS. Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles
URL or FTP address of the repository	https://www.nhgis.org/geographic-crosswalks
Description	From NHGIS: "NHGIS geographic crosswalks describe how U.S. census summary data from one year correspond to geographic units for another year."
Coordinate system	NA
Projection system	NA
Spatial Resolution	NA

Appendix References

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United States Census Bureau. (2023, May). *tl_2023_04_tabblock20.shp*. State of Arizona Census Blocks 2020. https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2023&layergroup=Blocks+%282020%29

United States Census Bureau. (2023, May). *tl_2010_04019_bg10.shp*. State of Arizona Census Block Groups 2010. https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2010&layergroup=Block+Groups

Disclaimer

Analyses contained in this report are estimates and not intended to be precise figures even when calculations appear to be so. The analysis is based on the best available information that is subject to change. It will need to be updated periodically, ideally annually.