Transportation Consortium of South-Central States

Tran-SET

Solving Emerging Transportation Resiliency, Sustainability, and Economic Challenges through the Use of Innovative Materials and Construction Methods: From Research to Implementation

Sustainable and Equitable Financing for Pedestrian Infrastructure Maintenance

Project No. 17PPUNM01

Lead University: University of New Mexico

Addressing Region 6 Transportation Needs

Final Report

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16. Abstract

In many communities, pedestrian infrastructure is discontinuous, inaccessible to those with physical disabilities, and poorly maintained. Correcting these problems would be a first step in providing infrastructure to achieve the active travel and related transportation goals of many communities. One nearly universal challenge to maintaining sidewalks in a state of good repair and addressing environmental justice concerns is an adequate, sustainable, and equitable source of funding. Municipal governments across the country maintain and repair their streets and roadways; however, most require residents to maintain and repair public sidewalks adjacent to their property. These policies are difficult to enforce and may be at least partly responsible for the poor condition of many sidewalks. They may also place a relatively high cost on low-income households. We evaluate three alternative options for financing the maintenance of public sidewalks in Albuquerque, New Mexico: increasing the gross receipts tax (GRT), the gasoline excise tax, or the property tax. These are broad-based taxes that many municipalities already levy to pay for public infrastructure, including streets. We conclude that any of the alternatives would perform better than policies that require adjacent property owners to maintain public sidewalks. They are generally less regressive, cost less on average, and would allow municipalities to more effectively manage sidewalk assets. The differences between the alternatives are relatively minor compared to their benefits. Additional considerations should include how the revenue from each tax may change over time.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ADA	Americans with Disabilities Act
ACS	American Community Survey (U.S. Census Bureau)
CES	Consumer Expenditure Survey
GIS	Geographic Information System
GRT	Gross Receipts Tax
LTAP	Local Technical Assistance Program
UNM	University of New Mexico
VMT	Vehicle Miles Traveled

EXECUTIVE SUMMARY

In many communities, pedestrian infrastructure is discontinuous, inaccessible to those with physical disabilities, and poorly maintained. Prior studies found evidence that lower-income households depend more on walking for transportation while also living in communities with poorer quality sidewalks. In data collected in Albuquerque, New Mexico for this study, we also find that lower income communities tend to have more sidewalk maintenance needs. Correcting these problems would be a first step in providing infrastructure to achieve the active travel and related transportation goals of many communities. One nearly universal challenge to maintaining sidewalks in a state of good repair and addressing environmental justice concerns is an adequate, sustainable and equitable source of funding.

Municipal governments across the country maintain and repair their streets and roadways; however, most require residents to maintain and repair public sidewalks adjacent to their property. Policies that require adjacent property owners to maintain sidewalks are difficult to enforce and may therefore be at least partly responsible for the poor condition of many sidewalks. They may also place a relatively high cost on low-income households. We evaluate three alternative options for financing the maintenance of public sidewalks in Albuquerque, New Mexico: increasing the gross receipts tax (GRT), the gasoline excise tax, or the property tax. These are broad-based taxes that many municipalities already levy to pay for public infrastructure, including streets. Each alternative can raise the same amount of needed revenue, but who pays and when, and who performs the maintenance differs.

We find that the current policy is both the most regressive (i.e., places a greater burden on lower-income households) and results in the most inequity in sidewalk repair costs across the city. The current policy is also relatively expensive. Increasing the GRT or gasoline excise tax would be the least costly options since, they have the largest tax bases (they both collect revenue from nonresidents). Each alternative is regressive, but less than the current policy.

Each of the alternatives would also turn over sidewalk maintenance responsibility to the municipality which could reduce costs through more effective asset management, lower administrative costs, and economies of scale during construction. The alternatives are also more likely to address equity and environmental justice concerns. The alternatives are more likely to result in adequate sidewalk maintenance since they would not have the enforcement difficulties of the current policy. This, alone, could eliminate the disparities in maintenance needs between neighborhoods.

We conclude that any of the alternatives would perform better than policies that require adjacent property owners to maintain public sidewalks. The differences between the alternatives are relatively minor compared to their benefits. Additional considerations should include how the revenue from each tax may change over time. The revenue from the gas tax is likely to decline over time, while revenue from the GRT and property taxes will depend on uncertain population and economic growth. While our analysis has been simplified in many ways as described in the methods section of this report, we believe it presents a very strong case for municipalities to reconsider how they manage sidewalks and how sidewalk repairs are financed.

IMPLEMENTATION STATEMENT

Implementation will consist of several activities designed to communicate the knowledge and information we generate from the project to those who can use it to implement strategies in their communities.

We will produce a highly accessible white paper. The white paper will be a concise document that summarizes our research approach, our main findings, and concludes with implementation guidance. The white paper will be aimed at municipal decision makers and planners and be written at a level that makes it accessible to most individuals. The purpose of the white paper is to transfer the information and knowledge that we generate to those who can use it to implement more effective, equitable, and sustainable strategies for financing the maintenance of sidewalks.

We will distribute the white paper and the principal investigator will make presentations to local community groups and staff from the City of Albuquerque, Bernalillo County, Mid-Regional Council of Governments and community groups. The project uses the Albuquerque area as a case study, we therefore expect that communities and agencies in the region will be in the most immediate position to use the knowledge and information we generate to implement new sidewalk maintenance strategies. To the extent that municipalities in the region adopt new strategies, these can serve as implementation examples that could be followed by other municipalities.

The white paper will also be added to the New Mexico LTAP Center website and quarterly newsletter for distribution to communities across New Mexico. We will also seek to distribute the white paper more broadly through the Transportation Research Board's Pedestrian Committee. Furthermore, we plan to submit a research paper discussing the project and its findings for consideration for presentation at the 2019 Annual Meeting of the Transportation Research Board and for publication in a peer-reviewed academic journal.

The project's findings will be used to develop lecture materials for undergraduate and graduate transportation engineering and urban planning courses currently offered by Dr. Rowangould at the University of New Mexico (UNM) as well as materials for training courses focused on infrastructure management provided through the New Mexico LTAP Center.

1. INTRODUCTION

Increasing the share of trips made using active modes of transportation such as walking can provide many benefits (*1–4*). Walking provides physical activity that provides health benefits; walking is relatively inexpensive; walking does not (directly) emit toxic or greenhouse gas emissions or consume non-renewable energy; walking requires less infrastructure than motorized transportation; and walking can increase community interactions that build stronger neighborhoods and local economies. Despite these and other benefits, there appears to be a wide gap between the provision and quality of pedestrian infrastructure such as sidewalks and that for motorized travel (*5–7*).

In many communities, pedestrian infrastructure is discontinuous, inaccessible to those with physical disabilities, and poorly maintained (*5*, *6*, *8*, *9*), including Albuquerque, New Mexico (*10*, *11*). Correcting these problems would be a first step in providing infrastructure to achieve the active travel and related transportation goals of many communities. While there are many reasons for the varying provision and quality of pedestrian infrastructure within and among different communities, one nearly universal challenge is an adequate, sustainable, and equitable source of funding for pedestrian infrastructure maintenance and reconstruction (*5*, *8*, *9*, *12*, *13*).

Municipal governments across the country maintain and repair their streets and roadways; however, most require residents to maintain and repair public sidewalks adjacent to their property (*5*, *8*, *9*, *12*). For example, a survey of 82 cities in 45 states by the Los Angeles Bureau of Street Services conducted in 2008 found that 71 cities required adjacent property owners to pay at least some portion of the cost of sidewalk repairs while only 11 cities assumed full responsibility for maintaining sidewalks (*9*). Policies requiring adjacent property owners to pay for sidewalk maintenance date back to at least the 19th century in the United States (*14*).

Placing the responsibility for maintaining public sidewalks and financing their repair costs on adjacent property owners may contribute to the challenge that most cities have with maintaining their sidewalks in a state of good repair. Several studies have documented that property owner compliance with requirements to maintain public sidewalks adjacent to their property is generally lacking and that many cities are reluctant or incapable of enforcing these policies (*5*, *6*, *12*, *13*). Sometimes there are no penalties for non-compliance (*6*). Furthermore, many cities do not have a routine program to identify maintenance needs (*9*), property owners may not be aware of what conditions require repair (*13*) and property owners may not know that they are responsible for sidewalk maintenance (*12*).

So why do so many municipalities require property owners to maintain public sidewalks adjacent to their property when evidence suggests that such policies are ineffective? The answer is unclear but history provides a few clues. It may be a policy held over from early British common law that required property owners to maintain a public right of way through their property (*8*); however, this does not explain the differing treatment of roadways. While some municipalities, especially in the 18th and 19th centuries built public sidewalks, it may also have been common for property owners to finance the construction of public streets and sidewalks adjacent to their property in order to increase their property values (*15*). In some places public sidewalks were privately owned, and therefore requiring the owners to maintain them might seem logical (*6*). Requirements to clear snow and ice (and other debris) from public sidewalks may have also lead to broader maintenance requirements (*16*, *17*). The inability of municipalities to gain public support for levying new taxes to pay for sidewalk maintenance has also been raised as a possible explanation (*9*, *12*). What is absent from the literature are arguments and evidence supporting the superiority or benefits of adjacent property owner maintenance policies over other public asset management models – and curiously, little discussion of why the roadway adjacent to sidewalks are not similarly maintained by adjacent property owners.

In this study we evaluate several alternative options for financing the maintenance of public sidewalks in Albuquerque, New Mexico. We consider increments to three broad-based taxes that many municipalities, including Albuquerque, already levy to pay for public infrastructure, including streets. Each alternative can raise the same amount of needed revenue, but who pays and when, and who performs the maintenance differs. Raising revenue through broad-based taxes would generally avoid the costs and difficulty associated with enforcing the current policy (and similar policies in most other cities) and eliminate the prospect of homeowners facing unexpected and potentially large sidewalk repair costs. We suspect that placing the municipality in charge of maintaining sidewalks would also be more cost-effective as maintenance needs could be tracked and prioritized, preventative maintenance might be a possibility, repairs could be combined with other street maintenance projects, and economies of scale in repair work could lower marginal costs. Another important consideration, and the focus of our study, is the distributional impact of each sidewalk financing alternative, including the current policy.

There are other ways to pay for sidewalks that we do not consider in our study. For example, tax increment finance districts, special assessment districts, and various federal grant funding programs. Tax increment finance districts and special assessment districts are generally used to reimburse developers or the government, respectively, for building new infrastructure, including sidewalks and roadways among other things. These are generally not used for routine infrastructure maintenance, although they could be appropriate for dealing with a large maintenance backlog. There are several federal programs that municipalities may apply to for sidewalk construction funding, but they are generally not meant and often explicitly prohibit funding maintenance activities. For example, federal Surface Transportation Block Grant (STBG) funding set asides for Transportation Alternatives (TA) and the Community Development Block Grant (CBDG) are two programs that provide funding that can be used for building new sidewalks or improving their accessibility; however, maintenance and repair activities are ineligible[1]. In our study, we focus on broad-based taxes that are commonly used to finance the day-to-day operation of a municipality, which we argue should include maintaining public sidewalks.

Each policy we consider has two potential, important, distributional impacts. First, to the extent that the current policy is insufficient at maintaining sidewalks in a state of good repair, which local evidence strongly suggests (*10*, *11*), there is the possibility that some communities will

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[1] The FAST Act's TA program extends the provisions of the MAP-21 TAP program which only funds the design and construction of new infrastructure: https://www.fhwa.dot.gov/map21/factsheets/tap.cfm.
Prohibitions on using CDBG funding for maintaining and repairing sidewalks is detailed in 24 C.F.R. § 570.207(b)(2)(i) 2015.

have more well-maintained sidewalks than others. Prior studies have found some evidence of poorer sidewalk conditions in lower income and minority communities (*18–21*) and an audit conducted by the City of Albuquerque (*11*) suggests that sidewalk conditions are worse in Albuquerque's lower-income communities. Furthermore, even if sidewalk conditions are similar across the city, lower-income households may be more dependent on walking for transportation which would also raise equity concerns regarding poor sidewalk maintenance. Additionally, the financial burden placed on households of different income levels should also be considered for each alternative and the current policy. The cost of replacing a concrete sidewalk in one neighborhood is generally the same as another (although differing widths may cause some variation); however, the ability of households to pay may vary greatly. The current policy is likely regressive since all households face similar costs but have differing income levels (i.e., lower income households would have to pay a larger share of their income). Furthermore, if low-income communities have greater deferred maintenance needs, then enforcement of the current policy would be even more regressive. Each of the alternatives that we consider in this study would spread the costs of sidewalk maintenance out differently and possibly more fairly. The revenue generated by each alternative is also likely to vary over time, therefore we also discuss the long-term sustainably of each alternative since raising taxes or levying new taxes is often a difficult task to accomplish.

2. OBJECTIVES

The overall aim of this project is evaluating municipal options for financing pedestrian infrastructure maintenance and reconstruction in the public right-of-way and identifying those that are most equitable and sustainable. The original project proposal contained three research questions related to the overall project aim:

1) How equitable are alternative financing methods?
2) How sustainable are various financing methods in the long run?
3) How efficient are alternative financing methods?

Evaluating the costs and equity of current and alternative financing methods (for example, by identifying which are least regressive and which are more likely to fund repairs where they are most needed) is the primary objective of this project.

An additional objective is evaluating the regional dynamics that affect a specific financing option's ability to continue to provide adequate revenue overtime to meet expected pedestrian infrastructure maintenance needs. We call this the financing option's sustainability. The revenue generated by alternative financing methods (e.g., taxes) may change over time based on various economic, technological, and behavioral factors. For example, the revenue produced by the gasoline excise tax may decline as vehicles become more fuel efficient and less people drive each year. Additionally, since the gasoline tax is not indexed to inflation, its purchasing power will decline over time even if the same amount of revenue were generated.

The final objective is evaluating the efficiency and cost-effectiveness of sidewalk maintenance policies. Requiring individual homeowners to identify, finance, and contract out the repair of sidewalk maintenance needs adjacent to their property may not be cost-effective or efficient. Many homeowners may not know what needs to be maintained or repaired. Individually contracting out the repair of small segments of sidewalk is also likely to have a relatively high overhead cost for homeowners (e.g., in identifying and procuring contractors) and higher maintenance costs than if repairs were managed by a municipality or other organization that could coordinate and manage maintenance for larger networks of sidewalk and related street infrastructure.

We did not have the resources and time to quantitatively evaluate the last two objectives; however, we evaluate them through the literature and discuss these considerations in our conclusions.

3. SCOPE

The research is based on a case study of Albuquerque, New Mexico. Albuquerque is selected because the University of New Mexico is located in the City; Albuquerque is a city that currently places all sidewalk maintenance responsibility on adjacent property owners; the City is pursuing multiple projects aimed at increasing active transportation and "smart growth"; the City has a large amount of poorly designed pedestrian infrastructure that needs replacement and a large maintenance backlog; and the City is developing an ADA transition plan for its pedestrian infrastructure.

The project will directly benefit Albuquerque as we use data from this region for our analysis, but we also expect the results to have broad relevance to municipalities across the nation. The challenges Albuquerque faces are similar to those most municipalities face. Large maintenance backlogs, inadequate funding, and a pedestrian infrastructure financing and planning model that varies dramatically from that of other types of transportation infrastructure. While some of our findings will be specific to Albuquerque, such as the dollar amount of maintenance needs and the distributional impact of individual financing options, the analysis approach we develop will be replicable. Furthermore, we will demonstrate the range of options that are available and how they can affect efficiency, equity, and sustainability – drawing importance to considering how we finance this often overlooked yet widely used transportation infrastructure.

4. METHODOLOGY

The research consists of three main tasks. In the first step we surveyed Albuquerque's sidewalks to create an inventory of maintenance needs by neighborhood. We then used the inventory of maintenance needs to estimate current maintenance costs and evaluate disparities in current sidewalk state of repair. In the final step we used the information on neighborhood maintenance costs to evaluate the equity of several alternative sidewalk financing methods and compared them to Albuquerque's current policy.

4.1. Sidewalk Inventory

When we began this project, Albuquerque, like many municipalities had no data describing existing sidewalk maintenance needs or even where sidewalks exist and their basic attributes; therefore, our first task was collecting data on common maintenance problems. Since Albuquerque is a large city it was not feasible for the research team to inventory every sidewalk and every possible type of problem. Therefore, we used a sampling scheme to collect small snapshots of common sidewalk defects across the City and then used those data to estimate sidewalk conditions for all areas of the City.

The sidewalk inventory collected data on two common types of sidewalk defects that reflect maintenance needs: vertical discontinuities (e.g., a slab that is raised above another that creates a tripping hazard or barrier to a wheelchair) and degraded walking surfaces (e.g., cracks, holes, spalling, and other types of deterioration that decreases the function of the sidewalk). We used existing federal ADA guidelines to determine the severity of these conditions that warrant a maintenance action (*22*). We did not inventory sidewalk features that are out of compliance with other aspects of ADA standards such as maximum cross slopes, grades, transition zones, presence of curb ramps, physical obstructions, etc., since these are generally the responsibility of the municipality to fix and are not related to maintenance.

We randomly selected 50 out of a total of 249 neighborhoods in Albuquerque to sample sidewalks for maintenance needs. We choose neighborhoods as our unit of analysis as sidewalk design and state of repair are likely to be more similar within neighborhoods than between them. Streets within neighborhoods were typically built around the same time by the same developer and with similar designs and materials. Furthermore, periodic city street maintenance generally occurs at the neighborhood level. Neighborhoods were identified from a Geographic Information System (GIS) data file of neighborhood association boundaries maintained by the City of Albuquerque[2]. Each neighborhood was assigned a random number and then the 50 neighborhoods with the lowest numbers were chosen. Within each of the neighborhoods we sampled, we randomly choose five intersections where we would evaluate the first 200 feet of each sidewalk extending outwards from the intersection. The intersections were chosen in each neighborhood by first randomly selecting five street segments using the same random number process that was used for selecting neighborhoods. Since most street segments make two intersections with other streets (one at each end of the segment unless the street is a cul-de-sac or dead end) we also randomly chose one of the two intersections for each selected street segment. Streets and intersections were selected from a GIS data file of

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[2] Data file "nbr.zip" downloaded from the city of Albuquerque GIS data website: https://www.cabq.gov/gis/geographic-information-systems-data

Albuquerque street centerlines maintained by the City of Albuquerque[3]. The sidewalk survey was completed between August 2017 and September 2017 and data were recorded in the field using paper forms and checklists and then entered in an ArcGIS geodatabase.

Before we conducted our field survey, we selected three neighborhoods to test our sampling methods by comparing defect rates within and between neighborhoods. We choose three neighborhoods to maximize diversity in terms of neighborhood age, urban form, and geographic location. The three neighborhoods, which we labeled "UNM/Central", "Westside", and "Northeast", represent an older, urban neighborhood, near downtown Albuquerque and the University of New Mexico (UNM); an older, more suburban, subdivision on the city's westside; and a new, suburban, subdivision in Albuquerque's northeast heights area, respectively (see Figure 1).

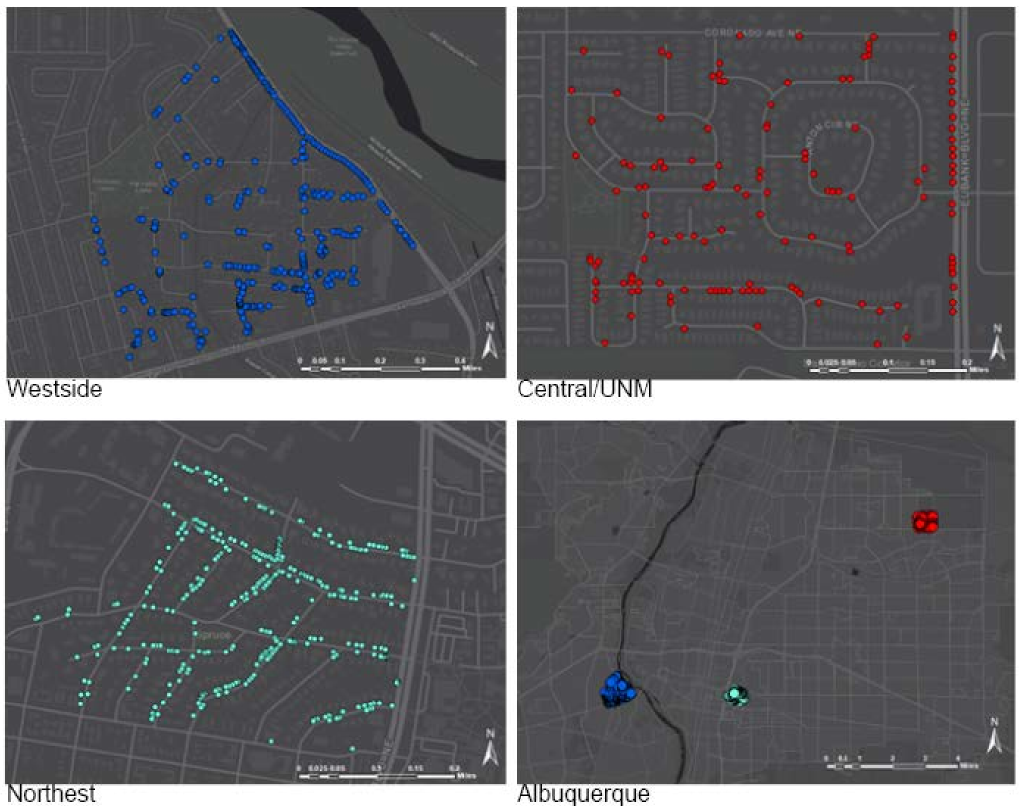

Figure 1. Sampling test neighborhoods (each dot represents a defect).

For each of the three test neighborhoods, we surveyed every street for defects and recorded the results in a GIS database as shown in Figure 1. We then compared defect rates between each neighborhood, finding that they varied from a high of 65 defects per mile in Central/UNM to a low of 24 defects per mile in Northeast (see Figure 2). We also compared defect rates within each neighborhood with estimates derived from different sized samples. We randomly sampled 5, 7 and, 10 intersections (surveying sidewalks extending out 200 feet in each direction of each

[3] Data file "netcurr.zip" downloaded from the city of Albuquerque GIS data website: https://www.cabq.gov/gis/geographic-information-systems-data

intersection) in each neighborhood. While increased sampling increased the precision of the defect rate estimates, accurate results with similar precision could be obtained by sampling just 5 intersections per neighborhood (see Figure 2). Based on these results we proceeded with sampling 5 randomly selected intersections in each of the 50 randomly selected neighborhoods.

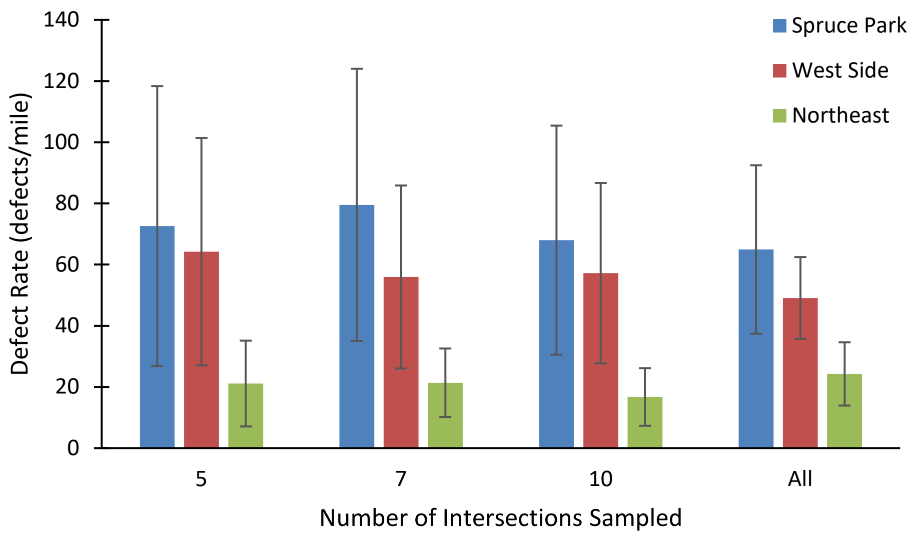

Figure 2. Defect rates from three test neighborhoods.

The results of our field data collection are shown in Figure 3. Generally, defect rates were higher in the center of the city and lower in the northwest and northeast parts of the city. Defects rates were also higher in the southern third of the city. The defect rates generally correspond to the age of the neighborhood with the central area being the oldest, followed by areas to the southwest and southeast. Many newer subdivisions have recently been built in the northeast and northwest areas.

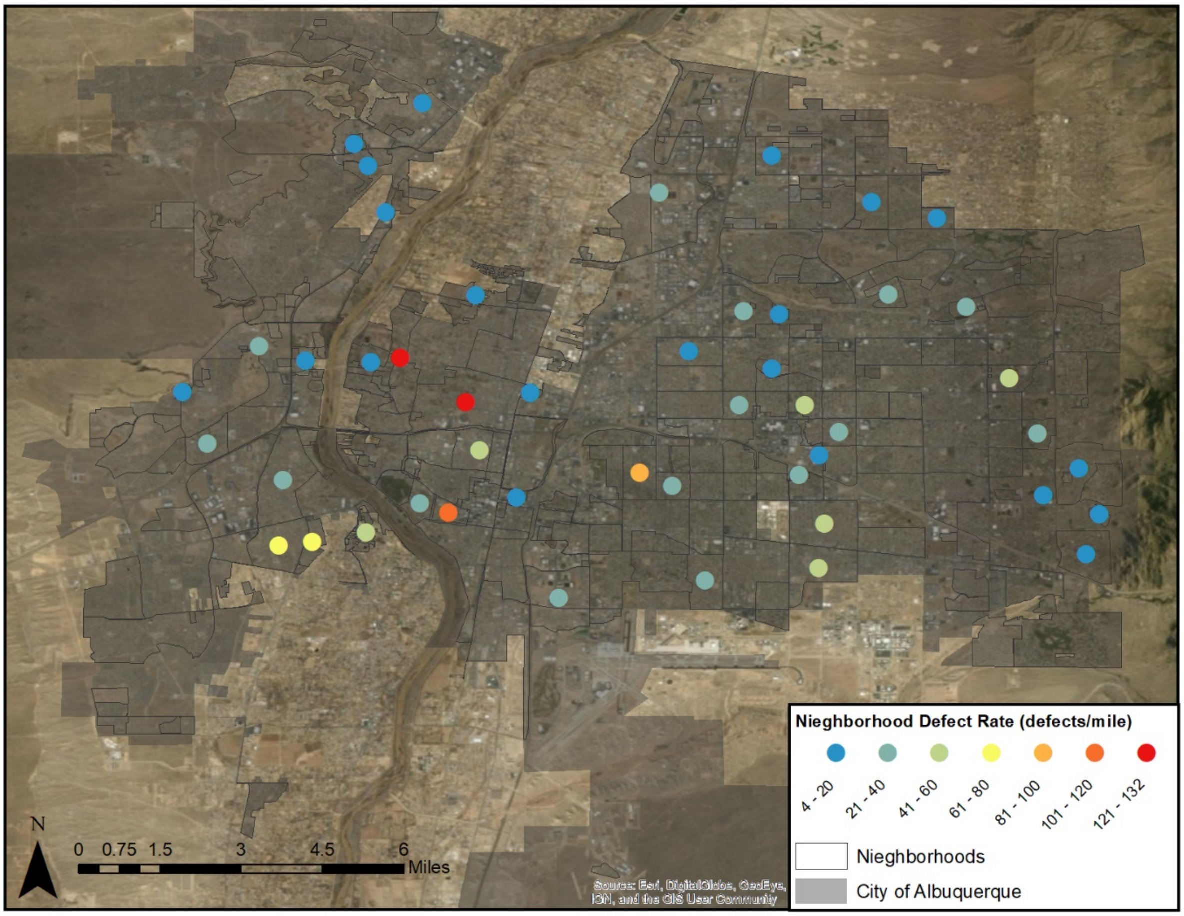

Figure 3. Defect rates from field survey of 50 neighborhoods (each dot represents a neighborhood centroid).

Defect rates from the field survey shown in Figure 3 were then used to estimate defect rates for all areas of the city. We used inverse distance weighting to estimate a defect rate raster covering the entire extent of the city. The raster was then used to estimate the average defect rate within each U.S. Census blockgroup (Figure 4). We aggregated the defect rates to blockgroups so that we could match defect rates with corresponding blockgroup level household and income data from the U.S. Census Bureau's American Community Survey (ACS) that will be used in our tax and equity analysis.

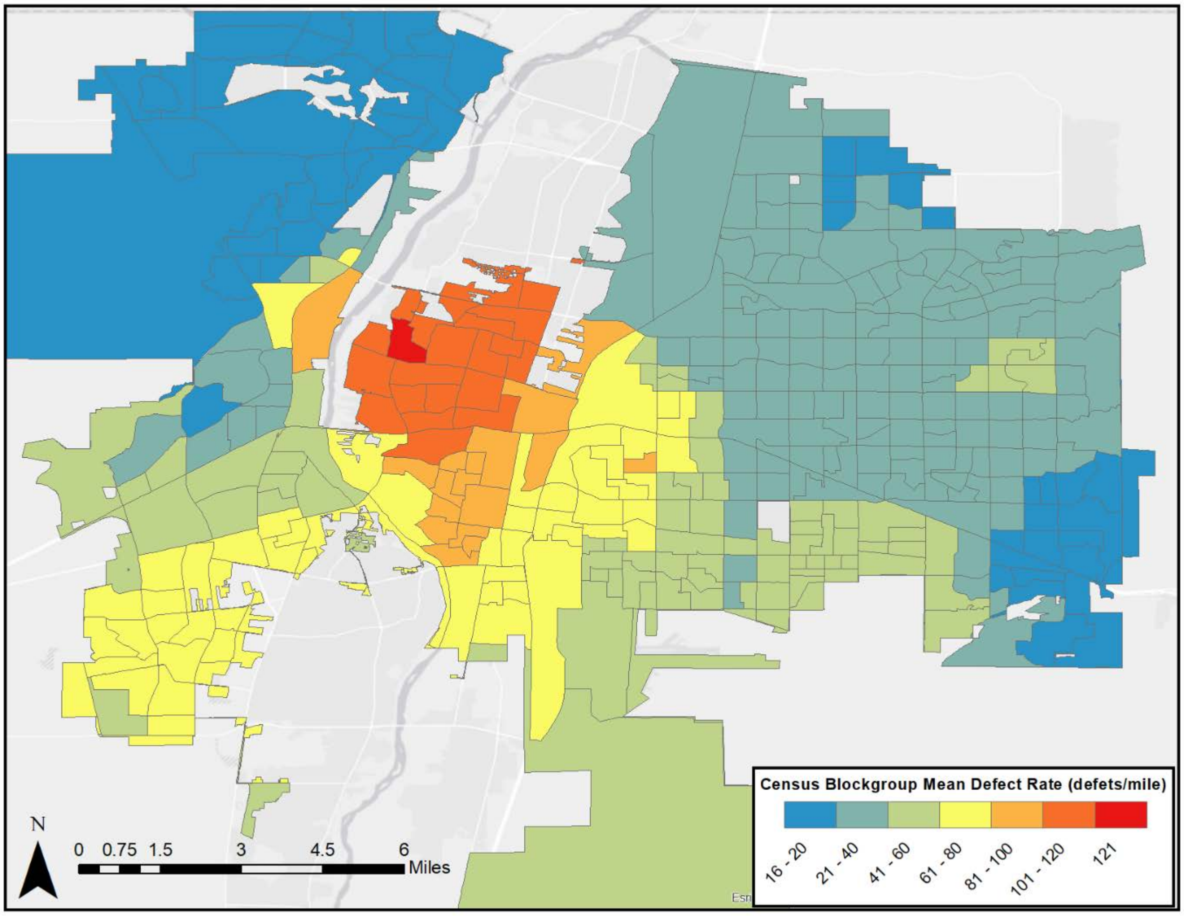

Figure 4. Interpolated defect rates aggregated to census blockgroups.

After we completed our sidewalk inventory we learned that a consultant hired by the City of Albuquerque was also completing an inventory of the city's sidewalks as part of the City's efforts to create an ADA transition plan. The consultant hired by the City completed a draft report of their inventory in October, 2017 (*10*). The consultant's study focused on identifying ADA compliance issues and estimating the costs associated with addressing them. Their analysis included the same sidewalk defects that we considered in addition to other ADA issues such as obstructions from utility poles, geometric design issues, and absent curb ramps. The City's study surveyed sidewalks by analyzing photographs of each sidewalk segment in the City. We plan to compare our results and cost estimates based on our field surveys with the City's image analysis; however, this analysis is outside the scope of this project. A quick visual inspection of the City's results indicates a pattern of defects similar to that shown in Figure 4; however, the defect rates are not comparable given the differing scope of each study.

4.2. Estimating Maintenance Costs

To estimate maintenance costs, we first estimated the miles of sidewalk in each census blockgroup within the City so that we could estimate the total number of defects. Albuquerque did not have a GIS data file on sidewalk infrastructure when we began this project[4], so we estimated the length of sidewalks as twice the length of each roadway in each census blockgroup. Roadways were identified from the City's street centerline GIS data set[5]. We excluded interstate highways and highway frontage roadways from our analysis as these roadway types generally do not have sidewalks along them. We then estimated the total number of defects in each census blockgroup by multiplying each blockgroup's estimated sidewalk length by its estimated defect rate (Figure 5).

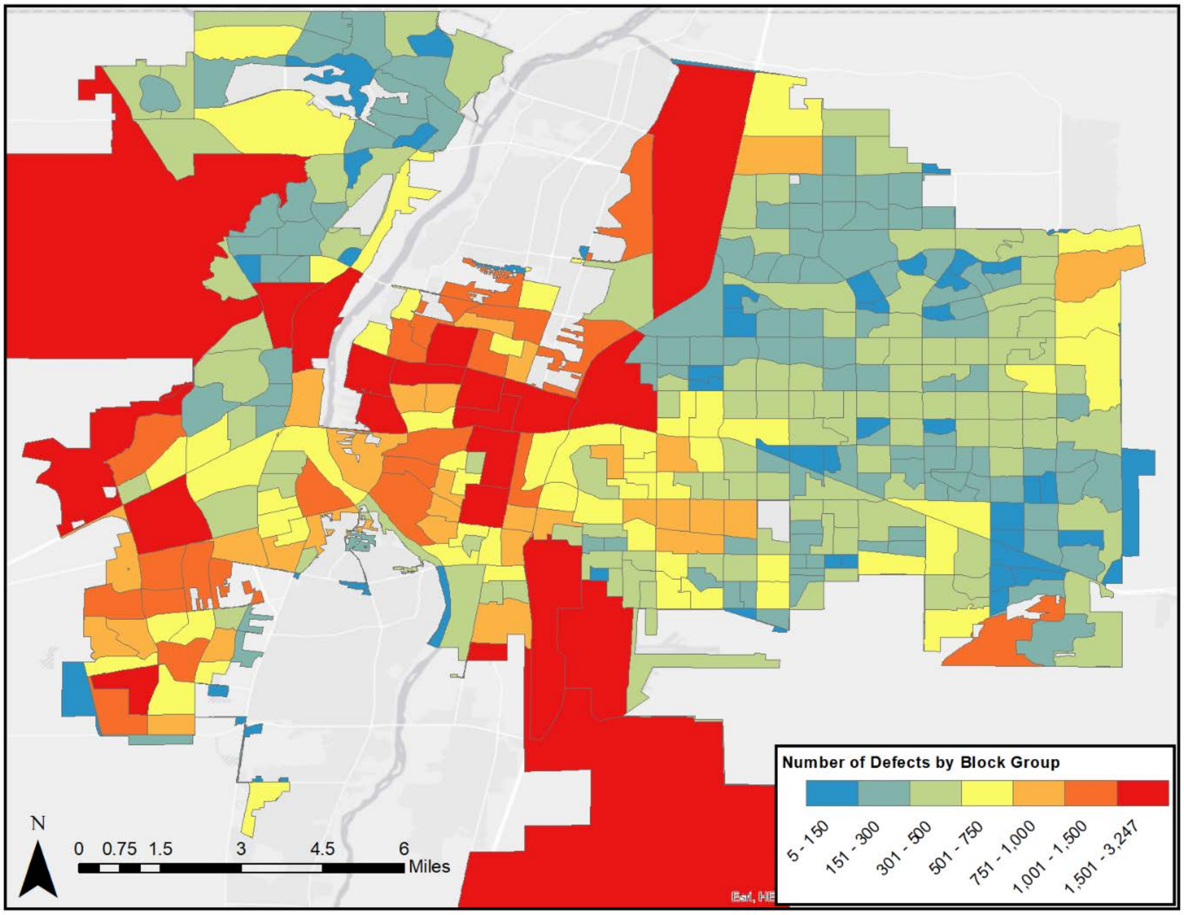

Figure 5. Number of defects by census blockgroup.

We estimated the cost to repair defects in each blockgroup by first determining an average defect repair cost using unit construction cost data from the City of Albuquerque[6] (Table 1). We assumed that each defect would require replacing one 4 by 6-foot section concrete sidewalk, which is a rough estimate of the average size of a sidewalk slab. Furthermore, we

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[4] A GIS layer indicating the location and presence of sidewalks was eventually created as part of the City's ADA transition plan study that was previously mentioned.
[5] Data file "netcurr.zip" downloaded from the city of Albuquerque GIS data website: https://www.cabq.gov/gis/geographic-information-systems-data
[6] City Engineer's Estimated Unit Prices for Contract Item 2018: https://www.cabq.gov/planning/documents/unit-price-guide.pdf

assumed that the concrete slab is 4 inches thick and is not reinforced and that the adjacent curb and gutter would not need to be replaced. We believe these assumptions are reasonable for a rough cost estimate. Some repairs may require replacing larger sections of sidewalk or the curb and gutter and some may require less costly repairs such as angle grinding to smooth over moderate vertical slab displacements. Sidewalk repair costs also included demolition of the existing sidewalk, construction mobilization, and traffic control. Finally, we multiplied the cost of replacing a sidewalk slab by the number of defects in each blockgroup to estimate the cost of repairing sidewalks in each blockgroup and the entire city. The total cost is estimated to be $26,800,000.

Table 1. City of Albuquerque sidewalk maintenance unit costs.

Item	Unit Cost
Construction Mobilization	4.26%
Construction Demobilization	0.3%
Traffic Control and Barriers	3.43%
4-Inch-Thick Concrete Sidewalk	$\$40/yd^2$
Sidewalk Demolition	$\$8/yd^2$
Total Sidewalk Repair Cost	$138.23/slab[a]

[a] slab = 4ft x 6ft

4.3. Equity and Sustainability Analysis

We evaluate three new methods for raising funds to cover the sidewalk maintenance cost estimated above. These include raising the City of Albuquerque's gross receipts tax (GRT, which is similar to a sales tax, but also applies to many services), raising the City of Albuquerque's property tax, and increasing New Mexico's gasoline excise tax, a portion of which is currently returned to municipalities. We also evaluate the current policy of charging adjacent property owners. We do not consider income taxes because most municipalities do not collect them. Each of these financing methods can raise the required revenue to clear the city's backlog of sidewalk maintenance but how their costs are distributed across neighborhoods and socioeconomic groups is likely to differ. Some taxes may be fairer than others. We consider progressive taxes (where lower-income households pay a tax that is a smaller share of their income than higher-income households) to be fairer than regressive taxes (where lower-income households pay a tax that is a higher share of their income than higher-income households).

4.3.1. Estimate Tax Increments

The first step of the tax analysis is determining by how much each of the three taxes would need to be increased to generate enough revenue to cover the estimated maintenance costs. For our study we consider tax increments required to pay for the repairs over 5 years. Changing the timeframe for completing the repairs would affect the magnitude of our results, but the distribution of the tax burden would be the same. The general approach for calculating each tax increment is given by Equation 1.

$$\Delta TR = \frac{C}{R} TR \qquad [1]$$

where:
ΔTR = tax rate increment,

C = estimated annual cost of annual sidewalk maintenance,
R = total annual revenue currently generated by the tax, and
TR = current tax rate.

Existing tax rates for Albuquerque were obtained from multiple state and local government sources. GRT rates were obtained from the New Mexico Taxation and Revenue Department[7] and City of Albuquerque GRT revenue forecasts were obtained from the City of Albuquerque's 2015 five year budget[8]. Property tax rates and revenue were obtained from the New Mexico Taxation and Revenue Department's "Property Tax Facts 2016" report[9]. Gasoline excise tax revenue distributed to the City of Albuquerque was obtained from the New Mexico Taxation and Revenue Department's Combined Fuel Tax Distribution Report[10]. The current tax rates, current revenue produced by each tax and the required tax increment calculated from Equation 1 are shown in Table 2.

Table 2. Year 2016 tax rates, tax revenue, and estimated tax increments.

Tax	Tax Rate (2016)	Tax Revenue (2016)	Tax Increment (Increase)	New Tax Rate (Increase)
GRT[a]	0.5678%	$87,868,000	0.0348%	0.6026%
Property Tax[b]	0.63899%	$80,907,542	0.04248%	0.68147%
Gasoline Excise Tax[c]	$0.01765	$4,832,434	$0.01964	$0.03729

[a] GRT collected by City for general purposes (estimated at 0.5678% out of total 7.1875% GRT).
[b] City portion of county property tax; revenue-weighted average of residential and nonresidential rates.
[c] State gasoline excise tax that is distributed to City of Albuquerque (10.38% of $0.17/gallon state gasoline excise tax).

Our tax incidence analysis is a simplified approach. The analysis does not account for possible demand effects (e.g., the potential of each tax increment to reduce consumption of the goods and services being taxed and increase consumption of other goods and services) which could affect the revenue raised. It also does not account for wider economic impacts, such as how the price of many other goods and services could be affected and how that might change individual's incomes. We also consider a household income rather than expenditures when evaluating tax burden. Expenditure (or consumption) data may provide a more accurate metric of a household's financial resources when evaluating tax burden because low-income households often receive various subsidies and older individuals may have large amounts savings to draw from. We use income data because it is available at a much finer spatial scale than expenditure data, and in our study spatial variation in costs is an important feature. Prior studies suggest that including these additional economic effects tends to moderate the findings (*23*, *24*). A more complete analysis would require far more data and resources than were

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[7] New Mexico GRT Rates: http://www.tax.newmexico.gov/gross-receipts-tax-historic-rates.aspx
[8] Albuquerque Five Year Budget: https://www.cabq.gov/dfa/documents/budget-documents/five-year-forecast-fiscal-2016.pdf
[9] New Mexico Property Tax Facts 2016: http://nmdfa.state.nm.us/uploads/FileLinks/ff1373ca37bb4c4f800f868687821827/Property_Tax_Facts_2016.pdf
[10] New Mexico Combined Fuel Tax Distribution Report: http://www.tax.newmexico.gov/combine-fuel-tax-distribution-reports-cft.aspx

available for this study. Varying levels of simplification are common due to costs and data requirements associated with more complete analyses (*25*). While our simplifications may cause some error, we believe our analysis is sufficient for raising important questions about how many cities finance routine sidewalk maintenance.

4.3.2. Cost of Current City Policy

Under the City's current policy, property owners are responsible for maintenance of sidewalks adjacent to their property. We estimate the expected cost of this policy for the average household in each blockgroup using Equation 2. We first multiply the total cost of sidewalk repairs estimated for each blockgroup by the proportion of residential land area in each blockgroup. This provides an estimate of household repair liability within each blockgroup. Land use data identifying residential and non-residential land use by parcel was obtained from a GIS data file maintained by the City of Albuquerque[11]. The total cost of residential repair liability in each blockgroup was then divided by the number of households in each blockgroup. Data on the number of households at the blockgroup level were obtained from the 2016 ACS 5-year dataset. This method assumes that each household in each blockgroup has an equal chance of having to repair the sidewalk adjacent to their property which causes some error in our calculations. For example, some households live in multifamily housing units and therefore the cost of sidewalk repairs would be shared among multiple households (assuming costs are passed through to tenants in their rent). Additionally, some lots are larger than others, creating greater exposure to sidewalks in need of repair.

$$EC_i = C_{r,i} L_{res,i} / HH_i \qquad [2]$$

where:
EC_i = the expected cost of annual sidewalk repairs for the average household in blockgroup i,
$C_{r,i}$ = estimated total cost of sidewalk maintenance in blockgroup i,
$L_{res,i}$ = estimated proportion of residential land area in blockgroup i, and
HH_i = number of households in blockgroup i.

To evaluate the burden of the current policy on households with different levels of household income, we divide the average household sidewalk repair cost in each blockgroup by each blockgroup's median household income. Blockgroup level median household income data were obtained from the 2016 ACS 5-year dataset. This provides the share of the average household's income in each blockgroup spent on sidewalk repairs.

Our analysis of the City's current policy and each alternative discussed below is aggregated at the blockgroup level as discussed above. We use blockgroup average repair costs and blockgroup median household incomes. This causes two types of potential error in our equity analysis. First, actual repair costs could vary significantly between households within each blockgroup (since some lots are larger than others or because some lots contain multifamily housing). If wealthier households are more likely to live in single family homes or on larger lots than lower-income households, than our analysis may overstate the apparent

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[11] Data file "landuse.zip" downloaded from the city of Albuquerque GIS data website: https://www.cabq.gov/gis/geographic-information-systems-data

repressiveness of the policy. Furthermore, median household incomes may not reflect differences in income distributions between blockgroups. Some blockgroups could have wider ranges of household income than others, and the median may not be a good metric of average household income.

While aggregation to the blockgroup affects our results, the size of the error is likely to be small. Census block groups are a relatively small spatial analysis unit. We expect the type of housing and the socioeconomic characteristics of households to be relatively similar within each blockgroup and more variable between blockgroups. Furthermore, while lower-income households are likely to have smaller lots and live in multifamily housing, there are many examples within Albuquerque of the opposite situation. For example, Albuquerque's more affluent neighborhoods in the Nob Hill, University of New Mexico, and downtown areas contain relatively small homes and a growing number of condos and high rent apartments. Furthermore, newer subdivisions tend to have smaller lots than the older subdivisions and neighborhoods where many of Albuquerque's lowest income households live.

4.3.3. Gross Receipts Tax Burden

To evaluate the average household costs of paying for sidewalk repairs by incrementing the GRT and the burden of an increment in the GRT on households from different income groups, we first need to determine how much households from different income groups spend on goods and services subject to the GRT. We obtain national expenditure data by income decile from the U.S. Bureau of Labor Statistics' 2016 Consumer Expenditure Survey[12]. Expenditure data by income decile are tabulated nationally; for select metropolitan regions but not Albuquerque; and the midwest, northeast, south, and west regions of the country. Although Albuquerque is located in the western U.S., we choose to use the national dataset instead of the west dataset since Albuquerque's lower cost of living and lower incomes are somewhat unique among other western U.S. cities. We identified consumer expenditure categories subject to New Mexico's GRT and summed expenditures in these categories for each of the ten household income quantiles. We then estimated the share of household income subject to New Mexico GRT for each income decile (Table 3).

[12] Consumer expenditure tables: https://www.bls.gov/cex/tables.htm#avgexp

Table 3. Average 2016 household consumer expenditures subject to New Mexico GRT by household income decile (dollars).

Expenditure Category	All	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Food away from home	4,049	2,407	2,596	3,089	3,136	3,526	3,868	4,257	5,219	5,509	6,876
Alcoholic beverages	484	143	173	230	291	312	388	514	624	785	1,378
Household maintenance, repairs, insurance, and other expenses	1,437	544	703	909	1,149	1,128	1,207	1,379	1,877	2,121	3,353
Household operations	1,384	547	621	785	845	923	1,068	1,263	1,574	2,256	3,962
Housekeeping supplies	660	388	365	466	568	582	663	648	720	996	1,208
Household furnishings and equipment	1,829	638	672	1,015	1,222	1,374	1,700	1,798	2,198	2,990	4,686
Apparel and services	1,803	876	845	1,094	1,233	1,381	1,657	1,869	2,050	2,526	4,493
Other Vehicle Expenses	2,884	1,203	1,413	1,695	1,927	2,374	2,881	3,460	3,638	4,629	5,621
Vehicle Maintenance and repairs	849	397	375	518	637	718	936	871	1,138	1,319	1,584
Entertainment	2,913	1,036	1,256	1,663	1,902	2,042	2,646	2,916	3,902	4,604	7,165
Personal care products and services	707	317	350	453	527	534	605	734	820	1,085	1,643
Reading	118	65	63	79	92	98	95	124	105	157	300
Tobacco products and smoking supplies	337	290	319	311	359	360	363	404	361	386	219
Miscellaneous	959	355	316	573	719	1,016	999	1,082	1,042	1,462	2,031
Total Expenditure subject to GRT	20,413	9,206	10,067	12,880	14,607	16,368	19,076	21,319	25,268	30,825	44,519
Mean Income	74,664	6,502	16,229	24,432	33,499	43,931	57,192	73,568	94,739	127,268	269,644
Share of Income Subject to GRT	0.27	1.42	0.62	0.53	0.44	0.37	0.33	0.29	0.27	0.24	0.17

The expenditures subject to New Mexico GRT tabulated in 3 contain several omissions and uncertainties. New Mexico tax laws provide various exemptions from the GRT or lower GRT rates for certain products and services. For example, the GRT rate for new cars is only 3% (instead of 5.15% plus county and municipal taxes), non-profit and government-funded medical service providers are exempt but not private medical providers, and prescription drugs are exempt but not over the counter drugs. Many consumer expenditure categories are not refined enough to account for these and other specific exemptions. In the case of motor vehicles, municipalities do not apply additional GRT, and therefore we exclude this category of expenditure from our analysis. We also exclude spending on lodging since we assume this expense would occur outside of Albuquerque for Albuquerque residents.

As shown in Figure 6, lower-income households spend a larger share of their income on GRT than higher income households. For our analysis we need to estimate the share of household income subject to GRT for households of various income levels (i.e., income levels that differ from those tabulated by the Bureau of Labor Statistics). Therefore, we used ordinary least squares regression to develop a simple function to estimate the share of household income subject to GRT by income (see Equation 3 and Table 4).

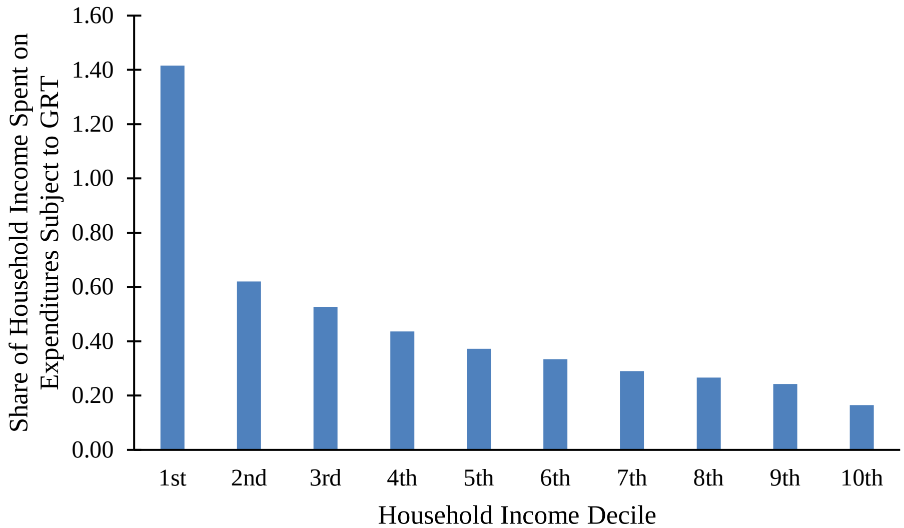


Figure 6. Share of household income spent on GRT by income decile.

$$\ln(S_{grt}) = \alpha + \beta * \ln(I) \quad [3]$$

where:
S_{grt} = share of household income subject to GRT,
α = intercept,
β = coefficient estimate for household income, and
I = average household income.

Table 4. GRT Expenditure by income regression analysis results.

Variable	Coefficient Est.	Std. Error	P value
α	4.95	0.358	<0.001
β	-0.548	0.033	<0.001
number of observations	10		
adjusted R^2	0.97		

We then estimate the additional GRT paid by households earning different annual incomes using the share of household income subject to GRT from Equation 3 in Equation 4. The share of household income spent on the GRT increment can then be estimated by dividing Equation 4 by annual household income.

$$\Delta T_{GRT,i} = I_i S_{GRT,i} \Delta TR_{GRT} \qquad [4]$$

where:
$\Delta T_{GRT,i}$ = additional GRT paid by household with income level i,
I_i = annual household income,
$S_{GRT,i}$ = share of household income subject to GRT for households with income level i, and
ΔTR_{GRT} = increment in GRT tax rate.

4.3.4. Property Tax Burden

To evaluate the average household costs of paying for sidewalk repairs by incrementing the local property tax and the burden of an increment in the local property tax on households from different income groups, we first need to determine how much households from different income groups spend on property taxes. The same CES dataset used in our analysis of the GRT contains household expenditures on property taxes by household income decile (Table 5).

Table 5. Average 2016 household consumer expenditure on property taxes by household income decile (dollars).

Expenditure Category	All	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Property Tax	1,969	566	861	1,018	1,319	1,350	1,587	1,990	2,402	3,110	5,498
Mean Income	74,664	6,502	16,229	24,432	33,499	43,931	57,192	73,568	94,739	127,268	269,644
Share of Income Spent on Property Tax	0.03	0.09	0.05	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.02

Similar to the GRT, lower-income households spend a greater share of their annual income on property taxes (Figure 7). Also, as with the GRT analysis, the CES data are from a national sample of household expenditures, therefore, there is some error in these estimates. For example, property tax rates and property values can vary significantly from across communities.

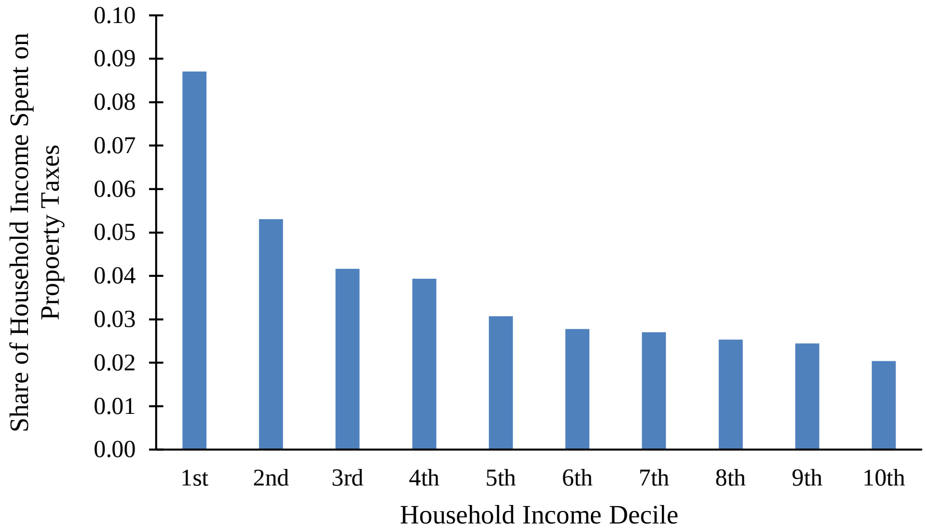


Figure 7. Share of household income spent on property tax by income decile.

Like the GRT analysis, we use ordinary least squares regression to create a simple equation for estimating the share of a household's income spent on property taxes by income level (Equation 5).

$$\ln(S_{prop}) = \alpha + \beta * \ln(I) \qquad [5]$$

where:
S_{prop} = share of household income spent on property tax,
α = intercept,
β = coefficient estimate for household income, and
I = average household income.

Table 6. Property tax expenditure by income regression analysis results.

Variable	Coefficient Est.	Std. Error	P value
α	0.858	0.375	0.051
β	-0.394	0.035	<0.001
number of observations	10		
adjusted R^2	0.93		

We then estimate the additional property tax paid by households earning different annual incomes using the share of household income spent on property taxes from Equation 5 in Equation 6. The share of household income spent on the property tax increment can then be estimated by dividing Equation 6 by annual household income.

$$\Delta T_{prop,i} = I_i S_{prop,i} (\frac{\Delta TR_{prop}}{TR_{prop}}) \quad [6]$$

where:
$\Delta T_{prop,i}$ = additional property tax paid by household with income level i,
I_i = annual household income,
$S_{prop,i}$ = share of household income spent on property tax for households with income level i,
ΔTR_{prop} = increment in property tax rate, and
TR_{prop} = current property tax rate.

4.3.5. Gas Tax Burden

To evaluate the average household costs of paying for sidewalk repairs by incrementing the gasoline excise tax and the burden of increasing the gasoline excise tax on households in different income groups, we need to first understand the relationship between household income and vehicle miles traveled (VMT). To do this we evaluate household travel survey data collected by the Mid-Region Council of Governments in 2013 (*26*). The household travel survey questionnaire asked a sample of residents in the Albuquerque metropolitan area to record all of their travel for one weekday during 2013 from which the distance of each trip was calculated. The questionnaire also asked respondents about their household income (respondents reported income in one of 10 ranges) and other socio-economic information. The survey data also contained household and trip sample weights that we used to estimate population statistics from the survey sample.

We evaluate the household travel survey data by first aggregating the number of households and the total distance of trips by household income category. We then estimate the average annual trip distance (annual VMT) per household for each income group as shown in Figure 8. Since the relationship is nearly linear we fit a linear equation to these data using ordinarily least squares regression (Equation 7 and Table 7) so that we can estimate VMT for households of various income levels. We exclude the high-income category in our regression analysis since it is based on a relatively small number of households and includes a very wide range of incomes.

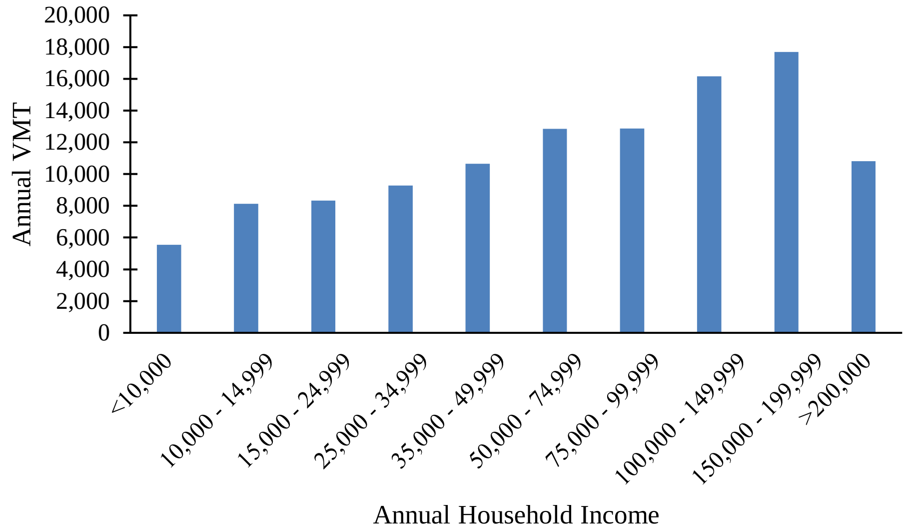


Figure 8. Relationship between household income and annual household vehicle travel.

$$VMT = \alpha + \beta(I) \quad [7]$$

where:
VMT = annual household vehicle miles traveled,
α = intercept,
β = coefficient estimate for household income, and
I = average household income.

Table 7. Household travel regression analysis results.

Variable	Coefficient Est.	Std. Error	P value
intercept	7,059	604.7	<0.001
annual household income	0.067	0.0073	<0.001
number of observations	9		
adjusted R^2	0.91		

We then estimate the additional gas tax paid by households earning different annual incomes using VMT estimated from Equation 7 and an average fuel economy of 22.0 miles per gallon in Equation 8. The average fuel economy is an estimate of the 2016 U.S. light-duty fleet average fuel economy made by the Federal Highway Administration *(20)*. The share of household income spent on the gas tax increment can then be estimated by dividing Equation 8 by annual household income.

$$\Delta T_{gas,i} = (\frac{VMT_i}{22.0})\Delta TR_{gas} \quad [8]$$

where:
$\Delta T_{gas,i}$ = amount of additional gas tax paid by a household with income level *i*,
VMTi = annual vehicle miles traveled by a household with income level *i*, and
ΔTR_{gas} = increment in gas tax rate.

5. FINDINGS

In this section we first present aggregate cost and cost burden results for each sidewalk repair finance option and then present spatially detailed analysis of these same quantitates. In addition to our evaluation of costs, we also evaluated how defect rates correlate with neighborhood income levels. Figure 9 shows the distribution of blockgroup average defect rates grouped by blockgroup average median household income level. The results in Figure 9 indicate that lower income blockgroups tend to have higher defect rates, although defect rates are quite variable across all income groups. This result is similar to what prior studies have found, including an audit conducted by the City of Albuquerque inspector general (*11*).

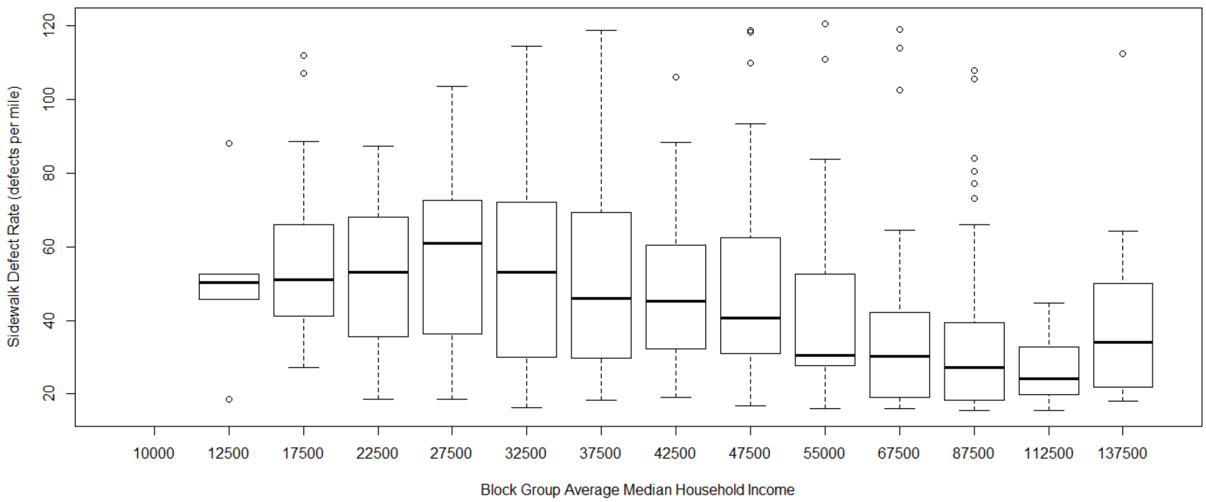


Figure 9. Defect rates by household income level.

Our analysis also finds that each sidewalk finance alternative would affect the average annual cost paid by households in Albuquerque as well as how those costs are distributed across households of different income levels (Figure 10). For all households financing sidewalk repairs by incrementing the GRT would be the lowest cost option, with most household paying between \$3 to \$10 annually over five years. Incrementing the gas tax would also be a lower cost option for most households and is similar to incrementing the GRT, with annual costs ranging from \$7 to \$15 annually. Some very low and high-income households would pay about the same or a little more annually under the gas tax alternative than the current policy. The property tax alternative would be the most expensive for almost all households with annual costs ranging from \$7 to \$30. Higher income households would have much higher costs than lower-income households with the property tax alternative. Finally, the current policy falls somewhere in between the various alternatives with annual costs ranging from \$7 to \$18. The current policy would cost middle-income households the most.

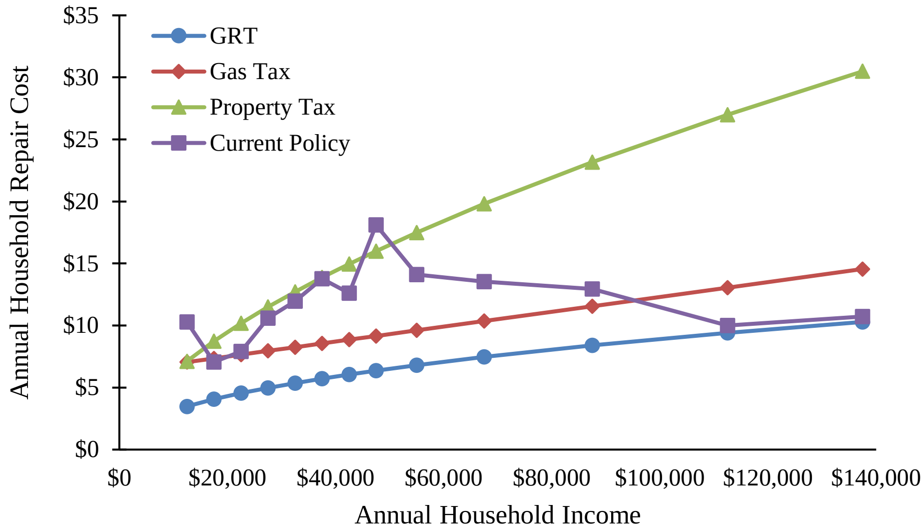


Figure 10. Average annual household repair costs by household income for each sidewalk finance policy.

While each finance option generally requires higher income households to pay more, these costs would be a smaller share of their annual household income (Figure 11). In other words, all of the options we evaluated are regressive, since they would require lower-income households to pay a larger share of their annual income towards sidewalk repairs. The current policy appears to be the most regressive option, followed by the gas tax. The property tax and GRT are similar in terms of repressiveness, although the GRT would cost all households less.

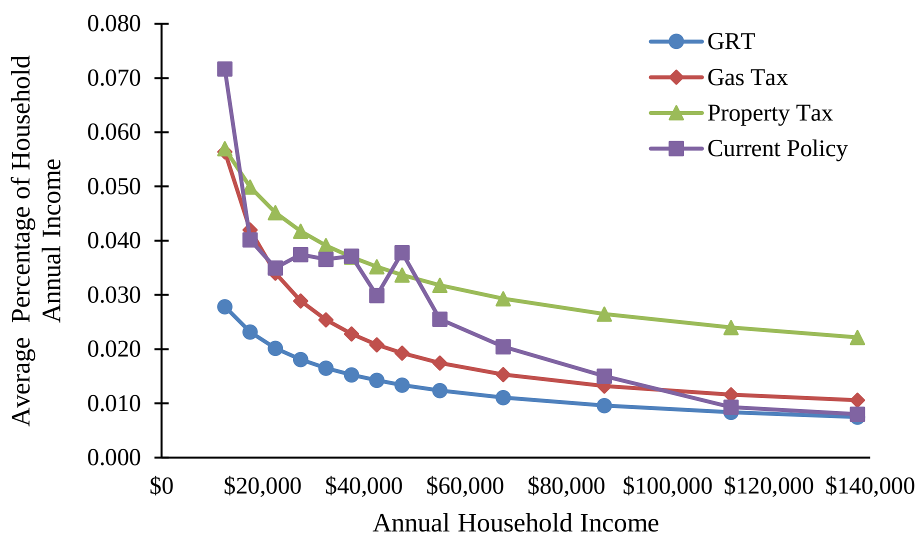
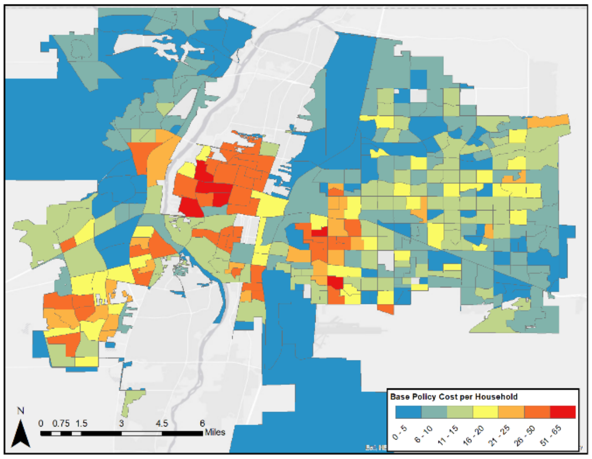
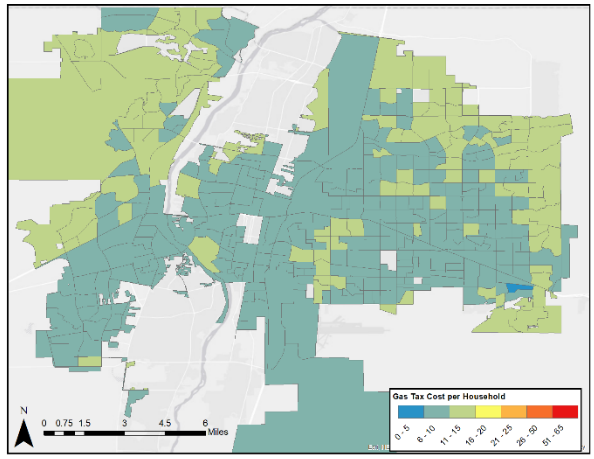


Figure 11. Average percentage of annual household income spent on sidewalk repairs for each sidewalk finance policy.

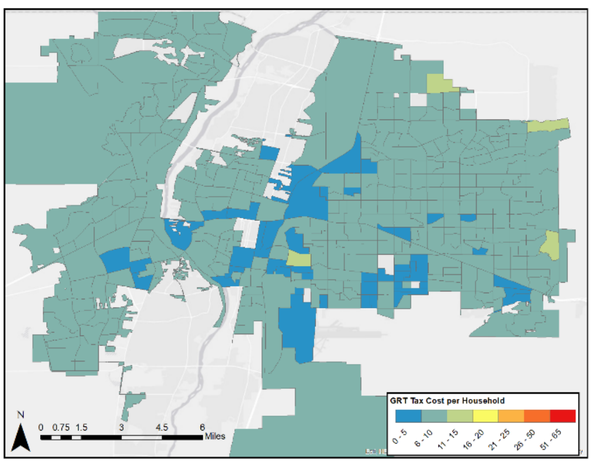
We also evaluated the spatial distribution of average household costs and cost burdens. As shown in Figure 12, each alternative affects the distribution of repair costs across neighborhoods. The current policy results in the greatest neighborhood-to-neighborhood variability in annual household repair costs followed by the property tax alternative. The current policy places the greatest costs on neighborhoods with the most defects, while the alternative policies distribute costs based on other factors (i.e., driving, property value, and spending) that are closely related to household income. The current policy and the property tax policy result in almost the complete opposite distribution of costs, with the property tax alternative placing greater costs on neighborhoods with fewer defects. The other alternatives spread costs out relatively evenly.



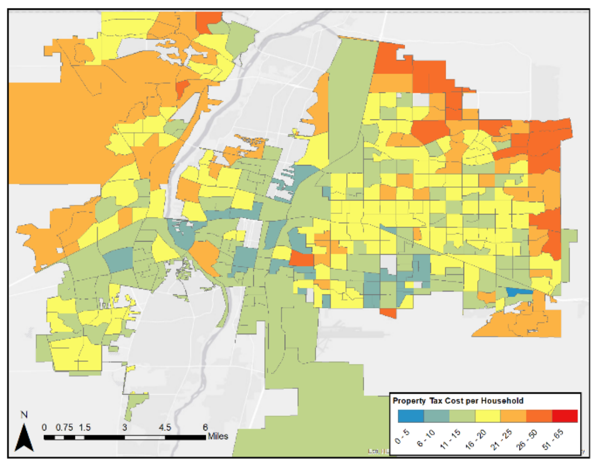
Baseline Policy



Gas Tax



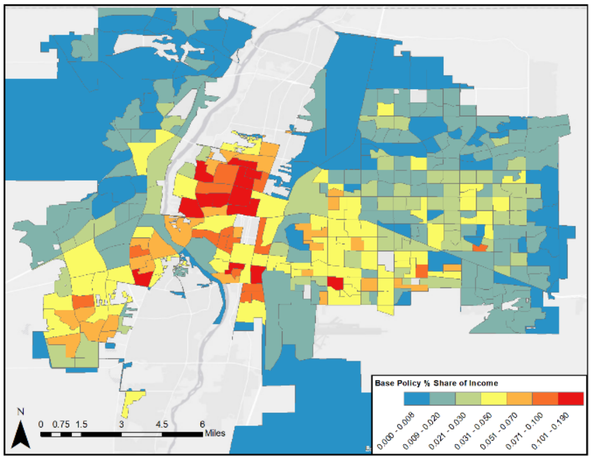
GRT



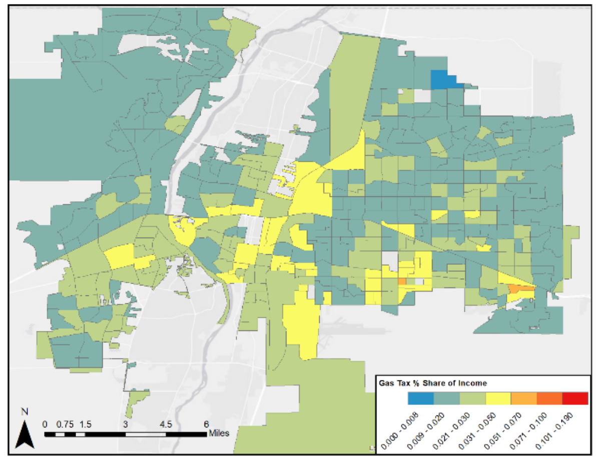
Property Tax

Figure 12. Blockgroup level average household repair costs for each sidewalk finance policy.

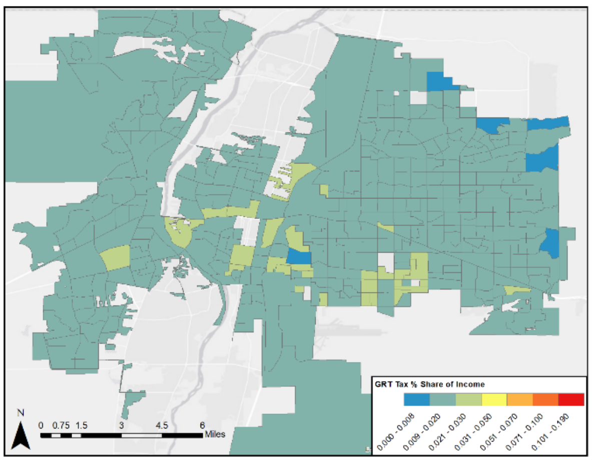
Since each financing alternative distributes cost differently across the City's neighborhoods, and since household income levels also vary across the city, each financing alternative results in a different spatial distribution of cost burden (Figure 13). The current policy results in the greatest neighborhood-to-neighborhood disparities in the share of a household's income spent on sidewalk repairs. Incrementing the GRT would result in the smallest amount of spatial variation while the other alternatives would result in relatively more disparity.



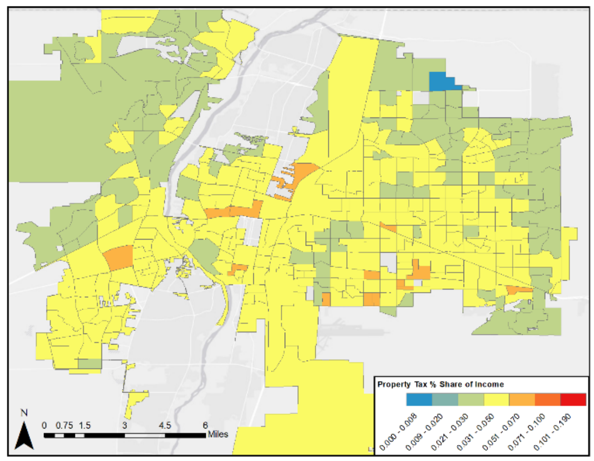
Baseline Policy



Gas Tax



GRT



Property Tax

Figure 13. Blockgroup level average percentage of household income spent on sidewalk repairs for each sidewalk finance policy.

6. CONCLUSIONS

In this study we set out to evaluate alternatives to the common municipal policy of requiring property owners to maintain public sidewalks adjacent to their property. Our review of the literature did not turn up any evidence in support of either the efficiency or effectiveness of this common policy. The origins of this policy and why it differs from how streets are maintained are still unclear. That many municipalities, including Albuquerque, have failed to maintain sidewalks suggests that the adjacent property owner asset management and financing model is ineffective. Furthermore, we did not identify any prior research evaluating the equity and environmental justice concerns related to the adjacent property owner responsibility model; however, prior research suggests that this policy is likely to raise concerns since lower-income communities may be more likely to have less maintained pedestrian facilities and because lower-income households may also depend on walking for transportation more so than higher income households. Our analysis of sidewalk conditions in Albuquerque finds that lower-income neighborhoods generally have a higher level of sidewalk defects and that the lack of maintenance presents equity and environmental justice concerns. While we cannot conclude that the property owner responsibility model is responsible for the inequitable state of sidewalk condition, the current policy seems unlikely to address these concerns.

We evaluated three alternative methods to finance the repair and maintenance of public sidewalks that would raise revenue through commonly collected municipal taxes. One advantage of municipal revenue generation and municipal responsibility for maintenance is that the costs of sidewalk repairs and maintenance could be reduced through coordination with other street maintenance and construction projects and economies of scale in making the repairs. Administrative costs of enforcing the current policy, costs that may be part of the reason many municipalities fail to maintain sidewalks, would also be eliminated. We were unable to evaluate these potential cost savings in this project, but they could be significant. These policies would also bring sidewalks into alignment with how adjacent roadways are financed and managed. It would not require an entirely new approach to municipal asset management.

The three alternatives we evaluated would all raise the same amount of additional revenue, which equals the current estimated cost of repairing all of Albuquerque's sidewalks (for routine maintenance issues and not for other ADA-related issues) over a period of five years. That is, the alternatives would not cost, on average, any more than the current policy if it were enforced. The main difference between the alternatives is how the costs of sidewalk repairs are distributed across the City's different neighborhoods and households of different income levels. Each alternative also has a different sized tax base that affects the average cost to Albuquerque residents. Therefore, we evaluated the average costs of each alternative and the distribution of costs. We also considered the fairness of each alternative by evaluating the burden of each tax on households with different income levels by considering the costs as a share of household income.

We found that the current policy is both the most regressive (i.e., places a greater burden on lower-income households) and results in the most inequity in sidewalk repair costs across the city's neighborhoods. The current policy is also relatively expensive and places the highest costs on middle-income households. Increasing the GRT or gasoline excise tax would be the least costly options since they have the largest tax bases (they both collect revenue from nonresidents). Increasing the property tax would cost many residents about the same on average as the current policy. However, it should be kept in mind that our cost estimates are annualized and that the current policy, if enforced, would require affected residents to pay sidewalk repair costs all at once and not over a period of several years or more. All of the alternatives are also regressive, but less so than the current policy.

7. RECOMMENDATIONS

So, what should a city do? Based on our literature review and the alternatives that we evaluated, we conclude that adjacent property owner sidewalk maintenance and finance policies are likely to be relatively regressive, expensive, inefficient, and may also be ineffective at maintaining sidewalks in a state of good repair since they are relatively difficult to enforce. Any of the alternatives that we evaluated would be better options for several reasons.

First, that the alternatives would turn over responsibility to the municipality could reduce costs through more effective asset management, lower administrative costs, and economies of scale. Additionally, sidewalks are generally publicly owned or on public easements. They are an essential part of a municipality's publicly owned and managed transportation network. Failure to maintain parts of the network can degrade the entire network. For example, a damaged sidewalk slab can require a large detour for a disabled pedestrian. The pedestrian network also connects most other modal trips to their final destinations (e.g., to walk to transit or to walk to a store from a parking space).

Second, the alternatives are more likely to address equity and environmental justice concerns. The alternatives are more likely to result in adequate sidewalk maintenance since they would not have the enforcement difficulties of the current policy. This, alone, could eliminate the disparities in maintenance needs between neighborhoods. Furthermore, the alternatives are less regressive. They would place a smaller burden on low-income households.

Third, for most residents the alternatives would also be less expensive. Increasing the GRT would be the least expensive option followed by the gas tax because these taxes generate revenue from non-residents. The property tax would cost about the same as the current policy since its tax base is Albuquerque residents and businesses – the same as the current policy.

It is difficult to conclude which of the alternatives would be the best policy option. Increasing the GRT would result in the lowest costs and reduce the burden on lower-income households the most. The gas tax would be similar to the GRT but a little more expensive and more regressive. However, as a tax on driving, the primary reason for why sidewalks are needed in the first place, the gas tax may be more aligned with the particular funding need (i.e., it could be considered a Pigouvian tax – a tax on a negative externality). The property tax is about as expensive as the current policy for middle to low-income households but less regressive. One potentially attractive attribute of increasing the property tax is that it is most similar to the current policy which places all maintenance responsibly on adjacent property owners. Both the current policy and increasing the property tax directly charge property owners for sidewalk maintenance.

An additional consideration should be the sustainability of each tax. Raising taxes is a difficult task and therefore a tax that requires fewer adjustments overtime may be desirable. All of the taxes will generate more revenue as the region's population grows, although growth likely means greater sidewalk maintenance costs too. The gas tax is the least sustainable because the vehicle fleet is expected to become more fuel efficient over time as more stringent federal fuel economy standards come into effect and the fleet turns over. Furthermore, an increasing market share of electric vehicles could further erode gas tax revenue. For a period of time VMT per capita was also declining, further eroding gas tax revenue; however, that trend has at least temporarily reversed. Revenue from the GRT depends on the region's economic activity. There is potential for both growth and decline. The GRT is likely the most volatile of the options but has a more sustainable future than the gas tax. Finally, property tax revenues are also tied to the regional economy but will likely respond more slowly to changing economic conditions than expenditures subject to the GRT.

While our analysis has been simplified in many ways as described in the methods section, we believe it presents a very strong case for municipalities to reconsider how they manage sidewalks and how sidewalk repairs are financed. Municipalities may consider conducting a more formal economic analysis of the wider economic impacts of any changes to current municipal tax rates that were not considered in our analysis. Since the increase in taxes that would be required are relatively small, significant economic impacts are unlikely. The potential benefits of the alternative sidewalk finance policies, including the potential ability of better-maintained sidewalks to increase property values and encourage economic development, reduce municipality liability to ADA and injury claims, and to reduce overall sidewalk repair costs would likely outweigh any negative economic impacts from increasing tax rates.

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