

# **Economic Effects of Access Management Techniques in North Carolina**

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<p>Abstract</p> <p>The NCDOT has made significant strides to reduce collisions and increase capacity along strategic highway corridors across the state. Efforts have led to the implementation of many different access management techniques along corridors, such as installing medians versus two-way left turn lanes, using leftovers, closing median openings, and installing superstreets. The Department has continued to receive comments from businesses along these corridors indicating their concern that these new designs will have a negative economic impact because of the lack of direct access to their properties. This study employs a perception based survey technique with the use of comparison sites to create a pseudo before-after study. Owners of businesses along treatment corridors viewed access management techniques in a more positive light than the perceptions of those on comparison sites. Their similar performance in terms of business revenues indicates that there is no direct evidence of negative economic impacts due to access management installations.</p>			
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## **Disclaimer**

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## **Executive Summary**

Access management has evolved over decades and has become a hot topic in recent years as transportation engineers are seeking to provide more sustainable transportation networks. If used correctly, access management techniques can provide significant safety and operational benefits over more traditional roadway designs such as two-way left turn lanes. However, businesses contend that median divided facilities limit the ability of their consumers to reach their establishments. Although research in other states does not suggest this is true, these business owners have been vocal opponents of these techniques in many public meetings throughout the state of North Carolina. In particular, North Carolina businesses are not trusting the results obtained from studies done in other states. Therefore, NCDOT initiated a non-biased research study to determine the effects of access management on surrounding businesses that are specific to this state. These findings, along with previous North Carolina research in the areas of operations and safety along these corridors, should provide important information related to the various trade-offs associated with installing median divided facilities.

The Institute for Transportation Research and Education was tasked with conducting this research effort. A perception based survey was employed by the research team talking to business owners and managers at various treatment installations across the state. Comparison sites were used to account for factors not attributed to the median, such as the recent economic downturn. Sixteen total sites were surveyed: eight treatment sites and eight matched comparison sites. A total of 789 businesses were surveyed.

When analyzing the available survey data, and accounting for external factors such as the economy, the research team determined the following results to be statistically significant at the 95% confidence interval.

### *Economic Effects*

- There was no statistically significant difference in self-reported revenue changes between comparison and treatment sites, even when looking at individual treatment/comparison pairs.
- Based on the data, the perceived effect on the number of customers per day was much worse at comparison sites than treatment sites, indicating that the median did not affect customers as severely as owners originally thought.
- The single-location local business was the only business type that had a statistically significant difference in perceived revenue decreases due to the economy **and** the median, noting that although the economy was the primary reason for decreased revenues, the median was the perceived cause in revenue decreases in many cases also.
- An analysis of the rate of new or vacant businesses (i.e. turnover) showed that treatment corridors typically had more new or vacant locations than their comparison sites. Thus, while the economic comparison of businesses on treatment and comparison sites showed very little differences, there may be evidence that some treatment-site businesses may have left the location prior to the survey date. Conversely, a high occurrence of new businesses points to at least some positive economic activities at the treatment sites.

### *Surrogate Effects*

- Overall, business owners and managers believed that roadway modifications did not improve safety; however, treatment sites were much more likely to indicate positive safety benefits. This is also true when looking at individual site pairs. This finding likely indicates a perception change after the median is actually installed and driver behavior changes.
- Only 15% of business owners and managers at treatment corridors actually ranked accessibility as the number one consideration of customers at their businesses. In fact, 62% of treatment respondents at these sites ranked accessibility as 4<sup>th</sup>, 5<sup>th</sup>, or 6<sup>th</sup>.
- Treatment sites responses said operations had improved or stayed the same 71% of the time, while comparison sites only thought operations would improve or stay the same 57% of the time, indicating that the before business survey population were less likely to agree with that operations would improve than those businesses that had seen the operational improvements following construction.
- Business responses said safety had improved or stayed the same following construction with a response rate of 64%.
- Accessibility to the store was perceived to be much worse between comparison and treatment respondents; however, the perception at treatment sites was much better than

comparison sites indicating again that the median did not affect customers as severely as originally thought.

In summary, it appears that the survey data indicates a significant and positive change in respondent's perceptions between comparison and treatment sites. In spite of the overall negative reactions to a proposed median installation, survey data from the businesses represented here appear to support a more favorable perception once the median is finally installed.

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## Introduction

Better highway safety and improved operations are key motivating factors in the majority of improvements made in vehicles and the roads they operate on. Many improvements have been made in the last twenty years on both fronts (*Demosthenes, 1999*). Vehicles are much safer with improvements in braking, front and side impact airbags, and improved structural support and energy absorption. Other vehicular improvements in safety operation have been made by automating vehicles through initiatives such as the Intelligent Vehicle Initiative and IntelliDrive (*FHWA 1998a-f, Lee et. al 2007, USDOT 2010*).

In the context of roadway design, access management has evolved over decades and is constantly progressing to encourage sustainable transportation networks (*Williams and Levinson, 2008*). An array of options exist now that aim to improve the highways we drive on, the majority of which involve access management techniques, defined as “the systematic control of the location, spacing, design and operation of driveways, median openings, interchanges, and street connections” (*TRB 2003*).

Generally speaking, access management techniques provide significant safety and operational benefits compared to traditional fully directional access designs such as two-way left turn lanes (TWLTL's). However, business owners—in particular those affected by a highway improvement project as opposed to new designs—generally argue that median divided facilities will provide limited access to their storefronts. Therefore, access management projects are oftentimes perceived by business owners as impacting their profits and competitiveness.

Business owner complaints and apparent lack of support for access management projects was the primary motivation for this research effort. The objective was to quantify the economic effects of access management techniques on businesses adjacent to multilane highways in an unbiased manner. This North Carolina (NC) specific research effort supplements research

already completed in NC on the operational and safety impacts of access management, all of which should provide great resources to DOTs and municipalities when engaging the public.

## **Background/Literature**

The literature on access management is primarily focused in three areas: economic, safety, and operational effects. The large majority of research has focused on the latter two, and only in the last ten years has work been done on the economic effects. Because this research effort focuses on the economic effects of access management, economic studies will be discussed first, followed by safety studies and then operational studies.

### ***Economic Studies***

Economic studies use three primary techniques to examine the economic effects of access management: 1) perception based surveys at retrofit median installation sites, 2) before-after survey based studies, and 3) empirical studies using quantitative data. Previous research utilizing one or more of these techniques is described in this section of the report.

The Florida Department of Transportation constructed medians on five corridors and evaluated median impacts using a perception based survey of drivers and businesses (*Ivey, Harris & Walls, Inc., 1995*). According to businesses, 57% thought the median changes had affected their volume of business positively or had no effect, while 43% of businesses felt that the median changes had a negative impact on their volume of business.

A study in Iowa examined nine in-state sites for access management impacts on local businesses using a before and after perception-based survey method (*CTRE, 1999*). The overwhelming majority of surveyed businesses (94%) reported that sales stayed the same or increased after the project was completed. Of the ten businesses reporting sales loss, five involved raised medians and four involved TWLTL's. In addition, the businesses along access-

managed corridor projects had a lower rate of failure than other businesses in Iowa, likely due to increased development and revitalization on those corridors.

NCHRP Project 25-4 examined the economic effects of restricting left turns on highways located throughout the US using empirical based sales and revenue data from 9,200 businesses (*TRB, 1998*). A large comparison group was used to account for increasing or decreasing trends in the case study areas. When left turn access into a gas station, non-durable goods retailer, or service business is restricted, these businesses were the most likely to be negatively affected with decreases in sales and an increase in failure rate. On the contrary, grocery stores and restaurants were most likely to be positively affected with increases in sales and a decrease in failure rate.

Eisele and Frawley studied ten access managed corridors in six cities in Texas using perception based surveys conducted before and after construction of the facilities along each of the ten corridors (*Eisele & Frawley, 2000*). Overall, businesses reported that regular customer visits were positively affected or had no effect 86% of the time. Surveyed customers reported that the updated roadway median design projects had no effect or a positive effect on their choice of sit-down restaurants (83%), gas stations (50%), and fast food restaurants (69%).

Vu, et al., studied six access managed corridors in King County, Washington by surveying businesses (Vu, et al., 2002). The majority of businesses reported that access management had a negative impact on their revenue and patronage. Perception models were utilized in this study to examine the relationship between the perception of accessibility and customer impacts due to access. The models confirmed the correlation of a business's perception of accessibility and customer impacts due to access.

Other studies have found similar results to those above. An overall look at the economic effects of access management shows a variety of experiences. Some businesses along facilities show

negative effects through survey feedback and analysis of sales and property data, while many other areas show either no effect or a positive effect when given surveys. Overall however, the synopsis of existing research indicates that access management strategies have either no effect, a reasonably desirable outcome considering other safety and operational benefits, or a positive effect. The following sections will elaborate on safety and operational effects of access management.

### ***Safety Studies***

Safety is often one of the key factors in access management strategies, including median installation. A previous study in NC examined corridor-level safety impacts by comparing 4-lane median divided roads to 5-lane roads with a TWLTL as the center lane (Phillips et al., 2005). The cross-sectional modeling comparison used 143 road segments from across the state and found that median divided segments were generally safer than TWLTL segments.

Potts, et al. (2004), studied the safety impact of U-turns at median openings along urban and suburban arterials. The authors examined 806 unsignalized median openings on 62 corridors in seven states. The results showed that U-turn and left turn crashes were infrequent (0.41 crashes per median opening per year for urban arterials; 0.20 for rural arterials), thus drawing the conclusion that U-turns at unsignalized median openings were not a serious safety problem.

Liu, et al. (2008), examined the safety of right turn plus U-turn maneuvers. They studied 140 roadway segments on urban and suburban arterials where directional median openings forced left-turning drivers to make a right turn and then a U-turn at a downstream median opening or signalized intersection. They concluded that U-turn crashes accounted for only a small percentage of crashes at these sites. For crashes that did occur, they determined that the major street Average Daily Traffic (ADT), the U-turn bay's location, and the separation distances

between driveway exits and downstream U-turn locations were major factors in the crash frequency.

NCHRP Report 420 summarized the results of 11 studies that examined the safety impacts of replacing TWLTLs with nontraversable medians (Gluck, Levinson, & Stover, 1999). The studies showed a clear trend of crash reductions after the median was installed. Report 420 found that sideswipe, rear-end, right-angle, left-turn, head-on, and pedestrian crashes were consistently reduced.

### ***Operational Studies***

Access management strategies are often implemented to improve operations of the roadway, especially for travel time and delay reduction for the mainline highway. Several studies have examined the operational impact of access management strategies on adjacent locations, such as delay at intersections due to increased U-turns and travel time issues for minor street traffic.

Carter, et al. (2005), examined the effects of increased U-turns at signalized intersections along the median-divided roads in North Carolina. The 16 intersections were selected on the basis of high U-turn percentages. They found that increased amounts of U-turns added a small operational delay for the left turn lane (approximately 2% decrease in saturation flow for every 10% increase in U-turns) but posed no significant safety issue, based on crash history at the intersections.

Liu, et al. (2008), investigated the effects of U-turns on the capacity of unsignalized intersections on four lane divided roads. They found that the capacity of the left turn lane decreases with an increase in U-turn percentage, on the order of 3% capacity decrease for every 10% increase in U-turns for moderately low traffic conditions, slightly larger than their result for left turn capacity at signalized intersections.

Zhou, et al. (2002), studied the operational effects of U-turns as alternatives to direct left turns from driveways. The authors collected data on delay and travel time at eight arterial sites in the Tampa Bay area. Their results detailed the situations where one maneuver or the other (direct left turn vs. right turn plus U-turn) would provide the more efficient traffic flow.

### ***Literature Summary***

The body of literature points to overall positive effects from access management. Safety on the road corridor is improved due to decreased conflict points and greater separation of opposing flows. Roadway operations are improved, typically with the greatest benefit going to the main road traffic. However, even minor road traffic has been shown to have improvements in travel time and a minor positive effect on delay at intersections. Economic experiences of businesses on access-managed corridors have been shown to be generally positive or having little to no effect. Concerning methodology, most research on economic effects used some kind of survey method to gather data from businesses, with limited studies using empirical data.

### **Study Methodology**

Based on the literature, three primary study methods exist: empirical, survey based before-after, and perception based surveys at managed facilities. Empirical based studies represent the most quantitative, unbiased studies; however, they are hard to conduct because of the limited availability of accurate, dependable data. The two most prevalent studies were before-after and perception based surveys at median facilities. Before-after survey based studies are the preferred survey method because they provide a method of determining perception changes; however, they are less common because they require data collection prior to the treatment installation. Timing and duration of access management studies typically make a before-after assessment infeasible. Perception based surveys following treatment installation therefore represent the overwhelming majority of access management studies conducted to date.

To provide the most reliable results, the research team initially proposed an empirical study using revenue based data of tenants along access management corridors, as found in the Economic Development Intelligence System at the Department of Commerce. A pilot test was conducted to determine if the data were usable or if other study methods needed to be explored. Similar to conclusions from many prior studies, the revenue data were obtained but found to be unreliable. Of the 31 businesses evaluated along the pilot corridor, 28 used estimates of revenue based on models, while only 3 were based on actual sales data. Because revenue data with modeled estimates provided insufficient accuracy, a perception based survey approach was devised. The selected test (treatment) sites were all existing access managed facilities, so the perception based treatment survey was used over a before-after survey method. In an effort to improve the study design, the team supplemented the data collection effort to include comparison sites, which allows for a pseudo before-after evaluation if the comparison sites are representative of broader economic trends along the access management study sites.

Comparison sites serve two primary purposes for our analysis. First, trends at comparison sites will help account for background economic trends, which are likely to have taken place during a general economic downturn in much of NC and the US in the years preceding this study. Second, business owners on comparison sites were asked questions using a “what-if” scenario, which will represent the pseudo before period for treatment sites. In this way, the team looked at perception changes from the pseudo before period (represented at comparison sites) to the actual perceptions following median installation at treatment sites to determine if perceptions improved following installation. The perceptions from both the treatment and comparison sites, therefore, look to gauge what the opinions of respondents are in a before-after type scenario. The analysis methods used in this report, for the most part, hinge on the assumption that the comparison sites accurately reflect what answers to the survey questions would likely have

been prior to median installation. The team believes the assumption is valid based on a comparison of site characteristics, traffic operations, and business types between treatment and comparison sites. The use of comparison sites results in a stronger study design than a mere after study at multiple treatment sites, which would not account for any of the perceived change in opinion of the median. So, while a true before-after survey would have been preferable, the comparison site approach was the best approach available to the research team.

## **Survey Development**

The objective of the survey was to determine the type and magnitude of effect that the access management treatment had on the businesses located along that roadway. This was accomplished by administering the survey to owners or managers of those businesses. Two slightly different versions of the survey were developed and used. One version was used at treatment locations—businesses along a roadway that received an access management installation. The other version was used at comparison locations—businesses along similar roadways that did not receive an access management installation, but that are comparable in site, traffic, and economic attributes to one of the treatment sites. The reason for having two versions was that some questions on the treatment survey would not logically apply to the comparison location (e.g., “what changed after the median was installed?”) and therefore needed to be modified or reworded to be appropriate for comparison site businesses.

Using surveys conducted in other prior research efforts as a starting point, the team developed the treatment and comparison surveys. The surveys included questions on economic effects as well as surrogate effects, such as operations and safety, which were important to tie business perceptions to quantitative studies done in past efforts. The survey layout was a two-page design (front and back). The first page of the survey was directed toward more general business-related questions with no mention of the median installation to eliminate any potential

bias in the first page answers. The second page of the survey asked questions specifically about the perceived effects of the median on various measures. It is important to emphasize that the interviewees were asked about economic indicators (revenues, daily customers, trends) *before* being asked about their opinions on the median installation on the second page. Table 1 lists the questions used on the treatment and comparison surveys and describes the purpose for asking each question. See Appendices A and B for examples of the comparison and treatment surveys, respectively.

**Table 1.** Survey Questions

Treatment Survey Question	Comparison Survey Question	Purpose
1. When did this business begin operations at this location?	Same question as treatment survey.	To determine whether the business was open at time of construction.  To evaluate turnover rate based on the treatment installation date.
2. How would you classify this business? (Local, Regional, National, etc)	Same question as treatment survey.	To categorize the business type.
3. Please rank the following considerations that customers use when selecting a business of your type. (Accessibility to Store, Customer Service, Distance to travel, Hours of operation, Product price, Product quality)	Same question as treatment survey.	To determine the factors that the business considers to be most important.  To determine how accessibility ranks compared to other considerations.
4. What percentage of your customers did not intend to stop at your particular business at the beginning of their trip?	Same question as treatment survey.	To determine how much of the business' customer base relies on pass-by traffic (as opposed to being a destination business).
5. What is your approximate number of sales transactions/patrons per day?	Same question as treatment survey.	To categorize the business size.

Treatment Survey Question	Comparison Survey Question	Purpose
6. Has your expected monthly revenue pattern changed since [date of access management installation]?	6. Has your expected monthly revenue pattern changed since [date of access management installation at matched treatment site]?	<p>(Treatment survey) To ascertain whether the access management installation affected the business revenues.</p> <p>(Comparison survey) To ascertain whether business revenues changed since the date of installation at the treatment site, to account for other factors that may have affected business, such as general economic conditions, changes in overall traffic volumes, or other effects unrelated to the access management installation.</p>
7. Are you familiar with the fact that the median design of the main roadway alongside your business changed in [date of installation]?	No comparable question asked on comparison survey.	To determine whether the survey should continue with specific questions about the effects of the access management treatment.
8. Were you in favor of the roadway modifications before construction? (Yes, No, list reasons)	7. Would you be in favor of roadway modifications to restrict left turns if the result were increased safety and/or operations?	<p>(Treatment survey) To determine the business' opinion before installation.</p> <p>(Comparison survey) To determine public opinion about potential access management treatments.</p>
<p>9. Did your business experience a change in the number of regular customers during construction on the project? (Decrease, No Change, Increase)</p> <p>Following the completion of the project, has your business experienced a change in the number of regular customers? (Decrease, No Change, Increase)</p>	No comparable question asked on comparison survey.	To determine the effect on the business customer traffic during and after the construction period.

Treatment Survey Question	Comparison Survey Question	Purpose
<p>10. Do you feel that the installation of the median <u>has made</u> the following parameters worse, better, or about the same as before the median project was constructed? (Traffic congestion, Traffic safety, Number of customers per day, Gross sales, Property value, Customer satisfaction with access to the store, Delivery convenience)</p>	<p>8. Do you feel that the installation of the raised median <u>would</u> make the following parameters worse, better, or about the same? (same list as treatment survey)</p>	<p>(Treatment survey) To determine the effect of the access management treatment on various aspects of business health and traffic operations and safety.</p> <p>(Comparison survey) To determine public opinion about how access management installations <u>would</u> affect these various aspects. This acts as the “pseudo-before” survey.</p>
<p>11. What was your involvement in the public hearing and public meeting process for this median project? (Attended several meetings, Attended one meeting, No involvement, Not aware of any public meetings)</p>	<p>No comparable question asked on comparison survey.</p>	<p>To determine how many business owners/managers got involved with the public meeting process.</p> <p>To determine if involvement in public meetings correlates to a positive or negative opinion of the project.</p>

To obtain the highest possible sample size and prevent respondent confusion when completing the survey, the decision was made to conduct door-to-door surveys in lieu of a mail-out method. Team members visited businesses along each site and spoke with owners or managers at each business. Most surveys were completed by the team member verbally interviewing the owner or manager. In cases where an owner or manager was not present, the team member would leave a stamped, addressed envelope and a blank survey form and ask for it to be given to the owner or manager for them to complete and mail back.

In addition to the survey, team members collected many types of descriptive data at the site, including where the business was located in relation to median breaks, vacant business locations, and the location and type of nearby traffic control devices.

## **Site Selection**

The selection of appropriate sites was critical for a successful study. For a site to be considered, it had to meet the following criteria:

*Appropriate access management treatment installed.* For consistency with previous NCDOT research on this topic, the preferred type of treatment was the installation of a raised median.

*Appropriate construction period.* Sites where access management treatments were installed too recently would have a short “after” period on which to base analysis. Sites where treatments were installed too many years in the past would create issues with accurate survey responses (i.e., difficult for respondents to remember that far back) and survey potential (i.e., businesses operating in the current time period may not have been in operation at the time of the treatment). The preferred time window of construction was 2003 to 2008.

*At least 0.25 miles in length.* Longer sections give a larger sample size of businesses and more efficient use of team member time and travel.

*Moderately high business density.* Higher density of businesses along the site gives a larger sample size. In this context it is also important that business density was comparable before and after median installation to be able to evaluate economic impacts. The research team did not consider sites where the median was installed as a part of major redevelopment along the corridor.

*Moderately high traffic volume.* The team wanted to avoid including sites with low traffic volume from concerns that the effect of the access management treatment would be potentially difficult to determine and the site may be relatively recently developed. Sites with established business development were preferred.

Team members began the process by assembling a list of all potentially eligible sites and then selecting final sites according to the selection criteria. Potentially eligible sites were identified by obtaining input from project panel members, district and division engineers across the state, and personal knowledge among team members. This process yielded a list of 62 potentially eligible sites across NC where access management projects had been installed within the past 15 years. The list of sites is provided in Appendix C. The projects included median installations, median break closings or modifications, and intersection restrictions. From this list, the researchers selected six treatment sites (shown as the top six in the list) for the study based on the above listed criteria. Two other sites were added later with a sister research project.

One comparison site was selected for each treatment site in order to provide a control for possible biases such as general economic conditions, specific local economic issues, and driver demographics. In general, the most appropriate comparison site would be a length of road that matched the treatment site as closely as possible, except for not receiving the access management treatment. Multiple comparison sites were identified for each treatment location, and a ranking was applied to select the best possible corridor for comparison. This selection was based on such factors as proximity, business density, driver population and demographics, and traffic volumes. In some cases, the researchers were simply able to use another section of

the same road that was adjacent to the treatment section but that did not receive the access management treatment. In other cases, the comparison site was selected by using a nearby road section that matched the characteristics of the treatment site. It should be noted here that the South Boulevard comparison site was used twice (shown with \* in Table 2) because it was the best matching site for the two treatment sites also located along South Boulevard. General matching characteristics when choosing comparison sites included business density, general distribution of business types, traffic volume, road function within the city, and road character. Table 2 shows the treatment and comparison sites, displayed with their matched pairs.

Six of the treatment sites were median installations and two were conversions of signalized intersections to signalized superstreets. Although median installation was the preferred treatment for this study, the two superstreet sites were included because they were being used in a sister research project and collection of data was convenient and efficient.

All sites studied were located on major arterials leading into and out of the respective city. Businesses along the sites were predominantly retail and services (e.g. food, beauty, and auto) along with a minority of financial, technical, and health business types as well. See Appendix D for a listing of characteristics for each site. A total of 535 surveys were successfully completed, comprising 240 surveys from treatment sites and 295 from comparison sites.

**Table 2.** Descriptive data on treatment and comparison sites chosen for study.

Street Name	Beginning Intx	Ending Intx	City	Segment Length (mi)	AADT	Lanes	Divided	Undivided	TWLT	Speed Limit	Access Point Density	Surveys Completed	Type of Project
Falls of Neuse Rd.	Spring Forest Rd.	Wake Forest Rd.	Raleigh	0.5	35000	4,5,6		X	X	45	32	16	
Western Blvd	Method Rd.	Gorman St.	Raleigh	0.38	35000	6	X			45	87	35	Median Install
Tryon Rd.	Sugar Creek Rd.	Lambeth Dr.	Charlotte	0.73	15000	5,6		X	X	45	95	58	
Albemarle Rd.	Independence Blvd.	Sharon Amity Rd.	Charlotte	0.55	37000	5	X			45	98	67	Median Install
Market St.	Barclay Hills Dr.	New Centre Dr.	Wilmington	0.98	39000	5			X	45	73	28	
Market St.	New Centre Dr.	MLK Jr. Pkwy	Wilmington	0.89	39000	4,5	X			45	43	24	Median Install
South Blvd.	Scaleybark Rd.	Seneca Pl.	Charlotte	1.38	30000	4		X		35, 40	75	27	
South Blvd.	Hartford Ave.	Scaleybark Rd.	Charlotte	0.44	31900	4	X			45	61	67	Median Install
South Blvd.	Scaleybark Rd.	Seneca Pl.	Charlotte	1.38	30000	4		X		35, 40	75	32	
South Blvd.	Tyvola Rd.	Archdale Dr.	Charlotte	0.82	30000	4	X			45	72	39	Median Install
Jake Alexander Blvd.	Statesville Blvd.	Maupin Ave.	Salisbury	2.2	30000	5			X	45	25	9	
Statesville Blvd.	Holly Ave.	Goodson Rd.	Salisbury	2.5	14000	4	X			45	49	7	Median Install
Sage Road	15-501	15-501	Chapel Hill	0.3	40000	4		X		45	13	51	
15-501	Europa Dr.	Europa Dr.	Chapel Hill	0.3	40000	4	X			45	23	39	Superstreet Conv.
S. College Rd.	Bragg Dr.	Satara Dr.	Wilmington	0.3	39000	6		X		45	17	19	
Carolina Beach Rd.	Julia Dr.	Piner Rd.	Wilmington	0.3	38000	6	X			45	37	17	Superstreet Conv.

## **Analysis and Results**

### ***Analysis Approach***

Ultimately, the survey seeks to capture the perceptions and attitudes of business owners and managers regarding the general economic effects that median installation may have had on their business. The survey coincided with a recent economic recessionary period across the state and much of the country, and it was understood that it may not be possible for survey respondents to completely untangle the effects of the median installation and recession in their minds. The comparison sites worked well in accounting for the potential effects of the economy on respondent answers.

It should be noted that treatment site 4 (Albemarle Road in Charlotte, NC), along with its comparison site 3 were deleted from the analysis. Observations from the staff conducting surveys in the field quickly noted that based on respondent feedback this particular site was likely an outlier. This is explained further in Tables 3 and 4. Albemarle Road is an east-west arterial that has fully-controlled access into the site. The issue with this site is that the only signalized intersection, the end of the study corridor on the east end, is also the only U-turn location for businesses at this site, while the western section requires drivers to go almost two miles back to the nearest interchange, an unexpected maneuver for a potential customer. When asked, NCDOT noted that design of the roadway would not allow a median opening at the west end of the corridor. Since the site was so unique, and since it was not representative of the types of access management sites targeted in this project, the team determined that the outlier site should be removed from the remaining analysis.

In summary, after removing sites 3 and 4, there were 566 unique non-vacant records in the final business database along with 101 unique recorded vacancies. As noted earlier, Site 7 (South Boulevard) functions as a comparison site for two treatment sites – sites 8 and 9 – also on

South Boulevard. Data for site 7 is duplicated for any comparison/treatment analyses involving treatment sites 8 and 9. In short, by duplicating site 7 in the database, the database used for the analyses presented here contains 668 non-vacant and 121 vacant business locations for a total of 789 records. Of the 668 non-vacant business locations in the database, 378 (57%) were from comparison sites and 290 (43%) were from treatment sites.

The research team categorized surveyed businesses according to classifications defined by the North American Industry Classification System (NAICS). Although NAICS can provide for high resolution classification, the research team used business classes defined by the first two digits of the six-digit NAICS code for analysis involving business type. This assured a sufficiently-large sample size of observations in each business category needed for analysis.

Table 3 provides a breakdown of NAICS classes represented in this database.

**Table 3.** Classification of Surveyed Business by NAICS Code

NAICS Code (2-digit)	Comparison	Treatment	Total Sample
23 - Construction	2	1	3
31 – 33 - Manufacturing	8	3	11
42 - Wholesale Trade	2		2
44 – 45 - Retail Trade	114	101	215
48 - Transportation, Warehousing		1	1
51 - Information		4	4
52 - Finance, Insurance	20	15	35
53 - Real Estate, Rental/Leasing	18	11	29
54 – Prof., Scientific, Technical Services	12	7	19
56 – Admin., Support, Waste Mgmt., Rem. Serv's	12	4	16
61 - Educational Services	3	2	5
62 - Healthcare, Social Assistance	12	15	27
71 - Arts, Entertainment, Recreation	13	4	17
72 - Accommodation, Food Services	91	67	158
81 - Other Services	66	53	119
92 - Public Administration	1	1	2
(blank or n/a)	69	54	123
Totals:	445	344	789

With a wide variety of businesses represented in the database, it is expected that certain classes of business are better represented than others. Businesses corresponding to the (2-digit) NAICS codes 44 and 45 (businesses related to retail trades) constitute the largest class with 215 records. Accommodation and Food Service businesses (NAICS code 72) form the second largest class with 158 records. The remaining NAICS 2-digit classes range in size from 119 records (code 81 - Other Services) down to 1 record.

Survey results are presented through the use of descriptive statistics. In many cases, survey questions asked respondents to classify parameters or rank several parameters in order of importance. These results are usually presented as tables of proportions. When appropriate, tests of significance for these proportions were performed to determine if the results represent a statistically significant change ( $p < 0.05$ ) in perception between the comparison and treatment sites. *Where findings are not significant but warrant showing p-values, the actual p-value will be given to the reader to make inferences.*

### ***Economic Impact***

On the first page of the treatment and comparison surveys, business owners were asked if their monthly revenue patterns changed since the year of the median installation. For comparison sites, the year of installation for the corresponding treatment site was used. At the very beginning of the questions, respondents were not told the reason for the survey and thus their responses were not biased based on the median installation.

Out of 484 total business responses to this question, 238 (49%) reported a decrease in monthly revenues, 103 (21%) reported an increase, and 143 (30%) reported no change in monthly revenues since the year of median installation. The breakdown of these results by comparison/treatment, business type, and site number are given in Table 4.

At a 5% level of significance, there is insufficient evidence to conclude that there are differences in the revenue proportions when comparing comparison/treatment and business type breakdown groups shown in Table 4.

**Table 4.** Survey Results: Monthly Revenue Change. Breakdown by Comparison/Treatment, Business Type, and Site.

(Excluding Sites 3 &4)		Down	No Change	Up
Comparison		50%	30%	20%
Treatment		48%	29%	23%

  

Business Type		Down	No Change	Up
Local - one location	Comparison	59%	28%	14%
	Treatment	50%	28%	22%
Local - multiple locations	Comparison	64%	18%	18%
	Treatment	56%	22%	22%
Regional	Comparison	39%	35%	26%
	Treatment	46%	21%	32%
National	Comparison	44%	31%	25%
	Treatment	48%	31%	22%

  

Site (C = Comparison, T = Treatment)	Down	No Change	Up
Site 1 - Falls of the Neuse Rd (C)	40%	26%	34%
Site 2 - Western Blvd (T)	44%	38%	19%
Site 5 - Market St (C)	64%	15%	21%
Site 6 - Market St (T)	55%	22%	24%
Site 7 - South Blvd (C)	50%	29%	21%
Site 8 - South Blvd (T)	43%	26%	31%
Site 7 - South Blvd (C) *	50%	29%	21%
Site 9 - South Blvd (T)	50%	35%	15%
Site 10 - Jake Alexander Blvd (C)	49%	44%	8%
Site 11 - Statesville Blvd (T)	51%	34%	14%
Site 12 - Chapel Hill Blvd (C)	43%	43%	14%
Site 13 - Erwin Rd (T)	20%	40%	40%
Site 14 - South College Rd (C)	41%	47%	12%
Site 15 - Carolina Beach Rd (T)	58%	26%	16%

Significance testing was not appropriate for the site breakdown group due to low survey counts in most cases. Although the significance testing suggests caution when considering similarities between comparison and treatment sites, it is not unreasonable to conjecture that, overall, businesses were generally operating at the same revenue that they would have been operating had the median not been installed. Looking at each category by row, comparison and treatment sites seem to have (roughly) equal proportions of change in revenue versus no change and increase in revenue. This suggests that the median does not appear to have affected the overall stability of the corridor when looking at revenues.

Investigating a little deeper into the perceptions of why a business may have experienced a change in revenue, there are clear indications that most businesses believe the “economy” is the primary factor of a negative change in revenue. As in the previous table, Table 5 shows the breakdown by comparison/treatment, business type, and site.

The results in this table are limited to those respondents that indicated that monthly revenues had decreased (for whatever reason) since the median installation. Reasons for decreased revenues are classified as “Economy,” “Median,” and “Other”. Note that the third portion of the table, “Site,” includes the number of survey responses since a few sites have low survey counts in that population.

**Table 5.** Survey Results: Decrease in Monthly Revenue. Breakdown by Comparison/Treatment, Business Type, and Site.

(Excluding Sites 3 &4)		Economy	Other	Median
Comparison		81%	4%	14%
Treatment		69%	7%	24%

  

Business Type		Economy	Other	Median
Local - one location	Comparison	87%	7%	5%
	Treatment	65%	12%	24%
Local - multiple locations	Comparison	78%	0%	22%
	Treatment	80%	0%	20%
Regional	Comparison	83%	0%	17%
	Treatment	85%	8%	8%
National	Comparison	76%	4%	20%
	Treatment	64%	5%	31%

Site (C = Comparison, T = Treatment)	Economy	Other	Median	N =
Site 1 - Falls of the Neuse Rd (C)	100%	0%	0%	14
Site 2 - Western Blvd (T)	71%	14%	14%	7
Site 3 – Tryon Road (C)	100%	0%	0%	12
Site 4 – Albemarle Road (T)	33%	20%	47%	15
Site 5 - Market St (C)	72%	16%	12%	25
Site 6 - Market St (T)	68%	4%	29%	28
Site 7 - South Blvd (C)	76%	3%	21%	33
Site 8 - South Blvd (T)	76%	12%	12%	25
Site 7 - South Blvd (C) *	76%	3%	21%	33
Site 9 - South Blvd (T)	54%	8%	38%	13
Site 10 - Jake Alexander Blvd (C)	95%	0%	5%	19
Site 11 - Statesville Blvd (T)	72%	6%	22%	18
Site 12 - Chapel Hill Blvd (C)	67%	0%	33%	3
Site 13 - Erwin Rd (T)	100%	0%	0%	2
Site 14 - South College Rd (C)	100%	0%	0%	7
Site 15 - Carolina Beach Rd (T)	64%	0%	36%	11

Significance testing for the proportions in Table 5 did not reveal a significant difference between comparison and treatment business responses considered as a whole ( $p = 0.093$ ). Tests for the business type breakdown category indicate a significant ( $p < 0.05$ ) difference between comparison and treatment sites for local businesses with one location; 87% of the comparison

sites vs. 65% of the treatment sites reporting a decrease in revenue and attributed the decrease to the economy. Although the difference among national chains was technically not significant ( $p = 0.055$ ), it deserves mention that 76% of the comparison sites vs. 64% of the treatment sites reported a decrease in revenue attributed the decrease to the economy with a fairly high level of confidence. Low survey counts prevented reliable significance results for the site breakdown group.

Sites 3 and 4 were provided in the “Site” breakdown to show additional justification for removing the Albemarle Road treatment site from the analysis. Note that the two sites were not included in the overall comparison/treatment site results at the top of the table. When looking at the reason for decreased revenue since the installation of the median, the median (47%) was the reason given by the majority of respondents, even though the economy during the time of the survey was suffering significantly. This finding likely indicates a significant bias against the median based on the design at this site. While it was excluded from the analysis, this site can serve as an interesting case study of the potential effects of “extreme” access management without adequate U-Turn and access opportunities. However, with a sample of only one site, other local characteristics and contributing factors may play into the observed trends.

Although there is a clear indication that the economy was the primary reason for any decrease in revenue, the treatment sites seemed to indicate the median was a larger issue than the comparison sites (24% vs. 14%). In addition, although the comparison sites indicated a median would be problematic, there was no actual median installed (note, respondents were not given information about the reason for the survey when asked this survey question). Although treatment sites were more likely to blame the median for decreased revenue, the economy was still the dominant factor.

As a side note that may support the perceived dominance of the economy as a large factor in business revenue patterns, there was no significant difference between corner and non-corner businesses at signalized median openings with regard to decreased monthly revenues. Both corner locations (47%) and non-corner locations (50%) indicated a decrease in revenues since installation of the median. There was no evidence of a significant difference between comparison and treatment sites.

**Table 6.** Primary Cause for Decrease in Monthly Revenues using NAICS Codes.

<i>NAICS 2-Digit Code</i>	<b>Economy</b>	<b>Other</b>	<b>Median</b>	<b>N =</b>
23 – Construction	100%	0%	0%	2
31 – 33 - Manufacturing	71%	0%	29%	7
42 - Wholesale Trade	100%	0%	0%	2
44 – 45 - Retail Trade	79%	6%	15%	68
48 - Transportation, Warehousing	N/A	N/A	N/A	0
51 – Information	100%	0%	0%	1
52 - Finance, Insurance	50%	0%	50%	18
53 - Real Estate, Rental/Leasing	100%	0%	0%	12
54 – Prof., Scientific, Technical Services	100%	0%	0%	2
56 - Administrative, Support, Waste Mgmt., Remediation Services	75%	0%	25%	8
61 - Educational Services	100%	0%	0%	1
62 - Healthcare, Social Assistance	100%	0%	0%	5
71 - Arts, Entertainment, Recreation	100%	0%	0%	5
72 - Accommodation, Food Services	68%	9%	23%	69
81 - Other Services	78%	8%	14%	37
82 – Indeterminate	100%	0%	0%	1

Survey data were also analyzed by business type using the North American Industry Classification System (NAICS). As shown in Table 6, the majority of business classes indicated the economy as a primary cause of decreased revenues. For instance, 79% of retail trade (those businesses corresponding to two-digit NAICS codes 44 and 45) respondents experienced a decrease in revenues attributed the decline to the economy. Under the two-digit NAICS classification, there were no significant findings for business classes that indicated the median was the primary cause of decreased revenues.

Another possible indicator of economic impact is business turnover rates following median installation. While the survey results could not provide direct historical data on the number of vacancies over time, the research team felt that an analysis of businesses that began operations after the median installation (referred to as “new” businesses) as well as current (at the time of survey) vacancy counts might yield some insight into the general economic conditions of the sites at the time of the survey. For terminology, any business location that is vacant or has a new tenant since the date of median installation is considered “new/vacant,” which may be considered as a surrogate measure for actual business “turnover” rate. Excluding the outlier treatment site 4 and its comparison site 3, 121 out of 789 (15%) business locations in the database were actually **vacant** (not new and vacant) at the time of the survey, further separated by comparison (15%) and treatment (16%) corridors. Table 7 breaks down new business/vacancy counts by comparison/treatment and by individual site.

Overall, the rate of new/vacant locations at treatment sites was significantly higher ( $p < 0.01$ ) than comparison sites. When looking at findings by individual sites, site 1 shows a reverse trend from the other pairs. As a potential explanation, the vacancies at this site were focused in an area surrounding a grocery store which relocated to a brand new location up the road. When asked, the grocery store manager said it was a business decision based on surrounding environment and not the road itself. Therefore, the site new/vacancy rate was not affected so much by the median as the movement of its big anchor on the west side of the corridor.

Looking at other individual sites (excluding sites 3 and 4), new/vacancy rates appear to be fairly consistent with slightly higher vacancies along treatment corridors than their comparison. So, while the economic comparison of businesses on treatment and comparison sites showed no difference, there may be evidence that some treatment-site businesses may have left the location prior to the survey date. On the other hand, a high occurrence of new businesses speaks to at least some positive economic activities at the treatment sites.

**Table 7.** Percentage of New/Vacant Business Locations. Breakdown by Comparison/Treatment and Site (\* represents very limited sample size).

(Excluding Sites 3 &4)	% New/Vacant
Comparison	24%
Treatment	30%
	% New/Vacant
Site 1 - Falls of the Neuse Rd (C)	44%
Site 2 - Western Blvd (T)	15%
Site 3 - Tryon Rd (C)	14%
Site 4 - Albemarle Rd (T)	47%
Site 5 - Market St (C)	24%
Site 6 - Market St (T)	36%
Site 7 - South Blvd (C)	21%
Site 8 - South Blvd (T)	30%
Site 7 - South Blvd (C) *	21%
Site 9 - South Blvd (T)	34%
Site 10 - Jake Alexander Blvd (C)	22%
Site 11 - Statesville Blvd (T)	35%
Site 12 - Chapel Hill Blvd (C)	0%*
Site 13 - Erwin Rd (T)	20%*
Site 14 - South College Rd (C)	0%
Site 15 - Carolina Beach Rd (T)	0%

### **Supplemental Findings**

Aside from the central question of economic effect, other survey results may yield insight into differences in perception between comparison and treatment sites. Regarding the median installation, survey respondents were asked if they were in favor of the roadway modification to increase safety. Similarly, comparison site businesses were asked if they *would be* in favor of roadway modifications to increase safety. Table 8 shows the results by comparison/treatment, business type, and by site.

The table shows a clear tendency towards more negative perceptions when discussing safety; however, it is important to note the significant change ( $p < 0.05$ ) in attitude between the

comparison and the treatment sites. However, testing on the business type breakdown revealed that there is not sufficient evidence (at a 5% level of significance) to conclude that there are differences between comparison and treatment responses when considered in the business type categories local (one or multiple locations), regional, or national.

**Table 8.** Survey Results: In Favor of Raised Median to Increase Safety. Breakdown by Comparison/Treatment, Business Type, and Site.

(Excluding Sites 3 &4)		Yes	No
Comparison		21%	79%
Treatment		34%	66%

  

Business Type		Yes	No
Local - one location	Comparison	15%	85%
	Treatment	24%	76%
Local - multiple locations	Comparison	25%	75%
	Treatment	44%	56%
Regional	Comparison	18%	82%
	Treatment	27%	73%
National	Comparison	27%	73%
	Treatment	40%	60%

  

Site (C = Comparison, T = Treatment)	Yes	No
Site 1 - Falls of the Neuse Rd (C)	29%	71%
Site 2 - Western Blvd (T)	50%	50%
Site 3 - Tryon Rd (C)	25%	75%
Site 4 - Albemarle Rd (T)	18%	82%
Site 5 - Market St (C)	19%	81%
Site 6 - Market St (T)	22%	78%
Site 7 - South Blvd (C)	20%	80%
Site 8 - South Blvd (T)	61%	39%
Site 7 - South Blvd (C) *	20%	80%
Site 9 - South Blvd (T)	50%	50%
Site 10 - Jake Alexander Blvd (C)	19%	81%
Site 11 - Statesville Blvd (T)	19%	81%
Site 12 - Chapel Hill Blvd (C)	50%	50%
Site 13 - Erwin Rd (T)	40%	60%
Site 14 - South College Rd (C)	13%	88%
Site 15 - Carolina Beach Rd (T)	33%	67%

Lastly, excluding sites 3 and 4, every individual comparison/treatment group showed that perceptions of safety increased or stayed the same, which aligns well with quantitative findings noted earlier in the literature which noted that safety did in fact increase after median installation.

While Table 8 would seem to indicate business owners are not sure if a median would improve safety, there is an interesting piece of related survey data that may shed a different light on the matter. One particular survey question asks participants to rank the attributes in order of importance as considered by their customers: accessibility to store, customer service, distance to travel, hours of operation, product price, and product quality. Only 18% of comparison site locations and 15% of treatment site locations ranked accessibility to store as their customers' highest priority. In fact, 59% of comparison site respondents and 62% of treatment site respondents ranked accessibility as 4<sup>th</sup>, 5<sup>th</sup>, or 6<sup>th</sup>. Thus, while businesses may have generally negative opinions on the impact of medians, they do not seem to feel accessibility is a high ranking consideration among their customers. Table 9 summarizes the survey results for this question by comparison and treatment groups.

**Table 9.** Survey Results: Ranking of Customer Considerations. Breakdown by Comparison/Treatment Sites.

(Excluding Sites 3 &4)		Ranking					
		1	2	3	4	5	6
Accessibility	Comparison	18%	9%	14%	20%	21%	18%
	Treatment	15%	13%	13%	17%	14%	29%
Customer Service	Comparison	48%	19%	16%	8%	5%	4%
	Treatment	33%	26%	22%	11%	5%	3%
Distance to Travel	Comparison	4%	14%	9%	17%	28%	27%
	Treatment	7%	8%	15%	16%	34%	22%
Hours of Operation	Comparison	2%	4%	9%	20%	27%	38%
	Treatment	2%	7%	11%	25%	25%	31%
Product Price	Comparison	14%	22%	29%	19%	10%	7%
	Treatment	16%	26%	21%	22%	10%	6%
Product Quality	Comparison	15%	32%	22%	16%	10%	6%
	Treatment	27%	19%	19%	10%	14%	10%

In further questions about the access management treatment, survey respondents were asked if the installation of the raised median made (or “would make” for comparison sites) the following better, worse, or stay the same: safety, congestion, number of customers per day, property value, accessibility to store, and delivery convenience (Table 10).

**Table 10.** Survey Results: Impact of Raised Median on Business-Related Attributes. Breakdown by Comparison/Treatment Sites.

(Excluding Sites 3 &4)		Better	Same	Worse
Traffic Congestion	Comparison	16%	41%	43%
	Treatment	30%	41%	29%
Traffic Safety	Comparison	52%	31%	17%
	Treatment	40%	24%	36%
Number of Customers per Day	Comparison	6%	38%	56%
	Treatment	12%	46%	42%
Property Value	Comparison	7%	55%	38%
	Treatment	18%	40%	42%
Store Access	Comparison	8%	21%	71%
	Treatment	10%	37%	53%
Delivery Convenience	Comparison	5%	39%	56%
	Treatment	7%	53%	40%

When examining each comparison/treatment pair response for worse (or better and same combined), the differences between proportions in each set of pairs is significant ( $p < 0.05$ ). Therefore, businesses in comparison sites versus treatment sites have very different perceptions of these attributes.

Looking at congestion, 43% of comparison site respondents felt that a median would worsen traffic congestion, whereas only 29% of treatment site respondents believed that the median actually did worsen congestion. Since comparison sites represent the “what if” condition (or before scenario), this indicates that perceptions of the median on congestion likely improved after installation. In addition, 71% of treatment respondents felt that traffic congestion remained the same or improved after median installation, which is important because these responses

indicate that only a small minority of businesses believe that congestion deteriorated. This finding supports previous research on operational impacts of access management techniques provided in the literature.

Even more pronounced is the perceived safety effect. Eighty-three percent (83%) of businesses along comparison corridors believed that safety would improve or stay the same, compared to 64% of businesses on treatment corridors. Although the perception of safety appeared to decrease following installation of the median, the majority of respondents did believe there were significant safety improvements. Like the operational effects, this mirrors prior research findings summarized in the literature.

Similarly, 44% of comparison respondents felt that a median installation would increase or have no change in the number of customers per day, while 58% of treatment site respondents indicated that the number of customers actually increased or stayed the same. These results suggest a shift in perception between comparison and treatment sites and may indicate that some negative preconceptions of median impact on sales may not have been well-founded.

Customer satisfaction with access to the store was also surveyed. Seventy-one percent (71%) of businesses at comparison sites thought that access to the store would get worse, while businesses at treatment sites said 53% of customers indicated access was worse. This is an important question because the perception of business owners in the comparison group represents a population subset similar to that of business owners that go to public meetings. This finding says that business owner's perception of customer accessibility improved. Also, looking at treatment sites only, an equal split of better and no change versus worse access is shown. This generally means that there was basically no perceived change from before to after median installation.

The last surrogate measure was delivery convenience. The perception of delivery convenience improved after installation of the median, shown as comparison site perceptions of better or no change at 44% versus treatment sites at 60%.

Finally, businesses at treatment sites were asked if they had experienced any change in the number of regular customers during construction and then after completion of the installation.

Table 11 summarizes these results by business type.

**Table 11.** Survey Results: Change in Regular Customer Volume, Treatment Sites Only. Breakdown by Business Type.

During Construction	Decrease	No Change	Increase
Local - one location	66%	37%	0%
Local - multiple locations	56%	44%	0%
Regional	69%	31%	0%
National	48%	43%	10%

After Installation	Decrease	No Change	Increase
Local - one location	50%	50%	0%
Local - multiple locations	50%	44%	6%
Regional	40%	53%	7%
National	55%	45%	0%

While it is clear that the majority of business types experienced no increase in regular customer volume during construction, these effects seemed to somewhat normalize after completed installation. It should be noted that the question on customer trends was not asked to comparison sites, and so it is somewhat difficult to isolate these responses from the background economic recession trends. Interestingly, when looking at averages, some local multiple-location and regional business types seemed to benefit from the installation with an increase in regular customer volume, although the sample sizes were small for both of these groups.

## **Conclusions**

This study deals with the perceptions and attitudes of business owners and managers towards access management. The team conducted a pseudo before-after study using businesses at comparison sites as a surrogate for the before period at treatment installations. A large sample of data was collected to determine the overall perceived effect of median installations, and in most cases sample sizes were large enough to do significance testing by individual site pairs. The major findings in this study are summarized below.

### ***Economic Effects***

There were no significant differences in self-reported revenue changes when comparing before and after survey responses from all sites. Even when looking at individual site pairs, it is reasonable to assume that businesses were generally operating at the same revenue they would have been operating had the median not been installed.

When looking at responses for decreased revenue after median installation, treatment sites seemed to indicate the median was a larger issue than the comparison sites, though not significant at the 95% confidence interval ( $p = 0.093$ ). When partitioning the data further by business type, single-location local businesses had a significant difference in perceived revenue decrease due to the economy, noting that although the economy was the primary reason for decreased revenues, the median was the perceived cause in revenue decreases in many cases also. In addition, national chains were affected in a similar way, though not significantly different at the 95 percentile confidence interval ( $p = 0.055$ ).

Overall, the rate of vacant or new businesses (a potential surrogate for turnover rate) at treatment sites was significantly higher ( $p < 0.01$ ) than comparison sites.

## ***Surrogate Effects***

Generally, before and after responses were negative when asked if roadway modifications would improve safety; however, there was a significant change in attitude from the before to after period which seems to indicate that perceptions improved following actual median installation, as opposed to the “what if” questions on expectations of businesses on comparison sites. When looking at individual site pairs, every pair showed that perceptions of safety increased or stayed the same after median installation.

A total of 62% of treatment respondents at treatment sites ranked accessibility as the 4<sup>th</sup>, 5<sup>th</sup>, or 6<sup>th</sup> consideration of customers for their business. Only 15% of businesses at treatment corridors actually ranked accessibility as the number one consideration of customers. The top three customer considerations when choosing a business that were indicated by respondents at treatment sites were 1) Customer Service - 33%, 2) Product Quality – 27%, and 3) Product Price – 16%.

When asked if the median installation would make various parameters better, worse, or stay the same, a very high percentage of respondents agreed that traffic congestion and safety would improve or stay the same. It appears that the perceived effect on the number of customers per day was much worse at comparison sites than treatment sites, indicating that the median did not affect customers as bad as it was originally thought. Accessibility to store was perceived to be much worse between comparison and treatment respondents; however, the perception at treatment sites was much better than comparison sites indicating again that the median did not affect customers as bad as originally thought.

In general, the survey data indicates a significant and positive change in respondent's perceptions between comparison and treatment sites. In spite of the overall negative reactions

to a proposed median installation, survey data from the businesses represented here appear to support a more favorable perception after installation occurs.

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