

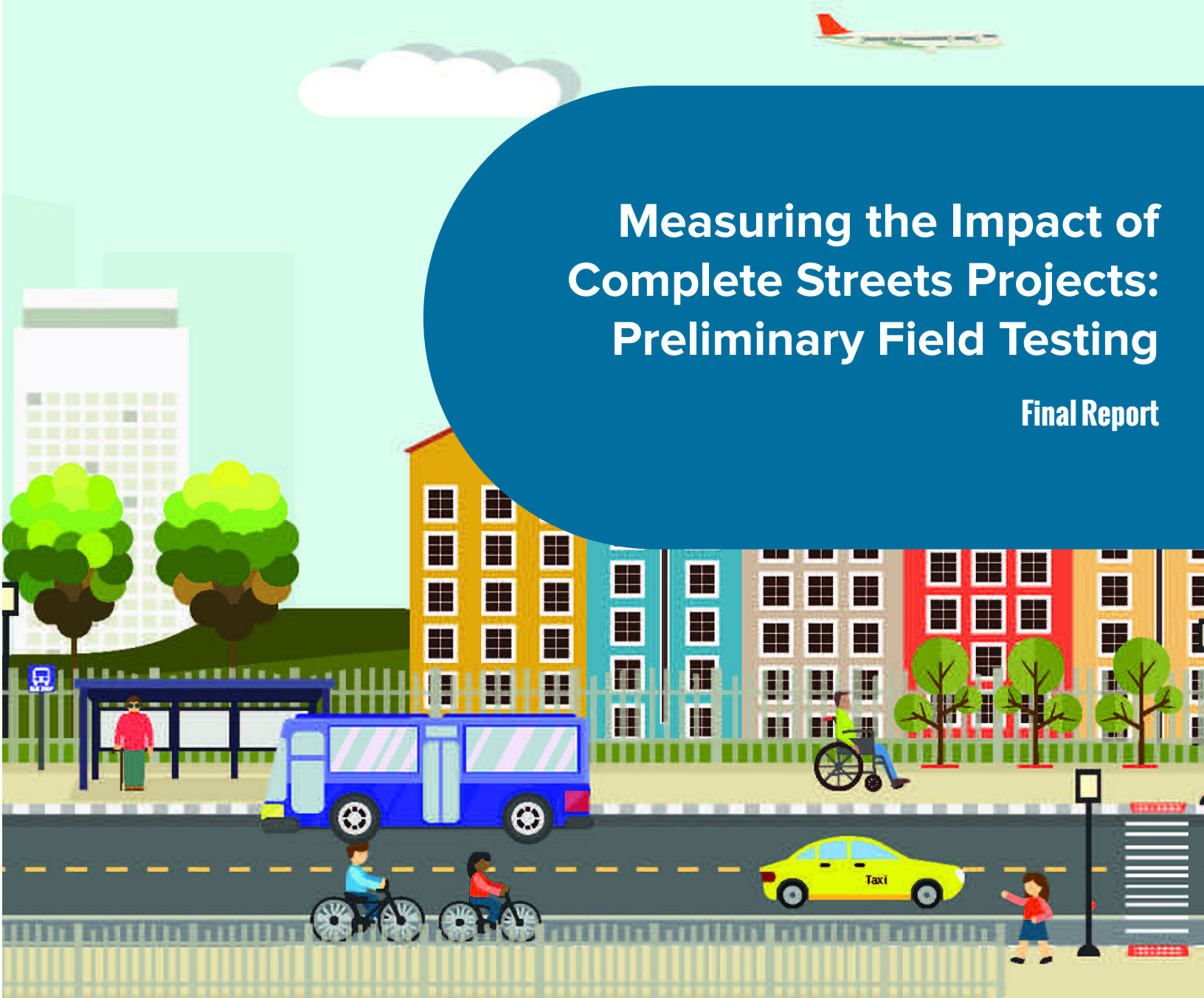


**NYSERDA**

**Department of  
Transportation**

# Measuring the Impact of Complete Streets Projects: Preliminary Field Testing

**Final Report**





# Measuring the Impact of Complete Streets Projects: Preliminary Field Testing

*Final Report*

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## Notice

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This report was funded in part through grant(s) from the Federal Highway Administration, United States Department of Transportation, under the State Planning and Research Program, Section 505 of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the United States Department of Transportation, the Federal Highway Administration or the New York State Department of Transportation. This report does not constitute a standard, specification, regulation, product endorsement, or an endorsement of manufacturers.

|  |  |  |           |
|--|--|--|-----------|
| 1. Report No. C-14-58  | 2. Government Accession No.                          | 3. Recipient's Catalog No.   |           |
| 4. Title and Subtitle<br>Measuring the Impact of Complete Streets Projects: Preliminary Field Testing  |  | 5. Report Date: December 2016  |           |
|  |  | 6. Performing Organization Code  |           |
| 7. Author(s): James A. Lenker, Jordana L. Maisel, Molly E. Ranahan   |  | 8. Performing Organization Report No. 16-19                                |           |
| 9. Performing Organization Name and Address:<br>Research Foundation of SUNY, University at Buffalo, Buffalo, NY 14260  |  | 10. Work Unit No.  |           |
|  |  | 11. NYSERDA Contract 46819   |           |
| 12. Sponsoring Agency Name and Address:<br>NYS Department of Transportation<br>50 Wolf Road, Albany, New York 12232<br><br>NYS Energy Research & Development Authority<br>17 Columbia Circle, Albany, NY 12203<br><br>GObike Buffalo<br>640 Ellicott Street, Buffalo, NY 14203   |  | 13. Type of Report and Period Covered: Final Report<br>January – July 2016 |           |
|  |  | 14. Sponsoring Agency Code   |           |
| 15. Supplementary Notes: Project funded in part with funds from the Federal Highway Administration.  |  |  |           |
| 16. Abstract: This report describes a field study that sought to assess the impact of Complete Streets (CS) projects in Buffalo, NY. Multiple data collection tools were deployed to capture a diversity of impacts on 8 street corridors where CS projects have been implemented or are planned. The goals were to evaluate Buffalo's CS initiative and explore the feasibility of the data collection methods. The survey responses from residents, merchants, and streetscape users indicate that Buffalo's CS projects have been popular among all three groups. Upcoming CS projects are targeting corridors that currently have low perceived streetscape quality. When pre- and post-implementation data points are available, the analysis indicates that CS corridors absorb higher volumes of vehicles, pedestrians, and bicyclists and become safer in terms of total crashes and injuries. With modest funding, the current study could be scaled-up to assess CS programs in other New York State municipalities. Streamlined approaches to capturing the survey information are yet needed. Ongoing CS data collection needs to become a shared priority among local Metropolitan Planning Organizations, Departments of Public Works, and CS groups. In order to meaningfully assess impact data, these local groups need to maintain a minimum data set for each CS project. |  |  |           |
| 17. Key Words:<br>Complete streets; active transportation; public works; program evaluation; outcomes measurement.   | 18. Distribution Statement<br>No restrictions        |  |           |
| 19. Security Classif. (of this report)<br>Unclassified   | 20. Security Classif. (of this page)<br>Unclassified | 21. No. of Pages<br>110  | 22. Price |

Form DOT F 1700.7 (8-72)

## **Abstract**

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This report describes a field study that sought to assess the impact of Complete Streets (CS) projects in Buffalo, NY. Complete Streets is an emerging transportation planning paradigm that seeks to balance the needs of automobile drivers with those of pedestrians, bicyclists, and public transportation users. Multiple data collection tools were deployed to capture a diversity of impacts on eight street corridors where CS projects have been implemented or are planned. The goals were to evaluate Buffalo's CS initiative and explore the feasibility of the data collection methods. The survey responses from residents, merchants, and streetscape users indicate that Buffalo's CS projects have been popular among all three groups. Upcoming CS projects are targeting corridors that currently have low perceived streetscape quality. Where pre- and post-implementation data points are available, the analysis indicated that CS corridors absorb higher volumes of vehicles, pedestrians, and bicyclists and become safer in terms of total crashes and injuries. With modest funding, the current study could be scaled-up to assess CS programs in other New York State municipalities. Streamlined approaches to capturing the survey information are yet needed. Ongoing CS data collection needs to become a shared priority among local Metropolitan Planning Organizations, Departments of Public Works, and CS groups. To meaningfully assess impact data, these local groups need to maintain a minimum data set for each CS project.

## **Keywords**

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Complete streets; active transportation; public works; program evaluation; outcomes measurement

# Acknowledgments

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This report reflects the contributions from numerous people who have been crucial to the process.

Volney Powell, Hector Boggio, Tim Trabold, and Amy Weymouth at the Greater Buffalo Niagara Regional Transportation Council provided invaluable data on mode counts, crash counts, fatalities, and injuries for corridors that were part of this study.

Daniel Gaille and Ziqiang Chen (Department of Biostatistics, University at Buffalo) provided statistical analysis support.

Paul Ray (University at Buffalo Regional Institute) provided sales data for businesses along the corridors being studied.

Justin Booth at GOBike Buffalo has provided ongoing support and guidance in virtually all aspects of this project.

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# Acronyms and Abbreviations

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|          |  |
|----------|--|
| GBNRTC   | Greater Buffalo-Niagara Regional Transportation Council  |
| IRB      | Institutional Review Board                               |
| MPO      | Metropolitan Planning Organization                       |
| NYS      | New York State   |
| NYS ALIS | NYS Accident Locator Information System                  |
| NYSERDA  | New York State Energy Research and Development Authority |
| UB       | University at Buffalo                                    |

# Summary

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## S.1 Overview

Complete Streets is an emerging transportation planning paradigm that seeks to balance the needs of automobile drivers with those of pedestrians, bicyclists, and public transportation users. This report describes the results of a field study that sought to assess the overall impact of Complete Streets projects in Buffalo, NY. Multiple data collection tools were used to capture a diversity of impacts, including: (a) streetscape quality; (b) street usability and satisfaction for drivers, bicyclists, and pedestrians; (c) traffic volume for vehicles, pedestrians, and bicyclists; (d) accidents and injuries; (e) economic vitality; and (f) health impact. These impact measures were deployed in a field test that focused on eight street corridors where Complete Streets projects had been implemented or are planned, including: Delaware Avenue, two sections of Elmwood Avenue, two sections of Fillmore Avenue, Linwood Avenue, Niagara Street, and Pearl Street. These corridors were chosen because of their socioeconomic diversity, their mix of commercial and residential uses, and their range of Complete Streets features. The goal was two-fold: (a) evaluate the success of Buffalo’s Complete Streets initiative, and (b) explore the feasibility of the data collection methods to determine how the approach might be scaled-up for evaluation of Complete Streets programs in other municipalities within New York State and elsewhere.

## S.2 Key Findings

Over 2,200 residents, merchants, and streetscape users were surveyed, reflecting a cross-section of age, race, and income levels. Along corridors where a Complete Streets project has already been implemented:

- 73.5 percent of residents indicated that they were “much more satisfied” or “somewhat more satisfied” with the street since the changes were implemented.
- 58.4 percent of merchants indicated that they were “much more satisfied” or “somewhat more satisfied” with the street since the changes were implemented.
- 75.7 percent of streetscape users indicated that they were “much more satisfied” or “somewhat more satisfied” with the street since the changes were implemented.

## **S-2.1 Most Liked Changes**

When asked “what they like most” about the changes, the three groups most frequently mentioned:

- Safety and convenience of the bike lanes.
- Traffic calming effect.
- Pedestrian safety.
- Vitality and aesthetics brought to the street.

## **S 2.2 Least Liked Changes**

When asked “what they least liked” about the changes, people most frequently mentioned:

- Nothing disliked.
- Want more amenities.

## **S 2.3 Traffic Safety**

- Delaware Avenue (W. Mohawk to North St.)
  - Vehicle counts are up by 13-20 at most intersections, and the volume at W. Tupper is up by 32 percent.
  - Pedestrian counts have doubled at W. Huron, are 30 percent higher at W. Tupper, and 21 percent higher at Allen St.
  - Commensurate with those volume increases, crashes are up by 24 percent; however, total injuries have declined by 3 percent, pedestrian injuries are down by 25 percent, and bike injuries are down by 100 percent.
- Linwood
  - Crashes are down by 33 percent, overall injuries are down by 22 percent, pedestrian injuries have declined by 100 percent (from 2 to 0) and bike injuries have remained the same (n=1).
- Elmwood – North (W. Ferry to Forest)
  - Vehicle counts are up by 13-39 percent for most intersections.
  - Crashes are down by 36 percent; total injuries down by 49 percent; bicycle injuries are down by 33 percent, and pedestrian injuries are down by 17 percent.
- Elmwood – South (Bryant to Anderson Pl.)
  - Vehicle counts at comparable intersections were not measured before and after Complete Streets implementation.
  - Crashes are down by 25 percent, overall injuries are down by 13 percent.



- Fillmore – North (Best to W. Ferry)
  - Vehicle counts at comparable intersections were not measured before and after Complete Streets implementation.
- Fillmore – South (William to Best)
  - Vehicle counts at comparable intersections were not measured before and after Complete Streets implementation.

#### **S.2.4 Health Behavior Impact**

- 28.5 percent of residents and 36.5 percent of Streetscape Users reported that they were walking “much more” or “somewhat more” frequently.
- 38.4 percent of residents and 35.8 percent of Streetscape Users reported that they were biking “much more” or “somewhat more” frequently.
- 27.7 percent of merchants reported that employees were walking “much more” or “somewhat more” frequently to work, and 40.4 percent reported that customers were walking “much more” or “somewhat more” frequently to the merchant’s business.

#### **S.2.5 Economic Vitality**

- 44.7 percent of merchants rated the overall economic health of their street corridor was “somewhat better” or “much better” since the changes had been made.
- 25.8 percent of merchants reported that their sales were “somewhat more” or “much more” since the streetscape changes were implemented; 70.7 percent reported a neutral impact on their business sales.

### **S.3 Discussion**

The survey responses from Buffalo Residents, Merchants, and Streetscape Users indicate that:

(a) Buffalo’s Complete Streets projects have been largely successful and very popular among all three stakeholder groups; (b) upcoming Complete Streets projects are properly targeting corridors that currently have lower perceived streetscape quality and safety; and (c) the survey tools created specifically for this study were efficiently administered and yielded meaningful data without being onerous for participants or data collectors.

When pre- and post-implementation volume counts for vehicles, pedestrians, and bicycles are available, the data indicate that Complete Streets corridors absorb higher volumes of vehicles, pedestrians, and bicyclists and become safer in terms of total crashes and injuries. Like most municipalities, Buffalo has not consistently gathered pedestrian and bicycle count data for all Complete Streets corridors. So, although the findings are very promising, additional research is needed to verify that increased mode volumes and enhanced safety are generalizable for Complete Streets projects across multiple corridors and municipalities.

When queried about their perceptions of economic impact in the aftermath of Complete Streets changes, local merchants reported a neutral-to-positive impact on the economic health of commercial entities along their street. In addition, open-ended statements from residents and streetscape users often mentioned that the Complete Streets changes had noticeably enhanced the vitality of the street. Assessing the economic impact of Complete Streets projects from an impartial perspective is less clear cut. Snapshots of commercial sales obtained from third-party databases (e.g., Reference USA) offer a quantitative metric. However, crediting Complete Streets projects for increased commercial sales could invite criticism from the business sector given numerous potentially confounding factors that could also influence the economic vitality of businesses along a corridor.

In terms of health impact, the self-reported data from all three survey groups indicated a positive and substantial increase in walking and biking behaviors, suggesting that Complete Streets corridors support and elicit healthy behaviors.

## **S.6 Recommendations for Future Research**

The following recommendations represent the most interesting and potentially fruitful directions forward based on the experiences with the current study and previous Complete Streets research:

1. With modest grant support, the current study could be scaled-up to assess Complete Streets programs in other municipalities in New York State. Such a study could be designed to achieve three aims: (a) reinforce the value of taxpayer-supported NYS CS initiatives; (b) provide much-needed research data that could substantiate the benefits of the Complete Streets paradigm; and (c) achieve a sustainable model of ongoing municipal evaluation of Complete Streets projects.

2. Survey data from residents, merchants, and streetscape users is invaluable but time-intensive and costly to procure without grant support. To achieve the ultimate goal of an ongoing and sustainable approach to Complete Streets program evaluation, modified approaches to capturing the survey information should be explored, including:
  - Reducing the survey length. Although the surveys were not long (10-12 minutes), it would not be difficult to reduce the length of the surveys by 30 percent by eliminating those items that yielded information of lesser quality and/or lower priority.
  - Exploring alternative data collection media. If the time required to complete the surveys could be reduced to 8-10 minutes, it could become realistic for merchants and residents to complete the surveys independently without the assistance of a canvasser. This approach would require a municipal commitment to advertise the importance of the surveys and incentivize voluntary completion.
  - To the extent that canvass teams might still be needed in the field, the use of cellular-enabled tablets (the method used in this study) is highly recommended so that data are immediately captured and uploaded to a centralized data repository. Smartphones could also serve as a hardware platform; however, tablets offer a larger screen interface that is easier to read and physically access.
3. Ongoing data collection needs to be a shared priority among local Metropolitan Planning Organizations (MPOs), Departments of Public Works, and local Complete Streets groups. These three entities should collaborate annually to ensure that measurement of volume counts (for vehicles, pedestrians, and bicyclists) is systematically occurring on corridors for which Complete Streets projects have been implemented or are proposed. These entities should also collaborate to ensure that crash and injury data are retrieved for the same corridors. All information could then be stored in a centralized municipal repository for Complete Streets project data.
4. To facilitate meaningful program evaluations across projects and geographic locations, local Complete Streets initiatives should create and maintain a minimum data set for each Complete Streets project that includes: (a) the geographic boundaries of the corridor; (b) the overall length of the corridor; (c) the Complete Streets features that were (or will be) implemented along the corridor; (d) the beginning and end dates for construction of the Complete Streets project; and (e) the public works cost of the project.

# 1 Background

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Complete Streets (CS) is an emerging transportation planning paradigm that seeks to balance the needs of automobile drivers with those of pedestrians, bicyclists, and public transportation users. A streetscape designed according to the Complete Streets paradigm often includes features such as traffic calming measures, designated bike lanes, wide sidewalks, center-turn lanes for automobiles, and enhanced intersections that facilitate pedestrian crossings (Handy and McCann 2010). The intended benefits of the CS approach include urban revitalization, traffic calming and improved pedestrian safety, reduced vehicle usage and the concomitant fuel consumption and greenhouse gas emissions, improved population health due to increases in walking and bicycling, and improved access to daily services for older adults and people with disabilities (Auchincloss et al. 2008, Boarnet et al. 2005, McCann and Rynne 2010, Wang et al. 2005).

Nationally, more than 900 jurisdictions have adopted CS policies over the past two decades (Seskin 2015). In accord with this trend, New York State enacted the Complete Streets Act, which was signed into law by Governor Andrew M. Cuomo in 2012. The Act requires NYS Department of Transportation (DOT) to “develop a report that demonstrates the Department’s implementation efforts and identifies best practices in Complete Streets implementation throughout New York State” and “show how the Department has institutionalized Complete Streets by incorporating its design features in planning, scoping, and design of transportation projects” (NYS Department of Transportation 2014). Across the State, 11 regional coordinators are responsible for promoting bicycle and pedestrian programs. Buffalo adopted a Complete Streets ordinance in 2008.

## 1.1 Related Research

McCann (2013) asserts that Complete Streets project evaluation should be an integral component of the overall municipal planning processes. Evaluation of CS projects can provide municipalities with data to support a cost-benefit argument to justify future expenditures on proposed Complete Streets projects (New York City Department of Transportation 2012).

However, the existing research literature on Complete Streets evaluation emphasizes case study reports of municipal projects that exemplify “best practices” (e.g., McCann and Rynne 2010, NYS DOT 2014). Two recent field studies conducted at the University at Buffalo (UB) found that municipalities around the country are generally not capturing data regarding the impact of their Complete Streets projects (Lenker et al., in press; Ranahan et al., submitted). In fact, many municipalities are not even maintaining

systematic quantitative descriptions of their Complete Streets project outputs. In phone interviews and online survey responses, many described a lack of time and resources needed to create a sustainable system that could track project outputs and outcomes.

As a result of this preliminary research, it became apparent that three developments were needed to foster increased collection of CS program evaluation data:

- A toolkit of measurement approaches is needed to give local governments a framework of potential data collection options.
- Based on that framework, specific measurement tools are needed that could be efficiently deployed to capture multiple relevant stakeholder perspectives.
- Municipalities will need guidance about effective and efficient approaches to program evaluation.

The first of these needs was previously addressed by the University at Buffalo's research team, in collaboration with GObike Buffalo, on a research project (funded by the University at Buffalo's Office of Civic Engagement & Public Policy) that culminated in a compendium of state-of-practice measurement approaches that could be used as a framework to evaluate the impacts of Complete Street projects on seven areas: (a) bicycle and pedestrian volume, (b) citizen surveys; (c) economic impact, (d) environmental impact, (e) health impact, (f) multi-modal level of service, and (g) safety impact. The compendium concluded with a six-step process to guide municipalities interested in starting their own CS evaluation program (Ranahan et al. 2014).

## **1.2 Goal of the Current Study**

The current work was an initial step toward addressing the second and third needs identified in Section 1.1 (i.e., development and pilot testing of different methods for data collection that could ultimately contribute to a practical toolkit for municipal-level Complete Streets program evaluation.) Specifically, the current study sought to capture indicators of: (a) streetscape quality and satisfaction; (b) convenience, safety, and usability of all transportation modes along a corridor; (c) traffic volume for vehicles, pedestrians, and bicyclists; (d) accidents and injuries; (e) economic vitality and impact; and (f) health impact. The indicators were deployed in a field test conducted in Buffalo that focused on eight transportation corridors where Complete Streets projects have either been implemented or are planned. The goal was to explore the feasibility of these data collection methods to identify those that might be refined and implemented as part of an ongoing Complete Streets program evaluation.

## 2 Method

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### 2.1 Design

Cross-sectional data were sought for a diversity of impact domains (e.g., streetscape quality, bike/pedestrian volume, accidents and injuries, economic activity) and data sources (e.g., residents, merchants, streetscape users, NYS crash data, and traffic volume data).

### 2.2 Corridors of Study

Eight corridors were chosen to reflect a diversity of factors, including: (a) uses, e.g., residential, commercial, mixed-use; (b) socioeconomic characteristics; (c) Complete Streets project status (i.e., “project completed” or “project planned, but not yet implemented”); and (d) Complete Streets features used along already implemented corridors (e.g., designated bike lanes, shared bike-car lanes, contraflow bike lanes, bulb-outs, and lane reductions). These corridors are summarized in Table 1.

### 2.3 Survey Tools

Six survey tools were created in order to generate items and response options that would be relevant to three stakeholder groups (resident, merchant, and streetscape user) and two conditions of CS project status: *Completed* (“post-implementation”) and *Planned* (“baseline”). The survey items and response options were created by three members of the research team who have been conducting Complete Streets-related research together for the past 3.5 years. Two of the team members have doctoral degrees in industrial engineering, and the third member is a doctoral student in urban planning. In addition, the team members with doctorates have professional degrees in occupational therapy (BS) and urban planning (MUP), respectively. The multidisciplinary nature of the team yielded contrasting perspectives that fostered an iterative and rigorous item creation process. The initial drafts of the surveys were then shared with members of the Buffalo Complete Streets working group, who provided feedback for additional refinement of items and response options. Survey Monkey was used as the platform for item creation and data collection for each of the six survey tools. Copies of these tools are available upon request from the authors.

**Table 1. Summary of Corridors Studied**

| <b>Corridor name</b> | <b>Length (miles)</b> | <b>Corridor Uses</b>           | <b>Socio-economic</b> | <b>CS Project Status</b> | <b>CS amenities, if already completed</b>  |
|----------------------|-----------------------|--------------------------------|-----------------------|--------------------------|--|
| Delaware             | 1.2                   | Commercial                     | High                  | Completed, 2013          | Dedicated bike lanes, lane reduction for cars, center turn lane, signal timing adjusted  |
| Elmwood North        | 1.0                   | Mixed: commercial, residential | High                  | Completed, 2012          | Shared bike-car lane with sharrow markings in pavement   |
| Elmwood South        | 0.3                   | Commercial                     | High                  | Completed, 2012          | Dedicated bike lane, auto lane reduction   |
| Fillmore North       | 0.8                   | Commercial                     | Low                   | Completed, 2014          | Shared bike-car lane with sharrow markings in pavement, bulb-outs, sidewalks, lighting, landscaping, enhanced crosswalks, green infrastructure |
| Fillmore South       | 1.3                   | Residential                    | Low                   | Completed, 2012          | Dedicated bike lane, auto lane reduction   |
| Linwood              | 1.4                   | Residential                    | High                  | Completed, 2012          | 1-way street with 2-way bike lanes, lane reduction for cars, dedicated bike traffic signal   |
| Niagara              | 3.7                   | Mixed: commercial, residential | Low                   | Planned                  | NA   |
| Pearl                | 1.0                   | Commercial                     | High                  | Planned                  | NA   |

The surveys for Residents, Merchants, and Streetscape Users were designed to contain substantially similar content and response options. The Resident Baseline and Post-Implementation tools have 28 items, the Merchant Baseline and Post-Implementation tools have 32 items; and the Streetscape User Baseline and Post-Implementation tools have 26 items. Each has seven common demographics questions (age, gender, sexual orientation, race/ethnicity, overall health, bike ownership, and car ownership). The Resident surveys included seven additional demographic questions related to type of building, ownership, composition of household, longevity in residence, employment status, and household income. The Merchant surveys include seven additional questions related to the business size, longevity, and economic indicators. The surveys of Streetscape Users contain two additional demographic questions regarding employment status and income.

Both Baseline and Post-Implementation surveys queried the three stakeholder groups about their assessment of four transportation modes along the corridor: walking, biking, public transportation, and driving. For each mode, the survey queried respondents regarding their frequency of mode usage and factors affecting mode choice, as well as their assessment of mode convenience, mode safety, traffic, pedestrian crossings, traffic speed, traffic impact on biking and walking, and personal safety along the corridor.

The items and five-point response scale options for the surveys of **Baseline** corridors were phrased so that respondents were making a snapshot rating of a streetscape attribute at the current time. For example:

Question 1: “How convenient is it to bike on this street?”

Answer Options: Very inconvenient; somewhat inconvenient, neither inconvenient nor convenient; somewhat convenient; very convenient.”

Question 2: “How would you rate your overall satisfaction with this street?”

Answer Options: Poor; fair, good; very good; excellent.”

In addition to the nine items with closed-form response scales, each of the Baseline surveys included an open-ended question that queried respondents about any “concerns” they had regarding the streetscape changes being planned for that corridor. The tools were translated into Spanish by a member of the canvassing team who is bilingual. The translations were reviewed by a local Spanish educator who verified the overall fidelity of the translations while also noting some differences that were attributable to the Puerto Rican dialect of Spanish spoken most commonly on the west side of Buffalo.

In contrast, the items and five-point response scale options for the **Post-Implementation** surveys were phrased so that respondents were rating the impact that had occurred since the Complete Streets changes were made. For example:

Question 1: Since the street changes were made, how convenient is it to bike on this street?

Answer options: Much less convenient; somewhat less convenient; neither more or less convenient; somewhat more convenient; much more convenient.”

Question 2: Since the street changes were made, how would you rate the change in your overall satisfaction with this street? Are you...

Answer options: much less satisfied; somewhat less satisfied; neither more or less satisfied; somewhat more satisfied; much more satisfied.

In addition to the nine items with forced response scales, each of the Post-Implementation surveys included two open-ended questions that queried respondents about things they “liked most” and “liked least” about the streetscape changes that had been implemented along that corridor.

Creating separate tools and wording perspectives was a pragmatic necessity. For the foreseeable future, local governments will need to assess corridors for which no baseline data exist, which necessitates tools that capture streetscape impacts using response options that are phrased retrospectively. In other cases,



local governments may wish to obtain snapshots of perceived streetscape quality before and after Complete Streets features have been implemented along a corridor in order to make pre/post comparisons of streetscape quality.

## **2.4 Canvassers**

A lead canvasser was hired who had substantial previous experience with conducting community-based surveys using a canvassing approach. He hired and trained a total of 11 canvassing assistants who worked at various times during their intervals of availability over the four-month data collection period (June through October 2015). One of the canvassing assistants administered the Spanish language version of the Baseline tools as needed, primarily along the Niagara Street corridor.

## **2.5 Data Collection Procedure**

Before data collection began, the protocol was reviewed by the University at Buffalo's Institutional Review Board (IRB). The IRB determined that the study fell outside their purview given the extremely low risk to respondents and that no personally identifiable information was being collected. The canvassers worked along each corridor to obtain survey responses from as many potential members of each stakeholder group as possible. Survey responses were sought only from adults (18 years and older). The team made multiple passes through each corridor over a 2- to 4-week period to ensure saturation of recruitment along each corridor. Once a prospective respondent had agreed to participate, the surveys were administered verbally, and the canvasser recorded responses directly into SurveyMonkey using a tablet computer with direct internet access via mobile phone network.

## **2.6 Mode Count, Accidents, and Injuries**

Mode volume, accident, and injury data for the corridors were gathered from the Greater Buffalo-Niagara Regional Transportation Council (GBNRTC), the region's designated Metropolitan Planning Organization (MPO) for transportation policymaking. The GBNRTC provided data regarding mode volume counts that had been locally gathered, and they provided crash and injury data from the NYS Accident Location Information System (ALIS) database.

## **2.7 Economic Data**

Data related to commercial sales along each corridor were obtained via the UB Regional Institute, which searched and retrieved data from a paid subscription database: Reference USA (Infogroup, Inc.).

## 2.8 Health Impact Data

Health impact was probed within the surveys of residents, merchants, and streetscape users. Specifically, Residents and streetscape users were asked to rate the change in their walking and biking behaviors along their corridor since the streetscape changes were implemented. Merchants rated whether customers and employees were walking and biking to the business more or less since the streetscape changes were implemented.

## 2.9 Data Analysis

Data from each source were descriptively summarized. The survey response data constituted ordinal responses and were additionally analyzed using standard non-parametric approaches. Kruskal-Wallis tests (Hollander and Wolfe 1973) were used to formally compare the distributions of survey responses across partitions of the data involving multiple levels, i.e. street corridors (6 levels), interviewee groups (3 types), age categories (3 levels, for the full data), customer volume of the business, and the longevity of the business (for merchant only data). Wilcoxon Rank Sum tests (Bauer 1972) were utilized to formally compare partitions for variables having two levels, e.g., gender, whether own a bike (for full data) and whether the business offers off-street parking (for merchant only data). P-values, unadjusted for multiplicity, were calculated.

One sided proportion tests were performed to formally test the null hypothesis that the population proportion of positive responses is less than or equal to the population proportion of negative responses versus the alternative hypothesis that the population proportion of positive responses exceeds the population proportion of negative responses. For this analysis, neutral responses (a scale at 3) were removed, scale responses of 4 or 5 are designated as positive, and scale responses of 1 or 2 were designated as negative.

Spearman Rank Correlation estimates for all possible pairing of ordinal response variables were calculated and visualized using the R package “*corrplot*” (Friendly 2002).

All statistical analyses were performed using the R statistical programming language (R Core Team 2013). Unless otherwise stated the significance level was set at 0.05 for all formal tests of hypotheses.

### 3 Survey Results from Residents, Merchants, and Streetscape Users on Post-Implementation Corridors

A total of 2,272 survey responses were obtained, of which 1,295 (57.0 percent) were collected by the lead canvasser. Comprehensive data summaries for each of the six field surveys are available upon request from the authors. Among all responses, 466 were from residents, 264 were from merchants, and 1,542 were from streetscape users. A breakdown of respondents by corridor and stakeholder group is included in Table 2. For each corridor, the proportion of resident-to-merchant respondents reflected the residential-to-retail proportions along those corridors. The proportion of streetscape users recruited for each corridor reflected the activity density and length of the corridors.

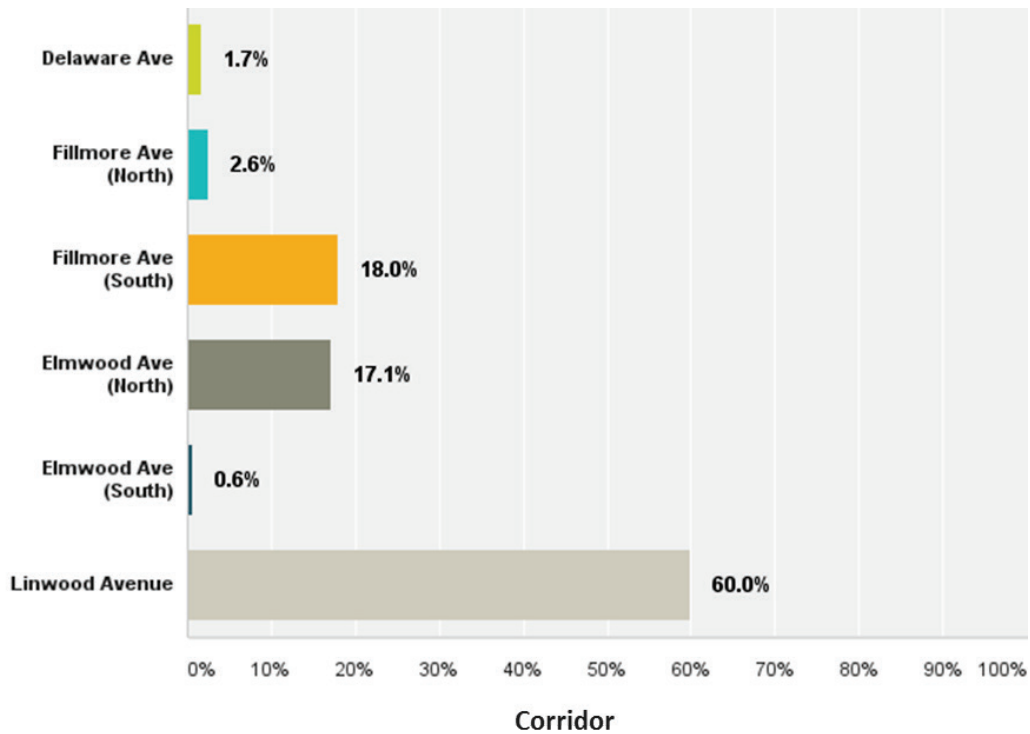
**Table 2. Summary of Participants by Corridor and Stakeholder Group**

| Corridor Name  | Complete Street Status of the Corridor | Resident | Merchant | Streetscape User | Totals |
|----------------|--|----------|----------|------------------|--------|
| Delaware       | Post-Implementation                    | 6        | 30       | 242              | 278    |
| Fillmore North | Post-Implementation                    | 9        | 20       | 118              | 147    |
| Fillmore South | Post-Implementation                    | 62       | 7        | 84               | 153    |
| Elmwood North  | Post-Implementation                    | 59       | 86       | 215              | 360    |
| Elmwood South  | Post-Implementation                    | 2        | 30       | 138              | 170    |
| Linwood        | Post-Implementation                    | 207      | 4        | 255              | 466    |
| Niagara        | Baseline                               | 119      | 72       | 229              | 420    |
| Pearl          | Baseline                               | 2        | 15       | 261              | 278    |

#### 3.1 Post-Implementation Residents

A total of 345 residents were surveyed along post-implementation corridors. Among these results, the distribution of residents surveyed across the six post-implementation corridors reflected the proportion of residential properties along the respective corridors, with preponderance of respondents coming from the Linwood (60 percent), Fillmore South (18 percent), and Elmwood North (17.1 percent) corridors (Figure 1). Among these, 59.3 percent were renters, and the remainder were owners.

**Figure 1. Post-Implementation: Residents by Corridor Breakdown (n=345)**



The age distribution, gender identity, racial/ethnic identity, and household income of residents in post-implementation corridors are reflected in Figures 2 through 5. A majority (80.7 percent) reported owning a car, and 66.4 percent reported owning a bike.

**Figure 2. Age Distribution of Post-Implementation Residents (n=295)**

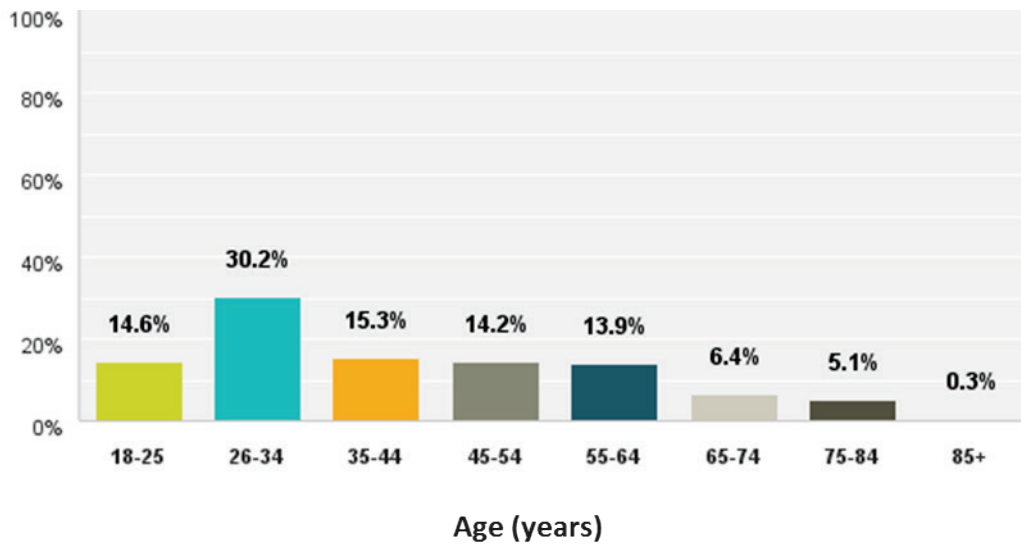


Figure 3. Gender Identity of Post-Implementation Residents (n=295)

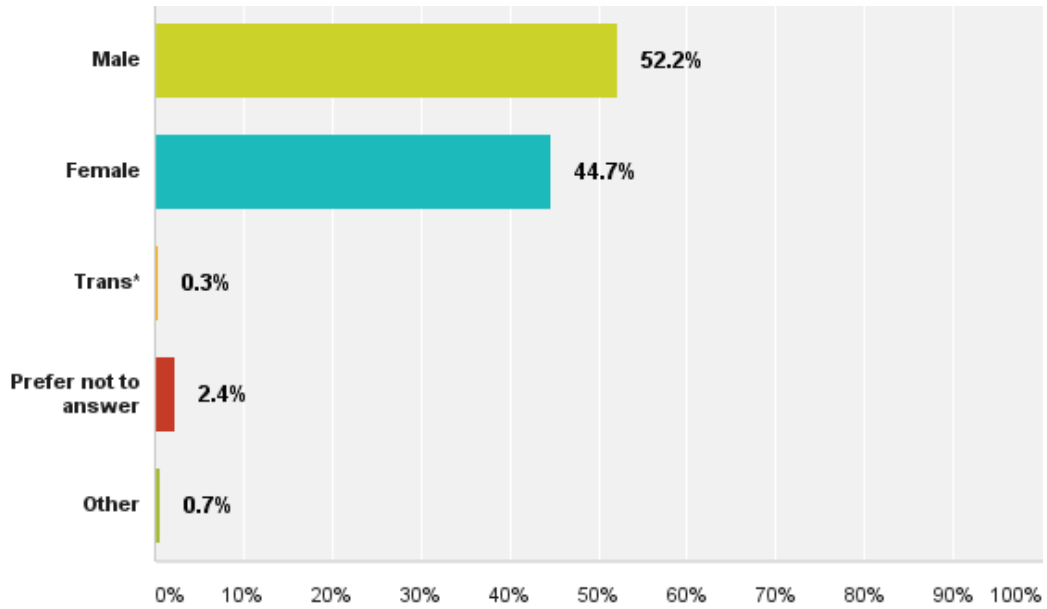
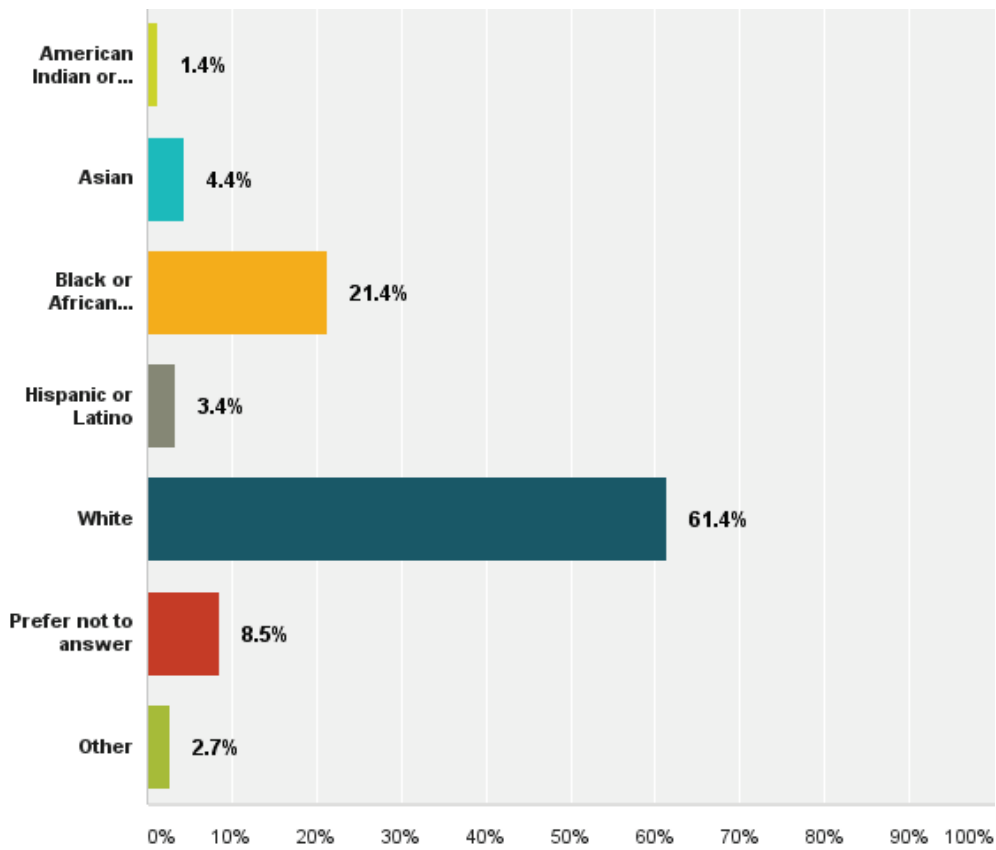
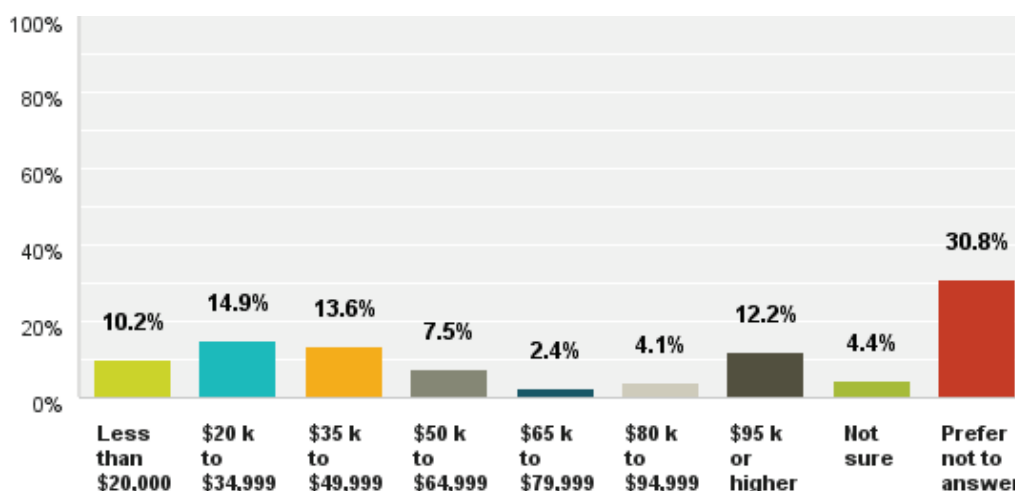


Figure 4. Racial/ethnic Identity of Post-Implementation Residents (n=295)



**Figure 5. Household Income of Post-Implementation Residents (n=295)**



### 3.1.1 Post-Implementation Residents: Key Indicators of Impact

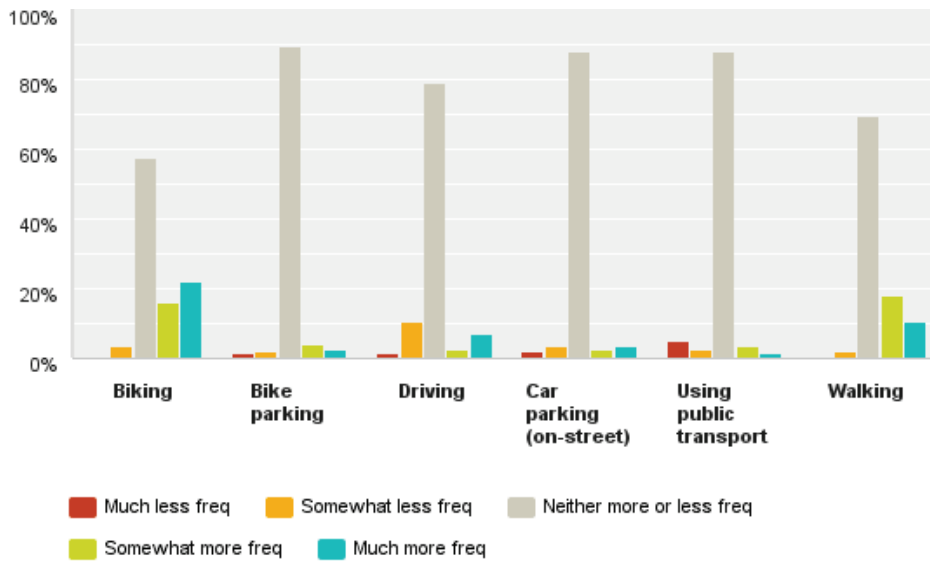
Residents experienced the following key indicators of Complete Streets impact experienced along post-implementation corridors:

- 73.5 percent indicated that they were “much more satisfied” or “somewhat more satisfied” with the street since the changes were implemented (Figure 6).
- 28.5 percent reported that they were walking “much more” or “somewhat more” frequently, and 38.4 percent reported that they were biking “much more” or “somewhat more” frequently (Figure 7).
- 44.6 percent reported that walking was “much more” or “somewhat more” convenient; 79.2 percent reported that biking was “much more” or “somewhat more” convenient; and 84.2 percent reported that driving along the corridor was as, or more, convenient than it was prior to the streetscape changes (Figure 8).
- 57.3 percent reported that walking was “somewhat more” or “much more” pleasant than it was prior to the change (Figure 9).
- 76.5 percent reported that biking was “somewhat more” or “much more” pleasant than it was prior to the changes (Figure 10).
- 37.3 percent indicated that drivers were exceeding the speed limit “somewhat less” or “much less” often than prior to changes (Figure 11).
- 41.9 percent reported that intersections were “somewhat easier” or “much easier” to cross (Figure 12).
- 44.3 percent indicated that walking was “somewhat more” or “much more” safe; 78.8 percent indicated that biking was “somewhat more” or “much more” safe; and 49 percent reported that driving was “somewhat more” or “much more” safe as a result of the changes (Figure 13).

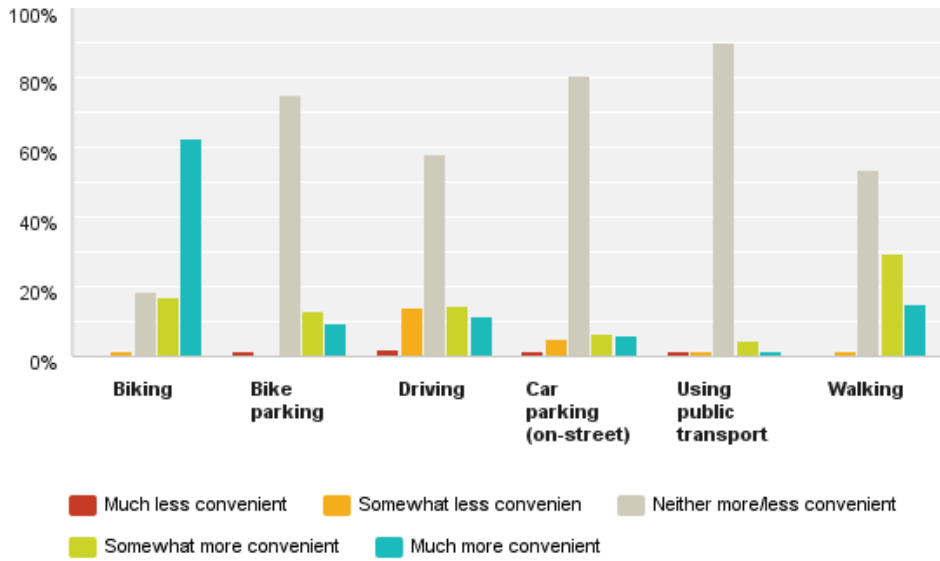
**Figure 6. Post-Implementation Residential: Overall satisfaction with this street since the changes were implemented (n=294)**



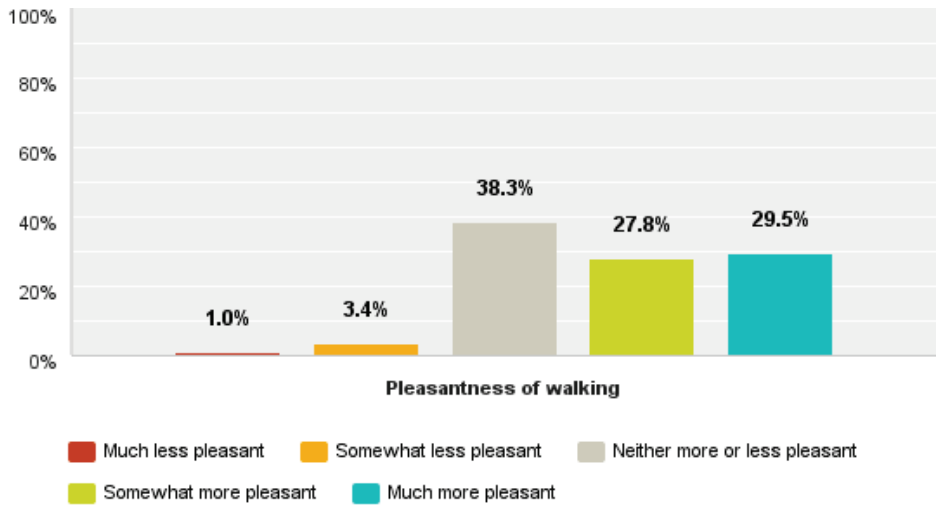
**Figure 7. Post-Implementation Residential: Frequency of Mode Use (n=298)**



**Figure 8. Post-Implementation Residential: Mode Convenience (n=298)**

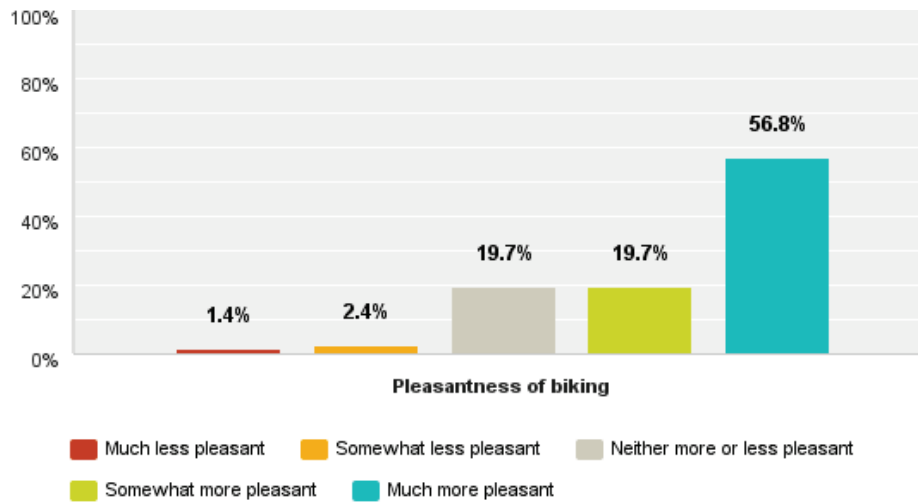


**Figure 9. Post-Implementation Residential: Pleasantness of Walking (n=295)**

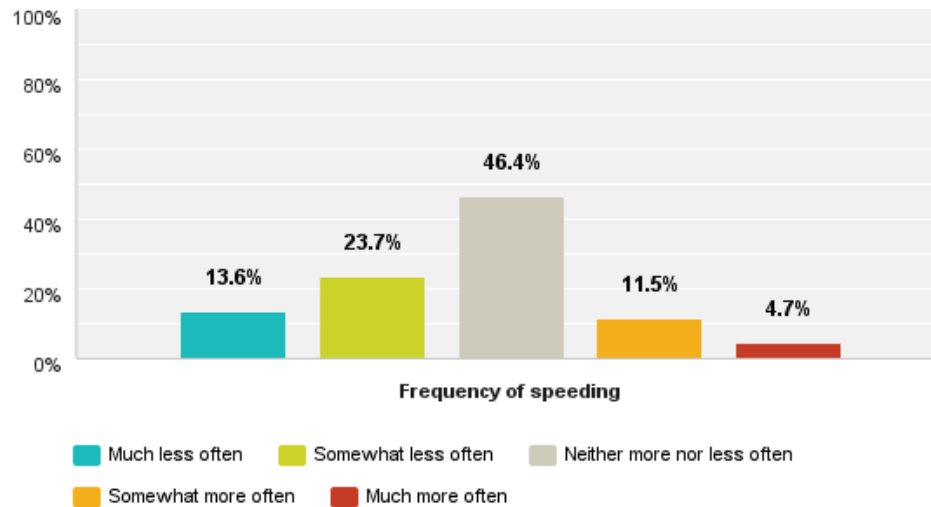




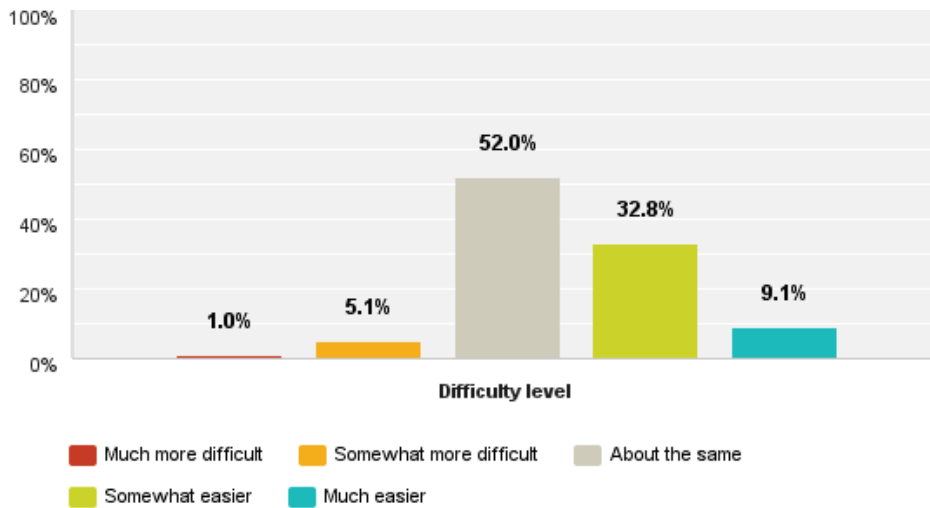
**Figure 10. Post-Implementation Residential: Pleasantness of Biking (n=294)**



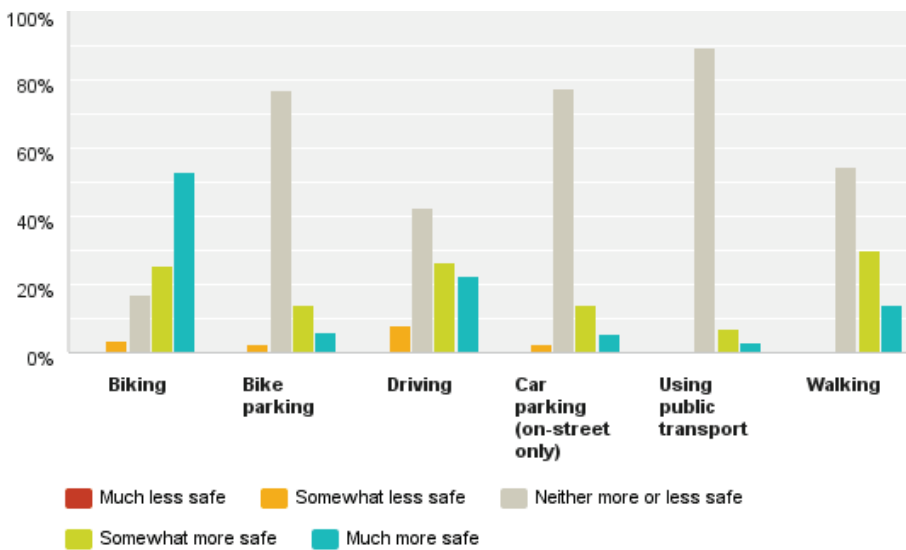
**Figure 11. Post-Implementation Residential: Frequency of Speeding (n=294)**



**Figure 12. Post-Implementation Residential: Intersection Crossing Difficulty (n=296)**



**Figure 13. Post-Implementation Residential: Mode Safety (n=297)**



### 3.1.2 Post-Implementation Residents: Qualitative Comments

Among 345 residents surveyed on post-implementation corridors, 280 provided comments about things they liked most about the corridor changes, and 282 provided comments about things they liked least about the corridor changes.

In many cases, respondent comments included more than one element that they liked or disliked; thus, a total of 365 statements about “what do you like most” and 282 statements regarding “what do you like least” were classified for residents along post-intervention corridors. A summary of the statement categories are included in Table 3 and Table 4.

In terms of most liked aspects of the changes, residents most frequently (n=110) expressed appreciation for the existence of the bike lanes in terms of the safety and convenience of having a dedicated navigation space along the corridor. Improved traffic flow and traffic calming (n=52), increased neighborhood vitality (n=42), and improved esthetics (n=22) that the changes brought to the corridor were also mentioned often. A number of residents (n=20) valued the separate lane designations for cars and bikes in terms of the safety and clarity of purpose it brought (“the street is more organized”) to the corridor. Improved pedestrian safety (n=19), increased driver awareness of bikes and pedestrians (n=15), and driver perceptions of driving safety and convenience (n=15) were also expressed. Twenty-six of the residents were either indifferent to the changes or had not noticed a change.

In terms of least liked aspects of the changes, residents most frequently replied (n=160) that they had “no complaints” or that there was “nothing” that they liked least. A number of the residents (n=23) expressed concerns that they might hit a bicyclist or pedestrian when exiting their driveway, turning, or getting out of their car. Most of these comments were from residents along the Linwood corridor, which features a one-way car lane, one bike lane that flows in the same direction as car traffic, and a contraflow bike lane that flows in the direction opposite to car traffic. Other residents expressed concerns about driver behavior (n=18) that was aggressive, encroached on bike lanes, speeding, or was simply less attentive to the presence of bikes and pedestrians. Some expressed concerns about bicyclist behavior (n=12), e.g., disobeying traffic rules, encroaching on car lanes, and riding on the sidewalk. Several complained about negative impacts on traffic flow and congestion (n=11) or increased challenges with car parking (n=6). For a number of residents (n=16), their biggest complaints were that there were not a greater number of bike amenities. For example, they expressed a desire for a greater number of dedicated lanes or paths, better amenities at transition points between improved and unimproved corridors, and greater overall connectivity among the various areas around the city where bicycle/pedestrian amenities are already in place.

**Table 3. Post-Implementation Residents: Factors most liked about the streetscape changes that have occurred (n=365)**

| <b>Factors most liked</b>           | <b>n</b> |
|-------------------------------------|----------|
| Bike lanes: safety, convenience     | 110      |
| Traffic flow, traffic calming       | 52       |
| Vitality to the street              | 42       |
| No difference/indifferent/nothing   | 26       |
| Esthetics                           | 22       |
| Lane designations, car/bike         | 20       |
| Ped safety/convenience              | 19       |
| Driver awareness/acknowledgement    | 15       |
| Driver safety/convenience           | 15       |
| Street condition improved           | 13       |
| Safety overall                      | 10       |
| Signage clearer                     | 5        |
| Traffic signals for cyclists        | 4        |
| Like changes in general             | 3        |
| Dislike changes                     | 3        |
| Eco friendly                        | 3        |
| Bump outs                           | 2        |
| Car parking convenience             | 2        |
| Bump outs                           | 2        |
| Incomplete, could not be classified | 7        |

**Table 4. Post-Implementation Residents: Factors least liked about the streetscape changes that have occurred (n=282)**

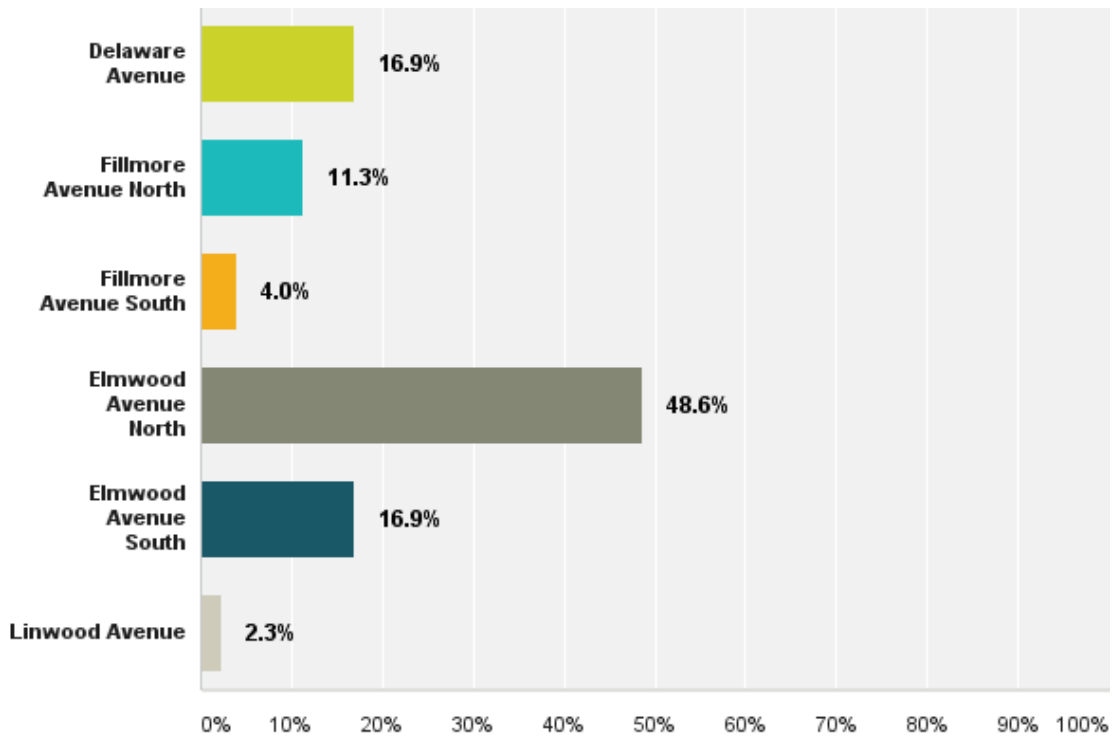
| <b>Factors least liked</b>                     | <b>n</b> |
|--|----------|
| Nothing/no complaints                          | 160      |
| Driver expressions of anxiety/concern          | 23       |
| Driver behavior                                | 18       |
| More amenities wanted                          | 16       |
| Bicyclists behavior                            | 12       |
| Traffic flow                                   | 11       |
| Car parking                                    | 6        |
| Signage worn/not visible (striping/road signs) | 4        |
| Bike lane esthetics                            | 3        |
| Car lane reduction                             | 3        |
| 1-way street                                   | 3        |
| Bump outs                                      | 3        |
| Road surface conditions                        | 2        |
| Signage excessive                              | 2        |
| Signage not visible                            | 2        |
| Bike lanes                                     | 2        |
| Pedestrians encroach on bike lanes             | 1        |
| Sidewalks not done                             | 1        |
| Intersections not safe                         | 1        |
| Not classified - incomplete/unclear            | 6        |

## **3.2 Post-Implementation Merchants**

### **3.2.1 Demographics**

A total of 177 merchants were surveyed along post-implementation corridors. Among these, the distribution of merchants surveyed across the 6 post-implementation corridors reflected the proportion of commercial properties along the respective corridors, with plurality of respondents coming from Elmwood North (48.6 percent), and most of the remainder divided among the Delaware Avenue (16.9 percent), Elmwood South (16.9 percent), and Fillmore North (11.3 percent) corridors (Figure 14). Among these, 58.2 percent were managers, and 41.8 percent were owners.

**Figure 14. Post-Implementation Merchants. Respondents by Corridor**



The age distribution, gender identity, and racial/ethnic identity of merchants in post-implementation corridors are reflected in Figures 15 through 17. The preponderance (91.3 percent) reported owning a car, and 66.0 percent reported owning a bike.

**Figure 15. Age Distribution of Post-Implementation Merchants (n=150)**

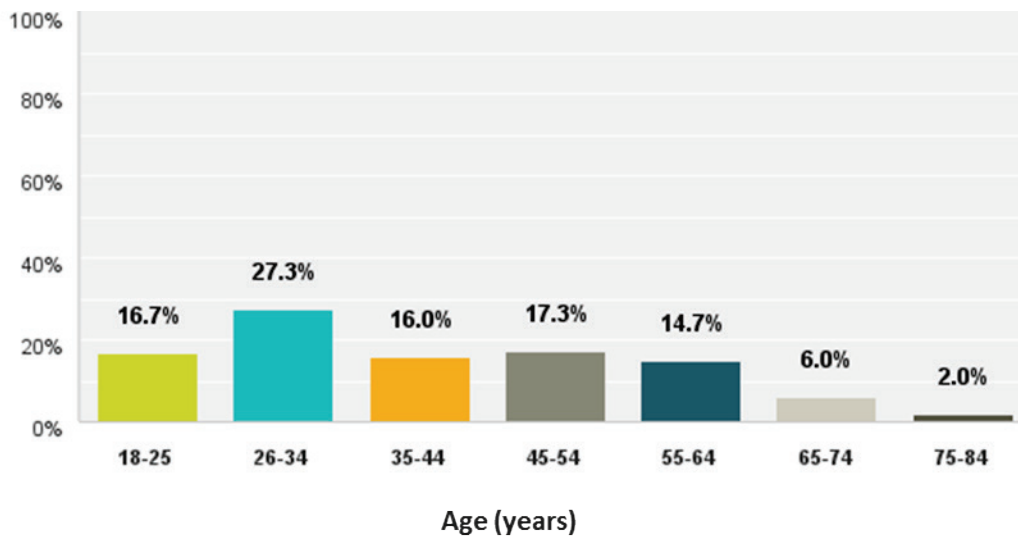


Figure 16. Gender Identity of Post-Implementation Merchants (n=150)

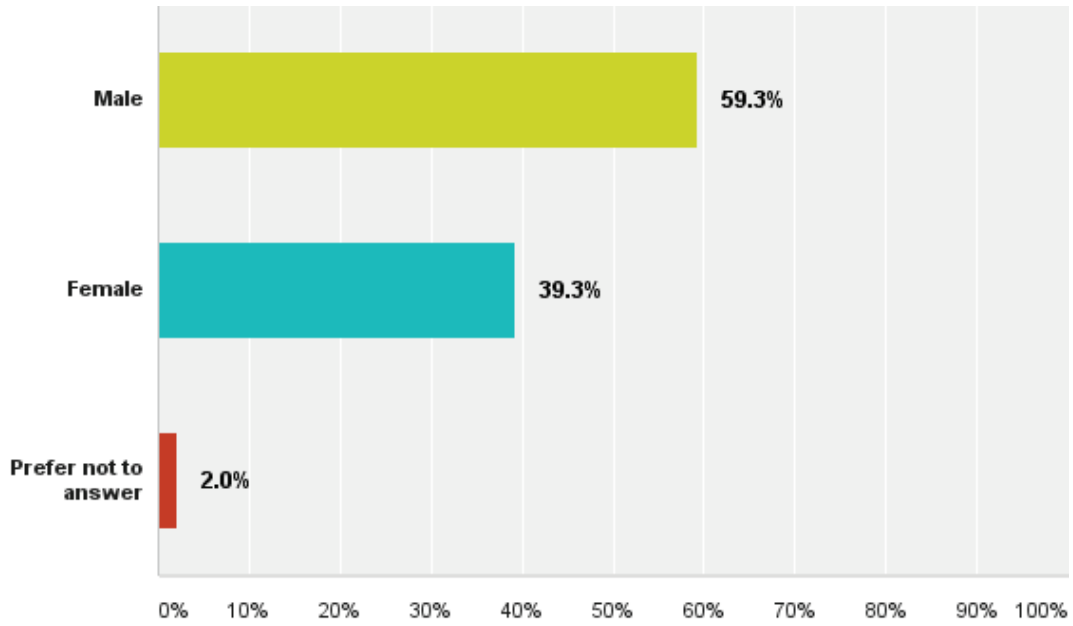
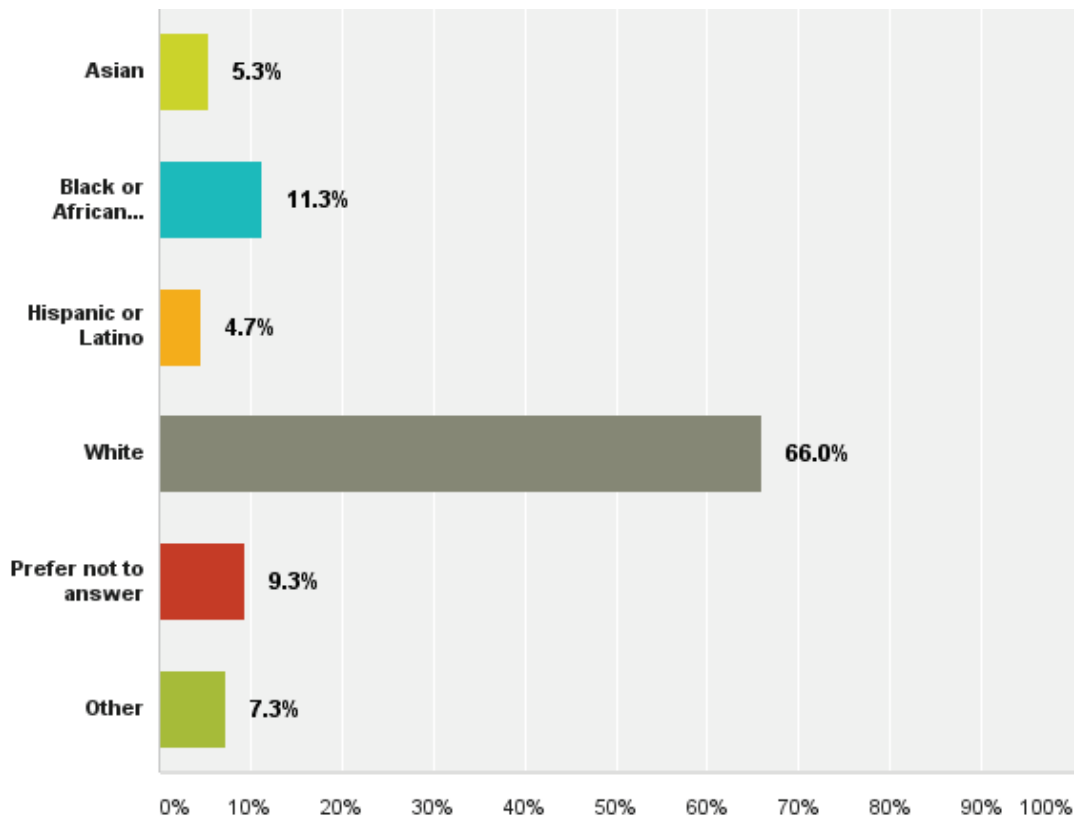


Figure 17. Racial/ethnic Identity of Post-Implementation Merchants (n=150)



### 3.3 Post-Implementation Merchants: Key Indicators of Impact

The key indicators of Complete Streets impact for Merchants reflected the following along post-implementation corridors:

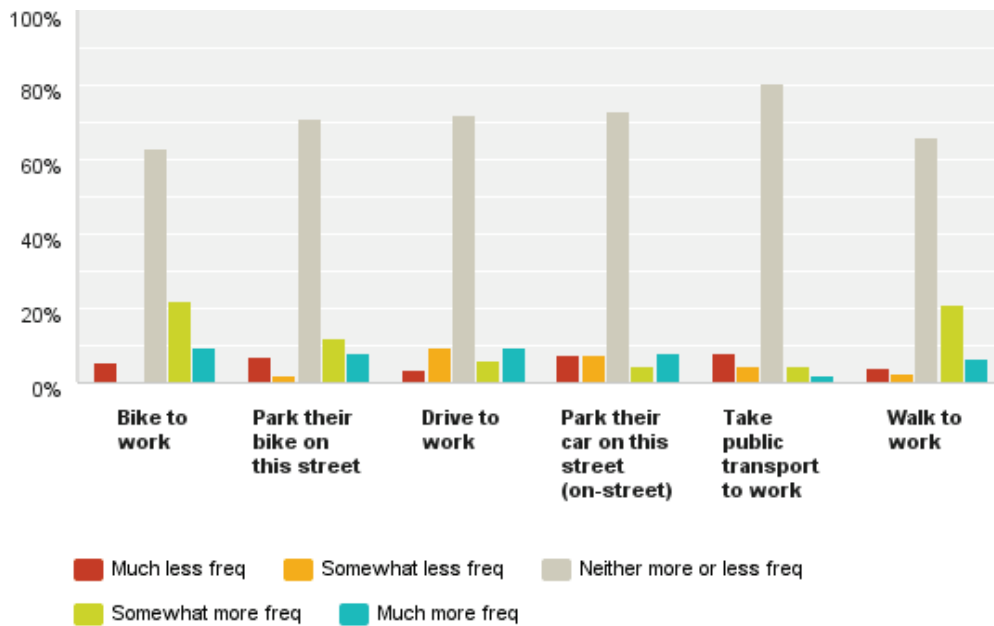
- 58.4 percent indicated that they were “much more satisfied” or “somewhat more satisfied” with the street since the changes were implemented (Figure 18).
- 27.7 percent reported that employees were walking “much more” or “somewhat more” frequently to work, and 31.2 percent reported that employees were biking “much more” or “somewhat more” frequently to work (Figure 19).
- 40.4 percent reported that customers were walking “much more” or “somewhat more” frequently to the merchant’s business, and 42.8 percent reported that customers were biking “much more” or “somewhat more” frequently to the business (Figure 20).
- 48 percent reported that walking was “much more” or “somewhat more” convenient; 71.7 percent reported that biking was “much more” or “somewhat more” convenient; and 67.5 percent reported that driving along the corridor was as, or more, convenient than it was prior to the streetscape changes (Figure 21).
- 43.3 percent reported that walking was “somewhat more” or “much more” pleasant than it was prior to the change (Figure 22).
- 52.6 percent reported that biking was “somewhat more” or “much more” pleasant than it was prior to the changes (Figure 23).
- Just over 50 percent reported that drivers were neither speed more nor less; roughly 25 percent felt that drivers were exceeding the speed limit “somewhat less” or “much less” often, and roughly 25 percent felt that drivers were speeding more often (Figure 24).
- 37.3 percent reported that intersections were “somewhat easier” or “much easier” to cross (Figure 25).
- 42.7 percent indicated that walking was “somewhat more” or “much more” safe; 58.7 percent indicated that biking was “somewhat more” or “much more” safe; and 82 percent reported that driving was as, or more, safe as a result of the changes (Figure 26).
- 44.7 percent indicated the overall economic health of the street was “somewhat better” or “much better” since the changes had been made (Figure 27).
- Almost three-quarters (70.7 percent) reported that their own business sales were unchanged, although 25.8 percent reported that their sales were “somewhat more” or “much more” since the streetscape changes were implemented (Figure 28).



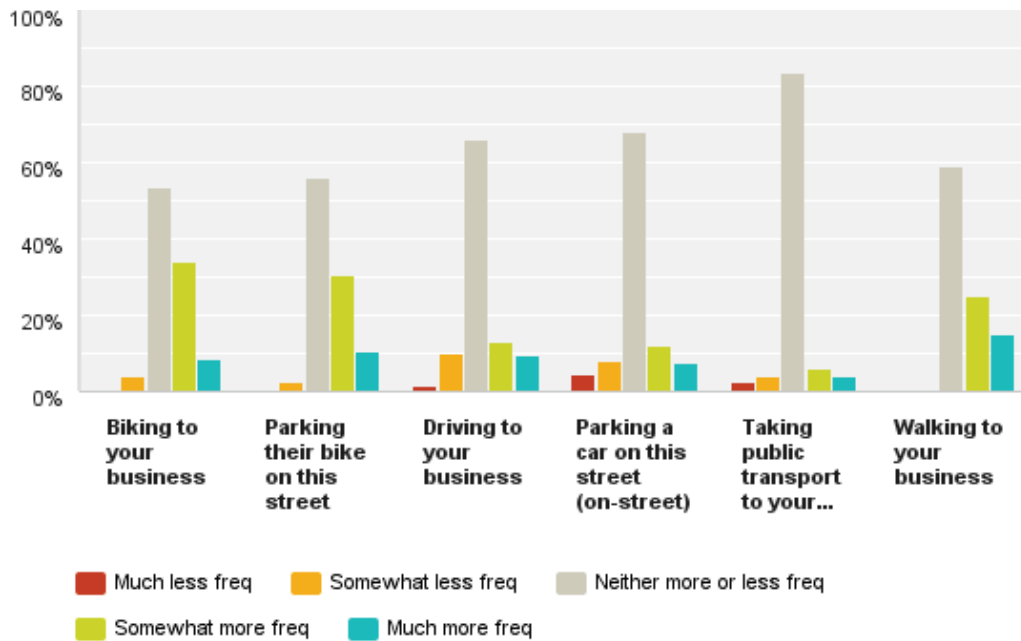
**Figure 18. Post-Implementation Merchants: Overall satisfaction with streetscape since the changes (n=149)**



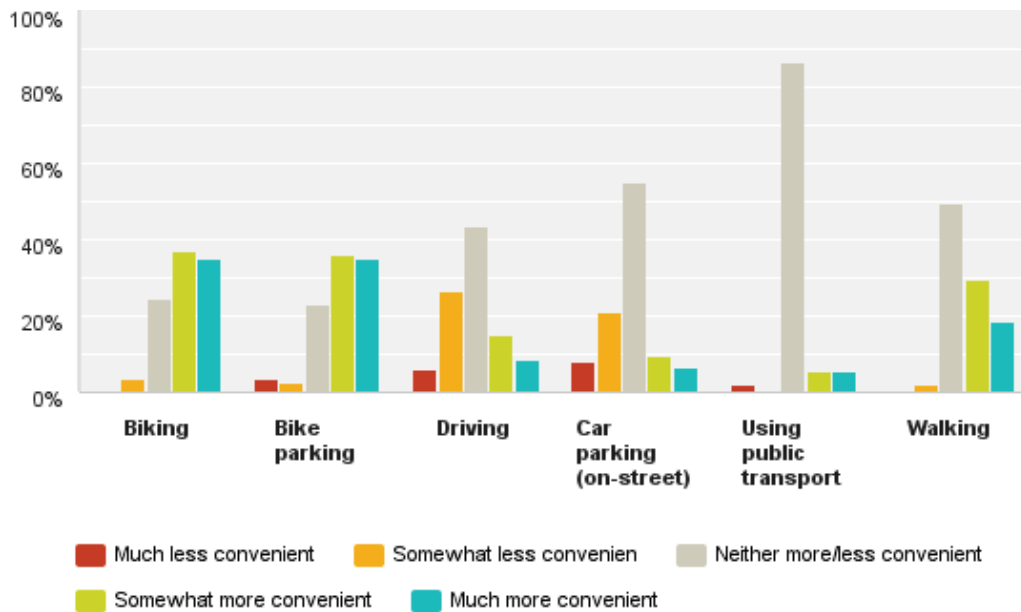
**Figure 19. Post-Implementation Merchants: Employee mode frequency (n=152)**



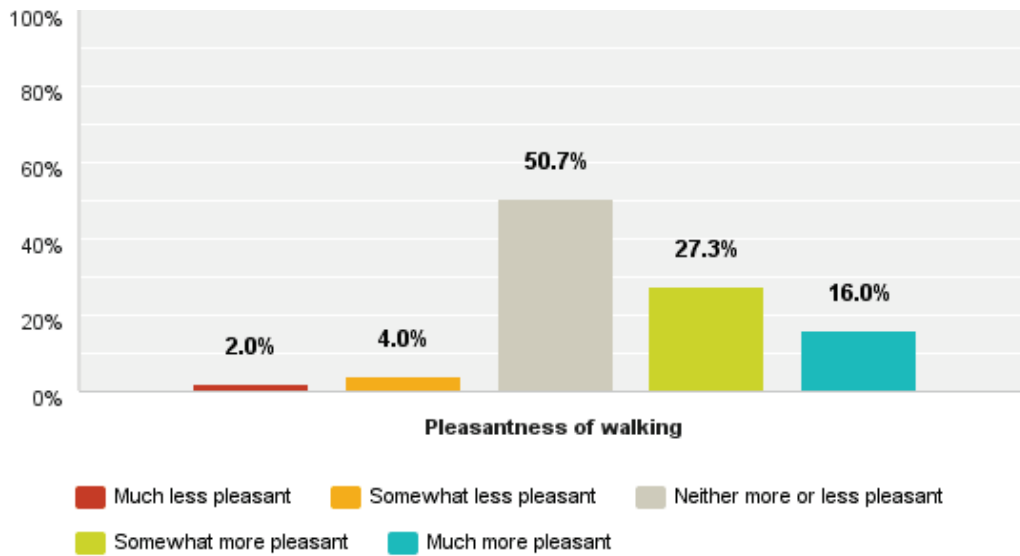
**Figure 20. Post-Implementation Merchants: Customer Mode Frequency (n=152)**



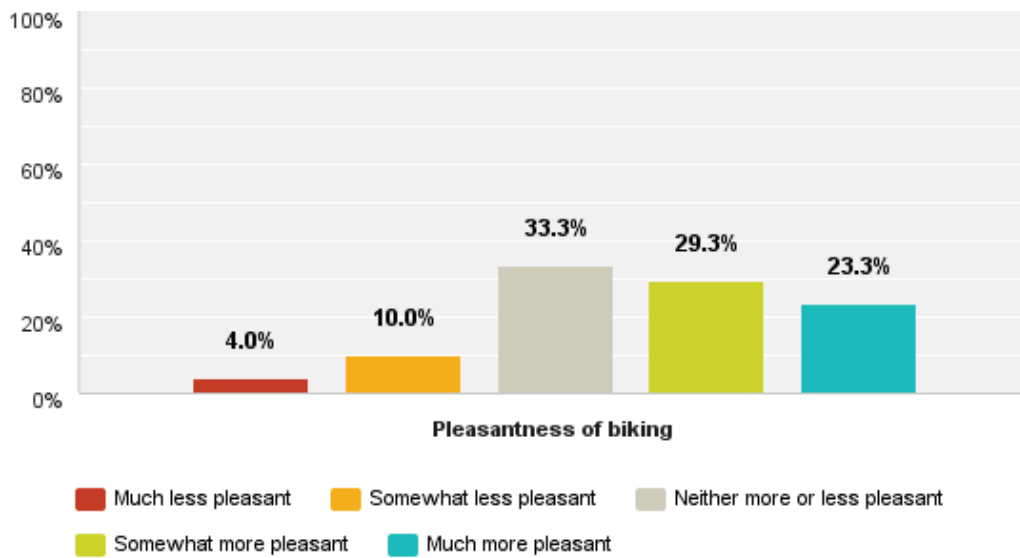
**Figure 21. Post-Implementation Merchants: Mode Convenience (n=152)**



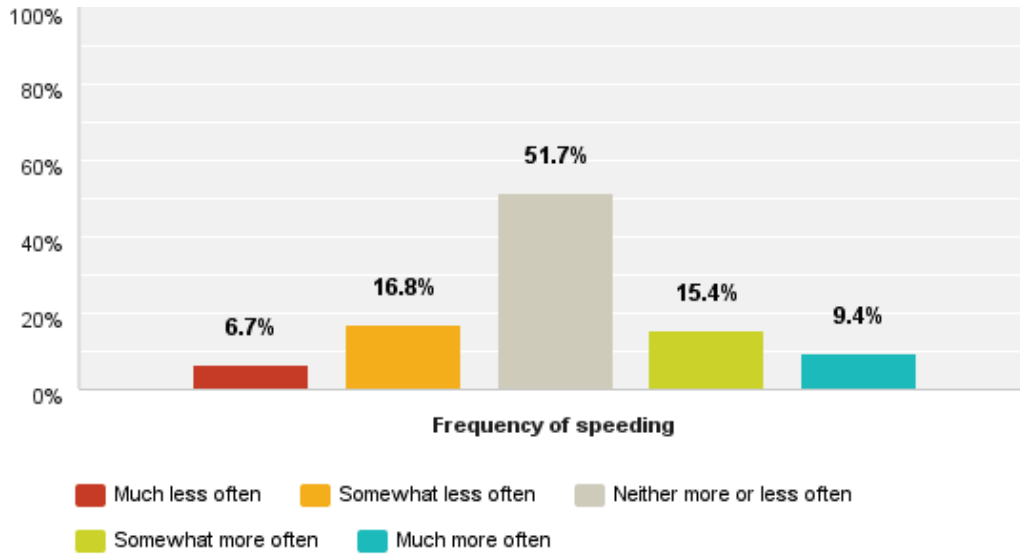
**Figure 22. Post-Implementation Merchants: Pleasantness of Walking (n=150)**



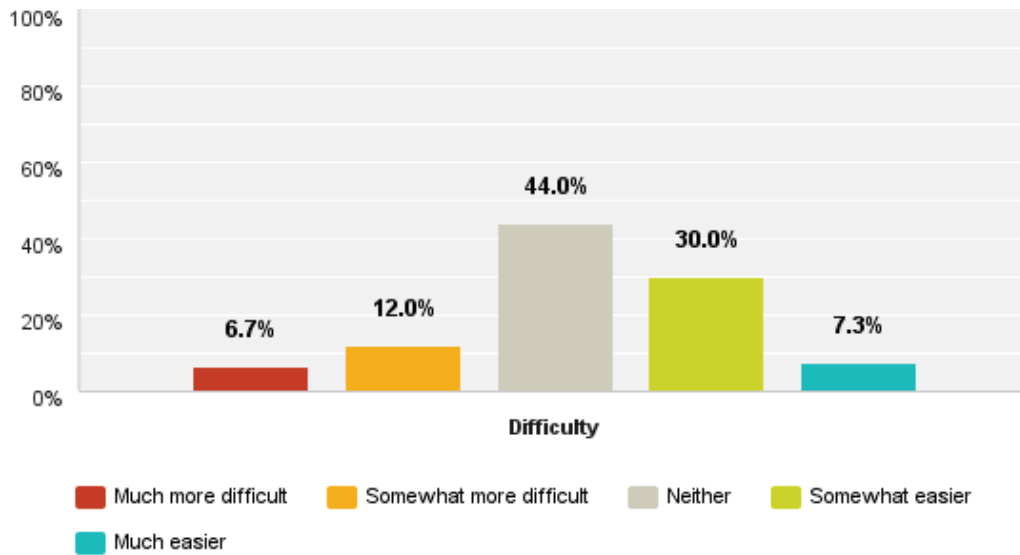
**Figure 23. Post-Implementation Merchants. Pleasantness of Biking (n=150)**



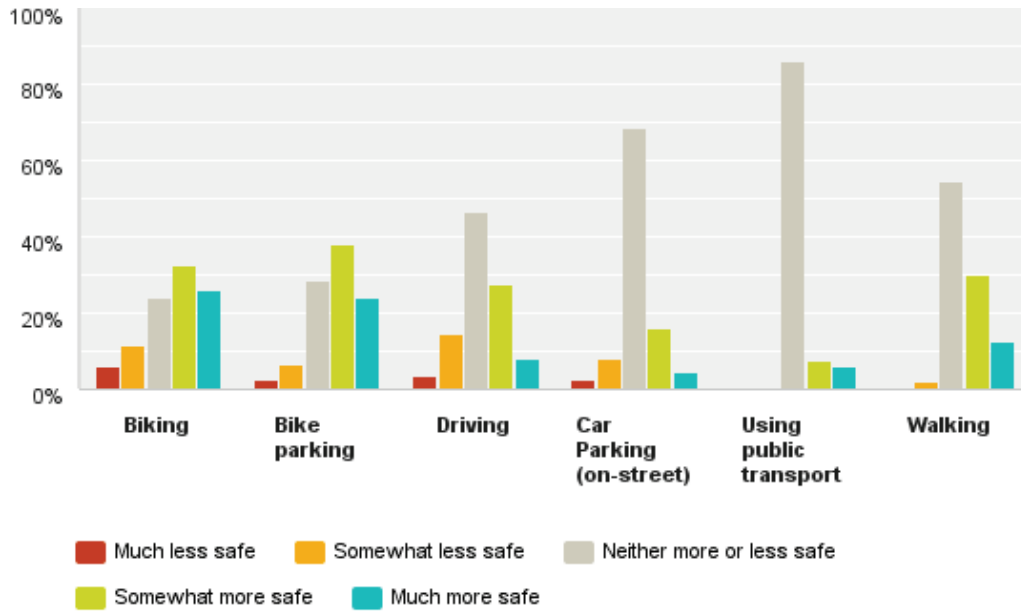
**Figure 24, Post-Implementation Merchants: Frequency of drivers exceeding the speed limit (n=149)**



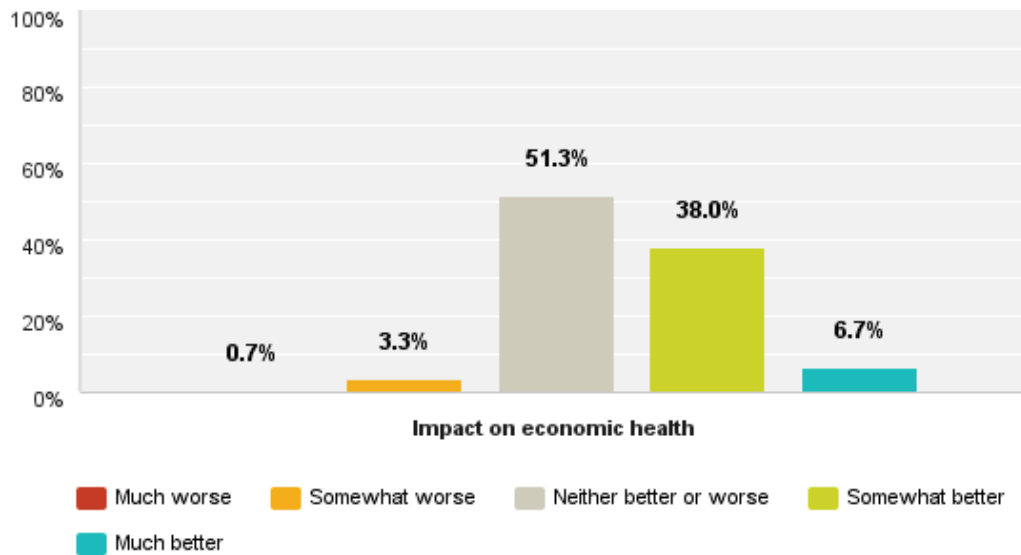
**Figure 25. Post-Implementation Merchants: Intersection Crossing Difficulty (n=150)**



**Figure 26. Post-Implementation Merchants: Mode Safety (n=150)**

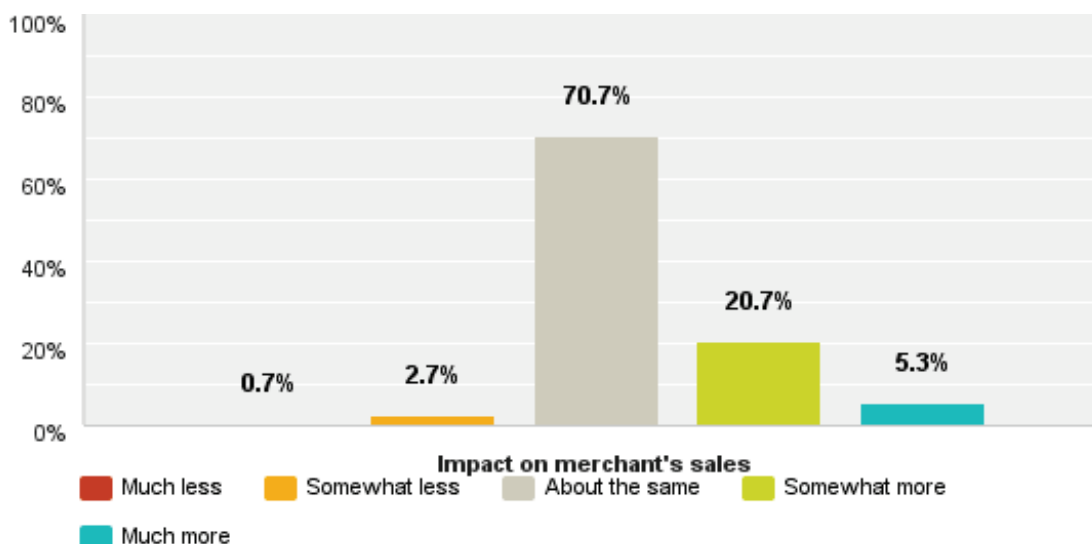


**Figure 27. Post-Implementation Merchants: Impact on economic health of the street (n=150)**



**Figure 28. Post-Implementation Merchants: Impact on merchant's sales (n=150)**

Merchants were asked if their sales were “much less, somewhat less, about the same, somewhat more, or much more” than prior to the CS changes on their street.



### 3.3.1 Post-Implementation Merchants: Qualitative Comments

Among 177 merchants surveyed on post-implementation corridors, 145 provided comments about things they liked most about the corridor changes and 139 provided comments about things they liked least about the corridor changes. As with the sample of residents, many merchants mentioned more than one element that they liked most or least. A total of 193 merchant statements about “what you like most” and 147 statements about “what do you like least” were classified along post-intervention corridors.

In terms of most liked aspects of the changes (Table 5), merchants most frequently (n=47) expressed appreciation that the bike amenities afforded increased safety and convenience for bicyclists along the corridor. Twenty-eight merchants were either indifferent to the changes, felt that the changes had little impact, or had not noticed a change. Others noted improved pedestrian safety and convenience (n=21), traffic flow and calming (n=15), esthetics (n=14), and increased vitality (n=9) that the changes brought to the corridor. Several (n=7) valued the separate lane designations for cars and bikes in terms “organizing” the street, and others noted increased driver awareness of bikes and pedestrians (n=7). They also welcomed the addition of bike racks (n=7) and improved car parking (n=6).

In terms of least liked aspects of the changes (Table 6), merchants most frequently replied (n=61) that they had “no complaints” or that there was “nothing” that they liked least. Fifteen merchants suggested the need for more bike amenities; among these, 12 suggested the need for dedicated bike lanes along the Elmwood-North corridor as an alternative to the shared car/bike lane currently found on that particular street. A comparable number expressed displeasure with existing amenities such as car lane reductions (n=8) and bike lanes (n=3). Twelve merchants expressed concerns about driver behavior that was aggressive, encroached on bike lanes, speeding, or was simply less attentive to the presence of bikes and pedestrians, while 8 expressed concerns about bicyclist behavior, e.g., disobeying traffic rules, riding on the sidewalk. Several expressed displeasure with the negative impacts on traffic flow and congestion (n=9), car parking (n=9), and lane reduction for cars (n=8).

**Table 5. Post-Implementation Merchants: Factors most liked about the streetscape changes (n=193)**

| <b>Most liked factors</b>  | <b>n</b> |
|----------------------------|----------|
| Biking safety/convenience  | 47       |
| Nothing/indifferent        | 28       |
| Ped safety/convenience     | 21       |
| Traffic flow               | 15       |
| Esthetics of the street    | 14       |
| Vitality of the street     | 9        |
| Car/bike lane designations | 7        |
| Bike racks                 | 7        |
| Driver awareness improved  | 7        |
| Overall supportive         | 6        |
| Car parking improved       | 6        |
| Signage better             | 5        |
| Driving safety/convenience | 4        |
| Street condition improved  | 3        |
| Eco friendly               | 3        |
| Dislike changes            | 3        |
| Safer overall              | 2        |
| Business impact            | 2        |
| Sidewalk condition         | 1        |
| Unclassified               | 3        |

**Table 6. Post-Implementation Merchants: Factors least liked about the streetscape changes (n=147)**

| <b>Least liked factors</b>      | <b>n</b> |
|---------------------------------|----------|
| Nothing disliked                | 61       |
| More amenities wanted           | 15       |
| Driver behavior/awareness       | 12       |
| Parking availability/cost       | 9        |
| Traffic flow/congestion         | 9        |
| Bicyclist behavior              | 8        |
| Car lane reduction              | 8        |
| Bike lanes (dislike)            | 3        |
| Bump outs                       | 3        |
| Construction                    | 3        |
| Signage faded/inconsistent      | 3        |
| Bike lane - more room needed    | 2        |
| Safety                          | 2        |
| Traffic lights                  | 2        |
| Biking could be more encouraged | 1        |
| Business impact: parking cost   | 1        |
| Unclassified                    | 5        |

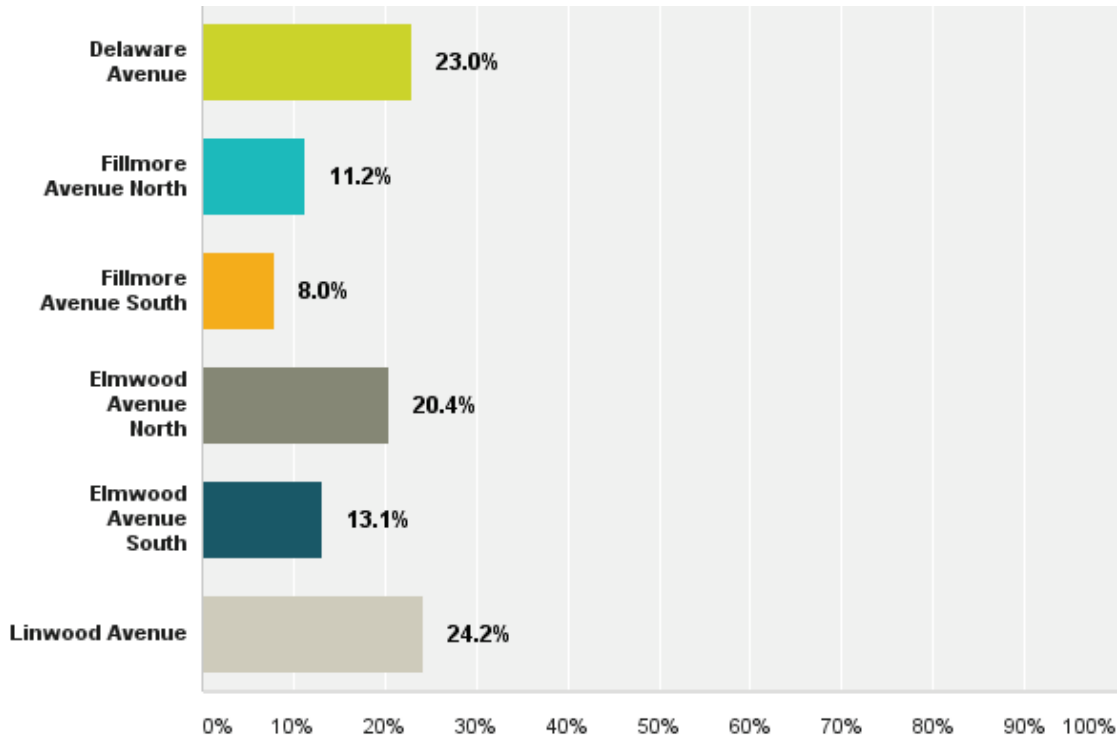
### **3.4 Post-Implementation Streetscape Users**

#### **3.4.1 Demographics**

A total of 1,052 streetscape users were surveyed along post-implementation corridors. The distribution of users across the six corridors was fairly equal, with none of the corridors representing more than 25 percent of the respondents in this group. The between-group proportions reflect the relative user density that one would typically observe along these corridors in summer months.



**Figure 29. Post-Implementation Streetscape Users by Corridor (n=1,052)**



The age distribution, gender identity, racial/ethnic identity, and household income of streetscape users surveyed along post-implementation corridors are reflected in Figures 30 through 33. Overall, 58.9 percent reported owning a car, and 69.8 percent reported owning a bike.

**Figure 30. Age Distribution of Post-Implementation Streetscape Users (n=987)**

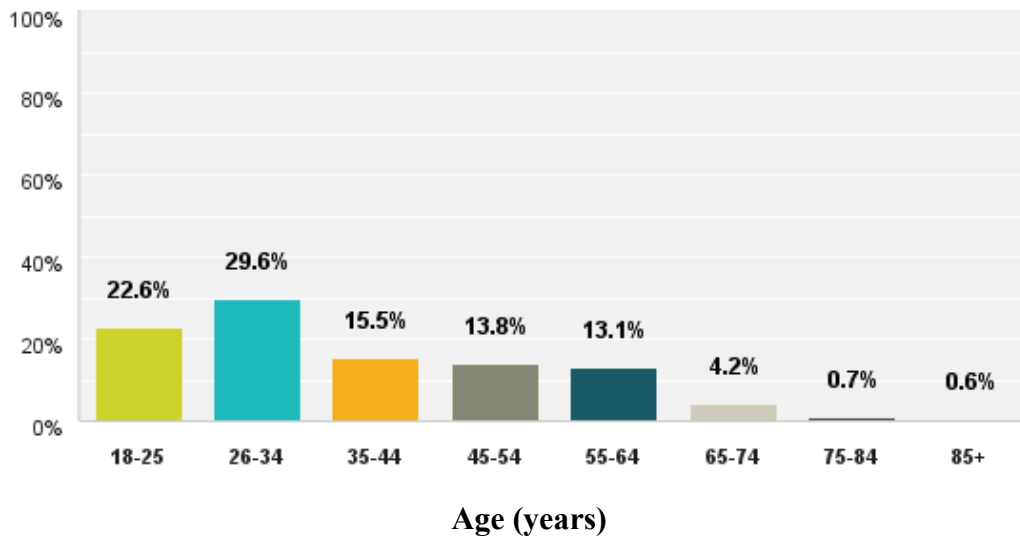


Figure 31. Gender Identity of Post-Implementation Streetscape Users (n=987)

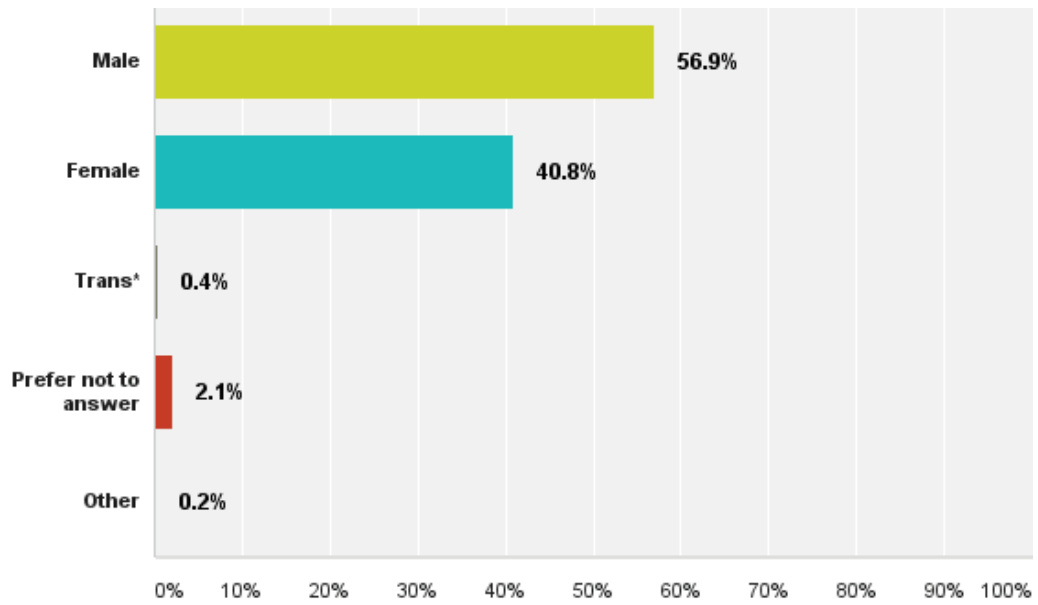
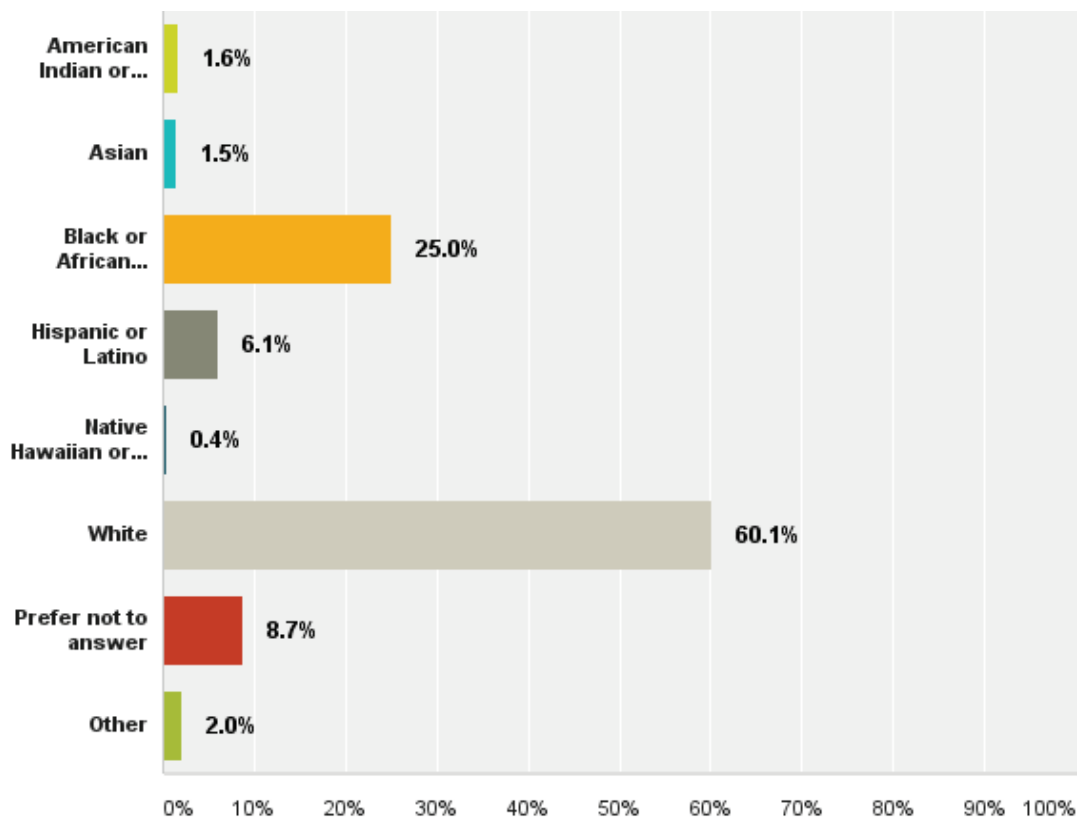
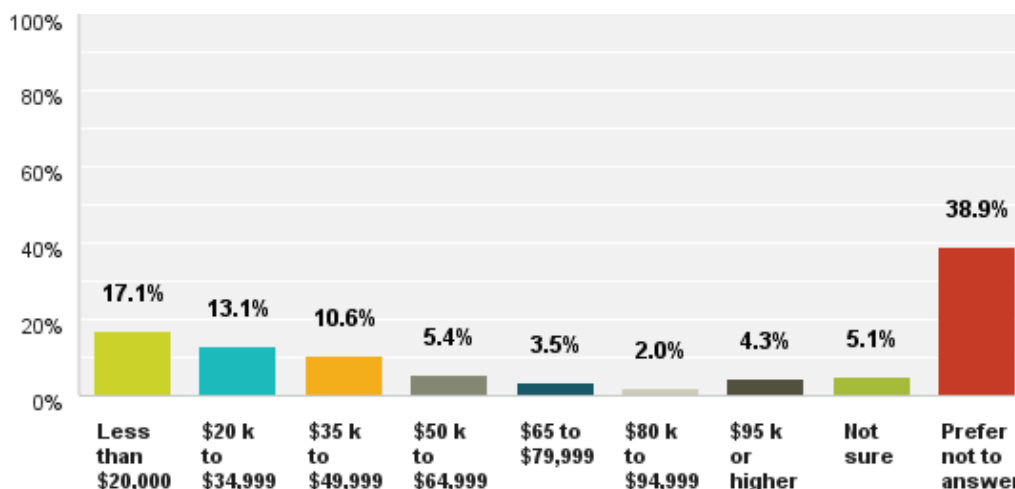


Figure 32. Racial/ethnic Identity of Post-Implementation Streetscape Users (n=987)



**Figure 33. Household Income of Post-Implementation Streetscape Users (n=987)**

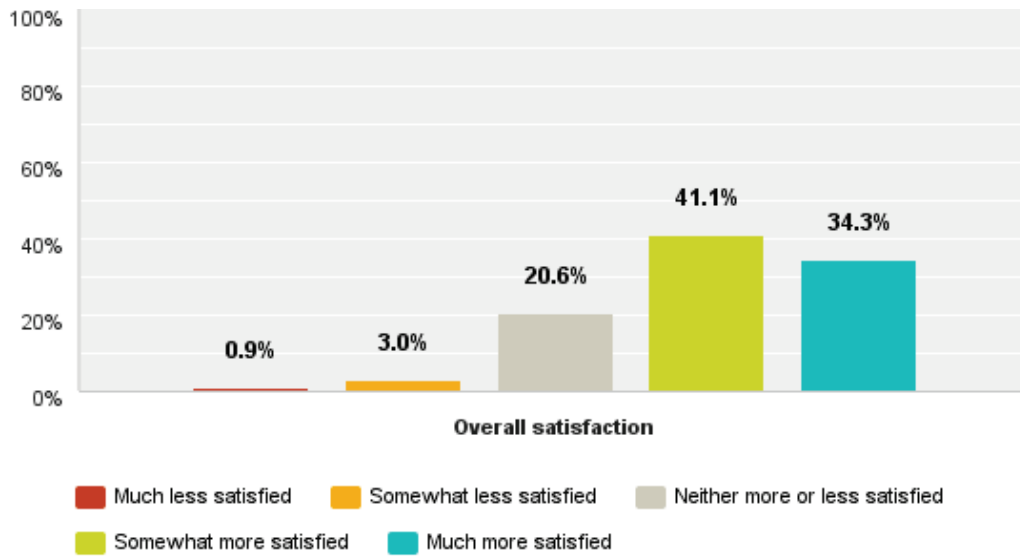


### 3.4.2 Post-Implementation Streetscape Users: Key Indicators of Impact

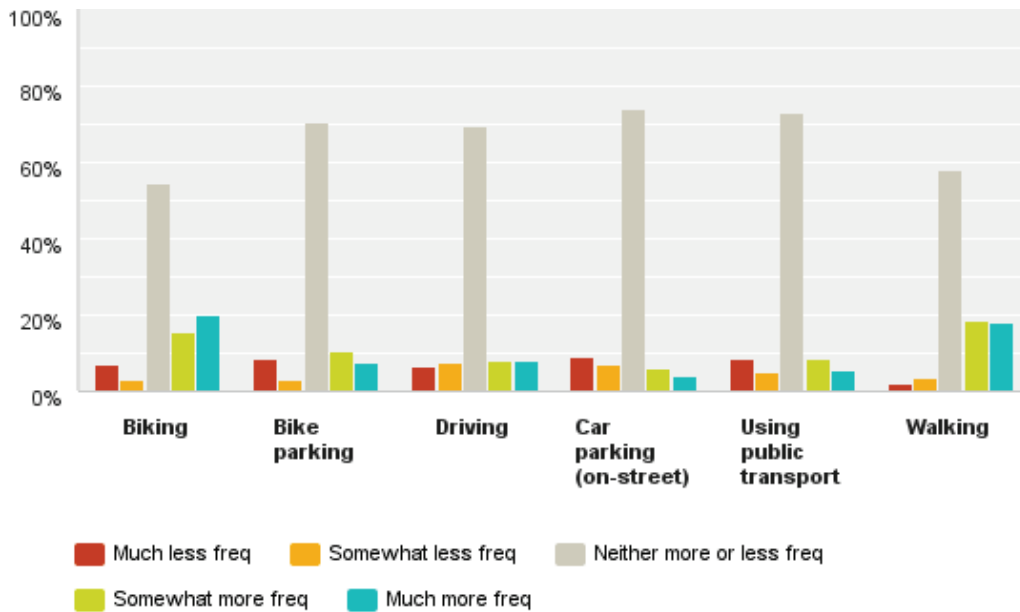
The key indicators of Complete Streets impact for Streetscape Users reflected the following along post-implementation corridors:

- 75.7 percent indicated that overall they were “much more satisfied” or “somewhat more satisfied” with the street since the changes were implemented (Figure 34).
- 36.5 percent reported that they were walking “much more” or “somewhat more” frequently, and 35.8 percent reported that they were biking “much more” or “somewhat more” frequently (Figure 35).
- 46.3 percent reported that walking was “much more” or “somewhat more” convenient; 64.7 percent reported that biking was “much more” or “somewhat more” convenient; and 83.6 percent reported that driving along the corridor was as, or more, convenient than it was prior to the streetscape changes (Figure 36).
- 43.1 percent reported that walking was “somewhat more” or “much more” pleasant than it was prior to the change (Figure 37).
- 46.7 percent reported that biking was “somewhat more” or “much more” pleasant than it was prior to the changes (Figure 38).
- 34.2 percent indicated that drivers were exceeding the speed limit “somewhat less” or “much less” often than prior to changes (Figure 39).
- 47.3 percent reported that intersections were “somewhat easier” or “much easier” to cross (Figure 40).
- 47.2 percent indicated that walking was “somewhat more” or “much more” safe; 60.4 percent indicated that biking was “somewhat more” or “much more” safe; and 39.3 percent reported that driving was “somewhat more” or “much more” safe as a result of the changes (Figure 41).

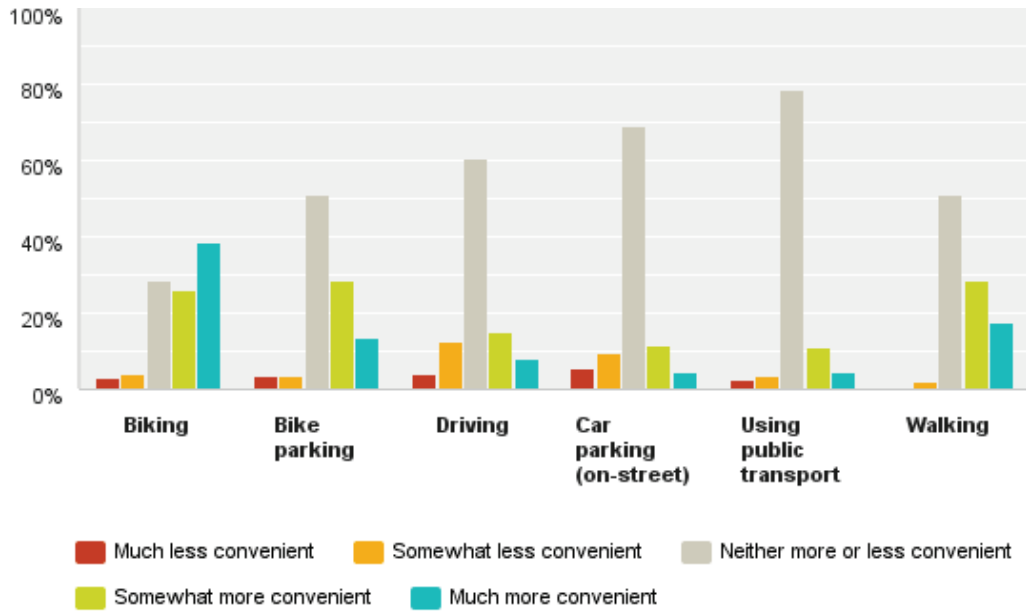
**Figure 34. Post-Implementation Streetscape User: Overall satisfaction with this street since the changes were implemented (n=986)**



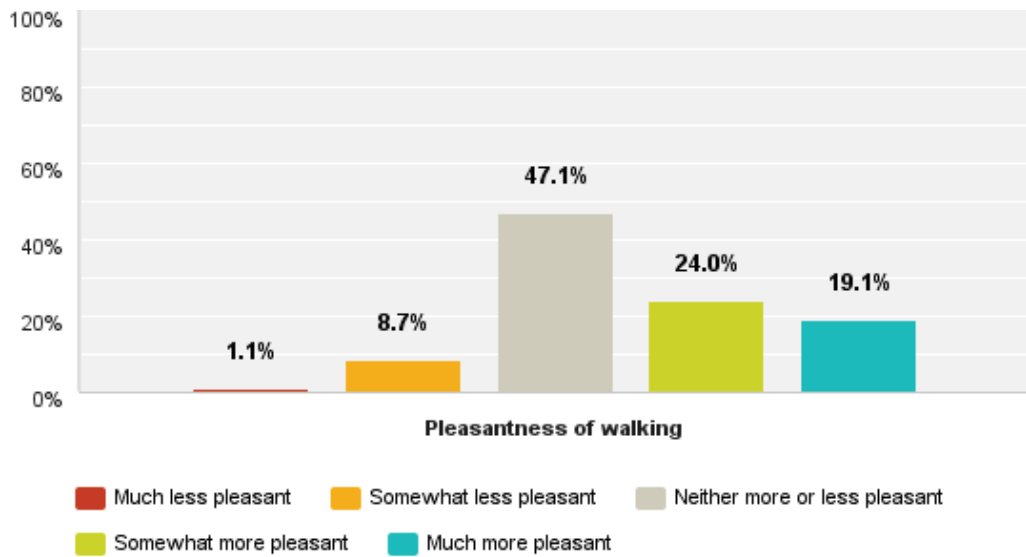
**Figure 35. Post-Implementation Streetscape User: Frequency of Mode Use (n=1,003)**



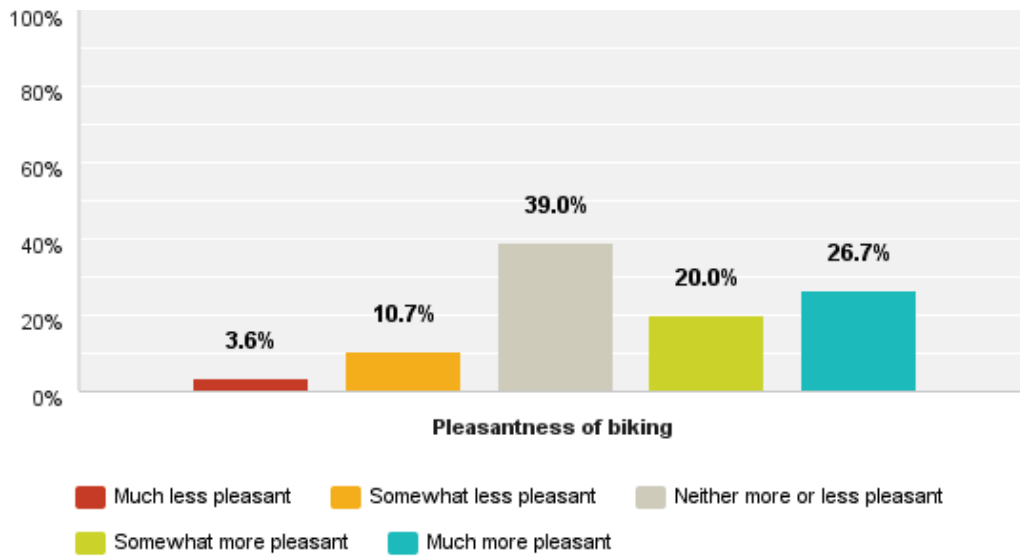
**Figure 36. Post-Implementation Streetscape User: Mode Convenience (n=993)**



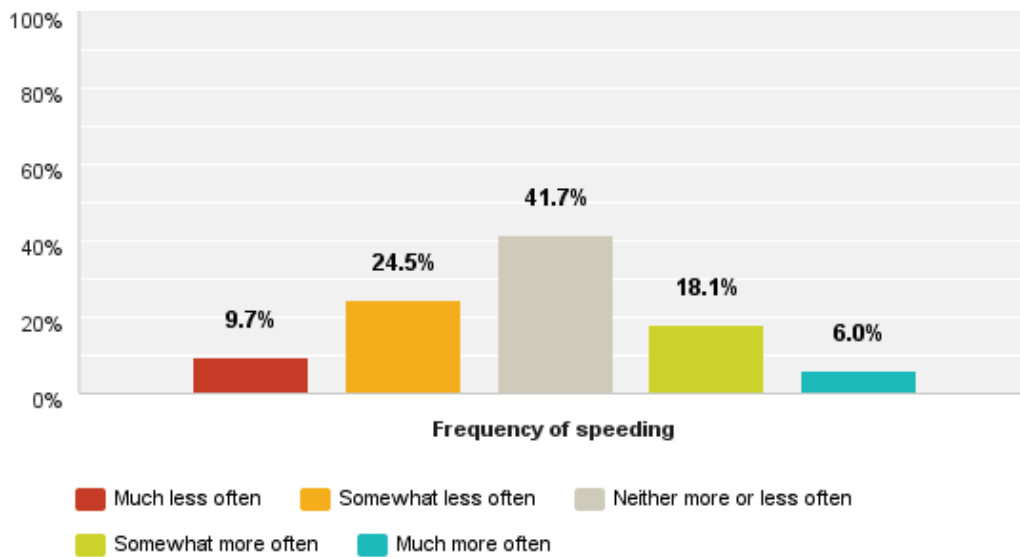
**Figure 37. Post-Implementation Streetscape User: Pleasantness of Walking (n=980)**



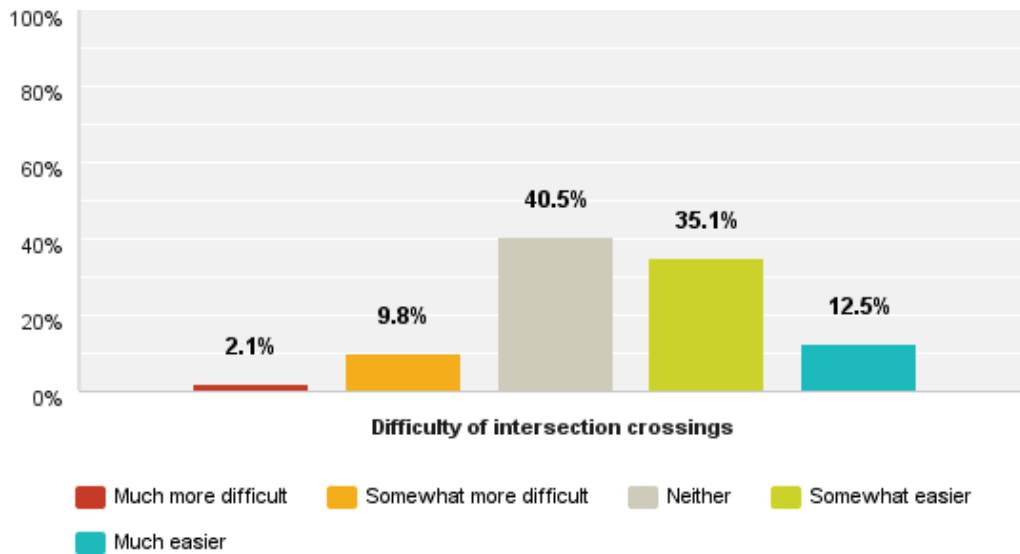
**Figure 38. Post-Implementation Streetscape User: Pleasantness of Biking (n=984)**



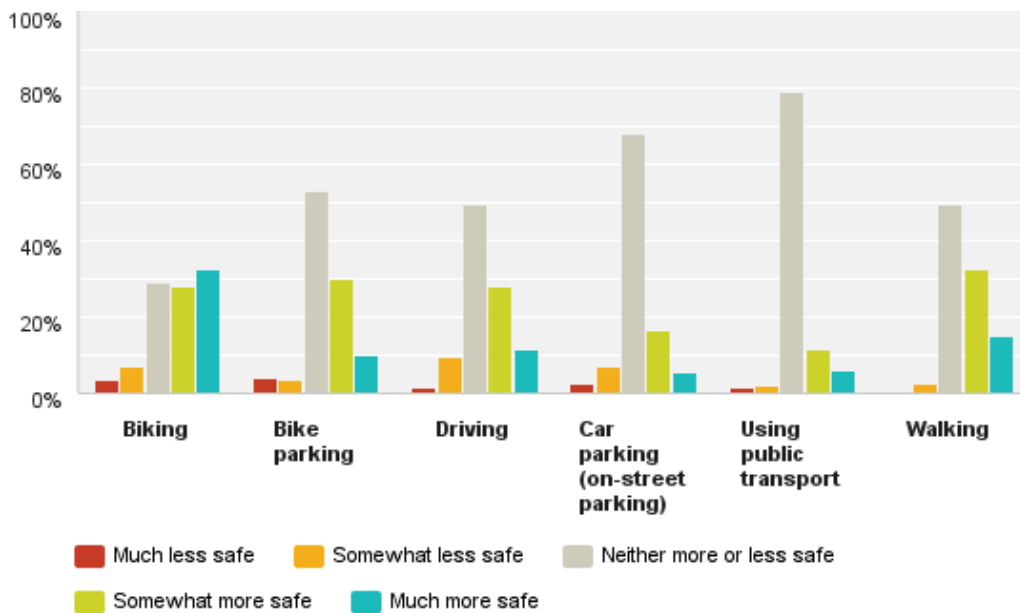
**Figure 39. Post-Implementation Streetscape User: Frequency of drivers exceeding speed limit (n=981)**



**Figure 40. Post-Implementation Streetscape User: Intersection Crossing Difficulty (n=990)**



**Figure 41. Post-Implementation Streetscape User: Mode Safety (n=981)**



### 3.4.3 Post-Implementation Streetscape Users: Qualitative Comments

Among 1,053 streetscape users surveyed on post-implementation corridors, 898 provided comments about things they liked most about the corridor changes and 765 provided comments about things they liked least about the corridor changes. As with the samples of residents and merchants, many streetscape users mentioned more than one element that they liked most or least. A total of 1,098 streetscape user statements about “what you like most” and 793 statements about “what do you like least” were classified along post-intervention corridors.

In terms of most liked aspects of the changes (Table 7), streetscape users most frequently (n=405) expressed enthusiasm for the increased safety and convenience afforded by all biking amenities, especially bike lanes. Ninety-eight of the streetscape users did not provide a comment, either because they were indifferent to the changes, had no opinion, or had not noticed a change. Many noted greater pedestrian safety (n=79) and improved traffic calming and flow (n=68). Improved visual appeal/aesthetics (n=79), increased neighborhood vitality (n=65), and increased driver awareness of bikes and pedestrians (n=51) were also prominent themes. Similar to the responses from residents and merchants, a number of streetscape users (n=35) described their appreciation for the order and organization that separate car/bike lane designations brought to the corridor. Streetscape users also noted the upgraded condition of street pavement (n=26), addition of bike racks (n=26), increased visibility of signage such as sharrows (n=23), and sidewalk improvements (n=16).

In terms of least liked aspects of the changes (Table 8), streetscape users most frequently replied (n=357) that they had “no complaints” or that there was “nothing” that they liked least. Many other streetscape users (n=101) indicated that their biggest complaint was that there were not a greater number of bike amenities, e.g., dedicated or protected lanes, greater overall connectivity among the various areas around the city where bicycle/pedestrian amenities are already in place, better transitions between improved and unimproved corridors, more bike racks, increased signage, landscaping, and crosswalk signals. In contrast, a much smaller number expressed displeasure with existing amenities, such as bike lanes (n=21) and car lane reductions (n=13).

Many expressed concerns about driver behavior (n=63) that was aggressive, encroached on bike lanes, speeding, or was inattentive to the presence of bikes and pedestrians. A smaller number (n=27) expressed concerns about bicyclist behavior, e.g., disobeying traffic rules, encroaching on car lanes, and riding on the sidewalk. Other comments targeted negative impacts on traffic flow and congestion (n=45) and increased challenges with car parking (n=30).



**Table 7. Streetscape users, Post-Implementation: Factors most liked about the streetscape changes (n=1,098)**

| <b>Changes Most Liked</b>                | <b>n</b> |
|--|----------|
| Biking safety/convenience                | 405      |
| Nothing/no opinion                       | 98       |
| Esthetics                                | 79       |
| Pedestrian safety/convenience            | 79       |
| Traffic flow/calming                     | 68       |
| Vitality of the street                   | 65       |
| Driver awareness increased               | 51       |
| Lane designations for car/bike           | 35       |
| Bike racks                               | 26       |
| Street condition improved                | 26       |
| Signage more visible (incl. sharrows)    | 23       |
| Safety overall improved                  | 19       |
| Sidewalk conditions improved             | 16       |
| Parking improved                         | 12       |
| Driving safety/convenience               | 11       |
| Eco friendly                             | 10       |
| Multiple modes accommodated              | 7        |
| Bump outs                                | 6        |
| Overall convenience/easier to get around | 6        |
| 1-way street                             | 4        |
| Overall supportive                       | 4        |
| City is prioritizing bikes               | 3        |
| Landscaping                              | 3        |
| Dislike changes                          | 2        |
| Bus travel easier/convenient             | 2        |
| Street lighting                          | 1        |
| Unclassified/unrelated                   | 19       |

**Table 8. Streetscape users, Post-Implementation: Factors least liked about the streetscape changes (n=793)**

| <b>Category</b>                         | <b>n</b> |
|---|----------|
| Nothing/none/no complaints/like changes | 357      |
| More amenities wanted                   | 101      |
| Driver behavior                         | 63       |
| Traffic flow/congestion                 | 45       |
| Parking                                 | 30       |
| Bicyclist behavior                      | 27       |
| Bike lanes: dislike                     | 21       |
| Car lane reduction                      | 13       |
| Driving convenience                     | 13       |
| Biking convenience/safety               | 12       |
| Bump outs                               | 10       |
| Traffic signals                         | 9        |
| Sidewalk conditions                     | 9        |
| Safety                                  | 8        |
| Striping visibility                     | 6        |
| Road surface conditions                 | 5        |
| Construction                            | 4        |
| Cars                                    | 3        |
| Esthetics                               | 3        |
| Dislike changes                         | 3        |
| Crime increase                          | 2        |
| Ped safety                              | 2        |
| Cost                                    | 1        |
| Unclassified/unclear/unrelated          | 44       |

### **3.5 Additional Analyses of Post-Implementation Data**

Additional analyses were conducted on the post-implementation data set to explore two key areas: (a) whether or not there were any underlying differences in ratings based on subgroups – in effect, to determine if some sub-groups more likely to provide positive ratings, and other groups more likely to provide negative ratings; and (b) whether or not there were correlations among different survey questions.

### 3.5.1 Differences in Ratings Based on Subgroups

One-sided proportion tests were performed to evaluate whether or not the population proportion of positive responses exceeded the population proportion of negative responses for five post-implementation survey items: overall satisfaction with the streetscape changes, frequency of walking, frequency of biking, safety of walking, and safety of biking. For this analysis, neutral responses (a scale at 3) were removed, scale responses of “4” or “5” are designated as “positive”, and scale responses of “1” or “2” were designated as “negative.” The purpose was to assess whether or not specific subgroups may have responded favorably, while others responded unfavorably.

Table 9 summarizes this analysis for the survey item related to overall satisfaction with the streetscape changes. In this table, Column 1 describes the subgroup. Column 2 lists the calculated proportion, ranging from 0 and 1.0, which gives an indication of the strength to which the positive responses to this question outweighed the negative responses. Column 3 indicates the statistical significance of the proportions in Column 2; the norm for assessing statistical significance for an individual test is  $p < 0.05$ .

**Table 9. Overall Satisfaction with Streetscape Changes: Analysis of Positive-to-Negative Responses**

| <b>Subgroup</b>   | <b>Proportion</b> | <b>p-value</b> |
|-------------------|-------------------|----------------|
| Female            | 0.9453            | < 0.001        |
| Male              | 0.954             | < 0.001        |
| Own a bike        | 0.9586            | < 0.001        |
| Do not own a bike | 0.92              | < 0.001        |
| Merchants         | 0.9062            | < 0.001        |
| Streetscape users | 0.9515            | < 0.001        |
| Residents         | 0.9513            | < 0.001        |
| Delaware          | 0.9683            | < 0.001        |
| Elmwood-North     | 0.9355            | < 0.001        |
| Elmwood-South     | 0.9167            | < 0.001        |
| Fillmore-North    | 0.9091            | < 0.001        |
| Fillmore-South    | 0.9143            | < 0.001        |
| Linwood           | 0.9717            | < 0.001        |

Data in Table 9 indicate that for overall satisfaction, the proportion of positive responses strongly outweighed negative responses to a statistically significant degree across all of the listed subgroups.

Tables 10 and 11 provide a similar data summary for the survey questions related to the frequency of walking and biking, respectively. For frequency of walking, all subgroups provided a much greater proportion of positive to negative responses at a statistically significant level. Among these responses, the strongest proportion of positive responses came from streetscape users, as well as those surveyed on Elmwood North and Linwood. These are not surprising. Elmwood North is an increasingly popular mixed use corridor that is considered highly walkable. The Complete Street changes on Linwood included lane narrowing and dedicated bike lanes on a one-way residential street that had previously experienced vehicles frequently traveling at higher-than-posted speeds. The least strong proportions came from those on Fillmore South and Elmwood South, which is not particularly surprising given that the Complete Streets amenities on these streets focused on dedicated bike lanes along corridors that were already walkable.

**Table 10. Frequency of Walking: Analysis of Positive-to-Negative Responses**

| <b>Subgroup</b>   | <b>Proportion</b> | <b>p-value</b> |
|-------------------|-------------------|----------------|
| Female            | 0.8903            | < 0.001        |
| Male              | 0.8682            | < 0.001        |
| Own a bike        | 0.8943            | < 0.001        |
| Do not own a bike | 0.8428            | < 0.001        |
| Merchants         | 0.8077            | < 0.001        |
| Streetscape users | 0.9341            | < 0.001        |
| Residents         | 0.8707            | < 0.001        |
| Delaware          | 0.8953            | < 0.001        |
| Elmwood-North     | 0.911             | < 0.001        |
| Elmwood-South     | 0.7848            | < 0.001        |
| Fillmore-North    | 0.8308            | < 0.001        |
| Fillmore-South    | 0.7647            | 0.0018         |
| Linwood           | 0.9231            | < 0.001        |

For frequency of biking, the strongest proportions of positive-to-negative responses came from Fillmore South, Linwood, streetscape users, and people who own bikes. These responses were unsurprising given that Complete Street amenities on Fillmore South and Linwood included dedicated bike lanes. The weakest proportions were found for Fillmore North and those who do not own a bike. Although the changes along Fillmore North included substantial enhancements to walkability and traffic calming, bicyclists and vehicles must share the lane of travel along this corridor.

**Table 11. Frequency of Biking: Analysis of Positive-to-Negative Responses**

| <b>Subgroup</b>   | <b>Proportion</b> | <b>p-value</b> |
|-------------------|-------------------|----------------|
| Female            | 0.7611            | < 0.001        |
| Male              | 0.8407            | < 0.001        |
| Own a bike        | 0.8761            | < 0.001        |
| Do not own a bike | 0.3718            | 0.9843         |
| Merchants         | 0.8393            | < 0.001        |
| Streetscape users | 0.9048            | < 0.001        |
| Residents         | 0.7841            | < 0.001        |
| Delaware          | 0.8516            | < 0.001        |
| Elmwood-North     | 0.8311            | < 0.001        |
| Elmwood-South     | 0.7297            | < 0.001        |
| Fillmore-North    | 0.4746            | 0.6027         |
| Fillmore-South    | 0.9111            | < 0.001        |
| Linwood           | 0.8901            | < 0.001        |

Table 12 and Table 13 provide similar data summaries for the survey questions related to the safety of walking and biking, respectively. For safety of walking, all subgroups exhibited response patterns that strongly favored positive responses over negative.

**Table 12. Safety of Walking: Analysis of Positive-to-Negative Responses**

| <b>Sub-group</b>  | <b>Proportion</b> | <b>p-value</b> |
|-------------------|-------------------|----------------|
| Female            | 0.9404            | < 0.001        |
| Male              | 0.9497            | < 0.001        |
| Own a bike        | 0.9505            | < 0.001        |
| Do not own a bike | 0.9292            | 0.9843         |
| Merchants         | 0.9412            | < 0.001        |
| Streetscape users | 0.9776            | < 0.001        |
| Residents         | 0.9352            | < 0.001        |
| Delaware          | 0.9535            | < 0.001        |
| Elmwood-North     | 0.9013            | < 0.001        |
| Elmwood-South     | 0.8857            | < 0.001        |
| Fillmore-North    | 0.9518            | 0.6027         |
| Fillmore-South    | 0.9672            | < 0.001        |
| Linwood           | 0.9801            | < 0.001        |

For safety of biking, the strongest proportions of positive responses were evident for Fillmore South, Linwood, and streetscape users. Dedicate bike lanes are a prominent feature on both Fillmore South and Linwood, so these results are not surprising. For Elmwood North, bicyclists and vehicles share the lanes of travel that are relatively narrow and 2-hour vehicle parking between the travel lanes and curb.

**Table 13. Safety of Biking: Analysis of Positive-to-Negative Responses**

| <b>Sub-group</b>  | <b>Proportion</b> | <b>p-value</b> |
|-------------------|-------------------|----------------|
| Female            | 0.8396            | < 0.001        |
| Male              | 0.8847            | < 0.001        |
| Own a bike        | 0.8734            | < 0.001        |
| Do not own a bike | 0.8441            | < 0.001        |
| Merchants         | 0.7719            | < 0.001        |
| Streetscape users | 0.9512            | < 0.001        |
| Residents         | 0.8516            | < 0.001        |
| Delaware          | 0.9234            | < 0.001        |
| Elmwood-North     | 0.7257            | < 0.001        |
| Elmwood-South     | 0.8091            | < 0.001        |
| Fillmore-North    | 0.6774            | < 0.001        |
| Fillmore-South    | 0.973             | < 0.001        |
| Linwood           | 0.9699            | < 0.001        |

### 3.5.2 Associations Among Survey Items

Spearman Rank Correlation estimates for all possible pairing of ordinal response variables were calculated. The key findings from this analysis revealed:

- Overall satisfaction with the streetscape changes was correlated most strongly with safety of biking ( $r=0.51$ ), convenience of biking ( $r=0.49$ ), and safety of driving ( $r=0.39$ ).
- Frequency of walking was most strongly correlated with convenience of walking ( $r=0.36$ ) and safety of walking ( $r=0.33$ ).
- Frequency of biking was most strongly correlated with convenience of biking ( $r=0.41$ ), safety of biking ( $r=0.37$ ), and overall satisfaction ( $r=0.33$ ).
- Safety of walking correlated most strongly with convenience of walking ( $r=0.6$ ), ease of pedestrian crossings ( $r=0.36$ ), safety of driving ( $r=0.34$ ), and frequency of walking ( $r=0.33$ ).
- Safety of biking correlated most strongly with convenience of biking ( $r=0.73$ ), overall satisfaction with the streetscape changes ( $r=0.51$ ), safety of driving ( $r=0.39$ ), and frequency of biking ( $r=0.37$ ).

## 4 Survey Results from Residents, Merchants, and Streetscape Users on Baseline Corridors

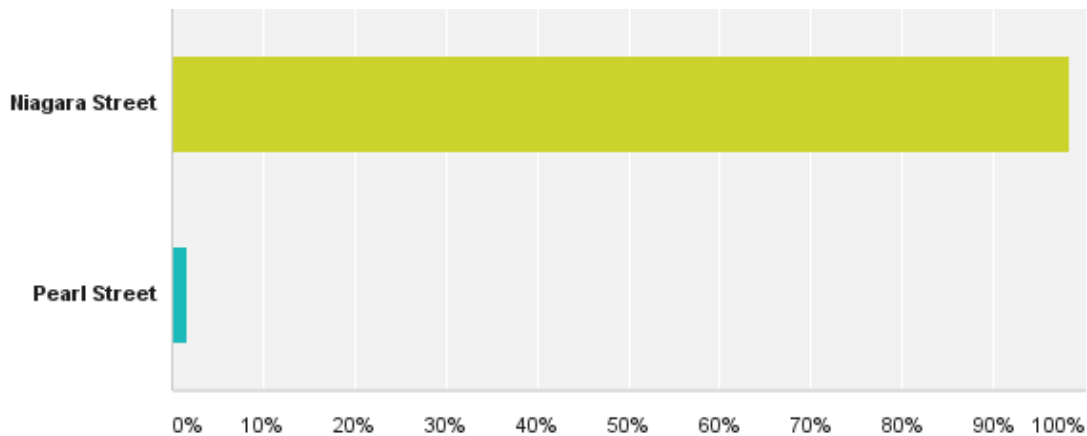
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### 4.1 Baseline Residents

#### 4.1.1 Demographics

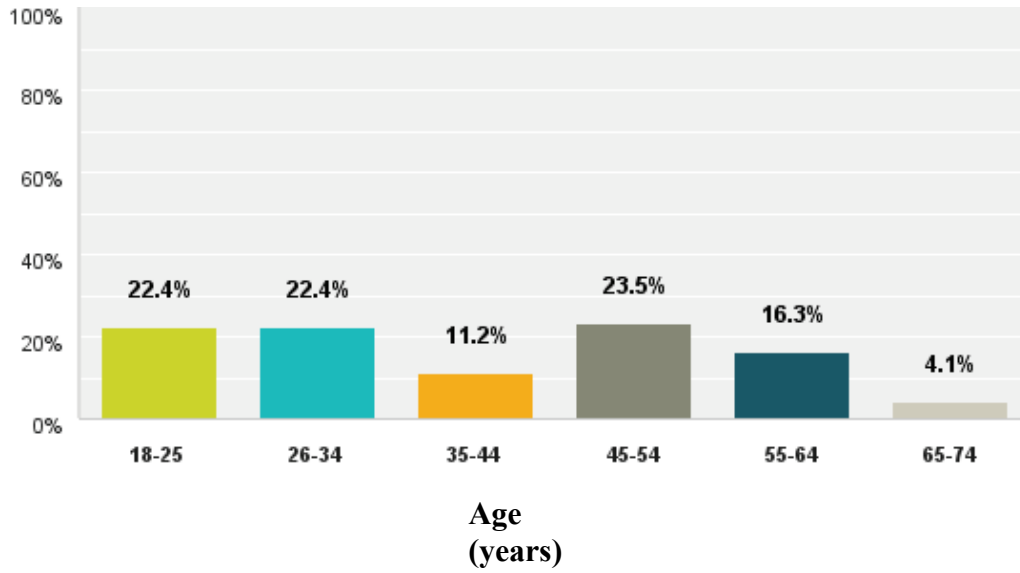
A total of 121 residents were surveyed along two baseline corridors (Figure 42), virtually all of whom were from the Niagara Street corridor (n=119; 98.4 percent). Among these, 71.4 percent were renters, and the remainder (28.6 percent) were owners.

**Figure 42. Baseline Residents by Corridor (n=121)**

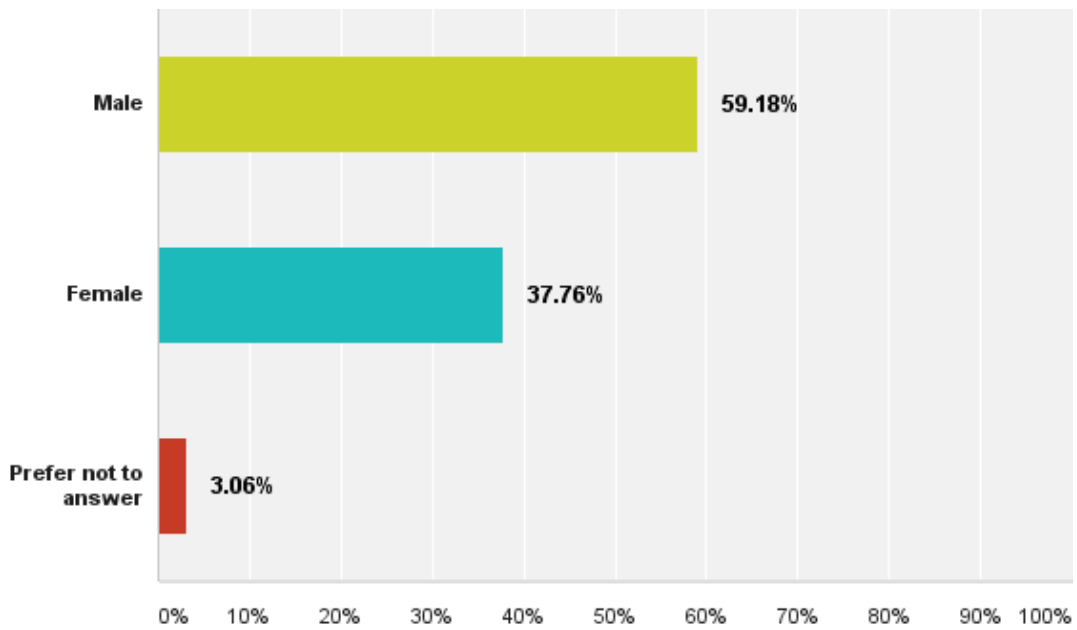


The age distribution, gender identity, racial/ethnic identity, and household income of residents in baseline corridors are reflected in Figures 43 through 46. Overall, 69.4 percent reported owning a car, and 62.2 percent reported owning a bike.

**Figure 43. Baseline Residents: Age Distribution (n=98)**

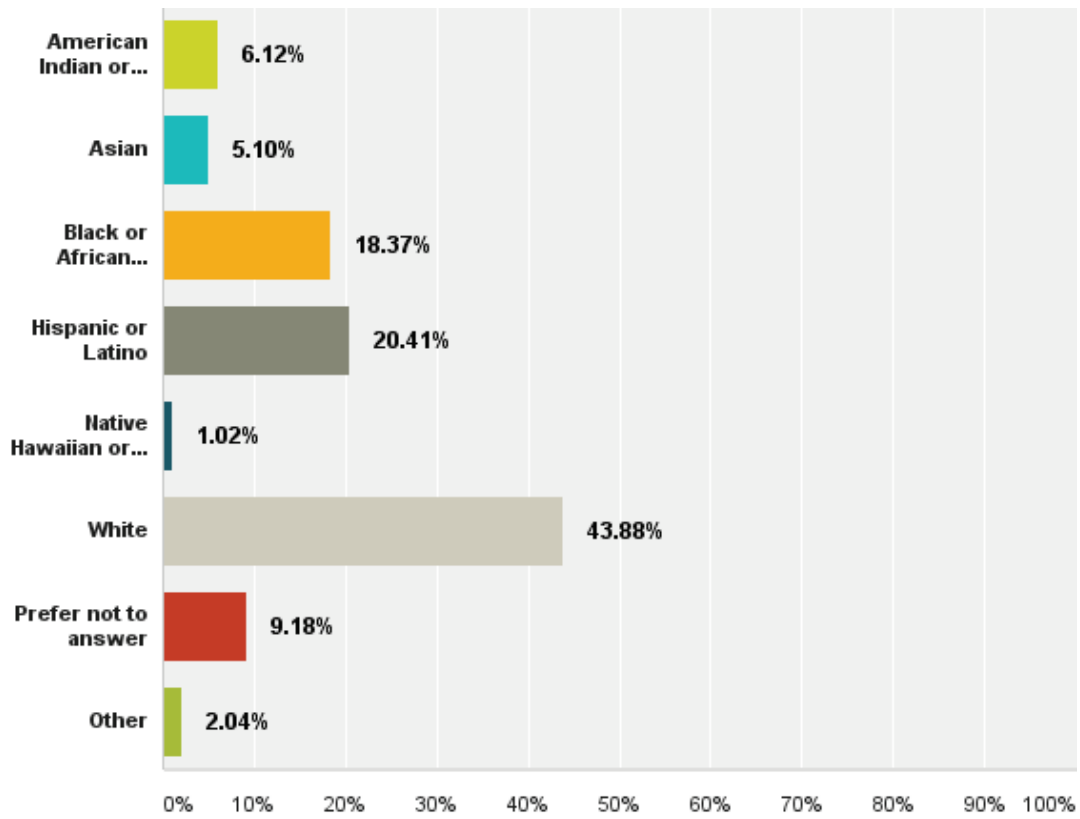


**Figure 44. Baseline Residents: Gender Identity Baseline Residents (n=98)**

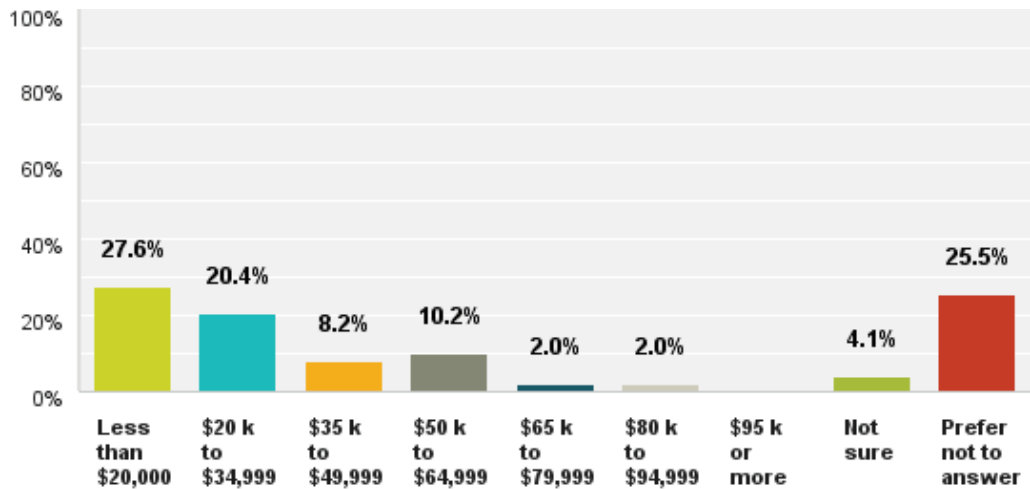




**Figure 45. Baseline Residents: Racial/Ethnic Identity**



**Figure 46. Baseline Residents: Household Income (n=98)**

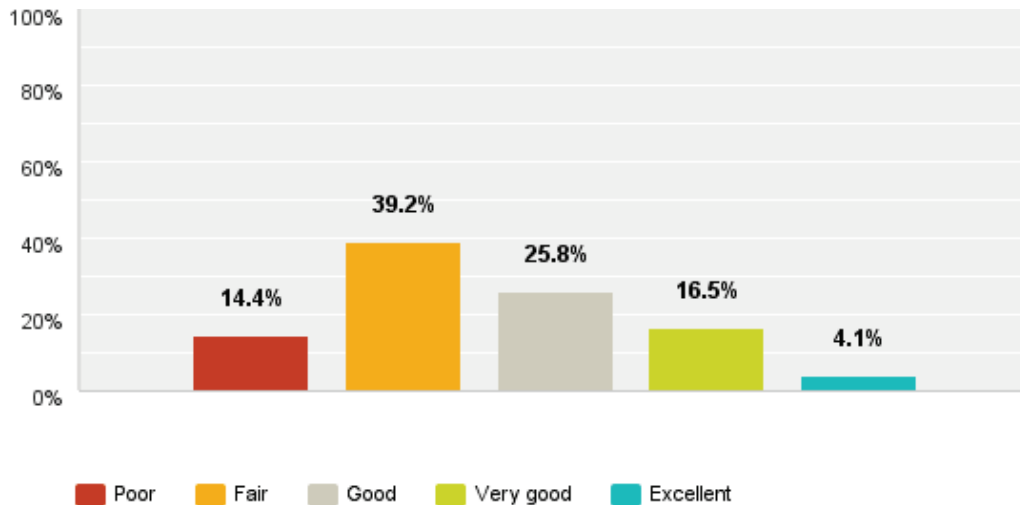


### 4.1.2 Baseline Residents: Key Indicators of Streetscape Quality

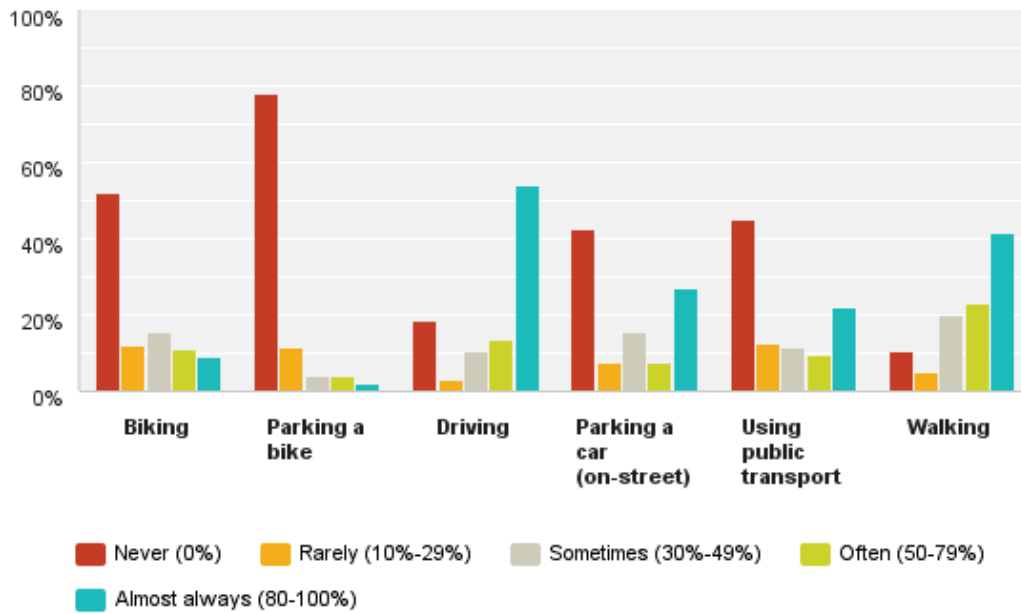
The key indicators of streetscape quality for Residents along Baseline corridors were:

- 53.6 percent rated the overall quality of the streetscape to be “fair” or “poor” (Figure 47).
- 64.2 percent reported that they “rarely” or “never” rode their bike along this street, while 64.6 percent reported that they “often” or “almost always” walked along the street (Figure 48).
- 50.5 percent reported that biking was “somewhat” or “very” inconvenient; 81.6 percent indicated that it was “somewhat” or “very” convenient to walk, and 69.1 percent indicated that it was “somewhat” or “very” convenient to drive (Figure 49).
- 52.5 percent reported that they “agree” or “strongly agree” with the statement that, “*the traffic along my street makes it difficult or unpleasant to walk*” (Figure 50).
- 69.4 percent “agree” or “strongly agree” with the statement that, “*the traffic along my street makes it difficult or unpleasant to bike*” (Figure 51).
- 73.9 percent “agree” or “strongly agree” with the statement: *Most drivers exceed the posted speed limit while driving on my street*” (Figure 52).
- 47.4 percent “agree” or “strongly agree” with the statement: *There are enough crosswalks and pedestrian signals on my street to help walkers and cyclists cross* (Figure 53).
- 61.9 percent rated biking as “somewhat unsafe” or “very unsafe” along the corridor; 71.1 percent rated walking to be “somewhat” or “very” safe (Figure 54).

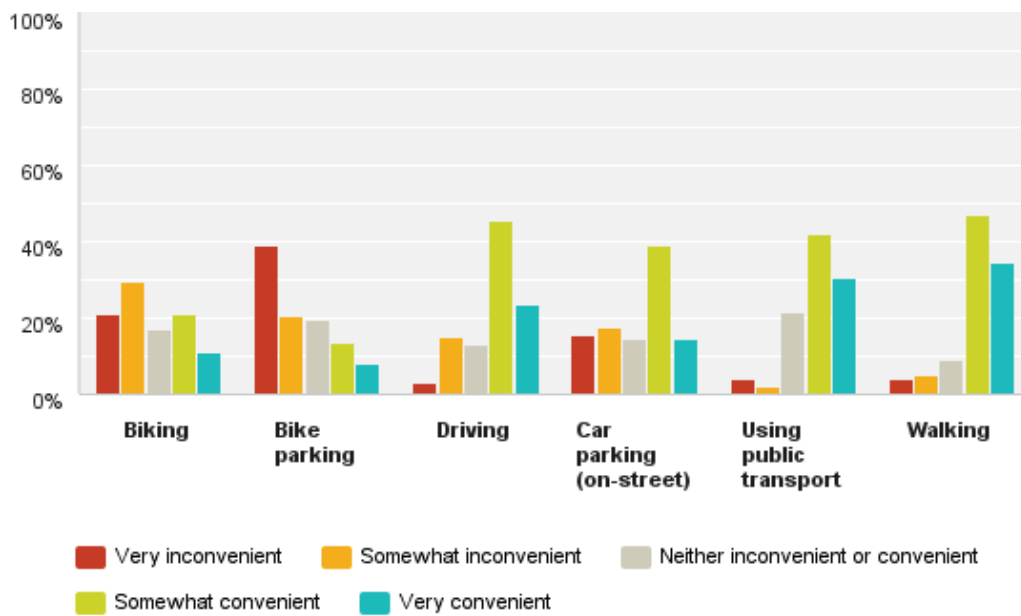
**Figure 47. Baseline Residents. Overall Rating of the Street**



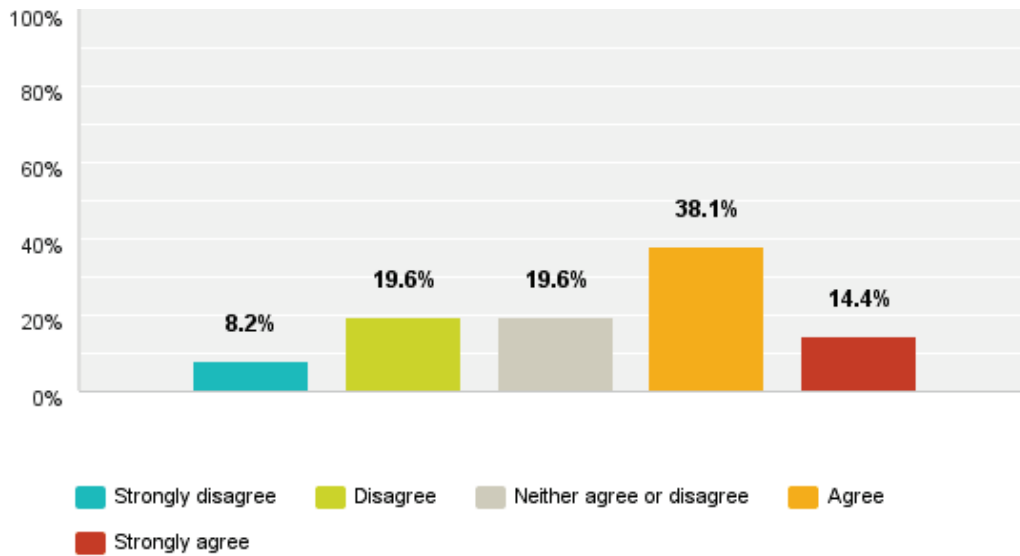
**Figure 48. Baseline Residents. Frequency of Mode Use Along this Corridor (n=98)**



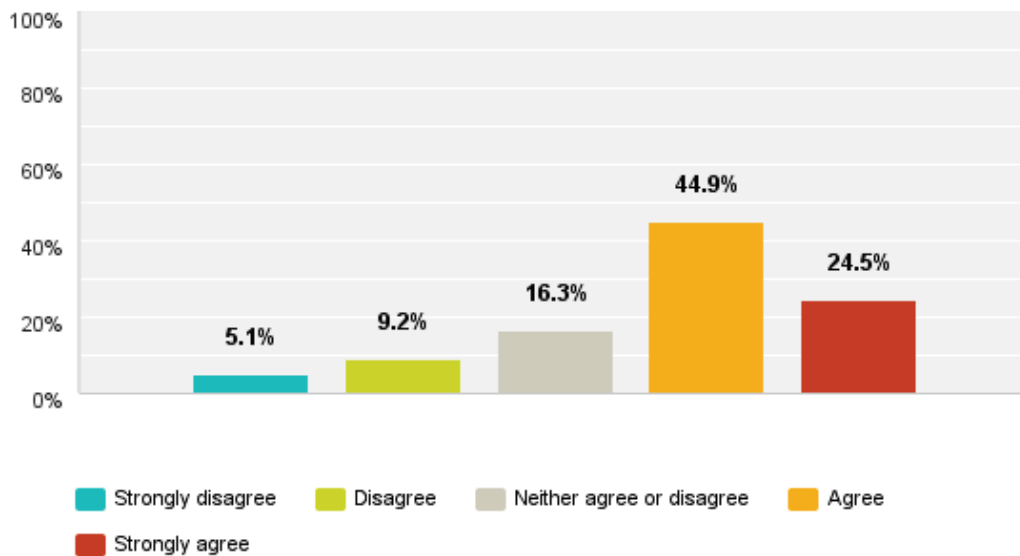
**Figure 49. Baseline Residents. Mode Convenience along this Corridor (n=99)**



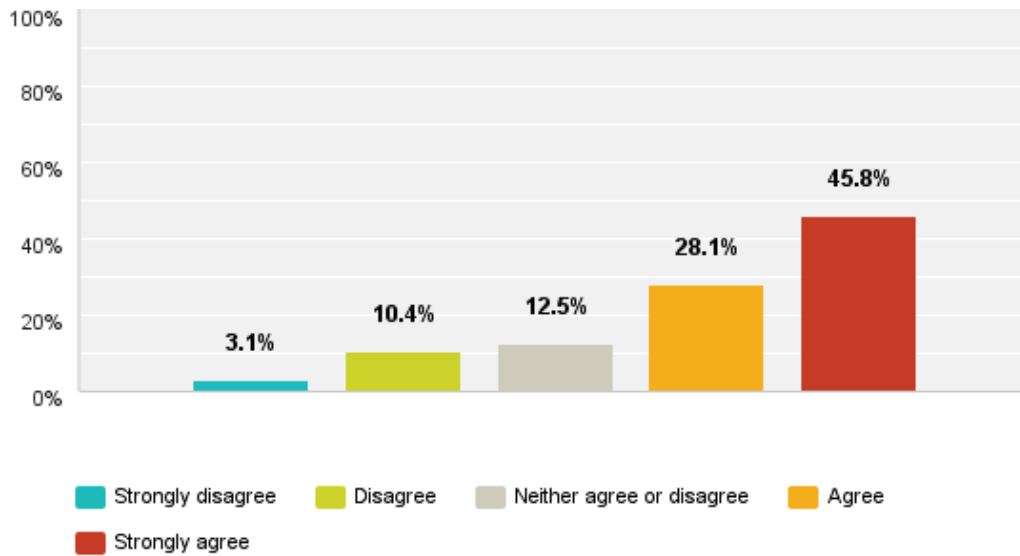
**Figure 50. Baseline Residents: Level of Agreement with the Statement – The traffic along my street makes it difficult or unpleasant to walk.**



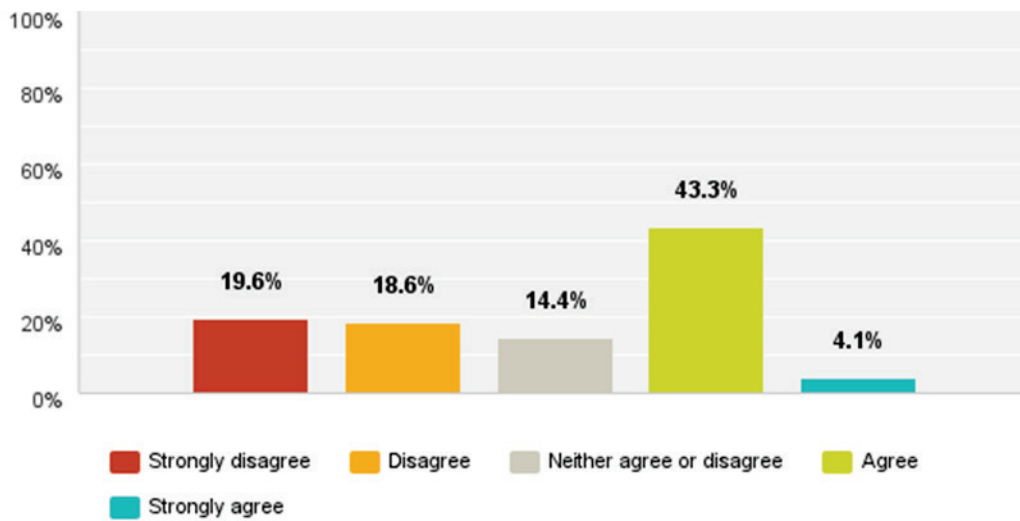
**Figure 51. Baseline Residents: Level of Agreement with the Statement – The traffic along my street makes it difficult or unpleasant to bike.**



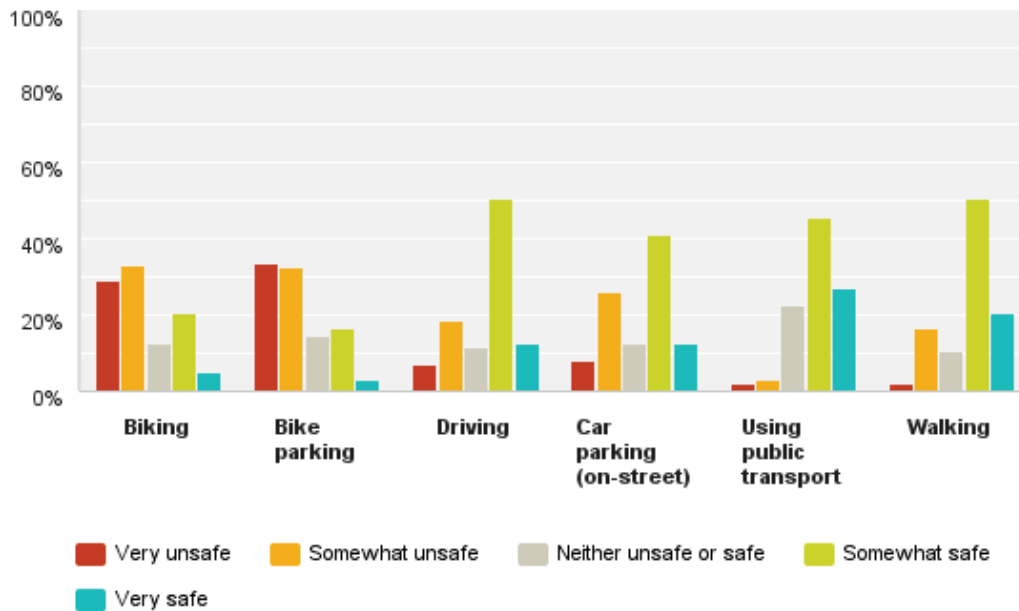
**Figure 52. Baseline Residents: Level of Agreement with the Statement – Most drivers exceed the posted speed limit while driving on my street.**



**Figure 53. Baseline Residents: Level of Agreement with the Statement – There are enough crosswalks and pedestrian signals on my street to help walkers and cyclists cross.**



**Figure 54. Baseline Residents: Mode Safety**



### 4.1.3 Baseline Residents: Qualitative Comments

Among 121 residents given baseline surveys on baseline corridors, 22 provided responses when queried about their concerns regarding the forthcoming streetscape changes. One respondent described two elements of concern; thus, 23 resident statements about “concerns regarding upcoming changes” were classified, the categorizations of which are summarized in the Table 14.

Nine residents indicated that they had no concerns about the changes. Six expressed concerns about the effects on traffic volume and flow, in particular speeding. The remainder expressed concerns about the quality of road treatments (n=3), the sufficiency of bike amenities (n=2) and the sufficiency of pedestrian amenities (n=2).

**Table 14. Baseline Residents: Concerns about upcoming streetscape changes (n=23)**

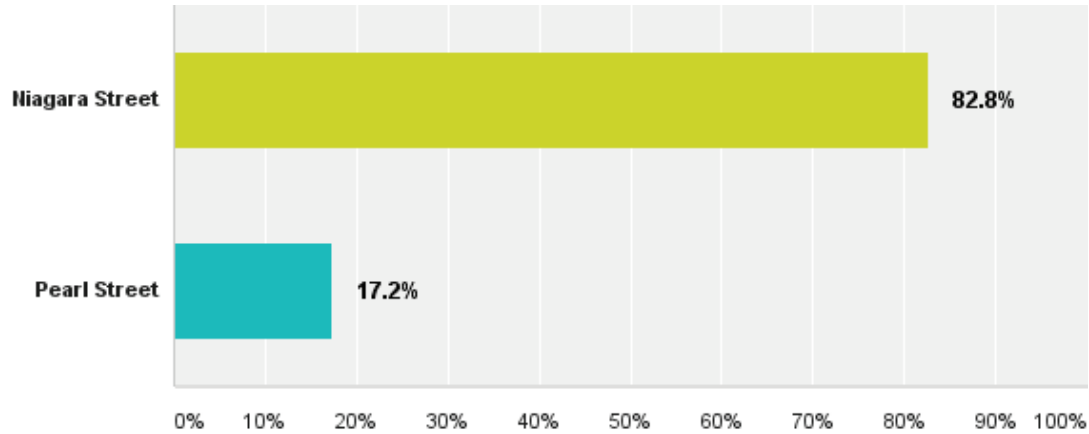
| Concerns                              | n |
|---------------------------------------|---|
| No concerns                           | 9 |
| Traffic flow (speeding, volume)       | 6 |
| Quality of road surface/maintenance   | 3 |
| Bike safety/ sufficiency of amenities | 2 |
| Ped safety/sufficiency of amenities   | 2 |
| Favor changes                         | 1 |

## 4.2 Baseline Merchants

### 4.2.1 Baseline Merchants: Demographics

A total of 87 merchants were surveyed along the two baseline corridors, 82.8 percent of whom were from the Niagara Street corridor, and 17.2 percent from the Pearl Street corridor. Among these, 62.1 percent were managers, and 37.9 percent were owners.

**Figure 55. Baseline Merchants by Corridor (n=87)**



The age distribution, gender identity, and racial/ethnic identity of merchants in baseline corridors are reflected in Figures 56 through 58. Overall, 90.4 percent reported owning a car, and 64.4 percent reported owning a bike.

**Figure 56. Baseline Merchants: Age Distribution (n=73)**

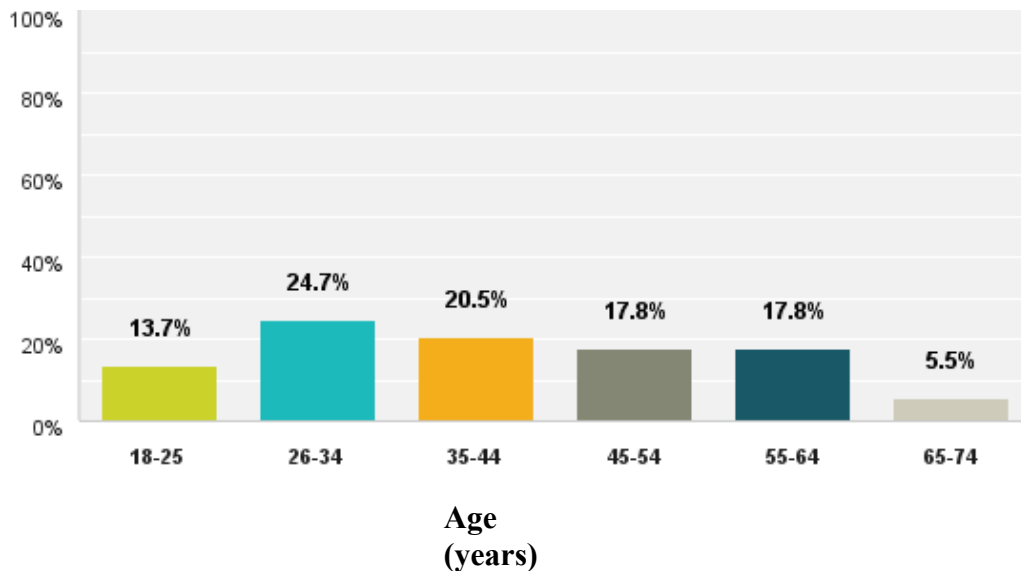


Figure 57. Baseline Merchants: Gender Identity (n=73)

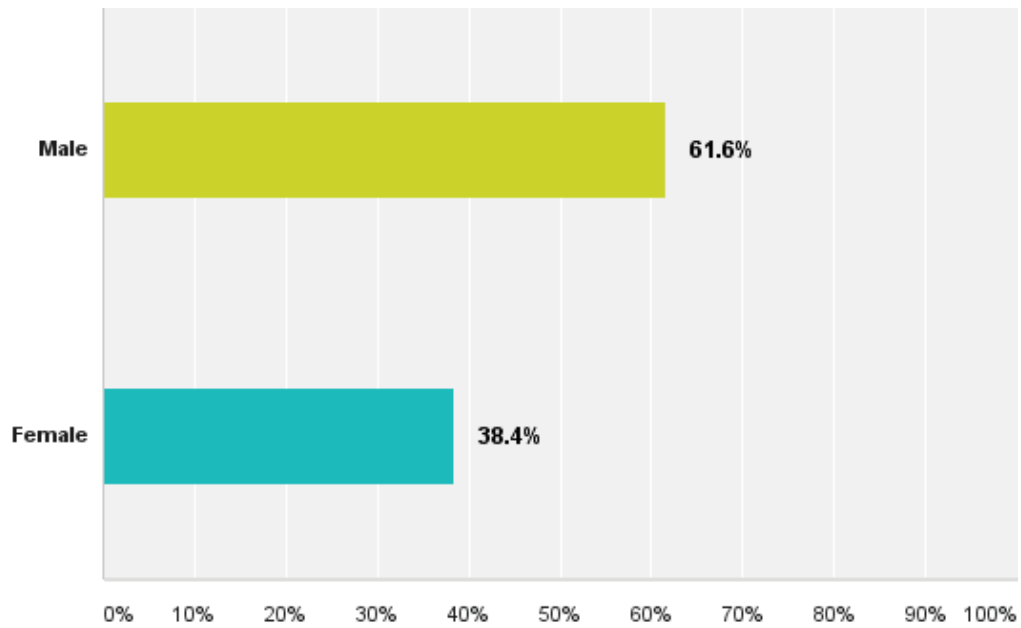
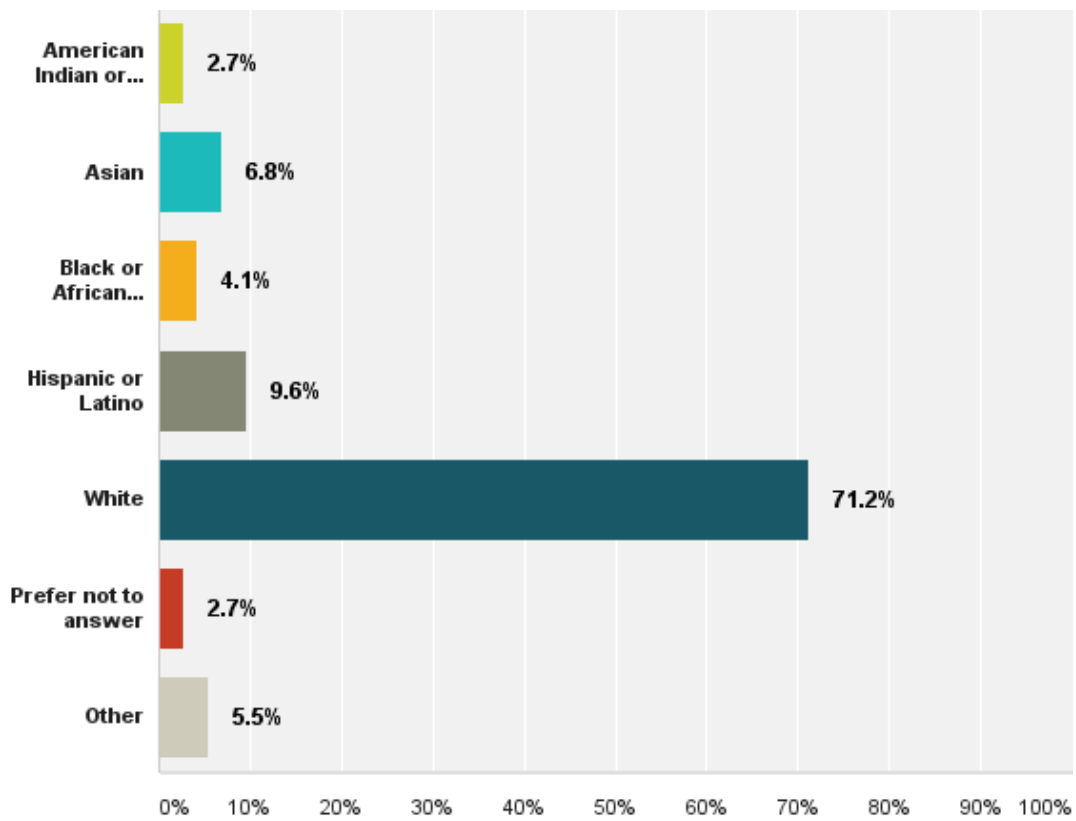


Figure 58. Baseline Merchants: Racial/Ethnic Identity (n=73)



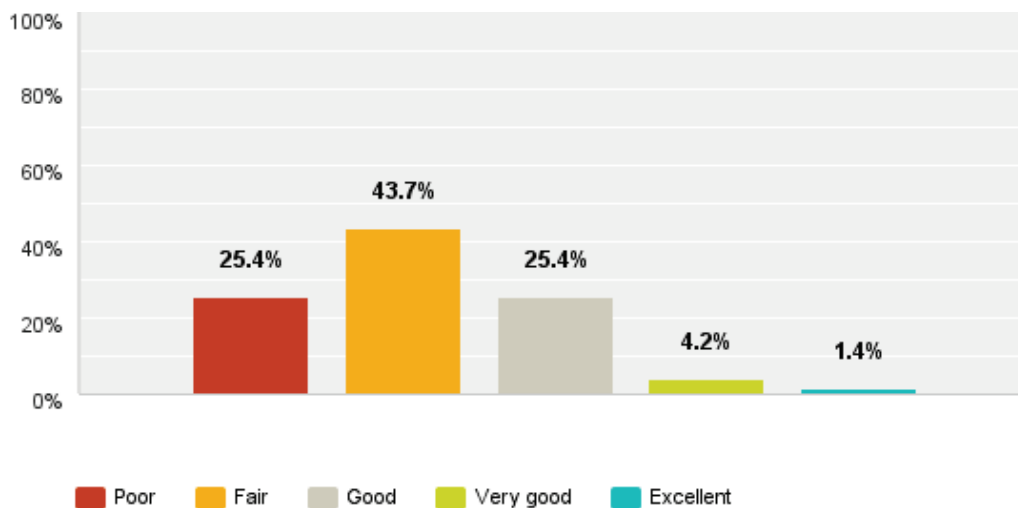


## 4.2.2 Baseline Merchants: Key Indicators of Streetscape Quality

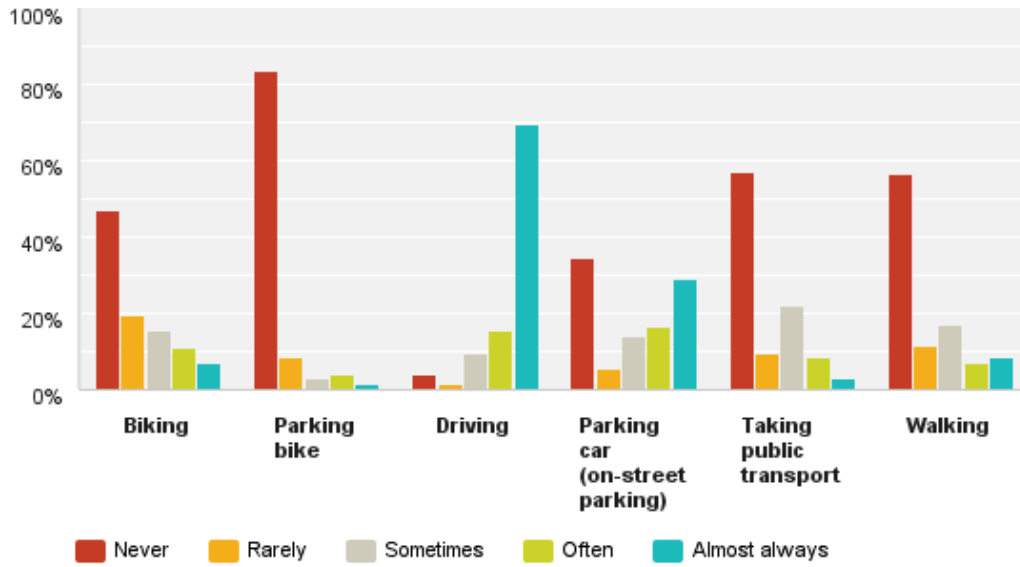
The key indicators of streetscape status for Merchants along Baseline corridors were:

- 69.1 percent rated the overall quality of the streetscape to be “fair” or “poor” (Figure 59).
- 66.6 percent reported that employees “rarely” or “never” rode their bike to work, while 67.6 percent reported that their employees “rarely” or “never” walk to work (Figure 60).
- 62.5 percent indicated that customers “rarely” or “never” rode their bike to the business, and 50.8 percent indicated that customers “rarely” or “never” walk to the business (Figure 61).
- 43.1 percent reported that biking is “somewhat” or “very” inconvenient along the corridor, while 65.3 percent reported that walking “somewhat” or “very” convenient along the corridor (Figure 62).
- 45 percent reported that they “agree” or “strongly agree” with the statement that, “*the traffic along my street makes it difficult or unpleasant to walk*” (Figure 63).
- 51.4 percent “agree” or “strongly agree” with the statement that, “*the traffic along my street makes it difficult or unpleasant to bike*” (Figure 64).
- 76.4 percent “agree” or “strongly agree” with the statement: *Most drivers exceed the posted speed limit while driving on my street*” (Figure 65).
- 43 percent “disagree” or “strongly disagree” with the statement: *There are enough crosswalks and pedestrian signals on my street to help walkers and cyclists cross* (Figure 66).
- 55.6 percent rated biking as “somewhat unsafe” or “very unsafe” along the corridor, and 54 percent rated walking to be “somewhat” or “very” safe (Figure 67).
- 61.1 percent rated the overall economic health of businesses along the corridor to be “good”, “very good”, or “excellent” (Figure 68).
- 37.5 percent indicated that their sales were “somewhat more” or “much more” than the year before (Figure 69).

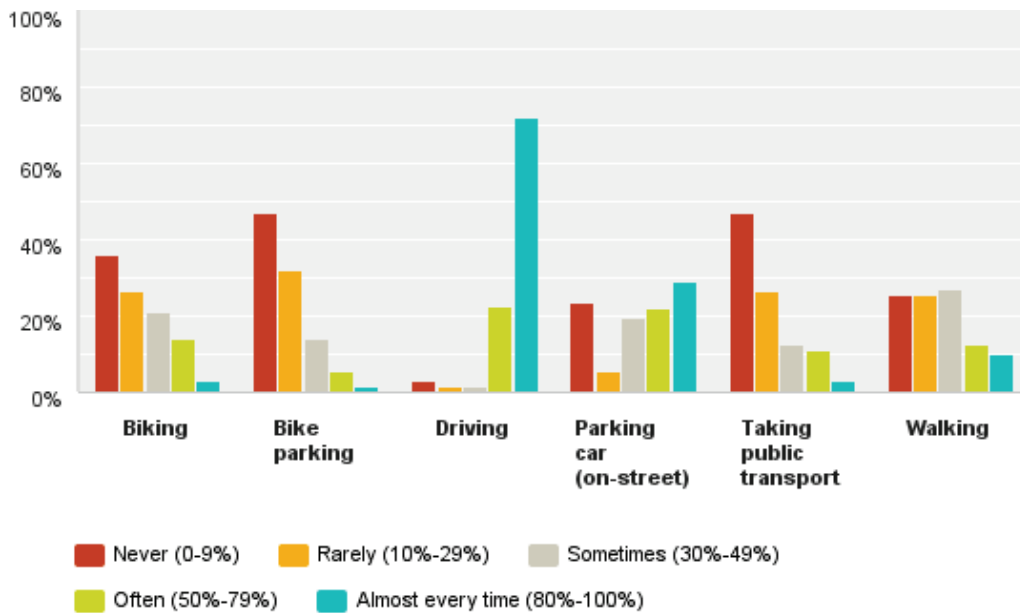
**Figure 59. Baseline Merchants: Overall Rating of the Street (n=71)**



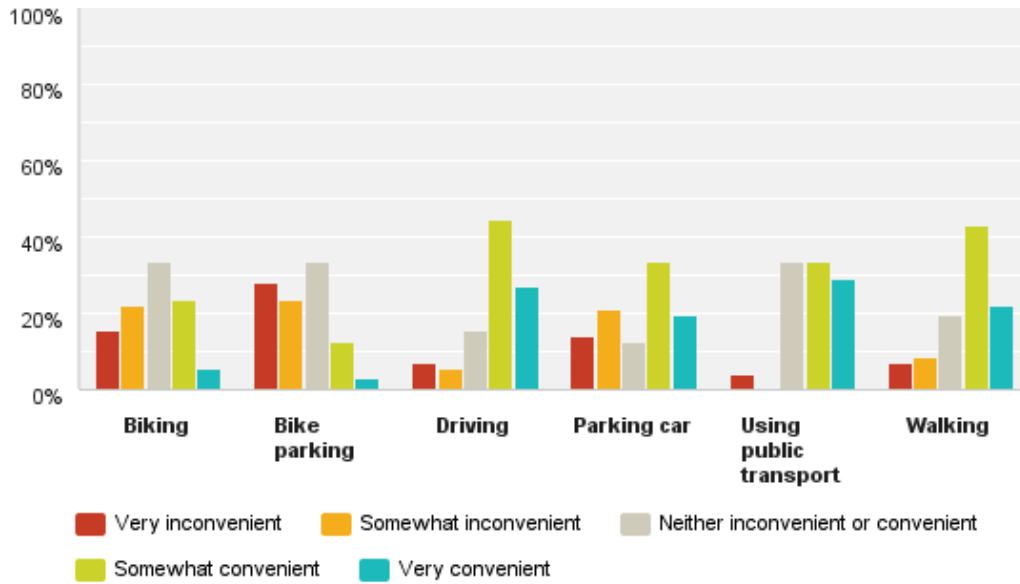
**Figure 60. Baseline Merchants: Employee Mode Choices to/from Work (n=72)**



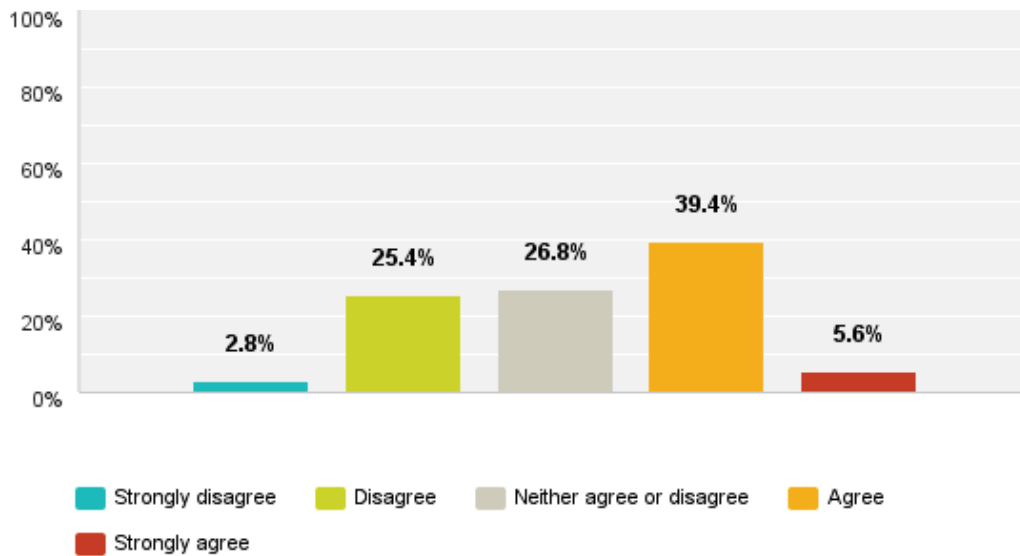
**Figure 61. Baseline Merchants. Customer Mode Choices To/From Your Business (n=72)**



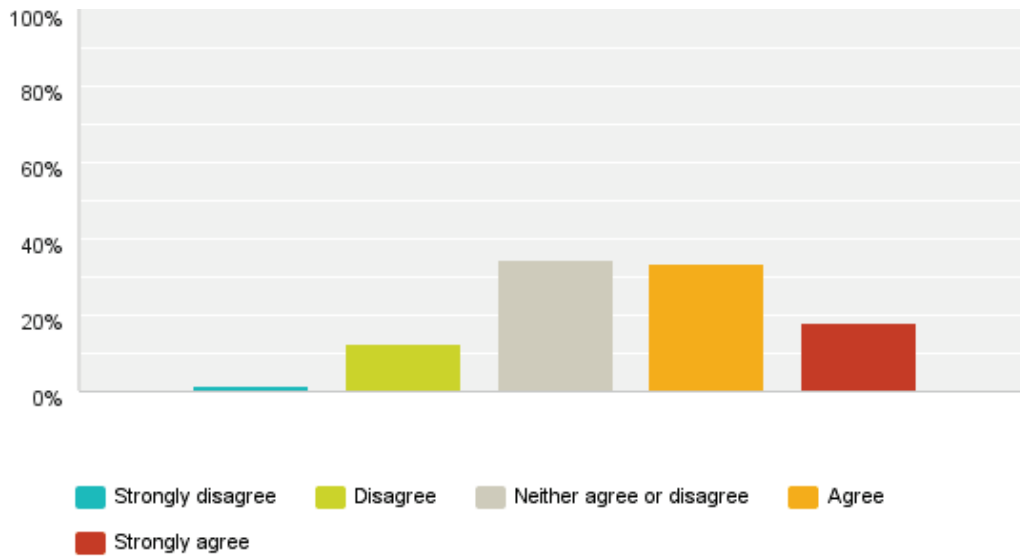
**Figure 62. Baseline Merchants: Mode Convenience Along this Corridor (n=72)**



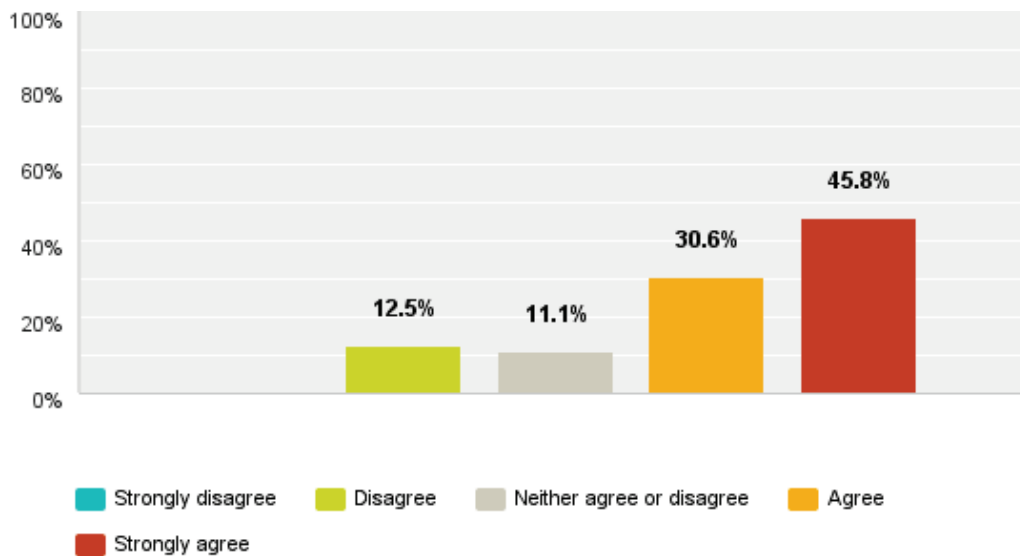
**Figure 63. Baseline Merchants: Level of Agreement with the Statement – The traffic along my street makes it difficult or unpleasant to walk (n=71)**



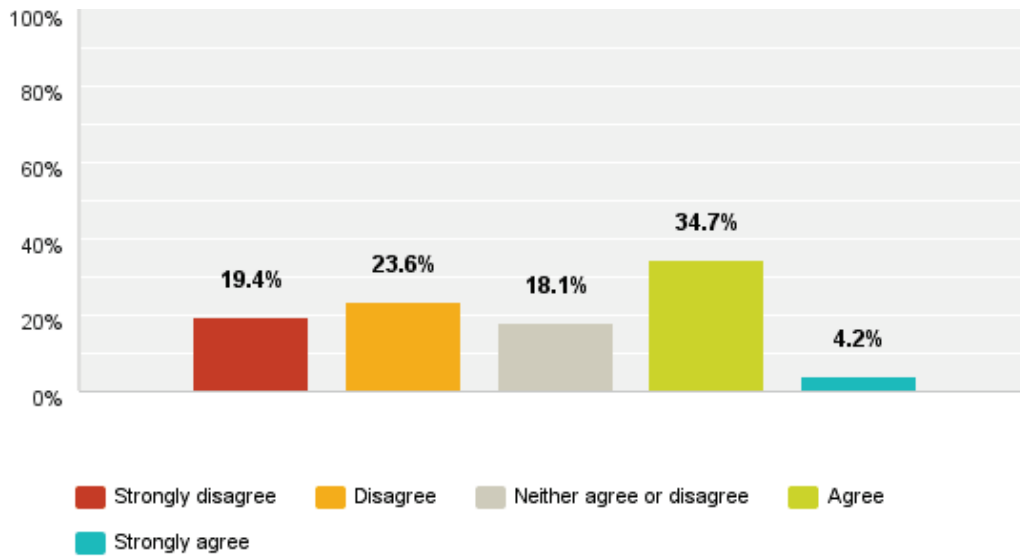
**Figure 64. Baseline Merchants: Level of Agreement with the Statement – The traffic along my street makes it difficult or unpleasant to bike (n=72)**



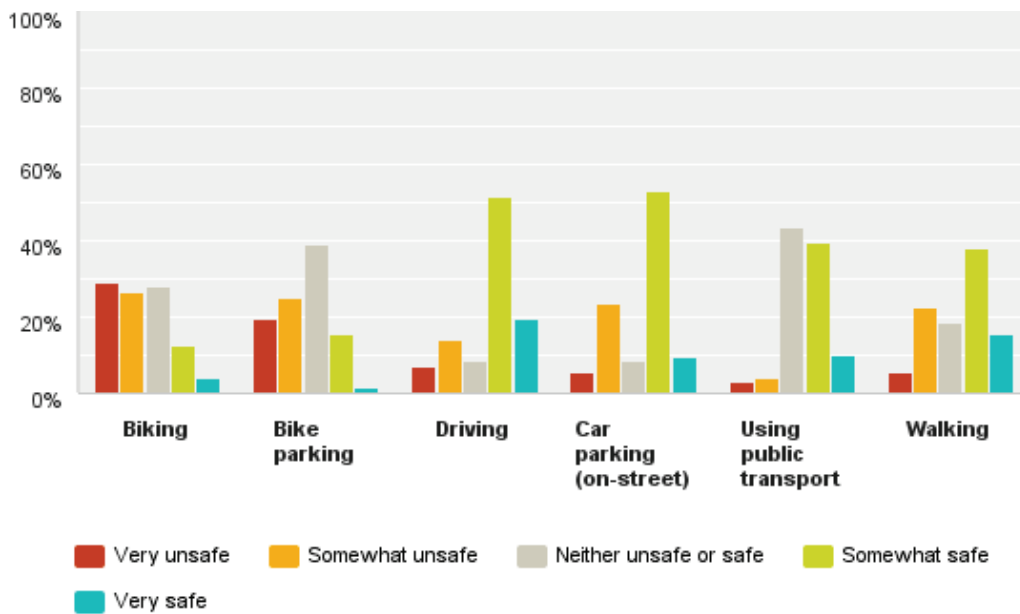
**Figure 65. Baseline Merchants: Level of Agreement with the Statement – Most drivers exceed the posted speed limit while driving on my street (n=72)**



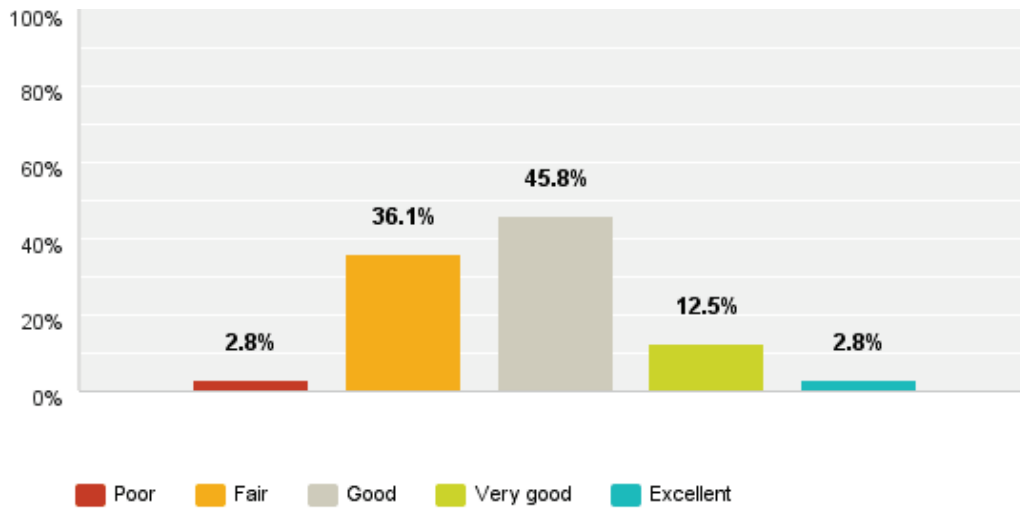
**Figure 66. Baseline Merchants: Level of Agreement with the Statement – There are enough crosswalks and pedestrian signals on my street to help walkers and cyclists cross**



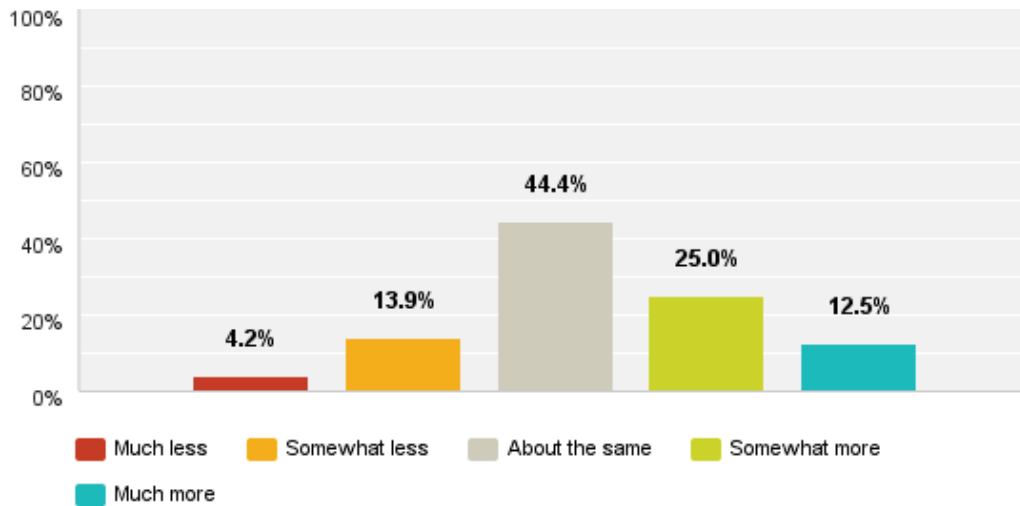
**Figure 67. Baseline Merchants: Ratings of mode safety along the corridor (n=72)**



**Figure 68. Baseline Merchants: Ratings of economic health of businesses along the corridor (n=72)**



**Figure 69. Baseline Merchants: How have sales changed over the past year, compared to the previous year? (n=72)**



### 4.2.3 Baseline Merchants: Qualitative Comments

A total of 72 merchants were given surveys along baseline corridors. Among these, only 37.5 percent were aware that streetscape changes were forthcoming. All were then informed of the planned changes for the corridor and asked if they had any “concerns regarding the upcoming street changes.” In response, 13 provided comments, the categorizations of which are summarized in Table 15.

Three indicated they had no concerns, 3 expressed their support for the changes, and 2 expressed concern that the construction period could hurt business. The remainder expressed concerns about the adequacy of car parking (n=2) and bike parking (n=1), as well as the overall feasibility and impact of the project (n=2).

**Table 15. Baseline Merchants: Concerns about upcoming streetscape changes (n=13)**

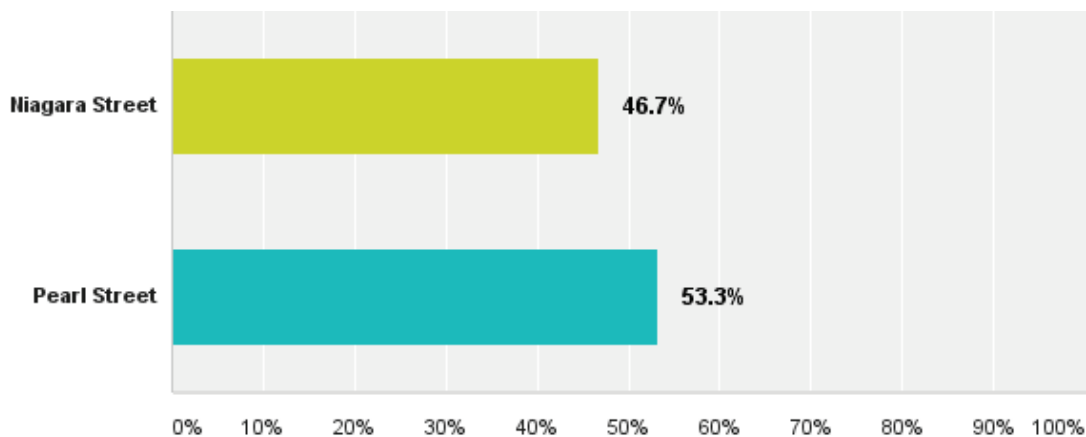
| Concerns                                | n |
|---|---|
| No concerns                             | 3 |
| Favor changes                           | 3 |
| Construction period could hurt business | 2 |
| Adequate car parking                    | 2 |
| Overall feasibility & impact            | 2 |
| Adequate bike parking                   | 1 |

### 4.3 Baseline Streetscape Users

#### 4.3.1 Baseline Streetscape Users: Demographics

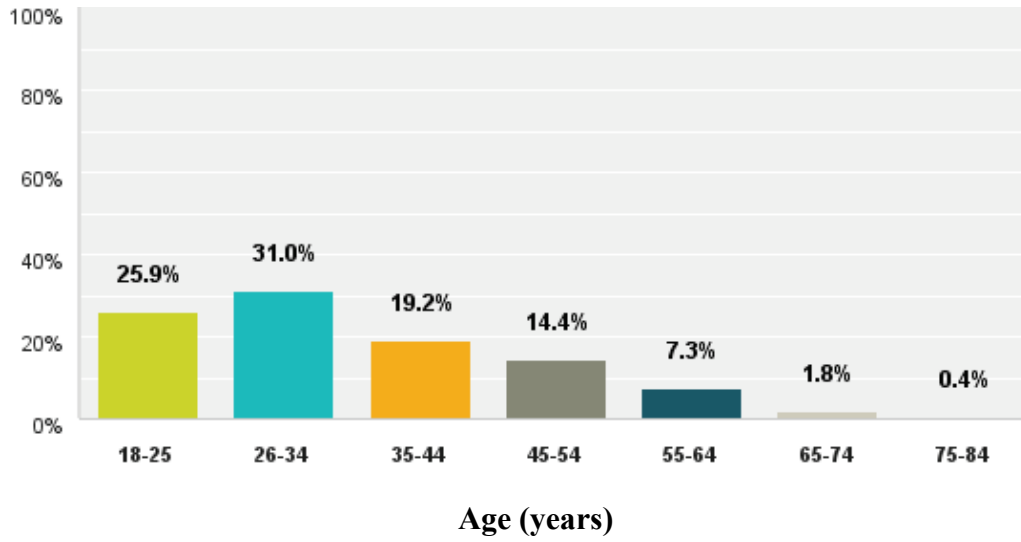
A total of 490 streetscape users were surveyed along the two baseline corridors, 53.3 percent of whom were from the Pearl Street corridor, and 46.7 percent from the Niagara Street corridor (Figure 70).

**Figure 70. Baseline Streetscape Users by Corridor (n=490)**



The age distribution, gender identity, racial/ethnic identity, and household income of residents in baseline corridors are reflected in Figures 71 through 74. Overall, 62.2 percent reported owning a car, and 62.8 percent reported owning a bike.

**Figure 71. Baseline Streetscape Users: Age Distribution (n=452)**



**Figure 72. Baseline Streetscape Users: Gender Identity (n=452)**

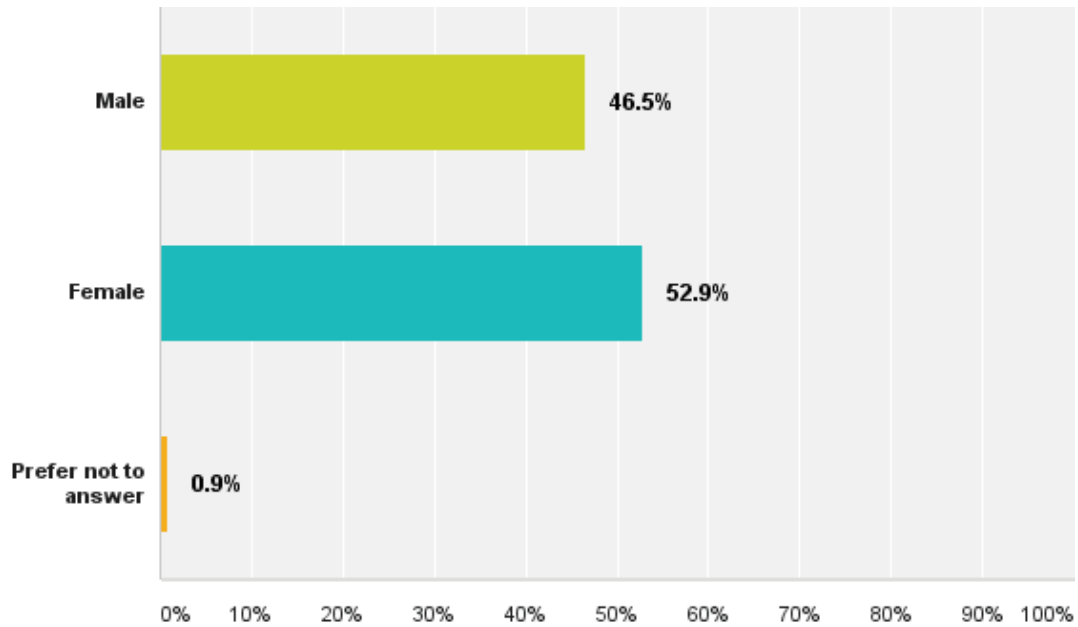




Figure 73. Baseline Streetscape Users: Racial/Ethnic Identity (n=452)

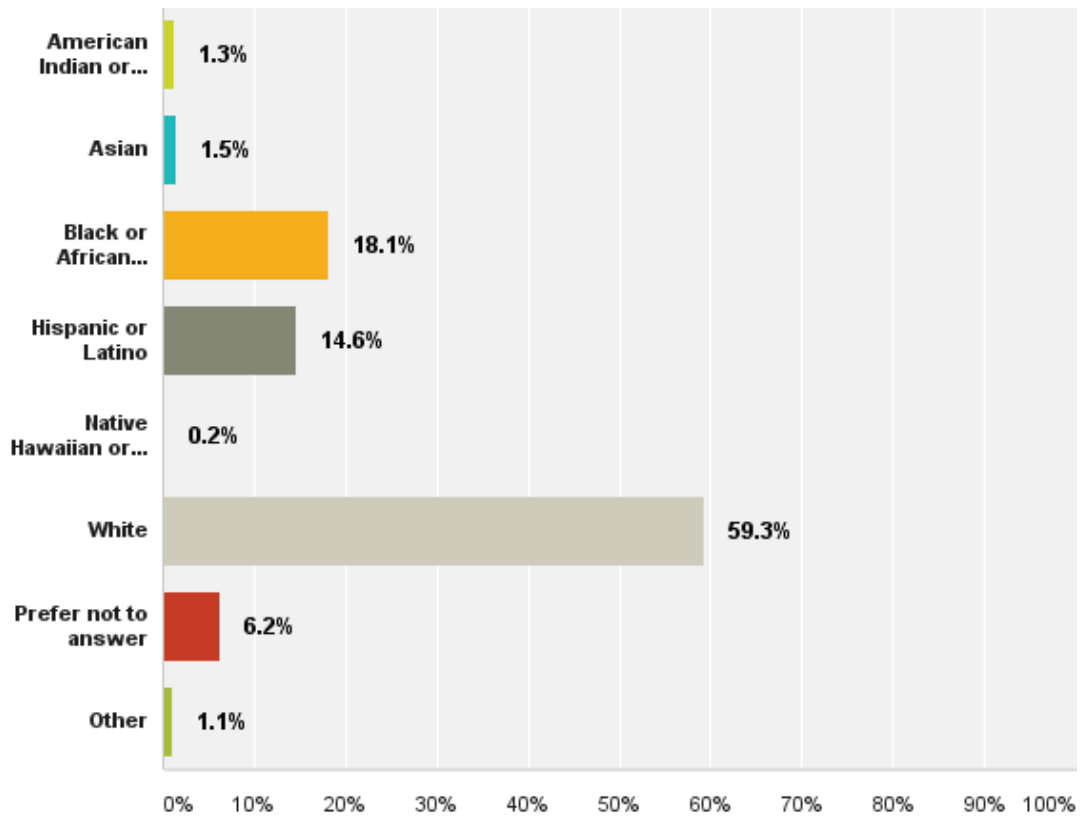
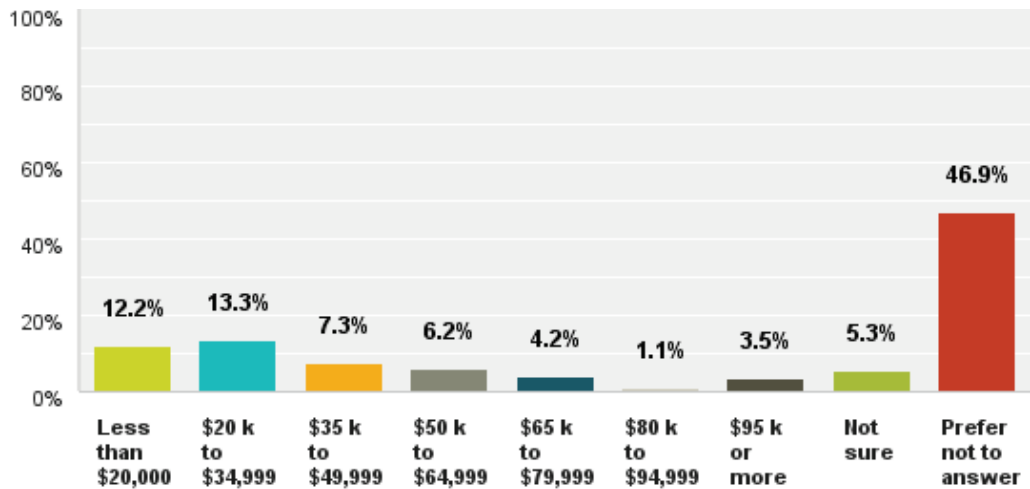


Figure 74. Baseline Streetscape Users: Household Income (n=452)

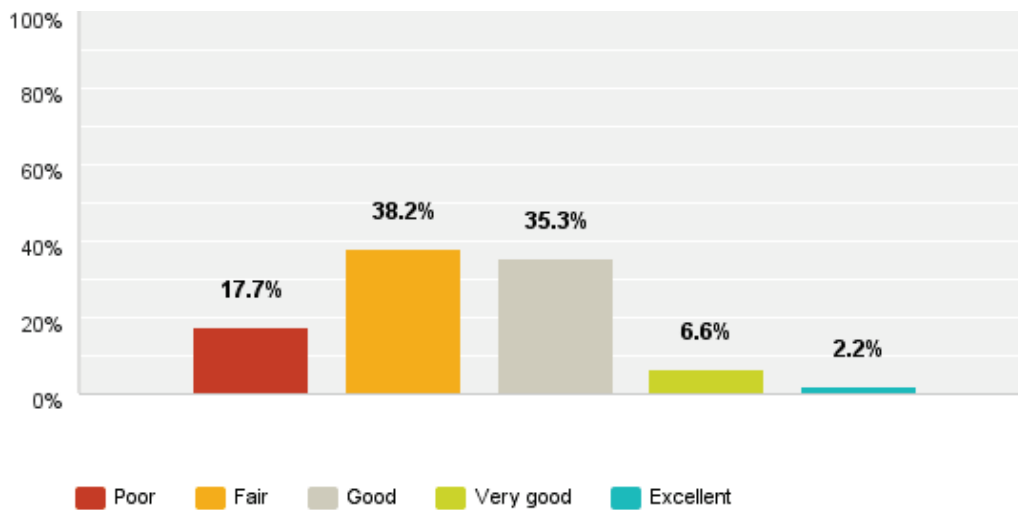


### 4.3.2 Baseline Streetscape Users: Key Indicators of Streetscape

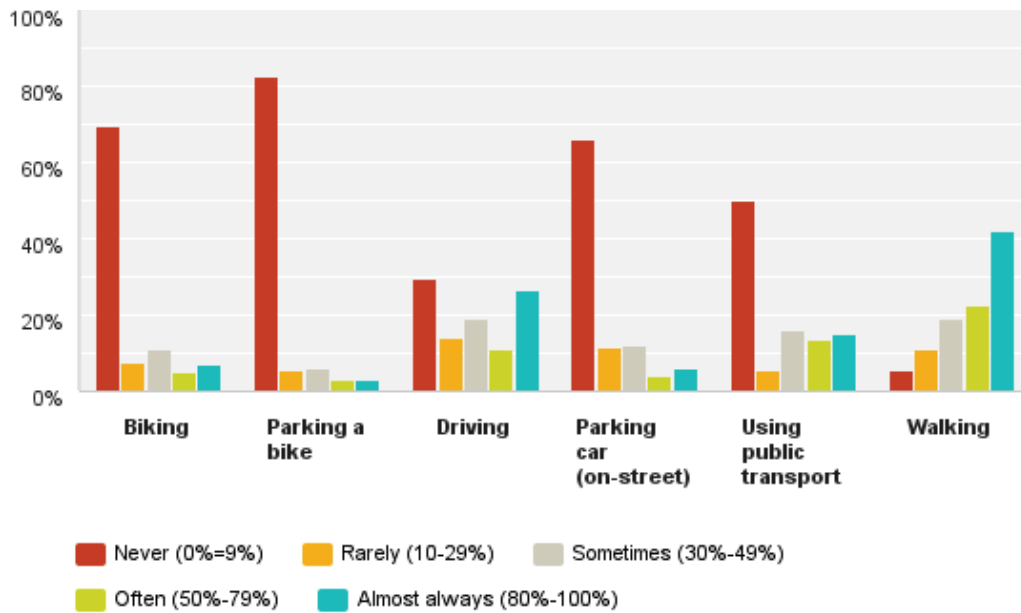
The key indicators of street status for Streetscape Users along Baseline corridors were:

- 55.9 percent rated the overall quality of the streetscape to be “fair” or “poor” (Figure 75).
- 77.3 percent reported that they “rarely” or “never” rode their bike along this street, while 64.6 percent reported that they “often” or “almost always” walked along the street (Figure 76).
- 40.2 percent reported that biking along the street was “somewhat” or “very” inconvenient; 77.7 percent indicated that it was “somewhat” or “very” convenient to walk along the street, and 44.8 percent indicated that it was “somewhat” or “very” convenient to drive along the street (Figure 77).
- 43.7 percent reported that they “agree” or “strongly agree” with the statement, “*the traffic along this street makes it difficult or unpleasant to walk*” (Figure 78).
- 52.2 percent “agree” or “strongly agree” with the statement that, “*the traffic along this street makes it difficult or unpleasant to bike*” (Figure 79).
- 70.1 percent “agree” or “strongly agree” with the statement: *Most drivers exceed the posted speed limit while driving on this street*” (Figure 80).
- 41.6 percent “disagree” or “strongly disagree” with the statement: *There are enough crosswalks and pedestrian signals on this street to help walkers and cyclists cross* (Figure 81).
- 50.5 percent rated biking as “somewhat unsafe” or “very unsafe” along the corridor; 67.1 percent rated walking to be “somewhat” or “very” safe (Figure 82).

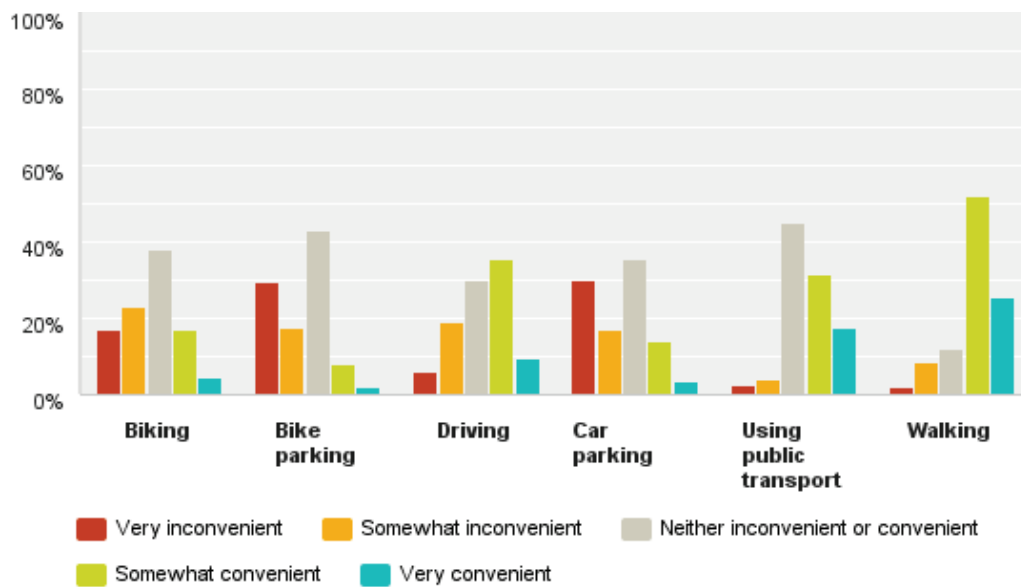
**Figure 75. Baseline Streetscape Users: Overall Rating of the Street (n=453)**



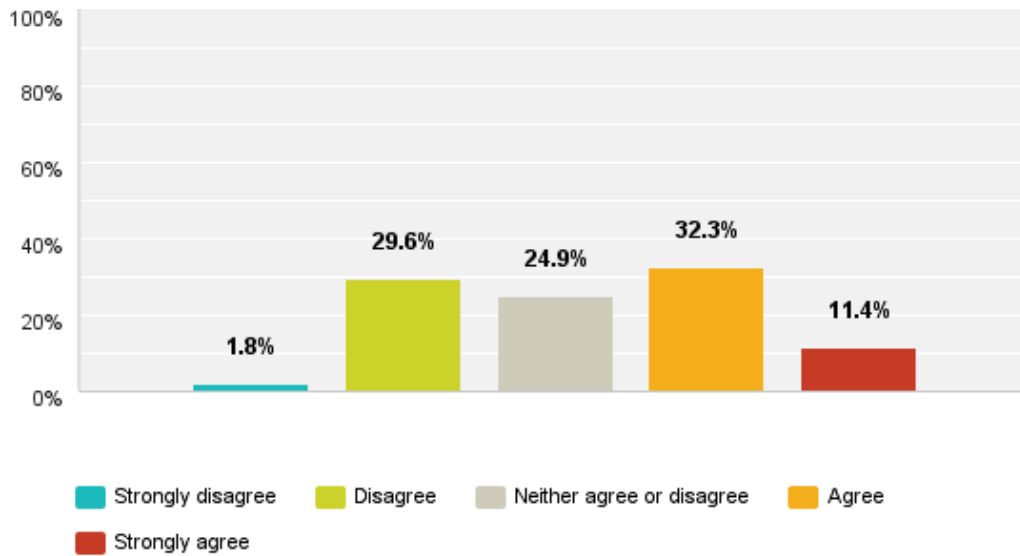
**Figure 76. Baseline Streetscape Users: Frequency of Mode Use Along this Corridor (n=457)**



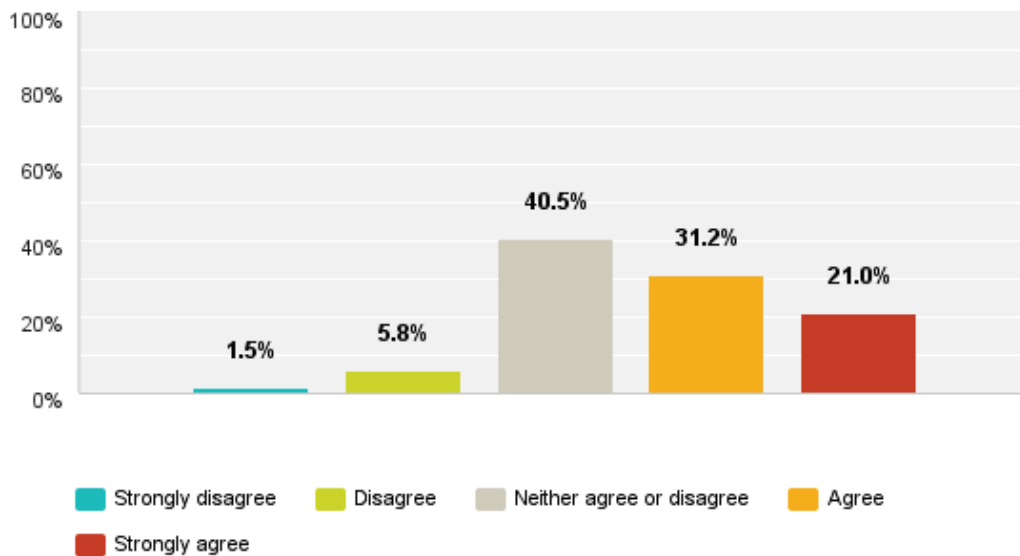
**Figure 77. Baseline Streetscape Users: Mode Convenience Along this Corridor (n=452)**



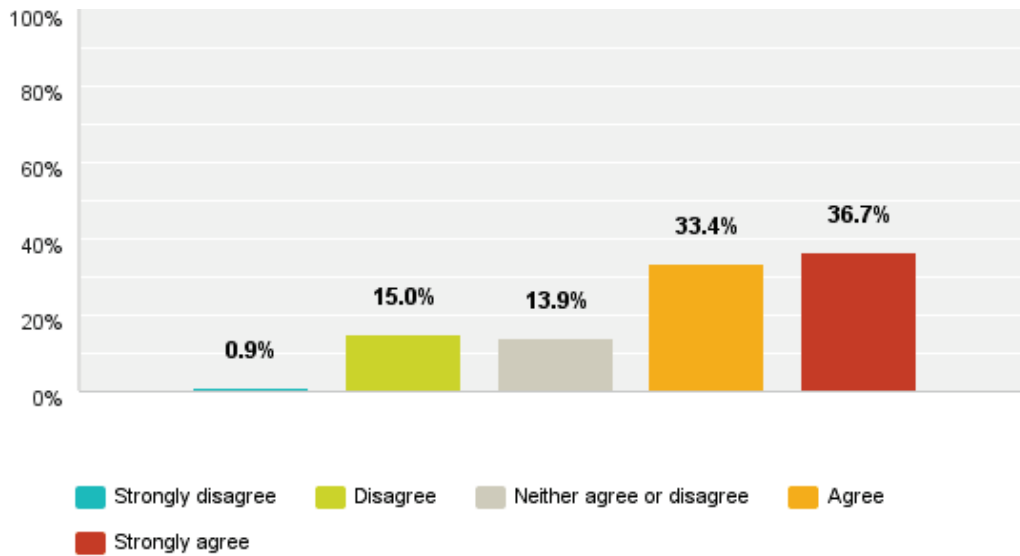
**Figure 78. Baseline Streetscape Users: Level of Agreement with the Statement – The traffic along this street makes it difficult or unpleasant to walk (n=449)**



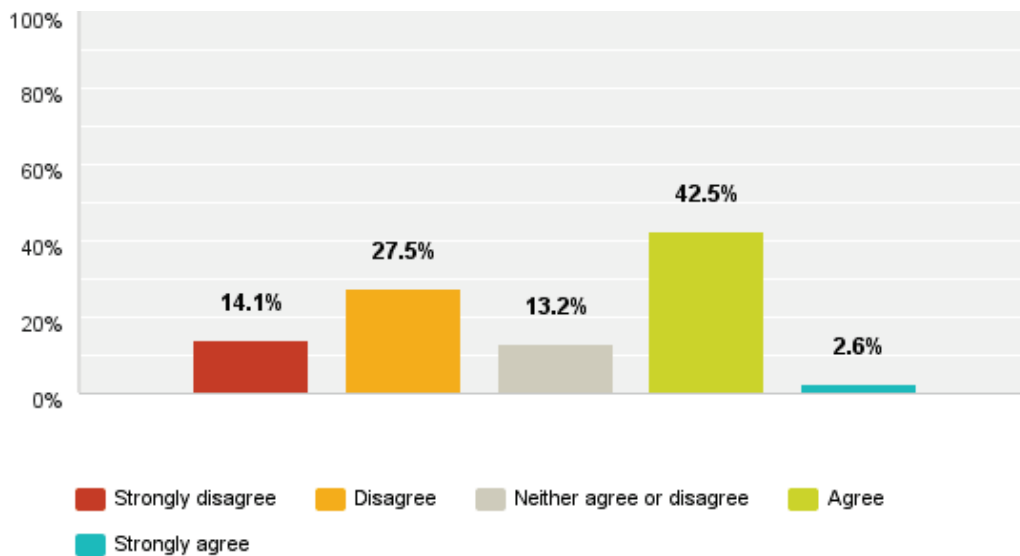
**Figure 79. Baseline Streetscape Users: Level of Agreement with the Statement – The traffic along this street makes it difficult or unpleasant to bike (n=452)**



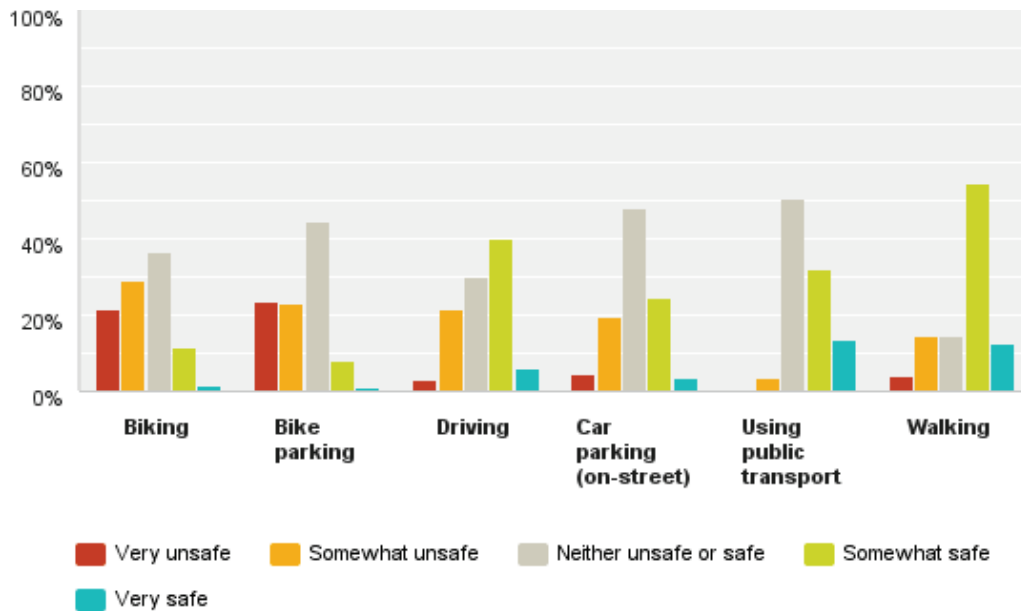
**Figure 80. Baseline Streetscape Users: Level of Agreement with the Statement – Most drivers exceed the posted speed limit while driving on this street (n=452)**



**Figure 81. Baseline Streetscape Users: Level of Agreement with the Statement – There are enough crosswalks and pedestrian signals on my street to help walkers and cyclists cross (n=454)**



**Figure 82. Baseline Streetscape Users: Ratings of Mode Safety (n=456)**



### 4.3.3 Baseline Streetscape Users: Qualitative Comments

Among 452 streetscape users queried, roughly one-third (33.4 percent) were aware that streetscape changes were forthcoming. All were then informed of the planned changes for the corridor and asked if they had any “concerns regarding the upcoming street changes.” In response, 144 provided comments, the categorizations of which are summarized in Table 16. Among these, 43 expressed their support for the changes, while 30 expressed concerns about the potential effects on traffic congestion and safety. These concerns were particularly concentrated in the Pearl Street corridor in the downtown Buffalo area. Eighteen expressed concerns for pedestrian quality and safety, and 13 expressed no concerns.

**Table 16. Baseline Streetscape Users: Concerns about upcoming street changes (n=144)**

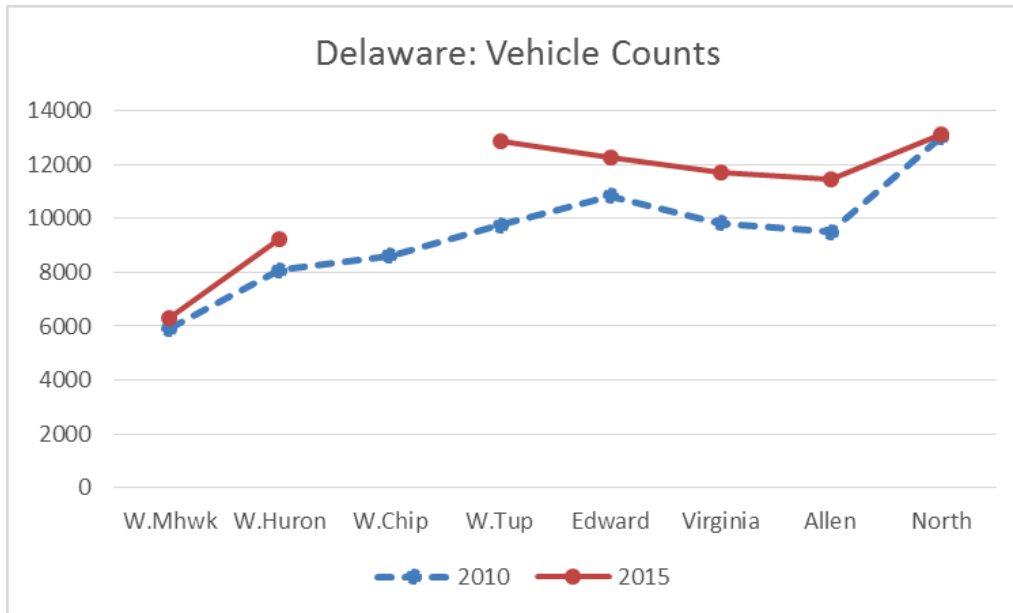
| <b>Category</b>                | <b>n</b> |
|--------------------------------|----------|
| Favor changes                  | 43       |
| Traffic flow/congestion/safety | 30       |
| Pedestrian quality & safety    | 18       |
| No concerns                    | 13       |
| Parking sufficiency            | 8        |
| Bike lane quality/sufficiency  | 6        |
| Bad idea                       | 5        |
| Unclear, could not classify    | 5        |
| Driver behavior                | 4        |
| Prefer 1-way street            | 3        |
| Road pavement quality          | 3        |
| Unaware of changes             | 2        |
| Unsure                         | 1        |
| Flooding                       | 1        |
| Street lights                  | 1        |
| Bus stops                      | 1        |

# 5 Mode Counts, Crash, Fatalities, and Injury Data

## 5.1 Delaware Corridor

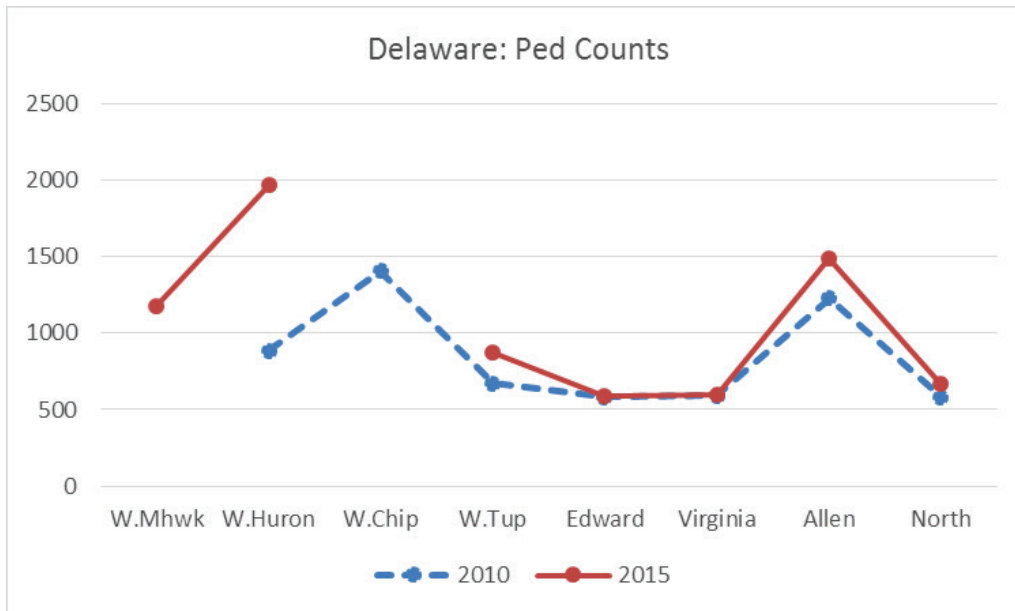
The Delaware corridor was completed in 2013. Pre-implementation counts for vehicles and pedestrians were available from 2010. Pre-implementation counts for bikes were not available. Post-implementation counts for vehicles, pedestrians, and bikes were available from 2015 (Figures 83 through 85). Compared to pre-implementation levels, post-implementation vehicle counts were 20 percent higher at three intersections, approximately 15 percent higher at two intersections, and approximately the same at two intersections (Figure 83). Compared to pre-implementation levels, pedestrian counts more than doubled at one intersection (W. Huron), were 15-30 percent higher at three intersections, and were approximately the same at three intersections (Figure 84). Pre- and post- comparisons were not possible for bicycle counts along the Delaware corridor because pre-implementation data were not captured (Figure 85).

**Figure 83. Delaware Corridor: Vehicle Counts, Pre- and Post-Implementation**

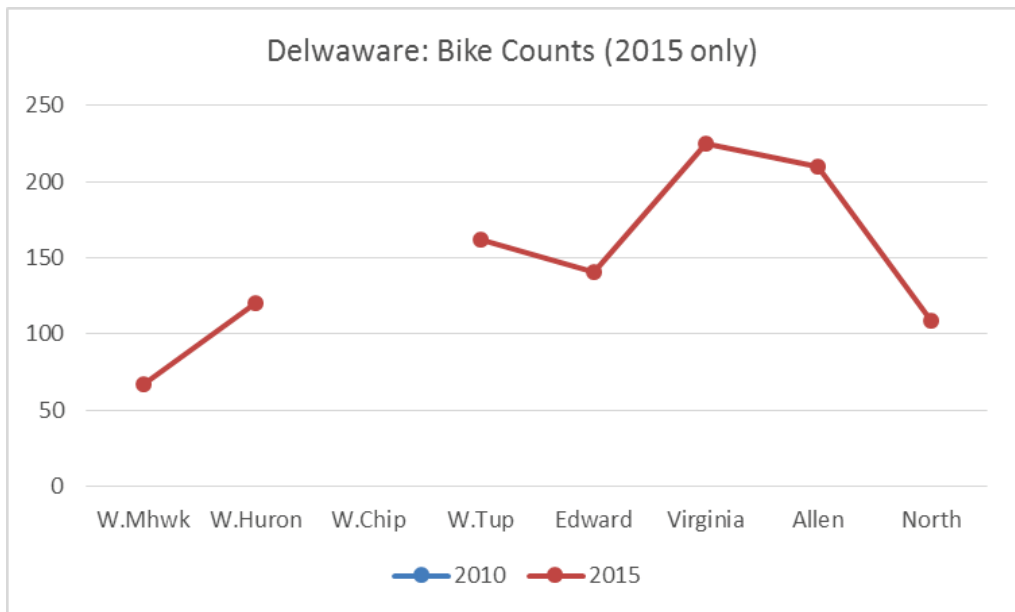




**Figure 84. Delaware Corridor: Pedestrian counts, Pre- and Post-Implementation**

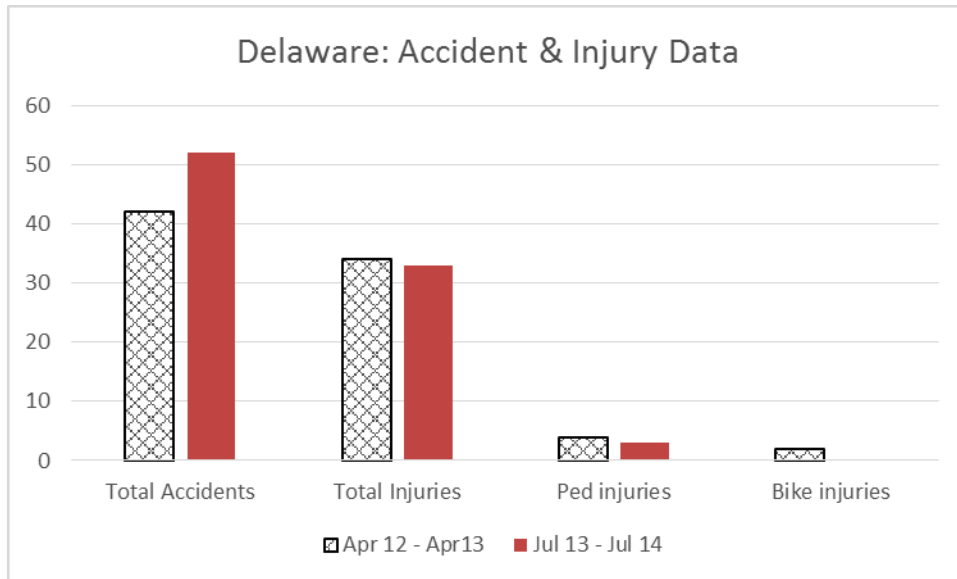


**Figure 85. Delaware Corridor: Bicycle Counts, Post-Implementation Only**



Accident and injury data for the Delaware corridor for 13-month periods before and after the 2013 implementation are depicted in Figure 86. Compared to pre-implementation levels, the total number of crashes rose by 24 percent; however, total injuries were down 3 percent, pedestrian injuries were down by 25 percent, and bike injuries were down by 100 percent. These results suggest that post-implementation crashes involved lower impact forces, perhaps due to lower impact speeds.

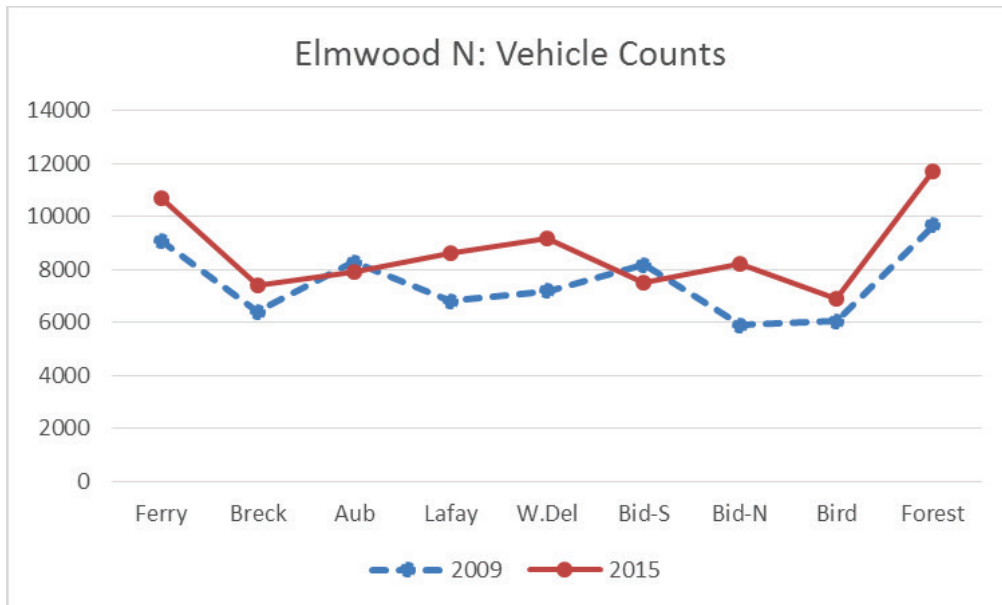
**Figure 86. Delaware Corridor: Accident and Injury Data Pre- and Post-Implementation**



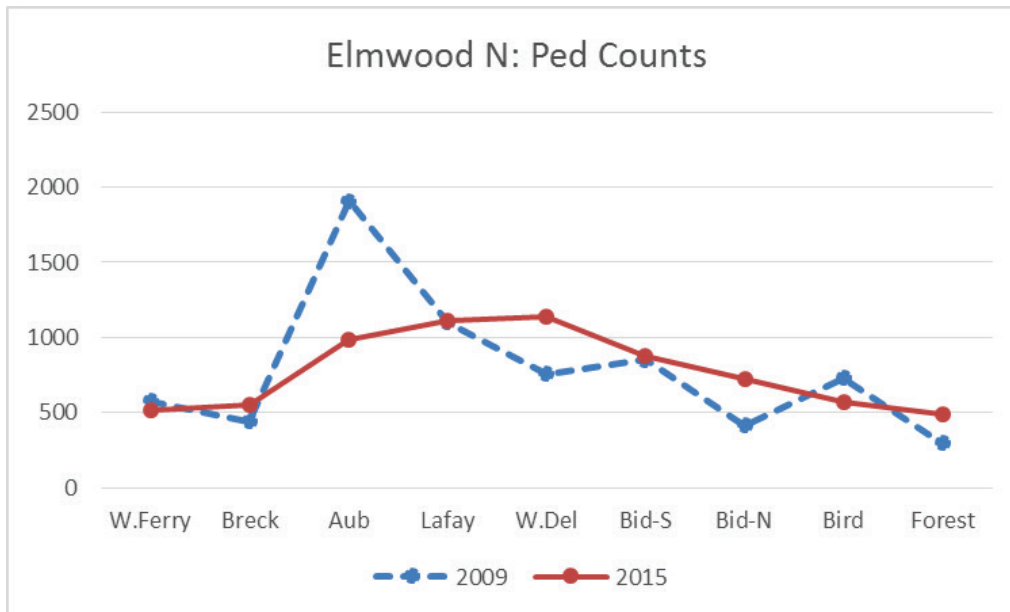
## 5.2 Elmwood North Corridor

The Elmwood North corridor was completed in 2012. Pre-implementation counts for vehicles and pedestrians were available from 2009. Pre-implementation counts for bikes were not available for this corridor. Post-implementation counts for vehicles, pedestrians, and bikes were available from 2015. Compared to pre-implementation levels, post-implementation vehicle counts were 13-39 percent higher at six intersections and 4-8 percent lower at two intersections (Figure 87). Compared to pre-implementation levels, pedestrian counts were higher at six of the nine intersections (Figure 88). Pre- and post- comparisons were not possible for bicycle counts along the Delaware corridor because pre-implementation data were not captured (Figure 89).

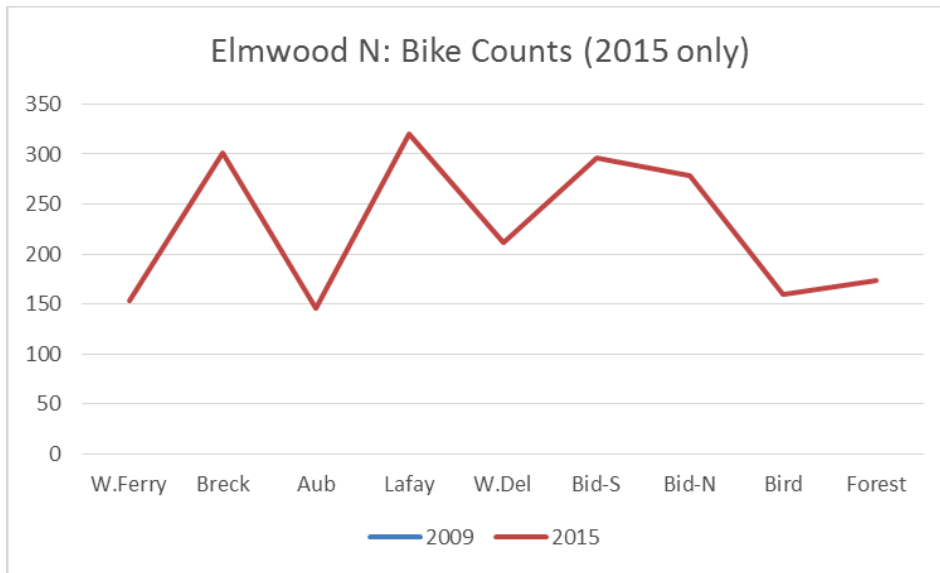
**Figure 87. Elmwood North Corridor: Vehicle Counts, Pre- and Post-Implementation**



**Figure 88. Elmwood North Corridor: Pedestrian Counts, Pre- and Post-Implementation**

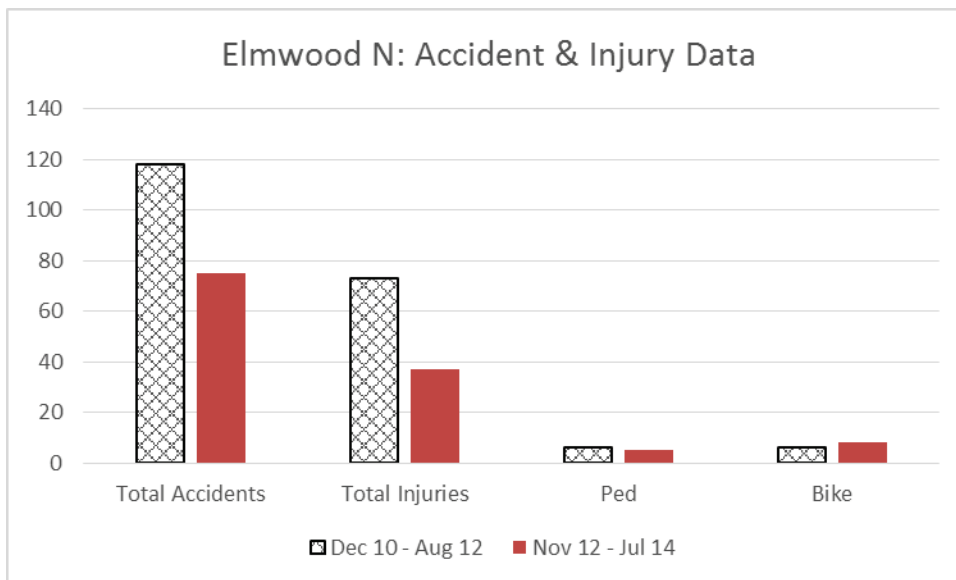


**Figure 89. Elmwood North Corridor: Bicycle Counts, Post-Implementation Only**



Accident and injury data for the Elmwood Avenue North corridor for 21-month periods before and after the 2012 implementation are shown in Figure 90. Compared to pre-implementation levels, total crashes were down by 36 percent. Total injuries were down by 49 percent, total pedestrian injuries were down by 17 percent, and total bicycle injuries increased by 33 percent, from six to eight.

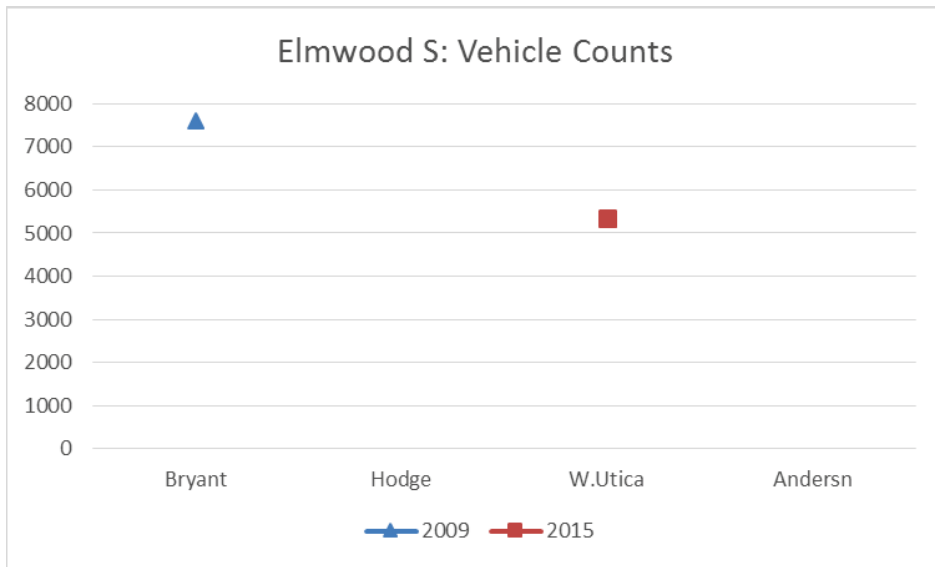
**Figure 90. Elmwood North Corridor: Accident and Injury Data Pre- and Post-Implementation**



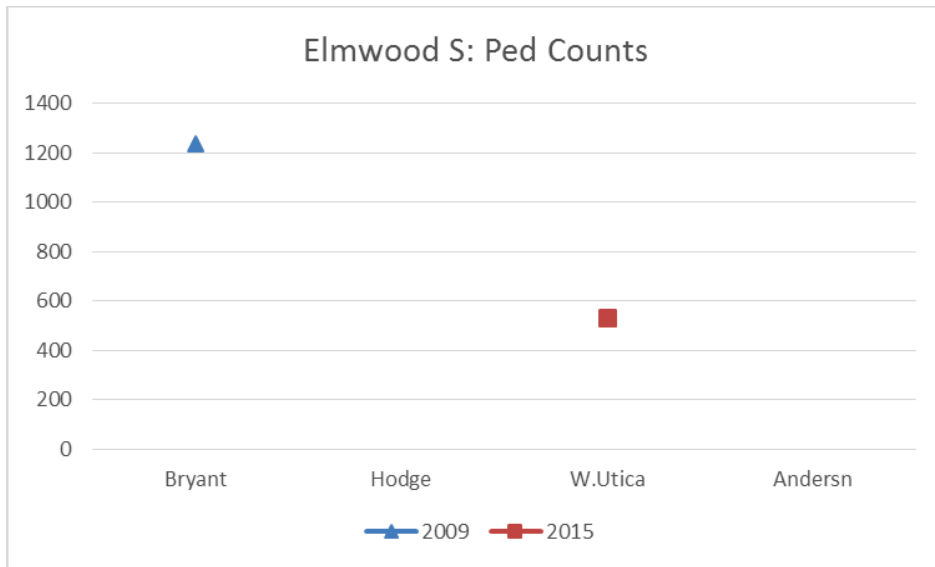
### 5.3 Elmwood South Corridor

The Elmwood South corridor was completed in 2012. Pre-implementation counts for vehicles and pedestrians were available from 2009 only at the Bryant intersection. Post-Implementation counts for vehicles, pedestrians, and bikes were available from 2015 only at the W. Utica intersection. Figures 91-93 summarize the count data for this corridor. Because comparable intersections were not measured before and after implementation, pre-post comparisons were not possible for any of the three mode counts.

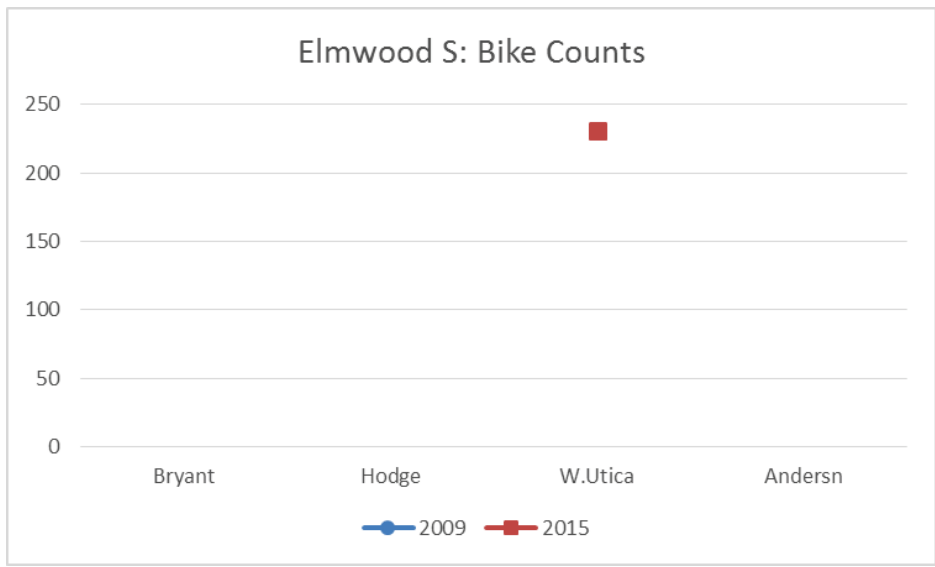
**Figure 91. Elmwood South Corridor: Vehicle Counts, Pre- and Post-Implementation**



**Figure 92. Elmwood South Corridor: Pedestrian Counts, Pre- and Post-Implementation Only**

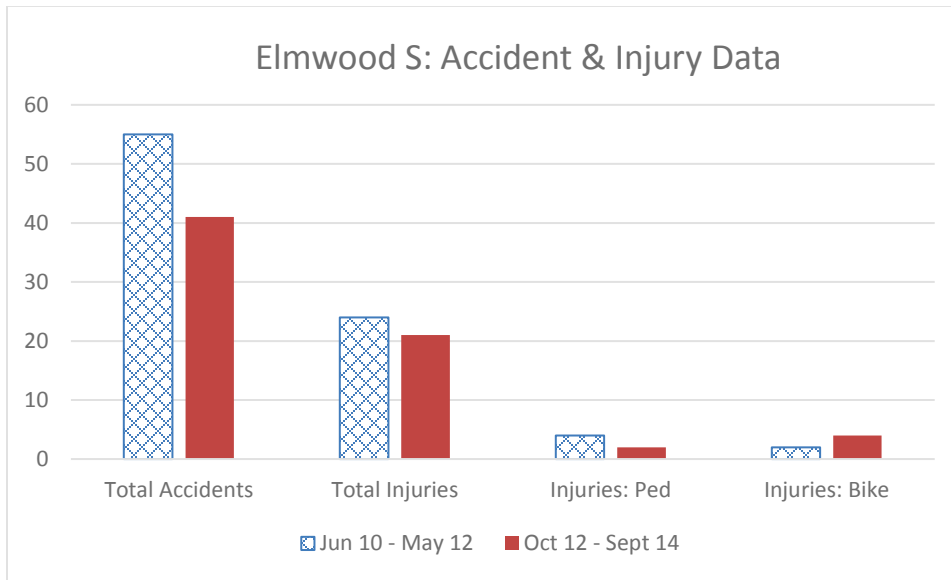


**Figure 93. Elmwood South Corridor: Bicycle Counts, Post-Implementation Only**



Accident and injury data for the Elmwood Avenue South corridor for 24-month periods before and after the 2012 implementation are shown in Figure 94. Compared to pre-implementation levels, total crashes were down by 25 percent, and total injuries were down by 13 percent. Among these results, total pedestrian injuries decreased by 50 percent (from 4 to 2), while total bicycle injuries increased from 2 to 4.

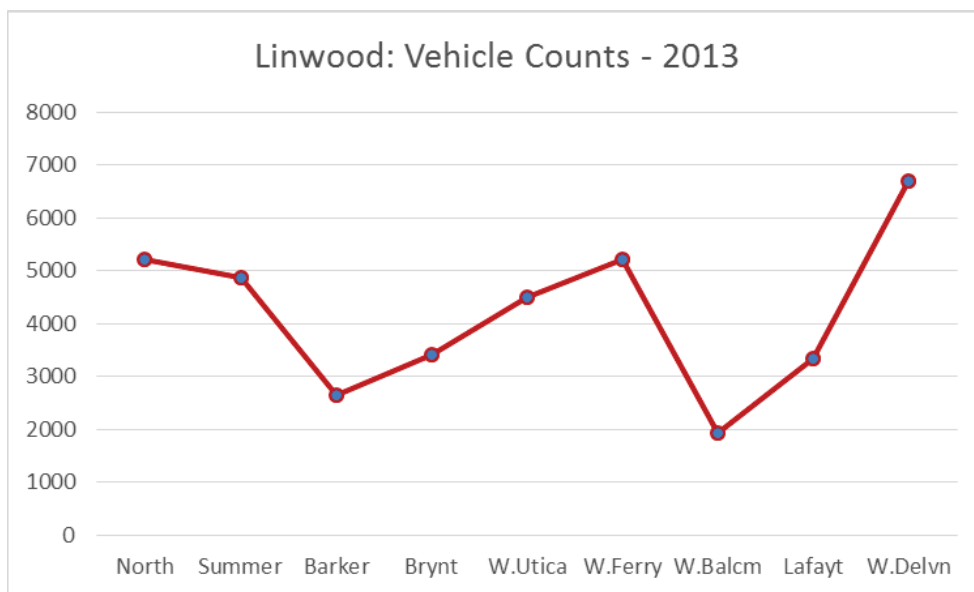
**Figure 94. Elmwood South Corridor: Accident and Injury Data Pre- and Post-Implementation**



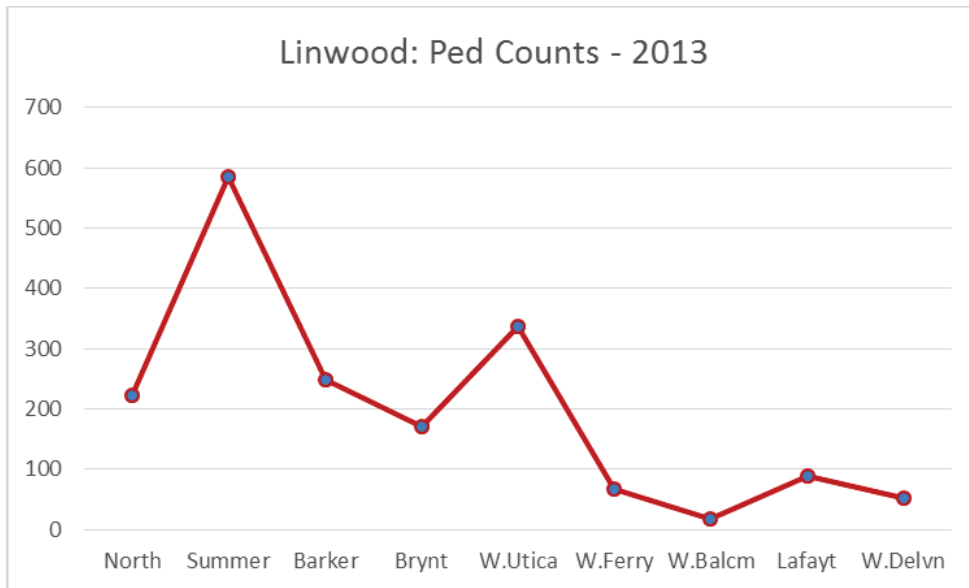
## 5.4 Linwood Corridor

The Linwood corridor was completed in 2012. Pre-implementation counts were not available for this corridor. Thus, pre- and post- comparisons were not possible for any of the three modes along the Linwood corridor. Post-implementation counts for vehicles, pedestrians, and bikes were available from 2013 and are depicted in Figures 95-97.

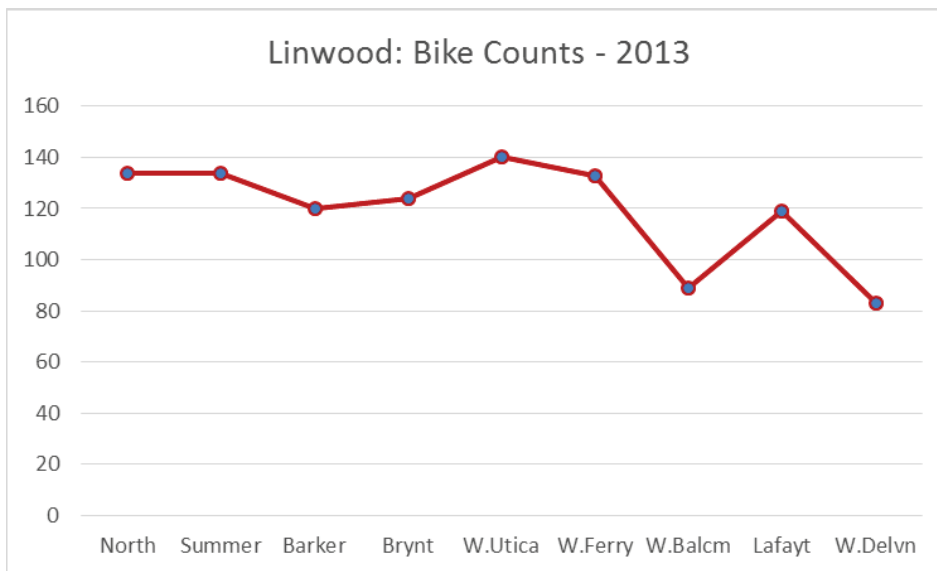
**Figure 95. Linwood Corridor: Vehicle Counts, Post-Implementation Only**



**Figure 96. Linwood Corridor: Pedestrian Counts, Post-Implementation Only**



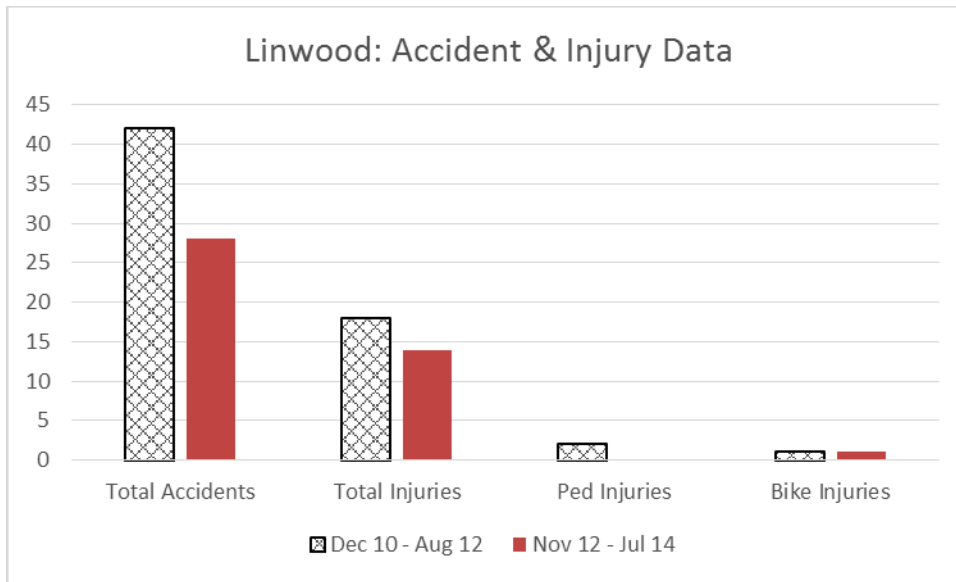
**Figure 97. Linwood Corridor: Bicycle Counts, Post-Implementation Only**



Accident and injury data for the Linwood Avenue corridor for 21-month periods before and after the 2012 implementation are shown below in Figure 98. Compared to pre-implementation levels, total crashes were down by 33 percent. Total injuries were down by 22 percent, pedestrian injuries were down 100 percent (from n=2 to n=0), and total bike injuries were unchanged.



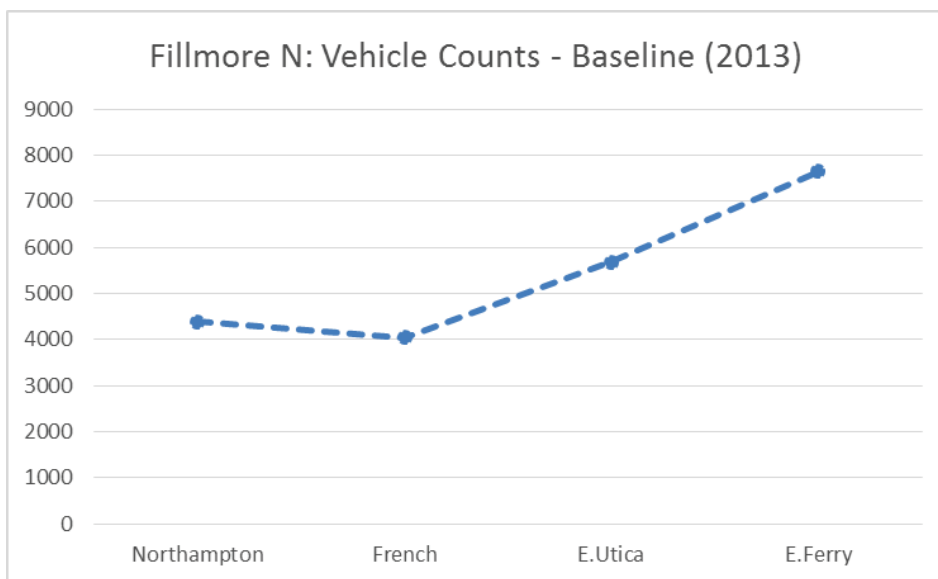
**Figure 98. Linwood Corridor: Accident and Injury Data, Pre- and Post-Implementation**



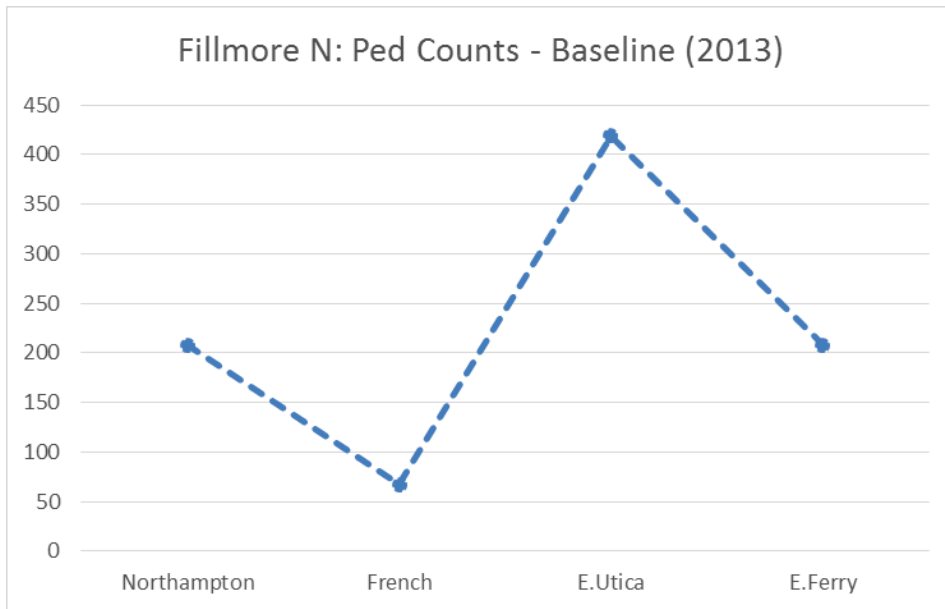
## 5.5 Fillmore North Corridor

For the Fillmore North corridor (completed in 2014), post-implementation counts for vehicles, pedestrians, and bikes were not available. Thus, pre- and post- comparisons were not possible for any of the three modes along the Fillmore North corridor. Pre-implementation counts for vehicles, pedestrians, and bicycles were available from 2013 and are depicted in Figures 99-101.

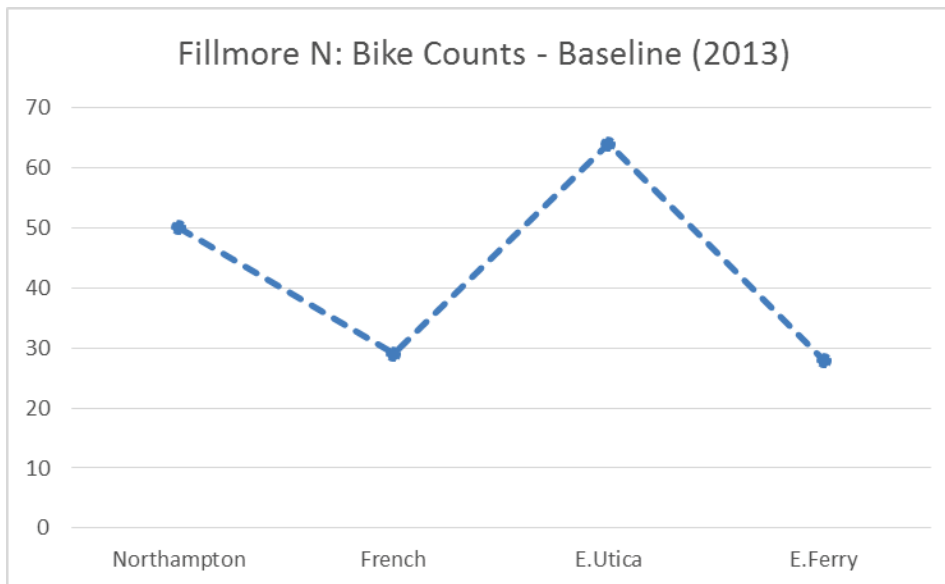
**Figure 99. Fillmore North Corridor: Vehicle Counts, Baseline Only**



**Figure 100. Fillmore North Corridor: Pedestrian Counts, Baseline Only**

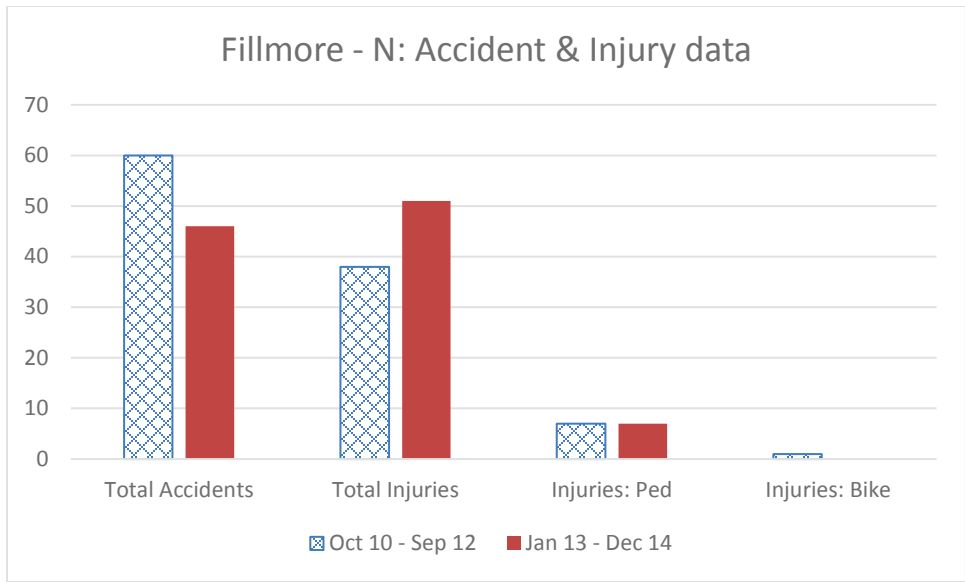


**Figure 101. Fillmore North Corridor: Bicycle Counts, Baseline Only**



Accident and injury data for the Fillmore Avenue North corridor for 24-month periods before and after the 2013-14 construction period are shown in Figure 102.

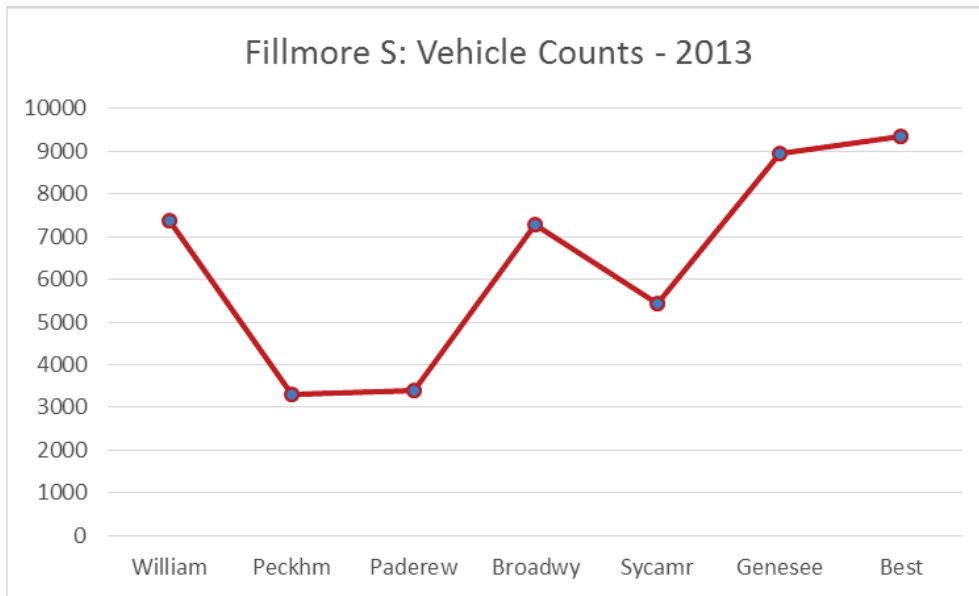
**Figure 102. Fillmore North Corridor: Accident and Injury data, Pre- and Post-Implementation**



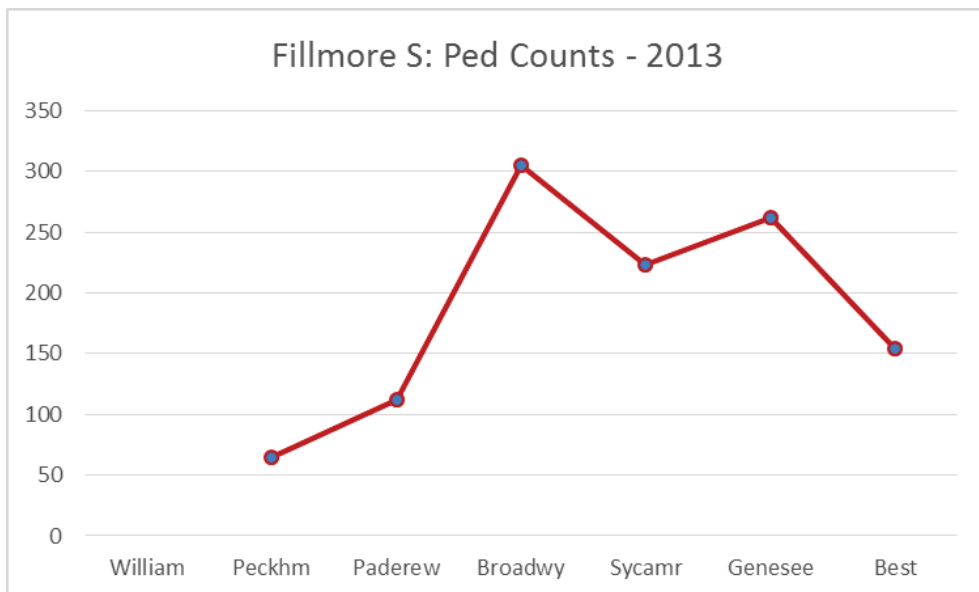
## 5.6 Fillmore South Corridor

The Fillmore South corridor was completed in 2012. Pre-implementation counts were not available. Thus, pre-/post- comparisons were not possible for any of the three modes along the Fillmore South corridor. Post-implementation counts for vehicles, pedestrians, and bikes were available from 2013 and are depicted below in Figures 103-105.

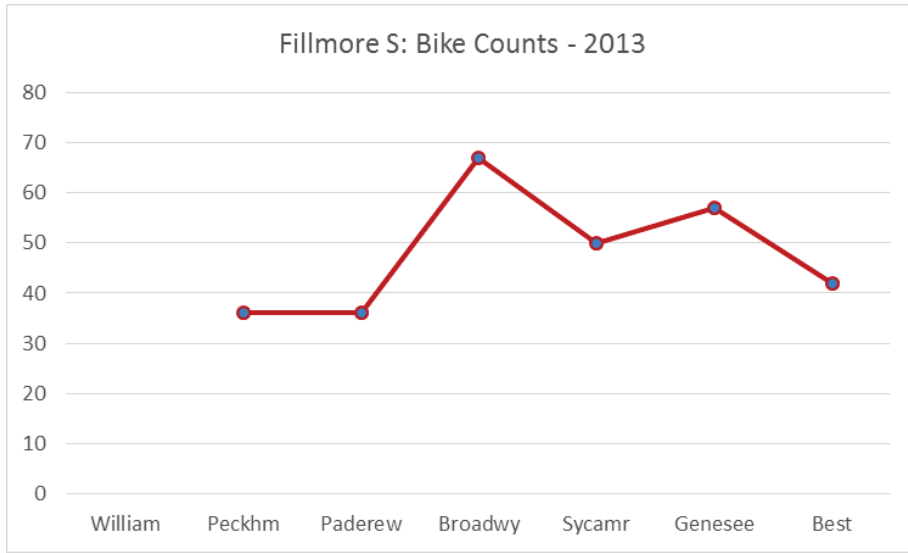
**Figure 103. Fillmore South Corridor: Vehicle Counts, Post-Implementation Only**



**Figure 104. Fillmore South Corridor: Pedestrian Counts, Post-Implementation Only**



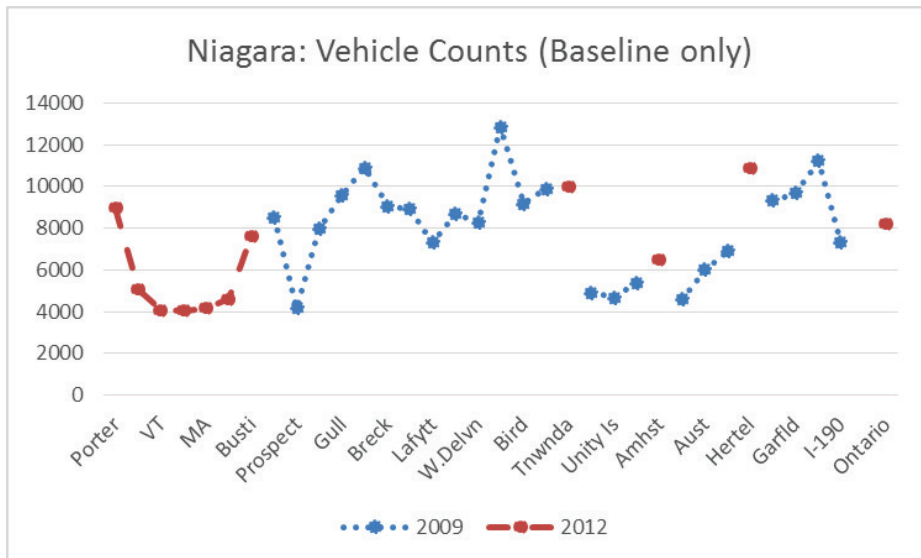
**Figure 105. Fillmore South Corridor: Bicycle Counts, Post-Implementation Only**



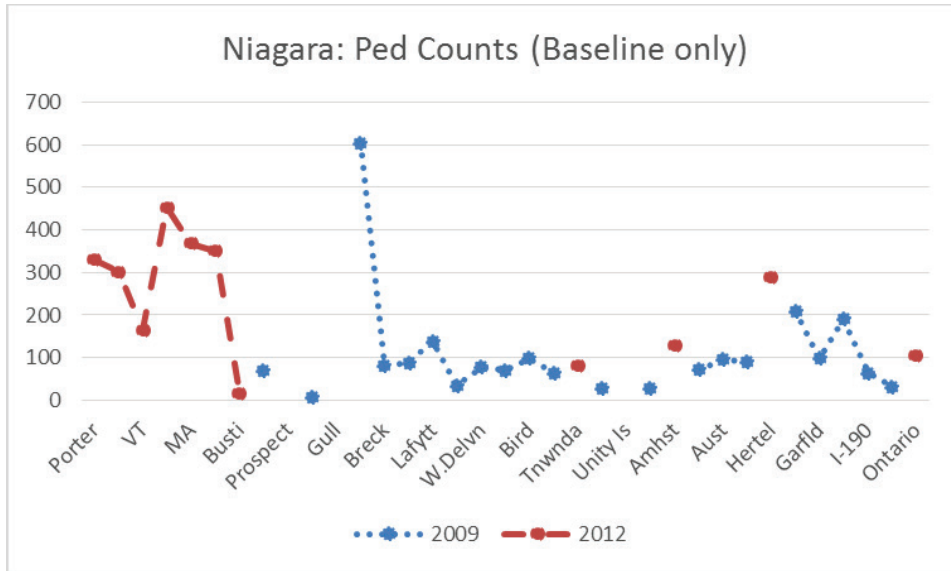
## 5.7 Niagara Street Corridor

The Niagara Street corridor project is scheduled to begin construction in 2017, and completion is projected to occur in late 2018. Baseline counts were available for vehicles and pedestrians from both 2009 and 2012. Baseline counts for bikes were not available from either 2009 or 2012. The baseline counts for vehicles and pedestrians are depicted in Figure 106 and Figure 107, respectively.

**Figure 106. Niagara Street Corridor: Vehicle Counts, Baseline**

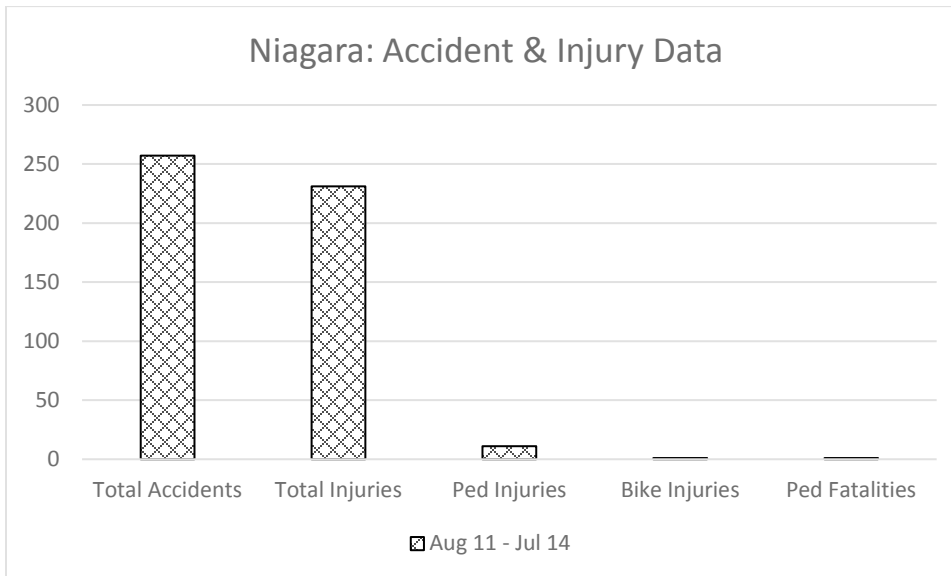


**Figure 107. Niagara Street Corridor: Pedestrian Counts, Baseline**



Baseline accident and injury data for the Niagara Street corridor are show below for a 36-month period ending in July 2014 (Figure 108).

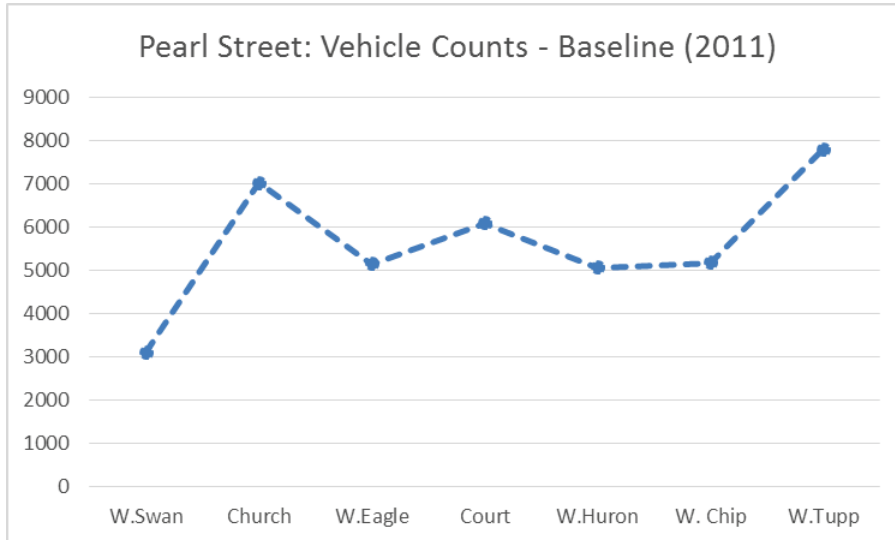
**Figure 108. Niagara Street Corridor: Accident and Injury Data, Baseline**



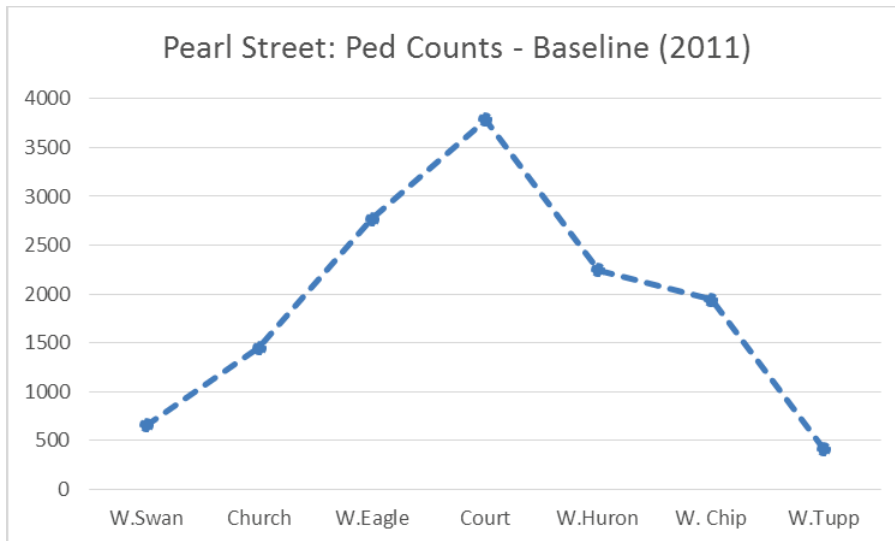
## 5.8 Pearl Street Corridor

The Pearl Street corridor is scheduled for 2016 completion. Baseline counts for vehicles and pedestrians are depicted in Figure 109 and Figure 110, respectively. Baseline counts for bikes were not available.

**Figure 109. Pearl Street Corridor: Vehicle Counts, Baseline**

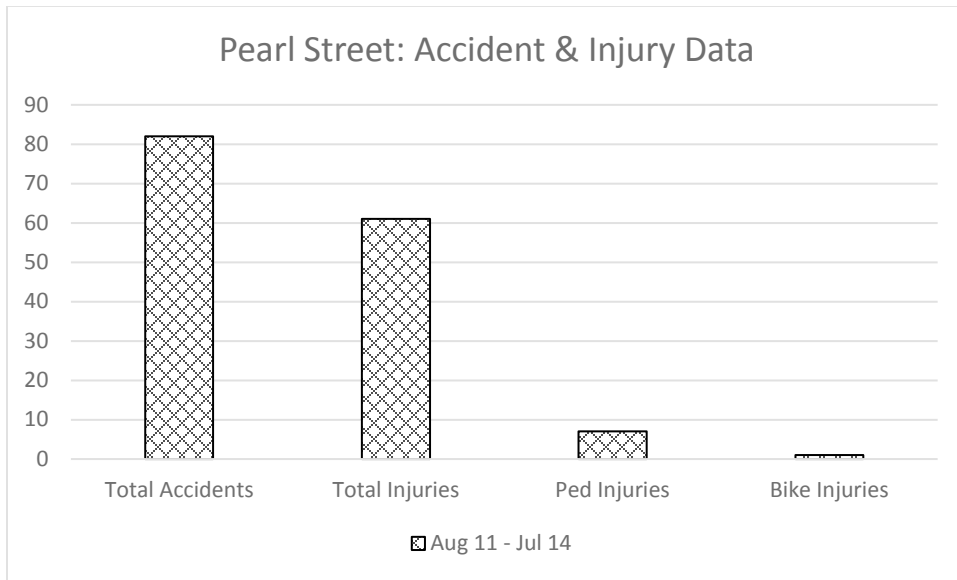


**Figure 110. Pearl Street Corridor: Pedestrian Counts, Baseline**



Baseline accident and injury data for the Pearl Street corridor are shown below for a 36-month period ending in July 2014 (Figure 111).

**Figure 111. Pearl Street Corridor: Accident and Injury Data, Baseline**





## 6 Economic Data

Data for commercial sales along each corridor are summarized in Table 17. The data reflect ownership types listed as Public/Private Company, Headquarter/Branch, or Home Based Business. Table 17 lists the number of businesses along each corridor, total sales across all businesses along the corridor, average sales per business, and median sales per business by corridor. Median sales values are substantially lower than the average sales along each corridor, suggesting that mean sales values are upwardly skewed by a small number of lucrative entities. The median sales values thus present a truer snapshot of the “average” economic activity for businesses along each corridor. Delaware Avenue, which is closest to downtown Buffalo, had the highest median sales. In contrast, two sections of Fillmore Avenue, which are in an area considered to have lower socioeconomic health, had median sales that were much lower.

**Table 17. Business sales data along each corridor**

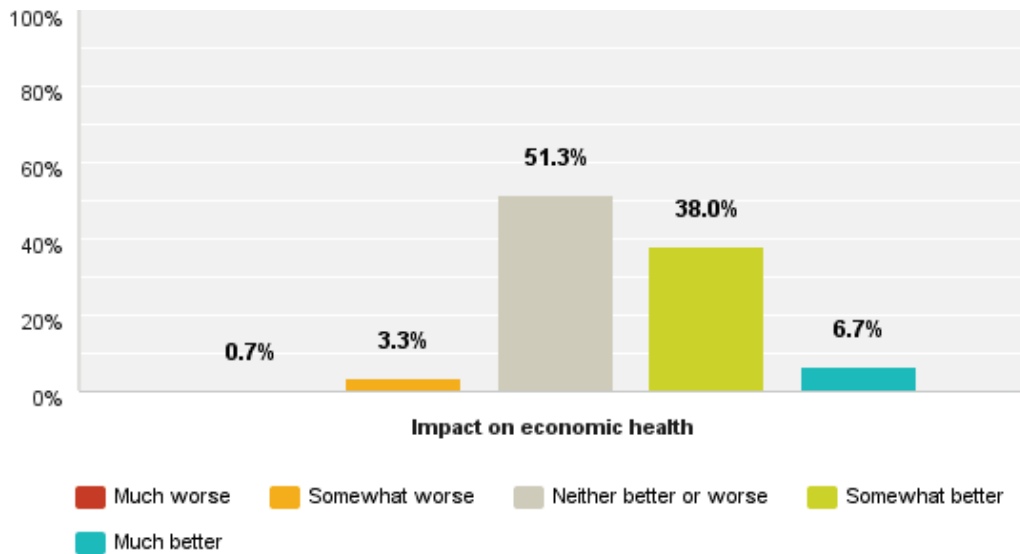
*(Data Source: Infogroup, Inc., ReferenceUSA database, March 2016)*

| <b>Corridor</b> | <b>#<br/>businesses</b> | <b>Total Sales</b> | <b>Mean sales</b> | <b>Median sales</b> |
|-----------------|-------------------------|--------------------|-------------------|---------------------|
| Delaware        | 73                      | \$ 643,335,000     | \$ 8,812,808      | \$ 2,064,000        |
| Elmwood South   | 28                      | \$ 54,825,000      | \$ 1,958,036      | \$ 413,000          |
| Elmwood North   | 53                      | \$ 200,423,000     | \$ 3,781,566      | \$ 1,365,000        |
| Fillmore North  | 12                      | \$ 14,899,000      | \$ 1,241,583      | \$ 532,000          |
| Fillmore South  | 11                      | \$ 15,495,000      | \$ 1,408,636      | \$ 703,000          |
| Linwood         | 10                      | \$ 22,936,000      | \$ 2,293,600      | \$ 1,621,500        |
| Niagara Street  | 79                      | \$ 2,973,403,000   | \$ 37,638,013     | \$ 2,151,000        |
| Pearl Street    | 29                      | \$ 459,524,000     | \$ 15,845,655     | \$ 2,063,000        |

As previously described in this report, merchants rated the economic health of their street and the change in their own sales since the streetscape changes were implemented:

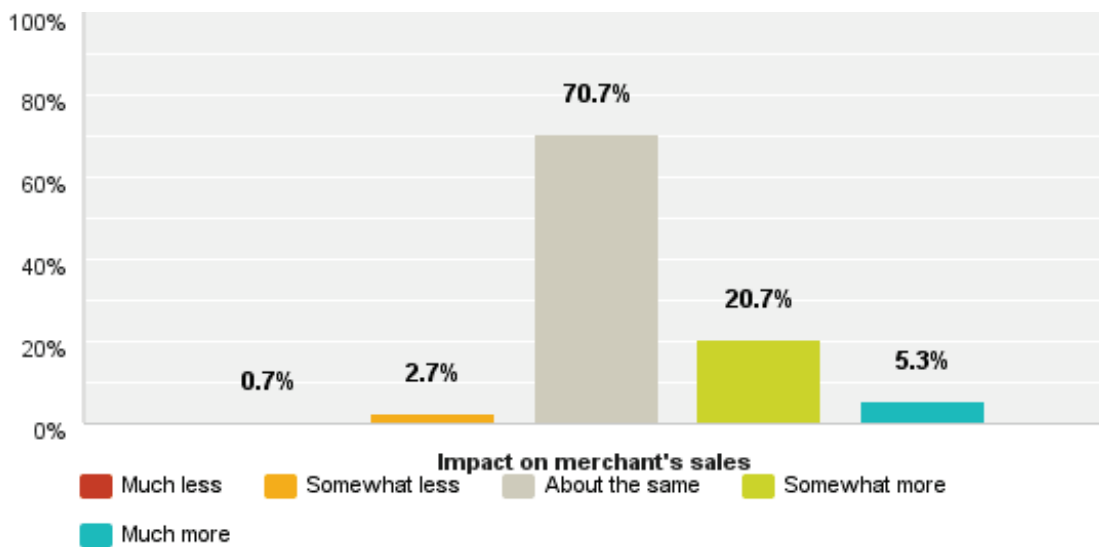
- 44.7 percent indicated the overall economic health of the street was “somewhat better” or “much better” since the streetscape changes had been made (Figure 112).
- Almost three-quarters (70.7 percent) reported that their own business sales were unchanged, although 25.8 percent reported that their sales were “somewhat more” or “much more” since the streetscape changes were implemented (Figure 113).

**Figure 112. Post-Implementation Merchants: Impact on Economic Health of the Street (n=150)**



**Figure 113. Post-Implementation Merchants: Impact on merchant's sales**

Merchants were asked if their sales were “much less, somewhat less, about the same, somewhat more, or much more” than prior to the CS changes on their corridor. (n=150)

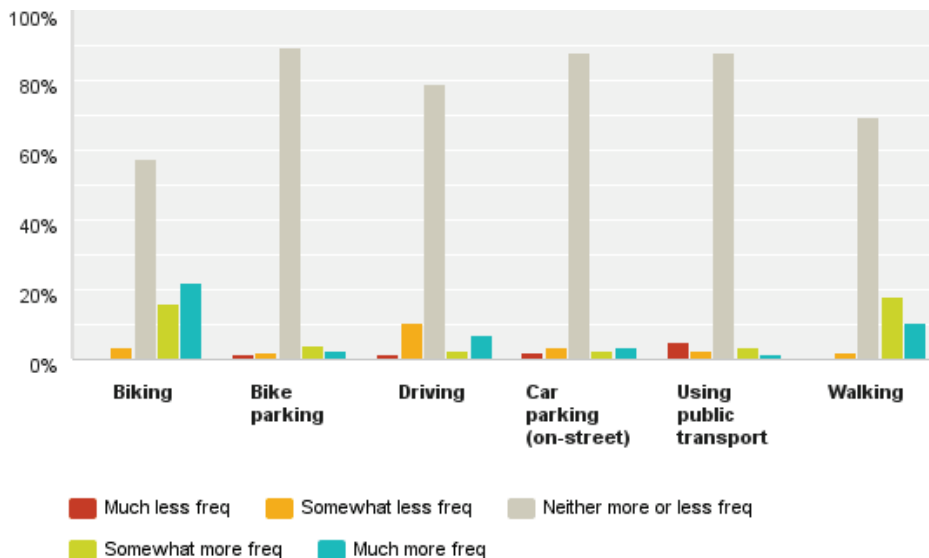


## 7 Health Impact

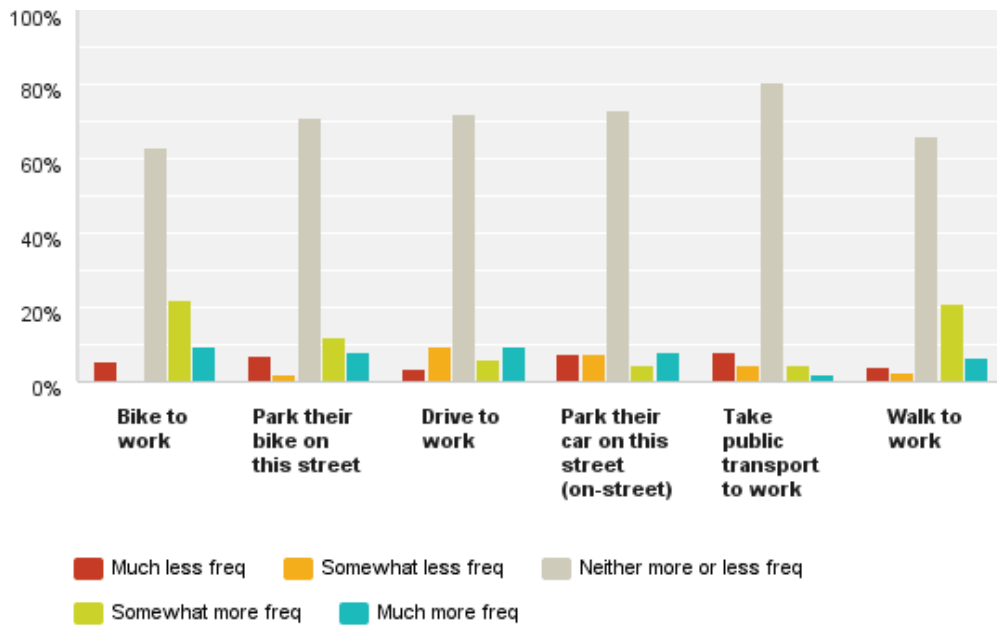
As reported in Chapter 3, self-reported health behavior data were captured via post-implementation surveys of Residents, Merchants, and Streetscape Users.

- 28.5 percent of residents reported that they were walking “much more” or “somewhat more” frequently, and 38.4 percent reported that they were biking “much more” or “somewhat more” frequently (Figure 114).
- 27.7 percent of merchants reported that employees were walking “much more” or “somewhat more” frequently to work, and 31.2 percent reported that employees were biking “much more” or “somewhat more” frequently to work (Figure 115).
- 40.4 percent of merchants reported that customers were walking “much more” or “somewhat more” frequently to the merchant’s business, and 42.8 percent reported that customers were biking “much more” or “somewhat more” frequently to the business (Figure 116).
- 36.5 percent of streetscape users reported that they were walking “much more” or “somewhat more” frequently, and 35.8 percent reported that they were biking “much more” or “somewhat more” frequently (Figure 117).

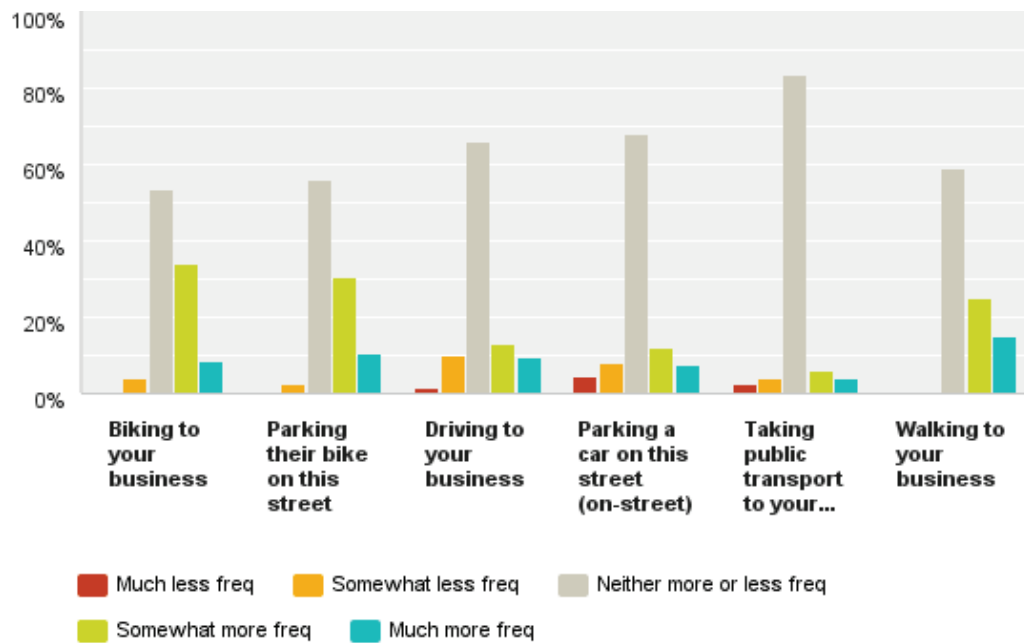
**Figure 114. Post-Implementation Residential: Frequency of Mode Use (n=298)**



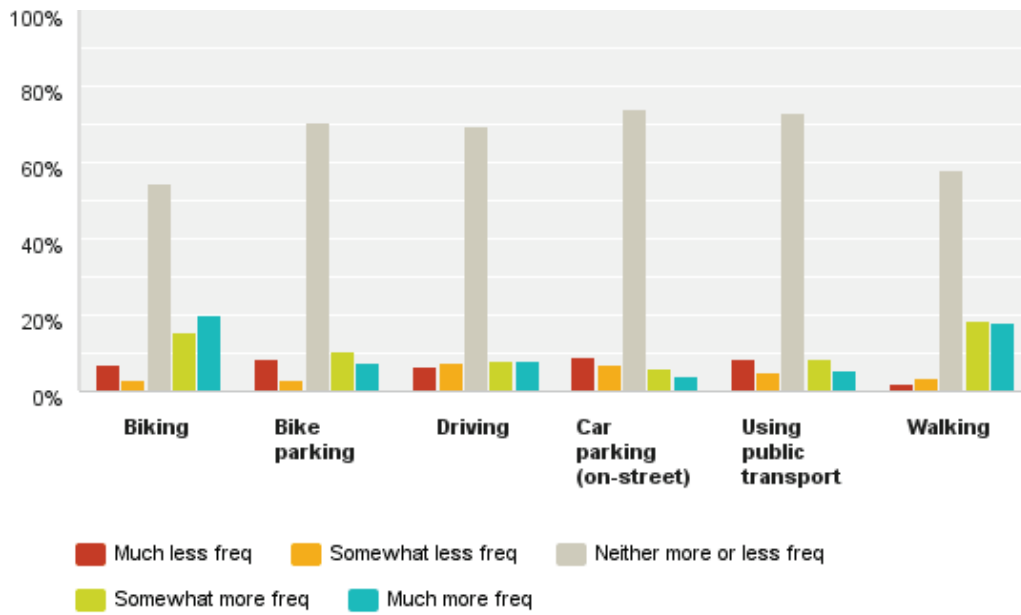
**Figure 115. Post-Implementation Merchants: Employee Mode Frequency (n=152)**



**Figure 116. Post-Implementation Merchants: Customer Mode Frequency (n=152)**



**Figure 117. Post-Implementation Streetscape User: Frequency of Mode Use (n=1,003)**



## 8 Discussion

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The survey data from residents, merchants, and streetscape users indicate that: (a) the Complete Streets projects implemented in the Buffalo area have been largely successful and very popular among all three stakeholder groups; (b) the planned-but-not-yet-implemented Complete Streets projects are rightfully targeting corridors having lower perceived streetscape quality; and (c) the survey tools created specifically for this study were efficiently administered and yielded meaningful data without being onerous for participants.

Although mode volume data for vehicles has been consistently gathered, pedestrian and bicycle count data along Complete Streets corridors has not been systematically captured. When pre- and post-implementation volume counts for all three modes are available, the data suggest that volumes for all three modes stay the same or increase after Complete Streets features have been implemented along a corridor. The crash and injury data indicate that corridors along which Complete Streets features have been implemented are safer in terms of total crashes and injuries. Although these findings are very promising, additional research data are needed to verify that increased mode volumes and enhanced safety are generalizable for Complete Streets projects across multiple corridors and municipalities.

Assessing the economic impact of Complete Streets projects is not clear cut. Obtaining sales snapshots from third-party databases (e.g., Reference USA) offers a quantitative metric. However, attributing causality for increases or decreases in commercial sales to streetscape changes due to Complete Streets would be vulnerable to criticism because of the multitude of potential confounding factors that could also be influencing the economic vitality of a corridor. In contrast, direct queries of merchants regarding the economic impact they have experienced as the result of streetscape changes provides much contextual authenticity. However, individual merchant ratings are vulnerable to their internal biases about the value of the streetscape changes.

The self-reported data from all three survey groups indicate a positive and substantial increase in walking and biking behaviors along those corridors. Although self-reported health activity data are not esteemed as highly as more robust measures involving electromechanical devices (e.g., smartphones and wrist watches with accelerometers), the latter approaches are not bias-free and require greater time investment from participants and the data collection team. Those disclaimers aside, the data gathered here nonetheless suggest that Complete Streets corridors support and elicit healthy behaviors.

## 9 Considerations for Future Work

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The following suggestions represent the most interesting and potentially fruitful directions forward based on the current study and history of Complete Streets research:

- With modest grant support, the current study could be scaled-up to assess Complete Streets programs in other municipalities in New York State. Such a study could be designed to achieve three aims: (a) reinforce the value of taxpayer-supported NYS Complete Streets initiatives; (b) provide much-needed research data that could substantiate the benefits of the Complete Streets paradigm; and (c) achieve a sustainable model of ongoing municipal evaluation of Complete Streets projects.
- Survey data from residents, merchants, and streetscape users are invaluable but time-intensive and costly to procure without grant support. To achieve the ultimate goal of an ongoing and sustainable approach to Complete Streets program evaluation, modified approaches to capturing the survey information should be explored, including:
  - Reducing the number of items in the surveys. Although the surveys were not lengthy (10-12 minutes), it would not be difficult to reduce the length of the surveys by 30 percent through eliminating items that are mildly overlapping or that yielded information of lesser priority.
  - Exploring alternative data collection media. If the time required to complete the surveys could be reduced to 8-10 minutes, it could become realistic for merchants and residents to complete the surveys independently without the assistance of a canvasser. This approach would require a municipal commitment to advertise the importance of the surveys and incentivize voluntary completion.
- Metropolitan Planning Organizations, municipal departments of public works, and local Complete Streets initiatives should collaborate annually to ensure that measurement of volume counts (for vehicles, pedestrians, and bicyclists) is systematically occurring on corridors for which Complete Streets projects have been implemented or are proposed. In a similar manner, these entities should also collaborate annually to ensure that crash and injury data along the same corridors are being captured and saved in a central repository of Complete Streets project data.
- To facilitate meaningful program evaluations across projects and geographic locations, local Complete Streets initiatives should create and maintain a minimum data set for each Complete Streets project. The data set for each project could include: (a) the geographic boundaries of the corridor; (b) the overall length of the corridor; (c) the Complete Streets features that were (or will be) implemented along the corridor; (d) the beginning and end dates for construction of the Complete Streets project; and (e) the public works cost of the project.

## 10 References

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