Technical Report Documentation Page

1. Report No. TTI No. P2009330	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle FORECASTING BICYCLE AND PEDESTRIAN USAGE AND RESEARCH DATA COLLECTION EQUIPMENT		5. Report Date December 2010
		6. Performing Organization Code
7. Author(s) Joan Hudson, Tong-Bin Qu, Shawn Turner		8. Performing Organization Report No. TTI Project 0000405810
9. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135		10. Work Unit No. (TRAIS)
		11. Contract or Grant No. Project No. P2009330
12. Sponsoring Agency Name and Address Capital Area Metropolitan Planning Organization PO. Box 1088 Austin, TX 78767		13. Type of Report and Period Covered Technical Report: July 2009 – September 2010
		14. Sponsoring Agency Code

15. Supplementary Notes

Research performed in cooperation with the Capital Area Metropolitan Planning Organization and the U.S. Department of Transportation, Federal Highway Administration.

Research Project Title: Forecasting Bicycle and Pedestrian Usage and Research Data Collection Equipment

16. Abstract

During recent years, community leaders and transportation professionals in the Austin area have increased their interest in pedestrian and bicycle travel. Advocacy groups, task forces, bicycling clubs, and volunteer organizations encourage governmental agencies to do more to improve safety and accommodations for these vulnerable users. The sentiments have been upheld by the Federal Highway Administration with policy statements supporting livability concepts which include bicycle and pedestrian transportation improvements.

With all of the attention on these forms of non-motorized transportation in the region, there is a need to know whether the programs are actually increasing the number of people who bike and walk. The Capital Area Metropolitan Planning Organization (CAMPO) hired the Texas Transportation Institute (TTI) to help them find the answer to these and other questions. The project's scope of work includes the following tasks:

1. Research bicycle and pedestrian monitoring programs in order to recommend an appropriate method to collect data,
2. Collect existing bicycle and pedestrian traffic counts in the five-county Austin-Round Rock Metropolitan Statistical Area while testing data collection equipment,
3. Forecast potential use from bicycle and pedestrian infrastructure,
4. Integrate the sketch planning tool into the CAMPO transportation planning process, and
5. Complete a final report, executive summary, and data collection training.

This document comprises the final report for the project and includes the results of each of the above tasks. It is organized by task with additional details provided in the appendix. Best practices and lessons learned from agencies that have pedestrian and bicycle monitoring programs are included. Based on these findings, researchers made recommendations for CAMPO. The tool developed by TTI identifies missing links in the pedestrian and bicycle network. Included in this report are pedestrian and bicycle volume data at 15 locations around the region.

17. Key Words Bicycle, pedestrian, data collection, travel demand model		18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161	
19. Security Classif.(of this report) Unclassified	20. Security Classif.(of this page) Unclassified	21. No. of Pages 86	22. Price

Form DOT F 1700.7 **(8-72)** **Reproduction of completed page authorized**

Forecasting Bicycle and Pedestrian Usage and Researching Data Collection Equipment

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December 2010

Disclaimer

The preparation of this report has been financed in part through grant[s] from the Federal Highway Administration, U.S. Department of Transportation, under the Surface Transportation Program, 23 U.S.C. 133. Section 1101(a)(4) of SAFETEA-LU. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation. The engineer in charge of the project was Joan G. Hudson, Texas P.E. #80624.

Acknowledgements

The researchers would like to thank TTI employees Elizabeth Yang for her assistance in the model development and Heather Ford for her assistance with report editing and formatting.

Several people shared their experiences with pedestrian and bicycle monitoring. We are very grateful for the time these people took. They include: Tara Goddard, City of Davis; Cindy Engelhart, Virginia Department of Transportation; Deb Ridgway, City of Kansas City; Tony Hull, Transit for Livable Communities in Minneapolis/St. Paul, Minnesota; Ann Chanecka, Pima Association of Governments, Tucson, Arizona; Cathy Ann Buckley, Boston Metropolitan Planning Organization; Heath Maddox, San Francisco Municipal Transportation Agency; Tessa Greegor, Cascade Bicycle Club, Seattle, Washington; Melissa McVay, City of Cincinnati, Ohio; Lan Nguyen, City of Los Angeles; and Frank Loewenherz, City of Bellevue, Washington.

Both Nathan Wilkes and Eric Dusza from the City of Austin provided their insight and knowledge of the most appropriate sites for data collection. In addition to site identification, Mr. Wilkes led the City's efforts to install the permanent bicycle and pedestrian counters bringing in Project Manager Chad Crager and Construction Inspector Mansoor Yazdi from the City. Mr. Crager's time and attention leading up to and on the day of installation is much appreciated. Gratitude also goes to Frank Guerra and his crew from Muniz, Inc. who installed the permanent counters and arranged for approval from Capital Metro, operator of the commuter rail adjacent to one of the sites.

Agencies represented by CAMPO also provided feedback on potential locations for data collection. Staff from the Cities of San Marcos, Bastrop, Pflugerville, and Round Rock as well as the Capital Metropolitan Transportation Agency (CapMetro) and Texas State University suggested locations. We are thankful for the time given by these agency representatives.

In addition, CAMPO staffers, Daniel Yang and Kevin Lancaster, were very helpful answering questions and providing needed information for development of the model.

The City of Austin's Traffic Management Center provided numerous hours of video recordings from morning and evening peak periods in order that our team could document the pedestrian and bicyclist activity through the location. We are thankful for Michael Kajimura, Kenny Moses, Brian Craig, and Ali Mozdbar. Special thanks to Jonathan Lammert for taking the lead and coordinating the video recording effort.

Special appreciation is extended to CAMPO's Senior Planner, Greg Griffin who developed the idea and initiated the contract. As the CAMPO representative for the project, Mr. Griffin provided invaluable guidance during the length of the project in all respects. His calm presence and leadership throughout the 13 months allowed for a very enjoyable work environment.

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Executive Summary

During recent years, community leaders and transportation professionals in the Austin area have increased their interest in pedestrian and bicycle travel. Advocacy groups, task forces, bicycling clubs, and volunteer organizations encourage governmental agencies to do more to improve safety and accommodations for these vulnerable users. The sentiments have been upheld by the Federal Highway Administration with policy statements supporting livability concepts which include bicycle and pedestrian transportation improvements.

The City of Austin has made significant progress increasing the number of bicycle-lane miles in the city. During the last quarter of 2009, they installed more bicycle lanes than in any other year of the program's existence. Because of their efforts to improve bicycling, they won the Silver Award for Bicycle Friendliness from the League of American Bicyclists *(1)*. The City of Austin isn't the only governmental agency focused on improving biking and walking in the CAMPO region. The City of San Marcos along with Texas State University is expanding its network of facilities; the City of Round Rock is in the final stages of development of a bicycle plan; and the Austin District of the Texas Department of Transportation (TxDOT) is working to improve safety and accommodations for bicyclists and pedestrians.

With all of the progress encouraging these forms of non-motorized transportation, there is a need to know whether the programs are actually increasing the number of people who bike and walk. Are the changes resulting in more people choosing bicycling and walking instead of driving? What is the impact of added space, signs, and markings on the demand? The Capital Area Metropolitan Planning Organization (CAMPO) hired the Texas Transportation Institute (TTI) to help them find the answer to these and other questions. The project's scope of work includes the following tasks:

1. Research bicycle and pedestrian monitoring programs in order to recommend an appropriate method to collect data,

2. Collect existing bicycle and pedestrian traffic counts in the five-county Austin-Round Rock Metropolitan Statistical Area while testing data collection equipment,

3. Forecast potential use from bicycle and pedestrian infrastructure,

4. Integrate the sketch planning tool into the CAMPO transportation planning process, and

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This document comprises the final report for the project and includes the results of each of the above tasks. It is organized by task with additional details provided in the appendix. Best practices and lessons learned from agencies that have pedestrian and bicycle monitoring programs are included. Based on these findings, researchers made recommendations for CAMPO. The tool developed by TTI identifies missing links in the pedestrian and bicycle network. Included in this report are pedestrian and bicycle volume data at 15 locations around the region.

After testing four products, the equipment from Eco Counters was selected as the best on the market. A large portion of the contract budget (30%) was spent on the purchase of their data collection equipment. Higher than anticipated, this expense was necessary to ensure that the agency has the ability to gather continuous bicycle and pedestrian volume data at two locations with permanent installations as well as the ability to collect data with portable equipment positioned in mixed traffic or a separate facility for a short or long duration.

The original scope of work included forecasting how improvements in bicycle and pedestrian infrastructure would increase usage. Before and after data following project completion could provide answers to mode shift as a result of the project. However, with just over 13 months to complete the project there was inadequate time to collect sufficient data. Therefore, this task was slightly modified by researchers and CAMPO staff. It is recommended that CAMPO use the newly acquired data collection equipment to evaluate the success of bicycle and pedestrian projects. Over a period of several years following numerous projects of various types (bicycle lanes, sidewalks, shared off street bike/pedestrian path, etc.), CAMPO staff will be able to more confidently forecast changes in use.

The tool provided as part of this project identifies links that need to be improved based on supply and demand for bicycle and pedestrian travel. The models can be integrated into the planning process at CAMPO. Non-motorized trip tables for all trip purposes were obtained from the CAMPO mode choice model. Total trips generated from each Traffic Analysis Zone (TAZ) reflect the demand. To estimate the supply researchers created indicators reflecting the compatibility of the roadway network for non-motorized travel. These include a Bicycle Compatibility Index (BCI) and a Pedestrian Friendly Index (PFI). A table of roadway links that are under-supplied for bicycle travel and a map showing TAZs that are under-supplied for pedestrian travel are provided.

Introduction

Bicycling and walking for transportation has seen significant attention in recent years in the CAMPO region. Transportation decision-makers are incorporating these modes of transportation into their planning documents and making more effort to accommodate pedestrians and bicyclists. Understanding how these decisions result in increased use of the bicycle and pedestrian network is critical for planning purposes. The Capital Area Metropolitan Planning Organization (CAMPO) entered into an Interlocal Agreement with the Texas Transportation Institute (TTI) to develop a model for estimating supply and demand of the bicycle/pedestrian network, test data collection equipment currently on the market, collect bicycle and pedestrian volume data, survey best practices, and recommend procedures for a monitoring program. This final report summarizes the results of these efforts.

Monitoring Programs

In the fall of 2009, TTI staff identified 21 agencies in the United States who collect bicycle and pedestrian data (see Table 8 in Appendix A). Efforts were made to obtain information from most of these agencies. Eleven of the 21 indicated that they have programs in place and answered questions or sent information about their programs. The following section summarizes the results of the survey.

Survey Summary and Findings

TTI received feedback from the following communities:

- Davis, CA
- Virginia DOT
- Kansas City, MO
- Minneapolis/St. Paul, MN
- Tucson, AZ
- Boston, MA
- San Francisco, CA
- Seattle, WA
- Cincinnati, OH
- Los Angeles, CA
- Bellevue, WA.

All of the above communities collect bicycle data and eight of them collect pedestrian data. The majority of them began their programs within the last five years. They vary as to how often they collect data as shown below:

- St. Paul collects annually in September at over 40 locations and collects monthly at 5 locations.

- Cincinnati counts sporadically but will implement more consistent counts this year as part of the National Bicycle and Pedestrian Documentation Project.
- Tucson does annual counts, but going to do 6-month counts at a few sites to see if snowbirds make a big difference.
- Virginia DOT counts every 1-3 years depending on what they need: cordon counts or trend information.
- The Boston Metropolitan Planning Organization does trail counts 2-3 times per year which are statewide. In the metro area, they count on an as needed basis.
- San Francisco has 1 automated counter that counts continuously and they are in the process of procuring and installing 22 more.

Five of those communities contacted do not have any counting equipment while six have either permanent or portable counters. Most noteworthy, St. Paul/Minneapolis has 41 permanent counters and 6 portable. A large majority (9 out of 11) do manual counting and most of these nine use volunteers. The reasons for collecting pedestrian and bicycle data extend the spectrum with most collecting to establish a baseline, measure trends, and evaluate projects. Fewer use the data to understand seasonal variations and to select projects. Beyond volume of bicyclists, five of the agencies contacted collect gender information and five collect helmet use information.

When asked about the biggest challenges facing their programs, the following items were mentioned most frequently.

- Resources – funding cuts mean they use more volunteers
- organizing and training volunteers
- mobilization of interns
- lack of good affordable technology

The biggest successes they have seen include:

- Volunteers are extremely dedicated
- Growing interest in count data
- Recruiting over 100 volunteers to count
- Successfully completed 2 annual statewide bicycle and pedestrian counts in Washington. Up to 160 locations with 250 volunteers across the state.

Finally, researchers asked those contacted if they could share advice for communities beginning monitoring programs. The answers are as follows:

- Look at counts as an ongoing activity and find resources for permanent counters.
- Try to model your program on the corresponding vehicular program.
- Data collected by volunteers may not be seen as credible to decision-makers/public.

- Choose locations carefully and make sure community understands your intentions on how data will be used.
- Take time to decide your objectives.
- Partner with a university civil engineering class to get help counting.
- Train people doing the counting ahead of time.
- 24-hour count data will prove helpful – being able to show a video of people using a pedestrian bridge at 3am proves better than anything else to skeptics that these facilities are needed.
- Make volume counts 15 hours instead of 12 hours. Consider ambient light.

Best Practices

Communities across the nation are realizing the importance of conducting pedestrian and bicycle counts. Transportation decisions are based on data. Without data, projects cannot be justified based on demand. The phrase, "If you aren't counted, then you don't count," is one that applies to bicyclists and pedestrians *(2)*. This section contains a summary of the best practices found in the survey of monitoring programs across the country.

State the goals of the monitoring program to underscore the reasons why the program is being established. The Pima Association of Governments (Tucson, AZ) lists five primary reasons for their bicycle monitoring program: conditions and trend analysis, network planning, crash analysis (exposure measures), travel demand forecasting (calibrating models), and travel demand management (TDM program effectiveness measured with tangible data that can be compared over time) *(3)*.

Though they are outside of the United States, Vancouver transportation leaders have set goals for the bicycle monitoring program which are worth mentioning. Their goal is "To improve our understanding of bicycle facility use, allowing us to plan for necessary improvements to and expansion of the bicycle network" *(4)*. The stated objectives to attain the goal include:

1. To track the growth or decline of bike trips along particular routes
2. To improve understanding of:
   a. Hourly variations in bike trips
   b. Daily variations in bike trips
   c. Seasonal variations in bike trips
3. To improve the efficiency with which data is collected
4. To refine the peak hour factor for bikes.

Establish a system whereby portable counters are rotated to the same locations over the course of a year. Collect data before and after a project is completed so that mode shift can be estimated for those types of improvements. For example, installation of the shared lane marking (sharrow) is expected to result in a certain percentage increase in bicyclists. Before and after data on one or more sharrow projects will give an estimated percentage to expect elsewhere if conditions are similar. Routine monitoring will provide an excellent glimpse into how usage is changing. Ensure that data collection is conducted across the geographical area of CAMPO. Pima County separates data results by location and geographical area: Downtown, Universities, Urban Core, Suburban, Rural *(3)*.

Use automated counters to gather data. Unlike motor vehicle data collection, counting pedestrians and bicyclists is not a simple process. Since these users often travel in a non-linear pattern, experience random stops, and move in groups, data collection has been mainly performed with video or manually using tally sheets. As such, it is primarily conducted for a short period such as the typical morning and evening peak periods. However, without an understanding of volume outside of the traditional peak periods, decision makers will not know how the demand changes throughout the day or even in nighttime conditions. Using automatic data collection devices enables an extended view of demand. Infrared counters are the ones most frequently used *(5)*.

Continue to explore technology and purchase additional equipment as funding becomes available. Another option is to encourage agencies to purchase equipment to collect desired data and share information.

Expand the program so that the monitoring efforts grow to something akin to the data collection programs in existence for motor vehicles. Annual traffic data collection is conducted by TxDOT across the 5-county region on the state system. The City of Austin collects data on an as-needed basis and participates in saturation counts which are conducted on and off the state system every five years. The ideal pedestrian and bicycle monitoring program would collect data on a regular basis to understand trends. Equipment also needs to be available for project-specific needs.

Commit staff to be responsible for data collection. Without having someone assigned to deploy and pick up the equipment, process the data, tabulate and forward the results, the information will not be utilized to the highest degree.

Use the data for project selection. Like projects proposed for motor vehicle mobility and safety, use the bicycle and pedestrian volume data to identify areas where there is most need. Gaps in the pedestrian and bicycle system may be the exception to this method for prioritizing projects because without the facility, people may not be using the route. Before and after data would be critical for this type of connectivity project.

Publish the results so that the area agencies and the public understands baseline count results, trend information, and peak hour data. In addition to the permanent count data, provide data that is collected periodically and routinely.

Recommendations

Establishing a monitoring program needs careful thought and planning. It is recommended that CAMPO consider implementing a program containing best practices mentioned in the previous section. The ability to collect usage information is expected to result in many requests for the data. Adding or modifying a bicycle facility probably necessitates knowledge about demand. For example, the proposed bicycle boulevard on Nueces Street has been under consideration for at least 20 years. Having bicycle and pedestrian volume counts on this roadway over the course of these 20 years could have given decision-makers information about mode splits and trends. Like Nueces Street, there are certainly other projects under consideration which could benefit from more information about the levels of use. "If you build it, they will come" arguments may work initially, but over the long term decision makers need to know if the users actually did come. Additionally, prioritizing proposed projects requires data for comparisons.

Although Travis County appears to have a higher bicycle use than other counties, CAMPO should ensure that the counters are available for a wider geographical distribution and routinely collect volume data around the region, even if it is done every 2-3 years.

For the Austin area, CAMPO staff should seek assistance from the City of Austin's Transportation Department or Bicycle and Pedestrian Program data collection technicians since they understand what is involved in data collection and have the tools, equipment, work zone traffic control signs as well as vehicles to transport and deploy counters.

CAMPO should be the central hub for gathering and dispersing data. The CAMPO website serves as a vehicle to share information.

As mentioned earlier, most communities who gather pedestrian and bicycle volume data use volunteers to conduct manual counts. With the use of volunteers, the credibility of the data is often questioned and the effort involved in recruiting, training, and mobilizing volunteers is extensive. For these reasons, automatic counters are recommended for long-term data collection purposes. Permanent counters will provide a daily and seasonal variation establishing the best days and times for counting. If necessary, the seasonal or daily variation will enable the application of adjustment factors for decision-making purposes when waiting for ideal conditions is not possible.

It is recommended that CAMPO deploy portable counters for 12-24 hours to capture daytime hours (7am-7pm) at a minimum. In warmer months, it would be beneficial to extend the counting period to as early as 6:30am and as late as 10:00pm since the daylight conditions are longer and people bicycle and walk after dark.

A primary benefit of a bicycle and pedestrian monitoring program is that CAMPO can establish key performance measures related to usage and be able to evaluate the success. The report on the International Scan on Pedestrian and Bicyclist Safety and Mobility in Europe indicated that many of the European agencies provide regular performance reports on pedestrian and bicyclist safety and mobility *(6)*. Measuring the progress toward stated goals and outcomes will enable CAMPO to refine policies and strategies to ensure goals are met.

Equipment Testing

Methodology

Description of Study Sites

Selection of the study sites was dependent upon two key features: traffic volumes needed to be high enough to justify use of the trail, and shade coverage needed to be consistent to minimize the likelihood of erroneous readings caused by changing exposure to sunlight.

Wolf Pen Creek's shared use path in College Station was chosen for this study (Figure 1). Researchers conducted a series of baseline tests using predefined pedestrian traffic simulated by the research crew. The Wolf Pen Creek Trail is part of a system of multi-use trails in the city of College Station that link parks, residential areas, and commercial districts. This section of the trail provided an abundance of convenient mounting locations with multiple park benches and light poles, most of which were well shaded. The trail has relatively low volumes. Due to these low volumes and a need for consistent conditions to provide a set of baseline results for the counters, simulated passes through the detector were used as the counts for the pedestrians and bicyclists at this site.

Figure 1. View of Study Site at Wolf Pen Creek.

Test Method

Researchers conducted controlled tests at Wolf Pen Creek. Two key parameters were tested: 1) target speed and 2) group spacing. Each test consisted of 15 passes in front of the counters in each direction of the trail for each test measurement (Figure 2 shows an example of testing group spacing). To test target speed, researchers traveled in front of the counters at five different speeds: "stopping to talk", walking, jogging, running, and traveling by bicycle. Figure 3 shows the counter installation on a light pole. To test group spacing, pairs of researchers walked in front of the counters side-by-side and at spacings of 1-ft increments from 1 to 5 ft. For this project, only Eco-Counter was tested. Test results from previous studies were used to compare the results from Eco-Counter.

Figure 2. Controlled Test for 5 ft Spacing at Wolf Pen Creek Study Site.

Figure 3. Counter Installation at Wolf Pen Creek Study Site.

Calculation of Error Rates

Error rates can be analyzed in many different ways. The most common error rate in which customers of these products are interested is the overall error rate (Equation 1). None of the detectors tested can classify the mode of the person traveling (short of mounting the detectors at different heights to change the height of detection) and the overall error rate can summarize the detectors' accuracy with a single number. With the overall error rate, missed detections and false detections can potentially cancel each other out, leaving an overall error rate of zero. A negative difference indicates an overall undercount of the ground truth count.

Equation 1

$$\text{Overall Error Rate}(\%) = \frac{(\text{test device count} - \text{ground truth count})}{\text{ground truth count}}$$

Missed detection errors (Equation 2) were defined in this study on an individual count basis (i.e., a detector that did not detect one walking pedestrian would have one missed detection).

Equation 2

$$\text{Missed Detection Error Rate}(\%) = \frac{\text{count of missed detections}}{\text{ground truth count}}$$

Similarly, false detections (Equation 3) were any unexpected detections that a trail counter recorded in addition to the expected counts. Occasionally, slow pedestrians or pedestrians who happen to stop immediately in front of the detection zone will trigger a counter multiple times.

Equation 3

$$\text{False Detection Error Rate}(\%) = \frac{\text{count of false detections}}{\text{ground truth count}}$$

The error rate for different users (walking pedestrian, jogging pedestrian, bicyclists, strollers, etc.) was calculated using only single individuals. Since researchers could not determine from the counters' output which of the persons in the group were counted by the detectors, groups were not included.

Findings

Four counters are compared in this section; however, only the Eco-Counter was evaluated as part of this project. The four counters compared are:

- **Jamar Scanner (larger infrared counter),**
- **TrafX Sensor (small infrared counter),**
- **Diamond Trail Counter (break-beam with target), and**
- **Eco-Counter PYRO.**

Two settings of the Eco-Counter were tested for this project: standard mode and crowd mode.

Table 1 summarizes the controlled tests at Wolf Pen Creek. In general, all four trail sensors were able to accurately detect a single pedestrian at typical walking speed or a bicyclist at slow speed (5 to 10 mph). The Jamar sensor had difficulty counting bicyclists at the typical bicycling speed of greater than 10 mph.

Although expected, all four counters had difficulty counting trail users who were closely spaced, but the required separation varied by counter.

The following paragraphs describe the strengths and weaknesses of each of the four trail sensors.

- **Jamar Scanner (larger infrared counter):** This sensor had difficulty with detecting bicyclists traveling faster than 10 mph. It also had average performance with group detection, typically requiring 3 ft or more to detect individual users. The sensor functions and software interface were easy to use and the user's manual was adequate.
- **TrafX Sensor (small infrared counter):** This sensor performed well in group situations but also had difficulty detecting bicyclists faster than 15 mph. The sensor was small and compact, and could be easily hidden from view. The sensor functions and software interface were easy to use and the user's manual was adequate.
- **Diamond Trail Counter (break-beam with target):** This sensor performed well in single trail user and group situations. However, the sensor functions were limited to binned counts (not individual timestamps), the user interface was lacking, and the user's manual was very difficult to follow. Sensor setup also required additional time because of the target alignment and mounting.
- **Eco-Counter PYRO combo logger:** The crowd setting performed better than the standard setting in terms of the overall error rate. However, the standard setting results are consistent in terms of over-counting and under-counting. The counter shows overall better results than all other three counters.

Table 1. Summary of Results for Controlled Test at Wolf Pen Creek Trail.

Test Condition		Ground Truth Count			Overall Error Rate (%)					Missed Detection Error Rate (%)					False Detection Error Rate (%)				
		Jamar & Trafx	Diamond	Eco-Counter	Jamar	TrafX	Diamond	Eco-Std	Eco-Crowd	Jamar	TrafX	Diamond	Eco-Std	Eco-Crowd	Jamar	TrafX	Diamond	Eco-Std	Eco-Crowd
Baseline Walking	Walking	30	30	30	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	0%	7%
Baseline Biking	10 MPH	30		30	-97%	0%	n.a.	0%	0%	97%	0%	n.a.	0%	0%	0%	0%	n.a.	0%	0%
Group Spacing	0 ft	60	60	60	-53%	-50%	-50%	-50%	-45%	53%	50%	50%	50%	45%	0%	0%	0%	0%	0%
	1 ft	60	60	60	-58%	-50%	-40%	-45%	-22%	58%	50%	40%	45%	22%	0%	0%	0%	0%	0%
	2 ft	60	60	60	-47%	-50%	-2%	-27%	-18%	47%	50%	2%	27%	20%	0%	0%	0%	0%	2%
	3 ft	60		60	-15%	-37%	n.a.	0%	6%	15%	37%	n.a.	0%	2%	0%	0%	n.a.	0%	8%
	4 ft	60		60	-2%	-38%	n.a.	2%	3%	2%	38%	n.a.	0%	0%	0%	0%	n.a.	2%	3%
	5 ft	60		60	0%	-22%	n.a.	2%	7%	0%	22%	n.a.	0%	0%	0%	0%	n.a.	2%	7%
Pedestrian Speed	Stopped to talk	30	30	30	43%	-10%	7%	-10%	0%	0%	43%	0%	10%	0%	43%	33%	7%	0%	0%
	Jogged	30	30	30	-7%	-7%	-3%	3%	0%	7%	7%	3%	0%	0%	0%	0%	0%	3%	0%
	Running	30	30	30	-67%	-20%	-40%	0%	7%	67%	20%	40%	0%	0%	0%	0%	0%	0%	7%
Bicyclist Speed	5 mph	30		30	-3%	0%	n.a.	0%	0%	3%	0%	n.a.	0%	0%	0%	0%	n.a.	0%	0%
	15 mph	30		30	-100%	-87%	n.a.	0%	13%	100%	87%	n.a.	0%	0%	0%	0%	n.a.	0%	13%
	20 mph	30		15	-100%	-60%	n.a.	0%	0%	100%	60%	n.a.	0%	0%	0%	0%	n.a.	0%	0%
	25 mph	8		3	-100%	-100%	n.a.	0%	n.a.	100%	100%	n.a.	0%	n.a.	0%	0%	n.a.	0%	n.a.
Detection Range	30 ft	30	30		-13%	-100%	0%	n.a.	n.a.	13%	100%	0%	n.a.	n.a.	0%	0%	0%	n.a.	n.a.
	40 ft	30	30		-27%	-100%	0%	n.a.	n.a.	27%	100%	0%	n.a.	n.a.	0%	0%	0%	n.a.	n.a.
	50 ft	31	30		-52%	-100%	3%	n.a.	n.a.	52%	100%	0%	n.a.	n.a.	0%	0%	3%	n.a.	n.a.
Mounting Height	3.0 ft	30			0%	-13%	n.a.	n.a.	n.a.	0%	13%	n.a.	n.a.	n.a.	0%	0%	n.a.	n.a.	n.a.
	4.0 ft	28			0%	-32%	n.a.	n.a.	n.a.	0%	32%	n.a.	n.a.	n.a.	0%	0%	n.a.	n.a.	n.a.
	4.5 ft	30			0%	-43%	n.a.	n.a.	n.a.	0%	43%	n.a.	n.a.	n.a.	0%	0%	n.a.	n.a.	n.a.
	5.0 ft	30			0%	-63%	n.a.	n.a.	n.a.	0%	63%	n.a.	n.a.	n.a.	0%	0%	n.a.	n.a.	n.a.

*Jamar, TrafX, and Diamond: Tested July 6, 2006

**Eco-Counter: Tested April, 2010, Eco-Std=(Std, 0), Eco-Crowd=(+2,0), mounted at 80 cm (32 in) height about 2 ft from trail edge

Data Collection

The National Bicycle and Pedestrian Documentation Project (NBPD) guidance was used for collecting critical information *(7, 8)*. Project guidance recommended that, at a minimum, peak period data be collected. With the help of the City of Austin traffic surveillance cameras, TTI was able to stretch funding to gather more than peak period count information at several key locations. Seven of the 15 data collection locations were counted using the City's cameras and eight of the locations were counted using video data gathered by TTI data collection technicians. In both cases, data reduction was necessary to tally the number of bicyclists and pedestrians. In some cases, the data includes turning movements at intersections, and in others the data represents screenline information. No information on gender, helmet use or trip purpose is included. The original plan included the purchase of data collection equipment which would be installed and utilized to gather data at three locations. However, the equipment purchase process was more time-consuming than planned so TTI's data collection team gathered the necessary data using the traditional video-recording and reducing methodology. All data was gathered on Tuesday, Wednesday or Thursday. The NBPD project guidelines indicate that there is no significant difference in these three days of the week. Since the project is focused on transportation as opposed to recreational travel, the weekday peak hours were deemed highest importance. The City of Austin surveillance system cameras were limited to peak periods due to a problem with the recording process. Plans of collecting video from 7am to 6pm through their system were discarded when this problem was discovered and unable to be remedied in a timely manner.

Eight locations have peak period count data only and seven locations have data extended beyond the peak periods. The entire day from 7:00am to 6:00pm or later was gathered at five locations in the CAMPO region. Table 2 lists the locations, time window, and the highest hourly pedestrian and bicycle volume recorded.

Table 2. Data Collection Overview.

Location	**Observation Time**	**Pedestrian Volume** (highest hourly volume, hour(s) of day when highest volume occurred)	**Bicyclist Volume** (highest hourly volume, hour(s) of day when highest volume occurred)
W.3rd Street Ped/Bike Bridge over Shoal Creek	7am-8pm	73, 6:30-7:30pm	108, 6-7pm
E. 4th Street/IH-35	7am-8pm	43, 11:15am-12:15pm	34, 7-8pm
E. 51st Street/IH-35	7-9am, 5-7pm	13, 8-9am and 5-6pm	34, 5-6pm
Ann Richards Bridge (Congress Avenue)	7:15-9:15am, 5-7pm	174, 6-7pm	49, 5:45-6:45pm
Barton Springs Rd/Zilker Park	7-9am, 4-6pm	24, 7:15-8:15am	38, 4:15-5:15pm
Dean Keeton east of Red River	7-9am, 5-7pm	20, 5-6pm	33, 5-6pm
Jollyville Road north of Braker Lane	7-9am, 5-7pm	44, 6-7pm	25, 5:45-6:45pm
Lamar Blvd/W. 6th St	7:15-9:15am, 5-7pm	285, 5:45-6:45pm	61, 5:15-6:15pm and 5:30-6:30pm
LBJ Blvd/Sessoms (San Marcos)	7-10:45am, 3:30-6pm	399, 9-10am	25, 9-10am
Pleasant Valley Rd north of E. 7th Street	7-9am, 5-7pm	47, 5-6pm	18, 5-6pm
SH150 Ped/Bike Bridge over Colorado River (Bastrop)	7am-8pm	12, 2-3pm	4, 11-12pm and 12:15-1:15pm and 12:30-1:30pm and 5:30-6:30pm
Shoal Creek Blvd at Stoneway (near Far West Bridge over MoPac)	7-9am, 4-6pm	40, 7:15-8:15am	98, 5-6pm
Slaughter Rd west of Congress Avenue	7:15-9:15am, 5-7pm	2, 8-9am and 8:15-9:15am	2, 7:30-8:30 and 7:45-8:45am and 8-9am and 8:15-9:15am
Speedway/38th St	7am-6pm	55, 3-4pm	102, 5-6pm
University Drive at the Pedestrian Signal (San Marcos)	7am-6pm	328, 1:30-2:30pm	18, 4:15-5:15pm

The following points summarize the results of the data collection effort:

- The three highest hourly pedestrian volume locations is found in the downtown Austin and near university campuses
  - San Marcos near the Texas State University (TSU) where 399 pedestrians entered the intersection between 9-10am
  - San Marcos near TSU where 328 pedestrians crossed the pedestrian signal at University Drive between 1:30 and 2:30pm
  - Austin at N. Lamar Blvd and W. 6th Street where 285 pedestrians entered the intersection between 5:45 and 6:45pm

- The three highest hourly bicyclist volume locations are along well-marked routes in Central Austin:
  - W. 3rd Street pedestrian/bicycle bridge over Shoal Creek with 108 bicyclists from 6-7pm
  - Shoal Creek Boulevard north of RM2222 with 98 bicyclists from 5-6pm
  - Speedway at 38th Street with 102 bicyclists from 5-6pm

- Slaughter Lane near Congress Avenue had the lowest volume of all sites included in the data collection.
- Eastbound and westbound on 38th Street at Speedway had low pedestrian/bicycle volume compared to the northbound/southbound directions (203 E/W during 11 hours compared to 629 N/S during the same period). Also noteworthy, the pedestrian volume is significantly higher than bicyclist volume on 38th Street. The reverse is true for Speedway.
- The highest volume movements at the 3rd Street Bridge over Shoal Creek are northbound to eastbound and westbound to southbound.
- In many cases, the volume of pedestrians and bicyclists increases in the evening hours which indicates that data collection should extend beyond the evening peak period. For example, as data collection technicians were turning off video equipment and loading up at 8:00pm on August 4th near the West 3rd Street bridge and Shoal Creek they noted that many people were still walking and bicycling. This observation is especially true in the summer months as people wait until dusk or later for cooler temperatures.
- Peak volume demand for bicyclists and pedestrians does not necessarily line up with the traditional motor vehicle peak periods. At locations where data was collected across the day it was observed that 9-11am and lunchtime volumes were higher than those observed from 7-9am.

Modeling Regional Non-Motorized Travel in CAMPO

Methodology

Modeling non-motorized travel in the CAMPO area involves three modeling components: 1) demand, 2) supply, and 3) interaction between demand and supply. This report addresses each of the three aspects of the modeling work.

Non-Motorized Travel Demand

The demand of non-motorized travel can be estimated from a mode choice model. "Mode choice models are mathematical expressions used to estimate the share of travel on each available mode given the time and cost characteristics of each mode and the demographic and socio-economic characteristics of trip makers" *(9)*. The generalized form of the mode choice model can be illustrated in following equation:

Equation 4

$$\mathbf{P_i} = \frac{e^{Ui}}{\sum_k e^{Ui}}$$

where:

- P_i is the probability of a traveler choosing mode i;
- U_i is a linear function of the attributes of mode i that describe its attractiveness;
- $\sum_k e^{Ui}$ is the summation of the linear functions of the attributes of all the alternatives (k) for which a choice is feasible.

The mode choice model was developed and calibrated for the CAMPO area travel demand model. The nesting structure of the CAMPO area mode choice model is shown in Figure 4 *(9)*. As can be seen, the decision of motorized and non-motorized travel is the highest and foremost in choice of mode.

The Austin Household Survey and the Transit On-Board survey data were used to estimate the Austin mode choice models. There are seven different trip purposes used for mode choice model estimation and application:

- home-base work,
- home-based university,
- home-based school,
- home-based shop,
- home-based other,
- non-home-based work, and
- non-home-based other.

The resulting non-motorized trip tables for all trip purposes were obtained directly from the CAMPO mode choice model. The summation of these trip tables by each Traffic Analysis Zone (TAZ) constitutes the demand of the non-motorized travel. A geographic information system (GIS) application was used to join the sum of the non-motorized trips to a TAZ GIS map. The demand of non-motorized travel by TAZ for the CAMPO area is shown in Figure 5.

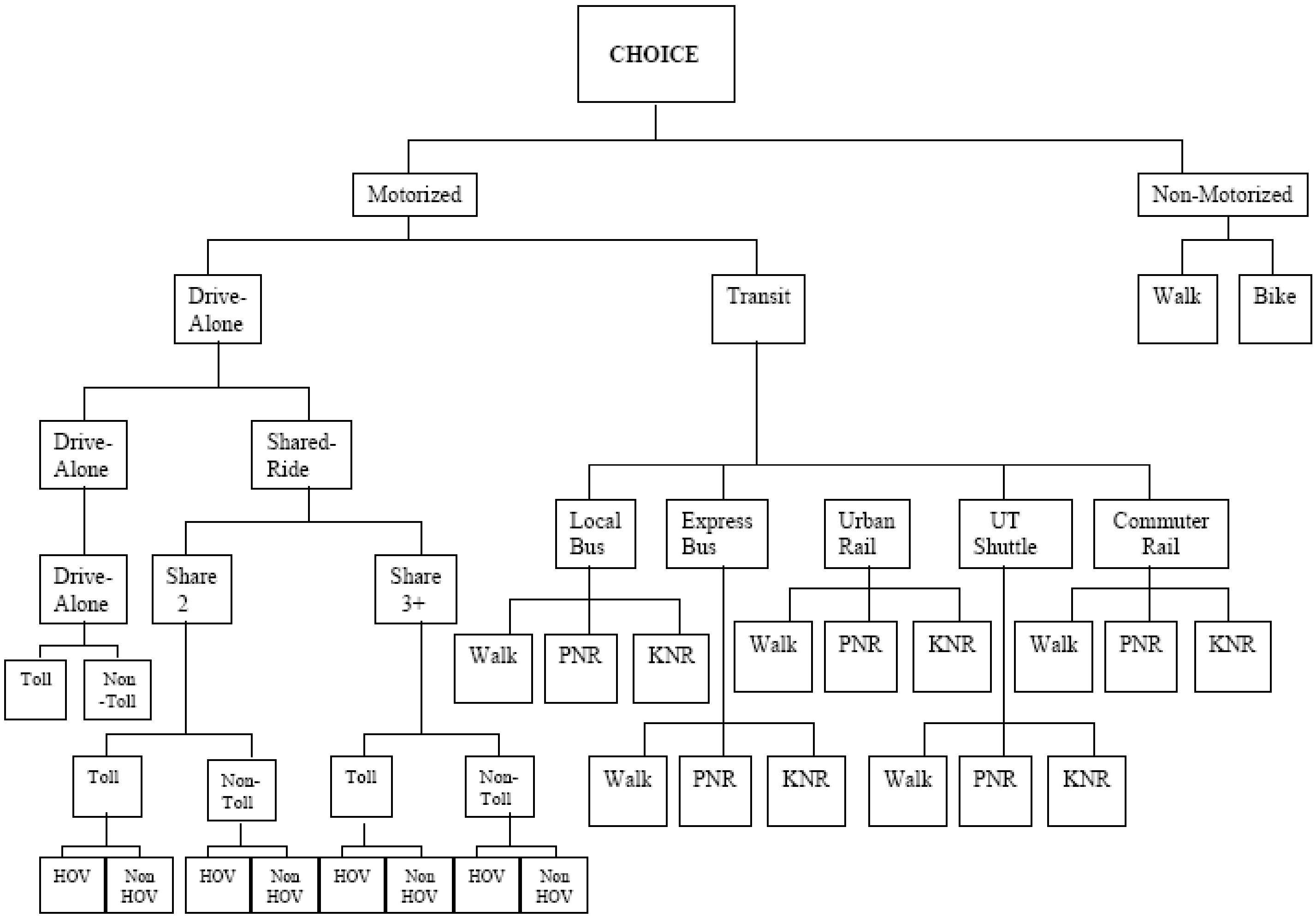

Figure 4. Mode Choice Model Structure.

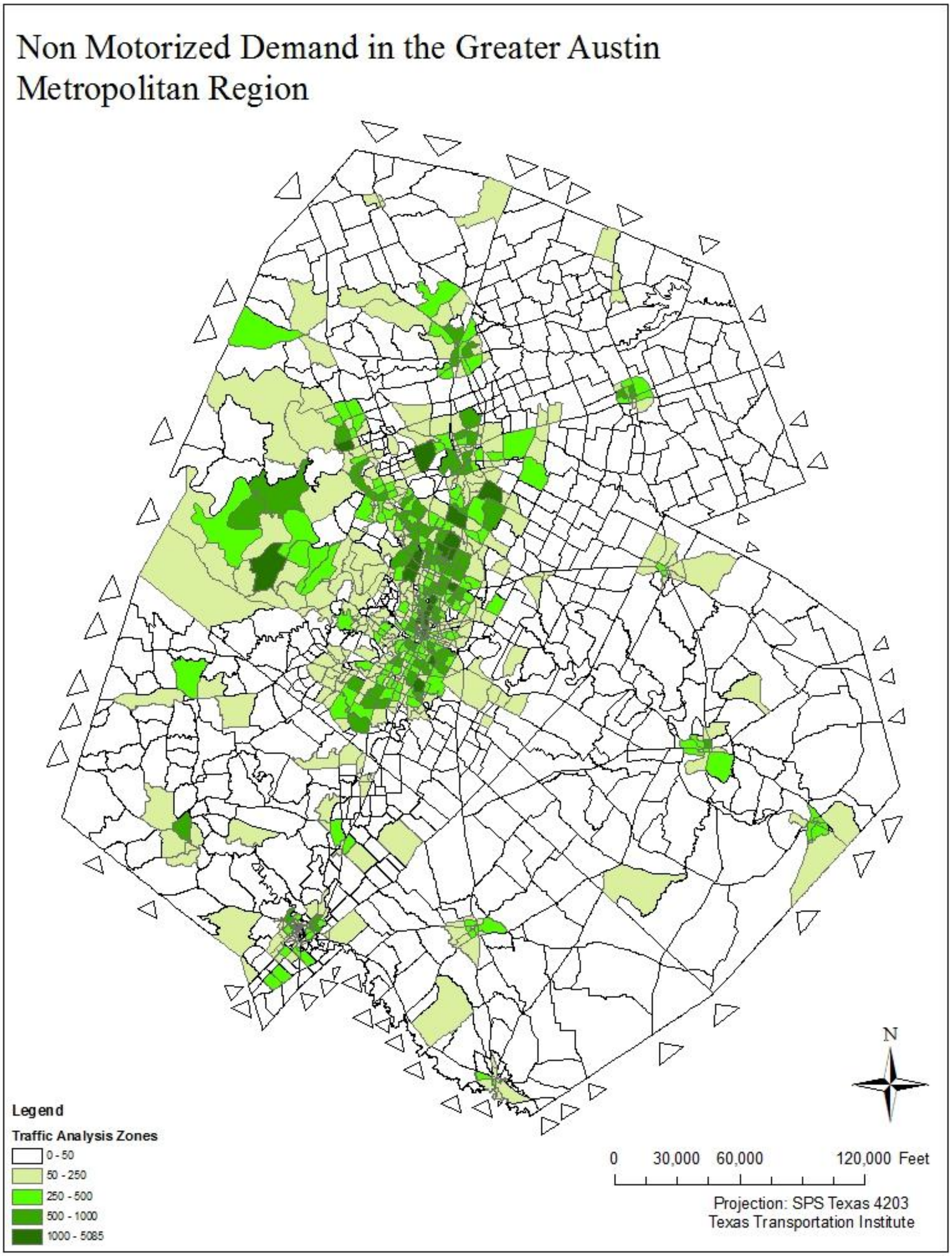

Figure 5. Demand for Non-Motorized Travel in CAMPO Area.

Non-Motorized Travel Supply

The supply of non-motorized travel has been modeled by creating indicators that reflect the compatibility of the roadway network for non-motorized travel. It is separated into bicycle travel supply and pedestrian travel supply.

Bicycle Travel Supply

The Federal Highway Administration's (FHWA) Bicycle Compatibility Index (BCI) was used to model the road network supply for bicycle travel *(10)*. The BCI was developed to indicate the compatibility of the roadway to bicycle travel. It incorporates variables that bicyclists typically use to assess the "bicycle friendliness" of a roadway, such as curb lane width, traffic volume, and vehicle speeds. The BCI model can be used for operational evaluation, design and planning applications. The formula and variables of the model are listed in Table 3. The lower the BCI, the more friendly the roadway is for bicyclists.

Although some roadways are perceived as unsafe or unfriendly to bicycle travel, bicyclists are considered vehicles and as such are allowed by law to travel all functional classes of roadways except where specifically prohibited. For this reason, the BCI was calculated for the entire roadway network in the CAMPO area. Three road network layers were integrated for the CAMPO area to form the entire bicycle supply network, namely bike lanes, sidewalks, and road network. A GIS application was used to integrate the three road networks. The bike lanes and vehicle travel road network were joined based on the TAZ. Since sidewalk facilities do not have the TAZ information, they were joined spatially using longitudes and latitudes.

The BCI calculation for the entire road network is introduced below.

- **Bike Lane or Shoulder (no unit):**
  The bike lane was coded 1 if the street had a bike lane and 0 if it didn't. The BCI values for streets with bike lanes were given from CAMPO, all the other streets that did not have a bike lane or shoulder were coded as 0 for the BCI.
- **Bike Lane/Shoulder width (Feet):**
  The bike lane/shoulder width was coded as 4 feet wide if the street had a bike lane.
- **Curb Lane width (Feet):**
  Curb lane width was coded as 12 feet wide for functional classes 1-3, and 11-12, and 11 feet for all other functional classes.
- **Curb Lane Volume (vehicle per hour):**
  The curb lane volume was calculated by 1)dividing the total daily traffic volume from 2010 (bi-direction) by 2 and by the number of lanes to obtain the daily volume per lane per direction, and 2)by dividing the daily volume per lane per direction by 12 to obtain the peak hour volume per lane per direction.
- **Non-Curb Lane Volume (vehicle per hour):**
  The non-curb lanes volume was obtained by subtracting the curb lane volume from the total hourly volume per direction.

Table 3. Bicycle Compatibility Index (BCI) model, (in English units).

$$\mathbf{BCI} = 3.67 - 0.966\mathbf{BL} - 0.125\mathbf{BLW} - 0.152\mathbf{CLW} + 0.002\mathbf{CLV} + 0.0004\mathbf{OLV} + 0.035\mathbf{SPD} + 0.506\mathbf{PKG} - 0.264\mathbf{AREA} + \mathbf{AF}$$

where:

BL = presence of a bicycle lane or paved shoulder > 3.0 ft *no = 0* *yes = 1* **BLW** = bicycle lane (or paved shoulder) width *ft (to the nearest tenth)* **CLW** = curb lane width *ft (to the nearest tenth)* **CLV** = curb lane volume *vph in one direction* **OLV** = other lane(s) volume -same direction *vph* **SPD** = 85th percentile speed of traffic *mi/h*	**PKG** = presence of a parking lane with more than 30 percent occupancy *no = 0* *yes = 1* **AREA** = type of roadside development *residential = 1* *other type = 0* **AF** = $f_t + f_p + f_{rt}$ where: f_t = adjustment factor for truck volumes (*see below*) f_p = adjustment factor for parking turnover (*see below*) f_{rt} = adjustment factor for right-turn volumes (*see below*)

Adjustment Factors

Hourly Curb Lane Large Truck Volume[1]	(f_t)	**Parking Time Limit (min)**	f_p
> 120	0.5	< 15	0.6
60 - 119	0.4	16 - 30	0.5
30-59	0.3	31 - 60	0.4
20-29	0.2	61 - 120	0.3
10-19	0.1	121 - 240	0.2
< 10	0.0	241- 480	0.1

Hourly Right-Turn Volume[2]	f_{rt}
> 270	0.1
< 270	0.0

1 Large trucks are defined as all vehicles with six or more tires.
2 Includes total number of right turns into driveways or minor intersections along a roadway segment.

- **85th Percentile Speed of Traffic (km per hour):**
  The 85th percentile speed of traffic is commonly used to set the speed limit. Therefore, the speed limit by functional class was decided and uniformly assigned to all roads in the same functional class. Table 4 lists the speed limit values used for this project.

Table 4. The 85th percentile speed used for BCI Calculation.

Functional Class	Type of Road	Speed Limit (mph)
1	Interstate	65
2	Freeways	65
3	Expressway	60
4	Major Arterial Divided (MAD)	50
5	Major Arterial Undivided (MAU)	50
6	Minor Arterial Divided	45
7	Minor Arterial Undivided (MNR)	45
8	Collector	40
9	Local	35
10	Direct Connector (none exist)	
11	Ramp	55
12	Frontage	50
13	HOV Mainlanes	65
14	HOV Ramps	65

- **Parking (no unit):**
  The parking variable is the presence of a parking lane with more than 30 percent occupancy. For this project, the parking value was uniformly set to 0 because the road facilities in the travel demand model network do not typically include functional classes lower than collector. Parking facilities typically do not exist on the roads with the functional class of collector or higher.

- **Area (no unit):**
  The area variable was calculated by assigning the value 1 to links that are considered urban and suburban residential area type and the value 0 to links that are not considered residential areas. Table 5 lists the values used for this project.

Table 5. Area values for BCI Calculation.

Area Type	Description	Area Value
1	Central Business District (Austin CBD)	0
2	Urban Intense	0
3	Urban Residential	1
4	Suburban Residential	1
5	Rural	0

- **Adjustment Factors (no unit):**
  The adjustment factors were assigned based on the functional class of the roadway, with high traffic lanes given the score 1.1, and other values assigned a score of 0.9. The reason for this is that highways have higher truck volumes as well as no parking, but also no right turn facilities. For other major arterial roads, the parking time and large truck volume are not as high, but there are more right turns. Table 6 lists the values used for this project.

Table 6. Adjustment Factors for BCI Calculation.

Functional Class	Type of Road	Adjustment Factor
1	Interstate	1.1
2	Freeways	1.1
3	Expressway	1.1
4	Major Arterial Divided (MAD)	0.9
5	Major Arterial Undivided (MAU)	0.9
6	Minor Arterial Divided	0.9
7	Minor Arterial Undivided (MNR)	0.9
8	Collector	0.9
9	Local	0.9
10	Direct Connector	
11	Ramp	1.1
12	Frontage	1.1
13	HOV Mainlanes	1.1
14	HOV Ramps	1.1

After the BCI was calculated for the entire integrated network, the road facilities were further classified by the level of service using the range established by FHWA *(10)*. The higher the BCI value, the lower the LOS is and the less friendly the roadway is. Figure 6 shows the BCI and the associated LOS for the integrated roadway network.

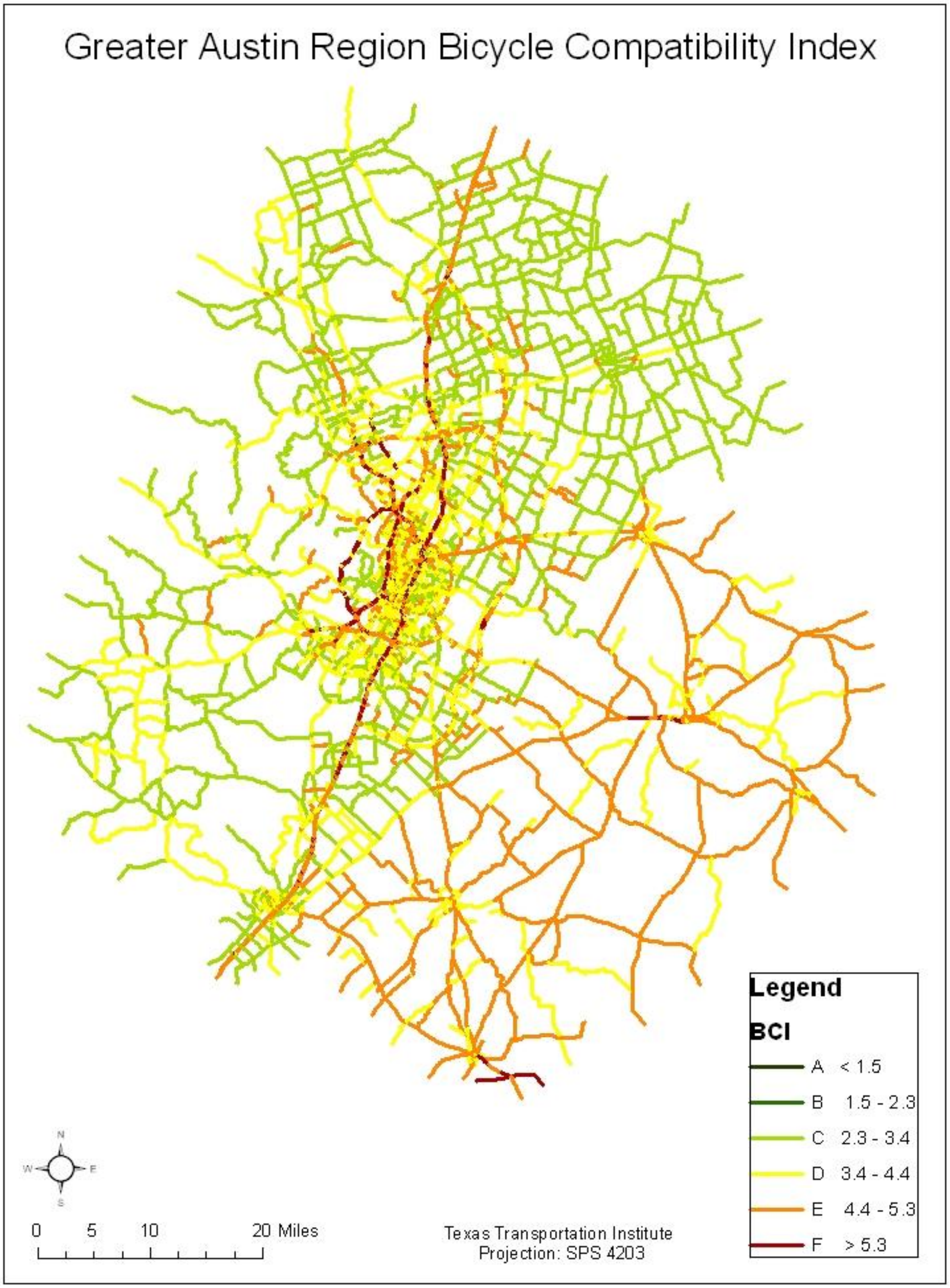

Figure 6. Bicycle Compatibility Index for the CAMPO Area.

Pedestrian Travel Supply

The pedestrian travel supply for the CAMPO region was modeled by creating the pedestrian friendliness index (PFI) for all TAZs in the area. The PFI for the CAMPO region was developed by Greg Griffin of CAMPO. The method uses variables such as population density, retail density, and intersection density to model the friendliness of a TAZ. The details of the variables and steps used to calculate PFI are quoted below. The PFI by TAZ for the CAMPO region is shown in Figure 7.

Population density is a straightforward estimate of population in the year 2010 per square mile (POPpMI), and was calculated by dividing the 2010 population estimate per TAZ by the number of acres in the TAZ, then multiplying by 640 acres in a square mile. The average population density in the region for 2010 is 1,871 people per square mile.

Retail density was used as a TAZ-level proxy for distance to a store, calculated as retail businesses per square mile (RETpMI). The CAMPO model used Texas Workforce Commission proprietary data, further refined by staff to estimate employment in the region categorized by sector. The average retail density in the region is 447.7 retail businesses per square mile.

Intersection density was computed as the number of roadway intersections per square mile (INTpMI). This variable has a strong relationship to walking mode choice, and is also relatively challenging to calculate at the regional scale. The average intersection density for the region was 43.2 intersections per square mile. For comparison, this figure is less dense than Los Angeles, CA (150 intersections/square mile), but more than Irvine, CA (15 intersections/square mile) *(11)*.

Following are the steps undertaken for computing the PFI:

1. Prepare pedestrian network

A complete street network of the five-county region was obtained from the Capital Area Council of Governments that was updated December, 2009. Since this study concerns the pedestrian network, segments not generally accessible by foot were removed including interstate main lanes and freeway ramps.

2. Identify street intersections

In order to automate the calculation of street intersection density, the "Find Nodes" ArcGIS script by Jason Parent of the University of Connecticut was run on the prepared pedestrian network. It outputs an ESRI point feature class containing the intersections of the network. The output point file was refined by removing nodes that are not pedestrian-accessible street intersections, such as freeway main lanes not coded in the CAPCOG dataset and airport access roads.

3. Calculate intersection density

The number of intersections were summed by the TAZ using the "Count Points in Polygons" tool within Hawth's Tools, another extension for ArcGIS written by Hawthorne L. Beyer. Intersection density was then computed by dividing the number of intersections in a TAZ by the number of acres in the TAZ, and multiplying by 640 acres in a square mile.

4. Estimating the Pedestrian Friendliness Index

In order to normalize the three variables to an index value, the maximum value in each of the TAZ records in the 5-county dataset was divided by 100. The average of these values was then computed for each TAZ as the Pedestrian Friendliness Index (PFI). Following Ewing and Cervero's meta-analysis in “Travel and the Built Environment,” the estimation method is relatively simple to calculate, yet may be a powerful estimation of pedestrian mode choice *(12)*.

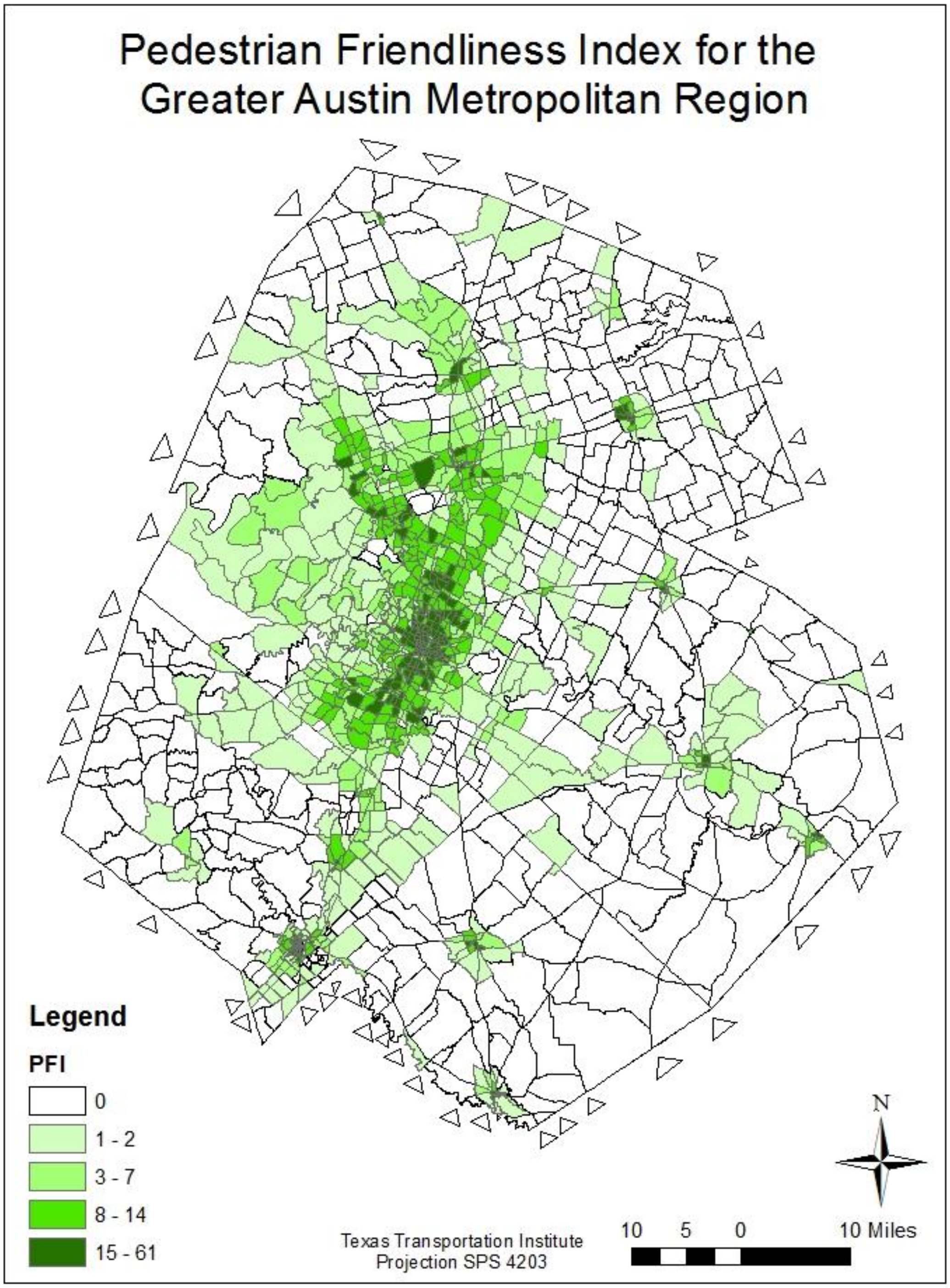

Figure 7. Pedestrian Friendliness Index (PFI) for the CAMPO Region.

Interaction between Demand and Supply

Sketch planning procedures were developed to model the interaction between the demand and supply for bicycle and pedestrian travel respectively.

Bicycle Travel Demand and Supply

The total non-motorized travel demand by TAZ which is the output of the mode choice model was used as the demand for the bicycle travel. Currently, no study has been conducted in CAMPO region regarding the split of pedestrian and bicycle travel. Therefore, using the total non-motorized travel demand as the bicycle travel demand for this project assumes that all non-motorized trips are bicycle trips. Although the assumption may not be accurate for estimating bicycle traffic (in fact, may overestimate bicycle traffic in most cases), it was made to identify the most effective locations for allocating resources to serve bicycle travel which is the primary objective for this project.

The BCI was used as the indicator of bicycle travel supply for the road facilities.

A GIS procedure was used to illustrate the interaction of bicycle travel demand and supply in the region and also identify the links that are undersupplied for bicycle travel. The steps are described below:

- Use colors to represent the Level of Service (supply) for the road links (as in Figure 8);
- Use thickness to represent the non-motorized demand of the road links; and
- Filter links that are LOS E and F as well as thicker than the threshold level of 1000 trips/day.

The assumptions made for these procedures are as follows:

- The non-motorized demand is evenly distributed within the TAZ. Therefore, the thickness of the road links are the same within the same TAZ;
- The road links that are LOS D, E and F are considered undersupplied for bicycle travel as suggested in reference *(10).* Due to size limitation of this report, only the links experiencing LOS E and F are shown in the Figure 8 and listed in Table 7 (there are 1,024 links in LOS D).

Figures 8, 9 and 10 illustrate the demand and supply in the CAMPO region, Travis County, and downtown Austin area respectively. Table 7 lists the road sections that are extremely undersupplied (LOS E or F) with over 1,000 non-motorized trips per day of demand. Figure 11 illustrates these road links on a map.

As mentioned in the beginning of this section, using the total non-motorized trips for the biking trips represents the best scenario for bicycle travel demand. With additional data and further study, the walking and biking trips by TAZ could be further split. Some of the road sections may not be as undersupplied for bicycle travel and may drop out of the list in Table 7. However, the list includes all possible undersupplied road sections that are effective locations for allocating resources to improve bicycle travel in the CAMPO area.

Table 7. Extremely Undersupplied Road Sections in Travis County.

LENGTH	TAZ	Functional Class	Area Type	Street Name	Start-End	LOS
2.86	231, 273, 256	5	2	Mesa Dr	Jollyville Rd - Rm 2222	E
1.28	346, 331	4	2	Speedway	45th St W - 26th St E	E
1.27	346, 319, 331	4	2	Duval St	45th St E - San Jacinto Blvd	E
2.55	457	7	2	Woodland Ave	Parker Ln - Burton Dr	E
1.01	493	7	3	Teri Rd	IH 35 S - Pleasant Valley Rd	E
0.89	457	7	2	Parker Ln	Riverside Dr - Burleson	E
0.88	219	7	2	Rutland Dr	Metric Blvd - Mountain Q	E
0.81	273	4	3	Balcones Dr	North Hills Dr - RM 2222	E
0.55	19	4	4	Lohman's Crossing	New Lohman's Crossing-RM 620	E
0.49	379, 381	6	1	Brazos St	4th St - 11th St E	E
0.49	380, 378	7	1	Colorado St	4th St - 11th St E	E
0.44	377, 380	5	1	Lavaca St	15th St W - 4th St W	F
0.39	231, 40	7	2	Jollyville Rd	Mesa Dr - US 183	E
0.38	380, 381	5	1	6th St	Guadalupe St - San Jacinto	E,F
0.33	319	4	2	Lamar Blvd	RM 2222 - 53rd St W	E
0.31	361	7	2	30th St W	Guadalupe St - Speedway	E
0.31	256	8	2	Hart Ln	Greystone Dr - Far West Blvd	E
0.22	379	6	1	9th St E/10th St E	Congress Ave - San Jacinto Blvd	E
0.22	378	6	1	9th St W/10th St W	Guadalupe St - Congress Ave	E
0.15	361	9	2	Wichita St	27th St - 26th St W	E
0.12	346	7	2	30th St E	Speedway - Speedway	E
0.07	377	4	1	15th St E	San Jacinto Ave - Trinity	E
0.05	319	9	2	46th St	Guadalulpe St - Guadalupe	E

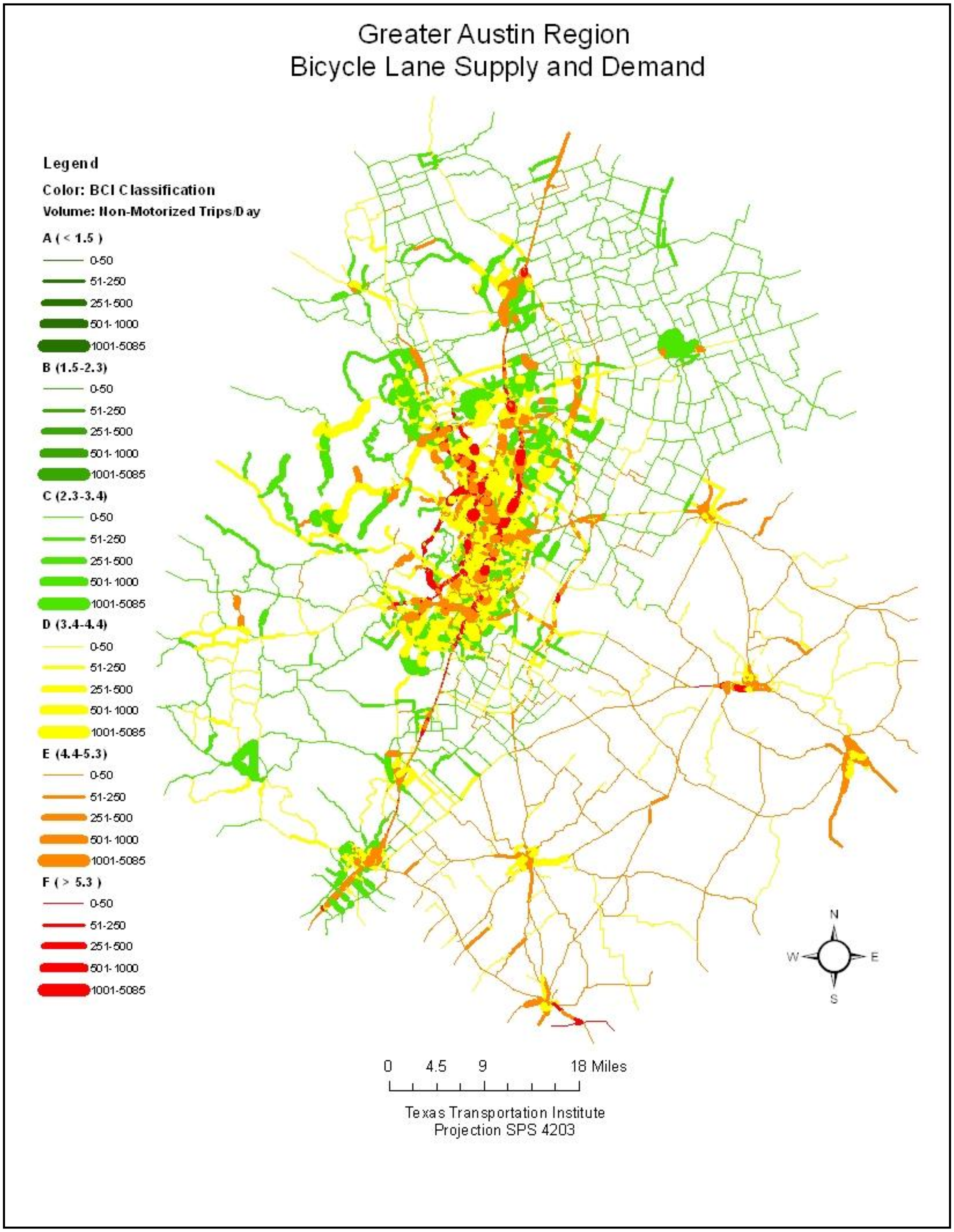

Figure 8. Supply and Demand for Bicycle Travel in CAMPO Region.

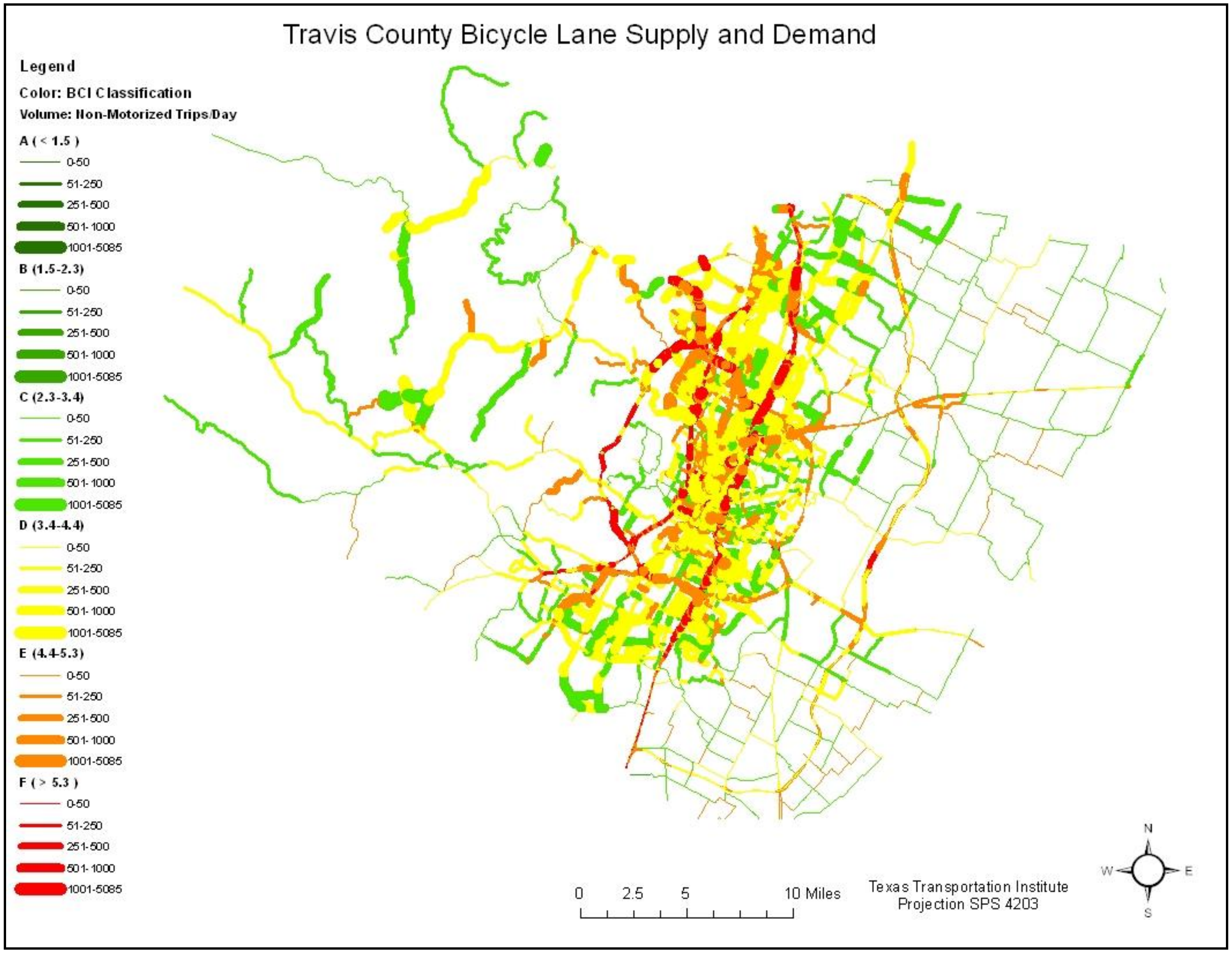

Figure 9. Supply and Demand for Bicycle Travel in Travis County

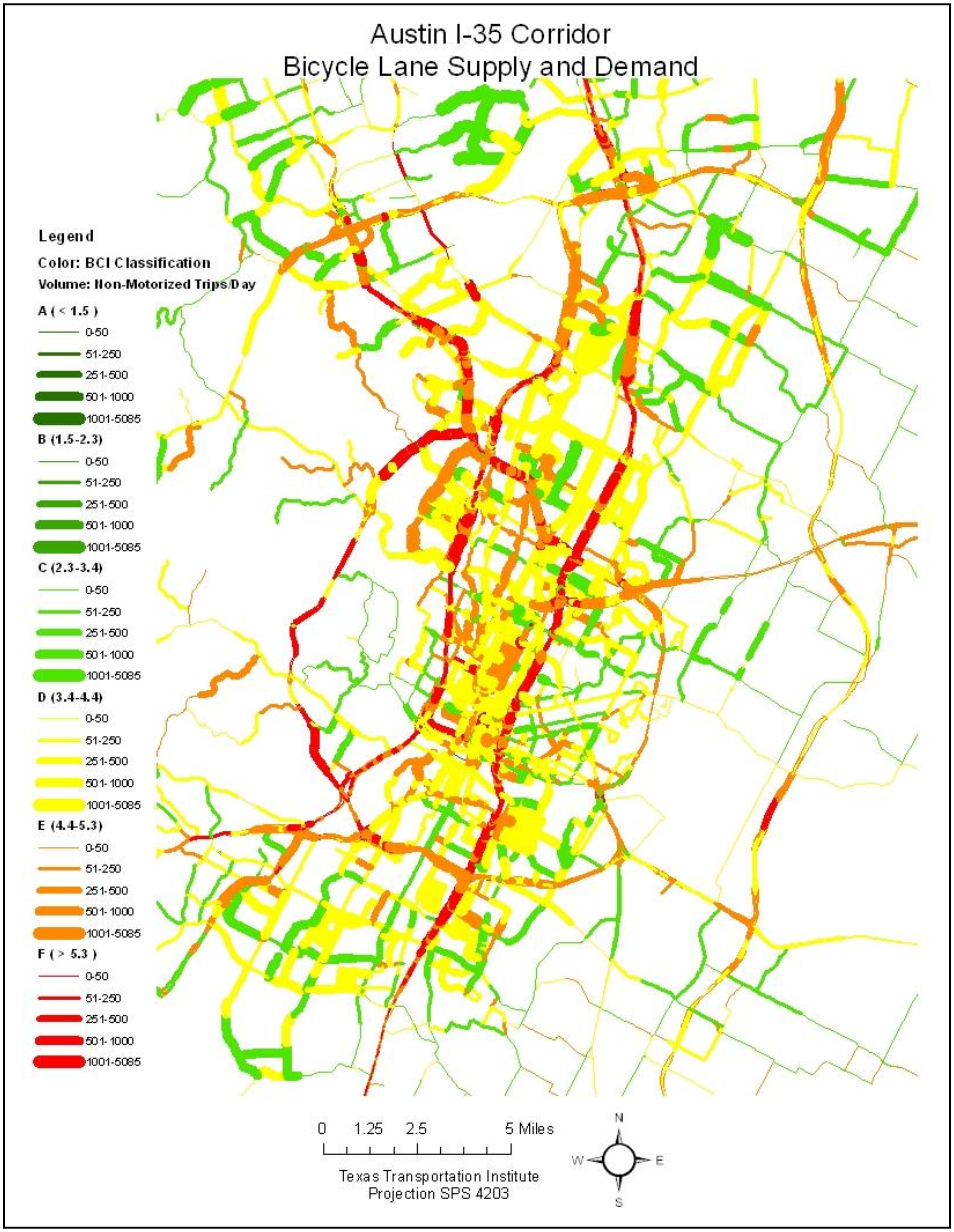

Figure 10. Supply and Demand for Bicycle Travel in Downtown Austin and UT Austin Area.

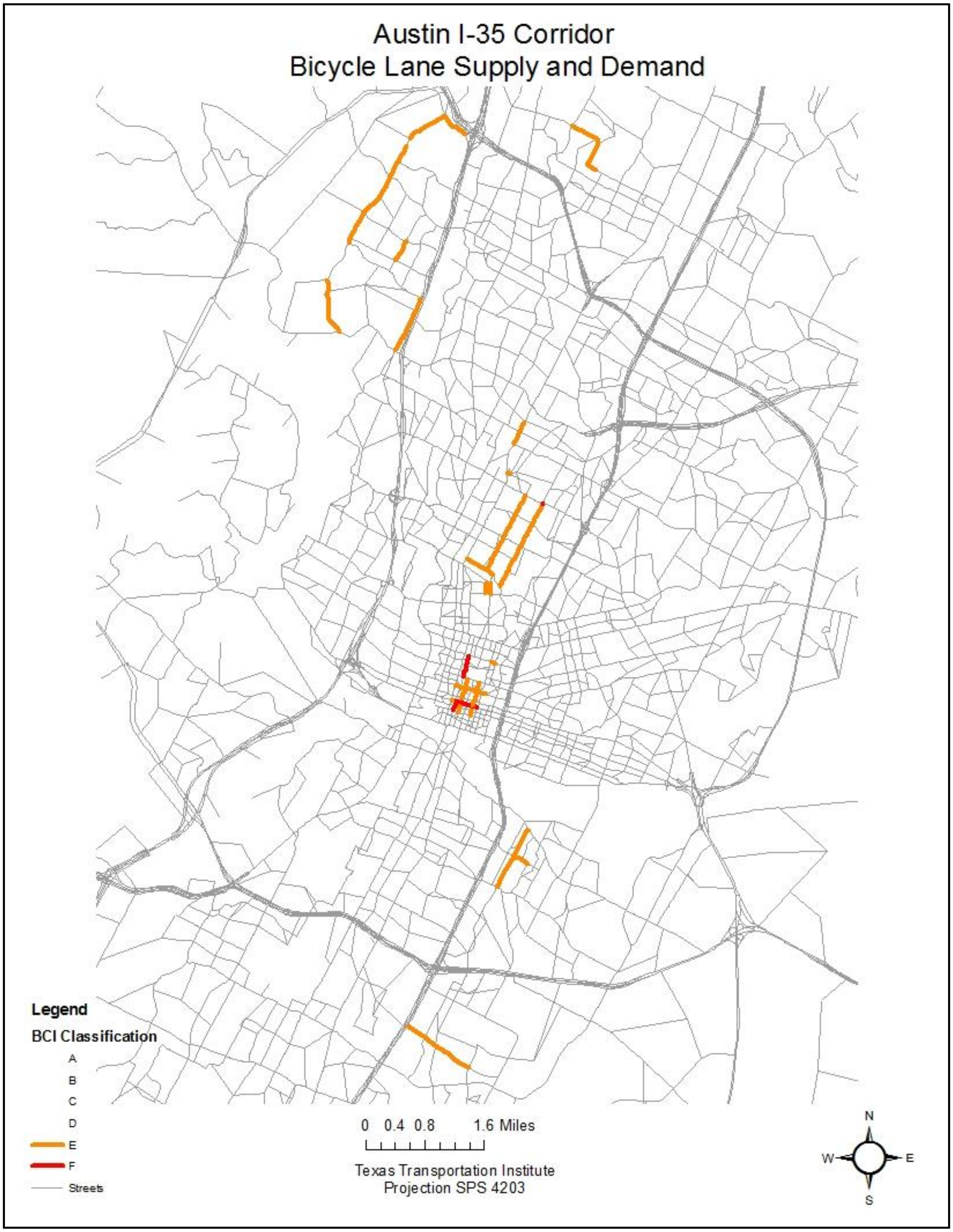

Figure 11. Extremely Undersupplied Road Sections (LOS E or F with 1000 trips per day).

Pedestrian Travel Demand and Supply

Similar to bicycle travel, the total non-motorized travel demand by TAZ was used as the demand for the pedestrian travel which represents the best scenario for pedestrian travel. The assumption was again made to identify the most effective locations for allocating resources to serve pedestrian travel.

The PFI was used as the indicator of pedestrian travel supply for the road facilities.

A mathematic relation was used to model the interaction of demand and supply for pedestrian travel. Equation below illustrates the relationship:

Equation 5

$$\frac{Demand}{Supply} = \frac{trips/day}{PFI}$$

Using the numbers of pedestrian trips per day divided by the PFI indicates the severity of the demand over supply for pedestrian travel. Due to the different units used for the demand and supply in Equation 5, the ratio is not exactly the times of demand over supply but nevertheless represents the degree of difference between the two values. Since there are 0 values of PFI for some TAZs, 1 was uniformly added to all TAZs on the PFI to avoid an infinity value.

Figure 12 shows the TAZs that have the demand supply ratio over 60 and 120 times. The TAZs that have over 120 times demand and supply ratio are all located in Lake Travis area where a considerable amount of recreation demand may exist. Most other undersupplied TAZs for pedestrian travel are located in suburban areas and CBD areas are relatively not as undersupplied as the suburban areas.

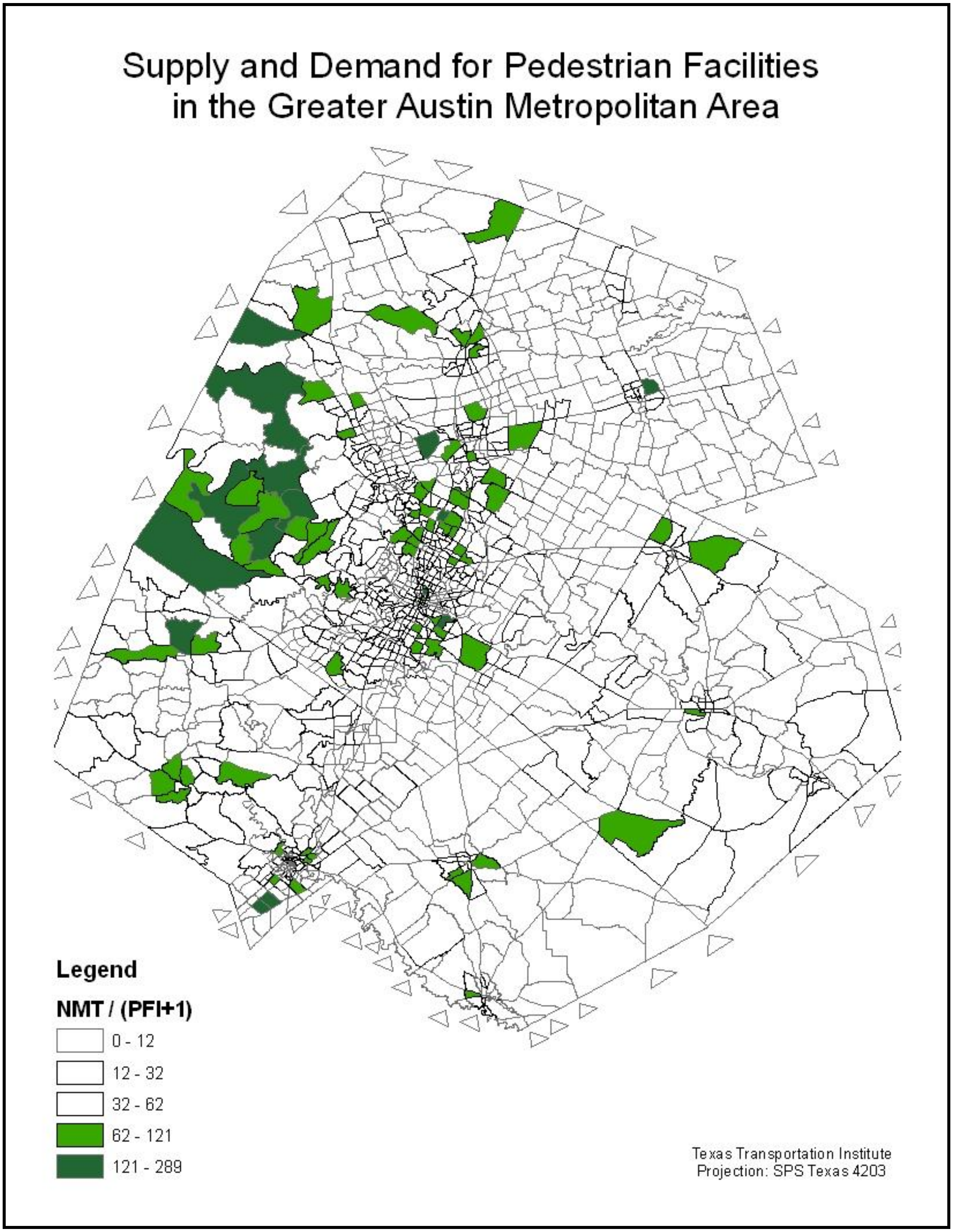

Figure 12. Supply and Demand for Pedestrian Travel in CAMPO Region.

Recommended Criteria for Project Selection

Many factors need to be considered when selecting improvement projects for pedestrian and bicycle travel. From the technical point of view, below are a few points for project selection.

- Bottleneck

  As in vehicular traffic network, bottlenecks exist in non-motorized traffic network. These bottlenecks are referred to short sections of roadway that are undersupplied in terms of pedestrian and bicycle usage sandwiched between well supplied sections. Projects to improve these bottlenecks will have better potential returns compared to non-bottlenecks because less impeded travel will induce more latent demand for pedestrian and bicycle travel.

- Connectivity

  When selecting pedestrian and bicycle improvement projects, the connectivity of the roadway is another important factor to consider. Given the same level of compatibility for pedestrian and bicycle travel, a road section that is well connected to many other roads will provide better accessibility for pedestrian and bicyclist compared to an isolated section of road.

Limitations and Future Research

The methodology developed for this project is at the sketch planning level in that it is relatively simple to understand and apply; however, it can be imprecise and may not adequately account for specific local conditions.

- The accuracy of the demand for pedestrian and bicycle travel heavily depends on the mode choice model within the CAMPO area travel demand model. If the utility function for the non-motorized travel in the mode choice model was inaccurate and outdated, the estimated demand for the non motorized travel for the area would be inaccurate and outdated. A large amount of data was used to establish the CAMPO area mode choice model (approximately 1,650 household surveys and 10,000 rider on-board surveys). The model was also validated and calibrated using collected data. However, the travel demand model is usually updated every 5 to 10 years. Therefore, the data used in developing the model may be outdated by 5 to 10 years. For non-motorized travel in the CAMPO area where bicycling appears to be experiencing a sharp increase, the change may be significant in that time frame.
- The non-motorized demand could be further split between walking and biking trips if more data and time/budget were available for this project. The split between walking and biking by TAZ would refine the locations identified by this project for allocating the resources to improve non-motorized travel. Nevertheless, the same method and procedures established by the project could be applied when such information becomes available. The locations identified by this project could serve as a starting point for a more refined study.

- The travel demand model is designed to estimate typical weekday travel. Using the output from the mode choice model as the demand for non-motorized travel only considered the demand of typical weekday utilitarian biking and walking trips. Other methods need to be used to estimate non-motorized demand on weekends and for recreational trips which may account for a significant portion of total non-motorized travel demand given the pro-bike and pro-walk culture in the region.

Conclusion

As bicycling and pedestrian activity continues to evolve in the CAMPO region, the agency is now better suited to understand these changes as a result of this project. The conceptual model developed by TTI can be integrated into the CAMPO Regional Travel Demand Model and utilized to understand the greatest needs for improvement. CAMPO should use this report to establish program guidelines for a Bicycle and Pedestrian Monitoring Program with experiences of other communities documented and recommendations listed. The region now has a baseline of volume information at 15 locations in Austin, San Marcos, and Bastrop. Data collection equipment which received the best results in the TTI test were purchased under this contract. Permanent and portable counters, now owned by and under the control of CAMPO, can be used to understand usage region-wide. Collecting before and after volume data where projects are implemented will enable the agency to better predict how similar pedestrian and bicycle projects will impact mode share which will aid in future planning decisions.

On September 17, 2010, the two permanent counters were installed at key locations into and out of downtown Austin which will provide 15-minute volume information on bicyclists and pedestrians by direction.

Although there is much interest in pedestrian and bicycle issues, most communities have only recently begun to see the need to gather usage information and model needs. In this way and other ways, CAMPO is charting new territory with this project. Beyond the model development, the permanent equipment installed captures directional data and separates bicyclists from pedestrians representing the first installations in Texas. Furthermore, having the ability to download data using Bluetooth technology to the World Wide Web is the first of its kind in the nation. The National Bicycle and Pedestrian Documentation Project (NBPD) began in 2004 by Alta Planning + Design *(13)* with little to no funding. The NBPD project received a funding boost in 2009 indicating that bicycle and pedestrian monitoring efforts are receiving increased attention. As such, CAMPO has an opportunity to be a leader in the development of a program all their own. They are now ready to take the next step in providing for bicyclists and pedestrians in the CAMPO region.

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Appendix A: Pedestrian and Bicycle Monitoring Program Contacts

Table 8. Pedestrian and Bicycle Monitoring Programs.

Community	Bike/Ped/ Both	Contact Name	Email	Tried to reach	Response / Comments
Bellevue, Washington	ped/bike	Franz Loewenherz	floewenherz@bellevuewa.gov	X	Sent City of Bellevue report, Fall 2009
Boston MPO	ped/bike	Cathy Buckley	cathy@ctps.org	X	Sent answers
Boulder, CO	Unknown	Martha Roskowski	roskowskim@ci.boulder.co.us	X	Did not respond
Cascade Bicycle Club (for WSDOT)	Ped/bike	Tessa Greegor	tessa.greegor@cascadebicycleclub.org	X	Sent answers
Cincinnati, Ohio	ped/bike	Jim Coppock	jim.coppock@cincinatti-oh.org	X	Sent answers
Columbia, Missouri					National Bicycle and Pedestrian Documentation Project
Davis, CA	Bike	Tara Goddard	tgoddard@cityofdavis.org	X	Sent answers
Graham, NC	Ped	Aaron Holland	aholland@cityofgraham.com	X	New program. No data yet.
Kansas City, Missouri	ped/bike	Deb Ridgway	deb_ridgway@kcmo.org	X	Sent answers
Kirkland, WA	Ped/bike	David Godfrey	dgodfrey@ci.kirkland.wa.us	X	Forwarded to Tessa Greegor with Cascade Bicycle Club
Los Angeles, CA	Bike	Jordann Turner	jordann.turner@lacity.org	X	Sent answers
Mammoth Lakes, CA	Ped		760-934-8989		Winter traffic and ped monitoring
Marin County, CA	Ped/bike	Alta			Part of NBPD Project
Minneapolis, Minnesota	ped/bike	Tony Hull	tonyh@tlcminnesota.org	X	Sent answers
Pima Association of Governments (Tucson area)	bike	Ann Chanecka	achanecka@pagnet.org	X	Sent answers
Portland Bureau of Transportation	bike	David Amiton	david.amiton@trans.ci.portland.or.us	X	Did not respond. Program info online.
San Diego, CA	Ped/bike				Seemless Travel project
San Francisco, CA	ped	Heath Maddox	heathmaddox@sfmta.com	X	Sent answers
Seattle, WA	ped	Barbara Gray	walkandbike@seattle.gov	X	Sent answers
Sheboygan, Wisconsin	Ped/bike	Alta			Part of NBPD Project
Virginia DOT	ped/bike	Cindy Engelhart	cindy.engelhart@vdot.virginia.gov	X	Sent answers

Note: NBPD – National Bicycle and Pedestrian Documentation

Appendix B: Pedestrian and Bicycle Monitoring Program Responses by Community

City of Davis, California

Tara Goddard, Bicycle/Pedestrian Coordinator
1717 5th Street Davis, CA 95616
530-757-5669
tgoddard@cityofdavis.org

Do you collect bicycle and pedestrian volume data?
Bicycle and pedestrian data is collected.

When did you initiate your monitoring program?
Bicycles data collection began many years ago. Pedestrian data, we are just starting to collect.

How often do you monitor?
Some places, yearly. For other lower volumes, every 3-5 years.

Do you have any permanent count locations? If so, how many?
No

Do you have any portable counters? If so, how many?
2 portable counters

What type of counters are you using?
Video counter, manual people counter, and pneumatic automated counter.

Do you have specific sites where data is collected routinely?
Bike lane/shoulder, wide outside lane, and shared use path

What is the purpose of the data collection?
Baseline, trends, project selection identification, and project evaluation

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?
Yes

Can you provide us with any other information regarding your collection of motor vehicle volume data as it relates to bike and/or pedestrian project such as how often this data is collected and what it is used for?
Only on a case-by-case project, and usually to test if adding bicycle facilities causes undue diversion of automobiles onto neighborhood streets.

Do you collect any other data associated with pedestrians/bicyclists?
Turning movement

What are some of the biggest challenges you face in your data collection efforts?
Resources (equipment and people).

Can you tell us a little about your biggest successes?
(No answer)

Do you have any advice for agencies that are getting ready to start a monitoring program?
Look at counts as an on-going activity, and find resources for permanent (e.g. in-pavement) counters when possible.

Is there anything else you would like to share?
We are just about to start out pedestrian counts, and are having to utilize volunteers due to staff lay-offs and other resource constraints. Still, we hope to get a better idea about pedestrian behavior here. We've historically been very bicycle/bicyclist focused, so I'm looking forward to focusing on pedestrians, too.

Virginia Department of Transportation
Cindy Engelhart, P.E.
Bicycle Pedestrian Transportation Engineer
14685 Avion Parkway, suite 345
Chantilly, VA 20151-1104
703-383-2231
Cindy.Engelhart@VDOT.Virginia.gov

Do you collect bicycle and pedestrian volume data?
Both bicycle and pedestrian

When did you initiate your monitoring program?
About 4 years ago under an SPR grant

How often do you monitor?
Our program is twofold. First to compare collection methods available to us and second to establish baseline data throughout the region. Counts may be collected between 1 to 3 years at any specific site depending on what we need(Cordon vs. education or trends).

Do you have any permanent count locations? If so, how many?
No

Do you have any portable counters? If so, how many?
Yes, 2

What type of counters are you using?
2 years with Miovision video counters with software counting, 1 year of in-house manual counting, and 2 years with an on call consultant with manual counting and video backup

Do you have specific sites where data is collected routinely?
No

What is the purpose of the data collection?
Baseline, trends (possible increases as more segments of system are built), and method evaluation

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?
No

Can you provide us with any other information regarding your collection of motor vehicle volume data as it relates to bike and/or pedestrian project such as how often this data is collected and what it is used for?
NA

Do you collect any other data associated with pedestrians/bicyclists?
Turning movement

What are some of the biggest challenges you face in your data collection efforts?
1) manpower cuts - due to recent cuts this program may be migrated to the local MPO. 2) separation of bikes and peds in a turning counts at the intersection of two trails, or parallel trails. 3) complex trail intersections where people have made additional short cut footpaths. 4) accuracy - our counts have to have the same status/prestige/believability as any vehicular count due to the litigious nature of our area.

Can you tell us a little about your biggest successes?
One month after our first count, the data had to be used as one of several issues sited when turning down a developer's application. Because the data was taken with trained employees from the Traffic Engineering Section(not volunteers), it could not be questioned.

Do you have any advice for agencies that are getting ready to start a monitoring program?
Try to model your program on the corresponding vehicular program. Deviations (such as using volunteers who may have a conflict of interest) open the program up to questions and possible criticism. If you are only going to use the data for planning, its probably not a big issue but as our field gains more prominence, the counts can be used to justify project prioritization between local jurisdictions, or to decide access issues as noted in the previous question.

Is there anything else you would like to share?
Given a choice we would have started with only video counts, whether they are manual or software counted. The ability to show a video of people using a ped bridge at 3am in the morning proves better than anything else to skeptics that these facilities are needed. Make one of your first counts the location you think will have the highest count and make it a 24 hour count. You will end up quoting that number more than anything else in the following years. Make your volume counts 15 hours instead of 12 hours since you can miss the peak with a 12 hour count. Consider ambient light. 24 hour counts can often be done with just ambient street lights instead of resorting to infrared cameras as suggested by some consultants. Recognize that you will probably have to train any on-call consultant to think in terms of volumes not in terms of ped movements at intersection counts. They have been trained to provide information for traffic signal phasing not mode choice. Good Luck.

City of Kansas City, Missouri
Deb Ridgway
Bicycle Pedestrian Coordinator
414 East 12th Street City Hall 20th Floor
Kansas City, MO 64106
816/513-2592 phone 816/513-2615
deb_ridgway@kcmo.org

Do you collect bicycle and pedestrian volume data?
Both bicycle and pedestrian

When did you initiate your monitoring program?
April 2009

How often do you monitor?
Annually

Do you have any permanent count locations? If so, how many?
No

Do you have any portable counters? If so, how many?
No

What type of counters are you using?
Volunteers

Do you have specific sites where data is collected routinely?
No

What is the purpose of the data collection?
Baseline

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?
No

Can you provide us with any other information regarding your collection of motor vehicle volume data as it relates to bike and/or pedestrian project such as how often this data is collected and what it is used for?
NA

Do you collect any other data associated with pedestrians/bicyclists?
Gender, Other (no more information given)

What are some of the biggest challenges you face in your data collection efforts?

We have over 280 square miles to cover and all work is done with volunteers. Once we collect the data we then rely on student interns to analyze the data. This is also our first year attempting to collect data.

Can you tell us a little about your biggest successes?
We were able to recruit and train more than 40 volunteers to help.

Do you have any advice for agencies that are getting ready to start a monitoring program?
Choose the locations carefully and make sure the community understands your intentions on how the data will be used. For example, in the Fall we conducted counts at locations where there are currently no facilities, but future facilities are planned. So we wanted to capture baseline data. The community thought we were trying to collect data on how many people bike/walk on daily basis.

Is there anything else you would like to share?
No answer given

Minneapolis/ St. Paul, Minnesota
Tony Hull
Evaluation & Program Specialist
Transit for Livable Communities Bike Walk, Twin Cities
626 Selby Ave St Paul, MN 55104
651-767-0298
tonyh@tlcminnesota.org

Do you collect bicycle and pedestrian volume data?
Both bicycle and pedestrian

When did you initiate your monitoring program?
2007

How often do you monitor?
Monthly. We conduct annual counts in September at over 40 locations and monitor 5 of these locations monthly to track seasonal variation.

Do you have any permanent count locations? If so, how many?
Yes, 41

Do you have any portable counters? If so, how many?
Yes, 6

What type of counters are you using?
Sensors

Do you have specific sites where data is collected routinely?
Sidewalks, bike lane/shoulder, wide outside lane, trail, and shared use path

What is the purpose of the data collection?

Baseline, seasonal variations, trends, and project evaluation

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?
No

Can you provide us with any other information regarding your collection of motor vehicle volume data as it relates to bike and/or pedestrian project such as how often this data is collected and what it is used for?
NA

Do you collect any other data associated with pedestrians/bicyclists?
Gender and helmet use

What are some of the biggest challenges you face in your data collection efforts?
Organizing our counts can be a challenge, we use trained volunteers to conduct manual counts, and take extra steps to ensure that all counts are conducted in a uniform manner.

Can you tell us a little about your biggest successes?
Our biggest success is the growing interest in count data we have expanded the volunteer base and number of agencies partnering for our counts. We are using this data to evaluate program investments but hope to institutionalize this data collection for ongoing benchmark of biking and walking in our community

Do you have any advice for agencies that are getting ready to start a monitoring program?
Take the time to decide what your objectives are and choose the count methods and locations that best meet your resources and data needs. ITE and ALTA Planning have developed great resources for developing your specific protocol, and sharing your data with the national database.

Is there anything else you would like to share?
Our count program is focused on evaluation for the Federal Nonmotorized Pilot Program (section 1807 of SAFETEA-LU http://www.fhwa.dot.gov/environment/bikeped/ntpp.htm). Our objective is to evaluate the impact of our investments on promoting mode-shift. We use the counts to provide bookend biking and walking data and monitor project specific impacts at key locations. We have only recently procured the 6 automated counters and will begin piloting the implementation later this month. The automated counters will help us to better understand the two-hour monthly and annual counts as they relate to round-the-clock travel behavior. We are committed to performing the manual counts with volunteer staffing for the duration of our program activity, as it provides the best possible observation of biking and walking data including key attributes of the traffic that cannot be replaced by automated counting. In addition, we find the volunteers become invested in the process for improving conditions for bicycling and walking so this is a great way to engage the community. We have developed forms and training materials that we use to be sure that all volunteers understand the purpose of the data collection and the importance of being accurate and consistent. It is important when working with people who want to advocate for biking and walking that you make it clear that over-reporting or exaggerating counts will not help the program., We have had, on occasion, volunteers who altered a screenline location or made efforts to increase their count total. This is why we perform a supervised check of EVERY count conducted to ensure that the counter is following protocol, and we can usually identify suspicious count results if there is a large change and will generally conduct a make-up count to validate.

Pima Association of Governments, Tucson, Arizona

Ann Chanecka
Transportation Planner
Pima Association of Governments
177 N. Church Ave, Suite 405 Tucson, AZ 85701
Ph (520) 792-1093 Fax (520) 620-6981
achanecka@pagnet.org

Do you collect bicycle and pedestrian volume data?
Bicycle

When did you initiate your monitoring program?
2008

How often do you monitor?
Annually, though we are also going to a few sites at the 6 month mark to see if the snowbirds make a big difference.

Do you have any permanent count locations? If so, how many?
No

Do you have any portable counters? If so, how many?
No

What type of counters are you using?
Manual counting with volunteers with tally sheets

Do you have specific sites where data is collected routinely?
Bike lane/shoulder, wide outside lane, shared use paths and residential streets we expect to convert to bike blvds.

What is the purpose of the data collection?
Baseline, trends, project selection identification, and project evaluation.

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?
No

Can you provide us with any other information regarding your collection of motor vehicle volume data as it relates to bike and/or pedestrian project such as how often this data is collected and what it is used for?
NA

Do you collect any other data associated with pedestrians/bicyclists?
Gender, helmet use, and origin/destination

What are some of the biggest challenges you face in your data collection efforts?

Organizing and training volunteers

Can you tell us a little about your biggest successes?
Recruiting over 100 volunteers to count

Do you have any advice for agencies that are getting ready to start a monitoring program?
Partner with a university civil engineering class to get counters

Is there anything else you would like to share?
(No answer given)

Boston Metropolitan Planning Organization

Cathy Ann Buckley
Chief Transportation Planner
Boston Metropolitan Planning Organization
PO 10 Park Plaza Boston MA 02116
617-973-7118 phone
cathy@bostonmpo.org

Do you collect bicycle and pedestrian volume data?
Both bicycle and pedestrian

When did you initiate your monitoring program?
1975

How often do you monitor?
Trail counts 2 - 3 times/year. These are statewide. Other counts - Boston metro only - specially scheduled.

Do you have any permanent count locations? If so, how many?
Yes (no other info given)

Do you have any portable counters? If so, how many?
No

What type of counters are you using?
Manual

Do you have specific sites where data is collected routinely?
Trails

What is the purpose of the data collection?
Baseline, seasonal variations, trends, project evaluation, and to help determine usage on future trails

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?

No

Can you provide us with any other information regarding your collection of motor vehicle volume data as it relates to bike and/or pedestrian project such as how often this data is collected and what it is used for?
NA

Do you collect any other data associated with pedestrians/bicyclists?
Gender and helmet use

What are some of the biggest challenges you face in your data collection efforts?
Almost all data collected by volunteers. Weather is a big factor - calling off counts at the last minute, trying to get volunteers the following week after calling a fully-scheduled count off.

Can you tell us a little about your biggest successes?
Volunteers are extremely dedicated, so we have many counts. Putting decades worth of data into a database was a challenge at many levels.

Do you have any advice for agencies that are getting ready to start a monitoring program?
Decide what you need and why. We started off collecting turning movements, which is a lot of work, and we are now doing total volumes past a point, on trails and road segments.

Is there anything else you would like to share?
see www.bostonmpo.org for the database and more info on the program.

San Francisco Municipal Transportation Agency
Heath Maddox
Transportation Planner
1 South Van Ness, San Francisco, CA 94103
415-701-4605
heath.maddox@sfmta.com

Do you collect bicycle and pedestrian volume data?
Bicycle

When did you initiate your monitoring program?
2006

How often do you monitor?
Annually. We have one automated counter that counts continuously and are in the process of procuring and installing 22 more

Do you have any permanent count locations? If so, how many?

Yes, 1

Do you have any portable counters? If so, how many?
No

What type of counters are you using?
Manual and automatic sensors,

Do you have specific sites where data is collected routinely?
Bike lane/shoulder, shared use path, and signed bike routes with "sharrows"

What is the purpose of the data collection?
Baseline, trends, project selection identification, project evaluation, and exposure

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?
Yes.

Can you provide us with any other information regarding your collection of motor vehicle volume data as it relates to bike and/or pedestrian project such as how often this data is collected and what it is used for?
I believe motor vehicle volume data would only be gathered in the event of a road diet

Do you collect any other data associated with pedestrians/bicyclists?
Gender and helmet use

What are some of the biggest challenges you face in your data collection efforts?
We count at 35 locations, requiring mobilization of a large number of interns. Due our current fiscal crisis, we will have far fewer interns next year. We are not able to use volunteer advocates because of the political volatility of bike projects in SF.

Can you tell us a little about your biggest successes?
(No answer given)

Do you have any advice for agencies that are getting ready to start a monitoring program?
Have a training for your counters ahead of time.

Is there anything else you would like to share?
(No answer given)

<u>**Cascade Bicycle Club, Seattle, Washington**</u>

Tessa Greegor
Principal Planner
PO Box 15165 Seattle, WA 98115
206-204-0913
tessa.greegor@cascadebicycleclub.org

Do you collect bicycle and pedestrian volume data?
Both bicycle and pedestrian

When did you initiate your monitoring program?
2008

How often do you monitor?
Annually

Do you have any permanent count locations? If so, how many?
Yes

Do you have any portable counters? If so, how many?
No

What type of counters are you using?
Manual sensors

Do you have specific sites where data is collected routinely?
Sidewalk, Bike Lane/Shoulder, Wide Outside Lane, Trail, Shared Use Path

What is the purpose of the data collection?
Baseline, trends, project selection identification, and project evaluation

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?
No.

Can you provide us with any other information regarding your collection of motor vehicle volume data as it relates to bike and/or pedestrian project such as how often this data is collected and what it is used for?
None.

Do you collect any other data associated with pedestrians/bicyclists?
Turning movement

What are some of the biggest challenges you face in your data collection efforts?
We coordinate the Washington state annual bicycle and pedestrian counts. In 2009 we conducted counts in about 25 cities across the state. The biggest difficulties are coordinating over 250 volunteers, manually inputting data, and encouraging the local municipalities to work with us to conduct volunteer outreach.

Can you tell us a little about your biggest successes?
We've successfully completed 2 annual statewide bike/ped counts -- increasing the number of cities from 20 to 25 and the number of count locations from about 100 to 160 or so. In 2009 we had over 250 volunteers across the state counting bicyclists and pedestrians.

Do you have any advice for agencies that are getting ready to start a monitoring program?
-choose locations that will serve as valuable data collection sites (planned projects, trend documentation, high crash locations etc. - select dates that will provide a representative picture of commute patterns.

Is there anything else you would like to share?
Feel free to look at our Statewide Count Report:
http://cascade.org/Advocacy/pdf/2009finalcountreport_cbc_wsdot.pdf

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City of Cincinnati, OH

Melissa McVay
City Planner
Department of Transportation & Engineering, 801 Plum Street, Room 450, Cincinnati, OH 45202
513-352-5269
melissa.mcvay@cincinnati-oh.gov

Do you collect bicycle and pedestrian volume data?
Bicycle

When did you initiate your monitoring program?
No answer

How often do you monitor?
Counts have been performed sporadically over the last ten years. We plan to implement consistent counts and locations this year, as part of the National Bicycle and Pedestrian Documentation Project.

Do you have any permanent count locations? If so, how many?
No

Do you have any portable counters? If so, how many?
No

What type of counters are you using?
Manual sensors

Do you have specific sites where data is collected routinely?
No

What is the purpose of the data collection?
None.

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?
Yes.

Can you provide us with any other information regarding your collection of motor vehicle volume data as it relates to bike and/or pedestrian project such as how often this data is collected and what it is used for?
As part of our recent sharrow pilot project, we collected speed and volume data for automobiles on the three corridors where sharrows were to be installed. We will collect this information again at the end of the 12 month period.

Do you collect any other data associated with pedestrians/bicyclists?
Helmet use

What are some of the biggest challenges you face in your data collection efforts?
Lack of staff, good affordable technology.
Can you tell us a little about your biggest successes?
(No answer given)

Do you have any advice for agencies that are getting ready to start a monitoring program?
(No answer given)

Is there anything else you would like to share?
(No answer given)

City of Los Angeles, CA

Lan Nguyen
Transportation Engineer
Department of Transportation, 100 South Main Street, Los Angeles, CA 90012
213-972-8491
Lan.Nguyen@lacity.org

Do you collect bicycle and pedestrian volume data?
Both

When did you initiate your monitoring program?
Too many years back, over 20 years

How often do you monitor?
On an as needed basis by request.

Do you have any permanent count locations? If so, how many?
No

Do you have any portable counters? If so, how many?
No

What type of counters are you using?
Manual sensors, using keypads

Do you have specific sites where data is collected routinely?
No

What is the purpose of the data collection?
Project selection identification.

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?
No.

Can you provide us with any other information regarding your collection of motor vehicle volume data as it relates to bike and/or pedestrian project such as how often this data is collected and what it is used for?
n/a

Do you collect any other data associated with pedestrians/bicyclists?
No.

What are some of the biggest challenges you face in your data collection efforts?
(No answer given)

Can you tell us a little about your biggest successes?
(No answer given)

Do you have any advice for agencies that are getting ready to start a monitoring program?
(No answer given)

Is there anything else you would like to share?
(No answer given)

Appendix C: Tabulated Survey Results

Do you collect bicycle and pedestrian volume data?

	Bicycle	Pedestrian
City of Davis, California	X	X
Virginia Department of Transportation	X	X
City of Kansas City, Missouri	X	X
St. Paul/Minneapolis, Minnesota	X	X
Pima Association of Governments, Tucson AZ	X	
Boston Metropolitan Planning Organization	X	X
San Francisco Municipal Transportation Agency	X	
Cascade Bicycle Club, Seattle WA	X	X
City of Cincinnati, Ohio	X	
City of Los Angeles, California	X	X
Bellevue, Washington	X	X

When did you initiate your monitoring program?

City of Davis, California	Bicycles, many years ago, Pedestrians, we are just starting.
Virginia Department of Transportation	about 4 years ago under an SPR grant
City of Kansas City, Missouri	April 2009
St. Paul/Minneapolis, Minnesota	2007
Pima Association of Governments, Tucson AZ	2008
Boston Metropolitan Planning Organization	1975
San Francisco Municipal Transportation Agency	2006
Cascade Bicycle Club, Seattle WA	2008
City of Cincinnati, Ohio	No answer
City of Los Angeles, California	Too many years back, over 20 years
Bellevue, Washington	2008

How often do you monitor?

	Answer	Comment
City of Davis, California	**Other**	Bicycles data collection began many years ago. Pedestrian data, we are just starting to collect.
Virginia Department of Transportation	**Other**	Our program is two fold. First to compare collection methods available to us and second to establish baseline data throughout the region. Counts may be collected between 1 to 3 years at any specific site depending on what we need (Cordon vs. education or trends).
City of Kansas City, Missouri	**Annually**	
St. Paul/Minneapolis, Minnesota	**Monthly**	We conduct annual counts in September at over 40 locations and monitor 5 of these locations monthly to track seasonal variation
Pima Association of Governments, Tucson AZ	**Annually**	Though we are also going to a few sites at the 6 month mark to see if the snowbirds make a big difference.
Boston Metropolitan Planning Organization	**Other**	Trail counts 2 - 3 times/year. These are statewide. Other counts - Boston metro only - specially scheduled.
San Francisco Municipal Transportation Agency	**Annually**	We have one automated counter that counts continuously and are in the process of procuring and installing 22 more
Cascade Bicycle Club, Seattle WA	**Annually**	
City of Cincinnati, Ohio	**Other**	Counts have been performed sporadically over the last ten years. We plan to implement consistent counts and locations this year, as part of the National Bicycle and Pedestrian Documentation Project.
City of Los Angeles, California	**Other**	On an as needed basis by request
Bellevue, Washington	**Annually**	Performed second annual count in September 2009.

Do you have permanent and temporary counters? If so, how many?

	Permament	#	Temporary	#
City of Davis, California	No		Yes	2
Virginia Department of Transportation	No		Yes	2
City of Kansas City, Missouri	No		No	
St. Paul/Minneapolis, Minnesota	Yes	41	Yes	6
Pima Association of Governments, Tucson AZ	No		No	
Boston Metropolitan Planning Organization	Yes	NA	No	
San Francisco Municipal Transportation Agency	Yes	1	No	
Cascade Bicycle Club, Seattle WA	Yes		No	
City of Cincinnati, Ohio	No		No	
City of Los Angeles, California	No		No	
Bellevue, Washington	No		No	

What type of counters are you using?

	Video	Manual	Automatic (sensors)	Other	Comments
City of Davis, California	**X**	**X**	**X**		Pneumatic tubes for the automatic sensors
Virginia Department of Transportation	**X**	**X**		**X**	2 years with Miovision video counters with software counting, 1 year of in-house manual counting, and 2 years with an on call consultant with manual counting and video backup
City of Kansas City, Missouri				**X**	Volunteers
St. Paul/Minneapolis, Minnesota			**X**		
Pima Association of Governments, Tucson AZ		**X**			We have volunteers count with tally sheets
Boston Metropolitan Planning Organization		**X**			
San Francisco Municipal Transportation Agency		**X**	**X**		
Cascade Bicycle Club, Seattle WA		**X**			
City of Cincinnati, Ohio		**X**			1
City of Los Angeles, California		**X**			using keypads
Bellevue, Washington	**X**	**X**			2009 first year with video capture. Volunteers and staff reduce data from city's traffic management cameras

Do you have specific sites where data is collected routinely?

	Sidewalk	Bike Lane/ Shoulder	Wide Outside Lane	Trail	Shared Use Path	Other
City of Davis, California		**X**	**X**		**X**	
Virginia Department of Transportation						
City of Kansas City, Missouri						
St. Paul/Minneapolis, Minnesota	**X**	**X**	**X**	**X**	**X**	
Pima Association of Governments, Tucson AZ		**X**	**X**		**X**	Residential streets we expect to convert to bike blvds
Boston Metropolitan Planning Organization			**X**	**X**		
San Francisco Municipal Transportation Agency		**X**			**X**	signed bike routes with "sharrows"
Cascade Bicycle Club, Seattle WA	**X**	**X**	**X**	**X**	**X**	
City of Cincinnati, Ohio						
City of Los Angeles, California						
Bellevue, Washington						

What is the purpose of the data collection?

	Baseline	Seasonal Variations	Trends	Project Selection Identification	Project Evaluation	Other	Comments
City of Davis, California	**X**		**X**	**X**	**X**		
Virginia Department of Transportation	**X**		**X**			method evaluation	(Use of trends) Possible increases as more segments of system are built
City of Kansas City, Missouri	**X**						
St. Paul/Minneapolis, Minnesota	**X**	**X**	**X**		**X**		
Pima Association of Governments, Tucson AZ	**X**		**X**	**X**	**X**		
Boston Metropolitan Planning Organization	**X**	**X**	**X**		**X**	to help determine usage on future trails	
San Francisco Municipal Transportation Agency	**X**		**X**	**X**	**X**	exposure	
Cascade Bicycle Club, Seattle WA	**X**		**X**	**X**	**X**		
City of Cincinnati, Ohio							
City of Los Angeles, California				**X**			

Do you track changes in motor vehicle volume after implementing bike and/or pedestrian projects?

City of Davis, California	Only on a case-by-case project, and usually to test if adding bicycle facilities causes undue diversion of automobiles onto neighborhood streets.
Virginia Department of Transportation	No
City of Kansas City, Missouri	No
St. Paul/Minneapolis, Minnesota	No
Pima Association of Governments, Tucson AZ	No
Boston Metropolitan Planning Organization	No
San Francisco Municipal Transportation Agency	Yes, I believe motor vehicle volume data would only be gathered in the event of a road diet
Cascade Bicycle Club, Seattle WA	No
City of Cincinnati, Ohio	As part of our recent sharrow pilot project, we collected speed and volume data for automobiles on the three corridors where sharrows were to be installed. We will collect this information again at the end of the 12 month period.
City of Los Angeles, California	No

Do you collect any other data associated with pedestrians/bicyclists?

	Gender	Helmet Use	Turning Movement	Origin/ Destination	Other
City of Davis, California			X		
Virginia Department of Transportation			X		
City of Kansas City, Missouri	X				X
St. Paul/Minneapolis, Minnesota	X	X			
Pima Association of Governments, Tucson AZ	X	X		X	X
Boston Metropolitan Planning Organization	X	X			
San Francisco Municipal Transportation Agency	X	X			
Cascade Bicycle Club, Seattle WA			X		
City of Cincinnati, Ohio		X			
City of Los Angeles, California					

	Biggest challenges faced in data collection efforts	Biggest successes in data collection efforts

	Biggest challenges faced in data collection efforts	Biggest successes in data collection efforts
City of Davis, California	Resources (equipment and people).	No Answer
Virginia Department of Transportation	1) manpower cuts - due to recent cuts this program may be migrated to the local MPO. 2) separation of bikes and peds in a turning counts at the intersection of two trails, or parallel trails. 3) complex trail intersections where people have made additional short cut footpaths. 4) accuracy - our counts have to have the same status/prestige/believability as any vehicular count due to the litigious nature of our area.	One month after our first count, the data had to be used as one of several issues sited when turning down a developer's application. Because the data was taken with trained employees from the Traffic Engineering Section(not volunteers), it could not be questioned.
City of Kansas City, Missouri	We have over 280 square miles to cover and all work is done with volunteers. Once we collect the data we then rely on student interns to analyze the data. This is also our first year attempting to collect data.	We were able to recruit and train more than 40 volunteers to help.
St. Paul/Minneapolis, Minnesota	Organizing our counts can be a challenge, we use trained volunteers to conduct manual counts, and take extra steps to ensure that all counts are conducted in a uniform manner.	Our biggest success is the growing interest in count data we have expanded the volunteer base and number of agencies partnering for our counts. We are using this data to evaluate program investments but hope to institutionalize this data collection for ongoing benchmark of biking and walking in our community
Pima Association of Governments, Tucson AZ	Organizing and training volunteers	Recruiting over 100 volunteers to count
Boston Metropolitan Planning Organization	Almost all data collected by volunteers. Weather is a big factor - calling off counts at the last minute, trying to get volunteers the following week after calling a fully-scheduled count off.	Volunteers are extremely dedicated, so we have many counts. Putting decades worth of data into a database was a challenge at many levels.
San Francisco Municipal Transportation Agency	We count at 35 locations, requiring mobilization of a large number of interns. Due our current fiscal crisis, we will have far fewer interns next year. We are not able to use volunteer advocates because of the political volatility of bike projects in SF.	No Answer
Cascade Bicycle Club, Seattle WA	We coordinate the Washington state annual bicycle and pedestrian counts. In 2009 we conducted counts in about 25 cities across the state. The biggest difficulties are coordinating over 250 volunteers, manually inputting data, and encouraging the local municipalities to work with us to conduct volunteer outreach.	We've successfully completed 2 annual statewide bike/ped counts -- increasing the number of cities from 20 to 25 and the number of count locations from about 100 to 160 or so. In 2009 we had over 250 volunteers across the state counting bicyclists and pedestrians.
City of Cincinnati, Ohio	Lack of staff, good affordable technology.	No Answer

	Biggest challenges faced in data collection efforts	Biggest successes in data collection efforts
City of Los Angeles, California	No Answer	No Answer

	Advice for agencies that are getting ready to start a monitoring program
City of Davis, California	Look at counts as an on-going activity, and find resources for permanent (e.g. in-pavement) counters when possible.
Virginia Department of Transportation	Try to model your program on the corresponding vehicular program. Deviations (such as using volunteers who may have a conflict of interest) open the program up to questions and possible criticism. If you are only going to use the data for planning, its probably not a big issue but as our field gains more prominence, the counts can be used to justify project prioritization between local jurisdictions, or to decide access issues as noted in the previous question.
City of Kansas City, Missouri	Choose the locations carefully and make sure the community understands your intentions on how the data will be used. For example, in the Fall we conducted counts at locations where there are currently no facilities, but future facilities are planned. So we wanted to capture baseline data. The community thought we were trying to collect data on how many people bike/walk on daily basis.
St. Paul/Minneapolis, Minnesota	Take the time to decide what your objectives are and choose the count methods and locations that best meet your resources and data needs. ITE and ALTA Planning have developed great resources for developing your specific protocol, and sharing your data with the national database.
Pima Association of Governments, Tucson AZ	Partner with a university civil engineering class to get counters
Boston Metropolitan Planning Organization	Decide what you need and why. We started off collecting turning movements, which is a lot of work, and we are now doing total volumes past a point, on trails and road segments.
San Francisco Municipal Transportation Agency	Have training for your counters ahead of time.
Cascade Bicycle Club, Seattle WA	-choose locations that will serve as valuable data collection sites (planned projects, trend documentation, high crash locations etc. - select dates that will provide a representative picture of commute patterns.
City of Cincinnati, Ohio	
City of Los Angeles, California	

Additional Comments	
City of Davis, California	We are just about to start out pedestrian counts, and are having to utilize volunteers due to staff lay-offs and other resource constraints. Still, we hope to get a better idea about pedestrian behavior here. We've historically been very bicycle/bicyclist focused, so I'm looking forward to focusing on pedestrians, too.
Virginia Department of Transportation	Given a choice we would have started with only video counts, whether they are manual or software counted. The ability to show a video of people using a ped bridge at 3am in the morning proves better than anything else to skeptics that these facilities are needed. Make one of your first counts the location you think will have the highest count and make it a 24 hour count. You will end up quoting that number more than anything else in the following years. Make your volume counts 15 hours instead of 12 hours since you can miss the peak with a 12 hour count. Consider ambient light. 24 hour counts can often be done with just ambient street lights instead of resorting to infrared cameras as suggested by some consultants. Recognize that you will probably have to train any on-call consultant to think in terms of volumes not in terms of ped movements at intersection counts. They have been trained to provide information for traffic signal phasing not mode choice. Good Luck.
City of Kansas City, Missouri	None
St. Paul/Minneapolis, Minnesota	Our count program is focused on evaluation for the Federal Nonmotorized Pilot Program (section 1807 of SAFETEA-LU http://www.fhwa.dot.gov/environment/bikeped/ntpp.htm). Our objective is to evaluate the impact of our investments on promoting mode-shift. We use the counts to provide bookend biking and walking data and monitor project specific impacts at key locations. We have only recently procured the 6 automated counters and will begin piloting the implementation later this month. The automated counters will help us to better understand the two-hour monthly and annual counts as they relate to round-the-clock travel behavior. We are committed to performing the manual counts with volunteer staffing for the duration of our program activity, as it provides the best possible observation of biking and walking data including key attributes of the traffic, that cannot be replaced by automated counting. In addition, we find the volunteers become invested in the process for improving conditions for bicycling and walking so this is a great way to engage the community. We have developed forms and training materials that we use to be sure that all volunteers understand the purpose of the data collection and the importance of being accurate and consistent. It is important when working with people who want to advocate for biking and walking that you make it clear that over-reporting or exaggerating counts will not help the program., We have had, on occasion, volunteers who altered a screen line location or made efforts to increase their count total. This is why we perform a supervised check of EVERY count conducted to ensure that the counter is following protocol, and we can usually identify suspicious count results if there is a large change and will generally conduct a make-up count to validate.
Pima Association of Governments, Tucson AZ	None
Boston Metropolitan Planning Organization	see www.bostonmpo.org for the database and more info on the program.
San Francisco Municipal Transportation Agency	None
Cascade Bicycle Club, Seattle WA	Feel free to look at our Statewide Count Report: http://cascade.org/Advocacy/pdf/2009finalcountreport_cbc_wsdot.pdf
City of Cincinnati, Ohio	None
City of Los Angeles, California	

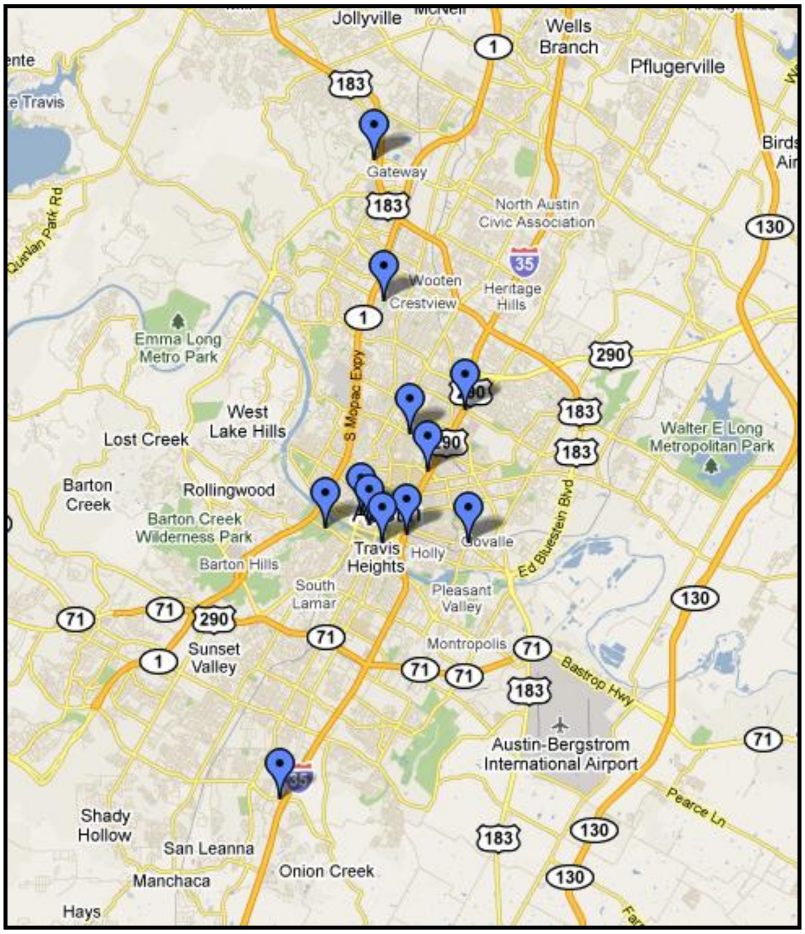
Appendix D: Data Collection Results

Table 9. Final Count Locations.

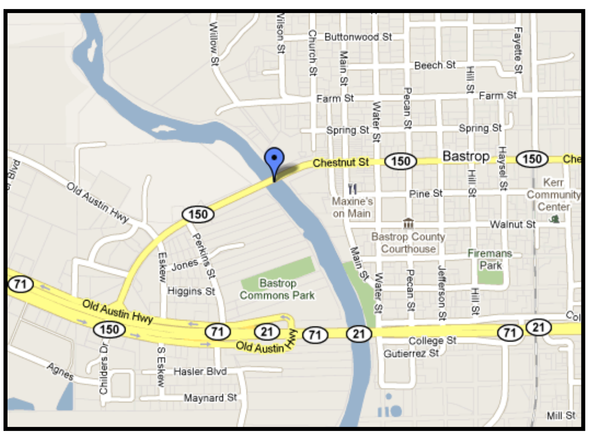
Bicycle							
	Route	From	To	Area of Austin/CAMPO	Comments	Count method	Progress
1	51st Street	IH35 WFR	IH35 EFR	Central Austin	Recent bicycle lanes, connection to Mueller, Requested by Nathan at COA	COA Traffic Management Center	7-9am completed 4/20/10 and 5-7pm completed 4/21/10
2	Barton Springs Road	Zilker Park		South Central Austin	Relatively new bicycle lanes	manual/video (TTI)	7-9am and 4-6pm completed, data provided
3	Dean Keeton Street	IH35	Red River St	UT	Bike lanes on Dean Keaton and colored lanes at IH-35 ramps, requested by Nathan at COA	COA Traffic Management Center	7-9am completed 4/27/10 and 5-7pm completed 4/20/10
4	E. 4th Street	IH35 WFR	IH35 EFR	Downtown Austin	Gateway into downtown from east and northeast - requested by Nathan at COA, part of LAB	manual/video (TTI)	7am-8pm Completed 8/2010
5	Jollyville Road	US183	Great Hills Trail or Braker Ln	Northwest Austin	Bike lanes and some sidewalks. Capture those going to Park n Ride.	COA Traffic Management Center	7-9am and 5-7pm completed 4/20/10
6	Shoal Creek Blvd	Far West bridge		North Central Austin	AM and PM peak to target commuters	manual/video (TTI)	AM and PM peak completed, data provided
7	Shoal Creek Trail	3rd	at bridge	Downtown Austin	Gateway into downtown from south and west Austin.	manual/video (TTI)	7am-8pm completed in July 2010
8	Speedway or Duval St	38th		north of UT campus		manual/video (TTI)	7:00am-6:00pm completed 3/25/10, data provided

Table 9. Final Count Locations (Continued)

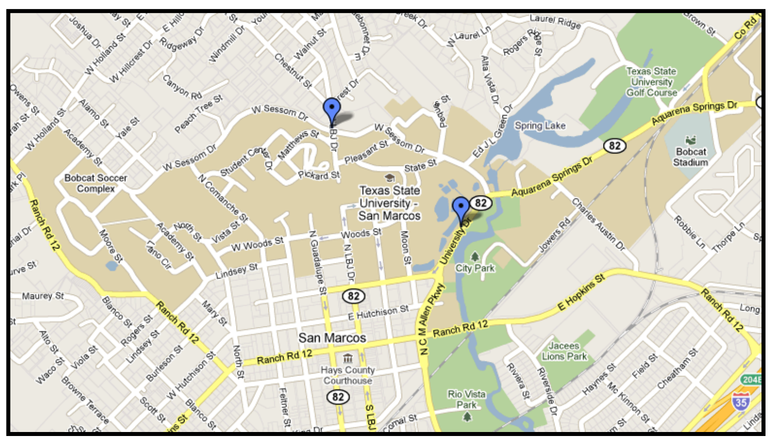
	Route	From	To	Area of Austin/CAMPO	Comments	Count method	Progress
Pedestrian							
9	Lamar Blvd	5th Street	6th Street	Downtown Austin	no bike lanes, high pedestrian activity area	COA Traffic Management Center	7-9am and 5-7pm completed 4/22/10
10	San Marcos	LBJ Dr	Sessoms Dr	Texas State Campus	NB peds channeled on east leg	manual/video (TTI)	7:00-10:45am and 3:30-6:00pm completed 4/29/10, data provided
Bicycle and Pedestrian							
	Route	From	To	Area of Austin/CAMPO	Comments	Count method	Progress
11	Ann Richards/Congress Ave Bridge	Riverside Dr	Cesar Chavez	Downtown Austin	wide sidewalk, no bike lanes but bicycles use the outer lane and sidewalk	COA Traffic Management Center	7-9am and 5-7pm completed 4/22/10
12	Bastrop	Loop 150 Ped/Bike Bridge		Downtown Bastrop	Two parallel sidewalks (one adjacent to roadway and other set back)	manual/video (TTI)	7am-8pm completed 7/2010
13	Pleasant Valley	Cesar Chavez		East central Austin		COA Traffic Management Center	7-9am and 5-7pm completed 4/27/10
14	San Marcos - University Drive	Pedestrian Signal	near City Park	San Marcos - Hays County	Major pedestrian crossing, bikes along University	manual/video (TTI)	AM and PM Peaks completed 4/8, 9am-4pm completed 4/14, data provided
15	West Slaughter Lane	west of S. Congress		South Austin	Bicycle lanes, major development of South Meadows	COA Traffic Management Center	7-9am and 5-7pm completed 4/21/10



Austin



Bastrop



San Marcos

Figure 13: Data Collection Locations.