Los Angeles County
Metropolitan Transportation Authority

Bicycle-Rail Trip Analysis and Greenhouse Gas Emissions Reduction Focused Study

Metro

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Purpose

The Los Angeles County Metropolitan Transportation Authority (Metro) recently began studying the ways in which bicycling, for transportation and in combination with transit, can reduce automobile use and lower greenhouse gas (GHG) emissions. The first of these focused studies concentrated on the Metro Orange Line and parallel bicycle path. This Bicycle Rail Trip Analysis and Greenhouse Gas Emissions Study looks more broadly at bicycle trips to and from Metro Rail. The purpose of this study is to establish the benefits of providing an integrated transportation system where bicyclists are accommodated at train stations and on trains.

Methodology

This focused study relies on bicycle trip data gathered by conducting intercept surveys of bicyclists at a subset of nineteen (19) Metro Rail stations. Counts and surveys were conducted during the weekday morning commute period (6 a.m. to 10 a.m.), the weekday evening commute period (4 p.m. to 8 p.m.) and the weekend midday period (10 a.m. to noon). Bicyclists were asked to report about the journey they were taking at that moment, from the origin to the final destination. Concurrently with the intercept surveys, volunteers recorded the total number of bicyclists entering and exiting each sampled station. Volunteers collected 605 usable surveys and counted 2,305 bicyclists at the 19 sampled stations.

This study uses survey data to calculate bicycle-rail trip distances and associated reductions in vehicle miles traveled (VMT) and GHG emissions. Bicycle count data collected at the sample stations was extrapolated to daily and annual bicycle trips at all stations using Metro Rail ridership data from fiscal year (FY) 2009, and commonly accepted traffic analysis methodology. For those bicycle trips that replaced auto-based trips, trip distances were calculated and used to calculate annual VMT reductions, which were then applied in the Caltrans Emissions Factors model to calculate estimate GHG, criteria pollutant, and mobile-source air toxics (MSAT) emissions reductions.[1]

Findings

- This study indicates that bicyclists are a small but important subset of riders on the Metro Rail system, and bicycle-rail trips offset vehicle miles traveled resulting in quantifiable greenhouse gas emissions. The counts and extrapolated methodology mirrors commonly accepted practices in traffic analysis. Some relevant extrapolated results, based on the data, are as follows: Approximately 1,195,000 bicyclists would use the Metro Rail system annually. (Which represents 1.3 percent of all annual trips.)

[1] Caltrans Emissions Factors model (CT-EMFAC) is a California-specific project-level analysis tool, which models the GHG constituent pollutant CO_2, as criteria pollutant and MSAT emissions using the latest version of the California Mobile Source Emission Inventory and Emission Factors model. The model was developed by UC Davis, in coordination with Caltrans and the California Air Resources Board (CARB), and is the Caltrans preferred model for quantification of mobile-source GHG emissions.

- Bicycle-rail trips would replace approximately 322,000 motor vehicle trips and reduce 3.96 million vehicle miles traveled each year, offsetting approximately 2,152 metric tons of carbon dioxide equivalents (CO_2e) annually. This would be equivalent to taking 422 motor vehicles off the road.[2]
- Bicyclists are universally using the Metro Rail system, with bicyclists reporting starting or ending their rail trip at 71 out of 73 Metro Rail stations surveyed.
- Over a quarter (27 percent) of bicycle-rail trips replace a motor vehicle trip.[3]
- In terms of getting to or from the station, twelve percent of bicycle trips replaced motor vehicle trips.[4]
- On average, 13 bicyclists per hour—one bicyclist every five minutes—enters or exits a Metro train during the weekday morning or weekday evening peak periods. An average of 10 bicyclists per hour – one every six minutes – enters or exits a Metro train during the weekend midday period.

This study provides data on the "bikeshed" of Metro Rail stations, and underscores the importance of increasing a bicyclists' reach by providing for bicycles on transit. On average, bicyclists traveled 2.2 miles to access train travel (these distance are within the typical bicycling catchment area of a train station). Bicyclists taking the bus travel an average of 4.9 miles to access a station.

Additional study results are as follows:

Bicyclists are using the Metro system just as other Metro riders do.

- Respondents generally follow commute trends, with 90 percent of respondents starting their weekday a.m. trip at home and 65 percent of respondents ending their weekday a.m. trip at work. Similarly, 54 percent of respondents started their weekday p.m. trip at work and 66 percent of respondents ended their weekday p.m. trip at home.

Accommodating bicyclists at rail stations and on trains provides mobility benefits.

- Thirteen percent of bicyclists would not make their trip if they couldn't bicycle and take the train.
- Respondents are more transit dependent than the general population, with 11 percent of respondents stating that they "rarely" have access to a motor vehicle and over a third of respondents (37 percent) stating that they "never" have access to a motor vehicle. In Los Angeles County, 9.4% of households do not have access to a motor vehicle.[5]

Allowing bicycles on trains is a major reason why people choose to bicycle, particularly for riders who have access to a motor vehicle.

- Survey respondents overwhelmingly said that being allowed to take their bike on the train influenced their decision to travel by bike and rail. Of the 477 people who responded to the

[2] On average, an automobile is driven 11,720 miles per year, producing 5.1 metric tons of CO_2e.

[3] Origin to final destination, or A to D trip.

[4] Origin to train station, for example, A to B or B to C trip.

[5] U.S. Census Bureau, 2006-2008 American Community Survey3-Year Estimates.

question, 65 percent chose "allowed to take bike on train" as a factor that influenced their decision.

- Respondents with access to a motor vehicle are more likely than those without access to a motor vehicle to cite "allowed to take bike on train," "no car parking at station," "bike lockers at station," and "have to pay for car parking at station" as factors that influenced their decision to bicycle.

Women are much less likely to bicycle to a Metro Rail station than men.

- Respondents were mostly male (86 percent) and 75 percent were between the ages of 18 and 39. This percentage of female bicyclists is consistent with the data collected through the 2009 City of Los Angeles Bike Count, which found only 15% of bicyclists counted were female.
- In other California urban areas, women typically represent between 25 and 30 percent of bicyclists rather than the 14 percent found by this study, suggesting that there may be ways that Metro can increase the percentage of women using the bike-rail mode.[6]

Structure

This report consists of the following sections:

Introduction:	Describes the study purpose and policy background, and discusses the methodology of the surveys and counts in detail
Study Results:	Summarizes the results from the counts and surveys.
Reductions in Vehicle Miles Traveled:	Calculates the estimated bicycle usage for the entire Metro Rail system, and the estimated vehicle miles reduced by bicycle-rail trips.
Estimated Greenhouse Gas Emissions Reduction:	Calculates the amount of carbon dioxide emissions (as well as criteria air pollutant and mobile-source air toxics emissions) offset by bicycle-rail trips.
Findings and Recommendations:	Describes key findings, lessons learned and provides policy recommendations for Metro to pursue in meeting its sustainability goals and providing for bicyclists on transit.
Appendices:	Provides survey instruments, survey data tables, count data tables and a graphic map of trips to and from the Metro Rail stations.

[6] The Seamless Travel Study by U.C. Berkeley's Safe Transportation Research and Education Center (2010) conducted intercept surveys of 212 bicyclists at 25 locations throughout San Diego County and found a gender breakdown of 68% male, 32% female. The San Francisco State of Cycling Report Card (2008) conducted intercept surveys of bicyclists and found a gender breakdown of 73% male, 23% female. Portland, Oregon, which has constructed an extensive network of bicycle facilities over the last decade and has an outreach program targeted to women bicyclists, has seen the percentage of female bicyclists increase to 32% as of 2009.

Introduction

Purpose

Metro recently began studying the ways in which bicycling, for transportation and in combination with transit, can reduce automobile use and lower GHG emissions. The first of these focused studies concentrated on the Metro Orange Line and parallel bicycle path. This Bicycle Rail Trip Analysis and Greenhouse Gas Emissions Reduction Focused Study concentrated more broadly at bicycle trips to and from Metro Rail lines. The purpose of this study is to determine the extent of the benefits of providing an integrated transportation system where bicyclists are a complementary mode-choice to riding the system. This focused study's methodologies, data, findings and recommendations will serve as another important dataset for future focused studies of multimodal benefits, and provide empirical support for improving bicycle-transit integration with the goal of reducing automobile miles and GHG emissions.

In 2006, Metro adopted the Metro Bicycle Transportation Strategic Plan which emphasizes infrastructure, access and connectivity improvements that will increase the use of bicycles as a transportation mode. This focused study establishes baseline data for the typical number of bicycle-rail trips that are made on Metro transit facilities, estimates the GHG emissions offset by bicycle-rail trips, and provides data that can be used to complement the development of climate change policies and transit industry protocols.

U.S. DOT Bicycle and Pedestrian Accommodation Policy

On March 15, 2010, U.S. Secretary of Transportation Ray LaHood announced a new federal policy[7] on the development of fully integrated active transportation networks. Transportation agencies, such as Metro are expected to take the lead on this new policy:

> The DOT policy is to incorporate safe and convenient walking and bicycling facilities into transportation projects. Every transportation agency, including DOT, has the responsibility to improve conditions and opportunities for walking and bicycling and to integrate walking and bicycling into their transportation systems. Because of the numerous individual and community benefits that walking and bicycling provide — including health, safety, environmental, transportation, and quality of life — transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes.

In light of this new federal policy statement, preparation of this Metro Rail Focused Mode Shift study comes at an opportune time. The study's purpose, to establish the sustainability benefits of providing an integrated transportation system where bicyclists are accommodated at train stations and on trains, can serve as the data to support this new policy. By quantifying these benefits, Metro should be able to follow USDOT's recommended actions with hard data to support this policy shift:

> The DOT encourages States, local governments, professional associations, community organizations, public transportation agencies, and other government agencies, to adopt similar policy statements on bicycle and pedestrian accommodation as an indication of their commitment

[7] United States Department of Transportation, *Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations*. (Signed on March 11, 2010 and announced March 15, 2010)

to accommodating bicyclists and pedestrians as an integral element of the transportation system. In support of this commitment, transportation agencies and local communities should go beyond minimum design standards and requirements to create safe, attractive, sustainable, accessible, and convenient bicycling and walking networks.

The "First Mile-Last Mile" Barriers

Bicycling offers one solution to overcoming the "first mile-last mile" barriers for people who would potentially take transit but choose not to because their starting point or final destination is not conveniently accessible to the transit stop due to distance, street patterns, or safety concerns. Metro recognizes the importance of bridging this last mile to attract drivers to transit, and the role that bicycling plays. Metro allows folding bicycles on trains at all times and is studying the feasibility of a subsidized folding bicycle program. Regionally, the Southern California Association of Governments (SCAG) and the City of Los Angeles recommended two bicycle-related strategies to address the "first mile-last mile" barrier in their 2009 report *Maximizing Mobility in Los Angeles:* increasing folding bicycle use and establishing bicycle sharing programs.[8] The data, findings and recommendations from that study can be used to guide, support and evaluate bicycle-related "first mile-last mile" programs.

Metro's Bicycle Policy

Metro's Bicycle Policy has an effect on how bicyclists are using the system. Bicycles are allowed on bus bike racks with no time restrictions. At the time the study was conducted, bicycles were restricted from the trains during the peak weekday commuting period, and through certain localities. However on April 28, 2011 that policy has been removed. However, if the arriving train is crowded, or the bus rack is full, then the bicyclist must wait for a train with available room.

Bicycle restrictions were: weekdays 6:30 a.m. - 8:30 a.m. and 4:30 p.m. - 6:30 p.m. Trains affected were all of the Blue Line, all of the Gold Line, Green Line from Norwalk station to Redondo Beach station, Red Line from Union Station to Wilshire/Vermont station (both directions).

Methodology

This focused study relies on bicycle trip data gathered by conducting intercept surveys of bicyclists at a subset of nineteen (19) Metro Rail stations to measure reductions in VMT and GHG emissions related to bicycle-rail trips. Count data, in conjunction with Metro Rail ridership data from FY 2009, are used to extrapolate VMT and GHG emissions reductions to annual numbers as is typically done in transportation analysis.

The sections below describe the methodology used for the surveys and the counts.

[8] SCAG, Maximizing Mobility in Los Angeles – First and Last Mile Strategies. Accessed July 7, 2010. http://www.scag.ca.gov/nonmotorized/pdfs/LA-Maximizing-Mobility-Final-Vol1.pdf

Survey Instrument

For each bicycle-train trip, surveyors collected: the origin of the trip (A), the station where the bicyclist boarded the train (B), the station where the bicyclist exited the train (C), and the final destination of the bicyclist (D). See Figure 1 for an illustration. The surveyor also collected the mode (e.g., walk, bike, bus, etc.) that the bicyclist took to get from the origin to the train station (A-B) and from the train station to the destination (C-D). Finally, bicyclists were asked how they would travel between their origin and destination (A-D) if they didn't have their bike and couldn't take the train.

Appendix A includes the survey instruments. The same information was collected of boarding bicyclists and alighting bicyclists. Note that to collect comparable data from boarding and alighting bicyclists, the survey instrument for the boarding bicyclists had to be worded slightly differently and have a different question order than the survey instrument for the alighting bicyclists.

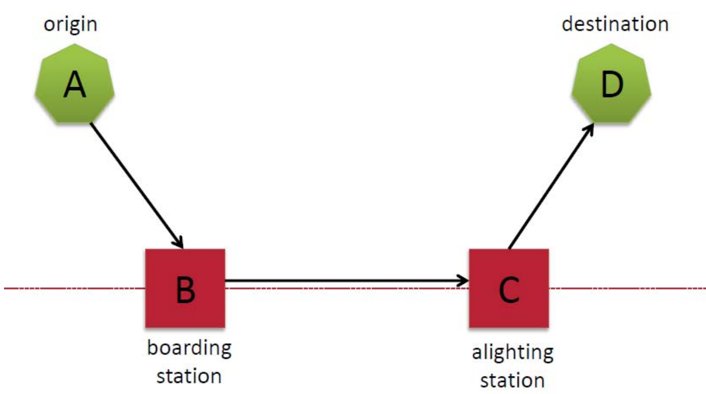


Figure 1: Schematic of Bicycle-Rail Trip

To improve the chances of collecting more accurate information, the surveyors recorded the bicyclists' answers, rather than having bicyclists fill out the forms themselves. Spanish-speaking surveyors were assigned to stations where high numbers of Spanish-speaking riders were expected, and all surveyors were given Spanish surveys in addition to English surveys.

Surveyors

The Los Angeles County Bicycle Coalition (LACBC) recruited volunteer surveyors. They had previous experience in spearheading the *2009 City of Los Angeles Bicycle and Pedestrian Count* project, and have the ability to mobilize a large amount of volunteers to conduct surveys and pedestrian counts simultaneously at several locations. LACBC used their weekly newsletter, which was sent out to their membership database, as well as to approximately 6,000 Los Angeles area residents/cyclists, to recruit volunteer surveyors for the project. In addition, LACBC posted this request on their Facebook page and sent out special volunteer opportunity emails to their members who have previously volunteered.

Volunteers were allowed to choose the locations and times with which they volunteered based on where they lived and their schedule. However, in some cases, volunteers were requested to conduct their surveys in areas where there were gaps in the planned schedule. LACBC conducted a volunteer training session, which included Metro's rail safety training course. During the training session, LACBC conducted the following:

- Described the purpose of the study;
- Reviewed the count and survey forms;
- Demonstrated a survey being taken in front of the volunteers;
- Led the volunteers to role play in taking and administering the survey;
- Provided instructions on the submittal of completed count and survey forms; and
- Provided contact information for LACBC volunteer coordinators.

Counts

During the same time periods that surveys were collected, the number of bicyclists exiting and entering the stations and the number of bicycles parked at the station were counted. Entering and exiting bicyclists were counted in fifteen-minute intervals, and parked bicycles were counted at the beginning and end of the count time.

Station Selection

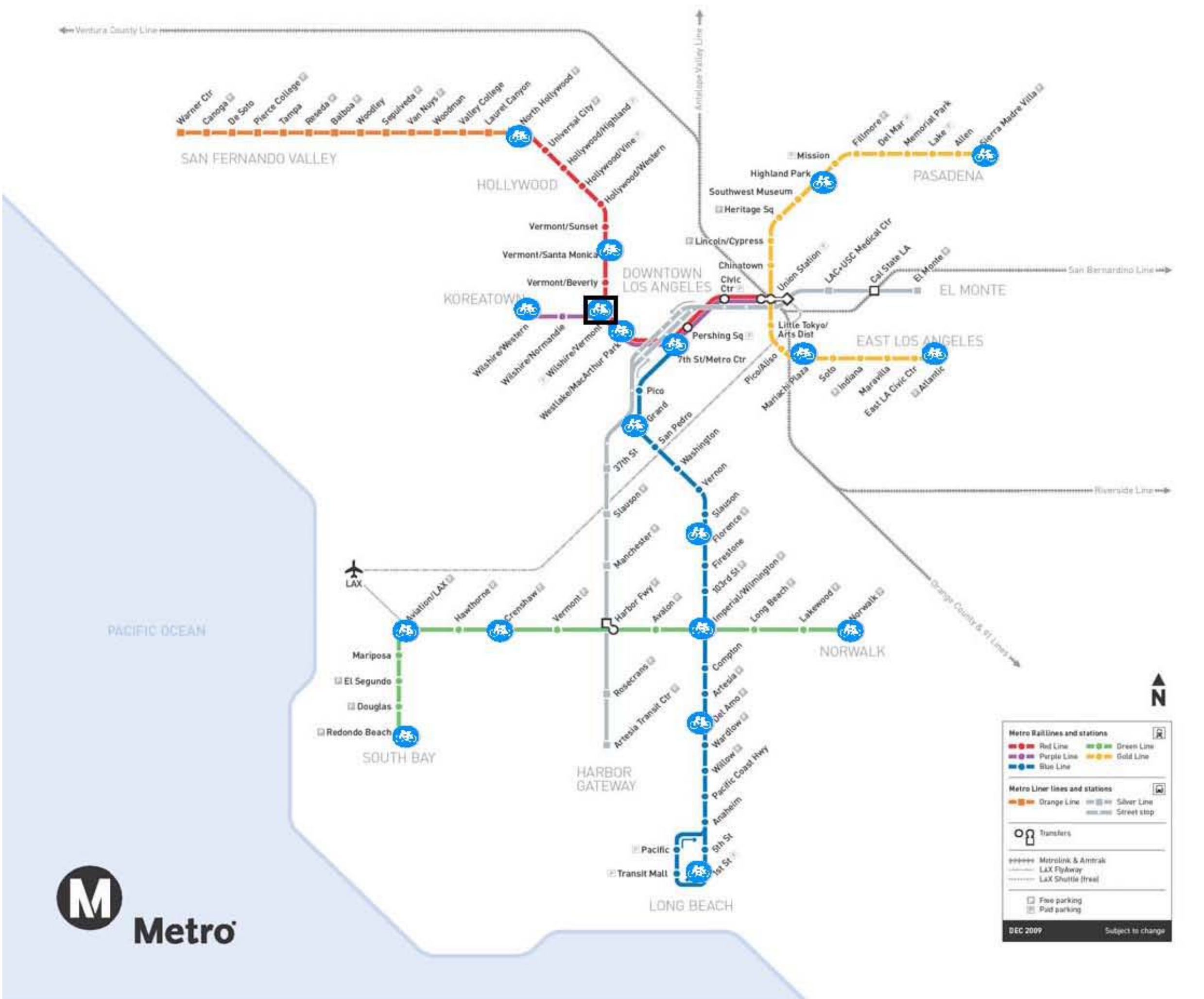
Bicyclists were intercepted and counted at twenty Metro Rail stations (see Figure 1), representing 29% of all rail stations on the Metro Red, Purple, Gold, Blue, and Green Lines. Bus Rapid Transit stations (Metro Orange and Silver Lines) were not included in this analysis. When selecting the stations, the following guidelines were used:[9]

1. All end-of-line stations were selected to capture people who might bicycle from outside Metro's service area to an end-of-line station.
2. Stations with generally higher ridership, and therefore perceived higher bicycle usage were prioritized.
3. All vehicle and bicycle parking facilities were represented (e.g. bicycle lockers, bicycle racks, pay parking, free parking, no parking).
4. Some mid-line stations were selected for geographical distribution.

Within these parameters, stations were selected randomly.

Table 1 lists the selected stations, the motor vehicle and bicycle parking status, and the location of the station within the transit network (i.e., whether a station is end of line or not).

[9] Geographical distribution and bicycle amenities were taken into consideration in an effort to obtain results from a variety of metropolitan living conditions, which would influence a person's usage of this mode-choice.



Note: Wilshire/ Vermont is counted as two stations since it is a major transfer hub and the Red and Purple line platforms are at separate locations.

Figure 2: Map of Survey Stations

Table 1: Stations Selected for Counts and Surveys

Station	Line(s)	Free Parking	Racks Only	Racks and Lockers	End of Line	Transfer Station	Notes
North Hollywood	Red	x		x	x		High-use
Vermont/Santa Monica	Red			x			High-use, Mid-line
Wilshire/Vermont[1]	Purple/Red	x		x		x	Mid-line
Wilshire/Western	Purple			x	x		
Westlake/MacArthur Park	Purple/Red		x				High-use, Mid-line
Sierra Madre Villa	Gold[3]	x		x	x		

Station	Line(s)	Free Parking	Racks Only	Racks and Lockers	End of Line	Transfer Station	Notes
Highland Park	Gold[3]			x			High-use, Mid-line
Mariachi Plaza	Gold[3]			x			Mid-line
Atlantic	Gold[3]	x		x	x		
7th St/Metro Center[2]	Blue/Red/ Purple					x	High-use
Grand	Blue						Mid-line
Florence	Blue	x	X				Mid-line
Imperial/Wilmington[2]	Blue	x		x		x	High-use, Mid-line
Del Amo	Blue	x		x			Mid-line
1st Street[1]	Blue	x			x		
Norwalk	Green	x		x	x		High-use
Crenshaw	Green	x		x			Mid-line
Aviation/LAX	Green	x		x			High-use
Redondo Beach	Green	x		x	x		

1. These stations offer free parking but provide patrons the option to pay for a reserved parking spot.
2. Only bicyclists on the Metro Blue Line were intercepted.
3. Includes both the Pasadena and Eastside Extension Lines.

Days and Times

Surveys and counts were conducted over the three-week period spanning from Tuesday, May 11, 2010 to Saturday, May 29, 2010. To avoid skewing results, data were not collected on Bike to Work Day (Thursday, May 14, 2010). Data were collected at each station three times: during both weekday morning (6:00 a.m. to 10:00 a.m.) and evening commute hours (4:00 p.m. to 8:00 p.m.) and once on the weekend (10:00 a.m. to noon). Weekday count and survey windows include times during which bicyclists are allowed to take their bike on the train, in addition to the times when bicyclists are restricted from taking their bike on the train. There are no restrictions during the weekend.

Weather was fair on all the days counts were collected.

Table 2 summarizes the data collection days and times, and lists the times that bicycles are restricted on trains.

Table 2: Data Collection Days and Times

Days	Times	Bicycle Restrictions
Weekday Morning (Tues, Wed, or Thurs)	6 a.m. to 10 a.m.	Bikes restricted on trains from 6:30 a.m. to 8:30 a.m.
Weekday Evening (Tues, Wed, or Thurs)	4 p.m. to 8 p.m.	Bikes restricted on trains from 4:30 p.m. to 6:30 p.m.
Weekend Saturday or Sunday	10 a.m. to noon	No restrictions in place.

Results

Overview of Data Collected

Surveyors collected 710 surveys at 19 stations. Fifteen percent of the collected surveys were Spanish. Over two thousand (2,305) bicyclists were counted entering or exiting the selected stations. Not every counted cyclist was surveyed. Survey rates were as low as 3 percent, and as high as 100 percent between the 19 stations. Stations with lower bicycle counts had better sample rates (see Table 3).

Since bicyclists were intercepted in the middle of their journey, there were occasions when not all information was collected before a bicyclist needed to catch a train or ride away from the station. Of the 710 survey responses received, 605 or 85 percent had at least one origin or destination address. The analysis in this report only uses the 605 surveys with origin or destination data. Of these 605 surveys, 106 had origin addresses only, 65 had destination addresses only, and 434 surveys had addresses for both origin and destination.

As shown in Table 4, a total of 2,305 bicyclists were counted entering or exiting the twenty sampled stations, with 909 bicyclists counted during the weekday morning period, 1,053 bicyclists counted during the weekday evening period, and 343 bicyclists counted during the weekend midday period.

Table 4 shows the average number of bicyclists counted per hour at each station. On average, 12.9 bicyclists were counted every hour at the 19 stations during the weekday peak hours. This is equivalent to one bicyclist every five minutes. During the weekend peak, an average of 10.1 bicyclists were counted every hour at 17 of the 19 stations – approximately one every six minutes.[10] Transfer stations Imperial/Wilmington, 7th St/Metro Center, and Wilshire/Vermont had the highest bicycle counts of any station, with weekday averages of 35.9, 32.9 and 24.0 bicyclists counted per hour, respectively. Despite having excellent bicycle access via the Metro Orange Line bicycle path, North Hollywood saw lower than average hourly bicycle counts. Though Mariachi Plaza, on the Metro Gold Line, saw the lowest weekday hourly bicycle counts of all the stations, surveyors observed many bicyclists using the bus adjacent to the station, rather than taking the train, underscoring the fact that these counts may not be indicative of bicycle use on the Metro Bus system.

[10] Bicycle counts were not recorded at two of the 19 stations during the weekend because the counts were not turned in despite repeated follow-up with volunteers (see Table 3).

Table 3: Number of Surveys Collected and Number of Bicyclists Counted

		Number of Surveys Collected			Counts			Percent of Bicyclists Surveyed*		
Station	**Line(s)**	**Weekday Morning**	**Weekday Evening**	**Weekend Midday**	**Weekday Morning**	**Weekday Evening**	**Weekend Midday**	**Weekday Morning**	**Weekday Evening**	**Weekend Midday**
1st Street	Blue	4	6	no data	9	15	3	44%	40%	n/a
7th St/Metro Center	Blue	4	15	8	131	132	52	3%	11%	15%
Atlantic	Gold	11	8	7	11	26	12	100%	31%	58%
Aviation/LAX	Green	6	8	4	42	43	11	14%	19%	36%
Crenshaw	Green	12	17	7	47	64	21	26%	27%	33%
Del Amo	Blue	7	16	3	46	53	13	15%	30%	23%
Florence	Blue	29	16	10	63	88	no data	46%	18%	n/a
Grand	Blue	22	22	7	42	36	15	52%	61%	47%
Highland Park	Gold	18	15	no data	35	35	22	51%	43%	n/a
Imperial/Wilmington	Blue	no data	no data	13	102	185	50	n/a	n/a	26%
Mariachi Plaza	Gold	3	1	no data	3	4	5	100%	25%	n/a
North Hollywood	Red	34	15	3	44	26	23	77%	58%	13%
Norwalk	Green	18	17	7	69	64	15	26%	27%	47%
Redondo Beach	Green	9	4	6	20	21	12	45%	19%	50%
Sierra Madre Villa	Gold	6	9	12	31	35	13	19%	26%	92%
Vermont/Santa Monica	Red	12	16	2	30	35	38	40%	46%	5%
Westlake/MacArthur Park	Red	15	13	no data	50	51	16	30%	25%	n/a
Wilshire/Vermont	Red/Purple	17	38	8	98	94	22	17%	40%	36%
Wilshire/Western	Purple	13	24	8	36	46	no data	36%	52%	n/a
Total		**240**	**260**	**105**	**909**	**1053**	**343**			

**Represents the number of bicycles surveyed compared to the number of bicycles counted entering/exiting the station.*

"No data" refers to locations for which there is no data available, typically because the count and survey forms were not turned in despite repeated follow-up.

Table 4: Bicycle Count Data Summary

Station	Line	Weekday Total Count	Weekday Hourly Average	Weekend Total Count	Weekend Hourly Average	Notes*
Imperial/Wilmington	Blue	287	35.9	50	25.0	TS, ML, HU
7th St/Metro Center	Blue	263	32.9	52	26.0	TS, HU
Wilshire/Vermont*	Red/Purple	192	24.0	22	11.0	TS, ML
Florence	Blue	151	18.9	no data	n/a	ML
Norwalk	Green	133	16.6	15	7.5	EOL, HU
Crenshaw	Green	111	13.9	21	10.5	ML
Westlake/MacArthur Park	Purple/Red	101	12.6	16	8.0	HU, ML
Del Amo	Blue	99	12.4	13	6.5	ML
Aviation/LAX	Green	85	10.6	11	5.5	HU
Wilshire/Western	Purple	82	10.3	no data	n/a	EOL
Grand	Blue	78	9.8	15	7.5	ML
North Hollywood	Red	70	8.8	23	11.5	EOL, HU
Highland Park	Gold	70	8.8	22	11.0	ML, HU
Sierra Madre Villa	Gold	66	8.3	13	6.5	EOL
Vermont/Santa Monica	Red	65	8.1	38	19.0	HU, ML
Redondo Beach	Green	41	5.1	12	6.0	EOL
Atlantic	Gold	37	4.6	12	6.0	EOL
1st Street	Blue	24	3.0	3	1.5	EOL
Mariachi Plaza	Gold	7	0.9	5	2.5	ML
Total		**1,962**	**12.9**	**343**	**10.1**	
By Line						
Metro Blue Line		*902*	*112.8*	*133*	*66.5*	
Metro Red/Purple Line		*510*	*63.8*	*99*	*49.5*	
Metro Green Line		*370*	*46.3*	*59*	*29.5*	
Metro Gold Line		*180*	*22.5*	*52*	*26.0*	

**Station type represented by EOL – "end of line," TS – "transfer station", ML – "mid-line," and HU – "high-use."*

***Wilshire/Vermont counts as two stations. "No data" refers to locations for which there is no data available.*

Peak Hour Use

Bicyclists peaking patterns roughly follow those of all Metro riders, but do show distinct differences. As shown in Figure 3, bicyclist use peaks before and after the weekday bicycle use restrictions, but shows the highest peak during the peak hour restriction. See Appendix C for a chart comparing overall Metro Rail peaking to bicyclist peaking.

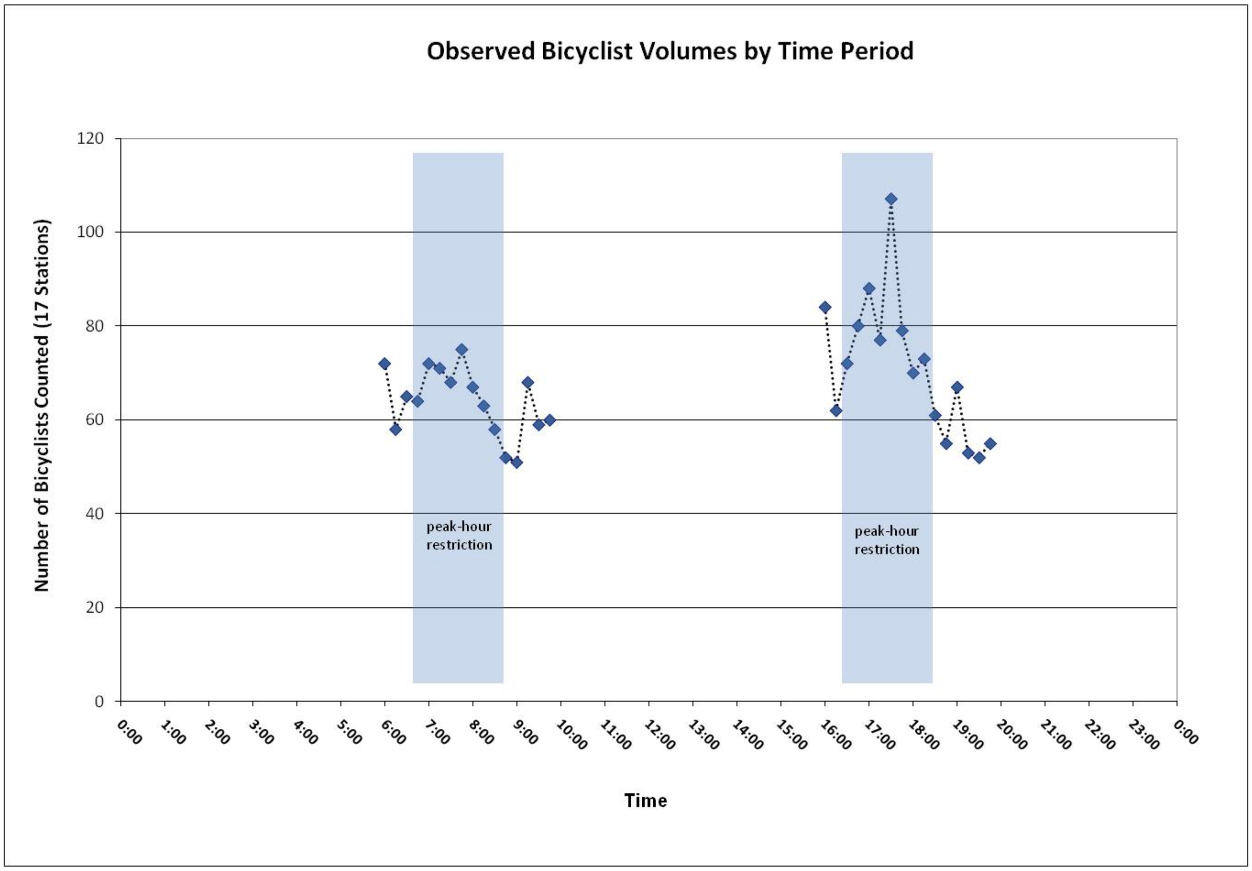


Figure 3: Bicycle Peaking Patterns

Boarding and Alighting

Bicyclists were asked to identify the station where they began their bicycle-rail trip, and the station at which they would end their trip. As shown in Table 5, bicyclists are universally using the Metro Rail system, with bicyclists reporting starting or ending their rail trip at 71 out of 73 Metro Rail stations (97 percent). Surveyors observed bicyclists using the bus parallel to the Gold Line, rather than the Gold Line. Appendix B lists the boarding and alighting stations, sorted by line.

Table 5: Bicyclist Boardings and Alightings by Line

	Number of Stations on Line	Number of Stations Where Bicyclists Boarded or Alighted	Percent of Stations Represented
Metro Red Line / Purple Line	16	16	100%
Metro Blue Line	22	22	100%
Metro Green Line	14	14	100%
Metro Gold Line	21	19	90%
Total	**73**	**71**	**97%**

Mode To or From Station

Bicyclists were asked to identify which modes they took to or from a station by choosing from a list of options. All of the 605 respondents answered the question, resulting in responses for 1,210 trips, as shown in Table 6. Not surprisingly, bicycling was the primary mode, with bicycle-only trips representing 81 percent of all trips (979 trips). Bicycle-transit trips were the next highest mode, representing 8% of all trips (92 trips).

Table 6: Mode Traveled to or From Station

Mode	Total Trips	Percentage
Biked	979	81.1%
Walked	26	2.1%
Drove alone	6	0.5%
Dropped off	6	0.5%
Carpooled	3	0.2%
Bus	54	4.5%
Linked Trips	130	10.7%
Biked & Bus	*42*	*3.5%*
Biked & Train/Subway/Light Rail	*40*	*3.3%*
Train/Subway/Light Rail	*28*	*2.3%*
Biked & Train/Subway/Light Rail & Bus	*10*	*0.8%*
Biked & Walked	*6*	*0.5%*
Train/Subway/Light Rail & Bus	*3*	*0.2%*
Biked & Walked & Bus	*1*	*0.1%*
No mode stated	6	0.6%
Total	**1,210**	**100%**

Trip Purpose

Respondents were asked to report generally where they were coming from and going to—their trip purpose. Choices included the following:

- Work;
- Store, restaurant, movies, or other shopping and entertainment;
- Family or friend's house;
- Home;
- Doctor, dentist, or other personal business; or
- Other (write-in field).

Many of the write-in answers were school-related, or could be categorized as one of the other trip purposes. This is reflected in Table 7 and Table 8.

The trip purpose varies by time of day and indicates that many of the respondents are using Metro Rail for work-related commuting. Respondents generally follow commuter trends, with 90 percent of respondents starting their weekday morning trip at home and 65 percent of respondents ending their weekday morning trip at work. Similarly, 54 percent of respondents started their weekday evening trip at work and 66 percent of respondents ended their weekday evening trip at home. During the weekend, these trends are less pronounced.

Table 7: Purpose of Trip: Start of Trip to Station, by Time Period

Start of trip	Weekday Morning	Weekday Evening	Weekend Midday
Doctor, dentist, or other personal business	0%	3%	0%
Family or friend's house	1%	6%	9%
Home	**90%**	22%	**73%**
Store, restaurant, movies, or other shopping and entertainment	1%	5%	6%
Work	5%	**54%**	8%
School	1%	7%	1%
Other	0%	2%	4%
Total	100%	100%	100%

Out of 596 respondents who answered question.
Totals may not add up to 100% due to rounding.

Table 8: Purpose of Trip: End of Trip from Station, by Time Period

End of trip	Weekday Morning	Weekday Evening	Weekend Midday
Doctor, dentist, or other personal business	5%	1%	3%
Family or friend's house	4%	10%	20%
Home	8%	**66%**	20%
Other	5%	4%	14%
School	11%	4%	0%
Store, restaurant, movies, or other shopping and entertainment	2%	5%	**24%**
Work	**65%**	10%	20%
Total	100%	100%	100%

Out of 601 respondents who answered question.

Mode Shift

"Travel mode" refers to the way in which people travel—bicycling, walking, driving alone, carpooling, taking the bus, and taking a train are all modes of travel. "Mode shift" refers to when people shift from one travel mode to another. This study is primarily concerned with whether survey respondents would shift from biking to driving, carpooling or getting dropped off if biking wasn't an option. Integrating bicycle and pedestrian facilities with transit facilities provides a higher multimodal level of service than transit or bicycle/pedestrian facilities alone, allowing travelers to switch more easily between modes and use more than one non-auto mode per trip. The ability to mode-shift is a part of the overall philosophy of sustainable and livable community strategies. To understand this, respondents were asked how they would make their trip if they couldn't use their bicycle. This question was asked three ways:

1. If you didn't have your bike, how would you get from your origin to the first station?
2. If you didn't have your bike, how would you get from the second station to your destination?
3. If you didn't have your bike and couldn't take a train, how would you get from your origin to your destination?

Respondents were asked to choose from a list of answers, and could choose more than one answer. Responses are summarized in Table 9, Table 10 and Table 11, below.

Trips To and From the Station

The answers to the first two questions were very similar. As shown in Figure 4, if respondents couldn't bicycle to or from the train station, between 42 and 43 percent would switch to walking and between 35 to 36 percent would switch to taking the bus. Only 8 percent of respondents would switch to driving alone, carpooling or getting dropped off. Three to 4 percent said they would not make the trip if they couldn't bicycle.

Trips from Origin to Destination

Responses to the third question were dramatically different, and showed more mode shift toward private motor vehicles and an increased percentage of respondents who would not make the trip at all. As shown in Figure 5, when respondents were asked about how they would get from their origin to their destination if they couldn't ride their bike and take the train, 18 percent would switch to walking and 40 percent would switch to taking the bus. Over a quarter, 27 percent, would shift to private motor vehicles (18 percent drive alone, 5 percent carpool and 4 percent dropped off). Thirteen percent would not make the trip if they couldn't bicycle and take the train, indicating that the bike-rail mode provides significant mobility benefits.

Table 9: If you didn't have your bike, how would you get from your origin to the first station?

Mode to Which Respondents Would Switch	Number	Percent
Walk	303	42%
Bus	258	36%
Drive Alone	55	8%
Train/Subway/Light Rail	32	4%
Carpool	19	3%
Drop off	18	2%
Other	13	2%
Would not make the trip	24	3%
Total	**719**	

Respondents could choose more than one answer.

Table 10: If you didn't have your bike, how would you get from the second station to your destination?

Mode to Which Respondents Would Switch	Number	Percent
Walk	315	44%
Bus	254	35%
Drive Alone	57	8%
Train/Subway/Light Rail	35	5%
Drop off	15	2%
Carpool	13	2%
Would not make the trip	28	4%
Total	**717**	

Respondents could choose more than one answer.

Table 11: If you didn't have your bike and couldn't take a train, how would you get from your origin to your destination?

Mode to Which Respondents Would Switch	Number	Percent
Bus	305	40%
Drive Alone	137	18%
Walk	135	18%
Carpool	37	5%
Drop off	33	4%
Other	14	2%
Train/Subway/Light Rail	10	1%
Would not make the trip	97	13%
Total	**768**	

Respondents could choose more than one answer.

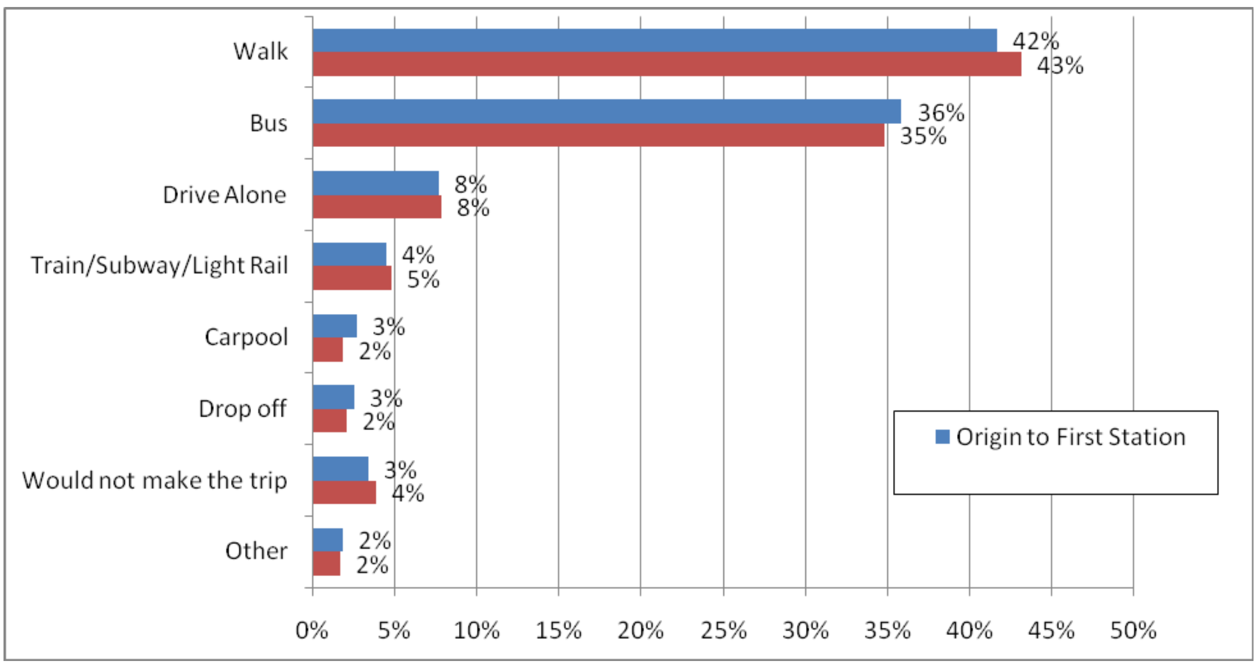


Figure 4: Responses to the Question: If you didn't have your bike, how would you get from your: (A) origin to first station, and (B) second station to destination

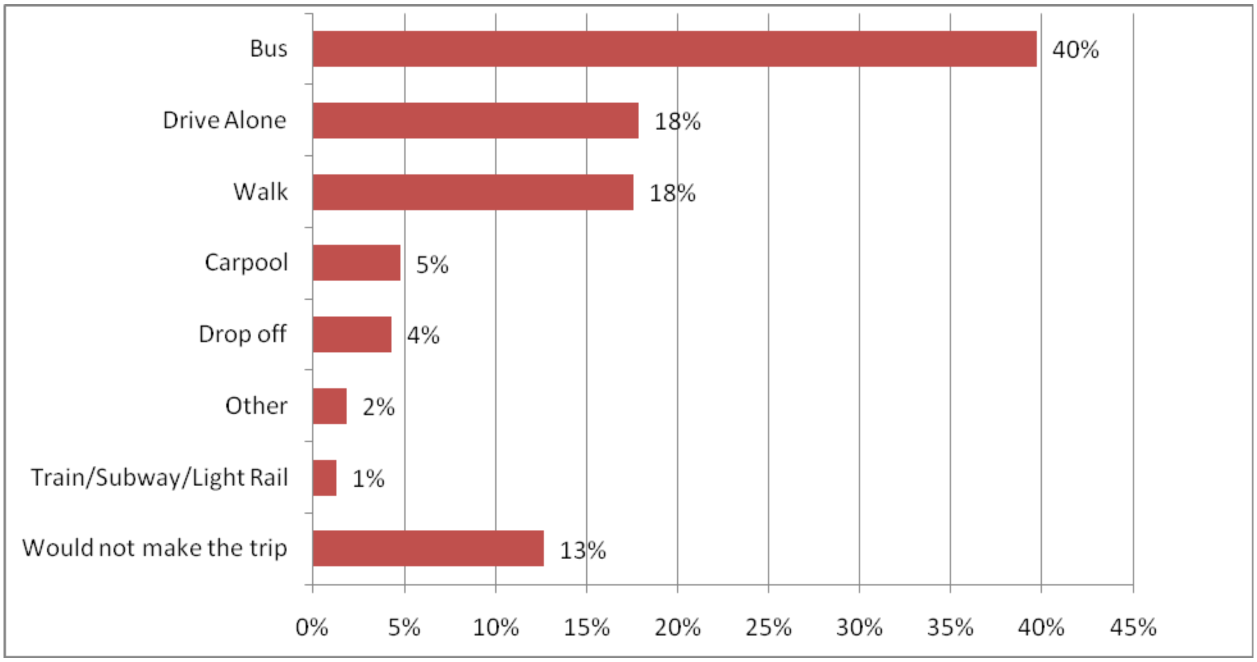


Figure 5: Responses to the Question: If you didn't have your bike and couldn't take a train, how would you get from your origin to your destination?

Access to a Motor Vehicle

Respondents were asked if they had access to a motor vehicle. Respondents are very transit-dependent, with over a third of respondents (37 percent) stating that they "never" have access to a motor vehicle and 11 percent of respondents stating that they "rarely" have access to a motor vehicle, as shown in Table 12 and in Figure 6. Twenty-three (23) percent of respondents "sometimes" have access to a motor vehicle and 30 percent "always" have access to a motor vehicle.

Table 12: How often do you have access to a motor vehicle?

Level of Access	Number	Percent
Always	161	30%
Sometimes	121	22%
Rarely	60	11%
Never	199	37%
Total	**541**	**100%**

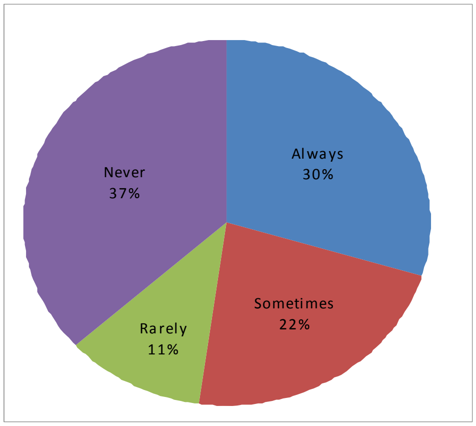


Figure 6: Responses to the Question: How often do you have access to a motor vehicle?

Reasons for Choosing the Bike-Rail Option

Respondents were asked the question, "Of the following choices, which ones influenced your decision to ride your bike to the train today, rather than walk, drive or take the bus?" and were provided a list of choices from which to choose:

- Allowed to take bike on train (65% of respondents)
- No car parking at station (4% of respondents)
- Good bike facilities on the way to the station (4% of respondents)
- Bike racks at the station (3% of respondents)
- Bike lockers at the station (3% of respondents)
- Have to pay for car parking at the station (3% of respondents)
- None of the above (32% of respondents)

Table 13 presents the percentages of survey respondents who identified which factor(s) influenced their decision to travel by bike and rail. Survey respondents overwhelmingly said that being allowed to take their bike on the train influenced their decision to travel by bike and rail. Of the 477 people who responded to the question, 65 percent chose "allowed to take bike on train" as a factor that influenced their decision. Thirty-two percent of respondents indicated that none of the given reasons influenced their decision to use their bike and rail, suggesting that there may be other factors besides bike access on trains, bike parking, motor vehicle parking, and bicycle facilities that influence a person's decision to travel by bike and rail.

When looking at responses broken down by access to a motor vehicle, a slightly different picture emerges. Respondents with access to a motor vehicle are more likely to cite "allowed to take bike on train," "no car parking at station," "bike lockers at station," and "have to pay for car parking at station" as factors that influenced their decision to bicycle. Respondents without access to a motor vehicle are slightly more likely to cite "good bicycle facilities on the way to station" as a factor that influenced their decision to bicycle, and are much more likely to state that none of the given choices influenced their decision to bicycle. Likely, not having access to a car was a major reason why these respondents chose to bicycle, though this was not included in the list of choices.

It should be noted that at many stations, bicyclists were intercepted on the station platform, rather than outside the station. It is likely that bicyclists who were parking their bicycle outside the station were under-represented in the sample. These bicyclists may rate bicycle parking, motor vehicle parking, or bike facilities differently, compared to the bicyclists that we intercepted on the platform.

Table 13: Factors Influencing a Person's Decision to Travel by Bike and Rail

	Number of Responses	Percent of Total	Percent for those who have access to a car "always" or "sometimes"	Percent for those who have access to a car "never" or "rarely"
Allowed to take bike on train	311	65%	72%	57%
No car parking at the station	19	4%	5%	2%
Good bike facilities on the way to the station	17	4%	3%	4%
Bike racks at the station	15	3%	3%	3%
Bike lockers at the station	12	3%	3%	1%
Have to pay for car parking at the station	12	3%	4%	0%
None of the above	151	32%	23%	42%
Total respondents who answered question	477		260	214

Respondents could select more than one answer, so percentages do not add up to 100%.

Breakdown by access to car does not include 3 respondents who did not answer the access to car question.

Demographics

Respondents were overwhelmingly male. Of the 566 bicyclists who indicated their gender, 86 percent were male, and 14 percent were female. This is consistent with the data collected through the 2009 City of Los Angeles Bike Count, which found only 15% of bicyclists counted were female. However, women typically represent between 25 and 30 percent of bicyclists rather than the 14 percent found by this study, suggesting that there may be ways that Metro can increase the percentage of women using the bike-rail mode.[11]

Of the 566 bicyclists who stated their age, nearly half (48%) were between the ages of 18 to 29, and over a quarter (27%) were between the ages of 30 and 39. This too, is typical of other bicycle intercept surveys, which show that bicyclists tend to be younger than the general population.

Figure 7 illustrates the gender and age breakdowns for the intercepted bicyclists.

[11] The Seamless Travel Study by U.C. Berkeley's Safe Transportation Research and Education Center (2010) conducted intercept surveys of 212 bicyclists at 25 locations throughout San Diego County and found a gender breakdown of 68% male, 32% female. The San Francisco State of Cycling Report Card (2008) conducted intercept surveys of bicyclists and found a gender breakdown of 73% male, 23% female. Portland, Oregon, which has constructed an extensive network of bicycle facilities over the last decade and has an outreach program targeted to women bicyclists, has seen the percentage of female bicyclists increase to 32% as of 2009.

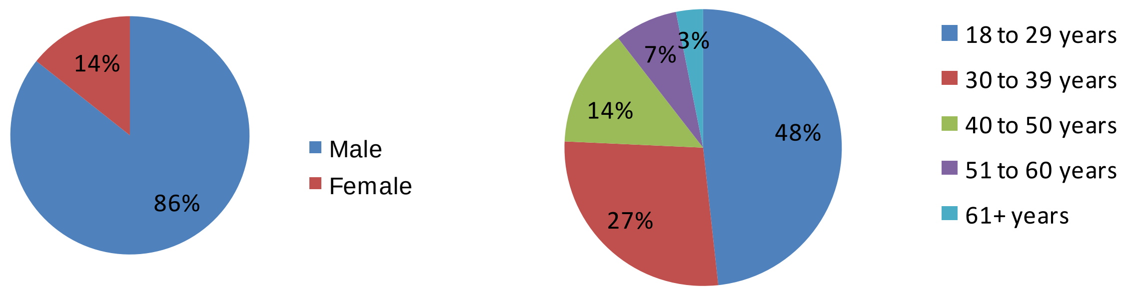


Figure 7: Gender and Age Breakdown of Survey Respondents

Reductions in Vehicle Miles Traveled

To estimate the amount of VMT and GHG emissions a bicycle-train trip offsets, one must answer at least two questions. First, how far is the total bicycle-train trip, from the origin to the destination? Second, did this trip replace a motor vehicle trip? This section calculates vehicle miles traveled for those bicyclists who indicated that they would switch to driving, carpooling or getting dropped off.

This section begins with an estimate of the total system-wide bicycle use, which is extrapolated from the bicycle counts collected during the study using Metro Rail ridership data for FY 2009.[12] It continues with description of how distances traveled by bicyclists were calculated based on the origin and destination locations reported by the intercepted bicyclists, and concludes with an estimate of the annual motor-vehicle miles replaced by bicycle-rail trips.

Bicycle Use Estimates

Mariachi Plaza and Atlantic Stations were not in operation in FY 2009, and, therefore, are not used in the calculations. Accordingly, only 17 of the 19 stations were sampled for the weekday and only 15 of the 19 stations for the weekend.[13] Table 14 estimates the total annual bicycle ridership on Metro Rail by extrapolating the bicycle trips recorded during the count periods at the sample stations to represent daily, weekly and annual bicycle trip numbers. These were then expanded to represent bicycle trips at all stations. The extrapolations use ratios based on Metro Rail ridership information for FY 2009.

Table 14 first estimates the daily weekday trips projected from weekday morning counts (Item A) and projected from weekday evening counts (Item B). It then averages these two counts to come up with the daily weekday bicycle trips (Item C). Annual weekday trips (Item D) are then calculated by applying the ratio of weekday trips/annual weekday trips. The same is conducted for weekend trips with daily weekend trips projected from weekend counts (Item E). These are then extrapolated using the ratio of

[12] This methodology was developed specifically for this study but was based on the standard methodology of extrapolating annual traffic counts from peak hour counts.

[13] Bicycle counts were not recorded at two of the 19 stations during the weekend. With two other stations not in operation in FY2009, only 15 stations were sampled for the weekend.

weekend trips/annual weekend trips to get annual weekend trips (Item F). Annual bicycle trips (Item G) are then calculated by summing the annual weekday and weekend trips.

Appendix C includes ridership calculations for the 17 stations which were in operation in FY2009.

Annually, there are approximately 1,194,200 bicycle trips taken on the Metro Rail system, representing 1.3 percent of all annual trips.[14]

Table 14: Estimated Annual Bicycle Trips for the Metro Rail System

	Count Stations*	All Stations**	Calculation Notes***
A. Daily Weekday Bicycle Trips Projected from 6 a.m. to 10 a.m. counts	1,693	3,937	Weekday boardings and alightings counted between 6 a.m.-10 a.m. (see Table 3) divided by 2 to get trips, divided by .268 (i.e. the ratio of 6 a.m.-10 a.m. weekday ridership to 24-hour weekday ridership)
B. Daily Weekday Bicycle Trips Projected from 4 p.m. to 8 p.m. counts	1,651	3,840	Weekday boardings and alightings counted between 4 p.m.-8 p.m. (see Table 3) divided by 2 to get trips, divided by .319 (i.e. the ratio of 4 p.m.-8 p.m. weekday ridership to 24-hour weekday ridership)
C. Daily Weekday Bicycle Trips	1,672	3,888	Average of A and B
D. Annual Weekday Bicycle Trips	426,310	991,552	Daily weekday trips (C) divided by .004 (i.e. the ratio of daily weekday transit trips to annual weekday transit trips)
E. Daily Weekend Bicycle Trips Projected from 10 a.m. to noon counts	1,468	3,698	Weekend boardings and alightings counted between 10 a.m.-noon (see Table 3) divided by 2 to get trips, divided by .117 (i.e. the ratio of 10 a.m.-noon weekend ridership to 24-hour weekend ridership)
F. Annual Weekend Bicycle Trips	80,418	202,613	Daily weekend trips (E) divided by .018 (i.e. the ratio of daily weekend transit trips to annual weekend transit trips)
E. Annual Bicycle Trips (including weekday, weekend, and holidays)	506,729	1,194,165	Annual weekday bicycle trips (D) plus annual weekend bicycle trips (F)

Notes (Table 14):
**Weekday counts include data at 17 stations. Weekend counts include data at 15 stations.*
***All station estimates are based on the total ridership ratio between the 17 weekday count stations (15 weekend count stations) and all stations. These ratios are calculated for the weekday as 0.421 (i.e. 62,062,071 riders per year at the 17 count stations compared to 147,586,879 riders per year at all stations) and for the weekend as 0.378 (i.e. 14,464,796 riders per year at the 15 count stations compared to 38,250,173 riders per year at all stations). A factor is also applied to account for the fact that two stations were not in operation in FY2009: Mariachi Plaza and Atlantic, both on the Metro Gold Line. A factor of 2.2% was applied on the weekday and 4.95% on the weekend, representing the percentage of riders counted at these stations (see Table 3).*
****Ratios are based on Metro Rail ridership information for FY 2009.*

[14] In FY 2009, the Metro rail system recorded 185 million boardings and alighting, which equates to approximately 92.9 million trips (a trip equals one boarding and one alighting).

Distance Traveled

Using the nearest cross-streets to the origins and destinations as reported by bicyclists, the authors calculated the shortest distance between points using Geographic Information Software (GIS) and a map of surface streets for Los Angeles County. Distance was calculated for each trip to or from a station (A to B and C to D), as well as for the hypothetical trip between origin and destination (A to D) (see Figure 8).

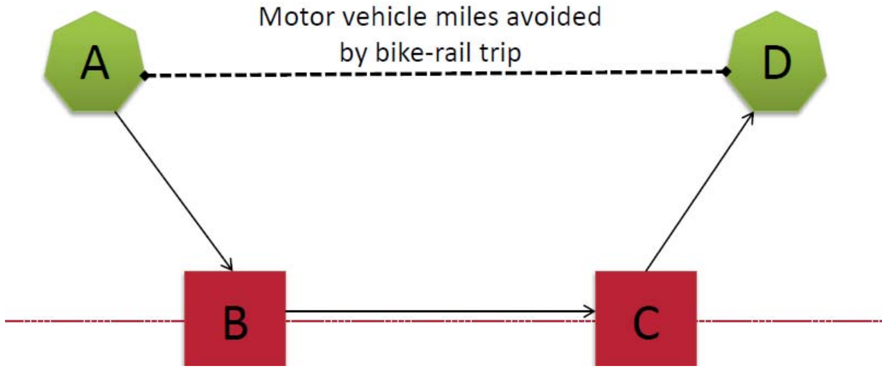


Figure 8: Schematic of Distance Calculations for Origin to Destination

The process of mapping origin and destination points is sensitive to the accuracy of the street names, and for this reason, only a subset of origin and destination points could be mapped. Within the time-frame of the study, unmapped cross-streets were reviewed and manually located on the map.

Distance To or From the Station

Of the 605 surveys with address information, 106 had origin addresses only, 65 had destination addresses only, and 434 surveys had addresses for both origin and destination. This works out to 1,039 trips to or from a station, of which distance could be calculated for 1000 trips, or 96 percent. The remaining 4 percent contained addresses that could not be located on the map.

Table 15 summarizes the distance traveled to or from station by mode. On average, bicyclists traveled 2.2 miles to access a station. Respondents who bicycled and took the bus traveled an average of 4.9 miles to access a station. Respondents using motor vehicles traveled the farthest to access a station. Table 15 summarizes the distance traveled to or from a station by mode.

Table 15: Distance Traveled to or From Station by Mode

Mode To or From Station	Average Miles per Trip	Max Miles Reported	Total Trips
Biked	2.2	50.5	829
Walked	2.4	30.2	18
Drove alone	7.9	9.7	5
Dropped off	4.2	6.5	3
Carpooled	5.8	9.9	3

Mode To or From Station	Average Miles per Trip	Max Miles Reported	Total Trips
Bus	8.6	106.0	40
Metrolink	6.5	6.5	1
Linked Trips (Average)	4.1	12.7	97
Biked & Bus	*4.9*	*15.7*	*33*
Biked & Train/Subway/Light Rail	*2.2*	*19.2*	*28*
Train/Subway/Light Rail	*5.1*	*21.5*	*19*
Biked &Train/Subway/Light Rail & Bus	*2.6*	*5.0*	*7*
Biked & Walked	*1.5*	*3.8*	*6*
Train/Subway/Light Rail & Bus	*11.4*	*22.9*	*3*
Biked & Walked & Bus	*0.7*	*0.7*	*1*
No mode stated	3.5	12.0	4

Distance from Origin and Destination

Of the 434 surveys that included both origin and destination addresses, distance was only calculated for the 114 respondents who indicated that they would switch to driving, carpooling or getting dropped off if they couldn't bicycle and take the train. Distance was calculated by using GIS to map the shortest route between the origin address and the destination address along surface streets. Average distance of an origin-destination trip along surface streets is 12.27 miles.

Vehicle Miles Avoided

Vehicle miles avoided are calculated for the length of the total bicycle-rail trip from origin to destination (A to D) (see Figure 8).

Respondents were asked how they would have made the entire trip, from their origin to their destination (A to D), if they couldn't take their bike and the rail. Twenty-seven percent indicated that they would shift from their bicycle-rail trip to driving alone, carpooling or being dropped off. Applying this percentage to the estimated total bicycle-rail trips translates to the reduction of 322,425 motor vehicle trips each year. The average distance of a shifted bicycle-rail trip is 12.27 miles. Applying this to the reduced motor vehicle trips yields the reduction of just under 4 million motor-vehicle miles each year, as presented in Table 16.

Table 16: Vehicle Miles Reduced by Combined Bicycling/Rail Trips

1	Total annual estimated system-wide bicycle-rail trips (Table 14)	1,194,165
2	Percent of trips that would be replaced by motor vehicle trip (Table 11)	27%
3	Total number of trips that would be replaced by a motor vehicle trip (line 1 x line 2)	322,425
4	Average distance per shifted trip (miles)	12.27
5	Total Annual Motor Vehicle Miles Avoided (line 3 x line 4)	3,957,422

Estimated Greenhouse Gas Emissions Reduction

Reductions in VMT will have the co-benefit of reducing mobile-source air pollutant emissions, which include greenhouse gas (GHG) emissions, criteria pollutant emissions, and air toxics emissions. All of these are regulated in California with the last two being regulated by the United States Environmental Protection Agency. Including a discussion of the emissions mentioned above will convey the entire spectrum of regulated air quality emissions.

A key issue related to GHG emissions is that vehicular travel contributes significantly to overall emissions. Statewide, transportation emissions from vehicles generate over one-third of overall emissions. At a municipal level, transportation may contribute more than 50 percent to citywide or countywide emissions[15].

The South Coast Air Basin (Basin) currently fails to meet national ambient air quality standards (NAAQS) for three criteria pollutants: ozone (O_3), inhalable particulates (PM_{10}) and fine particulates ($PM_{2.5}$). The 1990 amendments to the federal Clean Air Act identify specific emission-reduction goals for areas such as the Basin that do not meet NAAQS. Within the Basin, automobile exhaust comprises the largest source of O_3 precursor emissions reactive organic compounds (ROC) and nitrogen oxides (NO_X).

With respect to air toxics, the South Coast Air Quality Management District (SCAQMD) has recently completed the Multiple Air Toxics Exposure Study III (MATES III), which was an ambient air monitoring and evaluation study conducted in the Basin. The MATES III study concluded that the average carcinogenic risk throughout the Basin attributed to toxic air contaminants is approximately 1,194 in one million. Mobile sources (e.g., cars, trucks, trains, ships, aircraft, etc.) represent the greatest contributor to inhalation cancer risk.

Bicycle-rail trips, by reducing automobile travel, improve sustainability and livability by reducing GHG, criteria pollutant and mobile-source air toxics (MSAT) emissions. This section develops air pollutant reduction estimates and relates those estimates to annual vehicle offsets.

Senate Bill 375

Senate Bill 375 enhances California's ability to reach its AB 32 goals by promoting good planning with the goal of more sustainable communities. Per the law, the California Air Resources Board (ARB) developed regional greenhouse gas emission reduction targets for passenger vehicles, which account for a third of the states greenhouse gas emissions, during September 2010. ARB established targets for 2020 and 2035 for each region covered by one of the State's 18 metropolitan planning organizations (MPOs). Each of California's MPOs must now prepare a "sustainable communities strategy (SCS)" that demonstrates how the region will meet its greenhouse gas reduction target through integrated land use, housing and transportation planning. Once adopted by the MPO, the SCS will be incorporated into that region's federally enforceable regional transportation plan (RTP). ARB is also required to review each final SCS to determine whether it would, if implemented, achieve the greenhouse gas emission reduction target for its region. If the combination of measures in the SCS will meet the region's target, the MPO must prepare a separate "alternative planning strategy (APS)" to meet the target.

[15] CoolCalifornia.org, Green L.A.: Climate Action Plan to Lead Nation, accessed January 5, 2011.

On June 30, 2010, ARB, with cooperation from a technical working group formed of MPO staff members, released its *Draft Regional Greenhouse Gas Emission Reduction Targets for Automobiles and Light Trucks Pursuant to Senate Bill 375*. In the draft report, the Southern California Association of Governments (SCAG), the MPO for the project area, agreed to preliminary per capita reduction targets of 8% and 13% at years 2020 and 2035, respectively, compared to base year 2005 per capita emissions levels. These official reduction targets were adopted by ARB on September 23, 2010.[16]

Methodology

Vehicle emission volumes are determined by several factors, including the types of vehicles in circulation, how often they are started and stopped, how they are driven (speed distribution profile), and how far they are driven (VMT). The Caltrans Emissions Factors model (CT-EMFAC) was used to estimate GHG, criteria pollutant, and MSAT emissions reductions, based on the VMT reduction estimates derived from the survey results.

CT-EMFAC is a California-specific project-level analysis tool, which models the GHG constituent pollutant carbon dioxide (CO_2), as criteria pollutant and MSAT emissions using the latest version of the California Mobile Source Emission Inventory and Emission Factors model (EMFAC2007). The model was developed by UC Davis, in coordination with Caltrans and the California Air Resources Board (CARB), and is the Caltrans preferred model for quantification of mobile-source GHG emissions. Emissions rates vary by vehicle speed, and as a result, the ratio of air pollutant emissions generated per mile is not a flat rate. This estimate reflects the diversity of vehicle speeds based on the year 2010 EMFAC2007 speed distribution profile for Los Angeles County. For GHG constituent emissions nitrous oxide (N_2O) and methane (CH_4), average gram per mile emissions factors of 0.0065 and 0.016, respectively, were used to estimate emissions.[17]

GHG emissions other than CO_2 are commonly converted into carbon dioxide equivalents, which takes into account the differing global warming potential (GWP) of different gases. For example, the Intergovernmental Panel on Climate Change (IPCC) finds that N_2O has a GWP of 310 and methane has a GWP of 21. Thus, emissions of 1 ton of N_2O and 1 ton of CH_4 are represented as the emissions of 310 tons and 21 tons of CO_2 equivalent (CO_2e), respectively. This method allows for the summation of different GHG emissions into a single total.

Combined Bicycle-Rail Use Emissions Reductions

As stated earlier, bicyclists who use the Metro system to facilitate bicycle-rail trips result in an annual VMT reduction estimate of 3,957,422 miles. This would lead to a direct reduction in mobile-source emissions that include GHG emissions, criteria pollutant emissions, and MSAT emissions. Pollutant reduction estimates are provided below in Table 17.

[16] California Air Resources Board, *Draft CEQA Functional Equivalent Document (SCH#2010081021) for Proposed Regional Greenhouse Gas Emission Reduction Targets for Automobiles and Light Trucks Pursuant to Senate Bill 375*, August 9, 2010; California Air Resources Board, “News Release: California Takes the First Step Toward More Livable, Sustainable Communities,” September 23, 2010, http://www.arb.ca.gov/newsrel/newsrelease.php?id=154, accessed January 6, 2011.

[17] Derived by averaging the passenger vehicle emissions factors for years 2005 through 2008 provided in the Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories, Version 1.1, May 2010, prepared by the California Air Resources Board.

Table 17: Emissions Reductions in Tons per Year

Pollutant	Emissions Reduction Estimate (Tons/Yr)
GHG Emissions (Metric Tons)	
Carbon Dioxide (CO_2)	2,144
Nitrous Oxide (N_2O)	9
Methane (CH_4)	1
CO_2 equivalent (CO_2e)	2,154
Criteria Pollutant Emissions	
Reactive Organic Compounds (ROC)	1.1
Nitrogen Oxides (NO_X)	3.74
Carbon Monoxide (CO)	12.98
Sulfur Dioxide (SO_2)	0.02
Inhalable Particulates (PM_{10})	0.16
Fine Particulates ($PM_{2.5}$)	0.15
MSAT Emissions	
Diesel Particulate Matter	0.0928
Formaldehyde	0.0385
1,3-Butadiene	0.0042
Benzene	0.0235
Acrolein	0.0009
Acetaldehyde	0.0161

As shown above, bicyclists who use the Metro system to facilitate combined bicycle-rail trips would reduce GHG emissions by approximately 1,947 metric tons of CO_2e per year. As a co-benefit, there would also be reductions in criteria air pollutants and MSAT emissions.

Vehicle Offsets

Another way to assess the benefits of the combined bicycle-rail trips is to measure the GHG emission reductions in a different context, namely vehicle offsets. On average, an automobile is driven 11,720 miles per year, producing 5.1 metric tons of CO_2e[18]. The mode shift generated by combined bicycle-rail trips would take the equivalent of about 422 automobiles off the road annually.

Findings and Recommendations

Findings

This study indicates that bicyclists are a small but important subset of riders on the Metro Rail system, and bicycle-rail trips offset vehicle miles traveled resulting in quantifiable greenhouse gas emissions. The counts and extrapolated methodology mirrors commonly accepted practices in traffic analysis, with the exception of our small sample size. If a larger sample size were to validate our findings, then the following extrapolated numbers shows the potential for reducing VMT and GHGe:

[18] United States Environmental Protection Agency, Greenhouse Gas equivalencies calculator (http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results), May 31, 2011.

- Approximately 1,195,000 bicyclists would use the Metro Rail system annually. (Which represents 1.3 percent of all annual trips.)
- Bicycle-rail trips would replace approximately 322,000 motor vehicle trips and reduce 3.96 million vehicle miles traveled each year, offsetting approximately 2,154 metric tons of carbon dioxide equivalents (CO_{2e}) annually. This would be equivalent to taking 422 motor vehicles off the road.[19]
- Bicyclists are universally using the Metro Rail system, with bicyclists reporting starting or ending their rail trip at 71 out of 73 Metro Rail stations surveyed.
- Over a quarter (27 percent) of bicycle-rail trips replace a motor vehicle trip[20].
- In terms of getting to or from the station, twelve percent of bicycle trips replaced motor vehicle trips[21].
- On average, 13 bicyclists per hour—one bicyclist every five minutes—enters or exits a Metro train during the weekday morning or weekday evening peak periods. An average of 10 bicyclists per hour – one every six minutes – enters or exits a Metro train during the weekend midday period.

This study provides data on the “bikeshed” of Metro Rail stations, and underscores the importance of increasing a bicyclists’ reach by providing for bicycles on transit.

- On average, bicyclists traveled 2.2 miles to access train travel (these distance are within the typical bicycling catchment area of a train station). Bicyclists taking the bus travel an average of 4.9 miles to access a station.

Bicyclists are using the Metro system just as other Metro riders do.

- Respondents generally follow commute trends, with 90 percent of respondents starting their weekday a.m. trip at home and 65 percent of respondents ending their weekday a.m. trip at work. Similarly, 54 percent of respondents started their weekday p.m. trip at work and 66 percent of respondents ended their weekday p.m. trip at home.

Accommodating bicyclists at rail stations and on trains provides mobility benefits.

- Thirteen percent of bicyclists would not make their trip if they couldn’t bicycle and take the train.
- Respondents are more transit dependent than the general population, with 11 percent of respondents stating that they “rarely” have access to a motor vehicle and over a third of respondents (37 percent) stating that they “never” have access to a motor vehicle. In Los Angeles County, 9.4% of households do not have access to a motor vehicle.[22]

Allowing bicycles on trains is a major reason why people choose to bicycle, particularly for riders who have access to a motor vehicle.

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[19] On average, an automobile is driven 11, 720 miles per year, producing 5.1 metric tons of CO_2e.

[20] Origin to final destination, or A to D trip.

[21] Origin to train station, for example, A to B or B to C trip.

[22] U.S. Census Bureau, 2006-2008 American Community Survey 3-Year Estimates.

- Survey respondents overwhelmingly said that being allowed to take their bike on the train influenced their decision to travel by bike and rail. Of the 477 people who responded to the question, 65 percent chose "allowed to take bike on train" as a factor that influenced their decision.
- Respondents with access to a motor vehicle are more likely than those without access to a motor vehicle to cite "allowed to take bike on train," "no car parking at station," "bike lockers at station," and "have to pay for car parking at station" as factors that influenced their decision to bicycle.

Women are much less likely to bicycle to a Metro Rail station than men.

- Respondents were mostly male (86 percent) and 75 percent were between the ages of 18 and 39. This percentage of female bicyclists is consistent with the data collected through the 2009 City of Los Angeles Bike Count, which found only 15% of bicyclists counted were female.
- In other California urban areas, women typically represent between 25 and 30 percent of bicyclists rather than the 14 percent found by this study, suggesting that there may be ways that Metro can increase the percentage of women using the bike-rail mode.[23]

Recommendations

Bicycle travel is a small but important part of travel on Metro's facilities. This study demonstrates the impact of bicycling at Metro's rail stations. ***This study provides empirical data on travel by bicycle on Metro's facilities. Use of this data and other similar data that may be collected in the future will be key to designing effective strategies to promote, sustain, and expand bicycle mode share across Metro's system.***

One way to assess the current and potential impact of bicycling is to compare GHG reductions from bicycle trips to GHG reductions from other alternative mode options and energy saving strategies. Metro's "Greenhouse Gas Emissions Cost Effectiveness Study" (June 2010) quantified costs for, among others, bicycle facilities and incentives to reduce GHGe:

1. The options presented in that report represent two distinct investment pilots, both of which were shown to reduce GHG emissions. The cost-effectiveness of bicycle programs could be improved substantially by exploring ways to achieve the same or higher increases in bicycling at lower cost to Metro
2. Bicycle programs provide a number of co-benefits beyond emission reductions including increased safety for bicyclists and pedestrians, health benefits from increases in physical activity, and generating higher ridership on Metro buses and trains. Dollars per ton of GHG reduced are among several key criteria to judge the benefits of bicycling on Metro facilities.

[23] The Seamless Travel Study by U.C. Berkeley's Safe Transportation Research and Education Center (2010) conducted intercept surveys of 212 bicyclists at 25 locations throughout San Diego County and found a gender breakdown of 68% male, 32% female. The San Francisco State of Cycling Report Card (2008) conducted intercept surveys of bicyclists and found a gender breakdown of 73% male, 23% female. Portland, Oregon, which has constructed an extensive network of bicycle facilities over the last decade and has an outreach program targeted to women bicyclists, has seen the percentage of female bicyclists increase to 32% as of 2009.

3. The total potential impact of a program of coordinated bicycle investments is greater than the sum of its parts. There is a definite "network effect" to bicycle travel. While individual facilities do attract new users, more riders will be attracted to each facility when bicycles can be a safe, convenient, and efficient means of transport for all destinations in Los Angeles. The true benefits of bicycle strategies are likely to grow over time as the network becomes more robust and as more people view bicycling as a competitive mode of transportation.

Appendix A: Survey Instruments

Survey for Bicyclists
Arriving at Station to Board Train

Directions to Surveyor – Please read aloud each question and the answers to the bicyclist, and ask them to give you their one best answer. All questions should have only one answer, unless otherwise indicated.

When reading the questions, replace "______ (origin)" or "______ (destination)," with the origin and destination that the bicyclist told you. Questions 11 through 14 are optional, and should be asked if the bicyclist has enough time.

TO BE FILLED OUT BY SURVEYOR

Name ________________________

Station ________________________

Date of survey ________________________

Time of survey: ◯ AM Weekday ◯ PM Weekday ◯ mid-day weekend

ORIGIN

1. **Where did you come from just now to get to this train station?** *(origin)*
   - ◯ Home
   - ◯ Work
   - ◯ Store, restaurant, movies, or other shopping and entertainment
   - ◯ Family or friend's house
   - ◯ Doctor, dentist or other personal business
   - ◯ Other *(Please specify.)* ____________________

2. **How did you get here? *(Check all that apply.)***
   - ◯ Biked ◯ Walked ◯ Bus
   - ◯ Drove alone ◯ Carpooled ◯ Dropped off
   - ◯ Train/Subway/Light Rail
   - ◯ Other *(Please specify.)* ____________________

3. **What are the nearest cross streets and city to __________ (origin)?**

   Cross streets ________________________

   City or zip ________________________

   Other information that will help us identify the location (optional)

   ____

DESTINATION

4. **At which stop will you be exiting?**

   Station ________________________

   Line (check one):
   - ◯ Red ◯ Gold ◯ Blue
   - ◯ Green ◯ Purple

5. **Once you get off the train, where are you headed?** *(destination)*
   - ◯ Home
   - ◯ Work
   - ◯ Store, restaurant, movies, or other shopping and entertainment
   - ◯ Family or friend's house
   - ◯ Doctor, dentist or other personal business
   - ◯ Other *(Please specify.)* ____________________

6. **How will you get there? *(Check all that apply.)***
   - ◯ Bike ◯ Walk ◯ Bus
   - ◯ Drive alone ◯ Carpool ◯ Drop off
   - ◯ Train/Subway/Light Rail
   - ◯ Other *(Please specify.)* ____________________

7. **What are the nearest cross streets and city to __________ (destination)?**

   Cross streets ________________________

   City or zip ________________________

   Other information that will help us identify the location *(optional)*

   ____

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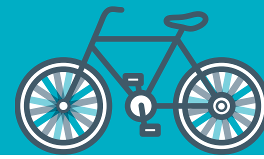
Please see back to complete the survey.

Survey for Bicyclists
Arriving at Station to Board Train (continued)



MODE CHOICE

8. Think about your trip from ___________ (origin) to this station. *If you didn't have your bike*, how would you have made the trip? *(Check all that apply.)*

- ◯ Walked
- ◯ Bus
- ◯ Drove alone
- ◯ Carpooled
- ◯ Dropped off
- ◯ Train/Subway/Light Rail
- ◯ Would not have made the trip
- ◯ Other *(Please specify.)* ________________________

9. Think about your trip from the train station you're going to and ___________ (destination). *If you didn't have your bike*, how would you make the trip? *(Check all that apply.)*

- ◯ Walk
- ◯ Bus
- ◯ Drive alone
- ◯ Carpool
- ◯ Drop off
- ◯ Train/Subway/Light Rail
- ◯ Would not make the trip
- ◯ Other *(Please specify.)* ________________________

10. Think about your trip from ___________ (origin) to ___________ (destination). *If you didn't have your bike and couldn't take the train*, how would you make the trip? *(Check all that apply.)*

- ◯ Walk
- ◯ Bus
- ◯ Drive alone
- ◯ Carpool
- ◯ Drop off
- ◯ Would not make the trip
- ◯ Other *(Please specify.)* ________________________

OPTIONAL QUESTIONS

To be asked by surveyors only if there is time.

"Do you have enough time to answer a few more questions?"

11. Do you have access to a car?

- ◯ Always
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

12. Of the following choices, which ones influenced your decision to ride your bike to the train today, rather than walk, drive or take the bus? *(Check all that apply.)*

- ◯ Bike racks at the station
- ◯ Bike lockers at the station
- ◯ Allowed to take bike on the train
- ◯ Good bike facilities on the way to the station
- ◯ Have to pay for car parking at the station
- ◯ No car parking at the station
- ◯ None of the above

13. What age group do you fall into?

- ◯ 18 to 29 years
- ◯ 30 to 39 years
- ◯ 40 to 50 years
- ◯ 51 to 60 years
- ◯ 61+ years

14. What gender do you identify with? *(Best to have the surveyor make a note rather than ask!)*

- ◯ Male
- ◯ Female

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Encuesta para ciclistas
que llegan a la estación para abordar el tren

Instrucciones para los encuestadores – Por favor lea en voz alta cada pregunta y respuesta a los ciclistas y pída que le den la mejor respuesta. Todas las preguntas deben tener sólo una respuesta a menos que se indique lo contrario.

Cuando lea la pregunta reemplace "______ (origen)" o "______ (destino)," con el origen y destino que el ciclista le indicó. Las preguntas 11 al 14 son opcionales y deben ser preguntadas si el ciclista tiene suficiente tiempo.

PARA SER LLENADO POR EL ENCUESTADOR

Nombre ______________________________

Ubicación de la estación ______________________________

Fecha de la encuesta ______________________________

Hora de la encuesta: ○ AM entre semana ○ PM entre semana ○ Medio día fin de semana

ORIGEN

1. **¿De dónde acaba de venir para llegar a esta estación de tren?** *(origen)*
   - ○ Casa
   - ○ Trabajo
   - ○ Tienda, restaurante, cine u otro lugar de compras y entretenimiento
   - ○ Casa de familia o amigos
   - ○ Doctor, dentista u otro negocio personal
   - ○ Otro *(Por favor especifique.)* ____________________

2. **¿Cómo llegó? *(Marque todas las que corresponden.)***
   - ○ En bicicleta
   - ○ Caminando
   - ○ En autobús
   - ○ Conduciendo solo
   - ○ En camioneta compartida
   - ○ Lo trajeron
   - ○ En tren/tren subterráneo/tren ligero
   - ○ Otro *(Por favor especifique.)* ____________________

3. **¿Cuáles son las calles de cruce y ciudad más cercana a __________ (origen)?**

   Calles de cruce ______________________________

   Ciudad o código postal ______________________________

   Otra información que pueda ayudarnos a identificar el lugar *(opcional)*

   ____

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DESTINO

4. **¿En qué parada bajará?**

   Estación ______________________________

   Línea *(Marque una.)*:
   - ○ Red
   - ○ Gold
   - ○ Blue
   - ○ Green
   - ○ Purple

5. **Una vez que baje del tren, ¿a dónde irá?** *(destino)*
   - ○ Casa
   - ○ Trabajo
   - ○ Tienda, restaurante, cine u otro lugar de compras y entretenimiento
   - ○ Casa de familia o amigos
   - ○ Doctor, dentista u otro negocio personal
   - ○ Otro *(Por favor especifique.)* ____________________

6. **¿Cómo llegará? *(Marque todas las que corresponden.)***
   - ○ En bicicleta
   - ○ Caminando
   - ○ En autobús
   - ○ Conduciendo solo
   - ○ En camioneta compartida
   - ○ Lo trajeron
   - ○ En tren/tren subterráneo/tren ligero
   - ○ Otro *(Por favor especifique.)* ____________________

7. **¿Cuáles son las calles de cruce y ciudad más cercana a __________ (destino)?**

   Calles de cruce ______________________________

   Ciudad o código postal ______________________________

   Otra información que pueda ayudarnos a identificar el lugar *(opcional)*

   ____

Voltee para completar la encuesta.

Encuesta para ciclistas que llegan a la estación para abordar el tren (continuado)

ELECCIÓN DEL MODO DE TRANSPORTE

8. **Piense en su viaje desde ___________ (origen) hasta esta estación. *Si no tuviera su bicicleta*, ¿cómo habría llegado? *(Marque todas las que corresponden.)***
   - ◯ Caminando
   - ◯ En autobús
   - ◯ Conduciendo solo
   - ◯ En camioneta compartida
   - ◯ Lo hubieron traído
   - ◯ En tren/tren subterráneo/tren ligero
   - ◯ No hubiera hecho el viaje
   - ◯ Otro *(Por favor especifique.)* ________________________

9. **Piense en su viaje desde la estación de tren a la que va y ___________ (destino). *Si no tuviera su bicicleta*, ¿cómo llegaría? *(Marque todas las que corresponden.)***
   - ◯ Caminando
   - ◯ En autobús
   - ◯ Conduciendo solo
   - ◯ En camioneta compartida
   - ◯ Lo hubieron traído
   - ◯ En tren/tren subterráneo/tren ligero
   - ◯ No hubiera hecho el viaje
   - ◯ Otro *(Por favor especifique.)* ________________________

10. **Ahora piense en su viaje de ___________ (origen) a ___________ (destino). *Si no tuviera su bicicleta y no pudiera tomar el tren*, ¿cómo llegaría? *(Marque todas las que corresponden.)***
   - ◯ Caminando
   - ◯ En autobús
   - ◯ Conduciendo solo
   - ◯ En camioneta compartida
   - ◯ Lo hubieron llevado
   - ◯ No hubiera hecho el viaje
   - ◯ Otro *(Por favor especifique.)* ________________________

PREGUNTAS OPCIONALES

Para ser incluidas en cada encuesta y preguntadas por los encuestadores sólo si hay tiempo.

"¿Tiene suficiente tiempo para contestar cuatro preguntas más?"

11. **¿Tiene acceso a un auto?**
   - ◯ Siempre
   - ◯ Algunas veces
   - ◯ Raramente
   - ◯ Nunca

12. **De las siguientes opciones, ¿cuales influenciaron su decisión para ir en bicicleta hacia el tren hoy, en vez de caminar, conducir, tomar el autobús? *(Marque todas las que corresponden.)***
   - ◯ Portabicicletas en la estación
   - ◯ Casilleros para bicicletas en la estación
   - ◯ Se le permite llevar la bicicleta en el tren
   - ◯ Buenas instalaciones para bicicletas en el camino a la estación
   - ◯ Tiene que pagar por estacionamiento de auto en la estación
   - ◯ No hay estacionamiento de auto en la estación
   - ◯ Ninguna de las anteriores

13. **¿A qué grupo de edad pertenece?**
   - ◯ 18 a 29 años
   - ◯ 30 a 39 años
   - ◯ 40 a 50 años
   - ◯ 51 a 60 años
   - ◯ más de 61 años

14. **¿Con qué género se identifica? *(¡Es preferible que el encuestador haga una nota en vez de preguntar!)***
   - ◯ Masculino
   - ◯ Femenino

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Survey for Bicyclists
Departing from Station after Exiting Train

Directions to Surveyor – Please read aloud each question and the answers to the bicyclist, and ask them to give you their one best answer. All questions should have only one answer, unless otherwise indicated.

When reading the questions, replace "_____ (origin)" or "_____ (destination)," with the origin and destination that the bicyclist told you. Questions 11 and 12 are optional, and should be asked if the bicyclist has enough time.

TO BE FILLED OUT BY SURVEYOR

Name ______________________________

Station ______________________________

Date of survey ______________________________

Time of survey: ◯ AM Weekday ◯ PM Weekday ◯ mid-day weekend

ORIGIN

1. At which station did you board the train?

Station ______________________________

Line *(Check one.)*:

◯ Red ◯ Gold ◯ Blue
◯ Green ◯ Purple

2. How did you get to that train station?

◯ Biked ◯ Walked ◯ Bus
◯ Drove alone ◯ Carpooled ◯ Dropped off
◯ Train/Subway/Light Rail
◯ Other *(Please specify.)* ______________

3. Where were you coming to the station from? *(origin)*

◯ Home
◯ Work
◯ Store, restaurant, movies, or other shopping and entertainment
◯ Family or friend's house
◯ Doctor, dentist or other personal business
◯ Other *(Please specify.)* ______________

4. What are the nearest cross streets and city to ________ (origin)?

Cross streets ______________________________

City or zip ______________________________

Other information that will help us identify the location *(optional)*

____

DESTINATION

5. Where are you going right now? *(destination)*

◯ Home
◯ Work
◯ Store, restaurant, movies, or other shopping and entertainment
◯ Family or friend's house
◯ Doctor, dentist or other personal business
◯ Other *(Please specify.)* ______________

6. How will you get there?

◯ Bike ◯ Walk ◯ Bus
◯ Drive alone ◯ Carpool ◯ Drop off
◯ Train/Subway/Light Rail
◯ Other *(Please specify.)* ______________

7. What are the nearest cross streets and city to ________ (destination)?

Cross streets ______________________________

City or zip ______________________________

Other information that will help us identify the location *(optional)*

____

Metro

Please see back to complete the survey.

Survey for Bicyclists
Departing from Station after Exiting Train (continued)

MODE CHOICE

8. Think about your trip from this station to __________ (destination).
If you didn't have your bike, how would you get there? *(Check all that apply.)*
   - ◯ Walk
   - ◯ Bus
   - ◯ Drive alone
   - ◯ Carpool
   - ◯ Drop off
   - ◯ Train/Subway/Light Rail
   - ◯ Would not make the trip
   - ◯ Other *(Please specify.)* ______________________

9. Think about your trip from __________ (origin) to the train station where you boarded. *If you didn't have your bike*, how would you have made the trip?
   - ◯ Walked
   - ◯ Bus
   - ◯ Drove alone
   - ◯ Carpooled
   - ◯ Dropped off
   - ◯ Train/Subway/Light Rail
   - ◯ Would not have made the trip
   - ◯ Other *(Please specify.)* ______________________

10. Now think about your trip from __________ (origin) to __________ (destination). *If you didn't have your bike and couldn't take the train*, how would you get there?
   - ◯ Walk
   - ◯ Bus
   - ◯ Drive alone
   - ◯ Carpool
   - ◯ Drop off
   - ◯ Train/Subway/Light Rail
   - ◯ Would not make the trip
   - ◯ Other *(Please specify.)* ______________________

OPTIONAL QUESTIONS

To be asked by surveyors only if there is time.

"Do you have enough time to answer a few more questions?"

11. Do you have access to a car?
   - ◯ Always
   - ◯ Sometimes
   - ◯ Rarely
   - ◯ Never

12. Of the following choices, which ones influenced your decision to ride your bike to the train today, rather than walk, drive or take the bus? *(Check all that apply.)*
   - ◯ Bike racks at the station
   - ◯ Bike lockers at the station
   - ◯ Allowed to take bike on the train
   - ◯ Good bike facilities on the way to the station
   - ◯ Have to pay for car parking at the station
   - ◯ No car parking at the station
   - ◯ None of the above

13. What age group do you fall into?
   - ◯ 18 to 29 years
   - ◯ 30 to 39 years
   - ◯ 40 to 50 years
   - ◯ 51 to 60 years
   - ◯ 61+ years

14. What gender do you identify with?
(Best to have the surveyor make a note rather than ask!)
   - ◯ Male
   - ◯ Female

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Encuesta para ciclistas que salen de la estación después de bajar del tren

Instrucciones para los encuestadores – Por favor lea en voz alta cada pregunta y respuesta a los ciclistas y pída que le den la mejor respuesta. Todas las preguntas deben tener sólo una respuesta a menos que se indique lo contrario.

Cuando lea la pregunta reemplace "_____ (origen)" o "_____ (destino)," con el origen y destino que el ciclista le indicó. Las preguntas 11 al 14 son opcionales y deben ser preguntadas si el ciclista tiene suficiente tiempo.

PARA SER LLENADO POR EL ENCUESTADOR

Nombre ____

Ubicación de la estación ______________________________

Fecha de la encuesta ________________________________

Hora de la encuesta:
- ◯ AM entre semana
- ◯ PM entre semana
- ◯ Medio día fin de semana

ORIGEN

1. ¿En qué estación tomó el tren?

Estación ____

Línea *(Marque una.)*:
- ◯ Red
- ◯ Gold
- ◯ Blue
- ◯ Green
- ◯ Purple

2. ¿Cómo llegó a esa estación del tren?
- ◯ En bicicleta
- ◯ Caminando
- ◯ En autobús
- ◯ Conduciendo solo
- ◯ En camioneta compartida
- ◯ Lo trajeron
- ◯ En tren/tren subterráneo/tren ligero
- ◯ Otro *(Por favor especifique.)* ________________________

3. ¿De dónde viajó para llegar a esa estación? *(origen)*
- ◯ Casa
- ◯ Trabajo
- ◯ Tienda, restaurante, cine u otro lugar de compras y entretenimiento
- ◯ Casa de familia o amigos
- ◯ Doctor, dentista u otro negocio personal
- ◯ Otro *(Por favor especifique.)* ________________________

4. ¿Cuáles son las calles de cruce y ciudad más cercana a ___________ (origen)?

Calles de cruce ____

Ciudad o código postal __________________________________

Otra información que pueda ayudarnos a identificar el lugar *(opcional)*

____

DESTINO

5. ¿Hacia dónde se dirige? *(destino)*
- ◯ Casa
- ◯ Trabajo
- ◯ Tienda, restaurante, cine u otro lugar de compras y entretenimiento
- ◯ Casa de familia o amigos
- ◯ Doctor, dentista u otro negocio personal
- ◯ Otro *(Por favor especifique.)* ________________________

6. ¿Cómo llegará?
- ◯ En bicicleta
- ◯ Caminando
- ◯ En autobús
- ◯ Conduciendo solo
- ◯ En camioneta compartida
- ◯ Lo trajeron
- ◯ En tren/tren subterráneo/tren ligero
- ◯ Otro *(Por favor especifique.)* ________________________

Metro®

Voltee para completar la encuesta.

Encuesta para ciclistas que salen de la estación después de bajar del tren (continuado)

7. **¿Cuáles son las calles de cruce y ciudad más cercana a __________ (origin)?**

   Calles de cruce ______________________________________

   Ciudad o código postal ________________________________

   Otra información que pueda ayudarnos a identificar el lugar *(opcional)*

   ____

ELECCIÓN DEL MODO DE TRANSPORTE

8. **Piense en su viaje desde esta estación hacia __________ (destino). *Si no tuviera su bicicleta*, ¿cómo llegaría?**
   - ◯ Caminando
   - ◯ En autobús
   - ◯ Conduciendo solo
   - ◯ En camioneta compartida
   - ◯ Lo hubieron traído
   - ◯ En tren/tren subterráneo/tren ligero
   - ◯ No hubiera hecho el viaje
   - ◯ Otro *(Por favor especifique.)* ____________________

9. **Piense en su viaje desde __________ (origen) hacia la estación en la que abordo el tren. *Si no tuviera su bicicleta*, ¿cómo habría llegado a la estación del tren?**
   - ◯ Caminando
   - ◯ En autobús
   - ◯ Conduciendo solo
   - ◯ En camioneta compartida
   - ◯ Lo hubieron traído
   - ◯ En tren/tren subterráneo/tren ligero
   - ◯ No hubiera hecho el viaje
   - ◯ Otro *(Por favor especifique.)* ____________________

10. **Ahora piense en su viaje de __________ (origen) a __________ (destino). *Si no tuviera su bicicleta y no pudiera tomar el tren*, ¿cómo llegaría?**
    - ◯ Caminando
    - ◯ En autobús
    - ◯ Conduciendo solo
    - ◯ En camioneta compartida
    - ◯ Lo hubieron llevado
    - ◯ No hubiera hecho el viaje
    - ◯ Otro *(Por favor especifique.)* ____________________

PREGUNTAS OPCIONALES

Para ser incluidas en cada encuesta y preguntadas por los encuestadores sólo si hay tiempo.

"¿Tiene suficiente tiempo para contestar dos preguntas más?"

11. **¿Tiene acceso a un auto?**
    - ◯ Siempre
    - ◯ Algunas veces
    - ◯ Raramente
    - ◯ Nunca

12. **De las siguientes opciones, ¿cuales influenciaron su decisión para ir en bicicleta hacia el tren hoy, en vez de caminar, conducir, tomar el autobús? *(Marque todas las que corresponden.)***
    - ◯ Portabicicletas en la estación
    - ◯ Casilleros para bicicletas en la estación
    - ◯ Se le permite llevar la bicicleta en el tren
    - ◯ Buenas instalaciones para bicicletas en el camino a la estación
    - ◯ Tiene que pagar por estacionamiento de auto en la estación
    - ◯ No hay estacionamiento de auto en la estación
    - ◯ Ninguna de las anteriores

13. **¿A qué grupo de edad pertenece?**
    - ◯ 18 a 29 años
    - ◯ 30 a 39 años
    - ◯ 40 a 50 años
    - ◯ 51 a 60 años
    - ◯ más de 61 años

14. **¿Con qué género se identifica? *(¡Es preferible que el encuestador haga una nota en vez de preguntar!)***
    - ◯ Masculino
    - ◯ Femenino

Metro

Appendix B: Additional Survey Data Tables

Survey responses to the questions:
Which station did you board the train? At which stop will you be exiting?

Blue	**180**	**191**	**Gold (con't)**		
103rd St	3	5	Mission	1	5
1st St	1	16	Pico / Aliso	1	1
5th St		4	Sierra Madre Vila	19	13
7th / Metro	30	19	Soto	1	
Anaheim	5	4	Southwest Museum	1	0
Artesia	1	10	Union Station	1	13
Compton	3	13	(blank)	1	2
Del Amo	25	7	**Green**	**114**	**107**
Firestone	3	6	Avalon	1	4
Florence	49	19	Aviation	18	14
Grand	28	30	Crenshaw	29	11
Imperial / Wilmington	16	15	Douglas	1	2
Pacific		1	El Segundo	2	8
Pacific Coast Hwy	3	5	Hawthorne	4	7
Pico		3	Imperial / Wilmington	2	3
San Pedro	2	5	Lakewood		5
Slauson	5	6	Long Beach	7	7
Transit Mall	1	1	Mariposa	4	2
Vernon		4	Norwalk	32	25
Wardlow		1	Redondo Beach	13	16
Washington	3	13	Union Station	1	
Willow	1	3	Vermont		2
(blank)	1	1	(blank)		1
Gold	**96**	**85**	**Red/Purple**	**212**	**219**
Allen	2	1	7th / Metro	4	10
Atlantic	21	12	Civic Center	8	4
Chinatown	3	2	Hollywood / Highland	7	15
Del Mar	2	2	Hollywood / Vine	6	12
Fillmore	1	1	Hollywood / Western	1	5
Highland Park	27	15	North Hollywood	41	35
Indiana	2	1	Pershing Square	7	7
Lake	1	7	Union Station	11	18
Lincoln / Cypress	3	2	Universal City	4	7
Little Tokyo	4	3	Vermont / Beverly	1	
Maravilla	1	1	Vermont / Santa Monica	22	21
Mariachi Plaza	3	1	Vermont / Sunset	3	5
Memorial Park	1	3	Westlake / MacArthur	17	23

Survey responses to the questions:
Which station did you board the train? At which stop will you be exiting?

Wilshire / Normandie	1	2
Wilshire / Vermont	47	26
Wilshire / Western	32	27
(blank)		2
Metrolink	**3**	**1**
Cal State LA		1
Industry	1	
Riverside	2	
Orange		**1**
De Soto		1
(blank)		**1**
(blank)		1
Grand Total	**605**	**605**

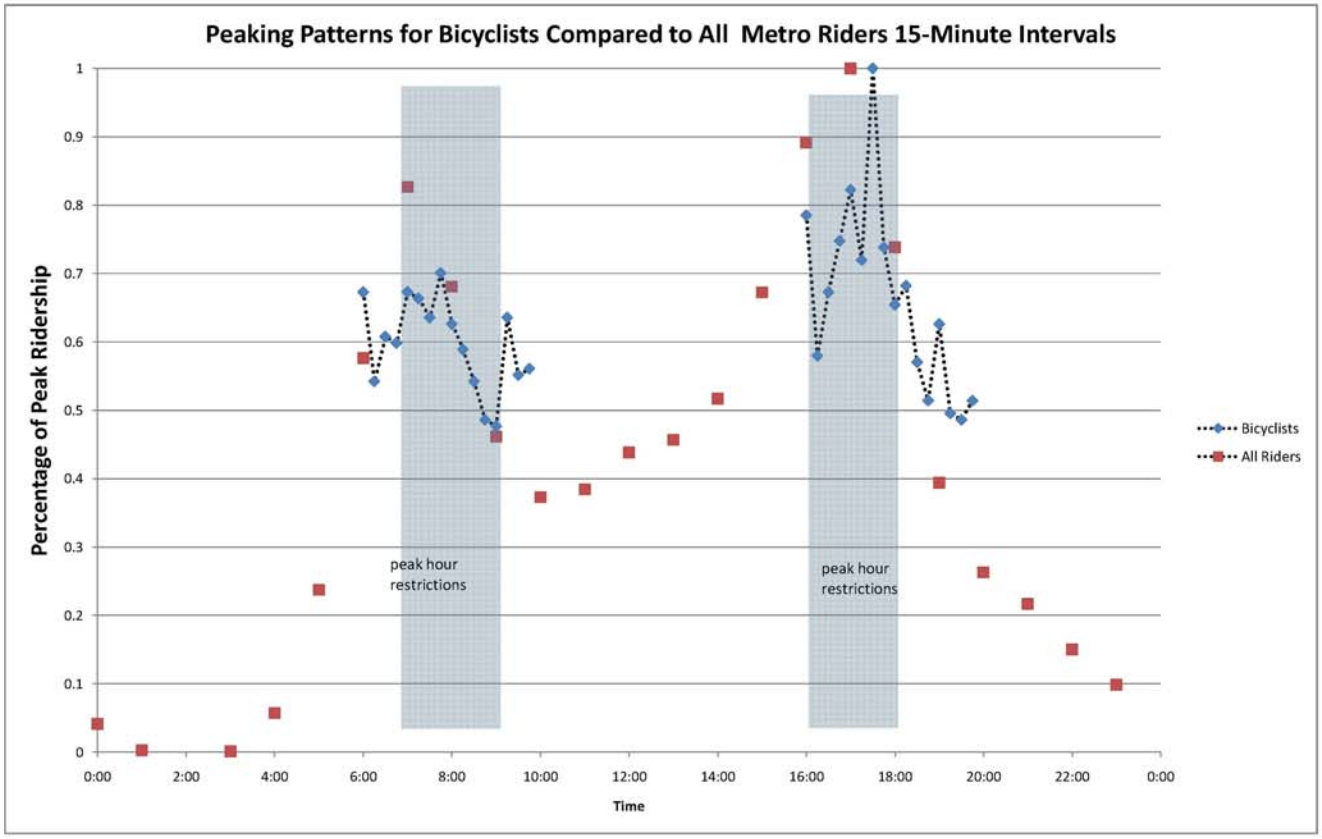
Calculations for Average Distance for Shifted Trips

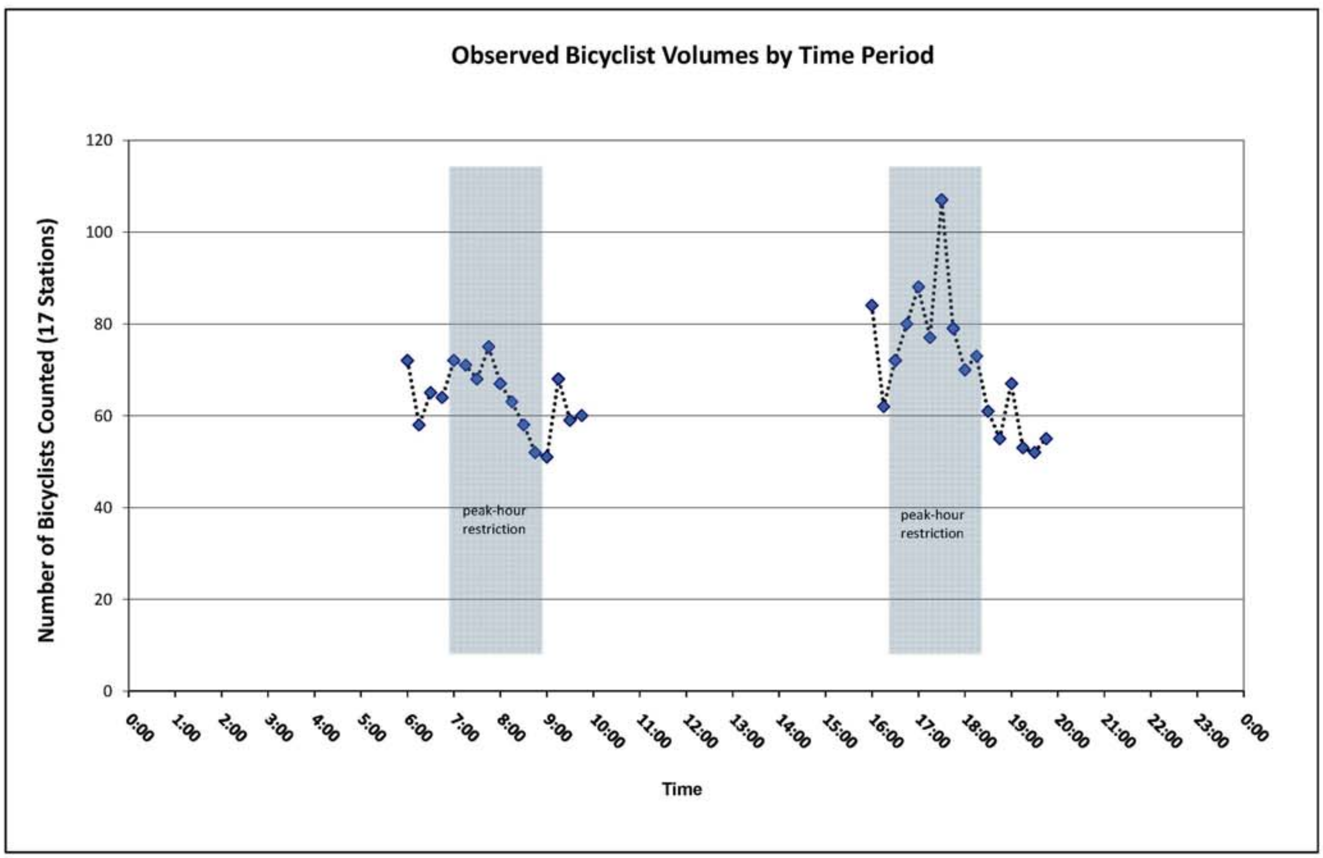
	Number of Shifted Trips for Which we can calculate distance	Total Vehicle Miles	Average Miles per Shifted Trip
Trips to or from a station	995	2657	2.67
Trips from origin to destination	114	1399	12.27

Appendix C: Additional Count Data Tables and Charts

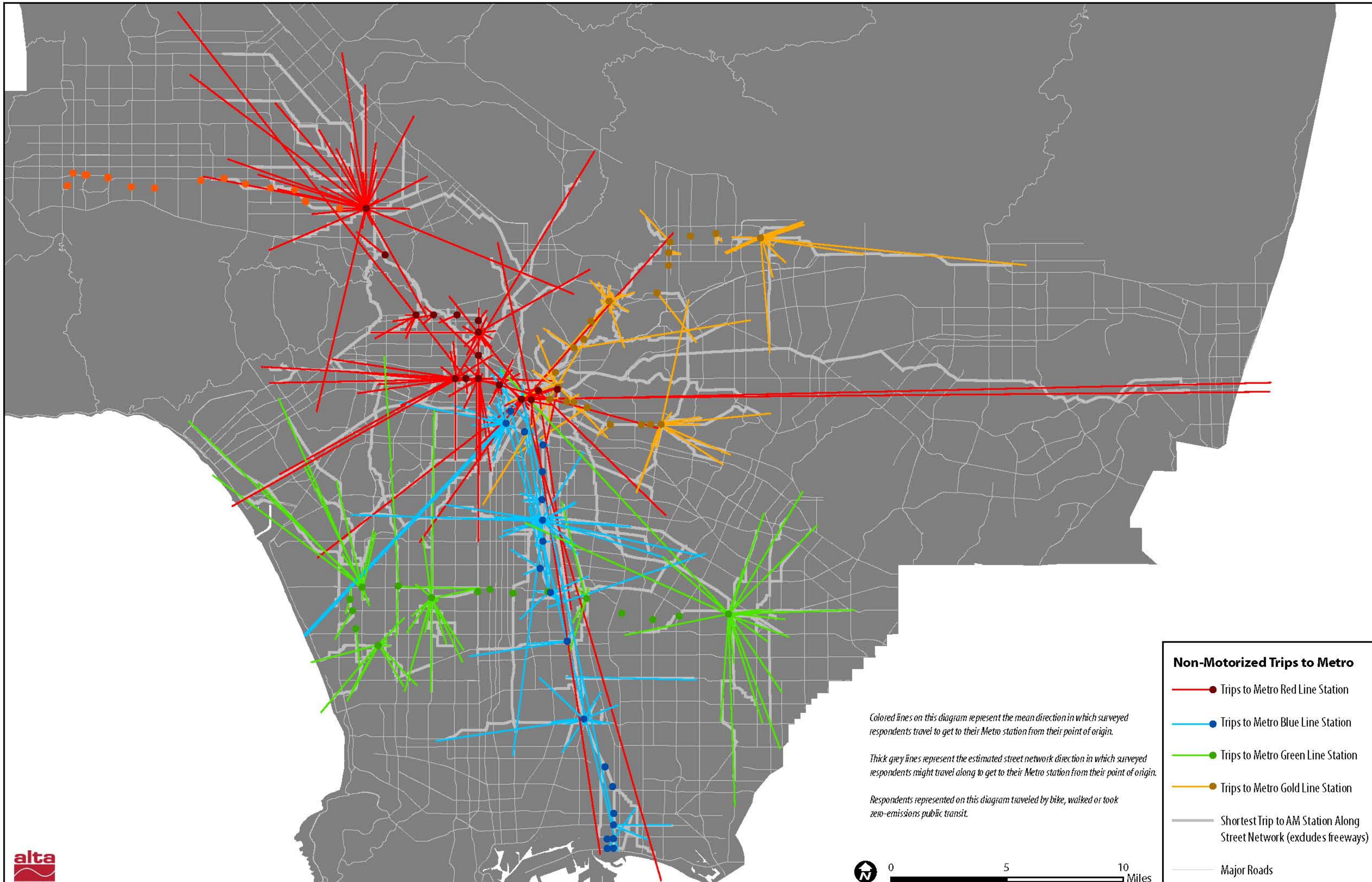
AM Weekday, PM Weekday, Midday Weekend Bicycle Counts by Station

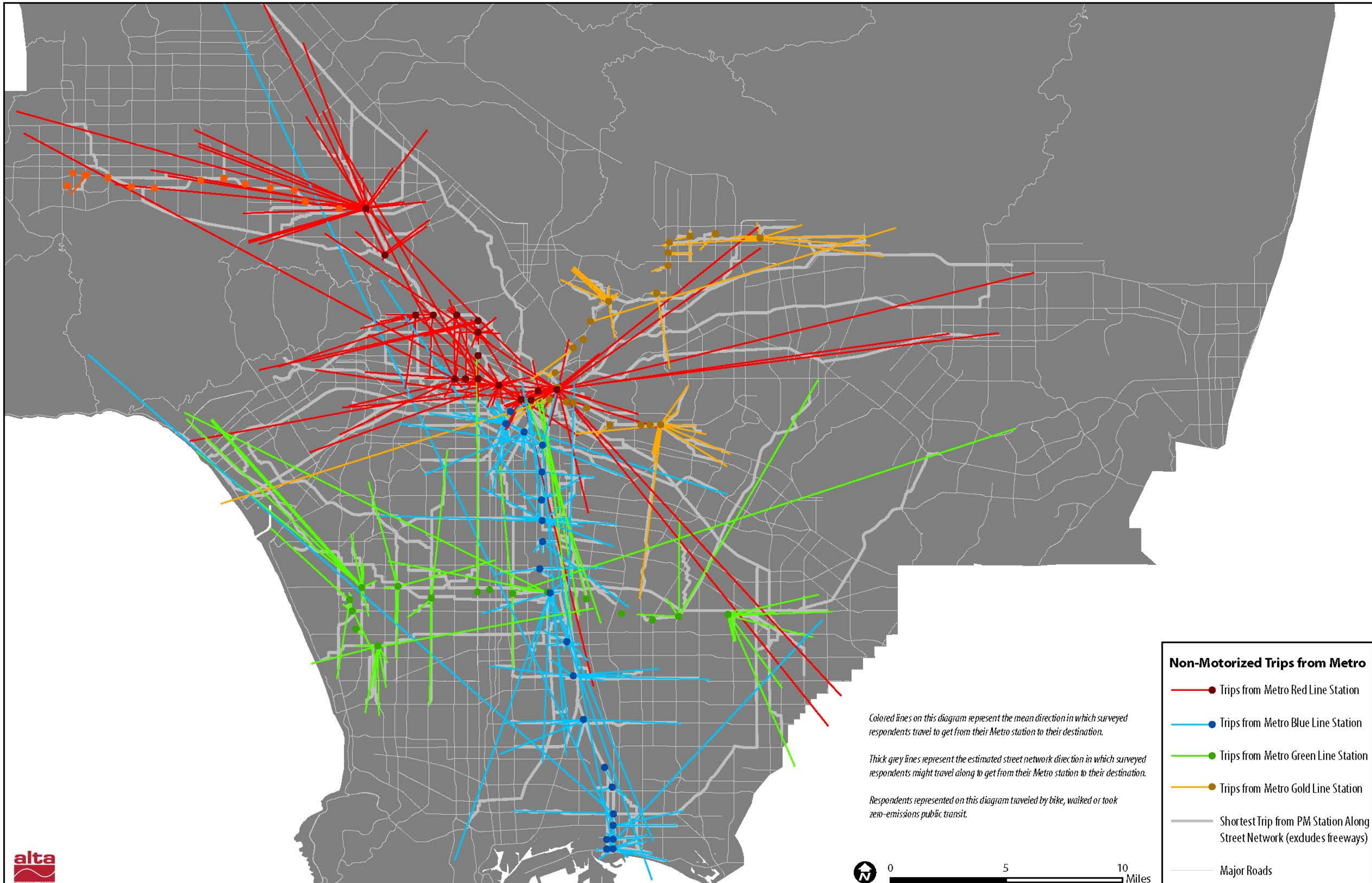
Station	Line	AM-Weekday	PM-Weekday	Weekend	Total	Hourly Counts	Notes
Imperial/Wilmington	Blue	102	185	50	337	33.7	Transfer Station
7th St/Metro Center	Blue	131	132	52	315	31.5	Transfer Station
Wilshire/Vermont	Red	98	94	22	214	21.4	
Florence	Blue	63	88	no data	151	18.9	
Norwalk	Green	69	64	15	148	14.8	End of line
Crenshaw	Green	47	64	21	132	13.2	
Westlake/MacArthur Park	Purple/Red	50	51	16	117	11.7	
Del Amo	Blue	46	53	13	112	11.2	
Vermont/Santa Monica	Red	30	35	38	103	10.3	Transfer Station
Wilshire/Western	Purple	36	46	no data	82	10.3	End of line
Aviation/LAX	Green	42	43	11	96	9.6	
North Hollywood	Red	44	26	23	93	9.3	End of line
Grand	Blue	42	36	15	93	9.3	
Highland Park	Gold	35	35	22	92	9.2	
Sierra Madre Villa	Gold	31	35	13	79	7.9	End of line
Redondo Beach	Green	20	21	12	53	5.3	End of line
Atlantic	Gold	11	26	12	49	4.9	End of line
1st Street	Blue	9	15	3	27	2.7	End of line
Mariachi Plaza	Gold	3	4	5	12	1.2	
Total		**909**	**1053**	**343**	**2,305**	**12.4**	


Peaking Patterns for Bicyclists Compared to All Metro Riders 15-Minute Intervals
Percentage of Peak Ridership
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
peak hour restrictions
peak hour restrictions
Bicyclists
All Riders
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time


Observed Bicyclist Volumes by Time Period
Number of Bicyclists Counted (17 Stations)
120
100
80
60
40
20
0
peak-hour restriction
peak-hour restriction
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time

Appendix D: Schematic Maps


Non-Motorized Trips to Metro
Trips to Metro Red Line Station
Trips to Metro Blue Line Station
Trips to Metro Green Line Station
Trips to Metro Gold Line Station
Shortest Trip to AM Station Along Street Network (excludes freeways)
Major Roads
Colored lines on this diagram represent the mean direction in which surveyed respondents travel to get to their Metro station from their point of origin.
Thick grey lines represent the estimated street network direction in which surveyed respondents might travel along to get to their Metro station from their point of origin.
Respondents represented on this diagram traveled by bike, walked or took zero-emissions public transit.
0
5
10
Miles
N
alta



Non-Motorized Trips from Metro
Trips from Metro Red Line Station
Trips from Metro Blue Line Station
Trips from Metro Green Line Station
Trips from Metro Gold Line Station
Shortest Trip from PM Station Along Street Network (excludes freeways)
Major Roads
Colored lines on this diagram represent the mean direction in which surveyed respondents travel to get from their Metro station to their destination.
Thick grey lines represent the estimated street network direction in which surveyed respondents might travel along to get from their Metro station to their destination.
Respondents represented on this diagram traveled by bike, walked or took zero-emissions public transit.
0
5
10
Miles
N
alta

Appendix E: Emmissions Calculations

Appendix E: Emmissions Calculations

```
Title             :       2011_ModeShift
Version           :       CT-EMFAC 2.6
Run Date          :       31 May 2011  01:57 PM
Scen Year         :       2011
Season            :       Annual
Temperature       :       67F
Relative Humidity :       56%
Area              :       Los Angeles (SC) County

Peak User Input   :
                         Total VMT        Volume (vph)     Road Length(mi)     Number of Hours
                           3957422
                         VMT Distribution(%) by Speed(mph)
               (mph)     5    10    15    20    25    30    35    40    45    50    55    60    65    70   >75
                   %           1     3    14    13    13     8     7     6     6     5     5     3    16
Offpeak User Input:
                         Total VMT        Volume (vph)     Road Length(mi)     Number of Hours

                         VMT Distribution(%) by Speed(mph)
               (mph)     5    10    15    20    25    30    35    40    45    50    55    60    65    70   >75
                   %

=====================================================================================================
          Running Exhaust Emissions (grams)
-----------------------------------------------------------------------------------------------------
         Pollutant Name   :  TOG_exh
```

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	0.875000	0.00	0.00	0.000000
10	0.557000	39,574.22	1.00	22,042.840540
15	0.357000	118,722.66	3.00	42,383.989620
20	0.250000	554,039.08	14.00	138,509.770000
25	0.198000	514,464.86	13.00	101,864.042280
30	0.163000	514,464.86	13.00	83,857.772180
35	0.140000	316,593.76	8.00	44,323.126400
40	0.127000	277,019.54	7.00	35,181.481580
45	0.120000	237,445.32	6.00	28,493.438400
50	0.120000	237,445.32	6.00	28,493.438400
55	0.128000	197,871.10	5.00	25,327.500800
60	0.142000	197,871.10	5.00	28,097.696200
65	0.167000	118,722.66	3.00	19,826.684220
70	0.185000	633,187.52	16.00	117,139.691200
75	0.211000	0.00	0.00	0.000000
Total		3,957,422.00	100.00	715,541.471820

Pollutant Name : SO2

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	0.012000	0.00	0.00	0.000000
10	0.009000	39,574.22	1.00	356.167980
15	0.007000	118,722.66	3.00	831.058620
20	0.006000	554,039.08	14.00	3,324.234480
25	0.005000	514,464.86	13.00	2,572.324300
30	0.004000	514,464.86	13.00	2,057.859440
35	0.004000	316,593.76	8.00	1,266.375040
40	0.004000	277,019.54	7.00	1,108.078160
45	0.004000	237,445.32	6.00	949.781280
50	0.004000	237,445.32	6.00	949.781280
55	0.004000	197,871.10	5.00	791.484400
60	0.004000	197,871.10	5.00	791.484400
65	0.005000	118,722.66	3.00	593.613300
70	0.005000	633,187.52	16.00	3,165.937600
75	0.005000	0.00	0.00	0.000000
Total		3,957,422.00	100.00	18,758.180280

Pollutant Name : Diesel_PM

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	0.072650	0.00	0.00	0.000000
10	0.050700	39,574.22	1.00	2,006.412954
15	0.034750	118,722.66	3.00	4,125.612435
20	0.025300	554,039.08	14.00	14,017.188724
25	0.021200	514,464.86	13.00	10,906.655032
30	0.018200	514,464.86	13.00	9,363.260452
35	0.016200	316,593.76	8.00	5,128.818912
40	0.015150	277,019.54	7.00	4,196.846031
45	0.015000	237,445.32	6.00	3,561.679800
50	0.015700	237,445.32	6.00	3,727.891524
55	0.017300	197,871.10	5.00	3,423.170030
60	0.019700	197,871.10	5.00	3,898.060670
65	0.022950	118,722.66	3.00	2,724.685047
70	0.027050	633,187.52	16.00	17,127.722416
75	0.032050	0.00	0.00	0.000000
Total		3,957,422.00	100.00	84,208.004027

Pollutant Name : PM2.5

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	0.132000	0.00	0.00	0.000000
10	0.089000	39,574.22	1.00	3,522.105580
15	0.061000	118,722.66	3.00	7,242.082260
20	0.045000	554,039.08	14.00	24,931.758600
25	0.036000	514,464.86	13.00	18,520.734960
30	0.030000	514,464.86	13.00	15,433.945800
35	0.026000	316,593.76	8.00	8,231.437760
40	0.024000	277,019.54	7.00	6,648.468960
45	0.023000	237,445.32	6.00	5,461.242360
50	0.024000	237,445.32	6.00	5,698.687680
55	0.025000	197,871.10	5.00	4,946.777500
60	0.029000	197,871.10	5.00	5,738.261900
65	0.033000	118,722.66	3.00	3,917.847780
70	0.037000	633,187.52	16.00	23,427.938240
75	0.042000	0.00	0.00	0.000000
Total		3,957,422.00	100.00	133,721.289380

Pollutant Name : PM10

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	0.143000	0.00	0.00	0.000000
10	0.097000	39,574.22	1.00	3,838.699340
15	0.067000	118,722.66	3.00	7,954.418220
20	0.048000	554,039.08	14.00	26,593.875840
25	0.039000	514,464.86	13.00	20,064.129540
30	0.032000	514,464.86	13.00	16,462.875520
35	0.028000	316,593.76	8.00	8,864.625280
40	0.026000	277,019.54	7.00	7,202.508040
45	0.025000	237,445.32	6.00	5,936.133000
50	0.026000	237,445.32	6.00	6,173.578320
55	0.028000	197,871.10	5.00	5,540.390800
60	0.031000	197,871.10	5.00	6,134.004100
65	0.036000	118,722.66	3.00	4,274.015760
70	0.040000	633,187.52	16.00	25,327.500800
75	0.045000	0.00	0.00	0.000000
Total		3,957,422.00	100.00	144,366.754560

Pollutant Name : NOX

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	1.575000	0.00	0.00	0.000000
10	1.206000	39,574.22	1.00	47,726.509320
15	0.970000	118,722.66	3.00	115,160.980200
20	0.856000	554,039.08	14.00	474,257.452480
25	0.805000	514,464.86	13.00	414,144.212300
30	0.771000	514,464.86	13.00	396,652.407060
35	0.752000	316,593.76	8.00	238,078.507520
40	0.746000	277,019.54	7.00	206,656.576840
45	0.754000	237,445.32	6.00	179,033.771280
50	0.777000	237,445.32	6.00	184,495.013640
55	0.818000	197,871.10	5.00	161,858.559800
60	0.881000	197,871.10	5.00	174,324.439100
65	0.975000	118,722.66	3.00	115,754.593500
70	1.085000	633,187.52	16.00	687,008.459200
75	1.251000	0.00	0.00	0.000000
Total		3,957,422.00	100.00	3,395,151.482240

Pollutant Name : FORMALDEHYDE

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	0.059699	0.00	0.00	0.000000
10	0.035109	39,574.22	1.00	1,389.411290
15	0.019169	118,722.66	3.00	2,275.794670
20	0.011805	554,039.08	14.00	6,540.431339
25	0.009522	514,464.86	13.00	4,898.734397
30	0.007834	514,464.86	13.00	4,030.317713
35	0.006648	316,593.76	8.00	2,104.715316
40	0.005891	277,019.54	7.00	1,631.922110
45	0.005526	237,445.32	6.00	1,312.122838
50	0.005540	237,445.32	6.00	1,315.447073
55	0.005935	197,871.10	5.00	1,174.364979
60	0.006739	197,871.10	5.00	1,333.453343
65	0.007980	118,722.66	3.00	947.406827
70	0.009373	633,187.52	16.00	5,934.866625
75	0.011226	0.00	0.00	0.000000
Total		3,957,422.00	100.00	34,888.988520

Pollutant Name : CO_2

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	1,212.895000	0.00	0.00	0.000000
10	924.462000	39,574.22	1.00	36,584,862.569640
15	731.045000	118,722.66	3.00	86,791,606.979700
20	600.510000	554,039.08	14.00	332,706,007.930800
25	515.724000	514,464.86	13.00	265,321,875.458640
30	458.540000	514,464.86	13.00	235,902,716.904400
35	421.562000	316,593.76	8.00	133,463,898.653120
40	400.405000	277,019.54	7.00	110,920,008.913700
45	392.743000	237,445.32	6.00	93,254,987.312760
50	397.829000	237,445.32	6.00	94,462,634.210280
55	416.352000	197,871.10	5.00	82,384,028.227200
60	450.572000	197,871.10	5.00	89,155,177.269200
65	504.788000	118,722.66	3.00	59,929,774.096080
70	512.026000	633,187.52	16.00	324,208,473.115520
75	523.366000	0.00	0.00	0.000000
Total		3,957,422.00	100.00	1,945,086,051.641040

Pollutant Name : CO

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	6.139000	0.00	0.00	0.000000
10	4.983000	39,574.22	1.00	197,198.338260
15	4.179000	118,722.66	3.00	496,141.996140
20	3.610000	554,039.08	14.00	2,000,081.078800
25	3.207000	514,464.86	13.00	1,649,888.806020
30	2.904000	514,464.86	13.00	1,494,005.953440
35	2.677000	316,593.76	8.00	847,521.495520
40	2.514000	277,019.54	7.00	696,427.123560
45	2.412000	237,445.32	6.00	572,718.111840
50	2.371000	237,445.32	6.00	562,982.853720
55	2.403000	197,871.10	5.00	475,484.253300
60	2.532000	197,871.10	5.00	501,009.625200
65	2.800000	118,722.66	3.00	332,423.448000
70	3.080000	633,187.52	16.00	1,950,217.561600
75	3.557000	0.00	0.00	0.000000
Total		3,957,422.00	100.00	11,776,100.645400

Pollutant Name : BUTADIENE

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	0.003895	0.00	0.00	0.000000
10	0.002582	39,574.22	1.00	102.180636
15	0.001775	118,722.66	3.00	210.732722
20	0.001302	554,039.08	14.00	721.358882
25	0.001034	514,464.86	13.00	531.956665
30	0.000858	514,464.86	13.00	441.410850
35	0.000746	316,593.76	8.00	236.178945
40	0.000681	277,019.54	7.00	188.650307
45	0.000653	237,445.32	6.00	155.051794
50	0.000660	237,445.32	6.00	156.713911
55	0.000701	197,871.10	5.00	138.707641
60	0.000788	197,871.10	5.00	155.922427
65	0.000927	118,722.66	3.00	110.055906
70	0.001025	633,187.52	16.00	649.017208
75	0.001179	0.00	0.00	0.000000
Total		3,957,422.00	100.00	3,797.937893

Pollutant Name : BENZENE

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	0.021015	0.00	0.00	0.000000
10	0.013555	39,574.22	1.00	536.428552
15	0.008904	118,722.66	3.00	1,057.106565
20	0.006339	554,039.08	14.00	3,512.053728
25	0.005042	514,464.86	13.00	2,593.931824
30	0.004174	514,464.86	13.00	2,147.376326
35	0.003613	316,593.76	8.00	1,143.853255
40	0.003282	277,019.54	7.00	909.178130
45	0.003134	237,445.32	6.00	744.153633
50	0.003158	237,445.32	6.00	749.852321
55	0.003355	197,871.10	5.00	663.857541
60	0.003770	197,871.10	5.00	745.974047
65	0.004432	118,722.66	3.00	526.178829
70	0.004932	633,187.52	16.00	3,122.880849
75	0.005685	0.00	0.00	0.000000
Total		3,957,422.00	100.00	18,452.825598

Pollutant Name : ACROLEIN

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	0.000768	0.00	0.00	0.000000
10	0.000523	39,574.22	1.00	20.697317
15	0.000375	118,722.66	3.00	44.520998
20	0.000282	554,039.08	14.00	156.239021
25	0.000223	514,464.86	13.00	114.725664
30	0.000185	514,464.86	13.00	95.175999
35	0.000162	316,593.76	8.00	51.288189
40	0.000148	277,019.54	7.00	40.998892
45	0.000142	237,445.32	6.00	33.717235
50	0.000144	237,445.32	6.00	34.192126
55	0.000152	197,871.10	5.00	30.076407
60	0.000171	197,871.10	5.00	33.835958
65	0.000201	118,722.66	3.00	23.863255
70	0.000220	633,187.52	16.00	139.301254
75	0.000250	0.00	0.00	0.000000
Total		3,957,422.00	100.00	818.632315

Pollutant Name : ACETALDEHYDE

speed(mph)	Emission Factor(grams/mile)	VMT by Speed	VMT-Speed Distribution (%)	Emissions by Speed
5	0.027100	0.00	0.00	0.000000
10	0.015686	39,574.22	1.00	620.761215
15	0.008248	118,722.66	3.00	979.224500
20	0.004900	554,039.08	14.00	2,714.791492
25	0.003969	514,464.86	13.00	2,041.911029
30	0.003261	514,464.86	13.00	1,677.669908
35	0.002753	316,593.76	8.00	871.582621
40	0.002424	277,019.54	7.00	671.495365
45	0.002264	237,445.32	6.00	537.576204
50	0.002267	237,445.32	6.00	538.288540
55	0.002436	197,871.10	5.00	482.014000
60	0.002776	197,871.10	5.00	549.290174
65	0.003296	118,722.66	3.00	391.309887
70	0.003935	633,187.52	16.00	2,491.592891
75	0.004767	0.00	0.00	0.000000
Total		3,957,422.00	100.00	14,567.507827

Idling Emissions (grams) (Currently NOT Available)

Evaporative Running Loss Emissions (grams)

Pollutant Name : TOG_los

Emission Factor(grams/min)	total running time(hrs)	Emissions
0.040000	121,065.68	290,557.639500

Pollutant Name : FORMALDEHYDE

Emission Factor(grams/min)	total running time(hrs)	Emissions
0.000000	121,065.68	0.000000

Pollutant Name : BUTADIENE

Emission Factor(grams/min)	total running time(hrs)	Emissions
0.000003	121,065.68	21.791823

Pollutant Name : BENZENE

Emission Factor(grams/min)	total running time(hrs)	Emissions
0.000399	121,065.68	2,898.312454

Pollutant Name : ACROLEIN

Emission Factor(grams/min)	total running time(hrs)	Emissions
0.000000	121,065.68	0.000000

Pollutant Name : ACETALDEHYDE

Emission Factor(grams/min)	total running time(hrs)	Emissions
0.000000	121,065.68	0.000000

Total Emissions

Pollutant Name	Total Emissions (grams)	Total Emissions (Kilograms)	Total Emissions (US Tons)
TOG	1,006,099.111320	1,006.099111	1.109034430
SO_2	18,758.180280	18.758180	0.020677354
Diesel_PM	84,208.004027	84.208004	0.092823435
PM2.5	133,721.289380	133.721289	0.147402490
PM10	144,366.754560	144.366755	0.159137106
NOX	3,395,151.482240	3,395.151482	3.742513881
FORMALDEHYDE	34,888.988520	34.888989	0.038458527
CO_2	1,945,086,051.641040	1,945,086.051641	2,144.090355445
CO	11,776,100.645400	11,776.100645	12.980928940
BUTADIENE	3,819.729716	3.819730	0.004210531
BENZENE	21,351.138052	21.351138	0.023535601
ACROLEIN	818.632315	0.818632	0.000902388
ACETALDEHYDE	14,567.507827	14.567508	0.016057929

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Methane and Nitrous Oxide Calculations

Annual VMT	3,957,422
Grams/Mile Emissions Factors	
Methane	0.0160
Nitrous Oxide	0.0065
Annual Emissions in Tons	
Methane	0.07
Nitrous Oxide	0.03
CO_2-Equevalent Emissions in Tons	
Methane	1.47
Nitrous Oxide	8.79

Appendix F: References

California Air Resources Board. May 2010. *Local Government Operations Protocol for the Quantification and Reporting of Greenhouse Gas Emissions Inventories*, Version 1.1.

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