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The California Environmental Quality Act (CEQA) and other state, federal, and local laws require the identification, analysis, and mitigation of transportation-related impacts of proposed land use projects. One of the first steps in preparing a transportation impact analysis (TIA) is to estimate the number of trips by automobiles, trucks, and other modes of travel that may result from a proposed land development project- a process commonly referred to as "trip generation."

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Caltrans Project P359, Trip Generation Rates for Transportation Impact Analyses of Smart Growth Land Use Projects

Final Report

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April 2017

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- Members of the project's Smart Growth Trip Generation (SGTG) Technical Advisory Panel for graciously volunteering their time and sharing their expertise in numerous project webinars and in review and feedback on project methods, analyses, results, and deliverables. The names and organizational affiliation of SGTG panel members are listed on Page 8 of this report.

Finally, special thanks are also extended to the dozens of property owners and managers of apartments and office buildings in California that granted Caltrans permission to conduct studies and collect trip generation data at their buildings and properties.

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BACKGROUND AND EXECUTIVE SUMMARY

The California Environmental Quality Act (CEQA) and other state, federal, and local laws require the identification, analysis, and mitigation of transportation-related impacts of proposed land use projects. One of the first steps in preparing a transportation impact analysis (TIA) is to estimate the number of trips by automobiles, trucks, and other modes of travel that may result from a proposed land development project – a process commonly referred to as "trip generation."

In most cases, practitioners use vehicle trip generation rates published by the Institute of Transportation Engineers (ITE), a national professional organization, or other rates established or accepted by local agencies requesting the TIA. These are derived from data that are almost all from suburban sites in single land use areas and with virtually all trips to and from the sites made by motor vehicle.

However, more recently, more development has occurred in areas served by transit and bicycle facilities. Developers have become more sensitized to making developments walkable, and there have been more mixed- and multi-use developments where complementary land uses are mixed closely together, facilitating walk and bicycle travel for some trips. This new (smart growth) style of development generates some trips by non-vehicle modes. Hence, to be credible and accurate, TIAs need to reflect the multimodal trip generation associated with such developments.

Caltrans initiated the Smart Growth Trip Generation (SGTG) project to determine the difference in vehicular trip generation between the suburban-oriented ITE rates and those to be determined from surveys of California smart growth developments. This report summarizes the findings and recommendations of Phase 2 of the SGTG project which followed the initial Phase 1 that was documented in a separate report.[1]

PHASE 2 PURPOSE

Phase 1 of SGTG established the basics for this project, including procedures for collecting and analyzing data, and provided data for 30 initial sites. Phase 2 was contracted to refine the approach used in Phase 1 based on Phase 1 experiences and findings, to add data from another 30 sites to the California smart growth trip generation database, and to extend the findings. More specifically, the goal of this Phase 2 project was to produce a validated and improved estimation method and a user-friendly tool to more accurately estimate trip generation for use in determining proper transportation improvements for smart growth developments in California and beyond. To improve the accuracy of the trip generation estimation model

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[1] Susan Handy, Kevan Shafizadeh, Robert Schneider, *California Smart Growth Trip Generation Rates Study*, University of California, Davis for the California Department of Transportation, Final Report, March 2013, http://downloads.ice.ucdavis.edu/ultrans/smartgrowthtripgen/Final_Report.pdf.

developed in Phase 1, this project was to collect trip generation data at approximately 30 smart growth sites and combine it with data already in the Caltrans database.

Phase 2 had four specific objectives.

1. Achieve significantly improved model accuracy.
2. Increase land use sample sizes to improve estimation accuracy.
3. Develop a model in which the:
    a. Independent variables are widely accepted by TIA preparers and reviewers;
    b. Model is fully transparent and comprehensible to the average user; and
    c. Future updates can be easily made when additional data become available.
4. Provide effective user training with work facilitated by user-friendly, transparent tools.

PRINCIPAL FINDINGS AND RECOMMENDATIONS

SURVEYS

- Weekday AM and PM peak period multimodal trip generation surveys from both Phases 1 and 2 confirmed that developments of several land uses surveyed indeed do generate fewer vehicle trips than similar developments in single use suburban areas. Depending on specific site and context characteristics, some trips from smart growth sites are made by transit, bicycle and walking. Non-vehicle trips range from a few percent to almost half of all site-generated person trips.
- Surveys in both phases included both person (and at many Phase 1 and all Phase 2 sites) vehicle cordon counts. Intercept interviews were conducted at building entrances where non-vehicle trips were a possibility to obtain travel mode and related information. Phase 1 interviews were conducted only in the outbound direction (asking questions about travel in both directions) at most sites. To increase the amount of data for inbound trips, Phase 2 interviews were conducted in both directions. Phase 1 and the first half of Phase 2 survey responses were recorded on traditional paper forms; the rest of Phase 2 used electronic tablets to automate response recording and enable direct data entry to expedite the process and increase data accuracy.
- The 30 Phase 1 survey sites covered apartment, office, retail, and coffee shop establishments in the Sacramento, San Francisco and Los Angeles regions. No targets were set for the number of sites for each land use type. The 30 Phase 2 sites were located in the Sacramento, San Francisco, Los Angeles and San Diego regions and were limited to mostly apartment buildings and some office buildings. This was done to bring the total apartment sites to approximately 30, the number of sites considered as the likely minimum for good statistical results. The other 30 Phase 2 sites were office buildings. Phase 2 sites were selected to attempt to have totals by land use in each region roughly proportional to the populations of each region. Total sites surveyed (both phases) were 29 apartment buildings and 26 office developments plus small numbers of retail, fitness and coffee shop sites.

- The research teams for both phases attempted to select sites for each land use that were relatively consistent using a detailed set of selection criteria. This was to try to eliminate as much "unexplained" variability in trip generation as possible.
- In addition to the cordon counts and interviews, site and context data were collected from internet sources and field observations for each site. These were used for site characteristics in the estimation method development. Based on findings in Phase 1, a few characteristics were added during Phase 2 and collected for sites from both phases.

ESTIMATION METHOD DEVELOPMENT

- Both phases developed estimation methods to yield vehicle trips generated by the particular land use, reflecting trips made by other modes. Traffic impacts are still the objective of trip estimation for TIAs.
- An objective of SGTG was to develop a trip generation estimation methodology that would have reasonable accuracy, generally as good as or better than the ITE vehicle trip methods. However, it was recognized from the beginning that multimodal modeling would be more complex and would need a significant number of survey sites per land use to yield such accuracy. The 30 sites spread over four land uses was not expected to be sufficient. The Phase 1 effort endeavored to expand the database by adding in data from what were considered similar sites, some for which data were more or less complete and others for which there were only partial data available. Phase 2 had 60 total SGTG sites in the database and tried to develop models only for two land uses, and used only additional sites for which there were complete data that were collected similarly. That yielded 39 apartment sites and 26 office sites.
- Regression analyses were used in both phases to develop estimation methods. Both phases checked cross correlation between candidate independent variables in an effort to exclude those that affected trip generation similarly. Phase 1 employed a two tiered approach that reflected effects of site and context in one tier and land use types in a second tier. Phase 2 used a stepwise regression including the most significant variable first, then the next, and so on. Different forms of independent variables were used, such as inverses, logarithmic, etc. depending on simple correlations. Equations were optimized using the Lasso regression statistical method. This Phase 2 approach – with a larger, more consistent database – produced much improved results. The Phase 1 AM and PM models resulted in R^2 values close to 0.30. Phase 2 models had R^2 values of 0.79 (AM) and 0.85 (PM) for apartment models and 0.71 (AM) and 0.66 (PM) for the office models. The apartment values were similar to those for ITE methods for the same land use. Office values were less than corresponding ITE values (0.82 AM and 0.83 PM), not surprising for a smaller database.
- Despite a high level of consistency in the types of apartment and office buildings surveyed, the amount of scatter in the trip generation rates was similar to that shown in ITE trip generation data for the same land uses. This can be attributed to the numerous variations in site and context conditions that cannot be represented in the kind of data that can are readily available. These characteristics include such items as adjacent land uses; economic viability of the developments surveyed; or building resident, customer or employee demographics.

TRIP GENERATION ESTIMATION

- The primary objectives were to (1) develop relatively accurate models for estimating trip generation for developments in smart growth areas, and (2) have the estimation procedure be user friendly and usable by staff typically used for such work. Input data were to be relatively straight forward and easy for those staff to produce.
- Each phase developed an estimation method that could be carried out manually. The Phase 1 methods required obtaining input for 8 independent variables for each site analyzed (nearby population and jobs; distances to regional CBD, building setback distance, presence of metered curb parking, buses and rail transit service within walking distance; and surface parking coverage ratio) .[2] Phase 2 methods required data for only two independent variables (site development units (dwelling units or square feet; adjacent intersection density). The phase 2 method requires fewer (only 2), easier to produce independent variables (building development size, nearby intersection density) and a simpler estimation equation form. However, both are straight forward using a spreadsheet.
- Both methods produced a spreadsheet tool for easy data entry and computation. Both include detailed direction for data acquisition and use.
- Since Phase 2 produced more accurate models for both apartment and office buildings in smart growth areas, those models should be used.

RECOMMENDED NEXT STEPS

- Offer the webinar training developed in Phase 2.
- The research team recommended that additional office sites be surveyed and the data added to the existing database and reanalyzed in hopes of further improving estimation accuracy.
- The research team also recommended collecting data and developing estimation models for additional land uses commonly analyzed in TIAs for smart growth areas. These land uses include:
    - Retail (featuring current tenant type mix)
        - Neighborhood/community centers
        - Free-standing large stores
        - Regional lifestyle centers
    - Hotels
        - Full service
        - Limited service
        - Boutique

[2] Susan Handy, Kevan Shafizadeh, Robert Schneider, *California Smart Growth Trip Generation Rates Study*, University of California, Davis for the California Department of Transportation, Final Report, Appendix F, March 2013, http://downloads.ice.ucdavis.edu/ultrans/smartgrowthtripgen/Appendix_F_Adjustment_Method.pdf.

- Phase 2 also developed a webinar training presentation for familiarizing practitioners (primarily TIA preparers and reviewers) about the key findings of the SGTG projects and how to use the estimation tool. This webinar should be made available on Caltrans and other relevant California websites.

1. INTRODUCTION

The California Environmental Quality Act (CEQA) and other state, federal, and local laws require the identification, analysis, and mitigation of transportation-related impacts of proposed land use projects. One of the first steps in preparing a transportation impact analysis (TIA) is to estimate the number of trips by automobiles, trucks, and other modes of travel that may result from a proposed land development project – a process commonly referred to as "trip generation."

In most cases, practitioners typically use vehicle trip generation rates published by the Institute of Transportation Engineers (ITE), a national professional organization, or other rates established or accepted by local agencies requesting the TIA. Nearly all TIAs have examined impacts of vehicular traffic to be generated by proposed developments, and most new developments are located in suburban areas where almost all trips are made by motor vehicle. Very few trips are made by transit, bicycle, or walking. The TIAs need vehicle trip generation rates to provide the basis for traffic estimates. ITE and other sources have developed vehicle trip generation databases from which to develop such rates.

However, more recently, more development has occurred in areas served by transit. Bicycle use has become more popular and feasible for commute as well as recreational trips. Developers have become more sensitized to making developments walkable, and there have been more mixed- and multi-use developments where complementary land uses are mixed closely together, facilitating walk and bicycle travel for some trips.

Caltrans initiated its Smart Growth Trip Generation (SGTG) study to examine the differences in trip generation between the traditional vehicular-oriented suburban development and the mixed-use smart growth development that encourages and utilizes multimodal transportation. More specifically, SGTG was established to determine the difference in vehicular trip generation between the suburban-oriented ITE rates and those to be determined from surveys of California smart growth developments.

PROJECT GOALS AND OBJECTIVES

The Caltrans Task 1940 project (referred to as Phase 1 in this report) and similar research conducted in California and other states have demonstrated that developments exhibiting smart growth characteristics (such as mixed or multiple uses, compactness, transit proximity, pedestrian friendly) generate fewer vehicle trips than do conventional suburban types of development. The lower vehicle trip generation rates then require less traffic mitigation and generate less vehicular emissions, among other benefits, and contribute to increasing sustainability.

Phase 1 of SGTG established the basics for this project, including a formal description of Smart Growth (development), procedures for collecting and analyzing data, and provided data for 30 initial sites.[3] This project, Phase 2 of SGTG, was contracted to refine the approach used in Phase 1 based on Phase 1 experiences and findings, to add data from another 30 sites to the California smart growth trip generation database, and to extend the findings. More specifically, the goal of this Phase 2 project was to produce a validated and improved estimation method and user-friendly tool to more accurately estimate trip generation for use in determining proper transportation improvements for smart growth developments in California and beyond. To improve the accuracy of the trip generation estimation model developed in Phase 1, this project was to collect trip generation data at approximately 30 smart growth sites and combine it with data already in the Caltrans database.

The project has four specific objectives.

1. Achieve significantly improved model accuracy.
2. Increase land use sample sizes to improve estimation accuracy.
3. Develop a model in which the:
    a. Independent variables are widely accepted by TIA preparers and reviewers;
    b. Model is fully transparent and comprehensible to the average user; and
    c. Future updates can be easily made when additional data become available.
4. Provide effective user training with work facilitated by user-friendly, transparent tools.

NEED FOR SMART GROWTH TRIP GENERATION RATES

For the most part, ITE and other trip vehicular generation rates used in TIAs are based on data obtained at suburban locations that lack significant transit or bicycle facilities and are not pedestrian-friendly. As described in the Phase 1 report, studies indicate that these rates often significantly over-estimate the number of vehicle trips for land use projects located in urban areas near transit and within easy walking distance of complementary land uses. In fact, ITE guidelines state that their trip generation rates data should not be used for such projects, here labeled as "smart growth" projects.

The intent of the SGTG project has been to develop what could become a commonly-accepted methodology to collect trip generation data and estimate trip generation rates for land use projects in "smart-growth" areas.

The purpose of Phase 2 is to improve the data collection and estimation methodology used to predict trips generated by developments in smart growth areas. This approach builds upon established methods so that it can be integrated easily into standard transportation

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[3] Handy, Susan, Kevin Shafizadeh, and Robert Schneider. *California Smart-Growth Trip Generation Rates Study,* Final Report. University of California, Davis for the California Department of Transportation, Final Report, March 2013, http://downloads.ice.ucdavis.edu/ultrans/smartgrowthtripgen/Final_Report.pdf

engineering and planning practice, most specifically for use in assessing traffic impacts of proposed smart growth style development.

ADVISORY PANEL

An advisory panel was established to provide technical guidance throughout the project. Panel members were invited based on their knowledge and experience in the subject matter and on similar projects. The individuals consist of California municipal TIA reviewers, California TIA preparers (consultants), California developers, a Phase 1 project team member, and leaders in similar research based in Florida, Oregon, and Washington, DC. Panel members are:

Name	Organization
Fred Dock	City of Pasadena
Jamie Parks	City of Oakland
Jane Bierstedt	Fehr & Peers
Pat Gibson	Gibson Transportation
Erik Ruehr	VRPA Technologies
Bob Schneider	University of Wisconsin, Milwaukee
Kelly Clifton	Portland State University
Stephanie Dock	Washington, D.C. Department of Transportation
Gary Sokolow	Florida Department of Transportation
Ann Cheng	Transform
Mott Smith	Council of Infill Builders
Pelle R. Clarke	City of Sacramento
Ron Milam	Fehr & Peers
Armen Hovenessian	City of Los Angeles

The Advisory Panel is intended to provide advice to Caltrans and the research team on matters such as:

- smart growth development types and land uses most frequently analyzed for traffic impacts;
- existing developments that might be good candidates for surveying;
- desired characteristics of the estimation model;
- review of findings, recommendations, and final report; and
- content needed in the training to enable preparers and reviewers to appropriately use the tools developed.

DEFINITIONS

Several definitions related to smart growth trip generation were established in SGTG Phase 1. Some have been shortened or refined for simplicity or clarity.

- Smart growth areas: Places where many common interactive land uses (e.g., workplaces, parks, restaurants, stores, homes) are located within a convenient walking distance of where many people live and work. Smart growth areas are also typically served by pedestrian and bicycle facilities and frequent and reliable public transportation. For a more detailed description, see SGTG Phase 1 final report, Appendix A.[4]
- Targeted land uses (also referred to as "study locations"): A single ITE land use category found within a smart growth area or as part of a mixed-use development.
- Person-trip: The movement of one person between two activity locations.
- Inbound trip: Travel from a person's previous activity location to one of the study locations.
- Outbound trip: Travel from one of the study locations to the person's next activity location.
- Person-trip generation rate: The total number of trips generated at the study location during a one-hour period per unit of development (e.g., square foot for office and retail land uses).
- Morning peak hour person trip generation rate: The highest rate for a one-hour period between 6:30 a.m.-9:30 a.m. or 7 a.m.-10 a.m.
- Afternoon peak-hour person-trip generation rate: The highest rate for a one-hour period between 4 p.m. and 7 p.m.
- Vehicle trip generation rate: The total number of automobile and truck trips generated at the targeted activity location during a one-hour period per unit of development. If two people are traveling in the same automobile to a targeted activity location, they are making two person-trips by automobile but only one automobile trip.
- Travel mode: Means of travel. For this project, the travel modes are motor vehicle (automobile, truck), transit (rail, bus), bicycle, and pedestrian/walk. In some cases these may be referred to as motorized (motor vehicle) and non-motorized (transit, bicycle, pedestrian).
- Primary travel mode: Generally defined as the mode used for the longest distance on the trip.
- Mode split: Refers to the percentage of total person trips that move by a particular mode. For example, if 5-of-15 trips are by bus, the bus mode split is 33 percent.

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[4] Handy, Susan, Kevin Shafizadeh, and Robert Schneider. *California Smart-Growth Trip Generation Rates Study,* Final Report. University of California, Davis for the California Department of Transportation, Final Report Appendix A, March 2013. *(http://downloads.ice.ucdavis.edu/ultrans/smartgrowthtripgen/Appendix_A_Definition.pdf).*

THREE APPROACHES TO ANALYZING DIFFERENCES IN TRIP GENERATION RATES

One of the important approaches examined in Phase 2 was how to assess differences in trip generation rates between traditional suburban and smart growth rates. There are two principal ways to accomplish this:

1. *Apply ratio of surveyed SGTG vehicle trip generation rates to the ITE national database.* This approach compares average vehicle trips for SGTG smart growth sites with average vehicle trip generation rates for suburban sites in the national database. When SGTG has been fully completed, the SGTG database is expected to have 30 or more sites per studied land use. The ITE database has several land uses with 100 or more sites, but some with fewer than five sites. Comparisons using average rates from the two databases might compare similar or very different depending on the numbers of sites. The comparison may be more or less valid depending on the two sample sizes. If a land use has five SGTG sites averaging nine vehicle trips per peak hour and 200 ITE sites averaging 12 trips per peak hour, one might conclude that the SGTG sites generate an average of 75 percent as many vehicle trips as the average ITE site. However, would a five-site average be credible when compared against a 200-site average?

2. *Apply the surveyed SGTG mode split to the ITE rates*. This approach computes the average SGTG vehicle trips percentage of total trips to the ITE average baseline rate. The ITE baseline rate is the ITE vehicle trip generation rate divided by the suburban vehicle trip mode split (usually 95 percent or higher based on survey data). So if a SGTG land use has five total trips and four vehicle trips per peak hour, its vehicle trip percentage would be 80 percent. If the ITE rate is 4.5 vehicle trips per peak hour and its baseline mode split is 95 percent vehicle trips, applying the SGTG mode split to the ITE rates would yield 4.5 x 0.80/0.95 = 3.8 vehicle trips per peak hour. This comparison would be of interest if the SGTG database was much smaller than the ITE database (e.g., SGTG 5 sites, ITE 50 sites). This approach assumes that the person trip generation rate is about the same for conventional (suburban) and smart growth sites.

   This approach could be further expanded to a three-part adjustment based on area, site, and/or transportation system characteristics:

   1. Person trips;
   2. Mode split; and
   3. Vehicle occupancy.

3. *Direct estimation of smart growth trip generation*. This approach develops equations or rates that estimate vehicle trips for smart growth sites by land use. Estimates are based on results of trip generation surveys of smart growth sites. An advantage is that use of separate rates or equations for smart growth and conventional sites means that the percentage and magnitude differences can both vary over the range of development

sizes. A potential disadvantage can be that for extreme sizes (small or large), smart growth site trip generation estimates may be higher than for conventional sites.

The original intent of SGTG was for an adjustment factor to be applied to the corresponding ITE rates to yield a smart growth trip generation rate. The adjustment factor was to be the ratio of SGTG vehicle trips to ITE vehicle trip for a land use. That could be credible if both the SGTG and ITE sample sizes are credible. However, if the SGTG sample size is small, the SGTG mode split could be applied directly to the ITE (baseline) rate to yield a smart growth vehicle trip generation rate. That would presume that the total person trip generation rates for both suburban and smart growth developments would be similar.

The first approach was used in Phase 1. The other two approaches were also considered for Phase 2 before the third approach was finally selected.

REPORT ORGANIZATION

The remainder of this project's final report contains the following chapters:

2. Data Collection Procedures and Site Selection;
3. Survey Data Reduction;
4. Survey Results;
5. Development of Improved Estimation Method;
6. Implementation Tools;
7. Next Steps – Recommendations; and

Appendices.

2. DATA COLLECTION PROCEDURES AND SITE SELECTION

Data collection procedures used in Phase 1 were reviewed in light of the project objectives and experience gained in Phase 1. Minor changes were made to simplify the process and to increase the portions of trips for which direct counts could be made to determine travel mode and vehicle occupancy rather than relying on interviews for a sample of trips. In addition, after half of the Phase 2 sites were surveyed in the spring of 2015, manual recording of interview responses on paper forms was replaced by direct entry to electronic tablets, thereby eliminating the need for a separate data-entry process. These changes are described throughout this chapter.

The approach for data collection continued to follow the same objectives set in Phase 1:

- Usable for any land use typically found in ongoing or future development, particularly in smart growth areas;
- Straightforward, easily replicated, and efficient to apply;
- Provide data needed to develop site trip generation rates usable for estimating trip generation for use in TIAs for developments in smart growth areas; and
- Build on and be compatible with established ITE site-based trip generation data collection guidelines so the resulting estimation method can produce estimates that can be compared with ITE vehicle trip generation estimates.

SITE SELECTION CRITERIA
Land Use

One of the first decisions made in Phase 2 was to try to increase the sample size for at least one land use to 30. This is the approximate number of samples considered to be needed for stability according to the Central Limit Theorem.[5] Phase 1 had provided the following numbers of samples for the four land uses surveyed.

Land Use	Phase 1 Sites Surveyed
Apartment buildings	12
General office buildings	9
Retail	3
Restaurants/coffee shops	6
Total	30

[5] Roscoe, John T., Holt, Rinehart and Winston, Inc., 1969, Fundamental *Research Statistics for the Behavioral Science.* The reliability of the estimated sample size is not felt to be as accurate when the number of observations on which it is based is small. Generally, sample sizes of less than about 30 are avoided to insure the sample results benefit from the central limit theorem that says the sampling distribution of the means will approach that of a normal distribution even if the population being sampled is not normally distributed.

Phase 2 was to collect data for at least 30 additional sites. Therefore, it was decided to increase the apartment building sample size to at least 30 sites and use the remainder of the 30 sites to increase the number of office building sites.

Data Should be Transferrable

Both trip data and development characteristics should be representative of the typical types of land uses expected to be developed in the future in California, especially those with smart growth characteristics.[6] This should include development size, mix of development components, and geographic location with respect to the area's transportation system and area development patterns.

Site Size

It was also decided to collect data only at sites large enough to generate at least 100 peak period trips. This was performed to obtain a sufficient number of interviews to provide a breakdown of mode splits for the site person trips. Apartment sites having 200 or more dwelling units (DUs) were sought as were office buildings having at least 100,000 gross square feet (GSF). Some smaller buildings were to be considered acceptable if they exhibited excellent smart growth characteristics. In some cases, multiple buildings totaling more than these threshold values would be acceptable if they could be surveyed as one site and as long as the full site operated as if it was a single building.

Smart Growth Area

The site should be surrounded by *convenient, complementary and interacting* land uses with which it interacts. The area should be conveniently walkable and pedestrian friendly (sidewalks on at least 50 percent of the block faces within ¼-mile of site). In the end, selected sites had sidewalks on virtually all block faces within ¼-mile.

At candidate sites, it should be attractive to use travel modes other than driving to make at least some normal trips. The area within ½-mile (straight line radius) of the site should be mostly developed; the site should not be on the periphery of an urban area. Within a radius of ½-mile, there should be at least 6,000 residents and 1,000 jobs (based on 2010 U.S. Census Bureau [Census] data).

Site and Area Maturity

The site or targeted building or land use within the site should be at least two years old (i.e., occupied for at least two years) and have at least 80 percent occupancy.

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[6] *Trip Generation Handbook*, 2nd Edition. Institute of Transportation Engineers, Washington, DC, June 2004, p. 17 not currently accessible online.

Transit Proximity

The site should be served by frequent transit service (at least 10 buses stopping within ¼-mile or five transit trains stopping within ½-mile during the weekday PM peak hour). Ferries and other forms of transit were not considered.

Bicycle Facility Proximity

The site should have bicycle lanes, multi-use paths, or other designated bicycle facilities within two blocks. This excludes shared lane markings (sharrows) and signed but unmarked bicycle routes.

Normal Conditions

There should be no construction or other activity at or near a study location that restricts access or volume of activity.

Atypical Conditions to be Avoided

Sites having characteristics that generate unusual conditions not typically associated with a proposed development site should generally be avoided. Examples of such conditions include:

- Higher or lower than normal customer bases or activity, such as the only grocery store in a downtown;
- Sites serving students and that are within ½-mile of major colleges or universities (5,000 or more students) or sites within ½-mile of Census tracts with more than 15 percent of the population between the ages of 18 and 21.
- Sites within ½-mile of a stadium, military base, major tourist attraction, commercial airport, or other specialty high-activity location.

EFFICIENCY OF SURVEY
Sufficient Activity

The site should be large and active enough to obtain the needed data sample sizes in the number of survey hours planned. Surveys to obtain peak hour data were to be 2-3 hours per peak period. It was desirable to obtain at least 50 samples per peak period for breakouts of trip characteristics such as mode split, but 100 or more should be sought.

A development being surveyed should appear to be economically viable. That is, it should appear that the business or other land use is economically healthy as represented by trips to and from the building and occupancy of the parking facilities. Relatively empty parking lots, restaurants with only a few tables occupied, and stores with few customers are all signs of a development that is not economically healthy and not representative of what a developer would want to develop.

Ability to Isolate and Survey Site

It should be possible to isolate the survey site and each land use to permit accurate complete cordon, door, and/or driveway counts and interviews covering all person trips and modes. Any trips using parking or access points that are shared with buildings or land uses not intended to be included in the survey need to be included so they can be subtracted to yield only trips from the targeted building or land use. In most cases, shared parking or access would rule out a site for a survey for SGTG.

It is also necessary to be able to conduct counts and conduct interviews at a site without the possibility of double-counting or missing trips.

Limited Number of Count and Interview Locations

A site is to have a limited (i.e., small number) of access points in order to limit the cost to collect counts and interviews.

Safe Count and Interview Locations

Locations to be used for survey personal to conduct counts (pedestrians, bicyclists, or vehicles) are to be safe for both survey personnel and passersby. It should not be necessary to arrange for elaborate safety provisions just to afford minimal safety.

No Through Trips

There should be no trips passing through the development unless they can be isolated and accurately accounted for. Presence of through trips increases the cost of surveys and also introduces the chance for errors.

Site Data Available

Data describing the site characteristics need to be confirmed to be available, either from the development property owner/manager or from field measurements.

Field Verification of Survey Suitability

Each prospective site was checked in the field to ensure that the above conditions could be met so the site could be surveyed efficiently and accurately. A preliminary data collection plan was developed as part of the field reconnaissance. If the site looked promising for a survey, this field visit might also include a visit with the property owner/manager to gain a better understanding about how the development functions, where all access points are located, and to answer questions that arise as the preliminary data collection plan is developed. This meeting might have also been used to initiate the permission request if the site is deemed desirable for a survey.

Obtain Permissions

It was necessary to obtain permission from the site property owner/manager to collect data at each site and land use. In some cases where the survey was to collect data from multiple (usually retail commercial) tenants at a site, it was necessary to obtain permissions from not only the property owner/manager, but also individual tenants. This was most easily accomplished if the property owner/manager sought permissions after giving their permission.

In some cases it was possible to collect all data at or from locations on public sidewalks, but it is preferred and good practice to request permissions as a matter of courtesy and to facilitate obtaining site-related data that normally comes from the property owner/manager (e.g., DUs, occupancy).

DATA TIMEFRAME

The data from this project needs to be usable for typical analyses used for TIAs and environmental impact reports (EIRs). These analyses typically focus on peak hours of weekday morning and afternoon commute travel periods, which often have the highest amount of traffic across the transportation system as a whole. Normally these analyses are conducted for the street peak hour during weekday morning (7-9 a.m.) and evening (4-6 p.m.) street peak hours because the peak total demand usually occurs during those hours. However, it is important to recognize that travel to and from some land use types (e.g., schools, churches, restaurants, theaters) may peak at different times or on different days than the transportation system as a whole. While transportation system impacts at times other than weekday commute periods are an important topic for future research, this project covered weekday street peak periods for each land use rather than peaks specific to individual land uses.

To obtain representative weekday street peak hour data, this project collected data during the following periods.

- *Time-of-day*. Data had been collected in Phase 1 from 7 a.m. to 10 a.m. and 4 p.m. to 7 p.m. However, for Phase 2, morning data were collected between 6:30 a.m. and 9:30 a.m. to better provide a peak period from which peak hours between 7-9 a.m. could be drawn. Both AM and PM peak period data were collected for all sites.
- *Day of the week*. Data were collected on typical weekdays — Tuesday, Wednesday, and Thursday. Traffic patterns on Mondays and Fridays are not always the same as the midweek days.
- *Season of the year*. Site trip generation for both apartment and office buildings is at typical levels during fair weather months in the spring and fall when school is in session (non-holiday weeks during March-May and September – mid-November). Phase 2 data collection was performed between May 5-20 in the spring of 2015 and September 29 - October 22 in the fall.

- *Weather.* Data were only collected on rain free days. No data collection days had abnormally high or low temperatures.

Data were only collected on typical days when school was in session. The data collection time periods did not represent any seasonal peaks or lows at the study locations.

DATA COLLECTION AND ANALYSIS PROCESS

As was done in Phase 1 of SGTG, the data collection and analysis process included the following four main components, described in greater detail in the following.

1. Select study locations in smart-growth areas where person trip generation by mode data could be collected efficiently.
2. Collect data at each location to quantify:
    a. The total number of person trips generated and percent of person trips by mode for each study location; and
    b. Site data describing the characteristics of the development or land use for use as independent variables in the analysis and estimation method development.
3. Combine and process modal person trip data with vehicle occupancy information to estimate actual trip generation rates by mode as well as the mode splits.
4. Compare actual surveyed vehicle trip generation to ITE vehicle trip generation estimates.

Select Study Locations in Smart Growth Areas

Candidate study sites were identified using Internet information regarding smart growth developments and transit-oriented developments, and by using Google Earth and Street View to identify and assess images of those buildings near rail transit stations that might meet the site selection criteria. Lists of smart growth, transit-oriented, and infill development areas and projects were also reviewed. The Advisory Panel was also asked to suggest candidate sites for consideration.

Given the smart growth and transit proximity criteria, the candidate sites were limited to the following regions:

- Sacramento;
- San Francisco-Oakland-San Jose;
- Los Angeles-Orange Counties; and
- San Diego.

As mentioned previously, the Phase 2 land uses were limited to general office and apartment buildings. Because interviews in apartment condominiums often require permissions from the building homeowner associations, it was decided to concentrate the apartment surveys on rental apartments. Sites with at least 200 units were sought, but some smaller developments were also included due to their locations relative to complementary land uses, transit stations/stops, or other characteristics. Office buildings of over 200,000 square feet were sought. In some cases, developments with multiple buildings totaling over 200,000 square feet and with shared parking and good walkability to other land uses were also included.

For both apartment and office buildings, Google Earth and Street View were used to conduct an initial check to see how many access points would need to be surveyed and if such a survey might be affordable. Some buildings were eliminated due to the high number of access points or difficulty to isolate the site. A few multiple- or mixed-use developments or areas that were neither apartment nor office buildings were included for field visits just in case they might afford an opportunity to survey several buildings or land uses in a single (albeit larger) survey.

Candidate Sites

Over 200 sites were identified and screened as candidates for surveys. Information was assembled for each site, including estimates of size, types of land use, locations, contact persons and information, and additional information that could help in the selection of the 30 sites to be surveyed. The information was updated after the field visits were made to each region.

Survey Locations

Candidate locations were visited in each of the four regions listed previously. The locations in each region that best met the site selection criteria and added site variety (that had not been previously surveyed) were identified. Once all of the best candidates had been identified, they were prioritized by how fully they met the site selection criteria, especially those related to vicinity land use and transit proximity.

However, two other considerations were also used. One was to have a sample of sites in each of the four regions. This included Phase 1 sites that had been concentrated mainly in the San Francisco-Oakland and Los Angeles regions. Emphasis was placed on getting more Sacramento sites (which proved difficult to find), to include several San Diego sites, and to significantly expand Los Angeles area sites. Furthermore, an attempt was made to locate Phase 2 sites in parts of the region where few or no surveys had been completed in Phase 1.

The other consideration was to try to obtain a range of independent variable values with which to "calibrate" the resulting estimation method. For example, researchers attempted to select large, medium, and small developments with locations adjacent, close, or marginally accessible to transit.

Table 2-1 shows the sites that were selected for Phase 2 surveys. The table also includes some basic site characteristics for each site. For the most part, to obtain as broad a sample as possible, researchers attempted to select sites that were in different locations than the Phase 1 sites. However, there were also some additional excellent examples of smart growth in areas from which Phase 1 samples were taken, so not all Phase 2 sites were in different parts of the four regions.

Table 2-1. General Characteristics of Study Locations – Phase 2 Sites

Location				Land Use (ITE Code)				Size and Occupancy							Surrounding Area Characteristics							
								Residential		Office		Retail							PM Peak Hour Transit Service			
ID	Name	Primary Address	City	Multi-Family Residential	Office	Retail	Fitness Center	Dwelling Units	Occupancy	GSF	Occupancy	GSF	Occupancy	Fitness GSF	Jobs Within ½ mile[5]	Population within ½ mile[6]	Rail Transit within ½ mile	Bicycle facilities within2 blocks	Buses Stopping Within ¼ Mile	Trains Stopping Within ½ mi	Rail/BRT Stations within 7 Miles of Closest Station	Path Distance to Nearest Rail Transit Station (feet)
24.1	Capitol Towers Apts.	1500 7th Street	Sacramento	222				206	0.931						66671	4646	Yes	Yes	67	10	34	690
25.1	LINQ Midtown Apts.	3111-3201 S Street	Sacramento	223				275	0.93						5388	4338	Yes	No	20	8	28	1120
26.1	One Concord Center	2300 Clayton Road	Concord		710					358,589	0.882				6377	5187	Yes	No	19	9	3	630
27.1	Avalon Walnut Creek Apts.	1001 Harvey Drive	Walnut Creek	223				385	0.96						6780	6838	Yes	No	13	9	4	540
28.1	Eaves by Avalon Apts.	1445 Treat Blvd.	Walnut Creek	223				510	0.96						5718	3560	Yes	No	13	9	4	1670
29.1	Park Regency Apts.	3128 Oak Road	Walnut Creek	223				892	0.96						6475	6538	Yes	No	14	9	4	1030
30.1	Fremont Office Center	39300 Civic Center Dr.	Fremont		710					190,000	1.00				11781	7385	Yes	Yes	22	8	2	860
31.1	Avalon at Cahill Pk. Apts.	754 The Alameda	San Jose	223				200	0.95						5788	6200	Yes	Yes	85	10	28	2600[3]
32.1	Villa Torino Apts.	29-39 Julian Street	San Jose	223				198	0.944						9947	8092	Yes	No	28	18	34	1440
33.1	Gardens at Wilshire Ctr.	635 S. Hobart Blvd.	Los Angeles	223				159	0.97						20945	35125	Yes	No	89	24	25	1310
34.1	Wilshire Vermont Stn. Apts.	3183 Wilshire Blvd.	Los Angeles	223				449	0.96						22457	33327	Yes	Yes	129	24	30	200
35.1	Wilshire Center (East)	3055 Wilshire Blvd.	Los Angeles		710					225,000	0.75				19962	33012	Yes	Yes	129	24	30	980
36.1	Wilshire Financial Tower	3200 Wilshire Blvd.	Los Angeles		710					200,000	0.85				23635	33623	Yes	Yes	129	24	30	730
37.1	Wilshire Serrano Office Bldg.	3699 Wilshire Blvd.	Los Angeles		710					330,000	0.71				20969	33012	Yes	No	89	24	25	800
37.2	24 Hour Fitness Center	3699 Wilshire Blvd.	Los Angeles				492							13,279	20969	33012	Yes	No	89	24	25	800
38.1	Acappella Pasadena Apts.	145 Chestnut Street	Pasadena	223				143	0.95						25471	8418	Yes	Yes	50	20	10	1990
39.1	Pasadena Gateway Villas	290 N. Hudson Avenue	Pasadena	223				140	0.914						14747	11821	Yes	No	17	20	9	840
40.1	The Stuart at Sierra Madre Villa Apartments	3360 Foothill Blvd.	Pasadena	223				188	0.96						7161	3735	Yes	Yes	34	10	6	730
41.1	Lake Corson Building	301 N. Lake Avenue	Pasadena		710					208,303	0.88				12548	11893	Yes	No	17	20	9	550

Table 2-1. General Characteristics of Study Locations – Phase 2 Sites (Continued)

Location				Land Use (ITE Code)				Site and Occupancy							Surrounding Area Characteristics							
								Residential		Office		Retail							PM Peak Hour Transit Service			
ID	Name	Primary Address	City	Multi-Family Residential	Office	Retail	Fitness Center	Dwelling Units	Occupancy	GSF	Occupancy	GSF	Occupancy	Fitness GSF	Jobs Within ½ mile[5]	Population within ½ mile[6]	Rail Transit within ½ mile	Bicycle facilities within 2 blocks	Buses Stopping Within ¼ Mile	Trains Stopping Within ½ mi	Rail/BRT Stations within 7 Miles of Closest Station	Path Distance to Nearest Rail Transit Station (feet)
42.1	NoHo 14 apartment Bldg.	5440 Tujunga Avenue	N. Hollywood	222				180	0.961						4,262	12,082	Yes	No	55	6[7]	9	890
43.1	Gallery NoHo Commons Apartments	5416 Fair Avenue	N. Hollywood	223				438	0.96						5,601	13,424	Yes	Yes	55	6[7]	9	1,070
44.1	The Academy Office Bldg.	5200 Lankershim Blvd.	N. Hollywood		710					157,000	0.98				5,006	13,577	Yes	Yes	55	6[7]	9	1,560
45.1	Lankershim Plaza Ofc. Bldg.	5250 Lankershim Blvd.	N. Hollywood		710					179,460	1.00				5,196	13,183	Yes	No	55	6[7]	9	1,060
46.1	AMLI at Warner Center Apartments	21200 Kittridge Street	Woodland Hills	223				522	0.94						9,573	8,353	No[2]	No[2]	55	6[7]	8	3,110[4]
47.1	Confidential Office Bldg.[1]	Confidential	L. A. area		710					511,000	1.00				26,091	3,560	Yes	No	31	12	10	650
48.1	Alterra at Grossmont Trolley Apartments	8707-47 Fletcher Pkwy.	La Mesa	223				297	0.963						8,535	4,295	Yes	Yes	8	16	15	470
49.1	Pravada at Grossmont Trolley Apartments	8625 Fletcher Parkway	La Mesa	223				230	0.983						8,960	4,241	Yes	Yes	8	16	15	500
50.1	Hazard Center Ofc. Tower	7676 Hazard Center Dr.	San Diego		710					283,000	0.93				8,600	3,402	Yes	Yes	11	8	19	690
51.1	Mission City Corporate Center	2355-85 Rio San Diego Drive	San Diego		710					291,000	0.93				2,519	3,632	Yes	Yes	0	8	14	2,320
52.1	Rio San Diego Plaza	8954 Rio San Diego Dr.	San Diego		710					278,096	0.80				8,619	3,065	Yes	Yes	0	8	15	2,320
53.1	Rio Vista Plaza	8885-9095 Rio San Diego Drive	San Diego		710					297,000	0.78				9,541	2,896	Yes	No	0	8	15	1,710
50.2	Hazard Center Shopping Center.	7610 Hazard Center Dr.	San Diego			820						137,064	0.89		8,600	3,402	Yes	Yes	11	8	19	5,80

[1] Floor area is occupied square feet; occupancy is dummy value.
[2] Based on walking distance to bus rapid transit station and bicycle facility; straight line distance misleading.
[3] About 2,600 feet to VTA light rail; 1,000 feet to Caltrain.
[4] Path distance to BRT station; no rail station.
[5] 2013 ACS 5-year (block groups).
[6] 2013 LEHD LODES (blocks).
[7] Includes only Red Line trains; Orange Line BRT buses included in bus count.

The apartment sites selected for Phase 1 ranged in size between 69 and 374 DUs. Most were between 100 and 235 DUs. Researchers tried to expand the upper end of this range with Phase 2 sites. The selected apartment sites had between 140 and 892 DUs, with most in the 190-300 range.

The office building sites were also mostly in different areas than the Phase 1 sites. However, the range in sizes was fairly similar to the Phase 1 size range. Phase 1 sites ranged between about 50,000 and 462,000 GSF with most between 240,000 and 320,000; Phase 2 sites ranged between 157,000 and 511,000 GSF with most being 200,000 to 300,000 GSF.

One requirement set for all Phase 2 sites was for every site to be within ¼-mile of bus service or ½-mile of a rail (or bus rapid transit [BRT] station with at least six trains (or rapid transit buses) per hour. Thirty-one of the 32 sites were easily within the straight line rail station distance. One site is close (almost adjacent) to a BRT station, but the actual path to the station is circuitous and well beyond the ½-mile parameter.

Table 2-1 also shows some characteristics of the areas surrounding each site. Among these are 2013 jobs and population data within ½-mile. The Phase 1 sites were provided with corresponding data from 2010, two years prior to the survey year. Providing the Phase 2 sites with 2013 data retains the two-year offset between data collection year and demographics year.

Table 2-1 additionally shows some transit-related characteristics. Presence of a rail transit station within ½-mile of the site and bicycle facilities within two blocks of the site were also provided for Phase 1 sites as were PM peak hour transit service figures. However, new for Phase 2 (and also determined for Phase 1 sites) is the path distance to the nearest rail transit station (at least six trains per PM peak hour). The path distance is the shortest distance that would be walked between the site and the station using "public" paths. In some cases this distance is much longer than the straight line radial distance and the researchers thought it might be a better measure of transit accessibility.

Table 2-2 shows the resulting profile of Phase 1 and Phase 2 survey sites by region. In total, there are 29 apartment sites, 22 office buildings sites, 4 retail sites, 6 coffee/donut shop sites, and 1 fitness center. The objective for Phase 2 was to get the total apartments sites to 30 and devote the remainder of the 30 Phase 2 sites to office buildings. Permissions were received that would have brought the apartments sites to 30, but scheduling difficulties at the end of the data collection period limited the apartments to 17 in Phase 2 and 29 total. Researchers were able to survey two additional sites that are contained within the boundaries of two of the Phase 2 sites. One was a shopping center that actually surrounds one of the surveyed office buildings (Hazard Center). The other is a major fitness center that is on part of the first and second floors of a surveyed office building (Wilshire Serrano). That yielded a total of 32 sites for Phase 2, 30 of which are targeted land uses for Phase 2.

Table 2-2. Survey Sites by Region

Region/Area	Survey Sites by Land Use and SGTG Phase												Total Sites by Region	Regional Percent of Total Sites	2010 Metropolitan Area Population	
	Apartments		Office		Retail				Coffee/Donut		Fitness					
					Shopping Center		Single Business								Millions	Percent of Total
	Ph. 1	Ph. 2	Ph. 1	Ph. 2	Ph. 1	Ph. 2	Ph. 1	Ph. 2	Ph. 1	Ph. 2	Ph. 1	Ph. 2				
Sacramento	1	2	2						1				6	10%	2	8%
San Francisco Bay Area														40%	6	25%
San Francisco	1		3						2				6			
Walnut Creek/Concord		3		1									4			
Oakland/Emeryville	3		3				2		3				11			
San Mateo/South Bay		2	1	1									4			
Los Angeles														39%	13	54%
Los Angeles/Culver City	4	2		3								1	10			
Pasadena	3	3		1	1								8			
San Fernando Valley		3		2									5			
Confidential				1									1			
San Diego														11%	3	13%
San Diego				4		1							5			
Mission Valley suburbs		2											2			
Total Sites	12	17	9	13	1	1	2	-	6	-	-	1	62	100%	24	100%
	29		22		2		2		6		1					

Table 2-2 additionally shows the numbers of Phase 1 and 2 sites by region and area. Phase 2 provided sites in several additional areas within the four California regions with rail transit systems. New areas included Walnut Creek/Concord, and South Bay in the San Francisco Bay Area; the San Fernando Valley in the Los Angeles area, and the San Diego area. Table 2-2 shows that the distribution of survey sites among the four regions is somewhat similar to the population distribution among those regions, with the San Francisco Bay Area being somewhat over-represented, and the Los Angeles region being somewhat under-represented. However, it should be noted that a combination of rail system coverage (numbers of stations) and maturity, and amounts of smart growth styles of development have resulted in more candidate sites being available in the Bay Area than in the Los Angeles region. While both regions have more identified candidate sites that could be surveyed, it is highly unlikely that good examples of apartment and office sites in the Los Angeles region could be increased enough to double the number of Bay Area sites. Figures 2-1 through 2-4 show the survey site locations in each of the four regions.

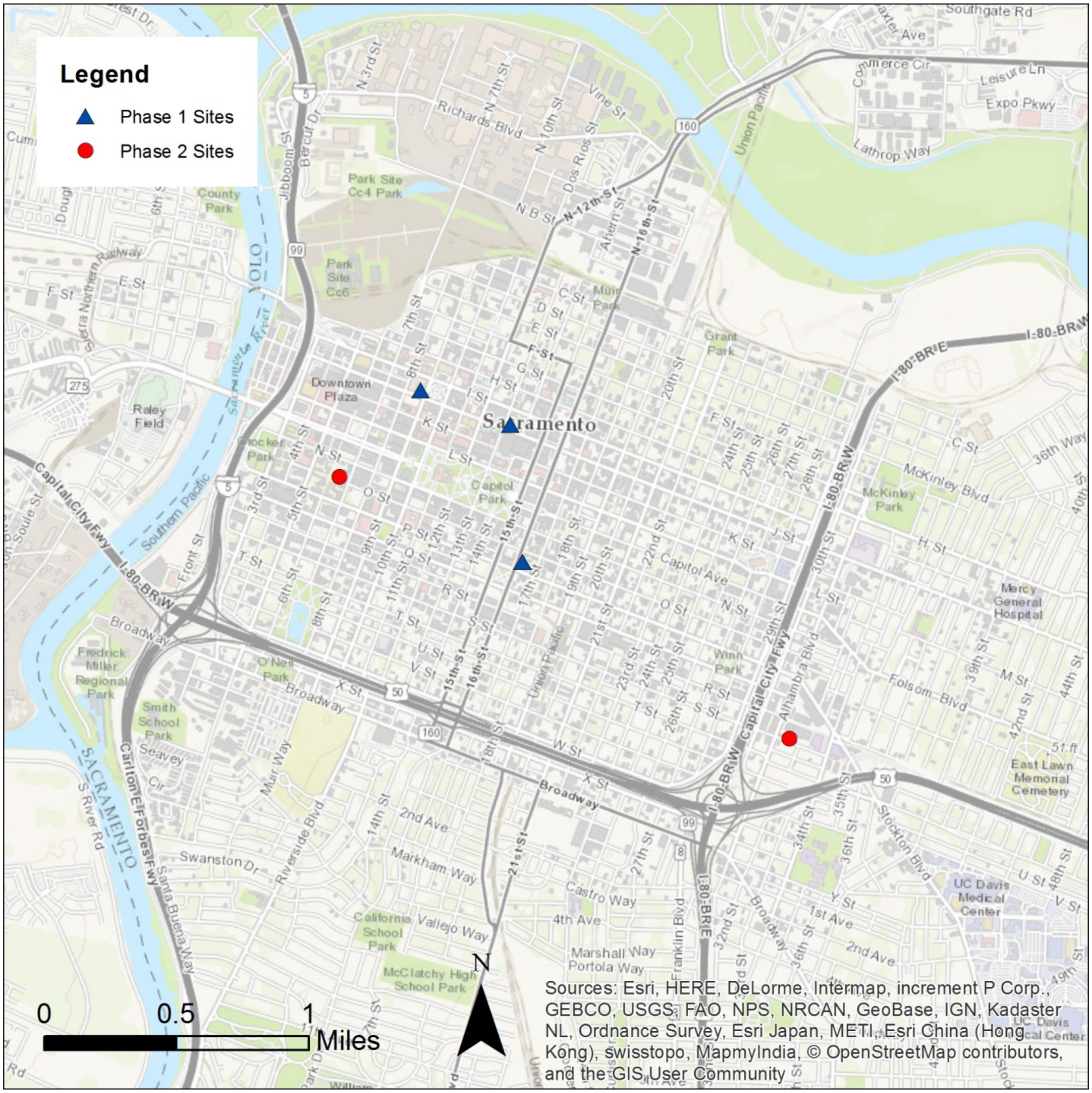

Figure 2-1. Sacramento Area Data Collection Sites

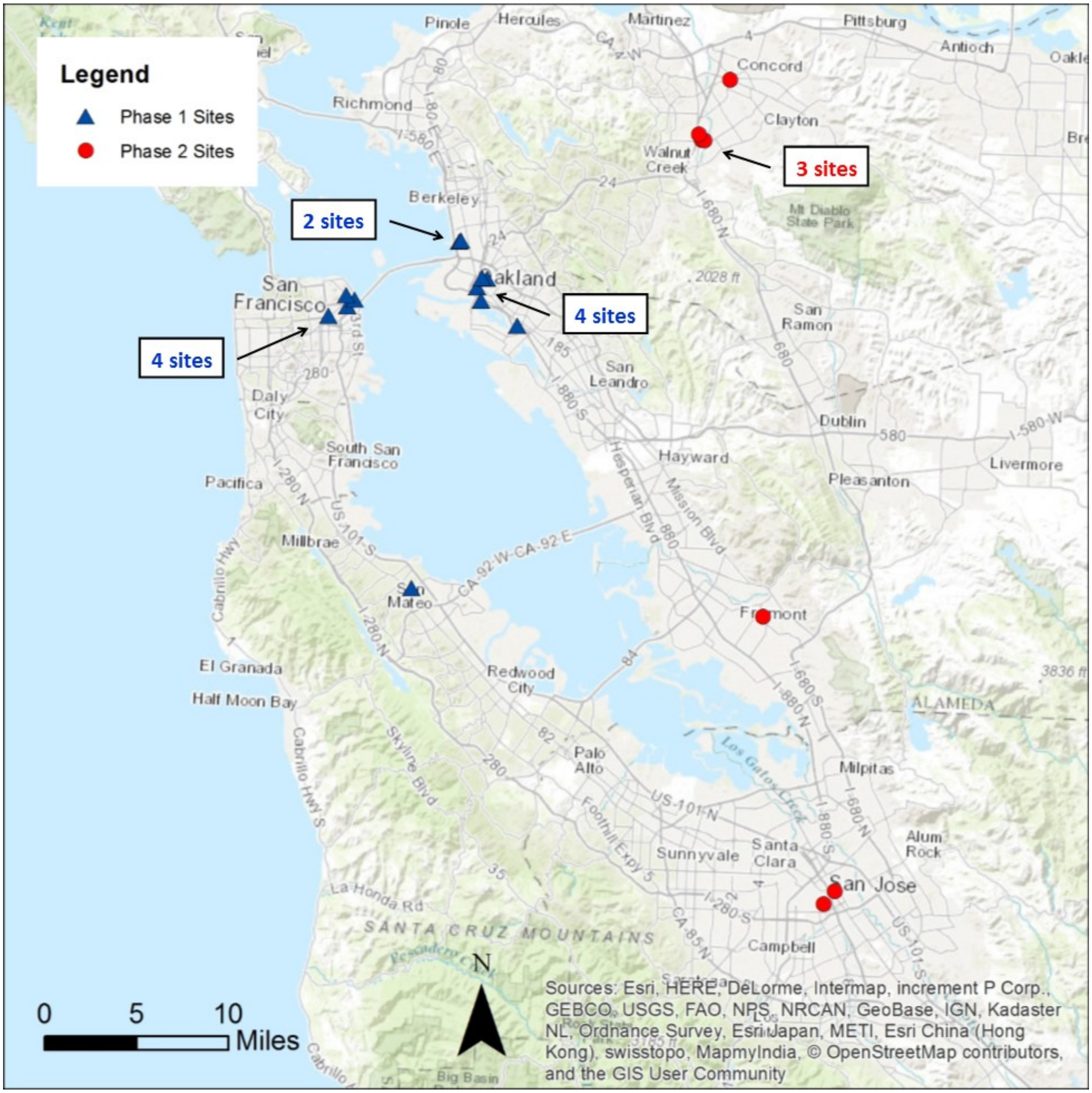

Figure 2-2. San Francisco Bay Area Data Collection Sites

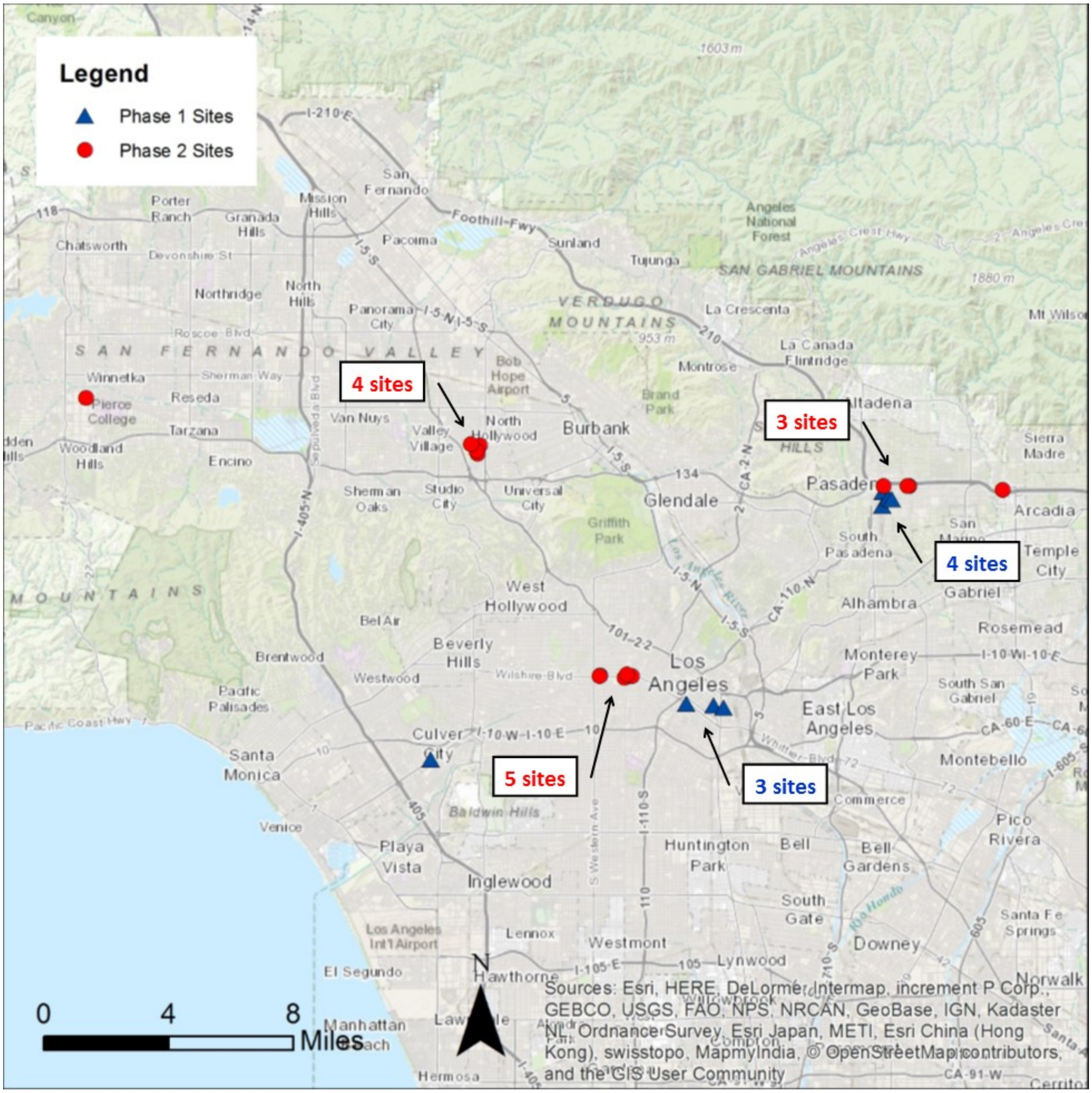

Figure 2-3. Los Angeles Region Data Collection Sites

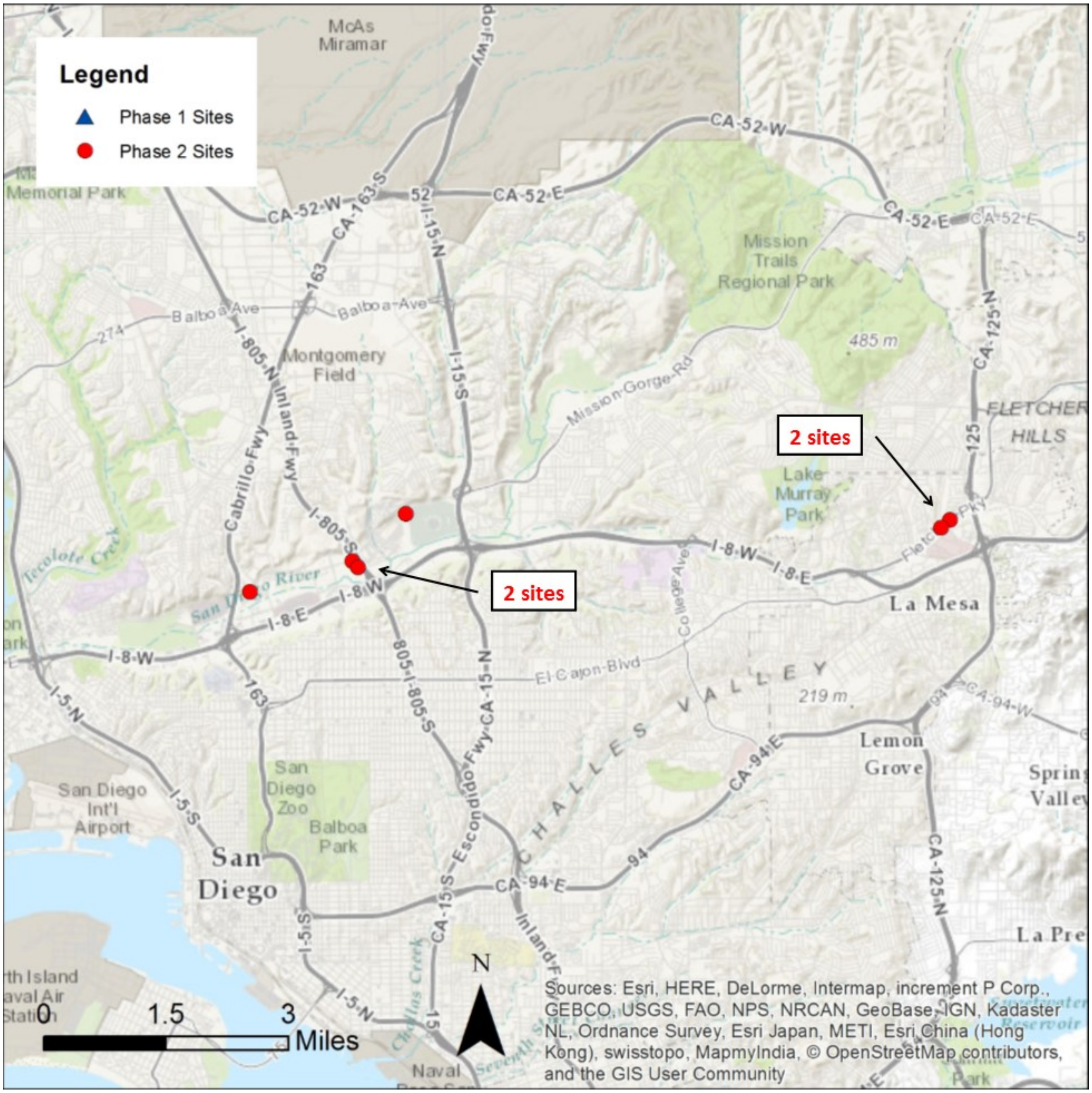

Figure 2-4. San Diego Region Data Collection Sites

COLLECT DATA TO QUANTIFY TOTAL PERSON-TRIPS GENERATED BY MODE

Site survey data were collected in spring and fall of 2015, with data collected at 16 sites during each season. The Los Angeles data were all collected in the spring. Data at the 16 sites in the other three regions were collected in the fall. In general, the data collection procedures were similar to what had been collected in Phase 1, but with a few notable changes.

- Interviews to obtain mode of travel were not used for vehicle trips since the travel mode was evident by observation (counts). Only six sites were selected where such interviews were needed to separate trips from multiple land uses on the site. This permitted a significant increase in percentage of trips for which the travel mode was certain, effectively increasing survey sample sizes. This improvement was accomplished through site selection and did not change any other survey method.
- Interviews were conducted in both inbound and outbound directions. Phase 1 interviews had been conducted almost exclusively in the outbound direction, although questions were asked about the preceding inbound trip. Interviewing in both directions both simplified the interviews and increased sampling percentages.
- The order of interview questions was changed and simplified in an attempt to (1) shorten interviews, and (2) simplify interviewer and respondent understanding of questions being asked. This appeared to reduce incorrect or illogical responses, and in many cases, reduced interview duration.
- For the fall surveys, researchers developed an app for use on tablets that permitted direct entry of interview responses to the survey database.[7] After some trial testing, this reduced interview durations, but more importantly, eliminated the need to key in the manually-recorded data from interview forms and eliminated data entry errors. The app still allowed survey supervisors to go back over individual interview records to check them for logic. The app did not allow for incomplete interviews except upon respondent refusal to answer any further questions. Although the app/tablet procedure did require some additional pre-survey time for each period to upload data and set up for the next period, it did reduce total interview-related time to conduct the survey and create an interview database. No changes were made for the door and driveway counts.

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[7] The tablets were configured so they could only be used for the interviews (i.e., Wi-Fi and all non-survey apps were locked and only accessible by supervisors). Extensive stress tests were performed to ensure questions would be clearly visible in bright sunlight, and that interviews could be conducted for several hours beyond scheduled survey periods without depleting batteries. To protect against breakage from dropping, ergonomic swivel grips with lanyards were used.

- Surveys were conducted between 6:30-9:30 a.m. rather than 7-10 a.m. in an attempt to better catch the peaks associated with apartment and office travel. No changes were made to the 4-7 p.m. afternoon survey period.

The survey (count and interview) plan was prepared for each site individually. Many of the sites had quirks that required specific counts and/or interviews that were a little different than normal. For example, at one office site, some hotel employees parked on office building property near the hotel then walked through a gate to the hotel. Those people were counted and interviewed as they passed through the gate in either direction so their trips could be subtracted from the office building trips. This type of condition was identified and prepared for during the site reconnaissance or pre-survey preparations.

SITE DATA COLLECTION FORMS

Door and driveway counts were made manually. No video, tube or other mechanical or electronic counts were made. Counts covered every access point or route across external cordons around the survey sites. Counts consisted of vehicles by type (including bicycle and pedestrian, and vehicle occupancy). Two forms were used to manually record the counts — one when counts consisted of vehicles and pedestrians (see Figure 2-5), and the other when counts included pedestrians only (see Figure 2-6).

Figure 2-7 shows the form used in the spring of 2015 for manual recording of interview responses. Interviews were used to determine the mode of travel and vehicle occupancy (if any) for all trips involving a walk across the site cordon. Those trips included pedestrian, bicycle, transit (rail or bus), and walking to/from a vehicle parked off-site.

In nearly all cases, interviews were conducted at every door, gate, or walkway having 5 or more peak period trips. Where activity was less or where there were several doors or gates serving the same part of a building or route to/from the building, interviews were conducted at a portion of the doors/gates and that data used for the similar access points. There were no cases where a busy pedestrian access point was left without an interviewer.

Interviewers were instructed to try to interview as many people entering or exiting the building as they could. There was no intent to interview only a proportional sample (e.g., one out of every five). Of course, not every passing pedestrian was willing to be interviewed and some passed by while an interviewer was busy interviewing someone else. Additionally, at certain times people were in more of a hurry and did not feel they had the time to stop. In other instances the assertiveness of an interviewer affected the sampling rate.

CORDON COUNT FORM – Driveways & Walkways

Building: ______________________________ Counter Name: ____________________ Cell Phone: (_____)_______________ Date: ______________ Hour Starting ___:00 am pm

Minutes after hour	Direc-tion	Door Location: ______	Door Location: ______	Door Location: ______	Driveway: ____________								Driveway: ____________								Door Location: ______	Door Location: ______	Door Location: ______
					Personal Vehicles				Delivery/Ser-vice Trucks		Walk	Bike	Personal Vehicles				Delivery/Ser-vice Vehicles		Walk	Bike			
					1	2	3	4+	1	2+			1	2	3	4+	1	2+					
:00-:15	In																						
	Out																						
:15-:30	In																						
	Out																						
:30-:45	In																						
	Out																						
:45-:00	In																						
	Out																						

Figure 2-5. Cordon Count Form – Driveways and Walkways

CORDON COUNT FORM – Walkways Only

Building: ______________________________ Counter Name: ____________________ Cell Phone: (_____)_______________ Date: ______________ Hour Starting ___:00 am pm

Minutes after hour	Direc-tion	Door Location: _______________	Door Location: _______________	Door Location: _______________	Door Location: _______________	Door Location: _______________
:00-:15	In					
	Out					
:15-:30	In					
	Out					
:30-:45	In					
	Out					
:45-:00	In					
	Out					

Figure 2-6. Cordon Count Form – Walkways Only

Intercept Survey Form: As persons ARRIVE or DEPART, intercept as they approach or leave a specific entrance.

Interviewer Name:________________ Cell Phone:(____)__________ Building:________________ Date:______________ Start Time:_____:_____ am pm Page _____ of _____

"Hello! Do you have a minute to take a brief transportation survey?" (This survey is for a research project for the California Department of Transportation. Feel free to decline to answer any questions you are not comfortable with.)

INBOUND			OUTBOUND			
Time of Survey	**Where are you headed now? (Check one only.)**	**How did you travel to get here? (Check each that applies.)**	**Where are you coming from now? (Check one only.)**	**How will you travel from here? (Check each that applies)**	**Other Info (Ask First Two)**	**Refusal?**
____:____ ☐ AM ☐ PM	☐ This building (office) ☐ This building (apartment) ☐ Other (specify) ____________	☐ **Walk**: Did you walk all the way? ☐ Y ☐ N ☐ **Auto**: Did you park? ☐ Y-On-site ☐ Y-Off-site ☐ N ☐ Was passenger in vehicle ☐ Got dropped off Number of people in vehicle ________ ☐ **Bus**: Got off on-site? ☐ Y ☐ N ☐ **Bus**: Used Orange Line? ☐ Y ☐ N ☐ **Train**: Got off on-site? ☐ Y ☐ N ☐ **Bicycle**	☐ This building (office) ☐ This building (apartment) ☐ Other (specify) ____________	☐ **Walk**: Will you walk all the way? ☐ Y ☐ N ☐ **Auto**: Are you parked? ☐ Y-On-site ☐ Y-Off-site ☐ N ☐ Will be passenger in vehicle ☐ Will get picked up Number of people in vehicle ________ ☐ **Bus**: Will catch on-site? ☐ Y ☐ N ☐ **Bus**: Will use Orange Line? ☐ Y ☐ N ☐ **Train**: Will catch on-site? ☐ Y ☐ N ☐ **Bicycle**	Home Zip Code: ________ Age: ________ Gender: ☐ M ☐ F	**~Age?** ________ **Gender:** ☐ **M** ☐ **F**
Time of Survey	**Where are you headed now? (Check one only.)**	**How did you travel to get here? (Check each that applies.)**	**Where are you coming from now? (Check one only.)**	**How will you travel from here? (Check each that applies)**	**Other Info (Ask First Two)**	**Refusal?**
____:____ ☐ AM ☐ PM	☐ This building (office) ☐ This building (apartment) ☐ Other (specify) ____________	☐ **Walk**: Did you walk all the way? ☐ Y ☐ N ☐ **Auto**: Did you park? ☐ Y-On-site ☐ Y-Off-site ☐ N ☐ Was passenger in vehicle ☐ Got dropped off Number of people in vehicle ________ ☐ **Bus**: Got off on-site? ☐ Y ☐ N ☐ **Bus**: Used Orange Line? ☐ Y ☐ N ☐ **Train**: Got off on-site? ☐ Y ☐ N ☐ **Bicycle**	☐ This building (office) ☐ This building (apartment) ☐ Other (specify) ____________	☐ **Walk**: Will you walk all the way? ☐ Y ☐ N ☐ **Auto**: Are you parked? ☐ Y-On-site ☐ Y-Off-site ☐ N ☐ Will be passenger in vehicle ☐ Will get picked up Number of people in vehicle ________ ☐ **Bus**: Will catch on-site? ☐ Y ☐ N ☐ **Bus**: Will use Orange Line? ☐ Y ☐ N ☐ **Train**: Will catch on-site? ☐ Y ☐ N ☐ **Bicycle**	Home Zip Code: ________ Age: ________ Gender: ☐ M ☐ F	**~Age?** ________ **Gender:** ☐ **M** ☐ **F**
Time of Survey	**Where are you headed now? (Check one only.)**	**How did you travel to get here? (Check each that applies.)**	**Where are you coming from now? (Check one only.)**	**How will you travel from here? (Check each that applies)**	**Other Info (Ask First Two)**	**Refusal?**
____:____ ☐ AM ☐ PM	☐ This building (office) ☐ This building (apartment) ☐ Other (specify) ____________	☐ **Walk**: Did you walk all the way? ☐ Y ☐ N ☐ **Auto**: Did you park? ☐ Y-On-site ☐ Y-Off-site ☐ N ☐ Was passenger in vehicle ☐ Got dropped off Number of people in vehicle ________ ☐ **Bus**: Got off on-site? ☐ Y ☐ N ☐ **Bus**: Used Orange Line? ☐ Y ☐ N ☐ **Train**: Got off on-site? ☐ Y ☐ N ☐ **Bicycle**	☐ This building (office) ☐ This building (apartment) ☐ Other (specify) ____________	☐ **Walk**: Will you walk all the way? ☐ Y ☐ N ☐ **Auto**: Are you parked? ☐ Y-On-site ☐ Y-Off-site ☐ N ☐ Will be passenger in vehicle ☐ Will get picked up Number of people in vehicle ________ ☐ **Bus**: Will catch on-site? ☐ Y ☐ N ☐ **Bus**: Will use Orange Line? ☐ Y ☐ N ☐ **Train**: Will catch on-site? ☐ Y ☐ N ☐ **Bicycle**	Home Zip Code: ________ Age: ________ Gender: ☐ M ☐ F	**~Age?** ________ **Gender:** ☐ **M** ☐ **F**
Time of Survey	**Where are you headed now? (Check one only.)**	**How did you travel to get here? (Check each that applies.)**	**Where are you coming from now? (Check one only.)**	**How will you travel from here? (Check each that applies)**	**Other Info (Ask First Two)**	**Refusal?**
____:____ ☐ AM ☐ PM	☐ This building (office) ☐ This building (apartment) ☐ Other (specify) ____________	☐ **Walk**: Did you walk all the way? ☐ Y ☐ N ☐ **Auto**: Did you park? ☐ Y-On-site ☐ Y-Off-site ☐ N ☐ Was passenger in vehicle ☐ Got dropped off Number of people in vehicle ________ ☐ **Bus**: Got off on-site? ☐ Y ☐ N ☐ **Bus**: Used Orange Line? ☐ Y ☐ N ☐ **Train**: Got off on-site? ☐ Y ☐ N ☐ **Bicycle**	☐ This building (office) ☐ This building (apartment) ☐ Other (specify) ____________	☐ **Walk**: Will you walk all the way? ☐ Y ☐ N ☐ **Auto**: Are you parked? ☐ Y-On-site ☐ Y-Off-site ☐ N ☐ Will be passenger in vehicle ☐ Will get picked up Number of people in vehicle ________ ☐ **Bus**: Will catch on-site? ☐ Y ☐ N ☐ **Bus**: Will use Orange Line? ☐ Y ☐ N ☐ **Train**: Will catch on-site? ☐ Y ☐ N ☐ **Bicycle**	Home Zip Code: ________ Age: ________ Gender: ☐ M ☐ F	**~Age?** ________ **Gender:** ☐ **M** ☐ **F**
Time of Survey	**Where are you headed now? (Check one only.)**	**How did you travel to get here? (Check each that applies.)**	**Where are you coming from now? (Check one only.)**	**How will you travel from here? (Check each that applies)**	**Other Info (Ask First Two)**	**Refusal?**
____:____ ☐ AM ☐ PM	☐ This building (office) ☐ This building (apartment) ☐ Other (specify) ____________	☐ **Walk**: Did you walk all the way? ☐ Y ☐ N ☐ **Auto**: Did you park? ☐ Y-On-site ☐ Y-Off-site ☐ N ☐ Was passenger in vehicle ☐ Got dropped off Number of people in vehicle ________ ☐ **Bus**: Got off on-site? ☐ Y ☐ N ☐ **Bus**: Used Orange Line? ☐ Y ☐ N ☐ **Train**: Got off on-site? ☐ Y ☐ N ☐ **Bicycle**	☐ This building (office) ☐ This building (apartment) ☐ Other (specify) ____________	☐ **Walk**: Will you walk all the way? ☐ Y ☐ N ☐ **Auto**: Are you parked? ☐ Y-On-site ☐ Y-Off-site ☐ N ☐ Will be passenger in vehicle ☐ Will get picked up Number of people in vehicle ________ ☐ **Bus**: Will catch on-site? ☐ Y ☐ N ☐ **Bus**: Will use Orange Line? ☐ Y ☐ N ☐ **Train**: Will catch on-site? ☐ Y ☐ N ☐ **Bicycle**	Home Zip Code: ________ Age: ________ Gender: ☐ M ☐ F	**~Age?** ________ **Gender:** ☐ **M** ☐ **F**

Figure 2-7. Manual Interview Form

Site data collection also included gathering information about the site and its surroundings. Figure 2-8 is the form used for recording site data. Some of the entries were sourced from technical references (e.g., land use and area codes), some came from site property managers (e.g., building occupancy), some came from field observations or measurements (e.g., average setbacks), and some came from GIS or other Internet sources (e.g., transit schedules).

Sample Sizes

Table 2-3 shows the sample sizes and rates for each of the sites for both AM and PM peak periods. The data presented is usable interviews – those for which enough information was obtained to provide information about the trip mode(s) of travel and vehicle occupancy if the respondent walked to a vehicle parked off-site and then drove. The two right columns show the percent of total pedestrians entering and leaving the site from which usable interviews were obtained. For the 32 sites combined, usable interviews were obtained from 48 percent of walking cordon crossings in the AM peak period and 44 percent in the PM peak period. Those percentages varied by site, ranging from a low of 18 percent to a high of 100 percent.

The research team had set a target of 50 or more usable interviews at each site for each peak period. A few sites had total peak period pedestrian counts lower than 50. For those sites where the peak period usable interviews were below 50, the usable interviews represented less than 25 percent of the total pedestrians at only one site.

As has been stated previously, the interview data were used only to split walking access trips into walk, transit, and bicycle trips. Trips by motor vehicle (driver, passengers) were determined in most cases by direct counts at site driveways; for those trips the sample rate was 100 percent. Hence, for a hypothetical site, if there were 30 percent non-vehicle trips and the sample rate for those was 40 percent, then 12 percent of all trips were reported in interviews (30 percent times 40 percent) and the 70 percent that were vehicle trips would all be represented by counts, yielding a total of 82 percent of all trips having modes directly reported.

More information about the survey data is reported in Chapter 3. Brief descriptions of each Phase 2 survey site are contained in Appendix A of this report.

SITE DATA - STUDY LOCATION CHARACTERISTICS

Crew park:____________________ ☐Comp ☐Pay $_____/shift **Meet:**_____________________________________

Restrooms:____

Building: ___________________________ **Surveyor:** ___________________________ **Date:** _________________

<table>
<tr><th colspan="2">Characteristic</th><th>Description</th><th>Value</th></tr>
<tr><td colspan="2">ITE Land Use Code</td><td>221= low-rise apartments (1-2 floors); 222 = high-rise apartments (11+ floors); 223 = mid-rise apartments (3-10 floors); 710 = general office. See ITE Trip Generation Manual, 9th ed. for definitions, additional classifications, if needed.</td><td></td></tr>
<tr><td colspan="2">ITE Area Type</td><td>See definitions in ITE Trip Generation Handbook, 3rd edition, 2012, p. 131. 0a=regional CBD (largest in region); 0b=Outlying CBD (any that is not region's largest); 1=urban core; 2=activity center; 3=general urban; 4=suburban business district; 5=suburban strip commercial; 6=general suburban; 7=special district; 8=rural town business district; 9=rural. Add following only where applicable: C=site within one mile of major (5,000+ student) university campus; M=mixed use within larger development; Ta=transit adjacent (within ½ mile of rail station; To=transit-oriented immediately adjacent or connected to rail station.</td><td></td></tr>
<tr><td rowspan="4">From Building Manager</td><td>Building size</td><td>☐ Office, retail: Gross square feet of building area _________
☐ Residential: Total dwelling units _________
Studio ______ Monthly rent ________ (range or lowest)
1 Bdrm _____ Monthly rent ________
2 Bdrm _____ Monthly rent ________
3+ Bdrm_____ Monthly rent ________</td><td></td></tr>
<tr><td>Portion occupied</td><td>0.00 – 1.00</td><td></td></tr>
<tr><td>On-site parking</td><td>Number of on-site parking spaces available for use by building being surveyed (includes adjacent facility on same block if designated parking for building)</td><td></td></tr>
<tr><td>On-site parking cost</td><td>Monthly rate per space ☐ incl. ☐ additional $________/month
Visitor rate: 1st hour $______ Cost/subsequent hour $______ Daily $_______</td><td></td></tr>
<tr><td colspan="2">Avg. bldg. setback dist.</td><td>Average building setback distance (feet) from each major building entrance to nearest sidewalk</td><td></td></tr>
<tr><td colspan="2">Metered on-street parking spaces</td><td>Number of metered on-street parking spaces within a 0.1-mile, straight-line radius of the center of the study site</td><td></td></tr>
<tr><td colspan="2">Metered on-street parking rate</td><td>First hour cost of metered on-street spaces within 0.1 mile of the center of the study site. If time limits vary for these spaces, use fee charged for 2 hour spaces.</td><td></td></tr>
<tr><td colspan="2">Residential Population Within ½ Mile</td><td>See description, sources</td><td></td></tr>
<tr><td colspan="2">Jobs Within ½ Mile</td><td>See description, sources</td><td></td></tr>
<tr><td colspan="2">Distance to Regional CBD</td><td>Miles to CBD of San Francisco, Oakland, Los Angeles, San Diego, Sacramento</td><td></td></tr>
<tr><td colspan="2">Bicycle facility proximity</td><td>Straight line distance (feet) to closest bicycle lane, path, or designated route.</td><td></td></tr>
<tr><td colspan="2">PM peak-hour bus stops within a ¼ mile, straight-line radius</td><td>Number of individual bus stop locations on all PM peak hour (4:30-5:30pm) bus routes that pass within a 1/4 mile, straight-line radius from the development's center.</td><td></td></tr>
<tr><td colspan="2">PM peak-hour buses stopping within a ¼ mile, straight-line radius</td><td>Number of buses stopping during PM peak hour (4:30-5:30pm) at bus stops within a ¼ mile, straight-line radius from the development's center</td><td></td></tr>
<tr><td colspan="2">PM peak-hour rail transit stops within a ½ mile, straight-line radius.</td><td>Number of individual rail transit stop locations on all PM peak hour (4:30-5:30pm) rail transit routes that pass within ½ mile, straight-line radius from the development's center.</td><td></td></tr>
<tr><td colspan="2">PM peak-hour rail transit trains stopping within a ½ mile, straight-line radius</td><td>Number of trains stopping at PM peak hour (4:30-5:30pm) rail transit stops within a ½ mile, straight-line radius from the development's center.</td><td></td></tr>
<tr><td colspan="2">site area covered by surface parking lots</td><td>Proportion (0.00 to 1.00) of site surface area covered by surface parking</td><td></td></tr>
<tr><td colspan="2">Site within 1 mile of major university</td><td>(1 = yes, 2 = no) Center of survey site is within 1 mile radius of any part of the main campus of a university with over 5,000 full-time students.</td><td></td></tr>
<tr><td colspan="2">Walk scores</td><td>Walkscore (0-100) _____ Transit score (0-100) ______ Bike score (0-100) ______</td><td></td></tr>
</table>

Figure 2-8. Site Characteristics Data Form

Table 2-3. Survey Intercept Percentages - Phase 2 Sites

Location ID	Site	Nondirectional Pedestrian Volume at Survey		Useable interviews		Percent Captured and Usable	
		AM	PM	AM	PM	AM	PM
224.1	Capitol Towers	153	223	103	127	67%	57%
225.1	LINQ Midtown Apartments	111	149	95	128	86%	86%
226.1	One Concord Center	400	337	262	206	66%	61%
227.1	Avalon Walnut Creek	189	251	64	145	34%	58%
228.1	Eaves by Avalon	314	266	271	263	86%	99%
229.1	Park Regency	270	314	237	270	88%	86%
230.1	Fremont Office Center	397	386	245	182	62%	47%
231.1	Avalon at Cahill Park	156	220	73	137	47%	62%
232.1	Villa Torino	124	207	106	116	85%	56%
233.1	Gardens at Wilshire Center	46	97	20	38	43%	39%
234.1	Wilshire Vermont Station	332	440	98	138	30%	31%
235.1	Wilshire Center East	157	199	60	69	38%	35%
236.1	Wilshire Financial Tower - North	226	170	41	41	18%	24%
237.1	Wilshire Serrano Building	446	342	138	140	31%	41%
237.2	24 Hour Fitness Center	472	787	117	160	25%	20%
238.1	Acappella Pasadena Apartments	40	102	36	65	90%	64%
239.1	Pasadena Gateway Villas	51	45	24	23	47%	51%
240.1	The Stuart at Sierra Madre Villa	26	33	23	33	88%	100%
241.1	Lake Corson Building	73	87	56	54	77%	62%
242.1	NoHo 14	36	80	11	23	31%	29%
243.1	Gallery at NoHo Commons	107	243	45	79	42%	33%
244.1	The Academy	306	415	160	102	52%	25%
245.1	Lankershim Plaza	401	585	176	200	44%	34%
246.1	AMLI Warner Center	102	178	35	48	34%	27%
247.1	Confidential Office Building	260	255	83	112	32%	44%
248.1	Alterra at Grossmont Trolley	187	356	60	140	32%	39%
249.1	Pravada at Grossmont Trolley	138	195	38	70	28%	36%
250.1	Hazard Center Office Tower	294	278	143	75	49%	27%
250.2	Hazard Center	162	231	53	79	33%	34%
251.1	Mission City Corporate Center	62	39	40	33	65%	85%
252.1	Rio San Diego Plaza	58	44	24	42	41%	95%
253.1	Rio Vista Plaza	56	70	25	17	45%	24%
	Total (by Peak Period)	6,152	7,624	2,962	3,355	48%	44%
	Total (Both Peak Periods)	13,776		6,317		46%	

3. SURVEY DATA REDUCTION

Once the Phase 2 surveys were completed, the next step was to enter the raw data into spreadsheets and to compile it to create a trip generation database. That database could then be used to (1) develop travel summaries for the 32 Phase 2 sites, and (2) combine with Phase 1 data for development of an enhanced methodology for estimating smart growth trip generation. This chapter describes how the first of these two actions was accomplished.

STEP 1 – PEAK PERIOD CORDON COUNTS OF TOTAL PERSON TRIPS

It was noted in the previous chapter that a cordon was established for each site to serve as a boundary across which all trips to and from survey sites were counted between 6:30-9:30 a.m. and 4:00-7:00 p.m. by 15-minute periods on Tuesdays – Thursdays. Each building access point or path was counted as a separate station. If the cordon station was a driveway, directional counts (i.e., inbound and outbound) were made of vehicles, vehicle occupants, and pedestrians (if any). Travel modes included in these counts were:

- Vehicle (including vehicle driver, vehicle passengers);
- Pedestrians (specific travel modes determined from interviews as discussed below):
    - Walk;
    - Rail transit;
    - BRT;
    - Bus;
    - Bicycle;
    - Parked off site but drove; and
    - Pick-up/drop-off.

STEP 2 – USING INTERVIEWS TO DETERMINE PEAK PERIOD MODE SPLITS

Interviewers attempted to intercept all persons walking to and from site access points. Interviewers were posted at all survey stations where there would be pedestrian activity (at a few access points where building managers said were very rarely, if ever used, counts were made but no interviews were conducted; in such cases data for an adjacent station were combined). Usable interviews (all those for which complete travel data were obtained) were grouped by survey station and time period.

For each survey station at a site the data collection yielded:

- Counts of people going to and from the site, either by vehicle, bicycling or walking; and
- Usable interviews from samples of those people who walked.

The next step was to compute expansion factors for the interview data so they would represent all counted trips walked across the cordon line at each survey station and site. Expansion factors were computed for each survey station (or group of stations if the number of interviews or count volumes were very low). The expansion factor at each location was computed for each peak period. The factor was simply the number of trips counted divided by the number of usable interviews at the location. For example, if a station had 30 counted outbound trips for a peak period and had 20 usable interviews, then that factor was F = 30/20 = 1.5. The expansion factor was added to each interview trip record for that movement during that period. The factors were used to expand or multiply the interview data by that amount, or in the case of the example, responses from each interview at that location during that period were multiplied by 1.5. That resulted in factored numbers of interviews equaling the corresponding peak hour counts at that location.

This was performed for all walk access stations for a site. Then it became possible to extract modal percentages for each direction (inbound and outbound) for each peak period.

However, two additional computations had to be added to obtain a finished mode split for each site and period. First, trips for which vehicles were driven but parked off-site had to be converted to vehicle trips since the predominant mode was driving, not walking. Second, pick-up/drop-off trips had to be changed from walk trips to two vehicle trips – one to and one from the site. In most cases the vehicle did not cross the site cordon, but again, the predominant mode of travel was a vehicle, not walking. Two vehicle trips had to be added because a pick-up/drop-off trip consists of a trip to the site and another one away from the site, both generated by site activity.

With these adjustments the count and survey data yielded (1) total vehicle trips plus total vehicle passenger trips (from vehicle occupancy counts), (2) total non-vehicle trips (remaining trips walked to and from the sites), and (3) percent of walk trips by the following actual modes:

- Walk;
- Rail transit;
- BRT;
- Bus; and
- Bicycle.

STEP 3 – PEAK HOUR TRIPS BY MODE

The objective was to determine the number of trips by mode for a typical weekday for the AM and PM peak hours of the adjacent street traffic between the hours of 7-9 a.m. and 4-6 p.m. (periods that match those used to estimate vehicle trips using the ITE definitions and procedures). This was another two-step process: (1) determine the peak hour (60 consecutive minutes) between 7-9 a.m. and 4-6 p.m. for each site, then sum the 15-minute cordon counts for each peak hour, and (2) multiply the non-vehicle mode split percentages by the adjusted peak hour non-vehicle trip counts. This produced AM and PM street peak hour inbound and outbound person trips by mode. This was performed for each site that could be fully isolated including its own parking supply (excluding small amounts of off-site parking).

EXCEPTION – SURVEY SITE WITH SHARED PARKING WITH OTHER ON-SITE LAND USES

The previous steps were used for 26 of the 32 Phase 2 sites. The other six sites used shared on-site parking, so the previous process could not isolate all of the site's trips in the same manner. For those sites, a similar but different process used similar counts and the same interviews.

The only way to fully isolate trips to and from the survey sites using on-site shared parking was to (1) count all people entering and leaving the survey building (all were on foot since none of these buildings had internal parking) and (2) interview as many as possible at all access points. Thus, this method, a version of which had been used for most Phase 1 sites, relied on interviews to establish travel by all modes, including those by vehicle. That meant that Step 2 was used to determine mode splits by all modes rather than just the non-vehicle modes.

The sites for which this method was used were:

- The Academy and Lankershim Plaza (office buildings) that each shared its parking garage with other office and apartment buildings;
- Wilshire Serrano office building and 24-Hour Fitness center that occupied the same building and shared the same underground parking garage; and
- Hazard Center Office Tower and Hazard Center shopping center that shared the same parking facility. An adjacent hotel also shared some parking but because most of it was cordoned off for hotel use it was easy to separate hotel and other parking and vehicle access movements.

Vehicle occupancy was determined from both the interviews and sample occupancy counts from the garage, using the occupancy counts as primary source and interviews for confirmation (except for Hazard Center for which opposites were used).

Table 2-3 in Chapter 2 shows the intercept interview capture rates – the percentages of pedestrians crossing the cordon lines from which usable surveys were obtained. Chapter 4 presents survey results.

4. SURVEY RESULTS

This chapter presents the resulting site trip generation estimates based on the Phase 2 data. Phase 1 results are described in the Phase 1 final report.[8] This chapter also shows the initial results of combining data collected in both Phases 1 and 2.

PHASE 2 RESULTS

Table 4-1 shows the weekday AM and PM street peak hour total person trips for each of the Phase 2 sites. Numbers shown are non-directional. That is, these are total trips for inbound and outbound directions combined. It is additionally important to emphasize that these numbers are for the peak hours during the 7-9 a.m. and 4-6 p.m. periods. These are not necessarily the highest hourly volumes during the extended peak periods often found in California's larger metropolitan areas. However, the 7-9 a.m. and 4-6 p.m. periods are being used because the goal of this project is to compare data with the ITE data, which are for those periods. Additionally, public agencies throughout California and the remainder of the country typically use these periods for analysis of development access needs and impacts.

Table 4-1 also shows person trip rates. These are person trips per occupied DUs for apartment buildings and per 1,000 GSF of floor area of a building (usually abbreviated "per 1,000 GSF") for office buildings. Person trip generation rates are popularly believed to be relatively consistent from building to building and area to area. As such, they are used as a basis to estimate site trip generation for use in traffic impact and related analyses.

Table 4-2 shows the same information for all 29 apartment sites surveyed in both Phases 1 and 2. Phase 1 sites have location ID numbers 204-221 while Phase 2 ID numbers are 224 and higher. The weighted average person trip generation rates for both phases are about the same as for Phase 2. The same is true for the standard deviations, indicating that the person trip generation rates from both phases have both similar magnitudes and similar variability.

Table 4-3 shows the person trip generation for the 22 office buildings surveyed in both Phases 1 and 2. The average person trip generation rates for Phase 2 are a little different than for Phase 1. The result is that the combined average for both peak hours is about 3 percent different than the average for Phase 2. The PM peak hour standard deviation is somewhat higher than the combined average, indicating more variability among rates for Phase 2 sites than for Phase 1 sites.

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[8] Handy, Susan, Kevan Shafizadeh, and Robert Schneider. *Final Report, California Smart-Growth Trip Generation Rates Study*, Appendix E. University of California, Davis for the California Department of Transportation, March 2013.

Table 4-1. Phase 2 Peak Hour Non-Directional Person Trips

ID	Site	Occupied DU	AM Peak Hour Person Trips		PM Peak Hour Person Trips	
			Total Trips	Trip Rate	Total Trips	Trip Rate
APARTMENTS						
224.1	Capitol Towers	192	69	0.36	91	0.47
225.1	LINQ Midtown Apartments	256	130	0.51	123	0.48
227.1	Avalon Walnut Creek	370	296	0.80	230	0.62
228.1	Eaves by Avalon	490	316	0.64	260	0.53
229.1	Park Regency	856	425	0.50	468	0.55
231.1	Avalon at Cahill Park	190	160	0.84	108	0.57
232.1	Villa Torino	187	129	0.69	126	0.67
233.1	Gardens at Wilshire Center	154	77	0.50	80	0.52
234.1	Wilshire Vermont Station	431	244	0.57	241	0.56
238.1	Acappella Pasadena Apartments	136	80	0.59	89	0.65
239.1	Pasadena Gateway Villas	128	52	0.41	46	0.36
240.1	The Stuart at Sierra Madre Villa	180	86	0.48	89	0.49
242.1	NoHo 14	173	68	0.39	109	0.63
243.1	Gallery at NoHo Commons	420	229	0.55	256	0.61
246.1	AMLI Warner Center	491	283	0.58	247	0.50
248.1	Alterra at Grossmont Trolley	286	141	0.49	208	0.73
249.1	Pravada at Grossmont Trolley	226	137	0.61	155	0.69
			Weighted Average	0.57		0.57
			Standard Deviation	0.13		0.09
			Estimated Equivalent ITE Rate	0.59		0.76
OFFICE BUILDINGS						
226.1	One Concord Center	316	242	0.77	242	0.77
230.1	Fremont Office Center	190	193	1.02	160	0.84
235.1	Wilshire Center East	171	253	1.48	412	2.41
236.1	Wilshire Financial Tower - North	170	293	1.72	244	1.44
237.1	Wilshire Serrano Building	271	450	1.66	349	1.29
241.1	Lake Corson Building	183	162	0.88	138	0.75
244.1	The Academy	154	166	1.08	129	0.84
245.1	Lankershim Plaza	179	302	1.68	485	2.70
247.1	Confidential Office Building	511	620	1.21	615	1.20
250.1	Hazard Center Office Tower	263	368	1.40	385	1.46
251.1	Mission City Corporate Center	271	355	1.31	386	1.43
252.1	Rio San Diego Plaza	222	335	1.51	363	1.63
253.1	Rio Vista Plaza	232	391	1.69	447	1.93
			Weighted Average	1.32		1.39
			Standard Deviation	0.31		0.59
			Estimated Equivalent ITE Rate	1.72		1.69
	RETAIL					
237.2	24 Hour Fitness Center	13	209	15.74	295	22.22
250.2	Hazard Center retail	122	393	3.22	941	7.71

Table 4-2. Phase 1 and 2 Apartment Peak Hour Non-Directional Person Trips

ID	Site	Occupied Dwelling Units	AM Peak Hour Person Trips		PM Peak Hour Person Trips	
			Total Trips	Trip Rate	Total Trips	Trip Rate
224.1	Capitol Towers	192	69	0.36	91	0.47
225.1	LINQ Midtown Apartments	256	130	0.51	124	0.48
227.1	Avalon Walnut Creek	370	297	0.80	230	0.62
228.1	Eaves by Avalon	490	316	0.64	260	0.53
229.1	Park Regency	856	425	0.50	468	0.55
231.1	Avalon at Cahill Park	190	160	0.84	109	0.57
232.1	Villa Torino	187	128	0.68	127	0.68
233.1	Gardens at Wilshire Center	154	77	0.50	80	0.52
234.1	Wilshire Vermont Station	431	243	0.56	242	0.56
238.1	Acappella Pasadena Apartments	136	81	0.60	89	0.65
239.1	Pasadena Gateway Villas	128	52	0.41	46	0.36
240.1	The Stuart at Sierra Madre Villa	180	86	0.48	89	0.49
242.1	NoHo 14	173	68	0.39	110	0.64
243.1	Gallery at NoHo Commons	420	229	0.55	255	0.61
246.1	AMLI Warner Center	491	283	0.58	247	0.50
248.1	Alterra at Grossmont Trolley	286	142	0.50	209	0.73
249.1	Pravada at Grossmont Trolley	226	138	0.61	155	0.69
204.1	Sakura Crossing	221	106	0.48	152	0.69
205.1	Artisan on 2nd	113	62	0.55	51	0.45
206.1	Victor on Venice	110	61	0.55	76	0.69
207.1	Pegasus	308	136	0.44	133	0.43
209.1	The Sierra	220	121	0.55	166	0.75
211.1	Archstone at Del Mar Station	221	98	0.44	102	0.46
212.1	Terraces at Emery Station	101	159	1.58	138	1.37
213.1	Holly Street Village	355	175	0.49	185	0.52
215.1	Broadway Grand	107	72	0.67	85	0.79
216.1	Terraces Apartment Homes	259	88	0.34	85	0.33
218.1	Argenta	178	89	0.50	107	0.60
221.1	Fremont Building	66	50	0.76	42	0.64
Weighted Average (Phase 2)				0.57		0.57
Standard Deviation (Phase 2)				0.13		0.09
Weighted Average (Phase 1 & 2)				0.56		0.57
Standard Deviation (Phase 1 & 2)				0.22		0.18

Table 4-3. Phase 1 and 2 Office Building Peak Hour Non-Directional Person Trips

ID	Site	Occupied GSF (000)	AM Peak Hour Person Trips		PM Peak Hour Person Trips	
			Total Trips	Trip Rate	Total Trips	Trip Rate
226.1	One Concord Center	316	243	0.77	242	0.77
230.1	Fremont Office Center	190	194	1.02	160	0.84
235.1	Wilshire Center East	171	253	1.48	412	2.41
236.1	Wilshire Financial Tower - North	170	293	1.72	244	1.44
237.1	Wilshire Serrano Building	271	449	1.66	349	1.29
241.1	Lake Corson Building	183	162	0.88	139	0.76
244.1	The Academy	154	167	1.09	129	0.84
245.1	Lankershim Plaza	179	303	1.69	484	2.70
247.1	Confidential Office Building	511	621	1.22	615	1.20
250.1	Hazard Center Office Tower	263	367	1.39	385	1.46
251.1	Mission City Corporate Center	271	355	1.31	386	1.43
252.1	Rio San Diego Plaza	222	335	1.51	363	1.63
253.1	Rio Vista Plaza	232	391	1.69	447	1.93
201.1	343 Sansome	229	316	1.38	333	1.46
202.1	Oakland City Center	192	248	1.29	221	1.15
210.1	180 Grand Avenue	175	184	1.05	143	0.82
214.1	Emery Station East	235	298	1.27	251	1.07
217.1	181 Second Avenue	50	101	2.03	114	2.28
219.1	Charles Schwab Building	321	510	1.59	401	1.25
220.1	Park Tower	416	617	1.48	566	1.36
222.1	Convention Plaza	310	514	1.66	491	1.58
223.1	Park Plaza	64	55	0.86	53	0.83
Weighted Average (Phase 2)				1.32		1.39
Standard Deviation (Phase 2)				0.31		0.59
Weighted Average (Phase 1 & 2)				1.36		1.35
Standard Deviation (Phase 1 & 2)				0.32		0.53

While it is hard to determine how consistent the rates may be from Tables 4-1 to 4-3, Figure 4-1 shows that there is a great deal of consistency among *person-trip* generation rates for the Phase 2 apartment buildings for both AM and PM peak hours. This is demonstrated by (1) the low ratios of standard deviation to weighted average rates in Table 4-1 (e.g., office AM ratio is 0.13/0.57), or about 23 percent; (2) the linearity of the rates as plotted against developments size (occupied DUs); (3) the high regression correlation coefficient (R^2) for which 1.00 is perfect and 0.5 is the minimum that ITE describes as meaningfully correlated; and (4) the regression intercept that is near the origin (regression line would pass through the 0,0 point on the chart).

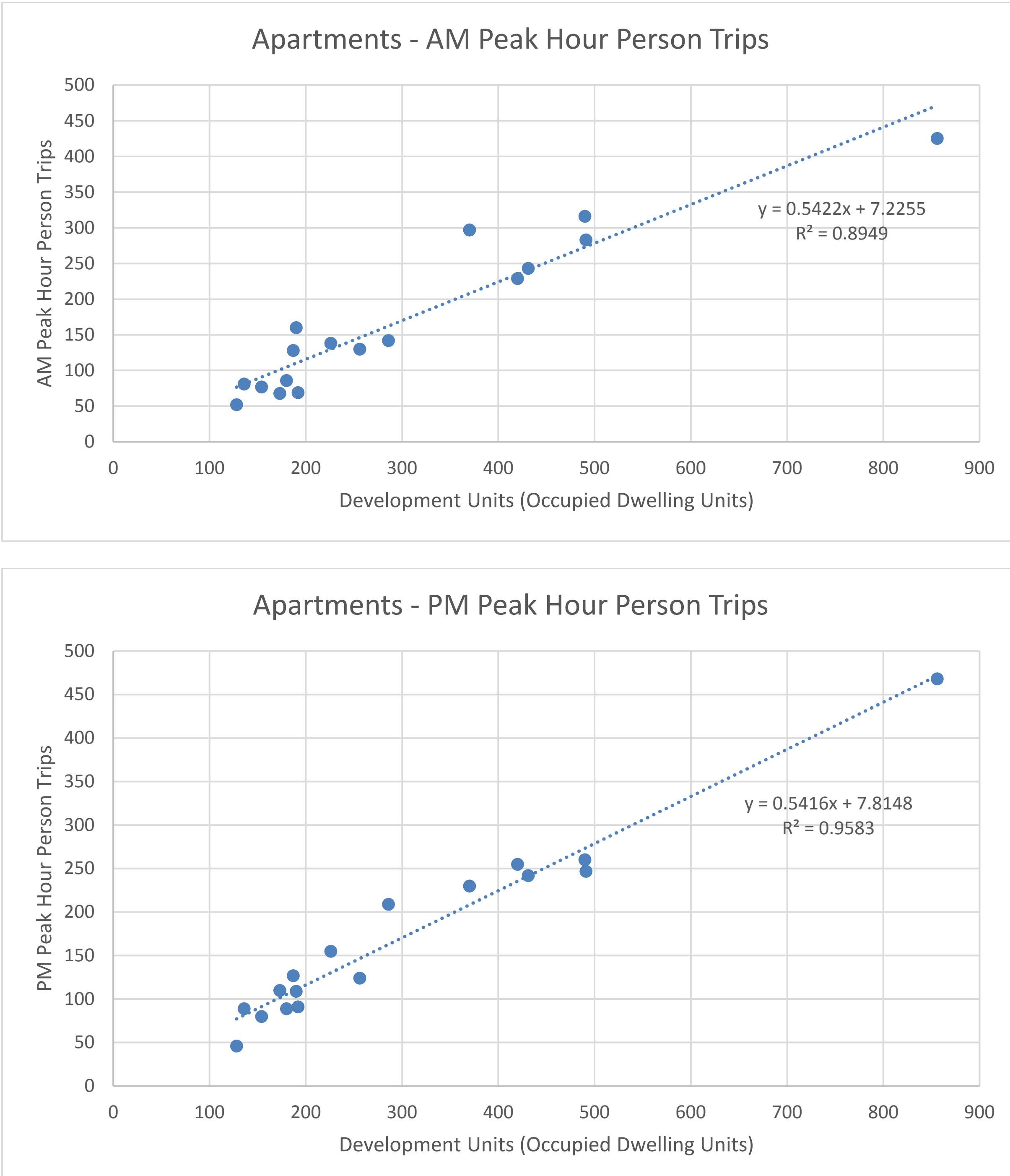
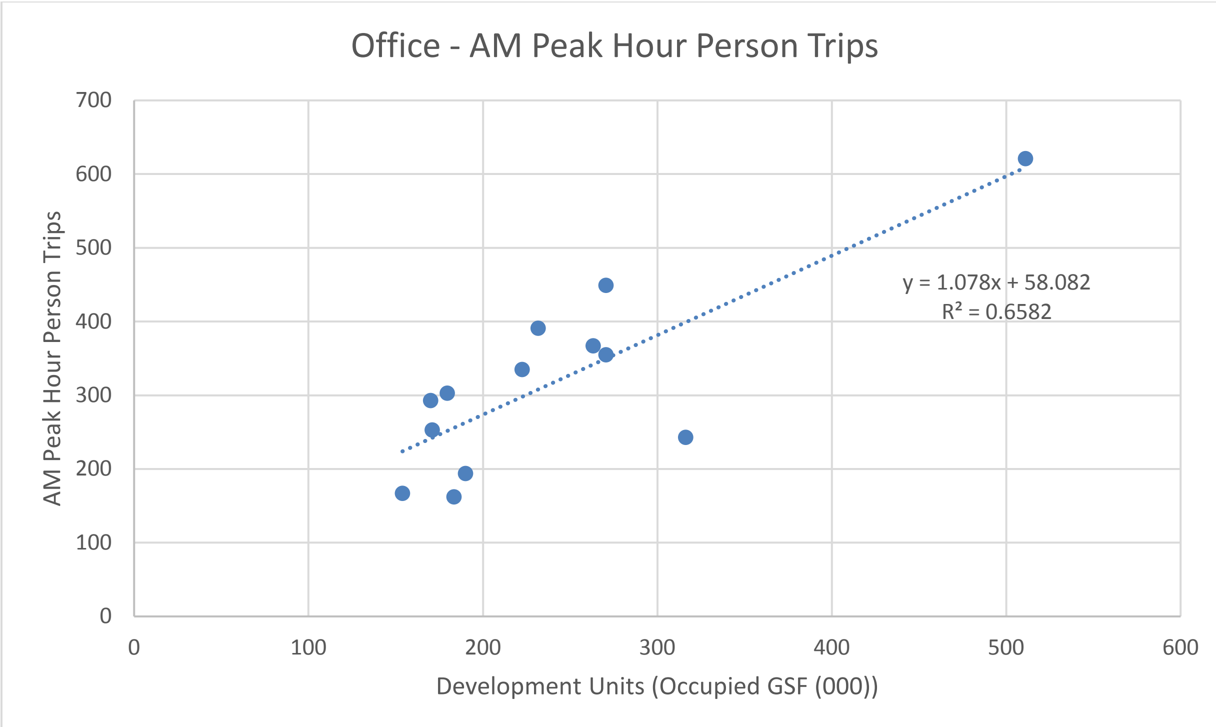


Figure 4-1. Phase 2 Apartment Peak Hour Person Trip Generation Scatter Diagrams

The consistency and correlations are not quite as strong for the Phase 2 office sites as shown in Figure 4-2, but the AM sites do demonstrate some consistency and correlation. There is more variation during the PM peak hour. This may result from differences in peak spreading and peak shifting and differences in building tenant mix among other factors.



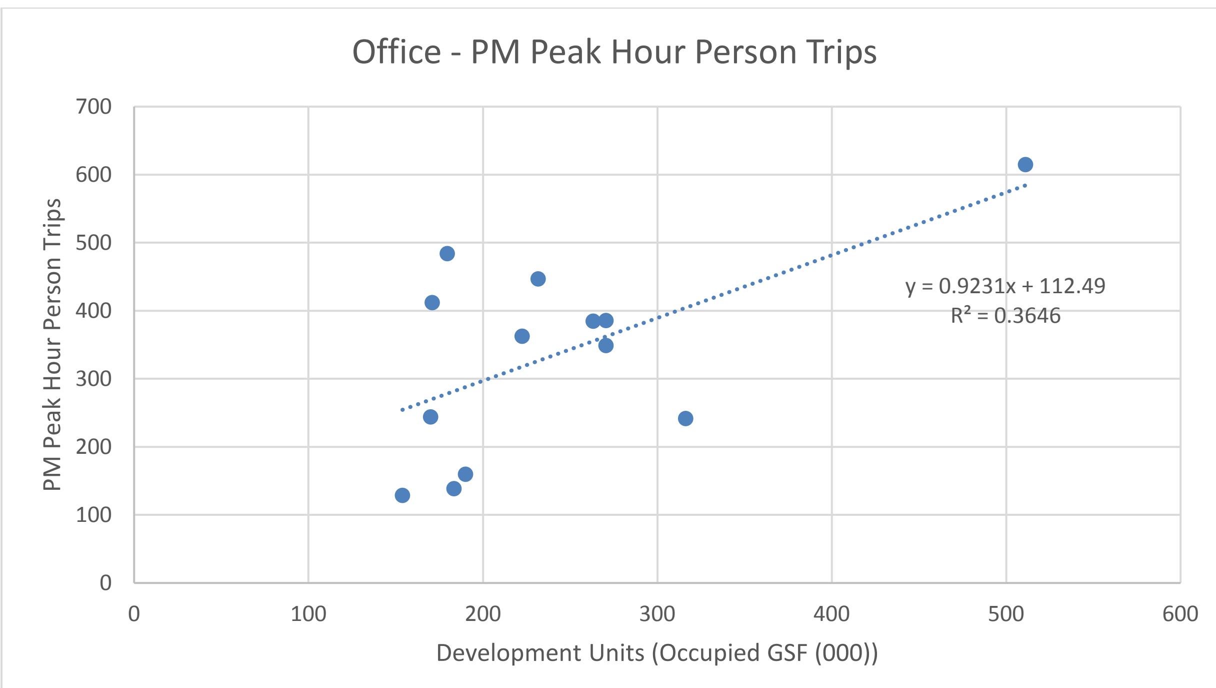


Figure 4-2. Phase 2 Office Building Peak Hour Person Trip Generation Scatter Diagrams

Table 4-1 also compares the total Phase 2 and estimated ITE equivalent person trip generation rates for each land use. For example, the apartment AM person trip rate is 0.57 person trips per DU. The estimated ITE rate is about 0.59.[9] These are very similar. However, the PM apartment and both office rates for Phase 2 sites are significantly lower than the estimated ITE rate would be. Again, this may result from peak spreading or shifting, different tenant mixes or just simply less travel, less (PM) travel due to availability of online shopping and other communication resources, or possibly due to the extent of congestion. This will again be addressed after Phase 1 and Phase 2 data are combined.

Table 4-4 shows the AM and PM peak period mode shares for the Phase 2 sites as derived from survey data. There is a high degree of variation. This was both intentional and expected. The site selection process was planned to obtain sites with a wide range of characteristics that would result in a range of mode splits and vehicle trip generation. This was accomplished by varying such site characteristics as transit station and stop proximity, amount of transit service close by, population and employment density (as surrogate for walkable destinations), etc. – variables that might cause differences in trip making.

[9] ITE does not publish person trip generation rates. These estimates are derived from very limited baseline site vehicle occupancy and non-vehicle trip data shown in Tables C.1 and C.2 of the *Trip Generation Handbook*, 3rd Edition, an ITE Proposed Recommended Practice, Institute of Transportation Engineers, Washington, DC, August 2014, not currently available online.

Table 4-4. Phase 2 Peak Period Mode Shares by Site

ID	Site	AM Peak Hour Mode Shares				AM Avg. Veh. Occupancy	PM Peak Hour Mode Shares				PM Avg. Veh. Occupancy
		Vehicle	Walk	Transit	Bicycle		Vehicle	Walk	Transit	Bicycle	
	RESIDENTIAL										
224.1	Capitol Towers	68%	20%	7%	4%	1.17	74%	15%	8%	3%	1.17
225.1	LINQ Midtown Apartments	77%	12%	4%	7%	1.08	70%	21%	4%	5%	1.12
227.1	Avalon Walnut Creek	63%	15%	23%	0%	1.20	61%	18%	20%	0%	1.26
228.1	Eaves by Avalon	50%	13%	36%	1%	1.28	58%	15%	27%	1%	1.28
229.1	Park Regency	61%	11%	28%	0%	1.21	64%	17%	17%	1%	1.25
231.1	Avalon at Cahill Park	50%	23%	25%	3%	1.13	44%	28%	26%	2%	1.12
232.1	Villa Torino	63%	15%	16%	6%	1.19	52%	18%	25%	5%	1.22
233.1	Gardens at Wilshire Center	68%	29%	4%	0%	1.19	73%	21%	6%	0%	1.24
234.1	Wilshire Vermont Station	42%	24%	33%	1%	1.08	44%	33%	22%	0%	1.13
238.1	Acappella Pasadena Apartments	78%	15%	5%	2%	1.06	67%	26%	4%	2%	1.19
239.1	Pasadena Gateway Villas	73%	15%	12%	0%	1.20	76%	17%	4%	2%	1.24
240.1	The Stuart at Sierra Madre Villa	87%	7%	5%	1%	1.17	89%	9%	2%	0%	1.29
242.1	NoHo 14	72%	19%	4%	4%	1.15	77%	15%	5%	3%	1.28
243.1	Gallery at NoHo Commons	78%	10%	12%	0%	1.20	75%	14%	11%	0%	1.32
246.1	AMLI Warner Center	94%	4%	2%	0%	1.18	91%	5%	4%	0%	1.24
248.1	Alterra at Grossmont Trolley	63%	13%	23%	0%	1.14	55%	26%	18%	1%	1.37
249.1	Pravada at Grossmont Trolley	64%	10%	25%	1%	1.21	67%	15%	17%	0%	1.30
204.1	Sakura Crossing	80%	17%	2%	1%	1.10	44%	56%	0%	0%	1.10
205.1	Artisan on 2nd	66%	34%	0%	0%	1.28	78%	19%	1%	1%	1.28
206.1	Victor on Venice	84%	15%	0%	1%	1.17	78%	5%	17%	0%	1.17
207.1	Pegasus	31%	65%	3%	0%	1.18	39%	61%	0%	0%	1.18
209.1	The Sierra	61%	16%	22%	1%	1.47	54%	26%	19%	0%	1.47
211.1	Archstone at Del Mar Station	67%	17%	16%	0%	1.31	59%	26%	8%	7%	1.31
212.1	Terraces at Emery Station	70%	21%	9%	0%	1.12	71%	26%	2%	1%	1.12
213.1	Holly Street Village	82%	13%	4%	0%	1.33	68%	32%	1%	0%	1.33
215.1	Broadway Grand	49%	29%	22%	0%	1.57	40%	40%	19%	0%	1.57
216.1	Terraces Apartment Homes	79%	18%	2%	1%	1.29	56%	43%	1%	0%	1.29

Table 4-4. Phase 2 Peak Period Mode Shares by Site (Continued)

ID	Site	AM Peak Hour Mode Shares				AM Avg. Veh. Occupancy	PM Peak Hour Mode Shares				PM Avg. Veh. Occupancy
		Vehicle	Walk	Transit	Bicycle		Vehicle	Walk	Transit	Bicycle	
218.1	Argenta	38%	38%	19%	6%	1.34	27%	49%	23%	1%	1.34
221.1	Fremont Building	62%	34%	4%	0%	1.23	67%	26%	3%	4%	1.23
	OFFICE										
226.1	One Concord Center	83%	5%	12%	0%	1.18	87%	6%	7%	0%	1.04
230.1	Fremont Office Center	85%	4%	10%	1%	1.04	79%	9%	11%	1%	1.18
235.1	Wilshire Center East	75%	14%	11%	0%	1.12	67%	22%	11%	0%	1.15
236.1	Wilshire Financial Tower - North	76%	11%	13%	0%	1.22	75%	13%	12%	0%	1.10
237.1	Wilshire Serrano Building	72%	12%	16%	0%	1.12	70%	16%	13%	1%	1.17
241.1	Lake Corson Building	91%	4%	4%	1%	1.09	87%	6%	6%	1%	1.08
244.1	The Academy	82%	3%	15%	0%	1.11	84%	5%	11%	0%	1.17
245.1	Lankershim Plaza	78%	8%	13%	1%	1.16	75%	11%	14%	1%	1.19
247.1	Confidential Office Building	86%	5%	8%	1%	1.28	87%	8%	5%	0%	1.39
250.1	Hazard Center Office Tower	89%	9%	3%	0%	1.13	90%	5%	5%	0%	1.21
251.1	Mission City Corporate Center	93%	6%	1%	0%	1.05	94%	5%	1%	1%	1.05
252.1	Rio San Diego Plaza	93%	6%	1%	0%	1.08	94%	5%	1%	0%	1.08
253.1	Rio Vista Plaza	85%	10%	5%	1%	1.05	88%	9%	3%	0%	1.07
201.1	343 Sansome	33%	34%	26%	7%	1.43	25%	39%	35%	1%	1.43
202.1	Oakland City Center	52%	2%	41%	6%	1.28	34%	10%	51%	6%	1.28
210.1	180 Grand Avenue	52%	11%	31%	6%	1.21	55%	13%	27%	5%	1.21
214.1	Emery Station East	51%	13%	22%	14%	1.14	56%	22%	14%	8%	1.14
217.1	181 Second Avenue	100%	0%	0%	0%	1.10	82%	14%	4%	0%	1.10
219.1	Charles Schwab Building	20%	17%	61%	2%	1.77	19%	15%	65%	2%	1.77
220.1	Park Tower	62%	27%	9%	2%	1.20	66%	19%	12%	3%	1.20
222.1	Convention Plaza	42%	16%	37%	5%	1.17	39%	16%	41%	4%	1.17
223.1	Park Plaza	68%	11%	8%	13%	1.27	68%	17%	8%	7%	1.27
	OTHER										
237.2	24-Hour Fitness Center	61%	28%	4%	7%	1.15	42%	42%	14%	2%	1.15
250.2	Hazard Center Retail	76%	18%	5%	1%	1.05	92%	5%	3%	0%	1.30

Table 4-4 shows that trips by vehicle (different from vehicle trips because these include vehicle passengers), vary for apartments from as low as 42 percent to as high as 93 percent in the morning peak hour. The afternoon is similar. For office buildings, the range is smaller, from 72 percent to 93 percent in the AM, with PM being fairly similar.

Table 4-4 also shows average vehicle occupancies (AVOs). There is a fair amount of variation there, too. Since these were counted directly for 26 of the 32 buildings, these are accurate for the dates surveyed. Variations may result from parking costs (all surveyed sites had adequate dedicated parking), availability of high-occupancy vehicle (HOV)/managed lanes on commute routes, rideshare incentives, level of congestion, etc.). Since transit and walking account for almost all non-vehicle travel, the estimation methodology should incorporate appropriate cause-effect relationships to reflect these differences.

Table 4-5 shows peak hour vehicle trip generation for the Phase 2 sites. The important thing here is to compare the average to the ITE vehicle trip generation rates. In all cases the average for Phase 2 sites is about ⅓ to ½ less than the ITE rates (apartments – 0.51 AM, 0.62 PM; office buildings: 1.56 AM, 1.49 PM). This should be expected since Phase 2 sites are smart growth type sites with a high degree of transit accessibility, walkability, and nearby complementary land uses. Many trips are expected to be made walking or by transit. On the other hand, ITE sites are normally suburban with almost no transit service and typical single-use zoning, so they should have nearly all trips by driving. This comparison will be addressed again with combined Phase 1 and Phase 2 data.

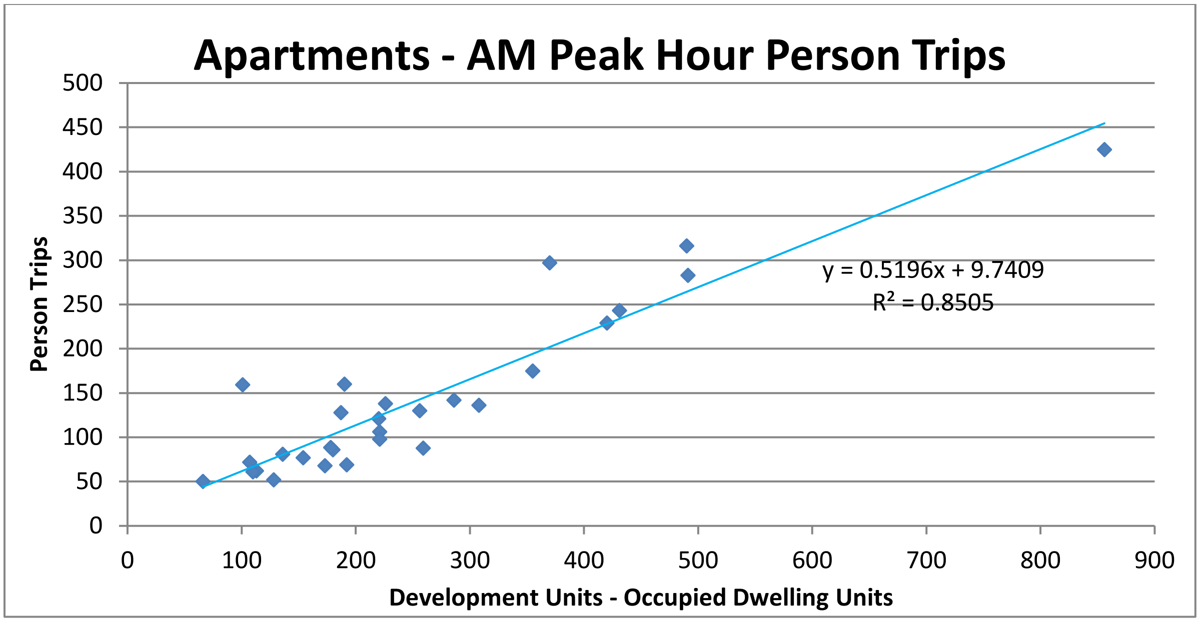
Table 4-5. Phase 2 Peak Hour Vehicle Trip Generation by Site

ID	Site	Occupied DU	Peak Hour Vehicle Trips			
			AM		PM	
			Total Trips	Trip Rate	Total Trips	Trip Rate
APARTMENTS						
224.1	Capitol Towers	192	40	0.21	57	0.30
225.1	LINQ Midtown Apartments	256	92	0.36	78	0.30
227.1	Avalon Walnut Creek	370	155	0.42	112	0.30
228.1	Eaves by Avalon	490	124	0.25	117	0.24
229.1	Park Regency	856	215	0.25	240	0.28
231.1	Avalon at Cahill Park	190	71	0.37	43	0.23
232.1	Villa Torino	187	67	0.36	54	0.29
233.1	Gardens at Wilshire Center	154	44	0.29	47	0.31
234.1	Wilshire Vermont Station	431	96	0.22	94	0.22
238.1	Acappella Pasadena Apartments	136	59	0.43	51	0.38
239.1	Pasadena Gateway Villas	128	32	0.25	28	0.22
240.1	The Stuart at Sierra Madre Villa	180	64	0.36	61	0.34
242.1	NoHo 14	173	42	0.24	66	0.38
243.1	Gallery at NoHo Commons	420	150	0.36	146	0.35
246.1	AMLI Warner Center	491	227	0.46	182	0.37
248.1	Alterra at Grossmont Trolley	286	79	0.28	83	0.29
249.1	Pravada at Grossmont Trolley	226	73	0.32	80	0.35
			Weighted Average	0.32		0.30
			Standard Deviation	0.08		0.05
OFFICE						
226.1	One Concord Center	316	170	0.54	202	0.64
230.1	Fremont Office Center	190	158	0.83	108	0.57
235.1	Wilshire Center East	171	170	0.99	240	1.40
236.1	Wilshire Financial Tower - North	170	182	1.07	165	0.97
237.1	Wilshire Serrano Building	271	289	1.07	210	0.78
241.1	Lake Corson Building	183	136	0.74	112	0.61
244.1	The Academy	154	124	0.81	93	0.60
245.1	Lankershim Plaza	179	203	1.13	304	1.69
247.1	Confidential Office Building	511	418	0.82	384	0.75
250.1	Hazard Center Office Tower	263	288	1.09	287	1.09
251.1	Mission City Corporate Center	271	314	1.16	342	1.26
252.1	Rio San Diego Plaza	222	288	1.29	314	1.41
253.1	Rio Vista Plaza	232	317	1.37	367	1.58
			Weighted Average	0.98		1.00
			Standard Deviation	0.23		0.39
OTHER						
237.2	24 Hour Fitness Center	13	111	8.36	109	8.21
250.2	Hazard Center Retail	122	285	2.34	667	5.47

PHASE 1 AND 2 COMBINED RESULTS

Phase 1 survey results are discussed in detail in the Phase 1 final report. When the person trip generation data were combined for apartment and office buildings, the results were somewhat similar, even though many Phase 1 sites were on the edge of downtowns and most Phase 2 sites were in more "midtown" and dispersed urban smart growth type locations.

Figures 4-3 and 4-4 show the scatter diagrams for the combined Phase 1 and Phase 2 AM and PM peak hour person trip generation data for apartments and office buildings. Figures 4-5 and 4-6 show scatter diagrams for vehicle trip generation for the Phase 1 and 2 apartments and office buildings, respectively. Because different sites have different characteristics that would cause different mode splits, it is expected that there would be more scatter in vehicle trips. While the person and vehicle trip scatter diagrams look very similar, the R^2 statistics indicate that there is indeed more scatter for vehicle trips than for person trips. However, as stated previously in the discussion of Phase 2 results, a high degree of linearity is not expected for smart growth area vehicle trip generation.



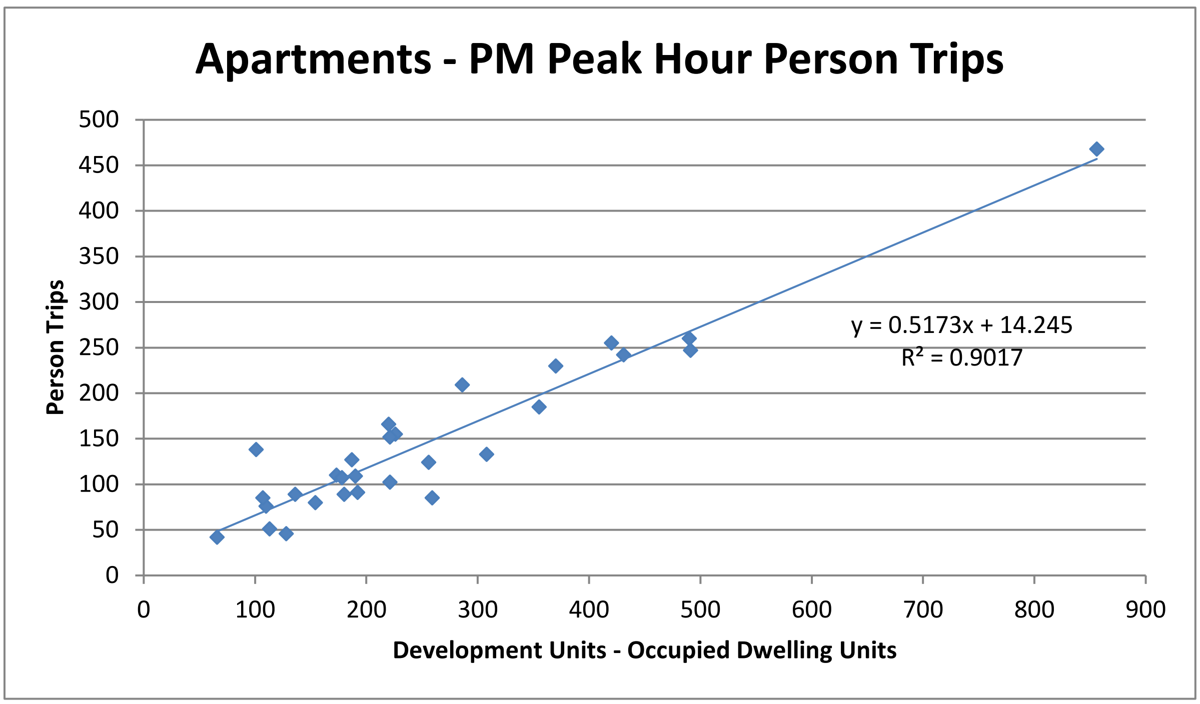
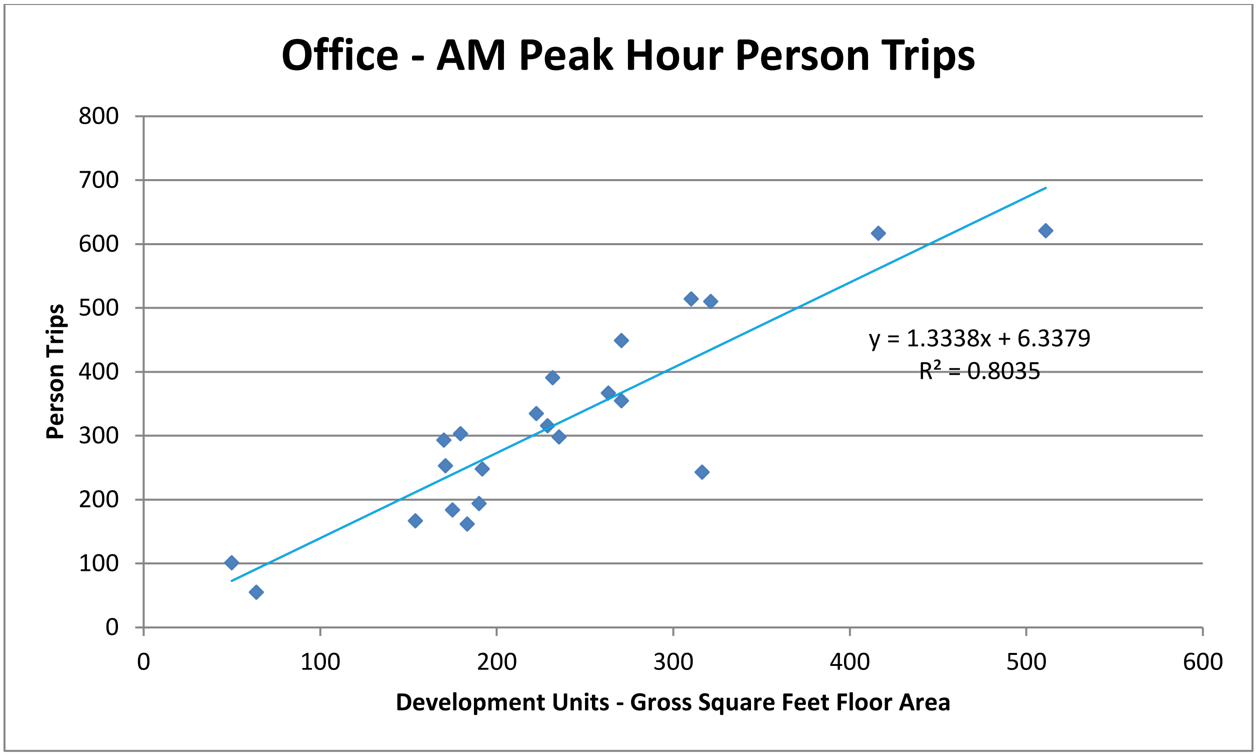


Figure 4-3. AM and PM Peak Hour Apartment Phase 1 and 2 Person Trip Scatter Diagrams



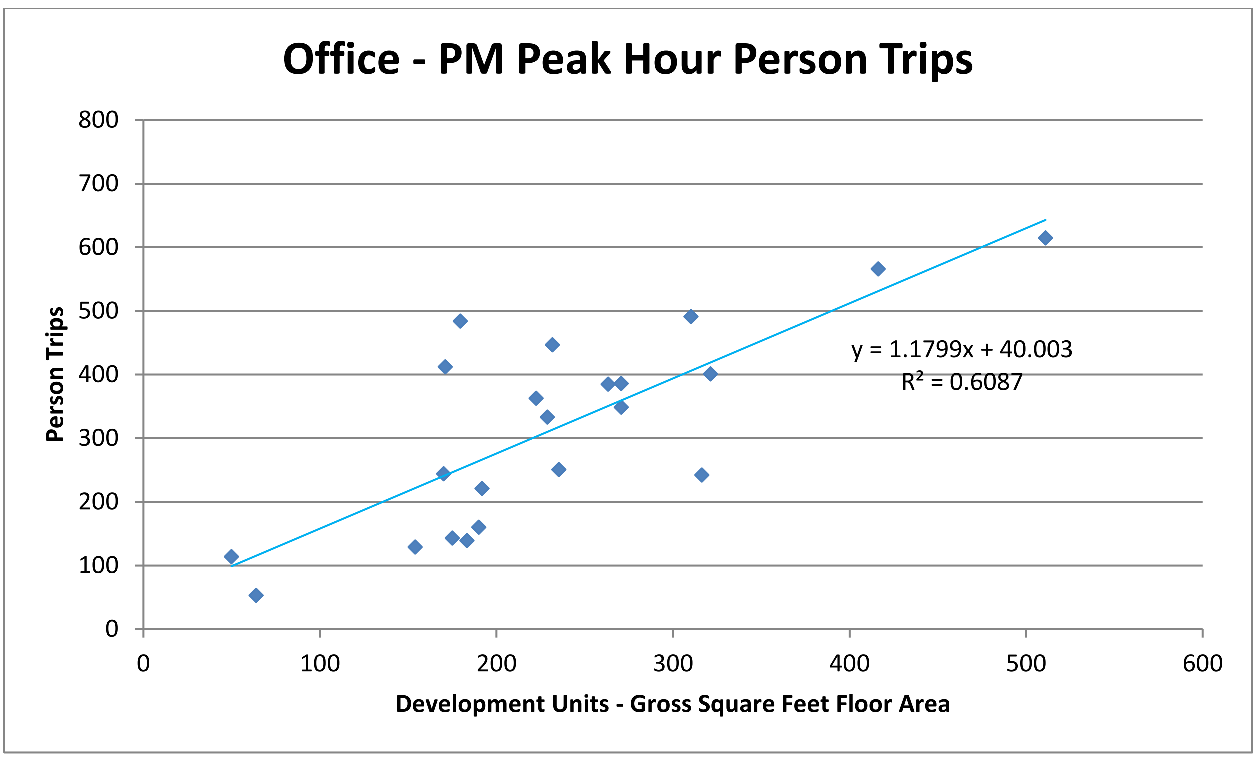
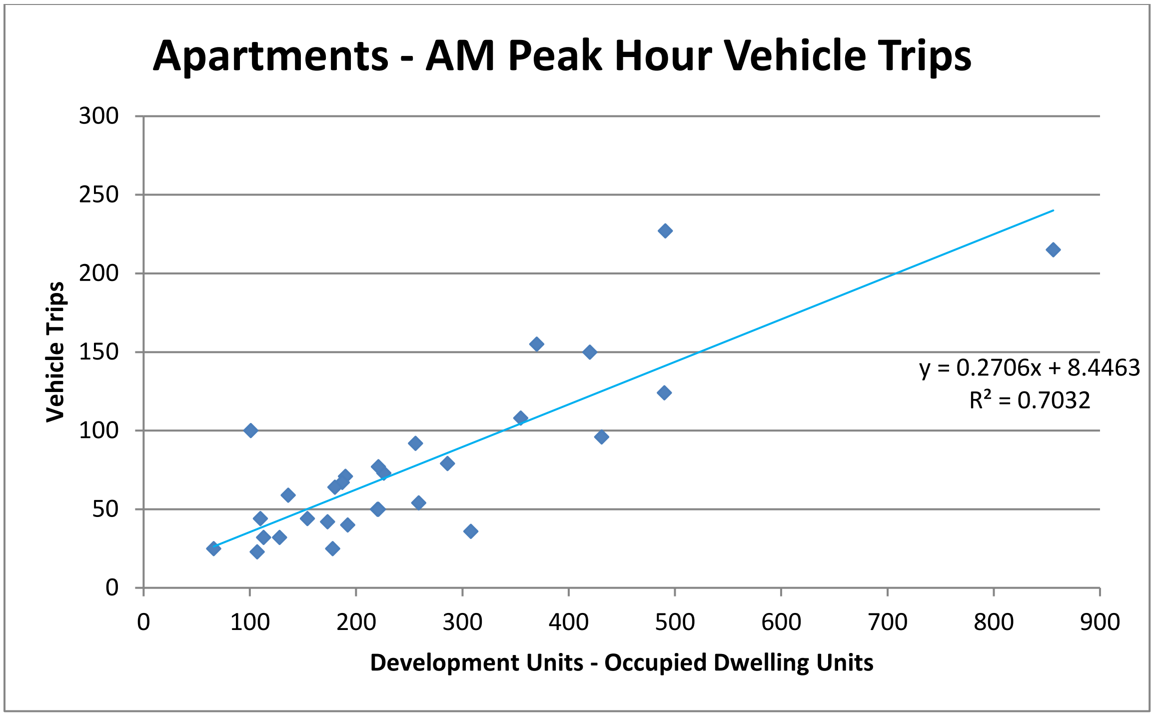


Figure 4-4. AM and PM Peak Hour Office Building Phase 1 and 2 Person Trip Scatter Diagrams



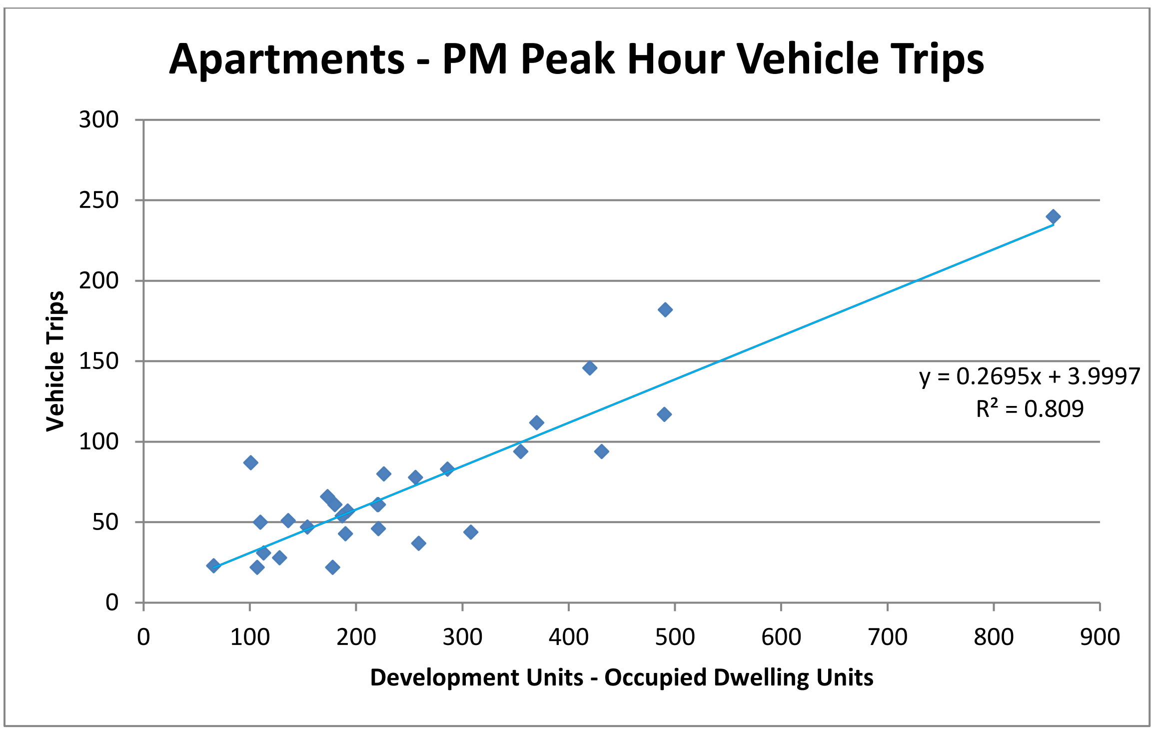
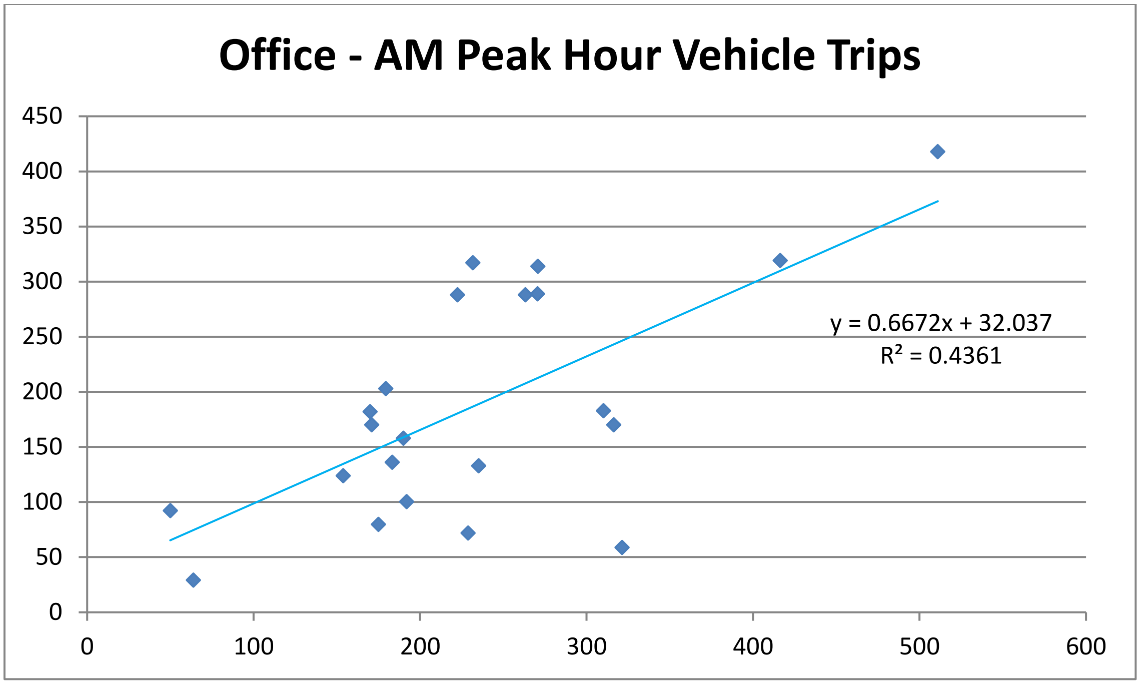


Figure 4-5. AM and PM Peak Hour Apartment Phase 1 and 2 Vehicle Trip Scatter Diagrams



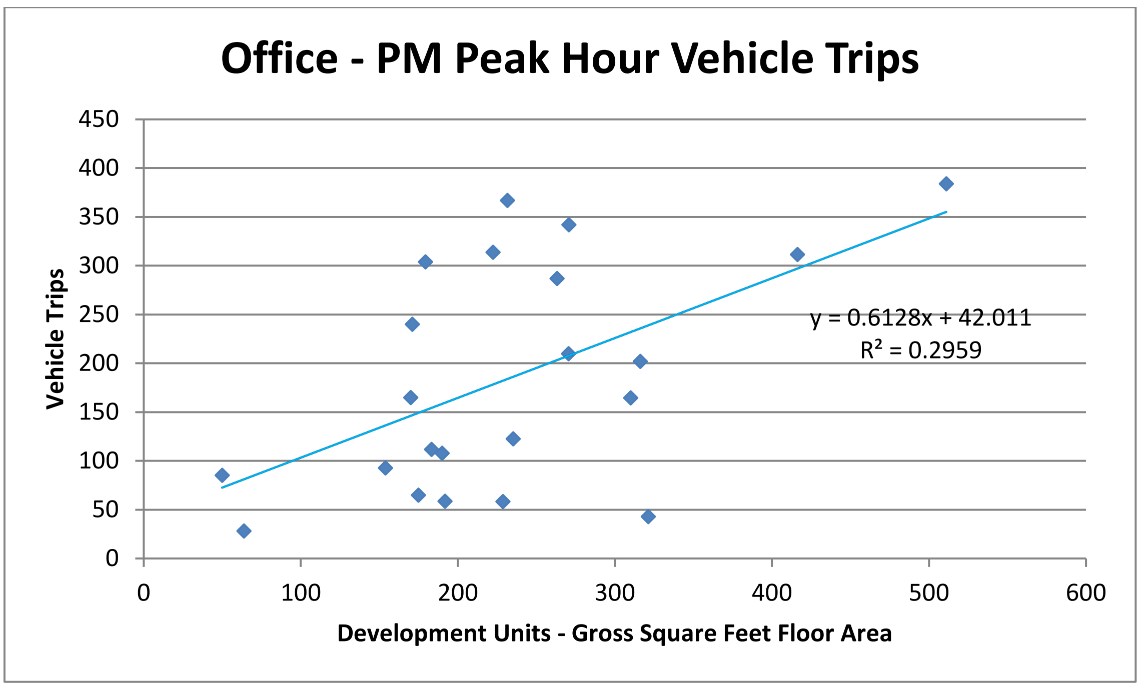


Figure 4-6. AM and PM Peak Hour Office Building Phase 1 and 2 Vehicle Trip Scatter Diagrams

Figure 4-6 shows scatter diagrams for the combined Phase 1 and 2 office building person trip generation data. Phase 1 sites were in locations that were more similar to each other than Phase 2 sites. The addition of sites from both phases yields both a significantly larger database as well as more consistency in person trip generation than was found for the Phase 2 sites alone. While the R^2 statistics are not as high as for the apartments, they are still above the ITE minimum to use to estimate site trip generation. The scatter in the Phase 2 PM data is still apparent in the combined data.

The data shown in Figures 4-3 and 4-4 were then used along with limited data from other California smart growth sites in the analysis and estimation method work described in the next chapter.

As is the case for the combined Phase 2 person trips, the combined Phase 1 and 2 vehicle trip scatter diagrams in Figures 4-5 and 4-6 show more scatter than for the person trips. Again, this is due to the varied characteristics surrounding the sites and was expected.

5. DEVELOPMENT OF IMPROVED ESTIMATION METHOD

OVERVIEW

Vehicle trip generation rates counted at the 65 California smart growth locations included in the Phase 2 database are almost all less than the ITE *Trip Generation Manual* suburban rates and equations estimates.[10] A comparison between Caltrans SGTG data and ITE estimates is presented in Figure 5-1 for the apartment study sites and in Figure 5-2 for the office study sites. The x-axis represents the actual vehicle trip counts; the y-axis represents the ITE-derived vehicle trip estimates. The solid line represents the "y=x" curve. A data point above that line indicates the ITE-derived estimate is higher than the actual count (i.e., the y-value is greater than the x-value).

On average, the smart growth apartment sites generate 44 percent fewer peak hour vehicle trips than would be estimated using ITE *Trip Generation Manual* rates and equations. On average, the smart growth office sites generate 49 percent fewer peak hour vehicle trips. This result confirms the Phase 1 finding that vehicle trip generation for smart growth sites is often significantly lower than for typical suburban apartment and office development sites.

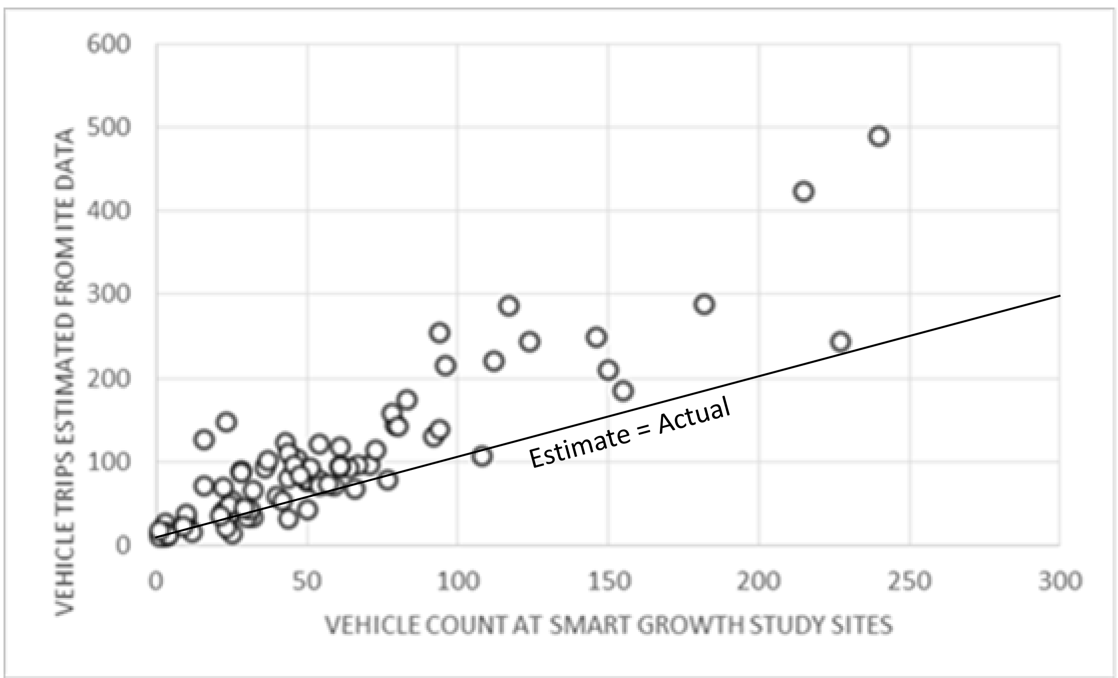


Figure 5-1. Comparison of Smart Growth Apartment AM and PM Peak Hour Vehicle Trips to Estimates from the ITE Suburban Trip Generation Data

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[10] *Trip Generation Manual*, 9th Edition, Institute of Transportation Engineers, Washington, DC, 2012, not currently accessible online.

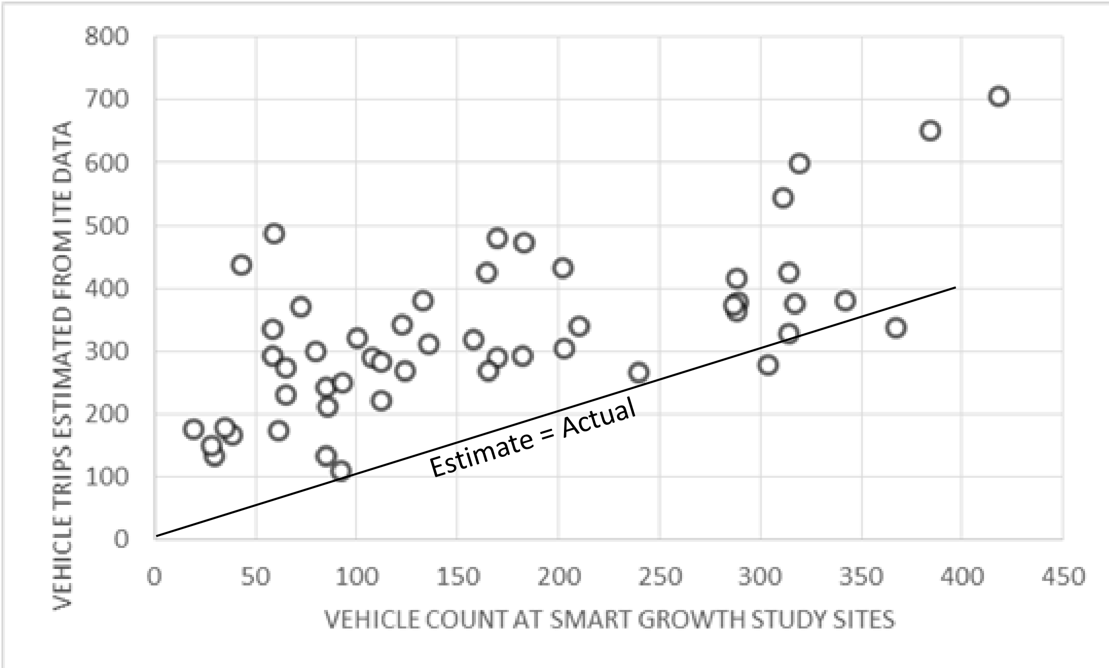

Figure 5-2. Comparison of Smart Growth Office Site AM and PM Peak Hour Vehicle Trips to Estimates from the ITE Suburban Trip Generation Data

The objective of the analysis efforts described in this chapter is to develop models that enable a practitioner to accurately estimate weekday AM and PM peak hour vehicle trip generation for apartment and office development sites with smart growth characteristics.

The Phase 2 analysis results and products have benefited from the model development analysis and conclusions that were developed during Phase 1. The Phase 1 documentation also included an assessment of the reported findings on recent literature covering the connections between trip-making and (1) site characteristics, (2) nearby transportation facilities and services, and (3) site context in terms of complementary nearby land uses.

The initial step in the analysis process was to test the accuracy of the model developed in Phase 1 to estimate vehicle trips generated at the study sites counted as part of Phase 2. The analysis found that the inclusion of Phase 2 data slightly reduces (worsens) the Phase 1 model accuracy. This finding prompted a complete reinvestigation of potential explanatory variables and their relationship to trip-making at smart growth sites.

The Phase 1 model produces a smart growth factor to apply to a vehicle trip estimate derived from the ITE *Trip Generation Manual* rates and equations. Phase 2 attempts to develop models to more accurately estimate this factor were unsuccessful unless a large number of independent variables were used, making the models unrealistic in terms of practical application. As an example, the AM apartment model required 15 independent variables to produce an acceptably accurate vehicle trip estimate.

The Phase 2 analysis has successfully developed models that produce vehicle trip estimates directly, rather than as a factor to apply to the ITE *Trip Generation Manual* rates and equations. Separate models were developed for apartment and office sites. The retail and restaurant sites included in the Phase 1 report and analysis were too few to be included in the Phase 2 analysis and model recommendations.

STUDY SITE DATA

Overall, 39 sites were used for the apartment model development and 26 sites were used for the office model development. Table 5-1 lists the number of apartment and office sites by their source, *Caltrans Smart Growth Trip Generation Study Phases 1 and 2* and *Caltrans Trip Generation Rates for Urban Infill Sites in California*. These were the only sites for which modal survey data were available.

Table 5-1. Study Sites in the Phase 2 Model Development and Analysis Database

Data Source	Number of Apartment Sites	Number of Office Sites
Phase 2 Data Collection	17	13
Phase 1 Data Collection	12	9
Caltrans Trip Generation Rates for Urban Infill Sites in California	10	4
Total	39	26

Table 5-2 lists the ranges of sizes for the study sites provided by each source. Phase 2 expanded the upper range of the number of DUs at apartment sites in the database and the upper range of the gross square footage of office sites.

Table 5-2. Range of Sizes for Study Sites in the Phase 2 Model Development and Analysis Database

Data Source	Occupied Dwelling Units	Occupied Office Gross Square Feet (000)
Phase 2 Data Collection	128 – 856	154 – 511
Phase 1 Data Collection	66 – 355	50 – 416
Caltrans Trip Generation Rates for Urban Infill Sites in California	34 – 421	85 – 135
All	34 – 856	50 - 511

The SGTG database includes three types of variables.

- The <u>classifier variables</u> contain descriptive text (e.g., data source, name of the survey site, ITE Land Use Code, area type, name of the region, type of rail transit) and simple yes/no codes (e.g., presence of nearby on-street parking, presence of nearby HOV lanes, presence of a rail transit station within ½-mile). These variables are not scalable. In future analyses, they could be used to create working subsets of the database.

- The dependent variables are described in the following section of this chapter.
- The explanatory variables are the independent variables to be tested for predicting a selected dependent variable. They are presented later in this chapter.

DEPENDENT VARIABLES

The dependent variable used in the Phase 1 model was the ratio of the actual vehicle count to the number of vehicle trips estimated by the ITE *Trip Generation Manual* rates or equations. For the study sites included in the Phase 1 analysis, the measured ratios for apartment and office sites during the AM and PM peak hours ranged as follows:

- Between 0.06 and 1.77 for apartment sites; and
- Between 0.10 and 1.09 for office sites.

For the additional study sites counted as part of the Phase 2 data collection, the measured ratios fell within the Phase 1 ratio ranges.

The Phase 2 analysis considered an expanded list of potential dependent variables. The dependent variable used in the recommended, preferred models product of Phase 2 is the number of vehicle trips generated by the study site (as is described later in this chapter). Chapter 7 of this report presents recommendations to continue, in future research and analysis, to refine the models and investigate additional dependent variables. Following is the full list of potential dependent variables considered as part of the Phase 2 analysis.

- Vehicle Trips
  - Numeric total, rate (per DU or per 1,000 GSF), and factor difference from the ITE suburban estimate
- Person Trips
  - Numeric total, rate (per DU or per 1,000 GSF), peak direction total, and peak direction rate
- Ratio of Vehicle Trips
  - Ratio to persons and to persons in personal passenger vehicles (the reciprocal of AVO)
- Personal Passenger Vehicle Person Trips
  - Numeric total, rate (per DU or per 1,000 GSF), and as a percentage of total person trips
- Walk + Bike + Transit Person Trips
  - Numeric total, rate (per DU or per 1,000 GSF), and as a percentage of total person trips

- Walk Trips
    - Numeric total, rate (per DU or per 1,000 GSF), and as a percentage of total person trips
- Walk + Bike Trips
    - Numeric total, rate (per DU or per 1,000 GSF), and as a percentage of total person trips
- Transit Person Trips
    - Numeric total, rate (per DU or per 1,000 GSF), and as a percentage of total person trips

EXPLANATORY VARIABLES

The Phase 1 reports summarize the extensive literature that identifies the breadth of factors that link built environment characteristics to trip generation. The development of models for Phase 2 has focused on potential explanatory variables that both correlate with the quantity of, and the mode used for, trip making and are readily available or relatively easy to measure or derive.

The following variables were compiled for the analyses conducted during Phase 2. The variables shown in *italics* were eliminated in early stages of correlation screening and were not considered in the development of the final models.

- Site Characteristics
    - Occupied DUs or Occupied GSF (1,000)
    - *Average Number of Bedrooms*
    - *Percent of All Units that Contain Two-or-More Bedrooms*
    - *Average Monthly Apartment Rent*
    - *Minimum Apartment Rent Apartment*
    - *Building Setback*
- Metropolitan Area Characteristics
    - *Core-Based Statistical Area Population*
    - *Core-Based Statistical Area Employment*
    - Distance to Central Business District (CBD) (miles)
- Site Context – Nearby Development
    - Population within ½-Mile
    - *Jobs within ½-Mile*
    - Population + Jobs within ½-Mile
- Site Context – Pedestrian or Bicyclist Facilities
    - Intersection Density within ½-Mile
    - *Walk Score*
    - *Bike Score*
- Site Context – Transit Facilities
    - *Path and Straight Line Distance to Nearest Rail Transit Station (feet)*

    - Stations within Seven Rail Miles of Nearest Rail Station
    - *PM Peak Hour Buses Stopping within ¼-Mile of Transit Service*
    - *PM Peak Hour Trains Stopping within ½-Mile of Transit Service*
- Journey-to-Work Data for Census Geography (Census Tract and Traffic Analysis Zone [TAZ])
    - AVO
    - *Average Trip Length*
    - Percent commute longer than 44 minutes
    - *Percent commute longer than 59 minutes*
    - *Walk Mode Share*
    - Walk + Bike Mode Share
    - Transit Mode Share
    - *Percent of All Non-Walk/Bike Trips made by Transit*
    - Percent of Person Trips made by Walk, Bike, or Transit

Several of the italicized explanatory variables in the previous list are indeed important components of the site context that affect trip making by mode at an apartment or office site. Examples include the proximity to a rail station and the number of bus and train stops in the site vicinity. However, the range of values for these characteristics for the study sites does not have a significant effect on trip making mode changes. Instead, the subset of urban development that qualifies as smart growth already reflects the typical necessary transit features to form a base level of transit usage.

Numerous variables and model structures were tested. Because smart growth characteristics are commonly found together (e.g., it is unusual to find high population density without frequent transit service, and vice versa), many of the potential explanatory factors were statistically correlated. After the selection of a promising explanatory variable, all correlated variables were prevented from being used in subsequent introductions of additional variables. The following is a list of pairs of explanatory variables that were determined to be correlated for the sites surveyed.

- Average number of bedrooms and the percentage of units with two or more bedrooms
- Average apartment rent and minimum apartment rent
- Core-based statistical area (CBSA) population and CBSA employment
- Jobs within ½-mile and population + jobs within ½-mile
- Journey-to-work walk mode share and journey-to-work walk + bike mode share
- Journey-to-work transit mode share and percentage of non-walk/bike trips that are by transit
- Journey-to-work percentage of non-walk/bike trips that are by transit and percentage of person trips by walk, bike, or transit
- Journey-to-work average trip length, percentage of trips longer than 44 minutes, and percentage of trips longer than 59 minutes

The last four bullets comprise data from the 2010 Census. For each of these fields, separate values were compiled for the Census tract and TAZ encompassing the study site. If the tract field was selected as an explanatory variable, the TAZ field was excluded from further consideration; and vice versa.

APPLICABILITY OF PHASE 1 MODEL

The initial step in the model analysis process was to evaluate the potential applicability of the Phase 1 model upon inclusion of the data collected during Phase 2. The following charts demonstrate that the Phase 1 model results slightly worsen (rather than improve) with the addition of Phase 2 data.

The data plotted in Figure 5-3 represents a comparison between the actual vehicle trips entering or exiting a Phase 1 study site (the x-axis) during the AM peak hour and the Phase 1 model estimate for the study site (the y-axis). As an example, there is a data point near 180,145. This point indicates there is a study site for which the actual vehicle count is 180 and the model estimate is 145.

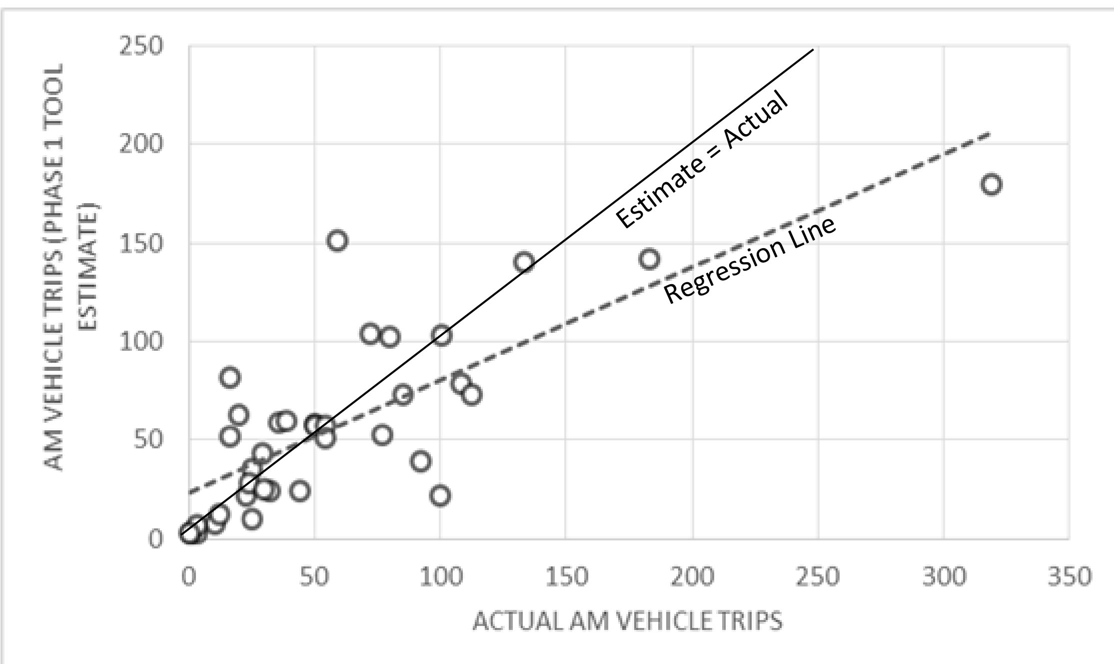

Figure 5-3. Comparison of Actual Phase 1 Site Vehicle Trips to Estimates from the Phase 1 Tool – AM

For this assessment of the accuracy of the model in estimating actual vehicle counts, two measures are used.

- Perfect correlation between the actual and estimated values would fall along the solid "y=x" line and would produce a fitted curve with a slope of 1.0. A linear fitted curve equation for these data points produces the dashed line that has a slope of 0.57. This relatively flat slope results in a significant divergence from perfect correlation for both modest and large apartment trip generators.
- The R^2 value for the fitted curve equation provides a measure of the data scatter. As the R^2 value moves closer to a value of 1.0, the scatter of the points around the fitted curve decreases (i.e., the tighter the points cluster around the fitted curve). The R^2 value for the fitted curve for this model is 0.60.

With the inclusion of the Phase 2 data, the Phase 1 spreadsheet tool produces the actual and estimated comparisons shown in Figure 5-4 for the AM peak hour. With the inclusion of Phase 2 data, the model accuracy slightly worsens (the slope decreases from 0.57 to 0.54) and the data remain relatively scattered (the R^2 changes from 0.60 to 0.61). The PM models likewise worsen with the Phase 2 data.

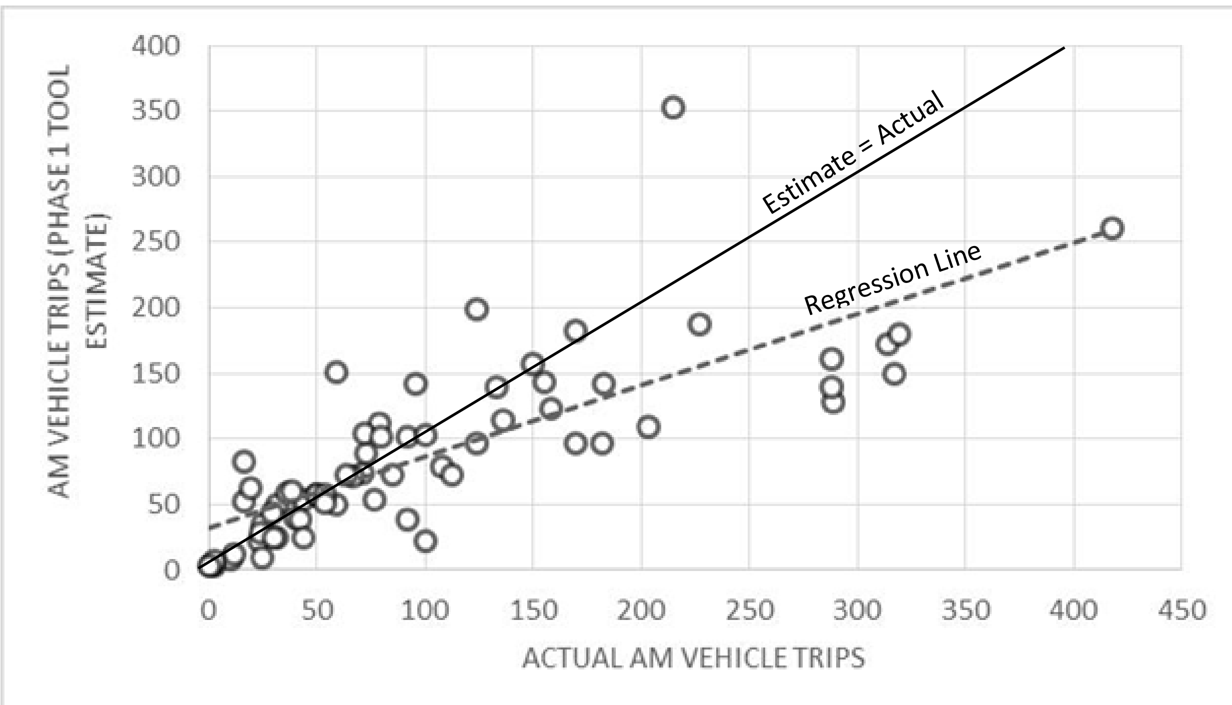

Figure 5-4. Comparison of Actual Phases 1 and 2 Site Vehicle Trips to Estimates from the Phase 1 Tool – AM

The conclusion of this analysis is that new models and explanatory variables need to be investigated to try to improve estimation accuracy.

Of the 17 apartment sites surveyed as part of the Phase 2 data collection (and one of the Caltrans infill study sites), six do not comply with the Phase 1 model spreadsheet criterion for minimum population within ½-mile of the study site. Of the 13 office sites surveyed as part of the Phase 2 data collection, six do not comply with the Phase 1 model spreadsheet criteria. In this respect, Phase 2 has expanded the range of population density characteristics in the Caltrans smart growth database for both apartment and office sites to include developments in more outlying locations within major metropolitan areas.

MODEL DEVELOPMENT, ANALYSIS, AND SELECTION

Principles

The selection and analysis of potential smart growth trip generation models and their subsequent evaluation was guided by the following principles.

- The model must be able to provide an estimate of vehicle trips generated by the study site, either directly or indirectly.
  - A direct estimation model would produce the vehicle trip estimate directly from the model using variables that represent the site and setting characteristics.
  - An indirect estimate requires more than a single step. Examples could include:
    - The model calculates a smart growth vehicle trip generation ratio that is in turn multiplied by an ITE estimate for a comparable study site in a non-smart growth setting (such as the Phase 1 model);
    - The model produces an estimate for person trips generated for a study site, which is then multiplied by vehicle trip mode share and vehicle occupancy factors for a study site (generated by another model); and
    - The model starts with ITE suburban vehicle trip estimates and conducts a series of adjustments to produce a vehicle trip estimate. The adjustments could be on the order of a person trip adjustment, mode share adjustment (either in total or incrementally, such as bike/walk, then transit), and vehicle occupancy adjustment.
- Must reflect an appropriate balance between the need for accuracy in the vehicle trip estimate and for ease of its use (i.e., a reasonable level of effort on the part of the practitioner to acquire required explanatory variable data).
- The optimum set of models should produce a common type of dependent variable for both the AM and PM models for both apartment and office study sites (i.e., the same type of direct or indirect model outputs, such as number of vehicle trips).
- The resulting models should produce accuracy statistics that are significantly better than those produced by the Phase 1 model.

Model Development Process

The development of predictive models was undertaken using a regression analysis supplemented with the lasso (least absolute shrinkage and selection operator) technique. The technique constrains the overall magnitude of the model coefficients so that important predictors are retained and less important predictors shrink, potentially to zero. The result is a parsimonious model, in scientific terms, the simplest plausible model with the fewest possible number of variables.

The analysis included an assessment of the scatterplots of all explanatory variables versus the primary dependent variables to identify any distinct non-linear trends. None were apparent. To exhaust any possibility for non-linearity, log-transformed and reciprocal versions of the two most significant explanatory variables in the models (i.e., occupied units and intersection density) were added to the list of explanatory variables. Log transformation was also tested for the AM and PM vehicle trips dependent variables.

Selected Explanatory Variables

Several alternatives were identified for the AM and PM apartment and office models. The explanatory variables used in the models, after eliminating variables that have high correlations with each other, include the following:

- Occupied DUs or Occupied GSF;
- Population within ½-mile;
- Population + Jobs within ½-mile;
- Intersection Density;
- Journey-to-Work Walk + Bike Mode Share;
- Stations within seven miles of Nearest Rail Station;
- Percentage of Journey-to-Work Person Trips that are by Walk, Bike, or Transit;
- Journey-to-Work Transit Percent of Non-Walk/Bike Trips;
- Journey-to-Work AVO;
- Journey-to-Work Percentage of trips longer than 44 minutes; and
- Distance to (Regional) CBD.

The model coefficients provide some perspective on the influence these variables have on vehicle trip estimations. A positive coefficient indicates that an increase in its value corresponds to an increase in the number of site-generated vehicle trips. The variables with positive coefficients in the models below include:

- Occupied DUs – there is a direct positive correlation between occupied units and vehicle trips; as the number of occupied units (whether apartments or office) increases, so also does the overall number of vehicle trips
- Distance to CBD – there is a direct positive correlation between distance to the regional CBD and vehicle trips for an apartment site; as the distance increases, so also does the overall number of vehicle trips
- Population within ½-mile and stations within seven miles of nearest rail station – for several office models, there is a direct positive correlation between both nearby population and the number of rail stations within seven miles and vehicle trips generated by an office; this positive correlation appears counter-intuitive because it

implies that as the area density increases so also does the number of office-generated vehicle trips; the inclusion of these variables in several office models described in the following was part of the rationale for their rejection (and selection of alternative models).

Conversely, a negative coefficient indicates that an increase in its value corresponds to a decrease in the number of site-generated vehicle trips. The variables with negative coefficients (or for which a reciprocal value is used) include:

- Intersection Density – as the number of intersections increases, the walkability of the area likely increases and the number or proportion of trips made by passenger vehicles additionally decreases; the reciprocal of intersection density can be interpreted as an average spacing between intersections;
- Population + Jobs within ½-mile – there is a direct negative correlation between nearby population and jobs and vehicle trips generated by an apartment site; as population and jobs increase (i.e., overall density increases), the overall number of vehicle trips decreases;
- Journey-to-Work Walk+Bike Mode Share – there is a direct negative correlation between the walk plus bike mode share for the Census tract and vehicle trips generated by either an apartment or office site; as the walk plus bike mode share increases, the overall number of vehicle trips decreases;
- Percentage of Person Trips that are by Walk, Bike, or Transit – there is a direct negative correlation between the walk, bike, and transit mode share for the Census tract and vehicle trips generated by either an apartment or office site; as walk, bike, and transit trips increase, the overall number of vehicle trips decreases;
- Journey-to-Work AVO – there is a direct negative correlation between AVO for the Census tract and vehicle trips generated by an office; as AVO increases, the overall number of vehicle trips decreases; and
- Journey-to-Work Percentage of Trips greater than 44 minutes – there is a direct negative correlation between the proportion of commute trips that are longer than 44 minutes for the Census tract and vehicle trips generated by an office; as the proportion of long duration commute trips increase, the overall number of vehicle trips decreases

The evaluation of alternative models and selection of a preferred model for each land use and for each time period is based primarily on how well the model replicates the vehicle counts for the Phase 1 and 2 data collection sites. The evaluation also considers the number of required explanatory variables and the level of effort to acquire values for those variables.

The following four sections describe the separate models developed for apartment and office use during the AM and PM peak hours. For each, a pair of models is presented. The first represents the best precision attainable with a limit of no more than seven explanatory variables. The second represents the best precision attainable with the use of no more than three explanatory variables, but reducing to two variables if accuracy is not significantly affected.

Apartment Site – AM Peak Hour

The data plotted in Figure 5-5 represents a comparison between the actual vehicle trips entering or exiting a study site (the x-axis) and the model estimate for the study site (the y-axis). As an example, there is a data point near 220,200. This point indicates there is a study site for which the actual vehicle count is 220 and the model estimate is 200.

The results presented in Figure 5-5 are for apartment smart growth sites – AM peak hour model that uses four primary independent variables: occupied units; intersection density; Census journey-to-work walk, bike, and transit mode share; and distance to the CBD. The equation is:

Vehicle Trips = 0.20 x occupied units
+
1862 / intersection density
+
0.58 x distance to CBD
-
28.4 x walk/bike/transit mode share for journey-to-work
+
3 (constant)

For this assessment of the accuracy of the model in estimating actual vehicle counts, two measures are used:

- Perfect correlation between the actual and estimated values would fall along the solid "y=x" line and would produce a fitted curve with a slope of 1.0. A linear fitted curve equation for these data points produces the dotted line that has a slope of 0.67; and
- The R^2 value for the fitted curve equation provides a measure of the data scatter. As the R^2 value gets closer to a value of 1.0, the scatter of the points around the fitted curve decreases (i.e., the tighter the points cluster around the fitted curve). The R^2 value for the fitted curve for this model is 0.82.

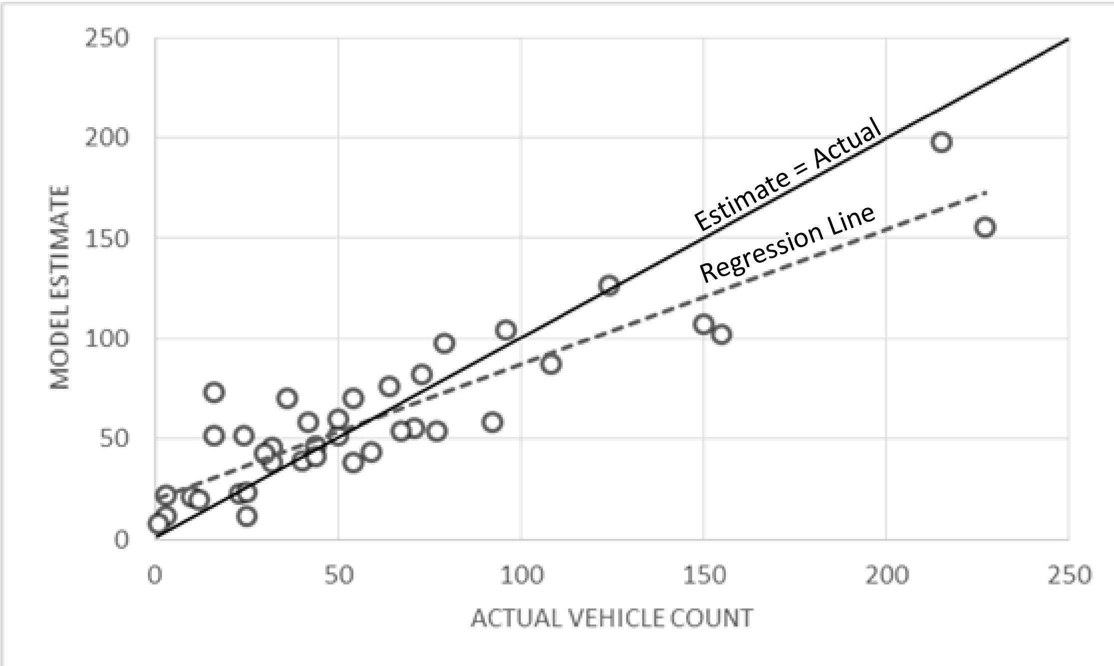

Figure 5-5. AM Apartment Vehicle Trip Estimation and Count – Based on a Four-Variable Model

Figure 5-6 presents a comparison data plot for a model that uses only two independent variables – occupied units and intersection density. The slope for this two-variable model is 0.79 – better than that for the model with four variables. The data points are more scattered in the two-variable model as verified by its R^2 value of 0.79 that is slightly lower than that for the four-variable model. The equation is:

Vehicle Trips = 0.24 x occupied units
+
4610 / intersection density
-
38 (constant)

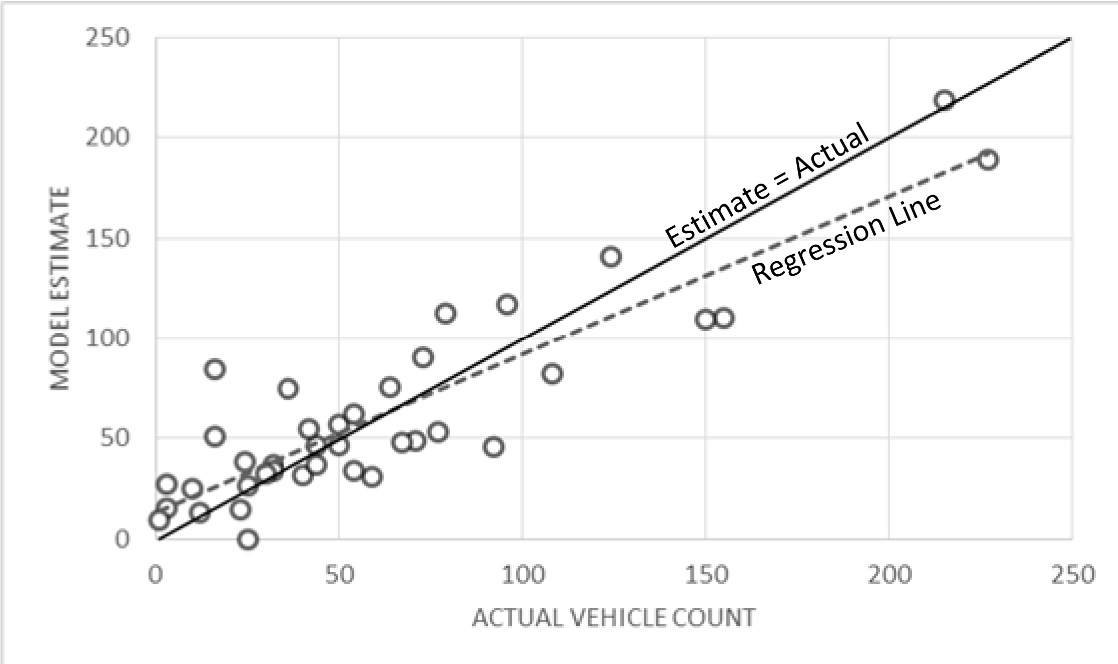

Figure 5-6. AM Apartment Vehicle Trip Estimation and Count – Based on a Two-Variable Model

A simple linear regression between occupied units and vehicle trips produces a model that is not as accurate as, and produces a data plot with significantly more scatter than, the two-variable model. The fitted curve R^2 value is 0.69.

The recommended model for estimating vehicle trips during the AM peak hour at an apartment smart growth site is the two-variable version described previously. The two-variable model has a better slope and its data scatter is essentially the same as that for the four-variable model.

Apartment Site – PM Peak Hour

The vehicle count and model estimate data plotted in Figure 5-7 are from a model for an apartment smart growth site during the PM peak hour. It uses five primary independent variables: occupied units, intersection density, population and jobs within ½-mile, Census journey-to-work walk, bike, and transit mode share; and distance to the CBD. The equation is:

Vehicle trips = 0.22 x occupied units
+
1409 / intersection density
+
0.32 x distance to CBD
-
0.000068 x sum of population and jobs within ½-mile
-
19.5 x walk/bike/transit mode share for journey to work
+
2 (constant)

Two measures are used to assess the accuracy of the model in estimating actual vehicle counts:

- A linear fitted curve equation for these data points produces the dotted line that has a slope of 0.76; and
- The R^2 value for the fitted curve, a measure of the scatter of the points around the fitted curve, is 0.87.

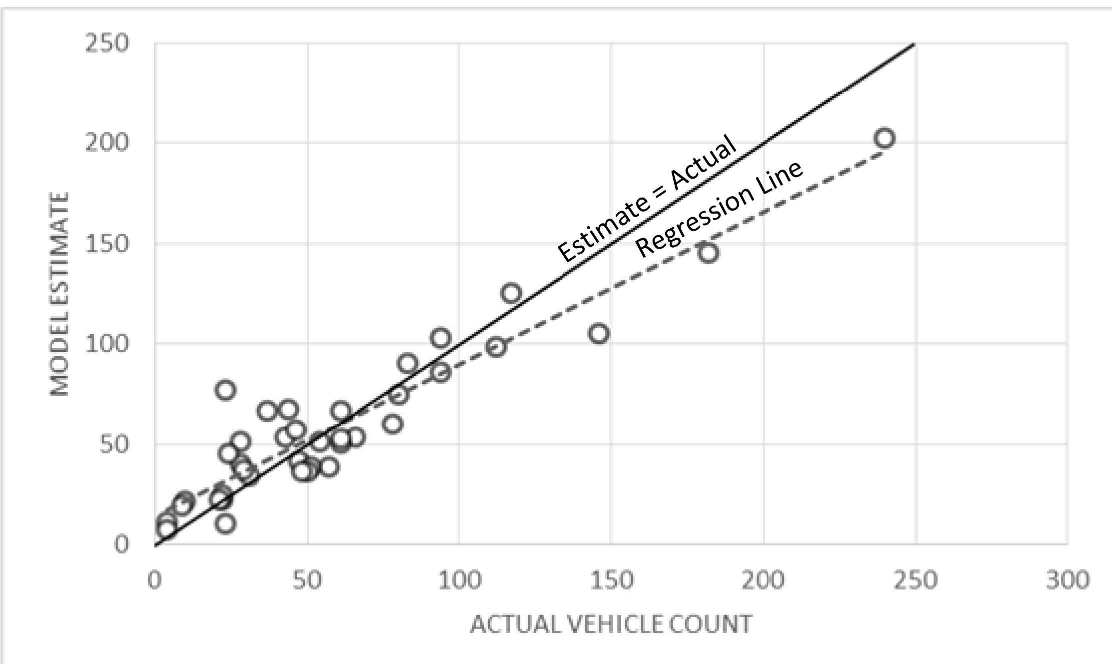

Figure 5-7. PM Apartment Vehicle Trip Estimation and Count – Based on a Five-Variable Model

Figure 5-8 presents a comparison data plot for a model that uses only two explanatory variables – occupied units and intersection density. The equation is:

Vehicle Trips = 0.24 x occupied units
+
3488 / intersection density
-
31 (constant)

The slope for this two-variable model is 0.85 – better than that for the model with five variables. The data points are slightly more scattered in the two-variable model as verified by its R^2 value of 0.85 that is lower than the R^2 value for the five-variable model.

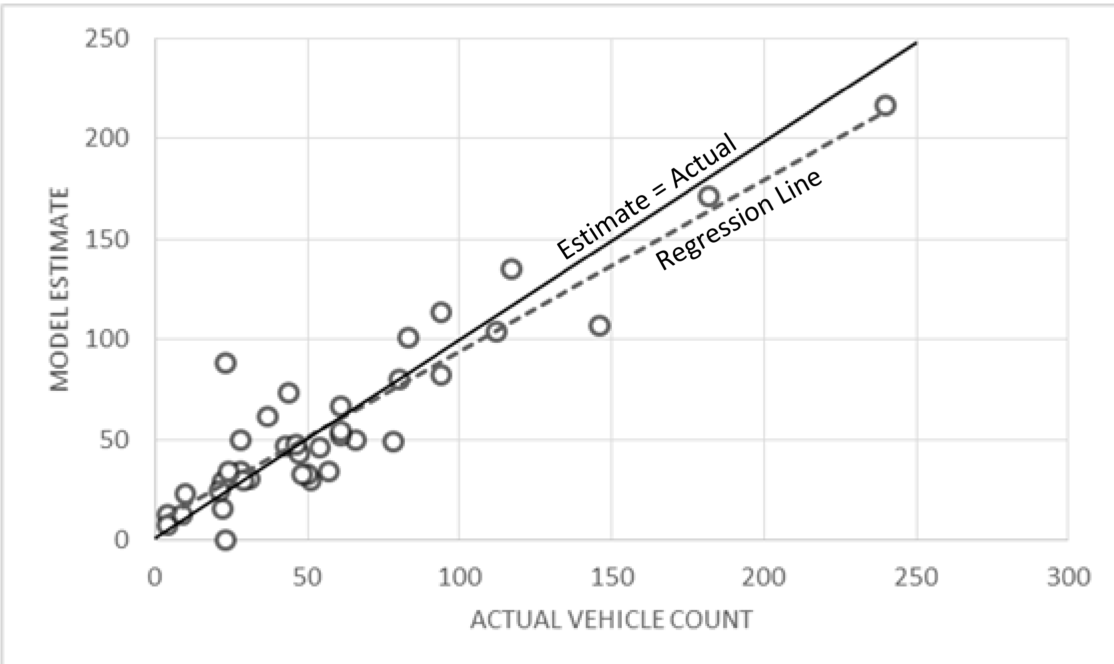

Figure 5-8. PM Apartment Vehicle Trip Estimation and Count – Based on a Two-Variable Model

A simple linear regression between occupied units and vehicle trips produces a model that is not as accurate as, and produces a data plot with significantly more scatter than, the two variable model. The fitted curve R^2 value is 0.79.

The recommended model for estimating vehicle trips during the PM peak hour at an apartment smart growth site is the two-variable version described previously. The two-variable model has a better slope and its data scatter is essentially the same as that for the five-variable model.

Office Site – AM Peak Hour

The vehicle count and model estimate data plotted in Figure 5-9 are from a model for an office smart growth site during the AM peak hour. It uses seven primary explanatory variables: occupied units; intersection density; population within ½-mile; number of rail stations within seven miles; Census journey-to-work values for walk, bike, and transit mode share; AVO; and percent with a commute of 45 minutes or longer. The equation is:

Vehicle Trips = 0.61 x occupied units (000)
+
1.6 x rail stations within seven miles
+
0.000988 x population within ½-mile
-
47.9 x ln(intersection density)
-
105.5 x walk/bike mode share of journey-to-work
-
178.6 x AVO for journey-to-work
-
216.6 x percentage of journey-to-work trips longer than 44 minutes
+
478 (constant)

Two measures are used to assess the accuracy of the model in estimating actual vehicle counts:

- A linear fitted curve equation for these data points produces the dotted line that has a slope of 0.79; and
- The R^2 value for the fitted curve, a measure of the scatter of the points around the fitted curve, is 0.90.

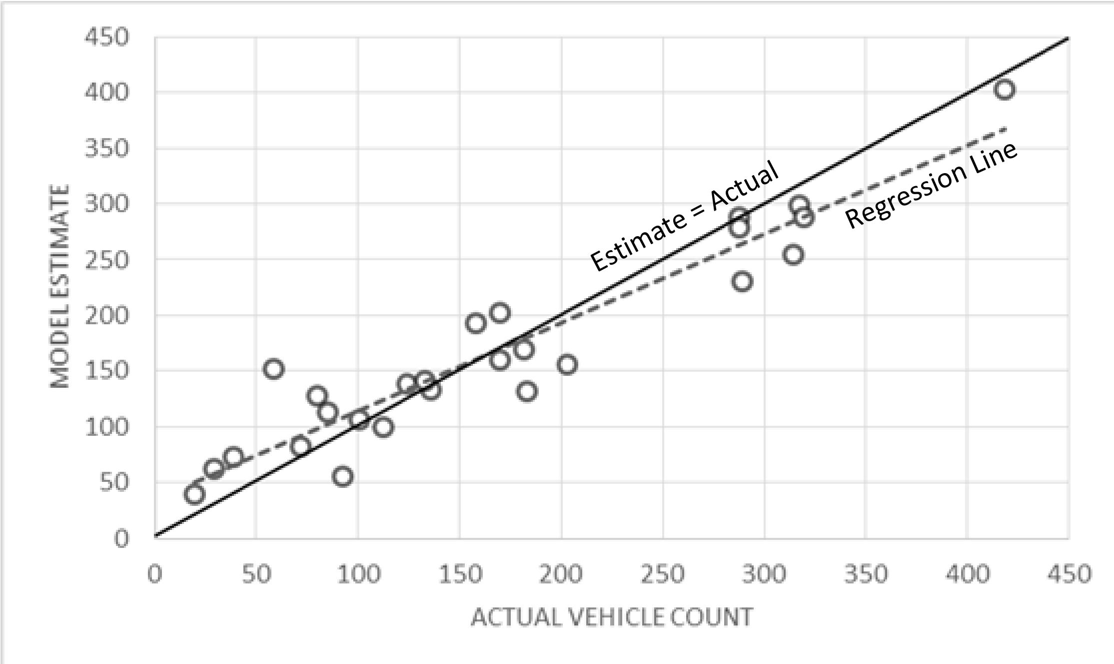

Figure 5-9. AM Office Vehicle Trip Estimation and Count – Based on a Seven-Variable Model

Figure 5-10 presents a comparison data plot for a model that uses only three explanatory variables – occupied units, intersection density, and Census journey-to-work AVO. The equation is:

Vehicle Trips = 0.69 x occupied units
+
2639 / intersection density
-
677.6 x AVO for journey-to-work
+
723 (constant)

The slope for this three-variable model is 0.79 – the same as that for the model with seven variables. The data points are also more scattered in the three-variable model as verified by its R^2 value of 0.79 that is lower than the R^2 value for the seven-variable model (0.90).

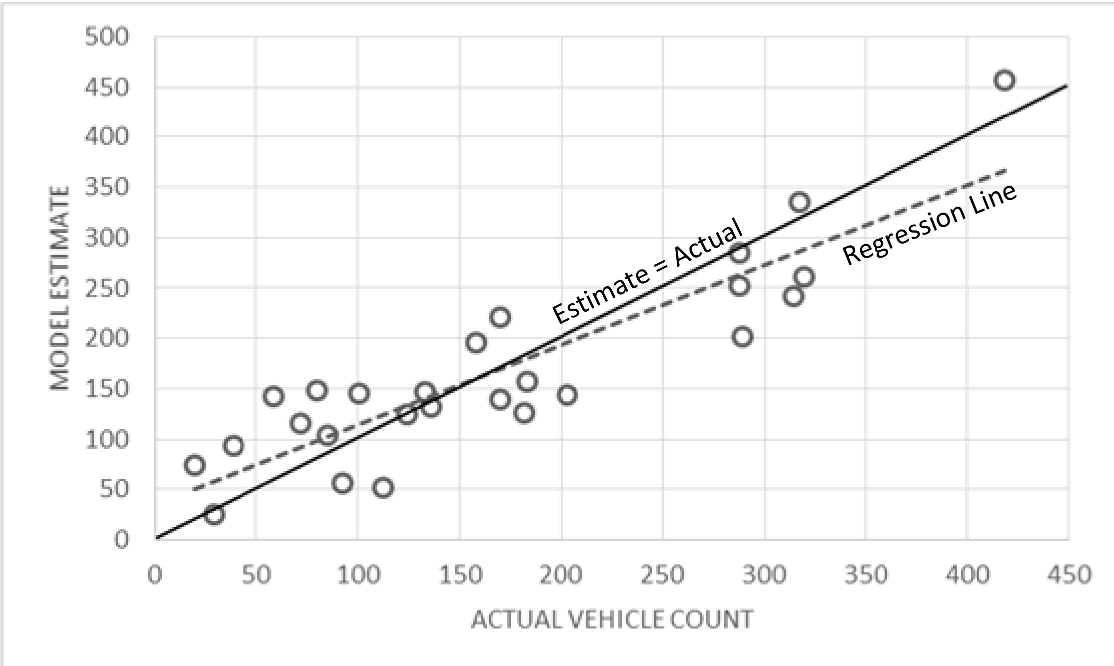

Figure 5-10. AM Office Vehicle Trip Estimation and Count – Based on a Three-Variable Model

Figure 5-11 presents a comparison data plot for a model that uses only two explanatory variables – occupied units and intersection density. The equation is:

Vehicle Trips = 0.62 x occupied units
+
3311 / intersection density
-
10 (constant)

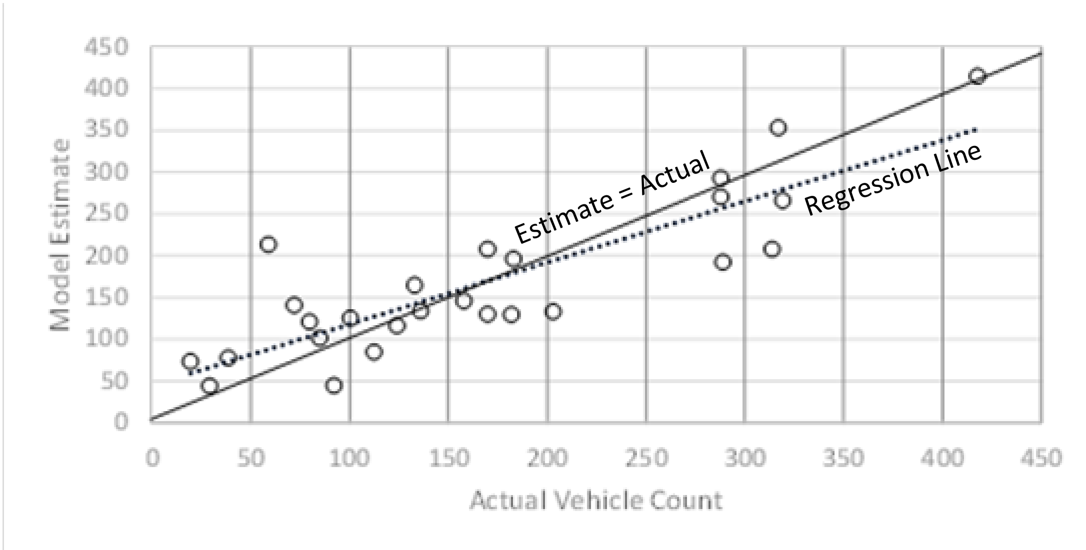

Figure 5-11. AM Office Vehicle Trip Estimation and Count – Based on a Two-Variable Model

The slope of the fitted line is 0.73. The fitted curve's R^2 value is 0.73. A test of the two- and three-variable models over the range of surveyed development sizes showed that the three-variable model produces illogical estimates for large developments, small developments with high intersection densities, and AVOs over 1.11. The two-variable model produces reasonable estimates over the full range.

A simple linear regression between occupied units and vehicle trips produces a model that is not as accurate as and produces a data plot with significantly more scatter than the three-variable model. The fitted curve R^2 value is 0.52.

The two-variable model is recommended for use. It combines relatively high accuracy over a full range of development sizes with user friendliness (need for only two input variables).

Office Site – PM Peak Hour

The vehicle count and model estimate data plotted in Figure 5-12 are from a model for an office smart growth site during the PM peak hour. It uses five primary explanatory variables: occupied units; intersection density; number of rail stations within seven miles, Census journey-to-work walk, bike, and transit mode share; and percent with a commute of 45 minutes or longer. The equation is:

Vehicle Trips =0.42 x occupied units (000)
+
0.73 x rail stations within seven miles
-
63.86 x ln(intersection density)
-
25.6 x walk, bike, and transit mode share for journey-to-work trips
-
76.02 x percentage of journey-to-work trips longer than 44 minutes
+
385 (constant)

Two measures are used to assess the accuracy of the model in estimating actual vehicle counts:

- A linear fitted curve equation for these data points produces the dotted line that has a slope of 0.58; and
- The R^2 value for the fitted curve, a measure of the scatter of the points around the fitted curve, is 0.76.

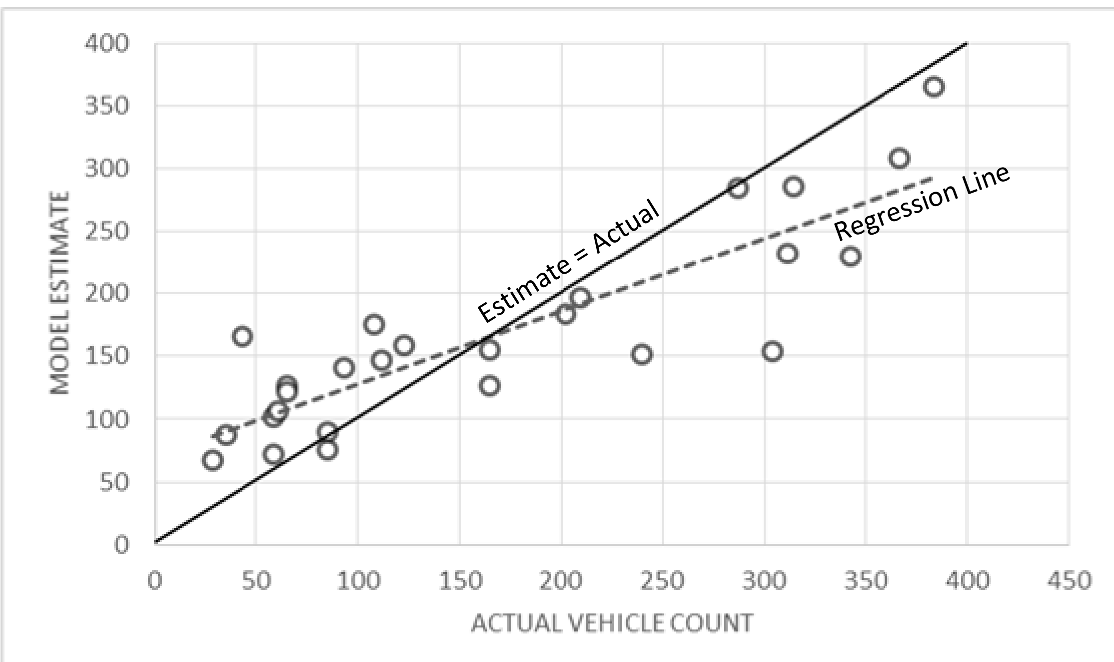

Figure 5-12. PM Office Vehicle Trip Estimation and Count – Based on a Five-Variable Model

Figure 5.13 presents a comparison data plot for a model that uses only two explanatory variables – occupied units and intersection density. The equation is:

Vehicle Trips = 0.54 x occupied units (000)
+
4128 / intersection density
-
7 (constant)

The slope for this two-variable model is 0.66 – better than that for the model with five variables. The data points are more scattered in the two-variable model as verified by its R^2 value of 0.66 that is lower than the R^2 value for the five-variable model.

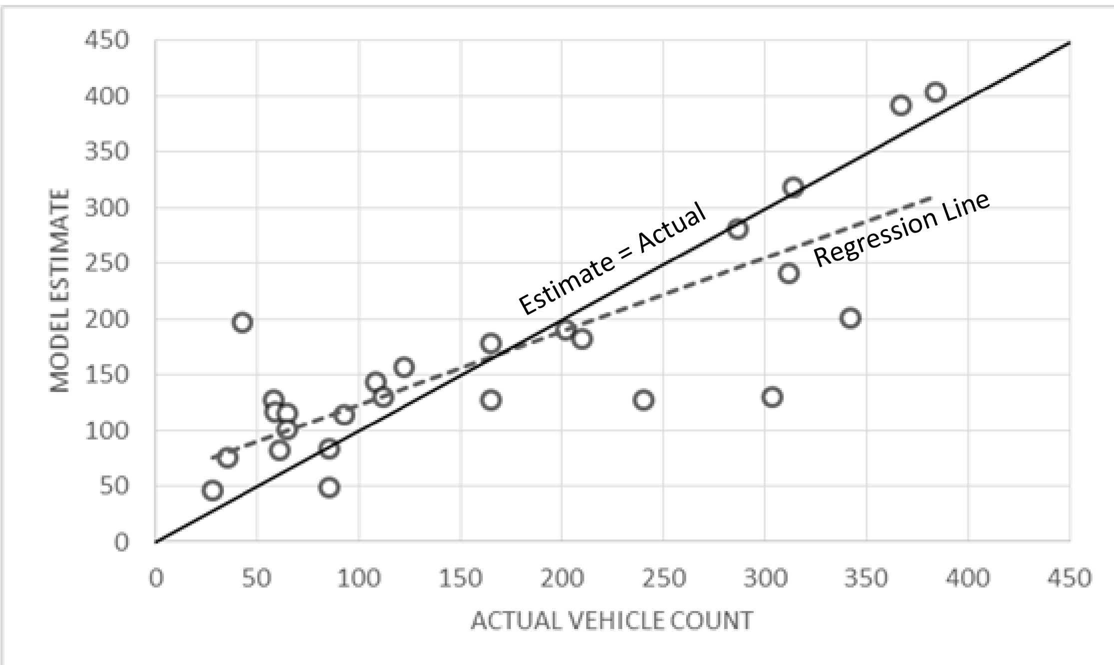

Figure 5-13. PM Office Vehicle Trip Estimation and Count – Based on a Two-Variable Model

A simple linear regression between occupied units and vehicle trips produces a model that is not as accurate as and produces a data plot with significantly more scatter than the two variable models. The fitted curve R^2 value is 0.39.

The recommended model for estimating vehicle trips during the AM peak hour at an office smart growth site is the two-variable version described previously. The two-variable model has a better slope than the five-variable model. The data scatter for the two-variable model is worse than that for the five-variable model, but it produces a significant number of data points that are essentially perfectly correlated (i.e., along the "y=x" solid line) from the smallest generator to the largest generator.

MODEL APPLICATION LIMITATIONS

It is important to remember that the sites used for model development meet a specific set of smart growth criteria, so they are not representative of all types of apartment and office sites. The models are only appropriate to use in locations that exhibit smart growth characteristics. In addition, they are not components of truly integrated mixed-use developments. For these, the research team recommends use of the procedures described in the current edition of the ITE *Trip Generation Handbook*.[11]

The criteria used to qualify sites to be considered potential smart growth data collection sites were:

- The area within a 0.5-mile radius of the site is mostly (at least 80 percent) developed (vacant parcels, rural land and open space are "undeveloped");
- There is a mix of land uses within a 0.25-mile radius of the site (i.e., there are at least two different major land use categories, such as residential, office, retail, industrial, etc.);
- The development site and surrounding vicinity are connected and walkable, or will be when the development is completed;
- There is no special attractor within a 0.25-mile radius of the site (e.g., stadium, military base, commercial airport, major tourist attraction); and
- During a typical weekday PM peak hour, there are at least:
    - 10 individual buses with stops within a 0.25-mile radius from the study site, or five individual trains with station stops within a 0.5-mile radius from the study site; and
    - These transit stops are conveniently walkable from the site.

The recommended models are based on counted trip making at study sites with specific on-site characteristics, site context, and nearby transportation services. The models have been determined to be applicable within the following ranges of site characteristics.

Apartment Sites

- Between 80 and 800 occupied units
- Population within ½-mile between 3,600 and 35,000
- Jobs within ½-mile of the site between 2,200 and 79,000
- Number of intersections within ½-mile between 50 and 150
- As much as a 22-mile distance to the CBD

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[11] *Trip Generation Handbook*, 2nd Edition. Institute of Transportation Engineers, Washington, DC, June 2004, p. 17 not currently accessible online.

Office sites

- Between 100,000 and 500,000 occupied gross square footage
- Population within ½-mile between 2,900 and 42,000
- Jobs within ½-mile of the site between 2,500 and 136,000
- number of intersections within ½-mile between 40 and 250

Caution should be exercised if the models are applied for apartment or office sites that do not fall within the above ranges. In particular, the accuracy of the models declines beyond both ends of the development size ranges.

6. IMPLEMENTATION TOOLS

This chapter describes the tools produced in this project that will help practitioners to:

- Estimate site vehicle trip generation for apartment and general office buildings within or adjacent to smart growth developments or areas; and
- Collect and process site trip generation data from such sites for use in developing trip generation rates for new land uses or special local applications or to enhance the databases and predictive models that were developed in this project.

This chapter presents an overview of purposes and objectives to be achieved as well as the procedures to be used. A separate user guide has been prepared to provide detailed procedures for these trip generation estimates as well as data collection and reduction. In addition, training materials were developed in this project and are available on the project website https://tti.tamu.edu/research-projects/featured-projects/ to facilitate understanding of procedures.

The contents of this chapter are:

- User Guide overview and contents;
- Spreadsheet Estimator overview; and
- Training Materials.

USER GUIDE

A user guide was prepared to provide practitioners instructions on how to estimate site trip generation for smart growth developments and additionally how to prepare for and collect site trip generation data for any land use classification. Additionally included is how to reduce and process the collected data.

The description of estimation procedures is presented for manual computation so the user can understand the complete process. However, the user guide also includes instructions on how to use an automated estimator in the form of a Microsoft® Excel spreadsheet. The spreadsheet only requires a limited amount of site data plus familiarity with the analysis site and the characteristics of the surrounding vicinity.

The data collection procedures provide step-by-step procedures beginning with establishing the purpose of the data collection and continuing through several steps including site selection, what data to collect, and suggested supervision procedures.

The data reduction procedures cover summarization of data and how to process the data to determine trip generation and mode split for trips to and from the survey site.

The user guide contains examples of the recommended survey forms (hard copy format) as well as samples of data summaries that can be helpful to analysts.

SPREADSHEET ESTIMATOR

The spreadsheet estimator tool developed under the SGTG project was designed to automate the trip generator estimation process described in the previous section. At the time this report was written, the spreadsheet tool estimates site trip generation for only apartment and general office buildings in well-developed areas outside regional CBDs. Nevertheless, it can expedite the estimation process and potentially eliminate computation errors.

The purpose of this tool is to enable users to quickly and simply estimate site trip generation for smart growth developments. The tool estimates inbound and outbound vehicle trip generation for typical weekdays when schools are in session, and for AM and PM street peak hours (peak hour between 7-9 a.m. and 4-6 p.m., respectively). The tool helps the user identify and document the analysis site and then qualify the site as being eligible as a smart growth site and appropriate for this method of trip generation estimation. The tool requests several site and vicinity characteristics to determine eligibility. In addition, limited quantitative site data are required for the trip generation computation.

The tool provides the user a simple one page report covering site information, eligibility criteria, input data, and vehicle trip generation estimates.

This tool is available at the following website: https://tti.tamu.edu/research-projects/featured-projects/. Figure 6-1 shows the tool's input/output page with a sample development included.

California Smart Growth Trip Generation Model Application Tool

DRAFT -- January 2017

Developed by Texas A&M Transportation Institute for the California Department of Transportation

** Not recommended for sites within core central business district developments. For estimating site vehicle trip generation for free-standing individual apartment and office buildings in smart growth areas. For mixed-use developments, see footnote 1.*

Identity	
Project name	Ajax Apartment Homes
Land use description	223
Address, city, state	2003 Ajax Street, Mountain Creek, CA
Analyst's name, organization, date	HGB, 1/12/2017
Checked by, date	JSS, 1/13/17
Analysis year	2018
Analysis period	Typical Weekday Site Peak Hour between 7 and 9 AM & between 4 and 6 PM
Additional comments	Apartment building within Ajax Park smart growth area

	Qualifiers & Model Inputs	*Please enter values below*
Size	ITE land use code (enter either 220, 221, or 223 for **Apartment** OR 710 for **Office**)[2]	223
Size	**Apartment** - Dwelling Units (enter number between 80 - 800)	300
Size	**Office** - Gross Square Feet in 1,000s (enter number between 100 - 500)	
Qualifiers	Adequate parking (on-site or conveniently walkable) to meet demand (See User Guide, Yes/No)[3]	Yes
Qualifiers	Walkable surroundings on and off site (See User Guide, Yes/No)	Yes
Qualifiers	Transit stop(s) within 1/4 mile conveniently accessible by foot from development (Yes/No)[4]	Yes
Qualifiers	Moderate to high development compactness and densities within 1/4 mile (See User Guide, Yes/No)[4]	Yes
Qualifiers	Well connected and conveniently walkable to adjacent land uses (Yes/No)[4]	Yes
Qualifiers	No major special attractors within ¼ mile of site (See User Guide, Yes/No)[4]	Yes
Qualifiers	Area within ½ mile of site at least 80% developed (Yes/No)[4]	Yes
Qualifiers	At least two interacting land uses within ¼ mile of site (Yes/No)[4]	Yes
Qualifiers	Number of public intersections – excluding freeways – within ½ mile radius of site: must be between 50 - 150 for **Apartments** OR 40 - 250 for **Office** (enter number)[4]	96
Qualifiers	Total jobs within ½ mile of site between: 2,200 - 79,000 for **Apartments** OR 2,500 - 136,000 for **Office** (Yes/No)[5]	Yes
Qualifiers	Total population within ½ mile of site between: 3,600 - 35,000 for **Apartments** OR 2,900 - 42,000 for **Office** (Yes/No)[5]	Yes
Qualifiers	Minimum of 10 PM peak hour buses stopping within ¼ mile of site OR Minimum of 5 PM peak hour rail transit trains stopping within ½ mile of site (Yes/No)[6]	Yes

Model Outputs		
Site qualified as a smart growth development based on sites used to develop this tool		Yes
Land use		Apartment
Estimated Vehicle Trips (street peak hour)		
Period	**Inbound**	**Outbound**
AM	16	66
PM	50	27

Figure 6-1. Sample Estimator Spreadsheet Input and Output Page

TRAINING MATERIALS

Additionally available for estimating smart growth site trip generation is a set of training materials. Their purpose is to explain:

1. What is a "smart growth" site and how does it differ from a conventional site?
2. SGTG project findings – what are the results, how are they usable, and differences that could occur in transportation impact analyses (TIAs) and environmental impact reports (EIRs) from using smart growth trip generation information;
3. Estimating smart growth trip generation, including qualifying sites, estimation equations, input data needed, outputs, and how to use the results;
4. How to prepare estimates both manually and automated; trip generation surveys and data collection, including purpose, differences from conventional site data collection, steps to organize and conduct surveys; and
5. How to reduce and analyze survey data and determine trip generation rates and mode splits.

The training materials include purposes and objectives, details procedures, materials and equipment needed, examples and case studies, common problems, and tips for success.

The training materials are in the form of PowerPoint presentations in modular form. Each slide has speaker notes to enhance understanding and enable instructors to easily perform the training. Modules were assembled by subject category and sub-category. For example, the estimator spreadsheet has modules that include an overview, user instructions, and a sample case study example. In addition, the materials are combined into (1) a 20-30 minute "executive" version providing an overview of the research and what it can be used for, and (2) a 45-90 minute "practitioner" version that provides much more detail for those who will actually estimate trip generation or collect and analyze similar data. The assembled version can be presented in the higher amount of time, but can be reduced all the way to the shortest times by deleting modules.

The training materials are available on-line at https://tti.tamu.edu/research-projects/featured-projects.

7. NEXT STEPS – RECOMMENDATIONS

Caltrans began Phase 1 of the SGTG research program with the objective of creating a credible trip generation estimation method for smart growth developments. Phases 1 and 2 of this program plus Caltrans' previous infill site trip generation projects have provided survey data for 39 apartment sites, 26 office sites, and small numbers of sites for other land uses. Both phases of research have produced estimation methods based on data available that was deemed applicable at the time.

Entering Phase 2, and relying on the Central Limit Theory, it was anticipated that if data could be collected from a sample of at least 30 sites for each land use that were carefully selected to meet a set of smart growth development characteristics, a credible trip generation estimation method could be developed. Phase 2 increased the number of Phase 1 and 2 apartment development sites to 29. Combined with 10 apartment sites from the infill program, a total 39 smart growth apartment development sites yielded enough data for comprehensive trip generation analysis for this land use type. While less than the desired 30 site threshold, office building sites from the three research projects totaled 26 sites.

Estimation methods were developed for both apartment and office developments. The Phase 2 sites expanded the range of sizes and other characteristics of the developments as well as provided a greater number of sites. There is a somewhat greater variation in the office sites, especially for context characteristics.

The following actions are recommended to expand the scope and usefulness of the current SGTG methodology capabilities as well as to further increase estimation accuracy for office building trip generation:

1. Identify priority land uses most frequently analyzed in TIAs and EIRs;
2. Determine if methodology needs to become multimodal;
3. Increase office building sample size;
4. Review data being collected elsewhere for applicability; and
5. Encourage SGTG data collection by others and update models.

1. IDENTIFY PRIORITY LAND USES MOST FREQUENTLY ANALYZED IN TIAS, EIRS

The goal of the SGTG program was to provide a credible (vehicle) trip generation estimation method for use with smart growth sites being analyzed for TIAs and EIRs. As of the end of Phase 2, there appears to be a credible estimation model for apartment developments. For office buildings, the estimation models are close to what could be considered widely credible, but probably could be improved with data from another 6-10 sites or more.

What about other frequently analyzed land uses? Other land uses most frequently included in TIAs and EIRs and large enough for trip generation to vary significantly at smart growth sites are possibly:

- Retail (featuring current tenant type mix)
    - Neighborhood/community centers
    - Free-standing large stores
    - Regional lifestyle centers
- Hotels
    - Full service
    - Limited service
    - Boutique

Other frequent smart growth development types to explore may be:

- Restaurants – impacts may be too small to justify Caltrans investment; and
- Entertainment – cinemas.

Discussions with municipal development review officials may help Caltrans to prioritize land uses that are most frequently analyzed, appear in smart growth areas, and are generally accepted as destinations for transit, walk, and/or bicycle trips when developed in smart growth areas.

If any of the above land uses (or additional land uses) is identified by municipalities as frequently analyzed in smart growth areas, it is recommended that one or more additional phases of SGTG be funded and performed by Caltrans to provide trip generation estimation methodologies for them. However, SGTG resources should probably be prioritized for those land uses having characteristics that are expected to produce significantly less vehicle trip generation when within smart growth developments or areas.

2. DETERMINE IF METHODOLOGY NEEDS TO BECOME MULTIMODAL

TIAs and EIRs increasingly address other travel modes beyond motor vehicles. Multimodal travel data are being collected in SGTG studies. So far the emphasis has been on estimating smart growth impact on vehicle trip generation. In Phase 2, person trips were reviewed briefly. It appears that the data collected can produce reasonably good estimates of total person trips. If so, estimates could be made of:

- Total person trips;
- Vehicle trips (and vehicle person trips by applying vehicle occupancy); and
- Non-vehicle person trips (combined person trips by transit, walk and bicycle modes).

Estimating those last three modes with reasonably good accuracy may require larger (interview) sample sizes at each site than collected so far. The transit, walk, and bicycle mode shares can still be small (one, two, or all three modes), so to have enough samples to accurately model the necessary number of interviews may require a second interview day or more interviewers at some future sites.

3. INCREASE OFFICE BUILDING SAMPLE SIZE

Not surprisingly, the accuracies of the apartment estimation models developed in Phase 2 are higher than for the general multi-tenant office building model for both AM and PM street peak periods. They also represent an improvement over Phase 1 results, as would be expected with more data. The apartment model statistics are favorably comparable to ITE's estimates for traditional suburban sites. The office building models, while better than Phase 1, still may be able to be improved with data from additional sites that would increase the total; probably at least another 10 sites selected to fill in less represented ranges of site and context characteristics.

4. REVIEW DATA BEING COLLECTED ELSEWHERE FOR APPLICABILITY

Similar data (but some not the same) are being collected in the San Francisco and Los Angeles regions in California plus in Portland, Oregon, Washington, D.C., and New York City. Careful examination of the data collection procedures used and the data produced may make it possible to combine some or all of the data for future analyses.

It would be beneficial if all smart growth trip generation data collection would use the same procedures and collect the same data. That could make more data applicable for trip generation-related impact analyses.

Person trip data costs more to collect than vehicle trip data and it requires more work to set up. As a result, there is often a desire to simplify the data collection process and yield non-compatible data. That can limit the data content and ability to support desired analyses. It would be beneficial to all users of smart growth trip generation data to use common procedures (i.e., SGTG methods) to collect the data needed for desired analyses.

5. ENCOURAGE SGTG DATA COLLECTION BY OTHERS AND UPDATE MODELS

Caltrans should encourage other entities to collect smart growth trip generation data and submit it to Caltrans. Such efforts should be performed considering the same general collection methods and SGTG criteria as used in this study to maintain consistency and comparability between data. Caltrans could periodically summarize the data and/or make it available on-line for use. When enough additional data has been accumulated, estimation models could be updated and disseminated by Caltrans or others.

APPENDIX A. PHASE 2 SURVEY SITE DESCRIPTIONS

A brief description of each Phase 2 study site is presented on the following pages. Each one-page description contains a general verbal description plus some more specific quantitative characteristics of the site, the building, and the conditions around the site.

Sites are arranged in order of:

- Regions (north to south);
- City (generally north to south);
- Land use (apartment, office, other); and
- Development name (alphabetic).

Sites are numbered following the convention used for the Phase 1 sites. Each separate site has its own number. Where multiple land uses were surveyed on one site, the land uses are numbered separately following a decimal placed after the site number. For example, if an apartment building and office building co-exist on the same site, the apartment building might be numbered site 1.1 and the office building site 1.2.

The descriptions or definitions for the "site information" contain in the left table of each description are as follows.

- ITE Land Use Code – Code assigned according to the list in *Trip Generation Manual*, 9th Ed., Institute of Transportation Engineers, Washington, D.C., 2012.[12]
- ITE Area Type – Code assigned according to definitions in ITE *Trip Generation Handbook*, 3rd Edition, Institute of Transportation Engineers, Washington, D.C., August 2014, p. 131, with modification for this project, 0a=regional CBD; 0b=outlying/suburban CBD; 1=urban core; 2=activity center; 3=general urban; 4=suburban business district; 5=suburban strip commercial; 6=general suburban; 7=special district; 8=rural town business district; 9=rural. Supplemental codes added only where applicable are: C=site within ½-mile of a university campus with over 5,000 students; M=mixed use within larger development; Ta=transit-adjacent (within ¼-mile of rail station; To=transit-oriented immediately adjacent or connect to rail station.[13]
- Building size – DUs (apartments) or GSF of floor area (other uses) as reported by building owner/manager.
- Building occupancy – percent of building occupied as reported by building owner/manager at survey time.

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[12] *Trip Generation Manual*, 9th Edition, Institute of Transportation Engineers, Washington, DC, 2012, not currently accessible online.
[13] *Trip Generation Handbook*, 2nd Edition. Institute of Transportation Engineers, Washington, DC, June 2004, p. 17 not currently accessible online.

- On-site parking spaces – total number of on-site parking spaces.
- On-site parking cost – cost of parking for visitors (first hour).
- Average building setback distance – Average setback distance at building access points.
- Curb parking spaces within 0.1-mile – total spaces within straight line radius, regardless of use restrictions.
- Metered curb parking rate – where metered, or free if applicable.
- Residential population within ½-mile (straight line radius) – 2013 American Community Survey (ACS).
- Jobs within ½-mile (straight line radius) – 2013 Longitudinal Employer-Household Dynamics (LEHD), LEHD Origin-Destination Employment Statistics (LODES).
- Distance to regional CBD – closest among Sacramento, San Francisco, Oakland, Los Angeles, and San Diego.
- Closest bicycle facility – straight line distance to bike lane, path (excludes sharrows and unmarked routes).
- PM peak-hour bus stops within a ¼-mile, straight-line radius – number of different bus stops within ¼-mile.
- PM peak-hour buses stopping within a ¼-mile (straight-line radius) – number of different buses stopping.
- PM peak-hour rail transit stops within a ½-mile (straight-line radius) – different rail transit stations (20-minute headways or less).
- PM peak-hour rail transit trains stopping within a ½-mile (straight-line radius) – Number of different trains.
- Site area covered by surface parking lots – percentage of total site area.
- Site within 1-mile of major university – straight line distance to universities with over 5,000 students.
- Walk scores – walk, transit, and/or bike scores (for residential sites) from walkscore.com.

Two tables are provided at the bottom right corner of each page.

- Peak Hour Trip Generation – This shows the number and percentage of person trips made to/from (combined) the development during midweek (Tuesday-Thursday) AM (7-9 a.m.) and PM (4-6 p.m.) peak hours. The peak hours are the highest four consecutive 15-minute intervals during the stated two-hour peak periods. Trips are presented by mode of travel defined as:
  - Motor vehicle – drivers and passengers in automobiles, motorcycles and trucks;
  - Walk – pedestrians, persons in wheel chairs;
  - Public transit – riders on public transit (bus or rail), privately operated buses or shuttles (e.g., hotel shuttles, tour buses); and
  - Bicycle – persons riding any form of bicycle.
- Peak Hour Vehicle Trip Generation – This shows the numbers of trips made by vehicles entering and exiting the development during the same peak hours. Actual surveyed trips are shown on the left; estimated (expected) trips using ITE rates or equations are

shown on the right. Vehicle occupancy (persons per vehicle) is also shown. The ITE estimates of vehicle trips are based on information contained in the ITE *Trip Generation Manual*, 9th Edition. The ITE estimates of vehicle occupancies are from Tables C.1 – C.2 of the ITE *Trip Generation Handbook*, 3rd Edition. The last row of this table shows the ITE classification used for the ITE estimate and whether a rate or equation was used (see following paragraphs for additional information).

Column totals may not always add to the total shown due to rounding.

Each site has an ITE land use code shown in the left table. ITE estimates of expected trip generation are for sites that are typically found in suburban locations. They are auto-oriented with plentiful convenient parking, very little or no transit service, few walkable destinations of complementary land uses, and no or very few specific accommodations for bicycles. Almost all trips are made by driving. For this project, survey sites fell into the following categories.

- Apartments:
    - Low-rise (ITE land use code 221) – one and two story apartment buildings. None of these were surveyed in either Phase 1 or Phase 2 of SGTG;
    - Mid-rise (code 223) – 3-to-10-story apartment buildings. Most apartment developments surveyed in both phases of SGTG were mid-rise;
    - High-rise (code 222) – apartment buildings with 11 or more stories. A few of these were surveyed in SGTG; and
    - Unclassified apartment buildings (code 220) – apartment buildings for which the number of stories was not provided with data submitted for the ITE database. The mix of low-, mid-, and high-rise developments in this data is not known but in all likelihood there are samples of all three types, especially mid-rise.
- General office buildings (ITE land use code 710) – multi-tenant buildings as typically found in urban areas.

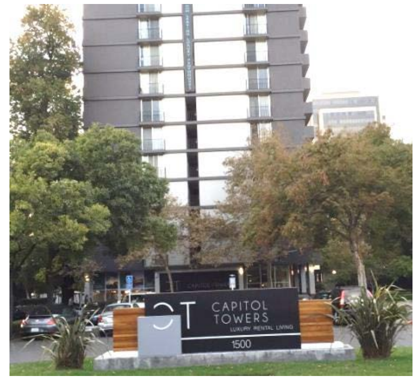
Vehicle trip estimates were made using ITE instructions described in the *Trip Generation Handbook*.[14] This entailed using trip generation equations for the office buildings. For apartment buildings, data provided in the *Trip Generation Manual* are very limited for mid-rise apartment developments (code 223). Almost no data samples came from developments of the sizes surveyed in SGTG Phase 2, and there are few samples overall. However, there are both many more samples and good coverage over the size range surveyed for high-rise apartments, so ITE equations were used for those estimates of vehicle trips. For mid-rise apartment developments, it was decided to use the code 220 data because most of the sites within that data category are probably 223 sites and it covers the size range surveyed in both SGTG phases. As stated previously, it is also expected that the majority of sites included in the 220 data are

[14] *Trip Generation Handbook*, 2nd Edition. Institute of Transportation Engineers, Washington, DC, June 2004, p. 17 not currently accessible online.

from mid-rise developments. The last row of the right table shows what source was used to estimate the ITE vehicle trips for the site.

Note that these estimates would be for typical suburban type sites and should NOT be the same as the actual counts since the surrounding conditions at SGTG sites are NOT typical suburban. The actual and ITE vehicle trips will be the basis for the correction "model" to be developed in SGTG Phase 2.

Study location 224.1
Name: Capitol Towers Apartments
Address: 1500 7th Street, Sacramento, CA 95814
Data collection date: Thursday, October 22, 2015



This 15-story apartment building is located on the southwest edge of downtown Sacramento about four blocks from the state Capitol. The ground floor of the development includes a restaurant, a community/game room, and the leasing office. Resident and visitor parking for the development are available in an on-site garage, on-site surface lots, and surrounding on-street parking spaces. Due to its near-downtown location, on-street parking spaces are difficult to find during weekday working hours, but more spaces become available to residents in the evenings after downtown offices and businesses close. The building is part of a large apartment development comprising an entire city block. The Blue, Gold, and Green Lines of the Sacramento Light Rail system pass by the site and the development is about ½-block from the 8th and O Street light rail station. Numerous bus routes also pass by the site with three bus stops located on streets adjacent to the site. The immediate vicinity has numerous office buildings, apartments, and condominiums. The site is walkable, with tenants being able to walk to downtown employment destinations, restaurants, entertainment venues, parks and museums, and the Capitol mall retail area. Pedestrian activity to and from the site was low, perhaps due to few retail and entertainment attractions located within the immediate vicinity of the site.

Site Information

ITE Land Use Code	222
ITE Area Type	1
Building size	206 DU
On-site parking spaces	236
On-site parking cost	1.25/hr
Average building setback distance	40 ft
Curb parking spaces within 0.1-mile	126
Metered curb parking rate	$2.50/ hr
Residential population within ½-mile	4,646
Jobs within ½-mile	66,671
Distance to regional CBD	0.4 miles
Closest bicycle facility	750 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	35
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	67
PM peak-hour rail transit stops within a ½-mile, straight-line radius	2
Site area covered by surface parking lots	0.10
Site within 1 mile of major university	No
Walk scores	90

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	47	68	67	74
Walk	14	20	14	15
Public transit	5	7	7	8
Bicycle	3	4	3	3
Total	69	100	91	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.17	1.17	1.11	1.18
Vehicle trips	40	57	58	74
ITE source			222 equ.	222 equ.

Study location 225.1
Name: LINQ Midtown Apartments
Address: 3111, 3151, 3201 S Street, Sacramento, CA 95816
Data collection date: Wednesday, October 21, 2015

This 275-unit apartment development is located in the Midtown area of Sacramento about one mile west of downtown. It is a large complex made up of three four-story apartment building structures that extend an entire city block. One of the three buildings has a small amount of ground floor retail with a restaurant. The ground floor apartment units along S Street have direct access out to the public sidewalk. Resident and visitor parking for the development is provided primarily via an on-site garage, though there is a small amount of free on-street parking available to residents and visitors on a first come first serve basis. The Gold Line of the Sacramento Light Rail system passes the site. The development is about one block from the 29th street light rail station. The site is served by three bus routes with several stops located with 1-to-2 blocks from the property. The immediate vicinity has numerous walkable destinations including a neighborhood market, restaurants, and various government and medical office buildings. Accurately accounting for all persons entering and leaving ground floor units along S Street was difficult during peak times when pedestrian activity on the sidewalk was heavy. The development is located less than one mile from the UC Davis Medical Center.

Site Information

ITE Land Use Code	223
ITE Area Type	3
Building size	275 DU
On-site parking spaces	334
On-site parking cost	0
Average building setback distance	10 ft
Curb parking spaces within 0.1-mile	206
Metered curb parking rate	0
Residential population within ½-mile	4,338
Jobs within ½-mile	5,388
Distance to regional CBD	1.7 miles
Closest bicycle facility	1,500 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	9
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	20
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0.01
Site within 1 mile of major university	No
Walk scores	75

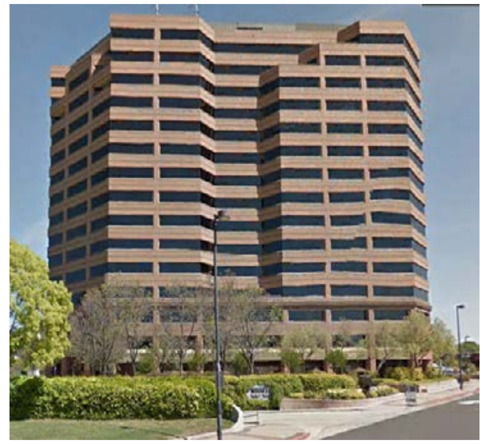
Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	100	77	86	70
Walk	16	12	26	21
Public transit	5	4	5	4
Bicycle	9	7	6	5
Total	130	100	123	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.08	1.12	1.11	1.18
Vehicle trips	92	78	129	158
ITE source			220 equ.	220 equ.

Study location 226.1
Name: One Concord Center Office Building
Address: 2300 Clayton Road, Concord, CA 94520
Data collection date: Tuesday, October 20, 2015



This 15-story office building is located near downtown Concord about 22 miles northeast of Oakland and 29 miles northeast of San Francisco. The building is located across the street from the BART Yellow Line Concord Station. Four bus routes serve the station. There are six bus stops within 1-2 blocks of the building. The building has a small first-floor deli open in the morning through mid-day serving the building, but few outside customers. Parking is provided in an on-site subsurface parking garage and a garage located across the street. The building has more parking than it currently uses for tenants and visitors. There is free on-street parking adjacent to the site that appears mostly taken by early arrivals to the BART station. The building is within walking distance to numerous restaurants, services, and hotels in Concord's small downtown area. In addition, within walking distance are other office buildings of similar size, several large multi-story apartment properties, a grocery/retail shopping center, and a single-family residential area.

Site Information

ITE Land Use Code	710
ITE Area Type	2
Building size	358,589 gsf
On-site parking spaces	881
On-site parking cost	$2.00/hr
Average building setback distance	40 ft
Curb parking spaces within 0.1-mile	27
Metered curb parking rate	0
Residential population within ½-mile	5,187
Jobs within ½-mile	6,377
Distance to regional CBD	SF 24 mi Oakland 17 mi
Closest bicycle facility	None
PM peak-hour bus stops within a ¼-mile, straight-line radius	10
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	19
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk scores	-

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	200	83	211	87
Walk	13	5	14	6
Public transit	28	12	16	7
Bicycle	1	0	1	0
Total	242	100	242	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.18	1.04	1.06	1.09
Vehicle trips	170	202	481	433
ITE source			710 equ.	710 equ.

Study location 227.1
Name: Avalon Walnut Creek Apartments
Address: 1001 Harvey Dr., Walnut Creek, CA 94597
Data collection date: Tuesday, October 13, 2015

This 3-4 story apartment building is located about 22 miles east of downtown San Francisco and 15 miles east of downtown Oakland. It is also within 0.2-miles of the Treat Boulevard interchange on I-680. The two main entrances to the site are 250 and 400 feet from the Pleasant Hill/Contra Costa Centre BART Station. Approximately 10 bus routes serve the station and nearby destinations. The building has limited first-floor retail with a breakfast/sandwich shop, dinner restaurant, and fitness club; all were excluded from the survey. The building provides on-site garage parking with its leases. Tenants park within a gated section of the garage. There are additional spaces for tenants, visitors, and retail customers both in the garage and in unmetered curb spaces. Numerous office buildings, a hotel, and retail are within short walking distance. There are also several apartment and condominium buildings nearby.

Site Information

ITE Land Use Code	223
ITE Area Type	2
Building size	385 DU
On-site parking spaces	439
On-site parking cost	0
Average building setback distance	0 ft
Curb parking spaces within 0.- mile	52
Metered curb parking rate	0
Residential population within ½-mile	6,838
Jobs within ½-mile	6,780
Distance to regional CBD	SF 22 mi Oakland 12 mi
Closest bicycle facility	2,000 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	4
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	13
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk scores	68

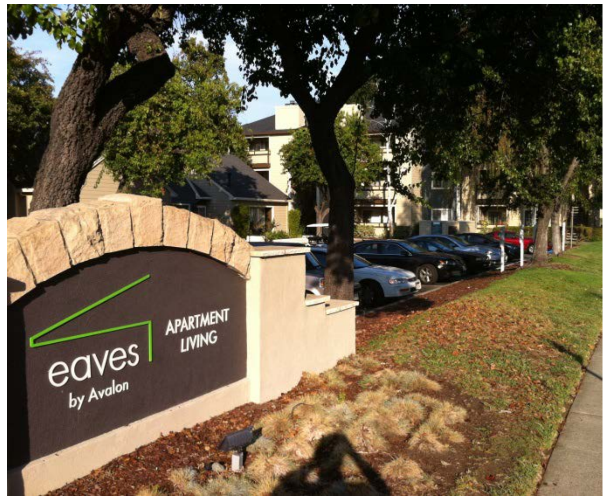
Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	185	63	141	61
Walk	44	15	41	18
Public transit	67	23	47	20
Bicycle	0	0	1	1
Total	296	100	230	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.20	1.26	1.11	1.18
Vehicle trips	155	120	185	221
ITE source			220 equ.	220 equ.

Study location 228.1
Name: Eaves by Avalon Apartments
Address: 1445 Treat Boulevard, Walnut Creek, CA 94597
Data collection date: Wednesday, October 14, 2005



This 3-story apartment building is located about 22 miles east of the San Francisco CBD, 15 miles east of downtown Oakland, and within ⅓-mile of the Treat Boulevard I-680 interchange. The site is close to the Pleasant Hill/Contra Costa Centre BART Station; the closest site entrance is within 500 feet of the station; the center of the site is within 850 feet. Approximately 10 bus routes serve the station and nearby destinations. The apartment building provides designated parking spaces in an on-site surface lot with its apartment leases. The parking supply is limited; unmetered on-street spaces adjacent to the site are used by some tenants. Off-site parking was included in the count and survey data. Numerous general and medical office buildings, a hotel, and some retail are within a short walking distance. There are also several apartment and condominium buildings nearby.

Site Information

ITE Land Use Code	223
ITE Area Type	2
Building size	510 DU
On-site parking spaces	595
On-site parking cost	0
Average building setback distance	150 ft
Curb parking spaces within 0.1-mile	14
Metered curb parking rate	0
Residential population within ½-mile	3,560
Jobs within ½-mile	5,718
Distance to regional CBD	SF 22 mi Oakland 12 mi
Closest bicycle facility	2,800 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	4
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	13
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0.30
Site within 1 mile of major university	No
Walk score	41

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	159	50	150	58
Walk	40	13	38	15
Public transit	115	36	70	27
Bicycle	2	1	2	1
Total	316	100	260	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.28	1.28	1.11	1.18
Vehicle trips	124	156	244	287
ITE source			220 equ.	220 equ.

Study location 229.1
Name: Park Regency Apartments
Address: 3128 Oak Road, Walnut Creek, CA 94597
Data collection date: Thursday, October 15, 2015

This 4-story apartment building is located about 22 miles east of the San Francisco CBD, 15 miles east of downtown Oakland, and within ⅓- mile of the interchange of Treat Boulevard and I-680. The site is close to the Pleasant Hill/Contra Costa Centre BART Station; the closest site entrance is within 700 feet of the station; the center of the site is within 1,100 feet. Approximately 10 bus routes serve the station and nearby destinations. The apartment provides designated parking spaces in on-site parking garages. The parking supply is adequate for tenants and visitors. Vehicle and pedestrian access is gated between 6 p.m. and 7 a.m. Numerous office buildings are within a short walking distance. Adjacent to one site entrance is a small retail shopping plaza with convenience retail and two restaurants. There are also several apartment and condominium buildings nearby.

Site Information

ITE Land Use Code	223
ITE Area Type	2
Building size	892 DU
On-site parking spaces	1,380
On-site parking cost	0
Average building setback distance	350 ft
Curb parking spaces within 0.1-mile	12
Metered curb parking rate	0
Residential population within ½-mile	6,538
Jobs within ½-mile	6,475
Distance to regional CBD	SF 22 mi Oakland 12 mi
Closest bicycle facility	2,100 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	6
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	14
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0.22
Site within 1 mile of major university	No
Walk scores	71

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	260	61	30081	64
Walk	45	11	80	17
Public transit	119	28	7	17
Bicycle	1	0		2
Total	425	100	468	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.21	1.25	1.11	1.18
Vehicle trips	215	240	423	489
ITE source			220 equ.	220 equ.

Study location 230.1
Name: Fremont Office Center
Address: 39300 Civic Center Drive and 2201 Walnut Avenue, Fremont, CA 94538
Data collection date: Thursday, October 22, 2015

This site consists of two adjacent office buildings that share parking. The site is in downtown Fremont adjacent to the Fremont BART Station (current end of the line). Due to its proximity to both the BART station and the civic center across the street, and an adjacent medical center, there is a moderately high volume of pedestrian activity within and adjacent to the site. Care had to be taken in separating trips generated by the site from those passing through the site. On-site parking is plentiful. Some is rented out to an adjacent development for use as regular daily parking. Trips involving that parking were excluded from the site data.

Site Information

ITE Land Use Code	710
ITE Area Type	4
Building size	190,000 gsf
On-site parking spaces	850
On-site parking cost	0
Average building setback distance	165 ft
Curb parking spaces within 0.1-mile	58
Metered curb parking rate	0
Residential population within ½-mile	7,385
Jobs within ½-mile	11,781
Distance to regional CBD	Oakland 25 mi
Closest bicycle facility	300 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	2
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	22
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0.30
Site within 1 mile of major university	No
Walk scores	-

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	164	85	127	79
Walk	7	4	14	9
Public transit	20	10	17	11
Bicycle	2	1	2	1
Total	193	100	160	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.04	1.18	1.06	1.09
Vehicle trips	158	108	320	291
ITE source			710 equ.	710 equ.

Study location 231.1
Name: Avalon at Cahill Park Apartments
Address: 754 The Alameda, San Jose, CA 95126
Data collection date: Tuesday, October 20, 2015

This development is located on the fringe of downtown San Jose. It consists of a free-standing building with apartments, above ground floor retail (excluded from the survey), and a three-building section of apartments and townhouses. The development is adjacent to the downtown San Jose Caltrain Station as well as the San Jose Diridon Station on the VTA Green Line. The Amtrak, ACE, Capitol Corridor, and Monterrey-San Jose Express commuter services also stop at that station providing comprehensive commuter service to numerous destinations throughout the Bay Area and beyond. Resident parking is provided in a garage below the building as well as a surface lot that also serves the ground floor retail in the north building (excluded from the survey). Visitor parking is available at nearby free curb spaces.

The vicinity is quite walkable. Walk access to much of downtown is within ¼-mile and areas beyond that distance can be reached by transit. The immediate vicinity has convenience retail and restaurants as well as numerous office buildings and other residential buildings.

Site Information

ITE Land Use Code	223
ITE Area Type	1
Building size	200 DU∗
On-site parking spaces	238
On-site parking cost	0
Average building setback distance	10 ft
Curb parking spaces within 0.1-mile	112
Metered curb parking rate	0
Residential population within ½-mile	6,200
Jobs within ½-mile	5,788
Distance to regional CBD	SF 41 miles SJ ½ mile
Closest bicycle facility	500 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	6
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	85
PM peak-hour rail transit stops within a ½-mile, straight-line radius	3
Site area covered by surface parking lots	0.10
Site within 1 mile of major university	No
Walk score	87

∗ 218 total DU less 18 DU in north building excluded from survey.

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	80	50	47	44
Walk	36	23	31	28
Public transit	40	25	28	26
Bicycle	4	3	2	1
Total	160	100	108	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.13	1.12	1.11	1.18
Vehicle trips	71	43	97	122
ITE source			220 equ.	220 equ.

Study location 232.l
Name: Villa Torino Apartments
Address: 29-39 Julian Street, San Jose, CA 95110
Data collection date: Wednesday, October 21, 2015

This apartment building is located just a few blocks north of downtown San Jose and immediately adjacent to the VTA Light Rail Blue/Yellow Line that runs on First Street. The St. James Station is less than 1,000 feet from Villa Torino, and several bus routes also serve the close proximity. Most of the surrounding development is multiple-family residential and office with some restaurant and convenience retail.

Resident parking is provided in an on-site garage below the building. The supply exceeds demand. Visitor parking is available at nearby metered and free (but time-limited) curb spaces.

Site Information

ITE Land Use Code	223
ITE Area Type	3
Building size	198
On-site parking spaces	230
On-site parking cost	0
Average building setback distance	18 ft
Curb parking spaces within 0.1-mile	84*
Metered curb parking rate	$0.50-1.00/hr
Residential population within ½-mile	8,092
Jobs within ½-mile	9,947
Distance to regional CBD	SF 41 mi SJ ½-mi
Closest bicycle facility	1,250 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	6
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	28
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	0.8 mi
Walk scores	86

* 55 free spaces, 29 metered spaces.

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	80	63	65	52
Walk	19	15	23	18
Public transit	21	16	32	25
Bicycle	8	6	6	5
Total	128	100	126	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.19	1.22	1.11	1.18
Vehicle trips	67	54	95	120
ITE source			220 equ.	220 equ.

Study location 233.1
Name: Gardens at Wilshire Center Apartments
Address: 635 Hobart Blvd., Los Angeles 90005
Data collection date: Tuesday, May 5, 2015

This apartment building is located along the moderately high-density Wilshire Boulevard office corridor about three miles west of downtown Los Angeles. The corridor has numerous office buildings along with convenience retail, restaurants, and a few other uses. There are numerous multiple-family high- and mid-rise residential buildings in the corridor making it very convenient to walk to a variety of destinations. Pedestrian volumes near this building are relatively heavy during peak periods. This building appeared to house a large number of high school and college students, which may have affected peak period trip generation peaking.

The building has a small amount of restaurant and convenience retail space. Parking for both residential and non-residential uses is provided in the same parking garage below the building (residential spaces do not fill) but parking for the non-residential uses is designated for a separate portion in the garage. Surveys distinguished between the two types of users. There is a Metrorail station of the Purple Line located two blocks away. Wilshire also has five bus routes that stop within two blocks of the Wilshire Serrano Building.

Site Information

ITE Land Use Code	223
ITE Area Type	3
Building size	159 DU
On-site parking spaces	300
On-site parking cost	0
Average building setback distance	10 ft
Curb parking spaces within 0.1-mile	123*
Metered curb parking rate	$1.00/hr
Residential population within ½-mile	35,125
Jobs within ½-mile	20,945
Distance to regional CBD	3.3 mi
Closest bicycle facility	None
PM peak-hour bus stops within a ¼-mile, straight-line radius	25
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	89
PM peak-hour rail transit stops within a ½-mile, straight-line radius	2
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk score	94

* 109 spaces metered, 14 spaces free.

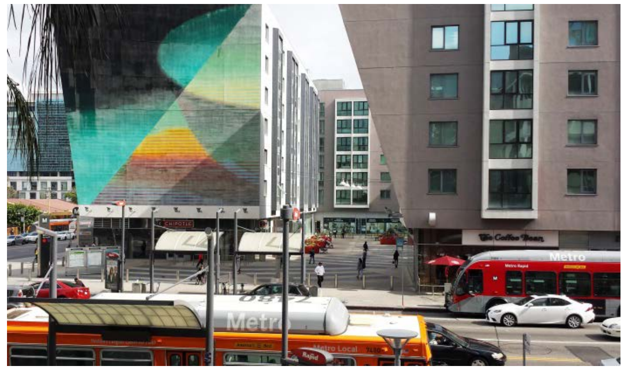
Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	52	68	58	73
Walk	22	29	17	21
Public transit	3	3	5	6
Bicycle	0	0	0	0
Total	77	100	80	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.19	1.24	1.11	1.18
Vehicle trips	44	47	79	102
ITE source			220 equ.	220 equ.

Study location 234.1
Name: Wilshire Vermont Station Apartments
Address: 3183 Wilshire Boulevard, Los Angeles, CA 90010
Data collection date: Thursday, May 7, 2015



This 7-story apartment building is located along the moderately high-density Wilshire Boulevard office corridor about 2½ miles west of downtown Los Angeles. The building is located directly over the Vermont/Wilshire Station along the Red and Purple Lines of the Metrorail system. A station entrance is located within the boundary of this apartment building. The site is accessible via several bus routes with seven bust stops located with two blocks of the building. This section of Wilshire Boulevard has a wide variety of office, retail, restaurant, and hotel uses. Adjacent to Wilshire there are numerous mid- and high-rise residential buildings. This is a very walkable area and site.

The ground floor of this building is occupied by convenience retail and eating establishments. These establishments were excluded from the survey. The apartments are on the second floor and above. Most first floor businesses have access from both the exterior streets bounding the site, but several have access from an interior courtyard. Pedestrian activity within and around the site is heavy going to-and-from the station as well as passing the site.

Site Information

ITE Land Use Code	223
ITE Area Type	3
Building size	449 DU
On-site parking spaces	525
On-site parking cost	$3.00/hr
Average building setback distance	10 ft
Curb parking spaces within 0.1-mile	12 metered
Metered curb parking rate	$1.00/hr
Residential population within ½-mile	33,327
Jobs within ½-mile	22,457
Distance to regional CBD	2.4 mi
Closest bicycle facility	800 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	22
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	129
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk score	96

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	104	42	106	44
Walk	58	24	81	33
Public transit	79	33	53	22
Bicycle	3	1	1	0
Total	244	100	241	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.08	1.13	1.11	1.18
Vehicle trips	96	94	215	255
ITE source			220 equ.	220 equ.

Study location 235.1
Name: Wilshire Center (East)
Address: 3055 Wilshire Boulevard, Los Angeles, CA 90010
Data collection date: Wednesday, May 6, 2015

This 12-story office building is located on the corner of Wilshire Boulevard and Westmoreland Avenue along the moderately high-density Wilshire corridor in central Los Angeles about 2½ miles west of downtown. The building is located one block east of the Vermont/Wilshire Station entrance along the Red and Purple Lines of the Metrorail system. The building is served by numerous bus routes with six bus stops located with two blocks of the site. This section of Wilshire Boulevard has a wide variety of office, retail, restaurant, and hotel uses. Adjacent to Wilshire there are numerous mid- and high-rise residential buildings. This is a very walkable area and site.

The building includes a bank and a small café on the ground floor. Pedestrian traffic to-and-from the bank was steady and a noticeable contributor to person traffic to the building. A bank ATM machine is located on the building's exterior façade on Wilshire. Pedestrian activity passing by the site is moderate due to its proximity to the Metrorail station, numerous bus stops, and the variety and density of nearby office, retail, and residential uses.

Site Information

ITE Land Use Code	710
ITE Area Type	1
Building size	225,000 ft^2
On-site parking spaces	528
On-site parking cost	$145/month
Average building setback distance	10 ft
Curb parking spaces within 0.1-mile	70
Metered curb parking rate	$1.00/hour
Residential population within ½-mile	33,012
Jobs within ½-mile	19,962
Distance to regional CBD	2.4 mi
Closest bicycle facility	650 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	22
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	129
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk scores	-

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	190	75	275	67
Walk	36	14	90	22
Public transit	27	11	47	11
Bicycle	0	0	0	0
Total	253	100	412	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.12	1.15	1.06	1.09
Vehicle trips	170	240	291	267
ITE source			710 equ.	710 equ.

Study location 236.1
Name: Wilshire Financial Tower – North
Address: 3200 Wilshire Blvd., Los Angeles, CA 90010
Data collection date: May 4, 2015

This 16-story office building is located on the corner of Wilshire Boulevard and Vermont Avenue along the moderately high-density Wilshire corridor in central Los Angeles about 2½ miles west of downtown. The building is located diagonally across the street from the Vermont/Wilshire Station entrance along the Red and Purple Lines of the Metrorail system. The building is served by numerous bus routes with six bus stops located with two blocks of the site. This section of Wilshire Boulevard is part of the 'Koreatown' area with high pedestrian activity and has a wide variety of office, retail, restaurant, and hotel uses. Adjacent to Wilshire there are numerous mid- and high-rise residential buildings. This is a very walkable area and site.

The ground floor of this building includes a bank and a small deli. An ATM machine for the bank is located outside of the building next to the building's main entry doors on Wilshire. Pedestrian activity passing by the site is high due to its proximity to the Metrorail station, numerous bus stops, and the variety and density of nearby office, retail, and residential uses.

Site Information

ITE Land Use Code	710
ITE Area Type	1
Building size	200,000 gsf
On-site parking spaces	888
On-site parking cost	$135/month
Average building setback distance	5 ft
Curb parking spaces within 0.1-mile	44
Metered curb parking rate	$1.00/hr
Residential population within ½-mile	33,623
Jobs within ½-mile	23,635
Distance to regional CBD	2.5 mi
Closest bicycle facility	650 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	22
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	129
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk score	-

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	222	76	182	75
Walk	32	11	32	13
Public transit	39	13	30	12
Bicycle	0	0	0	0
Total	293	100	244	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.22	1.10	1.06	1.09
Vehicle trips	182	165	293	269
ITE source			710 equ.	710 equ.

Study location 237.1
Name: Wilshire Serrano Building
Address: 3699 Wilshire Boulevard, Los Angeles, CA 90010
Data collection date: Wednesday, May 6, 2015

This 12-story office building is located along the moderately high density Wilshire Boulevard office corridor about three miles west of downtown Los Angeles. The corridor has numerous office buildings along with convenience retail, restaurants, and a few other uses. There are numerous multiple family high- and mid-rise residential buildings in the blocks adjacent to Wilshire Boulevard making the corridor very convenient for walk trips to a variety of destinations. Pedestrian volumes along sidewalks in the vicinity of this building are relatively heavy during peak periods. This building also has a fitness center on the first floor (separate survey site), which is accessible from both inside and outside the office building. The building has its own parking garage which does not normally fill during the day. There is a Metrorail station of the Purple Line located two blocks away. Wilshire also has five bus routes that stop within two blocks of the Wilshire Serrano Building.

Site Information

ITE Land Use Code	710
ITE Area Type	3
Building size	330,000 gsf
On-site parking spaces	660*
On-site parking cost	$8.00/hr
Average building setback distance	16 ft
Curb parking spaces within 0.1-mile	111**
Metered curb parking rate	$1.00/hr
Residential population within ½-mile	33,012
Jobs within ½-mile	20,969
Distance to regional CBD	3.3 mi
Closest bicycle facility	None
PM peak-hour bus stops within a ¼-mile, straight-line radius	25
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	89
PM peak-hour rail transit stops within a ½-mile. Straight-line radius	2
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk scores	-

* Shared with fitness center.
** 99 metered spaces plus 12 free spaces.

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	324	72	245	70
Walk	53	12	57	16
Public transit	71	16	45	13
Bicycle	2	0	2	1
Total	450	100	349	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.12	1.17	1.06	1.09
Vehicle trips	289	210	378	341
ITE source			710 equ.	710 equ.

Study location 237.2
Name: 24 Hour Fitness Center
Address: 3699 Wilshire Boulevard, Suite 110, Los Angeles, CA 90010
Data collection date: Wednesday, May 6, 2015

This fitness center is located on the 1st and 2nd floors of the 12-story Wilshire Serrano office building in a moderately high density Wilshire Boulevard office corridor about three miles west of downtown Los Angeles. The fitness center has direct access to both the outside front and lobby of the office building. Users have access and can use the building's underground parking for a fee but many walk to the fitness center from other buildings or park off-site.

This corridor has numerous office buildings along with convenience retail, restaurants, and a few other uses. There are also numerous multiple family high- and mid-rise residential buildings in the blocks adjacent to Wilshire Boulevard making the corridor very convenient for walk trips to a variety of destinations. Pedestrian volumes along sidewalks in the vicinity of this building are relatively heavy. The building's garage does not normally fill during the day and other pay parking is available off-site. There is a Purple Line Metrorail station located two blocks away. Wilshire also has five bus routes that stop within two blocks of the Wilshire Serrano Building.

Site Information

ITE Land Use Code	492
ITE Area Type	3
Building size	13,279 gsf
On-site parking spaces	660*
On-site parking cost	$8.00/hr
Average building setback distance	16 ft
Curb parking spaces within 0.1-mile	111**
Metered curb parking rate	$1.00/hr
Residential population within ½-mile	33,012
Jobs within ½-mile	20,969
Distance to regional CBD	3.3 mi
Closest bicycle facility	None
PM peak-hour bus stops within a ¼-mile, straight-line radius	25
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	89
PM peak-hour rail transit stops within a ½-mile, straight-line radius	2
Site area covered by surface parking lots	0
Site within 1 mile of major university	None
Walk scores	

* Shared with office building.
** 99 metered spaces plus 12 free spaces.

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	128	61	125	43
Walk	58	28	123	42
Public transit	9	4	41	14
Bicycle	14	7	5	2
Total	209	100	295	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.15	1.15	-	-
Vehicle trips	111	109	19	49
ITE source			492 rate	492 equ.

Study location 238.1
Name: Acappella Pasadena Apartments
Address: 145 Chestnut Street, Pasadena, CA 91103
Data collection date: Wednesday, May 13, 2015

This 3-story apartment building is located on the periphery of downtown Pasadena. It is within convenient walking distance of most destinations in the downtown including office buildings, restaurants, and retail of various types. Acappella Pasadena is approximately four blocks easy walking distance of the Gold Line Metrorail downtown station and about three blocks from the downtown bus transfer center, which is adjacent to the Metrorail station. Pedestrian volumes along sidewalks in the vicinity of this building are light to moderate. Acappella provides parking with its apartments leases and has enough spaces to meet tenant needs. Limited short-term curb parking spaces, some free, and some metered, are available in close proximity to the site. Acappella also has good access to I-210, which passes adjacent to the building.

Site Information

ITE Land Use Code	223
ITE Area Type	3
Building size	143 DU
On-site parking spaces	218
On-site parking cost	0
Average building setback distance	18 ft
Curb parking spaces within 0.1-mile	59*
Metered curb parking rate	$1.25/hr
Residential population within ½-mile	8,418
Jobs within ½-mile	25,471
Distance to regional CBD	9 mi
Closest bicycle facility	25 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	18
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	50
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	no
Walk score	90

* 8 metered spaces at $1.25/hr; 51 free two-hr spaces.

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	62	78	60	68
Walk	12	15	23	26
Public transit	4	5	4	4
Bicycle	2	2	2	2
Total	80	100	89	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.06	1.19	1.11	1.18
Vehicle trips	59	51	70	92
ITE source			220 equ.	220 equ.

Study location 239.1
Name: Pasadena Gateway Villas
Address: 290 N. Hudson Avenue, Pasadena, CA 91101
Data collection date: Tuesday, May 12, 2015

This apartment building is located about a mile from downtown Pasadena and is adjacent to another Phase 2 site, the Lake Corson Office Building. It is adjacent to I-210 and the Gold Line Metrorail line (in the freeway median). Gateway Villas is a block from a freeway interchange and an easy walk of about 600 feet walking distance to the Metrorail station. Several bus routes also serve the building from about a block away. Underground parking serves the tenant needs. Short-term visitor parking is available on-street using short-term free curb spaces. Numerous restaurants, office buildings, and some retail are located close by and conveniently walkable to meet many resident needs. Pedestrian volumes along sidewalks in the vicinity of this building are moderate. This development was reported to house a larger than normal number of retired residents, which may have lowered peak period trip generation rates.

Site Information

ITE Land Use Code	223
ITE Area Type	4
Building size	140 DU
On-site parking spaces	229
On-site parking cost	0
Average building setback distance	8 ft
Curb parking spaces within 0.1-mile	60
Metered curb parking rate	0
Residential population within ½-mile	11,821
Jobs within ½-mile	14,747
Distance to regional CBD	10 mi
Closest bicycle facility	None
PM peak-hour bus stops within a ¼-mile, straight-line radius	9
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	17
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk score	87

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	38	73	35	76
Walk	8	15	8	18
Public transit	6	12	2	4
Bicycle	0	0	1	2
Total	52	100	46	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.20	1.24	1.11	1.18
Vehicle trips	32	28	66	88
ITE source			220 equ.	220 equ.

Study location 240.1
Name: The Stuart at Sierra Madre Villa
Address: 3360 E. Foothill Boulevard, Pasadena, CA 91107
Data collection date: Thursday, May 14, 2015

This apartment complex is located along one of the regional arterial roadways serving Pasadena. The Stuart is about four miles east of downtown Pasadena. It is conveniently accessible to I-210, but also adjacent to the easternmost station of the Metrorail Gold Line (although this line has a future extension planned). The station itself is a 5-minute walk from the lobby of The Stuart using a route through the building (available to residents). There is ample parking on-site for residents (internal garage) and visitors (lot). There is a big box shopping center directly across Foothill Boulevard from The Stuart. There are a few eating places nearby as well plus a community theater on-site and a few other retail stores nearby. Pedestrian volumes along sidewalks in the vicinity of this building are light.

Site Information

ITE Land Use Code	223
ITE Area Type	4
Building size	188 DU
On-site parking spaces	300
On-site parking cost	0
Average building setback distance	170 ft
Curb parking spaces within 0.1-mile	0
Metered curb parking rate	-
Residential population within ½-mile	3,735
Jobs within ½-mile	7,161
Distance to regional CBD	16 mi
Closest bicycle facility	450 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	13
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	34
PM peak-hour rail transit stops within a ½-mile, straight line radius	1
Site area covered by surface parking lots	0.09
Site within 1 mile of major university	No
Walk score	76

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	75	87	79	89
Walk	6	7	8	9
Public transit	4	5	2	2
Bicycle	1	1	0	0
Total	86	100	89	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.17	1.29	1.11	1.18
Vehicle trips	64	61	92	117
ITE source			220 equ.	220 equ.

Study location 241.1
Name: Lake Corson Building
Address: 301 N. Lake Avenue, Pasadena, CA 91101
Data collection date: Tuesday, May 12, 2015

This 10-story office building is located about one mile east of downtown Pasadena at the intersection of Lake Avenue (a street of office, retail and restaurant uses) and I-210. The Metrorail Green Line passes the site running in the median of I-210 with a station approximately 350 feet from the building's entrance. Several bus routes also serve the building. The building has more parking (almost all underground) than it currently uses for tenants and visitors and there are also some short-term metered and unmetered parking curb spaces within walking distance. The building has a small first-floor deli open in the morning through mid-day, which serves the building but few outside customers. Numerous restaurants, other office buildings, and some retail are available close by to meet most mid-day employee needs. This building's tenants include a firm of investment advisors, medical offices, and several law offices, which may have affected peak hour trip generation peaking. There are also several apartment and condominium buildings nearby. Pedestrian volumes along sidewalks in the vicinity of this building are moderate.

Site Information

ITE Land Use Code	710
ITE Area Type	4
Building size	208,303 gsf
On-site parking spaces	650
On-site parking cost	$1.25/hr
Average building setback distance	14 ft
Curb parking spaces within 0.1-mile	30
Metered curb parking rate	0
Residential population within ½-mile	11,893
Jobs within ½-mile	12,548
Distance to regional CBD	10 mi
Closest bicycle facility	None
PM peak-hour bus stops within a ¼-mile, straight-line radius	9
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	17
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0.07
Site within 1 mile of major university	No
Walk scores	-

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	148	91	120	87
Walk	6	4	9	6
Public transit	7	4	8	6
Bicycle	1	1	1	1
Total	162	100	138	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.09	1.08	1.06	1.09
Vehicle trips	136	112	311	284
ITE source			710 equ.	710 equ.

Study location 242.1
Name: NoHo 14 Apartment Building
Address: 5440 Tujunga Avenue, North Hollywood, CA 91610
Data collection date: Wednesday, May 20, 2015

This 14-story apartment building is located along Lankershim Boulevard in North Hollywood, about 11 miles northwest of downtown Los Angeles. The nearby area has a mix of apartment and office buildings, restaurants, convenience retail, and other uses. The outer end station of the Metrorail Red Line and inner end station of the Orange BRT Line (extension of the Red Line) is across the street from NoHo 14. Several bus routes also serve NoHo 14 at stops adjacent to the rail station or in an off-street bus transfer center. A major park-and-ride lot is also next to the rail station. Resident parking is available in an on-site garage and is more than adequate to meet demand. Visitor parking is available in metered curb spaces in blocks adjacent to NoHo 14. The area is quite walkable although crossing Lankershim Boulevard can be time-consuming. Pedestrian volumes near NoHo 14 are generally fairly light except around the transit facilities where they are moderate to moderately heavy depending on the time-of-day. Pedestrian volumes become somewhat more substantial a few blocks to the south where most of the complementary uses are situated.

Site Information

ITE Land Use Code	222
ITE Area Type	3
Building size	180 DU
On-site parking spaces	360
On-site parking cost	0
Average building setback distance	3 ft
Curb parking spaces within 0.1-mile	149*
Metered curb parking rate	$1.00/hr
Residential population within ½-mile	12,082
Jobs within ½-mile	4,262
Distance to regional CBD	11 mi
Closest bicycle facility	1,000 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	9
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	55
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk score	87

* 16 metered spaces plus 133 free spaces.

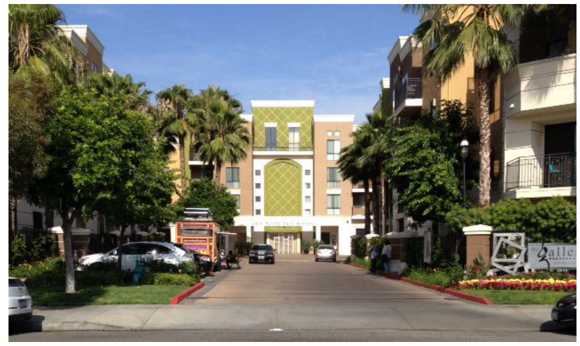
Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	49	72	84	77
Walk	13	20	17	15
Public transit	3	4	5	5
Bicycle	3	4	3	2
Total	68	100	109	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.15	1.28	1.11	1.18
Vehicle trips	42	66	53	68
ITE source			222 equ.	222 equ.

Study location 243.1
Name: Gallery at NoHo Commons Apartment Building
Address: 5416 Fair Avenue, North Hollywood, CA 91601
Data collection date: Wednesday, May 13, 2015



This apartment building is located about 11 miles northwest of downtown Los Angeles and adjacent to the North Hollywood Metrorail Red Line Station and park-and-ride lot and two walking blocks from the Orange Line BRT Station and a bus transfer center. NoHo Commons is a long block away from Lankershim Boulevard, which is flanked by a mixture of apartment and office buildings, restaurants, convenience retail, and other uses. Much of the other nearby development ranges from single- and multiple-family residential to retail, educational, and industrial uses.

Resident and visitor parking are available in two on-site garages that are more than adequate to meet demand. The area is walkable, but has limited pedestrian amenities in the immediate vicinity of NoHo Commons, but more attractive along and adjacent to Lankershim Boulevard. Pedestrian volumes are light in front of NoHo Commons but moderate to moderately heavy along Lankershim at the transit facilities and to the south where most complementary uses are located.

Site Information

ITE Land Use Code	223
ITE Area Type	3
Building size	438 DU
On-site parking spaces	850
On-site parking cost	0
Average building setback distance	70 ft
Curb parking spaces within 0.1-mile	103*
Metered curb parking rate	$1.00/hr
Residential population within ½-mile	13,424
Jobs within ½-mile	5,601
Distance to regional CBD	11 mi
Closest bicycle facility	360 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	6
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	55
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk score	90

* 12 metered spaces plus 12 free spaces.

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	179	78	193	75
Walk	22	10	35	14
Public transit	28	12	28	11
Bicycle	0	0	0	0
Total	229	100	256	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.20	1.32	1.11	1.18
Vehicle trips	150	146	210	249
ITE source			220 equ.	220 equ.

Study location 244.1
Name: The Academy Office Building
Address: 5200 Lankershim Blvd., North Hollywood, CA 91601
Data collection date: Tuesday, May 19, 2015

This 8-story office building is located along Lankershim Boulevard in North Hollywood, about 11 miles northwest of downtown Los Angeles. The building has a few ground floor non-office tenants, all of which were excluded from this survey. The adjacent area along Lankershim Boulevard has a mixture of office buildings, restaurants, convenience retail, and other uses. Several apartment complexes are nearby. The outer end station of the Metrorail Red Line and inner end station of the Orange BRT Line (an extension of the Red Line) are three blocks north. Several bus routes also serve the area with stops adjacent to the rail station, an adjacent off-street bus transfer center, and bus stops along Lankershim. Parking for tenants and visitors is provided in an on-site garage, which has plenty of parking to meet demands. The area is quite walkable. Pedestrian volumes near the site are generally moderate except around the transit facilities where they are moderate to moderately heavy depending on the time-of-day.

Site Information

ITE Land Use Code	710
ITE Area Type	4
Building size	157,000 gsf
On-site parking spaces	550
On-site parking cost	$1.50/15 min
Average building setback distance	50 ft
Curb parking spaces within 0.1-mile	71
Metered curb parking rate	$1.00/hr
Residential population within ½-mile	13,577
Jobs within ½-mile	5,006
Distance to regional CBD	11 mi
Closest bicycle facility	680 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	8
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	55
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk scores	-

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	136	82	109	84
Walk	5		6	5
Public transit	25	15	14	11
Bicycle	0	0	0	0
Total	166	100	129	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.11	1.17	1.06	1.09
Vehicle trips	124	93	270	251
ITE source			710 equ.	710 equ.

Study location 245.1
Name: Lankershim Plaza Office Building
Address: 5250 Lankershim Boulevard, North Hollywood, CA 91601
Data collection date: Wednesday, May 20, 2015

This 9-story office building is located along Lankershim Boulevard in North Hollywood, about 11 miles northwest of downtown Los Angeles. Building tenants include a culinary and art school, which takes up two floors. The adjacent area along Lankershim has a mixture of office buildings, restaurants, convenience retail, and other uses. Several apartment complexes are nearby. The outer end station of the Metrorail Red Line and inner end station of the Orange BRT Line (an extension of the Red Line) are two blocks north. Several bus routes also serve the area with stops adjacent to the rail station, an adjacent off-street bus transfer center, and bus stops along Lankershim. Parking for tenants and visitors is provided in an on-site garage, which has plenty of parking to meet demands. The area is quite walkable. Pedestrian volumes north of the site are generally light to moderate except around the transit facilities where they are moderate to moderately heavy depending on the time-of-day. Pedestrian volumes become more substantial adjacent to, and south of, the site where most of the complementary uses are situated.

Site Information

ITE Land Use Code	710
ITE Area Type	4
Building size	179,460 gsf
On-site parking spaces	723
On-site parking cost	$2.00/hr
Average building setback distance	100 ft
Curb parking spaces within 0.1-mile	126*
Metered curb parking rate	$1.00/hr
Residential population within ½-mile	13,183
Jobs within ½-mile	5,196
Distance to regional CBD	11 mi
Closest bicycle facility	1,150 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	8
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	55
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk scores	-

* 104 metered spaces plus 22 free spaces.

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	235	78	362	75
Walk	25	8	51	11
Public transit	40	13	66	14
Bicycle	2	1	6	1
Total	302	100	485	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.16	1.19	1.06	1.09
Vehicle trips	203	304	306	279
ITE source			710 equ.	710 equ.

Study location 246.1
Name: AMLI Warner Center Apartments
Address: 21200 Kittridge Street, Woodland Hills, CA 91303
Data collection date: Tuesday, May 19, 2015

This apartment development is located in Woodland Hills about 22 miles northwest of downtown Los Angeles. The site is flanked to the northeast by apartment buildings and other residential, educational, and commercial uses. Immediately adjacent to the site to the southwest is a BRT station, but there is no direct access. Walking distance to the station is ⅔-mile from the main entrance. Beyond the station are office buildings, retail, and other commercial, none of it conveniently walkable from AMLI Warner Center. Site parking is plentiful for residents in three parking garages. Limited visitor parking is available on-site, but free curb parking is plentiful nearby.

Site Information

ITE Land Use Code	223
ITE Area Type	6
Building size	522 DU
On-site parking spaces	1,212
On-site parking cost	0
Average building setback distance	10 ft
Curb parking spaces within 0.1-mile	97*
Metered curb parking rate	0
Residential population within ½-mile	8,353
Jobs within ½-mile	9,573
Distance to regional CBD	22 mi
Closest bicycle facility	470 ft**
PM peak-hour bus stops within a ¼-mile, straight-line radius	7
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	55
PM peak-hour rail transit stops within a ½-mile, straight-line radius	0
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk score	56

* All free parking.
** Straight-line distance misleading; walk distance is about 1,950 feet.

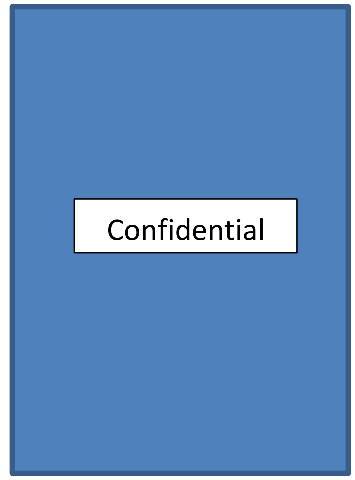
Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	267	94	225	91
Walk	10	4	12	5
Public transit	5	2	10	4
Bicycle	1	0	0	0
Total	283	100	247	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.18	1.24	1.11	1.18
Vehicle trips	227	182	244	288
ITE source			220 equ.	220 equ.

Study location 247.1
Name: Confidential Office Building
Address: Metropolitan Los Angeles
Data collection date: Thursday, May 14, 2015



This office building is situated outside of central Los Angeles but is served by a station along a Metrorail line and several bus routes. There are hotels, some convenience retail, and restaurant uses within walking distance as well as other office space with tenants that interact with tenants of the site. The immediate vicinity is moderately walkable; pedestrian volumes are moderately low. The building's parking had surplus parking at the time of the survey, in fact some garage spaces were being rented out for storage.

Site Information

ITE Land Use Code	710
ITE Area Type	7
Building size	NA
Occupied square feet	511,000 gsf
On-site parking spaces	2,000
On-site parking cost	$1.25/15 min
Average building setback distance	100 ft
Curb parking spaces within 0.1-mile	None
Metered curb parking rate	0
Residential population within ½-mile	3,560
Jobs within ½-mile	26,091
Distance to regional CBD	9 mi
Closest bicycle facility	None
PM peak-hour bus stops within a ¼-mile, straight-line radius	9
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	31
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk scores	-

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	535	86	533	87
Walk	31	5	47	8
Public transit	47	8	32	5
Bicycle	7	1	3	0
Total	620	100	615	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.28	1.39	1.06	1.09
Vehicle trips	418	384	706	651
ITE source			710 equ.	710 equ.

Study location 248.1
Name: Alterra at Grossmont Trolley Apartments
Address: 8707-8747 Fletcher Parkway, La Mesa, San Diego, CA 91942
Data collection date: Tuesday, September 29, 2015

This apartment development is located in the Mission Valley and I-8 corridor about 10 miles northeast of downtown San Diego. This development is immediately adjacent to the San Diego Trolley's Grossmont Station, which is on both the Green and Orange Lines. That station also is a stop on two bus routes. The immediate vicinity has additional apartment buildings (including the twin Pravada at Grossmont Trolley), a medical center, an office building, two major shopping centers, and several restaurants. Both Alterra and Pravada (see separate description) were developed as joint projects — one as a shopping center and the other as an office building, with extra parking provided at Alterra and Pravada for transit riders, shopping center restaurants, and office building employees. Resident parking is provided in the on-site garage, which is physically separated from parking for off-site uses. Visitor parking is provided in the same garage as off-site uses, but in designated locations; access from visitor parking to Alterra was isolated for this survey. The survey excluded trips related to vehicles associated with those off-site buildings. Walking to adjacent complementary land uses is convenient for Alterra trips as a result of internal elevators that provide access to entrances at the trolley station and street levels.

Site Information

ITE Land Use Code	223
ITE Area Type	3
Building size	297 DU
On-site parking spaces	430
On-site parking cost	0
Average building setback distance	20 ft
Curb parking spaces within 0.1-mile	4
Metered curb parking rate	0
Residential population within ½-mile	4,295
Jobs within ½-mile	8,535
Distance to regional CBD	10 mi
Closest bicycle facility	80 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	3
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	8
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk score	67

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	89	63	113	55
Walk	19	13	55	26
Public transit	33	23	38	18
Bicycle	0	0	2	1
Total	141	100	208	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.14	1.37	1.11	1.18
Vehicle trips	79	83	144	175
ITE source			220 equ.	220 equ.

Study location 249.1
Name: Pravada at Grossmont Trolley Apartments
Address: 8625 Fletcher Parkway, La Mesa, CA 91942
Data collection date: Tuesday, September 29, 2015

This apartment development is located in the Mission Valley and I-8 corridor about 10 miles northeast of downtown San Diego. This development is immediately adjacent to the San Diego Trolley's Grossmont Station, which is on both the Green and Orange Lines. That station also is a stop on two bus routes. The immediate vicinity has additional apartment buildings (including the twin Alterra at Grossmont Trolley), a medical center, an office building, two major shopping centers, and several restaurants. Both Pravada and Alterra (see separate description) were developed as joint projects — one as a shopping center and the other as an office building, with extra parking provided at Pravada and Alterra for transit riders, restaurants in the shopping center, and office building employees. Resident parking is provided in the on-site garage, which is physically separated from parking for off-site uses. Visitor parking is provided in the same garage as off-site uses, but in designated locations; access from visitor parking to Pravada could be isolated for this survey. The survey for this project excluded trips related to vehicles associated with those off-site buildings. Walking to adjacent complementary land uses is convenient for Pravada trips as a result of internal elevators that provide access to entrances at the trolley station and street levels.

Site Information

ITE Land Use Code	223
ITE Area Type	3
Building size	230 DU
On-site parking spaces	412
On-site parking cost	0
Average building setback distance	12 ft
Curb parking spaces within 0.1-mile	0
Metered curb parking rate	0
Residential population within ½-mile	4,241
Jobs within ½-mile	8,960
Distance to regional CBD	10 mi
Closest bicycle facility	85 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	3
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	8
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0
Site within 1 mile of major university	No
Walk score	67

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	87	64	104	67
Walk	14	10	24	16
Public transit	34	25	27	17
Bicycle	2	1	0	0
Total	137	100	155	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.21	1.30	1.11	1.18
Vehicle trips	73	80	115	142
ITE source			220 equ.	220 equ.

Study location 250.1
Name: Hazard Center Office Tower
Address: 7676 Hazard Center Drive, San Diego, CA 92108
Data collection date: Wednesday, September 30, 2015

This 15-story office building is located about four miles north of downtown San Diego along the I-8 corridor that runs through Mission Valley. The building is directly across the street from the San Diego Trolley Green Line Hazard Center Station. The building is part of a mixed-use development that also has a shopping center with several restaurants (described separately as a survey site) and a hotel. All uses share the same parking except the hotel, which has some of its own along with some in the retail center area. Adjacent blocks have shopping center and multi-family residential uses. Additionally, within convenient walking distance are more of the same plus some office. The office building has access to all parking levels.

Parking is provided on three levels, one of which is the top or plaza level – the main retail level. Two other levels are below the plaza level. Vehicular access is available to the plaza level from one side of the site and to the middle level from a second side. During the survey periods it appeared that overall parking was adequate. Pedestrian volumes were heavy within Hazard Center, but moderately light along adjacent streets.

Site Information

ITE Land Use Code	710
ITE Area Type	4
Building size	283,000 gsf
On-site parking spaces	2,054*
On-site parking cost	0
Average building setback distance	95 ft
Curb parking spaces within 0.1-mile	10
Metered curb parking rate	0
Residential population within ½-mile	3,402
Jobs within ½-mile	8,600
Distance to regional CBD	4 mi
Closest bicycle facility	400 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	2
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	11
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0.40
Site within 1 mile of major university	No
Walk scores	-

* Shared with surrounding shopping center.

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	326	88	346	90
Walk	32	9	19	5
Public transit	10	3	19	5
Bicycle	0	0	1	0
Total	368	100	385	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.13	1.21	1.06	1.09
Vehicle trips	288	287	415	373
ITE source			710 equ.	710 equ.

Study location 250.2
Name: Hazard Center Shopping Center
Address: 7610 Hazard Center Drive, San Diego, CA 92108
Data collection date: Wednesday, September 30, 2015

The Hazard Center shopping center is located about four miles north of downtown San Diego along the I-8 corridor in Mission Valley. The building is directly across the street from the San Diego Trolley Green Line Hazard Center Station. The shopping center is part of a mixed-use development that includes an office building (described separately as a survey site) and a hotel. All uses share the same parking except the hotel which has some of its own along with some in the retail center area. Convenient pedestrian access is provided to all parking levels. Adjacent blocks consist of shopping center and multiple-family residential uses. Additionally, within convenient walking distance are more of the same plus some office.

Parking is provided on three levels, one of which is the top or plaza level – the main retail level. Two other levels are below the plaza level. Vehicular access is available to the plaza level from one side of the site and to the middle level from a second side. During the survey periods it appeared that overall parking was adequate. Pedestrian volumes were heavy within Hazard Center, but moderately light along adjacent streets.

Site Information

ITE Land Use Code	820
ITE Area Type	4
Building size	137,064 gsf
On-site parking spaces	2,054*
On-site parking cost	0
Average building setback distance	50 ft
Curb parking spaces within 0.1-mile	10
Metered curb parking rate	0
Residential population within ½-mile	3,402
Jobs within ½-mile	8,600
Distance to regional CBD	4 mi
Closest bicycle facility	350 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	2
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	11
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0.40
Site within 1 mile of major university	No
Walk scores	-

* Shared with on-site office building,

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	301	77	867	92
Walk	69	18	43	5
Public transit	20	5	29	3
Bicycle	3	1	2	0
Total	393	100	941	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.05	1.30	-	-
Vehicle trips	285	667	176	684
ITE source			820 equ.	820 equ.

Study location 251.1
Name: Mission City Corporate Center
Address: 2355, 2365, 2375, 2385 Northside Drive, San Diego, CA 92108
Data collection date: Thursday, October 1, 2015

This development consists of four office buildings that share two parking garages and a small amount of surface parking on a densely-developed site. It is located along the I-8 corridor in Mission Valley and is approximately 5 miles from downtown San Diego. It is also along the San Diego Trolley Green Line, about ⅓-mile from the Fenton Parkway Station. The station is conveniently reached by walking through a shopping center that extends between the site and the trolley station.

Adjacent development includes a major shopping center, multiple-family residential, restaurants, and the San Diego Chargers (Qualcomm) football stadium. Pedestrian volumes in the area close to the site are focused mainly on the shopping center and trolley station.

Site Information

ITE Land Use Code	710
ITE Area Type	3
Building size	291,000 gsf
On-site parking spaces	1,750
On-site parking cost	$1.00/hr
Average building setback distance	185 ft
Curb parking spaces within 0.1-mile	20
Metered curb parking rate	0
Residential population within ½-mile	3,632
Jobs within ½-mile	2,519
Distance to regional CBD	5 mi
Closest bicycle facility	550 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	0
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	0
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0.05
Site within 1 mile of major university	No
Walk scores	-

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	330	93	361	94
Walk	20	6	18	5
Public transit	4	1	5	1
Bicycle	1	0	2	1
Total	355	100	386	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.05	1.05	1.06	1.09
Vehicle trips	314	342	424	382
ITE source			710 equ.	710 equ.

Study location 252.1
Name: Rio San Diego Plaza
Address: 8954 Rio San Diego Drive and 2275 Rio Bonita Way, San Diego, CA 92108
Data collection date: Wednesday, September 30, 2015

This site includes two office buildings that share parking. It is located along the I-8 corridor in Mission Valley and is about 4½ miles from downtown San Diego. It is also along the San Diego Trolley Green Line, about ⅓-mile from the Rio Vista Station. A multipurpose path (pedestrian, bicycle) runs along the trolley line from a point about 700 feet directly south of Rio San Diego Plaza to the Rio Vista Station. Most adjacent development is office and apartments, but a shopping center, a hotel, and a few sandwich shops and restaurants are within convenient walking distance. Parking at Rio San Diego Plaza was well in excess of demand during the survey periods.

Site Information

ITE Land Use Code	710
ITE Area Type	4
Building size	278,096 gsf
On-site parking spaces	917
On-site parking cost	0
Average building setback distance	15 ft
Curb parking spaces within 0.1-mile	129
Metered curb parking rate	0
Residential population within ½-mile	3,065
Jobs within ½-mile	8,618
Distance to regional CBD	5 miles
Closest bicycle facility	370 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	0
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	0
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0.80
Site within 1 mile of major university	No
Walk scores	-

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	310	93	341	94
Walk	21	6	17	5
Public transit	4	1	5	1
Bicycle	0	0	0	0
Total	335	100	363	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.08	1.08	1.06	1.09
Vehicle trips	288	314	363	328
ITE source			710 equ.	710 equ.

Study location 253.1
Name: Rio Vista Plaza
Address: 8885, 8889, 8989, 9095 Rio San Diego Drive, San Diego, CA 92108
Data collection date: Thursday, October 1, 2105

This site is located along the I-8 corridor in Mission Valley and is about 4½ miles from downtown San Diego. It is also along the San Diego Trolley Green Line, about ¼-mile from the Rio Vista Station. A multipurpose path (pedestrian, bicycle) runs along the trolley line from a point about 700 feet directly south of Rio San Diego Plaza to the Rio Vista Station. This site includes four office buildings that share parking. An adjacent hotel that was once part of the original development (later sold off as a separate property) also shares some site parking. However, the hotel trips and parking were excluded from the survey data.

Most adjacent development is office and apartments, but a shopping center, the hotel, and a few sandwich shops and restaurants are within convenient walking distance. Parking at Rio Vista Plaza, with the building occupancy as it was at survey time, was well in excess of demand during the survey periods.

Site Information

ITE Land Use Code	710
ITE Area Type	4
Building size	297,000 gsf
On-site parking spaces	802
On-site parking cost	0
Average building setback distance	270 ft
Curb parking spaces within 0.1-mile	217
Metered curb parking rate	0
Residential population within ½-mile	2,896
Jobs within ½-mile	9,541
Distance to regional CBD	5 mi
Closest bicycle facility	980 ft
PM peak-hour bus stops within a ¼-mile, straight-line radius	0
PM peak-hour ***buses stopping*** within a ¼-mile, straight-line radius	0
PM peak-hour rail transit stops within a ½-mile, straight-line radius	1
Site area covered by surface parking lots	0.70
Site within 1 mile of major university	No
Walk scores	-

Peak Hour Person Trip Generation

	AM		PM	
Mode	Trips	Percent	Trips	Percent
Personal vehicle	332	85	392	88
Walk	39	10	39	9
Public transit	18	4	14	3
Bicycle	2	1	2	0
Total	391	100	447	100

Peak Hour Vehicle Trip Generation

	Actual		ITE Estimate	
	AM	PM	AM	PM
Vehicle occupancy	1.05	1.07	1.06	1.09
Vehicle trips	317	367	375	338
ITE source			710 equ.	710 equ.