City of Los Angeles VMT Calculator Documentation

Version 1.3

Los Angeles Department of Transportation (LADOT) and
Los Angeles Department of City Planning (DCP)

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Chapter 1. Executive Summary

The City of Los Angeles Vehicle Miles Traveled (VMT) Calculator was developed to estimate project-specific daily household VMT per capita and daily work VMT per employee metrics for land use development projects. This tool is intended to be used for development projects within the City of Los Angeles, and the VMT methodology and impact thresholds are tailored to the City of Los Angeles *Transportation Assessment Guidelines* (TAG). The tool also applies the screening criteria described in the TAG for determining whether a VMT analysis is required for a project

The VMT Calculator is intended for evaluation of residential and office projects in accordance with the TAG and reports daily vehicle trips, daily VMT, daily household VMT per capita, and daily work VMT per employee. It is not intended for evaluation of regional-serving retail projects; the TAG should be consulted for methods to evaluate regional-serving retail projects, entertainment projects, or event centers. This document describes the methodology for how vehicle trips and VMT are calculated in the tool and how transportation demand management (TDM) strategies are applied to reduce vehicle trips and VMT estimates from the Calculator. The tool is divided into the following four sections.

1.1 Project Information

The project information section of the tool allows users to enter the project name, location and land use mix. The tool relies on the City of Los Angeles geocoder to find the location of the project's address. The latitude and longitude are passed to a lookup function in the tool to define more detailed information about the surrounding land uses, travel characteristics, built environment, and trip lengths. The lookup information is obtained from the City of Los Angeles Travel Demand Forecasting (TDF) Model and the City of Los Angeles Travel Behavior Zones (TBZ).

This is also the section of the tool that allows the user to enter their project information. This includes entering the type and quantity of existing land use(s) to be removed by the project and the proposed project land use(s). The tool provides information for 32 distinct land uses. It also provides the option to submit custom land use information if the project proposes a land use category not included in the tool.

1.2 Base Vehicle Trips and VMT Calculations

After the user enters the project location and land use information, the tool estimates base daily vehicle trip generation and daily VMT. The base trip generation is primarily based on the Institute of Transportation Engineers' (ITE's) *Trip Generation, 9th Edition* manual. However, there are a few land uses that rely on other sources for trip generation information.

The base trip generation estimate is adjusted in this step using the MXD methodology. This methodology relies on socio-demographic and built environment factors of the project's surroundings. These factors include the following information which is provided in the first step of the model:

- **The relative numbers of residents and jobs** – the better the site's jobs/housing balance, the greater the proportion of commute trips that remain internal.
- **The density of development** – the greater the concentration of dwellings and commercial space per acre, the greater the likelihood that the interacting land uses will be near enough together to encourage walking or short-distance internal driving.
- **The connectivity for walking or driving among different activities** – measured in terms of the ratio of intersections to total land area within one mile directly influences trip internalization and the number of trips made by walking instead of driving. An example of this is an area like Koreatown which has a higher intersection density versus Toluca Lake which has a lower intersection density. Walking or biking to destinations in Koreatown is easier because the street grid is more connected, making short trips easier than in Toluca Lake where a more circuitous route is needed to reach a destination.
- **The availability of transit** – the greater the number of jobs within a reasonable travel time via transit, the greater the share of travel likely to occur by transit, and the lower the vehicular traffic generation. An example of this is someone who lives close to the Metro Red Line and has access to many jobs via transit versus someone living in an area less well served by transit who has limited access to jobs via transit and will be more likely to drive.
- **The number of convenient trip destinations within the immediate area** – the number of retail and other jobs in neighborhoods immediately surrounding the site increases the amount of walking to/from the site and reduces traffic generation.
- **Vehicle ownership** – a higher number of cars available per household increases the likelihood that trips will use a vehicle instead of taking other modes.

- **Household Size –** as the size of the household increases, more trips are made by the household.

1.3 Transportation Demand Management Strategies

The Transportation Demand Management (TDM) Strategies section of the VMT Calculator includes a series of VMT reduction strategies that the user defines for the proposed project and for the proposed project with applied mitigation measures. Many TDM strategies were explored for this section, but the tool only includes strategies that have empirical evidence documenting their potential to reduce VMT. The seven categories from which users can select strategies include:

1. **Parking**: Reducing, unbundling, permitting, pricing parking.
2. **Transit**: Transit subsidies, reduced headways, neighborhood shuttles.
3. **Education & Encouragement**: Travel behavior change program, promotions/marketing.
4. **Commute Trip Reductions**: Required commute trip reduction program, alternative work schedules and telecommuting, vanpool, ride-share.
5. **Shared Mobility**: Car-share, bike share, school carpool program.
6. **Bicycle Infrastructure**: On-street bike facilities, bike parking, bike facilities, showers.
7. **Neighborhood Enhancement**: Traffic calming, pedestrian network improvements.

1.4 Reporting

Vehicle trip and VMT reporting is tailored to the City of Los Angeles guidelines and impact criteria. The VMT Calculator reports daily vehicle trips, daily VMT, daily household VMT per capita, and daily work VMT per employee. The trips and VMT are reported for the proposed project and for the project with mitigation measures. The VMT for the project and the VMT for the project with mitigation are also compared against the City's thresholds for household VMT per capita and work VMT per employee. In addition to the summary reporting, the VMT Calculator also provides the following four detailed reports:

1. **Project & Analysis Overview**: Documents the inputs and outputs of the tool for the specified project.
2. **TDM Inputs**: Provides a breakdown of the TDM measures that were selected for the project.

3. **TDM Outputs**: Reports the VMT reductions associated with the TDM measures selected.
4. **MXD Methodology**: Reports the VMT reductions associated with the mix of land uses in the project and the demographics and built form of the surrounding area.

Chapter 2. Project Information

2.1 Address Lookup

The address lookup uses the LA City Geocoder to find the latitude and longitude of the project address. Users may also enter the latitude and longitude if they have information that is more accurate than the geocoder.

As discussed further in Section 3.2.3, the VMT Calculator uses a project's latitude and longitude to look up various information from the City of Los Angeles Travel Demand Forecasting Model. The address lookup also determines within which Travel Behavior Zone the project is located. TBZs are classified as one of the following four uses:

1. **Suburban (Zone 1):** Very low-density development primarily centered around single-family homes and minimally connected street network.
2. **Suburban Center (Zone 2):** Low-density developments with a mix of residential and commercial uses with larger blocks and lower intersection density.
3. **Compact Infill (Zone 3):** Higher density neighborhoods that include multi-story buildings and well connected streets.
4. **Urban (Zone 4):** High-density neighborhoods characterized by multi-story buildings with a dense road network.

A detailed description of the TBZ development and a map of the TBZ system is shown in **Appendix A**.

2.2 Land Use Type

The land use categories included in the VMT Calculator tool are based on the land uses identified in the *ITE Trip Generation* manual (except where otherwise identified in Section 3.1). The following land uses are included in the VMT Calculator:

- Single family residential
- Multi-family residential
- Townhouse
- Affordable housing

    - Family
    - Senior
    - Special Needs
    - Permanent Supportive
- Hotel
- Motel
- General retail
- Furniture store
- Pharmacy/drugstore
- Supermarket
- Bank
- Health club
- High-turnover sit-down restaurant
- Fast-food restaurant
- Quality restaurant
- Auto repair
- Home improvement superstore
- Free-standing discount store
- Movie theater
- General office
- Medical office
- Light industrial
- Manufacturing
- Warehouse
- University
- High school
- Middle school
- Elementary school
- Private school (K-12)

Users can input custom land uses if the project does not fall within one of these pre-defined categories. The user will need to provide the following information about custom land uses:

- Define if the land use is a retail or non-retail land use.

- Define the number of residents and/or employees in the land use.
- Define the trip purpose split for productions and attractions from and to the land use. This information should be provided using the best available information about travel characteristics of similar land uses and/or using engineering judgement. The trip purpose splits in **Appendix E** can also be used as a reference.

Chapter 3. Base Vehicle Trips and VMT Calculations

The LA VMT calculator has three distinct steps to calculate base vehicle trips and VMT. These steps include:

1. Initial Trip Generation
2. Mixed-use (MXD) Trip Reductions and Travel Demand Model Lookup Values
3. Household VMT per Capita and Work VMT per Employee

3.1 Initial Trip Generation

All land uses utilize the average daily vehicle trip generation rates from the *ITE Trip Generation, 9th Edition* (Institute of Transportation Engineers, 2012) as a starting point[1]. These trip generation rates are shown in **Table 1** (note: this table also shows population or job factors per unit, which is explained further in Section 3.3). The following land uses are exceptions to this rule.

- High-Turnover Restaurants: Use the ITE 932 daily rate of 127.15 trips per thousand square feet for Suburban and Suburban Center TBZs. Urban and Compact Infill TBZs are reduced by one standard deviation (41.77 daily trips) to account for the increased amount of walking, biking, and transit trips in more dense environments.
- General Office: Use the ITE 710 Log Equation Ln(T) = 0.76 Ln(X) + 3.68 for office space above 206KSF and the average rate of 11.03 for office space at or below 206KSF.
- Affordable Housing: Uses a base average daily trip rate depending on the type of affordable housing:
    - Family: 4.16
    - Senior: 1.72
    - Special Needs: 1.49
    - Permanent Supportive 1.23

  These base rates are further reduced using MXD based on surrounding demographics and built environment factors. These rates were determined using observations of 42

[1] The LA VMT Calculator was under development prior to release of the 10th Edition of ITE's trip generation manual in late 2017. The VMT Calculator was validated to LA conditions based on the empirical counts conducted at market rate residential, affordable housing, office, and mixed-use sites in the City, regardless of the source of the rates used as a starting point.

affordable housing sites in the Los Angeles area. More information on the Affordable Housing rates can be found in **Appendix B**.

- Multi-Family Dwelling: Use 2002 Multi Family Trip Rates from the San Diego Association of Governments (SANDAG) of six trips per unit[2]. This Southern California based rate more closely matches rates that were observed in Los Angeles.

Table 1: Land Use and Trip Generation Base Assumptions

Land Use	Unit	ITE Code	Daily Vehicle Trip Rate [A]	Population/ Jobs Per Unit [B]
Single Family Residential	DU	210	9.52	3.15
Multi-Family Residential	DU	NA [C]	6.00	2.25
Townhouse	DU	230	5.81	2.25
Affordable Housing - Family	DU	NA [D]	4.16	3.14
Affordable Housing - Senior	DU	NA [D]	1.72	1.21
Affordable Housing - Special Needs	DU	NA [D]	1.49	1.85
Affordable Housing - Permanent Supportive	DU	NA [D]	1.23	1.12
General Retail	KSF	820	42.70	2.0
Furniture Store	KSF	890	5.06	0.75
Pharmacy/Drugstore	KSF	880	90.06	2.0
Supermarket	KSF	850	102.24	4.0
Bank	KSF	912	148.15	5.0
Health Club	KSF	492	32.93	1.0
High-Turnover Sit-Down Restaurant	KSF	932	127.15 [E]	4.0
Fast-Food Restaurant	KSF	932	127.15 [E]	6.7
Quality Restaurant	KSF	931	89.95	4.0
Auto Repair	KSF	942	26.80	1.0

[2] San Diego Association of Governments, *(Not So) Brief Guide of Vehicular Traffic Generation Rates for the San Diego Region*, April 2002.

Home Improvement Superstore	KSF	862	30.74	2.2
Free-Standing Discount Store	KSF	813	50.75	2.0
General Office	KSF	710	Log Equation [F]	4.0
Medical Office	KSF	720	36.13	3.0
Light Industrial	KSF	110	6.97	1.0
Manufacturing	KSF	140	3.82	0.5
Warehousing/Self-Storage	KSF	151	2.50	0.33
Hotel (including restaurant, facilities, etc.)	Rooms	310	8.17	0.5
Motel	Rooms	320	5.63	0.5
Movie Theater (Theater with Matinee)	Seats	444	0.70	0.02
University	Students	550	1.71	0.25
High School	Students	530	1.71	0.1
Middle School	Students	522	1.62	0.1
Elementary School	Students	520	1.29	0.1
Private School (K-12)	Students	534	2.48	0.15

A: Source: Institute of Transportation Engineers, *Trip Generation, 9th Edition*, 2012, except where otherwise noted.
B: See Section 3.4.
C: Multi-Family uses SANDAG 2002 Multi Family Trip Rates of 6 trips per unit.
D: These rates were determined from vehicle trip counts conducted at 42 affordable housing sites in the City of Los Angeles. Because these local data reflect conditions in Los Angeles more closely than ITE trip rates, the VMT Calculator applies an MXD multiplier to the base rate to improve the MXD model fit for affordable housing uses.
E: Uses the daily ITE 932 rate of 127.15 trips per thousand square feet for Suburban and Suburban Center TBZs. Urban and Compact Infill TBZs are reduced by one standard deviation (41.77 daily trips).
F: General Office uses the ITE 710 Log Equation when office space is of sufficient size (above 206 KSF). When the office space is at or below this size, and the log equation exceeds 11.03 trips per KSF, General Office uses the ITE average rate of 11.03 trips per KSF.

3.2 MXD Reductions

3.2.1 MXD Methodology

The ITE trip generation methodology is primarily based on data collected at suburban, single-use, freestanding sites. These defining characteristics limit ITE's applicability to mixed-use or multi-use development projects, and may not accurately estimate the project vehicle trip generation. In response to the limitations in the ITE methodology, and to provide a straightforward and empirically validated method of estimating vehicle trip generation at mixed-use developments,

the U.S. Environmental Protection Agency (EPA) sponsored a national study of the trip generation characteristics of multi-use sites. Travel survey data was gathered from 239 mixed-use developments (MXDs) in six major metropolitan regions and correlated with the characteristics of the sites and their surroundings. The findings indicate that the amount of external traffic generated is affected by a wide variety of factors, each pertaining to one or more of the following characteristics:

- **The relative numbers of residents and jobs** – the better the site jobs/housing balance, the greater the proportion of commute trips that remain internal.
- **The density of development** – the greater the concentration of dwellings and commercial space per acre, the greater the likelihood that the interacting land uses will be close enough together to encourage walking or short-distance internal driving.
- **The connectivity for walking or driving among different activities** – measured in terms of the ratio of intersections to total land area within one mile directly influences trip internalization and the number of trips made by walking instead of driving. Walking or biking to destinations in areas with a higher intersection density is easier because the street grid is more connected, making short trips easier than in areas with lower intersection density where a more circuitous route may be needed to reach a destination.
- **The availability of transit** – the greater the number of jobs within a reasonable travel time via transit, the greater the share of travel likely to occur by transit, and the lower the vehicular traffic generation. An example of this is someone who lives close to the Metro Red Line and has access to many jobs via transit versus someone living in an area less well served by transit who has limited access to jobs via transit and will be more likely to drive.
- **The number of convenient trip destinations within the immediate area** – the number of retail and other jobs in neighborhoods immediately surrounding the multi-use site increases the amount of walking to/from the site and reduces traffic generation.
- **Vehicle ownership** – a higher number of cars available per household increases the likelihood that trips will use a vehicle instead of other modes.
- **Household Size –** the number of people per household increases the amount of overall trips to a site.

These characteristics were related statistically to the trip behavior observed at the study development sites using hierarchical linear modeling (HLM) techniques. This quantified relationships between characteristics of the MXDs and the likelihood that trips generated by

those MXDs will stay internal and/or use modes of transportation other than the private vehicle. These statistical relationships produced equations, known as the EPA MXD model, that allows predicting external vehicle trip reduction as a function of the MXD characteristics. Applying the external vehicle trip reduction percentage to "raw trips", as predicted by ITE, produces an estimate for the number of vehicle trips traveling in or out of the site.

The MXD model has been approved for use by the EPA[3]. It has also been peer-reviewed in the American Society of Civil Engineers (ASCE) Journal of Urban Planning and Development[4], peer-reviewed in a 2012 Transportation Research Board (TRB) paper evaluating various smart growth trip generation methodologies[5], recommended by SANDAG for use on mixed-use smart growth developments[6], and has been used successfully in multiple certified environmental impact reports (EIRs) in California.

3.2.2 LA VMT Calculator MXD Refinements

The version of MXD used in the VMT Calculator was further refined to conditions local to Los Angeles to reflect survey information collected from 51 market rate sites and 42 affordable housing sites. The market rate sites include 24 residential, 10 office, and 17 mixed use sites. The key refinements that were made to the MXD model were adjusting which base trip generation rates, defined in **Table 1**, best match Los Angeles conditions. The MXD model was also refined to use transit mode split data and surrounding demographic data from the Los Angeles travel demand model, allowing the MXD model to be more sensitive to neighborhood characteristics.

3.2.3 Travel Demand Model Information

The VMT Calculator relies on information from the calibrated 2016 City of Los Angeles TDF Model to better calculate trip reductions using MXD. MXD applies vehicle trip reductions based on

[3] Trip Generation Tool for Mixed-Use Developments (2012). https://www.epa.gov/smartgrowth/smart-growth-tools#Transportation

[4] "Traffic Generated by Mixed-Use Developments—Six-Region Study Using Consistent Built Environmental Measures." Journal of Urban Planning and Development, 137(3), 248–261.

[5] Shafizadeh, Kevan et al. "Evaluation of the Operation and Accuracy of Available Smart Growth Trip Generation Methodologies for Use in California". Presented at 91st Annual Meeting of the Transportation Research Board, Washington, D.C., 2012

[6] SANDAG Smart Growth Trip Generation and Parking Study. http://www.sandag.org/index.asp?projectid=378&fuseaction=projects.detail

access to nearby destinations explained in Section 3.2.1. Below are key MXD inputs that are provided by the TDF Model by traffic analysis zone (TAZ).

1. Intersections per square mile
2. Population within one mile
3. Employment within one mile
4. Transit mode splits by trip purpose
5. Vehicles per household
6. Travel demand

3.2.4 Validation

The LA VMT Calculator was validated against data collected from 93 sites within Los Angeles for daily vehicle trip generation. These sites varied from large to small multi-family developments, office developments, mixed-use developments, and affordable housing developments. These sites were located in a variety of community types within Los Angeles. The specific project addresses and land use mixes that the model was validated against are found in **Appendix C**. Trip generation validation relied on driveway counts at each of these validation sites. **Table 2** shows the validation statistics of the LA VMT Calculator using the MXD methodology. These results are compared with the ITE trip generation rates for market rate sites. Affordable housing was not included as part of the ITE trip generation analysis. As the results show, the MXD methodology improves the trip generation estimates for the validation sites. A visualization of how the modeled trip generation compares to the driveway counts is shown in **Appendix D**.

Table 2: Daily Trip Generation Validation Statistics

Validation Sites	Average Model Error		Root-Mean Square Error (RMSE)		Correlation Coefficient	
	ITE	MXD	ITE	MXD	ITE	MXD
Market Rate Residential, Office, and Mixed-Use Sites	68%	12%	95%	57%	0.96	0. 97
Affordable Housing Sites	NA	3%	NA	40%	NA	0. 82

3.3 Vehicle Miles Traveled

The VMT Calculator uses trip length information from the TDF Model to calculate vehicle miles traveled. The Calculator divides the trip generation estimates into trip purposes (HBW, home-based other [HBO], and non-home-based [NHB] productions and attractions) using the trip purpose type splits in **Appendix E**. Trip lengths are obtained from the model by trip purpose for both trip productions and attractions for the TAZ in which a project is located. Trip lengths are also obtained and averaged for TAZs within ⅛ mile of the project address. These trip length values are multiplied by the vehicle trip generation by trip purpose and summed to determine total VMT, household VMT, and work VMT for a project.

3.4 Site Specific Population and Employment Assumptions

The City of Los Angeles VMT thresholds were developed based on household VMT per capita and work VMT per employee. Therefore, population and employment estimates are required to convert vehicle trips and VMT to a per capita/employee value. **Table 1** summarizes the population and employment factors utilized in the VMT Calculator to estimate a project's population and employment by land use type.

The population factors for single family households and multi-family households were derived from Census data for the City of Los Angeles[7]. The population factors for affordable housing uses were derived from data regarding the affordable housing sites observed within the City of Los Angeles as part of developing empirical trip generation rates and data from the City. The employment factors were derived from a variety of resources. These include Los Angeles Unified School District floor area per employee data[8], 2012 SANDAG Activity Based Model floor area per employee data, ITE trip generation rates per thousand square feet divided by the trip generation rates per employee, the US Department of Energy, and other modeling resources. A variety of sources were used because the land use categories in the VMT Calculator are generalized. Therefore, the employment rate for a specific land use in the Calculator may refer to an approximation of multiple similar land uses.

[7] United States Census Bureau, ACS 2015, 5-year estimates.
[8] Los Angeles Unified School District, *2012 Developer Fee Justification Study*, February 2012.

Chapter 4. Transportation Demand Management Strategies

The TDM section of the VMT Calculator allows application of TDM strategies both as project design features and as mitigation measures to reduce project VMT. These strategies are applied to the base trip generation and VMT calculations to reduce the total trips and VMT created by the project. The TDM strategies may be applied for the proposed project or for the project with mitigation measures. While many TDM strategies were explored, strategies were only included in the tool if they had empirical evidence documenting their potential to reduce vehicle travel. The TDM section has seven categories from which users can select strategies:

1. Parking
2. Transit
3. Education & encouragement
4. Commute trip reductions
5. Shared mobility
6. Bicycle infrastructure
7. Neighborhood enhancement

The effectiveness of each of the TDM strategies included in the VMT Calculator is based primarily on research documented in the 2010 California Air Pollution Control Officers Association (CAPCOA) publication, *Quantifying Greenhouse Gas Mitigation Measures* (CAPCOA, 2010). CAPCOA offers methodology based on preferred literature, along with methodology based on alternative literature, for each strategy. The strategies used in the VMT Calculator follow CAPCOA guidance by either directly applying the CAPCOA methodology, applying the alternative literature methodology, or adjusting the methodology offered by CAPCOA to account for local needs and departmental goals. Where more recent research (since 2010) or local empirical data are available, those methods have been used in place of the methodology outlined by CAPCOA.

To ensure the effectiveness of TDM strategies is not overstated, the VMT reductions in the VMT Calculator are both *dampened* and *capped*:

- **Dampening:** Within each type of trip (home-based work trip starting at the home end, for example), a multiplicative dampening formula is applied. For example, if both Strategy A

and Strategy B are applied, the combined effectiveness is not A+B, but rather 1-(1-A)*(1-B). This captures the reality that many people who would consider using Strategy B overlap with the potential market for Strategy A, and would choose A or B for each trip, but not both A and B.

- **Capping:** For the full set of strategies selected across all trip types, a place-type limit, or cap, is applied. The place-type is a pre-defined category based on land use characteristics of the location where the project is sited. Four place-types, or travel behavior zones (TBZs), have been developed by the City: Urban, Compact Infill, Suburban Center, and Suburban. Consistent with CAPCOA, for urban locations, the maximum VMT reduction that can be achieved by combining TDM strategies is 75%. For compact infill locations, the maximum is 40%. For suburban center locations, the maximum is 20%, and for suburban locations the maximum is 15%. These maximums are described and substantiated in CAPCOA. The TBZ system is illustrated in **Appendix A**.

More information regarding the TDM strategies available for selection in the VMT Calculator, including description and applicability of each strategy, methodology for estimating effectiveness of each strategy, and research sources supporting the effectiveness calculations, is provided in Attachment G to the City of Los Angeles *Transportation Assessment Guidelines*.

Chapter 5. Reporting

The VMT Calculator reports daily vehicle trips, daily VMT, daily household VMT per capita, and daily work VMT per employee. The trips and VMT are reported for the proposed project (including any TDM strategies selected as project design features) and for the project with TDM strategies selected as mitigation measures. Both the proposed project and the project with mitigation measures use the methodology explained in Chapter 3 and Chapter 4. These methodologies are combined to produce the final results. Below is a summary of how these outputs are calculated:

- **Daily Vehicle Trips**: Trip generation for HBW, HBO, and NHB productions and attractions to the project. These trips take into account reductions from the MXD model as well as reductions from selected TDM measures. The MXD and TDM reductions are sensitive to trip purposes and trip productions and attractions.
- **Daily Vehicle Miles Travel**: The daily trip generation described above is multiplied by the corresponding trip length for HBW, HBO, and NHB productions and attractions to the project derived from the TDF Model by TAZ.
- **Daily Household VMT per Capita**: The daily household VMT per capita is the home based production VMT from the MXD model combined with selected TDM strategies that reduce home based production VMT. This VMT is then divided by the number of people living within the project.
- **Daily Work VMT per Employee:** The daily work VMT per employee is the HBW attraction VMT from the MXD model combined with selected TDM strategies that reduce HBW attraction VMT. This VMT is then divided by the number of people working within the project.
- **Significant VMT Impact:** The daily household VMT per capita and daily work VMT per employee are compared with the City of Los Angeles VMT impact criteria by Area Planning Commission (APC). These targets are 15% below the APC average daily household VMT per capita and average daily work VMT per employee shown in the City of Los Angeles TAG. The project is then flagged if it has a significant VMT impact, both without and with the selected TDM mitigation measures.

In addition to the summary reporting mentioned above, the VMT Calculator also provides the following four detailed reports:

1. **Project & Analysis Overview:** Documents the inputs and outputs of the tool for the specified project. This includes the project land use, the total employees and population of the project, and the summary statistics mentioned above.
2. **TDM Inputs:** Provides a detailed breakdown of the TDM measures that were selected for the project. The user interface for the tool doesn't allow for the user to see all options at once. This report provides a complete summary of the TDM inputs for the project. These inputs are tabulated for both the proposed project and proposed project with mitigations.
3. **TDM Outputs:** Reports the VMT reductions associated with the TDM measures selected. These reductions are documented for both the proposed project and proposed project with mitigations. The VMT reductions are also reported by trip purpose. The individual TDM reductions are combined and capped for the maximum TDM effect associated with the project's place type.
4. **MXD Methodology :** Reports the VMT reductions associated with the mix of land uses in the project and the demographics and built form of the surrounding area. The MXD tab reports the VMT reductions by trip purpose for both the proposed project and the project with mitigation measures.

APPENDIX A

TRAVEL BEHAVIOR ZONES

TECHNICAL SUMMARY

Characterizing Travel Behavior Zones in Los Angeles

TRANSPORTATION IMPACT ANALYSIS REFORM

The City of Los Angeles is in the process of adopting project impact assessment methods based on vehicle miles traveled (VMT). The City aims to encourage reductions in greenhouse gas emissions, support multimodal transportation, and promote diverse infill development by reducing VMT. Projects estimated to generate VMT exceeding the City's thresholds of significance will be required to implement Transportation Demand Management (TDM) to reduce vehicle trips generated by the project, and thus, mitigate its impacts on the environment.

The effectiveness of TDM depends on the location efficiency of a proposed project's site, which is determined by the surrounding built environment and demographic context. Los Angeles comprises 469 square miles and is made up of diverse neighborhood typologies, from low density rural to high density urban communities. The City of Los Angeles developed a Travel Behavior Zone (TBZ) categorization method to help assign VMT and single-occupant vehicle trip reductions of TDM.

DEFINING TRAVEL BEHAVIOR ZONES

The Travel Behavior Zone (TBZ) Index is weighted composite value that captures built environment and demographic characteristics demonstrated to influence residents, employees, and visitors' propensity to use transit. The TBZ Index considers population density, daytime population density, land use diversity, intersection density, and distance from major Metro BRT/Rail stations and bus stops. First, the value for all six variables must be calculated for each Census Tract within the City, as defined in Table 1.

Table 1: Travel Behavior Zone Index Data Inputs

Variable	Definition	Data Source
Population Density	Number of people / land area in square feet	2015 American Community Survey 5-Year Estimate
Daytime Population Density	Number of people present during average weekday daytime hours / land area in square feet	Derived from Census Transportation Planning Products and 2013 ACS population estimates
Land Use Diversity Score[1]	Measure of diversity in land uses represented in an area. For this project, the mix measure considered five land use types: residential, retail (excluding region-serving or "big box" uses of 300,000 square feet or larger), entertainment (including restaurants), office, and institutional (including schools and community institutions)	Los Angeles County Assessor's Tax Roll, 2015
Intersection Density	Number of intersections / land area in square feet	Bureau of Engineering Street Centerline
Distance to nearest fixed guideway bus stop or station	Geodesic distance (in miles) between Census Tract centroid and nearest fixed guideway transit station or stop	Los Angeles County Metropolitan Transportation Authority (Metro)
Distance to nearest major bus stop	Geodesic distance (in miles) between Census Tract centroid and nearest major bus stop, as defined by Metro	Los Angeles County Metropolitan Transportation Authority (Metro)

[1] Brown, B. B., Yamada, I., Smith, K. R., Zick, C. D., Kowaleski-Jones, L., & Fan, J. "Mixed land use and walkability: Variations in land use measures and relationships with BMI, overweight, and obesity". *Health & Place*, 15(4), (2009) 1130-1141.

City of Los Angeles Department of Transportation | 100 S. Main Street, 9th Floor, Los Angeles, CA 90012 | ladot.lacity.org
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Next, the standard score, or z-score, is calculated for every Census Tract using the mean and standard deviation of each variable, to normalize the distribution of each variable's value based on the average value for each characteristic in the City. Table 2 features the mean and standard deviation values for each of the six variables included in the TBZ Index calculation.

Table 2: Travel Behavior Zone Index Variables Mean and S.D.

Variable	Mean	Standard
Population Density	$\mu = 0.000622$	$\sigma = 0.000547$
Daytime Population Density	$\mu = 0.000538$	$\sigma = 0.000496$
Land Use Diversity Score	$\mu = 0.490099$	$\sigma = 0.224065$
Intersection Density	$\mu = 0.000005$	$\sigma = 0.000002$
Distance to nearest fixed guideway bus stop or station	$\mu = 0.754328$	$\sigma = 0.792255$
Distance to nearest major bus stop	$\mu = 1.944587$	$\sigma = 1.99588$

Using the z-score value of each variable, the TBX Index Value is calculated for every Census Tract using the following equation:

> *Travel Behavior Zone Index Value = (0.25 * z-population density) + (0.25 * z-daytime population density) + (0.24 * z-land use diversity score) + (0.23 * z-intersection density) + (-0.5 * z-distance to nearest major BRT/Rail station) + (-0.25 * z-distance to nearest major bus stop)*

The equation assigns varying weight values to each z-score variable relative to its influence residents, employees, and visitors' propensity to use transit[2] and qualitative descriptions of place types VMT mitigation measures may be applied[3].

RESULTS

The average Travel Behavior Zone (TBZ) Index value is 0.057 and the standard deviation is 1.092. Figure 1 visualizes the almost normal distribution of TBZ Index values in the City and identifies the value of the breakpoints used to designate each TBZ type. Breakpoints were determined using the Jenks Natural method, which minimizes the difference within classes and maximizes the difference between classes. Designations range from Zone 1, equivalent to a neighborhood context with low population densities, homogenous land uses, low intersection density, and removed from frequent and regular transit service, to Zone 4, which describes an urban built environment with high population and employment densities, high street network connectivity, and access to transit. Areas where large employers owned and/or occupied the majority of the land area with no residential population were manually assigned a Zone 3 designation because centralized transportation demand management is anticipated to have high effectiveness on commuter trips at these campus-style contexts. Figure 2 is a map of TBZ designations within the City of Los Angeles.

[2] Ewing, Reid, and Robert Cervero. "Travel and the built environment: a meta-analysis." *Journal of the American planning association* 76, no. 3 (2010): 265-294.
[3] California Air Pollution Control Officers Association. "Quantifying Greenhouse Gas Mitigation Measures-A Resource for Local Government to Assess Emission Reductions from Greenhouse Gas Mitigation Measures." *Sacramento: CAPCOA* (2010): A-4, A-7 & A-8.

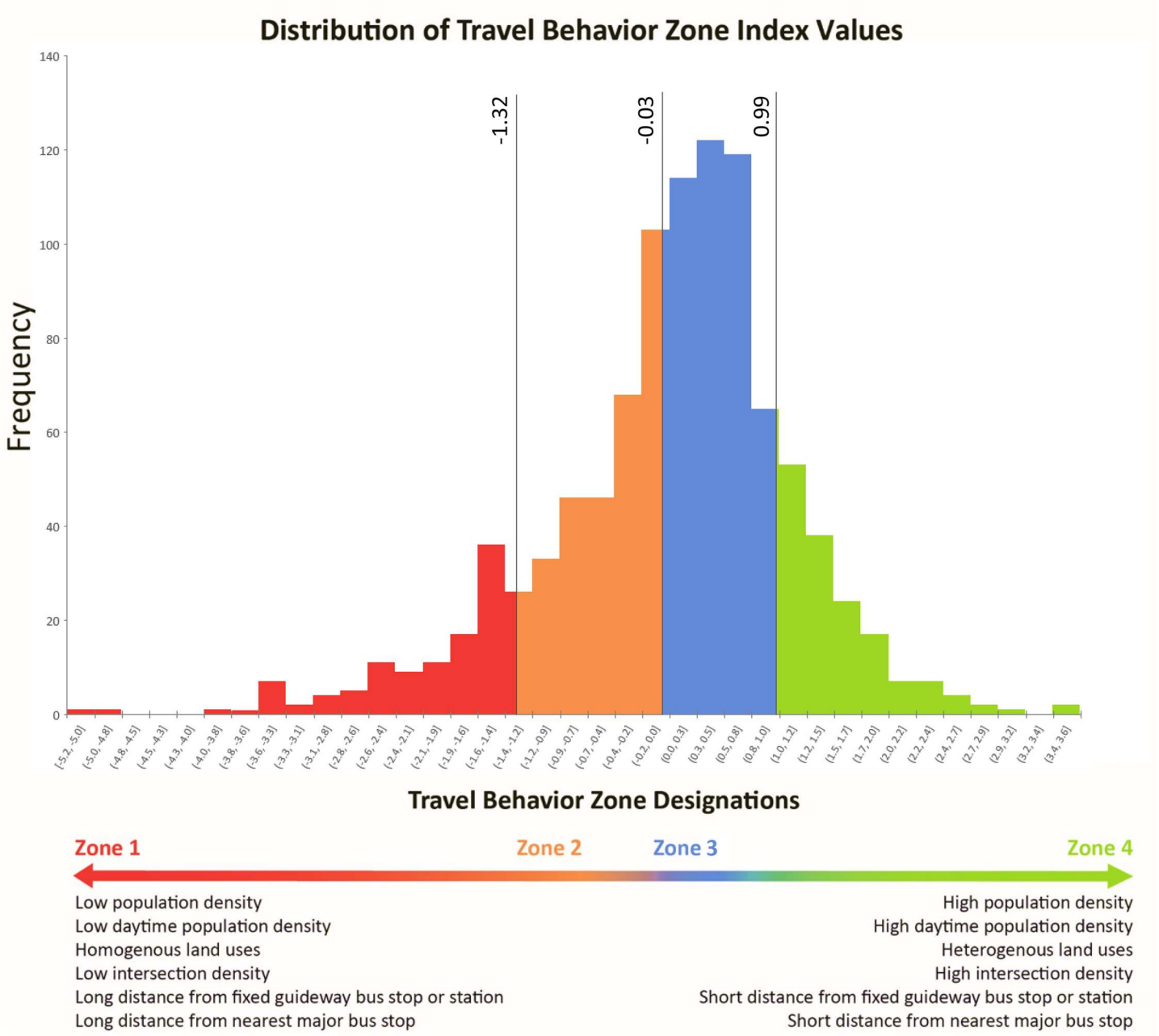


Figure 1: Distribution and Range of TBZ Designations

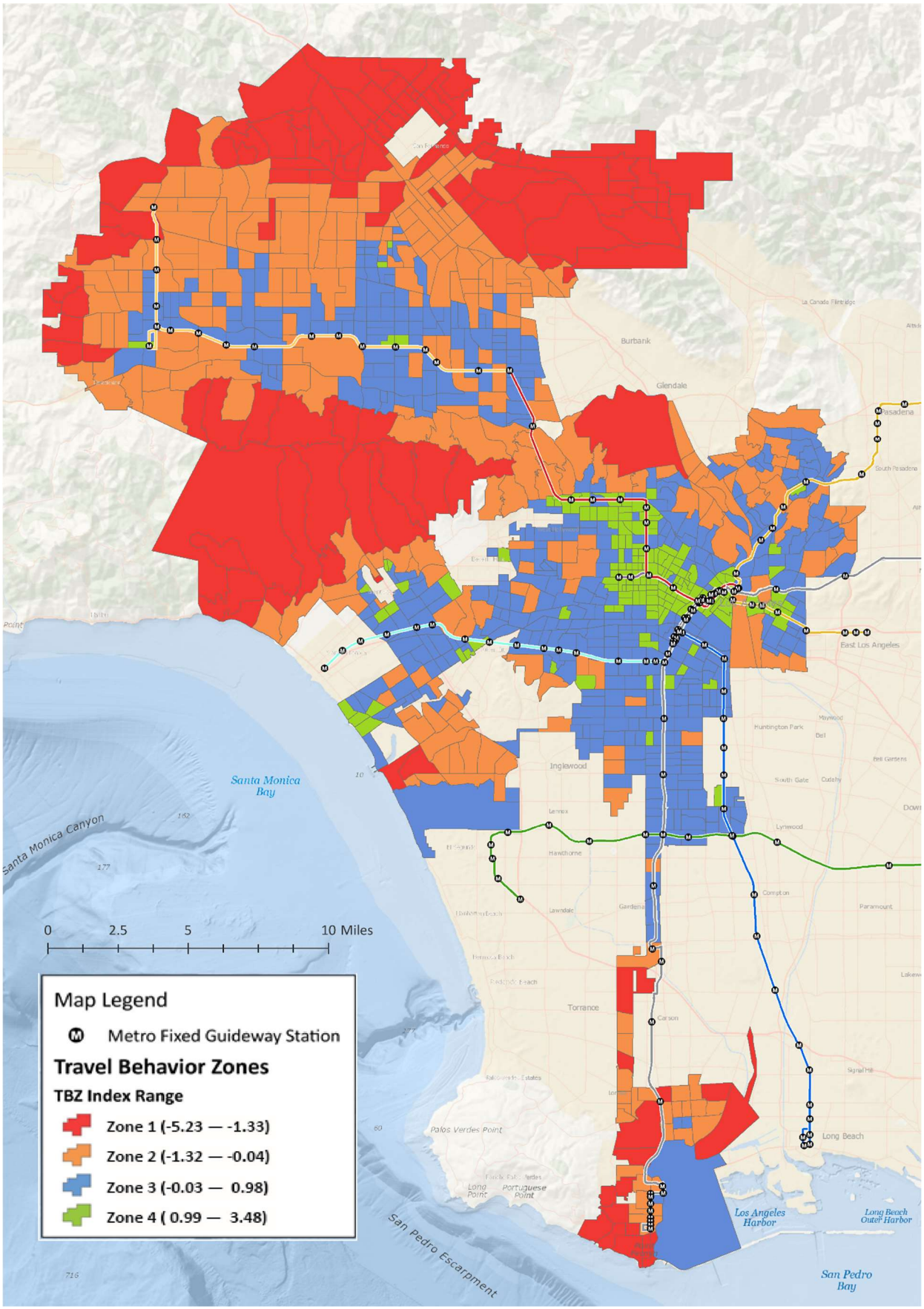


Figure 2: Map of City of Los Angeles Travel Behavior Zones

APPENDIX B

AFFORDABLE HOUSING TRIP GENERATION STUDY

FEHR PEERS

Measuring the Miles
Developing new metrics for vehicle travel in LA

MEMORANDUM

Date: April 20, 2017

To: Claire Bowin & David Somers, Los Angeles Department of City Planning

Cc: Tom Carranza, Los Angeles Department of Transportation

From: Tom Gaul & Cary Bearn, Fehr & Peers

Subject: ***Infill and Complete Streets Study***
Task 2.1A Local Affordable Housing Trip Generation Study

Ref: LA15-2755

This memo serves as a summary of Task 2.1A, Local Affordable Housing Trip Generation Study, as part of the City of Los Angeles' *Infill and Complete Streets: Capturing VMT Impacts & Benefits Pursuant to CEQA* study. As part of Task 2.1A, vehicle trip generation and parking utilization surveys were conducted at numerous affordable housing locations throughout the City of Los Angeles in order to provide an improved understanding of vehicle trip generation and parking demand characteristics of affordable housing uses in Los Angeles.

The empirical trip generation data collected through this effort will be used to customize and calibrate the MXD model for Los Angeles to be integrated into the vehicle miles traveled (VMT) VMT Calculator to be developed for the City as part of later tasks in the study.

METHODOLOGY

Twenty-four hour driveway vehicle counts were conducted at the various survey sites using video cameras. Manual overnight parking utilization sweeps were also conducted.

Criteria for selection of the survey sites included:

- Sample Size – The Institute of Transportation Engineers (ITE) recommends that at least three and preferably five independent survey sites be used to establish a local trip generation rate for a particular land use. This recommendation was exceeded for all land use types included in this study, including for each of the subcategories of affordable housing sites.
- 100% Affordable – The affordable housing site must be 100% affordable (other than the manager's unit). This was to ensure that the counts reflect the trip generation behavior solely of affordable units.
- Isolatable Use – The sites must be standalone and not part of a mixed-use development.

- Countable Driveway(s) – Driveways must be serving parking lots for the use of the site and not also serving parking lots for other land uses in the surrounding area.
- Successful Development – The development should be mature, be located in a mature environment, and appear to be economically healthy.
- Permission of Property Owners/Managers – Permission was obtained in order to survey a site.

AFFORDABLE HOUSING TRIP GENERATION AND PARKING

Data Collection

Twenty-four hour driveway counts and overnight parking sweeps were conducted at a total of 42 affordable housing sites within the City of Los Angeles (35 sites counted in May-June 2016 and seven additional sites counted in November 2016). The affordable housing study locations were identified in consultation with the City of Los Angeles Department of City Planning and the City of Los Angeles Housing+Community Investment Department. The sites were categorized according to two criteria considered to influence the level of vehicle ownership and tripmaking but also considered to be available and applicable to future projects (i.e., measureable and able to be determined using a readily available data source): proximity to transit and affordable housing type:

- Proximity to Transit – The Southern California Association of Governments (SCAG) has defined "Transit Priority Areas" (TPAs) as the area within ½ mile of an existing major transit stop, and defines a major transit stop as either a rail station or an intersection of 2 or more major bus routes with peak service frequencies of 15 minutes or less. The transit priority area defined by SCAG applies a ½ mile radial from the station or intersection. For this study, a ½ mile walkshed along the transportation network was used in lieu of the ½ mile radius. Additionally, stations for the Metro Orange Line and Silver Line Busways were not included in the SCAG definition but were added as part of the rail stations. These busways provide peak hour service less than 15 minutes and operate in dedicated rights-of-way. Study locations were defined as either inside or outside a transit priority area. Twenty of the study locations were within a TPA and 22 were outside of a TPA.
- Housing Type – Affordable housing type was categorized as serving families, seniors, special needs, or permanent supportive. Family affordable housing offers affordable dwelling units designed for households with children. Senior affordable housing provides affordable dwelling units designed for mature residents. The category of special needs housing includes facilities serving a variety of populations, including foster youth, disabled, mentally ill, and HIV/AIDs. Permanent supportive housing provides long-term housing with supportive services designed to enable homeless persons and individuals/families at risk of homelessness to ensure that they remain housed and live as independently as possible. Fourteen of the study sites were designated as family housing, thirteen were senior, eight were special needs, and seven were permanent supportive. Each of these categories were divided roughly equally between sites within a TPA and sites outside of a TPA.

Retail job density was also considered as a possible variable influencing tripmaking but, based on exploratory data analysis and discussions with LADOT, the final trip generation analysis was disaggregated based on proximity to transit and housing type only.

Table 1 presents the list of properties included in the analysis. Table 2 shows the aggregated vehicle trip generation results based on proximity to transit and housing type. Table 2 also shows relevant trip generation rates from ITE's *Trip Generation, 9th Edition*, for comparison. Table 3 shows the aggregated parking demand and utilization results based on proximity to transit and housing type. For comparison, Table 3 also shows relevant parking requirements from the Los Angeles Municipal Code (LAMC).

Property managers for 36 of the 42 surveyed sites provided information regarding selected characteristics of the sites. All of the respondents stated that they provide parking but do not charge residents for parking on-site. None of the respondents provide partially or fully-subsidized transit passes to residents, none provide car-share services, and one provides a shuttle to grocery stores.

Results

Reviewing Table 2, the following observations can be made:

- The empirical vehicle trip generation rates across the affordable housing survey sites are higher for the affordable family units relative to the senior, special needs, and permanent supportive affordable units.
- The empirical trip generation rates are generally lower for units located within a TPA than for units located outside of a TPA.
- The empirical trip generation rates averaged across all 42 of the affordable housing survey sites are lower than the ITE trip rates for standard apartments for all three time periods (daily, AM peak hour, and PM peak hour). This holds true as well for almost all of the disaggregated subcategories (the sole exception being affordable family units outside of a TPA during the AM peak hour).
- Affordable family units both inside and outside of a TPA are the only categories with empirical rates higher than the ITE high-rise apartment rates (an ITE category which primarily consists of buildings within urban areas).
- The empirical rates for senior, special needs, and permanent supportive affordable housing are far lower than both the ITE apartment and ITE high-rise apartment rates.
- The empirical rates for the senior affordable housing are lower than ITE rates for senior adult housing.

Reviewing Table 3, the following observations can be made:

- The empirical parking demand ratios are higher for the affordable family units relative to the senior, special needs, and permanent supportive units.

- The empirical parking demand ratios for each of the subcategorizations of the affordable housing survey sites (by affordable housing type and by transit proximity) are lower than the LAMC parking requirement for apartments.
- The empirical parking demand ratios for family affordable housing range from 0.82 to 0.85 spaces per unit and are lower than the parking requirements under the LAMC Affordable Housing Density Bonus Option 2 (LAMC 12.22A.25(d)(2)) for restricted affordable units (1 space per unit).
- The empirical parking demand ratios for senior, special needs, and permanent supportive affordable housing range from 0.20 to 0.48 spaces per unit and are lower than the parking requirements under the LAMC Affordable Housing Density Bonus Option 2 (LAMC 12.22A.25(d)(2)) for units restricted to low or very low income senior citizen or disabled (0.5 spaces per unit).
- The empirical parking demand ratios are lower for units located within a TPA than for units located outside of a TPA for the senior, special need, and permanent supportive units but not for the family units.

SOURCES

Trip Generation, 9th Edition, Institute of Transportation Engineers, 2012.

Trip Generation Handbook, 3rd Edition, Institute of Transportation Engineers, 2014.

Los Angeles Municipal Code.

TABLE 1

Affordable Housing Trip Generation and Parking Utilization Survey Locations

Count	Name	Address	Transit Priority Area	Housing Type
1	Barnsdall Court	1632 N Normandie Ave, Hollywood, CA 90027	Inside	Family
2	Parkside Apartments	900 S Grand Ave, Los Angeles, CA 90015	Inside	Family
3	El Dorado Family Apts	12129 N El Dorado Ave, Los Angeles, CA 91342	Inside	Family
4	Union Point	420 Union Dr, Los Angeles, CA 90017	Inside	Family
5	Coronita Family	204 S Lucas Ave, Los Angeles, CA 90026	Inside	Family
6	New Venice 1A	535 Santa Clara Ave, Venice, CA 90291	Inside	Family
7	New Venice 2C	1002 5th Ave, Venice, CA 90291	Inside	Family
8	Sichel Family Apts	1805 Sichel St, Los Angeles, CA 90031	Inside	Family
9	Bonnie Brae Village	208 S Bonnie Brae St, Los Angeles, CA 90057	Inside	Permanent Supportive
10	Gower Street Apts	1140 N Gower St, Los Angeles, CA 90038	Inside	Permanent Supportive
11	The Villas At Gower	1726 N Gower St, Hollywood, CA 90028	Inside	Permanent Supportive
12	NoHo Seniors Villa	5525 Klump Ave, North Hollywood, CA 91601	Inside	Seniors
13	Morgan Place Senior Apts	7301 S Crenshaw Blvd, Los Angeles, CA 90043	Inside	Seniors
14	Figueroa Senior Housing	7621 S Figueroa St, Los Angeles, CA 90044	Inside	Seniors
15	Hollenbeck Terrace	610 S Saint Louis St, Los Angeles, CA 90023	Inside	Seniors
16	Ward Villas	1177 W Adams Blvd, Los Angeles, CA 90007	Inside	Seniors
17	Vermont Manzanita	1225 S Vermont Ave, Los Angeles, CA 90006	Inside	Special Needs
18	New Carver	1624 S Hope St, Los Angeles, CA 90015	Inside	Special Needs
19	Charles Cobb Apts	521 S San Pedro St, Los Angeles, CA 90013	Inside	Special Needs
20	New Genesis	452 S Main St, Los Angeles, CA 90013	Inside	Special Needs
21	Rio Vista Apts	3000 N Verdugo Rd, Los Angeles, CA 90065	Outside	Family
22	New Venice 4B	915 7th Ave, Venice, CA 90291	Outside	Family
23	Cuatro Vientos	5331 E Huntington Dr, Los Angeles, CA 90032	Outside	Family
24	Lorena Terrace	611 South Lorena St, Los Angeles, CA 90023	Outside	Family
25	Laurel Village	9700 Laurel Canyon Blvd, Pacoima, CA 91331	Outside	Family
26	New Venice 2D	919 5th Ave, Venice, CA 90291	Outside	Family
27	Cornerstone Apts	14128 Calvert St, Van Nuys, CA 91401	Outside	Permanent Supportive
28	Willis Avenue Apts	14731 W Rayen St, Los Angeles, CA 91402	Outside	Permanent Supportive
29	PATH Villas At Del Rey	11734 Courtleigh Dr, CA 90066	Outside	Permanent Supportive
30	Winnetka Senior Apts	20750 Sherman Way, Los Angeles CA 91306	Outside	Permanent Supportive
31	TELACU Pointe	3100 Fletcher Dr, Los Angeles, CA 90065	Outside	Seniors
32	Asturias Senior Apts	9628 Van Nuys Blvd, Panorama City, CA 91402	Outside	Seniors
33	Cantabria Senior Apts	9640 N Van Nuys Blvd, Los Angeles, CA 91402	Outside	Seniors
34	TELACU Vista	4900 N Via Marisol, Highland Park, CA 90032	Outside	Seniors
35	Andalucia Senior Apts	15305 W Lanark St, Los Angeles, CA 91406	Outside	Seniors
36	TELACU Las Flores	12793 Mercer St, Pacoima, CA 91331	Outside	Seniors
37	Buckingham Sr. Housing	4020 S Buckingham Rd, Los Angeles, CA 90008	Outside	Seniors
38	Villa Valley	15950 Sherman Way, Los Angeles, CA 91406	Outside	Seniors
39	Allesandro Street Apts	1934 Allesandro St, Los Angeles, CA 90039	Outside	Special Needs
40	Innes Heights, Lp	1245 Innes Ave, Los Angeles, CA 90026	Outside	Special Needs
41	Woodland Terrace	15532 W Nordhoff St, North Hills, CA 91343	Outside	Special Needs
42	Guy Gabaldon Apts	3553 Beswick St, Los Angeles, CA 90023	Outside	Special Needs

TABLE 2

Vehicle Trip Rates for Affordable Housing Sites in Los Angeles

(By Transit Priority Area and Affordable Housing Type)

Counts conducted May, June, and November 2016

TPA Area	Affordable Housing Type	Bin	Sample Size	Daily Rate (Trips per DU)	Average AM Peak Hour Rate (Trips per DU)	AM Percent In	AM Percent Out	Average PM Peak Hour Rate (Trips per DU)	PM Percent In	PM Percent Out
Inside	-		20	2.32	0.26	40%	60%	0.20	56%	44%
Outside	-		22	2.48	0.25	46%	54%	0.24	52%	48%
-	Family		14	4.16	0.52	38%	62%	0.38	55%	45%
-	Seniors		13	1.72	0.12	38%	62%	0.15	52%	48%
-	Special Needs		8	1.49	0.17	43%	57%	0.11	54%	46%
-	Permanent Supportive		7	1.23	0.08	67%	33%	0.13	53%	47%
Inside	Family	Inside, Family	8	4.16	0.49	37%	63%	0.35	56%	44%
Inside	Seniors	Inside, Seniors	5	1.31	0.13	38%	62%	0.13	47%	53%
Inside	Special Needs	Inside, Special Needs	4	1.00	0.10	30%	70%	0.05	67%	33%
Inside	Permanent Supportive	Inside, Permanent Supportive	3	0.87	0.08	62%	38%	0.09	59%	41%
Outside	Family	Outside, Family	6	4.15	0.55	40%	60%	0.43	55%	45%
Outside	Seniors	Outside, Seniors	8	1.97	0.11	38%	62%	0.17	55%	45%
Outside	Special Needs	Outside, Special Needs	4	1.98	0.24	54%	46%	0.16	44%	56%
Outside	Permanent Supportive	Outside, Permanent Supportive	4	1.50	0.09	71%	29%	0.16	49%	51%

ITE for Comparison

ITE Record Number	Description	Sample Size	Daily Rate (Trips per DU)	Average AM Peak Hour Rate (Trips per DU)	AM Percent In	AM Percent Out	Average PM Peak Hour Rate (Trips per DU)	PM Percent In	PM Percent Out
ITE 220	Apartment	78-90	6.65	0.51	20%	80%	0.62	65%	35%
ITE 222	High-Rise Apartment	9-17	4.20	0.30	25%	75%	0.35	61%	39%
ITE 252	Senior Adult Housing-Attached	5-10	3.44	0.20	34%	66%	0.25	54%	46%
ITE 253	Congregate Care Facility	2-3	2.02	0.06	59%	41%	0.17	55%	45%
ITE 255	Continuing Care Retirement Community	4-6	2.40	0.14	65%	35%	0.16	39%	61%

TABLE 3

Parking Demand Rates for Affordable Housing Sites in Los Angeles

(By Transit Priority Area and Affordable Housing Type)

Surveys conducted May, June, and November 2016

TPA Area	Affordable Housing Type	Sample Size	Parking Demand Per Dwelling Unit	Parking Utilization
Inside	-	20	0.53	64%
Outside	-	22	0.56	63%
-	Family	14	0.84	72%
-	Seniors	13	0.46	71%
-	Special Needs	8	0.32	43%
-	Permanent Supportive	7	0.37	56%
Inside	Family	8	0.85	74%
Inside	Seniors	5	0.44	73%
Inside	Special Needs	4	0.20	34%
Inside	Permanent Supportive	3	0.29	64%
Outside	Family	6	0.82	70%
Outside	Seniors	8	0.48	69%
Outside	Special Needs	4	0.44	52%
Outside	Permanent Supportive	4	0.43	50%

LAMC for Comparison

		Parking Requirement per Unit
Apartments (LAMC 12.21A.4(a))		
	<3 habitable rooms	1
	3 habitable rooms	1.5
	>3 habitable rooms	2
Projects with Affordable Housing Density Bonus - Option 1 (applies to all units, not just restricted units) (LAMC 12.22A.25(d)(1))		
	0-1 bedroom	1
	2-3 bedrooms	2
	4 or more bedrooms	2.5
Projects with Affordable Housing Density Bonus - Option 2 (applies to restricted units only) (LAMC 12.22A.25(d)(2))		
	restricted affordable units	1
	restricted to low or very low income senior citizen or disabled	0.5
	restricted affordable units in residential hotel	0.25

APPENDIX C

VALIDATION SITES

Validation Sites

Address	Multi-Family Units	Affordable Units	General Retail	Bank	Health Club	High-Turnover Sit-Down Restaurant	Fast-Food Restaurant	General Office	Medical Office
725 S Bixel St, Los Angeles, CA 90017	632								
6220 W 3rd St, Los Angeles, CA 90036	610								
21200 Kittridge Street, Woodland Hills, CA 91303	522								
2160 Century Park East, Los Angeles, CA 90067	496								
3183 Wilshire Blvd, Los Angeles, CA 90005	449		26.28	4.06		1.86	4.83		
5416 Fair Avenue, North Hollywood, CA 91601	438								
151 E Holly St, Pasadena, CA 91103	374								
612 S Flower St, Los Angeles, CA 90017	322								
639 N Broadway, Los Angeles, CA 90012	280		22.00						
375 E Green St, Pasadena, CA 91101	276								
265 S Arroyo Pkwy, Pasadena, CA 91105	235								
235 S San Pedro St, Los Angeles, CA 90012	230								
10501 Wilshire, Los Angeles, CA 90024	208								
1850 Whitley Ave, Los Angeles, CA 90028	206								
930 Figueroa Terrace, Los Angeles, CA 90012	198								
1234 Wilshire Blvd, Los Angeles, CA 90017	197		8.90						
3360 E. Foothill Boulevard, Pasadena, CA 91107	188								
5440 Tujunga Ave, North Hollywood, CA 91601	180								
3460 W 7th St Los Angeles, CA 90005	168		4.37						
3675 Wilshire Blvd, Los Angeles, CA 90010	159								
145 Chestnut Street, Pasadena, CA 91103	143								
290 N. Hudson Avenue, Pasadena, CA 91101	140								
2000 Main Street, Santa Monica, California	133								
10490 Wilshire, Los Angeles, CA 90024	128								
3075 Wilshire Blvd, Los Angeles, CA 90010	127		2.91						
25 South Oak Knoll Avenue, Pasadena, CA	120		1.80						
601 E 2nd St, Los Angeles, CA 90012	118								
10001 Venice Blvd, Los Angeles, CA 90034	116								
10727 Wilshire, Los Angeles, CA 90024	93								
901 Hancock Ave, West Hollywood, CA 90069	39								
12301 Wilshire Blvd, Los Angeles, CA 90025								105.98	
10351 Santa Monica Blvd, Los Angeles, CA 90025								101.50	
3785 Wilshire Blvd, Los Angeles, CA 90010	186		40.00						

Validation Sites

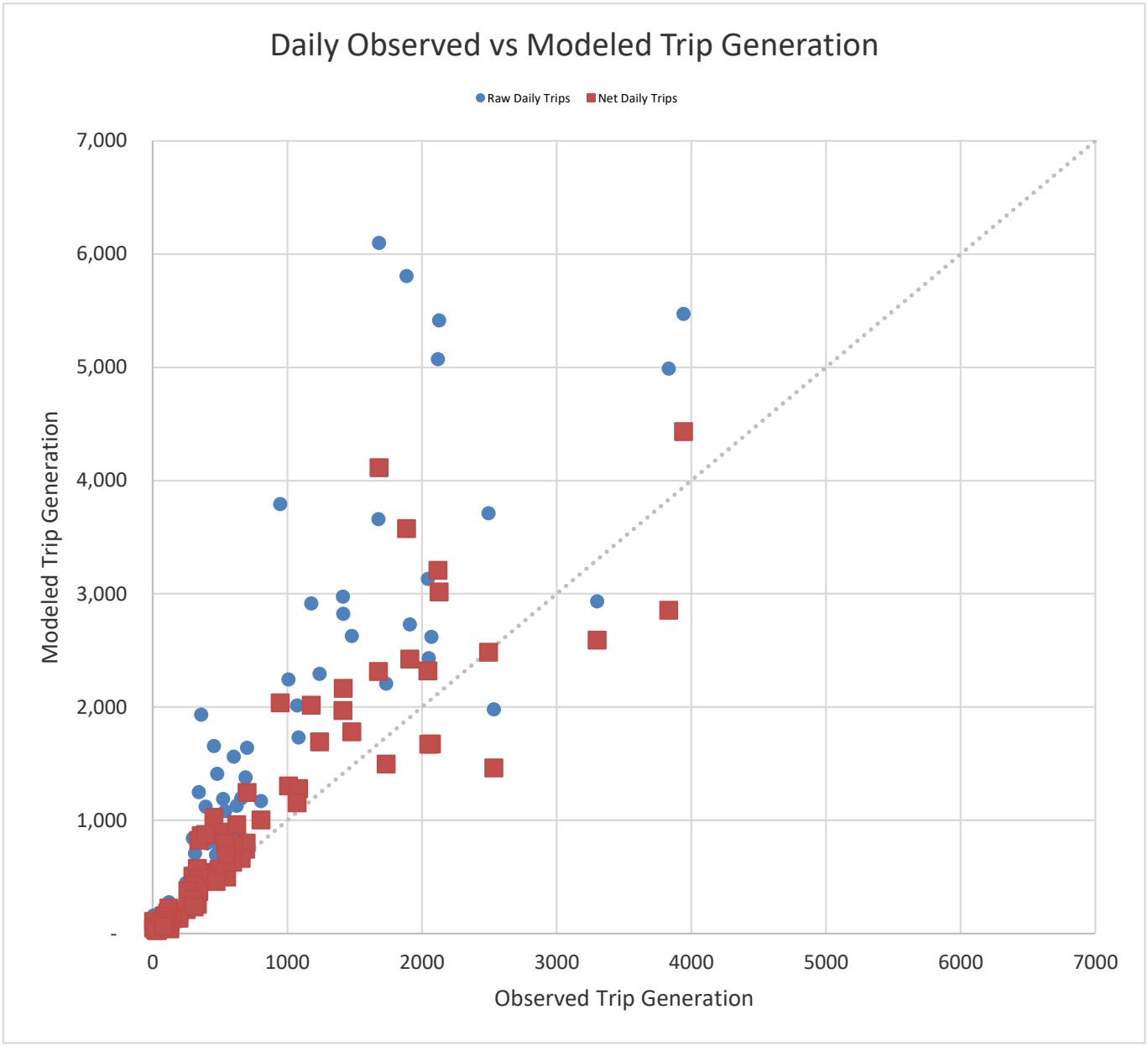
Address	Multi-Family Units	Affordable Units	General Retail	Bank	Health Club	High-Turnover Sit-Down Restaurant	Fast-Food Restaurant	General Office	Medical Office
1055 W 7th St, Los Angeles, CA 90017						1.86		620.50	
3435 Wilshire Blvd, Los Angeles, CA 90010			0.62	6.17		3.45		510.00	
3699 Wilshire Blvd, Los Angeles, CA 90010					13.28			333.00	
6255 Sunset Blvd, Los Angeles, CA 90028			29.70	7.16		4.47	4.76	294.23	
12233 Olympic Dr, Los Angeles, CA 92646			25.89	3.05		12.30		279.30	
12045 East Waterfront Drive, Los Angeles, CA 90094								262.00	
3600 Wilshire Blvd, Los Angeles, CA 90010			5.98	7.96		10.62	0.55	256.32	
3055 Wilshire Blvd, Los Angeles, CA 90010								225.00	
301 N Lake Ave, Pasadena, CA 91101								208.30	
5455 Wilshire Blvd, Los Angeles, CA 90036			5.72			1.04		200.04	10.37
3200 Wilshire Blvd, Los Angeles, CA 90010								200.00	
5250 Lankershim Blvd, North Hollywood, CA 91601								179.46	
5510 Lincoln Blvd, Playa Vista, CA 90094					25.50			170.64	5.86
5200 Lankershim Blvd, North Hollywood, CA 91601								157.00	
6380 Wilshire Blvd, Los Angeles, CA 90048						1.28		138.79	
626 Wilshire Blvd, Los Angeles, CA 90017			11.38					138.54	
7083 Hollywood Blvd, Los Angeles, CA 90028								82.18	
4700 Wilshire Blvd, Los Angeles, CA 90010								74.01	
15950 Sherman Way, Los Angeles, CA 91406		145							
1177 W Adams Blvd, Los Angeles, CA 90007		120							
452 S Main St, Los Angeles, CA 90013		102							
4900 N Via Marisol, Highland Park, CA 90032		100							
610 S Saint Louis St, Los Angeles, CA 90023		96							
20750 Sherman Way, Los Angeles CA 91306		95							
15305 W Lanark St, Los Angeles, CA 91406		94							
208 S Bonnie Brae St, Los Angeles, CA 90057		92							
1624 S Hope St, Los Angeles, CA 90015		91							
3100 Fletcher Dr, Los Angeles, CA 90065		84							
9640 N Van Nuys Blvd, Los Angeles, CA 91402		81							
900 S Grand Ave, Los Angeles, CA 90015		79							
9700 Laurel Canyon Blvd, Pacoima, CA 91331		78							
521 S San Pedro St, Los Angeles, CA 90013		76							
12793 Mercer St, Pacoima, CA 91331		75							
1726 N Gower St, Hollywood, CA 90028		70							

Validation Sites

Address	Multi-Family Units	Affordable Units	General Retail	Bank	Health Club	High-Turnover Sit-Down Restaurant	Fast-Food Restaurant	General Office	Medical Office
9628 Van Nuys Blvd, Panorama City, CA 91402		69							
4020 S Buckingham Rd, Los Angeles, CA 90008		68							
12129 N El Dorado Ave, Los Angeles, CA 91342		60							
7301 S Crenshaw Blvd, Los Angeles, CA 90043		54							
1140 N Gower St, Los Angeles, CA 90038		52							
3000 N Verdugo Rd, Los Angeles, CA 90065		50							
611 South Lorena St, Los Angeles, CA 90023		49							
5525 Klump Ave, North Hollywood, CA 91601		49							
14731 W Rayen St, Los Angeles, CA 91402		42							
1225 S Vermont Ave, Los Angeles, CA 90006		40							
1632 N Normandie Ave, Hollywood, CA 90027		38							
14128 Calvert St, Van Nuys, CA 91401		36							
1805 Sichel St, Los Angeles, CA 90031		36							
7621 S Figueroa St, Los Angeles, CA 90044		35							
3553 Beswick St, Los Angeles, CA 90023		33							
15532 W Nordhoff St, North Hills, CA 91343		31							
1002 5Th Ave, Venice, CA 90291		26							
919 5Th Ave, Venice, CA 90291		26							
5331 E Huntington Dr, Los Angeles, CA 90032		25							
11734 Courtleigh Dr, CA 90066		23							
535 Santa Clara Ave, Venice, CA 90291		22							
420 Union Dr, Los Angeles, CA 90017		21							
204 S Lucas Ave, Los Angeles, CA 90026		21							
1245 Innes Ave, Los Angeles, CA 90026		19							
1934 Allesandro St, Los Angeles, CA 90039		17							
915 7Th Ave, Venice, CA 90291		15							

APPENDIX D

OBSERVED VERSUS MODELED TRIP GENERATION


Daily Observed vs Modeled Trip Generation
Raw Daily Trips
Net Daily Trips
Modeled Trip Generation
Observed Trip Generation
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
0
1000
2000
3000
4000
5000
6000
7000

APPENDIX E

TRIP PURPOSE ASSUMPTIONS

Appendix E
Trip Purpose Assumptions by Land Use

Land Use	Productions			Attractions		
	Home Based Work	Home Based Other	Non-Home Based	Home Based Work	Home Based Other	Non-Home Based
Single Family Residential	15%	41%	19%	0%	20%	5%
Multi-Family Residential	15%	41%	19%	0%	20%	5%
Townhouse	15%	41%	19%	0%	20%	5%
Affordable Housing	15%	41%	19%	0%	20%	5%
General Retail	0%	0%	22%	7%	50%	22%
Furniture Store	0%	0%	18%	21%	42%	18%
Pharmacy/Drugstore	0%	0%	23%	3%	52%	23%
Supermarket	0%	0%	22%	6%	50%	22%
Bank	0%	0%	22%	5%	51%	22%
Health Club	0%	0%	22%	4%	51%	22%
High-Turnover Sit-Down Restaurant	0%	0%	22%	7%	50%	22%
Fast-Food Restaurant	0%	0%	21%	11%	47%	21%
Quality Restaurant	0%	0%	22%	6%	50%	22%
Auto Repair	0%	0%	22%	5%	51%	22%
Home Improvement Superstore	0%	0%	21%	10%	48%	21%
Free-Standing Discount Store	0%	0%	22%	6%	50%	22%
General Office	0%	0%	12%	53%	24%	12%
Medical Office	0%	0%	18%	12%	52%	18%
Light Industrial	0%	0%	20%	21%	40%	20%
Manufacturing	0%	0%	20%	19%	41%	20%
Warehousing/Self-Storage	0%	0%	20%	19%	41%	20%
Hotel (including restaurant, facilities, etc.)	0%	0%	9%	9%	73%	9%
Motel	0%	0%	9%	13%	70%	9%
Movie Theater (Theater with Matinee)	0%	0%	10%	4%	77%	10%
University	0%	0%	7%	21%	65%	7%
High School	0%	0%	8%	8%	76%	8%
Middle School	0%	0%	8%	9%	76%	8%
Elementary School	0%	0%	7%	11%	74%	7%
Private School (K-12)	0%	0%	8%	9%	75%	8%

Sources: City of Los Angeles travel demand forecasting model; Transportation Research Board, *National Cooperative Highway Research Program Report 365, Travel Estimation Techniques for Urban Planning* , 1998; Transportation Research Board, *National Cooperative Highway Research Program Report 716, Travel Demand Forecasting: Parameters and Techniques* , 2012; and Fehr & Peers.

APPENDIX F

CALCULATOR UPDATE REPORTS

Updates to the Los Angeles VMT Calculator Version 1.2

The Los Angeles VMT Calculator Version 1.2, released November 2019, was updated in order to add new features and to incorporate the latest available substantiated information. The tool is expected to be updated over time in future update cycles in order to provide the best user-experience and to stay current. Here's what you will find in the latest update:

1. New screening tab

A new tab was added to allow users to enter the Existing Land Use as well as the Proposed Project Land Use. After all project information is entered in the Screening tab, the Calculator will indicate whether a project is required to perform VMT analysis in the bottom right corner of the Screening tab.

2. Minor adjustments to Travel Behavior Zones

The methodology used to determine Travel Behavior Zones was modified to acknowledge the impact of proximity to transit on travel behavior. For full documentation on Travel Behavior Zones, please see the City of Los Angeles VMT Calculator Documentation - Appendix A.

3. Minor adjustments to VMT calculation

The VMT Calculator uses trip length information from the TDF Model to calculate vehicle miles traveled. In Version 1.2 of the VMT Calculator, trip lengths for all Travel Analysis Zones (TAZs) within a ¼ mile of the project address are averaged. These trip length values are multiplied by the vehicle trip generation by trip purpose and summed to determine total VMT, household VMT, and work VMT for a project. For full documentation on VMT calculation, please see the City of Los Angeles VMT Calculator Documentation Section 3.3.

4. Added Telecommuting to TDM Strategies

Telecommuting was added as a TDM strategy. Please see the VMT Strategy Appendix for more information regarding telecommuting and VMT reductions.

5. Added notification when maximum TDM is achieved

For the full set of TDM strategies selected across all trip types, a place-type limit, or cap, is applied. The place-type or Travel Behavior Zone (TBZ) is based on land use characteristics of the location of the project. Version 1.2 of the VMT Calculator alerts the user when they have reached this cap. When Max TDM Achieved changes from "No" to "Yes", this indicates that selecting additional TDM strategies will not further reduce VMT because the TDM strategies cap has been reached.

Updates to the Los Angeles VMT Calculator Version 1.3

The Los Angeles VMT Calculator Version 1.3, released May 2020, was updated in order to incorporate the latest available substantiated information. The tool is expected to be updated over time in future update cycles in order to provide the best user experience and to stay current. Here's what you will find in the latest update:

6. Adjustments to VMT Calculation: Trip Length Averaging

The VMT Calculator uses trip length information from the City's Travel Demand Forecasting (TDF) Model to calculate vehicle miles traveled. In Version 1.2 of the VMT Calculator, trip lengths for Travel Analysis Zones (TAZs) within 1/4 mile of the project address are averaged. In Version 1.3, trip lengths are averaged for TAZs within 1/8 mile of the project address.

7. Adjustments to VMT Calculation: Transit Mode Splits

The City's VMT significance thresholds were established using the TDF Model. In Version 1.2 of the Calculator, transit mode splits were estimated through the MXD process, which was informed by the level of transit service in the area. Version 1.3 utilizes transit mode split data directly from the calibrated TDF Model, thus providing a greater level of consistency between the Calculator results and the modeled thresholds.

8. Adjustments to VMT Calculation: Trip Purpose Splits

The City's VMT significance thresholds were established using the TDF Model. In prior versions of the Calculator, trip purpose splits were applied using national data as adapted for and integrated into the MXD process embedded within the Calculator. Version 1.3 utilizes home-based production trip purpose splits from the TDF Model, thus providing a greater level of consistency between the Calculator results and the modeled thresholds.

Non-home-based (NHB) productions in the TDF Model represent resident-generated trips that stop elsewhere on their way to their final destination and thus are not a pure home-based work (HBW) or home-based other (HBO) production. When the data was compiled from the TDF Model to create the daily household VMT per capita thresholds, only the HBW productions and the HBO other productions were included, consistent with the OPR guidance which suggests that, "When a trip-based method is used to analyze a residential project, the focus can be on home-based trips."[1] As such, the Calculator trip purpose splits were adjusted to reflect that only the HBW productions and HBO other productions are included in the model-generated thresholds.

For full documentation on VMT calculation, please see the City of Los Angeles VMT Calculator Documentation report. For full documentation on the TDF Model, please see the City of Los Angeles Travel Demand Model Development Report.

State of California, Governor's Office of Planning and Research, *Technical Advisory on Evaluating Transportation Impacts in CEQA*, December 2018.