



**City of Moreno Valley
Transportation Engineering Division**

**Transportation Impact Analysis
Preparation Guide
for
Vehicle Miles Traveled
and
Level of Service Assessment**

June 2020

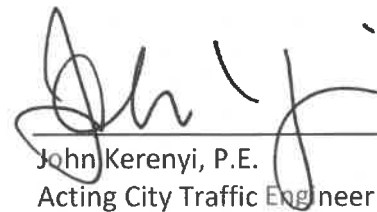

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Table of Contents

Introduction 1

Need for Transportation Impact Analysis 2

 Transportation Impact Analysis Exemption 2

Level of Service Analysis 7

 Methodologies..... 7

 Study Area Boundaries for LOS assessment 8

 Analysis Scenarios..... 9

 Data Collection, Project Trip Generation, and Forecasting Methodologies..... 10

 Intersection General Plan Consistency Requirements 14

 Roadway Segment General Plan Consistency Requirements 16

 Site Access, Safety, and Other Analyses 16

 Improvements for Transportation Impacts 19

CEQA Assessment - VMT Analysis 21

 Analysis Methodology 21

 CEQA VMT Impact Thresholds..... 26

 VMT Mitigation Measures 26

CEQA Assessment - Active Transportation and Public Transit Analysis 28

 Transportation Impact Study Format..... 29

 Content and Format..... 29

SUBMITTAL REQUIREMENTS AND PROCEDURE..... 31

Acknowledgements 32

Attachments 33

 Project Scoping Form..... 34

 Detailed VMT Forecasting Information 39

Introduction

The City of Moreno Valley Transportation Engineering Division (TED) requires that the traffic and circulation impacts of proposed development projects, General Plan Amendments, and Specific Plans be analyzed through the preparation of a Traffic Impact Analysis (TIA) prepared in conformance with Transportation Engineering Division requirements. The TIA must be prepared, signed and sealed by a Traffic Engineer or a Civil Engineer registered in the State of California, qualified to practice traffic engineering. This Traffic Impact Analysis Preparation Guide (Guide) identifies the required contents and methodology to be utilized in the study preparation, subject to the review and approval of the Transportation Engineering Division.

The passage of SB 743 created the need for a TIA to include both level of service analysis to maintain level of service standards required by the General Plan, and VMT impacts required by the California Environmental Quality Act (CEQA) process.

These recommendations are general guidelines and the City has the discretion to modify the TIA requirements based on the unique characteristics of a particular project.

Need for Transportation Impact Analysis

The need for a Transportation Impact Analysis (TIA) may be required for CEQA compliance, to maintain level of service standards required by the General Plan, or both.

CEQA compliance is established via a multi-step process to focus analysis effort on projects which may significantly increase Vehicle Miles Traveled (VMT) and screen out projects that would not. Data for the VMT and General Plan consistency analyses will be derived from the Riverside County Transportation Analysis Model (RIVTAM), and the Riverside County Model (RIVCOM).

Level of Service (LOS) analysis focuses on the project's direct impacts for the near-term scenario for projects that are consistent with the General Plan and/or zoning, and both near-term and build-out for projects that are not. Feasible mitigation to maintain the required level of service shall be identified. Cumulative impacts will generally be addressed by payment of development impact fees. Direct and/or cumulative impacts to facilities in other jurisdictions are addressed by payment of Traffic Uniform Mitigation Fee (TUMF) or fair-share contributions, or both.

Near-term analysis will compare existing and existing plus project scenarios. Build-out analysis will compare the General Plan Without Project scenario to the General Plan With Project scenario.

The Transportation Engineering Division shall determine whether the TIA shall be a minor or major study. In general a minor study shall assess the project's points of access and adjacent intersections for project completion conditions. A major study shall assess the project's points of access, adjacent intersections, and intersections not adjacent to the project site for project completion conditions and possibly General Plan Buildout conditions, based upon the previous bullet points.

Transportation Impact Analysis Exemption

Certain projects, because of their size, nature, or location, are exempt from the requirements of preparing a TIA. The Transportation Engineering Division, at its discretion, may require that a TIA be prepared for any development, regardless of size, if

there are concerns over safety, operational issues, or if located in an area known to be impacted by traffic.

Need to Complete LOS as part of the TIA

The following activities generally will not require a TIA that includes LOS analysis. This presumption is based on the activities associated with the project (e.g. they are local serving) or the limited trip generation of the project (e.g. projects that generate less than 100 peak hour trips as projects that generate 100 or less trips typically do not affect LOS significantly once distributed to the local roadway network).

- All residential parcel maps
- Single family residential tracts of less than 100 lots
- Apartments and multi-family projects of less than 150 units
- Plot plan and uses cases for projects of one acre or less
- Preschools
- Local serving churches, lodges, community centers, neighborhood parks and community parks (weekend peak generation analyses may be required for churches)
- Mini storage yards
- Congregate care facilities that contain significant special services, such as medical facilities, dining facilities, recreation facilities and support retail services
- Any use which can demonstrate trip generation of less than 100 vehicle trips in the peak hour.

The City reserves the right to require an applicant to prepare additional traffic analysis based on:

- Presence of an existing or potential safety problem
- Location of the development in an environmentally or otherwise sensitive area, or in an area that is likely to generate public controversy
- Presence of a nearby substandard intersection or street
- Need for a focused study for access/operational issues
- Request from an affected agency, such as Caltrans or adjacent City; if the request is deemed reasonable and appropriate

Projects that involve special uses, such as truck intensive projects or special events, may also be required to perform additional analysis to determine project impacts.

The following uses may require a TIA:

Truck intensive uses. In addition to the standard TIA requirements, or if the standard TIA requirements are waived, projects that are "truck intensive" may be required to submit a study addressing the truck access routes (as defined in the Municipal Code Section 12.36.010), adequacy of the existing streets to be used (in terms of geometry and structural section), safety issues relating to the truck traffic, and the impacts of the truck traffic on existing residences and/or businesses. Truck traffic shall be evaluated utilizing PCEs. This information shall be provided in the Scoping Agreement.

Special Event Uses. Special event land uses that do not exhibit typical trip generation characteristics may require unique analysis, including weekend and off-peak scenarios. Examples of such uses would be parades, carnivals, sporting events, open air markets, entertainment venues, assemblies, etc., or uses that exhibit substantial traffic peaking associated with special events that are scheduled on a periodic basis. The traffic analysis for such uses shall include a traffic management plan to control traffic impacts associated with the special events. Adequate circulation shall be provided to the site and all impacts shall be alleviated to the maximum extent possible. Parking requirements and availability shall also be assessed.

Need to Complete VMT as part of the TIA

Some projects and activities will not require a TIA that includes VMT. This presumption is based on the substantial evidence provided in the OPR Technical Advisory supporting SB 743 implementation or is related to projects that are local serving which, by definition, would decrease the number of trips or the distance those trips travel to access the development (and are VMT-reducing projects). The following activities generally will not require a TIA that includes VMT:

- Projects located in a Transit Priority Areas (TPA)
- Projects located in a low-VMT generating area (as defined later in this guidance)
- Local-serving K-12 schools
- Local parks
- Day care centers
- Local-serving gas stations
- Local-serving banks
- Local-serving hotels (e.g. non-destination hotels)
- Student housing projects
- Local serving community colleges that are consistent with the assumptions noted in the Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS)

- Projects generating less than 400 daily vehicle trips¹, exclusive of any existing daily vehicle trips generated by the site.
 - This generally corresponds to the following “typical” development potentials²:
 - 42 single family housing units
 - 60 multi-family, condominiums, or townhouse housing units
 - 41,000 sq. ft. of office
 - 10,500 sq. ft. general retail
 - 57,500 sq. ft. of light industrial
 - 112,500 sq. ft. of warehousing
 - 285,700 sq. ft. of high cube transload and short-term storage warehouse

Coordination with the Transportation Engineering Division

In order to streamline the TIA preparation and review process, the Engineer shall solicit input and approval from the Transportation Engineering Division (TED) prior to the preparation and submittal of a draft document. A TIA Scoping Agreement (Exhibit B) shall be prepared by the Engineer and submitted to the TED for approval prior to the preparation of a draft TIA. Contact the TED at 951.413.3140 to obtain an electronic copy. The Scoping Agreement provides for agreement on the following key points:

- Determination of study area, intersections, and roadway links to be analyzed.
- Project trip generation, distribution, and assignment.
- Presentation of screening criteria used to screen the project from VMT assessment or proposed methodology/metrics that will be applied to estimate VMT.

¹ The OPR technical advisory notes that CEQA provides a categorical exemption for existing facilities, including additions to existing structures of up to 10,000 square feet, so long as the project is in an area where public infrastructure is available to allow for maximum planned development and the project is not in an environmentally sensitive area. (CEQA Guidelines, § 15301, subd. (e)(2)). Typical project types for which trip generation increases relatively linearly with building footprint (i.e., general office building, single tenant office building, office park, and business park) generate or attract an additional 110-124 trips per 10,000 square feet. However, local air quality analysis has shown that various developments can have GHG production below AQMD limits with up to 400 trips per day. Therefore, absent substantial evidence otherwise, it is reasonable to conclude that the addition of 400 or fewer trips could be considered not to lead to a significant impact.

² Threshold may be higher depending on the tenant and the use of the site. This number was estimated using rates from ITE’s Trip Generation Manual.

- For those projects located near the city limits, the Engineer shall also solicit comments on the above from the adjacent agency(ies)'s staff. The Engineer shall submit all comments from other agency staff to the Transportation Engineering Division for review and consideration.
- Identification of issues specific to the project being evaluated (i.e. safety, transit, pedestrian, bicycle, access, adjacent land uses, design, etc.).

Level of Service Analysis

Methodologies

The Level of Service analysis is required to maintain intersection and link performance in accordance with General Plan policies.

Intersections

The most recent version of the Highway Capacity Manual (HCM) (Transportation Research Board) should be utilized for both signalized and unsignalized intersections. Analysis parameters not specifically provided later in this guide shall be determined using the Engineer's judgment and are subject to review and comment by the City. Any uncertainty should be resolved during report preparation in consultation with the TED.

The following parameters should be included in the analysis.

- Saturation Flow Rate consistent with field measurements *or* 1,900 passenger cars/hour/lane.
- Heavy Vehicle Factor based on count data; analyst may use a Passenger Car Equivalent (PCE) conversion to reflect heavy vehicles in the volume *or* incorporate the heavy vehicle factor in the capacity calculation consistent with HCM requirements (2-Axle = 1.5 PCE, 3-Axle = 2.0 PCE, 4+-Axle = 3.0 PCE).
- Grade based on existing or proposed grade of the facility.
- Minimum green time should be a minimum of 7 seconds per movement in light pedestrian areas or per the HCM guidance in high pedestrian activity areas.
- Cycle lengths should be set to the HCM optimal cycle length once all other parameters have been defined, with an upper limit of 120 seconds unless otherwise approved in writing by the TED.
- Peak hour factors should be based on count data; future peak hour factor should be 0.95.
- Intersections must be evaluated with HCM-consistent software; for locations where closely spaced intersections occur or queues build over space and time (extending to upstream or downstream intersections), microsimulation should be utilized to accurately evaluate the intersections as a system. This may require inclusion of freeway facilities.

When developing mitigation, the following recommendations should be considered.

- Exclusive left-turn lanes should be considered when peak-hour left-turn volume exceed 100 vehicles per hour.
- Dual left-turn lanes should be considered when peak-hour left-turn volume exceed 300 vehicles per hour.
- Protected left-turn phasing should be considered when the peak-hour left-turn volume exceeds 240 vehicles per hour, the opposing through movement consists of two or more lanes, and/or the posted speed limit is greater than 45 miles per hour.

Roadway Segment Assessment

The Transportation Engineering Division may require that analysis of Average Daily Traffic (ADT) be conducted in certain cases, such as when intersection analyses are not the controlling factor, roadway deletion or reclassification is being requested phasing of improvements are being determined, or for general planning purposes. The daily service volume standards are provided in **Table 1**.

Study Area Boundaries for LOS assessment

In general, the minimum area to be studied should include any intersection of “Collector” or higher classification street, with “Collector” or higher classification streets; at which the proposed project will add 50 or more peak hour trips. The study area should not exceed a 5-mile radius from the project site unless evidence is available to justify a larger area. For residential projects or projects adjacent to residential zones, residential streets/intersections may need to be included. The Transportation Engineering Division may require deviation from these requirements based upon area conditions.

Table 1: Roadway Segment Capacities					
Type of Roadway	Level of Service*				
	A	B	C	D	E
6 Lane Divided Arterial	33,900	39,400	45,000	50,600	56,300
4 Lane Divided Arterial	22,500	26,300	30,000	33,800	37,500
4 Lane Undivided Arterial	15,000	17,500	20,000	22,500	25,000
2 Lane Industrial Collector	7,500	8,800	10,000	11,300	12,500
2 Lane undivided Residential	N/A	N/A	N/A	N/A	2,000

* - *Maximum Average Daily Traffic (ADT)*
 NOTE: These roadway capacities are "rule of thumb" estimates for planning purposes. The LOS "E" service volumes are estimated maximum daily capacity for respective classifications. Capacity is affected by such factors as intersections (spacing, configuration, and control features), degree of access control, roadway grades, design geometrics (horizontal and vertical alignment standards), sight distance, vehicle mix (truck and bus traffic), and pedestrian and bicycle traffic.

Analysis Scenarios

For LOS capacity analyses, the following study scenarios shall be included:

Tracts, Plot Plans, Use Cases, Etc.

Existing Traffic. Existing traffic data will be collected to determine current conditions. This constitutes the environmental setting for a CEQA analysis at the time that the hearing body reviews the project. Traffic count data shall have been collected within one year of the first draft submittal. Any exception to this must be requested prior to approval of the Scoping Agreement.

Project Completion (existing plus ambient growth plus project). Traffic conditions prior to the time that the proposed development is completed will be estimated by increasing the existing traffic counts by an appropriate growth rate to be provided by the Transportation Engineering Division, projected to the year that the project is estimated to be complete (minimum of two years). Traffic generated by the proposed project will then be added, and the impacts on the circulation system will be analyzed. This will be

the basis for determining project-specific (direct) impacts, mitigation, and conditions of approval. It is essential that without and with project traffic conditions evaluated under this scenario are provided. The lack of this information will result in a resubmittal.

Project Phasing. Traffic conditions at each project phase completion are to be analyzed using the same approach as for the project completion year, if applicable. Traffic associated with each previous project phase shall be included in the analyses of each successive phase of the proposed project.

Land Use or Circulation Element General Plan Amendments, Zone Changes, Specific Plans

Development proposals that also include a General Plan Amendment, Specific Plan, Zone Change or other approval that increases traffic beyond what was approved in the General Plan will also be required to perform a General Plan Buildout analysis to assess long term impacts. This analysis will determine if the Circulation Element of the General Plan is adequate to accommodate projected traffic at the required LOS, or if additional mitigation is necessary.

Phased projects may be evaluated in three ways. First, the analyst can identify which phase of a project triggers a needed improvement based on the comparison of Background Conditions to Background Plus Project Conditions. Alternatively, he or she can provide a phased assessment looking at opening years of each phase. Finally, for large phased projects, the project as a whole could be evaluated initially; however, subsequent traffic studies would have to be completed for each proposed phase or enabling project implementation to ensure that improvements are implemented when they are needed. The Engineer must coordinate with the TED to identify which approach is most appropriate for a proposed project if phasing is proposed; however, the first option noted above is recommended for most phased projects.

Data Collection, Project Trip Generation, and Forecasting Methodologies

The following recommendations pertaining to traffic count collection, project trip development, and traffic forecasting methodologies have been developed to maintain consistency across different TIAs and reflect current state of the practice.

Traffic Counts

Data for existing traffic conditions should be collected for the project using the following guidelines.

- Peak period turning movement counts at all study intersections, roadway segments (if required) and/or driveways, including bicycle and pedestrian counts at intersections with high non-motorized use, should be collected. For intersections with high percentages of heavy vehicles, turning movement counts should count heavy vehicles separately.
- Average Daily Traffic (ADT) for all roadways within study area (if required by the Scoping Agreement) and vehicle classification counts in areas with a high percentage of heavy vehicle use.
- Traffic counts more than one year old should not be used without prior approval.
- Traffic data should not be collected on weeks that include a holiday and non-school session time periods, or weekday PM peak periods on school minimum days), unless approved by the TED.
- Traffic data should not be collected between Thanksgiving and the first week of the new year without prior approval.
- Traffic counts should be conducted on Tuesdays, Wednesdays (see mid-day/school release peak period note below), or Thursdays.
- For congested conditions, back of queue estimates by approach (and turning movement) should be conducted every 15 minutes.
- Traffic counts should not be conducted in active construction work areas or where a major detour is in place.

Unless directed otherwise by the TED, counts should be collected during the following time frames presuming the time period captures the beginning and end times of any congested conditions.

- Morning (7:00 a.m. to 9:00 a.m.)
- Afternoon/evening (4:00 p.m. to 6:00 p.m.)
- Midday and “School-Release” peak hours (11:30 a.m. to 1:30 p.m.), to be analyzed if directed by the TED. Moreno Valley Unified school release currently coincides with mid-day on Wednesdays; this is subject to change by the School District.
- Other peak hours, off-peak, weekend or special event, may also be required depending on the project location and type of use.

Count data shall be included in the study appendices.

Trip Generation

Trip generation rates shall be obtained from the Institute of Transportation Engineers (ITE) Trip Generation Handbook, latest edition. Trip generation rates and truck mix percentages for high truck-generating uses such as high cube warehouses, logistics space, etc. shall be reviewed with the TED on a case-by-case basis. Use of non-ITE data, including locally sourced and/or custom derived data, shall be approved in advance. The proposed trip generation source and land use code shall be listed in the scoping form for review and approval prior to study initiation.

Trip internalization for mixed use developments (if applicable) should be calculated using state of the practice methodologies. At the time of this memorandum, the EPA's mixed-use trip generation (or MXD) methodology or ITE's mixed use trip generation method are the state of the practice and should be approved by the local agency prior to use in any studies. Trip internalization calculations (including gross trips, net trips after internalization, and MXD input assumptions such as intersection density, TOD assumptions, acres, etc.) should be documented in the TIA.

Truck Intensive Uses

For projects that anticipate the generation of significant truck traffic, all truck trips shall be evaluated utilizing Passenger Car Equivalents (PCEs). The PCE conversion shall be as follows:

- 2-Axle = 1.5 PCE
- 3-Axle = 2.0 PCE
- 4+-Axle = 3.0 PCE

In lieu of converting traffic volumes to PCEs, the use of a Heavy Vehicle Factor (HVF) may be based on count data to reflect heavy vehicles in the volume. If a HVF is used, it must be based on the segregated count data and be consistent with HCM requirements.

TED may also require an analysis addressing the truck access routes (as defined in the Municipal Code Section 12.36.010), adequacy of the existing streets to be used (in terms of geometry and structural section), safety issues relating to the truck traffic, and the impacts of the truck traffic on existing residences and/or businesses.

All trip generation information shall be provided in the Scoping Agreement.

Trip Distribution

The project's trip distribution should be based on expected origin-destination patterns related to the project's land uses. Preferred methods include the use of mobile device data measuring trip distribution for similar sites or land uses (a minimum of three locations), or a select zone assignments from RIVTAM and/or RIVCOM. Other data may be used to help refine trip distribution patterns including the relative location of population, commercial, recreational and employment centers; existing peak-hour link and turning movement volumes; ADT volumes; proximity to regional transportation corridors; and knowledge of local and regional traffic circulation. A preliminary trip distribution pattern map must be submitted as part of the scoping agreement form for review and approval by TED.

The trip distribution may be further refined, after consultation with the TED, based on consideration of following factors:

- Type of proposed development
- Location and intensity of development
- Conditions on the roadway network in the vicinity
- Similar land use in the vicinity
- Truck route system
- As directed by the local agency

Buildout Studies for General Plan Amendments and Specific Plans

Traffic projections for General Plan Buildout scenarios shall utilize the RIVTAM and/or RIVCOM, or other approved model, and shall be identified and agreed to in the Scoping Agreement. The Engineer shall use the model projections as the basis for determining turning movement volumes for the required intersection analysis. A manual assignment of the project traffic added to the Buildout traffic may be used to determine total future traffic, as approved by the TED.

Certain large-scale Specific Plans and General Plan Amendments have the potential to create traffic impacts that are significantly greater than the traffic projections used in the forecasting model, and which also affect the modeling assumptions. For these projects, the TED may request that the Buildout analysis utilize the RIVTAM and/or RIVCOM to develop more detailed focused model runs in order to determine the projected Buildout traffic. The following are thresholds for projects considered to be significant to General Plan Buildout and subject to the revised modeling requirements:

- 1,500 residential dwelling units or more
- 25 acres of commercial uses or greater
- 150 acres of industrial uses or greater
- Any project producing 15,000 daily trips or greater.

Intersection General Plan Consistency Requirements

Consistent with the acceptable General Plan LOS (defined in the General Plan Circulation Element), the City considers the following criteria for application in a traffic study to identify infrastructure improvements required to provide acceptable operations. Please note that this analysis will be completed to demonstrate general plan consistency. Specific CEQA thresholds, which are based on VMT requirements, are described later in these guidelines and shall be the sole basis for determining CEQA-related impacts.

Level of Service Analysis

The City of Moreno Valley General Plan has established minimum Level of Service standards for its roadway network. The Traffic Impact Analysis shall determine whether the required Levels of Service will be maintained after the proposed project is constructed, or what improvements would be necessary to maintain the required LOS.

The City's Level of Service standards, as published in the City's General Plan, are included in the attached Exhibit C. Consistent with the City's acceptable LOS, the following intersection requirements should be considered and improvements recommended if the project exceeds the noted operational goals:

LOS D is applicable to intersections that are adjacent to freeway on/off ramps, and adjacent to employment generating land uses. LOS C is applicable to all other intersections. For boundary intersections, LOS D is assumed to be acceptable.

Signalized Intersection Operating Requirements

- Any signalized study intersection operating at acceptable LOS without project traffic in which the addition of project traffic causes the intersection to degrade to unacceptable LOS shall identify improvements to provide acceptable LOS.

- Any signalized study intersection that is operating at unacceptable LOS without project traffic where the project increases delay by 5.0 or more seconds shall identify improvements to offset the increase in delay.

LOS D is applicable to intersections that are adjacent to freeway on/off ramps, and adjacent to employment generating land uses. LOS C is applicable to all other intersections. For boundary intersections, LOS D is assumed to be acceptable.

Unsignalized Intersection Impacts

Consistent with the acceptable General Plan LOS, use the following unsignalized intersection criteria when identifying operational deficiencies:

An operational improvement would be required if the study determines that either section a) or both sections b) and c) occur:

- a) The addition of project related traffic causes the intersection to degrade from an acceptable LOS to unacceptable LOS.

OR

- b) The project adds 5.0 seconds or more of delay to an intersection that is already projected to operate without project traffic at unacceptable LOS,

AND

- c) The intersection meets the peak hour traffic signal warrant after the addition of project traffic.

If the conditions above are satisfied, improvements should be identified that achieve the following:

- LOS D or better for case a) above or to pre-project LOS and delay for case b) above.

Roadway Segment General Plan Consistency Requirements

Intersections typically provide the transportation constraint on vehicle capacity. As such, these guidelines focus on the evaluation of intersections. However, in some instances, roadway segment evaluation will be required.

Consistent with the City's acceptable LOS, the following roadway segment requirements should be considered and improvements recommended if the project exceeds the noted operational goals:

- Any study roadway segment operating at acceptable LOS without project traffic in which the addition of project traffic causes the segment to degrade to unacceptable LOS should identify improvements to achieve acceptable LOS.
- Any roadway segment that operates at unacceptable LOS in the no project scenario where the project adds traffic in excess of 5% of the roadway capacity (e.g. a volume-to-capacity ratio increase of 0.05) should identify improvements to add capacity to the segment.

Site Access, Safety, and Other Analyses

A project's TIA should analyze site access and safety around the project and on adjacent streets. The recommended analyses are summarized below.

Site Access Analysis

The following analyses are recommended to improve the project access circulation and to limit driveways and local street access on arterial streets:

- a) **Intersection Sight Distance** – All on-site intersections, project access driveways or streets to public roadways should provide adequate sight distance. Adequate intersection sight distance should be determined using the Caltrans Highway Design Manual, or locally developed standards.
- b) **Driveway Length and Gated Entrance** – Primary project driveways should have a throat of sufficient length to allow vehicles to enter the project area without causing subsequent vehicles to back up into the public street system.
- c) **Limit Driveway Impacts** – Driveways and local streets access on arterial streets should be limited to minimize the impacts on arterial streets. Driveways should be located to maintain a reasonable distance from an adjacent intersection

and/or driveway. Whenever possible, driveways should be consolidated with adjacent properties.

- d) **Corner Clearance** – A driveway should be a sufficient distance from a signalized intersection so that right-turn egress movements do not interfere with the right-turn queue at the intersection. In addition, every effort should be made to provide right-turn egress movements with sufficient distance to enter the left-turn pocket at the adjacent intersection.
- e) **Right Turn Lanes at Driveways** – If the project right turn peak hour volume is 50 or more vehicles, a right-turn deceleration lane should be reviewed for appropriateness on all driveways accessing major arterial and secondary streets. The length of right turn lane should be sufficient to allow a vehicle traveling at the posted speed to decelerate before entering the driveway as outlined in the Caltrans Highway Design Manual.
- f) **Adequacy of pedestrian facilities** – Access to/from the project site providing convenient and direct access for those users.
- g) **Bicycle accessibility** – Access to/from nearby bike routes to the project site.
- h) **Accessibility from adjacent transit stops** – Access to/from the project site providing convenient and direct access for those users.

On-site Circulation

The TIA shall examine the proposed on-site circulation for the project and address its adequacy. This includes identifying the desired level of traffic control at project driveways and/or intersections.

Safety and Operational Analysis

The TIA shall examine existing roadway conditions to determine if safety and/or operational improvements are necessary due to an increase in traffic from the project or cumulative conditions. The types of improvements to be identified may include, but are not limited to:

- Need for turning lanes
- Intersections needing future sight distance studies
- On-street parking restrictions
- Measures to reduce cut-through traffic in adjacent residential areas and/or assessment of needed traffic calming measures
- Potential impacts to adjacent schools, parks, and/or trails

Intersection Turn Lane Queuing Analysis

The TIA shall examine the impacts on queue lengths, need for additional queuing area, and access to turn lanes at intersections and/or site access driveways.

Traffic Calming Measures

For residential developments, the need for traffic calming measures shall be assessed. Residential streets in excess of 660 feet in length shall be reviewed for potential excessive speeds (i.e., tangent sections greater than 660 feet in length, grades steeper than three percent, etc.) and cut-through traffic. If these issues are deemed as a possibility, then recommended traffic calming measures shall be discussed. The Engineer may coordinate with the Transportation Engineering Division prior to a TIA submittal to discuss possible solutions. Pending the approval of the TIA, the development application may require modification per the TIA findings.

For non-residential development near residential areas, schools, and/or parks, the potential for cut-through traffic shall be assessed. Recommendations to reduce the cut-through traffic potential shall be provided (i.e. number of driveways, driveway locations, access restrictions, etc.). Pending the approval of the TIA, the development application may require modification per the TIA findings.

Transit, Pedestrian, and Bicycle Facilities

The TIA shall identify existing transit routes, locations of heavy pedestrian activity, and designated bikeways within the study area. A qualitative assessment of these facilities' conditions shall be discussed in the TIA. Planned transit routes, pedestrian facilities, and bikeways shall also be identified for the study area. Incorporation of these planned facilities into the proposed project shall be discussed as necessary.

Traffic Signal Warrant Analysis

The Engineer shall review intersections within the study area, including the project access points, to determine if signal warrants are met for any of the study year scenarios (existing, opening year without and with project, etc.). The signal warrant analysis shall utilize the California MUTCD peak hour warrants for existing intersections and the California daily warrant (also in the California MUTCD) for new intersections. The warrant analysis worksheets shall be included in the study appendices.

In determining the location of a new traffic signal on an arterial street or approaching an arterial street, traffic progression and simulation analysis will be required using Synchro/SimTraffic software or equivalent at the direction of the TED.

Improvements for Transportation Impacts

As part of the final acceptance of a TIA, the local agency should review and approve any required improvements and/or fair share contributions necessary to improve the transportation-related deficiencies caused by the proposed development. These will normally be included as part of the conditions of approval and should be in addition to any improvements required by any other departments. Any transportation improvements based on a transportation study will be in addition to any other fees related to the existing fee programs. Credit can be taken against fees due if allowed by the fee program.

Fair share contributions identified in the TIA and subsequently listed in the conditions of approval shall be required before a building permit will be issued. Improvements required in a TIA and subsequently listed in the conditions of approval shall be completed prior to occupancy.

Proposed Mitigation Measures

Only feasible mitigation measures (i.e. right-of-way exists or can be acquired, receiving lanes exist or can be provided for additional turn lanes, environmental constraints do not exist, utilities do not prohibit the improvement, improvement costs are reasonable, etc.) shall be recommended. Mitigation measures that are determined to be infeasible should be discussed in the TIA and the factors resulting in the mitigation being infeasible should be identified.

All studies that propose increasing the number of travel lanes on a road or intersection as mitigation measures, either beyond existing conditions or for General Plan conditions beyond what is planned for that segment, shall clearly identify the impacts associated with such a change (i.e. right-of-way needed, parkway widths, utility relocations, traffic signal modifications, existing adjacent land uses and driveways, etc.). Identification of funding mechanisms available to fund the improvements and exhibits showing the lane configuration must be provided in the report. ***Additional through lanes above and beyond those identified in the City's General Plan should be viewed as a last resort in determining feasible mitigation.***

Funding Mechanisms

The project shall identify those facilities in the study area that are DIF facilities, TUMF facilities, covered by the traffic signal mitigation fee, covered by the interchange improvement fee, and/or identified in another regional funding mechanism.

Level of Service Improvements

Improvements for project level impacts should focus on providing operations that offset the project impact (e.g. achieve a “no project” level of service). Improvements could consist of signal phasing changes, providing Intelligent Transportation Systems features such as monitoring and control via agency-owned communication link to the City’s Transportation Management Center, intersection lane reassignment, or adding new lanes to study facilities.

Finally, the project applicant could revisit the project description in an effort to reduce the project impacts if viable.

For improvements to neighboring agency facilities, or improvements that are cumulative in nature, a fair share computation should be computed and reported for each such mitigation. The fair share amount should be calculated using the following formula:

$$\text{Fair share percentage} = \frac{\text{project trips}}{\text{project trips} + \text{future development trips}}$$

Trips noted above should correspond to the peak hour where the deficiency occurs for intersection assessment or daily trips for roadway segment impacts. If a project degrades operations during both peak hours, then the analysis should identify the peak hour for fair share assessment that has the higher fair-share percentage.

Fair-share contributions shall be calculated based on a reasonable planning-level cost estimate for the needed improvement. Said cost estimate shall be included in the report and is subject to TED review and comment prior to finalization.

CEQA Assessment - VMT Analysis

A key element of SB 743, signed in 2013, is the elimination of automobile delay and LOS as the sole basis of determining CEQA impacts. The most recent CEQA guidelines, released in December 2018, recommend VMT as the most appropriate measure of project transportation impacts. However, SB 743 does not prevent a city or county from continuing to analyze delay or LOS as part of other plans (e.g., the General Plan), studies, or ongoing network monitoring.

The following recommendations assist in determining VMT impact thresholds and mitigation requirements for various land use projects' TIAs.

Analysis Methodology

For purposes of SB 743 compliance, a VMT analysis should be conducted for land use projects as deemed necessary by the TED and would apply to projects that have the potential to increase the average VMT per capita/employee compared to the City's threshold. Normalizing VMT per capita/employee provides a transportation efficiency metric that allows the City to compare the project to the remainder of the incorporated area for purposes of identifying transportation impacts.

These guidelines are based on the WRCOG Implementation Pathway Study which provides methodologies for VMT screening. The methodology and significance thresholds presented below are based on the WRCOG Implementation Pathway Study.

Baseline VMT Methodology and Data

WRCOG calculated Base Year (2012) total VMT per service population (i.e., population plus employment), home-based VMT per capita, and home-based work VMT per worker, using outputs from the Southern California Association of Governments' (SCAG) Regional Transportation Plan travel forecasting model, the Riverside County Transportation Analysis Model (RIVTAM), and the Riverside County Model (RIVCOM).

In addition, WRCOG used data from the California Household Travel Survey to compare model derived estimates of home-based VMT with those based on survey observations. VMT results were compared to determine the appropriate metric and data source in WRCOG's subregion. WRCOG has also developed a screening tool that would use RIVTAM/RIVCOM model inputs and outputs based on an efficiency form of VMT. This tool can be utilized to provide an initial screening of potential VMT impacts for projects and to provide evidence to support presumptions of less than significant impact findings.

Project Screening

Three screens can be applied to effectively screen activities/projects from project-level assessment.

Step 1: Transit Priority Area (TPA) Screening

Projects located within a TPA³ may be presumed to have a less than significant impact absent substantial evidence to the contrary. This presumption may not be appropriate if the project:

1. Has a Floor Area Ratio (FAR) of less than 0.75;
2. Includes more parking for use by residents, customers, or employees of the project than required by the jurisdiction (if the jurisdiction requires the project to supply parking);
3. Is inconsistent with the applicable Sustainable Communities Strategy (as determined by the lead agency, with input from the Metropolitan Planning Organization); or
4. Replaces affordable residential units with a smaller number of moderate- or high-income residential units.

³ A TPA is defined as a half-mile area around an existing major transit stop or an existing stop along a high quality transit corridor per the definitions below.

Pub. Resources Code, § 21064.3 - 'Major transit stop' means a site containing an existing rail transit station, a ferry terminal served by either a bus or rail transit service, or the intersection of two or more major bus routes with a frequency of service interval of 15 minutes or less during the morning and afternoon peak commute periods.

Pub. Resources Code, § 21155 - For purposes of this section, a 'high-quality transit corridor' means a corridor with fixed route bus service with service intervals no longer than 15 minutes during peak commute hours.

Step 2: Low VMT Area Screening

Residential and office projects located within a low VMT-generating area may be presumed to have a less than significant impact absent substantial evidence to the contrary. In addition, other employment-related and mixed-use land use projects may qualify for the use of screening if the project can reasonably be expected to generate VMT per resident, per worker, or per service population that is similar to the existing land uses in the low VMT area.

For this screening in the WRCOG area, the RIVTAM travel forecasting model was used to measure VMT performance for individual jurisdictions and for individual traffic analysis zones (TAZs). TAZs are geographic polygons similar to Census block groups used to represent areas of homogenous travel behavior. Total daily VMT per service population (population plus employment) was estimated for each TAZ. This presumption may not be appropriate if the project land uses would alter the existing built environment in such a way as to increase the rate or length of vehicle trips.

To identify if the project is in a low VMT-generating area, the analyst may review the WRCOG screening tool and apply the appropriate threshold (identified later in this chapter) within the tool. Additionally, as noted above, the analyst must identify if the project is consistent with the existing land use within that TAZ and use professional judgement that there is nothing unique about the project that would otherwise be misrepresented utilizing the data from the travel demand model.

The WRCOG screening tool can be accessed at the following location:

<http://gis.fehrandpeers.com/WRCOGVMT/>

Step 3: Project Type Screening

Local serving retail projects less than 50,000 square feet may be presumed to have a less than significant impact absent substantial evidence to the contrary. Local serving retail generally improves the convenience of shopping close to home and has the effect of reducing vehicle travel.

In addition to local serving retail, the following uses can also be presumed to have a less than significant impact absent substantial evidence to the contrary as their uses are local serving in nature:

- Local-serving K-12 schools
- Local parks
- Day care centers

- Local-serving gas stations
- Local-serving banks
- Local-serving hotels (e.g. non-destination hotels)
- Student housing projects
- Local serving community colleges that are consistent with the assumptions noted in the RTP/SCS
- Projects generating less than 400 daily vehicle trips⁴
 - This generally corresponds to the following “typical” development potentials⁵:
 - 42 single family housing units
 - 60 multi-family, condominiums, or townhouse housing units
 - 41,000 sq. ft. of office
 - 10,500 sq. ft. general retail
 - 57,500 sq. ft. of light industrial
 - 112,500 sq. ft. of warehousing
 - 285,700 sq. ft. of high cube transload and short-term storage warehouse

VMT Assessment for Non-Screened Development

Projects not screened through the steps above should complete VMT analysis and forecasting through the RIVTAM/RIVCOM model to determine if they have a significant VMT impact. This analysis should include ‘project-generated VMT’ and ‘project effect on VMT’ estimates for the project TAZ (or TAZs) under the following scenarios:

- Existing conditions: This data is already available in the web screening map, but shall be interpolated to reflect the Notice of Preparation (NOP) Baseline Year.

⁴ The OPR technical advisory notes that CEQA provides a categorical exemption for existing facilities, including additions to existing structures of up to 10,000 square feet, so long as the project is in an area where public infrastructure is available to allow for maximum planned development and the project is not in an environmentally sensitive area. (CEQA Guidelines, § 15301, subd. (e)(2)). Typical project types for which trip generation increases relatively linearly with building footprint (i.e., general office building, single tenant office building, office park, and business park) generate or attract an additional 110-124 trips per 10,000 square feet. However, local air quality analysis has shown that various developments can have GHG production below AQMD limits with up to 400 trips per day. Therefore, absent substantial evidence otherwise, it is reasonable to conclude that the addition of 400 or fewer trips could be considered not to lead to a significant impact.

⁵ Threshold may be higher depending on the tenant and the use of the site. This number was estimated using rates from ITE’s Trip Generation Manual.

- **Existing Plus Project:** The project land use would be added to the project TAZ or a separate TAZ would be created to contain the project land uses. A full base year model run would be performed and VMT changes would be isolated for the project TAZ and across the full model network. The model output must include reasonableness checks of the production and attraction balancing to ensure the project effect is accurately captured. If this scenario results in a less-than-significant impact, then additional cumulative scenario analysis may not be required (more information about this outcome can be found in the Thresholds Evaluation discussion later in this chapter).
- **Cumulative No Project:** This data is available from WRCOG.
- **Cumulative Plus Project:** The project land use would either be added to the project TAZ or a separate TAZ would be created to contain the project land uses. The addition of project land uses should be accompanied by a reallocation of a similar amount of land use from other TAZs; especially if the proposed project is significant in size such that it would change other future developments. Land use projects will generally not change the cumulative no project control totals for population and employment growth. Instead, they will influence the land use supply through changes in general plan land use designations and zoning. If project land uses are simply added to the cumulative no project scenario, then the analysis should reflect this limitation in the methodology and acknowledge that the analysis may overestimate the project's effect on VMT.

The model output should include total VMT, which includes all vehicle trips and trip purposes. Total VMT (by speed bin) is needed as an input for air quality, greenhouse gas (GHG), and energy impact analysis.

Both “plus project” scenarios noted above will summarize two types of VMT: (1) project generated VMT per capita/employee and comparing it back to the appropriate benchmark noted in the thresholds of significance, and (2) the project effect on VMT, comparing how the project changes VMT on the network looking at Citywide VMT per and comparing it to the no project condition.

Project-generated VMT shall be extracted from the travel demand forecasting model using the origin-destination trip matrix and shall multiply that matrix by the final assignment skims. The project-effect on VMT shall be estimated using a subregional boundary (such as a City limit or WRCOG TUMF Zone boundary) and extracting the total link-level VMT for both the no project and with project condition.

A detailed description of this process is attached to these guidelines (Exhibit C).

CEQA VMT Impact Thresholds

The following are the Moreno Valley thresholds of significance for use as part of the environmental review process under CEQA:

1. A project would have a significant VMT impact if, in the Existing Plus Project scenario, its net VMT per capita (for residential projects) or per employee (for office and industrial projects) exceeds the per capita VMT for Moreno Valley. For all other uses, a net increase in VMT would be considered a significant impact.
2. If a project is consistent with the regional RTP/SCS, then the cumulative impacts shall be considered less than significant subject to consideration of other substantial evidence. If it is not consistent with the RTP/SCS, then it would have a significant VMT impact if:
 - a. For residential projects its net VMT per capita exceeds the average VMT per capita for Moreno Valley in the RTP/SCS horizon-year.
 - b. For office and industrial projects its net VMT per employee exceeds the average VMT per employee for Moreno Valley in the RTP/SCS horizon year
 - c. For all other land development project types, a net increase in VMT in the RTP/SCS horizon-year would be considered a significant impact.

Note that the Cumulative No Project scenario shall reflect the adopted RTP/SCS; as such, if a project is consistent with the regional RTP/SCS, then the cumulative impacts shall be considered less than significant subject to consideration of other substantial evidence.

VMT Mitigation Measures

Any initial study prepared for a proposed project would consider and address the above threshold of significance, in addition to the other questions presented in the Initial Study checklist. If the project exceeds the threshold, it would normally be determined that the proposed project would have a significant impact on the environment, thereby requiring VMT reduction measures. Various Transportation Demand Management (TDM) strategies have been reviewed and their effectiveness for reducing VMT. Given Moreno Valley's suburban land use context, the following key strategies provide the best opportunities to reduce VMT.

To mitigate VMT impacts, the following choices are available to the applicant:

1. Project-level mitigation includes measures such as site design, location efficiency, and building operations.
2. Increase diversity of land uses: This strategy focuses on inclusion of mixed uses within projects or in consideration of the surrounding area to minimize vehicle travel in terms of both the number of trips and the length of those trips.
3. Provide pedestrian network improvements: This strategy focuses on creating a pedestrian network with the project and connecting to nearby destinations. For example, a nearby sidewalk gap closure could be included as a mitigation measure.
4. Traffic calming measures and low-stress bicycle network improvements: Traffic calming creates networks with low vehicle speeds and volumes that are more conducive to walking and bicycling. Building a low-stress bicycle network produces a similar outcome.
5. Implement car-sharing program: This strategy reduces the need to own a vehicle or reduces the number of vehicles owned by a household by making it convenient to access a shared vehicle for those trips where vehicle use is essential.
6. Increase transit service frequency and speed: This strategy focuses on improving transit service convenience and travel time competitiveness with driving. New forms of low-cost demand-responsive transit service could be provided.
7. Encourage telecommuting and alternative work schedules: This strategy relies on effective internet access and speeds to individual project sites/buildings to provide the opportunity for telecommuting.
8. Provide ride-sharing programs: This strategy focuses on encouraging carpooling and vanpooling by project site/building tenants and has similar limitations as the strategy above.

Evaluation of VMT reductions should be evaluated using state-of-the-practice methodologies recognizing that many of the TDM strategies are dependent on building tenant performance over time. As such, to verify actual VMT reductions on-going monitoring may be necessary to gauge performance related to mitigation expectations.

CEQA Assessment - Active Transportation and Public Transit Analysis

Potential impacts to public transit, pedestrian facilities and travel, and bicycle facilities and travel can be evaluated using the following criterion.

- A significant impact occurs if the project conflicts with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decreases the performance or safety of such facilities.

Therefore, the TIA should include analysis of a project to examine if it is inconsistent with adopted policies, plans, or programs regarding active transportation or public transit facilities, or otherwise decreases the performance or safety of such facilities and make a determination as to whether it has the potential to conflict with existing or proposed facilities supporting these travel modes.

Transportation Impact Study

Format

Content and Format

TIA Content

The format and required elements to be included in the TIA report are specified in the outline below. Deviations from this format require the approval of the TED.

The TIA will generally include the following major components:

- Level of Service analysis
- Proposed mitigation measures and determination of feasibility Traffic signal warrant analysis
- On-site circulation assessment
- Identification of safety and operational improvements
- Need for traffic calming measures in residential areas, including areas near schools and/or parks
- Transit, pedestrian, and bicycle facilities assessment

In addition to the above, General Plan Amendments and Specific Plans shall include the following:

- General Plan conformance review
- Identification of regional funding mechanisms

TIA Format

The recommended TIA format is as follows:

1. Executive Summary
 - a. Table summarizing significant impacts and mitigation measures
2. Introduction
 - a. Purpose of the TIA and study objective
 - b. Project location and vicinity map (Exhibit)
 - c. Project size and description
 - d. Existing and proposed land use and zoning
 - e. Site plan and proposed project (Exhibit)
 - f. Proposed project opening year and analysis scenarios
3. Methodology and Impact Thresholds
4. Existing Conditions
 - a. Existing roadway network
 - b. Existing traffic control and intersection geometrics (Exhibit)
 - c. Existing traffic volumes – AM and PM peak hour and ADT (Exhibit)
 - d. Existing level of service (LOS) at intersections (Table)
 - e. Existing bicycle facilities (Exhibit)
 - f. Existing transit facilities (Exhibit)
 - g. Existing pedestrian facilities
5. Project Traffic
 - a. Trip generation (Table)
 - b. Trip distribution and assignment (Exhibit)
 - c. Project peak hour turning movements and ADT (Exhibit)
6. Background Conditions (Opening Year) Analysis
 - a. No Project analysis
 - i. Committed (funded) roadway improvements
 - ii. Approved project trip generation (Table, if required)
 - iii. Approved project trip assignment and distribution (Exhibit, if required)
 - iv. Peak turning movement and ADT (Exhibit)
 - v. Intersection level of service (Table)
 - vi. Roadway segment level of service (Table)
 - b. With Project analysis
 - i. With Project peak turning movement and ADT (Exhibit)
 - ii. Intersection level of service (Table)
 - iii. Roadway segment level of service (Table)

- iv. Identification of intersection and roadway segment deficiencies
- 7. Traffic Signal Warrant Analysis
- 8. Site Access Analysis
- 9. Safety and Operation Improvement Analysis
- 10. Active Transportation and Public Transit Analysis
- 11. Improvements and Recommendations
 - a. Proposed improvements at intersections
 - b. Proposed improvements at roadway segments
 - c. Recommended Improvements categorized by whether they are included in fee plan or not (identify if these improvements are included in an adopted fee program)
- 12. Vehicle Miles Traveled (VMT) Analysis
 - a. Project VMT per person/employee for all analysis scenarios
 - b. Project impact on VMT for all analysis scenarios
 - c. Identification of VMT impacts
 - d. Proposed VMT Mitigation Measures
- 13. Appendix
 - a. Approved scope of work
 - b. Traffic counts
 - c. Intersection analysis worksheets
 - d. VMT and TDM calculations
 - e. VMT and TDM mitigation calculations
 - f. Signal warrant worksheets

SUBMITTAL REQUIREMENTS AND PROCEDURE

A TIA report will not be reviewed until the Planning Department has assigned a case number to the project (coordinate with the project applicant for this information), a Scoping Agreement has been signed by the Transportation Engineering Division, and review fees have been paid to the Permit Technician, Land Development Division. Contact the Land Development Division at 951.413.3110 prior to the delivery of the traffic study for submittal and fee payment requirements. Review fees are based upon whether the TIA is a minor or major study and are subject to change at the beginning of a fiscal year.

Upon approval of the Scoping Agreement and completion of the first draft of traffic study report, submit two bound copies and one electronic copy of the TIA report to the Permit Technician, Land Development Division with the appropriate fee amount. Clearly identify the project case number on the cover of the report. The approved Scoping Agreement shall be included as an appendix to the TIA report.

If revisions to the TIA report are necessary, resubmit two complete bound copies and one electronic copy along with a copy of the comments provided by the TED. Additional copies of the complete bound report may be requested after approval of the final draft.

Acknowledgements

The City wishes to thank Rob Olson with HR Green, whose extensive, timely, expert assistance made this version of the document possible.

Attachments

- Exhibit A. Scoping Agreement for TIA
- Exhibit B. LOS Standards (from General Plan)
- Exhibit C. Detailed VMT Forecasting Information

EXHIBIT A

Project Scoping Form

This scoping form shall be submitted to the Lead Agency to assist in identifying infrastructure improvements that may be required to support traffic from the proposed project.

Project Identification:

Case Number:	
Related Cases:	
SP No.	
EIR No.	
GPA No.	
CZ No.	
Project Name:	
Project Address:	
Project Opening Year:	
Project Description:	

	Consultant:	Developer:
Name:		
Address:		
Telephone:		
Email:		

Trip Generation Information:

Trip Generation Data Source: _____

Current General Plan Land Use:

Proposed General Plan Land Use:

Current Zoning:

Proposed Zoning:

	Existing Trip Generation			Proposed Trip Generation		
	In	Out	Total	In	Out	Total
AM Trips						
PM Trips						

Trip Internalization: Yes No (_____% Trip Discount)

Pass-By Allowance: Yes No (_____% Trip Discount)

Potential Screening Checks

Is your project screened from specific analyses (see Page 3 of the guidelines related to LOS assessment and Pages 22-23 for VMT screening criteria).

Is the project screened from LOS assessment? Yes No

LOS screening justification (see Page 3 of the guidelines): _____

Is the project screened from VMT assessment? Yes No

VMT screening justification (see Pages 22-23 of the guidelines): _____

Level of Service Scoping

- Proposed Trip Distribution (Attach Graphic for Detailed Distribution):

North	South	East	West
%	%	%	%

Link level of service and data collection:

_____ will be required
 _____ will not be required

- Attach list of study intersections (and roadway segments if applicable)
- Attach site plan
- Other specific items to be addressed:
 - Site access
 - On-site circulation
 - Parking
 - Consistency with Plans supporting Bikes/Peds/Transit
 - Other _____
- Date of Traffic Counts _____
- Attach proposed analysis scenarios (years plus proposed forecasting approach)
- Attach proposed phasing approach (if the project is phased)

VMT Scoping

For projects that are not screened, identify the following:

- Travel Demand Forecasting Model Used _____
- Attach WRCOG Screening VMT Assessment output or describe why it is not appropriate for use
- Attach proposed Model Land Use Inputs and Assumed Conversion Factors (attach)

EXHIBIT B: Level of Service Standards

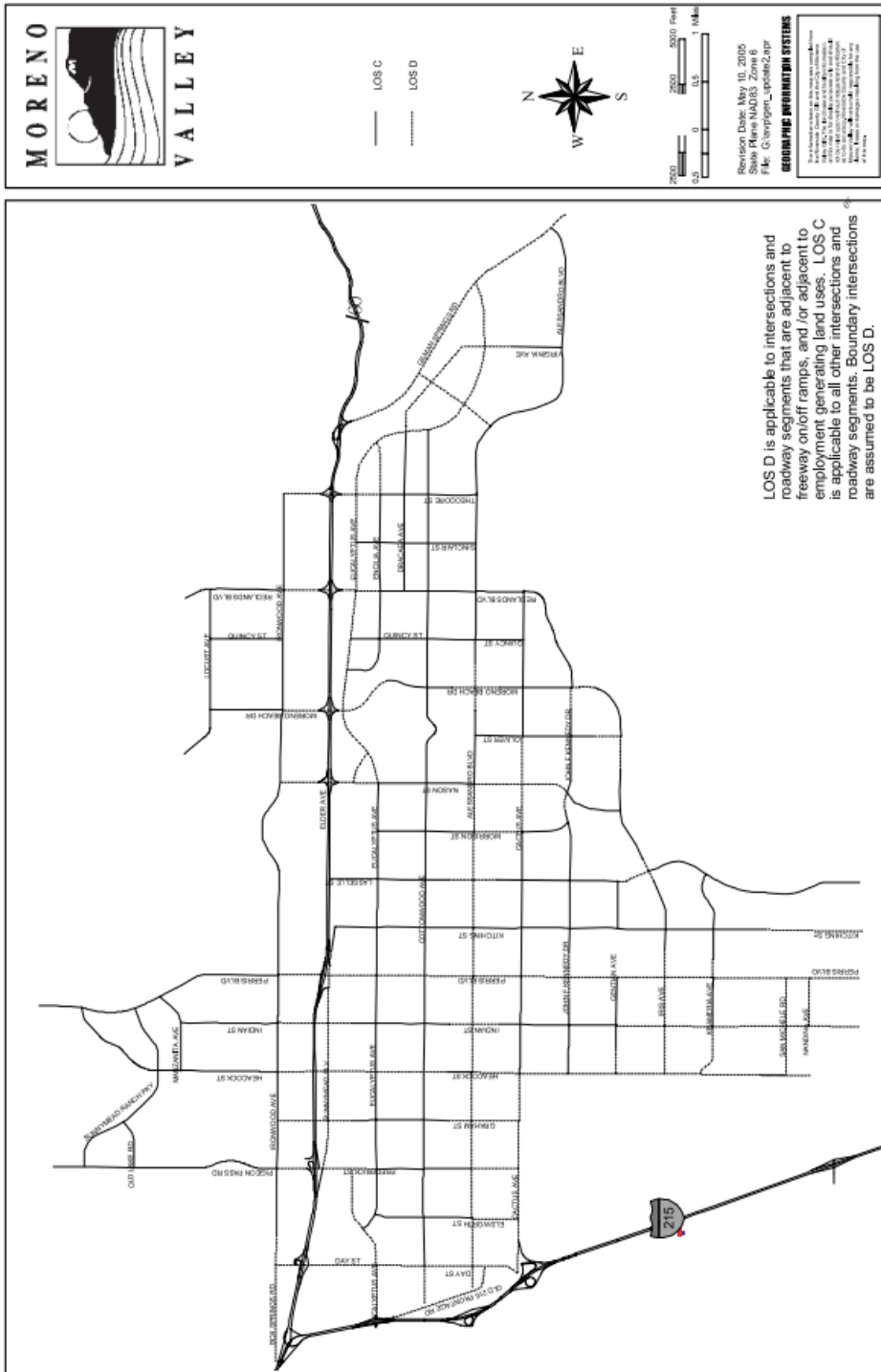


Figure 5.2-7
LOS Standards

City of Moreno Valley
 July 2006

Moreno Valley General Plan
 Final Program EIR

EXHIBIT C

Detailed VMT Forecasting Information

Most trip-based models generate daily person trip-ends for each TAZ across various trip purposes (Home Based Work – HBW; Home Based Other – HBO; and Non-Home Based – NHB; for example) based on population, household, and employment variables. This may create challenges for complying with the VMT guidance because trip generation is not directly tied to specific land use categories. The following methodology addresses this particular challenge among others.

Production and attraction trip-ends are separately calculated for each zone, and generally, production trip-ends are generated by residential land uses and attraction trip-ends are generated by non-residential land uses. OPR's guidance addresses residential, office, and retail land uses. Focusing on residential and office land uses, the first step to forecasting VMT requires translating the land use into model terms, the closest approximations are:

- Residential: home-based production trips
- Office: home-based work attraction trips

Note that this excludes all non-home-based trips including work-based other and other-based other trips.

The challenges with computing VMT for these two types of trips in a trip-based model are 1) production and attraction trip-ends are not distinguishable after the P-A to O-D conversion process and 2) trip purposes are not maintained after the mode choice step. For these reasons, it not possible to use the VMT results from the standard vehicle assignment (even using a select zone re-assignment). A separate post-process must be developed to re-estimate VMT for each zone that includes trip-end types and trip purposes. Two potential approaches to tackle this problem are described below.

Quick and Easy

This approach uses standard model output files and requires minimal custom calculations. It is based on a regional MPO trip-based model with peak (PK) and off-peak (OP) skims and person trip production-attraction (P-A) matrices.

- Calculate custom vehicle trip PA matrices from PK and OP person trip matrices
 - Keep trip purposes and modes separate
 - Use average vehicle occupancy rates for drive-alone and shared ride trips

- Use the final congested drive-alone PK and OP skim matrices to estimate trip length between zones
- Multiply the skim matrices by vehicle trip matrices to estimate VMT
- Sum the PK and OP results to estimate daily VMT and aggregate mode trip purpose and mode
- Calculate automobile VMT for individual TAZs using marginal totals:
 - Residential (home-based) - row total
 - Office (home-based work) - column total

Detailed and Complicated

The quick and easy process described above simplifies the approach but does not account for different congestion patterns throughout the day (AM, MD, PM, and NT), the direction of travel (all productions are origins and all attractions are destinations), or the benefits of exclusive lanes (HOV or HOT lanes). This more detailed approach attempts to address these limitations and better estimate the VMT produced by the vehicle assignment model.

- Re-skim final loaded congested networks for each mode and time period
- Run a custom P-A to O-D process that replicates actual model steps, but:
 - Keeps departure and return trips separate
 - Keeps trip purpose and mode separate
 - Converts person trips to vehicle trips based on auto occupancy rates and isolates automobile trips
 - Factors vehicle trips into assignment time periods
- Multiply appropriate distance skim matrices by custom O-D matrices to estimate VMT
- Sum matrices by time period, mode, and trip purpose to calculate daily automobile VMT
- Calculate automobile VMT for individual TAZs using marginal totals:
 - Residential (home-based) - row of departure matrix plus column of return matrix
 - Office (home-based work) - column of departure matrix plus row of return matrix

Appropriateness Checks

Regardless of which method is used, the number of vehicle trips from the custom P-A to O-D process and the total VMT should match as closely as possible with the results from

the traditional model process. The estimated results should be checked against the results from a full model run to understand the degree of accuracy. Note that depending on how each model is setup, these custom processes may or may not include IX/XI trips, truck trips, or special generator trips (airport, seaport, stadium, etc.).

When calculating VMT for comparison at the study area, citywide, or regional geography, the same methodology that was used to estimate project-specific VMT should be used. The VMT for these comparisons can be easily calculated by aggregating the row or column totals for all zones that are within the desired geography.