



Traffic Impact Study Manual



MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION
TRAFFIC SYSTEMS MANAGEMENT DIVISION
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INTRODUCTION

One of Maricopa County's key objectives is to operate and maintain a safe and efficient roadway system. The review and management of development-generated traffic is an integral part of reaching this goal. The Traffic Impact Procedures as outlined in this document have been established to meet this objective. The Traffic Impact Procedures establish a range of traffic impact study categories based on the characteristics of the development and the estimated peak hour traffic volumes. The procedures also outline the analysis approach and methods.

A Traffic Impact Study (TIS) or a Traffic Statement (TS) identifies existing traffic volumes and conditions, proposed development traffic volumes and conditions and their combined impacts on the existing and future roadway system. The study is a useful tool for early identification of potential traffic problems and can play an important part in the success of a development. When insufficient attention is given to the assessment of traffic impacts, the following problems may result:

- on-site congestion and/or congestion on adjacent roadways
- inadequate access capacity
- high accident experience
- limited flexibility to modify the development to eliminate problems or adjust to changed conditions

These problems can negatively affect the success of a development and can damage the marketability and return on investment of the development. A traffic study provides an opportunity for the County and the developer to share information and jointly address traffic related problems. It provides a means of balancing development needs with the functional integrity of the roadways that serve both the development and the region.

The need for a Traffic Study or Traffic Statement should be assessed as early as possible in the development process when there is maximum flexibility for eliminating traffic-related problems. This generally may occur when the development application is filled out and a Technical Advisory Committee (TAC) meeting is held at the county's Planning and Development Department. Preparation of a TIS at this stage in the development process is also recommended by the Institute of Transportation Engineers (ITE) in the publication "Transportation and Land Development".

The procedures contained herein are provided to:

- assist developers through the approval process by outlining the requirements and level of detail of traffic analysis that will be required of them during the approval process
- standardize the types and details of analysis required in the assessment of traffic impacts for developments with similar levels of size and intensity
- ensure consistency in the preparation and review of a TIS through standardization of the reports

A TIS shall be required of all developments or additions to existing developments generating 100 or more trips during the morning or afternoon peak hour on adjacent streets. The criteria for submitting a TIS is further discussed in Section 1.1. Figure 1 is intended to show the development process that would require a TIS.

For developments generating less than 100 peak hour trips, a Traffic Statement (TS) may be required. The criteria for submitting a TS is further discussed in Section 1.2.

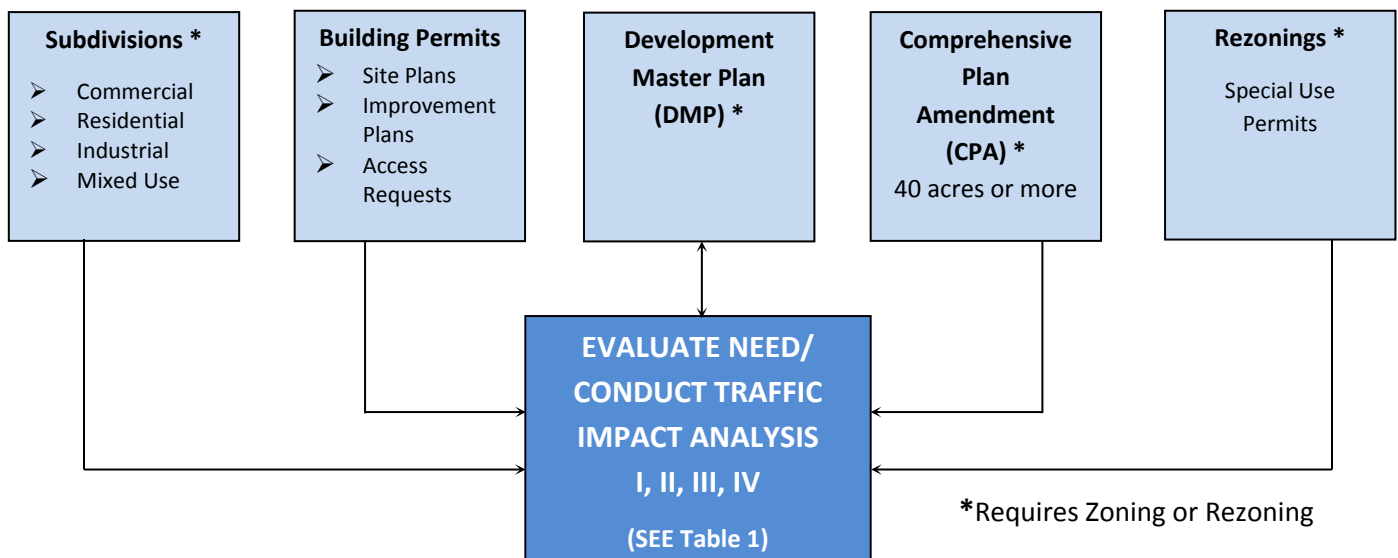
All large development projects processed under a Development Master Plan (DMP), a Comprehensive Plan Amendment (CPA), or rezoning case will generally all require a TIS at first submittal. Subsequent or revised TIS may be required during the subdivision or building permit processes under the following conditions:

- development phasing exceeds two-years
- the level of development changes significantly to warrant a new study
- the adjacent roadway system changes significantly to warrant a new study
- detailed information for commercial access analysis was not available during the initial development process

A final sealed TIS shall be submitted to both the developer and the County for review. Under certain circumstances, a preliminary traffic study may be submitted to the County for general guidance. Review comments are to be provided within two weeks of submittal whenever possible. If it is determined that the proposed development impacts two or more governmental jurisdictions, additional time should be allowed for review by other agencies.

Transportation Systems Management Division

**Figure 1
Typical Developments that Would Require A TIS**



1 Traffic Impact Studies and Traffic Statements

1.1 Traffic Impact Study (TIS)

As discussed in the Introduction above, a Traffic Impact Study (TIS) is required for all new developments or additions to existing developments, for any of the development processes shown in Figure 1, which generate 100 or more trips during the morning or afternoon peak hour. The specific analysis requirements and level of detail are summarized in Table 1 and are determined by the following categories:

CATEGORY I - Developments which generate 100 or more peak hour trips but fewer than 500 trips during the morning or afternoon peak hour. A Category I Traffic Impact Study (TIS) may also be required for sites generating less than 100 trips during the morning or afternoon peak hour for any of the following reasons:

- the existence of any current traffic problems or concerns in the local area such as an offset intersection, a high number of traffic accidents, et cetera
- the sensitivity of the adjacent neighborhoods or other areas where the public may perceive an adverse impact
- the proximity of site drives to other drives or intersections
- other specific problems or concerns that may be aggravated by the proposed development

Should any of the aforementioned conditions arise the MCDOT Transportation Systems Management Division will evaluate the need for the study based on these issues.

CATEGORY II - Developments which generate 500 or more peak hour trips but fewer than 1,000 trips during the morning or afternoon peak hour.

CATEGORY III - Developments which generate between 1,000 and 1500 peak hour trips during the morning or afternoon peak hour.

CATEGORY IV - Developments which generate more than 1,500 trips during the morning or afternoon peak hour.

The estimated number of vehicle trips generated by the proposed development during the peak hours is based on the latest edition of the ITE Trip Generation Manual. A table of common trip generating facilities is provided in Appendix A.

1.2 Traffic Statement (TS)

As discussed in the Introduction above, a development or revision to an existing developed site that generates less than 100 peak hour trips may be required to submit a TS. The TS is a scaled down and simplified version of the TIS and is intended for smaller projects that will have lesser impacts on existing traffic as compared to the larger type developments. It shall address pertinent features of the proposed

development which may impact traffic on the existing roadways adjacent to the site. The TS shall include, but not be limited to:

- Vicinity map and/or site map showing the location of the site and all adjacent roadways. A discussion of the roadway the site is accessing, including number of lanes, classification, ADT and jurisdiction should be included.
- All existing traffic control (stop sign or signal) near the site that will impact traffic.
- Description of the proposed development. Use the appropriate ITE Land Use code when feasible. Provide an opening year and/or buildout date if known.
- AM and PM peak hour trips generated for all movements at the proposed site access points. Usually opening year peak hour trips will be adequate, but for some projects, if the total peak hour trips are approaching the 100 trip threshold, then a horizon year of 5 years after opening may be required.
- Location, size and spacing of proposed driveways, along with driveways and access points adjacent to and opposite of the proposed development.
- Trip distribution for both AM and PM peak hour site generated traffic entering and exiting the site.
- Percent of site truck/passenger vehicles expected and site design vehicle.
- Need for right or left turn lanes into or out of the site.
- Identify whether a significant number of peak hour trips will be heavy trucks, either during construction or standard operation of the project. If heavy construction traffic, discuss any mitigation measures that will be taken to accommodate that traffic.
- Discuss any other features of the project which could have an adverse impact on existing traffic. These could include seasonal or off-peak operations, etc.
- Include recommendations for roadway improvements needed due to site generated traffic.

2 TIS Analysis Approach and Methods

The traffic analysis approach and methods are presented below:

2.1 Project Description

The study shall discuss the proposed project including type (residential, commercial), size (number of lots, building square footage) along with expected opening dates. The description should include the number of acres and a general description of the surrounding area (agricultural, suburban). This section should also include a discussion of jurisdictional boundaries. Which jurisdictions besides Maricopa County may be affected by the project and which other jurisdictions may need to approve the traffic study or issue construction permits.

2.2 Study Area

The minimum study area will be determined by project type and size in accordance with the criteria in Table 1. The study area for the proposed development should include signalized and unsignalized intersections. Proposed driveway accesses should also be analyzed to ensure their operation and adequate level of service. The MCDOT Transportation Systems Management Division may require expansion of the study area based upon project complexity, topography, and other roadway characteristics that may be impacted by the proposed project or any neighborhood that is adjacent to the proposed development for the Category I analysis. Category III analysis may have study areas extending to two or more miles beyond the project boundary. For example, a large (Category III) development in a rural area located two miles from a freeway interchange from which most of the trips are anticipated to access the development may require an enlarged study area to include assessment of the freeway interchange and coordination with state DOT (ADOT).

Table 1: Criteria for Determining Study Requirements

Analysis Category	Development Characteristic	Study Horizons a	Minimum Study Area b
I	Small Development 100-499 peak hour trips (AM or PM)	<ol style="list-style-type: none"> 1. Opening year 2. 3-5 years after opening 	<ol style="list-style-type: none"> 1. Site access driveways 2. Adjacent signal controlled intersections within ¼ mile and/or major street intersections without signal control and driveways within 500 feet
II	Moderate Development 500-999 peak hour trips (AM or PM)	<ol style="list-style-type: none"> 1. Opening year 2. 5 years after opening 	<ol style="list-style-type: none"> 1. Site access driveways 2. All signal controlled intersections within ½ mile and/or major street intersections without signal control and driveways within ½ mile
III	Large Development 1,000-1,500 peak hour trips (AM or PM)	<ol style="list-style-type: none"> 1. Opening year 2. 10 years after opening 	<ol style="list-style-type: none"> 1. Site access driveways 2. All signal controlled intersections within 1 mile and/or major street intersections without signal control and driveways within 1 mile
IV	Regional Development >1,500 peak hour trips (AM or PM)	<ol style="list-style-type: none"> 1. Opening year 2. Significant phases 3. 15 years after opening 	<ol style="list-style-type: none"> 1. Site access driveways 2. Key signal controlled intersections and major street intersections without signal control within 3 miles

- a. Assume full occupancy and build-out for single-phase developments. Multi-phase developments may require assessment of up to three (3) horizon years corresponding to key phases as directed

by the County Traffic Engineer.

- b. An enlarged study area may be required when the minimum study areas identified in Table 1 does not provide sufficient information to meet the intent of the Traffic Impact Study guidelines.

2.3 Study Horizon Years

The study horizon years will be determined by the project type and the size of a development in accordance with the criteria in Table 1. Any known significant developments within the study area that have been approved or are planned within the specified horizon year shall be identified and discussed in the study. Opening year should be evaluated as a minimum. If the buildout year is different from opening year, then buildout year should also be evaluated. For most studies, a minimum of three years and preferably five years after buildout should also be evaluated unless otherwise specified by MCDOT. If the project has multiple phases, the horizon year should correlate to each phase.

2.4 Project Phasing

The study shall state whether the project will be built in one or multiple phases. If multiple phasing is planned, the study shall identify each phase and what roadway improvements will be constructed with each phase. The phasing should then relate to the horizon year. The Developer, or their consultant, shall include the number of trips generated and time line for each phase if known. For large and multiple phased projects, the TIS should indicate if traffic studies will be submitted for future phases.

2.5 Analysis Time Period

2.5.1 Morning and Afternoon (AM/PM) Weekday Peak Hours

The TIS shall analyze the traffic peak hours. Peak hours generally occur during both the morning and afternoon weekday peak hours, typically between 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. respectively. Normal peak hours may vary under certain conditions as described below:

- If the proposed project is expected to generate no trips or a very low number of trips during either the morning or evening peak periods, the requirement to analyze one or both of these periods may be waived by MCDOT.
- Where the peak traffic hour in the study area occurs during midday weekday (schools require an analysis of the peak period during the school start-up and school let-out), or occurs on a weekend (park events, shopping centers, church facilities), or if the proposed project has unusual peak hour characteristics (such as retirement areas), these peak hours must also be analyzed.

2.6 Seasonal Adjustments

The traffic volumes for the analysis hours shall be adjusted for the peak season if appropriate. Use of seasonal adjustment factors should be coordinated with and approved by MCDOT. The intent of this adjustment is not to maximize volumes, but to address variations in peak seasonal volumes. For example, if traffic counts were collected in a retirement community in July, and the peak traffic period occurs during the winter months, the counts shall be adjusted to winter months.

2.7 Existing Conditions

This section should discuss the surrounding roadway network. The major roads adjacent to and near the proposed project should be included. The discussion should include but not be limited to the following:

2.7.1 Roadway Configuration

Roadway configuration and geometry should be discussed, including roadway classification, lane and shoulder width, number of lanes, turning lanes, including elevation or grade differences. Discuss the location of nearby driveways, lane configuration at intersections and any striping configurations such as extra wide lanes, carrots, etc.

2.7.2 Data Collection

All data is to be collected in accordance with the latest edition of the ITE *Manual of Transportation Engineering Studies* or as directed by the MCDOT's Transportation Systems Management Division if not specifically covered in the ITE Manual.

2.7.3 Traffic Volumes

Both existing ADT's and turning movement counts should be discussed in this section. The current and projected daily traffic volumes shall be presented in the report. Available daily count data may be obtained from the MCDOT website and extrapolated a maximum of two years with the concurrence of the MCDOT's Transportation Systems Management Division. Both AM and PM turning movement counts should be obtained for all existing intersections directly adjacent to or within proximity where the proposed site traffic will have a direct impact on the intersection. The exact need for turning movement counts will depend on the size and type of project and should be determined by the traffic engineer preparing the TIS as to what benefit they would be to the analysis. Available turning movement counts may be extrapolated a maximum of two years with concurrence of the MCDOT's Transportation Systems Management Division.

Where daily count data are not available, the Transportation Systems Management Division may require counts for those roadway segments.

2.7.4 Crash Data

Traffic crash data shall be obtained from Maricopa County or ADOT (ALISS) for the most current three-year period available. The predominant collision types, their locations, and driver behavior (if necessary) should be included in the collision discussion.

2.7.5 Traffic Control Devices

The location and type of intersection control whether signalized or stop controlled shall be identified for roads adjacent or nearby the proposed site.

2.7.6 Existing Level of Service Analysis

The existing Level of Service (LOS) for all adjacent or nearby intersections should be shown and discussed in this section. Both the AM and PM LOS for all existing turning movements should be identified and shown. If any movement shows a LOS of E or F that particular movement should be discussed further.

2.8 Project Conditions

This section should discuss the traffic expected to be generated by the proposed project. Tables and figures should also be used to convey some of the following information. Discuss any known planned projects (private or public) near the project site with construction dates if known. This discussion should also include but not be limited to the following:

2.8.1 Trip Generation

- The latest edition of ITE's *Trip Generation Manual* shall be used for selecting trip generation rates for the proposed development. The guidelines contained in the *Trip Generation Manual* shall be used to determine whether the average trip generation rate or equation should be used.
- The TIS shall refer to the land use categories in the ITE's *Trip Generation Manual* and use the appropriate category for the proposed project. This traffic can then be referred to as site traffic. If the proposed project does fall into one of the ITE land use categories, the TIS shall clearly explain which trip generation category is the most appropriate and why.
- Other rates can be used if ITE's *Trip Generation Manual* does not include rates for the specific land use, or the available data is limited, or where local trip rates (if available) differ from the ITE rates. Obtain the County Traffic Engineer's approval before using other rates.
- Trip reduction factors may be used due to internal capture and/or pass-by trips. If an internal capture rate greater than 15% is proposed, the TIS shall clearly indicate and refer to other studies of comparable projects to justify the higher rate. For some projects, such as large commercial retail projects, both internal capture rate and pass-by trip reductions may be appropriate. Any internal capture rate or pass by trip reduction used in the TIS shall follow the ITE calculation mythology and be clearly shown in a trip generation type summary table.

2.8.2 Traffic Volumes/Distribution/Site Access

ADT and AM/PM peak hour volumes should be shown using figures/exhibits that clearly indicate the year and for which movement the volumes apply. All movements should be shown for all access/driveways that will access the site, existing and proposed. Trip distribution is the percentage or number of trips entering and leaving the site from each direction. The percent of trips (both AM/PM) in each direction for all driveways should also be indicated. Any specific assumptions and/or data sources used in deriving trip distribution and assignment shall be documented and referenced in the report.

2.8.3 Background (Non-site) Traffic

Background traffic is defined as the volume of traffic on the roadway network surrounding and adjacent to the proposed development, but unrelated to the proposed development. The background traffic, both average daily ADT and peak hour volumes should be clearly identified for existing conditions, opening year, and the predefined horizon year(s).

2.8.4 Site Traffic

Site traffic is the traffic generated by the proposed development. Site traffic should also be indicated for average daily ADT and peak hour volumes. The proposed site traffic should include opening year,

buildout year (if different) as well as the horizon year (s). If the project includes multiple phases, the future phase traffic should be discussed or if appropriate also shown in an exhibit or figure.

2.8.5 Total Traffic

Total traffic is the combination of the background traffic and site traffic. Total traffic should also be indicated by the average daily ADT and peak hour volumes and should be shown for buildout, horizon year(s) or future phases.

2.9 Capacity Analysis

Capacity analysis shall be performed on each of the major street and site intersections/driveways (signalized and stop controlled) in the study area and for the proposed site. MCDOT accepts Level of Service (LOS) analysis performed using software such as Synchro and HCS and may accept other analysis if first approved by the Transportation Systems Management Division.

- Level of service shall be computed using with the latest edition of the *Highway Capacity Manual* or the latest version of HCS software. The LOS should be calculated for each study area intersection directly impacted by the proposed site. All movements at those intersections should be evaluated for both the AM and PM peak hours. The LOS at each proposed driveway should also be evaluated for all movements both AM and PM peak hour.
- For signal controlled intersections, operational analyses shall be performed for opening year and project buildout and for time horizons up to 5 years after buildout.
- For urban roadways, and rural highways where signal controlled intersections are at or less than 1 mile apart, the capacity of the roadway is generally dominated by the capacity of the adjacent signal controlled intersections. Roadway levels of service need not be computed for these facilities.
- For rural highways where the signal controlled intersections are more than 1 mile apart, the level of service on the highway may be estimated in accordance with the latest edition of the *Highway Capacity Manual* or HCS software.
- The Transportation Systems Management Division does not accept any driveway or site access point where the overall intersection LOS for either the AM or PM peak hour is less than LOS D. If any movement is shown with a LOS of E or F, mitigation measures should be discussed that will increase the LOS. If mitigation measures will not increase the LOS, then that specific movement may result in a restricted type access.
- Peak Hour Factors (PHF) used for future capacity conditions are generally derived from traffic counts, however in the absence of field measurements, the Highway Capacity Manual advises the following reasonable approximations may be used:
 - a. PHF = 0.95 for congested conditions
 - b. PHF = 0.92 for urban areas
 - c. PHF = 0.88 for rural areas

2.10 Traffic Signals

- A traffic signal warrant study based on the *Manual on Uniform Traffic Control Devices (MUTCD)* shall be conducted for all arterial/arterial, arterial/collector and collector/collector intersections within the Study Area for the opening and buildout year. If the project is to be completed in phases, signal warrants may need to be evaluated if the completion of the final phase is beyond the horizon year stated in the study.
- For a Category I TIS, both opening year and buildout should be evaluated for signal needs.
- For large commercial developments with high peak hour volumes, the major driveway access may also require a signal warrant analysis to be conducted.
- Traffic signals will be installed only when they meet warrants in the MUTCD and as determined by the MCDOT's Transportation Systems Management Division.
- If the proposed development is near an existing signal, discuss impacts of the site generated traffic on the signal. Discuss if the signal timing and or phasing may be affected, i.e. if currently permissive phasing, will protected/permissive phasing be required?
- Table 3 below can be used as a guide line for determining if a future signal may be needed:
 - a. Signal warrants as a result of a new roadway or driveway may be met when the following criteria is satisfied:
 - b. The estimated ADT on the major street and on the higher volume minor street or driveway approach to the intersection equals or exceeds the values in the following table:

Table 3: General Guidelines For Determining if a Signal May be Warranted

Lanes for Moving Traffic on Each Approach		Estimated ADT*	
Major Street	Minor Street	Major Street	Minor Street
1	1	10,000	3,000
2 or more	1	12,000	3,000
2 or more	2 or more	12,000	4,000
1	2 or more	10,000	4,000
1	1	15,000	1,500
2 or more	1	18,000	1,500
2 or more	2 or more	18,000	2,000
1	2 or more	15,000	2,000

*Based on the volumes projected to be present within 5 years of the completion of the roadway project, commercial development, or 5-year horizon for that Category II, III, and IV developments.

2.11 Queuing Analysis

A queuing analysis shall be conducted to identify appropriate vehicle storage at all turn lanes under stop or signal control within the study area. Storage lengths should also be calculated for all recommended right and/or left turn lanes at all proposed site driveways. Various methods for computing queue lengths may be used. Examples of approximate methods for estimating queue lengths for signal controlled and non-signal controlled intersections are shown below. Storage for left turn lanes into new

developments shall be adequate to accommodate the left turn movements with no queuing or spillover into the through lanes for opening year and buildout.

2.11.1 Signal Controlled Intersections

For signal controlled intersections, find the number of vehicles arriving at the intersection:

$$\text{Vehicles/cycle (for random arrivals)} = 2 \times (\text{vehicles/hour}) / (\text{cycles/hour})$$

$$\text{Storage length} = \text{vehicles/cycles} \times 25 \text{ feet}$$

Example: Find the storage length required for 150 vph turning left if the signal cycle is 90 seconds.

$$\text{Vehicles/cycle} = 2 \times (150 \text{ veh/hr}) / (1 \text{ cycle @ } 90 \text{ sec}) / (3600 \text{ sec/hr}) = 7.5 \text{ veh/cycle}$$

$$\text{Storage length} = 7.5 \text{ veh/cycle} \times 25 \text{ feet} = 187.5 \text{ feet}$$

USE 200 feet

2.11.2 Non-Signal/Stop Controlled Intersections

For non-signal controlled intersections, find the number of vehicles per average 2 minute period: (from AASHTO)

$$\text{Vehicles/2 min period} = (\text{vehicles/hour}) / (30 \text{ periods/hour})$$

$$\text{Storage length} = \text{vehicles/2 min period} \times 25 \text{ feet}$$

Example: Find the storage length required for 150 peak hour vehicles turning left at a non-signal controlled intersection.

$$\text{Vehicles/2 min period} = (150 \text{ veh/1 hr}) / (30 \text{ periods/hr}) = 5 \text{ vehicles}$$

$$\text{Storage length} = 5 \text{ veh} \times 25 \text{ feet} = 125 \text{ feet}$$

USE 125 feet

All results should be round up to the nearest 25 foot interval.

2.12 Special Considerations

- For all development driveways/access points, proper intersection sight distance needs to be provided. MCDOT refers to AASHTO for determining sight distance, so either the MCDOT Roadway Design Manual or AASHTO can be referenced.
- Vehicle type should also be considered in the traffic study. If a proposed project is industrial or heavy commercial with a high percentage of large trucks (WB-40 or larger), auxiliary lane storage and return radii will need to be evaluated.
- For some highways and/or roadways where the vehicle speed is higher than the posted speed limit, a speed of 5 MPH over the posted speed limit or the 85 percentile speed, as directed by the MCDOT's Transportation Planning, Project and Systems Management Division, should be

used to estimate safe stopping and cross-corner sight distances for highways and roadways with posted speeds of 35 MPH or greater.

2.13 Improvement Analysis

The roadways and intersections adjacent to or near the project site shall be analyzed with and without the proposed development to identify any projected impacts in regard to level of service and safety. All proposed driveways should also be evaluated for LOS for all movements both AM and PM.

- Intersection Level of Service (LOS) design objectives shall align with the recommendations listed for each functional classification of roadway type in Chapter 2 of the *Maricopa County Roadway Design Manual*. The minimum acceptable LOS at buildout for a Traffic Impact Study will be LOS D for arterial roads.
- Intersection Level of Service (LOS) 'B' shall be the design objective for retirement communities. Intersection Level of Service (LOS) 'C' shall be the design objective for all other developments.
- Intersection through lane movements shall not fall below LOS D, and no intersection turning movement shall fall below LOS E at buildout or opening year.
- If a full access driveway is proposed onto an arterial, a left turn lane is generally required for the left in movement. If the LOS for any driveway movement is E or F, a restricted access such as a $\frac{3}{4}$ or right in/right out access should be recommended and constructed. Any movement having a LOS of E will require special discussion and may be allowed with specific approval from MCDOT. An intersection LOS less than D shown for future phases or horizon years may be acceptable with discussion of future mitigation measures that can be implemented with future phases.
- Evaluate need for auxiliary lanes. Criteria for both right and left turn lanes are given in the MCDOT Roadway Design Manual. All proposed development driveways should be analyzed. If the development is proposing a full access driveway onto an arterial, and no left turn lane exists on that arterial, a left turn lane may be required to be constructed by the proposed development. Developments on the corner of two arterials, should also evaluate turn lanes at the intersection.

2.14 Golf Cart/Bicycle Facilities

- Developments may need to consider the impacts of Golf Carts/Neighborhood Electric Vehicles (NEV) on the roadway system, especially if the development or project is within a retirement community. A circulation plan may be required where there is a high usage of these vehicles. Per state law, golf carts are allowed to travel on roadways posted at 35mph or less in retirement communities.
- MCDOT's arterial and collector roadway cross sections provide for bicycle lanes. If applicable, the study should provide an analysis of the bicycle facilities in the area of the development, and an analysis of future bicycle needs. Recommendations for bicycle signing and striping should also be discussed in the conclusion and recommendations section.

2.15 Traffic Calming

All traffic calming features proposed for a development shall conform to the current MCDOT Policies for Neighborhood Traffic Calming. Proposed developments that will access collector or local county roadways where significant residential driveway access exists shall evaluate the impacts of the proposed development buildout traffic on those roadways. If necessary, traffic calming measures would then be incorporated as part of the project improvements on those existing roadways.

2.16 Conclusions/Recommendations

This section should discuss the results and findings of the overall study and then recommend what improvements will be required to the surrounding roadways to accommodate the proposed site traffic. For larger projects, separate sections for the conclusions and then recommendations may be necessary. This section should discuss the findings for the following:

- Overall and peak hour LOS at all proposed driveways (all movements) for opening year, buildout year and horizon year. Discuss any potential conflicts with surrounding accesses (existing or planned).
- Right and left turn lanes required with all storage shown. Discuss any roadway widening (arterials) required to accommodate left turn movements.
- Driveway/intersection sight distance analysis
- New signal warrants met or adjustment of timing to nearby existing signals
- Impacts of any known future roadway improvements whether by developers, MCDOT or other jurisdictions

The recommendations discussion should include the specific improvements needed to mitigate the development generated traffic. This section should include the timing of all improvements whether at opening year or buildout. If the project is phased, this section should describe improvements required for each phase. This section should be referred to and used by the civil engineers and designers preparing the offsite roadway and traffic plans.

2.17 Certification

The Traffic Impact Study as well as the Traffic Statement shall be prepared under the supervision of a Professional Engineer (Civil) registered in the State of Arizona. When submitted to MCDOT, the final TIS or TS shall be sealed and signed by the professional engineer preparing the study.

3 Study and Report Format

Below is a suggested format and outline for TIS and as applicable for TS. As all developments and projects are somewhat unique, all sections listed below may not be applicable to every project and the report preparer should use their judgement to decide which sections are applicable.

3.1 Introduction and Summary

a. Introduction

The Introduction of the Traffic Impact Study shall state the purpose of report, describe the proposed project and define the study objectives.

b. Executive Summary

The Executive Summary of the Traffic Impact Study shall include the following information:

- Site location and study area
- Development description
- Principal findings
- Conclusions/Recommendations

3.2 Proposed Development (Site and Surroundings)

This section of the Traffic Impact Study shall describe the proposed development. This includes the following information:

- Site location
- Land use and intensity (use ITE Land Use code)
- Site plan with access geometrics
- Number of Trips and type of traffic (passenger vehicle, truck) the site will generate
- Development phasing with opening and buildout dates if known.

3.3 Study Area Conditions

3.3.1 Study area

- Area of significant traffic impact (including road segments, intersections and driveways)

3.3.2 Land use

- Existing surrounding land use
- Any known or planned future development

3.4 Existing Conditions

3.4.1 Physical characteristics

- Roadways, including classification/characteristics/posted speed limits
- Traffic control devices
- Pedestrian/bicycle facilities
- Location and alignment of adjacent and opposite driveways

3.4.2 Traffic volumes

- Current ADT and AM and PM peak hour volumes adjacent to the site.

3.4.3 Level of service

- Existing LOS for all movements for both AM and PM peak hours.

3.4.4 Safety related deficiencies

- Note any traffic deficiencies such as pedestrian and bicycle safety concern that may exist near the site.

3.4.5 Data sources

- Reference any known/planned development or roadway improvement projects.

3.5 Project Conditions

3.5.1 Background traffic (each horizon year)

- MCDOT website/MAG projections.

3.5.2 Site traffic (each horizon year)

- Trip generation table (use ITE trip generation factors), include AM and PM peak hour.
- Mode split (if applicable)
- Pass-by traffic (if applicable)
- Internal Capture Rate (if applicable)
- Trip distribution
- Predominant site vehicle type/design vehicle, include truck percentage if applicable
- Include opening year and buildout year
- Discuss any future phases with expected traffic generated (if applicable)

3.5.3 Total traffic (each horizon year)

- Site plus background. Include opening year and buildout year, discuss phasing (if applicable).

3.5.4 Site accessibility

- Number and location of each proposed access/driveway
- Driveways/site circulation

3.6 Traffic and Improvement Analysis

3.6.1 Level of service analysis

- Indicate LOS with/without project for each horizon year
- Indicate LOS analysis for all movements at all proposed accesses

3.6.2 Site access

- Full access versus restricted access (based on LOS analysis)
- Turn Lane Evaluation

3.6.3 Roadway improvements

- Improvements required by development to mitigate site generated traffic

- Known future roadway projects, public and private

3.6.4 Pedestrian and bicyclist considerations (if applicable)

3.6.5 Traffic signal needs (Buildout plus 3-5-year horizon)

- Evaluate traffic signal needs at major driveways or intersections near the site.

3.7 Conclusions/Recommendations

This section should summarize findings of the overall study including at opening and at buildout year. Future horizon years or phasing should also be discussed.

List all necessary roadway improvements to accommodate/mitigate site generated traffic.

3.8 Appendices

The appendix may include (but not limited to) the following:

- Existing traffic counts
- Capacity analyses worksheets
- Traffic signal warrant analysis
- LOS analysis (Synchro and HCS)
- Queuing/storage analysis (if not in main report)
- All other pertinent supporting data (crash data source, future project plans, MAG data, etc)

3.9 Figures and Tables

The following information is suggested to be shown in tables or figures/exhibits:

- Site location/Jurisdictional boundaries
- Site plan
- Existing and future area development
- Existing ADT and peak hour volumes
- Site generated traffic
- Directional distribution of site traffic (daily and peak period)
- Peak hour movements at all site access points for opening year site generated traffic.
- Peak hour movements at all site access points for buildout year site generated traffic.
- Projected LOS (all movements) for opening, buildout and other horizon years.

Category I Figures and Tables may be documented within the text. For Categories II, III, and IV the items should be included as separate figures and/or tables. All figures and tables must be legible.

4 Design Standard Reference

List all references used to prepare the study, such as the MCDOT Roadway Design Manual, ITE, MUTCD, AASHTO or any other reference source that was used to prepare the study.

APPENDIX A

THRESHOLDS FOR REQUIRING A TRAFFIC IMPACT STUDY

PROJECT SIZES GENERATING 100 MORNING OR AFTERNOON PEAK HOUR TRIPS

The following table shows examples of various development sizes, which generate 100 morning or afternoon peak hour trips. These sizes were determined using trip generation rates from the *ITE Trip Generation Manual*. As the manual is updated, the latest edition should be used for selecting the trip generation rates.

THRESHOLDS FOR REQUIRING TRAFFIC IMPACT ANALYSIS
(Project Sizes Generating 100 Peak Hour Trips)

ITE CODE	Land Use	Unit of Measure	Peak Hour	Peak Hour Trip Rate	%Entering/%Exiting	Threshold for TIA
INDUSTRIAL						
130	Industrial Park	1000 sf	PM	0.86	21/79	115000 sf
140	Manufacturing	1000 sf	AM	0.78	68/32	128000 sf
151	Mini-Warehouse	1000 sf	PM	0.29	53/47	345000 sf
RESIDENTIAL						
210	Single-Family Detached Housing	DU	PM	1.02	64/36	100 DU
220	Apartment	DU	PM	0.67	61/39	150 DU
230	Residential Condominium/Townhouse	DU	PM	0.52	64/36	200 DU
240	Mobile Home Park	DU	PM	0.60	61/39	170 DU
270	Residential Planned Unit Development	DU	PM	0.72	64/36	140 DU
RECREATIONAL						
416	Campground/Recreational Vehicle Park	Spaces	PM	0.41	62/38	250 Spaces
445	Multiplex Movie Theater	1000 sf	FRI	17.87	58/42	6,000 sf
492	Health/Fitness Club	1000 sf	PM	4.06	51/49	25,000 sf
INSTITUTIONAL/MEDICAL						
520	Elementary School	1000 sf	AM	4.69	54/46	22,000 sf
522	Middle School/Junior High School	1000 sf	AM	4.35	55/45	23,000 sf
530	High School	1000 sf	AM	3.06	71/29	35,000 sf
560	Church	1000 sf	SUN	11.76	50/50	8,500 sf
565	Day Care Center	Students	AM	0.82	53/47	120 Students
630	Clinic	1000 sf	N/A	31.45	50/50	3,200 sf
OFFICE						
710	General Office Building	1000 sf	AM	1.55	88/12	65,000 sf
720	Medical/Dental Office Bldg	1000 sf	PM	4.45	40/60	23,000 sf
730	Government Office Bldg	1000 sf	PM	11.03	74/26	9,000
750	Office Park	1000 sf	AM	1.74	89/11	58,000 sf
770	Business Park	1000 sf	AM	1.43	84/16	70,000 sf
RETAIL						
813	Free-Standing Discount Superstore	1000 sf	SAT	5.01	51/49	20,000 sf
815	Free-Standing Discount Store	1000 sf	SAT	7.58	51/49	14,000 sf
820	Shopping Center	1000 sf	SAT	4.97	52/48	21,000 sf
850	Supermarket	1000 sf	PM	12.02	53/47	8,500 sf
851	Convenience Market (Open 24 Hours)	1000 sf	SAT	77.11	50/50	1,500 sf
862	Home Improvement Superstore	1000 sf	SAT	5.40	53/47	19,000
863	Electronics Superstore	1000 sf	PM	4.50	49/51	23,000
876	Apparel Store	1000 sf	PM	4.20	50/50	24,000 sf
880	Pharmacy/Drugstore (without Drive-Through)	1000 sf	PM	11.07	50/50	9,000 sf
890	Furniture Store	1000 sf	SUN	0.92	N/A	109,000 sf
SERVICES						
912	Drive-in Bank	1000 sf	PM	53.46	51/49	2,000 sf
925	Drinking Place	1000 sf	SAT	10.82	59/41	10,000 sf
931	Quality Restaurant	1000 sf	SAT	20.00	63/37	5,000 sf
932	High-Turnover (Sit-Down) Restaurant	1000 sf	AM	54.81	51/49	2,000 sf
934	Fast Food Restaurant with Drive-Through Window	1000 sf	PM	15.49	68/32	7,000 sf
942	Automobile Care Center	1000 sf	PM	4.01	51/49	25,000 sf
945	Gasoline/Service Station (with Convenience Market)	Pumps	PM	13.57	50/50	8 pumps