



# **Traffic Impact Analysis Procedures**

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July 1, 2008

## I. INTRODUCTION

Transportation Impact Analysis reports (TIA's) are also sometimes referred to as Transportation Impact Studies. For the purposes of this document, the City of Avondale will call them Traffic Impact Analysis reports, or TIA's. TIA's are required for Master Site Plans, Site Plans and Preliminary Plats. TIA's, or a reduced analysis called a Traffic Statement described below, may be also required for General Plan Amendments, rezoning, and conditional use permit applications. This section presents the analysis process and requirements for completing a traffic impact analysis to determine needed modifications to the existing and planned transportation system as a result of proposed development.

One of the City of Avondale's primary 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 that objective. The Traffic Impact Analysis Procedures as outlined in this document have been established for this purpose. The Traffic Impact Analysis Procedures establish a range of traffic impact study categories based on the characteristics of development and estimated peak hour traffic volumes. The TIA procedures also outline the analysis approach and methods.

A TIA identifies existing traffic volumes and conditions, development traffic volumes and conditions and their combined impacts on the existing and future roadway system. The TIA 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, on-site congestion and/or congestion on adjacent roadways, inadequate access capacity, or limited flexibility to modify the development to eliminate problems or adjust to changed conditions may occur.

These problems can also negatively affect the return on investment of a development. The TIA provides an opportunity for the City 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 surrounding transportation system. The need for a TIA should be assessed as early as possible in the development process when there is maximum flexibility for eliminating traffic-related problems. The results of the TIA can also affect the Site Plan or development proposal, so it is important to begin the traffic analysis early and incorporate the TIA recommendations into the development plans during design. Preparation of a TIA is also recommended in Chapter 2 "Site Planning" of the *Institute of Transportation Engineers* 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 TIA through standardization of the reports

## II. GENERAL INFORMATION

A TIA will be required of all new developments, additions, or expansions to existing developments. For development projects generating less than 100 peak hour trips, a Traffic Statement may be submitted in lieu of a full TIA. A TIA or traffic statement including addressing site specific concerns may also be required for developments generating lower peak hour volumes where:

- current traffic problems or concerns exist
- the public may perceive an adverse impact on the adjacent neighborhoods or other areas
- the proximity of site drives to other drives or intersections could create traffic concerns, or
- other specific problems or concerns may be aggravated by the proposed development

Should such conditions arise, the City Traffic Engineer will evaluate the need for the study based on technical merit. Developments processed under previously approved Development Master Plans, Planned Area Developments or Amendments, or rezoning cases with current approvals that have not expired and have approved traffic impact analysis reports will not be required to provide a new or revised TIA during the subdivision or building permit processes unless:

- 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
- access drives or openings are proposed to change
- increase in intensity of or change in land uses
- addition of drive-through facilities
- addition of schools

The need for an initial TIA or a revised TIA will be determined by the City Traffic Engineer in accordance with the intent of these guidelines. Rezoning applications will be required to submit a Traffic Statement describing the increase (or decrease) in trips generated, impacts on the surrounding roadway network, and any circulation issues. A full TIA will be required at Master Site Plan or Preliminary Plat.

The TIA is required to be prepared by a registered professional engineer in the State of Arizona with a professional traffic engineering consulting firm. The report shall be

bound, signed, sealed, and stamped by the registered professional engineer. The TIA is required to be submitted with the Development Application package to the Development Services Department. Additional copies may be required if needed for distribution to other involved agencies impacted by the proposed development. Reviews and comments on TIA reports will follow procedures and standards set as part of the standard Development Review process with the application submittal.

**It is imperative that the results of the TIA are shared with the developer prior to submitting the Development Application and any recommendations or requirements incorporated into the site plan, master site plan or preliminary plat prior to submitting.** This will help not only reduce the number of comments, but also reduce review times, number of reviews, necessary revisions, and resubmittals.

### **Major Issues Addressed in Transportation Analysis**

The Transportation Impact Analysis (TIA) document will address such issues as:

- The current transportation system and operational characteristics in the site vicinity
- The interface between the on-site circulation system and the adjacent circulation system
- The intensity and character of the development
- Trip generation
- Distribution and assignment estimates, and
- Impacts of the development on the existing and planned transportation systems

It is the City of Avondale's intent to have open discussions between staff, the applicant, and the study traffic engineering consultant. Initial feedback and guidance on traffic issues and conducting a traffic impact analysis will be given at the pre-application meeting on the project. The need for, and extent of, the study shall be based on the criteria described in this guide. Project discussion between the applicant's traffic engineering consultant and the City Traffic Engineer is encouraged prior to the consultant beginning to conduct the analysis to confirm understanding of requirements and scope of study. It is City's intention to be available to answer questions during the analysis process to minimize the review time and the number of comments.

It is extremely important that the traffic engineering consultant explain the results and recommendations of the TIA in detail to the applicant prior to submittal of the development package to the City. The TIA includes recommendations that affect the site plan and could impact the design of the development. The TIA is not meant to be a report submitted to the City simply to meet requirements, but rather a tool used by the applicant to guide the safe design of the project. Projects submitted to the City that fail to include the results of the TIA on the site plan may be returned as incomplete, and to be revised and resubmitted for-staff review.

### III. SCOPE OF ANALYSIS

This section describes what size of development or minimum square footages of land uses trigger the need for a TIA, the levels of categories for TIA analysis, and the requirements that must be included in the TIA analysis.

#### A. Levels of Study

A Traffic Impact Analysis is required for all projects which generate 100 or more peak hour trips. To quickly estimate if a proposed project will generate enough peak hour trips to need a TIA, please see Table 1. This table should be used only to estimate if a TIA is required and not as the basis for actual trip generation calculations. The most recent version of the ITE Trip Generation Manual should be used for all trip generation calculations in the TIA or Traffic Statement. Rates for additional land uses not listed in Table 1 may need to be used from the ITE Trip Generation Manual. Please be aware verification of the land use and size, and number of peak hour trips generated, will be required prior to submittal. In addition, site specific conditions and site plan design will be required by the City of Avondale Engineering Department to be reviewed for safety and to address anticipated traffic concerns with the proposed development.

**Table 1**

ITE LUC	Land Use	Unit	Threshold
<b>Residential</b>			
210	Single Family	DU	100 DU
230	Condominium/Townhomes	DU	175 DU
220	Apartments	DU	150 DU
240	Mobile Homes	DU	170 DU
254	Assisted Living	BEDS	260 BEDS
310	Hotel	ROOMS	135 ROOMS
<b>Commercial</b>			
911	Walk-in Bank	1,000 SF	2,500 SF
912	Drive-in Bank	1,000 SF	1,800 SF
820	Shopping Center	1,000 SF	20,000 SF
850	Grocery Store	1,000 SF	8,000 SF
851	24-Hour Convenience Store	1,000 SF	1,500 SF
815	Discount Store	1,000 SF	16,000 SF
890	Furniture Store	1,000 SF	180,000 SF
812	Lumber Store	1,000 SF	20,000 SF
816	Hardware/Paint Store	1,000 SF	20,000 SF
841	Auto Sales—New Cars	1,000 SF	35,000 SF
817	Nursery/Garden Center	ACRE	13 ACRES
565	Day Care	STUDENTS 1,000 SF	120 STUDENTS 7,000 SF

ITE LUC	Land Use	Unit	Threshold
<b>Commercial – continued</b>			
843	Auto Parts Sales	1,000 SF	15,000 SF
942	Automobile Care Center	1,000 SF	25,000 SF
944	Gas Station	PUMP	6 SINGLE PUMPS
491	Racquet Club	COURT	23 COURTS
492	Health Club	1,000 SF	24,000 SF
931	Quality Restaurant	1,000 SF	11,000 SF
932	Sit Down High Turnover Restaurant	1,000 SF	5,300 SF
934	Fast Food (with drive-thru)	1,000 SF	2,000 SF
<b>Offices</b>			
710	Office	1,000 SF	60,000SF
720	Medical-Dental Office	1,000 SF	20,000 SF
750	Office Park	1,000 SF	60,000 SF
770	Business Parks	1,000 SF	70,000 SF
760	Research & Development	1,000 SF	90,000 SF

Proposed projects will fall into one of five categories for purposes of traffic impact analysis.

1. **TRAFFIC STATEMENT:** If the proposed project generates less than 100 peak hour trips, a traffic statement that addresses trip generation and any site specific issues may be submitted in lieu of a full traffic impact analysis. These projects are assumed to have insignificant impacts on the surrounding transportation system. Rezoning may also submit traffic statements because a full TIA will be required at Master Site Plan or Plat application and the information including in the traffic statement is sufficient for determination of traffic impacts in a rezoning case. (See additional information below).
2. **CATEGORY 1:** The first category is proposed projects that are deemed to have minor or minimal traffic impacts.
3. **CATEGORY 2:** The second category is projects that have localized impacts to the city's transportation system.
4. **CATEGORY 3:** The third category is proposed developments that have significant impacts to the transportation system that may extend beyond the vicinity of the site.
5. **CATEGORY 4:** The fourth category is proposed for developments that have regional impacts to the transportation system that extend beyond the vicinity of the site, may cross jurisdictional boundaries.

These categories are further described below. The study years (horizon years) and study areas are listed in Table 2. For those situations where it is questionable as to which category is appropriate, the City's Traffic Engineer will make the final determination. The City's Traffic Engineer also has the authority to waive the

requirement for a traffic impact analysis for unusual situations that fall outside of the following guidelines or where the analysis is deemed to be unnecessary based on previous studies or current traffic conditions. “Existing, allowed land use” will be interpreted as development that is allowed under the city’s current zoning and General Plan designation. Development may be restricted to previously approved site plans and development programs where prescribed by zoning stipulations. For those situations where it is questionable as to what level of development is allowed on the site, the Zoning Administrator will make the final determination.

**Table 2**

<b>TIA Category</b>	<b>Development Characteristic</b>	<b>Study Horizon</b>	<b>Study Area</b>
Traffic Statement	Rezoning or developments less than 500 daily trips	1. Opening Year	1. Site access drives if applicable
1	Small development less than 499 peak hour trips	2. Opening Year	1. Site access drives 2. Adjacent signal controlled intersections within ¼ mile and/or major street intersections without signal control and driveways within 500 feet
2	Moderate Development 500 - 999 peak hour trips	1. Opening Year 2. 5 Years after opening	1. Site access drives 2. All signal controlled intersections within ¼ mile and/or major street intersections without signal control and major driveways within ¼ mile
3	Large Development 1,000 -1,500 peak hour trips	1. Opening Year 2. 20 Years after opening	1. Site access drives 2. All signal controlled intersections within 1 mile and/or major street intersections without signal control and major driveways within 1 mile
4	Regional Development Greater than 1,500 peak hour trips	1. Opening Year 2. 20 Years after opening	1. Site access drives 2. All signal controlled intersections within 2 mile and/or major street intersections without signal control and major driveways within 1 mile

Other issues required to be analyzed in the TIA as applicable include:

- Driveway spacing and design

- Transit
- Pedestrian Circulation and/or trail connectivity
- School traffic circulation
- Neighborhood traffic calming
- Proximity to and potential impact upon nearby residential areas
- Other special conditions and circumstances particular to the development or the transportation system.

For the Horizon Year, the Opening Year shall mean to 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 of the proposed project. An enlarged study area may be required when the minimum study areas identified in Table 2 do not provide sufficient information to meet the intent of the Traffic Impact Study guidelines.

### **TRAFFIC STATEMENT**

A Traffic Statement shall be written and prepared by a registered professional engineer in the State of Arizona with a professional traffic engineering consulting firm. The statement can be submitted in letter format, stapled with attachments, and shall be signed, sealed, and stamped by the registered professional engineer. The statement is required to be submitted with the Development Application package to the Development Services Department and should include the following:

- description of proposed land uses and sizes
- trip Generation, daily and peak hour
- driveway design including location, spacing, access, number of driveways, width, throat length, deceleration lane requirements, number of ingress and egress lanes, etc.
- street description and classification of adjacent streets
- on-site traffic circulation issues and any other traffic safety issues
- impact to traffic signals, if any
- transit, bike and pedestrian facilities and requirements, if applicable

### **Rezoning**

For Rezoning Applications that are not submitting a Site Plan, Master Site Plan or Preliminary Plat, a traffic statement letter can be submitted in lieu of a full TIA. The Traffic Statement shall include the items described above in addition to:

- description of existing and proposed land uses and description of allowable land uses under existing and proposed zoning, which may be different than the actual proposed land uses
- trip generation calculations of “worst case scenario” land uses allowed under both existing and proposed zoning
- the percent change (increase or decrease) in trips for both daily and peak hours

- discussion of unique traffic circulation impacts by proposed zoning such as traffic signals, traffic patterns, street alignments, etc. Include list of needed roadway improvements with additional traffic

A full TIA will then be required at Master Site Plan or Preliminary Plat submittal.

## **B. Study Area**

The study area will be the roadway segments, intersections and major driveways as described in Table 2 above.

For a Category 4 Regional Development study, the intersections to be analyzed greater than 1 mile radius within the study area as described above in Table 2 can be pre-approved prior to beginning to conduct the TIA. To obtain pre-approval, a list of all intersections within the study area may be submitted to the City Traffic Engineer along with a proposed list of which ones may not need to be studied if they are insignificantly impacted by the proposed development.

## **C. Horizon Years**

For a Category 1 study, the traffic analysis will be based on traffic conditions for the build-out or completion year of the development. In some cases, staff may require an additional horizon year if there are significant changes anticipated to the surrounding infrastructure or traffic volumes.

For a Category 2 study, the traffic analysis will be based on traffic conditions for the build-out or completion year of the development, and a minimum 5-year projection from the anticipated build-out date. If the project is a large, multi-phased development, the initial horizon year will be the date that corresponds to the opening of the first major phase of development. In some cases staff may require an additional horizon year for multi-phase projects or projects with significant changes anticipated to the surrounding infrastructure or traffic volumes. Category 3 and 4 studies may require additional years be analyzed for interim phases in addition to the 20-year horizon year.

The study will provide morning and evening peak hour approach and turning movement volumes for each intersection in the study area for the required horizon years. Level-of-service analyses for these peak hour conditions, without the site traffic and with the site traffic, will be included in the report.

## **IV. EVALUATION**

### **A. Existing Conditions**

The TIA will provide current approach volumes for 24 hours of a typical weekday, and turning movement volumes in 15 minute intervals for the time periods of 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m., for all intersections of streets that are classified as

collector (major, minor or industrial), arterial (major or minor), road of regional significance, parkway, expressway, or freeway in the study area. The results of a level-of-service analysis for the peak, fifteen-minute periods in the morning and evening for the existing conditions, will be included in the report.

## **B. Peak Traffic Hours**

The report will analyze the peak traffic periods on the adjacent street system during the morning and evening, peak, 15-minute periods. The report will also analyze the peak traffic periods for the development, should these periods occur at different times or on different days from the peak periods of the adjacent street system.

## **C. Background Data**

The City of Avondale Traffic Engineering Division conducts annual traffic volume counts available on the City's website at [www.avondale.org/traffic](http://www.avondale.org/traffic). The consultant will use the most recently available data, at a minimum. The consultant may not use traffic volume data older than 12 months as current information. If traffic volume data more recent than 12 months is not available, then the developer is responsible for obtaining the information directly. If data from earlier years is deemed pertinent, the consultant may utilize it to supplement the most recent data.

The City of Avondale Transportation Plan prepared traffic volume projections for 5-year increments. This information will be available to the consultant (see website at [www.avondale.org/traffic](http://www.avondale.org/traffic)). However, the information will need to be reviewed by the consultant for applicability to the TIA. Adjustment and recalculation may be necessary. In the event that the proposed development is very large in terms of anticipated traffic generation or in terms of deviation from the Avondale General Plan, comprehensive traffic projection modeling may be necessary.

## **D. Off-Site**

The City of Avondale, based upon a public records request, will provide copies of approved TIAs prepared for previous proposed developments that may be pertinent to a current analysis. The city will also provide other transportation related reports that may be of assistance. The consultant will be responsible for reviewing these reports and incorporating their data, conclusions, and recommendations where appropriate.

The consultant will be responsible for obtaining copies of the Avondale Transportation Plan, the current Circulation Element of the General Plan for the City of Avondale, the General Engineering Requirements, the Supplement to MAG Uniform Standard Specification and Details, the ADOT Traffic Safety in School Areas manual (as applicable), and any other applicable, governing documents, and adhering to the policies and guidelines they contain.

## **E. Field Data and Data Collection**

Existing traffic volume data can be used if less than one year old. If current traffic volume data is not available, the consultant will be responsible for obtaining traffic volume data in accordance with the requirements of the study, as stated previously. The consultant must also obtain the following information as applicable for the study analysis:

- speed limit information
- analyze sight distance availability and requirements
- bicycle, pedestrian and trail facilities
- transit facilities in the vicinity of the site of the proposed development

The consultant will be responsible for incorporating the needs of these facilities into the analysis and report.

## **F. Traffic Forecasting**

Estimates of non-site traffic are required for a complete analysis of horizon-year conditions. These estimates represent the “base” conditions, that is, without the site development. There are two principle methods of projecting off-site traffic that are acceptable: use of area- wide modeled data and trends or growth rates. Each method has its appropriate use depending on the availability of data and the size of the proposed development.

Growth rates can be determined from historical data. Annual traffic count data in the City of Avondale from previous years is available on the website. Modeled data for 20-year projections are available in the Avondale Transportation Plan, also available on the website. In those cases where this data is not available, the City will determine if the data needs to be produced for an adequate analysis, or if a trends analysis will suffice.

Future traffic demand estimates are developed by adding the estimated site generated traffic, all approved (or potential) development in the area, and current traffic volumes adjusted for general growth in the area. The consultant will determine the levels of service in the study area based on the non-site traffic for the horizon year.

## **G. Trip Generation**

The consultant should follow the guidelines contained in the most recent edition of the ITE “Trip Generation Handbook: An ITE Recommended Practice”. Proposals for deviations from the ITE Recommended Practice should be presented and pre-approved by the City Traffic Engineer prior to conducting the TIA analysis. Trip generation rates other than those included in the ITE Handbook will be required to be studied at three equivalent sites in the Valley, and compared to similar rates in ITE. Worst case trip generation rates may be required to be used for the TIA analysis.

Occasionally, a development proposal will consist of special or unusual land uses for which typical trip generation rates or equations are not available, or do not apply. Judgment must be applied to identify a land use or combination of land uses that best represent the trip-making characteristics of the site. For any trip generation calculations based on rates not included in the ITE Trip Generation Manual, the reasoning and data used by the consultant in developing a trip generation estimate for a special or unusual generator must be pre-approved by the City Traffic Engineer, justified and explained in the report.

## **H. Internal Capture and Pass-By Trips**

It is usually assumed that all trips entering and exiting a new development are new trips that were not made to or through the area prior to the development being completed. However, for some non-residential developments, a portion of these trips may be “captured” from trips already being made to other existing developments on the adjacent street system, or they may be merely passing by on the way from one place to another. The driveway volume for a new development may, therefore, be significantly different from the amount of traffic added to the adjacent street system. For example, retail establishments, restaurants, banks, service stations, and convenience markets attract people from the passing stream of traffic; these are known as pass-by trips.

ITE’s Trip Generation Handbook contains discussions and references on the issue of pass-by trips. Because of the limited data available, adjustments for pass-by trips should be applied carefully. If pass-by trips are a major consideration, studies and interviews at similar land uses must be conducted or referenced.

## **I. Traffic Distribution and Assignment**

The directions from which traffic will access the site can vary depending on many factors, including:

1. The type of proposed development and the area from which it will attract traffic
2. The presence or absence of competing developments within the same market area
3. The size of the proposed development, and
4. The conditions on the surrounding street system

The influence area of the development needs to be identified for the site. Ideally, the influence area should contain approximately 80% of the trip ends that will be attracted to the site. If a market study is available, it should be used in establishing the influence area. Otherwise, an influence area should be established based on a reasonable documented estimate.

The three most common methods for estimating trip distribution are by analogy, model, and surrogate data. In most cases, a surrogate data method can be utilized

for developing the trip distribution. Utilizing this procedure involves using socioeconomic and demographic data to establish population or employment land use distributions around the site. In most cases, population can be used as the basis for estimating distribution of office, retail, and entertainment trips; employment is a reasonable surrogate for residential trips, and other trips can be similarly distributed using logical surrogates. For horizon years, land use estimates based on the city's General Plan should be utilized.

For some very large-scale developments, a trip distribution model should be utilized to estimate site trip distribution. The gravity model portion of the city's traffic forecasting model is available for this purpose.

### **Redevelopment Projects**

Since the purpose of the impact study is to evaluate a development proposal's impact on the transportation system, redevelopment projects require some special analysis. In the case of redevelopment projects, existing site-generated trips should be subtracted from existing and horizon year off-site traffic. The traffic generated by the proposed development is then added to the adjusted off-site traffic according to the above procedures to determine the impacts on the transportation system.

The consultant will establish the existing site generated trips through the collection of driveway counts. If the redevelopment area is substantial, or for some other reason does not lend itself to the collection of driveway counts for this purpose, trip generation rates may be applied to establish the existing site generated trips.

## **V. CAPACITY ANALYSIS**

This section describes the analytical techniques used to derive the study findings, conclusion, and recommendations. Capacity analysis must be performed at each of the major street and site access intersection locations (signalized and unsignalized), as well as transportation links, located within the study area. In some cases, there may be a need to analyze additional critical intersections or segments located outside the basic study area.

### **A. Total Traffic Estimate**

For each analysis period being studied, a projected total traffic volume must be estimated for each segment of the roadway system being analyzed. These projected total traffic volumes (consisting of site and non-site traffic) will be used in the capacity analyses. The traffic impact report must clearly depict the total traffic estimate and its components. Projected daily traffic volumes must be determined for all major streets within the study area as well.

## **B. Guidelines**

Once the total traffic volume estimate has been established, capacity analyses will be performed. In some cases, the projected demand may be unrealistically higher than the capacity available on the existing or proposed transportation system components. In those cases where improvements are not feasible, an adjustment may be necessary in the site and/ or background traffic to reflect realistic traffic diversion caused by capacity restraint. In such cases, the traffic components on all adjusted segments must be added again to obtain a more realistic total traffic projection. The original traffic estimates and specific reference to trip diversion shall be included in the report.

## **C. Identification of Impacts, Needs & Common Deficiencies**

The analysis is intended to show the relationship between the operations and geometry and to assess deficiencies, as well as to identify alternatives for further consideration. This requires the identification of impacts, needs, and deficiencies.

## **D. Level of Service and Capacity Analysis**

The evaluation of traffic operating conditions is referred to as level of service (LOS). The assessment of LOS is based on the quantitative effect of factors, such as speed and volume of traffic, geometric features of the roadway or intersection, traffic interruptions and delay, and freedom to maneuver.

### **1. Signalized Intersections**

Signalized intersection level of service will be determined utilizing the methods contained in the Highway Capacity Manual (HCM), 2000 or most recent edition. Two methods (operational and planning) are used for the analysis of signalized.

The operational analysis requires detailed information on all prevailing traffic, roadway, and signalization characteristics. It provides for a full analysis of capacity and level of service and can be used to evaluate alternative traffic demands, geometric designs, signal plans, or all three. Because of the detailed data requirements, the operational analysis should be used only for the evaluation of existing conditions or for the analysis of projects with a horizon year of less than 5 years in the future.

When more distant horizon years are studied or critical variables are missing, such as when anticipating upcoming planned or assumed development, it may be necessary to conduct a planning analysis.

The planning analysis only addresses capacity because it is not necessary or practical to perform detailed calculations of delay given the accuracy of the data that are generally available for planning purposes. The planning method generates 2

important products: (a) a projection of the status of the intersection with respect to its capacity, and (b) an approximation of a signal timing plan. Combining this approximation with appropriate values for other parameters used in the operational analysis, it is possible to extend the planning analysis into the level of the operational analysis.

## 2. Unsignalized intersections

Unsignalized intersection level of service will be determined utilizing the methods contained in the Highway Capacity Manual (HCM), Third Edition. Procedures have been developed to analyze both 2-way stop controlled intersections and all-way stop controlled intersections. Each of these analysis methods is further divided into analysis of 4-way intersections and T-intersections.

## 3. Arterials

In most cases, the capacity of an arterial street is dictated by the signalized intersections operating along its length. The analysis procedures described in the HCM rely on the results of the analysis methods above as a part of the input. Planning applications may use the entire arterial methodology, in a straightforward but somewhat simplified way, by computing stopped delay using certain default values as outlined in the signalized intersection analysis section. A reasonable estimation of the intended signal timing and quality of progression is vital to this process. The Avondale Transportation Plan, available on the City's website at [www.avondale.org/traffic](http://www.avondale.org/traffic) reviews LOS and capacity on arterial streets.

## 4. Capacity Analysis Software

Software that accurately replicates the HCM computations may be used in lieu of manual computations. Assumptions should be verified, as well as checking default values. The consultant must verify that the city has access to the software that it intends to use, so that city staff may properly verify inputs and results. Synchro software is also acceptable where appropriate.

## **E. Formulation of Mitigation Alternatives**

When the analyses indicate that a particular location is projected to operate at an acceptable level of service, no improvements are required, except as required for site specific improvements. If, however, deficiencies are recognized, then improvements in access, geometry, or operations must be investigated. Some improvements may be required if site generated traffic impacts off-site infrastructure that is not adjacent to the proposed project. When reasonable improvements cannot sufficiently accommodate projected traffic, more detailed assessments of project size, land use, or development phasing may be required.

Many major projects necessitate improvements to the area's roadway infrastructure, both internally and externally. The nature of these improvements and their timing must be related to the anticipated phasing of the development, as well as the changes within the study area as a whole.

For redevelopment projects, mitigation alternatives may include transportation demand management measures, including, but not limited to transit, traffic calming, bicycle, and pedestrian improvements.

## **VI. SITE ACCESS & OFF-SITE IMPROVEMENTS**

To develop recommendations for site access and off-site roadway improvements requires that judgments be applied to a number of alternative solutions or recommendations.

### **A. Level of Service Goals**

Study recommendations and conclusions are intended to provide safe and efficient movement of traffic to and from, within and past, the proposed development, while minimizing the impact to non-site trips. The following levels of service are required after the completion of each phase of the development, as well as completion of the entire project:

1. All intersections and arterials must operate at LOS D (or better) during the peak traffic hour of the roadway system. All intersection approaches, and intersection turning movements should operate at LOS D (or better) and must operate at LOS D (or better) during the peak traffic hour of the roadway system. When the planning analysis is performed, the requirement will be that all intersections operate at "near capacity" or "under capacity."
2. In areas where current levels of service, or future levels of service without the development, are LOS E or worse in the peak hour, the delay or v/c ratio may not be significantly increased by the development traffic.

### **B. Development of Recommendations**

During the final phase of the study, all analyses are reviewed and re-assessed to best respond to the actual transportation needs of the project and the adjacent area. Results must be placed in logical perspective and sequence.

In high-growth areas, particularly when large developments are being analyzed, it is important to determine the impact of individual phases of the development. This procedure becomes necessary in situations requiring assessments to fund improvements. In such cases, the following analyses should be completed:

1. Levels of service under existing conditions.
2. Levels of service for future horizon dates, with anticipated non-site generated traffic growth. Committed improvements should be included for each horizon

year in the analyses. Additional improvements necessary to attain LOS D for base conditions should be identified.

3. Levels of service including site generated traffic for horizon years, both with and without proposed additional improvements to local and regional roadways beyond those identified in step 2.

### **C. Network Improvements**

Network improvements recognize that individual developments and increasing traffic volumes are part of the long-term growth of an area. Roadway improvements associated strictly with any given development may not necessarily address the long-term needs of the rest of the region on a systematic basis, and thus not address overall transportation system needs. Therefore, a section of the traffic impact study will address compatibility with the existing and planned infrastructure.

### **D. Localized Improvements**

Localized improvements consist of modification, expansion, and in some cases addition of roadway facilities in the immediate vicinity of the proposed development. The scope of these improvements will be consistent with the LOS criteria established above. They will address specific site and through traffic needs, and will be compatible with the city's long-term improvement plans.

### **E. Program Improvements**

If adequate transportation improvements cannot be reasonably recommended, consideration should be given to reducing trip generation during problem periods by reducing the project magnitude or altering the land use mix.

### **F. Implementation Schedule**

It is important to view recommendations for improvements within appropriate time perspectives. Recommendations should be sensitive to the following issues:

1. Timing of short-term and long-term network improvements that are already planned, scheduled, and/or funded.
2. Time schedules of adjacent developments.
3. Size and timing of individual phases of development.
4. Right-of-way needs and availability of additional rights-of-way within appropriate time frames.
5. City priorities for transportation improvements and funding.
6. Cost-effectiveness of implementing improvements at a given stage of development.
7. Necessary lead-time for additional design and construction.

## **VII. ON-SITE CIRCULATION**

An integral part of an overall traffic impact study relates to basic site planning principles. It is extremely important that off-site roadway improvements be fully integrated with on-site recommendations. In addition to capacity analysis, several other transportation service-related factors shall be considered, including:

- Safety
- Circulation patterns
- Traffic control needs
- Turn lanes (left, right, dual, deceleration, etc.)
- Driveways, including spacing, location and design
- Access management issues
- Transit needs or impacts
- Transportation system management
- Neighborhood impacts
- Pedestrian and bicycle circulation
- Service and delivery vehicle access and circulation

The analysis of internal circulation, parking, off-site circulation, and capacity analyses will provide the basis for identifying transportation deficiencies and needs related to the proposed development. The analyses shall be conducted for conditions both with and without the proposed project in order to establish the incremental impacts of the project and the incremental needs it generates.

### **A. Approach to Site Planning**

Internal design will have a direct affect on the adequacy of site access points. The identification of access points between the site and the external roadway system, and subsequent recommendations concerning the design of those access points, is directly related to both the directional distribution of site traffic and the internal circulation system configuration. It is clear that driveway traffic volumes of varying sizes need to be accommodated on the site in terms of both providing sufficient capacity and queuing space, and of distributing automobiles to and from parking spaces, pick-up/drop-off points, and drive-through lanes. An integrated system should deliver vehicles from the external roadway system in a manner that is easily understood by drivers, maximizes efficiency, accommodates anticipated traffic patterns, and ensures public safety. Pedestrian linkages should conveniently and safely connect transit stops, roadway intersections and parking facilities with building entrances. Similar linkages should be provided between buildings.

### **B. Access Points**

Requirements for access to the public street system are detailed in the City of Avondale General Engineering Requirements. Exceptions will only be granted according to the deviation process outlined in the General Engineering Requirements for circumstances demonstrating justifiable hardships. The General Engineering

Requirements reference standards for driveway and side street spacing, location, median openings, signal spacing and other access management principles.

Joint access (the sharing of a driveway by two or more properties) is desirable; particularly where property frontages are short and driveway volumes will be low. Such driveways should be located on joint property lines or be accessible via cross-access easements on the private property being served by the joint driveway. Joint driveways may be required to provide one or more parcels appropriate access to the adjacent street system that would otherwise be restricted as a single parcel when full or safe connections to adjacent roadways cannot be provided.

### **C. Driveway Design**

Analysis should review spacing between driveways, distance to nearest driveways adjacent to site and across the street from site, and spacing of off-set driveways across the street from site. Driveway locations should be reviewed for appropriateness and alignment with parking lot layout and intersecting drive aisles. Driveway width should be analyzed for necessary turning radii, truck turning movements, ingress and egress lanes. Driveway length should be reviewed for minimum throat length needed to accommodate all inbound traffic safely on-site without back-ups on traffic onto the intersecting street, and to accommodate all outbound traffic queued at driveway to exit without blocking intersecting drive aisles, median openings or parking spaces. The effective length of a vehicle shall be measured in increments of 25-feet.

### **D. Vehicular Queuing Storage**

Adequate internal and external vehicle queuing storage is essential to providing safe and efficient access and circulation. Queuing analyses must be included to demonstrate the adequacy of the proposed storage lanes, for all turn lanes, drive-throughs, and drop-off/pick-up zones. The effective length of a vehicle shall be measured in increments of 25-feet. For all right and left turn lanes, a table should be provided in the TIA that summarizes the existing (if applicable), required (as calculated per the TIA), and proposed storage lengths for all driveways and intersections analyzed.

Drive-in and drive-through establishments should be provided with adequate queue storage capacity to accommodate normal peak queues. Since many of these businesses have major daily or seasonal variations in activity, peaking characteristics should be carefully evaluated.

### **E. Right Turn Deceleration Lanes**

At driveways on arterial and collector roadways, deceleration lanes may be required. Additional right-of-way may also be required to accommodate the deceleration lanes.

To determine the need for a deceleration lane, the proposed site conditions must meet a **minimum of three** of the following criteria:

1. At least 5,000 vehicles per day are using or are expected (five years after the development is built-out) to be using the adjacent street.
2. The posted speed limit is 35 mph or greater.
3. At least 1,000 vehicles per day are using or are expected to use the driveway for the development or adjacent development(s) (existing or future).
4. At least 30 vehicles are expected to make right-turns into the driveway for a one-hour period for the development or adjacent developments (existing or future).

At the discretion of the City Engineer or their designee, a deceleration lane may be required regardless of the above minimum criteria, if site specific conditions warrant the addition of such a lane. In no event shall adjacent driveways be located within the area of the deceleration lane and the required taper lengths unless specifically approved by the City Engineer.

### **Deceleration Lane Length**

The length of a deceleration lane shall be based on a queuing length calculated from an average 2-min period within the peak hour. The minimum queue length shall not be less than space required for two (2) vehicles, where the effective length of a vehicle shall be measured in increments of 25-feet. The total length (taper plus stacking) shall not be less than the minimum length required to accommodate the queuing length plus the breaking distance plus the taper length.

The type of vehicles used in the calculation shall depend solely on the type facility being studied accounting for 10% truck traffic (minimum of one) where applicable. The taper of a deceleration lane should be approximately 8-feet to 15-feet longitudinally per 1-foot transversely (8:1 to 15:1).

### **F. Internal Vehicular Circulation**

Internal circulation is the means by which vehicular traffic is delivered between entry points and parking areas, pick-up/drop-off points, and service areas. Internal circulation roadways should permit access between all areas. These roads should be designed to safely and efficiently deliver vehicles and pedestrians to their respective destinations. Parking lot layouts and on-site traffic control should be reviewed for safe circulation. Recommendations for traffic control should be made as appropriate.

### **G. Service and Delivery Vehicles**

Service and delivery vehicles require separate criteria for movement to and from the site. Of particular interest is that adequate turning paths are provided for large service vehicles to allow entry and exit without encroaching upon opposing lanes or curbed areas. In addition, sufficient storage areas and loading zones must be provided so

that service vehicles do not hinder the use of parking and circulation routes for other visitors to the site.

A minimum of one driveway for all proposed projects with commercial or industrial uses shall be designated as truck delivery access drives and shall meet the minimum turning path for a WB-67 design vehicle, without requiring maneuvering into more than one traffic lane within the public roadway. Additional driveways may be required to meet this criteria when determined by the City Engineer based on local conditions. For projects with storage facility uses, if it was determined that a deceleration lane is not warranted, the main access driveway shall meet the minimum turning path for a MH/B design vehicle.

## **H. Pedestrian, Transit, Bicycles, and Accessible Facilities**

Overall site plans must consider public transportation, pedestrians, bicyclists and those with disabilities. Adequate facilities for parking bicycles should be included. Transit facilities, car pool parking, and shuttle bus staging areas should be provided as appropriate for the development. Where provided, these facilities should be located adjacent to service drive and entrance locations, at key locations along circulation drives, or at major pedestrian focal points along the external roadway system.

Pedestrian connections between these facilities and the site's buildings must be integrated into the overall project design and provide maximum accessibility through the use of sidewalk ramps, etc. These connections must also be provided to the public sidewalk and path or trail systems surrounding the site.

Pedestrian circulation should be comprehensive and provide connections between all buildings, and from all streets, signals and transit stops into the site. Pedestrian connections to nearby trail systems will also be required.

### **1. Pedestrians and Bicycles**

The site plan should be reviewed to ensure that the internal circulation system and external access points are designed for pedestrian safety and to minimize vehicle/pedestrian conflicts. Locations for transit stops and their associated pedestrian flows to building access points require thorough assessment to ensure safety. Similarly, pedestrian flows to and from parking facilities need careful consideration during site planning, which often requires detailed information on the project's use and layout.

These considerations should also be addressed for projects expected to generate significant bicycle traffic. Bike racks, long-term bike lockers, and facilities for employees to change clothes and shower should be considered.

### **2. Transit**

Transit standards are based off of regional standards for consistency because the City of Avondale participates in the regional transit system provided by Phoenix RPTA/ValleyMetro. There are two types of transit stops: bus pull-out bays typically on the departure side of signalized intersections, and bus stop pads where no pull-out bay is required. Specific standards and design details for transit stop and pull-out bay locations are found in the Avondale General Engineering Requirements and the City's Supplement to MAG Standard Specifications and Details. Adjacent developments should also enhance transit stops and amenities by incorporating architectural themes from the project into the transit stop.

## **I. Traffic Calming**

For subdivision and residential projects, traffic calming features may be required on long streets, streets near schools, locations with pedestrian or trail crossings, or other locations with traffic concerns. Review of these concerns and suggestions for locations where traffic calming may be appropriate may be required as part of the traffic study. Types of traffic calming features can range from traffic circles, medians, intersection narrowings, bulb-outs, raised crossings, or other depending on the conditions and applications.

## **J. Schools**

For locations where schools are proposed, site specific analysis of the school site plan will be required that includes the following:

- Safe Walking Routes to School
- Crossing Locations
- Traffic Control
- Traffic Calming
- Driveway Locations
- On-Site Drop-off/Pick-up—to maximize effectiveness of on-site queuing and eliminate back-ups onto public streets
- Pedestrian & Bicycle Circulation
- Bus Circulation
- Conformance with the ADOT "Traffic Safety for School Areas" Manual and applicable City of Avondale Codes.

## **VIII. DEVELOPING CONCLUSIONS & RECOMMENDATIONS**

### **A. Purpose and End Uses**

The purpose of the traffic impact analysis is to identify and measure the effects of a proposed development on the surrounding transportation system, and determine appropriate measures necessary to mitigate those impacts. The developer will be able to utilize the report to evaluate their development proposal and site plan design. The city will also utilize the report in reviewing the attributes of proposed

developments in conjunction with requests for annexation, land subdivision, zoning changes, building permits, or other development reviews.

**The results and recommendations of the TIA should be reviewed by the owner and applicant prior to submitting to the City of Avondale with the development package, and ensure that the recommendations and improvements are included in the proposed project and the site plan.** In most cases, results of the TIA impact the design of the development, and are required to be incorporated as an integral part of the site development. The end use of the TIA is to guide the applicant during the development of the proposed project.

The TIA report will include at a minimum:

1. Study purpose and objectives
2. A description of the site and study area
3. Existing conditions in the area of the development
4. Anticipated nearby development
5. Trip generation
6. Trip distribution
7. Modal split
8. Traffic assignment resulting from the development
9. Projected future traffic volumes
10. An assessment of the change in roadway operating conditions resulting from the development traffic
11. On-site traffic circulation issues including driveway location and design
12. Traffic safety issues including pedestrian, bicycles and transit; and
13. Recommendations for site access and transportation improvements needed to maintain traffic flow to, from, within, and past the site at an acceptable and safe level of service

Please follow the sample report outline provided (attached) and any instructions provided by the Traffic Division staff when completing the analysis and report. Incomplete reports will be returned to the consultant for revisions or completion prior to a full review of the analysis.

## **B. Certification**

The report shall be prepared by a professional traffic engineering consultant, bound, signed, sealed, and stamped by a registered professional engineer in the State of Arizona.

The TIA is required to be submitted with the Development Application package to the Development Services Department, who will then route to the required Traffic Engineering representative. Reviews and comments on TIA reports will follow procedures and standards set as part of the standard Development Review process with the application submittal. Written approval from the City Traffic Engineer is required prior to the development project being advertised for hearing.

### **C. Sample Report Outline**

A sample outline structure is attached in Figure 1. It provides a framework for the Traffic Impact Analysis report. Studies that follow this outline will be easily documented; however, additional sections may be warranted because of specific issues to be addressed and/or the results of the study. Likewise, inapplicable sections listed in the outline may be omitted from the report.

### **D. Appendices**

All appendices and attachments must be included as hard copies with the report. Appendices should be separated by tabs and/or colored paper.

## Figure 1 TIA REPORT OUTLINE

- I. Executive Summary
  - A. Purpose of Report and Study Objectives
  - B. Site Locations and Study Area **\*NOTE: Clearly state what Category TIA\***
  - C. Development Description
  - D. Principal Findings
  - E. Conclusions
  - F. Recommendations
  
- II. Proposed Development
  - A. Description of On-Site Development
    - 1. Location
    - 2. Site Plan/Vicinity Map
    - 3. Zoning
    - 4. Lane Use and Intensity
    - 5. Phasing and Timing
  - B. Off Site Development
  
- III. Area Conditions
  - A. Study Area **\*NOTE: Clearly state what Category TIA\***
    - 1. Area of Influence
    - 2. Area of Significant Traffic Impact
  - B. Study Area Land Use
    - 1. Existing Land Uses
    - 2. Existing Zoning
    - 3. Anticipated Future Development, Land Uses & Zoning
  - C. Site Accessibility
    - 1. Area Roadway System, both Existing & Future
      - a. Roadway classification & Posted Speed Limits
      - b. Right-of-Way, existing and required
    - 2. Traffic Volumes and Conditions
    - 3. Transit Service
    - 4. Existing Relevant Transportation Systems
  
- IV. Projected Traffic
  - A. Site Traffic (each Horizon Year)
    - 1. Trip Generation
    - 2. Trip Distribution
    - 3. Modal Split
    - 4. Trip Assignment
  - B. Through Traffic (each Horizon Year)
    - 1. Method of Projections

2. Non-Site Traffic for Anticipated Development in Study Areas
  - a. Method of Projections
  - b. Trip Generation
  - c. Trip Distribution
  - d. Modal Split
  - e. Trip Assignment
3. Through Traffic
4. Estimated Volumes

#### V. Traffic Analysis

- A. Capacity and Level of Service
- B. Traffic Safety
- C. Traffic Signals
- D. Turn Lanes, both Right and Left Turn Lanes—Include Table of Existing, Required, and Proposed

#### VI. Site-Specific Traffic Analysis

- A. Site Access
- B. Driveway Location, Spacing, Design, Width, Throat Length, Stacking, Queuing, etc. —Include Table as needed
- C. Deceleration Lane Analysis—Include Table of Required, and Proposed
- D. Drive-through Queuing and Stacking Requirements—Include Table if needed
- E. Site Circulation, On-Site Traffic Control, Parking
- F. Sight Visibility

#### VII. Improvement Analysis

- A. Improvements to Accommodate Base Traffic
- B. Additional Improvements to Accommodate Site Traffic
- C. Alternative improvements
- D. Status of Improvements already Funded, Programmed, or Planned
- E. Evaluation

#### VIII. Conclusions & Recommendations

- A. Summary of Findings
  1. Traffic Impacts
  2. Need for Improvements
  3. Compliance with Applicable City of Avondale Requirements and Codes
- B. Site Accessibility/Circulation Plan
- C. Roadway Improvements
  1. On-Site
  2. Off Site
  3. Phasing, if Applicable
  4. Summary of Improvements Based on Background Traffic vs. Based on Site Generated Traffic
- D. Transportation System & Other