SECTION 4

TRAFFIC IMPACT STUDIES

4-1 GENERAL – The City of Roseville has established the following guidelines for the preparation of traffic studies to ensure consistency of analysis and adequacy of information to aid City staff and decision makers in the consideration of project approval with regard to impacts to the City's transportation system.

4-2 PURPOSE OF TRAFFIC IMPACT STUDIES – Traffic impact studies are an important tool in the overall development planning process (residential, commercial, industrial, institutional, etc.) for the City. They provide the necessary information to allow an assessment of the potential traffic impacts associated with proposed projects as they relate to transportation policies established by the City. Traffic impact studies are also used to identify appropriate mitigation and/or recommendations where practicable to offset project impacts.

4-3 RESPONSIBILITY FOR TRAFFIC IMPACT STUDIES – The City utilizes on-call transportation services with approved transportation Consultants for the preparation of all city-required transportation studies. Traffic impact studies, when required by the City, shall adequately assess the impacts of a development proposal on the existing and/or planned street system.

Applicants should contact the Planning Division as early as possible and provide a site plan with proposed land use and associated square footages prior to submitting an application so that the City can evaluate the traffic study requirements. Should it be determined that a traffic study will be required, the City will provide an estimated cost, scope and scheduled for the study, and the project applicant will be required to authorize the City to proceed with the traffic study and deposit the necessary funds prior to the City commencing with the study.

Note: The City will not accept traffic studies prepared directly by an applicant's traffic/transportation Consultant.

4-4 TYPES OF TRAFFIC IMPACT STUDIES – The flow chart shown in Figure 4-1 shall be used to determine when and what type of traffic study may be required for proposed development projects. The City utilizes both short-term and long-term traffic studies for assessing the potential impacts of a proposed project.

Short-Term Traffic Studies – The primary purpose of a short-term traffic study is to identify the project's impact to the roadway network under existing and/or near-term conditions and to evaluate proposed site access.

Where access points are not defined at the time the traffic study is prepared, additional analysis may be required when the access points are defined.

When only short-term traffic studies are prepared, they shall include an explanation as to why the future scenario need not be analyzed (e.g., the proposed land use is consistent with the General Plan, therefore the project's long term traffic impact is already accounted for via the City's Capital Improvement Program which was derived from the City-wide traffic model).

Long-Term Traffic Studies – Long-term traffic studies are generally required when a proposed project will generate greater than 50 p.m. peak hour trip ends and the land use is not consistent with the assumptions of the City's travel demand forecasting model, with regard to intensity of development and/or type of use.

Cumulative traffic impacts are evaluated using the latest version of the City's CIP travel demand model. A LOS comparison of with and without project conditions for all signalized intersections (existing & future) is reported and intersections that degrade from acceptable to unacceptable (per the City's current LOS policy) shall be identified and appropriate mitigation identified where feasible. The term "impact" in this case refers to violation of the City's intersection LOS policy as described below: Maintain a level of service (LOS) "C" standard at a minimum of 70 percent of all signalized intersections and roadway segments in the City during the p.m. peak hours or causing an intersection operating at LOS "C" to operate at worse than LOS "C". Exceptions to the LOS "C" standard may be considered for intersections where the city finds that the required improvements are unacceptable based on established criteria identified in the implementation measures. In addition, Pedestrian Districts may be exempted from the LOS standard.

Both short-term and long-term traffic analysis shall include graphics that show traffic volumes for private access points, study intersections and roadway segments, as required:

1. Existing P.M. peak hour directional roadway traffic volumes including turning movements at intersections. (Short-Term).

2. The data in item 1 above plus projected site traffic volumes for the development scenario being analyzed. Include projected turning movements at driveways. It is acceptable to combine items 1 and 2 into one graphic. (Short-Term).

3. Future P.M. peak hour directional roadway traffic volumes including turning movements at intersections without the project. (Long-Term).

4. The data in item 3 above plus projected site traffic volumes. Include projected turning movements at driveways. It is acceptable to combine items 3 and 4 into one graphic (Long-Term).

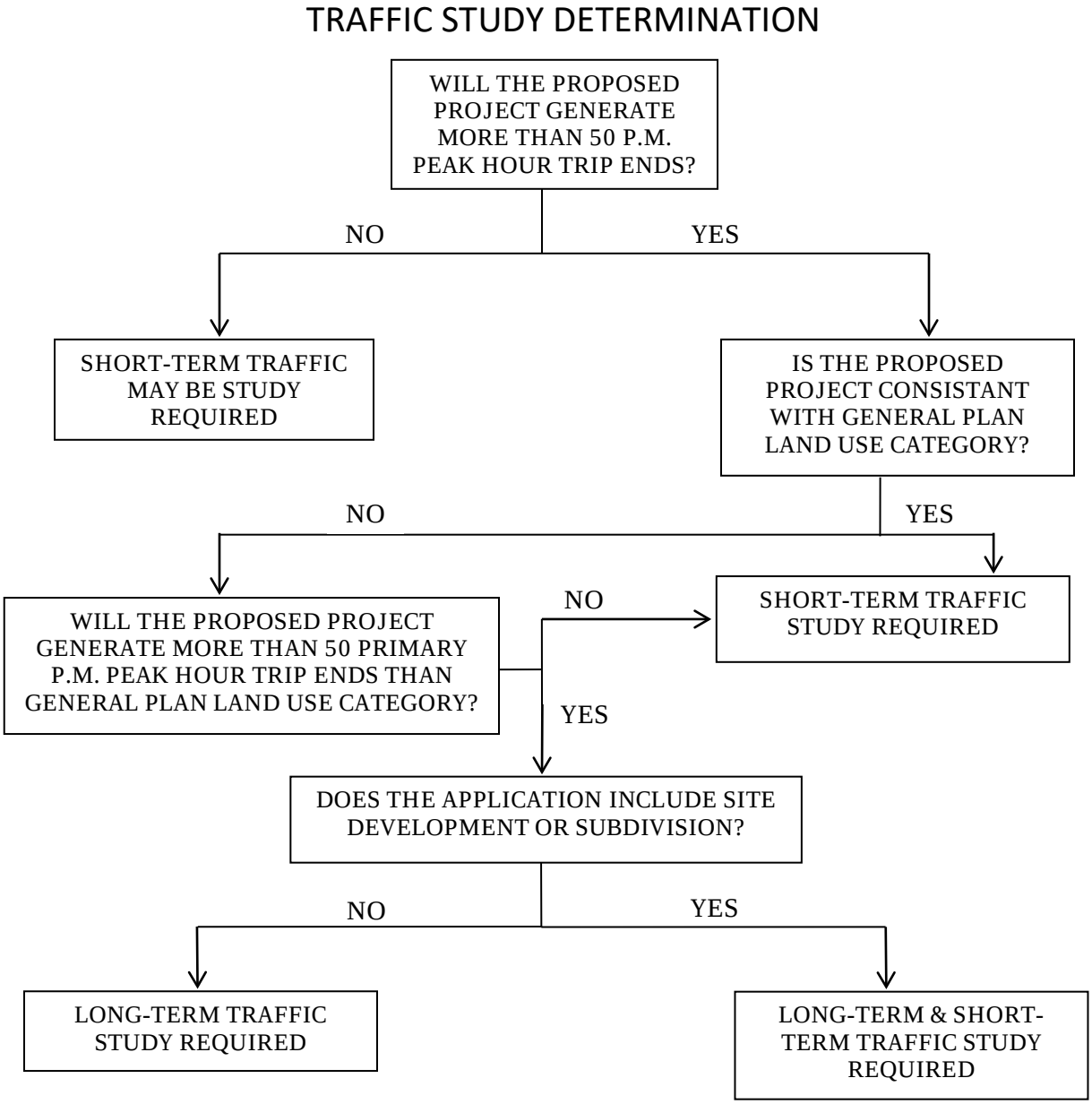


FIGURE 4-1

Other peak hours that are determined by the City to be critical to site traffic and the street system in the study area shall be included and shall show the same information as is provided for above. Examples of other peak hours are A.M. peak, noon peak, and project peak.

Note: All previous traffic studies that are more than two years old will generally be required to be updated unless the Development Services Engineering Division determines that conditions have not changed significantly.

4-5 TRAFFIC STUDY FORMAT – In order to provide consistency and to facilitate staff review, the following format shall be used in the preparation of such studies by transportation consultants:

A. Introduction – The introduction of the report shall contain the following:

1. Project Location and Study Area – A brief description of the location within the City and the region shall be included in the section. In addition, roadways that afford access to the site and those that are included in the study area shall be identified. General terrain features within the study area should also be described.

The exact limits of the study area should be based on engineering judgment and an understanding of existing traffic conditions surrounding the site. In all instances, however, the study area limits shall be subject to approval of the Development Services Engineering Division. A vicinity map that shows the site and the study area boundaries in relation to the surrounding transportation system shall be included.

2. Existing and Proposed Site Uses – The existing and proposed uses of the site shall be identified in terms of the various zoning categories of the City. In addition, the specific use for which the request is being made shall be identified, if known, since a number of uses may be permitted under existing zoning. Parcels in the vicinity of the site shall also be identified with respect to the zoning, land use and specific uses. This information shall include square footage of the various uses or the number and size of the units proposed. All driveways in the vicinity of the project that could affect operations of any proposed driveways shall also be shown.

It shall be the intent of the traffic study to evaluate the worst-case impacts for the proposed development allowed by zoning unless a specific use/users is identified by the applicant. If several different uses are permitted by the zoning, the land use with the greatest overall traffic impact shall be assumed for the study.

3. Study Area Conditions – Within the study area, the traffic study shall describe and provide volumes for existing roadways, intersections and driveways including geometric and traffic signal control as well as improvements that have been proposed by government agencies and other development projects. The study

shall identify roadway improvements within the study area that are planned to be constructed by the City as part of the City's Capital Improvement Program.

Note: The City will provide copies of current traffic count information, where available; however, the Consultant is ultimately responsible to provide up-to-date traffic volume count information for all study locations. Traffic count information for many locations are available on the City's website. Please visit the following link for more information: http://www.roseville.ca.us/pw/engineering/traffic_engineering/default.asp

B. Project Trip Generation - A summary table listing each specific use, the size involved, the trip generation rates used (total daily traffic and A.M. /P.M. peak hours) and the resultant total trips generated shall be that of a typical weekday and shall coincide with the peak hour of the roadway system (not the peak hour of the project). However, there may be instances where a unique project use requires an analysis during different time frames; such as a weekend.

This section shall also include a discussion on how the project's trip generation rate compares with typical trip generation rates for the site's existing General Plan land use category. If the proposed project represents only a portion of a larger overall site, such as a phased project, then the traffic study shall discuss the degree to which both the initial phase and the ultimate development impact the roadway network.

Trip generation shall be calculated based on data contained within the latest edition of the Institute of Transportation Engineer's (ITE) Trip Generation Manual approved for use by the City or more appropriate local data as approved by the Development Services Engineering Division. Any internal trip reductions or modal split assumptions will require analytical support to demonstrate how the figures were derived.

Pass-by trip factors may be used to reduce the estimated additional traffic to streets serving a proposed development. However, the percentage of pass-by traffic shall be documented and referenced as to the source of the assumptions (e.g., ITE Trip Generation Manual, ITE Journal article, local study, etc.). Pass-by rates are not to be applied to reduce turning movement volumes at driveways serving the proposed development.

C. Trip Distribution – The directional distribution of trips entering and departing the proposed project site shall be clearly identified on a figure. The methodology of distribution shall be discussed in the study.

D. Traffic Assignment – The assignment of site-generated traffic onto the area's street system shall be clearly depicted on a map/figure. The traffic assignment shall consider the general trip distribution, logical routing, turn movement restrictions, available and projected roadway capacities and travel times. The technical analysis steps, basic methods, and assumptions used in this work shall be clearly stated.

E. Level of Service – The traffic study report shall include appropriate tables indicating the LOS and volume/capacity (V/C) of all study intersections and roadway segments, comparing with and without project scenarios. Signalized intersections shall be evaluated using the Transportation Research Board (TRB) Circular 212 planning methodology, or Highway Capacity Manual methodology, as determined by the Development Services Engineering Division, with the City-approved critical capacity adjustments. There may be instance where the City desires to evaluate signalized intersections utilizing the "operations methodology" as described in the latest edition of the Highway Capacity Manual. In such instances, the City will provide direction to the Consultant in the development of the scope of the traffic study. Unsignalized intersections shall be analyzed using the latest version of the Highway Capacity Manual, or other appropriate methodology as approved by the Development Services Engineering Division.

A minimum intersection Level of Service "C" shall be the peak hour design objective. If the proposed project is shown to cause degradation of intersection LOS to worse than "C" (or whichever LOS has been approved by the City Council for a particular intersection) after considering any improvements already planned by the City, then the traffic study shall recommend feasible mitigation measures to bring the intersection Level of Service within acceptable standards in accordance with the City's LOS policy. The Consultant shall inquire with the Development Services Engineering Division as to planned roadway and intersection improvements.

The report shall include a discussion of assumptions made in the above calculations, such as saturation flow rates, peak hour factors and lane configurations. Full documentation of the LOS calculations shall be provided in an appendix.

F. Site Access – A short-term traffic study shall discuss how the proposed site access compares with the City's access standards as described in this section and in Section 5 of these Design Standards entitled "Site Access." Some of the topics that must be included in the

traffic study are: number of driveways serving a parcel or site, right turn deceleration lane or right turn curb flares for driveways, left turn deceleration lane for driveways, storage requirements for turn lanes, minimum offset for opposing driveways, restricted turning movements for driveways and sight distance. Each site access point shall be discussed separately. If the proposed site access does not meet the City's standards, then the traffic study shall identify what modifications to the proposed site access would be necessary to meet City standards and explain why these modifications are not proposed.

1. Driveways – Minimum Required Throat Depth (MRTD):
The traffic study shall evaluate the Minimum Required Throat Depth (MRTD) needed on-site for each access point for the proposed development. The MRTD, as illustrated in Figure 4-2 entitled "MINIMUM REQUIRED THROAT DEPTH", is measured from the back of sidewalk to the first drive aisle or parking stall. The purpose of the MRTD is to allow enough stacking distance for egressing vehicles so that the first drive aisle or parking stall is not blocked. This minimizes the possibility of incoming vehicles queuing out into the traveled way of the main street thereby creating a safety concern as shown in Figure 4-2.

The MRTD shall be measured in car length increments of 25 feet and rounded up to the nearest division of 25 feet. In no case will the City allow a MRTD of less than 25 feet for any project. Throat depths greater than the calculated MRTD are encouraged. On-site parking shall not be permitted within the MRTD area.

Note: The MRTD requirement does not apply to single family residential or duplex uses.

Figure 4-2 illustrates that the MRTD is a function of the length of the queue of vehicles waiting to exit the driveway. The length of this queue is a function of two variables: the number of vehicles desiring to egress during a given time period versus the number of vehicles that can enter the traffic stream of the main road during that same time period.

If the proposed project represents only a portion of a larger overall site, or if it is expected that vehicles generated by other than the project will use the access under study, then the total expected turning movement volumes at the subject access location shall be used in determining the MRTD.

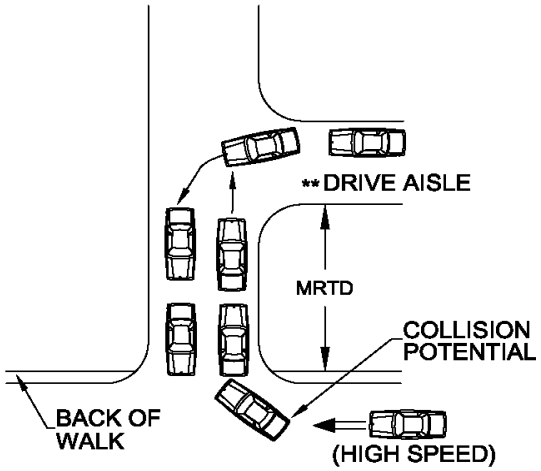
As shown in Figure 4-2, there are cases when a MRTD of 25 feet is acceptable. This is when the first drive isle is "one way only" to the right in the figure. Another scenario where a MRTD of 25 feet is acceptable is when a raised center median is constructed in the

driveway throat from the back of sidewalk to the calculated MRTD distance. In this case, the nearest drive aisle can be two-way, but turning movements into and out of the drive aisle are restricted by the raised median, thereby mitigating the concern as shown in Figure 4-2.

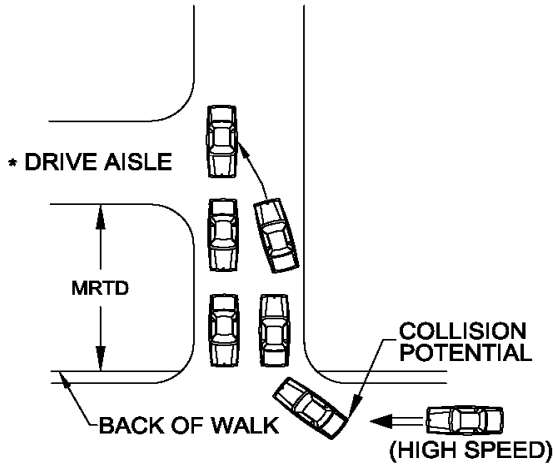
If the calculated MRTD is physically or unreasonable too long for the proposed development, then the traffic study shall suggest ways to reduce the MRTD by either reducing the egressing demand volume, or by increasing the movement capacity. Examples of reducing the egressing demand volume at an access location would be to suggest additional egress locations, cause a different distribution of vehicles by modifying the on-site design, or somehow reduce the site's trip generation. Examples of increasing the movement capacity at an access location would be to suggest additional egress lanes or, in the case of an unsignalized access location, suggest fewer allowed turning movements onto the roadway. In any case, the traffic study shall fully evaluate the impacts of any such modifications.

MRTD lengths at **unsignalized** project driveways shall be based on a series of regression equations that the City uses to predict maximum queue lengths at minor stop-controlled intersections. These equations are based on the methodology presented in *Estimation of Maximum Queue Lengths at Unsignalized Intersections (*ITE Journal, November 2001). Exhibit 4-1 presents the methodologies used for calculating the MRTD for various unsignalized driveway conditions. Major street volumes shall be based on projected future traffic volumes from the latest version of the Citywide traffic model. Alternative methodologies for calculating unsignalized MRTD lengths may be considered, but shall first be approved by the Development Services Engineering Division prior to incorporation into traffic studies.

MINIMUM REQUIRED THROAT DEPTH (MRTD)



MAIN ROAD



MAIN ROAD

* NOTE: IF THE DRIVE AISLE IS "ONE-WAY ONLY" TOWARDS THE DRIVEWAY THROAT, THEN A MRTD OF 25' IS ACCEPTABLE.

** NOTE: IF THE DRIVE AISLE IS "ONE-WAY ONLY" AWAY FROM THE DRIVEWAY THROAT, THEN A MRTD OF 25' IS ACCEPTABLE.

FIGURE 4-2

MRTD lengths at **signalized** project driveways are a function of egressing traffic volumes, lane geometrics and traffic signal timing. Typically, signalized access locations will have more than one approach lane for egressing vehicles; therefore, the MRTD shall be determined from the lane with the longest queue. The MRTD should be based on the Operational Analysis methodology contained in the latest version of the Highway Capacity Manual, or other methodology as approved by the Development Services Engineering Division. Major street volumes shall be based on projected future traffic volumes from the latest version of the Citywide traffic model. For existing traffic signals, the Consultant is recommended to discuss likely signal timing parameters with City staff. There may be some restrictions to signal timing parameters for existing signals due to progression, etc.

2. "Drive-Thru Service" Uses – On-Site Storage Requirements for traffic studies evaluating "drive-thru service" type land uses, the study shall evaluate vehicle storage requirements to ensure that vehicles will not queue out into the public right-of-way. Such types of uses/conditions include, drive-thru restaurants, drive-thru pharmacies, carwash facilities, gated communities, gated self-storage facilities, parking garages etc. The required storage length shall be determined based on expected arrival rates and service rates using accepted statistical practices. The distance is measured from the back of sidewalk at the street driveway to the service point in increments of 25 feet. All supporting assumptions and calculations shall be provided in the appendix.

3. Left-Turn Ingress Storage Requirements:
Left-turn ingress lanes serving the proposed project shall be evaluated with respect for turn lane storage/deceleration lengths. The left-turn storage shall be based on the regression equations that the City uses to predict maximum queue lengths at left-turn lanes based on the methodology presented in *Estimation of Maximum Queue Lengths at Unsignalized Intersections* (ITE Journal, November 2001). Table 4-1 presents the regression equation for approximating left-turn storage requirements for major-street left-turn movements. Major street through volumes shall be based on projected future traffic volumes from the latest version of the Citywide traffic model. Alternative methodologies for calculating storage lengths may be considered, but shall first be approved by the Development Services Engineering Division prior to incorporation into traffic studies.

G. Traffic Signals – The need for new traffic signals shall be based on warrants contained in the latest edition of the California Manual of Uniform Traffic Control Devices (California MUTCD), or other

approved source identified by the Development Services Engineering Division.

Where intersection controls are warranted on a two or four lane roadway, and at the direction of either the Public Works Director or the City Engineer, a formal evaluation shall be completed by the developer to identify the feasibility and operating benefits of a roundabout. The evaluation shall analyze space requirements and whether the installation of a roundabout would perform better than other control modes by reducing delay, improving safety, or solve other operational issues.

If a new traffic signal is being proposed which is not already a part of the City's Capital Improvement Program, and the signal installation would result in less than 1, 320 feet between signals, then the study shall include a signal progression analysis. The section of roadway to be analyzed for signal progression shall be determined by the Development Services Engineering Division and will include all existing and planned future signalized intersections.

The progression pattern calculations shall use a cycle consistent with current signal timing policies of the City. A desirable bandwidth of 50 percent of the signal cycle shall be used where existing conditions allow. Where intersections have no existing signals presently, but are expected to have planned future signals, typically a 60 percent mainline, and 40 percent cross street cycle split should be assumed. Cycle split assumptions shall relate to volume assumptions in the capacity analysis of individual intersections, and, where computerized progression analysis techniques are used, they shall be of the type which utilizes turning movement volume data and pedestrian clearance times in the development of time/space diagrams.

Those intersections that would reduce the optimum bandwidth if a traffic signal were installed may be required to remain unsignalized and have turning movements limited by access design or median islands.

Traffic studies for proposed projects located along a corridor that either currently has or is proposed to have coordinated traffic signals shall provide a new or updated traffic signal coordination plan along the entire section of coordinated roadway. This plan shall be created and modeled with the latest version of traffic signal optimization software used by the City. City staff shall be allowed to review and comment on the proposed coordination plan and staff suggestions shall be included in the final plan submitted with the traffic study. The coordination plan shall consider, at a minimum, the A.M., mid-day and P.M. periods of the day. More periods may be necessary if determined by staff to be relevant. The electronic coordination file shall be

delivered along with the paper coordination plans contained in the traffic study and they shall become the property of the City.

H. Traffic Accidents – Traffic accident data for affected street corridors may be required in the study as required by the City. The study period will normally be three years. The locations shall be specified by the Development Services Engineering Division and the Public Works Department. Accident data is on file in the Public Works Department. It shall be the Consultant's responsibility to make copies of the data.

Estimates of increased or decreased accident potential shall be evaluated for the development, particularly if the proposed development might impact existing traffic safety problems in the study area. Safety improvements shall be recommended where necessary.

I. On-Site Circulation – Where applicable, the Consultant shall review and evaluate the site plan with respect to vehicular and non-vehicular circulation and safety. All recommendations shall be clearly documented in the report.

J. Report Documentation – The analysis conducted for traffic studies shall be documented in a report for review by the City, with supporting tables and figures.

An executive summary shall be provided that clearly and concisely describes the project scope and purpose, findings, conclusion and mitigation measures and recommendations. Technical publications, calculations, data reporting and detail design shall not be included in the executive summary. The executive summary should be short, complete in itself and not dependent on supplementary data included by reference.

A table of contents, list of tables & figures and an appendix with supporting data, calculations, etc., should also be included, when appropriate to produce a professional and readable document.

4-6 PREPARATION AND SUBMITTAL REQUIREMENTS - The following requirements shall pertain to all traffic studies, unless otherwise directed by the City staff.

1. Traffic studies shall be prepared and stamped by a Registered Traffic Engineer or a Registered Civil Engineer with demonstrated competence and adequate experience in Transportation Engineering.

2. Initially, **five (5)** hard copies and **one (1)** electronic version of the Draft traffic study shall be submitted to the Development Services

Engineering Division for review and comment. The City will forward one hard copy to the applicant for the review.

3. Upon completing their review, the City will provide the Consultant with comments and discuss revisions to be incorporated into the final report.

4. The Consultant shall submit **three (3)** hard copies and **one (1)** electronic version of the Final traffic study.

5. All copies of the traffic study submitted to the City shall become the property of the City.

6. Traffic studies that are not in compliance with the requirements set forth in these Design Standards may be rejected until corrected to the satisfaction of the City.

Exhibit 4-1
Minimum Required Throat Depth Regression Equations
(Unsignalized Project Driveways)

Regression Equations		
Movement	**Condition**	**Equation**
Major-street left turn	Approach volume ≤ 100 VPH/PHF	Max. Queue = -2.042 + 1.167 In(AppVol) + .0975*TS
	Approach volume > 100 VPH/PHF	Max. Queue = +4.252 – 1.23*Lanes + 0.07996*Speed + 1.412*TS – 374.028/AppVol + 0.00001144*AppVol *ConflVol
Minor-street left turn	Approach volume ≤ 100 VPH/PHF	Max. Queue = +0.958 + 0.00111*(AppVol)^2 + 0.000333* (ConflVol)
	Approach volume > 60 VPH/PHF	Max. Queue = +6.174 – 2.313*TS + 0.03307*Speed – 1201.644/ConflVol + 0.00006549 (AppVol)^2
Minor-street right turn	**See Graph on Exhibit 4-2**	
Minor-street shared Left/through/right	All conditions	Max. Queue = -12.916 + 3.225ln(AppVol) + 0.00569*(ConflVol for LTs & THs) – 0.000177*(ConflVol for Rts) – 2.109*(RT%) – 3.157*TS

Source: Fehr & Peers, Transportation Consultants
Based on the methodology presented in *Estimation of Maximum Queue Lengths at Unsignalized Intersections* (ITE Journal, November 2001).

AppVol = hourly traffic volume divided by peak-hour factor (PHF) for subject movement;

ConflVol = hourly traffic volume divided by PHF that conflicts with subject movement (refer to the *Highway Capacity Manual 3 to identify movements that conflict with subject approach);*

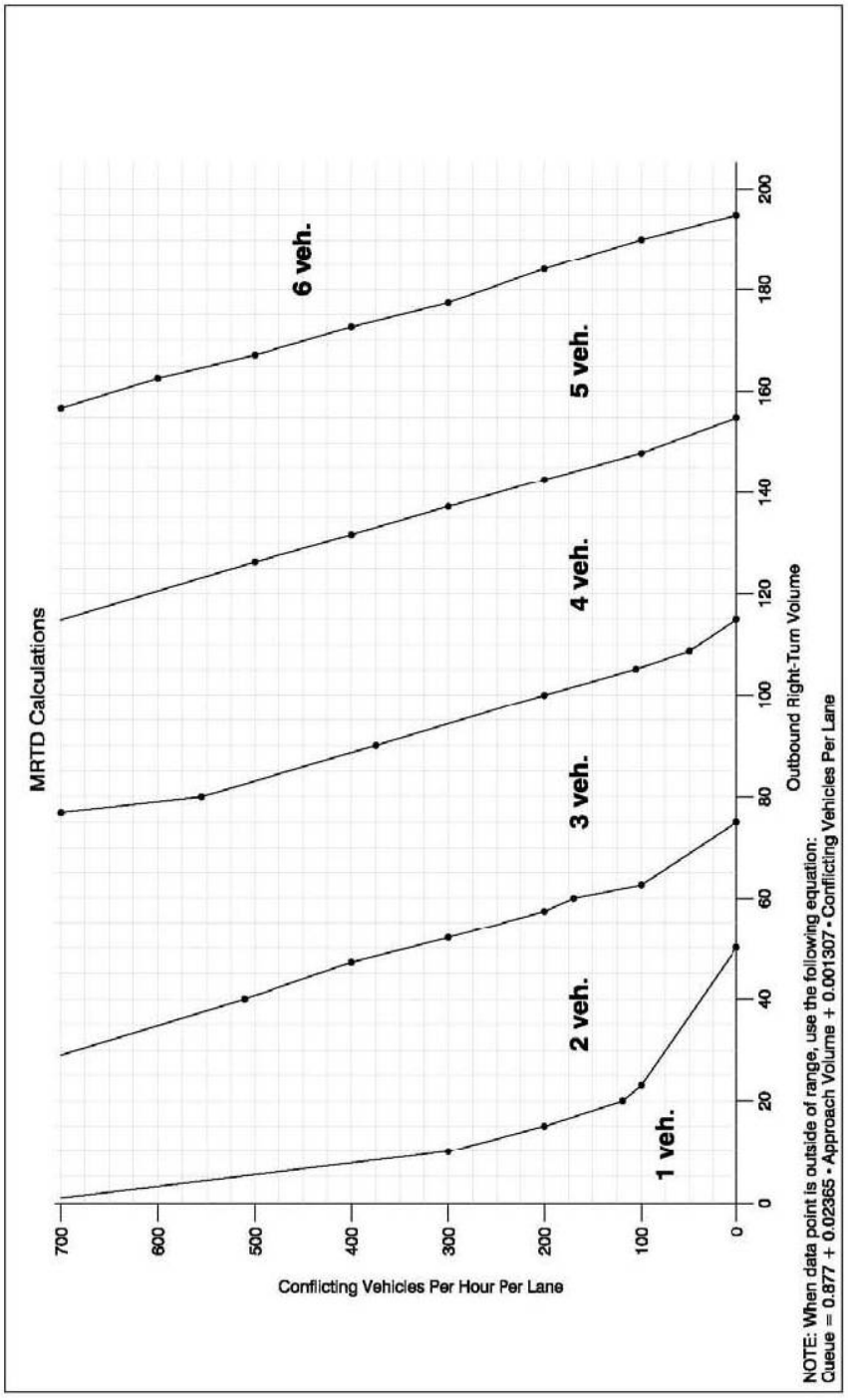
TS = a dummy variable with a value of 1 if a traffic signal is located on the major street within one-quarter mile of the subject intersection and o otherwise;

Lanes = number of through lanes occupied by conflicting traffic;

Speed = posted speed limit on major street (in miles per hour); and

RT % = Percentage of vehicles on shared left/through/right minor street approach that turn right.

Exhibit 4-2
Minimum Required Throat Depth



For Right-Turn Only Movements
(Unsignalized Project Driveways)
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