Transportation Impact Procedures Issues and Options

Revised - October 7, 2005

Prepared for:
City of Sacramento, California

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GLOSSARY OF TERMS

LOS	Level of Service
HCM	*Highway Capacity Manual*
VT/capita	Vehicle Trips Per Capita
VMT/capita	Vehicle Miles Traveled per Capita
TIA Guidelines	Transportation Impact Analysis Guidelines
GPU	General Plan Update
ADT	Average Daily Traffic
V/C	Volume to Capacity Ratio
CEQA	California Environmental Quality Act
Lead Agency	Agency responsible for Environmental Impact Reports
TOD	Transit Oriented Development
EIR	Environmental Impact Report

1. STUDY PURPOSE & SCOPE

In the context of the General Plan Update (GPU), City staff felt it was appropriate to re-visit the City's procedures for evaluating and mitigating transportation impacts from development and infrastructure projects. This activity is being conducted as an early element of the GPU because it sets the policy framework for evaluating GPU alternatives with respect to transportation. Additionally, City staff felt that opportunities to implement Smart Growth policies were being missed with the new developments that are being proposed while the GPU is in progress.

This study **includes** the following major steps:

- Document the City's current policies and procedures regarding transportation impact analysis
- Identify methods being used by other jurisdictions
- Develop viable options for consideration
- Present the options to decision-makers
- Facilitate a policy decision by the City prior to analysis of General Plan preferred alternative

This background report provides a discussion of the relevant issues, a description of the City's current procedures, and options for consideration.

While important issues, the following are **not covered** in this study:

- *Roadway cross-sections*: The City adopted new standard roadway cross-sections in 2004, which are reflective of the previously adopted Smart Growth Principles.
- *Residential quality-of-life:* The City has desired a definitive means to assess the impact of additional traffic on neighborhood quality-of-life. Unfortunately, there are no nationally-recognized methods appropriate for this purpose. Developing an assessment tool will require significant effort, beyond the budget or schedule of this study, to correlate the many variables (speed, traffic volume, set-back, buffers, etc.) to resident's quality-of-life experience. A discussion of this issue is provided in Appendix B.
- *Application of residential roadway cross-sections*: The City has guidelines on which roadway cross-section to apply in a given circumstance. While defining a service level policy dictates how many lanes should be provided, the issue of whether homes should front a roadway is more subjective and related to the quality-of-life issue described above.

2. LEVEL OF SERVICE – THE TECHNICAL SIDE

This section discusses the technical aspects of automobile LOS.

Level of service is a term used by traffic engineers to describe traffic operating conditions. The term is defined in the *Highway Capacity Manual* (HCM), Transportation Research Board, 2000. The 2000 version of the HCM is the sixth publication of this reference document, which was first published in 1950. Each new release typically reflects the results of the latest research related to improving the understanding of traffic flow characteristics.

The 2000 HCM contains procedures and methodology for calculating LOS for different transportation facilities and travel modes. Chapter 15 of this manual discusses the LOS for urban streets which is based on the average through-vehicle travel speed for the segment or for the entire street.

The LOS grades for roadway facilities are generally defined from the perspective of automobile/truck users:

- **LOS A** represents free-flow travel with an excellent level of comfort and convenience and the freedom to maneuver.
- **LOS B** has stable operating conditions, but the presence of other road users causes a noticeable, though slight, reduction in comfort, convenience, and maneuvering freedom.
- **LOS C** has stable operating conditions, but the operation of individual users is substantially affected by the interaction with others in the traffic stream.
- **LOS D** represents high-density, but stable flow. Users experience severe restriction in speed and freedom to maneuver, with poor levels of comfort and convenience.
- **LOS E** represents operating conditions at or near capacity. Speeds are reduced to a low but relatively uniform value. Freedom to maneuver is difficult with users experiencing frustration and poor comfort and convenience. Unstable operation is frequent, and minor disturbances in traffic flow can cause breakdown conditions.
- **LOS F** is used to define forced or breakdown conditions. This condition exists wherever the volume of traffic exceeds the capacity of the roadway. Long queues can form behind these bottleneck points with queued traffic traveling in a stop-and-go fashion.

Each LOS is based on quantitative performance measures and defines a range of operating conditions. Signalized intersection LOS is based on control delay (e.g., delay caused by the traffic signal) per vehicle. For example, control delay for LOS C conditions at a signalized intersection ranges from above 20 seconds up to 35 seconds. Performance measures vary depending on the type of transportation facility or travel mode. For roadway facilities, the performance measures used to determine LOS are typically based on the speed, volume, or density of vehicles during a peak hour. The 2000 HCM LOS procedures calculate these measures for peak hour conditions based on the highest 15-minute flow rate of vehicles during the peak hour.

3. HISTORICAL CONTEXT

The City has been conducting traffic impact studies for land development and transportation projects since the 1970's. These studies were/are intended to identify how much additional traffic congestion can be expected in the vicinity of a proposed project. The degree of congestion is expressed as a level of service (LOS) on a scale of A to F. The City's General Plan identifies **a goal** of providing LOS C or better conditions. This goal has been interpreted as a California Environmental Quality Act (CEQA) threshold for purposes of determining significant impacts. Consequently, what was intended to be a general, city-wide goal has become a rigid standard applied to every intersection throughout the City without consideration of context or broader City objectives.

With the development of traffic impact analysis guidelines in the mid 1990's, standard technical methods were identified to achieve more consistency between studies. Methods to assess impacts to bicycle and transit facilities were also introduced in the guidelines. These guidelines were last updated in 1996. An update to these technical guidelines was developed in 2002 but never adopted by City Council because the broader policy questions were not addressed, which is the purpose of this current study.

The historical purpose of conducting these studies and identifying impacts/mitigations was three-fold:

- Satisfying CEQA requirements to disclose impacts
- Understanding what improvements would be needed to meet the City's goal of LOS C
- Developing the nexus to require new development to provide improvements to mitigate its traffic impacts

In recent years, many of the reported significant impacts were not mitigated (by adopting a finding of "overriding considerations") because the mitigation was either too expensive or it was counter to other City goals, such as protecting neighborhoods.

Starting in the late 1990's, persons interested in Smart Growth issues began to question the results of the City's methods of conducting impact studies and the related LOS C threshold. Some of the concerns expressed include:

- Does a goal of LOS C promote sprawl through consequences such as reducing/eliminating congestion and by requiring more expensive improvements in infill areas?
- Does a localized measurement of congestion miss the bigger issue of how the same number of persons/jobs would affect overall travel if they were placed elsewhere?
- Does a focus on measuring/mitigating auto impacts create a disadvantage for alternative modes by providing larger roadways or by concentrating funding into auto-related improvements?

4. RELEVANT ISSUES

CALIFORNIA ENVIRONMENTAL QUALITY ACT REQUIREMENTS

CEQA has no LOS requirements. However, it does encourage the adoption of standards of significance to be used in determining significant impacts. It is the responsibility of the Lead Agency to determine the definition of "significant." CEQA guidelines provide the following direction.

> In evaluating the significance of the environmental effect of a project, the Lead Agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project.[1]

The difficulty comes in developing a procedure to measure or quantify physical changes to the environment. In this case, the City's standards of significance for transportation impact procedures are based on automobile LOS. CEQA guidelines state that significance thresholds need to be "an identifiable quantitative, qualitative or performance level."[2] Standardized LOS policies fit these descriptions. If developing standards of significance beyond automobile LOS policies, attention needs to be given to the following in order to produce defendable environmental documents.

> (a) Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant.
>
> (b) Thresholds of significance to be adopted for general use as part of the lead agency's environmental review process must be adopted by ordinance, resolution, rule, or regulation, and developed through a public review process and be supported by substantial evidence.[2]

CEQA case law has previously stated that "a project will normally have a significant effect on the environment if it will ... [c]ause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system."[3] This tends to point in the direction of automobile based standards of significance as opposed to a multi-modal approach involving pedestrians, bicyclists, and transit. It also focuses mitigation measures on directly mitigating automobile congestion, which may not benefit alternative modes, and often is detrimental to alternative modes. For example, widening a street or intersection to reduce automobile congestion will increase the length of time a pedestrian is exposed to conflicts with automobiles and worsen the quality of experience for pedestrians.

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[1] CEQA, Section 15064, 2 D

[2] CEQA, Section 15064.7, Thresholds of Significance.

[3] CEQA Online Reference, http://www.rbeerslaw.com/ceqastan.html#INTRODUCTION, CEQA Significance Standards

SMART GROWTH AND INFILL IMPLICATIONS

While the City of Sacramento's current procedures do address alternative modes at a qualitative level, the procedures developed by most jurisdictions are focused exclusively on automobile LOS, which can be counter to Smart Growth objectives. For example, higher densities associated with Smart Growth generally lead to greater localized traffic congestion. An automobile-focused LOS standard would conclude that this increased congestion is a problem to be fixed; consequently, the Smart Growth polices appear detrimental in the absence of other information. What is lacking in these circumstances is information for decision-makers on the relationship between land use density, land use mix, and physical design on the transportation system as a whole. While localized congestion may increase, Smart Growth policies lead to a reduction in overall automobile use, greater transportation choices, sustainability, etc.

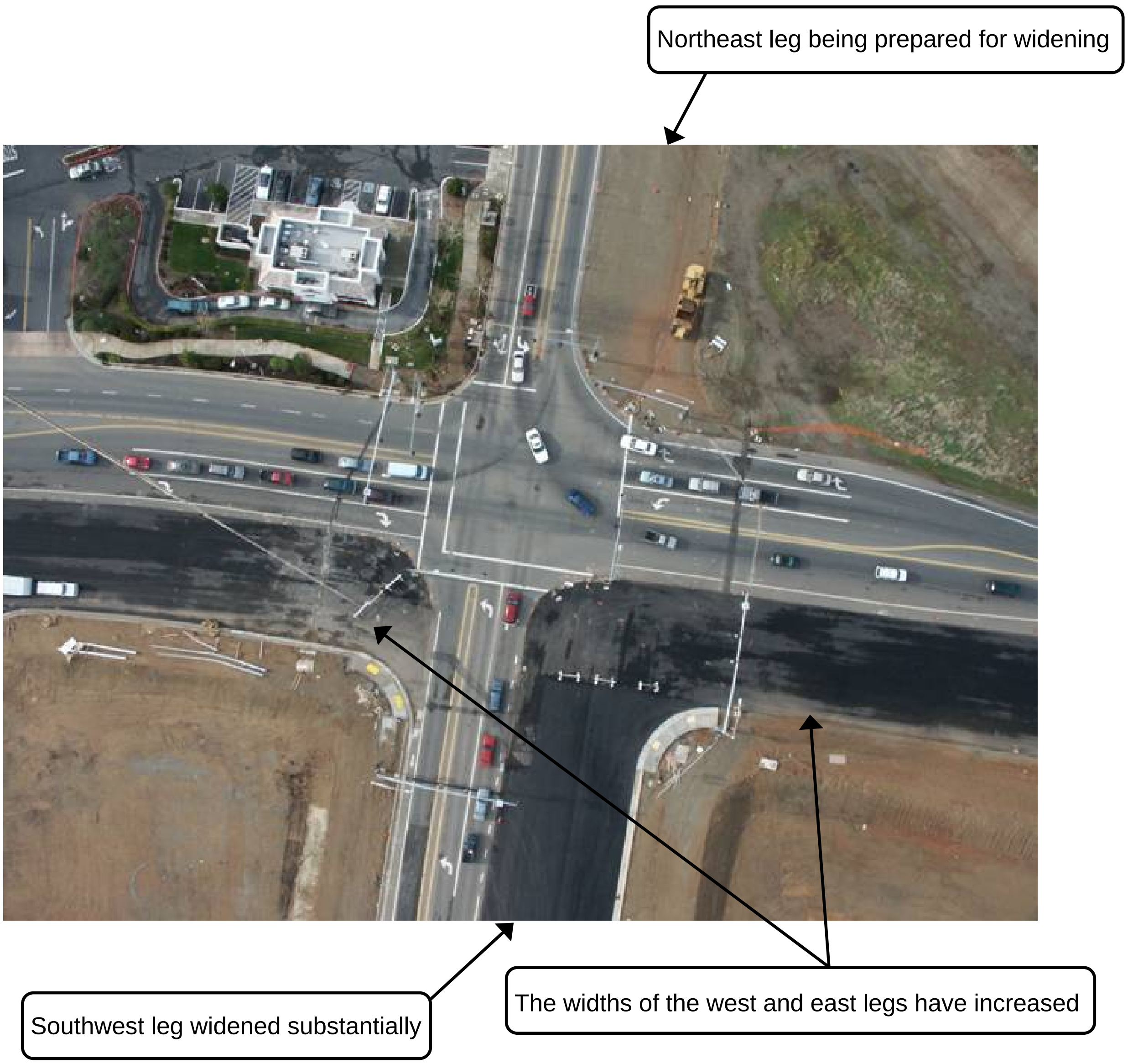
Automobile LOS is a quantitative measure that has long been used to identify roadway capacity problems and to design roadways. Smart Growth goals involve issues that are often difficult to quantify, such as: quality-of-life, community character, social equity, and sustainability. Inherent in these goals is a desire for greater use of alternative modes, which can be measured/estimated by the number of users expected by mode. However, the reliability of these estimates decreases when evaluating small-scale changes in the environment (such as constructing an individual development). More typically, the quality of facilities provided (width of sidewalk, frequency of bus service, or availability of bike lanes) as a proxy for determining the degree to which Smart Growth policies are being implemented.

An LOS policy that is a guideline rather than a standard allows for engineering judgment to be used. This is beneficial to help prevent ineffective spot improvements by taking into consideration the overall transportation system. For example, a poor LOS at a single intersection may be sacrificed if the project is of high value to the community and the "fix" would not be cost-effective or counter-productive to broader goals. At the same time, an LOS policy needs to clear and effective to avoid confusion and to prevent inequities in its application.

As an Example…

An infill project can be deterred by a rigid LOS policy standard. Mitigation improvements in developed areas can be expensive due to geometric constraints. Instead of developing an infill project with expensive mitigation, a developer may instead choose to develop on the outer, less dense, areas of town where mitigation is cheaper or not needed. If infill projects are desired, the LOS policy should address how the effects of the infill development are handled.

An LOS policy that strives for a high standard (such as C), can impact impact alternative modes. The following picture was taken in California as an example of how LOS policy has reshaped the environment making the roadways and intersections in the picture less environmentally friendly to bicyclists, pedestrians, and other roadway user groups. These user groups are affected by longer crossing times and distances, greater exposure to the traffic streams, etc. This picture depicts the change to an LOS C from an LOS D/E as required by LOS policy. Although the lane re-striping of this intersection has not occurred, the added pavement width reflects the widened intersection on the southeast and southwest legs, with the northeast leg being prepared for pavement.



ALTERNATIVE MODES

This section discusses the issues involved with quantifying impacts to alternative modes. This is an emerging field, but there are some inherent problems in comparing results across modes and in establishing the direct linkage between development proposals and alternative mode impacts.

Pedestrian

An LOS threshold for pedestrian activity could be based on sidewalk continuity, ease of crossing, directness, amenities, and safety, as well as others. Currently there are no standardized measures for pedestrian LOS (refer to the example in this section). Several jurisdictions are using pedestrian LOS as part of a multi-modal LOS policy. Some jurisdictions have identified pedestrian-friendly areas where automobile delay and LOS are not considered the priority. Roseville, for example, has a pedestrian overlay designation in their General Plan.

Bicycle

Two standardized LOS methodologies are available for bicycles. Both utilize roadway geometrics, traffic operations data, and parking data as LOS criteria. The LOS ranges from A, the best, to F, the worst, similar to automobile LOS. The methodologies are used to analyze on-street mid-block bicycle LOS only, they are not for intersection LOS analysis. Several jurisdictions use a connectivity based bicycle LOS. This approach places more emphasis on creating and preserving a complete network of bicycle facilities than on the LOS on a particular segment.

Transit

Many options are available for analyzing transit LOS. Criteria for these methodologies ranges from trip time and service coverage to cost and comfort.

Multi-Modal

Although a multi-modal LOS approach appears to be a fair method for determining transportation impacts, it does have its difficulties. One major drawback to using alternative modes in a transportation impact procedure is the lack of a national standard for LOS analysis (such as *Highway Capacity Manual* (HCM) for automobile analysis). Multi-modal LOS policies are often more cumbersome than traditional automobile LOS policies. These policies can take valuable staff resources to develop and implement.

As an Example…

Automobile LOS is based on the traffic volume using the roadway compared to the capacity of the roadway. HCM describes pedestrian LOS in the same way. If pedestrian LOS were to be measured similarly then a large, unused, nearly vacant sidewalk in an industrial area with limited connectivity, would have a very good LOS. While a busy sidewalk in a vibrant downtown area filled with outdoor cafes and shops would have a poor LOS. This example emphasizes how separate LOS thresholds are needed to accurately reflect the various transportation modes.

INFRASTRUCTURE FUNDING

Funding for transportation infrastructure improvements currently comes from a variety of sources: federal & state funds distributed by SACOG and Caltrans, City funds from sources such as sales tax, and from developers (through direct mitigations or contributions to fee programs). By state law, developers may only be required to pay their share for impacts created by their development. No data is available regarding what percentage of Sacramento's transportation system was built from development funds, but the percentage has increased over time with a drop in available state and federal funds. For example, the transportation system in North Natomas, including the new interchanges, has been built largely from development fees.

The City's current impact procedures identify when a proposed development would impact a planned pedestrian or bicycle facility, but they do not require the implementation of any off-site pedestrian or bicycle facilities. The current procedures do not require any transit investment from new development. If they City were to adopt a less stringent automobile LOS standard, then it may be appropriate to require development-related contributions to alternative mode construction (directly or via fees).

STAFFING

The amount of staff time required to create and/or review a transportation impact study will vary depending on the chosen service level standards and related guidelines. For example, a complex multi-modal approach, more complex than the current LOS policy, will consume more staff time. The current system requires approximately 10-12 weeks to prepare the initial traffic impact study. However, the entire environmental review process takes considerably longer, as it involves: scoping, review of the impact study, negotiations with developers, communications with neighborhood and other interest groups, incorporation of the impact study into the broader environmental document, and public review.

Even with a conventional impact procedure executed largely by consultants, City staff is needed to review reports, review development plans, and finalize mitigations. Consequently, the availability of City staff should be considered when choosing a transportation impact procedure.

As an Example…

Converting from a city-wide LOS C to LOS E threshold could conserve valuable staff resources. Fewer project related impacts would be triggered by a LOS E threshold. Fewer impacts would result in less City and consultant staff time proposing and analyzing mitigation measures. The process of a traffic impact analysis can be more time consuming when numerous mitigation measures are required.

TIMING

Transportation impact procedures affect the timing of development. Similar to the effects on staffing requirements, complex transportation impact procedures can delay the approval of projects. A traffic impact study that normally takes 12-16 weeks could take longer with a more stringent LOS policy. Similar to staffing requirements, a less complex transportation impact procedure could accelerate the approval of projects.

STATE-OWNED ROADWAYS

Unfortunately, there isn't a good connection between proposed development and the effects on state-owned roadways. The addition of proposed project trips on City roadways is within a magnitude perceivable by a motorist. On the contrary, the addition of proposed project trips on state roadways often goes unnoticed. Although a large amount of vehicles use state freeways, as little as one proposed project trip being added to those facilities creates a project impact, according to recent interpretation by Caltrans staff.

Impacts to state facilities raise several other questions. How should a proposed project mitigate an impact on a state roadway? Does the addition of proposed project traffic on a freeway warrant the widening of miles of that facility? The scale between the project trips that cause an impact on a state roadway and the mitigation required are not proportional.

5. CITY'S CURRENT PRACTICES

This section describes the current traffic impact study procedures for the City.[4] This discussion includes the triggers, breadth, facilities studied, methods, and impact criteria for traffic impact studies.

WHAT TRIGGERS A STUDY?

According to the City's guidelines, a traffic impact study is warranted for a proposed project if one of the following is met.

1. The project will generate at least 100 AM or PM peak hour trip-ends.
2. The project will generate at least 50 AM or PM peak hour trips on a facility likely to be on a main route used by project traffic and the facility is already operating at LOS D-F.
3. The project may create a hazard to public safety.
4. The project will substantially change the off-site transportation system or connections to it.

However, these are not fixed guidelines and traffic impact studies may be required based on a case-by-case review. City staff is responsible for determining the need for a traffic impact study or an environmental impact report.

For example, adhering strictly to the guidelines would require an impact study for a proposed development that would generate 101 trips and not require one that would generate 99 trips. To avoid these situations the City has prepared a traffic impact study determination flowchart as shown below.[5] This flowchart provides a range of 75 to 150 new peak hour trips that can trigger an impact study (with less than 75 triggering an impact study if the streets are "sensitive"[5] to new trips). Using this flowchart as an addition to the City's traffic impact study guidelines allows for more flexibility when requiring traffic impact studies.

WHAT IS THE BREADTH OF THE STUDY?

City staff determines the scope of the traffic study based on the project description and the type of environmental document being prepared. They also decide whether the study will be performed by City staff or by consultants. If the work is to be performed by consultants, then City staff is still responsible in determining the breadth of the study and conveying this information to the consultant.

The City's guidelines state that the scope of work should include analysis of the following issues.

- On-site Circulation
- Off-site Roadway and Intersection Operations
- Transit Operations (Capacity)
- Freeway Ramp Operations

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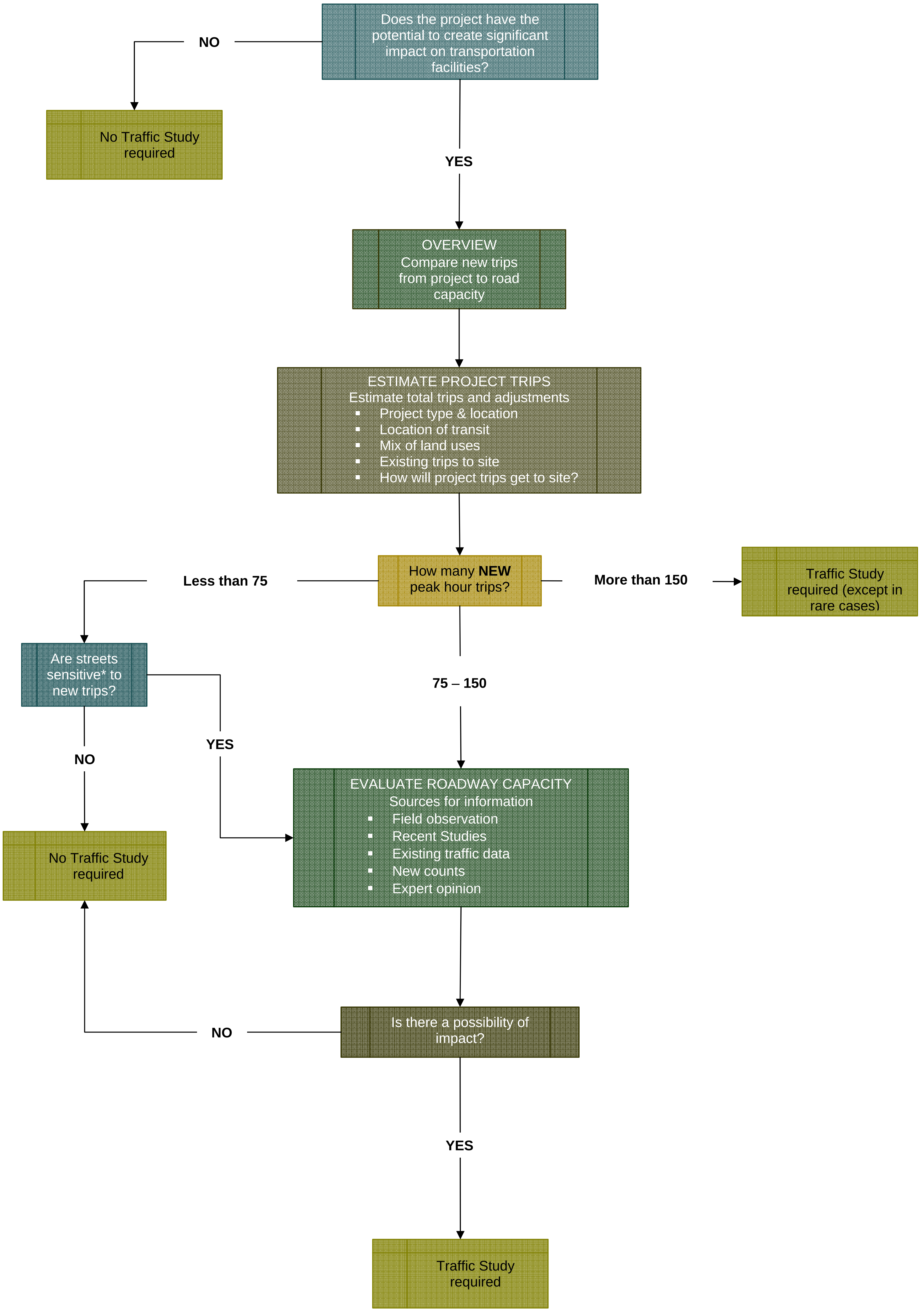
[4] City of Sacramento. *Interim Traffic Impact Analysis Guidelines*. February 1996.
[5] City of Sacramento. *Traffic Impact Study Determination Process Private Development Projects*. May 2004.

Traffic Impact Study Determination Process



* Sensitive is defined by a number of technical features.

- Freeway Operations
- Bicycle Facilities
- Pedestrian Facilities
- Parking Availability
- Accommodations for Trucks

Traffic safety and residential impacts may be added to this list based on individual circumstances.

Several of the above topics necessitate a qualitative analysis due to the unavailability of analysis methodologies. For example, an analysis of pedestrian facilities is intended to identify any significant facilities that would be modified by the project.

Off-site Roadway and Intersection analysis refers to the study of individual roadway segments and intersections at all locations where:

1. the project circulation system intersects the existing or planned street system; and
2. project traffic may substantially affect the operation of a roadway or intersection.

The City requires analysis to be performed for the following scenarios.

- Existing Conditions
- Existing Plus Project Conditions
- Future Conditions
- Future Plus Project Conditions

Future conditions has historically been defined as approximately 20 years into the future. Traffic volumes for this scenario are usually developed using a travel demand forecasting model. Input from City staff is used to determine which land use and roadway network changes are to be anticipated for future conditions.

Analysis of future conditions can be exempted from the traffic impact study "if the project is consistent (less than or equal to number of trips generated) with what was assumed for the site in a recent (1990+) master plan/community plan/specific plan and the project's financial contribution to future improvements has already been established."[6]

WHAT METHODS ARE EMPLOYED?

The City of Sacramento guidelines state that the 1994 HCM methodology should be used for analysis. Although this was the latest version of the HCM methodology available when the City's guidelines were developed, it has since been updated. The 2000 HCM methodology is commonly used on traffic impact studies within the City of Sacramento. HCM methodology is used for LOS analysis of freeway segments, freeway ramps, freeway weaving segments, and signalized and unsignalized intersections. Roadway segments are analyzed using a volume threshold table in which ADT volumes on the roadway are compared to thresholds that have been developed based on HCM methodologies.

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[6] City of Sacramento. *Interim Traffic Impact Analysis Guidelines*. February 1996.

Bicycle and pedestrian facilities are analyzed to determine if they would physically impact an existing or planned facility. .

WHAT ARE THE IMPACT CRITERIA?

Level of Service C has been interpreted in the City as the minimum acceptable performance level for use in CEQA analysis. This standard is based upon the1988 General Plan goal of achieving an overall LOS C condition. While the General Plan goal may not have been intended as a CEQA standard, it has been used as such in the absence of any adopted standards.

For roadway segments, a significant impact is created when the increase of project trips causes a segment to degrade from LOS C conditions or better to LOS D or worse. For a segment operating at LOS D or worse conditions, or one that is anticipated to operate at LOS D or worse, an impact is created when the addition of project trips increases the volume to capacity (V/C) ratio by 0.02 or more.

For signalized and unsignalized intersections, a significant impact is created when the increase of project trips causes an intersection to degrade from LOS C conditions or better to LOS D or worse. For an intersection operating at LOS D or worse conditions, or one that is anticipated to operate at LOS D or worse, an impact is created when the addition of project trips increases the average delay by 5 seconds or more.

The City's guidelines state that a project creates a significant impact when it causes a freeway or freeway ramp to change from acceptable to unacceptable operations. "Acceptable conditions" are based on the LOS goals defined in a Caltrans' Transportation Concept Report (which are unique to each state facility). The City's guidelines don't identify a threshold of significance for project-related impacts on freeway facilities already operating worse than the acceptable level. Caltrans has asked the City to consider one additional trip as significant in this circumstance.

A significant impact is created on transit facilities when the proposed project, when added to existing or future ridership, increases transit ridership beyond the available or planned system capacity.

Bicycle and pedestrian impacts occur if a project causes unsafe conditions or an unsafe increase in conflicts with other modes. Bicycle impacts also are defined as conditions when a project hinders or eliminates an existing or proposed bikeway.

Other issues that may cause non-significant impacts and require special attention are on-site circulation, pedestrian (safe and efficient pedestrian movements near the project), parking, and heavy vehicles.

6. CURRENT PERFORMANCE RELATIVE TO CURRENT POLICY

The following section discuses how the current automobile transportation situation compares to current City policy.

As part of the GPU, an LOS analysis was recently performed on 213 major roadway segments and 38 freeway segments within and around the City of Sacramento. This roadway analysis compared PM peak hour traffic volumes to LOS volume thresholds (several of the freeway segments and one-way roads were analyzed during the AM peak hour). The LOS volume thresholds take into consideration the type of roadway (i.e., collector, undivided arterial, divided arterial, etc.) as well as the number of lanes.

Of the 213 major roadways analyzed in and around the City, slightly less than 42% of those are operating at LOS C or better and more than 40% at LOS E or F.

Two-lane collector streets and two-lane arterials were also analyzed. Of the 32 two-lane collectors analyzed 31% are operating at LOS F conditions while 34% are operating at LOS C or better.

It is important to note that not all City roadways were analyzed. Therefore, the results aren't percentages of total roadways. Roadways that are operating at a good LOS most likely were not analyzed.

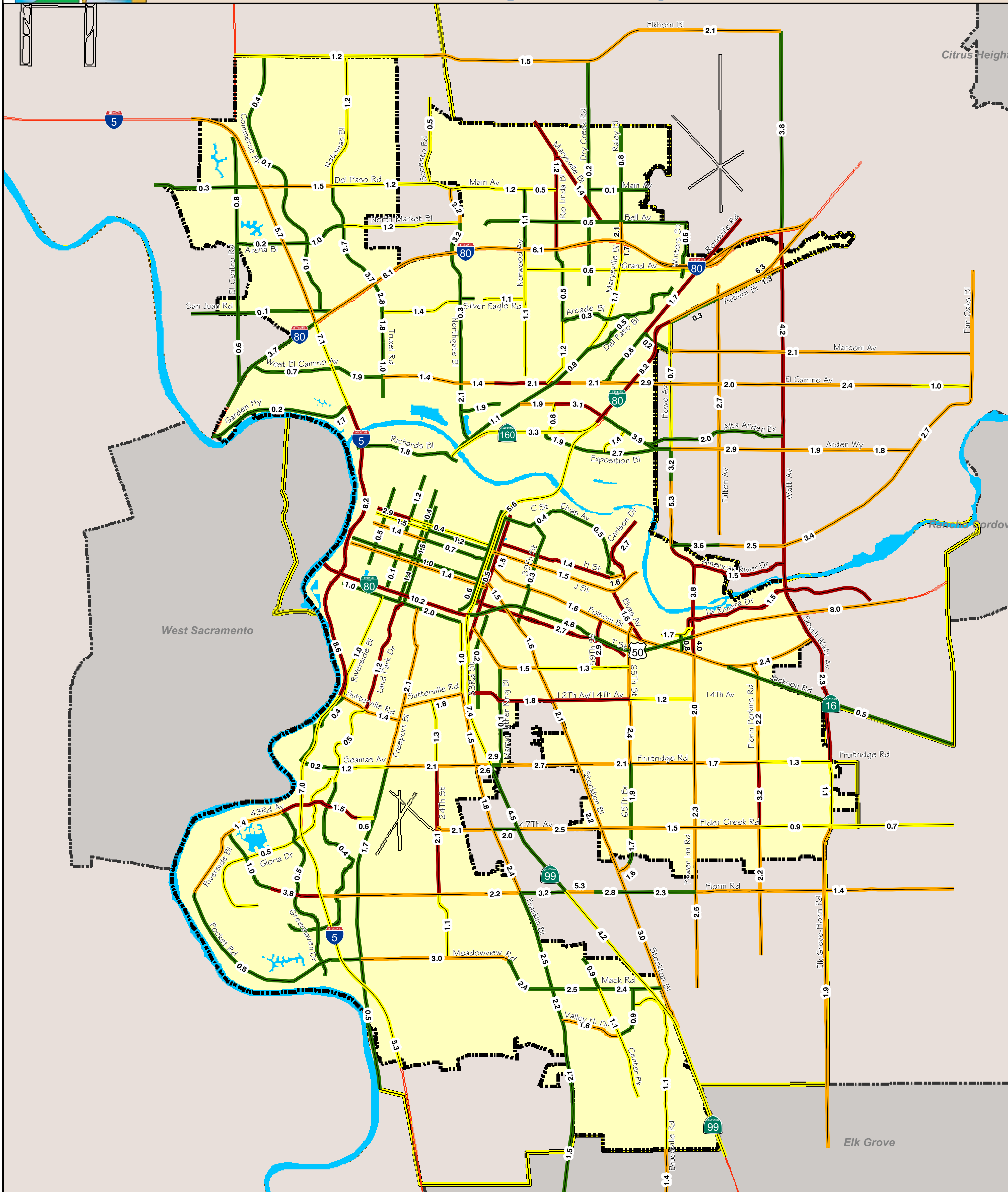
Figure 1 displays the peak hour traffic volume and LOS of roadways in and around the City of Sacramento.

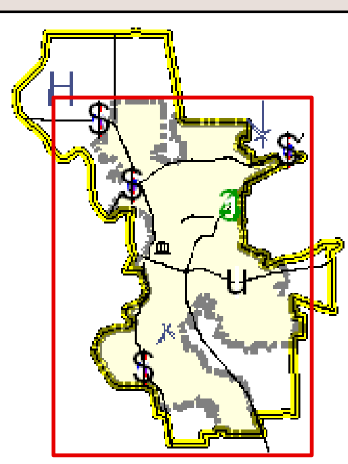
Table 1 summarizes the PM peak hour LOS of major roadways (not including freeways) in the City of Sacramento. For a complete LOS list of all roadways study please refer to the GPU Background Report.

TABLE 1
MAJOR ROADWAY LEVEL OF SERVICE
(INCLUDING COLLECTORS AND ARTERIALS, NO FREEWAYS)
PM PEAK HOUR – EXISTING CONDITIONS

LOS	Roadway Segments	Percent of Total
A - C	89	41.8%
D	37	17.4%
E	63	29.6%
F	24	11.3%
Total	**213**	**100%**

CITY OF SACRAMENTO
GENERAL PLAN
Building a Great City





Legend

Level of Service

- A Thru C
- D
- E
- F

Policy Area

City Limit

1.2 Peak Hour Volumes (x 1,000)

Figure 1

Level of Service and Peak Hour Volumes

0 0.25 0.5
Miles

Item #5

7. POLICIES APPLIED BY OTHER AGENCIES

We conducted an informal survey of jurisdictions in the Western U.S. to help identify commonly used LOS policies as well as unconventional alternatives being employed.

The most commonly used transportation impact procedure of the respondents was based on automobile LOS. These procedures use automobile LOS as the main threshold for identifying impacts associated with new development. Automobile LOS policies are frequently employed by jurisdictions in the Sacramento region.

Refer to Appendix C for summaries of the transportation impact procedures of the surveyed jurisdictions.

AUTOMOBILE APPROACHES

Triggers

The triggers for an automobile LOS oriented impact study vary, with many jurisdictions using criteria similar to the current City of Sacramento guidelines (based on the number of peak hour trips added to the roadway network by the proposed development).

Measurement Issues

The majority of jurisdictions surveyed use the latest edition of HCM for LOS analysis. Several jurisdictions surveyed use Circular 212 methodology for LOS analysis. In addition, there are jurisdictions that operate on a case-by-case approach due in some instances to not having one single guiding impact study policy.

LOS Thresholds

Of the jurisdictions surveyed, the LOS thresholds range from LOS C to LOS F. The most commonly used LOS threshold for urban areas is LOS D or E. In rural areas LOS C tends to be the threshold, although this doesn't hold true in all instances.

Most of the jurisdictions surveyed allowed for deviations in their LOS policies. The most common deviations are those locations within close proximity to a state facility, in which case a worse LOS is allowed. Several jurisdictions surveyed did not allow deviation, such as the City of Price, Utah, a rural city which maintains an LOS C policy.

The City of Berkeley has no LOS policy. The City is built-out and does not have an LOS threshold. Berkeley is in the process of switching to a multi-modal transportation impact procedure. San Francisco is pursuing a similar approach; namely, they will not consider congestion as an impact provided they establish a comprehensive fee program to fund transit and other alternative mode improvements. This approach is predicated on the creation of a citywide transportation master plan and corresponding environmental document that establishes

Some jurisdictions have no defined LOS threshold. Yolo County simply strives to maintain an LOS C condition, but does not interpret that as a standard for every location.

MULTI-MODAL APPROACHES

Multi-modal transportation impact procedures incorporate LOS for pedestrians, bicyclists, transit, and automobiles. These procedures attempt to ensure acceptable LOS operations for the four modes of transportation, one reason why they are more extensive than automobile only policies.

As discussed in Chapter 3, multi-modal approaches require the creation or adoption of LOS policies for pedestrian, bicyclists, and transit. Several jurisdictions in the western US have developed methods for multi-modal analysis. The City of Fort Collins, Colorado developed analysis methodologies to meet their needs of ensuring multi-modal connectivity with the addition of proposed projects trips. Seattle, Washington continues to develop a multi-modal LOS policy that gives preference to different modes of transportation in distinct corridors (based on the characteristics of the corridor). The City desires to reset their transportation priorities from a mainly automobile approach to a broader multi-modal approach.

UNCONVENTIONAL APPROACHES

Alternatives to the standard automobile LOS traffic impact studies have been developed. Several of the jurisdictions surveyed place emphasis on the quality of their streets. This "livable street" ideology places emphasis on pedestrian and bicycle activity on residential as well as non-residential streets. The City of Pleasanton uses a "quality of life" measure to help keep residential streets free of non-residential automobile traffic. Provo City, Utah uses roadway traffic volumes to measure the livability of a street, not the LOS. Refer to Appendix B for a residential quality of life discussion.

Other jurisdictions have created policies that break the mold of identifying impacts intersection by intersection. The North San Jose Development Policy uses an area-wide weighted average LOS to determine if project trips would create an impact. If improvements are needed, they are made in an effort to improve the weighted average LOS and not merely spot improvements at various intersections.

The City of Orlando, Florida has a detailed "Transportation Concurrency Exception Area." The roadway system within this area is exempt from transportation concurrency (LOS) "in order to promote infill development and encourage use of alternative transportation modes."[7] Additionally, it is a high priority to increase transit frequency in order to provide additional capacity to the transportation system within this area.

[7] City of Orlando, Planning and Development. *Growth Management Plan, Transportation*. June 2004.

8. STUDY TRIGGERS

CURRENT POLICY

The current policy is described on Page 1 of the TIA Guidelines contained in Appendix A. The policy identifies four triggers for an impact study (any of the following need to apply):

1. The project will generate at least 100 AM or PM peak hour trip-ends.
2. The project will generate at least 50 AM or PM peak hour trips on facility likely to be on a main route used by project traffic and the facility is already operating at LOS D-F.
3. The project may create a hazard to public safety.
4. The project will substantially change the off-site transportation system or connections to it.

As discussed in Chapter 5, the proposed project generated trip thresholds are guidelines and not steadfast rules. The number of new peak hour trips that can trigger an impact study range from 75 to 150 trips (with less than 75 triggering an impact study if the streets are "sensitive"[8] to the new trips). City staff is responsible for determining the need for a traffic impact study. This determination often requires staff to do a preliminary study to calculate the project's trip generation, estimate the spatial distribution of project trips, and determine how many trips are likely to be added to intersections near or worse than the LOS C standard.

For context, the following amount of land use will generate 100 peak hour trips:

- 27,000 square feet of retail (equivalent to a small grocery store)
- 67,000 square feet of office (a typical 2-3 story office building), or
- 99 single-family dwelling units

Implications

This existing policy has many vague aspects that are subject to interpretation; consequently, a legitimate argument can be made to require a study in virtually every situation. This policy gives City staff significant leverage to require a study. It also provides a means for project opponents to demand a study in many cases. Additionally, exempting proposed developments from studying future conditions because the development is consistent with a community plan (regardless of the number of plan amendments that have occurred) may not fully disclose all possible impacts.

These types of specific triggers for a traffic impact study are used by many other jurisdictions. They are relatively easy and quick to apply. The amount of proposed development that causes the need for an impact study varies by jurisdiction. Like the City of Sacramento, other jurisdictions also include subjective means to require a traffic impact study for issues such as safety.

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[8] City of Sacramento. *Traffic Impact Study Determination Process Private Development Projects*. May 2004.

The following three options are provided to guide the development of a new LOS policy. These options reflect City staff's desired changes to reduce the amount of unnecessary traffic impact studies.

OPTION A – SIMPLIFY

The current guidelines leave room for interpretation. The City could remove the more subjective aspects of the decision to do a study (the 75 to 150 new peak hour trips range, the sensitive street question, potential risk, substantial changes, etc.) and use a strict numerical trigger. Additionally, this trigger could be raised to 100 peak hour trips, regardless of condition of adjacent facilities.

Implications

Simplification would leave no room for interpretation. The removal of triggers due to potential risks and substantial changes would simplify the traffic impact procedures by requiring a study only for when a set amount of trips would be produced.

As an example, a proposed development of 90 single-family dwelling units would be exempt from a traffic impact study because the peak hour trip generation would be less than the 100 peak hour trip threshold.

OPTION B – FEWER STUDIES

The numerical criteria for what triggers a study could be modified such that the 100 trip threshold applies **only** to those facilities likely to be impacted (facilities operating near or worse than the minimum acceptable LOS). The current City guidelines include a similar trigger but not as the only qualification for triggering an impact study.

Implications

This option could reduce the number of traffic studies. For example, if the new standard is LOS F (i.e., LOS E is acceptable), then a study would only be required if a proposed development or infrastructure project is expected to add 100 trips to a facility already at LOS E or F. The two key changes from current policy would be:

- Changing the LOS threshold from LOS C to D or E.
- Changing the amount of trips generated from 50 to 100.

For example, if a project generates 200 peak hour trips, but only 25% (50 trips) are expected to use an intersection that is near or worse than the standard, then no need for detailed study.

Using an option like this would continue to require guidance and some preliminary analysis from City staff to determine the likelihood of a facility being impacted by project-related trips.

OPTION C – EXEMPTIONS

The City could exempt the need for an impact study if a proposed development is consistent with current zoning and/or General Plan designation and the project is more than a certain distance from any neighborhood (perhaps ½ mile).

and/or

The City could exempt projects in designated infill or TOD areas if the proposed development is more than a certain distance from any neighborhood.

A similar practice is being utilized by the City in that the analysis of future conditions can be exempted if the proposed project is consistent with what was assumed in a community plan (including specific and master plans).

The CEQA-related legal issues regarding this approach need to be examined. The basic purpose of CEQA is to disclose potential environmental impacts. It can be reasonably argued that traffic congestion is not an **environmental** impact; however, the CEQA guidelines directly identify congestion as an issue to be studied. At a minimum, the City would want to adopt clear policies stating its priorities regarding infill and the need to accept greater levels of congestion in those circumstances.

Implications

Enacting exemptions based on concurrency with existing community plans may result in fewer traffic impact studies. For example, a proposed housing development would be exempt from a traffic impact study if the number of residential units was within the amount specified in a relevant master plan.

Exemptions raise several questions that need to be answered. When does a community plan become outdated? The City's guidelines state that a plan must be "recent". Equally important are land use changes to the community plan after its adoption. Land use changes affect travel patterns which could create impacts from a proposed project (even if that project is part of the original community plan).

Exemptions would allow for situations where automobile LOS could be overlooked when high value is placed on a project. For example, an infill project in the downtown area may add trips to the roadway network but may also increase the aesthetic and social value of the area.

9. IMPACT ANALYSIS – ALTERNATIVES FOR CONSIDERATION

This section provides four individual alternatives for consideration. The implications of each analysis are detailed and compared and each alternative is applied to a real example in the City of Sacramento.

Table 3 provides a summary of alternatives to the existing policy. These alternatives are not mutually exclusive, nor are they exhaustive. They are meant to illustrate a range of possible approaches and provide a basis for discussing their merits. The alternatives are:

- **1A. Change the LOS Threshold** to a lower standard, namely LOS D being acceptable.
- **1B. Change the LOS Threshold** to a lower standard, namely LOS E being acceptable.
- **2. Adopt a Multi-modal LOS** to provide a platform to examine all modes and vary the standards by facility type to imply a preference to selected modes based upon the context (see Table 2 for example).
- **3. Create Exemption Areas** (downtown, infill, TOD's) that have a lesser standard than the balance of the City.
- **4. Add Informational Measures** as a supplement to any of the above. This is meant to provide contextual information that goes beyond localized impacts.
- **5. A Combined Alternative** that changes the LOS threshold, supports multi-modal goals, creates exempt areas, and tiers off Community Plans.

Objectives to consider in selecting a new approach are:

- Supports Smart Growth principles
- Reduces processing time and cost for development
- Provides good information to decision-makers and interested parties
- Satisfies CEQA requirements
- Provides both certainty and substantial levels of funding for transportation infrastructure
- Creates a definitive nexus between impact and mitigation
- Resolves issue of providing project-specific improvements to state facilities
- Minimizes staff time in preparation of studies
- Supports multi-modal improvements
- Recognizes that different LOS policies may be applicable for different geographic areas within the City

It is unlikely that any method will be able to provide all of the following (otherwise it would be the norm), as some of these objectives partially or completely conflict others.

TABLE 2
EXAMPLE MULTI-MODAL SERVICE LEVEL APPROACH

	Collector	Arterial	Downtown	Freeway
Auto	F	E	F	F
Transit	D	C	C	D
Bicycle	B	C	B	n/a
Pedestrian	B	C	B	n/a

Item #5

TABLE 3

IMPACT ANALYSIS ALTERNATIVES

	Current Policy	Alt 1A – Change Acceptable LOS to D	Alt 1B – Change Acceptable LOS to E	Alt 2 – Adopt Multi-Modal LOS	Alt 3 – Exemption Areas	Alt 4 – Add Informational Measures	Alt 5 – Combined, includes Additional Measures
Auto Measure	HCM Analysis	HCM Analysis	HCM Analysis	HCM Analysis	HCM Analysis	VT/capita, VMT/capita, & consistency with Blueprint	HCM Analysis
Auto Impact	LOS D or worse, or add 5 seconds to already impacted location	LOS E or add 2% more traffic to already impacted location	LOS F or add 2% more traffic to already impacted location	Varies by facility. See Table 3 for example.	LOS E or add 2% more traffic to already impacted location	No impacts – Only information relative to regional average or alt. site	LOS E or add 2% more traffic to already impacted location
Exemptions	None	None	None	None	Downtown, Infill, or TOD allow LOS E[9]	Not relevant for infrastructure projects	Downtown, Infill, or TOD allow LOS E[9]
Cumulative Analysis	Not required if consistent with zoning	Not required if consistent with community plan.[10]	Not required if consistent with community plan.[10]	Required for all	Not required if consistent with community plan.[10]	n/a	Not required if consistent with community plan.[10]
Neighborhood Impacts	No standards. In some cases, increase in volume is identified	Present volume increase but don't identify impacts	Present volume increase but don't identify impacts	Present volume increase but don't identify impacts	Council to adopt policy to over-ride neighborhood impacts for infill		City to develop locally-calibrated standards
Bike Measure	Consistency with plans	Consistency with plans	Consistency with plans	Develop bicycle LOS model for use in City master plan.	Consistency with plans	Bike/ped facilities within project site	Consistency with master plan. Emphasis on connectivity. LOS used for infrastructure but not development analysis. Disruptions to existing facilities.
Bike Threshold	Physically impacts existing or planned facility	Physically impacts existing or planned facility	Physically impacts existing or planned facility	Physically impacts existing or planned facility	Physically impacts existing or planned facility		Implement localized portion of master plan.
Pedestrian Measure	Modification of existing facilities	Consistency with plans	Consistency with plans	Develop pedestrian LOS model for use in City master plan.	Consistency with plans	Bike/ped facilities within project site	Consistency with master plan. Emphasis on connectivity. LOS used for infrastructure but not development analysis. Disruptions to existing facilities.
Pedestrian Threshold	n/a	Physically impacts existing or planned facility	Physically impacts existing or planned facility	Physically impacts existing or planned facility	Physically impacts existing or planned facility		Implement localized portion of master plan.
Transit Measure	Additional riders	Consistency with plans	Consistency with plans	HCM LOS method	Consistency with plans		Consistent with master plan.
Transit Threshold	Causes need for more service	Physically impacts existing or planned facility	Physically impacts existing or planned facility	Not relevant for development projects	Physically impacts existing or planned facility		Physically impacts existing or planned facility
State Roadways	Impact at LOS F. One trip added to impacted location.	Impact at LOS F or add 2% more traffic to impacted location.[11]	Impact at LOS F or add 2% more traffic to impacted location.	Impact at LOS F or add 2% more traffic to impacted location.	Impact at LOS F or add 2% more traffic to impacted location.		Impact at LOS F or add 2% more traffic to impacted location.

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[9] These locations would need to be defined in the GPU.
[10] Requires frequent updates of community plans and adoption of citywide fee program (or would only apply in areas with fee program).
[11] Improvements on the state roadways are typically not proportional to development projects in scale and cost; therefore, it would be preferable to spread costs via a fee program.

IMPLICATIONS OF ALTERNATIVES

Table 4 summarizes the implications of the alternatives.

Changing the LOS threshold, whether in exempted areas or city-wide, would enact Smart Growth aspects by reducing the need for larger roadways and intersections. A multi-modal LOS approach provides more information, but it doesn't resolve issues of conflict or priority between modes as illustrated in the 65th Street Transit Village example. A multi-modal approach is also not conducive to evaluating development proposals because bicycle, pedestrian, and transit LOS is dictated by the quality of facilities and not the number of users.

The City's current policy is able to collect more money for roadway improvements than the proposed alternative impact procedures. However, the current policy creates the need for more roadway improvements than the proposed alternatives. A multi-modal approach may direct more public funds to alternative modes of transportation.

Alternatives 1A, 1B, 3, and 5 would result in lower costs (fees) for developers in comparison to the City's current procedure. Costs for Alternative 2, the multi-modal approach alternative, would vary depending on the LOS policies implemented.

A typical traffic impact study for the City takes 8-12 weeks to complete and would not be expected to change with Alternatives 1A, 1B, 3, and 5. Completing a transportation impact study under Alternative 2 is more complex, requires more analysis, and would take longer to complete.

Alternatives 3 and 5 may raise issues with respect to CEQA compliance. Additionally, by exempting certain areas, Alternatives 3 and 5 may not address concerns of residents that live on the borders of those areas.

Alternatives 1A and 1B (as well as 5) may give the impression to some that the City has reduced their thresholds in order to avoid responsibilities and issues of complying with the current LOS C threshold.

As mentioned in Chapter 3, impacts to state facilities are not well defined. There is no definition of a significant impact if the facility is already operating unacceptably. Additionally, it is unrealistic for projects to individually pay for improvements to state facilities. Often the improvements to state facilities are large-scale improvements such as adding travel lanes along several miles of freeway. It is not practical to assign the responsibility of such an improvement to one project. The issues of LOS, mitigations, and impact fees on state facilities need to be revisited, in a broader context. One possibility is for the City to develop corridor improvement plans with corresponding development fees (similar to the N. Natomas approach).

A traffic impact study's geographic boundaries are very narrow (on the order of a mile). Consequently, any land development is going to increase traffic when measured at this scale, and the traditional measures (LOS) only reflect localized congestion. However, the important unaddressed issue is whether this same level of development, if placed elsewhere in the region, would create greater or lesser impacts. The additional measures presented in Alternative 4 such as vehicle trips per capita and vehicle miles traveled per capita provide a comparative measure of development in one location versus alternative locations or the regional average.

TABLE 4

COMPARISON OF ALTERNATIVES

	Current Policy	Alt 1A – Change Acceptable LOS to D	Alt 1B – Change Acceptable LOS to E	Alt 2 – Adopt Multi-Modal LOS	Alt 3 – Exemption Areas	Alt 4 – Add Informational Measures	Alt 5 – Combined, includes Additional Measures
Congestion	Strives to minimize congestion, but over-rides and limited funding have diluted this intent	Would accept slightly higher congestion, probably not perceivable to user	Would accept significantly higher congestion – adding 30 sec. of delay per signal compared to LOS C	Would result in more congestion then current policy – variable by location	Would result in more congestion in the exemption areas	n/a	Would accept significantly higher congestion – adding 30 sec. of delay per signal compared to LOS C
Economic Development	This is a very complex issue with diverse opinions. Increased congestion clearly impacts the costs of good movement and creates impacts to individuals who lose productive time due to longer travel times. Some of have argued that Smart Growth (more density, more congestion, greater use of alternative modes) will result in greater long-term economic sustainability due to reduction in the use of limited resources.						
Infill & Smart Growth	Results in high number of impacts, relatively large roadway cross-sections	Fewer impacts and smaller roadways for collectors and arterials.	Fewer impacts and smaller roadways for collectors and arterials.	Meets spirit of Smart Growth principles	Fewer impacts & smaller roadways in key areas	Provides better contextual information to show how more dense projects support Smart Growth goals, despite localized increase in congestion.	
State Roadways	Impacts not well defined, no reasonable mitigations	Substantial change in this area depends upon developing an agreed upon master plan to address state facilities, creating a fee program, collecting funds, and delivering projects. LOS E or F are realistic thresholds for state facilities.					
Infrastructure Funding	Maximizes developer direct responsibility	Fewer developer funded improvements	Fewer developer funded improvements	Might direct more public money to alt modes, would reduce developer contributions	Reduced developer funding in key areas	n/a	n/a
Design of Transportation Projects	Can result in larger roadways and more ROW	Generally smaller roadways	Generally smaller roadways	Depends on specific thresholds	Smaller roadways in key areas		
Cost Implications	Higher costs for development	Lower development costs	Lower development costs	Not clear	Lower development costs in key areas		
Time Implications (to complete studies)	Studies typically take 8-12 weeks, not longer than other jurisdictions	No change	No change	Longer study time due to added complexity	Less time needed for exempted areas		10% more time for study
CEQA Compliance	Strong track-record	No problems	No problems	Alt mode measures would not apply to development projects	Legally defensible, but may initiate more neighborhood challenges	Contextual information – not binding	Would only help
Other Issues		Some stakeholders may perceive City has reduced thresholds to avoid responsibilities	Some stakeholders may perceive City has reduced thresholds to avoid responsibilities		Areas would need to be well-defined and persons on border may be concerned	n/a	Makes documents more complex

EXAMPLE APPLICATION (FOLSOM BLVD)

To further illustrate the implications of the alternative methods, we applied them to a critical element of the Folsom Boulevard Widening Project. "The goal of the proposed project is to make Folsom Boulevard one of the great streets in Sacramento by improving traffic capacity, traffic operations, safety, pedestrian and bicycle mobility, while promoting the development of the 65th Street University/Transit Village."

The stakeholders involved with this project have debated the appropriate improvements to the 65th Street/Folsom Boulevard intersection. The following discusses how alternative LOS policies might influence the choice of improvements for the intersection.

The current and projected conditions at the intersection are as follows:

Scenario	AM Peak Hour LOS (delay)	PM Peak Hour LOS (delay)
Existing	D (41 sec)	E (67 sec)
2025 w/o improvement*	F (184 sec)	F (179 sec)
2025 with improvements**	D (53 sec)	F (88 sec)

* Assumes widening of Folsom Blvd to 4 lanes but no improvements at 65th Street/Folsom Boulevard

** At 65th Street/Folsom Boulevard – add second westbound left turn and "free" eastbound right-turn (requires widening southbound leg from 2 to 3 lanes between 65th Street and Highway 50)

Current Policy

The existing and projected service levels are worse than the City's LOS C standard; however, the magnitude of improvement necessary to accomplish LOS C was deemed by the stakeholders as too expensive and inconsistent with the creation of a pedestrian village. The proposed roadway improvements are intended to keep the queues and delays comparable to current conditions, while respecting the desire for a pedestrian village. The current LOS policy was essentially irrelevant in this circumstance, and the environmental documents included statements of overriding consideration.

The proposed bicycle improvements (on-street bike lane and widening of railroad undercrossing) are consistent with the current policy of requiring development or infrastructure projects to implement the relevant portions of the citywide bicycle master plan.

The proposed sidewalk improvements (widening and filling gaps) are consistent with City policy.

Alternative 1A (LOS D) or Alternative 1B (LOS E)

Under Alternative 1A or 1B, the outcome from the Folsom Boulevard Widening Project would not have changed. The intersection would have been projected to operate at LOS F (without improvements) which is beyond the threshold for either of these alternatives, and a compromise would still have been necessary between the desire to maintain/improve mobility and create a pedestrian-friendly environment.

Alternative 2 – Multi-modal LOS

A multi-modal LOS policy would have required the analysis of bicycle, pedestrian, and transit conditions in the corridor (if not already covered in citywide bike and ped master plans). This would be useful in confirming or modifying the proposed facilities with respect to lane width, sidewalk width, pedestrian amenities, bike lanes, etc. However, it would not directly address the issue of whether to add turn lanes at the intersection. The bicycle and pedestrian LOS methods are not intersection-specific. A subjective decision would still be needed regarding relative merits of improved vehicular operations versus increased crossing times for pedestrians and cyclists.

Alternative 3 – Exempt Areas

Alternative 3 would allow exempt areas for infill development, TOD's, or within the downtown area. The intersection of 65th Street/Folsom Boulevard would likely be in an exempt area because it is located within a transit village and redevelopment area, and situated less than ¼ mile from the 65th Street Transit Station. This exempt area would then allow LOS E conditions. Similar to Alternative 1B, the outcome at this intersection wouldn't differ from the current recommendations.

Alternative 4 – Additional Information

The additional measures associated with this alternative (VMT/capita and VT/capita) would not be relevant for an infrastructure project such as the Folsom Boulevard Widening. They are intended to provide perspective on development proposals, such as the neighboring transit village. The impact study for the transit village showed many impacts from placing more residents & employees in this area. However, the study would have benefited from these comparative measures, which would have shown the transit village as a superior place for development (lower VMT and VT) when compared to a suburban location or the regional average.

Alternative 5 – Combination

This alternative would change the acceptable LOS to D and create exempt areas in the City. Similar to Alternative 3, 65th Street/Folsom Boulevard would likely be in an exempt area with an acceptable LOS of E. The outcome at this intersection wouldn't differ from the current recommendations.

APPENDIX A

TRAFFIC IMPACT ANALYSIS GUIDELINES

FOR THE CITY OF SACRAMENTO

CITY OF SACRAMENTO

CALIFORNIA

DEPARTMENT OF
PUBLIC WORKS

TRANSPORTATION AND ENGINEERING
PLANNING DIVISION

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February 28, 1996

MEMORANDUM

TO: Users or Preparers of Traffic Impact Studies in the City of Sacramento

FROM: Steve Brown, Senior Engineer, Transportation & Engineering Planning *SB*

SUBJECT: **TRAFFIC IMPACT GUIDELINES**

The Transportation Planning Section of the Public Works Department prepared the attached *Interim Traffic Impact Analysis Guidelines* in response to the following issues:

- Feedback from our customers that analysis procedures have been applied inconsistently
- A desire for consistency while relying more upon consultants
- Changes in analysis procedures developed by national board
- Feedback from our customers suggesting that the scope of studies have been too limited
- The need for a communication tool to explain study procedures to interested parties

We intend to apply these interim guidelines in the execution of all traffic impact studies. The word **interim** is used because we want feedback from our customers about the effectiveness of these guidelines and their application. We will conduct a formal survey of your observations after 6 months of applying these interim guidelines, but we welcome your feedback any time. After this interim period will take the final guidelines to the City Council for formal adoption, along with recommendations for revisions to the City's level of service policy.

The term **guidelines** is important in that we recognize that every project and study context is unique. These guidelines are intended as a "check-list" for study preparers to be sure they have not missed any important items. They are not intended to be prescriptive to the point of eliminating professional judgement or creativity.

SB:eaj
sb11-01

Interim Traffic Impact Analysis Guidelines
City of Sacramento
February 1996

A. Need for Study

A traffic impact study is necessary if any of the following are true:

1. The project will generate at least 100 AM or PM peak hour trip-ends[1].
2. The project generates at least 50 AM or PM peak hour trips on facility likely to be on main route used by project traffic and facility is already operating at LOS D-F.
3. The project may create a hazard to public safety.
4. The project will substantially change the off-site transportation system or connections to it.

The AM peak hour shall be defined as peak hour between 7-9 AM and the PM peak hour shall be defined as peak hour between 4-6 PM.

B. Scope of Study

Four steps should be followed in developing a scope of work:

1. Identify scenarios or alternatives that are necessary for any environmental documentation.
2. Contact the project manager to determine if a community meeting is appropriate to solicit feedback on scope of study from concerned parties.
3. If a community meeting is appropriate, then a draft scope should be presented and any reasonable requests should be included in the study.
4. Review scope of work and key assumptions with key parties (project manager, applicant, consultant, others).

Review NOP Comments

The scope of work should include the following subject areas:

On-site Circulation Review and evaluate access locations, driveway throat depths, and size of major circulation features with respect to operations and safety.

[1] A trip-end is defined as either an origin or departure of a trip. Example- a round trip between two locations creates two trip ends at each locations and four total trip ends.

Off-site Roadways[2]	Study all locations where: 1) the project circulation system intersects the existing or planned street system, and 2) project traffic may substantially affect the operation of a roadway or intersection.
Transit	Study all bus or rail lines that have, or will have, a station within 1/4 mile of the project.
Freeway Ramps	Study all freeway ramps that may be substantially affected by the project.
Freeways	Study all freeway sections that may be substantially affected by the project.
Bicycles	Identify an existing or planned (Bicycle Master Plan) facilities that will be modified by the project or are within 1/4 mile of project.
Pedestrians	Identify any significant pedestrian facilities that will be modified by the project.
Parking	Compare the expected demand for parking (using ITE or other information) with the proposed supply and City zoning requirements.
Trucks	For industrial projects, identify the number of truck trips that will be generated and design accommodations necessary to support these trucks.

Other subject areas should be considered as warranted (such as traffic safety, residential impacts, etc.) by individual circumstances.

C. Study Scenarios

Most traffic impact studies should incorporate the following scenarios:

- existing
- existing + project
- future (2015)
- future (2015) + project

If the project is consistent (less than or equal to number of trips generated) with what was assumed for the site in a recent (1990+) master plan/community plan/specific plan **and** the

[2] The determination of whether to study roadway segments or intersections should be made on an individual project basis. In general, intersections should be studied in in-fill areas and where/when traffic volumes will not change substantially in the future. In some cases, it may be appropriate to study intersections for the near-term analysis and roadways for the long-term analysis.

project's financial contribution to future improvements has already been established (through a fee program or other mechanism), then the future analysis can be omitted.

The determination of study time periods should be made separately for each project based upon the peaking of project traffic and surrounding street system. Office, industrial, and residential projects should generally be studied during both the AM and PM peak hours. Retail projects need only be studied during the PM peak hour. Special circumstances may require mid-day or weekend analysis.

D. Trip Reduction

Any trip reductions associated with Transportation Management Plans should not be included in the impact analysis because the effectiveness of the TMPs is not sufficiently predictable or enforceable (and can therefore be considered speculative). However, a trip reduction program can be considered as a mitigation measure provided that results can be demonstrated for comparable projects and that a monitoring/enforcement mechanism is clearly defined. A comparable physical improvement measure shall be identified for all locations that rely upon a trip reduction program for mitigation. The physical improvement measure will serve as a contingency should the necessary trip reduction not be achieved, and a deposit/bond will be collected to implement the improvement should the trip reduction requirement not be met.

E. Measurement Techniques

Trip Generation: Professional sources (ITE, San Diego Trip Generators, etc..) are acceptable for categorical uses (office, retail, and residential). However, counts at comparable locations are acceptable for specific uses (Big box retailers, hospitals, driving ranges, etc..). Whenever possible, multiple sources should be evaluated and compared.

Traffic Counts: Weekday traffic counts should be conducted on Tuesdays, Wednesdays, or Thursdays (excluding weeks with a holiday). If possible, the counts should be conducted on days when schools are in session. Peak hour counts should be conducted between 7-9 AM and 4-6 PM.

Signalized Intersections: The 1994 HCM methodology should be applied with sufficient detail to produce a result measured in seconds of delay. Default assumptions for signal timing, parking, lane widths, etc... are acceptable if the information is unavailable or speculative. A peak hour factor of 1.0 (to represent average hourly conditions) should be used.

Unsignalized Intersections: The 1994 HCM methodology should be applied and the results reported for the intersection as a whole[3]. A signal warrant analysis should be prepared for all scenarios where the reported service level is "D" or worse. A peak hour factor of 1.0 (to represent average hourly conditions) should be used.

Roadways/ Freeways: Roadway segment analysis should be based upon the daily volume thresholds established in the Sacramento County General Plan (Exhibit A).

Freeway Ramps: The 1994 HCM thresholds should be used as shown in Exhibit B.

Transit: The most recent transit boarding information should be compared to both seating and crush load capacity.

F. Travel Forecasting

The current version of the SACMET model should be used unless it is necessary to use a prior version to ensure consistency with recent studies. Studies conducted in, or near, the North Natomas and Southern Pacific/Richards planned developments should assume full build-out of these areas when sizing transportation facilities.

The land use assumptions in the vicinity of the project should always be verified with the SACOG TAZ land use data and checked against the land use designations for the area as indicated on Community Plan land use maps maintained on the City's Geographic Information System. As necessary, the SACMET model should be disaggregated in the vicinity of the proposed project to provide sufficient detail to properly analyze the study facilities.

G. Impact Thresholds (Significant Impacts)

The following categories have specific "standards of significance" for determining impacts:

Off-site Roadways: An impact is considered significant for roadways or intersections when the project causes the facility to change from LOS C or better to LOS D or worse. For facilities that are, or will be, worse than LOS C without the project, an impact is also considered significant if the project: 1) increases the average delay by 5 seconds or more at an intersection, or 2) increases the v/c ratio by .02 or more on a roadway.

[3] The 1985 HCM methodology may be substituted in cases where 1994 HCM results to not reflect observed traffic conditions.

Transit:	An impact is considered significant if the project will cause transit boardings to increase beyond the crush load of a transit vehicle **or** if the project will cause a 10% or greater increase in travel time along any route.
Freeway Ramps:	An impact is considered significant when the project causes the facility to change from acceptable to unacceptable according to the LOS threshold defined in the Caltrans Route Concept Report for the facility.
Freeways:	An impact is considered significant when the project causes the facility to change from acceptable to unacceptable according to the LOS threshold defined in the Caltrans Route Concept Report for the facility.
Bicycles:	An impact is considered significant if implementation of the project will disrupt or interfere with existing or planned (BMP) bicycle or pedestrian facilities.

H. Problem Identification (Non-significant Impacts)

The following categories do not have thresholds of significance; however, problems should be identified in these categories and recommendations made for improvements.

On-site Circulation:	Problems should be identified where the project circulation system fails to conform with common traffic engineering practice. City standards for intersection and driveway spacing should be applied to all proposed new facilities.
Pedestrians:	Identify any significant pedestrian facilities that will be modified by the project. Recommend facilities that will facilitate safe and efficient pedestrian movements on or near the project.
Parking:	Compare the expected demand for parking (using ITE or other information) with the proposed supply and identify shortfalls.
Trucks:	For industrial projects, identify the number of truck trips that will be generated and the design accommodations necessary to support these trucks.

I. Mitigation Measures

Existing Deficiencies

Recommendations, not mitigations, should be identified for facilities that do not meet the established standards.

Project Impacts

If a project causes an impact, then a mitigation measure should be identified for which the project is 100% responsible.

Future (w/o project)

Recommendations, not mitigations, should be identified for facilities that do not meet the established standards.

Future (with project)

If a project causes an impact, then a mitigation measure should be identified for which the project should pay a "fair share". The project's fair share shall be defined as its percentage of traffic relative to the total expected increase over current conditions[4].

Additional Recommendations

The traffic study should include recommendations for problems identified, for which the City does not have an established standard (see section H).

J. Reports

Reports should be prepared to comply with the attached standard format (Exhibit C). All reports should be prepared using WordPerfect or compatible software. Technical calculations should be included in a separate appendix.

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[4] If a facilities plan and/or financing plan covers the facility in question, then the project shall pay its fair share as defined in the facilities/financing plan.

EXHIBIT A
ROADWAYS/FREEWAYS
Level of Service Criteria[1]

Facility Type	# of Lanes	Maximum Volume for Given Service Level A	B	C	D	E
Rural, 2-lane highway	2	2,400	4,800	7,900	13,500	22.900
Arterial, low access control	2	9,000	10,500	12,000	13,500	15,000
	4	18,000	21,000	24,000	27,000	30,000
	6	27,000	31,500	36,000	40,500	45,000
Arterial, moderate access control	2	10,800	12,600	14,400	16,200	18,000
	4	21,600	25,200	28,800	32,400	36,000
	6	32,400	37,800	43,200	48,600	54,000
Arterial, high access control	2	12,000	14,000	16,000	18,000	20,000
	4	24,000	28,000	32,000	36,000	40,000
	6	36,000	43,000	48,000	54,000	60,000
Freeway	2	14,000	21,600	30,800	37,200	40,000
	4	28,000	43,200	61,600	74,400	80,000
	6	42,000	64,800	92,400	111,600	120,000
	8	56,000	86,400	123,200	148,800	160,000

Facility Type	Stops/Mile	Driveways	Speed
Arterial, low access control	4+	Frequent	25-35 MPH
Arterial, moderate access control	2-4	Limited	35-45 MPH
Arterial, high access control	1-2	None	45-55 MPH

[1] Sacramento County General Plan Update, Technical Appendix, DKS Associates, February 1992

EXHIBIT B
LEVEL OF SERVICE FOR FREEWAY RAMPS[a]

LOS	≤ 20 MPH		21-30 MPH		31-40 MPH		41-50 MPH		≥ 51 MPH	
	One Lane	Two Lane	One Lane	Two Lane	One Lane	Two Lane	One Lane	Two Lane	One Lane	Two Lane
A	b	b	b	b	b	b	b	b	750	1500
B	b	b	b	b	b	b	1100	2150	1100	2200
C	b	b	b	b	1300	2500	1500	2950	1600	3200
D	b	b	1500	2750	1600	3050	1900	3650	1950	3950
E	1700	3050	1800	3350	1900	3600	2000	3900	2100	4200
F	Widely Variable									

[a] *Assumes: 12 foot lane width, normal driver population, peak hour factor (PHF) of 1.0, ten percent heavy trucks.*

[b] *Level of service not attainable due to restricted design speed.*

Source: Transportation Research Board, 1994.

Derivation of Freeway Ramp Service Flow Rates

The analysis of freeway ramps is guided using methodologies outlined in Chapter 5 of the Transportation Research Board's, *Highway Capacity Manual (HCM),* Special Report 209, 1994. Specifically, Table 5-6 of the 1994 HCM provides approximate ramp capacities for a range of free-flow speeds. The above table identifies levels of service (LOS) based on volume/capacity ratios that define LOS in Table 5-5 in the 1985 HCM using ramp capacities in Table 5-6 of the 1994 HCM. If the LOS is D, E, or F according to the above table, the ramp should be analyzed using the more detailed method in Chapter 5 of the 1994 HCM.

c\ej\exhibit

EXHIBIT C
STANDARD LANGUAGE FOR TRAFFIC IMPACT ANALYSIS REPORTS

Level of Service Concept (Motorists)

The operating conditions experienced by motorists are described by "levels of service." Level of service is a qualitative measure of the effect of a number of factors, including speed and travel time, traffic interruptions, freedom to maneuver, driving comfort and convenience. Levels of service are designated "A" through "F" from best to worst, which cover the entire range of traffic operations that might occur. Level of Service (LOS) "A" through "E" generally represent traffic volumes at less than roadway capacity, while LOS "F" represents over capacity and/or forced flow conditions. Table 1 presents level of service definitions for arterial traffic flow.

The City of Sacramento utilizes a LOS "C" goal for roadway operating conditions. Because of the constraints of existing development in the City, and because of other environmental concerns, this goal cannot always be met.

Signalized Intersection Analysis

Signalized intersection analyses were conducted using a methodology outlined in the Transportation Research Board's Special Report 209, Highway Capacity Manual, 1994. The methodology utilized is known as "operational analysis." This procedure calculates an average stopped delay per vehicle at a signalized intersection, and assigns a level of service designation based upon the delay. The method also provides a calculation of the volume-to-capacity (v/c) ratio of the critical movements at the intersection. Table 2 presents the level of service criteria for signalized intersections.

Unsignalized Intersection Analysis

Stop controlled intersections were analyzed utilizing the methodology outlined in the Transportation Research Board's Special Report 209, Highway Capacity Manual, 1994. This methodology calculates an average total delay per vehicle for each controlled movement and for the intersection as a whole. A level of service designation is assigned based upon the delay. Table 3 presents the relationship of total delay to level of service for two-way stop-controlled intersections. Intersection levels of service reported in this analysis are based upon average total delay per vehicle for the intersection as a whole.

TABLE 1 LEVEL OF SERVICE DEFINITIONS FOR ARTERIALS	
Level of Service A describes primarily free flow operations at average travel speeds, usually about 90 percent of the free-flow speed for the arterial classification. Vehicles are completely unimpeded in their ability to maneuver within the traffic stream. Stopped delay at intersections is minimal. ***Level of Service B*** represents reasonably unimpeded operations at average travel speeds, usually about 70 percent of the free-flow speed for the arterial classification. The ability to maneuver within the traffic stream is only slightly restricted and stopped delays are not bothersome. Drivers are not generally subjected to appreciable tension. ***Level of Service C*** represents stable operations; however, ability to maneuver and change lanes in midblock locations may be more restricted than at LOS B, and longer queues, adverse signal coordination, or both may contribute to lower average travel speeds of about 50 percent of the average free-flow speed for the arterial classification. Motorists will experience appreciable tension while driving.	***Level of Service D*** borders on a range in which small increases in flow may cause substantial increases in delay and hence decreases in arterial speed. LOS D may be due to adverse signal progression, inappropriate signal timing, high volumes, or some combination of these factors. Average travel speeds are about 40 percent of free-flow speed. ***Level of Service E*** is characterized by significant delays and average travel speeds of one-third the free-flow speed or less. Such operations are caused by some combination of adverse progression, high signal density, high volumes, extensive delays at critical intersections, and inappropriate signal timing. ***Level of Service F*** characterizes arterial flow at extremely low speeds below one-third to one-fourth of the free-flow speed. Intersection congestion is likely at critical signalized locations, with high delays and extensive queuing. Adverse progression is frequently a contributor to this condition.
Source: Highway Capacity Manual, Transportation Research Board, Special Report No. 209, Washington, D.C., 1994.	

TABLE 2 LEVEL OF SERVICE CRITERIA SIGNALIZED INTERSECTIONS		
LEVEL OF SERVICE (LOS)	**STOPPED DELAY PER VEHICLE (seconds)**	**DESCRIPTION**
A	0 -5	Very Low Delay. Occurs when progression is extremely favorable and most vehicles arrive during the green phase. Most vehicles do not stop at all. Short cycle lengths may also contribute to low delay.
B	5.1 - 15	Generally occurs with good progression, short cycle lengths, or both. More vehicles stop than with LOS "A," causing higher levels of average delay.
C	15.1 - 25	These higher delays may result from fair progression, longer cycle lengths, or both. Individual cycle failures may begin to appear at this level. The number of vehicles stopping is significant at this level, though many still pass through the intersection without stopping.
D	25.1 - 40	The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high v/c ratios. Many vehicles stop, ant the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
E	40.1 - 60	These high delay values generally indicate poor progression, long cycle lengths, and high v/c ratios. Individual cycle failures are frequent occurrences.
F	60.1 +	This level, considered to be unacceptable to most drivers, often occurs with oversaturation, that is, when arrival flow rates exceed the capacity of the intersection. It may also occur at high v/c ratios below 1.0 with many individual cycle failures. Poor progression and long cycle lengths may also be major contributing causes to such delay levels.
Source: *Highway Capacity Manual, Transportation Research Board, Special Report No. 209, Washington, D.C., 1994.*		

TABLE 3 LEVEL OF SERVICE CRITERIA TWO-WAY STOP-CONTROLLED INTERSECTIONS	
LEVEL OF SERVICE (LOS)	**TOTAL DELAY PER VEHICLE (seconds)**
A	0 - 5
B	5.1 - 10
C	10.1 - 20
D	20.1 - 30
E	30.1 - 45
F	45.1 +
Source: *Highway Capacity Manual, Transportation Research Board, Special Report No. 209, Washington, D.C., 1994.*	

STANDARDS OF SIGNIFICANCE

Signalized and Unsignalized Intersections

In the City of Sacramento, a significant traffic impact (intersection) occurs when:

1. the traffic generated by a project degrades *Level of Service* (LOS) from A, B, or C (without project) to D, E, or F (with project), or,

2. the LOS (without project) is D, E, or F, and project generated traffic increases the *average vehicle delay* by 5 seconds or more.

This standard has been developed consistent with a goal set forth in the City of Sacramento, General Plan Update (1988). Specifically, Section 5-11 - Goal D, states to "Work towards achieving a Level of Service C on the City's local and major street system."

IMPACT CLASSIFICATION

This analysis classifies impacts in the following manner:

No Impact
- Less Than Significant (mitigation unnecessary)
- Significant Avoidable (impact can be mitigated to less-than-significant levels)
- Significant Unavoidable (impact cannot be mitigated to less-than-significant levels)

Impacts are considered avoidable if and when a feasible mitigation measure will improve plus-project operating conditions to levels which would not have resulted in identification of an impact. For instance, if an intersection has an average vehicle delay of 35 seconds under existing conditions, and project generated traffic were to increase the delay to 40 seconds, mitigation measures would be required to reduce the delay back to no more than 39 seconds (less than an increase of 5 seconds over existing conditions).

This method generally ensures that a proposed project will only be responsible to mitigate the traffic impact it creates. In some cases, the LOS or average vehicle delay may be improved beyond the "no project" condition, such that the project has more than offset the traffic impact it created. This typically occurs because a necessary improvement, such as an additional lane or new traffic signal, provides additional capacity beyond that necessary to mitigate the impact. Such improvements cannot be "partially" implemented.

Feasible Mitigation Measures

Feasible traffic mitigation measures usually consist of physical intersection improvements (e.g., signalization, restriping, additional travel lanes) proven, through calculation to achieve the desired effect. Occasionally, changes to signal timing and/or phasing may be appropriate. Physical improvements such as additional travel lanes are usually considered feasible if right-of-way exists or can be easily acquired. Right-of-way is generally obtainable only if adjacent to the proposed project so the applicant can dedicate the right-of-way. Off-site right-of-way is usually difficult, if not impossible, to obtain because of existing land uses.

APPENDIX B

RESIDENTIAL QUALITY OF LIFE STUDY PROPOSAL

(NOT ACTIVE, FOR REFERENCE ONLY)

Residential Street Livability

Proposal Submitted to the City of Sacramento
by Fehr & Peers Associates, Inc.

Need for Livability Index

Roadway *levels of service* have long been used in systems planning and traffic operations. They are by far the most widely used performance measures among transportation agencies. In planning major roads, roadway levels of service will, understandably, be of prime concern. After all, the main purpose of such roads is to move traffic efficiently. However, on lower order streets, particularly residential streets, mobility is secondary to land access and amenity functions. "Staying and playing" are just as important as "coming and going."

The City of Sacramento has struggled with this issue for many years. As a mature City, much of the development is infill in nature. Consequently, many development projects create impacts to existing neighborhoods. To date, these impacts have only been quantified in terms of level of service and not livability. The City has not had an objective tool to quantify the level of impact, nor a standard to address the significance of neighborhood livability concerns. The Sierra-Curtis Neighborhood has proposed a "neighborhood traffic yardstick." While perhaps a good starting point, the Sierra-Curtis measure has no official standing nor empirical basis.

Under this proposal, Fehr & Peers Associates would develop a livability formula for streets that is empirically based and could be applied with confidence by the City to implement and prioritize traffic calming projects, assess development impacts, and plan new subdivisions. **The study would result in a means to quantify livability as it relates to traffic issues; however, the decision to develop a "standard" will be made during the course of the study.** Due to the novel and empirically based nature of this work, it is anticipated that the resulting index will be of interest to communities throughout the United States.

Earlier Research on Livability

From the 1960s through the early 1980s, much research was conducted on the causes of residential satisfaction. In study after study, overall residential satisfaction was modeled in terms of characteristics of the residents surveyed, characteristics of their housing units, and/or characteristics of the neighborhood or community in which they lived.[1] Traffic or street variables were occasionally tested as part of these studies.[2]

[1] Representative of this extensive literature are M.D. Menchik, *Residential Environmental Preferences and Choice: Some Preliminary Empirical Results Relevant to Urban Form,* National Technical Information Service, Springfield, VA, 1971; and G.C. Galster and G.W. Hesser, "Residential Satisfaction—Compositional and Contextual Correlates," *Environment and Behavior*, Vol. 13, 1981, 735-758.

[2] J.B. Lansing, R.W. Marans, and R.B. Zehner, *Planned Residential Environments*, Survey Research Center, University of Michigan, Ann Arbor, 1970; and R.W. Marans and W. Rodgers, "Toward an Understanding of

The first researcher to focus specifically on traffic as a quality-of-life factor was Colin Buchanan, whose *Traffic in Towns* was published by the British government in 1963.[3] One outgrowth of Buchanan's work was the British "environmental traffic management" movement. In the heyday of the movement, many streets were closed, converted to one-way, and otherwise altered to reduced traffic volumes. Another result of Buchanan's work was the concept of environmental capacity. As traffic volume exceeds some threshold value, usually well below the physical capacity of streets, the street environment ceases to be acceptable to residents. This volume was dubbed the street's environmental capacity. Since then, several researchers have sought to estimate the environmental capacities of streets.[4]

Building on Buchanan's work, Don Appleyard used survey and experimental research methods to quantify the relationships between traffic speeds and volumes on the one hand, and various aspects of livability on the other. Appleyard's groundbreaking work was published in the book *Livable Streets* and in a federal government report *Improving the Residential Street Environment*.[5] Appleyard found that satisfaction with residential streets declined with increasing traffic volumes and speeds. He also found that household attitudes and activity levels varied with traffic volumes. Contact with neighbors, perceptions of air quality, willingness to let children play outside, and other quality-of-life indicators all declined as traffic grew.

Since these studies were completed, almost two decades ago, little follow-up research has been conducted. Understanding what makes a residential environment "livable" has not progressed much beyond where it was in Appleyard's day. One of the few exceptions is a study by Fehr & Peers Associates, Inc. Using measured volumes, speeds, and vehicle composition as independent variables, and perceptions of traffic from a resident survey as dependent variables, Matthew Ridgway and Jim Daisa found that traffic speed was highly correlated with perceptions of traffic as unsafe, noisy, and so on.[6] By contract, at least for the volume range studied, perceived traffic

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Community Satisfaction," In A.H. Hawley and V.P. Rock (eds.), *Metropolitan America in Contemporary Perspective*, John Wiley & Sons, New York, 1975, pp. 299-352.

[3] C. Buchanan, *Traffic in Towns - A Study of the Long Term Problems of Traffic in Urban Areas*, Her Majesty's Stationery Office, London, 1963, pp. 203-213.

[4] H. Marks, "Traffic Capacity," *Traffic Circulation Planning for Communities*, Gruen Associates, Los Angeles, 1974, pp. 223-231; S. Spitz, "How Much Traffic Is Too Much (Traffic)," *ITE Journal*, Vol. 52, May 1982, pp. 44-45; A. Davis, "Liveable Streets through Environmental Capacity Limits," In *Environmental Issues*, PTRC Education and Research Services Ltd., London, England, 1992, pp. 103-114; R. Klaeboe, "Measuring the Environmental Impact of Road Traffic in Town Areas," In *Environmental Issues*, PTRC Education and Research Services Ltd., London, England, 1992, pp. 81-88; and L.N. Dallam, "Environmental Capacity of Neighborhood Streets," *ITE 1996 Compendium of Technical Papers*, Institute of Transportation Engineers, Washington, D.C., 1996, pp. 422-423.

[5] D. Appleyard, *Livable Streets*, University of California Press, Berkeley, 1981, p. 133; and D.T. Smith and D. Appleyard, "Studies of Speed and Volume on Residential Streets," *Improving the Residential Street Environment*, Federal Highway Administration, Washington, D.C., 1981, pp. 113-130.

[6] M. Ridgway and J. Daisa, "Residential Streets—Quality of Life Assessment," *Compendium of Technical Papers*, Sustainable Communities Conference, Institute of Transportation Engineers, Washington, D.C., 1997.

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problems appeared independent of traffic volumes. Also, Ridgway and Daisa determined that urban residents had a greater tolerance for both traffic volume and speed than did suburban residents.

The three streams of literature relating to residential satisfaction, environmental capacity, and livable streets, create the following imperatives for any study that follows:

- Use multiple measures to capture the concept of livability, some related to traffic conditions, others to the street environment, and still others to the residential environment generally;

- Test multiple explanatory variables for correlations with perceived livability, including characteristics of traffic, streets, housing, neighborhoods, and respondents themselves;

- Survey significant numbers of residents, from large numbers of streets, to obtain samples that are large enough and varied enough to support statistical analyses of livability vs. traffic and street characteristics;

- When testing traffic and street variables for correlations with perceived livability, control for influences of housing type, neighborhood character, and respondent sociodemographics; and

- Distinguish between the effects of traffic volumes and traffic speeds on livability, and insofar as possible, capture the interaction of these two variables in multivariate analyses.

Scope of Work

The major tasks in the scope of work are anticipated to be as follows:

Task 1 -- *Develop an oversight committee of 10-20 persons.*

An oversight committee would assist in the selection of study streets, review/test the questionnaire, provide feedback on methodological issues, and discuss findings and conclusions. It is anticipated that the committee will include approximately 5 City Staff and 10 community representatives (one from each council district and a few at-large). It is anticipated that this group would meet once a month for an 8 month period.

Task 2 - Select residential streets throughout the City that represent geographic, physical, and economic diversity.

The earlier Fehr & Peers study took a sample of 50 streets, better than Don Appleyard's sample of three streets but a small number for statistical purposes. A larger sample will be taken for this study. The exact number will be chosen with a target confidence level and interval in mind.

Random or stratified random sampling will be used to the select the streets in the sample. Streets with recent data (speed, volume, vehicle composition) will be favored to minimize data collection.

Task 3 - Collect traffic speed, volume, and vehicle composition data for each street in the sample.

Basic traffic data will be collected for each street in sample. Streets will be chosen in an attempt to capitalize on existing data. Measurements will be taken with automatic counters. Because the sample size is so large, data collection will be limited to these three types of traffic data.

Task 4 - Measure physical characteristics of each street and adjacent land uses.

Street cross sectional widths, tree location and spacing, building setbacks, and other variables that may affect perceptions of livability will be measured. Where street characteristics vary along a given street, each section will be measured separately.

Task 5 - Survey residents of each street in the sample.

Residents of each street in the sample will be surveyed about: household attitudes toward traffic and quality-of-life on their street; household activities that might be affected by traffic, such as strolling along the street and letting children play outside; and household characteristics that might affect attitudes toward traffic, such as the presence of young children at home. The large number of streets in the sample will preclude large samples of residents on each street. Instead, the sampling plan will keep the numbers surveyed on each street to the absolute minimum required for inference testing and modeling. It is anticipated that surveys will be conducted door-to-door, as this will be most efficient given the clustered nature of the samples. In any event, randomness will be maintained in the selection of surveyed households on each street.

Task 6 - Analyze relationships between resident attitudes and activities on the one hand, and traffic and street characteristics on the other.

Using multivariate statistical methods, resident attitudes and activities will be related to traffic and street characteristics, controlling for sociodemographic and other characteristics of respondents. It is expected that overall measures of satisfaction with the street environment will be developed; these then will be modeled in terms of traffic volumes, speeds, and composition, plus physical characteristics of the street and adjacent land uses. The resulting formulas will allow the City to predict levels of residential satisfaction as a function of all these variables.

Task 7 – Propose a measurement index and possibly a standard of acceptability.

From the formulas developed in Task 5, standards will be proposed for traffic speed, volume, and composition as a function of physical characteristics of streets and adjacent land uses. This will be done in close consultation with the oversight committee.

Task 8 - Conduct a public workshop to solicit comments.

A public workshop will be held to solicit feedback on the study results. At this workshop, the study purpose will be described, the various tasks outlined, and the results presented. The focus will doubtless be on the livable street index itself, which will be subject to change based on public reactions. That is, the relative weights given to different residential satisfaction measures, and the thresholds and ceilings, will all be subject to change. To help the public interpret the results, examples of Sacramento streets that meet or violate the proposed standards will be presented.

Task 9 - Bring the livable street index to the Planning Commission and City Council for adoption.

Once refined in response to public comments, a livable street index (and possibly a standard) will be presented to the Planning Commission and City Council for discussion, modification, and adoption. Proposed uses of the results will be suggested as well, and may be endorsed by Council for subsequent staff implementation.

Project Personnel

Reid Ewing of Fehr & Peers Associates, Inc. will serve as the project director, overseeing all technical aspects of the study and attending critical committee meetings and Planning Commission/City Council hearings. Due to his presence in Sacramento and familiarity with local issues, Steve Brown will manage the project on a day-to-day basis and attend all committee meetings. Joel Franklin in the Roseville office will perform the calculations and field analysis.

We anticipate retaining the services of JD Franz research to help develop the survey instrument and conduct the field interviews.

Projected Costs

Until the specific number and location of study roadways are selected, we cannot provide a specific cost estimate. However, the costs can be minimized by selecting roadways for which data has been collected in recent years. The costs can be further reduced if City staff collect all traffic and physical data. It may even be possible for members of the oversight committee to perform some or all of the interviews with appropriate training. We estimate the range of cost for our services (depending upon data collection and survey effort) to be between $50,000 to $80,000.

Schedule

We anticipate that the results will be ready for presentation to the Planning Commission and City Council within 8 months from the time of the first oversight committee meeting.

APPENDIX C

TRANSPORTATION IMPACT PROCEDURE SURVEYS

Automobile LOS Approach

Jurisdiction: **County of Amador**

LOS Approach Used: Automobile

LOS Threshold: D (within urban areas)
C (outside urban areas)

Deviation Allowed?: Yes.

Methodology Used: HCM 2000

Jurisdiction: **City of Boise, Idaho**

LOS Approach Used: Automobile/Case-by-Case

LOS Threshold: Several standards have been used from LOS C to LOS E. No single policy governs.

Deviation Allowed?: Yes.

Methodology Used: Case by case approach

Note: For the downtown Boise area multiple LOS thresholds have been established through policies and design standards ranging in date from 1995 to 2002.

Jurisdiction: **City of Chico**

LOS Approach Used: Automobile

LOS Threshold: D

Deviation Allowed?: Yes. LOS E allowed in built-out areas with transit service.

Methodology Used: HCM 2000

Jurisdiction: **El Dorado County**

LOS Approach Used: Automobile

LOS Threshold: E (Community Regions)
D (Rural Regions)

Deviation Allowed?: Yes. Several County road segments allowed to operate at LOS F given right-of-way and physical limitations for improvements.

Methodology Used: HCM 2000

Note: Information from the 2004 General Plan, approved by voters in March 2005 but currently not in place.

Jurisdiction: **City of Gilroy**

LOS Approach Used: Automobile

LOS Threshold: C

Deviation Allowed?: Yes. LOS D is allowed in certain areas.

Methodology Used: HCM 2000

Note: Impacts occur if project trips cause intersections operating at LOS D to degrade by two or more seconds of average vehicle delay or cause intersections operating at LOS E or F to degrade by one or more seconds of average vehicle delay.

Jurisdiction: **City of Las Vegas**

LOS Approach Used: Automobile/Trip Generation Percentage

LOS Threshold: D

Deviation Allowed?: Yes. Las Vegas collects fees for traffic improvements based on the trip generation of the development and the amount of trips added to intersections by the development.

Methodology Used:

Jurisdiction: **City of Menlo Park**

LOS Approach Used: Automobile

LOS Threshold: C (Collector Streets)
D (Arterial Streets)

Deviation Allowed?: Yes.

Methodology Used: HCM 2000

Note: Impacts are determined based on LOS differences between near term and near term plus project scenarios. Impacts on arterials also occur if project trips cause unacceptable LOS to degrade by at least 23 seconds of average vehicle delay (for intersections operating at LOS A, B, C, or D) or at least 0.8 seconds of average delay to vehicles on critical movements (for intersections operating at LOS E or F). Minor arterials, collectors, and local streets may also need to be analyzed. Separate analysis methods and threshold are available for these roadways and are based on the percent of added vehicles and the capacity of the roadway.

Jurisdiction: **Park City, Utah**

LOS Approach Used: Automobile

LOS Threshold: D (within Park City)
C (Park City area)

Deviation Allowed?: Yes.

Methodology Used: HCM 2000

Note: LOS policy being updated. LOS D or E is being recommended for all of Park City.

Jurisdiction: **Price, Utah**

LOS Approach Used: Automobile

LOS Threshold: C

Deviation Allowed?: No.

Methodology Used: HCM 2000

Note: Rural area. No deviations from LOS C allowed.

Jurisdiction: **City of Rancho Cordova**

LOS Approach Used: Automobile

LOS Threshold: D

Deviation Allowed?: Yes. Worse LOS allowed on Folsom Blvd. and over river crossings.

Methodology Used: Circular 212

Jurisdiction: **City of Reno**

LOS Approach Used: Automobile

LOS Threshold: D (inside McCarran Loop)
C (outside McCarran Loop)

Deviation Allowed?: Yes.

Methodology Used: HSM 2000

Note: LOS standard has been in place for over 10 years. Impact fees are paid and go towards regional road improvements.

Jurisdiction: **County of Sacramento**

LOS Approach Used: Automobile

LOS Threshold: E (inside Urban Services Boundary)
D (outside Urban Services Boundary)

Deviation Allowed?: Yes.

Methodology Used: Circular 212

Jurisdiction: **City of San Jose**

LOS Approach Used: Automobile

LOS Threshold: D

Deviation Allowed?: Yes. LOS F allowed in downtown area.

Methodology Used: HCM 2000

Jurisdiction: **City of West Sacramento**

LOS Approach Used: Automobile

LOS Threshold: C

Deviation Allowed?: Yes. Within ¼ mile of Freeway interchanges and bridge crossings.

Methodology Used: Circular 212

Jurisdiction: **Yolo County**

LOS Approach Used: Automobile

LOS Threshold: No defined LOS standard. The County shall strive to maintain LOS C.

Deviation Allowed?: Yes. Due to no set standard deviations are case by case.

Methodology Used: HCM 2000

Note: LOS based on peak hour traffic volumes, including roadway segments.

Jurisdiction: **Yuba City**

LOS Approach Used: Automobile

LOS Threshold: D

Deviation Allowed?: Yes. The downtown area and bridge crossings are exempt from the LOS D threshold.

Methodology Used: HCM 2000

Note: Other exemptions need to gain City approval.

Multimodal LOS Approach

Jurisdiction: **City of Fort Collins, Colorado**

LOS Approach Used: Multimodal

LOS Threshold: Transit – LOS D for at least 70% of the land area outside of Mixed Use Center and Commercial Corridors
– LOS B for Mixed Use Centers and Commercial Corridors
Pedestrian – Minimum pedestrian LOS (between A and C) set for five different pedestrian area types.
Bicycle – LOS C is the base city-wide minimum. LOS A for public school sites. LOS B for recreation sites and for community and neighborhood commercial centers. Bicycle LOS is based on connectivity to bike facilities in connecting corridors.
Motor Vehicle – LOS based on roadway functional class. LOS E threshold on arterials in commercial corridors.

Deviation Allowed?: Yes.

Methodology Used: N/A

Note: Project approval will not be granted to projects which do not meet the pedestrian and bicycle LOS thresholds. Transit and motor vehicle LOS thresholds undergo development review. Pedestrian LOS used and developed by the City of Fort Collins.

Jurisdiction: **City of Seattle, Washington**

LOS Approach Used: Multimodal

LOS Threshold: N/A

Deviation Allowed?: N/A

Methodology Used: N/A

Note: The LOS approach is focused on using a balancing process. Seattle uses a street classification system to prioritize roadways based on characteristics. Improvements, or changes, are made along a corridor (sometimes as short as a block or as long as a city-wide corridor). The improvement is balanced between transit, bicycle, pedestrian, auto, and truck uses. For example, if a corridor is identified as an important bicycle corridor, then an adjustment to the physical roadway needs to be designed as desirable (compared to minimal) for bicycle LOS while auto LOS in the same location only needs to be minimal (compared to desirable).

This is a work in progress by the City of Seattle. The City's previous LOS policy was based on Automobile LOS.

Alternative LOS Approaches

Jurisdiction: **City of Berkeley**

LOS Approach Used: Case-by-Case

LOS Threshold: None

Deviation Allowed?: N/A

Methodology Used: N/A

Note: The City of Berkeley has no LOS standard. The City is built-out and is attempting to move towards a multimodal approach. The City's written policy is as follows.

> Policy T-18 Level of Service
>
> When considering transportation impacts under the California Environmental Quality Act, the City shall consider how a plan or project affects all modes of transportation, including transit riders, bicyclists, pedestrians, and motorists, to determine the transportation impacts of a plan or project. Significant beneficial pedestrian, bicycle, or transit impacts, or significant

beneficial impacts on air quality, noise, visual quality, or safety in residential areas, may offset or mitigate a significant adverse impact on vehicle Level of Service (LOS) to a level of insignificance. The number of transit riders, pedestrians, and bicyclists potentially affected will be considered when evaluating a degradation of LOS for motorists.

Action:

A. Establish new multi-modal levels of service (LOS) City standards that consider all modes of transportation, including transit, bicycles, and pedestrians in addition to automobiles.

Jurisdiction: **City of Pleasanton**

LOS Approach Used: Automobile/“Quality of Life”

LOS Threshold: D

Deviation Allowed?:

Methodology Used: HCM 2000

Note: An automobile LOS policy is used for intersections and roadways not considered residential streets. A “Quality of Life” standard is used to measure LOS on residential streets. This standard considers several factors in its LOS table such as the amount of thru traffic (i.e., how many residential blocks the traffic has previously traveled on), cut-thru traffic, speed, average daily traffic volume and peak hour traffic volume (additionally, the traffic volume per minute), ease of crossing the street either by walking or bicycling, and the ease of exiting driveways.

Jurisdiction: **Provo City, Utah**

LOS Approach Used: Automobile/“Livable Streets”

LOS Threshold: N/A

Deviation Allowed?: Yes. The Municipal Council can allow development to continue and accept congestion over allowable limits.

Methodology Used: HCM (used to develop thresholds)

Note: Provo City, Utah uses a measure of livability to asses the impact of new development. Livable street standards have been developed for different roadway classifications and types. The livable street standards are represented by roadway volume thresholds, not by a roadway LOS threshold, rather by an amount of vehicles that no longer allow for a livable street. These standards represent 90% of the maximum capacity of the roadway.

Jurisdiction: **North San Jose Development Policy** (within City of San Jose)

LOS Approach Used: Automobile/Area-Wide Weighted Average LOS

LOS Threshold: D

Deviation Allowed?: No. If an adjacent city declines the proposed mitigation, then those corresponding intersections will be removed from the weighted average LOS.

Methodology Used: HCM 2000

Note: A weighted LOS average is calculated from all intersection in the area whose critical volumes are altered by one percent or more with the inclusion of project generated traffic. The following section from the North San Jose Development Policy describes this policy.

> The performance standard set by this policy requires that an overall weighted average LOS "D" will be achieved for all intersections whose critical volumes are impacted one percent or more by project generated traffic. Only those intersections which are impacted one percent or more will be used in the weighted average LOS calculation for a particular project.
>
> In cases where development generated traffic causes the weighted average LOS of these impacted intersections to exceed the acceptable level of "D", intersection improvements to increase the critical capacity will be required of development as necessary to achieve a LOS "D" and be in conformance with this policy.
