Transportation Impact Analysis Guidelines

CITY OF
ISSAQUAH
WASHINGTON

City of Issaquah, Washington

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The Guidelines

The City of Issaquah Development Services Department (DSD) and Public Works Engineering (PWE) Department have established Guidelines for the preparation of Transportation Impact Analyses (TIA). Consistent with the Transportation Concurrency and multi-modal transportation impact fees in the City, these guidelines pertain to all modes of transportation, both motorized and non-motorized. The purpose of these Guidelines is to establish requirements and procedures to ensure timely and consistent analysis. These guidelines are subject to modifications by the City as deemed necessary.

Why is a Transportation Impact Analysis (TIA) conducted?

TIAs are conducted to evaluate the impacts of proposed land use developments on the existing transportation network and to identify consistent and appropriate mitigation measures.

The main purposes of TIAs are:

- To ascertain the operational conditions on the adjacent roadway network when a proposed development is accommodated within the existing transportation infrastructure along with other proposed developments.
- To identify transportation improvements required to maintain the City's operational standards.
- To determine whether access to the proposed development will impact traffic conditions and safety near the site.
- To identify present or future transportation system1 deficiencies with or without the new development.
- To provide decision makers with a basis for assessing the transportation implications of approving proposed zoning changes and development applications.
- To provide a basis for estimating the cost of proposed mitigation measures. Consequently, a TIA can be used to determine the "fair share" of the improvement cost to be paid by the developer.

When is a TIA required?

Generally, a TIA may be required as part of the approval process for any of the following:

- Developments generating 30 or more Trips
- Zoning change
- Building permit
- Site plan or modifications to a site plan
- Subdivision/platting
- Driveway (access) requests
- Comprehensive plan amendments requested by the developer
- Requests for a new signal to control driveways serving a proposed or existing development

A TIA generally will be required if the proposed development or redevelopment will add thirty (30) or more peak hour trips to the transportation system. In some cases, a TIA (or some elements of a traffic study) may be required even if the 30-trip volume threshold is not met, but the City finds that the traffic impacts attributable to the development have the potential to significantly impact the safe and efficient operation of the existing public transportation system. A TIA may also be required for a development located near a sensitive area, a high accident location or an area already suffering from congestion.

A preliminary trip generation assessment of proposed development should be conducted to determine if a traffic study would be required. Typically, the trip generation assessment is supplied to the City by the applicant with the Transportation Concurrency Application.

The transportation concurrency assessment for future planned growth has already been completed by the City for system-wide concurrency intersections. Furthermore, mitigation for the corresponding planned growth has been identified by the City, as well, and a transportation impact fee has been calculated to administer those transportation improvements to keep up with growth. **As a result, a system-wide intersection capacity analysis is no longer required by individual development applicants, as long as the type, amount, and location of the proposed development is consistent with the City's future planned growth.** A "trip bank" has been calculated, from which proposed developments can withdraw trips for their development, provided the traffic impact fee is paid. See the Transportation Concurrency Ordinance 2733 for more details on the trip bank methodology.

However, the concurrency assessment does not negate the need for a localized analysis of traffic impacts in the immediate vicinity of the project site at driveways or non-concurrency intersections, and/or other non-motorized, safety, geometric, construction, or transit impacts, as described in the subsequent section, "Thresholds for Defining a Probable Significant Adverse Impact". After completion of the concurrency assessment, the applicant should immediately consult with the City DSD staff to verify the applicant's need to conduct a TIA documenting some or all of these other impacts.

Finally, a TIA may not be required if the project is part of a larger development for which a traffic study has already been prepared for the City of Issaquah. In this instance, it is the project applicant's responsibility to sufficiently demonstrate to the City that the project's impacts are consistent with the previously prepared traffic study. City staff shall make the final determination on the sufficiency of an existing traffic study.

What are thresholds for a probable significant adverse impact?

The type and timing of required localized improvements/mitigation is determined through the local TIA and depends on the significance of the developments' impacts to roadway and intersection operational performance (LOS, delay, 95th percentile queue lengths, etc.), safety, specific access and site circulation needs, neighborhood impacts, impacts on pedestrians and transit facilities, or as required by other City Ordinances. The specific criteria utilized for determination of significant impacts include but are not limited to the following:

Intersection Level-of-Service

The intersection level of service (LOS) standard in Issaquah shall be LOS D, as defined by the latest edition of the Highway Capacity Manual. Any development that exceeds the maximum allowable delay at a driveway or local roadway not included in the City's transportation concurrency analysis is considered as having a probable significant adverse impact and will be required to mitigate the impact.

Refer to other impacted jurisdiction's (WSDOT, King County, Sammamish) Traffic Impact Guidelines for their LOS standards.

Safety

The addition of ten (10) or more peak hour vehicular trips to a High Accident Location (HAL) will be considered a probable significant adverse impact. When a development proposal impacts a HAL, the City may require reasonable mitigation even if the LOS thresholds are not exceeded. The City may also consider other safety threshold requirements such as sight distance and turning movements, etc. Mitigation may take the form of developer-constructed improvements or traffic mitigation payment to a city project if one is programmed for the HAL location.

Channelization

Addition of sufficient peak hour vehicular trips to a local non-concurrency intersection or access connection that triggers the need for channelization improvements (e.g., separate or longer turn lanes, acceleration/deceleration lane, etc.) will be considered a probable significant adverse impact.

Traffic Control Devices

Requests for a new (or modified) traffic signal or 4-way stop-controlled intersections at driveways or streets serving a proposed or existing development will be considered an adverse impact.

Pedestrians and Bicycles

A pedestrian or bicycle impact is considered to be significant if the project:

- Results in potential conflicts for pedestrians or bicyclists;
- Does not satisfy Americans with Disabilities Act requirements;
- Fails to provide adequate bicycle and pedestrian access; or
- Exacerbates a current unsafe pedestrian or bicycle condition in the project area.

Transit

A transit impact is considered to be significant if the project causes transit demand above the levels able to be adequately provided by local transit operators or agencies.

Site and Circulation

A site and site circulation impact is considered to be significant if the project:

- Results in interference with traffic flow on public streets at site access driveways;
- Results in potential internal circulation conflicts for pedestrian and motorists;
- Results in insufficient or inadequate accessibility for delivery or service vehicles that would interfere with traffic flow.

Parking

A parking impact is considered to be significant if the project:

- Results in projected parking demand that would exceed the proposed parking supply on a regular and frequent basis; or
- Results in an increased use of permanent neighborhood parking for area residents.

What are the submission and review procedures for TIAs?

TIAs shall be prepared under the supervision of a registered Professional Civil Engineer in the State of Washington who has experience and specific training in traffic and transportation engineering and non-motorized transportation mobility options.

The following shall be submitted to the City for review and approval:

- Preliminary Scoping Memorandum – Submitted prior to conducting traffic counts and other data collection (See **Appendix A** for content detail);
- Draft Report (See **Appendix B** for content detail); and
- Final report with responses to City comments and questions (response letter to be attached to the report).

Synchro/SimTraffic version 8.0 software or other City approved software should be used for the capacity analysis. **Appendix C** contains the City of Issaquah Synchro Modeling Guidelines which provides a listing of the various assumptions, factors and methodologies to be used for Synchro analyses.

Two (2) copies of the draft report with appendices and one (1) electronic copy containing all of the analyses shall be provided to the City at the time of submittal. Additional copies may be requested if other jurisdictions are involved with the review process.

If there are other impacted jurisdictions within the project influence area (e.g., WSDOT, King County, Sammamish) and it has been determined that a traffic study is required, the study preparer shall establish a scoping meeting with all necessary agencies to address relevant issues. This will foster improved coordination and reduce potential for later revisions to the study. Correspondence with other jurisdictions shall be provided to the City staff.

Revisions to the TIA may be required based on the completeness of the study, the accuracy of the data, the thoroughness of the impact evaluation, the compatibility of the study with the proposed access and development plan, or other considerations which may develop after submittal and review of the draft report.

A traffic study may need to be revised if the proposed land use is changed by type or size over the course of the project development. In addition, a traffic study may need to be revised if the study is older than two (2) years and no substantial progress has been made to advance the project through the City's approval process.

A consolidated final version of the TIA shall be submitted, incorporating all revisions and supplementary analyses resulting from the review process. This will facilitate review, both by staff and by the public. Final documents shall bear the seal of the responsible registered Professional Engineer.

Two (2) of the final (consolidated) TIA with appendices and one (1) electronic copy containing all of the final analyses shall be submitted to the City. Additional copies may be requested if other jurisdictions are involved with the review process.

TIAs become public record upon submittal. Information provided in the study can be used for subsequent studies. The original sources of data and information should be cited when taken from prior submittals.

Appendix A
Scope of Transportation Impact Analysis

It is recommended that the applicant's traffic engineer consult with the City DSD and PWE staff prior to preparing the study to establish the scope and basic assumptions of the study and any requested deviations from these Guidelines to avoid unnecessary delays or revisions. The appropriate level of traffic analysis is determined by the specifics of a project, the prevailing roadway conditions servicing the project, and the forecasted traffic volumes. The City will review each development application on a case-by-case basis and may make recommendations that differ from the guidelines.

A preliminary scoping memorandum, including but not limited to, the following project-related information must be submitted to the City for review and comment:

- Description of the proposed development and zoning
- Type and size of development (number of residential units and/or square footage of building)
- Project location (vicinity map and site plan)
- Proposed access and relationship to adjacent properties/driveways and streets
- Phasing and timing of development - If the proposed development/redevelopment is to be constructed in phases, describe each phase and the proposed implementation timing
- Trips generation per the latest edition of the Institute of Transportation Engineers (ITE) Trip Generation manual and Trip Generation handbook, and assumptions used for trip generation
- Project trip distribution percentages and assignment at project driveways and/or localized non-concurrency intersections

The City will review the scoping memo to determine whether or not further analyses are needed. If a TIA is required, the following items will be provided to the applicant:

- Available traffic count data
- Accident data
- Existing Synchro files
- Programmed/funded motorized and non-motorized improvements in the study area
- Pipeline projects and area wide growth assumptions (background traffic calculation methods)
- Need for special analyses/studies

A TIA scoping meeting may need to be held after review of the preliminary information to clarify issues surrounding a project or some elements of the review process. The City reserves the right to establish the study area as may be deemed necessary. Correspondence with other affected jurisdictions impacted by the development shall be discussed at the scoping meeting.

Appendix B
Transportation Impact Analysis Format and Required Elements

The TIA should document the purpose, procedures, data sources, assumptions, findings, conclusions and recommendations of the study. The report might be of interest to decision makers and other non-technical people. Hence, technical terms and jargon need to be explained, clarity should not be sacrificed, and it should be concise and complete.

Description of coordination efforts with other affected jurisdictions impacted by the development shall be included in the report.

The report format presented below provides a uniform framework that will facilitate both the preparation and the review of the report. **However, not all of the contents described below may be required for each development. Rather the City will identify the sections required for each development TIA at the scoping meeting based on the *Thresholds for Probable Adverse Significant Impacts* described on pages 2 through 4.**

Report Cover

Include development name and location, applicant's name, preparer's name and organization, and report date.

Title Page

Include project name and address, application number, applicant's name, address and telephone number, date of original report and revision date, preparer's name, title, organization, address and telephone number, name, address, phone number and/or email address of licensed engineer, stamp and expiration date.

Table of Contents, List of Figures, Tables and Appendices

The report should contain a table of contents and a list of figures, tables and appendices.

Executive Summary

The Executive Summary of the report shall include the study purpose, a general description of the project scope, site location, development description, study area, concise description of major findings, recommendations and mitigation measures.

Description of Proposed Development

The TIA should provide a full description of the proposed development including but not limited to the following:

- A vicinity map shall be provided illustrating the site location, study area, and the surrounding transportation network (major streets and key intersections). The limits of the study area will have been determined at the scoping meeting with the City.
- Location of approved or proposed developments in the vicinity of the project should be included in the report. These can be obtained from the City. These developments should be included as base assumptions where applicable in the analysis of the transportation impacts.
- Location and type of existing and proposed improvements, buildings, building appurtenances, fuel pumps, and drive through facilities.
- Size of Development (total development area, total area of each building and locations, floor space including a summary of each type of land use including number of residential units, etc.).
- Existing land use and zoning.
- Proposed land use and zoning – Intended use of the site, including the range of uses allowed without additional land-use approvals. The land use with the greatest overall traffic impact shall be assumed in the study (worst case scenario), unless the applicant specifies the uses for the site.
- Existing and proposed parking (number of spaces, dimensions, circulation).
- A detailed site plan including location and orientation of existing and proposed access points and type of access (full access, right-in/right-out, turning movement restrictions, sight lines, etc.), driveway throat lengths, other access points adjacent to or opposite the site, project internal roadway system, adjacent streets, parking facilities, internal circulation patterns for vehicles, bicyclists and pedestrians, fire lanes, traffic control devices and tracking patterns of the design vehicles for the access, circulation, loading docks and garbage receptacles. Distances from existing streets, driveways, and/or median openings to development access should also be shown. The site plan shall be at an appropriate scale to allow proper review by the City staff and should be included in the appendix of the report if possible or submitted as an attachment to the traffic study. For situations where a site plan does not exist, a prototypical site roadway and access system should be assumed for purposes of the study. Subsequent update will be necessary when a site plan becomes available.

- The TIA shall describe the proposed development schedule and staging/phasing, including the anticipated opening date, the anticipated completion date for each major phase of development and the anticipated full build out completion date.
- Each TIA shall present an analysis of the traffic conditions without and with the proposed project at year of completion, including all pipeline development at project driveways and local non-concurrency intersections. The future year traffic volumes, including pipeline development, can be obtained from the City's travel demand model, or by other means approved by the City.
- The critical time periods for traffic is directly associated to the scope of the TIA and with the peaking characteristics of the background traffic and the proposed development traffic. In most cases, the weekday evening (PM) peak hour of the street will be the only analysis period required for the traffic study. For certain types of development (e.g., churches, schools, some retail uses, shopping centers, etc.) other peak hours may be added (e.g., a.m., midday or weekend, holidays, project peak hours, etc.) or eliminated from the analysis, if approved by the DSD or PWE Department.
- Any other pertinent information

Existing Conditions

Study Area Roadway System

A thorough review of available data and description of the existing transportation system within the study area, using a combination of maps and other documentation should identify relevant information, such as the following:

- All applicable roads on which a driveway is proposed and/or an impact to a non-concurrency intersection has been identified. The road description should include the number of lanes, lane usage (i.e., identify through lanes, two-way left-turn lanes, merge lanes, shoulders/curbing, parking/type, etc.), pavement type, right-of-way width, shoulder and sidewalk widths, general topography, roadway classification and posted speed limits.
- Traffic control devices including signalizations, signing and pavement markings that might affect or be affected by the project.
- Distances from existing streets and driveways to development access points.
- Alignment with existing streets and driveways to development access points.
- If appropriate, on-street parking in the vicinity of the development site and those that affect the operation of key intersections being analyzed.
- Heavy vehicle prohibitions and restrictions
- Marked pedestrian crosswalks in the vicinity of the development site.
- School route plan (if relevant to the proposed development).
- Existing and planned bicycle and pedestrian facilities including bike lanes, sidewalks, and multi-use paths adjacent to the project site, utilized by the project, connected to by the project, or impacted by the project should be identified and described in detail.

- Any transit facilities including the service provider(s), route numbers, frequency, and location/amenities of existing bus stops in the immediate vicinity of the project should be provided.
- Minimum turning path of design vehicles, following the AASHTO guidelines of selecting the design vehicle and measuring, recording and reporting existing and proposed turning radii.
- Other pertinent information

Traffic Volumes

Daily and peak hour traffic counts should be collected for use in the study at impacted intersections where the City does not already maintain an existing count. If counts are required, these counts shall typically be collected between 4-6 PM on a typical Tuesday, Wednesday, or Thursday for all roadways and intersections in the study area. However, the type of development or local conditions may require counts be also taken on weekends or other time periods. Establishment of times for turning movement and daily counts will be made during the scoping meeting.

The counts should be conducted during weeks which have no holidays and if possible during the school year. In situations when traffic counts must be conducted while school is not in session, a seasonal adjustment shall be applied to daily and peak hour volumes collected for use in the study. The seasonal adjustment should be approved by the DSD or PWE staff. For projects which include improvements to schools or sites adjacent to schools, it will be necessary to include peak hour counts from the school take-in and dismissal times. No counts should be performed from the end of the school year through the week of Labor Day. In addition, traffic data should not be collected during the following:

- December 15 to the week which includes New Year's Day
- School holidays or late opening/early closing
- Occasions influenced by an accident, road or lane closure, inclement weather, or other events

Typical traffic data should be collected in 15-minute increments. Intersection turning movement counts shall include peak hour factor calculations, heavy vehicle percentages, pedestrian and bicycle counts, and HOV lane counts. The exact locations, how, and when counts were taken should be included in the report. The existing counts should be presented in a diagram format in the report.

Future Conditions

Programmed Roadway Improvements

Projects from the City's Capital Improvement Program (roadways and intersections or any other transportation circulation improvements) may be used in the future year analysis. The traffic study should include a discussion of the scope and the status of the assumed improvements. The improvements of other jurisdictional agencies within the study area should also be identified. DSD and PWE staff will determine what approved City traffic improvements may be considered in the analysis. A map showing the committed and funded improvements should be included in the report.

Projected Traffic Volumes

For estimating the traffic impacts of a proposed development, it is recommended to use the traffic volumes from the City's travel demand model for two cases: (a) without the proposed development, and (b) with the proposed development. The incremental impacts are attributed to the site-generated traffic. The report should include graphical presentations which illustrate peak hour and daily (including turning movements at the study intersections) forecast volumes for the future year with and without the proposed project traffic.

Future/Background Traffic Volumes without Development

Background traffic should reflect any existing facilities plus planned future traffic. Planned future traffic is included in the City's travel demand model.

Proposed Project Traffic

The latest edition of the Institute of Transportation Engineers (ITE) Trip Generation Manual, Trip Generation Handbook, or other industry publications such as the ITE Journal should be used to estimate project-generated trips for the daily and study peak periods. Data limitations, data age, choice of peak hour or adjacent street traffic, choice of independent variable and choice of average rate versus statistical significant modification shall be presented and discussed.

In cases where published trip generation rates are based on very limited data or do not adequately represent the proposed land use(s), a local trip generation study following procedures prescribed in the ITE Trip Generation manual may be required to provide sufficient justification for the proposed generation rate. Deviations from ITE rates must be justified, documented and approved by the City DSD or PWE Department prior to the submittal of the report.

Trip credits can be taken for land uses that will be discontinued once the development is complete, assuming those uses were active within one year of the traffic study submittal.

Trip generation adjustments may be justified to account for internal and/or pass-by trips. Internal trip reductions can only be applied for mixed-use types of developments and pass-by reductions for retail/commercial type developments (e.g., fast food restaurants with drive-through windows, service stations). Pass-by trip reductions greater than 15% require approval by the City, and should be discussed in the traffic study. Captured/internal trip reduction greater than 5% requires consultation and acceptance by City, and should be discussed in the traffic study. The justification for internal or pass-by trip reductions will require analytical support based on verifiable actual similar developments to demonstrate how the figures were derived and will require approval by DSD or PWE staff prior to use. All trips, including pass-by trips, must be included in the analysis of the project's driveways.

Trip generation adjustments for transit and Transportation Demand Management (TDM) actions must also be justified with analytical support to show how the figures were derived. Optimistic assumptions regarding transit use and TDM actions will not be acceptable unless accompanied by specific implementation proposals that will become a condition of approval. Such implementation proposals must have a reasonable expectation of realization within a 2-year period after project initiation.

A table must be provided in the study report identifying the categories and quantities of land uses, with the corresponding trips rates or equations and the resulting number of trips. This table also needs to identify all adjustments to the trip generation, specifically pass-by trips, existing trips, internal trips, TDM and transit trips. For large developments that will be constructed in phases, the table should identify each significant phase separately.

Project Trip Distribution and Assignment

The City's travel demand model (select zone analysis) or other City approved methods should be used to estimate site trip distribution and assignment. Any adjustments to the model distribution shall be fully documented and subject to approval by the DSD or PWE staff. As needed, the City's travel demand model may need to be disaggregated in the vicinity of the proposed project to provide sufficient detail to appropriately analyze study area facilities/driveways. All model assumptions and modifications should be documented. No modifications other than documented land use or roadway network assumptions should be made to the travel demand model without approval of the DSD or PWE.

The distribution of site generated traffic at project driveways and/or local non-concurrency intersections should be presented (including distribution/assignment of pass-by trips) in the report in a graphic format showing, by direction, percentage and number of site generated trips. The presentations should include Average Daily Traffic (ADT) and peak hour directional volumes as well as turning movements.

Future Traffic Volumes with Development

Total peak hours and daily traffic volumes shall be graphically shown combining project and background traffic for the project horizon years.

Traffic Analysis and Impact

To determine the potential localized traffic impacts of a proposed development, the following scenarios shall be analyzed for the study time periods when appropriate:

- Existing Traffic Conditions without project traffic
- Future/Background Traffic Conditions without Development
- Future Traffic Conditions with Development

Conclusions regarding the adverse impacts caused by the project on the roadway system should be discussed in this section. Depending on the development type, size, location, etc., all or some of the following technical analyses may need to be included in the traffic study.

Operational/Capacity Analysis

Capacity analyses must be performed using the principles of the latest version of the Highway Capacity Manual for all identified intersections/access points determined through the scoping meeting. Synchro/SimTraffic version 8.0 software or other City approved software should be used for the capacity analysis. City may recommend the use of other traffic analysis software where applicable.

The City's traffic operations model will be provided with the available existing conditions Synchro files that contain the existing signalized intersections channelization and signal timings, etc. These files may need to be updated with the new traffic counts (e.g., volumes, peak hour factors, heavy vehicle %, pedestrian and bicycle volumes, etc.) and other applicable project related information (e.g., new roadways or intersections, adding unsignalized intersection or driveways, etc.). No changes to signal timing/phasing from those included in the City's Synchro model shall be made without the approval of the DSD or PWE staff. The City will determine whether or not the existing timings should be used for the future condition analysis after review of the project information and horizon year(s). Geometric data such as the number of lanes, lane widths, adjacent parking lanes and grade may be available from the City (Synchro files). Where not available, the consultant will have to obtain the missing data.

All assumptions and modifications used in the performance of analysis concerning lane configurations/use, pedestrian activity, saturation flows, lane utilization factors and other relevant parameters should be noted and justified in the text of the report. Modifications without justification can lead to delays in review as we wait for clarification from the Consultant. Appendix C contains the City of Issaquah Synchro Modeling Guidelines which provides a listing of the various assumptions, factors and methodologies to be used for Synchro analyses.

The performance of intersections should be reported as overall intersection LOS, delay and V/C ratio (for signalized, roundabout, and all-way stop intersections); and individual intersection approach movements LOS, delay, V/C ratio for all intersection control types. The analysis results, deficiencies and impacts should be discussed in the report especially for the following conditions:

- The overall V/C ratio of an intersection exceeds 0.85;
- The V/C ratio of an individual thru movement or shared thru/turning movement exceeds 0.85;
- The V/C ratio of an exclusive turning movement exceeds 1.0; or,
- LOS and delay for the overall intersection or any individual movement exceeds the acceptable LOS threshold.

Supplementary surveys or analyses may be needed to assess saturation flows and gap availability. In the case of congested intersections, particularly where the existing volume/capacity ratio is greater than 1.0, it is advisable to conduct further field observations of intersection operations, saturation flows, queues, and delays to confirm and/or rationalize the results of the performance analysis.

Where the traffic volumes through an intersection do not appear to reflect actual demand, for example, where the intersection throughput is constrained by downstream congestion, performance analyses may indicate low (good) volumes/capacity ratios which mask actual problems. Field observations may be necessary in these situations to determine the necessary adjustments to performance calculations so that actual conditions are fairly represented.

All software outputs should be clearly labeled indicating the time frame for analysis. The output sheets should show all of the capacity analysis results that are listed in the tables included in the body of the report. Software output must explicitly show all input and phase lengths used in analysis. All electronic

data files for software must be provided on a CD as a supplement to the report. Please ensure that staff can interrelate data tables in your report, printouts in your appendices and all data files on the CD.

Traffic Control Needs

When needed, an analysis to determine whether traffic control warrants (traffic signals, stop signs, or yield signs) are met with the development traffic may be required. The warrant analysis should be based on the procedures in the latest edition of the Manual on Traffic Control Devices (MUTCD). The percentage of right-turns-on-red must be justified on the signal warrant analysis.

In cases where a new signal is being proposed within a corridor of existing signals, a supplementary analysis of traffic signal "system" operations may be required to assess effects on traffic signal coordination. In this scenario, both concurrency and non-concurrency intersections may be included in the analysis. The acceptability of the signal locations must be demonstrated through a signal progression analysis.

Signal warrant analyses may be conducted using projected traffic volumes to identify potential need for the installation of traffic signals. However, traffic signals will not be installed until actual traffic counts at the intersection meet warrant thresholds.

Gap Study

A gap study identifies the gaps in traffic to determine if the frequency and duration of the gaps is sufficient to permit the safe crossing and merging of side-street traffic, and/or pedestrians. Particular attention should be given to elderly pedestrians and children who have slower than average walking speeds. A gap analysis will need to be performed on a driveway where a signal is requested.

Accident Analysis

Five years of the most current accident data shall be obtained for intersections and roadways within the study area. Accidents involving pedestrian and bicyclists should also be included. This data shall be summarized within the report in tabular form (accident type, number and severity for each location) along with a brief written description at each location. A discussion of accident occurrence as it relates to sight distance or other roadway geometric deficiencies, signing, and illumination should be included.

Average accident rates should be calculated and compared with statewide averages for similarly classified roadways and/or the citywide averages provided by the City of Issaquah. Intersection rates are calculated independently from mid-block segment accident rates. Intersection accident rates should be calculated as accidents per million entering vehicles, whereas mid-block accident rates should be calculated as accidents per million vehicle miles.

Site Access and Circulation

Access points should be evaluated in terms of capacity, safety and adequacy of queue storage. Access points should be free of all encumbrances and provide appropriate sight triangles. The quality of access as it relates to the internal site circulation will have a direct relationship on the quality of traffic flow in and around the site development, as well as a direct impact on public safety. Proposed access points

should be evaluated with respect to possible mutual interference with other adjacent or opposed access points. Joint access and cross access by two or more properties may be desirable depending upon use.

Site access and circulation analysis shall be conducted and recommendations shall be included in the traffic study to address safe and acceptable traffic operations. The identification of access points between the site and the external roadway system and subsequent recommendation concerning the design of those access points is directly related to both the directional distribution of site traffic and the internal circulation of the facility.

Provisions for appropriate vehicular-exit queuing should be made at all access drives to a development. For small developments, parking areas and access points should be designed so that exiting drivers can align their vehicles perpendicular to the off-site roadway system. For large developments, queuing areas should be sufficient so that vehicles stored at exits do not block internal circulation.

The traffic study should calculate anticipated queues and minimum required throat depth at the project access points. The analysis should also evaluate the proposed site plan for sight distance and other unsafe traffic conditions and provide recommendations to mitigate them. The need to restrict certain movements to avoid conflicts should be assessed. Direct access to arterial roads should be justified in the context of available alternative access opportunities.

Adverse effects of site access on road and transit operations should be identified and appropriate remedial measures identified and evaluated.

The requirements for left-turn and right-turn lanes at the driveway (exiting the site) and on the public roadway at the project driveway (entering the site) should be evaluated. Where appropriate, potential weaving problems should be assessed and evaluated, including the need for acceleration or deceleration lanes, and conflicts with pedestrian and bicycle movements.

Internal circulation should provide access to all areas in a manner understood to drivers. Internal roadways should be marked and signed in accordance with recommendations in the MUTCD. Delivery vehicle/courier loading/unloading facilities and the tracking of design vehicle movements related to access points, circulation roads/aisles, loading docks, and garbage receptacles should be evaluated with respect to location, size and design. Convenient access should be provided to off-street loading facilities to minimize the possibility that pick-up/delivery operation will occur on the public street.

Evaluate the potential for access and circulation movements associated with on-site parking or other activity (such as drive-through service windows) resulting in queues extending onto public streets, or vehicles backing onto public streets.

Describe and evaluate site access provisions for pedestrians and cyclists with particular emphasis on convenient and safe access to transit services.

Sight Distance Evaluation

At each access point and at each intersection where a new road is proposed, the sight distance requirements (intersection, stopping, entering, corner sight distance, etc.) should be determined based

on appropriate standards (City, WSDOT and AASHTO standards), and the availability of sight distance determined from actual field measurements of existing streets or based on subdivision plans for large scale developments. Line of sight triangles for determining sight distances and landscape and/or other restrictions shall be drawn on the site plan. If a deficiency exists, recommendations to improve the deficiency need to be incorporated into the report. Necessary line-of-sight-clearing to insure adequate sight distance should be clearly indicated.

Neighborhood Impacts

Neighborhood transportation impacts are primarily caused by site generated traffic using neighborhood streets as short cuts. This "cut-through" traffic can impact pedestrian safety and community cohesion. Most neighborhoods are sensitive to cut-through traffic and hence an analysis should be conducted (if applicable) to evaluate the neighborhood impacts of the proposed development.

Evaluation of Transit, Bicycle and Pedestrian Facilities

Impacts to non-motorized facilities (including park-and-ride) should be identified, particularly in cases where the development is located in an area with incomplete non-motorized facilities, and/or the existing facilities will be modified by the proposed development.

Evaluate future pedestrian activity associated with the development and related implications for signal warrant calculation and signal timing requirements to provide pedestrian road-crossing opportunities. Of particular interest are pedestrian connections to transit services.

Parking Generation Analysis

In cases where parking is not provided on site, and/or proposed parking is less than recommended by the City of Issaquah, a parking generation study may be required.

Other Special Analyses and Studies

Specific focused traffic analyses and studies may be requested by the City relevant to the proposed development to address issues such as; truck estimates and pavement design, parking impacts (including on-street and off-street and special events), safe school routes, spot speed studies, queue length studies, emergency routes, etc.

Mitigation Identification and Recommendations

This section outlines the process of identification of operational and safety transportation improvements and other measures required to ensure that acceptable and safe operation of the transportation system is maintained.

Project impacts (i.e., capacity, operational, safety, etc.) are measured by comparing "Future without Project" to "Future with project" traffic conditions. For identified impacts, the traffic study must identify and discuss mitigation measures that will be implemented by the proposed development. Mitigation measures should be specific and feasible actions that will improve adverse transportation impacts to acceptable levels of service or safety levels. An effective mitigation measure shall adequately avoid, minimize, rectify, or compensate an impact.

The capacity analysis results, summaries, and software output should be prepared as described in the Operational/Capacity Analysis section of these guidelines.

Potential mitigation measures include:

- Locate access point(s) to optimize visibility/sight distance and reduce potential conflicts. Dedicate visibility easement to assure adequate sight distance at intersections and driveways.
- Addition of travel lanes (left, right, thru, acceleration and deceleration lanes). The report must identify the impacts associated with such a change (right-of-way need and feasibility). All mitigations should be reviewed in the field to make sure that they can be accommodated.
- Increasing the length of turn lanes storage pockets/bays.
- Traffic control modification.
- Upgrade and/or modification of phasing at existing signals.
- Signal timing modification. If signal timing modifications are proposed for an intersection within a coordinated signal system, the entire signal system must be analyzed to ensure that any proposed changes do not cause the entire system or part of the system to fail.
- Provide channelized islands.
- Restriction of project driveway(s) turning movements.
- Installation of traffic signs
- ITS improvements such as CCTV traffic cameras and fiber optic communication equipment
- Transit facilities, such as bus turn-outs, park-and-ride lots, and/or bus stops.
- Design on-site traffic circulation and parking facilities to allow free flow access and to avoid queuing onto public streets. Provide adequate off-street parking in accordance with City Code and ITE Demand statistics.
- Bicycle and Pedestrian Facilities - Provide for access to, from, and through development for bicyclists and pedestrians. Recommend designing bicycle paths, lanes, and facilities; sidewalks, shared use routes, other walkways.
- Reduce or change proposed land use
- Provide transportation demand management (TDM) measures, where feasible. TDM measures include flexible work hours or adjusting shift schedules to avoid peak hours of the adjacent roadways, promoting ridesharing or vanpools, and promoting alternate modes of travel to include bicycles, pedestrians and public transportation. When TDM plans are proposed as mitigation measures, the applicant may be required to submit a report to PWE Transportation to document the success of the program two years after full occupancy of the development.

Maps and graphics shall be included in the report depicting all mitigation measures dealing with roadway, parking and access points. These maps and graphics must be drawn to scale with existing and recommended roadway geometrics dimensioned (e.g., road width, lane width, 95th percentile queue length, etc.). The intent of such graphics is to assist in determining the feasibility of a proposed mitigation. Graphics must include adjacent structures/trees, parking areas, bus stops, pedestrian crosswalks, driveways, etc. All recommended improvements shall meet current City standards.

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

- Timing of short- or long-range network improvements that are already planned and scheduled
- Anticipated time schedule of adjacent developments
- Size and timing of individual phases of the proposed developments
- Logical sequencing of various improvements or segments
- Availability and feasibility of additional right-of-way within the appropriate time frames
- Local priorities for transportation improvements and funding
- Cost-effectiveness of implementing improvements at a given stage of development
- Necessary lead-time for additional design and construction.

All recommended improvements including construction schedule and financing plan should be identified on a summary sheet in this section of the report. In cases where phased development of a project is proposed, a schedule identifying the improvements needed to mitigate traffic impacts at each phase will be required.

Transportation system changes proposed in conjunction with the development or redevelopment proposal must be compatible with other elements of the transportation system and must be warranted, safe, and contribute to more effective and efficient movement of people and goods. Generally, the proponent of a development or redevelopment proposal is financially responsible for transportation improvements reasonably required to accommodate the proposal or to mitigate adverse impacts of the proposal. Normally such changes will be included as conditions of development approval.

Appendix

The following information when applicable should be included in the appendices of the report:

- Site Plan drawn to scale
- Raw traffic count data
- Plots and other applicable information from the Transportation Model runs
- Capacity and Queue calculations (detailed worksheets). Software output must explicitly show all input and phase lengths used in analysis.
- Signal Progression/Arterial Analyses (all input and output)
- Warrant worksheets for signals, all-way stops, right and left-turn lanes, etc.
- Intersection and driveway sight distance (drawn to scale)
- Accident Data
- Additional tables or figures not included in the report
- Maps (drawn to scale) and graphics not contained in the body of the report
- Other relevant supportive information and/or analyses

Appendix C
Synchro Modeling Guidelines

These guidelines are intended to describe the ideal level of detail to be used within Synchro for modeling intersections and corridors. They also provide some of the default values used by City staff when preparing Synchro models.

Map Window

A study street network is drawn to approximate the true corridor layout, with individual intersections located at their Washington State Plane (North Zone) coordinates. The links within the network should be aligned so that through movements at intersections are represented by through movements in Synchro.

Lane Window

A drawing of the existing channelization should be collected in the field, with all turn pocket storage lengths, lane widths, and pedestrian crosswalk distances measured. The City provided Synchro files include all this information. Ideally, the distances from each stop bar to the leading signal detector loops should also be measured. However, as this is not always possible, detector spacing should be determined based on the speed limit as shown on the City of Issaquah Traffic Loop Standard detail sheet.

The grade for each approach should be estimated in the field, although measurements from a topographic map or GIS source are potentially more accurate.

The Lane Utilization Factor needs to be adjusted under special conditions (e.g. merge lanes, dual left-turns, etc.). In this case, the factor can be calculated using the following formula:

$f_{LU} = vg/(vg1*N)$ where vg is total approach volume, vg1 is highest lane volume and N is the number of lanes

If the individual lane volumes are unknown, percentages can be approximated. For example, if a two-lane arterial is widened to five lanes through an intersection, then narrows back down to two lanes, studies have indicated that less than 20% of through-movement vehicles will use the outside lane through the intersection. A Lane Utilization Factor of 0.60 should be used to account for the fact that the outside lane will be underutilized at the intersection.

Any prohibition of right turns on red should be noted.

Future alternative analyses should include channelization dimensions (only if revised or new channelization is proposed) as specified in City of Issaquah Street Standards and/or determined by the traffic study.

Volume Window

For existing-condition models, the existing actual peak hour volumes and conflicting pedestrian and bicycle volumes should be entered. The peak hour factor and heavy vehicle percentage for each approach should be entered from the count sheets.

For future-condition modeling of seven (7) or less years in the future, the existing pedestrian and bicycle volumes, peak hour factors (PHF), and heavy vehicle percentages should be used. However, if the proposed land use development/project will increase the pedestrian, bicycle and vehicular volumes significantly (e.g. pedestrian trails, near a transit center, public schools, shopping centers, etc.) at the intersections, the future estimated pedestrian and bike volumes and a higher PHF (i.e., 0.92, 0.95) should be used for the analysis. For future years beyond seven (7) years, the Synchro PHF default value of 0.92 can be used. If the intersection is expected to become very congested, a peak hour factor of 0.95 should be used.

Bus Blockages – this factor is applicable where data is available. The location of nearby bus stops and the route numbers serving them should be noted when the channelization is collected. Also, the location of adjacent parking spaces and the regulatory signage for those spaces should be noted.

The worst case scenario should be assumed for bus blockages. Every bus serving a given stop during the peak hour should be assumed to stop. Bus route times can be determined by consulting www.kingcounty.gov website.

The number of adjacent parking lanes should be entered, with an appropriate number of parking maneuvers per hour.

Mid-block traffic percentages are usually ignored unless they represent a significant portion of the link volume.

Timing Window

For existing and future built out/full occupancy (7 years or less) conditions analysis, current signal timing sheets or City provided Synchro files should be obtained, and the existing timing appropriate to each studied time period should be coded as closely as possible. The existing phase order, left-turn protection, and right-turn overlap should be based on actual field observation or as shown in City Synchro files.

The protected and permitted phase numbers for each movement should be taken from the signal timing sheets or City provided Synchro files and replicated in the Synchro model. The left-turn protection type and right-turn overlap, if any, should be coded.

If the intersection is running fully actuated, the controller should be set to “Actuated-Uncoordinated” in most cases. If the controller is running coordinated time-of-day plans, set the controller type to “Actuated-Coordinated,” and use the plan that runs during the studied time period to determine the appropriate cycle length and offset. Even if only one intersection is being modeled, it should be coded as if it were part of a coordinated system. Ideally, the entire coordinated corridor should be modeled. City staff will determine which signals should be included in the Synchro model.

The basic timing from the signal timing sheets or the City Synchro model provides the minimum initial, yellow time, and all-red time. It is usually easier to input these values, together with the minimum split, maximum split, lead/lag phase order, vehicle extension, minimum gap, time before reduce, time to reduce, recall mode, walk time, and flash don't walk time in the phasing window. The phasing window lists the timing by phase, which is how it is printed from the controller.

For protected-only left-turn phases, the minimum split time should be at least 13 seconds if the volume is less than 50 vehicles per hour; if the volume is more than 50 vehicles per hour, the minimum split should be at least 15 seconds. For protected-permissive phasing, these times can be lowered by one second. These minimum left-turn split time values may need to be adjusted to accommodate heavy bus and truck volumes. In order to avoid the left-turn "yellow trap" condition, the protected-permissive left-turn phases should always be coded as "Lead" and "Fixed".

For future year (beyond 7 years) analysis, the existing timing should be coded initially, and then optimized if needed. The minimum split time values from the City Synchro files should still be entered in the future years Synchro files. However, if the pedestrian crossing distances/"FDW" values are increased due to pavement widening (e.g. adding a left or a right-turn lane, etc.) or "Walk" time values are increased due to higher pedestrian volumes (e.g. near schools, etc.), the existing minimum split time values should be increased/adjusted and entered in the future conditions Synchro files.

For coordinated signals, the minimum cycle length is 60 seconds and the maximum cycle length is 140 seconds.

The recall mode for the coordinated phases should be set to C-Max. At a few signalized intersections, (i.e., E. Lake Sammamish Parkway/SE 56th Street, Front Street/Gilman Boulevard) as shown in the City Synchro files, we are running dual coordination. Therefore, the additional coordinated phases should be set to "Max". The remaining non-coordinated phases should be typically set to "None" unless shown otherwise in City Synchro files. A recall should not be placed on the minor street or for non-coordinated turning movements.

For future year analysis, a new left-turn phase may need to be added or the existing left-turn phasing may need to be modified due to increased future traffic volumes, etc. The selection of the most appropriate form of left-turn phasing should be supported by an engineering study. Left-turn phasing can be either permissive, protected/permissive or protected. Factors that may be considered in the study include, but are not necessarily limited to, sight distances, traffic volumes, multiple left-turn lanes, intersection capacity analysis (LOS, delay, 95th percentile queue), accident history, posted speed limit, number of opposing through traffic, traffic signal progression, intersection geometric design, maneuverability of particular classes of vehicles, high pedestrian volumes, adequacy of gaps, etc. The appropriate type of left-turn phasing based on the above factors should be coded in future conditions Synchro files.

The reference point for the coordinated City signals is "TS2-1st Green" (reference to first of coordinated phases to turn green) and for the WSDOT SR 900 and Front Street coordinated signals, is "Begin of Red" (reference to the first of coordinated phases to turn red). The reference phases are usually the main

street phases. The City Signal Operations Engineer will determine the coordinated phases for each intersection in the system. The yield point is typically "Single" unless otherwise noted in the City provided Synchro files.

Phasing Window

From the signal timing sheets or City provided Synchro files, enter the minimum initial, yellow time, all-red time, the minimum split, maximum split, lead/lag phase order, vehicle extension, minimum gap, recall mode, walk time, and flash don't walk time, etc. in the phasing window. (Note that the maximum split is not the same as Max 1 Green which is typically used for uncoordinated/free signals. The maximum split also includes the yellow and all-red times.). The maximum split values for uncoordinated/free signals include MAX 1 + Yellow + AR times. The minimum split values for coordinated signals should not be less than Walk + Don't Walk + Yellow + AR + 1.0 second.

The Synchro default values for some of these timing parameters differ in some cases from City of Issaquah defaults. The City defaults that can be used for new signals or modified signals (e.g. adding a left-turn phase, adding a new approach to the intersection, etc.) are as follows:

Minimum Initial:	7.0-10.0 seconds for major movements (major arterials), 5.0 seconds for side streets/minor movements
Yellow Time:	4.0 seconds typical
All-Red Time:	1.0 seconds
Vehicle Extension:	2.0 seconds typical (depends on loop configuration, speed, etc.)
Minimum Gap:	2.0 seconds typical (same value as the vehicle extension)
Walk Time:	7.0 seconds (this value should be increased to 10 seconds higher for high pedestrian volume areas, e.g., schools, sports venues, etc.)
Don't Walk Time:	Based on pedestrian crossing distance (MUTCD requirements)
Max I Time:	40-60 seconds for major arterial
	30-50 seconds for minor arterial
	20-40 seconds for collector, local and driveway
	15-20 seconds for left-turn

The number of "Pedestrian Calls" for each phase should assume that there is a call for each counted pedestrian, unless the count also included the number of actuations or it is located in an area with very high pedestrian volumes (e.g. schools, sports venues, etc.).

Assume "yes" for the Dual Entry variable.