Maryland State Highway Administration

Guidelines for Traffic Impact Reports/Studies

The purpose of a Traffic Impact Study (TIS), prepared for submittal to the Maryland State Highway Administration (SHA), is to review impacts of a proposed development on the State Highway System, generally in conjunction with the issuance of an access permit. The authority to require a TIS and related road improvements is found in COMAR Section 11.04.05. The evaluation shall consider traffic capacity, signalization, safety, and multimodal issues. This report will be used to evaluate the needed improvements to support the proposed site access to the State Highway road system.

Many counties/jurisdictions have established traffic impact study guidelines which outline their requirements for report preparation. In cases where County/jurisdiction guidelines are available, SHA recommends that all guidelines and procedures established by those counties/jurisdictions be fulfilled. In circumstances where SHA determines the potential for a significant roadway safety/operational concern that cannot be adequately addressed through County/jurisdictional guidelines, and an SHA Access Permit is needed, the following supplemental guidelines and procedures established by SHA for traffic impact study report preparation and traffic mitigation must be met. For those counties/jurisdictions that have not established their own traffic impact study guidelines, and an SHA Access Permit is needed, only SHA's traffic impact study guidelines and procedures are to be followed.

A TIS is required for any proposed development or redevelopment that generates more than 50 peak hour trips, or that is expected to directly impact traffic operations on the State road(s). In general, the TIS will analyze the site access to the State road. The extent of the required study area to be included in the analysis will be based on the maximum peak hour trips generated by the proposed development. Site specific issues and/or conditions, such as the presence of a signal system, adjacent signalized intersections or interchanges just outside of the study area, and/or other constraints may result in the addition or exclusion of the study area discussed above. These site specific issues, as well as the appropriate study area, should be discussed and established during the initial scoping meeting for the TIS. Participants in the scoping meeting should include engineers/planners from SHA, the applicable County/Counties, any local jurisdictions, and the developer/developer's consultants.

SHA should be involved from the initial scoping meeting or process for a proposed development to discuss site specific criteria, including but not limited to: study area, site and background trip generation, analysis time frame, and analysis methodology. Ideally, such discussions should occur in cooperation with the appropriate County/local jurisdiction, with any subsequent updates

provided to all parties. A scoping agreement form should be completed and submitted to the appropriate representatives of SHA's District Office. The purpose of this agreement will be to document the discussion held during the scoping meeting (e.g. determining site specific criteria for the development, including but not limited to: study area, trip generation, analysis time frame).

The TIS must evaluate traffic operations within the study area based on existing conditions, background traffic, and total traffic conditions. The TIS must identify traffic operational deficiencies and propose mitigation to any development generated impacts in the deficient areas. This should include identifying any queuing, storage, blockage, delay, weaving, merging, diverging, or safety issues. Mitigation must be proposed to address these issues. Mitigation must also be proposed to address any overall intersections or movements operating below LOS D, when the study indicates background conditions operate at acceptable levels of service (LOS D or better). Mitigation proposed must address the impact of the proposed development when background conditions indicate substandard Levels of Service exist.

SHA's role in the Traffic Impact Study process includes, but is not limited to, the following actions:

- Participation in the initial scoping process to discuss site specific criteria

- Ensuring that mitigation proposed as part of the Traffic Impact Study meets the requirements established in the corresponding County's/jurisdiction's Adequate Public Facilities Ordinance (APFO) and/or in this document, prior to approval of the Traffic Impact Study

- Ability to provide approval of the submitted Traffic Impact Study when all applicable requirements have been satisfied.

It should be noted that SHA approval of a Traffic Impact Study pertains to the analysis of a development's proposed traffic impacts on the surrounding roadway network and any required mitigation within SHA right-of-way. Final approval of the proposed access concept will be determined as part of the Access Permit plan review process.

A Traffic Impact Study Report should include the following information:

- Table of Contents

- Introduction

    - Explanation of Project/Purpose of Report
    - Area Map showing site location (including any new proposed access points or use of existing access points)
    - List and area map of intersections included in the analysis
    - Brief description of key roadway and roadside characteristics (e.g. roadway classification, cross-section, posted speed limit, non-motorized access)
    - Mile point of the development along the road of the primary access point
    - Land use for the proposed development
    - Forecasted total trips entering and total trips exiting the site due to the proposed development
    - Proposed build out year to be used

- Existing Conditions

    - Traffic counts & analysis
    - Existing lane configuration sketch
    - Existing operations relating to the study area; these will include traffic operations, but may also include pedestrian, bicycle, and transit operations

- Background Conditions, without site

    - Annual growth in traffic to build year, if appropriate, as stipulated by the scoping letter
    - Traffic generated by other approved, but currently unbuilt, developments
    - Background Analysis (Background Traffic = Existing Traffic + Growth in Existing Traffic + Approved Development Traffic)
    - Background analysis with approved/funded highway projects, including possible pedestrian, bicycle, and transit operations, as needed

- Projected Conditions, with site

    - Traffic generated by the proposed development (i.e. site generated traffic) at build out, and/or at any significant phase/stage of development
    - Total Traffic Analysis (Total Traffic = Existing + Growth + Approved Development + Site Generated)

    - Analyze total traffic with improvements, including possible pedestrian, bicycle, and transit operations, as needed

- Conclusions/Recommendations

    - Explain results of analysis
    - If found to be needed, the consultant/developer should suggest improvements to mitigate the site traffic impacts, either in the TIS or under a separate mitigation proposal, and provide analysis results of these mitigations

- Appendix

    - All analysis and calculation work sheets, traffic related data, and pertinent correspondence, including approved scoping agreement form

Any operational modeling files (e.g. Synchro/SimTraffic, VISSIM files) used or developed for the Traffic Impact Study must be submitted electronically in conjunction with the report.

A summary of the Traffic Impact Study Guidelines to be used to develop the project study area, identify potential traffic operational analysis tools, and determine appropriate traffic mitigation strategies is shown in Table 1:

Table 1: Traffic Impact Study Guidelines – Overview Summary

Type of Development	Peak Hour Trips Generated	Study Area*	Typical Operational Analysis Tools - Examples	Mitigation
Small	50-100	1. Site access driveways 2. All intersections involving at least two state highways and all intersections of a state highway and a county/local collector (or higher functionally classified roadway), within a ¼ mile radius of outermost site access driveways	1. CLV 2. HCS 3. Synchro/SimTraffic 4. SIDRA 5. Other as needed	1. Developer generated impacts for any intersection movements operating below LOS D. 2. Any storage or blocking issues caused by the development. 3. Any merge, diverge, weaving issues caused by the development.
Medium	101-750	1. Site access driveways 2. All intersections involving at least two state highways and all intersections of a state highway and a county/local collector (or higher functionally classified roadway), within a ½ mile radius of outermost site access driveways	1. CLV 2. HCS 3. Synchro/SimTraffic 4. SIDRA 5. VISSIM 6. Other as needed	1. Developer generated impacts for any intersection movements operating below LOS D. 2. Any storage or blocking issues caused by the development 3. Any merge, diverge, weaving issues caused by the development.
Large	> 750	1. Site access driveways 2. All intersections involving at least two state highways and all intersections of a state highway and a county/local collector (or higher functionally classified roadway), within a minimum 1 mile radius of outermost site access driveways	1. CLV 2. HCS 3. Synchro/SimTraffic 4. SIDRA 5. VISSIM 6. Other as needed	1. Developer generated impacts for any intersection movements operating below LOS D. 2. Any storage or blocking issues caused by the development 3. Any merge, diverge, weaving issues caused by the development.

*During the scoping meeting, any site specific issues/conditions, such as the presence of a signal system, adjacent signalized intersections just outside of the study area, any specific unsignalized intersection(s), any relevant freeway segments or interchange ramps, and/or other constraints, should be discussed to determine the appropriate study area for an individual project. This may result in addition or exclusion of study intersections and roadway segments per the above table, but would result in a study area that accurately captures the impact of a proposed project.

The following is a more detailed explanation of the various aspects involved in preparing the report:

- **Study Area**

    - The extent of the study area to consider in the traffic operational analysis is to be based on the peak hour trips generated by the proposed development. Table 1 provides a tiered approach to determining the study area.

    - During the scoping meeting, any site specific issues/conditions, such as the presence of a signal system, adjacent signalized intersections just outside of the study area, any specific unsignalized intersection(s), any relevant freeway segments or interchange ramps, and/or other constraints, should be discussed to determine the appropriate study area for an individual project. This may result in addition or exclusion of study intersections per the above table, but would result in a study area that accurately captures the impact of a proposed project.

- **Existing Traffic**

    - Turning movement counts are to be performed at each intersection to be analyzed, if current turning movement counts are not available.

    - Counts should, as a rule, not be more than 1 year old from the date of study publication. Counts between 1 and 2 years old may be used if factored to the current year. Counts older than 2 years will not be accepted. As part of the scoping agreement, updated traffic counts may be requested in locations where significant background development has been completed within the last 2 years, and/or where traffic volumes are expected to have varied significantly within the last 2 years.

    - Peak hour counts are acceptable at intersections, generally between 7-9 AM and 4-6 PM. Expanded hours or different time periods may be determined as part of the scoping agreement (e.g. 11am - 2pm Saturday count at a shopping center) when the development would be expected to generate a significant level of traffic outside of the traditional weekday peak periods. All intersection counts are to include pedestrian and bicycle counts as well.

    - 13-hour turning movement counts are to be performed at any intersection where it is anticipated that a new traffic signal may be needed.

- The most recent traffic volume counts (within 1 to 2 years maximum), whether by SHA, consultant or local jurisdiction, may be used for the study, unless local conditions dictate that counts be taken during a specific period of the year (e.g. summer traffic counts on roadways significantly impacted by summer tourist traffic).

- Counts are not to be taken on or within 2 business days of State or Federal holidays, with the exception of Christmas Day and New Year's Day. Counts are not to be taken during the period beginning 5 business days prior to Christmas Day, through at least 2 business days after Martin Luther King, Jr. Day. Standard weekday counts must be taken on Tuesdays, Wednesdays, or Thursdays, and under normalized conditions (fair weather, limited to no roadway construction, etc.).

- The presence of schools in the area must be considered when determining the date of counts. SHA reserves the right to determine if counts must be taken while local schools are in session.

- Other existing traffic data to be collected may include queuing and travel time data (in the field), peak hour observations (AM, PM, and/or Midday), pedestrian, bicycle, and transit facilities, signal timings, classified vehicular counts (e.g. for facilities with a high truck percentage), etc. These requirements need to be discussed during the scoping meeting for each individual project on a case-by-case basis.

- All existing traffic data collected or obtained from any agency (e.g. queuing data, travel time data, peak hour observations, pedestrian, bicycle, and transit facilities data, signal timings, etc.) must be included in the appendices of the TIS report.

- All existing traffic data collected or obtained from any agency (e.g. queuing data, travel time data, peak hour observations, pedestrian, bicycle, and transit facilities data, signal timings, etc.) shall have a statute of limitations of two years from the time of collection. If a Traffic Impact Study does not reach the review stage and/or is not approved within the two year period, SHA reserves the right to request updated data collection and analysis. SHA also reserves the right to request updated data and analysis if significant development occurs within the study area that was not previously considered or was not previously open to traffic, or if geometric or operational changes to the roadway network were performed.

- **Traffic Analysis**

  Analysis Methodologies

  - All intersections will be analyzed using the SHA critical lane volume (CLV) technique and factors; however, CLV is a sketch level planning tool ideal for quick capacity calculations under isolated conditions. This tool has drawbacks that make analysis using alternative tools imperative. Alternative tools to be used for more detailed analysis along with CLV are based on the following standards:

    - Synchro/SimTraffic must be used to analyze all interrupted flow facilities (local streets, collectors, arterials, etc.). Highway Capacity Manual (HCM) methodologies within the software are to be used to report various Measures of Effectiveness (MOEs), including Level of Service (LOS), intersection delay, and volume to capacity ratio for each intersection, and/or for particular turning movements at each intersection. SimTraffic queues are to be used to report 95th percentile queues. Existing calibrated Synchro/SimTraffic files developed by SHA should be used when available.

    - SIDRA Intersection may be used to analyze roundabouts only; however, VISSIM (or a comparable advanced traffic microsimulation tool) must be used to analyze roundabouts that are in close proximity to adjacent intersections and/or have upstream or downstream operational impacts in the study network.

    - Highway Capacity Software (HCS) may be used to analyze all uninterrupted flow facilities (basic freeway segments, merge, diverge, and weaving segments); however, VISSIM (or a comparable advanced traffic microsimulation tool) must be used to analyze uninterrupted flow facilities that are in close proximity to adjacent intersections and/or have upstream or downstream operational impacts in the study network.

    - HCS may also be used to analyze isolated unsignalized intersections in rural areas.

    - In circumstances where an analysis tool or methodology exhibits the capability of evaluating operational and safety impacts due to non-motorized modes of travel (e.g. pedestrians and bicycles), SHA reserves the right to require the traffic analysis to adequately incorporate these non-motorized impacts on study intersections and/or the study roadway network.

Evaluation of non-motorized modes of travel will be discussed during the scoping meeting,

- In special cases, after discussion during the scoping meeting, VISSIM (or a comparable advanced traffic microsimulation tool) analysis of the entire study network may be required.

- In special cases where the development type is categorized as "Small," per Table 1 above, it is possible that microsimulation analysis would not be necessary. Such scenarios and analysis requirements can be discussed during the initial scoping process.

Calibration Standards for Synchro/SimTraffic Based Analysis

- If a microsimulation model is used in the analysis, the model must be calibrated for existing conditions. When available, SHA microsimulation models are to be used. Common calibration requirements and techniques for the Synchro/SimTraffic software are provided below:

  - In order to ensure a reasonable representation of traffic conditions that would be expected with a background and/or proposed development in place, it is necessary to first calibrate the Synchro/SimTraffic model to existing conditions for the AM, PM, and occasionally, weekend peaks.

  - An existing Synchro file must be calibrated before any "Build" Synchro file can be created and analyzed.

    Common data needed for Synchro model calibration includes travel time runs (at least five runs per direction during the AM and PM peak periods on a typical traffic day, usually Tuesday, Wednesday, or Thursday), which provide observed conditions regarding vehicular speeds and delays throughout the corridor. Travel time runs must be taken for the mainline movements along major roadways (e.g. MD routes) within the study area, and/or for additional movements. The extent of the travel time runs necessary, or if alternative methods/data can be used, can be discussed at the scoping meeting.

  - Model seeding time must allow a car to travel from one end of the network to the next; customary simulation seeding times span from 900 seconds (15 minutes) to 1,800 seconds (30 minutes). Longer seeding times may be considered for

excessively large networks or high congestion. Recording time must be at least one hour for each peak, and must account for the peak hour factor.

- A minimum of 5 model runs must be completed before average outputs of all runs can be used for analysis. Additional runs may be necessary, up to 15 runs.

- Observations must also be made (preferably during the same day as the travel time runs, but as a separate effort) at each study intersection and along the study corridor that document vehicular queues for each turning movement.

    - Queues should be observed over a couple of signal cycles at least, and queue lengths should be recorded for each turning movement.

    - Noting where queues are excessive (e.g. spill out of the turning bays, extend beyond the turning bays and to an adjacent intersection) can provide valuable information when calibrating the microsimulation model.

- It must be determined whether or not adverse traffic operations (e.g. excessive queues, delays) that are known to occur outside of the study roadway network adversely affect operations within the Synchro study network.

    - If adverse outside operations do impact the roadway network, it is important to incorporate these impacts into the Synchro model; otherwise, the Synchro model developed may reflect conditions that are more optimistic than actually observed.

- Simulation travel time (from SimTraffic) is to be within 10% of observed travel time by roadway segment, by direction (e.g. from one major signalized intersection to another, by direction), and within 5% of overall observed travel time by corridor as a whole (by direction).

- Simulation turning movement queues must reasonably reflect queues observed in the field. This includes left, through, and right turn queues at every approach of every major intersection included in the Synchro roadway network.

Calibration Standards for VISSIM Based Analysis

- Common calibration requirements and techniques for VISSIM microsimulation software is provided below:

    - Two calibration approaches are required of all VISSIM models

        - Travel time and/or speed
        - Vehicle throughput

    - Seeding time must allow a car to travel from one end of the network to the next; customary simulation seeding times span from 900 seconds (15 minutes) to 1,800 seconds (30 minutes). Longer seeding times may be considered for excessively large networks or high congestion.

    - A minimum of 5 runs must be completed before average outputs of all runs can be used for analysis. Additional runs may be necessary, up to 15 runs.

    - Calibration of the network using travel times or speed must use short segment data, rather than overall corridor travel time/speed. A maximum of a ± 10 percent variation is permitted for small segments no more than 1 mile long.

    - For a facility spanning more than 1 mile, it is recommended to break the facility into segments based on obvious breakpoints (e.g. between signalized intersections, or at ramps). These new smaller segments would then be calibrated at ± 10 percent variation with an overall corridor calibration of ± 5 percent. On a facility longer than 1 mile without obvious breakpoints (e.g. between freeway ramps), the FHWA standard of ± 10 percent is considered appropriate.

Measures of Effectiveness to Report

- For Synchro/SimTraffic:

    - Highway Capacity Manual (HCM) methodologies within the software may be used to report various Measures of Effectiveness (MOEs), including Level of Service (LOS), intersection delay, and volume to capacity ratio for each intersection, and/or for particular turning movements at each intersection.

- In certain circumstances, as discussed during the scoping meeting, arterial LOS will be required for major roadway segments, by direction, within the study area.

- 95th percentile queues for all turning movements at each study area intersection (using SimTraffic simulation outputs). Please note that SimTraffic does not have the capability to directly report queue lengths that significantly exceed the link on which queues originate, or those that exceed available storage bays. Queues provided in the SimTraffic Queuing Report that appear to reach or slightly exceed the link or storage bay lengths (usually up to 75 feet greater than the link or storage bay) must be verified by observing the SimTraffic simulations to determine the actual queue length. An alternative methodology would involve gradually increasing the available storage bay length to determine the actual queuing demand. In the case of through queues, subsequent bend node queue lengths are to be added to the origin link reported queue lengths to determine the total queue.

- In circumstances where 95th percentile queues for a particular turning movement block access to an adjacent travel lane (e.g. through queues blocking access to a right or left turn bay, left or right turn queues blocking access to a through lane), Percent Blocking times for 95th percentile queues must be reported (using SimTraffic outputs).

- Network performance measures of effectiveness (using SimTraffic simulation outputs)

    - Network overall delays
    - Network overall travel times
    - Latent vehicles (“vehicles denied entry”)

- For VISSIM:

    - Simulated travel times and speeds for each major roadway segment. A major roadway segment typically consists of a section of roadway between two major signalized and/or unsignalized intersections.

    - Maximum queue lengths for each turning movement of each study area intersection.

        - Intersection LOS, based on HCM methodology and thresholds (calculated from node delay)

        - Diverge, merge, and/or weave densities and corresponding LOS (if applicable to the study area). LOS must be calculated, based on HCM thresholds.

        - Network performance measures of effectiveness

            - Network overall delays
            - Network overall travel times
            - Latent vehicles ("vehicles denied entry")

    - In study areas where a large number of pedestrian and/or bicycle traffic is expected to be present, pedestrian and bicycle delay, as well as pedestrian and bicycle LOS, is required for all crosswalks within the study area. Requirements for providing these MOEs will be discussed during the scoping meeting.

    - If microsimulation software tools are used to perform an analysis that involves signalized intersections, submission of existing signal timing phase diagrams (hard copy or digital) will be required.

    - Any operational modeling files (e.g. Synchro/SimTraffic, VISSIM files) used or developed for the Traffic Impact Study must be submitted electronically in conjunction with the report.

    - In the event that analysis results from the alternative tool differ from the results obtained from the CLV analysis, the results that yield the greatest detrimental impact to users of the roadway within the study area will be used. Justification should be included as to why a particular analysis tool was chosen for the study area. The MOEs from the alternative tools must be summarized, rather than only given in raw output form.

- **Trip Generation**

    - Local trip generation rates should be used. If local rates are not available, the latest ITE *Trip Generation Manual* should be used. In the event ITE does not address the development, or is of a limited sample size, studies of similar uses may be used. Documentation of these studies should be submitted for verification during the scoping agreement process and be included in the TIS report.

- When information is not contained in the ITE *Trip Generation Manual*, engineering judgment should be used in establishing trip generation assumptions and explained in the TIS report.

- An existing development may be considered as trips generated only if the development was fully in use at the time the traffic counts were performed. Such a scenario may apply to situations where an expansion of an existing development/site is being proposed.

- **Growth in Existing Traffic**

  - Growth in existing traffic is described as a factor representative of travel growth through the study area associated with regional traffic growth. This factor should be applied to the existing through traffic, and appropriate turning movements, before approved development traffic is applied. The volume should be compounded to the reasonable build out years, typically 3-10 years, depending on the build out schedule.

  - Growth rates used in the study must be provided by and/or approved by SHA's Travel Forecasting and Analysis team and/or by the local agency during the scoping process.

  - Using growth rates to forecast build-out year traffic for large developments (developments generating more than 750 peak hour trips) is not the proper approach. Developments of this size require use of either the local Metropolitan Planning Organization (MPO) forecasting models or SHA's statewide model to forecast traffic through the study area. The proper model to use will be discussed during scoping.

- **Approved Development Traffic**

  - Approved development traffic is described as traffic generated by all approved developments within the area at the time of the report preparation. Developments outside of the area are considered to be accounted for with the Growth in Existing Traffic noted above. These sites can be obtained from the local jurisdiction and should be documented in the TIS.

  - For large developments with extended build out periods (5 years+), the full impact of the development on the road system may not be required. However, the impact of this development corresponding to the build out of the proposed development will be necessary. Prior

approval for background build out assumptions is required by SHA as part of the scoping agreement process.

- **Background Analysis**

    - Background analysis includes existing traffic, plus growth in existing traffic, plus approved developments. This analysis should take into consideration all transportation improvements expected to be in place within the study area by the proposed development's build out year. These improvements should include those which are already programmed or funded by the state or local jurisdiction. For any background development included in the TIS, its approved off-site road improvements should be included.

    - Any improvement suggested as being implemented by "others" should indicate by whom. If funded by a public agency (e.g. the SHA, the Consolidated Transportation Program (CTP) or local jurisdiction), then a copy of the page from the appropriate document should be included in the report. If funded by another developer, then documentation should likewise be included.

- **Site Conditions – Trip Generation**

    - Local trip generation rates should be used. In the absence of available local rates, the latest ITE *Trip Generation Manual* rates should be used.

    - If using the latest ITE rates, ITE's latest edition *Trip Generation Handbook: An ITE Recommended Practice* is to be used to estimate the appropriate trip generation for the proposed development site. Section 3.3 of the *Handbook* provides guiding principles for the approach to follow, and is summarized below:

        - Trip generation can be estimated through use of a regression equation or a weighted average rate.

            - Use of the regression equation is recommended when:

                - A regression equation is provided

                - The independent variable is within the range of surveyed data

        - Either the data plot has at least 20 data points or the regression equation has an R^2 value greater than or equal to 0.75, the regression equation falls within the data cluster in the plot, and the standard deviation is greater than 110 percent of the weighted average rate.

    - Use of the weighted average rate is recommended when:

        - At least three data points are available.

        - The independent variable is within the range of surveyed data.

        - The standard deviation is less than or equal to 110 percent of the weighted average rate.

        - The regression equation has an R^2 value less than 0.75, or no equation is provided.

        - The weighted average falls within the data cluster in the plot.

- SHA is currently in the process of developing a formal policy regarding Transit Oriented Development (TOD) guidelines, including requirements for a TOD designation. A more definitive TOD standard is expected in the future. At this time, developers seeking to receive TOD credits will be considered on a case by case basis.

- **Site Conditions – Trip Distribution**

    - Discussion of the assumptions behind the distribution of generated trips (both site and approved background development) must be provided. The methodology to be used should be discussed at the scoping meeting. For large developments (those generating more than 750 peak hour trips), local MPO models or SHA's statewide model should be used to identify site trip distribution percentages on roadways within the study area.

- **Site Conditions – Trip Assignment**

    - Trips generated by the site will be assigned to the roadway network based on the defined trip distribution and existing travel patterns.

- **Projected Conditions**

    - Site traffic is described as traffic which will be generated by the development.

    - Total traffic is to be calculated after the site traffic is projected.

    - If the proposed site development is to be phased, earlier phases shall not be analyzed as "background" generated trips for subsequent phase traffic impact studies. Site generated trips from earlier phases must be considered as part of the total site trips generated for subsequent phase traffic impact studies.

    - After total traffic is developed, an analysis of traffic operations, with projected future roadway improvements in place (e.g. improvements addressed in the background analysis), is to be performed.

      After the analysis of total traffic is completed, the following information must be identified:

        - All intersections and intersection movements within the study area resulting in a Level of Service worse than "D".

        - All study intersection turning movement queues (e.g. left turn, right turn, and through queues) (95^{th} percentile queues for Synchro/SimTraffic; Maximum queues for VISSIM). Queues are to be listed for Existing, Background, and Total, as well as the available storage length for each movement.

        - In certain circumstances, any arterial segment (by direction), diverge, merge, weave, and/or freeway segment (by direction) with a LOS "E" or "F" within the study area.

        - In certain circumstances (such as particular microsimulation analysis, as determined by SHA), the overall roadway network delay, overall network travel time, and latent demand ("vehicles denied entry").

        - In areas with a large pedestrian and/or bicyclist presence, any expected degradation in pedestrian or bicycle LOS or delay.

- **Conclusions/Recommendations**

    - Any intersections and intersection movements shown not to meet the minimum overall “D” Level of Service must be addressed. For roundabouts, entry lane movements with volume to capacity ratios exceeding 0.85 must also be addressed. Mitigation may be proposed as part of this report, and must improve overall intersections and intersection movements to a “D” level of service if the study indicates background conditions operate at acceptable levels of service (e.g. Level of Service “D” or better). For roundabouts, mitigation must also improve any entry lane volume to capacity ratio to 0.85 if the study indicates background conditions with corresponding volume to capacity ratios of 0.85 or less. Improvements proposed must mitigate the impact of the proposed development if background conditions indicate substandard Levels of Service exist. For roundabouts, improvements proposed must also mitigate the impact of the proposed development if background conditions indicate substandard volume to capacity ratios exist for entry lane movements.

    - Any 95th percentile (for SimTraffic outputs) or Maximum (for VISSIM outputs) study intersection turning movement queues (including through queues) that exceed available storage bays or otherwise block access to major commercial and residential access points within the study area, due to the presence of the projected development, must be mitigated. Improvements may be proposed as part of this study. SHA reserves the right to require additional mitigation if the total traffic resulting queues are perceived to present a safety concern for roadway users.

    - Any arterial segment, diverge, merge, weave, and/or freeway segment within the study area shown not to meet the minimum “D” Level of Service must be addressed. Improvements may be proposed as part of this report, and must improve segments, diverges, merges, and weave areas to a “D” Level of Service if the study indicates background conditions operate at acceptable levels of service. Improvements proposed must mitigate the impact of the proposed development if background conditions indicate substandard Levels of Service exist.

    - Increases to the overall network delay, overall network travel time, and latent demand parameters as a result of the proposed development must be addressed. Improvements proposed as part of this report must mitigate any degradation in value of any of the parameters beyond that established under background conditions.

- Improvements should be proposed that will accommodate adequate pedestrian and bicycle access to the proposed development, as stated in COMAR Section 11.04.05.

- In circumstances where analysis results from the alternative tool/methodology differ from the results obtained from the CLV analysis, the results that yield the greatest detrimental impact to users of the roadway within the study area will be used.

- In circumstances where the impact of the proposed development or phased developments on roadway operations is expected to be minor (as determined by SHA), and required mitigation would be impractical (e.g. extension of a storage bay by less than 25 feet), SHA reserves the right to require the cooperation of one or several proposed developments in or near the study area to develop mitigation strategies that address the cumulative traffic operational impact of these developments.

- *In circumstances where the impact of the proposed development or phased developments on roadway operations is not commensurate with the mitigation required (as determined by SHA), and the opportunity to establish the cooperation of one or several other proposed developments in or near the study area to develop mitigation strategies is not feasible, SHA reserves the right to determine a reasonable mitigation strategy.

- *In circumstances where required traffic mitigation in the form of "traditional" roadway improvements (e.g. mainline roadway corridor widening) is not feasible or compatible with local jurisdiction strategic transportation plans (as determined by SHA), SHA reserves the right to consider alternative congestion mitigation strategies, such as Active Traffic Management and Intelligent Transportation Systems strategies, and/or non-motorized improvement strategies. Alternative strategies will be considered by SHA on a case-by-case basis.

- If mitigation is not included in the report but is deemed necessary according to the requirements listed above, a supplemental mitigation proposal must be submitted and approved prior to the traffic impact study being deemed complete.

- If a traffic signal is to be proposed, then a signal warrant analysis must be performed in accordance with SHA's warrant analysis procedures, and be included in the report. Considerations such as turning phase analysis, special operations (e.g. flashing signals) and pedestrian and bicycle accommodations should be documented as well. After review of this analysis, SHA may require additional study, including exploring

other alternatives to signalization, before reaching a final determination as to the need for a signal. Meeting of a signal warrant(s) does not automatically guarantee SHA approval of a new signal. All new traffic signal proposals (or other mitigation) must follow SHA's established approval procedures.

- If improvements are noted in the study, there must be some discussion of the feasibility of constructing any recommended improvement. While detailed construction plans are not expected, some discussion of any obvious constraints is necessary, including right of way, structural, utilities, and environmental impacts.

- If improvements are noted in the study, a final analysis of the study area must be performed to include any recommended improvements.

POLICY: CRITERIA FOR EVALUATING MULTI-JURISDICTIONAL IMPACTS OF PROPOSED ACCESS PERMITS

Applicants for SHA highway access permits that are substantial in scope, in close proximity to adjacent counties or municipalities, or when it is determined that the local Adequate Public Facilities Ordinance (APFO) is not adequate in evaluating and addressing necessary improvements, shall include regional impacts on the State's highway system in the required traffic impact studies beyond the jurisdiction of location. County and/or municipal boundaries cannot be the determining factor for where traffic impacts will be evaluated and mitigated.

When a proposed access point meets the following criteria, a regional traffic impact study shall be required:

- If the local APFO or other public infrastructure tool does not consider the traffic impacts of development beyond the jurisdiction of origin, and

- If the access point is within the following radial distances, based on development size, from an adjacent County or municipality:

    - ¼ mile for a small development
    - ½ mile for a medium development
    - 1 mile for a large development

A development's size is determined by the number of peak hour trips expected to be generated by the development, based on local trip generation rates or the latest version of the ITE *Trip Generation Manual*:

- Small Development: 50 – 100 Peak Hour Trips
- Medium Development: 101 – 750 Peak Hour Trips

- Large Development: > 750 Peak Hour Trips

The specific impact area to be considered in the multi-jurisdictional traffic impact study shall be defined at the scoping meeting with the applicant, applicant's traffic engineer, State Highway Administration, and affected local jurisdictions. The multi-jurisdictional traffic impact study shall follow the methodology of the local APFO for the jurisdiction of origin, or the SHA traffic study methodology if an APFO does not apply, or in circumstances where SHA determines the potential for a significant roadway safety concern that cannot be adequately addressed through County/jurisdictional guidelines. The multi-jurisdictional traffic impact study will need to account for planned development in adjacent jurisdictions. If the development has multimodal aspects (including but not limited to rail and bus transit), The Maryland Department of Transportation shall provide support.