TRAFFIC IMPACT STUDY GUIDELINES

Vertmont Agency of Transportation
Policy and Planning Division
Traffic Research Unit

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INTRODUCTION

I Traffic Impact Study Definition

A Traffic Impact Study is an evaluation of the congestion and safety effects of a particular development on its surrounding and supporting transportation infrastructure. It is performed to ascertain if a development will have an adverse impact on that infrastructure and, if so, how that impact can be mitigated. The current Vermont Agency of Transportation (VTrans) practice is one of not participating in the costs for any mitigation measures.

II Purpose of the Traffic Impact Study Guidelines

The VTrans Traffic Research Unit is charged with the review of Traffic Impact Studies for proposed development in the State of Vermont. This document is provided as a guideline for Traffic Engineers preparing Traffic Impact Studies to address the traffic impacts that development projects have on the ability of the transportation infrastructure to handle those projects' demands. It is also provided as a reference for the Traffic Research Unit and other professional(s) reviewing such analyses.

The information contained herein is meant to serve as a guide in the development of Traffic Impact Studies. It should not be construed as all inclusive regarding every conceivable situation or technical application. It does not preclude the requesting of additional supporting information. It is assumed and expected that those performing these types of analyses are educated in and experienced with the literature and methodologies referenced and will exercise good engineering judgment in reaching meaningful and reasonable conclusions.

III Recommended References

In addition to this guideline, it is recommended that Traffic Engineers preparing Traffic Impact Studies also consult the Institute of Transportation Engineer's Proposed Recommended Practice Transportation Impact Analysis for Site Development (ITE, 2006). The discussions of many aspects of preparing Traffic Impact Studies, especially those labeled "Caution" and "Guidance," within the Proposed Recommended Practice are excellent.

IV Large Complex Developments

In the case of large complex developments, preliminary discussions with the Traffic Research Unit are recommended. Such issues as Trip Generation assumptions, geographic scope of study or VTrans' or local concerns should be dealt with. The areas of agreement should be documented. Any changes that occur due to changed circumstances should be documented, also. On smaller studies, phone calls or e-mail may suffice to answer any questions.

V Departure from Traffic Impact Study Guidelines

Occasionally, Traffic Engineers engaged in preparing Traffic Impact Studies wish to depart from the standards set forth in these Traffic Impact Study guidelines. Such departures should be discussed beforehand with the Traffic Research Unit and be documented thoroughly in the Traffic Impact Study, including appropriate data collected.

VI Variables for Estimating Trip Generation Rates

Data collected by the Institute of Transportation Engineers (ITE) indicate that Traffic Impact Studies, as currently required by jurisdictions throughout the country, commonly use the following variables (among others) to determine when the generated trips[1] trigger a requirement for a traffic impact analysis:

- Specified number of peak hour trips
- Specified number of daily trips
- Specified number of dwelling units or square footage

There is little consistency in specific threshold quantities among various states' guidelines for the first three criteria.

The Agency's review staff exercises the discretion to determine the most appropriate variable(s).

VII When is a Traffic Impact Study Required?

Generally, a traffic impact study should be considered when the proposed development generates 75 or more peak hour trips directly accessing the State Highway System[2]. Usually, the peak hour is considered to be the peak hour of adjacent street traffic. This normally occurs on weekday evenings during the journey from work to home. However, some land uses so dominate traffic that the peak hour may occur during the morning commute time. Near large retail areas, the Saturday peak hour may represent the peak hour of the week. In winter resort areas, the peak hour may occur on Fridays in the evening, on Saturdays during the day or on Sundays in the afternoon. Determining the peak hour requires knowledge of the proposed land use and of local traffic patterns.

In addition to peak hour considerations, there are situations where VTrans may set a higher or lower threshold depending on such factors as directional distribution, peak hour of the generator or existing traffic conditions. In addition, VTrans normally expects that the geographic scope of the study includes the immediate access points, those intersections or highway segments receiving 75 or more project generated peak hour

[1] "A trip or trip end is a single or one direction vehicle movement with either the origin or the destination (exiting or entering) inside a study site. For trip generation purposes, the total trip ends for a land use over a given period of time are the total of all trips entering plus all trips exiting a site during a designated time period", Source ;- Institute of Transportation Engineers Trip Generation 7th Edition, Volume 1 of 3, User's Guide, page 11.
[2] This could be A.M., P.M., or weekend peak hour trips, depending upon use. The specific number of trips (75) is based on 19 V.S.A. Ch. 11 § 1111.

trips, and those intersections or highway segments that may fail[3] as a result of the development.

Furthermore, VTrans may request a Traffic Impact Study in additional instances, such as when a development occurs in a sensitive[4] area or when financial assessments are required and the extent of impact must be determined.

Developments requiring a Traffic Impact Study come to the attention of the Traffic Research Unit from several different sources:

- Applications for Access Permits in accordance with 19 VSA Chapter 11 § 1111
- Act 250 Weekly Agenda of recent applications for an Act 250 permit
- Local Municipalities
- Regional Planning Commissions

VIII Traffic Impact Study Request Protocol

Whenever a project requires a Traffic Impact Study, the VTrans Traffic Research Unit will request the study directly from the applicant or through Act 250 via an Entry of Appearance. Alternatively, the VTrans Utilities and Permits Unit may request a study from the applicant as part of the access permit process and then forward the study to the Traffic Research Unit for review.

[3] In general, those intersections or highway segments experiencing LOS "F."
[4] The term "sensitive" refers to safety, traffic congestion, the environment, historical areas, development pressure or any other, similar "sensitivity."

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TRAFFIC IMPACT STUDY ELEMENTS − DETAILS

I Existing Conditions Data and Analysis

A. Geometrics (Sketch Plans)

The Traffic Impact Study should address the geometric configuration for each approach and each direction of an intersection at the point(s) of proposed access, and at each intersection affected by the proposed project in terms of:

- Traffic lanes including number of lanes, lane width, and lane usage (i.e., identify through lanes, auxiliary lanes, shoulders/curbing, parking/type, etc.)
- Gradient of the roadway and approaches
- Operating issues including nearby intersecting roads and drives with associated features
- Traffic control devices including signalization, signing and pavement markings that might affect or be affected by the project
- Feature Inventory including sidewalks, crosswalks, bicycle lanes and shared use paths, where applicable
- Bus stops and/or shelters
- Minimum Turning Path of Design Vehicles, following the AASHTO[5] Chapter 2 guidelines of selecting the design vehicle and measuring, recording and reporting existing and proposed turning radii
- A sketch plan showing these details is usually quite helpful in describing them

B. Speed Limit

Provide the speed limit, as well as operating or other appropriate measures of speed identified for use in various analyses for the highway being accessed and for all intersecting roadways, drives and streets.

C. Sight Distance

Sight distance considerations are indicated as follows:

1) In order to identify potential safety concerns, the Traffic Impact Study shall address, measure and record any and/or all applicable elements of sight distance(s) throughout the limits of the project always in relation to the corresponding posted speed limit. The content of the Traffic Impact Study shall follow the AASHTO[5] Chapter 3 guidelines in terms of:

- Stopping Sight Distance
- Passing Sight Distance
- Intersection Sight Distance (i.e., Corner Sight Distance) at all intersections.

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[5] AASHTO – A Policy on Geometric Design of Highways and Streets, latest edition

2) The Traffic Impact Study shall be exempted from compliance with the AASHTO procedures for recording and reporting any and/or all the elements of Sight Distance wherever the roadway alignment is horizontally straight and vertically flat.

The Traffic Impact Study shall instead address all the elements of Sight Distance, with sufficient and liable engineering judgment, criteria and site photographs to support any statement that the Traffic Impact Study makes in reference to the safety and appropriateness of any and/or all the elements of Sight Distance and/or the necessary mitigation(s) to provide and/or maintain all the elements of Sight Distance within the AASHTO recommended values.

3) The Traffic Impact Study shall always address and propose mitigations to "obstructions to all element of sight distance" taking into consideration the effect that the weather, seasons and presence or absence of daylight and street illumination have on such obstructions.

D. Crash Data

The Traffic Impact Study should note whether the highway section or intersection being analyzed is a VTrans High Crash Location (HCL). The VTrans High Crash Location Report is available from the VTrans Highway Research Unit.

The current policy for including crash records in VTrans listings is crashes involving personal injury or fatality. All police-reported crashes are included in VTrans crash listings.

1) Crash data should include the following:

- Crash analysis for the point of access and along the highway system as appropriate, in order to identify existing areas of high crash incidence and patterns that might be affected by the project.
- Generally, the most recent five year history of crash data, derived from police reported crashes, should be used to provide as statistically reliable a representation as possible of current conditions.
- Crashes involving pedestrians and bicyclists should be included.

2) Crash rate formulas are shown in the VTrans High Crash Location Report. Crash rates should be presented as follows:

- For sections, number of crashes per million vehicle miles of travel (Acc/MVM)
- For intersections, number of crashes per total number (million) of entering vehicles (Acc/MV)

3) Summary crash listings are available on the VTrans Highway Research website for the following locations:

- Highways on the State System
- Class 1 Town Highways through various village and/or urban areas

- Federal Aid Urban (FAU) Highways
- Town Highway Major Collectors

4) Also available from VTrans Highway Research Unit
- Abbreviated listings for crashes on all other facilities
- Average summary statistics for various highway classes

E. Committed VTrans Highway Improvements

These may include projects on the Agency of Transportation's "Construction Program" or improvements as a result of other developments in the area.

The Traffic Impact Study should address:

1) The impact that other Pending or Planned Highway Improvements Project(s) may have on the Development for which the Traffic Impact Study is performed.

2) The impact that the Development for which the Traffic Impact Study is performed may have on other Pending or Planned Highway Improvements Project(s).

F. Other Planned Developments

The Traffic Impact Study should include, in the appropriate scenario(s), the number of trips generated by:

1) Other permitted but not yet built developments

These vehicle trip estimates and their distributions can normally be obtained from traffic studies that have already been prepared for those developments.

2) Other planned-but-not-yet-permitted developments

VTrans encourages the practice of researching and including the number of trips generated by that are in the permitting stage. Since development parameters often change during the permitting process, whether trips from such developments should be included in the Traffic Impact Study is a matter to be discussed with VTrans Traffic Research Unit.

G. Public Transportation Service

Provide information on existing and planned public transportation routes and schedules as well as bus stop locations that could serve the proposed development. This information may be obtained from the local Public Transportation provider or from VTrans Public Transit Section. The term "planned" in this context refers to new or expanded routes that are linked to a reasonably foreseeable funding program (e.g., Private funds, New Starts, JARC etc.). If no services exist, this should be so noted.

H. Bicycle and Pedestrian Facilities

The Traffic Impact Study should also include the following:

1) Existing and committed bicycle and pedestrian facilities

Provide information on existing and committed bicycle and pedestrian facilities in the area. This information may be obtained from the local municipality or from the VTrans Bicycle and Pedestrian Program. The term "committed" in this context refers to facilities for which funding exists. If no such facilities exist, this should be so noted.

2) "Safe Routes to School Program" facilities

If a project area includes a designated "Safe Route to School" or other popular pathway, these should be described in the Existing Conditions section of the TIS.

Refer to the following link for more information:

http://www.vtbikeped.org/what/safety/SR2SApp06FINAL.pdf

II Project Parameters

A. General Description

A general description of the project, including land use type (ITE LUC) and size is necessary. Also, a discussion of construction constraints or other elements affecting site layout are helpful aids in understanding specific features not readily apparent.

B. Site Plan/Layout/Circulation Plan

Plans or layouts of the development site, preferably to scale, showing its relationship to the adjacent transportation network and other pertinent physical features, including bicycle and pedestrian facilities, should be provided. Provision for public transportation should be noted, as well as access and circulation.

C. Project Generated Traffic

With respect to Trip Generation, the Traffic Impact Study needs to include the following,:

1) Trip Generation Rates

Trip Generation involves using estimated trip rates based on known relationships obtained from various studies around the country. ITE maintains a fairly extensive database of trip rates for various types of developments. These trip rates represent the number of trip ends (essentially this is the number of vehicles entering and exiting a site during a given time period) generated based on an independent unit of land use or activity such as:

- Acreage for large industrial/commercial sites
- Square footage for well defined industrial/commercial and retail types of land use
- Number of employees for employment in general
- The number of occupied/units for various types of residential housing or lodging
- Others as correlation indicates appropriate

2) Total Number of Trips

The number of vehicle trips generated as a result of summing the product of the trip rate times the magnitude of development for each land use represents the total number of trips directly accessing the site.

The Trip Generation Handbook, "an Institute of Transportation Engineers Recommended Practice", March 2001, Chapter 5, page 27, defines the various descriptions of trips as follows:

- Pass-by trips are made as intermediate stops on the way from an origin to a primary trip destination without a route diversion. Pass-by trips are attracted from traffic passing the site on an adjacent street or roadway that offers direct access to the generator. Pass-by trips are not diverted from another roadway. Pass-by trips do not involve a route diversion to enter the site driveway.
- Non-pass-by trips are simply all trips generated by the site that are not pass-by trips. This term is sometimes used when diverted linked trips are not tabulated separately from primary trips.
- Primary trips (new trips) are trips made for the specific purpose of visiting the generator. The stop at the generator is the primary reason for the trip. The trip typically goes from origin to generator and then returns to the origin. For example, a home-to-shopping-to home combination of trips is a primary trip set.
- Diverted Link Trips are trips that are attracted from the traffic volume on roadways within the vicinity of the generator but that require a diversion from that roadway to another roadway to gain access to the site. These trips could travel on highways or freeways adjacent to a generator, but without access to the generator. Diverted trips add traffic to streets adjacent to a site, but may not add traffic the area's major travel routes (see Figure 5.1 Trip Generation Handbook, an Institute of Transportation Engineers Recommended Practice, March 2001, Chapter 5, page 27). Both pass-by and diverted trips may be part of a multiple-stop chain of trips.

3) Local Trip Generation Rates

The use of local Trip Generation rates is preferable to using ITE Trip Generation rates or equations, but only where sufficient data has been collected at specific sites to insure statistical reliability. When it is desired to use local rates, a preliminary discussion with the reviewer at VTrans is quite helpful in reducing review times. **The consultant should be prepared to present the complete data on which the use of local Trip Generation rates is based and to demonstrate that the sites selected for analysis are comparable to the proposed site in size, location and traffic characteristics.**

4) "Grandfathered" Trip Generation

VTrans Traffic Research Unit does not accept the theory that a given development has a Trip Generation allocation good for all subsequent metamorphoses of the development. Nobody can "own" a piece of traffic flow or have a vested interest in a public highway, see *Ehrhart v. Agency of Transportation,* ____ *Vt.* ____*; 904 A.2d 1200, 2006 VT.* Therefore, developers take the situation as they find it and base their analyses and mitigation proposals on existing site Trip Generation plus reasonably projected Trip Generation due to the development or redevelopment proposal.

5) Traffic Distribution Methods

Traffic Distribution Methodologies used to distribute and assign the generated traffic may be as straight forward as basing directional splits on patterns of nearby similar generators or existing background traffic patterns or as complex as applying more sophisticated distribution using the Gravity Model in conjunction with “Shortest Path” or “User Equilibrium Assignment” models for large more complex projects, which often involve the use of computer programs developed for these purposes.

6) Public Transportation

The Traffic Impact Study should address the existence or possible availability of public transportation to estimate the percent of trips that could potentially be diverted to public transportation.

7) Modal Split Analysis

For any proposed development where public transportation service either exists or could be made available and where there is a co-operative and comprehensive transportation planning process as well as appropriate modeling tools, a modal split analysis should be undertaken to estimate the percent of trips that could potentially be diverted to public transportation.

8) Bicycle and Pedestrian Generated Trips

Bicycle and pedestrian generated trips should also be estimated using appropriate methodology[6]. Such an analysis should be realistic in its projections and preferably should be compared to services at similar developments in the area.

D. Parking Demands

The number of parking spaces generally depends on peak traffic generation and turn-over rate of the land use being served. Adequate parking is necessary to ensure that the public highway is not affected by overflow parking needs during peak demand periods.

The Traffic Impact Study should describe the consistency of on-site parking supply with the proposed demand in relation to the trip generation, keeping in mind that parking demands for urban sites are quite different from suburban sites.

[6] FHWA Guidebook on Methods to Estimate Non-Motorized Travel: Supporting Documentation (FHWA-RD-98-166) and Overview of Methods (FHWA-RD-98-165), July 1999.

The Traffic Impact Study should include:

- Anticipated parking demands, including bicycle parking
- A plan or layout of the site identifying parking areas in respect to internal circulation patterns and access to the highway/street system
- Any proposed, new or modified access to the highway/street system shall be performed in conformance with the VTrans Access Management Guidelines, specifically addressing the number of accesses, proper driveway throat design, parking/roadway interactions and driveway spacing.
- Parking demands should also comply with Local Regulations, where applicable
- An attempt should be made to reconcile parking estimates with Trip Generation estimates

The Agency of Natural Resources (ANR) presently uses the number of parking spaces as a mechanism for requiring submittal of an Air Quality Permit and should be contacted for specific criteria in this regard.

E. Planned Phasing

Any planned phasing of a development should be clearly identified. If the Traffic Impact Study does not clearly identify the development phases, or the project is planned as one unit, then impacts at full build-out should be addressed. Otherwise, as each lot or other unit in a development is proposed, an updated traffic study is required to address and include cumulative impacts of the development up to that point, including the element(s) being added. For further discussion on this topic see Appendix D: Large, Long-Term, Multi-Use Developments.

F. Proposed Public Transportation Service

In cases where the proposed development will be served by an existing, expanded or a new public transportation route, the site layout should be designed to accommodate buses entering, transiting and exiting the site. In addition, the proposed new or expanded route should be noted as well as bus stop locations.

When public transportation is indicated as a mitigation measure, the Traffic Impact Study shall produce written assurance from the transit provider of its intent to serve the site/project and that adequate capacity exists to service the development.

G. Proposed Pedestrian and Bicycle Facilities

If it is proposed that the development be connected to planned or committed pedestrian or bicycle facilities, that the details of such connections should be shown.

III Traffic Projections for Access(es) and Other Study Intersections and Highway Sections

A. Existing Traffic Data (AADT and DHV)

1) Annual Average Daily Traffic (AADT)

The AADT is a fundamental statistic for developing the Traffic Impact Study. The VTrans Traffic Research Unit annually calculates the AADT on each segment of state highway in the State of Vermont and on some local roads. These AADTs are available in the VTrans Route Log AADT publications which are separately published for Major Collector, Federal Aid Urban Streets and State Highways. Available on the Internet at:

http://www.aot.state.vt.us/Planning/Documents/TrafResearch/Publications/pub.htm

In the Route Log AADT Publications, the AADTs are followed by an "A" or an "E."

a) VTrans AADT (A) - from Actual Count

These AADTs are calculated from actual recent Automatic Traffic Recorder (ATR) counts and are identified in the Route Log with an "A" beside the AADT.

b) VTrans AADT (E) - from Estimated Counts

These AADTs are derived from growth factors applied to prior year AADTs, or from actual counts taken in neighboring sections used in conjunction with appropriate turning movement traffic volumes. Estimated AADTs are identified in the Route Log with an "E" beside the AADT.

Estimated AADTs are sufficiently accurate for estimating annual Vehicle Miles of Travel (VMT) for the Highway Performance Monitoring System (HPMS). **They are not sufficiently accurate for estimating DHVs for Traffic Impact Studies.**

c) Conducting ATR counts to calculate AADTs

When Traffic Impact Studies involve segments of roadway for which an actual AADT has not been calculated, it is recommended that the applicant conduct an automatic traffic recorder count (ATR) and calculate an AADT.

Before working in the State’s right-of-way, it is important to obtain a Highway Permit. Contact the VTrans Utilities and Permits Unit at http://www.aot.state.vt.us/techservices/Utilities/utilitiesandpermits.htm or (802) 828-2485 for a Highway Permit application.

The "Vermont Traffic Monitoring Standards for Contractual Agreements" provide information regarding ATR types, count duration, data formats, etc. This publication is available at:

http://www.aot.state.vt.us/Planning/Documents/TrafResearch/Publications/trafficstandards.pdf

Upon completion of the count, apply appropriate seasonal factors contained in the VTrans Traffic Research Unit Publication "Continuous Traffic Counter (CTC) Grouping Study and Regression Analysis" (a.k.a., the "Red Book."), available at:

http://www.aot.state.vt.us/Planning/Documents/TrafResearch/Publications/2005RedbookText.pdf

Demonstrate and document the procedures used in calculating the AADT.

2) Design Hourly Volume (DHV)

The DHV is generally the 30th highest hourly volume during the year. It is a value that, in conjunction with turning movement counts, roadway classification and roadway geometry, is used to develop a traffic distribution pattern for existing and future scenarios, and, in turn, estimate the Level of Service (LOS) of a project site.

Since it is impractical to design a highway for the highest volume encountered during the year, highway engineers have sought a compromise between capacity and cost. Thus, a highway is designed for the 30th highest hourly volume of the year, commonly known as the "Design Hour Volume" (DHV). Several techniques have been developed for estimating the DHV. The applicability of each technique depends on the existence, number and reliability of traffic counters.

The following is a list from VTrans most-preferred to the least-preferred method to obtain a DHV based on the availability, collected data size, type and recentness of the traffic stations.

a) Use the DHV from a Continuous Traffic Counter (CTC)

This method is applicable when there is a CTC so ideally located in relation to the new project that the DHV from such counter can be considered without any doubt as the DHV for the development in question. Refer to the CTC Summary in the Red Book for a list of CTC sites and their DHVs.

b) Use the %k from a Continuous Traffic Counter (CTC)

This method is applicable when there is a CTC along the project route, but not directly in the project area, and the AADTs in the area are known and based on actual counts. The CTC should be within a reasonable distance of the proposed development. A CTC located outside the project region is unlikely to represent traffic in the project area and should not be used without quantitative justification.

c) VTrans "Alternative DHV Determination Method" by Poll Group

This method is applicable when there is no CTC site in the project area and the AADTs in the area are based on actual counts. Refer to the Alternative DHV Determination Method procedure in the back of the Red Book.

Note: The Alternative DHV Determination Method is not applicable to Poll Group 6: Summer/Winter Recreational – TH. For these recreational town highways, use only DHVs or k factors from specific CTCs. Future editions of the Red Book will make a note to this effect.

d) "CTC Method"

This method is only applicable under the same conditions as the method of using the %k from a Continuous Traffic Counter (method b, above.) Refer to Appendix J: CTC Method for Calculating the DHV Factor.

e) DHV Determination Based on AADT and Highway Class

This method is applicable under the same conditions as the Alternative DHV Determination Method above, but is not the preferred method. Refer to the *DHV Determination Based on AADT and Highway Class* chart in the back of the Red Book.

3) Directional Design Hour Volume (DDHV)

The Design Hour Volume (DHV) needs to be broken down by direction to produce the Directional Design Hour Volume (DDHV). Turning movement counts are quite helpful in this regard.

4) Design Hour Turning Movements

Turning movements to be used in LOS analyses should be adjusted to match the Design Hour Volume on the appropriate approach. If more than one approach has a calculated DHV, then the Design Hour Turning Movements can be adjusted to meet the DHVs using Kruithof's algorithm[7]. The Fratar method and least squares approaches can also be applied in these cases.

5) AM and PM Directional Distribution (%D)

The %D represents the variation of traffic pattern with time. It helps to determine the most representative peak hour, i.e., AM or PM. It is normally used in geometric and LOS analyses and it is an important factor in selecting the proper

[7] Schaefer, Mark C., "Estimation of Intersection Turning Movements from Approach Counts," ITE JOURNAL, Vol. 58, #10, October, 1988, pp 41-46

signalization timing patterns throughout the day in locations where pre-set timed signals are still in use.

6) Truck Traffic (%T)

The %T pertains to the peak hour. It is an important parameter that can be used to translate the number of trucks into an equivalent number of passenger cars as a means to simplify the LOS analysis.

B. Growth Factors

Growth factors are obtained from a population of AADTs recorded by CTCs. The AADTs are grouped by roadway class and used to perform a regression analysis. The growth factor aids in forecasting future traffic based on a traffic trend that is updated every year. The same problems described above with regard to DHV calculations also occurs here in selecting growth factors. In the Traffic Impact Study itself, the growth assumptions should be clearly described and growth factors clearly indicated.

To select an appropriate growth factor, refer to the Regression Analysis Report in the Red Book. Select the appropriate regression analysis group or site for the project location.

C. Traffic Projection Scenarios

1) Construction Year No-Build

The Traffic Impact Study should establish a baseline traffic data representing existing highway conditions for the year the development/phases are to be constructed/commence operation.

Traffic impacts during construction can be significant, as they usually include many truck trips. If construction traffic is expected to be significant, VTrans requires that the Traffic Impact Study include a “Construction Period Traffic Analysis” with traffic mitigation measurements for High Construction Traffic Impact Developments (HCTID)[8] that includes the construction generated traffic.

2) Construction Year Build (Construction Year No-Build plus project generated traffic)

The Traffic Impact Study should include a Construction Year Build projection combining traffic from the Construction Year No-Build projection and the project generated traffic.

3) Planning Year No-Build (generally five (5) years after the construction year)

[8] HCTID: Developments whose construction schedules span more than one year, and/or generate 75 or more truck trips per day during two consecutive months during any phase of the construction schedule, and/or require more than one event of traffic-detour for more than 5 consecutive working days during any phase of the construction schedule.

The Traffic Impact Study should include a No-Build planning projection of the baseline traffic at least five (5) years from the construction year. This may be extended for phased developments.

This is important because:

- It provides a reference to determine how this site's traffic, or any nearby site affected by the proposed development, will impact the overall traffic conditions in the future without the proposed development.
- It helps in determining the additional improvements that this site, or any nearby site affected by the proposed development, will need in the future to provide sufficient site access and capacity for passing traffic without the proposed development
- It is used to ensure that the present system, as well as any improvements, are not obsolete as soon as or shortly after the development is in place and to include those improvements that nearby sites would have already needed in the future regardless of the proposed development.
- In addition, this type of analysis allows the developer to follow the project or site as it matures, not in regard to any planned phasing, but as related to establishing full development of a site's potential as in the case of lots in an industrial/commercial park, stores/shops in a shopping mall, building of houses in a subdivision, etc.

4) Planning Year Build (Planning Year No-Build plus project generated traffic)

The Traffic Impact Study should include a Planning Year Build projection combining traffic from the Planning Year No-Build projection and the project generated traffic.

D. Modal Split Analysis for Major Developments

For ***major developments***[9] where public transportation service either exists or could be made available and where there is a co-operative and comprehensive transportation planning process as well as appropriate modeling tools, a modal split analysis should be undertaken to estimate the percent of trips that could potentially be diverted to public transportation. Such an analysis should be realistic in its projections and, preferabl, should be compared to services at similar developments in the area.

E. Alternative Transportation Analyses

1) Bicycle and Pedestrian

Bicycle and pedestrian generated trips should also be estimated using appropriate methodology[10]. Again, such an analysis should be realistic in its projections and preferably should be compared to services at similar developments in the area.

[9] The parameters for a major development have yet to be developed, but an example would be a Wal*Mart.
[10] FHWA Guidebook on Methods to Estimate Non-Motorized Travel: Supporting Documentation (FHWA-RD-98-166) and Overview of Methods (FHWA-RD-98-165), July 1999.

2) Transportation Demand Management (TDM)

Transportation Demand Management strategies include such activities as flexible work hours, car pooling and van pooling and ride matching services. As such, they are designed to reduce travel by manipulating demand for travel. A partial list of such strategies is contained in the attachment to the Level of Service Policy, Appendix E. If these strategies are recommended for consideration in mitigating the impacts of a development, an estimate of their efficacy is needed. Again, such an analysis should be realistic in its projections and preferably should be compared to services at similar developments in the area.

F. Traffic Counts and Calculations in the Traffic Impact Study

To hasten the Traffic Impact Study review process, counts done by the consultant should be included in the study, unadjusted. The counts should be labeled with the date they were done, and the count location. Data calculations should be clearly documented in the study, e.g., derivation of DHV and growth factors.

IV Capacity and Warrant Analyses

The intent of this study element is to provide commonly understood analyses of the impact of development traffic on the transportation system. Also, if the transportation system is shown to be inadequate in light of the proposed development, then proposed mitigation measures need to be addressed.

A. Capacity and Level of Service (LOS) Analyses

Capacity and level of service (LOS) analyses should be performed for intersections and highway sections being studied to address the construction and planning years for the no-build and build traffic scenarios. If mitigation is shown to be necessary, then additional LOS analyses are needed to show the results with proposed mitigation. When a Traffic Impact Study is submitted for review, the particular software package used to calculate the LOS needs to be clearly indicated, including the version number.

VTrans recommends using the capacity and LOS methods described in the most recent edition of the Transportation Research Board’s Highway Capacity Manual, Special Report 209. VTrans recommends using the DHV for capacity and LOS analyses with a time period of one hour and peak hour factors of 1.0.

VTrans has a Policy on Level of Service, as follows:

> It is the agency’s policy to design its highways and to require others accessing its facilities to effect improvements that will maintain a LOS “C” for the prescribed design period. In interpreting this policy, LOS refers to the overall LOS for the particular facility as defined in the latest HCM. LOS is defined as a quality measure for various highway facilities, including freeways, two-lane rural highways, signalized and un-signalized intersections.

For the complete Level of Service Policy, see Appendix E: Level of Service Policy.

B. Proposed Geometric Features

1) Immediate Access Design

New accesses should be designed to Vermont's B-71 standards. New accesses and changes in access onto State Highways must be approved by the VTrans Utilities and Permits Unit. Refer to Appendix A for links to VTrans access management publications.

2) Left and Right Turn Lane Warrant Analyses

Left-turn lane warrants and design considerations should be checked for un-signalized intersections. VTrans Traffic Research Unit uses the Harmelink[11] method. Reference: Green Book[12] and the Vermont Agency of Transportation Guidelines for Traffic Engineering Issues, Revised August 1995.

Right-turn lane warrants and design considerations addressing the need for any additional lanes should be checked using VTrans warrant for Right Turn Auxiliary Lanes. Refer to Appendix H.

3) Queuing Length Analysis

The Traffic Impact Study should perform a Queuing Analysis in all scenarios assuming vehicle length of 25 feet and 95% percentile queue length.

4) Storage lengths

The Traffic Impact Study should check all scenarios-“storage lengths vs. length of queue" and propose mitigation to cure any deficiency.

5) Merging, Acceleration, and Deceleration lanes

The Traffic Impact Study should address, particularly on high speed roads, the need for Merging, Acceleration and/or Deceleration Lanes. Any, addition or modification to these lanes, shall be supported with an analysis of the impact that their modification or addition has on the corridor.

6) Signing and Pavement Marking

The Traffic Impact Study should investigate if the subject development will require modifications and/or additions to the existing roadway signs and pavement markings. Should the subject project so require, the Traffic Impact Study should include an Existing Signing and Marking Survey and conform to the Manual of Uniform Traffic Control Devices latest edition, for code reference and for the design of the proposed addition and or modification.

---

[11] Harmelink, M.D., "Volume Warrants for Left Turn Storage Lanes at Unsignalized Grade Intersections," Highway Research Record #211, Highway Research Board (now Transportation Research Board), Washington, D.C., 1967

[12] "A Policy on Geometric Design of Highways and Streets," AASHTO, latest edition

7) Sight Distance

The Traffic Impact Study should address sight distance issues, implement at least a minimum standard-compliance and resolve sight distance issues with clearly feasible improvements, if needed.

8) Transit Facilities

The Traffic Impact Study should indicate the existence-of, the need-for or the modification-to the following facilities:

- Bus shelters
- Signs
- Pull- offs, etc.

9) Non-motorized transportation facilities

The Traffic Impact Study should indicate the existence-of, the need-for or the modification-to the following facilities:

- Sidewalks
- Crosswalks
- Bicycle lanes, etc.
- Shared use paths
- Other facilities

10) Bike/Pedestrian Network vs. Proper Roadway Geometry

The Traffic Impact Study should address proper roadway geometry to safely accommodate bicycle traffic on the site and adjacent to the site, as well as to the general connectivity of the site to the public network. The quality and completeness of the bicycle and pedestrian network should be addressed.

C. Signalization Warrant Analysis

1) Signals

If the installation of signals is proposed, a signal warrant analysis should be performed in accordance with the latest Manual on Uniform Traffic Control Devices (MUTCD). VTrans recommends using an Annual Average Weekday Traffic (AAWDT) volume for signal warrant analysis. On the assumption that the turning movement count was done on an average weekday for a given month, Monthly Average Weekday Traffic (MAWDT) to AAWDT factors from the VTrans' Red Book can be applied to adjust the count to an Annual Average Weekday Traffic volume.

If a signal is warranted, an assessment of the need for and design of pedestrian phases should be included. Pedestrian phases would normally be included only if pedestrian facilities lead up to the leg of the intersection on which the pedestrian phase would be provided.

2) Roundabouts

Vermont legislature, Act 141, Section 37 LEGISLATIVE SUPPORT FOR ROUNDABOUTS, 2001-2002 session dictates:

> "The Agency of Transportation is directed to carefully examine and pursue the opportunities for construction of roundabouts at intersections determined to pose safety hazards for motorists."
>
> (Refer to Appendix F: Roundabout Legislation for the compete text.)

Consequently, if a traffic signal is found to be warranted at any intersection analyzed, including the site driveway intersection; and the developer proposes to install a traffic signal, then VTrans' Traffic Research Unit strongly recommends that a roundabout also be analyzed for installation at the same locations. A full life-cycle cost analysis should be undertaken to compare life-cycle costs of both a traffic signal and a roundabout installation. VTrans is in the process of developing relevant parameter values.

V Consideration of Bicycle and Pedestrian Access and Safety

If there are existing bicycle and/or pedestrian facilities in the area to be impacted by a proposed development, assessment should be included of how these facilities may be impacted. For example, if there are bicycle lanes on the roadway and a turn lane is needed to mitigate traffic impacts, provision must be made for continuity of the bicycle lane. Infrastructure changes proposed to mitigate traffic impacts should not result in the degradation of bicycle or pedestrian access or safety.

VI Safety Analyses

A. VTrans High Crash Locations

If a highway segment or intersection is identified as a High Crash Location (HCL), then the crashes contributing to the HCL need to be analyzed and a collision diagram prepared that identifies, to the extent possible, the causes of the crashes. If a highway geometric or traffic operation condition is found to be contributing to the identified crashes, then recommendations to ameliorate those conditions should be prepared and included in the Traffic Impact Study. Refer to Appendix A for more information on obtaining current crash data.

B. Sight Distance

Sight distances described above in IC. Sight Distance need to be compared to applicable sight distance standards. If a deficiency exists, recommendations to ameliorate the deficiency need to be incorporated into the Traffic Impact Study.

Necessary line-of-sight-clearing to insure adequate sight distance should be clearly indicated.

VII Summary of Findings

The Traffic Impact Study should include a clear and factual summary of findings that easily identifies the impact of the project in terms of Level of Service, Delay and Queue Lengths, and their relation with the roadway network, geometry and traffic flow.

VIII Impact Mitigation Recommendations

A. Recommended Geometric Improvements

These recommendations would include any and/or all items under IVB., Proposed Geometric Features.

B. Signal Installation or Re-timing Recommendations

C. Recommended Access Management Improvements

In recommending access management improvements, the developer should consider combining accesses, access spacing, corner clearance, access via Town Highways, one-way entrances and exits, etc. Developers should also consider any possible interconnection between their development and neighboring land uses. For example, residents of a housing development which abuts a proposed commercial activity ideally should not have to get into their cars, work their way from local streets to arterial highways and then enter the commercial activity. Preferably, there would be some sort of direct connection between the two land use activities. However, such interconnections depend on local planning and VTrans recognizes that they may not always be feasible for existing developments.

D. Recommended Transportation Demand Management (TDM) measures (vanpools, ridesharing, flextime, etc.)

TDM measures should also be considered. TDM measures include flexible work hours or adjusting shift schedules to avoid peak hours of the adjacent roadway, promoting ridesharing or vanpooling and promoting alternate modes of travel to include bicycle, pedestrian and public transportation. A more extensive list is shown in Appendix E Attachment: Transportation Demand Management Strategies.

E. Recommended Public Transportation, Pedestrian and Bicycle Facilities

Developers can mitigate impacts through the appropriate use of public transportation services as well as bicycle and pedestrian facilities. Estimates of the number (or percent) of trips mitigated by use of public transportation, bike and pedestrian facilities should be realistic and based on local/regional observations or comparable data from similar regions around the country.

F. Monitoring Conditions

It frequently occurs that a particular improvement is not warranted in the opening year of a development, but is warranted in the future year. Because the future year analyses are based on a number of conservative assumptions, they represent a "worst case" scenario, and may not be entirely indicative of what will occur in five years. In these instances, a monitoring condition may be imposed. This requires that the developer conduct traffic counts before a development opens, at opening, and five years after opening. If an improvement is warranted by reason of the monitoring counts, then the developer is required to pay for it. If several developers contribute to traffic causing the failure, then all have to contribute to fixing the problem. As presently constituted, this would have to be adjudicated locally or through Act 250.

Recently, because of the uncertainties in traffic projections, we have been recommending to all the local Act 250 commissions that they retain jurisdiction for five years and impose monitoring conditions, as described below, on developers. The language of the following Monitoring Conditions are to be adapted to fit each development's scope, location and need.

Typical Monitoring Conditions:

Six months to one year, and five years, after the development is fully constructed and occupied, a traffic monitoring study will be conducted by the developer to ascertain if excessive congestion has occurred at the intersections included in the study. The monitoring study will include conducting turning movement counts at these intersections and analyzing the results for turn-lane warrants, Level-of-Service, delay and queue lengths. Additionally, crash records will be examined to ascertain if highway safety in the study area is negatively impacted.

If congestion or safety problems are identified, then results of the above studies are to be submitted to the Act 250 Commission for further adjudication. The developer must contribute to the amelioration measures acceptable to VTrans and the city or town, as appropriate.

Before a monitoring study is undertaken, the consultant should contact VTrans Traffic Research Unit to determine the scope, nature and extent of the expected monitoring study.

G. Speed Limit Reduction

If reduced speed limits are being proposed, please refer to Appendix I.

APPENDICES

Appendix A: VTrans Resources

Available from Traffic Research

- Automatic Traffic Recorder Counts
- Continuous Traffic Counts*
    - Monthly Hourly Reports
    - 200 High Hour Report
    - 30th Highest Hour
- WIM Data (Weigh in Motion)
- Route Logs AADT publications*
- CTC Grouping Study and Regression Analysis ("Red Book")*
- Turning Movement Count Database (an index to completed counts – not actual count data)*
- Turning Movement Counts
- Guidelines for Traffic Engineering Issues

*Obtain on the web at:
http://www.aot.state.vt.us/Planning/Documents/TrafResearch/Publications/pub.htm

Available from Mapping and GIS

- Town Maps

Obtain on the web at:
http://www.aot.state.vt.us/Planning/MapGIS/Town_Maps1.htm

Available from Highway Research

- Crash Data

Obtain on the web at:
http://www.aot.state.vt.us/Planning/Documents/HighResearch/Publications/pub.htm

For most current data, and the High Crash Location Report, E-mail request to: AOT–crashrequests@state.vt.us

Available from Permits and Utilities

- Vermont Access Management website at:

http://www.vtaccessmanagement.info/

- Access Management Program Guidelines

Obtain on the web at:
http://www.vtaccessmanagement.info/Documents/AccManProgGuidelinesRev072205.pdf

Public Transportation – 802-828-2828

Bicycle and Pedestrian Program – 802-828-5799

Appendix B: Other Resources

- "A Policy on Geometric Design of Highways and Streets" (AASHTO, 2001 or latest edition)

- Traffic Signal Information on State Routes (Traffic Design Section)

- "Highway Capacity Manual". (TRB Report 209- 2000 Edition)

- "Manual on Uniform Traffic Control Devices" (MUTCD - 2000 Edition)

- ITE Publications
  - Traffic Engineering Handbook
  - Trip Generation, 7th Edition, 2003
  - Trip Generation Handbook, 2001
  - Parking Generation, 2003
  - Transportation Impact Analysis for Site Development (A Proposed Recommended Practice – 2006)
  - Design and Safety of Pedestrian Facilities, 1998

- VAOT Standard Sheets
  - A-76
  - B-13
  - B-71

- Vermont Pedestrian and Bicycle Facility and Design Manual (December 2002)

Appendix C: Applicable Statutes/Policies

- Statutes
  - 19 V.S.A. Section 1111 (Access Permits)
  - 23 V.S.A. Section 1025 (Standards for traffic control signs, signals and markings)
  - 24 V.S.A., Ch. 126, § 5081 (Public Transportation)
  - Roundabout Analysis

- Policies
  - VAOT Level of Service Policy
  - VAOT Traffic Signal Installation Policy

Appendix D: Large, Long-Term, Multi-Use Developments

Occasionally, extensive developments, such as ski areas, industrial parks and combined housing developments and shopping centers are proposed. Typically, such developments are completed in phases with different levels of mitigation required in each phase. A frequent question that arises is what form Traffic Impact Studies for such developments should take, especially how the timing for future impacts should be structured. For large developments that are expected to open all at once, such as a supermarket or a discount store, traffic impacts are analyzed in the year the development opens and five years later in the future. But this sort of scenario is hard to fit to a development that is expected to open in several phases over a number of years.

Overall, VTrans Traffic Research Unit would like to know what traffic mitigation measure will be necessary when the development is fully built out. This would imply a traffic analysis at full build-out plus five years even if that is twenty-five years in the future. However, a lot can change in twenty-five years. Therefore, VTrans Traffic Research Unit should have Traffic Impact Studies at regular intervals during the life of a large, long-term, multi-use, multi-phase development. VTrans Traffic Research Unit, the developer and consultants should be involved in making the determination of the extent and frequency of Traffic Impact Studies.

Another problem with large, long-term, multi-use, multi-phase developments is that they may have longer-term and greater ranging effects than VTrans Traffic Research Unit normally expects and for which there exists the analysis tools. Normally, VTrans Traffic Research Unit would expect developers to pay for left- and right-turn lanes and traffic signals at their access intersections and nearby affected intersections. However, if several such developments occur in close proximity, larger and much more expensive mitigation measure may be needed, such as road widening or interstate bridge replacement. In such an instance, if several developments contribute to the need, they should share the cost equitably. As development review is currently constituted in Vermont, such cost sharing arrangements would have to be enacted through Act 250.

Another issue that arises in these instances is insuring there are sufficient funds to pay for the mitigation when it is needed, if it is needed. If one developer is going to be available for the long term, as is the case for a shopping center or ski area, then it is only necessary to require that developer to pay for the mitigation when it is needed. Usually some sort of sinking fund or escrow account will suffice. However, in an instance where the original developer sells lots for individual development, as in an industrial park, and when all lots are sold that developer is no longer available, the ultimate responsibility for paying for mitigation is much less clear. In such an instance, all lot owners should be responsible for paying for mitigation in some equitable manner, and this should be known to individual lot developers when they buy their lots. Admittedly, this is more a legal issue than a traffic issue; nevertheless, the Traffic Impact Study should address it in some manner.

Appendix E: Level of Service Policy

VERMONT AGENCY OF TRANSPORTATION (VTrans)
HIGHWAY DESIGN "LEVEL OF SERVICE" POLICY

Purpose:

The purpose of this policy is to establish a **Highway Design Performance Measure** which addresses mobility and capacity issues on Vermont roadways. The measure selected is the Motor Vehicle **Level of Service (LOS)** of a facility as defined in the latest version of the Highway Capacity Manual (HCM) 2000 Edition, also known as Transportation Research Board Special Report 209. This policy applies to all roadway facilities.

Special Notes

The Agency has developed Performance Measures and targets that address mobility at a corridor level for planning purposes. These measures are defined in the Agency's Highway System Policy Plan and include intercity travel times and volume to capacity (v/c) ratios for different land uses.

Policy:

All Facilities:
It is the Agency's policy to design its highways and to require others accessing its facilities to effect improvements that will maintain a LOS "C" for the prescribed design period. In interpreting this policy, LOS refers to the overall LOS for the particular facility as defined in the latest HCM. LOS is defined as a quality measure for various highway facilities, which include, but are not limited to:

- Freeways
- Two-lane two-way rural highways
- Urban streets
- Signalized intersections
- Unsignalized intersections

Reduced LOS criteria may be acceptable, when approved by the Secretary of Transportation or designee on a case-by-case basis, especially within densely settled areas. Such determination should take into consideration, at a minimum, the following:

- Current and future traffic volumes
- Essential Emergency Response routing and maintenance accessibility
- The delay incurred by the traveling public
- The volume to capacity (v/c) ratio
- Facility safety (crash rates)

- The negative impacts (cultural, environmental, etc.) which may result to the surrounding area, because of improvements required to achieve a Level of Service "C" for the facility
- Effects of economic suppression due to inadequate infrastructure and subsequent displaced development

In extreme circumstances, where the existing LOS is less than desired and where the necessary geometric improvements are not feasible, a lower LOS may be acceptable, as long as the safety and mobility of the traveling public is improved. Strategies effecting such improvements should include traditional traffic engineering approaches such as

- Installation of traffic and pedestrian signals
- Adjustment to signal phasings and timings
- Modification to existing lane configurations
- Pedestrian crossings
- Other, similar measures

In addition, where appropriate, these approaches may be carried out with Transportation Demand Management (TDM) strategies or TDM strategies may be carried out independently. Examples of possible alternative strategies or improvements are listed in the *Transportation Demand Management Strategies* attachment. The attached list is not intended to be all inclusive and is provided for information purposes only.

Town and Regional officials should be consulted on any mitigation strategies proposed for projects under their jurisdiction or in their geographic area.

Two-Way Stop Controlled Intersections:
For two-way stop controlled intersections, the HCM does not define a procedure for obtaining an overall LOS or a LOS for major street approaches. Therefore, VTrans LOS Policy for two-way stop controlled intersections is to maintain a LOS "D," or better, for side roads with volumes exceeding 100 vehicles/hour for a single lane approach, or 150 vehicles/hour for a two lane approach. No LOS criteria are in effect for volumes less than these.

VTrans' main objective at unsignalized two-way stop controlled intersections is to minimize potential consequences when vehicle operators exit stop-controlled side streets by accepting unsafe gaps in the major street through traffic.

This policy supersedes the policy dated July 25, 1996.

EFFECTIVE DATE: __May 31, 2007_______________

APPROVED: ___**Original Signed**_______________ DATE:___5/31/07_____________
Neale Lunderville
Secretary of Transportation

Attachment
Vermont Agency of Transportation
Highway Design "Level of Service" Policy

Transportation Demand Management (TDM) Strategies

	Strategy Type	Employer/Developer Provides
1.	Carpools/Vanpools	Preferential Parking Ride Matching onsite Financial Incentive Guaranteed Ride Home
2.	Transit	Subsidized Passes Shuttle from Park & Ride lot or Transit Station Guaranteed Ride Home
3.	Work Place	Showers and Secure, Covered Bicycle Parking Alternative Work Schedules Staggered schedules for demand dampening Telecommuting Charging for Parking On-site Informational Programs
4.	Infrastructure Investments	Contributions to: Park & Ride lots Bus Shelters Sidewalks Bicycle Lanes & Parking Shared Use Paths Dedicated Capital Development funds for capacity

NOTE: THIS LISTING IS NOT CONSIDED TO BE ALL INCLUSIVE NOR IS ANY ONE EMPLOYER/DEVELOPER OR VTRANS EXPECTED TO IMPLEMENT ALL STRATEGIES.

Appendix F: Roundabout Legislation

Sec. 37. LEGISLATIVE SUPPORT FOR ROUNDABOUTS

The general assembly finds that the installation of roundabouts at dangerous intersections in the state has been cost-efficient, and has enhanced the safe operation of vehicles at these locations. The Agency of Transportation is directed to carefully examine and pursue the opportunities for construction of roundabouts at intersections determined to pose safety hazards for motorists.

Appendix G: Checklist for Bicycle and Pedestrian Considerations

1. Is the proposed development on a highway that limits access by bicyclists and pedestrians?

   If YES, STOP – no further information on bicycle and pedestrian accommodation is needed.
   If NO – Continue to other items on this checklist.

2. What existing bicycle and/or pedestrian facilities are located in the affected highway corridor:

   - □ Sidewalks
   - □ Crosswalks
   - □ Bicycle lanes (identified with specific signs and pavement markings)
   - □ Shared use path (note: paths may be outside the highway Right of Way)

3. Does the developer's site plan show continuity of bicycle and/or pedestrian facilities? E.g. if sidewalks on one or both sides of the parcel being developed, are connecting sidewalks being provided on the parcel proposed for development?

4. Are there provisions for bicyclists and pedestrians to safely access the development from the street? (note: this question may be relevant even if on a limited access highway IF served by public transit)

5. Do proposed traffic improvements (signals, turn lanes, etc.) maintain safe bicyclist/pedestrian access?

6. Are pedestrian phases included in any signal upgrades/installations?

7. If bicycle and/or pedestrian trips are being used to offset proposed vehicle trips or as a TDM measure, is the rationale for the number of trips reasonable?

Appendix H: Right Turn Lanes at Unsignalized Intersections

VERMONT AGENCY OF TRANSPORTATION
TRAFFIC VOLUME WARRANTS FOR RIGHT TURN AUXILLARY LANES
At Unsignalized Intersections

Problem Statement:

Upon review of current literature, with improved traffic operation and reduced accident experience the principal concerns, the following procedure is recommended based on traffic volume and speed warrants. Where the approach highway speed limit is 25 MPH, or the difference between the speed limit and the intersection design speed for right turning vehicles (reference 1990 AASHTO Publication A Policy on Geometric Design of Highways and Streets, Table III-17, etc.) does not exceed 15 MPH, these criteria are generally exempt.

- The need for a right turn lane shall be met for two-lane highways where the advancing (total approach volume excluding lefts utilizing a separate left turn lane) traffic volume (V) exceeds the relationship

  $$V = 33\sqrt{\frac{80 - S}{R(1 - R)}};$$

  where S is the highway speed (speed limit assumed), in MPH, and R is the ratio of right turns to the advancing traffic volume for design conditions, expressed as a decimal.

- The need for a right-turn lane shall be met for four-lane highways where the above two-lane warrant is met and a minimum of 50 right turning vehicles is exceeded. Two-lane versus four-lanes highway determination is based on the number of advancing volume lanes used to carry through traffic; e.g. where one approach lane carries through traffic it is considered a two-lane highway.

Specific safety concerns may also be cause for inclusion, on a case by case basis, such as restricted sight distance or other severe geometric conditions. In any event it shall be the Agency's prerogative to determine the implementation of any improvements in considering any impacts or hardships that might result from such improvements.

APPROVED: ___**Original Signed**_______________ DATE: ___11/06/89_____________
Arthur Goss
Director of Planning

Appendix I: Reducing Speed Limits

Much like installing traffic signals, reducing speed limits is often seen as a panacea for traffic ills. Speed limits must be set in accordance to the MUTCD. The MUTCD, in section 2B.13, requires than an engineering study be completed in accordance with established engineering principles. It states that the speed limit should be set within 5 mph of the 85th percentile speed of free-flowing traffic. Other factors which may be considered along with the 85th percentile speed are road characteristics (geometry), pace speed, roadside development and environment, parking practices and pedestrian activity and reported crash experience.

Since the 85th percentile speed is quite often higher than the existing speed limit, it is difficult to justify a lower speed limit. Arbitrarily setting a lower speed limit is not an effective method to reduce driver speeds – drivers select their operating speed by “feel”, with little regard to the posted speed limit unless there is active enforcement. Assuming that the majority of drivers are prudent and safe drivers, the 85th percentile speed is deemed a reasonable speed limit unless there are factors which strongly suggest that drivers are making poor decisions at that speed.

On state highways, speed limits are set by the Vermont Traffic Committee. A town governing body may request that the Traffic Committee consider a reduced speed limit by sending a letter to the Traffic & Safety Unit stating their request with as much supporting information as they have available. In the case of school speed limit requests, the request must also be signed by the school board.

Appendix J: CTC Method for Calculating the DHV Factor

Purpose: To obtain a DHV factor to adjust the volumes of a given peak hour Turning Movement Count (TMC) to represent design hour volumes.

Criteria: The CTC station and the TMC station are along the same corridor.

Example:

Scenario: *TMC is conducted on Wednesday, July 5, 2006 at the intersection of US 2 and VT 15 in Danville.*

The TMC shows that the PM peak hour is from 4:45 PM to 5:45 and the intersection peak hour volume is 640.

Steps:

1. Using the VTrans Station History or Red Book Report, determine if VTrans has a CTC station located along US 2 or VT 15 in the Danville area. **There should not be any significant traffic breaks between the TMC station and the CTC station.**

   In this case, use station P6C028 on US 2 in Danville.

2. From the Red Book, look up the DHV for the year the TMC was done:

   The 2006 DHV for P6C028 is 777.

3. Determine the peak hour volume at the CTC site for the day the TMC was done.

   The peak hour volume at P6C028 on July 5, 2007 was 720 (between 4:00 and 5:00 PM).

4. Calculate the DHV factor as: CTC DHV/CTC Peak Hour Volume:

   DHV Factor = 777/720 = 1.08

5. Multiply the TMC peak hour volumes by the DHV factor to adjust the count to the DHV.

Appendix K: Proposed Signal Timing Changes as a Development Mitigation Measure

In response to the need for mitigating their traffic impacts, developers' traffic engineers will quite often recommend traffic signal timing changes, reducing the time on one leg of an intersection in order to increase it on another leg, usually the one impacted by the developer's development. This is an easy and inexpensive way to provide mitigation.

In the ordinary course of events, in the absence of sudden changes in traffic volumes, signal timing changes take place on a regular basis, e.g., annually, bi-annually, etc. Adjustments are made to accommodate changes in traffic volumes.

Typically, the signal in question is at the development driveway onto a main highway. In practice, what this means is that green time on the main highway is reduced to provide more time on the development driveway leg. This is a detriment to the through traffic on the main highway. At an isolated intersection, if not approaching capacity, this can be accommodated.

Intersections in a coordinated system present far different and more complex problems. Coordination in this context implies that adjacent signals are timed in such a manner that vehicles pass through the system without being stopped. Coordinated systems are delicately balanced and timed to attempt to insure that stops and delay are minimized. Anything that upsets the delicate balance can create chaos. Therefore, any developer's traffic engineer proposing signal modifications in a coordinated system must analyze the entire system to insure that any proposed changes do not cause the entire system to fail. Such a signal ***<u>cannot</u>*** be analyzed as an isolated intersection. In a coordinated system, signal timing changes can take weeks to implement, including time spent in the field refining the signal timings. **Any proposed signal timing changes must be paid for by the developer.**

In the absence of signal timing changes, often the only other feasible mitigation measures are geometric changes, such as adding or lengthening turning lanes or adding or lengthening lanes of side roads.

If any proposed signal timing changes cannot be accommodated in a coordinated signal system, then the proposed development is eligible for denial under Act 250 criterion 9(K), if the development will

> materially jeopardize or interfere with the function, efficiency, or safety of, or the public's use or enjoyment of or access to the facility, service, or lands.

Signal timing changes in a coordinated system can certainly "interfere with the function, efficiency or safety" of the highway in question.

Developers' traffic engineers must be careful of recommending signal timing changes in coordinated systems and must be prepared to fully analyze the entire extent of coordinated signal systems, including geometric changes.

Appendix L: Obtaining Crash Reports

As a part of the Safety Analyses (see **Error! Reference source not found.**), consultants are required to perform a collision diagram if a High Crash Location (HCL) is identified either by the consultant or by VTrans. This requires that the consultant obtain crash reports from VTrans. The Highway Research Unit is the sole repository for crash reports in VTrans Policy and Planning Division, and crash reports must be obtained from them.

The owner of the crash reports is the Department of Motor Vehicles (DMV). They are governed by the Driver Privacy Protection Act (DPPA) (18 U.S.C. 2721) regarding driver information that is available. With the recent increase in Identify Theft and concerns regarding privacy, the DMV is enforcing the provisions of the DPPA strictly. In order to obtain crash report information, DPPA approval is required from DMV. The DPPA approval form can be obtained from this website:

http://www.aot.state.vt.us/dmv/documents/TA/Vg/Tavg118.pdf.

In filling out this form, the proper use of the data to be obtained from the crash reports is in research activities. The consultant is then barred from disclosing or publishing personal information or contacting individuals involved in the crashes described in the crash reports. The reason for requesting the information is to prepare crash diagrams for use in Traffic Impact Studies in those locations designated as High Crash Locations. After the form has been filled out, submitted and approved by Commissioner of the Department of Motor Vehicles, no further approval is necessary indefinitely.

The procedure for obtaining crash reports for the Highway Research Unit of VTrans Policy and Planning Division is as follows:

--If a VTrans (or Regional Planning Commission [RPC] or Chittenden County Metropolitan Planning Organization [CCMPO]) consultant requests fewer than 30 reports, the Highway Research Unit will make copies and block out the personal information. No Driver Privacy Protection Act (DPPA) approval by DMV is necessary and there will be no charge for the copies. As always, the consultant should return the copies when done and the Highway Research Unit will shred them. Consultants working for private clients will need DPPA approval and will be charged for VTrans' time and paper.

--If any consultant requests more than 30 reports, the consultant has two options:

> --The consultant needs to obtain DPPA approval from DMV. Once DPPA approved, they have to come to VTrans, Highway Research to **view the reports in-house.** No hard copies will be made. Consultant cannot bring paper reports home. Any information they want, they will have to tabulate themselves. We will not make blocked out hard copies.
>
> or,

--If the consultant does not want to come here to view, they can go to DMV for hard copies and pay $15 (current charge by DMV) for each report. The contact at DMV is Holly Chapin (802-828-2066).

This change in procedure is necessitated by the Highway Research Unit's increased workload and reduced personnel levels. Furthermore, the Highway Research Unit needs as much time as possible, but no less than two weeks, to obtain and copy this information.