Massachusetts Department of Transportation
Highway Division
Revised 5/31/2022

Traffic and Safety Engineering
25% Design Submission Guidelines

As noted in MassDOT's *Project Development & Design Guide*, the following guidelines provide additional information related to the traffic and safety engineering elements of a project. These guidelines contain detailed descriptions and requirements of the report and plans to be included with the 25% Design Submission. A Functional Design Report (FDR), preliminary design plans, and the completed 25% Traffic and Safety Engineering Review Checklist are necessary components for all Transportation and Safety Improvement Projects, all Category II and III Highway Access Permit applications submitted to the Massachusetts Department of Transportation Highway Division (MassDOT), and any other type of Highway Access Permit application submitted for mitigation projects (referred to as "private development") permitted through the Massachusetts Environmental Policy Act (MEPA) process for which a Section 61 Finding has been issued. These guidelines standardize the preparation of Functional Design Reports and streamline the MassDOT review process.

I. Functional Design Report

A. Existing Conditions

1. *Study Area* – Description of the study area including, but not limited to: project length, roadway jurisdiction and classification, roadway geometry (i.e. lane layouts, usage, and width, shoulder widths, location and type of crosswalks, sidewalks, bike lane, shared use path, etc.), pavement conditions, vehicular, bicycle and pedestrian traffic control, posted speed limits as well as any applicable Speed Regulations, adjacent land use, number and operation of existing adjacent driveways, transit stations, bus stops (whether in-lane or pull-out), and on-street parking conditions. Include a project locus map.
2. *Existing Conditions* – Discussion of any physical or operational deficiencies or problem areas with the existing conditions (e.g., poor sight distance, excessive speeds, inefficient signal operation, lack of vehicular capacity, absence of pedestrian and bicycle accommodations, etc.). Evaluate the condition of the existing signals, signage, and pavement markings for potential repair or replacement. Document any specific areas of concern identified in the field.

B. Traffic Volumes

1. *Traffic Count Data* – MassDOT prefers the use of traffic counts (TMC and ATR by observation preferred, probe or sensor data discouraged) taken on or after March 1, 2022, rather than using historical data, except as noted in the following paragraph. However, projects that have already received MassDOT approval for traffic count adjustment methodology will be allowed to use those data. Project FDRs using historical count data collected between

January 1, 2014 and March 13, 2020 will be accepted if submitted to MassDOT prior to September 1, 2022, as long as the Procedures for Adjusting Historical Counts (see Appendix) are followed. Approved methodology correspondence with the MassDOT State Traffic Engineer for adjusting traffic counts taken between March 14, 2020 and February 28, 2022 to a non-pandemic condition shall be included in the FDR appendix.

Traffic counts taken on or after March 1, 2022 in areas where adjacent land use predominantly consists of office use may still vary significantly from pre-pandemic levels. The purpose, need, and type of count, should be taken into consideration by the design engineer or planner when developing a new count program in these area types. Furthermore, new counts in these area types may need to be adjusted to account for more workers returning to offices in the very near future. The methodology to adjust traffic counts taken on or after March 1, 2022 in these areas will need to be approved by the MassDOT State Traffic Engineer prior to the start of any traffic counting program. Adjustments to counts taken on or after March 1, 2022 that are used for Traffic Signal Warrants will not be accepted, except use of seasonal factors to adjust volumes to average month if MassDOT has published a factor for the year and month when counts were conducted.

See Section I.G.1.a regarding other Traffic Count Data requirements for traffic management during construction.

The traffic count data should be collected on an average Tuesday through Thursday when schools are in session, if possible, and exclude weeks with a holiday. The timeframe for conducting traffic counts may be altered based on land use or seasonal variations. Additional traffic count data may be required for the preparation of the Construction Management Outline (refer to Section I.G. Traffic Management for details).

a. *Automatic Traffic Recorder (ATR) Counts* – Counts should be conducted on the major roadway (both directions) for construction and safety improvement projects and on the roadway providing primary access to private development projects. The counts shall be continuous and completed over a minimum of 48 weekday-hours. The counts should be summarized in 15-minute, hourly, and daily intervals. If the project includes potential installation/modification of a traffic signal, ATR counts for the side street approaches shall be collected for a minimum of 24 continuous weekday-hours.

b. *Turning Movement Counts (TMC)* – Turning movement counts shall be collected in 15-minute intervals on all approaches of study area intersections, generally for a minimum of 2 hours during both the morning and evening roadway peak periods. However, additional peak hours shall be counted if the study area roadways and/or Private Development project-generated trips peak at a time other than the traditional morning and evening peak periods. A minimum of 8 hours of turning movement count data is required for justification of warrant

analysis for proposed signal installation. It may be necessary to review the ATR counts to determine the morning, evening, and 8-hour peak periods. The number of heavy vehicles, bicyclists, and pedestrians shall be collected as part of the TMC. Traffic network figures shall be provided for vehicle, bicycle, and pedestrian volumes during each peak hour studied.

2. *Base Year Traffic Volumes* – The FDR shall clearly identify the base year. Base year traffic volumes should represent an average month during the year the FDR is submitted. If the traffic count data were not collected during the FDR submission year, the data shall be factored by a seasonal and/or annual growth rate and adjusted by any traffic pattern changes from developments or roadway projects that have been completed since the time of the original count, as applicable. In the case of a private development project permitted through MEPA, the base year traffic should represent an average month no more than 2 years prior to the date of the FDR submission. Traffic network figures that show the base year volumes shall be provided for reference.

    a. Seasonal Factors – Base year volumes should be adjusted, in addition to the above, if the project is located in a region that experiences a notable seasonal variation or is primarily retail. A seasonal and monthly average factor should be based primarily upon MassDOT's *Weekday Seasonal Factors* file.

    b. Annual Background Growth Rate – Background growth rate, associated with region-wide population and employment trends, can be developed from documented historical data, or be directly supplied by the Office of Transportation Planning or the RPA. Justification of the background growth rate used shall be documented.

3. *Future Year Traffic Volumes* – All projects shall be evaluated with future year volumes. The future year is defined as 7 years, as a minimum, from the base year. In the case of private development projects, a timeframe of 7 years is recommended as the future year to allow for 2 years for the permitting process and a mandatory 5 years from occupancy. The volumes are typically comprised of the base year volumes, factored by the compounded annual background growth rate (refer to Section I.B.2.b Annual Background Growth Rate for details), and estimated vehicle trips for other specific developments or roadways projects that would be expected to change traffic patterns within the study area. Traffic network figures that show the future year volumes shall be provided for reference.

    a. *Other Specific Development* – Vehicle trips for other specific development or roadway projects should be included as identified by a MEPA filing or discussions with local and regional planning agencies, municipalities, or MassDOT.

    b. *Private Development Trips* – All private development projects should show new trip generation estimates and calculations. The method used for distributing trips should be documented and shown graphically;

this includes pass-by and diverted link trips. Pass-by rates should be consistent with the EOEA/EOT *Guidelines for EIR/EIS Traffic Impact Assessment*. Theoretical reductions in trip generation due to Transportation Demand Management (TDM) may be quantified in tabular format; however, full trip generation shall be used to provide a conservative analysis. Traffic network figures that show the base year volumes, the future year volumes without the project ("No-Build" condition), the new trip generation/distribution, the future year project trip assignment (to study area intersections), and the future year volumes with the project trips should be provided for reference.

C. Safety Analysis

1. *Crash Analysis* – Collection and analysis of crash records for all corridors and intersections within the study area is required. The crash data should be based on the latest 5 years of data available (preferred) or the latest 3 years of data available (minimum) and can be requested through the Traffic and Safety Engineering Section of the MassDOT Highway Division. Crash data should be compiled in tabular format and analysis of the data shall include, but not be limited to: discussion of trends, probable causes, and geometric shortfalls (e.g. stopping and intersection sight distance) based on all collected data.
2. *Crash Rate Worksheets* – Calculation of the study area segment(s) crash rates, for Interstate and locally classified roadways, using the standard MassDOT Crash Rate Worksheet are required. Arterial and collector roadways can be evaluated using the crash-based Network Screening Tool. Discussion shall be provided noting how the segment(s) calculated rates for the project compare to the District and State-wide average crash rates or how the segment ranks within the region and State, based on roadway functional classification.
3. *Collision Diagrams* – Collision diagrams are a helpful tool used to examine crash patterns at intersections and determine where improvements should be considered. Collision diagrams shall be based on the Massachusetts State Police or local police reports with crash diagrams and narratives and shall be completed for all study area intersections with more than 3 crashes per year. Back-up data to support the collision diagrams shall be provided.
4. *Collision Mapping* – Collision mapping is also a helpful tool used to examine patterns of crashes along a corridor. A collision map shall be created for study area corridors noting the number, type, and location of crashes.
5. *Safety Review* – Consideration shall be given to (but not limited to) the items listed in the Safety Review Prompt List during a site visit. Discussion shall be included in the FDR regarding the safety evaluation. If all or a portion of the project area is considered HSIP-eligible, the Safety Review shall be replaced with a Road Safety Audit (RSA) for the specific area. The Road Safety Audit shall be conducted in accordance with MassDOT Road Safety Audit Guidelines and shall be conducted prior to developing the 25% Design Plans. An HSIP-Eligible location is a high crash location, designated by region,

which is highlighted on the *Top Crash Locations* and identified as the latest year HSIP cluster (including Bicycle, Pedestrian, etc.).

D. MUTCD Signal Warrants

1. *Traffic Data* – The traffic count data for the major-street and the minor-street approaches shall be collected by turning movement count method. The data should be factored to an average month using the *Weekday Seasonal and Axle Correction Factors* file for the year that corresponds to the raw count data, if there is one published. If the Weekday Seasonal and Axle Correction Factors file is not published for the year that corresponds to the raw count data, the data should not be factored to average month. The resulting data shall be analyzed for a minimum of the highest 8 hours of the day. The volume data should be shown in tabular form for review.
2. *Warrant Analysis – MUTCD* Chapter 4C: Traffic Control Signal Needs (Warrants) *and the Massachusetts Amendments to the MUTCD* should be reviewed to determine if signal installation should be considered, or if an existing signal remains warranted.

E. Operational Analysis

1. *Capacity Analysis* – Capacity analysis should be conducted for all study area intersections using the latest *Highway Capacity Manual* methodologies, unless otherwise scoped and approved by the State Traffic Engineer. Capacity analysis results, including volume-to-capacity ratio, vehicle delay, and level of service (as available) should be shown in tabular format for each peak hour studied by lane group and overall intersection (as available). Where appropriate, short lane segments that operate effectively in the field as turning pockets, without being striped or signed as such, can be included in the capacity analyses. Engineering judgment shall be used in making this adjustment. All assumptions should be field verified and documented in the report text, and, to the extent possible, reviewed with MassDOT prior to conduct of the work. All analyses shall be included in the appendix; electronic files of these analyses shall be made available to MassDOT upon request.
    a. *Peak Hour Factor (PHF)* – All intersection approaches shall be evaluated based on the peak 15 minutes of data collected during the peak hour. The PHF shall be applied on an approach-by-approach basis for analysis of base year traffic volumes. For future year traffic volumes, the PHF shall be 0.88 for rural areas and 0.92 for urban areas.
    b. *Heavy Vehicle Percentage* – The traffic volume data used in the analysis shall include the percentage of heavy vehicles reflected in the actual TMC data. The percentage may be applied on an approach-by-approach basis, or by lane group as necessary.
    c. *Pedestrian Phase* – The existing or proposed pedestrian and bicycle signal phases should be incorporated into the analysis based on field

observation and engineering judgement and documented in the report text.

d. *Analysis Scenarios* – The following cases should be reviewed:

1. Base Year Traffic Volumes with Existing Geometry
2. Future Year Traffic Volumes with Existing Geometry
3. Future Year Traffic Volumes with Proposed Geometry

For Private Development Projects, scenarios 1 and 2 above shall be considered in addition to the following two scenarios:

- Future Year Traffic Volumes including full build development trips with Existing Geometry
- Future Year Traffic Volumes including full build development trips with Mitigated Geometry

2. *Systems Analysis* – A systems analysis shall be completed for closely spaced intersections and/or coordinated signal systems, using an analysis tool capable of providing the appropriate measures of effectiveness, subject to approval of the MassDOT HQ Traffic and Safety Engineering section. The systems analysis can be either arterial or network format. The scope for systems analysis shall be defined by the designer and approved by the MassDOT HQ Traffic and Safety Engineering Section, or the designer shall justify why a systems analysis is not needed. Areas of influence beyond the project limits may be included in the simulation if determined necessary by MassDOT. The most appropriate modeling software for the simulation shall be determined by the designer and also approved by the MassDOT HQ Traffic and Safety Engineering Section. The system model shall appropriately simulate the existing conditions before modeling alternative scenarios. Electronic files of these analyses shall be submitted to MassDOT for review.

3. *Queue Length Analysis* – Both 50th (average) and 95th-percentile queue length results should be depicted graphically as well as summarized in tabular format for the analysis scenarios listed above. Queue lengths should be determined from microsimulation analysis unless the designer can justify use of other methods. A standard vehicle length of 25 feet should be used unless data can be provided to support an alternate length.

4. *Basic Signal Strategy* – The capacity analyses evaluating the existing condition should accurately reflect the existing conditions such as timing and phasing, as determined by a field visit. The capacity analyses evaluating the Build condition shall replicate what is depicted in the plans.

F. Proposed Design

1. *Modified Geometry* – The report shall include discussion of the alternative designs considered, if any, and the proposed geometric changes associated with the preferred alternative. List out the strengths and weaknesses of each alternative and how a preferred alternative was determined. Discussion shall include the rationale for selecting the design criteria for the project. If the

Intersection Control Evaluation (ICE) procedures are conducted for the project, the report may refer to that document in lieu of a discussion. In that case, the ICE shall be included in the report appendix. When a roundabout intersection is proposed for a project, reference the MassDOT *Guidelines for the Planning and Design of Roundabouts*.

2. *Bicycle and Pedestrian Accommodation* – A narrative describing how the project improves or addresses bicycle and pedestrian accommodation shall be included, including pedestrian access to or from transit stations or bus stops. This narrative should also include impacts associated with meeting design requirements (i.e. ROW, environmental impacts, change in scope, construction costs).
3. *Proposed Traffic Control Modifications* – Modifications to the existing traffic control shall be documented through the *Intersection Control Evaluation* procedures, if applicable, as well as including specific details regarding the layout and intended operation of any new equipment.
4. *Mitigation Requirements* – For all Private Development projects the proposed mitigation requirements (Section 61 Finding, if applicable) should be clearly defined and a copy shall be included in the Appendix. This includes all phased work up to full build-out (mitigation phases based on occupancy, trip generation or other means). The schedule for improvements should be clearly defined in the document.
5. *Traffic Calming* – If a project is submitted to MassDOT for review that includes any form of traffic calming, it should follow the "Traffic Calming Guidelines" as developed by the New England Section of the Institute of Transportation Engineers on behalf of MassDOT. Traffic calming is primarily intended for functionally classified local roads.
6. *Safety Enhancements* – All study area intersections shall include corrective design measures based on the safety analysis. Discussion shall include all detailed recommendations to reduce the severity and/or number of crashes and enhance the overall safety condition of the roadway based on the field visit, collision diagrams/mapping and engineering judgment. In addition, all potential enhancements identified in the RSA report should be included in the proposed design or justified in the FDR why they are not feasible or appropriate.
7. *Work by Others* – The project shall document the "work to be done by others" and how the schedule for this work impacts the proposed project. Lapses in construction sequencing should be addressed with temporary improvements as necessary.

G. Traffic Management

1. *Construction Management Outline* – Provide a description of all major construction components of the project (utilities, culverts, sidewalks, roadway grading, etc.) and how vehicle, pedestrian, and bicycle accommodations will be maintained during that construction component (lane closures, bicycle and

pedestrian routes, detours and detour route descriptions, etc). The description should be detailed and include at a minimum: the number and width of available travel lanes for each direction of travel and proposed work hours. The traffic management approach selected for each component should result in the least adverse impact possible to all facility users. All temporary pedestrian facilities shall be fully accessible as directed by the Massachusetts Architectural Access Board (MAAB) and the Federal Americans with Disabilities Act Accessibility Guidelines (ADAAG).

a. *Traffic Count Data* – Traffic count data will be necessary for all construction projects that impact the roadways. In general, the criteria set forth in the I.B.1 Traffic Count Data section shall apply in addition to the following statement: Friday through Monday (weekend) counts will be necessary if construction will occur on those days given the difference in traffic patterns and time of day volumes when compared to a typical weekday. Traffic count data shall consist of 48-hour (minimum) ATR data for all roadways impacted by construction within the project limits. The ATR data shall include vehicle classification and speed information. If there is an existing or proposed traffic signal, existing designated turn lane(s), or multiple lanes approaching an unsignalized intersection, peak hour (based on the ATR data collected) Turning Movement Counts (TMCs) shall be submitted in addition to the ATRs. The TMCs shall provide classification by vehicle, bicycle and pedestrians. If the traffic signal is part of a coordinated system of signals additional TMCs and ATRs are required at the adjacent intersections both upstream and downstream of the project location. If construction impacts are such that they may have corridor or regional impacts additional count data may also be required as directed by the State Traffic Engineer.

b. *Traffic Signal Analysis* – The requirements of section 1.D MUTCD Signal Warrants section apply to temporary signals proposed for traffic management purposes, as well as to any existing traffic signals for which significant temporary modifications are proposed. For the purposes of this section, significant temporary modifications are defined as any modifications other than timing and coordination changes, or relocations of signal indications or pedestrian pushbuttons.

c. *Capacity Analysis* – Roadway capacity shall be evaluated using the required ATR data and the Measured Work Zone Capacities table provided on Figure Gen-1 of the *Standard Details and Drawings for the Development of Temporary Traffic Control Plans*. If the analysis shows traffic impacts, and backups are expected, additional mitigation may be required.

II. Preliminary Design Plans

A. Basic Design Plan Set

1. *Format* – The plan set should follow the guidelines specified in MassDOT's current *Project Development & Design Guide*. Refer to the most current "25% Highway Design Review Checklist" for step-by-step procedures. Sign & Pavement Marking plans, and Traffic Signal plans, shall be cut sheets matching the Construction Plans whenever feasible. Each Traffic Signal and Sign & Pavement Marking plan shall include reference to the sheet number (and for sheets where a traffic signal is included, the signal location number) of the corresponding Construction, Traffic Signal, and Sign & Pavement Marking plan as applicable. Adjacent plan sheets shall include an overlap of 100 feet (minimum). At project limits, plan sheets shall also depict existing conditions for at least 100 feet outside the limits.
2. *Roadway Cross-Section* – The typical cross-section for the roadway segments included in the project should be developed in accordance with MassDOT's *Project Development & Design Guide* to ensure a context-sensitive design that accommodates all users safely. This includes, but is not limited to, the provision for bicycle accommodation. Right-of-Way, environmental, historic and other constraints may influence the development of the roadway cross-section. The Designer is responsible for obtaining any necessary design exceptions at this stage of the design process.
3. *Additional Detail* – It is recommended to supply additional details on the preliminary plans, including but not limited to: lane and shoulder pavement markings, sign locations, crosswalk and pedestrian curb ramp placements, location of sidewalk facilities, and other bicycle, pedestrian, and transit accommodations.

B. Traffic Signal Plans

1. Traffic Signal Plans shall be prepared for each traffic signal, pedestrian hybrid beacon, and emergency hybrid beacon in the project. Each signal or hybrid beacon in a project shall be assigned a unique location number, which shall be consistent throughout all project documents.
2. *Signal Head Placement* – All existing and proposed traffic signal heads for motor vehicles, bicycles, transit vehicles (light rail and bus), and pedestrians shall be identified on the plans and positioned at their intended angle of sight.
3. *Signal Head Data* – The type and quantity of each signal head configuration shall be noted on the plans.
4. *Pavement Markings* – The pavement markings necessary to the operation of the traffic signals (e.g. lane layouts, stop lines, dedicated turn lanes) should be included on the traffic signal layout plans. Crosswalks may be depicted schematically.

5. *Sequence and Timing Chart* – Each signalized location shall have the appropriate sequence and timing chart included with the plan set. The sequence and timing chart detailed on the plans shall be consistent with the text and analysis in the Functional Design Report. Signal timings are not required at the 25% submission level.
6. *Preferential Phasing Diagram* – A preferential phasing diagram shall be shown for each signalized location and shall include the bicycle, pedestrian, transit, and emergency vehicle preemption phases as applicable. The phasing sequence detailed on the plans shall be consistent with the text and analysis in the Functional Design Report.
7. *Coordinated System* – A proposed method of coordination shall be noted for new coordinated traffic signal systems. If modification of an existing coordinated system is proposed, then the additional components shall be noted. Time-Space Diagrams for the interconnected signals are recommended at the 25% submission, although not required until the 75% submission stage.
8. *Signal Detectors* – Although this is not a requirement at the 25% design stage, it is recommended that traffic signal detector information be included in the signal plans. Location and detector type information is more important than specifics on hardwiring and geometrics. Bicycle detection is required at all signal installations unless the phase accommodating bicycles will be called during every cycle, except for movements where bicycles are prohibited, such as approaches to limited access highways.
9. *Miscellaneous* – Early coordination with MassDOT, the municipality, and the transit operator is helpful when considering emergency vehicle pre-emption, transit signal priority, the ownership and maintenance of signal equipment, and the payment of utility expenses.

C. Traffic Management Plans (TMP) – For significant projects, a TMP consists of a Temporary Traffic Control Plan (TTCP) and addresses the Intelligent Transportation System Monitoring Plan (IMP) and the Public Information Plan (PIP) aspects of the project.

1. *Basic TTCPs* – While it is not a requirement at the 25% design level, it is recommended that some preliminary temporary traffic control plans (TTCP) be provided at this stage. At a minimum, construction staging for bridge work shall be submitted at this stage if not sooner (pre-25%).
2. *Typical Layouts* – Each project shall include TTCP layouts expected to be used on the project. Unless the designer prepares site-specific layouts, the plans shall include, at a minimum, a typical TTCP layout as provided in the *MUTCD* or as provided in MassDOT's Standard Details and Drawings for the Development of Temporary Traffic Control Plans; however, modifications are usually necessary.
3. *Detour Routes* – All proposed detour routes should be clearly marked out and be "user friendly" to the general public. If a detour route uses roads not under

MassDOT jurisdiction then the plan shall be reviewed and approved by the municipality or agency having jurisdiction over the roads in the detour route.

4. *Pedestrian and Bicycle Accommodations* – All TTCPs shall address pedestrian and bicycle accommodation, including pedestrian access to or from transit stations or bus stops. If bicycle or pedestrian facilities are temporarily closed due to construction, then alternate routes shall be provided and clearly marked. Pedestrian accommodations should be provided on the shortest, easiest, most direct route feasible. All temporary pedestrian facilities shall be fully accessible as directed by the MAAB and the ADAAG.

APPENDIX

Procedures for Adjusting Historical Counts

The following procedures should be followed to adjust counts taken between January 1, 2014 and March 13, 2020 to approximate base year existing conditions. Use of these procedures will be accepted until September 1, 2022 without any additional approval required. Use of historical counts and these procedures will be accepted if the project's FDR is submitted to MassDOT prior to September 1, 2022.

How MassDOT Determines Growth Rates

MassDOT oversees approximately 500 permanent counting stations across the Commonwealth that are constantly taking volume data. In addition, MassDOT supplements these permanent count stations with spot counts taken at various locations. All of the count data is geolocated and, when processed, has the following metadata tagged to it:

- Geographic Area Type
  - U = Urban
  - R = Rural
- Functional Class
  - 1 = Interstate
  - 2 = Freeways & Expressways
  - 3 = Other Principal Arterial
  - 4 = Minor Arterial
  - 5 = Major Collector
  - 6 = Minor Collector
  - 7 = Local Road or Street
- Region
  - Boston = Middlesex, Suffolk, and Norfolk Counties
  - Essex = Essex County
  - *Southeast = Bristol, Plymouth, Barnstable, Nantucket, and Dukes Counties
  - *West = Berkshire, Franklin, Hampshire, and Hampden Counties
  - Worcester = Worcester County

This combination of Geographic Area Type, Functional Class, and Region is referred to as Factor Group. Based upon the aggregated count data for each Factor Group, MassDOT establishes day of week, monthly, yearly, and axle correction adjustment factors. These factors are published into reports that can be used to determine historical growth rates.

*Note that beginning in 2016, MassDOT has further refined some of the Factor Groups for portions of the Commonwealth that experience significant seasonal fluctuations in traffic. These Factor Groups supersede Geographic Area Type, Functional Class, and Region and may be applied to counts taken in 2016 or later anywhere within their boundaries. These Factor Groups are defined as:

- REC East: all towns on Cape Cod, the Town of Plymouth south of Route 3A, all towns on Martha's Vineyard, and Nantucket.

- REC West: roadways with a Functional Class of 3-5 in the towns of Becket, Great Barrington, Lee, Lenox, Stockbridge, and West Stockbridge.

Procedures for Estimating Average Annual Daily Traffic (AADT)

To estimate existing AADT from an historical count, the count location should be classified by Geographic Area Type, Functional Class, and Region per the descriptions from the previous section. Once the classification has been completed, the following steps are required.

1. Axle Correction

(Please note this step is required only if the original count did not include vehicle classification data, typically a single pneumatic tube. If classification data has been included, please proceed directly to Step 2.)

- Identify the year the count was taken.
- Open the *Weekday Seasonal and Axle Correction Factors* file for the year that corresponds to the raw count data.
- Multiply the average daily traffic (ADT) taken from the raw count data by the Axle Factor for the corresponding Factor Group.

2. Seasonal Factor

- Identify the month and year the count was taken.
- Open the *Weekday Seasonal and Axle Correction Factors* file for the year that corresponds to the raw count data.
- Multiply the number obtained in Step 1 (or the raw count data if it contains vehicle classification data) by the Monthly Factor for the corresponding Factor Group to determine the average-month condition.

3. Yearly Growth

- Identify the year the count was taken.
- Open the Yearly Growth Rate file. Note that MassDOT considers the calendar year when submitting the data to be existing.
- The Growth Factors are set up to factor count data to the year shown in the header column from the previous year. Therefore, using the appropriate Factor Group, multiply the number obtained in Step 2 by the growth factor for the year after it was taken. Repeat the factoring until it is grown to 2019. Then look at a nearby continuous count station to develop a factor for 2019 to the current year and adjust accordingly.
    - A count taken in 2018 will need the 2019 factor applied to it and then the factor associated with the nearby continuous count station.
    - A count taken in 2015 will need to go through five steps of factoring: the 2016 factor, the 2017 factor, the 2018 factor, the 2019 factor, and finally the factor associated with the nearby continuous count station.
- Once these steps have been completed, the existing AADT may be estimated.

Procedures for Estimating Turning Movement Counts (TMCs)

In cases where historic TMCs are available for an intersection, those volumes may be adjusted based upon these procedures in order to estimate existing traffic volumes.

1. Seasonal Factor

- Identify the day, month, and year the count was taken.
- Open the *Weekday Seasonal and Axle Correction Factors* file for the corresponding year.
- Using the appropriate Factor Group, identify the Seasonal Factor by month and day, and multiply the TMC by that number.

2. Yearly Growth

- Using the count data seasonally-factored to an average-month condition, follow the steps found in Part 3 of Procedures for Estimating AADT.