Intersection Control Evaluation (ICE) Procedure Requirements

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1. Intersection Control Evaluation Introduction

The purpose of an Intersection Control Evaluation (ICE) is to consider multiple context-sensitive control strategies in a consistent manner when planning a new intersection or modifying an existing intersection. The ICE process provides an opportunity for safety to be integrated into intersection control decisions, leading to the implementation of safer, more balanced cost-effective solutions. The goal of an ICE is to objectively select a control strategy that meets the project's purpose and need and fits the intersection's location context and roadway classification, while achieving the overall long-term best value.

The intersection control strategies analyzed in the ICE Procedure include Two-Way Stop Control, All-Way Stop Control, Traffic Signal, Roundabout, Displaced Left Turn (DLT), Median U-Turn (MUT), Signalized Restricted Crossing U-Turn (RCUT), Unsignalized RCUT, Continuous Green T (CGT) Intersection, Jughandle, and Quadrant Roadway (QR) Intersection.

2. Applicability

All projects in the Advertising Program and any development projects that require MEPA review and were specifically scoped for an Intersection Control Evaluation will require the Project Proponent to determine if ICE is applicable or not for the permanent condition. ICE is not intended to be applied for temporary traffic control conditions. ICE is not applicable to Highway Access Permit Projects, unless it was subject to review as part of the MEPA process and the project was specifically scoped for ICE and the intersection control has not yet been determined. Refer to the MA Amendments to MUTCD for additional information.

ICE applicability is determined by a multi-step process. The Project Proponent should first determine if the project is exempt from ICE or not. If the project is not exempt, the Project Proponent will then need to check all intersections within the project to determine whether each intersection is exempt from ICE or not. For the purpose of the ICE Procedure, all major driveways are considered intersections.

Project Exemption

A project is **exempt** from the ICE Procedure if any of the following conditions apply:

- The project is:
    - municipally-led, *and*
    - entirely on locally-maintained roadways, *and*
    - not funded using Federal Highway Administration funds, *and*
    - not being designed by MassDOT or by consultants under contract with MassDOT, *and*
    - not advertised by MassDOT
- The project is entirely funded through Chapter 90 or a MassDOT grant program, and is entirely on locally-maintained roadways
- The project receives a written waiver from the State Traffic Engineer (See Section 2a)

- The project has been reviewed through the MEPA process and has a Section 61 Finding with specific mitigation requirements

- The project contains no intersections within the limits of work

- The project is any of the following types: Bridge Preservation, Deck Replacement, Superstructure Replacement, Pavement Preservation, District-wide Maintenance, Quick-Build/Systemic Safety, Various Locations, Highway and Tunnel Maintenance, ADA Retrofits, Sidewalk Construction and Repairs, or Resiliency

Intersection Exemption

The Project Proponent shall determine if ICE is required for each project intersection. A project intersection is **exempt** from the ICE Procedure if either of the following two conditions apply:

1. All minor street approaches to the intersection have an AADT less than 1,000 vehicles per day
2. The intersection receives a written waiver from the State Traffic Engineer (see section 2a)

ICE is **required** when a project intersection meets one or more of the Intersection Criteria below, unless the project intersection is exempt. If none of the Intersection Criteria below apply to a project intersection, ICE Procedure is not required for that project intersection.

Intersection Criteria

- Creating a new intersection
- Adding a leg to an existing intersection
- Adding one or more through lanes, left-turn lanes, channelized turn lanes, or bypass lanes to an existing intersection approach (Note: this does not include reallocating existing pavement. For example, changing the lane use on an approach from a through lane to a left-turn lane does not constitute adding a lane.)
- Changing the traffic control at an existing intersection. Examples include:
    - Adding or removing a traffic signal
    - Adding or removing a Stop or Yield sign to control an intersection movement on an approach (Note: this does not include replacing a Stop or Yield sign with a traffic signal for channelized right turn at an intersection where the main control is a signal)
- High-crash location, except when the scope of work is limited to maintenance or resurfacing. For the purpose of the ICE Procedure, a high-crash location is defined as an intersection within a cluster (to include vehicle, pedestrian, or bicycle) for the most recent period shown on the MassDOT Interactive Crash Cluster Map (https://gis.massdot.state.ma.us/topcrashlocations/). Note that a high-crash location is defined differently for purposes of Road Safety Audits.
    - Ramp terminals, roundabouts, and rotary intersections are not included on MassDOT's Interactive Crash Cluster Map. If a subject location is one of these intersection types,

MassDOT Traffic Safety should be contacted (TrafficSafetyAnalysis@dot.state.ma.us) to determine whether the location is a high crash location or not. This determination should be formally documented with MassDOT HQ and District Traffic sections copied.

MassDOT encourages municipalities to perform an ICE for intersection projects they lead and fund on locally-maintained roadways, but ultimately it is the choice of the municipality.

Applicability Form

The Applicability Form, located on the MassDOT ICE webpage, is to be completed by the Project Proponent or their designee at Project Initiation and submitted through MaPIT for new MassDOT Highway Division, Non-MassDOT State Agency, or Municipal project types. If ICE is not applicable, it must be noted in MaPIT. The Applicability Form is reviewed by MassDOT HQ and District staff. The Applicability Form may also be used for projects that have already been initiated but have not been submitted at the 25% design stage.

If significant changes are made to a project, including but not limited to design changes, scope increases, or changes to project limits, MassDOT may require reevaluation on whether the ICE Procedure is applicable or not. Additionally, if the only trigger for ICE is an "Unknown" for the added lane or change in traffic control criteria on the form, there will be a pause in the ICE process until more details are known about intended scope (i.e. until traffic counts are taken to know if a turn lane is needed). A new Applicability Form with definitive "Yes" or "No" answers should be submitted and approved prior to commencing design.

The approved ICE Applicability Form should be attached to the 25% Design documentation.

2a. Waiver Procedure

If a written waiver from the State Traffic Engineer is being requested, an email with a memo containing the below information shall be sent to James Danila, P.E., State Traffic Engineer (James.Danila@dot.state.ma.us) with the Traffic Safety Analysis group (TrafficSafetyAnalysis@dot.state.ma.us) copied.

- Project information summary (including MassDOT project number, if known)
- Whether the waiver is being requested for the entire project or individual intersection(s) within the project
  - If the waiver is for the entire project, project limits shall be specified
  - If the waiver is for individual intersections, the intersections shall be specified
- Narrative describing reasons for the waiver
- Any supporting analysis, such as traffic volumes, if available

A waiver should be requested prior to project scoping, but also can be requested at any time during the ICE process if the Proponent feels there is a valid reason for the request. Examples of reasons why waivers may be considered include, but are not limited to:

- Alternatives analysis was conducted prior to project initiation
- Short-term project at the same location as a proposed long-term project where the intersection control will be evaluated as part of the long-term project
- Implementation of only low to medium cost countermeasures from a road safety audit
- Intersection outside of project limits and proposed improvements limited to minor changes (signal phasing, signage, pavement markings only) to mitigate project-related queues
- No viable control options other than existing control
- Closely spaced intersections requiring a systems analysis to be performed outside of the ICE process (details on the alternatives analysis to be performed and the proposed evaluation criteria should be included in the request)

Waiver request documentation and approval must be attached to the 25% Design documentation.

2b. Applicability for Projects Already Initiated

For MassDOT-led projects and any projects on State Highway that were initiated before the ICE Procedure went into effect on March 31, 2021, and meet the criteria for requiring the ICE Procedure, all applicable ICE Stages **shall** be completed prior to the 25% submission if the project's 25% submission package has not yet been submitted or is being resubmitted. The ICE Procedure is not required if the project's 25% submission package was received by MassDOT prior to March 31, 2021.

For municipally-led projects that were initiated before the ICE Procedure went into effect on March 31, 2021, and meet the criteria for requiring the ICE Procedure, all applicable ICE Stages **should** be completed prior to the 25% submission if the project's 25% submission package has not yet been submitted or is being resubmitted. The ICE Procedure is not required if the project's 25% submission package was received by MassDOT prior to March 31, 2021.

3. Conducting an Intersection Control Evaluation

The MassDOT ICE Procedure includes up to three stages and is the same whether it involves new intersections or modifications to existing intersections. One stage is completed at a time, and advancement to the next stage shall only be done after HQ Traffic & Safety and District Traffic's approval of the previous stage. The Procedure ends at the stage where a single preferred intersection control strategy can be justified and documented. Each of the three stages require more detailed analyses with each iteration as follows:

- **Stage 1: Screening –** considers a wide range of control strategies. Stage 1 includes the ICE Form and the following optional items: count data, preliminary capacity analysis (CAP-X), warrants analysis, safety analysis, high level sketch of alternatives, or any other analysis prepared as part of Stage 1. Eliminates fatally-flawed alternatives. Fatal flaws include but are not limited to:

    - Alternatives that do not fit with the project needs, objectives, and scope
    - Alternatives that trigger Article 97, when other alternatives exist that do not require Article 97 takings

- Right-of-way (ROW) for municipal projects: municipality does not support the ROW acquisition process
- Impacts that require a lengthy ROW acquisition or permitting process that may push the project schedule beyond the programmed timeline
- Traffic control strategy not in conformance with MUTCD, including MA Amendments
- Relocation of power transmission lines
- Removal of five or more shade trees within an Environmental Justice community

- **Stage 2: Initial Assessment** – is only conducted if more than one viable control strategy emerges from Stage 1 and after HQ Traffic & Safety and District Traffic's approval of Stage 1. Stage 2 includes the ICE Form and traffic operations analyses; crash predictions or qualitative safety analysis; conceptual level sketches of alternatives; and planning level estimates of probable design, right-of-way, and construction costs. Traffic data used in Stage 2 shall adhere to MassDOT Traffic and Safety Engineering 25% Design Submission Guidelines. If a proposed alternative includes traffic signals, a MUTCD traffic signal warrant analysis shall be conducted.

  At closely spaced intersections including highway interchanges with multiple ramp junctions, MassDOT may request that the intersections be considered and evaluated through the ICE Procedure as a system. In some cases, a quantitative safety analysis may not be possible, and a qualitative safety analysis will be required. Some examples of where qualitative analyses may be needed include, but are not limited to, the following situations:

  - Ramp terminals
  - Rotaries
  - Intersections with more than four approach legs
  - Intersections with one or more legs operating one-way from the intersection

  Consult with MassDOT Traffic and Safety group on how to proceed in these cases.

- **Stage 3: Detailed Assessment** – is only conducted if more than one preferred control strategy emerges from Stage 2 and after HQ Traffic and Safety and District Traffic's approval of Stage 2. Stage 3 includes the ICE Form, more detailed traffic operations analyses, preliminary geometric designs, and opinions of probable costs. The increased level of detail informs more detailed opinions of probable costs.

Table 1 summarizes details about each submission, the timeline, and responsible parties for MassDOT Advertisement projects and all other types of projects where an ICE is required.

Table 1. ICE Procedure Submissions, Timeline, and Responsible Parties when ICE is Required

Applicability	When the Stage is completed	Who completes the Stage	What is included in the submission	Who approves the Stage	Next step
All Projects	Submitted in MaPIT at Project Initiation (MassDOT and Municipal) Determined at Scoping (MEPA projects specifically scoped for ICE)	Project Proponent or their designee	▪ ICE Applicability Form in PDF	MassDOT District Traffic	After District approval, advance to Stage 1 for any intersections where ICE is applicable. If ICE is not applicable, the design process may advance.
Stage 1					
MassDOT Advertisement Projects	Submitted prior to the Project Scoping Meeting	Project Proponent or their designee	▪ ICE Stage 1 Form ▪ Optional: CAP-X analysis, count data, warrants analysis, safety evaluation, high-level sketch of alternatives or any other analysis completed for Stage 1	MassDOT HQ Traffic and Safety and District Traffic	If a single viable control strategy emerges from ICE Stage 1 then ICE is complete, and the design process may advance. If multiple viable control strategies emerge from ICE Stage 1, move to ICE Stage 2 after approval from MassDOT HQ Traffic & Safety and District Traffic.
All other Projects	Must be completed and approved before the 25% submission. It is recommended that ICE Stage 1 is completed as early as possible. When ICE is scoped for projects requiring a MEPA review, it is recommended that Stage 1 be completed prior to the Traffic Impact Assessment (TIA).	Project Proponent's Designer			
Stage 2					
MassDOT Advertisement Projects	Submitted after MassDOT approval of Stage 1 and completion of the Scoping Checklist, but prior to the pre-25% Over-the-Shoulder meeting	Project Designer	▪ ICE Stage 2 Form ▪ ICE Tool ▪ Safety Alternatives Analysis Tool ▪ Conceptual level sketch ▪ Any supporting traffic data or analysis (including but not limited to traffic count data, capacity analysis, cost estimate, Traffic Signal Warrant analysis, if applicable) completed for Stage 2	MassDOT HQ Traffic and Safety and District Traffic	If a single clearly preferred control strategy emerges from ICE Stage 2 then ICE is complete, and the design process may advance. If more than one preferred control strategy emerges from ICE Stage 2, move to ICE Stage 3 after approval from MassDOT HQ Traffic & Safety and District Traffic.
All other Projects	Must be completed and approved before the 25% submission and after MassDOT acceptance of Stage 1. When ICE is scoped for projects requiring a MEPA review, it is recommended that Stage 2 be completed with the Traffic Impact Assessment (TIA).	Project Proponent's Designer			
Stage 3					
MassDOT Advertisement Projects	Submitted after MassDOT approval of Stage 2, but prior to the Pre-25% Over-the-Shoulder meeting	Project Designer	▪ ICE Stage 3 Form ▪ Preliminary geometric design ▪ Any new supporting traffic data or analysis (including but not limited to traffic count data, capacity analysis, simulations, detailed cost estimate, Traffic Signal Warrant analysis, if applicable) completed for Stage 3	MassDOT HQ Traffic and Safety and District Traffic	A single alternative must be selected. ICE is complete and the design process may advance after approval from MassDOT HQ Traffic & Safety and District Traffic.
All other Projects	Must be completed and approved before the 25% submission and after MassDOT acceptance of Stage 2.	Project Proponent's Designer			

Notes:

- **When ICE is scoped for projects requiring a MEPA review, MassDOT HQ Traffic & Safety and District Traffic should both provide concurrence that the ICE process has been adequately completed and a single control strategy selected prior to the issuance of a Section 61 Finding.**
- **If significant design changes are made to an intersection during design development after an intersection has advanced in the ICE Procedure process, MassDOT may require resubmission of a previous ICE stage.**

4. ICE Documentation and Tools

The project proponent or designer shall prepare an ICE Form documenting the outcomes of each evaluation stage. The ICE Form shall identify the control strategies considered, reasons for eliminating control strategies, and reasons or analyses results for selecting a preferred strategy or strategies. The latest version of the ICE forms can be downloaded from https://www.mass.gov/info-details/massdot-intersection-control-evaluation-ice. Forms and other tools are continually updated on the website, and the latest versions should be used for each submission.

The project proponent or designer may use the CAP-X tool, MassDOT Safety Alternatives Analysis Guide, and MassDOT ICE Tool during the ICE Procedure, depending on the evaluation stage. A description of each tool, as well as when it is used during the Procedure, is provided below. The latest version of the MassDOT ICE Tool, and links to the CAP-X tool and Safety Alternatives Analysis Guide, are available on https://www.mass.gov/info-details/massdot-intersection-control-evaluation-ice.

- Capacity Analysis for Planning of Junctions (CAP-X). When turning movement count data is available, this tool is a recommended but optional step during ICE Stage 1. This Microsoft® Excel spreadsheet-based tool is used to evaluate various intersection control strategies using peak flow volumes and lane configurations as inputs. The output is a volume-to-capacity ratio for each control strategy based either on critical lane volume summations or HCM equations.

- MassDOT Safety Alternatives Analysis Guide. These guidelines and accompanying Microsoft® Excel spreadsheets use MassDOT-calibrated SPFs and CMFs to calculate predicted and expected crashes at a location. These calculated crashes may be used as input for the MassDOT ICE Tool. The MassDOT Safety Alternatives Analysis Guide can be found on the Highway Safety Improvement Program page.

- MassDOT ICE Tool. This Microsoft® Excel spreadsheet-based tool is used during ICE Stage 2 and provides a project life-cycle net present value and benefit-to-cost ratio for potential intersection control strategies. The tool incorporates several considerations for screening and assessing intersection control strategies including safety performance, operational and capacity considerations, as well as impacts and costs associated with right-of-way, design, and construction.

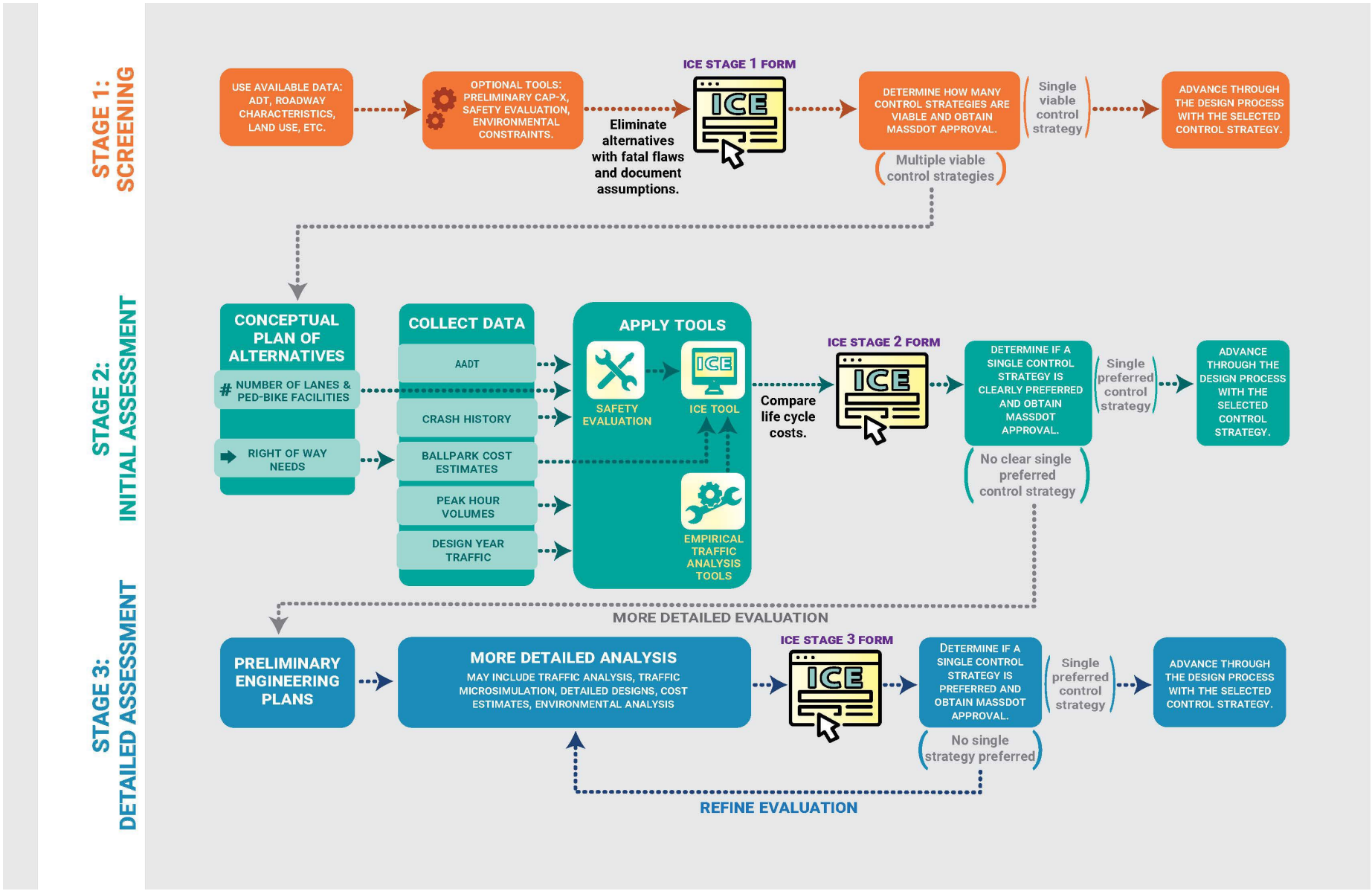
5. ICE Submission Requirements

The level of required documentation varies by ICE Stage. Submission requirements include the following:

- **Stage 1: Screening**
  - Required
    - ICE Stage 1 Form in PDF (one per intersection)
  - Optional (compiled into a single PDF with table of contents)
    - Approved ICE Applicability Form
    - High level sketch of alternatives
    - CAP-X analysis in PDF (Tab 5b – Detailed Report) and Excel formats, if performed
    - Traffic volume data/source, if used to perform CAP-X
    - Warrants analyses, if referenced in justifications for any control strategies
    - Safety analysis, if performed
- **Stage 2: Initial Assessment**
  - Required
    - ICE Stage 2 Form in PDF (one per intersection)
    - ICE Tool in PDF (one per intersection). Excel to be submitted as back up.
    - Safety Analysis Spreadsheet or qualitative analysis (one per intersection, multiple years can be combined into a single PDF). Excel files to be submitted as back up.
    - Concept sketches in PDF (one per intersection)
    - All supporting analysis, combined into a single PDF with a table of contents
      - Capacity analysis
      - Crash data
      - Traffic Signal Warrants Analysis, if applicable
      - Count data
      - Planning level cost estimates
      - Any other supporting documentation prepared for Stage 2
- . **Stage 3: Detailed Assessment**
  - Required
    - ICE Stage 3 Form in PDF (one per intersection)
    - Preliminary geometric design in PDF
    - Detailed cost estimate in PDF
    - Capacity analysis in PDF
    - Any other supporting documentation prepared for Stage 3 (compiled into a single PDF with table of contents)

The results of the ICE submissions (including waivers, if granted) should be documented in a project's Functional Design Report (FDR) or Traffic Impact Study (TIS), as required. https://www.mass.gov/info-details/massdot-intersection-control-evaluation-ice

The exhibit below illustrates all three stages of the ICE Procedure:


STAGE 1: SCREENING
USE AVAILABLE DATA: ADT, ROADWAY CHARACTERISTICS, LAND USE, ETC.
OPTIONAL TOOLS: PRELIMINARY CAP-X, SAFETY EVALUATION, ENVIRONMENTAL CONSTRAINTS.
Eliminate alternatives with fatal flaws and document assumptions.
ICE STAGE 1 FORM
ICE
DETERMINE HOW MANY CONTROL STRATEGIES ARE VIABLE AND OBTAIN MASSDOT APPROVAL.
Single viable control strategy
ADVANCE THROUGH THE DESIGN PROCESS WITH THE SELECTED CONTROL STRATEGY.
Multiple viable control strategies
STAGE 2: INITIAL ASSESSMENT
CONCEPTUAL PLAN OF ALTERNATIVES
NUMBER OF LANES & PED-BIKE FACILITIES
RIGHT OF WAY NEEDS
COLLECT DATA
AADT
CRASH HISTORY
BALLPARK COST ESTIMATES
PEAK HOUR VOLUMES
DESIGN YEAR TRAFFIC
APPLY TOOLS
SAFETY EVALUATION
ICE TOOL
EMPIRICAL TRAFFIC ANALYSIS TOOLS
Compare life cycle costs.
ICE STAGE 2 FORM
ICE
DETERMINE IF A SINGLE CONTROL STRATEGY IS CLEARLY PREFERRED AND OBTAIN MASSDOT APPROVAL.
Single preferred control strategy
ADVANCE THROUGH THE DESIGN PROCESS WITH THE SELECTED CONTROL STRATEGY.
No clear single preferred control strategy
MORE DETAILED EVALUATION
STAGE 3: DETAILED ASSESSMENT
PRELIMINARY ENGINEERING PLANS
MORE DETAILED ANALYSIS
MAY INCLUDE TRAFFIC ANALYSIS, TRAFFIC MICROSIMULATION, DETAILED DESIGNS, COST ESTIMATES, ENVIRONMENTAL ANALYSIS
ICE STAGE 3 FORM
ICE
DETERMINE IF A SINGLE CONTROL STRATEGY IS PREFERRED AND OBTAIN MASSDOT APPROVAL.
Single preferred control strategy
ADVANCE THROUGH THE DESIGN PROCESS WITH THE SELECTED CONTROL STRATEGY.
No single strategy preferred
REFINE EVALUATION