Appendix
Merrimack Valley Metropolitan Planning Organization
Federal Fiscal Years 2019 to 2023 Transportation Improvement Program

Appendix Final Report

May 2018

Prepared by the Merrimack Valley Planning Commission

This document was prepared by the Merrimack Valley Planning Commission under Contracts #95416, #MA-80-011 and #MA-80-012 with MassDOT and with the assistance of the Merrimack Valley Regional Transit Authority, MassDOT, the Federal Highway Administration and the Federal Transit Administration.

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Table of Contents

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Appendices

Appendix A and B: Other Regional Priorities

Appendix A Other Regional Priority Bridge Projects

(No Funding Available)

Bridges That Do Not Fit into Fiscally Constrained Targets and therefore have No Funding Available in Any Year (By Town):

ID	Location	Project Description	Estimated Total Project Cost
602322	Ames.	Amesbury - Bridge Replacement, A-07-008, Oak Street Over the B&M Railroad (Abandoned Line)	$1,000,000
	And.	Andover - Rehab. Bridge (A-09-001) Route 28 (North Main Street) Over the Shawsheen River	
605418	And.	Andover - Bridge Preservation, A-09-028, Chandler Road over I-93	$3,450,000
606522	And.	Andover - Bridge Rehabilitation, A-09-036, I-495 over ST 28 (SB), A-09-037, I-495 over B&M and MBTA, A-09-041, I-495 over ST 28 (NB)	$22,706,948
605304	Hav.	Haverhill- Bridge Replacement, H-12-007 & H-12-025, Bridge Street (SR 125) over the Merrimack River and the Abandoned B&M RR (Proposed Bikeway)	$63,437,220
604839	Law.	Lawrence – Bridge Replacement, L-04-027, Lowell Street over B&M Railroad	$4,473,000
	Law.	Lawrence - Bridge Rehabilitation, L-04-042, South Union Connector over South Street	

Appendix A Other Regional Priority Bridge Projects (Continued)

(No Funding Available)

Bridges That Do Not Fit into Fiscally Constrained Targets and therefore have No Funding Available in Any Year (By Town):

ID	Location	Project Description	Estimated Total Project Cost
	Nbypt.	Newburyport - Bridge (N-11-002) State Route 113 (High Street) Over Railroad	
	Nbypt.	Newburyport - Bridge (N-11-014) State Route 1A (High Street) over US 1	
607115	Nbypt.	Newburyport - Bridge Repairs, N-11-015, Washington St. over US 1	$1,400,000

Appendix B Other Regional Priority Roadway Projects

(No Funding Available)

Roadway Projects That Do Not Fit into Fiscally Constrained Targets and therefore have No Funding Available in Any Year (By Town)

ID	Location	Project Description	Estimated Total Project Cost
608336	Andover	Andover – Reconstruction on Route 133 (Lowell Street), from Lovejoy Road to Route 28 (North Main Street) TEC = 11.00	$7,245,000
607708	Andover/ Lawrence	Andover - Lawrence - Resurfacing and re-lated work on Route 28 TEC = 5.22	$1,062,600
606721	Boxford	Boxford - Reconstruction of Route 133 (Washington Street) from North Andover town line to Main Street TEC = 5.60	$5,172,164
	Boxford	Boxford Reconstruction of Route 97 from Georgetown to Topsfield (2 miles)	$3,785,000
607540	Boxford	Boxford - Border to Boston Trail TEC = 3.32	$4,174,500
602843	Georgetown	Georgetown – Reconstruction on Route 97 (W. Main Street) from Moulton Street to Groveland T.L. TEC = 4.77	$7,239,453
	Haverhill	Haverhill -Intersection Improvements Route 110 and Elliott Street	
	Haverhill	Haverhill – Widen Route 97 (Broadway) from Computer Drive to Research Drive	

Appendix B Other Regional Priority Roadway Projects (Continued)

(No Funding Available)

Roadway Projects That Do Not Fit into Fiscally Constrained Targets and therefore have No Funding Available in Any Year (By Town):

ID	Location	Project Description	Estimated Total Project Cost
607711	Haverhill	Haverhill - Resurfacing and related work on Route 125 (from N. And. TL to Boston Rd) TEC = 5.80	$1,062,600
608721	Haverhill	Haverhill – Corridor Improvements on Water Street (Route 97/113), from Ginty Boulevard/Mill Street to Lincoln Boulevard/Riverside Avenue TEC = 7.98	$8,050,000
	Haverhill	Haverhill – Buttonwoods Trail	$2,000,000
602339	Haverhill	Haverhill-Historic Waterfront Walkway Phase II (Construction)	$3,110,184
	Lawrence/ North Andover	Lawrence - North Andover - Reconstruction of Route 114 from I-495 in Lawrence to Rt. 125 (Andover St.) in North Andover TEC = 12.8	

Appendix B Other Regional Priority Roadway Projects (Continued)

(No Funding Available)

Roadway Projects That Do Not Fit into Fiscally Constrained Targets and therefore have No Funding Available in Any Year (By Town):

ID	Location	Project Description	Estimated Total Project Cost
	Methuen	Methuen – Reconstruction of Route 110 from Burnham Road to Woodland Street	
	Newbury-port	Newburyport -Route 1 Rotary Reconfiguration	
608029	Newbury-port	Newburyport - Intersection Improvements Route 1 at Merrimac Street TEC = 7.22	$2,400,000
	North Andover	North Andover - Machine Shop Village im-provements	
	North Andover	North Andover – Reconstruction of Mass. Ave. and Sidewalks (from Osgood St. to I-495)	
605694	North Andover	North Andover - Resurfacing and related work Route 125 TEC = 7.45	$7,910,592
	North Andover	North Andover - Signals and turn lanes at Mass Ave. and I-495 NB and SB Ramps	
607710	Salisbury	Salisbury – Resurfacing and related work Route 1A TEC = 5.60	$2,300,000

Appendix C Transportation Evaluation Criteria Summary

Appendix C Transportation Evaluation Criteria Summary

Programmed for Funding in Draft TIP	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2019-2023)
No		Lawrence –North Andover - Reconstruction of Rt. 114 from I-495 to Rt. 125 (Andover St.)		30,000	5.6	3.00	3.00	3.00	1.80	1.50	0.50	**12.80**
Yes	608095	North Andover – Reconstruction of Rt. 114 from Rt. 125 (Andover St.) to Stop & Shop	$14,950	30,000	4.8	2.50	2.75	2.67	1.00	1.50	0.75	**11.17**
No	608336	Andover – Rt. 133 reconst. Lovejoy Road to Shawsheen Square (inc. Shawsheen Square)	$7,245	12,773	4.4	2.00	2.75	2.00	1.00	1.75	1.50	**11.00**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

Programmed for Funding in Draft TIP	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2019-2023)
Yes	608930	Lawrence – LMRC Rail Trail	$14,895	NA	NA	1.00	1.75	1.67	3.00	2.50	1.00	**10.92**
No		Lawrence – Merrimack St. (Parker St. to South Union St.)		9,654	0.6	2.50	1.25	1.33	1.60	2.25	0.75	**9.68**
Yes	608761	Haverhill - Intersection Improvements at Rt. 110 / Rt. 108	$1,944	NA	NA	1.00	1.75	1.67	1.20	1.75	1.00	**8.37**
Yes	602202	Salisbury – Reconstruction of Route 1 (Lafayette Road)	$6,331	12,147	4.8	1.50	2.00	2.00	0.60	1.5	0.5	**8.10**
No	608788	Haverhill - Reconstruction of North Ave. from Main St. to NH stateline	$12,213	13,172	4	2.50	1.75	1.00	2.00	0.00	0.75	**8.00**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

Programmed for Funding in Draft TIP	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2019-2023)
No	608721	Haverhill - Corridor Improvements on Water St. from Ginty Blvd / Mill St. to Lincoln Ave./ Riverside Ave.	$8,050	20,200	2	1.50	1.75	1.33	1.40	1.25	0.75	**7.98**
Yes	606159	North Andover – Intersection Improvements Route 125 at Mass. Ave.	$5,447	30,284	NA	1.50	1.75	2.00	1.20	0.75	0.75	**7.95**
No	605694	North Andover – Route 125 Resurfacing and related work	$7,911	20,400	9.4	2.50	1.00	1.00	1.20	1.25	0.50	**7.45**
No	608029	Newburyport – Intersection Improvements Rt. 1 at Merrimac St.	$2,400	24,850	NA	2.00	0.50	2.67	0.80	1.00	0.25	**7.22**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

Programmed for Funding in Draft TIP	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2019-2023)
Yes	608027	Haverhill – Bradford Rail Trail extension	$1,088	NA	NA	0.50	1.50	1.00	2.40	1.25	0.50	**7.15**
Yes	602418	Amesbury – Reconstruction of Elm Street	$12,064	12,436	3.4	1.50	0.50	1.33	0.40	1.50	0.75	**5.98**
In FFY 2018 TIP	605020	Salisbury – Multi-use Trail Extension (Border to Boston Trail), includes new bridge S-02-004	$7,184	NA	NA	1.00	1.25	1.33	0.80	0.75	0.75	**5.88**
No	607711	Haverhill – Resurfacing and related work Rt. 125	$1,063	19,224	4.1	2.00	0.75	1.00	0.80	0.75	0.50	**5.80**
No	606721	Boxford - Route 133 (North Andover TL to Main St.)	$5,172	6,149	2.9	1.50	1.00	1.00	0.60	0.50	1.00	**5.60**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

Programmed for Funding in Draft TIP	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2019-2023)
No	607710	Salisbury – Resurfacing and related work Route 1A	$2,300	11,411	8.0	2.00	0.75	1.00	0.60	0.75	0.50	**5.60**
Proposed Amend to add to FFY 2018	608946	Lawrence – Intersection Improvements Haverhill Street (Rt 110) at Ames Street	$1,268	NA	NA	1.50	1.25	1.33	1.20	0.00	0.25	**5.53**
No	607708	Andover / Lawrence – Route 28 resurfacing and related work	$1,063	19,728	4.0	2.50	0.25	0.67	0.80	0.50	0.50	**5.22**
Yes	607542	Georgetown – Square to Byfield (Northern) section of Border to Boston Trail	$3,876	NA	NA	0.50	1.25	0.67	0.80	1.50	0.50	**5.22**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

Programmed for Funding in Draft TIP	ID#	Project Description	Project Cost in 1000s	AADT	Linear Lane Miles	Condition	Mobility	Safety & Security	Community Effects & Support	Land Use & Economic Development	Environmental Effects	Total TEC Score (2019-2023)
Yes	607541	Georgetown- Boxford– south of Square to Georgetown Road (Southern) section of Border to Boston Trail	$1,735	NA	NA	0.50	1.25	0.67	0.80	1.25	0.75	**5.22**
No	605753	Groveland – Route 97 (Parker Rd. to Gardner St.)	$3,894	13,500	1.8	1.50	0.50	1.00	0.40	1.00	0.50	**4.90**
Yes	608298	Groveland - Community Trail	$2,191	NA	NA	0.50	1.25	0.67	1.20	1.00	0.25	**4.87**
No	604950	Georgetown – Park and Ride construction at I-95 and Route 133 interchange	$3,276	NA	NA	0.00	1.75	0.33	0.20	0.75	0.75	**3.78**
No	607540	Boxford – section of Border to Boston Trail	$4,175	NA	NA	0.50	1.00	0.67	0.40	0.50	0.25	**3.32**

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Appendix D Sample Project Evaluation Worksheet

Sample Project Evaluation Worksheet
Merrimack Valley Planning Commission and MassDOT Evaluation Criteria
Project: Andover - Reconstruct Rt. 133 from Lovejoy Rd to Rt. 28 Project #: 608336
Project Cost: $7,245,000 AADT: 12,773 Distance: 2.2 Linear Lane Miles: 4.4

Condition	Score	Additional Comments
A. Magnitude of pavement condition improvement.	2	PNF indicates longitudinal & lateral pavement cracking, utility patch failure, shoving and rutting of pavement along route.
B. Magnitude of improvement of other infrastructure.	2	Current shoulder width 0' to 2', project to increase shoulder width to 4' or 5' for bikes and > safety for pedestrians, upgrade signals, drainage improvements
Condition Average	**2.0**	

Mobility	Score	Additional Comments
A. Effect on magnitude and duration of congestion.	3	Adding left turn lanes at intersection at MA-133/ Lovejoy /Greenwood. Also Rt 133/ Rt 28 improvements
B. Effect on travel time and connectivity / access.	2	Widening shoulder, realigning Rt 133/ Lovejoy and adding left turn lanes.
C. Effect on other modes using the facility.	3	Widening shoulder for bicycles, sidewalks on both sides.
D. Effect on regional and local traffic.	3	Widening shoulder, adding left turn lanes. Additional connector I-495 to I-93. NHS roadway.
Mobility Average	**2.75**	

Sample Project Evaluation Worksheet (Cont.)

Project: Andover - Reconstruct Rt. 133 from Lovejoy Rd to Rt. 28 Project #: 608336

Safety and Security	Score	Additional Comments
A. Effect on crash rate compared to State average.	3	PNF Rt 133/ Lovejoy / Greenwood has a crash rate of .94, District 4 average is .78 and the arterial between two signalized intersections is 3.8, Avg. is 2.12. Have had 1 pedestrian with injuries and 1 bicycle crash. HSIP eligible per MassDOT "Crash Cluster" 2 intersections.
B. Effect on bicycle and pedestrian safety.	2	Widening shoulder for bicycles, sidewalks on both sides.
C. Effect on transportation security and evacuation routes/	1	Is an NHS roadway. Is an evacuation route.
Safety and Security Average	**2.00**	

Community Effects and Support	Score	Additional Comments
A. Residential effects: ROW, noise, aesthetics, cut through traffic, and other.	2	For the most part all within ROW. General appearance and less noise from better pavement conditions.
B. Public, local government, legislative, and regional support.	2	
C. Effect on service to minority or low-income neighborhoods. (Title VI and EJ)	0	Not Title VI or EJ area.
D. Other impacts / benefits to minority or low-income neighborhoods. (Title VI and EJ).	0	Not Title VI or EJ area.
E. Effect on development and redevelopment of housing	1	
Community Effects and Support Average	**1.00**	

Sample Project Evaluation Worksheet (Cont.)

Project: Andover - Reconstruct Rt. 133 from Lovejoy Rd to Rt. 28 Project #: 608336

Land Use and Economic Development	Score	Additional Comments
A. Business effects; ROW, noise, traffic, parking, freight access, other.	2	Improve access to existing businesses.
B. Sustainable development effects. Consistent with MVPGS.	2	Access to MVPGS Rolling Green Regional PDA. Improves transportation choice (walk/bike) for area residents.
C. Consistent with regional land-use and economic development plans and PGS.	2	Access to MVPGS Rolling Green Regional PDA. Improves transportation choice (walk/bike) for area residents.
D. Effect on job creation.	1	Should provide better access to Brickstone Square State PDA.
Land Use and Economic Development Average	**1.75**	

Sample Project Evaluation Worksheet (Cont.)

Project: Andover - Reconstruct Rt. 133 from Lovejoy Rd to Rt. 28 Project #: 608336

Environmental Effects	Score	Additional Comments
A. Air quality / Climate effects. GHG Impact Description – Assumed Nominal Decrease in Emissions from Other Improvements	2	Adding bike lanes and sidewalks. Reducing delays at intersections.
B. Water quality/supply effects; wetlands effects.	1	There will be deep sump catch basins
C. Historic and cultural resources effects.	3	Shawsheen Village Historic District
D. Effect on wildlife habitat and endangered species.	0	Not endangered species habitat area.
Environmental Effects Average	**1.5**	
Overall Project TEC score	**11.00**	

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Appendix E Greenhouse Gas (GHG) Monitoring and Evaluation

2019 - 2023
Transportation Improvement Program
Greenhouse Gas Monitoring and Evaluation

Introduction

This section summarizes the greenhouse gas (GHG) impacts that are anticipated to result from the projects that are included in this FFY 2018 – 2022 Transportation Improvement Program (TIP). It includes a summary of the state laws and policies that call for reducing greenhouse gas in order to mitigate global climate change, actions that are being taken to respond to these state laws and policies, the role of regional planning and TIP development in reducing GHG emission and tracking these reductions, and the projected GHG emission impacts from the projects programmed in the TIP.

State Policy Context

The Global Warming Solutions Act (GWSA), which was signed into law in August 2008, makes Massachusetts a leader in setting aggressive and enforceable GHG reduction targets, and implementing policies and initiatives to achieve these targets. In keeping with the law, on December 29, 2010 the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), in consultation with other state agencies and the public, released the Massachusetts *Clean Energy and Climate Plan for 2020*. In December 2014 the Department of Environmental Protection issued new regulations that require Metropolitan Planning Organizations to quantify impacts from project investments, track progress towards reductions, and consider impacts in the prioritization of GHG impacts from project investments. The targets for overall statewide GHG emissions are:

- By 2020: 25 percent reduction below statewide 1990 GHG emission levels, and
- By 2050: 80 percent reduction below statewide 1990 GHG emission levels

GreenDOT Policy

The transportation sector is the single largest emitter of greenhouse gases, accounting for over a third of GHG emissions, and therefore the transportation sector is a key focus of the *Clean Energy and Climate Plan*. MassDOT's approach to supporting the implementation of the plan is set forth in its GreenDOT Policy Directive, a comprehensive sustainability initiative that sets three principal objectives:

- **Reduce greenhouse gas (GHG) emissions.** MassDOT will achieve this by taking GHG emissions into account in all of its responsibilities, from strategic planning to project design and construction and system operations;
- **Promote the healthy transportation modes of walking, bicycling, and public transit.** MassDOT will achieve this by pursuing multi-modal, "complete streets" design standards; providing choice in transportation services; and by working with MPOs and other partners to prioritize and program a balance of projects that serve drivers, pedestrians, bicyclists, and public transit riders, and
- **To support smart growth development.** MassDOT will achieve this by working with MPOs and other partners to make transportation investments that enable denser, smart growth development patterns that support reduced GHG emissions.

GreenDOT Policy and Metropolitan Planning Organizations

The Commonwealth's thirteen metropolitan planning organizations (MPOs) are integrally involved in helping to achieve the GreenDOT goals and supporting the GHG reductions mandated under the GWSA. The MPOs are most directly involved in helping to achieve the GHG emissions reductions under the second goal – to promote healthy transportation modes through prioritizing and programming an appropriate balance of roadway, transit, bicycle and pedestrian investments – and assist in the third goal by supporting smart growth development patterns through the creation of a balanced multi-modal transportation system. This will be realized through the transportation goals and policies espoused in the Regional Transportation Plans (RTPs), the major projects planned in the RTPs, and the mix of new transportation projects that are programmed and implemented through the TIPs. The GHG tracking and evaluation processes enable the MPOs to identify the anticipated GHG impacts of the planned and programmed projects, and also to use GHG impacts as a criterion in prioritizing transportation projects.

Regional GHG Tracking and Evaluation in RTPs

MassDOT coordinated with MPOs and regional planning agency (RPA) staffs on the implementation of GHG tracking and evaluation in development of each MPO's 2035 RTPs, which were adopted in September 2011. This collaboration has continued for the MPO's 2040 RTPs and FFYs 2018-2022 TIPs.

Working together, MassDOT and the MPOs have attained the following milestones:

- Modeling and long-range statewide projections for GHG emissions resulting from the transportation sector. Using the Boston MPO's regional model and the statewide travel demand model for the remainder of the state, GHG emissions

were projected for 2021 no-build and build conditions, and for 2035 no-build and build conditions.
- All of the MPOs included these GHG emission projections in their RTPs, along with a discussion of climate change and a statement of MPO support for reducing GHG emissions as a regional goal.

Project-Level GHG Tracking and Evaluation in the Transportation Improvement Program

It is also important to monitor and evaluate the GHG impacts of the transportation projects that are programmed in the MPO Transportation Improvement Programs (TIP). The TIP includes both the larger, regionally-significant projects from the RTPs, which have already had their aggregate GHG impacts calculated and reported in the RTP, as well as smaller projects that are not included in the RTP but that may nevertheless have impacts on GHG emissions. The principal objective of this tracking is to enable the MPOs to evaluate expected GHG impacts of different projects and to use this information as a criterion for prioritizing and programming projects in future TIPs.

In order to monitor and evaluate the GHG impacts of TIP projects, MassDOT and the MPOs have developed the following approach for identifying anticipated GHG impacts and quantifying GHG impacts of projects, when appropriate, through the TIP. Different types of projects will have different anticipated GHG emissions impacts. The different project categories are outlined on the next two pages with this region's project tracking sheets on the third page.

Calculation of GHG Impacts for TIP Projects

The Office of Transportation Planning at MassDOT provided the spreadsheets that are used for determining Congestion Management and Air Quality (CMAQ) eligibility. These spreadsheets require the same inputs as the CMAQ calculations, and have been adapted to provide CO_2 impacts. The data and analysis required for these calculations is available from functional design reports that should be submitted for projects that would produce a measurable GHG impact.

- **Projects with Quantified Impacts**
    - **RTP Projects -** Major capacity expansion projects would be expected to have a significant impact on GHG emissions. However, these projects are included in the RTPs and analyzed using the statewide model or Boston regional model, which would reflect their GHG impacts. Therefore, no independent TIP calculations are required.
    - **Quantified Decrease in Emissions -** Projects that would be expected to produce a measurable decrease in emissions. The approach for

calculating these impacts is described below. These projects should be categorized in the following manner:

- **Quantified Decrease in Emissions from Traffic Operational Improvement -** An intersection reconstruction or signalization project that is projected to reduce delay and congestion.
- **Quantified Decrease in Emissions from Pedestrian and Bicycle Infrastructure -** A shared-use path that would enable increased walking and biking and decreased vehicle-miles traveled (VMT).
- **Quantified Decrease in Emissions from New/Additional Transit Service -** A bus or shuttle service that would enable increased transit ridership and decreased VMT.
- **Quantified Decrease in Emissions from a Park and Ride Lot** - A park-and-ride lot that would enable increased transit ridership/ increased ridesharing and decreased VMT.
- **Quantified Decrease in Emissions from Bus Replacement** A bus replacement that would directly reduce GHG emissions generated by that bus service.
- **Quantified Decrease in Emissions from Complete Streets Improvements**
  Improvements to roadway networks that include the addition of bicycle and pedestrian accommodations where none were present before.
- **Quantified Decrease in Emissions from Other Improvement**

- **Quantified Increase in Emissions –** Projects that would be expected to produce a measurable increase in emissions.

- **Projects with Assumed Impacts**

  - **No Assumed Impact/Negligible Impact on Emission -** Projects that do not change the capacity or use of a facility (e.g. a resurfacing project that restores a roadway to its previous condition, or a bridge rehabilitation/replacement that restores the bridge to its previous condition) would be assumed to have no GHG impact.

- **Assumed Nominal Decrease in Emissions -** Projects that would be expected to produce a minor decrease in emissions that cannot be calculated with any precision. Examples of such projects include roadway repaving or reconstruction projects that add a new sidewalk or new bike lanes. Such a project would enable increased travel by walking or bicycling, but there may be no data or analysis to support any projections of GHG impacts. These projects should be categorized in the following manner:
  - **Assumed Nominal Decrease in Emissions from Sidewalk Infrastructure**
  - **Assumed Nominal Decrease in Emissions from Bicycle Infrastructure**
  - **Assumed Nominal Decrease in Emissions from Sidewalk and Bicycle Infrastructure**
  - **Assumed Nominal Decrease in Emissions from Intelligent Transportation Systems (ITS) and/or Traffic Operational Improvements**
  - **Assumed Nominal Decrease in Emissions from Other Improvements**

- **Assumed Nominal Increase in Emissions -** Projects that would be expected to produce a minor increase in emissions that cannot be calculated with any precision.

Regional Greenhouse Gas Impact Summary Tables for FFYs 2019 – 2023 TIP

The following tables summarize the calculated quantitative and assumed qualitative impacts of the projects included in the regional FFYs 2019 – 2023 TIP by year.

FFYs 2019 to 2023 Projects GHG Tracking Summary

2019 Merrimack Valley Region MPO Transportation Improvement Program
Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼	Additional Information▼
602418	AMESBURY-RECONSTRUCTION OF ELM STREET	$ 4,065,071	Quantified		Quantified Decrease in Emissions from Complete Streets Project	$ 12,064,000	AC yr 1 of 2. Quantity of CO_2 emissions shown in Yr 2, FFY 2020.
MV0001	FLEX TO FTA FOR MVRTA NEW BUS UPGRADE TO CLEANER FUEL BUSES	$ 698,541	Qualitative		Qualitative Decrease in Emissions	$ 698,541	

2019 Merrimack Valley Region MPO Transportation Improvement Program
Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project De-scription ▼	Total Program-med Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Im-pact De-scription ▼	Total Cost ▼	Additional Information▼
605306	HAVERHILL-SUPERSTRUCTURE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$ 23,703,426	Qualitative		No assumed impact/ neg-ligible impact on emissions	$ 118,786,388	AC yr 2 of 6. Sum Year 2 Cost = $23,703,426. Total Project Cost = $118,786,388.
608792	NEWBURYPORT - IMPROVEMENTS AT NOCK MIDDLE SCHOOL & MOLIN UPPER ELEMENTARY SCHOOL (SRTS)	$ 1,866,615	Qualitative		Qualitative Decrease in Emissions	$ 1,866,615	

2019 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project De-scription ▼	Total Program-med Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Im-pact De-scription ▼	Total Cost ▼	Additional Information▼
606159	NORTH ANDOVER-INTERSECTION & SIGNAL IMPROVEMENTS AT ROUTE 125 & MASSACHUSETTS AVENUE	$ 5,446,662	Quantified	482,727	Quantified Decrease in Emissions from Traffic Operational Improvement	$ 5,446,662	
	2019 Total GHG Emissions			482,727			

2020 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
602418	AMESBURY- RECONSTRUCTION OF ELM STREET	$ 7,998,929	Quantified	1,336	Quantified Decrease in Emissions from Complete Streets Project	$ 12,064,000	AC yr 2 of 2. Quantified decrease in emissions = 1,335 kg/yr.
608027	HAVERHILL - BRADFORD RAIL TRAIL EXTENSION, FROM ROUTE 125 TO RAILROAD STREET	$ 1,131,000	Quantified	422	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 1,131,000	Quantified decrease in emissions = 422 kg/yr.

2020 Merrimack Valley Region MPO Transportation Improvement Program
Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
605306	HAVERHILL-SUPERSTRUCTURE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$ 19,797,731	Qualitative		No assumed impact/ negligible impact on emissions	$ 118,786,388	AC yr 3 of 6. Sum Year 3 Cost = $19,797,731. Total Project Cost = $118,786,388
	2020 Total GHG emissions			1,757			

2021 Merrimack Valley Region MPO Transportation Improvement Program Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
608298	GROVELAND- GROVELAND COMMUNITY TRAIL, FROM MAIN STREET TO KING STREET	$ 2,365,973	Quantified	2,710	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 2,365,973	Quantified decrease in emissions = 2,710 kg/yr.
608761	HAVERHILL - INTERSECTION IMPROVEMENTS ON ROUTE 108 (NEWTON ROAD) AT ROUTE 110 (KENOZA AVENUE AND AMESBURY ROAD)	$ 2,099,520	Quantified	8,307	Quantified Decrease in Emissions from Traffic Operational Improvement	$ 2,099,520	Quantified decrease in emissions = 8,307 kg/yr.

2021 Merrimack Valley Region MPO Transportation Improvement Program Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project De-scription ▼	Total Pro-grammed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
608095	NORTH ANDOVER-CORRIDOR IMPROVEMENTS ON ROUTE 114, BETWEEN ROUTE 125 (ANDOVER STREET) & STOP & SHOP DRIVEWAY	$ 6,313,159	Qualitative		Qualitative De-crease in Emis-sions	$ 16,816,717	AC Year 1 of 2.
605306	HAVERHILL-SUPERSTRUCTURE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$ 19,797,731	Qualitative		No assumed impact/ neg-ligible impact on emissions	$ 118,786,388	AC yr 4 of 6. Sum Year 4 Cost = $19,797,731. Total Project Cost = $118,786,388

2021 Merrimack Valley Region MPO Transportation Improvement Program Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
608494	NEWBURY - NEWBURYPORT - SALISBURY - RESURFACING AND RELATED WORK ON ROUTE 1	$ 10,271,664	Qualitative		Qualitative Decrease in Emissions	$ 10,271,664	
607541	GEORGETOWN-BOXFORD-BORDER TO BOSTON TRAIL, FROM GEORGETOWN ROAD TO WEST MAIN STREET (ROUTE 97)	$ 1,874,028	Quantified	2,667	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 1,874,028	Quantified decrease in emissions = 2,667 kg/yr.
2021 Total GHG emissions				13,684			

2022 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
608095	NORTH ANDOVER-CORRIDOR IMPROVEMENTS ON ROUTE 114, BETWEEN ROUTE 125 (ANDOVER STREET) & STOP & SHOP DRIVEWAY	$10,503,558	Qualitative		Qualitative Decrease in Emissions.	$ 16,816,717	AC Year 2 of 2.
607542	GEORGETOWN-NEWBURY-BORDER TO BOSTON TRAIL (NORTHERN GEORGETOWN TO BYFIELD SECTION)	$ 4,341,120	Quantified	15,682	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 4,341,120	Quantified decrease in emissions = 15,682 kg/yr.

2022 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Total Cost ▼	Additional Information ▼
605306	HAVERHILL-SUPERSTRUCTURE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$ 19,797,731	Qualitative		No assumed impact/ negligible impact on emissions	$ 118,786,388	AC yr 5 of 6. Sum Year 5 Cost = $19,797,731. Total Project Cost = $118,786,388.
	2022 Total GHG emissions			15,682			

2023 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼	Additional Information▼
602202	SALISBURY - RECONSTRUCTION OF ROUTE 1 (LAFAYETTE ROAD)	$ 7,343,750	Qualitative		No assumed impact/negligible impact on emissions	$ 7,343,750	
605306	HAVERHILL - BRIDGE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$ 15,892,036	Qualitative		No assumed impact/negligible impact on emissions	$ 118,786,388	AC yr 6 of 6. Sum Year 6 Cost = $15,892,036. Total Project Cost = $118,786,388.

2023 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID ▼	MassDOT/FTA Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr)▼	GHG Impact Description ▼	Total Cost ▼	Additional Information▼
608788	HAVERHILL - ROADWAY RECONSTRUCTION ON NORTH AVENUE, FROM MAIN STREET (ROUTE 125) TO PLAISTOW NH	$ 3,894,590	Qualitative		No assumed impact/negligible impact on emissions	$ 14,167,080	AC yr 1 of 2. Sum Year 1 Cost = $3,894,590. Total Project Cost = $14,167,080.
608930	LAWRENCE - LAWRENCE MANCHESTER RAIL CORRIDOR (LMRC) RAIL TRAIL	$ 17,278,635	Quantified	175,927	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 17,278,635	Quantified decrease in emissions = 175,927 kg/yr.
		2023 Total GHG emissions		175,927			

2019 Merrimack Valley Region Transit GHGs						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Anlysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0006769	Preventive Maintenance	$3,250,095	Qualitative		No assumed impact/ negligible impact on emissions	$3,250,095
RTD0006770	ADA Operating Expense	$1,456,420	Qualitative		No assumed impact/ negligible impact on emissions	$1,456,420
RTD0006771	Short Range Transit Planning	$100,000	Qualitative		No assumed impact/ negligible impact on emissions	$100,000
RTD0006772	Operating Assistance	$780,250	Qualitative		No assumed impact/ negligible impact on emissions	$780,250
RTD0007127	SGR Riverbank stabilization Design/Permitting	$235,035	Qualitative		No assumed impact/ negligible impact on emissions	$235,035

2019 Merrimack Valley Region Transit GHGs (Cont.)						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Anlysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0007126	SGR Refurbish 4 vehi-cle lifts	$400,000	Qualitative		No assumed impact/ negligible impact on emissions	$400,000
RTD0006785	Replace 1 Model Yr 2013 Support Vehicle	$45,205	Qualitative		No assumed impact/ negligible impact on emissions	$45,205

2020 Merrimack Valley Region Transit GHGs						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Anlysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0006773	Preventive Maintenance	$3,347,595	Qualitative		No assumed impact/ negligible impact on emissions	$3,347,595
RTD0006774	Non-Fixed Route ADA Pa-ra Serv	$1,500,110	Qualitative		No assumed impact/ negligible impact on emissions	$1,500,110
RTD0006775	Short Range Transit Plan-ning	$100,000	Qualitative		No assumed impact/ negligible impact on emissions	$100,000
RTD0006776	Operating Assistance	$924,950	Qualitative		No assumed impact/ negligible impact on emissions	$924,950
RDT0007130	SGR Replace 1 Model Year 2013 supervisory ve-hicle	$46,530	Qualitative		No assumed impact/ negligible impact on emissions	$46,530

2020 Merrimack Valley Region Transit GHGs (Cont.)						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Anlysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0006781	Replace 3 Model Yr 2007 buses delivery 2020	$1,377,150	Quantified	8,166	Quantified Decrease in Emissions from Bus Replacement	$1,377,150
RTD0007129	SGR Riverbank stabilization Construction	$1,750,330	Qualitative		No assumed impact/ negligible impact on emissions	$1,750,330

2021 Merrimack Valley Region Transit GHGs						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Anlysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0006777	Preventive Maintenance	$3,385,520	Qualitative		No assumed impact/ negligible impact on emissions	$3,385,520
RTD0006778	Non-Fixed Route ADA Para Serv	$1,482,610	Qualitative		No assumed impact/ negligible impact on emissions	$1,482,610
RTD0006783	Operating Assistance	$917,450	Qualitative		No assumed impact/ negligible impact on emissions	$917,450
RTD0006779	Short Range Transit Plan-ning	$100,000	Qualitative		No assumed impact/ negligible impact on emissions	$100,000
RTD0007131	SGR Replace 1 Model Yr 2016 supervisory vehicle	$47,900	Qualitative		No assumed impact/ negligible impact on emissions	$47,900

2021 Merrimack Valley Region Transit GHGs (Cont.)						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Anlysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0006784	Replace 16 Model Yr 2015 vans with new	$1,185,310	Quantified	32,764	Quantified Decrease in Emissions from Bus Replacement	$1,185,310

2022 Merrimack Valley Region Transit GHGs						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Anlysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0006787	Preventive Maintenance	$3,488,955	Qualitative		No assumed impact/ negligible impact on emissions	$3,488,955
RTD0006788	Non-Fixed Route ADA Para Serv	$1,528,960	Qualitative		No assumed impact/ negligible impact on emissions	$1,528,960
RTD0006790	Operating Assistance	$947,970	Qualitative		No assumed impact/ negligible impact on emissions	$947,970
RTD0006789	Short Range Transit Plan-ning	$100,000	Qualitative		No assumed impact/ negligible impact on emissions	$100,000
RTD0006791	Replace Model Yr 2009 buses delivery 2022 7 of 9	$3,309,565	Quantified	19,755	Quantified Decrease in Emissions from Bus Replacement	$3,309,565

2023 Merrimack Valley Region Transit GHGs						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Anlysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0007132	Preventive Maintenance	$3,464,060	Qualitative		No assumed impact/ negligible impact on emissions	$3,464,060
RTD0007134	Non-Fixed Route ADA Para Serv	$1,445,270	Qualitative		No assumed impact/ negligible impact on emissions	$1,445,270
RTD0007133	Operating Assistance	$769,110	Qualitative		No assumed impact/ negligible impact on emissions	$769,110
RTD0007142	Short Range Transit Plan-ning	$100,000	Qualitative		No assumed impact/ negligible impact on emissions	$100,000
RTD0007136	Replace 6 Model Yr 2017 vans delivery 2023	$471,260	Qualitative		Not yet enough infor-mation to calculate	$471,260

2023 Merrimack Valley Region Transit GHGs (Cont.)						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Anlysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0007135	Replace 2 Model Yr 2009 buses delivery 2023	$973,910	Quantified	5,644	Quantified Decrease in Emissions from Bus Replacement	$973,910

Amesbury Reconstruction of Elm Street **CMAQ Air Quality Analysis**

CMAQ Air Quality Analysis Worksheet for Complete Streets Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2019**

MPO: **Merrimack Valley** **Municipality:** Amesbury

Project: **# 602418 Reconstruction of Elm Street**

Step 1: Calculate New Walk and Bike Miles Traveled:

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

				User Input (blank for default)	Default
A.	Facility Length **(L)**:	1.1	Miles		
B	Types of Improvements Implemented:	Both	(select Pedestrian, Bicycle, or Both)		
B.	Service Area Radius for Bicycling **(RB)**:	0.5	Miles		0.5
C.	Service Area Radius for Walking **(RW)**:	0.25	Miles		0.25
D.	Service Area of Community(ies) **for Bicycling (SAB)**: L * 2RB = SAB	1.13	Sq. Miles		
E.	Service Area of Community(ies) **for Walking (SAW)**: L * 2RW = SAW	0.565	Sq. Miles		
F.	Land Area of Neighborhoods Served **(AN)**: Popula-	11.2	Sq. Miles		
G.	tion of Neighborhoods Served **(PN)**:	7,137	Persons		
H.	Population Density of Neighborhoods Served **(PD)**:	637	Persons/Sq. Mile		
I.	Population Served by Facility for Bicycling **(PB)**: PD * SAB = PB	720	Persons		
J.	Population Served by Facility for Walking **(PW)**: PD * SAW = PW	360	Persons		
K.	Trips per Person per Day in Service Area **(T)**:	4.7	Trips		4.7
L.	Baseline Bicycle Mode Share in Service Area **(MSB)**:	0.6%	Percent		

Amesbury Reconstruction of Elm Street **CMAQ Air Quality Analysis (Cont.)**

M.	Baseline Walk Mode Share in Service Area **(MSW)**:	4.7%	Percent		
N.	Relative Increase in Service Area Bicycle Mode Share from Improvements **(BI)**:	30.0%	Percent		30.0%
O.	Relative Increase in Service Area Walk Mode Share from Improvements **(WI)**:	7.5%	Percent		7.5%
P.	New Bike Trips **(BT)**: PB * T * MSB * BI = BT	6	1-Way Trips/Day		
Q.	New Walk Trips **(WT)**: PW * T * MSW * WI = WT	6	1-Way Trips/Day		
R.	Average Bike Trip Length (**LB**):	2.3	Miles		2.3
S.	Average Walk Trip Length (**LW**):	0.7	Miles		0.7
T.	New Bike and Walk Miles of Travel **(BWM)**:	18	Miles per Day		
	Step 2: Calculate the VMT Reduction:				
U.	Prior Drive Mode Share of New Bike and Walk Trips **(MSD)**:	59.0%	Percent	59%	
V.	VMT Reduced per Day **(VMTR)**: BWM * MSD = VMTR	11	Miles per Day		
W.	VMTR * Operating Days Per Year 16 * 365 =	3,942	VMTR Per Year		
	If the Vehicle Miles Traveled Reduction is known enter in the box to the right.		VMTR Per Year		
	Note: A manual entry of the VMTR will override the calculated cell.				

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
0.1	**0.3**	**8.4**	**1,335.5**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$1,000,000	/	0.1	=	**$8,355,241**
Summer NOx	$1,000,000	/	0.3	=	**$3,058,798**
Summer CO	$1,000,000	/	8.4	=	**$118,866**
Summer CO2	$1,000,000	/	1,335.5	=	**$749**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Georgetown - Boxford Border-to-Boston Trail **CMAQ Air Quality Worksheet**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2019**

MPO: **Merrimack Valley** **Municipality: Georgetown, Boxford**

Project: **# 607541 Georgetown-Boxford Border to Boston Trail**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A.	Facility Length **(L)**:	2.0	Miles	
B.	Service Area Radius **(R)**:	1.0	Miles Sq.	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	4	Miles Sq.	
D.	Total Land Area of Community(ies) **(T)**:	36.5	Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	11.0%		
F.	Total Population of Community(ies) **(TP)**: Popu-	16,579	Persons	
G.	lation Served by Facility **(P)**: LA * TP = P	1,817	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	5,828	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	639	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	8,647	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH Work-	1.48	Persons	
L.	ers in Service Area **(WSA)**: HS * WPHH = WSA	948		
M.	Population Density of the Service area **(PD)**: P / SA = PD	454	Persons Per Sq. Mile	

Georgetown - Boxford Border-to-Boston Trail **CMAQ Air Quality Worksheet (Cont.)**

N. If the bicycle and pedestrian commuter mode share is known, enter the percentage at the right. **(BMS)** 0.8%

If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.
http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O. Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 7 One-Way Trips

P. Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 12 One-Way Trips

(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A. ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 39.4 VMTR Per Day

B. VMTR * Operating Days Per Year 39.4 * 200 = 7,872 VMTR Per Year

If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year

Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Georgetown - Boxford Border-to-Boston Trail **CMAQ Air Quality Worksheet (Cont.)**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
0.2	**0.7**	**16.8**	**2,666.9**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$1,874,028	/	0.2	=	**$7,840,800**
Summer NOx	$1,874,028	/	0.7	=	**$2,870,465**
Summer CO	$1,874,028	/	16.8	=	**$111,547**
Summer CO2	$1,874,028	/	2,666.9	=	**$703**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Georgetown - Newbury Border to Boston Trail **CMAQ Air Quality Worksheet**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2020**

MPO: **Merrimack Valley** **Municipality: Georgetown, Newbury**

Project: **# 607542 Georgetown-Newbury Border to Boston Trail**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A.	Facility Length **(L)**:	3.6	Miles	
B.	Service Area Radius **(R)**:	1.0	Miles Sq.	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	7.2	Miles Sq.	
D.	Total Land Area of Community(ies) **(T)**:	36.3	Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	19.8%		
F.	Total Population of Community(ies) **(TP)**: Popu-	15,088	Persons	
G.	lation Served by Facility **(P)**: LA * TP = P	2,993	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	5,808	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	1,152	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	8,055	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH Work-	1.39	Persons	
L.	ers in Service Area **(WSA)**: HS * WPHH = WSA	1,598		
M.	Population Density of the Service area **(PD)**: P / SA = PD	416	Persons Per Sq. Mile	

Georgetown - Newbury Border to Boston Trail **CMAQ Air Quality Worksheet (Cont.)**

N. If the bicycle and pedestrian commuter mode share is known, enter the percentage at the ri **(BMS)** 1.5%
If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.
http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O. Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 24 One-Way Trips

P. Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 40 One-Way Trips
(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A. ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 231.5 VMTR Per Day

B. VMTR * Operating Days Per Year 231.5 * 200 = 46,290 VMTR Per Year
If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year
Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Georgetown - Newbury Border to Boston Trail **CMAQ Air Quality Worksheet (Cont.)**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
1.4	**3.8**	**98.8**	**15,681.6**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$4,341,120	/	1.4	=	**$3,088,934**
Summer NOx	$4,341,120	/	3.8	=	**$1,130,838**
Summer CO	$4,341,120	/	98.8	=	**$43,945**
Summer CO2	$4,341,120	/	15,681.6	=	**$277**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Groveland Community Trail Project # 608298 **CMAQ Air Quality Worksheet**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2020**

MPO: **Merrimack Valley** **Municipality:** Groveland

Project: **Groveland Community Trail Project # 608298**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A.	Facility Length **(L)**:	2.2	Miles	
B.	Service Area Radius **(R)**:	1.0	Miles Sq.	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	4.4	Miles Sq.	
D.	Total Land Area of Community(ies) **(T)**:	8.9	Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	49.4%		
F.	Total Population of Community(ies) **(TP)**:	6,646	Persons	
G.	Population Served by Facility **(P)**: LA * TP = P	3,286	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	2,385	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	1,179	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	3,405	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH	1.43	Persons	
L.	Workers in Service Area **(WSA)**: HS * WPHH = WSA	1,683		
M.	Population Density of the Service area **(PD)**: P / SA = PD	747	Persons Per Sq. Mile	

Groveland Community Trail Project # 608298 **CMAQ Air Quality Worksheet (Cont.)**

N. If the bicycle and pedestrian commuter mode share is known, enter the percentage at the righ **(BMS)** 0.4%

If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.
http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O. Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 7 One-Way Trips

P. Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 11 One-Way Trips

(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A. ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 40.0 VMTR Per Day

B. VMTR * Operating Days Per Year 40.0 * 200 = 7,999 VMTR Per Year

If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year

Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Groveland Community Trail Project # 608298 **CMAQ Air Quality Worksheet (Cont.)**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
0.2	**0.7**	**17.1**	**2,709.9**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$2,672,677	/	0.2	=	**$11,004,874**
Summer NOx	$2,672,677	/	0.7	=	**$4,028,811**
Summer CO	$2,672,677	/	17.1	=	**$156,560**
Summer CO2	$2,672,677	/	2,709.9	=	**$986**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Haverhill Bradford Rail Trail Extension from Route 125 to Railroad St. **CMAQ Air Quality Analysis**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2019**

MPO: **Merrimack Valley** **Municipality:** **Haverhill**

Project: **# 608027 Bradford Rail Trail Extension from Route 125 to Railroad Street**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A.	Facility Length **(L)**:	0.2	Miles	
B.	Service Area Radius **(R)**:	1.0	Miles Sq.	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	0.4	Miles Sq.	
D.	Total Land Area of Community(ies) **(T)**:	33	Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	1.2%		
F.	Total Population of Community(ies) **(TP)**: Popu-	62,079	Persons	
G.	lation Served by Facility **(P)**: LA * TP = P	752	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	23,781	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	288	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	30,696	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH Work-	1.29	Persons	
L.	ers in Service Area **(WSA)**: HS * WPHH = WSA	372		
M.	Population Density of the Service area **(PD)**: P / SA = PD	1,881	Persons Per Sq. Mile	

Haverhill Bradford Rail Trail Extension from Route 125 to Railroad St. **CMAQ Air Quality Analysis (Cont.)**

N. If the bicycle and pedestrian commuter mode share is known, enter the percentage at the ri **(BMS)** 3.1%
If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.
http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O. Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 12 One-Way Trips

P. Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 20 One-Way Trips
(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A. ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 6.2 VMTR Per Day

B. VMTR * Operating Days Per Year 6.2 * 200 = 1,246 VMTR Per Year
If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year
Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Haverhill Bradford Rail Trail Extension from Route 125 to Railroad St. **CMAQ Air Quality Analysis (Cont.)**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
0.0	**0.1**	**2.7**	**422.0**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$1,176,240	/	0.0	=	**$31,101,222**
Summer NOx	$1,176,240	/	0.1	=	**$11,385,951**
Summer CO	$1,176,240	/	2.7	=	**$442,461**
Summer CO2	$1,176,240	/	422.0	=	**$2,787**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Haverhill - Intersection Reconstruction on Route 108 at Route 110 **CMAQ Air Quality Analysis Worksheet**

CMAQ Air Quality Analysis Worksheet for Traffic Flow and Intersection Improvements

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TIP YEAR **2021**

MPO: **Merrimack Valley** **Municipality:** **Haverhill**

Project: **# 608761 Intersection Reconstruction on Route 108 (Newton Road) at Roiute 110 (Kenoza Av & Amesbury Rd)**

Step 1: Calculate Existing AM Peak Hour Total Intersection Delay in Seconds:

Street Name	Dir	Left-Turns (Vol / PHF)	X delay per veh	=	Total move. delay	+	Thru (Vol / PHF)	X delay per veh	=	Total move. delay	+	Right-Turns (Vol / PHF)	X delay per veh	=	Total move. delay	=	Total approach delay
	NB	0 / 1.00	0.0	=	0	+	350 / 1.00	0.0	=	0	+	12 / 1.00	0.0	=	0	=	0
Rt 108	SB	0 / 1.00	0.0	=	0	+	610 / 1.00	0.0	=	0	+	114 / 1.00	0.0	=	0	=	0
Rt 110	EB	0 / 1.00	0.0	=	0	+	411 / 1.00	0.0	=	0	+	185 / 1.00	0.0	=	0	=	0
Rt 110	WB	0 / 1.00	0.0	=	0	+	458 / 1.00	0.0	=	0	+	21 / 1.00	0.0	=	0	=	0
																Total Intersection Delay/Seconds =	**0**

Haverhill - Intersection Reconstruction on Route 108 at Route 110 **CMAQ Air Quality Analysis Worksheet (Cont.)**

Step 2: Calculate Existing PM Peak Hour Total Intersection Delay in Seconds:

Street Name	Dir	Left-Turns (Vol / PHF)		X delay per veh	=	Total move. delay	+	Thru (Vol / PHF)		X delay per veh	=	Total move. delay	+	Right-Turns (Vol / PHF)		X delay per veh	=	Total move. delay	=	Total approach delay
	NB		1.00		=	0	+	0	1.00		=	0	+		1.00		=	0	=	0
Rt 108	SB	40	1.00	43.3	=	1,732	+	0	1.00		=	0	+	134	1.00	43.3	=	5,802	=	7,534
Rt 110	EB	253	1.00	9.7	=	2,454	+	463	1.00	0.0	=	0	+	0	1.00		=	0	=	2,454
Rt 110	WB	0	1.00		=	0	+	421	1.00	0.0	=	0	+	145	1.00	0.0	=	0	=	0
																		Total Intersection Delay/Seconds	=	**9,988**

Step 3: The spreadsheet automatically chooses the peak hour with the longer total intersection delay for the next step in the analysis.

Peak Hour: PM Total Intersection Delay: 9,988

Step 4: Calculate the existin PM Peak Hour Total Intersection Delay with Improvements:

Street Name	Dir	Left-Turns (Vol / PHF)		X delay per veh	=	Total move. delay	+	Thru (Vol / PHF)		X delay per veh	=	Total move. delay	+	Right-Turns (Vol / PHF)		X delay per veh	=	Total move. delay	=	Total approach delay
	NB		1.00		=	0	+		1.00		=	0	+		1.00		=	0	=	0
Rt 108	SB	40	1.00	60.6	=	2,424	+	0	1.00		=	0	+	134	1.00	13.1	=	1,755	=	4,179
Rt 110	EB	253	1.00	9.7	=	2,454	+	463	1.00		=	0	+	0	1.00		=	0	=	2,454
Rt 110	WB	0	1.00		=	0	+	421	1.00		=	0	+	145	1.00		=	0	=	0
																		Total Intersection Delay/Seconds	=	**6,634**

Haverhill - Intersection Reconstruction on Route 108 at Route 110 **CMAQ Air Quality Analysis Worksheet (Cont.)**

Step 5: Calculate vehicle delay in hours per day:

	(	Delay in seconds	X	Hours per day)	/	Seconds per hour	=	Delay in hours / day
Existing peak hour intersection delay	(	9,988	X	10)	/	3600	=	27.7
Peak hour intersection delay w/ improvements	(	6,634	X	10)	/	3600	=	18.4

Step 6: MOVES 2014a emission factors for idling speed: AM or PM **PM**

2020 Summer VOC Factor grams/hour	2020 Summer NOx Factor grams/hour	2020 Winter CO Factor grams/hour	2020 Summer CO2 Factor grams/hour
0.249	**0.630**	**3.569**	**3565.610**

Step 7: Calculate net emissions change in kilograms per day:

	Delay in Hours per Day	Summer VOC Emissions kilograms/day	Summer NOx Emissions kilograms/day	Winter CO Emissions kilograms/day	Summer CO2 Emissions kilograms/da
Existing Conditions	27.7	0.007	0.017	0.099	98.929
With Improvements	18.4	0.005	0.012	0.066	65.701
Net Change		**-0.002**	**-0.006**	**-0.033**	**-33.228**

Step 8: Calculate net emissions change in kilograms per year (seasonally adjusted)

	Net change per day (kg)		Avg. weekdays per year		Seasonal adj. factor		Adj. net change in kg per year
Summer VOC Emissions	-0.002	X	250	X	1.0188	=	**-0.591**
Summer NOx Emissions	-0.006	X	250	X	1.0188	=	**-1.494**
Winter CO Emissions	-0.033	X	250	X	0.9812	=	**-8.158**
Summer CO2 Emissions	-33.228	X	250	X	1.000		**-8,306.881**

Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Adj. net change in kg per year		First year cost per kilogram
Summer VOC	$1,944,000	/	-0.591	=	**3,291,034**
Summer NOx	$1,944,000	/	-1.494	=	**1,300,809**
Winter CO	$1,944,000	/	-8.158	=	**238,286**
Summer CO2	$1,944,000	/	-8,306.881	=	**234**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Lawrence Manchester Rail Corridor Rail Trail **CMAQ Air Quality Worksheet**

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

FILL IN SHADED BOXES ONLY

TIP YEAR: **2023**

MPO: **Merrimack Valley** **Municipality:** Lawrence

Project: **Lawrence Manchester Rail Corridor (LMRC) Rail Trail Project # 608930**

Step 1: Calculate Estimated Reduction in Vehicle Miles Traveled (VMT):

If VMT reduction per year is known then go to Step 2B, if not proceed with Step 1 :

A.	Facility Length **(L)**:	1.5	Miles	
B.	Service Area Radius **(R)**:	1.0	Miles Sq.	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	2.92	Miles Sq.	
D.	Total Land Area of Community(ies) **(T)**:	6.93	Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	42.1%		
F.	Total Population of Community(ies) **(TP)**:	79,337	Persons	
G.	Population Served by Facility **(P)**: LA * TP = P	33,429	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	25,759	HH HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	10,854	Persons	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	33,261	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH	1.29	Persons	
L.	Workers in Service Area **(WSA)**: HS * WPHH = WSA	14,015		
M.	Population Density of the Service area **(PD)**: P / SA = PD	11,448	Persons Per Sq. Mile	

Lawrence Manchester Rail Corridor Rail Trail **CMAQ Air Quality Worksheet (Cont.)**

N. If the bicycle and pedestrian commuter mode share is known, enter the percentage at the right **(BMS)** 4.7%

If not, use US Census - American Community Survey data to determine the mode share and enter the percentage.
http://www.census.gov/programs-surveys/acs/guidance/estimates.html

O. Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT 659 One-Way Trips

P. Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT 1,120 One-Way Trips

(Latest planning assumptions estimate non-work utilitarian trips to be 1.7 times the work utilitarian.)

Step 2: Calculate the VMT Reduction Per Day:

A. ((2 * BWT) + (2 * BNWT)) * (0.5* L) = VMTR 2596.6 VMTR Per Day

B. VMTR * Operating Days Per Year 2,596.6 * 200 = 519,313 VMTR Per Year

If the Vehicle Miles Traveled Reduction is known enter in the box to the right. VMTR Per Year

Note: A manual entry of the VMTR will override the calculated cell.

Step 3: MOVES 2014a Emission Factors for Unrestricted PM:

Note: Use 35 MPH as a default if average speed is not known. Speed Used: 35 MPH Eastern

2020 Passenger Summer VOC Factor grams/mile	2020 Passenger Summer NOx Factor grams/mile	2020 Passenger Summer CO Factor grams/mile	2020 Passenger Summer CO2 Factor grams/mile
0.030	**0.081**	**2.095**	**338.769**

Lawrence Manchester Rail Corridor Rail Trail **CMAQ Air Quality Worksheet (Cont.)**

Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):

Summer VOC	Summer NOx	Summer CO	Summer CO2
15.8	**43.1**	**1,108.2**	**175,927.3**

Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost		Emission Reduction in kg per year		First year cost per kilogram
Summer VOC	$14,895,375	/	15.8	=	**$944,750**
Summer NOx	$14,895,375	/	43.1	=	**$345,867**
Summer CO	$14,895,375	/	1,108.2	=	**$13,440**
Summer CO2	$14,895,375	/	175,927.3	=	**$85**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

North Andover - Intesection & Signal Improvements Route 125 & Mass. Ave. **CMAQ Air Quality Analysis Worksheet**

CMAQ Air Quality Analysis Worksheet for Traffic Flow and Intersection Improvements

FILL IN SHADED BOXES ONLY

TIP YEAR **2018**

MPO: **Merrimack Valley** **Municipality:** **North Andover**

Project: **# 606159 Intersection & Signal Improvements at Route 125 & Massachusetts Avenue**

Step 1: Calculate Existing AM Peak Hour Total Intersection Delay in Seconds:

Street Name	Dir	Left-Turns (Vol / PHF)		X delay per veh	=	Total move. delay	+	Thru (Vol / PHF)		X delay per veh	=	Total move. delay	+	Right-Turns (Vol / PHF)		X delay per veh	=	Total move. delay	=	Total approach delay
Rt 125	NB	134	0.95	18.1	=	2,553	+	350	0.95	17.1	=	6,300	+	12	0.95	12.2	=	154	=	9,007
Rt 125	SB	36	0.95	27.6	=	1,046	+	610	0.95	30.8	=	19,777	+	114	0.95	30.8	=	3,696	=	24,519
Mass Ave	EB	92	0.95	51.8	=	5,016	+	411	0.95	51.8	=	22,410	+	185	0.95	12.6	=	2,454	=	29,880
Mass Ave	WB	8	0.95	23.5	=	198	+	458	0.95	23.5	=	11,329	+	21	0.95	23.5	=	519	=	12,047
																		Total Intersection Delay/Seconds	=	**75,453**

Step 2: Calculate Existing PM Peak Hour Total Intersection Delay in Seconds:

Street Name	Dir	Left-Turns (Vol / PHF)	X delay per veh	= Total move. delay	+ Thru (Vol / PHF)	X delay per veh	= Total move. delay	+ Right-Turns (Vol / PHF)	X delay per veh	= Total move. delay	= Total approach delay
Rt 125	NB	304 / 0.95	54.1	= 17,312	+ 800 / 0.95	47.1	= 39,663	+ 17 / 0.95	10.5	= 188	= 57,163
Rt 125	SB	13 / 0.95	29.4	= 402	+ 580 / 0.95	23.7	= 14,469	+ 97 / 0.95	23.7	= 2,420	= 17,292
Mass Ave	EB	93 / 0.95	120.6	= 11,806	+ 542 / 0.95	120.6	= 68,805	+ 182 / 0.95	14.6	= 2,797	= 83,409
Mass Ave	WB	37 / 0.95	259.9	= 10,122	+ 476 / 0.95	259.9	= 130,224	+ 19 / 0.95	259.9	= 5,198	= 145,544
										Total Intersection Delay/Seconds	= **303,407**

Step 3: The spreadsheet automatically chooses the peak hour with the longer total intersection delay for the next step in the analysis.

Peak Hour: PM Total Intersection Delay: 303,407

Step 4: Calculate the existi PM Peak Hour Total Intersection Delay with Improvements:

Street Name	Dir	Left-Turns (Vol / PHF)	X delay per veh	= Total move. delay	+ Thru (Vol / PHF)	X delay per veh	= Total move. delay	+ Right-Turns (Vol / PHF)	X delay per veh	= Total move. delay	= Total approach delay
Rt 125	NB	304 / 0.95	34.0	= 10,880	+ 800 / 0.95	21.3	= 17,937	+ 17 / 0.95	21.3	= 381	= 29,198
Rt 125	SB	13 / 0.95	27.5	= 376	+ 580 / 0.95	37.9	= 23,139	+ 97 / 0.95	37.9	= 3,870	= 27,385
Mass Ave	EB	93 / 0.95	31.0	= 3,035	+ 542 / 0.95	47.4	= 27,043	+ 182 / 0.95	47.4	= 9,081	= 39,159
Mass Ave	WB	37 / 0.95	46.8	= 1,823	+ 476 / 0.95	20.9	= 10,472	+ 19 / 0.95	20.9	= 418	= 12,713
										Total Intersection Delay/Seconds	= **108,454**

North Andover - Intesection & Signal Improvements Route 125 & Mass. Ave. **CMAQ Air Quality Analysis Worksheet (Cont.)**

Step 5: Calculate vehicle delay in hours per day:

	(	Delay in seconds	X	Hours per day)	/	Seconds per hour	=	Delay in hours / day
Existing peak hour intersection delay	(	303,407	X	10	)	/ 3600	=	842.8
Peak hour intersection delay w/ improvements	(	108,454	X	10	)	/ 3600	=	301.3

Step 6: MOVES 2014a emission factors for idling speed: AM or PM **PM**

2020 Summer VOC Factor grams/hour	2020 Summer NOx Factor grams/hour	2020 Winter CO Factor grams/hour	2020 Summer CO2 Factor grams/hour
0.249	**0.630**	**3.569**	**3565.610**

Step 7: Calculate net emissions change in kilograms per day:

	Delay in Hours per Day	Summer VOC Emissions kilograms/day	Summer NOx Emissions kilograms/day	Winter CO Emissions kil-ograms/day	Summer CO2 Emissions kilograms/da
Existing Conditions	842.8	0.210	0.531	3.008	3,005.09
With Improvements	301.3	0.075	0.190	1.075	1,074.18
Net Change		**-0.135**	**-0.341**	**-1.933**	**-1,930.91**

Step 8: Calculate net emissions change in kilograms per year (seasonally adjusted)

	Net change per day (kg)		Avg. weekdays per year		Seasonal adj. factor		Adj. net change in kg per year
Summer VOC Emissions	-0.135	X	250	X	1.019	=	**-34.326**
Summer NOx Emissions	-0.341	X	250	X	1.019	=	**-86.845**
Winter CO Emissions	-1.933	X	250	X	0.981	=	**-474.091**
Summer CO2 Emissions	-1,930.907	X	250	X	1.000		**-482,726.774**

Calculate cost effectiveness (first year cost per kg of emissions reduced)

Emission	Project Cost	/	Adj. net change in kg per year	=	First year cost per kilogram
Summer VOC	$3,785,640	/	-34.326	=	**110,284**
Summer NOx	$3,785,640	/	-86.845	=	**43,591**
Winter CO	$3,785,640	/	-474.091	=	**7,985**
Summer CO2	$3,785,640	/	-482,726.774	=	**8**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Merrimack Valley RTA Replace 3 (2007) Buses with 3 (2020) Buses

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: **2020** **Bus Replacements**

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

Project #RTD0006781 - Replace 3 (2007) Buses with 3 (2020) Buses

Emission Rates in grams/mile at assumed operating speed bin of: 18 MPH (Bin 5 (17.5-22.5))

Scenario Comparison		Model Year	**Summer VOC** (grams/mile)	**Summer NOx** (grams/mile)	**Winter CO** (grams/mile)	**Summer CO2** (grams/mile)
Existing Model*	=	2007	0.115	3.750	0.659	1,200.600
New Bus Purchase**	=	2020	0.048	0.764	0.275	1,133.23

* Please contact OTP for assistance on Existing Model emission factors

** MOVES 2014a Commercial Emission Factors - Please Specify the Following:

AM or PM:	PM	Restricted or Unrestricte	Unrestricted

Change (Buy-Base)	-0.067	-2.986	-0.384	-67.370

Calculate fleet vehicle miles per day:

Revenue miles per year	X	Deadhead factor	= fleet miles per year	\ operating days per year	= fleet miles per day
104,490		1.16	121,208	**354**	342

Merrimack Valley RTA Replace 3 (2007) Buses with 3 (2020) Buses (Cont.)

Calculate emissions change in kilograms per summer day

Change	rate change grams/mile	/ 1000 g/kg	X fleet miles per day	X seasonal adj factor	= change/day in kg
Change in Summer VOC	-0.067	1,000	342	1.0188	**-0.023**
Change in Summer NOx	-2.986	1,000	342	1.0188	**-1.042**
Change in Winter CO	-0.384	1,000	342	0.9812	**-0.129**
Change in Summer CO2	-67.370	1,000	342	1.0000	**-23.067**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.023	354	-8.274
Summer NOx	-1.042	354	-368.733
Winter CO	-0.129	354	-45.669
Summer CO2	-23.067	354	-8165.810

Calculate cost effectiveness (cost per kg of emissions reduced)

Pollutant	Total Project Cost	/ Project Life in years	/ reduction per year in kg	= annual cost per kg
Summer VOC	**$1,377,150**	**12**	8.274	**$13,871**
Summer NOx	**$1,377,150**	**12**	368.733	**$311**
Winter CO	**$1,377,150**	**12**	45.669	**$2,513**
Summer CO2	**$1,377,150**	**12**	8165.810	**$14**

Template prepared by the Office of Transportation Planning Updated March 2016

Merrimack Valley RTA Replace 16 (2015) Vans with 16 (2021) Vans

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: **2021** **Bus Replacements**

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

Project #RTD0006784 - Replace 16 (2015) Vans with 16 (2021) vans

Emission Rates in grams/mile at assumed operating speed bin of: 18 MPH (Bin 5 (17.5-22.5))

Scenario Comparison		Model Year	**Summer VOC** (grams/mile)	**Summer NOx** (grams/mile)	**Winter CO** (grams/mile)	**Summer CO2** (grams/mile)
Existing Model*	=	2015	0.008	0.058	2.014	501.185
New Bus Purchase**	=	2021	0.003	0.025	0.593	435.854

* Please contact OTP for assistance on Existing Model emission factors

** MOVES 2014a Commercial Emission Factors - Please Specify the Following:

AM or PM: PM

Restricted or Unrestricted: Unrestricted

Change (Buy-Base)	-0.005	-0.033	-1.421	-65.331

Calculate fleet vehicle miles per day:

Revenue miles per year	X	Deadhead factor	= fleet miles per year	operating days per year	= fleet miles per day
436,096		1.15	501,510	**359**	1,397

Merrimack Valley RTA Replace 16 (2015) Vans with 16 (2021) Vans (Cont.)

Calculate emissions change in kilograms per summer day

Change	rate change grams/mile	/ 1000 g/kg	X fleet miles per day	X seasonal adj factor	= change/day in kg
Change in Summer VOC	-0.005	1,000	1,397	1.0188	**-0.007**
Change in Summer NOx	-0.033	1,000	1,397	1.0188	**-0.047**
Change in Winter CO	-1.421	1,000	1,397	0.9812	**-1.948**
Change in Summer CO2	-65.331	1,000	1,397	1.0000	**-91.265**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.007	359	-2.555
Summer NOx	-0.047	359	-16.861
Winter CO	-1.948	359	-699.249
Summer CO2	-91.265	359	-32764.176

Calculate cost effectiveness (cost per kg of emissions reduced)

Pollutant	Total Project Cost	/ Project Life in years	/ reduction per year in kg	= annual cost per kg
Summer VOC	**$1,185,310**	**4**	2.555	**$115,993**
Summer NOx	**$1,185,310**	**4**	16.861	**$17,575**
Winter CO	**$1,185,310**	**4**	699.249	**$424**
Summer CO2	**$1,185,310**	**4**	32764.176	**$9**

Template prepared by the Office of Transportation Planning Updated March 2016

Merrimack Valley RTA Replace 7 (2009) Buses with 7 (2022) Buses

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: **2022** **Bus Replacements**

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

Project #RTD0006791 - Replace 7 (2009) Buses with 7 (2022) Buses

Emission Rates in grams/mile at assumed operating speed bin of: 18 MPH (Bin 5 (17.5-22.5))

Scenario Comparison		Model Year	**Summer VOC** (grams/mile)	**Summer NOx** (grams/mile)	**Winter CO** (grams/mile)	**Summer CO2** (grams/mile)
Existing Model*	=	2009	0.115	3.750	0.659	1,203.080
New Bus Purchase**	=	2022	0.048	0.764	0.275	1,133.23

* Please contact OTP for assistance on Existing Model emission factors

** MOVES 2014a Commercial Emission Factors - Please Specify the Following:

AM or PM:	PM	Restricted or Unrestricted	Unrestricted

Change (Buy-Base)	-0.067	-2.986	-0.384	-69.850

Calculate fleet vehicle miles per day:

Revenue miles per year	X	Deadhead factor	= fleet miles per year	/ operating days per year	= fleet miles per day
243,810		1.16	282,820	**354**	799

Merrimack Valley RTA Replace 7 (2009) Buses with 7 (2022) Buses (Cont.)

Calculate emissions change in kilograms per summer day

Change	rate change grams/mile	/ 1000 g/kg	X fleet miles per day	X seasonal adj factor	= change/day in kg
Change in Summer VOC	-0.067	1,000	799	1.0188	**-0.055**
Change in Summer NOx	-2.986	1,000	799	1.0188	**-2.430**
Change in Winter CO	-0.384	1,000	799	0.9812	**-0.301**
Change in Summer CO2	-69.850	1,000	799	1.0000	**-55.805**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.055	354	-19.305
Summer NOx	-2.430	354	-860.376
Winter CO	-0.301	354	-106.561
Summer CO2	-55.805	354	-19754.949

Calculate cost effectiveness (cost per kg of emissions reduced)

Pollutant	Total Project Cost	/ Project Life in years	/ reduction per year in kg	= annual cost per kg
Summer VOC	**$3,309,565**	**12**	19.305	**$14,286**
Summer NOx	**$3,309,565**	**12**	860.376	**$321**
Winter CO	**$3,309,565**	**12**	106.561	**$2,588**
Summer CO2	**$3,309,565**	**12**	19754.949	**$14**

Template prepared by the Office of Transportation Planning Updated March 2016

Merrimack Valley RTA Replace 2 (2009) Buses with 2 (2023) Buses

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: **2023** **Bus Replacements**

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

Project #RTD0007135 - Replace 2 (2009) Buses with 2 (2023) Buses

Emission Rates in grams/mile at assumed operating speed bin of: 18MPH(Bin5(17.5-22.5))

Scenario Comparison		Model Year	**Summer VOC** (grams/mile)	**Summer NOx** (grams/mile)	**Winter CO** (grams/mile)	**Summer CO2** (grams/mile)
Existing Model*	=	2009	0.115	3.750	0.659	1,203.080
New Bus Purchase**	=	2023	0.048	0.764	0.275	1,133.23

* Please contact OTP for assistance on Existing Model emission factors

** MOVES 2014a Commercial Emission Factors - Please Specify the Following:

AM or PM: PM Restricted or Unrestricted: Unrestricted

Change (Buy-Base)	-0.067	-2.986	-0.384	-69.850

Calculate fleet vehicle miles per day:

Revenue miles per year	X	Deadhead factor	= fleet miles per year	/ operating days per year	= fleet miles per day
69,660		1.16	80,806	**354**	228

Merrimack Valley RTA Replace 2 (2009) Buses with 2 (2023) Buses (Cont.)

Calculate emissions change in kilograms per summer day

Change	rate change grams/mile	/ 1000 g/kg	X fleet miles per day	X seasonal adj factor	= change/day in kg
Change in Summer VOC	-0.067	1,000	228	1.0188	**-0.016**
Change in Summer NOx	-2.986	1,000	228	1.0188	**-0.694**
Change in Winter CO	-0.384	1,000	228	0.9812	**-0.086**
Change in Summer CO2	-69.850	1,000	228	1.0000	**-15.944**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.016	354	-5.516
Summer NOx	-0.694	354	-245.822
Winter CO	-0.086	354	-30.446
Summer CO2	-15.944	354	-5644.271

Calculate cost effectiveness (cost per kg of emissions reduced)

Pollutant	Total Project Cost	/ Project Life in years	/ reduction per year in kg	= annual cost per kg
Summer VOC	**$973,910**	**12**	5.516	**$14,714**
Summer NOx	**$973,910**	**12**	245.822	**$330**
Winter CO	**$973,910**	**12**	30.446	**$2,666**
Summer CO2	**$973,910**	**12**	5644.271	**$14**

Template prepared by the Office of Transportation Planning Updated March 2016

Appendix F Completed Highway and Transit Projects GHG Summary

Merrimack Valley Region MPO Completed Highway Projects GHG Summary

MassDOT Project ID ▼	MassDOT Project Description ▼	Total Program-med Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Additional Description ▼	Year of Contract Award (2015 and for-ward)
606503	NEWBURYPORT CLIPPER CITY RAIL TRAIL ALONG THE CITY BRANCH (PHASE II)	$ 4,061,158	Quantified	34,996	Quantified Decrease in Emissions from Bicycle and Pedes-trian Infrastructure	Advertised 9/19/2015 Notice to Proceed 4/1/2016	2016
606161	HAVERHILL - IMPROVEMENTS ON MAIN STREET (ROUTE 125)	$ 3,635,519	Quantified	16,491	Quantified Decrease in Emissions from Traffic Operational Improvement	Advertised 9/17/2016 Notice to Proceed 4/12/17	2017
607573	HAVERHILL - RECONSTRUCTION ON ROUTE 97 (BROADWAY), FROM SILVER BIRCH LANE TO RESEARCH DRIVE	$ 6,526,912	Quantified	41,800	Quantified Decrease in Emissions from Traffic Operational Improvement	Advertised 5/13/2017 Notice to Proceed 2/9/18	

Merrimack Valley Region MPO Completed Transit Projects GHG Summary

FTA Activity Line Item ▼	Transit Agency ▼	Project Description ▼	Total Cost ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Fiscal Year Programmed (2015 and forward) ▼
	MVRTA	Purchase -Replacement: Vans 11 Model Year 2009 Delivery 2015	$ 627,000	Quantified	41,814	Quantified Decrease in Emissions from Bus Replacement	2015
111202	MVRTA	Replace 10 of 17 Model Year 2004 Transit Buses with new buses (Delivery 2016)	$4,200,000	Quantified	12,557	Quantified Decrease in Emissions from Bus Replacement	2015
111215	MVRTA	Replace 5 Model Year 2011 Paratransit Vehicles (Delivery 2016)	$ 320,000	Quantified	15,992	Quantified Decrease in Emissions from Bus Replacement	2016
111202	MVRTA	Replace 7 Model Year 2004 Buses with new	$2,989,000	Quantified	18,271	Quantified Decrease in Emissions from Bus Replacement	2017

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Appendix G List of Acronyms

MVMPO List of Commonly Used Acronyms		
A	AADT	Average Annual Daily Traffic
	AASHTO	American Association of State Highway Transportation Officials
	ABP	MassDOT Accelerated Bridge Program
	AC	Advance Construction
	ADA	Americans with Disabilities Act (1990)
	ADT	Average Daily Traffic
	ARRA	American Recovery and Reinvestment Act (of 2009)
	AQ	Air Quality
B	B to B	Border to Boston Rail Trail
	BR, BR-On, BR-Off	Bridge Rehabilitation or Replacement (On- or Off-National Highway System)
C	(C)	Type of Project = Capital Improvement
	3C	Continuing, Comprehensive and Coordinated (Transportation Planning)
	CAAA	Clean Air Act Amendments of 1990
	CFR	Code of Federal Regulations
	CIP	Capital Investment Plan
	CLF	Conservation Law Foundation
	CMAQ	Congestion Mitigation and Air Quality Improvement Program
	CMP	Congestion Management Process
	CMR	Code of Massachusetts Regulations
	CNG	Compressed Natural Gas
	CO	Carbon Monoxide

D	DEP	Department of Environmental Protection
	DOT	Department of Transportation
	DPW	Department of Public Works
E	EB	Eastbound
	EIR	Environmental Impact Report
	EIS	Environmental Impact Statement
	EJ	Environmental Justice
	ENF	Environmental Notification Form
	E.O.	Executive Order (of the Governor of the Commonwealth)
	EPA	U.S. Environmental Protection Agency
F	FA	Federal-Aid
	FAPRO	Federal Aid Program Reimbursement Office
	FAST Act	Fixing America's Surface Transportation Act legislation signed into law December 4, 2015
	FHWA	Federal Highway Administration
	FTA	Federal Transit Administration
	FY	(State) Fiscal Year
	FFY	Federal Fiscal Year
G	GANs	Grant Anticipation Notes
	GHG	Greenhouse Gas
H	HPP	USDOT High Priority Project
	HSIP	Highway Safety Improvement Program

I	IM	Interstate Maintenance
	ITS	Intelligent Transportation System
	ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
L	LEP	Limited English Proficiency
	LOS	Level of Service
	LTA	Local Technical Assistance
M	(M)	Type of project = Maintenance
	MAP-21	Moving Ahead for Progress in the 21st Century legislation signed into law July 6, 2012
	MassDOT	Massachusetts Department of Transportation
	MCAD	Massachusetts Commission Against Discrimination
	MEPA	Massachusetts Environmental Policy Act
	M.G.L.	Massachusetts General Laws
	MOA	Memorandum of Agreement
	MOD	Massachusetts Office on Disabilities
	MOU	Memorandum of Understanding
	MPO	Metropolitan Planning Organization
	MVMPO	Merrimack Valley Metropolitan Planning Organization
	MVPC	Merrimack Valley Planning Commission
	MVPGS	Merrimack Valley Priority Growth Strategy
	MVRTA	Merrimack Valley Regional Transit Authority
N	(N)	Type of project = other, not capital expense, or operating expense, but other such as planning or design

	NAAQS	National Ambient Air Quality Standards
	NARC	National Association of Regional Councils
	NB	Northbound
	NEPA	National Environmental Policy Act
	NFA	Non-Federal Aid
	NHS	National Highway System
	NMCOG	Northern Middlesex Council of Governments
	NOx	Nitrogen Oxide
	NPRM	Notice of Proposed Rulemaking (Federal Register)
O	(O)	Type of Project = Operating Expense
	O&M	Operations and Maintenance
P	PCI	Pavement Condition Index
	PDA	Priority Development Area
	PL	(Metropolitan) Planning Funds
	PMS	Pavement Management System
	PPP	Public Participation Plan
	PRC	(MassDOT) Project Review Committee
	PSAC	Project Selection Advisory Council
	PS&E	The Plans, Specifications and Estimate to be used by contractors to bid on construction proposals
R	RGGI	Regional Greenhouse Gas Initiative
	ROW	Right-of-Way
	RPA	Regional Planning Agency
	RPMS	Regional Pavement Management System
	RTA	Regional Transit Authority
	RTP	Regional Transit Plan

S	SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
	SB	Southbound
	SD	Structurally Deficient
	SGR	State of Good Repair
	SIP	State (Air Quality) Implementation Plan
	SOV	Single Occupancy Vehicle
	SPR	Statewide Planning and Research Funds
	STBG	Surface Transportation Block Grant Program
	STIP	Statewide Transportation Improvement Program
	STP	Surface Transportation Program
T	TA	Transportation Alternatives
	TAM	Transit Asset Management
	TAP	Transportation Alternatives Program
	TCSP	Transportation and Community System Preservation Grant Program
	TDM	Transportation Demand Management
	TEA-21	Transportation Equity Act for the 21st Century
	TEC	Transportation Project Evaluation Criteria
	TERM score	Transit Economic Requirements Model score used to rate transit facility conditions
	TIP	Transportation Improvement Program
	TMA	Transportation Management Area
	TMC	Turning Movement Count
	TOD	Transit-Oriented Development
	TRB	Transportation Research Board

U	ULB	Useful Life Benchmark
	UPWP	Unified Planning Work Program
	USDOT	U.S. Department of Transportation
V	V/C	Volume/Capacity Ratio
	VMT	Vehicle Miles Traveled
	VOC	Volatile Organic Compound
W	WB	Westbound

Massachusetts Executive Orders		
EO	526	Nondiscrimination, Diversity, Equal Employment Opportunity and Affirmative Action
EO	12898	Environmental Justice in Minority and Low Income Populations, February 1994
EO	13166	Improving Access to Programs (and Services) for persons with limited English Proficiency

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Appendix H Key to Maps Showing Locations of Transportation Projects

Appendix H Key to Maps Showing Locations of Transportation Projects

Map Number	Project Number	City/Town	Project Description
1	602418	Amesbury	Amesbury – Reconstruction of Elm Street
2	607541	Georgetown-Boxford	Georgetown – Boxford Border to Boston Trail from Georgetown Road to West Main Street (Route 97)
2	607542	Georgetown-Newbury	Georgetown– Newbury Border to Boston Trail (Northern Georgetown to Byfield Section)
3	608298	Groveland	Groveland- Groveland Community Trail, from Main Street to King Street
4	608027	Haverhill	Haverhill- Bradford Rail Trail Extension, from Route 125 to Railroad Street
4	RTD - 7129	MVRTA	SGR Riverbank Stabilization Construction
4	605306	Haverhill	Haverhill – Bridge Replacement, H-12- 039, I-495 (NB & SB) over Merrimack River
4	608761	Haverhill	Haverhill – Intersection Reconstruction on Route 108 (Newton Road) at Route 110 (Kenoza Avenue and Amesbury Road)
5	608930	Lawrence	Lawrence - Lawrence Manchester Rail Corridor (LMRC) Rail Trail

Appendix H Key to Maps Showing Locations of Transportation Projects (Continued)

Map Number	Project Number	City/Town	Project Description
6	608494	Newbury / Newburyport / Salisbury	Resurfacing of Route 1
7	608792	Newburyport	Newburyport SRTS Middle and Elementary Schools
8	608095	North Andover	North Andover- Corridor Improvements on Route 114, between Route 125 (Andover Street) & Stop & Shop driveway
9	606159	North Andover	North Andover – Intersection & Signal Improvements at Route 125 & Massachusetts Avenue
10	602202	Salisbury	Salisbury – Reconstruction of Route 1 (Lafayette Road)
11	608788	Haverhill	Haverhill – Roadway Reconstruction on North Avenue, from Main Street (Route 125) to Plaistow NH

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Appendix I Comments Received on Draft MVMPO FFYs 2019 to 2023 TIP

Charles D. Baker, Governor
Karyn E. Polito, Lieutenant Governor
Stephanie Pollack, MassDOT Secretary & CEO

massDOT
Massachusetts Department of Transportation

May 9, 2018

Karen Sawyer Conard, Executive Director
Merrimack Valley Planning Commission
160 Main Street
Haverhill, MA 01830

Dear Ms. Conard:

The Massachusetts Department of Transportation (MassDOT) Office of Transportation Planning (OTP) has reviewed the draft 2019-2023 Transportation Improvement Program (TIP) released by the Merrimack Valley Metropolitan Planning Organization (MPO) on April 25, 2018. The following MassDOT comments include both general guidance and specific comments on the MPO's 3C planning process related to the content of this document as released for public review.

Please note the following comments specific to the information contained in the MPO's draft 2019-2023 TIP.

Narrative

- Page 10 - The narrative should include a reference to the Transportation Asset Management Plan (TAMP), which is being developed by MassDOT to address pavement and bridge conditions on the NHS system.
- Pages 13 – 16 – Please ensure that the graphs are as legible as possible - consider using landscape to increase the size of the graphs.
- Page 44 – Please ensure that in the final version, the dates that currently include question marks on this page are properly filled in.
- Page 45 - Please clarify that MassDOT general guidelines for TIP amendments advise MPOs to release a TIP amendment when project costs change more than $500,000 for projects costing less than $5 million and when project costs change more than 10% for projects over $5 million.
- Pages 103 – 107 – Please revise tables based on changes to funding sources as listed below.

Federal Highway Project Listing

FFY 2019

- 606159 - Please revise funding sources to include $4,978,305 of STP and $442,956 of HSIP. Additionally, under Section 1B, please change the funding source from "Other FA" to "HPP."

FFY2020

- 608027 – Please revise funding sources to include $1,062,149 of STP and $68,851 of TAP.

Ten Park Plaza, Suite 4160, Boston, MA 02116
Tel: 857-368-4636, TrY: 857-368-0655
www.mass.gov/massdot

FFY2021

- 608298- Please revise funding sources to include $1,633,129 of STP, $408,848 of CMAQ, and $323,996 ofTAP.
- 608095- Please revise funding sources to include $4,411,814 of STP, $351,000 of TAP, $442,956 of HSIP, and $1,107,389 of CMAQ.
- 608620- Please add AC nomenclature to Additional Information column.

FFY 2022

- 608095- Please revise funding sources to include $8,602,213 of STP, $351,000 of TAP, $442,956 of HSIP, and $1,107,389 of CMAQ.

GHG Impacts

FFY 2019 Highway

- Project MV0001 should be quantified in the 2019 transit tab, showing as a qualitative decrease.
- Lines that do not contain funded projects should not have GHG impact information.
- Project 608792 should be labeled as a qualitative decrease.

FFY 2020 Highway

- Lines that do not contain funded projects should not have GHG impact information.

FFY 2021 Highway

- Lines that do not contain funded projects should not have GHG impact information.
- Project 608494 should be labeled as a qualitative decrease.
- Project 608095 should be labeled as a qualitative decrease if addressed in the statewide model.

FFY 2022 Highway

- Lines that do not contain funded projects should not have GHG impact information.

FFY 2023 Highway

- Lines that do not contain funded projects should not have GHG impact information.

Please contact me at (857) 368-8865 or Derek Krevat at (857) 368-8868 if you have any questions.

Sincerely,

David Mohler
Executive Director
Office of Transportation Planning

Cc: Jeffrey McEwen, Division Administrator, Federal Highway Administration
Mary Beth Mello, Regional Administrator, Federal Transit Administration
Paul Stedman, District 4 Highway Director
Astrid Glynn, Rail and Transit Division Administrator

MVRTA Comments

The adopted FY 2019-2023 MVRTA Capital Plan correctly programs the purchase of buses in the year the FTA grant request is made so the grant request conforms to the programming document versus the Grants Plus payment method which is when the buses are delivered-so I would think that the Transit Project Section should be changed to correctly program bus projects-all the other projects are correct.

On the signature pages-use this:

Joseph Costanzo
Administrator/CEO
MVRTA

Comments received at 1 PM Public Hearing on May 16, 2018

Gina Garafalo supports the program of projects in the Draft 2019 to 2023 TIP.

Response to MassDOT comments:

Narrative

Page 10 - added that MassDOT is currently developing the Transportation Asset Management Plan (TAMP), as required by MAP-21, to address pavement and bridge conditions on the NHS system.

Page 13-16 (now page 13-19) – Changed to landscape orientation to make the graphs more legible.

Page 44 (now page 47) – The Public Review and Comment dates of May 1, 2018 to May 21, 2018 and the Public Hearings date and times of May 16, 2018 at 1 PM and 6 PM were included in the Draft document that went out to public review.

Page 45 – (now page 48) – Revised the MVMPO TIP to match MassDOT guidelines for TIP amendments, the difference being that previously the TIP stated that cost increases of 10%, or more, required a formal amendment, where as, MassDOT guidelines state that for projects costing less than $5 million a formal Amendment is only required if the cost increases more than $500,000. For projects costing more than $5 million nothing has changed, an increase of more than 10% requires a formal TIP Amendment.

Pages 103-107 – (now pages 105-109) – Tables revised based on funding source changes made.

Federal Highway Project Listing

This year MassDOT allocated the Regional Target Funding into the STP, CMAQ, TAP and HSIP funding categories on a project by project basis and informed the regions of the changes to make for the Final documents. These changes have been made.

GHG Impacts

The GHG section changes have been made except for quantifying project MV0001, the new bus upgrade to cleaner fuel buses. Currently there is not yet enough information to quantify the GHG emissions.