Appendix

Merrimack Valley Metropolitan Planning Organization

Federal Fiscal Years 2021 to 2025 Transportation Improvement Program

Appendix Draft Report

April 2020

Prepared by the Merrimack Valley Planning Commission

This document was prepared in cooperation with the Massachusetts Department of Transportation and the U.S. Department of Transportation. (under Contract # 108056 with MassDOT) The views and opinions of the Merrimack Valley Planning Commission expressed herein do not necessarily state or reflect those of the Massachusetts Department of Transportation or the U.S. Department of Transportation.

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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
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	
	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
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 = 6.63	$6,662,599
	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
608788	Haverhill	Haverhill – Roadway Reconstruction on North Avenue, from Main Street (Route 125) to Plaistow, NH TEC = 8.25	$17,875,000
608721	Haverhill	Haverhill – Corridor Improvements on Water Street (Route 97/113), from Ginty Boulevard/Mill Street to Lincoln Boulevard/Riverside Avenue TEC = 8.18	$8,050,000
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 = 13.05	
	Newburyport	Newburyport -Route 1 Rotary Reconfiguration	
608029	Newburyport	Newburyport - Intersection Improvements Route 1 at Merrimac Street TEC = 7.67	$2,400,000

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
	North Andover	North Andover – Reconstruction of Mass. Ave. and Sidewalks (from Osgood St. to I-495)	
	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	$2,300,000

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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 (2021-2025)
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	1.75	0.50	**13.05**
Yes	608095	North Andover – Reconstruction of Rt. 114 from Rt. 125 (Andover St.) to Stop & Shop	$25,057	30,000	4.8	2.00	2.75	2.67	1.40	1.75	0.75	**11.32**
Yes	608930	Lawrence – LMRC Rail Trail	$14,895	NA	NA	1.00	1.75	2.00	3.00	2.50	1.00	**11.25**
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 (2021-2025)
Yes	609509	Lawrence – Intersection Improvements at Merrimack Street and South Broadway (Route 28)	$1,549	NA	NA	2.50	2.25	2.00	1.20	2.25	0.50	**10.70**
Yes	602202	Salisbury – Reconstruction of Route 1 (Lafayette Road)	$6,331	12,147	4.8	2.00	2.00	2.33	0.60	1.5	0.5	**8.93**
Yes	608761	Haverhill - Intersection Improvements at Rt. 110 / Rt. 108	$1,980	NA	NA	1.50	1.75	1.67	1.20	1.75	1.00	**8.87**
No	608788	Haverhill - Reconstruction of North Ave. from Main St. to NH stateline	$17,875	13,172	4.0	2.50	1.75	1.00	2.00	0.00	1.00	**8.25**

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 (2021-2025)
No	608721	Haverhill - Corridor Improvements on Water St. from Ginty Blvd / Mill St. to Lincoln Ave./ Riverside Ave.	$8,050	20,200	2.0	1.50	1.75	1.33	1.60	1.25	0.75	**8.18**
No	608029	Newburyport – Intersection Improvements Rt. 1 at Merrimac St.	$2,400	24,850	NA	2.00	0.50	2.67	1.00	1.25	0.25	**7.67**
No	602843	Georgetown – Reconstruction on Route 97 (W. Main) from Moulton St. to Groveland TL	$7,239	15,486	2.2	1.50	1.25	1.33	0.80	1.50	1.00	**7.38**
In 2020 TIP	608027	Haverhill – Bradford Rail Trail extension	$1,766	NA	NA	0.50	1.50	1.00	2.40	1.25	0.50	**7.15**

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 (2021-2025)
Yes	609251	Lawrence – Intersection Improvements at South Broadway (Route 28) and Mount Vernon St.	$1,014	NA	NA	2.00	1.00	1.67	1.60	0.50	0.25	**7.02**
Yes	610663	Newburyport – Riverfront Clipper City Rail Trail	$1,901	NA	NA	1.50	1.25	1.00	1.00	1.75	0.50	**7.00**
Yes	610658	Methuen – Intersection Improvements at Riverside Drive and Burnham Road	$930	NA	NA	1.50	1.25	1.67	1.60	0.25	0.25	**6.52**
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**
Yes	607542	Georgetown – Newbury – Border to Boston Trail (Northern Georgetown to Byfield Section)	$5,076	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 (2021-2025)
Yes	607541	Georgetown – Boxford – Border to Boston Trail, from Georgetown Road to West Main Street (Route 97)	$2,423	NA	NA	0.50	1.25	0.67	0.80	1.25	0.75	**5.22**
Yes	608298	Groveland - Community Trail	$1,985	NA	NA	0.50	1.25	0.67	1.20	1.00	0.25	**4.87**
Yes	609392	Rowley – Safety Improvements at Route 1, Central and Glen Streets	$2,041	NA	NA	0.50	1.00	1.33	1.00	0.25	0.00	**4.08**
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**

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.
B. Effect on bicycle and pedestrian safety.	2	Widening shoulder for bicycles and provides greater safety for pedestrians.
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) Tracking

2021 - 2025
Transportation Improvement Program
Greenhouse Gas Tracking

This section summarizes the greenhouse gas (GHG) impacts that are anticipated to result from the projects that are included in this FFY 2021 – 2025 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 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 (DEP) 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 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

The Role of Metropolitan Planning Organizations

The Commonwealth's MPOs are integrally involved in supporting the GHG reductions mandated under the GWSA. The MPOs are most directly involved in helping to achieve the GHG emissions reductions through the promotion of healthy transportation modes through prioritizing and programming an appropriate balance of roadway, transit, bicycle and pedestrian investments – and assisting smart growth development patterns through the creation of a balanced multi-modal transportation system. This is 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. GHG tracking and evaluation processes enable the MPOs to identify the anticipated GHG impacts of planned and programmed projects, and also to use GHG impacts as a criterion in prioritizing transportation projects.

Project-Level GHG Tracking and Evaluation in TIPs

It is also important to monitor and evaluate the GHG impacts of the transportation projects that are programmed in the MPOs' TIPs. The TIPs include both the larger, regionally-significant projects from the RTPs, which are reported in the Statewide GHG report, as well as smaller projects that are not included in the RTP but that may nevertheless have impacts on GHG emissions. The primary 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.

Calculation of GHG Impacts for TIP Projects

MassDOT has adopted spreadsheets used by MPOs to determine CMAQ eligibility and that also include CO_2 impacts. The data and analysis required for these calculations is available from functional design reports that are submitted for projects that would produce a measurable GHG impact.

Projects with Quantified Impacts

RTP Projects

Major capacity expansion projects are expected to have a significant impact on GHG emissions. These projects are included in each MPO's RTP and analyzed using either the statewide model or Boston MPO's regional model, which reflect GHG impacts. As a result, no independent TIP calculations are required.

Quantified Decrease in Emissions

For those projects that are expected to produce a measurable decrease in emissions, the approach for calculating these impacts is described below. These projects are 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 enables 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 enables increased transit ridership and decreased VMT.
- **Quantified Decrease in Emissions from a Park and Ride Lot** - A park-and-ride lot that enables increased transit ridership/ increased ridesharing and decreased VMT.

- **Quantified Decrease in Emissions from Bus Replacement**
  A bus replacement that directly reduces GHG emissions generated by 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 Alternative Fuel Vehicle Procurements –** A vehicle procurement where alternative fuel/ advanced technology vehicles replace traditional gas or diesel vehicles.
- **Quantified Decrease in Emissions from Anti-idling Strategies –** Implementation of policies such as limiting idling allowed, incorporationg anti-idling technology into fleets and using LED lights on trucks for the purpose of illuminating worksites.
- **Quantified Decrease in Emissions from Bike Share Projects –** A new bike share project or capacity added to existing project.
- **Quantified Decrease in Emissions from Induced Travel Projects –** A project that changes roadway capacity.
- **Quantified Decrease in Emissions from Speed Reduction Programs –** Programs that reduce speed to no less than 55 miles per hour.
- **Quantified Decrease in Emissions from Transit Signal Priority Projects –** A project that applies this technology to a signal intersection or along a corridor that impacts bus service.
- **Quantified Decrease in Emissions from Truck Stop Electrification Projects –** A new truck stop electrification project or capacity added to an existing project.
- **Quantified Decrease in Emissions from Other Improvement**

Quantified Increase in Emissions

Projects expected to produce a measurable increase in emissions.

Projects with No Assumed Impacts

No Assumed Impact/Negligible Impact on Emissions - Projects that do not change the capacity or use of a facility (e.g. roadway median barrier or retaining wall replacement, or bridge rehabilitation/replacement that restores the bridge to its previous condition) are assumed to have no/negligible GHG impact.

Qualitative Decrease in Emissions

Projects expected to produce a minor decrease in emissions that cannot be calculated with any precision. Examples of such projects include roadway repaving, signage improvement, ITS improvement, or transit marketing/customer experience improvement.

Qualitative Increase in Emissions

Projects expected to produce a minor increase in emissions that cannot be calculated with any precision.

Regional Greenhouse Gas Impact Summary Tables for FFYs 2021 – 2025 TIP

The following tables summarize the calculated quantitative and assumed qualitative impacts of the projects included in the regional FFYs 2021 – 2025 TIP by year.

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FFYs 2021 to 2025 Projects GHG Tracking Summary

2021 Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**	**Additional Information**
608761	HAVERHILL- INTERSECTION RECONSTRUCTION ON ROUTE 108 (NEWTON ROAD) AT ROUTE 110 (KENOZA AVENUE AND AMESBURY ROAD)	$1,980,067	Quantified	8,307	Quantified De-crease in Emis-sions from Traffic Operational Im-provement	$1,980,067	
609251	LAWRENCE – INTERSECTION IMPROVEMENTS AT SOUTH BROADWAY (ROUTE 28) AND MOUNT VERNON STREET	$1,013,739	Quantified	380,222	Quantified De-crease in Emis-sions from Traffic Operational Im-provement	$1,013,739	

2021 Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**	**Additional Information**
S10777	MVRTA – FLEX TO FTA TO REPLACE YR 2009 BUSES WITH NEW BUSES DELIVERY 2022 (7 OF 9)	$3,467,361	Quantified	20,049	Quantified Decrease in Emissions from Bus Replacement	$3,467,361	
608298	GROVELAND-GROVELAND COMMUNITY TRAIL FROM MAIN STREET TO KING STREET	$1,984,861	Quantified	2,710	Quantified Decrease in Emissions from Bi-cycle and Pedestrian Infrastructure	$1,984,861	

2021 Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**	**Additional Information**
610663	NEWBURYPORT – RIVERFRONT CLIPPER CITY RAIL TRAIL CONSTRUCTION	$1,900,802	Qualitative		Qualitative De-crease in Emis-sions	$1,900,802	GHG emis-sions had been includ-ed in quanti-fying New-buryport Clipper City Rail Trail Phase II Pro-ject # 606503 which has been com-pleted.
605306	HAVERHILL- BRIDGE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$15,305,880	Qualitative		No assumed im-pact/ negligible im-pact on emissions	$108,833,832	AC Yr 4 of 6.

2022 Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**	**Additional Information**
607541	GEORGETOWN-BOXFORD- BORDER TO BOSTON TRAIL, FROM GEORGETOWN ROAD TO WEST MAIN STREET (ROUTE 97)	$2,520,436	Quantified	2,667	Quantified De-crease in Emis-sions from Bicycle and Pedestrian Infrastructure	$2,520,436	
605306	HAVERHILL- BRIDGE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$18,203,683	Qualitative		No assumed im-pact/ negligible impact on emis-sions	$108,833,832	AC Yr 5 of 6.

2022 (Cont.) Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**	**Additional Information**
609509	LAWRENCE – INTERSECTION IMPROVEMENTS AT MERRIMACK STREET AND SOUTH BROADWAY (ROUTE 28)	$1,610,960	Quantified	52,372	Quantified De-crease in Emis-sions from Traffic Operational Im-provement	$1,610,960	
610658	METHUEN – INTERSECTION IMPROVEMENTS AT RIVERSIDE DRIVE AND BURNHAM ROAD	$967,200	Quantified	333,725	Quantified De-crease in Emis-sions from Traffic Operational Im-provement	$967,200	
608494	NEWBURY-NEWBURYPORT-SALISBURY-RESURFACING AND RELATED WORK ON ROUTE 1	$9,807,200	Qualitative		Qualitative De-crease in Emis-sions	$9,807,200	

2023 Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary

Mass DOT/ FTA Project ID	MassDOT/ FTA Project Description	Total Pro-grammed 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)	$6,837,284	Qualitative		Qualitative Decrease in Emissions	$6,837,284	
608095	NORTH ANDOVER- CORRIDOR IMPROVEMENTS ON ROUTE 114, BETWEEN ROUTE 125 (ANDOVER STREET) & STOP & SHOP DRIVEWAY	$4,401,056	Qualitative		RTP project included in the Statewide model.	$27,061,794	AC Yr 1 of 4
608930	LAWRENCE- LAWRENCE MANCHESTER RAIL CORRIDOR (LMRC) RAIL TRAIL	$16,087,005	Quantified	175,927	Quantified Decrease in Emissions from Bicycle and Pedes-trian Infrastructure	$16,087,005	

2023 (Cont.) Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Im-pact (kg/yr)**	**GHG Impact Description**	**Total Cost**	**Additional Information**
605306	HAVERHILL- BRIDGE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$12,994,233	Qualitative		No assumed impact/ negligible impact on emissions	$108,833,832	AC Yr 6 of 6.
609466	HAVERHILL- BRIDGE REPLACEMENT, H-12-040, I-495 (NB & SB) OVER MERRIMACK RIVER	$22,901,531	Qualitative		No assumed impact/ negligible impact on emissions	$99,783,090	AC Yr 1 of 3.

2024 Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Im-pact (kg/yr)**	**GHG Impact Description**	**Total Cost**	**Additional Information**
606522	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)	$15,056,661	Qualitative		No assumed impact/ negligible impact on emissions	$131,458,071	AC Yr 1 of 5
607542	GEORGETOWN-NEWBURY- BORDER TO BOSTON TRAIL, (NORTHERN GEORGETOWN TO BYFIELD SECTION)	$5,685,059	Quantified	15,682	Quantified Decrease in Emissions from Bicycle and Pedestrian Infra-structure	$5,685,059	

2024 (Cont.) Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**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	$11,385,638	Qualitative		RTP project included in the Statewide model.	$27,061,794	AC Yr 2 of 4
609466	HAVERHILL- BRIDGE REPLACEMENT, H-12-040, I-495 (NB & SB) OVER MERRIMACK RIVER	$43,180,558	Qualitative		No assumed impact/ negligible impact on emissions	$99,783,090	AC Yr 2 of 3.

2024 (Cont.) Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Im-pact (kg/yr)**	**GHG Impact Description**	**Total Cost**	**Additional Information**
605304	HAVERHILL- BRIDGE REPLACEMENT, H-12-007 & H-12-025, BRIDGE STREET (SR 125) OVER MERRIMACK RIVER AND THE ABANDONED B&M RR (PROPOSED BIKEWAY)	$17,912,404	Qualitative		No assumed impact/ negligible impact on emissions	$116,320,512	AC Yr 1 of 5.

2025 Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Im-pact (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	$11,119,839	Qualitative		RTP project included in the Statewide Mod-el.	$27,061,794	AC Yr 3 of 4
609392	ROWLEY – SAFETY IMPROVEMENTS AT ROUTE 1, CENTRAL AND GLEN STREETS	$2,368,068	Qualitative		Not enough infor-mation available to quantify.	$2,368,068	
609466	HAVERHILL- BRIDGE REPLACEMENT, H-12-040, I-495 (NB & SB) OVER MERRIMACK RIVER	$33,701,001	Qualitative		No assumed impact/ negligible impact on emissions	$99,783,090	AC Yr 3 of 3.

2025 (Cont.) Merrimack Valley Region MPO TIP Highway Projects GHG Tracking Summary							
Mass DOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Im-pact (kg/yr)**	**GHG Impact Description**	**Total Cost**	**Additional Information**
605304	HAVERHILL- BRIDGE REPLACEMENT, H-12-007 & H-12-025, BRIDGE STREET (SR 125) OVER MERRIMACK RIVER AND THE ABANDONED B&M RR (PROPOSED BIKEWAY)	$27,949,092	Qualitative		No assumed impact/ negligible impact on emissions	$116,320,512	AC Yr 2 of 5.
606522	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)	$20,997,351	Qualitative		No assumed impact/ negligible impact on emissions	$131,458,071	AC Yr 2 of 5

2021 Merrimack Valley Region Transit Projects GHGs						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0008592	Preventive Maintenance	$3,495,970	Qualitative		No assumed impact/ negligible impact on emissions	$3,495,970
RTD0008593	Non-Fixed Route ADA Para Serv	$1,741,065	Qualitative		No assumed impact/ negligible impact on emissions	$1,741,065
RTD0008594	Short Range Transit Plan-ning	$100,000	Qualitative		No assumed impact/ negligible impact on emissions	$100,000
RTD0008595	Operating Assistance	$1,116,240	Qualitative		No assumed impact/ negligible impact on emissions	$1,116,240
RTD0008596	Replace 16 Model Yr 2015 vans with new	$1,180,480	Quantified	33,208	Quantified Decrease in Emissions from Bus Replacement	$1,180,480

2021 MerrimackValley Region Transit Projects GHGs (Cont.)						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0007697	SGR Replace 1 model yr 2016 supervisory vehicle	$47,900	Qualitative		No assumed impact/ negligible impact on emissions	$47,900
RTD0009132	SGR Replace Security Cam-era System at McGovern Center	$131,000	Qualitative		No assumed impact/ negligible impact on emissions	$131,000
RTD0009131	Riverbank Stabilization Con-struction	$1,750,330	Qualitative		No assumed impact/ negligible impact on emissions	$1,750,330
TBD	Replace Model Yr 2009 Bus-es Delivery 2022 (2 of 9)	$990,674	Quantified	5,728	Quantified Decrease in Emissions from Bus Replacement	$990,674

2022 Merrimack Valley Region Transit Projects GHGs						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0008597	Preventive Maintenance	$3,611,335	Qualitative		No assumed impact/ negligible impact on emissions	$3,611,335
RTD0008598	Non-Fixed Route ADA Para Serv	$1,801,630	Qualitative		No assumed impact/ negligible impact on emissions	$1,801,630
RTD0008599	Short Range Transit Plan-ning	$100,000	Qualitative		No assumed impact/ negligible impact on emissions	$100,000
RTD0008600	Operating Assistance	$1,289,890	Qualitative		No assumed impact/ negligible impact on emissions	$1,289,890
RTD0008609	SGR Replace 2 model year 2016 supervisory vehicles	$97,740	Qualitative		No assumed impact/ negligible impact on emissions	$97,740

2023 Merrimack Valley Region Transit Projects GHGs						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0008603	Preventive Maintenance	$3,730,510	Qualitative		No assumed impact/ negligible impact on emissions	$3,730,510
RTD0008604	Operating Assistance	$1,478,730	Qualitative		No assumed impact/ negligible impact on emissions	$1,478,730
RTD0008605	Non-Fixed Route ADA Para Serv	$1,861,090	Qualitative		No assumed impact/ negligible impact on emissions	$1,861,090
RTD0008606	Replace 4 Model Yr 2011 buses delivery 2023	$2,009,600	Qualitative		Not enough information to calculate	$2,009,600
RTD0008607	Replace 6 model yr 2017 vans delivery 2023	$469,620	Qualitative		Not enough information to calculate	$469,620

2023 Merrimack Valley Region Transit Projects GHGs (Cont.)						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0008608	Short Range Transit Plan-ning	$100,000	Qualitative		No assumed impact/ negligible impact on emissions	$100,000
RTD0008960	SGR Replace 1 model yr 2017 supervisory vehicle	$50,335	Qualitative		No assumed impact/ negligible impact on emissions	$50,335

2024 Merrimack Valley Region Transit Projects GHGs						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0008611	Preventive Maintenance	$3,618,265	Qualitative		No assumed impact/ negligible impact on emissions	$3,618,265
RTD0008613	Non-Fixed Route ADA Para Serv	$1,805,255	Qualitative		No assumed impact/ negligible impact on emissions	$1,805,255
RTD0008612	Operating Assistance	$1,429,680	Qualitative		No assumed impact/ negligible impact on emissions	$1,429,680
RTD0008614	Short Range Transit Plan-ning	$100,000	Qualitative		No assumed impact/ negligible impact on emissions	$100,000
RTD0008610	SGR Replace model year 2011 buses delivery 2024 (4 of 8)	$2,098,970	Qualitative		Not enough information to calculate	$2,098,970

2024 Merrimack Valley Region Transit Projects GHGs (Cont.)						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0008961	SGR Replace 1 model yr 2018 supervisory vehicle	$51,845	Qualitative		No assumed impact/ negligible impact on emissions	$51,845

2025 Merrimack Valley Region Transit Projects GHGs						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0008963	Preventive Maintenance	$3,690,630	Qualitative		No assumed impact/ negligible impact on emissions	$3,690,630
RTD0008965	Non-Fixed Route ADA Para Serv	$1,841,365	Qualitative		No assumed impact/ negligible impact on emissions	$1,841,365
RTD0008964	Operating Assistance	$1,458,270	Qualitative		No assumed impact/ negligible impact on emissions	$1,458,270
RTD0008962	Short Range Transit Plan-ning	$100,000	Qualitative		No assumed impact/ negligible impact on emissions	$100,000
RTD0008615	SGR Replace model yr 2012 buses 4 of 8 delivery 2025	$2,193,840	Qualitative		Not enough information to calculate	$2,193,840

2025 Merrimack Valley Region Transit Projects GHGs (Cont.)						
MassDOT/ FTA Project ID	**MassDOT/ FTA Project Description**	**Total Pro-grammed Funds**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Total Cost**
RTD0008966	SGR Replace 1 model yr 2019 supervisory vehicle	$52,880	Qualitative		No assumed impact/ negligible impact on emissions	$52,880

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: **2022**

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	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	4	Sq. Miles	
D.	Total Land Area of Community(ies) **(T)**:	36.5	Sq. Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	11.0%		
F.	Total Population of Community(ies) **(TP)**:	16,579	Persons	
G.	Population Served by Facility **(P)**: LA * TP = P	1,817	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	5,828	HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	639	HH	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	8,647	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH	1.48	Persons	
L.	Workers in Service Area **(WSA)**: HS * WPHH = WSA	948	Persons	
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	$2,520,436	/	0.2 =	**$10,545,326**
Summer NOx	$2,520,436	/	0.7 =	**$3,860,574**
Summer CO	$2,520,436	/	16.8 =	**$150,023**
Summer CO2	$2,520,436	/	2,666.9 =	**$945**

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: **2024**

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	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	7.2	Sq. Miles	
D.	Total Land Area of Community(ies) **(T)**:	36.3	Sq. Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	19.8%		
F.	Total Population of Community(ies) **(TP)**:	15,088	Persons	
G.	Population Served by Facility **(P)**: LA * TP = P	2,993	Persons	
H.	Total Number of Households in Community(ies) **(HH)**:	5,808	HH	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	1,152	HH	
J.	Total Number of Workers Residing in Community(ies) **(W)**:	8,055	Persons	
K.	Workers Per household **(WPHH)**: W / HH = WPHH	1.39	Persons	
L.	Workers in Service Area **(WSA)**: HS * WPHH = WSA	1,598	Persons	
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	$5,685,059	/	1.4	=	**$4,045,217**
Summer NOx	$5,685,059	/	3.8	=	**$1,480,927**
Summer CO	$5,685,059	/	98.8	=	**$57,549**
Summer CO2	$5,685,059	/	15,681.6	=	**$363**

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:	**2022**		
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	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	4.4	Sq. Miles	
D.	Total Land Area of Community(ies) **(T)**:	8.9	Sq. 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	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	1,179	HH	
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	Persons	
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	$2,064,255	/	0.2	=	**$8,499,667**
Summer NOx	$2,064,255	/	0.7	=	**$3,111,672**
Summer CO	$2,064,255	/	17.1	=	**$120,920**
Summer CO2	$2,064,255	/	2,709.9	=	**$762**

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

FILL IN SHADED BOXES ONLY

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 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
	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/day
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	$1,980,067	/	-0.591	=	**3,352,093**
Summer NOx	$1,980,067	/	-1.494	=	**1,324,943**
Winter CO	$1,980,067	/	-8.158	=	**242,707**
Summer CO2	$1,980,067	/	-8,306.881	=	**238**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Lawrence - Intersection Improvements at South Broadway (Rt 28) and Mount Vernon St **CMAQ Air Quality Analysis Worksheet**

CMAQ Air Quality Analysis Worksheet for Traffic Flow and Intersection Improvements

FILL IN SHADED BOXES ONLY

TIP YEAR: **2021**

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

Project: **#609251 Intersection Improvements at South Broadway (Routet 28) and Mount Vernon St**

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
S. Broadway	NB	185	0.95	230.1	=	44,809	+	335	0.95	230.1	=	81,141	+	0	0.95	230.1	=	0	=	125,949
S. Broadway	SB	0	0.95	15.9	=	0	+	543	0.95	15.9	=	9,088	+	42	0.95	15.9	=	703	=	9,791
Mt. Vernon St	EB	87	0.95	26.3	=	2,409	+	0	0.95	26.3	=	0	+	313	0.95	26.3	=	8,665	=	11,074
McKinley Ave	WB	5	0.95	15.0	=	79	+	0	0.95		=	0	+	10	0.95	15.0	=	158	=	237
																		Total Intersection Delay/Seconds	=	**147,051**

Lawrence - Intersection Improvements at South Broadway (Rt 28) and Mount Vernon St **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
S. Broadway	NB	213	0.95	235.5	=	52,802	+	494	0.95	235.5	=	122,460	+	0	0.95	235.5	=	0	=	175,262
S. Broadway	SB	0	0.95	14.0	=	0	+	454	0.95	14.0	=	6,691	+	67	0.95	14.0	=	987	=	7,678
Mt. Vernon St	EB	90	0.95	24.4	=	2,312	+	0	0.95	24.4	=	0	+	228	0.95	24.4	=	5,856	=	8,168
McKinley Ave	WB	3	0.95	21.1	=	67	+	0	0.95	21.1	=	0	+	2	0.95	21.1	=	44	=	111
																		Total Intersection Delay/Seconds	=	**191,218**

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: 191,218

Step 4: Calculate the existing 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
S. Broadway	NB	213	0.95	15.0	=	3,363	+	489	0.95	14.7	=	7,567	+	5	0.95	14.7	=	77	=	11,007
S. Broadway	SB	5	0.95	23.1	=	122	+	452	0.95	23.1	=	10,991	+	66	0.95	23.1	=	1,605	=	12,717
Mt. Vernon St	EB	89	0.95	40.6	=	3,804	+	1	0.95	40.6	=	43	+	228	0.95	40.6	=	9,744	=	13,590
McKinley Ave	WB	2	0.95	66.1	=	139	+	1	0.95	66.1	=	70	+	2	0.95	66.1	=	139	=	348
																		Total Intersection Delay/Seconds	=	**37,663**

Lawrence - Intersection Improvements at South Broadway (Rt 28) and Mount Vernon St **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	(	191,218	X	10	)	/ 3600	=	531.2
Peak hour intersection delay w/ improvements	(	37,663	X	10	)	/ 3600	=	104.6

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/day
Existing Conditions	531.2	0.132	0.334	1.896	1,893.914
With Improvements	104.6	0.026	0.066	0.373	373.027
Net Change		**-0.106**	**-0.269**	**-1.522**	**-1,520.887**

Lawrence - Intersection Improvements at South Broadway (Rt 28) and Mount Vernon St **CMAQ Air Quality Analysis Worksheet (Cont.)**

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	-0.106	X	250	X	1.0188	=	**-27.037**
Summer NOx Emissions	-0.269	X	250	X	1.0188	=	**-68.404**
Winter CO Emissions	-1.522	X	250	X	0.9812	=	**-373.419**
Summer CO2 Emissions	-1,520.887	X	250	X	1.000		**-380,221.742**

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	$1,013,739	/	-27.037	=	**37,494**
Summer NOx	$1,013,739	/	-68.404	=	**14,820**
Winter CO	$1,013,739	/	-373.419	=	**2,715**
Summer CO2	$1,013,739	/	-380,221.742	=	**3**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Lawrence - Intersection Improvements at Merrimack St and South Broadway (Rt 28) **CMAQ Air Quality Analysis Worksheet**

CMAQ Air Quality Analysis Worksheet for Traffic Flow and Intersection Improvements

FILL IN SHADED BOXES ONLY

TIP YEAR: **2022**

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

Project: **# 609509 Intersection Improvements at Merrimack Street and South Broadway (Route 28)**

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
S. Broadway	NB	0	0.95	21.8	=	0	+	596	0.95	21.8	=	13,677	+	101	0.95	21.8	=	2,318	=	15,994
Broadway	SB	163	0.95	47.3	=	8,116	+	741	0.95	27.2	=	21,216	+	1	0.95	27.2	=	29	=	29,360
Wolcott Ave	EB	1	0.95	11.5	=	12	+	0	0.95	11.5	=	0	+	0	0.95	11.5	=	0	=	12
Merrimack St	WB	245	0.95	18.9	=	4,874	+	0	0.95	18.9	=	0	+	134	0.95	18.9	=	2,666	=	7,540
																		Total Intersection Delay/Seconds	=	**52,907**

Lawrence - Intersection Improvements at Merrimack St and South Broadway (Rt 28) **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
S. Broadway	NB	0	0.95	24.7	=	0	+	616	0.95	24.7	=	16,016	+	100	0.95	24.7	=	2,600	=	18,616
Broadway	SB	187	0.95	91.4	=	17,991	+	682	0.95	23.8	=	17,086	+	2	0.95	23.8	=	50	=	35,127
Wolcott Ave	EB	6	0.95	11.6	=	73	+	2	0.95	11.6	=	24	+	2	0.95	11.6	=	24	=	122
Merrimack St	WB	168	0.95	20.4	=	3,608	+	1	0.95	20.4	=	21	+	249	0.95	20.4	=	5,347	=	8,976

Total Intersection Delay/Seconds = **62,841**

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: 62,841

Step 4: Calculate the existing 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
S. Broadway	NB	0	0.95	22.5	=	0	+	616	0.95	22.5	=	14,589	+	100	0.95	4.9	=	516	=	15,105
Broadway	SB	187	0.95	14.6	=	2,874	+	682	0.95	14.0	=	10,051	+	2	0.95	14.0	=	29	=	12,954
Wolcott Ave	EB	6	0.95	50.5	=	319	+	2	0.95	50.5	=	106	+	2	0.95	50.5	=	106	=	532
Merrimack St	WB	168	0.95	31.5	=	5,571	+	1	0.95	31.5	=	33	+	249	0.95	28.6	=	7,496	=	13,100

Total Intersection Delay/Seconds = **41,691**

Lawrence - Intersection Improvements at Merrimack St and South Broadway (Rt 28) **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	(	62,841	X	10	)	/ 3600	=	174.6
Peak hour intersection delay w/ improvements	(	41,691	X	10	)	/ 3600	=	115.8

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/day
Existing Conditions	174.6	0.043	0.110	0.623	622.412
With Improvements	115.8	0.029	0.073	0.413	412.924
Net Change		**-0.015**	**-0.037**	**-0.210**	**-209.488**

Lawrence - Intersection Improvements at Merrimack St and South Broadway (Rt 28) **CMAQ Air Quality Analysis Worksheet (Cont.)**

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	-0.015	X	250	X	1.0188	=	**-3.724**
Summer NOx Emissions	-0.037	X	250	X	1.0188	=	**-9.422**
Winter CO Emissions	-0.210	X	250	X	0.9812	=	**-51.435**
Summer CO2 Emissions	-209.488	X	250	X	1.000		**-52,371.982**

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	$1,610,960	/	-3.724	=	**432,573**
Summer NOx	$1,610,960	/	-9.422	=	**170,978**
Winter CO	$1,610,960	/	-51.435	=	**31,320**
Summer CO2	$1,610,960	/	-52,371.982	=	**31**

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	(Default = 1)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	2.92	Sq. Miles	
D.	Total Land Area of Community(ies) **(T)**:	6.93	Sq. 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	
I.	Number of Households Served by Facility **(HS)**: LA * HH = HS	10,854	HH	
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	Persons	
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	$16,087,005	/	15.8	=	**$1,020,330**
Summer NOx	$16,087,005	/	43.1	=	**$373,536**
Summer CO	$16,087,005	/	1,108.2	=	**$14,516**
Summer CO2	$16,087,005	/	175,927.3	=	**$91**

Spreadsheet Template Prepared by Office of Transportation Planning Updated March 2016

Methuen - Intersection Improvements at Riverside Dr and Burnham Rd **CMAQ Air Quality Analysis Worksheet**

CMAQ Air Quality Analysis Worksheet for Traffic Flow and Intersection Improvements

FILL IN SHADED BOXES ONLY

TIP YEAR: **2022**

MPO: **Merrimack Valley** **Municipality:** **Methuen**

Project: **# 610658 Intersection Improvements at Riverside Drive and Burnham Road**

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
Driveway	NB	2	0.95	16.8	=	35	+	2	0.95	16.8	=	35	+	9	0.95	16.8	=	159	=	230
Burnham Rd	SB	60	0.95	36.3	=	2,293	+	10	0.95	36.3	=	382	+	63	0.95	36.3	=	2,407	=	5,082
Riverside Dr	EB	50	0.95	2.1	=	111	+	250	0.95	2.1	=	553	+	2	0.95	2.1	=	4	=	668
Riverside Dr	WB	5	0.95	0.2	=	1	+	290	0.95	0.2	=	61	+	80	0.95	0.2	=	17	=	79
																		Total Intersection Delay/Seconds	=	**6,058**

Methuen - Intersection Improvements at Riverside Dr and Burnham Rd **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
Driveway	NB	1	0.95	23.4	=	25	+	10	0.95	23.4	=	246	+	12	0.95	23.4	=	296	=	567
Burnham Rd	SB	182	0.95	524.3	=	100,445	+	12	0.95	524.3	=	6,623	+	76	0.95	524.3	=	41,944	=	149,012
Riverside Dr	EB	80	0.95	2.9	=	244	+	315	0.95	2.9	=	962	+	4	0.95	2.9	=	12	=	1,218
Riverside Dr	WB	16	0.95	0.5	=	8	+	395	0.95	0.5	=	208	+	127	0.95	0.5	=	67	=	283
																		Total Intersection Delay/Seconds	=	**151,079**

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: 151,079

Step 4: Calculate the existing 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
Driveway	NB	1	0.95	9.0	=	9	+	10	0.95	9.0	=	95	+	12	0.95	9.0	=	114	=	218
Burnham Rd	SB	182	0.95	12.8	=	2,452	+	12	0.95	12.8	=	162	+	76	0.95	12.8	=	1,024	=	3,638
Riverside Dr	EB	80	0.95	11.7	=	985	+	315	0.95	11.7	=	3,879	+	4	0.95	11.7	=	49	=	4,914
Riverside Dr	WB	16	0.95	13.3	=	224	+	395	0.95	13.3	=	5,530	+	127	0.95	13.3	=	1,778	=	7,532
																		Total Intersection Delay/Seconds	=	**16,302**

Methuen - Intersection Improvements at Riverside Dr and Burnham Rd **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	(	151,079	X	10	) /	3600	=	419.7
Peak hour intersection delay w/ improvements	(	16,302	X	10	) /	3600	=	45.3

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 kilograms/day	Summer CO2 Emissions kilograms/day
Existing Conditions	419.7	0.104	0.264	1.498	1,496.360
With Improvements	45.3	0.011	0.029	0.162	161.461
Net Change		**-0.093**	**-0.236**	**-1.336**	**-1,334.900**

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	-0.093	X	250	X	1.0188	=	**-23.731**
Summer NOx Emissions	-0.236	X	250	X	1.0188	=	**-60.039**
Winter CO Emissions	-1.336	X	250	X	0.9812	=	**-327.755**
Summer CO2 Emissions	-1,334.900	X	250	X	1.000		**-333,724.936**

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	$967,200	/	-23.731	=	**40,757**
Summer NOx	$967,200	/	-60.039	=	**16,110**
Winter CO	$967,200	/	-327.755	=	**2,951**
Summer CO2	$967,200	/	-333,724.936	=	**3**

Spreadsheet Template Prepared by 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: **2021** **Bus Replacements**

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

Project # S10777 - Flex to FTA to 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
247,441		1.16	287,032	**355**	809

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	809	1.0188	**-0.055**
Change in Summer NOx	-2.986	1,000	809	1.0188	**-2.460**
Change in Winter CO	-0.384	1,000	809	0.9812	**-0.305**
Change in Summer CO2	-69.850	1,000	809	1.0000	**-56.476**

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	355	-19.593
Summer NOx	-2.460	355	-873.189
Winter CO	-0.305	355	-108.148
Summer CO2	-56.476	355	-20049.154

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	**$3,467,361**	**12**	19.593	**$14,748**
Summer NOx	**$3,467,361**	**12**	873.189	**$331**
Winter CO	**$3,467,361**	**12**	108.148	**$2,672**
Summer CO2	**$3,467,361**	**12**	20049.154	**$14**

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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 #RTD0008596 - 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
457,933		1.11	508,306	**355**	1,432

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	1,432	1.0188	**-0.007**
Change in Summer NOx	-0.033	1,000	1,432	1.0188	**-0.048**
Change in Winter CO	-1.421	1,000	1,432	0.9812	**-1.996**
Change in Summer CO2	-65.331	1,000	1,432	1.0000	**-93.544**

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	355	-2.589
Summer NOx	-0.048	355	-17.089
Winter CO	-1.996	355	-708.723
Summer CO2	-93.544	355	-33208.115

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	**$1,180,480**	**4**	2.589	**$113,976**
Summer NOx	**$1,180,480**	**4**	17.089	**$17,269**
Winter CO	**$1,180,480**	**4**	708.723	**$416**
Summer CO2	**$1,180,480**	**4**	33208.115	**$9**

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Merrimack Valley RTA Replace 2 (2009) Buses with 2 (2022) Buses

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

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

MPO: **Merrimack Valley**

RTA: **Merrimack Valley**

FTA Sect 5307 Project # TBD Replace 2 (2009) Buses with 2 (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
70,698		1.16	82,010	**355**	231

FTA Sect 5307 Project # TBD Replace 2 (2009) Buses with 2 (2022) Buses

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	231	1.0188	**-0.016**
Change in Summer NOx	-2.986	1,000	231	1.0188	**-0.703**
Change in Winter CO	-0.384	1,000	231	0.9812	**-0.087**
Change in Summer CO2	-69.850	1,000	231	1.0000	**-16.136**

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	355	-5.598
Summer NOx	-0.703	355	-249.485
Winter CO	-0.087	355	-30.900
Summer CO2	-16.136	355	-5728.376

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	**$990,674**	**12**	5.598	**$14,748**
Summer NOx	**$990,674**	**12**	249.485	**$331**
Winter CO	**$990,674**	**12**	30.900	**$2,672**
Summer CO2	**$990,674**	**12**	5728.376	**$14**

Template prepared by the Office of Transportation Plannning Updated March 2016

Appendix F Completed Highway and Transit Projects GHG Summary

Merrimack Valley Region MPO TIP Completed Highway Projects GHG Tracking Summary

Mass DOT/ Project ID	MassDOT Project Description	Total Pro-grammed Funds	GHG Analysis Type	GHG CO_2 Im-pact (kg/yr)	GHG Impact Description	Additional Description	Fiscal Year of Contract Award (2015 and forward)
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 Pedestrian Infra-structure	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 Improve-ment	Advertised 9/17/2016 Notice to Proceed 4/12/2017	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 Improve-ment	Advertised 5/13/2017 Notice to Proceed 2/9/2018	

Merrimack Valley Region MPO TIP Completed Highway Projects GHG Tracking Summary (Cont.)

Mass DOT/ Project ID	MassDOT Project Description	Total Pro-grammed Funds	GHG Analysis Type	GHG CO_2 Im-pact (kg/yr)	GHG Impact Description	Additional Description	Fiscal Year of Contract Award (2015 and forward)
604585	FLEX TO FTA FOR MVRTA NEW BUS UPGRADE TO CLEANER FUEL BUSES	$645,840	Quantified	26,343	Quantified Decrease in Emissions from Bus Replacement	Flexed to FTA	2017
605020	SALISBURY- MULTI-USE TRAIL EXTENSION (BORDERS TO BOSTON TRAIL), INCLUDES NEW BRIDGE S-02-004 AND BOARDWALK (S-02-012) (BYX)	$5,918,500	Quantified	18,631	Quantified Decrease in Emissions from Bicycle and Pedestrian Infra-structure	Advertised 8/25/2018 Contract Awarded 12/12/18 Notice to Proceed 1/18/19	2018

Merrimack Valley Region MPO TIP Completed Highway Projects GHG Tracking Summary (Cont.)

Mass DOT/ Project ID	MassDOT Project Description	Total Pro-grammed Funds	GHG Analysis Type	GHG CO_2 Impact (kg/yr)	GHG Impact Description	Additional Description	Fiscal Year of Contract Award (2015 and forward)
602418	AMESBURY- RECONSTRUCTION OF ELM STREET	$7,223,053	Quantified	1,336	Quantified Decrease in Emissions from Complete Streets Project	Advertised 7/13/19. Ac'd 2019 and 2020. Total Project Cost = $11,178,124	
607737	AMESBURY- SALISBURY- TRAIL CONNECTOR @ I-95	$2,574,805	Quantified	3,972	Quantified Decrease in Emissions from Bicycle and Pedes-trian Infrastructure	Advertised 9/15/2018 Notice to Proceed 4/18/19	

Merrimack Valley Region MPO TIP Completed Highway Projects GHG Tracking Summary (Cont.)

Mass DOT/ Project ID	MassDOT Project Description	Total Pro-grammed Funds	GHG Analysis Type	GHG CO_2 Impact (kg/yr)	GHG Impact Description	Additional Description	Fiscal Year of Contract Award (2015 and forward)
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	Advertised 1/12/2019 Notice to Proceed 8/14/19	

Merrimack Valley Region MPO TIP Completed Transit Projects GHG Tracking Summary								
FTA Activity Line Item	**Transit Agency**	**Project Description**	**Total Cost**	**GHG Analysis Type**	**GHG CO_2 Impact (kg/yr)**	**GHG Impact Description**	**Additional 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

Merrimack Valley Region MPO TIP Completed Transit Projects GHG Tracking Summary (Cont.)

FTA Activity Line Item	Transit Agency	Project Description	Total Cost	GHG Analysis Type	GHG CO_2 Impact (kg/yr)	GHG Impact Description	Additional Description	Fiscal Year Programmed (2015 and forward)
111202	MVRTA	Replace 7 MY 2004 Transit Buses with new buses	$2,989,000	Quantified	18,271	Quantified Decrease in Emissions from Bus Replacement		2017
111202	MVRTA	Replace 6 Model Year 2004 Buses (Delivery 2018)	$2,689,500	Quantified	15,661	Quantified Decrease in Emissions from Bus Replacement		2018
RTD0007687	MVRTA	Replace 3 Model Yr 2007 buses delivery 2020	$1,377,150	Quantified	8,166	Quantified Decrease in Emissions from Bus Replacement		2020

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
	AQ	Air Quality
B	B to B	Border to Boston Rail Trail
C	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
	CO_2	Carbon Dioxide

MVMPO List of Commonly Used Acronyms (Cont.)		
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

MVMPO List of Commonly Used Acronyms (Cont.)		
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	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

MVMPO List of Commonly Used Acronyms (Cont.)		
N	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&M	Operations and Maintenance
	OTP	MassDOT Office of Transportation Planning
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

MVMPO List of Commonly Used Acronyms (Cont.)		
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 Transportation 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

MVMPO List of Commonly Used Acronyms (Cont.)		
T (Con.)	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

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	606522	Andover	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)
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	RTD - 9131	MVRTA	SGR Riverbank Stabilization Construction
4	605306	Haverhill	Haverhill – Bridge Replacement, H-12- 039, I-495 (NB & SB) over Merrimack River
4	609466	Haverhill	Haverhill – Bridge Replacement, H-12-040, I-495 (NB & SB) over Merrimack River
4	605304	Haverhill	Haverhill- Bridge Replacement, H-12-007 & H-12-025, Bridge Street (SR 125) over Merrimack River and the Abandoned B&M RR (Proposed Bikeway)

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

Map Number	Project Number	City/Town	Project Description
5	608761	Haverhill	Haverhill – Intersection Reconstruction on Route 108 (Newton Road) at Route 110 (Kenoza Avenue and Amesbury Road)
6	608930	Lawrence	Lawrence - Lawrence Manchester Rail Corridor (LMRC) Rail Trail
7	609251	Lawrence	Lawrence – Intersection Improvements at South Broadway (Route 28) and Mount Vernon Street
7	609509	Lawrence	Lawrence – Intersection Imporvements at Merrimack Street and South Broadway (Route 28)
8	610658	Methuen	Methuen – Intersection Improvements at Riverside Drive and Burnham Road
9	608494	Newbury / Newburyport / Salisbury	Resurfacing of Route 1
10	610663	Newburyport	Newburyport – Riverfront Clipper City Rail Trail Construction

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

Map Number	Project Number	City/Town	Project Description
11	608095	North Andover	North Andover- Corridor Improvements on Route 114, between Route 125 (Andover Street) & Stop & Shop driveway
12	609392	Rowley	Rowley – Safety Improvements at Route 1, Central and Glen Streets
13	602202	Salisbury	Salisbury – Reconstruction of Route 1 (Lafayette Road)