Appendices to the Merrimack Valley Metropolitan Planning Organization Federal Fiscal Years 2017 to 2021 Transportation Improvement Program as Amended through May 2017

Final Report

May 2017

Prepared by the Merrimack Valley Planning Commission

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Appendices

Appendix A and B: Other Regional Priorities

Appendix A Other Regional Priority Bridge Projects

Merrimack Valley Metropolitan Planning Organization
FY 2017-2021 Transportation Improvement Program
Implementing Agency: MassDOT

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

ID	Location	Project Description	Highway District	Estimated Total Project Cost
602322	Ames.	Amesbury - Bridge Replacement, A-07-008, Oak Street Over the B&M Railroad (Abandoned Line)	4	$1,000,000
	And.	Andover - Rehab. Bridge (A-09-001) Route 28 (North Main Street) Over the Shawsheen River	4	
605418	And.	Andover - Bridge Preservation, A-09-028, Chandler Road over I-93	4	$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)	4	$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)	4	$63,437,220
604839	Law.	Lawrence – Bridge Replacement, L-04-027, Lowell Street over B&M Railroad	4	$4,473,000
	Law.	Lawrence - Bridge Rehabilitation, L-04-042, South Union Connector over South Street	4	

Appendix A Other Regional Priority Bridge Projects (Continued)

Merrimack Valley Metropolitan Planning Organization
FY 2017-2021 Transportation Improvement Program
Implementing Agency: MassDOT

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

ID	Location	Project Description	Highway District	Estimated Total Project Cost
605421	Medford, Methuen, Stoneham, Woburn	Medford, Methuen, Stoneham, Woburn – Bridge Painting on I-93 Corridor: M-12-037, M-12-044, M-17-007, S-27-008, W-43-035	4	$1,200,000
	Nbypt.	Newburyport - Bridge (N-11-002) State Route 113 (High Street) Over Railroad	4	
	Nbypt.	Newburyport - Bridge (N-11-014) State Route 1A (High Street) over US 1	4	
607115	Nbypt.	Newburyport - Bridge Repairs, N-11-015, Washington St. over US 1	4	$1,400,000

Appendix B Other Regional Priority Roadway Projects

Merrimack Valley Metropolitan Planning Organization
FY 2017-2021 Transportation Improvement Program By Town

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

ID	Location	Project Description	District	Estimated Total Project Cost
608336	Andover	Andover – Reconstruction on Route 133 (Lowell Street), from Lovejoy Road to Route 28 (North Main Street) TEC = 10.75	4	$7,245,000
607708	Andover/ Lawrence	Andover - Lawrence - Resurfacing and related work on Route 28 TEC = 5.22	4	$1,062,600
606721	Boxford	Boxford - Reconstruction of Route 133 (Washington Street) from North Andover town line to Main Street TEC = 5.60	4	$5,172,164
	Boxford	Boxford Reconstruction of Route 97 from Georgetown to Topsfield (2 miles)	4	$3,785,000
607540	Boxford	Boxford - Border to Boston Trail TEC = 3.32	4	$4,174,500
602843	George.	Georgetown - Reconstruction on Route 97 (W. Main Street) from Moulton Street to Groveland townline TEC = 4.77	4	$2,400,000
604950	George.	Georgetown – Park & Ride lot construction at I-95 and Route 133 Interchange TEC = 3.78	4	$3,276,594
	Haverhill	Haverhill -Intersection Improvements Route 110 and Elliot Way	4	

Appendix B Other Regional Priority Roadway Projects (Continued)

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

ID	Location	Project Description	District	Estimated Total Project Cost
	Haverhill	Haverhill – Widen Route 97 (Broadway) from Computer Drive to Forrest Street	4	
607711	Haverhill	Haverhill - Resurfacing and related work on Route 125 (from N. And. TL to Boston Rd) TEC = 4.97	4	$1,062,600
	Haverhill	Haverhill – Reconstruction of Route 110 (Amesbury Road) / Route 108 (Newton Road) intersection	4	$700,000
	Haverhill	Haverhill – Reconstruction of North Avenue	4	
	Haverhill	Haverhill – Buttonwoods Trail	4	$2,000,000
602339	Haverhill	Haverhill-Historic Waterfront Walkway Phase II (Construction)	4	$3,110,184
	Lawrence/ North Andover	Lawrence - North Andover - Reconstruction of Route 114 from South Union St. in Lawrence to Rt. 125 (Andover St.) in North Andover TEC = 12.8	4	$16,300,000
607712	Lawrence/ North Andover	Lawrence - North Andover – Resurfacing and related work on Route 114 from I-495 to Waverly Road TEC = 3.97	4	$885,500

Appendix B Other Regional Priority Roadway Projects (Continued)

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

ID	Location	Project Description	District	Estimated Total Project Cost
	Lawrence	Lawrence - Reconstruct Merrimack Street from Parker Street to South Union Street TEC = 9.05	4	
	Methuen	Methuen – Reconstruction of Route 110 from Burnham Road to Woodland Street	4	
	Newburyport	Newburyport -Route 1 Rotary Reconfiguration	4	
608029	Newburyport	Newburyport - Intersection Improvements Route 1 at Merrimac Street TEC = 6.88	4	$2,400,000
	North Andover	North Andover - Machine Shop Village improvements	4	
	North Andover	North Andover – Reconstruction of Mass. Ave. and Sidewalks (from Osgood St. to I-495)	4	
605694	North Andover	North Andover - Resurfacing and related work Route 125 TEC = 7.45	4	$7,910,592
	North Andover	North Andover - Signals and turn lanes at Mass Ave. and I-495 NB and SB Ramps	4	
602202	Salisbury	Salisbury - Reconstruction of Route 1 (Lafayette Road) TEC = 7.3	4	$6,330,819
607710	Salisbury	Salisbury - Resurfacing and related work Route 1A TEC = 6.05	4	$2,300,000

Appendix C Transportation Evaluation Criteria Summary

Appendix C Transportation Evaluation Criteria Summary

	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 (2017-2021)
OPP		Lawrence –North Andover - Reconstruction of Rt. 114 from I-495 to Rt. 125 (Andover St.)		30,000	5.2	3.00	3.00	3.00	1.80	1.50	0.50	**12.80**
TIP	608095	North Andover – Reconstruction of Rt. 114 from Rt. 125 (Andover St.) to Stop & Shop	$15,548	30,000	4.8	2.50	2.75	2.67	1.00	1.50	0.75	**11.17**
OPP	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	1.25	**10.75**
TIP	608407	Lawrence – Traffic Signal and ADA Common & Lowell St	$2,057	NA	NA	1.50	2.00	2.33	2.00	1.50	0.75	**10.08**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

	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 (2017-2021)
TIP	606161	Haverhill – Route 125, three intersections	$3,636	NA	NA	2.50	2.00	1.67	1.40	1.00	0.75	**9.32**
OPP		Lawrence – Merrimack St. (Broadway to South Union St.)		9,654	0.6	2.50	1.25	1.00	1.80	1.75	0.75	**9.05**
OPP	608261	Lawrence – Intersection Improvements at Marston St/ Ferry St/ Common-wealth Dr.	$750	NA	NA	1.5	1.25	2.00	2.00	0.75	0.25	**7.75**
TIP	606159	North Andover – Intersec-tion Improvements Route 125 at Mass. Ave.	$3,640	30,284	NA	1.50	1.75	2.00	1.20	0.75	0.50	**7.70**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

	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 (2017-2021)
OPP	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**
OPP	602202	Salisbury – Reconstruction of Route 1 (Lafayette Road)	$6,331	12,147	4.8	1.50	2.00	2.00	0.80	0.75	0.25	**7.30**
TIP	607573	Haverhill – Reconstruction of Route 97 (Broadway) from Silver Birch Lane to Research Drive)	$6,527	14,352	1.8	2.00	1.25	1.00	1.00	1.25	0.75	**7.25**
OPP	608029	Newburyport – Intersection Improvements Rt. 1 at Mer-rimac St.	$2,400	24,850	NA	2.00	0.50	2.33	0.80	1.00	0.25	**6.88**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

	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 (2017-2021)
TIP	608027	Haverhill – Bradford Rail Trail extension	$1,088	NA	NA	0.50	1.50	1.00	2.40	1.25	0.00	**6.65**
TIP	605020	Salisbury – Multi-use Trail Extension (Border to Boston Trail), includes new bridges S-02-004	$5,919	NA	NA	1.00	1.25	1.33	1.00	0.75	0.75	**6.08**
OPP	607710	Salisbury – Resurfacing and related work Route 1A	$2,300	11,411	8.0	2.00	0.75	1.00	0.80	0.75	0.75	**6.05**
TIP	602418	Amesbury – Reconstruction of Elm Street	$8,993	12,436	3.4	1.50	0.50	1.33	0.40	1.50	0.75	**5.98**
TIP	607476	Methuen – Resurfacing and related work Route 213	$11,988	53,000	16	3.00	0.25	0.33	0.80	1.00	0.25	**5.63**
OPP	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.)

	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 (2017-2021)
OPP	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**
TIP	607542	Georgetown – Square to By-field (Northern) section of Bor-der to Boston Trail	$3,876	NA	NA	0.50	1.25	0.67	0.80	1.50	0.50	**5.22**
TIP	605753	Groveland – Route 97 (Parker Rd. to Gardner St.)	$3,600	13,500	1.8	1.50	0.50	1.00	0.60	1.00	0.50	**5.10**
TIP	607541	Georgetown- Boxford– south of Square to Georgetown Road (Southern) section of Border to Boston Trail	$1,702	NA	NA	0.50	1.00	0.67	0.80	1.25	0.75	**4.97**
OPP	607711	Haverhill – Resurfacing and related work Rt. 125	$1,063	19,224	4.1	2.00	0.50	0.67	0.80	0.75	0.25	**4.97**

Appendix C Transportation Evaluation Criteria Summary (Cont.)

	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 (2017-2021)
TIP	608298	Groveland Community Trail	$2,376	NA	NA	0.50	1.25	0.67	1.20	1.00	0.25	**4.87**
OPP	602843	Georgetown – Route 97 from Moulton St. to Groveland TL	$2,400	15,486	2.2	1.50	0.50	0.67	0.60	1.00	0.50	**4.77**
OPP	607712	Lawrence – North Andover resurfacing of Route 114	$885	32,900	2.8	1.50	0.25	0.67	0.80	0.50	0.25	**3.97**
OPP	604950	Georgetown – Park & Ride Construction at I-95 and Route 133 Interchange	$3,277	NA	NA	0.00	1.75	0.33	0.20	0.75	0.75	**3.78**
TIP	606669	Amesbury – Powwow River-walk Construct. New Design	$671	NA	NA	0.50	0.25	0.00	0.40	1.50	0.75	**3.40**
OPP	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: Amesbury - Intersection Improvements Rt 110 @ Rt 150 **Project Number: 608028**

Project Cost: $1,800,000 AADT: 21,000 Distance: NA Linear Lane Miles: NA

Condition	Score	Additional Comments
A. Magnitude of pavement condition improvement.	1	Existing pavement is in Fair condition.
B. Magnitude of improvement of other infrastructure.	2	Signal upgrade. New turning lane. Some sidewalk segments on 110 and 150 are discontinuous.
Condition Average	**1.5**	

Mobility	Score	Additional Comments
A. Effect on magnitude and duration of congestion.	2	
B. Effect on travel time and connectivity / access.	2	
C. Effect on other modes using the facility.	2	
D. Effect on regional and local traffic.	2	
Mobility Average	**2**	

Sample Project Evaluation Worksheet (Cont.)

Project: Amesbury - Intersection Improvements Rt 110 @ Rt 150 **Project Number: 608028**

Safety and Security	Score	Additional Comments
A. Effect on crash rate compared to State average.	3	Crash Cluster EPDO = 72. (15th worst in region.)
B. Effect on bicycle and pedestrian safety.	3	Middle school nearby.
C. Effect on transportation security and evacuation.	2	Is an evacuation route in 10 mile radius of nuclear power plant. Not NHS.
Safety and Security Average	**2.67**	

Community Effects and Support	Score	Additional Comments
A. Residential effects: ROW, noise, aesthetics, cut through traffic, and other.	2	
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 stock.	0	
Community Effects and Support Average	0.8	

Sample Project Evaluation Worksheet (Cont.)

Project: Amesbury - Intersection Improvements Rt 110 @ Rt 150 **Project Number: 608028**

Land Use and Economic Development	Score	Additional Comments
A. Business effects; ROW, noise, traffic, parking, freight access, other.	1	
B. Sustainable development effects. Consistent with MVPGS.	2	Adjacent to Rt. 150 Gateway Village Regional PDA.
C. Consistent with regional land-use and economic development plans and PGS.	2	Adjacent to Rt. 150 Gateway Village Regional PDA.
D. Effect on job creation.	0	
Land Use and Economic Development Average	**1.25**	

Sample Project Evaluation Worksheet (Cont.)

Project: Amesbury - Intersection Improvements Rt 110 @ Rt 150 **Project Number: 608028**

Environmental Effects	Score	Additional Comments
A. Air quality / Climate effects. GHG Impact Description – Assumed Nominal Decrease in Emissions from Other Improvements	1	
B. Sustainable development effects. Consistent with MVPGS.	0	Adjacent to Rt. 150 Gateway Village Regional PDA.
C. Consistent with regional land-use and economic development plans and PGS.	0	Adjacent to Rt. 150 Gateway Village Regional PDA.
D. Effect on job creation.	0	
Environmental Effects Average	**0.25**	
Overall Project TEC score	**6.97**	

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Appendix E Greenhouse Gas (GHG) Monitoring and Evaluation

2017-2021
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 2017 – 2021 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 2017-2021 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**

o **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 2017 – 2021 TIP

The following tables summarize the calculated quantitative and assumed qualitative impacts of the projects included in the regional FFYs 2017 – 2021 TIP by year.

FFYs 2017 to 2021 Projects GHG Tracking Summary

2017 Merrimack Valley Region MPO Transportation Improvement Program
Highway Projects GHG Tracking Summary

MassDOT/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 ▼
606669	AMESBURY - POWWOW RIVERWALK CONSTRUCTION	$ 671,207	Qualitative		Qualitative Decrease in Emissions	$ 671,207	Not yet enough information to generate an estimate.
607561	ANDOVER- METHUEN- INTERSTATE MAINTENANCE & RELATED WORK ON I-93	$ 10,357,600	Qualitative		No assumed impact/negligible impact on emissions	$ 10,357,600	
604585	FLEX TO FTA FOR MVRTA NEW BUS UPGRADE TO CLEANER FUEL BUSES	$ 645,840	Qualitative		Qualitative Decrease in Emissions	$ 645,840	Not yet enough information to generate an estimate.
607573	HAVERHILL - RECONSTRUCTION ON ROUTE 97 (BROADWAY), FROM SILVER BIRCH LANE TO RESEARCH DRIVE	$ 6,526,912	Qualitative		Qualitative Decrease in Emissions	$ 6,526,912	Not yet enough information to generate an estimate.

2017 (Cont.) Merrimack Valley Region MPO Transportation Improvement Program
Highway Projects GHG Tracking Summary

MassDOT/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	$ 12,000,000	Qualitative		No assumed impact/negligible impact on emissions	$ 50,772,179	AC yr 1 of 3. Sum Year 1 Cost = $12,000,000. Total Project Cost = $50,772,179
608002	LAWRENCE- SAFE ROUTES TO SCHOOL (BRUCE ELEMENTARY)	$ 2,016,148	Qualitative		Qualitative Decrease in Emissions	$ 2,016,148	
		2017 Total GHG emissions		0			

2018 Merrimack Valley Region MPO Transportation Improvement Program

Highway Projects GHG Tracking Summary

MassDOT/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 ▼
606159	NORTH ANDOVER- INTERSECTION & SIGNAL IMPROVEMENTS AT ROUTE 125 & MASSACHUSETTS AVENUE	$ 3,785,640	Qualitative		Qualitative Decrease in Emissions	$ 3,785,640	Not yet enough information to generate an estimate.
605020	SALISBURY - MULTI-USE TRAIL EXTENSION (BORDERS TO BOSTON TRAIL)	$ 6,155,240	Quantified	6,837	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 6,155,240	
605306	HAVERHILL- SUPERSTRUCTURE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$ 23,000,000	Qualitative		No assumed impact/negligible impact on emissions	$ 50,772,179	AC yr 2 of 3. Sum Year 2 Cost = $23,000,000. Total Project Cost = $50,772,179
607737	AMESBURY- SALISBURY- TRAIL CONNECTOR @ I-95	$ 2,677,798	Qualitative		Qualitative Decrease in Emissions	$ 2,677,798	Not yet enough information to generate an estimate.
		2018 Total GHG emissions		6,837			

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

MassDOT/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 ▼
MV0001	FLEX TO FTA FOR MVRTA NEW BUS UPGRADE TO CLEANER FUEL BUSES	$ 698,541	Qualitative		Qualitative Decrease in Emissions	$ 698,541	Not yet enough information to generate an estimate.
608027	HAVERHILL - BRADFORD RAIL TRAIL EXTENSION, FROM ROUTE 125 TO RAILROAD STREET	$ 1,176,240	Quantified	2,935	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 1,176,240	
602418	AMESBURY- RECONSTRUCTION OF ELM STREET	$ 3,337,520	Qualitative		No assumed impact/negligible impact on emissions	$ 9,726,521	AC yr 1 of 2. Sum Year 1 Cost = $3,337,520. Total Project Cost = $9,726,521
605753	GROVELAND- RECONSTRUCTION OF ROUTE 97 (SCHOOL STREET) FROM PARKER STREET TO GARDNER STREET	$ 3,893,760	Qualitative		No assumed impact/negligible impact on emissions	$ 3,893,760	
605306	HAVERHILL- SUPERSTRUCTURE REPLACEMENT, H-12-039, I-495 (NB & SB) OVER MERRIMACK RIVER	$ 15,772,179	Qualitative		No assumed impact/negligible impact on emissions	$ 50,772,179	AC yr 3 of 3. Sum Year 3 Cost = $15,772,179. Total Project Cost = $50,772,179

2019 (Cont.) Merrimack Valley Region MPO Transportation Improvement Program Highway Projects GHG Tracking Summary

MassDOT/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 ▼
607541	GEORGETOWN- BOXFORD-BORDER TO BOSTON TRAIL, FROM GEORGETOWN ROAD TO WEST MAIN STREET (ROUTE 97)	$ 1,874,028	Quantified	1,520	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 1,874,028	
608187	HAVERHILL- MERRIMAC-AMESBURY- TRAFFIC & GUIDE SIGN REPLACEMENT ON A SECTION OF I-495	$ 4,807,449	Qualitative		No assumed impact/negligible impact on emissions	$ 4,807,449	
		2019 Total GHG Emissions		4,455			

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

MassDOT/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	$ 2,672,677	Quantified	2,552	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 2,672,677	
602418	AMESBURY-RECONSTRUCTION OF ELM STREET	$ 6,389,001	Qualitative		No assumed impact/negligible impact on emissions	$ 9,726,521	AC yr 1 of 2. Sum Year 1 Cost = $3,337,520. Total Project Cost = $9,726,521
607542	GEORGETOWN-NEWBURY- BORDER TO BOSTON TRAIL (NORTHERN GEORGETOWN SECTION)	$ 4,341,120	Quantified	17,460	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	$ 4,341,120	
		2020 Total GHG emissions		20,012			

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

MassDOT/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	$ 9,775,158	Qualitative		Qualitative Decrease in Emissions	$ 18,188,961	Not yet enough information generate an estimate. AC Year 1 of 3. $9,775,158 = Sum of Year 1. Total Project Cost = $ 18,188,961
		2021 Total GHG emissions		0			

2017 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/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▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004542	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2018 (O)	$ 3,054,810	Qualitative		No assumed impact/negligible impact on emissions	**$ 3,054,810**		
5307 ► RTD0004541	Capital funding used for operating ADA service and considered as an operating expense for FY 2018 (O)	$ 1,371,830	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,371,830**		
5307 ► RTD0004550	MVPC Short RangeTransit Planning & Technical Support UPWP FY 2018 (20% match from MVPC) (N)	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 100,000**		
5307 ► RTD0004540	Refurbish Engine/Trans-mission 8 Model Year 2011 Buses (M)	$ 280,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 280,000**		
5307 ► RTD0004919	Replace Parking Facilities Revenue Collection Equipment (M)	$ 300,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 300,000**		
5307 ► RTD0004989	Bus/Van Mobile location Project (C)	$ 300,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 300,000**		
5307 ► RTD0004932	Replace 7 Model Yr 2004 Buses with new (M)	$ 2,989,000	Quantified	18,271	Quantified Decrease in Emissions from Bus Replacement	**$ 2,989,000**		

2017 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/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 ▼	Fiscal Year of Contract Award (2015 and forward) ▼
5307 ► RTD0004990	Replace 1 Model Yr 2013 Support Vehicle (M)	$ 46,350	Qualitative		No assumed impact/negligible impact on emissions	**$ 46,350**		
5307 ► RTD0004552	Operating Assistance FY 2018 (O)	$ 1,257,050	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,257,050**		
Other ► RTD0005219	Newburyport Intermodal Transit Facility Year 1 of 2	$ 2,500,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 5,000,000**		

2018 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/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 ▼	Fiscal Year of Contract Award (2015 and forward) ▼
5307 ► RTD0004544	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2019 (O)	$ 3,152,905	Qualitative		No assumed impact/negligible impact on emissions	**$ 3,152,905**		
5307 ► RTD0004543	Capital funding used for operating ADA service and considered as an operating expense for FY 2019 (O)	$ 1,403,370	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,403,370**		
5307 ► RTD0004555	MVPC Short RangeTransit Planning & Technical Support UPWP FY 2019 (20% match from MVPC) (N)	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 100,000**		
5307 ► RTD0004545	Refurbish Engine/ Transmisssions on 8 Model Year 2011 Transit Buses (M)	$ 288,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 288,000**		
5307 ► RTD0004954	Replace 6 Model Yr 2004 Buses Delivery 2018 (M)	$ 2,725,755	Quantified	15,661	Quantified Decrease in Emissions from Bus Replacement	**$ 2,725,755**		

2018 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/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 ▼	Fiscal Year of Contract Award (2015 and forward) ▼
5307 ► RTD0004991	Replace 1 Model Yr 2013 Support Vehicle (M)	$ 47,750	Qualitative		No assumed impact/negligible impact on emissions	**$ 47,750**		
5307 ► RTD0004921	State of Good Repair Gateway Parking (M)	$ 20,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 20,000**		
5307 ► RTD0004554	Operating Assistance FY 2019 (O)	$ 1,392,480	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,392,480**		
Other ► RTD0005408	Newburyport Intermodal Transit Facility Year 2 of 2	$ 2,500,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 5,000,000**		

2019 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/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▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004547	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2020 (O)	$ 3,250,095	Qualitative		No assumed impact/negligible impact on emissions	**$ 3,250,095**		
5307 ► RTD0004548	Capital funding used for operating ADA service and considered as an operating expense for FY 2020 (O)	$ 1,456,420	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,456,420**		
5307 ► RTD0004556	MVPC Short RangeTransit Planning & Technical Support UPWP FY 2020 (20% match from MVPC) (N)	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 100,000**		
5307 ► RTD0004955	Purchase 3 new 35' buses delivery 2019 (C)	$ 1,373,355	Qualitative		Qualitative Decrease in Emissions	**$ 1,373,355**	Not yet enough information to generate an estimate.	
5307 ► RTD0004992	Replace 1 Model Yr 2013 Support Vehicles (M)	$ 49,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 49,000**		
5307 ► RTD0004922	State of Good Repair Gateway Parking (M)	$ 10,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 10,000**		
5307 ► RTD0004558	Operating Assistance FY 2020 (O)	$ 1,531,220	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,531,220**		

2020 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/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 ▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004559	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2021 (O)	$ 3,347,595	Qualitative		No assumed impact/negligible impact on emissions	**$ 3,347,595**		
5307 ► RTD0004560	Capital funding used for operating ADA service and considered as an operating expense for FY 2021 (O)	$ 1,500,110	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,500,110**		
5307 ► RTD0004561	MVPC Short RangeTransit Planning & Technical Support UPWP FY 2021 (20% match from MVPC) (N)	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 100,000**		
5307 ► RTD0004956	Replace 3 Model Yr 2007 buses delivery 2020 (M)	$ 1,456,621	Quantified	7,830	Quantified Decrease in Emissions from Bus Replacement	**$ 1,456,621**		
5307 ► RTD0004993	Replace 11 Model Yr 2015 vans (M)	$ 756,966	Quantified	23,042	Quantified Decrease in Emissions from Bus Replacement	**$ 756,966**		
5307 ► RTD0004923	State of Good Repair Gateway Parking (M)	$ 10,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 10,000**		
5307 ► RTD0004563	Operating Assistance FY 2021 (O)	$ 1,684,340	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,684,340**		

2021 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/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▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004933	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2022 (O)	$ 3,448,020	Qualitative		No assumed impact/negligible impact on emissions	**$ 3,448,020**		
5307 ► RTD0004934	Capital funding used for operating ADA service and considered as an operating expense for FY 2022 (O)	$ 1,545,115	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,545,115**		
5307 ► RTD0004935	MVPC Short RangeTransit Planning & Technical Support UPWP FY 2022 (20% match from MVPC) (N)	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 100,000**		
5307 ► RTD0004957	Replace 2 Model Yr 2009 buses delivery 2022 (M)	$ 984,821	Quantified	5,412	Quantified Decrease in Emissions from Bus Replacement	**$ 984,821**		
5307 ► RTD0004959	Replace 5 Model Yr 2016 vans with new (M)	$ 354,200	Quantified	6,355	Quantified Decrease in Emissions from Bus Replacement	**$ 354,200**		
5307 ► RTD0004958	Operating Assistance FY 2022 (O)	$ 1,852,770	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,852,770**		

GHG Calculations Worksheets

CMAQ Air Quality Analysis Worksheet for Complete Streets Project Page 1 of 3

FILL IN SHADED BOXES ONLY

TIP YEAR: 2019

MPO: Merrimack Valley Municipality: Haverhill

Project: Haverhill - Bradford Rail Trail Extension, from Route 125 to Railroad Street # 608027

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 defau	Default
A.	Facility Length (L):	0.2	Miles		
B	Types of Improvements Implemented:	Both	(select Pedestrian, Bicycle, or Both from list)		
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	0.20833333	Sq. Miles		
E.	Service Area of Community(ies) for Walking (SAW): L * 2RW = SAW	0.10416667	Sq. Miles		
F.	Land Area of Neighborhoods Served (AN):	1.4	Sq. Miles		
G.	Population of Neighborhoods Served (PN):	8,702	Persons		
H.	Population Density of Neighborhoods Served (PD):	6,216	Persons/Sq. Mile		
I.	Population Served by Facility for Bicycling (PB): PD * SAB = PB	1,295	Persons		
J.	Population Served by Facility for Walking (PW): PD * SAW = PW	647	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		
M.	Baseline Walk Mode Share in Service Area (MSW):	7.2%	Percent		

Spreadhseet Template Prepared by the Office of Transportation Planning

CMAQ Air Quality Analysis Worksheet for Complete Streets Project (cont.)

TIP YEAR: 2019

MPO: Merrimack Valley | Municipality: Haverhill

Project: Haverhill - Bradford Rail Trail Extension, from Route 125 to Railroad Street # 608027

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	11	1-Way Trips/Day		
Q.	New Walk Trips (WT): PW * T * MSW * WI = WT	16	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):	37	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	22	Miles per Day	
W.	VMTR * Operating Days Per Year 22 * 365 =	7,974	VMTR Per Year	
	If the Vehicles 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.

Spreadhseet Template Prepared by the Office of Transportation Planning

CMAQ Air Quality Analysis Worksheet for Complete Streets Project (cont.) Page 3 of 3

TIP YEAR: 2019

MPO: Merrimack Valley Municipality: Haverhill

Project: Haverhill - Bradford Rail Trail Extension, from Route 125 to Railroad Street #6 08027

Step 3: Emission Factors for Average Commuter Travel Speed:

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

2016 Auto Summer VOC Factor grams/mile	2016 Auto Summer NOx Factor grams/mile	2016 Auto Summer CO Factor grams/mile	2016 Auto Summer CO2 Factor grams/mile
0.232	0.178	3.540	368.100

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

Summer VOC	Summer NOx	Summer CO	Summer CO2
1.9	1.4	28.8	2,935.3

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	$1,176,240	/	1.9 =	$624,076
Summer NOx	$1,176,240	/	1.4 =	$813,402
Summer CO	$1,176,240	/	28.8 =	$40,900
Summer CO2	$1,176,240	/	2,935.3 =	$401

Spreadhseet Template Prepared by the Office of Transportation Planning

	CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project				
	Fill in shaded boxes only				
	TIP YEAR:	**2018**			
	MPO:	**Merrimack Valley Planning Commission**	**Municipality:**		**Salisbury**
	Project:	**Salisbury Rail Trail Mudnock Road to NHSL along Abandoned RR**			
	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)**:	2.3	Miles		
B.	Service Area Radius **(R)**:	1.0	Miles	(Default = 1 Mile)	
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	4.5	Sq. Miles		
D.	Total Land Area of Community(ies) **(T)**:	15.4	Sq. Miles		
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	29.2%			
F.	Total Population of Community(ies) **(TP)**:	8,283	Persons		
G.	Population Served by Facility **(P)**: LA * TP = P	2,420	Persons		
H.	Total Number of Households in Community(ies) **(HH)** :	3,441	HH		
I.	Number of Households Served by Facility **(HS)** : LA * HH = HS	1,005	HH		
J.	Total Number of Workers Residing in Community(ies) **(W)**:	3,950	Persons		
K.	Workers Per household **(WPHH)** : W / HH = WPHH	1.15	Persons		
L.	Workers in Service Area **(WSA)**: HS * WPHH = WSA	1,154	Persons		
M.	Population Density of the Service area **(PD)**: P / SA = PD	538	Persons Per Sq. Mile		
N.	If the bicycle and pedestrian commuter mode share is known, enter the percentage at the right.		**(BMS)**	1.3%	
	If not, use the 2000 US Census Journey to Work data to determine the mode share and enter the percentage to the right.				

	CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project							
	Project:	**Salisbury Rail Trail Mudnock Road to NHSL along Abandoned RR (Continued)**						
O.	Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT					15	One-Way Trips	
P.	Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT					26	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					91.2	VMTR Per Day	
B.	VMTR * Operating Days Per Year			91.2	* 200 =	18,231	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: MOBILE 6 Emission Factors for Average Commuter Travel Speed:							
	Note: Use 35 MPH as a default if average speed is not known				Speed Used:	35 MPH		
	2016 Auto Summer VOC Factor grams/mile	2016 Auto Summer NOx Factor grams/mile		2016 Auto Summer CO Factor grams/mile		2016 Auto Summer CO2 Factor grams/mile		
	0.232	0.178		3.540		368.100		
	Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):							
	Summer VOC	Summer NOx		Summer CO		Summer CO2		
	4.3	3.3		65.8		6,837.0		
	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	$3,687,500	/	4.3	=	**$855,749**		
	Summer NOx	$3,687,500	/	3.3	=	**$1,115,359**		
	Summer CO	$3,687,500	/	65.8	=	**$56,083**		
	Summer CO2	$3,687,500	/	6,837.0	=	**$539**		

	CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project				
	Fill in shaded boxes only				
	TIP YEAR:	**2019**			
	MPO:	**Merrimack Valley**	**Municipality:**	**Georgetown**	
	Project:	**Georgetown - Southern Section of B to B Trail from Georgetown Square to Boxford TL**			
	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)**:	1.6	Miles		
B.	Service Area Radius **(R)**:	1.0	Miles	(Default = 1 Mile)	
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA	3.2	Sq. Miles		
D.	Total Land Area of Community(ies) **(T)**:	12.9	Sq. Miles		
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA	24.8%			
F.	Total Population of Community(ies) **(TP)**:	8,183	Persons		
G.	Population Served by Facility **(P)**: LA * TP = P	2,030	Persons		
H.	Total Number of Households in Community(ies) **(HH)** :	2,937	HH		
I.	Number of Households Served by Facility **(HS)** : LA * HH = HS	729	HH		
J.	Total Number of Workers Residing in Community(ies) **(W)**:	3,783	Persons		
K.	Workers Per household **(WPHH)** : W / HH = WPHH	1.29	Persons		
L.	Workers in Service Area **(WSA)** : HS * WPHH = WSA	938	Persons		
M.	Population Density of the Service area **(PD)** : P / SA = PD	634	Persons Per Sq. Mile		
N.	If the bicycle and pedestrian commuter mode share is known, enter the percentage		**(BMS)**	0.5%	
	If not, use the 2000 US Census Journey to Work data to determine the mode share and enter the percentage to the right.				

	CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project							
	Project:	**Georgetown - Southern Section of B to B Trail (Continued)**						
O.	Bike and Ped. Work Utilitarian Trips **(BWT)**: WSA * BMS = BWT					5	One-Way Trips	
P.	Bike and Ped. Non-Work Utilitarian Trips **(BNWT)**: BWT * 1.7 = BNWT					8	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					20.3	VMTR Per Day	
B.	VMTR * Operating Days Per Year			20.3	* 200 =	4,054	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: MOBILE 6 Emission Factors for Average Commuter Travel Speed:							
	Note: Use 35 MPH as a default if average speed is not kn				Speed Used:	35 MPH		
	2016 Auto Summer VOC Factor grams/mile	2016 Auto Summer NOx Factor grams/mile	2016 Auto Summer CO Factor grams/mile	2016 Auto Summer CO2 Factor grams/mile				
	0.232	0.178	3.540	368.100				
	Step 4: Calculate emissions reductions in kilograms per year (Seasonally Adjusted):							
	Summer VOC	Summer NOx	Summer CO	Summer CO2				
	1.0	0.7	14.6	1,520.3				
	Step 5: Calculate cost effectiveness (first year cost per kg of emissions reduced)							
	Emission	Project Cost		Emission Reducti in kg per year		First year cost per kilogram		
	Summer VOC	$1,480,000	/	1.0	=	$1,544,559		
	Summer NOx	$1,480,000	/	0.7	=	$2,013,133		
	Summer CO	$1,480,000	/	14.6	=	$101,225		
	Summer CO2	$1,480,000	/	1,520.3	=	$973		

	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:	**Georgetown - North Section of B to B Trail from Georgetown Square to Byfield Center**				
	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 Mile)
C.	Service Area of Community(ies) **(SA)**: L * 2R = SA			7.2	Sq. Miles	
D.	Total Land Area of Community(ies) **(T)**:			37.1	Sq. Miles	
E.	Service Area % of Community(ies) Land Area **(LA)**: SA / T = LA			19.4%		
F.	Total Population of Community(ies) **(TP)**:			14,849	Persons	
G.	Population Served by Facility **(P)**: LA * TP = P			2,882	Persons	
H.	Total Number of Households in Community(ies) **(HH)** :			5,531	HH	
I.	Number of Households Served by Facility **(HS)** : LA * HH = HS			1,073	HH	
J.	Total Number of Workers Residing in Community(ies) **(W)**:			7,259	Persons	
K.	Workers Per household **(WPHH)** : W / HH = WPHH			1.31	Persons	
L.	Workers in Service Area **(WSA)**: HS * WPHH = WSA			1,409	Persons	
M.	Population Density of the Service area **(PD)**: P / SA = PD			400	Persons Per Sq. Mile	
N.	If the bicycle and pedestrian commuter mode share is known, enter the percentage				**(BMS)**	1.7%
	If not, use the 2000 US Census Journey to Work data to determine the mode share and enter the percentage to the right.					

CMAQ Air Quality Analysis Worksheet for Bicycle and Pedestrian Project

Project: **Georgetown - North Section of B to B from Georgetown Square to Byfield Center (Continued)**

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		41	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		232.8	VMTR Per Day
B.	VMTR * Operating Days Per Year	232.8 * 200 =	46,557	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: MOBILE 6 Emission Factors for Average Commuter Travel Speed:

Note: Use 35 MPH as a default if average speed is not knov — Speed Used: 35 MPH

2016 Auto Summer VOC Factor grams/mile	2016 Auto Summer NOx Factor grams/mile	2016 Auto Summer CO Factor grams/mile	2016 Auto Summer CO2 Factor grams/mile
0.232	0.178	3.540	368.100

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

Summer VOC	Summer NOx	Summer CO	Summer CO2
11.0	8.4	167.9	17,459.6

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

Emission	Project Cost		Emission Reductio in kg per year		First year cost per kilogram
Summer VOC	$3,600,000	/	11.0	=	$327,149
Summer NOx	$3,600,000	/	8.4	=	$426,396
Summer CO	$3,600,000	/	167.9	=	$21,440
Summer CO2	$3,600,000	/	17,459.6	=	$206

CMAQ Air Quality Analysis Worksheet for Complete Streets Project Page 1 of 3

FILL IN SHADED BOXES ONLY

TIP YEAR: 2020

MPO: Merrimack Valley Municipality: Groveland

Project: Groveland Community Trail, from Main Street to King 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 defau	Default
A.	Facility Length (L):	2.2	Miles		
B	Types of Improvements Implemented:	Both	(select Pedestrian, Bicycle, o		
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	2.18	Sq. Miles		
E.	Service Area of Community(ies) for Walking (SAW): L * 2RW = SAW	1.09	Sq. Miles		
F.	Land Area of Neighborhoods Served (AN):	10.3	Sq. Miles		
G.	Population of Neighborhoods Served (PN):	5,929	Persons		
H.	Population Density of Neighborhoods Served (PD):	573	Persons/Sq. Mile		
I.	Population Served by Facility for Bicycling (PB): PD * SAB = PB	1,250	Persons		
J.	Population Served by Facility for Walking (PW): PD * SAW = PW	625	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		
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%

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CMAQ Air Quality Analysis Worksheet for Complete Streets Project (cont.) Page 2 of 3

TIP YEAR: 2020

MPO: Merrimack Valley Municipality: Groveland

Project: Groveland Community Trail, from Main Street to King Street

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	11	1-Way Trips/Day		
Q.	New Walk Trips (WT): PW * T * MSW * WI = WT	10	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):	32	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	19	Miles per Day		
W.	VMTR * Operating Days Per Year 19 * 365 =	6,843	VMTR Per Year		
	If the Vehicles 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.				

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CMAQ Air Quality Analysis Worksheet for Complete Streets Project (cont.) **Page 3 of 3**

TIP YEAR: 2020

MPO: Merrimack Valley **Municipality:** Groveland

Project: Groveland Community Trail, from Main Street to King Street

Step 3: Emission Factors for Average Commuter Travel Speed:

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

2016 Auto Summer VOC Factor grams/mile	2016 Auto Summer NOx Factor grams/mile	2016 Auto Summer CO Factor grams/mile	2016 Auto Summer CO2 Factor grams/mile
0.232	0.178	3.540	368.100

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

Summer VOC	Summer NOx	Summer CO	Summer CO2
1.6	1.2	24.7	2,519.1

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	/	1.6 =	$1,652,313
Summer NOx	$2,672,677	/	1.2 =	$2,153,577
Summer CO	$2,672,677	/	24.7 =	$108,287
Summer CO2	$2,672,677	/	2,519.1 =	$1,061

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CMAQ Bus Replacement Air Quality Analysis Worksheet Page 1 of 3

FILL IN SHADED BOXES ONLY

TIP YEAR: 2017 Bus Replacements

MPO: Merrimack Valley

RTA: MVRTA

Project #RTD0004932 - Replace 7 (2004 model year) Buses with 7 (2017 model year) Buses

Emission Rates in grams/mile at assumed operating speed of : 18 MPH

Scenario Comparison		Model Year	Summer VOC (grams/mile)	Summer NOx (grams/mile)	Winter CO (grams/mile)	Summer CO2 (grams/mile)
Existing Model*	=	2004	1.734	7.542	3.180	1,200.600
New Bus Purchase*	=	2017	0.048	0.764	0.275	1,133.230

HDDV 7 Enter vehicle type used for New Bus emission factors (For example, HDGV 6 or HDDV 2b)

*Please refer to the 'Emission Factors' tab to determine the most appropriate 'New Bus' factors based on fuel type and gross vehicle weight. If you require factors for an operating speed other that 18MPH, or for the 'Existing Model' being replaced, please contact Ethan Britland at 857-368-8840 or at Ethan.Britland@state.ma.us
*Please refer to the 'Emission Factors' tab to determine the most appropriate 'New Bus' factors based on fuel type and gross vehicle weight. If you require factors for an operating speed other than 18 MPH, or for the 'Existing Model' being replaced, please contact Ethan Britland at 857-368-8840 or at Ethan.Britland@state.ma.us

Change (Buy-Base)	-1.686	-6.778	-2.905	-67.370

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Replace 7 (2004 model year) Buses with 7 (2017 model year) Buses (Cont.)
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
235,827		1.15	271,201	**304**	892

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	-1.686	1,000	892	1.0188	**-1.532**
Change in Summer NOx	-6.778	1,000	892	1.0188	**-6.160**
Change in Winter CO	-2.905	1,000	892	0.9812	**-2.543**
Change in Summer CO2	-67.370	1,000	892	1.0000	**-60.101**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-1.532	304	-465.841
Summer NOx	-6.160	304	-1872.759
Winter CO	-2.543	304	-773.028
Summer CO2	-60.101	304	-18270.815

Template prepared by the Office of Transportation Planning

Replace 7 (2004 model year) Buses with 7 (2017 model year) Buses (Cont.) **Page 3 of 3**

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	**$2,989,000**	**12**	465.841	**$535**
Summer NOx	**$2,989,000**	**12**	1872.759	**$133**
Winter CO	**$2,989,000**	**12**	773.028	**$322**
Summer CO2	**$2,989,000**	**12**	18270.815	**$14**

Template prepared by the Office of Transportation Planning

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: 2018 Bus Replacements

MPO: Merrimack Valley

RTA: MVRTA

Project # RTD0004954 - Replace 6 (2004 model year) Buses with 6 (2018 model year) Buses

Emission Rates in grams/mile at assumed operating speed of : 18 MPH

Scenario Comparison		Model Year	Summer VOC (grams/mile)	Summer NOx (grams/mile)	Winter CO (grams/mile)	Summer CO2 (grams/mile)
Existing Model*	=	2004	1.734	7.542	3.180	1,200.600
New Bus Purchase*	=	2018	0.048	0.764	0.275	1,133.230

HDDV 7 Enter vehicle type used for New Bus emission factors (For example, HDGV 6 or HDDV 2b)

*Please refer to the 'Emission Factors' tab to determine the most appropriate 'New Bus' factors based on fuel type and gross vehicle weight. If you require factors for an operating speed other that 18MPH, or for the 'Existing Model' being replaced, please contact Ethan Britland at 857-368-8840 or at Ethan.Britland@state.ma.us
*Please refer to the 'Emission Factors' tab to determine the most appropriate 'New Bus' factors based on fuel type and gross vehicle weight. If you require factors for an operating speed other than 18 MPH, or for the 'Existing Model' being replaced, please contact Ethan Britland at 857-368-8840 or at Ethan.Britland@state.ma.us

Change (Buy-Base)	-1.686	-6.778	-2.905	-67.370

Template prepared by the Office of Transportation Planning

Project # RTD0004954 - Replace 6 (2004 model year) Buses with 6 (2018 model year) Buses
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
202,138		1.15	232,459	**304**	765

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	-1.686	1,000	765	1.0188	**-1.313**
Change in Summer NOx	-6.778	1,000	765	1.0188	**-5.280**
Change in Winter CO	-2.905	1,000	765	0.9812	**-2.180**
Change in Summer CO2	-67.370	1,000	765	1.0000	**-51.516**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-1.313	304	-399.294
Summer NOx	-5.280	304	-1605.226
Winter CO	-2.180	304	-662.597
Summer CO2	-51.516	304	-15660.743

Template prepared by the Office of Transportation Planning

Project # RTD0004954 - Replace 6 (2004 model year) Buses with 6 (2018 model year) Buses

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	**$2,725,755**	**12**	399.294	**$569**
Summer NOx	**$2,725,755**	**12**	1605.226	**$142**
Winter CO	**$2,725,755**	**12**	662.597	**$343**
Summer CO2	**$2,725,755**	**12**	15660.743	**$15**

Template prepared by the Office of Transportation Planning

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: 2020 Bus Replacements

MPO: Merrimack Valley

RTA: MVRTA

Project #RTD0004956 - Replace 3 (2007 model year) Buses with 3 (2020 model year) Buses

Emission Rates in grams/mile at assumed operating speed of : 18 MPH

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	1,133.230

HDDV 7 Enter vehicle type used for New Bus emission factors (For example, HDGV 6 or HDDV 2b)

*Please refer to the 'Emission Factors' tab to determine the most appropriate 'New Bus' factors based on fuel type and gross vehicle weight. If you require factors for an operating speed other than 18 MPH, or for the 'Existing Model' being replaced, please contact Ethan Britland at 857-368-8840 or at Ethan.Britland@state.ma.us

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

Template prepared by the Office of Transportation Planning

Project #RTD0004956 - Replace 3 (2007 model year) Buses with 3 (2020 model year) Buses
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
101,069		1.15	116,229	**304**	382

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	382	1.0188	**-0.026**
Change in Summer NOx	-2.986	1,000	382	1.0188	**-1.163**
Change in Winter CO	-0.384	1,000	382	0.9812	**-0.144**
Change in Summer CO2	-67.370	1,000	382	1.0000	**-25.758**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.026	304	-7.934
Summer NOx	-1.163	304	-353.586
Winter CO	-0.144	304	-43.793
Summer CO2	-25.758	304	-7830.371

Template prepared by the Office of Transportation Planning

Project #RTD0004956 - Replace 3 (2007 model year) Buses with 3 (2020 model year) Buses

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	$1,456,621	12	7.934	$15,300
Summer NOx	$1,456,621	12	353.586	$343
Winter CO	$1,456,621	12	43.793	$2,772
Summer CO2	$1,456,621	12	7830.371	$16

Template prepared by the Office of Transportation Planning

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: 2020 Bus Replacements (Paratransit Vehicles)

MPO: Merrimack Valley

RTA: MVRTA

Project # RTD0004993 - Replace 11 (2015 model year) Vans with new (2020 model year)

Emission Rates in grams/mile at assumed operating speed of : 18 MPH

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*	=	2020	0.003	0.025	0.593	435.854

HDGV 3 Enter vehicle type used for New Bus emission factors (For example, HDGV 6 or HDDV 2b)

*Please refer to the 'Emission Factors' tab to determine the most appropriate 'New Bus' factors based on fuel type and gross vehicle weight. If you require factors for an operating speed other than 18 MPH, or for the 'Existing Model' being replaced, please contact Ethan Britland at 857-368-8840 or at Ethan.Britland@state.ma us

Change (Buy-Base)	-0.005	-0.033	-1.422	-65.331

Template prepared by the Office of Transportation Planning

Project # RTD0004993 - Replace 11 (2015 model year) Vans with new (2020 model year)

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
309,386		1.14	352,700	**304**	1,160

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	1,160	1.0188	**-0.006**
Change in Summer NOx	-0.033	1,000	1,160	1.0188	**-0.039**
Change in Winter CO	-1.422	1,000	1,160	0.9812	**-1.618**
Change in Summer CO2	-65.331	1,000	1,160	1.0000	**-75.797**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.006	304	-1.946
Summer NOx	-0.039	304	-11.707
Winter CO	-1.618	304	-492.019
Summer CO2	-75.797	304	-23042.246

Template prepared by the Office of Transportation Planning

Project # RTD0004993 - Replace 11 (2015 model year) Vans with new (2020 model year)

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	**$756,966**	**4**	1.946	**$97,255**
Summer NOx	**$756,966**	**4**	11.707	**$16,164**
Winter CO	**$756,966**	**4**	492.019	**$385**
Summer CO2	**$756,966**	**4**	23042.246	**$8**

Template prepared by the Office of Transportation Planning

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: 2021 Bus Replacements

MPO: Merrimack Valley

RTA: MVRTA

Project #RTD0004957 - Replace 2 (2009 model year) Buses with 2 (2022 model year) Buses

Emission Rates in grams/mile at assumed operating speed of : 18 MPH

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	1,133.230
Change (Buy-Base)			-0.067	-2.986	-0.384	-69.850

HDDV 7 Enter vehicle type used for New Bus emission factors (For example, HDGV 6 or HDDV 2b)

*Please refer to the 'Emission Factors' tab to determine the most appropriate 'New Bus' factors based on fuel type and gross vehicle weight. If you require factors for an operating speed other than 18 MPH, or for the 'Existing Model' being replaced, please contact Ethan Britland at 857-368-8840 or at Ethan.Britland@state.ma.us

Template prepared by the Office of Transportation Planning

Project #RTD0004957 - Replace 2 (2009 model year) Buses with 2 (2022 model year) Buses

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
67,379		1.15	77,486	**304**	255

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	255	1.0188	**-0.017**
Change in Summer NOx	-2.986	1,000	255	1.0188	**-0.775**
Change in Winter CO	-0.384	1,000	255	0.9812	**-0.096**
Change in Summer CO2	-69.850	1,000	255	1.0000	**-17.804**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.017	304	-5.289
Summer NOx	-0.775	304	-235.723
Winter CO	-0.096	304	-29.195
Summer CO2	-17.804	304	-5412.387

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Project #RTD0004957 - Replace 2 (2009 model year) Buses with 2 (2022 model year) Buses

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	**$984,821**	**12**	5.289	**$15,516**
Summer NOx	**$984,821**	**12**	235.723	**$348**
Winter CO	**$984,821**	**12**	29.195	**$2,811**
Summer CO2	**$984,821**	**12**	5412.387	**$15**

Template prepared by the Office of Transportation Planning

CMAQ Bus Replacement Air Quality Analysis Worksheet

FILL IN SHADED BOXES ONLY

TIP YEAR: 2021 **Bus Replacements (Paratransit Vehicles)**

MPO: Merrimack Valley

RTA: MVRTA

Project # RTD0004959 - Replace 5 (2016 model year) Vans with new (2021 model year)

Emission Rates in grams/mile at assumed operating speed of : 18 MPH

Scenario Comparison		Model Year	Summer VOC (grams/mile)	Summer NOx (grams/mile)	Winter CO (grams/mile)	Summer CO2 (grams/mile)
Existing Model*	=	2016	0.008	0.058	2.014	475.496
New Bus Purchase*	=	2021	0.003	0.025	0.593	435.854

HDGV 3 Enter vehicle type used for New Bus emission factors (For example, HDGV 6 or HDDV 2b)

*Please refer to the 'Emission Factors' tab to determine the most appropriate 'New Bus' factors based on fuel type and gross vehicle weight. If you require factors for an operating speed other than 18 MPH, or for the 'Existing Model' being replaced, please contact Ethan Britland at 857-368-8840 or at Ethan.Britland@state.ma us

Change (Buy-Base)	-0.005	-0.033	-1.421	-39.642

Template prepared by the Office of Transportation Planning

Project # RTD0004959 - Replace 5 (2016 model year) Vans with new (2021 model year)

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
140,630		1.14	160,318	304	527

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	527	1.0188	**-0.003**
Change in Summer NOx	-0.033	1,000	527	1.0188	**-0.017**
Change in Winter CO	-1.421	1,000	527	0.9812	**-0.735**
Change in Summer CO2	-39.642	1,000	527	1.0000	**-20.906**

Calculate emissions change in kilograms per year

Pollutant	= change/day in kg	X op.days per year	= change per year in kg
Summer VOC	-0.003	304	-0.884
Summer NOx	-0.017	304	-5.315
Winter CO	-0.735	304	-223.527
Summer CO2	-20.906	304	-6355.334

Template prepared by the Office of Transportation Planning

Project # RTD0004959 - Replace 5 (2016 model year) Vans with new (2021 model year)

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	**$354,200**	4	0.884	**$100,159**
Summer NOx	**$354,200**	4	5.315	**$16,660**
Winter CO	**$354,200**	4	223.527	**$396**
Summer CO2	**$354,200**	4	6355.334	**$14**

Template prepared by the Office of Transportation Planning

Appendix F List of Completed Highway and Transit Projects (FFYs 2015 – 2016) with Green House Gas Emissions Analysis

Completed Projects from FFYs 2015 and 2016 GHG Tracking Summary

Merrimack Valley Region MPO Completed Highway Projects GHG

MassDOT Project ID ▼	MassDOT Project Description ▼	Total Programmed Funds ▼	GHG Analysis Type ▼	GHG CO_2 Impact (kg/yr) ▼	GHG Impact Description ▼	Additional Description ▼	Fiscal Year of Contract Award (2015 and forward) ▼
605720	HAVERHILL - RIVERWALK CONSTRUCTION (BRADFORD SECTION), FROM ROUTE 125 TO COUNTY ROAD	$ 2,410,718	Quantified	3,520	Quantified Decrease in Emissions from Bicycle and Pedestrian Infrastructure	Advertised 9/20/2014 Notice to Proceed 7/27/2015	
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 Infrastructure	Advertised 9/19/2015 Notice to Proceed 4/1/2016	

Merrimack Valley Region MPO Completed Transit Projects GHG

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

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Appendix G Projects from MVRTA Capital Program FFYs 2017 - 2021

Adopted May 5, 2016

Transit Projects

2017 Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tails▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2018 (O)	Carry-over Used	$2,442,850	$0	$0	$0	$610,960	$0	$3,053,810
	MV-RTA	Capital funding used for operating ADA service and considered as an operating expense for FY 2018 (O)	Carry-over Used	$1,097,465	$0	$0	$0	$274,365	$0	$1,371,830
	MV-RTA	Continue Short Range Transit Planning MVPC UPWP FY 2018 (20% match from MVPC) (N)	Carry-over Used	$40,000	$0	$0	$0	$0	$10,000	$50,000

2017 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Program ▼	RTA ▼	Project Description ▼	Carry-over or Earmark Details ▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	MVPC Technical Support to MVRTA FY 2018 (20% match from MVPC) (N)	Carry-over Used	$40,000	$0	$0	$0	$0	$10,000	$50,000
	MV-RTA	Refurbish Engines on 8 Model year 2011 Transit Buses (M)	Carry-over Used	$224,000	$56,000	$0	$0	$0	$0	$280,000
	MV-RTA	Replace 6 Model Year 2004 35' Transit Buses with New Delivery 2018 (M)	Carry-over Used	$2,180,605	$545,150	$0	$0	$0	$0	$2,725,755
	MV-RTA	Replace 1 Model Year 2013 Supervisory Vehicle (M)		$37,080	$9,270	$0	$0	$0	$0	$46,350
	MV-RTA	Operating Assistance FY 2018 (O)	Carry-over Used	$493,680	$0	$0	$0	$493,680	$0	$987,360

2017 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tails▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	Replace Parking Revenue Collection Equipment (M)	Carry-over Used	$240,000	$60,000	$0	$0	$0	$0	$300,000
	MV-RTA	Purchase Bus/Van Mobile Location System (C)	Carry-over Used	$240,000	$60,000	$0	$0	$0	$0	$300,000
	MV-RTA	Bus Area Buckley Center Lawrence (M)	Carry-over Used	$250,000		$0	$0	$0	$0	$250,000
		5307 Subtotal►		**$7,285,680**	**$730,420**	**$0**	**$0**	**$1,379,005**	**$20,000**	**$9,415,105**

2017 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tail▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5309 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5309 Subto-tal►								
5310 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5310 Subto-tal►								
5311 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5311 Subto-tal►								
5316 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5316 Subto-tal►								
5317 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5317 Subto-tal►								

2017 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Program ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tail▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
SoGR ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
Livabil-ity►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
TIGER►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		Grants Subtotal►		$0	$0	$0	$0	$0	$0	$0
Other►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		Operating Subtotal►		$0	$0	$0	$0	$0	$0	$0
		Total►		**$7,285,680**	**$730,420**	**$0**	**$0**	**$1,379,005**	**$20,000**	**$9,415,105**

2017 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

Fiscal Constraint Analysis				
Federal Funding Source ▼	**Programmed ▼**	**Available ▼**	**(+/-) ▼**	
FFY 17 / 5307	**$4,472,572**	$5,681,648	$1,209,076	Available
Carryover / 5307	$2,813,110	$	-	Available
Total 5307	**$7,285,680**	**$5,681,648**	**$1,209,076**	**Available**
State Funding Source ▼	**Programmed ▼**	**Available ▼**	**(+/-) ▼**	
RTACAP	**$730,420**	**$730,420**		
SCA	**$1,379,005**	**$1,379,005**		

2018 Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tails▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2019 (O)	Carry-over Used	$2,522,325	$0	$0	$0	$630,580	$0	$3,152,905
	MV-RTA	Capital funding used for operating ADA service and considered as an operating expense for FY 2019 (O)	Carry-over Used	$1,130,695	$0	$0	$0	$282,675	$0	$1,413,370
	MV-RTA	Continue Short Range Transit Planning MVPC UPWP FY 2019 (20% match from MVPC) (N)	Carry-over Used	$40,000	$0	$0	$0	$0	$10,000	$50,000

2018 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/16

FTA Program ▼	RTA ▼	Project Description ▼	Carry-over or Earmark Details ▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	MVPC Technical Support to MVRTA FY 2019 (20% match from MVPC) (N)	Carry-over Used	$40,000	$0	$0	$0	$0	$10,000	$50,000
	MV-RTA	Refurbish Engine/ Transmissions on 8 model year 2012 transit buses (M)	Carry-over Used	$230,000	$57,600	$0	$0	$0	$0	$288,000
	MV-RTA	Replace 1 Model Year 2013 Supervisory Vehicle (M)	Carry-over Used	$38,200	$9,550	$0	$0	$0	$0	$47,750
	MV-RTA	State of Good Repair – Lawrence Gateway Parking, Phase I (M)	Carry-over Used	$16,000	$4,000	$0	$0	$0	$0	$20,000
	MV-RTA	Operating Assistance FY 2019 (O)	Carry-over Used	$696,240	$0	$0	$0	$696,240	$0	$1,392,480

2018 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tails▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	Purchase Three New 35' Transit Buses (Delivery 2019) (C)	Carry-over Used	$1,098,685	$274,670	$0	$0	$0	$0	$1,373,355
		5307 Subtotal ►		**$5,812,145**	**$345,820**	**$0**	**$0**	**$1,609,495**	**$20,000**	**$7,787,460**

2018 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tail▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5309 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5309 Subto-tal►								
5310 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5310 Subto-tal►								
5311 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5311 Subto-tal►								
5316 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5316 Subto-tal►								
5317 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5317 Subto-tal►								

2018 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Car-ry-over or Ear-mark De-tail ▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
SoGR ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
Livabil-ity►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
TIGER►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		Grants Subtotal►		$0	$0	$0	$0	$0	$0	$0
Other►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		Operating Subtotal►		$0	$0	$0	$0	$0	$0	$0
		Total►		**$5,812,145**	**$345,820**	**$0**	**$0**	**$1,609,495**	**$20,000**	**$7,787,460**

2018 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

Fiscal Constraint Analysis				
Federal Funding Source ▼	**Programmed ▼**	**Available ▼**	**(+/-) ▼**	
FFY 18 / 5307	$4,603,070	$5,818,010	$1,214,940	Available
Carryover / 5307	$1,209,075		-	Available
Total 5307	**$5,812,145**	**$5,818,010**	**$1,214,940**	**Available**
State Funding Source ▼	**Programmed ▼**	**Available ▼**	**(+/-) ▼**	
RTACAP	$345,820			
SCA	$1,609,495	$		

2019 Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tails▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	Capital funding used for Preven-tive Maintenance and considered as an operating expense for FY 2020 (O)	Carry-over Used	$2,600,075	$0	$0	$0	$650,020	$0	$3,250,095
	MV-RTA	Capital funding used for operat-ing ADA service and considered as an operating expense for FY 2020 (O)	Carry-over Used	$1,165,135	$0	$0	$0	$291,285	$0	$1,456,420
	MV-RTA	Continue Short Range Transit Planning MVPC UPWP FY 2020 (20% match from MVPC) (N)	Carry-over Used	$40,000	$0	$0	$0	$0	$10,000	$50,000

2019 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Program ▼	RTA ▼	Project Description ▼	Carry-over or Earmark Details ▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	MVPC Technical Support to MVRTA FY 2020 (20% match from MVPC) (N)	Carry-over Used	$40,000	$0	$0	$0	$0	$10,000	$50,000
	MV-RTA	Replace 3 of 3 Model Year 2007 Transit Buses with new (delivery in 2020) (M)	Carry-over Used	$1,165,295	$291,325	$0	$0	$0	$0	$1,456,620
	MV-RTA	Replace 1 Model Year 2013 Supervisory Vehicle (M)	Carry-over Used	$39,200	$9,800	$0	$0	$0	$0	$49,000
	MV-RTA	Operating Assistance FY 2020 (O)	Carry-over Used	$765,610	$0	$0	$0	$765,610	$0	$1,531,220

2019 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Program ▼	RTA ▼	Project Description ▼	Carry-over or Earmark Details ▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	State of Good Repair – Lawrence Gateway Parking, Phase II (M)	Carry-over Used	$8,000	$2,000	$0	$0	$0	$0	$10,000
		5307 Subtotal ►		**$5,823,315**	**$303,125**	**$0**	**$0**	**$1,706,915**	**$20,000**	**$7,853,355**

2019 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tail▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5309 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5309 Subto-tal►								
5310 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5310 Subto-tal►								
5311 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5311 Subto-tal►								
5316 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5316 Subto-tal►								
5317 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5317 Subto-tal►								

2019 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tail▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
SoGR ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
Livabil-ity►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
TIGER ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		Grants Subtotal►		$0	$0	$0	$0	$0	$0	$0
Other►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		Operating Subtotal►		$0	$0	$0	$0	$0	$0	$0
		Total►		**$5,823,315**	**$303,125**	**$**	**$**	**$1,706,915**	**$20,000**	**$7,853,355**

2019 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

Fiscal Constraint Analysis				
Federal Funding Source ▼	**Programmed ▼**	**Available ▼**	**(+/-) ▼**	
FFY 19 / 5307	$4,608,375	$5,957,640	$1,349,265	Available
Carryover / 5307	$1,214,940	$	-	
Total 5307	**$5,823,315**	**$5,957,640**	**$1,349,265**	**Available**
State Funding Source ▼	**Programmed ▼**	**Available ▼**	**(+/-) ▼**	
RTACAP	$303,125	$	-	
SCA	$1,706,915	$	-	

2020 Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tail▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2021 (O)	Carry-over, FY 2018 Funds Used	$2,678,075	$0	$0	$0	$669,520	$0	$3,347,595
	MV-RTA	Capital funding used for operating ADA service and consid-ered as an operating expense for FY 2021 (O)	Carry-over Used	$1,200,090	$0	$0	$0	$300,020	$0	$1,500,110
	MV-RTA	Continue Short Range Transit Plan-ning MVPC UPWP FY 2021 (20% match from MVPC) (N)	Carry-over Used	$40,000	$0	$0	$0	$0	$10,000	$50,000

2020 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Program ▼	RTA ▼	Project Description ▼	Carry-over or Earmark Details ▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	MVPC Technical Support to MVRTA FY 2021 (20% match from MVPC) (N)	Carry-over Used	$40,000	$0	$0	$0	$0	$10,000	$50,000
	MV-RTA	Replace 11 Model Year 2015Paratransit Vehicles (M)	Carry-over Used	$605,970	$151,395	$0	$0	$0	$0	$757,365
	MV-RTA	Operating Assistance FY 2021 (O)	Carry-over Used	$842,170	$0	$0	$0	$842,170	$0	$1,684,340
	MV-RTA	State of Good Repair – Lawrence Gateway Parking, Phase II (M)	Carry-over Used	$8,000	$2,000	$0	$0	$0	$0	$10,000

2020 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Descrip-tion ▼	Carry-over or Ear-mark De-tails▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
		5307 Subtotal ►		**$5,414,305**	**$153,395**	**$0**	**$0**	**$1,811,710**	**$20,000**	**$7,399,410**

2020 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tail▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5309 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5309 Subto-tal►								
5310 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5310 Subto-tal►								
5311 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5311 Subto-tal►								
5316 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5316 Subto-tal►								
5317 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5317 Subto-tal►								

2020 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tail▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
SoGR ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
Livabil-ity►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
TIGER ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		Grants Subtotal►		$0	$0	$0	$0	$0	$0	$0
Other►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		Operating Subtotal►		$0	$0	$0	$0	$0	$0	$0
		Total►		**$5,414,305**	**$153,395**	**$0**	**$0**	**$1,811,710**	**$20,000**	**$7,399,410**

2020 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

Fiscal Constraint Analysis				
Federal Funding Source ▼	**Programmed ▼**	**Available ▼**	**(+/-) ▼**	
FFY 20 / 5307	$4,065,040	$6,100,623	$2,035,582	Available
Carryover / 5307	$1,349,265	$	-	
Total 5307	**$5,414,305**	**$6,100,623**	**$2,035,582**	**Available**
State Funding Source ▼	**Programmed ▼**	**Available ▼**	**(+/-) ▼**	
RTACAP	$153,395		-	
SCA	$1,811,710		-	

2021 Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Program ▼	RTA ▼	Project Description ▼	Carry-over or Earmark Details ▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5307 ►	MV-RTA	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2022 (O)	Carry-over, FY 2018 Funds Used	$2,758,415	$0	$0	$0	$689,605	$0	$3,448,020
	MV-RTA	Capital funding used for operating ADA service and considered as an operating expense for FY 2022 (O)	Carry-over Used	$1,236,090	$0	$0	$0	$309,025	$0	$1,545,115
	MV-RTA	Continue Short Range Transit Planning MVPC UPWP FY 2022 (20% match from MVPC) (N)	Carry-over Used	$40,000	$0	$0	$0	$0	$10,000	$50,000

2021 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Program ▼	RTA ▼	Project Description ▼	Carry-over or Earmark Details ▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
	MV-RTA	MVPC Technical Support to MVRTA FY 2022 (20% match from MVPC) (N)	Carry-over Used	$40,000	$0	$0	$0	$0	$10,000	$50,000
	MV-RTA	Replace 2 of 9 Model Year 2009Transit Buses with new (delivery FY 2022) (M)	Carry-over Used	$787,855	$196,965	$0	$0	$0	$0	$984,820
	MV-RTA	Replace 5 Model Year 2016Paratransit Vehicles (Delivery 2021) (M)	Carry-over Used	$283,360	$70,840	$0	$0	$0	$0	$354,200
	MV-RTA	Operating Assistance 2022 (O)	Carry-over Used	$926,385	$0	$0	$0	$926,385	$0	$1,852,770
		5307 Subtotal ►		**$6,072,105**	**$267,805**	**$0**	**$0**	**$1,925,015**	**$20,000**	**$8,284,925**

2021 (Cont.) Merrimack Valley MPO 2017 – 2021TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tail▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
5309 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5309 Subto-tal►								
5310 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5310 Subto-tal►								
5311 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5311 Subto-tal►								
5316 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5316 Subto-tal►								
5317 ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		5317 Subto-tal►								

2021 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

FTA Pro-gram ▼	RTA ▼	Project Description ▼	Carry-over or Ear-mark De-tail▼	Federal Funds ▼	State Match Source RTA-CAP ▼	State Match Source MAP ▼	State Match Source TDC ▼	State Match Source SCA ▼	Local Funds ▼	Total Cost ▼
SoGR ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
Livabil-ity►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
TIGER ►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		Grants Subtotal►		$0	$0	$0	$0	$0	$0	$0
Other►		No Projects Programmed	N/A	$0	$0	$0	$0	$0	$0	$0
		Operating Subtotal►		$0	$0	$0	$0	$0	$0	$0
		Total►		**$6,072,105**	**$267,805**	**$0**	**$0**	**$1,925,015**	**$20,000**	**$8,284,925**

2021 (Cont.) Merrimack Valley MPO 2017 – 2021 TIP from MVRTA Capital Program Adopted 5/5/2016

Fiscal Constraint Analysis				
Federal Funding Source ▼	**Programmed ▼**	**Available ▼**	**(+/-) ▼**	
FFY 21 / 5307	$4,036,520	$6,072,105	$2,035,582	Available
Carryover / 5307	$2,035,585	$	-	
Total 5307	**$6,072,105**	**$6,072,105**	**$2,035,582**	**Available**
State Funding Source ▼	**Programmed ▼**	**Available ▼**	**(+/-) ▼**	
RTACAP	$267,805	$	-	
SCA	$1,925,015	$	-	

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	606669	Amesbury	Amesbury - Powwow Riverwalk Construction – New Design
1	602418	Amesbury	Amesbury – Reconstruction of Elm Street
1	607737	Amesbury/ Salisbury	Amesbury – Salisbury Trail Connector at I-95
2	607561	Andover/ Methuen	Andover/ Methuen Interstate Maintenance and related work on I – 93
3	RTD-5219	MVRTA	Newburyport – Intermodal Transit Parking Facility Construction
4	608298	Groveland	Groveland- Groveland Community Trail, from Main Street to King Street
4	605753	Groveland	Groveland- Reconstruction of Route 97 (School Street) from Parker Street to Gardner Street
5	607573	Haverhill	Haverhill – Reconstruction of Route 97 (Broadway) from Silver Birch Lane to Research Drive)
5	608027	Haverhill	Haverhill- Bradford Rail Trail Extension, from Route 125 to Railroad Street
6	608095	North Andover	North Andover- Corridor Improvements on Route 114, between Route 125 (Andover Street) & Stop & Shop driveway

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

Map Number	Project Number	City/Town	Project Description
7	606159	North Andover	North Andover – Intersection & Signal Improvements at Route 125 & Massachusetts Avenue
8	605020	Salisbury	Salisbury - Multi-use Trail Extension (Borders to Boston Trail)
9	608187	Haverhill – Merrimac - Salisbury	Haverhill – Merrimac– Amesbury Traffic &Guide Sign Replacement on I-495
10	608002	Lawrence	Lawrence – Safe Routes to School (Bruce Elementary)
11	607541	Georgetown-Boxford	Georgetown – Boxford Border to Boston Trail From Georgetown Road to West Main Street (Route 97)
11	607542	Georgetown-Newbury	Georgetown– Newbury Border to Boston Trail (Northern Georgetown to Byfield Section)
12	608261	Lawrence	Lawrence – Intersection Improvements at Marston Street & Ferry Street / Commonwealth Drive

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Appendix I 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	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 Improvements Plan (or Program)
	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
	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 Gases
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
	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
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
	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
	TIP	Transportation Improvement Program
	TMA	Transportation Management Area
	TMC	Turning Movement Count
	TOD	Transit-Oriented Development
	TRB	Transportation Research Board
U	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 J Comments received on Draft FFY 2017-2021 TIP

Comments Received on Draft MVMPO 2017-2021 TIP

MVRTA Comment: In Black Cat FY 2017 the following project is listed: Replace 7 Model Year 2004 buses Federal $2,391,200 RTACAP $597,800. This is consistent with the replacement of these buses ordered in October 2015 and expected to be delivered in April 2017 - This project is missing from the FY 2017 Draft TIP Transit element and should be consistent with BC and to line up with the CMAQ funds for the Hybrid drive available in FY 2017.

Response: Changes Made.

Haverhill Chamber of Commerce Comment: The Haverhill Chamber of Commerce supports "Complete Streets" projects.

MassDOT Comments on the Narrative:

- Page 1 - Please use consistent font and size for Table of Contents.
- Page11 - Please provide a web link to Merrimack Valley MPO's Public Participation Plan.
- The TIP document does not include an equity analysis. Please provide a regional equity analysis of FFY 2017-2021 programmed TIP projects, as well as a regional equity analysis for FFY2012-2016.

Response: Changes Made.

MassDOT Comments on <u>Part B. Project Listings: Highway Projects</u>:

- Please make sure TIP template is legible.

Response: Change made.

- FFY2017
  - 606669 - Revise project description to AMESBURY – POWWOW RIVERWALK CONSTRUCTION, MAIN STREET TO WATER STREET, INCLUDES PED BRIDGE OVER THE BACK RIVER & PED BRIDGE OVER THE POWWOW RIVER. Revise programmed cost estimate to TFPCC of $1,870,218.

    Response: The above description and cost (from the MassDOT project listing) is incorrect. The scope of the project has been reduced and no longer includes bridges. The project is being re-designed and the project cost is well less than half of $1,870,218, it is currently programmed for in FY 2017 for a total project cost of $671,207.

  - 607681-Revise project number to read 607561.

    Response: Change made.

MassDOT comments on <u>Part B. Project Listings (Cont.): Transit Projects</u>:

- 2017 – Please add the following project: Replace 7 Model Yr 2004 buses with new, $2,989,000 (Section 5307: $2,391,200; RTACAP: $597,800).

Response: Changes Made.

MassDOT comments on Part C. Air Quality Conformity:

- Please update date from August 2015 to August 2016.

Response: Change Made.

MassDOT comments on Part C. Title VI Notice of Public Protection:

- Please revise this section title to 'Title VI Notice to Beneficiaries."

Response: Change Made.

MassDOT comments on Appendix E: Greenhouse Gas (GHG) Monitoring and Evaluation:

- Please correct spelling of "greenhouse" in appendix title.

Response: Change Made.

- Please update greenhouse gas emission results on statewide funded projects with the information that will be provided by the Office of Transportation Planning before endorsement.

Response: Will make changes when results are available.

- For the purpose of ensuring compliance with *310 CMR 60.05: Global Warming Solutions Act Requirements for the Transportation Sector and the Massachusetts Department of Transportation,* we have provided the following comments to be addressed in the GHG sections of your TIP (for more information on reporting, please see the guidance document issued by MassDOT in December 2015: https://www.massdot.state.ma.us/GreenDOT/GreenhouseGasReduction.aspx

MassDOT comments on <u>Appendix E: Greenhouse Gas (GHG) Monitoring and Evaluation</u> (Cont.):

- 2017 Highway
  - 607573 - For projects labeled qualitative decrease in emissions, please include project characteristics that cause the decrease in the additional description field. (This allows MassDOT to determine common project types that may require a new spreadsheet tool).

    Response: This project should be able to be quantified in the future with the Complete Streets and the Intersections spreadsheet tools. Currently there is not yet enough information to generate an estimate.

  - 604585 - Please quantify with the bus replacement tool.

    Response: There is not enough information to generate an estimate, would need emission factors for the cleaner fuel buses, which are not available.

  - 606669 - Please quantify with the bicycle/ pedestrian tool.

    Response: There is not enough information to generate an estimate, the project is being re-designed.

- 2018 Highway
  - 606159 - Please quantify with the traffic operations tool.

    Response: There is not yet enough information to generate an estimate.

MassDOT comments on <u>Appendix E: Greenhouse Gas (GHG) Monitoring and Evaluation</u> (Cont.):

- 2019 Highway
  - MV0001-Please quantify with the bus replacement tool.

    Response: There is not enough information to generate an estimate, would need emission factors for the cleaner fuel buses, which are not available.

  - 608027-Pleasequantifywiththebicycle/pedestrian tool.

    Response: Change made, quantified.

- 2020 Highway
  - 608298-Please quantify with the bicycle/pedestrian tool.

    Response: Change made, quantified.

- 2021 Highway
  - 608095 - For projects labeled qualitative decrease in emissions, please include project characteristics that cause the decrease in the additional description field. (This allows MassDOT to determine common project types that may require a new spreadsheet tool).

    Response: This project should be able to be quantified in the future with the Complete Streets and the Intersections spreadsheet tools. Currently there is not yet enough information to generate an estimate.

- Completed Highway
  - It is not necessary to include qualitative projects.

    Response: Change Made.

MassDOT comments on <u>Appendix E: Greenhouse Gas (GHG) Monitoring and Evaluation</u> (Cont.):

- Completed Transit
    - It is not necessary to include qualitative projects.

      Response: Change Made.

    - Please quantify all new service and bus replacement projects.

      Response: Many projects have been quantified, awaiting more data for input to spreadsheet tool to complete more.

- Transit Tabs
    - All new service and bus replacement projects should be quantified

      Response: Many projects have been quantified, awaiting more data for input to spreadsheet tool to complete more.

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Appendix K Transit Projects GHG Summary

2017 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/ 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▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004542	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2018 (O)	$ 3,054,810	Qualitative		No assumed impact/negligible impact on emissions	**$ 3,054,810**		
5307 ► RTD0004541	Capital funding used for operating ADA service and considered as an operating expense for FY 2018 (O)	$ 1,371,830	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,371,830**		
5307 ► RTD0004550	MVPC Short Range Transit Planning & Technical Support UPWP FY 2018 (20% match from MVPC) (N)	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 100,000**		
5307 ► RTD0004540	Refurbish Engine/Transmission 8 Model Year 2011 Buses (M)	$ 280,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 280,000**		
5307 ► RTD0004919	Replace Parking Facilities Revenue Collection Equipment (M)	$ 300,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 300,000**		

2017 (Cont.) Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/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▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004989	Bus/Van Mobile location Project (C)	$ 300,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 300,000**		
5307 ► RTD0004932	Replace 7 Model Yr 2004 Buses with new (M)	$ 2,989,000	Quantified	18,271	Quantified Decrease in Emissions from Bus Replacement	**$ 2,989,000**		
5307 ► RTD0004990	Replace 1 Model Yr 2013 Support Vehicle (M)	$ 46,350	Qualitative		No assumed impact/negligible impact on emissions	**$ 46,350**		
5307 ► RTD0004552	Operating Assistance FY 2018 (O)	$ 1,257,050	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,257,050**		
Other ► RTD0005219	Newburyport Intermodal Transit Facility Year 1 of 2	$ 2,500,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 5,000,000**		

2018 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/ 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▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004544	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2019 (O)	$ 3,152,905	Qualitative		No assumed impact/negligible impact on emissions	**$ 3,152,905**		
5307 ► RTD0004543	Capital funding used for operating ADA service and considered as an operating expense for FY 2019 (O)	$ 1,403,370	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,403,370**		
5307 ► RTD0004555	MVPC Short Range Transit Planning & Technical Support UPWP FY 2019 (20% match from MVPC) (N)	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 100,000**		
5307 ► RTD0004545	Refurbish Engine/ Transmissions on 8 Model Year 2011 Transit Buses (M)	$ 288,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 288,000**		
5307 ► RTD0004954	Replace 6 Model Yr 2004 Buses Delivery 2018 (M)	$ 2,725,755	Quantified	15,661	Quantified Decrease in Emissions from Bus Replacement	**$ 2,725,755**		

2018 (Cont.) Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/ 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▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004991	Replace 1 Model Yr 2013 Support Vehicle (M)	$ 47,750	Qualitative		No assumed impact/negligible impact on emissions	**$ 47,750**		
5307 ► RTD0004921	State of Good Repair Gateway Parking (M)	$ 20,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 20,000**		
5307 ► RTD0004554	Operating Assistance FY 2019 (O)	$ 1,392,480	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,392,480**		
Other ► RTD0005408	Newburyport Intermodal Transit Facility Year 2 of 2	$ 2,500,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 5,000,000**		

2019 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/ 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▼	Fiscal Year of Contract Award (2015 an forward)▼
5307 ► RTD0004547	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2020 (O)	$ 3,250,095	Qualitative		No assumed impact/negligible impact on emissions	**$ 3,250,095**		
5307 ► RTD0004548	Capital funding used for operating ADA service and considered as an operating expense for FY 2020 (O)	$ 1,456,420	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,456,420**		
5307 ► RTD0004556	MVPC Short Range Transit Planning & Technical Support UPWP FY 2020 (20% match from MVPC) (N)	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 100,000**		
5307 ► RTD0004955	Purchase 3 new 35' buses delivery 2019 (C)	$ 1,373,355	Qualitative		Qualitative Decrease in Emissions	**$ 1,373,355**	Not yet enough information to generate an estimate.	

2019 (Cont.) Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/ 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▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004992	Replace 1 Model Yr 2013 Support Vehicles (M)	$ 49,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 49,000**		
5307 ► RTD0004922	State of Good Repair Gateway Parking (M)	$ 10,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 10,000**		
5307 ► RTD0004558	Operating Assistance FY 2020 (O)	$ 1,531,220	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,531,220**		

2020 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/ 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▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004559	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2021 (O)	$ 3,347,595	Qualitative		No assumed impact/negligible impact on emissions	**$ 3,347,595**		
5307 ► RTD0004560	Capital funding used for operating ADA service and considered as an operating expense for FY 2021 (O)	$ 1,500,110	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,500,110**		
5307 ► RTD0004561	MVPC Short Range Transit Planning & Technical Support UPWP FY 2021 (20% match from MVPC) (N)	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 100,000**		
5307 ► RTD0004956	Replace 3 Model Yr 2007 buses delivery 2020 (M)	$ 1,456,621	Quantified	7,830	Quantified Decrease in Emissions from Bus Replacement	**$ 1,456,621**		

2020 (Cont.) Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/ 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▼	Fiscal Year of Contract Award (2015 an forward)▼
5307 ► RTD0004993	Replace 11 Model Yr 2015 vans with 2020 (M)	$ 756,966	Quantified	23,042	Quantified Decrease in Emissions from Bus Replacement	**$ 756,966**		
5307 ► RTD0004923	State of Good Repair Gateway Parking (M)	$ 10,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 10,000**		
5307 ► RTD0004563	Operating Assistance FY 2021 (O)	$ 1,684,340	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,684,340**		

2021 Merrimack Valley Region MPO Transportation Improvement Program

Transit Projects GHG Tracking Summary

MassDOT/ 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▼	Fiscal Year of Contract Award (2015 and forward)▼
5307 ► RTD0004933	Capital funding used for Preventive Maintenance and considered as an operating expense for FY 2022 (O)	$ 3,448,020	Qualitative		No assumed impact/negligible impact on emissions	**$ 3,448,020**		
5307 ► RTD0004934	Capital funding used for operating ADA service and considered as an operating expense for FY 2022 (O)	$ 1,545,115	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,545,115**		
5307 ► RTD0004935	MVPC Short Range Transit Planning & Technical Support UPWP FY 2022 (20% match from MVPC) (N)	$ 100,000	Qualitative		No assumed impact/negligible impact on emissions	**$ 100,000**		
5307 ► RTD0004957	Replace 2 Model Yr 2009 buses delivery 2022 (M)	$ 984,821	Quantified	5,412	Quantified Decrease in Emissions from Bus Replacement	**$ 984,821**		
5307 ► RTD0004959	Replace 5 Model Yr 2016 vans with new 2021 (M)	$ 354,200	Quantified	6,355	Quantified Decrease in Emissions from Bus Replacement	**$ 354,200**		
5307 ► RTD0004958	Operating Assistance FY 2022 (O)	$ 1,852,770	Qualitative		No assumed impact/negligible impact on emissions	**$ 1,852,770**		

Merrimack Valley Region MPO Completed Transit Projects GHG

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

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Appendix L January 2017 Amendments and Comments

Summary of Amendments and Comments on the Draft January 2017 Amendments

January 2017 Amendment # 1:

In FFY 2017 increase the cost of Project # 607561, Andover – Methuen Interstate Maintenance on I-93, from $10,357,600 to $13,932,707 by adding $3,575,107 to Interstate Maintenance (IM) (NHPP) funding.

No comments were received.

January 2017 Amendment # 2:

In FFY 2018 repurpose $20,315 of Earmark funds ($20,315 Federal dollars) leftover from the Rehabilitation of Parker River Road (Demo ID MA 175) to Project # 606159, North Andover Intersection and Signal Improvements at Route 125 & Massachusetts Avenue, replacing STP funds in FFY 2018 for a total of $25,394 including State match.

No comments were received.

January 2017 Amendment # 3:

In FFY 2017 add Project # 608261, Lawrence – Intersection Improvements at Marston Street & Ferry Street / Commonwealth Drive for a Total Project Cost of $1,350,694 = $907,738 STP Funding + $442,956 HSIP Funding.

No comments were received.

Appendix M April 2017 Amendments and Comments

Summary of Amendments and Comments on the Draft April 2017 Amendments

April 2017 Amendment # 1:

Remove Highway Project # 605306 (Haverhill – Superstructure Replacement, H-12-039, I-495 (NB & SB) Over the Merrimack River) from the FFYs 2017 to 2021 TIP where it was AC'd over three years from 2017 to 2019 for a total project cost of $50,772,179. It is being programmed in the FFYs 2018 to 2022 TIP as a full bridge replacement to be AC'd over four years from FFYs 2018 to 2021 for a total project cost of $79,000,000.

MassDOT commented that the project description has now changed from "Superstructure Replacement" to "Bridge Replacement".

April 2017 Amendment # 2:

Move Highway Project # 608187 (Haverhill – Merrimac – Amesbury – Traffic & Guide Sign Replacement on a Section of I-495) from FFY 2019 to FFY 2017 reducing cost from $4,807,449 to $4,451,342. (No inflation in FFY 2017.)

No comments were received.

April 2017 Amendment # 3:

Add to FFY 2017 Transit Project titled Construction and Administrative Support for the Newburyport Intermodal Parking Facility with a Total Project Cost of $1,875,000 = Federal Section 5307 funding of $1,500,000 + a Non-Federal Aid match of $375,000 now being provided by MassDOT.

The MVRTA commented that the source of the Non-Federal match should be changed from the City of Newburyport to MassDOT (RTACAP). This non-Federal match is already programmed in FFY 2018 as part of the Non-Federal Aid project Newburyport Intermodal Transit Facility. The $1,500,000 FTA funds will be accessed in FFY 2018. MVRTA commented that the name of the project has changed to "Newburyport Intermodal Parking Facility".