

Technical Appendix

Measure-Specific Documentation:

- **GHG Reduction Estimate Method:** Biking/pedestrian infrastructure projects were collected from municipalities and counties that already completed plans for projects. To calculate GHG reduction, the CMAQ tool kit for bicycle, pedestrian, and shared micromobility was used. Here is the link for the tool: https://www.fhwa.dot.gov/environment/air_quality/cmaq/toolkit/
- **Models/Tools Used:** The primary calculation tool used to calculate GHG emission reduction is The Federal Highway Administration (FHWA) Office of Natural Environment' Congestion Mitigation and Air Quality Improvement (CMAQ) Program. Here is the link for the tool: https://www.fhwa.dot.gov/environment/air_quality/cmaq/toolkit/
- **Measure Implementation Assumptions:** Assumptions for costs were provided by the municipalities or counties that are planning the projects. Assumptions for how many vehicles each project would take off the road is based on the local calculations for user demands found in the Northumberland county Non-Motorized Rail Trail Master Plan (Page 20): <https://drive.google.com/file/d/150-1lxwbgsfzzAuFGKpyDyuStlCqYAWm/view>. The calculation assumes that 290 users per day will use the new biking/pedestrian infrastructure. The assumption is that each user could potentially be a vehicle user. The assumption is that similar trails in other counties and municipalities would have similar trail use, and thus a similar number of cars being replaced by bicycle or walking.
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- **Reference Case Scenario (GHG Emissions or Activity Level):** The reference case scenario will use the Northumberland County Rail Trail calculations for vehicle use. The primary reduction will be a reduction in vehicle use across all the implementation projects. In the [Northumberland County Non-Motorized Rail Trail Plan](#). This study was performed by Micheal Baker International. The study assumed that 290 users per day would use the trail. It is assumed that 290 users would have normally used vehicle transportation, thus each user, by using the trail, would not be driving. Therefore, 290 cars would not be driven. Since 290 cars would be removed from the road, in the CMAQ calculator (See screenshot below), in "(2)" the change would be 290. Because the proposed GHG implementation project is a walking/biking trail that is 35 miles along, "Typical Trip Distance" would be 35. Distribution of trip distances was selected. The tool automatically calculates the GHG reduction.

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INPUT						User Guide																		
<p>(1) What is your project evaluation year? 2024 Reset Interface</p> <p>(2) Estimate the shift in daily motorized passenger vehicle trips to non-motorized travel due to the bicycle and pedestrian project.</p> <div style="text-align: center; margin-bottom: 10px;"> <p>Daily Passenger Vehicle Trips</p> <table style="margin: auto; border-collapse: collapse;"> <tr> <td style="padding: 5px;">Before</td> <td style="padding: 5px;">After</td> <td style="padding: 5px;">Change</td> </tr> <tr> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> </tr> </table> </div> <p>(3a) Select the data type used for entering the typical one-way trip distance of passenger vehicles below:</p> <div style="text-align: center; margin-bottom: 10px;"> <p>Trip Distance Source</p> <div style="display: flex; justify-content: center; gap: 10px;"> - Select from list - <- Fill National Values </div> </div> <p>(3b) If you selected "Average" above, enter the typical one-way trip distance. If you selected "Distribution" above, enter the typical distribution of one-way trip distances.</p> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 30%; text-align: center;"> <p>Typical Trip Distance (miles one way)</p> <div style="border: 1px solid black; width: 100px; height: 20px; margin: 5px auto;"></div> </div> <div style="width: 65%; text-align: center;"> <p>Distribution of Trip Distances (daily fraction per mileage bin)</p> <table style="margin: auto; border-collapse: collapse;"> <tr> <th style="padding: 5px;">$x < 1$</th> <th style="padding: 5px;">$1 \leq x < 2$</th> <th style="padding: 5px;">$2 \leq x < 3$</th> <th style="padding: 5px;">$3 \leq x < 4$</th> <th style="padding: 5px;">$4 \leq x \leq 5$</th> <th style="padding: 5px;">Sum</th> </tr> <tr> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> <td style="border: 1px solid black; width: 100px; height: 20px;"></td> </tr> </table> </div> </div>							Before	After	Change				$x < 1$	$1 \leq x < 2$	$2 \leq x < 3$	$3 \leq x < 4$	$4 \leq x \leq 5$	Sum						
Before	After	Change																						
$x < 1$	$1 \leq x < 2$	$2 \leq x < 3$	$3 \leq x < 4$	$4 \leq x \leq 5$	Sum																			
OUTPUT						Calculate Output																		
EMISSION REDUCTIONS																								
	Pollutant	Total	*Units in kg/day unless otherwise noted																					
	Carbon Monoxide (CO)	0.000																						
	Particulate Matter $\leq 2.5 \mu\text{m}$ (PM _{2.5})	0.000																						
	Particulate Matter $\leq 10 \mu\text{m}$ (PM ₁₀)	0.000																						
	Nitrogen Oxides (NOx)	0.000																						
	Volatile Organic Compounds (VOC)	0.000																						
	Carbon Dioxide (CO ₂)	0.000																						
	Carbon Dioxide Equivalent (CO ₂ e)	0.000																						
	Total Energy Consumption (MMBTU/day)	0.000																						

- **Measure-Specific Activity Data:** Miles of pedestrian/biking trails or infrastructure improvement tools is 45.19. See table below.

Infrastructure Project	Name	Miles
Lycoming County	Susquehanna River Walk Extension	4
Northumberland County	Northumberland County Non-Motorized Rail Trail	35
Sunbury (Northumberland County)	Sunbury Riverwalk Extension	0.67
Clinton County	Bald Eagle Valley Trail: New Trail Connections to Industry and Employment Project	2.5
Mifflin County	Pilot Project A (from Mifflin Moves): Bicycle-Pedestrian Connection Feasibility Study (.83); Pilot Project D (from Mifflin Moves): Active Transportation Improvement Plan for Reedsville Growth Area (.79); Victory Park to Stone Arch Bridge & Victory Park to Kish Park (1.4 miles of new trail infrastructure)	3.02
		45.19

- **GHG Emissions Reduced:** For each GHG reduction measure, provide measure-specific estimated annual GHG emission reductions (e.g., absolute reduction in metric tons of CO₂ equivalent [mtCO₂ e]) and cumulative GHG emission reductions for the periods 2025 through 2030, and 2025 through 2050.

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Pollutant <i>(Units in kg/day unless otherwise noted)</i>	2025 to 2030
Carbon Monoxide (CO)	351,622.64
Particulate Matter $\leq 2.5 \mu\text{m}$ (PM2.5)	1,038.35
Particulate Matter $\leq 10 \mu\text{m}$ (PM10)	5,244.20
Nitrogen Oxides (NOx)	18,130.94
Volatile Organic Compounds (VOC)	10,594.30
Carbon Dioxide (CO2)	43,272,543.39
Carbon Dioxide Equivalent (CO2e)	43,394,609.51
Total Energy Consumption (MMBTU/day)	584,181.82

Pollutant <i>(Units in kg/day unless otherwise noted)</i>	2030 to 2050
Carbon Monoxide (CO)	1,758,113.19
Particulate Matter $\leq 2.5 \mu\text{m}$ (PM2.5)	5,191.74
Particulate Matter $\leq 10 \mu\text{m}$ (PM10)	26,220.98
Nitrogen Oxides (NOx)	90,654.68
Volatile Organic Compounds (VOC)	52,971.50
Carbon Dioxide (CO2)	216,362,716.96
Carbon Dioxide Equivalent (CO2e)	216,973,047.54
Total Energy Consumption (MMBTU/day)	2,920,909.09

G. GHG Reduction Calculations

Explanation of calculations: Tables on the next page shows the length of each trail or infrastructure related project. The total distance combined is 45.19 miles. It is assumed (see sections above) that approximately 290 cars will “removed” from the road because an individual has decided to walk instead of drive a car. This is 290 cars per day.

The second table shows the output from the Air Quality Improvement (CMAQ) Program. Here is the link for the tool: https://www.fhwa.dot.gov/environment/air_quality/cmaq/toolkit/. Since 1450 cars per day would be “removed” from the road because of the proposed GHG reduction measures, this amount was entered in the CMAQ tool. Trip distanced was entered as 45.19 miles and the “Distribution” option was selected. The table shows the multiplication of 1 day, to 1 year, to 5 years, and finally 25 years.

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Project	Distance	Cars Removed
Susquehanna River Walk Extension	4	290
Northumberland County Non-Motorized Rail Trail	35	290
Sunbury Riverwalk Extension	0.67	290
Bald Eagle Valley Trail: New Trail Connections to Industry and Employment Project	2.5	290
Pilot Project D (from Mifflin Moves): Active Transportation Improvement Plan for Reedsville Growth Area (.79); Victory Park to Stone Arch Bridge & Victory Park to Kish Park (1.4 miles of new trail infrastructure)	3.02	290
	45.19	1450

Pollutant	1 day	1 year	5 years	25 years
Carbon Monoxide (CO)	192.67	70324.5277	351622.6	1758113.2
Particulate Matter $\leq 2.5 \mu\text{m}$ (PM2.5)	0.56896	207.669478	1038.347	5191.7369
Particulate Matter $\leq 10 \mu\text{m}$ (PM10)	2.87353	1048.83939	5244.197	26220.985
Nitrogen Oxides (NOx)	9.93476	3626.18733	18130.94	90654.683
Volatile Organic Compounds (VOC)	5.8051	2118.85999	10594.3	52971.5
Carbon Dioxide (CO2)	23711	8654508.68	43272543	216362717
Carbon Dioxide Equivalent (CO2e)	23777.9	8678921.9	43394610	216973048
Total Energy Consumption (MMBTU/day)	320.1	116836.364	584181.8	2920909.1