Congestion and Air Quality Management Annual Report - Fiscal Year 2025

Appendix A: Quantitative Assessment Calculations

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For: DelDOT Division of Planning

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1 INTRODUCTION

This appendix was prepared to provide a record of the calculations completed for the four projects assessed quantitatively for DelDOT's FY2024 submissions to the CMAQ PAS (see **Table 1**).

Table 1. FY2025 CMAQ Program Summary

Project Category	Project No.	Project Name
Multi-modal Congestion Management	T202104102	Old Capitol Trail - Newport Road to Stanton Road
Bicycle and Pedestrian Facility	T202301701	Munchy Branch Pathway – Phase 2
Carpooling and Vanpooling	T202604801	Rideshare, FY26

The methods for completing the emission reduction calculations are discussed in Section 3.0 of the *Congestion and Air Quality Management Annual Report - Fiscal Year 2025*. The following sections present the inputs, standard variables, and outputs generated used by DelDOT to complete these estimation procedures for each of the four quantitative assessments.

1.1 Old Capitol Trail, Newport Road to Stanton Road

This project was reported to PAS for FY2025 as a quantitative entry. The project is listed under CMAQ ID No. T202104102. The information presented in the tables and figures below was used to calculate annual emissions reductions.

Table 2. Old Capitol Trail, Newport Road to Stanton Road - Background

Project Description	**Project No.**	T202104102
	Evaluation Year	2040
	Project Name	Old Capitol Trail, Newport Road to Stanton Road
	Parallel Route	Old Capitol Trail
	Limits	Old Capitol Trail - Orchard Road to 300' North of Newport Road Newport Road – Greenbank Road to Lafayette Street Stanton Road – Orchard Road to Old Capitol Trail Washington Ave – Newport Road to 200' South
	Length (mi)	0.60

Table 3. Old Capitol Trail, Newport Road to Stanton Road – Mode-Shift Estimate

Input Variables	*Bike*	1
	PED	1
	D[1]	250
	AADT	9,350
	A[2]	0.0019
	C[3]	0.003
Mode Shift Estimate	*Total Annual Traffic*	3,412,750
	Total Annual Trips reduced from Bike Improvements	11,454
	Total Annual Trips reduced from Ped Improvements	11,454
	Total Annual Trips Reduced	171,806
	Avg. Reduction in Daily Passenger Trips	31
	Final AADT	9,319

[1]This variable (D) is the number of days a year when the facility would be open per year. It is used to translate the change in AADT to annual trips converted. The longer a facility is predicted to be in use each year, the more trips converted each year.

[2] This variable (A) is used to determine what percentage of the AADT will be converted into pedestrian and cyclist trips. A is the variable that is used to adjust the AADT reduction estimate based on three criteria: the existing AADT on the parallel route, the length of the proposed facility, and the presence of a university nearby. Facilities adjacent to high-volume routes are assigned a lower adjustment factor than those on low-volume routes. Facilities at least a mile or more in length are assigned a higher adjustment factor than shorter facilities. Facilities near a university are assigned a higher adjustment factor than those that are not.

[3] The value of the variable (C) is determined by the number of activity centers within a 0.25 and 0.5-mile buffer around the project limits. Projects with many activity centers within their 0.25 and 0.5-mile buffer are assigned a larger credit than those with few.

Table 4. Old Capitol Trail, Newport Road to Stanton Road – Newport Road Roundabout Operational Summary

Operational Characteristic	Roundabout Segments			
	Approach 1	*Approach 2*	*Approach 3*	*Approach 4*
Average Annual Daily Traffic Volume (AADT)	9,350	2,993	9,350	2,993
Peak-hour Volume	481	228	481	228
Truck Percentage	5%	5%	5%	5%
Existing Delay per Vehicle	56.85	68.5	53.75	62.75
Number of Lanes	1	1	1	1
Existing Intersection % Left Turns	5%	18%	25%	23%
Existing Intersection % Right Turns	15%	32%	18%	20%

Table 5. Old Capitol Trail, Newport Road to Stanton Road – Stanton Road Roundabout Operational Summary

Operational Characteristic	Roundabout Segments			
	Approach 1	*Approach 2*	*Approach 3*	
Average Annual Daily Traffic Volume (AADT)	4,535	3,923	3,834	
Peak-hour Volume	458	304	273	
Truck Percentage	5%	5%	5%	
Existing Delay per Vehicle	3.45	0	28.65	
Number of Lanes	1	1	1	
Existing Intersection % Left Turns	38%		14%	
Existing Intersection % Right Turns		25%	86%	

Figure 1. Old Capitol Trail, Newport Road to Stanton Road – Project Datasheet

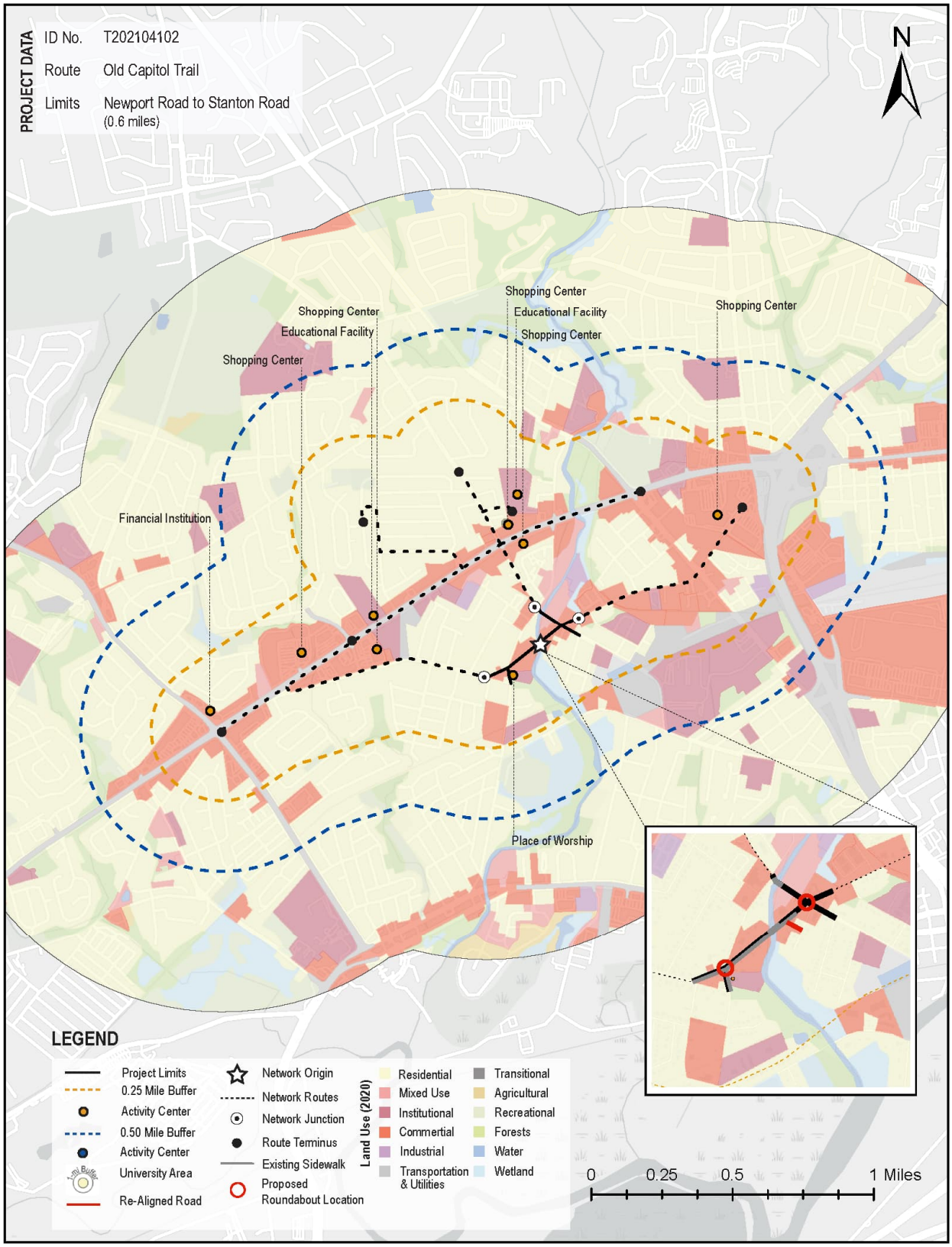


Figure 2. Old Capitol Trail, Newport Road to Stanton Road – Newport Road Roundabout Detail

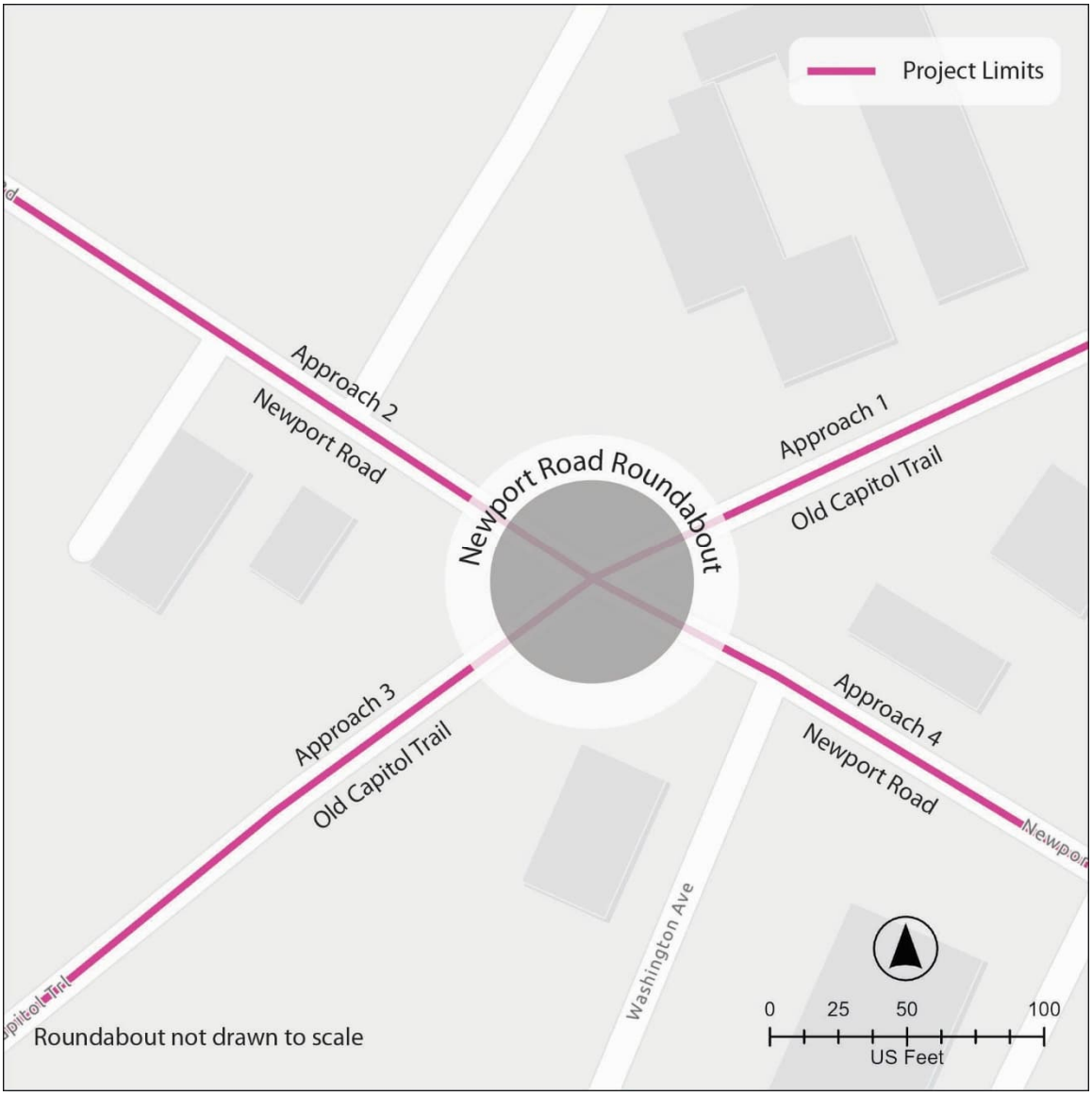


Figure 3. Old Capitol Trail, Newport Road to Stanton Road – Stanton Road Roundabout Detail

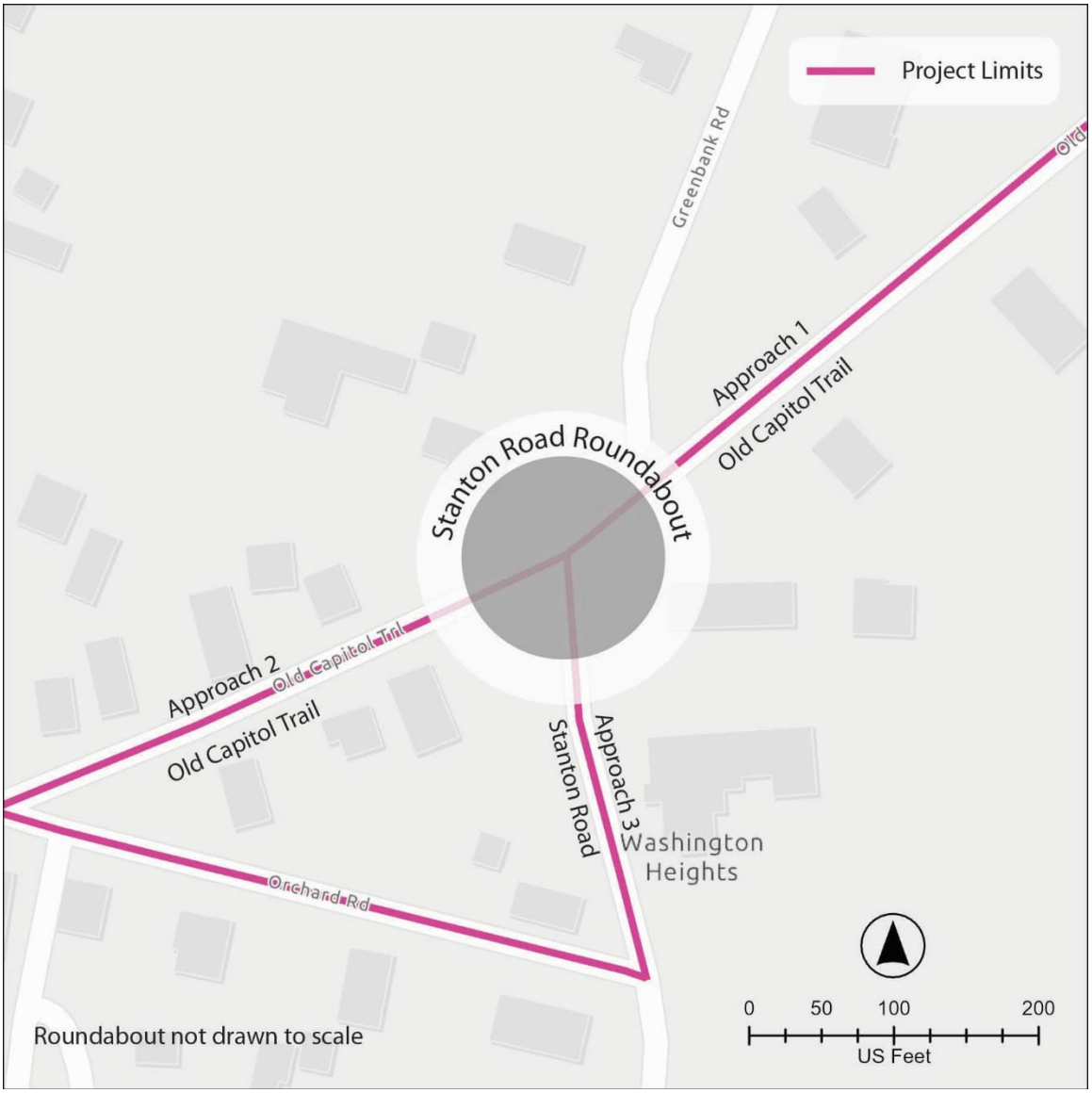
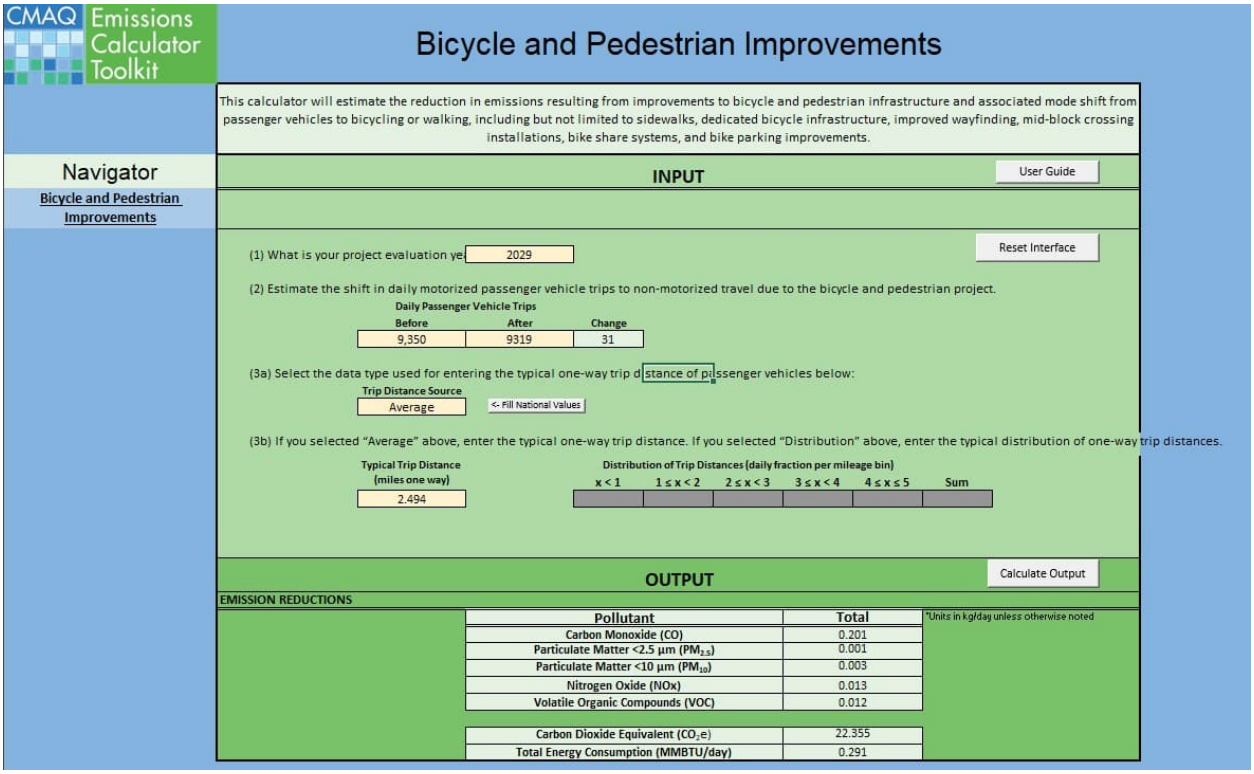


Figure 4. Old Capitol Trail, Newport Road to Stanton Road – Bike-Ped CMAQ Toolkit Output



CMAQ Emissions Calculator Toolkit

Bicycle and Pedestrian Improvements

This calculator will estimate the reduction in emissions resulting from improvements to bicycle and pedestrian infrastructure and associated mode shift from passenger vehicles to bicycling or walking, including but not limited to sidewalks, dedicated bicycle infrastructure, improved wayfinding, mid-block crossing installations, bike share systems, and bike parking improvements.

Navigator

Bicycle and Pedestrian Improvements

INPUT

User Guide

Reset Interface

(1) What is your project evaluation ye: 2029

(2) Estimate the shift in daily motorized passenger vehicle trips to non-motorized travel due to the bicycle and pedestrian project.

Daily Passenger Vehicle Trips		
Before	After	Change
9,350	9319	31

(3a) Select the data type used for entering the typical one-way trip distance of passenger vehicles below:

Trip Distance Source: Average <- Fill National Values

(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.

Typical Trip Distance (miles one way)	Distribution of Trip Distances (daily fraction per mileage bin)					
	x < 1	1 ≤ x < 2	2 ≤ x < 3	3 ≤ x < 4	4 ≤ x ≤ 5	Sum
2.494						

OUTPUT

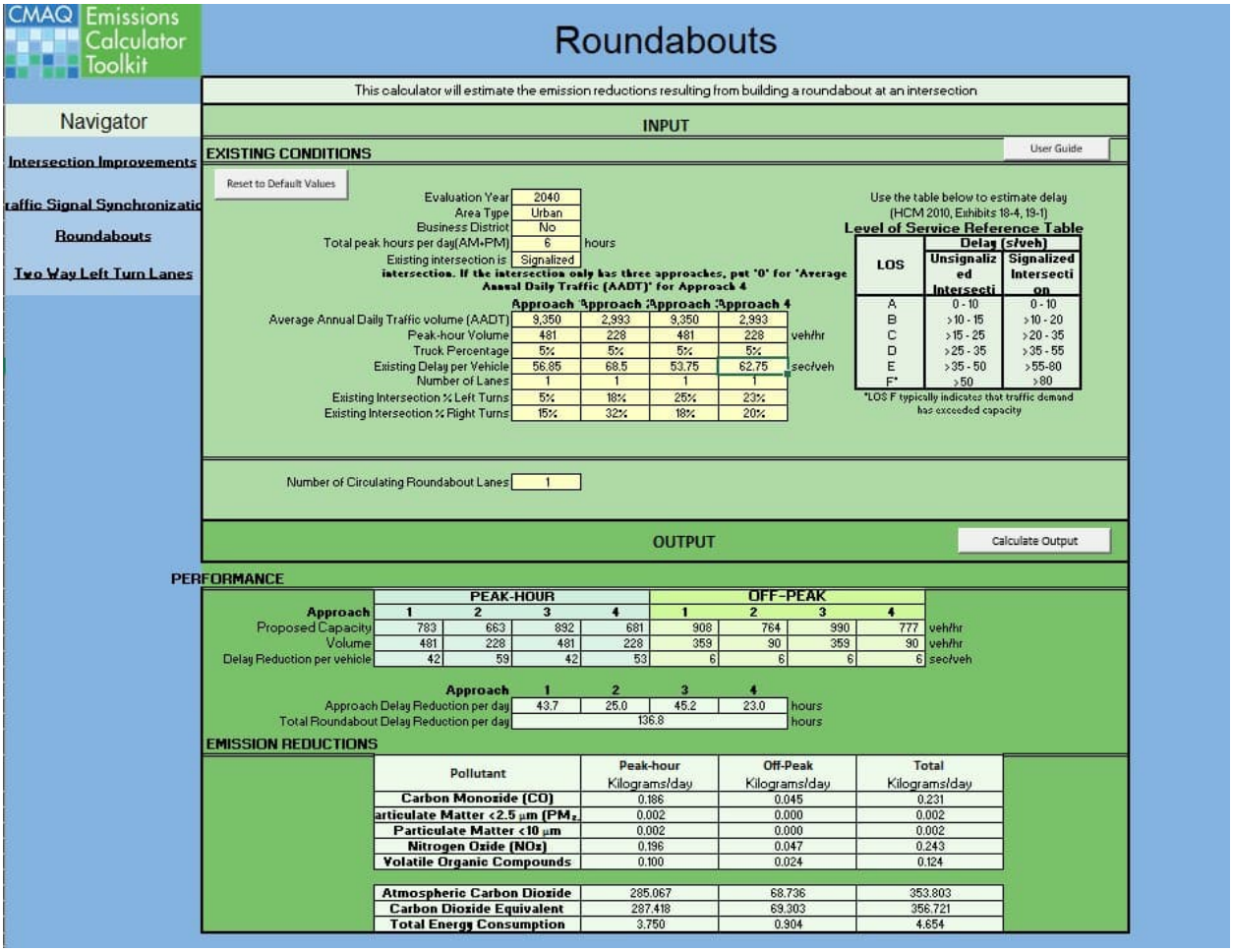
Calculate Output

EMISSION REDUCTIONS

Pollutant	Total
Carbon Monoxide (CO)	0.201
Particulate Matter <2.5 µm ($PM_{2.5}$)	0.001
Particulate Matter <10 µm (PM_{10})	0.003
Nitrogen Oxide (NOx)	0.013
Volatile Organic Compounds (VOC)	0.012
Carbon Dioxide Equivalent (CO_2e)	22.355
Total Energy Consumption (MMBTU/day)	0.291

*Units in kg/day unless otherwise noted

Figure 5. Old Capitol Trail, Newport Road to Stanton Road – Newport Road Roundabout Toolkit Output



CMAQ Emissions Calculator Toolkit

Roundabouts

This calculator will estimate the emission reductions resulting from building a roundabout at an intersection

Navigator

- Intersection Improvements
- raffic Signal Synchronizatio
- Roundabouts
- Two Way Left Turn Lanes

INPUT

EXISTING CONDITIONS — User Guide

Reset to Default Values

Evaluation Year	2040				
Area Type	Urban				
Business District	No				
Total peak hours per day(AM+PM)	6	hours			
Existing intersection is	Signalized				

intersection. If the intersection only has three approaches, put '0' for 'Average Annual Daily Traffic (AADT)' for Approach 4

	Approach 1	Approach 2	Approach 3	Approach 4	
Average Annual Daily Traffic volume (AADT)	9,350	2,993	9,350	2,993	
Peak-hour Volume	481	228	481	228	veh/hr
Truck Percentage	5%	5%	5%	5%	
Existing Delay per Vehicle	56.85	68.5	53.75	62.75	sec/veh
Number of Lanes	1	1	1	1	
Existing Intersection % Left Turns	5%	18%	25%	23%	
Existing Intersection % Right Turns	15%	32%	18%	20%	

Use the table below to estimate delay (HCM 2010, Exhibits 18-4, 19-1)

Level of Service Reference Table

LOS	Delay (s/veh) Unsignalized Intersecti	Signalized Intersecti on
A	0 - 10	0 - 10
B	>10 - 15	>10 - 20
C	>15 - 25	>20 - 35
D	>25 - 35	>35 - 55
E	>35 - 50	>55-80
F*	>50	>80

*LOS F typically indicates that traffic demand has exceeded capacity

Number of Circulating Roundabout Lanes: 1

OUTPUT — Calculate Output

PERFORMANCE

	PEAK-HOUR				OFF-PEAK				
Approach	1	2	3	4	1	2	3	4	
Proposed Capacity	783	663	892	681	908	764	990	777	veh/hr
Volume	481	228	481	228	359	90	359	90	veh/hr
Delay Reduction per vehicle	42	59	42	53	6	6	6	6	sec/veh

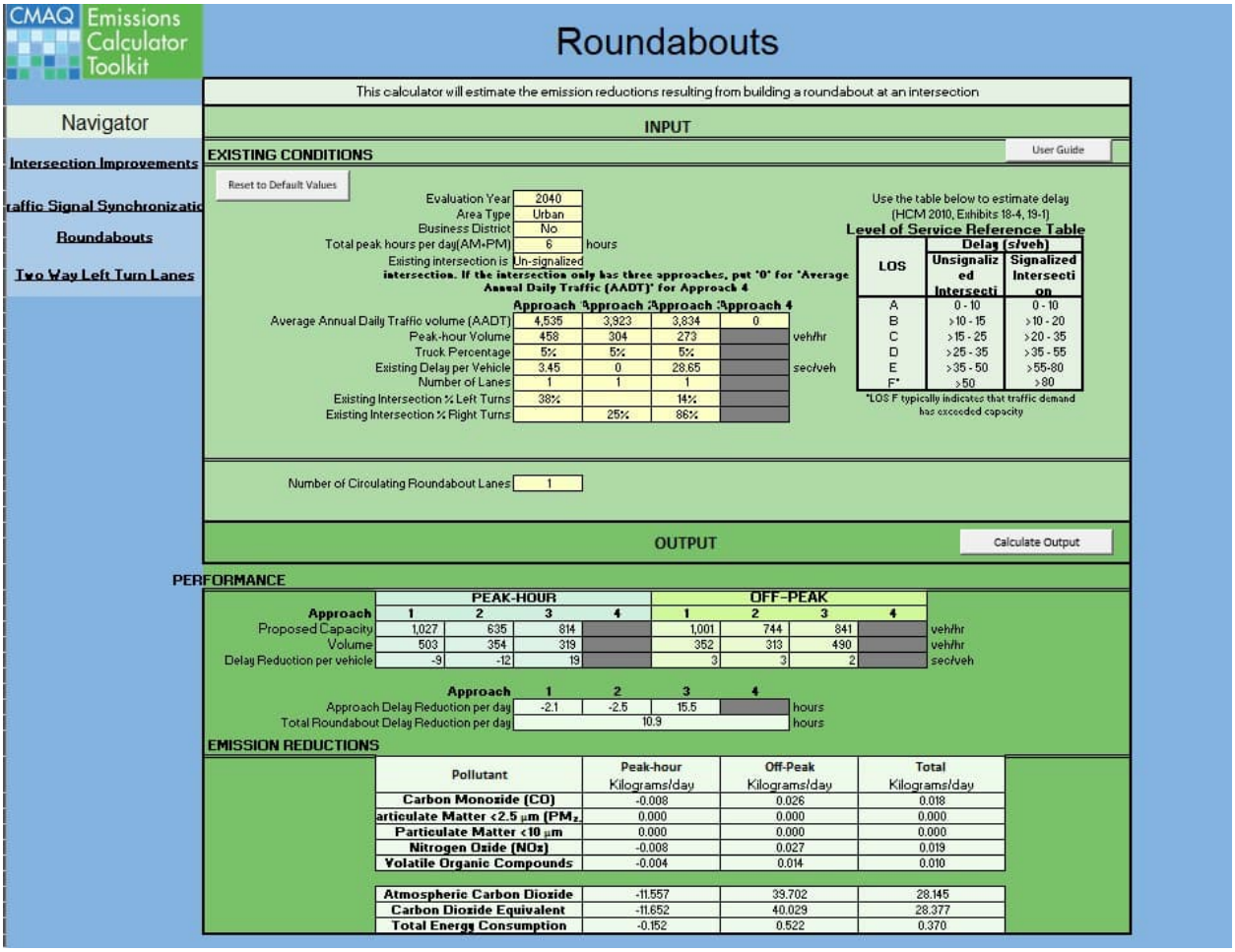
Approach	1	2	3	4	
Approach Delay Reduction per day	43.7	25.0	45.2	23.0	hours
Total Roundabout Delay Reduction per day	136.8				hours

EMISSION REDUCTIONS

Pollutant	Peak-hour Kilograms/day	Off-Peak Kilograms/day	Total Kilograms/day
Carbon Monoxide (CO)	0.186	0.045	0.231
Particulate Matter <2.5 µm ($PM_{2.5}$)	0.002	0.000	0.002
Particulate Matter <10 µm	0.002	0.000	0.002
Nitrogen Oxide (NO_x)	0.196	0.047	0.243
Volatile Organic Compounds	0.100	0.024	0.124

Atmospheric Carbon Dioxide	285.067	68.736	353.803
Carbon Dioxide Equivalent	287.418	69.303	356.721
Total Energy Consumption	3.750	0.904	4.654

Figure 6. Old Capitol Trail, Newport Road to Stanton Road – Stanton Road Roundabout Toolkit Output



CMAQ Emissions Calculator Toolkit

Roundabouts

This calculator will estimate the emission reductions resulting from building a roundabout at an intersection

Navigator

- Intersection Improvements
- raffic Signal Synchronizatic
- Roundabouts
- Two Way Left Turn Lanes

INPUT

EXISTING CONDITIONS — User Guide

Reset to Default Values

Evaluation Year	2040
Area Type	Urban
Business District	No
Total peak hours per day(AM+PM)	6 hours
Existing intersection is	Un-signalized

intersection. If the intersection only has three approaches, put '0' for 'Average Annual Daily Traffic (AADT)' for Approach 4

	Approach 1	Approach 2	Approach 3	Approach 4	
Average Annual Daily Traffic volume (AADT)	4,535	3,923	3,834	0	
Peak-hour Volume	458	304	273		veh/hr
Truck Percentage	5%	5%	5%		
Existing Delay per Vehicle	3.45	0	28.65		sec/veh
Number of Lanes	1	1	1		
Existing Intersection % Left Turns	38%		14%		
Existing Intersection % Right Turns		25%	86%		

Use the table below to estimate delay (HCM 2010, Exhibits 18-4, 19-1)

Level of Service Reference Table

LOS	Delay (s/veh) Unsignalized Intersection	Signalized Intersection
A	0 - 10	0 - 10
B	>10 - 15	>10 - 20
C	>15 - 25	>20 - 35
D	>25 - 35	>35 - 55
E	>35 - 50	>55-80
F*	>50	>80

*LOS F typically indicates that traffic demand has exceeded capacity

Number of Circulating Roundabout Lanes: 1

OUTPUT — Calculate Output

PERFORMANCE

	PEAK-HOUR				OFF-PEAK				
Approach	1	2	3	4	1	2	3	4	
Proposed Capacity	1,027	635	814		1,001	744	841		veh/hr
Volume	503	354	319		352	313	490		veh/hr
Delay Reduction per vehicle	-9	-12	19		3	3	2		sec/veh

Approach	1	2	3	4	
Approach Delay Reduction per day	-2.1	-2.5	15.5		hours
Total Roundabout Delay Reduction per day	10.9				hours

EMISSION REDUCTIONS

Pollutant	Peak-hour Kilograms/day	Off-Peak Kilograms/day	Total Kilograms/day
Carbon Monoxide (CO)	-0.008	0.026	0.018
Particulate Matter <2.5 µm ($PM_{2.5}$)	0.000	0.000	0.000
Particulate Matter <10 µm	0.000	0.000	0.000
Nitrogen Oxide (NO_x)	-0.008	0.027	0.019
Volatile Organic Compounds	-0.004	0.014	0.010

Atmospheric Carbon Dioxide	-11.557	39.702	28.145
Carbon Dioxide Equivalent	-11.652	40.029	28.377
Total Energy Consumption	-0.152	0.522	0.370

1.2 Munchy Branch Pathway, Phase 2

This project was reported to PAS for FY2025 as a quantitative entry. The project is listed under CMAQ ID No. T202301701. The information presented in the tables and figures below was used to calculate annual emissions reductions.

Table 6. Munchy Branch Pathway, Phase 2 - Background

Project Description	**Project No.**	T202301701
	Evaluation Year	2026
	Project Name	Munchy Branch Pathway - Phase 2
	Parallel Route	Munchy Branch Road
	Limits	Field Lane to Wolfe Neck Road
	Length (mi)	0.69

Table 7. c – Mode-Shift Estimate

Input Variables	*Bike*	1
	PED	1
	D[1]	250
	AADT	1,710
	A[2]	0.0019
	C[3]	0.0015
Mode Shift Estimate	*Total Annual Traffic*	624,150
	Total Annual Trips reduced from Bike Improvements	1,454
	Total Annual Trips reduced from Ped Improvements	1,454
	Total Annual Trips Reduced	2,907
	Avg. Reduction in Daily Passenger Trips	43,605
	Final AADT	1,702

[1]This variable (D) is the number of days a year when the facility would be open per year. It is used to translate the change in AADT to annual trips converted. The longer a facility is predicted to be in use each year, the more trips converted each year.

[2] This variable (A) is used to determine what percentage of the AADT will be converted into pedestrian and cyclist trips. A is the variable that is used to adjust the AADT reduction estimate based on three criteria: the existing AADT on the parallel route, the length of the proposed facility, and the presence of a university nearby. Facilities adjacent to high-volume routes are assigned a lower adjustment factor than those on low-volume routes. Facilities at least a mile or more in length are assigned a higher adjustment factor than shorter facilities. Facilities near a university are assigned a higher adjustment factor than those that are not.

[3]The value of the variable (C) is determined by the number of activity centers within a 0.25 and 0.5-mile buffer around the project limits. Projects with many activity centers within their 0.25 and 0.5-mile buffer are assigned a larger credit than those with few.

Figure 7. Munchy Branch Pathway, Phase 2 – Project Datasheet

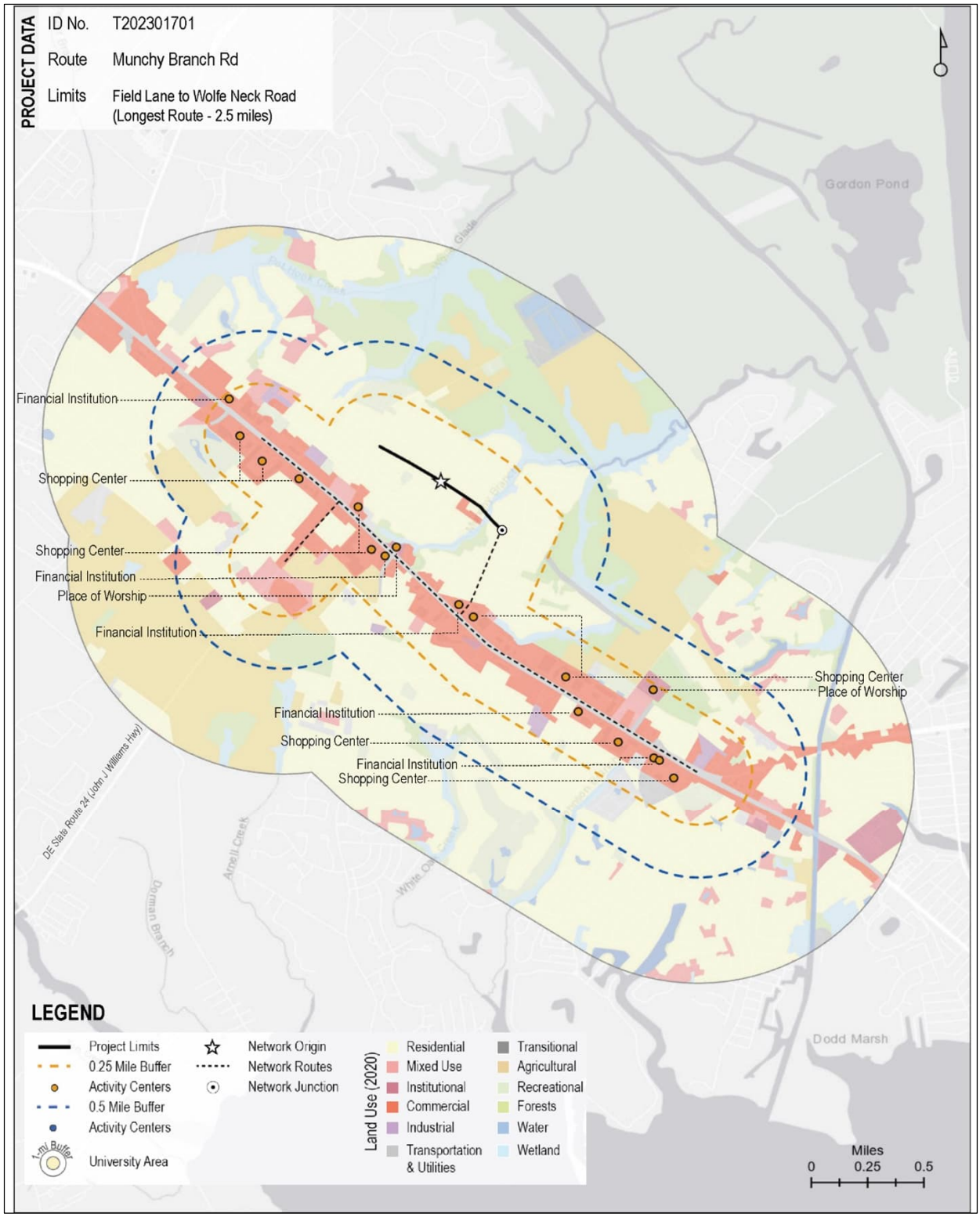
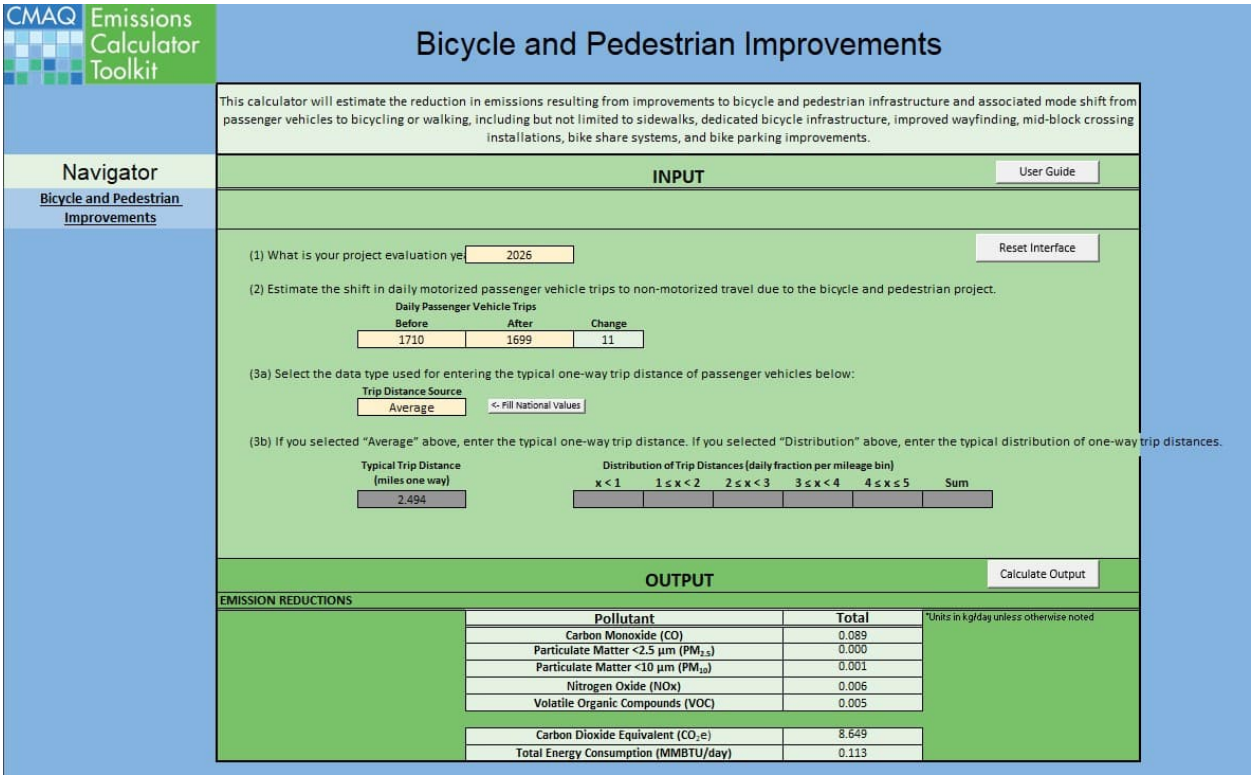


Figure 8. Munchy Branch Pathway, Phase 2 – CMAQ Toolkit Output



CMAQ Emissions Calculator Toolkit

Bicycle and Pedestrian Improvements

This calculator will estimate the reduction in emissions resulting from improvements to bicycle and pedestrian infrastructure and associated mode shift from passenger vehicles to bicycling or walking, including but not limited to sidewalks, dedicated bicycle infrastructure, improved wayfinding, mid-block crossing installations, bike share systems, and bike parking improvements.

Navigator

Bicycle and Pedestrian Improvements

INPUT — User Guide — Reset Interface

(1) What is your project evaluation ye: 2026

(2) Estimate the shift in daily motorized passenger vehicle trips to non-motorized travel due to the bicycle and pedestrian project.

Daily Passenger Vehicle Trips		
Before	After	Change
1710	1699	11

(3a) Select the data type used for entering the typical one-way trip distance of passenger vehicles below:

Trip Distance Source: Average <- Fill National Values

(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.

Typical Trip Distance (miles one way)	Distribution of Trip Distances (daily fraction per mileage bin)					
	x < 1	1 ≤ x < 2	2 ≤ x < 3	3 ≤ x < 4	4 ≤ x ≤ 5	Sum
2.494						

OUTPUT — Calculate Output

EMISSION REDUCTIONS

Pollutant	Total
Carbon Monoxide (CO)	0.089
Particulate Matter <2.5 µm ($PM_{2.5}$)	0.000
Particulate Matter <10 µm (PM_{10})	0.001
Nitrogen Oxide (NOx)	0.006
Volatile Organic Compounds (VOC)	0.005
Carbon Dioxide Equivalent (CO_2e)	8.649
Total Energy Consumption (MMBTU/day)	0.113

*Units in kg/day unless otherwise noted

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1.3 Rideshare FY2026

Rideshare FY26 was reported to PAS for FY2025 as a quantitative entry. The project is listed under CMAQ ID No. T202604801. All information for FY2026 Rideshare is a projection based on previous years' emission reduction calculations. The information presented in the tables and figures below was used to calculate annual emissions reductions.

Table 8. Rideshare FY2026 - Background

Project Description	*Project No.*	T202604801
	Project Name	2026
	Type	FY26 Rideshare Program Projection
	Limits	New Users

Table 9. Rideshare Performance Statistics from FY20- FY25

QUANTITATIVELY ASSESSED PROJECTS														
Programming Information			*Daily Emission Benefit (kg/day)*						*$ of CMAQ Funding per Kg of Daily Emission Reduction*					
Project Year	*State Project ID*	*CMAQ Capital Amount*	*VOC*	*CO*	*NOX*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*VOC*	*CO*	*NO_X*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
2020	T202004802	360,000	0.141	5.375	0.082	0.02	0.425	772.415	$2,553,191	$66,977	$4,390,244	$18,000,000	$847,059	$466
2021	T202104801	384,000	0.167	5.987	0.093	0.023	0.442	858.682	$2,299,401	$64,139	$4,129,032	$16,695,652	$868,778	$447
2022	T202204802	333,767	0.187	8.247	0.558	0.033	0.140	1267.655	$1,784,848	$40,471	$598,148	$10,114,139	$2,384,047	$263
2023	T202304802	383,951	0.039	1.61	0.028	0.007	0.103	247.33	$9,844,885	$238,479	$13,712,519	$54,850,076	$3,727,675	$1,552
2024	T202404801	384,000	0.029	1.176	0.022	0.005	0.071	184.596	$13,241,379	$326,531	$17,454,545	$76,800,000	$5,408,451	$2,080
2025	T202604801	456,885	0.052	2.245	0.044	0.01	0.129	366.979	$8,786,250	$203,512	$10,383,750	$45,688,500	$3,541,744	$1,245
Average Cost Effectiveness									$7,191,353	$174,626	$9,255,599	$40,829,673	$3,186,139	$1,118

Table 10. FY26 Rideshare Project Performance Projections

FORECASTED PROJECTS														
Programming Information			*Daily Emission Benefit (kg/day)*						*$ of CMAQ Funding per Kg of Daily Emission Reduction*					
Project Year	*State Project ID*	*CMAQ Capital Amount*	*VOC*	*CO*	*NO_X*	*PM_{10}*	*$PM_{2.5}$*	*CO2*	*VOC*	*CO*	*NO_X*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
2026	T202404801	384,000	0.053	2.199	0.041	0.009	0.121	343.588	$7,191,353	$174,626	$9,255,599	$40,829,673	$3,186,139	$1,118