6. Benefit-Cost Analysis Narrative

A. Project Overview

Rhode Island Department of Transportation (RIDOT) and Quonset Development Corporation (QDC) request $81 million from the Multimodal Project Discretionary Grant (MPDG) Program to support Completing the I-95 Missing Move and Ramps to Quonset Business Park (QBP), a surface transportation project to construct a series of new interchanges and ramps to connect I-95 and RI-4 and move freight traffic from QBP off local roads. This $135 million public-private partnership project will realize unfinished plans from the 1950s to improve safety and freight connectivity. The specific technical aspects of this project include:

- **Safety**: Remove traffic from local roads through interchange realignments and the construction of new ramps while incorporating high friction surface treatments on project pavement;
- **State of Good Repair:** Construct three new ramps, a new bridge overpass, and new signalized intersection to modernize RI-4 and replace outdated transportation infrastructure;
- **Economic Impacts, Freight Movement & Job Creation:** Install three new ramps to provide a direct connection from QBP to RI-403, improving efficiency of freight movement through this important economic center;
- **Climate Change, Resiliency, and the Environment:** Reduce greenhouse gas emissions by more than 500 tons every year, and construct a more functional, resilient emergency evacuation route;
- **Equity, Multimodal Options, and Quality of Life:** Remove traffic from local roads in a Justice40 community through construction of three new ramps connecting QBP with RI-403, improving safety and reducing greenhouse gas emissions, particularly in disadvantaged neighborhoods; and
- **Innovation:** Deploy design-build project delivery methods to maximize efficiency and minimize traffic disruptions.

Component 1 will complete the "Missing Movements" between Interstate 95 (I-95) and RI-4 to create a direct freeway connection at one of the busiest junctions in the state while removing traffic from local roads. Component 2 will construct three ramps to service RI Route 403 (RI-403) which were deferred during initial construction in 2008, expanding access to Quonset Business Park (QBP) and improving safety in nearby neighborhoods. Taken together, these improvements will address immediate freight connectivity and safety issues while along this critical corridor in the heart of Rhode Island.

This project is an efficient and cost-effective investment, and so are each of its two components independently.

- *Completing the I-95 Missing Move and Ramps to Quonset Business Park* has a favorable Benefit-Cost Ratio of **2.18** and a net present value (NPV) of **$134.68 million**.
- **Component 1, The Missing Moves,** has a B-C Ratio of **2.17** and a NPV of **$91.73 million**.
- **Component 2, The Quonset Connector Ramps,** has a B-C Ratio of **2.21** and a NPV of **$42.95 million.**

The analysis submitted shows that this project generates substantial safety, emissions, and travel time savings benefits. The benefit-cost analysis (BCA) for this project assumes a 7% real discount rate with an alternative yearly discount rate of 3%. Complete calculations are included in the BCA attached as **Appendix D**.

Based on feedback from USDOT on RIDOT's 2022 INFRA grant application, the BCA for this project has been revised in the following ways:

- **Traffic Modeling:** As the preliminary design of the project has continued to progress, design details have been refined in terms of roadway alignments and lengths for storage lanes. Additionally, the original submission of this construction grant was made in 2021, at a time where traffic volumes were significantly impact by the pandemic.

  For this 2023/2024 submission a full study area traffic count program was completed and that information used to update the traffic modeling to reflect more clearly the current conditions. In addition, **following guidance from the USDOT grant review team, RIDOT utilized a 0.25% growth rate for traffic projections, plus additional traffic generated by estimated growth at Quonset Business Park. This is the growth rate USODT officials identified as an acceptable growth rate for this and future analyses.** These updates carried through to the safety and air quality/emission models as well.

- **Safety Analysis:** Building on the updated traffic data, this BCA analysis used the most up to date crash data available (2016-2022) to project safety impacts due to the project.

  For Route 403, the network changes cannot be captured using the Crash Modification Factor methodology, and therefore, predictive modeling was used. That modeling relies on traffic data, and so the predictive model was also updated with new traffic data from the counts program conducted earlier this year.

- **Workzone Impact Refinements and Recalculations:** As the preliminary design of the project has continued to progress, constructability and construction phasing details have been refined. As such, the design consultant has proposed an approach to constructing each of the ramps offline (not within the roadway network) which eliminates a need for work zones or lane closures/shifts.

  The design consultant has identified a small window of time necessary for tying in the new ramps with the existing roadway network which will result in a small disruption to traffic. The goal will be to minimize impacts through off-peak period work and weekend work as feasible. A smaller workzone impact than was calculated in previous benefit-cost analyses of this project is therefore shown in the revised BCA analysis.

B. Findings

Completing the Missing Move and Ramps to Quonset Business Park has a favorable benefit-cost ratio of 2.18, and a net present value of $134.68 million. Component 1 has a BCA of 2.17 and Component 2 has a BCA of 2.21. It is therefore a cost-effective investment. The Benefit-Cost Analysis shows that this project generates safety, emissions, and travel time savings over 30 years. Complete calculations are included in **Appendix D** and the BCA spreadsheet. Calculations are documented in the Benefit-Cost Analysis Calculations spreadsheet in **Appendix D**.

Figure 6-1 Benefit-Cost Analysis Summary

Item	Value
Project Benefits Evaluation Period	30
Primary Discount Rate:	7%
Alternative Discount Rate:	3%
Present Value Benefit (7%):	$248,841,254.66
Present Value Cost (7%):	$114,160,328.08
Project Benefit-Cost Ratio (7%):	**2.18**
Net Present Value (NPV) (7%)	$134,680,926.58

C. Assumptions and Methodology

(1) Baseline

The assumptions and methodology used to produce this analysis are detailed in the attached BCA. In general, this analysis compares the proposed alternative to a baseline/no-build scenario in which all roadway geometry would remain unchanged.

No facility expansions or enhancements are included in the baseline.

Key assumptions for this analysis include:

- **Safety:** Recent crash history is considered representative of the future crashes over the planning horizon, and a correlated to roadway volume.
- **Safety:** Application of Crash Modification Factors (CMFs) is the preferred methodology, however, in the case of each interchange reconstruction use of ISATe, the Highway Safety Manual (HSM) crash prediction model is an appropriate surrogate. The national default model was applied and outcomes applied to the relevant crash history.
- **Travel Time:** VISSIM Microsimulation software was used to model the 2023 Existing and future 2028 No Build, 2058 No Build, 2028 Build, and 2058 Build Conditions.
- **Travel Time:** The modeled travel time results are limited to the smaller sub-study areas, and do not include counts for the portion of RI-4 linking the two component areas. While speed reductions in the future No Build Condition may at times spill back onto other portions of RI-4 and I-95, as well as into the upstream interchanges, those impacts are not included in this model.
- **Travel Time:** While the RI-4/I-95 study area supports a high volume of commuter, commercial, and freight traffic year-round and on all days of the week, this analysis conservatively assumes that benefits are only accrued on weekdays.
- **Emissions:** Emission factors for the study area were developed using the Motor Vehicle Emission Simulator model (MOVES3) developed by the US Environmental Protection Agency.
- **Emissions:** Emissions were analyzed for the opening year of operations (2028) and the design year (2058). Analyses were conducted for the No Build and Build alternatives to determine the emissions reduction associated with the Project.
- **Emissions:** The emission factors utilized represent the corresponding year in the traffic modeling conducted for this analysis. The factors were derived by calculating a seasonal average during the evening peak hour with a representative vehicle mix.

This project will generate significant benefits for **Safety, Travel Time Savings, and Emissions.** The table below summarizes the quantified primary project benefits.

Figure 6-2 Summary of Primary Project Benefits

Parameter	Baseline Scenario (No INFRA Funding)	Preferred Action Scenario (With INFRA Funding)
Safety	• No substantive safety enhancements	• Broad implementation of high friction surface treatment. • Interchange modifications to provide additional access. • Adaptive signal control on Post Road corridor
Travel Time	• Maintain existing traffic conditions, which continue to deteriorate increasing travel delay over time as general travel on Route 4 increases and as employment at Quonset Business Park increases by 5,000 employees during planning horizon.	• Signalized at-grade intersection can better manage traffic in future years. Impact is negligible in the near-term, however and reduces travel delay in future years.
Emissions	• Within each study area, emissions continue to grow as vehicle delays increase in the future as traffic operations deteriorate.	• Improved traffic access management results in reductions in emissions primarily in future years.
Work Zone Disbenefits	• No existing work zone	• Through preliminary engineering, work zone impacts to general traffic are minimized through emphasis on offline construction.

(2) Data Sources

Key sources of data used to project outcomes include but are not limited to

- 2022 RIDOT traffic count data;
- RIDOT crash data from January 1, 2016, to December 31, 2022;
- Highway Safety Manual ISATe default model and results;
- VISSIM Microsimulation results;
- Motor Vehicle Emissions Simulator (MOVES3) model;
- Cost data from the RIDOT Office of Bridge Engineering; and
- Preliminary design documents.

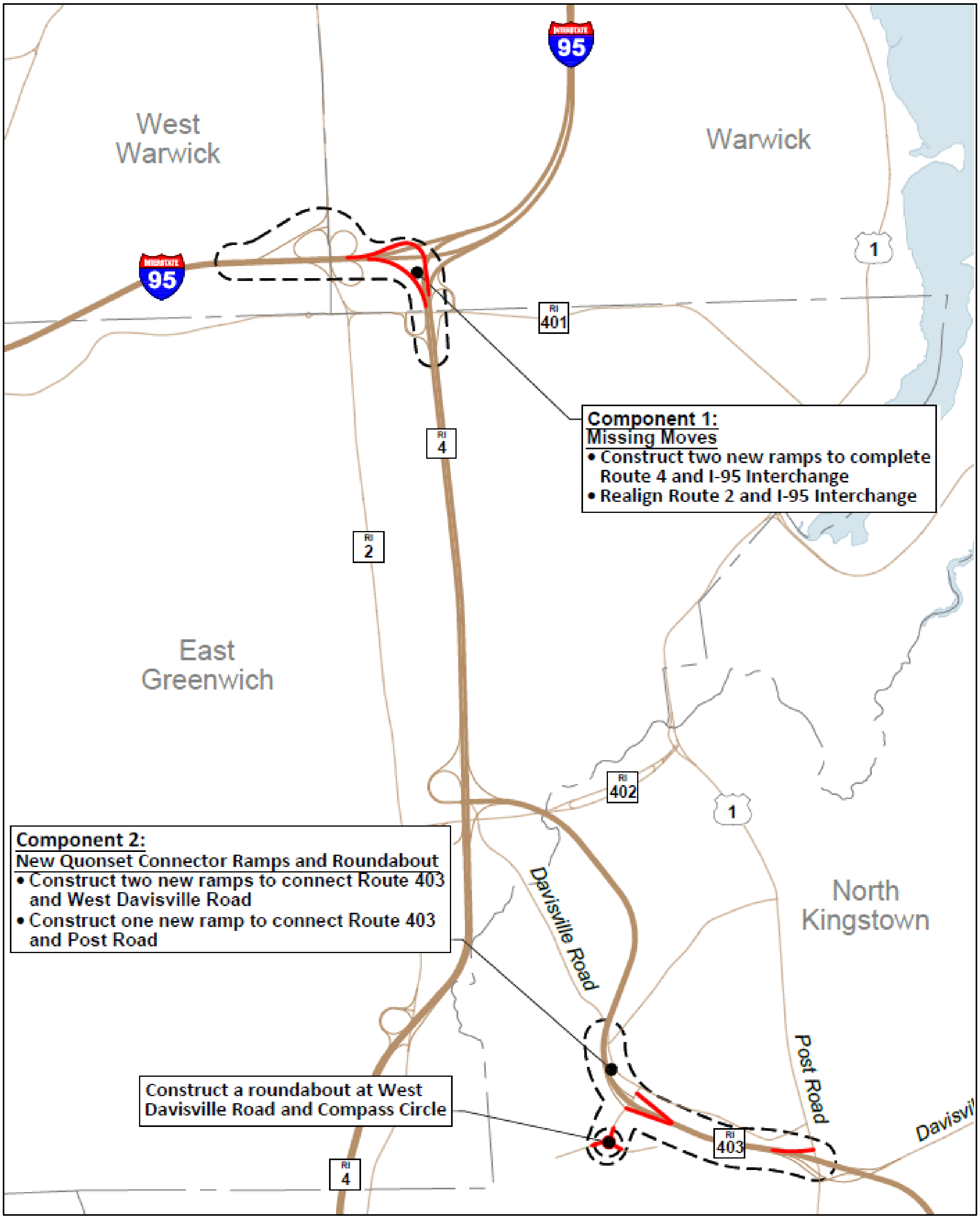
(3) Key Input Parameters

In addition to the Data Sources listed, all key input parameters in this analysis are taken from USDOT's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs," January 2023, unless otherwise noted. Safety benefit calculations utilize Crash Modification Factor Clearinghouse (CMF) inputs.

(4) Spatial Extents

To accurately align the scope of the project with its estimated costs and benefits, two distinct spatial extents were used. The extents are shown in the graphic below.

Figure 6-3 Project Spatial Extents



D. Project Benefits

This project generates a range of quantified benefits to the state and local communities by directly addressing several baseline challenges with targeted interventions.

To ensure project benefits were not overstated and the highest standard of transparency was maintained, RIDOT and supporting consultants made several enhancements to the benefit-cost analysis preparation process. The enhancements were made in direct response to feedback from USDOT in debriefs of recently submitted grant applications, which included a critique that RIDOT's future BCAs would benefit from additional supporting documentation to improve transparency.

All key input parameters in this analysis are taken from USDOT's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs," January 2023, unless otherwise noted. Safety benefit calculations utilize Crash Modification Factor Clearinghouse (CMF) inputs.

The team was deliberately conservative in its assumptions supporting the BCA. While the study area experiences heavy traffic year-round, the number of affected days for the travel time savings calculation was assumed to be 270, rather than a year-round 365-day calculation.

This benefit-cost analysis is accompanied by several supporting technical analysis appended to this narrative to elaborate on assumptions made, methodological considerations, data utilized, scenario assessments, analysis results, model calibrations, and more.

Component 1 of this project is a major generator of travel time savings and, by extension, a reduction in greenhouse gas emissions. More than 200,000 vehicles travel through the I-95/RI-4 interchange every day, and the proposed action will generate **$795 million in travel time savings over 30 years.** The reduction in congestion during the same period will prevent an estimated **732 metric tons of greenhouse gas emissions.** Overall, Component 1, The Missing Moves, **has a positive Benefit-Cost Ratio of 2.17 and a NPV of $91.73 million.**

Component 2 will deliver safety enhancements and reduce travel times in its own right. Shifting traffic away from local roads will prevent an estimated **30 crashes each year**. Improving freeway access will **increase average speeds in the area by nearly 15 percent, reducing delays by an average of 1,020 hours in traffic each day.** Overall, Component 2, The Quonset Connector Ramps, **has a positive Benefit-Cost Ratio of 2.21 and a NPV of $42.95 million.**

Collectively, *Completing the I-95 Missing Move and Ramps to Quonset Business Park* **has a favorable Benefit-Cost Ratio of 2.18 and a NPV of $134.68 million,** indicating that the entire project as proposed in this grant application is a cost-effective and worthwhile investment.

The figure below provides a summary of the baseline challenges addressed by this project, including a description of the proposed change to each baseline condition in the preferred action scenario and the anticipated impacts of each intervention. For the entire project, key impacts include safety enhancements, travel time savings, emissions reductions, and notably low workzone disbenefits due to the innovations proposed in the base technical concept.

Figure 6-4 Baseline Challenges, Proposed Changes, and Impacts

Baseline Challenge	Change to Baseline	Impacts
Safety High rate of crashes, particularly in component 1 study area.	Install high friction surface treatment on key curves and speed transitions in each study area and adaptive traffic signal control at key busy intersections. These safety benefits are realized despite new conflict points introduced as a result of improving freeway access through new interchange ramps.	Component 1: Nearly $0.6 M in safety benefits annually and a reduction of 3 fatal/serious injury crashes over 30 years. Component 2: $4M safety benefit over 30 years with a total reduction of 80 crashes.
Travel Time Maintain existing traffic conditions, which continue to deteriorate increasing travel delay over time as general travel on Route 4 increases and as employment at Quonset Business Park increases by 5,000 employees during planning horizon.	Improved access to Route 4, I-95, and Route 403 improves travel efficiency and reliability.	Component 1: $795M in travel times savings benefits resulting in 2,400 hours in reduced travel delay daily over the 30 year period. Component 2: $270.5 M in travel time savings over 30 years with daily reduction in delay of 1,020 hours.
Emissions See above travel time baseline which continues to deteriorate in the future with QBP growth.	See above changes in travel patterns that improves flow through the network.	Component 1: Project reduces greenhouse gas emissions by 22,000 metric tons over 30 years with $7.7 M in benefits Component 2: While CO_2 emissions increase, this is coupled with the improved travel network providing capacity for 2,000 additional vehicles per day
Work Zone Disbenefit Work zones are not present	A minimal work zone is needed to complete construction of this project.	Work zone activities are primarily offline and the disbenefit of work zone activities is limited to $2.4M across both components.

E. Project Costs

The costs associated with this project are [1] the $135 million future eligible construction and design cost and [2] lifecycle management costs.

Detailed budget information can be found in the Project Budget section of this application including a budget by phase and a separate budget by item type, tracked internally by RIDOT from a project's conception to completion.

F. Calculations

This benefit-cost analysis is accompanied by several supporting technical analysis appended to this narrative to elaborate on assumptions made, methodological considerations, data utilized, scenario assessments, analysis results, model calibrations, and more. They are:

- **Appendix D – Benefit Cost Analysis:** The calculations spreadsheet is reproduced here for easy reference. Each benefit and cost associated with the project is summarized and backup calculations are included. Each backup tab includes, at a minimum, a statement of the Assumptions, methodology, Baseline, Sources of Data, and Key Input Parameters, pursuant to the latest BCA guidance from USDOT (January 2023).
- **Appendix D-1 – Safety:** Two technical memos explaining and documenting the strategies and methodologies deployed to estimate safety issues, accident counts, and proposed interventions throughout each component Study Area. It identifies, explains, and justifies the use of selected Crash Modification Factors (CMFs) and supplies calculations utilized to arrive at data inputs for the master BCA spreadsheet.
- **Appendix D.2 – Travel Time:** Two technical memos documenting the methodologies and assumptions used in the development of the VISSIM microsimulation model for each project component and provides documentation of the model results. Data collection, model calibration, and travel time segment comparisons are discussed.
- **Appendix D-3 – Emissions:** Two technical memos document the air quality study undertaken for each component of the project, including a detailed mesoscale analysis over two selected years within the benefits period.

Appendix D
Benefit-Cost Analysis

Project Benefit-Cost Analysis (BCA) Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Both Components, [1] Missing Moves and [2] Quonset Connector Ramps**
Date: **August 21, 2023**

This project will generate considerable safety, emissions, and time travel savings, which more than offset the cost of construction, work zone impacts, and long-term maintenance costs. The project's costs and benefits are summarized here, and reported in more detail in the "Project B&C Backup by Year" tab, which aggregates the annual benefits and costs from each area of this Benefit-Cost Analysis (BCA).

This project has a **favorable benefit-cost ratio of 2.18, and a net present value (NPV) of $134,680,926.58,** indicating that **the Completing the I-95 Missing Move and Quonset Connector Ramps Project is a worthwhile and cost-effective investment.**

Following a recommendation from USDOT, this BCA separates the two components of this project to evaluate their costs and benefits separately. The tabs pertaining to Component 1, The Missing Moves at I-95 and RI-4, are each labeled with the prefix "MM_" for "Missing Moves." The tabs pertaining to Component 2, the Quonset Connector Ramps, are labeled with the prefix "Q_", for "Quonset".

In each section of this BCA, Component 1 costs and benefits appear first, followed by Component 2. This tab and its companion tab, "ALL_ES-2. B&C Summary Backup," tabulate the total costs and benefits of this entire project as a whole. Both components have positive B-C ratios, making each component independently worthwhile and cost-effective investments. However, because the two components complement one another in completing an essential freeway link for freight travel, RIDOT and its co-applicant Quonset Development Corporation (QDC) recommend delivery of the two components as a single project, and preliminary engineering work to date has combined the two components under one contract.

Table ES-1.1 summarizes the project's costs and benefits.
Table ES-1.2 shows the calculation of the project's benefits by year, discounted at both the primary (7%) and alternative (3%) discount rates.
Table ES-1.3 summarizes the project's costs by year, discounted at both the primary (7%) and alternative (3%) discount rates.

Table ES-1.1 Summary of Project Costs and Benefits

Item	Value
Project Benefits Evaluation Period	30
Primary Discount Rate:	7%
Alternative Discount Rate:	3%
Present Value Benefit (7%):	$ 248,841,254.66
Present Value Cost (7%):	$ 114,160,328.08
Project Benefit-Cost Ratio (7%):	**2.18**
Net Present Value (NPV) (7%)	$ 134,680,926.58
Alternative B-C Ratio (3%)	3.97
Alternative NPV (3%)	$ 411,519,380.10

Table ES-1.2 Project Benefits by Year

Year#	Year	Present Value (PV) Project Benefits	Project Benefits at 7% Discount Rate*	Project Benefits at 3% Discount Rate
1	2022	$ -	$ -	$ -
2	2023	$ (113,871.34)	$ (99,459.64)	$ (107,334.66)
3	2024	$ (498,662.78)	$ (407,057.37)	$ (456,347.08)
4	2025	$ (628,195.04)	$ (479,246.99)	$ (558,143.16)
5	2026	$ (628,195.04)	$ (447,894.38)	$ (541,886.56)
6	2027	$ 12,929,052.51	$ 8,616,536.38	$ 10,827,877.93
7	2028	$ 14,718,255.16	$ 9,167,768.01	$ 11,967,288.33
8	2029	$ 16,280,202.07	$ 9,477,901.15	$ 12,851,741.85
9	2030	$ 17,756,415.24	$ 9,661,810.98	$ 13,608,813.75
10	2031	$ 19,231,061.77	$ 9,780,437.06	$ 14,309,716.04
11	2032	$ 20,706,518.82	$ 9,842,937.62	$ 14,958,829.76
12	2033	$ 22,181,975.86	$ 9,855,603.39	$ 15,557,991.57
13	2034	$ 23,657,432.91	$ 9,824,684.77	$ 16,109,560.64
14	2035	$ 25,132,889.96	$ 9,755,827.64	$ 16,615,801.06
15	2036	$ 26,608,347.01	$ 9,654,125.64	$ 17,078,885.43
16	2037	$ 28,083,804.06	$ 9,524,168.33	$ 17,500,898.22
17	2038	$ 29,559,261.11	$ 9,370,085.33	$ 17,883,839.10
18	2039	$ 31,034,718.16	$ 9,195,586.84	$ 18,229,626.09
19	2040	$ 32,510,175.20	$ 9,004,000.88	$ 18,540,098.65
20	2041	$ 33,985,632.25	$ 8,798,307.36	$ 18,817,020.57
21	2042	$ 35,461,089.30	$ 8,581,169.48	$ 19,062,082.88
22	2043	$ 36,936,546.35	$ 8,354,962.31	$ 19,276,906.55
23	2044	$ 38,412,003.40	$ 8,121,799.18	$ 19,463,045.16
24	2045	$ 39,887,460.45	$ 7,883,555.72	$ 19,621,987.45
25	2046	$ 41,362,917.50	$ 7,641,891.92	$ 19,755,159.76
26	2047	$ 42,838,374.54	$ 7,398,272.33	$ 19,863,928.41
27	2048	$ 44,313,831.59	$ 7,153,984.53	$ 19,949,602.00
28	2049	$ 45,789,288.64	$ 6,910,156.01	$ 20,013,433.61
29	2050	$ 47,264,745.69	$ 6,667,769.61	$ 20,056,622.90
30	2051	$ 48,740,202.74	$ 6,427,677.63	$ 20,080,318.18
31	2052	$ 50,215,659.79	$ 6,190,614.70	$ 20,085,618.40
32	2053	$ 51,691,116.83	$ 5,957,209.50	$ 20,073,575.00
33	2054	$ 53,166,573.88	$ 5,727,995.54	$ 20,045,193.80
34	2055	$ 54,642,030.93	$ 5,503,420.88	$ 20,001,436.73
35	2056	$ 56,107,639.46	$ 5,282,934.60	$ 19,939,723.55
36	2057	$ 56,131,944.45	$ 4,941,717.73	$ 19,367,340.92
Total		**$ 1,095,468,243.41**	**$ 248,841,254.66**	**$ 549,850,252.82**

Table ES-1.3 Project Costs by Year

Present Value (PV) Project Costs	Project Costs at 7% Discount Rate	Project Costs at 3% Discount Rate
$ 1,180,000.00	$ 1,102,803.74	$ 1,145,631.07
$ 7,580,000.00	$ 6,620,665.56	$ 7,144,876.99
$ 68,400,000.00	$ 55,834,774.78	$ 62,595,689.50
$ 29,100,000.00	$ 22,200,250.67	$ 25,854,973.09
$ 12,525,000.00	$ 8,930,151.90	$ 10,804,175.02
$ 16,215,000.00	$ 10,804,739.16	$ 13,579,807.22
$ 1,048,166.67	$ 652,745.52	$ 852,255.42
$ 1,048,166.67	$ 610,042.54	$ 827,432.45
$ 1,048,166.67	$ 570,133.22	$ 803,332.47
$ 1,048,166.67	$ 532,834.78	$ 779,934.44
$ 1,048,166.67	$ 497,976.43	$ 757,217.90
$ 1,048,166.67	$ 465,398.54	$ 735,163.01
$ 1,048,166.67	$ 434,951.90	$ 713,750.50
$ 1,048,166.67	$ 406,497.10	$ 692,961.65
$ 1,048,166.67	$ 379,903.84	$ 672,778.30
$ 1,048,166.67	$ 355,050.31	$ 653,182.81
$ 1,048,166.67	$ 331,822.72	$ 634,158.07
$ 1,048,166.67	$ 310,114.69	$ 615,687.45
$ 1,048,166.67	$ 289,826.82	$ 597,754.80
$ 1,048,166.67	$ 270,866.18	$ 580,344.47
$ 1,048,166.67	$ 253,145.97	$ 563,441.23
$ 1,048,166.67	$ 236,585.02	$ 547,030.32
$ 1,048,166.67	$ 221,107.49	$ 531,097.40
$ 1,048,166.67	$ 206,642.52	$ 515,628.54
$ 1,048,166.67	$ 193,123.85	$ 500,610.24
$ 1,048,166.67	$ 180,489.58	$ 486,029.36
$ 1,048,166.67	$ 168,681.85	$ 471,873.16
$ 1,048,166.67	$ 157,646.59	$ 458,129.28
$ 1,048,166.67	$ 147,333.26	$ 444,785.71
$ 1,048,166.67	$ 137,694.63	$ 431,830.79
$ 1,048,166.67	$ 128,686.57	$ 419,253.19
$ 1,048,166.67	$ 120,267.83	$ 407,041.93
$ 1,048,166.67	$ 112,399.84	$ 395,186.34
$ 1,048,166.67	$ 105,046.58	$ 383,676.06
$ 1,048,166.67	$ 98,174.37	$ 372,501.03
$ 1,048,166.67	$ 91,751.75	$ 361,651.49
$ 166,445,000.00	**$ 114,160,328.08**	**$ 138,330,872.73**

Project Benefit-Cost Analysis (BCA) Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 1, The Missing Moves**

Date: **August 21, 2023**

This tab provides a summary of project costs and benefits by year.

Table ES-2.1 shows all project benefits by year.

Table ES-2.2 shows all project costs by year.

All estimates of project benefits and costs are derived from calculations presented in tabs 1 thru 12. All methodological assumptions and data sources are provided on the relevant sheets.

Table ES-2.1 Project Benefits by Year

Year #	Year	Safety Benefits	Emissions Benefits, NOT Including CO_2	Emissions Benefits, CO_2 Only	Travel Time Savings Benefits	Foregone Cost Savings	Work Zone Disbenefits	TOTAL BENEFITS	TOTAL BENEFITS at 7% Discount Rate (CO_2 Discounted at 3% per NOFO)	TOTAL BENEFITS at 3% Discount Rate
1	2023	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2	2024	$ -	$ -	$ -	$ -	$ -	$ (113,871.34)	$ (113,871.34)	$ (99,459.64)	$ (107,334.66)
3	2025	$ -	$ -	$ -	$ -	$ -	$ (498,662.78)	$ (498,662.78)	$ (407,057.37)	$ (456,347.08)
4	2026	$ -	$ -	$ -	$ -	$ -	$ (628,195.04)	$ (628,195.04)	$ (479,246.99)	$ (558,143.16)
5	2027	$ -	$ -	$ -	$ -	$ -	$ (628,195.04)	$ (628,195.04)	$ (447,894.38)	$ (541,886.56)
6	2028	$ 723,725.80	$ 66,422.64	$ 7,962.88	$ 12,531,393.55	$ -	$ (400,452.36)	$ 12,929,052.51	$ 8,616,536.38	$ 10,827,877.93
7	2029	$ 723,725.80	$ 78,096.08	$ 10,393.99	$ 13,992,394.13	$ -	$ (86,354.84)	$ 14,718,255.16	$ 9,167,768.01	$ 11,967,288.33
8	2030	$ 723,725.80	$ 90,182.25	$ 12,899.31	$ 15,453,394.71	$ -	$ -	$ 16,280,202.07	$ 9,477,901.15	$ 12,851,741.85
9	2031	$ 723,725.80	$ 102,573.45	$ 15,720.70	$ 16,914,395.29	$ -	$ -	$ 17,756,415.24	$ 9,661,810.98	$ 13,608,813.75
10	2032	$ 723,725.80	$ 113,528.54	$ 18,411.55	$ 18,375,395.87	$ -	$ -	$ 19,231,061.77	$ 9,780,437.06	$ 14,309,716.04
11	2033	$ 723,725.80	$ 124,483.64	$ 21,912.92	$ 19,836,396.45	$ -	$ -	$ 20,706,518.82	$ 9,842,937.62	$ 14,958,829.76
12	2034	$ 723,725.80	$ 135,438.74	$ 25,414.29	$ 21,297,397.04	$ -	$ -	$ 22,181,975.86	$ 9,855,603.39	$ 15,557,991.57
13	2035	$ 723,725.80	$ 146,393.83	$ 28,915.66	$ 22,758,397.62	$ -	$ -	$ 23,657,432.91	$ 9,824,684.77	$ 16,109,560.64
14	2036	$ 723,725.80	$ 157,348.93	$ 32,417.03	$ 24,219,398.20	$ -	$ -	$ 25,132,889.96	$ 9,755,827.64	$ 16,615,801.06
15	2037	$ 723,725.80	$ 168,304.03	$ 35,918.40	$ 25,680,398.78	$ -	$ -	$ 26,608,347.01	$ 9,654,125.64	$ 17,078,885.43
16	2038	$ 723,725.80	$ 179,259.13	$ 39,419.77	$ 27,141,399.36	$ -	$ -	$ 28,083,804.06	$ 9,524,168.33	$ 17,500,898.22
17	2039	$ 723,725.80	$ 190,214.22	$ 42,921.14	$ 28,602,399.94	$ -	$ -	$ 29,559,261.11	$ 9,370,085.33	$ 17,883,839.10
18	2040	$ 723,725.80	$ 201,169.32	$ 46,422.51	$ 30,063,400.52	$ -	$ -	$ 31,034,718.16	$ 9,195,586.84	$ 18,229,626.09
19	2041	$ 723,725.80	$ 212,124.42	$ 49,923.89	$ 31,524,401.10	$ -	$ -	$ 32,510,175.20	$ 9,004,000.88	$ 18,540,098.65
20	2042	$ 723,725.80	$ 223,079.51	$ 53,425.26	$ 32,985,401.68	$ -	$ -	$ 33,985,632.25	$ 8,798,307.36	$ 18,817,020.57
21	2043	$ 723,725.80	$ 234,034.61	$ 56,926.63	$ 34,446,402.27	$ -	$ -	$ 35,461,089.30	$ 8,581,169.48	$ 19,062,082.88
22	2044	$ 723,725.80	$ 244,989.71	$ 60,428.00	$ 35,907,402.85	$ -	$ -	$ 36,936,546.35	$ 8,354,962.31	$ 19,276,906.55
23	2045	$ 723,725.80	$ 255,944.80	$ 63,929.37	$ 37,368,403.43	$ -	$ -	$ 38,412,003.40	$ 8,121,799.18	$ 19,463,045.16
24	2046	$ 723,725.80	$ 266,899.90	$ 67,430.74	$ 38,829,404.01	$ -	$ -	$ 39,887,460.45	$ 7,883,555.72	$ 19,621,987.45
25	2047	$ 723,725.80	$ 277,855.00	$ 70,932.11	$ 40,290,404.59	$ -	$ -	$ 41,362,917.50	$ 7,641,891.92	$ 19,755,159.76
26	2048	$ 723,725.80	$ 288,810.09	$ 74,433.48	$ 41,751,405.17	$ -	$ -	$ 42,838,374.54	$ 7,398,272.33	$ 19,863,928.41
27	2049	$ 723,725.80	$ 299,765.19	$ 77,934.85	$ 43,212,405.75	$ -	$ -	$ 44,313,831.59	$ 7,153,984.53	$ 19,949,602.00
28	2050	$ 723,725.80	$ 310,720.29	$ 81,436.22	$ 44,673,406.33	$ -	$ -	$ 45,789,288.64	$ 6,910,156.01	$ 20,013,433.61
29	2051	$ 723,725.80	$ 321,675.38	$ 84,937.59	$ 46,134,406.91	$ -	$ -	$ 47,264,745.69	$ 6,667,769.61	$ 20,056,622.90
30	2052	$ 723,725.80	$ 332,630.48	$ 88,438.96	$ 47,595,407.49	$ -	$ -	$ 48,740,202.74	$ 6,427,677.63	$ 20,080,318.18
31	2053	$ 723,725.80	$ 343,585.58	$ 91,940.33	$ 49,056,408.08	$ -	$ -	$ 50,215,659.79	$ 6,190,614.70	$ 20,085,618.40
32	2054	$ 723,725.80	$ 354,540.67	$ 95,441.71	$ 50,517,408.66	$ -	$ -	$ 51,691,116.83	$ 5,957,209.50	$ 20,073,575.00
33	2055	$ 723,725.80	$ 365,495.77	$ 98,943.08	$ 51,978,409.24	$ -	$ -	$ 53,166,573.88	$ 5,727,995.54	$ 20,045,193.80
34	2056	$ 723,725.80	$ 376,450.87	$ 102,444.45	$ 53,439,409.82	$ -	$ -	$ 54,642,030.93	$ 5,503,420.88	$ 20,001,436.73
35	2057	$ 723,725.80	$ 387,405.96	$ 105,945.82	$ 54,890,561.88	$ -	$ -	$ 56,107,639.46	$ 5,282,934.60	$ 19,939,723.55
36	2058	$ 723,725.80	$ 398,361.06	$ 109,447.19	$ 54,900,410.40	$ -	$ -	$ 56,131,944.45	$ 4,941,717.73	$ 19,367,340.92
Present Value Benefits		**$ 22,435,499.80**	**$ 7,247,784.09**	**$ 1,773,069.82**	**$ 1,066,367,621.12**	**$ -**	**$ (2,355,731.41)**	**$ 1,095,468,243.41**	**$ 248,841,254.66**	**$ 549,850,252.82**

Project Benefit-Cost Analysis (BCA) Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 1, The Missing Moves**

Date: **August 21, 2023**

Table ES-2.2 Project Costs by Year

Year #	Year	Future Eligible Project Costs	Lifecycle Management Costs	TOTAL COSTS	TOTAL COSTS at 7% Discount Rate	TOTAL COSTS at 3% Discount Rate
1	2023	$ 1,180,000.00	$ -	$ 1,180,000.00	$ 1,102,803.74	$ 1,145,631.07
2	2024	$ 7,580,000.00	$ -	$ 7,580,000.00	$ 6,620,665.56	$ 7,144,876.99
3	2025	$ 68,400,000.00	$ -	$ 68,400,000.00	$ 55,834,774.78	$ 62,595,689.50
4	2026	$ 29,100,000.00	$ -	$ 29,100,000.00	$ 22,200,250.67	$ 25,854,973.09
5	2027	$ 12,525,000.00	$ -	$ 12,525,000.00	$ 8,930,151.90	$ 10,804,175.02
6	2028	$ 16,215,000.00	$ -	$ 16,215,000.00	$ 10,804,739.16	$ 13,579,807.22
7	2029	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 652,745.52	$ 852,255.42
8	2030	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 610,042.54	$ 827,432.45
9	2031	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 570,133.22	$ 803,332.47
10	2032	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 532,834.78	$ 779,934.44
11	2033	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 497,976.43	$ 757,217.90
12	2034	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 465,398.54	$ 735,163.01
13	2035	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 434,951.90	$ 713,750.50
14	2036	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 406,497.10	$ 692,961.65
15	2037	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 379,903.84	$ 672,778.30
16	2038	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 355,050.31	$ 653,182.81
17	2039	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 331,822.72	$ 634,158.07
18	2040	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 310,114.69	$ 615,687.45
19	2041	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 289,826.82	$ 597,754.80
20	2042	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 270,866.18	$ 580,344.47
21	2043	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 253,145.97	$ 563,441.23
22	2044	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 236,585.02	$ 547,030.32
23	2045	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 221,107.49	$ 531,097.40
24	2046	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 206,642.52	$ 515,628.54
25	2047	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 193,123.85	$ 500,610.24
26	2048	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 180,489.58	$ 486,029.36
27	2049	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 168,681.85	$ 471,873.16
28	2050	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 157,646.59	$ 458,129.28
29	2051	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 147,333.26	$ 444,785.71
30	2052	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 137,694.63	$ 431,830.79
31	2053	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 128,686.57	$ 419,253.19
32	2054	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 120,267.83	$ 407,041.93
33	2055	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 112,399.84	$ 395,186.34
34	2056	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 105,046.58	$ 383,676.06
35	2057	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 98,174.37	$ 372,501.03
36	2058	$ -	$ 1,048,166.67	$ 1,048,166.67	$ 91,751.75	$ 361,651.49
Present Value Costs		**$ 135,000,000.00**	**$ 31,445,000.00**	**$ 166,445,000.00**	**$ 114,160,328.08**	**$ 138,330,872.73**

Project Benefit-Cost Analysis (BCA) Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Component 1 of this project , the Missing Moves, will generate considerable safety, emissions, and time travel savings, which more than offset the cost of construction, work zone impacts, and long-term maintenance costs. The project's costs and benefits are summarized here, and reported in more detail in the "Project B&C Backup by Year" tab, which aggregates the annual benefits and costs from each area of this Benefit-Cost Analysis.

Component 1 of this project has a **favorable benefit-cost ratio of 2.17 and a net present value (NPV) of $91,729,383.89,** indicating that **Component 1 of the Completing the I-95 Missing Moves and Quonset Connector Ramps project is a worthwhile and cost-effective investment.**

Table ES-1.1 summarizes the project's costs and benefits.
Table ES-1.2 shows the calculation of the project's benefits by year, discounted at both the primary (7%) and alternative (3%) discount rates.
Table ES-1.3 summarizes the project's costs by year, discounted at both the primary (7%) and alternative (3%) discount rates.

Table ES-1.1 Summary of Project Costs and Benefits

Item	Value
Project Benefits Evaluation Period	30
Primary Discount Rate:	7%
Alternative Discount Rate:	3%
Present Value Benefit (7%):	$ 170,246,453.10
Present Value Cost (7%):	$ 78,517,069.21
Project Benefit-Cost Ratio (7%):	**2.17**
Net Present Value (NPV) (7%)	$ 91,729,383.89
Alternative B-C Ratio (3%)	4.14
Alternative NPV (3%)	$ 301,228,065.35

Table ES-1.2 Project Benefits by Year

Year#	Year	Present Value (PV) Project Benefits	Project Benefits at 7% Discount Rate*	Project Benefits at 3% Discount Rate
1	2022	$ -	$ -	$ -
2	2023	$ (113,871.34)	$ (99,459.64)	$ (107,334.66)
3	2024	$ (455,485.36)	$ (371,811.73)	$ (416,833.63)
4	2025	$ (455,485.36)	$ (347,487.60)	$ (404,692.84)
5	2026	$ (455,485.36)	$ (324,754.77)	$ (392,905.67)
6	2027	$ 4,342,493.96	$ 2,894,639.23	$ 3,636,770.33
7	2028	$ 6,035,354.20	$ 3,760,198.69	$ 4,907,295.26
8	2029	$ 7,500,938.35	$ 4,368,025.31	$ 5,921,310.00
9	2030	$ 8,967,172.47	$ 4,880,821.43	$ 6,872,591.02
10	2031	$ 10,432,679.22	$ 5,307,618.75	$ 7,762,893.13
11	2032	$ 11,899,107.61	$ 5,658,526.36	$ 8,596,168.51
12	2033	$ 13,365,535.99	$ 5,941,027.48	$ 9,374,318.03
13	2034	$ 14,831,964.38	$ 6,162,567.88	$ 10,099,846.02
14	2035	$ 16,298,392.76	$ 6,329,911.89	$ 10,775,157.66
15	2036	$ 17,764,821.15	$ 6,449,199.65	$ 11,402,562.70
16	2037	$ 19,231,249.53	$ 6,525,999.87	$ 11,984,278.91
17	2038	$ 20,697,677.92	$ 6,565,358.27	$ 12,522,435.53
18	2039	$ 22,164,106.30	$ 6,571,842.24	$ 13,019,076.52
19	2040	$ 23,630,534.69	$ 6,549,581.79	$ 13,476,163.74
20	2041	$ 25,096,963.07	$ 6,502,307.23	$ 13,895,579.96
21	2042	$ 26,563,391.46	$ 6,433,383.84	$ 14,279,131.84
22	2043	$ 28,029,819.84	$ 6,345,843.61	$ 14,628,552.78
23	2044	$ 29,496,248.23	$ 6,242,414.50	$ 14,945,505.59
24	2045	$ 30,962,676.61	$ 6,125,547.19	$ 15,231,585.19
25	2046	$ 32,429,105.00	$ 5,997,439.76	$ 15,488,321.15
26	2047	$ 33,895,533.38	$ 5,860,060.17	$ 15,717,180.11
27	2048	$ 35,361,961.77	$ 5,715,167.03	$ 15,919,568.18
28	2049	$ 36,828,390.15	$ 5,564,328.54	$ 16,096,833.19
29	2050	$ 38,294,818.53	$ 5,408,939.88	$ 16,250,266.94
30	2051	$ 39,761,246.92	$ 5,250,239.17	$ 16,381,107.27
31	2052	$ 41,227,675.30	$ 5,089,321.98	$ 16,490,540.15
32	2053	$ 42,694,103.69	$ 4,927,154.75	$ 16,579,701.60
33	2054	$ 44,160,532.07	$ 4,764,586.99	$ 16,649,679.66
34	2055	$ 45,626,960.46	$ 4,602,362.41	$ 16,701,516.17
35	2056	$ 47,093,388.84	$ 4,441,129.14	$ 16,736,208.54
36	2057	$ 47,108,665.17	$ 4,154,421.83	$ 16,254,016.98
Total		**$ 820,313,181.59**	**$ 170,246,453.10**	**$ 397,274,395.85**

Table ES-1.3 Project Costs by Year

Present Value (PV) Project Costs	Project Costs at 7% Discount Rate	Project Costs at 3% Discount Rate
$ 700,000.00	$ 654,205.61	$ 679,611.65
$ 5,390,000.00	$ 4,707,834.75	$ 5,080,591.95
$ 48,500,000.00	$ 39,590,447.03	$ 44,384,370.48
$ 18,200,000.00	$ 13,884,692.86	$ 16,170,464.27
$ 7,400,000.00	$ 5,276,097.73	$ 6,383,305.00
$ 10,810,000.00	$ 7,203,159.44	$ 9,053,204.81
$ 870,833.33	$ 542,311.23	$ 708,067.19
$ 870,833.33	$ 506,832.93	$ 687,443.87
$ 870,833.33	$ 473,675.63	$ 667,421.24
$ 870,833.33	$ 442,687.51	$ 647,981.78
$ 870,833.33	$ 413,726.64	$ 629,108.53
$ 870,833.33	$ 386,660.41	$ 610,784.98
$ 870,833.33	$ 361,364.87	$ 592,995.13
$ 870,833.33	$ 337,724.18	$ 575,723.42
$ 870,833.33	$ 315,630.08	$ 558,954.78
$ 870,833.33	$ 294,981.38	$ 542,674.54
$ 870,833.33	$ 275,683.53	$ 526,868.49
$ 870,833.33	$ 257,648.16	$ 511,522.80
$ 870,833.33	$ 240,792.67	$ 496,624.08
$ 870,833.33	$ 225,039.88	$ 482,159.30
$ 870,833.33	$ 210,317.65	$ 468,115.83
$ 870,833.33	$ 196,558.55	$ 454,481.39
$ 870,833.33	$ 183,699.58	$ 441,244.06
$ 870,833.33	$ 171,681.85	$ 428,392.30
$ 870,833.33	$ 160,450.33	$ 415,914.85
$ 870,833.33	$ 149,953.58	$ 403,800.83
$ 870,833.33	$ 140,143.53	$ 392,039.64
$ 870,833.33	$ 130,975.26	$ 380,621.01
$ 870,833.33	$ 122,406.79	$ 369,534.96
$ 870,833.33	$ 114,398.86	$ 358,771.80
$ 870,833.33	$ 106,914.83	$ 348,322.14
$ 870,833.33	$ 99,920.40	$ 338,176.83
$ 870,833.33	$ 93,383.55	$ 328,327.02
$ 870,833.33	$ 87,274.35	$ 318,764.10
$ 870,833.33	$ 81,564.81	$ 309,479.71
$ 870,833.33	$ 76,228.79	$ 300,465.74
$ 117,125,000.00	**$ 78,517,069.21**	**$ 96,046,330.51**

Project Benefit-Cost Analysis (BCA) Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

This tab provides a summary of project costs and benefits by year.

Table ES-2.1 shows all project benefits by year.

Table ES-2.2 shows all project costs by year.

All estimates of project benefits and costs are derived from calculations presented in tabs 1 thrugh 12. All methodological assumptions and data sources are provided on the relevant sheets.

Table ES-2.1 Project Benefits by Year

Year #	Year	Safety Benefits	Emissions Benefits, NOT Including CO_2	Emissions Benefits, CO_2 Only	Travel Time Savings Benefits	Foregone Cost Savings	Work Zone Disbenefits	TOTAL BENEFITS	TOTAL BENEFITS at 7% Discount Rate (CO_2 Discounted at 3% per NOFO)	TOTAL BENEFITS at 3% Discount Rate
1	2023						$ -	$ -	$ -	$ -
2	2024						$ (113,871.34)	$ (113,871.34)	$ (99,459.64)	$ (107,334.66)
3	2025						$ (455,485.36)	$ (455,485.36)	$ (371,811.73)	$ (416,833.63)
4	2026						$ (455,485.36)	$ (455,485.36)	$ (347,487.60)	$ (404,692.84)
5	2027						$ (455,485.36)	$ (455,485.36)	$ (324,754.77)	$ (392,905.67)
6	2028	$ 596,682.00	$ 16,416.52	$ 6,147.80	$ 3,950,990.33		$ (227,742.68)	$ 4,342,493.96	$ 2,894,639.23	$ 3,636,770.33
7	2029	$ 596,682.00	$ 27,685.59	$ 8,844.22	$ 5,402,142.39	$ -	$ -	$ 6,035,354.20	$ 3,760,198.69	$ 4,907,295.26
8	2030	$ 596,682.00	$ 39,337.53	$ 11,624.37	$ 6,853,294.45	$ -	$ -	$ 7,500,938.35	$ 4,368,025.31	$ 5,921,310.00
9	2031	$ 596,682.00	$ 51,329.32	$ 14,714.63	$ 8,304,446.51	$ -	$ -	$ 8,967,172.47	$ 4,880,821.43	$ 6,872,591.02
10	2032	$ 596,682.00	$ 62,694.54	$ 17,704.10	$ 9,755,598.58	$ -	$ -	$ 10,432,679.22	$ 5,307,618.75	$ 7,762,893.13
11	2033	$ 596,682.00	$ 74,059.76	$ 21,615.21	$ 11,206,750.64	$ -	$ -	$ 11,899,107.61	$ 5,658,526.36	$ 8,596,168.51
12	2034	$ 596,682.00	$ 85,424.97	$ 25,526.32	$ 12,657,902.70	$ -	$ -	$ 13,365,535.99	$ 5,941,027.48	$ 9,374,318.03
13	2035	$ 596,682.00	$ 96,790.19	$ 29,437.42	$ 14,109,054.76	$ -	$ -	$ 14,831,964.38	$ 6,162,567.88	$ 10,099,846.02
14	2036	$ 596,682.00	$ 108,155.41	$ 33,348.53	$ 15,560,206.83	$ -	$ -	$ 16,298,392.76	$ 6,329,911.89	$ 10,775,157.66
15	2037	$ 596,682.00	$ 119,520.62	$ 37,259.64	$ 17,011,358.89	$ -	$ -	$ 17,764,821.15	$ 6,449,199.65	$ 11,402,562.70
16	2038	$ 596,682.00	$ 130,885.84	$ 41,170.74	$ 18,462,510.95	$ -	$ -	$ 19,231,249.53	$ 6,525,999.87	$ 11,984,278.91
17	2039	$ 596,682.00	$ 142,251.05	$ 45,081.85	$ 19,913,663.01	$ -	$ -	$ 20,697,677.92	$ 6,565,358.27	$ 12,522,435.53
18	2040	$ 596,682.00	$ 153,616.27	$ 48,992.95	$ 21,364,815.08	$ -	$ -	$ 22,164,106.30	$ 6,571,842.24	$ 13,019,076.52
19	2041	$ 596,682.00	$ 164,981.49	$ 52,904.06	$ 22,815,967.14	$ -	$ -	$ 23,630,534.69	$ 6,549,581.79	$ 13,476,163.74
20	2042	$ 596,682.00	$ 176,346.70	$ 56,815.17	$ 24,267,119.20	$ -	$ -	$ 25,096,963.07	$ 6,502,307.23	$ 13,895,579.96
21	2043	$ 596,682.00	$ 187,711.92	$ 60,726.27	$ 25,718,271.26	$ -	$ -	$ 26,563,391.46	$ 6,433,383.84	$ 14,279,131.84
22	2044	$ 596,682.00	$ 199,077.14	$ 64,637.38	$ 27,169,423.33	$ -	$ -	$ 28,029,819.84	$ 6,345,843.61	$ 14,628,552.78
23	2045	$ 596,682.00	$ 210,442.35	$ 68,548.48	$ 28,620,575.39	$ -	$ -	$ 29,496,248.23	$ 6,242,414.50	$ 14,945,505.59
24	2046	$ 596,682.00	$ 221,807.57	$ 72,459.59	$ 30,071,727.45	$ -	$ -	$ 30,962,676.61	$ 6,125,547.19	$ 15,231,585.19
25	2047	$ 596,682.00	$ 233,172.79	$ 76,370.70	$ 31,522,879.51	$ -	$ -	$ 32,429,105.00	$ 5,997,439.76	$ 15,488,321.15
26	2048	$ 596,682.00	$ 244,538.00	$ 80,281.80	$ 32,974,031.58	$ -	$ -	$ 33,895,533.38	$ 5,860,060.17	$ 15,717,180.11
27	2049	$ 596,682.00	$ 255,903.22	$ 84,192.91	$ 34,425,183.64	$ -	$ -	$ 35,361,961.77	$ 5,715,167.03	$ 15,919,568.18
28	2050	$ 596,682.00	$ 267,268.43	$ 88,104.01	$ 35,876,335.70	$ -	$ -	$ 36,828,390.15	$ 5,564,328.54	$ 16,096,833.19
29	2051	$ 596,682.00	$ 278,633.65	$ 92,015.12	$ 37,327,487.76	$ -	$ -	$ 38,294,818.53	$ 5,408,939.88	$ 16,250,266.94
30	2052	$ 596,682.00	$ 289,998.87	$ 95,926.23	$ 38,778,639.83	$ -	$ -	$ 39,761,246.92	$ 5,250,239.17	$ 16,381,107.27
31	2053	$ 596,682.00	$ 301,364.08	$ 99,837.33	$ 40,229,791.89	$ -	$ -	$ 41,227,675.30	$ 5,089,321.98	$ 16,490,540.15
32	2054	$ 596,682.00	$ 312,729.30	$ 103,748.44	$ 41,680,943.95	$ -	$ -	$ 42,694,103.69	$ 4,927,154.75	$ 16,579,701.60
33	2055	$ 596,682.00	$ 324,094.52	$ 107,659.54	$ 43,132,096.01	$ -	$ -	$ 44,160,532.07	$ 4,764,586.99	$ 16,649,679.66
34	2056	$ 596,682.00	$ 335,459.73	$ 111,570.65	$ 44,583,248.08	$ -	$ -	$ 45,626,960.46	$ 4,602,362.41	$ 16,701,516.17
35	2057	$ 596,682.00	$ 346,824.95	$ 115,481.76	$ 46,034,400.14	$ -	$ -	$ 47,093,388.84	$ 4,441,129.14	$ 16,736,208.54
36	2058	$ 596,682.00	$ 358,190.17	$ 119,392.86	$ 46,034,400.14	$ -	$ -	$ 47,108,665.17	$ 4,154,421.83	$ 16,254,016.98
Present Value Benefits		**$ 18,497,142.00**	**$ 5,816,712.49**	**$ 1,892,140.07**	**$ 795,815,257.12**	**$ -**	**$ (1,708,070.10)**	**$ 820,313,181.59**	**$ 170,246,453.10**	**$ 397,274,395.85**

Project Benefit-Cost Analysis (BCA) Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 1, The Missing Moves**

Date: **August 21, 2023**

Table ES-2.2 Project Costs by Year

Year #	Year	Future Eligible Project Costs	Lifecycle Management Costs	TOTAL COSTS	TOTAL COSTS at 7% Discount Rate	TOTAL COSTS at 3% Discount Rate
1	2023	$ 700,000.00		$ 700,000.00	$ 654,205.61	$ 679,611.65
2	2024	$ 5,390,000.00		$ 5,390,000.00	$ 4,707,834.75	$ 5,080,591.95
3	2025	$ 48,500,000.00		$ 48,500,000.00	$ 39,590,447.03	$ 44,384,370.48
4	2026	$ 18,200,000.00		$ 18,200,000.00	$ 13,884,692.86	$ 16,170,464.27
5	2027	$ 7,400,000.00		$ 7,400,000.00	$ 5,276,097.73	$ 6,383,305.00
6	2028	$ 10,810,000.00		$ 10,810,000.00	$ 7,203,159.44	$ 9,053,204.81
7	2029	$ -	$ 870,833.33	$ 870,833.33	$ 542,311.23	$ 708,067.19
8	2030	$ -	$ 870,833.33	$ 870,833.33	$ 506,832.93	$ 687,443.87
9	2031	$ -	$ 870,833.33	$ 870,833.33	$ 473,675.63	$ 667,421.24
10	2032	$ -	$ 870,833.33	$ 870,833.33	$ 442,687.51	$ 647,981.78
11	2033	$ -	$ 870,833.33	$ 870,833.33	$ 413,726.64	$ 629,108.53
12	2034	$ -	$ 870,833.33	$ 870,833.33	$ 386,660.41	$ 610,784.98
13	2035	$ -	$ 870,833.33	$ 870,833.33	$ 361,364.87	$ 592,995.13
14	2036	$ -	$ 870,833.33	$ 870,833.33	$ 337,724.18	$ 575,723.42
15	2037	$ -	$ 870,833.33	$ 870,833.33	$ 315,630.08	$ 558,954.78
16	2038	$ -	$ 870,833.33	$ 870,833.33	$ 294,981.38	$ 542,674.54
17	2039	$ -	$ 870,833.33	$ 870,833.33	$ 275,683.53	$ 526,868.49
18	2040	$ -	$ 870,833.33	$ 870,833.33	$ 257,648.16	$ 511,522.80
19	2041	$ -	$ 870,833.33	$ 870,833.33	$ 240,792.67	$ 496,624.08
20	2042	$ -	$ 870,833.33	$ 870,833.33	$ 225,039.88	$ 482,159.30
21	2043	$ -	$ 870,833.33	$ 870,833.33	$ 210,317.65	$ 468,115.83
22	2044	$ -	$ 870,833.33	$ 870,833.33	$ 196,558.55	$ 454,481.39
23	2045	$ -	$ 870,833.33	$ 870,833.33	$ 183,699.58	$ 441,244.06
24	2046	$ -	$ 870,833.33	$ 870,833.33	$ 171,681.85	$ 428,392.30
25	2047	$ -	$ 870,833.33	$ 870,833.33	$ 160,450.33	$ 415,914.85
26	2048	$ -	$ 870,833.33	$ 870,833.33	$ 149,953.58	$ 403,800.83
27	2049	$ -	$ 870,833.33	$ 870,833.33	$ 140,143.53	$ 392,039.64
28	2050	$ -	$ 870,833.33	$ 870,833.33	$ 130,975.26	$ 380,621.01
29	2051	$ -	$ 870,833.33	$ 870,833.33	$ 122,406.79	$ 369,534.96
30	2052	$ -	$ 870,833.33	$ 870,833.33	$ 114,398.86	$ 358,771.80
31	2053	$ -	$ 870,833.33	$ 870,833.33	$ 106,914.83	$ 348,322.14
32	2054	$ -	$ 870,833.33	$ 870,833.33	$ 99,920.40	$ 338,176.83
33	2055	$ -	$ 870,833.33	$ 870,833.33	$ 93,383.55	$ 328,327.02
34	2056	$ -	$ 870,833.33	$ 870,833.33	$ 87,274.35	$ 318,764.10
35	2057	$ -	$ 870,833.33	$ 870,833.33	$ 81,564.81	$ 309,479.71
36	2058	$ -	$ 870,833.33	$ 870,833.33	$ 76,228.79	$ 300,465.74
Present Value Costs		**$ 91,000,000.00**	**$ 26,125,000.00**	**$ 117,125,000.00**	**$ 78,517,069.21**	**$ 96,046,330.51**

Project Benefit-Cost Analysis (BCA) Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Component 2 of this project , the Quonset Connector Ramps, will generate considerable safety, emissions, and time travel savings, which more than offset the cost of construction, work zone impacts, and long-term maintenance costs. The project's costs and benefits are summarized here, and reported in more detail in the "Project B&C Backup by Year" tab, which aggregates the annual benefits and costs from each area of this Benefit-Cost Analysis.

Component 2 of this project has a **favorable benefit-cost ratio of 2.21 and a net present value (NPV) of $42,951,542.69,** indicating that **Component 2 of the Completing the I-95 Missing Moves and Quonset Connector Ramps project is a worthwhile and cost-effective investment.**

Table ES-1.1 summarizes the project's costs and benefits.
Table ES-1.2 shows the calculation of the project's benefits by year, discounted at both the primary (7%) and alternative (3%) discount rates.
Table ES-1.3 summarizes the project's costs by year, discounted at both the primary (7%) and alternative (3%) discount rates.

Table ES-1.1 Summary of Project Costs and Benefits

Item	Value
Project Benefits Evaluation Period	30
Primary Discount Rate:	7%
Alternative Discount Rate:	3%
Present Value Benefit (7%):	$ 78,594,801.56
Present Value Cost (7%):	$ 35,643,258.87
Project Benefit-Cost Ratio (7%):	**2.21**
Net Present Value (NPV) (7%)	$ 42,951,542.69
Alternative B-C Ratio (3%)	3.61
Alternative NPV (3%)	$ 110,291,314.75

Table ES-1.2 Project Benefits by Year

Year#	Year	Present Value (PV) Project Benefits	Project Benefits at 7% Discount Rate*	Project Benefits at 3% Discount Rate
1	2022	$ -	$ -	$ -
2	2023	$ -	$ -	$ -
3	2024	$ (43,177.42)	$ (35,245.64)	$ (39,513.46)
4	2025	$ (172,709.68)	$ (131,759.39)	$ (153,450.32)
5	2026	$ (172,709.68)	$ (123,139.62)	$ (148,980.89)
6	2027	$ 8,586,558.55	$ 5,721,897.15	$ 7,191,107.60
7	2028	$ 8,682,900.96	$ 5,407,569.32	$ 7,059,993.07
8	2029	$ 8,779,263.71	$ 5,109,875.84	$ 6,930,431.85
9	2030	$ 8,789,242.77	$ 4,780,989.55	$ 6,736,222.72
10	2031	$ 8,798,382.54	$ 4,472,818.31	$ 6,546,822.91
11	2032	$ 8,807,411.21	$ 4,184,411.25	$ 6,362,661.25
12	2033	$ 8,816,439.87	$ 3,914,575.91	$ 6,183,673.54
13	2034	$ 8,825,468.54	$ 3,662,116.90	$ 6,009,714.63
14	2035	$ 8,834,497.20	$ 3,425,915.75	$ 5,840,643.40
15	2036	$ 8,843,525.86	$ 3,204,925.99	$ 5,676,322.73
16	2037	$ 8,852,554.53	$ 2,998,168.47	$ 5,516,619.31
17	2038	$ 8,861,583.19	$ 2,804,727.06	$ 5,361,403.57
18	2039	$ 8,870,611.85	$ 2,623,744.60	$ 5,210,549.57
19	2040	$ 8,879,640.52	$ 2,454,419.09	$ 5,063,934.91
20	2041	$ 8,888,669.18	$ 2,296,000.13	$ 4,921,440.61
21	2042	$ 8,897,697.85	$ 2,147,785.64	$ 4,782,951.03
22	2043	$ 8,906,726.51	$ 2,009,118.70	$ 4,648,353.77
23	2044	$ 8,915,755.17	$ 1,879,384.69	$ 4,517,539.58
24	2045	$ 8,924,783.84	$ 1,758,008.53	$ 4,390,402.26
25	2046	$ 8,933,812.50	$ 1,644,452.16	$ 4,266,838.60
26	2047	$ 8,942,841.16	$ 1,538,212.16	$ 4,146,748.30
27	2048	$ 8,951,869.83	$ 1,438,817.50	$ 4,030,033.82
28	2049	$ 8,960,898.49	$ 1,345,827.47	$ 3,916,600.42
29	2050	$ 8,969,927.15	$ 1,258,829.73	$ 3,806,355.96
30	2051	$ 8,978,955.82	$ 1,177,438.47	$ 3,699,210.91
31	2052	$ 8,987,984.48	$ 1,101,292.72	$ 3,595,078.25
32	2053	$ 8,997,013.15	$ 1,030,054.75	$ 3,493,873.40
33	2054	$ 9,006,041.81	$ 963,408.55	$ 3,395,514.14
34	2055	$ 9,015,070.47	$ 901,058.48	$ 3,299,920.57
35	2056	$ 9,014,250.62	$ 841,805.46	$ 3,203,515.01
36	2057	$ 9,023,279.28	$ 787,295.89	$ 3,113,323.93
Total		**$ 275,155,061.83**	**$ 78,594,801.56**	**$ 152,575,856.97**

Table ES-1.3 Project Costs by Year

Present Value (PV) Project Costs	Project Costs at 7% Discount Rate	Project Costs at 3% Discount Rate
$ 480,000.00	$ 448,598.13	$ 466,019.42
$ 2,190,000.00	$ 1,912,830.81	$ 2,064,285.04
$ 19,900,000.00	$ 16,244,327.75	$ 18,211,319.02
$ 10,900,000.00	$ 8,315,557.81	$ 9,684,508.82
$ 5,125,000.00	$ 3,654,054.17	$ 4,420,870.02
$ 5,405,000.00	$ 3,601,579.72	$ 4,526,602.41
$ 177,333.33	$ 110,434.29	$ 144,188.23
$ 177,333.33	$ 103,209.61	$ 139,988.57
$ 177,333.33	$ 96,457.58	$ 135,911.23
$ 177,333.33	$ 90,147.27	$ 131,952.65
$ 177,333.33	$ 84,249.79	$ 128,109.37
$ 177,333.33	$ 78,738.12	$ 124,378.03
$ 177,333.33	$ 73,587.03	$ 120,755.37
$ 177,333.33	$ 68,772.92	$ 117,238.22
$ 177,333.33	$ 64,273.76	$ 113,823.52
$ 177,333.33	$ 60,068.94	$ 110,508.27
$ 177,333.33	$ 56,139.19	$ 107,289.58
$ 177,333.33	$ 52,466.53	$ 104,164.64
$ 177,333.33	$ 49,034.14	$ 101,130.72
$ 177,333.33	$ 45,826.30	$ 98,185.17
$ 177,333.33	$ 42,828.32	$ 95,325.40
$ 177,333.33	$ 40,026.47	$ 92,548.94
$ 177,333.33	$ 37,407.91	$ 89,853.34
$ 177,333.33	$ 34,960.67	$ 87,236.25
$ 177,333.33	$ 32,673.52	$ 84,695.39
$ 177,333.33	$ 30,536.00	$ 82,228.53
$ 177,333.33	$ 28,538.32	$ 79,833.53
$ 177,333.33	$ 26,671.33	$ 77,508.28
$ 177,333.33	$ 24,926.47	$ 75,250.75
$ 177,333.33	$ 23,295.77	$ 73,058.99
$ 177,333.33	$ 21,771.75	$ 70,931.05
$ 177,333.33	$ 20,347.43	$ 68,865.10
$ 177,333.33	$ 19,016.29	$ 66,859.32
$ 177,333.33	$ 17,772.23	$ 64,911.96
$ 177,333.33	$ 16,609.56	$ 63,021.32
$ 177,333.33	$ 15,522.95	$ 61,185.75
$ 49,320,000.00	**$ 35,643,258.87**	**$ 42,284,542.22**

Project Benefit-Cost Analysis (BCA) Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

This tab provides a summary of project costs and benefits by year.

Table ES-2.1 shows all project benefits by year.

Table ES-2.2 shows all project costs by year.

All estimates of project benefits and costs are derived from calculations presented in tabs 1 through 12. All methodological assumptions and data sources are provided on the relevant sheets.

Table ES-2.1 Project Benefits by Year

Year #	Year	Safety Benefits	Emissions Benefits, NOT Including CO_2	Emissions Benefits, CO_2 Only	Travel Time Savings Benefits	Foregone Cost Savings	Work Zone Disbenefits	TOTAL BENEFITS	TOTAL BENEFITS at 7% Discount Rate (CO_2 Discounted at 3% per NOFO)	TOTAL BENEFITS at 3% Discount Rate
1	2023							$ -	$ -	$ -
2	2024						$ -	$ -	$ -	$ -
3	2025						$ (43,177.42)	$ (43,177.42)	$ (35,245.64)	$ (39,513.46)
4	2026						$ (172,709.68)	$ (172,709.68)	$ (131,759.39)	$ (153,450.32)
5	2027						$ (172,709.68)	$ (172,709.68)	$ (123,139.62)	$ (148,980.89)
6	2028	$ 127,043.80	$ 50,006.12	$ 1,815.08	$ 8,580,403.22		$ (172,709.68)	$ 8,586,558.55	$ 5,721,897.15	$ 7,191,107.60
7	2029	$ 127,043.80	$ 50,410.49	$ 1,549.77	$ 8,590,251.74	$ -	$ (86,354.84)	$ 8,682,900.96	$ 5,407,569.32	$ 7,059,993.07
8	2030	$ 127,043.80	$ 50,844.72	$ 1,274.94	$ 8,600,100.26	$ -	$ -	$ 8,779,263.71	$ 5,109,875.84	$ 6,930,431.85
9	2031	$ 127,043.80	$ 51,244.12	$ 1,006.07	$ 8,609,948.78	$ -	$ -	$ 8,789,242.77	$ 4,780,989.55	$ 6,736,222.72
10	2032	$ 127,043.80	$ 50,834.00	$ 707.44	$ 8,619,797.30	$ -	$ -	$ 8,798,382.54	$ 4,472,818.31	$ 6,546,822.91
11	2033	$ 127,043.80	$ 50,423.88	$ 297.71	$ 8,629,645.82	$ -	$ -	$ 8,807,411.21	$ 4,184,411.25	$ 6,362,661.25
12	2034	$ 127,043.80	$ 50,013.76	$ (112.03)	$ 8,639,494.33	$ -	$ -	$ 8,816,439.87	$ 3,914,575.91	$ 6,183,673.54
13	2035	$ 127,043.80	$ 49,603.65	$ (521.76)	$ 8,649,342.85	$ -	$ -	$ 8,825,468.54	$ 3,662,116.90	$ 6,009,714.63
14	2036	$ 127,043.80	$ 49,193.53	$ (931.50)	$ 8,659,191.37	$ -	$ -	$ 8,834,497.20	$ 3,425,915.75	$ 5,840,643.40
15	2037	$ 127,043.80	$ 48,783.41	$ (1,341.23)	$ 8,669,039.89	$ -	$ -	$ 8,843,525.86	$ 3,204,925.99	$ 5,676,322.73
16	2038	$ 127,043.80	$ 48,373.29	$ (1,750.97)	$ 8,678,888.41	$ -	$ -	$ 8,852,554.53	$ 2,998,168.47	$ 5,516,619.31
17	2039	$ 127,043.80	$ 47,963.17	$ (2,160.70)	$ 8,688,736.93	$ -	$ -	$ 8,861,583.19	$ 2,804,727.06	$ 5,361,403.57
18	2040	$ 127,043.80	$ 47,553.05	$ (2,570.44)	$ 8,698,585.45	$ -	$ -	$ 8,870,611.85	$ 2,623,744.60	$ 5,210,549.57
19	2041	$ 127,043.80	$ 47,142.93	$ (2,980.17)	$ 8,708,433.96	$ -	$ -	$ 8,879,640.52	$ 2,454,419.09	$ 5,063,934.91
20	2042	$ 127,043.80	$ 46,732.81	$ (3,389.91)	$ 8,718,282.48	$ -	$ -	$ 8,888,669.18	$ 2,296,000.13	$ 4,921,440.61
21	2043	$ 127,043.80	$ 46,322.69	$ (3,799.64)	$ 8,728,131.00	$ -	$ -	$ 8,897,697.85	$ 2,147,785.64	$ 4,782,951.03
22	2044	$ 127,043.80	$ 45,912.57	$ (4,209.38)	$ 8,737,979.52	$ -	$ -	$ 8,906,726.51	$ 2,009,118.70	$ 4,648,353.77
23	2045	$ 127,043.80	$ 45,502.45	$ (4,619.12)	$ 8,747,828.04	$ -	$ -	$ 8,915,755.17	$ 1,879,384.69	$ 4,517,539.58
24	2046	$ 127,043.80	$ 45,092.33	$ (5,028.85)	$ 8,757,676.56	$ -	$ -	$ 8,924,783.84	$ 1,758,008.53	$ 4,390,402.26
25	2047	$ 127,043.80	$ 44,682.21	$ (5,438.59)	$ 8,767,525.08	$ -	$ -	$ 8,933,812.50	$ 1,644,452.16	$ 4,266,838.60
26	2048	$ 127,043.80	$ 44,272.09	$ (5,848.32)	$ 8,777,373.59	$ -	$ -	$ 8,942,841.16	$ 1,538,212.16	$ 4,146,748.30
27	2049	$ 127,043.80	$ 43,861.97	$ (6,258.06)	$ 8,787,222.11	$ -	$ -	$ 8,951,869.83	$ 1,438,817.50	$ 4,030,033.82
28	2050	$ 127,043.80	$ 43,451.85	$ (6,667.79)	$ 8,797,070.63	$ -	$ -	$ 8,960,898.49	$ 1,345,827.47	$ 3,916,600.42
29	2051	$ 127,043.80	$ 43,041.73	$ (7,077.53)	$ 8,806,919.15	$ -	$ -	$ 8,969,927.15	$ 1,258,829.73	$ 3,806,355.96
30	2052	$ 127,043.80	$ 42,631.61	$ (7,487.26)	$ 8,816,767.67	$ -	$ -	$ 8,978,955.82	$ 1,177,438.47	$ 3,699,210.91
31	2053	$ 127,043.80	$ 42,221.49	$ (7,897.00)	$ 8,826,616.19	$ -	$ -	$ 8,987,984.48	$ 1,101,292.72	$ 3,595,078.25
32	2054	$ 127,043.80	$ 41,811.37	$ (8,306.73)	$ 8,836,464.71	$ -	$ -	$ 8,997,013.15	$ 1,030,054.75	$ 3,493,873.40
33	2055	$ 127,043.80	$ 41,401.25	$ (8,716.47)	$ 8,846,313.22	$ -	$ -	$ 9,006,041.81	$ 963,408.55	$ 3,395,514.14
34	2056	$ 127,043.80	$ 40,991.13	$ (9,126.20)	$ 8,856,161.74	$ -	$ -	$ 9,015,070.47	$ 901,058.48	$ 3,299,920.57
35	2057	$ 127,043.80	$ 40,581.01	$ (9,535.94)	$ 8,856,161.74	$ -	$ -	$ 9,014,250.62	$ 841,805.46	$ 3,203,515.01
36	2058	$ 127,043.80	$ 40,170.89	$ (9,945.67)	$ 8,866,010.26	$ -	$ -	$ 9,023,279.28	$ 787,295.89	$ 3,113,323.93
Present Value Benefits		**$ 3,938,357.80**	**$ 1,431,071.59**	**$ (119,070.25)**	**$ 270,552,364.00**	**$ -**	**$ (647,661.31)**	**$ 275,155,061.83**	**$ 78,594,801.56**	**$ 152,575,856.97**

Project Benefit-Cost Analysis (BCA) Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 2, The Quonset Connector Ramps**

Date: **August 21, 2023**

Table ES-2.2 Project Costs by Year

Year #	Year	Future Eligible Project Costs	Lifecycle Management Costs	TOTAL COSTS	TOTAL COSTS at 7% Discount Rate	TOTAL COSTS at 3% Discount Rate
1	2023	$ 480,000.00		$ 480,000.00	$ 448,598.13	$ 466,019.42
2	2024	$ 2,190,000.00		$ 2,190,000.00	$ 1,912,830.81	$ 2,064,285.04
3	2025	$ 19,900,000.00		$ 19,900,000.00	$ 16,244,327.75	$ 18,211,319.02
4	2026	$ 10,900,000.00		$ 10,900,000.00	$ 8,315,557.81	$ 9,684,508.82
5	2027	$ 5,125,000.00		$ 5,125,000.00	$ 3,654,054.17	$ 4,420,870.02
6	2028	$ 5,405,000.00		$ 5,405,000.00	$ 3,601,579.72	$ 4,526,602.41
7	2029	$ -	$ 177,333.33	$ 177,333.33	$ 110,434.29	$ 144,188.23
8	2030	$ -	$ 177,333.33	$ 177,333.33	$ 103,209.61	$ 139,988.57
9	2031	$ -	$ 177,333.33	$ 177,333.33	$ 96,457.58	$ 135,911.23
10	2032	$ -	$ 177,333.33	$ 177,333.33	$ 90,147.27	$ 131,952.65
11	2033	$ -	$ 177,333.33	$ 177,333.33	$ 84,249.79	$ 128,109.37
12	2034	$ -	$ 177,333.33	$ 177,333.33	$ 78,738.12	$ 124,378.03
13	2035	$ -	$ 177,333.33	$ 177,333.33	$ 73,587.03	$ 120,755.37
14	2036	$ -	$ 177,333.33	$ 177,333.33	$ 68,772.92	$ 117,238.22
15	2037	$ -	$ 177,333.33	$ 177,333.33	$ 64,273.76	$ 113,823.52
16	2038	$ -	$ 177,333.33	$ 177,333.33	$ 60,068.94	$ 110,508.27
17	2039	$ -	$ 177,333.33	$ 177,333.33	$ 56,139.19	$ 107,289.58
18	2040	$ -	$ 177,333.33	$ 177,333.33	$ 52,466.53	$ 104,164.64
19	2041	$ -	$ 177,333.33	$ 177,333.33	$ 49,034.14	$ 101,130.72
20	2042	$ -	$ 177,333.33	$ 177,333.33	$ 45,826.30	$ 98,185.17
21	2043	$ -	$ 177,333.33	$ 177,333.33	$ 42,828.32	$ 95,325.40
22	2044	$ -	$ 177,333.33	$ 177,333.33	$ 40,026.47	$ 92,548.94
23	2045	$ -	$ 177,333.33	$ 177,333.33	$ 37,407.91	$ 89,853.34
24	2046	$ -	$ 177,333.33	$ 177,333.33	$ 34,960.67	$ 87,236.25
25	2047	$ -	$ 177,333.33	$ 177,333.33	$ 32,673.52	$ 84,695.39
26	2048	$ -	$ 177,333.33	$ 177,333.33	$ 30,536.00	$ 82,228.53
27	2049	$ -	$ 177,333.33	$ 177,333.33	$ 28,538.32	$ 79,833.53
28	2050	$ -	$ 177,333.33	$ 177,333.33	$ 26,671.33	$ 77,508.28
29	2051	$ -	$ 177,333.33	$ 177,333.33	$ 24,926.47	$ 75,250.75
30	2052	$ -	$ 177,333.33	$ 177,333.33	$ 23,295.77	$ 73,058.99
31	2053	$ -	$ 177,333.33	$ 177,333.33	$ 21,771.75	$ 70,931.05
32	2054	$ -	$ 177,333.33	$ 177,333.33	$ 20,347.43	$ 68,865.10
33	2055	$ -	$ 177,333.33	$ 177,333.33	$ 19,016.29	$ 66,859.32
34	2056	$ -	$ 177,333.33	$ 177,333.33	$ 17,772.23	$ 64,911.96
35	2057	$ -	$ 177,333.33	$ 177,333.33	$ 16,609.56	$ 63,021.32
36	2058	$ -	$ 177,333.33	$ 177,333.33	$ 15,522.95	$ 61,185.75
Present Value Costs		**$ 44,000,000.00**	**$ 5,320,000.00**	**$ 49,320,000.00**	**$ 35,643,258.87**	**$ 42,284,542.22**

1. Safety Benefits Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

This review also considers the safety impacts associated with constructing new ramps to expand connectivity between I-95 and Route 4. This change to the roadway network is not well represented by data in the Crash Modification Factor (CMF) Clearinghouse. For safety improvements on newly constructed assets, surrogates for crash modification factors were derived from a comparison of predictive analyses between no-build and preferred action scenarios and a local and national research review.

When evaluating countermeasures crash modification factors (CMF) clearinghouse are used to determine the percentage decrease in crashes with the proposed improvements. CMF descriptions can be reviewed at cmfclearinghouse.org. When CMFs are not available for certain countermeasures, local and national research is reviewed and applied. This project is designed to reduce run-off-the-road crashes along horizontal curves by installing high-friction pavement on the Route 4 NB to I-95 NB curve. The assumed CMF for this improvement is CMF #10318, and CMF #10319.

For both analyses, crash data were collected for the study area between January 1, 2016 and December 31, 2022. From the U.S. Department of Transportation's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs", the monetized value for the value of injuries were obtained to determine a monetary benefit.

Safety impacts are summarized in the tables below. New ramp connections create some new merge, diverge, and weave areas on Route 4 and I-95. Given the high volume of vehicles traveling on Route 4 and I-95 the number of vehicles exposed to this change is high and not offset by the proportionally smaller number of vehicles benefiting from the new routing. Separate of the new ramp construction, the high friction surface treatment (pavement) on the Route 4 to I-95 curve provides a clear benefit for reducing run-off-the-road crashes. These benefits do not outweigh the risk associated with improved freeway connectivity.

After considering both safety challenges and opportunities, the net change in crashes is approximately 18 additional crashes per year with a, estimated annual safety benefit averaging $0.6 million per year. While there is a small increase in crashes they are property damage only, low severity. The potential severe crash reductions outweight the low severity crash increases.

Despite crashes increasing there is still a measurable benefit because the severity of crashes is lower, the crashes that are projected are low severity injuries and property damage crashes. This can be attributed to lower speeds on the freeway in the vicinity of new, additional connections. This is also attributable to the high-friction surface treatment which addresses approximately 50% of all run-off-the-road crashes in that segment. While the goal is always to reduce crashes, reducing the most serious crashes (fatal and serious injury) provide an important benefit to society. This is consistent with the FHWA Safe System Approach which recognizes that every crash will not be preventable and a focus should be placed on severity.

The assumptions, methodology, a description of the baseline scenario, source of data, and key input parameters are documented in Tab 1B as well as Appendix A-1.

Table 1-1. Safety Issue 1: Missing Move at I-95, Route 2, and Route 4 Interchange
Countermeasure(s): Provide Missing Move Ramps Alt 2E - CMF Estimated using ISATe Build and No-Build Predictions for Design Year 2058, Added HFST for Exit Loop Ramps

Crash Severity	Total Crashes	Number of Crashes per Year	Crash Reduction Factor	Predicted Annual Crash Reduction	Value of Injuries	Annual Savings
O - No Injury	201.00	201.00	(0.09)	(18.09)	$ 4,000.00	$ (72,360.00)
C - Possible Injury	46.00	46.00	0.00	0.18	$ 78,500.00	$ 14,444.00
B - Non-Incapacitating	4.00	4.00	0.05	0.20	$ 153,700.00	$ 30,740.00
A - Incapacitating	1.00	1.00	0.06	0.06	$ 564,300.00	$ 33,858.00
K - Killed	1.00	1.00	0.05	0.05	$ 11,800,000.00	$ 590,000.00
U - Injured (Severity Unknown)		-		-	$ 213,900.00	$ -
# Accidents Reported (Unknown if Injured)		-		-	$ 162,600.00	$ -
Injury Crash		-		-	$ 307,800.00	$ -
Fatal Crash		-		-	$ 13,046,800.00	$ -
Total	**253.00**	**253.00**	**0.01**	**-17.60**		**$ 596,682.00**

1. Safety Benefits Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Table 1-2. Safety Issue 2:
Countermeasure(s):

Crash Severity	Total Crashes	Number of Crashes per Year	Crash Reduction Factor	Predicted Annual Crash Reduction	Value of Injuries	Annual Savings
O - No Injury		-		-	$ 4,000.00	$ -
C - Possible Injury		-		-	$ 78,500.00	$ -
B - Non-Incapacitating		-		-	$ 153,700.00	$ -
A - Incapacitating		-		-	$ 564,300.00	$ -
K - Killed		-		-	$ 11,800,000.00	$ -
U - Injured (Severity Unknown)		-		-	$ 213,900.00	$ -
# Accidents Reported (Unknown if Injured)		-		-	$ 162,600.00	$ -
Injury Crash		-		-	$ 307,800.00	$ -
Fatal Crash		-		-	$ 13,046,800.00	$ -
Total	**0.00**	**0.00**	**#DIV/0!**	**0.00**		**$ -**

Table 1-3. Safety Issue 3:
Countermeasure(s):

Crash Severity	Total Crashes	Number of Crashes per Year	Crash Reduction Factor	Predicted Annual Crash Reduction	Value of Injuries	Annual Savings
O - No Injury		-		-	$ 4,000.00	$ -
C - Possible Injury		-		-	$ 78,500.00	$ -
B - Non-Incapacitating		-		-	$ 153,700.00	$ -
A - Incapacitating		-		-	$ 564,300.00	$ -
K - Killed		-		-	$ 11,800,000.00	$ -
U - Injured (Severity Unknown)		-		-	$ 213,900.00	$ -
# Accidents Reported (Unknown if Injured)		-		-	$ 162,600.00	$ -
Injury Crash		-		-	$ 307,800.00	$ -
Fatal Crash		-		-	$ 13,046,800.00	$ -
Total	**0.00**	**0.00**	**#DIV/0!**	**0.00**		**$ -**

Table 1-5. Safety Benefits Summary

Crash Severity	Total Crashes	Number of Crashes per Year	Crash Reduction Factor	Predicted Annual Crash Reduction	Value of Injuries	Annual Savings	30-Year Total
N/A	253.00	253.00	#DIV/0!	(17.60)	-	$ 596,682.00	18,497,142.00

$ 17,900,460.00

1B. Safety Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Assumptions	The analysis assumes that crashes experienced over the 5 year period are consistent throughout the 30 year planning horizon.
Methodology	The analysis used the Highway Safety Manual (HSM) Part C methodology to estimate the potential change in safety performance. A no-build prediction was built using ISATe and other relevant HSM Spreadsheets using proposed traffic volumes with the development in 2058. A build prediction was also made for the 2058 volumes, then the two were compared to estimate a safety performance function (SPF). These were applied to an "existing" crash frequency, which was based on crash frequency at the site for 2016 through 2022 then grown to 2058 using the ratio between the no-build 2028 prediction and 2058 no-build prediction.
Baseline	The Existing Conditions model represents crashes between 2016 and 2022.
Sources of Data	RIDOT Crash Data 2016-2022; FHWA CMF Clearinghouse
Key Input Parameters	The model required crash frequency and severity derived from the RIDOT crash reports as well as Crash Modification Factors (form the FHWA Crash Modification Factor Clearinghouse) determined to be most appropriate to existing conditions.

Table 1B-1. Safety Benefits by Year

Year	Traffic Count	Estimated Total Crashes, No Build Scenario (Crashes/Yr)	Estimated Total Crashes, Preferred Action Scenario	Predicted Crash Reduction, Preferred Action Scenario (Crashes/Yr)	Realized Safety Benefit ($/Year)
2023	217,868.67	253.00	270.60	(17.60)	$ -
2024	218,843.00	253.00	270.60	(17.60)	$ -
2025	219,817.33	253.00	270.60	(17.60)	$ -
2026	220,791.67	253.00	270.60	(17.60)	$ -
2027	221,766.00	253.00	270.60	(17.60)	$ -
2028	222,740.33	253.00	270.60	(17.60)	$ 596,682.00
2029	223,714.67	253.00	270.60	(17.60)	$ 596,682.00
2030	224,689.00	253.00	270.60	(17.60)	$ 596,682.00
2031	225,663.33	253.00	270.60	(17.60)	$ 596,682.00
2032	226,637.67	253.00	270.60	(17.60)	$ 596,682.00
2033	227,612.00	253.00	270.60	(17.60)	$ 596,682.00
2034	228,586.33	253.00	270.60	(17.60)	$ 596,682.00
2035	229,560.67	253.00	270.60	(17.60)	$ 596,682.00
2036	230,535.00	253.00	270.60	(17.60)	$ 596,682.00
2037	231,509.33	253.00	270.60	(17.60)	$ 596,682.00
2038	232,483.67	253.00	270.60	(17.60)	$ 596,682.00
2039	233,458.00	253.00	270.60	(17.60)	$ 596,682.00
2040	234,432.33	253.00	270.60	(17.60)	$ 596,682.00
2041	235,406.67	253.00	270.60	(17.60)	$ 596,682.00
2042	236,381.00	253.00	270.60	(17.60)	$ 596,682.00
2043	237,355.33	253.00	270.60	(17.60)	$ 596,682.00
2044	238,329.67	253.00	270.60	(17.60)	$ 596,682.00
2045	239,304.00	253.00	270.60	(17.60)	$ 596,682.00
2046	240,278.33	253.00	270.60	(17.60)	$ 596,682.00
2047	241,252.67	253.00	270.60	(17.60)	$ 596,682.00
2048	242,227.00	253.00	270.60	(17.60)	$ 596,682.00
2049	243,201.33	253.00	270.60	(17.60)	$ 596,682.00
2050	244,175.67	253.00	270.60	(17.60)	$ 596,682.00
2051	245,150.00	253.00	270.60	(17.60)	$ 596,682.00
2052	246,124.33	253.00	270.60	(17.60)	$ 596,682.00
2053	247,098.67	253.00	270.60	(17.60)	$ 596,682.00
2054	248,073.00	253.00	270.60	(17.60)	$ 596,682.00
2055	249,047.33	253.00	270.60	(17.60)	$ 596,682.00
2056	250,021.67	253.00	270.60	(17.60)	$ 596,682.00
2057	250,996.00	253.00	270.60	(17.60)	$ 596,682.00
2058	251,970.33	253.00	270.60	(17.60)	$ 596,682.00
	8,457,102	**9,108**	**9,741.46 $**	**(633.46)**	**$ 18,497,142.00**

1. Safety Benefits Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

This review considers the safety impacts associated with constructing 3 new ramps along Route 403. This change to the roadway network is not well represented by data in the Crash Modification Factor (CMF) Clearinghouse. When CMFs are not available for certain countermeasures, local and national research is reviewed and applied. Crash data was collected for the study area between January 1, 2016 and December 31, 2022. For safety improvements on newly constructed assets, surrogates for crash modification factors were derived from a comparison of predictive analyses between no-build and preferred action scenarios. From the U.S. Department of Transportation's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs," the monetized value for the value of injuries were obtained to determine a monetary benefit.

Safety impacts are summarized in the tables below. New ramp connections create some new merge, diverge, and weave areas on Route 403. Additionally, a higher volume of vehicles in a future condition (after significant development) increases exposure. These drawbacks are offset, however, by more efficient access and egress to/from the freeway which elminiates many conflict points (intersections) from the vehicle route.

After considering both safety challenges and opportunities, the net benefit is a crash savings of approximately 30 crashes per year with a total estimated annual safety benefit attributable to this project is expected to average **$0.1 million per year.**

The assumptions, methodology, a description of the baseline scenario, source of data, and key input parameters are documented in Tab 1B as well as in Appendix A-1

Table 1-1. Safety Issue 1: Missing Ramps in Route 403 Interchange Areas
Countermeasure(s): Provide Missing Ramps - CMF Derived from comparison of predictive analyses for no-build, build in 2058 with proposed development

Crash Severity	Total Crashes	Number of Crashes per Year	Crash Reduction Factor	Predicted Annual Crash Reduction	Value of Injuries	Annual Savings
O - No Injury	23.50	23.50	0.11	2.59	$ 4,000.00	$ 10,340.00
C - Possible Injury	4.70	4.70	0.09	0.42	$ 78,500.00	$ 33,205.50
B - Non-Incapacitating	1.40	1.40	(0.09)	(0.13)	$ 153,700.00	$ (19,366.20)
A - Incapacitating	0.30	0.30	0.05	0.02	$ 564,300.00	$ 8,464.50
K - Killed	0.20	0.20	0.04	0.01	$ 11,800,000.00	$ 94,400.00
U - Injured (Severity Unknown)		-		-	$ 213,900.00	$ -
# Accidents Reported (Unknown if Injured)		-		-	$ 162,600.00	$ -
Injury Crash		-		-	$ 307,800.00	$ -
Fatal Crash		-		-	$ 13,046,800.00	$ -
Total	**30.10**	**30.10**	**0.04**	**2.91**		**$ 127,043.80**

1. Safety Benefits Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Table 1-2. Safety Issue 2:
Countermeasure(s):

Crash Severity	Total Crashes	Number of Crashes per Year	Crash Reduction Factor	Predicted Annual Crash Reduction	Value of Injuries	Annual Savings
O - No Injury		-		-	$ 4,000.00	$ -
C - Possible Injury		-		-	$ 78,500.00	$ -
B - Non-Incapacitating		-		-	$ 153,700.00	$ -
A - Incapacitating		-		-	$ 564,300.00	$ -
K - Killed		-		-	$ 11,800,000.00	$ -
U - Injured (Severity Unknown)		-		-	$ 213,900.00	$ -
# Accidents Reported (Unknown if Injured)		-		-	$ 162,600.00	$ -
Injury Crash		-		-	$ 307,800.00	$ -
Fatal Crash		-		-	$ 13,046,800.00	$ -
Total	**0.00**	**0.00**	**#DIV/0!**	**0.00**		**$ -**

Table 1-3. Safety Issue 3:
Countermeasure(s):

Crash Severity	Total Crashes	Number of Crashes per Year	Crash Reduction Factor	Predicted Annual Crash Reduction	Value of Injuries	Annual Savings
O - No Injury		-		-	$ 4,000.00	$ -
C - Possible Injury		-		-	$ 78,500.00	$ -
B - Non-Incapacitating		-		-	$ 153,700.00	$ -
A - Incapacitating		-		-	$ 564,300.00	$ -
K - Killed		-		-	$ 11,800,000.00	$ -
U - Injured (Severity Unknown)		-		-	$ 213,900.00	$ -
# Accidents Reported (Unknown if Injured)		-		-	$ 162,600.00	$ -
Injury Crash		-		-	$ 307,800.00	$ -
Fatal Crash		-		-	$ 13,046,800.00	$ -
Total	**0.00**	**0.00**	**#DIV/0!**	**0.00**		**$ -**

Table 1-5. Safety Benefits Summary

Crash Severity	Total Crashes	Number of Crashes per Year	Predicted Annual Crash Reduction	Value of Injuries	Annual Savings	30-Year Total
N/A	30.10	30.10	2.91	-	$ 127,043.80	3,938,357.80

1B. Safety Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Assumptions	The analysis assumes that crashes experienced over the 5 year period are consistent throughout the 30 year planning horizon.
Methodology	The analysis used the Highway Safety Manual (HSM) Part C methodology to estimate the potential change in safety performance. A no-build prediction was built using ISATe and other relevant HSM Spreadsheets using proposed traffic volumes with the development in 2058. A build prediction was also made for the 2058 volumes, then the two were compared to estimate a safety performance function (SPF). These were applied to an "existing" crash frequency, which was based on crash frequency at the site for 2016 through 2022 then grown to 2058 using the ratio between the no-build 2028 prediction and 2058 no-build prediction.
Baseline	The Existing Conditions model represents crashes between 2016 and 2022.
Sources of Data	RIDOT Crash Data 2016-2022; FHWA CMF Clearinghouse
Key Input Parameters	The model required crash frequency and severity derived from the RIDOT crash reports as well as Crash Modification Factors (form the FHWA Crash Modification Factor Clearinghouse) determined to be most appropriate to existing conditions.

Table 1B-1. Safety Benefits by Year

Year	Traffic Count	Estimated Total Crashes, No Build Scenario (Crashes/Yr)	Estimated Total Crashes, Preferred Action Scenario	Predicted Crash Reduction, Preferred Action Scenario (Crashes/Yr)	Realized Safety Benefit ($/Year)
2023	67,440.33	30.10	27.20	2.91	$ -
2024	67,888.00	30.10	27.20	2.91	$ -
2025	68,335.67	30.10	27.20	2.91	$ -
2026	68,783.33	30.10	27.20	2.91	$ -
2027	69,231.00	30.10	27.20	2.91	$ -
2028	69,678.67	30.10	27.20	2.91	$ 127,043.80
2029	70,126.33	30.10	27.20	2.91	$ 127,043.80
2030	70,574.00	30.10	27.20	2.91	$ 127,043.80
2031	71,021.67	30.10	27.20	2.91	$ 127,043.80
2032	71,469.33	30.10	27.20	2.91	$ 127,043.80
2033	71,917.00	30.10	27.20	2.91	$ 127,043.80
2034	72,364.67	30.10	27.20	2.91	$ 127,043.80
2035	72,812.33	30.10	27.20	2.91	$ 127,043.80
2036	73,260.00	30.10	27.20	2.91	$ 127,043.80
2037	73,707.67	30.10	27.20	2.91	$ 127,043.80
2038	74,155.33	30.10	27.20	2.91	$ 127,043.80
2039	74,603.00	30.10	27.20	2.91	$ 127,043.80
2040	75,050.67	30.10	27.20	2.91	$ 127,043.80
2041	75,498.33	30.10	27.20	2.91	$ 127,043.80
2042	75,946.00	30.10	27.20	2.91	$ 127,043.80
2043	76,393.67	30.10	27.20	2.91	$ 127,043.80
2044	76,841.33	30.10	27.20	2.91	$ 127,043.80
2045	77,289.00	30.10	27.20	2.91	$ 127,043.80
2046	77,736.67	30.10	27.20	2.91	$ 127,043.80
2047	78,184.33	30.10	27.20	2.91	$ 127,043.80
2048	78,632.00	30.10	27.20	2.91	$ 127,043.80
2049	79,079.67	30.10	27.20	2.91	$ 127,043.80
2050	79,527.33	30.10	27.20	2.91	$ 127,043.80
2051	79,975.00	30.10	27.20	2.91	$ 127,043.80
2052	80,422.67	30.10	27.20	2.91	$ 127,043.80
2053	80,870.33	30.10	27.20	2.91	$ 127,043.80
2054	81,318.00	30.10	27.20	2.91	$ 127,043.80
2055	81,765.67	30.10	27.20	2.91	$ 127,043.80
2056	82,213.33	30.10	27.20	2.91	$ 127,043.80
2057	82,661.00	30.10	27.20	2.91	$ 127,043.80
2058	83,108.67	30.10	27.20	2.91	$ 127,043.80
	2,709,882	**1,084**	**979.02 $**	**104.58**	**$ 3,938,357.80**

2. Emissions Benefits Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

This project will benefit local air quality by improving transportation operations and reducing vehicle delay in the corridor. Improvements in air quality will benefit the area by reducing local pollutant concentrations and regional emissions reductions.
An air quality study of the Project was conducted using traffic data developed with VISSIM to calculate Travel Time Savings. Emission factors for the study area were developed using the Motor Vehicle Emission Simulator model (MOVES3) developed by the US Environmental Protection Agency (EPA). Emissions were analyzed for the first year of operations (2028) and design year (2058) for Baseline and Proposed Action alternatives.
The Preferred Alternative will result in emission costs savings for all years of analysis. Reduced congestion across the network reduces the emissions sufficiently to counteract the expected increase in VMT resulting in an emissions benefit. This project will reduce emissions by a projected **732** tons, a net savings of **$7.7 million** over 30 years.

The assumptions, methodology, a description of the baseline scenario, source of data, and key input parameters are documented in Tab 2B and Appendix A-3.

Table 2-1. Projected Emissions Reduction by Year, Selected Years (Metric Tons/Year)

Year	NO_X	SOx	$PM_{2.5}$	CO_2	PM_{10}	VOC	Total
2028	0.16	0.00	0.02	100.78	0.10	0.06	101.11
2029	0.22	0.00	0.03	142.65	0.19	0.09	143.18
2030	0.28	0.00	0.04	184.51	0.28	0.13	185.24
2031	0.34	0.00	0.05	226.38	0.37	0.17	227.31
2032	0.40	0.00	0.06	268.24	0.46	0.20	269.37
							-
2058	2.01	0.01	0.35	1,356.74	2.81	1.15	1,363.07
Average	**1.08**	**0.00**	**0.18**	**728.76**	**1.45**	**0.60**	**732.09**

Table 2-2. Projected Monetary Benefit from Emissions Reductions by Year, Selected Years

Year	NO_X	SOx	$PM_{2.5}$	CO_2	PM_{10}	VOC	Total
2028	$ 2,785.69	$ 29.70	$ 13,601.14	$ 6,147.80	$ -	$ -	$ 22,564.32
2029	$ 3,959.19	$ 42.71	$ 23,683.69	$ 8,844.22	$ -	$ -	$ 36,529.81
2030	$ 5,197.79	$ 56.24	$ 34,083.50	$ 11,624.37	$ -	$ -	$ 50,961.90
2031	$ 6,451.78	$ 70.23	$ 44,807.32	$ 14,714.63	$ -	$ -	$ 66,043.95
2032	$ 7,621.93	$ 83.21	$ 54,989.40	$ 17,704.10	$ -	$ -	$ 80,398.65
2058	$ 38,045.98	$ 420.74	$ 319,723.45	$ 119,392.86	$ -	$ -	$ 477,583.03
Average	**$ 21,070.85**	**$ 232.42**	**$ 172,039.93**	**$ 61,740.75**	**$ -**	**$ -**	**$ 255,083.95**

Table 2-3. Emissions Benefits Summary

Year	NOX	SOx	PM2.5	CO2	PM10	VOC	30-Year Total
2028-2058	$ 634,911.24	$ 7,002.24	$ 5,174,799.01	$ 1,858,370.21	$ -	$ -	$ 7,675,082.70

2B. Emissions Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Assumptions	The analysis relies on assumption made for the traffic analysis which assumes that traffic patterns remain consistent through this study area, however, traffic volumes will continue to grow at a rate of approximately 0.25% annually over the 30-year planning horizon with additional background trips added to account for the build out of Quonset Business Parkfor this analysis. Quonset Business Park is projected to generate 5,000 jobs upon full buildout, a portion of which will travel through this study area.
Methodology	An air quality study of the Project was conducted using traffic data developed in the transportation analysis. Emission factors for the study area were developed using the Motor Vehicle Emission Simulator model (MOVES3) developed by the US Environmental Protection Agency. Emissions were analyzed for the first five years of operation (2023-2028) and the design year (2058). Analyses were conducted for the No Build and Build alternatives to determine the emissions reduction associated with the Project. The emission factors represent the corresponding year of the traffic modeling. The factors were derived by calculating a seasonal average during the evening peak hour with a representative vehicle mix. Oxides of Nitrogen (NOX), Sulfur Dioxide (SO2), Particulate Matter (PM2.5) and Carbon Dioxide (CO2) were studied based on the latest grant application guidance. Volatile Organic Compounds (VOC) and Particulate Matter 10 (PM10) emissions savings were included for informational purposes, but cost savings were not quantified per the latest grant application guidance. Emissions reductions are scaled linearly by year between the opening and design years.
Baseline	The Existing Conditions model represents a 2028 No Build Mesoscale Air Quality Analysis
Sources of Data	Output from project's VISSIM microsimulation model
Key Input Parameters	Average speed; Vehicle Miles Traveled; Vehicle Hours Traveled

2B. Emissions Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Table 2B-1. Mesoscale Air Quality Analysis - Air Pollutants by Year, No-Build Scenario

Year	NOX	SOx	PM2.5	CO2	PM10	VOC	Total
2023							-
2024							-
2025							-
2026							-
2027							-
2028	46.69	0.56	2.31	89,103.51	8.67	34.72	89,196.46
2029	46.06	0.55	2.32	88,974.78	8.85	34.54	89,067.11
2030	45.43	0.55	2.32	88,846.05	9.04	34.37	88,937.76
2031	44.81	0.55	2.32	88,717.32	9.22	34.20	88,808.41
2032	44.18	0.55	2.32	88,588.58	9.40	34.02	88,679.06
2033	43.55	0.55	2.32	88,459.85	9.58	33.85	88,549.71
2034	42.92	0.55	2.33	88,331.12	9.77	33.68	88,420.36
2035	42.29	0.55	2.33	88,202.39	9.95	33.50	88,291.01
2036	41.66	0.55	2.33	88,073.66	10.13	33.33	88,161.66
2037	41.03	0.55	2.33	87,944.93	10.32	33.15	88,032.31
2038	40.40	0.55	2.33	87,816.20	10.50	32.98	87,902.96
2039	39.78	0.55	2.34	87,687.46	10.68	32.81	87,773.61
2040	39.15	0.54	2.34	87,558.73	10.86	32.63	87,644.26
2041	38.52	0.54	2.34	87,430.00	11.05	32.46	87,514.91
2042	37.89	0.54	2.34	87,301.27	11.23	32.29	87,385.56
2043	37.26	0.54	2.34	87,172.54	11.41	32.11	87,256.21
2044	36.63	0.54	2.34	87,043.81	11.60	31.94	87,126.86
2045	36.00	0.54	2.35	86,915.08	11.78	31.77	86,997.51
2046	35.38	0.54	2.35	86,786.34	11.96	31.59	86,868.16
2047	34.75	0.54	2.35	86,657.61	12.14	31.42	86,738.81
2048	34.12	0.54	2.35	86,528.88	12.33	31.25	86,609.46
2049	33.49	0.54	2.35	86,400.15	12.51	31.07	86,480.11
2050	32.86	0.54	2.36	86,271.42	12.69	30.90	86,350.76
2051	32.23	0.53	2.36	86,142.69	12.88	30.73	86,221.41
2052	31.60	0.53	2.36	86,013.96	13.06	30.55	86,092.06
2053	30.97	0.53	2.36	85,885.22	13.24	30.38	85,962.72
2054	30.35	0.53	2.36	85,756.49	13.42	30.21	85,833.37
2055	29.72	0.53	2.37	85,627.76	13.61	30.03	85,704.02
2056	29.09	0.53	2.37	85,499.03	13.79	29.86	85,574.67
2057	28.46	0.53	2.37	85,370.30	13.97	29.69	85,445.32
2058	27.83	0.53	2.37	85,241.57	14.16	29.51	85,315.97
Total	**1,155.11**	**16.79**	**72.63**	**2,702,348.69**	**353.81**	**995.55**	**2,704,942.57**

2B. Emissions Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 1, The Missing Moves**

Date: **August 21, 2023**

Table 2B-2. Mesoscale Air Quality Analysis - Air Pollutants by Year, Preferred Action Scenario

Year	NOX	SOx	PM2.5	CO2	PM10	VOC	Total
2023							-
2024							-
2025							-
2026							-
2027							-
2028	46.54	0.55	2.30	89,002.73	8.57	34.66	89,095.35
2029	45.85	0.55	2.29	88,832.13	8.67	34.45	88,923.93
2030	45.16	0.55	2.28	88,661.53	8.76	34.24	88,752.52
2031	44.46	0.55	2.27	88,490.94	8.85	34.03	88,581.10
2032	43.77	0.55	2.26	88,320.34	8.94	33.82	88,409.69
2033	43.08	0.55	2.25	88,149.74	9.04	33.61	88,238.27
2034	42.39	0.55	2.24	87,979.15	9.13	33.40	88,066.86
2035	41.70	0.55	2.23	87,808.55	9.22	33.19	87,895.44
2036	41.01	0.55	2.22	87,637.95	9.31	32.98	87,724.03
2037	40.32	0.54	2.21	87,467.36	9.41	32.77	87,552.61
2038	39.63	0.54	2.21	87,296.76	9.50	32.56	87,381.20
2039	38.94	0.54	2.20	87,126.16	9.59	32.35	87,209.78
2040	38.25	0.54	2.19	86,955.57	9.68	32.14	87,038.37
2041	37.56	0.54	2.18	86,784.97	9.78	31.93	86,866.95
2042	36.87	0.54	2.17	86,614.37	9.87	31.72	86,695.54
2043	36.18	0.54	2.16	86,443.78	9.96	31.51	86,524.12
2044	35.49	0.54	2.15	86,273.18	10.05	31.30	86,352.71
2045	34.80	0.53	2.14	86,102.58	10.15	31.09	86,181.29
2046	34.11	0.53	2.13	85,931.99	10.24	30.88	86,009.88
2047	33.41	0.53	2.12	85,761.39	10.33	30.67	85,838.47
2048	32.72	0.53	2.11	85,590.80	10.42	30.46	85,667.05
2049	32.03	0.53	2.10	85,420.20	10.52	30.25	85,495.64
2050	31.34	0.53	2.09	85,249.60	10.61	30.04	85,324.22
2051	30.65	0.53	2.08	85,079.01	10.70	29.83	85,152.81
2052	29.96	0.53	2.08	84,908.41	10.79	29.62	84,981.39
2053	29.27	0.53	2.07	84,737.81	10.89	29.41	84,809.98
2054	28.58	0.52	2.06	84,567.22	10.98	29.20	84,638.56
2055	27.89	0.52	2.05	84,396.62	11.07	29.00	84,467.15
2056	27.20	0.52	2.04	84,226.02	11.16	28.79	84,295.73
2057	26.51	0.52	2.03	84,055.43	11.26	28.58	84,124.32
2058	25.82	0.52	2.02	83,884.83	11.35	28.37	83,952.90
Total	**1,121.49**	**16.65**	**66.92**	**2,679,757.12**	**308.80**	**976.87**	**2,682,247.86**

2B. Emissions Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 1, The Missing Moves**

Date: **August 21, 2023**

Table 2B-3. Mesoscale Air Quality Analysis - Estimated Reduction in Air Pollutants by Year, Preferred Action Scenario

Year	NOX	SOx	PM2.5	CO2	PM10	VOC	Total
2023	-	-	-	-	-	-	-
2024	-	-	-	-	-	-	-
2025	-	-	-	-	-	-	-
2026	-	-	-	-	-	-	-
2027	-	-	-	-	-	-	-
2028	0.16	0.00	0.02	100.78	0.10	0.06	101.11
2029	0.22	0.00	0.03	142.65	0.19	0.09	143.18
2030	0.28	0.00	0.04	184.51	0.28	0.13	185.24
2031	0.34	0.00	0.05	226.38	0.37	0.17	227.31
2032	0.40	0.00	0.06	268.24	0.46	0.20	269.37
2033	0.47	0.00	0.07	310.11	0.55	0.24	311.44
2034	0.53	0.00	0.08	351.97	0.64	0.28	353.50
2035	0.59	0.00	0.09	393.84	0.73	0.31	395.57
2036	0.65	0.00	0.11	435.70	0.82	0.35	437.63
2037	0.71	0.00	0.12	477.57	0.91	0.38	479.70
2038	0.77	0.00	0.13	519.43	1.00	0.42	521.76
2039	0.84	0.00	0.14	561.30	1.09	0.46	563.83
2040	0.90	0.00	0.15	603.16	1.18	0.49	605.89
2041	0.96	0.00	0.16	645.03	1.27	0.53	647.96
2042	1.02	0.00	0.17	686.90	1.36	0.57	690.02
2043	1.08	0.00	0.18	728.76	1.45	0.60	732.09
2044	1.15	0.00	0.20	770.63	1.54	0.64	774.15
2045	1.21	0.00	0.21	812.49	1.63	0.68	816.22
2046	1.27	0.01	0.22	854.36	1.72	0.71	858.28
2047	1.33	0.01	0.23	896.22	1.81	0.75	900.35
2048	1.39	0.01	0.24	938.09	1.90	0.78	942.41
2049	1.46	0.01	0.25	979.95	1.99	0.82	984.48
2050	1.52	0.01	0.26	1,021.82	2.08	0.86	1,026.54
2051	1.58	0.01	0.27	1,063.68	2.17	0.89	1,068.61
2052	1.64	0.01	0.28	1,105.55	2.26	0.93	1,110.67
2053	1.70	0.01	0.30	1,147.41	2.36	0.97	1,152.74
2054	1.77	0.01	0.31	1,189.28	2.45	1.00	1,194.80
2055	1.83	0.01	0.32	1,231.14	2.54	1.04	1,236.87
2056	1.89	0.01	0.33	1,273.01	2.63	1.07	1,278.93
2057	1.95	0.01	0.34	1,314.87	2.72	1.11	1,321.00
2058	2.01	0.01	0.35	1,356.74	2.81	1.15	1,363.07
Total	**33.61**	**0.14**	**5.70**	**22,591.57**	**45.01**	**18.67**	**22,694.71**

2B. Emissions Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 1, The Missing Moves**

Date: **August 21, 2023**

Table 2B-4. Mesoscale Air Quality Analysis - Estimated Reduction in Air Pollutants by Year, Preferred Action Scenario

Year	NOX	SOx	PM2.5	CO2	PM10	VOC	Total
2023	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2024	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2025	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2026	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2027	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2028	$ 2,785.69	$ 29.70	$ 13,601.14	$ 6,147.80	$ -	$ -	$ 22,564.32
2029	$ 3,959.19	$ 42.71	$ 23,683.69	$ 8,844.22	$ -	$ -	$ 36,529.81
2030	$ 5,197.79	$ 56.24	$ 34,083.50	$ 11,624.37	$ -	$ -	$ 50,961.90
2031	$ 6,451.78	$ 70.23	$ 44,807.32	$ 14,714.63	$ -	$ -	$ 66,043.95
2032	$ 7,621.93	$ 83.21	$ 54,989.40	$ 17,704.10	$ -	$ -	$ 80,398.65
2033	$ 8,792.09	$ 96.19	$ 65,171.47	$ 20,777.31	$ -	$ -	$ 94,837.07
2034	$ 9,962.24	$ 109.18	$ 75,353.55	$ 23,934.25	$ -	$ -	$ 109,359.22
2035	$ 11,132.40	$ 122.16	$ 85,535.63	$ 27,174.92	$ -	$ -	$ 123,965.11
2036	$ 12,302.55	$ 135.14	$ 95,717.71	$ 30,499.31	$ -	$ -	$ 138,654.72
2037	$ 13,472.71	$ 148.12	$ 105,899.79	$ 34,385.01	$ -	$ -	$ 153,905.63
2038	$ 14,642.87	$ 161.10	$ 116,081.87	$ 37,918.73	$ -	$ -	$ 168,804.57
2039	$ 15,813.02	$ 174.09	$ 126,263.95	$ 41,536.19	$ -	$ -	$ 183,787.24
2040	$ 16,983.18	$ 187.07	$ 136,446.03	$ 45,237.37	$ -	$ -	$ 198,853.64
2041	$ 18,153.33	$ 200.05	$ 146,628.11	$ 49,022.29	$ -	$ -	$ 214,003.77
2042	$ 19,323.49	$ 213.03	$ 156,810.18	$ 53,577.82	$ -	$ -	$ 229,924.53
2043	$ 20,493.64	$ 226.01	$ 166,992.26	$ 57,572.06	$ -	$ -	$ 245,283.98
2044	$ 21,663.80	$ 238.99	$ 177,174.34	$ 61,650.03	$ -	$ -	$ 260,727.17
2045	$ 22,833.96	$ 251.98	$ 187,356.42	$ 65,811.73	$ -	$ -	$ 276,254.09
2046	$ 24,004.11	$ 264.96	$ 197,538.50	$ 70,057.16	$ -	$ -	$ 291,864.73
2047	$ 25,174.27	$ 277.94	$ 207,720.58	$ 75,282.55	$ -	$ -	$ 308,455.33
2048	$ 26,344.42	$ 290.92	$ 217,902.66	$ 79,737.30	$ -	$ -	$ 324,275.30
2049	$ 27,514.58	$ 303.90	$ 228,084.74	$ 84,275.79	$ -	$ -	$ 340,179.01
2050	$ 28,684.73	$ 316.89	$ 238,266.82	$ 88,898.00	$ -	$ -	$ 356,166.44
2051	$ 29,854.89	$ 329.87	$ 248,448.89	$ 93,603.95	$ -	$ -	$ 372,237.60
2052	$ 31,025.04	$ 342.85	$ 258,630.97	$ 97,288.08	$ -	$ -	$ 387,286.95
2053	$ 32,195.20	$ 355.83	$ 268,813.05	$ 100,972.21	$ -	$ -	$ 402,336.29
2054	$ 33,365.36	$ 368.81	$ 278,995.13	$ 104,656.34	$ -	$ -	$ 417,385.64
2055	$ 34,535.51	$ 381.79	$ 289,177.21	$ 108,340.47	$ -	$ -	$ 432,434.99
2056	$ 35,705.67	$ 394.78	$ 299,359.29	$ 112,024.60	$ -	$ -	$ 447,484.34
2057	$ 36,875.82	$ 407.76	$ 309,541.37	$ 115,708.73	$ -	$ -	$ 462,533.68
2058	$ 38,045.98	$ 420.74	$ 319,723.45	$ 119,392.86	$ -	$ -	$ 477,583.03
Total	**$ 634,911.24**	**$ 7,002.24**	**$ 5,174,799.01**	**$ 1,858,370.21**	**$ -**	**$ -**	**$ 7,675,082.70**

2. Emissions Benefits Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

This project will benefit local air quality by improving transportation operations and reducing vehicle delay in the corridor. Improvements in air quality will benefit the area by reducing local pollutant concentrations and regional emissions reductions.
An air quality study of the Project was conducted using traffic data developed with VISSIM to calculate Travel Time Savings. Emission factors for the study area were developed using the Motor Vehicle Emission Simulator model (MOVES3) developed by the US Environmental Protection Agency (EPA). Emissions were analyzed for the first year of operations (2028) and design year (2058) for Baseline and Proposed Action alternatives.
The Preferred Alternative will result in emission costs savings for all years of analysis. Reduced congestion across the network reduces the emissions sufficiently to counteract the expected increase in VMT resulting in an emissions benefit. This project will reduce generate a net greenhouse gas reduction savings of **$1.3 million** over 30 years.

The assumptions, methodology, a description of the baseline scenario, source of data, and key input parameters are documented in Tab 2B.

Table 2-1. Projected Emissions Reduction by Year, Selected Years (Metric Tons/Year)

Year	NO_X	SOx	$PM_{2.5}$	CO_2	PM_{10}	VOC	Total
2028	0.32	(0.00)	0.05	29.76	0.29	0.08	30.50
2029	0.32	(0.00)	0.05	25.00	0.29	0.08	25.74
2030	0.32	(0.00)	0.05	20.24	0.29	0.08	20.98
2031	0.32	(0.00)	0.05	15.48	0.29	0.07	16.22
2032	0.33	(0.00)	0.05	10.72	0.29	0.07	11.46
							-
2058	0.36	(0.00)	0.04	(113.02)	0.30	0.01	(112.32)
Average	**0.34**	**(0.00)**	**0.04**	**(41.63)**	**0.29**	**0.04**	**(40.91)**

Table 2-2. Projected Monetary Benefit from Emissions Reductions by Year, Selected Years

Year	NO_X	SOx	$PM_{2.5}$	CO_2	PM_{10}	VOC	Total
2028	$ 5,723.93	$ (8.69)	$ 44,290.88	$ 1,815.08	$ -	$ -	$ 51,821.21
2029	$ 5,846.66	$ (10.32)	$ 44,574.15	$ 1,549.77	$ -	$ -	$ 51,960.26
2030	$ 6,002.55	$ (12.02)	$ 44,854.19	$ 1,274.94	$ -	$ -	$ 52,119.66
2031	$ 6,127.19	$ (13.78)	$ 45,130.71	$ 1,006.07	$ -	$ -	$ 52,250.19
2032	$ 6,155.02	$ (15.32)	$ 44,694.31	$ 707.44	$ -	$ -	$ 51,541.45
2058	$ 6,878.59	$ (55.43)	$ 33,347.73	$ (9,945.67)	$ -	$ -	$ 30,225.22
Average	**$ 6,464.34**	**$ (33.04)**	**$ 39,604.22**	**$ (3,795.77)**	**$ -**	**$ -**	**$ 42,239.75**

Table 2-3. Emissions Benefits Summary

Year	NOX	SOx	PM2.5	CO2	PM10	VOC	30-Year Total
2028-2058	$ 199,654.11	$ (1,000.00)	$ 1,232,417.48	$ (112,058.01)	$ -	$ -	$ 1,319,013.58

2B. Emissions Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Assumptions	The analysis relies on assumption made for the traffic analysis which assumes that traffic patterns remain consistent through this study area, however, traffic volumes will continue to grow at a rate of approximately 0.25% annually over the 30-year planning horizon with additional background trips added to account for the build out of Quonset Business Parkfor this analysis. Quonset Business Park is projected to generate 5,000 jobs upon full buildout.
Methodology	An air quality study of the Project was conducted using traffic data developed in the transportation analysis. Emission factors for the study area were developed using the Motor Vehicle Emission Simulator model (MOVES3) developed by the US Environmental Protection Agency. Emissions were analyzed for the first five years of operation (2028-2031) and the design year (2058). Analyses were conducted for the No Build and Build alternatives to determine the emissions reduction associated with the Project. The emission factors represent the corresponding year of the traffic modeling. The factors were derived by calculating a seasonal average during the evening peak hour with a representative vehicle mix. Oxides of Nitrogen (NOX), Sulfur Dioxide (SO2), Particulate Matter (PM2.5) and Carbon Dioxide (CO2) were studied based on the latest grant application guidance. Volatile Organic Compounds (VOC) and Particulate Matter 10 (PM10) emissions savings were included for informational purposes, but cost savings were not quantified per the latest grant application guidance. Emissions reductions are scaled linearly by year between the opening and design years.
Baseline	The Existing Conditions model represents a 2028 No Build Mesoscale Air Quality Analysis
Sources of Data	Output from project's VISSIM microsimulation model
Key Input Parameters	Average speed; Vehicle Miles Traveled; Vehicle Hours Traveled

2B. Emissions Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 2, The Quonset Connector Ramps**

Date: **August 21, 2023**

Table 2B-1. Mesoscale Air Quality Analysis - Air Pollutants by Year, No-Build Scenario

Year	NOX	SOx	PM2.5	CO2	PM10	VOC	Total
2023							-
2024							-
2025							-
2026							-
2027							-
2028	6.68	0.07	0.43	11,908.12	1.98	4.91	11,922.21
2029	6.60	0.07	0.43	11,900.50	1.99	4.89	11,914.47
2030	6.52	0.07	0.43	11,892.87	2.00	4.86	11,906.74
2031	6.43	0.07	0.42	11,885.24	2.00	4.83	11,899.01
2032	6.35	0.07	0.42	11,877.61	2.01	4.80	11,891.27
2033	6.27	0.07	0.42	11,869.99	2.02	4.77	11,883.54
2034	6.18	0.07	0.42	11,862.36	2.03	4.75	11,875.81
2035	6.10	0.07	0.41	11,854.73	2.03	4.72	11,868.07
2036	6.02	0.07	0.41	11,847.10	2.04	4.69	11,860.34
2037	5.93	0.07	0.41	11,839.48	2.05	4.66	11,852.61
2038	5.85	0.07	0.41	11,831.85	2.06	4.64	11,844.87
2039	5.77	0.07	0.40	11,824.22	2.06	4.61	11,837.14
2040	5.68	0.07	0.40	11,816.60	2.07	4.58	11,829.41
2041	5.60	0.07	0.40	11,808.97	2.08	4.55	11,821.67
2042	5.52	0.07	0.40	11,801.34	2.09	4.52	11,813.94
2043	5.44	0.07	0.40	11,793.71	2.09	4.50	11,806.21
2044	5.35	0.07	0.39	11,786.09	2.10	4.47	11,798.47
2045	5.27	0.07	0.39	11,778.46	2.11	4.44	11,790.74
2046	5.19	0.07	0.39	11,770.83	2.12	4.41	11,783.01
2047	5.10	0.07	0.39	11,763.21	2.12	4.38	11,775.27
2048	5.02	0.07	0.38	11,755.58	2.13	4.36	11,767.54
2049	4.94	0.07	0.38	11,747.95	2.14	4.33	11,759.81
2050	4.85	0.07	0.38	11,740.32	2.15	4.30	11,752.07
2051	4.77	0.07	0.38	11,732.70	2.15	4.27	11,744.34
2052	4.69	0.07	0.37	11,725.07	2.16	4.25	11,736.61
2053	4.60	0.07	0.37	11,717.44	2.17	4.22	11,728.87
2054	4.52	0.07	0.37	11,709.82	2.17	4.19	11,721.14
2055	4.44	0.07	0.37	11,702.19	2.18	4.16	11,713.41
2056	4.35	0.07	0.36	11,694.56	2.19	4.13	11,705.67
2057	4.27	0.07	0.36	11,686.93	2.20	4.11	11,697.94
2058	4.19	0.07	0.36	11,679.31	2.20	4.08	11,690.21
Total	**168.49**	**2.26**	**12.25**	**365,605.15**	**64.89**	**139.38**	**365,992.43**

2B. Emissions Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Table 2B-2. Mesoscale Air Quality Analysis - Air Pollutants by Year, Preferred Action Scenario

Year	NOX	SOx	PM2.5	CO2	PM10	VOC	Total
2023							-
2024							-
2025							-
2026							-
2027							-
2028	6.36	0.07	0.38	11,878.37	1.69	4.83	11,891.71
2029	6.28	0.07	0.38	11,875.50	1.70	4.81	11,888.74
2030	6.20	0.07	0.38	11,872.63	1.70	4.78	11,885.76
2031	6.11	0.07	0.37	11,869.76	1.71	4.76	11,882.79
2032	6.03	0.07	0.37	11,866.89	1.72	4.73	11,879.82
2033	5.94	0.07	0.37	11,864.03	1.73	4.71	11,876.84
2034	5.86	0.07	0.37	11,861.16	1.73	4.68	11,873.87
2035	5.77	0.07	0.37	11,858.29	1.74	4.65	11,870.90
2036	5.69	0.07	0.36	11,855.42	1.75	4.63	11,867.93
2037	5.60	0.07	0.36	11,852.55	1.76	4.60	11,864.95
2038	5.52	0.07	0.36	11,849.69	1.76	4.58	11,861.98
2039	5.43	0.07	0.36	11,846.82	1.77	4.55	11,859.01
2040	5.35	0.07	0.36	11,843.95	1.78	4.53	11,856.03
2041	5.26	0.07	0.36	11,841.08	1.78	4.50	11,853.06
2042	5.18	0.07	0.35	11,838.21	1.79	4.48	11,850.09
2043	5.09	0.07	0.35	11,835.35	1.80	4.45	11,847.12
2044	5.01	0.07	0.35	11,832.48	1.81	4.43	11,844.14
2045	4.92	0.07	0.35	11,829.61	1.81	4.40	11,841.17
2046	4.84	0.07	0.35	11,826.74	1.82	4.38	11,838.20
2047	4.75	0.07	0.34	11,823.87	1.83	4.35	11,835.22
2048	4.67	0.07	0.34	11,821.01	1.84	4.32	11,832.25
2049	4.58	0.07	0.34	11,818.14	1.84	4.30	11,829.28
2050	4.50	0.07	0.34	11,815.27	1.85	4.27	11,826.31
2051	4.42	0.07	0.34	11,812.40	1.86	4.25	11,823.33
2052	4.33	0.07	0.33	11,809.53	1.87	4.22	11,820.36
2053	4.25	0.07	0.33	11,806.67	1.87	4.20	11,817.39
2054	4.16	0.07	0.33	11,803.80	1.88	4.17	11,814.41
2055	4.08	0.07	0.33	11,800.93	1.89	4.15	11,811.44
2056	3.99	0.07	0.33	11,798.06	1.89	4.12	11,808.47
2057	3.91	0.07	0.32	11,795.19	1.90	4.10	11,805.49
2058	3.82	0.07	0.32	11,792.33	1.91	4.07	11,802.52
Total	**157.89**	**2.28**	**10.89**	**366,895.73**	**55.78**	**138.00**	**367,260.57**

2B. Emissions Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 2, The Quonset Connector Ramps**

Date: **August 21, 2023**

Table 2B-3. Mesoscale Air Quality Analysis - Estimated Reduction in Air Pollutants by Year, Preferred Action Scenario

Year	NOX	SOx	PM2.5	CO2	PM10	VOC	Total
2023	-	-	-	-	-	-	-
2024	-	-	-	-	-	-	-
2025	-	-	-	-	-	-	-
2026	-	-	-	-	-	-	-
2027	-	-	-	-	-	-	-
2028	0.32	(0.00)	0.05	29.76	0.29	0.08	30.50
2029	0.32	(0.00)	0.05	25.00	0.29	0.08	25.74
2030	0.32	(0.00)	0.05	20.24	0.29	0.08	20.98
2031	0.32	(0.00)	0.05	15.48	0.29	0.07	16.22
2032	0.33	(0.00)	0.05	10.72	0.29	0.07	11.46
2033	0.33	(0.00)	0.05	5.96	0.29	0.07	6.70
2034	0.33	(0.00)	0.05	1.20	0.29	0.07	1.94
2035	0.33	(0.00)	0.05	(3.56)	0.29	0.06	(2.82)
2036	0.33	(0.00)	0.05	(8.32)	0.29	0.06	(7.58)
2037	0.33	(0.00)	0.05	(13.08)	0.29	0.06	(12.34)
2038	0.33	(0.00)	0.05	(17.84)	0.29	0.06	(17.11)
2039	0.34	(0.00)	0.05	(22.60)	0.29	0.05	(21.87)
2040	0.34	(0.00)	0.05	(27.35)	0.29	0.05	(26.63)
2041	0.34	(0.00)	0.04	(32.11)	0.29	0.05	(31.39)
2042	0.34	(0.00)	0.04	(36.87)	0.29	0.05	(36.15)
2043	0.34	(0.00)	0.04	(41.63)	0.29	0.04	(40.91)
2044	0.34	(0.00)	0.04	(46.39)	0.29	0.04	(45.67)
2045	0.34	(0.00)	0.04	(51.15)	0.29	0.04	(50.43)
2046	0.35	(0.00)	0.04	(55.91)	0.29	0.04	(55.19)
2047	0.35	(0.00)	0.04	(60.67)	0.29	0.03	(59.95)
2048	0.35	(0.00)	0.04	(65.43)	0.29	0.03	(64.71)
2049	0.35	(0.00)	0.04	(70.19)	0.29	0.03	(69.47)
2050	0.35	(0.00)	0.04	(74.95)	0.29	0.03	(74.23)
2051	0.35	(0.00)	0.04	(79.70)	0.29	0.03	(78.99)
2052	0.36	(0.00)	0.04	(84.46)	0.30	0.02	(83.75)
2053	0.36	(0.00)	0.04	(89.22)	0.30	0.02	(88.51)
2054	0.36	(0.00)	0.04	(93.98)	0.30	0.02	(93.27)
2055	0.36	(0.00)	0.04	(98.74)	0.30	0.02	(98.03)
2056	0.36	(0.00)	0.04	(103.50)	0.30	0.01	(102.79)
2057	0.36	(0.00)	0.04	(108.26)	0.30	0.01	(107.56)
2058	0.36	(0.00)	0.04	(113.02)	0.30	0.01	(112.32)
Total	**10.60**	**(0.02)**	**1.36**	**(1,290.59)**	**9.12**	**1.39**	**(1,268.14)**

2B. Emissions Benefits Backup, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 2, The Quonset Connector Ramps**

Date: **August 21, 2023**

Table 2B-4. Mesoscale Air Quality Analysis - Estimated Reduction in Air Pollutants by Year, Preferred Action Scenario

Year	NOX	SOx	PM2.5	CO2	PM10	VOC	Total
2023	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2024	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2025	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2026	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2027	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2028	$ 5,723.93	$ (8.69)	$ 44,290.88	$ 1,815.08	$ -	$ -	$ 51,821.21
2029	$ 5,846.66	$ (10.32)	$ 44,574.15	$ 1,549.77	$ -	$ -	$ 51,960.26
2030	$ 6,002.55	$ (12.02)	$ 44,854.19	$ 1,274.94	$ -	$ -	$ 52,119.66
2031	$ 6,127.19	$ (13.78)	$ 45,130.71	$ 1,006.07	$ -	$ -	$ 52,250.19
2032	$ 6,155.02	$ (15.32)	$ 44,694.31	$ 707.44	$ -	$ -	$ 51,541.45
2033	$ 6,182.85	$ (16.87)	$ 44,257.90	$ 399.30	$ -	$ -	$ 50,823.18
2034	$ 6,210.68	$ (18.41)	$ 43,821.49	$ 81.64	$ -	$ -	$ 50,095.40
2035	$ 6,238.51	$ (19.95)	$ 43,385.09	$ (245.54)	$ -	$ -	$ 49,358.10
2036	$ 6,266.34	$ (21.49)	$ 42,948.68	$ (582.24)	$ -	$ -	$ 48,611.28
2037	$ 6,294.17	$ (23.04)	$ 42,512.27	$ (941.54)	$ -	$ -	$ 47,841.87
2038	$ 6,322.00	$ (24.58)	$ 42,075.87	$ (1,302.03)	$ -	$ -	$ 47,071.26
2039	$ 6,349.83	$ (26.12)	$ 41,639.46	$ (1,672.04)	$ -	$ -	$ 46,291.12
2040	$ 6,377.66	$ (27.66)	$ 41,203.05	$ (2,051.58)	$ -	$ -	$ 45,501.47
2041	$ 6,405.49	$ (29.21)	$ 40,766.65	$ (2,440.63)	$ -	$ -	$ 44,702.30
2042	$ 6,433.32	$ (30.75)	$ 40,330.24	$ (2,876.07)	$ -	$ -	$ 43,856.74
2043	$ 6,461.15	$ (32.29)	$ 39,893.83	$ (3,288.91)	$ -	$ -	$ 43,033.78
2044	$ 6,488.98	$ (33.83)	$ 39,457.43	$ (3,711.28)	$ -	$ -	$ 42,201.29
2045	$ 6,516.81	$ (35.38)	$ 39,021.02	$ (4,143.16)	$ -	$ -	$ 41,359.29
2046	$ 6,544.64	$ (36.92)	$ 38,584.61	$ (4,584.56)	$ -	$ -	$ 40,507.77
2047	$ 6,572.47	$ (38.46)	$ 38,148.21	$ (5,096.14)	$ -	$ -	$ 39,586.07
2048	$ 6,600.30	$ (40.00)	$ 37,711.80	$ (5,561.34)	$ -	$ -	$ 38,710.75
2049	$ 6,628.13	$ (41.55)	$ 37,275.39	$ (6,036.06)	$ -	$ -	$ 37,825.92
2050	$ 6,655.96	$ (43.09)	$ 36,838.99	$ (6,520.29)	$ -	$ -	$ 36,931.56
2051	$ 6,683.78	$ (44.63)	$ 36,402.58	$ (7,014.04)	$ -	$ -	$ 36,027.69
2052	$ 6,711.61	$ (46.17)	$ 35,966.17	$ (7,432.84)	$ -	$ -	$ 35,198.77
2053	$ 6,739.44	$ (47.72)	$ 35,529.77	$ (7,851.65)	$ -	$ -	$ 34,369.84
2054	$ 6,767.27	$ (49.26)	$ 35,093.36	$ (8,270.45)	$ -	$ -	$ 33,540.92
2055	$ 6,795.10	$ (50.80)	$ 34,656.95	$ (8,689.26)	$ -	$ -	$ 32,711.99
2056	$ 6,822.93	$ (52.35)	$ 34,220.55	$ (9,108.06)	$ -	$ -	$ 31,883.07
2057	$ 6,850.76	$ (53.89)	$ 33,784.14	$ (9,526.87)	$ -	$ -	$ 31,054.14
2058	$ 6,878.59	$ (55.43)	$ 33,347.73	$ (9,945.67)	$ -	$ -	$ 30,225.22
Total	**$ 199,654.11**	**$ (1,000.00)**	**$ 1,232,417.48**	**$ (112,058.01)**	**$ -**	**$ -**	**$ 1,319,013.58**

3. Travel Time Savings Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

This project will reduce travel times and distance by providing more efficient access to the freeway at the critical junction of Route 4 at I-95. The proposed improvements in this project were conceived to allow traffic to flow through the network more easily through the construction of missing ramps connecting Route 4 and I-95 and to remove pass-through traffic from Route 2.

This project will generate an estimated $1.4 million in travel time savings benefits in the first year of operations (2028). Over 30 years, travel time savings are total $795 million.

Assumptions, methodology, a description of the baseline scenario, source of data, and key input parameters are documented in Tabs 3B, 3C, and 3D and Appendix A-2.

Table 3-1. Travel Time Savings Benefits Summary, Opening Year (2028)

Scenario	Total Traffic in Network (Veh/Day)	Vehicle Miles Traveled (VMT/Day)	Vehicle Hours Traveled (VHT/Day)	Average Speed (MPH)	Average Delay (Hrs/Veh/Day)	Travel Time Savings Benefit ($/Day)	Annual Benefit ($/Year)
2028 No-Build	221,892.00	707,210.63	15,151.49	47.20	0.01	$ -	-
2028 Preferred Action	221,766.00	708,319.06	14,993.33	47.64	0.01	$ 3,861.52	1,409,453.96

Table 3-2. Travel Time Savings Benefits Summary, Design Year (2058)

Scenario	Total Traffic in Network (Veh/Day)	Vehicle Miles Traveled (VMT/Day)	Vehicle Hours Traveled (VHT/Day)	Average Speed (MPH)	Average Delay (Hrs/Veh/Day)	Travel Time Savings Benefit ($/Day)	Annual Benefit ($/Year)
2058 No-Build	255,302.00	790,801.94	25,823.43	35.91	0.04	$ -	-
2058 Preferred Action	250,996.00	795,377.31	20,613.33	41.55	0.02	$ 164,887.68	60,184,003.16

Table 3-3. Travel Time Savings Change Rates, 2028-2058

Scenario	Total Traffic in Network (Veh/Day)	Vehicle Miles Traveled (VMT/Day)	Vehicle Hours Traveled (VHT/Day)	Average Speed (MPH)	Average Delay (Hrs/Veh/Day)	Travel Time Savings Benefit ($/Day)	Annual Benefit ($/Year)
Annual Change No-Build	1,113.67	2,786.38	355.73	(0.38)	0.00	$ -	-
Annual Change Preferred Action	974.33	2,901.94	187.33	(0.20)	0.00	$ 5,367.54	1,959,151.64

Table 3.4 Travel Time Savings Summary

Scenario	Total Traffic in Network (Avg. Veh/Day)	Vehicle Miles Traveled (Avg. VMT/Day)	Vehicle Hours Traveled (Avg. VHT/Day)	Average Speed (MPH)	Total Delay (Avg. Hours/Day)	Travel Time Savings Benefit (Avg. $/Year)	30-Year Total
No-Build, 2028-2058	236,926.50	744,826.72	19,953.86	42.12	5,683.24	0	0
Preferred Action, 2028-2058	234,919.50	747,495.27	17,522.33	44.90	3,253.15	$ 26,527,175.24	$ 795,815,257.12
Total	**(2,007.00)**	**2,668.55**	**(2,431.53)**	**2.78**	**(2,430.09)**	**$ 26,527,175.24**	**$ 795,815,257.12**

3B. Travel Time Savings Backup, 2028 (Opening Year)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Assumptions	The analysis assumes that traffic patterns remain consistent through this study area, however, traffic volumes will continue to grow at a rate of approximately 0.25% annually over the 5-year construction period and then 0.10% annually over the 30-year planning horizon for this analysis. Additionally, known development in the study area anticipated before Opening Year (2028) is also included as part of traffic growth. Quonset Business Park projects generating 5,000 new jobs upon full buildout, a portion of which will travel through this study area. Growth in delay times and volumes are assumed to be linear between the opening year and design year.
Methodology	VISSIM microscopic traffic modelling software was used to project travel times through the study area for five different scenarios (2023 Existing, 2028 No-Build, 2028 Preferred Action - Opening Year, 2058 No-Build, and 2058 Preferred Action). Each scenarios was run for a 15-hour period from 5:00am-8:00pm for 10 iterations (random seeds) each. Model outputs included vehicles in the network, vehicle miles traveled, vehicle hours traveled, average speed, and average delay. In this tab (3B), 2028 travel time impacts are profiled for existing, no-action, and preferred action scenarios. In Tab 3C, no-action and preferred action scenarios are profiled for the design year (2058). In Tab 3D, those inputs were then extended to annual impacts. 2028 impacts are calculated as a baseline benefits year, but benefits are not captured in that year as the project is expected to complete in late 2028.
Baseline	The Existing Condtion model represents a 2023 condition.
Sources of Data	Historic and 2022 turning movement counts and traffic volume data adjusted to represent a 2023 Existing Condition.
Key Input Parameters	The model outputs were monetized using the value of travel time savings and assumed vehicle occupancy rates provided by the Benefit Cost Analysis Guidance for Discretionary Grant Programs (March 2023).

3B. Travel Time Savings Backup, 2028 (Opening Year)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Table 3B-1. Project Limit Network MOEs Summary - Existing 2023 Conditions

Time	Total Vehicles in Network	VMT: Total Path Distance (mi)	VHT: Total Time in Network (hr)	Average Speed (mph)	Total Delay (hr)	Average Delay (hr/veh)
5:00 AM	6,259	19,846	407	49	25	0.004
6:00 AM	10,446	34,186	700	49	46	0.004
7:00 AM	17,572	57,829	1,234	47	127	0.007
8:00 AM	16,024	52,430	1,098	48	96	0.006
9:00 AM	12,889	42,264	868	49	61	0.005
10:00 AM	11,730	38,536	788	49	52	0.004
11:00 AM	11,722	38,737	792	49	52	0.004
12:00 PM	13,591	42,741	894	48	73	0.005
1:00 PM	13,943	44,687	950	47	90	0.006
2:00 PM	18,943	58,870	1,300	45	165	0.009
3:00 PM	20,189	62,978	1,422	44	209	0.010
4:00 PM	20,864	65,272	1,488	44	231	0.011
5:00 PM	18,352	57,237	1,245	46	144	0.008
6:00 PM	12,671	39,142	820	48	68	0.005
7:00 PM	9,115	28,250	584	48	41	0.005
Total	**214,310.00**	**683,005.63**	**14,588.61**	**47.28**	**1,479.99**	**0.01**

3B. Travel Time Savings Backup, 2028 (Opening Year)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Table 3B-2. Delays by Vehicle Type, Existing 2023 Conditions

Time	Car Traffic Share	Truck Traffic Share	Car Traffic	Car Delay (hrs)	Truck Traffic	Truck Delay (hrs)
5:00 AM	94%	6%	5,883	23.68	376	1.51
6:00 AM	94%	6%	9,819	43.29	627	2.76
7:00 AM	94%	6%	16,518	119.48	1054	7.63
8:00 AM	94%	6%	15,063	90.04	961	5.75
9:00 AM	94%	6%	12,116	57.38	773	3.66
10:00 AM	94%	6%	11,026	48.88	704	3.12
11:00 AM	94%	6%	11,019	48.97	703	3.13
12:00 PM	94%	6%	12,776	68.28	815	4.36
1:00 PM	94%	6%	13,106	84.61	837	5.40
2:00 PM	94%	6%	17,806	154.67	1137	9.87
3:00 PM	94%	6%	18,978	196.05	1211	12.51
4:00 PM	94%	6%	19,612	217.42	1252	13.88
5:00 PM	94%	6%	17,251	135.08	1101	8.62
6:00 PM	94%	6%	11,911	64.38	760	4.11
7:00 PM	94%	6%	8,568	38.87	547	2.48
Total			**201,451.40**	**1,391.08**	**12,858.60**	**88.79**

Table 3B-3. Project Limits Network MOEs Summary, Projected 2028 No-Action Conditions

Time	Total Vehicles in Network	VMT: Total Path Distance (mi)	VHT: Total Time in Network (hr)	Average Speed (mph)	Total Delay (hr)	Average Delay (hr/veh)
5:00 AM	14,031	44,060	921	48	75	0.005
6:00 AM	6,463	20,469	419	49	26	0.004
7:00 AM	10,868	35,529	725	49	47	0.004
8:00 AM	18,206	59,807	1,287	46	144	0.008
9:00 AM	16,662	54,327	1,167	47	130	0.008
10:00 AM	13,454	43,984	911	48	72	0.005
11:00 AM	12,215	40,097	817	49	53	0.004
12:00 PM	12,231	40,377	823	49	53	0.004
1:00 PM	14,405	46,316	982	47	91	0.006
2:00 PM	19,590	61,016	1,342	45	166	0.008
3:00 PM	20,829	65,144	1,467	44	212	0.010
4:00 PM	21,428	67,097	1,541	44	250	0.012
5:00 PM	19,025	59,335	1,300	46	158	0.008
6:00 PM	13,086	40,511	849	48	71	0.005
7:00 PM	9,399	29,143	601	48	42	0.004
Total	**221,892.00**	**707,210.63**	**15,151.49**	**47.20**	**1,589.16**	**0.01**

3B. Travel Time Savings Backup, 2028 (Opening Year)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Table 3B-4. Delays by Vehicle Type, Projected 2028 No-Action Conditions

Time	Car Traffic Share	Truck Traffic Share	Car Traffic	Car Delay (hrs)	Truck Traffic	Truck Delay (hrs)
5:00 AM	94%	6%	13,189	70.23	842	4.48
6:00 AM	94%	6%	6,075	24.03	388	1.53
7:00 AM	94%	6%	10,216	43.87	652	2.80
8:00 AM	94%	6%	17,114	135.25	1092	8.63
9:00 AM	94%	6%	15,662	121.86	1000	7.78
10:00 AM	94%	6%	12,647	67.55	807	4.31
11:00 AM	94%	6%	11,482	49.50	733	3.16
12:00 PM	94%	6%	11,497	49.85	734	3.18
1:00 PM	94%	6%	13,541	85.83	864	5.48
2:00 PM	94%	6%	18,415	155.55	1175	9.93
3:00 PM	94%	6%	19,579	199.49	1250	12.73
4:00 PM	94%	6%	20,142	235.39	1286	15.02
5:00 PM	94%	6%	17,884	148.43	1142	9.47
6:00 PM	94%	6%	12,301	66.63	785	4.25
7:00 PM	94%	6%	8,835	39.59	564	2.53
Total			**208,578.48**	**1,493.06**	**13,313.52**	**95.30**

Table 3B-5. Project Limits Network MOEs Summary - Projected 2028 (Opening Year) Proposed Action Conditions

Time	Total Vehicles Traveling Within the Network	VMT: Total Path Distance (mi)	VHT: Total Time Within the Network (hr)	Average Speed (mph)	Total Delay: All Vehicles (hr)	Average Delay: Per Vehicle (hr/veh)
5:00 AM	14,046	44,430	926	48	76	0.005
6:00 AM	6,463	19,954	410	49	27	0.004
7:00 AM	10,867	35,968	730	49	47	0.004
8:00 AM	18,211	60,494	1,282	47	131	0.007
9:00 AM	16,659	54,921	1,141	48	97	0.006
10:00 AM	13,409	44,407	906	49	63	0.005
11:00 AM	12,229	40,511	822	49	53	0.004
12:00 PM	12,242	40,833	829	49	54	0.004
1:00 PM	14,405	45,999	970	47	89	0.006
2:00 PM	19,587	60,802	1,331	46	163	0.008
3:00 PM	20,834	65,127	1,440	45	191	0.009
4:00 PM	21,453	67,084	1,506	45	221	0.010
5:00 PM	18,908	58,833	1,272	46	145	0.008
6:00 PM	13,068	40,156	838	48	69	0.005
7:00 PM	9,385	28,800	591	49	40	0.004
Total	**221,766.00**	**708,319.06**	**14,993.33**	**47.64**	**1,465.69**	**0.01**

3B. Travel Time Savings Backup, 2028 (Opening Year)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 1, The Missing Moves**

Date: **August 21, 2023**

Table 3B-6. Project Limits Network MOEs Summary - Projected 2028 (Opening Year) Proposed Action Delays

Time	Car Traffic Share	Truck Traffic Share	Car Traffic	Car Delay (hrs)	Truck Traffic	Truck Delay (hrs)
5:00 AM	94%	6%	13,203	71.55	843	4.57
6:00 AM	94%	6%	6,075	25.33	388	1.62
7:00 AM	94%	6%	10,215	43.81	652	2.80
8:00 AM	94%	6%	17,118	122.92	1093	7.85
9:00 AM	94%	6%	15,659	90.82	1000	5.80
10:00 AM	94%	6%	12,604	58.86	805	3.76
11:00 AM	94%	6%	11,495	49.69	734	3.17
12:00 PM	94%	6%	11,507	50.60	735	3.23
1:00 PM	94%	6%	13,541	83.95	864	5.36
2:00 PM	94%	6%	18,412	153.58	1175	9.80
3:00 PM	94%	6%	19,584	179.68	1250	11.47
4:00 PM	94%	6%	20,166	207.32	1287	13.23
5:00 PM	94%	6%	17,774	136.51	1134	8.71
6:00 PM	94%	6%	12,284	65.10	784	4.16
7:00 PM	94%	6%	8,822	37.93	563	2.42
Total			**208,460.04**	**1,377.67**	**13,305.96**	**87.94**

Table 3B-7. Travel Time Savings Benefits Summary - Projected 2028 Conditions

Time	Car Delay Savings (hrs)	Truck Delay Savings (hrs)	Car Savings Benefits (Daily)	Truck Savings Benefits (Daily)	Total Benefits, Low (270 Days)	Total Benefits, High (365 Days)
5:00 AM	(1.32)	(0.08)	$ (41.51)	$ (2.73)	$ (11,945.17)	$ (16,148.10)
6:00 AM	(1.30)	(0.08)	$ (40.80)	$ (2.69)	$ (11,740.67)	$ (15,871.65)
7:00 AM	0.06	0.00	$ 1.91	$ 0.13	$ 549.23	$ 742.47
8:00 AM	12.33	0.79	$ 386.99	$ 25.49	$ 111,370.07	$ 150,555.84
9:00 AM	31.04	1.98	$ 974.42	$ 64.19	$ 280,423.02	$ 379,090.38
10:00 AM	8.70	0.56	$ 273.11	$ 17.99	$ 78,597.65	$ 106,252.38
11:00 AM	(0.18)	(0.01)	$ (5.79)	$ (0.38)	$ (1,666.65)	$ (2,253.06)
12:00 PM	(0.75)	(0.05)	$ (23.49)	$ (1.55)	$ (6,759.04)	$ (9,137.22)
1:00 PM	1.88	0.12	$ 59.04	$ 3.89	$ 16,992.27	$ 22,971.03
2:00 PM	1.97	0.13	$ 61.76	$ 4.07	$ 17,775.03	$ 24,029.21
3:00 PM	19.81	1.26	$ 621.89	$ 40.96	$ 178,971.93	$ 241,943.53
4:00 PM	28.07	1.79	$ 881.27	$ 58.05	$ 253,616.95	$ 342,852.54
5:00 PM	11.92	0.76	$ 374.32	$ 24.66	$ 107,723.78	$ 145,626.59
6:00 PM	1.52	0.10	$ 47.87	$ 3.15	$ 13,776.80	$ 18,624.19
7:00 PM	1.65	0.11	$ 51.86	$ 3.42	$ 14,924.58	$ 20,175.82
Total			**$ 3,622.88**	**$ 238.64**	**$ 1,042,609.78**	**$ 1,409,453.96**

3C. Travel Time Savings Backup, 2057 (Last Year of Analysis)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Table 3C-1. Project Limit Network MOEs Summary - Projected 2058 No-Action Conditions

Time	Total Vehicles in Network	VMT: Total Path Distance (mi)	VHT: Total Time in Network (hr)	Average Speed (mph)	Total Delay (hr)	Average Delay (hr/veh)
5:00 AM	15,553	49,472	1,042	47	92	0.006
6:00 AM	7,206	22,892	469	49	29	0.004
7:00 AM	12,329	40,524	830	49	57	0.005
8:00 AM	20,201	64,187	1,844	35	620	0.031
9:00 AM	18,949	58,008	2,476	24	1,369	0.073
10:00 AM	16,656	53,025	1,727	32	717	0.043
11:00 AM	14,737	48,159	1,201	42	284	0.018
12:00 PM	14,365	47,429	1,077	45	175	0.012
1:00 PM	15,906	51,638	1,101	47	108	0.007
2:00 PM	21,382	67,061	1,626	41	338	0.016
3:00 PM	21,890	68,218	2,312	30	1,014	0.046
4:00 PM	21,166	60,575	3,588	17	2,433	0.115
5:00 PM	21,696	61,035	3,240	19	2,064	0.095
6:00 PM	19,270	55,070	1,992	28	927	0.048
7:00 PM	13,996	43,511	1,300	34	460	0.032
Total	**255,302.00**	**790,801.94**	**25,823.43**	**35.91**	**10,687.11**	**0.04**

Table 3C-2. Delays by Vehicle Type, Projected 2058 No-Action Conditions

Time	Car Traffic Share	Truck Traffic Share	Car Traffic	Car Delay (hrs)	Truck Traffic	Truck Delay (hrs)
5:00 AM	94%	6%	14,619.82	86.38	933.18	5.51
6:00 AM	94%	6%	6,773.64	27.60	432.36	1.76
7:00 AM	94%	6%	11,589.26	53.66	739.74	3.43
8:00 AM	94%	6%	18,988.94	582.64	1,212.06	37.19
9:00 AM	94%	6%	17,812.06	1,302.95	1,136.94	83.17
10:00 AM	94%	6%	15,656.64	670.58	999.36	42.80
11:00 AM	94%	6%	13,852.78	252.97	884.22	16.15
12:00 PM	94%	6%	13,503.10	157.24	861.90	10.04
1:00 PM	94%	6%	14,951.64	101.88	954.36	6.50
2:00 PM	94%	6%	20,099.08	317.51	1,282.92	20.27
3:00 PM	94%	6%	20,576.60	954.64	1,313.40	60.93
4:00 PM	94%	6%	19,896.04	2,292.19	1,269.96	146.31
5:00 PM	94%	6%	20,394.24	1,943.46	1,301.76	124.05
6:00 PM	94%	6%	18,113.80	870.72	1,156.20	55.58
7:00 PM	94%	6%	13,156.24	426.59	839.76	27.23
Total			**239,983.88**	**10,041.02**	**15,318.12**	**640.92**

3C. Travel Time Savings Backup, 2057 (Last Year of Analysis)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Table 3C-3. Project Limits Network MOEs Summary - Projected 2058 Proposed Action Conditions

Time	Total Vehicles Traveling Within the Network	VMT: Total Path Distance (mi)	VHT: Total Time Within the Network (hr)	Average Speed (mph)	Total Delay: All Vehicles (hr)	Average Delay: Per Vehicle (hr/veh)
5:00 AM	15,563	49,748	1,046	48	95	0.006
6:00 AM	7,206	22,338	460	49	31	0.004
7:00 AM	12,326	40,988	835	49	57	0.005
8:00 AM	20,244	65,432	1,768	37	524	0.026
9:00 AM	19,247	61,579	1,910	32	741	0.038
10:00 AM	16,148	53,625	1,445	37	429	0.026
11:00 AM	13,988	46,501	951	49	69	0.005
12:00 PM	13,986	46,798	955	49	67	0.005
1:00 PM	15,906	51,268	1,087	47	106	0.007
2:00 PM	21,697	67,950	1,553	44	250	0.012
3:00 PM	22,748	70,210	2,051	35	709	0.032
4:00 PM	23,312	71,183	2,437	29	1,079	0.046
5:00 PM	22,061	66,488	2,190	30	916	0.041
6:00 PM	16,129	49,077	1,251	40	308	0.019
7:00 PM	10,435	32,192	673	48	57	0.005
Total	**250,996.00**	**795,377.31**	**20,613.33**	**41.55**	**5,437.82**	**0.02**

Table 3C-4. Project Limits Network MOEs Summary - Projected 2058 Delays, Proposed Action

Time	Car Traffic Share	Truck Traffic Share	Car Traffic	Car Delay (hrs)	Truck Traffic	Truck Delay (hrs)
5:00 AM	94%	6%	14,629.22	89.16	933.78	5.69
6:00 AM	94%	6%	6,773.64	29.11	432.36	1.86
7:00 AM	94%	6%	11,586.44	53.39	739.56	3.41
8:00 AM	94%	6%	19,029.36	492.49	1,214.64	31.44
9:00 AM	94%	6%	18,092.18	696.40	1,154.82	44.45
10:00 AM	94%	6%	15,179.12	401.95	968.88	25.66
11:00 AM	94%	6%	13,148.72	64.36	839.28	4.11
12:00 PM	94%	6%	13,146.84	63.18	839.16	4.03
1:00 PM	94%	6%	14,951.64	99.59	954.36	6.36
2:00 PM	94%	6%	20,395.18	235.00	1,301.82	15.00
3:00 PM	94%	6%	21,383.12	675.88	1,364.88	43.14
4:00 PM	94%	6%	21,913.28	1,014.77	1,398.72	64.77
5:00 PM	94%	6%	20,737.34	860.31	1,323.66	54.91
6:00 PM	94%	6%	15,161.26	285.07	967.74	18.20
7:00 PM	94%	6%	9,808.90	53.05	626.10	3.39
Total			**235,936.24**	**5,113.71**	**15,059.76**	**326.41**

3C. Travel Time Savings Backup, 2057 (Last Year of Analysis)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Table 4C-7. Travel Time Savings Benefits Summary - Projected 2058 Conditions

Time	Car Delay Savings (hrs)	Truck Delay Savings (hrs)	Car Savings Benefits (Daily)	Truck Savings Benefits (Daily)	Total Benefits, Low (270 Days)	Total Benefits, High (365 Days)
5:00 AM	(2.78)	(0.18)	$ (87.22)	$ (5.75)	$ (25,101.87)	$ (33,934.01)
6:00 AM	(1.51)	(0.10)	$ (47.26)	$ (3.11)	$ (13,600.42)	$ (18,385.75)
7:00 AM	0.27	0.02	$ 8.49	$ 0.56	$ 2,444.36	$ 3,304.42
8:00 AM	90.15	5.75	$ 2,830.46	$ 186.45	$ 814,564.79	$ 1,101,170.92
9:00 AM	606.55	38.72	$ 19,043.37	$ 1,254.41	$ 5,480,399.41	$ 7,408,688.09
10:00 AM	268.63	17.15	$ 8,433.94	$ 555.55	$ 2,427,163.01	$ 3,281,164.81
11:00 AM	188.61	12.04	$ 5,921.65	$ 390.06	$ 1,704,161.82	$ 2,303,774.32
12:00 PM	94.06	6.00	$ 2,953.05	$ 194.52	$ 849,844.59	$ 1,148,863.98
1:00 PM	2.28	0.15	$ 71.72	$ 4.72	$ 20,639.15	$ 27,901.07
2:00 PM	82.51	5.27	$ 2,590.54	$ 170.64	$ 745,519.45	$ 1,007,831.84
3:00 PM	278.76	17.79	$ 8,751.80	$ 576.49	$ 2,518,637.15	$ 3,404,824.30
4:00 PM	1,277.42	81.54	$ 40,105.95	$ 2,641.82	$ 11,541,896.01	$ 15,602,933.49
5:00 PM	1,083.15	69.14	$ 34,006.46	$ 2,240.04	$ 9,786,553.90	$ 13,229,971.01
6:00 PM	585.65	37.38	$ 18,386.96	$ 1,211.17	$ 5,291,493.57	$ 7,153,315.38
7:00 PM	373.54	23.84	$ 11,727.70	$ 772.52	$ 3,375,058.65	$ 4,562,579.29
Total	**4,927.30**	**314.51**	**$ 154,697.60**	**$ 10,190.08**	**$ 44,519,673.57**	**$ 60,184,003.16**

3D. Travel Time Savings Backup 3, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Table 3D-1. Daily Project Limits Network MOEs Summary, No-Action Scenario by Year

Year	Total Traffic in Network (Veh/Day)	Vehicle Miles Traveled (VMT/Day)	Vehicle Hours Traveled (VHT/Day)	Average Speed (MPH)	Total Delay (hrs/day)	Average Delay (Hrs/Veh/Day)
2023	217,437	696,065.12	13,728.56	48.70	376.10	0.0025
2024	218,551	698,851.50	14,084.29	48.32	679.37	0.0035
2025	219,665	701,637.88	14,440.02	47.95	982.63	0.0045
2026	220,778	704,424.25	14,795.75	47.57	1,285.90	0.0055
2027	221,892	707,210.63	15,151.49	47.20	1,589.16	0.0065
2028	223,006	709,997.01	15,507.22	46.82	1,892.43	0.0075
2029	224,119	712,783.38	15,862.95	46.44	2,195.69	0.0086
2030	225,233	715,569.76	16,218.68	46.07	2,498.96	0.0096
2031	226,347	718,356.14	16,574.41	45.69	2,802.22	0.0106
2032	227,460	721,142.52	16,930.14	45.31	3,105.49	0.0116
2033	228,574	723,928.89	17,285.88	44.94	3,408.75	0.0126
2034	229,688	726,715.27	17,641.61	44.56	3,712.02	0.0136
2035	230,801	729,501.65	17,997.34	44.19	4,015.28	0.0146
2036	231,915	732,288.02	18,353.07	43.81	4,318.55	0.0156
2037	233,029	735,074.40	18,708.80	43.43	4,621.81	0.0166
2038	234,142	737,860.78	19,064.53	43.06	4,925.08	0.0176
2039	235,256	740,647.15	19,420.26	42.68	5,228.34	0.0186
2040	236,370	743,433.53	19,776.00	42.31	5,531.61	0.0196
2041	237,483	746,219.91	20,131.73	41.93	5,834.87	0.0206
2042	238,597	749,006.29	20,487.46	41.55	6,138.14	0.0216
2043	239,711	751,792.66	20,843.19	41.18	6,441.40	0.0226
2044	240,824	754,579.04	21,198.92	40.80	6,744.67	0.0237
2045	241,938	757,365.42	21,554.65	40.42	7,047.93	0.0247
2046	243,052	760,151.79	21,910.38	40.05	7,351.20	0.0257
2047	244,165	762,938.17	22,266.12	39.67	7,654.46	0.0267
2048	245,279	765,724.55	22,621.85	39.30	7,957.73	0.0277
2049	246,393	768,510.92	22,977.58	38.92	8,260.99	0.0287
2050	247,506	771,297.30	23,333.31	38.54	8,564.26	0.0297
2051	248,620	774,083.68	23,689.04	38.17	8,867.52	0.0307
2052	249,734	776,870.06	24,044.77	37.79	9,170.79	0.0317
2053	250,847	779,656.43	24,400.51	37.41	9,474.05	0.0327
2054	251,961	782,442.81	24,756.24	37.04	9,777.32	0.0337
2055	253,075	785,229.19	25,111.97	36.66	10,080.58	0.0347
2056	254,188	788,015.56	25,467.70	36.29	10,383.85	0.0357
2057	255,302	790,801.94	25,823.43	35.91	10,687.11	0.0367
2058	256,416	793,588.32	26,179.16	35.53	10,990.38	0.0378
Average	**236,927**	**744,826.72**	**19,953.86**	**42.12**	**5,683.24**	**0.0201**

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Table 3D-2. Daily Project Limits Network MOEs Summary, Preferred Action Scenario by Year

Year	Total Traffic in Network (Veh/Day)	Vehicle Miles Traveled (VMT/Day)	Vehicle Hours Traveled (VHT/Day)	Average Speed (MPH)	Total Delay (hrs/day)	Average Delay (Hrs/Veh/Day)
2023	217,869	696,711.29	14,243.99	48.45	936.07	0.0044
2024	218,843	699,613.24	14,431.33	48.25	1,068.48	0.0049
2025	219,817	702,515.18	14,618.66	48.05	1,200.88	0.0053
2026	220,792	705,417.12	14,805.99	47.84	1,333.29	0.0057
2027	221,766	708,319.06	14,993.33	47.64	1,465.69	0.0061
2028	222,740	711,221.00	15,180.66	47.44	1,598.09	0.0065
2029	223,715	714,122.94	15,367.99	47.23	1,730.50	0.0069
2030	224,689	717,024.89	15,555.33	47.03	1,862.90	0.0073
2031	225,663	719,926.83	15,742.66	46.83	1,995.31	0.0078
2032	226,638	722,828.77	15,929.99	46.63	2,127.71	0.0082
2033	227,612	725,730.71	16,117.33	46.42	2,260.12	0.0086
2034	228,586	728,632.65	16,304.66	46.22	2,392.52	0.0090
2035	229,561	731,534.59	16,492.00	46.02	2,524.92	0.0094
2036	230,535	734,436.54	16,679.33	45.81	2,657.33	0.0098
2037	231,509	737,338.48	16,866.66	45.61	2,789.73	0.0102
2038	232,484	740,240.42	17,054.00	45.41	2,922.14	0.0106
2039	233,458	743,142.36	17,241.33	45.21	3,054.54	0.0111
2040	234,432	746,044.30	17,428.66	45.00	3,186.94	0.0115
2041	235,407	748,946.24	17,616.00	44.80	3,319.35	0.0119
2042	236,381	751,848.19	17,803.33	44.60	3,451.75	0.0123
2043	237,355	754,750.13	17,990.66	44.39	3,584.16	0.0127
2044	238,330	757,652.07	18,178.00	44.19	3,716.56	0.0131
2045	239,304	760,554.01	18,365.33	43.99	3,848.97	0.0135
2046	240,278	763,455.95	18,552.66	43.79	3,981.37	0.0139
2047	241,253	766,357.89	18,740.00	43.58	4,113.77	0.0144
2048	242,227	769,259.84	18,927.33	43.38	4,246.18	0.0148
2049	243,201	772,161.78	19,114.66	43.18	4,378.58	0.0152
2050	244,176	775,063.72	19,302.00	42.97	4,510.99	0.0156
2051	245,150	777,965.66	19,489.33	42.77	4,643.39	0.0160
2052	246,124	780,867.60	19,676.67	42.57	4,775.80	0.0164
2053	247,099	783,769.54	19,864.00	42.36	4,908.20	0.0168
2054	248,073	786,671.49	20,051.33	42.16	5,040.60	0.0173
2055	249,047	789,573.43	20,238.67	41.96	5,173.01	0.0177
2056	250,022	792,475.37	20,426.00	41.76	5,305.41	0.0181
2057	250,996	795,377.31	20,613.33	41.55	5,437.82	0.0185
2058	251,970	798,279.25	20,800.67	41.35	5,570.22	0.0189
Average	**234,920**	**747,495.27**	**17,522.33**	**44.90**	**3,253.15**	**0.0117**

3D. Travel Time Savings Backup 3, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 1, The Missing Moves**

Date: **August 21, 2023**

Table 3D-3. Tavel Time Savings Benefits Summary, Preferred Action Scenario, All Years

Year	Car Delay Savings (Hrs/Day)	Truck Delay Savings (Hrs/Day)	Car Savings Benefits ($/Day)	Truck Savings Benefits ($/Day)	Annual Benefits, Low (270 Days)	Annual Benefits, High (365 Days)
2023						
2024						
2025						
2026						
2027					$ -	$ -
2028	437.28	27.91	$ 13,728.96	$ 904.34	$ 3,950,990.33	$ 5,341,153.59
2029	597.89	38.16	$ 18,771.44	$ 1,236.49	$ 5,402,142.39	$ 7,302,896.19
2030	758.50	48.42	$ 23,813.93	$ 1,568.65	$ 6,853,294.45	$ 9,264,638.80
2031	919.11	58.67	$ 28,856.41	$ 1,900.80	$ 8,304,446.51	$ 11,226,381.40
2032	1,079.72	68.92	$ 33,898.89	$ 2,232.95	$ 9,755,598.58	$ 13,188,124.00
2033	1,240.33	79.17	$ 38,941.38	$ 2,565.11	$ 11,206,750.64	$ 15,149,866.61
2034	1,400.94	89.42	$ 43,983.86	$ 2,897.26	$ 12,657,902.70	$ 17,111,609.21
2035	1,561.55	99.67	$ 49,026.35	$ 3,229.41	$ 14,109,054.76	$ 19,073,351.81
2036	1,722.16	109.92	$ 54,068.83	$ 3,561.57	$ 15,560,206.83	$ 21,035,094.41
2037	1,882.77	120.18	$ 59,111.31	$ 3,893.72	$ 17,011,358.89	$ 22,996,837.02
2038	2,043.37	130.43	$ 64,153.80	$ 4,225.87	$ 18,462,510.95	$ 24,958,579.62
2039	2,203.98	140.68	$ 69,196.28	$ 4,558.03	$ 19,913,663.01	$ 26,920,322.22
2040	2,364.59	150.93	$ 74,238.76	$ 4,890.18	$ 21,364,815.08	$ 28,882,064.83
2041	2,525.20	161.18	$ 79,281.25	$ 5,222.33	$ 22,815,967.14	$ 30,843,807.43
2042	2,685.81	171.43	$ 84,323.73	$ 5,554.49	$ 24,267,119.20	$ 32,805,550.03
2043	2,846.42	181.69	$ 89,366.22	$ 5,886.64	$ 25,718,271.26	$ 34,767,292.63
2044	3,007.03	191.94	$ 94,408.70	$ 6,218.79	$ 27,169,423.33	$ 36,729,035.24
2045	3,167.64	202.19	$ 99,451.18	$ 6,550.95	$ 28,620,575.39	$ 38,690,777.84
2046	3,328.25	212.44	$ 104,493.67	$ 6,883.10	$ 30,071,727.45	$ 40,652,520.44
2047	3,488.86	222.69	$ 109,536.15	$ 7,215.25	$ 31,522,879.51	$ 42,614,263.05
2048	3,649.47	232.94	$ 114,578.64	$ 7,547.41	$ 32,974,031.58	$ 44,576,005.65
2049	3,810.08	243.20	$ 119,621.12	$ 7,879.56	$ 34,425,183.64	$ 46,537,748.25
2050	3,970.68	253.45	$ 124,663.60	$ 8,211.71	$ 35,876,335.70	$ 48,499,490.85
2051	4,131.29	263.70	$ 129,706.09	$ 8,543.87	$ 37,327,487.76	$ 50,461,233.46
2052	4,291.90	273.95	$ 134,748.57	$ 8,876.02	$ 38,778,639.83	$ 52,422,976.06
2053	4,452.51	284.20	$ 139,791.06	$ 9,208.17	$ 40,229,791.89	$ 54,384,718.66
2054	4,613.12	294.45	$ 144,833.54	$ 9,540.33	$ 41,680,943.95	$ 56,346,461.27
2055	4,773.73	304.71	$ 149,876.02	$ 9,872.48	$ 43,132,096.01	$ 58,308,203.87
2056	4,934.34	314.96	$ 154,918.51	$ 10,204.63	$ 44,583,248.08	$ 60,269,946.47
2057	5,094.95	325.21	$ 159,960.99	$ 10,536.79	$ 46,034,400.14	$ 62,231,689.08
2058	5,094.95	325.21	$ 159,960.99	$ 10,536.79	$ 46,034,400.14	$ 62,231,689.08
Total			**$ 2,765,310.24**	**$ 182,153.68**	**$ 795,815,257.12**	**$ 1,075,824,329.07**

3. Travel Time Savings Summary

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

This project will reduce travel times and distance by providing more efficient access to the freeway for the Quonset Development Corporation campus and adjacent community. The challenge of congestion and delay becomes more significant in future years as the Quonset Development Corporation continues to expand the campus.

Traffic analyses for this application studied the network as a year-round trip generator and destination because it is home to commercial developments that are busy every day. The proposed improvements in this project were conceived to allow traffic to flow through the network more easily through the construction of missing ramps accessing Route 403 WB. The missing ramps provide more efficient connectivity to Route 403 removing commuter and commercial traffic from adjacent residential roads. The estimated shift in vehicles off of Devil's Foot Road and on to Route 403 is 2,500 vehicles per day. This is a mix is commuters working in the area and commercial vehicles that typically travel between sections of the QDC campus.

This project will generate an estimated $13.8 million in travel time savings benefits in the first year of operations (2028). Over 30 years, travel time savings are total $270 million.

Assumptions, methodology, a description of the baseline scenario, source of data, and key input parameters are documented in Tabs 3B, 3C, and 3D and in Appendix A-2.

Table 3-1. Travel Time Savings Benefits Summary, Opening Year (2028)

Scenario	Total Traffic in Network (Veh/Day)	Vehicle Miles Traveled (VMT/Day)	Vehicle Hours Traveled (VHT/Day)	Average Speed (MPH)	Average Delay (Hrs/Veh/Day)	Travel Time Savings Benefit ($/Day)	Annual Benefit ($/Year)
2028 No-Build	68,660.00	87,630.58	3,627.45	31.04	0.03	$ -	-
2028 Preferred Action	69,231.00	90,511.74	2,552.50	35.77	0.01	$ 37,841.57	13,812,174.08

Table 3-2. Travel Time Savings Benefits Summary, Design Year (2058)

Scenario	Total Traffic in Network (Veh/Day)	Vehicle Miles Traveled (VMT/Day)	Vehicle Hours Traveled (VHT/Day)	Average Speed (MPH)	Average Delay (Hrs/Veh/Day)	Travel Time Savings Benefit ($/Day)	Annual Benefit ($/Year)
2058 No-Build	80,599.00	105,000.46	4,203.34	31.35	0.03	$ -	-
2058 Preferred Action	82,661.00	109,707.22	3,116.91	35.87	0.01	$ 54,607.48	19,931,730.03

Table 3-3. Travel Time Savings Change Rates, 2028-2058

Scenario	Total Traffic in Network (Veh/Day)	Vehicle Miles Traveled (VMT/Day)	Vehicle Hours Traveled (VHT/Day)	Average Speed (MPH)	Average Delay (Hrs/Veh/Day)	Travel Time Savings Benefit ($/Day)	Annual Benefit ($/Year)
Annual Change No-Build	397.97	579.00	19.20	0.01	0.00	$ -	-
Annual Change Preferred Action	447.67	639.85	18.81	0.00	0.00	$ 558.86	203,985.20

Table 3.4 Travel Time Savings Summary

Scenario	Total Traffic in Network (Avg. Veh/Day)	Vehicle Miles Traveled (Avg. VMT/Day)	Vehicle Hours Traveled (Avg. VHT/Day)	Average Speed (MPH)	Total Delay (Avg. Hours/Day)	Travel Time Savings Benefit (Avg. $/Year)	30-Year Total
No-Build, 2028-2058	74,032.55	95,447.03	3,886.60	31.18	1,511.84	0	0
Preferred Action, 2028-2058	75,274.50	99,149.71	2,806.49	35.82	488.24	$ 9,018,412.13	$ 270,552,364.00
Total	**1,241.95**	**3,702.68**	**(1,080.11)**	**4.64**	**(1,023.60)**	**$ 9,018,412.13**	**$ 270,552,364.00**

3B. Travel Time Savings Backup, 2027 (Opening Year)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Assumptions	The analysis assumes that traffic patterns remain consistent through this study area, however, traffic volumes will continue to grow at a rate of approximately 0.25% annually over the 30-year planning horizon for this analysis. Additionally, known development in the study area anticipated before Opening Year (2028) is also included as part of traffic growth. Quonset Business Park is projected to generate 5,000 new jobs upon full buildout. Growth in delay times and volumes are assumed to be linear between the opening year and design year.
Methodology	VISSIM microscopic traffic modelling software was used to project travel times through the study area for five different scenarios (2023 Existing, 2028 No-Build, 2028 Preferred Action - Opening Year, 2058 No-Build, and 2058 Preferred Action). Each scenarios was run for a 15-hour period from 5:00am-8:00pm for 10 iterations (random seeds) each. Model outputs included vehicles in the network, vehicle miles traveled, vehicle hours traveled, average speed, and average delay. In this tab (3B), 2028 travel time impacts are profiled for existing, no-action, and preferred action scenarios. In Tab 3C, no-action and preferred action scenarios are profiled for the design year (2058). In Tab 3D, those inputs were then extended to annual impacts. 2028 impacts are calculated as a baseline benefits year, but benefits are not captured in that year as the project is expected to complete in late 2028.
Baseline	The Existing Condtion model represents a 2023 condition.
Sources of Data	Historic and 2022 turning movement counts and traffic volume data adjusted to represent a 2023 Existing Condition.
Key Input Parameters	The model outputs were monetized using the value of travel time savings and assumed vehicle occupancy rates provided by the Benefit Cost Analysis Guidance for Discretionary Grant Programs (March 2022).

3B. Travel Time Savings Backup, 2027 (Opening Year)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 2, The Quonset Connector Ramps**

Date: **August 21, 2023**

Table 3B-1. Project Limit Network MOEs Summary - Existing 2023 Conditions

Time	Total Vehicles in Network	VMT: Total Path Distance (mi)	VHT: Total Time in Network (hr)	Average Speed (mph)	Total Delay (hr)	Average Delay (hr/veh)
5:00 AM	3,192	5,787	132	44	9	0.003
6:00 AM	3,919	5,935	153	39	15	0.004
7:00 AM	4,185	6,172	161	38	18	0.004
8:00 AM	4,470	5,957	172	35	25	0.006
9:00 AM	3,004	3,831	116	33	17	0.006
10:00 AM	2,912	3,412	109	31	17	0.006
11:00 AM	3,509	4,021	134	30	24	0.007
12:00 PM	5,190	6,214	209	30	42	0.008
1:00 PM	4,893	5,954	193	31	35	0.007
2:00 PM	7,193	9,418	298	32	66	0.009
3:00 PM	7,394	9,142	329	28	98	0.013
4:00 PM	5,617	6,663	220	30	49	0.009
5:00 PM	4,957	5,751	187	31	35	0.007
6:00 PM	3,408	3,823	127	30	22	0.006
7:00 PM	2,392	2,714	87	31	12	0.005
Total	**66,235.00**	**84,792.24**	**2,626.55**	**32.86**	**484.97**	**0.01**

3B. Travel Time Savings Backup, 2027 (Opening Year)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 2, The Quonset Connector Ramps**

Date: **August 21, 2023**

Table 3B-2. Delays by Vehicle Type, Existing 2023 Conditions

Time	Car Traffic Share	Truck Traffic Share	Car Traffic	Car Delay (hrs)	Truck Traffic	Truck Delay (hrs)
5:00 AM	94%	6%	3,000	8.48	192	0.54
6:00 AM	94%	6%	3,684	14.06	235	0.90
7:00 AM	94%	6%	3,934	16.70	251	1.07
8:00 AM	94%	6%	4,202	23.86	268	1.52
9:00 AM	94%	6%	2,824	15.59	180	0.99
10:00 AM	94%	6%	2,737	15.88	175	1.01
11:00 AM	94%	6%	3,298	22.14	211	1.41
12:00 PM	94%	6%	4,879	39.87	311	2.54
1:00 PM	94%	6%	4,599	33.35	294	2.13
2:00 PM	94%	6%	6,761	62.21	432	3.97
3:00 PM	94%	6%	6,950	92.77	444	5.92
4:00 PM	94%	6%	5,280	45.76	337	2.92
5:00 PM	94%	6%	4,660	33.30	297	2.13
6:00 PM	94%	6%	3,204	20.54	204	1.31
7:00 PM	94%	6%	2,248	11.59	144	0.74
Total			**62,260.90**	**456.09**	**3,974.10**	**29.11**

Table 3B-3. Project Limits Network MOEs Summary, Projected 2028 No-Action Conditions

Time	Total Vehicles in Network	VMT: Total Path Distance (mi)	VHT: Total Time in Network (hr)	Average Speed (mph)	Total Delay (hr)	Average Delay (hr/veh)
5:00 AM	3,329	6,006	138	44	10	0.003
6:00 AM	4,189	6,327	163	39	16	0.004
7:00 AM	4,440	6,544	172	38	19	0.004
8:00 AM	4,731	6,326	184	34	27	0.006
9:00 AM	3,207	4,104	124	33	18	0.006
10:00 AM	3,002	3,548	113	31	17	0.006
11:00 AM	3,598	4,156	139	30	24	0.007
12:00 PM	5,313	6,377	216	29	45	0.008
1:00 PM	5,019	6,112	199	31	37	0.007
2:00 PM	7,503	9,872	315	31	72	0.010
3:00 PM	7,790	9,711	396	25	154	0.020
4:00 PM	5,735	6,768	356	24	185	0.039
5:00 PM	4,915	5,640	392	26	249	0.069
6:00 PM	3,405	3,604	373	25	277	0.100
7:00 PM	2,484	2,537	347	26	280	0.112
Total	**68,660.00**	**87,630.58**	**3,627.45**	**31.04**	**1,430.46**	**0.03**

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 2, The Quonset Connector Ramps**

Date: **August 21, 2023**

Table 3B-4. Delays by Vehicle Type, Projected 2028 No-Action Conditions

Time	Car Traffic Share	Truck Traffic Share	Car Traffic	Car Delay (hrs)	Truck Traffic	Truck Delay (hrs)
5:00 AM	94%	6%	3,129	8.94	200	0.57
6:00 AM	94%	6%	3,938	15.29	251	0.98
7:00 AM	94%	6%	4,174	17.96	266	1.15
8:00 AM	94%	6%	4,447	25.50	284	1.63
9:00 AM	94%	6%	3,015	16.85	192	1.08
10:00 AM	94%	6%	2,822	16.39	180	1.05
11:00 AM	94%	6%	3,382	22.86	216	1.46
12:00 PM	94%	6%	4,994	42.24	319	2.70
1:00 PM	94%	6%	4,718	34.74	301	2.22
2:00 PM	94%	6%	7,053	68.06	450	4.34
3:00 PM	94%	6%	7,323	147.29	467	9.40
4:00 PM	94%	6%	5,391	211.68	344	13.51
5:00 PM	94%	6%	4,620	319.20	295	20.37
6:00 PM	94%	6%	3,201	318.84	204	20.35
7:00 PM	94%	6%	2,335	262.08	149	16.73
Total			**64,540.40**	**1,527.91**	**4,119.60**	**97.53**

Table 3B-5. Project Limits Network MOEs Summary - Projected 2028 (Opening Year) Proposed Action Conditions

Time	Total Vehicles Traveling Within the Network	VMT: Total Path Distance (mi)	VHT: Total Time Within the Network (hr)	Average Speed (mph)	Total Delay: All Vehicles (hr)	Average Delay: Per Vehicle (hr/veh)
5:00 AM	3,332	6,011	133	45	11	0.003
6:00 AM	4,193	6,366	154	41	14	0.003
7:00 AM	4,398	6,538	161	41	18	0.004
8:00 AM	4,708	6,355	171	37	25	0.005
9:00 AM	3,188	4,136	116	36	17	0.005
10:00 AM	2,990	3,559	103	35	15	0.005
11:00 AM	3,593	4,190	126	33	20	0.006
12:00 PM	5,288	6,399	195	33	37	0.007
1:00 PM	5,016	6,192	182	34	30	0.006
2:00 PM	7,473	10,009	292	34	60	0.008
3:00 PM	7,864	10,086	305	33	67	0.009
4:00 PM	5,880	7,268	214	34	41	0.007
5:00 PM	5,259	6,349	189	34	35	0.007
6:00 PM	3,570	4,120	126	33	21	0.006
7:00 PM	2,479	2,933	85	34	11	0.005
Total	**69,231.00**	**90,511.74**	**2,552.50**	**35.77**	**422.51**	**0.01**

3B. Travel Time Savings Backup, 2027 (Opening Year)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Table 3B-6. Project Limits Network MOEs Summary - Projected 2028 (Opening Year) Proposed Action Delays

Time	Car Traffic Share	Truck Traffic Share	Car Traffic	Car Delay (hrs)	Truck Traffic	Truck Delay (hrs)
5:00 AM	94%	6%	3,132	9.89	200	0.63
6:00 AM	94%	6%	3,941	13.50	252	0.86
7:00 AM	94%	6%	4,134	17.18	264	1.10
8:00 AM	94%	6%	4,426	23.52	282	1.50
9:00 AM	94%	6%	2,997	15.82	191	1.01
10:00 AM	94%	6%	2,811	13.69	179	0.87
11:00 AM	94%	6%	3,377	18.67	216	1.19
12:00 PM	94%	6%	4,971	34.41	317	2.20
1:00 PM	94%	6%	4,715	28.54	301	1.82
2:00 PM	94%	6%	7,025	56.63	448	3.61
3:00 PM	94%	6%	7,392	63.18	472	4.03
4:00 PM	94%	6%	5,527	38.54	353	2.46
5:00 PM	94%	6%	4,943	32.97	316	2.10
6:00 PM	94%	6%	3,356	19.99	214	1.28
7:00 PM	94%	6%	2,330	10.58	149	0.68
Total			**65,077.14**	**397.10**	**4,153.86**	**25.35**

Table 3B-7. Travel Time Savings Benefits Summary - Projected 2028 Conditions

Time	Car Delay Savings (hrs)	Truck Delay Savings (hrs)	Car Savings Benefits (Daily)	Truck Savings Benefits (Daily)	Total Benefits, Low (270 Days)	Total Benefits, High (365 Days)
5:00 AM	(0.96)	(0.06)	$ (30.03)	$ (1.98)	$ (8,641.15)	$ (11,681.56)
6:00 AM	1.79	0.11	$ 56.26	$ 3.71	$ 16,190.20	$ 21,886.76
7:00 AM	0.78	0.05	$ 24.44	$ 1.61	$ 7,034.06	$ 9,509.00
8:00 AM	1.98	0.13	$ 62.17	$ 4.10	$ 17,891.84	$ 24,187.11
9:00 AM	1.02	0.07	$ 32.14	$ 2.12	$ 9,250.40	$ 12,505.17
10:00 AM	2.70	0.17	$ 84.91	$ 5.59	$ 24,434.70	$ 33,032.10
11:00 AM	4.19	0.27	$ 131.48	$ 8.66	$ 37,838.65	$ 51,152.25
12:00 PM	7.83	0.50	$ 245.97	$ 16.20	$ 70,785.72	$ 95,691.80
1:00 PM	6.20	0.40	$ 194.74	$ 12.83	$ 56,043.34	$ 75,762.30
2:00 PM	11.43	0.73	$ 358.97	$ 23.65	$ 103,304.87	$ 139,652.88
3:00 PM	84.10	5.37	$ 2,640.51	$ 173.93	$ 759,900.86	$ 1,027,273.39
4:00 PM	173.15	11.05	$ 5,436.09	$ 358.08	$ 1,564,424.82	$ 2,114,870.59
5:00 PM	286.23	18.27	$ 8,986.40	$ 591.94	$ 2,586,151.67	$ 3,496,093.93
6:00 PM	298.86	19.08	$ 9,382.93	$ 618.06	$ 2,700,267.26	$ 3,650,361.30
7:00 PM	251.50	16.05	$ 7,895.99	$ 520.12	$ 2,272,347.42	$ 3,071,877.06
Total			**$ 35,502.96**	**$ 2,338.61**	**$ 10,217,224.66**	**$ 13,812,174.08**

3C. Travel Time Savings Backup, 2057 (Last Year of Analysis)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Table 3C-1. Project Limit Network MOEs Summary - Projected 2058 No-Action Conditions

Time	Total Vehicles in Network	VMT: Total Path Distance (mi)	VHT: Total Time in Network (hr)	Average Speed (mph)	Total Delay (hr)	Average Delay (hr/veh)
5:00 AM	3,894	6,914	162	43	14	0.004
6:00 AM	5,288	7,927	208	38	25	0.005
7:00 AM	5,476	8,076	213	38	26	0.005
8:00 AM	5,763	7,787	223	35	33	0.006
9:00 AM	4,009	5,220	155	34	22	0.006
10:00 AM	3,352	4,014	129	31	22	0.007
11:00 AM	3,974	4,655	157	30	30	0.008
12:00 PM	5,677	6,835	267	27	85	0.016
1:00 PM	5,288	6,416	306	28	139	0.037
2:00 PM	8,374	11,024	480	29	214	0.040
3:00 PM	9,353	12,036	557	26	266	0.044
4:00 PM	7,064	8,743	442	27	226	0.052
5:00 PM	6,217	7,607	375	29	185	0.049
6:00 PM	4,027	4,545	287	28	166	0.060
7:00 PM	2,843	3,201	242	29	158	0.064
Total	**80,599.00**	**105,000.46**	**4,203.34**	**31.35**	**1,611.31**	**0.03**

Table 3C-2. Delays by Vehicle Type, Projected 2058 No-Action Conditions

Time	Car Traffic Share	Truck Traffic Share	Car Traffic	Car Delay (hrs)	Truck Traffic	Truck Delay (hrs)
5:00 AM	94%	6%	3,660.36	13.21	233.64	0.84
6:00 AM	94%	6%	4,970.72	23.90	317.28	1.53
7:00 AM	94%	6%	5,147.44	24.02	328.56	1.53
8:00 AM	94%	6%	5,417.22	31.34	345.78	2.00
9:00 AM	94%	6%	3,768.46	21.13	240.54	1.35
10:00 AM	94%	6%	3,150.88	20.50	201.12	1.31
11:00 AM	94%	6%	3,735.56	28.60	238.44	1.83
12:00 PM	94%	6%	5,336.38	87.44	340.62	5.58
1:00 PM	94%	6%	4,970.72	186.28	317.28	11.89
2:00 PM	94%	6%	7,871.56	312.96	502.44	19.98
3:00 PM	94%	6%	8,791.82	383.13	561.18	24.45
4:00 PM	94%	6%	6,640.16	345.75	423.84	22.07
5:00 PM	94%	6%	5,843.98	288.85	373.02	18.44
6:00 PM	94%	6%	3,785.38	227.95	241.62	14.55
7:00 PM	94%	6%	2,672.42	170.92	170.58	10.91
Total			**75,763.06**	**2,165.99**	**4,835.94**	**138.25**

3C. Travel Time Savings Backup, 2057 (Last Year of Analysis)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Table 3C-3. Project Limits Network MOEs Summary - Projected 2058 Proposed Action Conditions

Time	Total Vehicles Traveling Within the Network	VMT: Total Path Distance (mi)	VHT: Total Time Within the Network (hr)	Average Speed (mph)	Total Delay: All Vehicles (hr)	Average Delay: Per Vehicle (hr/veh)
5:00 AM	3,892	6,908	154	45	10	0.003
6:00 AM	5,282	7,964	193	41	19	0.004
7:00 AM	5,457	8,091	199	41	22	0.004
8:00 AM	5,749	7,840	209	38	30	0.005
9:00 AM	3,997	5,227	143	37	19	0.005
10:00 AM	3,338	4,029	115	35	16	0.005
11:00 AM	3,959	4,680	140	33	22	0.006
12:00 PM	5,796	7,060	217	32	43	0.007
1:00 PM	5,493	6,806	200	34	34	0.006
2:00 PM	8,813	11,911	350	34	78	0.009
3:00 PM	9,901	13,109	435	30	136	0.014
4:00 PM	7,404	9,374	283	33	64	0.009
5:00 PM	6,536	8,283	235	35	40	0.006
6:00 PM	4,172	4,971	146	34	22	0.005
7:00 PM	2,872	3,454	98	35	12	0.004
Total	**82,661.00**	**109,707.22**	**3,116.91**	**35.87**	**568.57**	**0.01**

Table 3C-4. Project Limits Network MOEs Summary - Projected 2058 Delays, Proposed Action

Time	Car Traffic Share	Truck Traffic Share	Car Traffic	Car Delay (hrs)	Truck Traffic	Truck Delay (hrs)
5:00 AM	94%	6%	3,658.48	9.78	233.52	0.62
6:00 AM	94%	6%	4,965.08	17.83	316.92	1.14
7:00 AM	94%	6%	5,129.58	20.89	327.42	1.33
8:00 AM	94%	6%	5,404.06	28.24	344.94	1.80
9:00 AM	94%	6%	3,757.18	18.31	239.82	1.17
10:00 AM	94%	6%	3,137.72	14.77	200.28	0.94
11:00 AM	94%	6%	3,721.46	20.66	237.54	1.32
12:00 PM	94%	6%	5,448.24	40.60	347.76	2.59
1:00 PM	94%	6%	5,163.42	31.54	329.58	2.01
2:00 PM	94%	6%	8,284.22	73.57	528.78	4.70
3:00 PM	94%	6%	9,306.94	127.66	594.06	8.15
4:00 PM	94%	6%	6,959.76	60.36	444.24	3.85
5:00 PM	94%	6%	6,143.84	37.94	392.16	2.42
6:00 PM	94%	6%	3,921.68	20.78	250.32	1.33
7:00 PM	94%	6%	2,699.68	11.23	172.32	0.72
Total			**77,701.34**	**534.16**	**4,959.66**	**34.10**

3C. Travel Time Savings Backup, 2057 (Last Year of Analysis)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Table 4C-7. Travel Time Savings Benefits Summary - Projected 2058 Conditions

Time	Car Delay Savings (hrs)	Truck Delay Savings (hrs)	Car Savings Benefits (Daily)	Truck Savings Benefits (Daily)	Total Benefits, Low (270 Days)	Total Benefits, High (365 Days)
5:00 AM	3.43	0.22	$ 107.74	$ 7.10	$ 31,004.89	$ 41,914.02
6:00 AM	6.07	0.39	$ 190.51	$ 12.55	$ 54,825.91	$ 74,116.51
7:00 AM	3.13	0.20	$ 98.35	$ 6.48	$ 28,303.96	$ 38,262.76
8:00 AM	3.11	0.20	$ 97.59	$ 6.43	$ 28,085.55	$ 37,967.50
9:00 AM	2.83	0.18	$ 88.82	$ 5.85	$ 25,560.55	$ 34,554.07
10:00 AM	5.72	0.37	$ 179.74	$ 11.84	$ 51,725.24	$ 69,924.86
11:00 AM	7.93	0.51	$ 249.08	$ 16.41	$ 71,680.19	$ 96,901.00
12:00 PM	46.84	2.99	$ 1,470.53	$ 96.86	$ 423,195.46	$ 572,097.57
1:00 PM	154.74	9.88	$ 4,858.15	$ 320.01	$ 1,398,103.28	$ 1,890,028.51
2:00 PM	239.39	15.28	$ 7,515.94	$ 495.08	$ 2,162,975.91	$ 2,924,022.99
3:00 PM	255.47	16.31	$ 8,020.67	$ 528.33	$ 2,308,228.83	$ 3,120,383.42
4:00 PM	285.39	18.22	$ 8,960.19	$ 590.22	$ 2,578,610.93	$ 3,485,899.96
5:00 PM	250.92	16.02	$ 7,877.78	$ 518.92	$ 2,267,108.70	$ 3,064,795.10
6:00 PM	207.17	13.22	$ 6,504.26	$ 428.44	$ 1,871,830.86	$ 2,530,438.01
7:00 PM	159.68	10.19	$ 5,013.39	$ 330.24	$ 1,442,779.20	$ 1,950,423.74
Total	**1,631.82**	**104.16**	**$ 51,232.73**	**$ 3,374.75**	**$ 14,744,019.47**	**$ 19,931,730.03**

3D. Travel Time Savings Backup 3, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Table 3D-1. Daily Project Limits Network MOEs Summary, No-Action Scenario by Year

Year	Total Traffic in Network (Veh/Day)	Vehicle Miles Traveled (VMT/Day)	Vehicle Hours Traveled (VHT/Day)	Average Speed (MPH)	Total Delay (hrs/day)	Average Delay (Hrs/Veh/Day)
2023	67,068	85,314.60	3,550.67	31.00	1,406.35	0.0267
2024	67,466	85,893.59	3,569.86	31.01	1,412.38	0.0267
2025	67,864	86,472.59	3,589.06	31.02	1,418.40	0.0267
2026	68,262	87,051.58	3,608.26	31.03	1,424.43	0.0267
2027	68,660	87,630.58	3,627.45	31.04	1,430.46	0.0267
2028	69,058	88,209.58	3,646.65	31.05	1,436.49	0.0267
2029	69,456	88,788.57	3,665.85	31.06	1,442.52	0.0267
2030	69,854	89,367.57	3,685.04	31.07	1,448.55	0.0267
2031	70,252	89,946.56	3,704.24	31.08	1,454.57	0.0267
2032	70,650	90,525.56	3,723.43	31.09	1,460.60	0.0267
2033	71,048	91,104.56	3,742.63	31.10	1,466.63	0.0267
2034	71,446	91,683.55	3,761.83	31.11	1,472.66	0.0267
2035	71,844	92,262.55	3,781.02	31.12	1,478.69	0.0267
2036	72,242	92,841.54	3,800.22	31.13	1,484.72	0.0267
2037	72,640	93,420.54	3,819.41	31.14	1,490.74	0.0267
2038	73,038	93,999.54	3,838.61	31.15	1,496.77	0.0267
2039	73,436	94,578.53	3,857.81	31.16	1,502.80	0.0267
2040	73,834	95,157.53	3,877.00	31.17	1,508.83	0.0267
2041	74,232	95,736.52	3,896.20	31.18	1,514.86	0.0267
2042	74,630	96,315.52	3,915.40	31.19	1,520.89	0.0267
2043	75,027	96,894.52	3,934.59	31.20	1,526.91	0.0267
2044	75,425	97,473.51	3,953.79	31.21	1,532.94	0.0267
2045	75,823	98,052.51	3,972.98	31.22	1,538.97	0.0267
2046	76,221	98,631.50	3,992.18	31.23	1,545.00	0.0267
2047	76,619	99,210.50	4,011.38	31.24	1,551.03	0.0267
2048	77,017	99,789.50	4,030.57	31.25	1,557.06	0.0268
2049	77,415	100,368.49	4,049.77	31.26	1,563.08	0.0268
2050	77,813	100,947.49	4,068.96	31.28	1,569.11	0.0268
2051	78,211	101,526.48	4,088.16	31.29	1,575.14	0.0268
2052	78,609	102,105.48	4,107.36	31.30	1,581.17	0.0268
2053	79,007	102,684.48	4,126.55	31.31	1,587.20	0.0268
2054	79,405	103,263.47	4,145.75	31.32	1,593.22	0.0268
2055	79,803	103,842.47	4,164.94	31.33	1,599.25	0.0268
2056	80,201	104,421.46	4,184.14	31.34	1,605.28	0.0268
2057	80,599	105,000.46	4,203.34	31.35	1,611.31	0.0268
2058	80,997	105,579.46	4,222.53	31.36	1,617.34	0.0268
Average	**74,033**	**95,447.03**	**3,886.60**	**31.18**	**1,511.84**	**0.0267**

3D. Travel Time Savings Backup 3, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Table 3D-2. Daily Project Limits Network MOEs Summary, Preferred Action Scenario by Year

Year	Total Traffic in Network (Veh/Day)	Vehicle Miles Traveled (VMT/Day)	Vehicle Hours Traveled (VHT/Day)	Average Speed (MPH)	Total Delay (hrs/day)	Average Delay (Hrs/Veh/Day)
2023	67,440	87,952.34	2,477.24	35.76	403.04	0.0056
2024	67,888	88,592.19	2,496.06	35.76	407.90	0.0057
2025	68,336	89,232.04	2,514.87	35.77	412.77	0.0057
2026	68,783	89,871.89	2,533.69	35.77	417.64	0.0057
2027	69,231	90,511.74	2,552.50	35.77	422.51	0.0057
2028	69,679	91,151.59	2,571.31	35.78	427.38	0.0057
2029	70,126	91,791.44	2,590.13	35.78	432.25	0.0057
2030	70,574	92,431.29	2,608.94	35.78	437.12	0.0057
2031	71,022	93,071.14	2,627.75	35.79	441.99	0.0057
2032	71,469	93,710.99	2,646.57	35.79	446.85	0.0058
2033	71,917	94,350.84	2,665.38	35.79	451.72	0.0058
2034	72,365	94,990.69	2,684.20	35.80	456.59	0.0058
2035	72,812	95,630.53	2,703.01	35.80	461.46	0.0058
2036	73,260	96,270.38	2,721.82	35.80	466.33	0.0058
2037	73,708	96,910.23	2,740.64	35.81	471.20	0.0058
2038	74,155	97,550.08	2,759.45	35.81	476.07	0.0058
2039	74,603	98,189.93	2,778.27	35.81	480.94	0.0058
2040	75,051	98,829.78	2,797.08	35.82	485.80	0.0059
2041	75,498	99,469.63	2,815.89	35.82	490.67	0.0059
2042	75,946	100,109.48	2,834.71	35.82	495.54	0.0059
2043	76,394	100,749.33	2,853.52	35.82	500.41	0.0059
2044	76,841	101,389.18	2,872.33	35.83	505.28	0.0059
2045	77,289	102,029.03	2,891.15	35.83	510.15	0.0059
2046	77,737	102,668.88	2,909.96	35.83	515.02	0.0059
2047	78,184	103,308.73	2,928.78	35.84	519.89	0.0060
2048	78,632	103,948.58	2,947.59	35.84	524.75	0.0060
2049	79,080	104,588.43	2,966.40	35.84	529.62	0.0060
2050	79,527	105,228.27	2,985.22	35.85	534.49	0.0060
2051	79,975	105,868.12	3,004.03	35.85	539.36	0.0060
2052	80,423	106,507.97	3,022.85	35.85	544.23	0.0060
2053	80,870	107,147.82	3,041.66	35.86	549.10	0.0060
2054	81,318	107,787.67	3,060.47	35.86	553.97	0.0060
2055	81,766	108,427.52	3,079.29	35.86	558.84	0.0061
2056	82,213	109,067.37	3,098.10	35.87	563.70	0.0061
2057	82,661	109,707.22	3,116.91	35.87	568.57	0.0061
2058	83,109	110,347.07	3,135.73	35.87	573.44	0.0061
Average	**75,275**	**99,149.71**	**2,806.49**	**35.82**	**488.24**	**0.0059**

3D. Travel Time Savings Backup 3, All Years

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Table 3D-3. Tavel Time Savings Benefits Summary, Preferred Action Scenario, All Years

Year	Car Delay Savings (Hrs/Day)	Truck Delay Savings (Hrs/Day)	Car Savings Benefits ($/Day)	Truck Savings Benefits ($/Day)	Annual Benefits, Low (270 Days)	Annual Benefits, High (365 Days)
2023						
2024						
2025						
2026						
2027					$ -	$ -
2028	949.65	60.62	$ 29,815.31	$ 1,963.96	$ 8,580,403.22	$ 11,599,433.99
2029	950.74	60.69	$ 29,849.53	$ 1,966.22	$ 8,590,251.74	$ 11,612,747.72
2030	951.83	60.76	$ 29,883.75	$ 1,968.47	$ 8,600,100.26	$ 11,626,061.46
2031	952.92	60.82	$ 29,917.97	$ 1,970.73	$ 8,609,948.78	$ 11,639,375.20
2032	954.01	60.89	$ 29,952.19	$ 1,972.98	$ 8,619,797.30	$ 11,652,688.94
2033	955.10	60.96	$ 29,986.42	$ 1,975.23	$ 8,629,645.82	$ 11,666,002.68
2034	956.19	61.03	$ 30,020.64	$ 1,977.49	$ 8,639,494.33	$ 11,679,316.41
2035	957.28	61.10	$ 30,054.86	$ 1,979.74	$ 8,649,342.85	$ 11,692,630.15
2036	958.37	61.17	$ 30,089.08	$ 1,982.00	$ 8,659,191.37	$ 11,705,943.89
2037	959.46	61.24	$ 30,123.30	$ 1,984.25	$ 8,669,039.89	$ 11,719,257.63
2038	960.55	61.31	$ 30,157.53	$ 1,986.51	$ 8,678,888.41	$ 11,732,571.37
2039	961.64	61.38	$ 30,191.75	$ 1,988.76	$ 8,688,736.93	$ 11,745,885.10
2040	962.73	61.45	$ 30,225.97	$ 1,991.01	$ 8,698,585.45	$ 11,759,198.84
2041	963.82	61.52	$ 30,260.19	$ 1,993.27	$ 8,708,433.96	$ 11,772,512.58
2042	964.91	61.59	$ 30,294.41	$ 1,995.52	$ 8,718,282.48	$ 11,785,826.32
2043	966.00	61.66	$ 30,328.63	$ 1,997.78	$ 8,728,131.00	$ 11,799,140.06
2044	967.09	61.73	$ 30,362.86	$ 2,000.03	$ 8,737,979.52	$ 11,812,453.80
2045	968.18	61.80	$ 30,397.08	$ 2,002.29	$ 8,747,828.04	$ 11,825,767.53
2046	969.27	61.87	$ 30,431.30	$ 2,004.54	$ 8,757,676.56	$ 11,839,081.27
2047	970.36	61.94	$ 30,465.52	$ 2,006.79	$ 8,767,525.08	$ 11,852,395.01
2048	971.45	62.01	$ 30,499.74	$ 2,009.05	$ 8,777,373.59	$ 11,865,708.75
2049	972.54	62.08	$ 30,533.97	$ 2,011.30	$ 8,787,222.11	$ 11,879,022.49
2050	973.63	62.15	$ 30,568.19	$ 2,013.56	$ 8,797,070.63	$ 11,892,336.22
2051	974.72	62.22	$ 30,602.41	$ 2,015.81	$ 8,806,919.15	$ 11,905,649.96
2052	975.81	62.29	$ 30,636.63	$ 2,018.06	$ 8,816,767.67	$ 11,918,963.70
2053	976.90	62.36	$ 30,670.85	$ 2,020.32	$ 8,826,616.19	$ 11,932,277.44
2054	977.99	62.43	$ 30,705.07	$ 2,022.57	$ 8,836,464.71	$ 11,945,591.18
2055	979.08	62.49	$ 30,739.30	$ 2,024.83	$ 8,846,313.22	$ 11,958,904.91
2056	980.17	62.56	$ 30,773.52	$ 2,027.08	$ 8,856,161.74	$ 11,972,218.65
2057	980.17	62.56	$ 30,773.52	$ 2,027.08	$ 8,856,161.74	$ 11,972,218.65
2058	981.26	62.63	$ 30,807.74	$ 2,029.34	$ 8,866,010.26	$ 11,985,532.39
Total	**965.93**	**61.66**	**$ 940,119.22**	**$ 61,926.57**	**$ 270,552,364.00**	**$ 365,746,714.30**

10. Future Eligible Project Costs (With INFRA)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Assumptions	Apart from the requested MPDG funding, no funding for this project requires satisfying any unique conditions. If RIDOT were to receive an award that differs from the request in this application, the Department would make every effort to identify alternative sources of funding to make up the gap and ensure that award execution and obligation would proceed on the timeline outlined in this application. If this project does not receive any grant funding, it will revert to its original limited scope and extended schedule. These calculations also assume that the project will begin construction in 2025.
Methodology	RIDOT and VHB developed a cost estimate based on the items identified in inspection reports, field reviews, and additional prioritization of preventative work to reduce further maintenance costs. Quantity-level estimates were developed and revised as shown below.
Baseline	N/A
Sources of Data	RIDOT WAUP data; bridge inspection data; historical average soft costs
Key Input Parameters	2% future inflation rate; RIDOT blue book cost escalation policies

Table 10-1. Future Eligible Project Costs by Phase and Task

Phase	Task	Federal Fiscal Year (FFY)	Expected Cost ($)	Contingency ($)	Total ($)
Design	Design	2022	$ 630,000.00	$ 70,000.00	$ 700,000.00
Design	Design and Construction Initiation	2023	$ 4,851,000.00	$ 539,000.00	$ 5,390,000.00
Design	Construction Phase 1	2024	$ 43,650,000.00	$ 4,850,000.00	$ 48,500,000.00
Construction	Construction Phase 2	2025	$ 16,380,000.00	$ 1,820,000.00	$ 18,200,000.00
Construction	Construction Phase 3	2026	$ 6,660,000.00	$ 740,000.00	$ 7,400,000.00
Construction	Project Closeout	2027	$ 9,729,000.00	$ 1,081,000.00	$ 10,810,000.00
Total			**$ 81,900,000.00**	**$ 9,100,000.00**	**$ 91,000,000.00**

10. Future Eligible Project Costs (With INFRA)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Assumptions	Apart from the requested MPDG funding, no funding for this project requires satisfying any unique conditions. If RIDOT were to receive an award that differs from the request in this application, the Department would make every effort to identify alternative sources of funding to make up the gap and ensure that award execution and obligation would proceed on the timeline outlined in this application. If this project does not receive any grant funding, it will revert to its original limited scope and extended schedule. These calculations also assume that the project will begin construction in 2024.
Methodology	RIDOT and VHB developed a cost estimate based on the items identified in inspection reports, field reviews, and additional prioritization of preventative work to reduce further maintenance costs. Quantity-level estimates were developed and revised as shown below.
Baseline	N/A
Sources of Data	RIDOT WAUP data; bridge inspection data; historical average soft costs
Key Input Parameters	2% future inflation rate; RIDOT blue book cost escalation policies

Table 10-1. Future Eligible Project Costs by Phase and Task

Phase	Task	Federal Fiscal Year (FFY)	Expected Cost ($)	Contingency ($)	Total ($)
Design	Design	2022	$ 432,000.00	$ 48,000.00	$ 480,000.00
Design	Design and Construction Initiation	2023	$ 1,971,000.00	$ 219,000.00	$ 2,190,000.00
Design	Construction Phase 1	2024	$ 17,910,000.00	$ 1,990,000.00	$ 19,900,000.00
Construction	Construction Phase 2	2025	$ 9,810,000.00	$ 1,090,000.00	$ 10,900,000.00
Construction	Construction Phase 3	2026	$ 4,612,500.00	$ 512,500.00	$ 5,125,000.00
Construction	Project Closeout	2027	$ 4,864,500.00	$ 540,500.00	$ 5,405,000.00
Total			**$ 39,600,000.00**	**$ 4,400,000.00**	**$ 44,000,000.00**

11. Work Zone Impact Costs (With Grant)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Assumptions	It is estimated that approximately **221,892** vehicles will be directly impacted by bridge work zone impacts from this project.
Methodology	To be conservative, RIDOT is calculating the anticipated work zone impact using 200% of the projected 2028 weighted average delay. In other words, this benefit-cost analysis assumes that for the duration of the construction period, typical DELAY times through the corridor will increase by 100% for all vehicles traveling through the immediate area. The construction timeframe for the preferred action scenario is approximately 30 days for the bridge work.
Baseline	Existing conditions and alignments within the project limits
Sources of Data	Traffic analysis presented in Section 4 of this BCA
Key Input Parameters	The expense of additional travel time for all affected vehicles is calculate below. From the U.S. Department of Transportation's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs," All Purpose private vehicle travel monetized value is $18.80 and for Commercial Vehicle operators (an average of truck drivers and bus drivers) is $32.40.

Table 11-1. Preferred Action Scenario Bridge Rehab Work Zone Impact

Daily Traffic:	221,892.00	vehicles
Percentage of daily cars:	94%	
Percentage of daily trucks:	6%	
Cost of Additional Travel Time (cars):	$18.80	dollars
Cost of Additional Travel Time (commercial):	$32.40	dollars
Additional commuting time:	0.0131	hours/day
Length of work zone impacts	30	days

Total Bridge Rehab Work Zone Impact $ 1,708,070.10
With Proposed Improvements (Preferred Action Scenario--With Grant)

Table 11-2. Projected Impact by Year

Year	**Cost**
2022	
2023	$ 113,871.34
2024	$ 455,485.36
2025	$ 455,485.36
2026	$ 455,485.36
2027	$ 227,742.68

11. Work Zone Impact Costs (With Grant)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Assumptions	It is estimated that approximately 68,660 vehicles will be directly impacted by bridge work zone impacts from this project.
Methodology	To be conservative, RIDOT is calculating the anticipated work zone impact using 200% of the projected 2028 weighted average delay. In other words, this benefit-cost analysis assumes that for the duration of the construction period, typical DELAY times through the corridor will increase by 100% for all vehicles traveling through the immediate area. The construction timeframe for the preferred action scenario is approximately 18 days for the bridge work.
Baseline	Existing conditions and alignments within the project limits
Sources of Data	Traffic analysis presented in Section 4 of this BCA
Key Input Parameters	The expense of additional travel time for all affected vehicles is calculate below. From the U.S. Department of Transportation's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs," All Purpose private vehicle travel monetized value is $17.80 and for Commercial Vehicle operators (an average of truck drivers and bus drivers) is $32.00.

Table 11-1. Preferred Action Scenario Bridge Rehab Work Zone Impact

Daily Traffic:	68,660	vehicles
Percentage of daily cars:	94%	
Percentage of daily trucks:	6%	
Cost of Additional Travel Time (cars):	$18.80	dollars
Cost of Additional Travel Time (commercial):	$32.40	dollars
Additional commuting time:	0.0267	hours/day
Length of work zone impacts	18	days

Total Bridge Rehab Work Zone Impact $ 647,661.31
With Proposed Improvements (Preferred Action Scenario--With Grant)

Table 11-2. Projected Impact by Year

Year	Cost	
2022		
2023	$ 43,177.42	3
2024	$ 172,709.68	12
2025	$ 172,709.68	12
2026	$ 172,709.68	12
2027	$ 86,354.84	6

12. Lifecycle Management Costs (With INFRA)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

Assumptions	Represents the anticipated 30-year maintenance needs for newly constructed infrastructure
Methodology	Based on historic bridge data and best practices, the existing bridge deterioration is projected to future years. Similarly, based on historic information, future unit cost projections are applied to the projected deterioration.
Baseline	Cost estimation based on bridge condition.
Sources of Data	RIDOT Bridge Inspection Reports, RIDOT weighted average unit price database.
Key Input Parameters	RIDOT historic cost estimates

Table 12-1. Future Bridge Maintenance Costs, Preferred Action Scenario

Bridge ID	Description / Task	Unit Cost	Iterations	30 Year Maintenance Cost	30-Year Cost ($)
100001	Bridge Inspection	$52,000	15	$780,000	$1,560,000
100001	High Pressure Water Cleaning on Bridge Structure	$23,500	15	$352,500	$705,000
100001	Concrete Surface Treatment (Protective Coating)	$96,000	5	$480,000	$960,000
100001	Joint Replacement	$94,500	4	$378,000	$756,000
100001	Paint Superstructure	$3,624,000	1	$3,624,000	$7,248,000
100001	Replace Wearing Surface	$3,613,000	1	$3,613,000	$7,226,000
				$0	$0
				$0	$0
				$0	$0
				$0	$0
				$0	$0
				$0	$0
Total					**$ 18,455,000.00**

12. Lifecycle Management Costs (With INFRA)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 1, The Missing Moves**

Date: **August 21, 2023**

Table 12-2. Future Pavement Maintenance Costs, Preferred Action Scenario

Road	Description/Task	Units/Square Feet/Each	Unit Cost/EA/SF	Iterations	Total Cost
I-95 South	Crack Sealing	1	$ 75,000.00	10	$ 750,000.00
New Ramps	Crack Sealing	1	$ 65,000.00	10	$ 650,000.00
I-95 S and Ramps	Mill & Fill	750,000.00	$ 3.00	2	$ 4,500,000.00
Subtotal Foregone Cost Before EC&M					**$ 5,900,000.00**
Engineering, Contingencies, and Mobilizations (30%)					$ 1,770,000.00
Subtotal Foregone Cost, Pavement Reconstruction					**$ 7,670,000.00**

Table 12-3. Future Eligible Costs Summary

Item	Description	Cost Over 30 Years
Bridge Maintenance	30-Year Lifecycle Maintenance	$ 18,455,000.00
Pavement Maintenance	30-Year Lifecycle Maintenance	$ 7,670,000.00
Total		**$ 26,125,000.00**

12. Lifecycle Management Costs (With INFRA)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 2, The Quonset Connector Ramps**

Date: **August 21, 2023**

Assumptions	Represents the anticipated 30-year maintenance needs for newly constructed infrastructure
Methodology	Based on historic bridge data and best practices, the existing bridge deterioration is projected to future years. Similarly, based on historic information, future unit cost projections are applied to the projected deterioration.
Baseline	Cost estimation based on bridge condition.
Sources of Data	RIDOT Bridge Inspection Reports, RIDOT weighted average unit price database.
Key Input Parameters	RIDOT historic cost estimates

Table 12-1. Future Bridge Maintenance Costs, Preferred Action Scenario

Bridge ID	Description / Task	Unit Cost	Iterations	30 Year Maintenance Cost	30-Year Cost ($)
N/A	Retaining Wall Inspection	$ 25,000.00	15	$ 375,000.00	$ 750,000.00
N/A	Sound Wall Inspection	$ 10,000.00	15	$ 150,000.00	$ 300,000.00
N/A	Misc Wall Maintenance	$ 50,000.00	5	$ 250,000.00	$ 500,000.00
				$ -	$ -
				$ -	$ -
				$ -	$ -
				$ -	$ -
				$ -	$ -
				$ -	$ -
				$ -	$ -
				$ -	$ -
				$ -	$ -
Total					**$ 1,550,000.00**

12. Lifecycle Management Costs (With INFRA)

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**

Component: **Component 2, The Quonset Connector Ramps**

Date: **August 21, 2023**

Table 12-2. Future Pavement Maintenance Costs, Preferred Action Scenario

Road	Description/Task	Units/Square Feet/Each	Unit Cost/EA/SF	Iterations	Total Cost
RI-403	Crack Sealing	1	$ 45,000.00	10	$ 450,000.00
New Ramps	Crack Sealing	1	$ 35,000.00	10	$ 350,000.00
RI-403 and Ramps	Mill & Fill	350,000.00	$ 3.00	2	$ 2,100,000.00
Subtotal Foregone Cost Before EC&M					**$ 2,900,000.00**
Engineering, Contingencies, and Mobilizations (30%)					$ 870,000.00
Subtotal Foregone Cost, Pavement Reconstruction					**$ 3,770,000.00**

Table 12-3. Future Eligible Costs Summary

Item	Description	Cost Over 30 Years
Bridge Maintenance	30-Year Lifecycle Maintenance	$ 1,550,000.00
Pavement Maintenance	30-Year Lifecycle Maintenance	$ 3,770,000.00
Total		**$ 5,320,000.00**

Appendix A. Parameter Values

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

This tab includes parameter values published in USDOT's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs" (March 2022).

The values listed on this tab are utilized throughout this benefit-cost analysis.

Table A-1/A-2. Value of Reduced Fatalities, Injuries, and Damage

KABCO Level/Crash Type	Monetized Value (2021 $)
O - No Injury	$ 4,000.00
C - Possible Injury	$ 78,500.00
B - Non-Incapacitating	$ 153,700.00
A - Incapacitating	$ 564,300.00
K - Killed	$ 11,800,000.00
U - Injured (Severity Unknown)	$ 213,900.00
# Accidents Reported (Unknown if Injured)	$ 162,600.00
Injury Crash	$ 307,800.00
Fatal Crash	$ 13,046,800.00

Table A-2. Property Damage Only (PDO) Crashes

Crash Type	Monetized Value (2021 $)
Property Damage Only (PDO)	$ 4,800.00

Table A-3. Recommended Travel Time Savings

Category	Hourly Value
Personal	$ 17.00
Business	$ 31.90
All Purposes	$ 18.80
Walking, Cycling, Waiting, Standing, and Transfer Time	$ 34.00
Truck Drivers	$ 32.40
Bus Drivers	$ 35.00
Transit Rail Operators	$ 58.40
Locomotive Engineers	$ 57.40

Table A-4. Average Vehicle Occupancy Rates for Highway Passenger Vehicles

Vehicle Type	Average Occupancy
Passenger Vehicles (Weekday Peak)	1.48
Passenger Vehicles (Weekday Off-Peak)	1.58
Passenger Vehicles (Weekend)	2.02
Passenger Vehicles (All Travel)	1.67

Table A-5. Vehicle Operating Costs

Vehicle Type	Recommended Value per Mile (2021 $)
Light Duty Vehicles	$ 0.46
Commercial Trucks	$ 1.01

Table A-6. Damage Costs for Emissions per Metric Ton*

Year	NOX	SOx	PM2.5	CO2
2022	$ 16,600.00	$ 44,300.00	$ 796,700.00	$ 56.00
2023	$ 16,800.00	$ 45,100.00	$ 810,500.00	$ 57.00
2024	$ 17,000.00	$ 46,000.00	$ 824,500.00	$ 58.00
2025	$ 17,200.00	$ 46,900.00	$ 838,800.00	$ 59.00
2026	$ 17,500.00	$ 47,800.00	$ 852,100.00	$ 60.00
2027	$ 17,900.00	$ 48,700.00	$ 865,600.00	$ 61.00
2028	$ 18,200.00	$ 49,500.00	$ 879,400.00	$ 62.00
2029	$ 18,600.00	$ 50,400.00	$ 893,400.00	$ 63.00
2030	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 65.00
2031	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 66.00
2032	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 67.00
2033	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 68.00
2034	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 69.00
2035	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 70.00
2036	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 72.00
2037	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 73.00
2038	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 74.00
2039	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 75.00
2040	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 76.00
2041	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 78.00
2042	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 79.00
2043	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 80.00
2044	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 81.00
2045	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 82.00
2046	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 84.00
2047	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 85.00
2048	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 86.00
2049	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 87.00
2050	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2051	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2052	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2053	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2054	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2055	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2056	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2057	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2058	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2059	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00

January 2023 USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs does not provide values beyond 2050, therefore those values are assumed to hold.

Table A-7. Inflation Adjustment Values

Base Year	Multiplier
2003	1.44
2004	1.40
2005	1.36
2006	1.32
2007	1.28
2008	1.26
2009	1.25
2010	1.24
2011	1.21
2012	1.19
2013	1.17
2014	1.15
2015	1.14
2016	1.12
2017	1.10
2018	1.08
2019	1.06
2020	1.04
2021	1.00

Table A-8. Pedestrian Facility Improvements

Improvement Type	Recommended Value
Expanded Sidewalk (per ft added width)	$ 0.11
Reducing Upslope by 1%	$ 1.05
Reducing Traffic Speed by 1mph (speeds ≤ 45 mph)	$ 0.09
Reducing Traffic Volume by 1 vph (for ADT ≤ 55,000)	$ 0.0009
Marked-Crosswalks on Roadway, Volume >10k/day	$ 0.18
Signal and Pedestrian Crossing on Roadway, Volume >1	$ 0.48

Table A-9. Cycling Facility Improvements

Facility Type	Recommended Value per Cycling Mile (2021 $)
Cycling Path with At-Grade Crossings	$ 1.49
Cycling Path with no at-Grade Crossings	$ 1.87
Dedicated Cycling Lane	$ 1.77
Cycling Boulevard/Sharrow	$ 0.28
Separated Cycle Track	$ 1.77

Table A-13. Mortality Reduction Benefits of Induced Active Transportation

Mode and Age Range	Recommended Value
Walking, Ages 20-74	$ 7.20
Cycling, Ages 20-64	$ 6.42

Table A-10. Transit Facility Amenity

Attribute Type	Bus Stop	Light Rail/Streetcar Stop	Rail Station
Clocks	$ 0.03	$ 0.03	$ 0.06
Electronic Real-Time Information Displays	$ 0.31	$ 0.15	$ 0.86
Information /Emergency Button	$ 0.24	$ 0.24	$ 0.11
PA System	$ 0.31	$ 0.05	$ 0.10
Platform/Stop Seating Availability1	$ 0.19	$ 0.13	$ 0.13
Platform/Stop Weather Protection1	$ 0.25	$ 0.16	$ 0.13
Restroom Availability	$ 0.14	$ 0.14	$ 0.10
Retail/Food Outlet Availability	$ 0.11	$ 0.11	$ 0.06
Staff Availability	$ 0.08	$ 0.03	$ 0.18
Step-Free Access to Station/Stop	$ 0.32	$ 0.32	$ 0.20
Step-Free Access to Vehicle	$ 0.42	$ 0.08	$ 0.07
Surveillance Cameras	$ 0.31	$ 0.31	$ 0.32
Temperature Controlled Environment1	$ 0.62	$ 0.62	$ 0.62
Ticket Machines	$ 0.10	$ 0.10	$ 0.07
Timetables	$ 0.23	$ 0.10	$ 0.48
Bike Facilities	$ -	$ -	$ 0.10
Car Access Facilities	$ -	$ -	$ 0.11
Elevator	$ -	$ -	$ 0.07
Escalators	$ -	$ -	$ 0.04
On-Site Ticket Office	$ -	$ -	$ 0.09
Taxi Pickup/Dropoff	$ -	$ -	$ 0.05
Waiting Room	$ -	$ -	$ 0.20

Table A-11. Transit Vehicle Amenity Values

Attribute Type	Bus	Light Rail/Streetcar	Rail
Electronic Real-Time Information Displays	$ 0.22	$ 0.22	$ 0.22
Handrails	$ 0.13	$ 0.13	$ 0.31
Luggage Storage	$ 0.09	$ 0.09	$ 0.09
PA System	$ 0.38	$ 0.38	$ 0.39
Surveillance Cameras	$ 0.22	$ 0.22	$ 0.63
Temperature Control	$ 0.31	$ 0.12	$ 0.47
Wheelchair Space	$ 0.04	$ 0.04	$ 0.04
Food Service Availability	$ -	$ -	$ 0.03
Restroom Availability	$ -	$ -	$ 0.19

Table A-12. Transit Mode Ride and Boarding Quality Revealed Preference Values

Transit Mode	Boarding Qual	Vehicle Ride Quality**
Low-Intensive BRT	$ 0.31	$ 0.38
Medium-Intensive BRT	$ 0.63	$ 0.75
High-Intensive BRT	$ 1.57	$ 1.50
Streetcar or On-street Light Rail Transit	$ 1.88	$ 1.88
Off-street Light Rail Transit	$ 3.13	$ 3.38
Heavy Rail	$ 3.45	$ 3.76
Commuter Rail	$ 5.01	$ 3.76
Ferry	$ 3.45	$ 3.76

*Benefit per Boarding

**Benefit per passenger hour

Table A-14. External Highway Use Costs Noise and Congestion

Vehicle Type	Location	Congestion (2020 $)	Noise (2020 $)
Light Duty	Urban	$ 0.1240	$ 0.0017
Light Duty	Rural	$ 0.0260	$ 0.0002
Light Duty	All	$ 0.1040	$ 0.0010
Buses and Trucks	Urban	$ 0.3100	$ 0.0393
Buses and Trucks	Rural	$ 0.0670	$ 0.0033
Buses and Trucks	All	$ 0.2120	$ 0.0197
All Vehicles	Urban	$ 0.1380	$ 0.0046
All Vehicles	Rural	$ 0.0330	$ 0.0006
All Vehicles	All	$ 0.1150	$ 0.0028

Appendix A. Parameter Values

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

This tab includes parameter values published in USDOT's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs" (March 2022).

The values listed on this tab are utilized throughout this benefit-cost analysis.

Table A-1/A-2. Value of Reduced Fatalities, Injuries, and Damage

KABCO Level/Crash Type	Monetized Value (2021 $)
O - No Injury	$ 4,000.00
C - Possible Injury	$ 78,500.00
B - Non-Incapacitating	$ 153,700.00
A - Incapacitating	$ 564,300.00
K - Killed	$ 11,800,000.00
U - Injured (Severity Unknown)	$ 213,900.00
# Accidents Reported (Unknown if Injured)	$ 162,600.00
Injury Crash	$ 307,800.00
Fatal Crash	$ 13,046,800.00

Table A-2. Property Damage Only (PDO) Crashes

Crash Type	Monetized Value (2021 $)
Property Damage Only (PDO)	$ 4,800.00

Table A-3. Recommended Travel Time Savings

Category	Hourly Value
Personal	$ 17.00
Business	$ 31.90
All Purposes	$ 18.80
Walking, Cycling, Waiting, Standing, and Transfer Time	$ 34.00
Truck Drivers	$ 32.40
Bus Drivers	$ 35.00
Transit Rail Operators	$ 58.40
Locomotive Engineers	$ 57.40

Table A-4. Average Vehicle Occupancy Rates for Highway Passenger Vehicles

Vehicle Type	Average Occupancy
Passenger Vehicles (Weekday Peak)	1.48
Passenger Vehicles (Weekday Off-Peak)	1.58
Passenger Vehicles (Weekend)	2.02
Passenger Vehicles (All Travel)	1.67

Table A-5. Vehicle Operating Costs

Vehicle Type	Recommended Value per Mile (2021 $)
Light Duty Vehicles	$ 0.46
Commercial Trucks	$ 1.01

Table A-6. Damage Costs for Emissions per Metric Ton*

Year	NOX	SOx	PM2.5	CO2
2022	$ 16,600.00	$ 44,300.00	$ 796,700.00	$ 56.00
2023	$ 16,800.00	$ 45,100.00	$ 810,500.00	$ 57.00
2024	$ 17,000.00	$ 46,000.00	$ 824,500.00	$ 58.00
2025	$ 17,200.00	$ 46,900.00	$ 838,800.00	$ 59.00
2026	$ 17,500.00	$ 47,800.00	$ 852,100.00	$ 60.00
2027	$ 17,900.00	$ 48,700.00	$ 865,600.00	$ 61.00
2028	$ 18,200.00	$ 49,500.00	$ 879,400.00	$ 62.00
2029	$ 18,600.00	$ 50,400.00	$ 893,400.00	$ 63.00
2030	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 65.00
2031	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 66.00
2032	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 67.00
2033	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 68.00
2034	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 69.00
2035	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 70.00
2036	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 72.00
2037	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 73.00
2038	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 74.00
2039	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 75.00
2040	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 76.00
2041	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 78.00
2042	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 79.00
2043	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 80.00
2044	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 81.00
2045	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 82.00
2046	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 84.00
2047	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 85.00
2048	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 86.00
2049	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 87.00
2050	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2051	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2052	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2053	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2054	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2055	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2056	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2057	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2058	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00
2059	$ 18,900.00	$ 51,300.00	$ 907,600.00	$ 88.00

January 2023 USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs does not provide values beyond 2050, therefore those values are assumed to hold.

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

Table A-7. Inflation Adjustment Values

Base Year	Multiplier
2003	1.44
2004	1.40
2005	1.36
2006	1.32
2007	1.28
2008	1.26
2009	1.25
2010	1.24
2011	1.21
2012	1.19
2013	1.17
2014	1.15
2015	1.14
2016	1.12
2017	1.10
2018	1.08
2019	1.06
2020	1.04
2021	1.00

Table A-8. Pedestrian Facility Improvements

Improvement Type	Recommended Value
Expanded Sidewalk (per ft added width)	$ 0.11
Reducing Upslope by 1%	$ 1.05
Reducing Traffic Speed by 1mph (speeds ≤ 45 mph)	$ 0.09
Reducing Traffic Volume by 1 vph (for ADT ≤ 55,000)	$ 0.0009
Marked-Crosswalks on Roadway, Volume >10k/day	$ 0.18
Signal and Pedestrian Crossing on Roadway, Volume >1	$ 0.48

Table A-9. Cycling Facility Improvements

Facility Type	Recommended Value per Cycling Mile (2020 $)
Cycling Path with At-Grade Crossings	$ 1.49
Cycling Path with no at-Grade Crossings	$ 1.87
Dedicated Cycling Lane	$ 1.77
Cycling Boulevard/Sharrow	$ 0.28
Separated Cycle Track	$ 1.77

Table A-12. Mortality Reduction Benefits of Induced Active Transportation

Mode and Age Range	Recommended Value
Walking, Ages 20-74	$ 7.20
Cycling, Ages 20-64	$ 6.42

Table A-10. Transit Facility Amenity

Attribute Type	Bus Stop	Light Rail/Streetcar Stop	Rail Station
Clocks	$ 0.03	$ 0.03	$ 0.06
Electronic Real-Time Information Displays	$ 0.31	$ 0.15	$ 0.86
Information /Emergency Button	$ 0.24	$ 0.24	$ 0.11
PA System	$ 0.31	$ 0.05	$ 0.10
Platform/Stop Seating Availability1	$ 0.19	$ 0.13	$ 0.13
Platform/Stop Weather Protection1	$ 0.25	$ 0.16	$ 0.13
Restroom Availability	$ 0.14	$ 0.14	$ 0.10
Retail/Food Outlet Availability	$ 0.11	$ 0.11	$ 0.06
Staff Availability	$ 0.08	$ 0.03	$ 0.18
Step-Free Access to Station/Stop	$ 0.32	$ 0.32	$ 0.20
Step-Free Access to Vehicle	$ 0.42	$ 0.08	$ 0.07
Surveillance Cameras	$ 0.31	$ 0.31	$ 0.32
Temperature Controlled Environment1	$ 0.62	$ 0.62	$ 0.62
Ticket Machines	$ 0.10	$ 0.10	$ 0.07
Timetables	$ 0.23	$ 0.10	$ 0.48
Bike Facilities	$ -	$ -	$ 0.10
Car Access Facilities	$ -	$ -	$ 0.11
Elevator	$ -	$ -	$ 0.07
Escalators	$ -	$ -	$ 0.04
On-Site Ticket Office	$ -	$ -	$ 0.09
Taxi Pickup/Dropoff	$ -	$ -	$ 0.05
Waiting Room	$ -	$ -	$ 0.20

Table A-11. Transit Vehicle Amenity Values

Attribute Type	Bus	Light Rail/Streetcar	Rail
Electronic Real-Time Information Displays	$ 0.22	$ 0.22	$ 0.22
Handrails	$ 0.13	$ 0.13	$ 0.31
Luggage Storage	$ 0.09	$ 0.09	$ 0.09
PA System	$ 0.38	$ 0.38	$ 0.39
Surveillance Cameras	$ 0.22	$ 0.22	$ 0.63
Temperature Control	$ 0.31	$ 0.12	$ 0.47
Wheelchair Space	$ 0.04	$ 0.04	$ 0.04
Food Service Availability	$ -	$ -	$ 0.03
Restroom Availability	$ -	$ -	$ 0.19

Table A-12. Transit Mode Ride and Boarding Quality Revealed Preference Values

Transit Mode	Boarding Qual	Vehicle Ride Quality**
Low-Intensive BRT	$ 0.31	$ 0.38
Medium-Intensive BRT	$ 0.63	$ 0.75
High-Intensive BRT	$ 1.57	$ 1.50
Streetcar or On-street Light Rail Transit	$ 1.88	$ 1.88
Off-street Light Rail Transit	$ 3.13	$ 3.38
Heavy Rail	$ 3.45	$ 3.76
Commuter Rail	$ 5.01	$ 3.76
Ferry	$ 3.45	$ 3.76

*Benefit per Boarding
**Benefit per passenger hour

Table A-14. External Highway Use Costs Noise and Congestion

Vehicle Type	Location	Congestion (2020 $)	Noise (2020 $)
Light Duty	Urban	$ 0.1240	$ 0.0017
Light Duty	Rural	$ 0.0260	$ 0.0002
Light Duty	All	$ 0.1040	$ 0.0010
Buses and Trucks	Urban	$ 0.3100	$ 0.0393
Buses and Trucks	Rural	$ 0.0670	$ 0.0033
Buses and Trucks	All	$ 0.2120	$ 0.0197
All Vehicles	Urban	$ 0.1380	$ 0.0046
All Vehicles	Rural	$ 0.0330	$ 0.0006
All Vehicles	All	$ 0.1150	$ 0.0028

Appendix B. Project Information

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 1, The Missing Moves**
Date: **August 21, 2023**

This tab lists key input values for this benefit-cost analysis including the correct project name, due date of submission, design and construction schedules, and more.

Table B1. Basic Project Information

Input	Value
Project Name	Completing the I-95 Missing Move and Quonset Connector Ramps
Date of Submission	August 21, 2023
First Year of Analysis	2023
Last Year of Analysis	2058

Table B2. Project Scheduling Information

Input	Value
First Year of Design	2023
Last Year of Design	2024
First Year of Construction	2025
Last Year of Construction	2027

Table B3. Master List of Years

Year Number	Year
0	2023
1	2024
2	2025
3	2026
4	2027
5	2028
6	2029
7	2030
8	2031
9	2032
10	2033
11	2034
12	2035
13	2036
14	2037
15	2038
16	2039
17	2040
18	2041
19	2042
20	2043
21	2044
22	2045
23	2046
24	2047
25	2048
26	2049
27	2050
28	2051
29	2052
30	2053
31	2054
32	2055
33	2056
34	2057
35	2058

Appendix B. Project Information

Project Name: **Completing the I-95 Missing Move and Quonset Connector Ramps**
Component: **Component 2, The Quonset Connector Ramps**
Date: **August 21, 2023**

This tab lists key input values for this benefit-cost analysis including the correct project name, due date of submission, design and construction schedules, and more.

Table B1. Basic Project Information

Input	Value
Project Name	Completing the I-95 Missing Move and Quonset Connector Ramps
Date of Submission	August 21, 2023
First Year of Analysis	2023
Last Year of Analysis	2058

Table B2. Project Scheduling Information

Input	Value
First Year of Design	2023
Last Year of Design	2024
First Year of Construction	2025
Last Year of Construction	2027

Table B3. Master List of Years

Year Number	Year
0	2023
1	2024
2	2025
3	2026
4	2027
5	2028
6	2029
7	2030
8	2031
9	2032
10	2033
11	2034
12	2035
13	2036
14	2037
15	2038
16	2039
17	2040
18	2041
19	2042
20	2043
21	2044
22	2045
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27	2050
28	2051
29	2052
30	2053
31	2054
32	2055
33	2056
34	2057
35	2058

Appendix D-1

Safety

Memorandum

To: Ken White, Ph.D.
Assistant Director for Administrative Services
Division of Planning
Rhode Island Department of Transportation
Two Capitol Hill, Room 318
Providence, Rhode Island

Date: August 2023

Project #: 73337.05

From: Jeff Gooch, PE
Kristin Caouette, PE

Re: I-95 and Route 4 Missing Move Interchange Redesign

Introduction

The Rhode Island Department of Transportation (RIDOT) is responding to a Notice of Funding Opportunity (NOFO) for grant funding through the Nationally Significant Multimodal Freight & Highway Projects (INFRA) discretionary grant program to request a construction grant for **I-95 and Route 4 Missing Move Interchange Redesign**. RIDOT requested support from VHB for preparation of the NOFO application, including estimation of the traffic, safety, noise, environmental, and other impacts, as well as costs, of the proposed design. This memorandum summarizes the expected safety effects of the proposed design.

The primary safety issue is the absence of system interchange ramps connecting Northbound Route 4 to Southbound I-95 and Northbound I-95 to Southbound Route 4. This is a safety issue because vehicles who desire to make these movements are required to leave the access-controlled roads and navigate on surface streets through several intersections and ramp terminals. The proposed alternative includes new ramps providing continuous flow between the freeway facilities for those vehicles. Additionally, there are several features in the project area at high risk for roadway departure crashes, including four high-to-low speed exit loop ramps and a horizontal curve on Northbound Route 4 leading to Northbound I-95. RIDOT proposes the installation of High-Friction Surface Treatment (HFST) on these features.

The following sections describe the methodology, data, and results of the analysis for each safety issue.

Methodology

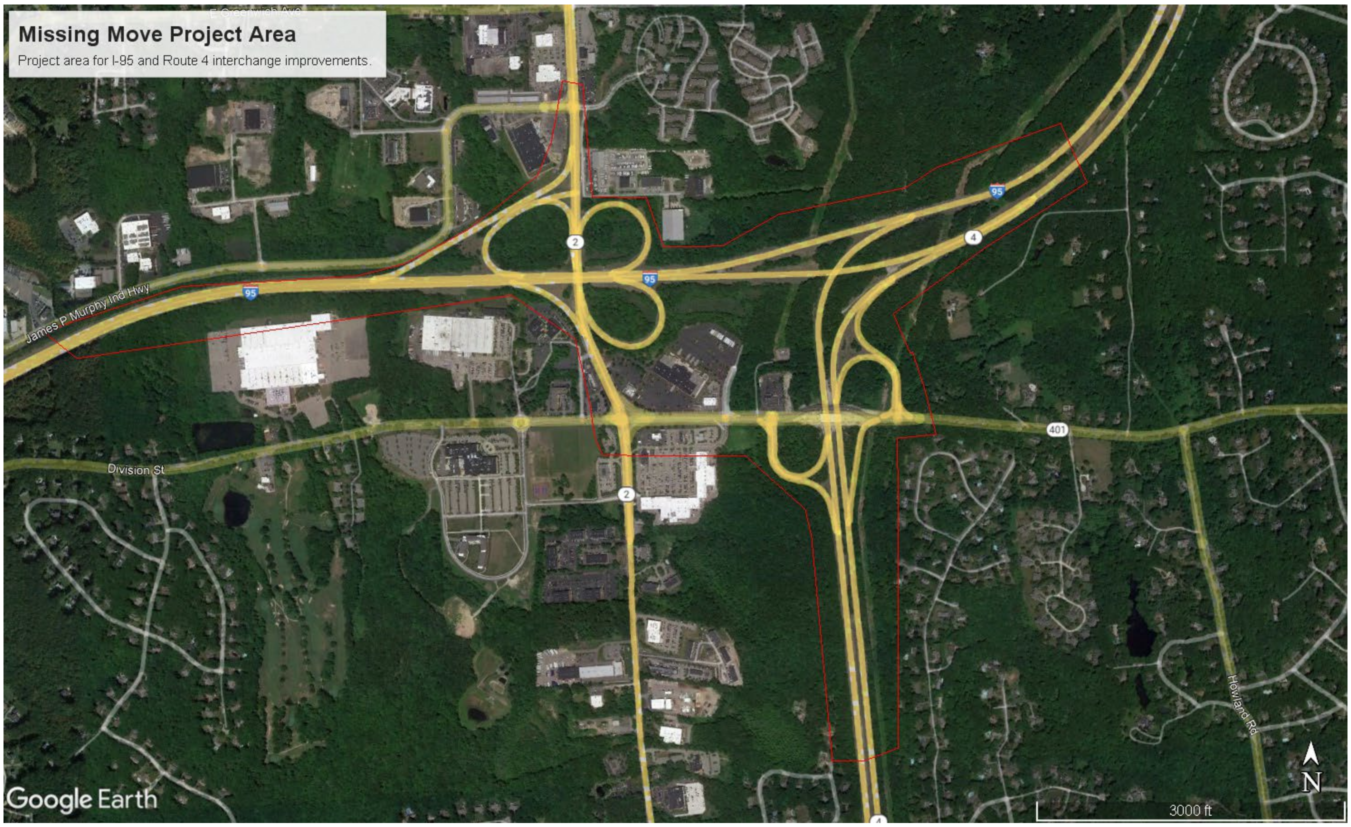
Guided by the U.S. Department of Transportation's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs," (January 2023) Crash Modification Factors (CMFs) for selected countermeasures were applied to the crash history by severity and by crash type. The monetized values for injuries by severity were obtained to determine a monetary benefit.

Reconstruction of the I-95 and Route 4 interchange is a substantial change in the transportation network that is not easily summarized using crash modification factors. In order to predict the change in crashes due to that change in roadway network, crash prediction models were used to quantify data-driven safety impacts and create a pseudo-CMF.

Missing Moves at I-95 and Route 4 Interchange

The existing I-95/Route 4 interchange has two missing system interchange ramps, requiring vehicles desiring to make two movements to use surface streets when transferring between freeways. Additionally, there are several ramps and a horizontal curve on Route 4 Northbound which could benefit from the addition of HFST. Figure 1 shows the project area considered for this safety issue.

Figure 1: Existing Conditions at the I-95 and Route 4 Interchange in Warwick, RI.

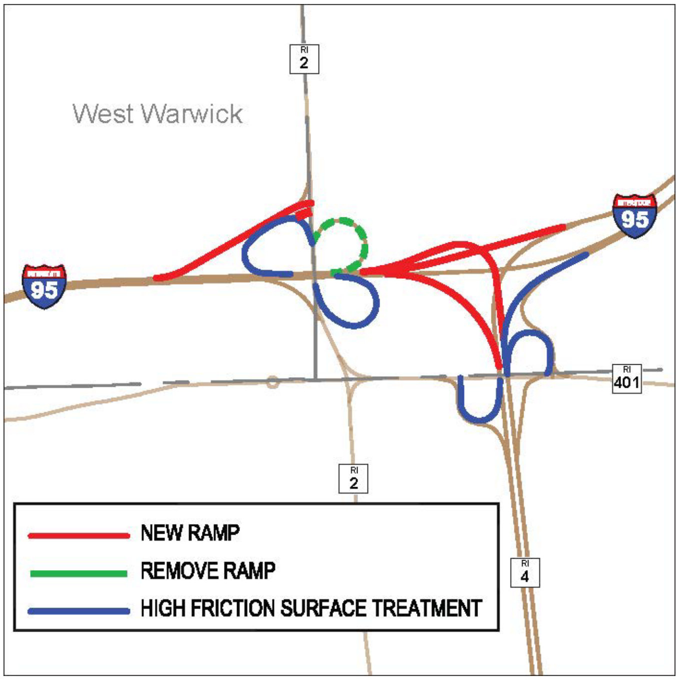


Source: Google Earth, 2023©

Proposed Improvements

Figure 2 shows RIDOT's proposed improvements for the interchange. This includes the construction of a new ramp connecting Northbound I-95 to Southbound Route 4 as well as a ramp connecting Northbound Route 4 and Southbound I-95. Additionally, the Northbound Route 2 to Southbound I-95 loop ramp is closed, and vehicles desiring to make that movement now turn left onto the Southbound Route 2 to Southbound I-95 direct ramp using a redesigned ramp terminal. Finally, HFST is proposed for the four loop exit ramps as well as the Northbound Route 4 horizontal curve to I-95.

Figure 2: Proposed Safety Issue 1 Improvements



Safety Analysis Methodology

Ideally, the safety analysis would include the application of CMFs to an expected future crash frequency calculated using the Empirical Bayes approach. Unfortunately, this is not feasible in this context for two reasons:

1. CMFs are not available for the proposed redesign of the interchange.
2. RIDOT does not have calibrated crash prediction models (CPMs) which could be used for Empirical Bayes.

Therefore, VHB proposed a modified approach to estimating safety performance using default Highway Safety Manual (HSM) CPMs. VHB applied the CPMs to predict crashes by KABCO severity category for existing conditions under current volumes and design year volumes. Additionally, VHB applied the HSM CPMs to predict crashes for the proposed design with design year volumes.

VHB proposed estimating design year safety performance ($C_{Obs,future}$) by taking the observed crash frequency during the study period ($C_{Annual,Observed}$) and growing it to the design year using the ratio of predicted crashes under existing conditions for the design year ($N_{Pr,Design}$) to the study years ($N_{Pr,Study}$). Figure 3 describes this calculation.

Figure 3: Calculating expected no-build crash frequency in the design year.

$$C_{exp,future} = C_{annual,observed} * {N_{Pr,Design}}/{N_{Pr,Study}}$$

VHB then calculated a surrogate CMF ($CMF_{Surrogate}$) using the ratio of predicted design year crashes ($N_{PR,Build}$) for the proposed design to the predicted design year crashes for the existing design ($N_{PR,Design}$). Figure 4 describes the calculation.

Figure 4: Calculate the surrogate CMF for the proposed design.

$$CMF_{Surrogate} = {N_{PR,Build}}/{N_{PR,Design}}$$

Finally, VHB estimated the change in safety performance ($C_{Reduced,Design}$) by applying the surrogate CMF to the grown design year crashes, as shown in Figure 5.

Figure 5: Calculation of expected crash reduction in the design year.

$$C_{Reduced,Design} = C_{obs,future} - C_{obs,future} * CMF_{Surrogate}$$

This process was repeated at each KABCO severity category. The next section describes the analysis performed following this methodology.

Safety Analysis Results

Existing Crash Frequency

VHB reviewed RIDOT crash data for this project location for the years 2016 through 2021 in support of prior conceptual design efforts. Table 1 summarizes those crashes by KABCO severity level[1] and crash type. Crash data for 2022 are not applicable due to construction for a separate project within the project area.

Table 1: Summary of Study Area Crashes - Safety Issue 1, 2016-2021

Crash Type	K Severity	A Severity	B Severity	C Severity	O Severity	Total
Angle	0	1	1	26	94	**122**
Head On	0	0	2	1	10	**13**
Not a Collision Between Two Motor Vehicles	4	1	9	33	163	**210**
Rear End	1	3	9	167	609	**789**
Sideswipe, Same Direction	0	0	3	13	210	**226**
Sideswipe, Opposite Direction	0	0	0	0	4	**4**
Other or Unknown	0	0	0	5	10	**15**
Total	**5**	**5**	**24**	**245**	**1100**	**1379**

The project area experienced 1,379 crashes during that time period, an average frequency of 230 per year, 46.5 of which are fatal and injury (FI, or KABC) and 183.5 of which are property damage only (PDO, or O).

[1] https://safety.fhwa.dot.gov/hsi0p/spm/conversion0_tbl/pdfs/kabco_ctable_by_state.pdf

Memorandum

Predicted Crash Frequency, No Build

VHB applied the proposed methodology using the applicable HSM spreadsheet tools, including the Enhanced Interchange Safety Analysis Tool (ISATe)[2] and the HSM Chapter 12 Urban and Suburban Arterials Spreadsheet[3], downloaded in July 2023. VHB followed HSM guidance when segmenting the area. The ramps, freeway mainline segments for I-95 and Route 4, and ramp terminals were modeled using the relevant ramp, mainline, and ramp terminal CPMs in ISATe. The remaining segments and intersections in the study area were modeled using the Chapter 12 spreadsheet CPMs. Table 2 summarizes the predicted crashes for 2023 traffic volumes and design year 2058 no-build traffic volumes.

Table 2: Summary of Annual Predicted Crashes for No-Build Conditions

Sites	Predicted FI Crashes, 2023	Predicted PDO Crashes, 2023	Predicted FI Crashes, 2058	Predicted PDO Crashes, 2058
Freeway Segments	21.6	70.4	24.0	78.1
Freeway Ramps	7.5	17.3	7.9	18.3
Freeway Ramp Terminals	9.1	26.0	9.6	28.1
Arterial Segments	2.8	9.9	3.5	11.2
Arterial Intersections	6.4	18.1	7.2	20.0
Total	**47.4**	**141.7**	**52.2**	**155.7**

[2] https://www.highwaysafetymanual.org/Documents/ISATe_Documents.zip
[3] https://www.highwaysafetymanual.org/Documents/HSM_CPM_UrbanSuburbanArterials_v3.2.xlsx

The results in Table 2 suggest FI and PDO crashes are both, on average, expected to increase by a factor of 1.10 from the study period to the design year. VHB used those results and the equation in Figure 3 to grow the observed crash frequency during the study period (2016-2021) to the expected no build crash frequency in the design year, broken down by KABCO severity level. Table 3 summarizes those results at each KABCO severity level.

Table 3: Calculation of Expected No Build Crashes in the Design Year

Crash Severity	Historic Crash Frequency	Growth Factor	Estimated Crashes in Design Year
K	0.8	1.07	0.89
A	0.8	1.08	0.90
B	4.00	1.07	4.26
C	40.8	1.12	45.69
PDO	183.5	1.10	201.38
All	230.0	N/A	253.1

Predicted Crash Frequency, Build

VHB used the same tools (ISATe and HSM Spreadsheets) to predict crashes in the design year (2058) for the Build condition. The proposed design was segmented within the project area to the best estimate of the proposed design. As described earlier, the proposed design also includes the implementation of HFST on 4 loop exit ramps as well as the Northbound Route 4 horizontal curve. To account for HFST in the Build prediction, VHB applied five-star rated HFST CMFs to the designated segments – 0.49 for FI crashes (CMF Clearinghouse ID 10319)[4] and 0.529 for All Severity crashes (CMF Clearinghouse ID 10318)[5]. Table 4 summarizes predicted crashes by severity for the Build condition by facility type.

Table 4: Summary of Predicted Crashes for the Design Year Proposed Conditions

Sites	FI, Design Year	PDO, Design Year
Freeway Segments	26.6	91.6
Freeway Ramps	5.4	13.2
Freeway Ramp Terminals	9.3	29.7
Arterial Segments	3.2	10.5
Arterial Intersections	6.8	19.1
Total	**51.3**	**164.1**

[4] https://www.cmfclearinghouse.org/detail.php?facid=10319
[5] https://www.cmfclearinghouse.org/detail.php?facid=10318

Memorandum

VHB applied the equation in Figure 4 and the results from Table 2 and Table 4 to calculate surrogate CMFs for each KABCO severity level – these are summarized in Table 5. Based on these results, VHB expects the proposed RIDOT improvements to result in an overall increase in crashes in the project area; however, there will be a reduction in fatal and injury crashes, which are expected to outweigh the increase in PDO crashes.

Table 5: Calculation of Surrogate CMFs.

Crash Severity	Predicted Crashes, No Build, Design Year	Predicted Crashes, Build, Design Year	Surrogate CMF
K	0.81	0.77	0.95
A	2.96	2.78	0.94
B	12.44	11.87	0.95
C	36.03	35.90	1.00
PDO	103.52	112.72	1.09

Finally, VHB used the results in Table 2 and Table 5 to calculate the expected change in safety performance with the equation in Figure 5. Table 6 summarizes the expected annual change in safety performance for the proposed design. In total, VHB expects the design to produce an annual reduction of 0.47 fatal and injury crashes offsetting an annual increase of 17.90 PDO crashes.

Table 6: Expected Annual Crash Reduction.

Crash Severity	Estimated Crash Frequency in Design Year, No Build	Surrogate CMF	Estimated Crash Frequency in Design Year, Build	Expected Annual Crash Reduction
K	0.89	0.95	0.85	0.05
A	0.90	0.94	0.85	0.06
B	4.26	0.95	4.07	0.19
C	45.69	1.00	45.51	0.17
PDO	201.38	1.09	219.28	-17.90

The Benefit Cost Analysis (BCA) process of the INFRA grant application requires the distribution of the change in safety performance to be summarized by crash severity category. For this application, RIDOT rounded estimated crash frequency in the design year no-build to the nearest whole crash. Table 7 summarizes the inputs and results of the INFRA grant safety BCA application. This includes the surrogate crash reduction factor (CRF), calculated as 1 minus the CMF. As shown in the table, the proposed design is expected to provide $596,682 in annual safety benefits, as the benefits from the reduction in injury crashes outweigh the disbenefits from the increase in PDO crashes.

Table 7: Expected Safety Benefits for INFRA Grant.

Crash Severity	Estimated Crash Frequency in Design Year, No Build	Surrogate CRF	Expected Annual Crash Reduction	Annual Savings
K	1	0.05	0.05	$590,000
A	1	0.06	0.06	$33,858
B	4	0.05	0.20	$30,740
C	46	0.004	0.18	$14,444
PDO	201	-0.09	-18.09	-$72,360
Total	**253**	**0.01**	**-17.60**	**$596,682**

Memorandum

To: Ken White, Ph.D.
Assistant Director for Administrative Services
Division of Planning
Rhode Island Department of Transportation
Two Capitol Hill, Room 318
Providence, Rhode Island

Date: August 18, 2023

Project #: 73337.05

From: Jeff Gooch, PE
Kristin Caouette, PE

Re: Route 403 Interchange Redesign

Introduction

The Rhode Island Department of Transportation (RIDOT) is responding to a Notice of Funding Opportunity (NOFO) for grant funding through the Nationally Significant Multimodal Freight & Highway Projects (INFRA) discretionary grant program to request a construction grant for **the Route 403 Interchange Redesign**. RIDOT requested support from VHB for preparation of the NOFO application, including estimation of the traffic, safety, noise, environmental, and other impacts, as well as costs, of the proposed design. This memorandum summarizes the expected safety effects of the proposed design.

The safety issue is the absence of several ramps connecting Route 403 to crossroads, meaning vehicles desiring to make certain access movements must use surface streets and intersections as opposed to the access control facility. RIDOT plans to address these concerns by constructing ramps for the missing movements. Additionally, RIDOT proposes adaptive signal controllers along the ramp termini and intersections on Post Road within the project area to improve traffic flow along the corridor. Finally, RIDOT proposes the installation of High-Friction Surface Treatment (HFST) on two sharp horizontal curves on Route 403 and an exit ramp to reduce the probability of severe roadway departure crashes, particularly related to wet pavement.

The following sections describe the methodology, data, and results of the analysis for each safety issue.

Methodology

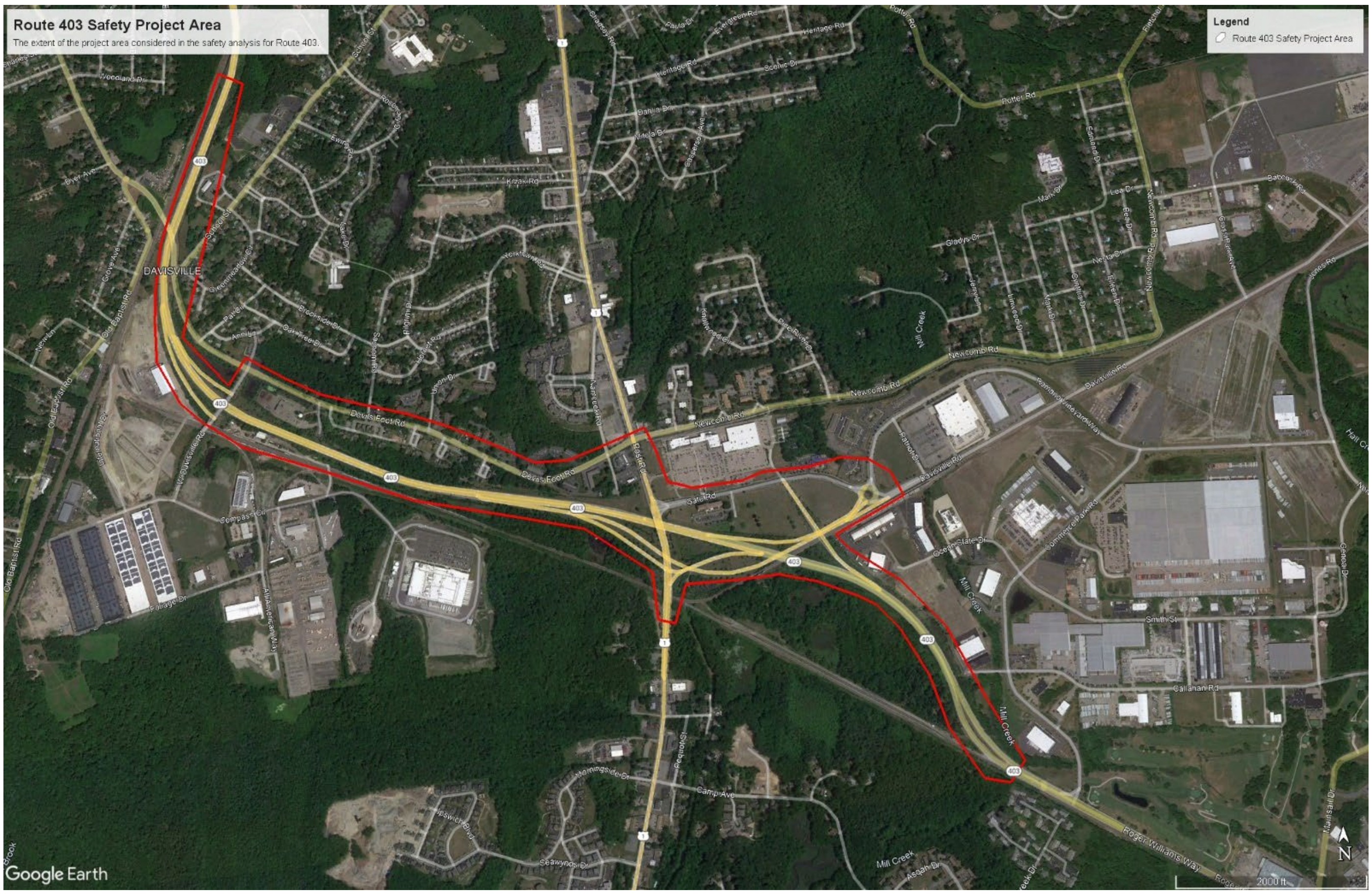
Guided by the U.S. Department of Transportation's "Benefit-Cost Analysis Guidance for Discretionary Grant Programs" (January 2023), Crash Modification Factors (CMFs) for selected countermeasures were applied to the crash history by severity and by crash type. The monetized values for injuries by severity were obtained to determine a monetary benefit.

Reconstruction of the Route 403 interchange area is a substantial change in the transportation network that is not easily quantified using CMFs. To predict the change in crashes due to that change in roadway network, crash prediction models (CPMs) were used to quantify data-driven safety impacts and create a pseudo-CMF.

Missing Moves on Route 403

The existing Route 403 interchange area has several missing interchange ramps, including Northbound exits and Southbound entrances to West Davisville Road as well as the Northbound entrance from Post Road. Figure 1 shows the project area considered for this safety issue. Facilities include Route 403 and ramps, West Davisville Road, Devils Foot Road, Post Road, and Gate Road.

Figure 1: Existing Conditions at the Route 403 Interchanges in North Kingstown, RI.



Source: Google Earth, 2023©

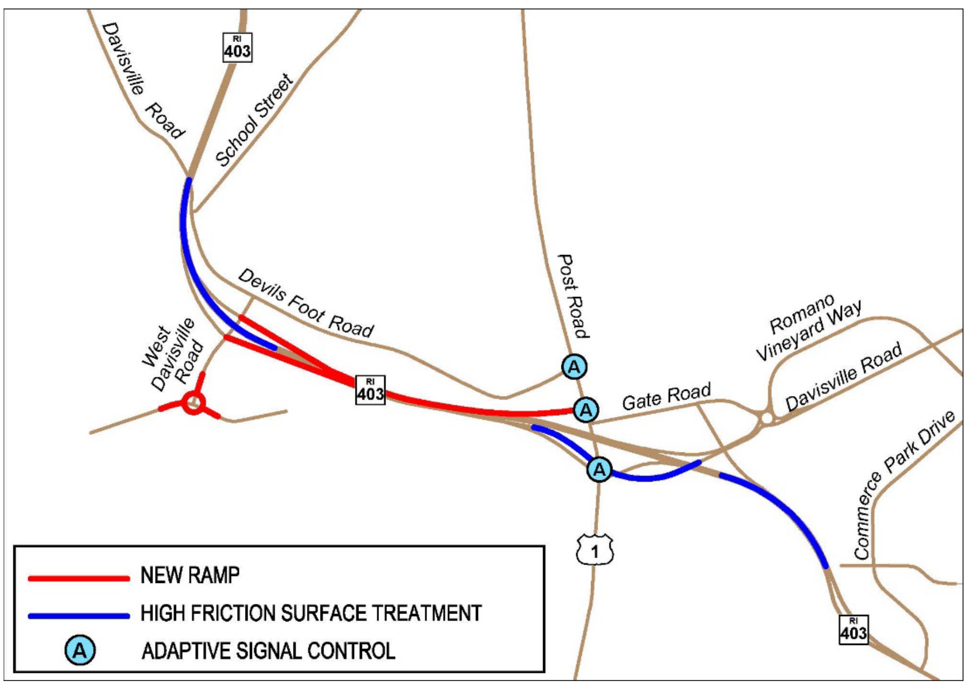
Proposed Improvements

Figure 2 shows RIDOT's proposed improvements for the interchange. This includes the construction of:

- An exit ramp from Northbound Route 403 to West Davisville Road.
- An entrance ramp from West Davisville Road to Southbound Route 403 .
- An entrance ramp from Post Road to Northbound Route 403.
- The installation of HFST for two sharp horizontal curves on Route 403 and on the Southbound Route 403 exit ramp to the Gate Road and Davisville Road roundabout.
- Conversion to adaptive signal control at the Southbound Route 403 and Post Road ramp terminal, the new Route 403 Northbound ramp and Post Road ramp terminal, and the Devils Foot Road and Post Road intersection.

Note there is also the proposed construction of a roundabout at the West Davisville Road and Compass Circle intersection; however, this was not included in the safety analysis.

Figure 2: Proposed Improvements



Safety Analysis Methodology

Ideally, the safety analysis would include the application of CMFs to an expected future crash frequency. Unfortunately, this is not feasible for two reasons:

1. CMFs are not available for the proposed redesign of the interchange.
2. RIDOT does not have calibrated crash prediction models (CPMs) which could be used for Empirical Bayes.

As a result, VHB proposed a modified approach to estimating safety performance using default Highway Safety Manual (HSM) CPMs. VHB applied the CPMs to predict crashes by KABCO severity category for existing conditions under current volumes and design year volumes. Additionally, VHB applied the HSM CPMs to predict crashes for the proposed design with design year volumes.

VHB proposed estimating design year safety performance ($C_{Obs,future}$) by taking the observed crash frequency during the study period ($C_{Annual,Observed}$) and growing it to the design year using the ratio of predicted crashes under existing conditions for the design year ($N_{Pr,Design}$) to the study years ($N_{Pr,Study}$). Figure 3 describes this calculation.

Figure 3: Calculating expected no-build crash frequency in the design year.

$$C_{exp,future} = C_{annual,observed} * {}^{N_{Pr,Design}}/_{N_{Pr,Study}}$$

VHB would then calculate a surrogate CMF ($CMF_{Surrogate}$) using the ratio of predicted design year crashes ($N_{PR,Build}$) for the proposed design to the predicted design year crashes for the existing design ($N_{PR,Design}$). Figure 4 describes the proposed calculation.

Figure 4: Calculate the surrogate CMF for the proposed design.

$$CMF_{Surrogate} = {}^{N_{PR,Build}}/_{N_{PR,Design}}$$

Finally, VHB would estimate the change in safety performance ($C_{Reduced,Design}$) by applying the surrogate CMF to the grown design year crashes, as shown in Figure 5.

Figure 5: Calculation of expected crash reduction in the design year.

$$C_{Reduced,Design} = C_{obs,future} - C_{obs,future} * CMF_{Surrogate}$$

This process can be repeated at each KABCO severity category. The next section describes the analysis performed following this methodology.

Memorandum

Safety Analysis Results

Existing Crash Frequency

VHB reviewed RIDOT crash data for this project location for the years 2016 through 2022 in support of prior conceptual design efforts. Table 1 summarizes those crashes by KABCO severity level[1] and crash type.

Table 1: Summary of Study Area Crashes - Safety Issue 1, 2016-2022

Crash Type	K Severity	A Severity	B Severity	C Severity	O Severity	Total
Angle	0	0	1	12	35	**48**
Head On	0	1	0	0	2	**3**
Not a Collision Between Two Motor Vehicles	0	1	6	5	30	**42**
Rear End	1	0	2	10	62	**75**
Sideswipe, Same Direction	0	0	0	1	14	**15**
Sideswipe, Opposite Direction	0	0	0	1	5	**6**
Other or Unknown	0	0	0	1	2	**3**
Total	**1**	**2**	**9**	**30**	**150**	**192**

The project area experienced 192 crashes during that time period, an average frequency of 27.4 per year, 6 of which are fatal and injury (FI, or KABC) and 21.4 of which are property damage only (PDO, or O).

[1] https://safety.fhwa.dot.gov/hsi0p/spm/conversion0_tbl/pdfs/kabco_ctable_by_state.pdf

Memorandum

Predicted Crash Frequency, No Build

VHB applied the proposed methodology using the applicable HSM spreadsheet tools, including the Enhanced Interchange Safety Analysis Tool (ISATe)[2] and the HSM Chapter 12 Urban and Suburban Arterials Spreadsheet[3], downloaded in July 2023. VHB followed HSM guidance when segmenting the area. The ramps, freeway mainline segments for Route 403, and ramp terminals were modeled using the relevant ramp, mainline, and ramp terminal CPMs in ISATe. The remaining segments and intersections in the study area were modeled using the Chapter 12 spreadsheet CPMs. Table 2 summarizes the predicted crashes for 2023 traffic volumes and design year 2058 no-build traffic volumes.

Table 2: Summary of Annual Predicted Crashes for No-Build Conditions

Sites	Predicted FI Crashes, 2023	Predicted PDO Crashes, 2023	Predicted FI Crashes, 2058	Predicted PDO Crashes, 2058
Freeway Segments	6.4	13.1	7.0	14.4
Freeway Ramps	1.4	1.9	1.4	1.9
Freeway Ramp Terminals	5.1	6.2	5.6	7.0
Arterial Segments	2.4	5.1	2.6	5.5
Arterial Intersections	3.1	5.5	3.5	6.1
Total	**18.4**	**31.8**	**20.1**	**34.9**

The results in Table 3 suggest that due to traffic growth, FI crashes are expected to increase 9 percent and PDO crashes are expected to increase 10 percent. VHB used those results and the equation in Figure 3 to grow the observed crash frequency during the study period (2016-2022) to the expected no build crash frequency in the design year, broken down by KABCO severity level.

Table 3: Calculation of Expected No Build Crashes in the Design Year

Crash Severity	Historic Crash Frequency	Growth Factor	Estimated Crashes in Design Year
K	0.1	1.08	0.2
A	0.3	1.09	0.3
B	1.3	1.08	1.4
C	4.3	1.09	4.7
PDO	21.4	1.10	23.5
Total	**27.4**	**1.10**	**30.1**

[2] https://www.highwaysafetymanual.org/Documents/ISATe_Documents.zip
[3] https://www.highwaysafetymanual.org/Documents/HSM_CPM_UrbanSuburbanArterials_v3.2.xlsx

Predicted Crash Frequency, Build

VHB used the same tools (ISATe and HSM Spreadsheets) to predict crashes in the design year (2058) for the Build condition. The proposed design was segmented within the project area to the best estimate of the proposed design. VHB included CMFs in the build prediction to account for the proposed HFST and adaptive signals. The CMFs include:

- HFST - 0.49 for FI crashes (CMF Clearinghouse ID 10319)[4] and 0.529 for All Severity crashes (CMF Clearinghouse ID 10318)[5].
- Adaptive Signal Control – 0.958 for FI crashes (CMF Clearinghouse ID 11236)[6] and 0.943 for PDO crashes (CMF Clearinghouse ID 11237)[7].

Table 4 summarizes predicted crashes by severity for the Build condition by facility type.

Table 4: Summary of Predicted Crashes for the Design Year Proposed Conditions

Sites	FI, Design Year	PDO, Design Year
Freeway Segments	6.5	13.9
Freeway Ramps	2.9	2.1
Freeway Ramp Terminals	6.1	8.2
Arterial Segments	1.9	3.8
Arterial Intersections	1.8	2.9
Total	**19.2**	**30.9**

VHB applied the equation in Figure 4 and the results from Table 2 and Table 4 to calculate surrogate CMFs for each KABCO severity level, as shown in Table 5. Based on these results, VHB expects the proposed RIDOT improvements to generally decrease crashes in the area at all severity levels except for suspected minor injury crashes (B).

Table 5: Calculation of Surrogate CMFs.

Crash Severity	Predicted Crashes, No Build, Design Year	Predicted Crashes, Build, Design Year	Surrogate CMF
K	0.26	0.25	0.96
A	1.2	1.1	0.95
B	4.5	4.9	1.09
C	14.1	12.9	0.91
PDO	34.9	31.1	0.89

[4] https://www.cmfclearinghouse.org/detail.php?facid=10319
[5] https://www.cmfclearinghouse.org/detail.php?facid=10318
[6] https://www.cmfclearinghouse.org/detail.php?facid=11236
[7] https://www.cmfclearinghouse.org/detail.php?facid=11237

Memorandum

Finally, VHB used the results in Table 2 and Table 5 to calculate the expected change in safety performance with the equation in Figure 5. Table 6 summarizes the expected annual change in safety performance for the proposed design. The improvements are expected to produce a reduction of 0.31 annual FI crashes and 2.60 PDO crashes.

Table 6: Expected Annual Crash Reduction.

Crash Severity	Estimated Crash Frequency in Design Year, No Build	Surrogate CMF	Estimated Crash Frequency in Design Year, Build	Expected Annual Crash Reduction
K	0.2	0.96	0.1	0.01
A	0.3	0.95	0.3	0.02
B	1.4	1.09	1.5	-0.12
C	4.7	0.91	4.3	0.41
PDO	23.5	0.89	20.9	2.60

The Benefit Cost Analysis (BCA) process of the INFRA grant application requires the distribution of the change in safety performance to be summarized by crash severity category. For the purpose of the application, RIDOT rounded estimated crash frequency in the design year no-build to the nearest whole crash. Table 7 summarizes the inputs and results of the INFRA grant safety BCA application. This includes the surrogate crash reduction factor (CRF), calculated as 1 minus the CMF. As shown in the table, the proposed design is expected to provide $127,044 in annual safety benefits.

Table 7: Expected Safety Benefits for INFRA Grant.

Crash Severity	Estimated Crash Frequency in Design Year, No Build	Surrogate CRF	Expected Annual Crash Reduction	Annual Savings
K	0.2	0.04	0.01	$94,400
A	0.3	0.05	0.02	$8,465
B	1.4	-0.09	-0.12	-$19,366
C	4.7	0.09	0.41	$33,206
PDO	23.5	0.11	2.60	$10,340
Total	**30.1**	**0.02**	**2.92**	**$127,045**

Appendix D-2

Travel Time

Memorandum

To: Ken White, Ph.D.
Assistant Director for Administrative Services
Division of Planning
Rhode Island Department of Transportation
Two Capitol Hill, Room 318
Providence, Rhode Island

Date: August 18, 2023

Project #: 73337.05

From: Kristin Caouette, PE
Peter Pavao, PE
Amphone Soupharath
Zachary Tiang, PE

Re: Completing the Missing Move – I-95 at Route 4 – Travel Time Savings

The Rhode Island Department of Transportation (RIDOT) is responding to a Notice of Funding Opportunity (NOFO) for grant funding through Multimodal Project Discretionary Grant program to request a construction grant for the **Completing The Missing Move**. RIDOT requested support from VHB for preparation of the NOFO application, including estimation of the traffic, safety, noise, environmental, and other impacts, as well as costs, of the proposed design.

This memorandum documents the traffic and travel time analysis completed for Component 1 of the Completing the Missing Move Project focused on the I-95 at Route 4 interchange and providing new access between Route 4N-I-95S and I-95N-Route 4S.

RIDOT has requested that VHB evaluate and determine the travel time savings associated with the proposed improvements at the Route 4 and I-95 interchange by installing new on/off-ramps from Route 4 northbound to I-95 southbound and from I-95 northbound to Route 4 southbound, respectively. The purpose of this memorandum is to document the methodologies and assumptions used in the development of the VISSIM microsimulation model and provide documentation of the model results.

At the I-95 at Route 4 interchange, a review identified “missing moves” that if installed, would create direct travel between the interstate and freeway, alleviating principal arterials that currently facilitate movement between the Route 4 at Route 401 and I-95 at Route 2 interchanges. This review found that there would be positive travel time benefits by installing the two deferred ramp systems. The results presented in the Benefit Cost Analysis (BCA) are the net results for the Route 4 and I-95 interchange modeled study area, described in the following section. This memorandum concludes with a summary of the change in travel time by roadway facility in the modeled study area.

Study Area

The Route 4 and I-95 interchange study area includes Route 4 and I-95 freeway network system as well as the Route 2 and Route 401 arterial roadways network system, providing both local and regional travel between the nearby developments in East Greenwich, Warwick, and West Warwick and access the regional developments such as Quonset Business Park. The study area extends between the I-95 at Route 4 interchange, Route 4 at Route 401 interchange, and Route 401 at Route 2 intersection. The following is a description of the study area roadways and intersections.

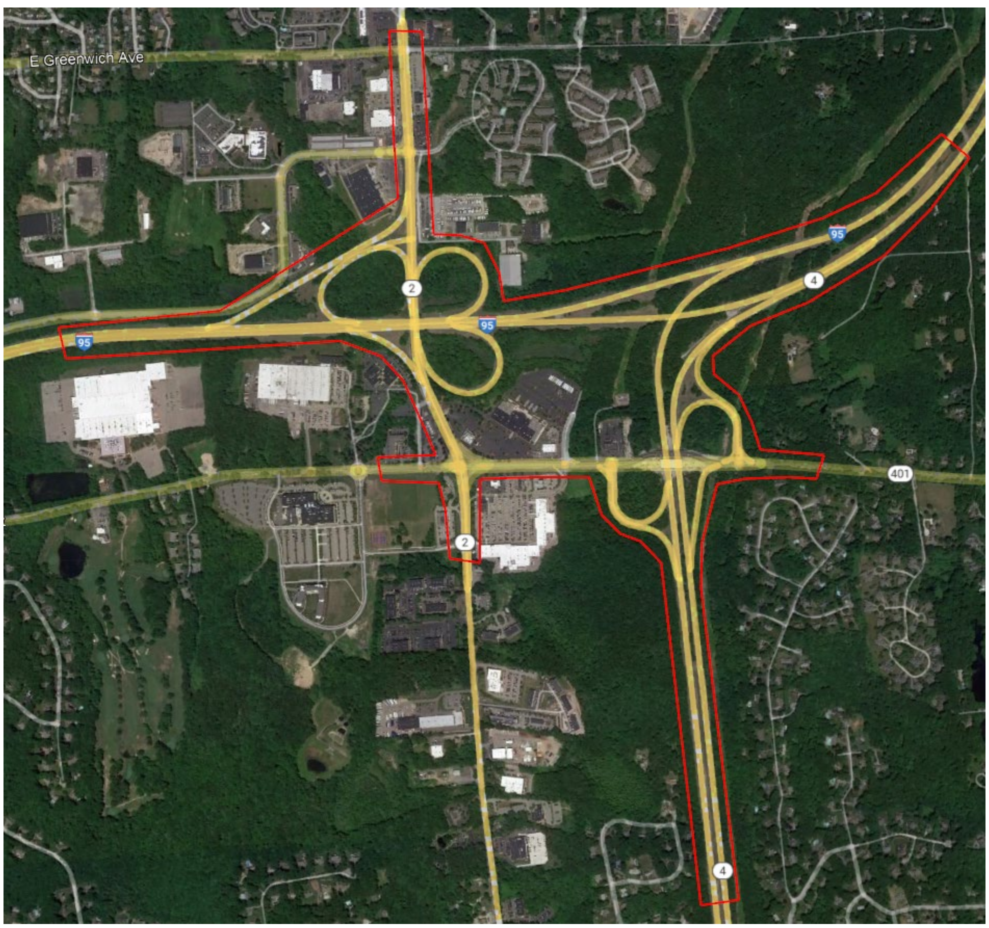
Colonel Rodman Highway (Route 4) is a north-south six-lane divided freeway under the jurisdiction of the Rhode Island Department of Transportation (RIDOT). RIDOT also currently maintains the ramps and the approaches to the bridge over Route 4. Overhead roadway lighting is present throughout the study area. The posted speed limit within the study area is 55 mph for southbound traffic and from 55 mph to 45 mph following Exit 9A (Route 401 East) for northbound traffic.

I-95 is a north-south four-lane interstate south of Route 4 and widened to eight-lane north of Route 4, under RIDOT jurisdiction. Overhead roadway lighting is present throughout the study area. The posted speed limit within the study area goes from 65 mph to 55 mph following Exit 24B for northbound traffic and from 55 mph to 65 mph following Exit 24A for southbound traffic.

Division Street (Route 401) is an east-west principal arterial under RIDOT jurisdiction. In the study area, there are on- and off-ramps providing access to and from Route 4 with access to I-95 North and access to and from I-95 South can be accommodated with the connection off Route 2Overhead roadway lighting is present throughout the study area. The posted speed limit within the study area is generally 35 mph.

Quaker Lane (Route 2) is a north-south principal arterial under RIDOT jurisdiction. Route 2 and Route 401 connect Route 4 to I-95 and is currently the only way to directly travel from I-95 northbound to Route 4 southbound and Route 4 northbound to I-95 southbound. Overhead roadway lighting is present throughout the study area. The posted speed limit within the study area is 45 mph.

Figure 1 Study Area



Study Area modeled – Google Earth

Model Development

To quantify existing traffic operations, the study area roadways and intersections were modeled and analyzed using VISSIM microscopic traffic simulation software (Version 21). Because of its extensive modeling and analysis capabilities, the VISSIM model provides a more comprehensive evaluation of complex transportation facilities. VISSIM can therefore better model complex networks that include such things as multi-modal users, ramp systems with closely spaced intersections (signalized, stop/yield controlled and/or roundabout), compared to the traditional traffic analysis methodology based on the Highway Capacity Manual. For the purpose of the Infrastructure for Rebuilding America (INFRA) grant, VISSIM is well suited to provided network level measures for quantifying impacts and benefits. For this analysis, traffic was projected to the year 2028 (opening year) and 2058 (30 year planning horizon). No Build and Build Condition analyses were completed for each year. The VISSIM model was calibrated to model existing 2023 conditions and then used to project future operations with (Build Condition) and without (No Build Condition) the project.

Data Collection

To identify current traffic flow characteristics, traffic counts were collected in December 2022 at key intersections in the study area as well as along I-95 and Route 4. A review of the historical traffic counts in the November 2020 Interchange Justification Report and historical local counts revealed that the December 2022 counts were comparable to the 2020 counts. A review of the seasonal adjustment factors in December was approximately 2 percent less, therefore, the December 2022 volumes were adjusted by the seasonal factor to develop the 2023 existing conditions. The 2023 existing daily and peak hour volumes are shown below in Table 1.

Table 1 Existing Traffic Volumes

	Daily	Weekday Morning Peak Hour		Weekday Evening Peak Hour	
Location	Weekday[1]	Volume[2]	Dir. Dist.[3]	Volume[2]	Dir. Dist.[3]
I-95, west of Route 4	58,144	5,024	55% NB	5,233	60% SB
Route 4, at Route 401	83,000	7,544	55% SB	7,991	58% NB
Route 2, south of I-95	37,788	2,911	73% SB	3,401	51% SB
Route 401, west of Route 4	32,522	1,947	57% EB	2,927	55% EB

Source: PDI. Based on automatic traffic recorder (ATR) counts conducted in December 2022.
1 average daily traffic (ADT) volume expressed in vehicles per day
2 peak hour traffic volumes expressed in vehicles per hour
3 directional distribution of peak period traffic
Note: Peak hours do not necessarily coincide with the peak hours of the individual intersection turning movement counts

Google Maps average traffic conditions and travel times were used to provide travel time and speed measurements and to help identify hotspot and bottleneck locations. StreetLight was used to perform a 2019 Origin/Destination study to determine the proportion of origins and their destinations in the study area. These proportions help determine the turning movements throughout the network.

Model Geometrics and Traffic Controls

The existing roadway, interchange, and intersection geometries were initially modeled using aerial mapping provided within VISSIM and verified with a combination of field observations, Google Maps/StreetView, and Nearmap. Traffic controls and signal timings were modeled and verified by field observations. Vehicle speed data was modeled and verified using the Posted Speed Limit, in miles-per-hour (mph) in the field.

Model Verification and Error Checking

Before beginning the calibration process, the model was checked for errors. Roadway geometry, traffic volumes and routes, speeds, signal timing data, and other inputs were reviewed along with a visual check of the simulation. The VISSIM error file was also reviewed, and critical errors were corrected. The simulation was reviewed to verify traffic signals were operating correctly, to visually inspect queue lengths, and to check general traffic operations throughout the model. Coding errors were corrected and adjustments were made to various model parameters to accurately reflect field conditions.

Model Calibration and Results

The North America default network parameters were used and adjusted as part of the calibration process including conflict areas, lane-change distances, and driver behaviors.

Based on the required benefit-cost analysis inputs, the 2023 existing VISSIM model was developed and modeled for 15-hours from 5:00 AM to 8:00 PM in order to capture both the AM and PM peak hour periods as well as the shoulder hours building up the congestion and the recovering periods after the peak hour periods. This 15-hour period accounted for approximately 90% of the daily traffic demand.

Ten model runs with random seed numbers were simulated to provide varying nature of vehicles entering the network. The simulated traffic volumes (average of the ten model runs) were within 10% of the 2022 counted volumes and the simulated travel times and speeds were with 15% of the observed data. A visual inspection of the calibrated model simulation during the AM and PM peak hour periods indicated that the model simulates the traffic operations reasonably and correctly. The heat/speed maps shown in Figures 2 and 3 during the AM and PM peak hours, respectively, are consistent with field observations. The 2023 existing VISSIM model has been calibrated and serves as the base model for the future No-Build and Build alternatives.

Figure 2 2023 Existing AM Peak Condition

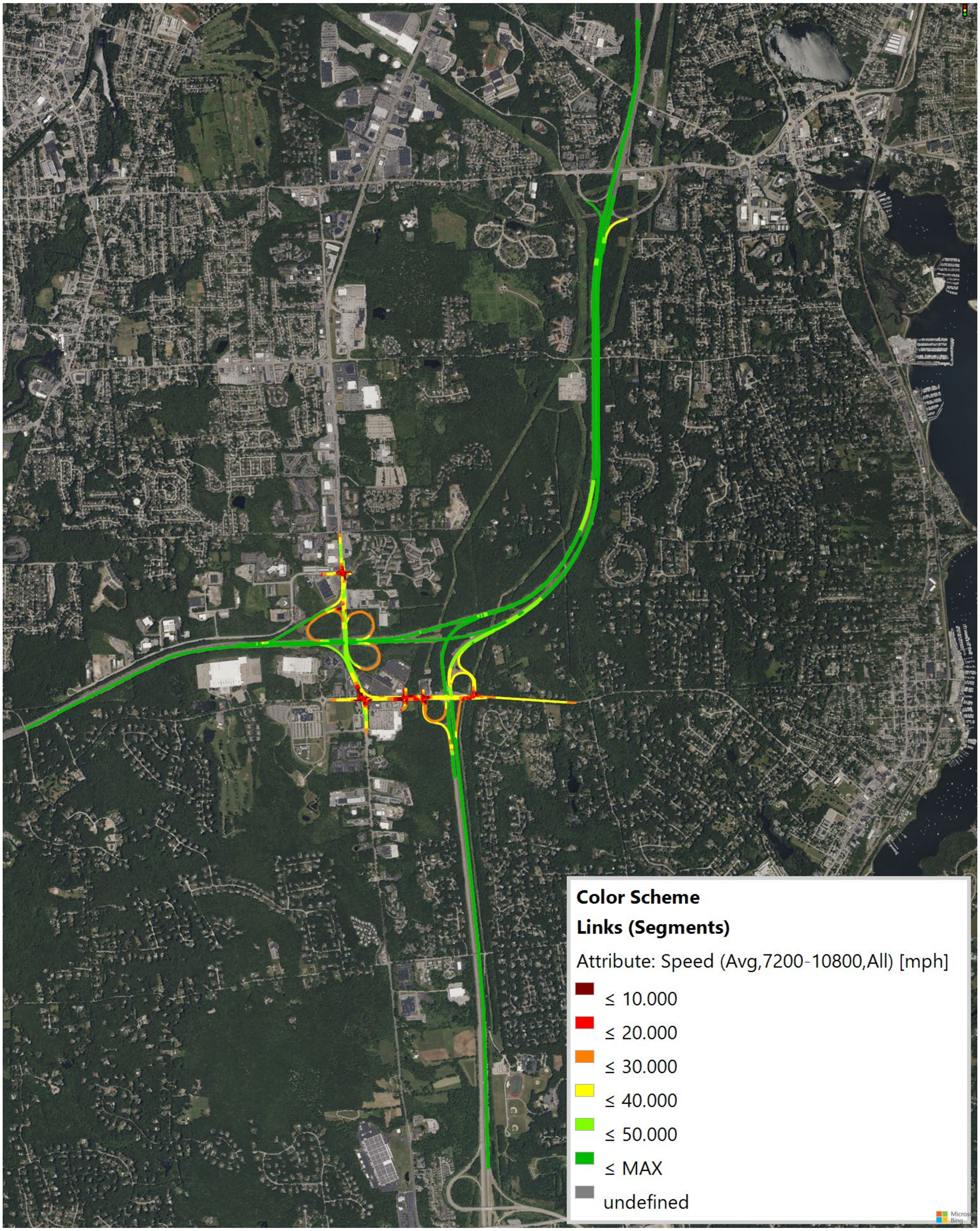
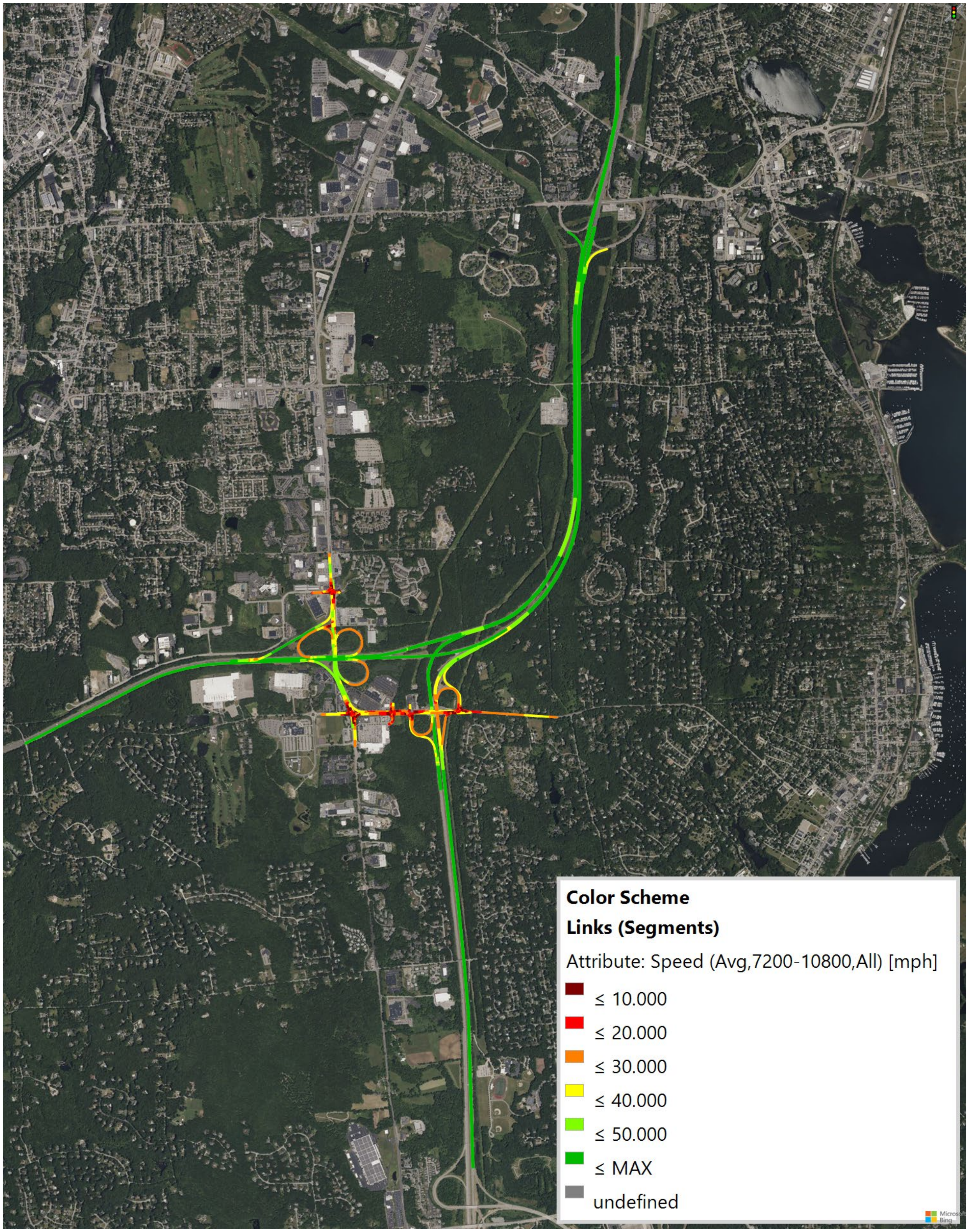


Figure 3 2023 Existing PM Peak Condition



Alternatives Analysis

The proposed improvements are expected to be constructed and opened to traffic in 5 years. This alternatives analysis will be evaluating the following future year conditions:

- No-Build - Opening Year (2028),
- Build - Opening Year (2028),
- No-Build – 30 Year Planning Horizon (2058),
- Build – 30 Year Planning Horizon (2058)

Traffic volumes in and around the project area are expected to change in the future based on the ambient background traffic growth in addition to the Quonset Development Corporation (QDC) master plan. A review of the RIDOT historical count data indicated that traffic volumes in the area remained steady with minimal growth. In order to provide some growth in the area, a background traffic growth rate of 0.25% annually was chosen and applied to the 2023 existing condition to get the 2028 condition and a conservative growth rate of 0.10% annually was chosen and applied to the 2028 condition to get to the 2058 condition. The Quonset Business Park has available land, and the Interchange Justification Report (IJR) for the Route 4 and I-95 Interchange has outlined known traffic growth due to business developments. The IJR based planned project traffic growth on the increase of employees by 5,000 (approximately 40% increase) as projected in the 2019 QDC Master Plan. The additional 5,000 employees are anticipated to be realized by the 30-year project horizon. Approximately 20% of that number is anticipated by 2026. While the IJR assumed approximately 40% of the 5,000 employees would arrive/depart during a peak hour, it seems more likely that these employees would be working across more shifts per day than, for example, office workers who often work during one shift. For the VISSIM exercise these trips were distributed across the 15-hour analysis with significant peaks during traditional work day shifts but additional windows of activity during the off-peak periods. This distribution is based loosely on available 24-hour traffic counts at gateways to the various QDC sites. Trips are generated to I-95 and Route 4 based on the size (acreage) of vacant parcels accessed by each gateway.

In addition to employees, this analysis assumed that an approximately 40% increase in employees would also result in a proportional increase in truck activity. Using origin-destination information, historic truck counts, and best available traffic volumes, approximately 40% more truck activity for the future conditions were also estimated and layered into the No Build and Build Condition models. Table 2 summarizes the 2058 daily traffic volumes.

Table 2 Projected 2058 Traffic Volumes

	Daily	Weekday Morning Peak Hour		Weekday Evening Peak Hour	
Location	Weekday[1]	Volume[2]	Dir. Dist.[3]	Volume[2]	Dir. Dist.[3]
I-95, west of Route 4	62,214	5,376	55% NB	5,599	60% SB
Route 4, at Route 401	88,810	8,072	55% SB	8,550	58% NB
Route 2, south of I-95	40,433	3,115	73% SB	3,639	51% SB
Route 401, west of Route 4	34,799	2,083	57% EB	3,132	55% EB

Source: PDI. Based on automatic traffic recorder (ATR) counts conducted in December 2022 grown annually by 0.25% from 2023 to 2028 and 0.20% from 2028 to 2058.
1 average daily traffic (ADT) volume expressed in vehicles per day
2 peak hour traffic volumes expressed in vehicles per hour
3 directional distribution of peak period traffic
Note: Peak hours do not necessarily coincide with the peak hours of the individual intersection turning movement counts

Projected 2028 and 2058 No-Build Conditions

Figures 4 to 7 illustrate the 2028 and 2058 No-Build Condition AM and PM peak hour heat/speed maps. There are few changes in speed under the 2028 No-Build AM peak hour. With the anticipated 20 percent buildout of Quonset Business Park by 2028 and full buildout (5,000 trips) by the year 2058 and the lack of direct connection from I-95 North to Route 4 South and from Route 4 North to I-95 South, the existing arterial network system along Route 401 and Route 2 will experience increased in delay. However, the existing deficiencies on the Route 4 North and I-95 North after the Route 4 merge will be significantly improved with the proposed I-95 North improvements. With full buildout of Quonset Business Park and the increase in background traffic volumes in 2058, the speed along the arterial network system as well as the I-95/Route 2 and Route 4/Route 401 interchanges would be significantly reduced.

It should be noted that a background project is programmed for 2024 which will extend the Route 4 North on-ramp auxiliary lane to provide some additional weaving space for vehicles. This is included in all No-Build and Build Conditions.

Figure 4 2028 No-Build AM Peak Condition

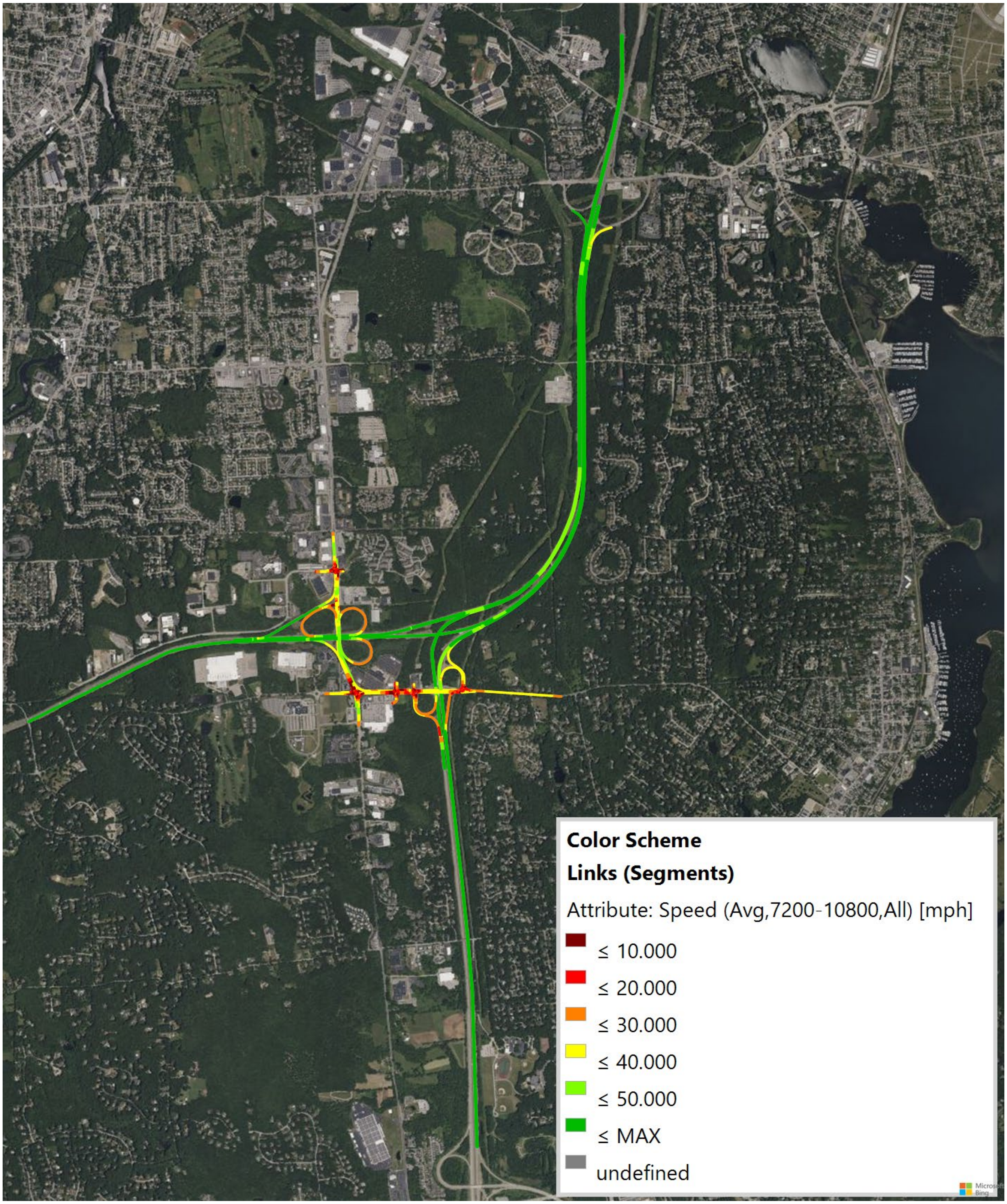


Figure 5 2028 No-Build PM Peak Condition

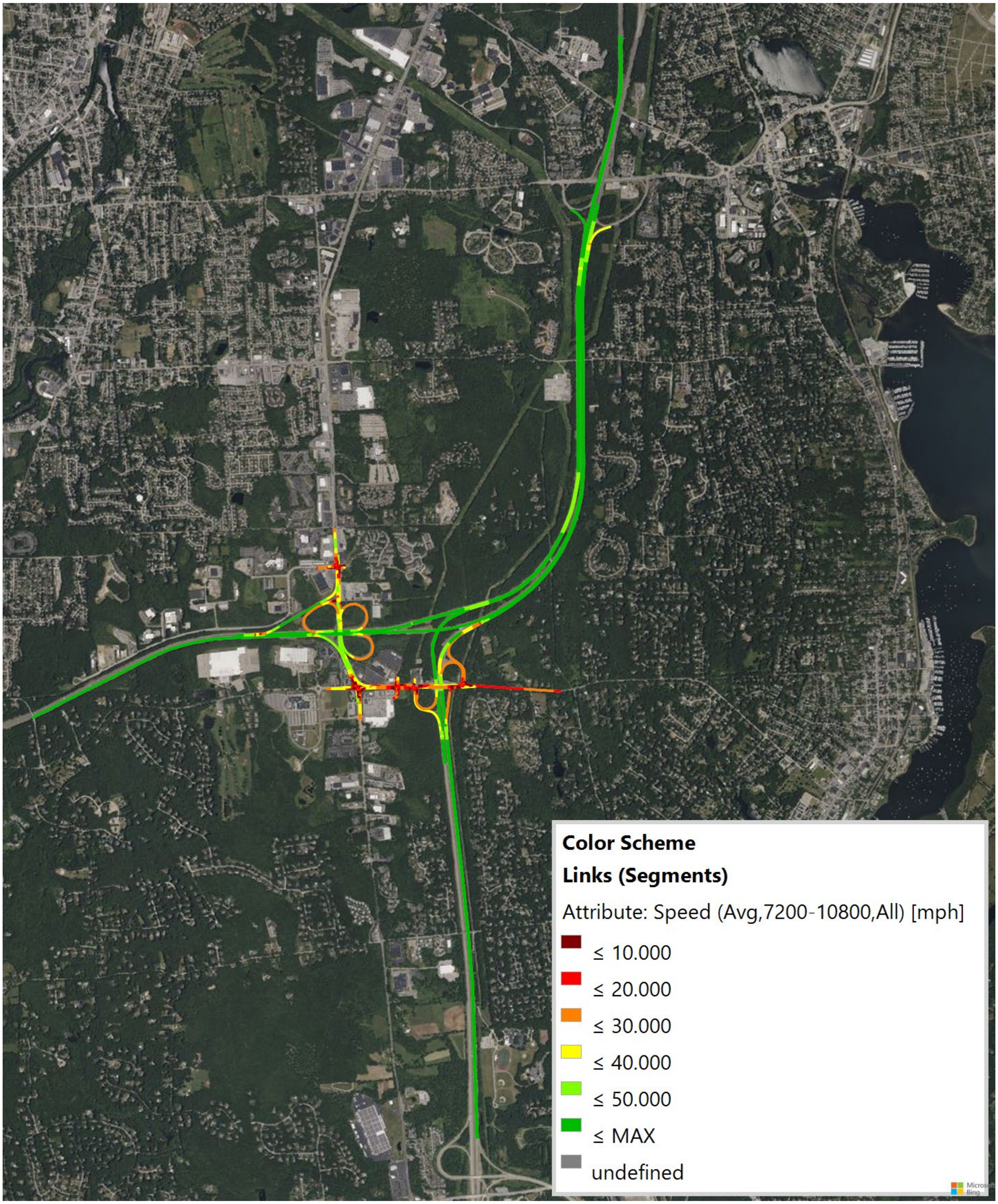


Figure 6 2058 No-Build AM Peak Condition

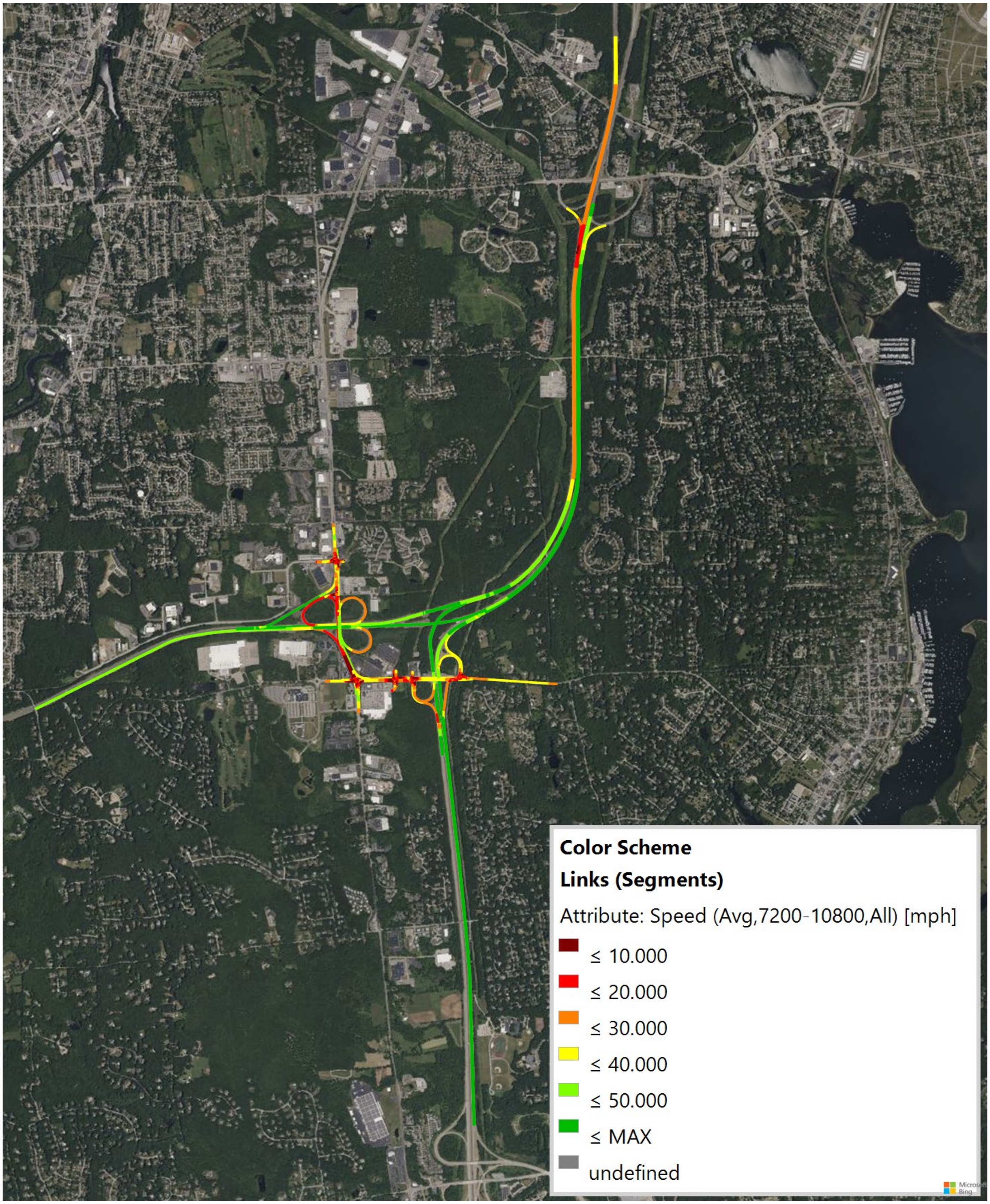
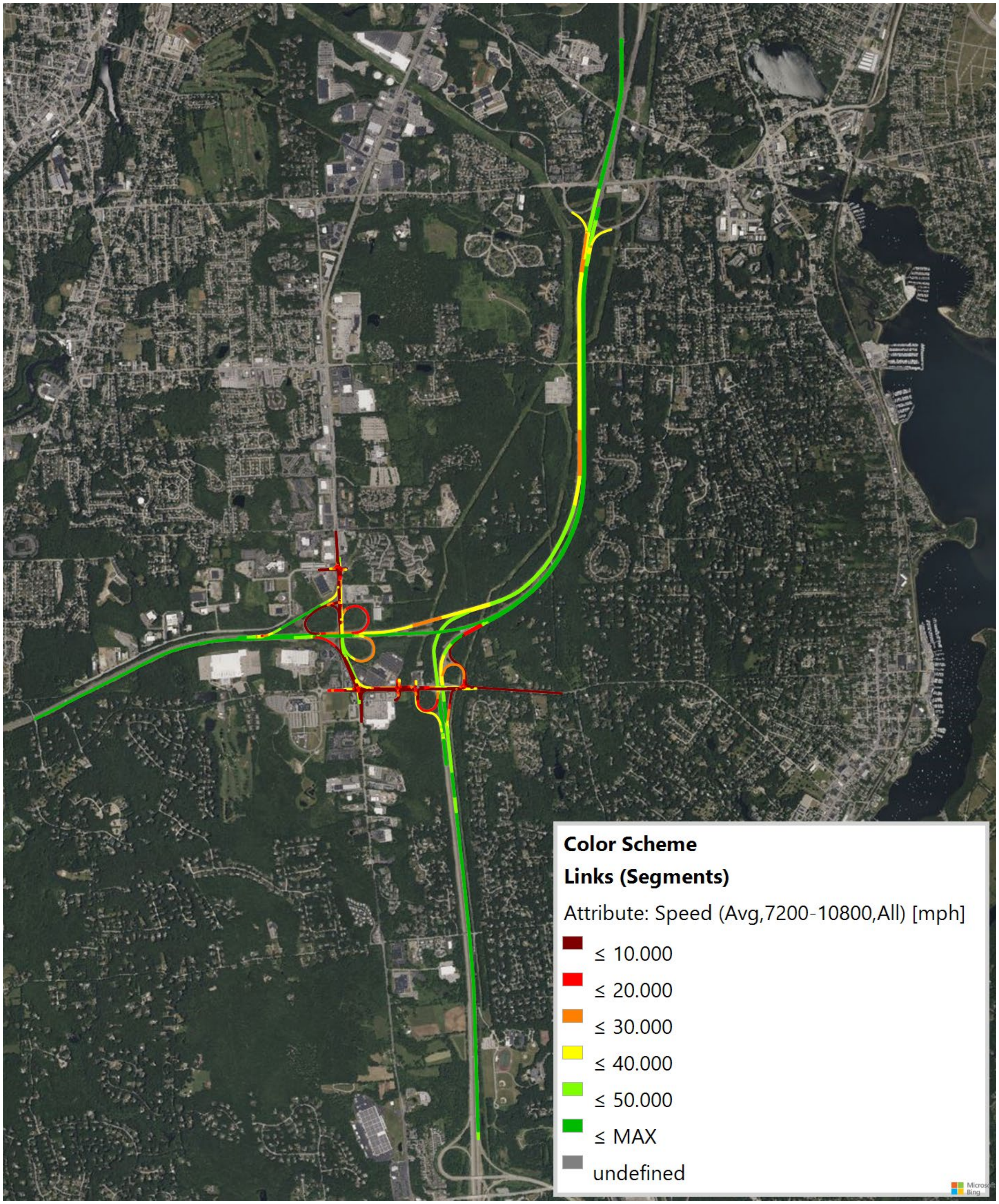


Figure 7 2058 No-Build PM Peak Condition



Projected 2028 and 2058 Build Conditions

The proposed Route 4 and I-95 interchange improvements will install a new ramp from I-95 northbound to Route 4 southbound. Additionally, a ramp from Route 4 northbound to I-95 southbound will be installed to complete the interchange and allow for simultaneous access to and from Route 4.

Tables 3 and 4 summarize the Route 4 and I-95 freeway network system and the arterial roadway network system, respectively, for the hourly volumes, vehicle miles traveled (VMT), vehicle hours traveled (VHT), average speed, and total delay comparison between the 2058 No-Build and Build conditions. As noted earlier, the 15-hour modeling period accounted for 90% of the total daily demand. As highlighted in Table 3, the proposed improvements "Build" alternative is expected to process more vehicles in the network with increases in VMT and decreases to VHT as traffic volumes are shifting from the arterial to the freeway. The traffic volumes, VMT, and VHT along the arterial roadway network system are expected to decrease. Even though the average speeds are comparable between the No-Build and Build alternatives, the delays are less especially during the PM peak hour periods with the proposed improvements.

Table 3 Freeway Network System Measures of Effectiveness (MOE) Comparison

Time	Total Vehicles in Network		VMT: Total Path Distance (mi)		VHT: Total Time in Network (hr)		Average Speed (mph)		Total Delay (hr)		Average Delay (hr/veh)	
	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build
6:00 AM	5,981	6,125	19,000	18,987	389	391	48	48	8	8	0.001	0.001
7:00 AM	10,233	10,477	33,635	34,840	689	710	47	48	16	18	0.002	0.002
8:00 AM	16,767	17,207	53,275	55,618	1,531	1,503	40	40	178	307	0.011	0.018
9:00 AM	15,728	16,360	48,146	52,342	2,055	1,624	37	40	393	456	0.025	0.028
10:00 AM	13,824	13,726	44,011	45,581	1,433	1,228	39	42	206	239	0.015	0.017
11:00 AM	12,232	11,890	39,972	39,526	996	808	45	47	82	22	0.007	0.002
12:00 PM	11,923	11,888	39,366	39,778	894	812	45	47	50	22	0.004	0.002
1:00 PM	13,024	13,294	41,439	42,585	880	891	46	47	30	28	0.002	0.002
2:00 PM	13,202	13,520	42,859	43,578	914	924	47	47	40	33	0.003	0.002
3:00 PM	17,747	18,442	55,661	57,758	1,349	1,320	45	46	125	85	0.007	0.005
4:00 PM	18,169	19,336	56,621	59,679	1,919	1,744	40	38	377	320	0.021	0.017
5:00 PM	17,568	19,815	50,277	60,505	2,978	2,072	31	38	904	530	0.051	0.027
6:00 PM	18,008	18,752	50,659	56,514	2,689	1,861	33	40	767	443	0.043	0.024
7:00 PM	15,994	13,710	45,708	41,716	1,653	1,064	40	43	344	136	0.022	0.010
8:00 PM	11,617	8,870	36,114	27,363	1,079	572	42	47	171	20	0.015	0.002
Total	**212,015**	**213,412**	**656,743**	**676,370**	**21,449**	**17,523**	**41**	**43**	**3,692**	**2,667**	**0.0174**	**0.0125**

Table 4 Arterial Roadway Network System Measures of Effectiveness (MOE) Comparison

Time	Total Vehicles in Network		VMT: Total Path Distance (mi)		VHT: Total Time in Network (hr)		Average Speed (mph)		Total Delay (hr)		Average Delay (hr/veh)	
	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build
6:00 AM	1,225	1,081	3,892	3,351	80	69	28	28	21	23	0.017	0.021
7:00 AM	2,096	1,849	6,889	6,148	141	125	27	26	41	39	0.019	0.021
8:00 AM	3,434	3,037	10,912	9,815	314	265	23	27	442	217	0.129	0.071
9:00 AM	3,221	2,887	9,861	9,237	421	287	22	27	976	285	0.303	0.099
10:00 AM	2,832	2,422	9,014	8,044	294	217	25	27	511	190	0.180	0.078
11:00 AM	2,505	2,098	8,187	6,975	204	143	27	26	202	46	0.081	0.022
12:00 PM	2,442	2,098	8,063	7,020	183	143	27	27	124	46	0.051	0.022
1:00 PM	2,667	2,346	8,488	7,515	180	157	26	25	73	63	0.027	0.027
2:00 PM	2,704	2,386	8,778	7,690	187	163	26	25	68	73	0.025	0.031
3:00 PM	3,635	3,255	11,400	10,193	276	233	20	17	212	165	0.058	0.051
4:00 PM	3,721	3,412	11,597	10,532	393	308	13	19	638	389	0.171	0.114
5:00 PM	3,598	3,497	10,298	10,677	610	366	11	24	1,529	549	0.425	0.157
6:00 PM	3,688	3,309	10,376	9,973	551	328	12	27	1,297	473	0.352	0.143
7:00 PM	3,276	2,419	9,362	7,362	339	188	19	22	583	172	0.178	0.071
8:00 PM	2,379	1,565	7,397	4,829	221	101	25	18	289	38	0.121	0.024
Total	**43,425**	**37,661**	**134,514**	**119,359**	**4,393**	**3,092**	**21**	**24**	**7,006**	**2,768**	**0.1613**	**0.00735**

Figures 8 to 11 illustrate the 2028 and 2058 Build Condition AM and PM peak hour speeds. The speeds along arterial roadway network system are expected to y improve with the proposed improvements as traffic are shifting to the freeway network system compared to the No-Build alternative.

Figure 8 2028 Build AM Peak Condition

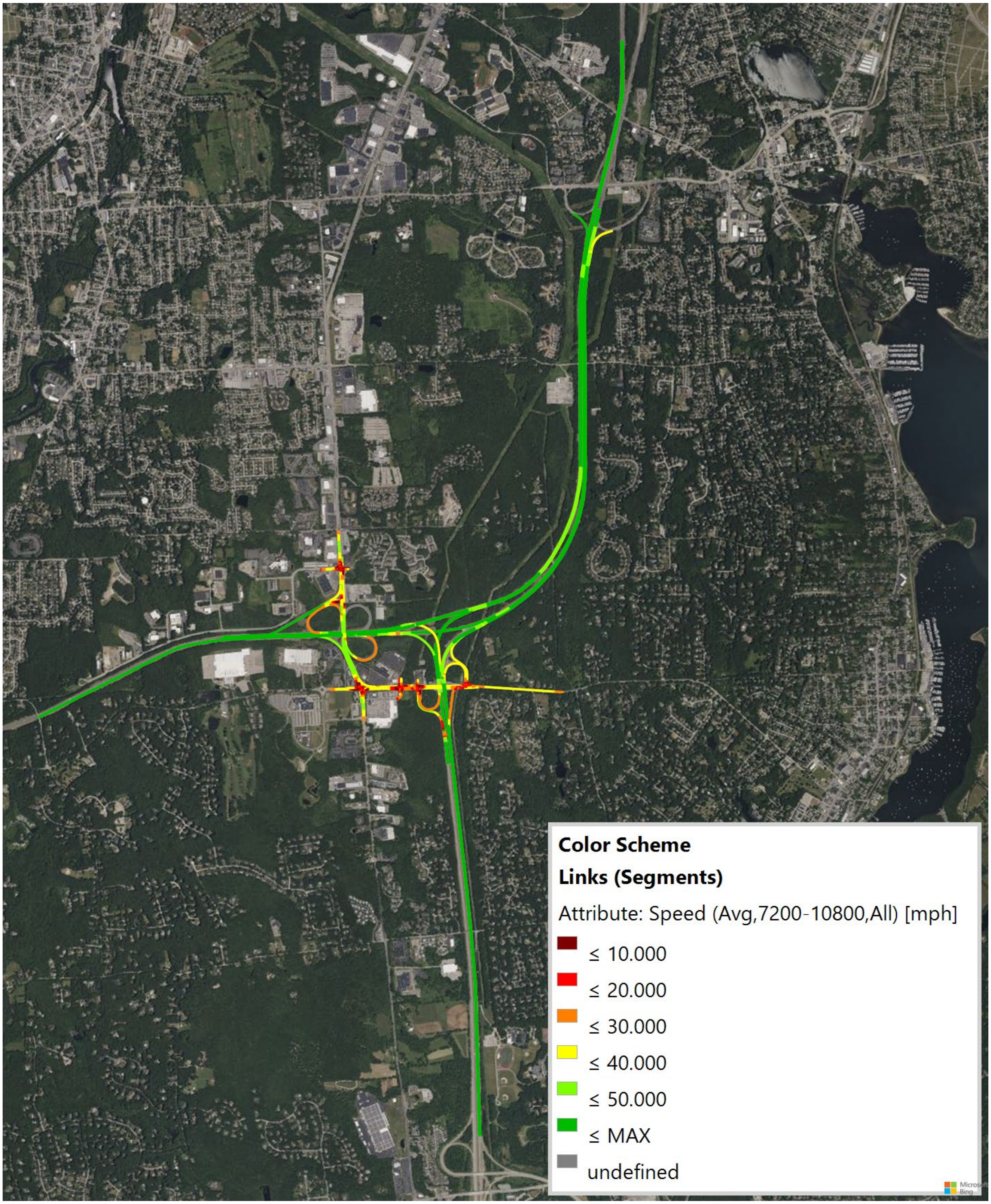


Figure 9 2028 Build PM Peak Condition

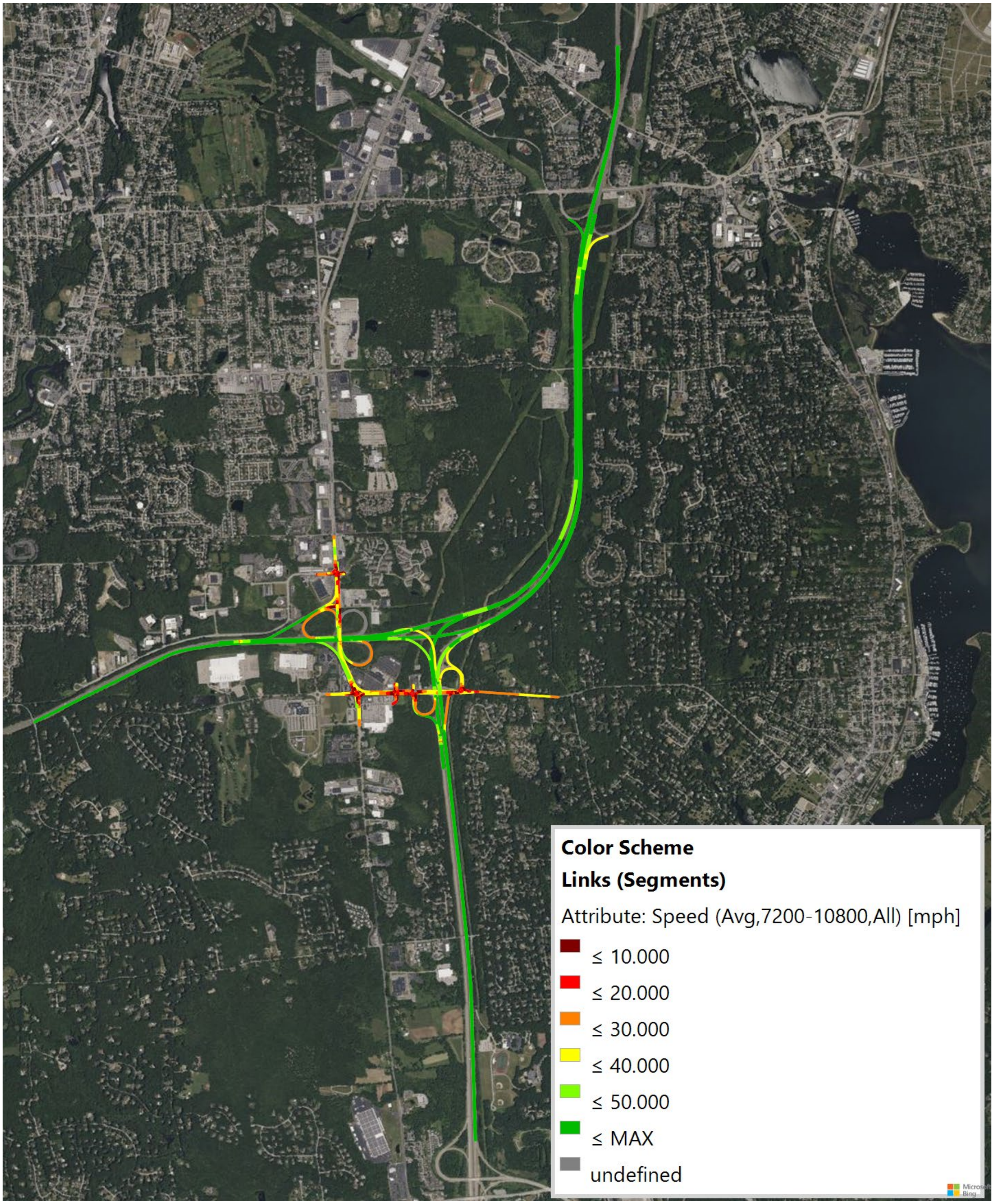


Figure 10 2058 Build AM Peak Condition

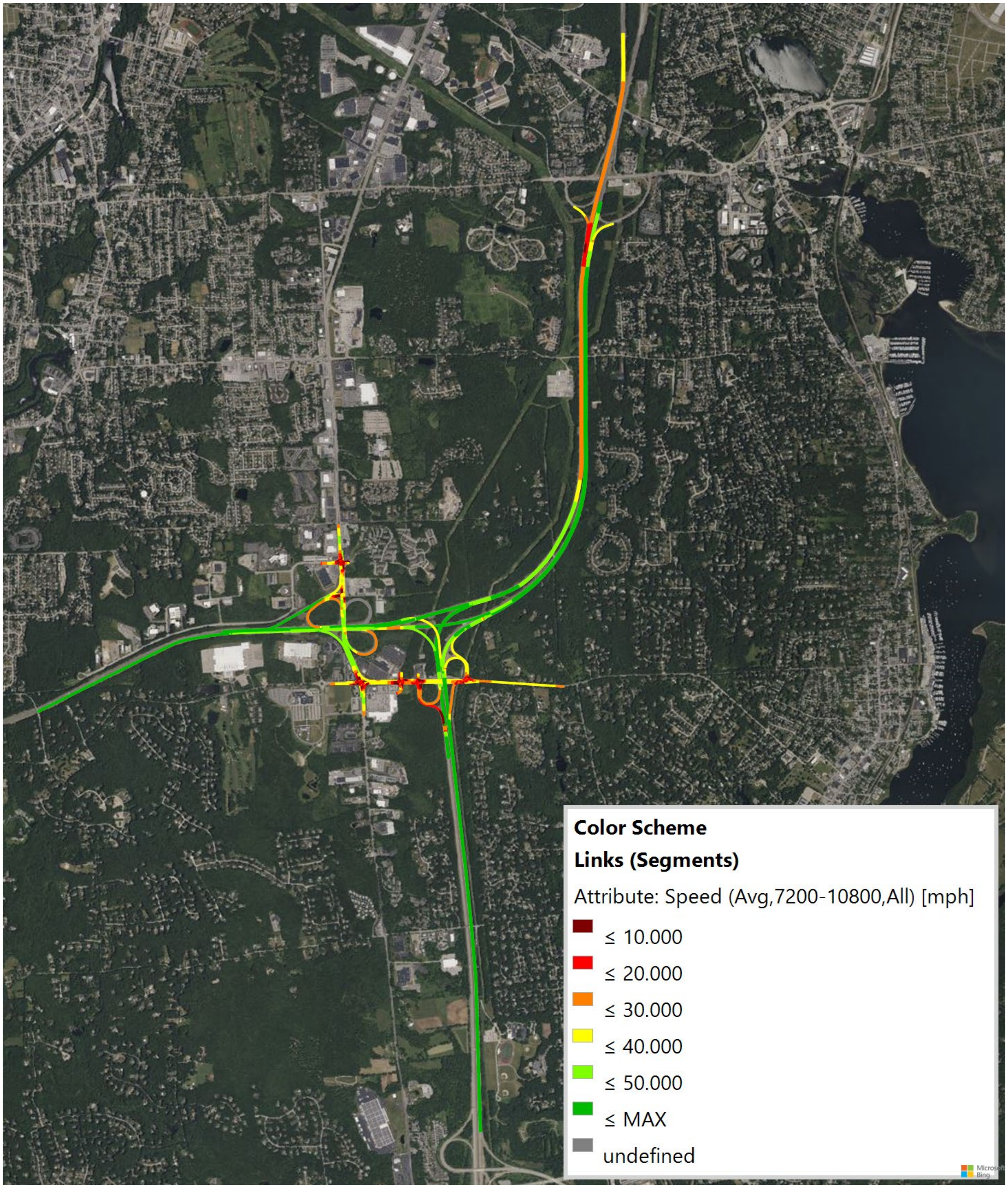


Figure 11 2058 Build PM Peak Condition

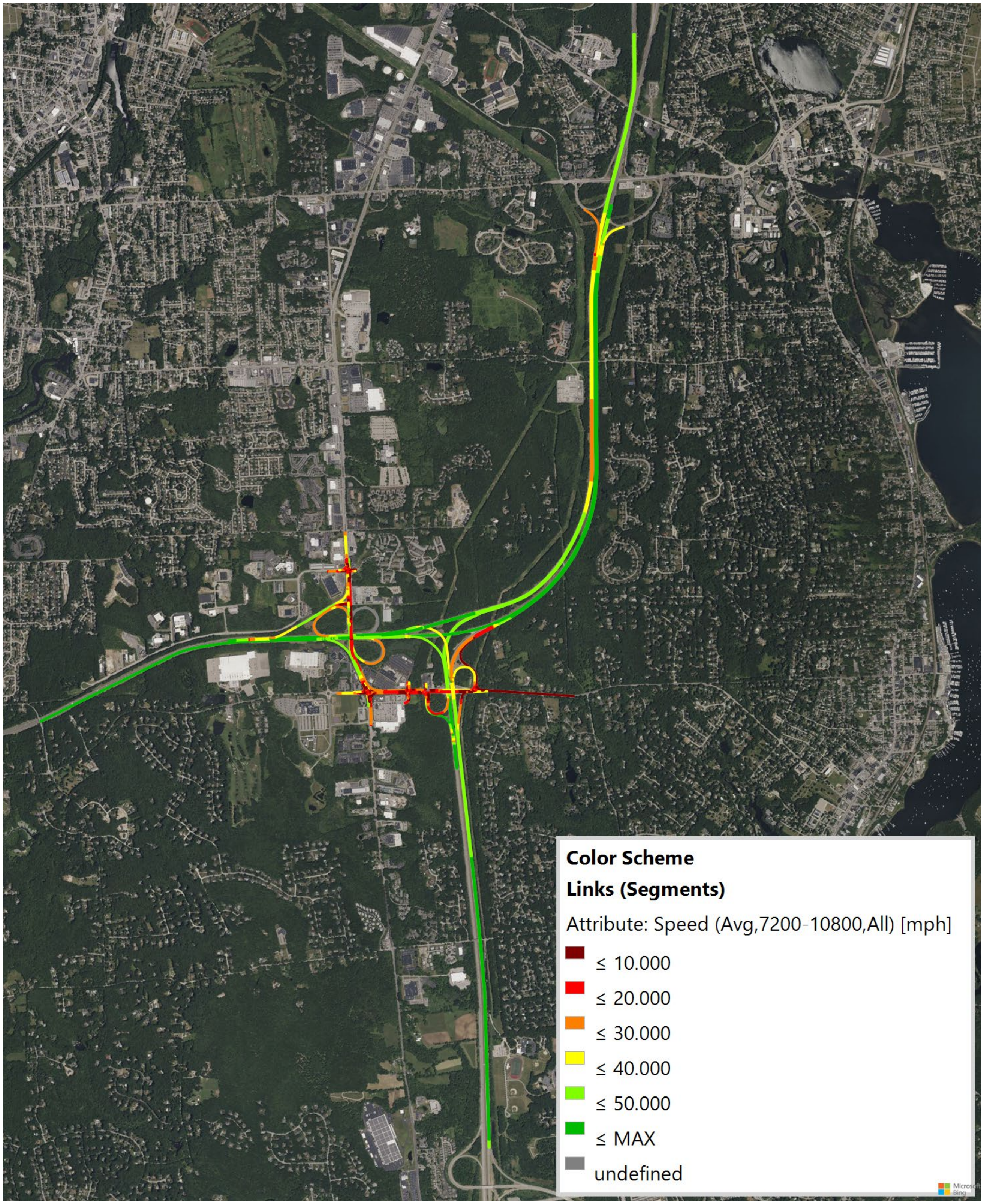


Table 5 summarizes the study area travel time segment comparison between the 2058 No-Build and Build conditions. While some segments show minor increases to travel time, the I-95 Northbound to Route 4 Southbound movement shows significant decreases in travel time, primarily in the weekday PM peak hour which was identified to be the worst-case condition.

Table 5 Travel Time Segment Comparison

	2058 No-Build				2058 Build			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
Travel Time Segments	sec	min	sec	min	sec	min	sec	min
Freeway Route 4 NB to I-95 NB	321	5.4	329	5.5	322	5.4	362	6.0
Freeway I-95 SB to Route 4 SB	284	4.7	241	4.0	281	4.7	298	5.0
Freeway I-95 NB to Route 4 SB	404	6.7	643	10.7	192	3.2	227	3.8
Arterial Route 2 SB to Route 4 SB	337	5.6	865	14.4	304	5.1	196	3.3

Memorandum

To: Ken White, Ph.D.
Assistant Director for Administrative Services
Division of Planning
Rhode Island Department of Transportation
Two Capitol Hill, Room 318
Providence, Rhode Island

Date: August 18, 2023

Project #: 73337.05

From: Kristin Caouette, PE
Peter Pavao, PE
Amphone Soupharath
Zachary Tiang, PE

Re: Completing the Missing Move – Route 403 – Travel Time Savings

The Rhode Island Department of Transportation (RIDOT) is responding to a Notice of Funding Opportunity (NOFO) for grant funding through Multimodal Project Discretionary Grant program to request a construction grant for the **Completing The Missing Move**. RIDOT requested support from VHB for preparation of the NOFO application, including estimation of the traffic, safety, noise, environmental, and other impacts, as well as costs, of the proposed design.

This memorandum documents the traffic and travel time analysis completed for Component 2 of the Completing the Missing Move Project focused on the Route 403 corridor and providing new access between Post Road (US-1), Route 403, and West Davisville Road.

RIDOT has requested that VHB evaluate and determine the travel time savings associated with the proposed improvements at the Route 403 at Route 1 (Post Road) and Route 403 at West Davisville Road interchanges by installing an on-ramp from Post Road to Route 403 westbound and on/off-ramps to West Davisville Road westbound/eastbound respectively. The purpose of this memorandum is to document the methodologies and assumptions used in the development of the VISSIM microsimulation model and provide documentation of the model results.

Along Route 403, a review identified "missing moves" that if installed, would create direct travel between the two Quonset Business Parks and alleviate local roads that currently facilitate movement between the two parks. This review found that there would be positive travel time benefits by installing the three deferred ramp systems. The results presented in the Benefit Cost Analysis (BCA) are the net results for the Route 403 modeled study area, described in the following section. This memorandum concludes with a summary of changes in travel times by roadway facility in the modeled study area.

Study Area

The Route 403 study area includes the Route 403 freeway network system and the arterial roadway network system, providing both local and regional access to the Quonset developments and North Kingstown. The study area extends from Route 403 approaching West Davisville Road at the ramp terminus, along Route 403 to the roundabout east of Gate Road and west of the Quonset Business Park. The study area also includes the ramps and approach roads on the ends of Post Road, including the Route 403 interchange and The Shops at Quonset Point driveways. The following is a description of the study area roadways and intersections.

Route 403 is an east-west four-lane divided freeway under the jurisdiction of the Rhode Island Department of Transportation (RIDOT). RIDOT also currently maintains the ramps and the approaches to the West Davisville Road Bridge. Overhead roadway lighting is present throughout the study area. The posted speed limit is 45 mph however vehicles operate at much higher speeds.

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Post Road is a north-south principal arterial under RIDOT jurisdiction in North Kingstown. In the study area, there are on- and off-ramps providing access to and from Route 403 and Quonset Business Park. Sidewalks are present along both sides of Post Road. The posted speed limit within the study area is 35 mph.

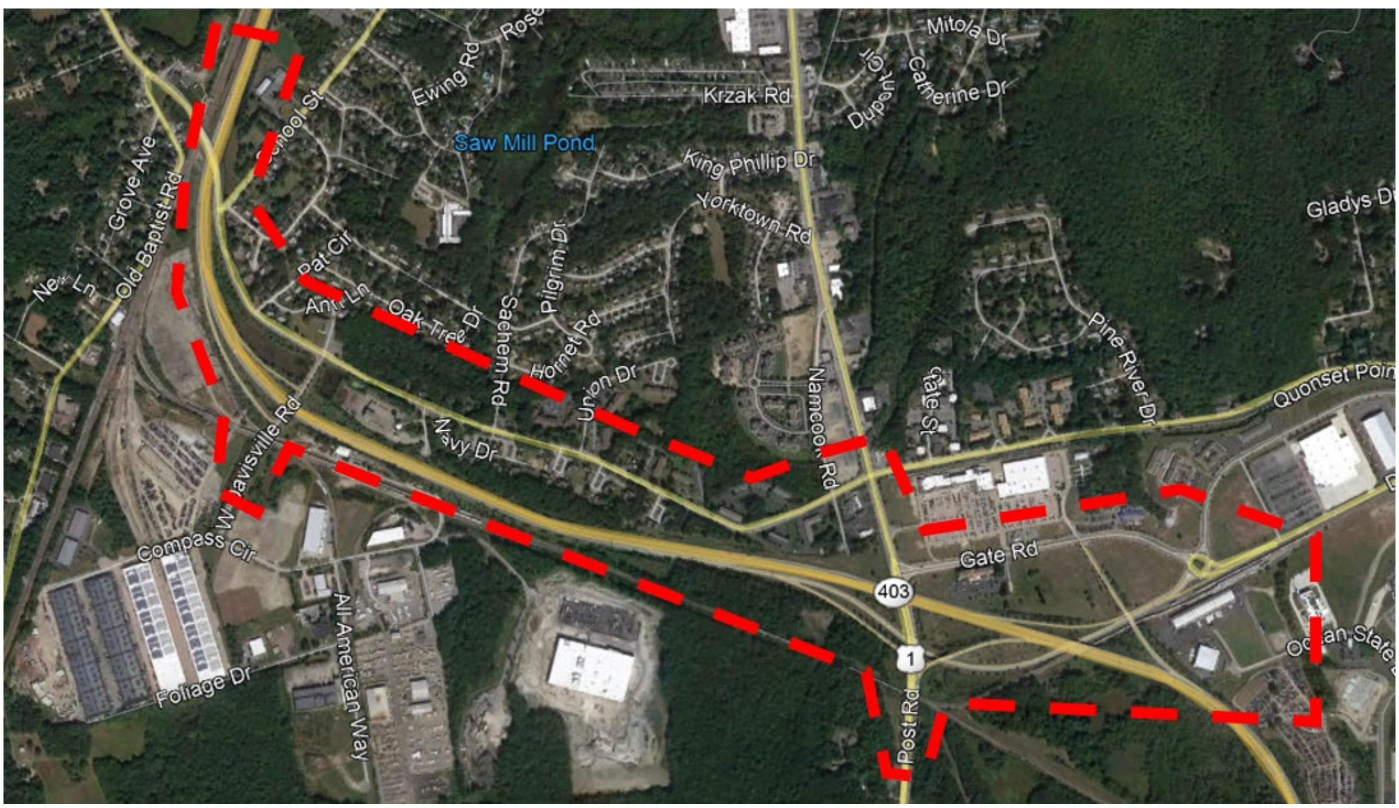
Gate Road is an east-west major collector under RIDOT jurisdiction in North Kingstown. Gate Road provides access between Post Road and the Quonset Business Park as well as The Shops at Quonset Point. Sidewalks are present along both sides of Gate Road. The posted speed limit within the study area is 35 mph.

Davisville Road is an east-west principal arterial under RIDOT jurisdiction in North Kingstown. Davisville Road is two legs of the roundabout and connects the northern Quonset Business Park to Post Road and Route 403 westbound. Overhead roadway lighting is present approaching the roundabout westbound. The posted speed limit within the study area is 25 mph.

Devils Foot Road is an east-west minor arterial under RIDOT jurisdiction in North Kingstown. Devils Foot Road connects Post Road to West Davisville and is currently the only way to access the West Davisville Business Park from Post Road. Sidewalks are present along both sides of Devils Foot Road. The posted speed limit within the study area is generally 35 mph.

West Davisville Road is a north-south major collector under North Kingstown's jurisdiction. In the study area, there are on- and off-ramps providing access to Route 407 westbound and from Route 403 eastbound. There are no ramps providing access to Route 403 eastbound or from Route 403 westbound. West Davisville Road provides access to and from the West Davisville Business Park. The posted speed limit within the study area is 25 mph.

Figure 1 Study Area



Study Area modeled – Google Earth

Model Development

To quantify existing traffic operations, the study area roadways and intersections were modeled and analyzed using VISSIM microscopic traffic simulation software (Version 21). Because of its extensive modeling and analysis capabilities, the VISSIM model provides a more comprehensive evaluation of complex transportation facilities. VISSIM can therefore better model complex networks that include such things as multi-modal users, ramp systems with closely spaced intersections (signalized, stop/yield controlled and/or roundabout), compared to the traditional traffic analysis methodology based on the Highway Capacity Manual. For the purpose of the Infrastructure for Rebuilding America (INFRA) grant, VISSIM is well suited to provide network level measures for quantifying impacts and benefits. For this analysis, traffic was projected to the year 2028 (opening year) and 2058 (30 year planning horizon). No Build and Build Condition analyses were completed for each year. The VISSIM model was calibrated to model the 2023 existing conditions and then used to project future operations with (Build Condition) and without (No Build Condition) the project.

Data Collection

To identify current traffic flow characteristics, supplemental traffic counts were collected in December 2022 at key intersections in the study area as well as along Post Road and Route 403. A review of the historical traffic counts in the November 2020 Interchange Justification Report and historical local counts revealed that the December 2022 counts were comparable to the 2020 counts. A review of the seasonal adjustment factor in December was approximately 2 percent less, therefore, the December 2022 volumes were adjusted by the seasonal factor to develop the 2023 existing conditions. The 2023 existing daily and peak hour volumes are shown below in **Table 1**.

Table 1 Existing Traffic Volumes

	Daily	Weekday Morning Peak Hour		Weekday Evening Peak Hour	
Location	Weekday[1]	Volume[2]	Dir. Dist.[3]	Volume[2]	Dir. Dist.[4]
Post Road, north of Devils Foot Road	15,632	729	56% SB	1,343	58% NB
Route 403, east of West Davisville Road	22,184	1,709	72% EB	1,655	73% WB

Source: PDI. Based on automatic traffic recorder (ATR) counts conducted in December 2022.
1 average daily traffic (ADT) volume expressed in vehicles per day
2 peak hour traffic volumes expressed in vehicles per hour
3 directional distribution of peak period traffic
Note: Peak hours do not necessarily coincide with the peak hours of the individual intersection turning movement counts

Google Maps average traffic conditions and travel times were used to provide travel time and speed measurements and to help identify hotspot and bottleneck locations. StreetLight was used to perform a 2019 Origin/Destination study to determine the proportion of origins and their destinations in the study area. These proportions help determine the turning movements throughout the network.

Model Geometrics and Traffic Controls

The existing roadway, interchange, and intersection geometries were initially modeled using aerial mapping provided within VISSIM and verified with a combination of field observations, Google Maps/StreetView, and Nearmap. Traffic controls and signal timings were modeled and verified by field observations. Vehicle speed data was modeled and verified using the Posted Speed Limit in the field.

Model Verification and Error Checking

Before beginning the calibration process, the model was checked for errors. Roadway geometry, traffic volumes and routes, speeds, signal timing data, and other inputs were reviewed along with a visual check of the simulation. The VISSIM error file was also reviewed, and critical errors were corrected. The simulation was reviewed to verify traffic signals were operating correctly, to visually inspect queue lengths, and to check general traffic operations throughout the model. Coding errors were corrected, and adjustments were made to various model parameters to accurately reflect field conditions.

Model Calibration and Results

The North America default network parameters were used and adjusted as part of the calibration process including conflict areas, lane-change distances, and driver behaviors.

Based on the required benefit-cost analysis inputs, the 2023 existing VISSIM model was developed and modeled for 15-hours from 5:00 AM to 8:00 PM in order to capture both the AM and PM peak hour periods as well as the shoulder hours building up the congestion and the recovering periods after the peak hour periods. This 15-hour period accounted for approximately 90% of the daily traffic demand.

Ten model runs with random seed numbers were simulated to provide varying nature of vehicles entering the network. The simulated traffic volumes (average of the ten model runs) were within 10% of the 2022 counted volumes and the simulated travel times and speeds were with 15% of the observed data. A visual inspection of the calibrated model simulation during the AM and PM peak hour periods indicated that the model simulates the traffic operations reasonably and correctly. The heat/speed maps shown in Figures 2 and 3 during the AM and PM peak hours, respectively, are consistent with field observations. The 2023 existing VISSIM model has been calibrated and serves as the base model for the future No-Build and Build alternatives.

Figure 2 2023 Existing AM Peak Condition

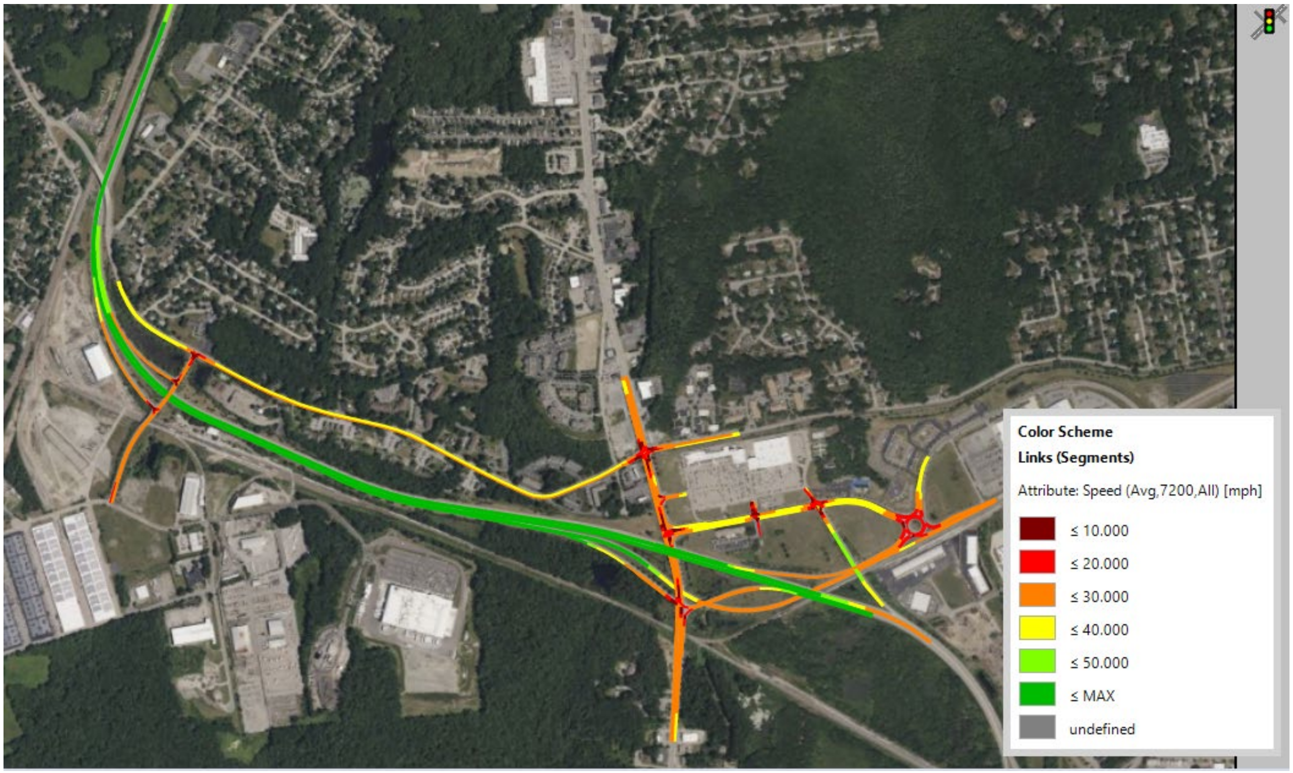
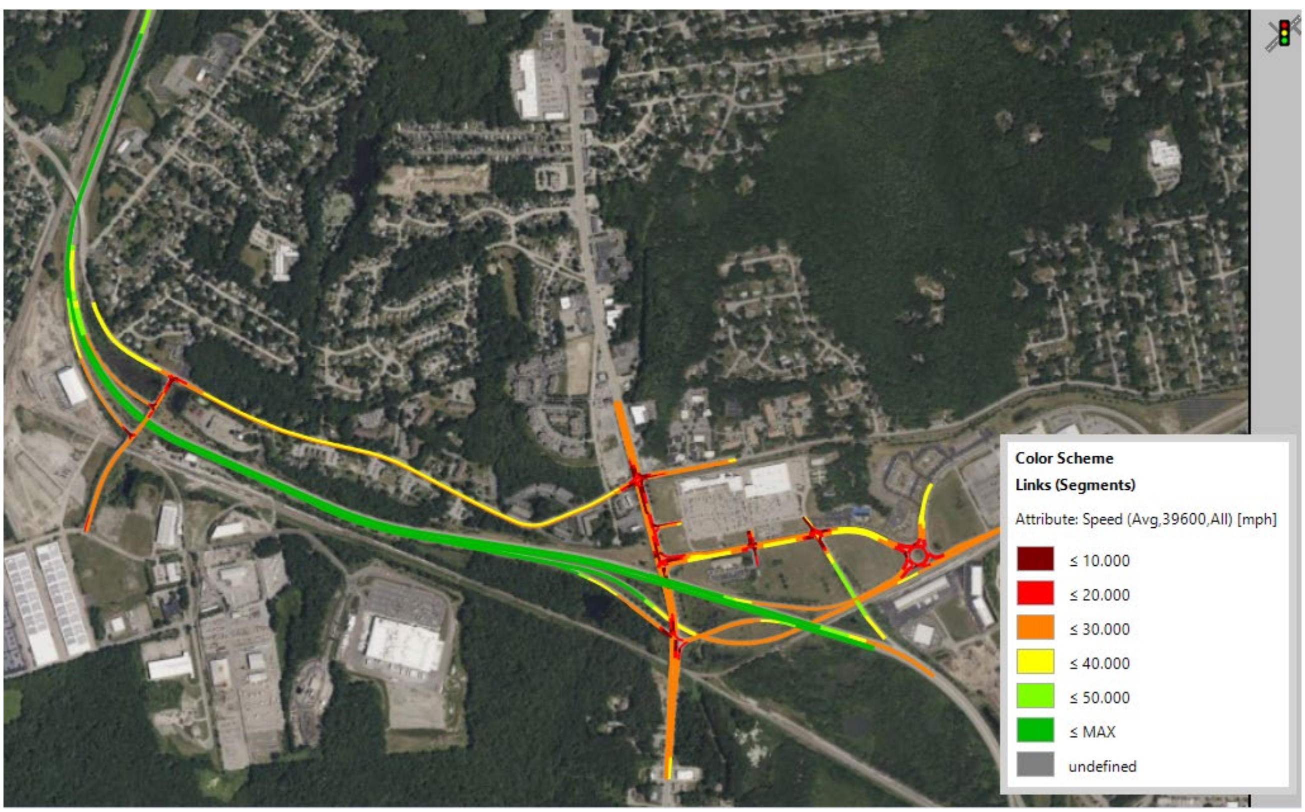


Figure 3 2023 Existing PM Peak Condition



Alternatives Analysis

The proposed improvements are expected to be constructed and opened to traffic in 5 years. This alternatives analysis will be evaluating the following future year conditions:

- No-Build - Opening Year (2028),
- Build - Opening Year (2028),
- No-Build – 30 Year Planning Horizon (2058),
- Build – 30 Year Planning Horizon (2058)

Traffic volumes in and around the project area are expected to change in the future based on the ambient background traffic growth in addition to the Quonset Development Corporation (QDC) master plan. A review of the RIDOT historical count data indicated that traffic volumes in the area remained steady with minimal growth. In order to provide some growth in the area, a background traffic growth rate of 0.25% annually was chosen and applied to the 2023 existing condition to get the 2028 and 2058 No-Build conditions. The Quonset Business Park has available land and the Interchange Justification Report (IJR) for the Route 4 and I-95 interchange has outlined known traffic growth due to business developments. The IJR based planned project traffic growth on the increase in the number of employees by 5,000 (approximately 40% increase) as projected in the 2019 QDC Master Plan. The additional 5,000 employees are anticipated to be realized by the 30-year project horizon. Approximately 20% of that number is anticipated by 2026. While the IJR assumed approximately 40% of the 5,000 employees would arrive/depart during a peak hour, it seems more likely that these employees would be working across more shifts per day than, for example, office workers who often work during one shift. For the VISSIM exercise these trips were distributed across the 15 hour analysis with significant peaks during traditional work day shifts but additional windows of activity during the off-peak periods. This distribution is based on available 24-hour traffic counts at gateways to the various QDC sites. Trips are generated to West Davisville Road, Davisville Road, or Roger Williams Way based on the size (acreage) of vacant parcels accessed by each gateway.

In addition to employees, this analysis assumed that an approximately 40% increase in employees would also result in a proportional increase in truck activity. Using origin-destination information, historic truck counts, and best available traffic volumes, approximately 40% more truck activity for the future conditions were also estimated and layered into the No Build and Build Condition models.

Table 2 summarizes the 2058 daily traffic volumes.

Table 2 Projected 2058 Traffic Volumes

	Daily	Weekday Morning Peak Hour		Weekday Evening Peak Hour	
Location	Weekday[1]	Volume[2]	Dir. Dist.[3]	Volume[2]	Dir. Dist.[3]
Post Road, north of Devils Foot Road	17,059	785	56% SB	1,446	58% NB
Route 403, east of West Davisville Road	32,576	2,443	55% EB	2,312	63% WB

Source: PDI. Based on automatic traffic recorder (ATR) counts conducted in December 2022 grown annually by 0.25%.
1 average daily traffic (ADT) volume expressed in vehicles per day
2 peak hour traffic volumes expressed in vehicles per hour
3 directional distribution of peak period traffic
Note: Peak hours do not necessarily coincide with the peak hours of the individual intersection turning movement counts

Projected 2028 and 2058 No-Build Conditions

Figures 4 to 7 illustrate the 2028 and 2058 No-Build Condition AM and PM peak hour heat/speed maps. There are minor changes in speed under the 2028 No-Build AM peak hour compared to the existing condition, primarily along Route 403 and more significant decreases to speed along Gate Road in the 2028 No-Build PM peak hour. Due to the existing lack of access from Post Road to Route 403 westbound, the northbound left-turn from Post Road to Devils Foot Road deficiency is expected to escalate in the future, causing speeds on Post Road and Gate Road to reduce with vehicle queues spilling back to the Iafrate Way off-ramp. With the increase in traffic volumes in 2058, the speed along Post Road would be further reduced.

Figure 4 2028 No-Build AM Peak Condition

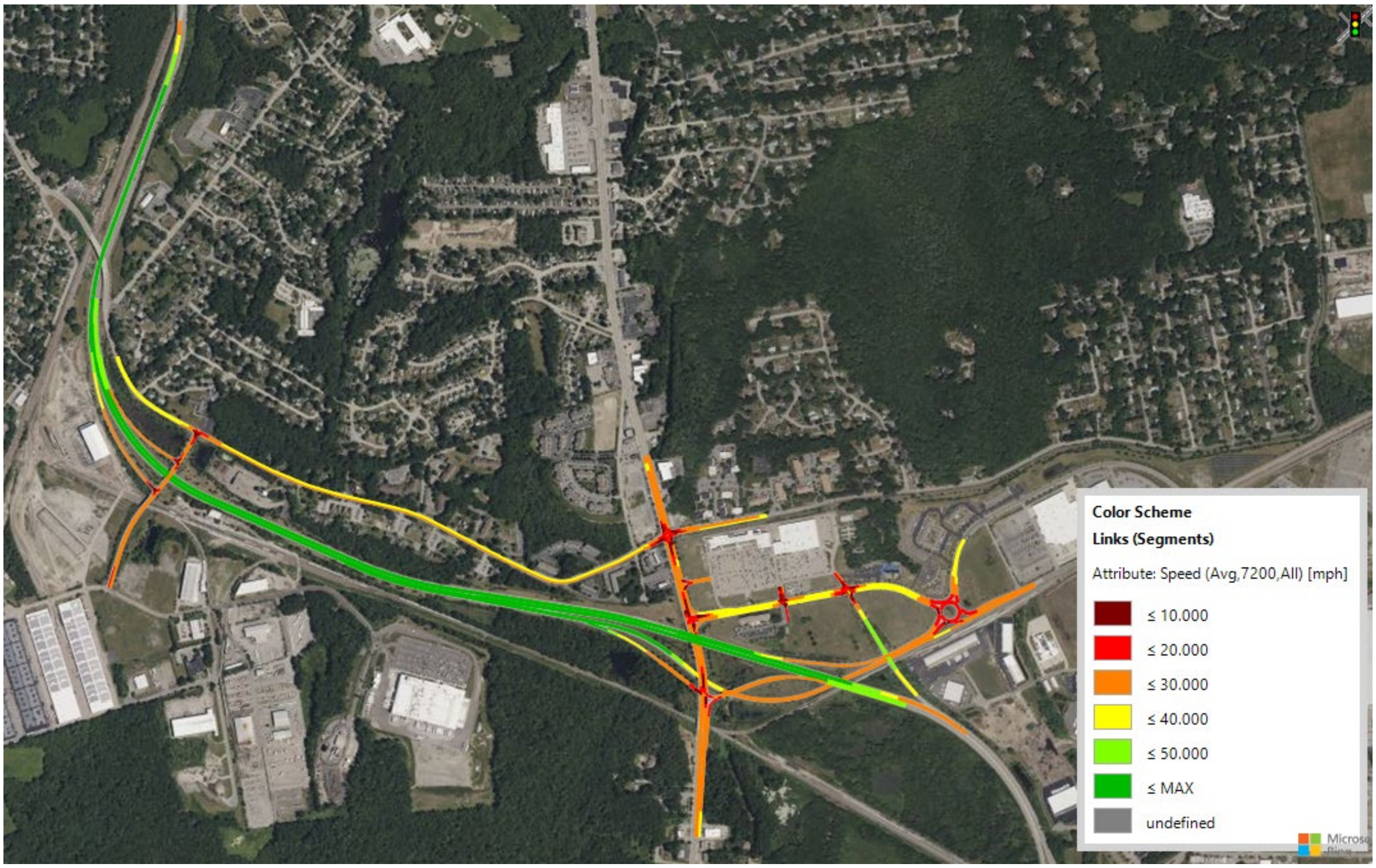


Figure 5 2028 No-Build PM Peak Condition

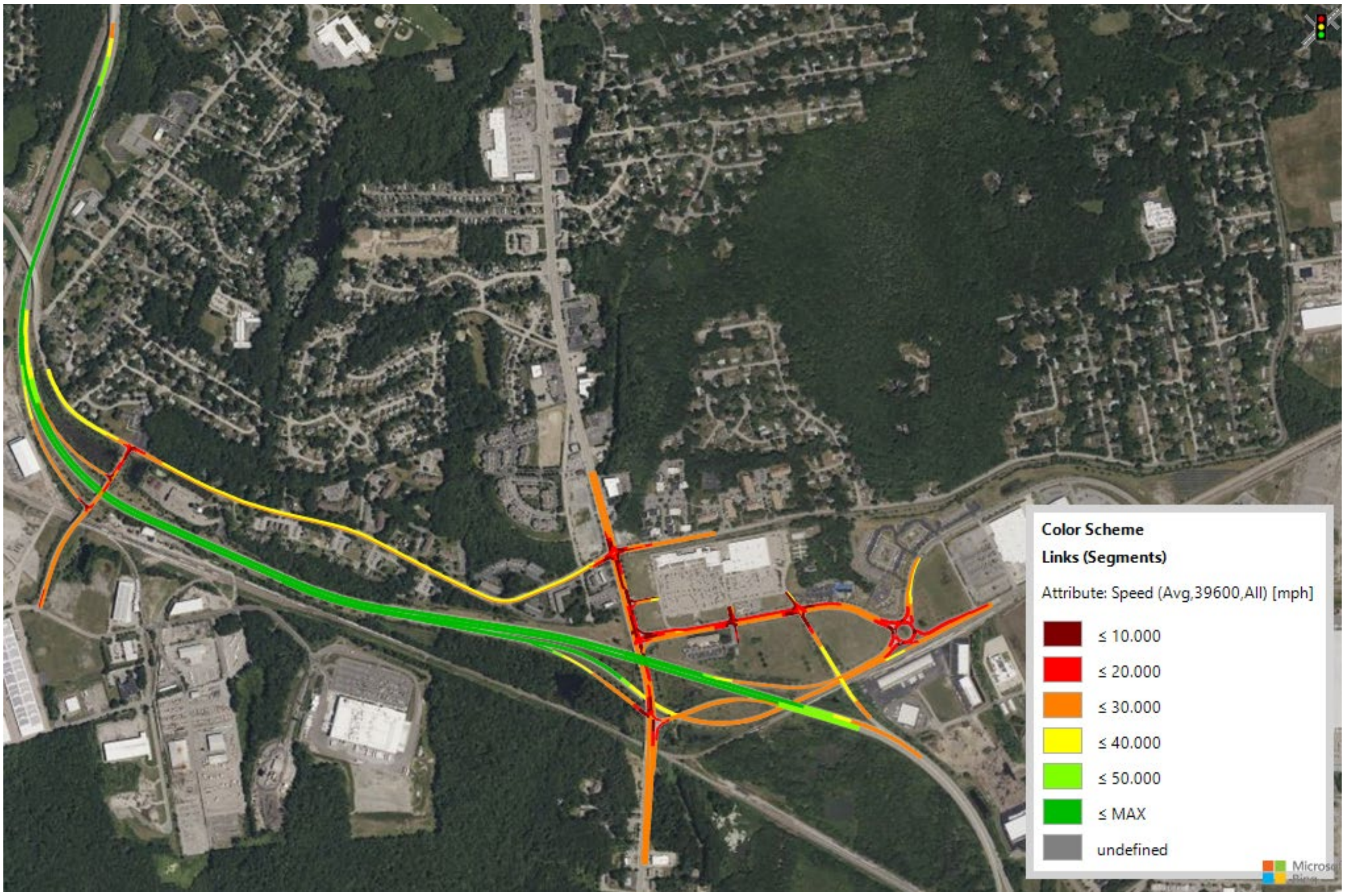


Figure 6 2058 No-Build AM Peak Condition

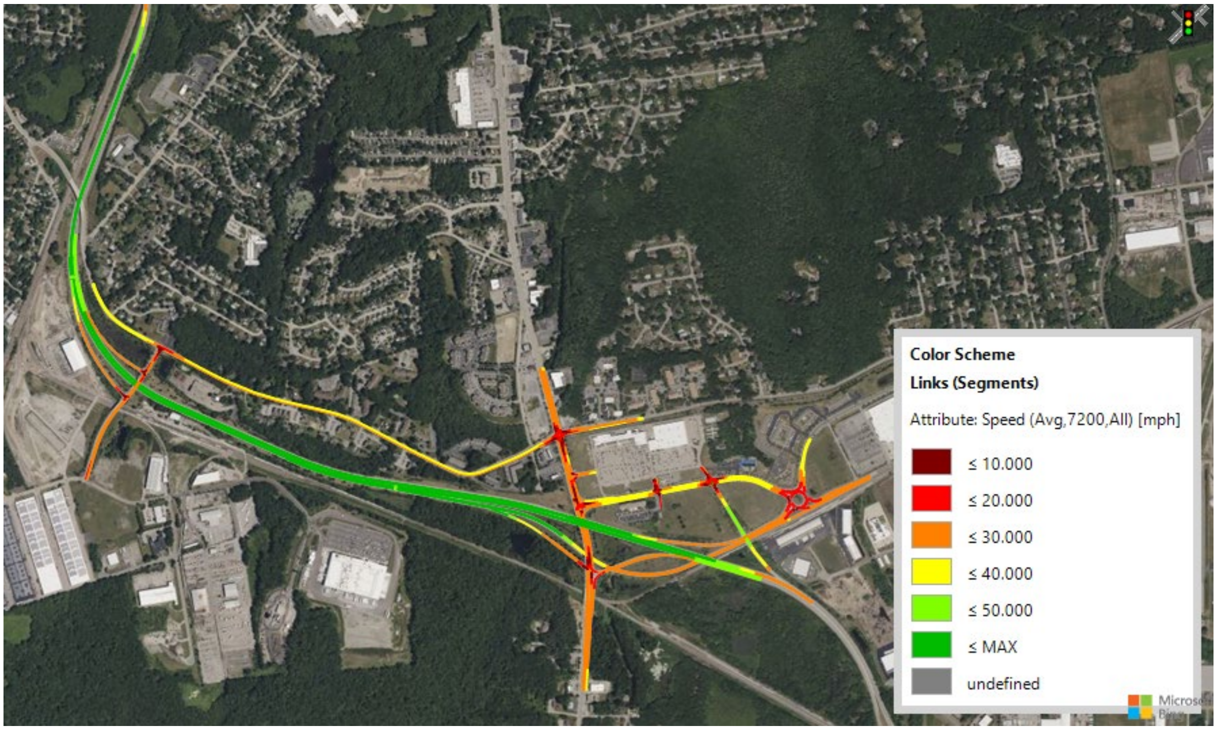
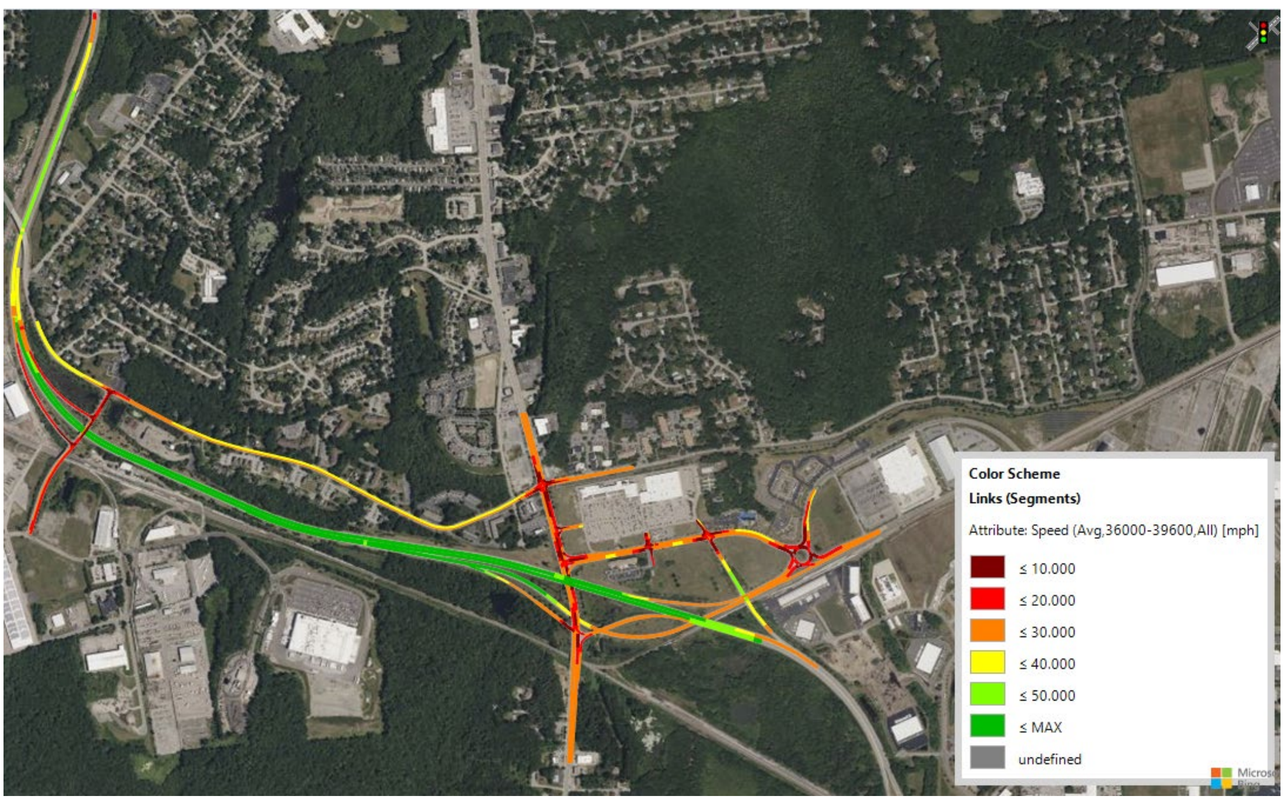


Figure 7 2058 No-Build PM Peak Condition



Projected 2028 and 2058 Build Conditions

The Route 403 proposed improvements will install a new ramp from Post Road to Route 403 westbound across from Gate Road. Additionally, a pair of on and off-ramps will be installed at West Davisville Road to complete the interchange and allow for simultaneous access to Route 403 eastbound and from Route 403 westbound.

Tables 3 and 4 summarize the Route 403 freeway network system and arterial roadway network system , respectively, for the hourly volumes, vehicle miles traveled (VMT), vehicle hours traveled (VHT), average speed, and total delay comparison between the 2058 No-Build and Build conditions. As noted earlier, the 15-hour modeling period accounted for 90% of the total daily demand. As highlighted in Table 3, the proposed improvements "Build" alternative is expected to process more vehicles in the network with increases in VMT and VHT along the freeway network system as traffic are shifting from the arterial to the freeway. However, the traffic volumes, VMT, and VHT along the arterial roadway network system are expected to decrease as shown in Table 4. Even though the average speeds are comparable between the No-Build and Build alternatives, the delays are less especially during the PM peak hour periods with the proposed improvements.

Table 3 **Route 403 Freeway Network System Measures of Effectiveness (MOE) Comparison**

Time	Total Vehicles in Network		VMT: Total Path Distance (mi)		VHT: Total Time in Network (hr)		Average Speed (mph)		Total Delay (hr)		Average Delay (hr/veh)	
	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build
5:00 AM	2,492	2,569	4,425	4,559	104	101	45	46	3	3	0.001	0.001
6:00 AM	3,384	3,486	5,073	5,256	133	127	45	46	6	4	0.002	0.001
7:00 AM	3,505	3,602	5,169	5,340	136	131	45	46	6	4	0.002	0.001
8:00 AM	3,688	3,794	4,983	5,174	143	138	45	46	8	5	0.002	0.001
9:00 AM	2,566	2,638	3,341	3,450	99	94	45	46	5	3	0.002	0.001
10:00 AM	2,145	2,203	2,569	2,659	83	76	45	46	5	3	0.002	0.001
11:00 AM	2,543	2,613	2,979	3,089	101	92	45	46	7	3	0.003	0.001
12:00 PM	3,633	3,825	4,375	4,660	171	144	45	46	20	7	0.005	0.002
1:00 PM	3,384	3,625	4,106	4,492	196	132	45	46	33	6	0.009	0.002
2:00 PM	5,359	5,817	7,055	7,862	307	231	43	44	51	19	0.009	0.003
3:00 PM	5,986	6,535	7,703	8,652	356	287	42	42	64	45	0.010	0.007
4:00 PM	4,521	4,887	5,595	6,187	283	187	42	44	54	19	0.012	0.004
5:00 PM	3,979	4,314	4,868	5,467	240	155	44	46	44	7	0.011	0.002
6:00 PM	2,577	2,754	2,909	3,281	183	96	45	47	40	3	0.015	0.001
7:00 PM	1,820	1,896	2,049	2,280	155	65	45	47	38	1	0.020	0.001
Total	**51,583**	**54,556**	**67,200**	**72,407**	**2,690**	**2,057**	**44**	**45**	**386**	**132**	**0.007**	**0.002**

Table 4 **Arterial Roadway Network System Measures of Effectiveness (MOE) Comparison**

Time	Total Vehicles in Network		VMT: Total Path Distance (mi)		VHT: Total Time in Network (hr)		Average Speed (mph)		Total Delay (hr)		Average Delay (hr/veh)	
	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build	2058 No-Build	2058 Build
5:00 AM	1,402	1,323	2,489	2,349	58	52	25	26	11	8	0.007	0.005
6:00 AM	1,904	1,796	2,854	2,708	75	66	25	25	19	15	0.009	0.008
7:00 AM	1,971	1,855	2,907	2,751	77	68	24	24	19	18	0.009	0.009
8:00 AM	2,075	1,955	2,803	2,666	80	71	24	24	25	25	0.011	0.012
9:00 AM	1,443	1,359	1,879	1,777	56	49	24	25	17	16	0.011	0.011
10:00 AM	1,207	1,135	1,445	1,370	47	39	24	25	17	13	0.013	0.011
11:00 AM	1,431	1,346	1,676	1,591	57	48	24	24	23	19	0.015	0.013
12:00 PM	2,044	1,971	2,461	2,400	96	74	22	24	64	36	0.029	0.017
1:00 PM	1,904	1,868	2,310	2,314	110	68	22	24	105	28	0.050	0.014
2:00 PM	3,015	2,996	3,969	4,050	173	119	21	23	162	59	0.049	0.018
3:00 PM	3,367	3,366	4,333	4,457	200	148	21	22	202	91	0.053	0.025
4:00 PM	2,543	2,517	3,147	3,187	159	96	21	23	172	46	0.061	0.017
5:00 PM	2,238	2,222	2,738	2,816	135	80	22	24	141	34	0.057	0.014
6:00 PM	1,450	1,418	1,636	1,690	103	50	23	24	126	19	0.077	0.013
7:00 PM	1,023	976	1,152	1,174	87	33	23	25	120	11	0.102	0.010
Total	**29,016**	**28,105**	**37,800**	**37,300**	**1,513**	**1,060**	**23**	**24**	**1,225**	**437**	**0.039**	**0.015**

Figure 4 2028 No-Build AM Peak Condition

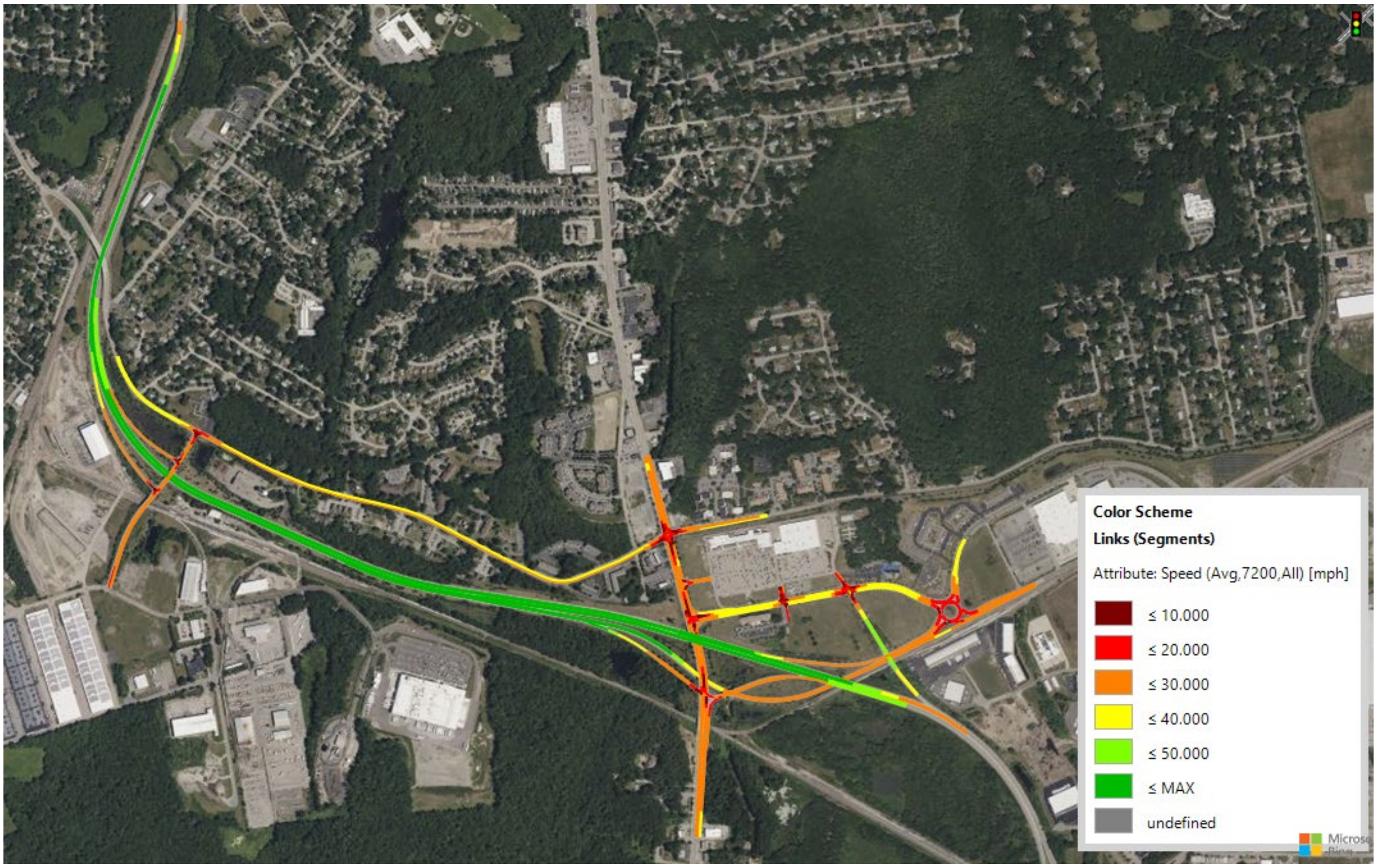


Figure 5 2028 No-Build PM Peak Condition

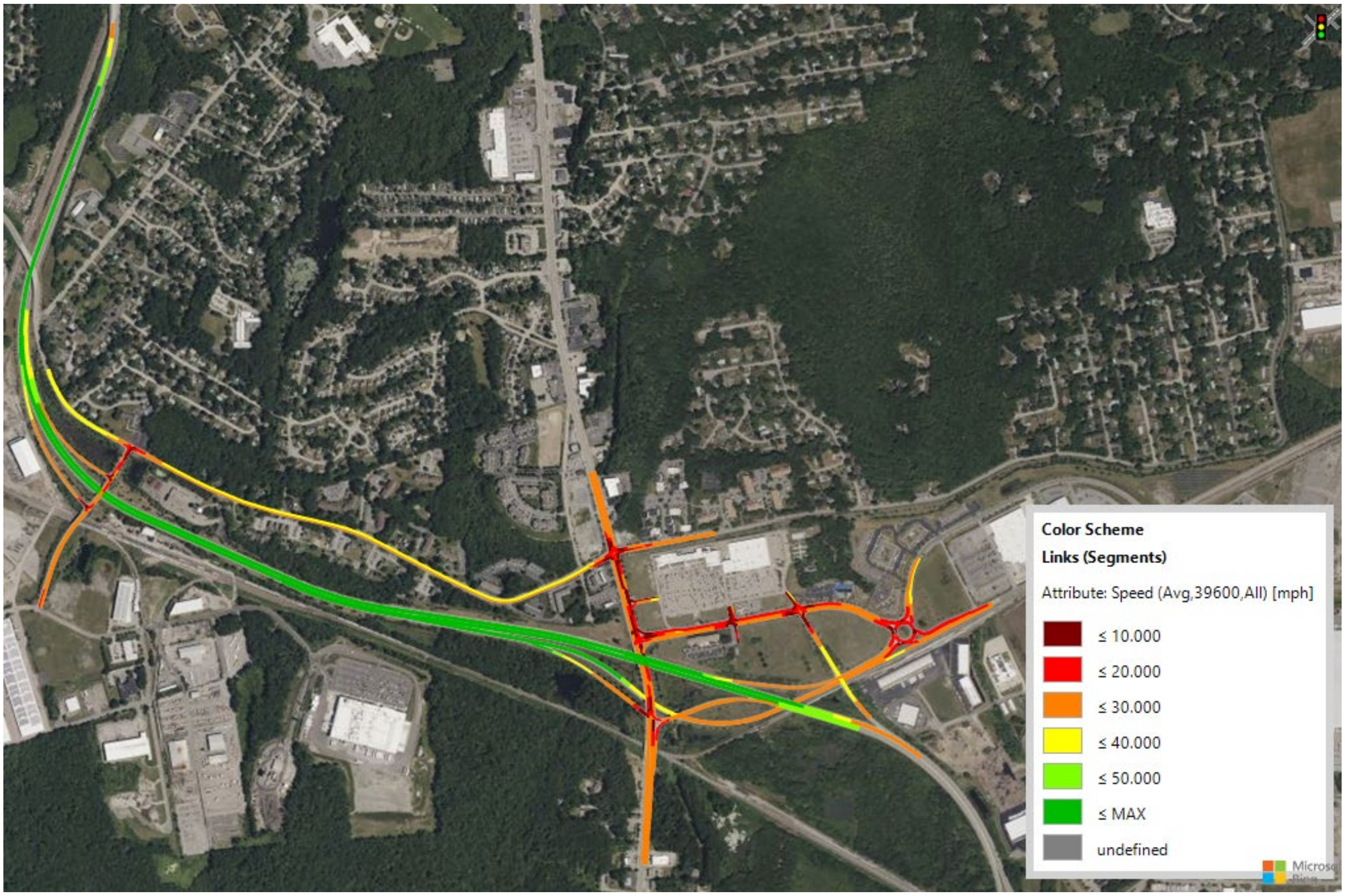


Figure 6 2058 No-Build AM Peak Condition

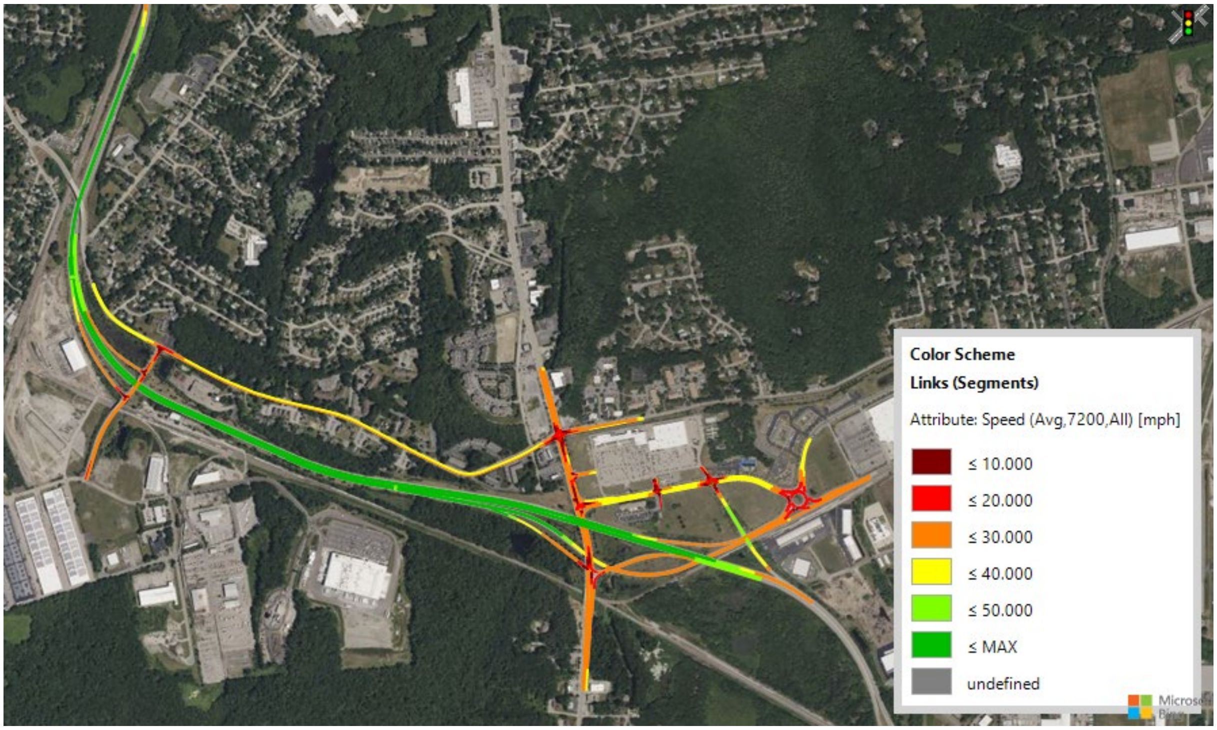


Figure 7 2058 No-Build PM Peak Condition

Figures 8 to 11 illustrate the 2028 and 2058 Build Condition AM and PM peak hour speeds. The proposed on-ramp from Post Road and the on/off-ramps at West Davisville Road improved the operation within both the freeway and arterial system compared to the No-Build alternative.

Figure 8 2028 Build AM Peak Condition

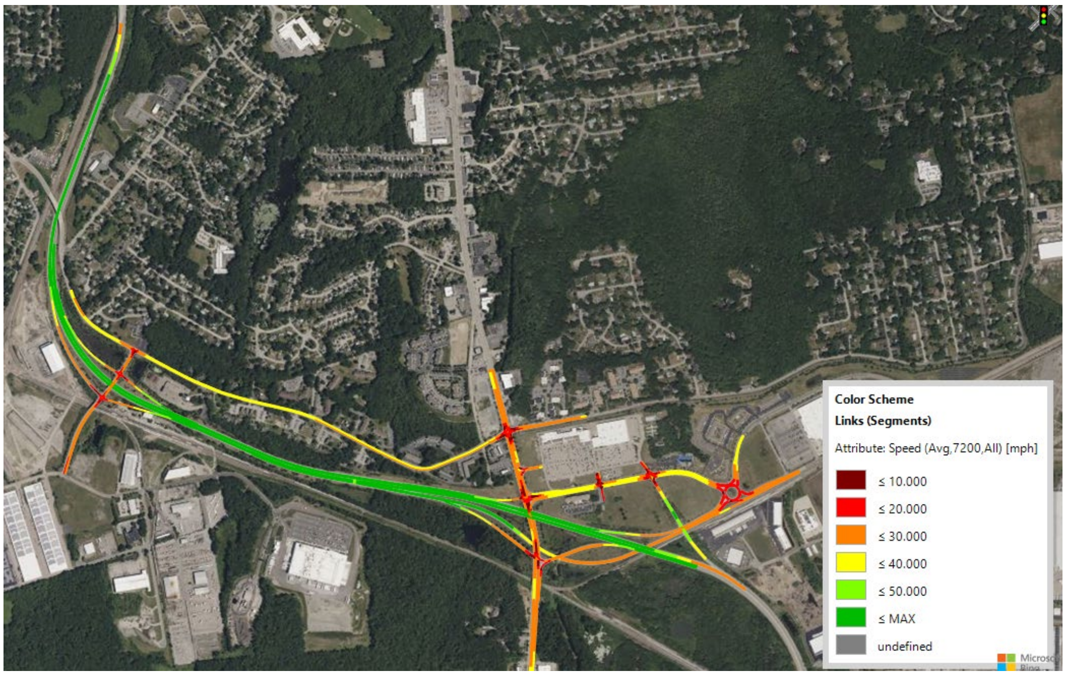


Figure 9 2028 Build PM Peak Condition

Figure 10 2058 Build AM Peak Condition

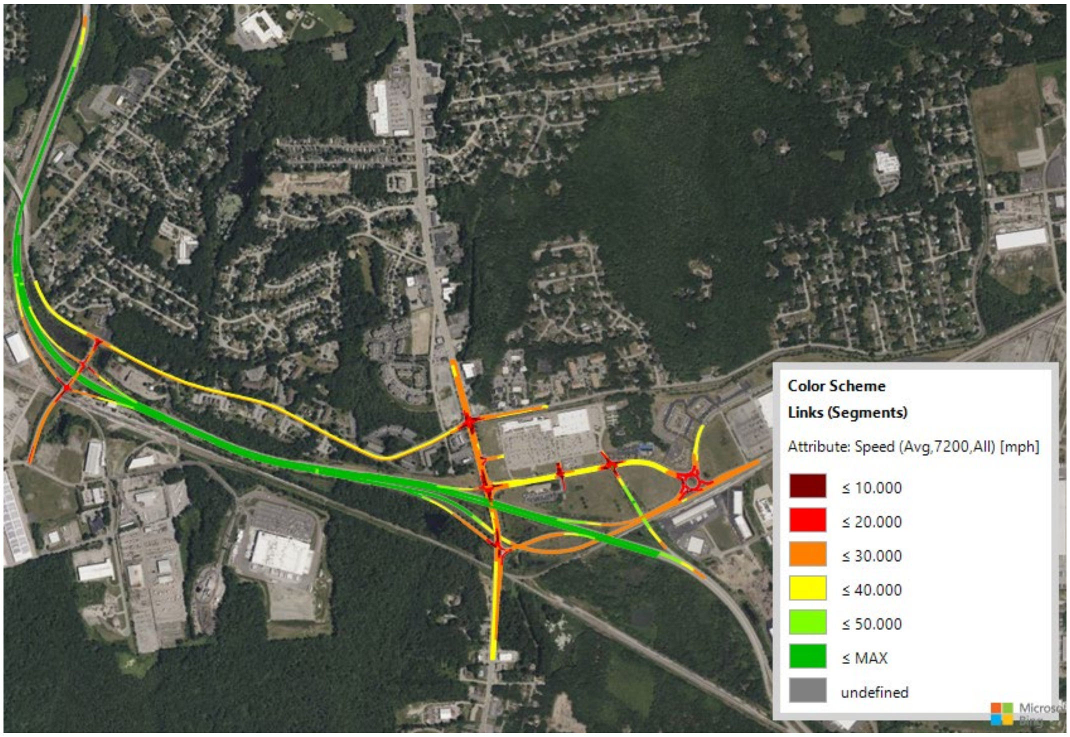


Figure 11 2058 Build PM Peak Condition

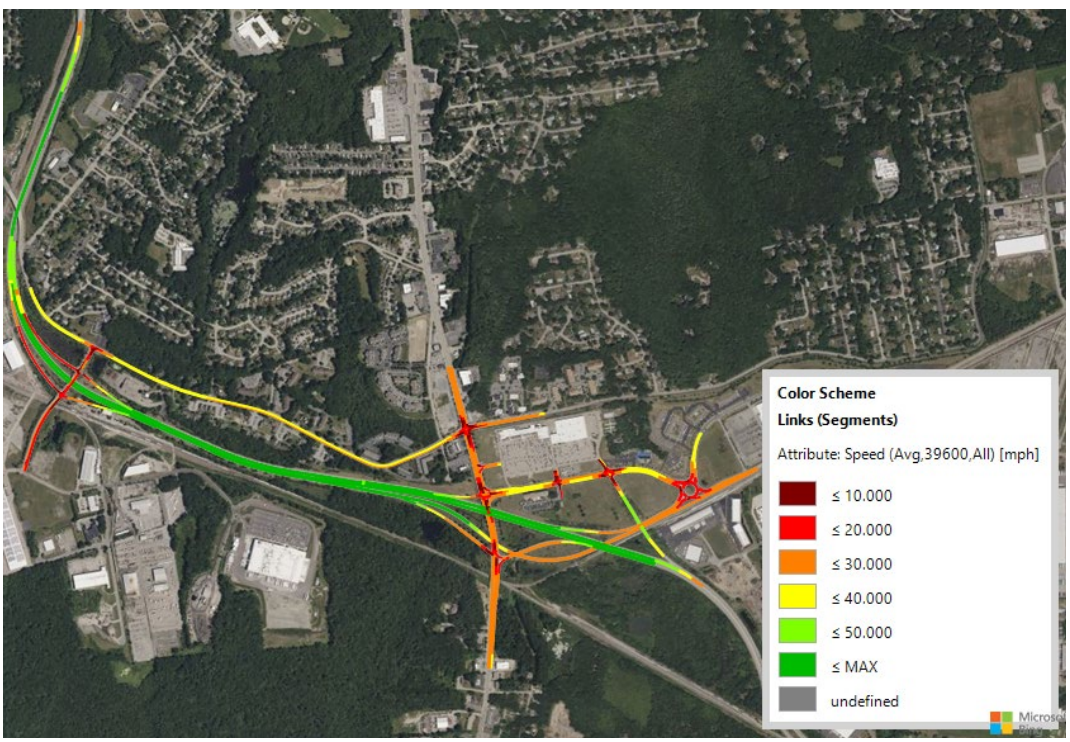


Table 5 summarizes the study area travel time segment comparison between the 2058 No-Build and Build conditions. While some segments show minor increases to travel time, the West Davisville to Post Road southbound movement shows significant decreases in travel time, primarily in the weekday PM peak hour which was identified to be the worst-case condition.

Table 5 Travel Time Segment Comparison

	2058 No-Build				2058 Build			
	AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour	
Travel Time Segments	sec	min	sec	min	sec	min	sec	min
Arterial Post Rd NB	102.5	1.71	120.0	2.00	104.7	1.75	117.3	1.96
Arterial Post Rd SB	92.3	1.54	204.6	3.41	94.8	1.58	111.8	1.86
Freeway West Davisville to Post Rd NB	238.4	3.97	287.4	4.79	240.6	4.01	290.1	4.84
Freeway West Davisville to Post Rd SB	263.5	4.39	315.3	5.26	191.9	3.20	226.9	3.78

DRAFT

Interchange Justification Report for I-95 and Route 4 Interchange Improvements

Kent County, RI

PTS ID 0048I

Prepared for:

U.S. Department of Transportation
Federal Highway Administration

October 26, 2020

Revised November 20, 2020

APPENDIX G

ROUTE 4 AND I-95 TRAFFIC COUNT COMPARISON AND GROWTH FACTORS

ROUTE 4 at I-95 GROWTH RATES
TRAFFIC COUNT COMPARISON And GOWTH FACTORS

INTERSECTIONS

Quaker Lane at J.P. Murphy Industrial Highway

AM Peak

2007 Total intersection entering volume 2771
2011 Total intersection entering volume 2358 **15% Lower**
No additional counts conducted after 2011

PM Peak

2007 Total intersection entering volume 3681
2011 Total intersection entering volume 3133 **15% Lower**
No additional counts conducted after 2011

Quaker Lane at I-95 SB off Ramp

AM Peak

2007 Total intersection entering volume 2433
2011 Total intersection entering volume 2219 **8.8% Lower**
No additional counts conducted after 2011

PM Peak

2007 Total intersection entering volume 2899
2011 Total intersection entering volume 2666 **8% Lower**
No additional counts conducted after 2011

Quaker Lane at Division Street

AM Peak

2007 Total intersection entering volume 3790
2011 Total intersection entering volume 3417 **9.8% Lower**
No additional counts conducted after 2011

PM Peak

2007 Total intersection entering volume 4637
2011 Total intersection entering volume 4494 **3% Lower**
No additional counts conducted after 2011

Division St. @ Showcase/EG Square

AM Peak

2007 Total intersection entering volume 2678
2011 Total intersection entering volume 2351 **12.6% Lower**
2019 Total intersection entering volume 2707 **1.1% Higher**

PM Peak

2007 Total intersection entering volume 3408
2011 Total intersection entering volume 3431 **0.7% Higher**
2019 Total intersection entering volume 3474 **1.9% Higher**

Division St. @ Route 4 SB Ramps/1149

AM Peak

2007 Total intersection entering volume 2958
2011 Total intersection entering volume 2653 **10% Lower**
2019 Total intersection entering volume 3054 **3.2% Higher**

PM Peak

2007 Total intersection entering volume 3972
2011 Total intersection entering volume 3819 **3.9% Lower**
2016 Total intersection entering volume 3163 **20% Lower**
2019 Total intersection entering volume 3792 **4.5% Lower**

Division St. @ Route 4 NB Ramps

AM Peak

2007 Total intersection entering volume 2969
2011 Total intersection entering volume 2655 **10.7% Lower**
2019 Total intersection entering volume 2784 **6.27% Lower**

PM Peak

2007 Total intersection entering volume 3824
2011 Total intersection entering volume 3686 **3.6% Lower**
2019 Total intersection entering volume 3715 **2.8% Lower**

CONCLUSIONS

- 2011 traffic counts were lower than 2007 counts at all 6 intersections except in one instance.

- At the Division St. @ Showcase/EG Square intersection the 2019 count was slightly higher than the 2007 count.

- At the Division Street at Route 4 SB Ramps/1149 intersection the 2016 PM peak count was 20% lower than the 2007 count. The 2019 counts were 3.2% higher during the AM peak and 4.5% lower during the PM peak.

- At the Division Street at Route 4 NB Ramps intersection the 2019 count was lower than the 2007 count during the AM and PM peaks.

RECOMMENDATIONS

Due to the majority of the counts taken since 2007 being lower than the 2007 counts it appears there was zero growth between 2007 and 2019. **Therefore, we recommend using the 2007 traffic counts for estimated 2020 volumes for the three (3) Route 2 intersections where no additional counts have been conducted since 2011**. New counts will be very low due to the Covid-19 virus and it is our opinion that the virus would also impact the percentage of turning volumes.

For the three (3) Division Street intersections we recommend using the July, 2019 counts.

ATR's

I-95 and ROUTE 4

I-95 at Route 2 – Station 380002 – Ten (10) months of 2019 counts were obtained from RIDOT. The average weekday AM and PM peak hour volumes are shown below and compared with the 2007 volumes.

	AM SB	PM SB	AM NB	PM NB
2007	2804	3484	3662	2826
2019	2643	3553	2938	2290

RECOMMENDATION: The 2007 volumes are higher in three of four peak hours but we recommend using the 2019 data for existing volumes in the report. These peak hour volumes are based on ten (10) months of counts and are much more recent.

Route 4 at Division Street – The count station on Route 4 south of Division Street was not working the last few years so the August, 2016 counts from the Division Street TMP were used. The average weekday AM and PM peak hour volumes are shown below and compared with the 2007 volumes.

	AM SB	PM SB	AM NB	PM NB
2007	1830	2436	4088	3575
2016	1732	2095	4204	4772

RECOMMENDATION: The 2007 volumes are higher on SB Route 4 and lower on NB Route 4. We recommend using the 2016 data for existing volumes in the report. These peak hour volumes are much more recent.

I-95 North of Route 4 – Station 351000 at Cowesett Rd. – 2019 counts were obtained from RIDOT. The average weekday AM and PM peak hour volumes are shown below and compared to the 2007 volumes.

	AM SB	PM SB	AM NB	PM NB
2007	4330	5491	8336	6881
2019	5708	6607	7257	6987

RECOMMENDATION: The 2007 volumes are higher on only one of the four peak hours. We recommend using the 2019 data for existing volumes in the report. They are based on twelve (12) months of counts and are much more recent.

GROWTH RATES

2020 (Existing) to 2025 (Construction)

From Statewide Planning's Model AADT Projections

Station	Location	2020	2025	% Inc.
380002	I-95 at Route 2 NB	38221	38731	1.3%
380002	I-95 at Route 2 SB	31744	31763	0.06%
350164	I-95 at Centerville NB	76164	77106	1.2%
350164	I-95 at Centerville SB	72654	73456	1.1%
090001	Route 4 So. of Division NB	40739	41311	1.4%
090001	Route 4 So. of Division SB	41666	42630	2.3%

CONCLUSION

- Percent increase over 5 years ranges from 0.06% to 2.3% which is no increase to 0.5% increase per year. The four other locations average 1.25% increase over 5 years which is 0.25 increase per year.

RECOMMENDATION

- **Use a growth rate of 0.25% increase per year for all locations for 2020 to 2025.**

2025 (Construction) to 2045 (Design Year)

From Statewide Planning's Model AADT Projections

Station	Location	2025	2045	% Inc.
380002	I-95 at Route 2 NB	38731	39642	2.4%
380002	I-95 at Route 2 SB	31763	32151	1.2%
350164	I-95 at Centerville NB	77106	79491	3.1%
350164	I-95 at Centerville SB	73456	76082	3.6%
090001	Route 4 So. of Division NB	41311	42812	3.6%
090001	Route 4 So. of Division SB	42630	44977	5.5%

CONCLUSION

- Percent increase over 20 years ranges from 1.2 to 5.5% which is 0.06% increase to 0.28% increase. The four other locations average 3.18% increase over 20 years which is 0.16% increase per year.

RECOMMENDATION

- **Use a growth rate of 0.20% increase per year for all locations for 2025 to 2045.**

APPENDIX H

QUONSET POINT FUTURE TRIP GENERATION

Quonset Point Future Trip Generation
From Master Plan and Development Plan 2019

- Page 42 – Projects 5,000 additional jobs
- Employment today – 11,700

Trip Generation

PM Peak 0.44 trips/employee x 5,000 = 2,200 trips

Enter 86%	1,892
Exit 14%	304

PM Peak 0.42 trips/employee x 5,000 = 2,100 trips

Enter 20%	420
Exit 80%	1,680

From 2001 Master Plan – Page 4-11

57% of traffic to/from 95N of Rt. 4
9% of traffic to/from Rt. 2 N. of Div.
9% of traffic to/from 95 S of Rt. 4

Assume Full Build Out By 2045
Assume 20% Build Out By 2025

AM Peak
1892 x .57 = 1078 trips 95S to Route 4 S (216 in 2025)
1892 x .09 = 170 trips Rt 2S to Div. St. E to 4S (34 in 2025)

1892 x .09 = 170 trips 95N to Rt. 2S to Division E to 4S (34 in 2025)

304 x .57 = 173 trips 4N to 95N (35 in 2025)
304 x .09 = 27 trips to 4N to Div. W to Rt. 2N (5 trips in 2025)

304 x .09 = 27 trips to 4N to Div. W to 2N & 95S (5 trips in 2025)

PM Peak
420 x .57 = 239 trips 95S to 4S (48 trips in 2025)
420 x .09 = 38 trips 2S to Div. E to 4S (8 trips in 2025)

420 x .09 = 38 trips 95N to 2S to Div. E to 4S (8 trips in 2025)

1680 x .57 = 958 trips 4N to 95N (192 trips in 2025)
1680 x .09 = 151 trips 4N to Div. W to 2N (30 trips in 2025)

1680 x.09 = 151 trips 4N to Div. W to 2N to 95S (30 trips in 2025)

The industrial park's roadway cross-section (shoulder width and landscaping) establishes the character of the development. A first class site should develop roadways with ample landscaping, large frontages and sufficient roadway capacities to accommodate peak period traffic flows. All collector roads are, therefore, recommended to be two-lane roads with shoulders.

Local Access Streets: Local streets are not discussed, as many of the existing streets are likely to be replaced to better serve future parcel development for industrial tenants/owners. Local streets should be two lanes wide and intersect with collector roads only, not with the three major roads, if at all feasible.

4.4 Parking

The RIEDC "Development Package" published in 1992 suggests various controls on development of the "Quonset Point/Davisville Industrial Park", including parking. Recognizing that these controls may not be readily adaptable to all development situations, RIEDC would work closely with business clients in adapting controls to specific development situations. Parking within the industrial park should be consistent with the RIEDC Revised Development Regulations prepared as part of the 1998 Draft Master Plan work effort. Major objectives of the revised regulations included parking requirements consistent with business and industry needs and site planning requirements that would provide for landscaped parking areas and transit oriented developments, where appropriate.

4.5 Commuter Characteristics

RIEDC sent a survey to Park employers in April 2001 to determine the commuting habits of employees within the Park. Employers were asked to indicate their district within the Park, current and future staffing levels, modes of transportation used by employees to arrive at work, employee transit use, staff arrival and departure times, and the estimated amount of vehicles arriving on site. In addition, employers were asked to provide a list of the towns and zip codes in which employees lived and the number of employees residing in each. As of May 2, 2001 survey forms were received from 32 companies and 31 zip code lists were received, covering approximately 3,500 employees. This response represents over half of the 6,200 employees at the site (56 percent) and provides a reasonable sample.

The economic reach of Quonset Davisville Port and Commerce Park spreads throughout the entire state of Rhode Island and into neighboring southeastern Connecticut and southeastern Massachusetts. Of the 3,498 employees for whom residence zip code information was provided by employers approximately 89 percent of current employees live in Rhode Island, 2.3 percent in Connecticut and 3.6 percent in Massachusetts. Over a third of the Rhode Island employees (37.3 percent) live within a 10-mile radius of the site, primarily in North Kingstown, Warwick, West Warwick and Coventry (see Figure ~~4.4.)~~4.3, Locations of Residences of Employees at Quonset Davisville.) *(Insert figure here.)* Secondary concentrations of employees are located in Providence (7.4 percent) and Cranston (4.9 percent). The largest concentrations of employees were in the following:

1. North Kingstown-392
2. Warwick-358
3. Coventry-321
4. Providence-276
5. West Warwick-158
6. Cranston-152
7. East Greenwich-109

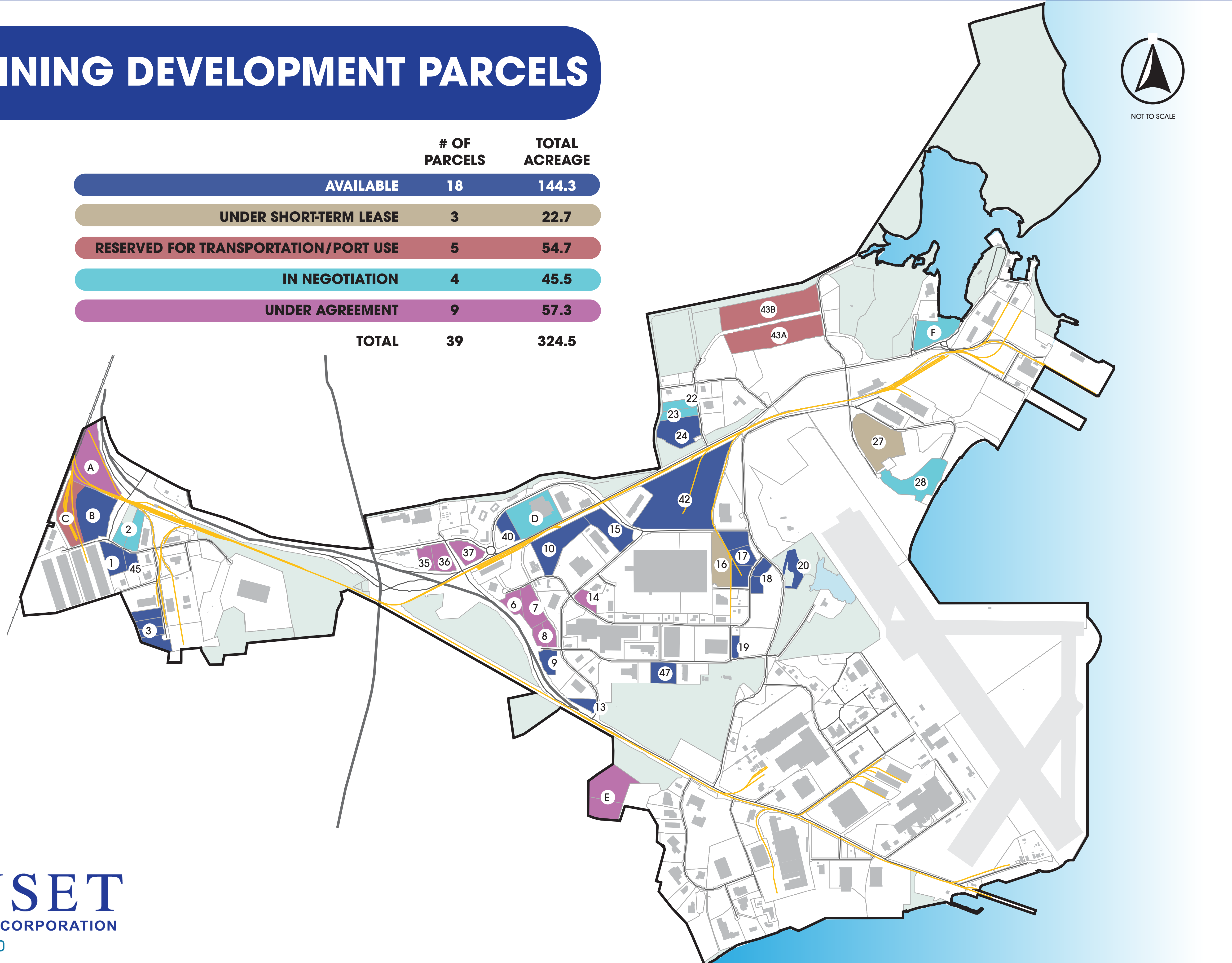
Major roads have been overlaid on top of the map showing the number of employees living within each zip code. From observing the map, it is assumed that most of these employees living within a10-mile radius travel on Routes 1, 4, 95, 138, and 403 (in various combinations) to and from the site.

A total of 3,534 employees are accounted for in the returned surveys. Based on the responses, virtually all employees commute by private automobile; very few by commuter van. According to the survey, very few employees use public transit because the schedules are inconvenient. According to the survey, over half of the companies (18 of 32 or 56 percent) did not express employee interest in an internal (on-site) shuttle bus service. Reasons cited varied, but generally included incompatibility with work hours, lack of single destinations, and the flexibility provided by using a car. However, over a third of the firms (36 percent) did state that employees would

REMAINING DEVELOPMENT PARCELS

Parcel	Acres	Parcel	Acres
1	5.1 ACRES	24	9.0 ACRES
2	6.1 ACRES	27	15.3 ACRES
3	8.3 ACRES	28	11.9 ACRES
6	3.3 ACRES	35	2.6 ACRES
7	5.8 ACRES	36	4.2 ACRES
8	2.1 ACRES	37	4.5 ACRES
9	3.2 ACRES	40	3.7 ACRES
10	11.7 ACRES	42	41.8 ACRES
13	2.0 ACRES	43A	18.7 ACRES
14	2.9 ACRES	43B	30.0 ACRES
15	8.4 ACRES	45	2.0 ACRES
16	7.4 ACRES	47	4.7 ACRES
17	10.6 ACRES	A	16.2 ACRES
18	4.0 ACRES	B	15.7 ACRES
19	1.4 ACRES	C	6.0 ACRES
20	12.7 ACRES	D	13.4 ACRES
22	2.7 ACRES	E	15.7 ACRES
23	2.9 ACRES	F	8.5 ACRES

	# OF PARCELS	TOTAL ACREAGE
AVAILABLE	18	144.3
UNDER SHORT-TERM LEASE	3	22.7
RESERVED FOR TRANSPORTATION/PORT USE	5	54.7
IN NEGOTIATION	4	45.5
UNDER AGREEMENT	9	57.3
TOTAL	39	324.5



QUONSET
DEVELOPMENT CORPORATION
DECEMBER 2020

Appendix D-3

Emissions

Memorandum

To: Ken White, Ph.D.
Assistant Director for Administrative Services
Division of Planning
Rhode Island Department of Transportation
Two Capitol Hill, Room 318
Providence, Rhode Island

Date: August 4, 2023

Project #: 73337.05

From: Mark Arnoldy, PE[1]
Kristin Caouette, PE
Peter Pavao, PE
Heidi Richards, PE[1]

Re: I-95 Missing Links Emissions Analysis

The proposed I-95 and Route 4 Interchange Improvements Project will provide full freeway-to-freeway access between I-95 and Route 4 in Warwick and East Greenwich, Rhode Island. The proposed improvements are needed because the current system of ramps at this interchange does not provide direct links for access from Interstate Route 95 northbound to Route 4 southbound nor for access from Route 4 northbound to Interstate Route 95 southbound. These missing freeway-to-freeway links force motorists to leave the freeway and use local streets for access. The Project will result in interchange-related traffic congestion being reduced in the surrounding communities and improvements to the commuter and freight roadway network.

An air quality study of the Project was conducted using traffic data developed for the transportation analysis. Emission factors for the study area were developed using the Motor Vehicle Emission Simulator (MOVES3)[2]. Emissions were analyzed for the opening year (2028) and the design year (2058). Analyses were conducted for the No Build and Build alternatives to determine the emissions reduction associated with the Project. The emission factors represent the corresponding year of the traffic modeling. The factors were derived by calculating a seasonal average during the evening peak hour with a representative vehicle mix. Oxides of Nitrogen (NO_X), Sulfur Dioxide (SO_2), Particulate Matter 2.5 ($PM_{2.5}$), and Carbon Dioxide (CO_2) were studied based on the latest grant application guidance. Volatile Organic Compounds (VOC) and Particulate Matter 10 (PM_{10}) were estimated for informational purposes and do not have associated damage costs.

Emissions Results

The detailed emissions analyses are presented in the summary table below and on the following pages. Damages costs are calculated using the latest benefit-cost analysis guidance from the US Department of Transportation.[3] Since the guidance only includes damage costs to 2050, damages in the design year of 2058 were calculated using the 2050

[1] Licensed in Massachusetts.
[2] MOVES3.1 (Motor Vehicle Emission Simulator), US EPA, Office of Mobile Sources, Ann Arbor, MI.
[3] "Benefit-Cost Analysis Guidance for Discretionary Grant Programs" US DOT. January 2023.

1 Cedar Street
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Providence, RI 02903-1023
P 401.272.8100

values. For the purposes of quantifying benefits for the grant application, it is reasonable to apply a linear approximation for the years between 2028 and 2058 using the values estimated in this document.

Table 1. I-95 Missing Links Emissions Analysis Summary

		NO_X	SO_2	$PM_{2.5}$	CO_2	VOC	PM_{10}	Total
2028	Savings (Metric Tons/yr)	0.16	0.0006	0.016	100.8	0.06	0.10	
	Savings ($)	**$2,832**	**$30**	**$13,818**	**$6,249**	**-**	**-**	**$22,929**
2058	Savings (Metric Tons/yr)	2.01	0.0082	0.352	1,356.7	1.15	2.81	
	Savings ($)	**$38,046**	**$421**	**$319,723**	**$119,393**	**-**	**-**	**$477,583**

In the opening year, the Build scenario operates with a slightly higher average speed than the No Build scenario, but also slightly increases the VMT in the study area. VMT is expected to increase from the No Build to Build scenario by approximately 0.2% in the opening year. Under the Build Scenario, average speeds are estimated to have a modest 0.5 mph increase relative to the No Build Scenario. As such, emission factors in the opening year are expected to decrease from the No Build to Build scenario by a range of 0.3% to 1.3%, depending on the pollutant. The larger increases in emission factors are seen for Particulate Matter because a major component of this pollutant is brakewear which is largely dependent on variations in speed. For all pollutants, the anticipated increase in VMT is less than the corresponding decrease in emission factor, resulting in a decrease in emissions. Overall, the estimated pollutant savings results in a moderate damage benefit for the opening year ($22,929).

By 2058, the No Build scenario is expected to deteriorate from opening year levels such that the change in speed between the No Build and Build scenarios is significant (approximately 5 mph). However, the VMT in the network is expected to only increase from the No Build scenario by 0.6%. This slight increase in VMT is counted by the significant increase in average travel speed and results in emission benefits for all pollutants. resulting in a benefit of $477,583. Further detail on the emissions analysis is presented on the following pages.

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I95/Rt4 Missing Link

Emissions Reduction Benefits

Year	Alternative		NO_X	SO_2	$PM_{2.5}$	CO_2	VOC	PM_{10}	Total
2028	I95/Rt4 Alt 2e	Savings (Short Tons/yr)	0.17	0.0007	0.017	111.0	0.06	0.11	
		Savings ($)	$2,832	$30	$13,818	$6,249	-	-	**$22,929**
2058	I95/Rt4 Alt 2e	Savings (Short Tons/yr)	2.22	0.0090	0.388	1,494.4	1.26	3.09	
		Savings ($)	$38,046	$421	$319,723	$119,393	-	-	**$477,583**

*Note pollutants costs have been updated to match the updated 2023 BCA Guidance

Year	Alternative		NO_X	SO_2	$PM_{2.5}$	CO_2	VOC	PM_{10}	Total
2028	I95/Rt4 Alt 2e	Savings (Metric Tons/yr)	0.16	0.0006	0.016	100.8	0.06	0.10	
		Savings ($)	$2,832	$30	$13,818	$6,249	-	-	**$22,929**
2058	I95/Rt4 Alt 2e	Savings (Metric Tons/yr)	2.01	0.0082	0.352	1,356.7	1.15	2.81	
		Savings ($)	$38,046	$421	$319,723	$119,393	-	-	**$477,583**

I95/Rt4 Mesoscale Air Quality Analysis

2028 Opening Year

Daily Traffic Parameters

Alt ID	Condition	Vehicle Hours Travelled (hrs/day)	Average Speed (mph)	Vehicle Miles Travelled (mi/day)	
NB	No Build	17,245	47.0	804,925	**VMT Change**
BD	Build Alternative	17,065	47.5	806,187	0.2%

Air Pollutants

Annual Daily

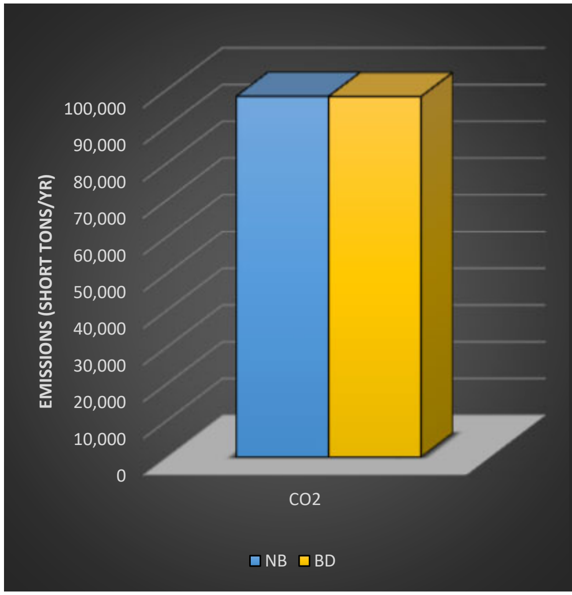
	NO_X	SO_2	$PM_{2.5}$	CO_2	VOC	PM_{10}	
	3	31	110+116+117	90	87	100+106+107	
NB Emission Factor (g/mi)	0.16	0.00189	0.0079	303.1	0.118	0.029	
BD Emission Factor (g/mi)	0.16	0.00188	0.0078	302.2	0.118	0.029	
Emission Factor Change (%)	-0.5%	-0.3%	-0.8%	-0.3%	-0.3%	-1.3%	
NB (kg/d)	127.83	1.521	6.33	243,940	95.04	23.74	
BD (kg/d)	127.40	1.519	6.29	243,664	94.88	23.47	
NB (tons/yr)	51.43	0.612	2.55	98,148	38.24	9.55	
BD (tons/yr)	51.26	0.611	2.53	98,037	38.18	9.44	
BD Emissions Savings (tons/yr)	**0.17**	**0.001**	**0.02**	**111**	**0.06**	**0.11**	
Damage Cost ($/short ton)	$16,523	$44,939	$798,366	$56	-	-	**Total**
BD Cost Savings ($/yr)	**$2,832**	**$30**	**$13,818**	**$6,249**	-	-	**$22,929**

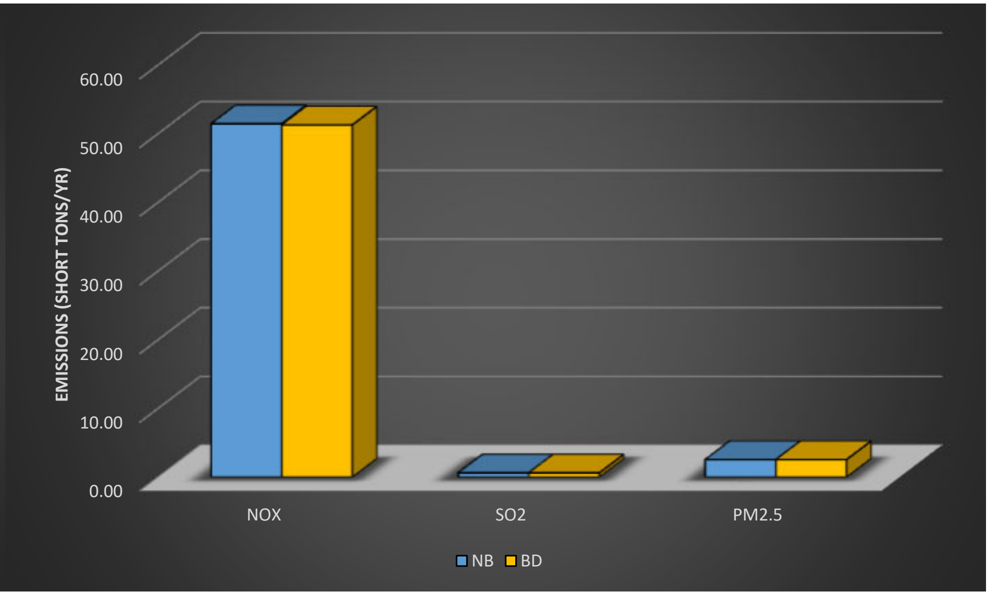
Notes:

-1 short ton equals 907.185 kilograms

I95/Rt4 Mesoscale Air Quality Analysis

2028 Opening Year





I95/Rt4 Mesoscale Air Quality Analysis

2058 Design Year

Daily Traffic Parameters

Alt ID	Condition	Vehicle Hours Travelled (hrs/day)	Average Speed (mph)	Vehicle Miles Travelled (mi/day)	
NB	No Build	29,391	35.9	900,066	**VMT Change**
BD	Build Alternative	23,461	41.1	905,274	0.6%
			5.2		

Air Pollutants

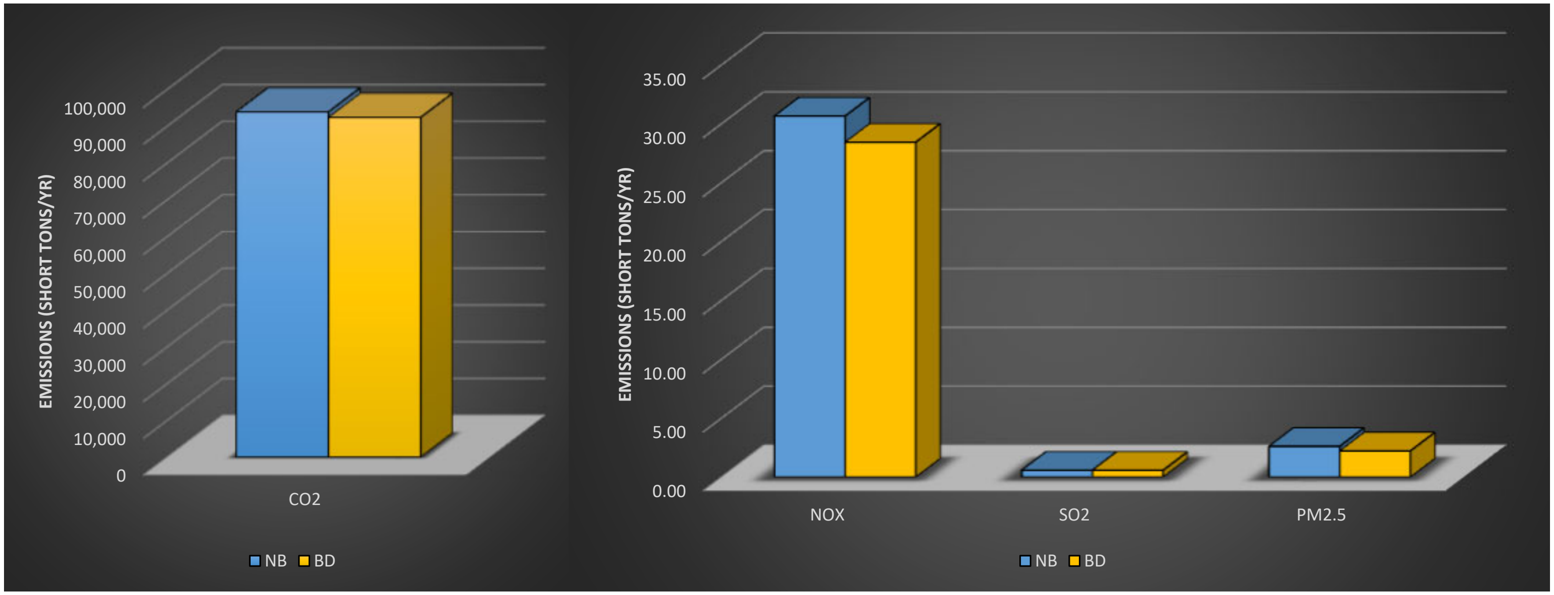
		NO_X	SO_2	$PM_{2.5}$	CO_2	VOC	PM_{10}	
		3	31	110+116+117	90	87	100+106+107	
	NB Emission Factor (g/mi)	0.08	0.00160	0.0072	259.3	0.090	0.043	
	BD Emission Factor (g/mi)	0.08	0.00157	0.0061	253.7	0.086	0.034	
	Emission Factor Change (%)	-7.8%	-2.1%	-15.3%	-2.2%	-4.4%	-20.3%	
Daily	NB (kg/d)	76.19	1.445	6.49	233,367	80.80	38.75	
	BD (kg/d)	70.68	1.422	5.53	229,653	77.66	31.07	
Annual	NB (tons/yr)	30.66	0.581	2.61	93,894	32.51	15.59	
	BD (tons/yr)	28.44	0.572	2.23	92,399	31.25	12.50	
	BD Emissions Savings (tons/yr)	**2.22**	**0.009**	**0.39**	**1,494**	**1.26**	**3.09**	
	Damage Cost ($/short ton)	$17,158	$46,573	$823,967	$80	-	-	**Total**
	BD Cost Savings ($/yr)	**$38,046**	**$421**	**$319,723**	**$119,393**	-	-	**$477,583**

Notes:

-1 short ton equals 907.185 kilograms

I95/Rt4 Mesoscale Air Quality Analysis

2058 Design Year



To: Ken White, Ph.D.
Assistant Director for Administrative Services
Division of Planning
Rhode Island Department of Transportation
Two Capitol Hill, Room 318
Providence, Rhode Island

Date: August 4, 2023

Memorandum

Project #: 73337.05

From: Mark Arnoldy, PE[1]
Kristin Caouette, PE
Peter Pavao, PE
Heidi Richards, PE[1]

Re: Route 403 Missing Links Emissions Analysis

The proposed Project will construct "missing" exit and entrance ramps on Route 403 at West Davisville Road and Post Road in North Kingstown, Rhode Island. These missing links force motorists to take indirect routes to access and leave the freeway. The Project will result in interchange-related traffic congestion being reduced in the surrounding communities and improvements to the commuter and freight roadway network by providing more direct routes.

An air quality study of the Project was conducted using traffic data developed for transportation analysis. Emission factors for the study area were developed using the Motor Vehicle Emission Simulator (MOVES3)[2]. Emissions were analyzed for the opening year (2028) and the design year (2058). Analyses were conducted for the No Build and Build alternatives to determine the emissions reduction associated with the Project. The emission factors represent the corresponding year of the traffic modeling. The factors were derived by calculating a seasonal average during the evening peak hour with a representative vehicle mix. Oxides of Nitrogen (NO_X), Sulfur Dioxide (SO_2), Particulate Matter 2.5 ($PM_{2.5}$), and Carbon Dioxide (CO_2) were studied based on the latest grant application guidance. Volatile Organic Compounds (VOC) and Particulate Matter 10 (PM_{10}) were estimated for informational purposes and do not have associated damage costs.

Emissions Results

The detailed emissions analyses are presented in the summary table below and on the following pages. Damages costs are calculated using the latest benefit-cost analysis guidance from the US Department of Transportation.[3] Since the guidance only includes damage costs to 2050, damages in the design year of 2058 were calculated using the 2050 values. For the purposes of quantifying benefits for the grant application, it is reasonable to apply a linear approximation for the years between 2028 and 2058 using the values estimated in this document.

[1] Licensed in Massachusetts.
[2] MOVES3.1 (Motor Vehicle Emission Simulator), US EPA, Office of Mobile Sources, Ann Arbor, MI.
[3] "Benefit-Cost Analysis Guidance for Discretionary Grant Programs" US DOT. January 2023.

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Memorandum

Table 1. Route 403 Missing Links Emissions Analysis Summary

		NO_X	SO_2	$PM_{2.5}$	CO_2	VOC	PM_{10}	Total
2028	Savings (Metric Tons/yr)	0.32	-0.0002	0.051	29.8	0.08	0.29	
	Savings ($)	**$5,820**	**-$9**	**$44,997**	**$1,845**	**-**	**-**	**$52,653**
2058	Savings (Metric Tons/yr)	0.36	-0.0011	0.037	-113.0	0.01	0.30	
	Savings ($)	**$6,879**	**-$55**	**$33,348**	**-$9,946**	**-**	**-**	**$30,225**

In the opening year (2028), the Build scenario will operate more efficiently than the No Build scenario, meaning average speeds are improved but vehicle miles travelled (VMT) will increase. The average speed is expected to increase by approximately 4 mph in the Build scenario. This increase in speed results in emission factor reductions between 2.9% and 17.5%, depending on the pollutant. On the other hand, VMT in the traffic network is expected to increase by 3.3%. Since the improvement in average speed generally leads to emission factor reductions that are equal to or larger than the estimated increase in VMT, the majority Build scenario pollutants emissions are expected to be the same or reduced from the No Build. The only exception is SO_2, which sees a minor increase in emissions as the change VMT is larger than the change reduction in SO_2 emission factors. The reductions in pollutant emissions lead to an overall damage benefit for the opening year of $52,653.

In 2058, the average speed improvement from the No Build scenario to the Build scenario is again approximately 4 mph across the network, but the anticipated VMT increase is approximately 5%. The VMT increase is partially due to the additional capacity from the proposed design that allows the unmet demand in the No Build scenario to be processed in the Build scenario. The improvement in speed results in emission factor reductions between 2.9% and 17.1%, depending on the pollutant. Similar to the Opening Year, since the improvement in SO_2 and CO_2 emission factors are estimated to be less than the increase in VMT, these pollutants show increases in emissions from the No Build scenario to the Build scenario. NOx, VOC and PM have emission factor reductions that are large enough to counteract the estimated increase in VMT, resulting in emissions reductions. Overall, these emissions reductions result in a slight damage benefit for the design year ($30,225), despite the increases in other pollutant emissions. Further detail on the emissions analysis is presented on the following pages.

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Route 403 Missing Link

Emissions Reduction Benefits

Year	Route		NO_X	SO_2	$PM_{2.5}$	CO_2	VOC	PM_{10}	Total
2028	Rt 403	Savings (Short Tons/yr)	0.35	-0.0002	0.056	32.8	0.09	0.32	
		Savings ($)	$5,820	-$9	$44,997	$1,845	-	-	**$52,653**
2058	Rt 403	Savings (Short Tons/yr)	0.40	-0.0012	0.040	-124.5	0.01	0.33	
		Savings ($)	$6,879	-$55	$33,348	-$9,946	-	-	**$30,225**

Year	Route		NO_X	SO_2	$PM_{2.5}$	CO_2	VOC	PM_{10}	Total
2028	Rt 403	Savings (Metric Tons/yr)	0.32	-0.0002	0.051	29.8	0.08	0.29	
		Savings ($)	$5,820	-$9	$44,997	$1,845	-	-	**$52,653**
2058	Rt 403	Savings (Metric Tons/yr)	0.36	-0.0011	0.037	-113.0	0.01	0.30	
		Savings ($)	$6,879	-$55	$33,348	-$9,946	-	-	**$30,225**

*Note pollutants costs have been updated to match the updated 2023 BCA Guidance

Rt 403 Mesoscale Air Quality Analysis

2028 Opening Year

Daily Traffic Parameters

Alt ID	Condition	Vehicle Hours Travelled (hrs/day)	Average Speed (mph)	Vehicle Miles Travelled (mi/day)	
NB	No Build	4,129	32.2	99,738	**VMT Change**
BD	Build Alternative	2,905	36.6	103,018	3.3%
			4.4		

Air Pollutants

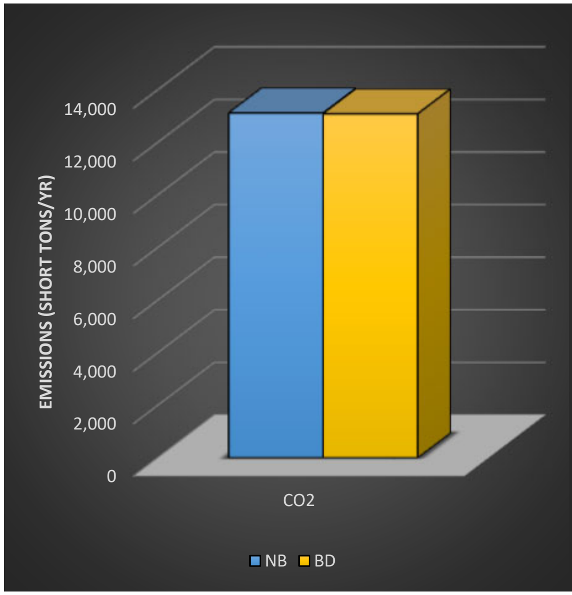
		NO_X	SO_2	$PM_{2.5}$	CO_2	VOC	PM_{10}	
		3	31	110+116+117	90	87	100+106+107	
	NB Emission Factor (g/mi)	0.18	0.00203	0.0118	326.9	0.135	0.054	
	BD Emission Factor (g/mi)	0.17	0.00197	0.0101	315.7	0.128	0.045	
	Emission Factor Change (%)	-7.8%	-2.9%	-14.7%	-3.4%	-4.8%	-17.5%	
Daily	NB (kg/d)	18.30	0.202	1.18	32,601	13.45	5.43	
Daily	BD (kg/d)	17.42	0.203	1.04	32,520	13.23	4.63	
Annual	NB (tons/yr)	7.36	0.081	0.48	13,117	5.41	2.18	
Annual	BD (tons/yr)	7.01	0.082	0.42	13,084	5.32	1.86	
	BD Emissions Savings (tons/yr)	**0.35**	**0.000**	**0.06**	**33**	**0.09**	**0.32**	
	Damage Cost ($/short ton)	$16,523	$44,939	$798,366	$56	-	-	**Total**
	BD Cost Savings ($/yr)	**$5,820**	**-$9**	**$44,997**	**$1,845**	-	-	**$52,653**

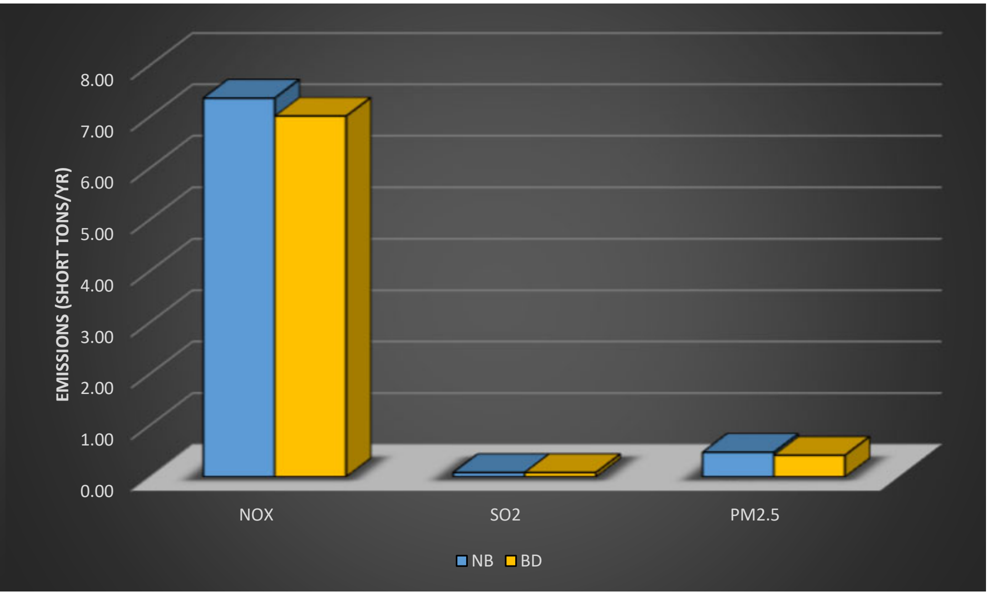
Notes:

-1 short ton equals 907.185 kilograms

Rt 403 Mesoscale Air Quality Analysis

2028 Opening Year





Rt 403 Mesoscale Air Quality Analysis

2058 Design Year

Daily Traffic Parameters

Alt ID	Condition	Vehicle Hours Travelled (hrs/day)	Average Speed (mph)	Vehicle Miles Travelled (mi/day)	
NB	No Build	4,784	32.2	119,508	**VMT Change**
BD	Build Alternative	3,548	36.5	124,865	4.5%
			4.3		

Air Pollutants

		NO_X	SO_2	$PM_{2.5}$	CO_2	VOC	PM_{10}	
		3	31	110+116+117	90	87	100+106+107	
	NB Emission Factor (g/mi)	0.10	0.00165	0.0082	267.6	0.093	0.050	
	BD Emission Factor (g/mi)	0.08	0.00160	0.0071	258.6	0.089	0.042	
	Emission Factor Change (%)	-12.6%	-2.9%	-14.1%	-3.4%	-4.5%	-17.1%	
Daily	NB (kg/d)	11.46	0.197	0.98	31,975	11.17	6.04	
Daily	BD (kg/d)	10.46	0.200	0.88	32,284	11.14	5.23	
Annual	NB (tons/yr)	4.61	0.079	0.40	12,865	4.49	2.43	
Annual	BD (tons/yr)	4.21	0.080	0.35	12,989	4.48	2.10	
	BD Emissions Savings (tons/yr)	**0.40**	**-0.001**	**0.04**	**-124**	**0.01**	**0.33**	
	Damage Cost ($/short ton)	$17,158	$46,573	$823,967	$80	-	-	**Total**
	BD Cost Savings ($/yr)	**$6,879**	**-$55**	**$33,348**	**-$9,946**	-	-	**$30,225**

Notes:

-1 short ton equals 907.185 kilograms

Rt 403 Mesoscale Air Quality Analysis

2058 Design Year