Prepared For:

New Hampshire DOT

Bow Concord I-93 Improvements Project

Bow and Concord, NH

Final Air Quality Analysis

Prepared By:

McFarland Johnson

53 Regional Drive • Concord, NH 03301

NHDOT Project No. 13742

June, 2018

CONTENTS

LIST OF TABLES

LIST OF FIGURES (at end of report)

LIST OF APPENDICES

1 INTRODUCTION

This report documents the methods and results of a microscale air quality analysis completed for the Bow-Concord 13742 project located on Interstate 93. FHWA's technical advisory on environmental documents requires consideration of air quality effects as part of NEPA compliance. This may include compliance with transportation conformity requirements under the Clean Air Act, emissions analysis to determine compliance with national standards, mobile source air toxics, and greenhouse gas emissions.

The Federal Clean Air Act requires that the Environmental Protection Agency (EPA) establish health-based National Ambient Air Quality Standards (NAAQS). The EPA has identified "criteria" pollutants for which NAAQS have been promulgated. The management of criteria pollutants is largely accomplished through control measures tailored by state, local, and tribal governments in their State Implementation Plans (SIP). The process of determining the classification of the SIP begins with State and Local Air Monitoring Stations (SLAMS) indicating Ambient Air Pollutants. The EPA monitors these stations and revises the ambient air standards every 5 years based on new scientific findings. The EPA then classifies state regions according to recent standards. This classification indicates "attainment" or meeting NAAQS, "non-attainment" or not meeting NAAQS, and "maintenance" or in remediation from previous non-attainment classification. The states amend or cater SIPs to meet the current standards pending EPA approval.

On July 18, 1997, the EPA adopted a new NAAQS for ozone and fine particulate matter. Under the 97' NAAQS the New Hampshire Counties of Merrimack, Hillsborough, Rockingham, and Strafford were classified as either serious or marginal nonattainment. On July 20, 2013, all of New Hampshire was re-classified as unclassifiable/attainment under the 2008 8-hour Ozone NAAQS, also known as the 2008 ozone standard, and the 1997 8-Hour Ozone NAAQS was revoked for transportation conformity purposes in the Boston-Manchester-Portsmouth (SE) NH area. On April 23, 2018 Federal Highway Administration sent out the memorandum "Interim Guidance on Conformity Requirements for the 1997 Ozone NAAQS" that states recent court proceedings struck down portions of the 2008 Ozone NAAQS and reinstituted the 1997 8-Hour Ozone NAAQS. It should be noted that the project is not located within the '97 Boston-Manchester-Portsmouth (SE) NH area. On March 10, 2014, EPA approved maintenance plans, known as "limited maintenance plans," for the City of Manchester and City of Nashua. These limited maintenance plans have a 2021 horizon year. (The second ten-year carbon monoxide (CO) maintenance period terminates on January 29, 2021.)

On June 2, 2010 the EPA issued a final rule revising the primary sulfur dioxide (SO_2) NAAQS, and simultaneously revoked both the existing 24-hour and annual primary SO_2 standard redesignating parts of central New Hampshire under Non-attainment.

Section 176(c) of the Clean Air Act prohibits Federal agencies from funding or approving activities that do not conform to an applicable SIP for achieving compliance with the NAAQS. A conformity determination may involve analysis of both regional and project level air quality effects.

This project is included in the latest Statewide Transportation Improvement Program (STIP) plan (amended 02/05/2018) and is listed as a regionally significant project. The 2017 – 2020 NH STIP has been developed through a statewide and metropolitan planning process that is consistent with the requirements of 23 CFR Part 450.216. All projects designated as regionally significant by the Metropolitan Planning Organizations (MPO) and Interagency Consultation (IAC), regardless of the funding source, are included in the STIP. The proposed widening of I-93 to 3 travel lanes and one auxiliary lane between exits in each direction, as embodied in the proposed alternative, was included as part of this conformity determination. Therefore, a regional analysis outside of that completed for the STIP conformity determination is not necessary.

The National Environmental Policy Act (NEPA) requires, to the fullest extent possible, that policies, regulations, and laws of the Federal Government be interpreted and administered in accordance with its environmental protection goals, and Federal agencies use an interdisciplinary approach in planning and decision-making for any action that adversely impacts the environment (42 U.S.C. 4332). Beginning October 7, 2016, project sponsors are required to use Motor Vehicle Emission Simulator (MOVES) to conduct emission analysis for both transportation conformity determinations and for NEPA purposes. Under NEPA this project is classified as requiring “quantitative analysis for projects with low potential MSAT effects”.

This hot-spot analysis is required per the Clean Air Act to show project-level conformity. Project-level conformity requires an analysis of Carbon Monoxide (CO), fine particles with a diameter of 2.5 micrometers or less (PM2.5), and coarser particles with a diameter of 10 micrometers or less (PM10). Vehicle travel has been identified as a major contributor to these criteria pollutants and as a result the microscale analysis was completed for the three most congested intersections during the period of highest traffic volumes, specifically the 2035 Build Alternative. Methods and results are reported below.

The levels for attainment for CO as established in the NAAQS are a primary 1-hour concentration of 35 ppm and an 8-hour concentration of 9 ppm. For particulate pollution PM2.5, the threshold is a primary 1-year annual average of 12 µg/m^3 and a 24-hour average of 35 µg/m^3. For particulate pollution PM10, the standard is set to a primary 24-hour average of 150 µg/m^3.

This microscale analysis was done for the preferred alternative build design year 2035, which had the highest traffic volumes of the build and no-build alternatives.

2 METHODOLOGY

The three Intersections in the analysis were chosen based on throughput traffic volumes, levels of service, and distance from or connection with the Interstate. The intersections are as follows:

- Exit 13 SPUI and Manchester Street (Figure 1).
- Exit 14 Northbound off Ramp with Ft Eddy Road (Figure 2).
- Exit 14 Southbound off and on ramp with Loudon Road (Figure 2).

The analysis was done with the EPA Motor Vehicle Emissions Simulator (MOVES2014a) and dispersion modeling software CAL3QHC through the CAL3i Windows interface. The function of the MOVES modeling was to determine emission factors and emission inventories from on-road motor vehicles. MOVES models the emissions produced from cars and trucks at the identified signalized intersections based on vehicle types, time period of analysis, geographical area, vehicle operating characteristics, and road types. The pollution output from motor vehicles as calculated through MOVES2014a is then used as input for the CAL3QHC dispersion modeling. The CAL3QHC dispersion modeling determines concentrations of the pollutants at set distances from the intersection based on roadway geometries, receptor locations, meteorological conditions and vehicular emission rates. This analysis is used to determine the concentrations of pollutants at receptor locations intended to replicate likely pedestrian experiences, essentially recording the air quality for someone walking along the sidewalk or nearby.

The worst-case scenario was modeled for the build design year with the presumption that if the concentrations of CO, $PM_{2.5}$, and PM10 are substantially below the NAAQS limits, then it can be safe to assume the project will meet these standards during other scenarios, and no further modeling is necessary. The worst-case modeling assumptions were made for traffic, meteorological conditions, and other inputs to generate estimates of the maximum concentrations. Traffic volumes used in the model were the peak hours for the AM and PM. The model was run for January because the winter months historically are found to have higher concentrations of air pollutants.

3 EMISSION RATES – MOVES2014A

3.1 MOVES Inputs

All modeling inputs and procedures were developed based on EPA guidance, including *EPA 1992 Guideline for Modeling Carbon Monoxide from Roadway Intersections*, *Using MOVES2014 in Project-Level Carbon Monoxide Analyses*, and *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in PM2.5 and PM10 Nonattainment and Maintenance Areas*. These inputs reflect the traffic information in Appendix B, including vehicle volumes and classifications (trucks, etc.). For vehicle speeds, the best method with available information to model the various links was determined to be the Average Speed Method. It was determined that a speed of 55 mph would be used on I-93 and 30 mph would be used for all other free flow links. Free flow link speeds are based on best engineering judgement and observations made by the engineer at peak hour conditions. The traffic was separated out by "links" depicting three distinct behaviors. Links were classified as queue links (Q), departing free flow links (DFF), or approach free flow links (AFF). Queue links represented vehicles waiting idle at the light. DFF and AFF represented vehicle movement as departing or approaching the intersection in absence of the traffic light, only constrained by geometry and volume.

Input data for MOVES is summarized in Tables 1 and 2.

Table 1. MOVES Input Parameters and Data Sources

Parameter	Project Specific Inputs for I-93 Exit 13 and Exit 14 Intersections
Scale	• On Road • Project • Inventory (CO, and PM10 queue and PM2.5 queue) • Emission Rates (PM2.5 and PM10 free flow links)
Time Span	• 2035 (Future design year) • January (Worst Case Scenario/ Conservative) • Weekday • AM (7am – 8am), PM (5pm – 6pm)
Geographic Bounds	• New Hampshire – Merrimack County • Database – see Table 2 below
Vehicles/Equipment On Road Vehicles	• Fuel – Diesel Fuel • Fuel – Gasoline • Source Type – Combination Short Haul Truck • Source Type – Motorcycle • Source Type – Passenger Car • Source Type – Passenger Truck • Source Type – Single Unit Short Haul Truck • Source Type – Transit Buses
Road Type	• Urban Unrestricted Access
Pollutants and Process	• Process o Running Exhaust o Start Exhaust o Evap Permeation o Evap Fuel Leaks o Crankcase Running Exhaust o Crankcase Start Exhaust o Crankcase Extended Idle Exhaust o Extended Idle Exhaust o Auxiliary Power Exhaust o Breakwear o Tirewear • Pollutant o Total Gaseous Hydrocarbons o Primary Exhaust PM2.5 – Total o Primary Exhaust PM2.5 – Species* o Primary PM2.5 – Breakwear Particulate o Primary PM2.5 – Tirewear Particulate o Primary Exhaust PM10 – Total o Primary PM10 – Breakwear Particulate o Primary PM10 – Tirewear Particulate
General Output	• Units – Grams, Joules and Miles • Activity – Distance Traveled; Population (CO, and PM10 queue and PM2.5 queue) • Activity – Default (PM2.5 and PM10 free flow links)

* Species Include – Aluminum, Ammonium (NH4), Calcium, Chloride< CMAQ5.0 Unspeciated (PMOTHR), Composite – NonECPM, Elemental Carbon, H2O (aerosol), Iron, Magnesium, Manganese Compounds, Nitrate (No3), Non – Carbon Organic Mater (NCOM)

Table 2. Additional MOVES Input Data

MOVES Project Data Manager	
Age Distribution	National Default Age Distribution by Source Type from EPA
Fuel	Exported Default Data from MOVES
Meteorology Data	Exported Default Data from MOVES
I/M Program	Exported Default Data from MOVES
Link Source Types	See Appendix B
Links	Using average speed method - See Appendix A

3.2 MOVES Output

The MOVES2014a model had to be run twice for both the AM and the PM design hours at each location to produce the pollutants in units of both Grams Per Vehicle-Miles for free flow links and Grams Per Vehicle-Hour for queue links. Those runs are reported in Table 3, Table 4, and Table 5 for CO, PM10, and PM2.5, respectively.

Table 3. CO Emission Rates Calculated from MOVES

Location	Link Description	Grams Per Vehicle-Mile (free-flow)	Grams Per Vehicle/ Hour (queue links)
Exit 14 NB 2035 Build A.M.	Loudon Rd WB Q		1.74022
Exit 14 NB 2035 Build A.M.	Loudon Rd WB AFF	0.95095	
Exit 14 NB 2035 Build A.M.	Loudon Rd WB DFF	0.93990	
Exit 14 NB 2035 Build A.M.	Loudon Rd EB Q		1.74022
Exit 14 NB 2035 Build A.M.	Loudon Rd EB AFF	1.29565	
Exit 14 NB 2035 Build A.M.	Loudon Rd EB DFF	0.95095	
Exit 14 NB 2035 Build A.M.	Exit 14 NB off Ramp NB Q		1.74022
Exit 14 NB 2035 Build A.M.	Exit 14 NB off Ramp NB AFF	0.69434	
Exit 14 NB 2035 Build A.M.	FT Eddy Rd NB DFF	0.75718	
Exit 14 NB 2035 Build A.M.	FT Eddy Rd SB Q		1.74022
Exit 14 NB 2035 Build A.M.	FT Eddy Rd SB AFF	1.25942	
Exit 14 NB 2035 Build A.M.	I 93 SB	0.756598	
Exit 14 NB 2035 Build A.M.	I 93 NB	0.756597	
Exit 14 NB 2035 Build P.M.	Loudon Rd WB Q		1.75284
Exit 14 NB 2035 Build P.M.	Loudon Rd WB AFF	0.96167	
Exit 14 NB 2035 Build P.M.	Loudon Rd WB DFF	0.96435	
Exit 14 NB 2035 Build P.M.	Loudon Rd EB Q		1.75284
Exit 14 NB 2035 Build P.M.	Loudon Rd EB AFF	1.32238	

Location	Link Description	Grams Per Vehicle-Mile (free-flow)	Grams Per Vehicle/ Hour (queue links)
Exit 14 NB 2035 Build P.M.	Loudon Rd EB DFF	0.96168	
Exit 14 NB 2035 Build P.M.	Exit 14 NB off Ramp NB Q		1.75284
Exit 14 NB 2035 Build P.M.	Exit 14 NB off Ramp NB AFF	0.70224	
Exit 14 NB 2035 Build P.M.	FT Eddy Rd NB DFF	0.76604	
Exit 14 NB 2035 Build P.M.	FT Eddy Rd SB Q		1.75284
Exit 14 NB 2035 Build P.M.	FT Eddy Rd SB AFF	1.29435	
Exit 14 NB 2035 Build P.M.	I 93 SB	0.796697	
Exit 14 NB 2035 Build P.M.	I 93 NB	0.796697	
Exit 14 SB 2035 Build A.M.	Loudon Rd WB Q		1.74021
Exit 14 SB 2035 Build A.M.	Loudon Rd WB AFF	1.09756	
Exit 14 SB 2035 Build A.M.	Loudon Rd WB DFF	1.53496	
Exit 14 SB 2035 Build A.M.	Loudon Rd EB Q		1.74022
Exit 14 SB 2035 Build A.M.	Loudon Rd EB AFF	0.68022	
Exit 14 SB 2035 Build A.M.	Loudon Rd EB DFF	1.09756	
Exit 14 SB 2035 Build A.M.	Exit 14 SB off Ramp SB Q		1.74022
Exit 14 SB 2035 Build A.M.	Exit 14 SB off Ramp SB AFF	0.69434	
Exit 14 SB 2035 Build A.M.	Exit 14 SB on Ramp SB DFF	0.79329	
Exit 14 SB 2035 Build A.M.	I 93 SB	0.766368	
Exit 14 SB 2035 Build A.M.	I 93 NB	0.766367	
Exit 14 SB 2035 Build P.M.	Loudon Rd WB Q		1.75284
Exit 14 SB 2035 Build P.M.	Loudon Rd WB AFF	1.12343	
Exit 14 SB 2035 Build P.M.	Loudon Rd WB DFF	1.55125	
Exit 14 SB 2035 Build P.M.	Loudon Rd EB Q		1.75285
Exit 14 SB 2035 Build P.M.	Loudon Rd EB AFF	0.68856	
Exit 14 SB 2035 Build P.M.	Loudon Rd EB DFF	1.12343	
Exit 14 SB 2035 Build P.M.	Exit 14 SB off Ramp SB Q		1.75285
Exit 14 SB 2035 Build P.M.	Exit 14 SB off Ramp SB AFF	0.70224	
Exit 14 SB 2035 Build P.M.	Exit 14 SB on Ramp SB DFF	0.80260	
Exit 14 SB 2035 Build P.M.	I 93 SB	0.787965	
Exit 14 SB 2035 Build P.M.	I 93 NB	0.787964	
Exit 13 SPUI 2035 Build A.M.	Manchester St WB Q		1.74022
Exit 13 SPUI 2035 Build A.M.	Manchester St WB AFF	0.78848	
Exit 13 SPUI 2035 Build A.M.	Manchester St WB DFF	0.97898	
Exit 13 SPUI 2035 Build A.M.	Manchester St EB Q		1.74022
Exit 13 SPUI 2035 Build A.M.	Manchester St EB AFF	1.07498	
Exit 13 SPUI 2035 Build A.M.	Manchester St EB DFF	1.14533	
Exit 13 SPUI 2035 Build A.M.	I 93 SB off Ramp Q		1.74022
Exit 13 SPUI 2035 Build A.M.	I 93 SB off Ramp AFF	0.95082	
Exit 13 SPUI 2035 Build A.M.	I 93 SB on Ramp DFF	1.25492	
Exit 13 SPUI 2035 Build A.M.	I 93 NB off Ramp Q		1.74022

Location	Link Description	Grams Per Vehicle-Mile (free-flow)	Grams Per Vehicle/ Hour (queue links)
Exit 13 SPUI 2035 Build A.M.	I 93 NB off Ramp AFF	0.94776	
Exit 13 SPUI 2035 Build A.M.	I 93 NB on Ramp DFF	0.91078	
Exit 13 SPUI 2035 Build A.M.	I 93 NB on slip ramp	1.00031	
Exit 13 SPUI 2035 Build A.M.	I 93 NB off slip ramp	1.88178	
Exit 13 SPUI 2035 Build A.M.	I 93 SB on slip ramp	1.03398	
Exit 13 SPUI 2035 Build A.M.	I 93 NB	0.7646755	
Exit 13 SPUI 2035 Build A.M.	I 93 SB	0.7646755	
Exit 13 SPUI 2035 Build P.M.	Manchester St WB Q		1.75285
Exit 13 SPUI 2035 Build P.M.	Manchester St WB AFF	0.79730	
Exit 13 SPUI 2035 Build P.M.	Manchester St WB DFF	0.99855	
Exit 13 SPUI 2035 Build P.M.	Manchester St EB Q		1.75284
Exit 13 SPUI 2035 Build P.M.	Manchester St EB AFF	1.09320	
Exit 13 SPUI 2035 Build P.M.	Manchester St EB DFF	1.15653	
Exit 13 SPUI 2035 Build P.M.	I 93 SB off Ramp Q		1.75284
Exit 13 SPUI 2035 Build P.M.	I 93 SB off Ramp AFF	0.96154	
Exit 13 SPUI 2035 Build P.M.	I 93 SB on Ramp DFF	1.26723	
Exit 13 SPUI 2035 Build P.M.	I 93 NB off Ramp Q		1.75285
Exit 13 SPUI 2035 Build P.M.	I 93 NB off Ramp AFF	0.95816	
Exit 13 SPUI 2035 Build P.M.	I 93 NB on Ramp DFF	0.95446	
Exit 13 SPUI 2035 Build P.M.	I 93 NB on slip ramp	1.01081	
Exit 13 SPUI 2035 Build P.M.	I 93 NB off slip ramp	1.93739	
Exit 13 SPUI 2035 Build P.M.	I 93 SB on slip ramp	1.08501	
Exit 13 SPUI 2035 Build P.M.	I 93 NB	0.796697	
Exit 13 SPUI 2035 Build P.M.	I 93 SB	0.796697	

Table 4. PM10 Emission Rates Calculated from MOVES

RUN	Link Description	Grams Per Vehicle-Mile (free-flow)	Grams Per Vehicle/ Hour (queue links)
Exit 14 NB 2035 Build A.M.	Loudon Rd WB Q		0.04602
Exit 14 NB 2035 Build A.M.	Loudon Rd WB AFF	0.06743	
Exit 14 NB 2035 Build A.M.	Loudon Rd WB DFF	0.08079	
Exit 14 NB 2035 Build A.M.	Loudon Rd EB Q		0.04602
Exit 14 NB 2035 Build A.M.	Loudon Rd EB AFF	0.05964	
Exit 14 NB 2035 Build A.M.	Loudon Rd EB DFF	0.06743	
Exit 14 NB 2035 Build A.M.	Exit 14 NB off Ramp NB Q		0.04602
Exit 14 NB 2035 Build A.M.	Exit 14 NB off Ramp NB AFF	0.09919	
Exit 14 NB 2035 Build A.M.	FT Eddy Rd NB DFF	0.08623	
Exit 14 NB 2035 Build A.M.	FT Eddy Rd SB Q		0.04602
Exit 14 NB 2035 Build A.M.	FT Eddy Rd SB AFF	0.01824	

RUN	Link Description	Grams Per Vehicle-Mile (free-flow)	Grams Per Vehicle/ Hour (queue links)
Exit 14 NB 2035 Build A.M.	I 93 SB	0.020448	
Exit 14 NB 2035 Build A.M.	I 93 NB	0.020448	
Exit 14 NB 2035 Build P.M.	Loudon Rd WB Q		0.03961
Exit 14 NB 2035 Build P.M.	Loudon Rd WB AFF	0.06368	
Exit 14 NB 2035 Build P.M.	Loudon Rd WB DFF	0.07584	
Exit 14 NB 2035 Build P.M.	Loudon Rd EB Q		0.03961
Exit 14 NB 2035 Build P.M.	Loudon Rd EB AFF	0.05655	
Exit 14 NB 2035 Build P.M.	Loudon Rd EB DFF	0.06368	
Exit 14 NB 2035 Build P.M.	Exit 14 NB off Ramp NB Q		0.03961
Exit 14 NB 2035 Build P.M.	Exit 14 NB off Ramp NB AFF	0.09310	
Exit 14 NB 2035 Build P.M.	FT Eddy Rd NB DFF	0.08089	
Exit 14 NB 2035 Build P.M.	FT Eddy Rd SB Q		0.03961
Exit 14 NB 2035 Build P.M.	FT Eddy Rd SB AFF	0.01722	
Exit 14 NB 2035 Build P.M.	I 93 SB	0.019433	
Exit 14 NB 2035 Build P.M.	I 93 NB	0.019433	
Exit 14 SB 2035 Build A.M.	Loudon Rd WB Q		0.04602
Exit 14 SB 2035 Build A.M.	Loudon Rd WB AFF	0.06743	
Exit 14 SB 2035 Build A.M.	Loudon Rd WB DFF	0.05246	
Exit 14 SB 2035 Build A.M.	Loudon Rd EB Q		0.04602
Exit 14 SB 2035 Build A.M.	Loudon Rd EB AFF	0.10620	
Exit 14 SB 2035 Build A.M.	Loudon Rd EB DFF	0.06743	
Exit 14 SB 2035 Build A.M.	Exit 14 SB off Ramp SB Q		0.04602
Exit 14 SB 2035 Build A.M.	Exit 14 SB off Ramp SB AFF	0.09919	
Exit 14 SB 2035 Build A.M.	Exit 14 SB on Ramp SB DFF	0.08079	
Exit 14 SB 2035 Build A.M.	I 93 SB	0.026213	
Exit 14 SB 2035 Build A.M.	I 93 NB	0.026213	
Exit 14 SB 2035 Build P.M.	Loudon Rd WB Q		0.03961
Exit 14 SB 2035 Build P.M.	Loudon Rd WB AFF	0.06368	
Exit 14 SB 2035 Build P.M.	Loudon Rd WB DFF	0.04974	
Exit 14 SB 2035 Build P.M.	Loudon Rd EB Q		0.03961
Exit 14 SB 2035 Build P.M.	Loudon Rd EB AFF	0.09960	
Exit 14 SB 2035 Build P.M.	Loudon Rd EB DFF	0.06368	
Exit 14 SB 2035 Build P.M.	Exit 14 SB off Ramp SB Q		0.03961
Exit 14 SB 2035 Build P.M.	Exit 14 SB off Ramp SB AFF	0.09310	
Exit 14 SB 2035 Build P.M.	Exit 14 SB on Ramp SB DFF	0.07584	
Exit 14 SB 2035 Build P.M.	I 93 SB	0.024712	
Exit 14 SB 2035 Build P.M.	I 93 NB	0.024712	
Exit 13 SPUI 2035 Build A.M.	Manchester St WB Q		0.04602
Exit 13 SPUI 2035 Build A.M.	Manchester St WB AFF	0.08079	

RUN	Link Description	Grams Per Vehicle-Mile (free-flow)	Grams Per Vehicle/ Hour (queue links)
Exit 13 SPUI 2035 Build A.M.	Manchester St WB DFF	0.07103	
Exit 13 SPUI 2035 Build A.M.	Manchester St EB Q		0.04602
Exit 13 SPUI 2035 Build A.M.	Manchester St EB AFF	0.06406	
Exit 13 SPUI 2035 Build A.M.	Manchester St EB DFF	0.05964	
Exit 13 SPUI 2035 Build A.M.	I 93 SB off Ramp Q		0.04602
Exit 13 SPUI 2035 Build A.M.	I 93 SB off Ramp AFF	0.06743	
Exit 13 SPUI 2035 Build A.M.	I 93 SB on Ramp DFF	0.05729	
Exit 13 SPUI 2035 Build A.M.	I 93 NB off Ramp Q		0.04602
Exit 13 SPUI 2035 Build A.M.	I 93 NB off Ramp AFF	0.06743	
Exit 13 SPUI 2035 Build A.M.	I 93 NB on Ramp DFF	0.06836	
Exit 13 SPUI 2035 Build A.M.	I 93 NB on slip ramp	0.06406	
Exit 13 SPUI 2035 Build A.M.	I 93 NB off slip ramp	0.05306	
Exit 13 SPUI 2035 Build A.M.	I 93 SB on slip ramp	0.06260	
Exit 13 SPUI 2035 Build A.M.	I 93 NB	0.021193	
Exit 13 SPUI 2035 Build A.M.	I 93 SB	0.021193	
Exit 13 SPUI 2035 Build P.M.	Manchester St WB Q		0.03961
Exit 13 SPUI 2035 Build P.M.	Manchester St WB AFF	0.07584	
Exit 13 SPUI 2035 Build P.M.	Manchester St WB DFF	0.06701	
Exit 13 SPUI 2035 Build P.M.	Manchester St EB Q		0.03961
Exit 13 SPUI 2035 Build P.M.	Manchester St EB AFF	0.06053	
Exit 13 SPUI 2035 Build P.M.	Manchester St EB DFF	0.05655	
Exit 13 SPUI 2035 Build P.M.	I 93 SB off Ramp Q		0.03961
Exit 13 SPUI 2035 Build P.M.	I 93 SB off Ramp AFF	0.06368	
Exit 13 SPUI 2035 Build P.M.	I 93 SB on Ramp DFF	0.05438	
Exit 13 SPUI 2035 Build P.M.	I 93 NB off Ramp Q		0.03961
Exit 13 SPUI 2035 Build P.M.	I 93 NB off Ramp AFF	0.06368	
Exit 13 SPUI 2035 Build P.M.	I 93 NB on Ramp DFF	0.06368	
Exit 13 SPUI 2035 Build P.M.	I 93 NB on slip ramp	0.06053	
Exit 13 SPUI 2035 Build P.M.	I 93 NB off slip ramp	0.05034	
Exit 13 SPUI 2035 Build P.M.	I 93 SB on slip ramp	0.05798	
Exit 13 SPUI 2035 Build P.M.	I 93 NB	0.019433	
Exit 13 SPUI 2035 Build P.M.	I 93 SB	0.019433	

Table 5. PM2.5 Emission Rates Calculated from MOVES

Location	Link Description	Grams Per Vehicle-Mile (free-flow)	Grams Per Vehicle/ Hour (queue links)
Exit 14 NB 2035 Build A.M.	Loudon Rd WB Q		0.04159
Exit 14 NB 2035 Build A.M.	Loudon Rd WB AFF	0.01278	
Exit 14 NB 2035 Build A.M.	Loudon Rd WB DFF	0.01366	
Exit 14 NB 2035 Build A.M.	Loudon Rd EB Q		0.04159

Location	Link Description	Grams Per Vehicle-Mile (free-flow)	Grams Per Vehicle/ Hour (queue links)
Exit 14 NB 2035 Build A.M.	Loudon Rd EB AFF	0.01290	
Exit 14 NB 2035 Build A.M.	Loudon Rd EB DFF	0.01278	
Exit 14 NB 2035 Build A.M.	Exit 14 NB off Ramp NB Q		0.04159
Exit 14 NB 2035 Build A.M.	Exit 14 NB off Ramp NB AFF	0.01536	
Exit 14 NB 2035 Build A.M.	FT Eddy Rd NB DFF	0.01414	
Exit 14 NB 2035 Build A.M.	FT Eddy Rd SB Q		0.04159
Exit 14 NB 2035 Build A.M.	FT Eddy Rd SB AFF	0.00657	
Exit 14 NB 2035 Build A.M.	I 93 SB	0.005768	
Exit 14 NB 2035 Build A.M.	I 93 NB	0.005768	
Exit 14 NB 2035 Build P.M.	Loudon Rd WB Q		0.03568
Exit 14 NB 2035 Build P.M.	Loudon Rd WB AFF	0.01173	
Exit 14 NB 2035 Build P.M.	Loudon Rd WB DFF	0.01259	
Exit 14 NB 2035 Build P.M.	Loudon Rd EB Q		0.03568
Exit 14 NB 2035 Build P.M.	Loudon Rd EB AFF	0.01179	
Exit 14 NB 2035 Build P.M.	Loudon Rd EB DFF	0.01173	
Exit 14 NB 2035 Build P.M.	Exit 14 NB off Ramp NB Q		0.03568
Exit 14 NB 2035 Build P.M.	Exit 14 NB off Ramp NB AFF	0.01425	
Exit 14 NB 2035 Build P.M.	FT Eddy Rd NB DFF	0.01306	
Exit 14 NB 2035 Build P.M.	FT Eddy Rd SB Q		0.03568
Exit 14 NB 2035 Build P.M.	FT Eddy Rd SB AFF	0.00601	
Exit 14 NB 2035 Build P.M.	I 93 SB	0.005202	
Exit 14 NB 2035 Build P.M.	I 93 NB	0.005202	
Exit 14 SB 2035 Build A.M.	Loudon Rd WB Q		0.04159
Exit 14 SB 2035 Build A.M.	Loudon Rd WB AFF	0.01278	
Exit 14 SB 2035 Build A.M.	Loudon Rd WB DFF	0.01389	
Exit 14 SB 2035 Build A.M.	Loudon Rd EB Q		0.04159
Exit 14 SB 2035 Build A.M.	Loudon Rd EB AFF	0.01607	
Exit 14 SB 2035 Build A.M.	Loudon Rd EB DFF	0.01278	
Exit 14 SB 2035 Build A.M.	Exit 14 SB off Ramp SB Q		0.04159
Exit 14 SB 2035 Build A.M.	Exit 14 SB off Ramp SB AFF	0.01536	
Exit 14 SB 2035 Build A.M.	Exit 14 SB on Ramp SB DFF	0.01366	
Exit 14 SB 2035 Build A.M.	I 93 SB	0.006525	
Exit 14 SB 2035 Build A.M.	I 93 NB	0.006525	
Exit 14 SB 2035 Build P.M.	Loudon Rd WB Q		0.03568
Exit 14 SB 2035 Build P.M.	Loudon Rd WB AFF	0.01173	
Exit 14 SB 2035 Build P.M.	Loudon Rd WB DFF	0.01261	
Exit 14 SB 2035 Build P.M.	Loudon Rd EB Q		0.03568
Exit 14 SB 2035 Build P.M.	Loudon Rd EB AFF	0.01491	
Exit 14 SB 2035 Build P.M.	Loudon Rd EB DFF	0.01173	
Exit 14 SB 2035 Build P.M.	Exit 14 SB off Ramp SB Q		0.03568
Exit 14 SB 2035 Build P.M.	Exit 14 SB off Ramp SB AFF	0.01425	

Location	Link Description	Grams Per Vehicle-Mile (free-flow)	Grams Per Vehicle/ Hour (queue links)
Exit 14 SB 2035 Build P.M.	Exit 14 SB on Ramp SB DFF	0.01259	
Exit 14 SB 2035 Build P.M.	I 93 SB	0.005978	
Exit 14 SB 2035 Build P.M.	I 93 NB	0.005978	
Exit 13 SPUI 2035 Build A.M.	Manchester St WB Q		0.04159
Exit 13 SPUI 2035 Build A.M.	Manchester St WB AFF	0.01366	
Exit 13 SPUI 2035 Build A.M.	Manchester St WB DFF	0.01295	
Exit 13 SPUI 2035 Build A.M.	Manchester St EB Q		0.04159
Exit 13 SPUI 2035 Build A.M.	Manchester St EB AFF	0.01266	
Exit 13 SPUI 2035 Build A.M.	Manchester St EB DFF	0.01290	
Exit 13 SPUI 2035 Build A.M.	I 93 SB off Ramp Q		0.04159
Exit 13 SPUI 2035 Build A.M.	I 93 SB off Ramp AFF	0.01278	
Exit 13 SPUI 2035 Build A.M.	I 93 SB on Ramp DFF	0.01306	
Exit 13 SPUI 2035 Build A.M.	I 93 NB off Ramp Q		0.04159
Exit 13 SPUI 2035 Build A.M.	I 93 NB off Ramp AFF	0.01278	
Exit 13 SPUI 2035 Build A.M.	I 93 NB on Ramp DFF	0.01305	
Exit 13 SPUI 2035 Build A.M.	I 93 NB on slip ramp	0.01266	
Exit 13 SPUI 2035 Build A.M.	I 93 NB off slip ramp	0.01379	
Exit 13 SPUI 2035 Build A.M.	I 93 SB on slip ramp	0.01297	
Exit 13 SPUI 2035 Build A.M.	I 93 NB	0.005938	
Exit 13 SPUI 2035 Build A.M.	I 93 SB	0.005938	
Exit 13 SPUI 2035 Build P.M.	Manchester St WB Q		0.03568
Exit 13 SPUI 2035 Build P.M.	Manchester St WB AFF	0.01259	
Exit 13 SPUI 2035 Build P.M.	Manchester St WB DFF	0.01192	
Exit 13 SPUI 2035 Build P.M.	Manchester St EB Q		0.03568
Exit 13 SPUI 2035 Build P.M.	Manchester St EB AFF	0.01160	
Exit 13 SPUI 2035 Build P.M.	Manchester St EB DFF	0.01179	
Exit 13 SPUI 2035 Build P.M.	I 93 SB off Ramp Q		0.03568
Exit 13 SPUI 2035 Build P.M.	I 93 SB off Ramp AFF	0.01173	
Exit 13 SPUI 2035 Build P.M.	I 93 SB on Ramp DFF	0.01192	
Exit 13 SPUI 2035 Build P.M.	I 93 NB off Ramp Q		0.03568
Exit 13 SPUI 2035 Build P.M.	I 93 NB off Ramp AFF	0.01173	
Exit 13 SPUI 2035 Build P.M.	I 93 NB on Ramp DFF	0.01173	
Exit 13 SPUI 2035 Build P.M.	I 93 NB on slip ramp	0.01160	
Exit 13 SPUI 2035 Build P.M.	I 93 NB off slip ramp	0.01254	
Exit 13 SPUI 2035 Build P.M.	I 93 SB on slip ramp	0.01159	
Exit 13 SPUI 2035 Build P.M.	I 93 NB	0.005202	
Exit 13 SPUI 2035 Build P.M.	I 93 SB	0.005202	

4 Emissions Dispersion Analysis – CAL3QHC

4.1 CAL3QHC Input

The traffic signal timings used reflect the existing timings and no analysis was made to change the timings to adjust for the build condition in the design year. Also, every run was with an assumed 0.0 concentration for ambient pollutant. All inputs were per the EPA guidance, including *Users Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections*. These inputs were modeled to show the one-hour CO and PM concentrations based on a varying wind direction. Each run modeled one of the 28 receptors under a varying wind. The input and output files for each run can be found in Appendix A.

Input data for CAL3QHC are shown in Table 6.

4.2 CAL3QHC Output

Receptor locations were per guidance and are located at every corner of the intersection, at intervals of 25 meters from the intersection on each leg for both sides of the roadway, at intervals of 50 meters from the intersection on each leg for both sides, and at the midpoint of each free flow link for both sides. These receptor locations are shown for each intersection in Figures 1, 2, and 3. The results of each run by receptor is shown in Appendix A. The length of a link was 300 meters or the distance from center point of the intersection of interest and center point of the nearest intersection; lengths used were the lesser of the two values, as anything further than that presumably would not have a measurable impact to the air quality at the intersection.

The largest concentrations found by receptor are shown in Table 7.

Table 6. CAL3QHC Input

Program Control Data	• Model Selection – CAL3QHC
	• Screening Level – EPA Default Data Values
	• Input / Output Control
	  ○ Units – Feet
	  ○ Pollutant – CO (ppm) or PM2.5 (Ug/m3) or PM10 (Ug/m3)

Link Data	• Free Flow Links – By Volume per hr and gram per veh mi • Queue Links – By Volume per hr and Gram Per veh hr • Type – At grade or Bridge • Link location and length – Feet • Signal Timings – Signal timing per queue link
Meteorological Data	• Average Time (min) – 60 • Surface Roughness (cm) – 175 Office • Settling Velocity (cm/s) – 0.0 • Deposition Velocity (cm/s) – 0.0 • (for CO) 1-hr to 9-hr Persistence Factor – 0.7 • (for pm2.5/pm10) 1-hour to 24-hour Persistence Factor – 0.4 • (for pm2.5) 1-hour to annual persistence factor – 0.1 • Transport Wind Speed U (m/s) – 1.0 • Wind Direction in Degrees BRG – 0 (varies) • Pasquill Atmospheric Stability Class – 4 (D) • Mixing Height MIXH (m) – 1000 • Ambient CO concentrations AMB (ppm) – 0.0 • DEGR – 10 • VAI (1) – 1 • VAI (2) – 2

Table 7. CAL3QHC Output: Highest Concentrations of Each Parameter at Each Intersection

Location	Pollutant	Receptor Location	Concentration
Exit 14 NB 2035 Build AM	CO	Rec #22 – East Leg South Side 25 m	0.10 ppm
Exit 14 NB 2035 Build AM	PM 2.5	Rec #17 – East Leg North Side 25 m	2.40 µg/m^3
Exit 14 NB 2035 Build AM	PM 10	Rec #23 – East Leg South Side 50 m	9.50 µg/m^3
Exit 14 NB 2035 Build PM	CO	Rec #19– East Leg North Side Mid Block	0.20 ppm
Exit 14 NB 2035 Build PM	PM 2.5	Rec #5 – North Leg West Side Corner	2.60 µg/m^3
Exit 14 NB 2035 Build PM	PM 10	Rec #19 – East Leg North Side Mid Block	12.7 µg/m^3
Exit 14 SB 2035 Build AM	CO	Rec #17 – East Leg North Side 25 m	0.30 ppm
Exit 14 SB 2035 Build AM	PM 2.5	Rec #13 – South Leg West Side Corner	2.80 µg/m^3
Exit 14 SB 2035 Build AM	PM 10	Rec #28 – West Leg South Side Mid Block	13.30 µg/m^3
Exit 14 SB 2035 Build PM	CO	Rec #17 – East Leg North Side 25 m	0.30 ppm
Exit 14 SB 2035 Build PM	PM 2.5	Rec #13 – South Leg West Side Corner	2.60 µg/m^3
Exit 14 SB 2035 Build PM	PM 10	Rec #28 – West Leg South Side Mid Block	12.5 µg/m^3
Exit 13 SPUI 2035 Build AM	CO	Rec #5 – North Leg West Side Corner	0.10 ppm
Exit 13 SPUI 2035 Build AM	PM 2.5	Rec #5 – North Leg West Side Corner	2.50 µg/m^3
Exit 13 SPUI 2035 Build AM	PM 10	Rec #5 – North Leg West Side Corner	11.7 µg/m^3
Exit 13 SPUI 2035 Build PM	CO	Rec #15 – South Leg West Side 50 m	0.20 ppm
Exit 13 SPUI 2035 Build PM	PM 2.5	Rec #9 – South Leg East Side Corner	2.40 µg/m^3
Exit 13 SPUI 2035 Build PM	PM 10	Rec #9 – South Leg East Side Corner	11.30 µg/m^3

5 MOBILE SOURCE AIR TOXIC ANALYSIS IN NEPA DOCUMENTS

5.1 Low potential MSAT Effects from Projects with Minor Widening

For each alternative in this EA, the amount of mobile source air toxics (MSAT) emitted would be proportional to the vehicle miles traveled, or VMT, assuming that other variables such as fleet mix are the same for each alternative. The VMT estimated for each of the Build Alternatives is slightly higher than that for the No Build Alternative, because the additional capacity increases the efficiency of the roadway and attracts rerouted trips from elsewhere in the transportation network. This increase in VMT would lead to higher MSAT emissions for the preferred action alternative along the highway corridor, along with a corresponding decrease in MSAT emissions along the parallel routes. The emissions increase is offset somewhat by lower MSAT emission rates due to increased speeds; according to the Environmental Protection Agency's (EPA) MOVES2014 model, emissions of all of the priority MSAT decrease as speed increases. Regardless of the effects of this project, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce annual MSAT emissions by over 90 percent between 2010 and 2050 (Updated Interim Guidance on Mobile Source Air Toxic Analysis in NEPA Documents, Federal Highway Administration, October 12, 2016). Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future in nearly all cases.

6 CONCLUSIONS

6.1 CO Emission Rates

The highest CO concentrations modeled ranged from 0.10 - 0.30 ppm at the three locations over the 24-hour period. With the majority of the receptors recording a negligible concentration of CO under the aforementioned worst-case scenario, it can be assumed that this project will not cause exceedances of the current 1-hour CO NAAQS of 35 ppm. Recent CO samples taken from the Londonderry Air Monitoring Station operated by NHDES at Moose Hill School in Londonderry, NH (approximately 29 miles southeast of the project area) show a maximum of 2.65 ppm over 8,600 hourly samples taken in 2011. Even if the ambient CO levels at the intersections of interest are equivalent to the highest measured concentrations at the Londonderry station, the concentrations would still be well below the 1-hour standard of 35 ppm. Due to these findings, no additional analysis of CO is deemed necessary.

6.2 PM10

Modeled PM10 concentrations ranged from 9.5 $\mu g/m^3$ to 13.3 $\mu g/m^3$ at the three locations over both time periods. The concentration limit in the NAAQS is 150 $\mu g/m^3$ averaged over a 24-hour period. There is no information in the SIP regarding an ambient concentration to consider in the modeling. Since modeled concentrations for the worst-case scenario are substantially below the NAAQS, no additional analysis of PM10 is believed to be necessary.

6.3 PM2.5

Modeled PM2.5 concentrations ranged from 2.4 $\mu g/m^3$ to 2.8 $\mu g/m^3$ at the three intersections over both time periods and are well below the 24-hour NAAQS concentration of 35 $\mu g/m^3$. Because these results represent the worst-case scenario for one hour, it is assumed the 24-hour average is well below the threshold and no further analysis is needed.

6.4 In Summary

The build conditions for the design year are well below the CO, PM2.5, and PM10 standards. Therefore, it is concluded that this project will not cause or contribute to exceedances of the NAAQS. No analysis of additional alternatives or design years is warranted.

FIGURES

LEGEND

EXIT 13 RECEPTOR LOCATIONS

PROPOSED IMPROVEMENTS

100 0 100 200
SCALE IN FEET

New Hampshire DOT

McFarland Johnson

BOW-CONCORD I-93 IMPROVEMENTS

AIR QUALITY ANALYSIS
RECEPTOR LOCATIONS

DATE: MAY 2018

SCALE: 1" = 200'

FIGURE 1

LEGEND

EXIT 14 NB FT EDDY ROAD RECEPTOR LOCATIONS X
EXIT 14 SB RECEPTOR LOCATIONS X
PROPOSED IMPROVEMENTS

100 0 100 200
SCALE IN FEET

New Hampshire DOT
McFarland Johnson

BOW-CONCORD I-93 IMPROVEMENTS

AIR QUALITY ANALYSIS
RECEPTOR LOCATIONS

DATE: MAY 2018

SCALE: 1" = 200'

FIGURE 2

APPENDIX A
CAL3QHC MODELING RESULTS

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

```
                   CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045
PAGE  1

      JOB: Bow Concord                                      RUN: Exit 14 NB Ft Eddy 2035 Build AM
CO

      DATE :  3/ 2/18
      TIME :  9:44:42

         The MODE flag has been set for calculating concentrations for POLLUTANT:  CO

       SITE & METEOROLOGICAL VARIABLES
       -------------------------------
       VS =   0.0 CM/S       VD =   0.0 CM/S       Z0 = 108. CM
        U =  1.0 M/S         CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =  1000. M   AMB =  0.0
PPM

       LINK VARIABLES
       --------------
         LINK DESCRIPTION     *        LINK COORDINATES (FT)          *    LENGTH  BRG TYPE   VPH
EF      H   W    V/C QUEUE
                              *   X1        Y1        X2        Y2     *     (FT)  (DEG)
(G/MI)  (FT) (FT)       (VEH)
      ------------------------*----------------------------------------*-------------------------------
---------------------------
       1. N Leg App - FreeFlow*    -20.0       0.0      80.0     470.0 *     481.    12. AG    273.
1.3   0.0 56.0
       2. N Leg App - Queue   *     -2.9      80.5       7.3     128.2 *      49.    12. AG     11.
100.0   0.0 56.0 0.38   2.5
       3. N Leg Dep - FreeFlow*     30.0       0.0     120.0     460.0 *     469.    11. AG    379.
0.7   0.0 44.0
       4. S Leg App - FreeFlow*     30.0       0.0     -70.0    -450.0 *     461.   193. AG   1112.
0.7   0.0 72.0
       5. S Leg App - FF #2   *    -70.0    -450.0     -70.0    -820.0 *     370.   180. AG   1112.
0.7   0.0 51.0
       6. E Leg App - FreeFlow*      0.0      20.0     980.0      10.0 *     980.    91. AG    803.
0.9   0.0 56.0
       7. E Leg App - Queue   *     73.7      19.2     183.2      18.1 *     109.    91. AG      9.
100.0   0.0 56.0 0.49   5.6
       8. E Leg Dep - FreeFlow*      0.0     -10.0     980.0     -40.0 *     980.    92. AG   1304.
1.3   0.0 47.0
       9. W Leg App - FreeFlow*      0.0     -10.0    -430.0    -110.0 *     441.   257. AG    673.
1.3   0.0 68.0
      10. W Leg App - Queue   *      0.0     -10.0     -67.1     -25.6 *      69.   257. AG     12.
100.0   0.0 68.0 0.31   3.5
      11. W Leg Dep - FreeFlow*    -10.0      40.0    -440.0     -50.0 *     439.   258. AG   1177.
0.9   0.0 78.0
      12. N Leg App - FF #2   *     80.0     470.0       0.0     980.0 *     516.   351. AG    273.
1.3   0.0 40.0
      13. N Leg Dep - FF #2   *    120.0     460.0      30.0     990.0 *     538.   350. AG    379.
0.7   0.0 52.0
      14. S Leg App - FF #3   *    -70.0    -820.0     -40.0    -970.0 *     153.   169. AG   1112.
0.7   0.0 36.0
      15. I93 NB N Leg - FF   *   -270.0     -40.0    -420.0     940.0 *     991.   351. BR   3863.
0.8  22.0 80.0
      16. I 93 NB S Leg - FF  *   -270.0     -40.0     -60.0   -1030.0 *    1012.   168. BR   3863.
0.8  22.0 80.0
      17. I 93 SB N Leg - FF  *   -350.0     -50.0    -500.0     940.0 *    1001.   351. BR   3304.
0.8  22.0 95.0
      18. I 93 SB S Leg - FF  *   -350.0     -50.0    -120.0   -1040.0 *    1016.   167. BR   3304.
0.8  22.0 95.0
```

DATE : 3/ 2/18
TIME : 9:44:42

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	*	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
2. N Leg App - Queue	*	120	98	2.0	273	1600	1.74	2	3
7. E Leg App - Queue	*	120	75	2.0	803	1600	1.74	2	3
10. W Leg App - Queue	*	120	75	2.0	673	1600	1.74	2	3

RECEPTOR LOCATIONS

RECEPTOR	*	X (FT)	Y (FT)	Z (FT)	*
1. N Leg, E Side-Corner	*	80.0	60.0	5.9	*
2. N Leg, E Side - 25 m	*	80.0	140.0	5.9	*
3. N Leg, E Side - 50 m	*	100.0	230.0	5.9	*
4. N Leg, E Side-Midblk	*	130.0	500.0	5.9	*
5. N Leg, W Side-Corner	*	-50.0	60.0	5.9	*
6. N Leg, W Side - 25 m	*	-20.0	170.0	5.9	*
7. N Leg, W Side - 50 m	*	0.0	250.0	5.9	*
8. N Leg, W Side-Midblk	*	40.0	500.0	5.9	*
9. S Leg, E Side-Corner	*	60.0	-50.0	5.9	*
10. S Leg, E Side - 25 m	*	30.0	-180.0	5.9	*
11. S Leg, E Side - 50 m	*	10.0	-240.0	5.9	*
12. S Leg, E Side-Midblk	*	-40.0	-510.0	5.9	*
13. S Leg, W Side-Corner	*	-30.0	-60.0	5.9	*
14. S Leg, W Side - 25 m	*	-50.0	-160.0	5.9	*
15. S Leg, W Side - 50 m	*	-70.0	-240.0	5.9	*
16. S Leg, W Side-Midblk	*	-110.0	-490.0	5.9	*
17. E Leg, N Side - 25 m	*	170.0	50.0	5.9	*
18. E Leg, N Side - 50 m	*	250.0	40.0	5.9	*
19. E Leg, N Side-Midblk	*	490.0	30.0	5.9	*
20. W Leg, N Side - 25 m	*	-130.0	50.0	5.9	*
21. W Leg, N Side - 50 m	*	-210.0	40.0	5.9	*
22. E Leg, S Side - 25 m	*	170.0	-40.0	5.9	*
23. E Leg, S Side - 50 m	*	250.0	-40.0	5.9	*
24. E Leg, S Side-Midblk	*	490.0	-50.0	5.9	*
25. W Leg, S Side - 25 m	*	-110.0	-80.0	5.9	*
26. W Leg, S Side - 50 m	*	-190.0	-90.0	5.9	*

JOB: Bow Concord RUN: Exit 14 NB Ft Eddy 2035 Build AM CO

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
70.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000
80.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000
90.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
100.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
110.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
120.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
130.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
140.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
150.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
160.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
170.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
180.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
190.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
200.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
210.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
220.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
280.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
290.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
300.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
310.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
320.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

```
 330.  *  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000
 340.  *  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000
 350.  *  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000
 360.  *  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000
 ------*-------------------------------------------------------------------------------------------
-------------------------
 MAX   *  0.0000  0.0000  0.0000  0.0000  0.1000  0.0000  0.0000  0.0000  0.1000  0.0000  0.0000
0.0000  0.1000  0.0000  0.0000
 DEGR. *     10      10      10      10     250      10      10      10      50      10      10      10
70      10      10
```

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR) *	CONCENTRATION (PPM) 16	17	18	19	20	21	22	23	24	25	26
10. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
20. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
30. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
40. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
50. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
60. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
70. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
80. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
90. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
100. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000
110. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
120. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
130. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
140. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
150. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
160. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
170. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
180. *	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000
190. *	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000
200. *	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000
210. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
220. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000
280. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
290. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
300. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
310. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
320. *	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000
330. *	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.1000
340. *	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.1000
350. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
360. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
MAX *	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.1000
DEGR. *	180	10	10	10	10	180	10	10	10	10	180

THE HIGHEST CONCENTRATION OF 0.1000 PPM OCCURRED AT RECEPTOR 22.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

PAGE 1

JOB: Bow Concord RUN: Exit 14 NB Ft Eddy 2035 Build AM pm2.5

DATE : 3/ 2/18
TIME : 10: 5:22

The MODE flag has been set for calculating concentrations for POLLUTANT: PM2.5

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 108. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 UG/M**3

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	-20.0	0.0	80.0	470.0	481.	12.	AG	273.	0.0	0.0	56.0		
2. N Leg App - Queue	-2.9	80.5	7.3	128.2	49.	12.	AG	0.	100.0	0.0	56.0	0.38	2.5
3. N Leg Dep - FreeFlow	30.0	0.0	120.0	460.0	469.	11.	AG	379.	0.0	0.0	44.0		
4. S Leg App - FreeFlow	30.0	0.0	-70.0	-450.0	461.	193.	AG	1112.	0.0	0.0	72.0		
5. S Leg App - FF #2	-70.0	-450.0	-70.0	-820.0	370.	180.	AG	1112.	0.0	0.0	51.0		
6. E Leg App - FreeFlow	0.0	20.0	980.0	10.0	980.	91.	AG	803.	0.0	0.0	56.0		
7. E Leg App - Queue	73.7	19.2	183.2	18.1	109.	91.	AG	0.	100.0	0.0	56.0	0.49	5.6
8. E Leg Dep - FreeFlow	0.0	-10.0	980.0	-40.0	980.	92.	AG	1304.	0.0	0.0	47.0		
9. W Leg App - FreeFlow	0.0	-10.0	-430.0	-110.0	441.	257.	AG	673.	0.0	0.0	68.0		
10. W Leg App - Queue	0.0	-10.0	-67.1	-25.6	69.	257.	AG	0.	100.0	0.0	68.0	0.31	3.5
11. W Leg Dep - FreeFlow	-10.0	40.0	-440.0	-50.0	439.	258.	AG	1177.	0.0	0.0	78.0		
12. N Leg App - FF #2	80.0	470.0	0.0	980.0	516.	351.	AG	273.	0.0	0.0	40.0		
13. N Leg Dep - FF #2	120.0	460.0	30.0	990.0	538.	350.	AG	379.	0.0	0.0	52.0		
14. S Leg App - FF #3	-70.0	-820.0	-40.0	-970.0	153.	169.	AG	1112.	0.0	0.0	36.0		
15. I93 NB N Leg - FF	-270.0	-40.0	-420.0	940.0	991.	351.	BR	3863.	0.0	22.0	80.0		
16. I 93 NB S Leg - FF	-270.0	-40.0	-60.0	-1030.0	1012.	168.	BR	3863.	0.0	22.0	80.0		
17. I 93 SB N Leg - FF	-350.0	-50.0	-500.0	940.0	1001.	351.	BR	3304.	0.0	22.0	95.0		
18. I 93 SB S Leg - FF	-350.0	-50.0	-120.0	-1040.0	1016.	167.	BR	3304.	0.0	22.0	95.0		

DATE : 3/ 2/18
TIME : 10: 5:22

2. N Leg App - Queue	*	120	98	2.0	273	1600	0.04	2
3								
7. E Leg App - Queue	*	120	75	2.0	803	1600	0.04	2
3								
10. W Leg App - Queue	*	120	75	2.0	673	1600	0.04	2
3								

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (FT) X	Y	Z	*
1. N Leg, E Side-Corner	*	80.0	60.0	5.9	*
2. N Leg, E Side - 25 m	*	80.0	140.0	5.9	*
3. N Leg, E Side - 50 m	*	100.0	230.0	5.9	*
4. N Leg, E Side-Midblk	*	130.0	500.0	5.9	*
5. N Leg, W Side-Corner	*	-50.0	60.0	5.9	*
6. N Leg, W Side - 25 m	*	-20.0	170.0	5.9	*
7. N Leg, W Side - 50 m	*	0.0	250.0	5.9	*
8. N Leg, W Side-Midblk	*	40.0	500.0	5.9	*
9. S Leg, E Side-Corner	*	60.0	-50.0	5.9	*
10. S Leg, E Side - 25 m	*	30.0	-180.0	5.9	*
11. S Leg, E Side - 50 m	*	10.0	-240.0	5.9	*
12. S Leg, E Side-Midblk	*	-40.0	-510.0	5.9	*
13. S Leg, W Side-Corner	*	-30.0	-60.0	5.9	*
14. S Leg, W Side - 25 m	*	-50.0	-160.0	5.9	*
15. S Leg, W Side - 50 m	*	-70.0	-240.0	5.9	*
16. S Leg, W Side-Midblk	*	-110.0	-490.0	5.9	*
17. E Leg, N Side - 25 m	*	170.0	50.0	5.9	*
18. E Leg, N Side - 50 m	*	250.0	40.0	5.9	*
19. E Leg, N Side-Midblk	*	490.0	30.0	5.9	*
20. W Leg, N Side - 25 m	*	-130.0	50.0	5.9	*
21. W Leg, N Side - 50 m	*	-210.0	40.0	5.9	*
22. E Leg, S Side - 25 m	*	170.0	-40.0	5.9	*
23. E Leg, S Side - 50 m	*	250.0	-40.0	5.9	*
24. E Leg, S Side-Midblk	*	490.0	-50.0	5.9	*
25. W Leg, S Side - 25 m	*	-110.0	-80.0	5.9	*
26. W Leg, S Side - 50 m	*	-190.0	-90.0	5.9	*

JOB: Bow Concord RUN: Exit 14 NB Ft Eddy 2035 Build AM pm2.5

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	0.1000	0.3000	0.3000	0.1000	0.1000	0.1000	0.1000	0.2000	1.1000	1.0000	1.1000	0.7000	1.8000	1.0000	0.8000
20.	0.0000	0.2000	0.1000	0.1000	0.4000	0.1000	0.2000	0.2000	1.2000	0.6000	0.7000	0.4000	1.7000	1.3000	0.9000
30.	0.0000	0.1000	0.0000	0.0000	0.5000	0.2000	0.2000	0.2000	1.1000	0.6000	0.6000	0.3000	1.6000	1.2000	1.0000
40.	0.0000	0.0000	0.0000	0.0000	0.7000	0.2000	0.2000	0.2000	1.2000	0.5000	0.5000	0.2000	1.6000	1.0000	1.1000
50.	0.0000	0.0000	0.0000	0.0000	0.8000	0.2000	0.2000	0.2000	1.3000	0.3000	0.4000	0.2000	1.8000	1.0000	1.0000
60.	0.0000	0.0000	0.0000	0.0000	0.9000	0.2000	0.2000	0.2000	1.3000	0.3000	0.4000	0.1000	1.8000	1.0000	0.9000
70.	0.0000	0.0000	0.0000	0.0000	0.8000	0.2000	0.2000	0.2000	1.2000	0.3000	0.4000	0.0000	1.9000	0.9000	0.8000
80.	0.1000	0.0000	0.0000	0.0000	1.0000	0.2000	0.2000	0.2000	1.2000	0.3000	0.1000	0.0000	1.4000	0.8000	0.6000
90.	0.6000	0.1000	0.0000	0.0000	1.3000	0.2000	0.2000	0.2000	0.8000	0.1000	0.0000	0.0000	1.0000	0.6000	0.5000
100.	1.2000	0.2000	0.2000	0.0000	1.5000	0.4000	0.4000	0.2000	0.3000	0.0000	0.0000	0.0000	0.7000	0.5000	0.5000
110.	1.5000	0.4000	0.2000	0.0000	1.7000	0.6000	0.4000	0.1000	0.1000	0.0000	0.0000	0.0000	0.5000	0.5000	0.5000
120.	1.5000	0.4000	0.3000	0.0000	1.5000	0.7000	0.5000	0.3000	0.0000	0.0000	0.0000	0.0000	0.5000	0.5000	0.5000
130.	1.5000	0.5000	0.3000	0.2000	1.3000	1.0000	0.5000	0.3000	0.0000	0.0000	0.0000	0.0000	0.5000	0.5000	0.5000
140.	1.4000	0.6000	0.3000	0.3000	1.4000	1.0000	0.6000	0.3000	0.0000	0.0000	0.1000	0.0000	0.6000	0.6000	0.6000
150.	1.2000	0.7000	0.4000	0.3000	1.4000	1.2000	0.5000	0.3000	0.0000	0.0000	0.1000	0.0000	0.6000	0.6000	0.6000
160.	1.2000	0.7000	0.4000	0.3000	1.7000	1.2000	0.7000	0.4000	0.0000	0.1000	0.1000	0.1000	0.7000	0.7000	0.7000
170.	1.1000	0.7000	0.4000	0.5000	1.8000	1.2000	0.9000	0.5000	0.1000	0.1000	0.2000	0.4000	0.8000	0.9000	0.9000
180.	1.4000	1.0000	0.5000	0.8000	1.9000	1.6000	1.2000	0.5000	0.4000	0.4000	0.5000	1.0000	1.0000	1.2000	1.1000
190.	1.6000	1.3000	1.0000	0.9000	1.7000	1.3000	1.1000	0.4000	0.8000	0.9000	1.1000	1.5000	0.9000	1.1000	1.0000
200.	1.8000	1.5000	1.3000	0.9000	1.5000	1.0000	0.9000	0.3000	1.2000	1.1000	1.4000	1.5000	0.7000	0.8000	0.7000
210.	1.7000	1.5000	1.1000	0.7000	1.3000	0.8000	0.6000	0.4000	1.1000	1.3000	1.3000	1.3000	0.5000	0.6000	0.5000
220.	1.7000	1.4000	1.1000	0.9000	1.3000	0.7000	0.6000	0.3000	1.1000	1.1000	1.2000	1.2000	0.4000	0.5000	0.5000
230.	1.8000	1.3000	0.9000	0.4000	1.4000	0.7000	0.6000	0.3000	1.0000	1.1000	1.1000	1.2000	0.4000	0.4000	0.5000
240.	1.6000	1.3000	0.8000	0.4000	1.4000	0.6000	0.4000	0.3000	0.9000	0.9000	1.1000	1.1000	0.3000	0.4000	0.5000
250.	1.5000	1.2000	0.5000	0.4000	1.4000	0.4000	0.3000	0.2000	1.0000	0.9000	1.0000	1.1000	0.5000	0.4000	0.5000
260.	1.2000	0.8000	0.4000	0.4000	1.1000	0.3000	0.3000	0.3000	1.1000	0.8000	0.9000	1.1000	0.7000	0.4000	0.4000
270.	0.8000	0.7000	0.4000	0.4000	0.8000	0.3000	0.3000	0.3000	1.7000	0.8000	1.0000	1.1000	1.1000	0.4000	0.5000
280.	0.9000	0.6000	0.4000	0.4000	0.6000	0.3000	0.3000	0.2000	1.9000	1.1000	0.9000	1.1000	1.2000	0.5000	0.5000
290.	0.9000	0.5000	0.5000	0.4000	0.6000	0.3000	0.3000	0.3000	1.9000	1.1000	1.1000	1.0000	1.3000	0.8000	0.7000
300.	0.9000	0.5000	0.5000	0.4000	0.5000	0.3000	0.3000	0.2000	1.9000	1.1000	1.2000	1.1000	1.5000	0.6000	0.7000
310.	0.8000	0.5000	0.5000	0.3000	0.5000	0.4000	0.3000	0.2000	1.9000	1.2000	1.2000	1.2000	1.5000	0.8000	0.7000
320.	0.7000	0.5000	0.4000	0.4000	0.6000	0.3000	0.3000	0.1000	1.7000	1.4000	1.3000	1.5000	1.7000	0.8000	0.8000

330.	0.5000	0.3000	0.3000	0.4000	0.4000	0.3000	0.2000	0.0000	1.7000	1.4000	1.4000	1.4000	1.6000	0.8000	0.7000
340.	0.2000	0.3000	0.3000	0.4000	0.2000	0.1000	0.0000	0.0000	1.4000	1.3000	1.4000	1.6000	1.7000	0.7000	0.7000
350.	0.2000	0.3000	0.4000	0.4000	0.0000	0.0000	0.0000	0.0000	1.3000	1.3000	1.2000	1.1000	1.6000	0.6000	0.5000
360.	0.2000	0.4000	0.4000	0.3000	0.0000	0.0000	0.0000	0.2000	1.3000	1.1000	1.4000	0.9000	1.6000	0.8000	0.4000
MAX	1.8000	1.5000	1.3000	0.9000	1.9000	1.6000	1.2000	0.5000	1.9000	1.4000	1.4000	1.6000	1.9000	1.3000	1.1000
DEGR.	230	200	200	220	180	180	180	170	300	320	200	340	70	20	40

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26
10.	0.6000	0.0000	0.0000	0.1000	0.0000	0.0000	1.1000	0.9000	0.8000	0.6000	0.6000
20.	0.9000	0.0000	0.0000	0.1000	0.1000	0.0000	1.1000	0.9000	0.8000	0.8000	0.6000
30.	1.0000	0.0000	0.0000	0.1000	0.1000	0.0000	1.0000	0.9000	0.8000	1.1000	0.6000
40.	0.9000	0.0000	0.1000	0.1000	0.2000	0.0000	1.0000	1.0000	1.0000	1.2000	1.0000
50.	0.9000	0.0000	0.1000	0.1000	0.3000	0.1000	1.0000	1.1000	1.0000	1.3000	1.0000
60.	0.7000	0.0000	0.1000	0.2000	0.5000	0.2000	1.1000	1.2000	1.1000	1.3000	1.2000
70.	0.6000	0.1000	0.2000	0.3000	0.6000	0.3000	1.3000	1.3000	1.3000	1.3000	1.2000
80.	0.5000	0.3000	0.5000	0.6000	1.0000	0.8000	1.4000	1.5000	1.3000	1.2000	1.1000
90.	0.5000	0.7000	0.9000	0.9000	1.4000	1.3000	1.2000	1.3000	1.0000	0.7000	0.7000
100.	0.5000	1.1000	1.1000	1.2000	1.6000	1.6000	0.6000	0.7000	0.5000	0.4000	0.3000
110.	0.5000	1.2000	1.2000	1.2000	1.6000	1.3000	0.2000	0.3000	0.2000	0.3000	0.2000
120.	0.5000	1.1000	1.1000	1.1000	1.5000	1.2000	0.1000	0.1000	0.1000	0.3000	0.2000
130.	0.6000	1.0000	1.0000	0.9000	1.5000	1.1000	0.1000	0.1000	0.1000	0.3000	0.2000
140.	0.6000	1.0000	0.8000	0.8000	1.2000	0.9000	0.0000	0.1000	0.0000	0.3000	0.2000
150.	0.7000	1.1000	0.8000	0.8000	1.0000	0.9000	0.0000	0.0000	0.0000	0.3000	0.2000
160.	0.8000	1.1000	0.8000	0.7000	0.9000	1.0000	0.0000	0.0000	0.0000	0.3000	0.4000
170.	1.1000	1.3000	0.8000	0.7000	1.2000	1.4000	0.0000	0.0000	0.0000	0.4000	0.7000
180.	1.1000	1.5000	0.8000	0.7000	1.3000	1.6000	0.0000	0.0000	0.0000	0.6000	1.0000
190.	1.0000	1.6000	0.8000	0.7000	1.2000	1.5000	0.1000	0.0000	0.0000	0.7000	0.9000
200.	0.8000	1.8000	1.1000	0.7000	1.2000	1.5000	0.4000	0.3000	0.0000	0.5000	0.8000
210.	0.7000	2.0000	1.2000	0.9000	1.3000	1.5000	0.6000	0.4000	0.1000	0.5000	0.7000
220.	0.7000	2.1000	1.2000	1.1000	1.3000	1.4000	0.4000	0.5000	0.3000	0.5000	0.6000
230.	0.5000	2.1000	1.4000	1.2000	1.5000	1.4000	0.6000	0.5000	0.4000	0.5000	0.5000
240.	0.5000	2.3000	1.6000	1.3000	1.3000	1.3000	0.6000	0.5000	0.4000	0.5000	0.6000
250.	0.5000	2.4000	2.1000	1.4000	1.3000	1.1000	0.5000	0.6000	0.4000	0.6000	0.7000
260.	0.5000	2.2000	2.1000	1.8000	1.0000	0.9000	1.0000	1.1000	0.7000	0.7000	0.8000
270.	0.5000	1.6000	1.6000	1.4000	0.8000	0.7000	1.7000	1.7000	1.4000	1.0000	1.0000
280.	0.5000	0.8000	1.0000	1.1000	0.7000	0.6000	1.9000	2.1000	1.6000	1.2000	1.1000
290.	0.5000	0.6000	0.7000	0.5000	0.6000	0.6000	2.0000	2.1000	1.6000	1.1000	1.3000
300.	0.7000	0.5000	0.4000	0.4000	0.6000	0.6000	2.0000	1.8000	1.4000	1.0000	1.3000
310.	0.7000	0.4000	0.4000	0.3000	0.6000	0.7000	2.1000	1.8000	1.3000	1.1000	1.3000
320.	0.8000	0.3000	0.4000	0.1000	0.6000	0.8000	1.9000	1.4000	1.0000	1.1000	1.4000
330.	1.1000	0.2000	0.1000	0.1000	0.5000	0.9000	1.6000	1.2000	0.8000	1.1000	1.4000
340.	1.1000	0.1000	0.0000	0.1000	0.4000	0.8000	1.5000	0.9000	0.8000	1.0000	1.5000
350.	0.8000	0.1000	0.0000	0.1000	0.1000	0.5000	1.4000	0.8000	0.8000	0.7000	1.1000
360.	0.5000	0.0000	0.0000	0.1000	0.0000	0.1000	1.3000	0.9000	0.8000	0.6000	0.7000
MAX	1.1000	2.4000	2.1000	1.8000	1.6000	1.6000	2.1000	2.1000	1.6000	1.3000	1.5000
DEGR.	170	250	260	260	110	100	310	280	280	50	340

THE HIGHEST CONCENTRATION OF 2.4000 UG/M**3 OCCURRED AT RECEPTOR 17.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

PAGE 1

JOB: Bow Concord RUN: Exit 14 NB Ft Eddy 2035 Build AM pm10

DATE : 3/ 2/18
TIME : 10:15:47

The MODE flag has been set for calculating concentrations for POLLUTANT: PM-10

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 108. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 UG/M**3

LINK VARIABLES

LINK DESCRIPTION	*	X1	Y1	X2	Y2	*	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	*	-20.0	0.0	80.0	470.0	*	481.	12.	AG	273.	0.0	0.0	56.0		
2. N Leg App - Queue	*	-2.9	80.5	7.3	128.2	*	49.	12.	AG	0.	100.0	0.0	56.0	0.38	2.5
3. N Leg Dep - FreeFlow	*	30.0	0.0	120.0	460.0	*	469.	11.	AG	379.	0.1	0.0	44.0		
4. S Leg App - FreeFlow	*	30.0	0.0	-70.0	-450.0	*	461.	193.	AG	1112.	0.1	0.0	72.0		
5. S Leg App - FF #2	*	-70.0	-450.0	-70.0	-820.0	*	370.	180.	AG	1112.	0.1	0.0	51.0		
6. E Leg App - FreeFlow	*	0.0	20.0	980.0	10.0	*	980.	91.	AG	803.	0.1	0.0	56.0		
7. E Leg App - Queue	*	73.7	19.2	183.2	18.1	*	109.	91.	AG	0.	100.0	0.0	56.0	0.49	5.6
8. E Leg Dep - FreeFlow	*	0.0	-10.0	980.0	-40.0	*	980.	92.	AG	1304.	0.1	0.0	47.0		
9. W Leg App - FreeFlow	*	0.0	-10.0	-430.0	-110.0	*	441.	257.	AG	673.	0.1	0.0	68.0		
10. W Leg App - Queue	*	0.0	-10.0	-67.1	-25.6	*	69.	257.	AG	0.	100.0	0.0	68.0	0.31	3.5
11. W Leg Dep - FreeFlow	*	-10.0	40.0	-440.0	-50.0	*	439.	258.	AG	1177.	0.1	0.0	78.0		
12. N Leg App - FF #2	*	80.0	470.0	0.0	980.0	*	516.	351.	AG	273.	0.0	0.0	40.0		
13. N Leg Dep - FF #2	*	120.0	460.0	30.0	990.0	*	538.	350.	AG	379.	0.1	0.0	52.0		
14. S Leg App - FF #3	*	-70.0	-820.0	-40.0	-970.0	*	153.	169.	AG	1112.	0.1	0.0	36.0		
15. I93 NB N Leg - FF	*	-270.0	-40.0	-420.0	940.0	*	991.	351.	BR	3863.	0.0	22.0	80.0		
16. I 93 NB S Leg - FF	*	-270.0	-40.0	-60.0	-1030.0	*	1012.	168.	BR	3863.	0.0	22.0	80.0		
17. I 93 SB N Leg - FF	*	-350.0	-50.0	-500.0	940.0	*	1001.	351.	BR	3304.	0.0	22.0	95.0		
18. I 93 SB S Leg - FF	*	-350.0	-50.0	-120.0	-1040.0	*	1016.	167.	BR	3304.	0.0	22.0	95.0		

DATE : 3/ 2/18
TIME : 10:15:47

2. N Leg App - Queue	*	120	98	2.0	273	1600	0.05	2	3
7. E Leg App - Queue	*	120	75	2.0	803	1600	0.05	2	3
10. W Leg App - Queue	*	120	75	2.0	673	1600	0.05	2	3

RECEPTOR LOCATIONS

RECEPTOR	*	X (COORDINATES (FT))	Y	Z	*
1. N Leg, E Side-Corner	*	80.0	60.0	5.9	*
2. N Leg, E Side - 25 m	*	80.0	140.0	5.9	*
3. N Leg, E Side - 50 m	*	100.0	230.0	5.9	*
4. N Leg, E Side-Midblk	*	130.0	500.0	5.9	*
5. N Leg, W Side-Corner	*	-50.0	60.0	5.9	*
6. N Leg, W Side - 25 m	*	-20.0	170.0	5.9	*
7. N Leg, W Side - 50 m	*	0.0	250.0	5.9	*
8. N Leg, W Side-Midblk	*	40.0	500.0	5.9	*
9. S Leg, E Side-Corner	*	60.0	-50.0	5.9	*
10. S Leg, E Side - 25 m	*	30.0	-180.0	5.9	*
11. S Leg, E Side - 50 m	*	10.0	-240.0	5.9	*
12. S Leg, E Side-Midblk	*	-40.0	-510.0	5.9	*
13. S Leg, W Side-Corner	*	-30.0	-60.0	5.9	*
14. S Leg, W Side - 25 m	*	-50.0	-160.0	5.9	*
15. S Leg, W Side - 50 m	*	-70.0	-240.0	5.9	*
16. S Leg, W Side-Midblk	*	-110.0	-490.0	5.9	*
17. E Leg, N Side - 25 m	*	170.0	50.0	5.9	*
18. E Leg, N Side - 50 m	*	250.0	40.0	5.9	*
19. E Leg, N Side-Midblk	*	490.0	30.0	5.9	*
20. W Leg, N Side - 25 m	*	-130.0	50.0	5.9	*
21. W Leg, N Side - 50 m	*	-210.0	40.0	5.9	*
22. E Leg, S Side - 25 m	*	170.0	-40.0	5.9	*
23. E Leg, S Side - 50 m	*	250.0	-40.0	5.9	*
24. E Leg, S Side-Midblk	*	490.0	-50.0	5.9	*
25. W Leg, S Side - 25 m	*	-110.0	-80.0	5.9	*
26. W Leg, S Side - 50 m	*	-190.0	-90.0	5.9	*

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	1.0000	2.0000	1.6000	0.9000	0.8000	0.5000	0.7000	1.0000	5.9000	5.2000	6.5000	4.7000	5.1000	4.3000	3.7000
20.	0.4000	1.0000	0.8000	0.5000	1.2000	0.8000	0.8000	1.0000	4.9000	3.5000	4.5000	2.7000	6.0000	5.5000	5.2000
30.	0.1000	0.4000	0.3000	0.3000	1.5000	0.8000	0.8000	1.0000	4.6000	2.5000	2.9000	1.4000	6.6000	6.2000	6.0000
40.	0.0000	0.2000	0.1000	0.2000	1.8000	0.9000	0.9000	0.9000	4.8000	2.2000	2.3000	1.1000	6.9000	6.1000	5.8000
50.	0.0000	0.1000	0.1000	0.2000	2.0000	0.9000	0.9000	0.9000	5.0000	2.1000	2.0000	1.0000	7.6000	6.0000	5.5000
60.	0.0000	0.1000	0.1000	0.2000	2.5000	0.9000	0.9000	0.8000	5.4000	2.2000	2.1000	0.7000	8.1000	5.9000	5.3000
70.	0.1000	0.1000	0.0000	0.1000	3.0000	0.8000	0.8000	0.8000	5.8000	2.0000	1.8000	0.3000	8.2000	5.5000	4.8000
80.	0.9000	0.1000	0.0000	0.1000	3.9000	0.8000	0.8000	0.8000	5.6000	1.4000	0.9000	0.0000	7.8000	4.8000	4.0000
90.	2.7000	0.6000	0.2000	0.1000	5.7000	1.2000	1.0000	0.8000	3.8000	0.5000	0.4000	0.0000	6.2000	3.9000	3.5000
100.	4.8000	1.6000	0.6000	0.1000	7.4000	2.1000	1.4000	0.8000	1.6000	0.1000	0.0000	0.0000	4.5000	3.6000	3.4000
110.	5.6000	2.2000	1.2000	0.4000	7.8000	2.7000	2.0000	1.0000	0.3000	0.0000	0.0000	0.0000	3.5000	3.4000	3.3000
120.	5.1000	2.3000	1.5000	0.6000	7.7000	3.1000	2.3000	1.3000	0.0000	0.0000	0.2000	0.1000	3.1000	3.2000	3.1000
130.	4.9000	2.3000	1.5000	1.0000	7.5000	3.1000	2.3000	1.7000	0.1000	0.1000	0.3000	0.2000	3.3000	3.3000	3.3000
140.	4.6000	2.4000	1.6000	1.2000	7.1000	3.4000	2.3000	1.7000	0.2000	0.2000	0.4000	0.2000	3.6000	3.7000	3.6000
150.	4.2000	2.3000	1.6000	1.5000	6.8000	3.5000	2.4000	1.6000	0.3000	0.3000	0.5000	0.3000	3.9000	4.0000	3.9000
160.	4.1000	2.4000	1.6000	1.8000	7.2000	4.1000	2.7000	1.8000	0.3000	0.3000	0.6000	0.7000	4.4000	4.5000	4.6000
170.	4.4000	2.9000	2.0000	2.5000	7.8000	4.9000	3.6000	2.2000	0.6000	0.8000	1.4000	2.4000	5.4000	5.7000	5.8000
180.	5.7000	4.5000	3.5000	3.9000	7.9000	5.7000	4.8000	2.9000	2.1000	2.4000	3.5000	5.2000	6.2000	6.6000	6.5000
190.	7.7000	6.7000	5.3000	5.3000	7.3000	5.3000	4.5000	2.9000	4.8000	5.0000	6.4000	7.7000	5.3000	5.7000	5.2000
200.	8.8000	7.3000	6.2000	5.1000	6.3000	4.0000	3.4000	2.1000	6.9000	6.8000	7.8000	7.9000	3.2000	3.5000	3.3000
210.	8.8000	6.7000	5.5000	4.2000	5.9000	3.3000	2.8000	1.9000	6.8000	7.0000	7.4000	7.2000	2.0000	2.3000	2.2000
220.	8.0000	5.7000	4.9000	3.3000	6.6000	3.3000	2.8000	1.5000	5.9000	6.1000	6.8000	6.4000	1.7000	1.7000	1.8000
230.	7.3000	5.5000	4.3000	2.6000	7.1000	3.3000	2.4000	1.1000	5.4000	5.6000	6.1000	5.9000	1.6000	1.6000	1.7000
240.	7.4000	5.4000	3.7000	2.3000	7.5000	2.5000	1.7000	1.0000	5.0000	5.2000	5.4000	5.5000	1.5000	1.6000	1.6000
250.	7.3000	4.7000	2.9000	2.1000	7.5000	1.8000	1.3000	0.9000	5.2000	4.8000	5.1000	5.2000	1.9000	1.5000	1.6000
260.	6.3000	3.3000	2.2000	2.1000	6.3000	1.4000	1.1000	0.9000	6.1000	4.5000	4.7000	5.3000	3.3000	1.5000	1.5000
270.	4.6000	2.6000	2.1000	2.1000	4.2000	1.2000	1.1000	0.9000	7.5000	4.8000	4.8000	5.6000	4.6000	1.7000	1.6000
280.	3.2000	2.4000	2.2000	2.1000	2.8000	1.1000	1.1000	0.9000	8.6000	5.7000	5.2000	5.4000	5.3000	2.5000	1.7000
290.	2.9000	2.3000	2.2000	2.2000	2.3000	1.2000	1.1000	1.0000	9.3000	6.1000	5.7000	5.2000	5.3000	3.0000	2.2000
300.	2.7000	2.2000	2.1000	2.1000	2.1000	1.2000	1.2000	0.9000	9.4000	6.1000	6.0000	5.7000	5.3000	3.3000	2.8000
310.	2.5000	2.3000	2.2000	1.9000	2.1000	1.3000	1.2000	0.6000	9.3000	6.4000	6.3000	6.6000	5.3000	3.4000	3.4000
320.	2.4000	2.4000	2.1000	2.0000	1.9000	1.2000	1.0000	0.3000	9.1000	6.8000	6.8000	7.4000	5.5000	3.5000	3.3000

330.	*	2.0000	2.1000	1.9000	2.2000	1.7000	0.9000	0.6000	0.0000	8.3000	7.0000	7.1000	8.0000	5.3000	3.5000	3.3000
340.	*	1.6000	2.0000	1.8000	2.5000	1.0000	0.3000	0.1000	0.1000	7.3000	6.8000	7.3000	7.8000	4.7000	3.2000	2.9000
350.	*	1.7000	2.2000	2.4000	2.4000	0.3000	0.1000	0.1000	0.4000	6.8000	6.9000	7.3000	7.1000	4.7000	2.6000	2.3000
360.	*	1.6000	2.5000	2.5000	1.7000	0.2000	0.2000	0.5000	0.8000	6.7000	6.6000	7.5000	6.5000	4.5000	3.1000	2.3000
MAX	*	8.8000	7.3000	6.2000	5.3000	7.9000	5.7000	4.8000	2.9000	9.4000	7.0000	7.8000	8.0000	8.2000	6.6000	6.5000
DEGR.	*	200	200	200	190	180	180	180	190	300	210	200	330	70	180	180

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26
10.	4.8000	0.1000	0.0000	0.3000	0.4000	0.3000	4.8000	4.5000	4.3000	3.3000	3.4000
20.	6.2000	0.0000	0.1000	0.3000	0.6000	0.4000	4.5000	4.5000	4.3000	4.0000	3.7000
30.	6.2000	0.1000	0.2000	0.4000	0.8000	0.6000	4.7000	4.6000	4.5000	4.2000	3.9000
40.	5.4000	0.1000	0.3000	0.5000	1.1000	0.6000	4.9000	5.1000	4.8000	4.4000	4.3000
50.	5.1000	0.1000	0.3000	0.6000	1.2000	0.8000	5.5000	5.6000	5.3000	4.7000	4.6000
60.	4.7000	0.2000	0.5000	0.9000	1.7000	1.1000	6.1000	6.3000	5.9000	5.1000	4.9000
70.	4.0000	0.4000	1.0000	1.6000	2.8000	2.1000	6.9000	7.2000	6.5000	5.9000	5.2000
80.	3.4000	1.4000	2.5000	3.1000	4.7000	4.5000	7.6000	7.8000	6.8000	5.4000	5.1000
90.	3.3000	3.5000	4.8000	5.0000	6.8000	7.0000	6.1000	6.6000	5.4000	4.0000	3.6000
100.	3.2000	5.4000	6.2000	6.1000	8.5000	7.7000	3.3000	3.7000	2.7000	2.6000	2.0000
110.	3.2000	5.8000	6.3000	6.2000	8.3000	7.0000	1.2000	1.5000	1.0000	1.9000	1.5000
120.	3.4000	5.2000	5.5000	5.6000	7.2000	5.9000	0.5000	0.7000	0.4000	1.8000	1.4000
130.	3.7000	4.7000	4.9000	4.8000	6.4000	5.4000	0.3000	0.4000	0.3000	1.8000	1.4000
140.	4.0000	4.5000	4.5000	4.4000	5.8000	4.9000	0.3000	0.4000	0.3000	1.8000	1.5000
150.	4.5000	4.2000	4.2000	4.1000	5.6000	5.0000	0.2000	0.3000	0.2000	2.1000	1.6000
160.	5.3000	4.1000	4.0000	4.0000	5.7000	5.6000	0.1000	0.1000	0.1000	2.3000	2.4000
170.	5.8000	4.3000	4.0000	3.8000	6.4000	6.9000	0.0000	0.0000	0.0000	3.0000	3.4000
180.	5.1000	4.8000	4.0000	3.8000	6.5000	7.1000	0.3000	0.0000	0.0000	3.3000	3.6000
190.	4.0000	5.6000	4.6000	3.8000	6.1000	6.7000	0.9000	0.4000	0.0000	2.9000	3.3000
200.	3.0000	6.5000	5.3000	4.4000	6.0000	6.6000	1.9000	1.2000	0.2000	2.1000	2.9000
210.	2.4000	7.4000	6.2000	4.7000	6.2000	6.5000	2.7000	2.1000	0.7000	1.9000	2.5000
220.	2.1000	7.7000	6.6000	5.6000	6.6000	6.6000	2.9000	2.4000	1.4000	1.7000	2.3000
230.	2.0000	8.2000	7.3000	6.2000	7.0000	6.8000	2.9000	2.6000	1.6000	1.7000	2.1000
240.	1.8000	8.4000	7.6000	6.9000	7.1000	6.5000	3.0000	2.5000	1.8000	1.8000	2.2000
250.	1.7000	8.4000	8.6000	7.7000	6.6000	5.5000	3.4000	3.0000	2.0000	2.1000	2.5000
260.	1.7000	7.8000	8.6000	8.4000	5.4000	4.1000	5.2000	5.2000	3.8000	3.0000	3.5000
270.	1.7000	5.6000	7.0000	7.2000	3.5000	2.9000	7.4000	7.8000	6.8000	4.2000	4.4000
280.	1.9000	3.2000	4.1000	4.9000	2.5000	2.3000	9.1000	9.5000	8.4000	5.1000	5.2000
290.	2.1000	2.2000	2.5000	2.8000	2.2000	2.2000	9.1000	9.3000	8.3000	5.1000	5.5000
300.	2.3000	1.8000	1.7000	1.8000	2.2000	2.4000	8.4000	8.4000	7.0000	5.0000	5.8000
310.	2.7000	1.7000	1.5000	1.4000	2.3000	2.6000	7.9000	7.5000	6.2000	5.1000	5.8000
320.	3.4000	1.5000	1.1000	0.9000	2.3000	2.9000	7.2000	6.4000	5.5000	5.1000	6.1000
330.	4.1000	1.0000	0.8000	0.6000	2.1000	3.2000	6.4000	5.6000	4.9000	5.2000	6.2000
340.	4.1000	0.8000	0.5000	0.4000	1.3000	2.8000	5.7000	4.9000	4.4000	4.5000	6.2000
350.	3.4000	0.7000	0.4000	0.3000	0.5000	1.7000	5.4000	4.7000	4.2000	3.7000	5.1000
360.	3.2000	0.4000	0.1000	0.4000	0.3000	0.6000	5.5000	4.7000	4.5000	3.2000	3.8000
MAX	6.2000	8.4000	8.6000	8.4000	8.5000	7.7000	9.1000	9.5000	8.4000	5.9000	6.2000
DEGR.	20	250	250	260	100	100	280	280	280	70	330

THE HIGHEST CONCENTRATION OF 9.5000 UG/M**3 OCCURRED AT RECEPTOR 23.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

PAGE 1

JOB: Bow Concord RUN: Exit 14 NB Ft Eddy 2035 Build PM CO

DATE : 3/ 2/18
TIME : 11:29: 1

The MODE flag has been set for calculating concentrations for POLLUTANT: CO

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 108. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	-20.0	0.0	80.0	470.0	481.	12.	AG	812.	1.3	0.0	56.0		
2. N Leg App - Queue	-2.9	80.5	21.7	196.1	118.	12.	AG	9.	100.0	0.0	56.0	0.56	6.0
3. N Leg Dep - FreeFlow	30.0	0.0	120.0	460.0	469.	11.	AG	1036.	0.8	0.0	44.0		
4. S Leg App - FreeFlow	30.0	0.0	-70.0	-450.0	461.	193.	AG	847.	0.7	0.0	72.0		
5. S Leg App - FF #2	-70.0	-450.0	-70.0	-820.0	370.	180.	AG	847.	0.7	0.0	51.0		
6. E Leg App - FreeFlow	0.0	20.0	980.0	10.0	980.	91.	AG	1397.	1.0	0.0	56.0		
7. E Leg App - Queue	73.7	19.2	1967.2	-0.1	1894.	91.	AG	11.	100.0	0.0	56.0	1.52	96.2
8. E Leg Dep - FreeFlow	0.0	-10.0	980.0	-40.0	980.	92.	AG	1573.	1.0	0.0	47.0		
9. W Leg App - FreeFlow	0.0	-10.0	-430.0	-110.0	441.	257.	AG	1266.	1.3	0.0	68.0		
10. W Leg App - Queue	0.0	-10.0	-122.9	-38.6	126.	257.	AG	11.	100.0	0.0	68.0	0.55	6.4
11. W Leg Dep - FreeFlow	-10.0	40.0	-440.0	-50.0	439.	258.	AG	1713.	1.0	0.0	78.0		
12. N Leg App - FF #2	80.0	470.0	0.0	980.0	516.	351.	AG	812.	1.3	0.0	40.0		
13. N Leg Dep - FF #2	120.0	460.0	30.0	990.0	538.	350.	AG	1036.	0.8	0.0	52.0		
14. S Leg App - FF #3	-70.0	-820.0	-40.0	-970.0	153.	169.	AG	847.	0.7	0.0	36.0		
15. I93 NB N Leg - FF	-270.0	-40.0	-420.0	940.0	991.	351.	BR	4380.	0.8	22.0	80.0		
16. I 93 NB S Leg - FF	-270.0	-40.0	-60.0	-1030.0	1012.	168.	BR	4380.	0.8	22.0	80.0		
17. I 93 SB N Leg - FF	-350.0	-50.0	-500.0	940.0	1001.	351.	BR	4000.	0.8	22.0	95.0		
18. I 93 SB S Leg - FF	-350.0	-50.0	-120.0	-1040.0	1016.	167.	BR	4000.	0.8	22.0	95.0		

JOB: Bow Concord RUN: Exit 14 NB Ft Eddy 2035 Build PM CO

DATE : 3/ 2/18
TIME : 11:29: 1

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
2. N Leg App - Queue	120	80	2.0	812	1600	1.75	2	3
7. E Leg App - Queue	120	93	2.0	1397	1600	1.75	2	3
10. W Leg App - Queue	120	73	2.0	1266	1600	1.75	2	3

RECEPTOR LOCATIONS

RECEPTOR	X	Y	Z
1. N Leg, E Side-Corner	80.0	60.0	5.9
2. N Leg, E Side - 25 m	80.0	140.0	5.9
3. N Leg, E Side - 50 m	100.0	230.0	5.9
4. N Leg, E Side-Midblk	130.0	500.0	5.9
5. N Leg, W Side-Corner	-50.0	60.0	5.9
6. N Leg, W Side - 25 m	-20.0	170.0	5.9
7. N Leg, W Side - 50 m	0.0	250.0	5.9
8. N Leg, W Side-Midblk	40.0	500.0	5.9
9. S Leg, E Side-Corner	60.0	-50.0	5.9
10. S Leg, E Side - 25 m	30.0	-180.0	5.9
11. S Leg, E Side - 50 m	10.0	-240.0	5.9
12. S Leg, E Side-Midblk	-40.0	-510.0	5.9
13. S Leg, W Side-Corner	-30.0	-60.0	5.9
14. S Leg, W Side - 25 m	-50.0	-160.0	5.9
15. S Leg, W Side - 50 m	-70.0	-240.0	5.9
16. S Leg, W Side-Midblk	-110.0	-490.0	5.9
17. E Leg, N Side - 25 m	170.0	50.0	5.9
18. E Leg, N Side - 50 m	250.0	40.0	5.9
19. E Leg, N Side-Midblk	490.0	30.0	5.9
20. W Leg, N Side - 25 m	-130.0	50.0	5.9
21. W Leg, N Side - 50 m	-210.0	40.0	5.9
22. E Leg, S Side - 25 m	170.0	-40.0	5.9
23. E Leg, S Side - 50 m	250.0	-40.0	5.9
24. E Leg, S Side-Midblk	490.0	-50.0	5.9
25. W Leg, S Side - 25 m	-110.0	-80.0	5.9
26. W Leg, S Side - 50 m	-190.0	-90.0	5.9

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
70.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
80.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
100.	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
110.	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
120.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
130.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
140.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
150.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
160.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
170.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
180.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
190.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
200.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
210.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
220.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000
280.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000
290.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000
300.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000
310.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
320.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

330. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
340. *	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
350. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
360. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
MAX *	0.1000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000
DEGR. *	100	10	10	340	200	10	10	10	60	10	10	10	270	10	10

JOB: Bow Concord RUN: Exit 14 NB Ft Eddy 2035 Build PM
CO

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	*	CONCENTRATION (PPM) 16	17	18	19	20	21	22	23	24	25	26
10.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
20.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000
30.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000
40.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000
50.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.1000
60.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.1000
70.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.1000
80.	*	0.0000	0.0000	0.0000	0.2000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000
90.	*	0.0000	0.1000	0.2000	0.2000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000
100.	*	0.0000	0.2000	0.2000	0.2000	0.1000	0.1000	0.0000	0.1000	0.0000	0.0000	0.0000
110.	*	0.0000	0.2000	0.2000	0.2000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
120.	*	0.0000	0.1000	0.2000	0.2000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
130.	*	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
140.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
150.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
160.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
170.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000
180.	*	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000
190.	*	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000
200.	*	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000
210.	*	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000
220.	*	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
230.	*	0.0000	0.0000	0.1000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
240.	*	0.0000	0.1000	0.1000	0.2000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
250.	*	0.0000	0.1000	0.2000	0.2000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
260.	*	0.0000	0.0000	0.2000	0.2000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000
270.	*	0.0000	0.0000	0.1000	0.2000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000
280.	*	0.0000	0.0000	0.0000	0.2000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000
290.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000
300.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000
310.	*	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.1000
320.	*	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.1000
330.	*	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.1000	0.0000	0.0000	0.1000
340.	*	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000
350.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2000
360.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000
MAX	*	0.1000	0.2000	0.2000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.2000
DEGR.	*	180	100	90	80	100	90	40	40	40	40	350

THE HIGHEST CONCENTRATION OF 0.2000 PPM OCCURRED AT RECEPTOR 19.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

PAGE 1

JOB: Bow Concord RUN: Exit 14 NB Ft Eddy 2035 Build PM pm2.5

DATE : 3/ 2/18
TIME : 11:50:29

The MODE flag has been set for calculating concentrations for POLLUTANT: PM2.5

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 108. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 UG/M**3

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	-20.0	0.0	80.0	470.0	481.	12.	AG	812.	0.0	0.0	56.0		
2. N Leg App - Queue	-2.9	80.5	21.7	196.1	118.	12.	AG	0.	100.0	0.0	56.0	0.56	6.0
3. N Leg Dep - FreeFlow	30.0	0.0	120.0	460.0	469.	11.	AG	1036.	0.0	0.0	44.0		
4. S Leg App - FreeFlow	30.0	0.0	-70.0	-450.0	461.	193.	AG	847.	0.0	0.0	72.0		
5. S Leg App - FF #2	-70.0	-450.0	-70.0	-820.0	370.	180.	AG	847.	0.0	0.0	51.0		
6. E Leg App - FreeFlow	0.0	20.0	980.0	10.0	980.	91.	AG	1397.	0.0	0.0	56.0		
7. E Leg App - Queue	73.7	19.2	1967.2	-0.1	1894.	91.	AG	0.	100.0	0.0	56.0	1.52	96.2
8. E Leg Dep - FreeFlow	0.0	-10.0	980.0	-40.0	980.	92.	AG	1573.	0.0	0.0	47.0		
9. W Leg App - FreeFlow	0.0	-10.0	-430.0	-110.0	441.	257.	AG	1266.	0.0	0.0	68.0		
10. W Leg App - Queue	0.0	-10.0	-122.9	-38.6	126.	257.	AG	0.	100.0	0.0	68.0	0.55	6.4
11. W Leg Dep - FreeFlow	-10.0	40.0	-440.0	-50.0	439.	258.	AG	1713.	0.0	0.0	78.0		
12. N Leg App - FF #2	80.0	470.0	0.0	980.0	516.	351.	AG	812.	0.0	0.0	40.0		
13. N Leg Dep - FF #2	120.0	460.0	30.0	990.0	538.	350.	AG	1036.	0.0	0.0	52.0		
14. S Leg App - FF #3	-70.0	-820.0	-40.0	-970.0	153.	169.	AG	847.	0.0	0.0	36.0		
15. I93 NB N Leg - FF	-270.0	-40.0	-420.0	940.0	991.	351.	BR	4380.	0.0	22.0	80.0		
16. I 93 NB S Leg - FF	-270.0	-40.0	-60.0	-1030.0	1012.	168.	BR	4380.	0.0	22.0	80.0		
17. I 93 SB N Leg - FF	-350.0	-50.0	-500.0	940.0	1001.	351.	BR	4000.	0.0	22.0	95.0		
18. I 93 SB S Leg - FF	-350.0	-50.0	-120.0	-1040.0	1016.	167.	BR	4000.	0.0	22.0	95.0		

DATE : 3/ 2/18
TIME : 11:50:29

2. N Leg App - Queue	*	120	80	2.0	812	1600	0.04	2
3								
7. E Leg App - Queue	*	120	93	2.0	1397	1600	0.04	2
3								
10. W Leg App - Queue	*	120	73	2.0	1266	1600	0.04	2
3								

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (FT) X	Y	Z	*
1. N Leg, E Side-Corner	*	80.0	60.0	5.9	*
2. N Leg, E Side - 25 m	*	80.0	140.0	5.9	*
3. N Leg, E Side - 50 m	*	100.0	230.0	5.9	*
4. N Leg, E Side-Midblk	*	130.0	500.0	5.9	*
5. N Leg, W Side-Corner	*	-50.0	60.0	5.9	*
6. N Leg, W Side - 25 m	*	-20.0	170.0	5.9	*
7. N Leg, W Side - 50 m	*	0.0	250.0	5.9	*
8. N Leg, W Side-Midblk	*	40.0	500.0	5.9	*
9. S Leg, E Side-Corner	*	60.0	-50.0	5.9	*
10. S Leg, E Side - 25 m	*	30.0	-180.0	5.9	*
11. S Leg, E Side - 50 m	*	10.0	-240.0	5.9	*
12. S Leg, E Side-Midblk	*	-40.0	-510.0	5.9	*
13. S Leg, W Side-Corner	*	-30.0	-60.0	5.9	*
14. S Leg, W Side - 25 m	*	-50.0	-160.0	5.9	*
15. S Leg, W Side - 50 m	*	-70.0	-240.0	5.9	*
16. S Leg, W Side-Midblk	*	-110.0	-490.0	5.9	*
17. E Leg, N Side - 25 m	*	170.0	50.0	5.9	*
18. E Leg, N Side - 50 m	*	250.0	40.0	5.9	*
19. E Leg, N Side-Midblk	*	490.0	30.0	5.9	*
20. W Leg, N Side - 25 m	*	-130.0	50.0	5.9	*
21. W Leg, N Side - 50 m	*	-210.0	40.0	5.9	*
22. E Leg, S Side - 25 m	*	170.0	-40.0	5.9	*
23. E Leg, S Side - 50 m	*	250.0	-40.0	5.9	*
24. E Leg, S Side-Midblk	*	490.0	-50.0	5.9	*
25. W Leg, S Side - 25 m	*	-110.0	-80.0	5.9	*
26. W Leg, S Side - 50 m	*	-190.0	-90.0	5.9	*

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR) * CONCENTRATION (UG/M**3)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	0.4000	0.8000	0.6000	0.4000	0.6000	0.2000	0.4000	0.5000	1.6000	1.2000	1.2000	0.8000	2.2000	1.5000	1.0000
20.	0.1000	0.4000	0.3000	0.2000	0.7000	0.5000	0.5000	0.5000	1.4000	0.9000	0.8000	0.5000	2.3000	1.3000	1.3000
30.	0.0000	0.2000	0.1000	0.1000	0.9000	0.7000	0.5000	0.5000	1.4000	0.7000	0.8000	0.3000	2.1000	1.3000	0.9000
40.	0.0000	0.1000	0.1000	0.1000	1.1000	0.8000	0.5000	0.5000	1.5000	0.7000	0.7000	0.3000	1.9000	1.1000	1.1000
50.	0.0000	0.1000	0.0000	0.1000	1.1000	0.8000	0.5000	0.5000	1.6000	0.7000	0.7000	0.3000	2.0000	1.2000	1.0000
60.	0.0000	0.0000	0.0000	0.1000	1.2000	0.9000	0.5000	0.4000	1.7000	0.8000	0.7000	0.3000	2.0000	1.2000	1.0000
70.	0.1000	0.0000	0.0000	0.1000	1.2000	1.0000	0.5000	0.4000	2.0000	0.7000	0.5000	0.1000	2.0000	1.2000	0.9000
80.	0.6000	0.1000	0.0000	0.1000	1.4000	1.1000	0.5000	0.4000	1.9000	0.6000	0.4000	0.1000	1.9000	1.0000	0.7000
90.	1.5000	0.4000	0.1000	0.0000	2.0000	1.4000	0.6000	0.4000	1.4000	0.2000	0.1000	0.0000	1.4000	0.8000	0.4000
100.	2.2000	0.8000	0.4000	0.1000	2.6000	1.6000	0.9000	0.4000	0.6000	0.0000	0.0000	0.0000	0.8000	0.4000	0.4000
110.	2.4000	1.1000	0.6000	0.2000	2.3000	2.0000	1.1000	0.5000	0.1000	0.0000	0.0000	0.0000	0.4000	0.4000	0.4000
120.	2.1000	1.0000	0.7000	0.3000	2.0000	1.9000	1.2000	0.8000	0.0000	0.0000	0.0000	0.0000	0.3000	0.3000	0.3000
130.	1.8000	1.0000	0.7000	0.4000	1.8000	1.7000	1.1000	0.8000	0.0000	0.0000	0.0000	0.0000	0.4000	0.4000	0.4000
140.	1.7000	0.9000	0.6000	0.5000	1.5000	1.7000	1.2000	0.7000	0.0000	0.0000	0.0000	0.0000	0.4000	0.4000	0.4000
150.	1.6000	0.9000	0.6000	0.5000	1.6000	1.6000	1.3000	0.7000	0.0000	0.0000	0.1000	0.0000	0.4000	0.4000	0.4000
160.	1.5000	0.9000	0.6000	0.7000	1.8000	1.6000	1.3000	0.8000	0.0000	0.0000	0.1000	0.1000	0.5000	0.5000	0.4000
170.	1.5000	0.9000	0.7000	0.9000	1.9000	1.6000	1.2000	0.8000	0.1000	0.1000	0.1000	0.3000	0.5000	0.7000	0.6000
180.	1.6000	1.1000	0.9000	1.2000	2.0000	1.7000	1.6000	0.9000	0.2000	0.3000	0.4000	0.8000	0.8000	0.9000	0.9000
190.	1.8000	1.5000	1.3000	1.7000	2.0000	1.4000	1.3000	0.9000	0.6000	0.7000	0.8000	1.1000	0.8000	0.9000	0.8000
200.	1.9000	1.9000	1.8000	2.0000	2.0000	1.2000	1.1000	0.4000	0.9000	1.0000	1.0000	1.2000	0.7000	0.6000	0.6000
210.	2.1000	2.0000	1.9000	1.5000	1.9000	1.0000	0.8000	0.5000	1.0000	1.0000	1.1000	1.1000	0.4000	0.6000	0.5000
220.	2.0000	2.0000	1.8000	1.4000	2.0000	0.9000	0.6000	0.3000	0.8000	0.9000	1.0000	1.0000	0.4000	0.5000	0.5000
230.	2.2000	1.8000	1.9000	1.0000	1.9000	0.8000	0.6000	0.3000	0.8000	0.9000	0.9000	1.0000	0.4000	0.4000	0.5000
240.	2.4000	2.0000	1.6000	0.9000	1.7000	0.8000	0.4000	0.3000	0.7000	0.8000	0.9000	0.9000	0.5000	0.4000	0.5000
250.	2.3000	1.7000	1.1000	0.8000	1.8000	0.4000	0.3000	0.3000	0.9000	0.8000	0.8000	0.9000	0.7000	0.4000	0.5000
260.	1.8000	1.5000	1.0000	0.8000	1.4000	0.4000	0.3000	0.3000	1.2000	0.8000	0.8000	0.9000	1.2000	0.4000	0.5000
270.	1.4000	1.3000	0.9000	0.8000	1.0000	0.4000	0.3000	0.3000	2.0000	0.9000	0.8000	0.9000	1.9000	0.5000	0.5000
280.	1.1000	1.3000	0.8000	0.8000	0.7000	0.3000	0.3000	0.3000	2.0000	0.9000	0.9000	0.9000	2.0000	0.7000	0.5000
290.	1.1000	1.3000	0.9000	0.8000	0.6000	0.4000	0.4000	0.3000	2.1000	1.2000	0.9000	0.9000	2.2000	0.9000	0.7000
300.	1.1000	1.3000	0.9000	0.8000	0.5000	0.4000	0.4000	0.2000	2.2000	1.2000	1.3000	0.9000	2.0000	0.8000	0.7000
310.	1.2000	1.2000	0.9000	0.8000	0.5000	0.4000	0.4000	0.2000	2.2000	1.3000	1.3000	0.9000	2.0000	1.0000	0.9000
320.	1.2000	1.2000	0.8000	0.8000	0.6000	0.3000	0.3000	0.1000	2.1000	1.4000	1.3000	1.4000	2.1000	1.0000	0.9000

330.	*	1.1000	0.9000	0.8000	1.0000	0.4000	0.3000	0.2000	0.0000	2.0000	1.5000	1.3000	1.5000	1.9000	1.1000	0.9000
340.	*	0.8000	0.8000	0.9000	1.1000	0.3000	0.1000	0.0000	0.0000	1.7000	1.2000	1.3000	1.4000	1.9000	1.0000	1.0000
350.	*	0.9000	1.0000	1.1000	1.1000	0.0000	0.0000	0.0000	0.2000	1.8000	1.3000	1.3000	1.1000	1.8000	0.8000	0.8000
360.	*	0.7000	1.1000	1.1000	0.7000	0.1000	0.1000	0.3000	0.5000	2.0000	1.3000	1.5000	0.9000	1.9000	1.1000	0.7000
MAX	*	2.4000	2.0000	1.9000	2.0000	2.6000	2.0000	1.6000	0.9000	2.2000	1.5000	1.5000	1.5000	2.3000	1.5000	1.3000
DEGR.	*	110	210	210	200	100	110	180	180	310	330	360	330	20	10	20

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

JOB: Bow Concord RUN: Exit 14 NB Ft Eddy 2035 Build PM pm10

DATE : 3/ 2/18
TIME : 11:56:48

The MODE flag has been set for calculating concentrations for POLLUTANT: PM-10

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 175. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 UG/M**3

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	-20.0	0.0	80.0	470.0	481.	12.	AG	812.	0.0	0.0	56.0		
2. N Leg App - Queue	-2.9	80.5	21.7	196.1	118.	12.	AG	0.	100.0	0.0	56.0	0.56	6.0
3. N Leg Dep - FreeFlow	30.0	0.0	120.0	460.0	469.	11.	AG	1036.	0.1	0.0	44.0		
4. S Leg App - FreeFlow	30.0	0.0	-70.0	-450.0	461.	193.	AG	847.	0.1	0.0	72.0		
5. S Leg App - FF #2	-70.0	-450.0	-70.0	-820.0	370.	180.	AG	847.	0.1	0.0	51.0		
6. E Leg App - FreeFlow	0.0	20.0	980.0	10.0	980.	91.	AG	1397.	0.1	0.0	56.0		
7. E Leg App - Queue	73.7	19.2	1967.2	-0.1	1894.	91.	AG	0.	100.0	0.0	56.0	1.52	96.2
8. E Leg Dep - FreeFlow	0.0	-10.0	980.0	-40.0	980.	92.	AG	1573.	0.1	0.0	47.0		
9. W Leg App - FreeFlow	0.0	-10.0	-430.0	-110.0	441.	257.	AG	1266.	0.1	0.0	68.0		
10. W Leg App - Queue	0.0	-10.0	-122.9	-38.6	126.	257.	AG	0.	100.0	0.0	68.0	0.55	6.4
11. W Leg Dep - FreeFlow	-10.0	40.0	-440.0	-50.0	439.	258.	AG	1713.	0.1	0.0	78.0		
12. N Leg App - FF #2	80.0	470.0	0.0	980.0	516.	351.	AG	812.	0.0	0.0	40.0		
13. N Leg Dep - FF #2	120.0	460.0	30.0	990.0	538.	350.	AG	1036.	0.1	0.0	52.0		
14. S Leg App - FF #3	-70.0	-820.0	-40.0	-970.0	153.	169.	AG	847.	0.1	0.0	36.0		
15. I93 NB N Leg - FF	-270.0	-40.0	-420.0	940.0	991.	351.	BR	4380.	0.0	22.0	80.0		
16. I 93 NB S Leg - FF	-270.0	-40.0	-60.0	-1030.0	1012.	168.	BR	4380.	0.0	22.0	80.0		
17. I 93 SB N Leg - FF	-350.0	-50.0	-500.0	940.0	1001.	351.	BR	4000.	0.0	22.0	95.0		
18. I 93 SB S Leg - FF	-350.0	-50.0	-120.0	-1040.0	1016.	167.	BR	4000.	0.0	22.0	95.0		

DATE : 3/ 2/18
TIME : 11:56:48

2. N Leg App - Queue	*	120	80	2.0	812	1600	0.04	2
3								
7. E Leg App - Queue	*	120	93	2.0	1397	1600	0.04	2
3								
10. W Leg App - Queue	*	120	73	2.0	1266	1600	0.04	2
3								

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (FT) X	Y	Z	*
1. N Leg, E Side-Corner	*	80.0	60.0	5.9	*
2. N Leg, E Side - 25 m	*	80.0	140.0	5.9	*
3. N Leg, E Side - 50 m	*	100.0	230.0	5.9	*
4. N Leg, E Side-Midblk	*	130.0	500.0	5.9	*
5. N Leg, W Side-Corner	*	-50.0	60.0	5.9	*
6. N Leg, W Side - 25 m	*	-20.0	170.0	5.9	*
7. N Leg, W Side - 50 m	*	0.0	250.0	5.9	*
8. N Leg, W Side-Midblk	*	40.0	500.0	5.9	*
9. S Leg, E Side-Corner	*	60.0	-50.0	5.9	*
10. S Leg, E Side - 25 m	*	30.0	-180.0	5.9	*
11. S Leg, E Side - 50 m	*	10.0	-240.0	5.9	*
12. S Leg, E Side-Midblk	*	-40.0	-510.0	5.9	*
13. S Leg, W Side-Corner	*	-30.0	-60.0	5.9	*
14. S Leg, W Side - 25 m	*	-50.0	-160.0	5.9	*
15. S Leg, W Side - 50 m	*	-70.0	-240.0	5.9	*
16. S Leg, W Side-Midblk	*	-110.0	-490.0	5.9	*
17. E Leg, N Side - 25 m	*	170.0	50.0	5.9	*
18. E Leg, N Side - 50 m	*	250.0	40.0	5.9	*
19. E Leg, N Side-Midblk	*	490.0	30.0	5.9	*
20. W Leg, N Side - 25 m	*	-130.0	50.0	5.9	*
21. W Leg, N Side - 50 m	*	-210.0	40.0	5.9	*
22. E Leg, S Side - 25 m	*	170.0	-40.0	5.9	*
23. E Leg, S Side - 50 m	*	250.0	-40.0	5.9	*
24. E Leg, S Side-Midblk	*	490.0	-50.0	5.9	*
25. W Leg, S Side - 25 m	*	-110.0	-80.0	5.9	*
26. W Leg, S Side - 50 m	*	-190.0	-90.0	5.9	*

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	2.700	5.100	4.300	2.400	2.000	1.500	1.800	2.600	8.600	6.100	6.500	4.600	8.000	5.700	4.900
20.	1.100	2.800	2.100	1.300	2.700	2.300	2.200	2.700	6.700	4.100	4.600	2.900	8.600	6.300	5.600
30.	0.200	1.200	0.900	0.800	3.000	2.600	2.500	2.500	5.900	3.100	3.200	1.800	8.800	6.500	5.700
40.	0.000	0.500	0.400	0.600	3.400	2.700	2.500	2.400	6.000	2.800	2.600	1.500	8.400	5.800	5.100
50.	0.000	0.400	0.200	0.500	3.500	2.700	2.400	2.200	6.400	2.900	2.500	1.300	8.600	5.700	5.000
60.	0.100	0.300	0.200	0.400	4.100	2.700	2.200	2.200	7.000	2.900	2.600	1.100	9.000	5.700	4.900
70.	0.400	0.200	0.100	0.300	4.900	2.600	2.100	2.200	7.500	2.700	2.300	0.500	9.300	5.500	4.500
80.	1.800	0.400	0.000	0.300	6.500	2.600	2.000	2.100	7.400	2.000	1.400	0.200	8.600	4.600	3.400
90.	4.600	1.200	0.300	0.200	9.100	3.600	2.300	2.100	5.300	0.700	0.500	0.000	6.500	3.400	2.700
100.	7.300	2.500	1.000	0.400	11.000	4.800	3.100	2.200	2.300	0.100	0.000	0.000	4.100	2.700	2.400
110.	7.900	3.500	1.900	0.700	11.500	5.500	3.900	2.600	0.500	0.000	0.000	0.000	2.600	2.400	2.300
120.	7.100	3.700	2.300	1.300	10.500	5.700	4.200	3.000	0.100	0.000	0.100	0.100	2.200	2.300	2.200
130.	6.500	3.500	2.400	1.900	9.600	5.600	4.500	3.300	0.100	0.100	0.200	0.100	2.300	2.400	2.300
140.	6.000	3.400	2.500	2.300	8.700	5.400	4.200	3.400	0.200	0.200	0.300	0.200	2.500	2.600	2.500
150.	5.700	3.400	2.300	2.700	8.300	5.500	4.700	3.200	0.200	0.200	0.400	0.200	2.800	2.800	2.800
160.	5.500	3.400	2.400	3.800	8.300	5.500	4.700	3.400	0.200	0.300	0.500	0.700	3.100	3.200	3.300
170.	5.600	4.000	2.800	5.200	8.600	5.700	5.500	3.800	0.600	0.600	1.200	1.900	4.000	4.100	4.200
180.	6.600	5.700	4.600	7.300	9.100	6.600	5.500	4.100	1.700	2.000	2.800	4.100	4.600	4.900	5.000
190.	8.300	8.300	7.000	9.300	9.000	6.100	5.500	3.800	3.700	4.000	4.700	5.900	4.400	4.500	4.400
200.	9.400	9.500	8.600	9.600	8.600	5.000	4.400	2.900	5.100	5.200	5.900	6.200	3.000	3.300	3.100
210.	10.100	9.900	9.000	8.400	8.500	4.500	3.900	2.200	5.300	5.300	5.800	5.700	2.100	2.300	2.500
220.	10.200	9.400	8.400	6.400	9.200	4.600	3.300	1.900	4.700	4.900	5.300	5.200	1.800	1.900	1.900
230.	10.600	9.400	7.800	5.200	9.900	4.300	3.000	1.400	4.300	4.500	4.800	4.900	1.700	1.700	1.900
240.	11.200	9.100	6.900	4.300	10.200	3.300	2.100	1.100	4.100	4.100	4.400	4.600	2.000	1.700	1.800
250.	11.300	7.700	5.400	4.000	9.700	2.200	1.400	1.100	4.700	3.900	4.100	4.400	2.900	1.700	1.700
260.	10.000	6.000	4.600	4.100	8.200	1.500	1.200	1.100	6.300	3.800	3.900	4.400	4.900	1.700	1.600
270.	7.600	5.200	4.300	4.000	5.700	1.300	1.200	1.100	8.400	4.200	4.000	4.600	6.800	2.200	1.800
280.	5.700	5.100	4.400	4.100	3.600	1.200	1.100	1.100	9.600	5.200	4.600	4.500	7.700	3.100	2.000
290.	4.600	4.800	4.400	4.300	2.700	1.300	1.300	1.100	9.900	5.900	5.200	4.400	7.800	3.900	2.700
300.	4.300	4.800	4.300	4.300	2.500	1.400	1.300	0.900	10.200	6.200	5.700	4.800	7.800	4.300	3.400
310.	4.500	4.800	4.300	4.700	2.400	1.400	1.300	0.700	10.400	6.400	6.200	5.600	7.500	4.400	4.000
320.	4.500	4.900	4.300	5.100	2.200	1.300	1.100	0.300	10.100	6.600	6.500	6.700	7.500	4.800	4.300

330. *	4.200	4.800	4.400	5.700	1.900	0.900	0.600	0.100	9.900	6.700	6.700	7.000	7.100	4.700	4.200
340. *	4.100	5.000	4.900	6.400	1.100	0.400	0.200	0.300	9.400	6.800	6.800	6.900	6.600	4.300	3.800
350. *	4.300	5.800	5.800	6.000	0.700	0.400	0.400	1.100	9.800	6.900	6.800	6.300	6.400	3.800	3.300
360. *	4.000	6.200	5.900	4.300	0.900	0.800	1.000	2.000	9.700	7.100	7.000	5.900	6.900	4.500	3.400
MAX *	11.300	9.900	9.000	9.600	11.500	6.600	5.500	4.100	10.400	7.100	7.000	7.000	9.300	6.500	5.700
DEGR. *	250	210	210	200	110	180	180	180	310	360	360	330	70	30	30

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR) *	CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26
10. *	4.700	0.300	0.200	0.800	0.800	0.400	6.700	6.500	6.200	6.300	5.400
20. *	5.300	0.000	0.300	0.700	1.400	0.900	6.200	6.300	6.100	7.100	6.000
30. *	4.900	0.100	0.500	0.800	1.900	1.200	6.500	6.600	6.300	7.600	6.700
40. *	4.500	0.200	0.600	1.000	2.100	1.200	7.100	7.200	6.800	7.400	7.200
50. *	4.300	0.300	0.800	1.300	2.200	1.600	7.600	7.900	7.400	7.400	7.400
60. *	3.900	0.400	1.100	2.000	3.000	2.000	8.500	8.800	8.200	7.300	7.600
70. *	3.200	1.000	2.300	3.600	4.400	3.400	9.400	9.700	8.800	7.500	7.700
80. *	2.600	2.900	4.900	6.400	6.900	6.500	9.800	10.200	8.800	6.700	6.900
90. *	2.400	6.300	8.700	9.300	9.800	9.400	8.000	8.500	6.800	4.600	4.300
100. *	2.300	8.900	10.500	10.600	11.400	10.600	4.200	4.700	3.600	2.400	2.200
110. *	2.300	9.100	10.300	10.300	10.800	9.100	1.500	1.900	1.400	1.500	1.300
120. *	2.500	8.100	9.000	9.100	9.300	7.700	0.600	0.800	0.600	1.400	1.100
130. *	2.600	7.200	8.200	7.800	8.000	6.800	0.400	0.500	0.400	1.300	1.100
140. *	2.800	6.700	7.200	6.900	7.200	6.300	0.300	0.400	0.300	1.300	1.100
150. *	3.300	6.100	6.600	6.500	7.000	6.200	0.200	0.300	0.200	1.500	1.100
160. *	3.900	5.800	6.400	6.200	7.500	7.100	0.100	0.200	0.100	1.600	2.100
170. *	4.600	5.900	6.400	6.000	8.000	8.500	0.000	0.000	0.000	2.400	3.100
180. *	4.700	6.400	6.300	6.000	8.300	8.700	0.200	0.000	0.000	2.900	3.800
190. *	3.900	6.900	6.900	6.000	8.100	8.500	0.900	0.400	0.000	2.700	3.600
200. *	3.200	7.700	7.700	6.400	8.100	8.500	1.700	1.200	0.100	2.300	3.200
210. *	2.600	8.400	8.300	7.000	8.200	8.500	2.400	1.900	0.700	2.200	2.800
220. *	2.300	9.000	9.000	7.800	8.800	8.600	2.700	2.100	1.400	2.000	2.600
230. *	2.200	9.600	9.700	8.800	9.200	8.700	2.500	2.300	1.400	1.900	2.600
240. *	2.100	10.500	11.000	10.300	9.400	8.200	2.600	2.400	1.700	2.000	2.700
250. *	1.900	11.400	11.900	11.500	8.700	7.100	3.500	3.400	2.400	2.800	3.500
260. *	1.900	10.800	12.300	12.700	6.800	5.200	5.800	5.900	4.600	4.200	4.900
270. *	1.900	8.200	10.600	12.000	4.500	3.500	8.800	9.100	8.100	5.800	6.300
280. *	2.100	5.000	7.100	8.500	3.100	2.800	10.800	11.400	10.700	6.800	7.500
290. *	2.200	3.400	4.200	5.200	2.600	2.600	11.000	11.800	10.900	7.200	7.900
300. *	2.500	3.100	3.100	3.500	2.500	2.800	10.900	10.800	9.800	7.200	8.000
310. *	3.000	2.900	2.700	2.500	2.600	2.900	10.100	10.000	8.900	7.000	7.700
320. *	3.800	2.600	2.200	2.100	2.600	3.200	9.500	9.000	7.800	7.000	8.000
330. *	4.800	2.000	2.100	1.500	2.300	3.400	8.700	8.100	7.100	6.900	8.100
340. *	4.600	1.900	1.700	1.100	1.600	3.000	7.900	7.600	6.400	6.700	8.100
350. *	3.700	1.700	1.100	0.900	0.700	1.800	7.800	7.400	6.200	5.900	7.100
360. *	3.700	1.100	0.400	0.900	0.400	0.800	7.600	7.000	6.400	5.500	5.600
MAX *	5.300	11.400	12.300	12.700	11.400	10.600	11.000	11.800	10.900	7.600	8.100
DEGR. *	20	250	260	260	100	100	290	290	290	30	330

THE HIGHEST CONCENTRATION OF 12.700 UG/M**3 OCCURRED AT RECEPTOR 19.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

JOB: Bow Concord RUN: Exit 14 SB 2035 Build AM co

DATE : 3/ 1/18
TIME : 11:32:45

The MODE flag has been set for calculating concentrations for POLLUTANT: CO

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 175. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	0.0	0.0	-110.0	990.0	996.	354.	AG	267.	0.7	0.0	43.7		
2. N Leg App - Queue	-7.1	63.9	-110.8	996.9	939.	354.	AG	9.	100.0	0.0	24.0	2.51	47.7
3. S Leg Dep - FreeFlow	0.0	0.0	250.0	-970.0	1002.	166.	AG	831.	0.8	0.0	43.7		
4. E Leg App - FreeFlow	0.0	30.0	440.0	100.0	446.	81.	AG	1706.	1.1	0.0	67.7		
5. E Leg App - Queue	25.5	34.1	94.5	45.1	70.	81.	AG	5.	100.0	0.0	48.0	0.37	3.5
6. E Leg Dep - FreeFlow	10.0	-30.0	450.0	60.0	449.	78.	AG	1279.	1.1	0.0	55.7		
7. W Leg App - FreeFlow	10.0	-30.0	-900.0	-160.0	919.	262.	AG	1428.	0.7	0.0	55.7		
8. W Leg App - Queue	-7.7	-32.5	-162.2	-54.6	156.	262.	AG	7.	100.0	0.0	36.0	0.64	7.9
9. W Leg Dep - FreeFlow	0.0	30.0	-900.0	-130.0	914.	260.	AG	1291.	1.5	0.0	67.7		
10. I93 NB N Leg - FF	170.0	30.0	20.0	1010.0	991.	351.	BR	4380.	0.8	22.0	62.0		
11. I93 NB S Leg - FF	170.0	30.0	380.0	-940.0	992.	168.	BR	4380.	0.8	22.0	62.0		
12. I93 SB N Leg - FF	90.0	20.0	-70.0	1010.0	1003.	351.	BR	4000.	0.8	22.0	62.0		
13. I93 SB S Leg - FF	90.0	20.0	310.0	-970.0	1014.	167.	BR	4000.	0.8	22.0	62.0		

JOB: Bow Concord RUN: Exit 14 SB 2035 Build AM co

DATE : 3/ 1/18
TIME : 11:32:45

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	*	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
2. N Leg App - Queue	*	120	112	2.0	267	1600	1.74	2	3
5. E Leg App - Queue	*	120	30	2.0	1706	1600	1.74	2	3
8. W Leg App - Queue	*	120	60	2.0	1428	1600	1.74	2	3

RECEPTOR LOCATIONS

RECEPTOR	*	X (FT)	Y (FT)	Z (FT)	*
1. N Leg, E Side-Corner	*	20.0	60.0	5.9	*
2. N Leg, E Side - 25 m	*	0.0	160.0	5.9	*
3. N Leg, E Side - 50 m	*	-10.0	240.0	5.9	*
4. N Leg, E Side-Midblk	*	-40.0	500.0	5.9	*
5. N Leg, W Side-Corner	*	-40.0	50.0	5.9	*
6. N Leg, W Side - 25 m	*	-50.0	150.0	5.9	*
7. N Leg, W Side - 50 m	*	-60.0	230.0	5.9	*
8. N Leg, W Side-Midblk	*	-90.0	490.0	5.9	*
9. S Leg, E Side-Corner	*	50.0	-60.0	5.9	*
10. S Leg, E Side - 25 m	*	60.0	-140.0	5.9	*
11. S Leg, E Side - 50 m	*	80.0	-220.0	5.9	*
12. S Leg, E Side-Midblk	*	140.0	-480.0	5.9	*
13. S Leg, W Side-Corner	*	-20.0	-70.0	5.9	*
14. S Leg, W Side - 25 m	*	10.0	-150.0	5.9	*
15. S Leg, W Side - 50 m	*	30.0	-240.0	5.9	*
16. S Leg, W Side-Midblk	*	90.0	-500.0	5.9	*
17. E Leg, N Side - 25 m	*	130.0	90.0	5.9	*
18. E Leg, N Side - 50 m	*	230.0	100.0	5.9	*
19. E Leg, N Side-Midblk	*	339.7	115.6	5.9	*
20. W Leg, N Side - 25 m	*	-120.0	50.0	5.9	*
21. W Leg, N Side - 50 m	*	-240.0	10.0	5.9	*
22. W Leg, N Side-Midblk	*	-460.0	-30.0	5.9	*
23. E Leg, S Side - 25 m	*	160.0	-40.0	5.9	*
24. E Leg, S Side - 50 m	*	260.0	-20.0	5.9	*
25. E Leg, S Side-Midblk	*	359.2	7.3	5.9	*
26. W Leg, S Side - 25 m	*	-120.0	-100.0	5.9	*
27. W Leg, S Side - 50 m	*	-210.0	-100.0	5.9	*
28. W Leg, S Side-Midblk	*	-440.0	-120.0	5.9	*

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (PPM) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000
20.	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000
30.	0.1000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
70.	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
80.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
100.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
110.	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
120.	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
130.	0.1000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
140.	0.2000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
150.	0.2000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
160.	0.2000	0.1000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
170.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
180.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
190.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
200.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
210.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
220.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
280.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
290.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
300.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
310.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
320.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
330.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

340.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
350.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
360.	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.1000	0.0000	0.0000	0.0000
MAX	0.2000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
DEGR.	140	10	10	10	80	10	10	10	10	130	20	10	10	10	10

JOB: Bow Concord RUN: Exit 14 SB 2035 Build AM co

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
20.	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30.	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
70.	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000
80.	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90.	0.0000	0.1000	0.1000	0.1000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
100.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
110.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
120.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
130.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
140.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
150.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
160.	0.0000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
170.	0.0000	0.3000	0.1000	0.1000	0.1000	0.1000	0.1000	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000
180.	0.0000	0.2000	0.2000	0.1000	0.1000	0.1000	0.1000	0.2000	0.1000	0.0000	0.0000	0.0000	0.0000
190.	0.0000	0.1000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000
200.	0.0000	0.1000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000
210.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000
220.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250.	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260.	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270.	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000
280.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000
290.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000
300.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
310.	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
320.	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000
330.	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000

340. *	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.2000	0.1000	0.0000	0.0000	0.0000	0.0000
350. *	0.0000	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000
360. *	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
MAX *	0.0000	0.3000	0.2000	0.1000	0.1000	0.1000	0.1000	0.2000	0.1000	0.1000	0.0000	0.0000	0.1000
DEGR. *	10	170	180	90	100	70	70	170	180	270	10	10	70

THE HIGHEST CONCENTRATION OF 0.3000 PPM OCCURRED AT RECEPTOR 17.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

```
                         CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045
PAGE  1

      JOB: Bow Concord                                        RUN: Exit 14 SB 2035 Build AM pm2.5

      DATE :  3/ 1/18
      TIME : 11:36:24

         The MODE flag has been set for calculating concentrations for POLLUTANT:  PM2.5

       SITE & METEOROLOGICAL VARIABLES
       -------------------------------
       VS =   0.0 CM/S      VD =   0.0 CM/S      Z0 = 175. CM
        U =  1.0 M/S        CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =  1000. M   AMB =  0.0
UG/M**3

       LINK VARIABLES
       --------------
         LINK DESCRIPTION     *         LINK COORDINATES (FT)         *    LENGTH  BRG TYPE   VPH
EF      H   W    V/C QUEUE
                              *   X1        Y1        X2        Y2     *     (FT)  (DEG)
(G/MI)  (FT) (FT)       (VEH)
      ------------------------*----------------------------------------*-------------------------------
--------------------------
       1. N Leg App - FreeFlow*      0.0       0.0    -110.0     990.0 *     996.   354. AG    267.
0.0   0.0 43.7
       2. N Leg App - Queue   *     -7.1      63.9    -110.8     996.9 *     939.   354. AG      0.
100.0   0.0 24.0 2.51  47.7
       3. S Leg Dep - FreeFlow*      0.0       0.0     250.0    -970.0 *    1002.   166. AG    831.
0.0   0.0 43.7
       4. E Leg App - FreeFlow*      0.0      30.0     440.0     100.0 *     446.    81. AG   1706.
0.0   0.0 67.7
       5. E Leg App - Queue   *     25.5      34.1      94.5      45.1 *      70.    81. AG      0.
100.0   0.0 48.0 0.37   3.5
       6. E Leg Dep - FreeFlow*     10.0     -30.0     450.0      60.0 *     449.    78. AG   1279.
0.0   0.0 55.7
       7. W Leg App - FreeFlow*     10.0     -30.0    -900.0    -160.0 *     919.   262. AG   1428.
0.0   0.0 55.7
       8. W Leg App - Queue   *     -7.7     -32.5    -162.2     -54.6 *     156.   262. AG      0.
100.0   0.0 36.0 0.64   7.9
       9. W Leg Dep - FreeFlow*      0.0      30.0    -900.0    -130.0 *     914.   260. AG   1291.
0.0   0.0 67.7
      10. I93 NB N Leg - FF   *    170.0      30.0      20.0    1010.0 *     991.   351. BR   4380.
0.0  22.0 62.0
      11. I93 NB S Leg - FF   *    170.0      30.0     380.0    -940.0 *     992.   168. BR   4380.
0.0  22.0 62.0
      12. I93 SB N Leg - FF   *     90.0      20.0     -70.0    1010.0 *    1003.   351. BR   4000.
0.0  22.0 62.0
      13. I93 SB S Leg - FF   *     90.0      20.0     310.0    -970.0 *    1014.   167. BR   4000.
0.0  22.0 62.0
```

JOB: Bow Concord RUN: Exit 14 SB 2035 Build AM pm2.5

DATE : 3/ 1/18
TIME : 11:36:24

2. N Leg App - Queue	*	120	112	2.0	267	1600	0.04	2
3								
5. E Leg App - Queue	*	120	30	2.0	1706	1600	0.04	2
3								
8. W Leg App - Queue	*	120	60	2.0	1428	1600	0.04	2
3								

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. N Leg, E Side-Corner	20.0	60.0	5.9
2. N Leg, E Side - 25 m	0.0	160.0	5.9
3. N Leg, E Side - 50 m	-10.0	240.0	5.9
4. N Leg, E Side-Midblk	-40.0	500.0	5.9
5. N Leg, W Side-Corner	-40.0	50.0	5.9
6. N Leg, W Side - 25 m	-50.0	150.0	5.9
7. N Leg, W Side - 50 m	-60.0	230.0	5.9
8. N Leg, W Side-Midblk	-90.0	490.0	5.9
9. S Leg, E Side-Corner	50.0	-60.0	5.9
10. S Leg, E Side - 25 m	60.0	-140.0	5.9
11. S Leg, E Side - 50 m	80.0	-220.0	5.9
12. S Leg, E Side-Midblk	140.0	-480.0	5.9
13. S Leg, W Side-Corner	-20.0	-70.0	5.9
14. S Leg, W Side - 25 m	10.0	-150.0	5.9
15. S Leg, W Side - 50 m	30.0	-240.0	5.9
16. S Leg, W Side-Midblk	90.0	-500.0	5.9
17. E Leg, N Side - 25 m	130.0	90.0	5.9
18. E Leg, N Side - 50 m	230.0	100.0	5.9
19. E Leg, N Side-Midblk	339.7	115.6	5.9
20. W Leg, N Side - 25 m	-120.0	50.0	5.9
21. W Leg, N Side - 50 m	-240.0	10.0	5.9
22. W Leg, N Side-Midblk	-460.0	-30.0	5.9
23. E Leg, S Side - 25 m	160.0	-40.0	5.9
24. E Leg, S Side - 50 m	260.0	-20.0	5.9
25. E Leg, S Side-Midblk	359.2	7.3	5.9
26. W Leg, S Side - 25 m	-120.0	-100.0	5.9
27. W Leg, S Side - 50 m	-210.0	-100.0	5.9
28. W Leg, S Side-Midblk	-440.0	-120.0	5.9

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	1.4000	1.5000	1.5000	1.4000	1.7000	1.7000	1.7000	1.5000	2.3000	2.0000	1.7000	1.5000	2.8000	2.1000	1.7000
20.	1.1000	1.2000	1.2000	1.2000	1.7000	1.6000	1.6000	1.6000	2.1000	1.7000	1.5000	1.2000	2.6000	2.0000	1.8000
30.	1.0000	0.9000	0.9000	0.9000	1.5000	1.6000	1.5000	1.5000	2.0000	1.5000	1.3000	1.2000	2.3000	1.9000	1.7000
40.	0.9000	0.8000	0.8000	0.8000	1.4000	1.4000	1.4000	1.4000	1.8000	1.3000	1.1000	0.9000	2.4000	1.7000	1.5000
50.	0.9000	0.7000	0.7000	0.7000	1.3000	1.3000	1.3000	1.2000	1.8000	1.2000	0.9000	0.7000	2.4000	1.6000	1.2000
60.	1.0000	0.6000	0.6000	0.6000	1.4000	1.3000	1.2000	1.2000	1.8000	1.0000	0.7000	0.6000	2.2000	1.4000	1.2000
70.	1.4000	0.6000	0.6000	0.6000	1.8000	1.3000	1.2000	1.2000	1.6000	0.8000	0.6000	0.6000	2.0000	1.2000	1.0000
80.	2.0000	0.6000	0.6000	0.6000	2.1000	1.3000	1.2000	1.2000	1.1000	0.6000	0.6000	0.6000	1.4000	1.0000	1.0000
90.	2.4000	0.7000	0.6000	0.6000	2.5000	1.4000	1.2000	1.2000	0.8000	0.6000	0.6000	0.6000	1.1000	1.0000	1.0000
100.	2.8000	1.0000	0.7000	0.6000	2.4000	1.7000	1.3000	1.2000	0.7000	0.6000	0.6000	0.6000	1.0000	1.0000	1.0000
110.	2.5000	1.2000	1.0000	0.7000	2.2000	1.9000	1.5000	1.2000	0.7000	0.7000	0.7000	0.8000	1.0000	1.0000	1.0000
120.	2.4000	1.3000	1.0000	0.8000	2.1000	2.1000	1.7000	1.3000	0.8000	0.8000	0.8000	0.9000	1.1000	1.2000	1.1000
130.	2.5000	1.5000	1.2000	1.0000	2.2000	2.2000	1.9000	1.6000	0.9000	0.9000	1.0000	1.0000	1.1000	1.2000	1.2000
140.	2.4000	1.7000	1.3000	1.2000	2.0000	2.0000	2.0000	1.8000	1.0000	1.1000	1.1000	1.2000	1.2000	1.4000	1.2000
150.	2.6000	1.9000	1.7000	1.7000	2.3000	2.1000	2.2000	2.0000	1.2000	1.3000	1.3000	1.3000	1.2000	1.4000	1.3000
160.	2.4000	1.9000	1.9000	2.1000	2.0000	1.8000	2.0000	2.0000	1.3000	1.4000	1.3000	1.4000	0.8000	1.0000	0.9000
170.	2.2000	2.1000	2.1000	2.4000	1.8000	1.3000	1.3000	1.4000	1.0000	1.1000	1.1000	1.1000	0.4000	0.5000	0.4000
180.	1.8000	1.8000	1.9000	2.2000	1.4000	0.7000	0.8000	0.7000	0.7000	0.8000	0.8000	0.9000	0.1000	0.2000	0.1000
190.	1.7000	1.8000	2.0000	1.8000	1.3000	0.6000	0.5000	0.3000	0.5000	0.6000	0.6000	0.7000	0.0000	0.0000	0.0000
200.	1.7000	1.7000	1.8000	1.6000	1.3000	0.7000	0.5000	0.2000	0.5000	0.6000	0.6000	0.6000	0.0000	0.0000	0.0000
210.	1.6000	1.8000	1.7000	1.4000	1.5000	0.7000	0.4000	0.2000	0.4000	0.5000	0.5000	0.5000	0.0000	0.0000	0.0000
220.	1.9000	1.8000	1.5000	1.3000	1.5000	0.6000	0.4000	0.2000	0.4000	0.4000	0.4000	0.5000	0.0000	0.0000	0.0000
230.	1.8000	1.6000	1.4000	1.2000	1.6000	0.6000	0.4000	0.2000	0.4000	0.4000	0.4000	0.4000	0.0000	0.0000	0.0000
240.	2.0000	1.5000	1.4000	1.0000	1.7000	0.6000	0.4000	0.0000	0.4000	0.4000	0.4000	0.4000	0.1000	0.0000	0.0000
250.	1.9000	1.3000	1.1000	0.9000	1.7000	0.4000	0.2000	0.0000	0.9000	0.4000	0.4000	0.4000	0.4000	0.0000	0.0000
260.	1.7000	1.2000	0.9000	0.9000	1.4000	0.2000	0.0000	0.0000	1.5000	0.6000	0.4000	0.4000	1.1000	0.2000	0.0000
270.	1.2000	0.9000	0.9000	0.9000	0.8000	0.0000	0.0000	0.0000	2.0000	0.9000	0.6000	0.4000	1.8000	0.4000	0.2000
280.	0.7000	0.9000	1.0000	0.9000	0.3000	0.0000	0.0000	0.0000	2.2000	1.1000	0.7000	0.4000	2.1000	0.6000	0.3000
290.	0.8000	1.0000	1.0000	1.0000	0.2000	0.0000	0.0000	0.0000	2.0000	1.2000	0.9000	0.7000	1.9000	0.8000	0.5000
300.	0.7000	1.0000	1.0000	1.1000	0.1000	0.0000	0.0000	0.0000	1.8000	1.3000	1.1000	0.7000	1.9000	0.7000	0.5000
310.	0.9000	1.1000	1.1000	1.2000	0.1000	0.0000	0.0000	0.0000	1.5000	1.3000	1.1000	0.8000	1.7000	0.8000	0.6000
320.	0.9000	1.2000	1.2000	1.3000	0.1000	0.0000	0.0000	0.0000	1.4000	1.3000	1.1000	0.9000	1.6000	0.8000	0.5000
330.	1.1000	1.4000	1.5000	1.5000	0.1000	0.0000	0.0000	0.0000	1.5000	1.4000	1.1000	1.0000	1.5000	0.8000	0.5000

```
 340.  *  1.2000  1.7000  1.7000  1.8000  0.1000  0.1000  0.1000  0.1000  1.8000  1.6000  1.7000
1.5000  1.6000  1.2000  0.8000
 350.  *  1.5000  1.9000  2.0000  1.9000  0.8000  0.7000  0.6000  0.5000  2.2000  2.1000  1.8000
1.9000  2.5000  1.7000  1.5000
 360.  *  1.4000  1.8000  1.7000  1.8000  1.4000  1.4000  1.3000  1.1000  2.4000  2.1000  1.8000
1.9000  2.7000  2.2000  1.9000
 -------*-------------------------------------------------------------------------------------------
-------------------------
 MAX   *  2.8000  2.1000  2.1000  2.4000  2.5000  2.2000  2.2000  2.0000  2.4000  2.1000  1.8000
1.9000  2.8000  2.2000  1.9000
 DEGR. *     100     170     170     170      90     130     150     160     360     350     350     350
10      360     360
```

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	1.6000	1.0000	0.0000	0.0000	0.9000	0.4000	0.1000	1.8000	0.9000	1.0000	2.2000	1.6000	1.2000
20.	1.4000	0.7000	0.1000	0.1000	0.9000	0.7000	0.4000	1.5000	0.9000	1.0000	2.1000	1.7000	1.5000
30.	1.3000	0.5000	0.1000	0.1000	1.0000	0.7000	0.4000	1.4000	1.0000	1.0000	2.3000	1.9000	1.6000
40.	1.0000	0.4000	0.1000	0.1000	0.9000	0.8000	0.5000	1.3000	1.0000	0.9000	2.0000	1.9000	1.8000
50.	0.9000	0.4000	0.1000	0.1000	0.9000	0.8000	0.5000	1.3000	1.0000	0.8000	2.2000	2.1000	1.9000
60.	0.9000	0.4000	0.2000	0.2000	0.9000	0.9000	0.7000	1.2000	0.8000	0.6000	2.0000	2.1000	2.2000
70.	0.9000	0.5000	0.4000	0.3000	1.0000	1.4000	1.3000	0.9000	0.5000	0.4000	1.6000	2.2000	2.3000
80.	0.9000	0.9000	0.7000	0.5000	1.5000	1.7000	1.8000	0.6000	0.2000	0.2000	1.0000	1.5000	2.0000
90.	0.9000	1.2000	1.0000	0.7000	1.9000	2.2000	2.0000	0.3000	0.1000	0.1000	0.6000	1.0000	1.5000
100.	0.9000	1.5000	1.2000	0.9000	1.8000	2.3000	2.1000	0.2000	0.0000	0.0000	0.5000	0.6000	0.7000
110.	1.0000	1.5000	1.3000	1.0000	1.6000	2.3000	1.8000	0.3000	0.0000	0.0000	0.6000	0.5000	0.5000
120.	1.1000	1.6000	1.2000	1.1000	1.8000	2.0000	1.7000	0.4000	0.0000	0.0000	0.7000	0.5000	0.4000
130.	1.1000	1.6000	1.1000	1.1000	2.0000	1.9000	1.6000	0.5000	0.0000	0.0000	0.7000	0.5000	0.4000
140.	1.2000	1.7000	1.0000	1.0000	2.0000	1.7000	1.4000	0.7000	0.0000	0.0000	0.7000	0.5000	0.3000
150.	1.1000	2.1000	1.0000	1.0000	1.8000	1.4000	1.1000	1.0000	0.0000	0.0000	0.5000	0.3000	0.0000
160.	0.7000	2.4000	1.2000	1.0000	1.7000	1.2000	1.1000	1.4000	0.2000	0.0000	0.2000	0.0000	0.0000
170.	0.3000	2.6000	1.8000	1.2000	1.5000	1.1000	1.1000	1.6000	0.5000	0.1000	0.0000	0.0000	0.0000
180.	0.1000	2.3000	2.1000	1.4000	1.1000	1.1000	1.1000	1.3000	1.0000	0.4000	0.0000	0.0000	0.0000
190.	0.0000	1.9000	2.2000	1.7000	1.1000	1.1000	1.1000	1.1000	1.1000	0.7000	0.0000	0.0000	0.0000
200.	0.0000	1.9000	2.1000	1.8000	1.1000	1.1000	1.1000	0.9000	1.1000	0.8000	0.0000	0.0000	0.1000
210.	0.0000	1.9000	2.0000	1.8000	1.1000	1.2000	1.2000	0.7000	0.9000	0.6000	0.0000	0.0000	0.1000
220.	0.0000	2.0000	2.0000	1.9000	1.1000	1.3000	1.4000	0.5000	0.8000	0.6000	0.0000	0.0000	0.1000
230.	0.0000	2.1000	2.2000	2.0000	1.3000	1.5000	1.5000	0.5000	0.8000	0.6000	0.0000	0.0000	0.2000
240.	0.0000	2.2000	2.4000	2.3000	1.4000	1.7000	1.7000	0.5000	0.8000	0.7000	0.0000	0.1000	0.3000
250.	0.0000	2.1000	2.5000	2.5000	1.3000	1.7000	1.6000	0.9000	1.2000	1.1000	0.2000	0.3000	0.7000
260.	0.0000	1.7000	2.3000	2.1000	0.8000	1.4000	1.4000	1.4000	1.7000	1.9000	0.5000	0.8000	1.3000
270.	0.0000	1.1000	1.6000	1.4000	0.4000	0.9000	0.9000	1.8000	1.9000	2.1000	1.0000	1.3000	1.8000
280.	0.0000	0.8000	1.0000	0.9000	0.1000	0.4000	0.4000	1.8000	2.2000	2.1000	1.3000	1.5000	1.9000
290.	0.2000	0.8000	1.0000	0.8000	0.0000	0.2000	0.2000	1.8000	2.0000	1.8000	1.2000	1.4000	1.7000
300.	0.2000	0.7000	1.0000	0.7000	0.0000	0.2000	0.2000	1.6000	1.9000	1.8000	1.1000	1.3000	1.6000
310.	0.2000	0.8000	1.1000	0.7000	0.0000	0.1000	0.1000	1.9000	2.0000	1.7000	1.2000	1.2000	1.3000
320.	0.2000	1.0000	1.3000	0.9000	0.0000	0.1000	0.1000	1.9000	2.1000	1.8000	1.1000	1.1000	1.2000
330.	0.3000	1.2000	1.3000	0.7000	0.0000	0.1000	0.1000	2.4000	2.1000	1.7000	1.2000	1.1000	1.2000

340.	*	0.6000	1.5000	1.1000	0.3000	0.0000	0.1000	0.1000	2.5000	1.9000	1.5000	1.3000	1.0000	1.2000
350.	*	1.1000	1.6000	0.6000	0.1000	0.2000	0.1000	0.1000	2.6000	1.4000	1.2000	1.4000	1.0000	1.2000
360.	*	1.6000	1.3000	0.2000	0.0000	0.5000	0.3000	0.1000	2.2000	1.0000	1.0000	1.8000	1.2000	1.2000
MAX	*	1.6000	2.6000	2.5000	2.5000	2.0000	2.3000	2.1000	2.6000	2.2000	2.1000	2.3000	2.2000	2.3000
DEGR.	*	360	170	250	250	130	100	100	350	280	270	30	70	70

THE HIGHEST CONCENTRATION OF 2.8000 UG/M**3 OCCURRED AT RECEPTOR 13.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

```
                    CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045
PAGE  1

      JOB: Bow Concord                                     RUN: Exit 14 SB 2035 Build AM pm10

      DATE :  3/ 1/18
      TIME : 11:40:30

         The MODE flag has been set for calculating concentrations for POLLUTANT:  PM-10

       SITE & METEOROLOGICAL VARIABLES
       -------------------------------
       VS =   0.0 CM/S       VD =   0.0 CM/S       Z0 = 175. CM
        U =  1.0 M/S         CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =  1000. M   AMB =  0.0
UG/M**3

       LINK VARIABLES
       --------------
         LINK DESCRIPTION     *         LINK COORDINATES (FT)          *    LENGTH  BRG TYPE   VPH
EF      H   W    V/C QUEUE
                              *   X1        Y1        X2        Y2     *     (FT)  (DEG)
(G/MI)  (FT) (FT)       (VEH)
      ------------------------*----------------------------------------*-------------------------------
--------------------------
       1. N Leg App - FreeFlow*      0.0       0.0    -110.0     990.0 *     996.   354. AG    267.
0.1   0.0 43.7
       2. N Leg App - Queue   *     -7.1      63.9    -110.8     996.9 *     939.   354. AG      0.
100.0   0.0 24.0 2.51  47.7
       3. S Leg Dep - FreeFlow*      0.0       0.0     250.0    -970.0 *    1002.   166. AG    831.
0.1   0.0 43.7
       4. E Leg App - FreeFlow*      0.0      30.0     440.0     100.0 *     446.    81. AG   1706.
0.1   0.0 67.7
       5. E Leg App - Queue   *     25.5      34.1      94.5      45.1 *      70.    81. AG      0.
100.0   0.0 48.0 0.37   3.5
       6. E Leg Dep - FreeFlow*     10.0     -30.0     450.0      60.0 *     449.    78. AG   1279.
0.1   0.0 55.7
       7. W Leg App - FreeFlow*     10.0     -30.0    -900.0    -160.0 *     919.   262. AG   1428.
0.1   0.0 55.7
       8. W Leg App - Queue   *     -7.7     -32.5    -162.2     -54.6 *     156.   262. AG      0.
100.0   0.0 36.0 0.64   7.9
       9. W Leg Dep - FreeFlow*      0.0      30.0    -900.0    -130.0 *     914.   260. AG   1291.
0.1   0.0 67.7
      10. I93 NB N Leg - FF   *    170.0      30.0      20.0    1010.0 *     991.   351. BR   4380.
0.0  22.0 62.0
      11. I93 NB S Leg - FF   *    170.0      30.0     380.0    -940.0 *     992.   168. BR   4380.
0.0  22.0 62.0
      12. I93 SB N Leg - FF   *     90.0      20.0     -70.0    1010.0 *    1003.   351. BR   4000.
0.0  22.0 62.0
      13. I93 SB S Leg - FF   *     90.0      20.0     310.0    -970.0 *    1014.   167. BR   4000.
0.0  22.0 62.0
```

DATE : 3/ 1/18
TIME : 11:40:30

2. N Leg App - Queue	*	120	112	2.0	267	1600	0.05	2
3								
5. E Leg App - Queue	*	120	30	2.0	1706	1600	0.05	2
3								
8. W Leg App - Queue	*	120	60	2.0	1428	1600	0.05	2
3								

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (FT) X	Y	Z	*
1. N Leg, E Side-Corner	*	20.0	60.0	5.9	*
2. N Leg, E Side - 25 m	*	0.0	160.0	5.9	*
3. N Leg, E Side - 50 m	*	-10.0	240.0	5.9	*
4. N Leg, E Side-Midblk	*	-40.0	500.0	5.9	*
5. N Leg, W Side-Corner	*	-40.0	50.0	5.9	*
6. N Leg, W Side - 25 m	*	-50.0	150.0	5.9	*
7. N Leg, W Side - 50 m	*	-60.0	230.0	5.9	*
8. N Leg, W Side-Midblk	*	-90.0	490.0	5.9	*
9. S Leg, E Side-Corner	*	50.0	-60.0	5.9	*
10. S Leg, E Side - 25 m	*	60.0	-140.0	5.9	*
11. S Leg, E Side - 50 m	*	80.0	-220.0	5.9	*
12. S Leg, E Side-Midblk	*	140.0	-480.0	5.9	*
13. S Leg, W Side-Corner	*	-20.0	-70.0	5.9	*
14. S Leg, W Side - 25 m	*	10.0	-150.0	5.9	*
15. S Leg, W Side - 50 m	*	30.0	-240.0	5.9	*
16. S Leg, W Side-Midblk	*	90.0	-500.0	5.9	*
17. E Leg, N Side - 25 m	*	130.0	90.0	5.9	*
18. E Leg, N Side - 50 m	*	230.0	100.0	5.9	*
19. E Leg, N Side-Midblk	*	339.7	115.6	5.9	*
20. W Leg, N Side - 25 m	*	-120.0	50.0	5.9	*
21. W Leg, N Side - 50 m	*	-240.0	10.0	5.9	*
22. W Leg, N Side-Midblk	*	-460.0	-30.0	5.9	*
23. E Leg, S Side - 25 m	*	160.0	-40.0	5.9	*
24. E Leg, S Side - 50 m	*	260.0	-20.0	5.9	*
25. E Leg, S Side-Midblk	*	359.2	7.3	5.9	*
26. W Leg, S Side - 25 m	*	-120.0	-100.0	5.9	*
27. W Leg, S Side - 50 m	*	-210.0	-100.0	5.9	*
28. W Leg, S Side-Midblk	*	-440.0	-120.0	5.9	*

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	5.300	5.300	5.300	5.400	5.300	5.100	5.000	4.400	10.100	8.100	7.300	7.200	12.500	9.900	8.900
20.	4.600	4.500	4.500	4.600	5.200	5.100	5.100	4.800	9.400	7.100	6.400	5.600	12.500	9.100	8.000
30.	4.300	3.800	3.800	3.900	4.800	4.700	4.600	4.700	9.000	6.600	5.800	4.600	12.100	8.500	7.500
40.	3.900	3.300	3.400	3.400	4.300	4.400	4.300	4.400	8.900	6.400	5.000	3.600	12.100	8.300	6.900
50.	3.900	2.900	2.900	3.100	4.500	4.000	4.000	4.100	9.000	5.700	4.200	3.100	11.800	7.700	6.000
60.	4.700	2.800	2.800	2.700	5.300	3.800	3.800	3.800	8.600	4.500	3.100	2.800	11.500	6.700	5.200
70.	6.700	2.600	2.600	2.600	7.200	3.800	3.800	3.800	7.400	3.500	2.700	2.700	10.500	5.700	4.800
80.	9.400	2.800	2.600	2.500	9.600	4.100	3.700	3.800	5.300	2.900	2.600	2.700	8.100	4.900	4.500
90.	11.000	3.500	2.700	2.500	11.100	4.800	4.100	3.800	3.600	2.600	2.600	2.800	5.800	4.600	4.500
100.	11.500	4.500	3.400	2.700	10.900	5.900	4.600	3.800	3.000	2.800	2.800	3.000	4.600	4.600	4.600
110.	11.100	5.600	4.200	3.000	10.300	6.800	5.400	4.100	3.000	3.100	3.200	3.400	4.600	5.000	4.900
120.	10.700	6.200	4.900	3.600	9.900	7.400	6.300	4.500	3.400	3.500	3.500	3.800	4.900	5.500	5.400
130.	10.200	6.600	5.700	4.400	10.000	7.600	6.800	5.500	3.800	3.900	3.900	4.300	5.400	5.900	5.700
140.	10.800	7.300	6.600	5.600	10.300	7.900	7.100	6.100	4.400	4.600	4.600	5.200	5.800	6.600	6.300
150.	11.300	8.200	7.500	6.900	10.600	8.400	7.900	6.900	5.100	5.600	5.600	6.000	5.800	6.800	6.200
160.	11.500	8.900	8.400	8.000	10.100	7.900	7.300	6.800	5.500	6.200	6.300	6.500	4.400	5.400	4.800
170.	10.600	8.300	7.800	8.000	8.100	5.800	5.400	4.800	4.900	6.000	5.800	6.200	2.200	2.900	2.400
180.	9.600	6.900	6.500	6.300	6.400	3.900	3.300	2.600	3.900	4.900	4.900	5.100	0.600	1.000	0.800
190.	8.800	6.000	5.600	4.900	5.700	3.100	2.300	1.500	3.100	3.900	3.900	4.200	0.100	0.300	0.200
200.	8.700	5.700	5.000	4.100	5.600	2.900	2.200	1.200	2.700	3.300	3.300	3.600	0.000	0.100	0.000
210.	8.700	5.300	4.800	3.800	5.900	3.000	2.200	1.200	2.500	2.900	2.900	2.900	0.100	0.100	0.000
220.	9.000	5.300	4.300	3.300	6.500	3.100	2.300	1.200	2.300	2.600	2.700	2.700	0.200	0.000	0.000
230.	9.200	5.100	4.300	2.900	7.000	3.200	2.200	0.800	2.200	2.400	2.400	2.500	0.300	0.000	0.000
240.	9.700	4.800	3.700	2.200	7.700	3.000	1.900	0.300	2.600	2.300	2.300	2.400	0.700	0.000	0.000
250.	9.600	4.000	2.800	1.800	7.700	2.100	1.000	0.000	4.400	2.700	2.500	2.400	2.500	0.200	0.000
260.	8.000	2.700	2.200	1.800	6.100	0.900	0.300	0.000	7.900	3.600	2.900	2.400	6.000	1.000	0.300
270.	5.200	2.000	1.800	1.800	3.300	0.200	0.000	0.000	10.700	5.000	3.600	2.500	9.200	2.600	1.000
280.	3.000	1.800	1.800	1.900	1.400	0.000	0.000	0.000	11.100	6.200	4.600	2.900	10.000	3.600	1.900
290.	2.000	1.800	1.900	1.900	0.700	0.000	0.000	0.000	9.800	6.600	5.200	3.700	8.900	3.800	2.500
300.	1.800	2.000	2.000	2.100	0.400	0.000	0.000	0.000	8.700	6.700	5.500	4.200	8.000	3.900	2.500
310.	1.800	2.200	2.200	2.300	0.400	0.000	0.000	0.000	7.900	6.800	5.800	4.900	7.400	3.700	2.400
320.	2.000	2.500	2.600	2.600	0.300	0.000	0.000	0.000	7.200	6.700	6.100	5.400	7.000	3.600	2.400
330.	2.600	3.000	3.100	3.100	0.300	0.100	0.100	0.000	7.200	6.900	6.400	6.500	6.600	3.800	2.700

```
 340.  *   3.400   3.900   4.100   4.000   0.700   0.600   0.400   0.400   7.800   7.500   7.300
7.900   7.400   5.000   3.900
 350.  *   4.600   5.100   5.100   4.900   2.000   2.000   1.800   1.500   9.000   8.300   8.100
9.100   9.300   7.300   6.500
 360.  *   5.400   5.700   5.700   5.500   4.000   3.900   3.600   2.900  10.200   8.600   8.000
9.000  11.500   9.600   8.300
 -------*-----------------------------------------------------------------------------------------------------
-------------------------
 MAX   *  11.500   8.900   8.400   8.000  11.100   8.400   7.900   6.900  11.100   8.600   8.100
9.100  12.500   9.900   8.900
 DEGR. *    100     160     160     160      90     150     150     150     280     360     350     350
10      10      10
```

JOB: Bow Concord RUN: Exit 14 SB 2035 Build AM pm10

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	7.400	3.900	0.200	0.200	2.600	1.400	0.400	8.500	4.900	5.100	7.900	7.300	7.000
20.	6.800	2.800	0.300	0.300	3.100	2.300	1.100	7.400	5.000	5.300	8.700	8.200	7.900
30.	6.000	2.200	0.400	0.500	3.100	2.700	1.600	6.900	5.200	5.200	9.000	8.900	9.000
40.	4.900	1.900	0.500	0.500	2.900	2.700	2.000	6.900	5.400	5.000	9.300	9.500	10.000
50.	4.500	1.600	0.600	0.600	2.800	2.800	2.400	6.800	5.200	4.100	9.700	10.300	11.100
60.	4.400	1.600	1.000	0.900	3.100	3.700	3.100	6.200	4.400	3.300	9.700	11.000	12.100
70.	4.400	2.500	2.000	1.700	4.000	5.400	5.400	4.600	2.900	2.200	8.000	10.600	13.300
80.	4.400	4.300	3.900	2.900	6.200	7.900	8.200	2.700	1.400	1.300	5.600	7.600	11.700
90.	4.300	6.400	5.500	3.700	7.900	9.200	9.900	1.400	0.400	0.500	3.500	4.400	7.700
100.	4.400	7.700	6.500	4.500	8.300	9.600	9.800	1.100	0.100	0.200	2.800	2.700	4.000
110.	4.700	7.700	6.800	5.300	8.300	9.500	9.100	1.200	0.000	0.200	2.800	2.400	2.900
120.	5.100	7.700	6.600	5.800	8.300	9.000	8.400	1.400	0.000	0.200	2.800	2.400	2.300
130.	5.400	7.700	6.000	5.900	8.600	8.500	7.700	1.900	0.000	0.100	3.100	2.500	2.000
140.	5.500	8.000	5.600	5.700	8.700	7.800	6.900	2.700	0.000	0.000	3.000	2.100	1.300
150.	4.800	9.100	5.400	5.500	8.300	6.900	6.000	4.000	0.100	0.000	2.400	1.300	0.500
160.	3.100	11.000	6.400	5.700	7.100	6.000	5.600	5.700	0.800	0.100	1.100	0.500	0.100
170.	1.500	11.900	8.600	6.600	5.800	5.500	5.600	6.600	2.400	0.600	0.300	0.000	0.000
180.	0.400	11.100	10.000	7.600	5.200	5.400	5.600	5.900	4.200	1.700	0.000	0.000	0.000
190.	0.100	9.400	10.100	8.300	4.900	5.400	5.700	4.400	4.700	2.700	0.000	0.000	0.200
200.	0.000	8.800	10.000	8.600	5.000	5.600	5.800	3.500	4.500	3.100	0.000	0.000	0.400
210.	0.000	8.800	10.000	9.000	5.100	5.800	6.100	2.900	3.900	3.000	0.000	0.000	0.600
220.	0.000	9.300	10.400	9.600	5.600	6.500	6.800	2.500	3.500	2.900	0.000	0.100	0.800
230.	0.000	9.800	11.100	10.300	6.100	7.200	7.500	2.400	3.500	2.800	0.000	0.100	1.000
240.	0.000	10.400	12.100	11.200	6.500	8.000	8.100	2.600	3.700	3.200	0.200	0.500	1.900
250.	0.000	9.900	12.300	12.100	6.100	7.900	7.600	4.300	5.100	5.200	1.100	2.000	4.300
260.	0.000	7.200	10.400	10.100	4.000	6.400	6.000	7.200	8.000	8.400	3.400	4.900	8.100
270.	0.000	4.200	6.400	6.500	1.600	3.700	3.600	9.300	10.000	10.500	5.900	7.900	10.600
280.	0.300	2.600	4.500	3.900	0.500	1.700	1.800	9.000	10.000	9.900	7.100	8.900	10.900
290.	0.800	2.200	3.900	3.200	0.200	0.900	0.900	8.200	9.500	9.300	6.700	8.100	9.800
300.	1.200	2.700	4.000	3.100	0.100	0.600	0.600	7.900	8.900	8.700	6.300	7.300	8.800
310.	1.300	3.000	4.400	3.200	0.100	0.500	0.500	7.900	8.900	8.500	5.900	6.700	7.900
320.	1.400	3.300	4.700	3.200	0.000	0.400	0.400	8.400	9.200	8.200	5.700	6.200	7.200
330.	1.600	4.200	4.800	2.600	0.000	0.300	0.300	9.200	9.200	7.800	5.500	5.800	6.800

340. *	3.100	5.400	4.100	1.500	0.000	0.200	0.200	10.700	8.700	7.000	5.600	5.900	6.700
350. *	5.300	6.100	2.400	0.500	0.500	0.300	0.300	11.500	7.000	5.900	6.100	6.200	7.000
360. *	7.500	5.400	0.800	0.100	1.400	0.700	0.200	10.200	5.400	5.200	7.000	6.600	6.900
MAX *	7.500	11.900	12.300	12.100	8.700	9.600	9.900	11.500	10.000	10.500	9.700	11.000	13.300
DEGR. *	360	170	250	250	140	100	90	350	270	270	60	60	70

THE HIGHEST CONCENTRATION OF 13.300 UG/M**3 OCCURRED AT RECEPTOR 28.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

JOB: Bow Concord   RUN: Exit 14 SB 2035 Build PM pm2.5

DATE : 3/ 1/18
TIME : 11:18:55

The MODE flag has been set for calculating concentrations for POLLUTANT: CO

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S   VD = 0.0 CM/S   Z0 = 175. CM
U = 1.0 M/S   CLAS = 4 (D)   ATIM = 60. MINUTES   MIXH = 1000. M   AMB = 0.0 PPM

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	0.0	0.0	-110.0	990.0	996.	354.	AG	267.	0.7	0.0	43.7		
2. N Leg App - Queue	-7.1	63.9	-110.8	996.9	939.	354.	AG	6.	100.0	0.0	24.0	2.51	47.7
3. S Leg Dep - FreeFlow	0.0	0.0	250.0	-970.0	1002.	166.	AG	831.	0.8	0.0	43.7		
4. E Leg App - FreeFlow	0.0	30.0	440.0	100.0	446.	81.	AG	1706.	1.1	0.0	67.7		
5. E Leg App - Queue	25.5	34.1	94.5	45.1	70.	81.	AG	5.	100.0	0.0	48.0	0.37	3.5
6. E Leg Dep - FreeFlow	10.0	-30.0	450.0	60.0	449.	78.	AG	1279.	1.1	0.0	55.7		
7. W Leg App - FreeFlow	10.0	-30.0	-900.0	-160.0	919.	262.	AG	1428.	0.7	0.0	55.7		
8. W Leg App - Queue	-7.7	-32.5	-162.2	-54.6	156.	262.	AG	7.	100.0	0.0	36.0	0.64	7.9
9. W Leg Dep - FreeFlow	0.0	30.0	-900.0	-130.0	914.	260.	AG	1291.	1.6	0.0	67.7		
10. I93 NB N Leg - FF	170.0	30.0	20.0	1010.0	991.	351.	BR	4380.	0.8	22.0	62.0		
11. I93 NB S Leg - FF	170.0	30.0	380.0	-940.0	992.	168.	BR	4380.	0.8	22.0	62.0		
12. I93 SB N Leg - FF	90.0	20.0	-70.0	1010.0	1003.	351.	BR	4000.	0.8	22.0	62.0		
13. I93 SB S Leg - FF	90.0	20.0	310.0	-970.0	1014.	167.	BR	4000.	0.8	22.0	62.0		

JOB: Bow Concord RUN: Exit 14 SB 2035 Build PM pm2.5

DATE : 3/ 1/18
TIME : 11:18:55

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
2. N Leg App - Queue	120	112	2.0	267	1600	1.18	2	3
5. E Leg App - Queue	120	30	2.0	1706	1600	1.75	2	3
8. W Leg App - Queue	120	60	2.0	1428	1600	1.75	2	3

RECEPTOR LOCATIONS

RECEPTOR	X (FT)	Y (FT)	Z (FT)
1. N Leg, E Side-Corner	20.0	60.0	5.9
2. N Leg, E Side - 25 m	0.0	160.0	5.9
3. N Leg, E Side - 50 m	-10.0	240.0	5.9
4. N Leg, E Side-Midblk	-40.0	500.0	5.9
5. N Leg, W Side-Corner	-40.0	50.0	5.9
6. N Leg, W Side - 25 m	-50.0	150.0	5.9
7. N Leg, W Side - 50 m	-60.0	230.0	5.9
8. N Leg, W Side-Midblk	-90.0	490.0	5.9
9. S Leg, E Side-Corner	50.0	-60.0	5.9
10. S Leg, E Side - 25 m	60.0	-140.0	5.9
11. S Leg, E Side - 50 m	80.0	-220.0	5.9
12. S Leg, E Side-Midblk	140.0	-480.0	5.9
13. S Leg, W Side-Corner	-20.0	-70.0	5.9
14. S Leg, W Side - 25 m	10.0	-150.0	5.9
15. S Leg, W Side - 50 m	30.0	-240.0	5.9
16. S Leg, W Side-Midblk	90.0	-500.0	5.9
17. E Leg, N Side - 25 m	130.0	90.0	5.9
18. E Leg, N Side - 50 m	230.0	100.0	5.9
19. E Leg, N Side-Midblk	339.7	115.6	5.9
20. W Leg, N Side - 25 m	-120.0	50.0	5.9
21. W Leg, N Side - 50 m	-240.0	10.0	5.9
22. W Leg, N Side-Midblk	-460.0	-30.0	5.9
23. E Leg, S Side - 25 m	160.0	-40.0	5.9
24. E Leg, S Side - 50 m	260.0	-20.0	5.9
25. E Leg, S Side-Midblk	359.2	7.3	5.9
26. W Leg, S Side - 25 m	-120.0	-100.0	5.9
27. W Leg, S Side - 50 m	-210.0	-100.0	5.9
28. W Leg, S Side-Midblk	-440.0	-120.0	5.9

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000
20.	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000
30.	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
70.	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
80.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
100.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
110.	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
120.	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
130.	0.1000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
140.	0.2000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
150.	0.2000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
160.	0.2000	0.1000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
170.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
180.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
190.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
200.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
210.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
220.	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270.	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
280.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
290.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
300.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
310.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
320.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
330.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

```
 340.  *  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000
 350.  *  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.1000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000
 360.  *  0.1000  0.1000  0.1000  0.1000  0.0000  0.0000  0.0000  0.0000  0.1000  0.1000  0.0000
0.1000  0.0000  0.0000  0.0000
 -------*-----------------------------------------------------------------------------------------------
-------------------------
 MAX   *  0.2000  0.1000  0.1000  0.1000  0.1000  0.0000  0.0000  0.0000  0.1000  0.1000  0.1000
0.1000  0.0000  0.0000  0.0000
 DEGR. *    140      10      10      10      80      10      10      10      10     130      20      10
10      10      10
```

JOB: Bow Concord RUN: Exit 14 SB 2035 Build PM pm2.5

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
20.	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30.	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
60.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
70.	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000
80.	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90.	0.0000	0.1000	0.1000	0.1000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
100.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
110.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
120.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
130.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
140.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
150.	0.0000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
160.	0.0000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
170.	0.0000	0.3000	0.2000	0.1000	0.1000	0.1000	0.1000	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000
180.	0.0000	0.2000	0.2000	0.1000	0.1000	0.1000	0.1000	0.2000	0.1000	0.0000	0.0000	0.0000	0.0000
190.	0.0000	0.1000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000
200.	0.0000	0.1000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000
210.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000
220.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260.	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270.	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000
280.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000
290.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000
300.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000
310.	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
320.	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000
330.	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000

340.	*	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.2000	0.1000	0.0000	0.0000	0.0000	0.0000
350.	*	0.0000	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000
360.	*	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
MAX	*	0.0000	0.3000	0.2000	0.1000	0.1000	0.1000	0.1000	0.2000	0.1000	0.1000	0.0000	0.0000	0.1000
DEGR.	*	10	170	170	90	100	70	70	170	180	270	10	10	70

THE HIGHEST CONCENTRATION OF 0.3000 PPM OCCURRED AT RECEPTOR 17.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

JOB: Bow Concord RUN: Exit 14 SB 2035 Build PM pm2.5

DATE : 3/ 1/18
TIME : 11:11:26

The MODE flag has been set for calculating concentrations for POLLUTANT: PM2.5

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 175. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 UG/M**3

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	0.0	0.0	-110.0	990.0	996.	354.	AG	267.	0.0	0.0	43.7		
2. N Leg App - Queue	-7.1	63.9	-110.8	996.9	939.	354.	AG	0.	100.0	0.0	24.0	2.51	47.7
3. S Leg Dep - FreeFlow	0.0	0.0	250.0	-970.0	1002.	166.	AG	831.	0.0	0.0	43.7		
4. E Leg App - FreeFlow	0.0	30.0	440.0	100.0	446.	81.	AG	1706.	0.0	0.0	67.7		
5. E Leg App - Queue	25.5	34.1	94.5	45.1	70.	81.	AG	0.	100.0	0.0	48.0	0.37	3.5
6. E Leg Dep - FreeFlow	10.0	-30.0	450.0	60.0	449.	78.	AG	1279.	0.0	0.0	55.7		
7. W Leg App - FreeFlow	10.0	-30.0	-900.0	-160.0	919.	262.	AG	1428.	0.0	0.0	55.7		
8. W Leg App - Queue	-7.7	-32.5	-162.2	-54.6	156.	262.	AG	0.	100.0	0.0	36.0	0.64	7.9
9. W Leg Dep - FreeFlow	0.0	30.0	-900.0	-130.0	914.	260.	AG	1291.	0.0	0.0	67.7		
10. I93 NB N Leg - FF	170.0	30.0	20.0	1010.0	991.	351.	BR	4380.	0.0	22.0	62.0		
11. I93 NB S Leg - FF	170.0	30.0	380.0	-940.0	992.	168.	BR	4380.	0.0	22.0	62.0		
12. I93 SB N Leg - FF	90.0	20.0	-70.0	1010.0	1003.	351.	BR	4000.	0.0	22.0	62.0		
13. I93 SB S Leg - FF	90.0	20.0	310.0	-970.0	1014.	167.	BR	4000.	0.0	22.0	62.0		

2. N Leg App - Queue	*	120	112	2.0	267	1600	0.04	2
3								
5. E Leg App - Queue	*	120	30	2.0	1706	1600	0.04	2
3								
8. W Leg App - Queue	*	120	60	2.0	1428	1600	0.04	2
3								

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (FT) X	Y	Z	*
1. N Leg, E Side-Corner	*	20.0	60.0	5.9	*
2. N Leg, E Side - 25 m	*	0.0	160.0	5.9	*
3. N Leg, E Side - 50 m	*	-10.0	240.0	5.9	*
4. N Leg, E Side-Midblk	*	-40.0	500.0	5.9	*
5. N Leg, W Side-Corner	*	-40.0	50.0	5.9	*
6. N Leg, W Side - 25 m	*	-50.0	150.0	5.9	*
7. N Leg, W Side - 50 m	*	-60.0	230.0	5.9	*
8. N Leg, W Side-Midblk	*	-90.0	490.0	5.9	*
9. S Leg, E Side-Corner	*	50.0	-60.0	5.9	*
10. S Leg, E Side - 25 m	*	60.0	-140.0	5.9	*
11. S Leg, E Side - 50 m	*	80.0	-220.0	5.9	*
12. S Leg, E Side-Midblk	*	140.0	-480.0	5.9	*
13. S Leg, W Side-Corner	*	-20.0	-70.0	5.9	*
14. S Leg, W Side - 25 m	*	10.0	-150.0	5.9	*
15. S Leg, W Side - 50 m	*	30.0	-240.0	5.9	*
16. S Leg, W Side-Midblk	*	90.0	-500.0	5.9	*
17. E Leg, N Side - 25 m	*	130.0	90.0	5.9	*
18. E Leg, N Side - 50 m	*	230.0	100.0	5.9	*
19. E Leg, N Side-Midblk	*	339.7	115.6	5.9	*
20. W Leg, N Side - 25 m	*	-120.0	50.0	5.9	*
21. W Leg, N Side - 50 m	*	-240.0	10.0	5.9	*
22. W Leg, N Side-Midblk	*	-460.0	-30.0	5.9	*
23. E Leg, S Side - 25 m	*	160.0	-40.0	5.9	*
24. E Leg, S Side - 50 m	*	260.0	-20.0	5.9	*
25. E Leg, S Side-Midblk	*	359.2	7.3	5.9	*
26. W Leg, S Side - 25 m	*	-120.0	-100.0	5.9	*
27. W Leg, S Side - 50 m	*	-210.0	-100.0	5.9	*
28. W Leg, S Side-Midblk	*	-440.0	-120.0	5.9	*

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	1.2000	1.3000	1.3000	1.3000	1.6000	1.6000	1.4000	1.4000	2.2000	1.6000	1.5000	1.5000	2.6000	2.0000	1.7000
20.	1.0000	1.1000	1.1000	1.1000	1.5000	1.5000	1.5000	1.5000	2.0000	1.3000	1.3000	1.2000	2.6000	1.6000	1.5000
30.	1.0000	0.8000	0.8000	0.9000	1.3000	1.5000	1.4000	1.3000	1.8000	1.3000	1.2000	0.9000	2.1000	1.6000	1.4000
40.	0.8000	0.7000	0.7000	0.7000	1.3000	1.2000	1.2000	1.2000	1.8000	1.3000	1.1000	0.8000	2.3000	1.7000	1.4000
50.	0.9000	0.6000	0.6000	0.6000	1.2000	1.2000	1.2000	1.2000	1.6000	1.0000	0.8000	0.6000	2.0000	1.5000	1.1000
60.	0.9000	0.6000	0.6000	0.6000	1.4000	1.2000	1.2000	1.2000	1.7000	0.9000	0.7000	0.6000	2.1000	1.2000	0.9000
70.	1.4000	0.6000	0.6000	0.6000	1.6000	1.1000	1.1000	1.2000	1.4000	0.8000	0.6000	0.6000	2.0000	1.1000	0.9000
80.	1.9000	0.6000	0.6000	0.6000	1.9000	1.1000	1.2000	1.1000	1.1000	0.6000	0.6000	0.6000	1.4000	1.0000	0.9000
90.	2.3000	0.7000	0.6000	0.6000	2.1000	1.2000	1.1000	1.2000	0.8000	0.6000	0.6000	0.6000	1.0000	0.9000	0.9000
100.	2.5000	0.9000	0.7000	0.6000	2.3000	1.5000	1.2000	1.1000	0.6000	0.6000	0.6000	0.6000	1.0000	1.0000	0.9000
110.	2.2000	1.0000	0.9000	0.6000	2.0000	1.7000	1.4000	1.2000	0.7000	0.7000	0.7000	0.8000	0.9000	1.0000	1.0000
120.	2.2000	1.2000	1.0000	0.7000	2.1000	1.8000	1.5000	1.2000	0.7000	0.7000	0.7000	0.8000	1.0000	1.0000	1.0000
130.	2.2000	1.4000	1.1000	0.9000	2.0000	2.0000	1.7000	1.4000	0.9000	0.9000	0.9000	1.0000	1.1000	1.2000	1.1000
140.	2.3000	1.5000	1.2000	1.1000	1.9000	1.9000	1.8000	1.7000	1.0000	1.0000	1.0000	1.1000	1.1000	1.2000	1.2000
150.	2.4000	1.7000	1.6000	1.5000	2.1000	1.8000	1.9000	1.9000	1.2000	1.2000	1.2000	1.3000	1.2000	1.3000	1.1000
160.	2.3000	1.7000	1.7000	2.0000	1.9000	1.5000	1.7000	1.9000	1.1000	1.1000	1.1000	1.2000	0.8000	1.0000	0.9000
170.	2.1000	1.7000	1.9000	2.1000	1.6000	1.3000	1.2000	1.3000	0.9000	1.1000	1.1000	1.0000	0.3000	0.4000	0.4000
180.	1.6000	1.7000	1.6000	2.0000	1.2000	0.6000	0.7000	0.6000	0.6000	0.8000	0.8000	0.8000	0.1000	0.1000	0.1000
190.	1.5000	1.7000	1.7000	1.7000	1.2000	0.6000	0.5000	0.3000	0.5000	0.6000	0.6000	0.6000	0.0000	0.0000	0.0000
200.	1.6000	1.5000	1.6000	1.4000	1.2000	0.6000	0.5000	0.2000	0.4000	0.5000	0.5000	0.6000	0.0000	0.0000	0.0000
210.	1.6000	1.6000	1.5000	1.3000	1.2000	0.7000	0.4000	0.2000	0.4000	0.5000	0.5000	0.5000	0.0000	0.0000	0.0000
220.	1.5000	1.6000	1.4000	1.2000	1.4000	0.6000	0.4000	0.2000	0.4000	0.4000	0.4000	0.4000	0.0000	0.0000	0.0000
230.	1.7000	1.5000	1.3000	1.1000	1.4000	0.6000	0.4000	0.2000	0.3000	0.4000	0.4000	0.4000	0.0000	0.0000	0.0000
240.	1.7000	1.3000	1.2000	0.8000	1.6000	0.6000	0.4000	0.0000	0.4000	0.4000	0.4000	0.4000	0.1000	0.0000	0.0000
250.	1.9000	1.1000	0.9000	0.8000	1.6000	0.4000	0.2000	0.0000	0.7000	0.4000	0.4000	0.4000	0.3000	0.0000	0.0000
260.	1.6000	0.9000	0.8000	0.8000	1.3000	0.2000	0.0000	0.0000	1.4000	0.6000	0.4000	0.4000	1.0000	0.1000	0.0000
270.	1.1000	0.7000	0.8000	0.8000	0.7000	0.0000	0.0000	0.0000	1.9000	0.8000	0.6000	0.4000	1.6000	0.4000	0.2000
280.	0.7000	0.7000	0.7000	0.8000	0.3000	0.0000	0.0000	0.0000	2.0000	1.1000	0.7000	0.4000	1.9000	0.6000	0.3000
290.	0.6000	0.8000	0.8000	0.8000	0.2000	0.0000	0.0000	0.0000	1.8000	1.1000	0.9000	0.6000	1.9000	0.7000	0.4000
300.	0.6000	0.9000	0.9000	0.9000	0.1000	0.0000	0.0000	0.0000	1.5000	1.2000	1.1000	0.6000	1.6000	0.7000	0.4000
310.	0.8000	1.0000	1.0000	1.0000	0.1000	0.0000	0.0000	0.0000	1.3000	1.2000	1.0000	0.8000	1.6000	0.8000	0.5000
320.	0.8000	1.1000	1.1000	1.1000	0.1000	0.0000	0.0000	0.0000	1.4000	1.1000	1.0000	0.8000	1.4000	0.7000	0.5000
330.	0.9000	1.2000	1.2000	1.3000	0.0000	0.0000	0.0000	0.0000	1.4000	1.2000	1.1000	0.9000	1.4000	0.8000	0.5000

```
 340.  *  1.1000  1.5000  1.5000  1.6000  0.1000  0.1000  0.1000  0.1000  1.7000  1.3000  1.4000
1.4000  1.5000  1.0000  0.8000
 350.  *  1.4000  1.7000  1.7000  1.6000  0.6000  0.6000  0.5000  0.5000  2.0000  2.0000  1.7000
1.8000  2.1000  1.6000  1.4000
 360.  *  1.4000  1.6000  1.6000  1.5000  1.3000  1.2000  1.2000  1.0000  2.3000  1.8000  1.6000
1.8000  2.5000  1.9000  1.6000
 -------*-----------------------------------------------------------------------------------------
-------------------------
 MAX   *  2.5000  1.7000  1.9000  2.1000  2.3000  2.0000  1.9000  1.9000  2.3000  2.0000  1.7000
1.8000  2.6000  2.0000  1.7000
 DEGR. *    100     160     170     170     100     130     150     150     360     350     350     350
10      10      10
```

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	1.5000	0.9000	0.0000	0.0000	0.8000	0.4000	0.1000	1.7000	0.8000	0.9000	1.9000	1.2000	1.1000
20.	1.4000	0.6000	0.0000	0.1000	0.9000	0.6000	0.3000	1.5000	0.9000	0.9000	2.0000	1.6000	1.5000
30.	1.3000	0.5000	0.1000	0.1000	0.9000	0.7000	0.4000	1.3000	0.9000	0.9000	2.0000	1.7000	1.5000
40.	0.9000	0.4000	0.1000	0.1000	0.8000	0.6000	0.4000	1.3000	0.9000	0.9000	1.8000	1.8000	1.6000
50.	0.9000	0.4000	0.1000	0.1000	0.7000	0.7000	0.5000	1.2000	0.9000	0.7000	1.9000	2.0000	1.9000
60.	0.8000	0.3000	0.2000	0.2000	0.7000	0.9000	0.7000	1.1000	0.7000	0.6000	1.7000	1.9000	2.0000
70.	0.9000	0.5000	0.4000	0.3000	1.0000	1.2000	1.2000	0.9000	0.5000	0.4000	1.5000	2.1000	2.1000
80.	0.9000	0.9000	0.6000	0.5000	1.3000	1.5000	1.6000	0.6000	0.2000	0.2000	0.9000	1.4000	1.9000
90.	0.9000	1.1000	1.0000	0.6000	1.9000	2.0000	1.9000	0.3000	0.1000	0.1000	0.6000	0.9000	1.2000
100.	0.9000	1.3000	1.1000	0.8000	1.7000	1.9000	1.9000	0.2000	0.0000	0.0000	0.5000	0.6000	0.7000
110.	0.9000	1.4000	1.2000	0.9000	1.6000	2.0000	1.7000	0.3000	0.0000	0.0000	0.5000	0.5000	0.5000
120.	1.0000	1.5000	1.1000	1.0000	1.6000	1.9000	1.6000	0.3000	0.0000	0.0000	0.5000	0.5000	0.4000
130.	1.1000	1.5000	1.1000	1.0000	1.8000	1.7000	1.4000	0.4000	0.0000	0.0000	0.7000	0.5000	0.4000
140.	1.0000	1.6000	1.0000	1.0000	1.8000	1.7000	1.3000	0.6000	0.0000	0.0000	0.7000	0.4000	0.2000
150.	0.8000	1.8000	0.9000	0.9000	1.8000	1.3000	1.0000	1.0000	0.0000	0.0000	0.4000	0.3000	0.0000
160.	0.6000	2.2000	1.1000	1.0000	1.5000	0.9000	1.0000	1.2000	0.2000	0.0000	0.2000	0.0000	0.0000
170.	0.3000	2.5000	1.6000	1.1000	1.2000	0.9000	1.0000	1.5000	0.5000	0.1000	0.0000	0.0000	0.0000
180.	0.1000	2.2000	2.0000	1.4000	1.1000	0.9000	1.0000	1.3000	1.0000	0.3000	0.0000	0.0000	0.0000
190.	0.0000	1.9000	2.0000	1.5000	1.1000	1.0000	1.0000	1.0000	1.0000	0.6000	0.0000	0.0000	0.0000
200.	0.0000	1.5000	2.0000	1.6000	1.0000	1.1000	1.1000	0.8000	0.9000	0.6000	0.0000	0.0000	0.1000
210.	0.0000	1.6000	1.8000	1.7000	1.1000	1.1000	1.1000	0.5000	0.9000	0.6000	0.0000	0.0000	0.1000
220.	0.0000	1.7000	1.9000	1.7000	1.0000	1.2000	1.2000	0.5000	0.8000	0.6000	0.0000	0.0000	0.1000
230.	0.0000	2.1000	2.1000	1.7000	1.1000	1.3000	1.4000	0.4000	0.8000	0.6000	0.0000	0.0000	0.1000
240.	0.0000	2.1000	2.4000	1.9000	1.3000	1.5000	1.6000	0.5000	0.7000	0.7000	0.0000	0.1000	0.3000
250.	0.0000	1.9000	2.3000	2.3000	1.2000	1.6000	1.5000	0.8000	1.1000	1.1000	0.1000	0.2000	0.7000
260.	0.0000	1.5000	1.9000	1.8000	0.8000	1.3000	1.3000	1.3000	1.5000	1.6000	0.5000	0.8000	1.2000
270.	0.0000	0.9000	1.4000	1.3000	0.4000	0.8000	0.8000	1.7000	1.8000	1.9000	1.0000	1.2000	1.6000
280.	0.0000	0.7000	1.0000	0.9000	0.1000	0.4000	0.4000	1.7000	2.0000	1.8000	1.1000	1.4000	1.7000
290.	0.2000	0.6000	0.9000	0.7000	0.0000	0.2000	0.2000	1.4000	1.9000	1.7000	1.0000	1.3000	1.6000
300.	0.2000	0.7000	0.9000	0.7000	0.0000	0.1000	0.1000	1.5000	1.7000	1.7000	1.1000	1.2000	1.4000
310.	0.2000	0.7000	1.0000	0.7000	0.0000	0.1000	0.1000	1.5000	1.7000	1.6000	1.0000	1.0000	1.3000
320.	0.2000	0.8000	1.1000	0.7000	0.0000	0.1000	0.1000	1.8000	1.8000	1.5000	1.1000	1.0000	1.2000
330.	0.3000	1.1000	1.0000	0.6000	0.0000	0.1000	0.1000	2.1000	1.8000	1.5000	1.2000	0.9000	1.1000

340.	0.6000	1.3000	1.0000	0.3000	0.0000	0.0000	0.1000	2.2000	1.8000	1.2000	1.2000	0.9000	1.1000
350.	1.0000	1.4000	0.5000	0.1000	0.1000	0.1000	0.1000	2.5000	1.4000	1.0000	1.3000	1.0000	1.2000
360.	1.5000	1.2000	0.2000	0.0000	0.4000	0.1000	0.1000	2.0000	0.9000	0.9000	1.6000	1.2000	1.2000
MAX	1.5000	2.5000	2.4000	2.3000	1.9000	2.0000	1.9000	2.5000	2.0000	1.9000	2.0000	2.1000	2.1000
DEGR.	10	170	240	250	90	90	90	350	280	270	20	70	70

THE HIGHEST CONCENTRATION OF 2.6000 UG/M**3 OCCURRED AT RECEPTOR 13.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

JOB: Bow Concord RUN: Exit 14 SB 2035 Build PM pm10

DATE : 3/ 1/18
TIME : 11:25:34

The MODE flag has been set for calculating concentrations for POLLUTANT: PM-10

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 175. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 UG/M**3

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	0.0	0.0	-110.0	990.0	996.	354.	AG	267.	0.1	0.0	43.7		
2. N Leg App - Queue	-7.1	63.9	-110.8	996.9	939.	354.	AG	0.	100.0	0.0	24.0	2.51	47.7
3. S Leg Dep - FreeFlow	0.0	0.0	250.0	-970.0	1002.	166.	AG	831.	0.1	0.0	43.7		
4. E Leg App - FreeFlow	0.0	30.0	440.0	100.0	446.	81.	AG	1706.	0.1	0.0	67.7		
5. E Leg App - Queue	25.5	34.1	94.5	45.1	70.	81.	AG	0.	100.0	0.0	48.0	0.37	3.5
6. E Leg Dep - FreeFlow	10.0	-30.0	450.0	60.0	449.	78.	AG	1279.	0.1	0.0	55.7		
7. W Leg App - FreeFlow	10.0	-30.0	-900.0	-160.0	919.	262.	AG	1428.	0.1	0.0	55.7		
8. W Leg App - Queue	-7.7	-32.5	-162.2	-54.6	156.	262.	AG	0.	100.0	0.0	36.0	0.64	7.9
9. W Leg Dep - FreeFlow	0.0	30.0	-900.0	-130.0	914.	260.	AG	1291.	0.0	0.0	67.7		
10. I93 NB N Leg - FF	170.0	30.0	20.0	1010.0	991.	351.	BR	4380.	0.0	22.0	62.0		
11. I93 NB S Leg - FF	170.0	30.0	380.0	-940.0	992.	168.	BR	4380.	0.0	22.0	62.0		
12. I93 SB N Leg - FF	90.0	20.0	-70.0	1010.0	1003.	351.	BR	4000.	0.0	22.0	62.0		
13. I93 SB S Leg - FF	90.0	20.0	310.0	-970.0	1014.	167.	BR	4000.	0.0	22.0	62.0		

	2. N Leg App - Queue	*	120	112	2.0	267	1600	0.04	2
3									
	5. E Leg App - Queue	*	120	30	2.0	1706	1600	0.04	2
3									
	8. W Leg App - Queue	*	120	60	2.0	1428	1600	0.04	2
3									

RECEPTOR LOCATIONS

RECEPTOR	*	X	Y	Z	*
	*	COORDINATES (FT)			*
1. N Leg, E Side-Corner	*	20.0	60.0	5.9	*
2. N Leg, E Side - 25 m	*	0.0	160.0	5.9	*
3. N Leg, E Side - 50 m	*	-10.0	240.0	5.9	*
4. N Leg, E Side-Midblk	*	-40.0	500.0	5.9	*
5. N Leg, W Side-Corner	*	-40.0	50.0	5.9	*
6. N Leg, W Side - 25 m	*	-50.0	150.0	5.9	*
7. N Leg, W Side - 50 m	*	-60.0	230.0	5.9	*
8. N Leg, W Side-Midblk	*	-90.0	490.0	5.9	*
9. S Leg, E Side-Corner	*	50.0	-60.0	5.9	*
10. S Leg, E Side - 25 m	*	60.0	-140.0	5.9	*
11. S Leg, E Side - 50 m	*	80.0	-220.0	5.9	*
12. S Leg, E Side-Midblk	*	140.0	-480.0	5.9	*
13. S Leg, W Side-Corner	*	-20.0	-70.0	5.9	*
14. S Leg, W Side - 25 m	*	10.0	-150.0	5.9	*
15. S Leg, W Side - 50 m	*	30.0	-240.0	5.9	*
16. S Leg, W Side-Midblk	*	90.0	-500.0	5.9	*
17. E Leg, N Side - 25 m	*	130.0	90.0	5.9	*
18. E Leg, N Side - 50 m	*	230.0	100.0	5.9	*
19. E Leg, N Side-Midblk	*	339.7	115.6	5.9	*
20. W Leg, N Side - 25 m	*	-120.0	50.0	5.9	*
21. W Leg, N Side - 50 m	*	-240.0	10.0	5.9	*
22. W Leg, N Side-Midblk	*	-460.0	-30.0	5.9	*
23. E Leg, S Side - 25 m	*	160.0	-40.0	5.9	*
24. E Leg, S Side - 50 m	*	260.0	-20.0	5.9	*
25. E Leg, S Side-Midblk	*	359.2	7.3	5.9	*
26. W Leg, S Side - 25 m	*	-120.0	-100.0	5.9	*
27. W Leg, S Side - 50 m	*	-210.0	-100.0	5.9	*
28. W Leg, S Side-Midblk	*	-440.0	-120.0	5.9	*

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	*	CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	*	4.900	5.000	5.000	4.900	4.800	4.700	4.600	4.100	9.500	7.800	6.900	6.800	11.700	9.100	8.300
20.	*	4.300	4.200	4.300	4.300	4.900	4.800	4.700	4.400	8.900	6.700	6.100	5.400	11.700	8.600	7.600
30.	*	4.100	3.500	3.600	3.600	4.500	4.300	4.300	4.300	8.600	6.300	5.500	4.400	11.300	7.900	7.100
40.	*	3.700	3.100	3.200	3.200	4.000	4.100	4.100	4.100	8.400	5.800	4.900	3.500	11.300	7.600	6.400
50.	*	3.700	2.800	2.800	2.800	4.200	3.600	3.700	3.700	8.500	5.300	3.800	3.000	11.100	7.200	5.700
60.	*	4.300	2.600	2.600	2.500	4.900	3.600	3.600	3.700	8.200	4.200	3.000	2.700	11.000	6.400	4.900
70.	*	6.100	2.400	2.400	2.400	6.900	3.500	3.500	3.500	7.100	3.200	2.500	2.500	9.900	5.400	4.500
80.	*	8.800	2.600	2.400	2.300	9.000	3.900	3.500	3.600	5.000	2.700	2.400	2.500	7.500	4.700	4.300
90.	*	10.400	3.300	2.500	2.300	10.300	4.500	3.700	3.600	3.300	2.400	2.400	2.500	5.300	4.300	4.200
100.	*	10.800	4.300	3.100	2.500	10.400	5.700	4.200	3.500	2.900	2.600	2.600	2.800	4.400	4.400	4.300
110.	*	10.400	5.300	4.000	2.800	9.500	6.400	5.100	3.800	2.900	2.900	3.000	3.200	4.400	4.700	4.600
120.	*	10.100	5.700	4.700	3.400	9.300	6.800	5.800	4.200	3.200	3.200	3.300	3.600	4.700	5.100	5.000
130.	*	9.700	6.200	5.400	4.100	9.200	7.100	6.300	5.200	3.500	3.700	3.700	4.000	5.100	5.700	5.400
140.	*	9.900	6.800	6.000	5.200	9.600	7.500	6.800	5.800	4.200	4.400	4.400	4.800	5.400	6.200	6.000
150.	*	10.700	7.600	7.200	6.400	10.200	7.800	7.200	6.500	4.900	5.300	5.300	5.700	5.400	6.400	5.900
160.	*	10.700	8.200	7.700	7.700	9.300	7.300	6.600	6.300	5.200	5.800	5.800	6.200	4.100	5.100	4.500
170.	*	9.900	7.600	7.200	7.300	7.700	5.500	5.100	4.700	4.600	5.600	5.600	5.800	2.100	2.800	2.300
180.	*	9.000	6.500	6.100	5.800	5.900	3.700	3.200	2.400	3.700	4.600	4.600	4.800	0.600	1.000	0.800
190.	*	8.300	5.600	5.100	4.500	5.400	2.900	2.200	1.400	3.000	3.600	3.700	4.000	0.100	0.300	0.200
200.	*	8.400	5.100	4.500	3.800	5.400	2.700	2.100	1.200	2.500	3.100	3.100	3.400	0.000	0.100	0.000
210.	*	8.200	4.900	4.400	3.500	5.600	2.900	2.000	1.200	2.300	2.700	2.800	2.700	0.100	0.100	0.000
220.	*	8.200	4.800	4.200	3.100	6.000	2.900	2.200	1.100	2.100	2.500	2.500	2.600	0.200	0.000	0.000
230.	*	8.600	4.800	4.000	2.600	6.600	3.000	2.200	0.800	2.100	2.200	2.300	2.400	0.200	0.000	0.000
240.	*	9.100	4.500	3.400	1.900	7.300	2.900	1.800	0.300	2.400	2.200	2.200	2.300	0.700	0.000	0.000
250.	*	9.100	3.700	2.600	1.600	7.300	2.100	1.000	0.000	4.200	2.500	2.300	2.200	2.300	0.200	0.000
260.	*	7.700	2.500	1.900	1.700	5.800	0.900	0.300	0.000	7.400	3.500	2.800	2.300	5.700	1.000	0.300
270.	*	4.900	1.800	1.600	1.700	3.100	0.200	0.000	0.000	10.000	4.800	3.400	2.400	8.700	2.300	0.900
280.	*	2.700	1.600	1.600	1.600	1.300	0.000	0.000	0.000	10.300	5.800	4.200	2.800	9.300	3.400	1.900
290.	*	1.900	1.600	1.700	1.700	0.600	0.000	0.000	0.000	9.100	6.100	5.000	3.300	8.400	3.600	2.300
300.	*	1.500	1.800	1.800	1.800	0.400	0.000	0.000	0.000	8.400	6.300	5.200	3.900	7.600	3.600	2.200
310.	*	1.600	2.000	2.000	2.000	0.300	0.000	0.000	0.000	7.500	6.400	5.400	4.600	7.000	3.500	2.300
320.	*	1.900	2.300	2.300	2.400	0.300	0.000	0.000	0.000	6.800	6.300	5.700	5.000	6.500	3.400	2.300
330.	*	2.300	2.700	2.700	2.800	0.300	0.100	0.100	0.000	6.700	6.400	6.200	6.000	6.300	3.500	2.500

```
 340.  *   3.200   3.600   3.700   3.600   0.500   0.400   0.400   0.400   7.200   7.000   6.700
7.400   6.900   4.800   3.700
 350.  *   4.200   4.700   4.700   4.500   1.800   1.900   1.700   1.200   8.400   7.800   7.400
8.600   8.500   6.800   6.100
 360.  *   4.900   5.300   5.300   5.000   3.700   3.700   3.300   2.700   9.400   8.100   7.600
8.100  10.500   8.900   7.800
 -------*----------------------------------------------------------------------------------------------
-------------------------
 MAX   *  10.800   8.200   7.700   7.700  10.400   7.800   7.200   6.500  10.300   8.100   7.600
8.600  11.700   9.100   8.300
 DEGR. *    100     160     160     160     100     150     150     150     280     360     360     350
10      10      10
```

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	7.000	3.700	0.200	0.200	2.400	1.400	0.400	8.000	4.600	4.800	7.600	6.900	6.600
20.	6.400	2.700	0.300	0.300	2.800	2.200	1.100	7.000	4.800	4.900	8.100	7.800	7.500
30.	5.600	2.100	0.400	0.400	2.900	2.400	1.600	6.500	4.900	5.000	8.500	8.300	8.400
40.	4.700	1.700	0.400	0.500	2.700	2.400	1.800	6.400	5.100	4.700	8.800	8.800	9.300
50.	4.300	1.500	0.600	0.600	2.600	2.600	2.100	6.300	4.900	4.000	9.000	9.700	10.200
60.	4.000	1.600	0.900	0.900	3.000	3.300	3.000	5.900	4.100	3.000	9.100	10.400	11.300
70.	4.100	2.300	1.900	1.600	3.700	5.100	5.000	4.400	2.700	2.100	7.400	9.900	12.500
80.	4.200	4.100	3.700	2.700	5.700	7.600	7.500	2.500	1.300	1.200	5.200	7.200	11.000
90.	4.000	6.000	5.200	3.500	7.500	8.700	9.400	1.400	0.400	0.500	3.400	4.200	7.300
100.	4.200	7.200	6.200	4.200	7.900	9.000	9.300	1.000	0.100	0.200	2.600	2.500	3.900
110.	4.400	7.400	6.400	5.000	7.700	8.900	8.700	1.100	0.000	0.200	2.500	2.300	2.600
120.	4.700	7.300	6.200	5.500	7.700	8.300	7.800	1.300	0.000	0.100	2.800	2.200	2.200
130.	5.000	7.300	5.700	5.500	8.000	8.000	7.200	1.800	0.000	0.100	2.800	2.300	1.900
140.	5.100	7.500	5.300	5.400	8.200	7.400	6.300	2.500	0.000	0.000	2.800	2.000	1.200
150.	4.600	8.800	5.100	5.200	7.700	6.500	5.600	3.800	0.100	0.000	2.200	1.300	0.500
160.	3.000	10.300	6.000	5.400	6.600	5.600	5.200	5.400	0.700	0.100	1.100	0.500	0.100
170.	1.400	11.400	8.000	6.200	5.500	5.200	5.200	6.200	2.200	0.600	0.300	0.000	0.000
180.	0.400	10.300	9.400	7.000	4.800	5.100	5.200	5.500	3.900	1.700	0.000	0.000	0.000
190.	0.100	8.800	9.600	7.900	4.600	5.100	5.400	4.200	4.400	2.400	0.000	0.000	0.200
200.	0.000	8.400	9.400	8.300	4.600	5.200	5.500	3.200	4.100	2.900	0.000	0.000	0.400
210.	0.000	8.400	9.500	8.600	4.900	5.500	5.700	2.800	3.800	2.800	0.000	0.000	0.600
220.	0.000	8.700	9.800	8.900	5.200	6.100	6.400	2.300	3.400	2.700	0.000	0.100	0.700
230.	0.000	9.200	10.400	9.800	5.700	6.900	7.100	2.300	3.300	2.500	0.000	0.100	1.000
240.	0.000	9.600	11.400	10.600	6.200	7.500	7.600	2.500	3.400	3.000	0.200	0.500	1.800
250.	0.000	9.300	11.500	11.200	5.800	7.500	7.200	4.100	5.000	4.900	1.000	1.800	4.100
260.	0.000	6.800	9.800	9.800	3.800	6.100	5.700	6.800	7.500	8.000	3.200	4.600	7.600
270.	0.000	3.900	6.300	6.200	1.600	3.500	3.400	8.800	9.500	9.700	5.500	7.500	9.900
280.	0.300	2.500	4.200	3.800	0.500	1.600	1.700	8.600	9.300	9.400	6.600	8.400	10.200
290.	0.700	2.200	3.500	3.000	0.200	0.800	0.900	7.700	9.100	8.700	6.300	7.600	9.300
300.	1.100	2.300	3.800	2.900	0.100	0.500	0.600	7.400	8.400	8.100	6.000	6.900	8.300
310.	1.300	2.700	4.000	3.000	0.100	0.400	0.500	7.500	8.500	7.900	5.600	6.300	7.400
320.	1.300	3.100	4.300	3.000	0.000	0.400	0.400	7.700	8.600	7.800	5.300	5.900	6.800
330.	1.400	3.900	4.600	2.500	0.000	0.300	0.300	8.700	8.700	7.300	5.200	5.600	6.400

340.	*	2.900	5.000	3.900	1.400	0.000	0.200	0.200	10.000	8.200	6.600	5.100	5.500	6.400
350.	*	5.100	5.700	2.300	0.500	0.500	0.300	0.300	10.700	6.700	5.600	5.800	5.800	6.700
360.	*	7.300	5.000	0.800	0.100	1.400	0.700	0.200	9.600	5.200	5.000	6.600	6.200	6.500
MAX	*	7.300	11.400	11.500	11.200	8.200	9.000	9.400	10.700	9.500	9.700	9.100	10.400	12.500
DEGR.	*	360	170	250	250	140	100	90	350	270	270	60	60	70

THE HIGHEST CONCENTRATION OF 12.500 UG/M**3 OCCURRED AT RECEPTOR 28.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

```
                         CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045
PAGE  1

      JOB: Bow Concord                                        RUN: Exit 13 SPUI 2035 Build AM pm2.5

      DATE :  3/ 7/18
      TIME :  8:53:11

         The MODE flag has been set for calculating concentrations for POLLUTANT:  PM2.5

       SITE & METEOROLOGICAL VARIABLES
       -------------------------------
       VS =   0.0 CM/S       VD =   0.0 CM/S       Z0 = 175. CM
        U =  1.0 M/S         CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =  1000. M   AMB =  0.0
UG/M**3

       LINK VARIABLES
       --------------
         LINK DESCRIPTION     *         LINK COORDINATES (FT)          *    LENGTH  BRG TYPE   VPH
EF      H   W    V/C QUEUE
                              *   X1        Y1        X2        Y2     *     (FT)  (DEG)
(G/MI)  (FT) (FT)       (VEH)
      ------------------------*----------------------------------------*-------------------------------
---------------------------
       1. N Leg App - FreeFlow*    -81.0     -29.0    -423.0     910.0 *     999.   340. AG    385.
0.0   0.0 41.7
       2. N Leg App - Queue   *   -127.2      98.0    -394.2     830.9 *     780.   340. AG      0.
100.0   0.0 22.0 1.50  39.6
       3. N Leg Dep - FreeFlow*     81.0      29.0    -261.0     969.0 *    1000.   340. AG     87.
0.0   0.0 41.7
       4. S Leg App - FreeFlow*     81.0      29.0     423.0    -910.0 *     999.   160. AG    359.
0.0   0.0 41.7
       5. S Leg App - Queue   *    127.2     -98.0     346.9    -701.1 *     642.   160. AG      0.
100.0   0.0 22.0 1.40  32.6
       6. S Leg Dep - FreeFlow*    -81.0     -29.0     261.0    -969.0 *    1000.   160. AG    319.
0.0   0.0 41.7
       7. E Leg App - FreeFlow*      0.0      20.0     982.0    -189.0 *    1004.   102. AG    907.
0.0   0.0 52.7
       8. E Leg App - Queue   *    196.8     -21.8     258.2     -34.9 *      63.   102. AG      0.
100.0   0.0 33.0 0.34   3.2
       9. E Leg Dep - FreeFlow*      0.0     -20.0     974.0    -227.0 *     996.   102. AG    947.
0.0   0.0 52.7
      10. W Leg App - FreeFlow*      0.0     -20.0    -612.0     110.0 *     626.   282. AG    509.
0.0   0.0 52.7
      11. W Leg App - Queue   *   -196.8      21.8    -231.2      29.1 *      35.   282. AG      0.
100.0   0.0 33.0 0.19   1.8
      12. W Leg Dep - FreeFlow*      0.0      20.0    -604.0     148.0 *     617.   282. AG   1522.
0.0   0.0 52.7
      13. N Leg SLIP- FreeFlow*    121.0      29.0    -221.0     969.0 *    1000.   340. AG    280.
0.0   0.0 36.0
      14. SELeg SLIP-FreeFlow *    210.0    -300.0     400.0    -110.0 *     269.    45. AG    715.
0.0   0.0 32.0
      15. SWLeg SLIP-FreeFlow *   -140.0     -29.0     240.0    -969.0 *    1014.   158. AG    165.
0.0   0.0 32.0
      16. i93 NB              *   -306.8     951.8     377.2    -926.1 *    1999.   160. BR   3863.
0.0  22.0 56.0
      17. I 93 SB             *   -377.2     926.1     306.8    -951.8 *    1999.   160. BR   3304.
0.0  22.0 56.0
```

JOB: Bow Concord RUN: Exit 13 SPUI 2035 Build AM pm2.5

DATE : 3/ 7/18
TIME : 8:53:11

2. N Leg App - Queue	*	100	82	8.0	385	1600	0.04	2	3
5. S Leg App - Queue	*	100	82	8.0	359	1600	0.04	2	3
8. E Leg App - Queue	*	100	38	4.0	907	1600	0.04	2	3
11. W Leg App - Queue	*	100	38	4.0	509	1600	0.04	2	3

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (FT) X	Y	Z	*
1. N Leg, E Side-Corner	*	104.9	24.7	5.9	*
2. N Leg, E Side - 25 m	*	80.2	92.4	5.9	*
3. N Leg, E Side - 50 m	*	52.2	169.5	5.9	*
4. N Leg, E Side-Midblk	*	-62.7	485.2	5.9	*
5. N Leg, W Side-Corner	*	-142.0	77.2	5.9	*
6. N Leg, W Side - 25 m	*	-166.6	144.9	5.9	*
7. N Leg, W Side - 50 m	*	-194.7	222.0	5.9	*
8. N Leg, W Side-Midblk	*	-309.6	537.7	5.9	*
9. S Leg, E Side-Corner	*	142.0	-77.2	5.9	*
10. S Leg, E Side - 25 m	*	166.6	-144.9	5.9	*
11. S Leg, E Side - 50 m	*	194.7	-222.0	5.9	*
12. S Leg, E Side-Midblk	*	309.6	-537.7	5.9	*
13. S Leg, W Side-Corner	*	-104.9	-24.7	5.9	*
14. S Leg, W Side - 25 m	*	-80.2	-92.4	5.9	*
15. S Leg, W Side - 50 m	*	-52.2	-169.5	5.9	*
16. S Leg, W Side-Midblk	*	62.7	-485.2	5.9	*
17. E Leg, N Side - 25 m	*	175.3	9.8	5.9	*
18. E Leg, N Side - 50 m	*	255.5	-7.3	5.9	*
19. E Leg, N Side-Midblk	*	491.7	-57.5	5.9	*
20. W Leg, N Side - 25 m	*	-212.4	92.2	5.9	*
21. W Leg, N Side - 50 m	*	-292.6	109.2	5.9	*
22. W Leg, N Side-Midblk	*	-528.8	159.4	5.9	*
23. E Leg, S Side - 25 m	*	212.4	-92.2	5.9	*
24. E Leg, S Side - 50 m	*	292.6	-109.2	5.9	*
25. E Leg, S Side-Midblk	*	528.8	-159.4	5.9	*
26. W Leg, S Side - 25 m	*	-175.3	-9.8	5.9	*
27. W Leg, S Side - 50 m	*	-255.5	7.3	5.9	*
28. W Leg, S Side-Midblk	*	-491.7	57.5	5.9	*

JOB: Bow Concord RUN: Exit 13 SPUI 2035 Build AM pm2.5

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	0.2000	0.2000	0.2000	0.2000	1.7000	1.8000	1.8000	1.8000	0.8000	0.5000	0.4000	0.3000	1.7000	1.4000	1.1000
20.	0.2000	0.2000	0.2000	0.2000	1.4000	1.6000	1.6000	1.6000	0.7000	0.5000	0.3000	0.2000	1.5000	1.2000	1.2000
30.	0.1000	0.2000	0.2000	0.2000	1.2000	1.5000	1.5000	1.5000	0.7000	0.5000	0.2000	0.2000	1.4000	1.2000	1.0000
40.	0.1000	0.1000	0.1000	0.1000	1.1000	1.4000	1.4000	1.4000	0.8000	0.5000	0.3000	0.2000	1.4000	1.2000	1.0000
50.	0.1000	0.1000	0.1000	0.1000	1.0000	1.3000	1.3000	1.3000	0.9000	0.4000	0.4000	0.2000	1.3000	1.1000	0.9000
60.	0.1000	0.1000	0.1000	0.1000	1.0000	1.4000	1.4000	1.4000	1.0000	0.5000	0.4000	0.1000	1.6000	1.2000	1.1000
70.	0.2000	0.1000	0.1000	0.1000	0.8000	1.3000	1.3000	1.3000	1.0000	0.5000	0.5000	0.0000	1.5000	1.1000	1.2000
80.	0.2000	0.1000	0.1000	0.1000	1.0000	1.4000	1.4000	1.4000	1.2000	0.6000	0.5000	0.0000	1.7000	1.3000	1.2000
90.	0.4000	0.1000	0.1000	0.1000	1.3000	1.4000	1.4000	1.4000	1.1000	0.5000	0.4000	0.0000	1.6000	1.3000	1.1000
100.	0.9000	0.3000	0.1000	0.1000	1.9000	1.6000	1.5000	1.4000	1.0000	0.3000	0.2000	0.0000	1.6000	1.2000	1.2000
110.	1.2000	0.5000	0.4000	0.2000	2.2000	1.9000	1.7000	1.5000	0.6000	0.1000	0.2000	0.0000	1.3000	1.2000	1.1000
120.	1.3000	0.8000	0.5000	0.2000	2.4000	2.1000	1.9000	1.7000	0.3000	0.1000	0.2000	0.0000	1.3000	1.2000	1.2000
130.	1.1000	0.8000	0.6000	0.4000	2.3000	2.2000	2.2000	2.0000	0.2000	0.1000	0.2000	0.0000	1.3000	1.2000	1.2000
140.	1.2000	0.9000	0.5000	0.4000	2.5000	2.5000	2.4000	2.3000	0.4000	0.3000	0.4000	0.1000	1.3000	1.2000	1.2000
150.	1.4000	0.9000	0.8000	0.7000	2.2000	2.1000	2.1000	2.1000	0.7000	0.7000	0.8000	0.3000	1.2000	1.2000	1.0000
160.	1.8000	1.5000	1.3000	1.1000	1.6000	1.3000	1.4000	1.6000	1.5000	1.4000	1.4000	0.8000	0.7000	0.8000	0.7000
170.	2.0000	1.6000	1.6000	1.3000	1.2000	0.7000	0.7000	0.7000	1.9000	1.9000	1.9000	1.3000	0.3000	0.3000	0.3000
180.	2.1000	1.5000	1.5000	1.2000	0.8000	0.6000	0.4000	0.3000	1.9000	2.0000	2.1000	1.8000	0.1000	0.2000	0.2000
190.	1.9000	1.3000	1.2000	1.1000	0.8000	0.5000	0.3000	0.1000	1.7000	1.8000	1.8000	1.7000	0.1000	0.1000	0.1000
200.	1.6000	1.1000	1.0000	1.1000	0.8000	0.6000	0.3000	0.1000	1.4000	1.6000	1.6000	1.6000	0.1000	0.1000	0.1000
210.	1.5000	0.9000	0.9000	1.0000	0.8000	0.6000	0.3000	0.1000	1.2000	1.5000	1.5000	1.5000	0.1000	0.1000	0.1000
220.	1.4000	1.0000	0.8000	0.9000	0.9000	0.5000	0.3000	0.0000	1.0000	1.3000	1.3000	1.3000	0.1000	0.1000	0.1000
230.	1.5000	0.9000	0.9000	0.8000	1.1000	0.5000	0.4000	0.0000	0.9000	1.3000	1.3000	1.3000	0.1000	0.1000	0.1000
240.	1.5000	1.0000	0.9000	0.8000	1.2000	0.5000	0.4000	0.0000	0.8000	1.3000	1.3000	1.3000	0.1000	0.1000	0.1000
250.	1.6000	1.0000	1.0000	0.7000	1.3000	0.5000	0.3000	0.0000	0.8000	1.3000	1.3000	1.3000	0.0000	0.1000	0.1000
260.	1.6000	1.0000	0.9000	0.7000	1.3000	0.5000	0.2000	0.0000	0.8000	1.3000	1.3000	1.3000	0.1000	0.1000	0.1000
270.	1.8000	1.2000	0.9000	0.8000	1.3000	0.3000	0.1000	0.0000	1.1000	1.3000	1.3000	1.3000	0.3000	0.1000	0.1000
280.	1.6000	0.9000	0.9000	0.8000	1.1000	0.1000	0.0000	0.0000	1.4000	1.5000	1.3000	1.3000	0.5000	0.1000	0.1000
290.	1.4000	1.0000	0.9000	0.9000	0.6000	0.0000	0.0000	0.0000	1.9000	1.7000	1.6000	1.5000	0.9000	0.4000	0.2000
300.	1.2000	1.1000	1.1000	1.1000	0.3000	0.0000	0.0000	0.0000	2.3000	2.0000	1.9000	1.6000	1.0000	0.5000	0.3000
310.	1.3000	1.2000	1.2000	1.0000	0.1000	0.0000	0.0000	0.0000	2.2000	2.4000	2.3000	1.9000	0.8000	0.5000	0.4000
320.	1.4000	1.4000	1.3000	1.0000	0.3000	0.2000	0.2000	0.2000	2.3000	2.3000	2.4000	2.3000	1.0000	0.4000	0.4000
330.	1.1000	1.0000	1.0000	0.7000	0.7000	0.6000	0.6000	0.4000	2.0000	1.9000	2.2000	2.2000	1.3000	0.9000	0.8000

340.	*	0.7000	0.7000	0.7000	0.5000	1.4000	1.4000	1.2000	0.9000	1.5000	1.3000	1.5000	1.6000	1.8000	1.4000	1.2000
350.	*	0.4000	0.4000	0.4000	0.4000	1.8000	1.8000	1.8000	1.5000	1.0000	0.7000	0.7000	1.0000	2.1000	1.7000	1.6000
360.	*	0.2000	0.2000	0.2000	0.2000	1.9000	2.0000	2.0000	1.7000	0.7000	0.5000	0.3000	0.5000	1.9000	1.6000	1.6000
MAX	*	2.1000	1.6000	1.6000	1.3000	2.5000	2.5000	2.4000	2.3000	2.3000	2.4000	2.4000	2.3000	2.1000	1.7000	1.6000
DEGR.	*	180	170	170	170	140	140	140	140	300	310	320	320	350	350	350

JOB: Bow Concord RUN: Exit 13 SPUI 2035 Build AM pm2.5

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	1.2000	0.0000	0.0000	0.0000	1.0000	0.7000	0.2000	1.0000	0.8000	0.8000	1.6000	1.3000	0.9000
20.	1.2000	0.0000	0.0000	0.0000	1.0000	0.7000	0.3000	0.9000	0.7000	0.7000	1.5000	1.3000	0.9000
30.	1.3000	0.0000	0.0000	0.0000	0.9000	0.7000	0.3000	0.9000	0.7000	0.7000	1.3000	1.4000	0.9000
40.	1.3000	0.0000	0.0000	0.0000	0.8000	0.7000	0.3000	0.8000	0.7000	0.7000	1.2000	1.5000	1.0000
50.	1.1000	0.0000	0.0000	0.0000	0.9000	0.8000	0.4000	0.9000	0.8000	0.8000	1.3000	1.6000	1.1000
60.	1.2000	0.0000	0.0000	0.0000	0.9000	0.8000	0.4000	0.8000	0.8000	0.8000	1.3000	1.7000	1.1000
70.	1.0000	0.1000	0.1000	0.1000	0.8000	0.8000	0.4000	0.9000	0.9000	0.9000	1.3000	1.6000	1.1000
80.	1.0000	0.1000	0.1000	0.1000	0.9000	0.8000	0.5000	1.1000	1.2000	1.0000	1.4000	1.6000	1.2000
90.	0.9000	0.3000	0.3000	0.3000	1.2000	1.1000	0.8000	1.1000	1.2000	1.0000	1.4000	1.4000	1.3000
100.	1.0000	0.9000	0.8000	0.7000	1.5000	1.7000	1.4000	1.0000	1.0000	0.8000	1.3000	1.3000	1.0000
110.	1.0000	1.3000	1.1000	0.9000	2.1000	2.1000	1.7000	0.6000	0.7000	0.5000	1.1000	0.9000	0.8000
120.	1.1000	1.5000	1.2000	1.0000	2.1000	1.9000	1.7000	0.3000	0.4000	0.2000	1.0000	0.7000	0.4000
130.	1.0000	1.3000	1.0000	0.9000	2.1000	1.8000	1.5000	0.2000	0.3000	0.1000	0.9000	0.6000	0.3000
140.	0.9000	1.2000	1.0000	0.9000	1.9000	1.8000	1.3000	0.2000	0.3000	0.1000	0.9000	0.6000	0.2000
150.	0.9000	1.1000	1.0000	0.8000	1.7000	1.4000	1.0000	0.1000	0.2000	0.0000	0.7000	0.3000	0.0000
160.	0.5000	1.3000	1.0000	0.8000	1.2000	0.9000	0.8000	0.3000	0.2000	0.0000	0.4000	0.1000	0.0000
170.	0.3000	1.6000	1.3000	0.7000	0.9000	0.8000	0.8000	0.9000	0.4000	0.0000	0.0000	0.0000	0.0000
180.	0.2000	1.7000	1.7000	0.7000	1.0000	0.8000	0.8000	1.1000	0.8000	0.0000	0.0000	0.0000	0.0000
190.	0.1000	1.8000	2.0000	1.1000	0.9000	0.8000	0.8000	1.0000	1.0000	0.1000	0.0000	0.0000	0.0000
200.	0.1000	1.5000	1.9000	1.0000	0.9000	0.8000	0.8000	0.9000	0.9000	0.3000	0.0000	0.0000	0.0000
210.	0.1000	1.4000	1.8000	1.1000	0.8000	0.8000	0.8000	0.9000	0.8000	0.4000	0.0000	0.0000	0.0000
220.	0.1000	1.3000	1.8000	1.1000	0.8000	0.8000	0.8000	0.9000	0.7000	0.3000	0.0000	0.0000	0.0000
230.	0.1000	1.4000	1.8000	1.3000	1.0000	1.0000	0.8000	0.9000	0.7000	0.3000	0.0000	0.0000	0.0000
240.	0.1000	1.4000	1.8000	1.3000	1.1000	1.1000	0.9000	0.9000	0.7000	0.4000	0.0000	0.0000	0.0000
250.	0.1000	1.5000	1.8000	1.3000	1.2000	1.2000	0.9000	0.9000	0.8000	0.5000	0.0000	0.0000	0.0000
260.	0.1000	1.7000	1.8000	1.3000	1.3000	1.3000	0.7000	0.9000	0.7000	0.5000	0.1000	0.1000	0.1000
270.	0.1000	1.7000	1.8000	1.3000	1.2000	1.2000	0.6000	1.0000	1.0000	0.7000	0.1000	0.1000	0.1000
280.	0.1000	1.5000	1.5000	1.1000	1.1000	1.0000	0.5000	1.3000	1.5000	1.1000	0.6000	0.4000	0.2000
290.	0.1000	1.1000	1.0000	1.0000	0.6000	0.5000	0.3000	1.7000	1.6000	1.5000	0.9000	0.7000	0.4000
300.	0.1000	0.9000	0.9000	0.6000	0.3000	0.2000	0.1000	1.8000	1.8000	1.5000	1.1000	0.9000	0.5000
310.	0.2000	0.9000	0.8000	0.5000	0.1000	0.1000	0.1000	1.8000	1.7000	1.3000	1.0000	0.8000	0.6000
320.	0.3000	0.9000	0.8000	0.3000	0.1000	0.1000	0.1000	1.6000	1.6000	1.1000	1.0000	0.8000	0.7000
330.	0.5000	0.6000	0.4000	0.0000	0.1000	0.1000	0.1000	1.5000	1.2000	0.9000	1.0000	0.8000	0.8000

```
 340.  *  1.0000  0.2000  0.1000  0.0000  0.4000  0.0000  0.0000  1.2000  0.9000  0.7000  1.2000
0.8000  0.7000
 350.  *  1.4000  0.0000  0.0000  0.0000  0.7000  0.3000  0.0000  0.8000  0.7000  0.7000  1.3000
0.9000  0.6000
 360.  *  1.4000  0.0000  0.0000  0.0000  0.9000  0.6000  0.0000  0.9000  0.7000  0.7000  1.5000
1.3000  0.6000
 -------*-----------------------------------------------------------------------------------------------
---------
 MAX   *  1.4000  1.8000  2.0000  1.3000  2.1000  2.1000  1.7000  1.8000  1.8000  1.5000  1.6000
1.7000  1.3000
 DEGR. *    350     190     190     230     110     110     110     300     300     290      10      60
90

 THE HIGHEST CONCENTRATION OF   2.5000 UG/M**3 OCCURRED AT RECEPTOR     5.
```

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

```
                              CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045
PAGE  1

      JOB: Bow Concord                                        RUN: Exit 13 SPUI 2035 Build AM pm10

      DATE :  3/ 7/18
      TIME :  9: 5:33

         The MODE flag has been set for calculating concentrations for POLLUTANT:  PM-10

       SITE & METEOROLOGICAL VARIABLES
       -------------------------------
       VS =   0.0 CM/S      VD =   0.0 CM/S      Z0 = 175. CM
        U =  1.0 M/S        CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =  1000. M   AMB =  0.0
UG/M**3

       LINK VARIABLES
       --------------
         LINK DESCRIPTION     *         LINK COORDINATES (FT)          *    LENGTH  BRG TYPE   VPH
EF      H   W    V/C QUEUE
                              *   X1        Y1        X2        Y2     *     (FT)  (DEG)
(G/MI)  (FT) (FT)       (VEH)
      ------------------------*----------------------------------------*-------------------------------
---------------------------
       1. N Leg App - FreeFlow*    -81.0     -29.0    -423.0     910.0 *     999.   340. AG    385.
0.1   0.0 41.7
       2. N Leg App - Queue   *   -127.2      98.0    -394.2     830.9 *     780.   340. AG      0.
100.0   0.0 22.0 1.50  39.6
       3. N Leg Dep - FreeFlow*     81.0      29.0    -261.0     969.0 *    1000.   340. AG     87.
0.1   0.0 41.7
       4. S Leg App - FreeFlow*     81.0      29.0     423.0    -910.0 *     999.   160. AG    359.
0.1   0.0 41.7
       5. S Leg App - Queue   *    127.2     -98.0     346.9    -701.1 *     642.   160. AG      0.
100.0   0.0 22.0 1.40  32.6
       6. S Leg Dep - FreeFlow*    -81.0     -29.0     261.0    -969.0 *    1000.   160. AG    319.
0.1   0.0 41.7
       7. E Leg App - FreeFlow*      0.0      20.0     982.0    -189.0 *    1004.   102. AG    907.
0.1   0.0 52.7
       8. E Leg App - Queue   *    196.8     -21.8     258.2     -34.9 *      63.   102. AG      0.
100.0   0.0 33.0 0.34   3.2
       9. E Leg Dep - FreeFlow*      0.0     -20.0     974.0    -227.0 *     996.   102. AG    947.
0.1   0.0 52.7
      10. W Leg App - FreeFlow*      0.0     -20.0    -612.0     110.0 *     626.   282. AG    509.
0.1   0.0 52.7
      11. W Leg App - Queue   *   -196.8      21.8    -231.2      29.1 *      35.   282. AG      0.
100.0   0.0 33.0 0.19   1.8
      12. W Leg Dep - FreeFlow*      0.0      20.0    -604.0     148.0 *     617.   282. AG   1522.
0.1   0.0 52.7
      13. N Leg SLIP- FreeFlow*    121.0      29.0    -221.0     969.0 *    1000.   340. AG    280.
0.1   0.0 36.0
      14. SELeg SLIP-FreeFlow *    210.0    -300.0     400.0    -110.0 *     269.    45. AG    715.
0.1   0.0 32.0
      15. SWLeg SLIP-FreeFlow *   -140.0     -29.0     240.0    -969.0 *    1014.   158. AG    165.
0.1   0.0 32.0
      16. i93 NB              *   -306.8     951.8     377.2    -926.1 *    1999.   160. BR   3863.
0.0  22.0 56.0
      17. I 93 SB             *   -377.2     926.1     306.8    -951.8 *    1999.   160. BR   3304.
0.0  22.0 56.0
```

JOB: Bow Concord RUN: Exit 13 SPUI 2035 Build AM pm10

DATE : 3/ 7/18
TIME : 9: 5:33

2. N Leg App - Queue	*	100	82	8.0	385	1600	0.05	2
3								
5. S Leg App - Queue	*	100	82	8.0	359	1600	0.05	2
3								
8. E Leg App - Queue	*	100	38	4.0	907	1600	0.05	2
3								
11. W Leg App - Queue	*	100	38	4.0	509	1600	0.05	2
3								

RECEPTOR LOCATIONS

RECEPTOR	*	COORDINATES (FT) X	Y	Z	*
1. N Leg, E Side-Corner	*	104.9	24.7	5.9	*
2. N Leg, E Side - 25 m	*	80.2	92.4	5.9	*
3. N Leg, E Side - 50 m	*	52.2	169.5	5.9	*
4. N Leg, E Side-Midblk	*	-62.7	485.2	5.9	*
5. N Leg, W Side-Corner	*	-142.0	77.2	5.9	*
6. N Leg, W Side - 25 m	*	-166.6	144.9	5.9	*
7. N Leg, W Side - 50 m	*	-194.7	222.0	5.9	*
8. N Leg, W Side-Midblk	*	-309.6	537.7	5.9	*
9. S Leg, E Side-Corner	*	142.0	-77.2	5.9	*
10. S Leg, E Side - 25 m	*	166.6	-144.9	5.9	*
11. S Leg, E Side - 50 m	*	194.7	-222.0	5.9	*
12. S Leg, E Side-Midblk	*	309.6	-537.7	5.9	*
13. S Leg, W Side-Corner	*	-104.9	-24.7	5.9	*
14. S Leg, W Side - 25 m	*	-80.2	-92.4	5.9	*
15. S Leg, W Side - 50 m	*	-52.2	-169.5	5.9	*
16. S Leg, W Side-Midblk	*	62.7	-485.2	5.9	*
17. E Leg, N Side - 25 m	*	175.3	9.8	5.9	*
18. E Leg, N Side - 50 m	*	255.5	-7.3	5.9	*
19. E Leg, N Side-Midblk	*	491.7	-57.5	5.9	*
20. W Leg, N Side - 25 m	*	-212.4	92.2	5.9	*
21. W Leg, N Side - 50 m	*	-292.6	109.2	5.9	*
22. W Leg, N Side-Midblk	*	-528.8	159.4	5.9	*
23. E Leg, S Side - 25 m	*	212.4	-92.2	5.9	*
24. E Leg, S Side - 50 m	*	292.6	-109.2	5.9	*
25. E Leg, S Side-Midblk	*	528.8	-159.4	5.9	*
26. W Leg, S Side - 25 m	*	-175.3	-9.8	5.9	*
27. W Leg, S Side - 50 m	*	-255.5	7.3	5.9	*
28. W Leg, S Side-Midblk	*	-491.7	57.5	5.9	*

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	* CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	1.000	1.000	1.000	1.000	5.100	5.300	5.100	4.700	3.900	2.300	1.800	1.100	8.100	6.300	5.600
20.	0.900	0.900	0.900	0.900	4.500	4.700	4.700	4.400	3.700	2.400	1.700	0.900	7.400	5.800	5.000
30.	0.700	0.800	0.800	0.800	4.000	4.200	4.200	4.200	3.700	2.300	1.500	0.800	7.000	5.100	4.500
40.	0.800	0.700	0.700	0.700	3.700	3.900	3.900	3.900	3.900	2.400	1.700	0.800	6.900	4.700	4.400
50.	0.800	0.700	0.700	0.700	3.500	3.700	3.700	3.700	4.000	2.200	1.700	0.700	7.000	4.700	4.100
60.	0.800	0.700	0.700	0.700	3.500	3.700	3.700	3.700	4.600	2.400	2.200	0.600	7.000	5.100	4.400
70.	0.800	0.700	0.700	0.700	3.600	3.800	3.800	3.800	4.900	2.500	2.400	0.200	7.300	5.100	4.500
80.	1.100	0.700	0.700	0.700	4.000	3.600	3.700	3.700	5.400	2.700	2.400	0.000	7.600	5.300	4.600
90.	2.300	1.000	0.700	0.700	5.600	3.900	3.800	3.700	5.700	2.500	1.800	0.000	7.900	5.200	4.400
100.	4.800	1.700	1.000	0.700	8.900	4.900	4.400	3.900	4.800	1.700	1.200	0.100	7.300	4.600	3.900
110.	6.500	2.900	1.900	0.900	11.200	6.400	5.300	4.400	2.900	0.800	0.800	0.100	5.900	4.100	3.700
120.	6.700	3.800	2.500	1.200	11.700	7.700	6.500	5.200	1.300	0.500	0.800	0.100	4.900	4.000	3.900
130.	6.000	3.900	2.900	1.700	11.200	8.200	7.200	6.000	0.900	0.600	0.900	0.200	4.700	4.300	4.200
140.	5.600	4.000	3.300	2.300	10.800	8.500	8.000	7.000	1.000	0.900	1.100	0.400	4.800	4.500	4.400
150.	6.100	4.700	3.900	3.200	10.000	7.900	7.300	6.800	2.200	2.000	2.000	1.100	4.400	4.300	4.000
160.	7.600	5.900	5.300	4.600	8.100	6.000	5.500	5.300	3.800	3.800	3.800	2.400	3.000	2.900	2.800
170.	8.800	6.900	5.900	5.600	5.900	4.100	3.300	2.900	5.400	5.500	5.400	3.600	1.500	1.400	1.500
180.	8.700	6.600	5.700	5.100	5.100	3.100	2.100	1.400	5.600	5.800	5.800	4.600	0.700	0.800	0.900
190.	8.400	5.800	5.000	4.400	4.900	2.800	1.800	1.000	5.000	5.200	5.300	4.800	0.500	0.500	0.500
200.	7.700	5.500	4.600	4.100	4.600	2.700	1.700	0.900	4.400	4.600	4.600	4.500	0.300	0.500	0.500
210.	7.200	5.100	4.400	4.000	4.400	2.700	1.700	0.700	3.900	4.200	4.200	4.100	0.300	0.400	0.500
220.	7.100	4.800	4.400	3.600	4.800	2.600	1.900	0.500	3.600	3.900	3.900	3.900	0.400	0.300	0.300
230.	7.100	4.600	4.000	3.100	5.100	2.600	1.800	0.100	3.400	3.700	3.700	3.700	0.400	0.300	0.300
240.	7.600	4.900	4.200	2.900	5.600	2.700	1.700	0.000	3.300	3.700	3.700	3.700	0.400	0.300	0.300
250.	8.100	4.900	4.300	2.600	6.300	2.800	1.600	0.000	3.400	3.800	3.800	3.800	0.400	0.300	0.300
260.	8.800	5.200	4.100	2.500	6.900	2.600	1.100	0.000	3.700	3.600	3.700	3.700	0.500	0.300	0.300
270.	9.300	4.900	3.700	2.600	7.200	1.800	0.400	0.000	4.700	4.000	3.800	3.800	1.200	0.300	0.300
280.	8.500	4.100	3.100	2.800	6.100	0.900	0.200	0.100	6.700	4.700	4.200	3.900	2.900	0.800	0.400
290.	6.600	3.500	3.200	3.100	3.600	0.300	0.100	0.100	8.900	5.900	5.100	4.200	4.300	1.700	1.000
300.	4.900	3.400	3.300	3.300	1.600	0.100	0.100	0.100	9.700	7.200	6.000	4.900	5.000	2.600	1.600
310.	4.400	3.700	3.700	3.500	0.900	0.200	0.200	0.200	9.600	7.800	7.000	5.800	4.900	2.900	2.100
320.	4.600	4.200	4.200	3.500	1.000	0.500	0.500	0.400	9.600	8.100	7.500	7.000	4.900	3.100	2.600
330.	4.700	4.100	3.900	3.100	2.100	1.700	1.600	1.200	8.600	7.400	7.200	7.000	5.600	4.100	3.300

340.	*	3.500	3.200	3.100	2.300	4.100	3.400	3.400	2.600	7.200	5.600	5.500	5.200	7.100	5.400	4.800
350.	*	2.200	2.100	2.100	1.700	5.400	5.200	5.100	3.700	5.200	3.800	3.300	2.800	8.400	6.700	6.100
360.	*	1.400	1.400	1.400	1.300	5.500	5.500	5.500	4.600	4.100	2.700	2.100	1.500	8.500	6.900	6.200
MAX	*	9.300	6.900	5.900	5.600	11.700	8.500	8.000	7.000	9.700	8.100	7.500	7.000	8.500	6.900	6.200
DEGR.	*	270	170	170	170	120	140	140	140	300	320	320	330	360	360	360

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	4.900	0.000	0.000	0.000	3.200	2.200	0.600	3.900	3.700	3.700	6.700	5.800	4.300
20.	4.600	0.000	0.000	0.000	2.900	2.100	1.000	3.800	3.600	3.600	6.300	5.700	4.700
30.	4.300	0.000	0.000	0.000	2.800	2.100	1.300	3.800	3.600	3.600	6.000	5.700	5.000
40.	4.000	0.100	0.100	0.100	2.800	2.200	1.500	3.800	3.700	3.700	5.900	5.900	5.000
50.	3.800	0.200	0.200	0.200	2.700	2.100	1.600	4.000	3.900	3.900	5.900	5.700	5.200
60.	3.700	0.300	0.300	0.300	2.800	2.200	1.600	4.400	4.400	4.400	6.200	6.100	5.400
70.	3.500	0.400	0.400	0.400	2.900	2.400	1.800	4.800	4.900	4.800	6.500	6.500	5.700
80.	3.100	0.800	0.800	0.700	3.300	2.900	2.400	5.400	5.500	5.000	7.000	6.800	6.200
90.	2.900	2.100	2.000	1.900	5.100	4.700	4.300	5.800	5.800	5.000	7.400	7.000	6.400
100.	3.000	4.500	4.300	3.900	8.300	8.000	7.500	4.800	4.900	3.800	6.700	6.300	5.600
110.	3.400	6.300	5.900	5.400	10.200	9.800	9.400	2.800	3.000	2.100	4.800	4.400	3.600
120.	3.600	6.600	6.200	5.800	10.500	9.800	9.300	1.300	1.500	0.900	3.700	2.900	2.300
130.	3.900	5.900	5.600	5.300	9.500	9.100	7.900	0.800	1.000	0.400	3.400	2.600	1.500
140.	3.900	5.400	5.200	4.800	8.800	8.000	6.700	0.600	0.900	0.200	3.200	2.200	1.000
150.	3.500	5.100	4.900	4.400	7.500	6.800	5.600	0.800	0.800	0.200	2.700	1.400	0.300
160.	2.400	5.500	4.800	4.000	6.000	5.300	4.800	1.400	1.000	0.100	1.200	0.600	0.100
170.	1.500	6.400	5.400	3.800	4.700	4.300	4.300	2.700	1.700	0.100	0.400	0.000	0.000
180.	0.800	7.100	6.300	4.200	4.600	4.400	4.400	3.200	2.500	0.100	0.000	0.000	0.000
190.	0.700	7.200	6.800	4.800	4.900	4.700	4.700	3.300	2.900	0.500	0.000	0.000	0.000
200.	0.600	6.800	6.600	5.100	4.600	4.500	4.500	3.000	2.700	1.200	0.000	0.000	0.000
210.	0.500	6.400	6.300	5.300	4.400	4.300	4.300	2.800	2.400	1.300	0.000	0.000	0.000
220.	0.400	6.300	6.500	5.700	4.600	4.600	4.400	2.800	2.300	1.400	0.100	0.100	0.100
230.	0.400	6.400	6.500	6.200	5.000	5.000	4.600	2.700	2.100	1.600	0.100	0.100	0.100
240.	0.400	6.600	6.900	6.600	5.500	5.500	4.600	2.700	2.100	1.700	0.100	0.100	0.100
250.	0.400	7.200	7.300	6.800	6.200	6.000	4.500	2.800	2.300	2.000	0.200	0.200	0.200
260.	0.400	7.800	7.700	7.400	6.700	6.600	3.900	3.000	2.400	2.400	0.300	0.300	0.300
270.	0.400	8.500	8.200	7.600	7.000	6.600	3.300	4.100	3.800	3.700	1.100	0.900	0.500
280.	0.400	7.800	7.500	6.700	5.800	5.400	2.600	6.100	5.900	5.900	2.500	2.200	1.000
290.	0.600	5.700	5.200	4.400	3.300	3.100	1.500	8.000	7.300	7.100	4.000	3.600	1.700
300.	0.700	4.000	3.300	2.400	1.400	1.400	0.800	8.500	8.000	7.200	4.900	4.500	2.500
310.	1.100	3.600	2.800	1.700	0.700	0.700	0.500	8.100	7.600	6.300	4.800	4.600	3.200
320.	1.800	3.400	2.400	1.100	0.500	0.400	0.400	7.400	7.000	5.400	4.500	4.300	3.600
330.	2.800	2.800	1.700	0.700	0.600	0.400	0.400	6.500	5.800	4.500	4.500	4.000	3.800

340.	*	4.500	1.400	0.600	0.200	1.300	0.500	0.300	5.100	4.400	3.800	4.900	4.100	3.700
350.	*	5.700	0.400	0.100	0.100	2.100	1.000	0.100	4.100	3.600	3.600	5.800	4.700	3.600
360.	*	5.400	0.000	0.000	0.000	3.000	1.700	0.200	3.700	3.500	3.600	6.500	5.500	3.800
MAX	*	5.700	8.500	8.200	7.600	10.500	9.800	9.400	8.500	8.000	7.200	7.400	7.000	6.400
DEGR.	*	350	270	270	270	120	110	110	300	300	300	90	90	90

THE HIGHEST CONCENTRATION OF 11.700 UG/M**3 OCCURRED AT RECEPTOR 5.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

```
                         CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045
PAGE  1

      JOB: Bow Concord                                        RUN: Exit 13 SPUI 2035 Build PM CO

      DATE :  3/ 7/18
      TIME :  9:41:34

         The MODE flag has been set for calculating concentrations for POLLUTANT:  CO

       SITE & METEOROLOGICAL VARIABLES
       -------------------------------
       VS =   0.0 CM/S       VD =   0.0 CM/S       Z0 = 175. CM
        U =  1.0 M/S         CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =  1000. M   AMB =  0.0
PPM

       LINK VARIABLES
       --------------
         LINK DESCRIPTION     *         LINK COORDINATES (FT)          *    LENGTH  BRG TYPE   VPH
EF      H   W    V/C QUEUE
                              *   X1        Y1        X2        Y2     *     (FT)  (DEG)
(G/MI)  (FT) (FT)       (VEH)
      ------------------------*----------------------------------------*-------------------------------
---------------------------
       1. N Leg App - FreeFlow*    -81.0     -29.0    -423.0     910.0 *     999.   340. AG    391.
1.0   0.0 41.7
       2. N Leg App - Queue   *   -127.2      98.0    -162.5     194.7 *     103.   340. AG      7.
100.0   0.0 22.0 0.81   5.2
       3. N Leg Dep - FreeFlow*     81.0      29.0    -261.0     969.0 *    1000.   340. AG    375.
1.0   0.0 41.7
       4. S Leg App - FreeFlow*     81.0      29.0     423.0    -910.0 *     999.   160. AG    199.
1.0   0.0 41.7
       5. S Leg App - Queue   *    127.2     -98.0     144.3    -144.8 *      50.   160. AG      7.
100.0   0.0 22.0 0.41   2.5
       6. S Leg Dep - FreeFlow*    -81.0     -29.0     261.0    -969.0 *    1000.   160. AG    894.
1.3   0.0 41.7
       7. E Leg App - FreeFlow*      0.0      20.0     982.0    -189.0 *    1004.   102. AG   1525.
0.8   0.0 52.7
       8. E Leg App - Queue   *    196.8     -21.8     354.4     -55.4 *     161.   102. AG      7.
100.0   0.0 33.0 0.68   8.2
       9. E Leg Dep - FreeFlow*      0.0     -20.0     974.0    -227.0 *     996.   102. AG   1527.
1.2   0.0 52.7
      10. W Leg App - FreeFlow*      0.0     -20.0    -612.0     110.0 *     626.   282. AG    971.
1.1   0.0 52.7
      11. W Leg App - Queue   *   -196.8      21.8    -297.0      43.1 *     102.   282. AG      7.
100.0   0.0 33.0 0.43   5.2
      12. W Leg Dep - FreeFlow*      0.0      20.0    -604.0     148.0 *     617.   282. AG    830.
1.0   0.0 52.7
      13. N Leg SLIP- FreeFlow*    121.0      29.0    -221.0     969.0 *    1000.   340. AG    383.
1.0   0.0 36.0
      14. SELeg SLIP-FreeFlow *    210.0    -300.0     400.0    -110.0 *     269.    45. AG    541.
1.9   0.0 32.0
      15. SWLeg SLIP-FreeFlow *   -140.0     -29.0     240.0    -969.0 *    1014.   158. AG    311.
1.1   0.0 32.0
      16. i93 NB              *   -306.8     951.8     377.2    -926.1 *    1999.   160. BR   4380.
0.8  22.0 56.0
      17. I 93 SB             *   -377.2     926.1     306.8    -951.8 *    1999.   160. BR   4000.
0.8  22.0 56.0
```

JOB: Bow Concord RUN: Exit 13 SPUI 2035 Build PM CO

DATE : 3/ 7/18
TIME : 9:41:34

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
2. N Leg App - Queue	120	92	8.0	391	1600	1.75	2	3
5. S Leg App - Queue	120	92	8.0	199	1600	1.75	2	3
8. E Leg App - Queue	120	58	4.0	1525	1600	1.75	2	3
11. W Leg App - Queue	120	58	4.0	971	1600	1.75	2	3

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. N Leg, E Side-Corner	104.9	24.7	5.9
2. N Leg, E Side - 25 m	80.2	92.4	5.9
3. N Leg, E Side - 50 m	52.2	169.5	5.9
4. N Leg, E Side-Midblk	-62.7	485.2	5.9
5. N Leg, W Side-Corner	-142.0	77.2	5.9
6. N Leg, W Side - 25 m	-166.6	144.9	5.9
7. N Leg, W Side - 50 m	-194.7	222.0	5.9
8. N Leg, W Side-Midblk	-309.6	537.7	5.9
9. S Leg, E Side-Corner	142.0	-77.2	5.9
10. S Leg, E Side - 25 m	166.6	-144.9	5.9
11. S Leg, E Side - 50 m	194.7	-222.0	5.9
12. S Leg, E Side-Midblk	309.6	-537.7	5.9
13. S Leg, W Side-Corner	-104.9	-24.7	5.9
14. S Leg, W Side - 25 m	-80.2	-92.4	5.9
15. S Leg, W Side - 50 m	-52.2	-169.5	5.9
16. S Leg, W Side-Midblk	62.7	-485.2	5.9
17. E Leg, N Side - 25 m	175.3	9.8	5.9
18. E Leg, N Side - 50 m	255.5	-7.3	5.9
19. E Leg, N Side-Midblk	491.7	-57.5	5.9
20. W Leg, N Side - 25 m	-212.4	92.2	5.9
21. W Leg, N Side - 50 m	-292.6	109.2	5.9
22. W Leg, N Side-Midblk	-528.8	159.4	5.9
23. E Leg, S Side - 25 m	212.4	-92.2	5.9
24. E Leg, S Side - 50 m	292.6	-109.2	5.9
25. E Leg, S Side-Midblk	528.8	-159.4	5.9
26. W Leg, S Side - 25 m	-175.3	-9.8	5.9
27. W Leg, S Side - 50 m	-255.5	7.3	5.9
28. W Leg, S Side-Midblk	-491.7	57.5	5.9

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	*	CONCENTRATION (PPM) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	*	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.2000
20.	*	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000
30.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
70.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
80.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
100.	*	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
110.	*	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
120.	*	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000
130.	*	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.2000	0.2000
140.	*	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.2000	0.2000	0.2000
150.	*	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.2000	0.2000	0.2000
160.	*	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000
170.	*	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000
180.	*	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
190.	*	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
200.	*	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
210.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
220.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
280.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
290.	*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000
300.	*	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.2000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000
310.	*	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.2000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
320.	*	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.2000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
330.	*	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.2000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000

```
 340.  *  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.1000  0.0000  0.1000
0.1000  0.0000  0.0000  0.0000
 350.  *  0.0000  0.0000  0.0000  0.0000  0.1000  0.1000  0.1000  0.0000  0.1000  0.0000  0.0000
0.0000  0.1000  0.1000  0.1000
 360.  *  0.0000  0.0000  0.0000  0.0000  0.1000  0.1000  0.1000  0.1000  0.1000  0.0000  0.0000
0.0000  0.1000  0.1000  0.2000
 -------*-----------------------------------------------------------------------------------------
-------------------------
 MAX   *  0.1000  0.1000  0.1000  0.1000  0.1000  0.1000  0.1000  0.1000  0.2000  0.1000  0.1000
0.1000  0.2000  0.2000  0.2000
 DEGR. *    100     170     170     160      10      10      10      10     300     170     170     180
140     130      10
```

JOB: Bow Concord RUN: Exit 13 SPUI 2035 Build PM CO

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
20.	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
30.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
40.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
50.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
60.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
70.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
80.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.1000
90.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.1000
100.	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
110.	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000
120.	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
130.	0.2000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
140.	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
150.	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
160.	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
170.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
180.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
190.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
200.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
210.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
220.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250.	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260.	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270.	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
280.	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
290.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000
300.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000
310.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
320.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2000	0.1000	0.1000	0.0000	0.0000	0.0000
330.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000

```
 340.  *  0.1000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.1000  0.1000  0.1000  0.0000
0.0000  0.0000
 350.  *  0.2000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.1000  0.1000  0.1000  0.0000
0.0000  0.0000
 360.  *  0.2000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.1000  0.1000  0.1000  0.0000
0.0000  0.0000
 ------*------------------------------------------------------------------------------------------
---------
 MAX   *  0.2000  0.1000  0.1000  0.1000  0.0000  0.0000  0.0000  0.2000  0.1000  0.1000  0.1000
0.1000  0.1000
 DEGR. *     10     100     100     110      10      10      10     320      10      10     290     290
80

 THE HIGHEST CONCENTRATION OF   0.2000 PPM OCCURRED AT RECEPTOR    15.
```

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

JOB: Bow Concord RUN: Exit 13 SPUI 2035 Build PM pm2.5

DATE : 3/ 7/18
TIME : 9:36: 5

The MODE flag has been set for calculating concentrations for POLLUTANT: PM2.5

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S VD = 0.0 CM/S Z0 = 175. CM
U = 1.0 M/S CLAS = 4 (D) ATIM = 60. MINUTES MIXH = 1000. M AMB = 0.0 UG/M**3

LINK VARIABLES

LINK DESCRIPTION	*	X1	Y1	X2	Y2	*	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	*	-81.0	-29.0	-423.0	910.0	*	999.	340.	AG	391.	0.0	0.0	41.7		
2. N Leg App - Queue	*	-127.2	98.0	-162.5	194.7	*	103.	340.	AG	0.	100.0	0.0	22.0	0.81	5.2
3. N Leg Dep - FreeFlow	*	81.0	29.0	-261.0	969.0	*	1000.	340.	AG	375.	0.0	0.0	41.7		
4. S Leg App - FreeFlow	*	81.0	29.0	423.0	-910.0	*	999.	160.	AG	199.	0.0	0.0	41.7		
5. S Leg App - Queue	*	127.2	-98.0	144.3	-144.8	*	50.	160.	AG	0.	100.0	0.0	22.0	0.41	2.5
6. S Leg Dep - FreeFlow	*	-81.0	-29.0	261.0	-969.0	*	1000.	160.	AG	894.	0.0	0.0	41.7		
7. E Leg App - FreeFlow	*	0.0	20.0	982.0	-189.0	*	1004.	102.	AG	1525.	0.0	0.0	52.7		
8. E Leg App - Queue	*	196.8	-21.8	354.4	-55.4	*	161.	102.	AG	0.	100.0	0.0	33.0	0.68	8.2
9. E Leg Dep - FreeFlow	*	0.0	-20.0	974.0	-227.0	*	996.	102.	AG	1527.	0.0	0.0	52.7		
10. W Leg App - FreeFlow	*	0.0	-20.0	-612.0	110.0	*	626.	282.	AG	971.	0.0	0.0	52.7		
11. W Leg App - Queue	*	-196.8	21.8	-297.0	43.1	*	102.	282.	AG	0.	100.0	0.0	33.0	0.43	5.2
12. W Leg Dep - FreeFlow	*	0.0	20.0	-604.0	148.0	*	617.	282.	AG	830.	0.0	0.0	52.7		
13. N Leg SLIP- FreeFlow	*	121.0	29.0	-221.0	969.0	*	1000.	340.	AG	383.	0.0	0.0	36.0		
14. SELeg SLIP-FreeFlow	*	210.0	-300.0	400.0	-110.0	*	269.	45.	AG	541.	0.0	0.0	32.0		
15. SWLeg SLIP-FreeFlow	*	-140.0	-29.0	240.0	-969.0	*	1014.	158.	AG	311.	0.0	0.0	32.0		
16. i93 NB	*	-306.8	951.8	377.2	-926.1	*	1999.	160.	BR	4380.	0.0	22.0	56.0		
17. I 93 SB	*	-377.2	926.1	306.8	-951.8	*	1999.	160.	BR	4000.	0.0	22.0	56.0		

DATE : 3/ 7/18
TIME : 9:36: 5

2. N Leg App - Queue	*	120	92	8.0	391	1600	0.04	2
3								
5. S Leg App - Queue	*	120	92	8.0	199	1600	0.04	2
3								
8. E Leg App - Queue	*	120	58	4.0	1525	1600	0.04	2
3								
11. W Leg App - Queue	*	120	58	4.0	971	1600	0.04	2
3								

RECEPTOR LOCATIONS

RECEPTOR	X (FT)	Y (FT)	Z (FT)
1. N Leg, E Side-Corner	104.9	24.7	5.9
2. N Leg, E Side - 25 m	80.2	92.4	5.9
3. N Leg, E Side - 50 m	52.2	169.5	5.9
4. N Leg, E Side-Midblk	-62.7	485.2	5.9
5. N Leg, W Side-Corner	-142.0	77.2	5.9
6. N Leg, W Side - 25 m	-166.6	144.9	5.9
7. N Leg, W Side - 50 m	-194.7	222.0	5.9
8. N Leg, W Side-Midblk	-309.6	537.7	5.9
9. S Leg, E Side-Corner	142.0	-77.2	5.9
10. S Leg, E Side - 25 m	166.6	-144.9	5.9
11. S Leg, E Side - 50 m	194.7	-222.0	5.9
12. S Leg, E Side-Midblk	309.6	-537.7	5.9
13. S Leg, W Side-Corner	-104.9	-24.7	5.9
14. S Leg, W Side - 25 m	-80.2	-92.4	5.9
15. S Leg, W Side - 50 m	-52.2	-169.5	5.9
16. S Leg, W Side-Midblk	62.7	-485.2	5.9
17. E Leg, N Side - 25 m	175.3	9.8	5.9
18. E Leg, N Side - 50 m	255.5	-7.3	5.9
19. E Leg, N Side-Midblk	491.7	-57.5	5.9
20. W Leg, N Side - 25 m	-212.4	92.2	5.9
21. W Leg, N Side - 50 m	-292.6	109.2	5.9
22. W Leg, N Side-Midblk	-528.8	159.4	5.9
23. E Leg, S Side - 25 m	212.4	-92.2	5.9
24. E Leg, S Side - 50 m	292.6	-109.2	5.9
25. E Leg, S Side-Midblk	528.8	-159.4	5.9
26. W Leg, S Side - 25 m	-175.3	-9.8	5.9
27. W Leg, S Side - 50 m	-255.5	7.3	5.9
28. W Leg, S Side-Midblk	-491.7	57.5	5.9

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	0.2000	0.3000	0.3000	0.3000	1.5000	1.4000	0.9000	0.9000	1.1000	0.7000	0.5000	0.2000	1.6000	1.6000	1.7000
20.	0.2000	0.2000	0.2000	0.2000	1.4000	1.4000	0.9000	0.9000	1.0000	0.7000	0.5000	0.2000	1.6000	1.6000	1.5000
30.	0.2000	0.2000	0.2000	0.2000	1.1000	1.3000	0.8000	0.8000	1.0000	0.7000	0.5000	0.2000	1.4000	1.4000	1.4000
40.	0.2000	0.2000	0.2000	0.2000	1.0000	1.3000	0.8000	0.8000	1.1000	0.8000	0.5000	0.2000	1.4000	1.6000	1.4000
50.	0.2000	0.2000	0.2000	0.2000	0.8000	1.2000	0.7000	0.7000	1.4000	0.8000	0.4000	0.2000	1.4000	1.4000	1.3000
60.	0.2000	0.2000	0.2000	0.2000	0.8000	1.2000	0.7000	0.7000	1.5000	0.8000	0.5000	0.2000	1.6000	1.6000	1.4000
70.	0.2000	0.2000	0.2000	0.2000	0.7000	1.2000	0.7000	0.7000	1.7000	0.8000	0.6000	0.0000	1.7000	1.6000	1.5000
80.	0.3000	0.2000	0.2000	0.2000	0.9000	1.2000	0.7000	0.7000	1.8000	0.7000	0.5000	0.0000	2.0000	1.7000	1.4000
90.	0.7000	0.2000	0.2000	0.2000	1.3000	1.4000	0.8000	0.8000	1.8000	0.8000	0.4000	0.0000	2.3000	1.8000	1.4000
100.	1.5000	0.5000	0.3000	0.2000	1.7000	1.6000	0.9000	0.8000	1.4000	0.4000	0.2000	0.0000	2.2000	1.5000	1.2000
110.	1.8000	0.9000	0.5000	0.2000	2.2000	1.8000	1.2000	0.8000	0.8000	0.2000	0.1000	0.0000	1.7000	1.1000	1.0000
120.	1.9000	1.0000	0.8000	0.3000	2.1000	2.1000	1.6000	1.1000	0.4000	0.1000	0.1000	0.0000	1.4000	1.2000	1.2000
130.	1.6000	1.0000	0.8000	0.5000	2.0000	2.0000	1.6000	1.1000	0.2000	0.1000	0.1000	0.0000	1.3000	1.3000	1.3000
140.	1.4000	1.0000	0.9000	0.6000	1.9000	2.2000	2.1000	1.4000	0.2000	0.1000	0.1000	0.0000	1.4000	1.5000	1.5000
150.	1.4000	1.1000	1.0000	0.7000	2.0000	1.9000	1.8000	1.4000	0.4000	0.3000	0.3000	0.1000	1.6000	1.5000	1.5000
160.	1.7000	1.5000	1.4000	1.2000	1.7000	1.4000	1.3000	1.2000	0.6000	0.6000	0.6000	0.3000	1.1000	1.1000	1.1000
170.	2.1000	1.8000	1.6000	1.7000	1.1000	0.8000	0.6000	0.5000	1.3000	1.0000	1.1000	0.5000	0.6000	0.7000	0.7000
180.	2.2000	2.1000	1.7000	1.4000	0.7000	0.5000	0.4000	0.3000	1.4000	1.0000	1.0000	0.8000	0.2000	0.4000	0.4000
190.	2.1000	1.8000	1.4000	1.2000	0.7000	0.5000	0.3000	0.2000	1.4000	1.0000	1.0000	0.9000	0.1000	0.2000	0.3000
200.	2.0000	1.5000	1.4000	1.1000	0.6000	0.5000	0.3000	0.2000	1.3000	0.9000	0.9000	0.9000	0.1000	0.1000	0.1000
210.	1.9000	1.6000	1.3000	1.1000	0.6000	0.5000	0.3000	0.0000	1.2000	0.9000	0.9000	0.9000	0.1000	0.1000	0.1000
220.	1.8000	1.4000	0.9000	0.9000	0.7000	0.5000	0.2000	0.0000	0.9000	0.7000	0.7000	0.7000	0.1000	0.1000	0.1000
230.	1.8000	1.2000	0.9000	0.7000	0.9000	0.5000	0.2000	0.0000	0.9000	0.7000	0.7000	0.7000	0.1000	0.1000	0.1000
240.	1.9000	1.2000	0.9000	0.7000	0.9000	0.5000	0.2000	0.0000	0.8000	0.7000	0.7000	0.7000	0.1000	0.1000	0.1000
250.	2.0000	1.1000	1.0000	0.7000	1.0000	0.4000	0.2000	0.0000	0.8000	0.8000	0.7000	0.7000	0.2000	0.1000	0.1000
260.	1.9000	1.1000	1.0000	0.7000	1.0000	0.3000	0.2000	0.0000	0.8000	0.8000	0.7000	0.7000	0.2000	0.1000	0.1000
270.	2.0000	1.1000	1.0000	0.7000	1.0000	0.2000	0.0000	0.0000	1.1000	0.9000	0.7000	0.7000	0.4000	0.1000	0.1000
280.	1.7000	1.0000	0.8000	0.7000	0.6000	0.1000	0.0000	0.0000	1.6000	1.1000	0.7000	0.7000	0.7000	0.2000	0.1000
290.	1.5000	1.0000	0.9000	0.9000	0.4000	0.0000	0.0000	0.0000	2.1000	1.7000	1.1000	0.9000	1.1000	0.4000	0.2000
300.	1.3000	1.0000	1.0000	1.0000	0.1000	0.0000	0.0000	0.0000	2.3000	1.6000	1.1000	0.9000	1.1000	0.5000	0.3000
310.	1.2000	1.1000	1.1000	1.0000	0.1000	0.0000	0.0000	0.0000	2.4000	1.9000	1.3000	1.1000	1.0000	0.7000	0.6000
320.	1.4000	1.3000	1.2000	1.1000	0.1000	0.1000	0.1000	0.1000	2.4000	2.1000	1.6000	1.2000	0.9000	0.7000	0.6000
330.	1.3000	1.2000	1.2000	1.0000	0.4000	0.3000	0.3000	0.1000	2.2000	2.0000	1.6000	1.3000	1.1000	0.8000	0.8000

340.	0.9000	1.0000	1.0000	0.7000	1.0000	0.8000	0.7000	0.4000	1.9000	1.5000	1.3000	0.9000	1.4000	1.3000	1.2000
350.	0.5000	0.6000	0.6000	0.5000	1.4000	1.2000	0.9000	0.7000	1.3000	0.9000	0.7000	0.4000	1.8000	1.7000	1.6000
360.	0.3000	0.4000	0.4000	0.4000	1.6000	1.4000	1.1000	0.9000	1.1000	0.6000	0.5000	0.2000	1.8000	1.6000	1.8000
MAX	2.2000	2.1000	1.7000	1.7000	2.2000	2.2000	2.1000	1.4000	2.4000	2.1000	1.6000	1.3000	2.3000	1.8000	1.8000
DEGR.	180	180	180	170	110	140	140	150	310	320	320	330	90	90	360

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	1.5000	0.0000	0.0000	0.0000	0.7000	0.5000	0.1000	1.3000	1.4000	1.1000	1.4000	1.6000	0.8000
20.	1.4000	0.0000	0.0000	0.0000	0.7000	0.5000	0.2000	1.3000	1.3000	1.0000	1.3000	1.6000	0.8000
30.	1.2000	0.0000	0.0000	0.0000	0.7000	0.5000	0.2000	1.3000	1.2000	1.0000	1.3000	1.6000	0.8000
40.	1.3000	0.0000	0.0000	0.0000	0.7000	0.5000	0.2000	1.3000	1.2000	1.0000	1.1000	1.7000	0.8000
50.	1.1000	0.1000	0.1000	0.1000	0.7000	0.5000	0.2000	1.5000	1.3000	1.2000	1.1000	1.7000	0.8000
60.	1.1000	0.1000	0.1000	0.1000	0.7000	0.6000	0.2000	1.6000	1.4000	1.3000	1.2000	1.7000	1.0000
70.	1.1000	0.1000	0.1000	0.1000	0.7000	0.7000	0.3000	1.6000	1.4000	1.4000	1.3000	1.7000	1.1000
80.	0.9000	0.2000	0.2000	0.2000	0.7000	0.7000	0.3000	1.6000	1.5000	1.5000	1.7000	1.9000	1.2000
90.	1.0000	0.7000	0.7000	0.4000	1.1000	1.0000	0.5000	1.7000	1.7000	1.5000	1.8000	1.8000	1.4000
100.	1.0000	1.3000	1.3000	1.1000	1.4000	1.4000	0.9000	1.4000	1.4000	1.1000	1.6000	1.8000	1.4000
110.	1.0000	2.0000	1.9000	1.5000	1.8000	1.5000	1.3000	0.8000	0.8000	0.7000	1.2000	1.1000	0.9000
120.	1.2000	2.2000	2.2000	1.6000	1.7000	1.7000	1.5000	0.4000	0.4000	0.2000	1.0000	0.8000	0.5000
130.	1.3000	1.9000	2.0000	1.5000	1.8000	1.6000	1.1000	0.2000	0.2000	0.1000	1.0000	0.8000	0.4000
140.	1.5000	1.8000	2.0000	1.4000	1.5000	1.5000	1.0000	0.2000	0.2000	0.1000	0.9000	0.7000	0.3000
150.	1.3000	1.5000	1.8000	1.2000	1.5000	1.5000	0.7000	0.2000	0.2000	0.1000	0.9000	0.5000	0.0000
160.	1.0000	1.3000	1.7000	1.1000	1.2000	1.1000	0.7000	0.2000	0.1000	0.0000	0.4000	0.2000	0.0000
170.	0.7000	1.5000	1.7000	1.0000	0.8000	0.8000	0.6000	0.5000	0.2000	0.0000	0.1000	0.0000	0.0000
180.	0.3000	1.9000	2.0000	1.1000	0.8000	0.8000	0.6000	0.7000	0.4000	0.0000	0.0000	0.0000	0.0000
190.	0.3000	2.0000	2.2000	1.3000	0.9000	0.8000	0.7000	0.7000	0.7000	0.1000	0.0000	0.0000	0.0000
200.	0.2000	1.8000	2.1000	1.3000	0.9000	0.6000	0.5000	0.6000	0.7000	0.2000	0.0000	0.0000	0.0000
210.	0.2000	1.7000	1.9000	1.3000	0.9000	0.6000	0.5000	0.6000	0.6000	0.2000	0.0000	0.0000	0.0000
220.	0.1000	1.7000	2.2000	1.5000	0.9000	0.6000	0.5000	0.6000	0.5000	0.3000	0.0000	0.0000	0.0000
230.	0.1000	1.7000	2.2000	1.5000	0.9000	0.7000	0.6000	0.8000	0.6000	0.4000	0.0000	0.0000	0.0000
240.	0.1000	1.8000	2.2000	1.7000	0.9000	0.7000	0.6000	0.8000	0.6000	0.4000	0.0000	0.0000	0.0000
250.	0.1000	2.0000	2.2000	1.8000	0.9000	0.8000	0.5000	0.9000	0.6000	0.5000	0.1000	0.1000	0.1000
260.	0.1000	1.9000	2.3000	1.9000	0.8000	0.8000	0.3000	0.9000	0.8000	0.6000	0.1000	0.1000	0.1000
270.	0.1000	2.0000	2.1000	2.1000	0.8000	0.8000	0.3000	1.1000	1.1000	0.8000	0.4000	0.2000	0.2000
280.	0.1000	1.7000	1.7000	1.7000	0.6000	0.6000	0.2000	1.6000	1.4000	1.6000	0.8000	0.6000	0.3000
290.	0.2000	1.3000	1.1000	1.1000	0.3000	0.3000	0.1000	1.9000	1.9000	2.1000	1.2000	0.9000	0.4000
300.	0.2000	0.9000	0.9000	0.6000	0.1000	0.1000	0.1000	2.0000	2.2000	2.0000	1.4000	1.0000	0.6000
310.	0.3000	0.9000	0.8000	0.4000	0.1000	0.1000	0.0000	2.0000	2.1000	1.8000	1.3000	1.2000	0.7000
320.	0.4000	0.9000	0.8000	0.3000	0.0000	0.0000	0.0000	2.1000	2.2000	1.5000	1.1000	1.2000	0.7000
330.	0.9000	0.7000	0.5000	0.1000	0.0000	0.0000	0.0000	1.9000	1.9000	1.3000	0.9000	1.2000	0.7000

```
 340.  *  1.5000  0.4000  0.1000  0.0000  0.1000  0.0000  0.0000  1.7000  1.5000  1.1000  0.9000
1.1000  0.6000
 350.  *  1.6000  0.0000  0.0000  0.0000  0.4000  0.2000  0.0000  1.2000  1.3000  1.0000  1.2000
1.2000  0.6000
 360.  *  1.8000  0.0000  0.0000  0.0000  0.6000  0.4000  0.0000  1.2000  1.3000  1.0000  1.3000
1.5000  0.6000
 -------*-----------------------------------------------------------------------------------------------
---------
 MAX   *  1.8000  2.2000  2.3000  2.1000  1.8000  1.7000  1.5000  2.1000  2.2000  2.1000  1.8000
1.9000  1.4000
 DEGR. *    360     120     260     270     110     120     120     320     300     290      90      80
90

 THE HIGHEST CONCENTRATION OF   2.4000 UG/M**3 OCCURRED AT RECEPTOR     9.
```

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045

JOB: Bow Concord   RUN: Exit 13 SPUI 2035 Build PM pm10

DATE : 3/ 7/18
TIME : 9:46: 8

The MODE flag has been set for calculating concentrations for POLLUTANT: PM-10

SITE & METEOROLOGICAL VARIABLES

VS = 0.0 CM/S   VD = 0.0 CM/S   Z0 = 175. CM
U = 1.0 M/S   CLAS = 4 (D)   ATIM = 60. MINUTES   MIXH = 1000. M   AMB = 0.0 UG/M**3

LINK VARIABLES

LINK DESCRIPTION	X1	Y1	X2	Y2	LENGTH (FT)	BRG (DEG)	TYPE	VPH	EF (G/MI)	H (FT)	W (FT)	V/C	QUEUE (VEH)
1. N Leg App - FreeFlow	-81.0	-29.0	-423.0	910.0	999.	340.	AG	391.	0.1	0.0	41.7		
2. N Leg App - Queue	-127.2	98.0	-162.5	194.7	103.	340.	AG	0.	100.0	0.0	22.0	0.81	5.2
3. N Leg Dep - FreeFlow	81.0	29.0	-261.0	969.0	1000.	340.	AG	375.	0.1	0.0	41.7		
4. S Leg App - FreeFlow	81.0	29.0	423.0	-910.0	999.	160.	AG	199.	0.1	0.0	41.7		
5. S Leg App - Queue	127.2	-98.0	144.3	-144.8	50.	160.	AG	0.	100.0	0.0	22.0	0.41	2.5
6. S Leg Dep - FreeFlow	-81.0	-29.0	261.0	-969.0	1000.	160.	AG	894.	0.1	0.0	41.7		
7. E Leg App - FreeFlow	0.0	20.0	982.0	-189.0	1004.	102.	AG	1525.	0.1	0.0	52.7		
8. E Leg App - Queue	196.8	-21.8	354.4	-55.4	161.	102.	AG	0.	100.0	0.0	33.0	0.68	8.2
9. E Leg Dep - FreeFlow	0.0	-20.0	974.0	-227.0	996.	102.	AG	1527.	0.1	0.0	52.7		
10. W Leg App - FreeFlow	0.0	-20.0	-612.0	110.0	626.	282.	AG	971.	0.1	0.0	52.7		
11. W Leg App - Queue	-196.8	21.8	-297.0	43.1	102.	282.	AG	0.	100.0	0.0	33.0	0.43	5.2
12. W Leg Dep - FreeFlow	0.0	20.0	-604.0	148.0	617.	282.	AG	830.	0.1	0.0	52.7		
13. N Leg SLIP- FreeFlow	121.0	29.0	-221.0	969.0	1000.	340.	AG	383.	0.1	0.0	36.0		
14. SELeg SLIP-FreeFlow	210.0	-300.0	400.0	-110.0	269.	45.	AG	541.	0.1	0.0	32.0		
15. SWLeg SLIP-FreeFlow	-140.0	-29.0	240.0	-969.0	1014.	158.	AG	311.	0.1	0.0	32.0		
16. i93 NB	-306.8	951.8	377.2	-926.1	1999.	160.	BR	4380.	0.0	22.0	56.0		
17. I 93 SB	-377.2	926.1	306.8	-951.8	1999.	160.	BR	4000.	0.0	22.0	56.0		

DATE : 3/ 7/18
TIME : 9:46: 8

2. N Leg App - Queue	120	92	8.0	391	1600	0.04	2	3
5. S Leg App - Queue	120	92	8.0	199	1600	0.04	2	3
8. E Leg App - Queue	120	58	4.0	1525	1600	0.04	2	3
11. W Leg App - Queue	120	58	4.0	971	1600	0.04	2	3

RECEPTOR LOCATIONS

RECEPTOR	COORDINATES (FT) X	Y	Z
1. N Leg, E Side-Corner	104.9	24.7	5.9
2. N Leg, E Side - 25 m	80.2	92.4	5.9
3. N Leg, E Side - 50 m	52.2	169.5	5.9
4. N Leg, E Side-Midblk	-62.7	485.2	5.9
5. N Leg, W Side-Corner	-142.0	77.2	5.9
6. N Leg, W Side - 25 m	-166.6	144.9	5.9
7. N Leg, W Side - 50 m	-194.7	222.0	5.9
8. N Leg, W Side-Midblk	-309.6	537.7	5.9
9. S Leg, E Side-Corner	142.0	-77.2	5.9
10. S Leg, E Side - 25 m	166.6	-144.9	5.9
11. S Leg, E Side - 50 m	194.7	-222.0	5.9
12. S Leg, E Side-Midblk	309.6	-537.7	5.9
13. S Leg, W Side-Corner	-104.9	-24.7	5.9
14. S Leg, W Side - 25 m	-80.2	-92.4	5.9
15. S Leg, W Side - 50 m	-52.2	-169.5	5.9
16. S Leg, W Side-Midblk	62.7	-485.2	5.9
17. E Leg, N Side - 25 m	175.3	9.8	5.9
18. E Leg, N Side - 50 m	255.5	-7.3	5.9
19. E Leg, N Side-Midblk	491.7	-57.5	5.9
20. W Leg, N Side - 25 m	-212.4	92.2	5.9
21. W Leg, N Side - 50 m	-292.6	109.2	5.9
22. W Leg, N Side-Midblk	-528.8	159.4	5.9
23. E Leg, S Side - 25 m	212.4	-92.2	5.9
24. E Leg, S Side - 50 m	292.6	-109.2	5.9
25. E Leg, S Side-Midblk	528.8	-159.4	5.9
26. W Leg, S Side - 25 m	-175.3	-9.8	5.9
27. W Leg, S Side - 50 m	-255.5	7.3	5.9
28. W Leg, S Side-Midblk	-491.7	57.5	5.9

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10.	1.400	1.500	1.500	1.500	5.100	5.100	4.600	4.100	6.000	3.500	2.500	1.400	8.000	7.600	7.500
20.	1.100	1.300	1.300	1.300	4.600	4.700	4.200	4.100	5.700	3.500	2.500	1.400	7.500	7.400	7.100
30.	1.100	1.100	1.100	1.100	4.100	4.400	3.700	3.800	5.600	3.400	2.300	1.200	7.100	7.000	6.900
40.	1.000	1.000	1.000	1.000	3.700	3.900	3.400	3.400	5.800	3.500	2.500	1.200	6.900	6.900	6.400
50.	1.200	0.900	0.900	0.900	3.600	3.800	3.300	3.300	6.300	3.700	2.600	1.100	7.200	7.100	6.200
60.	1.200	0.900	0.900	0.900	3.500	3.700	3.200	3.200	7.100	3.800	2.900	0.800	7.900	7.400	6.500
70.	1.100	0.900	0.900	0.900	3.600	3.800	3.300	3.300	7.700	4.100	3.100	0.400	8.700	7.800	6.800
80.	1.700	0.900	0.900	0.900	4.000	3.700	3.200	3.200	8.400	4.100	3.000	0.100	10.200	7.900	6.800
90.	3.700	1.300	1.000	0.900	5.700	4.100	3.300	3.200	8.900	3.500	2.100	0.000	11.100	7.600	5.900
100.	7.400	2.500	1.600	1.000	8.900	5.600	4.100	3.400	7.400	2.100	1.100	0.000	10.600	6.300	5.100
110.	9.900	4.300	2.600	1.300	10.900	7.600	5.700	4.100	4.000	0.800	0.600	0.000	7.700	5.200	4.700
120.	10.100	5.600	3.900	1.900	10.400	8.500	7.000	5.000	1.800	0.500	0.600	0.100	5.900	5.100	5.000
130.	8.900	5.600	4.400	2.500	9.500	8.200	7.300	5.900	0.900	0.400	0.600	0.100	5.800	5.600	5.500
140.	8.200	5.600	4.700	3.200	9.700	8.200	7.400	6.700	0.900	0.600	0.800	0.200	6.500	6.300	6.300
150.	7.900	6.000	5.400	4.400	9.300	8.000	7.200	6.500	1.500	1.200	1.300	0.600	6.600	6.500	6.400
160.	9.000	7.300	6.800	6.400	7.600	5.900	5.800	4.600	2.800	2.500	2.600	1.400	5.000	5.000	5.000
170.	10.300	8.600	7.900	7.400	5.400	3.700	3.300	2.400	4.500	4.000	4.000	2.500	2.800	3.000	3.000
180.	10.500	8.900	8.100	6.400	4.100	2.600	2.000	1.100	4.900	4.500	4.400	3.300	1.300	1.600	1.600
190.	10.600	8.400	7.200	5.400	3.600	2.200	1.600	0.800	4.800	4.400	4.400	3.800	0.800	1.000	1.000
200.	9.900	7.800	6.200	4.600	3.500	2.000	1.500	0.700	4.300	3.900	3.800	3.700	0.600	0.800	0.900
210.	9.300	7.100	5.300	4.300	3.400	2.100	1.500	0.500	3.900	3.500	3.500	3.400	0.600	0.800	0.800
220.	9.300	6.500	5.000	4.000	3.600	2.200	1.400	0.300	3.600	3.200	3.300	3.300	0.600	0.700	0.700
230.	9.700	5.900	4.400	3.600	3.800	2.100	1.300	0.000	3.500	3.100	3.100	3.200	0.700	0.500	0.600
240.	10.000	5.700	4.600	3.300	4.100	2.100	1.300	0.000	3.400	3.000	3.000	3.000	0.700	0.500	0.600
250.	10.400	5.300	4.800	3.200	4.500	2.100	1.200	0.000	3.400	3.100	3.000	3.100	0.700	0.500	0.600
260.	10.600	5.200	4.300	3.000	4.900	1.900	0.700	0.000	3.800	3.200	3.000	3.100	0.900	0.500	0.600
270.	10.400	5.100	4.000	3.200	4.700	1.200	0.300	0.000	5.000	3.400	3.000	3.100	1.900	0.600	0.600
280.	9.400	4.400	3.800	3.400	3.800	0.700	0.100	0.100	7.700	4.400	3.500	3.300	3.600	1.200	0.800
290.	7.100	4.200	3.800	3.800	2.100	0.200	0.100	0.100	9.900	5.700	4.300	3.600	4.900	2.100	1.300
300.	5.400	4.000	4.000	4.000	0.900	0.100	0.100	0.100	10.600	6.600	5.100	4.000	5.300	2.900	1.900
310.	5.300	4.700	4.700	4.400	0.600	0.200	0.200	0.200	11.000	7.600	5.900	4.800	4.800	3.000	2.500
320.	5.900	5.400	5.300	4.800	0.700	0.500	0.400	0.300	11.300	8.400	6.900	5.700	4.600	3.300	3.000
330.	6.100	5.600	5.600	4.600	1.700	1.400	1.200	1.000	11.000	8.500	7.000	5.900	5.300	4.000	3.800

340.	*	5.100	4.700	4.500	3.700	3.400	2.900	2.800	2.000	9.400	6.600	5.600	4.600	6.700	6.000	6.000
350.	*	3.100	3.100	3.000	2.800	5.100	4.600	4.200	3.100	7.400	4.800	3.800	2.600	8.100	7.700	7.500
360.	*	2.000	2.000	2.000	1.900	5.600	5.200	4.800	3.800	6.100	3.800	2.900	1.600	8.600	8.100	8.000
MAX	*	10.600	8.900	8.100	7.400	10.900	8.500	7.400	6.700	11.300	8.500	7.000	5.900	11.100	8.100	8.000
DEGR.	*	190	180	180	170	110	120	140	140	320	330	330	330	90	360	360

MODEL RESULTS

REMARKS : In search of the angle corresponding to the maximum concentration, only the first angle, of the angles with same maximum concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (UG/M**3) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	7.000	0.000	0.000	0.000	3.100	2.200	0.600	6.100	6.100	5.800	6.600	6.300	4.300
20.	6.200	0.000	0.000	0.000	3.000	2.400	1.200	5.900	5.900	5.600	6.300	6.300	4.600
30.	5.800	0.100	0.100	0.100	3.000	2.200	1.400	5.800	5.800	5.500	6.200	6.100	4.700
40.	5.400	0.200	0.200	0.200	2.900	2.200	1.500	6.000	5.900	5.700	6.000	6.100	4.800
50.	5.200	0.400	0.400	0.400	2.900	2.300	1.600	6.400	6.300	6.100	6.200	6.200	5.000
60.	5.000	0.500	0.500	0.500	3.000	2.300	1.600	7.100	6.900	6.800	6.600	6.700	5.400
70.	4.800	0.600	0.600	0.600	3.000	2.400	1.700	7.600	7.500	7.300	7.300	7.100	5.900
80.	4.200	1.300	1.300	1.200	3.500	2.800	2.100	8.400	8.300	7.900	8.500	7.900	6.600
90.	3.700	3.400	3.300	2.900	4.800	4.200	3.500	8.800	8.700	7.800	9.700	8.900	7.700
100.	4.000	7.200	6.900	6.000	7.400	7.100	5.900	7.100	7.100	6.000	9.000	8.400	7.000
110.	4.500	9.900	9.600	8.500	9.400	8.400	7.300	4.100	4.000	3.200	6.500	5.800	4.800
120.	5.000	10.200	10.100	9.100	8.900	8.400	7.200	1.700	1.900	1.300	4.800	4.000	2.500
130.	5.500	9.000	9.200	8.400	8.100	7.600	6.200	0.900	1.100	0.600	4.300	3.200	2.000
140.	6.000	8.100	8.400	7.500	7.800	6.800	5.100	0.700	0.900	0.400	4.400	3.100	1.400
150.	5.800	7.300	7.700	6.800	6.900	5.800	4.200	0.700	0.800	0.300	3.700	2.000	0.600
160.	4.800	7.300	7.400	6.200	5.200	4.600	3.400	1.100	0.800	0.200	2.000	0.700	0.100
170.	3.000	8.200	7.600	5.900	3.900	3.500	3.200	2.200	1.500	0.100	0.700	0.100	0.100
180.	1.800	8.900	8.400	6.100	3.400	3.400	3.200	3.000	2.300	0.100	0.100	0.000	0.000
190.	1.300	9.400	9.100	7.000	3.700	3.500	3.400	3.100	2.700	0.700	0.000	0.000	0.000
200.	1.100	9.000	8.900	7.300	3.600	3.300	3.200	2.900	2.700	1.100	0.000	0.000	0.000
210.	1.000	8.500	8.700	7.400	3.500	3.200	3.100	2.700	2.600	1.500	0.000	0.000	0.000
220.	0.800	8.600	8.800	7.700	3.700	3.400	3.100	2.800	2.400	1.500	0.100	0.100	0.100
230.	0.700	8.900	9.000	8.300	3.800	3.600	3.200	2.800	2.200	1.600	0.200	0.200	0.200
240.	0.700	9.500	9.600	9.000	4.100	3.900	3.000	2.900	2.200	1.700	0.200	0.200	0.200
250.	0.700	10.100	10.400	9.600	4.400	4.200	2.600	3.000	2.400	2.100	0.300	0.300	0.300
260.	0.700	10.600	10.800	10.400	4.500	4.400	2.100	3.400	2.900	2.600	0.600	0.600	0.500
270.	0.700	10.700	10.900	11.000	4.400	4.100	1.800	4.700	4.600	4.300	1.600	1.400	0.900
280.	0.800	9.000	9.100	9.600	3.500	3.100	1.300	7.200	7.200	7.400	3.300	3.000	1.800
290.	1.000	6.600	6.200	6.000	1.800	1.700	0.800	9.400	9.500	10.100	4.700	4.300	2.500
300.	1.200	4.800	4.100	3.400	0.700	0.700	0.400	10.400	10.300	10.300	5.300	5.000	3.200
310.	1.600	4.200	3.300	2.300	0.400	0.300	0.300	10.300	10.200	9.300	4.900	4.900	3.600
320.	2.600	4.200	2.900	1.600	0.200	0.200	0.200	10.200	9.600	8.000	4.400	4.600	3.700
330.	4.100	3.400	2.000	0.900	0.400	0.200	0.200	9.100	8.400	6.900	4.200	4.300	3.700

340.	*	6.700	1.800	0.900	0.300	0.900	0.300	0.100	7.500	6.900	5.900	4.600	4.400	3.400
350.	*	8.300	0.500	0.100	0.100	2.100	0.900	0.100	6.100	5.800	5.500	5.700	4.800	3.300
360.	*	8.100	0.000	0.000	0.000	2.900	1.700	0.100	5.700	5.900	5.600	6.400	5.700	3.600
MAX	*	8.300	10.700	10.900	11.000	9.400	8.400	7.300	10.400	10.300	10.300	9.700	8.900	7.700
DEGR.	*	350	270	270	270	110	110	110	300	300	300	90	90	90

THE HIGHEST CONCENTRATION OF 11.300 UG/M**3 OCCURRED AT RECEPTOR 9.

*** EPA CAL3QHC Model Run implemented using the FHWA Resource Center CAL3i graphical user interface

```
                         CAL3QHC: LINE SOURCE DISPERSION MODEL - VERSION 2.0 Dated 13045
PAGE  1

      JOB: Bow Concord                                        RUN: Exit 14 SB 2035 Build AM co

      DATE :  3/ 1/18
      TIME : 11:32:45

         The MODE flag has been set for calculating concentrations for POLLUTANT:  CO

       SITE & METEOROLOGICAL VARIABLES
       -------------------------------
       VS =   0.0 CM/S       VD =   0.0 CM/S       Z0 = 175. CM
        U =  1.0 M/S         CLAS =   4  (D)     ATIM =  60. MINUTES     MIXH =  1000. M   AMB =  0.0
PPM

       LINK VARIABLES
       --------------
         LINK DESCRIPTION     *         LINK COORDINATES (FT)          *    LENGTH  BRG TYPE   VPH
EF      H   W    V/C QUEUE
                              *   X1        Y1        X2        Y2     *     (FT)  (DEG)
(G/MI)  (FT) (FT)       (VEH)
      ------------------------*----------------------------------------*-------------------------------
---------------------------
       1. N Leg App - FreeFlow*      0.0       0.0    -110.0     990.0 *     996.   354. AG    267.
0.7   0.0 43.7
       2. N Leg App - Queue   *     -7.1      63.9    -110.8     996.9 *     939.   354. AG      9.
100.0   0.0 24.0 2.51  47.7
       3. S Leg Dep - FreeFlow*      0.0       0.0     250.0    -970.0 *    1002.   166. AG    831.
0.8   0.0 43.7
       4. E Leg App - FreeFlow*      0.0      30.0     440.0     100.0 *     446.    81. AG   1706.
1.1   0.0 67.7
       5. E Leg App - Queue   *     25.5      34.1      94.5      45.1 *      70.    81. AG      5.
100.0   0.0 48.0 0.37   3.5
       6. E Leg Dep - FreeFlow*     10.0     -30.0     450.0      60.0 *     449.    78. AG   1279.
1.1   0.0 55.7
       7. W Leg App - FreeFlow*     10.0     -30.0    -900.0    -160.0 *     919.   262. AG   1428.
0.7   0.0 55.7
       8. W Leg App - Queue   *     -7.7     -32.5    -162.2     -54.6 *     156.   262. AG      7.
100.0   0.0 36.0 0.64   7.9
       9. W Leg Dep - FreeFlow*      0.0      30.0    -900.0    -130.0 *     914.   260. AG   1291.
1.5   0.0 67.7
      10. I93 NB N Leg - FF   *    170.0      30.0      20.0    1010.0 *     991.   351. BR   4380.
0.8  22.0 62.0
      11. I93 NB S Leg - FF   *    170.0      30.0     380.0    -940.0 *     992.   168. BR   4380.
0.8  22.0 62.0
      12. I93 SB N Leg - FF   *     90.0      20.0     -70.0    1010.0 *    1003.   351. BR   4000.
0.8  22.0 62.0
      13. I93 SB S Leg - FF   *     90.0      20.0     310.0    -970.0 *    1014.   167. BR   4000.
0.8  22.0 62.0
```

DATE : 3/ 1/18
TIME : 11:32:45

ADDITIONAL QUEUE LINK PARAMETERS

LINK DESCRIPTION	CYCLE LENGTH (SEC)	RED TIME (SEC)	CLEARANCE LOST TIME (SEC)	APPROACH VOL (VPH)	SATURATION FLOW RATE (VPH)	IDLE EM FAC (gm/hr)	SIGNAL TYPE	ARRIVAL RATE
2. N Leg App - Queue	120	112	2.0	267	1600	1.74	2	3
5. E Leg App - Queue	120	30	2.0	1706	1600	1.74	2	3
8. W Leg App - Queue	120	60	2.0	1428	1600	1.74	2	3

RECEPTOR LOCATIONS

RECEPTOR	X (FT)	Y (FT)	Z (FT)
1. N Leg, E Side-Corner	20.0	60.0	5.9
2. N Leg, E Side - 25 m	0.0	160.0	5.9
3. N Leg, E Side - 50 m	-10.0	240.0	5.9
4. N Leg, E Side-Midblk	-40.0	500.0	5.9
5. N Leg, W Side-Corner	-40.0	50.0	5.9
6. N Leg, W Side - 25 m	-50.0	150.0	5.9
7. N Leg, W Side - 50 m	-60.0	230.0	5.9
8. N Leg, W Side-Midblk	-90.0	490.0	5.9
9. S Leg, E Side-Corner	50.0	-60.0	5.9
10. S Leg, E Side - 25 m	60.0	-140.0	5.9
11. S Leg, E Side - 50 m	80.0	-220.0	5.9
12. S Leg, E Side-Midblk	140.0	-480.0	5.9
13. S Leg, W Side-Corner	-20.0	-70.0	5.9
14. S Leg, W Side - 25 m	10.0	-150.0	5.9
15. S Leg, W Side - 50 m	30.0	-240.0	5.9
16. S Leg, W Side-Midblk	90.0	-500.0	5.9
17. E Leg, N Side - 25 m	130.0	90.0	5.9
18. E Leg, N Side - 50 m	230.0	100.0	5.9
19. E Leg, N Side-Midblk	339.7	115.6	5.9
20. W Leg, N Side - 25 m	-120.0	50.0	5.9
21. W Leg, N Side - 50 m	-240.0	10.0	5.9
22. W Leg, N Side-Midblk	-460.0	-30.0	5.9
23. E Leg, S Side - 25 m	160.0	-40.0	5.9
24. E Leg, S Side - 50 m	260.0	-20.0	5.9
25. E Leg, S Side-Midblk	359.2	7.3	5.9
26. W Leg, S Side - 25 m	-120.0	-100.0	5.9
27. W Leg, S Side - 50 m	-210.0	-100.0	5.9
28. W Leg, S Side-Midblk	-440.0	-120.0	5.9

JOB: Bow Concord RUN: Exit 14 SB 2035 Build AM co

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR) *	CONCENTRATION (PPM) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10. *	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000
20. *	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000
30. *	0.1000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
70. *	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
80. *	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90. *	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
100. *	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
110. *	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
120. *	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
130. *	0.1000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
140. *	0.2000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
150. *	0.2000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
160. *	0.2000	0.1000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000
170. *	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
180. *	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
190. *	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
200. *	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
210. *	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
220. *	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230. *	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240. *	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250. *	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260. *	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270. *	0.1000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
280. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
290. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
300. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
310. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
320. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
330. *	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

```
 340.  *  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000
 350.  *  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.1000  0.0000  0.0000
0.0000  0.0000  0.0000  0.0000
 360.  *  0.1000  0.1000  0.1000  0.1000  0.0000  0.0000  0.0000  0.0000  0.1000  0.1000  0.0000
0.1000  0.0000  0.0000  0.0000
 ------*---------------------------------------------------------------------------------------------
-------------------------
 MAX   *  0.2000  0.1000  0.1000  0.1000  0.1000  0.0000  0.0000  0.0000  0.1000  0.1000  0.1000
0.1000  0.0000  0.0000  0.0000
 DEGR. *    140      10      10      10      80      10      10      10      10     130      20      10
10      10      10
```

MODEL RESULTS

REMARKS : In search of the angle corresponding to
the maximum concentration, only the first
angle, of the angles with same maximum
concentrations, is indicated as maximum.

WIND ANGLE RANGE: 10.-360.

WIND ANGLE (DEGR)	CONCENTRATION (PPM) 16	17	18	19	20	21	22	23	24	25	26	27	28
10.	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
20.	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30.	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
50.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
60.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
70.	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000
80.	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
90.	0.0000	0.1000	0.1000	0.1000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
100.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
110.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
120.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
130.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
140.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
150.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
160.	0.0000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
170.	0.0000	0.3000	0.1000	0.1000	0.1000	0.1000	0.1000	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000
180.	0.0000	0.2000	0.2000	0.1000	0.1000	0.1000	0.1000	0.2000	0.1000	0.0000	0.0000	0.0000	0.0000
190.	0.0000	0.1000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000
200.	0.0000	0.1000	0.2000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000
210.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000
220.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
230.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
240.	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
250.	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
260.	0.0000	0.0000	0.1000	0.1000	0.1000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
270.	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000
280.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.1000
290.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000
300.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
310.	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
320.	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000
330.	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000

340.	*	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000	0.2000	0.1000	0.0000	0.0000	0.0000	0.0000
350.	*	0.0000	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000	0.2000	0.0000	0.0000	0.0000	0.0000	0.0000
360.	*	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0000	0.0000
MAX	*	0.0000	0.3000	0.2000	0.1000	0.1000	0.1000	0.1000	0.2000	0.1000	0.1000	0.0000	0.0000	0.1000
DEGR.	*	10	170	180	90	100	70	70	170	180	270	10	10	70

THE HIGHEST CONCENTRATION OF 0.3000 PPM OCCURRED AT RECEPTOR 17.

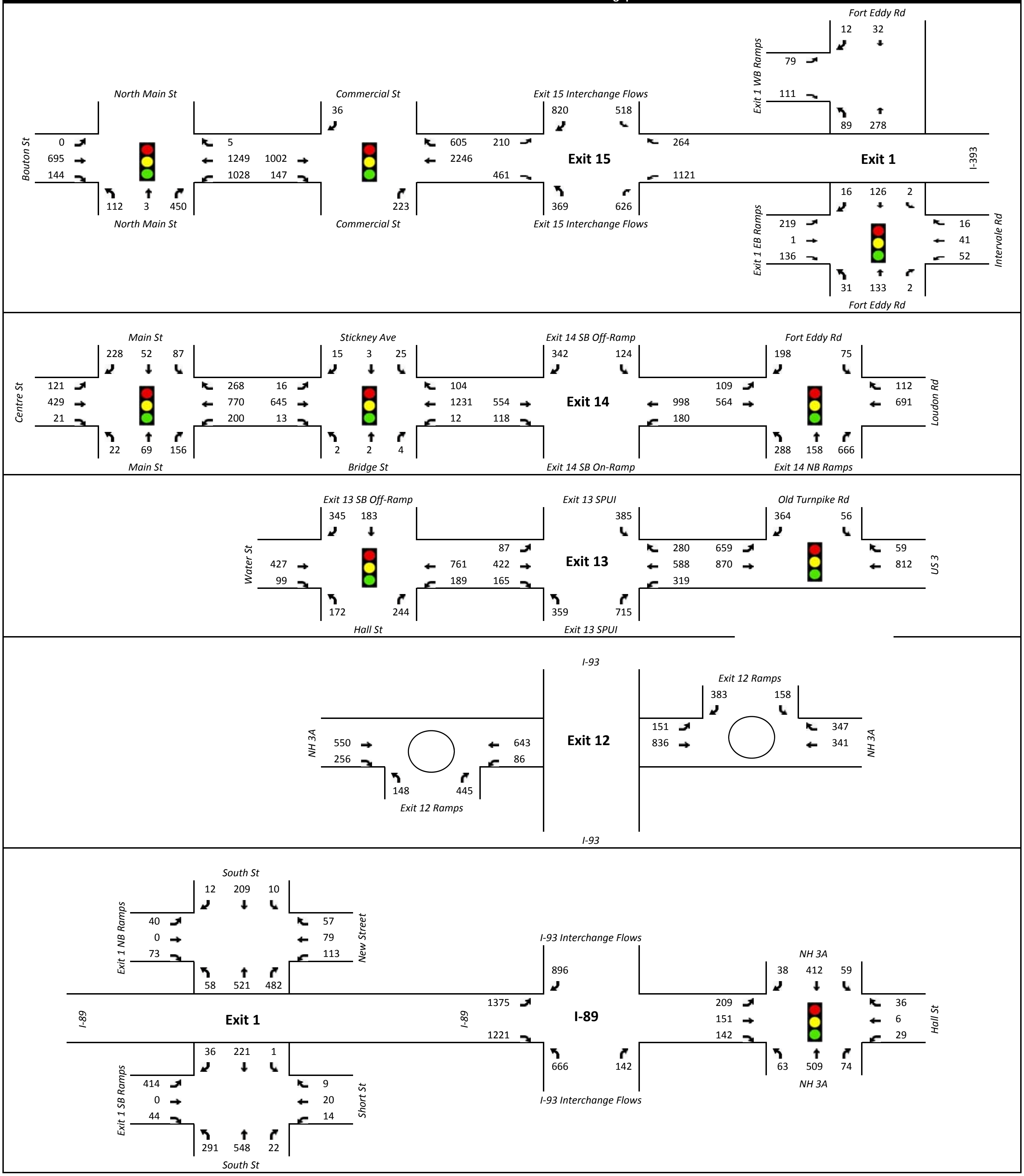
APPENDIX B

TRAFFIC DATA

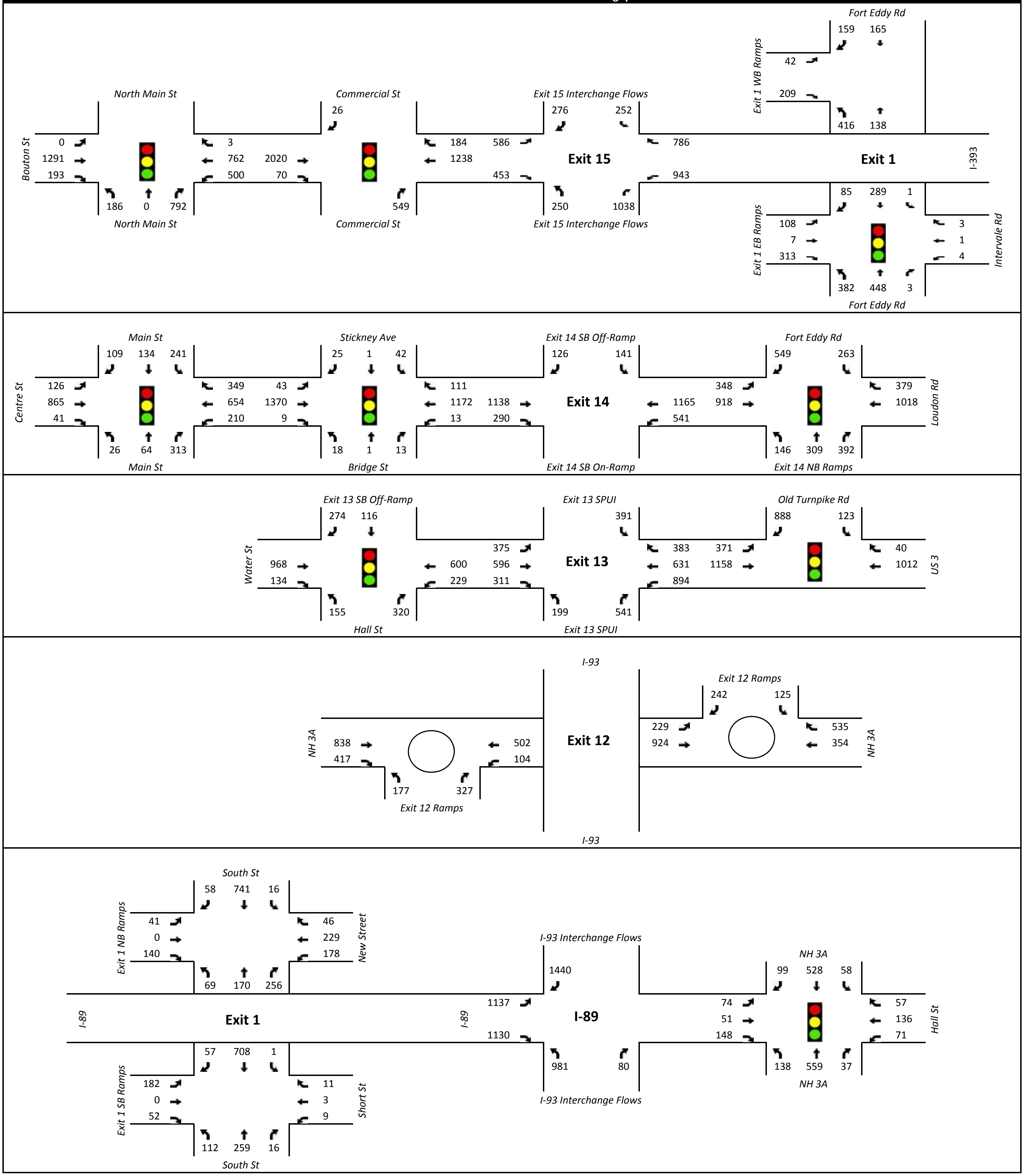
APPENDIX B

TRAFFIC DATA

Scenario D - 2035 AM Peak Hour Model Throughput



Scenario D - 2035 PM Peak Hour Model Throughput



Loudon Road & Stickney Ave

Coord Beg of Yellow

Yield Point: By Phase

	Cycle	Offset
AM	120	39
PM	120	77

	Barrier 1		Barrier 2	
Ring 1	1	2		4
Ring 2	5	6		8

Phase	1	2	4	5	6	8
Movement	WBL	EBT	SB	EBL	WBT	NB
Min Green	5	6	6	5	6	6
Yellow	4	4	4	4	4	4
All Red	2	2	2	2	2	2
Extension	2		3	2		3
AM Recall		Max			Max	
PM Recall		Max			Max	
Simult Gap (	Yes	Yes	Yes	Yes	Yes	Yes
Coordinated		Yes			Yes	
Walk + FDW		15	10		15	
Max Inhibit	No	-	No	No	-	No
AM Split	16	88	16	16	88	16
PM Split	20.4	83.6	16	16	88	16

Loudon Road & Exit 14 SB Ramps

Coord Beg of Yellow

Yield Point: By Phase

	Cycle	Offset
AM	120	16
PM	120	77

	Barrier 1		Barrier 2	
Ring 1	1	2		4
Ring 2		6		

Phase	1	2	4	6
Movement	WBL	EBT	SB	WBT
Min Green	6	6	6	6
Yellow	4	4	4	4
All Red	2	2	2	2
Extension	3	3	3	3
AM Recall		Min		Min
PM Recall		Max		Max
Simult Gap Out	Yes	Yes	Yes	Yes
Coordinated		Yes		Yes
Walk + FDW		15		15
Max Inhibit	No	-	No	-
AM Split	19	40	61	59
PM Split	36	60.3	23.7	96.3

Loudon Road & Fort Eddy Road

Coord Beg of Yellow

Yield Point: By Phase

	Cycle	Offset
AM	120	97
PM	120	74

	Barrier 1		Barrier 2	
Ring 1		2		
Ring 2	5	6	8	7

Phase	2	5	6	7	8
Movement	EBT	WBL (+SBR)	WBT	SB	NB
Min Green	4	4	4	4	4
Yellow	4	4	4	4	4
All Red	2	2	2	2	2
Extension	3	3	3	3	3
AM Recall		Min			Min
PM Recall		Min			Min
Simult Gap Out	Yes	Yes	Yes	Yes	Yes
Coordinated	Yes		Yes		
Walk + FDW	14		14		
Max Inhibit		Yes		Yes	Yes
AM Split	51	16	35	28	41
PM Split	53	20	33	45.8	21.2

Exit 13 SB Off Ramp & Water St

Coord Beg of Green

Yield Point: Single

	Cycle	Offset
AM	100	0
PM	120	107

	Barrier 1		Barrier 2		Barrier 3	
Ring 1		2		4		
Ring 2	5	6				8

Phase	2	4	5	6	8
Movement	WBT	SB	WBL	EBT	NB
Min Green	4	4	4	4	4
Yellow	4	4	4	4	4
All Red	2	2	2	2	2
Extension	4	4	4	4	4
AM Recall	Max			Max	
PM Recall	Max			Max	
Simult Gap Out	No	No	No	No	No
Coordinated	Yes			Yes	
Walk + FDW					
Max Inhibit		Yes	Yes		Yes
AM Split	51	28	16	35	21
PM Split	65	21	19	46	34

Exit 13 SPUI

Coord Beg of Yellow

Yield Point: By Phase

	Cycle	Offset
AM	100	0
PM	120	0

	Barrier 1		Barrier 2
Ring 1	1	2	4
Ring 2	5	6	8

Phase	1	2	4	5	6	8
Movement	WBL	EBT	NB	EBL	WBT	SB
Min Green	5	5	5	5	5	5
Yellow	4	4	4	4	4	4
All Red	2	4	8	2	4	8
Extension	2	3	3	3	3	3
AM Recall		Max			Max	
PM Recall		Max			Max	
Simult Gap (	No	No	No	No	No	No
Coordinated		Yes			Yes	
Walk + FDW						
Max Inhibit	Yes		Yes	Yes		Yes
AM Split	30	40	30	30	40	30
PM Split	36	48	36	36	48	36

I-93 Between Exits 15 and 16
7/9/2013

AM (7:00 - 8:00)

Biles	Cars	2 Axle Long	Busses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Comb	5 Axle Comb
15	2518	979	3	78	21	6	17	66
0.4%	67.5%	26.3%	0.1%	2.1%	0.6%	0.2%	0.5%	1.8%

94% cars and light trucks
6% medium and heavy trucks

PM (16:00-17:00)

Biles	Cars	2 Axle Long	Busses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axle Comb	5 Axle Comb
20	2612	1079	5	56	15	0	7	61
0.5%	67.5%	27.9%	0.1%	1.4%	0.4%	0.0%	0.2%	1.6%

96.0% cars and light trucks
4% medium and heavy trucks

AM (7:00 - 8:00)

>6 Axle Comb	<6 Axle Multi	6 Axle Multi	>6 Axle Multi
23	1	1	0
0.6%	0.0%	0.0%	0%

PM (16:00-17:00)

>6 Axle Comb	<6 Axle Multi	6 Axle Multi	>6 Axle Multi
8	1	4	0
0.2%	0.0%	0.1%	0%

		2035 Avg Maximum Queues (ft)			
		AM		PM	
		No Build	**Scen D**	**No Build**	**Scen D**
Stickney	EB	209	100	535	286
	WB	116	108	113	105
	NB	18	18	31	32
	SB	34	42	61	63
Exit 14 SB	EB	53	109	80	120
	WB	171	249	171	231
	SB	679	303	264	140
Exit 14 NB	EB	145	NA	160	NA
	WB	201		203	
Fort Eddy	EB	156	195	192	199
	WB	1390	526	2276	731
	NB	1087	314	241	318
	SB	58	167	288	333
Exit 13 SB Off-Ramp	EB	100	88	439	419
	WB	143	175	213	266
	NB	144	174	204	187
	SB	147	153	138	167
Exit 13 SPUI	EB	102	213	217	315
	WB	156	171	368	358
	NB	800	302	865	241
	SB	144	186	212	214

Prepared For:

New Hampshire DOT

Bow Concord I-93
Improvements Project

Bow and Concord, NH

Technical Feasibility Report

Prepared By:

McFarland Johnson

53 Regional Drive • Concord, NH 03301

NHDOT Project # 13742
Federal Project #T-A000(018)

September 2018

TABLE OF CONTENTS

List of Tables

APPENDIX A - Figures

List of Figures

1 Project Description

The New Hampshire Department of Transportation (NHDOT) and the Federal Highway Administration (FHWA) have prepared an Environmental Assessment/Draft Section 4(f) Evaluation (EA/4(f)) for proposed improvements to the Interstate Route 93 (I-93) corridor between the Town of Bow and the City of Concord, Merrimack County, New Hampshire. The basic purpose of the I-93 Bow-Concord project is to improve transportation efficiency and reduce safety problems within this approximately 4.5-mile segment of highway.

I-93 is the principal north-south arterial highway within New Hampshire and is part of the National System of Interstate and Defense Highways. I-93 extends a total distance of 132 miles within New Hampshire, from the Massachusetts border to the northern Vermont border. The proposed project covers a distance of approximately 4.5 miles from south of the I-93/Interstate Route 89 (I-89) Interchange in Bow to just north of the I-93/Interstate Route 393 (I-393) Interchange (Exit 15) in Concord. The segment of I-93 from Manchester to Exit 14 is also part of the Central Turnpike, commonly known as the F.E. Everett Turnpike. The project also extends along I-89 from its terminus with Route 3A (Bow Junction) approximately 4,700 feet to the west. Along I-393 the project extends from just west of the bridge over the Merrimack River to the Route 202/North Main Street intersection, a distance of approximately 4,600 feet. Refer to **Figure 1 Study Area Overview** that depicts the study area and the project limits.

A description of I-93 within the project limits is included in the Existing Roadway Conditions section. There are seven existing interchanges within the project limits. A description of each, from south to north, is also discussed in the Existing Roadway Conditions section.

2 Purpose of Report

The purpose of this Technical Feasibility Report (TFR) is to demonstrate that the proposed modifications of the Preferred Alternative for the Bow-Concord I-93 Improvements project "will not have a significant negative impact on the safety and operations of the Interstate System" per the FHWA *Policy on Access to the Interstate System* (Policy) dated May 22, 2017. There are access modifications proposed for several of the interchanges. A detailed description of the proposed improvements at each interchange is provided later in this report along with a discussion of its safety, operational, and engineering acceptability, as emphasized in the Policy.

The Existing Roadway Conditions section will outline the geometric and operational deficiencies that exist at the various project interchanges. The Proposed Modifications section will focus on how the proposed modifications would address these deficiencies. The geometric deficiencies were identified by comparing the existing geometry against the standards set forth in the NHDOT *Highway Design Manual, A Policy on Geometric Design of Highways and Streets* from the American Association of State Highway and Transportation Officials (AASHTO) commonly referred to as the "Green Book", and *A Policy on Design Standards Interstate System* from AASHTO (January 2005).

The operational deficiencies will reference the procedures for estimating the operating conditions of a roadway from the *Highway Capacity Manual, 6th Edition* (HCM). The basis for the HCM procedures is level-of-service (LOS), a quantitative measure describing the operating conditions as perceived by motorists driving in a traffic stream.

The HCM divides freeway facilities into three types of segments:

1. Basic – sections with no ramps
2. Merge or Diverge – 1,500-foot sections within either an on-ramp or an off-ramp
3. Weaving – sections with an on-ramp followed within 3,000 feet or less by an off-ramp.

Freeway LOS for all three segment types is based on vehicle density per lane, which is calculated by dividing the number of vehicles by the number of lanes and the average speed of those vehicles. There are six levels of service (LOS A to F) defined by the flow of traffic. **Table 1** shows the LOS Criteria for each segment type.

Table 1: LOS Criteria for Freeway Segments

LOS	Characteristics	Density (Passenger cars per mile per lane)		
		Basic	Weaving	Merge/Diverge
A	Free-flow operations	≤ 11	0-10	≤ 10
B	Reasonably free-flow	> 11-18	> 10-20	> 10-20
C	Speeds near free-flow	> 18-26	> 20-28	> 20-28
D	Speeds decline	> 26-35	> 28-35	> 28-35
E	Operation at capacity	> 35-45	> 35-43	> 35
F	Breakdown/Unstable flow	Demand Exceeds Capacity OR Density > 45	> 43, OR Demand Exceeds Capacity	Demand Exceeds Capacity

Freeway segments with LOS A to LOS C are considered acceptable. LOS D is generally considered acceptable during peak periods as the cost to make improvements to meet LOS C are typically unjustifiable. LOS E and LOS F are generally considered unacceptable with improvements necessary to provide an acceptable level of service.

2.1 Traffic Modeling

I-93 through Bow and Concord is a regionally significant corridor. Traffic data has been collected from both within the corridor and from outside the corridor. In cooperation with the Central New Hampshire Regional Planning Commission (CNHRPC), a regional model has been developed for the Central NH Region using the TransCAD software. The Regional Model includes the 20 communities that comprise the Central NH Region and the Town of Weare, which is part of the Southern NH region. The model was calibrated using traffic and land use data to emulate actual traffic conditions in the region. The Base Year for the Regional Model is 2014. Future land use, employment and housing data was used to develop the Design Year 2035 model.

To appropriately evaluate the complex roadway network that comprises the I-93 corridor, a Microsimulation Model has also been developed for the project using the TransModeler software. The Microsimulation Model is a more detailed model of the corridor that provides more accurate information on the interaction of traffic between and within the interchanges. Information from the Regional Model is used to generate traffic entering and exiting the Microsimulation Model boundary. The operational results presented in this report were all generated by the Microsimulation Model.

3 Existing Roadway Conditions

Interstate 93 (I-93) within the project limits is a four-lane divided urban principal arterial highway, a major roadway whose primary purpose is to move high volumes of traffic, with limited access provided only at the interchanges. An additional lane exists southbound from Exit 12 and extends south of I-89. South of the project limits, I-93 is a six-lane divided urban arterial highway. The posted speed limit within the project area is 55 miles per hour (mph). The design speed within the project limits varies but exceeds 60 mph in most cases.

This 4.5-mile segment serves approximately 75,000 vehicles per day with peak summer travel at over 85,000 vehicles per day. See **Figure 2** for a map indicating the current annual average daily traffic (AADT) on each project segment. There are significant backups on I-93 during summer months and especially during holidays or special events. The traffic backups on northbound I-93 during peak periods can stretch as far south as the Hooksett Toll Plaza, a distance of about seven miles from I-89. The traffic backup on southbound I-93 during peak periods can stretch as far north as Exit 17, a distance of about five miles from the Merrimack River. See **Figure 3** for a map of the morning and afternoon peak hour volumes for the project Base Year 2014. See **Figure 4** for a Typical Section that includes existing I-93 within the project limits.

There are seven existing interchanges within the project limits, each is described in detail in the following sections.

3.1 I-89 Exit 1

Exit 1 on I-89 is a full access (four access points) partial cloverleaf interchange with all ramps located on the west side of South Street and Logging Hill Road in order to provide separation with the ramps from the I-93/I-89 Interchange. There is only ¼ mile between Exit 1 and I-93. See **Figure 5** for the existing conditions of I-89 Exit 1.

The close proximity of the two interchanges results in short weaving sections for both northbound and southbound I-89 traffic between the two interchanges. AASHTO describes weaving as “highway segments where the pattern of traffic entering and leaving at contiguous points of access results in vehicle paths crossing each other”.

In particular, the southbound weave that involves traffic entering from Exit 1 and I-89 traffic exiting to southbound I-93 has long been a concern for those traveling in Bow. The distance between the entrance and exit ramps is approximately 440 feet, which is less than the AASHTO recommended 2,000 feet. This weave is made worse by the high speeds that are driven by traffic on southbound I-89. The grade of I-89 in the area is about 3% downhill and keeping traffic at or below the 40-mph speed limit has been unsuccessful. Reduced speed warning signs were installed several years ago but speeds continue to be well above the speed limit. The limited sight distance for those entering at Exit 1 along with the yield condition contributes to the poor operations as this entering traffic is traveling at speeds much lower than the traffic it is weaving with on I-89. This weave currently operates at a level of service (LOS) E/D (AM Peak Period/PM Peak Period) that projects to LOS F/E by 2035. The difficulty accessing I-89 at Exit 1 causes diversion to local streets as described by many Bow residents.

The northbound I-89 weave between I-93 and Exit 1 currently has an LOS B/E that by 2035 is projected to be LOS F/E. There is a substantial increase in morning peak hour traffic on the southbound I-93 to northbound I-89 ramp as a result of projected growth along the I-89 corridor that results in the dramatic reduction in LOS between 2014 and 2035. The distance between the entrance and exit ramps is approximately 500 feet, which is less than the AASHTO recommended 2,000 feet. Speed is not as critical an issue for this weave as traffic on I-89 is starting from a stopped condition at the Route 3A/Hall Street intersection.

3.2 I-93/I-89 Interchange

The I-93/I-89 Interchange is a modified trumpet interchange where I-89 ends at I-93. There are direct and loop ramps connecting the two Interstate routes. These four ramps constitute eight interstate access points. In addition, the extension of I-89 connects directly to NH Route 3A via a signalized at-grade intersection. There is only 1,200 feet between the I-93/I-89 Interchange and I-89 Exit 1. The AASHTO recommended spacing between interchanges in urban settings is one mile (5,280 feet). See **Figure 6** for the existing conditions of the I-93/I-89 Interchange.

There is a short weave within the I-93/I-89 Interchange between the two loop ramps on I-93 northbound. A collector-distributor (C-D) Road services this weaving section. This weave currently has a LOS E/E that projects to LOS F/F by 2035. The distance between the entrance and exit ramps is approximately 400 feet, which is less than the recommended 1,600 feet for this location by AASHTO. AASHTO standards allow a shorter weave distance on C-D Roads than on highway mainlines. These ramps have high volumes of traffic as they accommodate traffic moving between the two interstates.

3.3 I-93 Exit 12

Exit 12 is a full access partial cloverleaf interchange, but it has two sets of exit ramps from I-93 connecting to South Main Street (NH Route 3A). Therefore, there are six access points for Exit 12 as follows:

- Northbound exit to Route 3A south
- Northbound exit to Route 3A north
- Northbound entrance from Route 3A
- Southbound exit to Route 3A north
- Southbound exit to Route 3A south
- Southbound entrance from Route 3A

Three of the exit ramps at Exit 12 have deficient deceleration distances, both of the southbound exit ramps and the northbound exit ramp to northbound Route 3A. The spacing between the I-93/I-89 Interchange and Exit 12 is about 2/3-mile, less than the AASHTO recommended spacing of one mile. See **Figure 7** for the existing conditions of Exit 12.

3.4 I-93 Exit 13

Exit 13 is a full access (four access points) single point urban interchange (SPUI) with access to Water and Manchester Streets (US Route 3) in Concord. A SPUI terminates the ramps at a single point where a single traffic signal controls most of the movements within the intersection. A reconstruction of Exit 13 was completed in 2003 that anticipated a 6-lane I-93. Therefore, the interchange does not require reconstruction to accommodate this project's proposed widening.

One deficiency identified for Exit 13 concerns the northbound exit ramp. During AM peak periods, traffic backs up daily onto I-93 from the intersection of Manchester Street (Route 3). The cause of the backup is the high volume of traffic that makes a right turn onto Manchester Street. This movement is controlled by a stop sign and additionally the limited sight distance requires each turning vehicle to wait to make the turn. See **Figure 8** for the existing conditions of Exit 13.

3.5 I-93 Exit 14

Exit 14 is a full access (four access points) diamond interchange providing access to Loudon Road (NH Route 9). North of Exit 14 is Exit 15, only 2,800 feet away. See **Figure 9** for the existing conditions of Exit 14/15. The spacing between Exit 14 and Exit 15 is about ½-mile, less than the AASHTO recommended spacing of one mile. The minimal distance between Exits 14 and 15 results in deficient weaves on I-93 for both southbound and northbound directions. AASHTO recommends 2,000 feet between entrance and exit ramps for this ramp condition. The existing southbound weave is 380 feet long and the existing northbound weave is 370 feet long. The southbound weave along I-93 between Exits 14 and 15 operates at unacceptable levels. The current LOS F/D projects to LOS F/E by 2035. The northbound weave along I-93 between Exits 14 and 15 operates at unacceptable levels where the current LOS C/E is anticipated to be LOS C/F by 2035.

3.6 I-93 Exit 15

Exit 15 is a full cloverleaf interchange that includes four loop ramps and four directional ramps connecting I-93 and I-393. These eight ramps total 12 interstate access points. There are four short weave sections within the interchange, two for I-93 and two for I-393. These weaves are problematic because of the high volume of traffic using the ramps and because the weaves occur on the mainline. The weave distances are below those recommended by AASHTO, however, AASHTO treats cloverleaf interchanges differently than other weave conditions. See **Figure 9** for the existing conditions of Exit 14/15.

The weaves within Exit 15 along I-93 operate at unacceptable levels while those along I-393 operate at acceptable levels. The I-93 southbound weave within Exit 15 currently operates at LOS F/E that is anticipated to deteriorate to a LOS F/F by 2035. The northbound I-93 weave within Exit 15 currently operates at LOS C/E that is anticipated to remain LOS C/E by 2035.

3.7 I-393 Exit 1

Exit 1 of I-393 is a full access (four access points) partial cloverleaf with all ramps on the west side of College Drive because of its close proximity to the Merrimack River. The spacing between Exit 1 on I-393 and Exit 15 is about 2,500 feet, less than the AASHTO recommended spacing of one mile (5,290 feet). This close proximity results in deficient weaves on I-393 for both eastbound and westbound directions. AASHTO recommends 2,000 feet between entrance and exit ramps for this ramp condition. The existing eastbound weave is 540 feet long and the existing westbound weave is 600 feet long. However, the LOS for these two weaves, LOS B/B eastbound and LOS B/B westbound, is acceptable due to the relatively low volume of ramp traffic using I-393 Exit 1. See **Figure 10** for the existing conditions of I-393 Exit 1.

3.8 Adjacent Interchanges

The first adjacent interchanges on the three project interstates are described below. There is only one adjacent interchange for I-89 and I-393 as these both terminate at I-93. See **Figure 11** for the existing condition of these four interchanges.

- I-93 South: Exit 11 is the next interchange on I-93 south of the project. Exit 11 is a partial cloverleaf/diamond interchange 7 miles south of the I-93/I-89 Interchange and is located at the Hooksett Toll Plaza. I-93 is six lanes wide adjacent to Exit 11 with current peak hour ramp traffic ranging between 100 and 300 vehicles per hour (vph). There are no impacts or effects anticipated by the project because I-93 has sufficient capacity in this area and no diversion of traffic is anticipated as a result of the proposed modifications.
- I-93 North: Exit 16 is the next interchange on I-93 north of the project. Exit 16 is also a partial cloverleaf/diamond interchange. It is 1 ½ miles north of Exit 15. I-93 is four lanes wide at Exit 16 with current peak hour ramp traffic ranging between

100 and 450 vph. No discernable impacts or effects are anticipated by the project as minimal diversion of traffic is anticipated as a result of the proposed modifications.

- I-89 North: Exit 2 is the next interchange on I-89 north of the project. Exit 2 is a partial cloverleaf/diamond interchange with stop control at each ramp junction with NH Route 13 (Clinton Street). It is 2 miles north of Exit 1. I-89 is four lanes wide at Exit 2 with projected peak hour ramp traffic ranging between 110 and 585 vph. There are backups that occur along the exit ramps during peak periods. A separate project, currently scheduled for fiscal year 2023, will evaluate the ramp junctions. However, no impacts or effects are anticipated by the 13742 project as no diversion of traffic is anticipated as a result of the proposed modifications.
- I-393 East: Exit 2 is the next interchange on I-393 east of the project. Exit 2 is a partial cloverleaf with stop control at the westbound ramp junction and a signal at the eastbound ramp junction with NH Route 132 (East Side Drive). It is 1 mile east of Exit 1. I-393 is four lanes wide at Exit 2 with projected peak hour ramp traffic ranging between 90 and 860 vph. Minor traffic impacts are anticipated by the project as some diversion of traffic is anticipated due to the elimination of the northbound entrance ramp at Exit 14. The diverted traffic would use the westbound loop entrance ramp at Exit 2 that has a yield controlled right turn. The additional traffic would be expected to add no more than 5% to the volume, which can be accommodated at Exit 2.

4 Proposed Modifications

The traffic projections developed for the project indicate that traffic volumes will increase and by the 2035 design year I-93 through Bow and Downtown Concord will require six traffic lanes, three in each direction, to accommodate this future traffic demand. See **Figure 12** for the No Build projected design year (2035) peak hour volumes in the project area. As specified in AASHTO, there are two main criteria used to evaluate the need for auxiliary lanes: the operation of the ramp merges and diverges and the spacing between successive entrance and exit ramps. As a result of this evaluation, it was determined that auxiliary lanes are warranted between interchanges for all segments of I-93, both northbound and southbound. See **Figure 4** that includes a Typical Section of the proposed I-93.

4.1 I-89 Exit 1

Concept K developed for the I-89 Area proposes modifications to I-89 Exit 1 and the I-93/I-89 Interchange. For I-89 Exit 1, the four access points with I-89 would be retained in their current location as seen on **Figure 13**. The proposed modifications address the weaving issues that exist between I-89 Exit 1 and I-93, but also effect the access between I-89 Exit 1 and Routes 3A.

For the northbound entrance ramp and exit ramp at I-89 Exit 1 the access is the same between I-89 and South Street. However, the access from Route 3A to I-89 would be modified with a new road connecting Route 3A and South Street. The new road would eliminate the weave that presently exists between I-93 and Exit 1.

For the two southbound ramps, a new flyover ramp is proposed between I-89 Exit 1 and the I-93/I-89 Interchange. While the configuration with the flyover ramp is different, the access does not change. The entrance ramp would pass under the flyover ramp but the access to I-89 and both directions of I-93 would be retained. The flyover ramp would eliminate the weave that presently exists between Exit 1 and I-93. Access to Route 3A would also be affected. The Route 3A traffic has three options; I-89 Exit 1 and the new connecting road, the two loop ramps at the I-93/I-89 Interchange, or I-93 Exit 12.

4.2 I-93/I-89 Interchange

Concept K also retains the eight access points at the I-93/I-89 Interchange, but proposes a new directional ramp for northbound I-93 to northbound I-89 traffic. The new ramp provides the same access, but the traffic would no longer utilize the existing C-D Road. The weaving section on the C-D Road would remain, but there would be far less traffic using the weave. See **Figure 13** for a plan of Concept K.

The connection of northbound I-93 to South Street traffic would be retained but would utilize the new road connecting Route 3A and South Street. This new connection also provides access to Route 3A from northbound I-93 that does not presently exist.
The direct access that presently exists between Bow Junction (Route 3A/Hall Street/I-89 Extension) and I-89 would no longer exist with the proposed project. This traffic would use either I-89 Exit 1 and the new connecting road or Exit 12.

4.3 I-93 Exit 12

Concept F for Exit 12 proposes to retain the partial cloverleaf configuration, but would eliminate one exit ramp in each direction. While the access points would be reduced from six to four, access to both directions of Route 3A from both directions of I-93 are retained. The result is that all traffic accessing Route 3A would meet at two distinct intersections. Concept F proposes hybrid roundabouts for the two ramp intersections. See **Figure 14** for a plan of Concept F at Exit 12.

4.4 I-93 Exit 13

Concept B for Exit 13 has no proposed access modifications. The only proposed modification would be the northbound exit ramp would be widened to include two signalized right turn lanes onto southbound Route 3. See **Figure 15** for a plan of Concept B at Exit 13.

4.5 I-93 Exit 14

Concept F2 developed for the Exit 14/15 Area proposes modifications to Exit 14 and 15 but no modifications to I-393 Exit 1. For Exit 14, the four access points would be reduced to three access points as the northbound entrance ramp would be eliminated. Eliminating this ramp would allow the alignment of I-93 to be shifted east to avoid impacts to two historic properties, an electrical substation, an active railroad (also historic), a shopping plaza, and allows access to Stickney Avenue to remain. Access to Stickney Avenue is important as this is the primary access to I-93 for the Bus Terminal and a future rail station. Traffic exiting Stickney Avenue would be diverted to several other access points to northbound I-93, as described in detail in Section 6.5. Because the traffic would be diverted to several routes, no capacity issues are anticipated as a result of the diversion. See **Figure 16** for a plan of Concept F2 at Exit 14/15.

The elimination of the northbound entrance ramp also eliminates the deficient northbound weave between Exits 14 and 15. For the deficient southbound weave between Exits 14 and 15, a C-D Road is proposed as part of the project. The C-D Road benefits the weaving because the weaving traffic is traveling at slower speeds and there is no interference with I-93 traffic.

Several concepts were developed for Exit 14 that retained the northbound entrance ramp. Each of these impacted the two historic properties, Stickney Avenue, an electrical substation, an active railroad, and a shopping plaza mentioned above. The property and utility relocation costs for these impacts alone is estimated at approximately $20M with impacts to three historic properties.

4.6 I-93 Exit 15

Concept F2 also retains the 12 access points at Exit 15, but proposes a cloverstack configuration to replace the existing full cloverleaf as seen on **Figure 16**. The proposed cloverstack would eliminate two of the loop ramps and replace them with directional ramps. By eliminating two of the loop ramps at Exit 15, four weave sections would be eliminated.

4.7 I-393 Exit 1

Concept F2 has no proposed access modifications for I-393 Exit 1. There are no geometric modifications proposed for this interchange.

5 Safety Considerations

Along I-93 within the project limits there are two primary safety concerns: congestion and the close proximity of interchanges. The proposed widening of I-93 is expected to address congestion related safety issues. The access to I-93 afforded by the various interchanges and the effect of the proposed interchange modifications on this access are however more relevant to the purpose of this report. The safety factors associated with the proposed modifications to access are detailed in the following sections for each interchange. It should be noted, however, that the proposed improvements to I-93 are expected to improve the safety of accessing I-93 by including auxiliary lanes between adjacent interchanges along I-93. Crash Modification Factors (CMF) are used to measure the safety effectiveness of a proposed geometric modification. For weaving sections, a CMF of between 0.76 and 0.80 can be expected when auxiliary lanes are provided between entrance and exit ramps. This represents at least a 20% reduction in crashes when auxiliary lanes are provided.

5.1 I-89 Exit 1

The primary safety concerns on I-89 at Exit 1 are the two weaving sections between Exit 1 and I-93. **Figure 17** depicts the crash history at the I-89 Area for the ten-year period from January 2007 to December 2016. In the vicinity of Exit 1, clusters of crashes are present in the two weaving sections. The proposed modifications for the area would eliminate the weaving between the two interchanges, thereby eliminating this safety concern. Wider shoulders and modern ramp geometry are also expected to improve safety at Exit 1. There is no CMF for eliminating a weave, but the reduction in crashes would be expected to be greater than the 20% for providing an auxiliary lane.

5.2 I-93/I-89 Interchange

The primary safety concern at the I-93/I-89 Interchange is the weaving section on the C-D Road that handles northbound I-93 traffic. **Figure 17** depicts the crash history at the I-89 Area for the ten-year period from January 2007 to December 2016. In the vicinity of the I-93/I-89 Interchange, a cluster of crashes are present on the C-D Road weaving section. The proposed modifications for the interchange would significantly reduce the number of vehicles weaving, thereby reducing the number of potential crashes. Since the most significant independent variable affecting crash frequency is traffic volume, it could be stated the reduction is expected to be proportional to the reduction of weaving traffic. The proposed project is expected to reduce the volume of traffic exiting the weave by about 80% during the AM peak period and about 90% during the PM peak period.

There are also clusters of crashes near the I-93 merge and diverge areas of the interchange ramps. The widening of I-93 would be expected to reduce these crashes as there will be less congestion at the merge and diverge points.

5.3 I-93 Exit 12

The primary safety concern at Exit 12 is the deficient deceleration at several of the exit ramps. However, the crash history for the Exit 12 Area depicted on **Figure 18,** for the ten-year period from January 2007 to December 2016, does not indicate high numbers of crashes as a result of the deficiencies. Regardless, a reduction in crashes is expected as a result of providing longer deceleration lanes appropriate for the design speed. A CMF of about 0.60 (40% reduction) can be expected when a deceleration distance is increased as proposed.

There are clusters of crashes on I-93 near Exit 12 that appear to be the result of geometry and congestion. The crashes occur approaching two sharp horizontal curves on I-93 that often experience congestion during peak periods. The crash data indicates approximately 2/3 of the crashes occur with low severity, which suggests they are at lower speeds during congested periods. The widening of I-93 would be expected to reduce these crashes as there will be less congestion.

5.4 I-93 Exit 13

Figure 19 depicts the crash history at the Exit 13 Area for the ten-year period from January 2007 to December 2016. There are no clusters of crashes at Exit 13, however, there are crashes shown on the northbound exit ramp where traffic backups occur. For a five-year period (2009 to 2013) there were at least 7 rear-end crashes on the exit ramp, which is indicative of a ramp that experiences backups. The proposed widening of this ramp would be expected to reduce these crashes as the backups would be reduced.

5.5 I-93 Exit 14

A primary safety concern at Exit 14 are the weaving sections on I-93 between Exit 14 and Exit 15. **Figure 20** depicts the crash history at the Exit 14/15 Area for the ten-year period from January 2007 to December 2016. There are clusters of crashes between Exits 14 and 15 where the two weave sections exist. The proposed elimination of the exit 14 northbound entrance ramp would eliminate the northbound weave between Exit 14 and 15, thereby eliminating this safety concern. A greater than 20% reduction would be expected as stated above for I-89 Exit 1.

The proposed modifications also propose a C-D Road between Exit 14 and 15 for southbound traffic. This weave section would continue to have a short length, however, the C-D Road would have a lower design speed and operating speeds, as well as fewer vehicle conflict points, therefore, a reduction in crashes would be expected.

There are also clusters of crashes along Loudon Road within the project limits. The proposed elimination of one signalized intersection (the northbound entrance ramp), as well as implementation of standard lane widths and shoulders is expected to reduce these crashes. A CMF of about 0.75 can be expected when 10-foot lanes are widened to 11-foot lanes, a reduction of about 25%.

5.6 I-93 Exit 15

The primary safety concern at Exit 15 are the four weaving sections that exist within the cloverleaf interchange. **Figure 20** depicts the crash history at Exit 15 for the ten-year period from January 2007 to December 2016. At Exit 15 there are clusters of crashes present on each weaving section. The proposed modifications for the interchange would eliminate all four weaving sections, thereby eliminating this safety concern. A greater than 20% reduction would be expected as stated above.

5.7 I-393 Exit 1

Also refer to **Figure 20** for the crash history of the I-393 Exit 1. The two weaving sections between I-93 Exit 15 and I-393 Exit 1 along eastbound and westbound I-393 would continue to have short weaving lengths with the proposed project, however, there are no clusters of crashes indicated for them. The low volume of traffic on the Exit 1 ramps and the auxiliary lanes that exist within both weaving sections help to limit the numbers of crashes.

6 Operational Considerations

As mentioned above in the Safety discussion, the inclusion of auxiliary lanes between each interchange along I-93 is expected to improve the safety for those accessing the highway. Auxiliary lanes would also improve the operations between the interchanges, which benefits those accessing the highway. **Table 2** below shows a comparison of the diverge, merge and weave sections along I-93 between the Future No Build (See **Figure 12**) and the Proposed Project. **Figure 21** shows the projected design year (2035) peak hour volumes for the Preferred Alternative. The shaded values indicate those segments with unacceptable levels of service (LOS E or F). The term Not Applicable (N/A) applies to the elimination of a weaving segment or ramp. This comparison illustrates the improved operations that the proposed project would provide.

A comparison of the diverge, merge and weave sections along I-89 and I-393 between the Future No Build and the Proposed Project are found on **Table 3** and **Table 4**, respectively. The comparison for I-89 (Table 3) illustrates the improved operations that the proposed project would provide by eliminating many of the elements that contribute to the existing operational issues. The new flyover ramp and CD Road eliminate the weaving that currently occurs between I-93 and I-89 Exit 1.

The comparison for I-393 (Table 4) illustrates the improved operations that the proposed project would provide by eliminating the weaving that currently occurs along I-393 at Exit 15.

Table 2: I-93 Mainline Operations Comparison

I-93 Segment	Direction	Type	LOS (AM/PM) Projected 2035	
			No Build	Proposed
Exit 15 Off ramp	Southbound	Diverge	F/C	C/B
Exit 15 Weave	Southbound	Weaving	F/E	N/A
Between Exit 14 & 15	Southbound	Weaving	F/D	B/B
Exit 14 On Ramp	Southbound	Merge	D/E	B/B
Exit 13 Off ramp	Southbound	Diverge	D/E	B/B
Exit 13 On ramp	Southbound	Merge	D/F	B/C
Exit 12 Off ramp N	Southbound	Diverge	D/F	N/A
Exit 12 Off ramp S	Southbound	Diverge	D/F	B/C
Exit 12 On ramp	Southbound	Merge	B/C	B/C
I-89 On ramp	Southbound	Merge	B/B	B/C
I-89 Off ramp	Northbound	Diverge	D/C	C/D
I-93/I-89 Weave	Northbound	CD Weaving	F/F	D/C
I-89 On ramp	Northbound	Merge	F/F	C/C
Exit 12 Off ramp S	Northbound	Diverge	F/F	N/A
Exit 12 Off ramp N	Northbound	Diverge	F/F	C/C
Exit 12 On ramp	Northbound	Merge	F/F	C/C
Exit 13 Off ramp	Northbound	Diverge	F/F	C/C
Exit 13 On ramp	Northbound	Merge	F/F	B/C
Exit 14 Off ramp	Northbound	Diverge	F/F	B/C
Between Exit 14 & 15	Northbound	Weaving	B/E	N/A
Exit 15 Weave	Northbound	Weaving	B/E	N/A
Exit 15 On ramp	Northbound	Merge	B/D	B/E

Table 3: I-89 Mainline Operations Comparison

I-89 Segment	Direction	Type	LOS (AM/PM) Projected 2035 No Build	LOS (AM/PM) Projected 2035 Proposed
North of Exit 1	Southbound	Basic	F/D	D/C
Exit 1 Off ramp	Southbound	Diverge	F/D	D/C
Between Exit 1 Ramps	Southbound	Basic	F/E	N/A
Between Exit 1 & I-93	Southbound	Weaving	F/E	N/A
CD Road between Exit 1 & I-93	Southbound	Basic	N/A	E/D
I-93 NB Off ramp	Southbound	Diverge	F/C	N/A
Exit 1/I-93 NB On ramp	Southbound	Merge	N/A	D/C
I-93 NB On ramp	Northbound	Merge	B/B	N/A
Between Exit 1 & I-93	Northbound	Weaving	B/E	N/A
I-89 between Exit 1 & I-93	Northbound	Basic	N/A	A/A
Between Exit 1 Ramps	Northbound	Basic	B/C	B/D
Exit 1 Off ramp	Northbound	Diverge	N/A	B/B
Exit 1 On ramp	Northbound	Merge	B/C	B/D
CD Road On Ramp	Northbound	Merge	N/A	B/C

Table 4: I-393 Mainline Operations Comparison

I-393 Segment	Direction	Type	LOS (AM/PM) Projected 2035 No Build	LOS (AM/PM) Projected 2035 Proposed
At I-93 Exit 15	Eastbound	Weaving	A/B	N/A
SB I-93 On Ramp	Eastbound	Merge	N/A	A/B
Between I-93 and Exit 1	Eastbound	Weaving	A/C	B/C
Between Exit 1 Ramps	Eastbound	Basic	B/C	B/C
Exit 1 On ramp	Eastbound	Merge	B/D	B/D
East of Exit 1	Eastbound	Basic	B/D	B/D
East of Exit 1	Westbound	Basic	E/D	E/D
Exit 1 Off ramp	Westbound	Diverge	D/C	D/C
Between Exit 1 Ramps	Westbound	Basic	E/C	E/C
Between I-93 and Exit 1	Westbound	Weaving	C/C	C/C
At I-93 Exit 15	Westbound	Weaving	D/C	N/A
NB I-93 On Ramp	Westbound	Merge	N/A	B/A

The operational considerations associated with the proposed interchange modifications are highlighted below.

6.1 I-89 Exit 1

The proposed modifications at Exit 1 are focused on addressing the weaving issues that exist between Exit 1 and I-93. **Table 5** below compares the weaving operations of the proposed project to the No Build. The proposed modifications eliminate the weaves while maintaining the access.

Table 5: I-89 Exit 1 Weaving Comparison

Segment	Level of Service (LOS) Projected 2035			
	No Build		Proposed	
	AM	PM	AM	PM
I-89 Northbound between Exit 1 and I-93	B	E	N/A	N/A
I-89 Southbound between Exit 1 and I-93	F	E	N/A	N/A

The new directional ramp at the proposed I-93/I-89 Interchange for northbound I-93 to northbound I-89 traffic eliminates the direct I-89 extension to Bow Junction (Route 3A/Hall Street/I-89 Extension). This traffic can still access Bow Junction, but only by using I-89 Exit 1, the I-93/I-89 Interchange loop ramps, or Exit 12 on I-93. The additional traffic on South Street and Logging Hill Road require that both Exit 1 intersections are signalized. **Table 6** below presents the intersection operations for the proposed I-89 Exit 1 ramp intersections.

Table 6: I-89 Exit 1 Intersection Operations

Project Area	Intersection	Type	Projected 2035	
			Overall Delay (Seconds) (AM/PM)	LOS (AM/PM)
I-89 Exit 1	Logging Hill Road/I-89 Exit 1 Southbound Ramps	Signal	19/14	B/B
	South Street/I-89 Exit 1 Northbound Ramps	Signal	13/20	B/C

6.2 I-93/I-89 Interchange

The proposed modifications at the I-93/I-89 Interchange are focused on addressing the weaving issue that exists on the northbound C-D Road within the interchange. **Table 7** below compares the weaving operations of the proposed project to the No Build.

Table 7: I-93/I-89 Interchange Weaving Comparison

Segment	Level of Service (LOS)			
	Projected 2035			
	No Build		Proposed	
	AM	PM	AM	PM
I-93 Northbound CD Road connecting to I-89	F	F	D	C

The proposed project is expected to reduce the volume of traffic exiting the weave by about 80% during the AM peak period and about 90% during the PM peak period. The resulting LOS would be acceptable while maintaining the access between I-93 and I-89. Also, the existing loop ramp would be converted to a local ramp that terminates at the new connection between Route 3A and South Street. This provides access to Route 3A from I-93 that currently does not exist.

6.3 I-93 Exit 12

The proposed modifications at Exit 12 are focused on addressing the deficient deceleration that exists on three of the existing exit ramps. By eliminating two of the exit ramps, one in each direction of I-93, the remaining exit ramps can be designed with appropriate deceleration distances. The two ramp intersections are proposed to include hybrid roundabouts to access Route 3A. **Table 8** below presents the intersection operations for Exit 12 Concept F.

Table 8: Exit 12 Intersection Operations

Project Area	Intersection	Type	Projected 2035			
			Overall Delay (Seconds) (AM/PM)		LOS (AM/PM)	
			No Build	Proposed	No Build	Proposed
Exit 12	I-93 Exit 12 Northbound Ramps/NH 3A	Stop & Yield/ Roundabout	6/6	11/12	A/A	B/B
	I-93 Exit 12 Southbound Ramps/NH 3A	Stop & Yield/ Roundabout	6/8	12/14	A/A	B/B

The roundabouts effectively process the traffic accessing Route 3A. Full access is therefore maintained at Exit 12.

6.4 I-93 Exit 13

The proposed modifications at Exit 13 are focused on eliminating the queue along the northbound exit ramp that currently backs up onto I-93. Providing two right turn lanes and placing the right turn on signal control would prevent the queue from backing onto I-93. The proposed project would maintain the full access at Exit 13.

The signalized single point intersection at Exit 13 that provides access to US Route 3 would remain with the proposed project. **Table 9** below presents the intersection operations for Exit 13.

Table 9: Exit 13 Intersection Operations

Project Area	Intersection	Type	Projected 2035			
			Overall Delay (Seconds) (AM/PM)		LOS (AM/PM)	
			No Build	Proposed	No Build	Proposed
Exit 13	I-93 Exit 13 SPUI/US 3	Signal	123/100	44/51	F/F	D/D
	I-93 Exit 13 Southbound Ramp/US 3/Hall Street	Signal	20/30	21/32	C/C	C/C

The improved LOS for the SPUI intersection for the proposed is attributed to the significant reduction in delay on the northbound exit ramp. This delay is reduced during the AM peak period from 326 seconds for the No Build to 48 seconds for the proposed.

6.5 I-93 Exit 14

The modifications at Exit 14 propose retaining its diamond configuration for three of the ramps, however, the northbound entrance ramp would be eliminated. The projected (2035) peak hour traffic demand on this ramp is 110 vehicles per hour (vph) during the morning peak period and 281 vph during the afternoon peak period. The volumes are evenly split with about 50% coming from both Westbound and Eastbound Loudon Road. The traffic model predicts this traffic would divert to several other routes to access I-93. Those travelers who originate on the west side of I-93 would divert to I-393 via North Main Street, the new connection from Stickney Avenue, or the proposed Storrs Street Extension (to be constructed by the City of Concord). Those travelers who originate on the east side of I-93 would divert to I-393 via Fort Eddy Road or East Side Drive. Once these travelers are on I-393, they would access I-93 through Exit 15.

The dispersion of the relatively low existing northbound entrance ramp traffic to the various routes described above means no one route receives all of the traffic. **Table 10** below outlines the various intersections that would experience increased traffic as a result of the ramp elimination. The proposed layout of each intersection would be optimized to accommodate the additional traffic. All but the North Main Street/I-393 Extension/Boutin Street Intersection would operate at acceptable levels. However, the LOS of that intersection improves to LOS C/E compared to the No Build with LOS B/F.

Table 10: Exit 14 Entrance Ramp Closure Intersection Operations

Project Area	Intersection	Type	Projected 2035			
			Overall Delay (Seconds) (AM/PM)		LOS (AM/PM)	
			No Build	Proposed	No Build	Proposed
Exit 14	Loudon Road/Northbound Exit Ramp/Fort Eddy Road	Signal	299/209	30/46	F/F	C/D
	Loudon Road/Northbound Entrance Ramp	Signal	33/22	N/A	C/C	N/A
	Loudon Road/Stickney Avenue/Bridge Street	Signal	13/25	5/11	B/C	A/B
Exit 15	North Main Street/I-393 Extension/Bouton Street	Signal	19/127	22/67	B/F	C/E
	South Commercial Street/US 202 Eastbound	Signal	6/32	10/39	A/C	A/D
I-393 Exit 1	Westbound Ramps/College Park Drive (Eastbound Approach)	Stop	9/12	10/12	A/B	A/B
	Eastbound Ramps/Fort Eddy Road	Signal	13/17	13/16	B/B	B/B

The proposed modifications to the ramps at Exit 14 also benefits the operation of the Loudon Road corridor. The elimination of the northbound entrance ramp eliminates one of these intersections, which allows for more storage and fewer conflicts. The delay is significantly reduced as compared to the No Build. **Table 11** below presents a comparison of the intersection operations along Loudon Road between the No Build and proposed project.

Table 11: Loudon Road Intersection Operations

Project Area	Intersection	Type	Projected 2035			
			Overall Delay (Seconds) (AM/PM)		LOS (AM/PM)	
			No Build	Proposed	No Build	Proposed
Loudon Road	Loudon Road/Northbound Exit Ramp/Fort Eddy Road	Signal	299/209	30/46	F/F	C/D
	Loudon Road/Southbound Ramps	Signal	55/26	21/17	D/C	C/B
	Loudon Road/Stickney Avenue/Bridge Street	Signal	13/25	5/11	B/C	A/B

Access to I-93 in Concord is currently well signed. The signage would need to be revised to direct those destined for northbound I-93 to I-393 and then I-93. These signs would need to extend further radially from I-93 to divert to the best route. Traffic on Loudon Road east of Hazen Drive/Airport Road would be directed to East Side Drive that provides access via I-393 Exit 2. Traffic in Downtown Concord would be directed to I-393 via North Main Street.

The proposed modifications at Exit 14/15 address the weaving issues that exist between Exit 14 and I5. **Table 12** below compares the weaving operations of the proposed project to the No Build. The proposed modifications eliminate the northbound weave and improve the southbound weave to an acceptable LOS.

Table 12: Exit 14/15 Weaving Comparison

I-93 Segment	Direction	Type	LOS (AM/PM) Projected 2035	
			No Build	Proposed
Between Exit 14 & 15	Southbound	Weaving	F/D	B/B
Between Exit 14 & 15	Northbound	Weaving	B/E	N/A

6.6 I-93 Exit 15

The proposed modifications at Exit 15 are focused on addressing the weaving issues that exist at this full cloverleaf interchange. The proposed cloverstack configuration replaces two of the loop ramps with directional ramps thereby eliminating the four weaving sections within Exit 15. The new configuration retains full access at Exit 15. **Table 13** below compares the weaving operations of the proposed to the No Build.

Table 13: Exit 15 Weaving Comparison

Segment	Level of Service (LOS)			
	Projected 2035			
	No Build		Concept F2	
	AM	PM	AM	PM
I-93 Northbound at Exit 15	B	E	N/A	N/A
I-93 Southbound at Exit 15	F	E	N/A	N/A
I-393 Westbound at Exit 15	D	C	N/A	N/A
I-393 Eastbound at Exit 15	A	B	N/A	N/A

6.7 I-393 Exit 1

There are no proposed modifications at I-393 Exit 1 or the weaving sections between it and Exit 15. The weaves currently operate at acceptable levels and as shown below in **Table 14**, perform well into the future.

Table 14: I-393 Exit 1 Weaving Comparison

Segment	Level of Service (LOS)			
	Projected 2035			
	No Build		Concept F2	
	AM	PM	AM	PM
I-393 Westbound between Exit 15 and Exit 1	C	C	C	C
I-393 Eastbound between Exit 15 and Exit 1	A	C	B	C

7 Engineering Acceptability

The access modifications proposed by the Bow Concord I-93 Improvements Project would address existing operational and safety issues while maintaining all interstate access except for one ramp. That one point of access, the northbound entrance ramp at Exit 14, is removed in order to avoid impacts to two historic properties, Stickney Avenue, an electrical substation, an active railroad, and a shopping plaza. It also provides operational benefits by eliminating a weaving section on I-93 and eliminating a signalized intersection on Loudon Road. The projected peak hour traffic on this ramp is less than 300 vehicles per hour.

There is a reduction of total access points at Exit 12 from 6 to 4, however, the same access to the interstate is retained.

The overall project maintains a high level of interstate access especially considering that the 4.5 mile I-93 corridor has seven full access interchanges including two system interchanges.

8 Summary

Table 15 below summarizes the access point modifications proposed by the project.

Table 15: Access Point Summary

Interchange	Existing Access Points	Proposed Access Points	Description of Modification
I-89 Exit 1	4	4	Access maintained but new ramps and roadways to eliminate problem weaving sections.
I-93/I-89	8	8	Northbound 93 to northbound I-89 converted from a loop to a direct connection. New access to Route 3A from northbound I-93.
I-93 Exit 12	6	4	Retain as a partial cloverleaf interchange except with only one exit ramp in each direction.
I-93 Exit 13	4	4	Retain interchange except widen the northbound exit ramp.
I-93 Exit 14	4	3	Retain diamond interchange except eliminate the northbound entrance ramp.
I-93 Exit 15	12	12	Convert from cloverleaf to cloverstack configuration. Two loops are converted to direct connections.
I-393 Exit 1	4	4	No Changes.

See **Figure 22** for a composite plan of the Preferred Alternative.

APPENDIX A - FIGURES

Figure 1: Study Area Overview

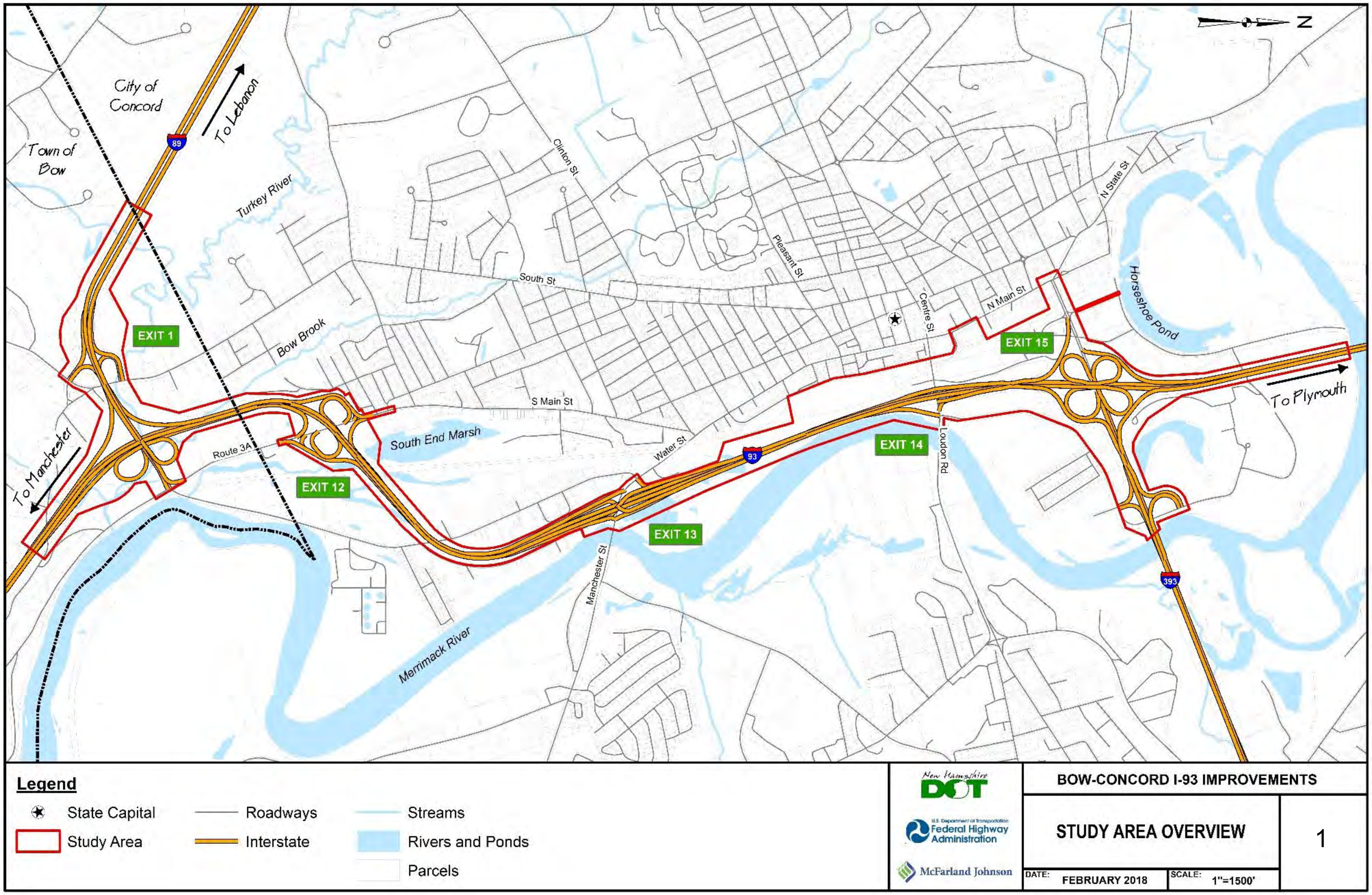


Figure 2: Current (2017) Project AADT

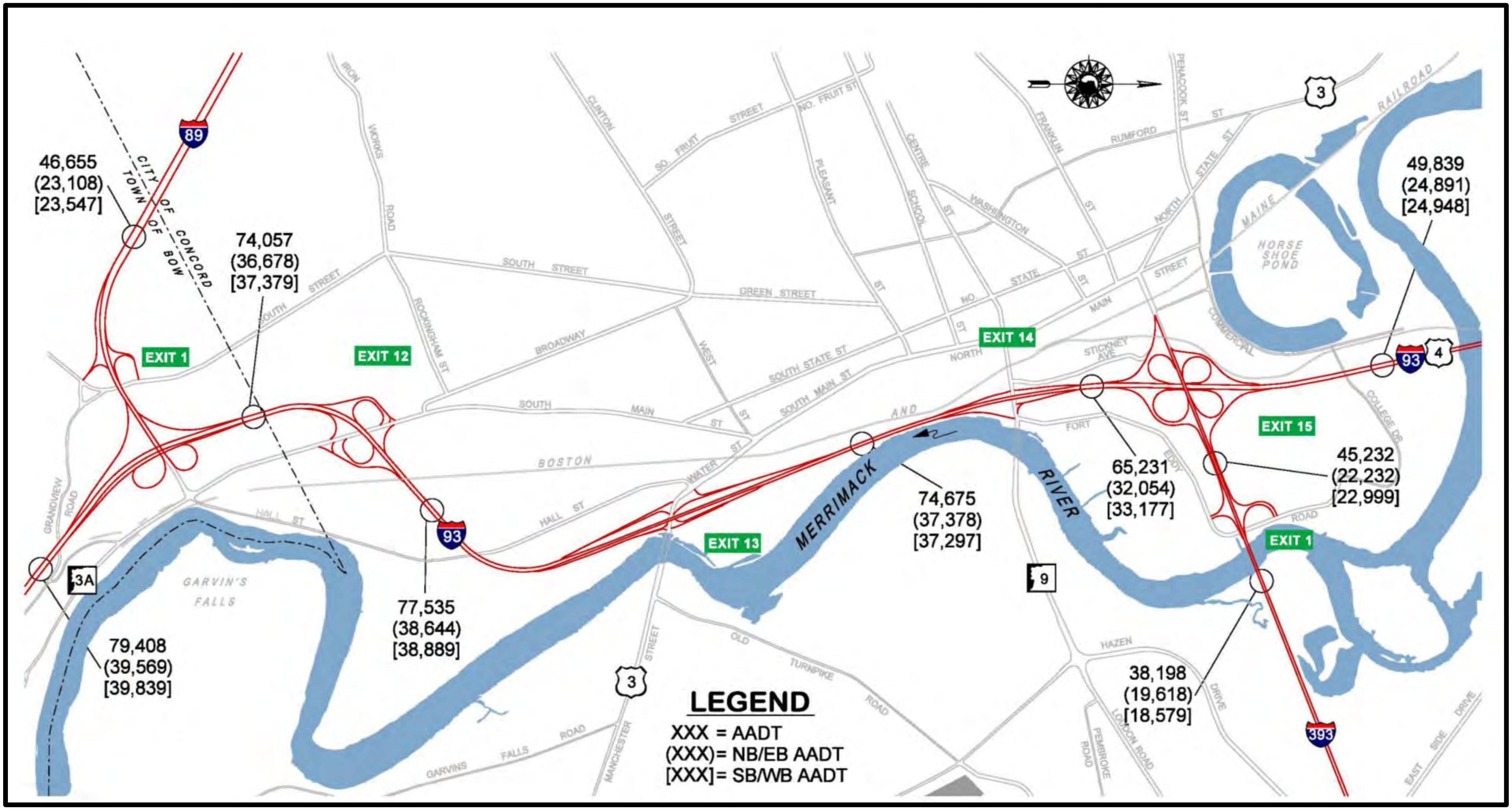


Figure 3: Base Year 2014 Peak Hour Traffic Volumes

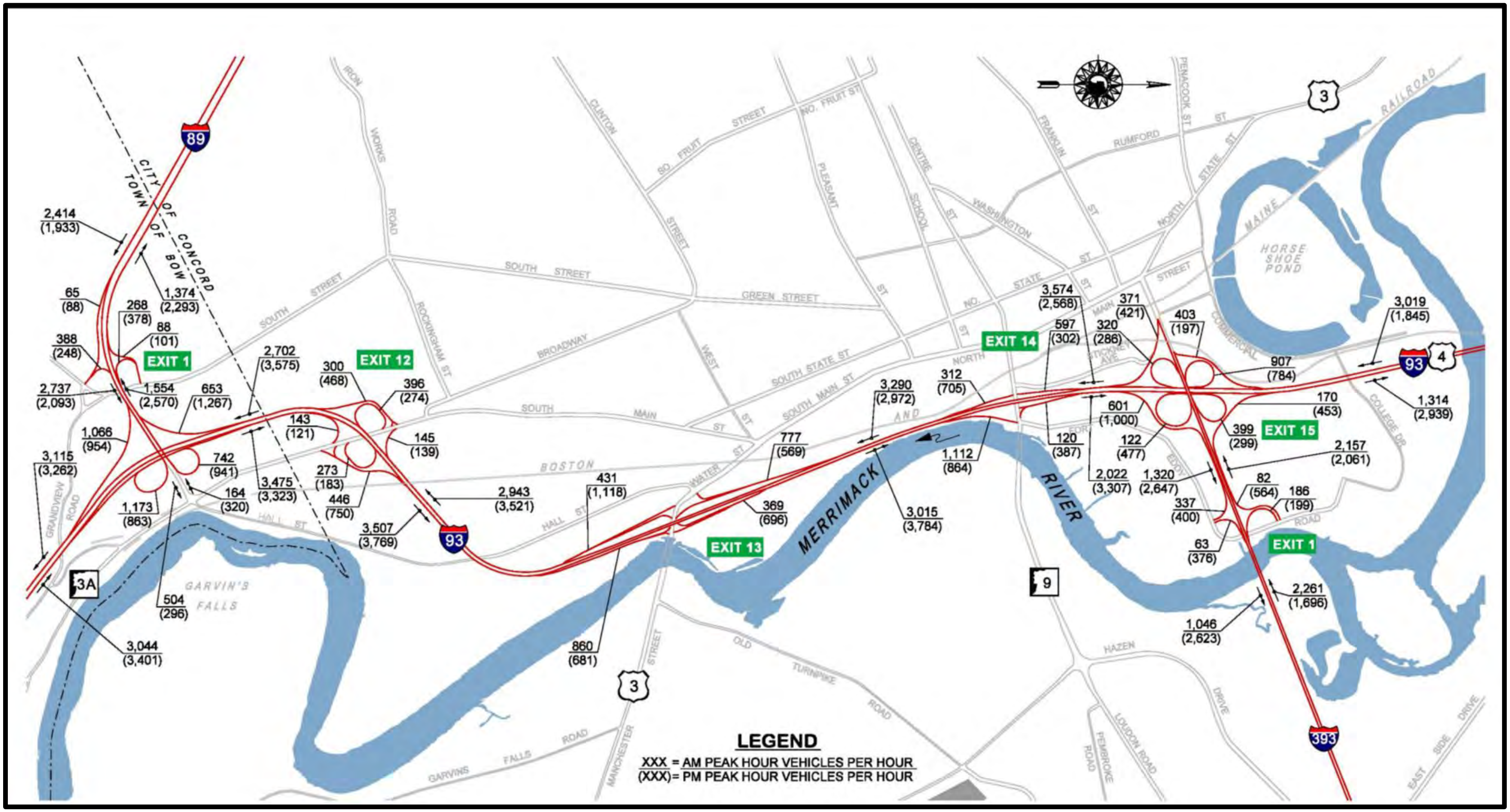


Figure 4: I-93 Typical Section

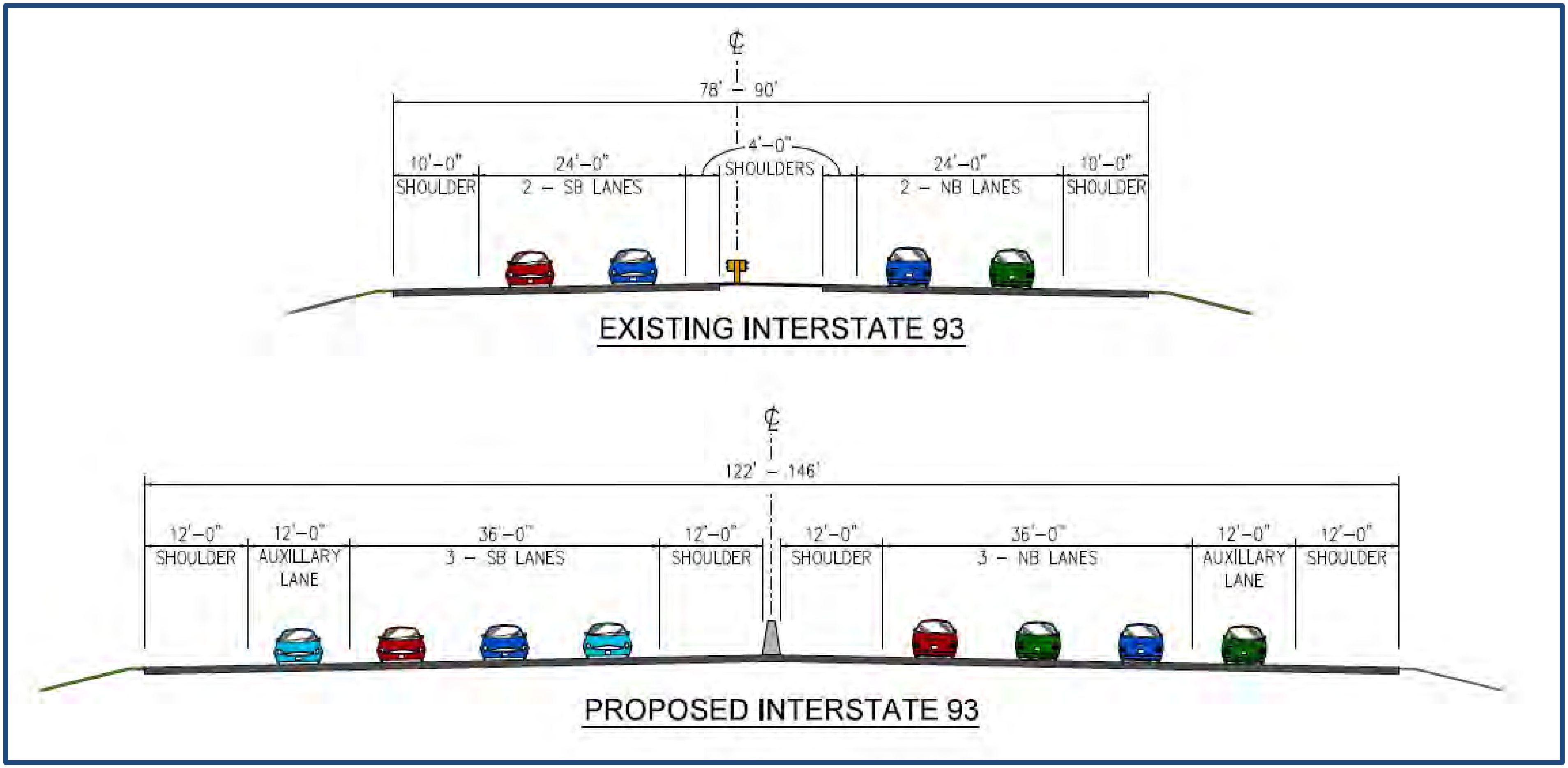


Figure 5: I-89 Exit 1 Existing Conditions

Figure 6: I-93/I-89 Interchange Existing Conditions

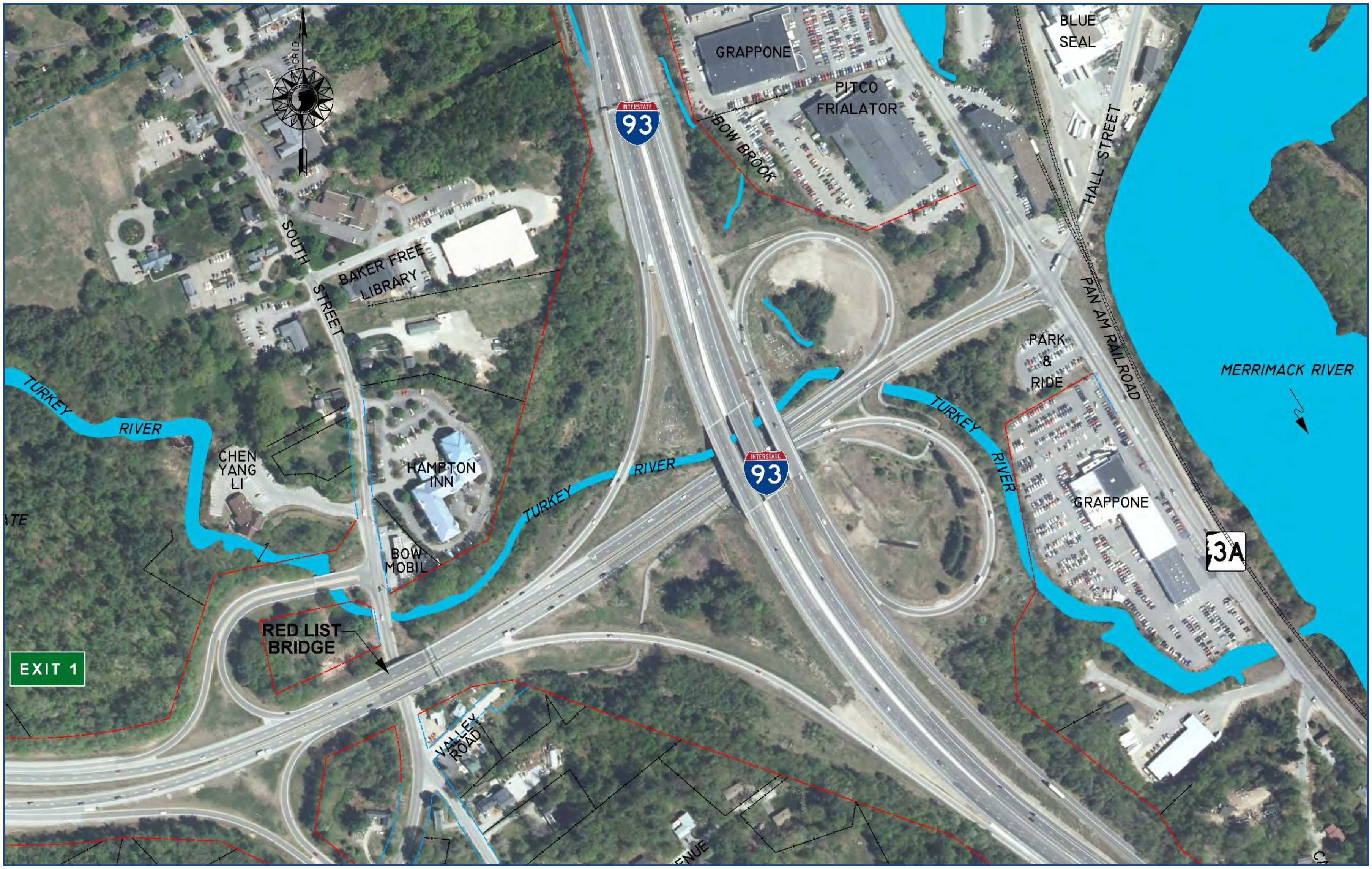


Figure 7: Exit 12 Existing Conditions

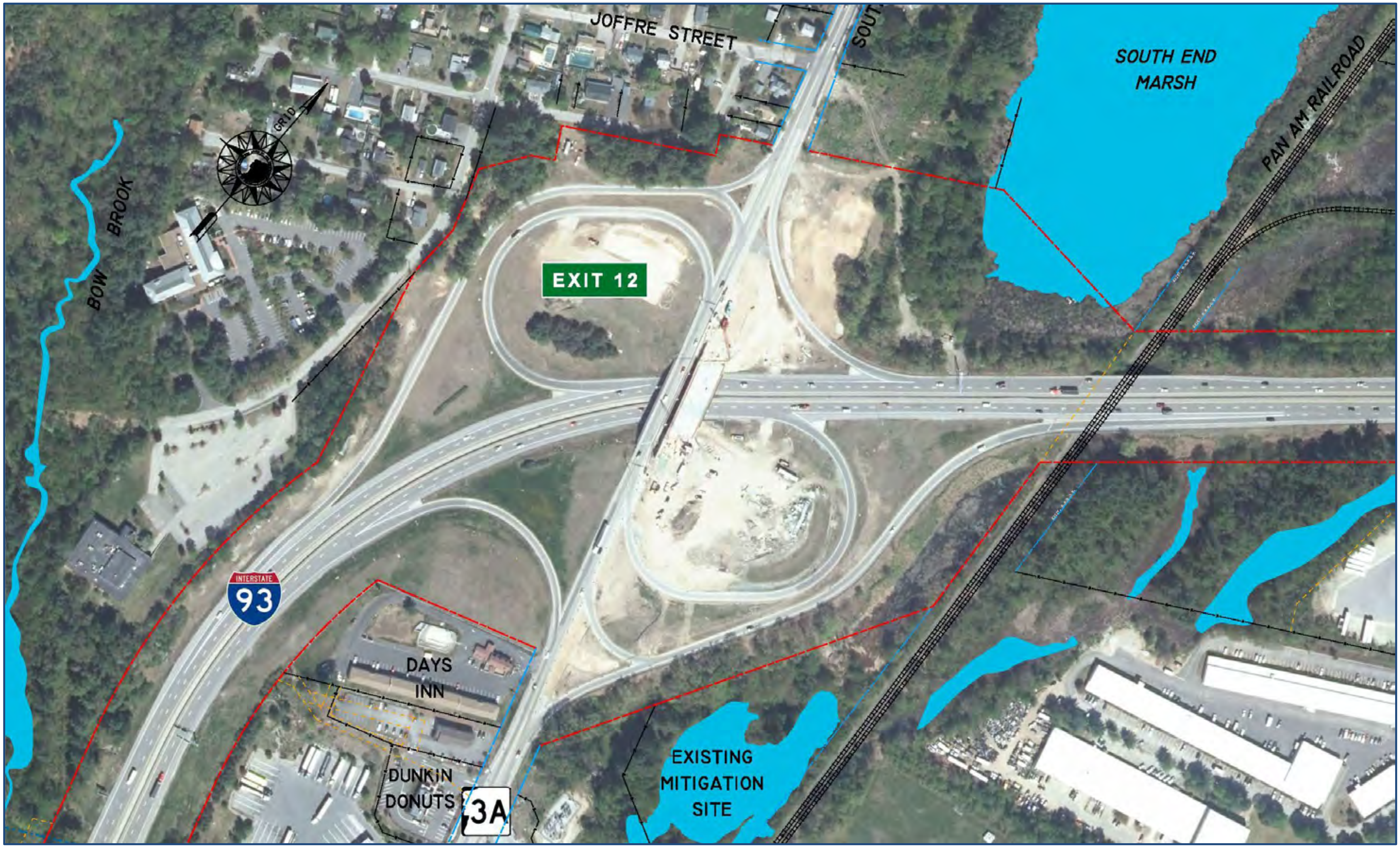


Figure 8: Exit 13 Existing Conditions

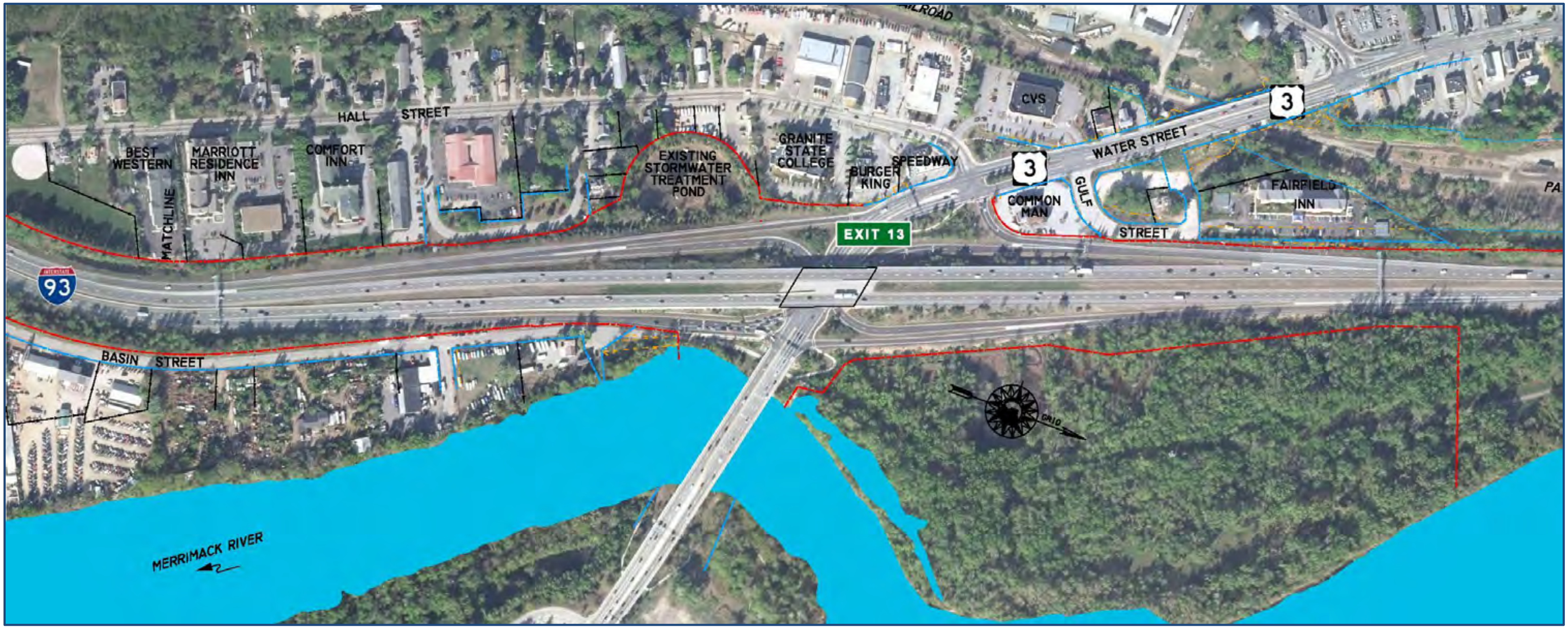


Figure 9: Exit 14/15 Existing Conditions

Figure 10: I-393 Exit 1 Existing Conditions

Figure 11: Adjacent Interchanges

I-93 Exit 16

I-89 Exit 2

I-93 Exit 11

I-393 Exit 2

Figure 12: No Build Year 2035 Peak Hour Traffic Volumes

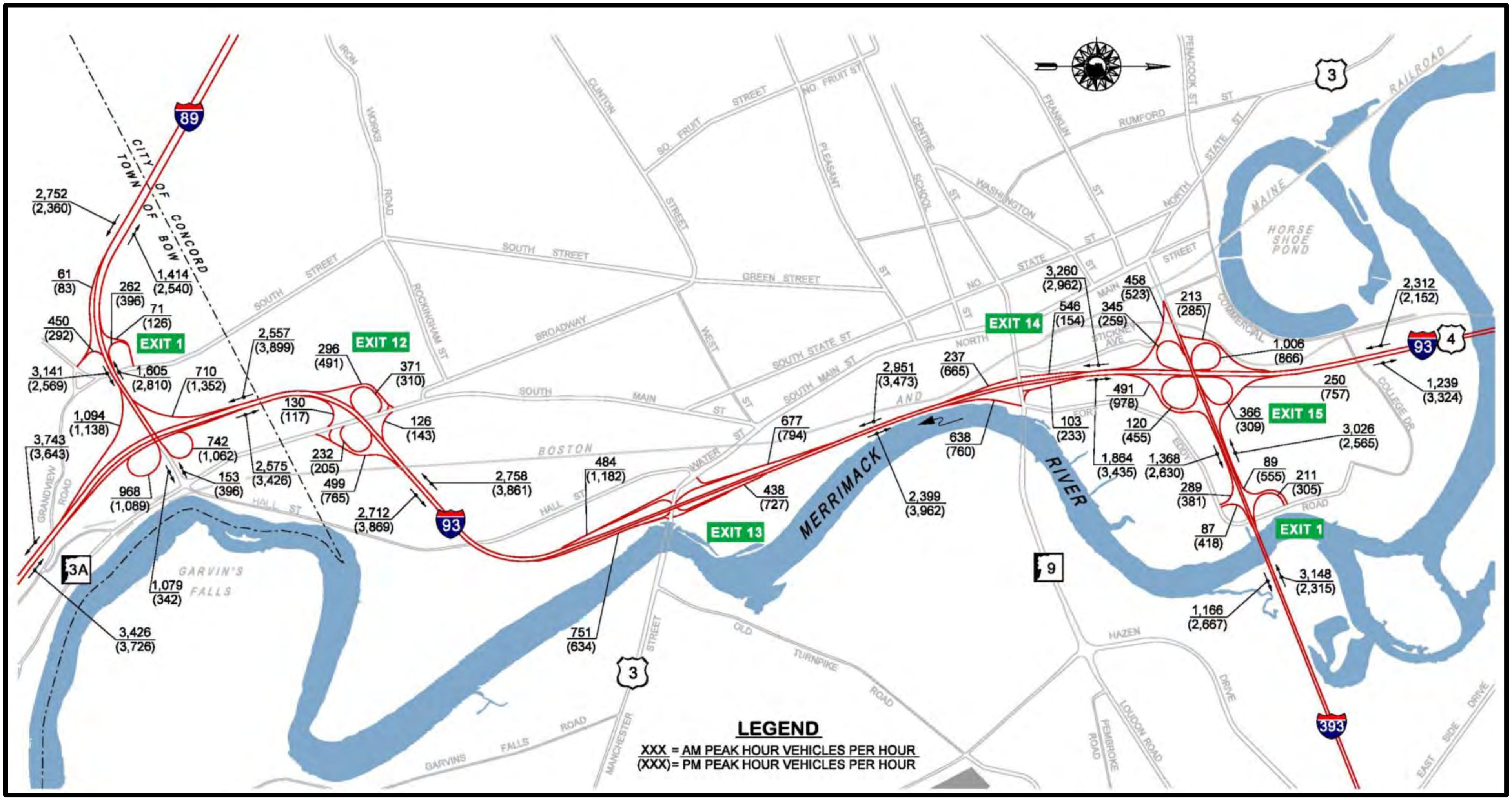


Figure 13: I-89 Area Concept K

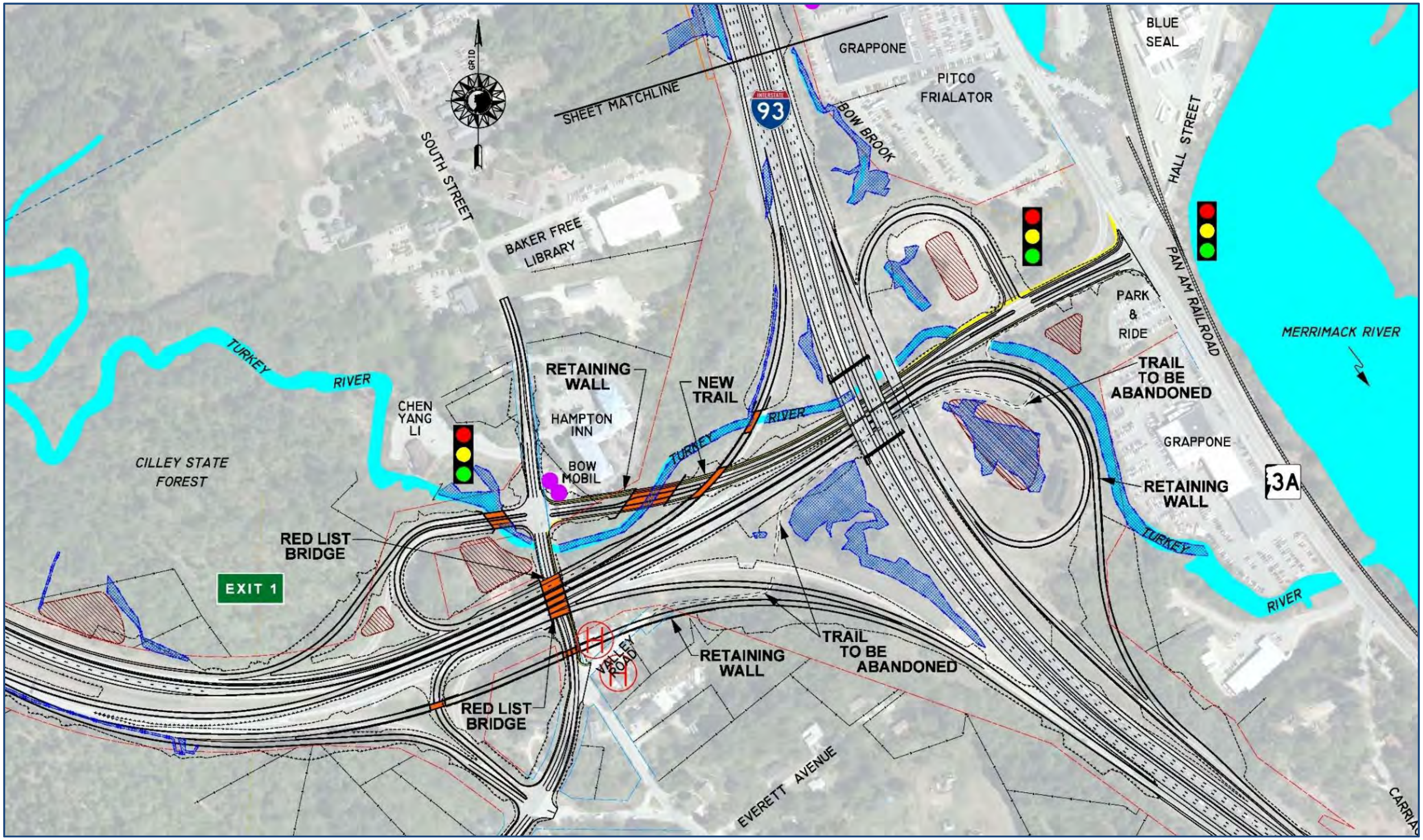


Figure 14: Exit 12 Area Concept F

Figure 15: Exit 13 Area Concept B

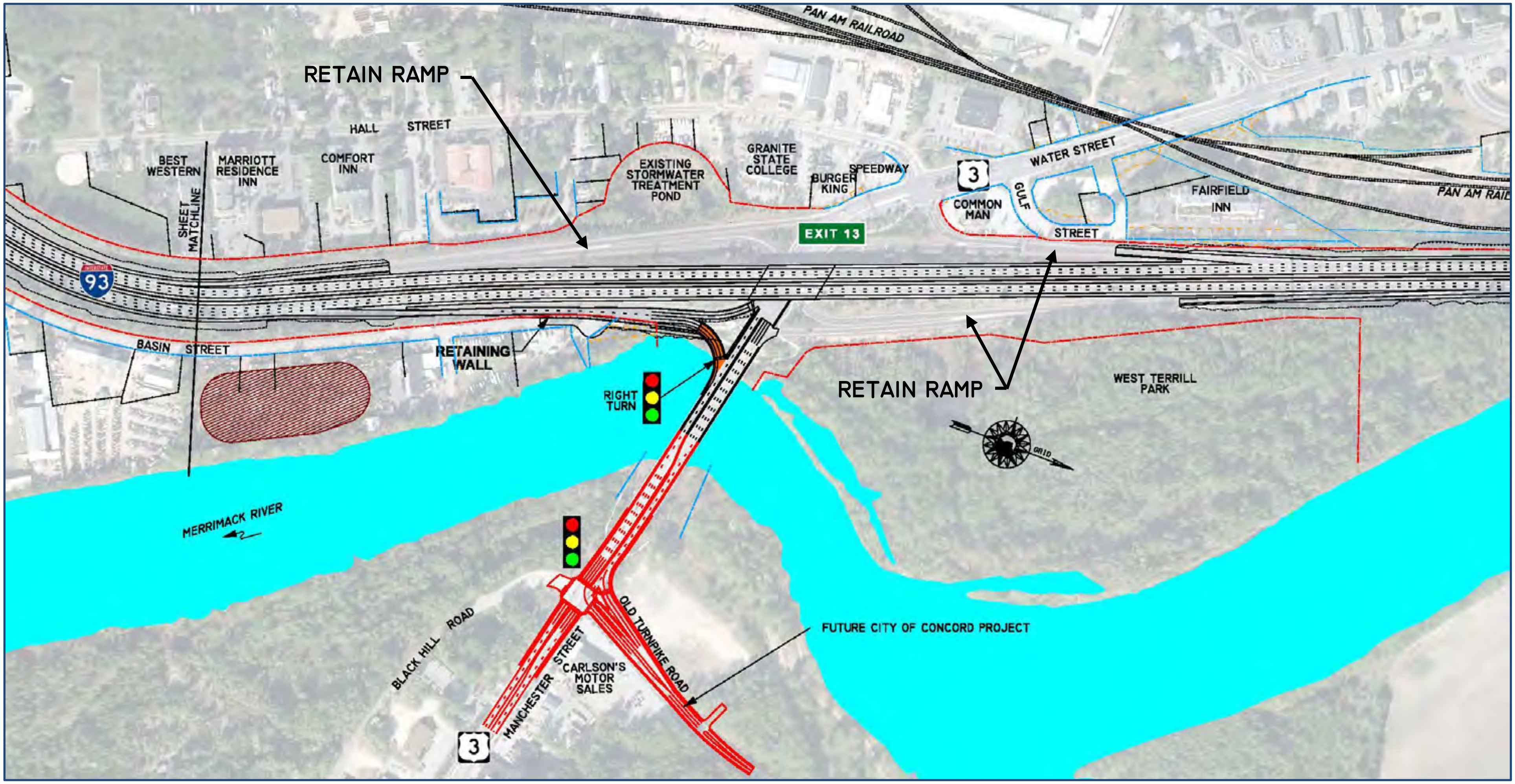


Figure 16: Exits 14/15 Concept F2

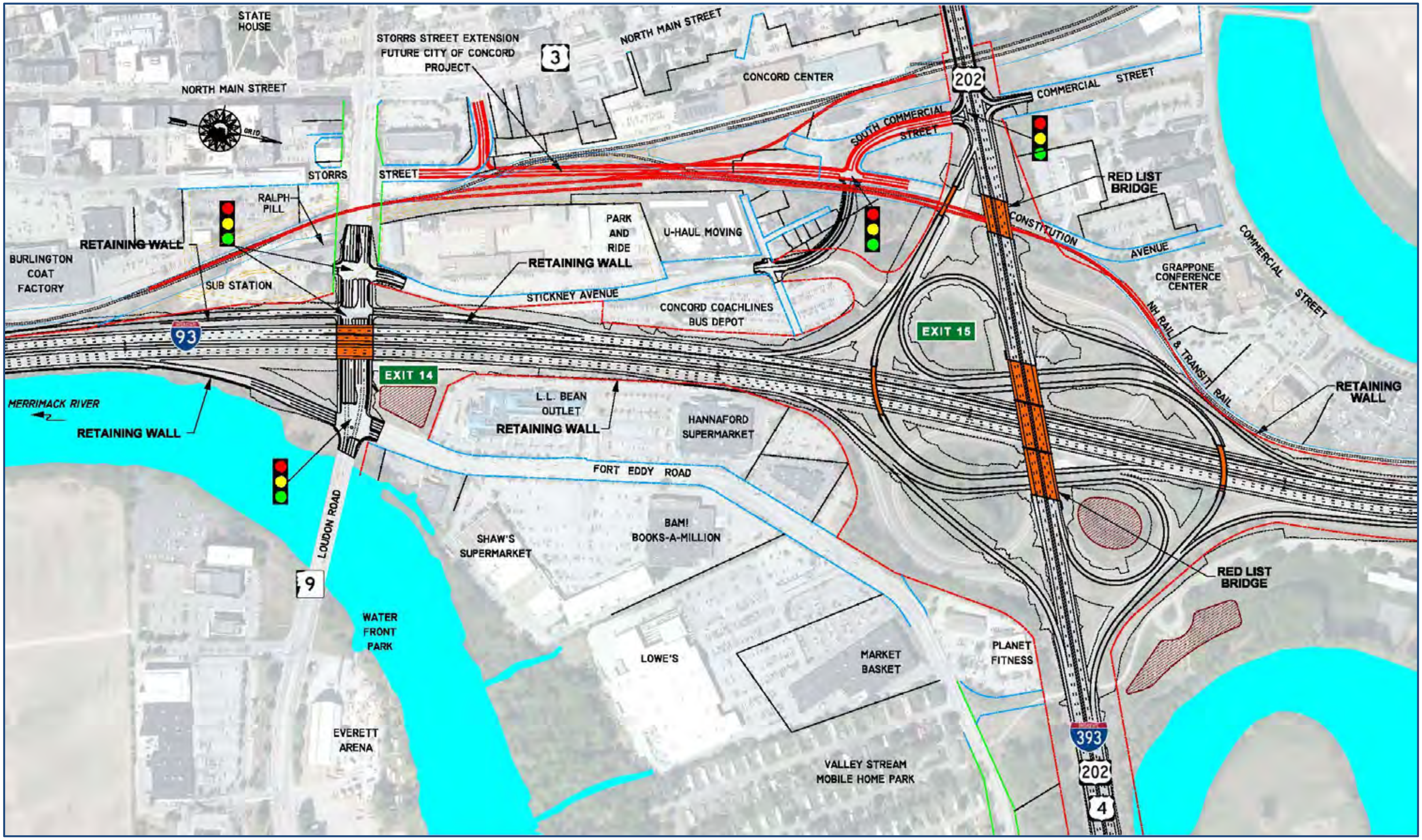


Figure 17: Crash History for the I-89 Area (2007 to 2016)

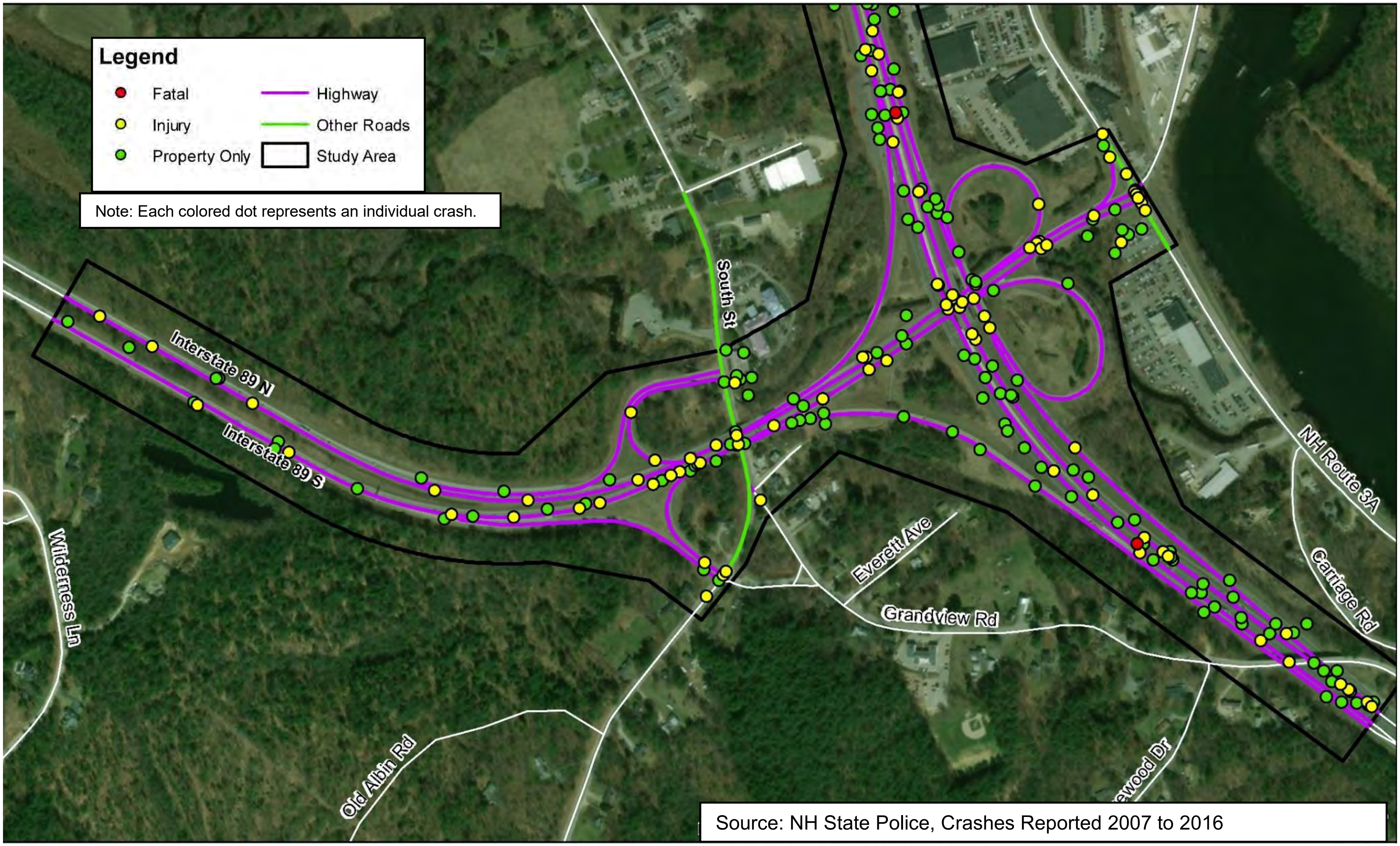


Figure 18: Crash History for the Exit 12 Area (2007 to 2016)

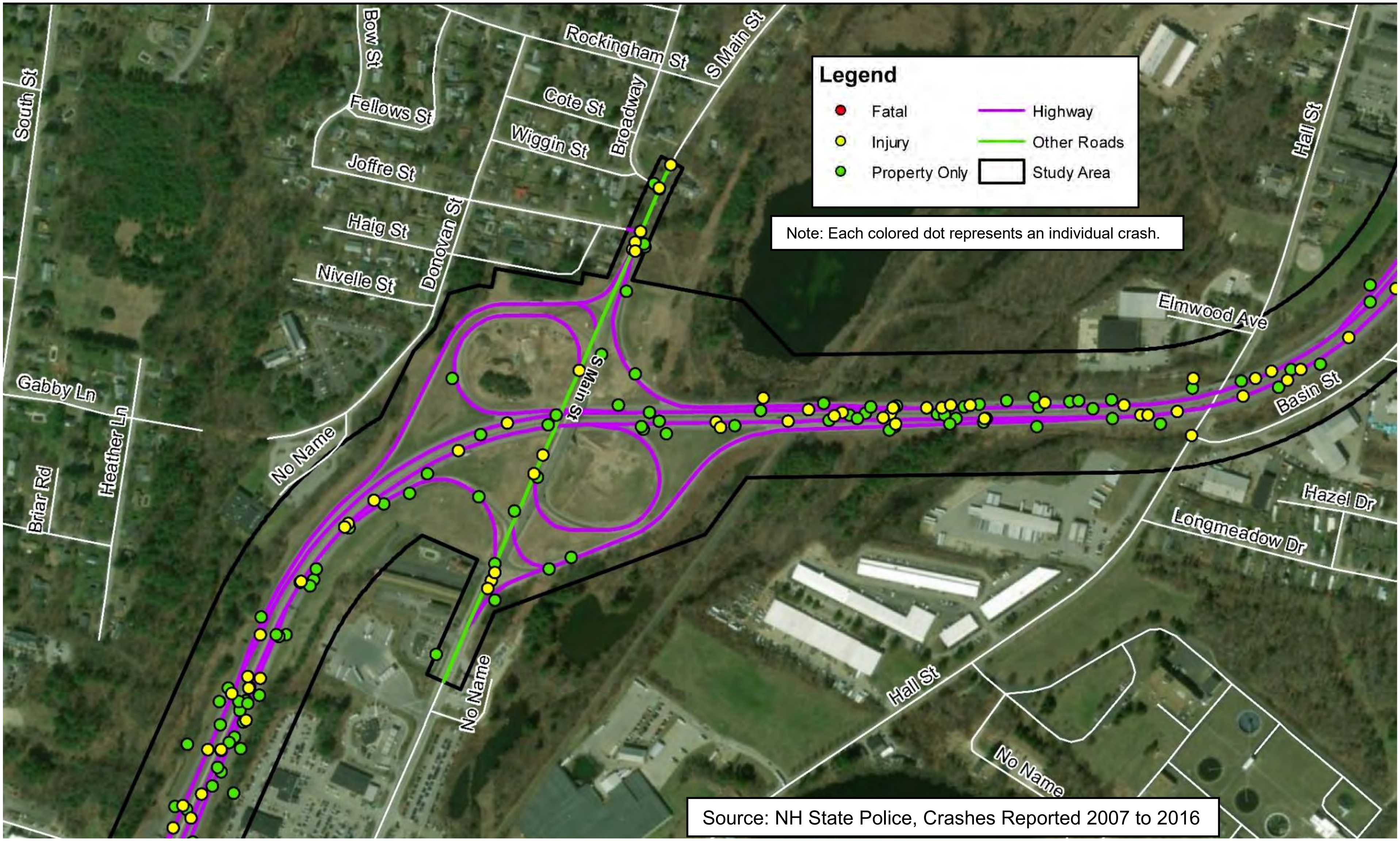


Figure 19: Crash History for the Exit 13 Area (2007 to 2016)

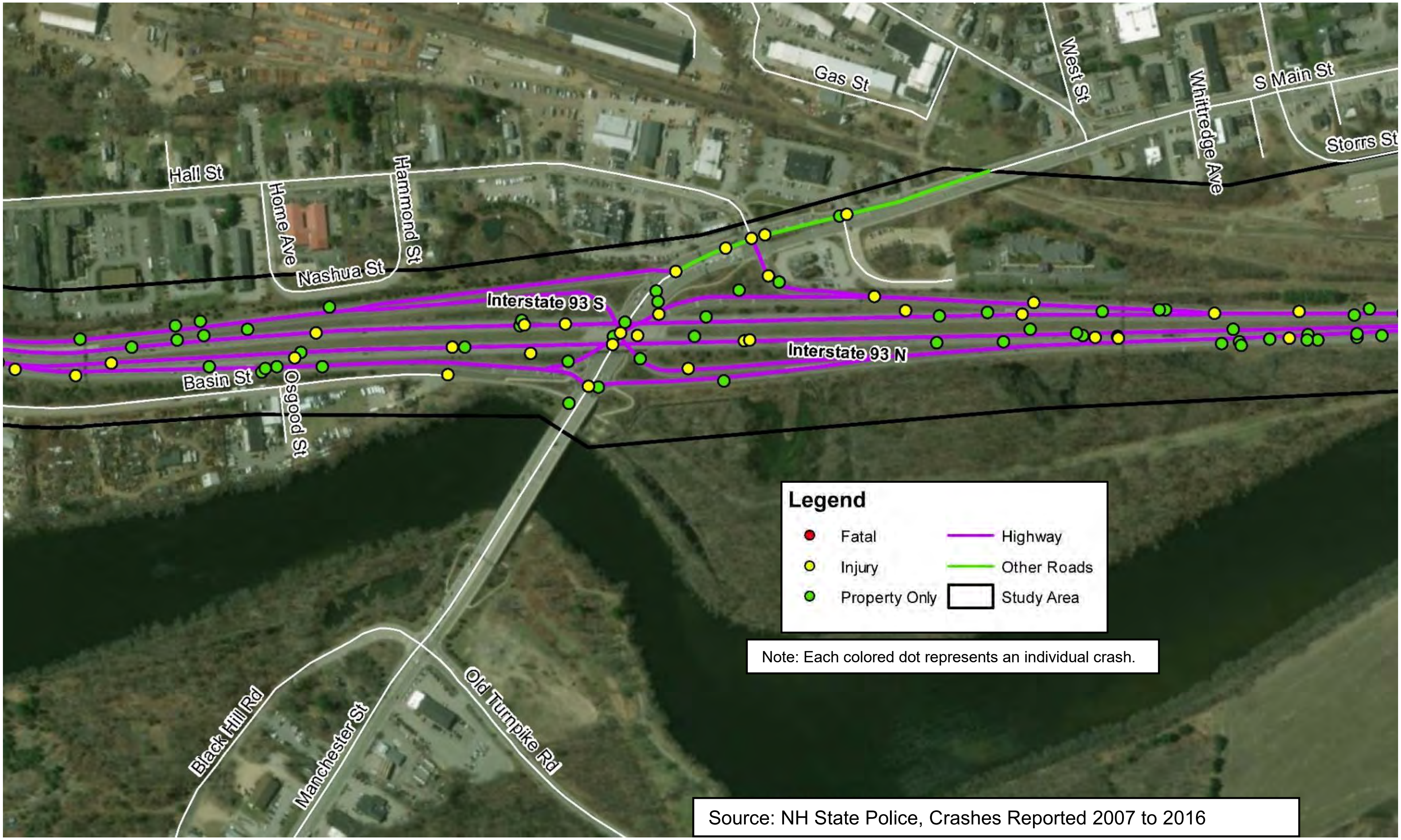


Figure 20: Crash History for the Exit 14/15 Area (2007 to 2016)

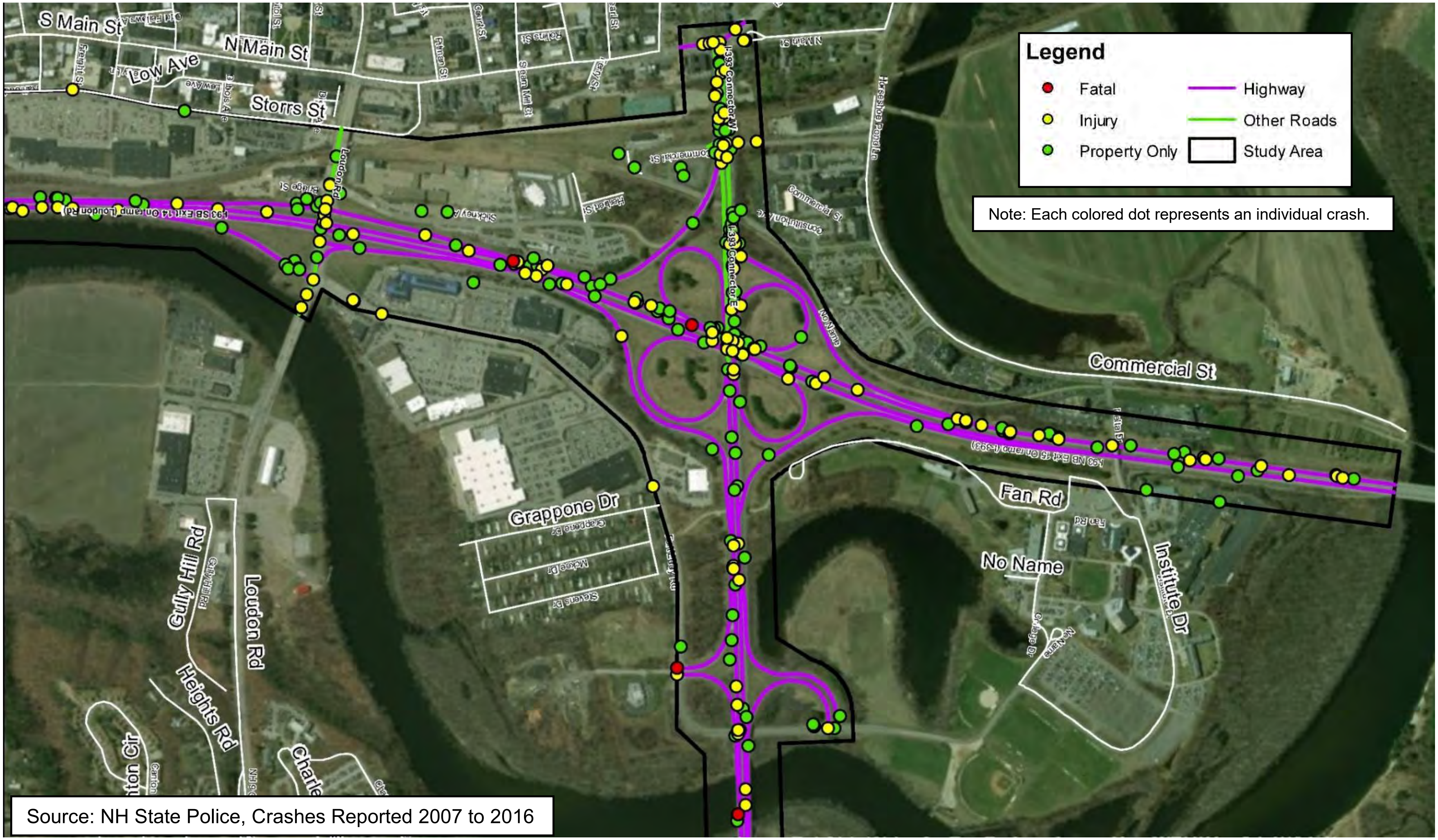


Figure 21: Preferred Alternative Year 2035 Peak Hour Traffic Volumes

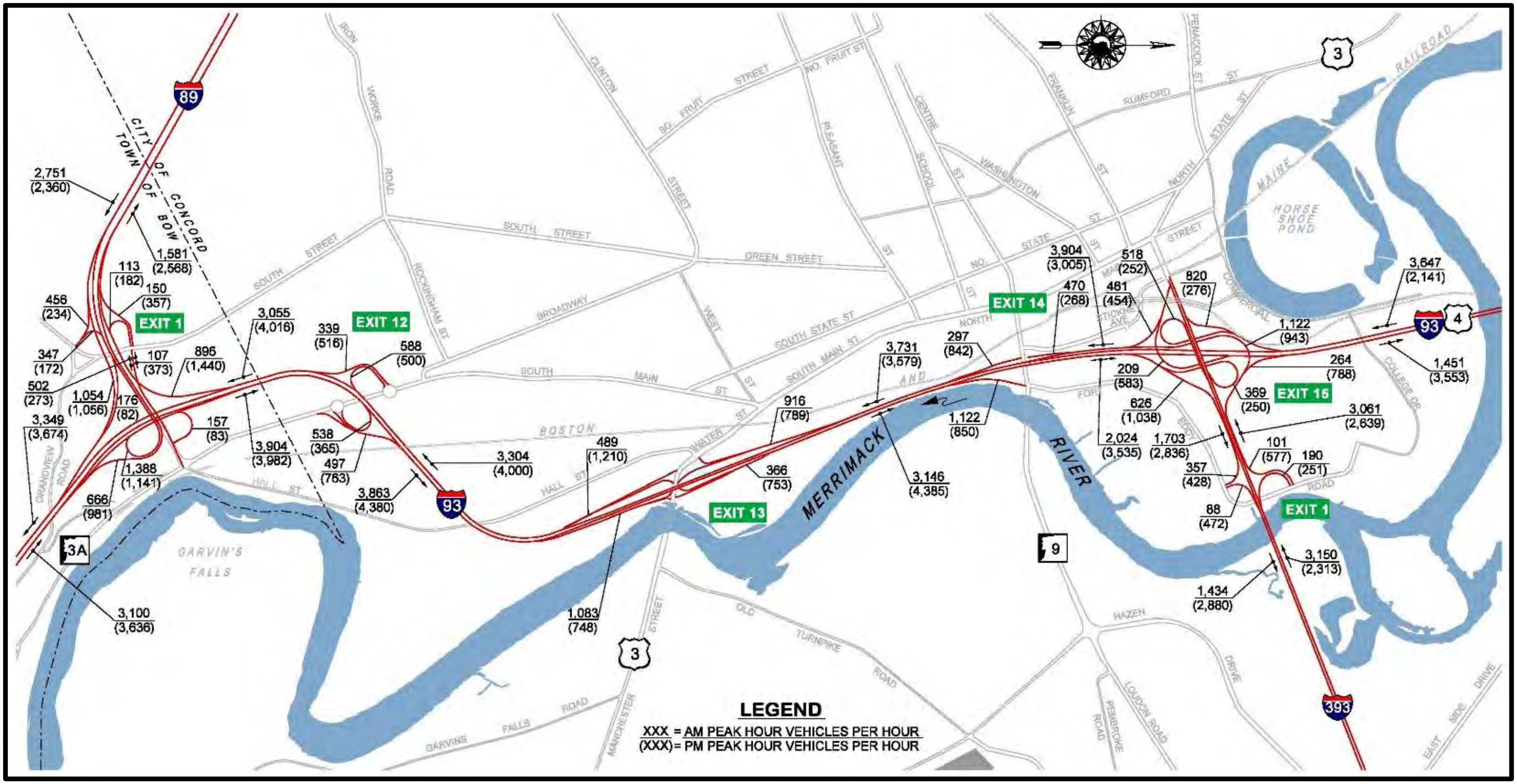
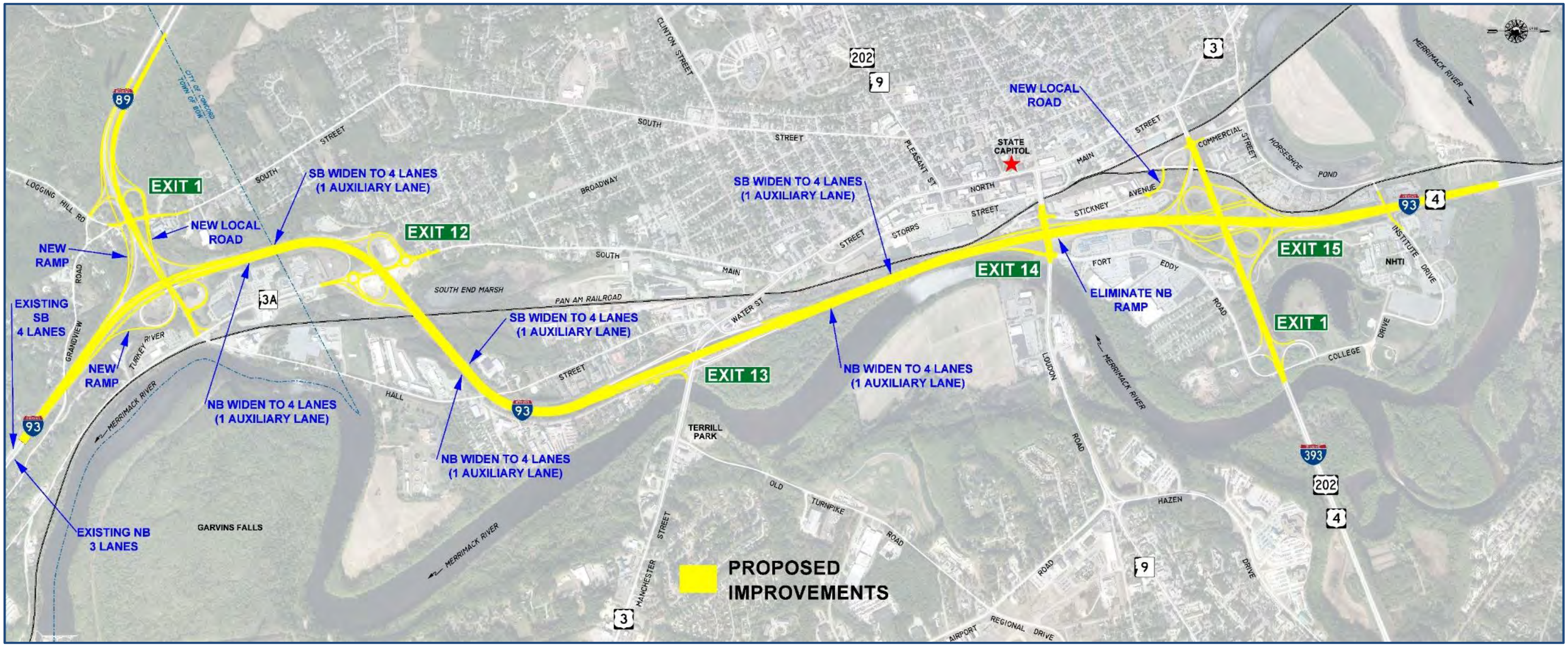


Figure 22: Preferred Alternative



HAZARDOUS MATERIALS EVALUATION REPORT

BOW TO CONCORD I-93 IMPROVEMENTS
BOW / CONCORD, NEW HAMPSHIRE
NH State Project No. 13742
Task 6.13

FOR

McFARLAND JOHNSON, INC.
MS. JENNIFER ZORN, PROJECT MANAGER
53 REGIONAL DRIVE
CONCORD, NEW HAMPSHIRE 03301

BY

NOBIS ENGINEERING, INC.

(800) 394-4182
www.nobiseng.com

Nobis Project No. 87810.00
AUGUST 8, 2018

Engineering a Sustainable Future

Nobis

Engineering a Sustainable Future

August 8, 2018
File No. 87810.00

McFarland Johnson, Inc.
Ms. Jennifer Zorn, AICP
Project Manager
53 Regional Drive,
Concord, New Hampshire, 03301

Re: Hazardous Materials Evaluation Report
Bow to Concord I-93 Improvements
Task 6.13
NH State Project No. 13742

Dear: Ms. Zorn

Nobis Engineering, Inc. (Nobis) is pleased to present the attached Hazardous Materials Summary Report, supporting Task 6.13 of NH state Project No. 13742, Bow to Concord I-93 Improvements. This submittal has been revised to address comments received by Nobis on June 18, 2018.

Please contact the undersigned with questions or comments pertaining to this submittal or for further information as necessary.

Sincerely,

NOBIS ENGINEERING, INC.

Joshua R. Stewart
Project Scientist

Clarence "Tim" Andrews, P.G.
Senior Project Manager
Director of Environmental Services

Attachment

c: File No. 87810.00 (w/attach.)

Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
T (603) 224-4182

TABLE OF CONTENTS
HAZARDOUS MATERIALS EVALUATION
BOW TO CONCORD I-93 IMPROVEMENTS
BOW / CONCORD, NEW HAMPSHIRE

SECTION **PAGE**

TABLE

NUMBER

FIGURE

NUMBER

TABLE OF CONTENTS (cont.)
NAME OF REPORT
NAME OF SITE
SITE LOCATION CITY, STATE

FIGURE (CONT.)

NUMBER

1.0 INTRODUCTION

Nobis Engineering, Inc. has prepared this report to identify and summarize hazardous material concerns with the potential to impact the proposed improvements to the study corridor. This report summarizes the results of Nobis's evaluation of hazardous materials within the study corridor. Hazardous materials include contaminated soil, groundwater, and construction materials, which may be contaminated with, but not limited to, petroleum products, metals, hazardous chemicals, asbestos, and lead-based paint.

This hazardous materials evaluation was performed to support Task 6.13 of NH State Project No. 13742.

2.0 HAZARDOUS MATERIALS EVALUATION APPROACH

The screening review of the corridor provides an initial listing of the contaminated sites within the corridor boundary and within a 100-foot setback from the corridor boundary, as depicted in Figure 1. If intrusive activities are to be performed, *e.g.*, excavations that might encounter known groundwater and/or soil contamination, additional assessment of the contaminated site may be required to manage potential exposure to petroleum or hazardous substances. A commercial database search, obtained from the commercial environmental due diligence database company EDR, Inc., was generated for the entire corridor boundary area, including the "Alternatives". Following the EDR report, the NHDES OneStop Geographic Information System (GIS) website was used to identify contaminated sites within the corridor boundary and 100-foot setback areas. The website includes NHDES project sites with administrative tracking records, such as underground storage tanks (USTs) and hazardous waste generators, as well as contaminated sites with documented discharges or suspected discharges of petroleum or hazardous materials. These contaminated sites are shown on the Asbestos Disposal Sites (ADSs) and Remediation Sites GIS layers. Due to the limitations of the OneStop GIS website for this application, a conservative approach was used where interpretation of the search distance was required, *i.e.*, some NHDES project sites reviewed may be just outside the corridor boundary and 100-foot setback area. Following the NHDES OneStop GIS website review, the New Hampshire Department of Transportation (NHDOT) Risk Assessment Survey for Contamination and Appraisal of Land (RASCAL) database was consulted for any additional known hazardous material concerns within the corridor boundary and 100-foot setback area.

In reviewing the corridor through the OneStop GIS website, two basic assumptions were applied: 1) groundwater flow within the corridor boundary is generally toward the Merrimack River, and 2) sites with a status of Closed or Inactive are assumed, in the absence of other mitigating factors or information, to be in compliance with state and federal requirements with respect to soil and groundwater. It is noted that, although regulators may not require additional action, Inactive ADSs may require special management if disturbed.

Given these assumptions, the corridor was reviewed relative to the following:

Is the NHDES project site shown on the Asbestos Disposal Site or Remediation Sites GIS layers?

- If No – Not considered a contaminated site and no further review performed.
- If Yes – Is the contaminated site within the corridor boundary and 100-foot setback, as depicted in GIS?
  - If No – No further review.
  - If Yes – listed in Table 1; is the site status other than Closed or Inactive?
    - If No – No further review.
    - If Yes – For contaminated sites with ongoing investigations or ongoing monitoring under a Groundwater Management Permit (GMP), is the site hydrologically upgradient of the corridor?
      - If No – No further review.
      - If Yes – refer to discussion below

Contaminated sites that are hydrologically upgradient of the corridor and are monitored under a GMP may require additional assessment if intrusive activities have the potential to encounter contaminated groundwater. The assessment may consist of as little as a review of NHDES reports available online to determine the general depth to groundwater. If excavations are anticipated that have the potential to encounter contaminated groundwater, then additional assessment of existing records may be required to determine any precautions to limit worker exposure and manage contaminated water.

3.0 IDENTIFIED HAZARDOUS MATERIALS SUMMARY

A discussion of identified Hazardous Material sites is presented in the sections below; sections are broken up by corridor study area subsections as depicted in Figures 2 through 9. A complete list of the 43 sites within the corridor boundary and 100-foot setback (as shown in Figure 1) identified in accordance with the criteria above are listed in Table 1.

3.1 I-89 Exit 1

Three sites were identified within the I-89 Exit 1 section of the corridor (Table 2). Two of the sites are listed as closed in the NHDES database and include a paint thinner spill on the I-89SB ramp to I-93SB and an auto repair shop listed for underground injection control due to the presence of floor drains. The one open remediation site is a gas station for a UST petroleum release.

3.2 I-89 and I-93 Interchange

Five sites were identified within the I-89 and I-93 interchange section of the corridor (Table 3). Four of the sites are listed as closed in the NHDES database and include a diesel fuel release from a truck accident on I-93NB, a motor oil spill at Grappone Collision, and two ether releases at the Grappone facilities. The one open remediation site is the Former Grappone Honda for an ether release. The main contaminant of concern from an ether release is the gasoline additive methyl tert-butyl ether (MtBE).

3.3 I-93 Exit 12

One site was identified within the I-93 Exit 12 section of the corridor (Table 4). The site, a sheet metal facility, where solvents were likely used, was listed for underground injection control due to the presence of floor drains. The site is listed as closed since 1997 in the NHDES OneStop database.

3.4 I-93 Exit 13

Ten sites were identified within the I-93 Exit 13 section of the corridor (Table 5). Five of the sites are listed as closed in the NHDES database and include releases from a former motel, a former gas station, a former commercial building, and a former jeweler. One of the closed sites was closed with an Activity and Use Restriction (AUR) in place. The five open remediation sites include the former Store 24 and the former Johnson & Dix bulk fuel storage facility for petroleum releases, Former Advanced Recycling for PCE and TCE releases, and the Concord Coal Gas and Exit 13 coal tar pond for releases related to coal gas production. The Concord Coal Gas and Exit 13 coal tar pond releases have created a sizable plume of groundwater contamination. The approximate plume limits are depicted on Figure 5. Additionally, two auto salvage yards (not included in the site count) were identified within this section of the corridor. No documented releases from the salvage yards were encountered during review; however, due to the nature of salvage yards, a hazardous materials condition may be present at these locations.

3.5 I-93 Exit 14 Area

Eight sites were identified within the I-93 Exit 14 Area section of the corridor (Table 6). Five of the sites are listed as closed in the NHDES database, including a motor oil release from a car accident on I-93NB at mile marker 37.9 and releases from a former gas station, a car service center, and former commercial buildings. The three open remediation sites include two gas stations with UST petroleum releases and former Concord Cleaners dry cleaner PCE release. One of the former gas station sites has an associated plume of groundwater contamination. The approximate plume limits are depicted on Figure 6.

3.6 I-93 Exits 14 and 15 Area

Sixteen sites were identified within the I-93 Exits 14 and 15 Area section of the corridor shown on Figures 7 through 9 (Table 7). Eight of the sites are listed as closed in the NHDES database and include a diesel fuel release from a truck accident on I-93SB at Exit 15 and another at the I-93/I-393 interchange, a gasoline spill on Storrs Street, releases from commercial buildings, and a former hotel. The eight open remediation sites include five gas stations with UST petroleum releases, a NHDOT facility with a UST release, an above ground storage tank release of fuel oil, and an inactive asbestos disposal site (ADS). Several of the open sites have associated plumes of groundwater contamination. The approximate plume limits are depicted on Figure 7.

4.0 FINDINGS

A contaminated site with an Activity and Use Restriction (AUR) may require additional assessment to understand the extent and limitations of the AUR if intrusive activities are required in close proximity to the AUR site. Reviewing NHDES and county records to determine the location of the AUR relative to the corridor may be all that is required. If an AUR includes or abuts the right-of-way, the AUR limitations should be reviewed to determine any restrictions on disturbances and material management requirements.

Contaminated sites that are hydrologically upgradient of the corridor and are monitored under a GMP may require additional assessment if intrusive activities have the potential to encounter contaminated groundwater. The assessment may consist of as little as a review of NHDES reports available online to determine the general depth to groundwater. If excavations are anticipated that have the potential to encounter contaminated groundwater, then additional assessment of existing records may be required to determine any precautions to limit worker exposure and manage contaminated water.

Inactive ADSs do not require ongoing monitoring and generally do not have administrative limitations. Appropriate precautions are advisable for any activities requiring surficial disturbance near an ADS. These precautions may include the need for ADS-certified workers and consultations with NHDES personnel to determine the likely presence of asbestos waste. If encountered, waste containing asbestos will require management in accordance with State and Federal requirements.

4.1 Per- and Polyfluoroalkyl Substances (PFAS)

Upon request by McFarland Johnson, Nobis also evaluated available information on the NHDES PFAS informational webpage. The PFAS database includes a state-wide map of all current PFAS sampling sites; however, this database is in the preliminary stages and does not include all possible sites, only those where testing has been conducted and reported. Many sites under NHDES oversight, which are scheduled to be sampled in 2018, are not yet included. For privacy purposes, the map does not include ownership information or addresses of current sampling sites, but it does provide a qualitative assessment of whether there are potential PFAS issues along the study corridor.

The PFAS database indicates that there are three sites with PFAS detections just to the north of the I-89/I-93 interchange. Laboratory analysis is performed for nine PFAS compounds. Currently, an Ambient Groundwater Quality Standard (AGQS) of 70 parts per trillion has been established for PFOS, PFOA or the sum of the two; standards for PFNA and PFHxS are expected to be established by January 1, 2019. The detections at the sites reviewed in the I-89/I-93 interchange area fall below 70 ppt.

4.2 Asbestos and Lead in Bridge Materials

Nobis obtained as-built plans from NHDOT of the bridges and overpasses present within the corridor boundary. A review of the plans by Nobis did not identify any evidence of the presence of asbestos or lead-based paint in the building materials of the bridges and overpasses within the corridor. In accordance with the Scope of Work, no inspections of these structures were conducted as part of this assessment.

4.3 Initial Site Assessments (ISAs)

Nobis understands that up to five non-intrusive Initial Site Assessments (ISAs) will be conducted on a limited number of properties in association with Part C of the Corridor Study. These properties along the corridor represent sites that are not already subject to NHDES oversight and reporting. Based on the data reviewed as part of this Hazardous Materials Evaluation, Nobis recommends that those ISAs be performed for the following sites:

- Central NH Sales, Inc., Auto Salvage Yard, Hall Street, Concord, NH
- Arnold’s Truck Salvage, Auto Salvage Yard, Hall Street, Concord, NH

These properties were selected based on their past and/or current uses as automotive salvage yards, lack of prior investigations or analytical data available for review, and unknown current environmental conditions. These properties may be potential sources of contaminated media and/or hazardous materials and a hazardous materials condition may be present at these locations.

TABLES

Table 1
Documented Environmental Sites Proximal to the I-93 Corridor
Interstate 93 Corridor
Bow/Concord, New Hampshire

NHDES Site Name	Site No.	Address	RCRA Generator	Project Type	Status	Contaminants of Concern	Reference Map
10 Fort Eddy Road (Proposed Boston Market)	199605029	10 Fort Eddy Road, Concord	No	HAZWASTE	Closed	PCE, TCE, MtBE, cis-1,2-DCE, 1,1,1-TCA	Figure 6
Agway, Inc.	198605615	650 South Commercial St, Concord	Yes - Inactive	OPUF	Closed	Fuel Oil	Figure 7
Black Jack Heavy Hauling	201106045	I-93 SB Exit 15	No	IRSPILL	Closed	Diesel	Figure 7
Cailler's Gulf	199212021	89 South Main Street, Concord	Yes - Inactive	HAZWASTE, LUST	Closed	BTEX, MtBE, Naphthalene, 1,2,4-TMB, 1,3,5-TMB	Figure 6
Car Preservation Center	198705003	74-76 South Main Street, Concord	No	LUST	Closed	BTEX, Methylene Chloride, Acetone, PCE	Figure 6
Concord Center Trust	199307012	10 Ferry Street, Concord	No	LUST, HAZWASTE Asbestos Disposal Site (Inactive)	Closed Open	PCE, Asbestos	Figure 7
Concord Cleaners	200011034	80 South Main Street, Concord	Yes - Inactive	IRSPILL UIC, HAZWASTE	Closed Open	PCE, TCE, cis-1,2-DCE	Figure 6
Concord Coal Gas Site	198904063	Gas St and South Main St, Concord	No	HAZWASTE	Open	BTEX, Napthalene, Styrene, 1,2,4-TMB, SVOCs	Figure 5
Cumberland Farms 2890	199210026	165 North Main Street, Concord	Yes - Inactive	LUST LUST	Closed Open	Benzene, Napthalene, MtBE, tBA, 1,2,4-TMB	Figure 7
Exit 13 Coal Tar Pond	199212014	Manchester Street Bridge Area	No	HAZWASTE	Open	Benzene, Naphthalene, MtBE, tBA, PAHs	Figure 5
Exxon Div of CFI 2861	199007029	196 North Main Street, Concord	Yes - Inactive	IRSPILL, LUST LUST	Closed Open	BTEX, Naphthalene, MtBE, tBA, tAME, 1,2,4-TMB, PCE	Figure 7
Former Econolodge	198612000	Gulf Street, Concord	No	HAZWASTE, LUST	Closed	BTEX, Napthalene, Styrene, MtBE	Figure 5
Former Gulf Station	198908007	21 Water Street, Concord	Yes - Inactive	LUST	Closed	Benzene	Figure 5
Former Highway Hotel Site	199108022	Fort Eddy Road, Concord	No	Site Assessment	Closed	PCE, TCE, 1,2-DCE, 1,1,1-TCA, Chloroform, MtBE	Figure 7
Former Johnson & Dix Bulk Fuel	199104009	1 Gulf Street, Concord	Yes - Declassified	SPILL/RLS, LUST, UIC FUEL, HAZWASTE, LUST	Closed Open	BTEX, Naphthalene, 1,2,4-TMB, 1,3,5-TMB, PCE, cis-1,2-DCE	Figure 5
Former NH Business Sales Office	199304013	10 Water Street, Concord	No	HAZWASTE	Closed	BTEX, PCE, Styrene, Chloroform, PAHs	Figure 5
Getty Station 55208	199812213	242 North Main Street, Concord	Yes - Declassified	LUST	Open	BTEX, Naphthalene, 1,2,4-TMB	Figure 7
Grappone Collision	200905045	594 Route 3A, Bow	Yes	IRSPILL	Closed	Oil	Figure 3
Grappone Ford	199702005	Route 3A, Bow	No	Site Assessment ETHER	Closed	MtBE, TPH-DRO, Metals	Figure 3
Grappone Honda	200304047	507 Route 3A, Bow	No	SPILL/RLS, Site Assessment ETHER	Closed Open	Oil,Toluene, Acetone, MtBE	Figure 3
Grappone Leasing, Former R&R Jewelery	198605461	4 Hall Street, Concord	No	MOST, OPUF, SPILL/RLS	Closed	PAHs, Lead	Figure 5
Grappone Toyota and Truck Center	199703048	594 Route 3A, Bow	Yes	ETHER	Closed	MtBE	Figure 3
Greenlands Corporation	199212027	8A Commercial Street, Concord	Yes - Inactive	Site Assessment	Closed	BTEX, TPH, PCE	Figure 7
Hess Station 29500	199306008	175 North Main Street, Concord	Yes	IRSPILL LUST	Closed Open	BTEX, MtBE, Naphthalene	Figure 7
Jerry's Auto Clinic	199412011	521 South Street, Bow	Yes - Inactive	UIC	Closed	Closed Floor drain for rain/snow melt	Figure 2
Lockwood Young Corporation	198805015	South Commercial Street, Concord	Yes - Inactive	UIC, LUST	Closed	BTEX, MtBE, Napthalene, Isopropylbenzene	Figure 7
Lot 26-1-10	199401020	14-16 Water Street, Concord	No	HAZWASTE	Closed - AUR	Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene	Figure 5
Merrimack Sheet Metal, Inc.	199704007	119 Hall Street, Concord	Yes - Inactive	UIC	Closed	Closed Floor Drain	Figure 4
Midas Muffler	200507010	79 Fort Eddy Road, Concord	Yes - Inactive	SPILL/RLS, ETHER	Closed	MtBE	Figure 7
Mobil 10571	199102011	519 South Street, Bow	Yes - Inactive	IRSPILL (2), UIC LUST	Closed Open	MtBE, 1,1-DCE	Figure 2
Mobil Station (01-367) 5D2	198904039	129 South Main Street, Concord	Yes - Inactive	UIC LUST, UIC	Closed Open	Benzene, tBA, 1,2-DCA	Figure 6
NHDOT Highway Garage 12	199004021	11 Stickney Ave, Concord	Yes - Declassified	UIC (2), IRSPILL, OPUF HAZWASTE, LUST	Closed Open	Fuel Oil, BTEX, Naphthalene, tBA, MtBE, TCE	Figure 7
Paint Thinner Release	201511018	I-89 SB Ramp to I-93 SB	No	IRSPILL	Closed	Paint Thinner	Figure 2
Penny Pitou Travel	200102053	87 South Main Street, Concord	No	LUST	Closed	BTEX, MtBE, Napthalene	Figure 6
Polarized new England Co./ Former Advanced Recycling	200606017	25 Sandquist Street, Concord	Yes	ETHER, HAZWASTE SPILL/RLS	Closed Open	PCE, TCE, MtBE, tBA	Figure 5
Prescott & Sons Oil	199407068	196 North Main Street, Concord	Yes - Inactive	LAST	Open	Fuel Oil	Figure 7
Roadside Spill	201207008	I-93 and I-393 Interchange	No	IRSPILL	Closed	Diesel, Hydraulic Oil	Figure 7
SNP Parking Associates, LLC	200110045	Storrs Street, Concord	Yes - Inactive	SPILL/RLS	Closed	Gasoline, Fuel Oil	Figure 7
South Commercial Street Mobil	198905028	32 South Commercial Street, Concord	Yes - Inactive	Site Assessment, IRSPILL LUST	Closed Open	Ethylbenzene, Xylenes, Isopropylbenzene, n-Propylbenzene, 1,2,4-TMB, 1,3,5-TMB	Figure 7
South Main Citgo	199302009	81 South Main Street, Concord	Yes - Inactive	LUST	Open	BTEX, MtBE, tBA, Naphthalene, 1,2,4-TMB, 1,3,5-TMB, EDB	Figure 6
Store 24	199007032	201 South Main Street, Concord	No	LUST	Open	BTEX, MtBE, Naphthalene, 1,2,4-TMB, 1,3,5-TMB, Isopropylbenzene	Figure 5
Truck Accident Diesel Release	201610204	I-93 NB	No	SPILL/RLS	Closed	Diesel	Figure 3
Vehicle Into the Merrimack River	201112041	I-93 NB, MM 37.9	No	IRSPILL	Closed	Motor Oil Spill	Figure 6

Notes:
1. Project information was obtained from the NHDES OneStop database during January 2018.
2. ETHER = Ether Contaminated Site, FUEL = Leaking Bulk Storage Facility Containing Heating Fuel Oil; HAZWASTE = Hazardous Waste; IRSPILL = Initial Response Spill; LAST = Leaking Aboveground Storage Tank; LUST = Leaking Underground Storage Tank; MOST = Leaking Motor Oil Storage Tank; OPUF = On-Premise Use Facility Containing Fuel Oil; SPILL/RLS = Spill/Release; UIC = Underground Injection Control
3. 1,1-DCE = 1,1-Dichloroethene; 1,2-DCA = 1,2-Dichloroethane; 1,1-DCE = 1,1-Dichloroethene; 1,2,4-TMB = 1,2,4-Trimethylbenzene; 1,3,5-TMB = 1,3,5-Trimethylbenzene; cis-1,2-DCE = cis-1,2-Dichloroethene; BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes; EDB = Ethylene Dibromide; MtBE = Methyl tert-Butyl Ether; PAHs = Polycyclic Aromatic Hydrocarbons; PCE = Tetrachloroethene; tBA = tert-Butyl Alcohol; TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics; TCE = Trichloroethene;

Table 2
Documented Environmental Sites I-89 Exit 1
Interstate 93 Corridor
Bow/Concord, New Hampshire

NHDES Site Name	Site No.	Address	RCRA Generator	Project Type	Status	Contaminants of Concern	Reference Map
Jerry's Auto Clinic	199412011	521 South Street, Bow	Yes - Inactive	UIC	Closed	Closed Floor drain for rain/snow melt	Figure 2
Mobil 10571	199102011	519 South Street, Bow	Yes - Inactive	IRSPILL (2), UIC LUST	Closed Open	MtBE, 1,1-DCE	Figure 2
Paint Thinner Release	201511018	I-89 SB Ramp to I-93 SB	No	IRSPILL	Closed	Paint Thinner	Figure 2

Notes:

1. Project information was obtained from the NHDES OneStop database during January 2018.

2. ETHER = Ether Contaminated Site, FUEL = Leaking Bulk Storage Facility Containing Heating Fuel Oil; HAZWASTE = Hazardous Waste; IRSPILL = Initial Response Spill; LAST = Leaking Aboveground Storage Tank; LUST = Leaking Underground Storage Tank; MOST = Leaking Motor Oil Storage Tank; OPUF = On-Premise Use Facility Containing Fuel Oil; SPILL/RLS = Spill/Release; UIC = Underground Injection Control

3. 1,1-DCE = 1,1-Dichloroethene; 1,2-DCA = 1,2-Dichloroethane; 1,1-DCE = 1,1-Dichloroethene; 1,2,4-TMB = 1,2,4-Trimethylbenzene; 1,3,5-TMB = 1,3,5-Trimethylbenzene; cis-1,2-DCE = cis-1,2-Dichloroethene; BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes; EDB = Ethylene Dibromide; MtBE = Methyl tert-Butyl Ether; PAHs = Polycyclic Aromatic Hydrocarbons; PCE = Tetrachloroethene; tBA = tert-Butyl Alcohol; TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics; TCE = Trichloroethene;

Table 3
Documented Environmental Sites I-98 and I-93 Interchange
Interstate 93 Corridor
Bow/Concord, New Hampshire

NHDES Site Name	Site No.	Address	RCRA Generator	Project Type	Status	Contaminants of Concern	Reference Map
Grappone Collision	200905045	594 Route 3A, Bow	Yes	IRSPILL	Closed	Oil	Figure 3
Grappone Ford	199702005	Route 3A, Bow	No	Site Assessment ETHER	Closed	MtBE, TPH-DRO, Metals	Figure 3
Grappone Honda	200304047	507 Route 3A, Bow	No	SPILL/RLS, Site Assessment ETHER	Closed Open	Oil,Toluene, Acetone, MtBE	Figure 3
Grappone Toyota and Truck Center	199703048	594 Route 3A, Bow	Yes	ETHER	Closed	MtBE	Figure 3
Truck Accident Diesel Release	201610204	I-93 NB	No	SPILL/RLS	Closed	Diesel	Figure 3

Notes:

1. Project information was obtained from the NHDES OneStop database during January 2018.

2. ETHER = Ether Contaminated Site, FUEL = Leaking Bulk Storage Facility Containing Heating Fuel Oil; HAZWASTE = Hazardous Waste; IRSPILL = Initial Response Spill; LAST = Leaking Aboveground Storage Tank; LUST = Leaking Underground Storage Tank; MOST = Leaking Motor Oil Storage Tank; OPUF = On-Premise Use Facility Containing Fuel Oil; SPILL/RLS = Spill/Release; UIC = Underground Injection Control

3. 1,1-DCE = 1,1-Dichloroethene; 1,2-DCA = 1,2-Dichloroethane; 1,1-DCE = 1,1-Dichloroethene; 1,2,4-TMB = 1,2,4-Trimethylbenzene; 1,3,5-TMB = 1,3,5-Trimethylbenzene; cis-1,2-DCE = cis-1,2-Dichloroethene; BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes; EDB = Ethylene Dibromide; MtBE = Methyl tert-Butyl Ether; PAHs = Polycyclic Aromatic Hydrocarbons; PCE = Tetrachloroethene; tBA = tert-Butyl Alcohol; TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics; TCE = Trichloroethene;

Table 4
Documented Environmental Sites I-93 Exit 12
Interstate 93 Corridor
Bow/Concord, New Hampshire

NHDES Site Name	Site No.	Address	RCRA Generator	Project Type	Status	Contaminants of Concern	Reference Map
Merrimack Sheet Metal, Inc.	199704007	119 Hall Street, Concord	Yes - Inactive	UIC	Closed	Closed Floor Drain	Figure 4

Notes:

1. Project information was obtained from the NHDES OneStop database during January 2018.

2. ETHER = Ether Contaminated Site, FUEL = Leaking Bulk Storage Facility Containing Heating Fuel Oil; HAZWASTE = Hazardous Waste; IRSPILL = Initial Response Spill; LAST = Leaking Aboveground Storage Tank; LUST = Leaking Underground Storage Tank; MOST = Leaking Motor Oil Storage Tank; OPUF = On-Premise Use Facility Containing Fuel Oil; SPILL/RLS = Spill/Release; UIC = Underground Injection Control

3. 1,1-DCE = 1,1-Dichloroethene; 1,2-DCA = 1,2-Dichloroethane; 1,1-DCE = 1,1-Dichloroethene; 1,2,4-TMB = 1,2,4-Trimethylbenzene; 1,3,5-TMB = 1,3,5-Trimethylbenzene; cis-1,2-DCE = cis-1,2-Dichloroethene; BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes; EDB = Ethylene Dibromide; MtBE = Methyl tert-Butyl Ether; PAHs = Polycyclic Aromatic Hydrocarbons; PCE = Tetrachloroethene; tBA = tert-Butyl Alcohol; TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics; TCE = Trichloroethene;

Table 5
Documented Environmental Sites I-93 Exit 13
Interstate 93 Corridor
Bow/Concord, New Hampshire

NHDES Site Name	Site No.	Address	RCRA Generator	Project Type	Status	Contaminants of Concern	Reference Map
Concord Coal Gas Site	198904063	Gas St and South Main St, Concord	No	HAZWASTE	Open	BTEX, Napthalene, Styrene, 1,2,4-TMB, SVOCs	Figure 5
Exit 13 Coal Tar Pond	199212014	Manchester Street Bridge Area	No	HAZWASTE	Open	Benzene, Naphthalene, MtBE, tBA, PAHs	Figure 5
Former Econolodge	198612000	Gulf Street, Concord	No	HAZWASTE, LUST	Closed	BTEX, Napthalene, Styrene, MtBE	Figure 5
Former Gulf Station	198908007	21 Water Street, Concord	Yes - Inactive	LUST	Closed	Benzene	Figure 5
Former Johnson & Dix Bulk Fuel	199104009	1 Gulf Street, Concord	Yes - Declassified	SPILL/RLS, LUST, UIC FUEL, HAZWASTE, LUST	Closed Open	BTEX, Naphthalene, 1,2,4-TMB, 1,3,5-TMB, PCE, cis-1,2-DCE	Figure 5
Former NH Business Sales Office	199304013	10 Water Street, Concord	No	HAZWASTE	Closed	BTEX, PCE, Styrene, Chloroform, PAHs	Figure 5
Grappone Leasing, Former R&R Jewelery	198605461	4 Hall Street, Concord	No	MOST, OPUF, SPILL/RLS	Closed	PAHs, Lead	Figure 5
Lot 26-1-10	199401020	14-16 Water Street, Concord	No	HAZWASTE	Closed - AUR	Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene	Figure 5
Polarized new England Co./ Former Advanced Recycling	200606017	25 Sandquist Street, Concord	Yes	ETHER, HAZWASTE SPILL/RLS	Closed Open	PCE, TCE, MtBE, tBA	Figure 5
Store 24	199007032	201 South Main Street, Concord	No	LUST	Open	BTEX, MtBE, Naphthalene, 1,2,4-TMB, 1,3,5-TMB, Isopropylbenzene	Figure 5

Notes:

1. Project information was obtained from the NHDES OneStop database during January 2018.
2. ETHER = Ether Contaminated Site, FUEL = Leaking Bulk Storage Facility Containing Heating Fuel Oil; HAZWASTE = Hazardous Waste; IRSPILL = Initial Response Spill; LAST = Leaking Aboveground Storage Tank; LUST = Leaking Underground Storage Tank; MOST = Leaking Motor Oil Storage Tank; OPUF = On-Premise Use Facility Containing Fuel Oil; SPILL/RLS = Spill/Release; UIC = Underground Injection Control
3. 1,1-DCE = 1,1-Dichloroethene; 1,2-DCA = 1,2-Dichloroethane; 1,1-DCE = 1,1-Dichloroethene; 1,2,4-TMB = 1,2,4-Trimethylbenzene; 1,3,5-TMB = 1,3,5-Trimethylbenzene; cis-1,2-DCE = cis-1,2-Dichloroethene; BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes; EDB = Ethylene Dibromide; MtBE = Methyl tert-Butyl Ether; PAHs = Polycyclic Aromatic Hydrocarbons; PCE = Tetrachloroethene; tBA = tert-Butyl Alcohol; TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics; TCE = Trichloroethene;

Table 6
Documented Environmental Sites I-93 Exit 14 Area
Interstate 93 Corridor
Bow/Concord, New Hampshire

NHDES Site Name	Site No.	Address	RCRA Generator	Project Type	Status	Contaminants of Concern	Reference Map
10 Fort Eddy Road (Proposed Boston Market)	199605029	10 Fort Eddy Road, Concord	No	HAZWASTE	Closed	PCE, TCE, MtBE, cis-1,2-DCE, 1,1,1-TCA	Figure 6
Cailler's Gulf	199212021	89 South Main Street, Concord	Yes - Inactive	HAZWASTE, LUST	Closed	BTEX, MtBE, Naphthalene, 1,2,4-TMB, 1,3,5-TMB	Figure 6
Car Preservation Center	198705003	74-76 South Main Street, Concord	No	LUST	Closed	BTEX, Methylene Chloride, Acetone, PCE	Figure 6
Concord Cleaners	200011034	80 South Main Street, Concord	Yes - Inactive	IRSPILL UIC, HAZWASTE	Closed Open	PCE, TCE, cis-1,2-DCE	Figure 6
Mobil Station (01-367) 5D2	198904039	129 South Main Street, Concord	Yes - Inactive	UIC LUST, UIC	Closed Open	Benzene, tBA, 1,2-DCA	Figure 6
Penny Pitou Travel	200102053	87 South Main Street, Concord	No	LUST	Closed	BTEX, MtBE, Napthalene	Figure 6
South Main Citgo	199302009	81 South Main Street, Concord	Yes - Inactive	LUST	Open	BTEX, MtBE, tBA, Naphthalene, 1,2,4-TMB, 1,3,5-TMB, EDB	Figure 6
Vehicle Into the Merrimack River	201112041	I-93 NB, MM 37.9	No	IRSPILL	Closed	Motor Oil Spill	Figure 6

Notes:
1. Project information was obtained from the NHDES OneStop database during January 2018.
2. ETHER = Ether Contaminated Site, FUEL = Leaking Bulk Storage Facility Containing Heating Fuel Oil; HAZWASTE = Hazardous Waste; IRSPILL = Initial Response Spill; LAST = Leaking Aboveground Storage Tank; LUST = Leaking Underground Storage Tank; MOST = Leaking Motor Oil Storage Tank; OPUF = On-Premise Use Facility Containing Fuel Oil; SPILL/RLS = Spill/Release; UIC = Underground Injection Control
3. 1,1-DCE = 1,1-Dichloroethene; 1,2-DCA = 1,2-Dichloroethane; 1,1-DCE = 1,1-Dichloroethene; 1,2,4-TMB = 1,2,4-Trimethylbenzene; 1,3,5-TMB = 1,3,5-Trimethylbenzene; cis-1,2-DCE = cis-1,2-Dichloroethene; BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes; EDB = Ethylene Dibromide; MtBE = Methyl tert-Butyl Ether; PAHs = Polycyclic Aromatic Hydrocarbons; PCE = Tetrachloroethene; tBA = tert-Butyl Alcohol; TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics; TCE = Trichloroethene;

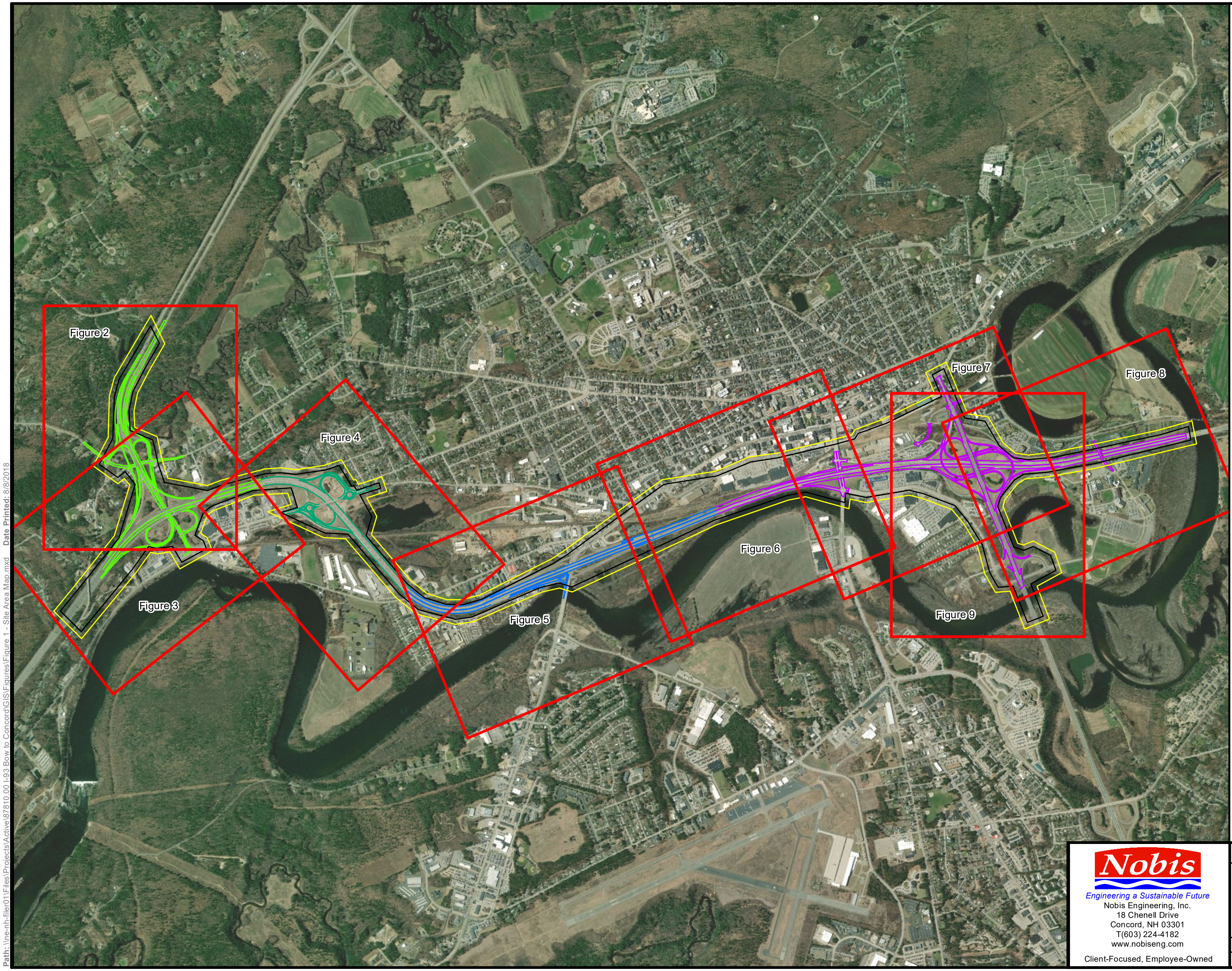
Table 7
Documented Environmental Sites I-93 Exits 14 and 15 Area
Interstate 93 Corridor
Bow/Concord, New Hampshire

NHDES Site Name	Site No.	Address	RCRA Generator	Project Type	Status	Contaminants of Concern	Reference Map
Agway, Inc.	198605615	650 South Commercial St, Concord	Yes - Inactive	OPUF	Closed	Fuel Oil	Figure 7
Black Jack Heavy Hauling	201106045	I-93 SB Exit 15	No	IRSPILL	Closed	Diesel	Figure 7
Concord Center Trust	199307012	10 Ferry Street, Concord	No	LUST, HAZWASTE Asbestos Disposal Site (Inactive)	Closed Open	PCE, Asbestos	Figure 7
Cumberland Farms 2890	199210026	165 North Main Street, Concord	Yes - Inactive	LUST LUST	Closed Open	Benzene, Napthalene, MtBE, tBA, 1,2,4-TMB	Figure 7
Exxon Div of CFI 2861	199007029	196 North Main Street, Concord	Yes - Inactive	IRSPILL, LUST LUST	Closed Open	BTEX, Naphthalene, MtBE, tBA, tAME, 1,2,4-TMB, PCE	Figure 7
Former Highway Hotel Site	199108022	Fort Eddy Road, Concord	No	Site Assessment	Closed	PCE, TCE, 1,2-DCE, 1,1,1-TCA, Chloroform, MtBE	Figure 7
Getty Station 55208	199812213	242 North Main Street, Concord	Yes - Declassified	LUST	Open	BTEX, Naphthalene, 1,2,4-TMB	Figure 7
Greenlands Corporation	199212027	8A Commercial Street, Concord	Yes - Inactive	Site Assessment	Closed	BTEX, TPH, PCE	Figure 7
Hess Station 29500	199306008	175 North Main Street, Concord	Yes	IRSPILL LUST	Closed Open	BTEX, MtBE, Naphthalene	Figure 7
Lockwood Young Corporation	198805015	South Commercial Street, Concord	Yes - Inactive	UIC, LUST	Closed	BTEX, MtBE, Napthalene, Isopropylbenzene	Figure 7
Midas Muffler	200507010	79 Fort Eddy Road, Concord	Yes - Inactive	SPILL/RLS, ETHER	Closed	MtBE	Figure 7
NHDOT Highway Garage 12	199004021	11 Stickney Ave, Concord	Yes - Declassified	UIC (2), IRSPILL, OPUF HAZWASTE, LUST	Closed Open	Fuel Oil, BTEX, Naphthalene, tBA, MtBE, TCE	Figure 7
Prescott & Sons Oil	199407068	196 North Main Street, Concord	Yes - Inactive	LAST	Open	Fuel Oil	Figure 7
Roadside Spill	201207008	I-93 and I-393 Interchange	No	IRSPILL	Closed	Diesel, Hydraulic Oil	Figure 7
SNP Parking Associates, LLC	200110045	Storrs Street, Concord	Yes - Inactive	SPILL/RLS	Closed	Gasoline, Fuel Oil	Figure 7
South Commercial Street Mobil	198905028	32 South Commercial Street, Concord	Yes - Inactive	Site Assessment, IRSPILL LUST	Closed Open	Ethylbenzene, Xylenes, Isopropylbenzene, n-Propylbenzene, 1,2,4-TMB, 1,3,5-TMB	Figure 7

Notes:

1. Project information was obtained from the NHDES OneStop database during January 2018.
2. ETHER = Ether Contaminated Site, FUEL = Leaking Bulk Storage Facility Containing Heating Fuel Oil; HAZWASTE = Hazardous Waste; IRSPILL = Initial Response Spill; LAST = Leaking Aboveground Storage Tank; LUST = Leaking Underground Storage Tank; MOST = Leaking Motor Oil Storage Tank; OPUF = On-Premise Use Facility Containing Fuel Oil; SPILL/RLS = Spill/Release; UIC = Underground Injection Control
3. 1,1-DCE = 1,1-Dichloroethene; 1,2-DCA = 1,2-Dichloroethane; 1,1-DCE = 1,1-Dichloroethene; 1,2,4-TMB = 1,2,4-Trimethylbenzene; 1,3,5-TMB = 1,3,5-Trimethylbenzene; cis-1,2-DCE = cis-1,2-Dichloroethene; BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes; EDB = Ethylene Dibromide; MtBE = Methyl tert-Butyl Ether; PAHs = Polycyclic Aromatic Hydrocarbons; PCE = Tetrachloroethene; tBA = tert-Butyl Alcohol; TPH-DRO = Total Petroleum Hydrocarbons - Diesel Range Organics; TCE = Trichloroethene;

FIGURES



Notes:

1. Site Sketch was developed from site plans available on the New Hampshire Department of Environmental Services (NHDES) OneStop database, NHDES GIS data layers downloaded on January 26, 2018, and observations by Nobis Engineering, Inc. Aerial photograph provided by ESRI.

2. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Corridor Boundary
- 100' Corridor Setback
- Map Location
- Exit 1/I-89 Area: Proposed Alt. K
- Exit 12 Area: Proposed Alt. F
- Exit 13 Area: Proposed Alt. B
- Exit 14/15 Area: Proposed Alt. F2

N

0 1,000 2,000 4,000

Feet

1 inch = 2,000 feet

Nobis
Engineering a Sustainable Future
Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
T(603) 224-4182
www.nobiseng.com
Client-Focused, Employee-Owned

FIGURE 1

SITE AREA MAP
I-93 CORRIDOR
BOW/CONCORD, NEW HAMPSHIRE

PREPARED BY: NZ	CHECKED BY: JR
PROJECT NO. 87810.00	DATE: JANUARY 2018

Path: \\ne-nh-filer01\Files\Projects\Active\87810.00 I-93 Bow to Concord\GIS\Figures\Figure 1 - Site Area Map.mxd Date Printed: 8/8/2018

Notes:

1. Site Sketch was developed from site plans available on the New Hampshire Department of Environmental Services (NHDES) OneStop database, NHDES GIS data layers downloaded on Janauary 26, 2018, and observations by Nobis Engineering, Inc. Aerial photograph provided by ESRI.

2. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Closed Remediation Sites
- Active Remediation Sites
- Corridor Boundary
- 100' Corridor Setback
- Exit 1/I-89 Area: Proposed Alt. K

0 200 400 800

Feet

1 inch = 400 feet

N

Nobis

Engineering a Sustainable Future

Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
T(603) 224-4182
www.nobiseng.com

Client-Focused, Employee-Owned

FIGURE 2

I-89 EXIT 1
CONCEPTS C, K, AND P
I-93 CORRIDOR
BOW/CONCORD, NEW HAMPSHIRE

PREPARED BY: NZ	CHECKED BY: JR
PROJECT NO. 87810.00	DATE: JANUARY 2018

Path: \\ne-nh-filer01\Files\Projects\Active\87810.00 I-93 Bow to Concord\GIS\Figures\Figure 2 - I-89 Exit 1.mxd Date Printed: 8/8/2018

Notes:

1. Site Sketch was developed from site plans available on the New Hampshire Department of Environmental Services (NHDES) OneStop database, NHDES GIS data layers downloaded on January 26, 2018, and observations by Nobis Engineering, Inc. Aerial photograph provided by ESRI.

2. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Active Remediation Sites selection
- Closed Remediation Sites
- Active Remediation Sites
- Corridor Boundary
- 100' Corridor Setback
- Exit 1/I-89 Area: Proposed Alt. K

Nobis
Engineering a Sustainable Future
Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
T(603) 224-4182
www.nobiseng.com
Client-Focused, Employee-Owned

FIGURE 3

I-89 AND I-93 INTERCHANGE
CONCEPTS C, K, AND P
I-93 CORRIDOR
BOW/CONCORD, NEW HAMPSHIRE

PREPARED BY: NZ	CHECKED BY: JR
PROJECT NO. 87810.00	DATE: JANUARY 2018

Path: \\ne-nh-filer01\Files\Projects\Active\87810.00 I-93 Bow to Concord\GIS\Figures\Figure 3 - 89-93 Intersection.mxd Date Printed: 8/8/2018

Notes:

1. Site Sketch was developed from site plans available on the New Hampshire Department of Environmental Services (NHDES) OneStop database, NHDES GIS data layers downloaded on January 26, 2018, and observations by Nobis Engineering, Inc. Aerial photograph provided by ESRI.

2. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Closed Remediation Sites
- Active Remediation Sites
- Corridor Boundary
- 100' Corridor Setback
- Exit 12 Area: Proposed Alt. F

N

0 200 400 800

Feet

1 inch = 400 feet

Nobis
Engineering a Sustainable Future
Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
T(603) 224-4182
www.nobiseng.com
Client-Focused, Employee-Owned

FIGURE 4

I-93 EXIT 12
CONCEPTS E AND F
I-93 CORRIDOR
BOW/CONCORD, NEW HAMPSHIRE

PREPARED BY: NZ	CHECKED BY: JR
PROJECT NO. 87810.00	DATE: JANUARY 2018

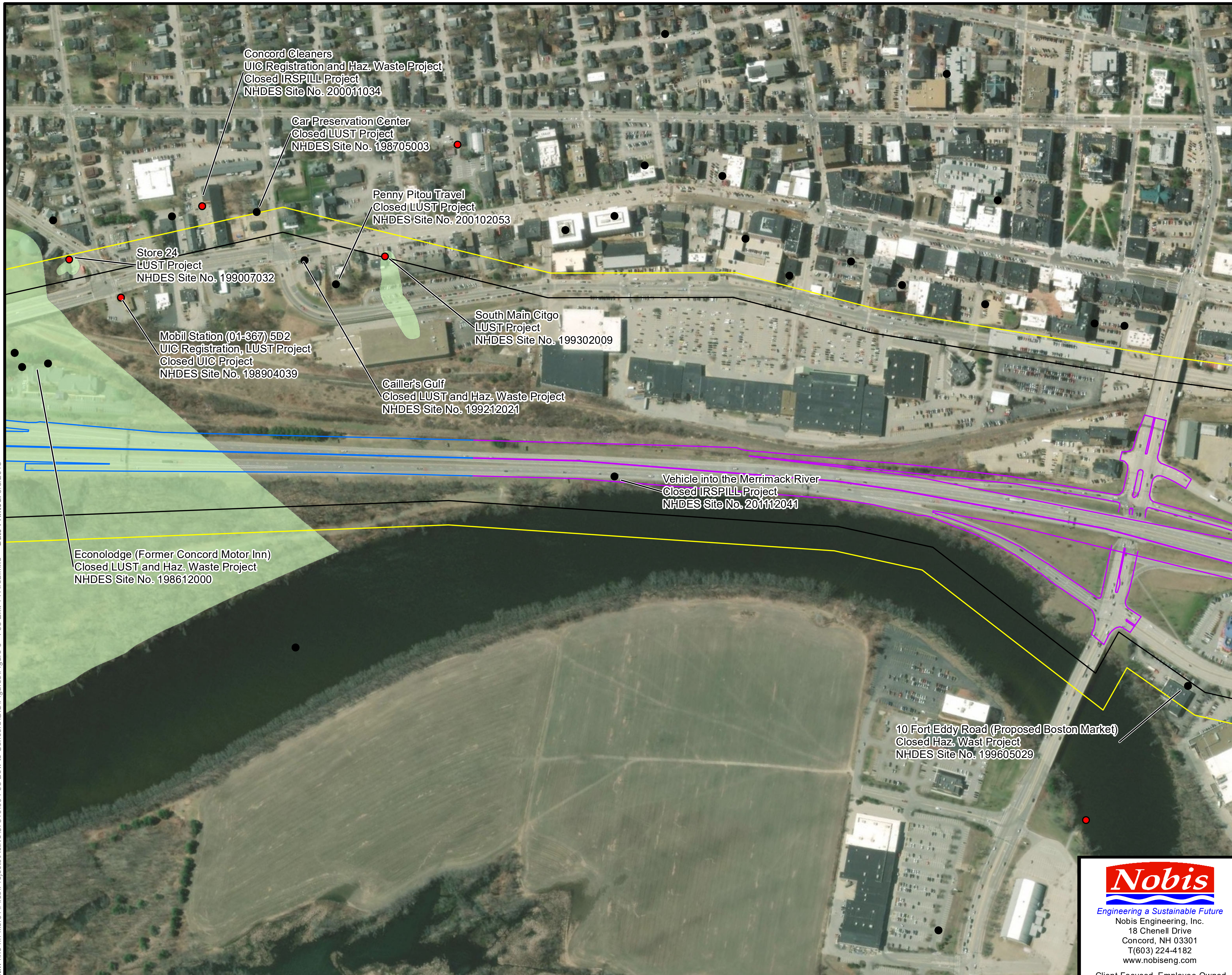
Path: \\ne-nh-filer01\Files\Projects\Active\87810.00 I-93 Bow to Concord\GIS\Figures\Figure 4 - I-93 Exit 12.mxd Date Printed: 8/8/2018

FIGURE 5

I-93 EXIT 13
CONCEPTS A AND B
I-93 CORRIDOR
BOW/CONCORD, NEW HAMPSHIRE

PREPARED BY: NZ	CHECKED BY: JR
PROJECT NO. 87810.00	DATE: JANUARY 2018

Path: \\ne-nh-filer01\Files\Projects\Active\87810.00 I-93 Bow to Concord\GIS\Figures\Figure 5 - I-93 Exit 13.mxd Date Printed: 8/8/2018



Notes:

1. Site Sketch was developed from site plans available on the New Hampshire Department of Environmental Services (NHDES) OneStop database, NHDES GIS data layers downloaded on January 26, 2018, and observations by Nobis Engineering, Inc. Aerial photograph provided by ESRI.

2. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Closed Remediation Sites
- Active Remediation Sites
- Corridor Boundary
- 100' Corridor Setback
- Groundwater Contaminant Plume
- Exit 13 Area: Proposed Alt. B
- Exit 14/15 Area: Proposed Alt. F2

N

0 200 400 800

Feet

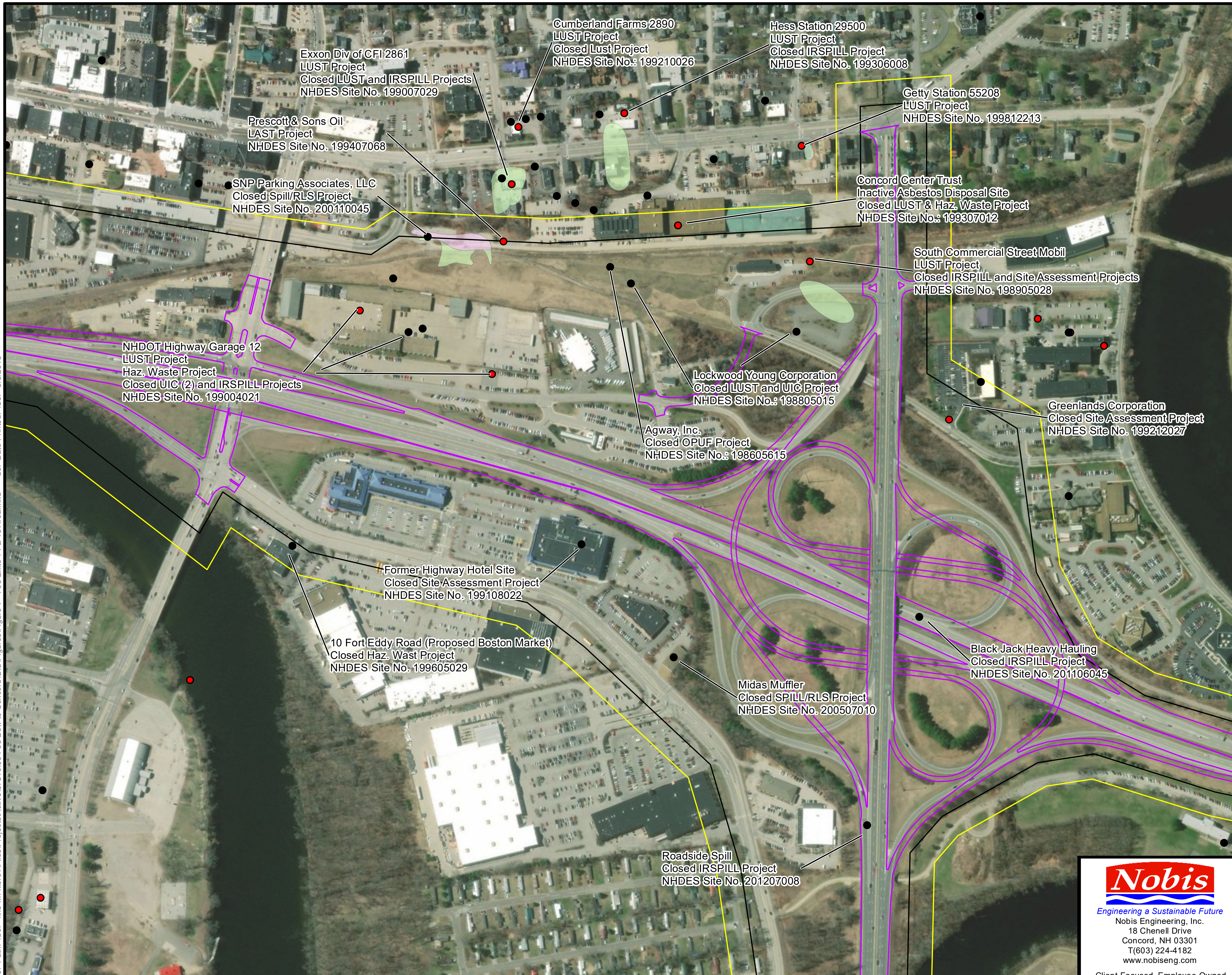
1 inch = 400 feet

Nobis
Engineering a Sustainable Future
Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
T(603) 224-4182
www.nobiseng.com
Client-Focused, Employee-Owned

FIGURE 6

I-93 EXIT 14 AREA
CONCEPT D2
I-93 CORRIDOR
BOW/CONCORD, NEW HAMPSHIRE

PREPARED BY: NZ	CHECKED BY: JR
PROJECT NO. 87810.00	DATE: JANUARY 2018



Notes:

1. Site Sketch was developed from site plans available on the New Hampshire Department of Environmental Services (NHDES) OneStop database, NHDES GIS data layers downloaded on January 26, 2018, and observations by Nobis Engineering, Inc. Aerial photograph provided by ESRI.

2. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Closed Remediation Sites
- Active Remediation Sites
- Corridor Boundary
- 100' Corridor Setback
- LNAPL Plume
- Groundwater Contaminant Plume
- Exit 14/15 Area: Proposed Alt. F2

N

0 200 400 800

Feet

1 inch = 400 feet

Nobis
Engineering a Sustainable Future
Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
T(603) 224-4182
www.nobiseng.com
Client-Focused, Employee-Owned

FIGURE 7

I-93 EXITS 14 AND 15 AREA
CONCEPT D2
I-93 CORRIDOR
BOW/CONCORD, NEW HAMPSHIRE

PREPARED BY: NZ	CHECKED BY: JR
PROJECT NO. 87810.00	DATE: JANUARY 2018

<bol>Path:</bol> \\ne-nh-filer01\Files\Projects\Active\87810.00 I-93 Bow to Concord\GIS\Figures\Figure 7 - I-93 Exits 14 & 15 Area.mxd <bol>Date Printed:</bol> 8/8/2018

Notes:

1. Site Sketch was developed from site plans available on the New Hampshire Department of Environmental Services (NHDES) OneStop database, NHDES GIS data layers downloaded on January 26, 2018, and observations by Nobis Engineering, Inc. Aerial photograph provided by ESRI.

2. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- ● Closed Remediation Sites
- ● Active Remediation Sites
- Corridor Boundary
- 100' Corridor Setback
- Exit 14/15 Exit Area: Proposed Alt. F2

N

0 200 400 800

Feet

1 inch = 400 feet

Nobis

Engineering a Sustainable Future

Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
T(603) 224-4182
www.nobiseng.com

Client-Focused, Employee-Owned

FIGURE 8

I-93 EXITS 14 AND 15 AREA
CONCEPT D2
I-93 CORRIDOR
BOW/CONCORD, NEW HAMPSHIRE

PREPARED BY: NZ	CHECKED BY: JR
PROJECT NO. 87810.00	DATE: JANUARY 2018

Path: \\ne-nh-filer01\Files\Projects\Active\87810.00 I-93 Bow to Concord\GIS\Figures\Figure 8 - I-93 Exits 14 and 15 Area.mxd **Date Printed:** 8/8/2018

Notes:

1. Site Sketch was developed from site plans available on the New Hampshire Department of Environmental Services (NHDES) OneStop database, NHDES GIS data layers downloaded on January 26, 2018, and observations by Nobis Engineering, Inc. Aerial photograph provided by ESRI.

2. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

Legend

- Closed Remediation Sites
- Active Remediation Sites
- Corridor Boundary
- 100' Corridor Setback
- Groundwater Contaminant Plume
- Exit 14/15 Area: Proposed Alt. F2

0 200 400 800

Feet

1 inch = 400 feet

N

Nobis

Engineering a Sustainable Future

Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
T(603) 224-4182
www.nobiseng.com

Client-Focused, Employee-Owned

FIGURE 9

I-93 EXITS 14 AND 15 AREA
CONCEPT D2
I-93 CORRIDOR
BOW/CONCORD, NEW HAMPSHIRE

PREPARED BY: NZ	CHECKED BY: JR
PROJECT NO. 87810.00	DATE: JANUARY 2018

Path: \\ne-nh-filer01\Files\Projects\Active\87810.00 I-93 Bow to Concord\GIS\Figures\Figure 9 - Exits 14 and Area.mxd Date Printed: 8/8/2018

Appendix I
Traffic Analysis

The traffic analysis for the project was conducted using the Bow-Concord Traffic Microsimulation Model prepared specifically for the project. The details of the microsimulation model are described in the *Bow-Concord Traffic Analysis Volume Documentation* memo dated March 28, 2017 prepared by RSG, which is included in this appendix. This memo describes the steps undertaken to develop the model and how the model was used to evaluate project concepts and alternatives.

The memo includes the testing of several build "scenarios" made up of combinations of concepts developed for the four project segments. These scenarios were assembled to ensure those concepts viewed as reasonable would be evaluated and that different configurations of I-93 would also be evaluated. The memo contains three build scenarios as described below:

<u>Scenario A</u>

- Auxiliary lanes between all interchanges along I-93 except southbound between I-89 and Exit 12.
- I-89 Area Concept C
- Exit 12 Area Concept F
- Exit 13 Area Concept A
- Exit 14/15 Area Concept D

<u>Scenario B</u>

- Auxiliary lanes between all interchanges along I-93 except northbound and southbound between Exit 12 and Exit 13.
- I-89 Area Concept K
- Exit 12 Area Concept F
- Exit 13 Area Concept B
- Exit 14/15 Area Concept C

<u>Scenario C</u>

- Auxiliary lanes between all interchanges along I-93 except southbound between Exit 14 and Exit 15 because Concept O eliminated the weaving segment.
- I-89 Area Concept P
- Exit 12 Area Concept E
- Exit 13 Area Concept B
- Exit 14/15 Area Concept O

The results of the above scenario model runs were used in the determination of the Project Preferred Alternative. Once the Preferred Alternative was recommended, it was modeled using the microsimulation model as Scenario D. The results of the modeling for the Preferred Alternative, Scenario D, are also included in this appendix. Scenario D is described below:

Scenario D (Preferred Alternative)

- Auxiliary lanes between all interchanges along I-93 except northbound between Exit 14 and Exit 15 as there is no need without the Exit 14 entrance ramp.
- I-89 Area Concept K
- Exit 12 Area Concept F
- Exit 13 Area Concept B
- Exit 14/15 Area Concept F2

A summary of the local intersection operations for all four modeled scenarios is included at the end of this appendix as well.

Bow-Concord Traffic Analysis Volume Documentation

March 28, 2017

Prepared by RSG

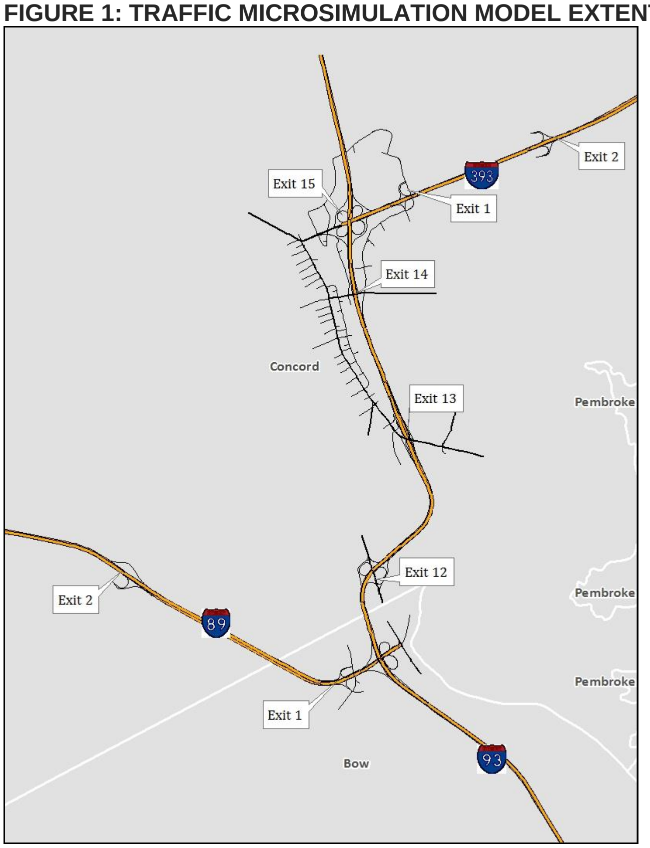
MEMO

TO: Gene McCarthy, PE
FROM: Ben Swanson; Erica Wygonik, PE/PhD
DATE: March 28, 2017
SUBJECT: Bow-Concord Traffic Analysis Volume Documentation

1.0 INTRODUCTION

The Bow-Concord Traffic Microsimulation Model has been developed to support a comprehensive assessment of the traffic implications associated with highway and interchange design alternatives developed for the I-93 corridor in central New Hampshire. The study corridor extends from south of I-89 to north of I-393 and includes interchanges along I-93, I-89, and I-393, as well as surface streets proximate to the study corridor (Figure 1). The microsimulation model is calibrated to weekday AM and PM peak design hour conditions and is developed in the TransModeler software program.

FIGURE 1: TRAFFIC MICROSIMULATION MODEL EXTENT



The Bow-Concord Traffic Microsimulation Model has been developed in parallel with a regional transportation demand model of the Central New Hampshire Regional Planning Commission (CNHRPC) region[1] (Figure 2). The regional model, which is developed in the TransCAD software platform, is calibrated to daily traffic conditions and provides insights into regional traffic patterns.

The roadway network and Traffic Analysis Zone (TAZ) structure for the regional model was established concurrently with the construction of the microsimulation model. By knowing the level of detail required by the microsimulation model during construction of the regional model, additional details beyond what would typically be necessary for a regional travel demand model could be added to the regional model in the microsimulation study area to enhance the correspondence between the two models.

The microsimulation model was developed based on a subarea extraction of the regional model network, the extent of which is shown in the expanded graphic below. Roadways and zones within the microsimulation model share common identification numbers and attributes with the regional model, to facilitate integration and cooperative analysis between the regional model and microsimulation model.

FIGURE 2: REGIONAL MODEL EXTENT (LEFT) AND MICROSIMULATION MODEL EXTENT (RIGHT)

2.0 MICROSIMULATION MODEL CALIBRATION

The Bow-Concord Traffic Microsimulation Model includes detailed information on roadway classification, speeds, geometrics, intersection controls, signal timings, and traffic volumes. Model traffic demand on the roadway network occurs between 93 unique TAZs using origin/destination (O/D) matrices for the weekday AM and PM peak hours. This model traffic is represented by the cumulative demand from over 8,000 potential unique origin/destination pairs. The peak hour O/D matrices were developed to match intersection turning movement counts at 39 intersections and 18 highway and ramp

[1] In addition to CNHRPC towns, the regional model includes the Town of Weare in order to keep a regular geometric shape to the model and to ensure all roadways used between CNHRPC towns are included in the model.

counts, and were informed by highway origin/destination data collected with Bluetooth monitoring devices installed along the I-93 corridor in 2014.

TARGET TRAFFIC VOLUME DATA

Intersection turning movement counts were obtained from the City of Concord and the CNHRPC, and additional count data were collected by RSG in 2014. Figure 3 and Figure 4 present lists of intersection turning movement count locations and highway and ramp count locations, respectively. Count data for the weekday AM and PM peak hours were adjusted to represent design hour conditions based on seasonal adjustment factors obtained from NHDOT continuous count stations 099012 and 099011 on I-93 between exits 12 and 13. Design hour adjustments increase raw count data by up to 11% depending on the count date.

FIGURE 3: TURNING MOVEMENT COUNT INTERSECTION LIST

#	Intersection	#	Intersection
1	US 3/US 202 and Bouton St	21	Main St/Ferry St
2	Commercial St/US 202	22	Main St/Pitman St
3	I-93/I-393 Interchange	23	Main St/Storrs St
4	College Drive/I-393 WB Ramps	24	Main St/Park St
5	College Drive/I-393 EB Ramps	25	Main St/Capitol St
6	US 202/Loudon Road/Centre Street	26	Main St/School St
7	Loudon Rd/Stickney Ave and Bridge St	27	Main St/Phenix St
8	Loudon Rd/I-93 SB ramps	28	Main St/Warren St
9	Loudon Rd/I-93 NB on ramp	29	Main St/Depot St
10	Loudon Rd/Fort Eddy Rd	30	N Main St/Pleasant St
11	I-93 SB off ramp and Hall St/Manchester St	31	Storrs St/Pleasant St Ext
12	I-93 (SPUI)/Manchester St	32	Main St/Hills Ave
13	Manchester St/Old Turnpike	33	Main St/Fayette St
14	I-93 Exit 12/South Main Street	34	Main St/Thompson St
15	South Street/I-89 Exit 1 NB Ramps	35	Main St/Theatre St
16	South Street/I-89 Exit 1 SB Ramps	36	Main St/Concord St
17	I-93/I-89	37	Main St/Thorndike St
18	NH-3A/I-89 and Hall St	38	S Main St/Storrs St/Perley St
19	Main St/Franklin St	39	Water St/S Main St
20	Main St/Ferry St		

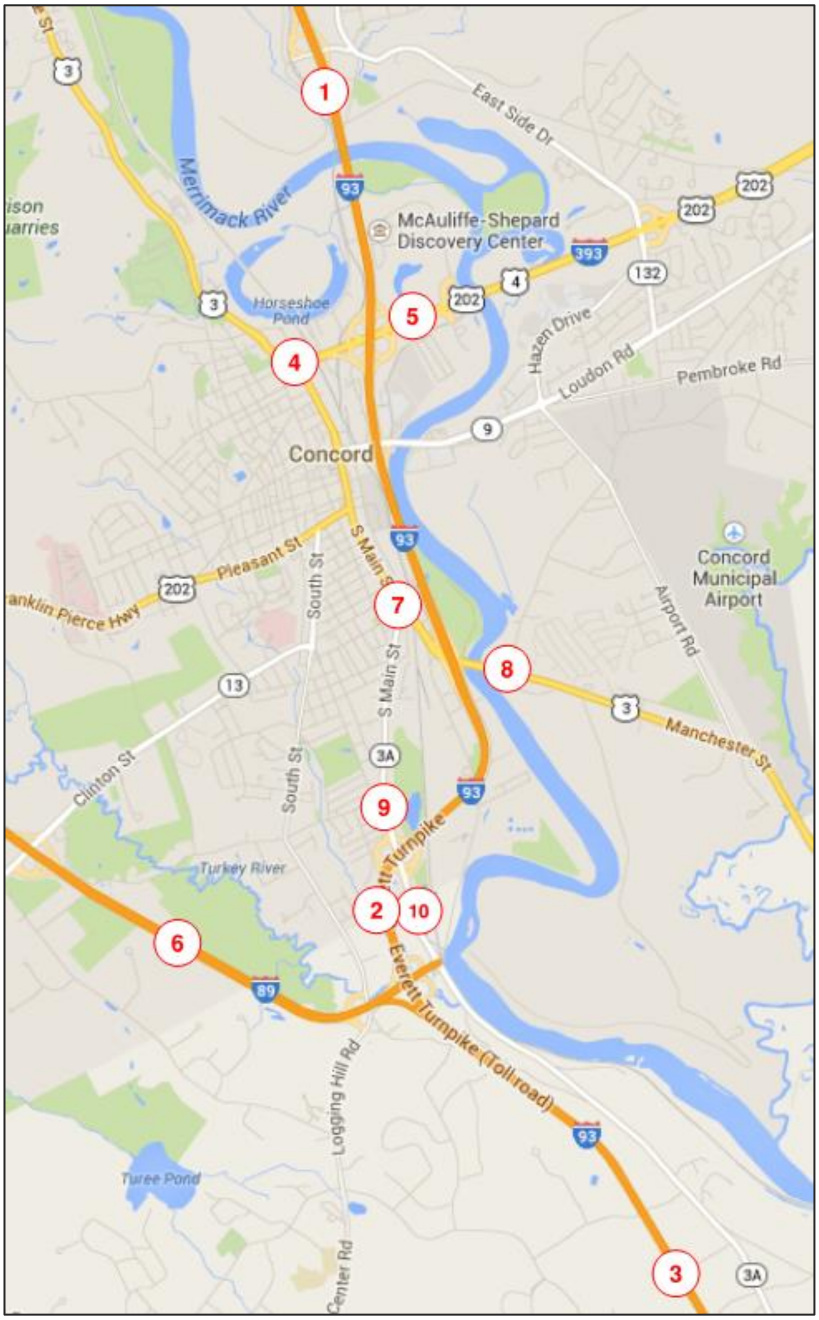
FIGURE 4: HIGHWAY SEGMENT COUNT LIST

#	Highway Count
1	I-93 NB between Exits 15 and 16
2	I-93 SB between Exits 15 and 16
3	I-93 NB between Exits 12 and 13
4	I-93 SB between Exits 12 and 13
5	I-93 NB at Hookset Toll Plaza
6	I-93 SB at Hookset Toll Plaza
7	I-89 NB between Exits 1 and 2
8	I-89 SB between Exits 1 and 2
9	I-393 EB over the Merrimack River
10	I-393 WB over the Merrimack River
11	I-393 Exit 2 EB Off-Ramp
12	I-393 Exit 2 EB On-Ramp
13	I-393 Exit 2 WB Off-Ramp
14	I-393 Exit 2 WB On-Ramp
15	I-89 Exit 2 EB Off-Ramp
16	I-89 Exit 2 EB On-Ramp
17	I-89 Exit 2 WB Off-Ramp
18	I-89 Exit 2 WB On-Ramp

BLUETOOTH COUNT LOCATIONS

In addition to target traffic volumes, origin/destination data was collected along the I-93 corridor at the 10 locations shown below in Figure 5, from April 30, 2014 through May 7, 2014. Unique and anonymous media access control identification numbers associated with passing Bluetooth devices were recorded at the Bluetooth monitoring stations shown below and are used to inform the distribution of traffic origin/destination pairs between interchanges.

FIGURE 5: BLUETOOTH MONITORING LOCATIONS



DEVELOPMENT OF AM AND PM PEAK HOUR TRIP TABLES

An important step in the model calibration process is the estimation of an origin-destination trip matrix ("O/D matrix"). The O/D matrix represents the zone-to-zone vehicle trips during the analysis peak hours. Including external TAZs, the model has 93 TAZs, which generates a 93 by 93 matrix of vehicle trips (i.e. 8,556 origin/destination pairs).

The calibration process involves assigning an estimated O/D matrix to the roadway network and comparing the simulated vehicle travel paths against the calibration count set. Every left, through, and right turn estimated in the model is compared against the actual number of left turns, through movements, and right turns within the calibrated count set, and the estimation process is repeated until satisfactory calibration targets between simulated and actual traffic volumes are met.

Calibration involves the iterative process of estimating the O/D matrix and comparing results with target volumes. For the Bow-Concord model there are several sources of information that are used to constrain the O/D estimation process, including:

- Bluetooth origin/destination flows along the I-93 corridor,
- Land-use information on model TAZs including type and size of specific land-uses,
- relative amount of available parking, and
- Zone-specific traffic counts that allow for the estimation process to constrain the vehicle origins and destinations for specific TAZs.

An iterative proportional fitting (IPF) process developed within the Python programming language was used to generate the AM and PM peak hour origin/destination trip tables.

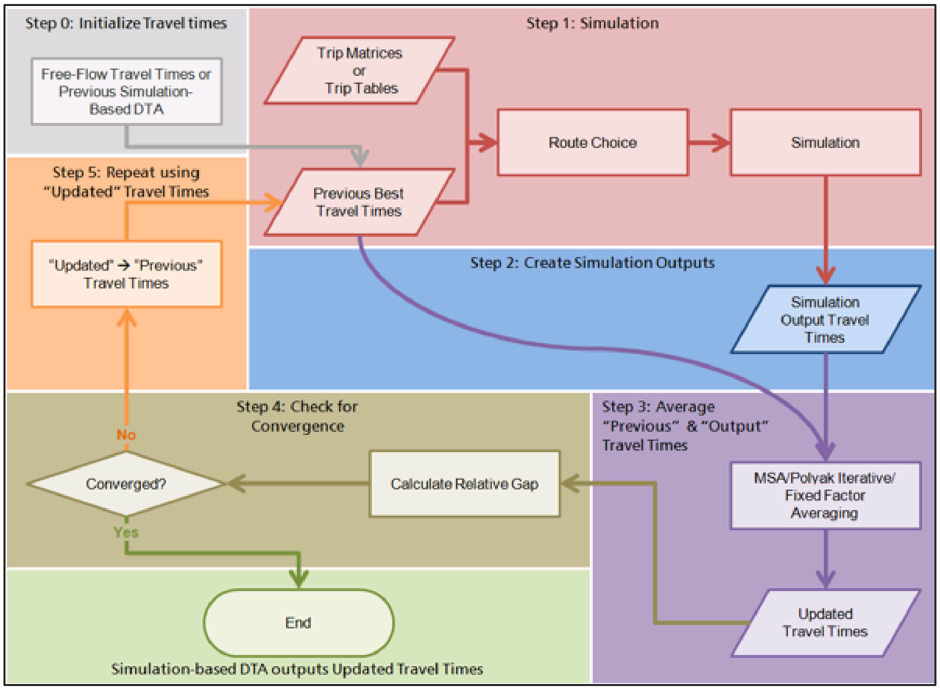
The IPF process works by repeatedly adjusting O/D path volume estimates to match the target volumes. Each path volume is adjusted multiple times, but each time it is adjusted the change is smaller. After iterating, the adjustments drop to zero. For this project, there were approximately 15,000 paths and 400 targets, and the IPF process converged after approximately 10 iterations. Comparing the results to the target volumes and the Bluetooth data showed the final estimate was well calibrated to actual volume measurements.

After completing the IPF process, we used the resulting O/D matrices to run the TransModeler microsimulation model. After completing the trip assignment process (described below) and simulating traffic through the microsimulation model, we compared the resulting model volumes with target volumes using statistical measures of fit (described below) to quantify the level of calibration. When the calibration thresholds are met, the calibration process is considered complete and the resulting model is considered valid for planning purposes.

TRIP ASSIGNMENT

Dynamic Traffic Assignment (DTA) is the process by which traffic between origin and destination pairs is distributed to all potential route paths within the microsimulation model. The DTA process starts by conducting a series of simulation runs from which travel times and turning delays are recorded for all links and turning movements within the model. For each simulation run, travel times and delays are compared with travel times and delays from previous simulation runs. With each iteration, subsequent simulation runs slightly modify the route choices and repeat the comparison of new travel times and delays with previous averages. The DTA process is considered complete when the iterative fluctuations in route choice no longer create significant changes to the overall travel times and delays. The goal of the DTA process is to arrive at a set of stable travel times and delays that route traffic between origin/destination pairs with the least amount of overall delay possible. Figure 6 presents a flow chart of the DTA process.

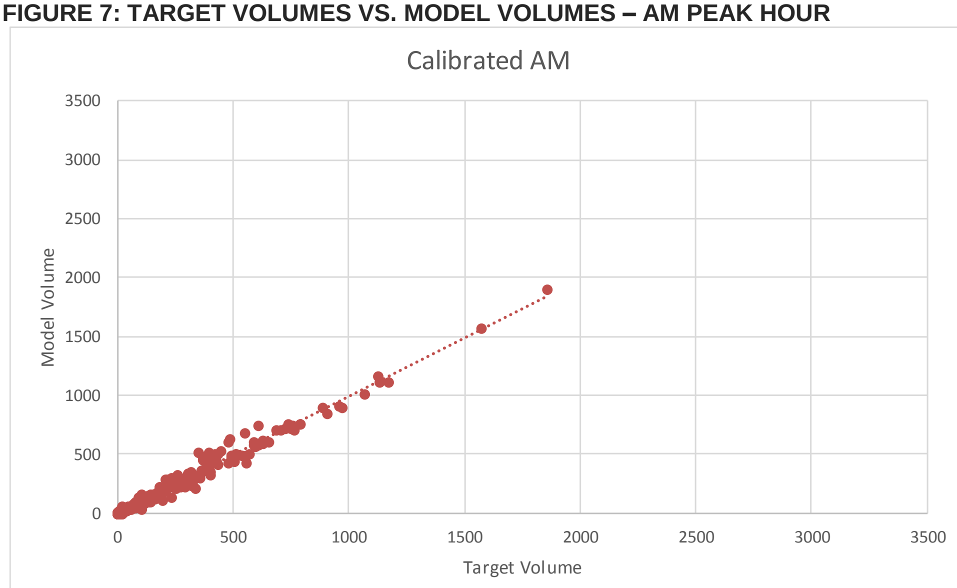
FIGURE 6: DYNAMIC TRAFFIC ASSIGNMENT PROCESS FLOW CHART[2]



CALIBRATION PERFORMANCE

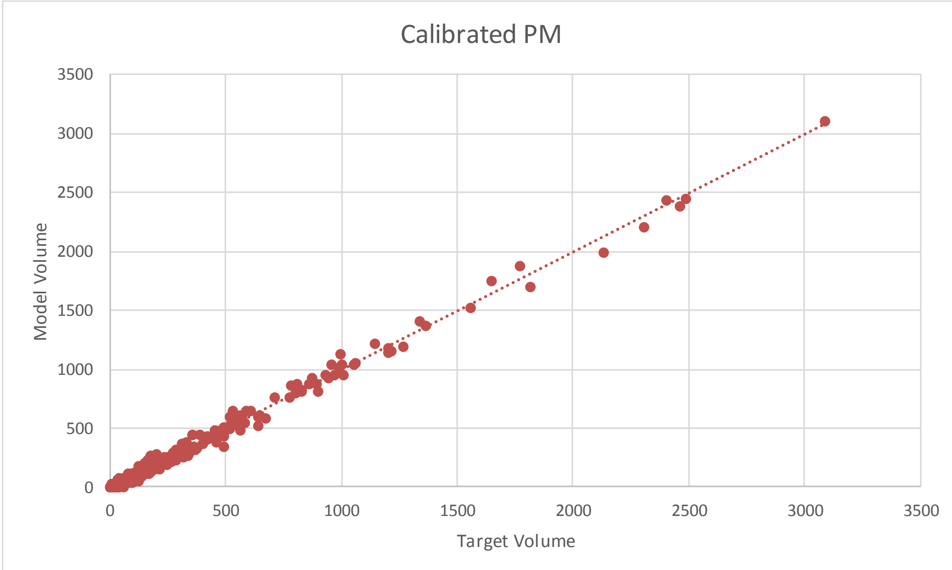
Figure 7 and Figure 8 below show the distribution of model output compared to target traffic count volumes during the AM and PM peak hours, respectively. A 45-degree line represents a perfect correlation of model output and target volumes. As can be seen below, the regression lines shown in the figures are nearly at a 45-degree angle, indicating the model volumes are in very good correlation with the target volumes.

FIGURE 7: TARGET VOLUMES VS. MODEL VOLUMES – AM PEAK HOUR



[2] Image courtesy Caliper Corporation

FIGURE 8: TARGET VOLUMES VS. MODEL VOLUMES – PM PEAK HOUR



The model has been compared to two calibration standards. The first calibration threshold relates to the standards conventionally applied to regional travel demand models. These standards have been developed by the Federal Highway Administration (FHWA) to provide an overall threshold of quality for transportation models used for regional transportation planning and are shown below in Figure 9.

FIGURE 9: CALIBRATION RELATIVE TO RECOMMENDED THRESHOLDS FOR REGIONAL MODELS

	Target	AM Model	PM Model
Root Mean Squared Error	<40%	14.0%	11.5%
Coefficient of Correlation (r)	>= 0.88	0.98	0.99
Percent Error (Region)	+/- 5%	-0.3%	0.1%

Additional standards have been developed specifically for microsimulation travel models. These standards were first published in 2004 by FHWA.[3] These standards rely upon the GEH statistic, which is an empirical measure of fit used to compare errors across roadways with largely different traffic flows. The GEH statistic is computed as in Equation 1.

EQUATION 1: GEH STATISTIC

$$GEH = \sqrt{\frac{(ModelVolume - CountVolume)^2}{0.5 * (ModelVolume + CountVolume)}}$$

In practice, a GEH value less than 5 indicates the model volume is a good fit with the target. A GEH between 5 and 10 indicates potential errors or a lack in model accuracy at the subject count area, and a GEH greater than 10 indicates an unacceptable level of correlation.

[3] "Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Software". FHWA-HRT-04-040. July 2004.

Figure 10 presents the performance of the Bow-Concord microsimulation model relative to the turning movement calibration targets for the GEH statistic.

FIGURE 10: MICROSIMULATION CALIBRATION METRIC COMPARISON

	Target	AM Model	PM Model
GEH <=5, by movement	>85%	94.5%	93.6%
5<GEH<=10, by movements	<=15%	5.5%	6.4%
GEH >10, by movement	0%	0.0%	0.0%

3.0 BASELINE NETWORK IMPROVEMENTS

At the time of model construction, the City of Concord was actively undertaking a major improvement project on Main Street in downtown Concord. This project adds streetscaping and increases sidewalk and public spaces while reducing the roadway cross-section from 4 lanes to 2 lanes between Loudon Road and Storrs Street. Roadway configurations at major intersections remain unchanged and the overall vehicle capacity of Main Street is not expected to have changed significantly with these improvements. However, this overall project does represent a relatively major change to the study area road network. For all future-year, 2035, scenario testing, we assume these Main Street "road diet" improvements are in place in all scenarios.

4.0 TRIP ASSIGNMENT FOR ALTERNATIVE TESTING

As the Bow-Concord project progresses, alternatives have been developed for various interchange, ramp access, and freeway configurations along the I-93 corridor. These alternatives are being tested for impacts and benefits to traffic operations using the traffic microsimulation model described above. To the extent that proposed improvements offer new or alternative connections to study area roadways, the model DTA process is used to reallocate traffic demand, considering these new or altered route paths.

5.0 FUTURE YEAR ANALYSIS

Future year traffic volumes for the 2035 microsimulation analysis year rely on growth projections developed by the Central New Hampshire Regional Planning Commission (CNHRPC) for the regional travel demand model. These projections are consistent with historical traffic trends within the project study area.

MODEL GROWTH

The regional model differs from the microsimulation model in that regional model network traffic is generated directly from population, household, and employment numbers, rather than a fixed matrix of OD demand. The CNHRPC regional model base year (2010) population, household, and employment numbers have been assigned to the model zones with data obtained from the US Census, New Hampshire Employment Security (NHES)[4], and the Longitudinal Employer-Household Dynamics

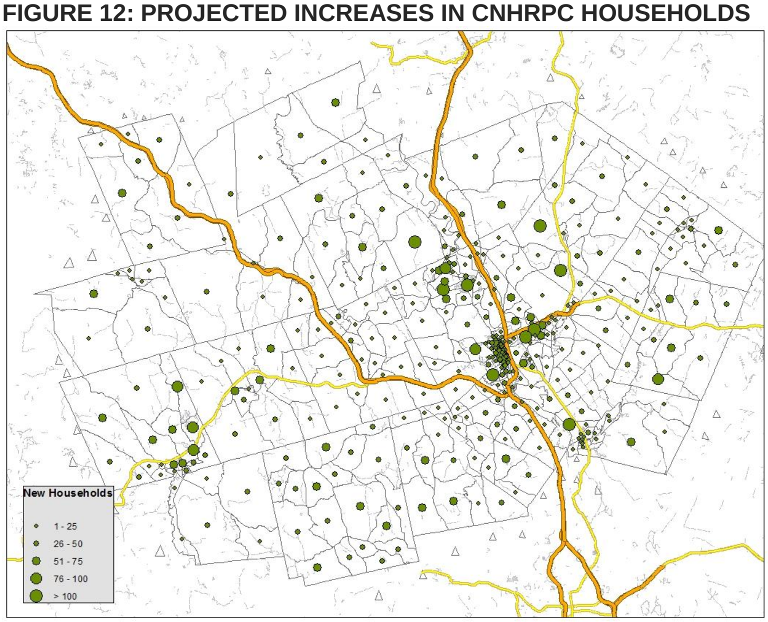
[4] http://www.nhes.nh.gov/elmi/products/documents/planning-regions.pdf

(LEHD) program.[5] Growth projections from these datasets were generated for the CNHRPC by Applied Economic Research, Inc. and indicate approximately 28% growth in employment and 9% growth in population by 2035. Actual traffic changes in the regional model vary based on the assigned locations of projected residential and employment growth at the zone level.

Land-use changes at the individual TAZ level, were developed by CNHRPC in consultation with representatives from member towns, to ensure projected growth was allocated where local experts anticipate it is most likely. Figure 11 and Figure 12 present the relative distribution of anticipated growth in regional employment and households by 2035.

FIGURE 11: PROJECTED INCREASES IN CNHRPC EMPLOYMENT

FIGURE 12: PROJECTED INCREASES IN CNHRPC HOUSEHOLDS



---

[5] http://lehd.ces.census.gov/

To identify projected growth within the microsimulation model study area, a subarea analysis was performed on the calibrated baseline regional model and again on the projected 2035 regional model. This process generates OD matrices based on the regional model baseline and future year travel demand, which are structured similarly to the calibrated microsimulation model's OD matrix. The future year and base year subarea analysis OD matrices and the calibrated baseline microsimulation model OD matrix were then all compared and subjected to an 8-case pivoting process to determine the projected growth for each OD pair. For each OD pair the projected traffic growth is dependent on the values in the regional model baseline and future year OD matrices and in the baseline microsimulation OD matrix. Where normal growth is expected and all three matrices have non-zero inputs, the projected growth is the rate of growth observed between the baseline and future year regional model matrices. Where any one of the three matrices has a zero entry for a given OD pair, or where extreme growth is projected by the proportional scaling method, one of seven other methods is applied. This pivoting process is described well in a paper by RAND Europe from 2011.[6] Figure 13, from the RAND study, illustrates the 8 growth cases addressed by this methodology.

FIGURE 13: EIGHT CASES OF TRAVEL DEMAND MODEL GROWTH[6]

Base (B)	Synthetic Base (S_b)	Synthetic Future (S_f)	Predicted (P)		Cell Type
0	0	0	0		1
0	0	>0	S_f		2
0	>0	0	0		3
0	>0	>0	Normal growth	0	4
			Extreme growth	$S_f - X_1$	
>0	0	0	B		5
>0	0	>0	$B + S_f$		6
>0	>0	0	0		7
>0	>0	>0	Normal growth	$B.\,S_f / S_b$	8
			Extreme growth	$B.X_2 / S_b + (S_f - X_2)$	

$$X_1 = k_2.Sb$$

$$X_2 = k_1.Sb + k_2.Sb.\max\left[\frac{Sb}{B}, \frac{k_1}{k_2}\right]$$

Overall, this method results in a projected traffic volume increase of approximately 18% during the weekday AM peak hour and approximately 12% during the weekday PM peak hour, by the 2035 future year.

HISTORICAL TRAFFIC TRENDS

We have also examined historic growth trends at three continuous traffic counter (CTC) stations in Concord. As shown in Figure 14, two CTC stations are on I-93 (between exits 12 and 13 and between exits 16 and 17) and one CTC station is on I-393 immediately east of Exit 1 over the Merrimack River.

Using data collected at these three NHDOT count stations since 1993, we have calculated historic growth trends over the past 10, 15, and 20 years of data, and have done so independently for the: 1) highest traffic hour of the year, 2) the annual average daily traffic volume (AADT), and 3) the 30th highest traffic hour of the year (which is typically regarded as representative of design hour conditions).

[6] A. Daly, J. Fox, and B. Patruni, RAND Europe. *Pivoting in Travel Demand Models*. Association for European Transport and Contributors, 2011.

FIGURE 14: NHDOT CONTINUOUS TRAFFIC COUNT (CTC) STATION LOCATIONS

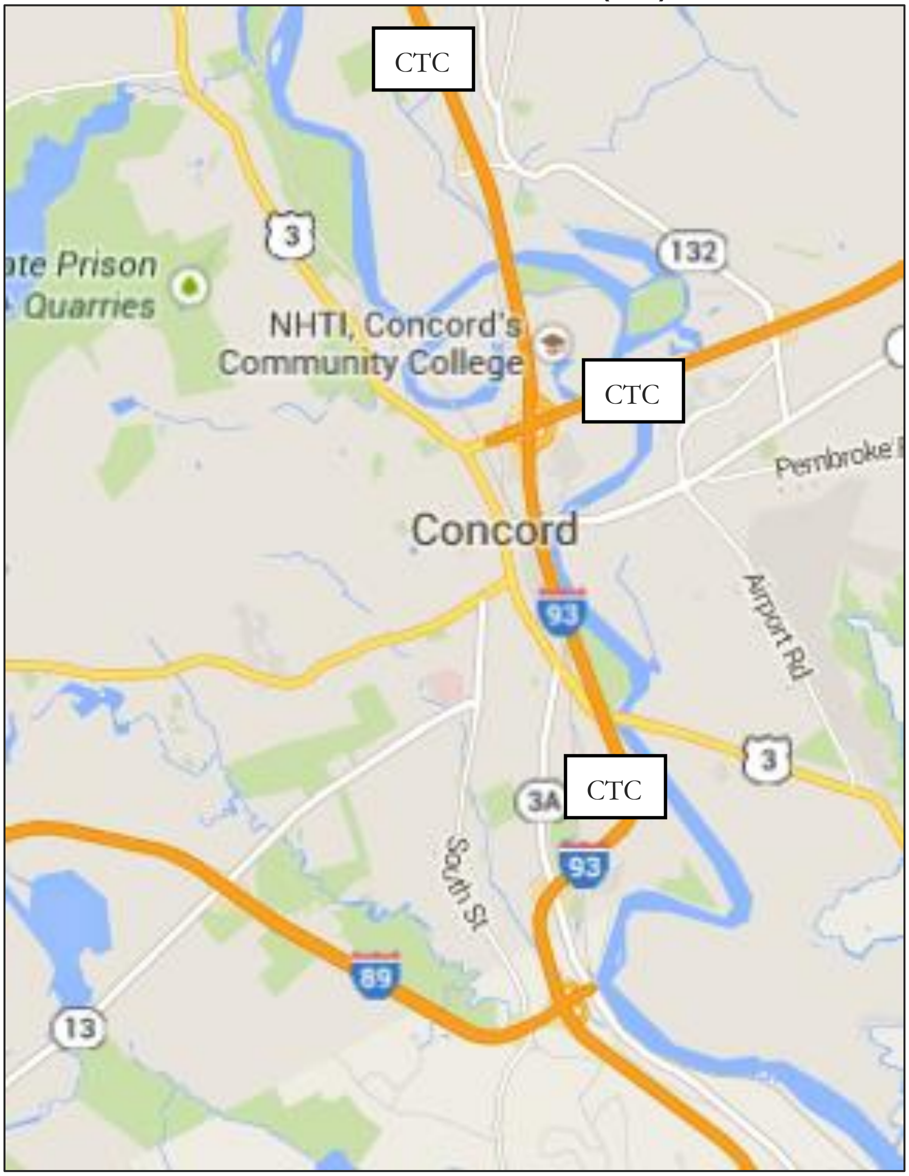


Figure 15 through Figure 17 present plots of these three sets of historic traffic data and include trend lines from the 20-year period and from the most recent 10-year period. As can be seen in these figures, the 20-year historic growth trends at all three count stations indicate continued growth. However, over the past 10 years, traffic volumes have declined at all three count stations and across all three datasets.

FIGURE 15: HIGHEST HOUR HISTORIC TRAFFIC TRENDS

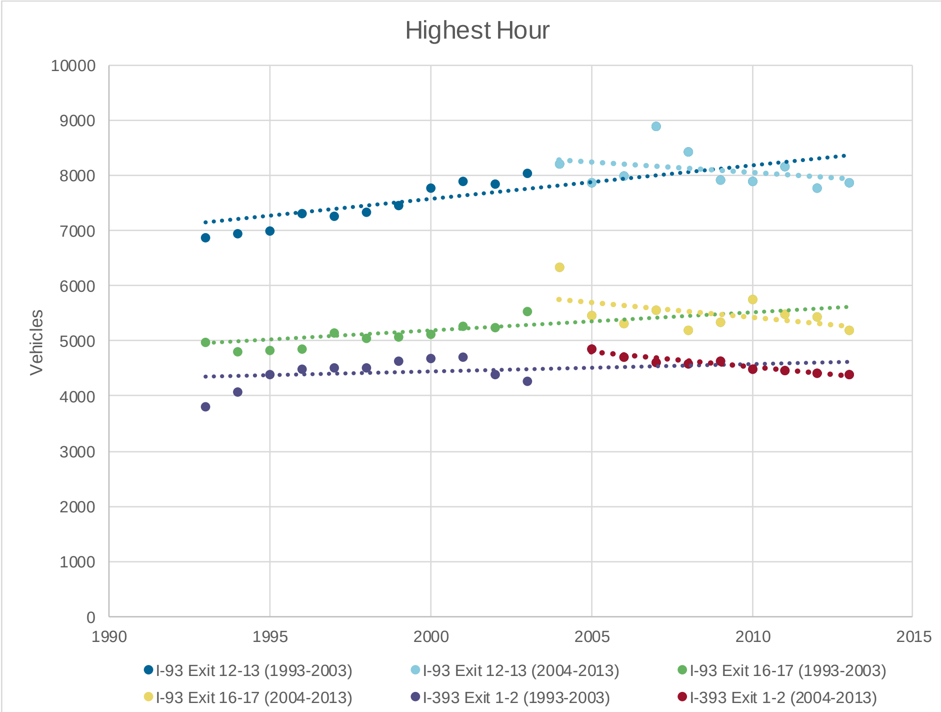


FIGURE 16: AADT HISTORIC TRAFFIC TRENDS

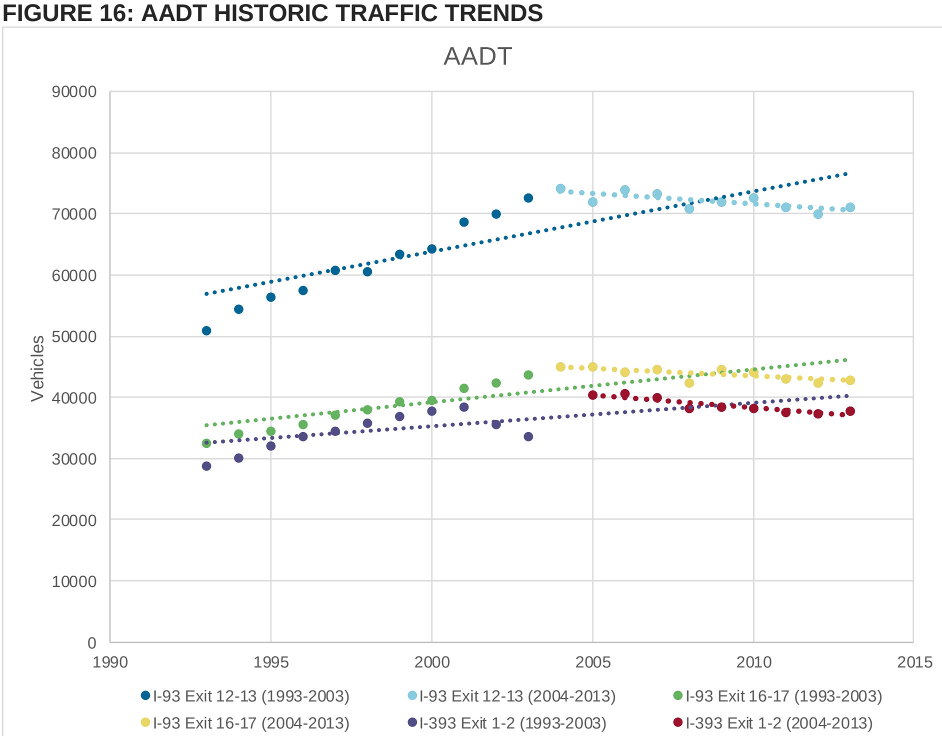


FIGURE 17: 30TH HIGHEST HOUR TRAFFIC TRENDS

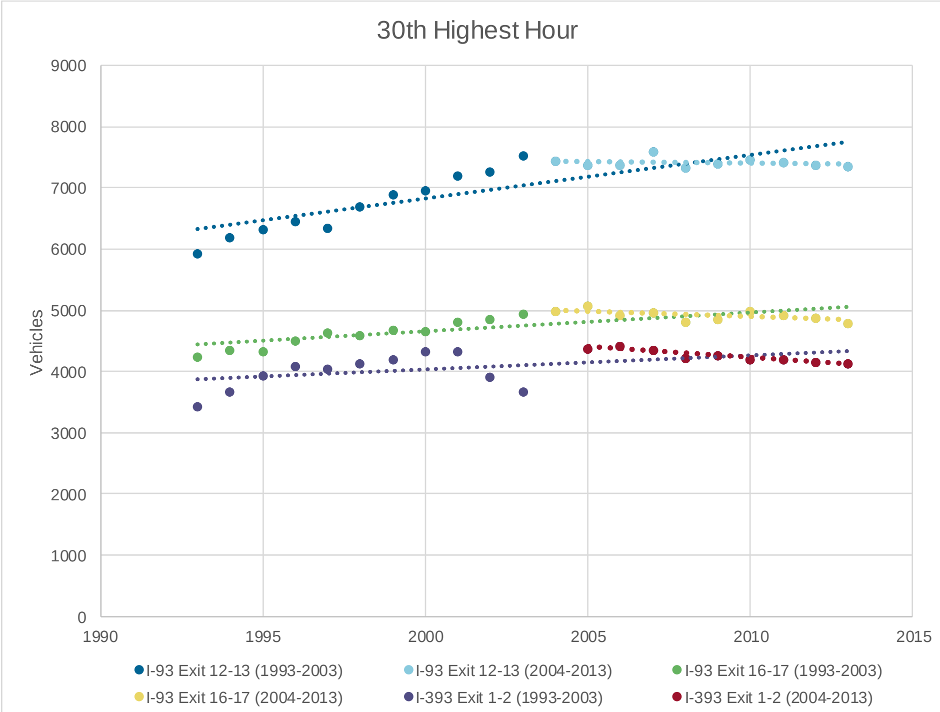


Figure 18 presents the overall projected percentage increase in traffic volumes out to the 2035 design year, based on the three datasets and calculated from 20-year, 15-year, and 10-year regression analyses. As evidenced by the plots above, the 20- and 15-year regression analyses indicate continued growth while the 10-year trends indicate a decline in traffic volumes. Additionally, the highest hours and 30th highest hours of traffic have grown less over 20 years than the AADT, indicating a sizable portion of daily traffic growth has occurred in off-peak hours (likely some portion related to peak spreading).

Taking an average of the projected increase to 2035 conditions across the three count locations, and based on the most conservative 20-year projections and considering the 30th highest hour dataset, which is typically regarded to represent design hour conditions, we calculate an average growth adjustment of approximately 14% overall to 2035 conditions, based on historic count trends.

FIGURE 18: GROWTH PROJECTION ADJUSTMENT TO 2035 ANALYSIS YEAR

	I-93 Between Exits 12-13			I-93 Between Exits 16-17			I-393 over Merrimack River		
	2014 - 2035 Growth			2014 - 2035 Growth			2014 - 2035 Growth		
	10 Yrs	15 Yrs	20 Yrs	10 Yrs	15 Yrs	20 Yrs	10 Yrs	15 Yrs	20 Yrs
#1 Highest Hour	-10%	5%	14%	-22%	4%	12%	-26%	-5%	6%
#30 Highest Hour	**-2%**	**7%**	**18%**	**-8%**	**4%**	**12%**	**-18%**	**1%**	**11%**
AADT	-10%	10%	24%	-13%	9%	24%	-24%	5%	20%

	Average Highway Growth		
	2014 - 2035 Growth		
	10 Yrs	15 Yrs	20 Yrs
#1 Highest Hour	-19%	1%	11%
#30 Highest Hour	**-9%**	**4%**	**14%**
AADT	-16%	8%	23%

Traffic projections based on historic count data are consistent with the model projected growth of ~12% during the weekday AM peak hour and ~18% during the weekday PM peak hour. Growth derived from the regional model process is used to test all scenarios in this analysis.

6.0 SCENARIO TESTING

The Bow-Concord Traffic Microsimulation Model has been developed to support a comprehensive assessment of the traffic implications associated with highway and interchange design alternatives developed for the I-93 corridor in central New Hampshire.

SCENARIOS

Within the project limits there are seven (7) full access interchanges including two freeway-to-freeway interchanges, I-93/I-89 and I-93/I-393. Because there is limited space between some of the interchanges, the project has been separated into four segments for the purposes of alternatives development. The four segments are as follows:

- I-89 Area, which includes I-93/I-89 and Exit 1 on I-89
- Exit 12
- Exit 13
- Exit 14-15, which also includes Exit 1 on I-393

MJ has developed several design concepts for each segment listed above, as well as the freeway segments between the interchanges. Segment concepts have been assembled as corridor scenarios for the purposes of modeling. These scenarios have been tested with the microsimulation model and refined iteratively to obtain the scenarios listed below. All scenarios include expanding I-93 from 2 lanes per direction to 3 lanes as a starting point. The number and design of merge, diverge, and weave areas differ by scenario. The scenarios were developed specifically to determine how differences in weaves, auxiliary lanes, merges, and access affect overall corridor operations.

Conceptual designs provided by MJ for each scenario are included as an attachment with this memorandum and are outlined below:

Scenario A

- **I-89 Area**: (MJ Concept C)
  - Maintains the existing interchange intersection configurations,
  - Reconstructs on- and off-ramps to increase weave distance between I-89 Exit 1 and the I-93/I-89 interchange
- **Exit 12**: (MJ Concept F)
  - Relocates southbound and northbound off-ramps downstream of NH-3A,
  - Converts four-way intersections to three-way intersections at the ramp terminals,
  - Constructs roundabouts at ramp terminals
- **Exit 13:** (MJ Concept A)
  - Signalize northbound right-turn and provide an overlap phase for this movement.
- **Exit 14-15:** (MJ Concept D)
  - Single Point Urban Interchange (SPUI) at Exit 14
  - Retains full cloverleaf at Exit 15

Scenario B

- **I-89 Area**: (MJ Concept K)
  - New roadway connecting NH-3A and South Street at the I-89 Exit 1 NB Ramp intersection,
  - Elimination of the direct I-89 connection to NH-3A,
  - New ramps from I-93 northbound to I-89 northbound and from I-89 southbound to I-93 southbound, which eliminate weaves between I-89 Exit 1 and the I-93/I-89 interchange
- **Exit 12**: (MJ Concept F)
  - Relocates southbound and northbound off-ramps downstream of NH-3A,
  - Converts four-way intersections to three-way intersections at the ramp terminals,
  - Constructs roundabouts at ramp terminals
- **Exit 13:** (MJ Concept B)
  - Signalize northbound right-turn and provide an overlap phase for this movement.
  - Widens northbound right-turn lane to two lanes.
- **Exit 14-15:** (MJ Concept C)
  - Single Point Urban Interchange (SPUI) at Exit 14,
  - New northbound and southbound collector-distributor roads between Exit 14 and Exit 15,
  - Retains full cloverleaf at Exit 15, but with collector-distributor roads extending through the cloverleaf.

Scenario C

- **I-89 Area**: (MJ Concept P)
  - New roadway connecting NH-3A and South Street at the I-89 Exit 1 NB Ramp intersection,
  - Elimination of the direct I-89 connection to NH-3A,
  - New ramps between I-93 and I-89 create a fully directional interchange,
  - Eliminates northbound and southbound weaves on I-89 between Exit 1 and I-93
  - Eliminates the northbound I-93 connector-distributor road weave.
- **Exit 12**: (MJ Concept E)
  - Relocates southbound and northbound off-ramps downstream of NH-3A,
  - Converts four-way intersections to three-way intersections at the ramp terminals,
  - Constructs signals at ramp terminals
- **Exit 13:** (MJ Concept B)
  - Signalize northbound right-turn and provide an overlap phase for this movement.
  - Widens northbound right-turn lane to two lanes.

- **Exit 14-15:** (MJ Concept O)
  - Reconfigures Exit 14 to eliminate southbound ramps at Loudon Road and to reconstruct the northbound on-ramp to be a loop ramp exiting south of Loudon Road,
  - Constructs a new local road between Stickney Avenue and Fort Eddy Road and adds southbound ramp connections to Stickney Avenue,
  - Reconfigures Exit 15 with relocated on-ramps to eliminate all weaves.

Auxiliary lanes between interchanges vary in these three scenarios. Figure 19 presents a summary of where full auxiliary lanes are assumed in each of the scenario packages. Locations marked are marked with "n/a" where previous weaves have been eliminated by the reconfigured design.

FIGURE 19: SUMMARY OF FULL AUXILIARY LANE LOCATIONS BY SCENARIO

	I-89 between Exit 1 and I-93/I-89	I-93 between I-93/I-89 and Exit 12	I-93 between Exit 12 and Exit 13	I-93 between Exit 13 and Exit 14	I-93 between Exit 14 and Exit 15	I-93 within Exit 15 Cloverleaf	I-393 between I-93/I-393 and Exit 1
Scenario A	NB, SB	NB	NB, SB	NB, SB	NB, SB	NB, SB	EB, WB
Scenario B	n/a	NB, SB		NB, SB	NB, SB	NB, SB	EB, WB
Scenario C	n/a	NB, SB	NB, SB	NB, SB	NB, n/a	n/a	EB, WB

2035 VOLUME MAPS

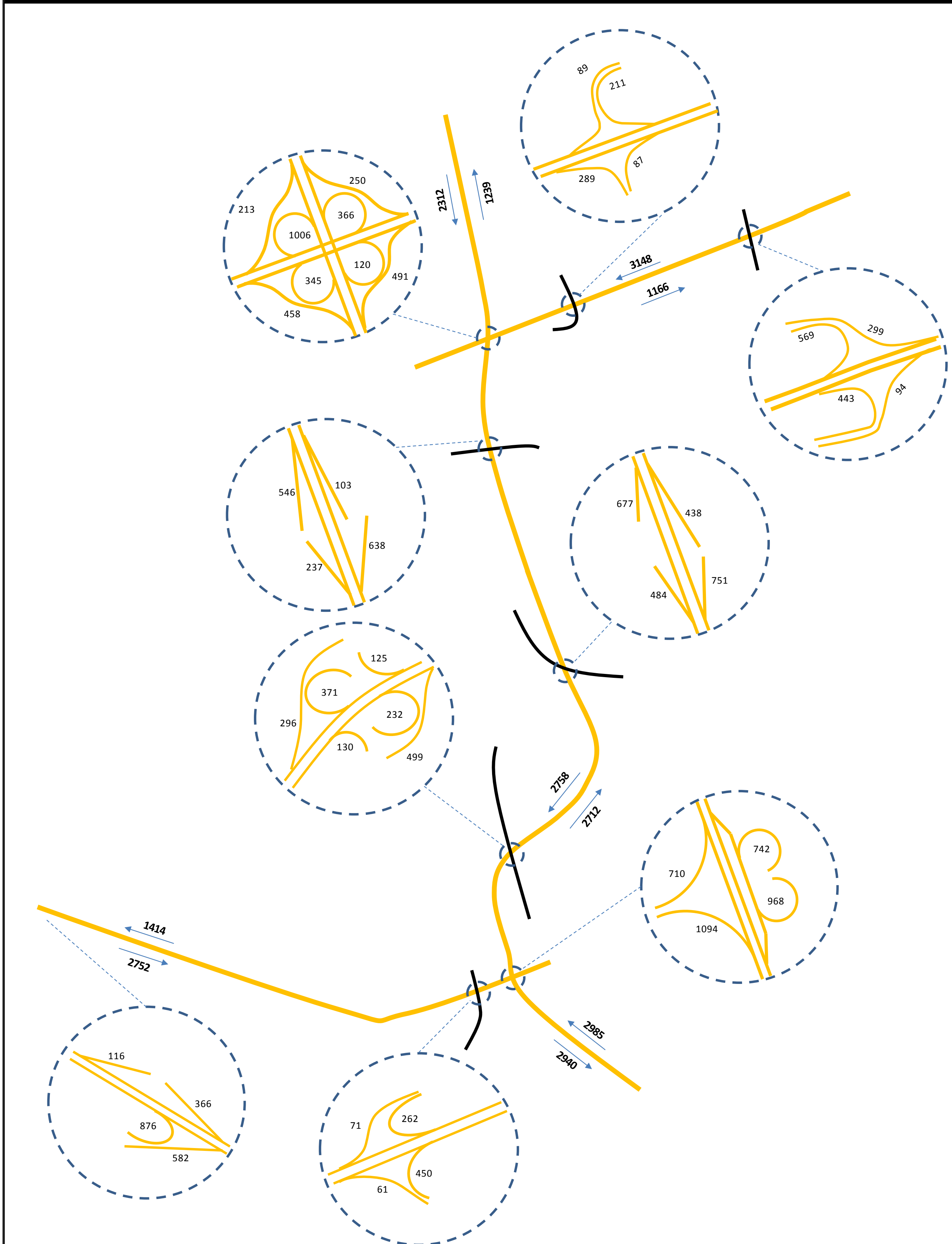
The maps below present the scenario traffic volumes for the No Build condition and the three alternatives listed above, during the 2035 weekday AM and PM peak hours. Highway and ramp volume maps are presented first, followed by interchange turning movement volume maps.[7]

With adjusted roadway network geometries and new/altered route paths, the model DTA process is used to re-distribute traffic demand to the new routes made available by the updated roadway network. The volume maps below present the model traffic processed for each scenario (Throughput). Volumes vary by scenario due to the relative attractiveness of various routes between scenarios.

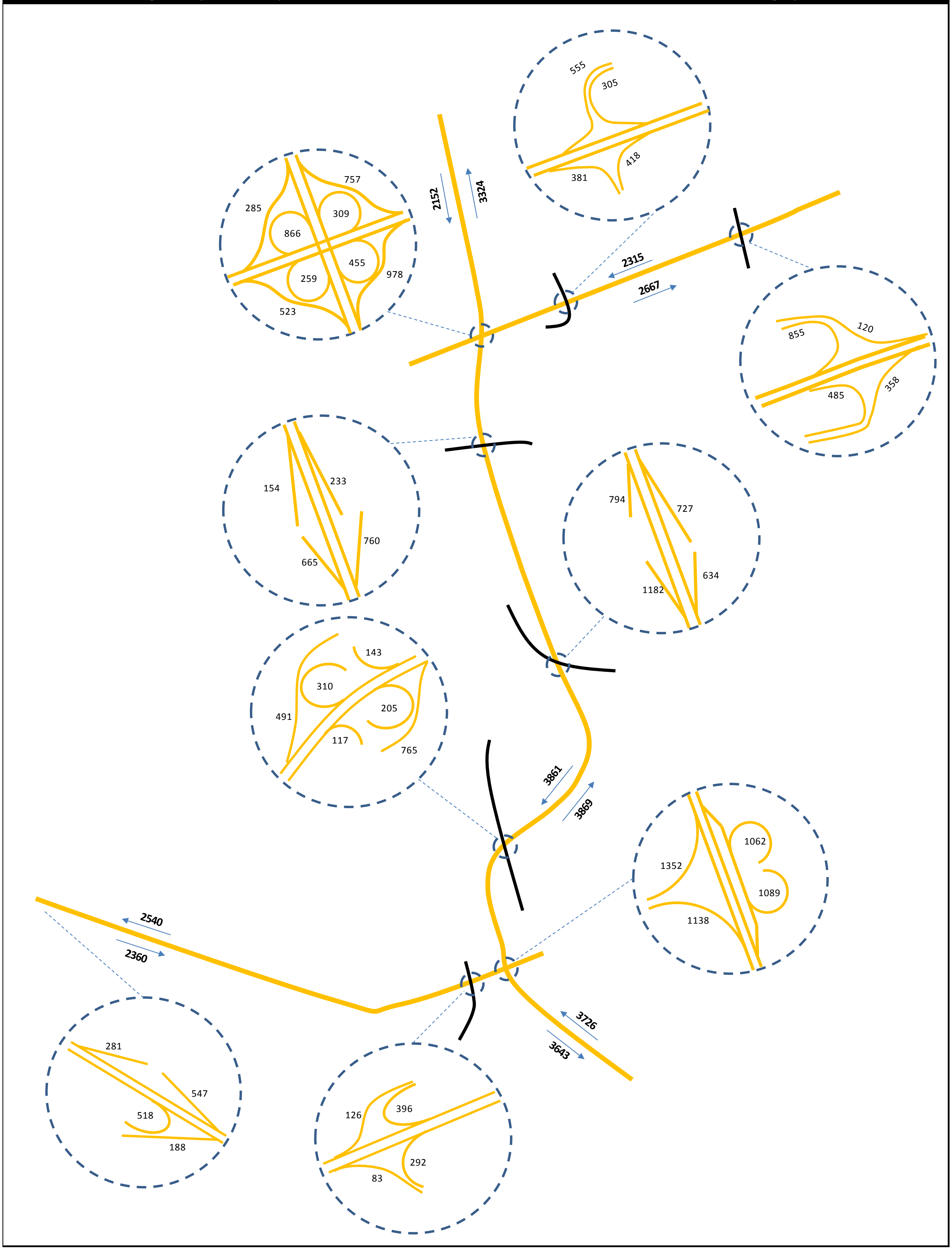
Because of constrained conditions in the 2035 No Build scenarios, the full demand is not served in the No Build simulation hours (significant queues persist at the end of the simulation hour). To present a more complete picture of No Build demand, we have also run the No Build AM and PM peak hour simulations with an additional simulation hour to process all vehicles in queue at the end of the peak hour. These figures (Demand) show the actual No Build demand, not just that which is processed in the peak hour.

[7] Because intersection volumes are recorded at a different location than ramp volumes, volumes presented for ramps may differ slightly from the total volume approaching or departing the corresponding interchange intersection. This is because some vehicles may have past the ramp count location and not the intersection count location (or vice versa) at the end of the simulation hour.

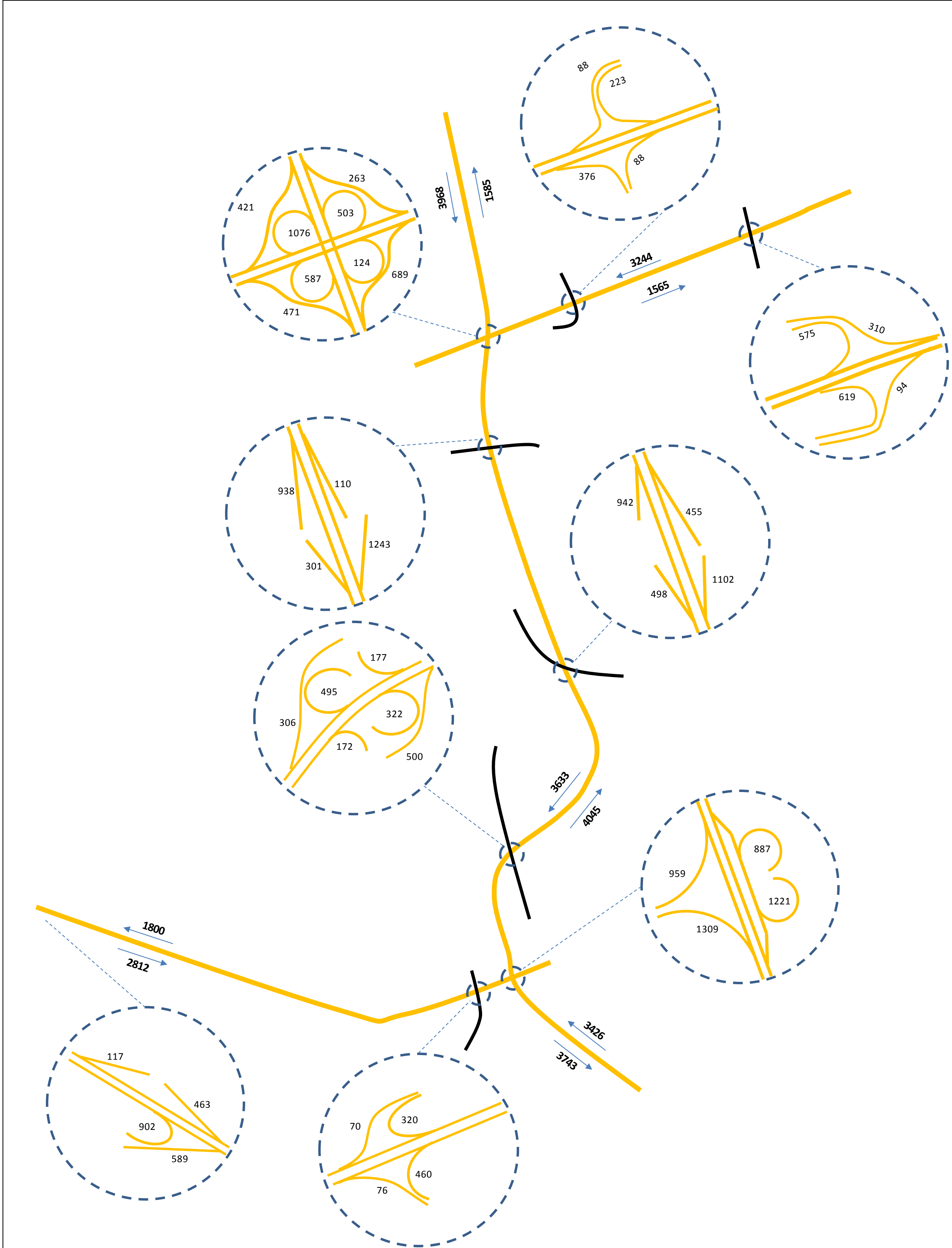
Highway & Ramp 2035 AM Peak Hour Traffic Volumes - Model Throughput



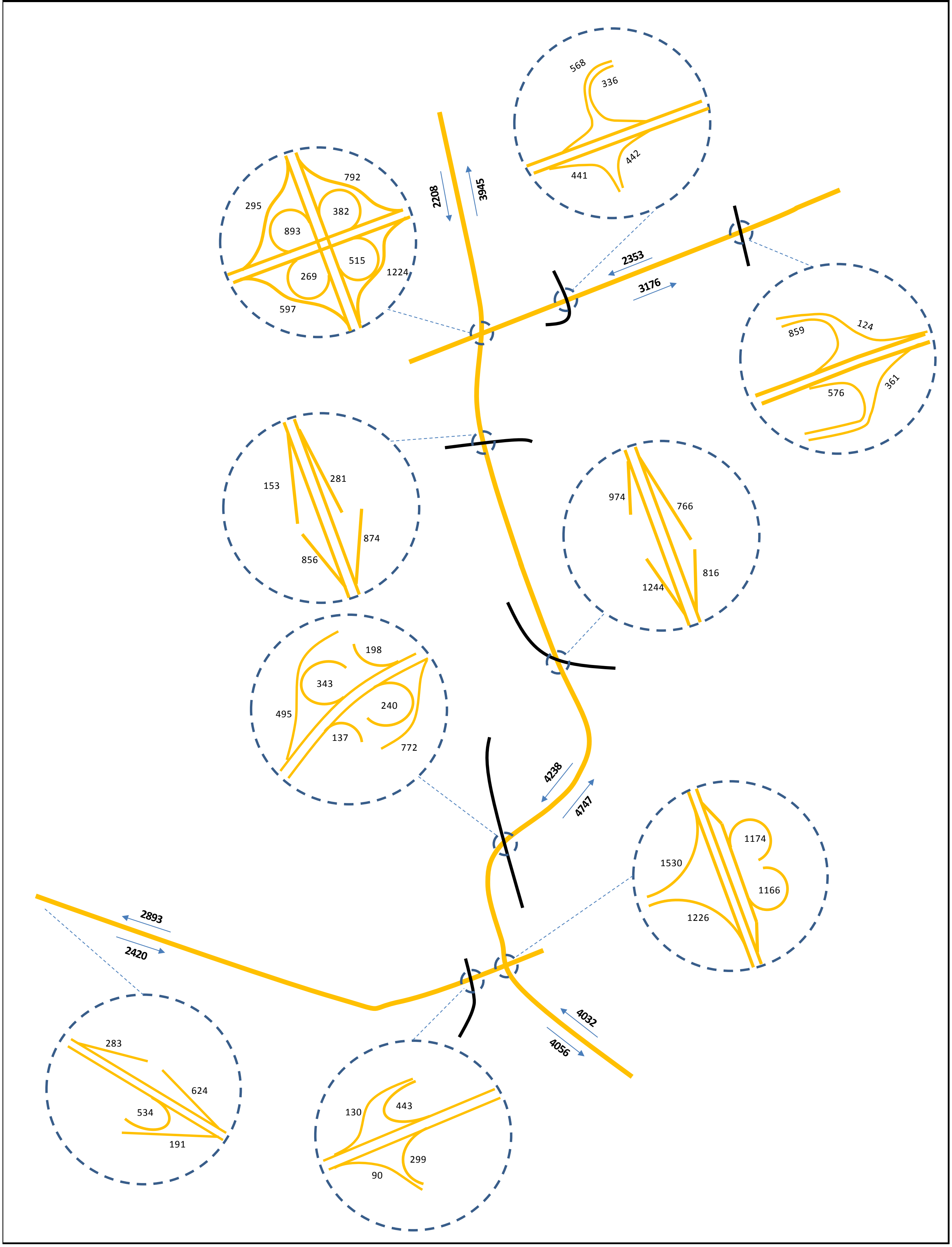
Highway & Ramp 2035 PM Peak Hour Traffic Volumes - Model Throughput



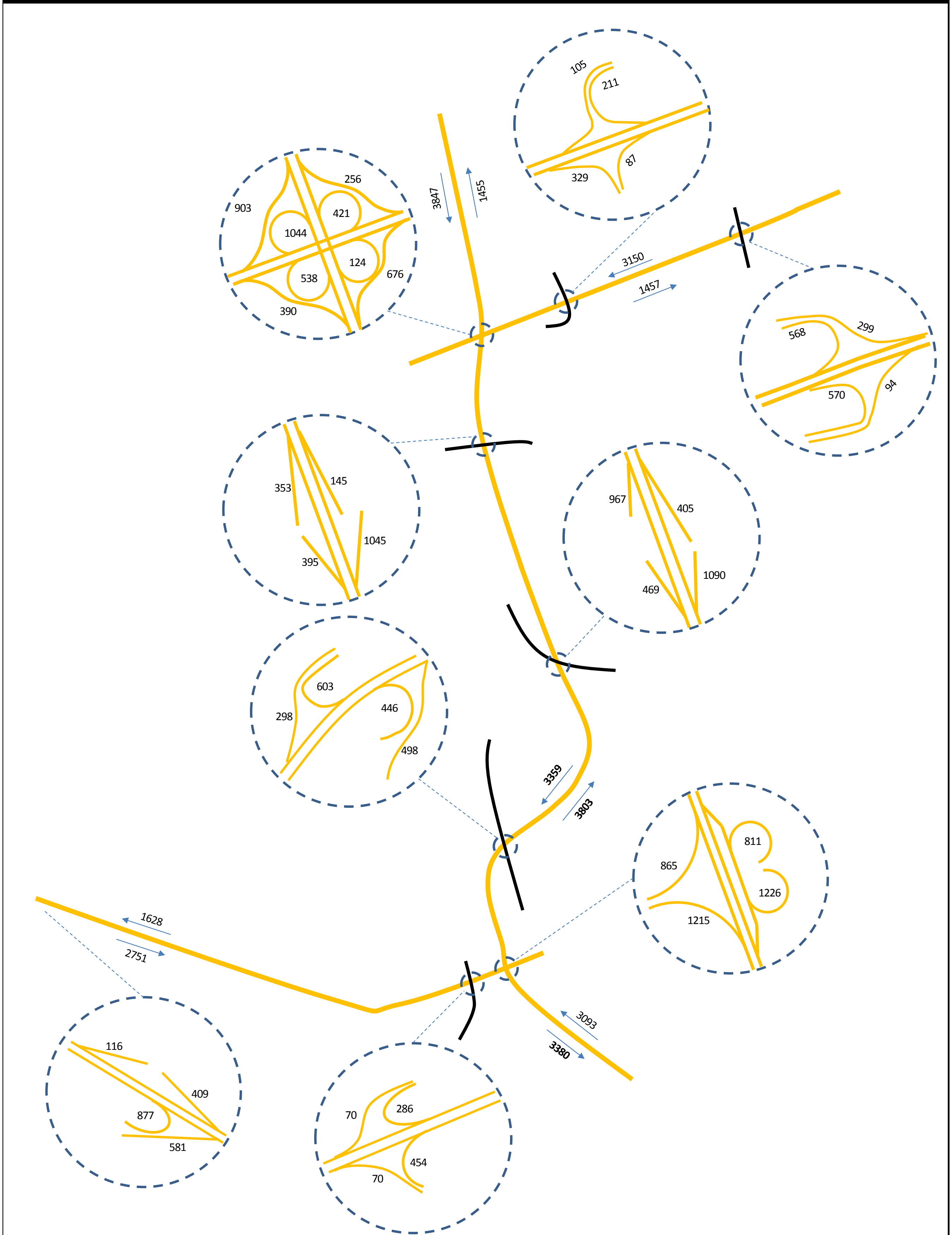
Highway & Ramp 2035 AM Peak Hour Traffic Volumes - Model Demand



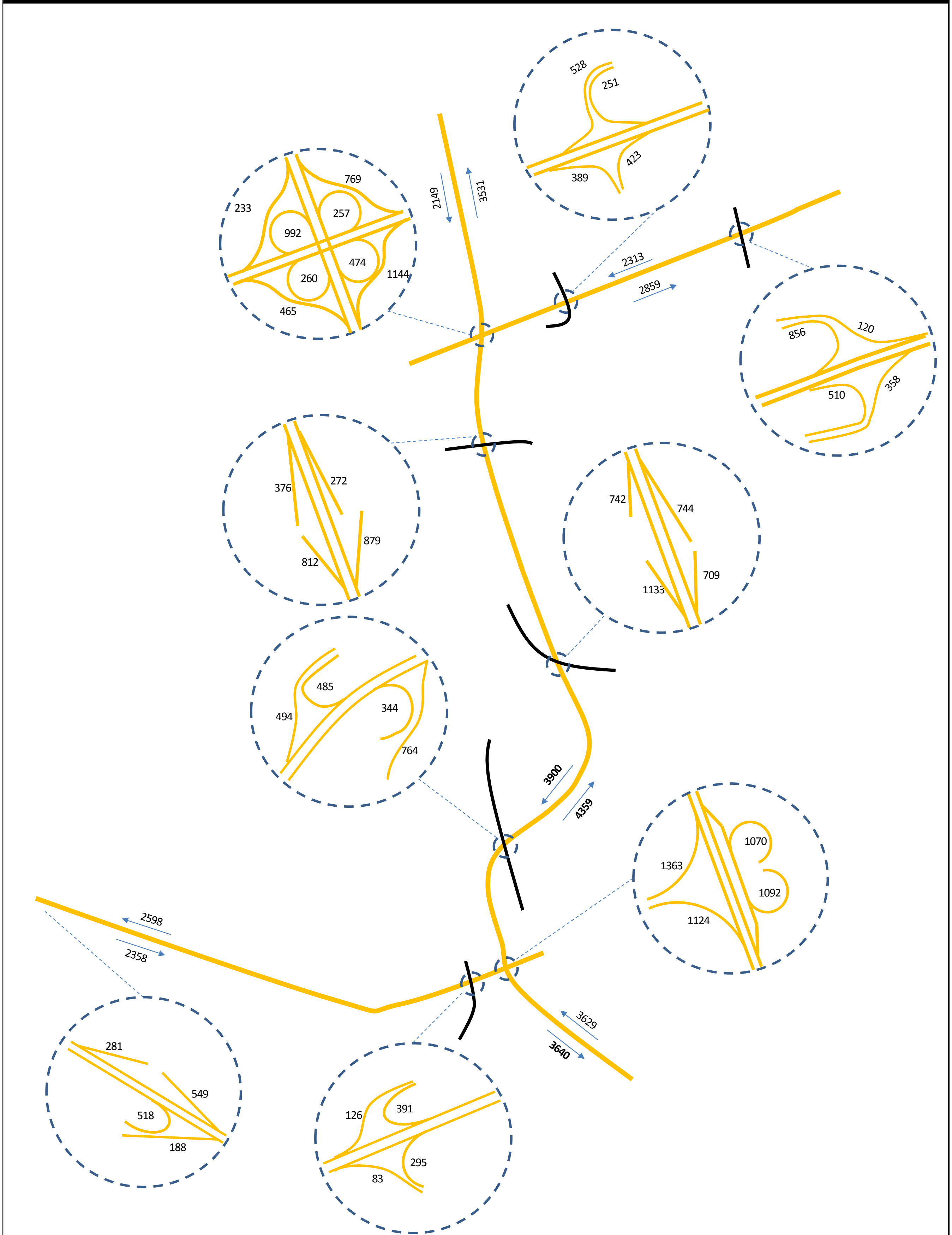
Highway & Ramp 2035 PM Peak Hour Traffic Volumes - Model Demand



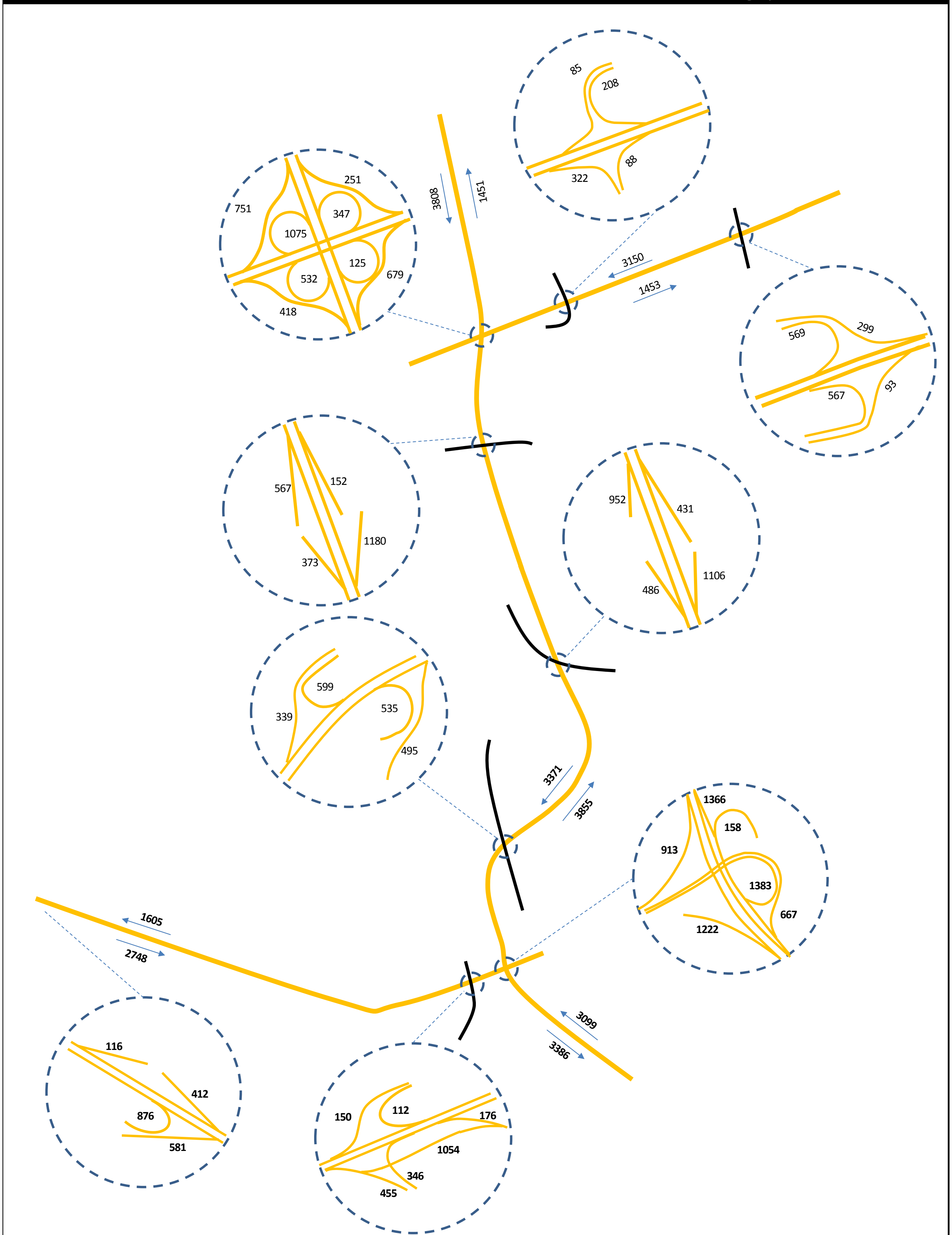
Scenario A - 2035 AM Peak Hour Traffic Volumes - Model Throughput



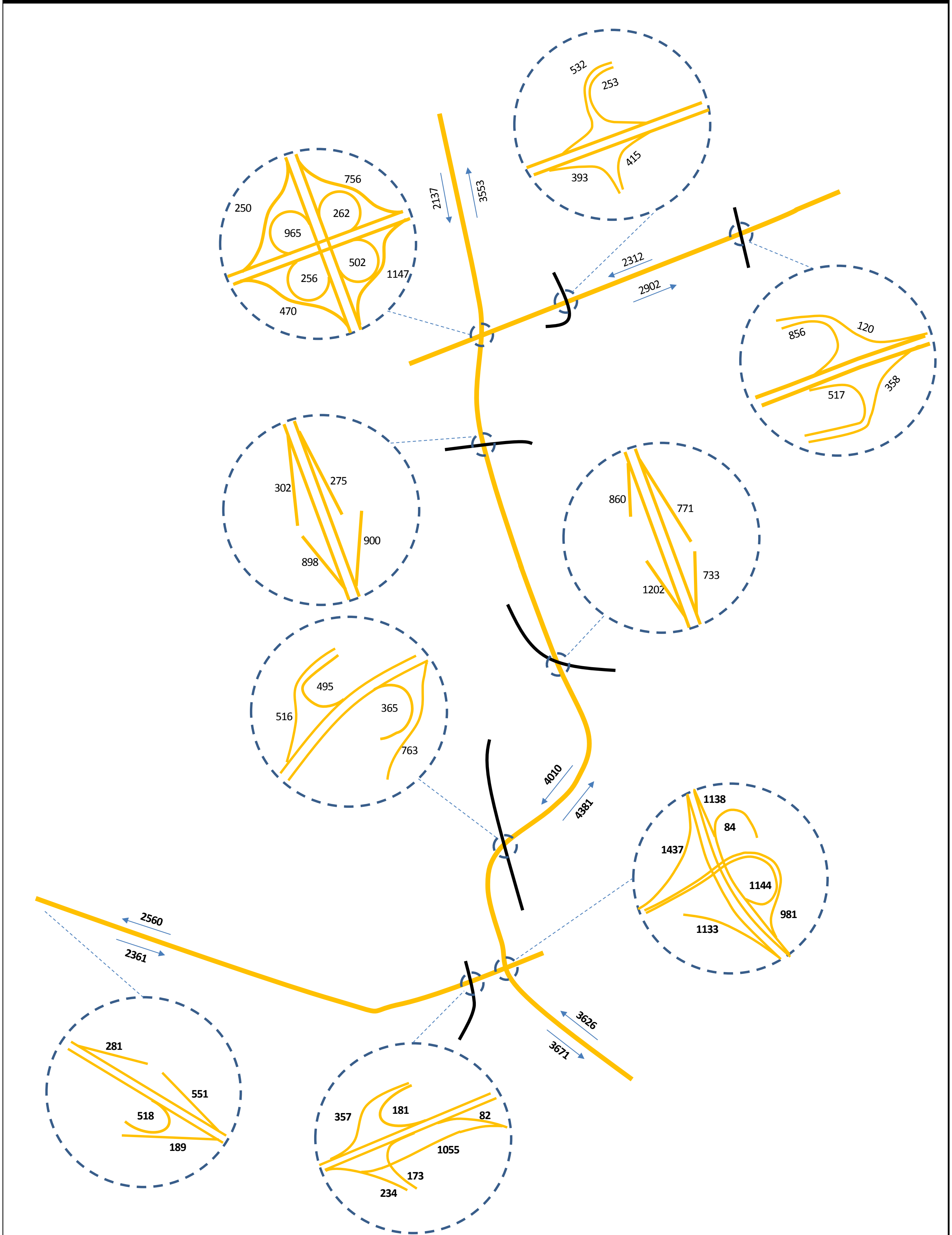
Scenario A - 2035 PM Peak Hour Traffic Volumes - Model Throughput



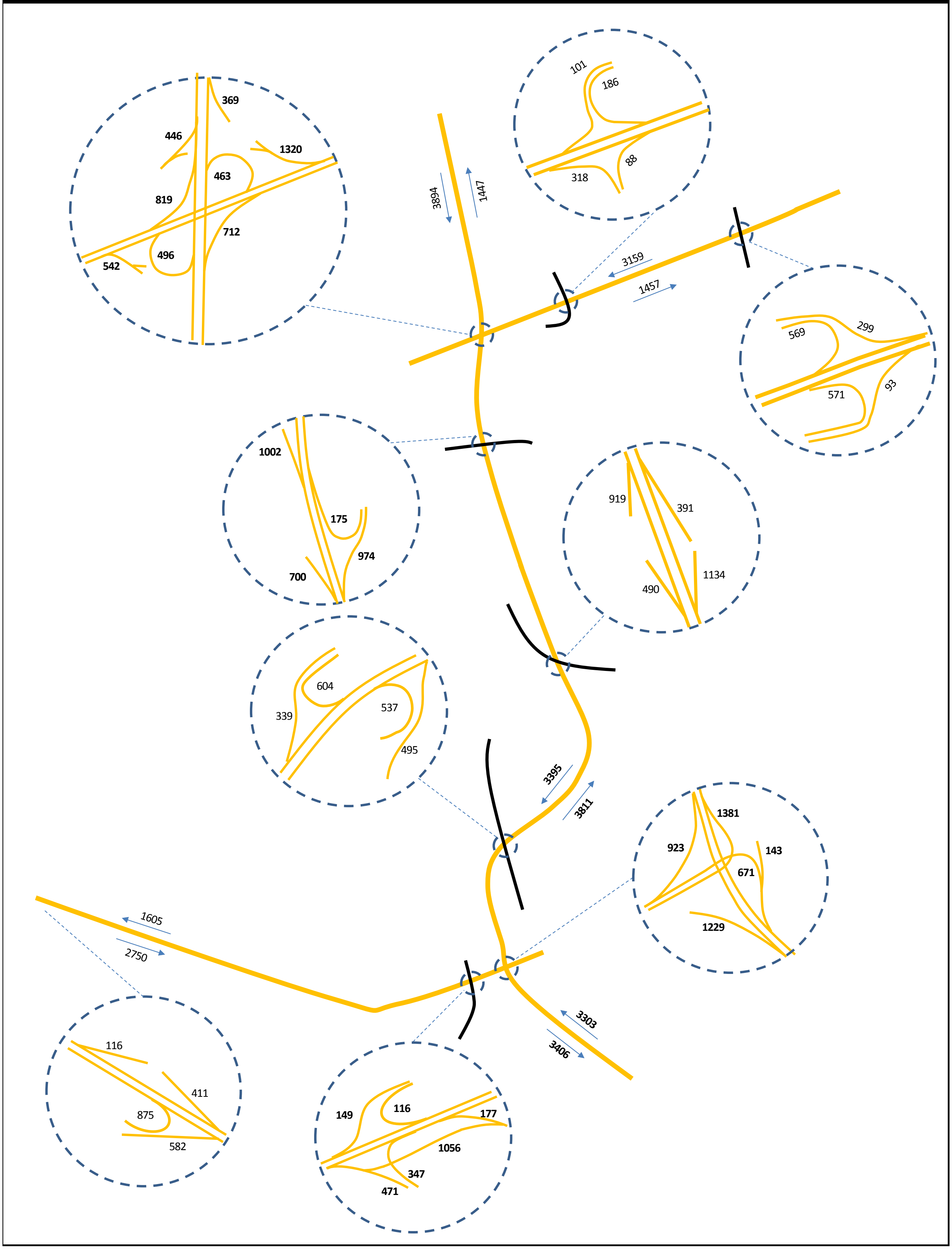
Scenario B - 2035 AM Peak Hour Traffic Volumes - Model Throughput



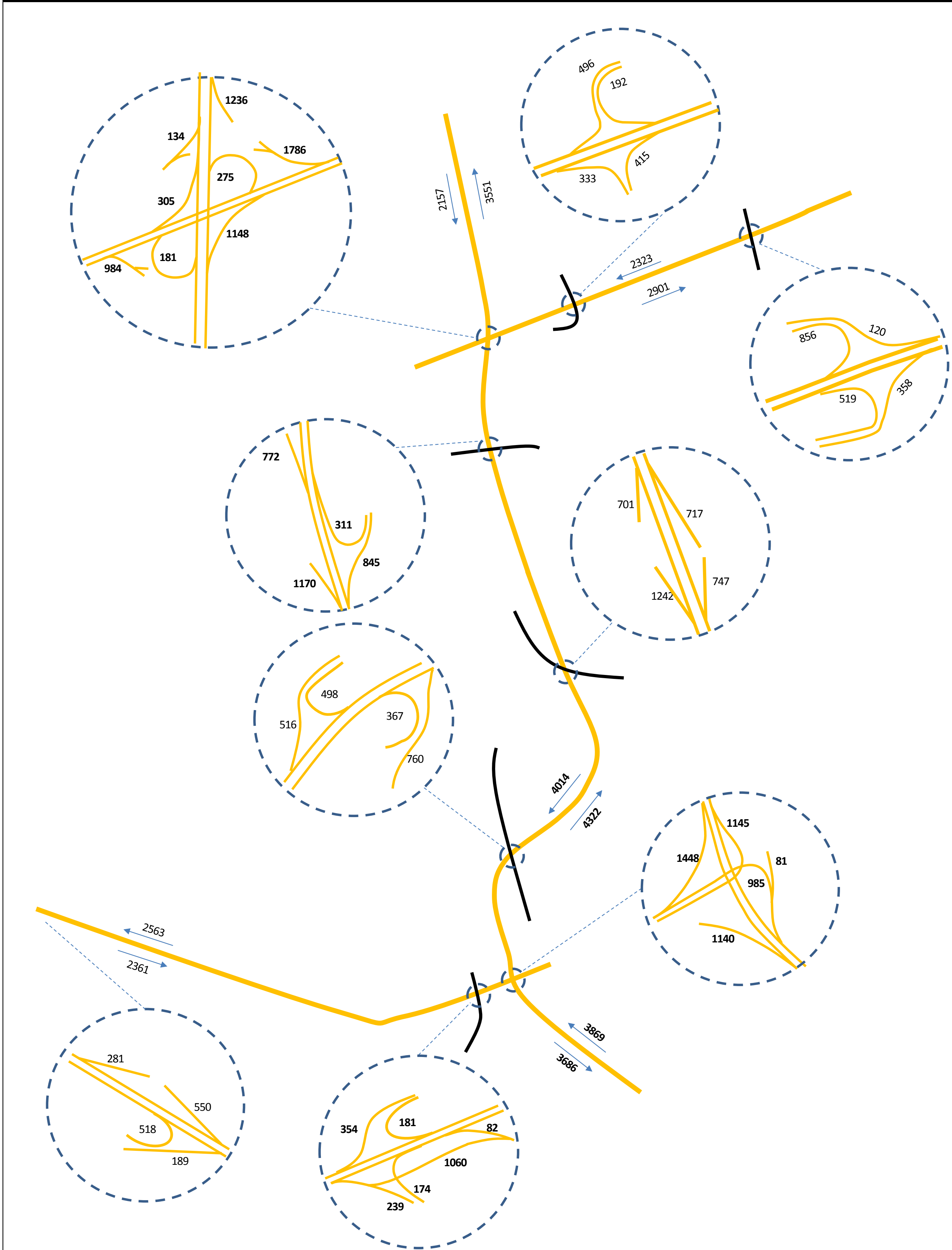
Scenario B - 2035 PM Peak Hour Traffic Volumes - Model Throughput



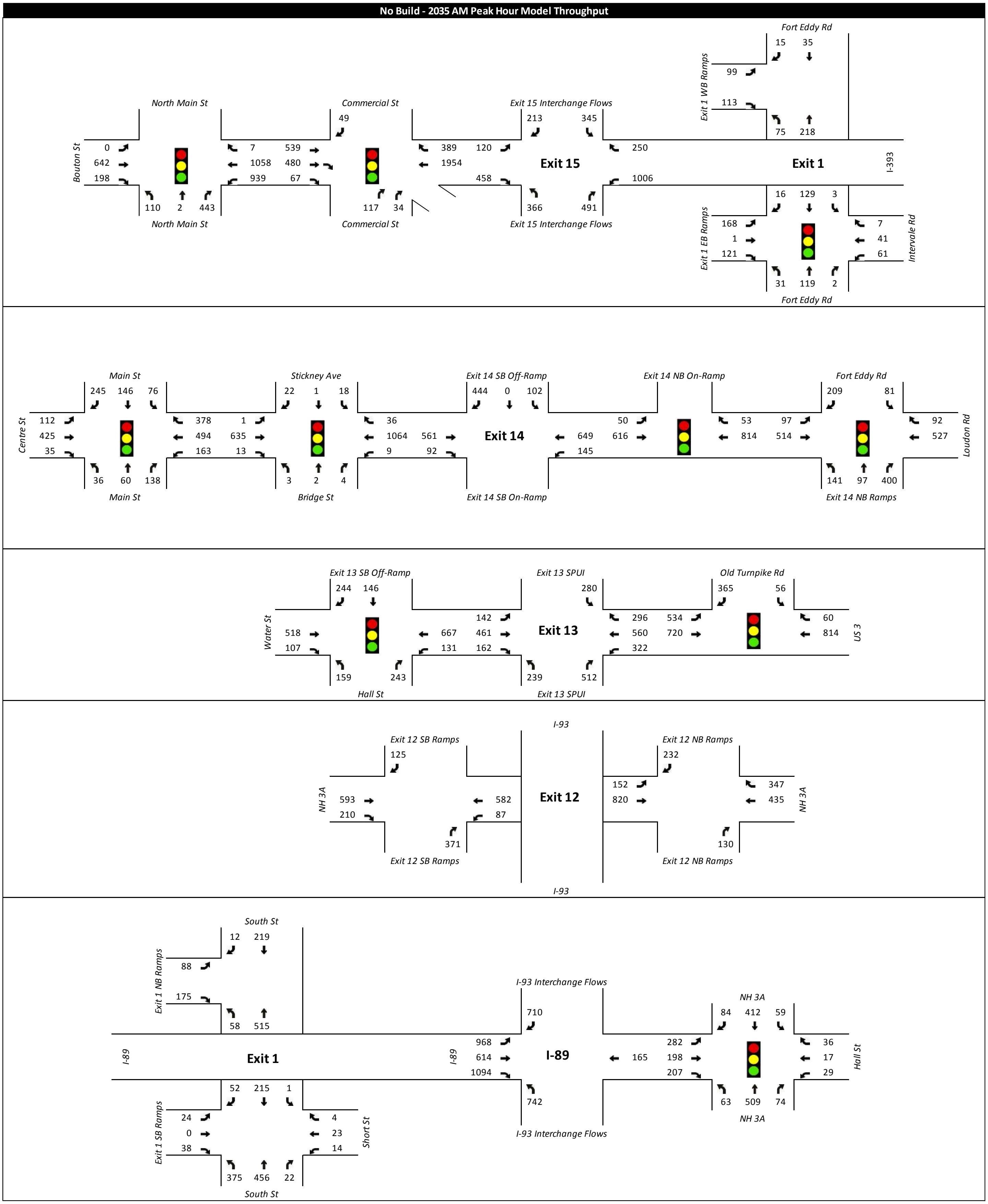
Scenario C - 2035 AM Peak Hour Traffic Volumes - Model Throughput



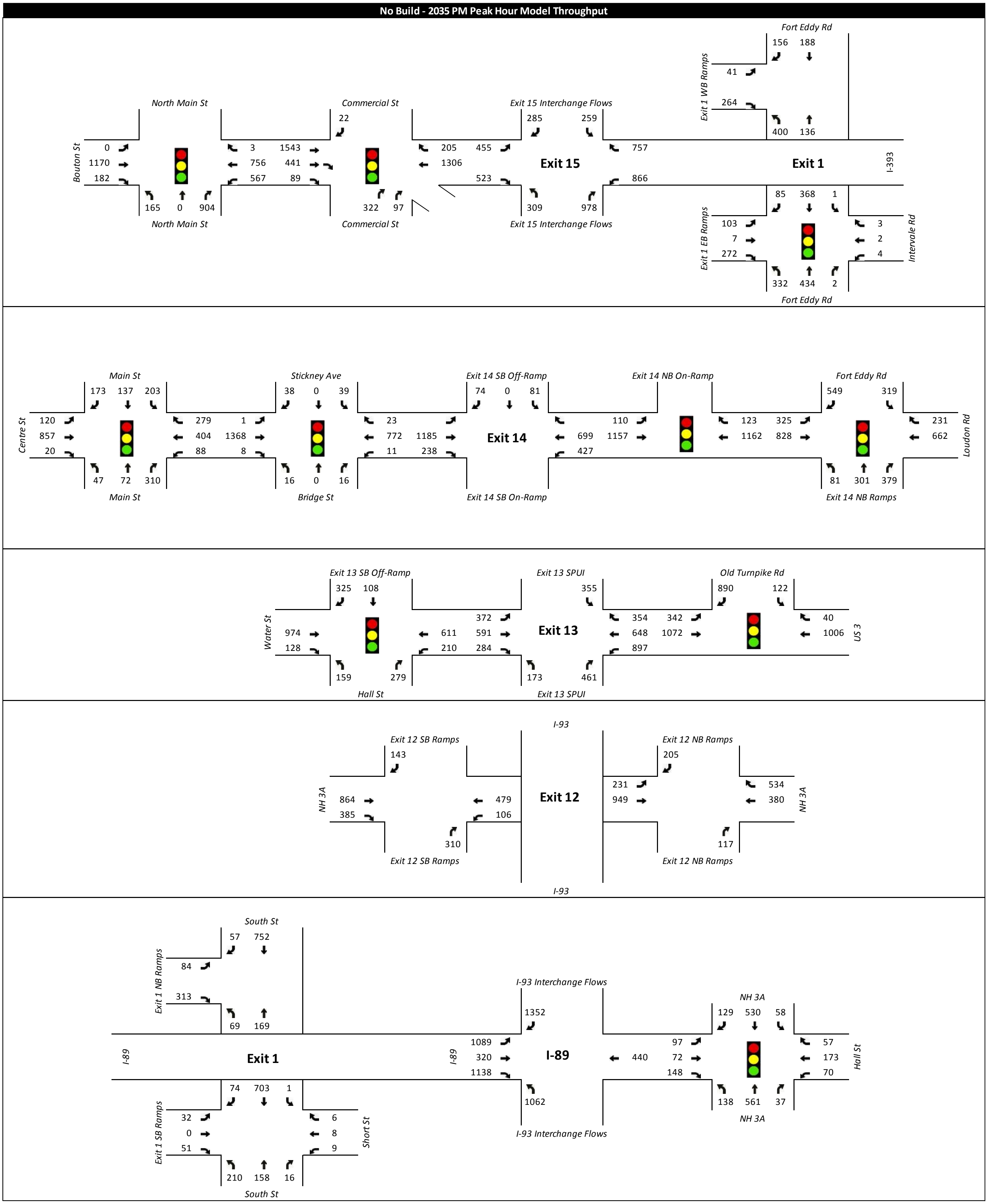
Scenario C - 2035 PM Peak Hour Traffic Volumes - Model Throughput



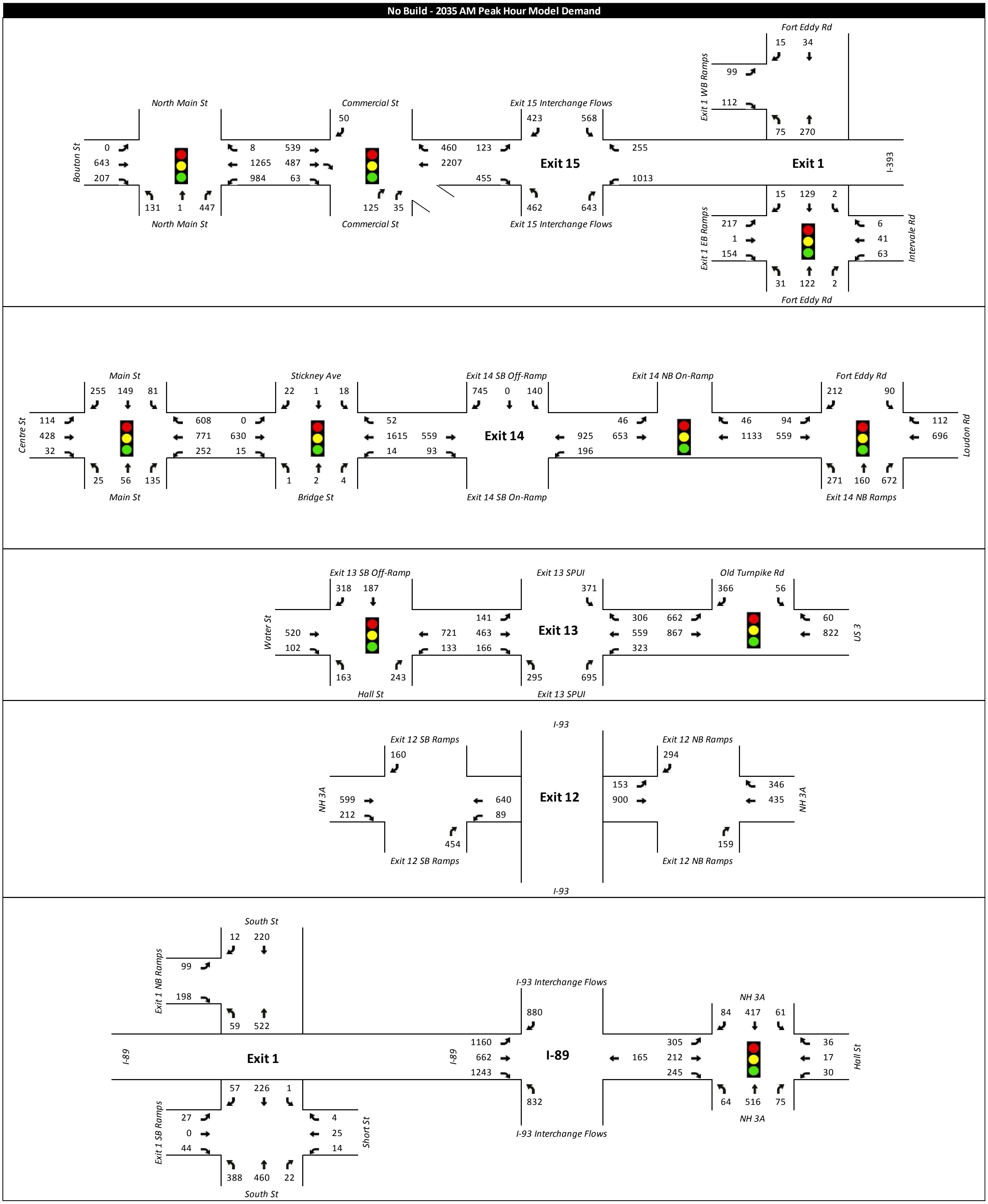
No Build - 2035 AM Peak Hour Model Throughput



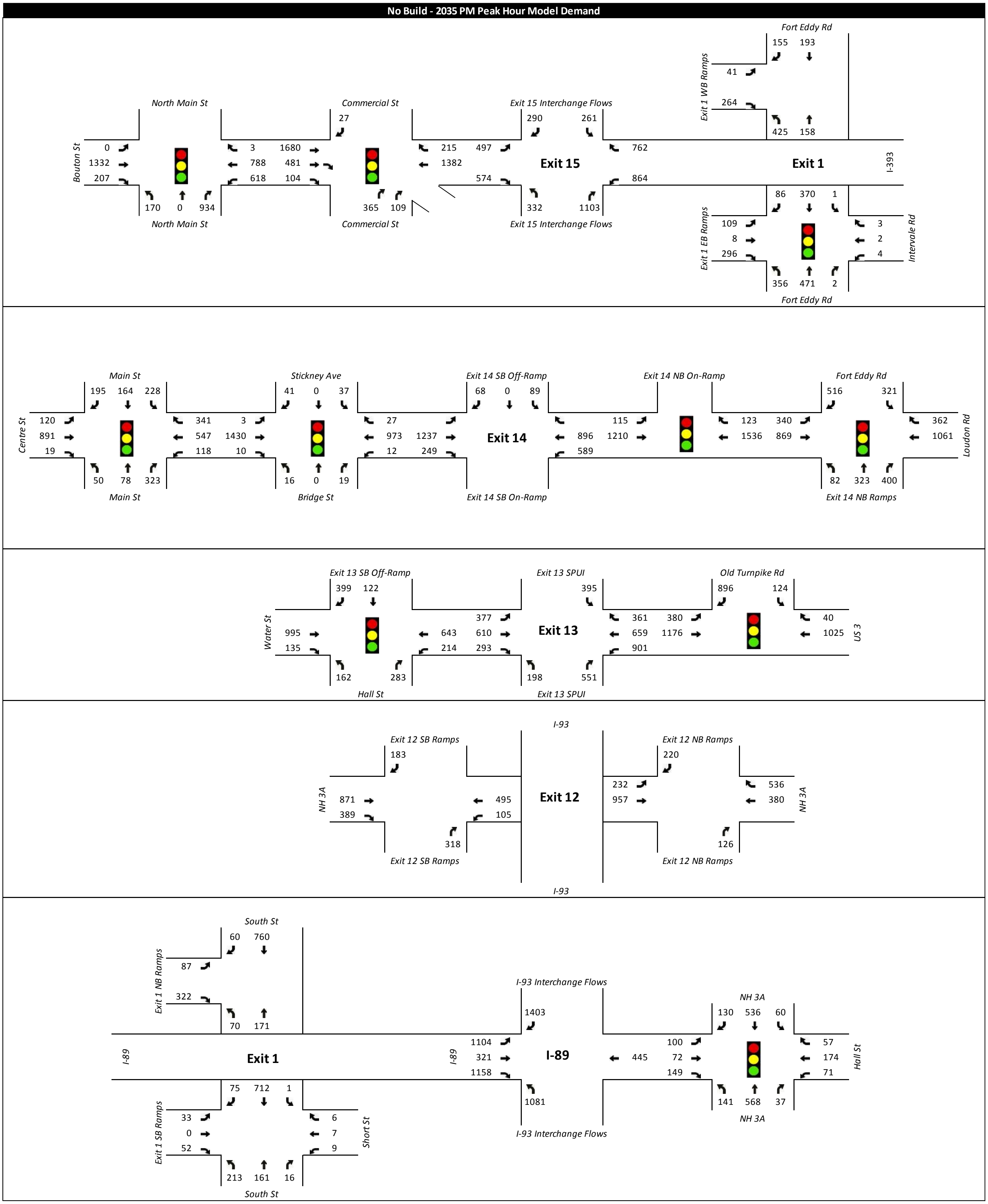
No Build - 2035 PM Peak Hour Model Throughput



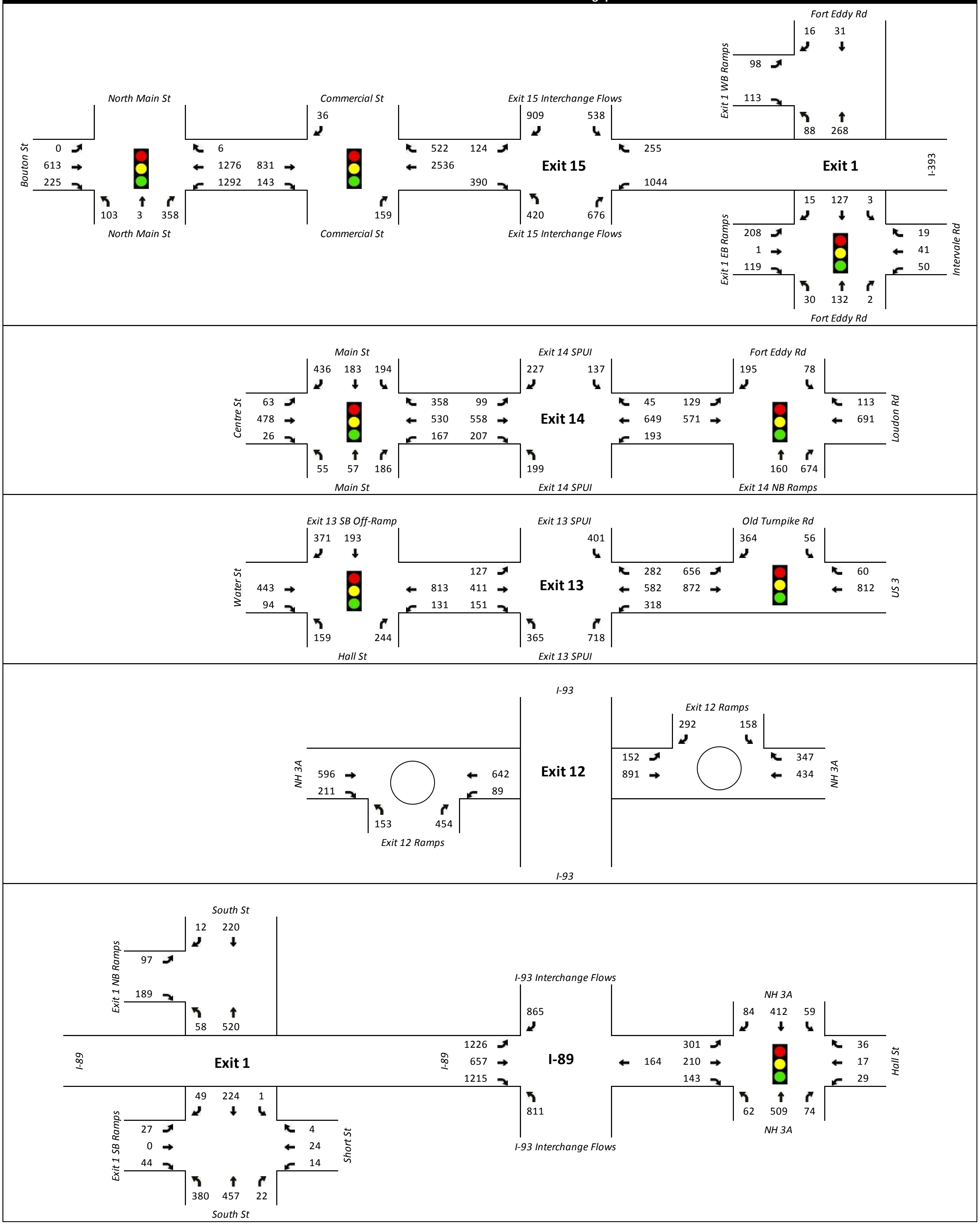
No Build - 2035 AM Peak Hour Model Demand



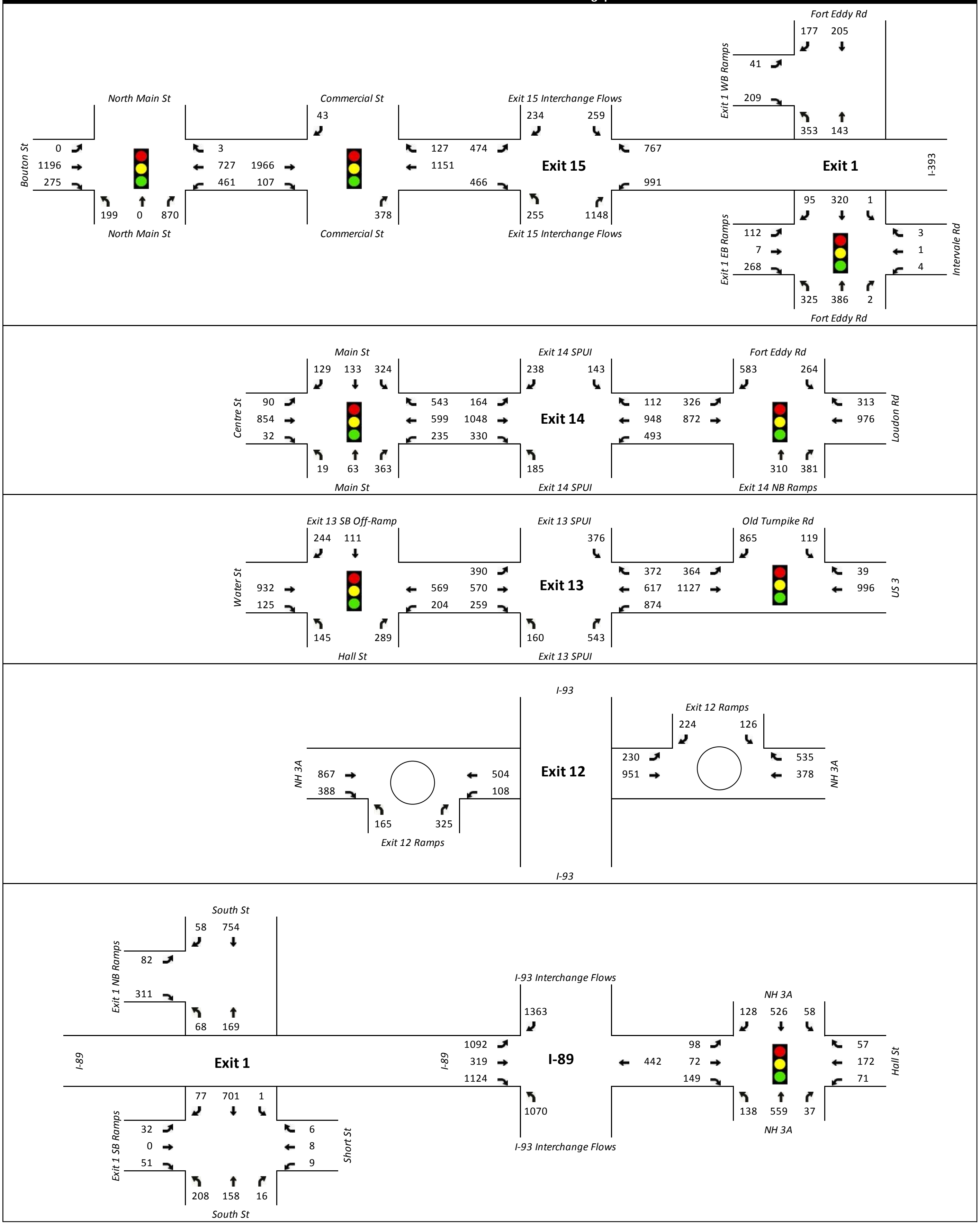
No Build - 2035 PM Peak Hour Model Demand



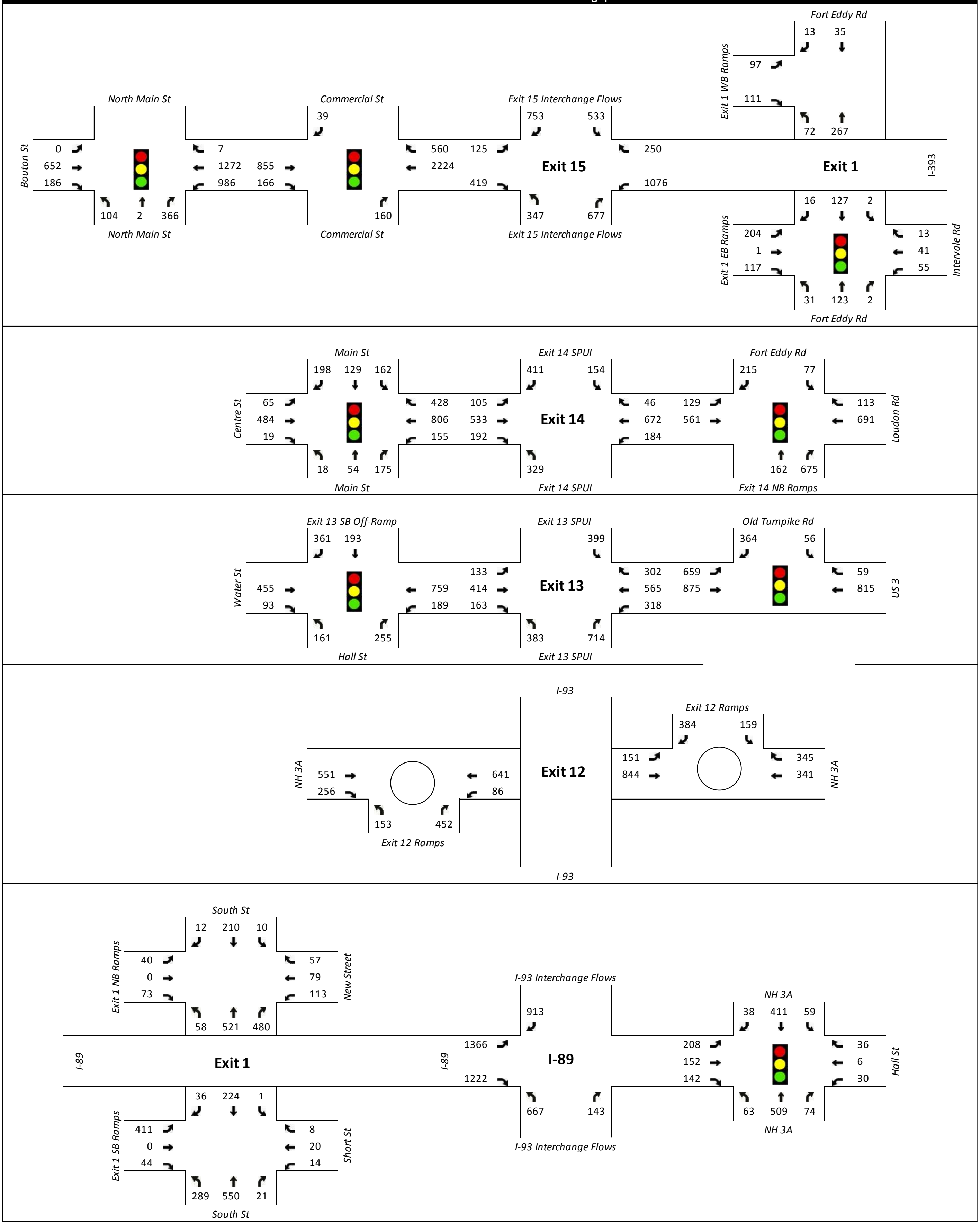
Scenario A - 2035 AM Peak Hour Model Throughput



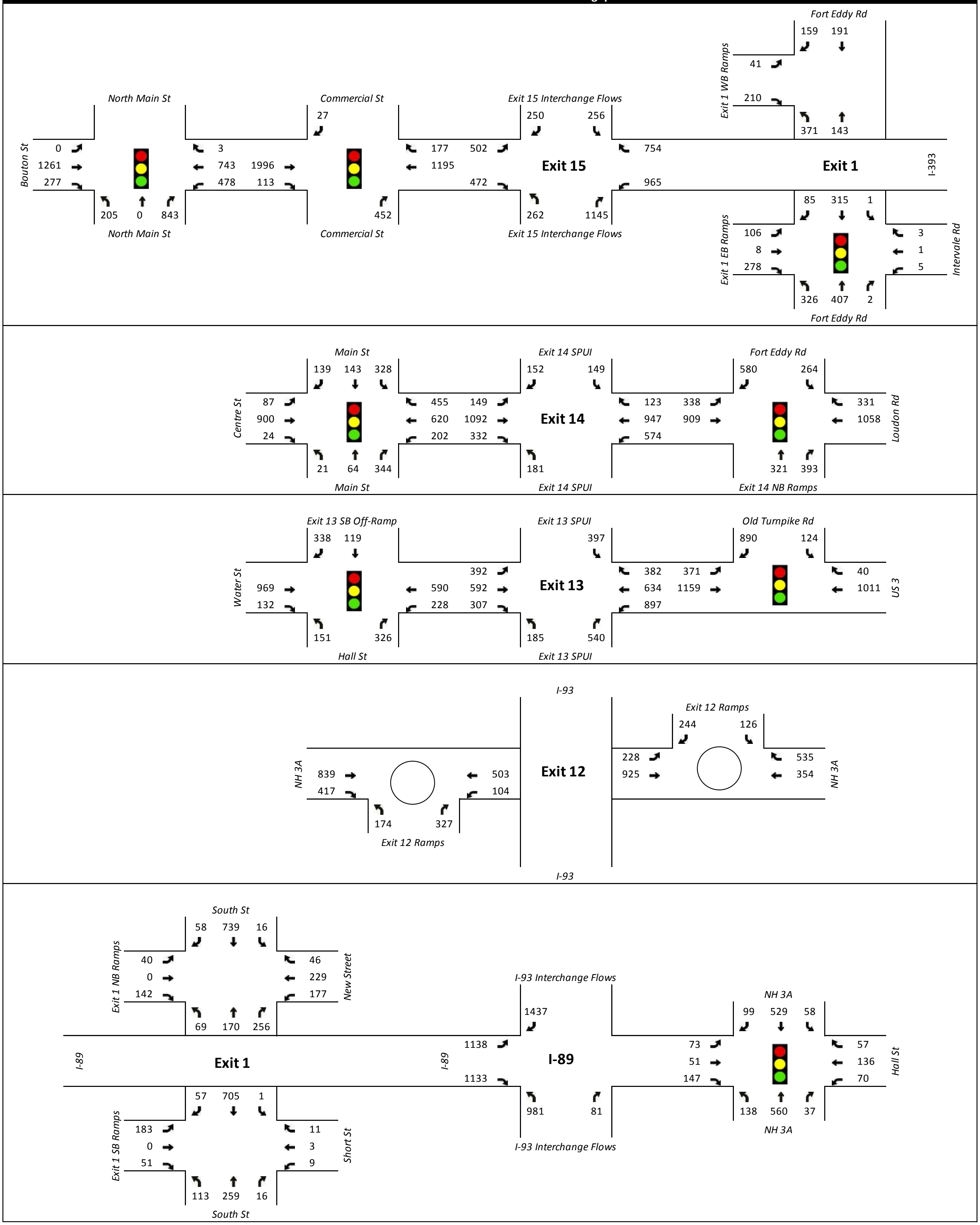
Scenario A - 2035 PM Peak Hour Model Throughput



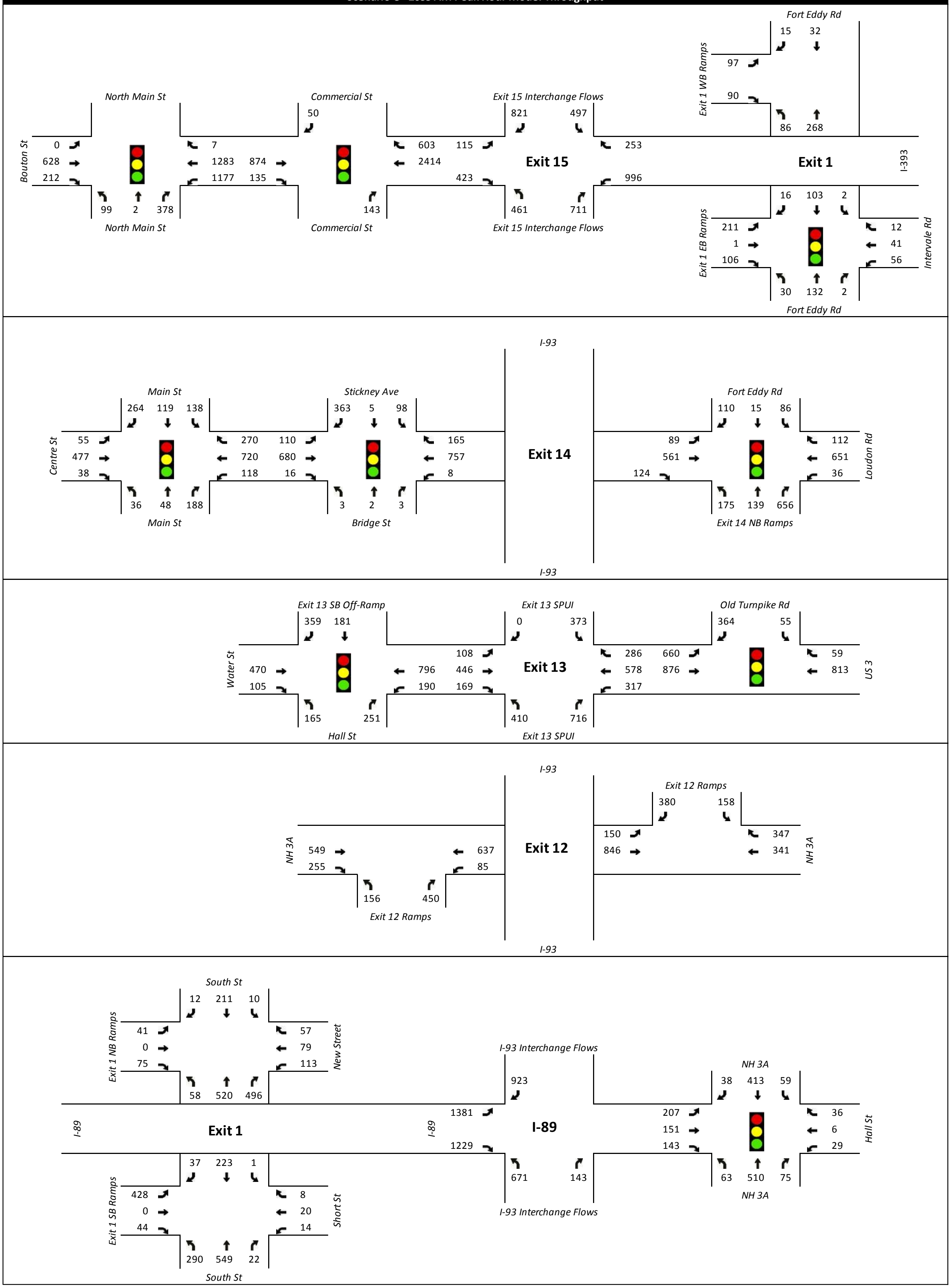
Scenario B - 2035 AM Peak Hour Model Throughput



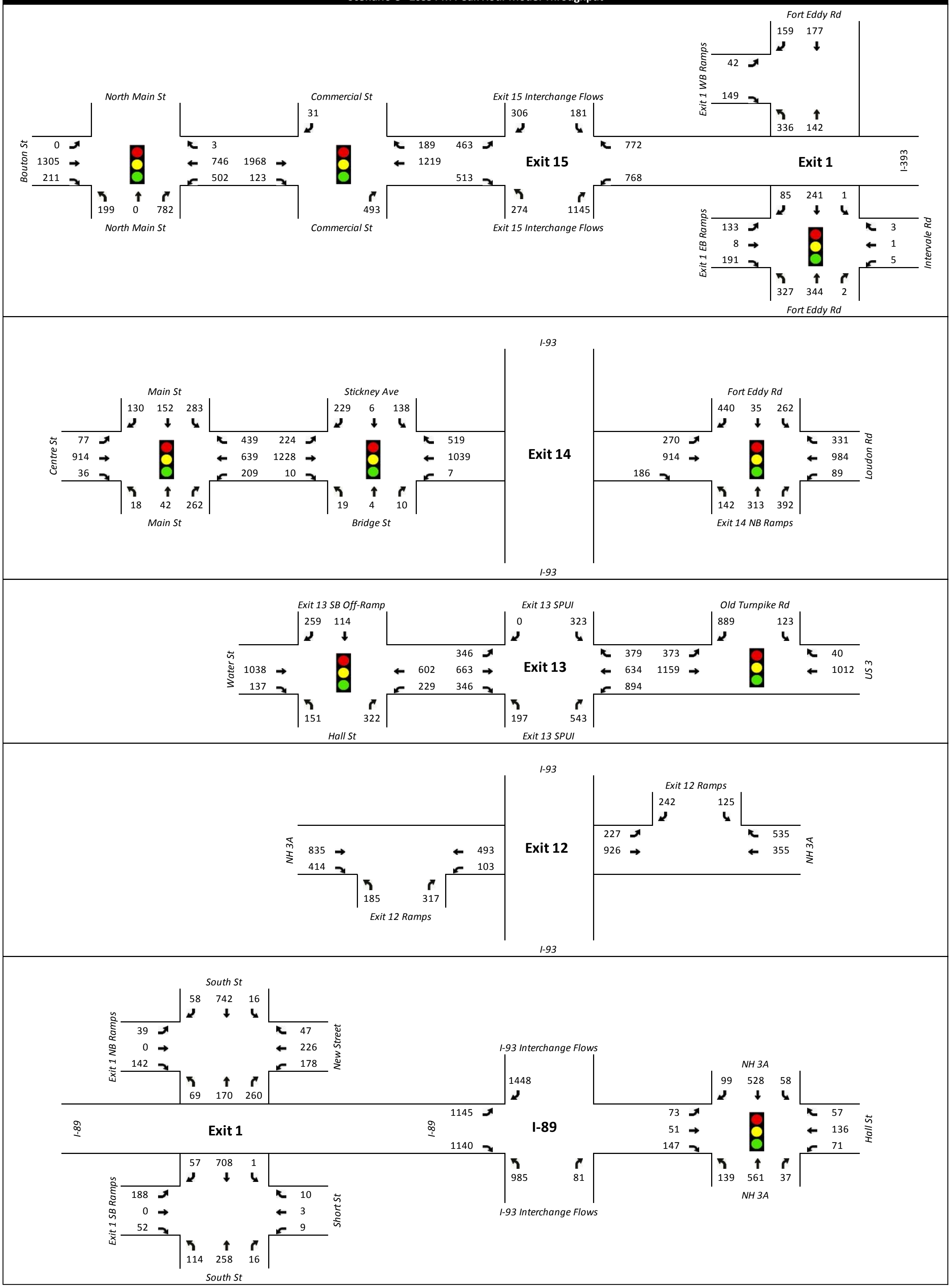
Scenario B - 2035 PM Peak Hour Model Throughput



Scenario C - 2035 AM Peak Hour Model Throughput



Scenario C - 2035 PM Peak Hour Model Throughput



7.0 FREEWAY ANALYSIS

To assess the relative benefits provided by each design alternative, freeway densities and levels of service are calculated for the study area segments in each scenario. Level of Service (LOS) is a qualitative measure describing the operating conditions as perceived by motorists. LOS definitions and calculation procedures are outlined in the 2010 Highway Capacity Manual (HCM 2010).

The HCM 2010 defines six qualitative grades to describe the LOS for freeway segments. LOS is based on the vehicle density. Figure 20 shows the various LOS grades and descriptions for basic, weave, merge, and diverge segments.

FIGURE 20: LOS CRITERIA FOR FREEWAY SEGMENTS

		DENSITY (PC/MI/LN)	
LOS	CHARACTERISTICS	BASIC	WEAVE/MERGE/DIVERGE
A	Free-flow operations	≤ 11	≤ 10
B	Reasonably free-flow	>11-18	>10-20
C	Speeds near free-flow	>18-26	>20-28
D	Speeds decline with	>26-35	>28-35
E	Operation at capacity	>35-45	>35
F	Breakdown/unstable flow	>45	Demand Exceeds Capacity

The figures below present the freeway LOS results for each of the design alternatives and for the No Build condition.

No Build

Route	Direction	Locaton	Description	Type	2035 AM Segment Density (veh/mi/ln)	2035 AM Speed (mph)	2035 AM LOS
I-93	Southbound	Exit 15	Mainline North of Exit 15	Basic	146	10	F
			Exit 15 SB Off-Ramp	Diverge	140	10	F
			Mainline between Exit 15 Off/On -Ramps	Basic	46	28	F
			Exit 15 Weave	Weaving	61	32	F
			Mainline between Exit 15 Off/On-Ramps	Basic	39	43	E
			Exit 15 to Exit 14 Weave	Weaving	49	42	F
		Exit 14	Mainline between Exit 14 On/Off Ramps	Basic	29	54	D
			Exit 14 SB On-Ramp	Merge	30	52	D
			Mainline between Exit 14 and Exit 13	Diverge	33	53	D
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	24	55	C
			Exit 13 SB On-Ramp	Merge	29	50	D
			Mainline between Exit 13 and Exit 12	Diverge	30	52	D
		Exit 12	Exit 12 SB Off-Ramp to Rte 3A SB	Diverge	33	48	D
			Mainline between Exit 12 Off/On-Ramps	Basic	25	55	C
			Mainline between Exit 12 On-Ramp and I-93 Off-Ramp to I-89 NB	Merge	14	56	B
		I-89	Mainline between I-93 Off/On-Ramps from I-89	Basic	12	59	B
			I-93 On-Ramp from I-89 SB	Merge	10	66	B
			Mainline South of I-89 SB On-Ramp	Basic	18	63	C
	Northbound	Exit 15	Mainline North of Exit 15	Basic	12	58	B
			Exit 15 NB On-Ramp	Merge	11	59	B
			Mainline between Exit 15 On/Off -Ramps	Basic	10	59	A
			Exit 15 Weave	Weaving	17	49	B
			Mainline between Exit 15 Off/On-Ramps	Basic	12	57	B
			Exit 14 to Exit 15 Weave	Weaving	20	53	B
		Exit 14	Mainline between Exit 14 On/Off Ramps	Basic	18	54	B
			Mainline between Exit 13 and Exit 14	Diverge	109	13	F
		Exit 13	Exit 13 NB On-Ramp	Merge	104	11	F
			Mainline between Exit 13 Off/On-Ramps	Basic	70	19	F
			Mainline between Exit 12 and Exit 13	Diverge	111	16	F
		Exit 12	Exit 12 NB On-Ramp	Merge	111	12	F
			Mainline between Exit 12 Off/On-Ramps	Basic	125	13	F
			Exit 12 NB Off-Ramp to Rte 3A NB	Diverge	112	15	F
			Exit 12 NB Off-Ramp to Rte 3A SB	Diverge	113	16	F
		I-89	I-89 SB On-Ramp to I-93 NB	Merge	112	11	F
			Mainline between Off/On Ramps to I-89	Basic	81	16	F
			Mainline South of I-89 NB Off-Ramp	Diverge	32	61	D
			I-93 NB CD Road at I-89 Ramps Weave	Weaving	97	11	F
I-89	Southbound	Exit 2	Mainline North of Exit 2	Basic	27	63	D
			Exit 2 SB Off-Ramp	Diverge	26	56	C
			Mainline between Exit 2 Off/On-Ramps	Basic	20	63	C
			Exit 2 SB On-Ramp	Merge	55	53	F
			Mainline between Exit 2 and Exit 1	Basic	51	33	F
		Exit 1	Exit 1 SB Off-Ramp	Diverge	66	19	F
			Mainline between Exit 1 Off/On-Ramps	Basic	84	17	F
			Exit 1 SB On-Ramp to I-93 SB Off-Ramp Weave	Weaving	80	22	F
			I-89 SB Off-Ramp to I-93 NB	Diverge	72	14	F
	Northbound	Exit 2	Mainline North of Exit 2	Basic	10	68	A
			Exit 2 NB On-Ramp	Merge	9	67	A
			Mainline between Exit 2 Off/On-Ramps	Basic	9	68	A
			Mainline between Exit 1 and Exit 2	Diverge	13	66	B
		Exit 1	Exit 1 SB On-Ramp	Merge	12	69	B
			Mainline between Exit 1 Off/On-Ramps	Basic	12	64	B
			I-93 SB On-Ramp to Exit 1 SB Off-Ramp Weave	Weaving	19	50	B
			I-93 NB On-Ramp to I-93 SB On-Ramp	Merge	10	51	B
I-393	Eastbound	I-93	I-93 On/Off-Ramp Weave	Weaving	8	50	A
			Mainline Between I-93 NB On-Ramp and I-93 NB Off-Ramp	Basic	9	57	A
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	10	55	A
			Mainline between Exit 1 Off/On-Ramps	Basic	11	56	B
			Exit 1 On-Ramp	Merge	12	56	B
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	13	56	B
			Exit 2 Off-Ramp	Diverge	12	54	B
			Mainline Between Exit 2 Off/On-Ramps	Basic	7	59	A
			Exit 2 On-Ramp	Merge	8	60	A
			Mainline East of Exit 2	Basic	8	58	A
	Westbound	I-93	I-93 Off/On-Ramp Weave	Weaving	33	38	D
			Mainline Between I-93 SB Off-Ramp and I-93 SB On-Ramp	Basic	38	44	E
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	27	45	C
			Mainline between Exit 1 Off/On-Ramps	Basic	40	43	E
			Exit 1 Off-Ramp	Diverge	32	49	D
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	36	50	E
			Exit 2 On-Ramp	Merge	35	40	D
			Mainline Between Exit 2 On/Off-Ramps	Basic	30	50	D
			Exit 2 Off-Ramp	Diverge	32	54	D

Baseline

	Direction	Locaton	Description	Type	2035 PM Segment Density (veh/mi/ln)	2035 PM Speed (mph)	2035 PM LOS
I-93	Southbound	Exit 15	Mainline North of Exit 15	Basic	22	56	C
			Exit 15 SB Off-Ramp	Diverge	23	54	C
			Mainline between Exit 15 Off/On -Ramps	Basic	21	51	C
			Exit 15 Weave	Weaving	41	42	E
			Mainline between Exit 15 Off/On-Ramps	Basic	28	51	D
			Exit 15 to Exit 14 Weave	Weaving	34	52	D
		Exit 14	Mainline between Exit 14 On/Off Ramps	Basic	30	54	D
			Exit 14 SB On-Ramp	Merge	39	42	E
			Mainline between Exit 14 and Exit 13	Diverge	40	49	E
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	29	52	D
			Exit 13 SB On-Ramp	Merge	56	28	F
			Mainline between Exit 13 and Exit 12	Diverge	47	42	F
		Exit 12	Exit 12 SB Off-Ramp to Rte 3A SB	Diverge	47	46	F
			Mainline between Exit 12 Off/On-Ramps	Basic	38	52	E
			Mainline between Exit 12 On-Ramp and I-93 Off-Ramp to I-89 NB	Merge	27	52	C
		I-89	Mainline between I-93 Off/On-Ramps from I-89	Basic	16	59	B
			I-93 On-Ramp from I-89 SB	Merge	13	66	B
			Mainline South of I-89 SB On-Ramp	Basic	22	62	C
	Northbound	Exit 15	Mainline North of Exit 15	Basic	36	52	E
			Exit 15 NB On-Ramp	Merge	34	50	D
			Mainline between Exit 15 On/Off -Ramps	Basic	28	54	D
			Exit 15 Weave	Weaving	37	46	E
			Mainline between Exit 15 Off/On-Ramps	Basic	27	52	D
			Exit 14 to Exit 15 Weave	Weaving	42	48	E
		Exit 14	Mainline between Exit 14 On/Off Ramps	Basic	36	52	E
			Mainline between Exit 13 and Exit 14	Diverge	58	35	F
		Exit 13	Exit 13 NB On-Ramp	Merge	73	19	F
			Mainline between Exit 13 Off/On-Ramps	Basic	81	24	F
			Mainline between Exit 12 and Exit 13	Diverge	61	35	F
		Exit 12	Exit 12 NB On-Ramp	Merge	73	22	F
			Mainline between Exit 12 Off/On-Ramps	Basic	88	23	F
			Exit 12 NB Off-Ramp to Rte 3A NB	Diverge	76	27	F
			Exit 12 NB Off-Ramp to Rte 3A SB	Diverge	85	26	F
		I-89	I-89 SB On-Ramp to I-93 NB	Merge	84	17	F
			Mainline between Off/On Ramps to I-89	Basic	47	34	F
			Mainline South of I-89 NB Off-Ramp	Diverge	24	63	C
			I-93 NB CD Road at I-89 Ramps Weave	Weaving	54	25	F
I-89	Southbound	Exit 2	Mainline North of Exit 2	Basic	23	65	C
			Exit 2 SB Off-Ramp	Diverge	22	60	C
			Mainline between Exit 2 Off/On-Ramps	Basic	19	63	C
			Exit 2 SB On-Ramp	Merge	31	56	D
			Mainline between Exit 2 and Exit 1	Basic	27	49	D
		Exit 1	Exit 1 SB Off-Ramp	Diverge	33	34	D
			Mainline between Exit 1 Off/On-Ramps	Basic	38	35	E
			Exit 1 SB On-Ramp to I-93 SB Off-Ramp Weave	Weaving	39	37	E
			I-89 SB Off-Ramp to I-93 NB	Diverge	20	41	C
	Northbound	Exit 2	Mainline North of Exit 2	Basic	20	65	C
			Exit 2 NB On-Ramp	Merge	19	63	B
			Mainline between Exit 2 Off/On-Ramps	Basic	18	66	B
			Mainline between Exit 1 and Exit 2	Diverge	23	65	C
		Exit 1	Exit 1 SB On-Ramp	Merge	22	66	C
			Mainline between Exit 1 Off/On-Ramps	Basic	24	58	C
			I-93 SB On-Ramp to Exit 1 SB Off-Ramp Weave	Weaving	42	40	E
			I-93 NB On-Ramp to I-93 SB On-Ramp	Merge	19	46	B
I-393	Eastbound	I-93	I-93 On/Off-Ramp Weave	Weaving	17	48	B
			Mainline Between I-93 NB On-Ramp and I-93 NB Off-Ramp	Basic	18	56	B
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	21	51	C
			Mainline between Exit 1 Off/On-Ramps	Basic	25	53	C
			Exit 1 On-Ramp	Merge	28	48	D
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	29	53	D
			Exit 2 Off-Ramp	Diverge	29	53	D
			Mainline Between Exit 2 Off/On-Ramps	Basic	23	55	C
			Exit 2 On-Ramp	Merge	25	54	C
			Mainline East of Exit 2	Basic	27	53	D
	Westbound	I-93	I-93 Off/On-Ramp Weave	Weaving	21	40	C
			Mainline Between I-93 SB Off-Ramp and I-93 SB On-Ramp	Basic	21	50	C
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	21	46	C
			Mainline between Exit 1 Off/On-Ramps	Basic	24	48	C
			Exit 1 Off-Ramp	Diverge	24	51	C
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	27	47	D
			Exit 2 On-Ramp	Merge	27	37	C
			Mainline Between Exit 2 On/Off-Ramps	Basic	16	52	B
			Exit 2 Off-Ramp	Diverge	16	57	B

Scenario A

Facility	Direction	Locaton	Description	Type	2035 AM Segment Density (veh/mi/ln)	2035 AM Speed (mph)	2035 AM LOS
I-93	Southbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	71	32	F
			3-Lane Mainline North of Exit 15	Diverge	30	51	D
			Mainline between Exit 15 Off/On -Ramps	Basic	21	54	C
			Exit 15 Weave	Weaving	27	43	C
			Mainline between Exit 15 Off/On-Ramps	Basic	27	53	D
			Exit 15 to Exit 14 Weave	Weaving	23	52	C
		Exit 14	Mainline between Exit 14 On/Off Ramps	Basic	25	54	C
			Mainline between Exit 14 and Exit 13	Weaving	21	55	C
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	21	54	C
			Exit 13 SB On-Ramp	Merge	17	55	B
			Mainline Between Exit 13 and Exit 12	Basic	18	56	B
		Exit 12	Exit 12 SB Off-Ramp	Diverge	18	53	B
			Mainline between Exit 12 Off/On-Ramps	Basic	22	54	C
			Exit 12 SB On-Ramp	Merge	22	52	C
			Mainline between Exit 12 and I-89	Diverge	24	53	C
		I-89	Mainline between I-93 Off/On-Ramps from I-89	Basic	15	58	B
			I-93 On-Ramp from I-89 SB	Merge	14	66	B
			Mainline South of I-89 SB On-Ramp	Basic	21	62	C
	Northbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	15	57	B
			Exit 15 NB On-Ramp	Merge	11	58	B
			Mainline between Exit 15 On/Off -Ramps	Basic	8	60	A
			Exit 15 Weave	Weaving	9	52	A
			Mainline between Exit 15 Off/On-Ramps	Basic	10	57	A
			Exit 14 to Exit 15 Weave	Weaving	12	53	B
		Exit 14	Mainline between Exit 14 Off/On Ramps	Basic	15	53	B
			Mainline between Exit 13 and Exit 14	Weaving	17	53	B
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	21	51	C
			Exit 13 NB Off-Ramp	Diverge	23	53	C
			Mainline Between Exit 12 and Exit 13	Basic	22	54	C
		Exit 12	Exit 12 NB On-Ramp	Merge	22	54	C
			Mainline between Exit 12 Off/On-Ramps	Basic	26	53	C
			Mainline between I-89 and Exit 12	Weaving	21	52	C
		I-89	Mainline between Off/On Ramps to I-89	Basic	18	54	B
			I-93 NB Off-Ramp to I-89NB	Diverge	25	63	C
			I-93 NB CD Road at I-89 Ramps Weave	Weaving	45	30	E
I-89	Southbound	Exit 2	Mainline North of Exit 2	Basic	27	63	D
			Exit 2 SB Off-Ramp	Diverge	26	56	C
			Mainline between Exit 2 Off/On-Ramps	Basic	20	63	C
			Exit 2 SB On-Ramp	Merge	37	50	E
			Mainline between Exit 2 and Exit 1	Basic	31	51	D
		Exit 1	Exit 1 SB Off-Ramp	Diverge	43	34	E
			Mainline between Exit 1 Off/On-Ramps	Basic	42	38	E
			Exit 1 SB On-Ramp to I-93 SB On-Ramp Weave	Weaving	32	40	D
			I-89 SB Off-Ramp to I-93 NB	Diverge	28	40	C
	Northbound	Exit 2	Mainline North of Exit 2	Basic	11	68	B
			Exit 2 NB On-Ramp	Merge	10	69	B
			Mainline between Exit 2 Off/On-Ramps	Basic	10	68	A
			Mainline between Exit 1 and Exit 2	Diverge	15	65	B
		Exit 1	Exit 1 NB On-Ramp	Merge	13	66	B
			Mainline between Exit 1 Off/On-Ramps	Basic	14	66	B
			I-93 SB Off-Ramp to Exit 1 NB Off-Ramp Weave	Weaving	12	61	B
			I-93 NB Off-Ramp to I-89 NB	Merge	11	54	B
I-393	Eastbound	I-93	I-93 On/Off-Ramp Weave	Weaving	9	49	A
			Mainline Between I-93 NB On-Ramp and I-93 NB Off-Ramp	Basic	11	57	A
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	12	55	B
			Mainline between Exit 1 Off/On-Ramps	Basic	15	55	B
			Exit 1 On-Ramp	Merge	15	54	B
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	15	55	B
			Exit 2 Off-Ramp	Diverge	16	53	B
			Mainline Between Exit 2 Off/On-Ramps	Basic	9	59	A
			Exit 2 On-Ramp	Merge	9	60	A
			Mainline East of Exit 2	Basic	10	58	A
	Westbound	I-93	I-93 Off/On-Ramp Weave	Weaving	33	39	D
			Mainline Between I-93 SB Off-Ramp and I-93 SB On-Ramp	Basic	38	44	E
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	26	46	C
			Mainline between Exit 1 Off/On-Ramps	Basic	39	45	E
			Exit 1 Off-Ramp	Diverge	33	50	D
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	37	48	E
			Exit 2 On-Ramp	Merge	36	39	E
			Mainline Between Exit 2 On/Off-Ramps	Basic	30	50	D
			Exit 2 Off-Ramp	Diverge	32	54	D

Scenario A

Road	Direction	Locaton	Description	Type	2035 PM Segment Density (veh/mi/ln)	2035 PM Speed (mph)	2035 PM LOS
I-93	Southbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	22	56	C
I-93	Southbound	Exit 15	3-Lane Mainline North of Exit 15	Diverge	14	56	B
I-93	Southbound	Exit 15	Mainline between Exit 15 Off/On -Ramps	Basic	13	56	B
I-93	Southbound	Exit 15	Exit 15 Weave	Weaving	18	48	B
I-93	Southbound	Exit 15	Mainline between Exit 15 Off/On-Ramps	Basic	19	55	C
I-93	Southbound	Exit 15	Exit 15 to Exit 14 Weave	Weaving	18	54	B
I-93	Southbound	Exit 14	Mainline between Exit 14 On/Off Ramps	Basic	18	56	C
I-93	Southbound	Exit 14	Mainline between Exit 14 and Exit 13	Weaving	19	54	B
I-93	Southbound	Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	20	54	C
I-93	Southbound	Exit 13	Exit 13 SB On-Ramp	Merge	22	52	C
I-93	Southbound	Exit 13	Mainline Between Exit 13 and Exit 12	Basic	21	53	C
I-93	Southbound	Exit 12	Exit 12 SB Off-Ramp	Diverge	21	52	C
I-93	Southbound	Exit 12	Mainline between Exit 12 Off/On-Ramps	Basic	29	49	D
I-93	Southbound	Exit 12	Exit 12 SB On-Ramp	Merge	32	45	D
I-93	Southbound	Exit 12	Mainline between Exit 12 and I-89	Diverge	34	50	D
I-93	Southbound	I-89	Mainline between I-93 Off/On-Ramps from I-89	Basic	17	58	B
I-93	Southbound	I-89	I-93 On-Ramp from I-89 SB	Merge	15	65	B
I-93	Southbound	I-89	Mainline South of I-89 SB On-Ramp	Basic	22	62	C
I-93	Northbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	40	49	E
I-93	Northbound	Exit 15	Exit 15 NB On-Ramp	Merge	32	51	D
I-93	Northbound	Exit 15	Mainline between Exit 15 On/Off -Ramps	Basic	18	56	C
I-93	Northbound	Exit 15	Exit 15 Weave	Weaving	17	54	B
I-93	Northbound	Exit 15	Mainline between Exit 15 Off/On-Ramps	Basic	19	56	C
I-93	Northbound	Exit 15	Exit 14 to Exit 15 Weave	Weaving	24	49	C
I-93	Northbound	Exit 14	Mainline between Exit 14 Off/On Ramps	Basic	26	52	C
I-93	Northbound	Exit 14	Mainline between Exit 13 and Exit 14	Weaving	28	49	D
I-93	Northbound	Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	27	51	D
I-93	Northbound	Exit 13	Exit 13 NB Off-Ramp	Diverge	21	54	C
I-93	Northbound	Exit 13	Mainline Between Exit 12 and Exit 13	Basic	24	55	C
I-93	Northbound	Exit 12	Exit 12 NB On-Ramp	Merge	21	54	C
I-93	Northbound	Exit 12	Mainline between Exit 12 Off/On-Ramps	Basic	26	53	D
I-93	Northbound	Exit 12	Mainline between I-89 and Exit 12	Weaving	21	53	C
I-93	Northbound	I-89	Mainline between Off/On Ramps to I-89	Basic	20	55	C
I-93	Northbound	I-89	I-93 NB Off-Ramp to I-89NB	Diverge	29	62	D
I-93	Northbound	I-89	I-93 NB CD Road at I-89 Ramps Weave	Weaving	47	28	F
I-89	Southbound	Exit 2	Mainline North of Exit 2	Basic	23	65	C
I-89	Southbound	Exit 2	Exit 2 SB Off-Ramp	Diverge	21	60	C
I-89	Southbound	Exit 2	Mainline between Exit 2 Off/On-Ramps	Basic	20	63	C
I-89	Southbound	Exit 2	Exit 2 SB On-Ramp	Merge	30	55	D
I-89	Southbound	Exit 2	Mainline between Exit 2 and Exit 1	Basic	26	51	D
I-89	Southbound	Exit 1	Exit 1 SB Off-Ramp	Diverge	35	35	E
I-89	Southbound	Exit 1	Mainline between Exit 1 Off/On-Ramps	Basic	35	37	E
I-89	Southbound	Exit 1	Exit 1 SB On-Ramp to I-93 SB On-Ramp Weave	Weaving	25	41	C
I-89	Southbound	Exit 1	I-89 SB Off-Ramp to I-93 NB	Diverge	20	40	C
I-89	Northbound	Exit 2	Mainline North of Exit 2	Basic	20	65	C
I-89	Northbound	Exit 2	Exit 2 NB On-Ramp	Merge	19	64	B
I-89	Northbound	Exit 2	Mainline between Exit 2 Off/On-Ramps	Basic	18	66	B
I-89	Northbound	Exit 2	Mainline between Exit 1 and Exit 2	Diverge	24	63	C
I-89	Northbound	Exit 1	Exit 1 NB On-Ramp	Merge	20	63	C
I-89	Northbound	Exit 1	Mainline between Exit 1 Off/On-Ramps	Basic	22	64	C
I-89	Northbound	Exit 1	I-93 SB Off-Ramp to Exit 1 NB Off-Ramp Weave	Weaving	19	58	B
I-89	Northbound	Exit 1	I-93 NB Off-Ramp to I-89 NB	Merge	16	55	B
I-393	Eastbound	I-93	I-93 On/Off-Ramp Weave	Weaving	17	49	B
I-393	Eastbound	I-93	Mainline Between I-93 NB On-Ramp and I-93 NB Off-Ramp	Basic	18	56	B
I-393	Eastbound	Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	20	53	C
I-393	Eastbound	Exit 1	Mainline between Exit 1 Off/On-Ramps	Basic	27	53	D
I-393	Eastbound	Exit 1	Exit 1 On-Ramp	Merge	30	46	D
I-393	Eastbound	Exit 2	Mainline Between Exit 1 and Exit 2	Basic	30	52	D
I-393	Eastbound	Exit 2	Exit 2 Off-Ramp	Diverge	31	52	D
I-393	Eastbound	Exit 2	Mainline Between Exit 2 Off/On-Ramps	Basic	24	55	C
I-393	Eastbound	Exit 2	Exit 2 On-Ramp	Merge	26	53	C
I-393	Eastbound	Exit 2	Mainline East of Exit 2	Basic	29	53	D
I-393	Westbound	I-93	I-93 Off/On-Ramp Weave	Weaving	22	39	C
I-393	Westbound	I-93	Mainline Between I-93 SB Off-Ramp and I-93 SB On-Ramp	Basic	23	48	C
I-393	Westbound	Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	21	48	C
I-393	Westbound	Exit 1	Mainline between Exit 1 Off/On-Ramps	Basic	25	48	C
I-393	Westbound	Exit 1	Exit 1 Off-Ramp	Diverge	24	50	C
I-393	Westbound	Exit 2	Mainline Between Exit 1 and Exit 2	Basic	28	46	D
I-393	Westbound	Exit 2	Exit 2 On-Ramp	Merge	28	36	C
I-393	Westbound	Exit 2	Mainline Between Exit 2 On/Off-Ramps	Basic	16	52	B
I-393	Westbound	Exit 2	Exit 2 Off-Ramp	Diverge	16	57	B

Scenario B

	Direction	Locaton	Description	Type	2035 AM Segment Density (veh/mi/ln)	Speed (mph)	LOS
I-93	Southbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	75	30	F
			3-Lane Mainline North of Exit 15	Diverge	28	54	C
			Mainline adjacent to CD Road at Exit 15	Basic	22	55	C
		Exit 14	CD Road/Mainline Merge	Merge	22	53	C
			Mainline between CD Road Merge and Exit 14 SB On-Ramp	Basic	26	53	D
			Exit 14 SB On-Ramp to Exit 13 SB Off-Ramp Weave	Weaving	21	55	C
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	20	55	C
			Exit 13 SB On-Ramp	Merge	26	50	C
			Mainline Between Exit 13 and Exit 12	Basic	25	52	C
		Exit 12	Exit 12 SB Off-Ramp	Diverge	17	54	B
			Mainline between Exit 12 SB Off/On-Ramps	Basic	21	55	C
			Exit 12 SB On-Ramp to I-93 SB Off-Ramp to I-89 NB Weave	Weaving	16	55	B
		I-89	Mainline between I-93 Off/On-Ramps from I-89	Basic	15	58	B
			I-93 On-Ramp from I-89 SB	Merge	14	65	B
			Mainline South of I-89 SB On-Ramp	Basic	21	62	C
	Northbound	Exit 15	3-Lane Mainline North of Exit 15	Basic	10	58	A
			CD Road/Mainline Merge	Merge	9	58	A
			Mainline adjacent to CD Road at Exit 15	Basic	8	58	A
		Exit 14	Mainline between Exit 14 NB Off-Ramp and CD Road	Diverge	17	56	B
			Exit 13 NB On-Ramp to Exit 14 NB Off-Ramp Weave	Weaving	18	52	B
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	19	54	C
			Exit 13 SB Off-Ramp	Diverge	40	45	E
			Mainline Between Exit 13 and Exit 12	Basic	36	42	E
		Exit 12	Exit 12 NB On-Ramp	Merge	36	44	E
			Mainline between Exit 12 Off/On-Ramps	Basic	27	50	D
			Exit 12 NB Off-Ramp	Weaving	22	53	C
		I-89	Mainline between Off/On Ramps to I-89	Basic	17	55	B
			Mainline South of I-89 NB Off-Ramp	Diverge	25	63	C
			I-93 NB CD Road at I-89 Ramps Weave	Weaving	29	34	D
I-89	Southbound	Exit 2	Mainline North of Exit 2	Basic	28	63	D
			Exit 2 SB Off-Ramp	Diverge	26	56	C
			Mainline between Exit 2 Off/On-Ramps	Basic	20	64	C
			Exit 2 SB On-Ramp	Merge	30	53	D
			Mainline between Exit 1 and Exit 2	Basic	30	52	D
		Exit 1	Exit 1 SB Off-Ramp to CD Road	Diverge	31	47	D
			CD Road between Exit 1 Off/On-Ramps	Basic	39	37	E
			I-89 SB to I-93 NB On-Ramp	Merge	30	35	D
	Northbound	Exit 2	Mainline North of Exit 2	Basic	11	67	B
			Exit 2 NB On-Ramp	Merge	11	67	B
			Mainline between Exit 2 Off/On-Ramps	Basic	11	67	A
			Mainline between Exit 1 and Exit 2	Diverge	15	64	B
		Exit 1	CD Road On-Ramp	Merge	14	57	B
			2-Lane Mainline from I-93 NB off-Ramp to I-89 NB	Basic	6	67	A
I-393	Eastbound	I-93	I-93 On/Off-Ramp Weave	Weaving	9	49	A
			Mainline Between I-93 NB On-Ramp and I-93 NB Off-Ramp	Basic	11	57	A
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	12	56	B
			Mainline between Exit 1 Off/On-Ramps	Basic	15	55	B
			Exit 1 On-Ramp	Merge	15	54	B
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	15	55	B
			Exit 2 Off-Ramp	Diverge	16	53	B
			Mainline Between Exit 2 Off/On-Ramps	Basic	9	59	A
			Exit 2 On-Ramp	Merge	9	60	A
			Mainline East of Exit 2	Basic	10	58	A
	Westbound	I-93	I-93 Off/On-Ramp Weave	Weaving	32	39	D
			Mainline Between I-93 SB Off-Ramp and I-93 SB On-Ramp	Basic	38	44	E
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	27	44	C
			Mainline between Exit 1 Off/On-Ramps	Basic	42	41	E
			Exit 1 Off-Ramp	Diverge	33	48	D
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	38	48	E
			Exit 2 On-Ramp	Merge	37	38	E
			Mainline Between Exit 2 On/Off-Ramps	Basic	30	50	D
			Exit 2 Off-Ramp	Diverge	33	54	D
I-93 CD	Southbound	Exit 14 & 15	Off-Ramp to CD Road	Diverge	21	49	C
			CD Road Exit 15 SB Off-Ramp to Exit 15 SB On-Ramp	Basic	11	51	A
			Exit 15 Weave	Weaving	20	41	C
			CD Road Exit 15 SB Off-Ramp to Exit 15 SB On-Ramp	Basic	17	54	B
			Exit 15 SB On-Ramp to Exit 14 SB Off-Ramp Weave	Weaving	14	54	B
			CD Road Between Exit 14 Off/On-Ramps	Basic	14	57	B
	Northbound	Exit 14 & 15	CD Road between Exit 15 NB On-Ramp and I-93 NB	Merge	7	58	A
			CD Road Exit 15 NB Off-Ramp to Exit 15 NB On-Ramp	Basic	4	60	A
			Exit 15 Weave	Weaving	7	47	A
			CD Road Exit 15 NB Off-Ramp to Exit 15 NB On-Ramp	Basic	7	58	A
			Exit 14 NB On-Ramp to Exit 15 NB Off-Ramp Weave	Weaving	10	53	A
			CD Road Between Exit 14 Off/On-Ramps	Basic	13	53	B
I-89 CD	Northbound	Exit 1	I-89 NB CD Road to Mainline	Merge	16	55	B
			CD Road between Exit 1 Off/On-Ramps	Basic	17	55	B
			CD Road between I-93 SB Off-Ramp and Exit 1 Off-Ramp	Diverge	10	53	A

Scenario B

Facility	Direction	Locaton	Description	Type	2035 PM Segment Density (veh/mi/ln)	2035 PM Speed (mph)	2035 PM LOS
I-93	Southbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	22	56	C
			3-Lane Mainline North of Exit 15	Diverge	13	59	B
			Mainline adjacent to CD Road at Exit 15	Basic	14	57	B
		Exit 14	CD Road/Mainline Merge	Merge	18	55	B
			Mainline between CD Road Merge and Exit 14 SB On-Ramp	Basic	20	55	C
			Exit 14 SB On-Ramp to Exit 13 SB Off-Ramp Weave	Weaving	18	56	B
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	20	54	C
			Exit 13 SB On-Ramp	Merge	37	36	E
			Mainline Between Exit 13 and Exit 12	Basic	32	48	D
		Exit 12	Exit 12 SB Off-Ramp	Diverge	20	54	B
			Mainline between Exit 12 SB Off/On-Ramps	Basic	26	53	D
			Exit 12 SB On-Ramp to I-93 SB Off-Ramp to I-89 NB Weave	Weaving	23	52	C
		I-89	Mainline between I-93 Off/On-Ramps from I-89	Basic	17	58	B
			I-93 On-Ramp from I-89 SB	Merge	15	65	B
			Mainline South of I-89 SB On-Ramp	Basic	22	62	C
	Northbound	Exit 15	3-Lane Mainline North of Exit 15	Basic	25	54	C
			CD Road/Mainline Merge	Merge	26	52	C
			Mainline adjacent to CD Road at Exit 15	Basic	16	56	B
		Exit 14	Mainline between Exit 14 NB Off-Ramp and CD Road	Diverge	27	55	C
			Exit 13 NB On-Ramp to Exit 14 NB Off-Ramp Weave	Weaving	25	52	C
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	25	54	C
			Exit 13 SB Off-Ramp	Diverge	32	52	D
			Mainline Between Exit 13 and Exit 12	Basic	33	52	D
		Exit 12	Exit 12 NB On-Ramp	Merge	29	51	D
			Mainline between Exit 12 Off/On-Ramps	Basic	27	53	D
			Exit 12 NB Off-Ramp	Weaving	21	54	C
		I-89	Mainline between Off/On Ramps to I-89	Basic	19	55	C
			Mainline South of I-89 NB Off-Ramp	Diverge	30	62	D
			I-93 NB CD Road at I-89 Ramps Weave	Weaving	22	35	C
I-89	Southbound	Exit 2	Mainline North of Exit 2	Basic	23	65	C
			Exit 2 SB Off-Ramp	Diverge	22	60	C
			Mainline between Exit 2 Off/On-Ramps	Basic	19	64	C
			Exit 2 SB On-Ramp	Merge	25	56	C
			Mainline between Exit 1 and Exit 2	Basic	25	54	C
		Exit 1	Exit 1 SB Off-Ramp to CD Road	Diverge	26	48	C
			CD Road between Exit 1 Off/On-Ramps	Basic	32	38	D
			I-89 SB to I-93 NB On-Ramp	Merge	23	37	C
	Northbound	Exit 2	Mainline North of Exit 2	Basic	20	64	C
			Exit 2 NB On-Ramp	Merge	19	63	B
			Mainline between Exit 2 Off/On-Ramps	Basic	18	65	B
			Mainline between Exit 1 and Exit 2	Diverge	24	62	C
		Exit 1	CD Road On-Ramp	Merge	23	51	C
			2-Lane Mainline from I-93 NB off-Ramp to I-89 NB	Basic	9	66	A
I-393	Eastbound	I-93	I-93 On/Off-Ramp Weave	Weaving	18	49	B
			Mainline Between I-93 NB On-Ramp and I-93 NB Off-Ramp	Basic	19	56	C
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	21	53	C
			Mainline between Exit 1 Off/On-Ramps	Basic	27	53	D
			Exit 1 On-Ramp	Merge	31	47	D
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	30	53	D
			Exit 2 Off-Ramp	Diverge	31	52	D
			Mainline Between Exit 2 Off/On-Ramps	Basic	25	55	C
			Exit 2 On-Ramp	Merge	27	53	C
			Mainline East of Exit 2	Basic	29	53	D
	Westbound	I-93	I-93 Off/On-Ramp Weave	Weaving	20	41	C
			Mainline Between I-93 SB Off-Ramp and I-93 SB On-Ramp	Basic	21	50	C
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	20	49	C
			Mainline between Exit 1 Off/On-Ramps	Basic	24	49	C
			Exit 1 Off-Ramp	Diverge	24	51	C
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	28	46	D
			Exit 2 On-Ramp	Merge	27	37	C
			Mainline Between Exit 2 On/Off-Ramps	Basic	17	52	B
			Exit 2 Off-Ramp	Diverge	16	57	B
I-93 CD	Southbound	Exit 14 & 15	Off-Ramp to CD Road	Diverge	8	54	A
			CD Road Exit 15 SB Off-Ramp to Exit 15 SB On-Ramp	Basic	6	54	A
			Exit 15 Weave	Weaving	12	45	B
			CD Road Exit 15 SB Off-Ramp to Exit 15 SB On-Ramp	Basic	13	56	B
			Exit 15 SB On-Ramp to Exit 14 SB Off-Ramp Weave	Weaving	12	56	B
			CD Road Between Exit 14 Off/On-Ramps	Basic	14	57	B
	Northbound	Exit 14 & 15	CD Road between Exit 15 NB On-Ramp and I-93 NB	Merge	18	53	B
			CD Road Exit 15 NB Off-Ramp to Exit 15 NB On-Ramp	Basic	12	58	B
			Exit 15 Weave	Weaving	11	51	B
			CD Road Exit 15 NB Off-Ramp to Exit 15 NB On-Ramp	Basic	11	58	B
			Exit 14 NB On-Ramp to Exit 15 NB Off-Ramp Weave	Weaving	18	50	B
			CD Road Between Exit 14 Off/On-Ramps	Basic	21	52	C
I-89 CD	Northbound	Exit 1	I-89 NB CD Road to Mainline	Merge	29	49	D
			CD Road between Exit 1 Off/On-Ramps	Basic	29	54	D
			CD Road between I-93 SB Off-Ramp and Exit 1 Off-Ramp	Diverge	18	51	B

Scenario C

	Direction	Locaton	Description	Type	2035 AM Segment Density (veh/mi/ln)	2035 AM Speed (mph)	2035 AM LOS
I-93	Southbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	57	40	F
			3-Lane Mainline North of Exit 15	Diverge	31	55	D
			Mainline between Exit 15 Off-Ramps	Basic	18	57	B
			Exit 15 SB Off-Ramp (to 393 EB)	Diverge	14	53	B
			Mainline between Exit 15 Off/On-Ramps	Basic	15	57	B
			Exit 15 SB On-Ramp	Merge	21	47	C
			Mainline between Exit 15 and 14	Basic	28	54	D
		Exit 14	Exit 14 On-Ramp	Merge	19	56	B
		Exit 13	Exit 13 Off-Ramp	Diverge	20	55	C
			Mainline between Exit 13 Off/On-Ramps	Basic	21	54	C
			Exit 13 On-Ramp	Merge	18	55	B
			Mainline between Exit 12 and Exit 13	Basic	18	55	B
		Exit 12	Exit 12 Off-Ramp	Diverge	18	54	B
			Mainline between Exit 12 Off/On-Ramps	Basic	20	54	C
			Exit 12 On-Ramp	Weaving	17	55	B
		I-89	Mainline between I-89 Off/On-ramps	Basic	15	58	B
			I-89 On-Ramp	Merge	15	65	B
			4-Lane Mainline South of I-89	Basic	20	63	C
	Northbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	15	56	B
			Exit 15 On-Ramp	Merge	13	56	B
			Mainline between Exit 15 Off/On-Ramps	Basic	10	58	A
			Exit 15 Off-Ramp (to 393 WB)	Diverge	9	54	A
			Exit 14 to 15 Weave	Weaving	12	55	B
		Exit 14	Mainline between Exit 14 Off/On-Ramps	Basic	16	53	B
			Exit 13 to Exit 14 Weave	Weaving	21	50	C
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	21	50	C
			Exit 13 Off-Ramp	Diverge	23	53	C
			Mainline between Exit 12 and Exit 13	Basic	21	54	C
		Exit 12	Exit 12 On-Ramp	Merge	22	54	C
			Mainline between Exit 12 Off/On-Ramps	Basic	26	52	D
			Exit 12 Off-Ramp	Weaving	22	53	C
		I-89	Mainline between I-89 Off/On-Ramps	Basic	18	56	B
			I-89 Off-Ramp	Diverge	24	59	C
			3-Lane Mainlin South of I-89	Basic	20	64	C
I-89	Southbound	Exit 2	Mainline North of Exit 2	Basic	28	63	D
			Exit 12 Off-Ramp	Diverge	26	56	C
			Mainline between Exit 2 Off/On-Ramps	Basic	20	64	C
			Exit 2 On-Ramp	Merge	31	52	D
			Mainline between Exit 2 and Exit 1	Basic	30	52	D
		Exit 1	Exit 1 Off-Ramp	Diverge	31	47	D
			Mainline between Exit 1 and I-93	Basic	38	37	E
			Exit 1 On-Ramp	Merge	22	37	C
	Northbound	Exit 2	Mainlin North of Exit 2	Basic	11	67	B
			Exit 2 On-Ramp	Merge	11	66	B
			Mainline between Exit 1 and Exit 2	Basic	11	67	A
			Exit 2 Off-Ramp	Diverge	15	65	B
		Exit 1	Exit 1 On-Ramp	Merge	13	65	B
			I-93 On-Ramp	Merge	13	65	B
			between Exit 1 off and on ramps	Basic	16	61	B
			Exit 1 Off-Ramp	Diverge	10	54	A
I-393	Eastbound	I-93	I-93 On-Ramp	Merge	8	48	A
			Mainline between I-93 On-Ramps	Basic	11	57	A
			I-93 to Exit 1 Weave	Weaving	12	56	B
		Exit 1	Mainline between Exit 1 Off/On-Ramps	Basic	14	56	B
			Exit 1 On-Ramp	Merge	15	55	B
			Mainline between Exit 1 and Exit 2	Basic	15	55	B
		Exit 2	Exit 2 Off-Ramp	Diverge	16	53	B
			Mainline between Exit 2 Off/On-Ramps	Basic	8	60	A
			Exit 2 On-Ramp	Merge	9	60	A
			Mainline East of Exit 2	Basic	9	58	A
	Westbound	I-93	I-93 On-Ramp	Merge	30	44	D
			Mainline between I-93 Off/On-Ramps	Basic	34	47	D
			Exit 1 to I-93 Weave	Weaving	25	49	C
		Exit 1	Mainline between Exit 1 Off/On-Ramps	Basic	33	52	D
			Exit 1 Off-Ramp	Diverge	32	53	D
			Mainline between Exit 1 and Exit 2	Basic	36	50	E
		Exit 2	Exit 2 On-Ramp	Merge	34	40	D
			Mainline between Exit 2 Off/On-Ramps	Basic	30	50	D
			Mainline East of Exit 2	Diverge	33	54	D

Scenario C

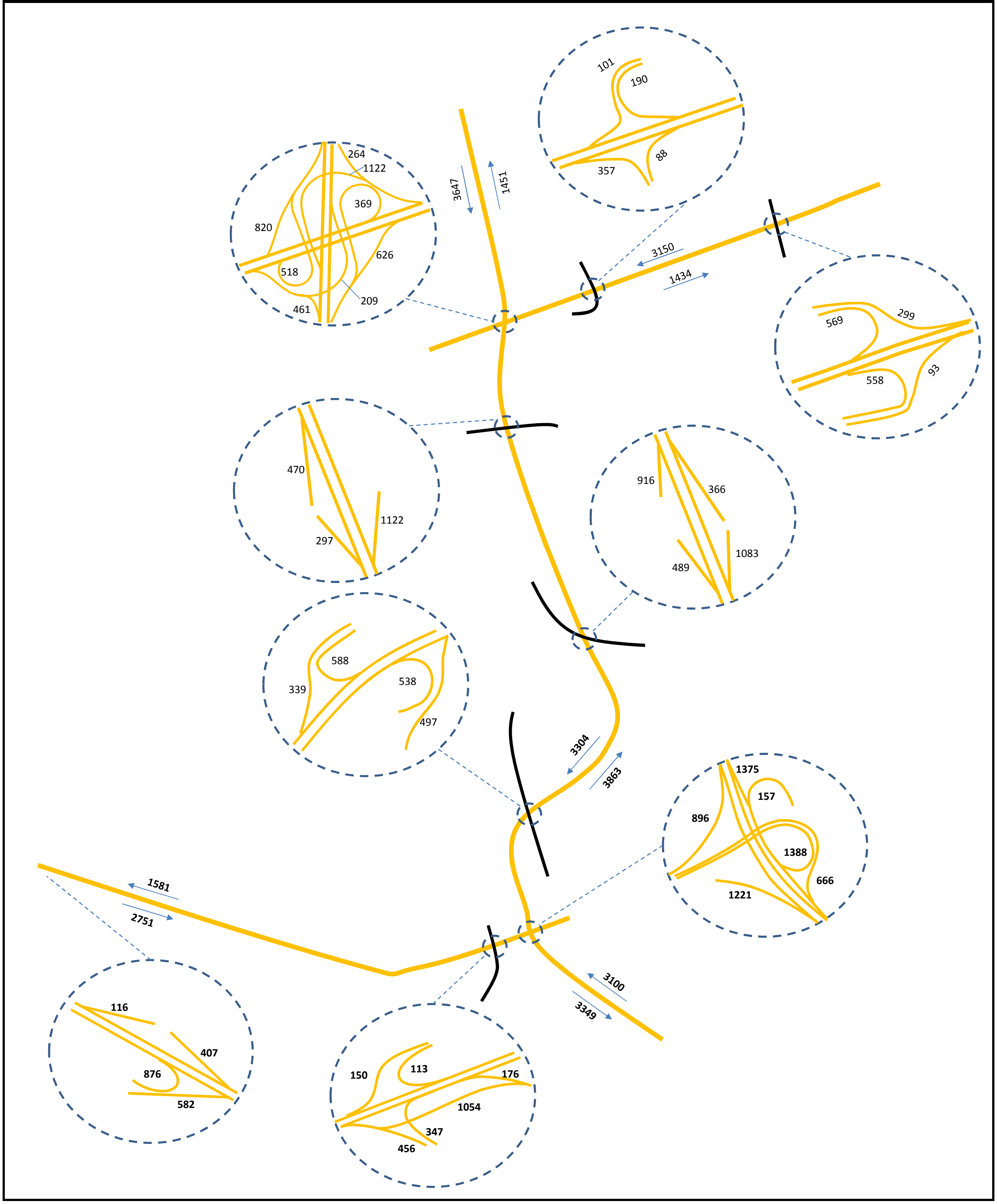
Road	Direction	Locaton	Description	Type	2035 PM Segment Density (veh/mi/ln)	2035 PM Speed (mph)	2035 PM LOS
I-93	Southbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	22	57	C
			3-Lane Mainline North of Exit 15	Diverge	15	58	B
			Mainline between Exit 15 Off-Ramps	Basic	11	59	B
			Exit 15 SB Off-Ramp (to 393 EB)	Diverge	8	56	A
			Mainline between Exit 15 Off/On-Ramps	Basic	10	58	A
			Exit 15 SB On-Ramp	Merge	13	53	B
			Mainline between Exit 15 and 14	Basic	22	56	C
		Exit 14	Exit 14 On-Ramp	Merge	18	56	B
		Exit 13	Exit 13 Off-Ramp	Diverge	18	55	B
			Mainline between Exit 13 Off/On-Ramps	Basic	19	54	C
			Exit 13 On-Ramp	Merge	24	51	C
			Mainline between Exit 12 and Exit 13	Basic	22	52	C
		Exit 12	Exit 12 Off-Ramp	Diverge	21	53	C
			Mainline between Exit 12 Off/On-Ramps	Basic	26	52	D
			Exit 12 On-Ramp	Weaving	23	52	C
		I-89	Mainline between I-89 Off/On-ramps	Basic	17	58	B
			I-89 On-Ramp	Merge	15	64	B
			4-Lane Mainline South of I-89	Basic	21	63	C
	Northbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	38	48	E
			Exit 15 On-Ramp	Merge	43	36	E
			Mainline between Exit 15 Off/On-Ramps	Basic	22	53	C
			Exit 15 Off-Ramp (to 393 WB)	Diverge	11	55	B
			Exit 14 to 15 Weave	Weaving	21	53	C
		Exit 14	Mainline between Exit 14 Off/On-Ramps	Basic	25	52	C
			Exit 13 to Exit 14 Weave	Weaving	25	52	C
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	26	52	D
			Exit 13 Off-Ramp	Diverge	21	54	C
			Mainline between Exit 12 and Exit 13	Basic	24	54	C
		Exit 12	Exit 12 On-Ramp	Merge	21	54	C
			Mainline between Exit 12 Off/On-Ramps	Basic	26	53	D
			Exit 12 Off-Ramp	Weaving	22	53	C
		I-89	Mainline between I-89 Off/On-Ramps	Basic	19	56	C
			I-89 Off-Ramp	Diverge	27	58	C
			3-Lane Mainlin South of I-89	Basic	23	63	C
I-89	Southbound	Exit 2	Mainline North of Exit 2	Basic	23	65	C
			Exit 12 Off-Ramp	Diverge	22	59	C
			Mainline between Exit 2 Off/On-Ramps	Basic	20	64	C
			Exit 2 On-Ramp	Merge	25	56	C
			Mainline between Exit 2 and Exit 1	Basic	25	54	C
		Exit 1	Exit 1 Off-Ramp	Diverge	26	48	C
			Mainline between Exit 1 and I-93	Basic	33	37	D
			Exit 1 On-Ramp	Merge	18	38	B
	Northbound	Exit 2	Mainlin North of Exit 2	Basic	20	64	C
			Exit 2 On-Ramp	Merge	20	63	B
			Mainline between Exit 1 and Exit 2	Basic	18	64	C
			Exit 2 Off-Ramp	Diverge	24	62	C
		Exit 1	Exit 1 On-Ramp	Merge	22	59	C
			I-93 On-Ramp	Merge	21	62	C
			between Exit 1 off and on ramps	Basic	26	59	D
			Exit 1 Off-Ramp	Diverge	17	52	B
I-393	Eastbound	I-93	I-93 On-Ramp	Merge	13	54	B
			Mainline between I-93 On-Ramps	Basic	18	57	C
			I-93 to Exit 1 Weave	Weaving	20	54	B
		Exit 1	Mainline between Exit 1 Off/On-Ramps	Basic	27	53	D
			Exit 1 On-Ramp	Merge	31	47	D
			Mainline between Exit 1 and Exit 2	Basic	31	53	D
		Exit 2	Exit 2 Off-Ramp	Diverge	32	52	D
			Mainline between Exit 2 Off/On-Ramps	Basic	24	55	C
			Exit 2 On-Ramp	Merge	27	53	C
			Mainline East of Exit 2	Basic	29	53	D
	Westbound	I-93	I-93 On-Ramp	Merge	13	49	B
			Mainline between I-93 Off/On-Ramps	Basic	14	56	B
			Exit 1 to I-93 Weave	Weaving	27	39	C
		Exit 1	Mainline between Exit 1 Off/On-Ramps	Basic	26	47	C
			Exit 1 Off-Ramp	Diverge	24	51	C
			Mainline between Exit 1 and Exit 2	Basic	28	47	D
		Exit 2	Exit 2 On-Ramp	Merge	27	36	C
			Mainline between Exit 2 Off/On-Ramps	Basic	16	51	B
			Mainline East of Exit 2	Diverge	16	57	B

Scenario D (Preferred Alternative) Model Results

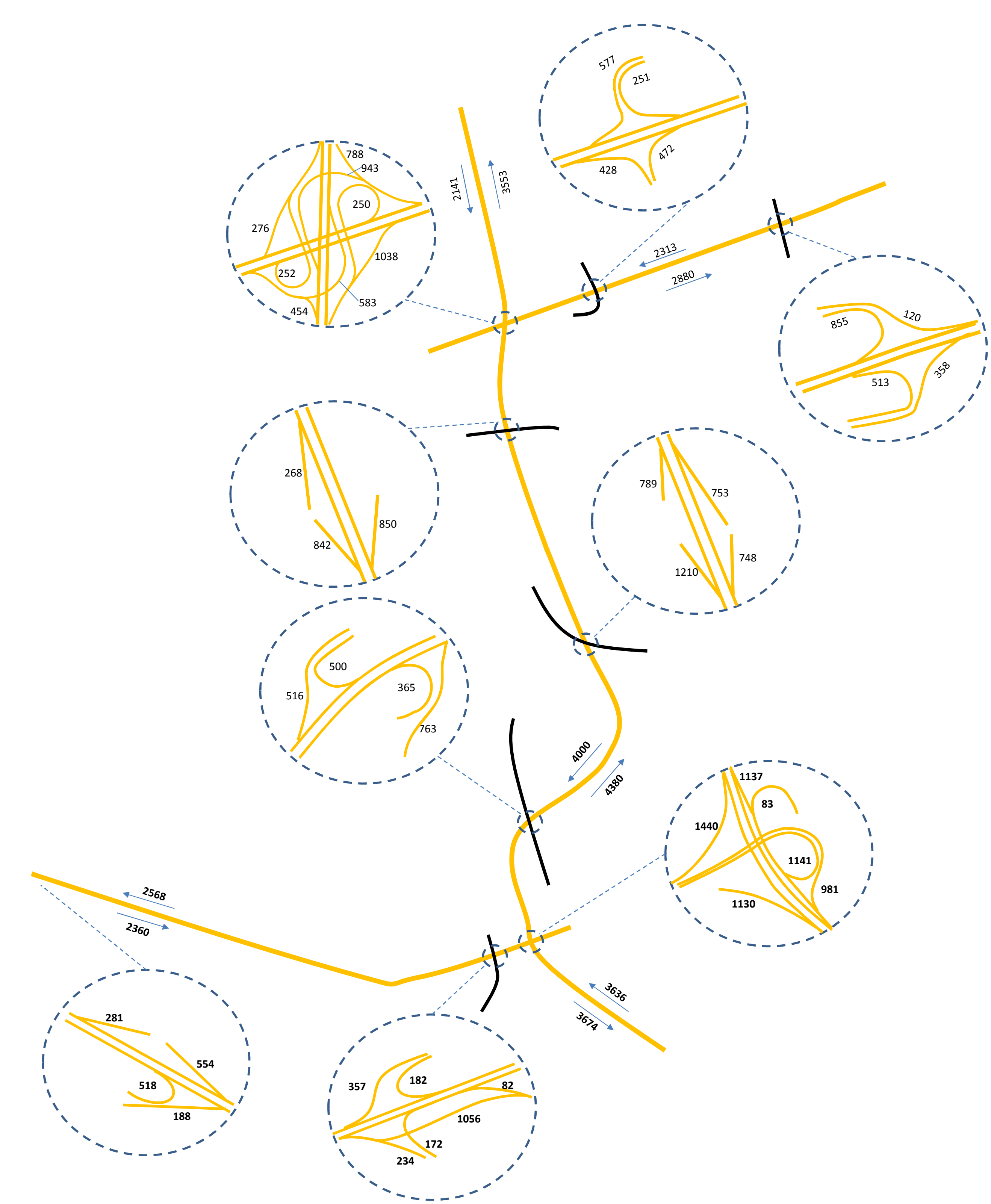
November 2017

Prepared by RSG

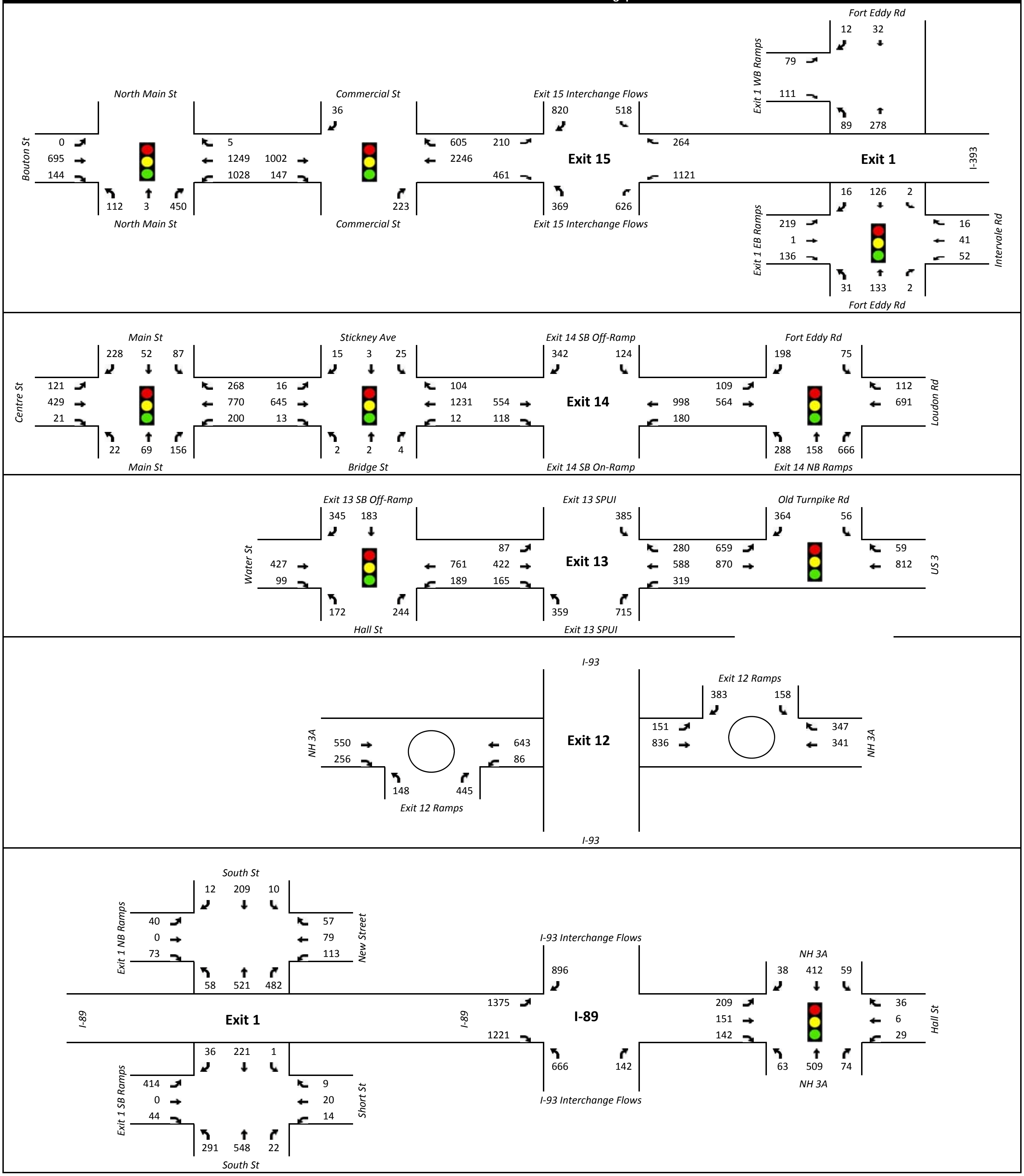
Scenario D - 2035 AM Peak Hour Traffic Volumes - Model Throughput



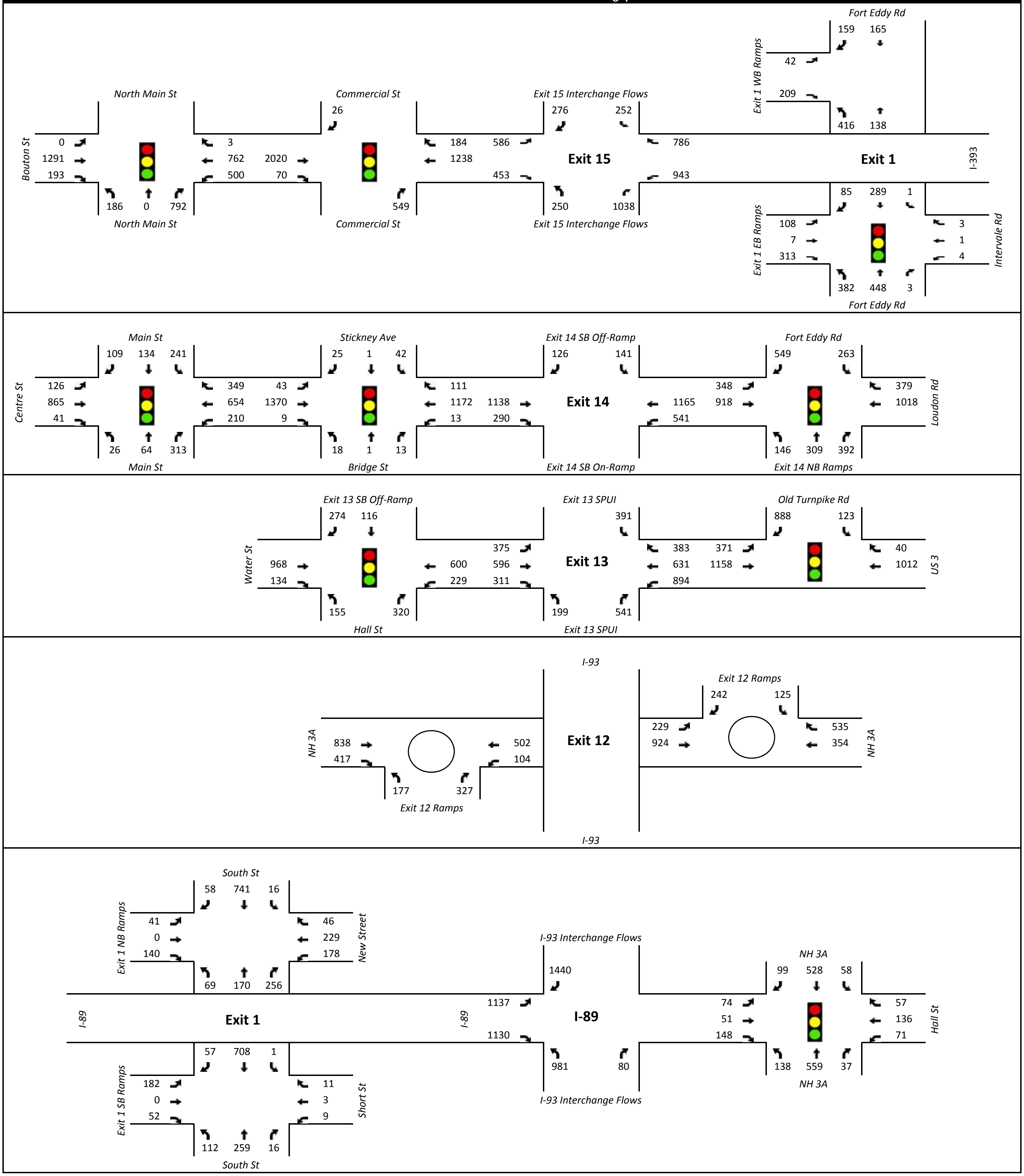
Scenario D - 2035 PM Peak Hour Traffic Volumes - Model Throughput



Scenario D - 2035 AM Peak Hour Model Throughput



Scenario D - 2035 PM Peak Hour Model Throughput



Scenario D

	Direction	Locaton	Description	Type	Segment Density (veh/mi/ln)	Speed (mph)	LOS
					2035 AM		
I-93	Southbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	81	27	F
			Exit 15 SB Off-Ramps	Diverge	26	55	C
			Mainline adjacent to CD Road at Exit 15	Basic	21	56	C
		Exit 14	CD Road/Mainline Merge	Merge	24	53	C
			Mainline between CD Road Merge and Exit 14 SB On-Ramp	Basic	28	54	D
			Exit 14 SB On-Ramp	Weaving	20	55	B
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	20	55	C
			Exit 13 SB On-Ramp	Merge	17	55	B
			Mainline Between Exit 13 and Exit 12	Diverge	17	55	B
		Exit 12	Exit 12 SB Off-Ramp	Diverge	18	54	B
			Mainline between Exit 12 SB Off/On-Ramps	Basic	21	54	C
			Exit 12 SB On-Ramp to I-93 SB Off-Ramp to I-89 NB Weave	Weaving	16	55	B
		I-89	Mainline between I-93 Off/On-Ramps from I-89	Basic	14	58	B
			I-93 On-Ramp from I-89 SB	Merge	15	65	B
			Mainline South of I-89 SB On-Ramp	Basic	21	62	C
	Northbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	15	56	B
			Exit 15 NB On-Ramp from I-393 WB	Merge	12	58	B
			Exit 15 NB On-Ramp from I-393 EB	Merge	7	59	A
			Mainline between Exit 15 NB Off/On Ramps	Basic	6	60	A
			Exit 15 NB Off-Ramp	Diverge	16	51	B
		Exit 14	Mainline between Exit 14 and Exit 15 Off-Ramps	Basic	15	53	B
			Exit 14 NB Off-Ramp	Weaving	17	52	B
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	21	52	C
			Exit 13 SB Off-Ramp	Diverge	25	53	C
			Mainline Between Exit 13 and Exit 12	Basic	22	55	C
		Exit 12	Exit 12 NB On-Ramp	Merge	23	54	C
			Mainline between Exit 12 Off/On-Ramps	Basic	25	53	C
			Exit 12 NB Off-Ramp	Weaving	22	52	C
		I-89	Mainline between Off/On Ramps to I-89	Basic	18	54	B
			Mainline South of I-89 NB Off-Ramp	Diverge	25	63	C
			I-93 NB CD Road at I-89 Ramps Weave	Weaving	29	34	D
I-89	Southbound	Exit 2	Mainline North of Exit 2	Basic	28	63	D
			Exit 2 SB Off-Ramp	Diverge	26	56	C
			Mainline between Exit 2 Off/On-Ramps	Basic	20	63	C
			Exit 2 SB On-Ramp	Merge	30	53	D
			Mainline between Exit 1 and Exit 2	Basic	31	52	D
		Exit 1	Exit 1 SB Off-Ramp to CD Road	Diverge	31	47	D
			CD Road between Exit 1 Off/On-Ramps	Basic	39	37	E
			I-89 SB to I-93 NB On-Ramp	Merge	29	35	D
	Northbound	Exit 2	Mainline North of Exit 2	Basic	11	67	B
			Exit 2 NB On-Ramp	Merge	10	68	B
			Mainline between Exit 2 Off/On-Ramps	Basic	10	67	A
			Mainline between Exit 1 and Exit 2	Diverge	15	64	B
		Exit 1	CD Road On-Ramp	Merge	13	57	B
			2-Lane Mainline from I-93 NB off-Ramp to I-89 NB	Basic	6	67	A
I-393	Eastbound	I-93	I-393 EB On-Ramp from I-93 SB	Merge	8	55	A
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	12	56	B
			Mainline between Exit 1 Off/On-Ramps	Basic	14	58	B
			Exit 1 On-Ramp	Merge	15	57	B
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	15	56	B
			Exit 2 Off-Ramp	Diverge	15	54	B
			Mainline Between Exit 2 Off/On-Ramps	Basic	9	59	A
			Exit 2 On-Ramp	Merge	9	59	A
			Mainline East of Exit 2	Basic	10	58	A
	Westbound	I-93	I-393 WB On-Ramp from I-93 NB	Merge	17	49	B
			Mainline Between I-93 NB Off-Ramp and I-93 NB On-Ramp	Basic	18	56	C
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	25	51	C
			Mainline between Exit 1 Off/On-Ramps	Basic	39	45	E
			Exit 1 Off-Ramp	Diverge	34	48	D
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	39	47	E
			Exit 2 On-Ramp	Merge	37	37	E
			Mainline Between Exit 2 On/Off-Ramps	Basic	31	49	D
			Exit 2 Off-Ramp	Diverge	32	54	D
I-93 CD	Southbound	Exit 14 & 15	Off-Ramp to CD Road	Diverge	19	51	B
			CD Road Exit 15 SB Off-Ramp to Exit 15 SB On-Ramp	Basic	6	60	A
			Exit 15 SB On-Ramp	Merge	17	51	B
			Exit 15 SB On-Ramp to Exit 14 SB Off-Ramp Weave	Weaving	15	52	B
			CD Road Between Exit 14 Off/On-Ramps	Basic	16	54	B
I-89 CD	Northbound	Exit 1	I-89 NB CD Road to Mainline	Merge	15	56	B
			CD Road between Exit 1 Off/On-Ramps	Basic	17	55	B
			CD Road between I-93 SB Off-Ramp and Exit 1 Off-Ramp	Diverge	10	52	B

Scenario D

Facility	Direction	Locaton	Description	Type	Segment Density (veh/mi/ln)	Speed (mph)	LOS
					2035 PM		
I-93	Southbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	22	55	C
			Exit 15 SB Off-Ramps	Diverge	14	59	B
			Mainline adjacent to CD Road at Exit 15	Basic	12	57	B
		Exit 14	CD Road/Mainline Merge	Merge	19	55	B
			Mainline between CD Road Merge and Exit 14 SB On-Ramp	Basic	22	56	C
			Exit 14 SB On-Ramp	Weaving	20	55	B
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	19	55	C
			Exit 13 SB On-Ramp	Merge	24	52	C
			Mainline Between Exit 13 and Exit 12	Diverge	22	52	C
		Exit 12	Exit 12 SB Off-Ramp	Diverge	21	52	C
			Mainline between Exit 12 SB Off/On-Ramps	Basic	28	52	D
			Exit 12 SB On-Ramp to I-93 SB Off-Ramp to I-89 NB Weave	Weaving	22	52	C
		I-89	Mainline between I-93 Off/On-Ramps from I-89	Basic	17	57	B
			I-93 On-Ramp from I-89 SB	Merge	16	65	B
			Mainline South of I-89 SB On-Ramp	Basic	22	62	C
	Northbound	Exit 15	2-Lane Mainline North of Exit 15	Basic	41	48	E
			Exit 15 NB On-Ramp from I-393 WB	Merge	35	52	E
			Exit 15 NB On-Ramp from I-393 EB	Merge	16	55	B
			Mainline between Exit 15 NB Off/On Ramps	Basic	15	57	B
			Exit 15 NB Off-Ramp	Diverge	24	51	C
		Exit 14	Mainline between Exit 14 and Exit 15 Off-Ramps	Basic	25	52	C
			Exit 14 NB Off-Ramp	Weaving	25	52	C
		Exit 13	Mainline between Exit 13 Off/On-Ramps	Basic	26	53	C
			Exit 13 SB Off-Ramp	Diverge	22	55	C
			Mainline Between Exit 13 and Exit 12	Basic	23	55	C
		Exit 12	Exit 12 NB On-Ramp	Merge	22	55	C
			Mainline between Exit 12 Off/On-Ramps	Basic	26	54	D
			Exit 12 NB Off-Ramp	Weaving	22	53	C
		I-89	Mainline between Off/On Ramps to I-89	Basic	19	55	C
			Mainline South of I-89 NB Off-Ramp	Diverge	29	62	D
			I-93 NB CD Road at I-89 Ramps Weave	Weaving	21	36	C
I-89	Southbound	Exit 2	Mainline North of Exit 2	Basic	23	65	C
			Exit 2 SB Off-Ramp	Diverge	22	60	C
			Mainline between Exit 2 Off/On-Ramps	Basic	19	64	C
			Exit 2 SB On-Ramp	Merge	25	56	C
			Mainline between Exit 1 and Exit 2	Basic	25	54	C
		Exit 1	Exit 1 SB Off-Ramp to CD Road	Diverge	26	48	C
			CD Road between Exit 1 Off/On-Ramps	Basic	32	38	D
			I-89 SB to I-93 NB On-Ramp	Merge	24	36	C
	Northbound	Exit 2	Mainline North of Exit 2	Basic	20	64	C
			Exit 2 NB On-Ramp	Merge	19	63	B
			Mainline between Exit 2 Off/On-Ramps	Basic	18	65	C
			Mainline between Exit 1 and Exit 2	Diverge	24	62	C
		Exit 1	CD Road On-Ramp	Merge	23	50	C
			2-Lane Mainline from I-93 NB off-Ramp to I-89 NB	Basic	8	66	A
I-393	Eastbound	I-93	I-393 EB On-Ramp from I-93 SB	Merge	13	57	B
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	21	53	C
			Mainline between Exit 1 Off/On-Ramps	Basic	26	54	C
			Exit 1 On-Ramp	Merge	30	49	D
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	30	53	D
			Exit 2 Off-Ramp	Diverge	31	52	D
			Mainline Between Exit 2 Off/On-Ramps	Basic	25	55	C
			Exit 2 On-Ramp	Merge	27	53	C
			Mainline East of Exit 2	Basic	29	53	D
	Westbound	I-93	I-393 WB On-Ramp from I-93 NB	Merge	9	52	A
			Mainline Between I-93 NB Off-Ramp and I-93 NB On-Ramp	Basic	9	57	A
		Exit 1	I-93 Off-Ramp to Exit 1 Off-Ramp Weave	Weaving	24	44	C
			Mainline between Exit 1 Off/On-Ramps	Basic	24	49	C
			Exit 1 Off-Ramp	Diverge	24	51	C
		Exit 2	Mainline Between Exit 1 and Exit 2	Basic	28	46	D
			Exit 2 On-Ramp	Merge	27	35	C
			Mainline Between Exit 2 On/Off-Ramps	Basic	17	51	B
			Exit 2 Off-Ramp	Diverge	16	57	B
I-93 CD	Southbound	Exit 14 & 15	Off-Ramp to CD Road	Diverge	9	57	A
			CD Road Exit 15 SB Off-Ramp to Exit 15 SB On-Ramp	Basic	7	59	A
			Exit 15 SB On-Ramp	Merge	15	54	B
			Exit 15 SB On-Ramp to Exit 14 SB Off-Ramp Weave	Weaving	13	55	B
			CD Road Between Exit 14 Off/On-Ramps	Basic	16	55	B
I-89 CD	Northbound	Exit 1	I-89 NB CD Road to Mainline	Merge	29	49	D
			CD Road between Exit 1 Off/On-Ramps	Basic	29	54	D
			CD Road between I-93 SB Off-Ramp and Exit 1 Off-Ramp	Diverge	17	50	B

Local Intersection Operations Summary

November 2017

Prepared by RSG

Design Year 2035 Intersection Operations Summary (AM Peak Period)

		AM									
		No Build		Scenario A		Scenario B		Scenario C		Scenario D	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
US 3/US 202 and Bouton St	Overall	19	B	27	C	21	C	22	C	22	C
	EB	23	C	27	C	24	C	25	C	26	C
	WB	18	B	29	C	20	C	21	C	21	C
	NB	17	B	17	B	18	B	16	B	17	B
Commercial St/US 202 WB	SB	33	C	81	F	52	D	67	E	48	D
Commercial St/US 202 EB	Overall	6	A	6	A	6	A	5	A	10	A
	EB	5	A	5	A	6	A	5	A	8	A
	NB	15	B	13	B	8	A	5	A	18	B
Exit 15 SB Off-Ramp	SB	1050	F	3	A	3	A	3	A	12	B
College Drive/I-393 WB Ramps	EB	9	A	10	A	10	A	10	A	10	A
	NB	0	A	0	A	0	A	0	A	0	A
	SB	0	A	0	A	1	A	0	A	1	A
College Drive/I-393 EB Ramps	Overall	13	B	13	B	13	B	14	B	13	B
	EB	11	B	11	B	12	B	12	B	11	B
	WB	18	B	16	B	15	B	16	B	16	B
	NB	13	B	13	B	14	B	13	B	13	B
	SB	13	B	16	B	14	B	15	B	16	B
US 202-Loudon Road and Centre Street	Overall	66	E	46	D	46	D	39	D	37	D
	EB	41	D	33	C	31	C	26	C	36	D
	WB	105	F	67	E	54	D	52	D	38	D
	NB	27	C	31	C	28	C	25	C	25	C
	SB	32	C	32	C	50	D	35	C	41	D
Loudon Rd/Stickney Ave and Bridge St	Overall	13	B					31	C	5	A
	EB	24	C					11	B	5	A
	WB	6	A	na		na		62	E	2	A
	NB	56	E					41	D	39	D
	SB	44	D					14	B	58	E
Loudon Rd/I-93 SB ramps	Overall	55	D	27	C	31	C			21	C
Exit 14 SPUI	EB	1	A	23	C	23	C			9	A
	WB	52	D	24	C	27	C	na		18	B
	NB	na		54	D	65	E			na	
	SB	111	F	25	C	25	C			39	D
Loudon Rd/I-93 NB on ramp	Overall	33	C								
	EB	15	B	na		na		na		na	
	WB	49	D								
Loudon Rd/Fort Eddy Rd	Overall	299	F	23	C	27	C	33	C	30	C
	EB	29	C	22	C	25	C	22	C	28	C
	WB	694	F	18	B	19	B	38	D	30	C
	NB	366	F	30	C	36	D	40	D	32	C
	SB	25	C	21	C	21	C	23	C	31	C
I-93 SB off ramp and Hall St/Manchester St	Overall	20	C	21	C	21	C	21	C	21	C
	EB	10	B	12	B	11	B	9	A	9	A
	WB	26	C	25	C	22	C	26	C	25	C
	NB	23	C	21	C	23	C	23	C	24	C
	SB	21	C	23	C	27	C	21	C	22	C
I-93 (SPUI)/Manchester St	Overall	123	F	38	D	43	D	44	D	44	D
	EB	28	C	50	D	53	D	51	D	53	D
	WB	37	D	36	D	35	D	35	C	32	C
	NB	326	F	31	C	44	D	47	D	48	D
	SB	45	D	47	D	45	D	43	D	46	D
Manchester St/Old Turnpike	Overall	18	B	19	B	16	B	17	B	17	B
	EB	12	B	13	B	12	B	13	B	11	B
	WB	30	C	33	C	27	C	30	C	29	C
	SB	10	B	12	B	11	B	9	A	10	A
Exit 12 SB Ramps	Overall	6	A	12	B	12	B	15	B	12	B
	EB	3	A	11	B	11	B	13	B	11	B
	WB	4	A	13	B	12	B	17	B	12	B
	NB	16	B	14	B	13	B	14	B	13	B
	SB	6	A	na		na		na		na	
Exit 12 NB Ramps	Overall	6	A	11	B	11	B	16	B	11	B
	EB	4	A	13	B	12	B	19	B	12	B
	WB	1	A	9	A	9	A	11	B	9	A
	NB	18	B	na		na		na		na	
	SB	10	A	5	A	5	A	17	B	4	A
South Street/I-89 Exit 1 NB Ramps	Overall	na		na		12	B	12	B	13	B
	EB	11	B	14	B	15	B	17	B	15	B
	WB	na		na		24	C	24	C	26	C
	NB	1	A	1	A	9	A	10	B	10	B
	SB	0	A	0	A	7	A	7	A	8	A
South Street/I-89 Exit 1 SB Ramps	Overall	na		na		19	B	19	B	19	B
	EB	21	C	24	C	25	C	27	C	26	C
	WB	36	D	42	D	15	B	14	B	12	B
	NB	6	A	7	A	15	B	16	B	16	B
	SB	1	A	1	A	20	B	19	B	20	B
NH-3A/I-89 and Hall St	Overall	41	D	42	D	35	C	34	C	34	C
	EB	45	D	48	D	30	C	29	C	31	C
	WB	38	D	37	D	31	C	27	C	27	C
	NB	36	D	36	D	29	C	29	C	28	C
	SB	43	D	43	D	46	D	46	D	47	D
I-93 NB Off-Ramp/New Road	Overall					5	A	3	A	5	A
	EB					4	A	na		4	A
	WB	na		na		4	A			5	A
	NB					na		15	B	na	
	SB					7	A	na		8	A

Design Year 2035 Intersection Operations Summary (PM Peak Period)

		PM									
		No Build		**Scenario A**		**Scenario B**		**Scenario C**		**Scenario D**	
		Delay	LOS	Delay	LOS	Delay	LOS	Delay		Delay	
US 3/US 202 and Bouton St	Overall	127	F	73	E	30	C	37	D	67	E
	EB	309	F	143	F	40	D	57	E	108	F
	WB	33	C	28	C	23	C	24	C	23	C
	NB	20	B	20	B	25	C	25	C	63	E
Commercial St/US 202 WB	SB	18	C	16	C	12	B	13	B	12	B
Commercial St/US 202 EB	Overall	32	C	22	C	15	B	21	C	39	D
	EB	14	B	10	B	12	B	24	C	33	C
	NB	116	F	76	E	28	C	9	A	63	E
Exit 15 SB Off-Ramp	SB	27	D	2	A	2	A	2	A	3	A
College Drive/I-393 WB Ramps	EB	12	B	13	B	11	B	12	B	12	B
	NB	1	A	2	A	1	A	1	A	1	A
	SB	4	A	4	A	6	A	4	A	5	A
College Drive/I-393 EB Ramps	Overall	17	B	16	B	16	B	14	B	16	B
	EB	13	B	14	B	14	B	14	B	13	B
	WB	28	C	24	C	14	B	18	B	29	C
	NB	14	B	13	B	14	B	12	B	15	B
	SB	24	C	24	C	21	C	20	B	22	C
US 202-Loudon Road and Centre Street	Overall	80	F	60	E	45	D	39	D	34	C
	EB	77	E	84	F	59	E	49	D	30	C
	WB	145	F	41	D	36	D	33	C	33	C
	NB	36	D	27	C	41	D	23	C	19	B
	SB	52	D	91	F	46	D	44	D	60	E
Loudon Rd/Stickney Ave and Bridge St	Overall	25	C					20	C	11	B
	EB	33	C					16	B	11	B
	WB	8	A	na		na		25	C	3	A
	NB	49	D					38	D	43	D
	SB	42	D					17	B	52	D
Loudon Rd/I-93 SB ramps	Overall	26	C	34	C	34	C			17	B
Exit 14 SPUI	EB	2	A	32	C	31	C			7	A
	WB	44	D	32	C	30	C	na		19	B
	NB	na		51	D	59	E			na	
	SB	123	F	44	D	65	E			43	D
Loudon Rd/I-93 NB on ramp	Overall	22	C								
	EB	10	B	na		na		na		na	
	WB	35	C								
Loudon Rd/Fort Eddy Rd	Overall	209	F	57	E	44	D	36	D	46	D
	EB	26	C	45	D	37	D	27	C	33	C
	WB	765	F	110	F	64	E	46	D	65	E
	NB	70	E	24	C	35	C	39	D	56	E
	SB	36	D	24	C	30	C	30	C	27	C
I-93 SB off ramp and Hall St/Manchester St	Overall	30	C	29	C	34	C	33	C	32	C
	EB	33	C	32	C	33	C	36	D	35	D
	WB	32	C	31	C	41	D	39	D	37	D
	NB	23	C	20	C	26	C	22	C	20	C
	SB	24	C	27	C	31	C	24	C	26	C
I-93 (SPUI)/Manchester St	Overall	100	F	47	D	51	D	50	D	51	D
	EB	46	D	52	D	50	D	50	D	51	D
	WB	52	D	51	D	54	D	50	D	51	D
	NB	329	F	28	C	45	D	49	D	48	D
	SB	52	D	52	D	55	E	54	D	51	D
Manchester St/Old Turnpike	Overall	31	C	33	C	15	B	15	B	16	B
	EB	11	B	13	B	11	B	11	B	12	B
	WB	22	C	23	C	20	B	23	C	22	C
	SB	69	E	78	E	17	B	14	B	15	B
Exit 12 SB Ramps	Overall	8	A	14	B	13	B	16	B	14	B
	EB	3	A	14	B	14	B	15	B	14	B
	WB	8	A	13	B	12	B	16	B	12	B
	NB	26	C	16	C	14	B	17	B	16	C
	SB	6	A	na		na		na		na	
Exit 12 NB Ramps	Overall	6	A	12	B	12	B	16	B	12	B
	EB	5	A	13	B	12	B	20	B	12	B
	WB	1	A	9	A	9	A	11	B	9	A
	NB	23	C	na		na		na		na	
	SB	11	B	4	A	4	A	18	B	3	A
South Street/I-89 Exit 1 NB Ramps	Overall	na		na		20	B	19	B	20	C
	EB	77	F	127	F	20	B	22	C	23	C
	WB	na		na		33	C	33	C	35	C
	NB	9	A	8	A	10	A	9	A	8	A
	SB	1	A	1	A	19	B	17	B	19	B
South Street/I-89 Exit 1 SB Ramps	Overall	na		na		14	B	14	B	14	B
	EB	29	D	25	D	26	C	24	C	26	C
	WB	34	D	31	D	16	B	17	B	15	B
	NB	20	C	26	D	8	A	8	A	7	A
	SB	1	A	1	A	14	B	14	B	14	B
NH-3A/I-89 and Hall St	Overall	51	D	56	E	42	D	45	D	45	D
	EB	31	C	32	C	31	C	23	C	24	C
	WB	46	D	51	D	37	D	39	D	39	D
	NB	40	D	42	D	33	C	33	C	33	C
	SB	73	E	83	F	56	E	68	E	69	E
I-93 NB Off-Ramp/New Road	Overall					4	A	na		4	A
	EB					2	A	na		2	A
	WB	na		na		4	A			5	A
	NB					na		14	B	na	
	SB					7	A	na		7	A

Interstate 93 Bow Concord Improvements

Rail and Transit Assessment Report

State Project #13742

Prepared for:

Federal Highway Administration &

New Hampshire Department of Transportation

October 5, 2018

TranSystems
EXPERIENCE | Transportation

101 Arch Street
Suite 301
Boston, MA 02110
857-453-5450

TABLE OF CONTENTS

1.0 Introduction

The purpose of the I-93 Bow-Concord project is to address the existing and future needs for all users of this four-mile segment of I-93, while balancing the needs of the surrounding communities, by providing a safe and efficient transportation corridor for people, goods and services.

I-93 is the principal north-south arterial highway within New Hampshire and is part of the National System of Interstate and Defense Highways. I-93 extends a distance of approximately 132 miles through New Hampshire from the Massachusetts border to the northern Vermont border. This study covers a distance of approximately 4.5 miles from just south of the I-93/I-89 Interchange in Bow to just north of the I-93/I-393 Interchange (Exit 15) in Concord. The segment of I-93 from the south to Exit 14 is also part of the Central Turnpike, commonly known as the F.E. Everett Turnpike.

The I-93 Bow-Concord project is in the alternatives development phase where alternatives for the corridor are being evaluated based on their ability to meet the criteria defined in the projects' purpose and need statement (shown in section 8.1).

In developing this alternatives document for the railroad corridor, consideration was given to collecting information on the existing ownership, operations and condition of the railroad. In addition, information was collected on future projects planned for this area as well as railroad operational plans that would affect the railroad corridor.

The *New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis – Final Report* dated December 2014 studied alternatives to improve the transit corridor from Concord to Boston. Three of the five alternatives recommended for further analysis including the construction of a regional commuter rail connecting the corridor and provide service similar to the MBTA Commuter Rail or Amtrak *Downeaster*.

At this time there is no plan to expand north to Montreal through Concord with high speed rail. An FRA press release dated July 20, 2016 details a central Massachusetts/Vermont connection to provide service between Montreal and Boston.

2.0 Description of Project Area and Current Planning

A clear understanding of the I-93 Bow-Concord project area is necessary to identify appropriate problems, concerns and opportunities. The railroad is an important aspect of this corridor and is therefore included in the planning and development. Proposed rail alternatives for this area are discussed in the *Summary/Classification Report Bow-Concord Interstate 93 Transportation Planning Study* dated April 2008, *New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis – Final Report* dated December 2014, and the *2012 New Hampshire State Rail Plan* dated June 2012.

2.1 Bow-Concord I-93 Project Area

The Bow-Concord section of Interstate 93, from the I-89/I-93 interchange in Bow to the I-93/I-393 interchange on the north side of Concord, serves as a critical link for statewide travel to the White Mountains and the Lakes Region, as well as an important local route within Concord. Within that area and adjacent to I-93 is a railroad corridor that currently serves as the only link for rail travel and rail freight shipments to and through Concord to central New Hampshire. In Figure 1 below, the rail corridor can be seen in red directly adjacent to and paralleling I-93.[1]

Figure 1 – Project Area

The April 2008 Summary/Classification report refers to the downtown Concord project area as the Opportunity Corridor, which has been identified as one of the most valuable assets in Concord. The Opportunity Corridor is a north-south area in downtown Concord bounded by Exit 12 to the south, Exit 15 to the north, Fort Eddy Road and Merrimack River to the east, and North Main and South Main Streets to the west. The orange hatching in Figure 2 on the following page details the location of the Opportunity Corridor.

[1] *New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis – Final Report* dated December, 2014

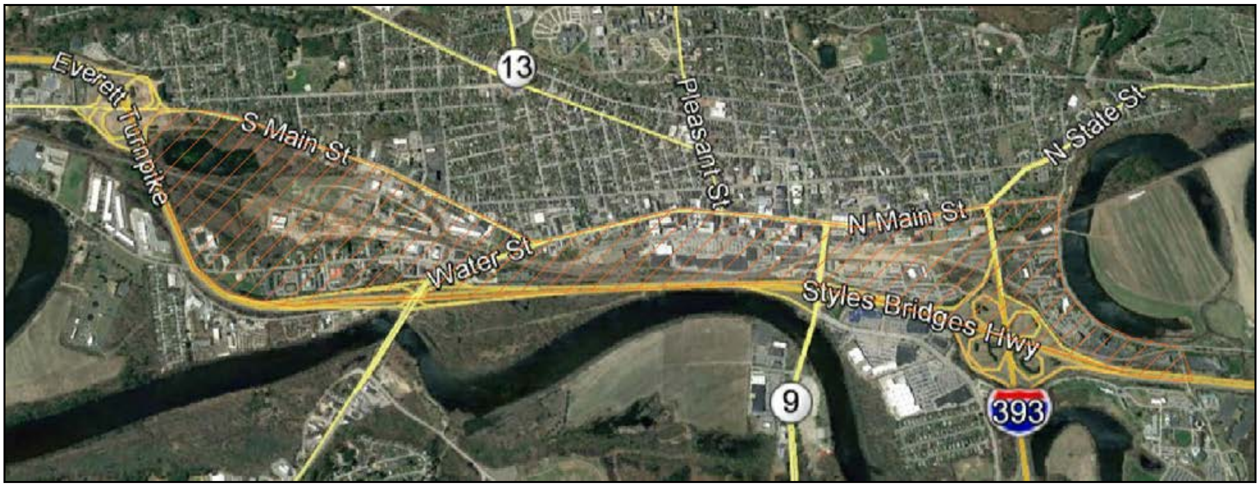


Figure 2 – Downtown Concord – within limits of orange hatching

Along I-93, south of the Exit 14 ramps and between I-93 and the Storrs Street Market Basket there is an area referred to as the “Pinch Point” of the corridor. At this location the railroad right-of way is of limited width and is only able to accommodate one track without impacting existing development, and I-93 is currently limited to four travel lanes. Figure 3 shows the “Pinch Point” location. This location previously carried two tracks, and reinstatement of a second track will need to be considered for future rail concepts.

Figure 3 – Location of “Pinch Point”

2.2 Summary/Classification Report

The April 2008 Summary/Classification Report discusses the roadway alternatives and screening processes used to define and evaluate potential improvements to the corridor. The outcome of this report was to develop reasonable alternatives to be reviewed for scope and preliminary design in "Part B". The report stated that several project components should be part of all build alternatives developed in Part B, including preservation of the existing rail corridor. The concepts currently under consideration in Part B all preserve the rail corridor.

However, passenger rail service is still seen as a favorable component to other reasonable alternatives as there is already an existing rail corridor with active freight traffic through Concord.

The likelihood of commuter rail service and high speed rail service from Boston to Concord still is a reasonable future possibility.

2.3 New Hampshire State Rail Plan

The *2012 New Hampshire State Rail Plan* in coordination with the *NH Long Range Transportation Plan 2010-2030* dated July 2010 identified and evaluated issues and opportunities related to rail transportation in New Hampshire. The state rail plan identifies nine core goals as follows:

1. Maintain the New Hampshire rail system in a state of good repair.
2. Provide a rail system that is financially stable and sustainable.
3. Expand the rail system and its capacity to promote growth in freight and passenger demand.
4. Provide a rail system that is environmentally supportive and sustainable.
5. Facilitate the ability of New Hampshire railroads to be competitive regionally, nationally and globally.
6. Support economic initiatives.
7. Realize public benefits for public investments.
8. Encourage public-private partnerships related to rail services.
9. Educate New Hampshire residents and businesses on the rail system in New Hampshire.

The report details the objectives, actions and policies related to each of these goals to identify achievement criteria. The report also presents descriptions for potential funding that local communities can apply for to for railroad improvements.

2.4 New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis

The *New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis – Final Report* dated December 2014, studied alternatives to alleviate traffic congestion between Concord and Boston. This 73-mile stretch between the cities is referred to as the Capital Corridor. The purpose of this study was to explore options to improve transit service along the Capital Corridor's northern end.

The study developed 12 conceptual alternatives which were then reduced to five for further review and analysis:

- No Build
- Manchester Regional Commuter Rail
- Nashua Minimum Commuter Rail
- Intercity 8
- Bus on Shoulder

Of these five alternatives, three involve a significant investment in commuter rail.

Manchester Regional Commuter Rail
This alternative would extend MBTA commuter rail service from its current terminus in Lowell, MA to Manchester, a distance of approximately 30 miles. This alternative would provide full day commuter rail service between Nashua and Boston (34 trains daily) with less frequent service north to Manchester (14 trains daily).

Under this alternative BX I-93 bus service (serving Manchester, North Londonderry, Londonderry and Salem) and BX Route 3 bus service (serving Manchester, Nashua and Tyngsborough, MA) would both be retained. Also, additional BX I-93 trips between Nashua and Manchester could be included to supplement the commuter rail schedule.

Four new stations would be added for this alternative: Tyngsborough, MA, Nashua, MHT/Bedford and Manchester. A new layover facility would also be constructed in the Manchester area.

The new trains would travel at an anticipated speed of 60 mph. Upgrades to existing track, bridges, signals and crossings would be required on the 30 mile segment between Lowell and Manchester. Installation of a 3.5 mile section of second track and three industrial sidings would also be required to provide double track service throughout the corridor and coordinate commuter rail and freight operations.

Nashua Minimum Commuter Rail
This alternative would extend MBTA commuter rail service from its current terminus in Lowell to South Nashua, a distance of approximately 13.5 miles. This alternative would provide peak-period only service between South Nashua and Boston (up to 11 trains in each direction daily).

Under this alternative BX I-93 bus service (serving Manchester, North Londonderry, Londonderry and Salem) and BX Route 3 bus service (serving Manchester, Nashua and Tyngsborough, MA) would both be retained. Also, additional BX Route 3 trips between Nashua and Lowell could be included to supplement this new peak-period only commuter rail service.

One new station would be added, in South Nashua, and a new layover facility would also be constructed in the South Nashua area.

The new trains would travel at an anticipated maximum speed of 60 mph. Upgrades to existing track, bridges, signals and crossings would be required on the 13.5 mile segment between Lowell and South Nashua. Installation of a 3.5 mile section of second track would also be required to provide double track service throughout, however no new industrial sidings would be needed.

<u>Intercity 8</u>
This alternative would provide limited commuter rail service from its current terminus in Lowell to Concord, a distance of approximately 48 miles. This alternative would provide four daily round trips between Concord and Boston.

Also, BX I-93 bus service (serving Manchester, North Londonderry, Londonderry and Salem) and BX Route 3 bus service (serving Manchester, Nashua and Tyngsborough, MA) would both be retained. However, unlike the other two commuter rail alternatives, no additional BX bus service is included as a supplement to the proposed commuter rail service.

Four new stations would be added for this alternative: Nashua, MHT/Bedford, Manchester and Concord. A new layover facility would also be constructed in the Manchester area, which would require dead head moves to and from Concord.

Upgrades to existing track, bridges, signals and crossings would be required on the 48 mile segment between Lowell and Concord. The track upgrades for this alternative are more significant than the previous commuter rail alternatives as the Intercity 8 alternative would operate at higher speeds: up to 79 mph if alignment allows between MHT/Bedford and Nashua and 70 mph at many other locations. Unlike the other commuter rail alternatives, no new sections of second track are required, however three industrial sidings would be required to coordinate commuter rail and freight operations.

3.0 Existing Conditions

The existing conditions of the railroad corridor fall into a number of categories: ownership and leasing, physical plant, equipment and facilities, sidetracks and industrial parks. Preceding a discussion of each category is a short history of the rail industry in the Concord area.

3.1 Concord Railroad History

The history of railroading in Concord and the State of New Hampshire is linked to that of the Boston and Maine (B&M) Corporation. By 1900, the B&M controlled 90% of all rail mileage in the state, and had located one of its principal shops in Concord. The Concord Shops was a major employer in the Concord area and performed heavy locomotive engine and car repairs along with yard operations that supported freight shipping of commodities such as paper and lumber for local area industries.

However, since the end of World War II, the overall rail economy has declined due to the changing industry base, construction of the Interstate Highway System, a growing airline industry and the American passion for automobile use (*New Hampshire State Rail Plan 2001* – dated April 2001, page 11). This is evidenced by the B&M total net revenue ton miles per mile through Concord, which was 21.5 million net tons in 1944, dropping to 5.1 million net tons in 1955. Such declines in rail shipment have resulted in a restructuring of the New Hampshire rail system to one third of its early 1900 size. The restructuring included the closing of the Concord Shops in the 1950's and the abandonment of freight operations between Concord and Lebanon/White River Junction, Vermont in the 1990's.

The State of New Hampshire, through the Department of Transportation's Division of Rail and Transit, has been actively monitoring rail line abandonments in past years. Where it has been determined to be in the public good the state has attempted to maintain rail operations on such lines through purchase and leases or preserving rail corridors for future needs (such as the Northern Railroad from Concord to Lebanon).

3.2 Railroad Right-of-Way and Ownership/Lease Descriptions

The railroad lines in the Concord area of the I-93 Bow-Concord corridor study are owned by two parties, the Pan Am Railways, Inc. (PAR), formerly the B&M Corporation, and the State of New Hampshire. The New England Southern (NEGS) interchanges with the PAR and operates on the NHDOT White Mountain Branch. Figure 4, on the next page, shows the current map of railroads in New Hampshire as published by the NHDOT.

The PAR currently owns the New Hampshire Main Line, yard tracks and right-of-way between Manchester and Concord (former Main Line South). To the north of Concord Center the PAR also owns a portion of the track and right-of-way of the former White Mountain Line (Northern Railroad) and the former Concord and Claremont (C&C). Pan Am Railway's ownership of the Northern Railroad ends near the Boscawen Town Line.

The NHDOT owns the Northern Railroad from Boscawen to Lebanon. This section of former railroad right-of-way is currently abandoned except for a two mile section in West Lebanon which is operated by the NECRR.

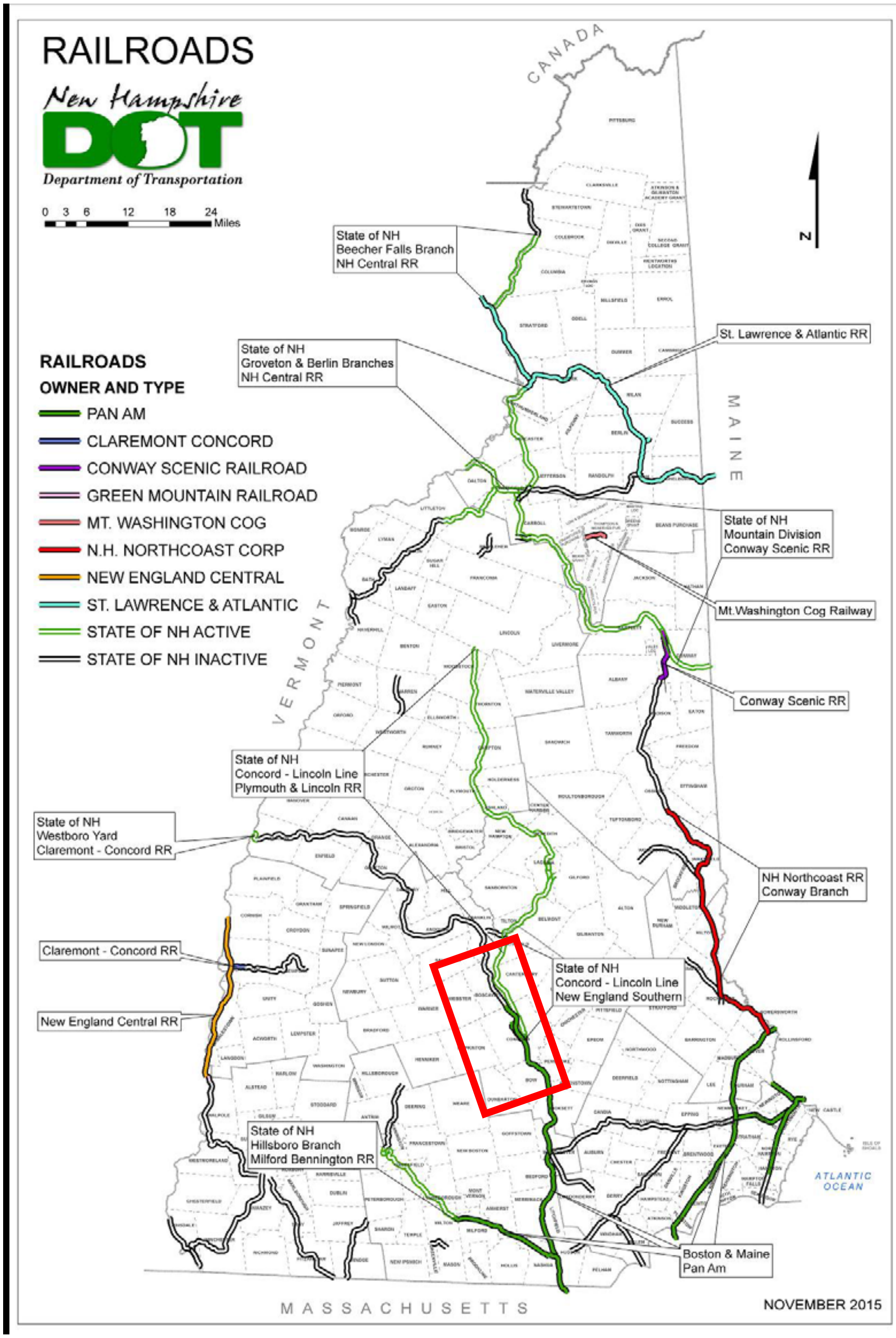


Figure 4 – Current Rail Systems in New Hampshire

The NEGS has a contract with the NHDOT to operate on the White Mountain Branch. The contract is for ten years, renewable in ten year increments.

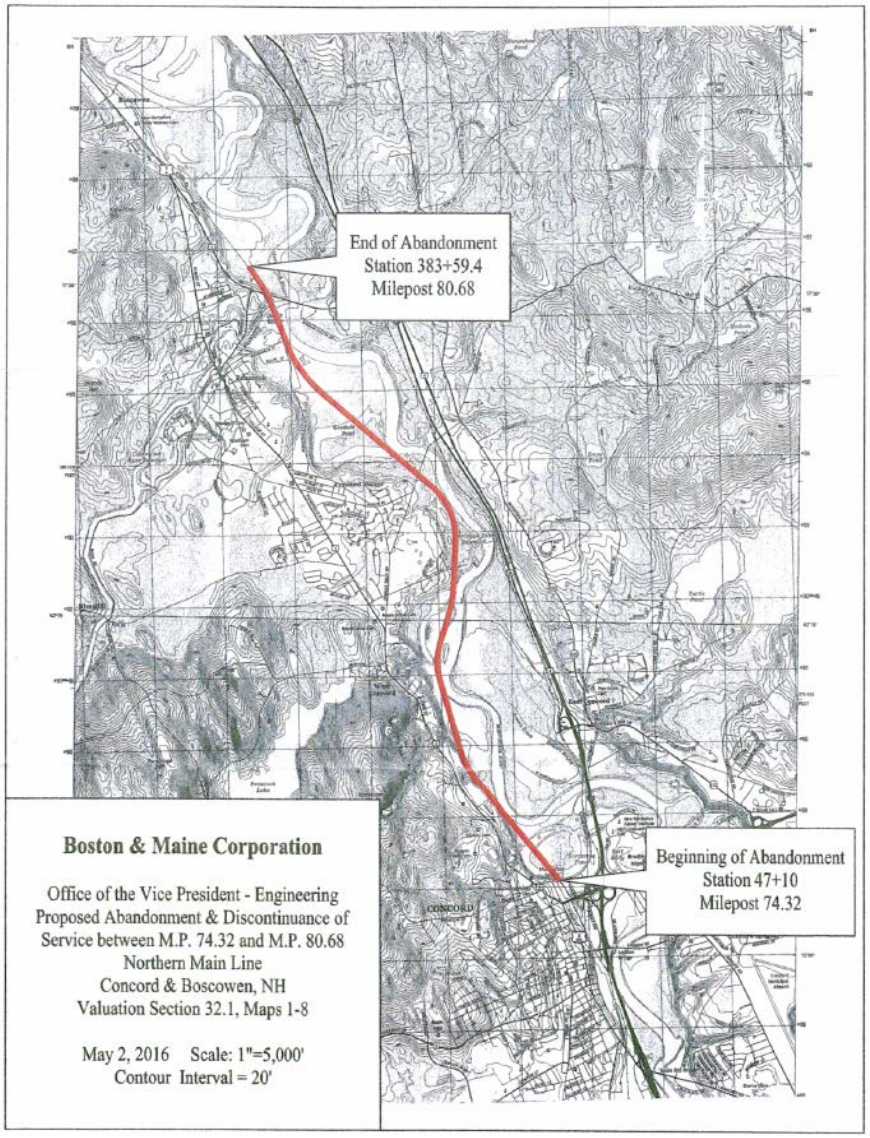


Figure 5 – PAR Abandoned Track

The NHDOT owns the Concord to Lincoln Line (White Mountain Branch) from the point of clearance of the Northern Main Line to Lincoln. A portion of the line was acquired in 1976 from the then B&M Railroad (now PAR) from the point of clearance (of the Northern Main Line) to approximately mile post 0.72. This portion was acquired by the Department from a request made by a developer of property along Commercial Street.

In September 2016 the PAR gave notice to abandon a 6.36 mile segment of Northern Main Line Track beginning at milepost 74.32 (immediately North of Horseshoe Pond Lane) to milepost 80.68 where the track currently ends.

3.3 Railroad Physical Plant

The existing railroad right-of-way from Bow through Concord has a width ranging in size from 50 feet to 200 feet, except for a spot location (approximate engineering station 1820+00 on valuation section 21 map 35) where the right-of-way width has been reduced and can currently accommodate only one track. This location corresponds to the "pinch point" described in Section 2.2. At this same location there is a 5 degree horizontal curve, with the remainder of the curves in the Bow/Concord area being less than 2 degrees. The existing grade in the Concord area is relatively flat with the maximum grade being 0.21% just north of Water Street.

The old track chart for the Bow/Concord area shows the existing track, sidetracks, branch lines, other important physical data, percent grade, and horizontal curvature is shown in Figure 6. The railroad physical plant in the Concord area has shrunk dramatically in size since the 1950's. A significant portion of the former Concord rail yard is now occupied by the I-93 corridor, built in the 1960's.

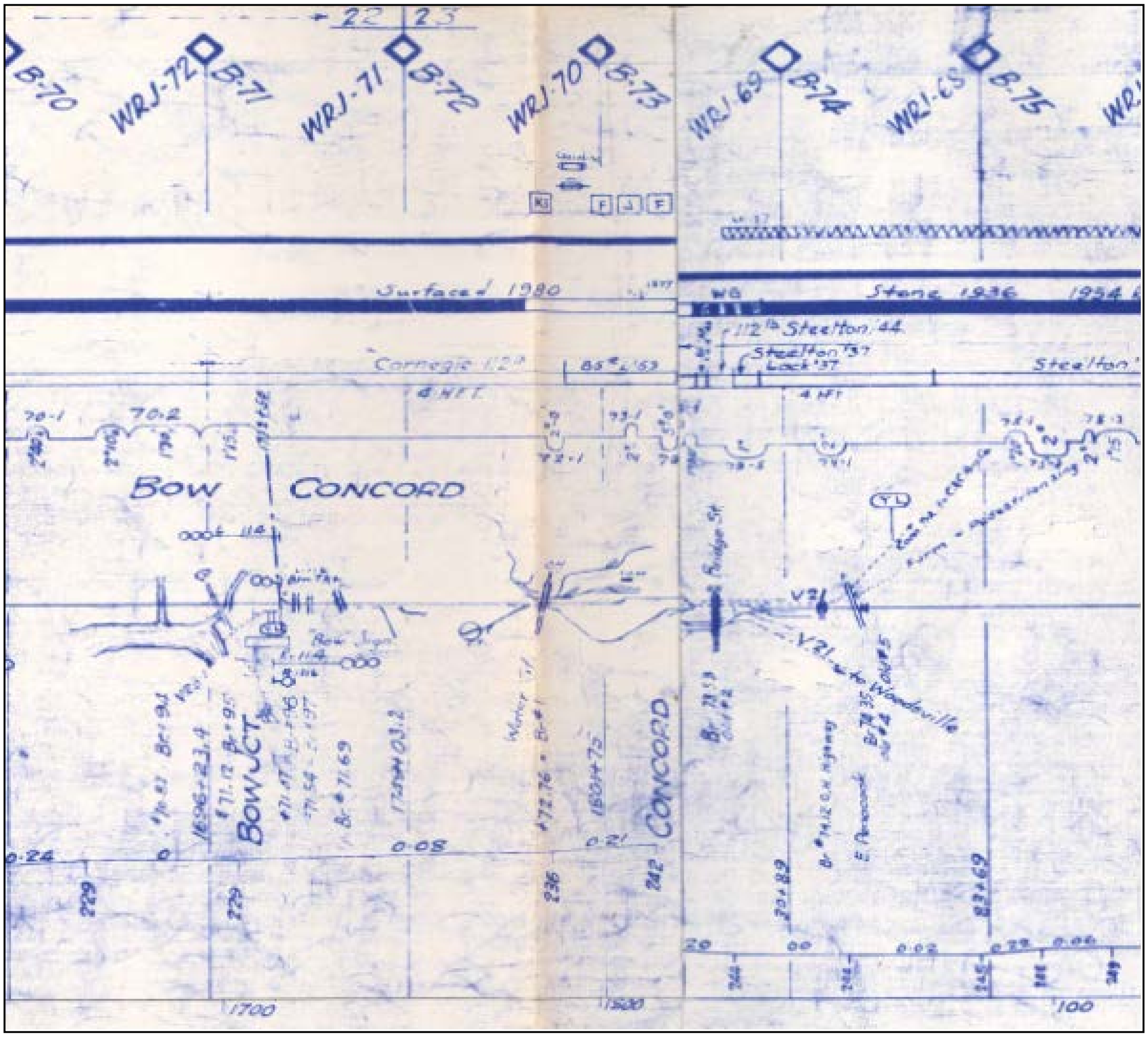


Figure 6 – Old Boston and Maine Corporation Track Chart for Bow-Concord Area

The PAR maintains track for the Northern Railroad to the Hall Street at-grade crossing in Manchester. The PAR track from approximately MP 38 north to Concord is excepted in yard limits; south of MP 38 the track is maintained to Federal Railroad Administration (FRA) Class 1. The maximum track speed is 10 mph.

The NEGS leases and maintains the PAR leased track for 22 miles of the White Mountain Branch. North of Mile Post C22 the rail line is leased to a tourist railroad under contract with the NHDOT. The NEGS currently maintains the White Mountain Branch to FRA Class 1 with an average track speed of 10 mph.

3.4 New England Southern (NEGS) Equipment and Facilities

NEGS Equipment: The NEGS currently has the following equipment to perform their railroad operations. The equipment is normally located in Cantebury, but may be used elsewhere, as work requires:

- 1 – SW1500 Locomotive
- 10 – Box/Flat/Ballast Cars (for worktrain and storage)
- 1 – RPO Passenger Car (used for office space, not for rail service)
- 1 – Tamper
- 1 – Tie Inserter
- 1 – Tie Crane (Handler)

NEGS Facilities: The NEGS current facilities are located off I-93 in the Concord Exit 18 area and consist of a field office and workshop. The NEGS corporate office is at 143 New Boston Road, Goffstown, NH 03045.

3.5 Sidetrack Customers

The PAR handles all of the sidetrack customers north of Manchester to Concord. Listed below are the sidetrack customers with rail access:

Origination	Product	Sidetrack Customer	Location	Status	Car/YR
Inbound	Cement	Ciment Quebec Inc.	Bow	Active	-
Outbound	Rail Equip.	Perini Corporation	Bow	Closed	-
Inbound	Tele. Poles/ Hydrous Ammonia	Eversource	Bow	Active	-
Outbound	Process Slag	Reed Minerals	Bow	Closed	-
Inbound	Grain	Blue Seal Feeds	Bow	Active	-
Inbound	Wine/Beer	Amoskeag Beverages	Bow	Inactive	-
Outbound	Steel/ASR	Schnitzer Steel	Concord	Active	-
Inbound	Steel	Cohen Steel	Concord	Inactive	-
Inbound	Tel. Poles	Fortek	Concord	Closed	-
Inbound	Lumber	Saxsonvil' USA	Concord	Closed	-
Inbound	Lumber	National Lumber	Concord	Inactive	-
Inbound	Chemicals	Allstate Asphalt	Concord	Active	-
Inbound	Fertilizer	Concord Crop Center	Concord	Closed	-
Inbound	Clay	3M	Concord	Active	12
Inbound	Rail Equip.	Plymouth and Lincoln	Lincoln	Active	5
Total Car Loads per Year					17*

** The National Guard has one additional train (outbound and inbound) served by NEGS every two to three years in Canterbury.*

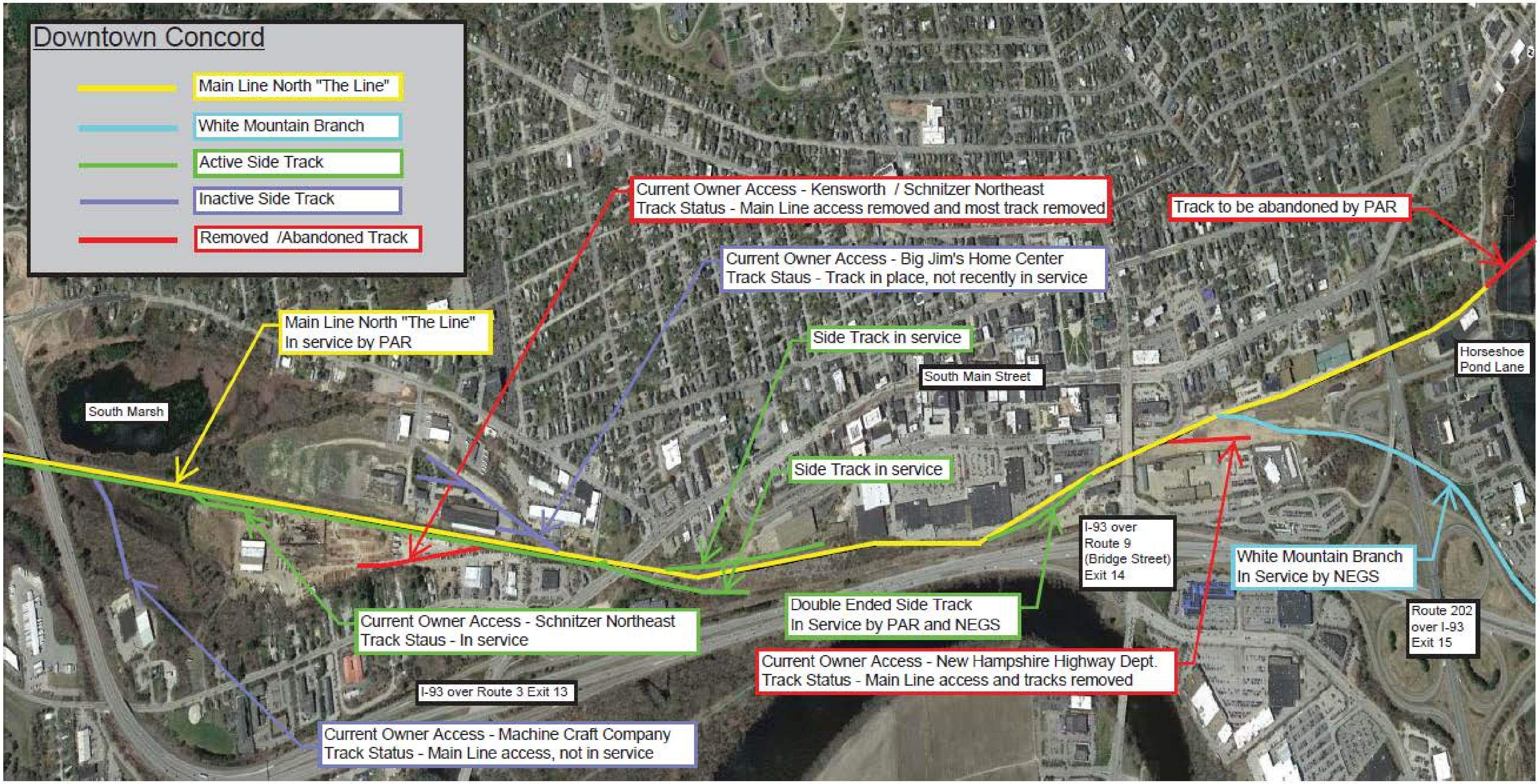


Figure 7 – Rail Access within Downtown Concord

4.0 Existing Railroad Operations

The existing railroad operations of PAR and NEGS are described below. The existing operations of PAR and NEGS have become greatly reduced in the Bow-Concord area over time. Refer to Figure 7 on Page 12 for rail access within the Opportunity Corridor in Concord.

4.1 PAR Operations

The PAR operates a coal train to the Public Service of New Hampshire (PSNH) Bow Power Plant in an "on-demand" status. The PAR operation starts in New York where interchange is made with the Norfolk Southern (NS). The coal train normally is approximately 106 cars in length. The PAR move to the PSNH requires the use of the main line to Garvan's Falls (just south of the Hall Street at-grade crossing) in order to set the loads into the plant and pull the empties out. The PAR service to the Bow Power Plant and Concord area (operating "on-demand") utilizes regular switching on the double ended siding near Bridge Street.

The PAR conducts switching on the double-ended siding south of Bridge Street (Exit 14) on average once per week. The trains are assembled by pushing cars under Bridge Street during runaround moves reversing the train at this siding south of Bridge Street.

The PAR no longer operates on the Northern Main Line past milepost 74.32, north of Route 202.

4.2 NEGS Operations

The NEGS currently is only serving customers north of Concord as needed (no regular service).

5.0 Proposed Future Rail Operations

The *New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis – Final Report* dated December 2014, details potential regional commuter rail operations proposed for this railroad corridor. This will have impacts on the portion of the railroad corridor adjacent to I-93. Additionally, if freight rail capacity improvement is desired in the future, improvements to the rail corridor may be necessary to provide for operational conflicts between future passenger and existing freight modes.

5.1 High Speed Rail

The Federal Railroad Administration (FRA) issued a press release dated July 20, 2016 detailing a central Massachusetts/Vermont connection to provide high speed rail service between Montreal and Boston. There is no current plan at this time to incorporate Concord in a high speed corridor to Montreal.

The *New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis – Final Report* also proposed further study for service similar to the Amtrak *Downeaster* to be utilized on the same commuter rail corridor connecting Concord to Boston.

5.2 Commuter Rail

The *2012 New Hampshire State Rail Plan* reports on page 81 that in June of 1999, the Nashua Regional Planning Commission completed a Major Investment Study (MIS) to evaluate alternatives for extending the MBTA commuter rail service to connect Boston with Nashua and to meet the requirements for filing an application for the FTA New Starts program. The MIS examined rail alternatives to help reduce congestion, particularly during peak-hour commuting.

The *New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis* has defined land-use policies to protect the existing rail corridors to retain the capacity for future rail. The probability of commuter service extensions from Boston to Nashua was discussed as a good first step but would not see the ridership or economic development as a line to Manchester which provides the most benefit at a high expense.

Summary/Classification Report Bow-Concord Interstate 93 Transportation Planning Study dated April 2008 included alternatives to incorporate the *Master Plan 2030 Concord* defined land-use policies to protect the existing rail corridors to retain the capacity for future rail service. The passenger rail service was a stand-alone alternative to provide passenger rail service to Concord instead of widening I-93. However, this alternative was considered unfavorable because of costly expense to implement passenger rail service where there currently is no service provided in the region. Also this would only address a small portion of the I-93 congestion. Moving forward from the summary/classification report, passenger rail service is still seen as a favorable component to other reasonable alternatives stated in the report and the likelihood of commuter rail service and high speed rail service from Boston to Concord still is a reasonable future possibility.

5.3 Freight Rail

The *New Hampshire State Rail Plan 2012* indicates that the total reported tonnage moved by rail in the State of New Hampshire in 2009 was 4.7 MGT and is projected to increase by 160% by 2040. The rail industry in general is experiencing a resurgence in rail traffic on both the passenger and freight sides as the benefits to public transportation are being realized in cleaner air, less highway traffic, and safer roads.

6.0 Possible Future Rail Facilities in the I-93 Project Area

The development of any commuter rail operations will require the provision for fixed plant facilities supporting those operations in the Concord area. It is anticipated that these ancillary facilities may likely be located within the Opportunity Corridor as presented in Section 2.3. In addition the increased use of the rail corridor by commuter rail operations may require modifications to the existing rail physical plant to improve the existing freight yard and switching operations (i.e. rebuilding track, relocating turnaround siding/spur, etc.) in order to reduce possible future conflicts between passenger and freight operations.

6.1 High Speed Rail Station

The New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis – Final Report proposed further study for service similar to the Amtrak *Downeaster* to be utilized on the same commuter rail corridor connecting Concord to Boston. Multimodal stations between Nashua and Manchester would be designed for high speed rail, commuter rail and freight requiring wide clearances for oversize loads. The *2012 State Rail Plan* and *Boston to Montreal High-Speed Rail Planning and Feasibility Study Phase 1*, dated April 2003, identified Concord as an Urban Intermediate Station with access to a major economic or tourism center. The station design criterion (in the study) indicates that the station should be located adjacent to the main line of the high-speed rail corridor. The report identifies that a basic premise of the high-speed rail design is that at-grade rail crossings shall be reduced or eliminated. The study also indicates (pages 2-43) that consideration should be given to expansion opportunities on a specific site that would include above and/or below ground parking garages (taking into account this area is within a floodplain). The economics of potential on-site versus off-site expansion should be considered for each station. The purchase of necessary areas for present and future needs should be considered as part of the first phase of project implementation.

6.2 Commuter Rail Station, Parking, and Layover Facility

In the *New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis*, cost were discussed to build and operate commuter stations and infrastructure throughout the I-93 area. The report also discussed the development of strategic land use planning that focuses on higher-density, mixed-use development near stations to reduce demand on the transportation network.

6.3 PAR and Sidetrack Facilities

Any rearrangement of rail facilities in the I-93 project area will have to provide for the existing PAR and current sidetrack customer operations and facilities, described in Section 3. Proposed relocations of these facilities required by the I-93 Bow-Concord project should be performed in a manner that protects the continued viability of the affected industry and is economically feasible for that industry. Scheduling of the rearrangement of such rail facilities would be incorporated into the project construction schedule during the final design stage of the I-93 Bow-Concord project.

6.4 Freight Rail Reconfiguration

Discussions with PAR found that the current freight yard operations use a five car passing track located south of Bridge Street. The PAR freight yard operations could be improved significantly by installing a cross over at the south end of the existing double track south of Water Street. This would allow the entire train to be run around at one time. PAR also proposed relocating the Team 1 and 2 tracks to a location at the south end of the Opportunity Corridor. However, any proposed reconfiguration would have to provide a track (similar to Track 10 north of Water Street) for the making up of trains. In addition, the reconstruction of a passing siding on the White Mountain Branch near the switch from the main line (a previous siding was removed during a hotel development project) would improve freight operations on the White Mountain Branch.

In order not to preclude future passenger rail service to and through this area, the existing rail corridor should be preserved and improved to provide a two track right-of-way with a minimum width of 50 feet. With this in mind, at-grade crossings should be eliminated and the horizontal geometry improved through the use of maximum 3 degree curves. Freight operations will need to be protected, possibly through the use of relocations that provide economically feasible rail service for sidetrack customers.

7.0 Railroad Design Criteria

Appropriate railroad design criteria have been taken from several different areas that provide for railroad facilities and railroad operations. These areas include criteria that protect railroad clearance and future railroad operations.

The criterion for track geometric design varies for freight and passenger rail operations and facilities. Generally accepted geometric design criteria, for each type of operation, is presented below. The sources for these criteria are the Massachusetts Bay Transportation Authority (MBTA) and the American Railway Engineering and Maintenance of Way Association (AREMA). The final design criteria will have to be determined and verified with the operating/owning railroad during the preliminary design stages of the project. The most restrictive criteria (freight or passenger) would be the controlling criteria for the design of the facility.

Considering the possible combinations of freight train, freight yard, freight sidetrack, commuter train, commuter stations, and commuter layover operations in the Concord Opportunity Corridor area, it would appear that a two track corridor through the Concord area should be reinstated. A two track corridor would provide the ability to design an efficient future rail operation in the Concord area to accommodate both freight and passenger rail. The possibility of reinstating two tracks through Concord is not currently possible at the "pinch point", identified in Section 2.2, where there is one single track alignment existing and the current railroad right-of-way width cannot accommodate more than one track without impacting existing development.

7.1 Railroad Clearance Criteria

The current *NHDOT Bridge Design Manual* (issued January 2015, revised April 2016) provides vertical clearance requirements in Chapter 2 Section 2.4.3. This manual refers to current AREMA Standards for horizontal track clearances. The pertinent clearances for the purposes of this document are as follows:

Track Centers (Main Line Tracks) ....15'-0"
Track Centers (Non-Main Line Tracks)..14'-0"
Private Track adjacent to any Main Track..18'-0"
Vertical Clearance ....22'-6"
Horizontal Clearance (Main and Passing Tracks)......................................9'-0"
Horizontal Clearance from Bridge (less requires crash walls) ....25'-0"
Horizontal Clearance from Crash Wall...12'-0"

The above dimensions are given for tangent and level track. They must be increased (as required) for curvature, super elevation, and other facilities such as inter-track fencing.

The *NHDOT Bridge Design Manual* also has included railroad clearance guidelines (Chapter 2, Section 2.4.3 Railroad Crossings Part E Vertical Clearances and Appendix 2.4-A2 issued January, 2015 and revised 4/01/2016). This section and appendix indicate that the minimum vertical clearance above top of rail is 22'-6" from top of high rail to bottom of low edge of bridge to meet the railroad clearance envelope, however 23'-0" is preferred. If site conditions will not allow these clearances for the railroad crossing to be achieved without considerable impacts, clearance may be reduced to 21'-0" with the Design Chief's approval, although this will restrict use of Phase II double stack containers and be a negative impact for corridor freight movements.

It should be noted that the current general outline for tangent track presented in the AREMA, *Manual for Railway Engineering*, Chapter 28 shows a vertical clearance of 23'-0" above top of rail and a side clearance of 9'-0" from the centerline of track (see Appendix for AREMA clearance information).

7.2 Freight Railroad Design Criteria

The main line freight rail design criteria, based on current industry design standards and AREMA standards, will be as follows:

- Speed: Federal Railroad Administration (FRA) Class 3 Track – 40mph;
- Grade: Maximum main line grade of 1.00%;
- Horizontal Curvature: No greater than existing curvature;
- Vertical Curvature (Rate of Change of Grade): 0.1 %/station (crest), 0.05%/station (sag);
- Superelevation: $E_a = 0.0007V^2D - E_u$ where V = Speed in mph, D = Degree of Curve (chord definition), E_a = Actual Superelevation, and E_u = Unbalanced Superelevation (3 inches - PAR); and,
- Capacity: 286,000 lb Phase II (full double stack) rail cars.

7.3 Passenger Railroad Design Criteria

The main line passenger rail design criteria, based on current MBTA, High Speed Rail, and AREMA standards will be expected to be as follows:

- Speed: FRA Class 4 Track – 80mph for Commuter Rail operations, FRA Class of Track and speed TBD based on High Speed Rail design criteria;
- Grade: MBTA allows a maximum grade of 1.50%;
- Horizontal Curvature: MBTA – the maximum degree of curve for main line tracks shall be 2 degrees (chord definition) with provisions for spirals;
- Rate of Change of Grade: Suggested maximum of r not to exceed 0.80%/station;
- Superelevation: $E_a = 0.0007V^2D - E_u$ where V = Speed in mph, D = Degree of Curve (chord definition), E_a = Actual Superelevation, and E_u = Unbalanced Superelevation (1.5 inches desirable);

- MBTA Commuter Rail Passenger Platforms: Platform length to provide for a minimum of three cars = 300 feet. The location of the platforms should be on the parking lot side of the main line. Inbound and outbound platform configurations will depend on site specifics; and,
- High Speed Rail Passenger Platforms: TBD based on High Speed Rail design criteria.

7.4 Commuter Rail Layover Facilities

Commuter Rail layover facilities for Commuter Rail operations should include the following items:

- Storage tracks for at-least two 830 foot long train sets;
- 480 volt standby power hookup for each train set;
- Containment structures at locomotive parking sites, complete with oil/water separator systems to prevent ground contamination;
- Access road alongside all storage tracks (with provisions for turning movements);
- Completely fenced area, including gates at the track entrances;
- Crew building, with attendant utility requirements; and,
- Parking lot for train crews.

8.0 Summary

During the development of the railroad corridor screening criteria, the existing and future conditions of the railroad corridor were studied. Assessment of the existing conditions found a railroad corridor and physical plant that was in fair to poor condition. However, that current condition is still adequate to support the freight operations of the Pan Am Railways and provide freight service to sidetrack customers in the Concord area and through Concord to Central New Hampshire. In addition, assessment of the railroad corridor future uses has found significant emphasis placed on both High Speed and Commuter Rail services. These services will require specific facilities that will need to be incorporated into any planning affecting the railroad corridor so that the future development of the railroad corridor will not be compromised.

Specifically, an assessment of the existing conditions and future needs of the railroad corridor adjacent to the I-93 corridor in the Bow-Concord area has revealed the following items:

- There is an existing freight railroad (PAR) with facilities and freight yard operations occurring in the Opportunity Corridor that supplies freight to rail customers between Manchester and Concord and to the north, to Central New Hampshire, on the White Mountain Branch.
- There are existing freight railroad customers in the Opportunity Corridor that are currently served by the PAR.
- Proposed future passenger operations of High Speed Rail and/or Commuter Rail services will require passenger station, parking, and intermodal transfer facilities within the Opportunity Corridor. Equipment layover facilities for commuter rail operations may be located within or outside of the Opportunity Corridor.

8.1 Project Purpose and Need[2]

8.1.1 Purpose

The purpose of the Interstate 93 Bow-Concord project is to address the existing and future transportation needs for all users of this four-mile segment of I-93, while balancing the needs of the surrounding communities, by providing a safe and efficient transportation corridor for people, goods and services.

8.1.2 Need

Mobility:

Interstate 93 is a principal north-south arterial Interstate highway within the State of New Hampshire and is part of the National System of Interstate and Defense Highways. The segment of Interstate 93 under study intersects two other Interstate highways, Interstate 89 and Interstate 393, providing a vital link for east/west travel, and passes through the City of Concord, the state capital.

[2] Bow-Concord Interstate 93 Environmental Assessment, September 16, 2015

Interstates 93, 89 and 393 carry a mix of traffic including trucks, cars and buses. The Interstate 93 corridor serves as an important link for New England wide tourist travel to the White Mountains, Lakes Region and Vermont, a regional commuting route for the Concord area, as well as an important local route. As one of the main arterials in the New Hampshire highway system, it is important to maintain the mobility of people, goods and services through this corridor.

Capacity:

Interstate 93 was constructed in the 1960's and now serves more than 70,000 vehicles per day with peak summer travel at over 85,000 vehicles per day. Traffic volumes on Interstate 93 through Bow and Concord tripled from 1980 to 2004. However, since 2004, traffic volumes have remained steady. Growth in the region is expected to occur in the coming years and place a greater burden on the transportation system. With an estimated 80,000 vehicle trips per day by the year 2035, increased congestion and increased travel times are expected, unless there is a reduction in demand, implementation of management strategies or improvements to this important regional travel corridor.

Regional Plans:

The project corridor is recognized by the State of New Hampshire and the Central New Hampshire Regional Planning Commission (CNHRPC) as a vital link for statewide travel as well as an important local route within Concord and the Central New Hampshire region. In recognition of these deficiencies, the project has been included in the State's Ten-Year Transportation Improvement Plan for years 2015 to 2024 as an unfunded priority, and is a top long-term transportation priority for the Central New Hampshire Regional Planning Commission (CNHRPC).

Safety:

The approximately four-mile project corridor currently contains numerous geometric deficiencies based upon current highway design standards. The deficiencies include: inadequate distances between entrance and exit ramps (causing weaving), short deceleration distances at exit ramps and short acceleration distances at entrance ramps. A review of the crash data for the period between 2002 and 2012 indicates many of the crashes occur at ramps or between ramps where the deficiencies exist, causing both property damage as well as injuries to drivers. As traffic volumes increase on Interstate 93, these geometric deficiencies will become more of a problem and crashes are anticipated to increase.

The corridor also contains three bridges currently on the "Red List" of state bridges which indicate the critical need for their replacement due to deterioration. Red-listed bridges are defined as those with "known structural deficiencies, poor structural conditions or weight restrictions."

Transportation Choice:

This project corridor accommodates various modes of transportation, but could improve access to those modes or accommodate additional modes. This in turn would make travel more efficient for all users. Commuter rail service is a possibility and bus service continues to expand in the region. Bow and Concord have networks of public trails within and near the project corridor and are actively expanding their networks in an effort to complete the Heritage Trail along the Merrimack River. The project has considered access to and augmentation of these trail systems.

8.2 Screening Criteria

The following screening criteria have been developed for the evaluation of I-93 Bow-Concord corridor study alternatives as they effect the railroad corridor. These criteria are considered to be essential for the protection of the existing and future uses of the railroad corridor.

- Alternatives must provide for the design criteria identified in Section 7.0;
- Alternatives must provide for the continued and uninterrupted operations currently occurring on the railroad corridor;
- Alternatives requiring relocation of existing railroad facilities and sidetracks must do so in a manner that will be economically feasible for the industries effected; and,
- Alternatives must provide for the railroad corridor needs consistent with proposed future High Speed Rail and/or Commuter Rail operations that have been included in area planning documents.

8.3 Future Considerations

The following opportunities have been identified from the perspective of protecting the existing railroad corridor and providing for future uses of the corridor:

- Provide for sidetrack relocations consistent with the development of the Opportunity Corridor that are economically feasible for the sidetrack customer;
- Restore a two track right-of-way through the Concord area to provide for efficient future passenger and freight operations;
- Provide improvements to the horizontal geometry of the existing railroad corridor by replacing the 5 degree curve located at the “pinch point” with a lesser degree curve consistent with future development of the corridor;
- Provide for future freight facilities that improve freight yard operations and movement of freight through the City of Concord to Central New Hampshire and Central New England connection points;
- Provide for future railroad passenger facilities (High Speed and Commuter Rail);

- Provide opportunity for the State of New Hampshire to acquire the railroad right-of-way from Bow to Boscawen (acquiring the right-of-way would minimize the number of takings that might be required and would allow the State more flexibility in the development of the I-93 Bow-Concord project);
- Eliminate any proposed at-grade crossings that may have been considered in the past; and,
- Reconstruct interchange runaround and set out track on state owned property.

Appendices

- Excerpts from AREMA *Manual for Railway Engineering*
- Excerpts from the NHDOT *Bridge Design Manual*
- References

APPENDIX A - AREMA *MANUAL FOR RAILWAY ENGINEERING*
SECTION 3.6 LEGAL CLEARANCE REQUIREMENTS
3.6.1 GENERAL (2004)

Table 28-3-3. Legal Clearance Requirements by State

State	Regulation Reference		Track Centers							
			Main Tracks	Any Two Subsidiary Tracks	Adjacent Subsidiary Track to Any Main Track	Ladder Track Adjacent to Any Parallel Track	Two Adjacent Parallel Ladder Tracks	Lead, Repair and Caboose Tracks	Team Tracks in Pairs	Unloading Tracks at Platforms
	2	3	4	5	6	7	8	9	10	11
NEW HAMPSHIRE	RSA 373:39	1957	14-0	14-0	15-0 C	18-0	18-0	14-0 (Note 18)	13-0	13-0

Table 28-3-3. Legal Clearance Requirements by State (Continued)

State	Vertical						Horizontal		
	General	Thru Bridges	Highway Bridges	Tunnels	Building Doors	In Buildings	General	Thru Bridges	Highway Bridges
	12	13	14	15	16	17	18	19	20
NEW HAMPSHIRE	22-0	22-0	22-0	22-0	17-0 (Note 3)	17-0	8-0 (Note 14)	8-0 (Note 14)	8-0 (Note 14)

Table 28-3-3. Legal Clearance Requirements by State (Continued)

State	Horizontal (Continued)								
	Tunnels	Building Doors	In Buildings	Platforms					
				A	B	C	D	E	F
	21	22	23	24	25	26	27	28	29
NEW HAMPSHIRE	8-0 (Note 14)	7-0 (Note 3)	8-0	0-12	5-4	4-0	5-9 (Note 7)		(Note 10)

Table 28-3-3. Legal Clearance Requirements by State (Continued)

	Horizontal (Continued)											
	Signals											
		Low, Between Tracks		Switch Boxes, Etc.								
State	High	Height	Clearance	Height	Clearance	Poles	Mail Cranes	Icing Docks	Ore And Coal Docks	Cattle Chutes	Wires	Pipelines
	30	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**
NEW HAMPSHIRE	8-6	3-2	5-5	0-4	3-0	8-6	6-1 (Note 11)	6-0	6-0	8-6		

THIS CHART FOR INFORMATION ONLY. NO LIABILITY CAN BE ASSUMED - CONSULT INDIVIDUAL STATE REGULATIONS FOR MORE DETAILED INFORMATION.

Architects, Contractors, etc., should check with railroad involved.

Dimensions:

- shown in feet and inches.
- are for tangent track - most laws specify increases for curved and superelevated track.
- Vertical - measured from top of rail.
- Horizontal - measured from centerline of track.
- apply to new construction, some reconstruction, and some extensions.
- some can be varied upon approval of application by governing body.
- are based on maximum car size for Arizona, California, Idaho, Minnesota, Montana, Nevada, North Dakota, Oregon, Washington, and West Virginia.
- all are minimum except columns 24, 26, 28, 31, and 33 which are maximum.

C = Conditional - See specific regulation

Columns:

2 - Shows basic regulation.
3 - Shows effective date or date of latest amendment.
7 and 8 - Apply to hand- and mechanically-operated switches except as noted.
12 and 18 - Prevails for all items not otherwise provided for.
13 and 19 - Bridges supporting tracks.
14 and 20 - Bridges spanning tracks.
24 and 25 - Passenger platforms.
26 and 27 - Freight platforms on side tracks except as noted.
28 and 29 - Freight platforms on side tracks / stepped platforms are not generally allowed.
35 - Other than trolley contact poles.
36 - To center of stand except as noted.
37 - Applies to both supports and platforms except as noted.

Notes:

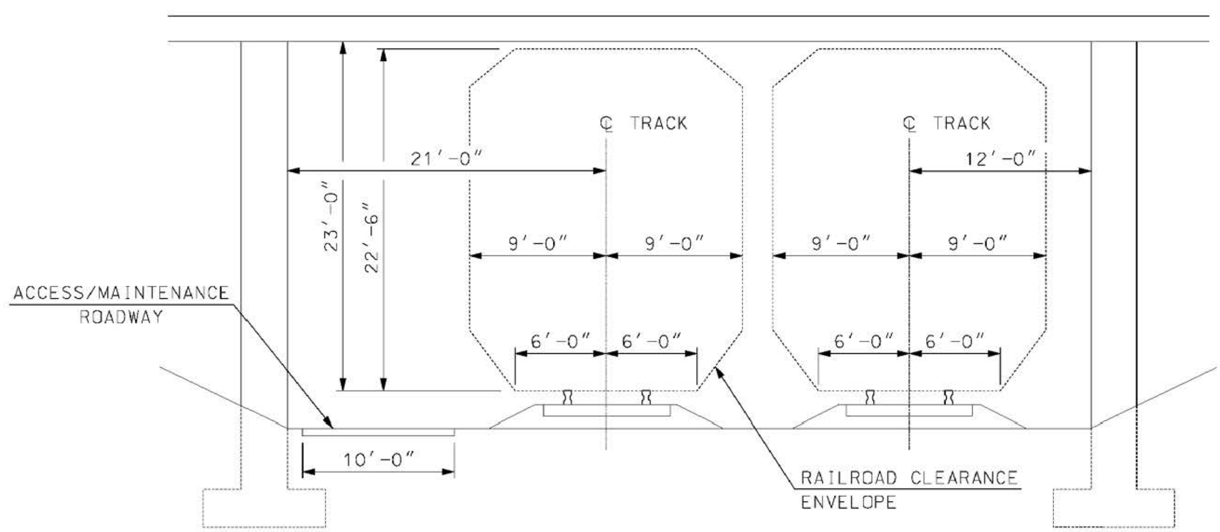
Note 3: Engine houses, shop buildings, tipples, and loading facilities permitted lesser dimensions.
Note 7: Only if 8-0 (7-3 for Montana and Wyoming; 8-6 for District of Columbia, Washington, Massachusetts and South Dakota) provided on opposite side.
Note 10: May be 8-0 at 4-6 for refrigerator car platforms only.
Note 11: To ends of arms in operating position
Note 14: 8-6 for main and passing tracks.
Note 18: Parallel lead tracks: 18-0.
Note 21: Must have additional side clearance of one-inch per 30 minutes of degree of curvature.

3.11.5 CLEARANCE DATA (1991)

a. Owner railroad should be responsible for maintaining up-to-date clearance data, both permanent and temporary. Adverse changes must be reported to both parties in a timely manner.

b. In the event tenant is the clearing party, owner railroad should furnish them with current data (i.e. clearance records, operating rules, timetable schedules, track charts, grade and curvature limits, rule books and general orders, etc.).

c. Future planning and improvement projects should not reduce the critical clearance envelope.



1. Clearances on a straight track shall not be less than those shown.
2. On a curved track, the lateral clearance each side of the track centerline shall be increased 1 ½" per degree of curvature in accordance with AREMA.
3. The clearances shown are for new construction. Clearances for reconstruction work or alterations are dependent on existing conditions and, where reasonably possible, should be improved to meet the requirements for new construction.

RAILROAD CLEARANCES

APPENDIX A - REFERENCES

1. NHDOT (December, 2014) *New Hampshire Capitol Corridor Rail & Transit Alternatives Analysis – Final Report*. Available: https://www.nh.gov/dot/org/aerorailtransit/railandtransit/corridor-rail-transit.htm

2. NHDOT (June, 2012) *2012 New Hampshire State Rail Plan.* Available: https://www.nh.gov/dot/org/aerorailtransit/railandtransit/documents/nhstaterailplan.pdf

3. NHDOT (July 2010) *NH Long Range Transportation Plan 2010-2030*. Available: https://www.nh.gov/dot/org/projectdevelopment/planning/documents/CompleteLRTP083110.pdf

4. NHDOT (April 2001) *New Hampshire State Rail Plan 2001*. Available: https://www.nh.gov/dot/org/aerorailtransit/railandtransit/documents/NHRailPlan.pdf

5. Parsons Brinckerhoff (April 2003) *Boston to Montreal High-Speed Rail Planning and Feasibility Study Phase 1.* Available: https://www.nh.gov/dot/org/aerorailtransit/railandtransit/documents/BostonMontrealHSR.pdf

6. AREMA (2017) *2017 Manual for Railway Engineering*. Available: https://www.arema.org/publications/mre/

7. NHDOT (issued January 2015, revised April 2016) *NHDOT Bridge Design Manual*. Available: https://www.nh.gov/dot/org/projectdevelopment/bridgedesign/manual.htm

8. NHDOT (April 2008) *Bow-Concord Interstate 93 Transportation Planning Study*. Available: http://www.i93bowconcord.com/Documents/Archives/Final%20Summary%20Classification%20Report.pc

9. NHDOT (September 2015) *Bow-Concord Interstate 93 Environmental Assessment*.

10. B&M (September 2016) *Northern Railroad Main Line Abandonment Notice*.

11. City of Concord (April 2005) *Concord Opportunity Master Plan.* Available: http://www.concordnh.gov/DocumentCenter/View/1663