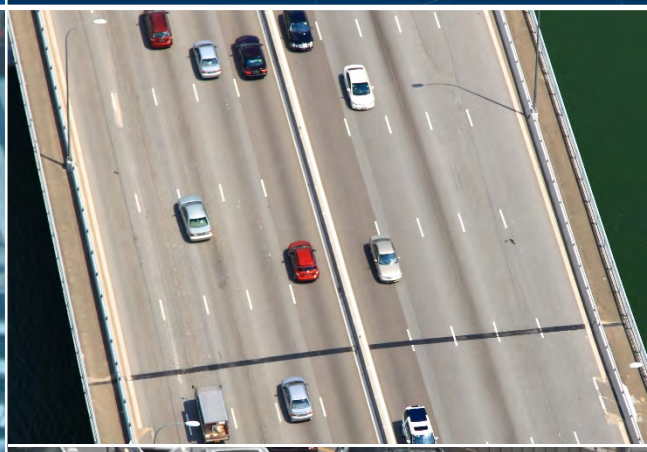
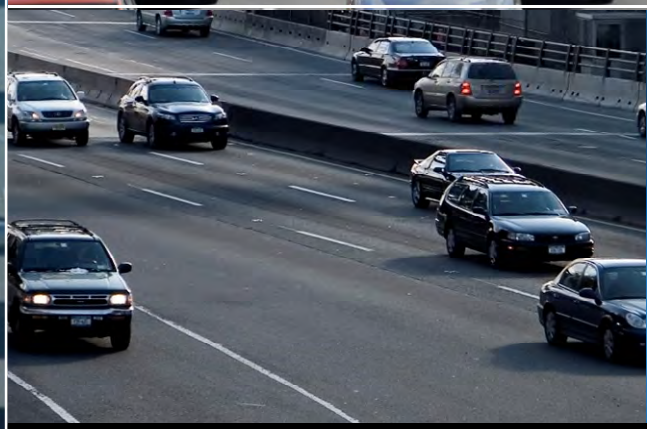
I-95 Improvements – Feasibility Evaluation Study (Greenwich to New Haven)

Technical Memorandum





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I-95 Improvements – Feasibility Evaluation Study (Greenwich to New Haven)

Executive Summary

The purpose of this technical memorandum is to evaluate the feasibility of adding one additional operational lane in each direction along I-95 between the Connecticut/New York state line in Greenwich and Bridgeport. Additionally, the study evaluates spot improvements that can be constructed between Bridgeport and New Haven, which will provide safety and operational improvements to the corridor. This evaluation is intended to be a high-level analysis of the constraints and issues with respect to adding the additional operational lane to I-95 and the associated impacts and costs.

As part of the analysis, the section of I-95 between Bridgeport and New Haven was reviewed to identify spot improvements that can be made to improve traffic operations since this section has sufficient capacity to accommodate existing and future volumes. The objective of the evaluation is to identify and develop early start projects which could be implemented with independent utility along with their anticipated construction, engineering, and inspection costs; as well as estimated impacts to rights-of-way and wetland areas.

This feasibility evaluation study focused on providing the Department with the following:

- Identification of the impacts and issues associated with adding one additional operational lane on I-95 between the Connecticut/New York state line in Greenwich and Bridgeport.
- Investigation of the various cross-sectional components that comply with current design standards (Unconstrained Section) as well as a develop a set of reduced "current design" standards (Combined Section), which would limit impacts to existing structures both carrying I-95 and crossing over I-95.
- Estimation of the quantity of wetland, right-of-way (ROW) and bridge structure impacts associated with adding one additional operation lane on I-95 between the Connecticut/New York state line in Greenwich and Bridgeport.
- Development of an estimate of probable costs for construction, engineering and inspection, environmental evaluations, and the identification of risks associated with the implementation process of an additional lane.

Methodology

This evaluation addressed the constraints and issues with respect to adding the additional operational lane, and was conducted in two phases as follows:

Phase 1: This phase consisted of existing data collection including assembling all available data on traffic conditions (volumes, crashes, congestion), bridges, major structures, wetland, right-of-way, and conducting a working group meeting with the Department to identify controlling design criteria.

Phase 2: This phase considered three options for I-95 widening at locations of structures carrying I-95 and at locations of structures over I-95.

1. **Constrained Section:** The Constrained Section consists of eight (8) 11' lanes (four in each direction), two (2) 10' right shoulders (one in each direction), and two (2) 4' left shoulders (one in each direction), a 6' wide median barrier and two (2) 1'-11" parapets (applicable only at locations of bridges carrying I-95). The total width of a typical Constrained Section at locations of bridges over I-95 and at locations of culverts is 122'. The total width of typical Constrained Section at locations of bridges carrying I-95 is estimated to be 125'-10". For locations that currently have entrance or exit ramps, an additional 12' lane per direction and additional widening is considered based on the ramp alignment. While this section was analyzed, it was not chosen as the recommended approach to future widening on or over existing structures, as it is undesirable to reduce travel lanes to 11' widths and maintain reduced shoulders for a continuous section. The Constrained Section was also not chosen as the recommended approach to widening along the corridor between structures, since the shoulder widths would not comply with current design standards. Reduced shoulder widths would negatively impact safety along the corridor and in performing future maintenance operations.

2. **Unconstrained Section:** The Unconstrained Section consists of eight (8) 12' lanes (four in each direction), two (2) 12' right shoulders (one in each direction), two (2) 12' left shoulders (one in each direction), a 6' wide median barrier, and two (2) 1'-11" parapets (applicable only at locations of bridges carrying I-95). The total width of a typical Unconstrained Section at locations of bridges over I-95 and at locations of culverts is 150'. The total width of a typical Unconstrained Section at locations of bridges carrying I-95 is 153'-10". For locations that currently have entrance or exit ramps, an additional 12' lane per direction and additional widening is considered based on the ramp alignment. The Unconstrained Section is to be used to construct I-95 to the ultimate width when widening between structures. This section should also be used at structures which require a full replacement. However, the Unconstrained Section should not be used if an existing structure does not require a full replacement, as right-of-way and structure impacts can be minimized by utilizing the Combined Section.

3. **Combined Section:** Based on further consideration by the Department, the "Constrained Section" was revised to reflect the utilization of 12' lanes in lieu of 11' lanes. Additionally, at structure locations, the cross section can be reduced to four (4) 12' lanes with reduced left and right shoulder widths to a minimum of 4' to avoid costly structure widening, in which existing structures are otherwise in acceptable condition. The total width of a typical Combined Section at locations of bridges over I-95 and at locations of culverts is 118'. The total width of typical Constrained Section at locations of bridges carrying I-95 is estimated to be 121'-10". To achieve the Combined Section at structures over I-95, barrier walls can

be utilized to protect abutments and piers. The Combined Section was chosen as the recommended approach to widening the corridor in the interim at structures which currently did not need to be replaced.

Analysis

The following information was assembled from various sources as part of Phase 1 of the study:

Mapping

- Aerial high-definition video of corridor operations along I-95 between Greenwich and New Haven was captured during the morning and evening peak periods to identify areas that are current bottlenecks and to assist in the evaluation of the various operational conditions that exist along the corridor.

- Base mapping for the corridor provided by the Department for existing highway right-of-way lines was used to identify wetland boundaries and property line data. This was used to evaluate the impacts to the various components and constraints along the alignment. Throughout the corridor, adequate right-of-way exists to support a widened facility.

Geometrics

- The feasibility of adding an additional operational lane between the New York state line and Bridgeport was studied by applying two different cross sections, the Unconstrained Section and the Combined Section. During the development of the analysis, a consensus was reached to use a "Combined Option" as the recommended approach. This option utilized 12' lanes and 12' shoulders throughout most of the corridor, which is consistent with the Unconstrained Section. However, in locations of structures, box culverts, and wetlands, where the reduction of the shoulder width could reduce impacts or the need to replace/ widen a structure, the Combined Section was used. At these more constrained locations, left shoulders will be reduced to a minimum width of 4', while right shoulders will be reduced to a minimum width of 10'. Retaining wall locations were identified to assist in reducing impacts.

Traffic Volumes

- The I-95 Corridor Congestion Relief Study/Value Pricing Pilot Program (VPPP) Data Collection/Existing Conditions report was used to assemble volume and congestion data and evaluate hot spots and congested locations. As part of the study initiated in 2013, speed, travel time and density/Level of Service (LOS) data were collected and analyzed from various sources including anonymous real-time cellphone INRIX data, Skycomp Aerial Video, and Photo Surveillance data. For example, the data showed that during the AM peak period in the Southbound direction, significant delay is evident between Greenwich and Bridgeport. Specifically, during the 8:00-9:00 AM hour, a through trip between New Haven and the New York State Line experienced 20 minutes of delay on average, with 18 minutes of that delay occurring between Bridgeport and Stamford.

Crashes

- Crash analysis was conducted to determine the impact of daily traffic volumes and mainline I-95 geometry on operating conditions. Crash records for I-95 from the most recent three-year

period (2014-2016) were assembled and analyzed from CTDOT/University of Connecticut (UConn) "Connecticut Crash Data Repository" website. Crashes are listed by date and include data on location, crash severity, crash type, road surface condition, and work zone related crashes. Crash rates (measured as number of crashes per Million Vehicle Miles Traveled - MVMT) were highest in two locations along the corridor in the Northbound direction; New Haven, between Exit 44 off-ramp and on-ramp from Ella Grasso Blvd. (7.9 crashes/MVMT); and Norwalk between the on-ramp from Scribner Avenue and Exit 14 off-ramp (6.4 crashes/MVMT), both of which have had ongoing construction activity. In the Southbound direction, the crash rate was highest in New Haven between the on-ramp from Route 34 and Exit 46 off-ramp (Long Wharf Drive) (9.9 crashes/MVMT).

Traffic Operations

- Simulation models were developed to estimate the effects of different widening alternatives. Five (5) different 2040 build (widening) conditions were analyzed, along with a 2040 No Build scenario. Two (2) additional No Build simulation models were assembled to estimate the traffic operation which would be obtained by adding a lane along certain segments of the roadway. The two additional No Build simulation runs were due to projects currently under construction.

- Significant operational improvements were recognized by adding lanes either in the northbound or southbound directions during peak directional periods. As an example, by adding a lane in the southbound direction between the New York State Line and Exit 9 in Stamford, a 9% decrease in Vehicle Hours of Travel (VHT) and a 35% decrease in Vehicle Hours of Delay (VHD) are realized. Similarly, adding a lane in the Northbound Direction between Exits 19 and 28 produced a 35% reduction of delay per vehicle. Additional simulations may reveal other areas where a lane could be added to improve operations.

Structures

- Structures along the corridor from Greenwich to Bridgeport number 120. 80 of these carry I-95 over local roadways, railroads or bodies of water. Seven (7) culverts also are present along the corridor and 33 structures carry local facilities over I-95.

Within the corridor, there are eight (8) major structures which will require varying degrees of modifications or total replacement to allow for adding an additional lane:

  - Mianus River Bridge (06015) – widening.
  - Stamford Area Structures (00027, 00028, 00029, and 00031) and retaining walls—widening and special study area.
  - I-95 over Metro-North Railroad (00032) - replacement, requires special study.
  - I-95 over Norwalk River (Yankee Doodle Bridge - 00059)—Replacement requires special study.
  - I-95 over Saugatuck River (00064)—widening.

Each structure was analyzed to determine the need for widening, replacement or modification to accommodate the different widening conditions to incorporate a fourth lane.

- 37 require complete replacement
- 59 can accommodate a reduced section
- 32 require widening

Interchanges

- Between Greenwich and Bridgeport, there are 27 interchange locations which will require improvements in varying degrees and complexity in order to add an additional lane in each direction. Of those 27, a number of interchange areas will require additional analysis, simulation and further study to identify the most effective treatment for these areas. Projects which are implemented in the future will evaluate interchange operations within the project limits. The following projects have the potential for improving operational capacity and safety. Specifically, the modifications to the following areas will represent a significant improvement to traffic flow:
  - Stamford Exits 7-9 including Bridge 32 over Metro-North
  - Norwalk Exit 13-16 including the Norwalk River Bridge
  - Exit 22-24 in Fairfield with closely spaced interchanges and local access roadways
  - Exit 27 – I-95/Route 8 Ramp Geometrics

Hot Spot Locations – Bridgeport to New Haven

Between Bridgeport and New Haven three (3) areas were identified for improvement:

- Exit 27A (I-95/Route 8/Route 25 Interchange)- Exit 27A is major interchange that provides access to Route 8/Route 25 in Bridgeport. During the morning and evening peak periods, this segment of I-95 experiences heavy congestion because of mainline and ramp capacity constraints, closely spaced ramps and steep ramp grades. These problems are expected to get worse in the future with traffic growth in the area.

- Exit 38 (Milford Parkway Connector to Wilbur Cross) – Exit 38 is a major interchange that provides access to Route 15 in the Milford area. At this location, the operational shortcomings include inadequate weaving distances in the Northbound section within the clover leaf interchange and a lack of ramp capacity in the Southbound direction. Potential improvements at this interchange include providing a direct connector flyover from Southbound Milford Parkway to Northbound I-95. Potential improvements also include adding an additional operational lane between Interchange 38 and Interchange 39 in both directions and widening of the Milford Parkway ramp to I-95. Bridge reconstruction at Wheeler's Farms Road will also be necessary.

- Exit 39 (Boston Post Road/Route 1) and Exit 40 (Woodmont Road) – Exit 39 is also a major interchange that provides access to Route 1 in Milford. Due to the proximity of significant commercial development near this interchange, there is a high volume of ramp movements and the existing cloverleaf interchange does not provide adequate weaving length in the

Northbound or Southbound directions. Consideration should be given to the reconstruction of this interchange by providing either a full movement diamond or through a single point urban interchange. Modifications to the off-ramp geometry from I-95 Southbound to Route 1 Northbound will also be required. A I-95 Northbound operational lane and Southbound operational lane to and from Exit 40 at Woodmont Road will also improve operations on I-95.

Cost Estimating

To model the uncertainty and variability of the construction costs associated with the widening of I-95 per the Combined Option, a Monte Carlo[1] simulation was performed on the base cost estimate that was developed for the project. The purpose of this analysis was to evaluate the risk and sensitivity of elements within the cost estimate and the risks and sensitivity of the total project cost to those changed conditions.

- A base cost estimate was developed to determine a unit cost per directional mile for the construction of an additional operational lane on I-95 from the New York border to Bridgeport. All estimate quantities were calculated based on a total directional length of 30 miles of Northbound widening and 30 miles of Southbound widening (60 miles total).
- A risk analysis was conducted to define the ranges of uncertainty and variability for each item in the base cost estimate. A Monte Carlo simulation was then performed to evaluate the risk and sensitivity of the individual cost elements. This analysis was used to highlight how the total project cost is subject the variability of each individual element.
- Based on the analysis, a summary of observed results was formulated, which includes:
    - the top five mean cost elements
    - the top five cost elements by potential cost range
    - and the cost probability and tornado charts for total cost with and without escalation/inflation.

All cost is on a per mile basis. Based on the risk analysis, the total project cost to add an operational lane to I-95 for 30 miles of Northbound I-95 and 30 miles of Southbound I-95 (60 total miles of additional operational lanes) was determined. Including escalation, the total approximate cost to construct 60 miles of an additional operational lane between the New York state line and

[1] A Monte Carlo simulation is a modeling technique which accounts for risk in both quantitative analysis and decision making. Monte Carlo provides a range of possible outcomes and probabilities for each element in the cost estimate. To develop the range of outcomes for cost elements and the total project, the Monte Carlo model simulates each item 10,000 times based on a defined cost range and probability distribution curve for each element. Each simulation uses a distinct set of values for each cost element based on these defined ranges and distribution curves.

Bridgeport is anticipated to range between $5.5 billion and $10.6 billion with a 95% confidence interval cost of $9.7 billion.

Recommendations for Next Steps

Following several meetings and workshops with the Department, the following course of action and resultant recommendations will be pursued.

- Prepare a Strategic Implementation Plan for initiation of directional improvements which will yield the greatest reduction in delay and improved travel time;
- Implement Short-Term projects and further evaluation of special study areas;
- Conduct additional Micro Simulations and improvements to determine benefits in delay reduction and travel time to determine phasing;
- Coordinate future bridge improvements to accommodate Unconstrained Section Elements;
- Use 12' travel lanes to implement an additional lane in areas targeted for implementation using standard shoulder widths to the greatest extent possible, and reduced shoulder widths at structures that do not require replacement/reconstruction.

1.1 Introduction

The purpose of this technical memorandum is to evaluate the feasibility of adding an additional operational lane in each direction along I-95 between the New York state line in Greenwich and Bridgeport. Additionally, the study evaluates spot improvements between Bridgeport and New Haven. This evaluation is intended to be a high-level analysis of the constraints and issues with respect to adding the operational lane and has been conducted in two phases as follows:

1. Phase 1- This phase consists of existing data collection including all available data on Traffic Conditions (Volumes, Crashes, Congestion), Bridges, Major Structures, Wetland, Right-of-way (ROW) and conducting a working group meeting with the Department in identifying design criteria.

2. Phase 2- This phase considered three options for widening feasibility:
    1. Unconstrained Option - Providing for the full design desired cross section of 12' travel lanes and 12' left and right shoulders.
    2. Constrained Option- Providing reduced cross section consisting of 11' travel lanes reduced shoulder widths of 4' for left shoulders and 10' for right shoulders at structures to avoid the need for replacement.
    3. Combined Option – Providing 12' travel lanes with reduced left and right shoulder widths of a minimum of 4' over and under structures to avoid the need for replacement. This option was chosen to be analyzed over the Constrained Option since it was deemed necessary to maintain 12' travel lanes but reduce shoulder widths where possible to prevent the replacement of bridge structures along the corridor.

Additionally, the section of I-95 between Bridgeport and New Haven was reviewed to identify spot improvements since this section has sufficient capacity to accommodate existing and future volumes. The objective of the evaluation is to identify and develop early start projects which could be implemented with independent utility along with their anticipated construction, engineering, and inspection costs; as well as impacts to rights-of-way and wetland areas.

This technical memorandum (tech memo) summarizes the efforts of Phases 1 and 2 of the project, and summarizes the impacts and costs associated with the proposed widening.

2.1 Objective

This feasibility evaluation study focuses on providing the Department with the following:

- Identify the impacts and issues associated with adding an operational lane on I-95 between the New York state line in Greenwich and Bridgeport.
- Incorporate the various cross-sectional components that comply with current design standards (Unconstrained Section) as well as a set of reduced "current design" standards (Combined Section). Tables 1 and 2 summarize design standards for the preferred Unconstrained and Combined Sections respectively.
- Quantifying the extent of wetland, right-of -way (ROW) and bridge structure impacts.

- Developing an estimate of probable costs for construction, engineering, and inspection and the identification of risks associated with the process to construct an additional operational lane on Northbound and Southbound I-95.

Table 1 – Design Criteria (Unconstrained Section)

Description	Design Standard (Unconstrained Section)
Design Classification	Freeway
Design Speed	60 MPH
Lane Width	12’
Number of Lanes	4 Lanes
Shoulder Width (Left)*	12’
Shoulder Width (Right)*	12’
Median Barrier Width	6’
Clear Zone	30’
Bridge Underpass Width	Meeting roadway width plus clear zone
Minimum Radius	2050’
Maximum Grade (Mainline)	4%
Maximum Grade (Ramps)	3% - 5%
Superelevation (emax)	6%
Minimum Vertical Clearance	16’-3”

Table 2 – Design Criteria (Combined Section)

Description	Design Standard (Combined)
Design Classification	Freeway
Design Speed	60 MPH
Lane Width	12’
Number of Lanes	4 Lanes
Shoulder Width (Left)*	12’ – Taper to 4’ minimum at structures*
Shoulder Width (Right)*	12’ – Taper to 4’ minimum at structures*
Median Barrier Width	6’
Clear Zone	30’
Bridge Underpass Width	Meeting roadway width plus clear zone
Minimum Radius	2050’
Maximum Grade (Mainline)	4%
Maximum Grade (Ramps)	3% - 5%
Superelevation (emax)	6%
Minimum Vertical Clearance	16’-3”

Note:
** Shoulder widths are to be reduced to these minimums when traveling over and crossing under existing bridge structures to minimize structure replacements. In all other areas, the Unconstrained Section should be utilized.*

3.1 Methodology

3.1.1 Data Collection

As part of Phase 1 of the study, information from various sources were assembled including base mapping, aerial video, bridge inventory, and reports of past studies performed in the Southern

Connecticut region along I-95 to evaluate existing conditions. The following section describes the data collection and summary efforts.

3.1.1.1 Aerial Video/Traffic Operations

PhotoFlight Aerial Media was contracted to record aerial high-definition video of corridor operations along I-95 between Greenwich and New Haven during the morning and evening peak periods. The video was recorded on June 8, 2016 (Wednesday) by a helicopter flying in the Northbound and Southbound direction, once in each direction, between 6:45-7:45 AM during the AM peak period (6:00-10:00 AM) and between 4:15-5:15 PM during the PM peak period (3;00-7:00 PM). The video was intended to identify areas that are current bottlenecks and to assist in the evaluation of the various operational conditions that exist along the corridor. Tables 3 through 6 below summarize the observations by direction of the aerial video review from two flights during the morning and evening peak hours along I-95, a total of four flights.

Table 3- AM Southbound Direction Observations

Town	Observations
New Haven/ West Haven	• No issues/ delay observed SB in advance of at West River New Haven/ West Haven line, although this is typically a crunch point. Only PM congestion observed.
Milford	• Short weave between US 1 NB on-ramp and Exit 39A (US 1 SB) off-ramp.
Fairfield	• Mainline congestion Exit 20 (Bronson Rd.) off-ramp and Mill Plain Rd. (Exit 21) on-ramp. • Mainline congestion between Maple Lane (Westport) and Center Street (Exit 19) on-ramp. • Crash near Westport.
Southport	• Exit 19 SB (US 1) off-ramp backed up on to I-95 Mainline because of STOP sign @ Paese Ave.
Norwalk	• Mainline heavily congested from Richards Avenue Overpass to Sherwood Island Connector (Exit 18) in Westport, CT. • Heavy Rt. 7 SB on-ramp (Exit 15) volume. Weaving issues with mainline traffic. • Weaving issues between East Ave. (Exit 16) on-ramp and Exit 15 off-ramp. • Crash near Richards Avenue overpass.
Darien	• Heavy on-ramp merge from US 1(Exit 13)
Stamford	• Heavy off-ramp volume to Exit 6 (West Ave.). • Heavy on-ramp volume from Washington Blvd. • Congestion between Exit 7 (Atlantic St.) and on-ramp from Washington Blvd. • Mainline dense and congested between Washington Blvd. on-ramp and Exit 7 (Atlantic St.) off-ramp. • Heavy on-ramp volume from Atlantic St. on-ramp.
Greenwich	• Mainline moving slowly between Indian Field Road (Exit 4) on-ramp and Exit 3 off-ramp. Short deceleration lane to Exit 3. • Mainline moving slowly between Harvard Road (Exit 6) on-ramp and Exit 5 off-ramp.

Table 4- AM Northbound Direction Observations

Town	Observations
Greenwich	• Off-ramp to Truck weigh station backs up on to I-95 mainline blocking right lane. • Congestion between Truck weigh-station off-ramp and CT/NY State border.

Town	Observations
Stamford	• Heavy on-ramp volume from West Ave. (Exit 6). Off-ramp to Exit 7 is heavy too. • Weaving issues between Exit 6 and Exit 7. Short weaving distance. • Exit 8 (Atlantic St.) off-ramp is backed up on to I-95 mainline blocking right lane.
Milford	• Short weave between Milford Parkway SB on-ramp and Exit 38 (Milford Parkway NB) off-ramp. • Short weave between US 1 SB on-ramp and Exit 39B (US 1 NB) off-ramp.
New Haven	• Congestion between Exit 42 (Saw Mill Rd.) and Exit 44 (Ella Grasso Blvd.)

Table 5- PM Northbound Direction Observations

Town	Observations
Greenwich	• Mainline heavily congested between Exit 3 (Arch St.) off-ramp and Exit 8 off-ramp.
Stamford	• Off-ramp to Exit 8 is backed up on to I-95 Mainline. • Mainline traffic clears up North of Exit 8 Off and on-ramp from Greyrock Pl. • Mainline heavily congested North of on-ramp from Greyrock Pl. (Exit 8) to Exit 10 (Darien).
Darien	• Mainline heavily congested between Exit 10 (Noroton Ave.) off-ramp and East Ave. (Exit 16) on-ramp (Norwalk).
Norwalk	• Mainline heavily congested between Exit 16 (Rt. 7 Ave.) and Exit 25 (Commerce Dr.) off-ramp. • Area under construction
Bridgeport/ Stratford	• Mainline congested between Commerce Dr. (Exit 25) on-ramp and Rt. 8 NB off-ramp (Exit 27A). • Mainline heavily congested between Rt. 8 SB on-ramp and Exit 30 (Hollister Ave.) off-ramp.
Milford/ Orange/ New Haven	• Short weave between Milford Parkway SB on-ramp and Exit 38 (Milford Parkway NB) off-ramp. • Short weave between US 1 SB on-ramp and Exit 39B (US 1 NB) off-ramp. • Mainline heavily congested between Exit 39B (US 1) off-ramp and New Haven.

Table 6- PM Southbound Direction Observations

Town	Observations
Milford/ Orange/ New Haven	• Mainline congestion between Exit 41 (Marsh Hill Rd.) off-ramp and Exit 38 (Milford Connector) off-ramp. • Exit 38 Exit lane slows down and backs up on to Mainline I-95. • Short weave between US 1 NB on-ramp and Exit 39A (US 1 SB) off-ramp. • Mainline heavily congested between New Haven and Exit 43 (1st Ave.) off-ramp.
Bridgeport/ Stratford	• Exit 27A (Rt. 8) off-ramp backed up on to mainline I-95. • Mainline congested between Exit 30 (Surf Ave.) off-ramp and Seaview Ave. (Exit 29) on-ramp.
Stamford	• Mainline heavily congested from Exit 6 to Darien rest stop on-ramp.
Greenwich/ Stamford	• Mainline congested between Harvard Avenue (Exit 6) on-ramp and NY/CT border.

3.1.2 Aerial Base Mapping

Base mapping for the corridor was provided by the Department based on 1983 aerial topographic LIDAR surveys including existing right-of-way mapping along I-95 for existing highway right-of-way lines. A Digital Terrain Model (DTM) was developed using the mapping with a 3D set of contour files and a 5' contour interval. Horizontal and vertical baselines were replicated in Bentley's InRoads Software to develop the scenarios for Combined and Unconstrained Options.

A detailed base plan incorporating the aerial mapping as well as wetland boundaries and property line data for each of the communities was incorporated into a Geo Data Base. This was used to evaluate the impacts to the various components and constraints along the alignment.

3.1.3 Previous Studies Along I-95

The I-95 Corridor Congestion Relief Study/Value Pricing Pilot Program (VPPP) Data Collection/Existing Conditions report[2] provided most of the current, if not all volume and congestion data to be used in evaluating hot spots and congested locations. As part of the study initiated in 2013, speed, travel time and Density/LOS data were collected and analyzed from various sources including anonymous real-time cellphone INRIX data and Skycomp Aerial Video and Photo Surveillance data. The following sections summarizes the results of the data analysis from those two sources.

3.1.3.1 INRIX Speed and Travel Time Data

To illustrate the build-up and duration of congestion across time and space," heat" maps were produced for I-95. Figures 1 through 4 in Appendix A show speed ranges as color bands across the entire length of the I-95 corridor for each travel direction over the AM and PM peak periods. The X-axis of the graphic is to scale by mile post and the y-axis is the selected time frame. The green color range illustrates speeds from 70mph to 60mph; yellow to light orange illustrates decrease in speed from 55mph to 40mph and dark orange to red illustrate speeds of 35mph to 20mph.

Figure 1 in Appendix A displays the Northbound direction of I-95 from Greenwich to New Haven between 6AM and 12:00 Noon. Very little delay is found to occur during the Northbound AM period. The slight degradation of speeds in the vicinity of New Haven can likely be attributed to the ongoing I-95 New Haven Harbor Crossing Corridor Improvement Program.

During the AM peak period in the Southbound direction (Figure 2 in Appendix A) significant delay is evident by the large swath of red and orange in the figure between 6:30-10:00 AM. Although there is some delay experienced between 7:30-9:30 AM between Stamford and Greenwich, most of the congestion is experienced between Bridgeport and Stamford. Table 7 shows the average speeds during 8:00-9:00 AM hour for a trip between New Haven and the New York state line and between Bridgeport and Stamford. During the peak 8:00 AM hour, 20 minutes of delay are being experienced on average for a through trip, with 18 minutes of that delay occurring between Bridgeport and

[2] CTDOT, I-95 Corridor Congestion Relief Study/Value Pricing Pilot Program (VPPP) Report, September 2016
http://www.dotdata.ct.gov/ct_congestion_site/documents/final/FULL%20PDF%20OF%20FINAL%20REPORT.pdf

Stamford. The additional 18 minutes of travel time over this 24-mile trip is an increase of more than 80% when compared to a delay free trip. Significant variation across the months occurs, with May and June having the highest levels of delay and the months of January and February having the lowest. On an average weekday in May and June, average delay increases significantly to around 40 minutes. It should be pointed out that the month of November should be considered somewhat of an anomaly in 2012 as Super Storm Sandy had significant impacts to travel in the northeast, including to Metro North and in particular to rail stations and subway lines in New York City. Improvements in the Long Wharf Area of New Haven were still under construction and not completed at the time of the INRIX data. Section 3.1 Simulation revised the existing condition at Long Wharf for the future condition.

Table 7- Average Weekday Southbound AM Peak Hour Speed and Delay (8:00-9:00 AM)

Time Period	New Haven to Greenwich (47 miles)			Bridgeport to Stamford (24 miles)		
	Travel Time (minutes)	Travel Speed (mph)	Delay (minutes)	Travel Time (minutes)	Travel Speed (mph)	Delay (minutes)
Freeflow	**44**	**65**	**0**	**22**	**65**	**0**
Average	**64**	**44**	**20**	**40**	**36**	**18**
JAN	56	50	12	32	45	10
FEB	52	54	8	29	50	7
MAR	60	47	16	36	40	14
APR	64	44	20	40	36	18
MAY	85	33	41	59	24	37
JUN	82	34	38	57	25	35
JUL	65	43	21	40	36	18
AUG	61	46	17	37	39	15
SEP	72	39	28	47	31	25
OCT	75	38	31	50	29	28
NOV	72	39	28	46	31	24
DEC	60	47	16	36	40	14

Data Source: INRIX

Figure 3 in Appendix A displays the Northbound direction between 3:00-9:00 PM. The swath of yellow and orange colors spans across 5 hours between Stamford and Norwalk. Similar to the AM Southbound direction, congestion on average is shown to be significant between Bridgeport and Greenwich, spanning nearly 4 hours in duration. Table 8 shows the average speeds during the 5:00-6:00 PM hour for a trip between the New York state line and New Haven and between Bridgeport and Stamford. During the peak 5:00 PM hour, 20 minutes of delay are being experienced on average for a through trip, with 16 minutes of that delay occurring between Stamford and Bridgeport. The

additional 16 minutes of travel time over this 24-mile trip is an increase of more than 70% when compared to a delay free trip.

Table 8 Average Weekday Northbound PM Peak Hour Speed and Delay (5:00-6:00 PM)

Time Period	Greenwich to New Haven (47 miles)			Stamford to Bridgeport (24 miles)		
	Travel Time (minutes)	Travel Speed (mph)	Delay (minutes)	Travel Time (minutes)	Travel Speed (mph)	Delay (minutes)
Freeflow	**44**	**65**	**0**	**22**	**65**	**0**
Average	**64**	**44**	**20**	**38**	**38**	**16**
JAN	54	52	10	30	48	8
FEB	52	54	8	29	50	7
MAR	57	49	13	33	44	11
APR	68	41	24	40	36	18
MAY	74	38	30	45	32	23
JUN	87	32	43	52	28	30
JUL	70	40	26	39	37	17
AUG	73	39	29	42	34	20
SEP	61	46	17	36	40	14
OCT	62	45	18	38	38	16
NOV	74	38	30	47	31	25
DEC	70	40	26	44	33	22

Data Source: INRIX

Figure 4 in Appendix A displays the Southbound direction of I-95 from Greenwich to New Haven between 3:00-9:00 PM. Some delay is evident through Greenwich and into Stamford between 5:00-7:00 PM reflecting the reverse commute out of Connecticut toward New York.

3.1.3.2 Skycomp Aerial Surveillance Data

Additional data on queuing and bottlenecks was collected for the VPP Study through Skycomp surveillance of AM and PM peak hours of I-95 between New Haven to the NY/CT border. Using a fixed-wing airplane to photograph the survey area, Skycomp collected high-resolution overlapping digital photographs during morning and evening peak hours, suitable for the extraction of traffic densities and queue lengths along I-95. The data was summarized from three flight days during morning and evening peak hours along I-95. In total, twelve flights were completed to provide average weekday queuing and bottleneck statistics.

Figures 5 through 8 in Appendix A illustrate performance rating (Level of Service) tables of traffic conditions on I-95 for morning and evening periods. The ratings are presented in tables by highway

segment, by direction, and by time slice. Each rating represents the average of approximately three flyovers (from three different days). The ratings are density-based level-of-service (LOS) designations A, B, C, D, E, and F, as defined in the Highway Capacity Manual (HCM). The definitions from the 2010 HCM are given below:

LOS A describes free-flow operations. Free-flow speed (FFS) prevails on the freeway, and vehicles are almost completely unimpeded in their ability to maneuver within the traffic stream. The effects of incidents or point breakdowns are easily absorbed.

LOS B represents reasonably free-flow operations, and FFS on the freeway is maintained. The ability to maneuver within the traffic stream is only slightly restricted, and the general level of physical and psychological comfort provided to drivers is still high. The effects of minor incidents and point breakdowns are still easily absorbed.

LOS C provides for flow with speeds near the FFS of the freeway. Freedom to maneuver within the traffic stream is noticeably restricted, and lane changes require more care and vigilance on the part of the driver. Minor incidents may still be absorbed, but the local deterioration in service quality will be significant. Queues may be expected to form behind any significant blockages.

LOS D is the level at which speeds begin to decline with increasing flows, with density increasing more quickly. Freedom to maneuver within the traffic stream is seriously limited and drivers experience reduced physical and psychological comfort levels. Even minor incidents can be expected to create queuing, because the traffic stream has little space to absorb disruptions.

LOS E describes operation at capacity. Operations on the freeway at this level are highly volatile because there are virtually no usable gaps within the traffic stream, leaving little room to maneuver within the traffic stream. Any disruption to the traffic stream, such as vehicles entering from a ramp or a vehicle changing lanes, can establish a disruption wave that propagates throughout the upstream traffic flow. At capacity, the traffic stream has no ability to dissipate even the most minor disruption, and any incident can be expected to produce a serious breakdown and substantial queuing. The physical and psychological comfort afforded to drivers is poor.

LOS F describes breakdown, or unstable flow. Such conditions exist within queues forming behind bottlenecks. Breakdowns occur for a number of reasons:

- Traffic incidents can temporarily reduce the capacity of a short segment, so that the number of vehicles arriving at a point is greater than the number of vehicles that can move through it.
- Points of recurring congestion, such as merge or weaving segments and lane drops, experience very high demand in which the number of vehicles arriving is greater than the number of vehicles that can be discharged.
- In analyses using forecast volumes, the projected flow rate can exceed the estimated capacity of a given location.

In all cases, breakdown occurs when the ratio of existing demand to actual capacity, or of forecast demand to estimated capacity, exceeds 1.00.

Figures 5 and 6 in Appendix A provide similar and consistent findings to the INRIX speed data, further illustrating the significant queuing and bottlenecks experienced on the I-95 corridor during the AM peak period. During the AM peak in the Southbound direction, travel operations are at LOS of "F" from the Bridgeport/Stratford town line at Exit 30 until the Norwalk/Darien town line at exit 12. From there, conditions ease to LOS of "D" with pockets of "E" and "F" until Exit 3. The duration of LOS "F" spans several hours. In the Northbound direction, LOS "E" and "F" were observed between I-287 and Exit 7 in Stamford. A small pocket of near breakdown conditions was observed between Exits 13 and 14 in Norwalk.

Figures 7 and 8 in Appendix A display the same information for I-95 during the PM peak period. In the Northbound direction LOS "F" begins south of Exit 4 and continues to Exit 27 in Bridgeport. As shown, this breakdown condition spans the entire survey period during the evening commute. In the Southbound direction, high densities were recorded between the New York State line and Exit 8 in Stamford indicative of the reverse commute back to New York.

3.1.4 Corridor Analysis Application of Typical Sections

The feasibility of adding an operational lane between the New York state line and Bridgeport was tested by applying two different cross sections- Unconstrained and Combined. Figure 1 shows the existing and planned Unconstrained/Combined Sections. During the development of the analysis, a consensus was reached to use an approach to the application of the typical called the "Combined Section". This option utilized 12' lanes and full width 12' shoulders, however in locations of structures, box culverts, and wetlands, the reduction of the shoulder width to a minimum of 4' could reduce impacts or the need to replace or widen a structure this approach was used.

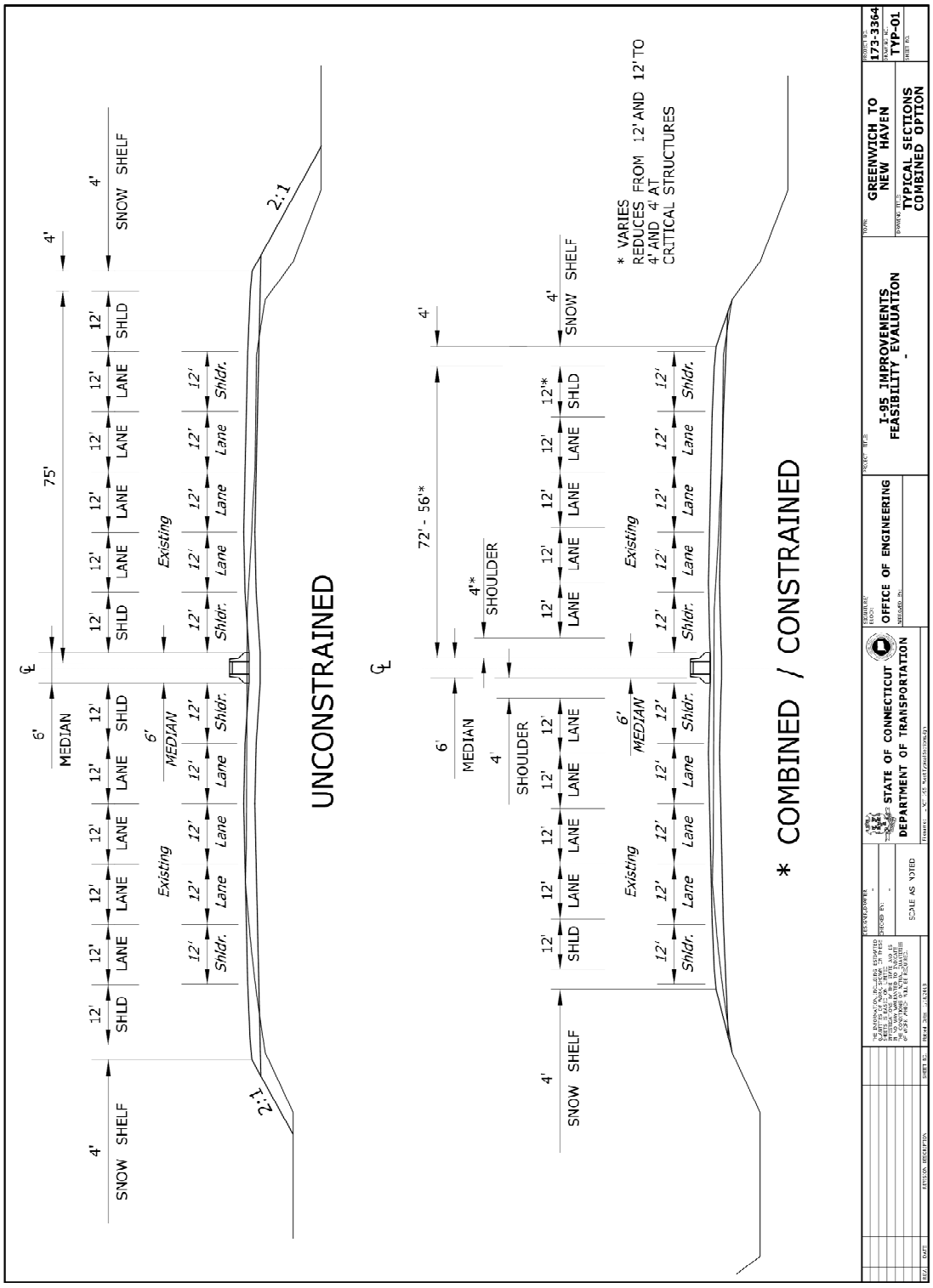
Since the difference in total cross sectional with between the Unconstrained Section and Combined Section is small (16' in each direction, 32' difference total), the impacts caused to ROW and wetlands for the two options was relatively minor. Retaining wall locations were identified to assist in reducing impacts. Table 9 summarizes the impacts Wetlands and Right-of-way (ROW).

Table 9 - Summary of Impacts

I-95 Unconstrained Section			
Direction	**Retaining Walls Length (linear feet)**	**Wetland Impacts (square feet)**	**ROW (square feet)**
Northbound	6,800	12,850	262,000 (Commercial) 25,500 (Residential)
Southbound	7,700	37,950	
TOTAL	14,500	50,800	
I-95 Combined Section			
Direction	**Retaining Walls Length (linear feet)**	**Wetland Impacts (square feet)**	**ROW (square feet)**
Northbound	4,850	12,850	261,000 (Commercial) 25,500 (Residential)
Southbound	4,900	19,500	
TOTAL	9,750	32,350	

After analyzing the impacts of the Unconstrained and Combined Sections on both the highway and bridge/structure locations, a Combined layout was evaluated introducing the Unconstrained Section in areas where the impacts were minor and introducing the Combined Section in other areas to reduce impacts to existing structures. Several of the major bridge structures have not been recommended for widening to accommodate either the Combined or Unconstrained Section since only a 1' to 2' widening would be required to achieve the Combined Section at a substantial cost. In addition, wetland impacts resulting from minor culvert or bridge widening have not been estimated in this exercise.

Figure 1 – Existing and Planned Unconstrained/Combined Sections



3.1.5 Crash Analysis

Crash analysis was conducted along I-95 between NY State Line and New Haven based on Traffic Volumes developed as part of the I-95 VPPP Study. The purpose of a Crash analysis is to determine the impact of Daily Traffic volumes and Geometry on operating conditions. Crash records for I-95 from the most recent three-year period, 2014-2016, were assembled and analyzed from CTDOT/University of Connecticut (UConn) "Connecticut Crash Data Repository" website. Crashes are listed by date and include among other things data on Location, Crash severity, Crash Type, Road Surface condition and Work Zone related crashes. This report also summarizes actual Crash rates for every roadway link along the corridor.

To better under the crash patterns, vehicular crashes were analyzed by Crash severity and type. A detailed summary of the findings by segment are presented in Appendix B.

3.1.5.1 High Crash Locations based on Crash Rate

Actual crash rates for each location based on the traffic volumes and vehicle miles traveled (VMT) of were calculated to identify the high crash locations within the study corridor. Any location with a crash rate greater than 2.5 was identified as a high crash location. Crash rate for roadway departure crashes was calculated based on the following formula:

$$R = \frac{C \times 100{,}000{,}000}{V \times 365 \times N \times L}$$

where
R = Roadway Departure crash rate for the road segment expressed as crashes per 100 million vehicle-miles of travel (MVMT),
C = Total number of roadway departure crashes in the study period
V = Traffic volumes using Average Annual Daily Traffic (AADT) volumes (from I-95 VPP Study)
N = Number of years of data (2014-2016- 3 years)
L = Length of the roadway segment in miles

In the Northbound direction, high crash rates were observed at the following locations:

- Stamford between Exits 6 and 9;
- Darien between Exits 12 and 13;
- Norwalk- Rt.7 Interchange- between Exits 14 and 16 (active construction) both of these locations;
- Westport between Exits 17 and 18;
- Bridgeport- Rt.8 Interchange- between Exits 27 and 27A;
- West Haven between Exits 42 and 44 (active construction).

Crash rates were highest in two locations along the corridor in the Northbound direction- West Haven, between Exit 44 off-ramp and on-ramp from Ella Grasso Blvd. (7.9 crashes/MVMT); and Norwalk, between on-ramp from Scribner Avenue and Exit 14 off-ramp (6.4 crashes/MVMT), had ongoing construction activity.

In the Southbound direction, high crash rates were observed at the following locations:

- New Haven between I-95/I-91 Interchange and Exit 46 (active construction);
- West Haven between Exits 45 and 43 (active construction);
- Bridgeport- Rt.8 interchange- between Exits 27B and 27A;
- Westport between Exits 18 and 17;
- Norwalk- Rt.7 interchange- between Exits 14 and 16 (active construction);
- Stamford between Exits 8 and 6.

In the Southbound direction, the crash rate was highest in New Haven between the on-ramp from Rt.34 and Exit 46 off-ramp (Long Wharf Drive) (9.9 crashes/MVMT). High crash rates could mainly be attributed to closely-spaced ramps, short acceleration and deceleration lanes, short weave sections between ramps and heavy congestion during peak periods.

3.1.5.2 Crashes by Severity

Crashes by severity involving Fatalities, Injuries or Property Damage are an important criterion in identifying unsafe locations along the corridor. Table 10 summarizes the crashes by severity along the corridor by direction.

Table 10 – Crashes by Severity and Highway Direction

Segment/ Crash Severity	Fatal		Injury of any type (Serious, Minor, Possible)		Property Damage Only		Total
	No.	%	No.	%	No.	%	
I-95 Northbound	12	0%	1633	25%	4810	75%	6455
I-95 Southbound	14	0.2%	1396	24%	4363	76%	5773
Total	26	0.2%	3029	25%	9173	75%	12228

As shown in Table 10, approximately 25% of all crashes involved Serious, Minor or Possible Injury. Majority of the crashes- approximately 75%- were property damage related.

There were a total of 26 fatal crashes (both directions combined) along the corridor-12 in the Northbound direction and 14 in the Southbound direction. In the Northbound direction, fatal crashes occurred at the following locations:

- Stamford (2 near Exit 9 and Exit 10);
- Westport (3 near Exits 17, 18 and 19);
- Fairfield (4 near Exit 21, Service Area and Exit 23);
- Bridgeport (1 near Exit 28), Milford (1 near Exit 36) and
- New Haven (1 near Exit 47).

In the Southbound direction, Fatal crashes occurred at the following locations:

- New Haven (2 near Exit 46);
- Milford (1 near Service Area/ Exit 40);
- Milford/ Stratford (1 near Exit 34);
- Stratford (1 near Exit 30)
- Westport (3 near Exits 17, 18 and 19)
- Norwalk (1 near Exit 14)
- Darien (2 near Exit 10 and the Service Area)
- Stamford (2 near Exit 6)
- Greenwich (1 near Exit 3)

3.1.5.3 Crashes by Collision Type

Crashes by collision type- Angled, Head On, Rear End etc.- are an important criterion in understanding the causes of crash and to determine improvements at high crash locations. Table 11 summarizes the crashes by severity along the corridor by direction.

Table 11 – Crashes by Collision Type

Segment/ Crash Type	Angled		Head On		Rear End		Sideswipe		Other		Total
	No.	%	No.	%	No.	%	No.	%	No.	%	
I-95 Northbound	64	1%	12	0%	4037	63%	1435	22%	907	14%	6455
I-95 Southbound	80	1%	11	0%	3410	59%	1409	24%	863	15%	5773
Total	144	1%	23	0%	7447	61%	2844	23%	1770	14%	12228

As shown in Table 11, more than 60% of all crashes in both directions were Rear end collisions, less than 23% of all crashes were Sideswipe collisions and the remaining 16% were Angled, Head On or Other (Unknown, Other) collisions.

Several locations had a high number of crashes of a particular type. In the Northbound direction, the locations with the highest number of rear end and sideswipe collisions are as follows:

- Greenwich near Exit 5 (180 crashes);
- Stamford near Exit 9 (182 crashes);
- Norwalk between Exits 13 and 14 (298 crashes), near Exit 16 (129 crashes);
- Westport between Exits 17 and 19 (611 crashes);
- Bridgeport near Exit 27 (144 crashes); and
- West Haven near Exit 44 (171 crashes).

In the Southbound direction, the highest number of rear end and sideswipe crashes occurred at the following locations:

- New Haven between I-95/I-91 Interchange and Exit 46 (243 crashes);
- West Haven near Exit 44 (107 crashes);
- Orange near Service Area/Exit 40 (108 crashes);

- Westport between Exits 18 and 17 (413 crashes);
- Norwalk near Exit 16 (286 crashes), between Exits 14 and 13 (412 crashes);
- Stamford near Exit 6 (141 crashes); and
- Greenwich near Exit 3 (105 crashes).

3.1.6 Simulation

CDM Smith in conjunction with Cambridge Systematics (CS) developed simulation models to estimate the traffic operations impacts for different widening scenarios. 5 different 2040 build (widening) conditions were analyzed, along with a revised 2040 No Build scenario. All widening scenarios/improvements assumed unconstrained conditions at Interchange ramps/local roads. CS also developed 2 additional No Build simulation models to estimate the traffic operations impacts associated with spot improvements. Spot improvement scenarios were performed primarily to understand the impacts associated with local improvements without any additional mainline widening. The scenarios to which the modeling methodology described in this section apply are listed as follow:

1. Revised No Build: Updated geometrics reflecting latest final designs for the ongoing I-91/95 interchange and I-95 West River Bridge construction projects that were not available at the time of the initial No Build model development.
2. Build #1: Add one lane SB from Exit 19 to Exit 13, add one lane NB from Exit 19 to Exit 28
3. Build #2: Add one lane between the NYS Line (I-287) to Exit 9, both NB and SB directions
4. Build #3 Add one lane between Exit 9 to Exit 18, both NB and SB directions
5. Build #4: Add one lane between the NYS Line (I-287) to Exit 18, both NB and SB directions
6. Build #5: Add one lane between Exit 13 to Exit 28, both NB and SB directions.
7. Spot Improvement A: Add SB Aux lane from Exit 7 to Exit 6 (AM peak period)
8. Spot Improvement B: Widen Exit 27A NB off-ramp to two lanes (PM peak period)

3.1.6.1 Network Development

The No Build model was built from a calibrated existing conditions model that reflected operating conditions (counts, speeds, and travel times) observed in 2012. Details of the calibration of the existing conditions model and the development of the initial 2040 No Build model (including traffic growth details and committed improvement projects) can be found in the separate reports prepared documenting and referencing the previous VPP work[3].

Each of the scenario widening conditions were coded into the initial 2040 No Build model AM and PM networks to develop the scenario networks. For all scenarios which added a lane between exits, a full travel lane was added, and it was assumed that the configuration of the existing interchanges was maintained into the new widened scenario. This includes the presence and length of any acceleration or deceleration lanes or auxiliary/ weaving lanes and would be the equivalent of

[3] CTDOT, I-95 Corridor Congestion Relief Study/Value Pricing Pilot Program (VPPP) Report, September 2016
http://www.dotdata.ct.gov/ct_congestion_site/documents/final/FULL%20PDF%20OF%20FINAL%20REPORT.pdf

adding the new lane on the left or median side of the existing roadway. The exception to this assumption was at the start and end points of the proposed widenings, where appropriate lane add or lane drop configurations were assumed given the roadway geometrics and ramp configurations.

All calibration parameters that were originally set in the No Build models were retained, although some modifications to look-ahead turning distances (sign-posting) were updated in the widened areas to reflect longer distances required for lane changing to off-ramps on a widened I-95.

3.1.6.2 Traffic Demand

For each of the major build conditions that add significant capacity through the widening projects (Builds #1-5), the Statewide Travel Demand Model used in the VPPP study was updated to estimate the additional demand that would desire to use a widened I-95 corridor. For each of these build scenarios, the widenings were coded into the travel demand model and the 2040 statewide vehicle Origin-Destination (OD) demands were assigned to the highway network. The resulting OD demands of all traffic entering and exiting the I-95 corridor were extracted using a subarea extraction process. These ramp to ramp OD patterns under each widened scenario were then compared to the same subarea extraction from the demand model for the 2040 No Build conditions, and the difference taken as the predicted change in demands created by the widening. This resulting change in ramp to ramp OD demands were added to the original 2040 No Build Simulation OD demands to create the simulation demands for each widening scenario. When new traffic was added, no changes were made to the temporal profiles of traffic loadings across the peak period, and the new traffic was distributed using the same temporal OD profiles as in the original 2040 No Build model.

For scenarios without significant capacity increases (revised No Build), the assumption was made that no significant change in the demand for the I-95 corridor would result from the projects being completed. As such, the same demands from the No Build simulation model were used in those Build simulation models.

3.1.6.3 Simulation Methodology

Using the above scenario network and demands, all scenarios were then simulated using Quadstone Paramics Microscopic Traffic Simulation Software (version 6.9.3). Both directions and were simulated for the 6-10 AM peak period and the 3-7 PM peak period. The simulations were observed to ensure that no coding errors existed and that the full improvements of the widening were being utilized by the simulated vehicles.

It is important to note that some modifications to some intersection controls of the ramp terminal intersections that were included in the original model may have been made to be sure that they would not become new bottlenecks for exiting or entering traffic under the build conditions with increased demand entering or exiting the I-95 corridor. The assumption behind this decision was that improvements to these controls (e.g. stop control to signal controlled, or extra turn lanes or signal modifications at existing signals) would also be made as part of the future build conditions. However, only stop or signal controls at ramp termini intersections were considered for modification. Ramp geometrics and lanes were not changed unless specifically called for modification in the build design.

Following the checks for coding and demand consistencies with the scenario design, each scenario was simulated five times using different random seeds. The same five random seed values were used consistently in all scenarios. The operational performance of the simulation model was recorded as either point detectors or link level statistics and the overall performance metrics (Vehicle Miles Traveled, Vehicle Hours Traveled, Vehicle Hours Delay, Speeds, Travel times, etc.) were either taken directly or calculated from the available model outputs. Those performance metrics for each of the five simulations were then averaged to minimize the stochastic noise present in any microsimulation model, and those averages were reported as the performance metrics of the widening scenario.

3.1.6.4 Simulation Results Summary

Tables 12 and 13 provide a summary of the modeling result-Vehicle Miles Traveled (VMT), Vehicle Hours Traveled (VHT), Vehicle Hours Delay (VHD) and Travel time per vehicle- during the peak direction conditions- Southbound AM and Northbound PM, respectively. Detailed charts and results by direction and period are presented in Appendix C.

Table 12 – Southbound AM Peak Period Performance Measures (6:00-10:00 AM)

	No Build	Build 1	Build 2	Build 3	Build 4	Build 5	Spot Improvement A
Widened Distance (mi)	0.0	9.5	9.6	10.7	20.7	16.5	0.4
VMT (veh-miles)	625,178	642,390	647,814	648,613	699,175	672,892	625,220
VMT % change		+3%	+4%	+4%	+12%	+8%	0%
VHT (veh-hours)	14,994	16,343	13,669	18,060	16,140	16,855	14,799
VHT % change		+9%	-9%	+20%	+8%	+12%	-1%
VHD (veh-hours)	4,683	5,785	3,035	7,373	4,654	5,761	4,486
VHD % change		+24%	-35%	+57%	-1%	+23%	-4%
Travel Time (min/veh)(1)	45.4	47.8	40.1	51.4	42.3	47.4	44.9
Travel Time % change		+5%	-12%	+13%	-7%	+4%	-1%

(1) From NYS Border to Bridgeport

As shown in Table 12, during the AM peak period, adding an extra lane between the NYS Line (I-287) to Exit 9 in the Southbound direction (Build 2), provides the greatest benefit to users when compared to the No Build condition, with a 4% increase in VMT (+4%); 9% decrease in VHT; 35% decrease in VHD; and 12% savings in Travel time. Additionally, adding an Auxiliary lane between Exits 7 and 6 in Stamford is shown to provide little or no benefit with respect to the number of vehicles able to enter or exit the system during the analysis period (Vehicle thoughput) or Delay.

Table 13 – Northbound PM Peak Period Performance Measure (3:00-7:00 PM)

	No Build	Build 1	Build 2	Build 3	Build 4	Build 5	Spot Improvement B
Widened Distance (mi)	0.0	6.3	9.7	10.8	20.7	16.5	0.1
VMT (veh-miles)	657,844	712,744	673,606	711,289	736,974	757,467	658,454
VMT % change		+8%	+2%	+8%	+12%	+15%	0%
VHT (veh-hours)	21,890	15,696	22,625	21,675	23,308	18,653	21,986
VHT % change		-28%	+3%	-1%	+6%	-15%	0%
VHD (veh-hours)	11,010	3,977	11,493	9,944	11,159	6,174	11,090
VHD % change		-64%	+4%	-10%	+1%	-44%	1%
Travel Time (min/veh)(1)	63.2	41.1	63.8	56.6	59.4	44.8	63.5
Travel Time % change		-35%	+1%	-10%	-6%	-29%	0%

(1) From NYS Border to Bridgeport

During the PM peak period (Table 13), however, Build 1 (add one lane NB from Exit 19 to Exit 28) and Build 5 (Add one lane Northbound between Exit 13 to Exit 28) provide the greatest benefit in terms of increased VMT and decreased VHT, VHD and Travel times. Adding a Northbound lane between Exits 19 and 28 provides 8% more Vehicles Miles traveled and 35% less delay per vehicle compared to No Build while, adding a Northbound lane between Exits 13 and 28 provides 15% more VMT and 29% less delay compared to No Build. As shown in Table 13, widening the Exit 27A off-ramp to Route 8 without widening the mainline provides little or no benefit in relation to Vehicles processed or Delay.

4.1 I-95 Greenwich to Bridgeport

4.1.1 Highway Improvements

The following (Figure 2) is an example of the analysis performed to identify associated impacts on right-of-way, environmental constraints, and structures due to the additional operational lane in the northbound and southbound direction of I-95. Estimated impacts were based on utilizing the Unconstrained Section along I-95, and the Combined Section over and under existing structures which cannot accommodate the Unconstrained Section without structure replacement.

Figure 2 – I-95 Improvements Feasibility Evaluation

4.1.2 Structures

This section of the memo will address structures in two ways, Grade Separated Structures which includes bridges over I-95, bridges carrying I-95, and culverts under I-95, and Major Structures.

4.1.2.1 Purpose and Tasks Performed

Structures along the corridor where evaluated to determine the impacts of adding an additional lane from Greenwich to Bridgeport and for certain "hot spot" locations (discussed in Section 5.1) in the Bridgeport to New Haven corridor. As a part of this exercise, the following tasks were performed:

1. The bridges carrying I-95 over local roadways, railroad and waterways and crossing over I-95 that would be impacted within the corridor (bridges from Greenwich through Bridgeport. In addition, bridges from Exits 37 to 41 in Milford and Orange) were identified

associated with Hot Spot Improvements. Using the Master Bridge Inventory database and other available listings the bridge numbers were tagged in Google Earth.

2. The original and latest set of construction plans were obtained from the Department's database in order to acquire an up to date general plan, elevation and typical section for each structure crossing I-95 and to determine the impact of widening I-95 on the structures spanning the mainline.
3. The Bridge Inventory Database was edited to summarize the important bridge information on each structure carrying I-95 and crossing over I-95. The database was updated to present the year of Major Rehabilitation or Re-construction of the bridge, changes that the structure underwent during that Major Rehabilitation or Re-construction and was updated to reflect the latest condition ratings which were obtained from the Department's database.
4. An evaluation was performed of all existing structures over I-95 and carrying I-95 to determine the feasibility of widening or the need for replacement or improvement of the structure. The structure was evaluated based on two (2) proposed widening concepts for adding an additional lane proposed for the segment from Greenwich to Bridgeport Harbor and improvements proposed at the hot spot locations between Bridgeport and New Haven.
5. The Bridge Inventory Database was updated to present the improvement requirements or replacement based on condition or widening impacts for structures over I-95 and structures carrying I-95 along with the cost associated for improvement or replacement.

4.1.2.2 Summary of Existing Structures

There are a total of 113 structures between Greenwich (New York State Line) and Bridgeport Harbor. Among the 113 structures, eight (8) of the structures are identified as major structures and will be discussed in detailed under a separate section. Those eight (8) major structures are:

- Mianus River Bridge - Structure No. 06015
- Stamford Area Structures – Structure No.'s 00027, 00028, 00029, and 00031
- Metro North Railroad Bridge – Structure No. 00032
- Yankee Doodle Bridge (Norwalk) – Structure No. 00059
- Saugatuck River Bridge – Structure No. 00064

Among the remaining 105 structures, seven (7) are culverts carrying I-95, 67 are bridges carrying I-95 and 31 are bridges over I-95.

In addition to the structures between Greenwich (New York State Line) and Bridgeport, seven (7) additional structures between Bridgeport and New Haven were also identified as part of the Hot Spot Analysis. Among these seven (7) structures, four (4) are bridges carrying I-95, one (1) is a culvert carrying I-95 and two (2) are bridges over I-95.

4.1.2.3 Culverts

The eight (8) culverts carrying I-95, seven (7) between Greenwich and Bridgeport Harbor and one (1) within hotspot locations between Bridgeport and New Haven, were constructed in 1958 and are cast in place concrete box culverts. The condition rating of 4 of these culverts are available

through the Department's database. These 4 culverts have a condition rating ranging from 5 to 6 with "5" signifying "Fair" condition and "6 or higher" signifying "Good" condition of the structure.

Condition ratings of the remaining 3 culverts are currently not available.

All the culverts were originally designed for HS-20 or H-20 Truck Live loads. The Load and Resistance Factor Rating (LRFR) reports are available for only few of the culverts, and those culverts are found have a Rating Factor >1 for HL-93 Live loads.

4.1.2.4 Bridges Carrying I-95

There are a total of 71 bridges carrying I-95 (including four (4) hotspot location bridges and excluding major structures). All these bridges were originally constructed in 1958 and many of these bridges have undergone major rehabilitations and replacements like parapet or median replacement or modifications, superstructure replacement or repair or widening, substructure repair or modifications etc., over the years. Major rehabilitations/ replacements and the year performed have been summarized in detail in Appendix D. Out of 71 bridges, three (3) were completely replaced in 2006 (Structure No's. 00099. 00101 and 00105A).

The condition ratings of all the bridges for the deck, superstructure and substructure were obtained, and the Condition Rating of all these bridges except for Structure No. 00062 deck, are found to be in the range of "5 to 7" with 5 signifying "Fair" condition and "6 or higher" signifying "Good" condition of the structure. The deck condition rating for Structure No. 00062 is found to be "4" which signifies "Poor" condition, however there is a Superstructure replacement for this bridge scheduled for construction in spring 2018.

All the bridges were originally designed for HS-20 or H-20 Truck Live loads. All structures that had superstructure and deck replacement or modification, as well as structures built after 2003, were most likely to be designed for HL-93 Live loads. The LRFR Load Rating reports are available only for few of the bridges, and these bridges are found to have a Rating Factor >1 for HL-93 Live loads.

4.1.2.5 Bridges Over I-95

There is a total of 33 bridges carrying local roads and exit or entrance ramps over I-95, including two (2) hot spot location bridges. A majority of the bridges over I-95 were originally constructed in 1958. Structure No. 00047 was originally constructed in 1952 and Structure No. 102-114 in 1967. Many of these bridges have undergone major rehabilitations and replacements like parapet or median replacement or modifications, superstructure replacement or repair or widening, Substructure repair or modifications, over the years. Major rehabilitations/ Replacements and the year performed have been summarized on Appendix D. Out of 33 bridges, three are currently being completely replaced or have been already replaced (Structure No's. 00053, 00054 and 00055).

The condition ratings of all the bridges for the deck, superstructure and substructure were obtained, and the condition rating for these bridges are found to be in the range of "4 to 7" with "4" signifying "Poor" condition, "5" signifying "Fair" condition and "6 or higher" signifying "Good" condition of the structure. The superstructure condition rating for Structure No. 00061 is found to be "4" which signifies "Poor" condition, however there is a superstructure replacement for this bridge scheduled for construction in spring 2018.

All the bridges were originally designed for HS-20 or H-20 Truck Live loads. All structures that had superstructure and deck replacement or modification, as well as structures that were built after 2003, are most likely to be designed for HL-93 Live loads. The LRFR Load Rating reports are available only for few of the bridges, and those bridges are found to have a Rating Factor >1 for HL-93 Live loads.

4.1.2.6 Proposed I-95 Cross Section

Three types of cross sections (see Figure 1) have been proposed for I-95 widening at locations of bridges carrying I-95 and at locations of bridges over I-95. Refer to Table 14 for a summary of the three proposed I-95 cross sectional widths.

1. **Constrained Section:** The Constrained Section consists of eight (8) 11' lanes (four in each direction), two (2) 10' right shoulders (one in each direction), and two (2) 4' left shoulders (one in each direction), a 6' wide median barrier and two (2) 1'-11" parapets (applicable only at locations of bridges carrying I-95). The total width of a typical Constrained Section at locations of bridges over I-95 and at locations of culverts is 122'. The total width of typical Constrained Section at locations of bridges carrying I-95 is estimated to be 125'-10". For locations that currently have entrance or exit ramps, an additional 12' lane per direction and additional widening is considered based on the ramp alignment. While this section was analyzed, it was not chosen as the recommended approach to future widening on or over existing structures, as it is undesirable to reduce travel lanes to 11' widths and maintain reduced shoulders for a continuous section. The Constrained Section was also not chosen as the recommended approach to widening along the corridor between structures, since the shoulder widths would not comply with current design standards. Reduced shoulder widths would negatively impact safety along the corridor and in performing future maintenance operations.

2. **Unconstrained Section:** The Unconstrained Section consists of eight (8) 12' lanes (four in each direction), two (2) 12' right shoulders (one in each direction), two (2) 12' left shoulders (one in each direction), a 6' wide median barrier, and two (2) 1'-11" parapets (applicable only at locations of bridges carrying I-95). The total width of a typical Unconstrained Section at locations of bridges over I-95 and at locations of culverts is 150'. The total width of a typical Unconstrained Section at locations of bridges carrying I-95 is 153'-10". For locations that currently have entrance or exit ramps, an additional 12' lane per direction and additional widening is considered based on the ramp alignment. The Unconstrained Section is to be used to construct I-95 to the ultimate width when widening between structures. This section should also be used at structures which require a full replacement. However, the Unconstrained Section should not be used if an existing structure does not require a full replacement, as right-of-way and structure impacts can be minimized by utilizing the Combined Section.

3. **Combined Section:** Based on further consideration by the Department, the "Constrained Section" was revised to reflect the utilization of 12' lanes in lieu of 11' lanes. Additionally, at structure locations, the cross section can be reduced to four (4) 12' lanes with reduced left and right shoulder widths to a minimum of 4' to avoid costly structure widening, in

which existing structures are otherwise in acceptable condition. The total width of a typical Combined Section at locations of bridges over I-95 and at locations of culverts is 118'. The total width of typical Constrained Section at locations of bridges carrying I-95 is estimated to be 121'-10". To achieve the Combined Section at structures over I-95, barrier walls can be utilized to protect abutments and piers. The Combined Section was chosen as the recommended approach to widening the corridor in the interim at structures which currently did not need to be replaced.

Table 14- Proposed I-95 Cross Section Widths

I-95 Cross Section	Travel Lane Width (ft)	Right Shoulder Width (ft)	Left Shoulder Width (ft)	Median Barrier Width (ft)	Parapet Width (ft)	Total Section Width Bridges Over I-95 (ft)	Total Section Width Bridges Carrying I-95 (ft)
Constrained Section	11'	10'	4'	6'	1'-11"	122'	125'-10"
Combined Section	12'	4' Min.	4' Min.	6'	1'-11"	118' Min.	121'-10" Min.
Unconstrained Section	12'	12'	12'	6'	1'-11"	150'	153'-10"

4.1.2.7 Structure Categorization

Culverts and Bridges Carrying I-95

The structures carrying I-95 have been separated into 5 different categories based on the type of structure & substructure, number of spans and the location of ramp approaches on the bridge. The categories are as follows:

1. Category 1 – Single Span Bridges with Full Height Abutments
2. Category 2 – Single Span Bridges with Stub Abutments
3. Category 3 – Multi Span Bridges
4. Category 4 – Bridges with Ramp Approaches
5. Category 5 – Culverts

Bridges Over I-95

The Structures over I-95 have been separated into 5 different categories based on the type of substructure and the location of ramp approaches on the bridge. The categories are as follows:

1. Category 1 – Bridges with Full Height Abutments & no setbacks from the edge of pavement
2. Category 2 – Bridges with Full Height Abutments & setbacks from the edge of pavement (Semi Stub)
3. Category 3 – Bridges with Stub Abutments
4. Category 4 – Bridges with Shoulder Piers and Stub Abutments
5. Category 5 – Bridges with Ramp Approaches

4.1.2.8 Evaluation Approach and Improvement Recommendations

Culverts and Bridges Carrying I-95: The Evaluation of these structures was performed in four (4) steps:

1. The Condition Rating of all the bridges carrying I-95 were reviewed. Bridges with superstructure or substructure condition rating less than 5 are recommended for repair or complete bridge replacement to fit the Unconstrained Section over the bridge. The bridges that have existing bridge widths sufficient to fit the Combined or Unconstrained Section and have deck condition rating less than 5 are recommended for deck replacement. The bridges that have existing bridge widths insufficient to fit the Combined Section and have deck condition rating less than 5 are recommended for deck replacement along with substructure widening and new wingwalls. There is just one bridge with a deck condition factor < 5 (Bridge No. 00061) but there is a superstructure replacement for this bridge scheduled for construction in spring 2018, as a result this bridge does not fall under this condition. Therefore, no bridges were considered with a condition rating < 5.

2. All the bridges and culverts carrying I-95 with condition ratings greater than or equal to 5 were evaluated for the Unconstrained condition. The bridges that require deck, superstructure and substructure widening of existing bridges to fit the Unconstrained Section, were reviewed to see if they can fit the Combined Section.

3. If the Combined condition does not fit on the existing bridge with condition ratings greater or equal to 5, then the bridge is recommended to be widened & modified to fit the Unconstrained Section over the bridge.

4. The Department's Bridge Management group reviewed all bridges within the study corridor, and projected which structures will require either rehabilitation or replacement by the year 2040. The cost for structures requiring a full bridge replacement prior to 2040 was accounted for in the project cost estimate. The cost for structures requiring rehabilitation was not included in the project cost estimate, as it is assumed maintenance of structures, not required to meet the Unconstrained condition, would be constructed separate of any project corresponding to the widening for the addition of a fourth travel lane in each direction.

Bridges Over I-95: Typical Evaluation of these structures are performed in four steps:

1. The Condition Rating of all the bridges over I-95 were reviewed. Bridges with superstructure or substructure condition rating less than 5 are recommended for complete bridge replacement to fit the Unconstrained Section under the bridge. If the bridges have deck condition ratings less than 5, then the bridges are recommended for deck replacement and for an addition of a retaining wall and concrete barrier curb in front of existing substructure to fit either the Combined or Unconstrained Section under the bridge.

2. All bridges over I-95 with condition ratings greater than or equal to 5 were evaluated for the Unconstrained condition without replacement of the existing structure. The locations that require replacement of the existing bridge over I-95 to fit the Unconstrained Section

under the bridge were checked to see if they fit the Combined Section with minor or no modification under the bridge.

3. If the Combined condition does not fit with minor or no modifications under the existing bridge, then the bridge is recommended to be replaced completely to fit the Unconstrained Section under the bridge.

4. The Department's Bridge Management group reviewed all bridges within the study corridor, and projected which structure will require either rehabilitation or replacement by the year 2040. The cost for structures requiring a full bridge replacement prior to 2040 was accounted for in the project cost estimate. The cost for structures requiring rehabilitation was not included in the project cost estimate, as it is assumed maintenance of structures, not required to meet the Unconstrained condition, would be constructed separate of any project corresponding to the widening for the addition of a fourth travel lane in each direction.

A typical evaluation flowchart for culverts and bridges carrying I-95 is shown on Figure 3. Structure No's. 00145, 00146, 00147, 00150 and 00151 are located at hotspots and are evaluated for only the Unconstrained Section. Refer to Section 4.1.2.10 for a cost estimate of the Hot Spot locations.

Typical evaluation flowchart for Bridges Over I-95 is shown on Figure 4. Structure No's. 00144 and 00148 are located at hotspots and are evaluated for only the Unconstrained Section. Refer to Section 4.1.2.10 for a cost estimate of the Hot Spot location.

Figures 1 thru 4 in Appendix E show Typical Proposed Plan and Elevations with the improvements for all Bridges Carrying I-95 and Bridges Over I-95.

Table 15 provides a summary of all structures carrying I-95 within the study corridor, as well as estimated costs for modifications, deck/superstructure replacement, and full structure replacement required to accommodate the Combined Section. The Major Structures are denoted in **Bold**.

Table 15 – Structures Carrying I-95

Structure No.	Features Intersected	Facility Carried	Can Accept Unconstrained Section w/o Modifications	Can Accept Combined Option w/o Modifications	CTDOT Bridge Management Recommendation by Year 2040	Recommended Approach	Cost of Modification to Accommodate Combined Section	Cost of Deck/ Superstructure Replacement to Accommodate Combined Section	Cost of Replacement to Accommodate Combined Section
00001	Byram River S Water St	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$101,933,294
00002	River Avenue	I-95	No	No	Deck Replacement, Superstructure Rehabilitation	Bridge Widening, Deck Replacement	$1,174,836	$977,665	-
00004	Delavan Avenue	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$14,941,004
00005	Ritch Avenue	I-95	No	Yes	Rehabilitation	None	-	-	-
00006	Field Point Road	I-95	No	Yes	None	None	-	-	-

Structure No.	Features Intersected	Facility Carried	Can Accept Unconstrained Section w/o Modifications	Can Accept Combined Option w/o Modifications	CTDOT Bridge Management Recommendation by Year 2040	Recommended Approach	Cost of Modification to Accommodate Combined Section	Cost of Deck/ Superstructure Replacement to Accommodate Combined Section	Cost of Replacement to Accommodate Combined Section
00007	Shore Road # 1	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$6,431,250
00008 (Culvert)	Horseneck Creek	I-95			Rehabilitation	None	-	-	-
00009	Arch Street	I-95	No	Yes	Superstructure Replacement	Superstructure Replacement	-	$3,734,948	-
00010	Steamboat Road	I-95	No	Yes	None	None	-	-	-
00011	Davis Street	I-95	No	Yes	None	None	-	-	-
00012	Davis Mill Pond	I-95	No	Yes	None	None	-	-	-
00014	Metro North Rr & Station	I-95	No	Yes	None	None	-	-	-
06015	**Mianus River & Local Rds.**	**I-95**	**No**	**Yes**	**None**	**None**	**-**	**-**	**-**
00019	Sound Beach Avenue	I-95	No	Yes	Rehabilitation	None	-	-	-
02565 (Culvert)	Brook	I-95			Rehabilitation	None	-	-	-
00020	Ferris Drive	I-95	No	Yes	Rehabilitation	None	-	-	-
00021	Laddins Rock Road	I-95	No	Yes	Rehabilitation	None	-	-	-
02566 (Culvert)	Brook	I-95			Rehabilitation	None	-	-	-
00022	Harvard Avenue	I-95	No	Yes	Rehabilitation	None	-	-	-
00023	West Avenue	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$5,404,193
00026	Greenwich Ave Rippowam	I-95 &I-95 Ramp 023	No	No	Rehabilitation	Bridge Widening	$13,796,374	-	-
00027	**Sr 493(Washington Blvd)**	**I-95**	**No**	**No**	**Deck Replacement, Superstructure & Substructure Rehabilitation**	**Bridge Widening, Deck Replacement**	**$117,500,000**	**-**	**-**
00028	**Atlantic Street**	**I-95**	**No**	**No**	**None**	**Bridge Widening**		**-**	**-**
00029	**Canal Street**	**I-95**	**No**	**No**	**None**	**Bridge Widening**		**-**	**-**
00031	**Elm Street**	**I-95**	**No**	**No**	**Superstructure Replacement, Substructure Rehabilitation**	**Bridge Widening & Superstructure Replacement**		**-**	**-**
00032	**MNRR & Local Roads**	**I-95 & I-95 Ramps**	**No**	**No**	**Bridge Replacement**	**Bridge Replacement**	**-**	**-**	**$600,000,000**

Structure No.	Features Intersected	Facility Carried	Can Accept Unconstrained Section w/o Modifications	Can Accept Combined Option w/o Modifications	CTDOT Bridge Management Recommendation by Year 2040	Recommended Approach	Cost of Modification to Accommodate Combined Section	Cost of Deck/ Superstructure Replacement to Accommodate Combined Section	Cost of Replacement to Accommodate Combined Section
00033	Maple Avenue	I-95	No	No	Rehabilitation	Bridge Widening	$1,748,633	-	-
00034	Lockwood Avenue	I-95	No	No	Rehabilitation	Bridge Widening	$1,881,126	-	-
00038	Hamilton Avenue	I-95	No	Yes	None	None	-	-	-
00039 (Culvert)	Noroton River	I-95			Rehabilitation	None	-	-	-
00040	Brookside Drive	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$7,053,844
00043	Us Route 1	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$10,413,253
00044	Kings Hwy-Goodwives Rv	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$15,220,625
00045	Route 136	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$4,689,938
00046	Metro North Railroad	I-95	No	No	Superstructure Replacement	Bridge Widening & Superstructure Replacement	$3,563,084	$11,479,169	-
00048	I-95 Rmp 047/Five Mi Riv	I-95	No	No	Rehabilitation	Bridge Widening	$1,589,591	-	-
00049	Richards Avenue	I-95	No	No	Rehabilitation	Bridge Widening	$1,033,149	-	-
00050	Keeler Avenue	I-95	No	No	Deck Replacement, Superstructure and Substructure Rehabilitation	Bridge Widening, Deck Replacement	$857,779	$835,807	-
00057	West Avenue	I-95	No	No	Deck Replacement, Superstructure and Substructure Rehabilitation	Bridge Widening, Deck Replacement	$2,778,138	$1,531,791	-
00058	Crescent St & Metro No	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$26,992,912
00059	**Norwalk Rv Hendricks Ave**	**I-95**	**No**	**No**	**Bridge Replacement**	**Bridge Replacement**	**-**	**-**	**$106,100,000**
00062	Route 33	I-95	No	No	None	Bridge Widening	$3,997,660	-	-
00063	Franklin Street	I-95	No	No	None	Bridge Widening	$2,075,180	-	-
00064	**Route 136 & Saugatuck R**	**I-95**	**No**	**Yes**	**None**	**None**	**-**	**-**	**-**
00065	Compo Road South	I-95	No	Yes	None	None	-	-	-
02571 (Culvert)	Muddy Brook	I-95			Culvert Rehabilitation	None	-	-	-

Structure No.	Features Intersected	Facility Carried	Can Accept Unconstrained Section w/o Modifications	Can Accept Combined Option w/o Modifications	CTDOT Bridge Management Recommendation by Year 2040	Recommended Approach	Cost of Modification to Accommodate Combined Section	Cost of Deck/ Superstructure Replacement to Accommodate Combined Section	Cost of Replacement to Accommodate Combined Section
00070	New Creek Road	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$4,688,932
00071	Maple Lane	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$5,245,246
00073 (Culvert)	Sasco Creek	I-95			Rehabilitation	None	-	-	-
00074	Westway Road	I-95	No	Yes	None	None	-	-	-
00075	Center Street	I-95	No	Yes	None	None	-	-	-
00076	Old Post Road	I-95	No	Yes	None	None	-	-	-
00077	U.S. Route 1	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$14,782,058
00079	Bronson Road No. 1	I-95	No	Yes	None	None	-	-	-
00080	Mill River	I-95	No	Yes	Deck Replacement, Superstructure and Substructure Rehabilitation	Deck Replacement	-	$1,971,281	-
00081	North Pine Creek Road	I-95	No	Yes	Rehabilitation	None	-	-	-
00082	Mill Plain Road	I-95	No	Yes	Deck Replacement, Superstructure and Substructure Rehabilitation	Deck Replacement	-	$1,616,363	-
00083	Unquowa Road	I-95	No	Yes	Deck Replacement, Superstructure and Substructure Rehabilitation	Deck Replacement	-	$1,848,298	-
00084	Round Hill Road	I-95	No	Yes	Deck Replacement, Superstructure and Substructure Rehabilitation	Deck Replacement	-	$1,635,060	-
00085	Route 135	I-95	No	Yes	Rehabilitation	None	-	-	-
00088	Us Route 1 Southbound	I-95	No	Yes	Deck Replacement, Superstructure and Substructure Rehabilitation	Deck Replacement	-	$1,501,953	-
00089	Grasmere Avenue	I-95	No	Yes	Deck Replacement, Superstructure and Substructure Rehabilitation	Deck Replacement	-	$1,179,940	-
00090	New England Avenue	I-95	No	Yes	Deck Replacement, Superstructure	Deck Replacement	-	$1,092,849	-

Structure No.	Features Intersected	Facility Carried	Can Accept Unconstrained Section w/o Modifications	Can Accept Combined Option w/o Modifications	CTDOT Bridge Management Recommendation by Year 2040	Recommended Approach	Cost of Modification to Accommodate Combined Section	Cost of Deck/ Superstructure Replacement to Accommodate Combined Section	Cost of Replacement to Accommodate Combined Section
					and Substructure Rehabilitation				
00091	Sunset Avenue	I-95	No	Yes	Rehabilitation	None	-	-	-
00092	Us Route 1 Southbound	I-95	No	Yes	Deck Replacement, Superstructure and Substructure Rehabilitation	Deck Replacement	-	$1,337,798	-
00093	Us Route 1 Northbound	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$5,483,667
00094	Chambers Street	I-95	No	Yes	Rehabilitation	None	-	-	-
00095	Brentwood Avenue	I-95	No	Yes	Deck Replacement, Superstructure and Substructure Rehabilitation	Deck Replacement	-	$1,200,284	-
00096	Coolidge Street	I-95	No	Yes	None	None	-	-	-
01680 (Culvert)	Ash Creek	I-95			None	None	-	-	-
00098	Commerce Drive	I-95	No	Yes	None	None	-	-	-
00099	Metro North Railroad	I-95	No	Yes	None	None	-	-	-
00100	Route 130 (Fairfield Av)	I-95	No	Yes	None	None	-	-	-
00101	Bostwick Ave	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$7,013,125
00102	Hancock Avenue	I-95	Yes	Yes	None	None	-	-	-
00103	Howard Avenue	I-95	Yes	Yes	None	None	-	-	-
00104	Wordin Avenue No. 2	I-95	Yes	Yes	None	None	-	-	-
00105A	Metro North & City Sts	I-95	Yes	Yes	None	None	-	-	-
00106	Myrtle Avenue No. 1	I-95	No	No	Bridge Replacement	Bridge Replacement	-	-	$6,625,473
00107	Warren Street	I-95	Yes	Yes	None	None	-	-	-
00108	Lafayette Street No. 2	I-95	No	Yes	Superstructure Rehabilitation	None	-	-	-
00110A	Broad Street	I-95	No	Yes		None	-	-	-

Table 16 provides a summary of all structures carrying I-95 within the hotspot locations, as well as estimated costs for modifications, deck/superstructure replacement, and full structure replacement to accommodate the Combined Section.

Table 16 – Structures Carrying I-95 in Hot Spot Locations

Structure No.	Features Intersected	Facility Carried	Can Accept Unconstrained Section w/o Modifications	Can Accept Combined Option w/o Modifications	CTDOT Bridge Management Recommendation by Year 2040	Recommended Approach	Cost of Modification to Accommodate Combined Section	Cost of Deck/ Superstructure Replacement to Accommodate Combined Section	Cost of Replacement to Accommodate Combined Section
00145 (Culvert)	Wepawaug River	I-95			Culvert Rehabilitation	None	-	-	-
00146	Route 121	I-95	No	Yes	Rehabilitation	None	-	-	-
00147	Orange Avenue	I-95	No	Yes	Deck Rehabilitation	None	-	-	-
00150	Indian River	I-95	No	Yes	Rehabilitation	None	-	-	-
00151	East Town Road	I-95	No	Yes	Rehabilitation	None	-	-	-

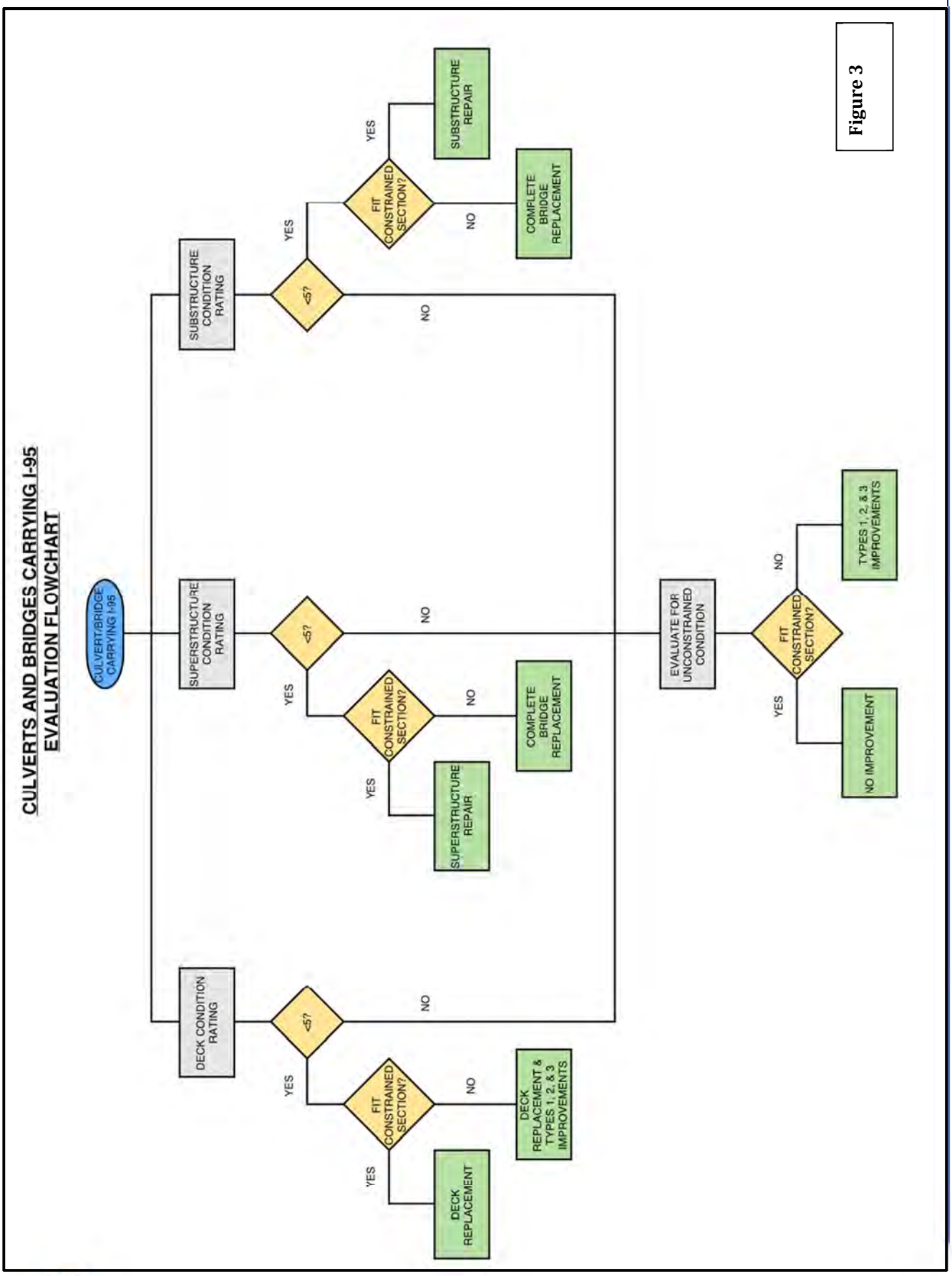

CULVERTS AND BRIDGES CARRYING I-95
EVALUATION FLOWCHART
CULVERT/BRIDGE CARRYING I-95
SUBSTRUCTURE CONDITION RATING
SUPERSTRUCTURE CONDITION RATING
DECK CONDITION RATING
<5?
YES
NO
FIT CONSTRAINED SECTION?
SUBSTRUCTURE REPAIR
COMPLETE BRIDGE REPLACEMENT
SUPERSTRUCTURE REPAIR
DECK REPLACEMENT
DECK REPLACEMENT & TYPES 1, 2, & 3 IMPROVEMENTS
EVALUATE FOR UNCONSTRAINED CONDITION
TYPES 1, 2, & 3 IMPROVEMENTS
NO IMPROVEMENT

Figure 3

Refer to Table 17 for a summary of all structures over I-95 within the study corridor, as well as estimated costs for modifications, deck/superstructure replacement, and full structure replacement to accommodate the Combined Section.

Table 17 – Structures over I-95 within Study Area

Structure No.	Features Intersected	Facility Carried	Can Accept Unconstrained Section w/o Modifications	Can Accept Combined Option w/o Modifications	CTDOT Bridge Management Recommendation by Year 2040	Recommended Approach	Cost of Modification to Accommodate Combined Section	Cost of Deck/ Superstructure Replacement to Accommodate Combined Section	Cost of Replacement to Accommodate Combined Section
00003	I-95	James Street	No	No	Bridge Replacement	Bridge Replacement	-	-	$5,099,511
00013	I-95	Indian Field Road	No	Yes	None	None	-	-	-
00016	I-95	Riverside Avenue	No	No	Bridge Replacement	Bridge Replacement	-	-	$6,022,780
00017	I-95	Lockwood Lane	No	No	None	Addition of Concrete Barrier Curb in front of Piers	$20,997	-	-
00018	I-95	I-95 Ramps To Us 1	No	No	Deck Replacement, Superstructure & Substructure Rehabilitation	Deck Replacement & Addition of Concrete Barrier Curb in front of Abutments	$22,310	$1,331,227	-
00024	I-95	Wilson Avenue	No	No	Bridge Replacement	Bridge Replacement	-	-	$4,903,928
00025	I-95	Fairfield Avenue 1	No	No	Bridge Replacement	Bridge Replacement	-	-	$6,281,824
00035	I-95	Maher Road	No	No	Rehabilitation	Addition of Concrete Barrier Curb in front of Abutments	$21,129	-	-
00036	I-95	Blachley Road	No	No	Rehabilitation	Addition of Concrete Barrier Curb in front of Abutments	$21,129	-	-
00037	I-95	Us Route 1	No	No	Superstructure Replacement, Substructure Rehabilitation	Bridge Replacement & Addition of Concrete Barrier Curb in front of Abutments	$30,446	-	$10,068,821
00041	I-95	Hollow Tree Rdg Rd	No	Yes	Rehabilitation	None	-	-	-

Structure No.	Features Intersected	Facility Carried	Can Accept Unconstrained Section w/o Modifications	Can Accept Combined Option w/o Modifications	CTDOT Bridge Management Recommendation by Year 2040	Recommended Approach	Cost of Modification to Accommodate Combined Section	Cost of Deck/ Superstructure Replacement to Accommodate Combined Section	Cost of Replacement to Accommodate Combined Section
00042	I-95	Noroton Avenue	No	No	Bridge Replacement	Bridge Replacement	-	-	$5,493,898
00047	I-95	Old Kings Hwy N #1	No	No	Bridge Replacement	Bridge Replacement & Addition of Concrete Barrier Curb in front of Abutments	$18,766	-	$4,199,570
00051	I-95	Rampart Road	No	No	None	Bridge Replacement & Addition of Concrete Barrier Curb in front of Abutments	$17,060	-	$3,918,553
00052	I-95	Scribner Avenue	No	No	Bridge Replacement	Bridge Replacement & Addition of Concrete Barrier Curb in front of Abutments	$21,129	-	$5,920,633
00053	I-95	Taylor Avenue	No	Yes	None	None	-	-	-
00054	I-95	Cedar Street	No	Yes	None	None	-	-	-
00055	I-95	Fairfield Avenue	No	Yes	None	None	-	-	-
00056	I-95	Stuart Avenue	No	No	Bridge Replacement	Bridge Replacement & Addition of Concrete Barrier Curb in front of Abutments	$17,060	-	$3,851,378
03562	I-95	Us Route 7	No	No	Rehabilitation	Bridge Replacement & Addition of Concrete Barrier Curb in front of Abutments	$38,400	-	$16,932,400
00060	I-95	East Avenue #1	No	No	Bridge Replacement	Bridge Replacement & Addition of Concrete Barrier Curb in front of Abutments	$33,071	-	$6,944,882

Structure No.	Features Intersected	Facility Carried	Can Accept Unconstrained Section w/o Modifications	Can Accept Combined Option w/o Modifications	CTDOT Bridge Management Recommendation by Year 2040	Recommended Approach	Cost of Modification to Accommodate Combined Section	Cost of Deck/ Superstructure Replacement to Accommodate Combined Section	Cost of Replacement to Accommodate Combined Section
00061	I-95	Strawberry Hill Av	No	No	None	Addition of Concrete Barrier Curb in front of Abutments	$21,129	-	-
00066	I-95	Hales Road	No	No	Bridge Replacement	Bridge Replacement	-	-	$4,467,158
00067	I-95	Hills Point Road	No	No	Bridge Replacement	Bridge Replacement	-	-	$5,230,898
00068	I-95	SR 476	No	No	Bridge Replacement	Bridge Replacement	-	-	$9,224,779
00069	I-95	Beachside Avenue	No	No	Deck Replacement, Superstructure and Substructure Rehabilitation	Deck Replacement & Addition of Concrete Barrier Curb in front of Abutments	$19,685	$1,550,003	-
00072	I-95	Sasco Creek Road	No	No	Bridge Replacement	Bridge Replacement	-	-	$5,297,862
00078	I-95	Mill Hill Road	No	No	Deck Replacement, Superstructure and Substructure Rehabilitation	Deck Replacement	-	$1,446,185	-
00086	I-95	Us Route 1 Sb	No	No	Bridge Replacement	Bridge Replacement	-	-	$5,506,104
00087	I-95	Meadowbrook Road	No	No	Bridge Replacement	Bridge Replacement	-	-	$6,214,068
03535	I-95	Rt 8 NB & Tr 806	Yes	Yes	Deck Rehabilitation	None	-	-	-

Refer to Table 18 for a summary of all structures over I-95 within the hotspot locations, as well as estimated costs for modifications, deck/superstructure replacement, and full structure replacement to accommodate the Combined Section.

Table 18 – Structures over I-95 within Hotspot Locations

Structure No.	Features Intersected	Facility Carried	Can Accept Unconstrained Section w/o Modifications	Can Accept Combined Option w/o Modifications	CTDOT Bridge Management Recommendation by Year 2040	Recommended Approach	Cost of Modification to Accommodate Combined Section	Cost of Deck/ Superstructure Replacement to Accommodate Combined Section	Cost of Replacement to Accommodate Combined Section
00144	I-95	West River Street	No	No	Bridge Replacement	Bridge Replacement	-	-	$3,989,079
00148	I-95	Forest Road	No	No	Bridge Replacement	Bridge Replacement	-	-	$4,569,442

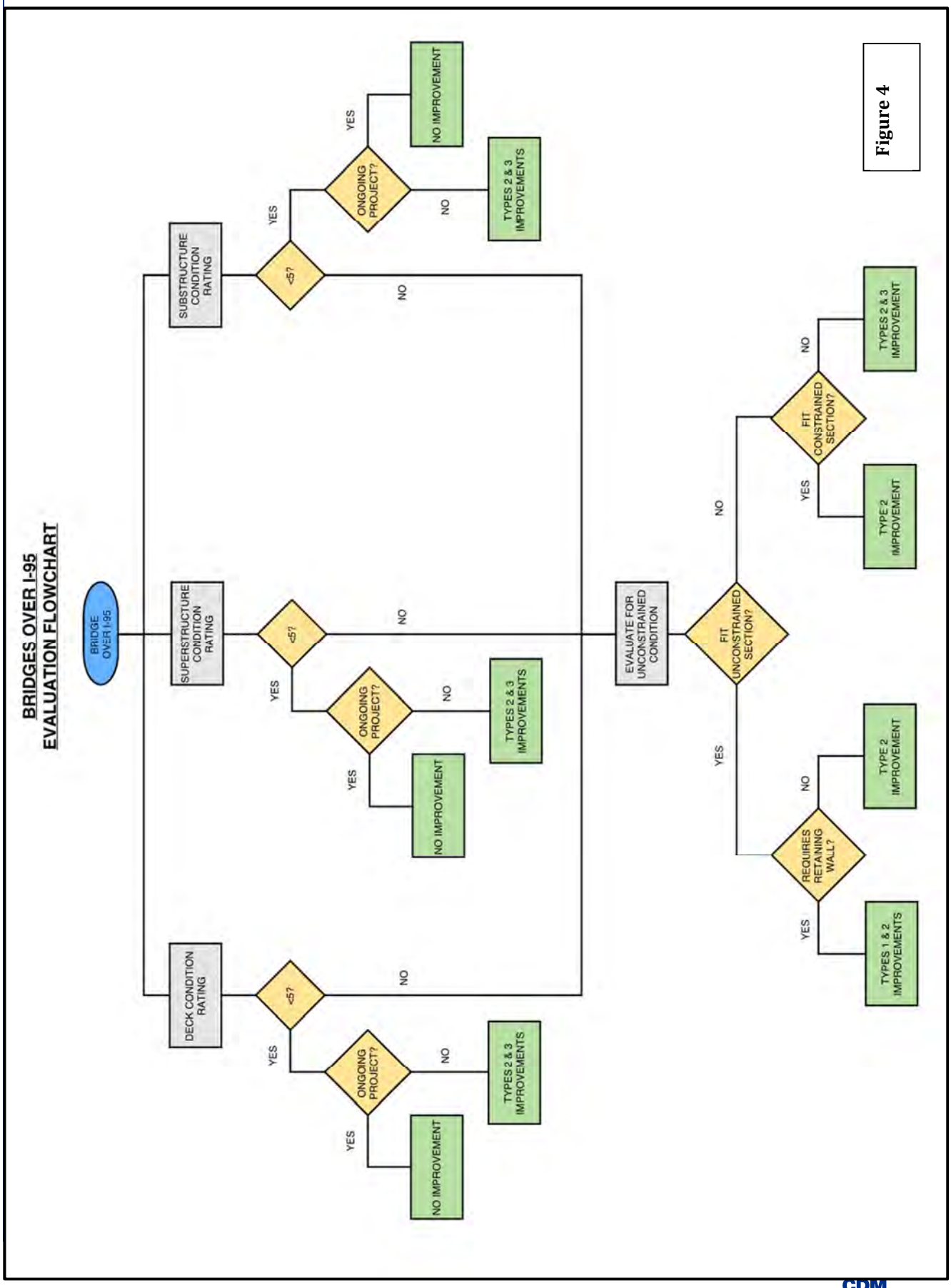

BRIDGES OVER I-95
EVALUATION FLOWCHART
BRIDGE OVER I-95
SUPERSTRUCTURE CONDITION RATING
SUBSTRUCTURE CONDITION RATING
DECK CONDITION RATING
<5?
YES
NO
ONGOING PROJECT?
NO IMPROVEMENT
TYPES 2 & 3 IMPROVEMENTS
EVALUATE FOR UNCONSTRAINED CONDITION
FIT UNCONSTRAINED SECTION?
FIT CONSTRAINED SECTION?
TYPE 2 IMPROVEMENT
TYPES 2 & 3 IMPROVEMENT
REQUIRES RETAINING WALL?
TYPES 1 & 2 IMPROVEMENTS

Figure 4

4.1.2.9 Summary of Findings

Tables 19 and 21 below summarize the findings of evaluation of Bridge Structures carrying I-95 and over I-95, respectively, between Greenwich and Bridgeport, excluding the major structures. Tables 20 and 22 summarize the findings of evaluation of Bridge Structures carrying I-95 and over I-95, respectively, for Hot Spot Areas between Bridgeport and New Haven.

Table 19 – Structures Carrying I-95 between Greenwich (New York line) and Bridgeport Harbor

Total Number of Structures	82
Total Number of Bridges	75
Total Number of Culverts	7
Total Number of Structures which achieve Unconstrained I-95 Section without Modifications	5
Total Number of Structures which achieve Combined I-95 Section without Modifications	43
Total Number of Structures Requiring Structure Widening, Superstructure Replacement, Deck Replacement, & Modifications	25
Total Number of Structures Requiring Complete Bridge Replacement	17

Table 20- Structures Carrying I-95 within hotspot locations between Bridgeport and New Haven

Total Number of Structures	5
Total Number of Bridges	4
Total Number of Culverts	1
Total Number of Structures which achieve Unconstrained I-95 Section without Modifications	0
Total Number of Structures which achieve Combined I-95 Section without Modifications	4
Total Number of Structures Requiring Structure Widening, Superstructure Replacement, Deck Replacement, & Modifications	0
Total Number of Structures Requiring Complete Bridge Replacement	0

Table 21- Bridges Over I-95 between Greenwich (New York line) and Bridgeport Harbor

Total Number of Bridges	31
Total Number of Structures which achieve Unconstrained I-95 Section without Modifications	1
Total Number of Structures which achieve Combined I-95 Section without Modifications	6
Total Number of Structures Requiring Structure Widening, Superstructure Replacement, Deck Replacement, & Modifications	7
Total Number of Structures Requiring Complete Bridge Replacement	18

Table 22- Bridges Over I-95 within hotspot locations between Bridgeport and New Haven

Total Number of Bridges	2
Total Number of Structures which achieve Unconstrained I-95 Section without Modifications	0
Total Number of Structures which achieve Combined I-95 Section without Modifications	0
Total Number of Structures Requiring Structure Widening, Superstructure Replacement, Deck Replacement, & Modifications	0
Total Number of Structures Requiring Complete Bridge Replacement	2

Recommendations:

The Department conducted a final evaluation of structure needs based on the existing Bridge Management System (BMS). Appendix D contains the Department's forecasted needs for bridge repair, replacement. These improvements where coordinated with the requirements for widening and have been incorporated in the recommendations and costs.

4.1.2.10 Cost Estimation

Structure replacement and modification costs were developed for the structures within the study corridor, based on estimated unit prices for each type of structure modification. Table 23 below summarizes the recommended unit costs (2017 Dollars) for Bridge Work between Greenwich and New Haven.

Table 23- Recommended Unit Costs for Bridge Work between Greenwich and New Haven

Recommended Unit Cost for Bridge Work as per 2017 dollar			
Description of Work	**Units**	**Estimated Unit Cost (1)**	**Recommended Unit Cost**
Complete Bridge Replacement	SF	$423 (2)	$525 (3)
Superstructure Widening, Substructure Widening & Modifications	SF	$423 (2)	$500 (3) + $750/lf of Existing Bridge Length
Superstructure Replacement	SF	$300	$325 + $75/sf of Existing Bridge Deck Area (4)
Retaining Wall	SF	$80-$150	$200 (5)
45" F-Shape Precast Concrete Barrier Curb	LF	$100	$200

Note:

1. *Unit Cost from CTDOT 2017 Estimating Guidelines unless noted.*
2. *Cost of Replacement Bridge only and do not include Demolition of Existing Structure.*
3. *Recommended Unit Cost includes Demolition.*
4. *High cost due to unfavorable site conditions (working over or under I-95).*
5. *High cost due to unfavorable site conditions (low head room under existing structures, adjacent to active highway).*

The estimated total cost associated with the structure work in order to improve traffic conditions on I-95 by adding an additional lane, the structure replacement/ modification cost (excluding major structures) is estimated to be $432,124,860 to achieve the Combined Section, and $512,149,490 to achieve the Unconstrained Section. Appendix D presents detailed evaluation charts of Costs for Culverts and Bridges carrying I-95 and Bridges over I-95.

4.1.3 Major Structures

This section will summarize the eight (8) major structures within the study corridor that will require modifications to accommodate the proposed I-95 operational lane between Greenwich and Bridgeport. The major structures are as follows:

- Mianus River Bridge - Structure No. 06015
- Stamford Area Structures – Structure No.'s 00027, 00028, 00029, and 00031
- Metro North Railroad Bridge – Structure No. 00032
- Yankee Doodle Bridge (Norwalk) – Structure No. 00059
- Saugatuck River Bridge – Structure No. 00064

4.1.3.1 Mianus River

The Mianus River Bridge is a 24-span steel plate multi-girder bridge which carries I-95 over the Mianus River in Greenwich (see Figures 1-4 in Appendix F and Figure 5 below). Along with the Mianus River, the bridge crosses the Greenwich Creek, Strickland Road, and River Road. A majority of the piers are multi-column pier bents, except for three of the piers which are steel straddle bents, needed to span over Strickland Road and River Road. The superstructure consists of 14 steel beams, seven in each direction.

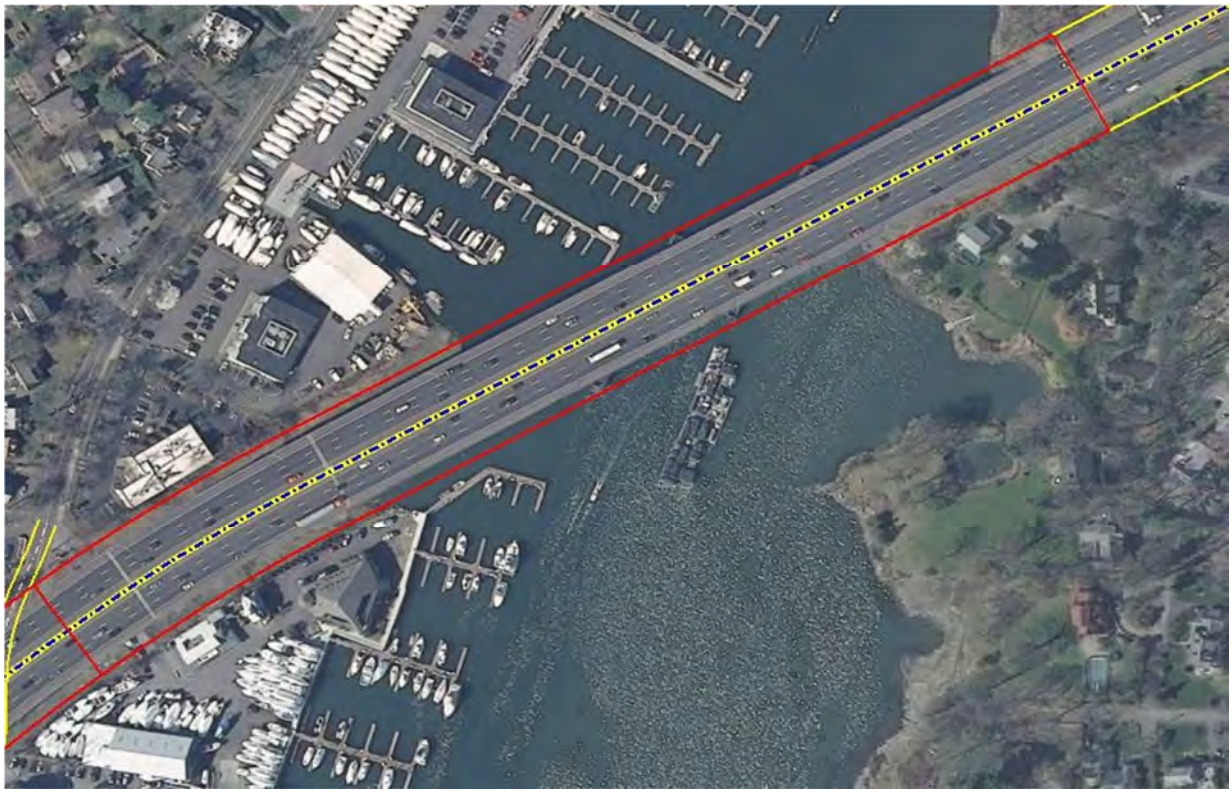
In order to accommodate the Combined Option, the bridge deck needs to be widened by 8' to accommodate 12' lanes. The 8' widening would require additional beams and piers. The exterior beams would need to be analyzed to determine if additional strengthening was required to handle the additional load. Adjustments to the piers would not be anticipated for 12' lanes, although the abutment u-wings would need modified to accommodate the additional width.

The Unconstrained Option (12' travel lanes, 12' left and right shoulders) is expected to require two additional beam lines in each direction to allow for the 15' of widening needed in each direction. The existing bridge deck is expected to be rehabilitated as needed, and then expanded. Two additional hammerhead piers will be needed at each pier location, one in each direction, to support the new beam lines. The abutments and wingwalls will also need to be widened.

The main difficulties with widening for the Unconstrained Option is the location of the two roadways which weave under the bridge. Four of the existing pier columns are already located in very close proximity to the roadway, and any additional pier columns would be in direct conflict with the existing roadway. One option is to adjust the alignment of the local roads to avoid the new pier columns. Additional options include offsetting the location of the new pier columns to miss the roadway, or to provide straddle bents instead of hammerheads in these specific locations.

The cost to provide the Unconstrained Option is estimated at $84.6 million in 2017 dollars. The Combined Option was not estimated, as it is infeasible to widen the Mianus River Bridge 8' to accommodate the Combined Section. Rather, the Combined Section can be accommodated on the existing bridge structure with narrow shoulders. See Appendix D for details.

Figure 5 – Mianus River Bridge



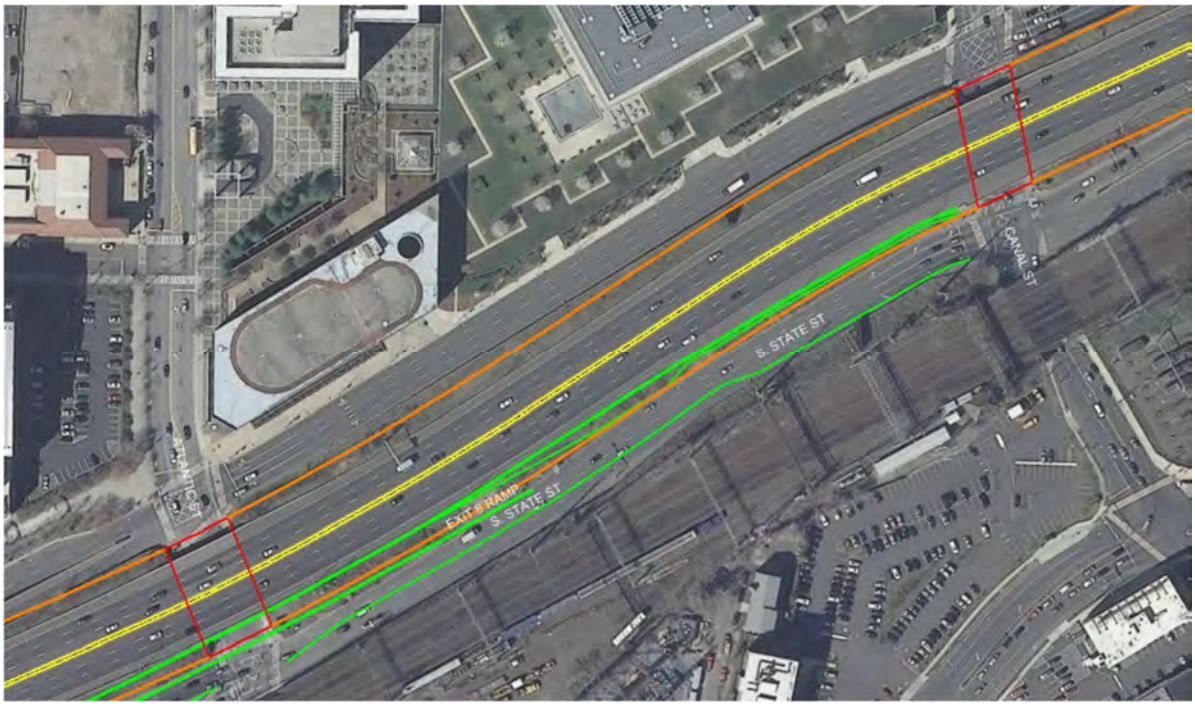
4.1.3.2 Stamford Corridor (Bridges 27-29, 31)

The Stamford Corridor is approximately one-mile-long and is made up of 4 bridge structures and multiple retaining wall (see Figures 5-10 in Appendix F and Figure 6 below). I-95 is adjacent to North and South State Streets, and crosses over Washington Blvd and the adjacent bus terminal, Atlantic St, Canal St, and Elm St. Along this stretch of I-95 there are two NB off-ramps and two on-ramps, while SB has two on-ramps and two off-ramps. Washington Blvd is an eight-span bridge, while the other three are single span bridges. All bridges have a multi-girder steel plate superstructure, and the piers for Washington Blvd are multi-column pier bents.

In order to accommodate the Combined Option, the shorter barrier walls adjacent to I-95 will need to be shifted to the south approximately 10’ to 14’ for the majority of the corridor, which should allow the existing retaining walls adjacent to N. and S. State Street to remain in-place. Each bridge will require an additional beam lines to accommodate widening in each direction. The Combined Option should allow all existing ramps to be maintained and should be coordinated with future projects.

The Unconstrained Option will require more extensive retaining wall work, with the two-tiered system replaced with full height retaining walls. The Unconstrained Option will most likely eliminate one NB on-ramp, a SB off-ramp, and a SB on-ramp. Each bridge would need an additional two to three beam lines, along with widened abutments. Because of the layout of the bus terminal below the Washington Blvd bridge, the existing bridge should be replaced with a continuous steel superstructure to eliminate some of the pier locations and reduce interference with the bus lanes.

Figure 6 – Atlantic Street Bridge in Stamford



The cost to provide the Combined Option is estimated at $27 million, and the cost for the Unconstrained Option is estimated at $117.5 million in 2017 dollars. See Appendix D for details.

4.1.3.3 Metro-North Railroad (Bridge 32)

The Metro-North Railroad Bridge is a 17-span steel plate multi-girder bridge, with a thru-girder main span over the Metro-North Railroad (see Figures 9 and 10 in Appendix F and Figure 7 below). The thru-girder system is on a very sharp skew, and therefore uses floor beams which span between the pier cap and the thru-girders. The bridge also spans S. State Street and Myrtle Avenue. The piers are all multi-column pier bents with various arrangements do to the different skew angles over the local roads and the railroad. There is also a ramp structure immediately to the north of the bridge, but is not attached to the railroad bridge in any way.

Figure 7 – Metro North Railroad Bridge

In order to accommodate both the Combined and the Unconstrained Options, the bridge will require a significant widening. Because the thru-girder system cannot be widened, a replacement bridge will be necessary for both options. In order to accommodate the widening, a portion of the new bridge should be built to the south of the existing bridge which can accommodate the existing Northbound traffic and on-ramp. Once the Northbound traffic is diverted onto the new bridge, half of the existing structure can be demolished. In order to accomplish demolition on half of a thru-girder, a support beam will be required to span the railroad and support the floor beams when one of the two thru-girders is removed. With half of the existing bridge removed, an additional portion of the new bridge can be built which will accommodate both Northbound and Southbound traffic. With all traffic on the new structure, the remainder of the existing bridge will be removed and the rest of the new bridge built. Based on the preferred option, either the Combined or Unconstrained width can be built. Consideration should be given to combining the Northbound on-ramp at Elm Street and Canal Street into one on-ramp. This will potentially reduce the impacts of widening over Metro-North Rail Line.

Besides the difficult staging operation, the other difficulty is maintaining the existing railroad service and coordinating with the tower that exists underneath the existing bridge. The longer spans should be countered by the continuous beams to help reduce the need to raise the vertical profile. However, it should be expected that some vertical profile change will be required. Multiple 250’ spans, similar to the ramp structure, will allow for a reduced number of piers and the ability to span over the split State Street roadway with less congestion.

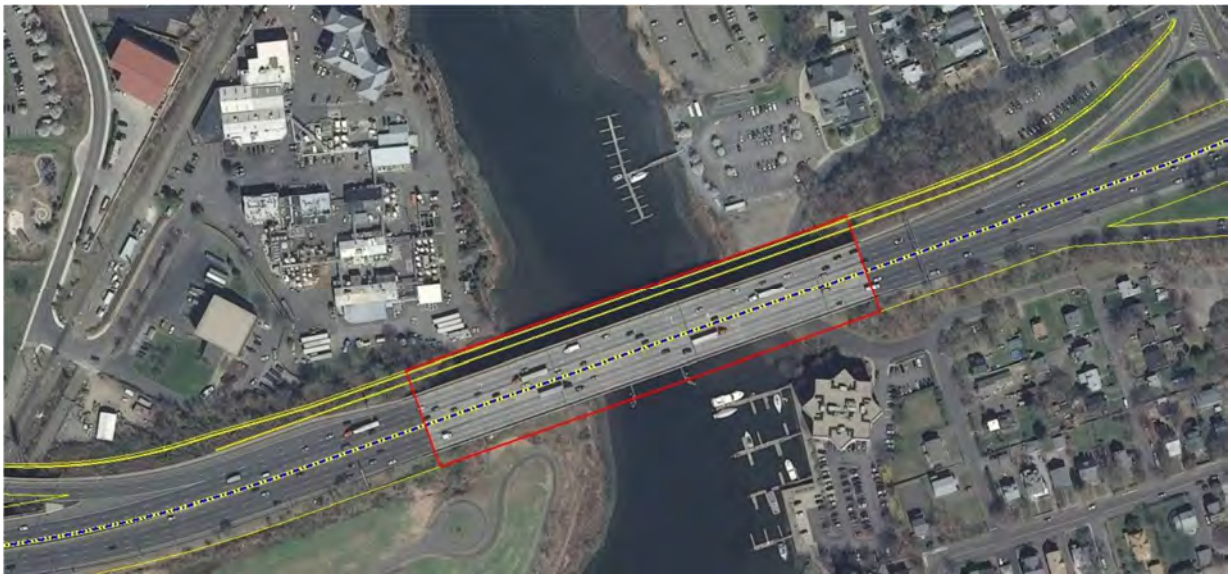
Additionally, Structure No. 00033 and 00034 may need to be widened or replaced entirely to accommodate the realignment necessary to reconstruct Structure No. 00032.

The estimated costs for replacement of this structure is $600 million (Appendix D). Due to the involvement of Metro North and rights of way requirements, the Department has commissioned an evaluation of the structure replacement and will be studied further during the concept phase.

4.1.3.4 Norwalk River (Bridge 59)

The Norwalk River Bridge is a seven-span steel multi-girder bridge which carries I-95 over the Norwalk River and Hendricks Avenue (see Figures 11-14 in Appendix F and Figure 8 below). The 11 steel plate girders use a pin and hanger connection, which was previously retrofitted. The bridge has six multi-column pier bents, and also carries a sidewalk adjacent to the Southbound roadway. Because of the large volume of traffic entering and exiting in the SB direction, two ramp lanes will need to be accommodated on the bridge, as opposed to the one ramp lane that currently exists.

Figure 8 – Norwalk River Bridge



In order to accommodate the Combined Option, the bridge deck needs to be widened by 16' in the Northbound direction and 33' in the Southbound direction. Because of the deteriorated condition of the existing bridge, and the pin and hanger connections, a full replacement of the bridge should be considered. If the bridge is not replaced, two beam lines will need to be added in the Northbound direction and three in the Southbound. Additional hammerhead piers can be built adjacent to the existing piers, and the existing abutments will need to be modified. The Unconstrained Option requires a similar widening, except that 31' will need to be added in the Northbound direction, and 49' in the Southbound direction. This will require 3 new beam lines for Northbound and 5 new beams for Southbound.

The cost to provide these improvements range between $80 million and $106 million in 2017 dollars for the structure. See Appendix D for details. Due to the proximity of this structure to the Exit 14-16 interchanges, several alternatives will need to be evaluated under the concept phase along this 2-mile segment of I-95.

4.1.3.5 Saugatuck River (Bridge 64)

The Saugatuck River Bridge is a 10-span steel multi-girder bridge which carries I-95 over the Saugatuck River, Riverside Avenue, and Saxon Lane (see Figures 15-17 in Appendix F and Figure 9 below). The bridge also spans parking facilities located under the bridge that are accessible from

Riverside Ave. and Saxon Ln. The bridge superstructure is made up of 18 continuous beams, while the substructure is made of multi-column pier bents.

In order to accommodate the Combined Option, the bridge deck needs to be widened by 2' in each direction to accommodate 11' lanes and widen 10' in each direction to accommodate 12' lanes. This can be accomplished by removing the existing overhang and replacing it with an overhang which is 2' wider. The exterior beams will need to be analyzed to determine if additional strengthening is required. In addition, the abutments and wingwalls will need adjusted to accommodate the widening. No adjustments to the piers is anticipated for the 11' lanes. Additional piers would be necessary for the 12' lanes.

The Unconstrained Option will require two additional beam lines to accommodate the 12' or 16' of widening required in each direction. New hammerhead piers will also be required to support the additional beam lines, and the abutments will need widened as well.

Figure 9 – Saugatuck River Bridge

The cost to provide the Unconstrained Option is estimated at $41.6 million in 2017 dollars. Four (4) 12' lanes can be accommodated with 4' shoulders. See Appendix D for details. The Combined Option was not estimated, as it is infeasible to widen the Saugatuck River Bridge 4' in total to accommodate the Combined Section. Rather, the Combined Section can be accommodated on the existing bridge structure with narrow shoulders.

4.1.4 Interchange Improvements

Interchange improvements required to accommodate the creation of the four-lane operation are discussed in following sections. They have been placed in one of three categories, depending on the impacts and improvements required to accommodate a fourth lane of operation. They are:

1. Minor Improvements
2. Moderate Improvements
3. Major Improvements

The level of improvement at each location is identified in the following section.

4.1.5 Interchange Level of Impacts

4.1.5.1 Minor Impact Improvements

- Up to $5 million in construction cost
- Minor realignment of acceleration and deceleration lanes, ramp alignment
- No wetland impacts
- No ROW impacts
- No retaining walls required
- No noise barrier walls
- Straightforward constructability and Maintenance and Protection of Traffic (MPT)

4.1.5.2 Moderate Impact Improvements

- Up to $10 million in construction cost
- Reconfiguration of ramps for better operations, widening and acceleration lanes
- Minor wetland impacts
- Minor of ROW impacts
- Minor retaining walls needed (up to 10’ high)
- Noise barrier walls required
- Possible short-term ramp closures during construction causing minor detours

4.1.5.3 Major Impact Improvements

- $19 million in construction cost
- Major reconfiguration of ramps for better operations
- Significant wetland impacts
- Major retaining walls (over 10’ high)
- Noise barrier walls required
- Relocation of local streets
- Widening/replacement of existing structures
- Constructability issues – long term ramp closures, possible permanent ramp closures

4.1.5.4 Interchange Improvements

Interchange 2 – Minor Improvements

- Northbound – Modifications to gore and merge areas.
- Southbound – Modifications to gore and merge areas.

Interchange 3 – Minor Improvements

- Northbound – Modifications to gore and merge areas.
- Southbound – Extend Southbound off-ramps, Modify merge areas.

Interchange 4 – Moderate Improvements

- Northbound – Modifications to gore and merge areas, possible retaining walls and ROW.

- Southbound – Modifications to gore and merge areas, possible retaining walls.

Interchange 5 – Moderate Improvements
- Northbound – Modifications to gore and merge areas.
- Southbound – Modifications to gore and merge areas.

Interchange 6 – Minor Modifications
- Northbound – Minor modifications to gore and merge areas.
- Southbound – Minor modifications to gore and merge areas.

Interchange 7 and 8 – Moderate Improvements
- Northbound – Modifications include gore and diverge tapers, retaining walls and widening.
- Southbound – Modifications include widening retaining walls and merge taper possible auxiliary lane.

Interchange 9 – Moderate Improvements
- Northbound – Reconfigure loop ramp, modify gore area and diverge.
- Southbound – Modifications to merge and gore areas, retaining walls necessary.

Interchange 10 – Moderate Improvements
- Northbound – Reconfigure Northbound on-ramp, acquire property, bring on-ramp south to Noroton Avenue, gore area modifications.
- Southbound – Merge and diverge improvements.

Interchange 11 – Moderate Improvements
- Northbound – Gore and merge area realignments with retaining and noise walls.
- Southbound – Ramp realignment with retaining walls.

Interchange 12 – Minor Improvements
- Northbound – Diverge and merge are modifications.
- Southbound – On-ramps merge area configuration.

Interchange 13 – Moderate Improvements
- Northbound – Diverge modifications.
- Southbound – Diverge and merge area modifications.

Interchange 14 – Moderate Improvements
- Northbound – On-ramps merge configuration.
- Southbound – Revised off-ramp geometry and lane storage reconfigure on-ramp geometrics.

Interchange 15 – Major Improvements

- Northbound – Adjust off-ramp diverge geometrics based on recent improvement project to Reed Street and Route 7. Modify Route 7 off-ramp to West Avenue and Northbound I-95 on-ramps.
- Southbound – Modify Route 7 Southbound on-ramp and West Avenue on-ramp to I-95 Southbound, consider eliminating West Avenue I-95 on-ramp and redirect movement to Route 1 and Route 7/I-95 Southbound on-ramp.

Interchange 16 – Moderate Improvements

- Northbound and Southbound – realign ramp gore, diverge and merge area realignments.

Interchange 17 – Moderate Improvements

- Northbound and Southbound – Diverge and loop ramp geometric changes and merge condition are required.

Interchange 18 – Moderate Interchange Improvements

- Northbound – Modify diverge/gore and merge conditions.
- Southbound – Change ramp configuration to half diamond.

Interchange 19 – Minor Improvements

- Northbound and Southbound – Modifications to diverge and merge areas and toper lengths.

Interchange 20 – Minor Improvements

- Northbound – On-Ramp
- Southbound – Off-ramp merge and diverge improvements widening of Mill River structure.

Interchange 21 – Minor Improvements

- Northbound and Southbound merge and diverge areas. Add auxiliary lane between 21 and 22 both directions.

Interchange 22 – Fairfield Service Plaza – Moderate Improvements

- Northbound – Add auxiliary lane Northbound between 21, 22, and 23.
- Southbound – Add auxiliary lane between 21, 22 and 23.

Interchange 23 – Moderate Improvements

- Northbound – Relocate off-ramp south of Kings Highway. Reconfigure intersection geometry. Modify on-ramp merge.
- Southbound – Move off-ramp diverge easterly.

Interchange 24 – Moderate Improvements

- Northbound and Southbound – Revise diverge/gore area geometrics.

Interchange 25 – Minor Improvements

- Northbound Off, Southbound On – Modify diverge and merge geometrics.

Interchange 26 to 27A/B – Major Improvements

- Northbound – Add Operational Lane, 5-lane section to achieve a two (2) lane of condition to Route 8 Northbound.
- Northbound – On-ramp, modify merge area and ramp.

Interchanges 7-9 have been identified as a special study area due to the complexity of the loud service roads, retaining walls, and the need to replace Bridge 00032 over the MNRR railroad.

Interchange 14, 15 and 16 areas and the Norwalk River Bridge crossing warrants special study due to the Route 7 movements; the use of I-95 as a local connector with East and South Norwalk. In addition, coordination of the study with improvements planned by the Developer at West Avenue will be critical.

Interchanges 22 to 24 have several local roadways which interface with I-95 and the on and off-ramps associated with service to both a commercial and residential area in Fairfield. The area is further impacted by the Service Plaza adjacent to Interchange 23. The area should be studied further to consider reducing conflicting movements and the possible incorporation of a series of Frontage Roads on the North and South sides of I-95.

Interchanges 15 and 26 to 27A/B were the only interchanges that require major improvement within the study corridor.

5.1 I-95 Bridgeport to New Haven – Hot Spots

5.1.1 Hot Spot Locations – Bridgeport to New Haven

Between Bridgeport and New Haven, three specific areas have been identified to improve traffic operations, improve mobility, safety and reduce congestion.

- Exit 27A (I-95/Route 8/Route 25 Interchange)- Exit 27A is major interchange that provides access to Route 8/Route 25 in Bridgeport. During the morning and evening peak periods, this segment of I-95 experiences heavy congestion because of mainline and ramp capacity constraints, closely spaced ramps and steep ramp grades. These problems are expected to get worse in the future with traffic growth in the area. Improvements proposed include widening the Route 8 Northbound ramp from I-95 Northbound to two lanes. The total cost of the improvements is estimated to be approximately $20,400,000.

- Exit 38 (Wilbur Cross Parkway)– Exit 38 is a major interchange that provides access to Route 15 in the Milford area. At this location, the operational shortcomings include inadequate weaving distances in the Northbound section within the clover leaf interchange, lack of ramp capacity in the Southbound direction. Improvements at this interchange include providing a direct connector flyover from Southbound Milford Parkway to Northbound I-95. Improvements also include adding an operational lane between Interchange 38 and Interchange 39 in both directions, widening of the Milford Connector ramp to I-95. Bridge reconstruction at Wheeler's Farms Road will also be necessary. A new

ramp from Milford Parkway to I-95 NB has been proposed in order to improve the existing ramp. The proposed ramp consists of an approximately 1,116' long and 29'-10" wide multi span flyover, an approximately 736' long and 26' approach on embankment, and an approximately 1,225' long retaining wall for the approaches. The total cost of the improvements is estimated to be approximately $148,600,000, which includes engineering, construction engineering and inspection, and right-of-way costs.

- Exit 39 (Boston Post Road/Route 1) and Exit 40 (Woodmont Road) – Exit 39 is also a major interchange that provides access to Route 1 in Milford. Due to the proximity of significant commercial development near this interchange, ramp movements are heavy and the Cloverleaf interchange which currently exists does not provide adequate weaving in the Northbound or Southbound directions. Consideration should be given to the reconstruction of this interchange by providing either a full movement diamond or through a single point urban interchange with I-95 over Route 1. Modifications to the off-ramp geometry from I-95 Southbound to Route 1 Northbound will also be required. A I-95 Northbound operational lane and Southbound operational lane to and from Exit 40 at Woodmont Road will also improve operations on I-95. This location also exhibits heavy commercial development with both retail and truck service plazas which exhibit significant truck movements both in the Northbound and Southbound directions. Continuation of the operational lane in the Northbound direction from Exit 39 to Exit 40 Woodmont Road is recommended. Widening of the Northbound off-ramp to Woodmont Road in conjunction with retaining walls to minimize impacts to private property is recommended. In addition, the inclusion of a Southbound I-95 operational lane from the Exit 40 Woodmont Road interchange to Exit 39 I-95/Route 1 is recommended to provide additional capacity and additional weaving distances between the Southbound Woodmont Road on-ramp and the Northbound Route 1 off-ramp at Exit 39. The total cost of the improvements is estimated to be approximately $86,400,000, which includes engineering and construction engineering and inspection costs.

All cost estimates are based on planning level analysis and subject to further review based on detailed engineering/highway analysis.

6.1 Improvements Summary (Greenwich to New Haven)

6.1.1 Highway

Given the evaluation, criteria, and considering the operation improvements that can be realized, implementing a four (4) lane operation on I-95 from Greenwich (NY State Line) to Bridgeport is feasible and practical.

The scope and budget of this study did not allow for detailed refinements and an in-depth evaluation of existing pavement and shoulder conditions for use as an operation lane. Further refinement of the following will be necessary including:

- Previous shoulder and drainage construction during median barrier and safety improvement projects to determine the need for reconstruction.
- Implementation of special studies in the following areas to evaluate alternatives for the improvements for each of these areas:
    - Stamford Interchanges 7 to 9
    - Norwalk Interchanges 13 to 16
    - Fairfield Interchanges 20 to 22 and 23 to 24
    - Bridgeport Interchange 27A
- Retaining walls have been used in key locations to accommodate ramp improvements.

6.1.2 Bridges

6.1.2.1 Grade Separated

Table 24 summarizes all structures carrying I-95 within the study area.

Table 24 – Structures Carrying I-95 between Greenwich (New York line) and New Haven

Total Number of Structures	87
Total Number of Bridges	79
Total Number of Culverts	8
Total Number of Structures which achieve Unconstrained I-95 Section without Modifications	5
Total Number of Structures which achieve Combined I-95 Section without Modifications	47
Total Number of Structures Requiring Structure Widening, Superstructure Replacement, Deck Replacement, & Modifications	25
Total Number of Structures Requiring Complete Bridge Replacement	17

Table 25 summarizes all structures overI-95 within the study area.

Table 25- Bridges Over I-95 between Greenwich (New York line) and New Haven

Total Number of Bridges	33
Total Number of Structures which achieve Unconstrained I-95 Section without Modifications	1
Total Number of Structures which achieve Combined I-95 Section without Modifications	6
Total Number of Structures Requiring Structure Widening, Superstructure Replacement, Deck Replacement, & Modifications	7
Total Number of Structures Requiring Complete Bridge Replacement	20

6.1.2.2 Major Structures

Table 26 summarizes the major structures within the study area.

Table 26 – Major Structures

	Existing	Combined	Unconstrained
Mianus River	No Widening, retain 57'		
Stamford Exit 7-9	Widen Unconstrained Section		
I-95 over MNRR	Replace Structure/Widen Structure to Unconstrained Section		
Norwalk River	Special Study/Replace Structure		
Saugatuck River	No widening, Limit shoulders 4'LT, 8'RT		
Bridgeport Harbor	Retain Existing Structure		

6.1.2.3 Special Studies

Special study areas have been identified based on the need for a future evaluation of different elements, areas, and potential solutions including:

- Major structures and structural requirements;
- Significant interchange operational deficiencies and existing geometric conditions;
- Major waterway crossings and improvement areas.

Special study areas are identified as follows:

- Stamford Exit 7 through Exit 9 including Bridge 32 over Metro North, a significant structure with inadequate roadway geometrics and operational issues in Stamford.
- Norwalk Exit 13 to Exit 16, predominantly caused by the Norwalk River Crossing structure and the proximity of the existing Route 7 Trumpet interchange on the west and the Exit 16 East Avenue interchange to the east of the Norwalk River. This area of I-95 experiences significant congestion and operational/weaving issues as a result of closely spaced ramps and mainline capacity constraints. These problems are anticipated to exacerbate as a result of traffic growth due to intense commercial development on the westerly side of the Norwalk River.
- Exit 22 to Exit 24 in Fairfield – This area exhibits significant operational issues with tightly spaced ramps that also serve a number of local roads. This segment might be better served by reconfiguring the interchanges through a series of frontage roads.
- Exit 27 I-95/Route 8 – The existing structure rehabilitated previously is wide enough to accommodate additional operational and auxiliary lanes on the structure to enhance improvements for the I-95 Northbound off movement to Route 8 north and Route 8 Southbound to I-95 Southbound movement. The area is predominantly located on existing structure and the existing Northbound I-95 to Route 8 off-ramp has steep vertical geometry causing commercial vehicles to take the movement at slower speeds and impacting operational characteristics of passenger vehicles operating potentially at higher speeds that results in a queue on I-95 in the Northbound direction. Consideration to improving the roadway assignment of pavement to lanes and accommodating a two lane off-ramp configuration to Route 8 Northbound.

7.1 Risk Analysis and Cost Estimates

A construction cost estimate has been prepared in 2017 dollars to provide four (4) operational lanes in both the Northbound and Southbound direction on I-95 between Greenwich and Bridgeport, as well as for the hot spot areas identified between Bridgeport and New Haven. The cost estimate has been prepared using the following approach and guidelines:

- A construction risk workshop was conducted with members of the Department's staff including planning, concept development, engineering, district construction, rights of way and environmental planning and compliance, which estimated ranges for cost elements (low, base, & high cost), which was used to perform a risk analysis of the construction costs.
- The Connecticut DOT 2017 Cost Estimating Guidelines were utilized to determine percentages for lump sum contract items and minor item allowances.
- Actual construction cost estimates for various recent construction projects as well as past and planned projects along I-95 was used to determine unit prices and contract item quantities.
- Engineering judgement was used in the assignment of unit costs for miscellaneous, minor, and incidental items.

The following factors should be considered when planning future projects along the corridor:

- The cost for roadway widening was developed using unit costs from recent I-95 project constructed and applying them to anticipated quantities for construction. Construction items included pavement, drainage, guide rail, lighting, maintenance, and protection of traffic, signing and markings were considered.
- Full depth shoulder reconstruction was included in the construction cost estimate, although some previous I-95 projects may have included all or portions of this previously.
- State police operations for interstate construction projects often carry a significant cost and is traditionally not included in the available construction cost history. Based on available data for projects constructed in Connecticut, the cost for State Police averages between 0.5%-2.5% of the total construction cost and is typically based on project complexity. Cost for tolling, if an option, has not been included.
- Engineering costs and construction inspection costs should be budgeted at 10% for engineering to include both design and program management and 10% for construction inspection.
- Contingency and miscellaneous items were included at 25% each and added to the subtotal.
- Rights-of-way costs where estimated by the Department at approximately $12 million exclusive of temporary or construction easements for either alternative.

To model the uncertainty and variability of the construction costs associated with the widening of I-95 to accommodate an additional operational lane in both the Northbound and Southbound direction from the New York line to Bridgeport, a Monte Carlo simulation and analysis was performed on the base cost estimate that was developed for the project. The purpose of this analysis is to evaluate the risk and sensitivity of elements within the cost estimate, and the total project cost risks and sensitivity.

A Monte Carlo simulation is a modeling technique which accounts for risk in quantitative analysis and decision making. Monte Carlo provides a range of possible outcomes and probabilities for each element in the cost estimate. To develop the range of outcomes for cost elements and the total project, the Monte Carlo model simulates each item 10,000 times based on a defined cost range and probability distribution curve for each element. Each simulation uses a distinct set of values for each cost element based on these defined ranges and distribution curves. By developing a range and distribution curve for each cost element, we get insight into several key data points: the mean value for each cost element and the total project, the cost range of each cost element and the total project, and a prioritized ranking of the sensitivity for each element. The Monte Carlo model was developed using Palisade's @Risk software, which is a Microsoft Excel add-in which allows the Monte Carlo simulation analysis to analyze risk in construction costs.

Base Cost Estimate:

A base cost estimate was developed to determine a unit cost per directional mile for the construction of an additional operational lane on I-95 from the New York border to Bridgeport. All estimate quantities were calculated based on a total directional length of 30 miles of Northbound widening and 30 miles of Southbound widening (60 miles total). The base cost estimate was determined by estimating quantities and unit costs of the following contract items:

- Bituminous Pavement
- Excavation & Borrow
- Drainage
- Metal Beam Rail and Concrete Median Barrier
- Highway Lighting
- Existing Concrete Base Pavement Repair
- Noise Barrier Wall
- Signing
- Retaining Walls
- Pavement Markings
- Interchange Improvements
- Wetland Mitigation
- Structure Replacement/Modifications
- Percentage Base Contract Items

Additionally, the following non-contract items costs were also estimated and included in the base cost estimate:

- Minor Item Allowance
- State Police Forces
- Intelligent Transportation Systems (ITS)
- Environmental Compliance
- Right-of-Way
- Construction Engineering & Inspection Services
- NEPA Documentation
- Program Management
- Design Services

Risk Analysis:

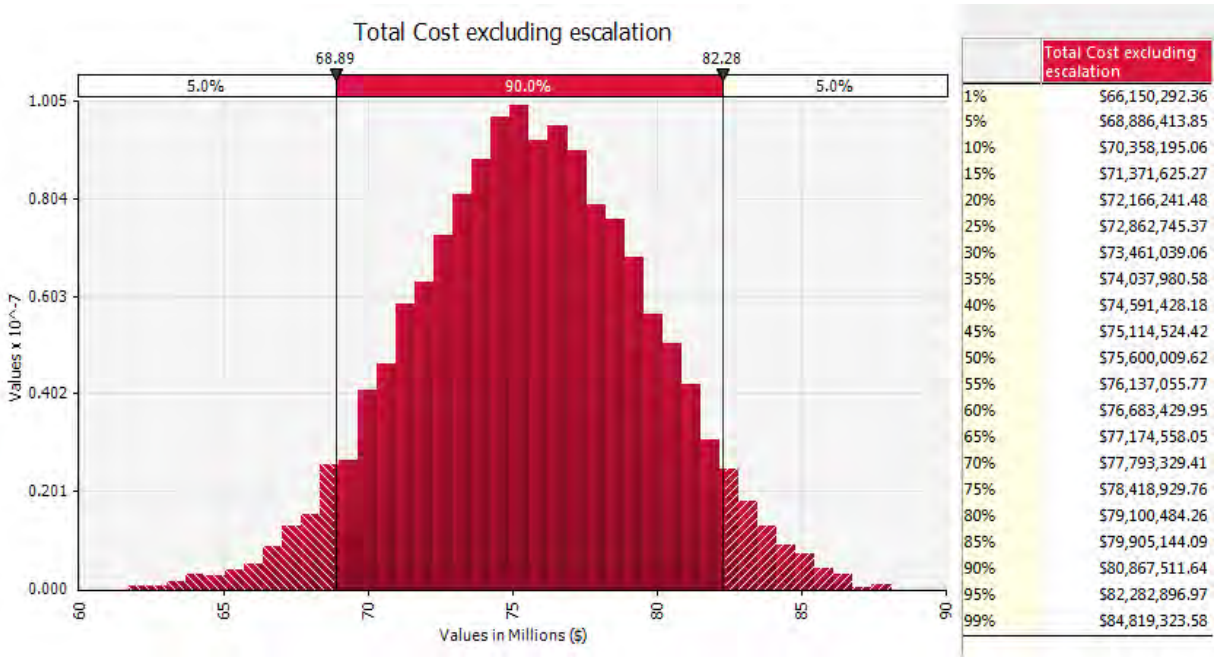
To determine the unique cost ranges, a minimum, most likely, and maximum value (3-point estimate) was assigned for each cost element based on the project team's cost estimate and engineering judgement. After the 3-point estimate was developed, potential probability distributions were evaluated. The United States Government Accountability Office identifies 8 commonly used probability distributions (GAO Cost Estimating and Assessment Guide, March 2009). From these 8 recommended distributions, the Beta and Triangular distributions are most commonly used for 3-point estimates.

Following the GAO cost estimating guidelines, the Monte Carlo risk model evaluated each cost element using the Beta distribution. The Beta distribution was chosen for the following reasons:

- Beta distribution uses a 3-point estimate with upper and lower bounds defined by the estimate.
- Like Triangular distribution, Beta distribution focuses on the "Most Likely" value over the minimum and maximum estimates.
- Beta distribution captures outcomes biased toward tail ends of a range (GAO, March 2009)
- Triangular distribution is not found in nature. Beta distribution provides a real-world curve found in nature and allows for a long tail towards pessimistic. This accounts for a potentially large cost impact for risks even when the event is very unlikely. (Integrative Cost-Schedule Risk Analysis, Dr. David Hulett, September 2012)

After running the Monte Carlo simulations, @Risk (Microsoft excel add-in to analyze risk) provides the mean cost and 90% cost range for each cost element and the total project. Additionally, @Risk output includes probability density graphs (Figure 10 & 12) and a sensitivity graph by total potential impact of each cost element. This sensitivity graph is called a tornado chart (Figure 11 & 13). This output is included in the results selection below. From the analysis, escalation was the highest factor in affecting the per mile cost. Subsequently, the risk model was run twice, both including and excluding escalation. This analysis was then used to determine the elements of the cost estimate which carry the most risk to the per mile cost.

Figure 10– Probability Density Graph – Total Cost Per Mile Excluding Escalation/Inflation



	Total Cost excluding escalation
1%	$66,150,292.36
5%	$68,886,413.85
10%	$70,358,195.06
15%	$71,371,625.27
20%	$72,166,241.48
25%	$72,862,745.37
30%	$73,461,039.06
35%	$74,037,980.58
40%	$74,591,428.18
45%	$75,114,524.42
50%	$75,600,009.62
55%	$76,137,055.77
60%	$76,683,429.95
65%	$77,174,558.05
70%	$77,793,329.41
75%	$78,418,929.76
80%	$79,100,484.26
85%	$79,905,144.09
90%	$80,867,511.64
95%	$82,282,896.97
99%	$84,819,323.58

Figure 11 – Tornado Chart – Total Cost Per Mile Excluding Escalation/Inflation

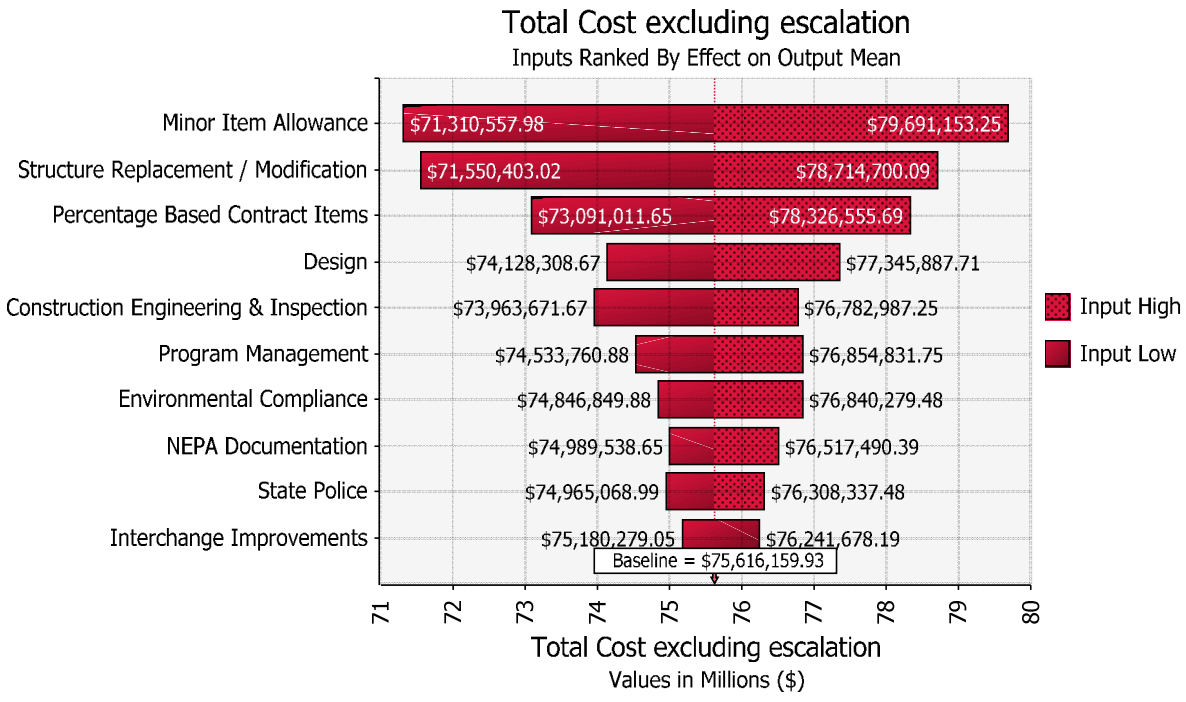
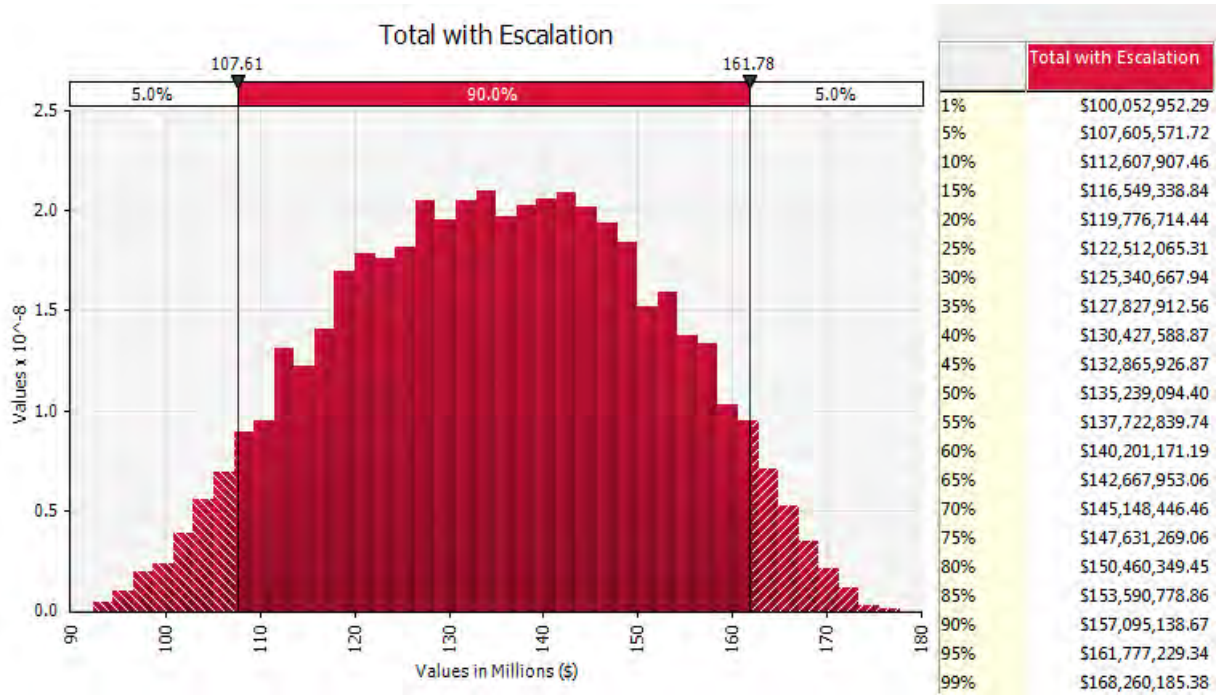
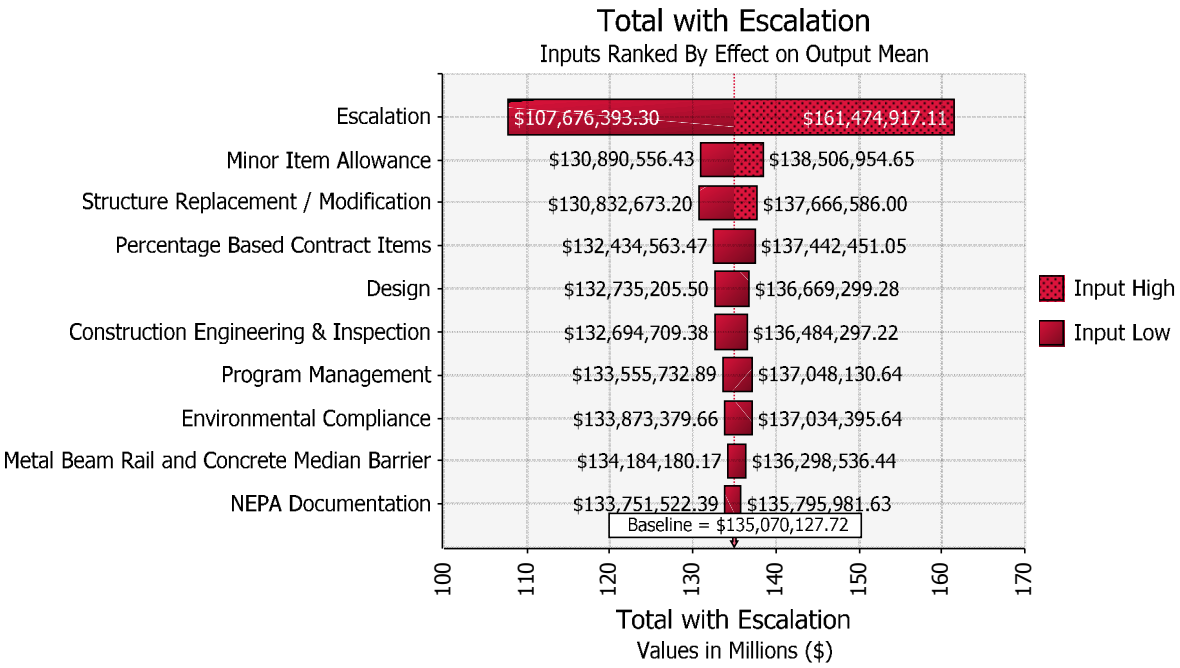


Figure 12 – Probability Density Graph – Total Cost Per Mile Including Escalation/Inflation



	Total with Escalation
1%	$100,052,952.29
5%	$107,605,571.72
10%	$112,607,907.46
15%	$116,549,338.84
20%	$119,776,714.44
25%	$122,512,065.31
30%	$125,340,667.94
35%	$127,827,912.56
40%	$130,427,588.87
45%	$132,865,926.87
50%	$135,239,094.40
55%	$137,722,839.74
60%	$140,201,171.19
65%	$142,667,953.06
70%	$145,148,446.46
75%	$147,631,269.06
80%	$150,460,349.45
85%	$153,590,778.86
90%	$157,095,138.67
95%	$161,777,229.34
99%	$168,260,185.38

Figure 13 – Tornado Chart – Total Cost Including Escalation/Inflation



Cost Analysis Results:

Based on the risk analysis, a summary of observed results was formulated, which includes the top five mean cost elements, the top five cost elements by potential cost range, and the cost probability and tornado charts for total cost with and without escalation/inflation. All cost is on a per mile basis.

The average total cost per mile to construct an additional directional operation lane is $75,616,160 excluding escalation/ inflation and $135,070,127 including escalation/ inflation. Escalation/ inflation is a primary driver in the potential cost per mile for construction; the average increase is roughly $59.5 million per mile (44% of the average total cost). For the basis of this estimate, escalation/inflation ranged from 3.5% to 4.0%, with a base escalation/inflation rate of 3.75%. The base year of the estimate is 2017, with the midpoint year of construction ranging from year 2030 to year 2040, with a base year of 2035. The minimum and maximum costs/mile were determined through risk analysis and were assigned likely possible percentages that the costs would be lower or higher than the base cost for each estimated item. These minimum and maximum percentages were determined through analysis at the risk workshops held with the Department. Once the minimum and maximum costs were determined, the Monte Carlo analysis calculated the contingency which should be applied to the total cost/mile. Table 27 depicts the minimum, average, maximum, and 95% confidence for total cost per mile with and without escalation.

Table 27- Total Directional Estimated Construction Costs*

	Minimum Cost/Mile	Average Cost/Mile	Maximum Cost/Mile	95% Confidence Cost/Mile
Total Cost w/o Escalation/Inflation	$61,727,710	$75,616,160	$88,108,105	$82,282,897
Total Cost with Escalation/Inflation	$92,314,536	$135,070,127	$177,710,612	$161,777,229

Note: * Cost estimates based on planning level analysis and subject to further review based on detailed engineering/highway analysis

The risk model developed from the Monte Carlo simulation is used to predict the contingency within the estimate. For this model, the 95% confidence level is utilized as the contingency estimate. Table 28 depicts the contingency cost and contingency percentage for both the cost with and without escalation/inflation. The contingency for the 95% confidence cost, without escalation/inflation, is 8.10%. With escalation/inflation, the contingency increases to 16.5%, since escalation/inflation is a large driver of the cost sensitivity.

Table 28- Total Directional Estimated Contingency*

	Average Cost/Mile	Contingency Cost/Mile	95% Confidence Cost/Mile	Contingency %
Estimate w/o Escalation/Inflation	$75,616,160	$6,666,737	$82,282,897	8.10%
Estimate with Escalation/Inflation	$135,070,127	$26,707,102	$161,777,229	16.5%

Note: * Cost estimates based on planning level analysis and subject to further review based on detailed engineering/highway analysis

The top five cost elements by mean cost per mile are listed below. These five items (of the total 24) account for 80% of the total cost with escalation.

1. Escalation/Inflation - $59,453,919
2. Structure Replacement/Modification - $20,625,122
3. Minor Item Allowance - $10,629,329
4. Percentage Based Contract Items - $10,133,149

5. Construction Engineering/Inspection - $6,124,422

The top five cost elements by cost range are:

1. Escalation/Inflation - $21,725,376 minimum to $94,190,816 maximum
2. Minor Item Allowance - $4,540,576 minimum to $16,083,640 maximum
3. Structure Replacement/Modification - $12,594,057 minimum to $24,484,939 maximum
4. Percentage Based Contract Items - $6,928,200 minimum to $13,753,491 maximum
5. Design - $3,082,191 minimum to $7,659,557 maximum

Based on the risk analysis, a total project cost to add an operational lane to I-95 for 30 miles of Northbound I-95 and 30 miles of Southbound I-95 (60 total miles of additional operational lanes) was determined. Including escalation, the total approximate cost to construct 60 miles of an additional operational lane between the New York state line and Bridgeport is anticipated to range between $5.5 billion and $10.6 billion with a 95% confidence interval cost of $9.7 billion.

Table 29- Total Estimated Construction Costs*

	Minimum Cost	Mean Cost	Maximum Cost	95% Confidence Cost
Total Cost w/o Escalation/Inflation	$3,703,662,600	$4,536,969,600	$5,286,486,300	$4,936,973,820
Total Cost with Escalation/Inflation	$5,538,872,160	$8,104,207,620	$10,662,636,720	$9,706,633,740

Note: * Cost estimates based on planning level analysis and subject to further review based on detailed engineering/highway analysis

Refer to Appendix D for the base cost estimate and basis of estimate, which includes all assumptions made to develop the base cost estimate.

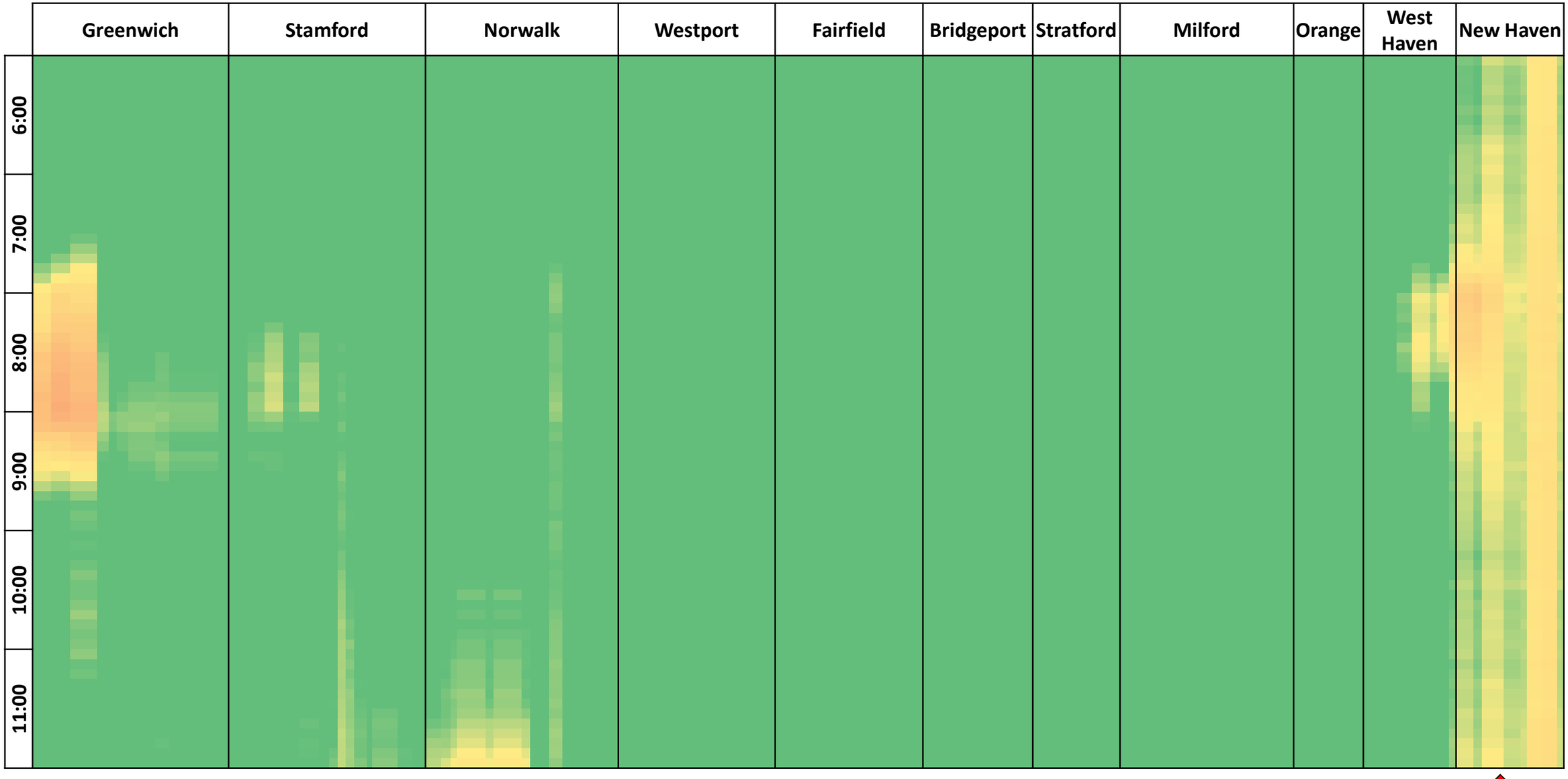
8.1 Conclusions and Recommendations

Following several meetings and workshops with the Department, the following course of action and resultant recommendations will be pursued.

- Prepare a Strategic Implementation Plan for initiation of directional improvements which will yield the greatest reduction in delay and improved travel time;
- Implement Short-Term projects and further evaluation of special study areas;
- Conduct additional Micro Simulations and improvements to determine benefits in delay reduction and travel time to determine phasing;
- Coordinate future bridge improvements to accommodate Unconstrained Section Elements;
- Use 12’ travel lanes to implement an additional lane in areas targeted for implementation using standard shoulder widths to the greatest extent possible, and reduced shoulder widths at structures that do not require replacement/reconstruction.
- Commence evaluation of areas requiring further concept development and investigation.

Appendix A

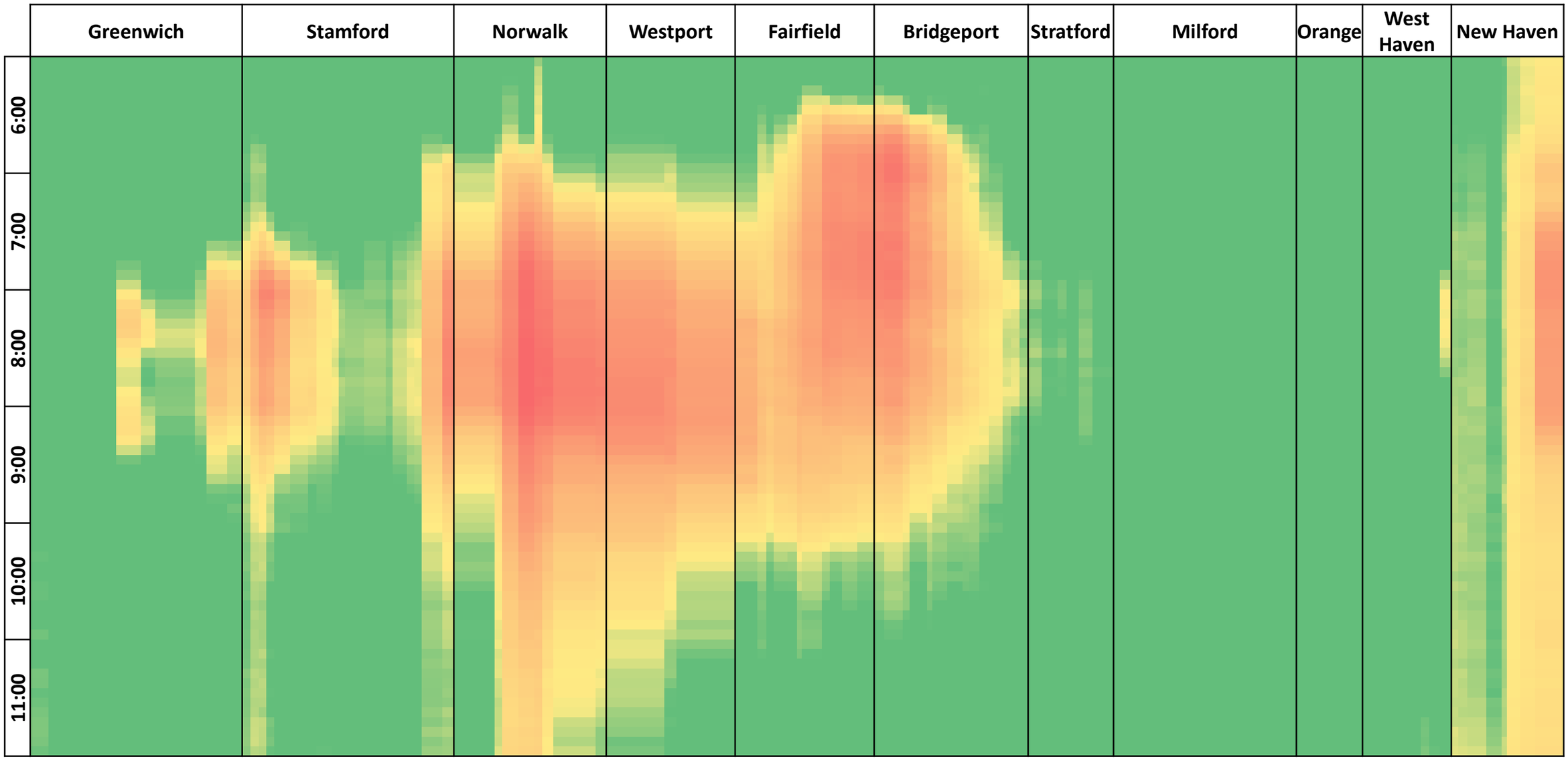
I-95 INRIX AND SKYCOMP DATA SUMMARY



CDM Smith

INRIX: I-95 AVERAGE WEEKDAY TRAVEL SPEEDS - NORTHBOUND AM

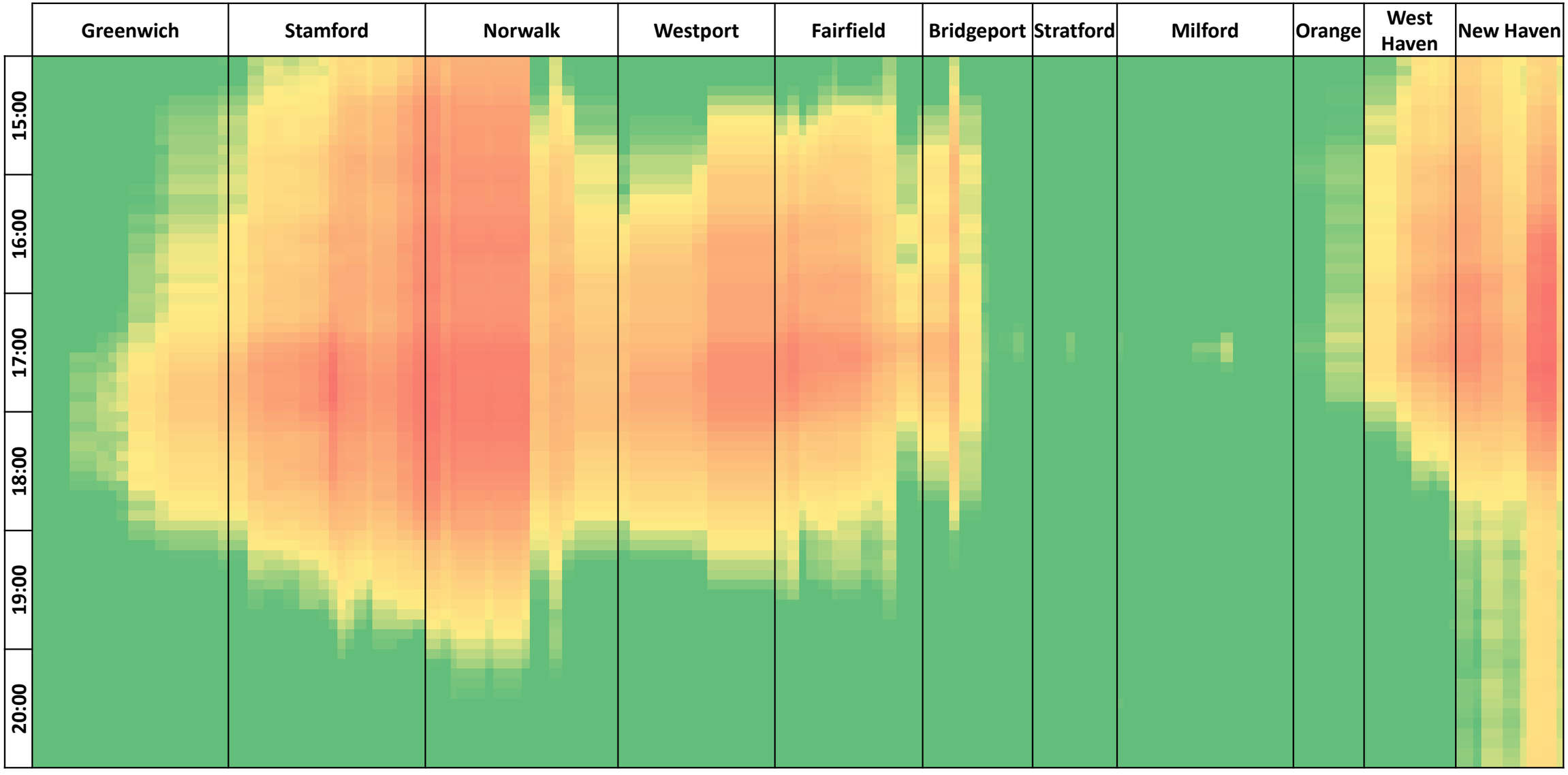
FIGURE 1



CDM Smith

INRIX: I-95 AVERAGE WEEKDAY TRAVEL SPEEDS - SOUTHBOUND AM

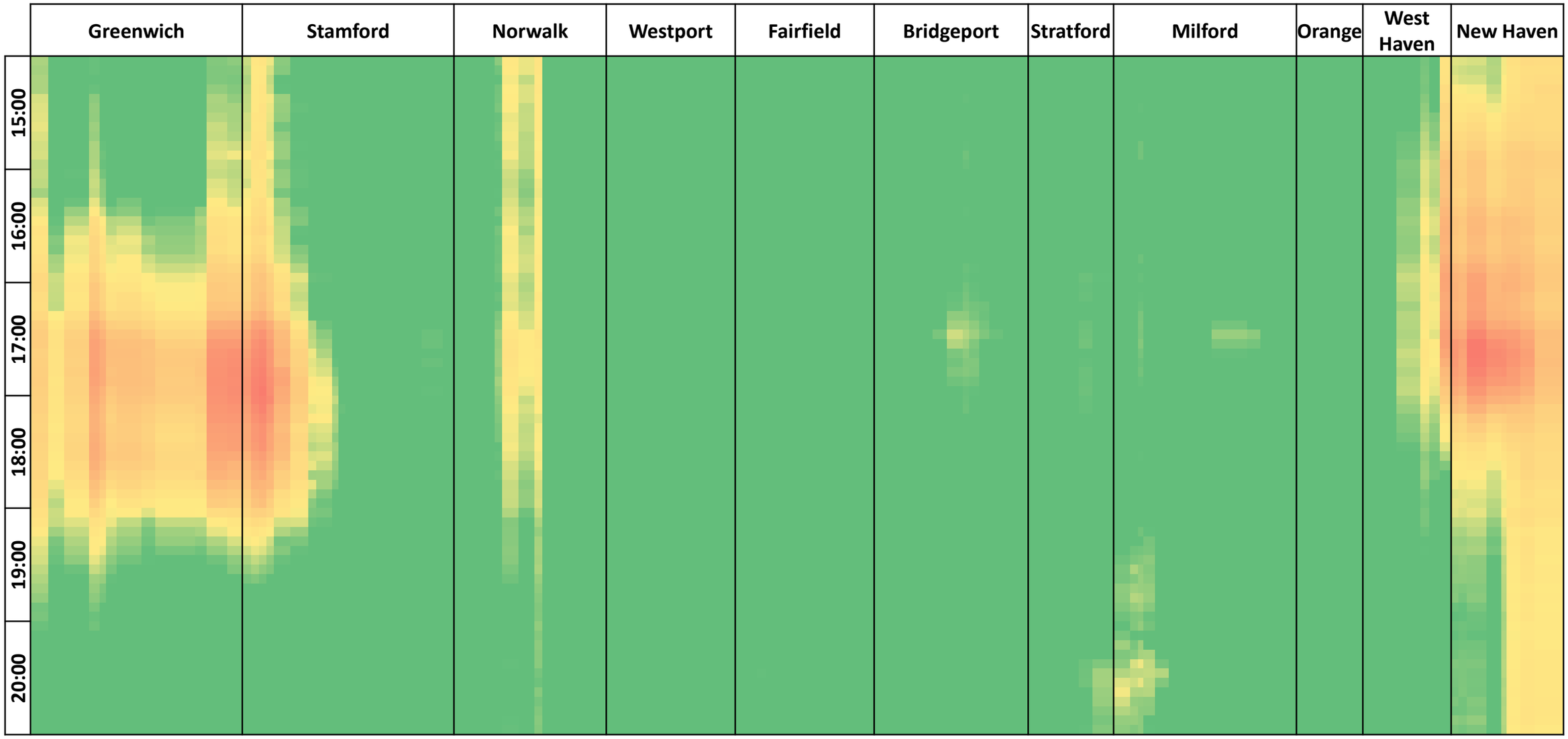
FIGURE 2



CDM Smith

INRIX: I-95 AVERAGE WEEKDAY TRAVEL SPEEDS - NORTHBOUND PM

FIGURE 3



CDM Smith

INRIX: I-95 AVERAGE WEEKDAY TRAVEL SPEEDS - SOUTHBOUND PM

FIGURE 4

Southbound

Time	21		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		21		22
	I-287	MP 0.78	Delavan Ave. / Byram Shore Rd.	MP 2.54	Arch St.	MP 3.73	Indian Field Rd.	MP 5.53	E. Putnam Ave.	MP 6.50 MP 6.62	West Ave.	MP 7.30	Greenwich Ave.	MP 7.67 MP 8.20	Atlantic St. / Elm St.	MP 9.28	US 1 (Boston Post Rd.)	MP 10.75	Noroton Ave.	MP 11.61	US 1	MP 12.23	SR 136 (Tokeneke Rd.)	MP 13.14	US 1	MP 14.83	US 1	MP 15.49	US 7	MP 16.24	East Ave.	MP 18.13	SR 33 / SR 136	MP 20.36	Sherwood Island Connector	MP 22.88 MP 23.12	Center St. / US 1	MP 23.72	Bronson Rd.	MP 24.38	Mill Plan Rd.	MP 25.03 MP 25.21	Round Hill Rd. / SR 135	Matchline A
6:30-7:00		B		B		C		C		C		D		C		C		D		C		D		D		D		D		E		F		D		D		E		E		E		F	
7:00-7:30		B		C		C		C		C		D		B		C		C		D		D		D		D		D		F		F		E		E		E		E		F	
7:30-8:00		C		C		D		D		E		E		C		C		D		D		E		D		F		F		F		F		F		F		E		E		F	
8:00-8:30		C		C		E		D		D		F		F		E		D		D		E		F		F		F		F		F		F		F		F		F		F	
8:30-9:00		C		C		E		E		E		E		D		D		D		E		D		F		F		F		F		F		F		F		E		F		F	
9:00-9:30		B		B		E		C		D		E		E		D		D		D		E		F		E		F		F		F		F		F		F		F		F	

Northbound

Time	21		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		21		22
	I-287	MP 0.78	Delavan Ave. / Byram Shore Rd.	MP 2.54	Arch St.	MP 3.73	Indian Field Rd.	MP 5.53	E. Putnam Ave.	MP 6.50 MP 6.62	West Ave.	MP 7.30	Greenwich Ave.	MP 7.67 MP 8.20	Atlantic St. / Elm St.	MP 9.28	US 1 (Boston Post Rd.)	MP 10.75	Noroton Ave.	MP 11.61	US 1	MP 12.23	SR 136 (Tokeneke Rd.)	MP 13.14	US 1	MP 14.83	US 1	MP 15.49	US 7	MP 16.24	East Ave.	MP 18.13	SR 33 / SR 136	MP 20.36	Sherwood Island Connector	MP 22.88 MP 23.12	Center St. / US 1	MP 23.72	Bronson Rd.	MP 24.38	Mill Plan Rd.	MP 25.03 MP 25.21	Round Hill Rd. / SR 135	Matchline B
6:30-7:00		C		C		C		C		C		C		A		C		B		C		B		B		B		B		B		B		B		A		A		B		B	
7:00-7:30		C		C		B		C		C		C		B		C		C		B		C		C		C		A		B		B		B		C		B		B		B	
7:30-8:00		C		D		C		D		D		E		B		C		C		C		D		C		C		C		C		C		B		C		B		C		C	
8:00-8:30		E		E		D		E		D		E		B		D		C		C		D		D		D		B		C		C		C		B		C		B		C	
8:30-9:00		F		F		D		E		D		E		C		B		A		C		C		D		F		C		C		D		C		B		C		B		C	
9:00-9:30		F		F		F		E		D		E		C		C		C		D		C		C		E		B		C		C		B		C		D		A		B	

LOS	Density
A/B/C/D	Less Than 31
D/E	31 - 40
E/F	41 - 62
F	More Than 62

CDM Smith

SKYCOMP DATA - I-95 MORNING LEVEL OF SERVICE PROFILE

FIGURE 5

Southbound

Matchline A

Time	22 Round Hill Rd. / SR 135	MP 25.03 / MP 25.21	23 US 1 (Kings Hwy.)	24 US 1 / Black Rock Tpke.	MP 26.72	25 State St. / SR 130	MP 27.43 / MP 27.64	26 Wordin Ave.	MP 28.29	27 SR 8 / SR 25	MP 29.00 / MP 29.03	28 SR 127 / East Main St.	MP 29.86	29 SR 130 / Stratford Ave.	MP 30.07	30 SR 113 / Surf Ave.	MP 31.07 / MP 31.30	31 Honeyspot Rd. / South Ave.	MP 32.11 / MP 32.29	32 West Broad St.	MP 32.86	33 US 1 / SR 110 / Ferry Blvd.	MP 33.91	34 US 1 (Bridgeport Ave.)	MP 35.37	35 Schoolhouse Rd.	MP 35.85	36 Plains Rd.	MP 36.69	38 Milford Pkwy.	MP 37.58	39 US 1 (Boston Post Rd.)	MP 39.12	40 Woodmont Rd.	MP 40.25	41 Marsh Hill Rd.	MP 41.80	42 Sawmill Rd.	MP 43.91	43 1st Ave	MP 44.87 / MP 45.19	45 SR 10 (Ella T Grasso Blvd.)	MP 46.05	47 SR 34	MP 47.60
6:30-7:00		F		F		F		F		F		F		C		C		D		C		C		B		C		C		C		C		B		C		C		D		C	
7:00-7:30		F		F		F		F		F		F		C		C		C		C		B		C		C		D		C		C		C		C		C		D	
7:30-8:00		F		F		F		F		F		F		E		F		D		D		C		C		D		D		D		C		C		C		D		D	
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8:30-9:00		F		F		F		F		F		F		E		E		E		C		C		B		D		C		D		D		C		C		C		D	
9:00-9:30		F		F		F		E		C		D		B		B		B		C		C		C		B		B		C		C		C		C		C		C	

MP 25.83

Northbound

Matchline B

Time	22 Round Hill Rd. / SR 135	MP 25.03 / MP 25.21	23 US 1 (Kings Hwy.)	24 US 1 / Black Rock Tpke.	MP 26.72	25 State St. / SR 130	MP 27.43 / MP 27.64	26 Wordin Ave.	MP 28.29	27 SR 8 / SR 25	MP 29.00 / MP 29.03	28 SR 127 / East Main St.	MP 29.86	29 SR 130 / Stratford Ave.	MP 30.07	30 SR 113 / Surf Ave.	MP 31.07 / MP 31.30	31 Honeyspot Rd. / South Ave.	MP 32.11 / MP 32.29	32 West Broad St.	MP 32.86	33 US 1 / SR 110 / Ferry Blvd.	MP 33.91	34 US 1 (Bridgeport Ave.)	MP 35.37	35 Schoolhouse Rd.	MP 35.85	36 Plains Rd.	MP 36.69	37/38 Milford Pkwy. / High St.	MP 37.58	39 US 1 (Boston Post Rd.)	MP 39.12	40 Woodmont Rd.	MP 40.25	41 Marsh Hill Rd.	MP 41.80	42 Sawmill Rd.	MP 43.91	43 Campbell Ave.	MP 44.87 / MP 45.19	45 SR 10 (Ella T Grasso Blvd.)	MP 46.05	47 SR 34	MP 47.60
6:30-7:00		B		B		A		B		B		A		C		C		B		A		B		B		B		B		B		B		C		B		D		B		A	
7:00-7:30		A		B		B		B		B		B		C		B		B		A		B		B		B		B		C		C		C		C		E		D		C	
7:30-8:00		C		C		C		C		C		B		C		C		C		D		C		C		C		C		D		D		C		D		E		E		D	
8:00-8:30		B		C		B		B		C		B		C		C		B		B		C		C		B		B		C		C		C		D		F		F		D	
8:30-9:00		D		D		B		B		C		B		C		C		B		B		C		B		B		B		C		C		B		C		E		C		D	
9:00-9:30		B		B		B		A		C		B		B		B		B		A		B		B		B		B		C		B		B		C		C		C		B	

MP 25.83

LOS	Density
A/B/C/D	Less Than 31
D/E	31 - 40
E/F	41 - 62
F	More Than 62

CDM Smith

SKYCOMP DATA - I-95 MORNING LEVEL OF SERVICE PROFILE

FIGURE 6

Southbound

Time	21 I-287	MP 0.78	2 Delavan Ave. / Byram Shore Rd.	MP 2.54	3 Arch St.	MP 3.73	4 Indian Field Rd.	MP 5.53	5 E. Putnam Ave.	MP 6.50 / MP 6.62	6 West Ave.	MP 7.30	7 Greenwich Ave.	MP 7.67 / MP 8.20	8 Atlantic St. / Elm St.	MP 9.28	9 US 1 (Boston Post Rd.)	MP 10.75	10 Noroton Ave.	MP 11.61	11 US 1	MP 12.23	12 SR 136 (Tokeneke Rd.)	MP 13.14	13 US 1	MP 14.83	14 US 1	MP 15.49	15 US 7	MP 16.24	16 East Ave.	MP 18.13	17 SR 33 / SR 136	MP 20.36	18 Sherwood Island Connector	MP 22.88 / MP 23.12	19 Center St. / US 1	MP 23.72	20 Bronson Rd.	MP 24.38	21 Mill Plan Rd.	MP 25.03 / MP 25.21	22 Round Hill Rd. / SR 135	Matchline A
4:00-4:30		B		C		C		C		D		C		C		C		C		C		D		D		F		F		B		C		B		C		C		C	
4:30-5:00		C		C		C		C		D		B		C		C		D		D		C		C		F		F		D		C		B		C		B		C	
5:00-5:30		D		D		D		C		D		D		B		D		C		C		C		D		D		C		C		C		B		C		B		C	
5:30-6:00		E		E		F		E		E		F		E		C		C		D		C		D		C		E		D		C		B		C		C		C	
6:00-6:30		D		F		D		D		F		F		E		A		C		D		C		C		C		D		C		B		B		C		C		B	
6:30-7:00		D		E		E		D		D		E		C		C		C		C		C		C		D		B		C		C		B		B		C		B	

Northbound

Time	21 I-287	MP 0.78	2 Delavan Ave. / Byram Shore Rd.	MP 2.54	3 Arch St.	MP 3.73	4 Indian Field Rd.	MP 5.53	5 E. Putnam Ave.	MP 6.50 / MP 6.62	6 West Ave.	MP 7.30	7 Greenwich Ave.	MP 7.67 / MP 8.20	8 Atlantic St. / Elm St.	MP 9.28	9 US 1 (Boston Post Rd.)	MP 10.75	10 Noroton Ave.	MP 11.61	11 US 1	MP 12.23	12 SR 136 (Tokeneke Rd.)	MP 13.14	13 US 1	MP 14.83	14 US 1	MP 15.49	15 US 7	MP 16.24	16 East Ave.	MP 18.13	17 SR 33 / SR 136	MP 20.36	18 Sherwood Island Connector	MP 22.88 / MP 23.12	19 Center St. / US 1	MP 23.72	20 Bronson Rd.	MP 24.38	21 Mill Plan Rd.	MP 25.03 / MP 25.21	22 Round Hill Rd. / SR 135	Matchline B
4:00-4:30		B		B		C		D		F		F		F		F		F		F		F		F		D		F		F		C		F		F		F		F	
4:30-5:00		C		C		C		C		E		E		D		F		F		F		F		F		F		F		F		F		F		F		F		F	
5:00-5:30		B		C		C		E		F		F		F		F		F		F		F		F		F		F		F		F		F		F		F		F	
5:30-6:00		C		C		D		F		F		F		F		F		F		F		F		F		F		F		F		F		F		F		F		F	
6:00-6:30		C		C		F		F		F		F		F		F		F		F		F		F		F		F		F		F		F		E		F		F	
6:30-7:00		B		C		D		F		F		F		F		F		F		F		F		F		C		D		E		E		F		D		D		E	

LOS	Density
A/B/C/D	Less Than 31
D/E	31 - 40
E/F	41 - 62
F	More Than 62

Southbound

Matchline A

Time	22 Round Hill Rd. / SR 135	MP 25.03 / MP 25.21	23 US 1 / (Kings Hwy.)	24 US 1 / Black Rock Tpke.	MP 26.72	25 State St. / SR 130	MP 27.43 / MP 27.64	26 Wordin Ave.	MP 28.29	27 SR 8 / SR 25	MP 29.00 / MP 29.03	28 SR 127 / East Main St.	MP 29.86	29 SR 130 / Stratford Ave.	MP 30.07	30 SR 113 / Surf Ave.	MP 31.07 / MP 31.30	31 Honeyspot Rd. / South Ave.	MP 32.11 / MP 32.29	32 West Broad St.	MP 32.86	33 US 1 / SR 110 / Ferry Blvd	MP 33.91	34 US 1 (Bridgeport Ave.)	MP 35.37	35 Schoolhouse Rd.	MP 35.85	36 Plains Rd.	MP 36.69	38 Milford Pkwy.	MP 37.58	39 US 1 (Boston Post Rd.)	MP 39.12	40 Woodmont Rd.	MP 40.25	41 Marsh Hill Rd.	MP 41.80	42 Sawmill Rd.	MP 43.91	43 1st Ave.	MP 44.87 / MP 45.19	45 SR 10 (Ella T Grasso Blvd.)	MP 46.05	47 SR 34	MP 47.60
6:30-7:00		C		C	C		D		C		C		D		C		B		B		D		B		C		C		C		C		D		D		C		E		D	
7:00-7:30		B		C	C		C		C		C		D		B		C		C		C		C		C		C		D		C		D		D		D		E		F	
7:30-8:00		D		C	D		D		C		D		D		C		C		C		C		C		C		C		D		C		D		D		E		E		F	
8:00-8:30		C		C	C		C		C		C		C		B		C		C		C		B		B		C		C		C		C		C		D		D		F	
8:30-9:00		C		C	D		C		B		B		D		C		B		D		C		B		C		B		B		B		C		C		C		D		D	
9:00-9:30		B		B	C		C		C		B		C		A		B		B		B		B		B		B		C		B		C		C		C		C		C	
	22	MP 25.83	23			24		25		26		27		28		29		30		31		32		33		34		35		36		37/38		39		40		41		42		43		45		47	

Northbound

Matchline B

Time	22 Round Hill Rd. / SR 135	MP 25.03 / MP 25.21	23 US 1 / (Kings Hwy.)	24 US 1 / Black Rock Tpke.	MP 26.72	25 State St. / SR 130	MP 27.43 / MP 27.64	26 Wordin Ave.	MP 28.29	27 SR 8 / SR 25	MP 29.00 / MP 29.03	28 SR 127 / East Main St.	MP 29.86	29 SR 130 / Stratford Ave.	MP 30.07	30 SR 113 / Surf Ave.	MP 31.07 / MP 31.30	31 Honeyspot Rd. / South Ave.	MP 32.11 / MP 32.29	32 West Broad St.	MP 32.86	33 US 1 / SR 110 / Ferry Blvd	MP 33.91	34 US 1 (Bridgeport Ave.)	MP 35.37	35 Schoolhouse Rd.	MP 35.85	36 Plains Rd.	MP 36.69	37/38 Milford Pkwy. / High St.	MP 37.58	39 US 1 (Boston Post Rd.)	MP 39.12	40 Woodmont Rd.	MP 40.25	41 Marsh Hill Rd.	MP 41.80	42 Sawmill Rd.	MP 43.91	43 Campbell Ave.	MP 44.87 / MP 45.19	45 SR 10 (Ella T Grasso Blvd.)	MP 46.05	47 SR 34	MP 47.60
6:30-7:00		F		D	D		F		F		B		D		D		D		D		D		C		B		B		C		D		D		F		E		F		D	
7:00-7:30		F		E	E		D		F		C		D		D		D		D		D		C		C		D		C		D		C		D		F		F		F		E	
7:30-8:00		F		F	E		C		D		C		E		E		D		D		D		C		D		F		E		D		B		C		F		F		F		E	
8:00-8:30		F		D	D		D		F		B		D		C		D		C		C		B		B		C		D		C		C		C		D		F		F		E	
8:30-9:00		E		E	C		D		F		C		C		D		C		B		D		B		C		C		B		D		C		C		C		C		D			
9:00-9:30		E		E	C		C		F		B		D		B		D		C		B		C		C		B		C		B		B		C		C		B		C			
	22	MP 25.83	23			24		25		26		27		28		29		30		31		32		33		34		35		36		37/38		39		40		41		42		43		45		47	

LOS	Density
A/B/C/D	Less Than 31
D/E	31 - 40
E/F	41 - 62
F	More Than 62

CDM Smith

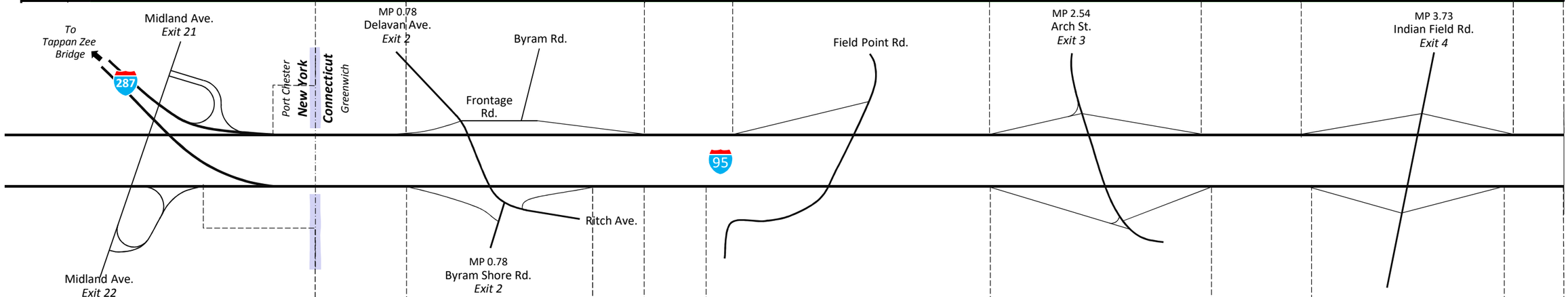
SKYCOMP DATA - I-95 EVENING LEVEL OF SERVICE PROFILE

FIGURE 8

Appendix B

CRASHES SUMMARY (2014-2016)

Distance			**0.54**	**0.41**	**0.93**	**0.44**	**0.3**	**0.85**	**0.34**	**1.46**
Crash Rate			**0.5**	**1.9**	**0.6**	**0.3**	**1.2**	**1.7**	**1.3**	**0.8**
Total			**24**	**61**	**49**	**10**	**27**	**125**	**38**	**109**
Severity	A	Fatality	0	0	0	0	1	0	0	0
	B	Injury	6	17	12	1	7	42	9	33
	C	Property Damage Only	18	44	37	9	19	83	29	76
Crash Type	A	Angle	0	1	2	1	0	2	0	1
	B	Head On	0	0	0	0	0	0	0	0
	C	Rear End	18	40	24	3	12	79	23	65
	D	Sideswipe	6	11	17	5	8	26	7	26
	E	Other	0	9	6	1	7	18	8	17
Work Zone Related	A	Yes	0	1	3	0	0	3	1	2
	B	No	15	43	34	8	14	91	21	65
	C	Other/ Unknown	9	17	12	2	13	31	16	42
Road Surface Condition	A	Dry	23	54	44	8	23	113	35	94
	B	Wet	1	7	3	1	2	8	2	11
	C	Snow/Ice/Slush	0	0	2	1	2	4	1	3
	D	Other/ Unknown	0	0	0	0	0	0	0	1



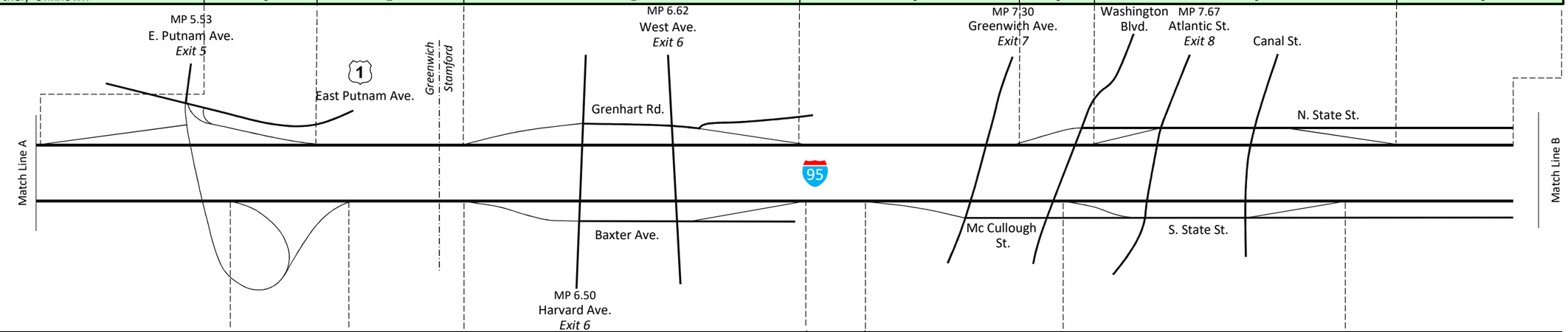
Distance			**0.45**	**0.5**	**0.48**	**0.39**	**0.53**	**0.29**	**0.85**	**0.3**	**1.68**
Crash Rate			**1.7**	**2.3**	**0.4**	**0.4**	**2.0**	**1.9**	**1.5**	**2.3**	**1.4**
Total			**59**	**86**	**16**	**12**	**88**	**41**	**113**	**58**	**200**
Severity	A	Fatality	0	0	0	0	0	0	0	0	0
	B	Injury	12	21	5	3	28	7	28	17	55
	C	Property Damage Only	47	65	11	9	60	34	85	41	145
Crash Type	A	Angle	2	1	0	0	0	1	0	0	2
	B	Head On	0	0	0	0	1	0	0	0	1
	C	Rear End	38	38	11	7	52	20	79	37	151
	D	Sideswipe	15	56	1	3	17	17	23	10	29
	E	Other	4	13	4	0	18	3	11	11	17
Work Zone Related	A	Yes	0	4	2	0	1	0	1	0	0
	B	No	42	61	10	8	61	31	78	40	149
	C	Other/ Unknown	17	21	4	4	26	10	34	18	51
Road Surface Condition	A	Dry	55	66	13	10	71	34	98	45	174
	B	Wet	4	14	1	1	10	7	10	7	18
	C	Snow/Ice/Slush	0	6	1	1	7	0	5	3	8
	D	Other/ Unknown	0	0	0	0	0	0	0	0	0

CDM Smith

MAINLINE CRASH SUMMARY

FIGURE 1

Distance			0.29	0.7	0.45	0.56	0.21	0.59	0.60
Crash Rate			1.6	1.5	0.23	3.1	1.6	1.9	2.1
Total			39	91	83	161	27	77	100
Severity	A	Fatality	0	0	0	2	0	0	0
	B	Injury	7	21	25	35	6	22	27
	C	Property Damage Only	32	70	58	124	21	55	73
Crash Type	A	Angle	0	1	1	3	2	1	0
	B	Head On	0	0	0	0	0	0	0
	C	Rear End	24	57	62	111	13	52	52
	D	Sideswipe	8	22	14	30	9	19	28
	E	Other	7	11	6	17	3	5	13
Work Zone Related	A	Yes	1	0	1	1	0	0	1
	B	No	23	57	60	115	16	55	67
	C	Other/ Unknown	15	34	22	45	11	22	32
Road Surface Condition	A	Dry	31	66	70	138	25	72	81
	B	Wet	7	21	10	22	1	5	16
	C	Snow/Ice/Slush	1	3	2	1	1	0	3
	D	Other/ Unknown	0	1	1	0	0	0	0



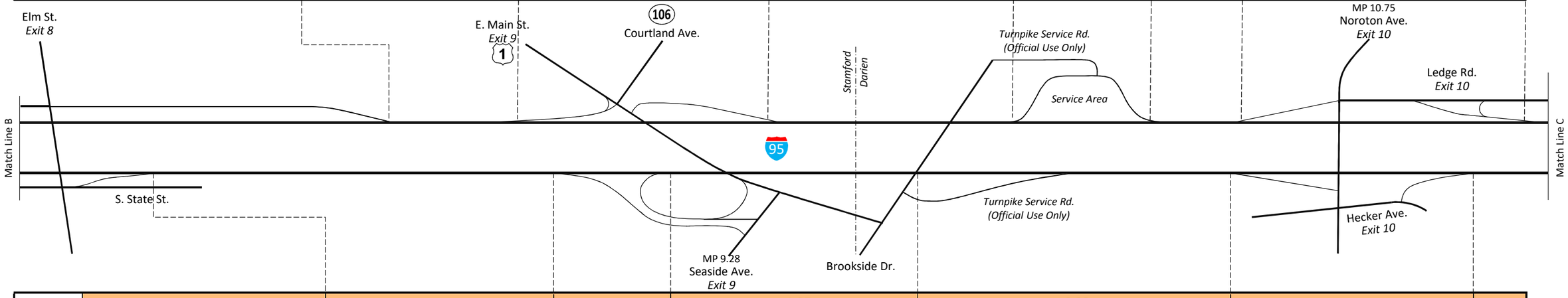
Distance			0.2	0.63	0.40	0.36	0.39	0.56	0.39
Crash Rate			2.3	1.8	2.5	2.9	3.2	3.3	1.4
Total			37	100	79	95	102	120	40
Severity	A	Fatality	0	0	0	0	0	0	0
	B	Injury	7	27	22	22	27	30	13
	C	Property Damage Only	30	73	57	73	75	90	27
Crash Type	A	Angle	0	1	0	5	0	3	0
	B	Head On	0	0	0	1	1	0	0
	C	Rear End	19	69	61	65	76	73	26
	D	Sideswipe	7	18	11	21	15	24	11
	E	Other	11	12	7	3	10	20	3
Work Zone Related	A	Yes	0	0	2	1	1	1	0
	B	No	25	70	56	70	61	69	18
	C	Other/ Unknown	12	30	21	24	40	50	22
Road Surface Condition	A	Dry	29	81	64	83	84	106	35
	B	Wet	8	14	12	10	15	9	5
	C	Snow/Ice/Slush	0	5	2	2	2	4	0
	D	Other/ Unknown	0	0	1	0	1	1	0

CDM Smith

MAINLINE CRASH SUMMARY

FIGURE 2

Distance			0.3	0.43	0.38	0.3	0.36	0.64
			3.5	1.7	2.0	0.5	0.7	1.1
Total			97	60	73	14	22	62
Severity	A	Fatality	0	0	0	0	1	0
	B	Injury	21	11	14	2	4	12
	C	Property Damage Only	76	49	59	12	17	50
Crash Type	A	Angle	3	0	0	0	0	1
	B	Head On	0	0	0	0	0	0
	C	Rear End	59	34	30	3	4	27
	D	Sideswipe	24	19	26	4	6	21
	E	Other	11	7	17	7	12	13
Work Zone Related	A	Yes	2	1	2	0	0	0
	B	No	62	37	48	6	12	38
	C	Other/ Unknown	3	22	23	8	10	24
Road Surface Condition	A	Dry	75	53	52	13	19	43
	B	Wet	17	4	13	1	1	14
	C	Snow/Ice/Slush	5	3	7	0	2	5
	D	Other/ Unknown	0	0	1	0	0	0



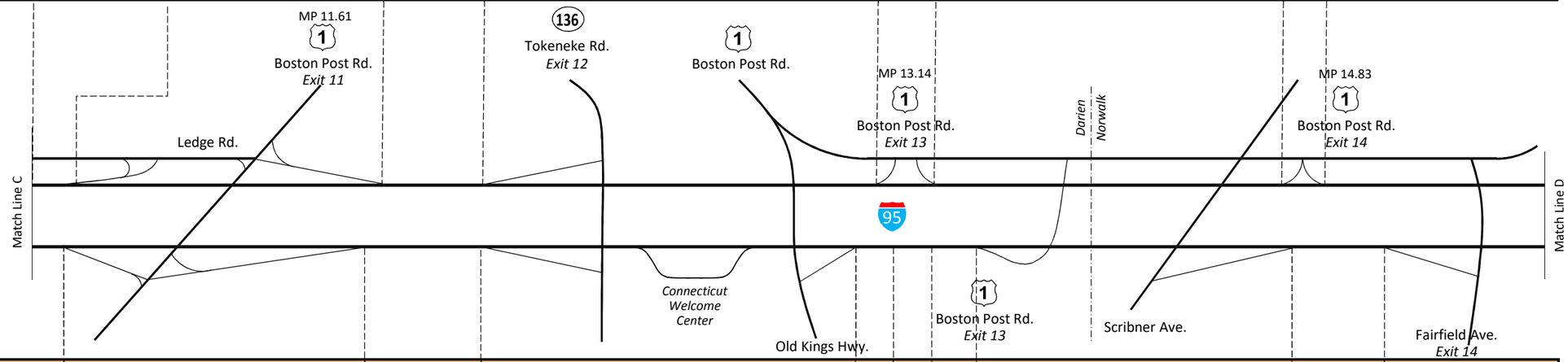
Distance			0.65	0.13	1.37	0.38	0.38	0.44
Crash Rate			3.4	4.5	0.6	2.5	2.1	1.3
Total			192	46	76	79	72	50
Severity	A	Fatality	1	0	1	0	0	0
	B	Injury	39	12	26	20	23	18
	C	Property Damage Only	152	34	49	59	49	32
Crash Type	A	Angle	2	1	2	0	1	1
	B	Head On	0	0	0	0	0	0
	C	Rear End	150	30	56	52	61	39
	D	Sideswipe	32	6	12	18	5	8
	E	Other	8	9	6	9	5	2
Work Zone Related	A	Yes	4	1	1	1	3	1
	B	No	138	29	47	53	42	35
	C	Other/ Unknown	50	16	28	25	27	14
Road Surface Condition	A	Dry	173	33	70	73	66	45
	B	Wet	16	12	5	4	6	4
	C	Snow/Ice/Slush	3	1	1	2	0	1
	D	Other/ Unknown	0	0	0	0	0	0

CDM Smith

MAINLINE CRASH SUMMARY

FIGURE 3

Distance			**0.21**	**0.49**	**0.21**	**0.87**	**0.24**	**1.46**	**0.18**	**0.57**
			1.4	**0.4**	**2.3**	**0.7**	**2.1**	**1.9**	**3.8**	**2.7**
Total			**28**	**19**	**47**	**55**	**42**	**249**	**56**	**142**
Severity	A	Fatality	1	0	0	0	0	0	0	1
	B	Injury	3	3	14	16	9	64	9	24
	C	Property Damage Only	24	16	33	39	33	185	47	117
Crash Type	A	Angle	0	0	2	1	0	0	1	1
	B	Head On	0	0	0	0	0	0	0	0
	C	Rear End	18	9	20	26	24	195	34	85
	D	Sideswipe	5	6	15	16	12	40	15	43
	E	Other	5	4	10	12	6	14	6	13
Work Zone Related	A	Yes	0	0	1	1	0	2	2	3
	B	No	16	11	32	41	33	180	38	100
	C	Other/ Unknown	12	8	14	13	9	67	16	39
Road Surface Condition	A	Dry	26	16	38	47	34	216	48	130
	B	Wet	1	2	8	7	4	27	7	12
	C	Snow/Ice/Slush	1	1	1	1	1	6	0	0
	D	Other/ Unknown	0	0	0	0	0	0	1	0



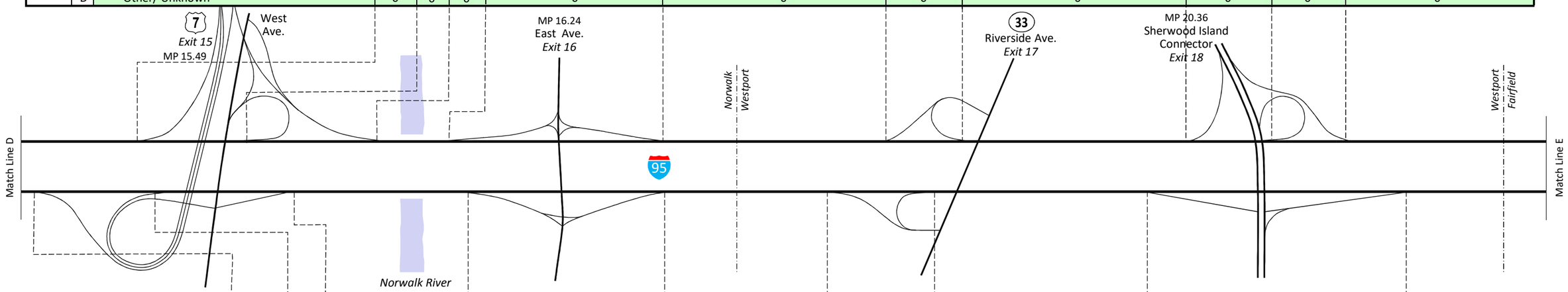
		Distance	0.44	0.28	0.28	0.32	0.25	0.18	1.59	0.32	0.16
Crash Rate			**1.3**	**1.7**	**1.7**	**2.5**	**2.4**	**3.3**	**1.5**	**6.4**	**4.0**
Total			**50**	**43**	**41**	**69**	**50**	**48**	**188**	**134**	**57**
Severity	A	Fatality	0	0	0	0	0	0	0	0	0
	B	Injury	18	11	10	8	10	9	49	21	13
	C	Property Damage Only	32	32	31	61	40	39	139	113	44
Crash Type	A	Angle	1	1	1	1	1	1	1	1	0
	B	Head On	0	1	0	0	1	1	0	0	0
	C	Rear End	39	32	31	29	29	27	143	99	36
	D	Sideswipe	8	6	2	23	12	12	31	25	5
	E	Other	2	3	7	16	7	7	13	9	16
Work Zone Related	A	Yes	1	2	0	1	0	0	4	9	2
	B	No	35	27	20	40	25	28	89	60	39
	C	Other/ Unknown	14	14	21	28	25	20	95	65	16
Road Surface Condition	A	Dry	45	32	39	55	46	42	169	114	49
	B	Wet	4	9	1	9	2	3	17	15	6
	C	Snow/Ice/Slush	1	2	1	3	2	2	2	4	2
	D	Other/ Unknown	0	0	0	1	0	0	0	0	0

CDM Smith

MAINLINE CRASH SUMMARY

FIGURE 4

Distance			0.2	0.22	0.31	0.24	1.57	0.17	2.08	0.16	0.15	2.2
			1.6	2.8	3.8	4.4	2.6	2.9	1.6	2.7	4.0	1.1
Total			23	45	101	72	306	34	244	29	40	170
Severity	A	Fatality	0	0	0	0	0	0	1	1	0	0
	B	Injury	5	13	24	9	72	7	47	8	9	50
	C	Property Damage Only	18	32	77	63	234	27	196	20	31	120
Crash Type	A	Angle	2	0	0	0	1	0	2	1	0	0
	B	Head On	0	0	0	0	1	0	0	0	0	1
	C	Rear End	12	29	68	48	235	23	174	19	25	114
	D	Sideswipe	6	7	23	19	51	2	38	1	8	34
	E	Other	3	9	10	5	18	9	30	8	7	21
Work Zone Related	A	Yes	1	0	3	3	5	0	1	0	0	1
	B	No	17	26	63	40	138	24	157	13	26	100
	C	Other/ Unknown	5	19	35	29	118	10	86	16	14	69
Road Surface Condition	A	Dry	18	36	83	64	268	25	212	22	37	148
	B	Wet	5	7	16	8	33	6	27	4	3	16
	C	Snow/Ice/Slush	0	2	2	0	5	3	5	3	0	6
	D	Other/ Unknown	0	0	0	0	0	0	0	0	0	0



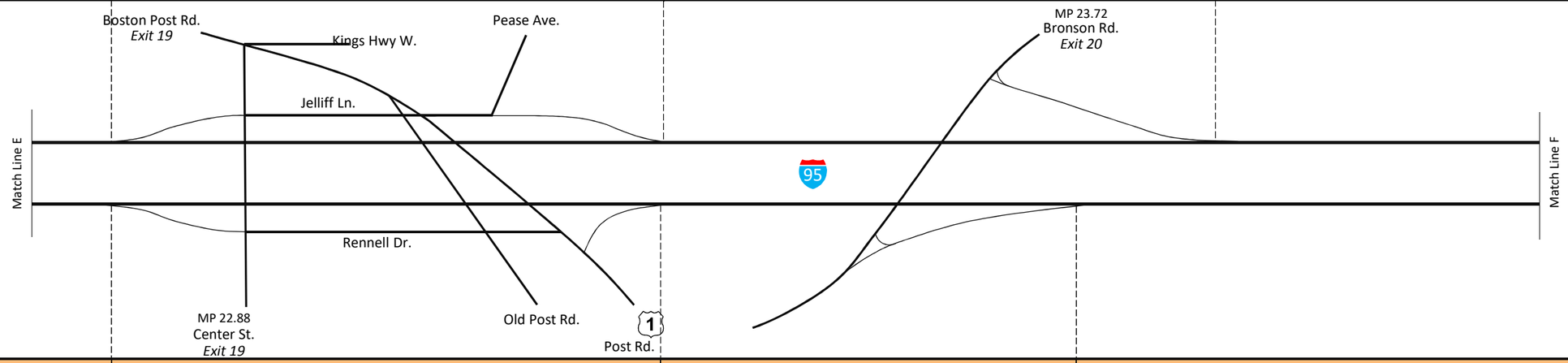
	Distance	0.26	0.2	0.46	0.27	1.46	0.24	2.06	0.39	2.19
Crash Rate		2.7	2.8	3.3	3.6	1.1	3.4	1.2	3.8	1.1
Total		50	34	141	75	136	62	198	112	193
Severity A	Fatality	0	0	0	0	0	1	1	0	1
B	Injury	15	7	30	21	30	18	47	36	43
C	Property Damage Only	35	27	111	54	106	43	150	76	149
Crash Type A	Angle	0	0	0	2	0	0	1	1	2
B	Head On	0	0	0	0	0	0	0	0	1
C	Rear End	29	20	95	40	93	33	145	82	119
D	Sideswipe	13	8	34	21	32	15	32	17	43
E	Other	8	6	12	12	11	14	20	12	28
Work Zone Related A	Yes	1	2	2	1	2	1	0	2	3
B	No	40	21	108	48	82	34	138	71	111
C	Other/ Unknown	9	11	33	26	52	27	60	39	79
Road Surface Condition A	Dry	43	30	126	63	119	51	171	105	171
B	Wet	6	4	12	10	15	9	25	5	20
C	Snow/Ice/Slush	1	0	3	2	2	1	2	2	2
D	Other/ Unknown	0	0	0	0	0	1	0	0	0

CDM Smith

MAINLINE CRASH SUMMARY

FIGURE 5

Distance			0.71	0.49	0.48
			1.9	1.7	0.9
Total			91	62	33
Severity	A	Fatality	1	0	0
	B	Injury	16	17	5
	C	Property Damage Only	74	45	28
Crash Type	A	Angle	1	0	1
	B	Head On	0	0	0
	C	Rear End	64	42	21
	D	Sideswipe	14	14	8
	E	Other	12	6	3
Work Zone Related	A	Yes	0	0	0
	B	No	60	39	22
	C	Other/ Unknown	31	23	11
Road Surface Condition	A	Dry	68	53	29
	B	Wet	18	8	3
	C	Snow/Ice/Slush	5	1	1
	D	Other/ Unknown	0	0	0



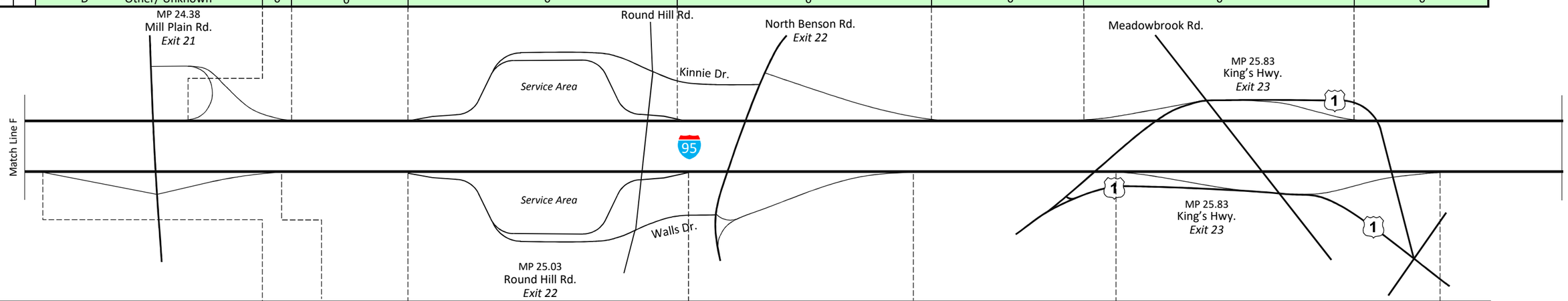
Distance			0.62	0.49	0.37
Crash Rate			1.6	0.8	2.3
Total			75	35	74
Severity	A	Fatality	0	0	0
	B	Injury	19	9	23
	C	Property Damage Only	56	26	51
Crash Type	A	Angle	1	0	1
	B	Head On	0	0	0
	C	Rear End	42	23	52
	D	Sideswipe	16	9	15
	E	Other	16	3	16
Work Zone Related	A	Yes	3	1	1
	B	No	51	19	49
	C	Other/ Unknown	21	15	24
Road Surface Condition	A	Dry	61	30	67
	B	Wet	14	3	7
	C	Snow/Ice/Slush	0	2	0
	D	Other/ Unknown	0	0	0

CDM Smith

MAINLINE CRASH SUMMARY

FIGURE 6

Distance			0.2	0.15	0.36	0.28	0.27	0.3	0.54
			1.4	2.6	0.9	1.1	1.6	1.9	1.6
Total			21	31	23	22	34	43	68
Severity	A	Fatality	0	0	0	0	0	0	0
	B	Injury	3	9	4	7	7	5	22
	C	Property Damage Only	18	22	19	15	27	38	46
Crash Type	A	Angle	0	0	0	0	0	0	0
	B	Head On	0	0	0	0	0	0	0
	C	Rear End	13	19	13	13	18	28	46
	D	Sideswipe	7	6	5	7	8	10	14
	E	Other	1	6	5	2	8	5	8
Work Zone Related	A	Yes	0	1	0	0	0	0	2
	B	No	14	16	18	18	22	32	41
	C	Other/ Unknown	7	14	5	4	12	11	25
Road Surface Condition	A	Dry	18	25	20	20	30	36	54
	B	Wet	3	4	3	2	3	5	12
	C	Snow/Ice/Slush	0	2	0	0	1	2	2
		D Other/ Unknown	0	0	0	0	0	0	0



Distance			0.31	0.16	0.38	0.28	0.37	0.23	0.47
Crash Rate			2.1	2.7	1.8	1.5	2.1	1.7	1.1
Total			54	39	56	33	71	33	45
Severity	A	Fatality	1	0	1	0	1	1	0
	B	Injury	13	8	12	7	21	6	7
	C	Property Damage Only	40	31	43	26	49	26	38
Crash Type	A	Angle	0	0	2	0	1	0	0
	B	Head On	1	0	0	0	0	0	0
	C	Rear End	33	22	29	19	30	12	19
	D	Sideswipe	7	9	11	10	24	10	14
	E	Other	13	8	14	4	16	11	12
Work Zone Related	A	Yes	1	0	5	0	3	2	5
	B	No	39	25	41	28	46	15	24
	C	Other/ Unknown	14	14	10	5	22	16	16
Road Surface Condition	A	Dry	50	31	46	28	56	24	33
	B	Wet	2	8	6	4	15	7	8
	C	Snow/Ice/Slush	2	0	4	1	0	2	4
	D	Other/ Unknown	0	0	0	0	0	0	0

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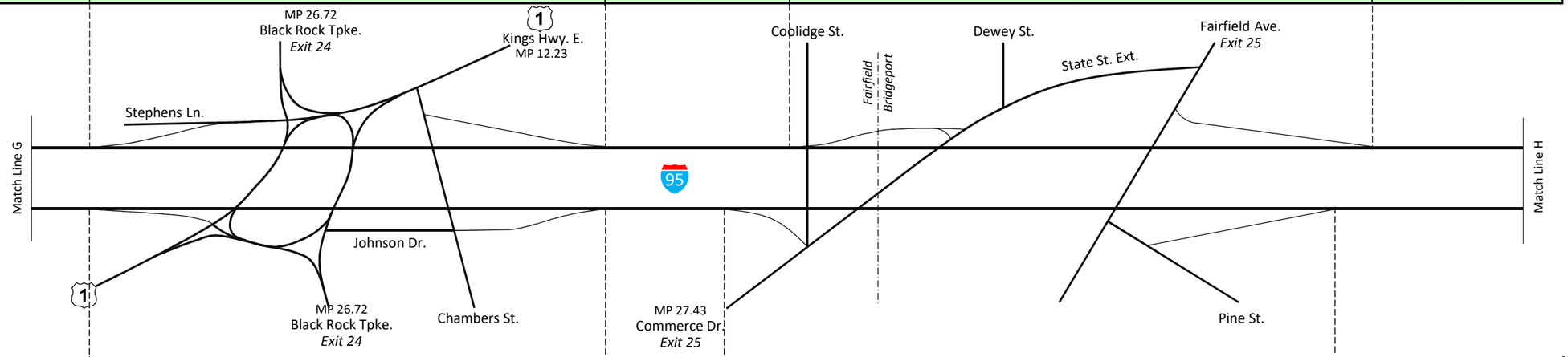
MAINLINE CRASH SUMMARY

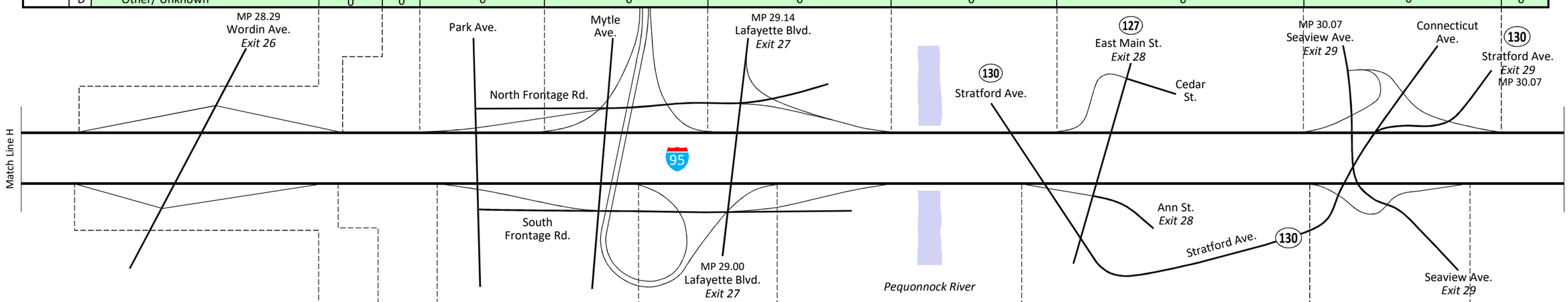
FIGURE 7

Distance			0.47	0.35	0.55	0.25
			1.6	2.2	0.8	1.8
Total			53	62	34	39
Severity	A	Fatality	0	0	0	0
	B	Injury	17	12	4	8
	C	Property Damage Only	36	50	30	31
Crash Type	A	Angle	1	1	1	0
	B	Head On	0	0	0	0
	C	Rear End	30	36	15	27
	D	Sideswipe	16	15	17	8
	E	Other	6	10	1	4
Work Zone Related	A	Yes	0	1	0	0
	B	No	31	40	19	27
	C	Other/ Unknown	22	21	15	12
Road Surface Condition	A	Dry	44	54	28	35
	B	Wet	7	6	6	4
	C	Snow/Ice/Slush	2	2	0	0
	D	Other/ Unknown	0	0	0	0



Distance			0.58	0.08	0.75	0.3
Crash Rate			1.7	1.5	0.8	2.1
Total			82	11	53	62
Severity	A	Fatality	0	0	0	0
	B	Injury	23	2	12	13
	C	Property Damage Only	59	9	41	49
Crash Type	A	Angle	1	0	0	2
	B	Head On	0	0	0	1
	C	Rear End	55	6	32	35
	D	Sideswipe	16	4	15	18
	E	Other	10	1	6	6
Work Zone Related	A	Yes	0	0	4	1
	B	No	58	9	26	47
	C	Other/ Unknown	24	2	23	14
Road Surface Condition	A	Dry	70	11	48	58
	B	Wet	9	0	4	4
	C	Snow/Ice/Slush	3	0	1	0
	D	Other/ Unknown	0	0	0	0

Distance			0.41	0.23	0.17	0.23	0.16	0.4	0.49	0.36	0.35
			1.4	2.2	2.6	1.3	4.5	3.5	0.3	1.3	1.3
Total			49	46	23	24	57	112	14	35	36
Severity	A	Fatality	0	0	0	0	0	0	0	0	0
	B	Injury	8	9	6	5	13	35	6	11	10
	C	Property Damage Only	41	37	17	19	44	87	8	24	26
Crash Type	A	Angle	0	0	2	0	1	4	0	1	0
	B	Head On	0	0	0	0	0	0	0	1	1
	C	Rear End	33	29	15	8	30	66	3	13	20
	D	Sideswipe	11	13	3	7	11	27	5	10	13
	E	Other	5	4	3	9	15	25	6	10	2
Work Zone Related	A	Yes	0	2	1	0	0	1	0	2	2
	B	No	34	27	14	19	37	87	12	21	24
	C	Other/ Unknown	15	17	8	5	20	34	2	12	10
Road Surface Condition	A	Dry	41	37	16	21	48	104	6	27	31
	B	Wet	7	9	6	2	8	17	7	7	5
	C	Snow/Ice/Slush	1	0	1	1	1	1	1	1	0
	D	Other/ Unknown	0	0	0	0	0	0	0	0	0



Distance			0.35	0.38	0.18	0.44	0.22	0.49	0.38	0.37
Crash Rate			2.7	4.1	5.5	2.0	2.6	1.2	1.2	1.1
Total			90	154	94	55	53	51	37	33
Severity	A	Fatality	0	0	0	0	0	1	0	0
	B	Injury	26	38	24	14	11	19	11	10
	C	Property Damage Only	64	116	70	41	42	31	26	23
Crash Type	A	Angle	0	1	0	1	1	1	0	1
	B	Head On	0	0	0	0	0	0	0	0
	C	Rear End	69	118	72	22	17	18	15	17
	D	Sideswipe	13	26	16	15	13	17	14	7
	E	Other	8	9	6	17	22	15	8	8
Work Zone Related	A	Yes	3	3	2	6	2	5	2	2
	B	No	59	102	66	36	27	33	25	24
	C	Other/ Unknown	28	49	26	13	24	13	10	7
Road Surface Condition	A	Dry	81	144	86	46	40	41	34	30
	B	Wet	7	10	6	8	13	9	2	2
	C	Snow/Ice/Slush	2	0	2	6	0	1	1	1
	D	Other/ Unknown	0	0	0	0	0	0	0	0

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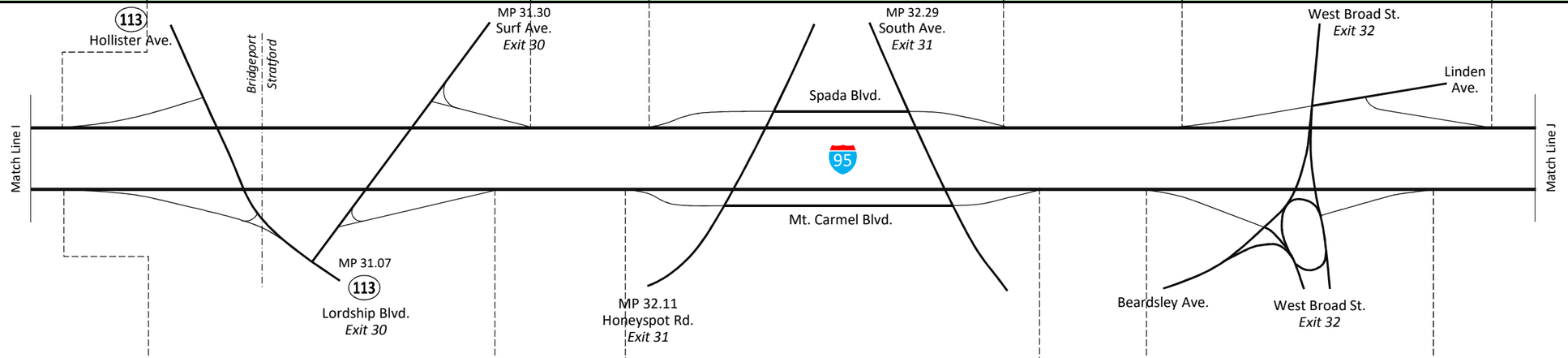
MAINLINE CRASH SUMMARY

FIGURE 9

Distance			0.61	0.49	0.44	0.3	0.32	0.5
			0.6	1.3	1.1	1.6	1.5	2.1
Total			25	46	31	34	31	75
Severity	A	Fatality	0	1	0	0	0	0
	B	Injury	6	8	12	8	9	15
	C	Property Damage Only	19	37	19	26	22	60
Crash Type	A	Angle	0	3	6	4	0	3
	B	Head On	0	2	0	0	0	0
	C	Rear End	12	19	11	12	16	29
	D	Sideswipe	8	11	7	6	8	29
	E	Other	5	11	7	12	7	14
Work Zone Related	A	Yes	1	1	4	1	3	8
	B	No	17	34	13	22	14	38
	C	Other/ Unknown	7	11	14	11	14	29
Road Surface Condition	A	Dry	21	42	27	30	24	65
	B	Wet	4	3	3	4	6	8
	C	Snow/Ice/Slush	0	1	1	0	1	2
	D	Other/ Unknown	0	0	0	0	0	0



Distance			0.47	0.54	0.47	0.29	0.29	0.7
Crash Rate			0.8	0.9	0.6	1.5	1.2	1.5
Total			28	35	20	32	23	78
Severity	A	Fatality	0	0	0	0	0	0
	B	Injury	10	7	7	4	6	23
	C	Property Damage Only	18	28	13	28	17	55
Crash Type	A	Angle	0	1	0	0	3	1
	B	Head On	0	0	0	0	0	0
	C	Rear End	11	12	3	13	8	20
	D	Sideswipe	5	9	8	12	7	33
	E	Other	12	13	9	7	5	24
Work Zone Related	A	Yes	0	0	0	2	3	11
	B	No	18	25	14	15	17	40
	C	Other/ Unknown	10	10	6	15	3	27
Road Surface Condition	A	Dry	26	33	14	29	17	60
	B	Wet	2	1	5	3	4	10
	C	Snow/Ice/Slush	0	1	1	0	2	8
	D	Other/ Unknown	0	0	0	0	0	0

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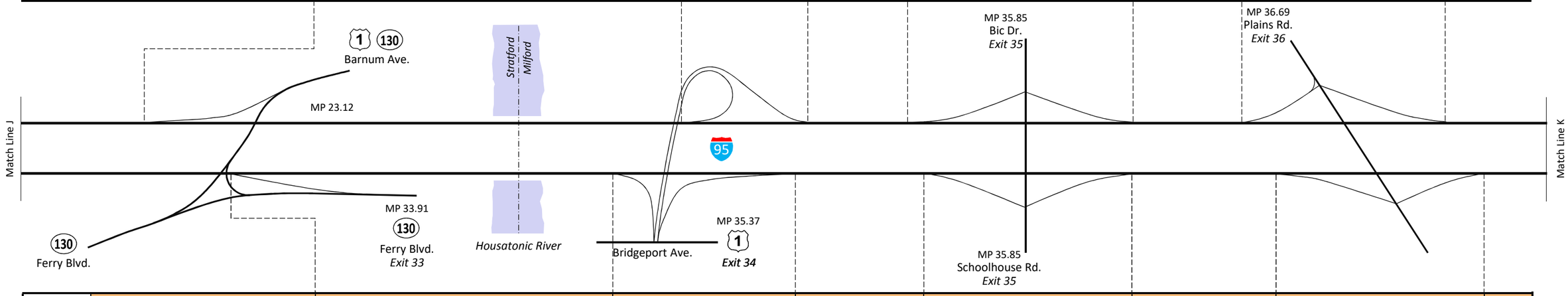
MAINLINE CRASH SUMMARY

FIGURE 10

Distance			1.83	1.97	0.2	0.28	0.49	0.35	0.59
Crash Rate			0.9	0.9	2.0	1.0	1.0	0.7	1.1
Total			90	109	28	19	33	17	47
Severity	A	Fatality	1	1	0	0	0	0	0
	B	Injury	27	31	8	5	9	5	14
	C	Property Damage Only	62	77	20	14	24	12	33
Crash Type	A	Angle	1	2	0	0	3	0	0
	B	Head On	1	1	0	1	0	0	1
	C	Rear End	22	30	10	7	17	10	29
	D	Sideswipe	40	45	11	9	7	7	10
	E	Other	26	31	7	2	6	0	7
Work Zone Related	A	Yes	10	12	6	1	1	0	1
	B	No	48	56	18	16	24	14	34
	C	Other/ Unknown	32	41	4	2	8	3	12
Road Surface Condition	A	Dry	74	88	22	17	24	16	44
	B	Wet	13	18	5	2	6	1	0
	C	Snow/Ice/Slush	3	3	1	0	3	0	3
	D	Other/ Unknown	0	0	0	0	0	0	0



Distance			1.59	0.28	0.18	0.3	0.53	0.32	0.48
Crash Rate			1.3	1.8	1.3	0.8	1.0	1.4	1.1
Total			135	27	16	16	37	31	39
Severity	A	Fatality	0	0	0	0	1	0	0
	B	Injury	34	7	2	3	11	10	10
	C	Property Damage Only	101	20	14	13	25	21	29
Crash Type	A	Angle	0	0	0	0	0	0	0
	B	Head On	0	0	0	0	1	0	0
	C	Rear End	50	9	8	9	13	18	30
	D	Sideswipe	51	7	6	6	12	7	3
	E	Other	34	11	2	1	11	6	6
Work Zone Related	A	Yes	10	0	0	0	0	0	0
	B	No	81	23	14	11	26	21	29
	C	Other/ Unknown	44	4	2	5	11	10	10
Road Surface Condition	A	Dry	116	26	12	16	31	26	34
	B	Wet	11	0	2	0	4	4	5
	C	Snow/Ice/Slush	7	1	2	0	2	1	0
	D	Other/ Unknown	1	0	0	0	0	0	0

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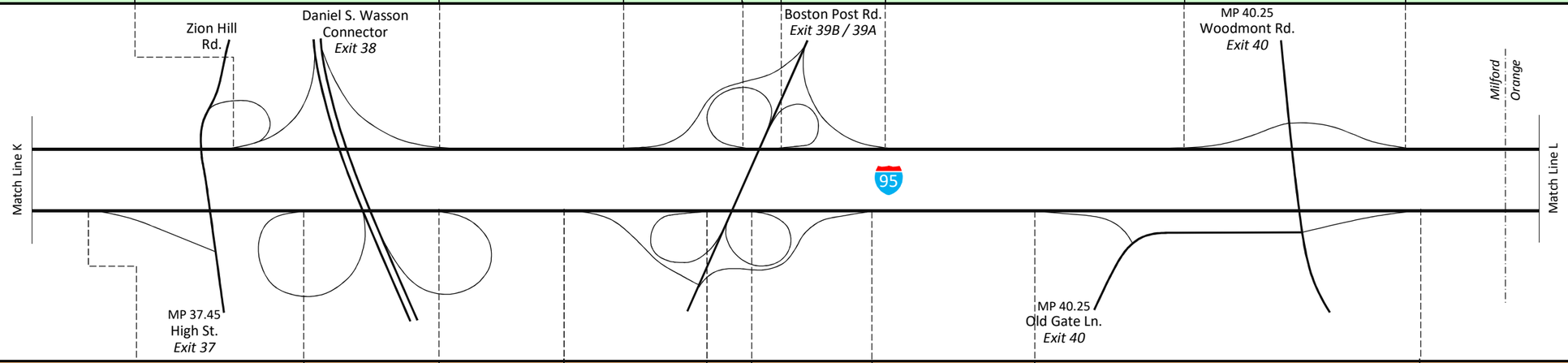
MAINLINE CRASH SUMMARY

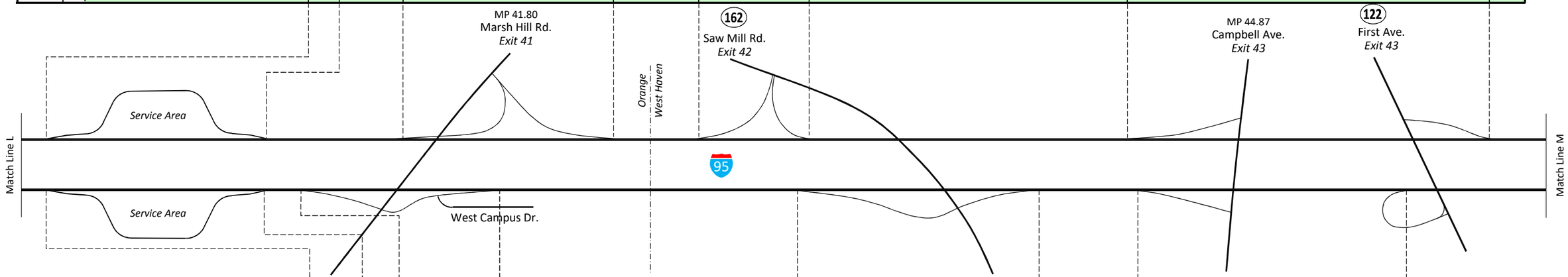
FIGURE 11

Distance			0.25	1.27	0.15	0.09	0.12	0.78	0.40	0.46
Crash Rate			1.8	0.7	1.3	1.7	2.6	0.8	1.3	3.6
Total			28	66	13	11	22	47	34	123
Severity	A	Fatality	0	0	0	0	0	0	0	1
	B	Injury	7	19	5	5	13	10	14	35
	C	Property Damage Only	21	47	8	6	9	37	20	87
Crash Type	A	Angle	0	0	0	0	0	2	0	0
	B	Head On	0	1	0	0	0	0	0	0
	C	Rear End	21	34	7	4	13	22	21	87
	D	Sideswipe	5	11	4	4	5	12	7	21
	E	Other	2	20	2	3	4	11	6	15
Work Zone Related	A	Yes	0	2	1	0	0	0	1	3
	B	No	19	39	9	7	16	25	24	82
	C	Other/ Unknown	9	25	3	4	6	22	9	38
Road Surface Condition	A	Dry	25	57	11	11	19	38	30	104
	B	Wet	3	8	1	0	2	6	3	13
	C	Snow/Ice/Slush	0	1	1	0	1	2	1	6
	D	Other/ Unknown	0	0	0	0	0	1	0	0



Distance			0.23	0.09	1.27	0.11	0.14	0.15	0.44	0.71	0.50
Crash Rate			1.4	2.3	0.4	1.2	0.8	1.1	1.5	1.1	0.6
Total			23	11	43	10	8	11	50	51	21
Severity	A	Fatality	0	0	0	0	0	0	0	0	0
	B	Injury	5	4	11	3	4	2	14	8	8
	C	Property Damage Only	18	7	32	7	4	9	36	43	13
Crash Type	A	Angle	0	1	0	0	1	0	0	1	1
	B	Head On	0	0	0	0	0	0	0	0	0
	C	Rear End	13	4	19	4	3	2	15	33	5
	D	Sideswipe	5	3	11	4	2	7	21	13	10
	E	Other	5	3	13	2	2	2	14	4	5
Work Zone Related	A	Yes	0	0	0	0	1	0	0	0	0
	B	No	14	11	33	8	7	6	31	34	15
	C	Other/ Unknown	9	0	10	2	0	5	19	17	6
Road Surface Condition	A	Dry	20	9	35	9	5	11	40	46	17
	B	Wet	3	1	6	1	3	0	7	4	4
	C	Snow/Ice/Slush	0	1	2	0	0	0	3	1	0
	D	Other/ Unknown	0	0	0	0	0	0	0	0	0

		Distance	0.35	0.4	0.4	1.38	0.32	0.89	0.63	0.55
			0.7	0.7	1.1	0.7	1.0	1.0	0.9	2.8
Total			16	19	29	75	22	73	44	128
Severity	A	Fatality	0	0	0	0	0	0	0	0
	B	Injury	4	2	4	21	6	20	10	41
	C	Property Damage Only	12	17	25	54	16	53	34	87
Crash Type	A	Angle	1	1	0	1	0	3	1	2
	B	Head On	0	0	0	0	0	0	0	1
	C	Rear End	8	5	12	36	9	27	20	72
	D	Sideswipe	3	7	8	19	6	18	13	35
	E	Other	4	6	9	19	7	25	10	18
Work Zone Related	A	Yes	0	0	0	0	0	4	2	6
	B	No	8	9	20	42	19	47	27	97
	C	Other/ Unknown	8	0	9	33	3	23	15	25
Road Surface Condition	A	Dry	15	16	24	61	17	60	37	102
	B	Wet	0	3	1	11	3	11	4	20
	C	Snow/Ice/Slush	1	0	4	3	2	2	2	6
	D	Other/ Unknown	0	0	0	0	0	0	1	0



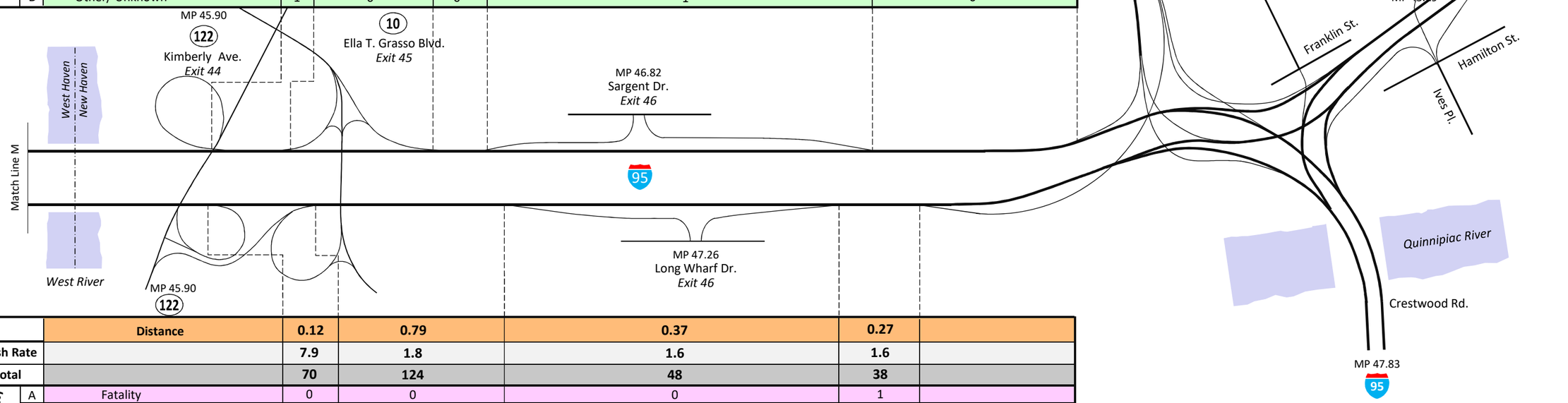
		Distance	0.34	0.22	0.53	1.69	0.34	0.62	0.44	0.75
Crash Rate			1.3	2.3	1.7	1.1	3.5	2.3	3.3	3.3
Total			30	38	62	34	80	108	103	193
Severity	A	Fatality	0	0	0	0	0	0	0	0
	B	Injury	5	15	24	39	21	26	34	56
	C	Property Damage Only	25	23	38	95	59	82	69	137
Crash Type	A	Angle	0	0	0	0	1	1	2	0
	B	Head On	0	0	0	1	0	0	0	0
	C	Rear End	13	23	41	85	54	75	77	142
	D	Sideswipe	9	13	11	29	17	23	17	29
	E	Other	8	2	10	19	8	9	7	22
Work Zone Related	A	Yes	0	2	0	1	1	1	4	6
	B	No	16	26	34	87	58	61	64	123
	C	Other/ Unknown	14	10	28	46	21	46	35	64
Road Surface Condition	A	Dry	26	53	51	115	70	99	91	166
	B	Wet	1	9	7	13	8	7	7	21
	C	Snow/Ice/Slush	3	6	4	6	2	2	5	5
	D	Other/ Unknown	0	0	0	0	0	0	0	1

CDM Smith

MAINLINE CRASH SUMMARY

FIGURE 13

		Distance	0.07	0.22	0.69	0.4	0.17
Crash Rate			**6.5**	**3.8**	**1.3**	**3.4**	**9.9**
Total			**37**	**71**	**80**	**113**	**154**
Severity	A	Fatality	0	0	0	1	1
	B	Injury	7	17	17	25	25
	C	Property Damage Only	30	54	63	87	128
Crash Type	A	Angle	0	2	1	2	0
	B	Head On	0	0	0	0	0
	C	Rear End	16	32	47	74	82
	D	Sideswipe	9	26	25	29	58
	E	Other	12	7	11	8	14
Work Zone Related	A	Yes	0	7	4	7	5
	B	No	27	45	34	79	100
	C	Other/ Unknown	10	19	42	27	49
Road Surface Condition	A	Dry	30	61	71	93	128
	B	Wet	3	8	7	14	24
	C	Snow/Ice/Slush	3	2	2	5	2
	D	Other/ Unknown	1	0	0	1	0



		Distance	0.12	0.79	0.37	0.27	
Crash Rate			**7.9**	**1.8**	**1.6**	**1.6**	
Total			**70**	**124**	**48**	**38**	
Severity	A	Fatality	0	0	0	1	
	B	Injury	16	25	7	4	
	C	Property Damage Only	54	99	41	33	
Crash Type	A	Angle	0	1	1	1	
	B	Head On	0	0	0	0	
	C	Rear End	47	73	17	21	
	D	Sideswipe	19	43	21	13	
	E	Other	4	7	9	3	
Work Zone Related	A	Yes	6	0	0	1	
	B	No	49	69	28	26	
	C	Other/ Unknown	15	55	20	11	
Road Surface Condition	A	Dry	65	110	42	37	
	B	Wet	5	13	6	1	
	C	Snow/Ice/Slush	0	1	0	0	
	D	Other/ Unknown	0	0	0	0	

Appendix C

MICRO-SIMULATION ANALYSIS SUMMARY

I-95 West
Future Alternative Scenarios
Micro-Simulation Model

presented to

Connecticut Department of Transportation

presented by

Keir Opie, Cambridge Systematics

CAMBRIDGE SYSTEMATICS

Think Forward

8/10/2017

Build Alternatives Simulated

- Initial Build: SB: Exit 19 to Exit 13, NB: Exit 19 to Exit 28
- Build #1: NYS Line (I-287) to Exit 9
- Build #2 Exit 9 to Exit 18
- Build #3: NYS Line (I-287) to Exit 18
- Build #4: Exit 13 to Exit 28
- Assumptions:
  - Forecasts of additional demand completed by CDM Smith
  - Widenings added to No Build conditions
  - No improvements to interchanges access designs assumed – additional lane added only

INITIAL BUILD:

NB: EXIT 19 (SOUTHPORT) TO EXIT 28 (BRIDGEPORT)

SB: EXIT 19 (SOUTHPORT) TO EXIT 13 (DARIEN)

Initial Build: Southbound Additional Lane

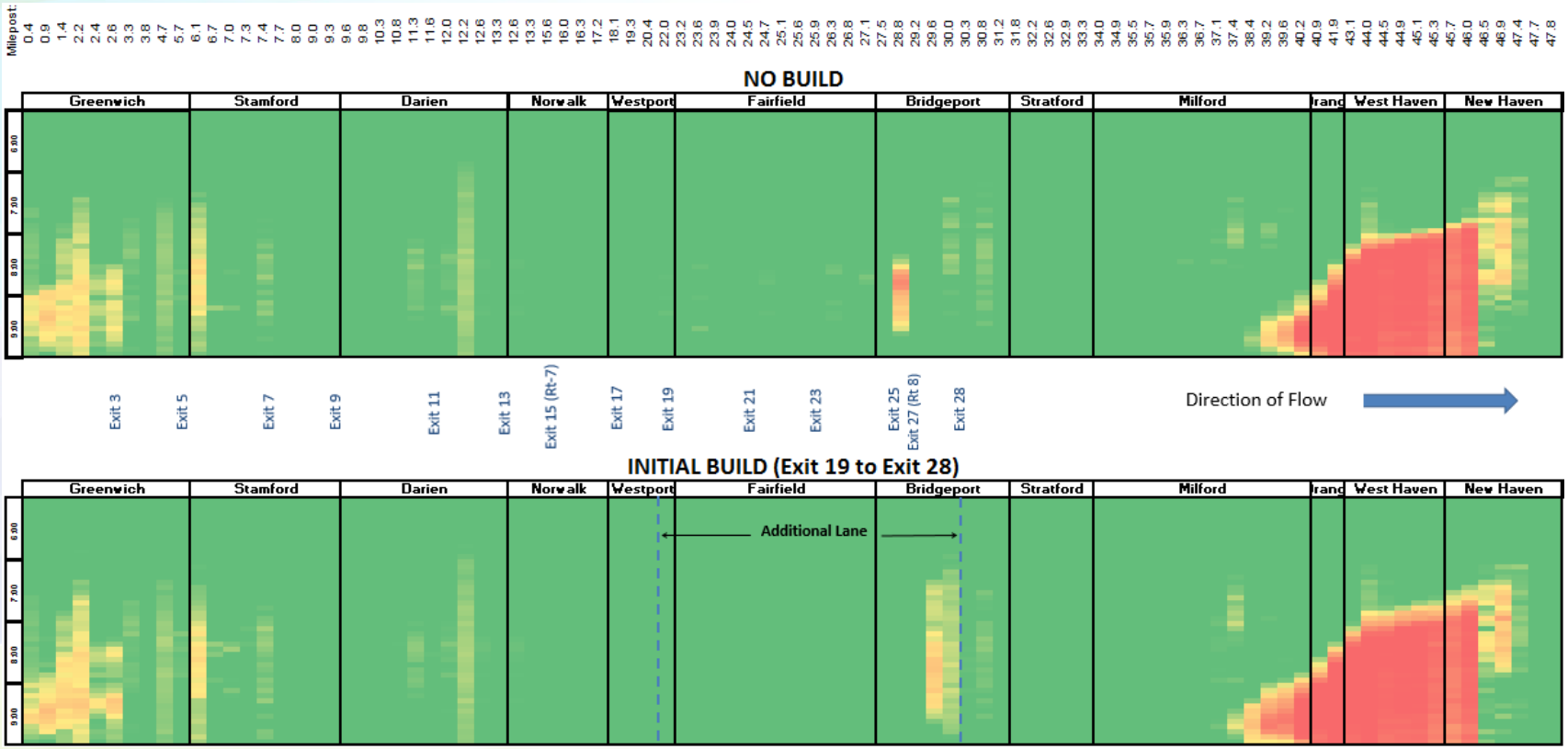
- Southbound - Exit 19 On-ramp (Southport) to Exit 13 Off-ramp (Darien)

CAMBRIDGE SYSTEMATICS

Initial Build: Northbound Additional Lane

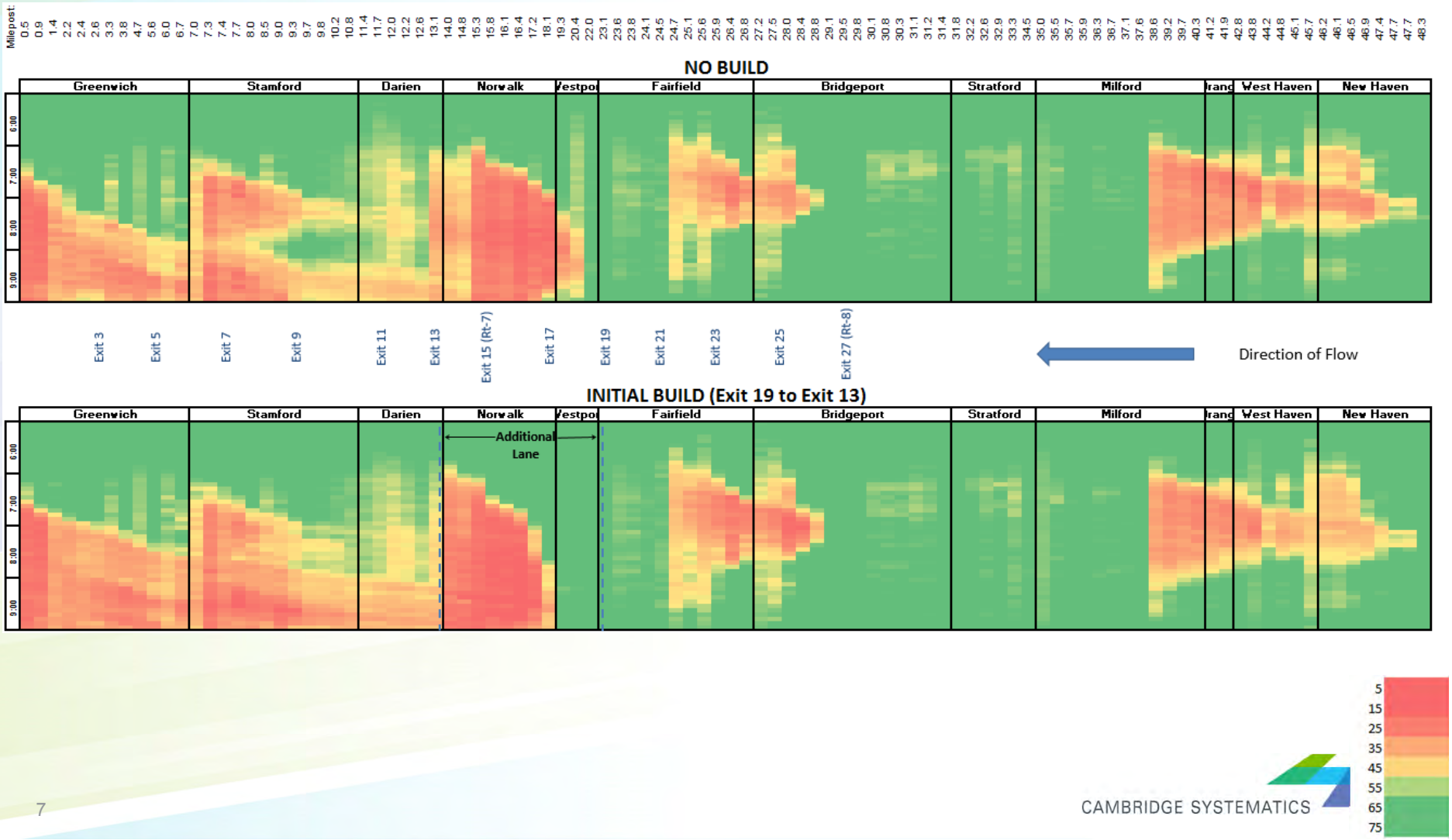
- Northbound: Exit 19 On-ramp (Southport) to Exit 28 Off-ramp (Bridgeport)

Initial Build: Speed Contours AM Northbound



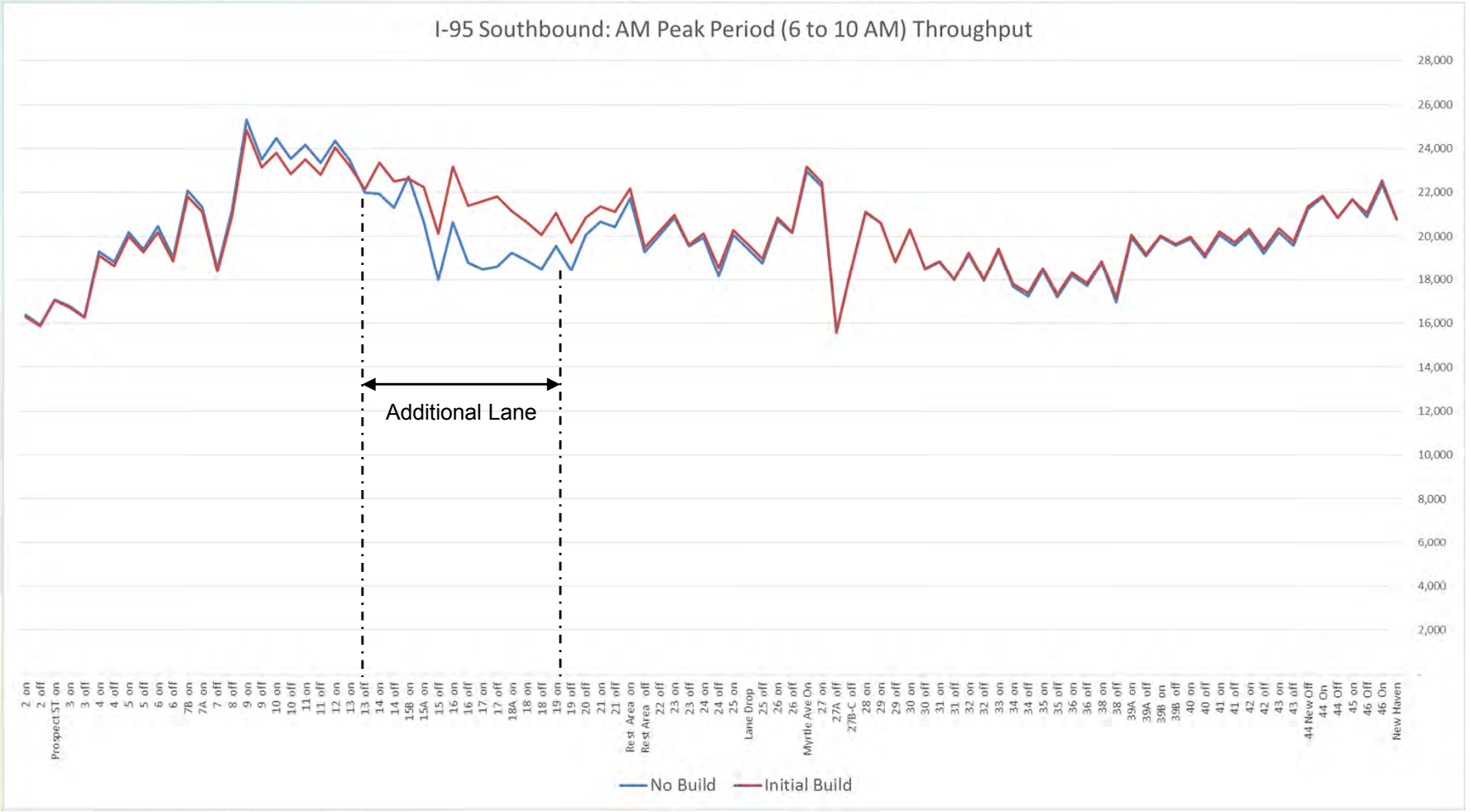
CAMBRIDGE SYSTEMATICS

Initial Build: Speed Contours AM Southbound



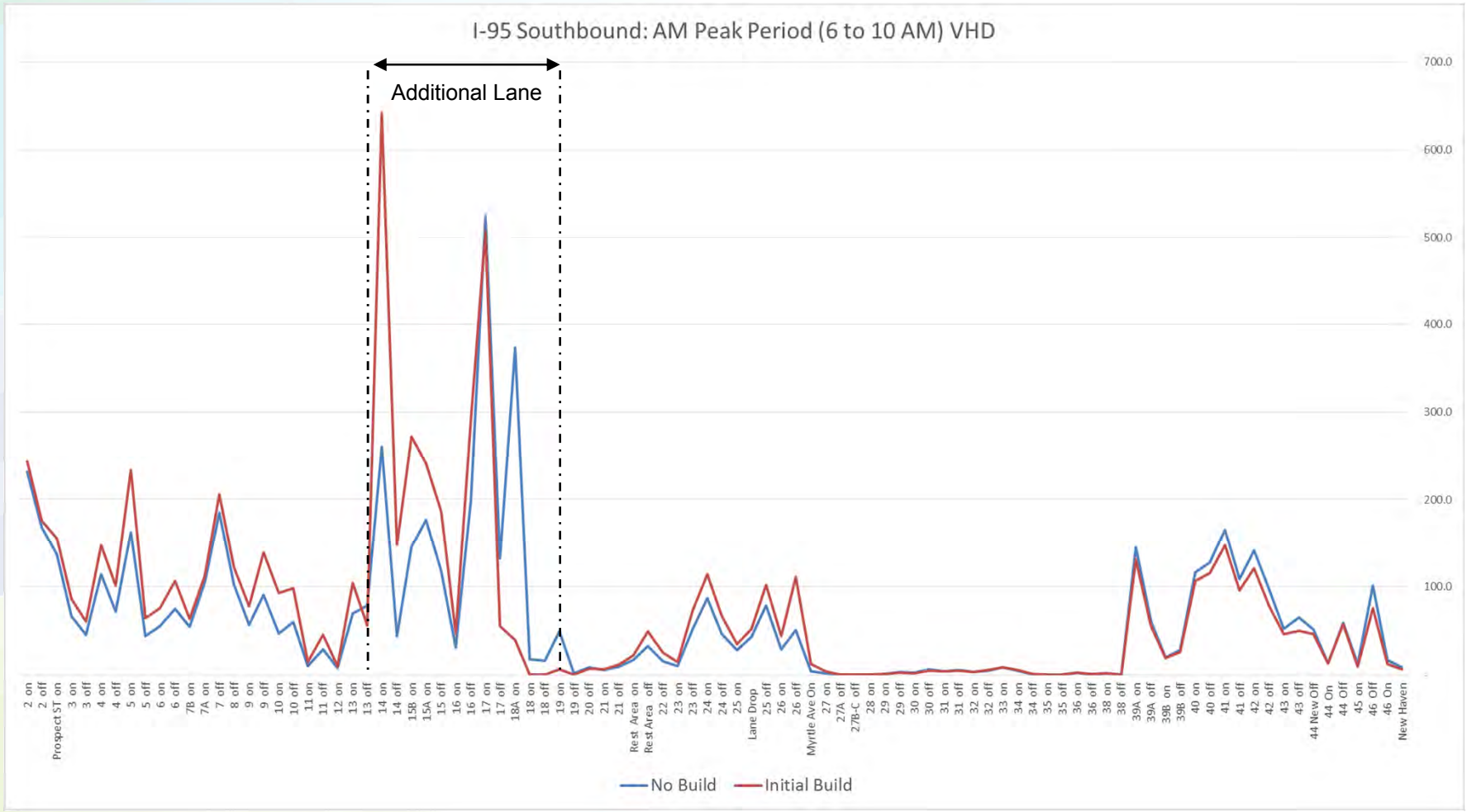
CAMBRIDGE SYSTEMATICS

Initial Build: Throughput AM Southbound



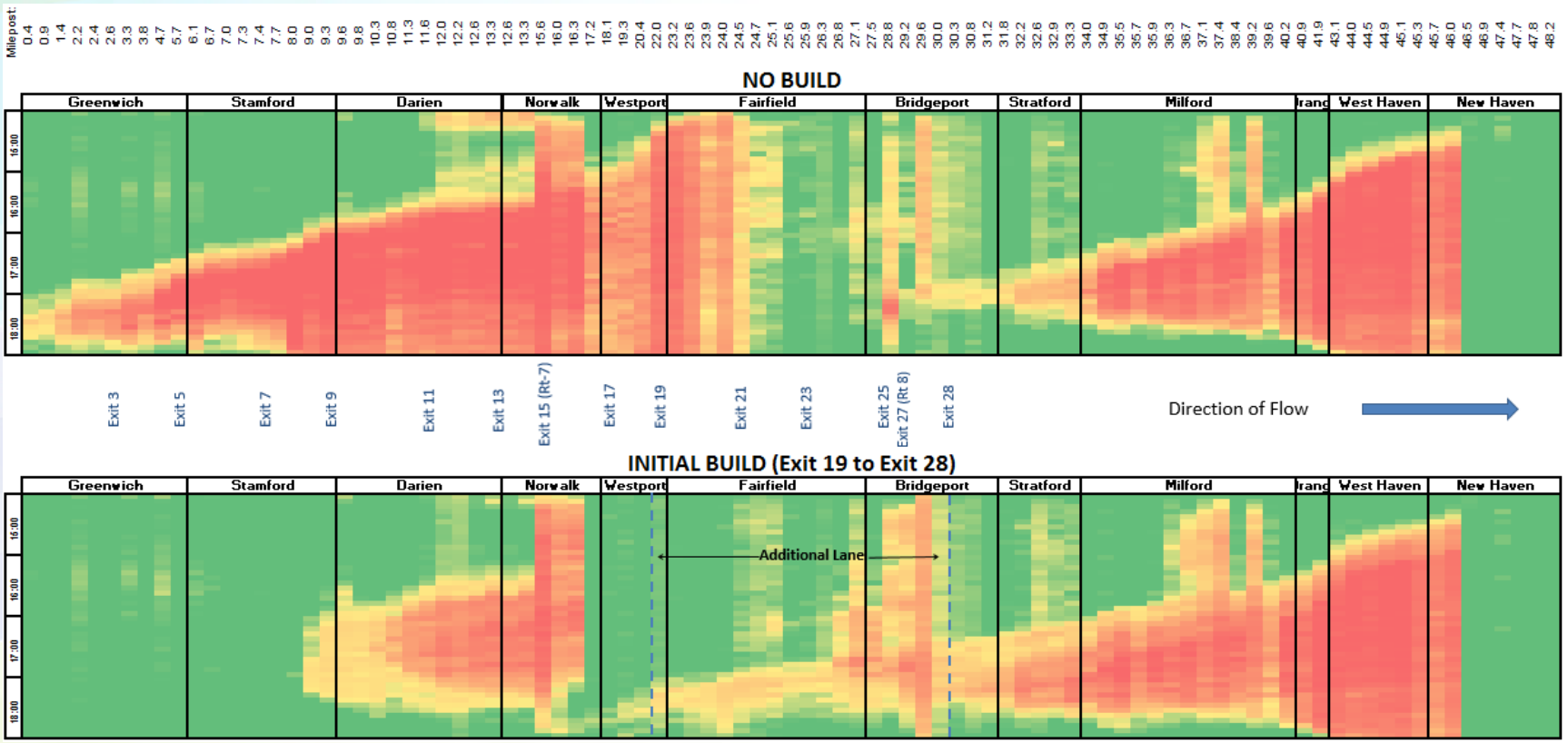
CAMBRIDGE SYSTEMATICS

Initial Build: Vehicle Hours of Delay AM Southbound



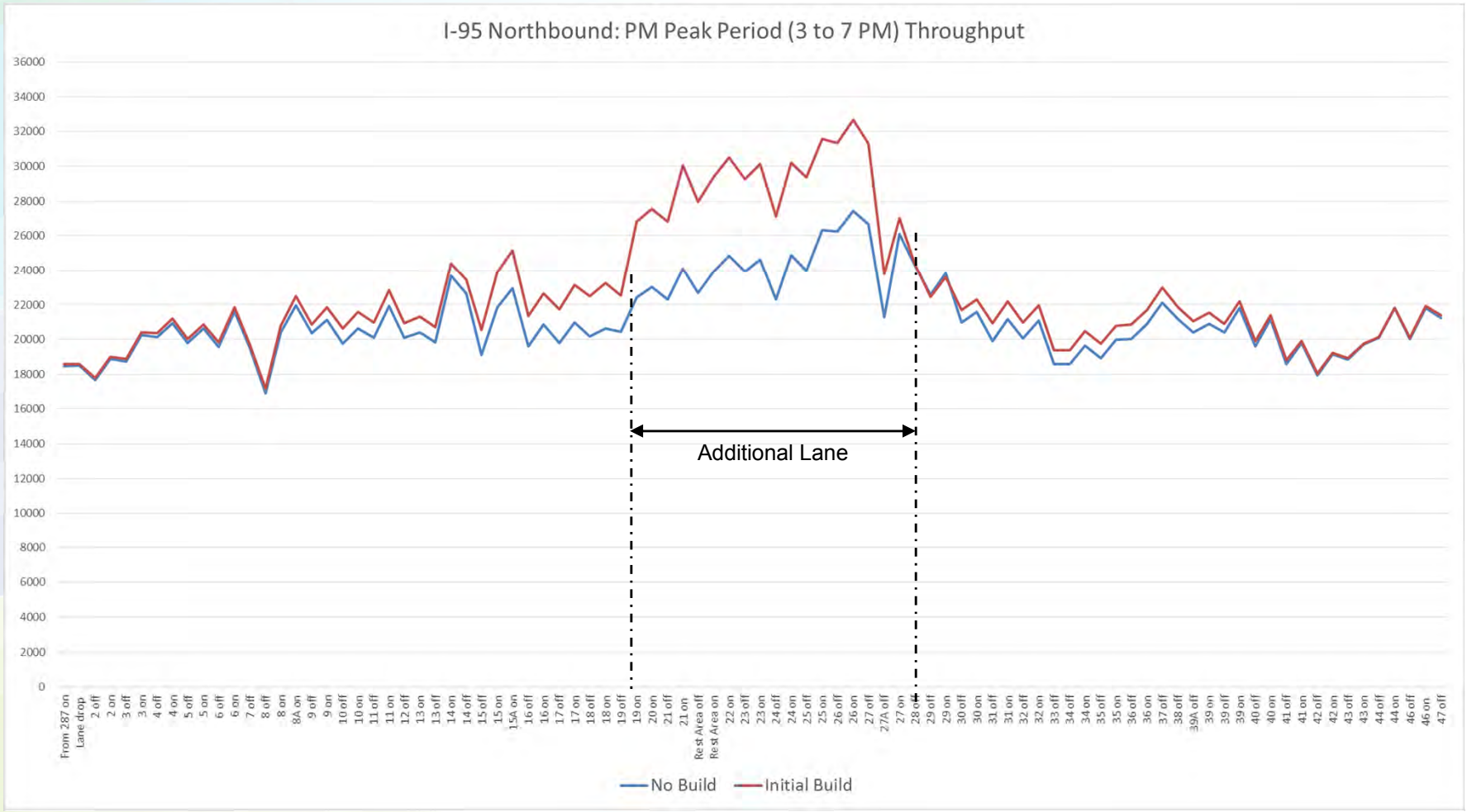
CAMBRIDGE SYSTEMATICS

Initial Build: Speed Contours PM Northbound



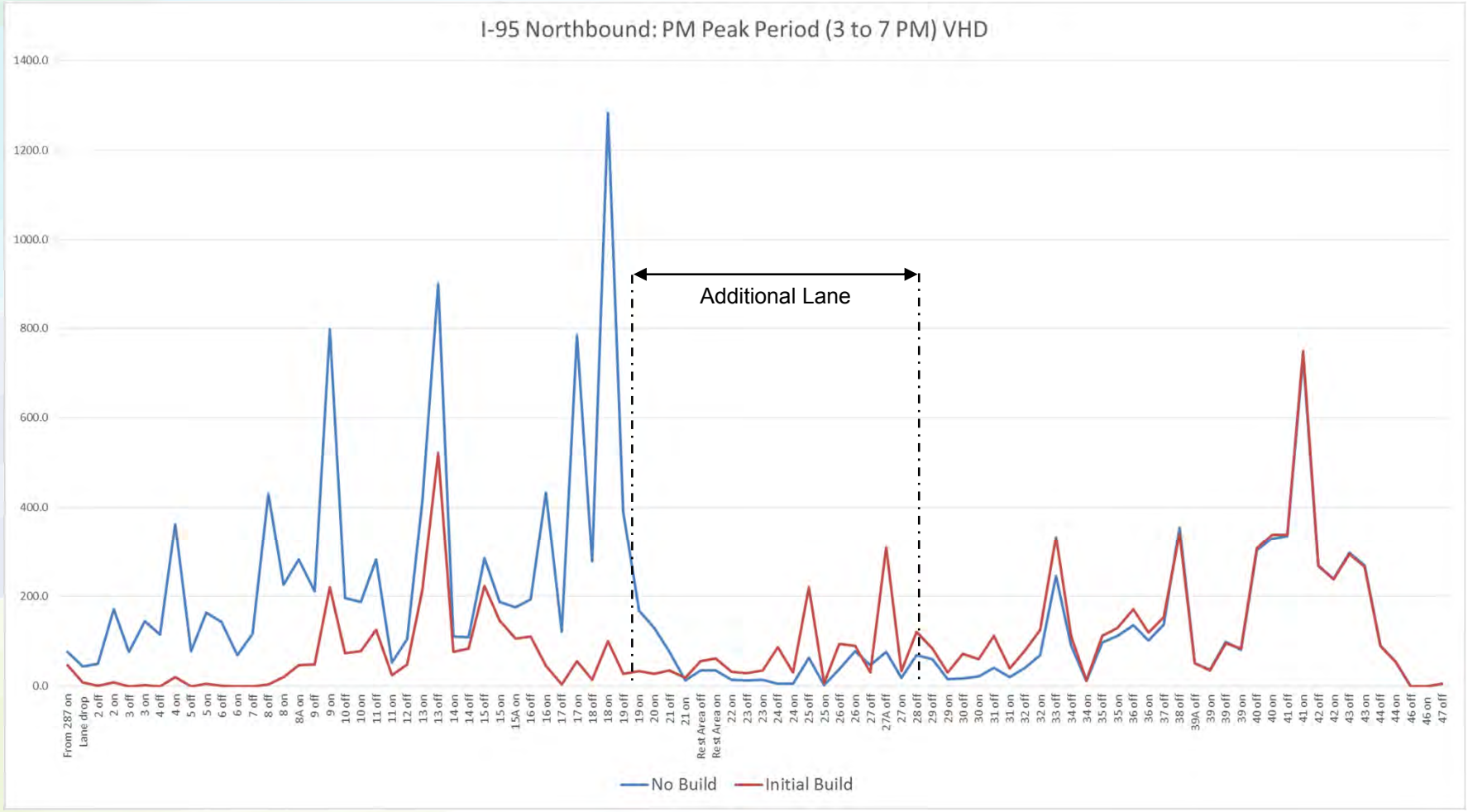
CAMBRIDGE SYSTEMATICS

Initial Build: Throughput PM Northbound



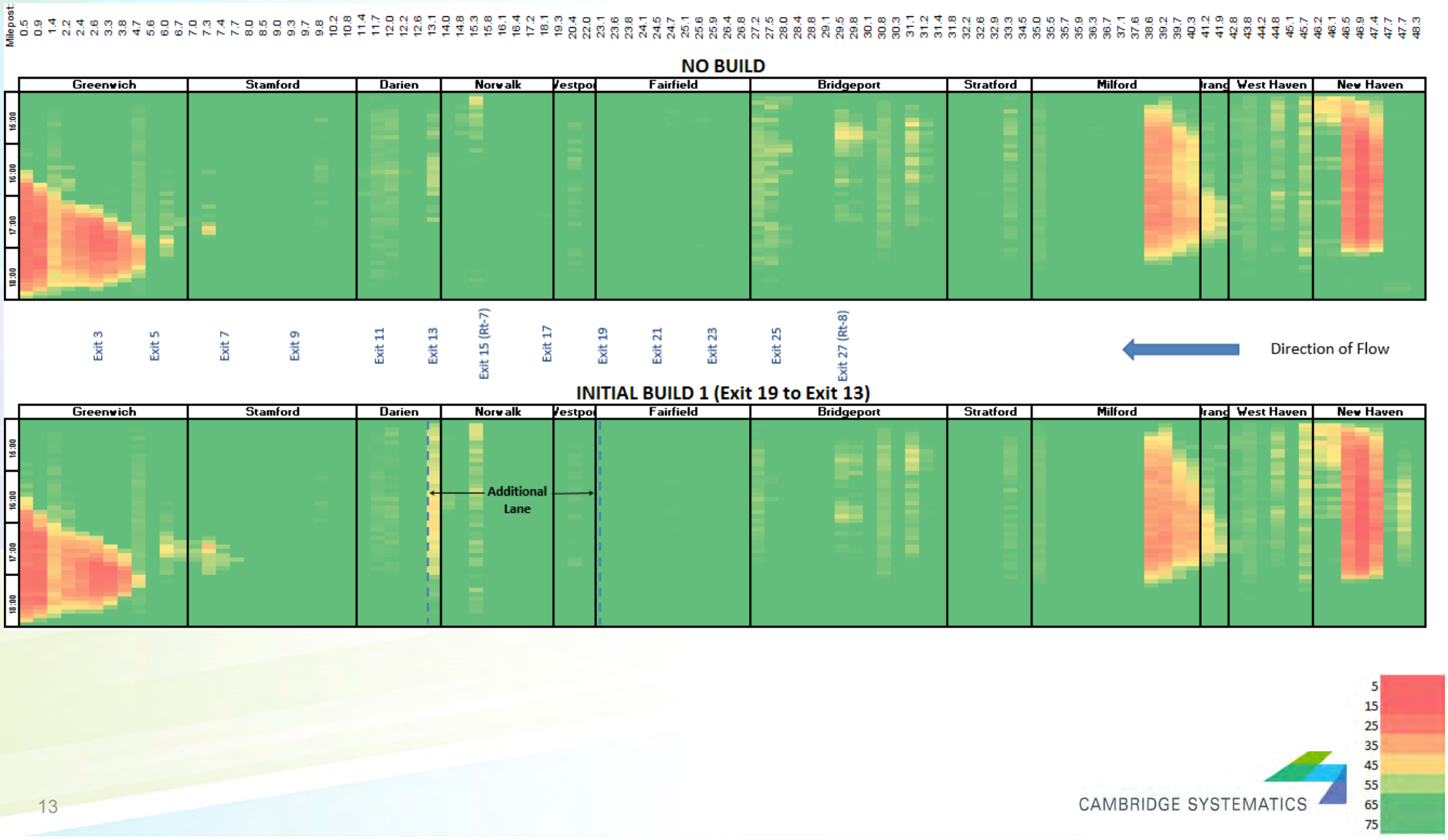
CAMBRIDGE SYSTEMATICS

Initial Build: Vehicle Hours of Delay PM Northbound



CAMBRIDGE SYSTEMATICS

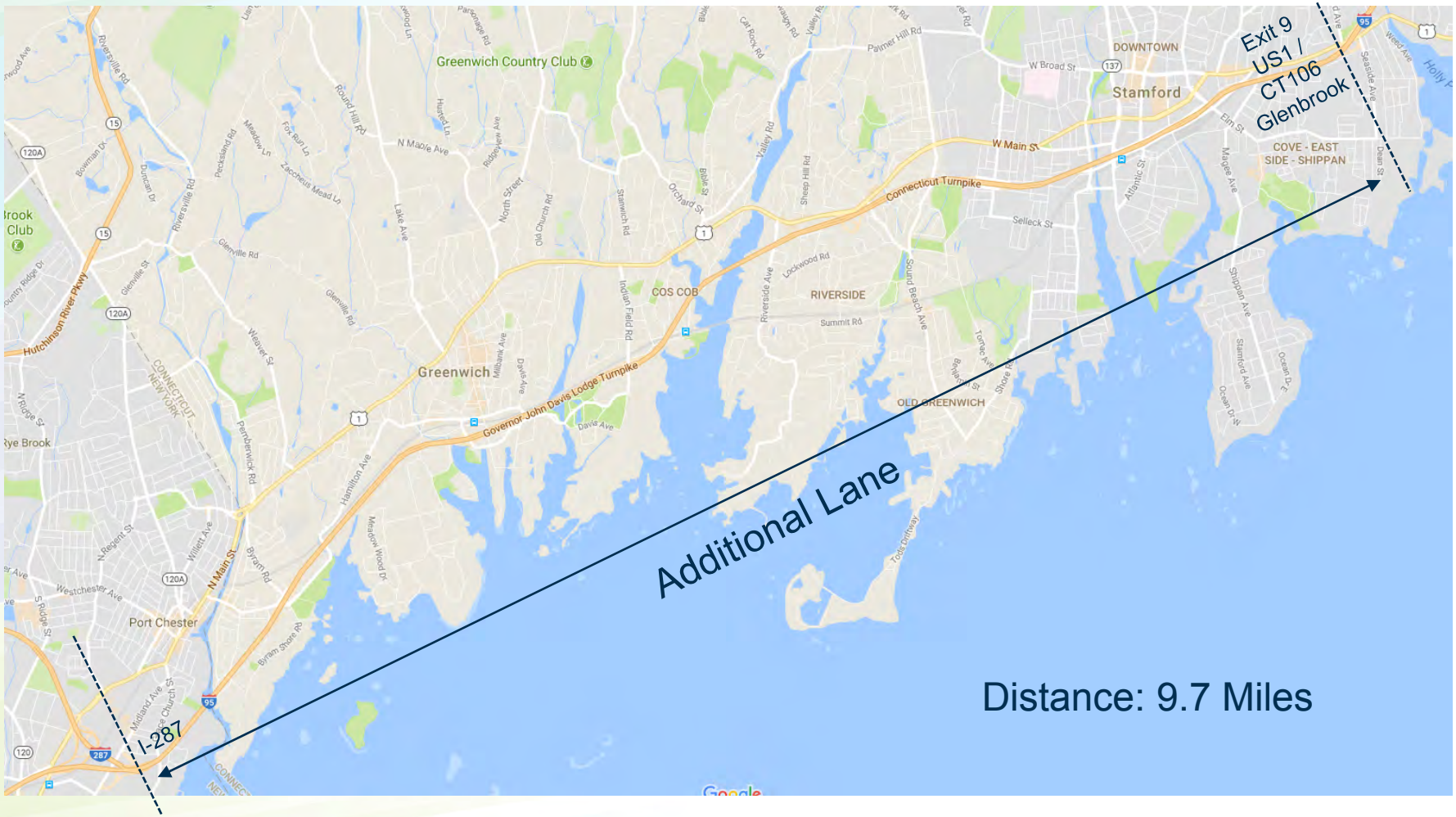
Initial Build: Speed Contours PM Southbound



CAMBRIDGE SYSTEMATICS

BUILD #1: I-287 (PORT CHESTER NY) TO EXIT 9 (STAMFORD)

Build #1: Widen Between I-287 (Port Chester NY) and Exit 9 (Stamford)



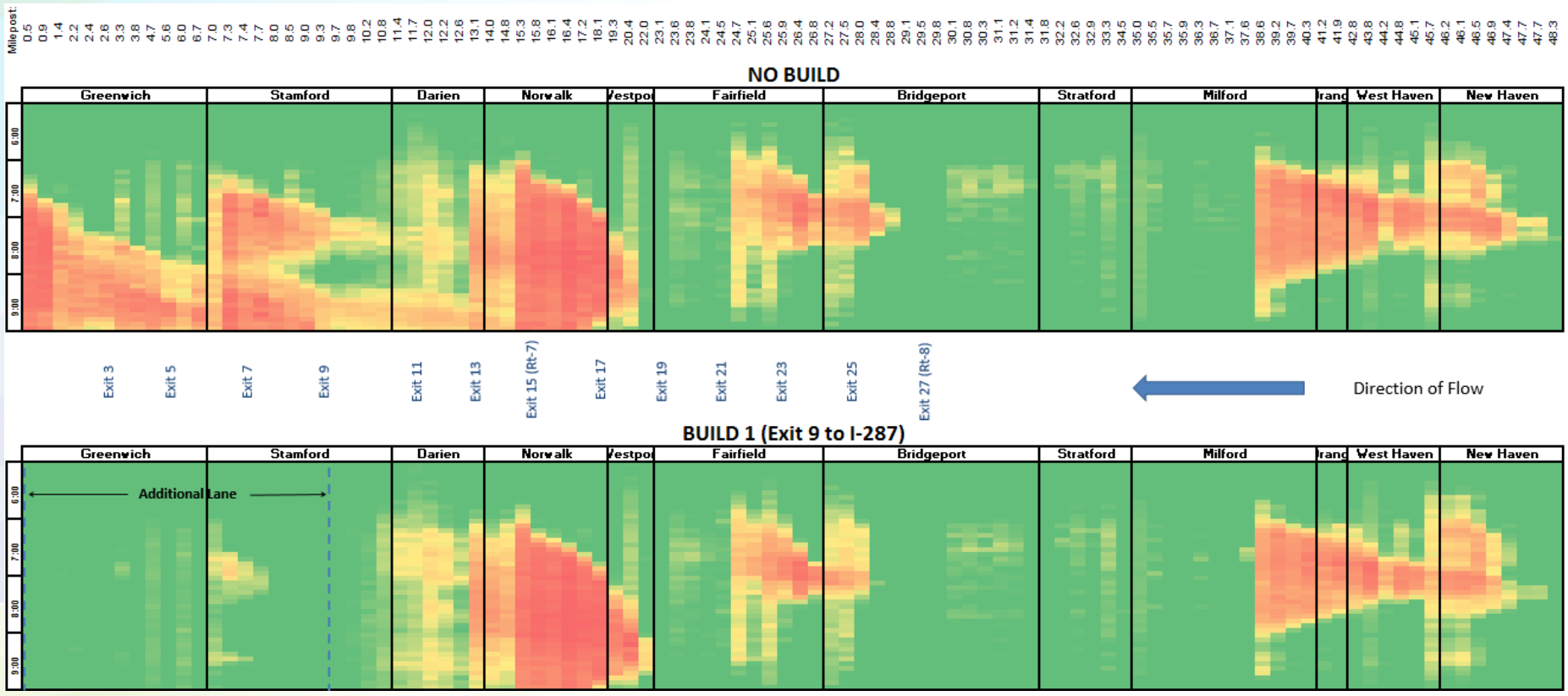
Note: Background Image Source: Google Maps

CAMBRIDGE SYSTEMATICS

Build #1: Speed Contours AM Northbound

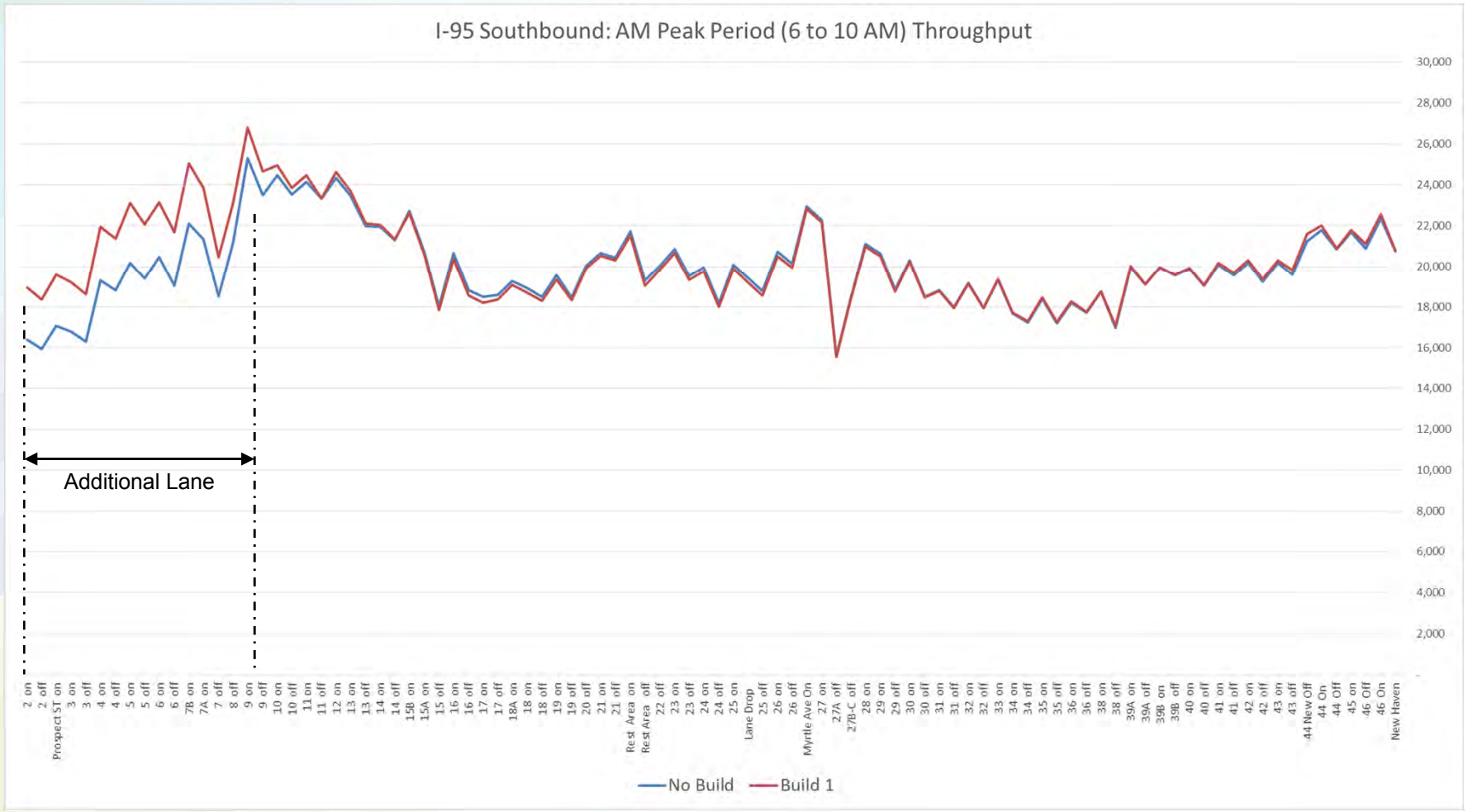
CAMBRIDGE SYSTEMATICS

Build #1: Speed Contours AM Southbound



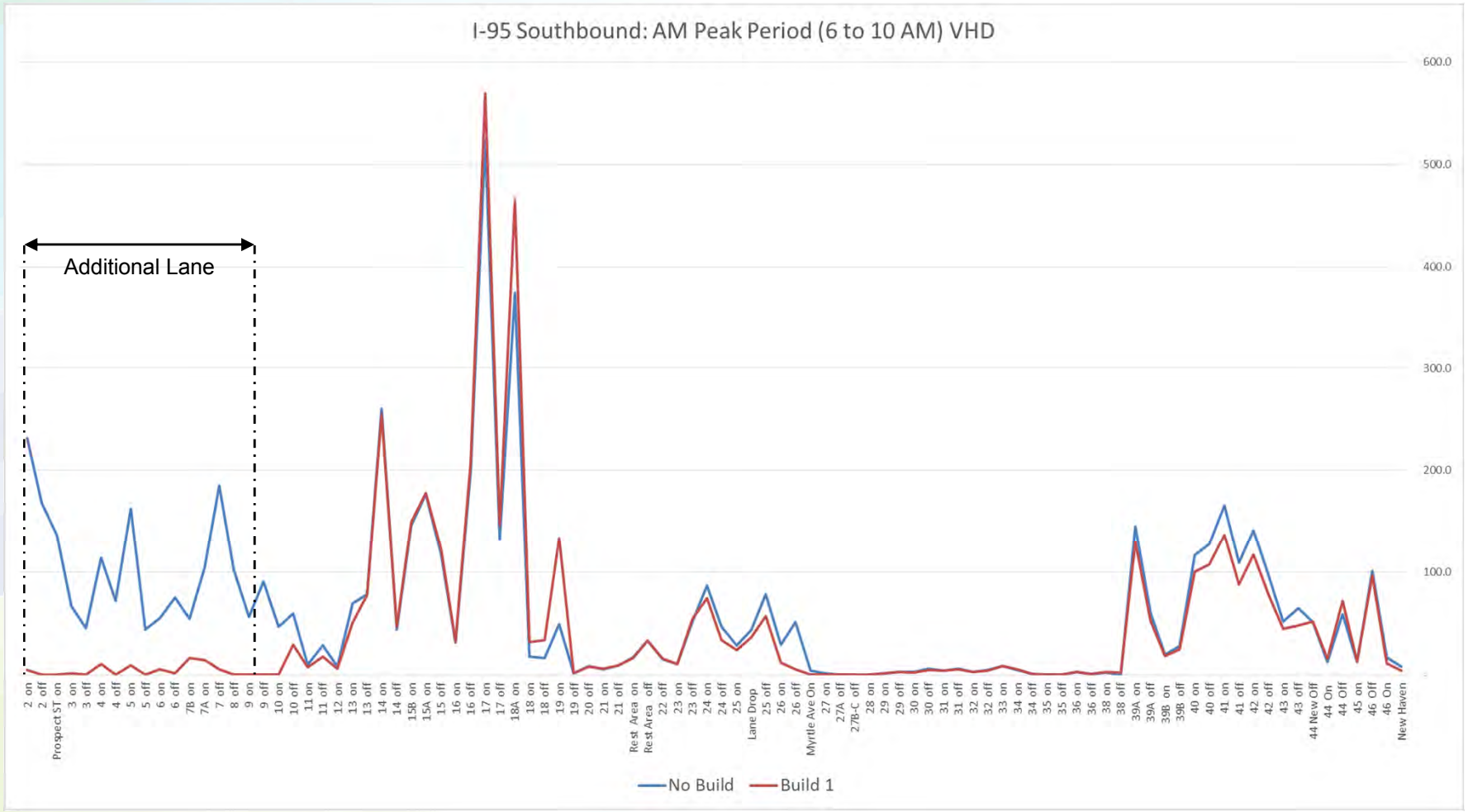
CAMBRIDGE SYSTEMATICS

Build #1: Throughput AM Southbound



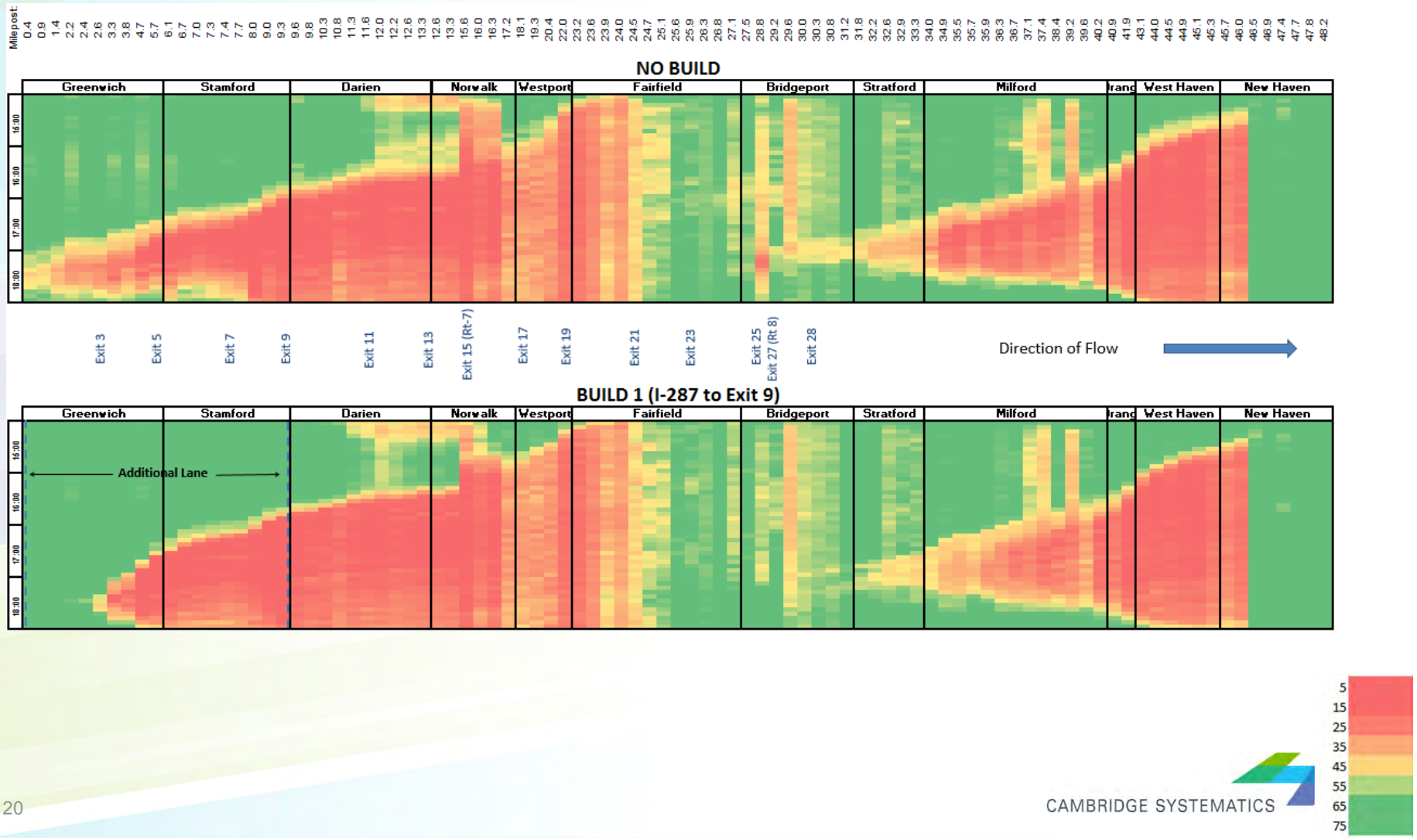
CAMBRIDGE SYSTEMATICS

Build #1: Vehicle Hours of Delay AM Southbound



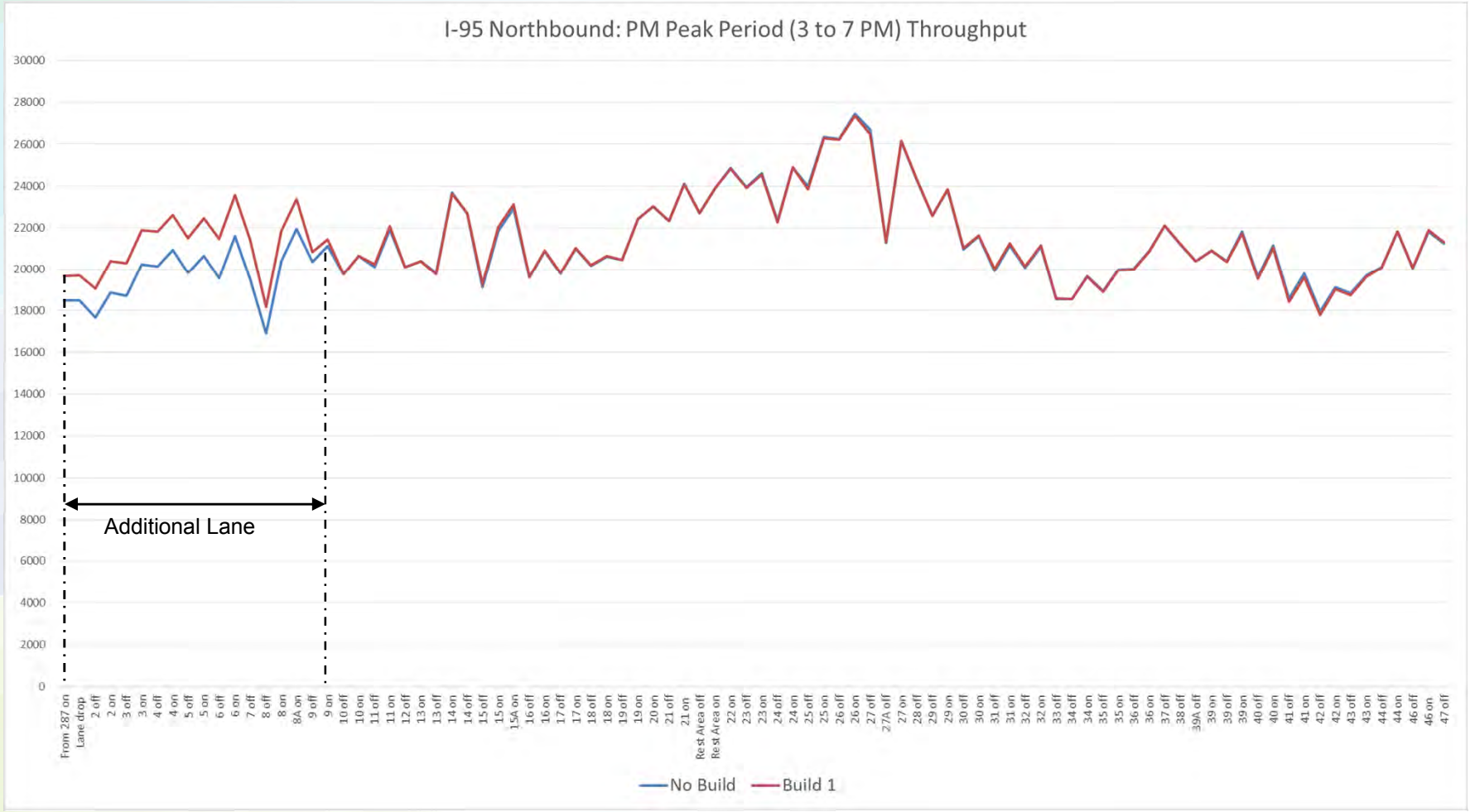
CAMBRIDGE SYSTEMATICS

Build #1: Speed Contours PM Northbound



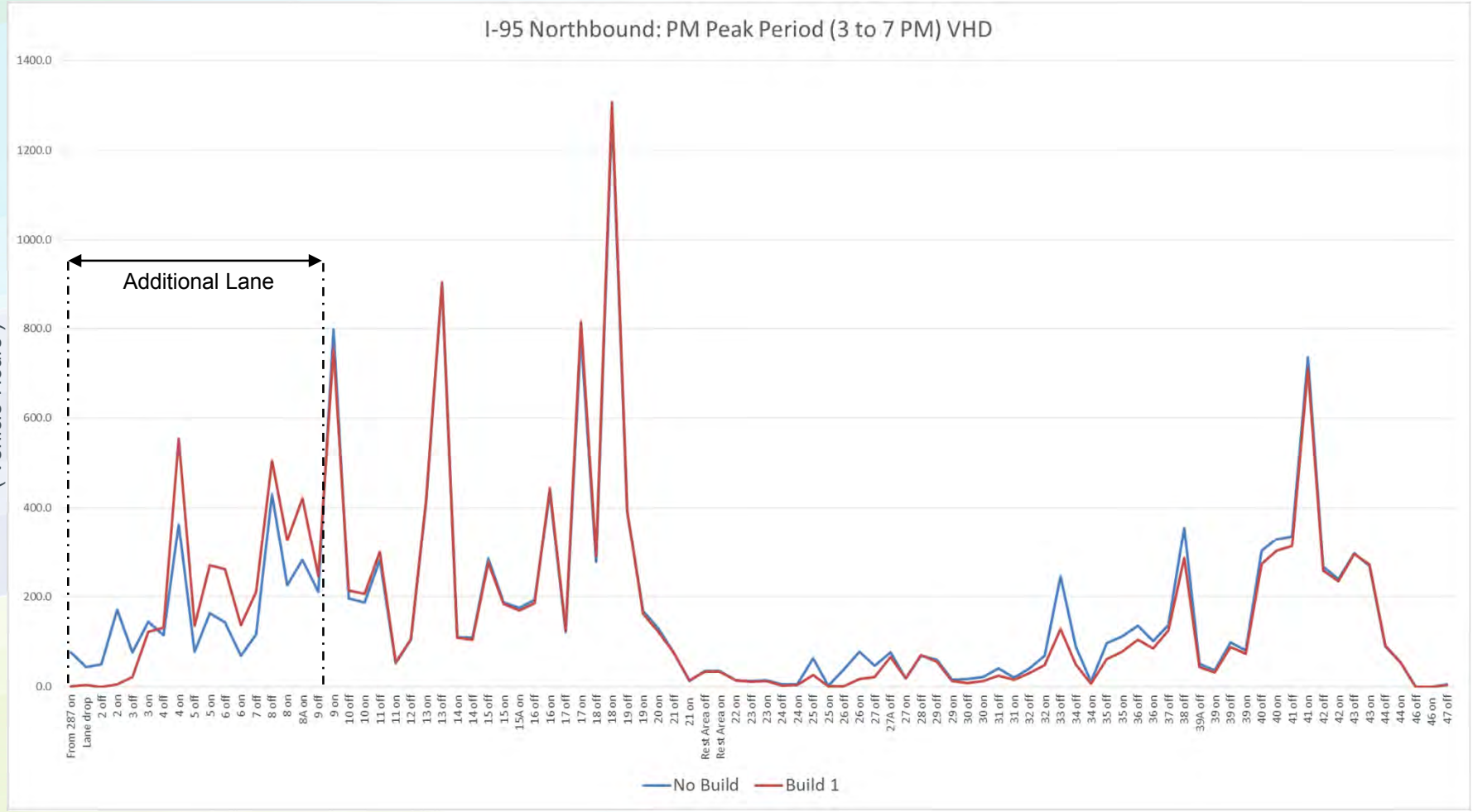
CAMBRIDGE SYSTEMATICS

Build #1: Throughput PM Northbound



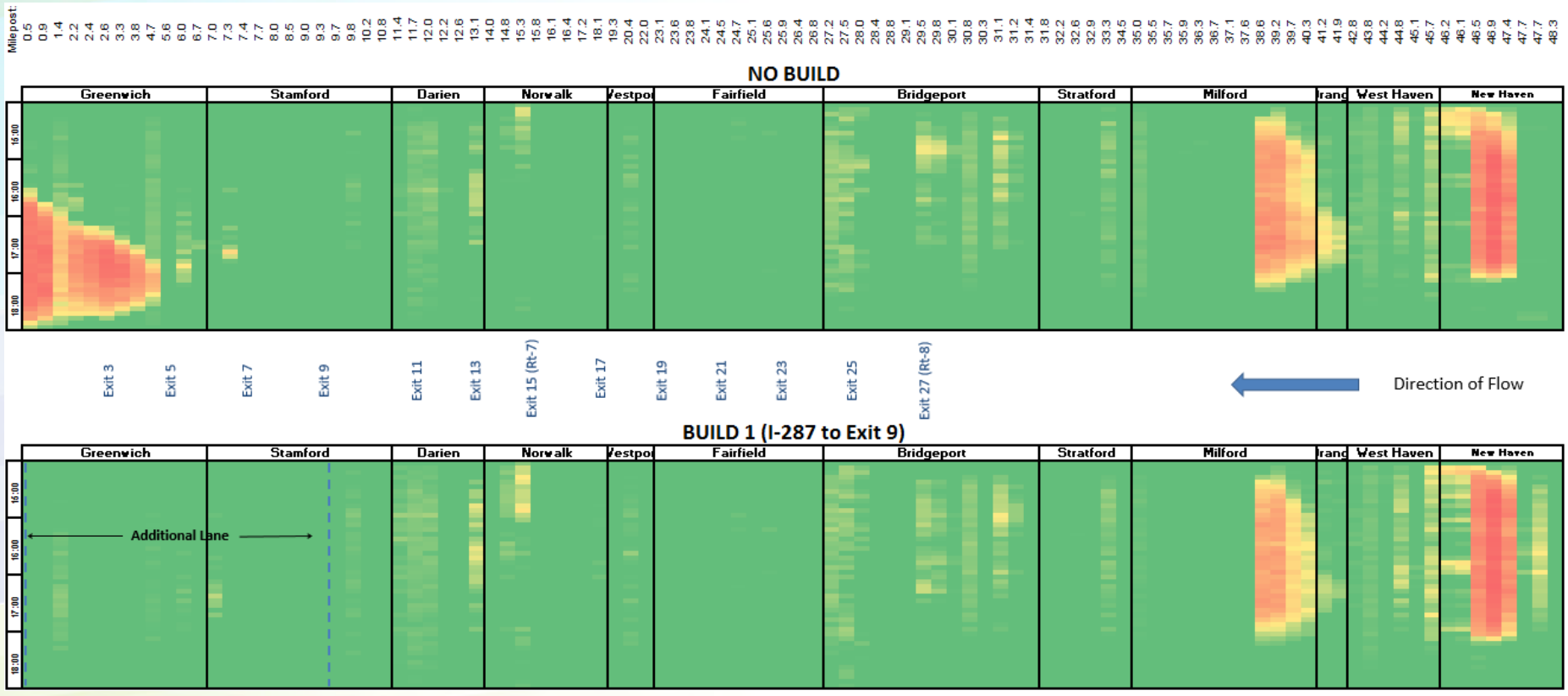
CAMBRIDGE SYSTEMATICS

Build #1: Vehicle Hours of Delay PM Northbound



CAMBRIDGE SYSTEMATICS

Build #1: Speed Contours PM Southbound



CAMBRIDGE SYSTEMATICS

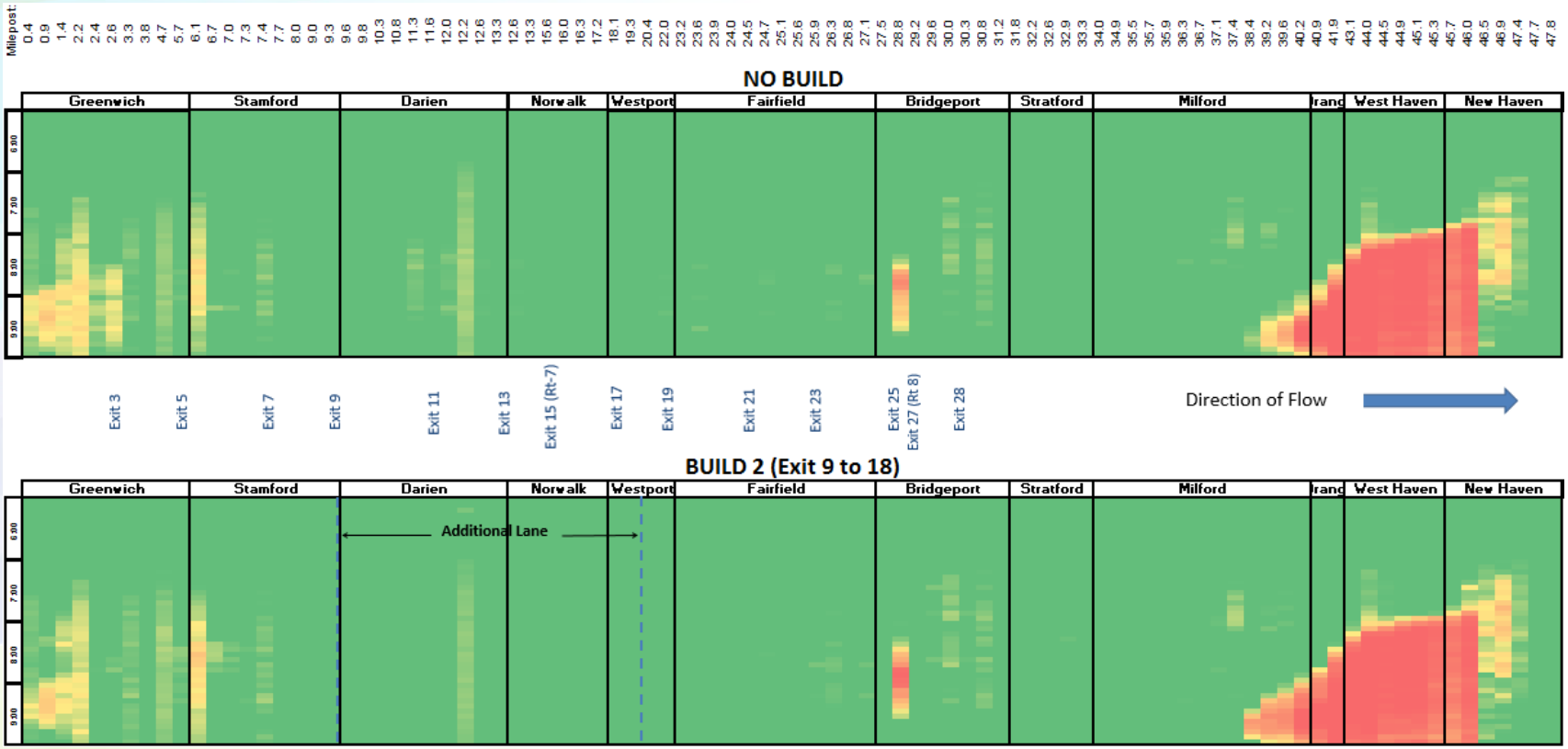
BUILD #2:
EXIT 9 (STAMFORD)
TO EXIT 18 (WESTPORT)

Build #2: Widen Between Exit 9 (Stamford) and Exit 18 (Westport)

Note: Background Image Source: Google Maps

CAMBRIDGE SYSTEMATICS

Build #2: Speed Contours AM Northbound



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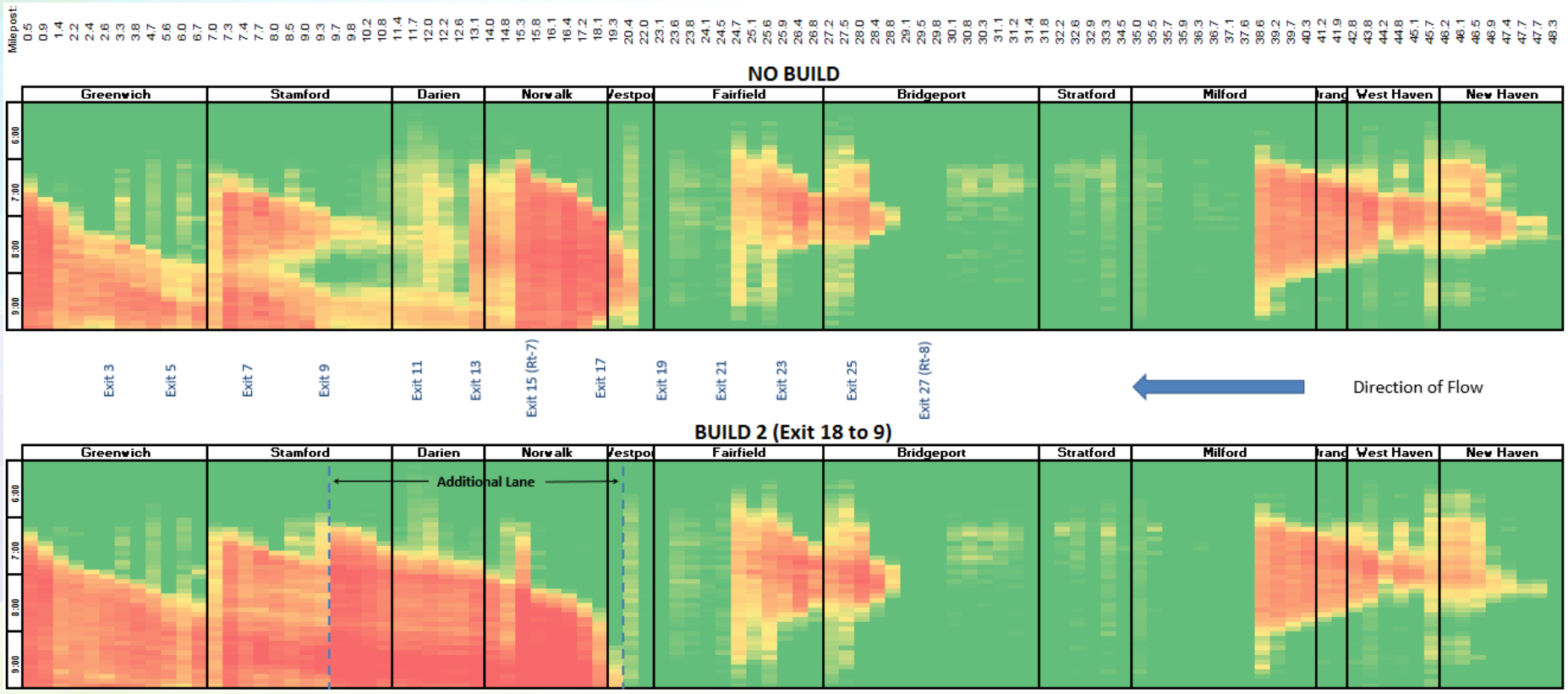
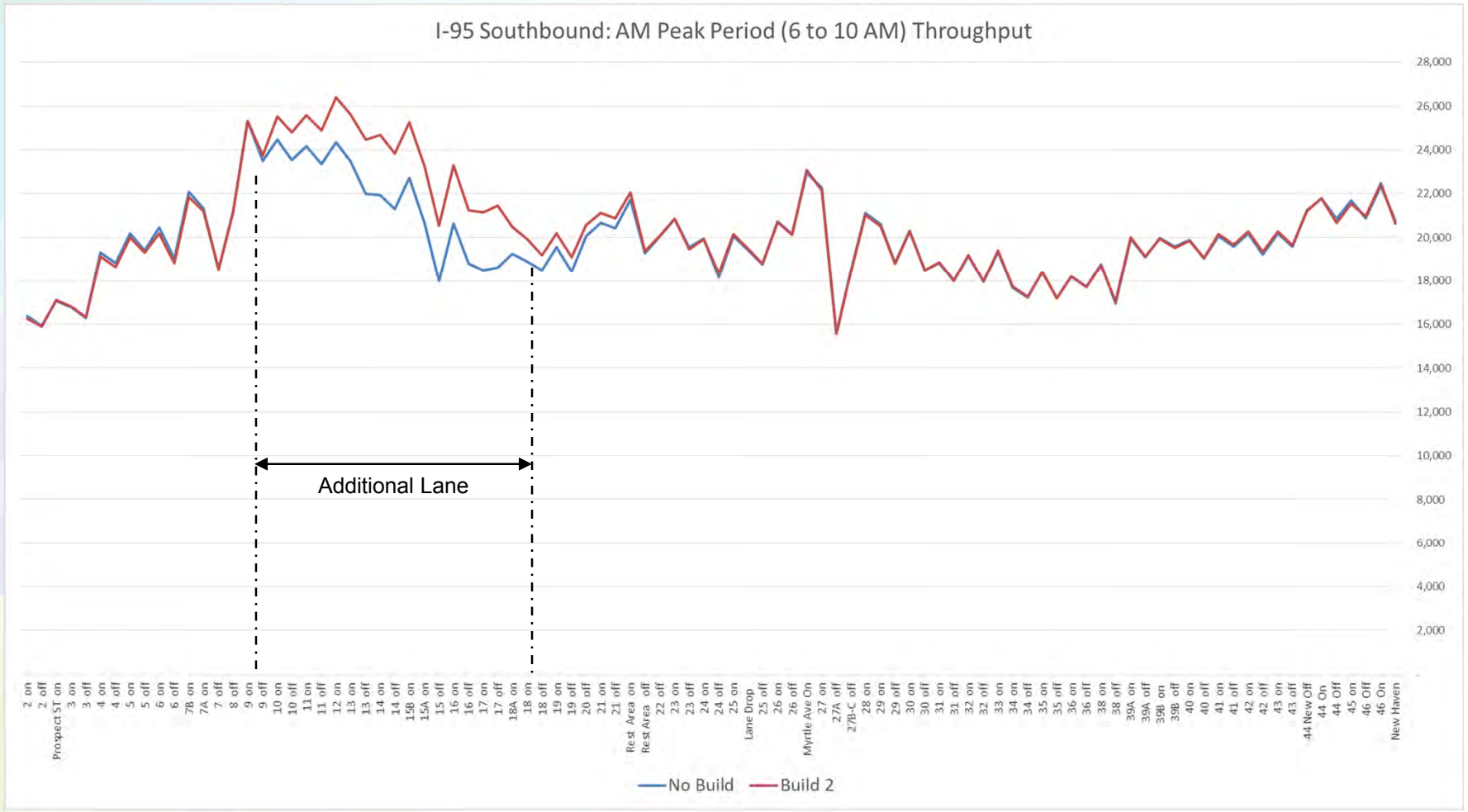


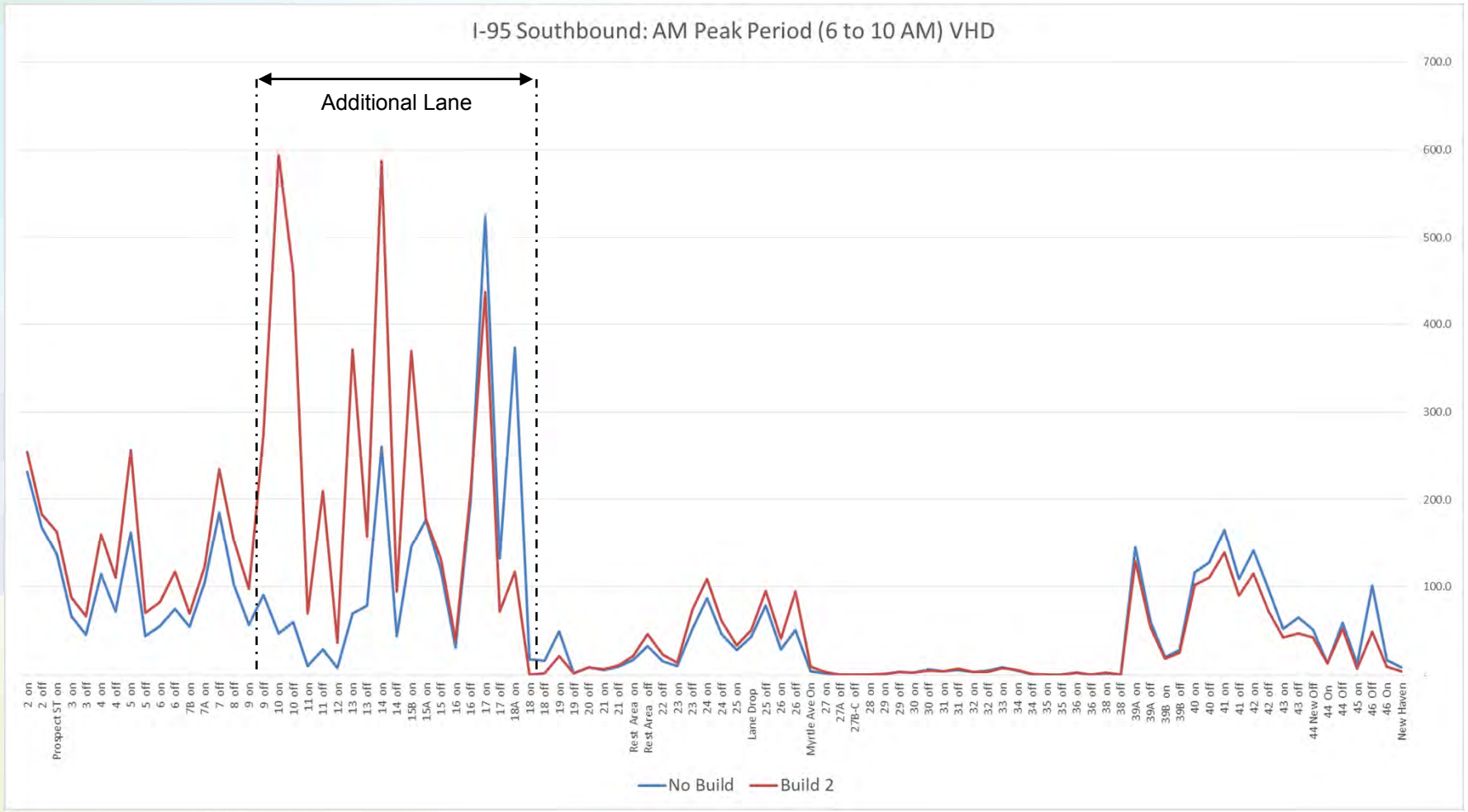
CAMBRIDGE SYSTEMATICS

Build #2: Throughput AM Southbound



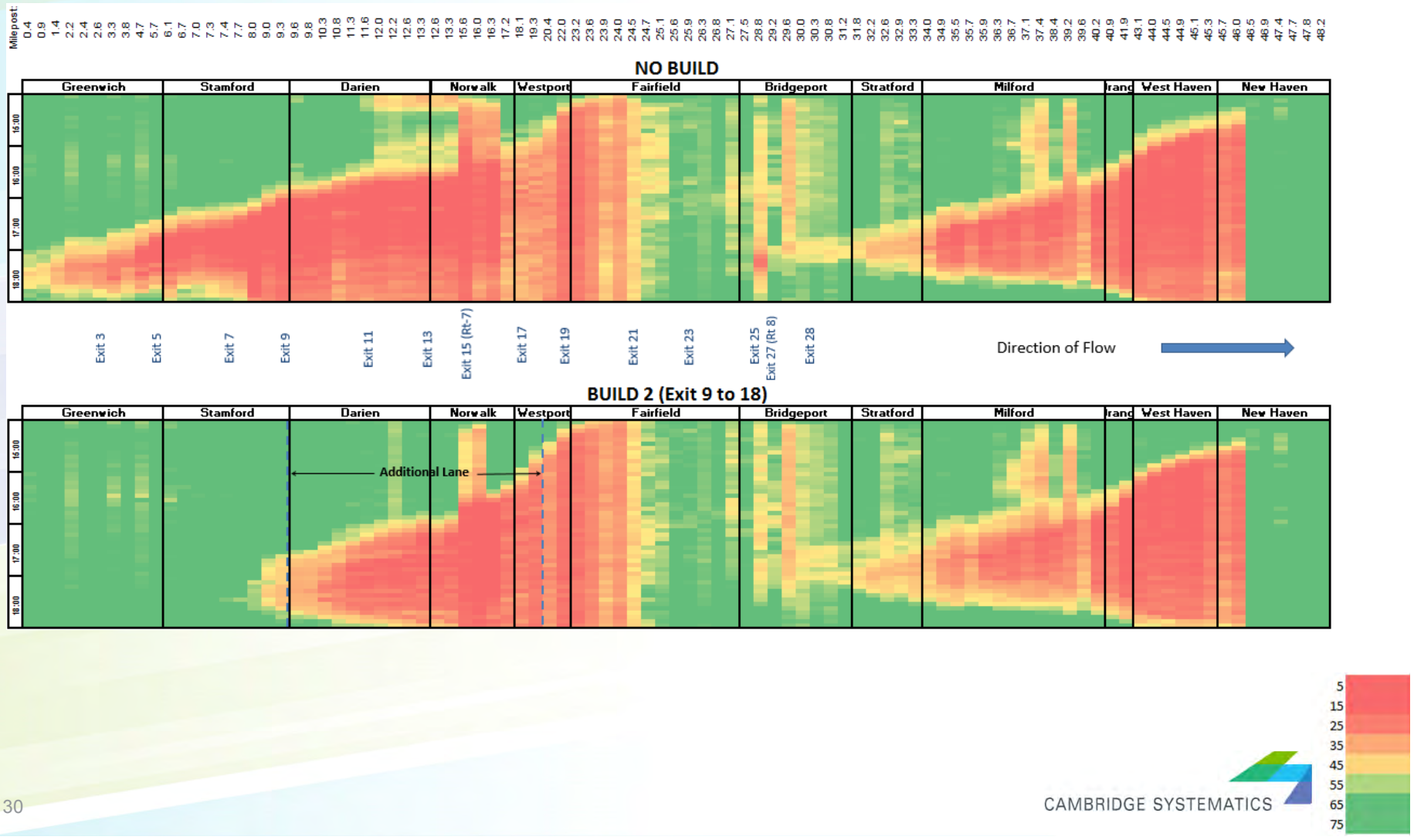
CAMBRIDGE SYSTEMATICS

Build #2: Vehicle Hours of Delay AM Southbound



CAMBRIDGE SYSTEMATICS

Build #2: Speed Contours PM Northbound



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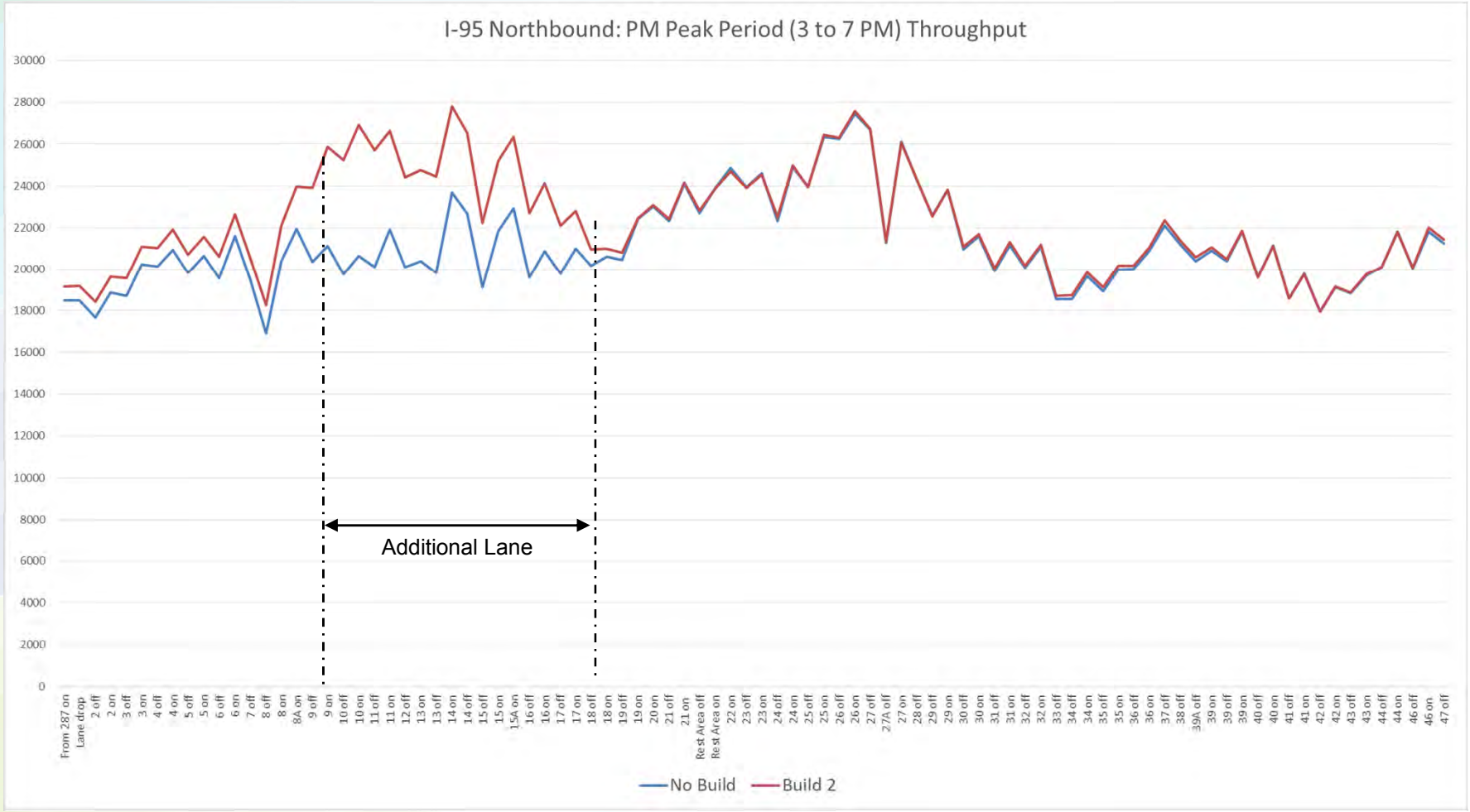
Build #2: Throughput PM Northbound



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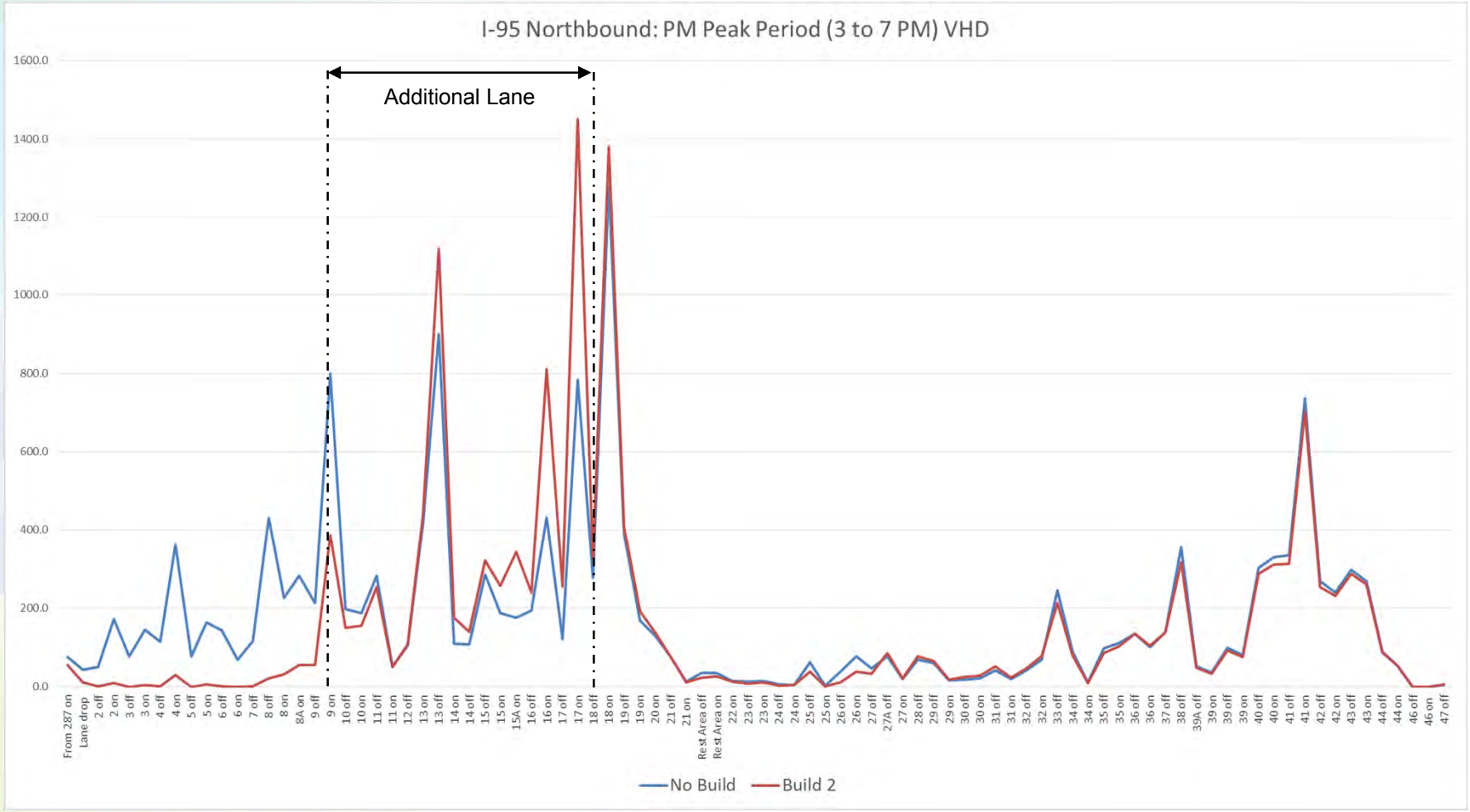
Build #2: Vehicle Hours of Delay PM Northbound



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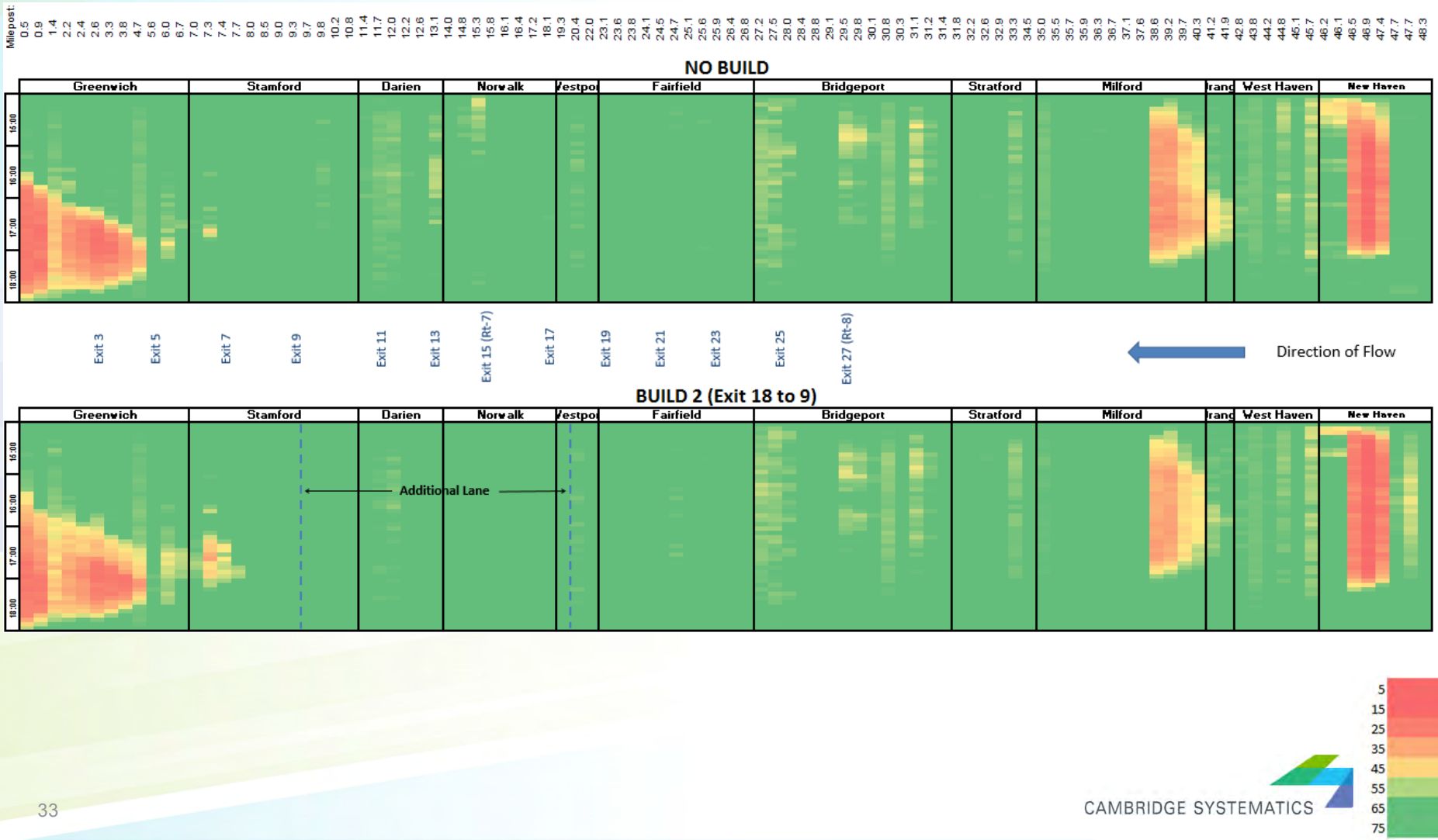
Build #2: Speed Contours PM Southbound



CAMBRIDGE SYSTEMATICS

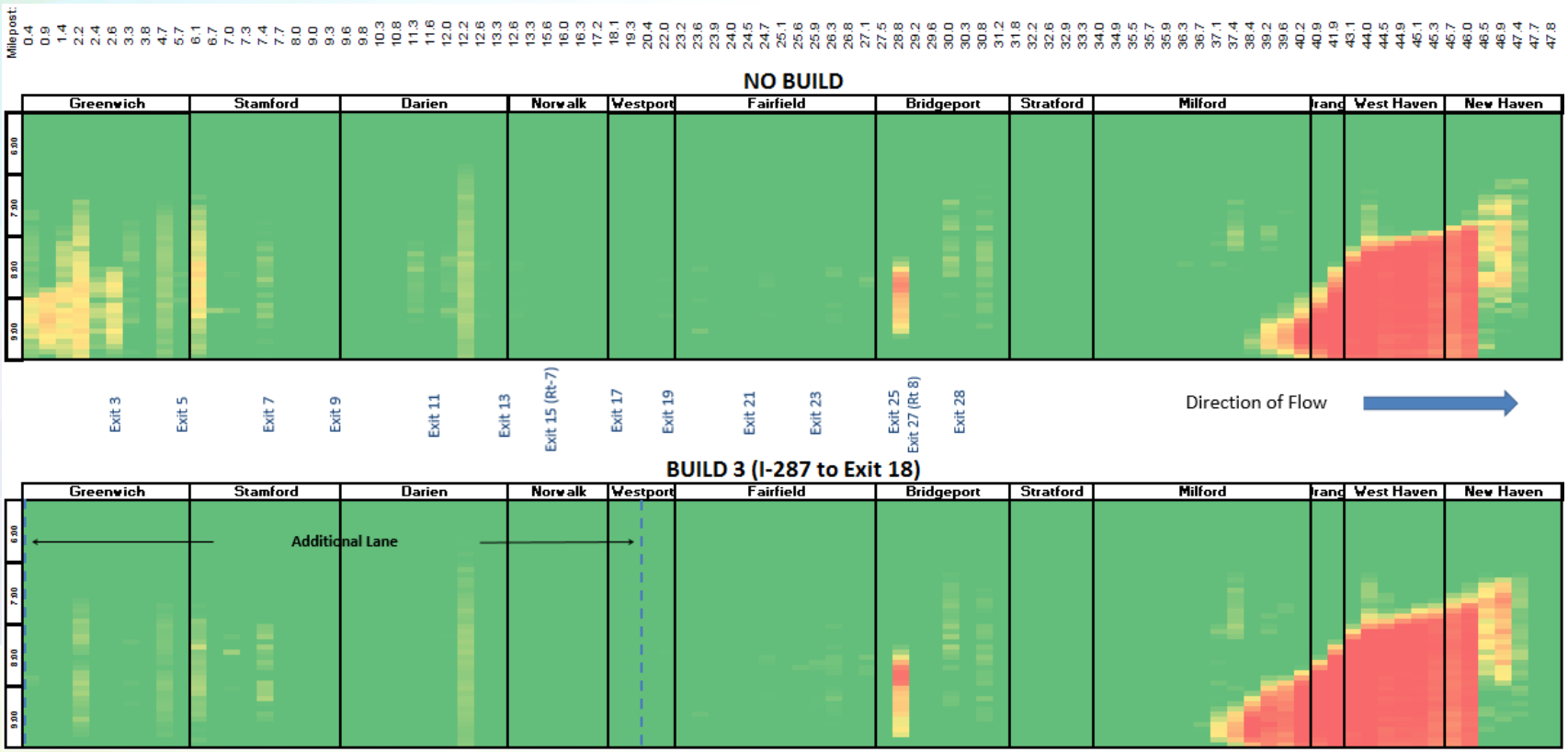
BUILD #3: WIDEN I-287 (PORT CHESTER NY) TO EXIT 18 (WESTPORT)

Build #3: Widen Between I-287 (Port Chester NY) and Exit 18 (Westport)

Note: Background Image Source: Google Maps

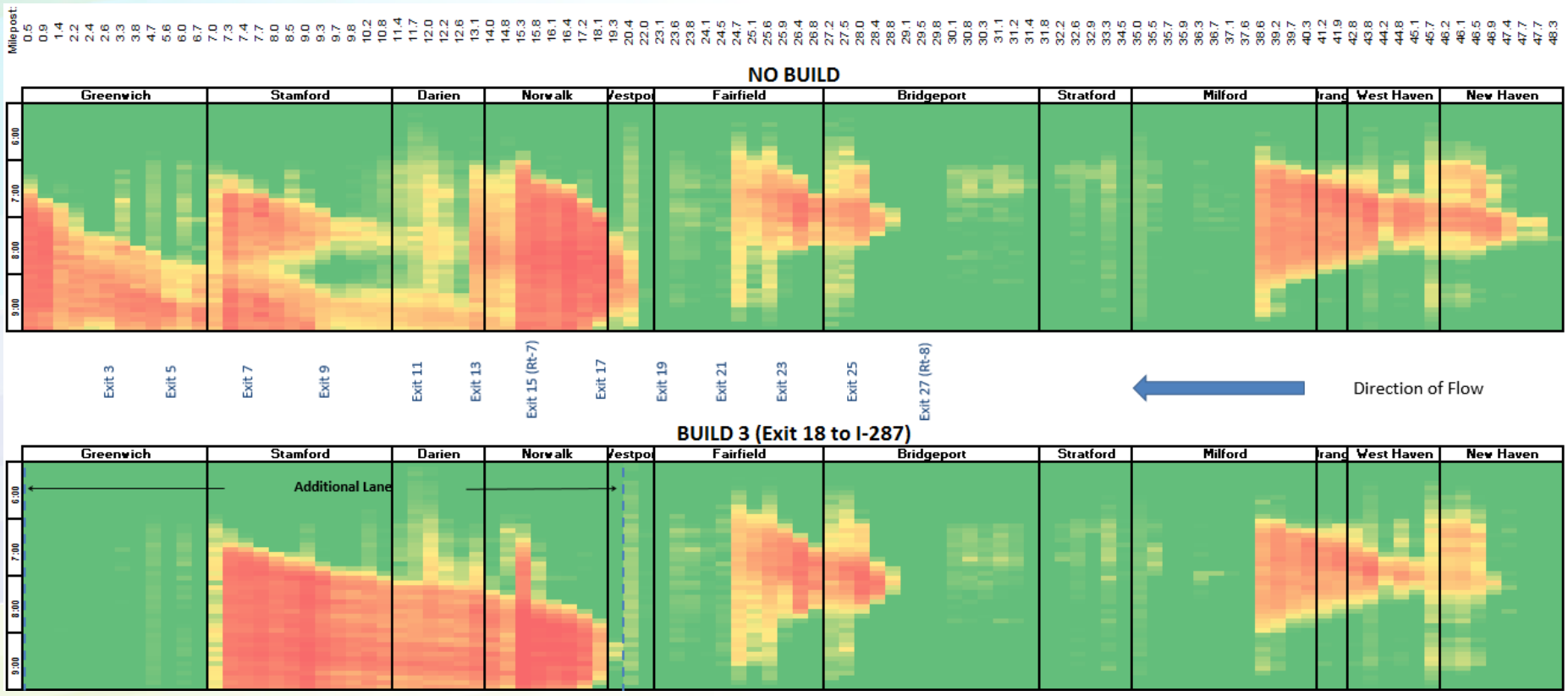
CAMBRIDGE SYSTEMATICS

Build #3: Speed Contours AM Northbound



CAMBRIDGE SYSTEMATICS

Build #3: Speed Contours AM Southbound



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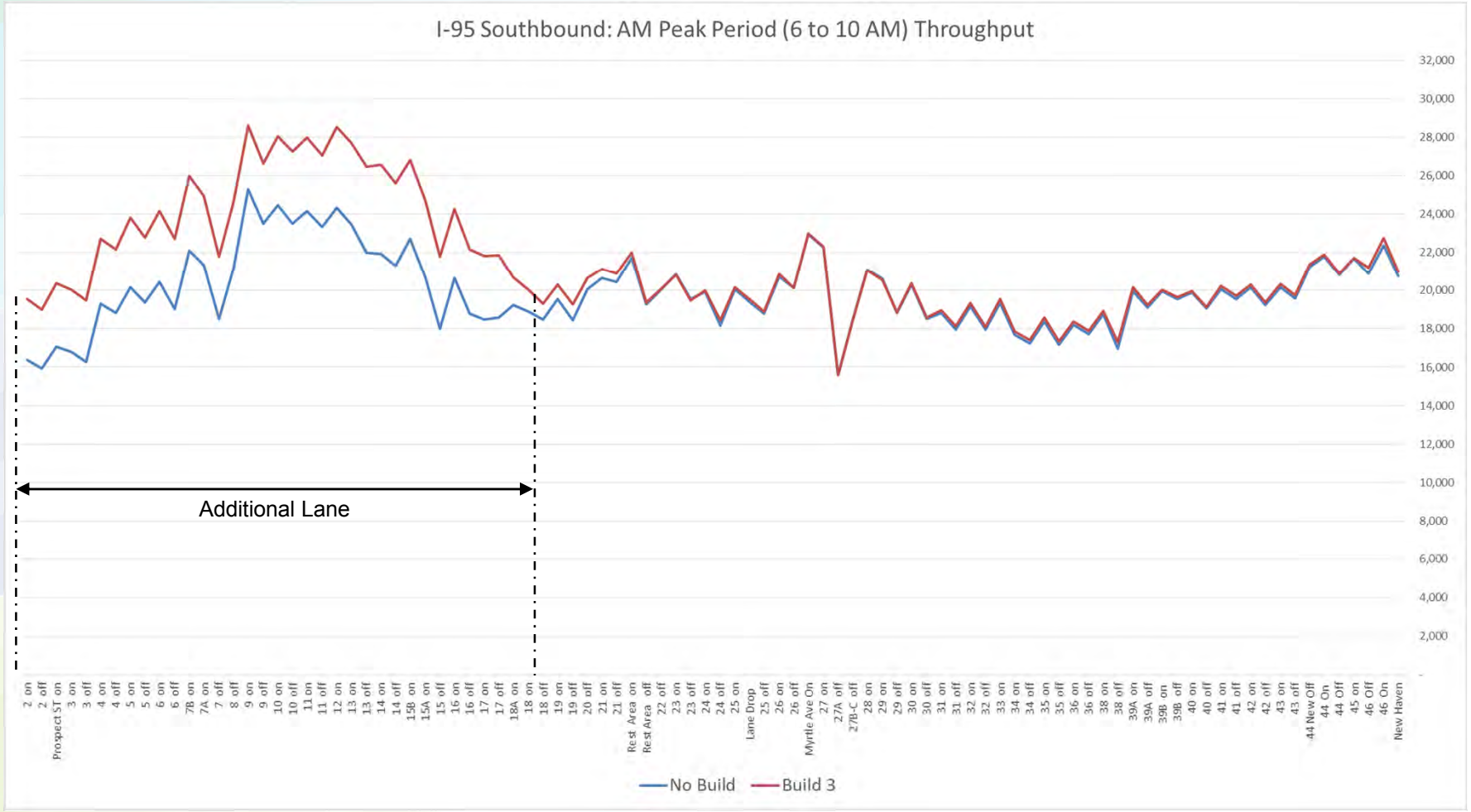
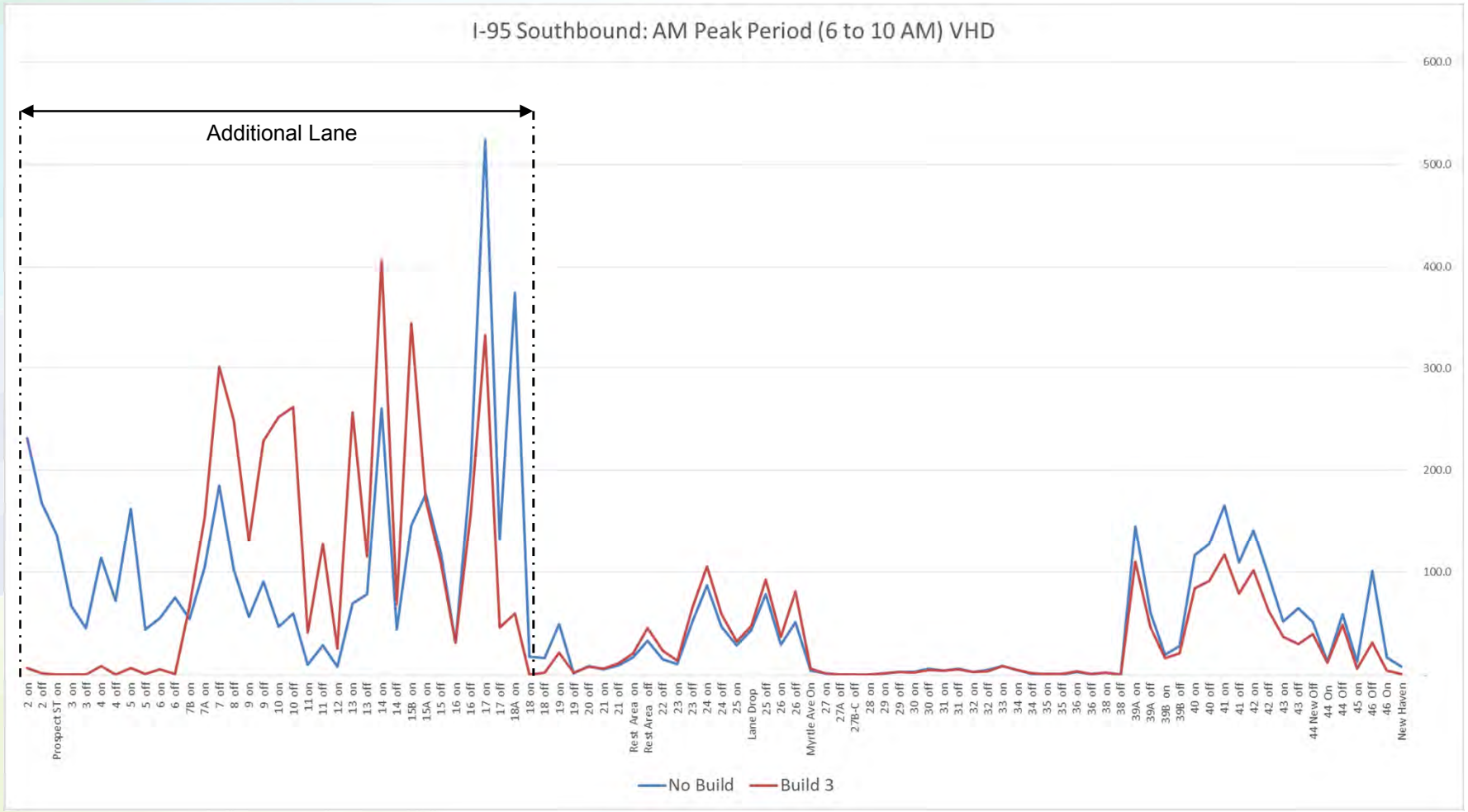
Build #3: Throughput AM Southbound



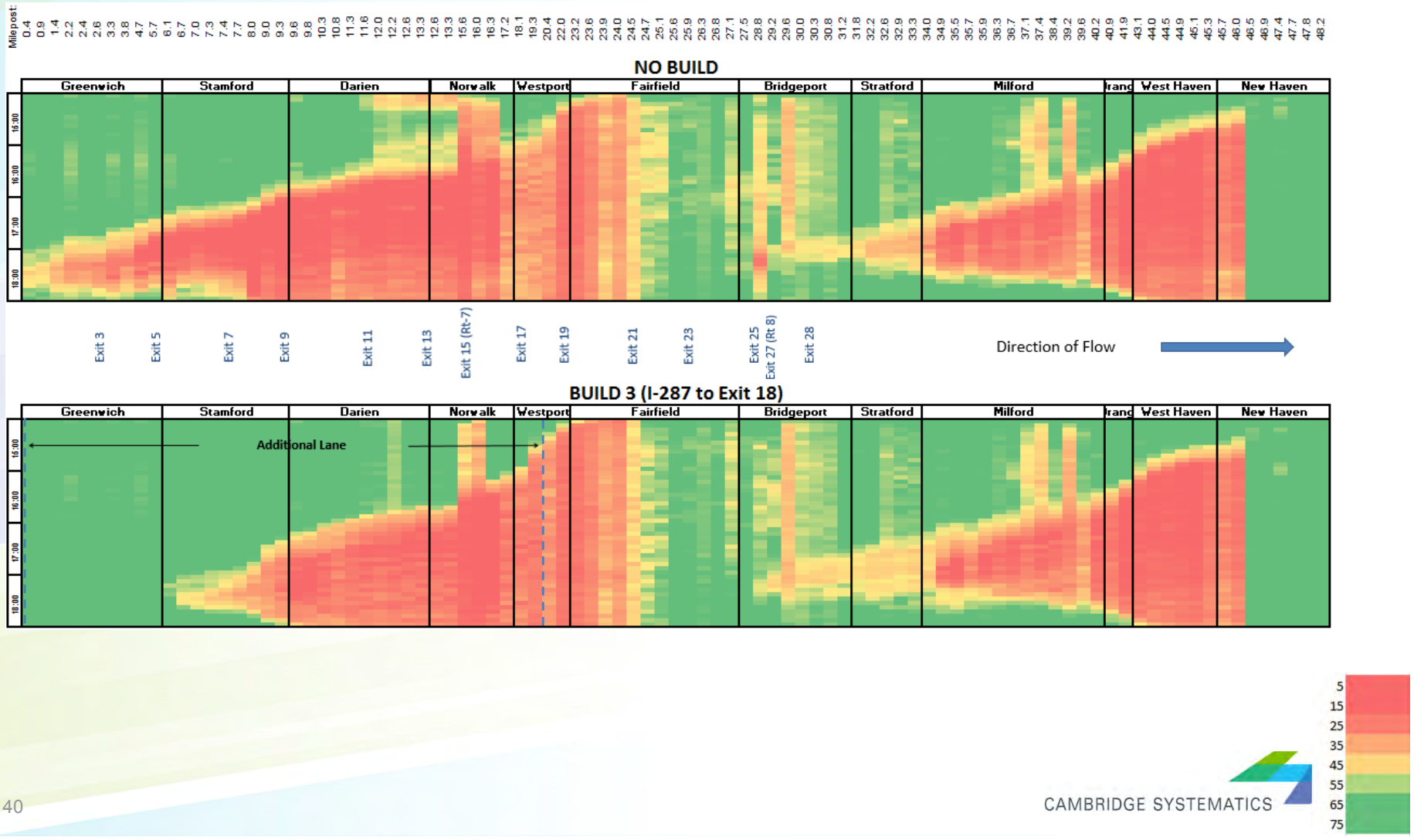
CAMBRIDGE SYSTEMATICS

Build #3: Vehicle Hours of Delay AM Southbound



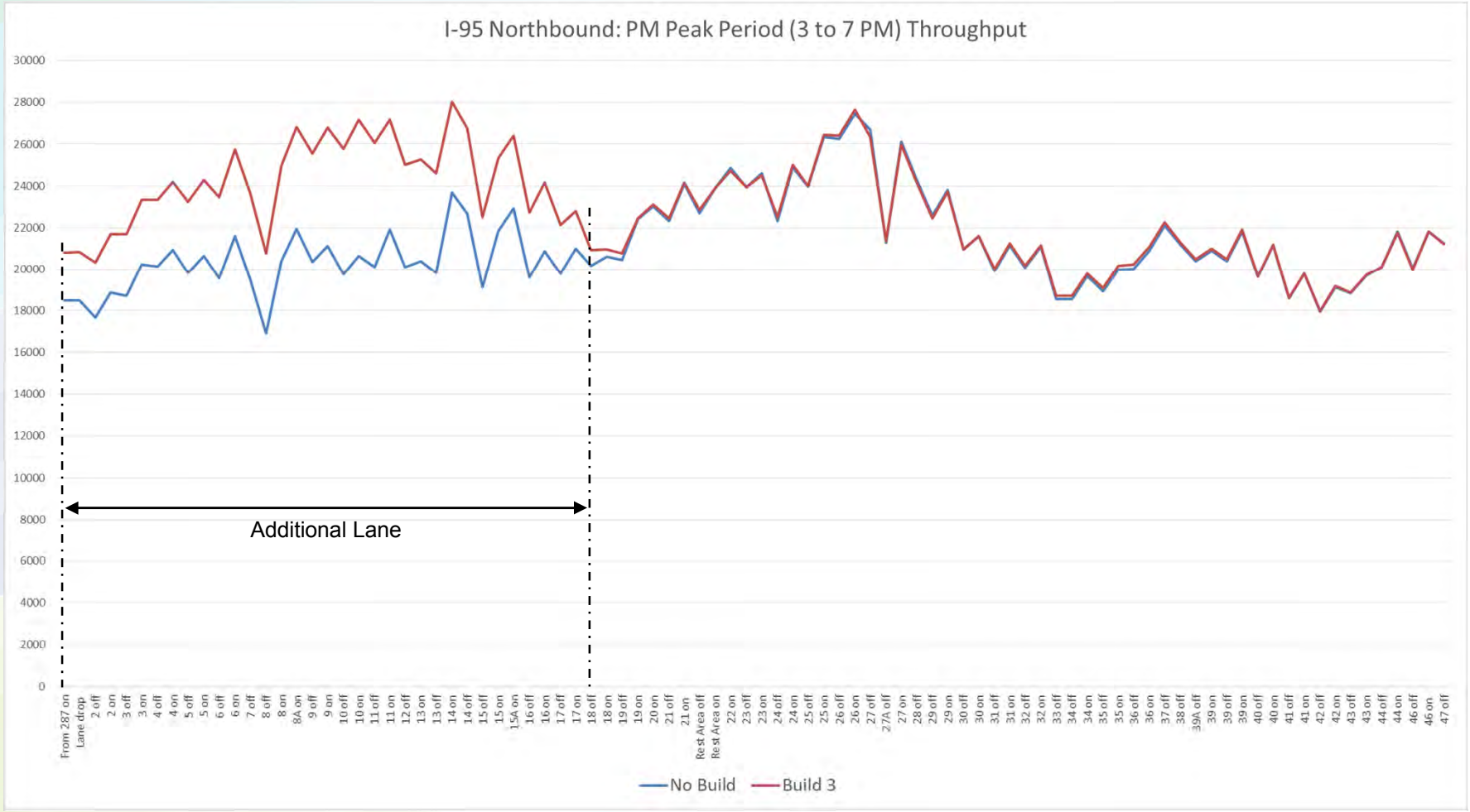
CAMBRIDGE SYSTEMATICS

Build #3: Speed Contours PM Northbound



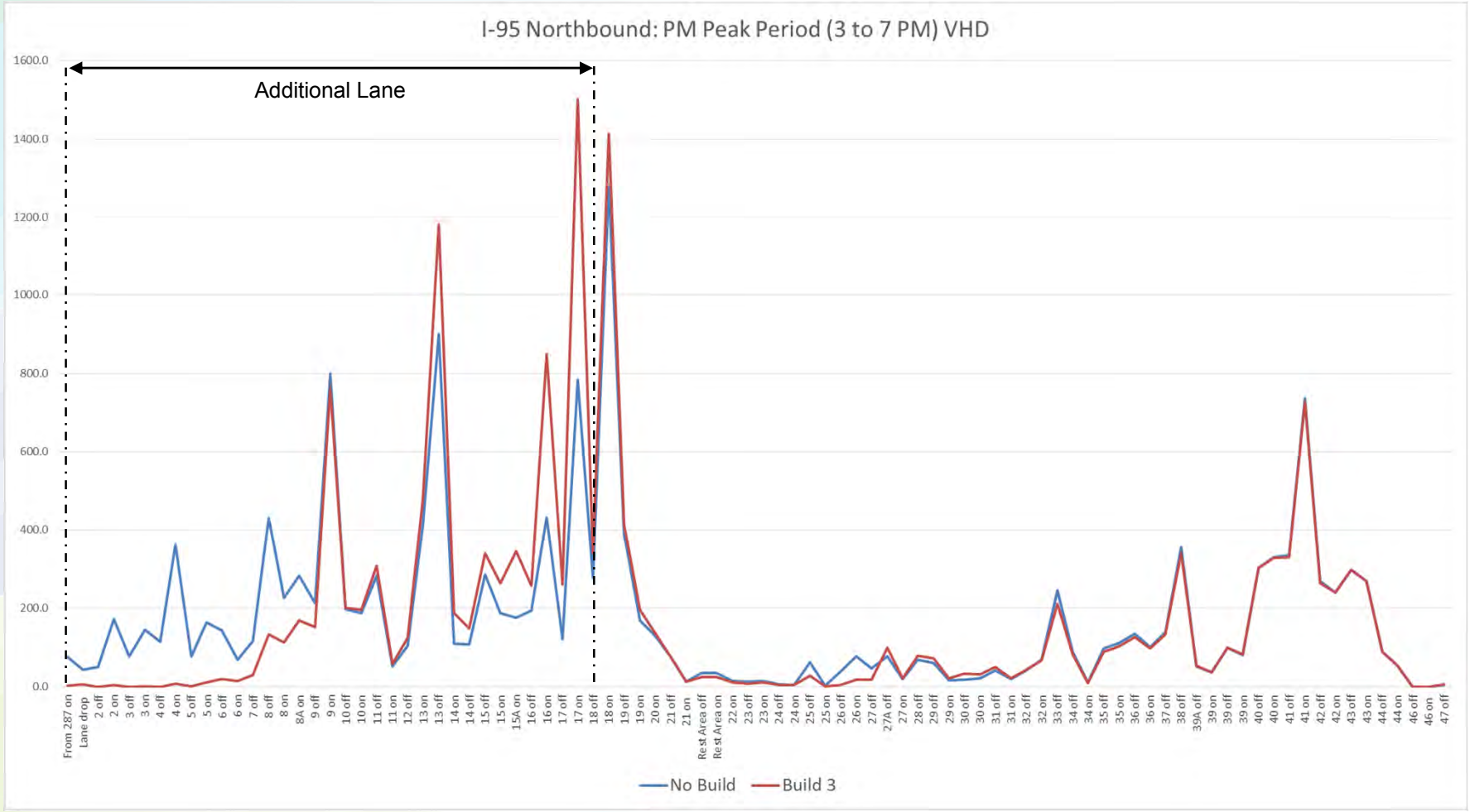
CAMBRIDGE SYSTEMATICS

Build #3: Throughput PM Northbound



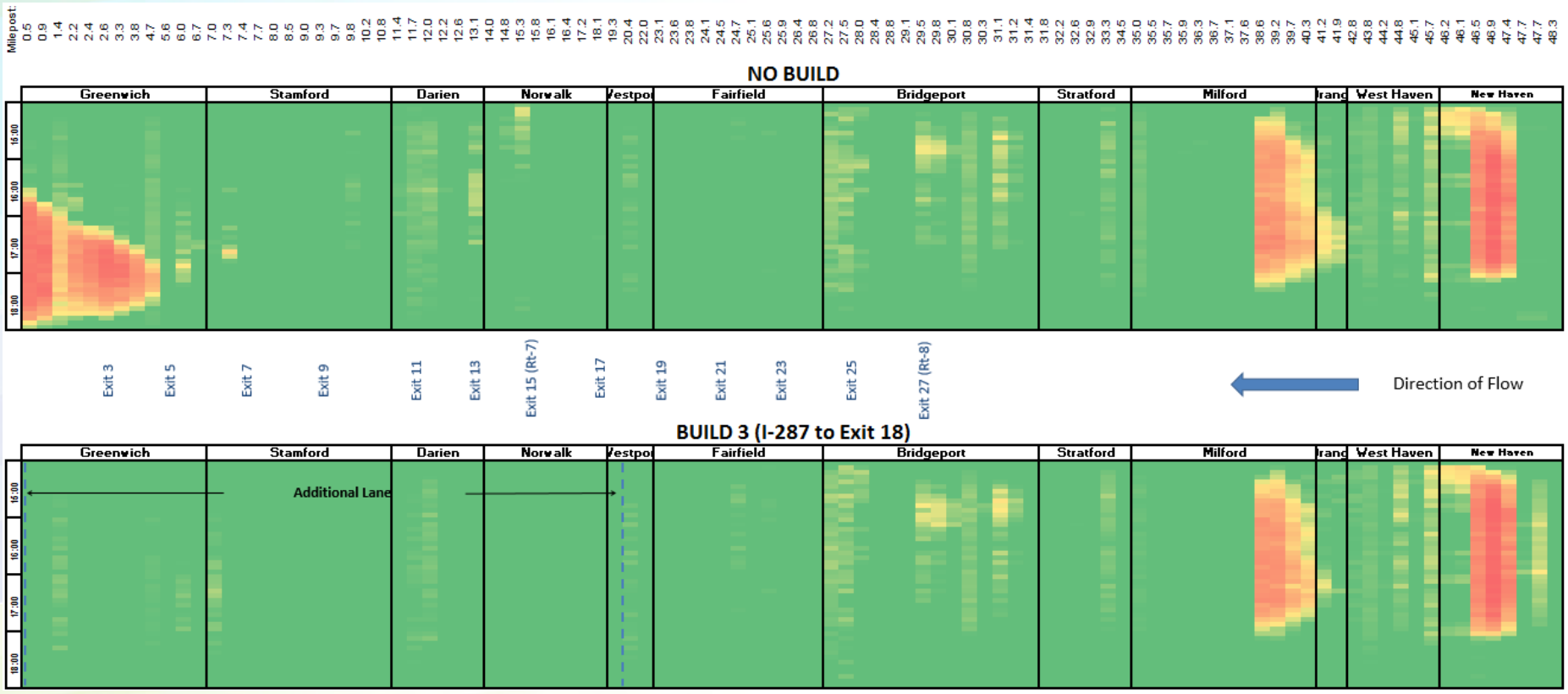
CAMBRIDGE SYSTEMATICS

Build #3: Vehicle Hours of Delay PM Northbound



CAMBRIDGE SYSTEMATICS

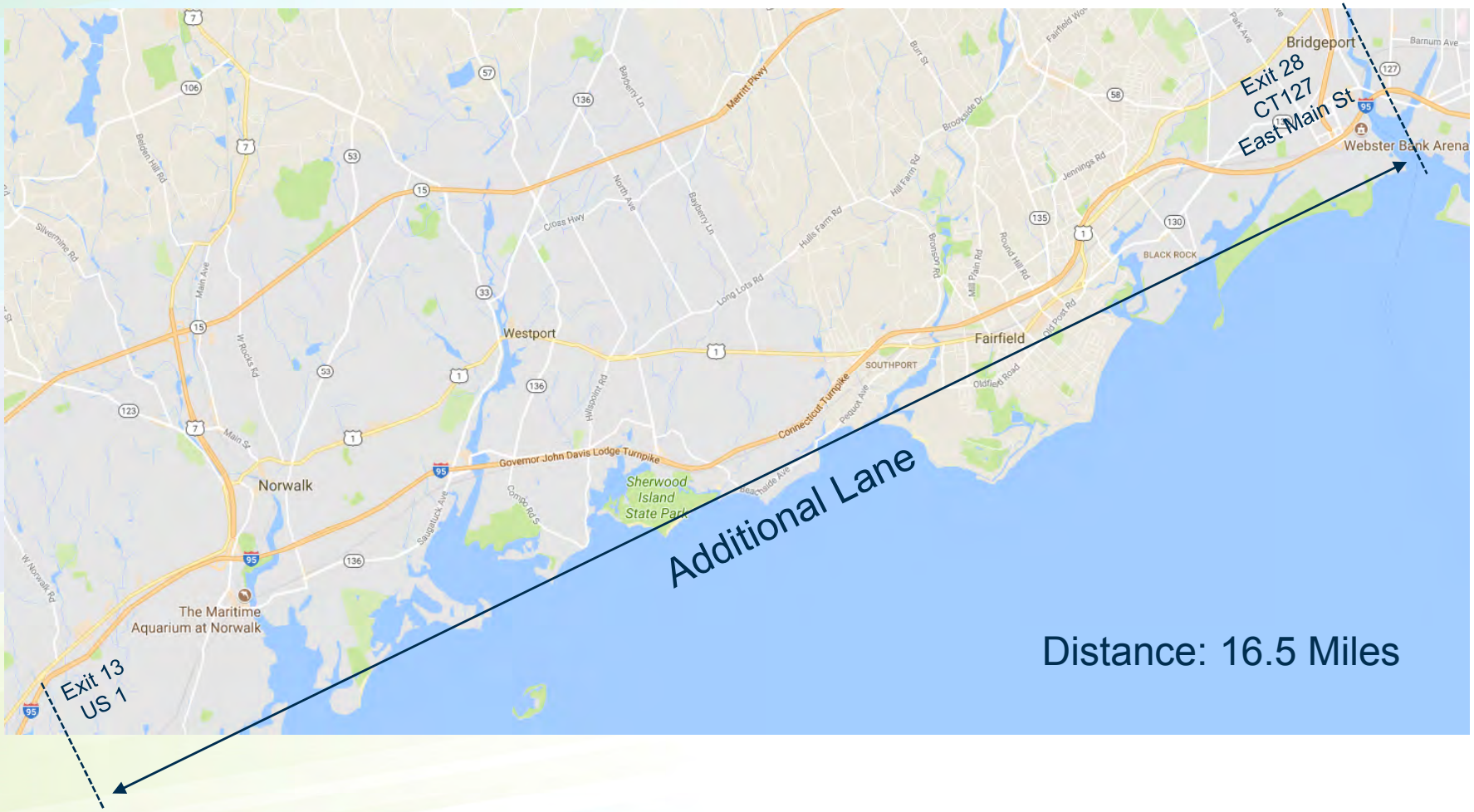
Build #3: Speed Contours PM Southbound



CAMBRIDGE SYSTEMATICS

BUILD #4:
EXIT 13 (DARIEN)
TO EXIT 28 (BRIDGEPORT)

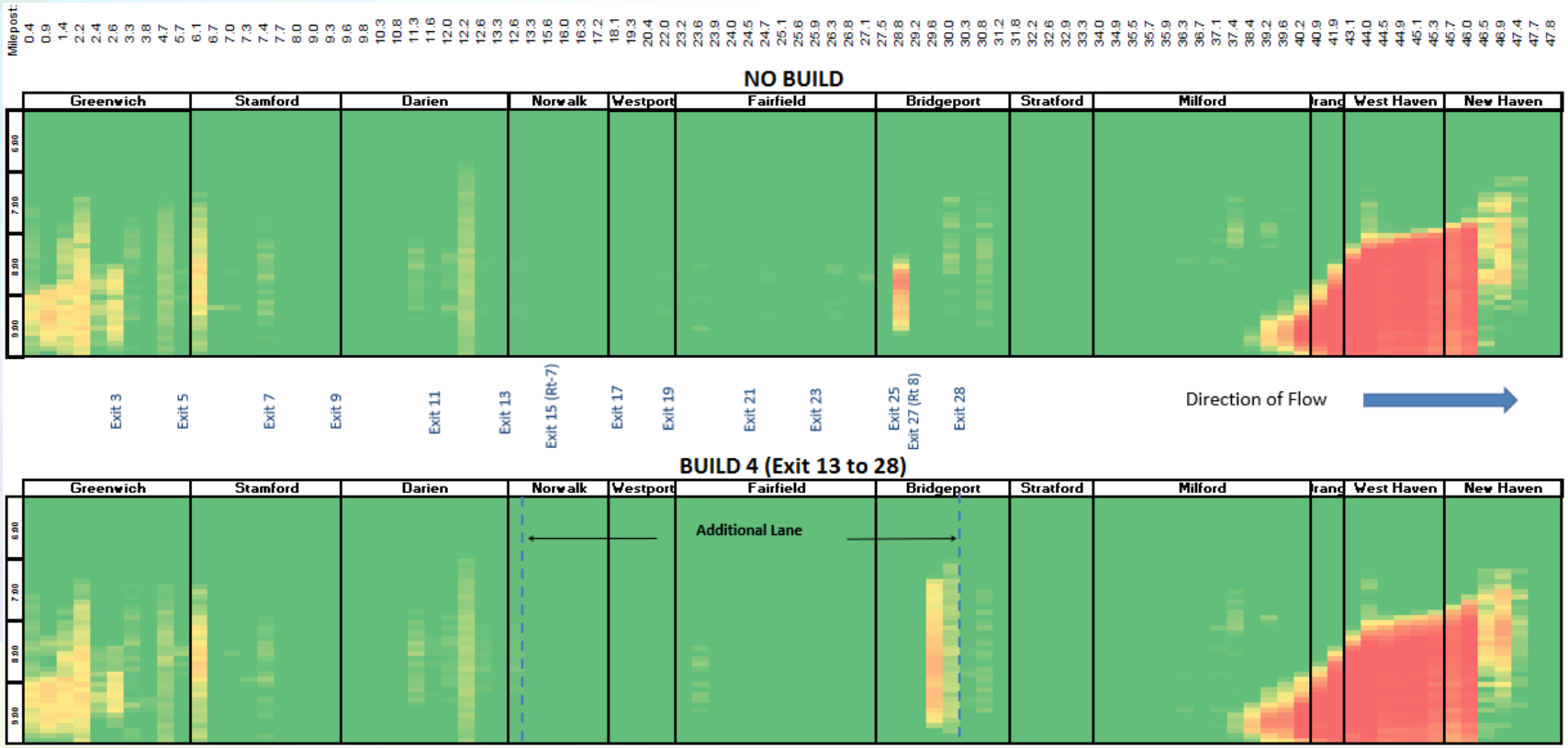
Build #3: Widen Between Exit 13 (Darien) and Exit 28 (Bridgeport)



Note: Background Image Source: Google Maps

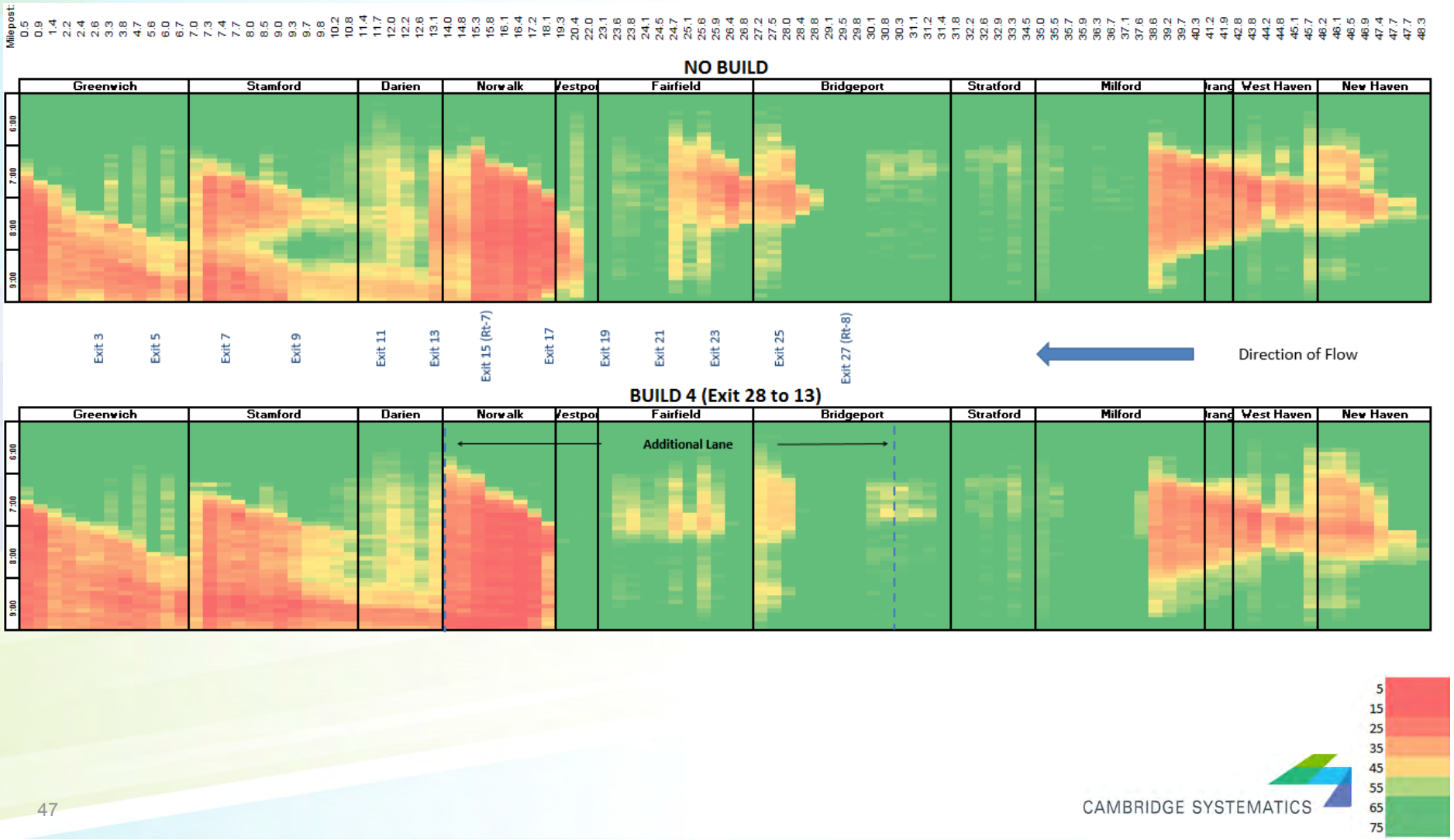
CAMBRIDGE SYSTEMATICS

Build #4: Speed Contours AM Northbound



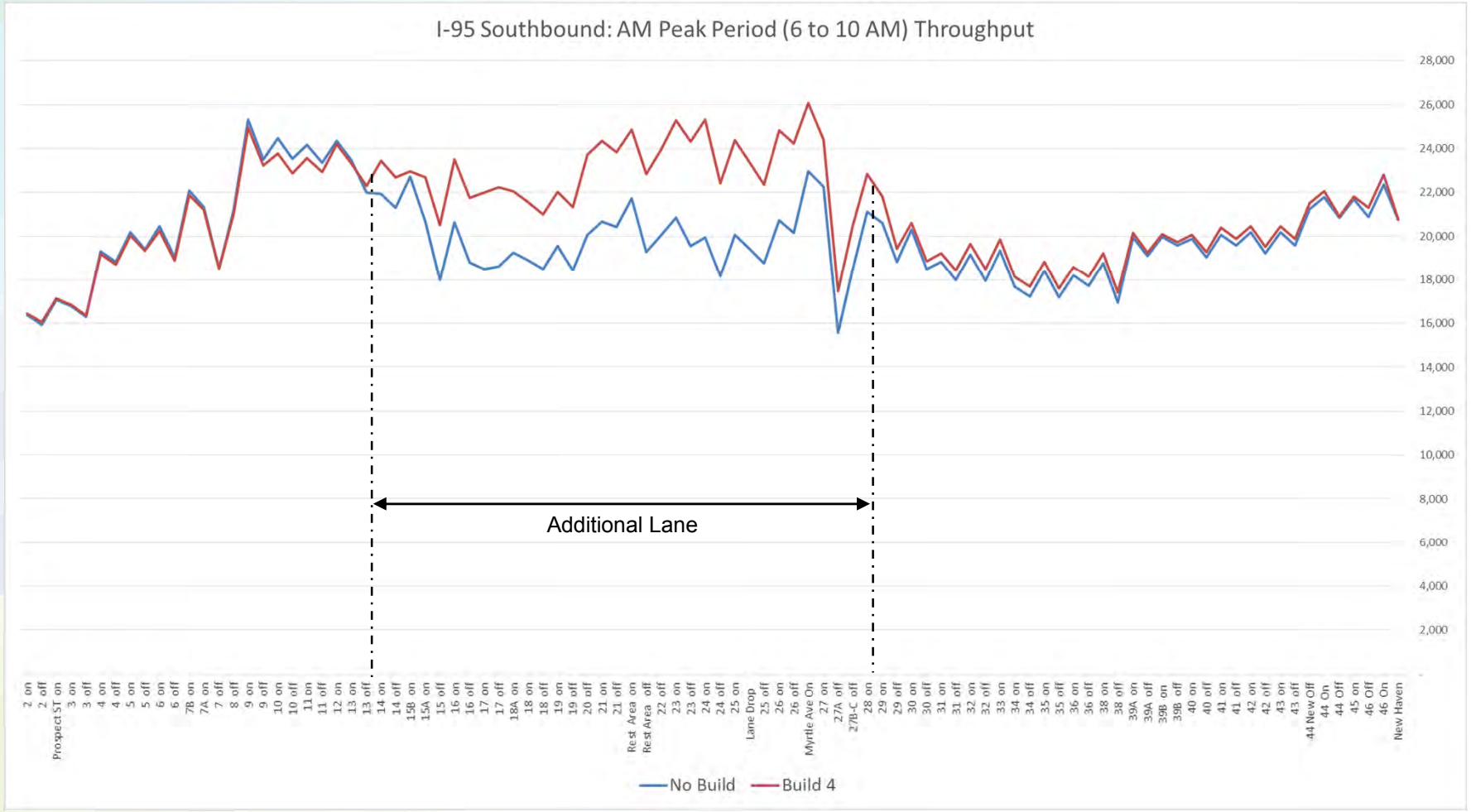
CAMBRIDGE SYSTEMATICS

Build #4: Speed Contours AM Southbound



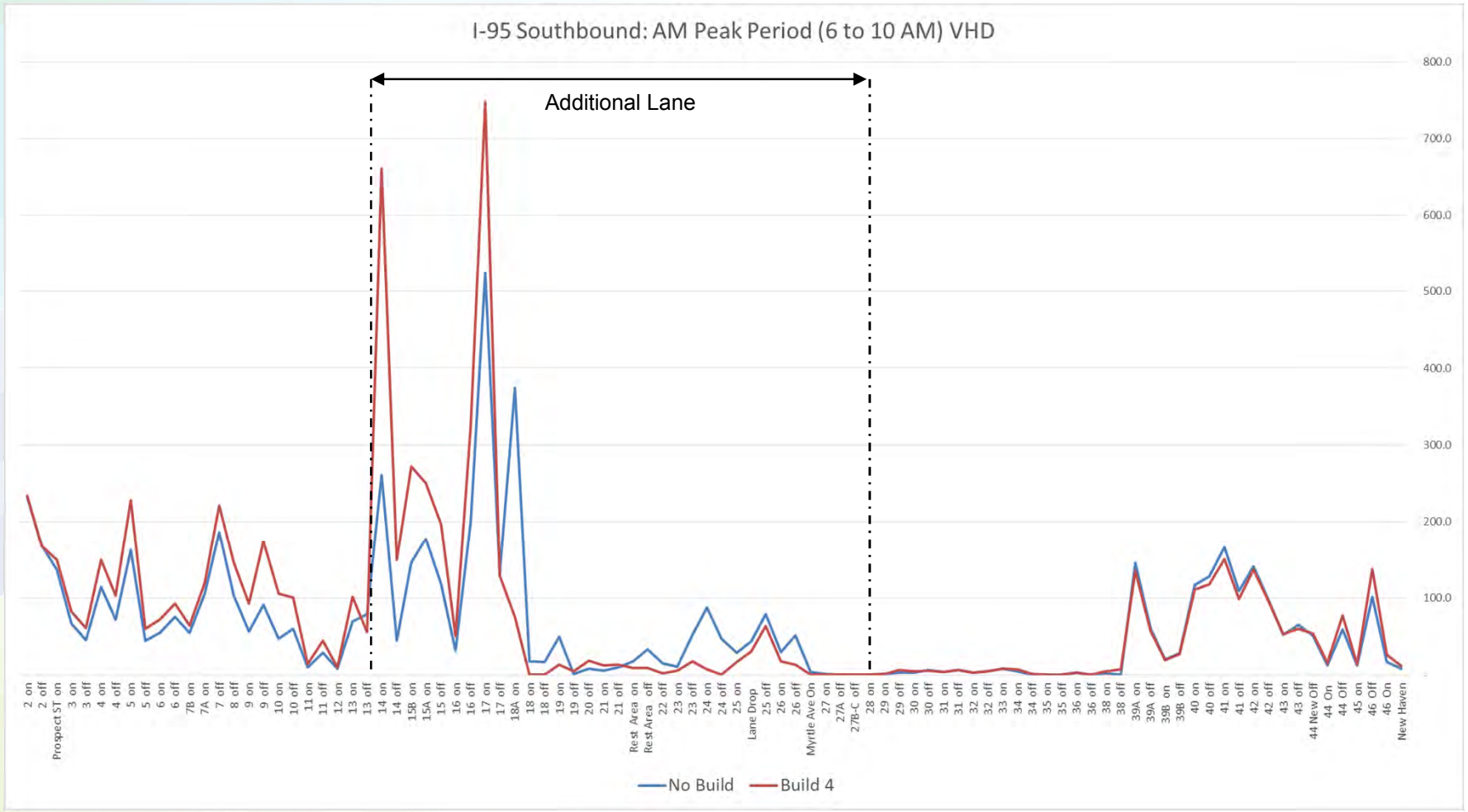
CAMBRIDGE SYSTEMATICS

Build #4: Throughput AM Southbound



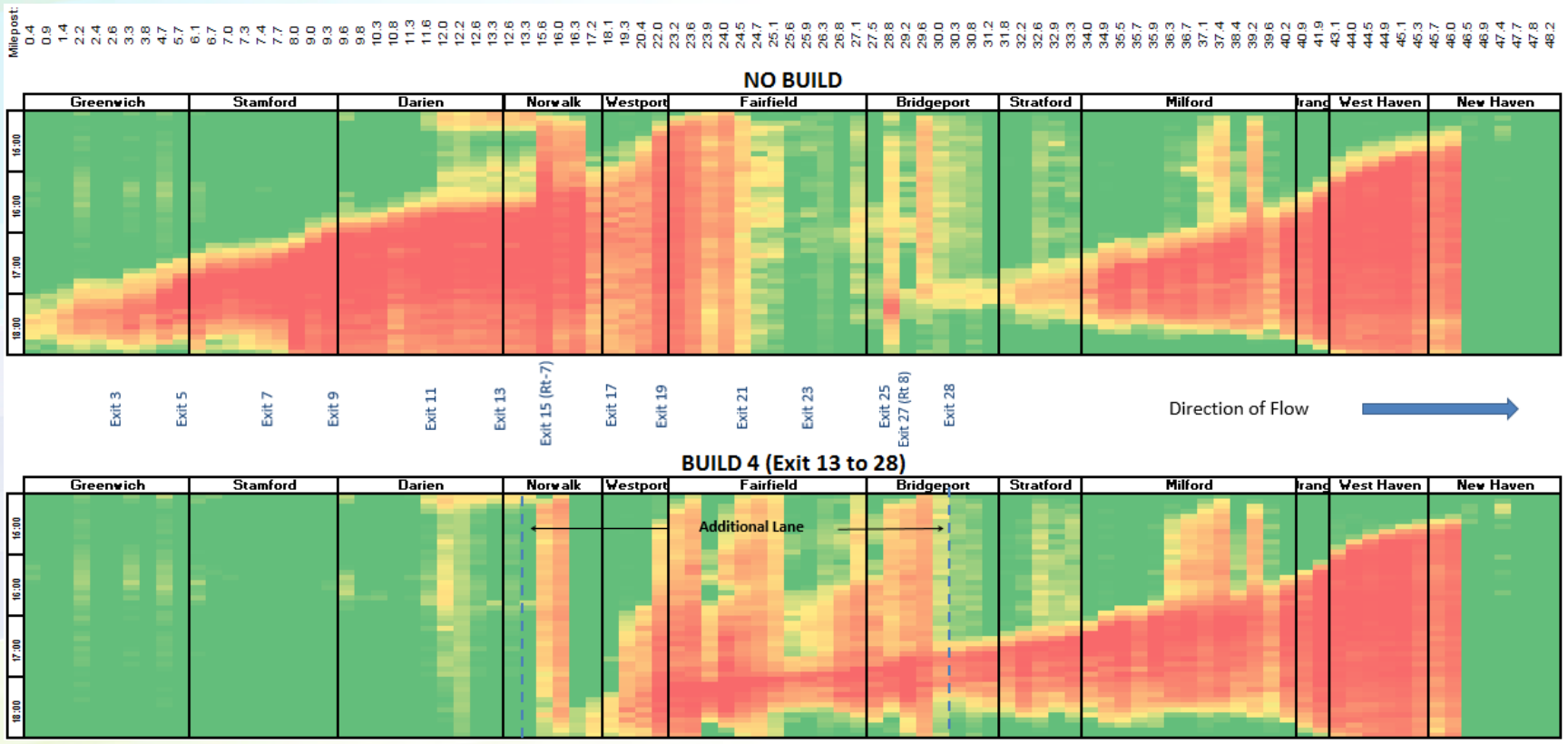
CAMBRIDGE SYSTEMATICS

Build #4: Vehicle Hours of Delay AM Southbound



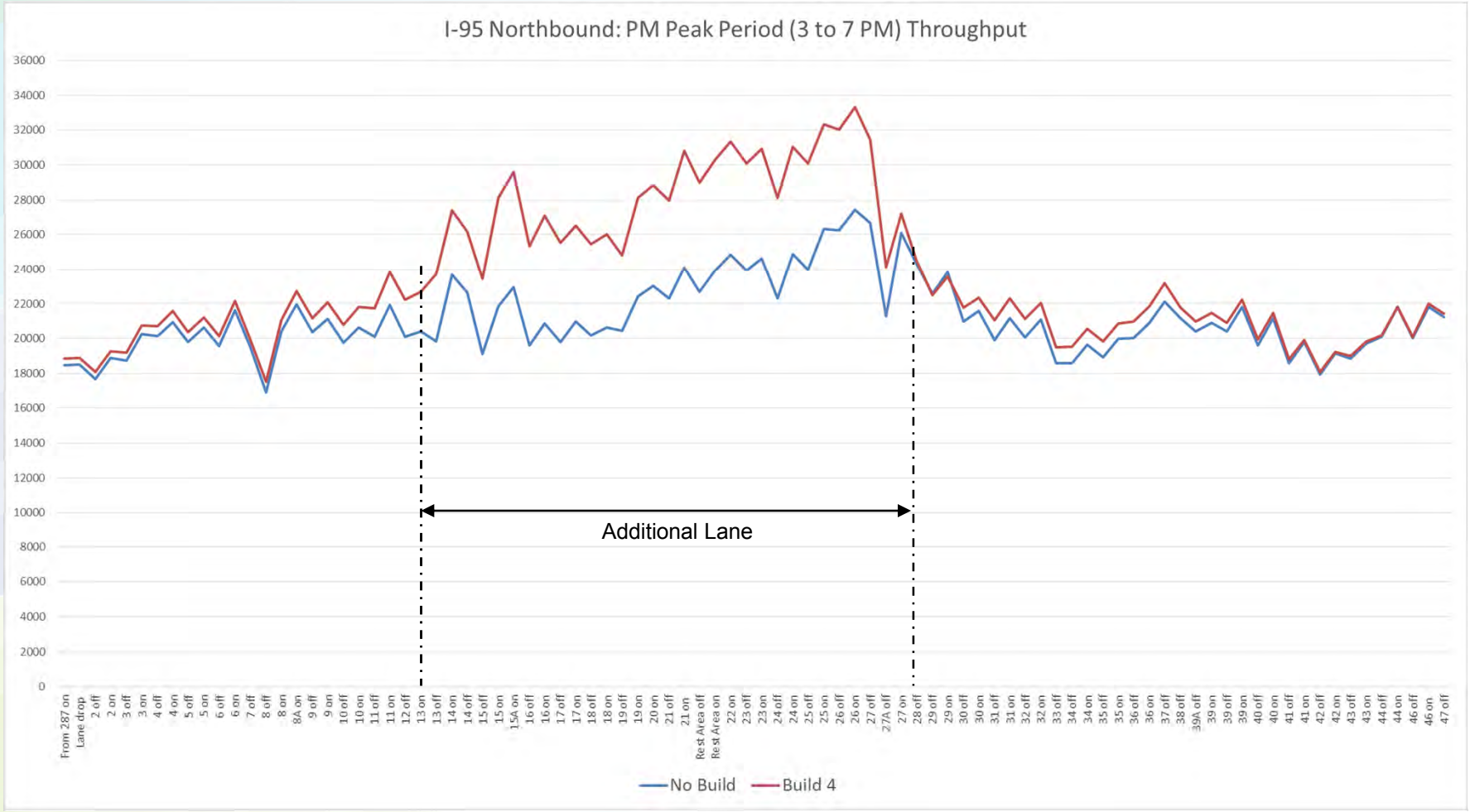
CAMBRIDGE SYSTEMATICS

Build #4: Speed Contours PM Northbound



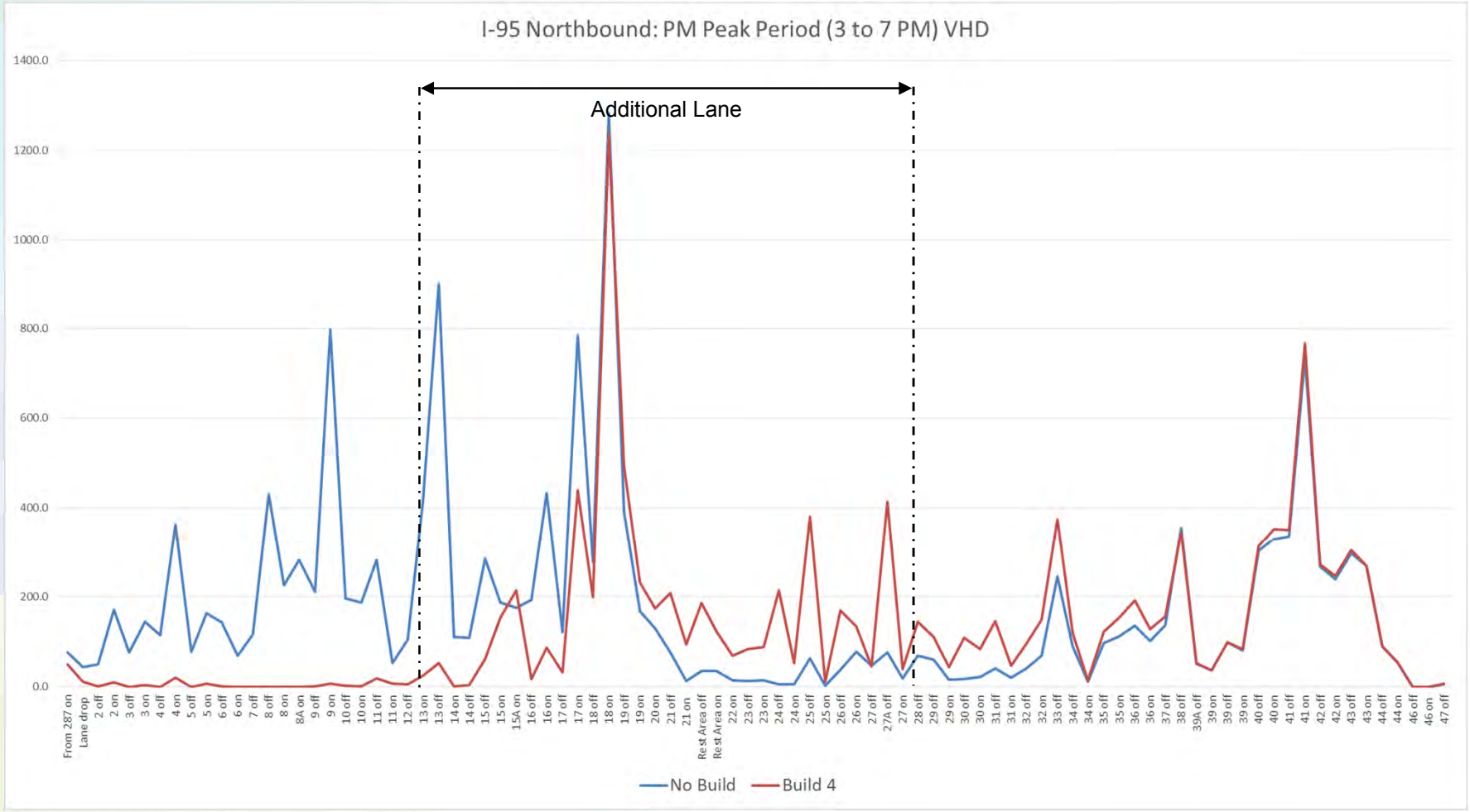
CAMBRIDGE SYSTEMATICS

Build #4: Throughput PM Northbound



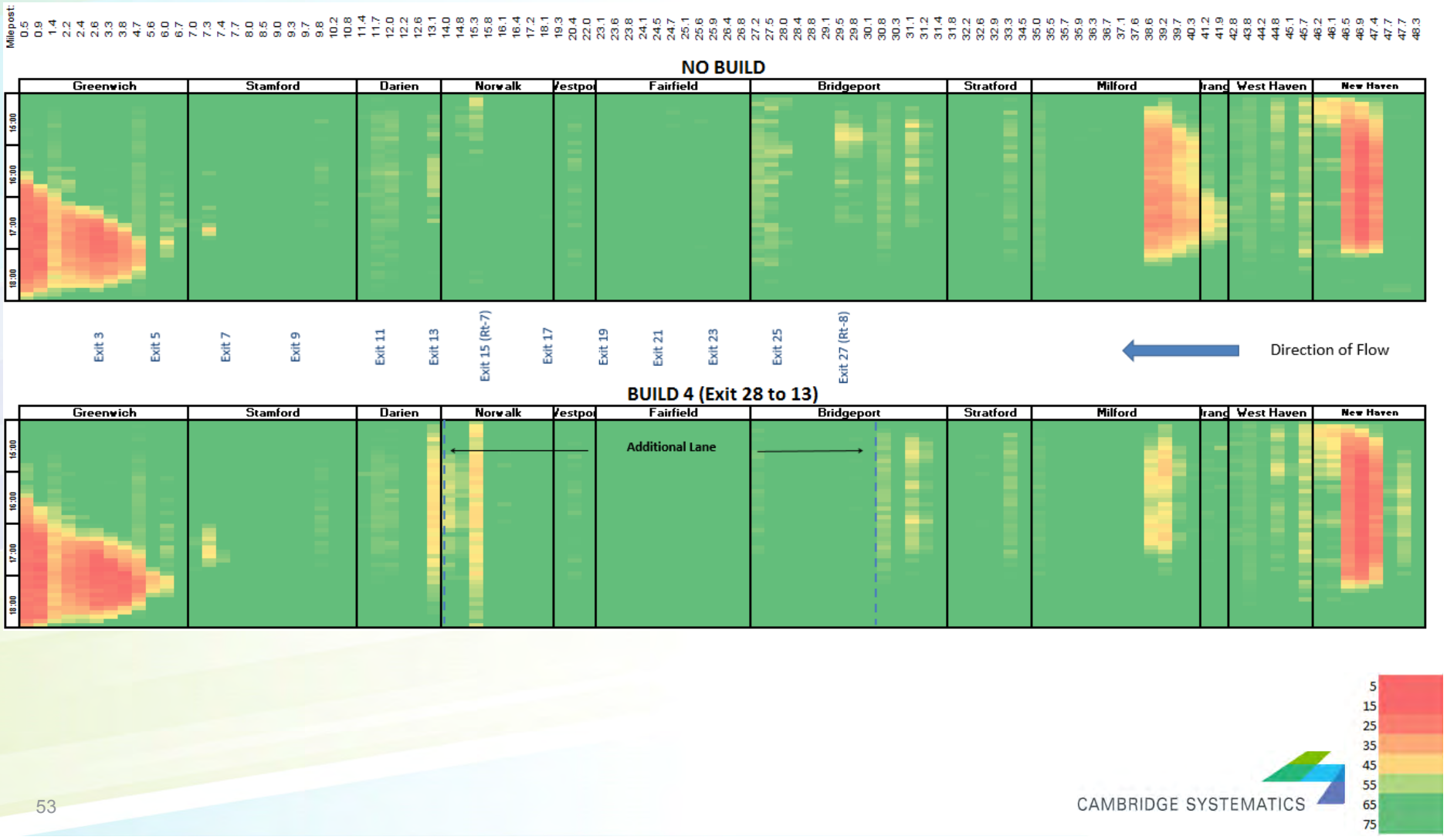
CAMBRIDGE SYSTEMATICS

Build #4: Vehicle Hours of Delay PM Northbound



CAMBRIDGE SYSTEMATICS

Build #4: Speed Contours PM Southbound



CAMBRIDGE SYSTEMATICS

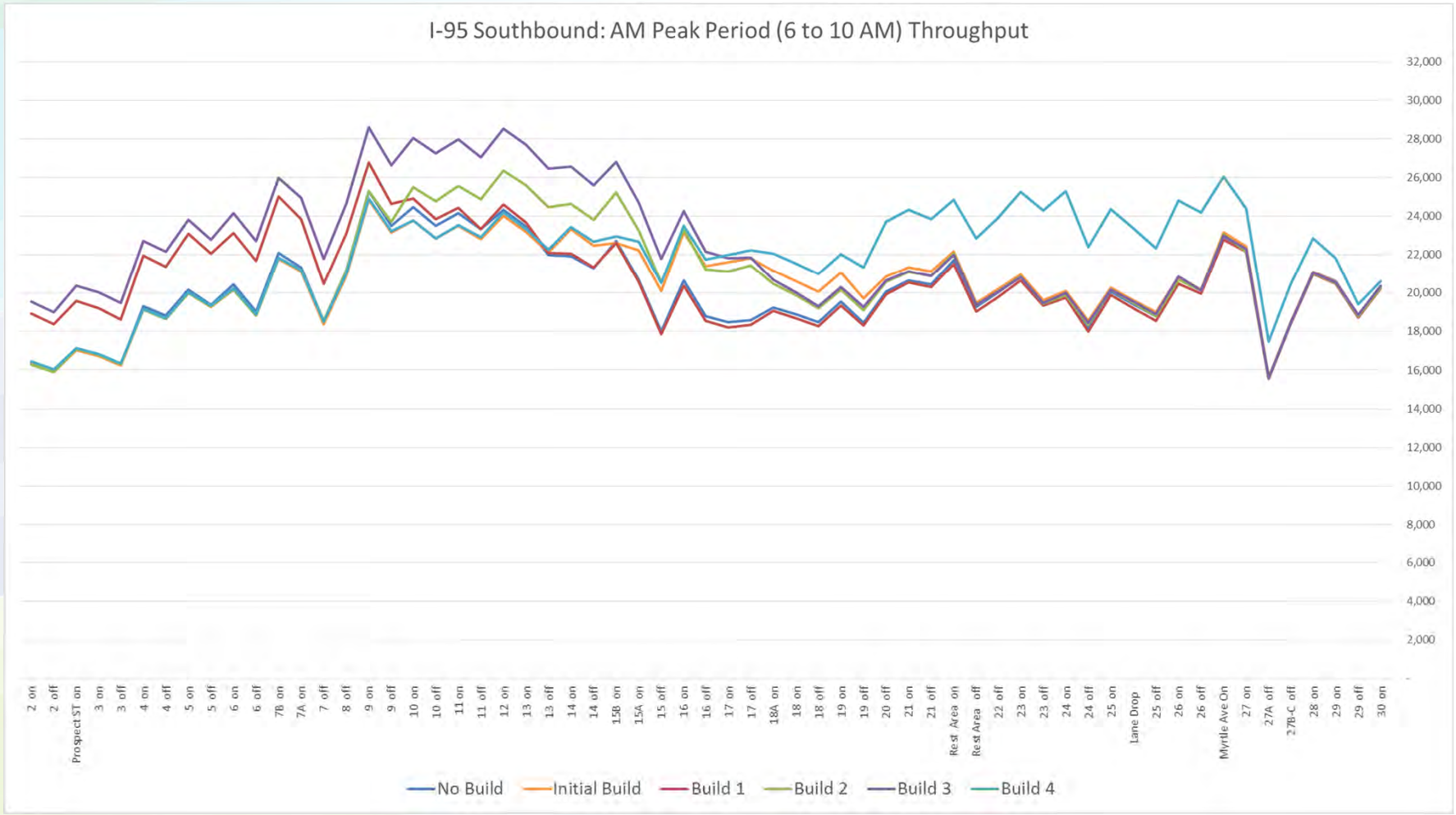
SUMMARY

AM Peak Period Metrics: SB from Bridgeport (Exit 30) to I-287

	SOUTHBOUND AM PEAK PERIOD (6-10 AM)					
	No Build	**Initial Build**	**Build 1**	**Build 2**	**Build 3**	**Build 4**
Widened Distance (mi)	0.0	9.5	9.6	10.7	20.7	16.5
VMT	625,178	642,390	647,814	648,613	699,175	672,892
(veh-miles)		+3%	+4%	+4%	+12%	+8%
VHT	14,994	16,343	13,669	18,060	16,140	16,855
(veh-hours)		+9%	-9%	+20%	+8%	+12%
VHD	4,683	5,785	3,035	7,373	4,654	5,761
(veh-hours)		+24%	-35%	+57%	-1%	+23%
Travel Time	45.4	47.8	40.1	51.4	42.3	47.4
(min / veh)		+5%	-12%	+13%	-7%	+4%
2017 Construction Costs	--	$292M	$447M	$498M	$958M	$764M

CAMBRIDGE SYSTEMATICS

AM Peak Throughput Compared: SB from Bridgeport (Exit 30) to I-287



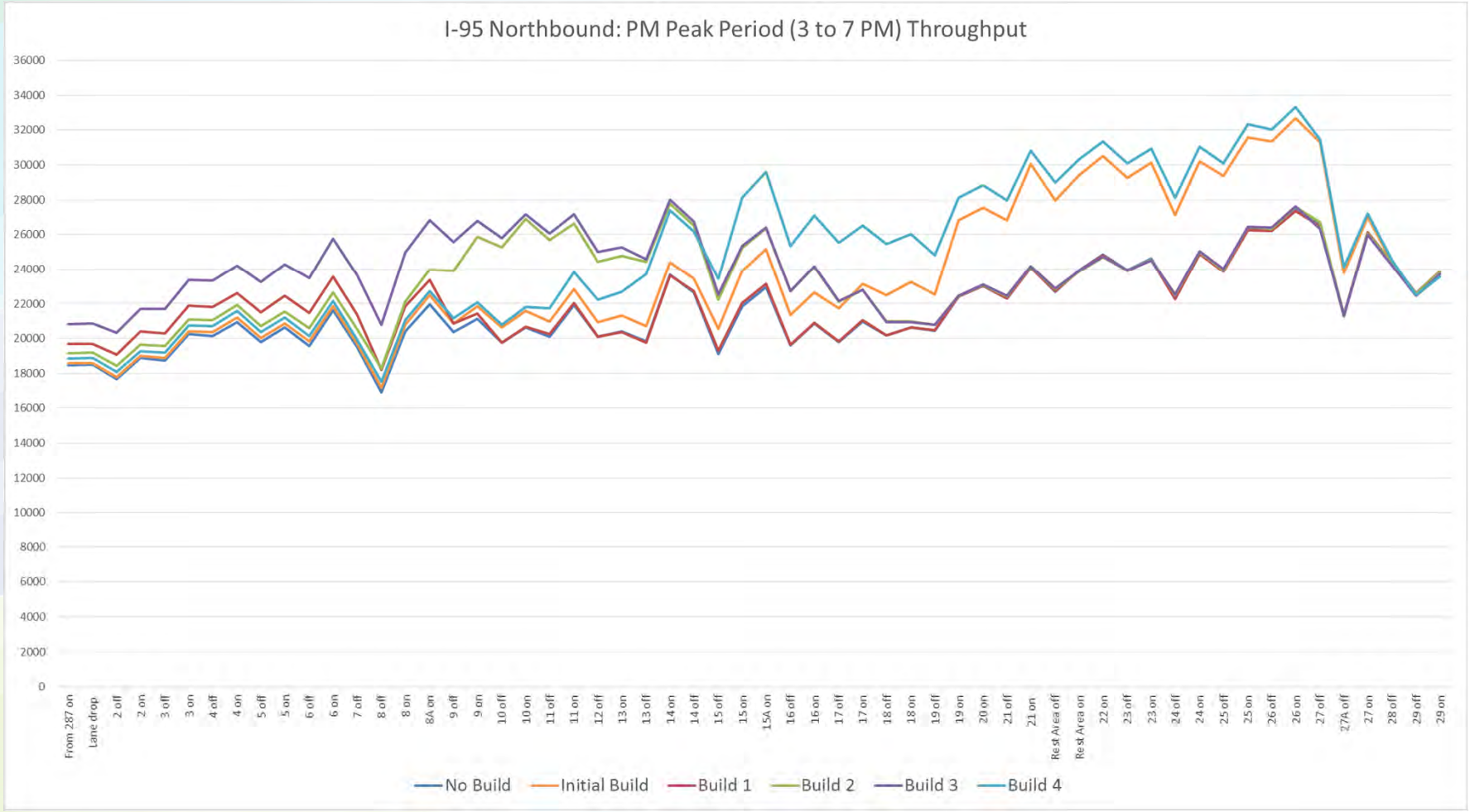
CAMBRIDGE SYSTEMATICS

PM Peak Period Metrics: NB from I-287 to Bridgeport (Exit 30)

	NORTHBOUND PM PEAK PERIOD (3-7 PM)					
	No Build	**Initial Build**	**Build 1**	**Build 2**	**Build 3**	**Build 4**
Widened Distance (mi)	0.0	6.3	9.7	10.8	20.7	16.5
VMT	657,844	712,744	673,606	711,289	736,974	757,467
(veh-miles)		+8%	+2%	+8%	+12%	+15%
VHT	21,890	15,696	22,625	21,675	23,308	18,653
(veh-hours)		-28%	+3%	-1%	+6%	-15%
VHD	11,010	3,977	11,493	9,944	11,159	6,174
(veh-hours)		-64%	+4%	-10%	+1%	-44%
Travel Time	63.2	41.1	63.8	56.6	59.4	44.8
(min / veh)		-35%	+1%	-10%	-6%	-29%
2017 Construction Costs	--	$440M	$447M	$498M	$958M	$764M

CAMBRIDGE SYSTEMATICS

PM Peak Throughput Compared: NB from I-287 to Bridgeport (Exit 30)



CAMBRIDGE SYSTEMATICS

QUESTIONS?

CAMBRIDGE SYSTEMATICS

I-95 West
Future Alternative Scenarios Micro-Simulation Model

presented to

Connecticut Department of Transportation

presented by

Keir Opie, Cambridge Systematics

CAMBRIDGE SYSTEMATICS

Think Forward

2017/10/20

Additional Alternatives Simulated

- Revised No Build: Updated I-95/I-91 interchange and West River Bridge area per as-built conditions and latest drawings
- Spot Improvement A: Add SB Aux lane from Exit 7 to Exit 6
- Spot Improvement B: Widen Exit 27A NB off ramp to two lane exit
- Assumptions:
  - Forecasts of additional demand completed by CDM Smith
  - All changes added to original No Build conditions

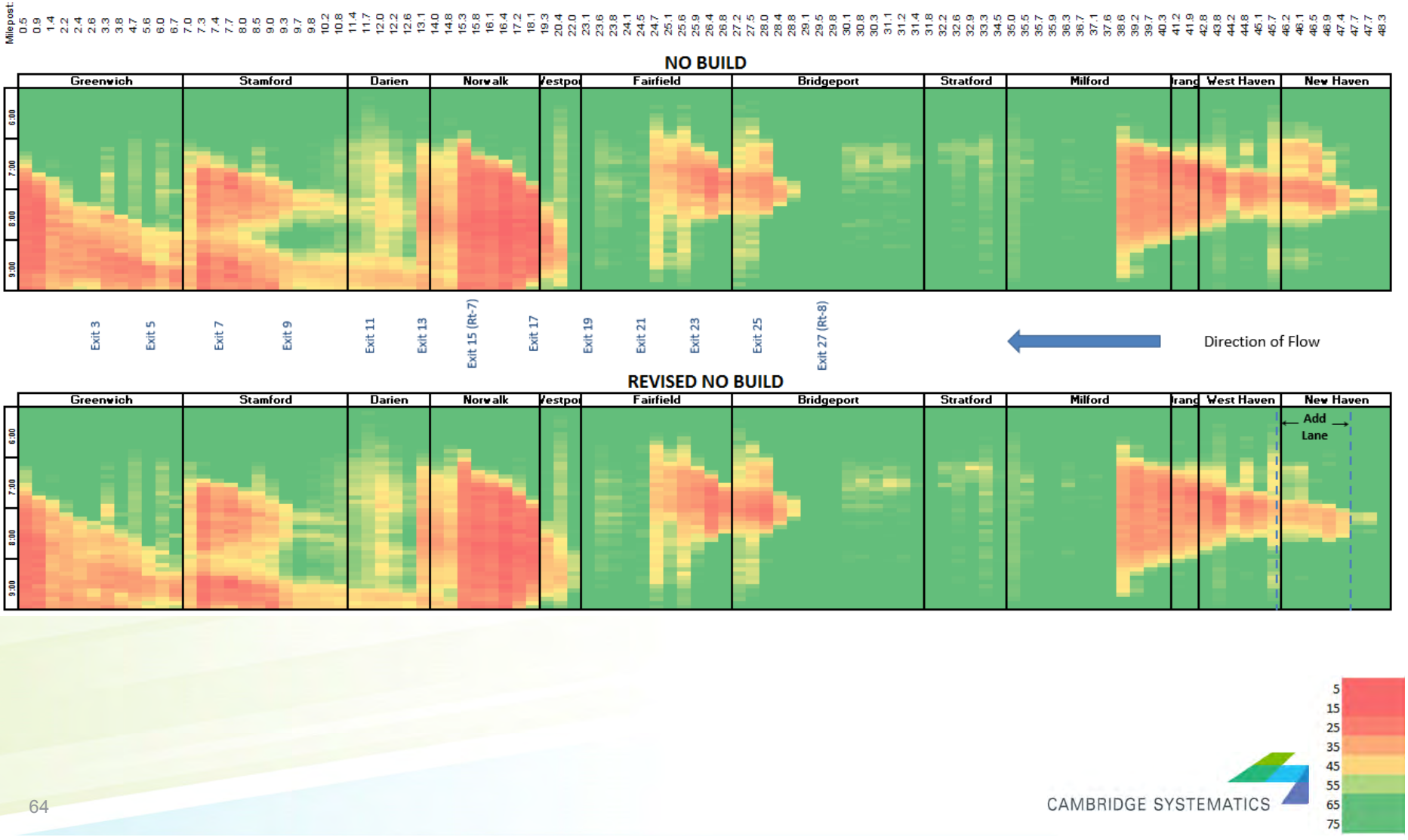
REVISED NO BUILD:

I-95/I-91 UPDATED LANE CONFIGURATIONS WEST RIVER BRIDGE DRAWINGS

Revised No Build: Speed Contours AM Northbound

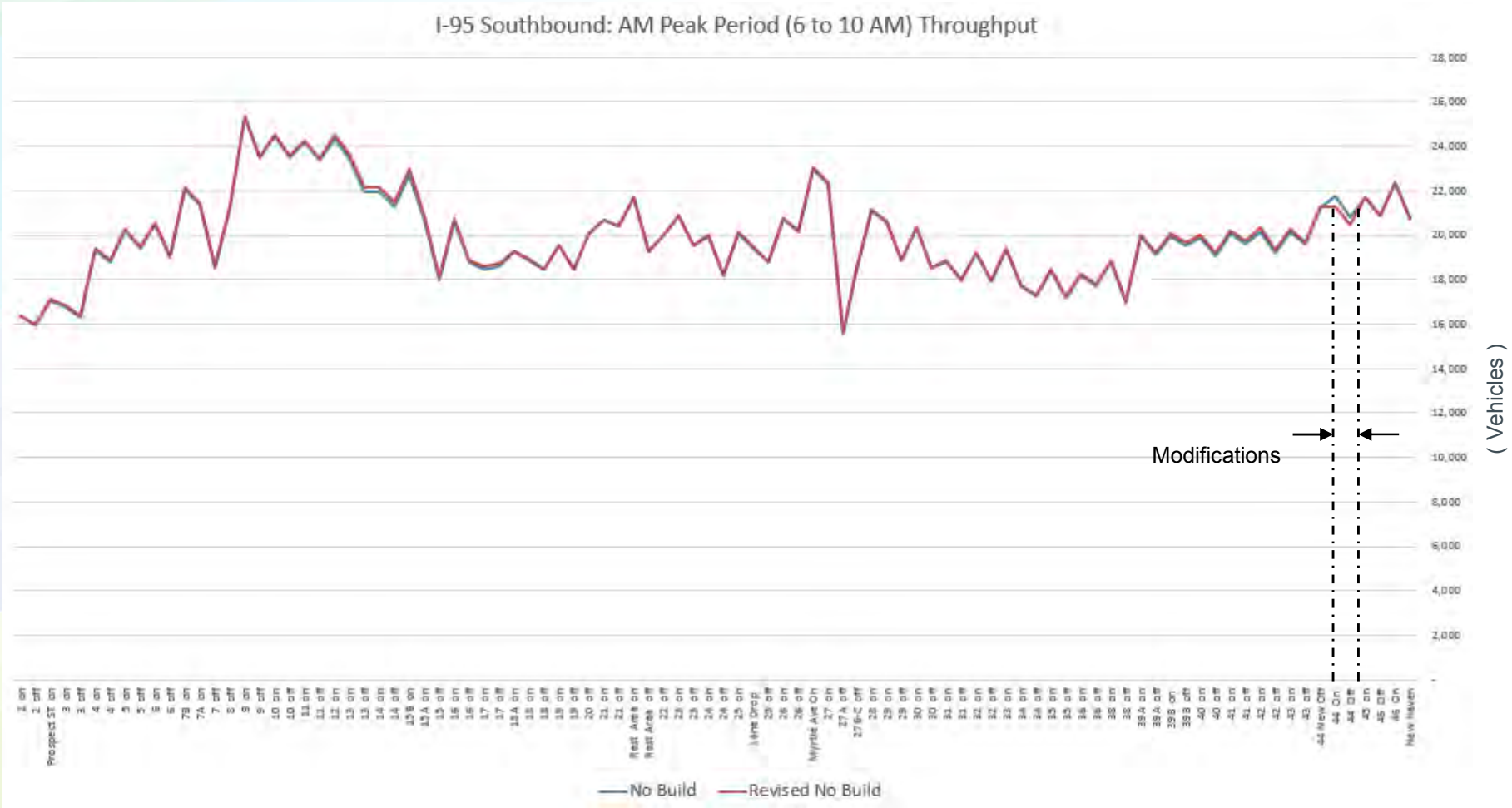
CAMBRIDGE SYSTEMATICS

Revised No Build: Speed Contours AM Southbound



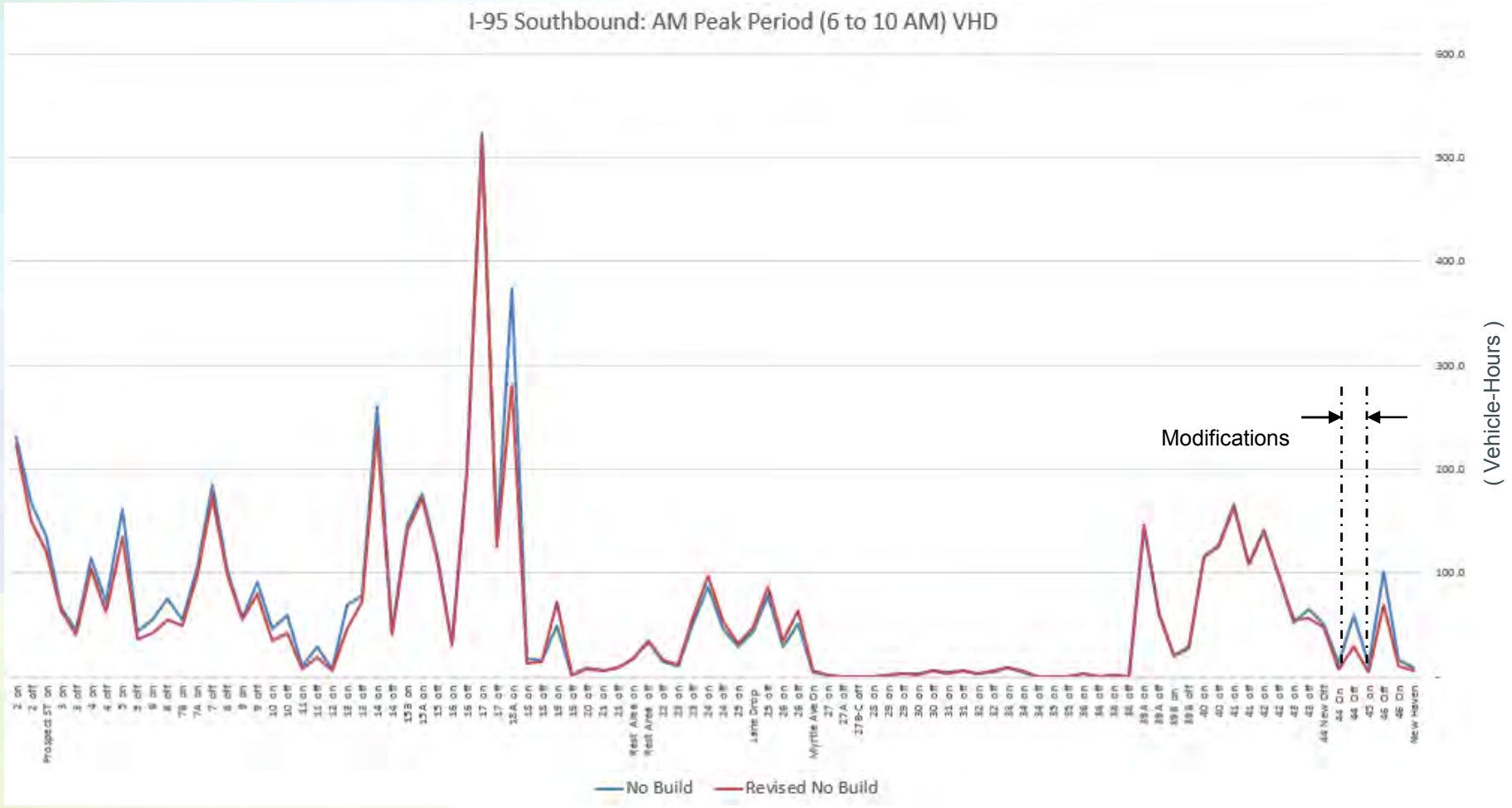
CAMBRIDGE SYSTEMATICS

Revised No Build: Throughput AM Southbound



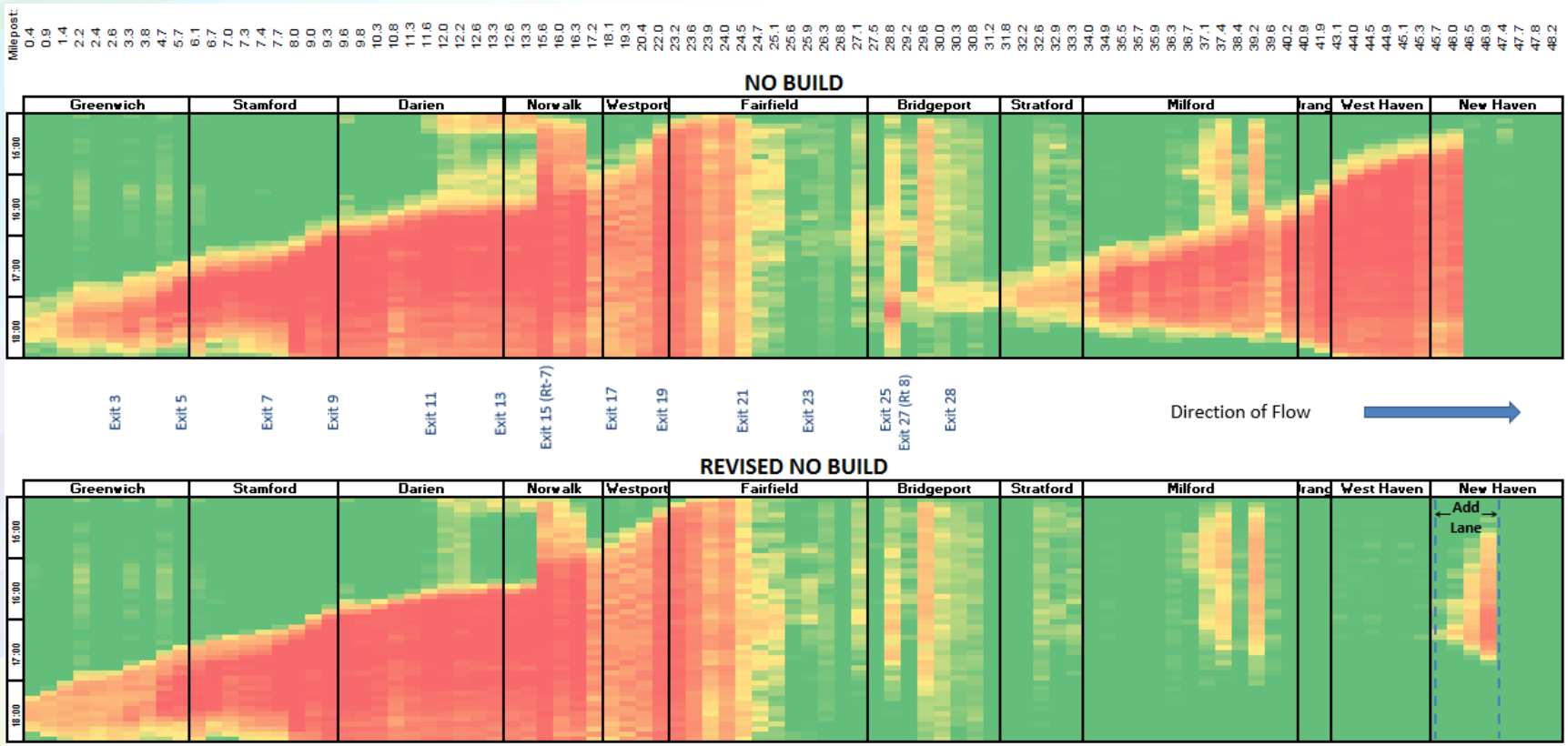
CAMBRIDGE SYSTEMATICS

Revised No Build: Vehicle Hours of Delay AM Southbound



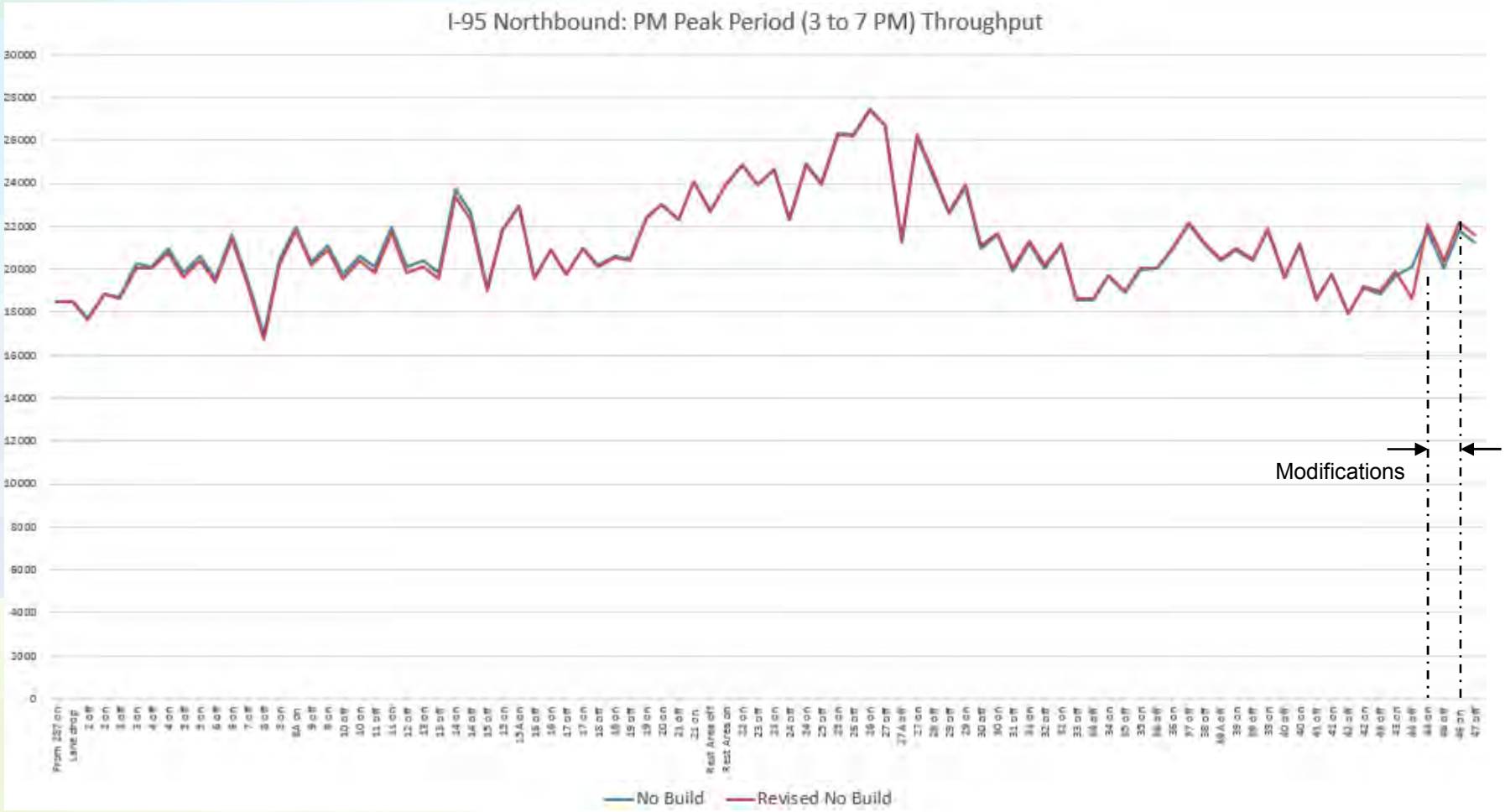
CAMBRIDGE SYSTEMATICS

Revised No Build: Speed Contours PM Northbound



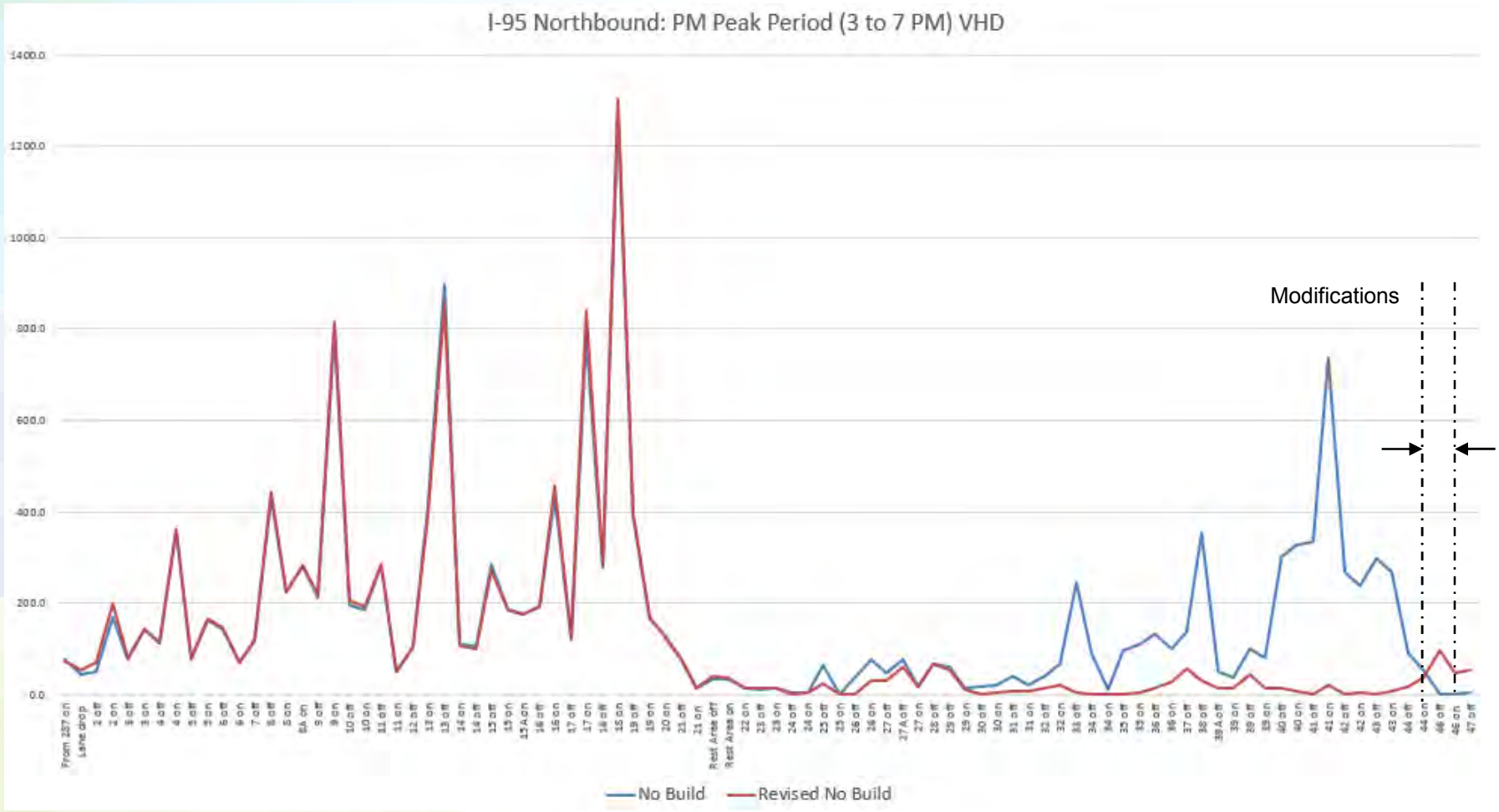
CAMBRIDGE SYSTEMATICS

Revised No Build: Throughput PM Northbound



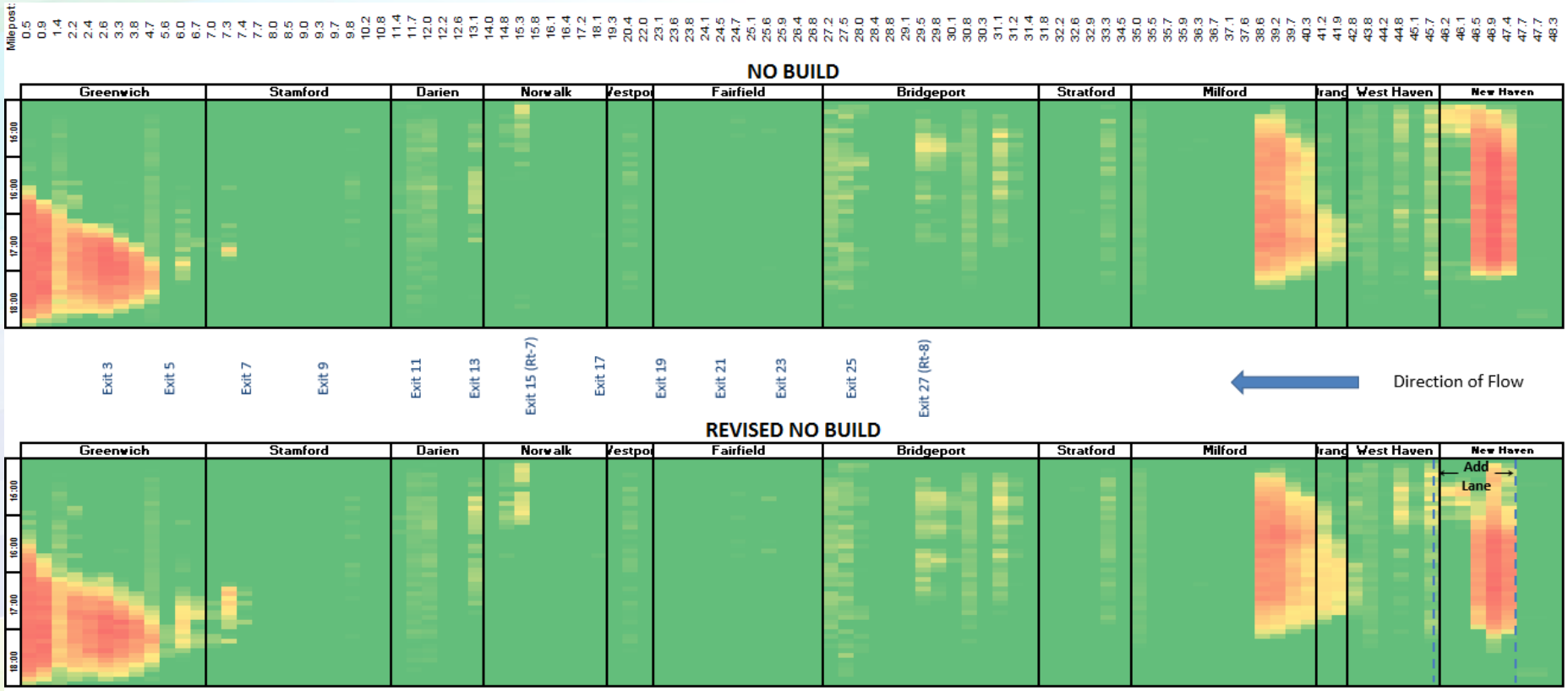
CAMBRIDGE SYSTEMATICS

Revised No Build: Vehicle Hours of Delay PM Northbound



CAMBRIDGE SYSTEMATICS

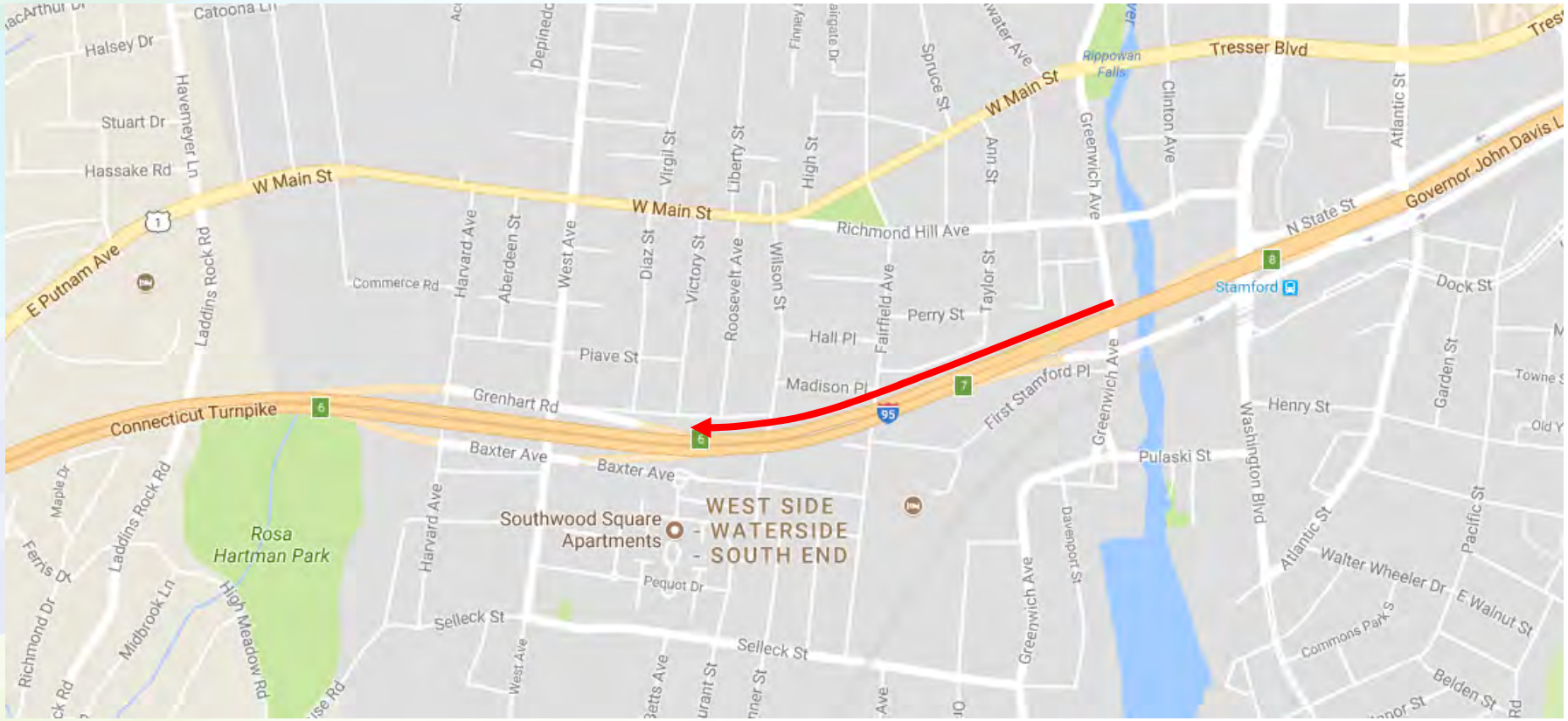
Revised No Build: Speed Contours PM Southbound



CAMBRIDGE SYSTEMATICS

SPOT IMPROVEMENT A: ADD SB AUXILIARY LANE FROM EXIT 7 TO EXIT 6 (STAMFORD)

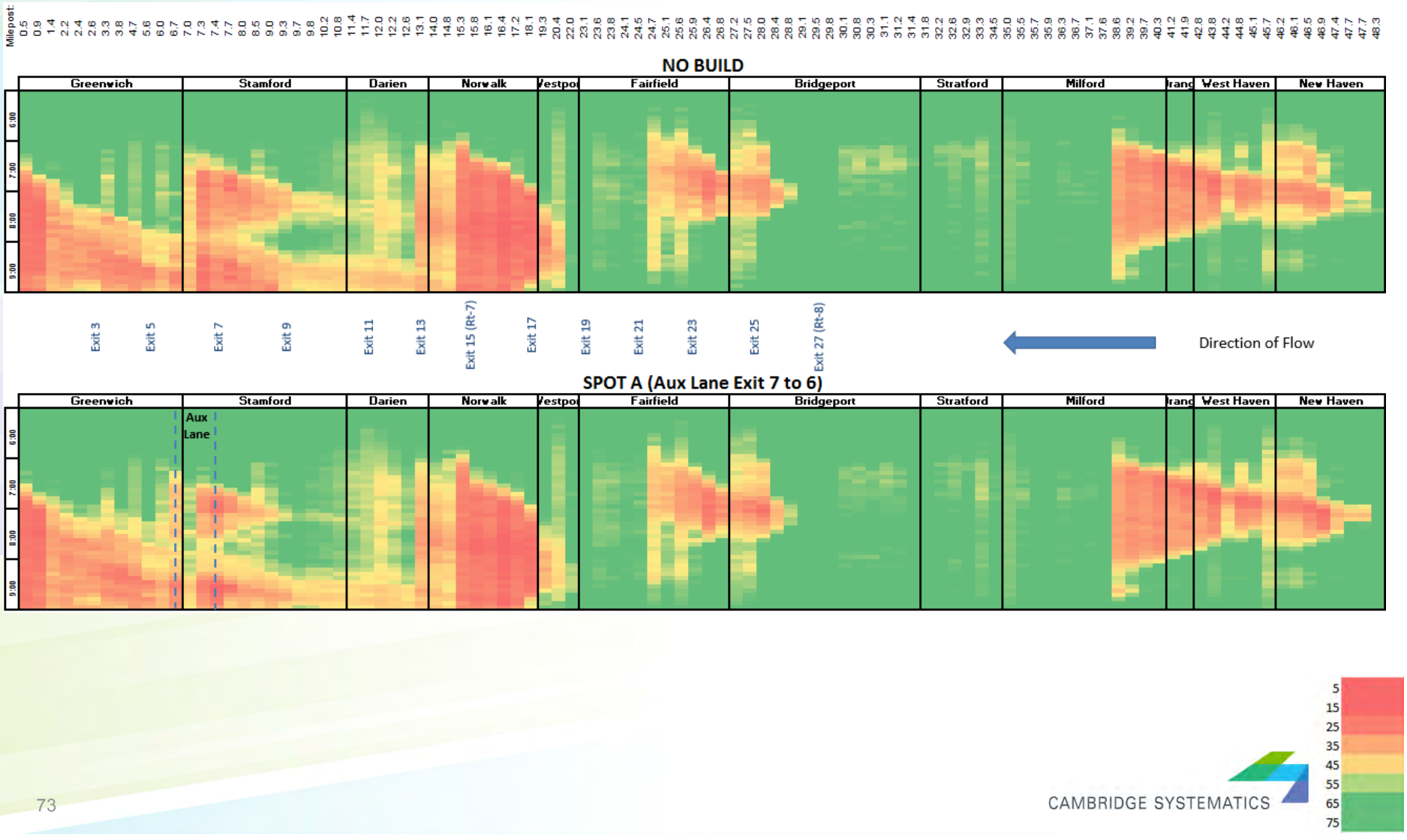
Spot Improvement A: SB Auxiliary Lane from Exit 7 to Exit 6 (Stamford)



Note: Background Image Source: Google Maps

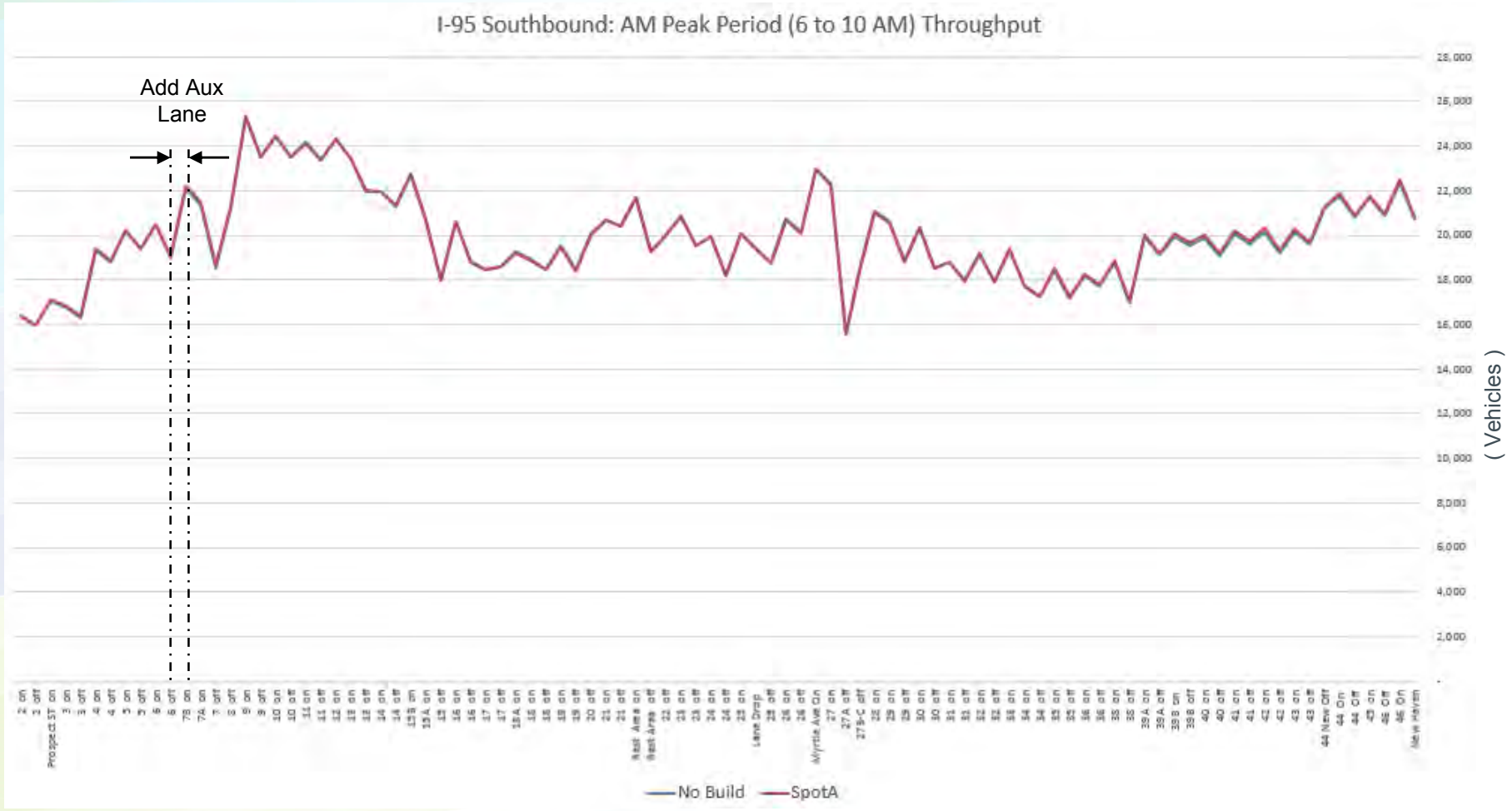
CAMBRIDGE SYSTEMATICS

Spot Improvement A: Speed Contours AM Southbound



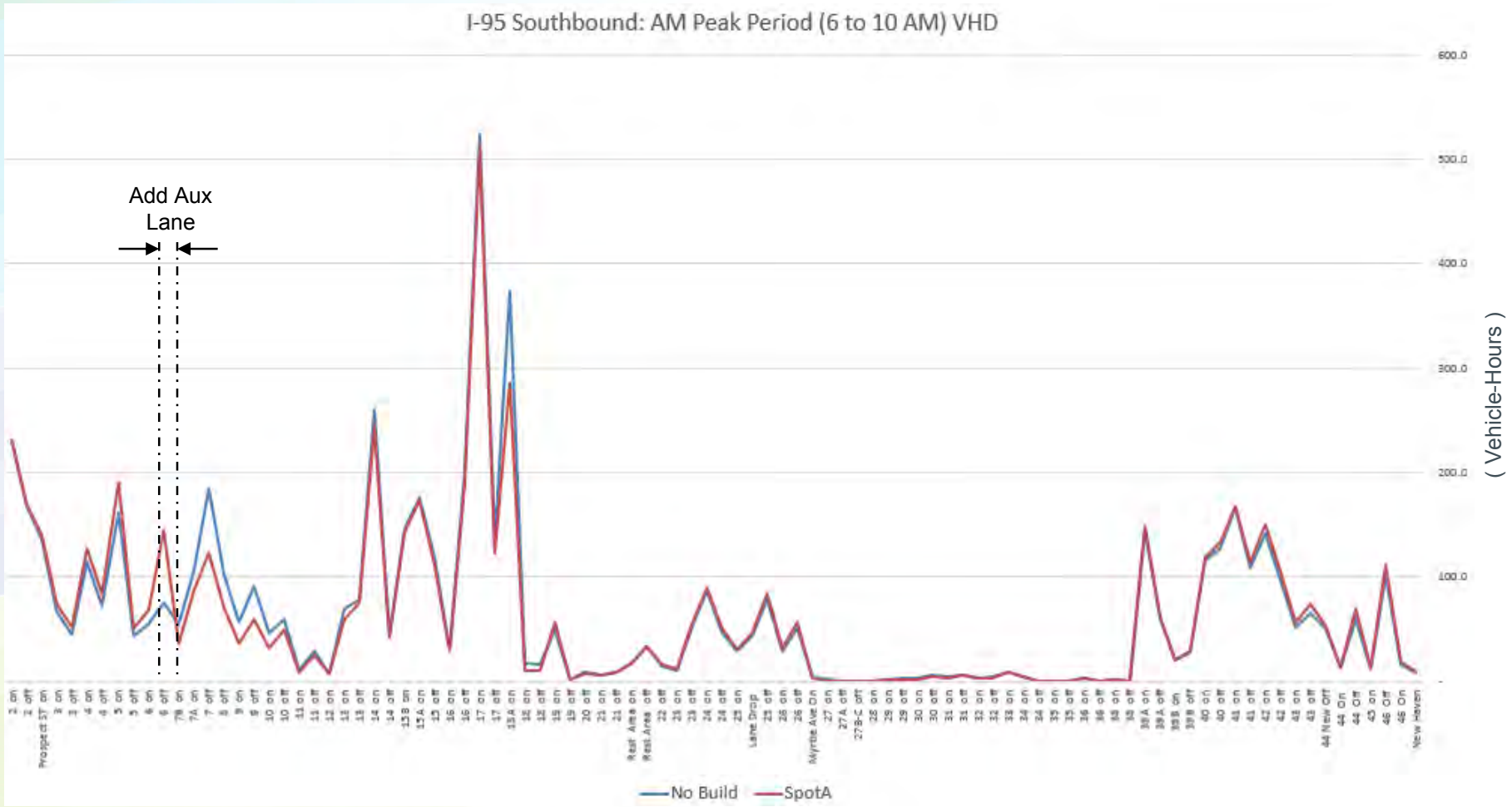
CAMBRIDGE SYSTEMATICS

Spot Improvement A: Throughput AM Southbound



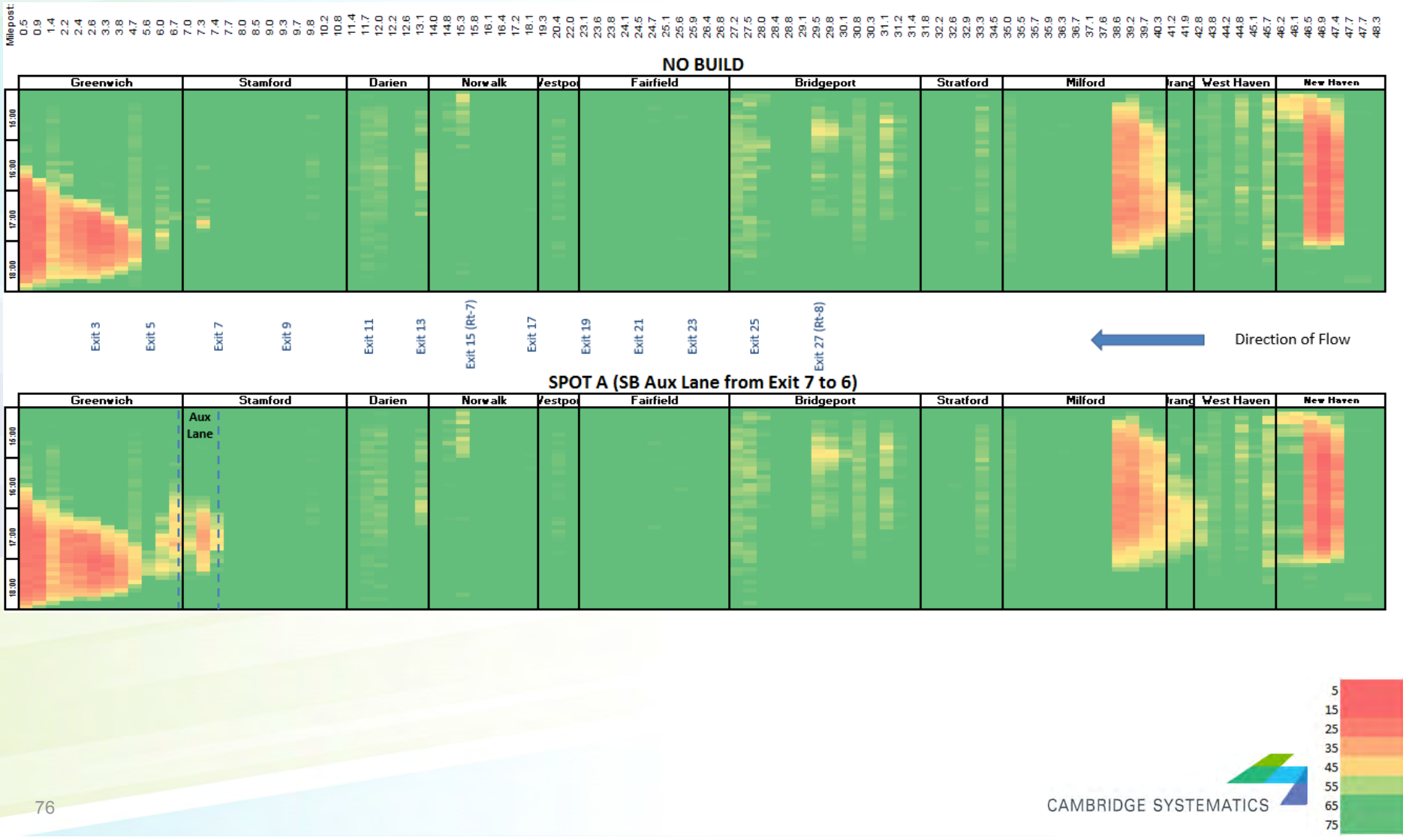
CAMBRIDGE SYSTEMATICS

Spot Improvement A: Vehicle Hours of Delay AM Southbound



CAMBRIDGE SYSTEMATICS

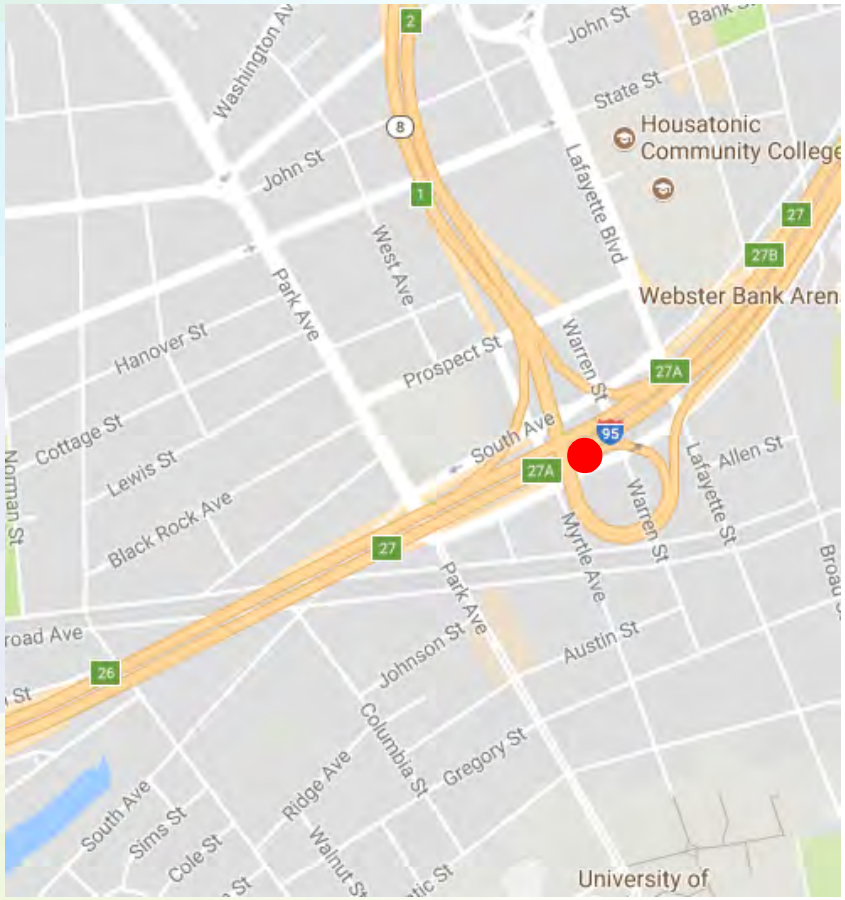
Spot Improvement A: Speed Contours PM Southbound

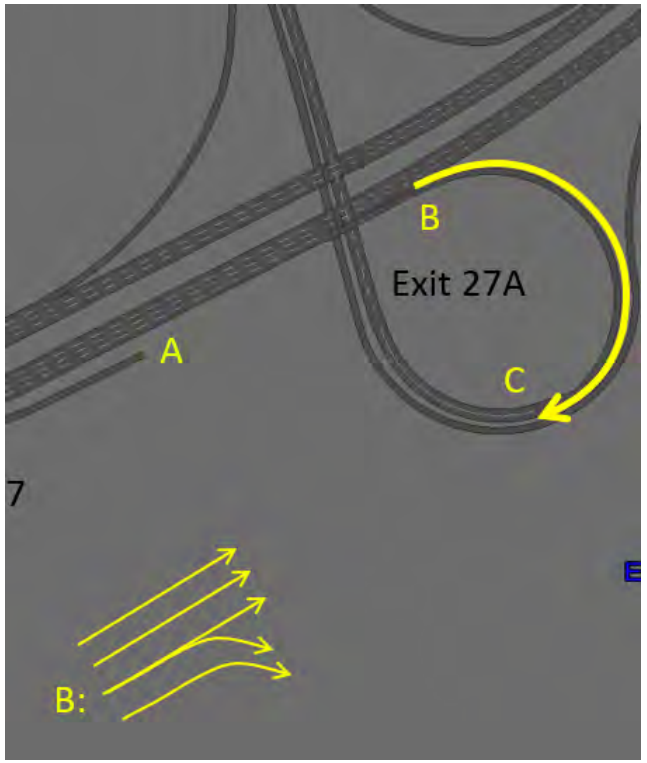


CAMBRIDGE SYSTEMATICS

SPOT IMPROVEMENT B: WIDEN NB EXIT 27A OFF RAMP TO TWO LANES (BRIDGEPORT)

Spot Improvement B: Widen NB Exit 27A Off Ramp to Two Lanes

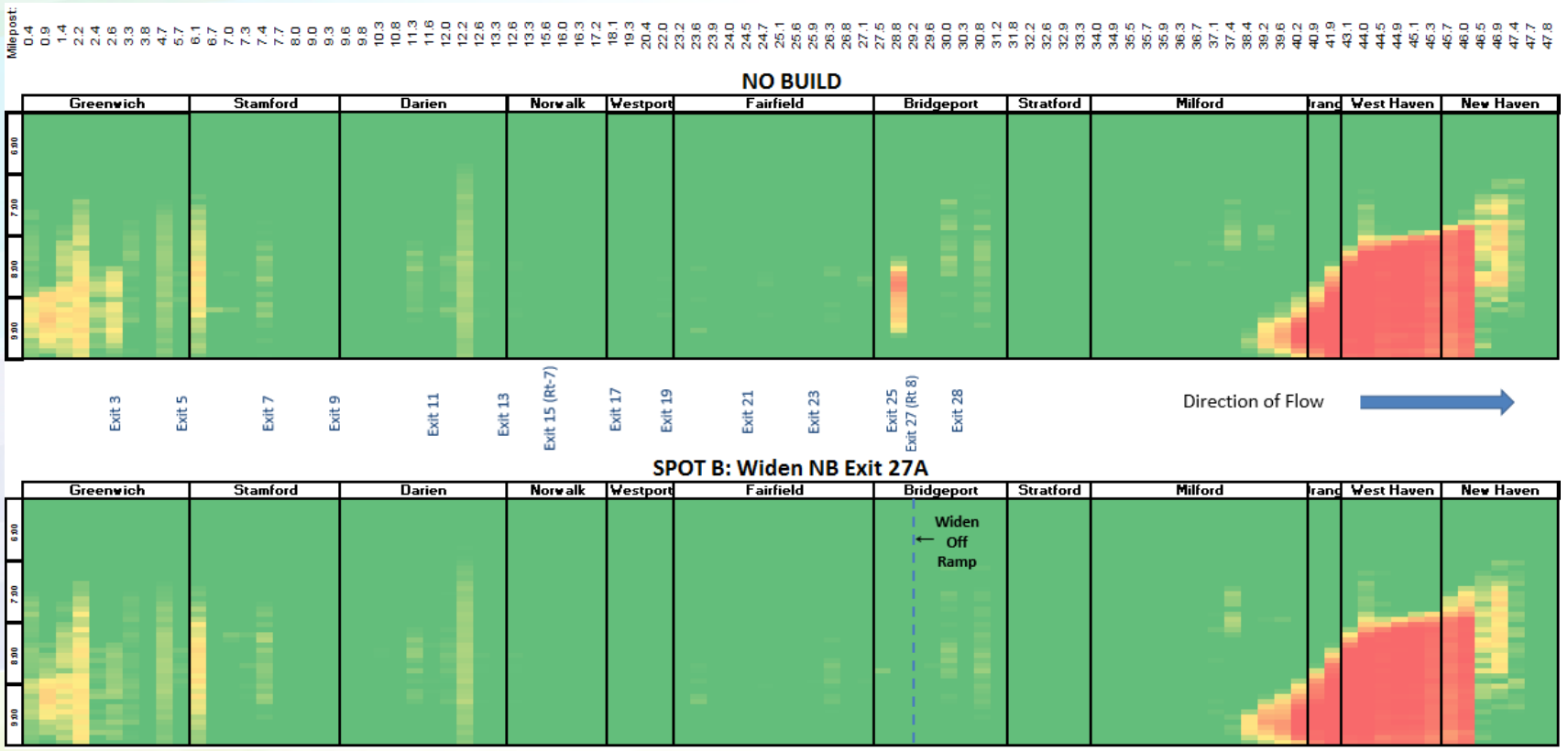




A: No additional deceleration lane
B: 4 lanes split: 2 lanes stay I-95 NB, 1 shared NB/exit, 1 exit only
C: Join existing 2nd lane on ramp

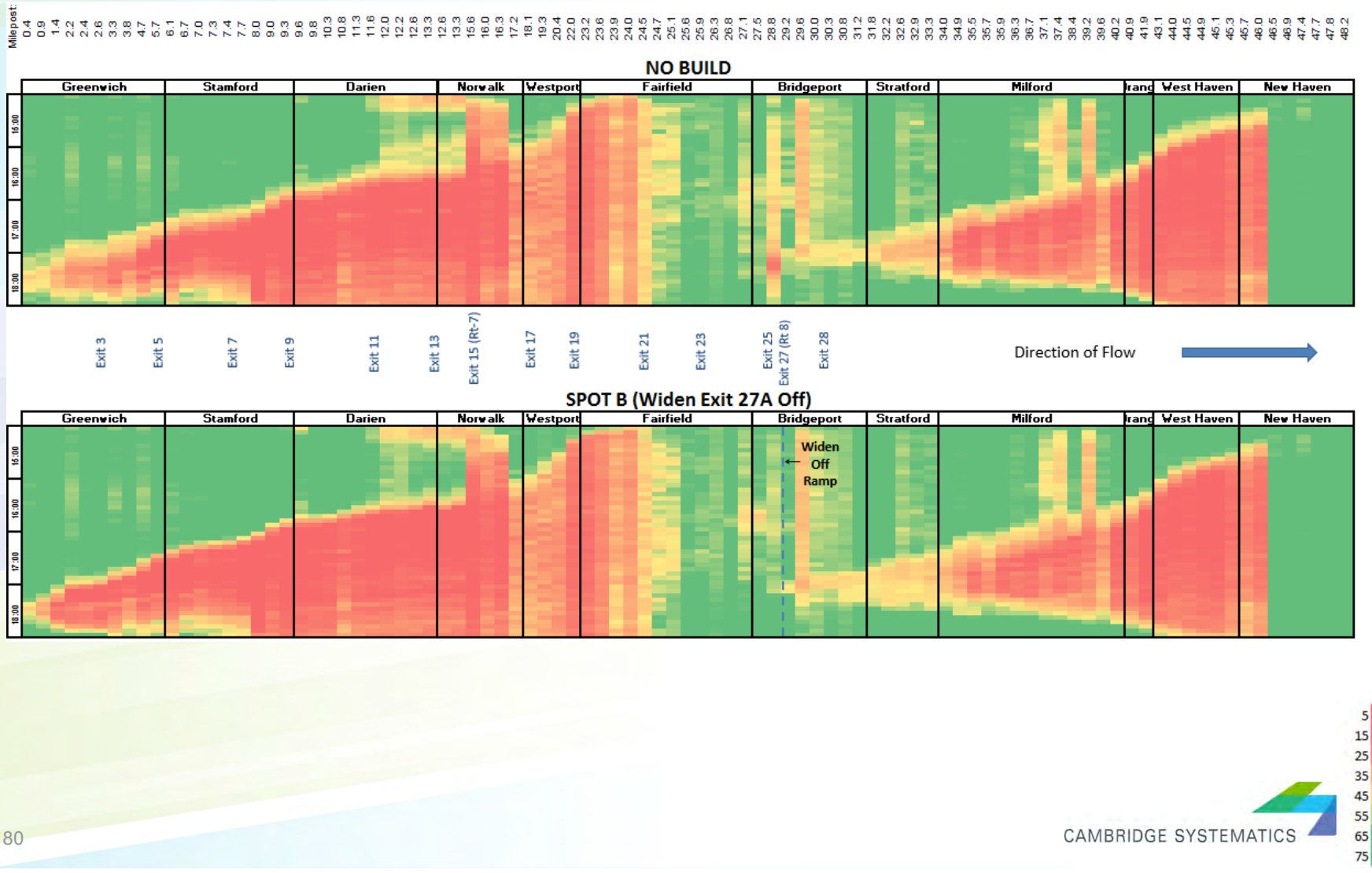
CAMBRIDGE SYSTEMATICS

Spot Improvement B: Speed Contours AM Northbound



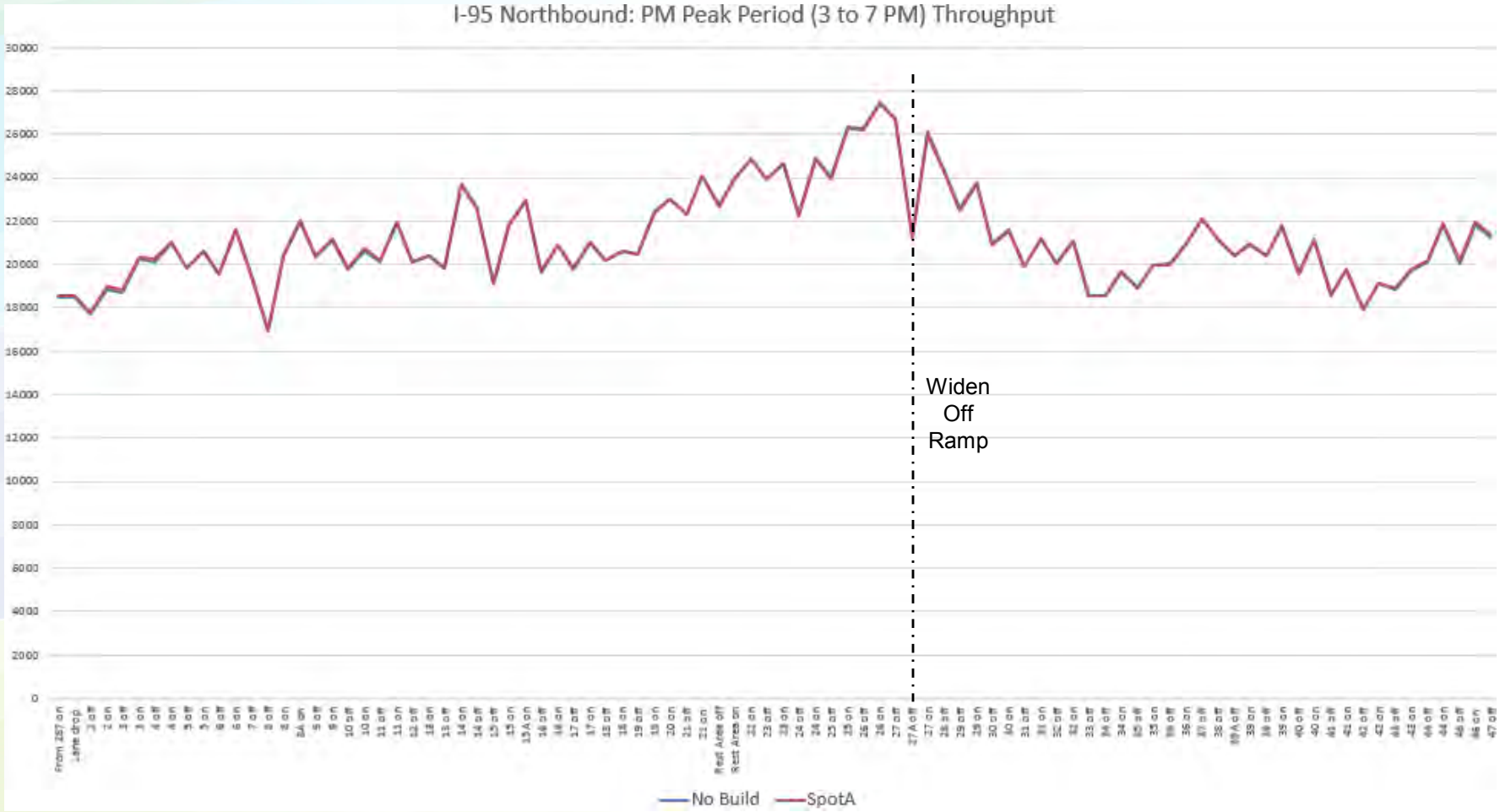
CAMBRIDGE SYSTEMATICS

Spot Improvement B: Speed Contours PM Northbound



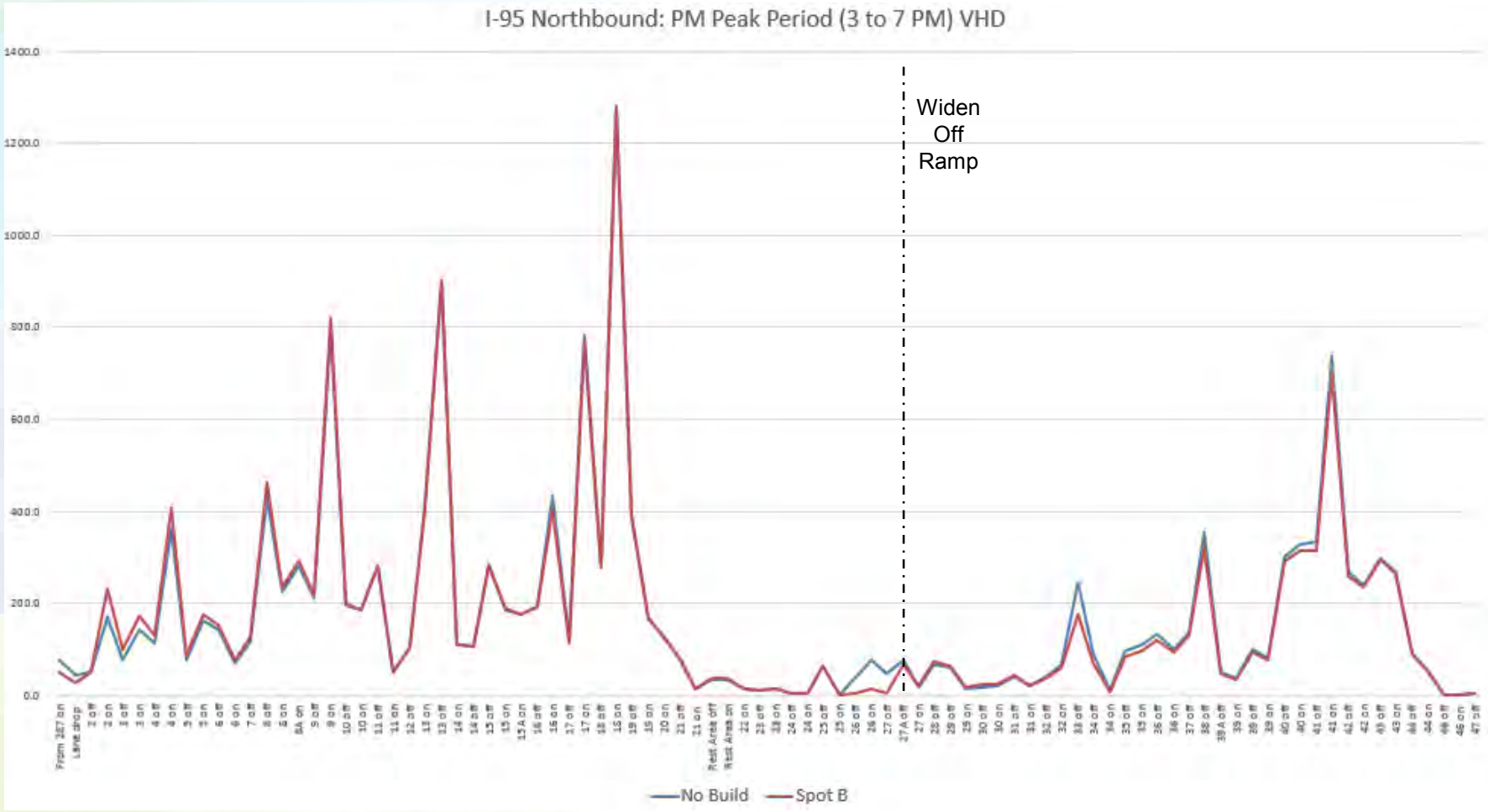
CAMBRIDGE SYSTEMATICS

Spot Improvement B: Throughput PM Northbound



CAMBRIDGE SYSTEMATICS

Spot Improvement B: Vehicle Hours of Delay PM Northbound



CAMBRIDGE SYSTEMATICS

SUMMARY

CAMBRIDGE SYSTEMATICS

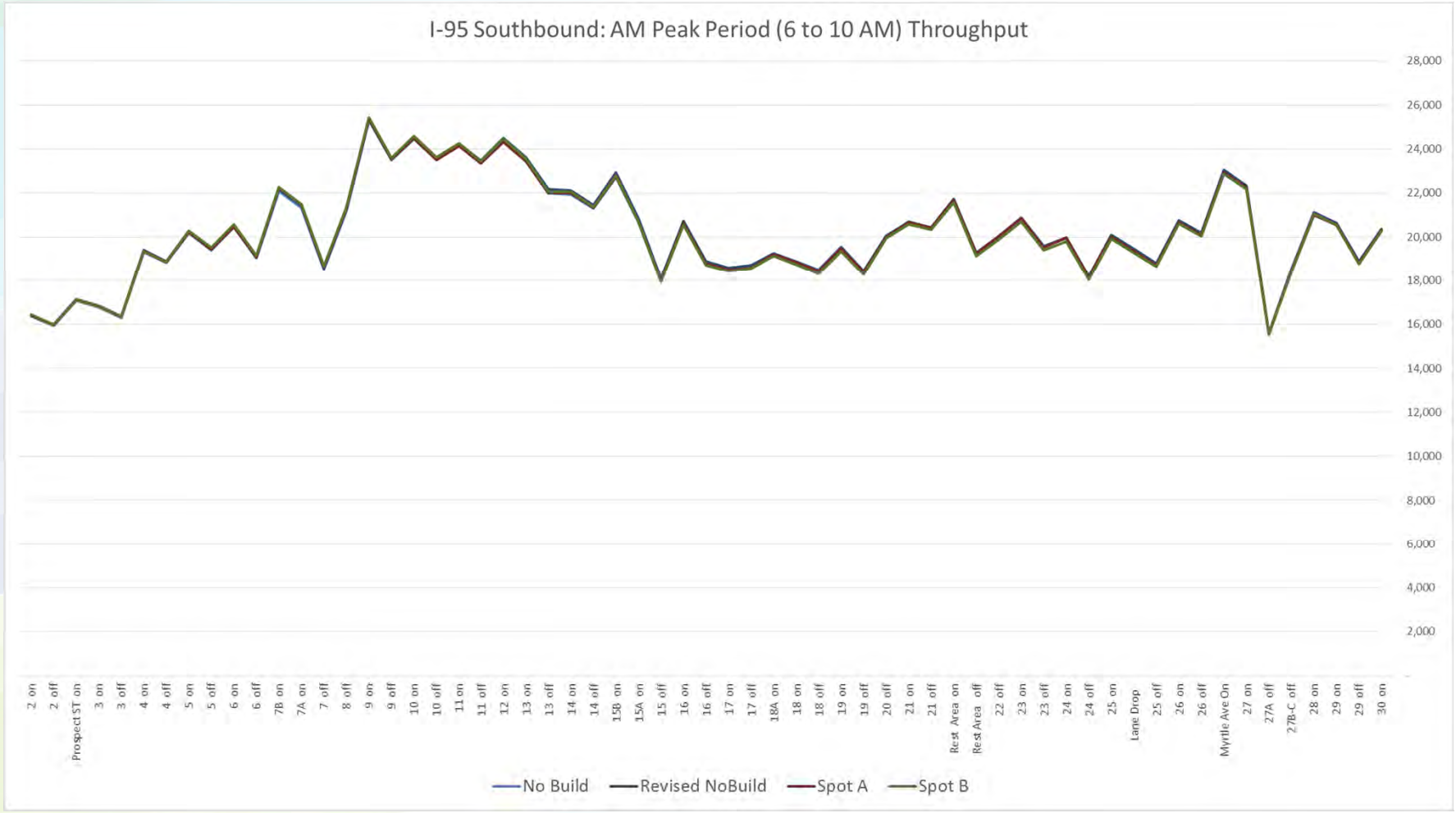
AM Peak Period Metrics: SB from Bridgeport (Exit 30) to I-287

	SOUTHBOUND AM PEAK PERIOD (6-10 AM)		
	No Build	**Revised No Build**	**Spot Improvement A***
Widened Distance (mi, From-To)	0.0	1.0 (Exit 46-44)	0.4 (Exit 7-6)
VMT	625,178	626,954	625,220
(veh-miles)		0%	0%
VHT	14,994	14,702	14,799
(veh-hours)		-2%	-1%
VHD	4,683	4,364	4,486
(veh-hours)		-7%	-4%
Travel Time	45.4	44.4	44.9
(min / veh)		-2%	-1%

*Spot A Improvement: Add Auxiliary Lane Exit 6-7 Southbound

CAMBRIDGE SYSTEMATICS

AM Peak Throughput Compared: SB from Bridgeport (Exit 30) to I-287



CAMBRIDGE SYSTEMATICS

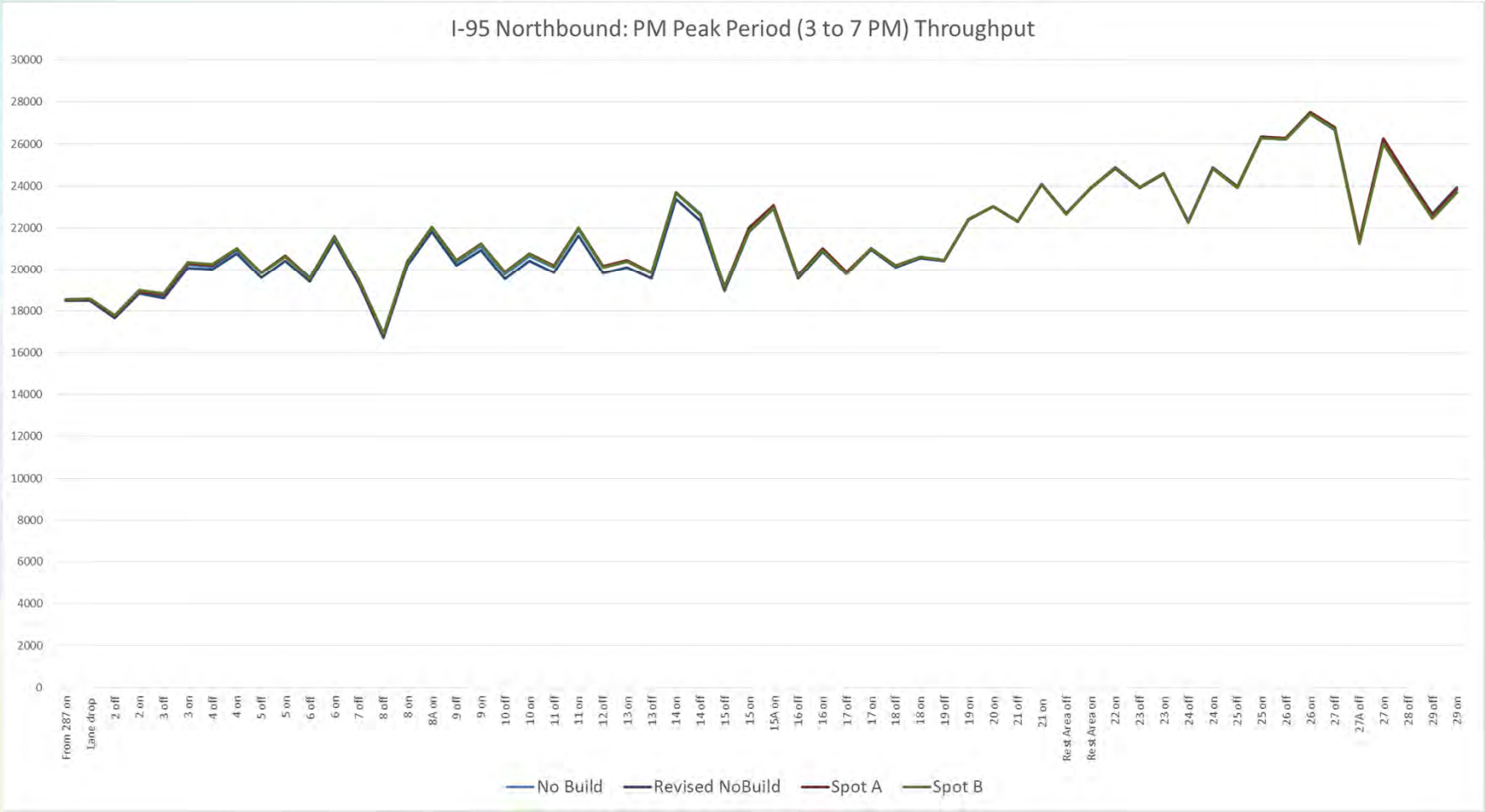
PM Peak Period Metrics: NB from I-287 to Bridgeport (Exit 30)

	NORTHBOUND PM PEAK PERIOD (3-7 PM)		
	No Build	**Revised No Build**	**Spot Improvement B**
Widened Distance (mi, From-To)	0.0	1.0 (Exit 44-46)	0.1 (Widen Exit 27A Off)
VMT	657,844	654,955	658,454
(veh-miles)		0%	0%
VHT	21,890	21,856	21,986
(veh-hours)		0%	0%
VHD	11,010	11,023	11,090
(veh-hours)		0%	1%
Travel Time	63.2	63.6	63.5
(min / veh)		1%	0%

*Spot B Improvement: Widen I-95/Rte 8 Northbound Off Ramp to a 2 Lane Exit

CAMBRIDGE SYSTEMATICS

PM Peak Throughput Compared: NB from I-287 to Bridgeport (Exit 30)



CAMBRIDGE SYSTEMATICS

Appendix D

COST ESTIMATES SUMMARY

CULVERTS & BRIDGES ALONG I-95 - DETAIL EVALUATION CHART - COMBINED OPTION

Structure Number	I-95 Section Type (See Note 4)	Features Intersected	Facility Carried	Lanes On Structure	Structure Length (ft)	I-95 Roadway Width Curb-To-Curb (ft)	Bridge Category	Improvement / Modifications	Cost of Modification	Cost of Deck/Superstructure Replacement	Cost of Total Replacement	Remarks
00001	U	BYRAM RIVER S WATER ST	INTERSTATE-95	6	1262.1	94.2	3	Type 6	-	-	$101,933,294	
00002	U	RIVER AVENUE	INTERSTATE-95	6	57.1	107.9	1	Type 1 & Type 3	$1,174,836	$977,665	-	
00003	U	INTERSTATE-95	JAMES STREET	6	185.04	122.0	8	Type 6	-	-	$5,099,511	
00004	U	DELAVAN AVENUE	INTERSTATE-95	6	107.0	119.1	3	Type 6	-	-	$14,941,004	
00005	C	RITCH AVENUE	INTERSTATE-95	6	69.9	119.1	1	None	-	-	-	
00006	C	FIELD POINT ROAD	INTERSTATE-95	6	65.0	122.0	1	None	-	-	-	
00007	U	SHORE ROAD # 1	INTERSTATE-95	8	68.9	144.0	1 & 4	Type 6	-	-	$6,431,250	
00008	U	HORSENECK CREEK	INTERSTATE-95	8	24.0	0.0	4 & 5	None	-	-	-	Culvert
00009	C	ARCH STREET	INTERSTATE-95	6	73.2	118.1	1	Type 2	-	$3,734,948	-	
00010	C	STEAMBOAT ROAD	INTERSTATE-95	8	67.9	149.0	1 & 4	None	-	-	-	
00011	C	DAVIS STREET	INTERSTATE-95	6	71.9	118.1	1	None	-	-	-	
00012	C	DAVIS MILL POND	INTERSTATE-95	6	85.0	118.1	2	None	-	-	-	
00013	C	INTERSTATE-95	INDIAN FIELD ROAD	6	185.04	122.0	7	None	-	-	-	
00014	C	METRO NORTH RR & STATION	INTERSTATE-95	6	515.1	120.4	3	None	-	-	-	
06015	C	MIANUS RIVER & LOCAL RDS	INTERSTATE-95	6	2662.1	113.8	3	None	-	-	-	
00016	U	INTERSTATE-95	RIVERSIDE AVENUE	6	183.07	122.0	6	Type 6	-	-	$6,022,780	
00017	C	INTERSTATE-95	LOCKWOOD LANE	6	235.89	122.0	9	Type 5 in front of Piers	$20,997	-	-	
00018	C	INTERSTATE-95	I-95 RAMPS TO US 1	7	159.12	133.7	4 & 6	Type 3 & Type 5 in front of Abutments	$22,310	$1,331,227	-	
00019	C	SOUND BEACH AVENUE	INTERSTATE-95	7	66.9	131.9	1 & 4	None	-	-	-	
02565	C	BROOK	INTERSTATE-95	6	14.0	0.0	5	None	-	-	-	Culvert
00020	C	FERRIS DRIVE	INTERSTATE-95	6	59.1	120.4	1	None	-	-	-	
00021	C	LADDINS ROCK ROAD	INTERSTATE-95	6	154.9	118.8	3	None	-	-	-	
02566	C	BROOK	INTERSTATE-95	7	14.3	0.0	5	None	-	-	-	Culvert
00022	C	HARVARD AVENUE	INTERSTATE-95	6	66.9	118.1	1	None	-	-	-	
00023	U	WEST AVENUE	INTERSTATE-95	6	66.9	118.1	1	Type 6	-	-	$5,404,193	
00024	U	INTERSTATE-95	WILSON AVENUE	6	176.84	128.0	7	Type 6	-	-	$4,903,928	
00025	U	INTERSTATE-95	FAIRFIELD AVENUE 1	6	190.94	122.0	7	Type 6	-	-	$6,281,824	
00026	U	GREENWICH AVE RIPPOWAM	I-95 &I-95 RAMP 023	7	435.0	102.7	3 & 4	Type 1	$13,796,374	-	-	
00027	U	SSR 493(WASHINGTON BLVD)	INTERSTATE-95	8	631.9	120.1	3 & 4	Type 1 & Type 3	-	-	-	
00028	U	ATLANTIC STREET	INTERSTATE-95	6	88.9	101.7	1	Type 1	-	-	-	
00029	U	CANAL STREET	INTERSTATE-95	6	77.1	110.2	1	Type 1	-	-	-	
00031	U	ELM STREET	INTERSTATE-95	8	77.1	120.4	1 & 4	Type 1 & Type 2	-	-	-	
00032	U	MNRR & LOCAL ROADS	I-95 & I-95 RAMPS	6	1065.0	94.8	3	Type 6	-	-	-	
00033	U	MAPLE AVENUE	INTERSTATE-95	7	74.1	125.7	1 & 4	Type 1	$1,748,633	-	-	
00034	U	LOCKWOOD AVENUE	INTERSTATE-95	7	79.1	113.2	1 & 4	Type 1	$1,881,126	-	-	
00035	C	INTERSTATE-95	MAHER ROAD	8	157.15	136.0	4 & 6	Type 5 in front of Abutments	$21,129	-	-	
00036	C	INTERSTATE-95	BLACHLEY ROAD	8	161.09	136.0	4 & 6	Type 5 in front of Abutments	$21,129	-	-	
00037	U	INTERSTATE-95	US ROUTE 1	8	251.97	134.0	4 & 6	Type 6 & Type 5 in front of Abutments	$30,446	-	$10,068,821	
00038	C	HAMILTON AVENUE	INTERSTATE-95	7	87.9	133.2	1 & 4	None	-	-	-	
00039	U	NOROTON RIVER	INTERSTATE-95	7	53.1	0.0	5	None	-	-	-	Culvert
00040	U	BROOKSIDE DRIVE	INTERSTATE-95	7	81.0	135.1	1	Type 6	-	-	$7,053,844	
00041	C	INTERSTATE 95	HOLLOW TREE RDG RD	7	192.91	132.0	8	None	-	-	-	
00042	U	INTERSTATE 95	NOROTON AVENUE	6	166.99	122.0	7	Type 6	-	-	$5,493,898	
00043	U	US ROUTE 1	INTERSTATE-95	6	128.9	108.9	1	Type 6	-	-	$10,413,253	
00044	U	KINGS HWY-GOODWIVES RV	INTERSTATE-95	8	163.1	145.3	1 & 4	Type 6	-	-	$15,220,625	
00045	U	ROUTE 136	INTERSTATE-95	6	58.1	113.8	1	Type 6	-	-	$4,689,938	
00046	U	METRO NORTH RAILROAD	INTERSTATE-95	6	194.9	108.9	3	Type 1 & Type 2	$3,563,084	$11,479,169	-	
00047	U	INTERSTATE-95	OLD KINGS HWY N #1	6	123.03	115.0	6	Type 6 & Type 5 in front of Abutments	$18,766	-	$4,199,570	
00048	U	I-95 RMP 047/FIVE MI RIV	INTERSTATE-95	6	86.9	108.9	1	Type 1	$1,589,591	-	-	
00049	U	RICHARDS AVENUE	INTERSTATE-95	6	58.1	107.9	1	Type 1	$1,033,149	-	-	
00050	U	KEELER AVENUE	INTERSTATE-95	6	46.9	108.9	1	Type 1 & Type 3	$857,779	$835,807	-	
00051	U	INTERSTATE-95	RAMPART ROAD	6	140.09	113.0	6	Type 6 & Type 5 in front of Abutments	$17,060	-	$3,918,553	
00052	U	INTERSTATE-95	SCRIBNER AVENUE	6	155.84	113.0	6	Type 6 & Type 5 in front of Abutments	$21,129	-	$5,920,633	
00053	C	INTERSTATE-95	TAYLOR AVENUE	9	173.88	158.0	4 & 7	None	-	-	-	Ongoing Project - 102-278
00054	C	INTERSTATE-95	CEDAR STREET	9	198.49	150.0	4 & 7	None	-	-	-	Ongoing Project - 102-278
00055	C	INTERSTATE-95	FAIRFIELD AVENUE	7	164.04	146.0	4 & 7	None	-	-	-	Ongoing Project - 102-278
00056	U	INTERSTATE-95	STUART AVENUE	7	147.97	127.0	4 & 7	Type 6 & Type 5 in front of Abutments	$17,060	-	$3,851,378	
03562	U	INTERSTATE-95	US ROUTE 7	7	335.96	112.0	4 & 9	Type 6 & Type 5 in front of Abutments	$38,400	-	$16,932,400	
00057	U	WEST AVENUE	INTERSTATE-95	7	87.9	108.9	1 & 4	Type 1 & Type 3	$2,778,138	$1,531,791	-	
00058	U	CRESCENT ST & METRO NO	INTERSTATE-95	7	310.0	107.9	3 & 4	Type 6	-	-	$26,992,912	
00059	U	NORWALK RV HENDRICKS AVE	INTERSTATE-95	8	910.1	107.9	3 & 4	Type 6	-	-	-	Upcoming Project - 102-348
00060	U	INTERSTATE-95	EAST AVENUE #1	6	150.92	111.0	7	Type 6 & Type 5 in front of Abutments	$33,071	-	$6,944,882	
00061	C	INTERSTATE-95	STRAWBERRY HILL AV	6	133.86	122.0	6	Type 5 in front of Abutments	$21,129	-	-	Upcoming Project - 102-295
00062	U	ROUTE 33	INTERSTATE-95	8	149.0	116.1	3 & 4	Type 1	$3,997,660	-	-	Upcoming Project - 102-295
00063	U	FRANKLIN STREET	INTERSTATE-95	6	68.9	112.2	1 & 4	Type 1	$2,075,180	-	-	
00064	C	ROUTE 136 & SAUGATUCK R	INTERSTATE-95	6	1219.2	112.2	3	None	-	-	-	
00065	C	COMPO ROAD SOUTH	INTERSTATE-95	6	92.8	118.1	1	None	-	-	-	
00066	U	INTERSTATE-95	HALES ROAD	6	172.90	122.0	8	Type 6	-	-	$4,467,158	
00067	U	INTERSTATE-95	HILLS POINT ROAD	6	184.06	122.0	8	Type 6	-	-	$5,230,898	
02571	C	MUDDY BROOK	INTERSTATE-95	6	12.3	0.0	5	None	-	-	-	Culvert
00068	U	INTERSTATE-95	SSR 476	7	202.10	134.0	4 & 7	Type 6	-	-	$9,224,779	
00069	C	INTERSTATE-95	BEACHSIDE AVENUE	6	209.97	122.0	6	Type 3 & Type 5 in front of Abutments	$19,685	$1,550,003	-	Upcoming Project - 158-206
00070	U	NEW CREEK ROAD	INTERSTATE-95	6	58.1	123.8	1	Type 6	-	-	$4,688,932	
00071	U	MAPLE LANE	INTERSTATE-95	6	65.0	118.1	1	Type 6	-	-	$5,245,246	
00072	U	INTERSTATE-95	SASCO CREEK ROAD	6	205.05	122.0	8	Type 6	-	-	$5,297,862	
00073	U	SASCO CREEK	INTERSTATE-95	6	38.1	0.0	5	None	-	-	-	Culvert
00074	C	WESTWAY ROAD	INTERSTATE-95	7	51.8	134.0	1 & 4	None	-	-	-	
00075	C	CENTER STREET	INTERSTATE-95	6	57.1	122.0	1	None	-	-	-	
00076	C	OLD POST ROAD	INTERSTATE-95	6	81.0	122.0	1	None	-	-	-	
00077	U	U.S. ROUTE 1	INTERSTATE-95	6	183.1	122.0	3	Type 6	-	-	$14,782,058	
00078	C	INTERSTATE-95	MILL HILL ROAD	6	226.05	136.0	8	Type 3	-	$1,446,185	-	
00079	C	BRONSON ROAD NO. 1	INTERSTATE-95	6	68.9	122.0	1	None	-	-	-	
00080	C	MILL RIVER	INTERSTATE-95	8	86.0	143.0	1 & 4	Type 3	-	$1,971,281	-	
00081	C	NORTH PINE CREEK ROAD	INTERSTATE-95	6	53.1	128.3	1 & 4	None	-	-	-	
00082	C	MILL PLAIN ROAD	INTERSTATE-95	7	77.1	130.2	1 & 4	Type 3	-	$1,616,363	-	
00083	C	UNQUOWA ROAD	INTERSTATE-95	8	79.1	146.3	1 & 4	Type 3	-	$1,848,298	-	
00084	C	ROUND HILL ROAD	INTERSTATE-95	8	57.1	181.4	1 & 4	Type 3	-	$1,635,060	-	
00085	C	ROUTE 135	INTERSTATE-95	6	80.1	118.1	1	None	-	-	-	
00086	U	INTERSTATE-95	US ROUTE 1 SB	7	213.25	136.0	4, 6 & 7	Type 6	-	-	$5,506,104	
00087	U	INTERSTATE-95	MEADOWBROOK ROAD	6	224.08	122.0	8	Type 6	-	-	$6,214,068	
00088	C	US ROUTE 1 SOUTHBOUND	INTERSTATE-95	8	66.9	143.9	1 & 4	Type 3	-	$1,501,953	-	
00089	C	GRASMERE AVENUE	INTERSTATE-95	7	57.1	132.0	1 & 4	Type 3	-	$1,179,940	-	
00090	C	NEW ENGLAND AVENUE	INTERSTATE-95	6	57.1	118.1	1	Type 3	-	$1,092,849	-	
00091	C	SUNSET AVENUE	INTERSTATE-95	8	51.8	144.6	1 & 4	None	-	-	-	
00092	C	US ROUTE 1 SOUTHBOUND	INTERSTATE-95	6	69.9	122.0	1	Type 3	-	$1,337,798	-	
00093	U	US ROUTE 1 NORTHBOUND	INTERSTATE-95	6	67.9	122.0	1	Type 6	-	-	$5,483,667	
00094	C	CHAMBERS STREET	INTERSTATE-95	6	58.1	122.0	1	None	-	-	-	
00095	C	BRENTWOOD AVENUE	INTERSTATE-95	7	58.1	134.0	1 & 4	Type 3	-	$1,200,284	-	
00096	C	COOLIDGE STREET	INTERSTATE-95	7	59.1	150.6	1 & 4	None	-	-	-	
01680	U	ASH CREEK	INTERSTATE-95	7	53.0	0.0	5 & 4	None	-	-	-	Culvert
00098	C	COMMERCE DRIVE	INTERSTATE-95	7	169.9	154.2	1 & 4	None	-	-	-	

CULVERTS & BRIDGES ALONG I-95 - DETAIL EVALUATION CHART - COMBINED OPTION

Structure Number	I-95 Section Type (See Note 4)	Features Intersected	Facility Carried	Lanes On Structure	Structure Length (ft)	I-95 Roadway Width Curb-To-Curb (ft)	Bridge Category	Improvement / Modifications	Cost of Modification	Cost of Deck/Superstructure Replacement	Cost of Total Replacement	Remarks
00099	C	METRO NORTH RAILROAD	INTERSTATE-95	7	496.1	154.2	3 & 4	None	-	-	-	
00100	C	ROUTE 130 (FAIRFIELD AV)	INTERSTATE-95	7	187.0	153.9	3 & 4	None	-	-	-	
00101	U	BOSTWICK AVE	INTERSTATE-95	8	75.1	151.9	1 & 4	Type 6	-	-	$7,013,125	
00102	U	HANCOCK AVENUE	INTERSTATE-95	7	83.0	164.0	1 & 4	None	-	-	-	
00103	U	HOWARD AVENUE	INTERSTATE-95	10	75.1	182.7	1 & 4	None	-	-	-	
00104	U	WORDIN AVENUE NO. 2	INTERSTATE-95	8	102.0	154.2	1	None	-	-	-	
00105A	C	METRO NORTH & CITY STS	INTERSTATE-95	10	2196.9	154.2	3 & 4	None	-	-	-	
00106	U	MYRTLE AVENUE NO. 1	INTERSTATE-95	7	76.1	154.2	1 & 4	Type 6	-	-	$6,625,473	
03535	C	INTERSTATE-95	RT 8 NB & TR 806	15	610.89	159.0	4 & 9	None	-	-	-	Ramp Location
00107	C	WARREN STREET	INTERSTATE-95	6	76.1	152.2	1 & 4	None	-	-	-	
00108	C	LAFAYETTE STREET NO. 2	INTERSTATE-95	7	87.9	152.2	1 & 4	None	-	-	-	
00110A	C	BROAD STREET	INTERSTATE-95	9	111.9	175.2	1 & 4	None	-	-	-	
00144	U	INTERSTATE-95	WEST RIVER STREET	6	178.15	129.0	7	Type 6	-	-	$3,989,079	Hotspot location
00145	U	WEPAWAUG RIVER	INTERSTATE-95	6	50.9	0.0	5	None	-	-	-	Culvert, Hotspot Location
00146	C	ROUTE 121	INTERSTATE-95	6	57.1	125.0	1	None	-	-	-	Hotspot Location
00147	C	ORANGE AVENUE	INTERSTATE-95	6	67.9	125.0	1	None	-	-	-	Hotspot Location
00148	U	INTERSTATE-95	FOREST ROAD	8	204.07	129.0	4 & 8	Type 6	-	-	$4,569,442	Hotspot location
00150	C	INDIAN RIVER	INTERSTATE-95	6	89.9	124.7	1	None	-	-	-	Hotspot Location
00151	C	EAST TOWN ROAD	INTERSTATE-95	7	107.0	135.2	3 & 4	None	-	-	-	Hotspot Location
								Subtotal Cost :	**$34,797,861**	**$36,270,619**	**$361,056,380**	

Notes:

1. As per "Bridge Inventory Database" Design Loads for all the structures are either H20 or HS20.
2. LRFR Load Rating reports are availabe only for few of the structures on Project wise. Code Compliant structures include all structures built after 2003 and structures for which LRFR R.F is > 1.
3. Non-Code Compliant structures include structures built before 2003 for which LRFR R.F are currently unavailable. LRFR Ratings shall be required to determine wether the structure is in compliance with the current codes (current design loads).

LEGEND:

Bridge Category 1 - Single Span Bridges with Full Height Abutments
Bridge Category 2 - Single Span Bridges with Stub Abutments
Bridge Category 3 - Multispan Bridges
Bridge Category 4 - Bridges with Ramp Approaches
Bridge Category 5 - Culverts
Bridge Category 6 - Bridges with Full Height Abutments & no setbacks
Bridge Category 7 - Bridges with Full Height Abutments & setbacks from the edge of pavement (Semi Stub)
Bridge Category 8 - Bridges with Stub Abutments
Bridge Category 9 - Bridges with Shoulder Piers and Stub Abutments

U - Unconstrained
C - Constrained

	Unit	Unit Price	Additional	
Type 1 - Bridge Widening	ft^2	$500	$750	per ft
Type 2 - Superstructure Replacement	ft^2	$325	$75	per sf of existing area
Type 3 - Deck Replacement	ft^2	$150		
Type 4 - Addition of Retaining Wall	ft^2	$200		
Type 5 - Addition of Concrete Barrier Curb	ft	$200		
Type 6 - Complete Bridge Replacement	ft^2	$525		

KEY

No Modification
Some Modification
Deck/Superstructure Replacement
Total Replacement

CULVERTS & BRIDGES ALONG I-95 - DETAIL EVALUATION CHART - UNCONSTRAINED OPTION

Structure Number	I-95 Section Type (See Note 4)	Features Intersected	Facility Carried	Lanes On Structure	Structure Length (ft)	I-95 Roadway Width Curb-To-Curb (ft)	Bridge Category	Improvement / Modifications	Cost of Modification	Cost of Deck/Superstructure Replacement	Cost of Total Replacement	Remarks
00001	U	BYRAM RIVER S WATER ST	INTERSTATE-95	6	1262.1	94.2	3	Type 6	-	-	$101,933,294	
00002	U	RIVER AVENUE	INTERSTATE-95	6	57.1	107.9	1	Type 1 & Type 3	$1,174,836	$977,665	-	
00003	U	INTERSTATE-95	JAMES STREET	6	185.04	122.0	8	Type 6	-	-	$5,099,511	
00004	U	DELAVAN AVENUE	INTERSTATE-95	6	107.0	119.1	3	Type 6	-	-	$14,941,004	
00005	U	RITCH AVENUE	INTERSTATE-95	6	69.9	119.1	1	Type 1	$967,002	-	-	
00006	U	FIELD POINT ROAD	INTERSTATE-95	6	65.0	122.0	1	Type 1	$898,903	-	-	
00007	U	SHORE ROAD # 1	INTERSTATE-95	8	68.9	144.0	1 & 4	Type 6	-	-	$6,431,250	
00008	U	HORSENECK CREEK	INTERSTATE-95	8	24.0	0.0	4 & 5	None	-	-	-	Culvert
00009	U	ARCH STREET	INTERSTATE-95	6	73.2	118.1	1	Type 1 & Type 2	$1,012,401	$4,357,342	-	
00010	U	STEAMBOAT ROAD	INTERSTATE-95	8	67.9	149.0	1 & 4	Type 1	$707,502	-	-	
00011	U	DAVIS STREET	INTERSTATE-95	6	71.9	118.1	1	Type 1	$994,241	-	-	
00012	U	DAVIS MILL POND	INTERSTATE-95	6	85.0	118.1	2	Type 1	$1,175,838	-	-	
00013	U	INTERSTATE-95	INDIAN FIELD ROAD	6	185.04	122.0	7	Type 4 & Type 5	$275,722	-	-	
00014	U	METRO NORTH RR & STATION	INTERSTATE-95	6	515.1	120.4	3	Type 1	$7,296,661	-	-	
06015	U	MIANUS RIVER & LOCAL RDS	INTERSTATE-95	6	2662.1	113.8	3	Type 1	-	-	-	
00016	U	INTERSTATE-95	RIVERSIDE AVENUE	6	183.07	122.0	6	Type 6	-	-	$6,022,780	
00017	U	INTERSTATE-95	LOCKWOOD LANE	6	235.89	122.0	9	Type 6	-	-	$6,500,972	
00018	U	INTERSTATE-95	I-95 RAMPS TO US 1	7	159.12	133.7	4 & 6	Type 6	-	-	$5,362,049	
00019	U	SOUND BEACH AVENUE	INTERSTATE-95	7	66.9	131.9	1 & 4	Type 1	$855,612	-	-	
02565	U	BROOK	INTERSTATE-95	6	14.0	0.0	5	None	-	-	-	Culvert
00020	U	FERRIS DRIVE	INTERSTATE-95	6	59.1	120.4	1	Type 1	$749,372	-	-	
00021	U	LADDINS ROCK ROAD	INTERSTATE-95	6	154.9	118.8	3	Type 1	$2,142,840	-	-	
02566	U	BROOK	INTERSTATE-95	7	14.3	0.0	5	None	-	-	-	Culvert
00022	U	HARVARD AVENUE	INTERSTATE-95	6	66.9	118.1	1	Type 1	$926,143	-	-	
00023	U	WEST AVENUE	INTERSTATE-95	6	66.9	118.1	1	Type 6	-	-	$5,404,193	
00024	U	INTERSTATE-95	WILSON AVENUE	6	176.84	128.0	7	Type 6	-	-	$4,903,928	
00025	U	INTERSTATE-95	FAIRFIELD AVENUE 1	6	190.94	122.0	7	Type 6	-	-	$6,281,824	
00026	U	GREENWICH AVE RIPPOWAM	I-95 &I-95 RAMP 023	7	435.0	102.7	3 & 4	Type 1	$13,796,374	-	-	
00027	U	SSR 493(WASHINGTON BLVD)	INTERSTATE-95	8	631.9	120.1	3 & 4	Type 1 & Type 3	-	-	-	
00028	U	ATLANTIC STREET	INTERSTATE-95	6	88.9	101.7	1	Type 1	-	-	-	
00029	U	CANAL STREET	INTERSTATE-95	6	77.1	110.2	1	Type 1	-	-	-	
00031	U	ELM STREET	INTERSTATE-95	8	77.1	120.4	1 & 4	Type 1 & Type 2	-	-	-	
00032	U	MNRR & LOCAL ROADS	I-95 & I-95 RAMPS	6	1065.0	94.8	3	Type 6	-	-	-	
00033	U	MAPLE AVENUE	INTERSTATE-95	7	74.1	125.7	1 & 4	Type 1	$1,748,633	-	-	
00034	U	LOCKWOOD AVENUE	INTERSTATE-95	7	79.1	113.2	1 & 4	Type 1	$1,881,126	-	-	
00035	U	INTERSTATE-95	MAHER ROAD	8	157.15	136.0	4 & 6	Type 6	-	-	$5,070,367	
00036	U	INTERSTATE-95	BLACHLEY ROAD	8	161.09	136.0	4 & 6	Type 6	-	-	$5,186,288	
00037	U	INTERSTATE-95	US ROUTE 1	8	251.97	134.0	4 & 6	Type 6 & Type 5 in front of Abutments	$30,446	-	$10,068,821	
00038	U	HAMILTON AVENUE	INTERSTATE-95	7	87.9	133.2	1 & 4	Type 1	$1,253,853	-	-	
00039	U	NOROTON RIVER	INTERSTATE-95	7	53.1	0.0	5	None	-	-	-	Culvert
00040	U	BROOKSIDE DRIVE	INTERSTATE-95	7	81.0	135.1	1	Type 6	-	-	$7,053,844	
00041	U	INTERSTATE 95	HOLLOW TREE RDG RD	7	192.91	132.0	8	Type 4 & Type 5	$232,415	-	-	
00042	U	INTERSTATE 95	NOROTON AVENUE	6	166.99	122.0	7	Type 6	-	-	$5,493,898	
00043	U	US ROUTE 1	INTERSTATE-95	6	128.9	108.9	1	Type 6	-	-	$10,413,253	
00044	U	KINGS HWY-GOODWIVES RV	INTERSTATE-95	8	163.1	145.3	1 & 4	Type 6	-	-	$15,220,625	
00045	U	ROUTE 136	INTERSTATE-95	6	58.1	113.8	1	Type 6	-	-	$4,689,938	
00046	U	METRO NORTH RAILROAD	INTERSTATE-95	6	194.9	108.9	3	Type 1 & Type 2	$3,563,084	$11,479,169	-	
00047	U	INTERSTATE-95	OLD KINGS HWY N #1	6	123.03	115.0	6	Type 6 & Type 5 in front of Abutments	$18,766	-	$4,199,570	
00048	U	I-95 RMP 047/FIVE MI RIV	INTERSTATE-95	6	86.9	108.9	1	Type 1	$1,589,591	-	-	
00049	U	RICHARDS AVENUE	INTERSTATE-95	6	58.1	107.9	1	Type 1	$1,033,149	-	-	
00050	U	KEELER AVENUE	INTERSTATE-95	6	46.9	108.9	1	Type 1 & Type 3	$857,779	$835,807	-	
00051	U	INTERSTATE-95	RAMPART ROAD	6	140.09	113.0	6	Type 6 & Type 5 in front of Abutments	$17,060	-	$3,918,553	
00052	U	INTERSTATE-95	SCRIBNER AVENUE	6	155.84	113.0	6	Type 6 & Type 5 in front of Abutments	$21,129	-	$5,920,633	
00053	U	INTERSTATE-95	TAYLOR AVENUE	9	173.88	158.0	4 & 7	Type 5	$17,060	-	-	Ongoing Project - 102-278
00054	U	INTERSTATE-95	CEDAR STREET	9	198.49	150.0	4 & 7	Type 5	$20,997	-	-	Ongoing Project - 102-278
00055	U	INTERSTATE-95	FAIRFIELD AVENUE	7	171.00	146.0	4 & 7	Type 5	$21,200	-	-	Ongoing Project - 102-278
00056	U	INTERSTATE-95	STUART AVENUE	7	147.97	127.0	4 & 7	Type 6 & Type 5 in front of Abutments	$17,060	-	$3,851,378	
03562	U	INTERSTATE-95	US ROUTE 7	7	335.96	112.0	4 & 9	Type 6 & Type 5 in front of Abutments	$38,400	-	$16,932,400	
00057	U	WEST AVENUE	INTERSTATE-95	7	87.9	108.9	1 & 4	Type 1 & Type 3	$2,778,138	$1,531,791	-	
00058	U	CRESCENT ST & METRO NO	INTERSTATE-95	7	310.0	107.9	3 & 4	Type 6	-	-	$26,992,912	
00059	U	NORWALK RV HENDRICKS AVE	INTERSTATE-95	8	910.1	107.9	3 & 4	Type 6	-	-	-	Upcoming Project - 102-348
00060	U	INTERSTATE-95	EAST AVENUE #1	6	150.92	111.0	7	Type 6 & Type 5 in front of Abutments	$33,071	-	$6,944,882	
00061	U	INTERSTATE-95	STRAWBERRY HILL AV	6	133.86	122.0	6	Type 6	-	-	$4,464,739	Upcoming Project - 102-295
00062	U	ROUTE 33	INTERSTATE-95	8	149.0	116.1	3 & 4	Type 1	$3,997,660	-	-	Upcoming Project - 102-295
00063	U	FRANKLIN STREET	INTERSTATE-95	6	68.9	112.2	1 & 4	Type 1	$2,075,180	-	-	
00064	U	ROUTE 136 & SAUGATUCK R	INTERSTATE-95	6	1219.2	112.2	3	Type 1	-	-	-	
00065	U	COMPO ROAD SOUTH	INTERSTATE-95	6	92.8	118.1	1	Type 1	$1,269,565	-	-	
00066	U	INTERSTATE-95	HALES ROAD	6	172.90	122.0	8	Type 6	-	-	$4,467,158	
00067	U	INTERSTATE-95	HILLS POINT ROAD	6	184.06	122.0	8	Type 6	-	-	$5,230,898	
02571	U	MUDDY BROOK	INTERSTATE-95	6	12.3	0.0	5	None	-	-	-	Culvert
00068	U	INTERSTATE-95	SSR 476	7	202.10	134.0	4 & 7	Type 6	-	-	$9,224,779	
00069	U	INTERSTATE-95	BEACHSIDE AVENUE	6	209.97	122.0	6	Type 3 & Type 5 in front of Abutments	$19,685	$1,550,003	-	Upcoming Project - 158-206
00070	U	NEW CREEK ROAD	INTERSTATE-95	6	58.1	123.8	1	Type 6	-	-	$4,688,932	
00071	U	MAPLE LANE	INTERSTATE-95	6	65.0	118.1	1	Type 6	-	-	$5,245,246	
00072	U	INTERSTATE-95	SASCO CREEK ROAD	6	205.05	122.0	8	Type 6	-	-	$5,297,862	
00073	U	SASCO CREEK	INTERSTATE-95	6	38.1	0.0	5	None	-	-	-	Culvert
00074	U	WESTWAY ROAD	INTERSTATE-95	7	51.8	134.0	1 & 4	Type 1	$713,701	-	-	
00075	U	CENTER STREET	INTERSTATE-95	6	57.1	122.0	1	Type 1	$789,945	-	-	
00076	U	OLD POST ROAD	INTERSTATE-95	6	81.0	122.0	1	Type 1	$1,121,359	-	-	
00077	U	U.S. ROUTE 1	INTERSTATE-95	6	183.1	122.0	3	Type 6	-	-	$14,782,058	
00078	U	INTERSTATE-95	MILL HILL ROAD	6	226.05	136.0	8	Type 3	-	$1,446,185	-	
00079	U	BRONSON ROAD NO. 1	INTERSTATE-95	6	68.9	122.0	1	Type 1	$953,382	-	-	
00080	U	MILL RIVER	INTERSTATE-95	8	86.0	143.0	1 & 4	Type 1 & Type 3	$1,135,198	$1,971,281	-	
00081	U	NORTH PINE CREEK ROAD	INTERSTATE-95	6	53.1	128.3	1 & 4	Type 1	$622,122	-	-	
00082	U	MILL PLAIN ROAD	INTERSTATE-95	7	77.1	130.2	1 & 4	Type 1 & Type 3	$1,061,518	$1,616,363	-	
00083	U	UNQUOWA ROAD	INTERSTATE-95	8	79.1	146.3	1 & 4	Type 1 & Type 3	$927,474	$1,848,298	-	
00084	U	ROUND HILL ROAD	INTERSTATE-95	8	57.1	181.4	1 & 4	Type 3	-	$1,635,060	-	
00085	U	ROUTE 135	INTERSTATE-95	6	80.1	118.1	1	Type 1	$1,107,739	-	-	
00086	U	INTERSTATE-95	US ROUTE 1 SB	7	213.25	136.0	4, 6 & 7	Type 6	-	-	$5,506,104	
00087	U	INTERSTATE-95	MEADOWBROOK ROAD	6	224.08	122.0	8	Type 6	-	-	$6,214,068	
00088	U	US ROUTE 1 SOUTHBOUND	INTERSTATE-95	8	66.9	143.9	1 & 4	Type 1 & Type 3	$993,687	$1,501,953	-	
00089	U	GRASMERE AVENUE	INTERSTATE-95	7	57.1	132.0	1 & 4	Type 1 & Type 3	$842,162	$1,179,940	-	
00090	U	NEW ENGLAND AVENUE	INTERSTATE-95	6	57.1	118.1	1	Type 1 & Type 3	$789,945	$1,092,849	-	
00091	U	SUNSET AVENUE	INTERSTATE-95	8	51.8	144.6	1 & 4	Type 1	$752,613	-	-	
00092	U	US ROUTE 1 SOUTHBOUND	INTERSTATE-95	6	69.9	122.0	1	Type 1 & Type 3	$967,002	$1,337,798	-	
00093	U	US ROUTE 1 NORTHBOUND	INTERSTATE-95	6	67.9	122.0	1	Type 6	-	-	$5,483,667	
00094	U	CHAMBERS STREET	INTERSTATE-95	6	58.1	122.0	1	Type 1	$803,565	-	-	
00095	U	BRENTWOOD AVENUE	INTERSTATE-95	7	58.1	134.0	1 & 4	Type 1 & Type 3	$856,682	$1,200,284	-	
00096	U	COOLIDGE STREET	INTERSTATE-95	7	59.1	150.6	1 & 4	Type 1	$222,139	-	-	
01680	U	ASH CREEK	INTERSTATE-95	7	53.0	0.0	5 & 4	None	-	-	-	Culvert
00098	U	COMMERCE DRIVE	INTERSTATE-95	7	169.9	154.2	1 & 4	Type 1	$276,844	-	-	

CULVERTS & BRIDGES ALONG I-95 - DETAIL EVALUATION CHART - UNCONSTRAINED OPTION

Structure Number	I-95 Section Type (See Note 4)	Features Intersected	Facility Carried	Lanes On Structure	Structure Length (ft)	I-95 Roadway Width Curb-To-Curb (ft)	Bridge Category	Improvement / Modifications	Cost of Modification	Cost of Deck/Superstructure Replacement	Cost of Total Replacement	Remarks
00099	U	METRO NORTH RAILROAD	INTERSTATE-95	7	496.1	154.2	3 & 4	Type 1	$808,087	-	-	
00100	U	ROUTE 130 (FAIRFIELD AV)	INTERSTATE-95	7	187.0	153.9	3 & 4	Type 1	$304,636	-	-	
00101	U	BOSTWICK AVE	INTERSTATE-95	8	75.1	151.9	1 & 4	Type 6	-	-	$7,013,125	
00102	U	HANCOCK AVENUE	INTERSTATE-95	7	83.0	164.0	1 & 4	None	-	-	-	
00103	U	HOWARD AVENUE	INTERSTATE-95	10	75.1	182.7	1 & 4	None	-	-	-	
00104	U	WORDIN AVENUE NO. 2	INTERSTATE-95	8	102.0	154.2	1	None	-	-	-	
00105A	U	METRO NORTH & CITY STS	INTERSTATE-95	10	2196.9	154.2	3 & 4	Type 1	$6,308,876	-	-	
00106	U	MYRTLE AVENUE NO. 1	INTERSTATE-95	7	76.1	154.2	1 & 4	Type 6	-	-	$6,625,473	
03535	U	INTERSTATE-95	RT 8 NB & TR 806	15	610.89	159.0	4 & 9	None	-	-	-	Ramp Location
00107	U	WARREN STREET	INTERSTATE-95	6	76.1	152.2	1 & 4	None	-	-	-	
00108	U	LAFAYETTE STREET NO. 2	INTERSTATE-95	7	87.9	152.2	1 & 4	Type 1	$7,274,180	-	-	
00110A	U	BROAD STREET	INTERSTATE-95	9	111.9	175.2	1 & 4	Type 1	$368,561	-	-	
00144	U	INTERSTATE-95	WEST RIVER STREET	6	178.15	129.0	7	Type 6	-	-	$3,989,079	Hotspot location
00145	U	WEPAWAUG RIVER	INTERSTATE-95	6	50.9	0.0	5	None	-	-	-	Culvert, Hotspot Location
00146	U	ROUTE 121	INTERSTATE-95	6	57.1	125.0	1	Type 1	$583,924	-	-	Hotspot Location
00147	U	ORANGE AVENUE	INTERSTATE-95	6	67.9	125.0	1	Type 1	$694,668	-	-	Hotspot Location
00148	U	INTERSTATE-95	FOREST ROAD	8	204.07	129.0	4 & 8	Type 6	-	-	$4,569,442	Hotspot location
00150	U	INDIAN RIVER	INTERSTATE-95	6	89.9	124.7	1	Type 1	$949,006	-	-	Hotspot Location
00151	U	EAST TOWN ROAD	INTERSTATE-95	7	107.0	135.2	3 & 4	Type 1	$1,209,394	-	-	Hotspot Location
								Subtotal Cost :	**$88,946,907**	**$35,561,787**	**$387,640,796**	

Notes:

1. As per "Bridge Inventory Database" Design Loads for all the structures are either H20 or HS20.
2. LRFR Load Rating reports are availabe only for few of the structures on Project wise. Code Compliant structures include all structures built after 2003 and structures for which LRFR R.F is > 1.
3. Non-Code Compliant structures include structures built before 2003 for which LRFR R.F are currently unavailable. LRFR Ratings shall be required to determine wether the structure is in compliance with the current codes (current design loads).

LEGEND:

Bridge Category 1 - Single Span Bridges with Full Height Abutments
Bridge Category 2 - Single Span Bridges with Stub Abutments
Bridge Category 3 - Multispan Bridges
Bridge Category 4 - Bridges with Ramp Approaches
Bridge Category 5 - Culverts
Bridge Category 6 - Bridges with Full Height Abutments & no setbacks
Bridge Category 7 - Bridges with Full Height Abutments & setbacks from the edge of pavement (Semi Stub)
Bridge Category 8 - Bridges with Stub Abutments
Bridge Category 9 - Bridges with Shoulder Piers and Stub Abutments

U - Unconstrained
C - Constrained

	Unit	Unit Price	Additional	
Type 1 - Bridge Widening	ft^2	$500	$750	per ft
Type 2 - Superstructure Replacement	ft^2	$325	$75	per sf of existing area
Type 3 - Deck Replacement	ft^2	$150		
Type 4 - Addition of Retaining Wall	ft^2	$200		
Type 5 - Addition of Concrete Barrier Curb	ft	$200		
Type 6 - Complete Bridge Replacement	ft^2	$525		

KEY

No Modification
Some Modification
Deck/Superstructure Replacement
Total Replacement

Forecasted Work Needed before 2040

Structure Number	Route Number (5D)	Town Code	Facility Carried	Features Intersected	Location (09)	Km point (11)	Latitude (16)	Longitude (17)	Bridge Management Forecast Work Needed Before 2040 *	Remarks
00001	95	00056	INTERSTATE-95	BYRAM RIVER S WATER ST	I95 AT N Y STATE LINE	0.129	41003600	73393600	Replace with a wider bridge	NYSTA may have lead responsibility
00002	95	00056	INTERSTATE-95	RIVER AVENUE	0.2 MI EAST OF NY LINE	0.274	41004800	73392400	Deck Replacement, super & sub rehab	
00003		00056	JAMES STREET	INTERSTATE-95					Bridge Replacement	
00004	95	00056	INTERSTATE-95	DELAVAN AVENUE	DELVAN AVENUE 08 E NYS	1.255	41001200	73390000	Bridge Replacement	
00005	95	00056	INTERSTATE-95	RITCH AVENUE	RITCH AV.5 MILE E OF EX.2	2.06	41003600	73384200	Rehab	
00006	95	00056	INTERSTATE-95	FIELD POINT ROAD	0.3 MI EAST OF EXT 3	3.556	41010600	73375400	none	
00007	95	00056	INTERSTATE-95	SHORE ROAD # 1	WEST of EXIT 3	3.862	41011200	73374200	Bridge Replacement	
00008	95	00056	INTERSTATE-95	HORSENECK CREEK	NEAR EXIT 3	3.91	41011200	73374200	Rehab	Culvert
00009	95	00056	INTERSTATE-95	ARCH STREET	ROUTE I 95 EXIT 3	4.087	41011200	73373600	Superstructure replacement	Work recommended due to underclearances
00010	95	00056	INTERSTATE-95	STEAMBOAT ROAD	1 MI EAST OF EX 3	4.312	41011200	73372400	none	
00011	95	00056	INTERSTATE-95	DAVIS STREET	.4 MI EAST OF EX 3	4.779	41011800	73370600	none	
00012	95	00056	INTERSTATE-95	DAVIS MILL POND	BETWEEN EXITS 3 & 4	5.052	41012400	73365400	none	
00013		00056	INDIAN FIELD ROAD	INTERSTATE-95					none	
00014	95	00056	INTERSTATE-95	METRO NORTH RR & STATION	COS COB RR STA @ EXIT 4	6.468	41014200	73360600	none	
06015	95	00056	INTERSTATE-95	MIANUS RIVER & LOCAL RDS	BETWEEN EXITS 4 & 5				none	
00016		00056	RIVERSIDE AVENUE	INTERSTATE-95					Replace	Underclearances equal to present minimum criteria
00017		00056	LOCKWOOD LANE	INTERSTATE-95					none	
00018		00056	I-95 RAMPS TO US 1	INTERSTATE-95					Deck Replacement, super & sub rehab	
00019	95	00056	INTERSTATE-95	SOUND BEACH AVENUE	0.2 M EAST OF I95 EXIT 5	9.252	41023200	73342800	Rehab	
02565	95	00056	INTERSTATE-95	BROOK	WESTPORT-FAIRFIELD T.L.	36.009	41074800	73174800	Rehab	Culvert
00020	95	00056	INTERSTATE-95	FERRIS DRIVE	0.3 M EAST OF I-95 EXIT 5	9.461	41023600	73341800	Rehab	
00021	95	00056	INTERSTATE-95	LADDINS ROCK ROAD	.1 MI WEST GR STAMFORD TL	9.96	41024200	73340000	Rehab	
02566	95	00135	INTERSTATE-95	BROOK	WESTPORT-FAIRFIELD T.L.	36.009	41074800	73174800	Rehab	Culvert
00022	95	00135	INTERSTATE-95	HARVARD AVENUE	.2 MI E OF GR STAMFORD TL	10.459	41024200	73333600	Rehab	
00023	95	00135	INTERSTATE-95	WEST AVENUE	INTERSTATE-95 EXIT NO. 6	10.652	41023600	73333000	Bridge Replacement	Underclearances somewhat better than minimum adequacy
00024		00135	WILSON AVENUE	INTERSTATE-95					Bridge Replacement	
00025		00135	FAIRFIELD AVENUE 1	INTERSTATE-95					Bridge Replacement	Underclearances equal to present minimum criteria
00026	95	00135	I-95 &I-95 RAMP 023	GREENWICH AVE RIPPOWAM	INTERSTATE-95 EXIT NO. 7	11.746	41024700	73324600	Rehab	
00027	95	00135	INTERSTATE-95	SSR 493(WASHINGTON BLVD)	AT RAILROAD STATION	12.019	41024800	73323600	Deck Replacement, super & sub rehab	
00028	95	00135	INTERSTATE-95	ATLANTIC STREET	I-95 NB EXIT NO. 8	12.341	41025400	73322400	none	
00029	95	00135	INTERSTATE-95	CANAL STREET	BETWEEN EXITS 7&8	12.695	41025400	73321200	none	
00031	95	00135	INTERSTATE-95	ELM STREET	I-95 EXIT NOS. 7 & 8	13.194	41030600	73314800	Superstructure replacement, substructure rehab	May need full replacement - needs further research
00032	95	00135	I-95 & I-95 RAMPS	MNRR & LOCAL ROADS	0.2 MI EAST OF EXIT 8 NB	13.516	41031200	73314200	Bridge Replacement	Short term rehab planned, but needs replacement
00033	95	00135	INTERSTATE-95	MAPLE AVENUE	0.1 MI S OF US ROUTE 1	13.934	41031800	73312400	Rehab	
00034	95	00135	INTERSTATE-95	LOCKWOOD AVENUE	0.5 MI S OF US ROUTE 1	14.063	41031800	73311800	Rehab	
00035		00135	MAHER ROAD	INTERSTATE-95					Rehab	
00036		00135	BLACHLEY ROAD	INTERSTATE-95					Rehab	
00037		00135	US ROUTE 1	INTERSTATE-95					Superstructure replacement, substructure rehab	Superstructure replacement planned for 2018
00038	95	00135	INTERSTATE-95	HAMILTON AVENUE	0.2 MI N OF US ROUTE 1	15.269	41033600	73303600	none	
00039	95	00135	INTERSTATE-95	NOROTON RIVER	STAMFORD\DARIEN TOWN LINE	15.495	41034200	73303000	Rehab	Culvert
00040	95	00035	INTERSTATE-95	BROOKSIDE DRIVE	0.2 MI S OF SERVICE AREA	15.575	41034800	73303000	Bridge Replacement	Will need replacement primarily due to substructure condition
00041		00035	HOLLOW TREE RDG RD	INTERSTATE 95					Rehab	
00042		00035	NOROTON AVENUE	INTERSTATE 95					Bridge Replacement	Underclearances Intolerable - high priority of corrective action
00043	95	00035	INTERSTATE-95	US ROUTE 1	JCT OF US1 EXIT 11	18.68	41041800	73283000	Bridge Replacement	Underclearances meet minimum tolerable limits
00044	95	00035	INTERSTATE-95	KINGS HWY-GOODWIVES RV	0.4 MI S OF ROUTE 136	19.115	41042400	73281200	Bridge Replacement	
00045	95	00035	INTERSTATE-95	ROUTE 136	JCT RT 136 EXIT 12	19.678	41043600	73275400	Bridge Replacement	
00046	95	00035	INTERSTATE-95	METRO NORTH RAILROAD	275 FT N OF ROUTE 136	19.759	41043600	73274800	Superstructure replacement	
00047		00035	OLD KINGS HWY N #1	INTERSTATE-95					Bridge Replacement	
00048	95	00102	INTERSTATE-95	I-95 RMP 047/FIVE MI RIV	I-95 NB EXIT NO. 13	21.432	41052400	73271200	Rehab	
00049	95	00102	INTERSTATE-95	RICHARDS AVENUE	0.4 M EAST OF I95 EXIT 13	21.834	41052400	73265400	Rehab	
00050	95	00102	INTERSTATE-95	KEELER AVENUE	1.0 MI N OF US ROUTE 1	22.301	41451592	72384915	Deck Replacement, super & sub rehab	
00051		00102	RAMPART ROAD	INTERSTATE-95					none	
00052		00102	SCRIBNER AVENUE	INTERSTATE-95					Bridge Replacement	Underclearances Intolerable - high priority of corrective action
00053		00102	TAYLOR AVENUE	INTERSTATE-95					none	Ongoing Project - 102-278
00054		00102	CEDAR STREET	INTERSTATE-95					none	Ongoing Project - 102-278
00055		00102	FAIRFIELD AVENUE	INTERSTATE-95					none	Ongoing Project - 102-278
00056		00102	STUART AVENUE	INTERSTATE-95					Bridge Replacement	
03562		00102	US ROUTE 7	INTERSTATE-95					Rehab	
00057	95	00102	INTERSTATE-95	WEST AVENUE	160 FT N OF US ROUTE 7	24.972	41062400	73251200	Deck Replacement, super & sub rehab	
00058	95	00102	INTERSTATE-95	CRESCENT ST & METRO NO	.2 MI WEST OF NORWALK RV	25.261	41062300	73245800	Bridge Replacement	
00059	95	00102	INTERSTATE-95	NORWALK RV HENDRICKS AVE	BETWEEN EXITS 15 & 16	25.599	41062400	73244800	consider Bridge Replacement	Upcoming Project - 102-348
00060		00102	EAST AVENUE #1	INTERSTATE-95					Bridge Replacement	To be replaced under Project #102-331
00061		00102	STRAWBERRY HILL AV	INTERSTATE-95						Superstructure to be replaced under Project #102-295
00062	95	00158	INTERSTATE-95	ROUTE 33	I-95 AT EXIT NO. 17	29.171	41071200	73222400		Superstructure to be replaced under Project #102-295
00063	95	00158	INTERSTATE-95	FRANKLIN STREET	0.1 MI N OF ROUTE 33	29.3	41071200	73222400	none	
00064	95	00158	INTERSTATE-95	ROUTE 136 & SAUGATUCK R	BETWEEN EXIT 17 & 18 I-95	29.445	41071407	73221383	none	
00065	95	00158	INTERSTATE-95	COMPO ROAD SOUTH	BETWEEN EXIT 17 AND 18	30.233	41080000	73254200	none	
00066		00158	HALES ROAD	INTERSTATE-95					Bridge Replacement	Superstructure replacement may be an alternate
00067		00158	HILLS POINT ROAD	INTERSTATE-95					Bridge Replacement	Superstructure replacement may be an alternate
02571	95	00158	INTERSTATE-95	MUDDY BROOK	WESTPORT-FAIRFIELD T.L.	36.009	41074800	73174800	Culvert Rehab	Culvert
00068		00158	SSR 476	INTERSTATE-95					Bridge Replacement	
00069		00158	BEACHSIDE AVENUE	INTERSTATE-95					Deck Replacement, super & sub rehab	Upcoming Project - 158-206
00070	95	00158	INTERSTATE-95	NEW CREEK ROAD	BETWEEN EXITS 18 & 19	34.175	41072400	73185400	Bridge Replacement	Underclearances meet minimum tolerable limits
00071	95	00158	INTERSTATE-95	MAPLE LANE	0.4 MI S OF SASCO CRK RD	34.69	41072400	73183600	Bridge Replacement	
00072		00158	SASCO CREEK ROAD	INTERSTATE-95					Bridge Replacement	
00073	95	00050	INTERSTATE-95	SASCO CREEK	WESTPORT-FAIRFIELD T.L.	36.009	41074800	73174800	Rehab	Culvert
00074	95	00050	INTERSTATE-95	WESTWAY ROAD	0.1 MILE SOUTH OF EXIT 19	36.412	41080000	73173600	none	
00075	95	00050	INTERSTATE-95	CENTER STREET	I-95 EXIT NO. 19	36.814	41081200	73172400	none	
00076	95	00050	INTERSTATE-95	OLD POST ROAD	EXIT 19	37.087	41081800	73171800	none	
00077	95	00050	INTERSTATE-95	U.S. ROUTE 1	EXIT 19	37.2	41081800	73171200	Bridge Replacement	
00078		00050	MILL HILL ROAD	INTERSTATE-95					Deck Replacement, super & sub rehab	
00079	95	00050	INTERSTATE-95	BRONSON ROAD NO. 1	INTERSTATE-95 EXIT 20	38.165	41083000	73164200	none	
00080	95	00050	INTERSTATE-95	MILL RIVER	EXIT 20	38.407	41083000	73163000	Deck Replacement, super & sub rehab	
00081	95	00050	INTERSTATE-95	NORTH PINE CREEK ROAD	BETWEEN EXITS 20 & 21	38.922	41083600	73160600	Rehab	
00082	95	00050	INTERSTATE-95	MILL PLAIN ROAD	INTERSTATE-95 EXIT NO 21	39.227	41083600	73155400	Deck Replacement, super & sub rehab	
00083	95	00050	INTERSTATE-95	UNQUOWA ROAD	0.5 MI S OF ROUTE 135	39.758	41084200	73153600	Deck Replacement, super & sub rehab	
00084	95	00050	INTERSTATE-95	ROUND HILL ROAD	0.2 MI S OF ROUTE 135	40.273	41084800	73151200	Deck Replacement, super & sub rehab	
00085	95	00050	INTERSTATE-95	ROUTE 135	I-95 SB EXIT NO. 22	40.563	41085400	73150000	Rehab	
00086		00050	US ROUTE 1 SB	INTERSTATE-95					Bridge Replacement	
00087		00050	MEADOWBROOK ROAD	INTERSTATE-95					Bridge Replacement	
00088	95	00050	INTERSTATE-95	US ROUTE 1 SOUTHBOUND	1.4 MI. SO. BRIDGEPORT TL	41.77	41093000	73143600	Deck Replacement, super & sub rehab	
00089	95	00050	INTERSTATE-95	GRASMERE AVENUE	0.1 MILE NORTH OF EXIT 23	41.866	41093000	73143600	Deck Replacement, super & sub rehab	
00090	95	00050	INTERSTATE-95	NEW ENGLAND AVENUE	BETWEEN EXIT 23 & 24	42.285	41094200	73142400	Deck Replacement, super rehab	
00091	95	00050	INTERSTATE-95	SUNSET AVENUE	0.2 MI S OF US ROUTE 1	42.526	41094800	73141800	Rehab	
00092	95	00050	INTERSTATE-95	US ROUTE 1 SOUTHBOUND	EXIT 24	42.88	41095400	73141200	Deck Replacement, super & sub rehab	
00093	95	00050	INTERSTATE-95	US ROUTE 1 NORTHBOUND	AT EXIT 24	42.992	41095400	73140000	Bridge Replacement	
00094	95	00050	INTERSTATE-95	CHAMBERS STREET	AT I-95 SB EXIT NO. 24	43.121	41095400	73135400	Rehab	
00095	95	00050	INTERSTATE-95	BRENTWOOD AVENUE	0.3 MI N OF US ROUTE 1	43.491	41100000	73134200	Deck Replacement, super & sub rehab	
00096	95	00050	INTERSTATE-95	COOLIDGE STREET	0.4 MI S OF ROUTE 130	43.845	41100600	73133000	none	
01680	95	00050	INTERSTATE-95	ASH CREEK	0.4 MI S OF ROUTE 131	43.845	41100600	73133000	none	Culvert
00098	95	00015	INTERSTATE-95	COMMERCE DRIVE	I-95 VICINITY EXIT 25	44.135	41100600	73131800	none	
00099	95	00015	INTERSTATE-95	METRO NORTH RAILROAD	BETWEEN EXITS 24 & 25	44.248	41100300	73131400	none	
00100	95	00015	INTERSTATE-95	ROUTE 130 (FAIRFIELD AV)	0.5 M N OF EXT 24 I-95 SB	44.473	41100000	73130600	none	

Structure Number	Route Number (5D)	Town Code	Facility Carried	Features Intersected	Location (09)	Km point (11)	Latitude (16)	Longitude (17)	Bridge Management Forecast Work Needed Before 2040 *	Remarks
00101	95	00015	INTERSTATE-95	BOSTWICK AVE	0.3 MI N OF ROUTE 130	44.907	41095400	73125400	Bridge Replacement	Superstructure replacement may be an alternate
00102	95	00015	INTERSTATE-95	HANCOCK AVENUE	1.0 MI S OF ROUTE 8	45.068	41095400	73123600	none	
00103	95	00015	INTERSTATE-95	HOWARD AVENUE	0.8 MI S OF ROUTE 8	45.261	41095400	73123000	none	
00104	95	00015	INTERSTATE-95	WORDIN AVENUE NO. 2	0.7 MI S OF ROUTE 8	45.519	41095400	73121800	none	
00105A	95	00015	INTERSTATE-95	METRO NORTH & CITY STS	I95 BETWEEN EXITS 26 & 27	45.857	41100000	73120600	none	May need substructure work
00106	95	00015	INTERSTATE-95	MYRTLE AVENUE NO. 1	150 FT S OF ROUTE 8	46.661	41101200	73113600	Bridge Replacement	SB Unconstrained & NB Constrained
03535		00015	RT 8 NB & TR 806	INTERSTATE-95					Deck rehab	Ramp Location
00107	95	00015	INTERSTATE-95	WARREN STREET	EXIT 27 I-95	46.774	41101200	73113000	none	
00108	95	00015	INTERSTATE-95	LAFAYETTE STREET NO. 2	0.1 MI N OF ROUTE 8	46.886	41101800	73112400	Superstructure rehab	
00109	95	00015	I-95 SB RAMP 305	NORTH FRONTAGE ROAD	EXIT 27 OFF I-95 SB	0.08	41102400	73112400	Bridge Replacement	
00112	95	00015	I-95 RAMP 093	NICHOLS STREET	ON RAMP TO I-95 SOUTH	0.145	41104800	73105400	Deck Replacement, super & sub rehab	
00113	95	00015	INTERSTATE-95	ROUTE 127	.2 M-N OF EXT 28 OF I-95N	48.045	41104200	73105200	none	
00114	95	00015	INTERSTATE-95	PEMBROKE STREET	0.1 MI N OF ROUTE 127	48.206	41104800	73104800	none	
00117	95	00015	I-95 SB RAMP 355	ROUTE 130 EB	I-95 SOUTHBOUND EXIT 29	0.402	41103600	73101421	none	
00118	95	00015	INTERSTATE-95	BEARDSLEY STREET	0.6 MI S OF ROUTE 113	49.107	41103000	73100852	Rehab	
00119	95	00015	INTERSTATE-95	NEWFIELD AVENUE	0.4 MI S OF ROUTE 113	49.3	41103000	73100000	none	
00120	95	00015	INTERSTATE-95	CENTRAL AVENUE	0.4 MI N OF ROUTE 130	49.477	41103000	73095400	Rehab	
00121	95	00015	INTERSTATE-95	UNION AVENUE	0.4 MI N OF ROUTE 130	49.622	41103000	73094800	Rehab	
00122	95	00015	INTERSTATE-95	RTE 113 (HOLLISTER AVE.)	0.7 MI N OF ROUTE 130	49.992	41103000	73091800	Bridge Replacement	
00110A	95	00015	INTERSTATE-95	BROAD STREET	0.2 MI N OF ROUTE 8	47.079	41102400	73112400	none	
00110B	95	00015	I-95 NB TR 806	BROAD STREET	0.5 MI S OF ROUTE 8 SB	0.241	41102400	73111800	none	
00111A	95	00015	INTERSTATE-95	BPORT HARBOR RT 130 MNRR	I-95 EXIT 27 - EXIT 28	47.192	41102400	73111800	Deck Replacement, super & sub rehab	
00111B	95	00015	I-95 NB Ramp 092	Route 130 & KOSSUTH	I-95NB EXIT 28 (Off Ramp)	0.161	41104200	73105400	none	
00111C	95	00015	I-95 RAMP 093	KOSSUTH STREET	I-95 SB ON-RAMP EXIT 28	0.145	41104200	73110000	none	
00115A	95	00015	INTERSTATE-95	YELLOW MILL POND&RTE 130	INTERSTATE-95 EXIT 29	48.383	41104200	73103600	Rehab	
00115B	95	00015	I-95 RAMP 097	RT 130&YELLOW MILL POND	I-95 NB EXIT 29 OFF RAMP	48.608	41103600	73102400	none	
00115C	95	00015	I-95 RAMP 096	SEAVIEW AVE&YLLW MILL PD	RAMP FROM RT 130 TO I95SB	0	41104200	73102400	none	
00143		00083	INTERSTATE-95	SR 796 (MILFORD PARKWAY)					Rehab	
00144		00083	WEST RIVER STREET	INTERSTATE-95					Bridge Replacement	Hotspot location
00145		00083	INTERSTATE-95	WEPAWAUG RIVER					Culvert Rehab	Culvert, Hotspot Location. Consider full replacement.
00146		00083	INTERSTATE-95	ROUTE 121					Rehab	Hotspot Location
00147		00083	INTERSTATE-95	ORANGE AVENUE					Deck rehab	Hotspot Location
00148		00083	FOREST ROAD	INTERSTATE-95					Bridge Replacement	Hotspot location
00149		00083	INTERSTATE-95	Rt 1 BOSTON POST RD					Bridge Replacement	Underclearances Intolerable - high priority of corrective action
00150		00083	INTERSTATE-95	INDIAN RIVER					Rehab	Hotspot Location
00151		00083	INTERSTATE-95	EAST TOWN ROAD					Rehab	Hotspot Location

* Includes all major component (deck, superstructure, substructure) replacements needed before 2040 (less than 10 years after the mid-point of construction) and major rehab work that will likely be needed while the widening project is in construction. Minor rehab work (joint replacement, ovelays, etc.) is not included.

The work shown is the optimum given life cycle cost analysis. Prioritization against other projects given limited funding is not considered. In reality, due to budget constraints, some of this work may be postponed or reduced in scope.

KEY

- Complete Replacement of bridge recommended
- Superstructure Replacement recommended
- Superstructure Replacement planned

I-95 Improvements - Feasibility Evaluation and Phasing Study (Greenwich to New Haven)

Low midpoint of expenditure:	**2030**
Base midpoint of expenditure:	**2035**
High midpoint of expenditure:	**2040**
Base year:	**2017**
LowInflation %:	**3.5%**
Base Inflation %:	**3.75%**
High Inflation %:	**4.0%**
Phase of Development:	**Preliminary Engineering**

TOTAL DIRECTIONAL COST SUMMARY

Activity	Low Cost/Mile	Base Cost/Mile	High Cost/Mile	Base Cost Percent of Total
Bituminous Pavement	$2,488,412.06	$2,619,381.12	$3,405,195.46	3.4%
Excavation & Borrow	$297,052.46	$330,058.29	$462,081.60	0.4%
Drainage	$654,474.52	$688,920.55	$895,596.71	0.9%
Metal Beam Rail and Concrete Median Barrier	$537,593.76	$597,326.40	$657,059.04	0.8%
Highway Lighting	$475,200.00	$528,000.00	$633,600.00	0.7%
Concrete Pavement Repair	$456,300.00	$507,000.00	$709,800.00	0.7%
Noise Barrier Wall	$2,507,946.67	$3,134,933.33	$3,448,426.67	4.1%
Signing	$183,810.36	$204,233.73	$255,292.16	0.3%
Retaining Walls	$315,400.00	$394,250.00	$512,525.00	0.5%
Pavement Markings	$8,494.20	$9,438.00	$10,381.80	0.0%
Interchange Improvements	$3,293,333.33	$3,466,666.67	$4,506,666.67	4.5%
Wetland Mitigation	$2,224.86	$2,472.07	$2,966.48	0.0%
Structure Replacement / Modification	$11,638,747.67	$21,262,081.00	$24,515,824.83	27.7%
Percentage Based Contract Items	$6,911,577.00	$10,079,605.00	$13,783,072.00	13.1%
Construction Subtotal	**$29,770,566.89**	**$43,824,366.15**	**$53,798,488.42**	**57.0%**

MINOR ITEM ALLOWANCE

	Low Cost Percentage	Base Cost Percentage	High Cost Percentage	Low Cost/Mile	Base Cost/Mile	High Cost/Mile	Base Cost Percent of Total
Minor Item Allowance	15%	25%	30%	$4,465,585.00	$10,956,092.00	$16,139,547.00	14.3%
Minor Item Allowance Subtotal				**$4,465,585.00**	**$10,956,092.00**	**$16,139,547.00**	**14.3%**

NON-CONTRACT ITEMS

	Low Cost Percentage	Base Cost Percentage	High Cost Percentage	Low Cost/Mile	Base Cost/Mile	High Cost/Mile	Base Cost Percent of Total
State Police	1.5%	2.5%	3.5%	$513,542.00	$1,369,511.00	$2,447,831.00	1.8%
Intelligent Transportation System (ITS)	N/A	N/A	N/A	$750,000.00	$1,000,000.00	$1,500,000.00	1.3%
Environmental Compliance	4%	5%	6%	$1,369,446.00	$2,739,023.00	$4,196,282.00	3.6%
Right-of-Way	N/A	N/A	N/A	$1,569,320.83	$1,651,916.67	$2,147,491.67	2.1%
NEPA Documentation	2%	3%	4%	$684,723.00	$1,643,414.00	$2,797,521.00	2.1%
Program Management	4%	5%	6%	$1,369,446.00	$2,739,023.00	$4,196,282.00	3.6%
Design	9%	10%	11%	$3,081,254.00	$5,478,046.00	$7,693,184.00	7.1%
Construction Engineering & Inspection	9%	10%	11%	$3,081,254.00	$5,478,046.00	$7,693,184.00	7.1%
Non-Contract Items Subtotal				**$12,418,985.83**	**$22,098,979.67**	**$32,671,775.67**	**28.7%**

CONTRACT DIRECTIONAL COST SUMMARY - WITHOUT RISK ANALYSIS
(Refer to Section 7.1 of the Tech Memo for 95% Confidence Cost)

	Low Cost/Mile	Base Cost/Mile	High Cost/Mile
Contract, Including Minor Item Allowance and Contingency in Base Year	**$46,655,138.00**	**$76,879,438.00**	**$102,609,811.00**
Contract, Including Minor Item Allowance, Contingency, and Inflation	**$67,883,226.00**	**$128,773,059.00**	**$197,010,837.00**
Total Contract Cost (Northbound & Southbound) Including Minor Item Allowance, Contingency, and Inflation	**$4,072,993,560.00**	**$7,726,383,540.00**	**$11,820,650,220.00**

Bituminous Pavement

Full Depth Pavement Section										
Item No.	**Item Description**	**Units**	**Width (ft)**	**Depth (in)**	**Length (mi)**	**Conversion Factor (tons/sy/in)**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0406171	HMA S0.5	Ton	24	4	60	0.0575	194,300	$89.00	$17,292,700.00	$288,211.67
0406170	HMA S1	Ton	24	8	60	0.0575	388,610	$89.00	$34,586,290.00	$576,438.17
0304002	Processed Aggregate Base	CY	24	10	60	N/A	234,670	$39.00	$9,152,130.00	$152,535.50
0212000	Subbase	CY	24	12	60	N/A	281,600	$46.00	$12,953,600.00	$215,893.33
0209001	Formation of Subgrade	SY	24	N/A	60	N/A	844,800	$2.00	$1,689,600.00	$28,160.00
								Total	**$75,674,320.00**	**$1,261,238.67**
Item No.	**Item Description**	**Units**	**Width (ft)**	**Length (mi)**	**Number of Applications**	**Conversion Factor (gal/sy)**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0406236	Material for Tack Coat	GAL	24	60	4	0.18	608,260	$5.00	$3,041,300.00	$50,688.33
								Total	**$3,041,300.00**	**$50,688.33**

Additional Full Depth Pavement for Left Shoulder Widening										
Item No.	**Item Description**	**Units**	**Width (ft)**	**Depth (in)**	**Total Length of I-95 Requiring Left Shoulder Widening (mi)**	**Conversion Factor (tons/sy/in)**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0406171	HMA S0.5	Ton	6.3	4	21.6	0.0575	18,360	$89.00	$1,634,040.00	$27,234.00
0406170	HMA S1	Ton	6.3	8	21.6	0.0575	36,720	$89.00	$3,268,080.00	$54,468.00
0304002	Processed Aggregate Base	CY	6.3	10	21.6	N/A	22,180	$39.00	$865,020.00	$14,417.00
0212000	Subbase	CY	6.3	12	21.6	N/A	26,610	$46.00	$1,224,060.00	$20,401.00
0209001	Formation of Subgrade	SY	6.3	N/A	21.6	N/A	79,834	$2.00	$159,667.20	$2,661.12
								Total	**$7,150,867.20**	**$119,181.12**
Item No.	**Item Description**	**Units**	**Width (ft)**	**Total Length of I-95 Requiring Left Shoulder Widening (mi)**	**Number of Applications**	**Conversion Factor (gal/sy)**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0406236	Material for Tack Coat	GAL	6.3	21.6	4	0.18	57,480	$5.00	$287,400.00	$4,790.00
								Total	**$287,400.00**	**$4,790.00**

Additional Full Depth Pavement for Left Shoulder Widening Notes:
Width of NB/SB left shoulder between Exit 7 and Exit 9 = 4', Length = 2.30 miles
Width of NB/SB left shoulder between Exit 9 and Exit 15 = 7', Length = 6.1 miles
Width of NB/SB left shoulder between Exit 15 and Exit 17 = 4', Length = 2.40 miles
Average width of left shoulder widening = 6.30' for a Length of 21.6 miles, both directions

Wedge Course for Shifting Crownline										
Item No.	**Item Description**	**Units**	**Width (ft)**	**Depth (in)**	**Length (mi)**	**Conversion Factor (tons/sy/in)**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0406171	HMA S0.5	Ton	24	0.5	60	0.0575	24,290	$89.00	$2,161,810.00	$36,030.17
								Total	**$2,161,810.00**	**$36,030.17**

Mill and Overlay Pavement Section										
Item No.	**Item Description**	**Units**	**Width (ft)**	**Depth (in)**	**Length (mi)**	**Conversion Factor (tons/sy/in)**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0406171	HMA S0.5	Ton	48	6	60	0.0575	582,910	$89.00	$51,878,990.00	$864,649.83
0406268	Milling of HMA (Over 4" to 8")	SY	48	N/A	60	N/A	1,689,600	$5.00	$8,448,000.00	$140,800.00
								Total Cost	**$60,326,990.00**	**$1,005,449.83**
Item No.	**Item Description**	**Units**	**Width (ft)**	**Length (mi)**	**Number of Applications**	**Conversion Factor (gal/sy)**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0406236	Material for Tack Coat	GAL	48	60	3	0.18	912,380	$5.00	$4,561,900.00	$76,031.67
								Total	**$4,561,900.00**	**$76,031.67**

Additional Full Depth Pavement for Concrete Base Replacement										
Item No.	**Item Description**	**Units**	**Width (ft)**	**Depth (in)**	**Length (mi)**	**Conversion Factor (tons/sy/in)**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0406171	HMA S0.5	Ton	36	0	3	0.0575	0	$89.00	$0.00	$0.00
0406170	HMA S1	Ton	36	6	3	0.0575	21,860	$89.00	$1,945,540.00	$32,425.67
0304002	Processed Aggregate Base	CY	36	10	3	N/A	17,600	$39.00	$686,400.00	$11,440.00
0212000	Subbase	CY	36	12	3	N/A	21,120	$46.00	$971,520.00	$16,192.00
0209001	Formation of Subgrade	SY	36	N/A	3	N/A	63,360	$2.00	$126,720.00	$2,112.00
								Total	**$3,730,180.00**	**$62,169.67**
Item No.	**Item Description**	**Units**	**Width (ft)**	**Length (mi)**	**Number of Applications**	**Conversion Factor (gal/sy)**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0406236	Material for Tack Coat	GAL	36	3	4	0.18	45,620	$5.00	$228,100.00	$3,801.67
								Total	**$228,100.00**	**$3,801.67**

Additional Full Depth Pavement for Concrete Base Replacement Notes:
Assumed 5% of the existing concrete base course will need to be replaced (60 miles * 5% = 3 miles)

	Total Cost	**Low Total Cost/Mile**	**Base Total Cost/Mile**	**High Total Cost/Mile**
Total Cost for Bituminous Pavement	**$145,766,320.00**	**$2,488,412.06**	**$2,619,381.12**	**$3,405,195.46**

Risk (%) that Low Total Cost is Less Than Base Cost	**5%**
Risk (%) that High Total Cost is Greater Than Base Cost	**30%**

Excavation & Borrow

Excavation for Full Depth Widening Within Existing Right Shoulder									
Item No.	**Item Description**	**Units**	**Width (ft)**	**Depth (in)**	**Length (mi)**	**Quantity (CY)**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0202000	Earth Excavation	CY	10	34	60	332,440	$12.00	$3,989,280.00	$66,488.00

Total Project Length = 60 miles
Length of Northbound Lanes in Cut Section = 1.26 miles
Length of Southbound Lane in Cut Section = 3.30 miles
Percentage of Roadway in Cut Section = 8%, round to 10%

Excavation for Full Depth Widening Outside of Existing Right Shoulder							
Description		**Units**	**Width (ft)**	**Depth (in)**	**Length (mi)**	**Quantity (CY)**	
Pavement Excavation		CY	14	34	60	465,420	
Item No.	**Item Description**	**Units**	**Percentage Cut vs. Fill**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0202000	Earth Excavation	CY	10%	46,542	$12.00	$558,504.00	$9,308.40
0207000	Borrow	CY	90%	418,878	$10.00	$4,188,780.00	$69,813.00

Excavation for Additional Full Depth Pavement for Left Shoulder Widening									
Item No.	**Item Description**	**Units**	**Width (ft)**	**Depth (in)**	**Length (mi)**	**Quantity (CY)**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0202000	Earth Excavation	CY	6.3	34	21.6	75,400	$12.00	$904,800.00	$41,888.89

Total Length of Project in Cut Section = 4.56 Miles
Length of Northbound Lanes with Visible Rock Outcrops = 0.92 miles
Length of Southbound Lanes with Visible Rock Outcrops = 1.92 miles
Percentage of Roadway in Rock Excavation Section = 8%, round to 10%

Additional Excavation for Widening						
Description	**Units**	**Excavation Assumption (CY/LF)**	**Length (mi)**	**Quantity (CY)**		
Additional Excavation for Widening	CY	2	60	633,600		
Item No.	**Item Description**	**Units**	**Percentage Cut vs. Fill**	**Quantity**	**Unit Cost**	**Total Cost**	**Total Cost/Mile**
0202000	Earth Excavation	CY	90%	570,240	$12.00	$6,842,880.00	$114,048.00
0202100	Rock Excavation	CY	10%	63,360	$27.00	$1,710,720.00	$28,512.00

	Total Cost	**Low Total Cost/Mile**	**Base Total Cost/Mile**	**High Total Cost/Mile**
Total Cost for Excavation and Borrow	**$18,194,964.00**	**$297,052.46**	**$330,058.29**	**$462,081.60**

Risk (%) that Low Total Cost is Less Than Base Cost	**10%**
Risk (%) that High Total Cost is Greater Than Base Cost	**40%**

Drainage

Catch Basins

Item No.	Item Description	Units	Quantity	Catch Basin Spacing (LF)	Unit Cost	Length (mi)	Total Quantity (LF)	Total Cost	Total Cost/Mile
0507006	Type "C" Catch Basin	EA	1	300	$2,000.00	60	1056	$2,112,000.00	$35,200.00
0507449	Type "C-M" Catch Basin	EA	1	300	$2,300.00	60	1056	$2,428,800.00	$40,480.00

Notes:
Assume 1 Type "C" and 1 Type "C-M" Catch Basins Every 300 LF

Pipes

Longitudinal Pipes

Item No.	Item Description	Units	Number of Pipe Runs	Length of Project (mi)	Total Quantity (LF)	Unit Cost	Total Cost	Total Cost/Mile
0651015	24" R.C. Pipe	LF	1	60	316,800	$70.00	$22,176,000.00	$369,600.00

Notes:
Assume One 24" R.C. Pipe Run for Total Length

Crossing Pipes

Item No.	Item Description	Units	Length of Pipe Across Roadway (LF)	Spacing of Crossing Pipes (LF)	Length of Project (mi)	Total Quantity	Unit Cost	Total Cost	Total Cost/Mile
0651012	15" R.C. Pipe	LF	72	300	60	76,032	$60.00	$4,561,920.00	$76,032.00

Notes:
Assume new 15" R.C. Pipe crossing every 300 LF

Trench Excavation

Trench Excavation for Longitudinal Pipes

Description	Units	Pipe Size (in)	Total Length of 24" RCP	Trench Width (ft)	Trench Depth (ft)	Total Quantity
Trench Excavation	CY	24	316,800	4	6	281,600

Trench Excavation for Crossing Pipes

Description	Units	Pipe Size (in)	Total Length of 15" RCP	Trench Width (ft)	Trench Depth (ft)	Total Quantity
Trench Excavation	CY	15	76,032	3.25	6	54,912

Item No.	Item Description	Units	Percentage Non Rock vs. Rock	Quantity	Unit Cost	Total Cost	Total Cost/Mile
0205003	Trench Excavation 0'-10' Deep	CY	90%	302,861	$16.00	$4,845,772.80	$80,762.88
0205004	Rock In Trench Excavation 0'-10' Deep	CY	10%	33,651	$80.00	$2,692,096.00	$44,868.27

Notes:
Length of Trench Excavation Determined by Length of Pipe

Bedding Material

Item No.	Item Description	Units	Trench Width (ft)	Depth (in)	Unit Cost	Total Length of Pipe (LF)	Percentage Non Rock vs. Rock	Total Quantity	Total Cost	Total Cost/Mile
0651001	Bedding Material (For Non-Rock Areas) 24" RCP	CY	4	4	$50.00	316,800	90%	14080	$704,000.00	$11,733.33
0651001	Bedding Material (For Non-Rock Areas) 15" RCP	CY	3.25	4	$50.00	76,032	90%	2746	$137,300.00	$2,288.33
0651001	Bedding Material (For Rock Areas) 24" RCP	CY	4	12	$50.00	316,800	10%	4693	$234,650.00	$3,910.83
0651001	Bedding Material (For Rock Areas) 15" RCP	CY	3.25	12	$50.00	76,032	10%	915	$45,750.00	$762.50

Endwalls

Item No.	Item Description	Units	Quantity	Endwall Spacing (LF)	Unit Cost	Length (mi)	Total Quantity	Total Cost	Total Cost/Mile
0601000	Class "A" Concrete	CY	5.45	1100	$890.00	60	1569.6	$1,396,944.00	$23,282.40

Notes:
Assume One Standard Endwall for 24" R.C. Pipe Every 1100 LF

	Total Cost	Low Total Cost/Mile	Base Total Cost/Mile	High Total Cost/Mile
Total Cost for Drainage	**$41,335,232.80**	**$654,474.52**	**$688,920.55**	**$895,596.71**

Risk (%) that Low Total Cost is Less Than Base Cost	**5%**
Risk (%) that High Total Cost is Greater Than Base Cost	**30%**

Metal Beam Rail and Concrete Median Barrier

Metal Beam Rail								
Item No.	**Item Description**	**Units**	**Unit Cost**	**Length (mi)**	**Percentage of Fill Sections**	**Total Quantity**	**Total Cost**	**Total Cost/Mile**
0910170	Metal Beam Rail (Type R-B 350)	LF	$25.00	60	75%	237,600	$5,940,000.00	$99,000.00

End Treatments								
Item No.	**Item Description**	**Units**	**Unit Cost**	**Spacing (LF)**	**Length (mi)**	**Total Quantity**	**Total Cost**	**Total Cost/Mile**
0910021	R-B End Anchorage - Type 1	EA	$1,190.00	1000	60	316.8	$376,992.00	$6,283.20
0910025	Metal Beam Rail Terminal Element	EA	$1,390.00	1000	60	316.8	$440,352.00	$7,339.20

Concrete Median Barrier								
Item No.	**Item Description**	**Units**	**Unit Cost**	**Length (mi)**	**Percentage of Barrier Replaced**	**Total Quantity**	**Total Cost**	**Total Cost/Mile**
0821502	F-Shape Precast Concrete Barrier Curb (21" X 45")	LF	$102.00	60	90%	285,120	$29,082,240.00	$484,704.00

	Total Cost	**Low Total Cost/Mile**	**Base Total Cost/Mile**	**High Total Cost/Mile**
Total Cost for Metal Beam Rail and Concrete Median Barrier	**$35,839,584.00**	**$537,593.76**	**$597,326.40**	**$657,059.04**

Risk (%) that Low Total Cost is Less Than Base Cost	**10%**
Risk (%) that High Total Cost is Greater Than Base Cost	**10%**

Highway Lighting

Item Description	Units	Unit Cost	Spacing (LF)	Length (mi)	Total Quantity	Total Cost	Total Cost/Mile
Expressway Lighting (Conduit & Cable)	LF	$60.00	N/A	60	316,800	$19,008,000.00	$316,800.00
Individual Highway Pole & Light	EA	$10,000.00	250	60	1267.2	$12,672,000.00	$211,200.00

	Total Cost	Low Total Cost/Mile	Base Total Cost/Mile	High Total Cost/Mile
Total Cost for Highway Lighting	**$31,680,000.00**	**$475,200.00**	**$528,000.00**	**$633,600.00**

Risk (%) that Low Total Cost is Less Than Base Cost	**10%**
Risk (%) that High Total Cost is Greater Than Base Cost	**20%**

Concrete Pavement Repair

Project 35-176 Reconstruction of Median & Resurfacing of I-95, Exit 10-15	
Length of Project Per Direction NB/SB (ft)	25,565
Length of Project (miles)	4.84
Volume of Concrete Pavement Joint Replacement (CY)	2,075
Joint Spacing (ft)	40
Number of Concrete Joints in Project Area	640
Average Joint Replacement Width (ft)	10
Joint Replacement Length (ft) (three 12' travel lanes)	36
Depth of Existing Concrete Pavement (in)	9
Percentage of Joints Replaced Under Project	33%
Number of Joints Replaced Under Project	211

Project 56-258 Resurfacing and Safety Improvements on Route I-95, NY State Line to Exit 3	
Length of Project Per Direction NB/SB (ft)	11,780
Length of Project (miles)	2.23
Volume of Concrete Pavement Joint Replacement (CY)	520
Joint Spacing (ft)	40
Number of Concrete Joints in Project Area	295
Average Joint Replacement Width (ft)	10
Joint Replacement Length (ft) (three 12' travel lanes)	36
Depth of Existing Concrete Pavement (in)	9
Percentage of Joints Replaced Under Project	18%
Number of Joints Replaced Under Project	53

Project 56-246 Reconstruction of Median & Resurfacing of I-95, Exit 5-7	
Length of Project Per Direction NB/SB (ft)	12,049
Length of Project (miles)	2.28
Volume of Concrete Pavement Joint Replacement (CY)	500
Joint Spacing (ft)	40
Number of Concrete Joints in Project Area	302
Average Joint Replacement Width (ft)	10
Joint Replacement Length (ft) (three 12' travel lanes)	36
Depth of Existing Concrete Pavement (in)	9
Percentage of Joints Replaced Under Project	17%
Number of Joints Replaced Under Project	51

Concrete Pavement Repair Calculation	
Total Length of I-95 in Study Area (Both Directions) (miles)	60
Joint Spacing (ft)	40
Number of Concrete Joints in Project Area	7,920
Number of Concrete Joints Replaced Under 3 Previous Projects	315
Number of Concrete Joints Yet to be Replaced	7,605
Estimated Percentage of Joints to be Replaced Under Future Widening Project	**20%**
Average Joint Replacement Width (ft)	10
Joint Replacement Length (ft) (three 12' travel lanes)	36
Estimated Area of Joint Replacement Under Futire Widening Project (sf)	60,840
Unit Price for Precast Joints (sy)	$500.00
Total Cost for Joint Replacement	$30,420,000.00
Cost Per Mile for Joint Replacement	$507,000.00

	Total Cost	Low Total Cost/Mile	Base Total Cost/Mile	High Total Cost/Mile
Total Cost for Concrete Pavement Repair	**$30,420,000.00**	**$456,300.00**	**$507,000.00**	**$709,800.00**

Risk (%) that Low Total Cost is Less Than Base Cost	**10%**
Risk (%) that High Total Cost is Greater Than Base Cost	**40%**

Noise Barrier Wall

Northbound Lanes	Length (ft)
Total Length of Northbound Lanes	158,400
Length of Northbound Lanes Bordering Metro North RR	22,900
Length of Northbound Lanes Requiring Noise Barrier Wall	**135,500**

Southbound Lanes	Length (ft)
Total Length of Northbound Lanes	158,400
Length of Northbound Lanes Bordering Metro North RR	0
Length of Northbound Lanes Requiring Noise Barrier Wall	**158,400**

Total Length of Noise Barrier Wall (NB & SB)	**293,900**

Item No.	Item Description	Units	Unit Cost	Wall Height (ft)	Length (ft)	Total Quantity	Total Cost	Total Cost/Mile
0916126	Noise Barrier Wall	SF	$40.00	16	293,900	4,702,400	$188,096,000.00	$3,134,933.33

	Total Cost	Low Total Cost/Mile	Base Total Cost/Mile	High Total Cost/Mile
Total Cost for Noise Barrier Wall	**$188,096,000.00**	**$2,507,946.67**	**$3,134,933.33**	**$3,448,426.67**

Risk (%) that Low Total Cost is Less Than Base Cost	**20%**
Risk (%) that High Total Cost is Greater Than Base Cost	**10%**

Signing

Project No. 0172-0388	
Total Bid Price of Project No. 0172-0388	$2,319,733.00
Number of Interchanges Per Direction	26
Length of Project (Miles)	55
Cost Per Interchange Per Direction	$44,610.25

I-95 East Sign Replacement Cost	
Number of Interchanges Per Direction	28
Length of Project Per Direction(Miles)	30
Total Cost Per Direction	$1,249,087.00
Total Cost Per Mile	$41,636.00
Total Cost	$2,498,160.00

Notes:

Cost of sign replacement determined by the cost to complete Project No. 0172-0388, Replacement of Highway Signs on I-395. Project No. 0172-0388 had a letting date of 10/16/13, and a contract length of 480 calendar days

Overhead Sign Supports Including Cantilevers, Full Overhead (monotube), Full Overhead (Truss), OVH Truss Foundation, Drilled Shaft Foundation		
	Cost/Mile	**Total Cost**
Overhead Sign Supports	$162,597.73	$9,755,863.80

Notes:

Cost of overhead sign supports determined by the Department based on Project 173-351, which had a total cost of $1,817,843 for sign support structure replacements, and a total project length of 11.18 miles

	Total Cost	**Low Total Cost/Mile**	**Base Total Cost/Mile**	**High Total Cost/Mile**
Total Cost for Signing	**$12,254,023.80**	**$183,810.36**	**$204,233.73**	**$255,292.16**

Risk (%) that Low Total Cost is Less Than Base Cost	**10%**
Risk (%) that High Total Cost is Greater Than Base Cost	**25%**

Retaining Walls

Northbound		
Segment No.	Segment	Length of Retaining Walls (LF)
1	NY State Line to Exit 7	1376
2	Exit 7 to Exit 9	3853
3	Exit 9 to Exit 14	1024
4	Exit 14 to Exit 17	0
5	Exit 17 to Exit 20	1114
6	Exit 20 to Exit 25	400
7	Exit 25 to Exit 28	0
Northbound Total		**7767**

Southbound		
Segment No.	Segment	Length of Retaining Walls (LF)
1	NY State Line to Exit 7	1754
2	Exit 7 to Exit 9	2960
3	Exit 9 to Exit 14	1564
4	Exit 14 to Exit 17	0
5	Exit 17 to Exit 20	1725
6	Exit 20 to Exit 25	0
7	Exit 25 to Exit 28	0
Southbound Total		8003

Total Length of Retaining Walls (LF) (Northbound and Southbound)	15770
Average Height of Retaining Walls (LF)	10
Length of Project (Miles) (Northbound and Southbound)	60
Retaining Wall Unit Cost (SF)	$150.00

Notes:
Length of Retaining Walls determined from I-95 Combined Option from the October 2016 I-95 Improvements - Feasibility Evaluation and Phasing Study (Greenwich to New Haven)

	Total Cost	Low Total Cost/Mile	Base Total Cost/Mile	High Total Cost/Mile
Total Cost for Retaining Walls	**$23,655,000.00**	**$315,400.00**	**$394,250.00**	**$512,525.00**

Risk (%) that Low Total Cost is Less Than Base Cost	**20%**
Risk (%) that High Total Cost is Greater Than Base Cost	**30%**

Pavement Markings

Epoxy Resin Pavement Markings								
Item No.	**Item Description**	**Units**	**Unit Cost**	**Length (mi)**	**Number of Lines**	**Total Quantity**	**Total Cost**	**Total Cost/Mile**
1210101	4" White Epoxy Resin Pavement Markings	LF	$0.65	60	N/A	316,800	$205,920.00	$3,432.00
1210102	4" Yellow Epoxy Resin Pavement Markings	LF	$0.65	60	N/A	316,800	$205,920.00	$3,432.00
1210103	6" White Epoxy Resin Pavement Markings	LF	$0.65	60	3	237,600	$154,440.00	$2,574.00

	Total Cost	**Low Total Cost/Mile**	**Base Total Cost/Mile**	**High Total Cost/Mile**
Total Cost for Pavement Markings	**$566,280.00**	**$8,494.20**	**$9,438.00**	**$10,381.80**

Risk (%) that Low Total Cost is Less Than Base Cost	**10%**
Risk (%) that High Total Cost is Greater Than Base Cost	**10%**

Interchange Improvements

Interchange Improvement Level	Cost
Minor Impact Improvements	$5,000,000
Moderate Impact Improvements	$10,000,000
Major Impact Improvemetns	$19,000,000

Notes:
Interchange level of impacts determined from I-95 Combined Option from the October 2016 I-95 Improvements - Feasibility Evaluation and Phasing Study (Greenwich to New Haven)

Interchange No.	Improvement Level	Base Cost
Interchange 2	Minor	$5,000,000
Interchange 3	Minor	$5,000,000
Interchange 4	Moderate	$10,000,000
Interchange 5	Moderate	$10,000,000
Interchange 6	Minor	$5,000,000
Interchange 7 and 8	Moderate	$10,000,000
Interchange 9	Moderate	$10,000,000
Interchange 10	Moderate	$10,000,000
Interchange 11	Moderate	$10,000,000
Interchange 12	Minor	$5,000,000
Interchange 13	Minor	$5,000,000
Interchange 14	Minor	$5,000,000
Interchange 15	Major	$19,000,000
Interchange 16	Moderate	$10,000,000
Interchange 17	Moderate	$10,000,000
Interchange 18	Moderate	$10,000,000
Interchange 19	Minor	$5,000,000
Interchange 20	Minor	$5,000,000
Interchange 21	Minor	$5,000,000
Interchange 22	Moderate	$10,000,000
Interchange 23	Moderate	$10,000,000
Interchange 24	Moderate	$10,000,000
Interchange 25	Minor	$5,000,000
Interchange 26 to 27A/B	Major	$19,000,000
	Total Interchange Cost	**$208,000,000**

Length of Project (Miles) (Northbound and Southbound) 60

	Total Cost	Low Total Cost/Mile	Base Total Cost/Mile	High Total Cost/Mile
Total Cost for Interchange Improvements	**$208,000,000.00**	**$3,293,333.33**	**$3,466,666.67**	**$4,506,666.67**

Risk (%) that Low Total Cost is Less Than Base Cost	**5%**
Risk (%) that High Total Cost is Greater Than Base Cost	**30%**

Wetland Mitigation

Northbound			
Segment No.	Segment	Area of Wetland Impacts (SF)	Area of Wetland Impacts (AC)
1	NY State Line to Exit 7	2,500	0.06
2	Exit 7 to Exit 9	0	0.00
3	Exit 9 to Exit 14	7,074	0.16
4	Exit 14 to Exit 17	1,250	0.03
5	Exit 17 to Exit 20	0	0.00
6	Exit 20 to Exit 25	2,000	0.05
7	Exit 25 to Exit 28	0	0.00
	Northbound Total	**12,824**	**0.29**

Southbound			
Segment No.	Segment	Area of Wetland Impacts (SF)	Area of Wetland Impacts (AC)
1	NY State Line to Exit 7	500	0.01
2	Exit 7 to Exit 9	0	0.00
3	Exit 9 to Exit 14	1,500	0.03
4	Exit 14 to Exit 17	0	0.00
5	Exit 17 to Exit 20	17,481	0.40
6	Exit 20 to Exit 25	0	0.00
7	Exit 25 to Exit 28	0	0.00
	Southbound Total	**19,481**	**0.45**

Total Area of Wetland Impacts (SF) (Northbound and Southbound)	32,305
Total Area of Wetland Impacts (AC) (Northbound and Southbound)	0.74
Length of Project (Miles) (Northbound and Southbound)	60
Wetland Mitigation Unit Cost (Per Acre)	$200,000.00

Notes:
Area of wetland impacts determined from I-95 Combined Option from the October 2016 I-95 Improvements - Feasibility Evaluation and Phasing Study (Greenwich to New Haven)

	Total Cost	Low Total Cost/Mile	Base Total Cost/Mile	High Total Cost/Mile
Total Cost for Wetland Mitigation	**$148,324.15**	**$2,224.86**	**$2,472.07**	**$2,966.48**

Risk (%) that Low Total Cost is Less Than Base Cost	**10%**
Risk (%) that High Total Cost is Greater Than Base Cost	**20%**

Structure Replacement / Modification

Minor Bridge Structures	Low Cost	Base Cost	High Cost
Cost of Bridge Modifications	$34,797,861	$34,797,861	$88,946,907
Cost of Bridge Deck Replacements	$36,270,619	$36,270,619	$35,561,787
Cost of Total Bridge Replacements	$361,056,380	$361,056,380	$387,640,796
Subtotal	**$432,124,860**	**$432,124,860**	**$512,149,490**

Major Bridge Structures	Low Cost	Base Cost	High Cost	Base Cost Based on Combined/Unconstrained
Mianus River	$0	$0	$84,600,000	Combined
Stamford	$27,000,000	$117,500,000	$117,500,000	Unconstrained
I-95 Over MNRR (Bridge 32)	$139,500,000	$600,000,000	$600,000,000	Unconstrained
Norwalk River	$79,700,000	$106,100,000	$106,100,000	Unconstrained
Saugatuck River	$0	$0	$41,600,000	No Replacement
Bridgeport Harbor	$11,000,000	$11,000,000	$0	Combined
Subtotal	**$257,200,000**	**$834,600,000**	**$949,800,000**	

	Low Cost	Base Cost	High Cost
Subtotal Structure Replacement Cost	**$689,324,860**	**$1,266,724,860**	**$1,461,949,490**

Utility Relocation Costs	
Total Number of Bridges Slated for Rehab/ Replacement Over I-95	15
Cost of Utility Relocation Per Bridge	$600,000
Total Utility Relocation Cost	**$9,000,000**

	Low Cost	Base Cost	High Cost
Total Structure Replacement Cost Including Utility Relocation	**$698,324,860**	**$1,275,724,860**	**$1,470,949,490**

Length of Project (Miles) (Northbound and Southbound)	60

Notes:

Cost of Structure replacement/modification determined from I-95 Combined Option from the October 2016 I-95 Improvements - Feasibility Evaluation and Phasing Study (Greenwich to New Haven)

	Low Cost/Mile	Base Cost/Mile	High Cost/Mile
Total Cost for Structures Replacement/Modification	**$11,638,747.67**	**$21,262,081.00**	**$24,515,824.83**

Risk (%) that Low Total Cost is Less Than Base Cost	**10%**
Risk (%) that High Total Cost is Greater Than Base Cost	**20%**

Percentage Based Contract Items

	Base Total Cost/Mile	Low Total Percentage	Base Total Percentage	HighTotal Percentage
Subtotal of Known Items	$33,744,761.15	83%	77%	71%

Low Total Cost/Mile

Item No.	Item Description	Units	Percent of Low Estimate	Equivalent Percent of Known Items	Low Total Cost/Mile
0201001	Clearing and Grubbing	LS	1%	1.20%	$406,563.00
0971001	Maintenance and Protection of Traffic	LS	7%	8.43%	$2,845,944.00
0975004	Mobilization and Project Closeout	LS	8%	9.64%	$3,252,507.00
0980001	Construction Staking	LS	1%	1.20%	$406,563.00

Base Total Cost/Mile

Item No.	Item Description	Units	Percent of Base Estimate	Equivalent Percent of Known	Base Total Cost/Mile
0201001	Clearing and Grubbing	LS	2%	2.60%	$876,487.00
0971001	Maintenance and Protection of Traffic	LS	10%	12.99%	$4,382,437.00
0975004	Mobilization and Project Closeout	LS	10%	12.99%	$4,382,437.00
0980001	Construction Staking	LS	1%	1.30%	$438,244.00

High Total Cost/Mile

Item No.	Item Description	Units	Percent of High Estimate	Equivalent Percent of Known Items	High Total Cost/Mile
0201001	Clearing and Grubbing	LS	3%	4.23%	$1,425,835.00
0971001	Maintenance and Protection of Traffic	LS	12%	16.90%	$5,703,340.00
0975004	Mobilization and Project Closeout	LS	12%	16.90%	$5,703,340.00
0980001	Construction Staking	LS	2%	2.82%	$950,557.00

	Low Total Cost/Mile	Base Total Cost/Mile	High Total Cost/Mile
Total Cost for Percentage Based Items	**$6,911,577.00**	**$10,079,605.00**	**$13,783,072.00**

Risk (%) that Low Total Cost is Less Than Base Cost	**10%**
Risk (%) that High Total Cost is Greater Than Base Cost	**20%**

Right-of-Way

Northbound		
Segment No.	Segment	Area of Right-of-Way Impacts (SF)
1	NY State Line to Exit 7	7,500
2	Exit 7 to Exit 9	48,000
3	Exit 9 to Exit 14	8,700
4	Exit 14 to Exit 17	0
5	Exit 17 to Exit 20	0
6	Exit 20 to Exit 25	0
7	Exit 25 to Exit 28	31,500
	Northbound Total	**95,700**

Southbound		
Segment No.	Segment	Area of Right-of-Way Impacts (SF)
1	NY State Line to Exit 7	0
2	Exit 7 to Exit 9	85,400
3	Exit 9 to Exit 14	0
4	Exit 14 to Exit 17	0
5	Exit 17 to Exit 20	0
6	Exit 20 to Exit 25	0
7	Exit 25 to Exit 28	51,000
	Southbound Total	**136,400**

Total Area of Right-of-Way Impacts (SF) (Northbound and Southbound)	232,100
Length of Project (Miles) (Northbound and Southbound)	60
Right-of-Way Unit Cost (SF)	$250.00
Total Right-of-Way Acquisition Cost	**$58,025,000.00**

Notes:
Area of Right-of-Way impacts determined from I-95 Combined Option from the October 2016 I-95 Improvements - Feasibility Evaluation and Phasing Study (Greenwich to New Haven)

Administrative Costs	
Number of Properties Impacted	6
Administrative Cost Per Property	$15,000
Total Administrative Costs	**$90,000**

Easements	
Temporary Easements	$30,000,000
Permanent Easements	$11,000,000
Total Easement Costs	**$41,000,000.00**

	Total Cost	Low Total Cost/Mile	Base Total Cost/Mile	High Total Cost/Mile
Total Cost for Right-of-Way	**$99,115,000.00**	**$1,569,320.83**	**$1,651,916.67**	**$2,147,491.67**

Risk (%) that Low Total Cost is Less Than Base Cost	**5%**
Risk (%) that High Total Cost is Greater Than Base Cost	**30%**

Basis of Estimate

The following is a list of assumptions made while assembling the construction cost estimate for the I-95 Improvements – Feasibility Evaluation and Phasing Study (Greenwich to New Haven).

General Assumptions:

- All estimate quantities are calculated based on direction, with a total construction length of 30 miles in each direction (northbound or southbound), 60 miles for both directions (northbound & southbound)

Unit Prices:

- All unit prices were generated from AASHTO Estimator's database, based on quantities of materials for 1 mile in length. Any unit pricing not found through Estimator was based off similar historical projects and engineering judgement.

Bituminous Pavement:

- Assumed the following full depth pavement course for all full depth widening areas:
  - 4" HMA S0.5
  - 8" HMA S1
  - 10" Processed Aggregate Base
  - 12" Subbase
- Additional full depth pavement for left shoulder widening calculated for the following areas:
  - NB & SB between Exit 7 and Exit 9
    - Existing left shoulder = 4', needs 8' of full depth pavement to widen to 12'
    - Length of 8' widening section = 2.30 miles per direction, 4.6 miles total
  - NB & SB between Exit 9 and Exit 15
    - Existing left shoulder = 7', needs 5' of full depth pavement to widen to 12'
    - Length of 5' widening section = 6.1 miles per direction, 12.2 miles total
  - NB & SB between Exit 15 and Exit 17
    - Existing left shoulder = 4', needs 8' of full depth pavement to widen to 12'
    - Length of 8' widening section = 2.40 miles per direction, 4.8 miles total
  - Average width of left shoulder widening = 6.30' for 21.6 miles (both NB & SB)
- A wedge course of HMA S0.5 will be required to shift the crown line 12' to center on the proposed 4 thru lanes
  - Assumed the wedge course will be 24' in width with an average depth of 0.5"
- Assumed Milling and Overlay of existing 3 travel lanes (12' width) and left shoulder (12' width) to expose the concrete base course. Total width of pavement for mill & overlay is 48'.
  - Assumed that 6" of HMA S0.5 will be placed on-top of the existing concrete base in mill and overlay sections
  - Assumed a milling depth of 4"-8"
- Assumed 3 applications of tack coat on the total proposed roadway width (22' widened section + 48' mill and overlay section)
- Assumed 5% of the existing concrete base course over the total project length (60 miles) will need to be replaced. Concrete base replacement length = 3 miles
  - HMA S0.5 set at 0" and HMA S1 set at 6" for this section since the 6" overlay course is covered under the mill & overlay pavement section

Excavation & Borrow:

- Assumed 34" depth of excavation for full depth pavement widening within the existing 10' right shoulder
- The remaining 14' of widening (24' total – 10' within the right shoulder = 14' remaining) for full depth pavement will be split between excavation and borrow:
    - Total Project Length = 60 miles
        - Length of Northbound Lanes in Cut Section = 1.26 miles
        - Length of Southbound Lanes in Cut Section = 3.30 miles
        - Percentage of Roadway in Cut Section = 8%, rounded up to 10%
    - 10% of roadway is in cut sections (earth excavation)
    - 90% of roadway is in fill sections (borrow)
- Assumed 34" depth of excavation for full depth pavement for left shoulder widening in areas where the left shoulder is less than 12'
    - Average width of widening of left shoulder = 6.3'
    - Length of left shoulder widening = 21.6 miles
- Assumed an additional 2CY of excavation per linear foot for tying in slopes for widening, of which:
    - Total Length of Project in Cut Section = 4.56 miles
        - Length of Northbound Lanes with Visible Rock Outcrops = 0.92 miles
        - Length of Southbound Lanes with Visible Rock Outcrops = 1.92 miles
        - Percentage of Roadway in Rock Excavation Section = 8%, rounded to 10%
    - 90% of additional excavation is earth excavation
    - 10% of additional excavation is rock excavation

Drainage:

- Assumed placing 1 Type "C" Catch Basin and 1 Type "C-M" Catch Basin every 300 LF along each direction (northbound/southbound) the total length of project
    - Catch Basin spacing determined by the average spacing of catch basins from Project 35-176 Reconstruction of Median and Resurfacing on I-95
- Assumed 1 run of 24" R.C. Pipe the total project length
    - Pipe sizes may vary from 15" to 36", 24" is a representative size for estimate purposes
- Assumed one 15" R.C. Pipe crossing the roadway every 300'
    - Crossing pipe spacing determined by the average spacing of catch basins from Project 35-176 Reconstruction of Median and Resurfacing on I-95
- Trench Excavation quantity was based on a longitudinal 24" R.C. Pipe and crossing 15" R.C. Pipe
    - Assumed average depth of 6'
    - Assumed 90% of trench excavation will be earth, 10% will be rock
        - 10% Rock Excavation determined from the earth excavation calculations
- Bedding Material quantity was based on longitudinal 24" R.C. Pipe and crossing 15" R.C. Pipe
    - Assumed 90% of bedding material will be in non-rock areas (4" bedding material depth), 10% of bedding material will be in rock areas (12" bedding material depth)
- Assumed 1 standard endwall for every 1100 LF of roadway
    - Quantity of Class "A" Concrete based on a standard endwall for a 36" pipe (5.45 CY). Quantity of Class "A" Concrete taken from Standard Highway Drawing HW-506_01.

- The spacing of endwalls determined by the average spacing of outlet structure from Project 35-176 Reconstruction of Median and Resurfacing on I-95.
- It is assumed that all existing corrugated metal pipes will be replaced within the project area. The cost of the CMP replacement is covered under the cost of new 24" RCP and 15" RCP placement.

Metal Beam Rail & Concrete Median Barrier:

- Assumed metal beam rail placed on 75% of the project length
- Assumed 1 R-B End Anchorage – Type I and 1 Metal Beam Rail Terminal Element every 1000 LF of roadway
- Assumed new F-Shape Precast Concrete Barrier Curb (21" x 45") on 75% of the project length

Highway Lighting:

- Assumed new conduit and cable the length of project in each direction
- Assumed 250' spacing between new highway lighting poles (same spacing as existing lighting along I-95)

Concrete Pavement Repair:

- Assumed concrete pavement repair will be replacement of the transverse joints with precast concrete joints
  - Assumed joint spacing is 40'
  - Assumed joints will be sawcut 5' on each side of the joint, for a 10' total width joint replacement
  - Assumed joints over the three (3) 12' travel lanes (36' total length) occur in the same transverse locations and have the same spacing
- Three existing Rehabilitation Projects along I-95 were used to estimate the number of joints already replaced. The quantity of concrete pavement (cy) on the bid tabulation sheet was used to estimate the number of joints replaced under each project. The assumed size of joint replacement was 10' width x 36' length x 9" depth.
  - Project 35-176 had an estimated 211 joints replaced (33% of the project length)
  - Project 56-258 had an estimated 53 joints replaced (18% of the project length)
  - Project 56-246 had an estimated 51 joints replaced (17% of the project length)
- The total number of joints on both the northbound and southbound travel lanes was estimated as 7,920, assuming a 40' spacing between joints
- It was assumed that a total of 315 joints have been replaced under projects 35-176, 56-258, and 56-246
- It was assumed that the joints previously replaced under the three improvement projects will not need to be replaced in future widening projects
- Of the remaining 7,605 joints in the corridor (7,920-315=7,605), **20%** will be replaced under future projects
- Assumed a replacement cost of $500/SY of precast joint replacement

Noise Barrier Wall:

- Assumed noise barrier wall will be placed along the entire project length, except for where I-95 is adjacent to the metro north railroad
    - Length of Northbound Travel Lanes = 158,400'
        - Length of Northbound Travel Lanes Bordering MNRR = 22,900'
        - Length of Northbound Travel Lanes Requiring Noise Barrier Wall = 135,500'
    - Length of Southbound Travel Lanes = 158,400'
        - Length of Southbound Travel Lanes Bordering MNRR = 0'
        - Length of Southbound Travel Lanes Requiring Noise Barrier Wall = 158,400'
- Assumed wall height of 16'

Signing:

- Cost of sign replacement based on the cost to complete for Project No. 0172-0388, Replacement of Highway Signs on I-395.
    - Total Bid Price of Project No. 0172-0388 = $2,319,733
    - Total Number of Interchanges for Project No. 0172-0388 = 26
    - Cost Per Interchange for Project No. 0172-0388 = $44,610.25
    - Cost of signing per interchange applied to 28 interchanges along I-95
    - Total cost per mile for sign replacement = $41,636.00
- Overhead sign supports including cantilevers, full overhead (monotube), full overhead (truss), overhead truss foundations, and drilled shaft foundations costs determined by the Department.
    - Costs determined from Project 173-351 completed in the Summer of 2015, which replaced all signs and supports on I-95 from Fairfield/Bridgeport line to the West Haven/New Haven Line
        - Total Project Length = 11.18 miles
        - Cantilevers = 5 each @ $48,954 average bid price for each
        - Full Overhead (monotube) = 2 each @ $88,385 average bid price for each
        - Full Overhead (truss) = 3 each @ $159,058 average bid price for each
        - OVH Truss Foundation = 6 each @ $75,396 average bid price for each
        - Drilled Shaft Foundation = 9 each @ $51,862 average bid price for each
        - Total average cost per mile for overhead sign supports = $162,597.73

Retaining Walls:

- Lengths of retaining walls for northbound and southbound I-95 based on Preliminary Design plans developed for the I-95 Improvements – Feasibility Evaluation and Phasing Study (Greenwich to New Haven)
- Average height of retaining walls assumed to be 10'

Pavement Markings:

- Assumed one (1) 4" white right shoulder line, one (1) 4" yellow left shoulder line, and three (3) 6" white broken lines (10' line length, 30' spacing) the entire project length.

Interchange Improvements:

- Assumed three different improvement levels for each interchange, Minor Improvements, Moderate Improvements, Major Improvements
    - Minor Improvements
        - $5 million construction cost
        - Minor realignment of acceleration and deceleration lanes, ramp alignment
        - No wetland impacts
        - No ROW impacts
        - No retaining walls required
        - No noise barrier walls
        - Straightforward constructability, MPT
    - Moderate Improvements
        - $10 million construction cost
        - Reconfiguration of ramps for better operations, widening and acceleration lanes
        - Minor wetland impacts
        - Minor ROW impacts
        - Minor retaining walls needed (up to 10' height)
        - Noise barrier walls required
        - Possible short-term ramp closures during construction causing minor detours
    - Major Improvements
        - $19 million construction cost
        - Major reconfiguration of ramps for better operations
        - Significant wetland impacts
        - Major retaining walls (over 10' height)
        - Noise barrier walls required
        - Relocation of local streets
        - Widening/replacement of existing structures
        - Constructability issues – long-term ramp closures, possible permanent ramp closures

Wetland Mitigation:

- Area of wetland impacts (Ac) for northbound and southbound I-95 based on Preliminary Design plans developed for the I-95 Improvements – Feasibility Evaluation and Phasing Study (Greenwich to New Haven)
- Assumed cost of $200,000/AC

Structure Replacement/Modification:

- Cost of Structure replacement/modification determined from I-95 Combined Option from the October 2016 I-95 Improvements - Feasibility Evaluation and Phasing Study (Greenwich to New Haven)
- Utility Relocation
    - Assumed cost of $600,000 per bridge rehab/replacement project
    - Total of 15 bridges slated for rehab/replacement over I-95 within project area

Percentage Based Items:

- All percentages for Clearing and Grubbing, Maintenance and Protection of Traffic, Mobilization and Project Closeout, and Construction Staking determined from the average percent of total bid from the Connecticut DOT 2017 Cost Estimating Guidelines. Average percentages were applied to the Total Construction Base Cost/Mile.

Minor Item Allowance:

- Percentage of minor item allowance determined by the midpoint of the percentage range for projects in the Programming Phase, as detailed in the Connecticut DOT 2017 Cost Estimating Guidelines
- Percentage applied to the Construction Subtotal
    - Low Percentage: 15%
    - Base Percentage: 25%
    - High Percentage: 30%

Intelligent Transportation Systems (ITS):

- Assumed that new fiber will be run the length of the project with replacement of dynamic message signs.
- Assumed Low cost of $750,000/mile
- Assumed Base cost of $1,000,000/mile
- Assumed High cost of $1,500,000/mile

Right-of-Way:

- Area of right-of-way impacts (sf) for northbound and southbound I-95 based on Preliminary Design plans developed for the I-95 Improvements – Feasibility Evaluation and Phasing Study (Greenwich to New Haven)
    - Assumed cost of $250/sf
- Number of properties with Right-of-Way impacts determined based on Preliminary Design plans developed for the I-95 Improvements – Feasibility Evaluation and Phasing
    - Administrative cost of $15,000 per property impact applied
    - Estimated a total of 6 properties that require acquisition
- Easements:
    - Assumed a total temporary easement cost of $30,000,000 for the entire project length
    - Assumed a total permanent easement cost of $11,000,000 for the entire project length
- Right-of-way impacts were only calculated for mainline I-95, and did not include any potential right-of-way impacts for interchange and ramp improvements. The costs of right-of-way impacts in the interchanges are included in the interchange improvement costs.

Non-Contract Item Percentages:

Percentages for each non-contract item applied to the Construction Subtotal **and** the Minor Item Allowance Subtotal. Assumed the following percentages for non-contract items for the Base estimate:

- State Police
    - Low Cost Percentage= 1.5%
    - Base Cost Percentage= 2.5%
    - High Cost Percentage= 3.5%

- Environmental Compliance
    - Low Cost Percentage= 4%
    - Base Cost Percentage= 5%
    - High Cost Percentage= 6%
- NEPA Documentation
    - Low Cost Percentage= 2%
    - Base Cost Percentage= 3%
    - High Cost Percentage= 4%
- Program Management
    - Low Cost Percentage= 4%
    - Base Cost Percentage= 5%
    - High Cost Percentage= 6%
- Design
    - Low Cost Percentage= 9%
    - Base Cost Percentage= 10%
    - High Cost Percentage= 11%
- CEI
    - Low Cost Percentage= 9%
    - Base Cost Percentage= 10%
    - High Cost Percentage= 11%

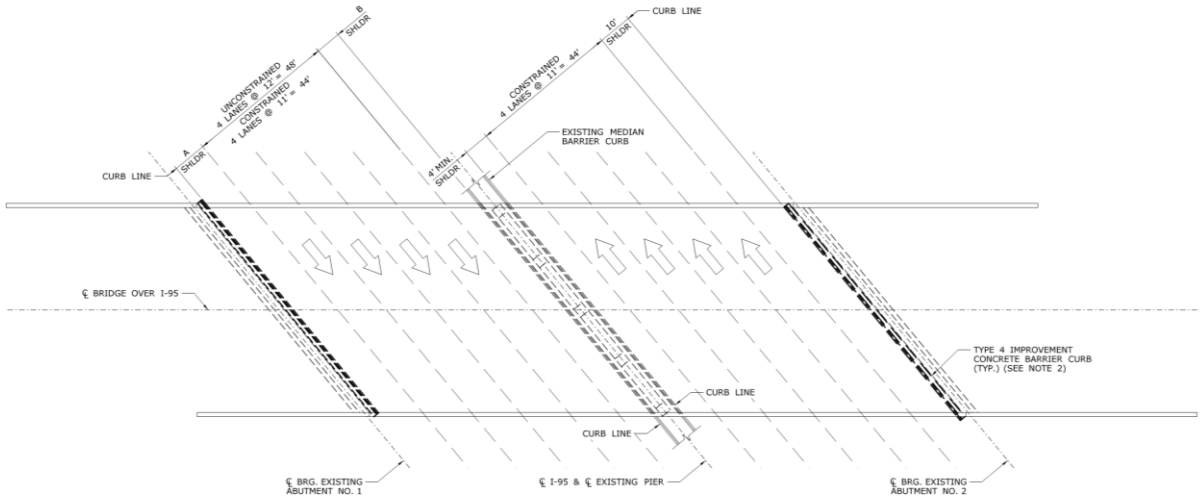
Inflation:

- Base Year = 2017
- Low Midpoint of Year of Expenditure = 2030
- Base Midpoint of Year of Expenditure = 2035
- High Midpoint of Year of Expenditure = 2040
- Low Inflation = 3.5%
- Base Inflation= 3.75%
- High Inflation= 4.0%

Appendix E

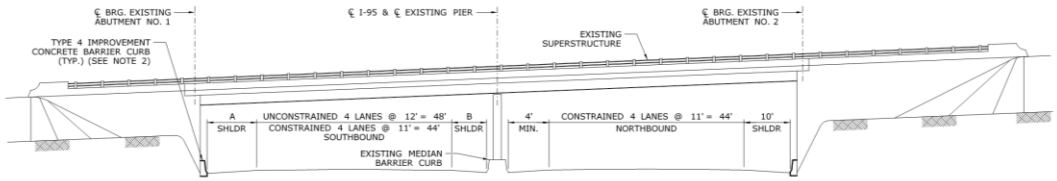
GRADE SEPARATED STRUCTURES

Full Height Abutments



TYPICAL PROPOSED PLAN
SCALE: 1" = 30'

SHOULDER DIMENSIONS		
LETTER	CONSTRAINED	UNCONSTRAINED
A	10'	12'
B	4' MIN.	10'



TYPICAL PROPOSED ELEVATION
SCALE: 1" = 30'

NOTES:

1. ELEVATION DIMENSIONS SHOWN ARE NORMAL TO ℄ I-95. BRIDGE SKEWS MAY VARY.
2. SEE TABLE BELOW FOR CATEGORY 1 BRIDGES AND TYPES OF IMPROVEMENTS.
3. FOR BRIDGES UNDER CATEGORY 5 (BRIDGES WITH RAMP APPROACHES), ADD AN ADDITIONAL LANE OF 11' FOR CONSTRAINED SECTIONS.
4. FOR BRIDGE NO. 00086, NORTHBOUND IS A CONSTRAINED SECTION AND SOUTHBOUND IS AN UNCONSTRAINED SECTION.

BRIDGE EVALUATION			
BRIDGE NO.	CATEGORY	IMPROVEMENT	SECTION TYPE
00016	1	TYPE 4	CONSTRAINED
00035	1 & 5	TYPE 4	CONSTRAINED
00036	1 & 5	TYPE 4	CONSTRAINED
00061	1	TYPE 4	CONSTRAINED
00086	1, 2, & 5	TYPE 4	SEE NOTE 4

CATEGORY 1 - BRIDGES WITH FULL HEIGHT ABUTMENTS & NO SETBACKS
CATEGORY 2 - BRIDGES WITH FULL HEIGHT ABUTMENTS & SETBACKS FROM THE EDGE OF PAVEMENT (SEMI STUB)
CATEGORY 3 - BRIDGES WITH STUB ABUTMENTS
CATEGORY 4 - BRIDGES WITH SHOULDER PIERS & STUB ABUTMENTS
CATEGORY 5 - BRIDGES WITH RAMP APPROACHES

FIGURE 1: FULL HEIGHT ABUTMENTS

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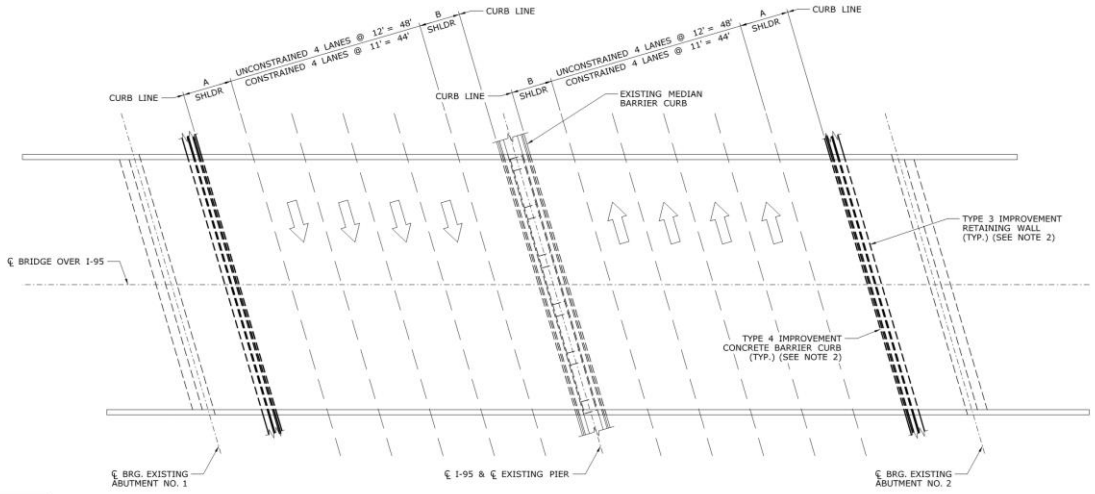
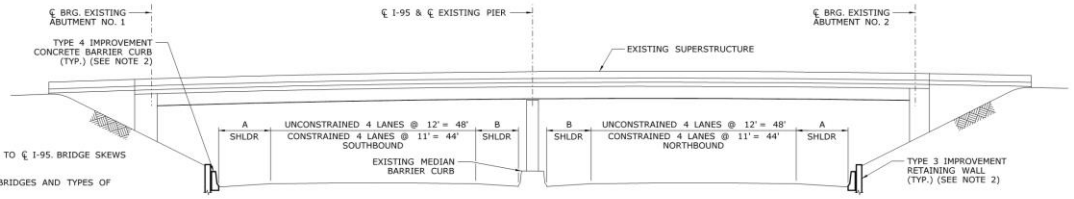
Semi Stub and Stub Abutments



TYPICAL PROPOSED PLAN

SCALE: 1" = 25'

SHOULDER DIMENSIONS		
LETTER	CONSTRAINED	UNCONSTRAINED
A	10'	12'
B	4' MIN.	10'



TYPICAL PROPOSED ELEVATION

SCALE: 1" = 25'

NOTES:

1. ELEVATION DIMENSIONS SHOWN ARE NORMAL TO ℄ I-95. BRIDGE SKEWS MAY VARY.
2. SEE TABLE BELOW FOR CATEGORY 2 AND 3 BRIDGES AND TYPES OF IMPROVEMENTS.
3. FOR BRIDGES UNDER CATEGORY 5 (BRIDGES WITH RAMP APPROACHES), ADD AN ADDITIONAL LANE OF 12' FOR UNCONSTRAINED SECTIONS AND 11' FOR CONSTRAINED SECTIONS.
4. TYPE 5 IMPROVEMENT - RELOCATE EXISTING CONCRETE BARRIER CURB

BRIDGE EVALUATION			
BRIDGE NO.	CATEGORY	IMPROVEMENT	SECTION TYPE
00003	3	TYPES 3 & 4	UNCONSTRAINED
00013	2	TYPES 3 & 4	UNCONSTRAINED
00025	2	TYPES 3 & 4	UNCONSTRAINED
00041	3	TYPES 3 & 4	UNCONSTRAINED
00042	2	TYPES 3 & 4	UNCONSTRAINED
00053	2 & 5	TYPE 5	CONSTRAINED
00066	3	TYPES 3 & 4	UNCONSTRAINED
00067	3	TYPES 3 & 4	UNCONSTRAINED
00068	2 & 5	TYPES 3 & 4	UNCONSTRAINED
00072	3	TYPES 3 & 4	UNCONSTRAINED
00078	3	TYPE 4	CONSTRAINED
00087	3	TYPES 3 & 4	UNCONSTRAINED

CATEGORY 1 - BRIDGES WITH FULL HEIGHT ABUTMENTS & NO SETBACKS
CATEGORY 2 - BRIDGES WITH FULL HEIGHT ABUTMENTS & SETBACKS FROM THE EDGE OF PAVEMENT (SEMI STUB)
CATEGORY 3 - BRIDGES WITH STUB ABUTMENTS
CATEGORY 4 - BRIDGES WITH SHOULDER PIERS & STUB ABUTMENTS
CATEGORY 5 - BRIDGES WITH RAMP APPROACHES

FIGURE 2: SEMI STUB AND STUB ABUTMENTS

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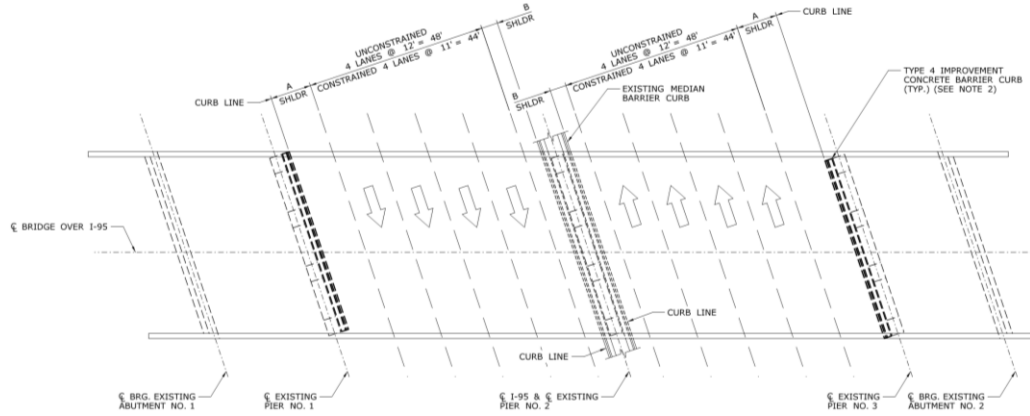
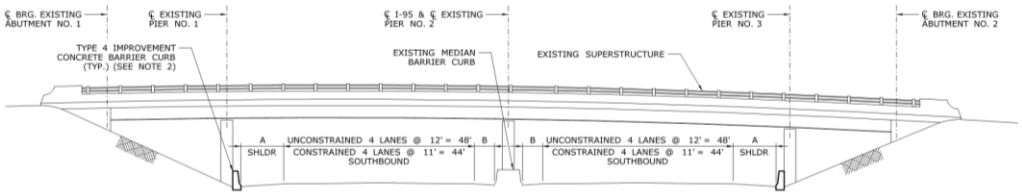
Shoulder Piers and Stub Abutments



SHOULDER DIMENSIONS

LETTER	CONSTRAINED	UNCONSTRAINED
A	10'	12'
B	4' MIN.	10'

TYPICAL PROPOSED PLAN
SCALE: 1" = 25'



TYPICAL PROPOSED ELEVATION
SCALE: 1" = 25'

NOTES:

1. ELEVATION DIMENSIONS SHOWN ARE NORMAL TO ℄ I-95. BRIDGE SKEWS MAY VARY.
2. SEE TABLE BELOW FOR CATEGORY 4 BRIDGES AND TYPES OF IMPROVEMENTS.
3. FOR BRIDGES UNDER CATEGORY 5 (BRIDGE WITH RAMP APPROACHES), ADD AN ADDITIONAL LANE OF 12' FOR UNCONSTRAINED SECTIONS.

FIGURE 3: SHOULDER PIERS AND STUB ABUTMENTS

BRIDGE EVALUATION

BRIDGE NO.	CATEGORY	IMPROVEMENT	SECTION TYPE
00017	4	TYPE 4	CONSTRAINED
102-114	4 & 5	TYPE 4	UNCONSTRAINED

CATEGORY 1 - BRIDGES WITH FULL HEIGHT ABUTMENTS & NO SETBACKS
CATEGORY 2 - BRIDGES WITH FULL HEIGHT ABUTMENTS & SETBACKS FROM THE EDGE OF PAVEMENT (SEMI STUB)
CATEGORY 3 - BRIDGES WITH STUB ABUTMENTS
CATEGORY 4 - BRIDGES WITH SHOULDER PIERS & STUB ABUTMENTS
CATEGORY 5 - BRIDGES WITH RAMP APPROACHES

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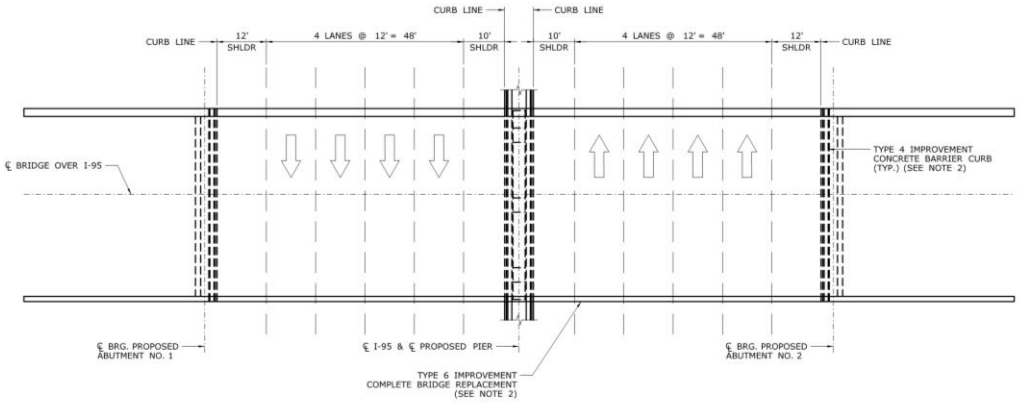
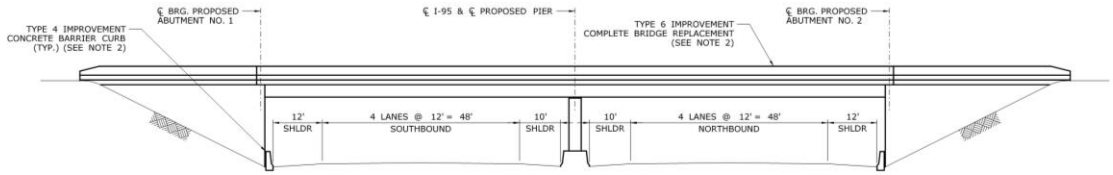
Complete Bridge Replacement



TYPICAL PROPOSED PLAN
SCALE: 1" = 25'



TYPICAL PROPOSED ELEVATION
SCALE: 1" = 25'

NOTES:

1. BRIDGE SHOWN IS NORMAL TO ℄ OF I-95. PROPOSED BRIDGES MAY ALSO BE SKEWED.
2. SEE TABLE BELOW FOR BRIDGE CATEGORIES AND TYPES OF IMPROVEMENTS.
3. FOR BRIDGES UNDER CATEGORY 5 (BRIDGES WITH RAMP APPROACHES), ADD AN ADDITIONAL LANE OF 12' FOR UNCONSTRAINED SECTIONS.

BRIDGE EVALUATION

BRIDGE NO.	CATEGORY	IMPROVEMENT	SECTION TYPE
00018	1 & 5	TYPES 4 & 6	UNCONSTRAINED
00037	1 & 5	TYPES 4 & 6	UNCONSTRAINED
00047	1	TYPES 4 & 6	UNCONSTRAINED
00051	1	TYPES 4 & 6	UNCONSTRAINED
00052	1	TYPES 4 & 6	UNCONSTRAINED
00056	2 & 5	TYPES 4 & 6	UNCONSTRAINED
00060	2	TYPES 4 & 6	UNCONSTRAINED
00069	1	TYPES 4 & 6	UNCONSTRAINED

CATEGORY 1 - BRIDGES WITH FULL HEIGHT ABUTMENTS & NO SETBACKS
CATEGORY 2 - BRIDGES WITH FULL HEIGHT ABUTMENTS & SETBACKS FROM THE EDGE OF PAVEMENT (SEMI STUB)
CATEGORY 3 - BRIDGES WITH STUB ABUTMENTS
CATEGORY 4 - BRIDGES WITH SHOULDER PIERS & STUB ABUTMENTS
CATEGORY 5 - BRIDGES WITH RAMP APPROACHES

FIGURE 4: COMPLETE BRIDGE REPLACEMENT

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Appendix F

MAJOR STRUCTURES

Appendix "F"
MAJOR STRUCTURES

Location		Existing NB	Existing SB	No Widening Shoulder Width NB	No Widening Shoulder Width SB	Required widening Constrained (58 ft) [1] NB	Required widening Constrained (58 ft) [1] SB	Required widening Unconstrained (72 ft) NB	Required widening Unconstrained (72 ft) SB	Existing Superstructure	Existing Substructure	Widening Option Constrained	Widening Option Unconstrained
Mianus River (Br 6015)		57 ft	57 ft	13 ft	13 ft	1 ft	1 ft	15 ft	15 ft	> 24 spans (2654 ft) > 14 steel plate girders > Deck Rating: 7 > Super Rating: 7	> 20 R/C multi-column piers > 3 straddle bents w/ steel cap > Sub Rating: 5	> Keep existing beams and deck > No add'l beams > Increase overhang OR > Do nothing to superstructure > Rehab 10% existing substructure > No additional substructure units or extention needed	> Keep existing beams and deck > 2 add'l beams (each dir) > Rehab 10% existing substructure > Add 20 hammerhead piers (ea dir) > Other 3 (tight with local roads): - Option 1: Realign local roads - Option 2: Straddle bent - Option 3: Parallel structure with alter span arrangement
Stamford (Washington-Elm)	Washington, Bus Terminal, Guernsey (Br 27)	60 ft (1 ramp)	60 ft (1 ramp)	5 ft (1 ramp)	5 ft (1 ramp)	9 ft (1 ramp)	9 ft (1 ramp)	24 ft (1 ramp)	24 ft (1 ramp) 12 ft (no ramp)	> 8 spans (627 ft) > 18 steel plate girders > Deck Rating: 5 > Super Rating: 6	> Multi-column piers > Piers around bus terminal > Sub Rating: 5	> Rehab deck > 1 add'l beams (each dir) > Add single column hammerhead > Widen abutments > Rehab 10% of existing substr	> Eliminate SB on-ramp > Revise span arrangement to 5 Spans > Multi-column pier bents > Place to maintain bus lanes
	Retaining Wall	48 ft	48 ft	4 ft	4 ft	10 ft	10 ft	24 ft	24 ft	--	> 6 walls > Concrete, Spread footing	> New wall at top of slope	> Full height wall > Eliminate SB on-ramp
	Atlantic St (Br 28)	48 ft	50 ft	4 ft	6 ft	10 ft	8 ft	24 ft	22 ft	> 1 span (85 ft) > 14 steel plate girders > Deck Rating: 7 > Super Rating: 7	> R/C Abutments > Sub Rating: 6	> Keep existing beams and deck > 1 add'l beam (each dir) > Widen abutments	> Keep existing beams and deck > 3 add'l beams (each dir) > Widen abutments
	Retaining Wall	48 ft	48 ft	4 ft	4 ft	10 ft	10 ft	24 ft	24 ft	--	> 4 walls > Precast & Doublewal	> New wall at top of slope	> Full height wall
	Canal St (Br 29)	60 ft	48 ft	16 ft	4 ft	--	10 ft	12 ft	24 ft	> 1 span (73 ft) > 16 steel plate girders > Deck Rating: 7 > Super Rating: 7	> R/C Abutments > Sub Rating: 6	> Keep existing beams and deck > 1 add'l beam (SB) > Widen abutments	> Keep existing beams and deck > 2 add'l beam (NB) > 3 addl beams (SB) > Widen abutments
	Retaining Wall	48 ft (+ ramp)	48 ft (+ ramp)	4 ft	4 ft	10 ft	10 ft	24 ft	24 ft	--	> 7 walls > Precast & Doublewal	> New wall at top of slope	> Full height wall > Eliminate NB and SB ramp
	Elm St (Br 31)	60 ft (1 ramp)	60 ft (1 ramp)	5 ft	5 ft	9 ft (1 ramp) 19-23 ft (offset)	9 ft (1 ramp) 0 ft (offset)	12 ft (no ramp) 35-39 ft (offset)	12 ft (no ramp) 0 ft (offset)	> 1 span (72 ft) > 16 steel plate girders > Deck Rating: 7 > Super Rating: 7	> R/C Abutments > Sub Rating: 6	> Keep existing beams and deck > Repaint beams > 1 add'l beam (each dir, no offset) > 3 add'l beams (NB, offset) > Widen abutments	> Keep existing beams and deck > Repaint beams > 2 add'l beams (no ramp, no offset) > 5 add'l beams (NB, offset) > Widen abutments
Metro-North RR (Bridge 32)		52 ft (1 ramp)	40 ft	-3 ft (1 ramp)	-4 ft	17 ft (1 ramp)	18 ft	32 ft (1 ramp)	32 ft	> 17 spans (1065 ft) > Plate and thru-girder > Deck Rating: 4 > Super Rating: 5	> R/C multi-column piers > Sub Rating: 4	> Staged widening > New multi-girder superstructure > New multi-column piers	> Staged widening > New multi-girder superstructure > New multi-column piers
Norwalk River (Bridge 59)		53 ft	53 ft (sidewalk)	-2ft	-2ft	16 ft (1 ramp)	33 ft (2 ramps + sidewalk)	31 ft (1 ramp)	49 ft (2 ramps + sidewalk)	> 7 spans (905 ft) > 11 steel plate girders > Pin and Hanger retrofit > Deck Rating: 5 > Super Rating: 4	> 6 R/C multi-column piers > Sub Rating: 5	> Rehab and widen super > 2 add'l beams NB > 3 add'l beam SB OR > Replace super > Rehab 10% of existing substructure > Add single column hammerheads	> Rehab and widen super > 3 add'l beam NB > 5 add'l beam SB OR > Replace super > Rehab 10% of existing substr > Add single column hammerheads
Saugatuck River (Bridge 64)		56 ft	56 ft	12 ft	12 ft	2 ft	2 ft	16 ft	16 ft	> 10 spans (1210 ft) > 18 steel multi-girder > Deck Rating: 6 > Super Rating: 6	> 9 R/C multi-column piers > Sub Rating: 6	> Keep existing beams and deck > No add'l beams > Increase overhang OR > Do nothing to superstructure	> Keep existing beams and deck > 2 add'l beams (each dir) > Add single column hammerheads

(1) 11' Lane

Mianus River, Southern Half - Unconstrained

- Potential widening Issues
  - Pier column interference with Strickland Road and River Road (Piers 1, 3, 9, 11)
    - Realign Strickland and River
    - Provide straddle bent over Strickland and River
    - Provide offset pier locations for widened section to avoid Strickland and River
  - Tight fit at Greenwich Racquet Club facility
- No-Widening: 13ft of shoulder
  Constrained: Widen 1ft each dir.
  Unconstrained: Widen 15ft each dir.

Mianus River, Northern Half - Unconstrained (No Major Concerns)

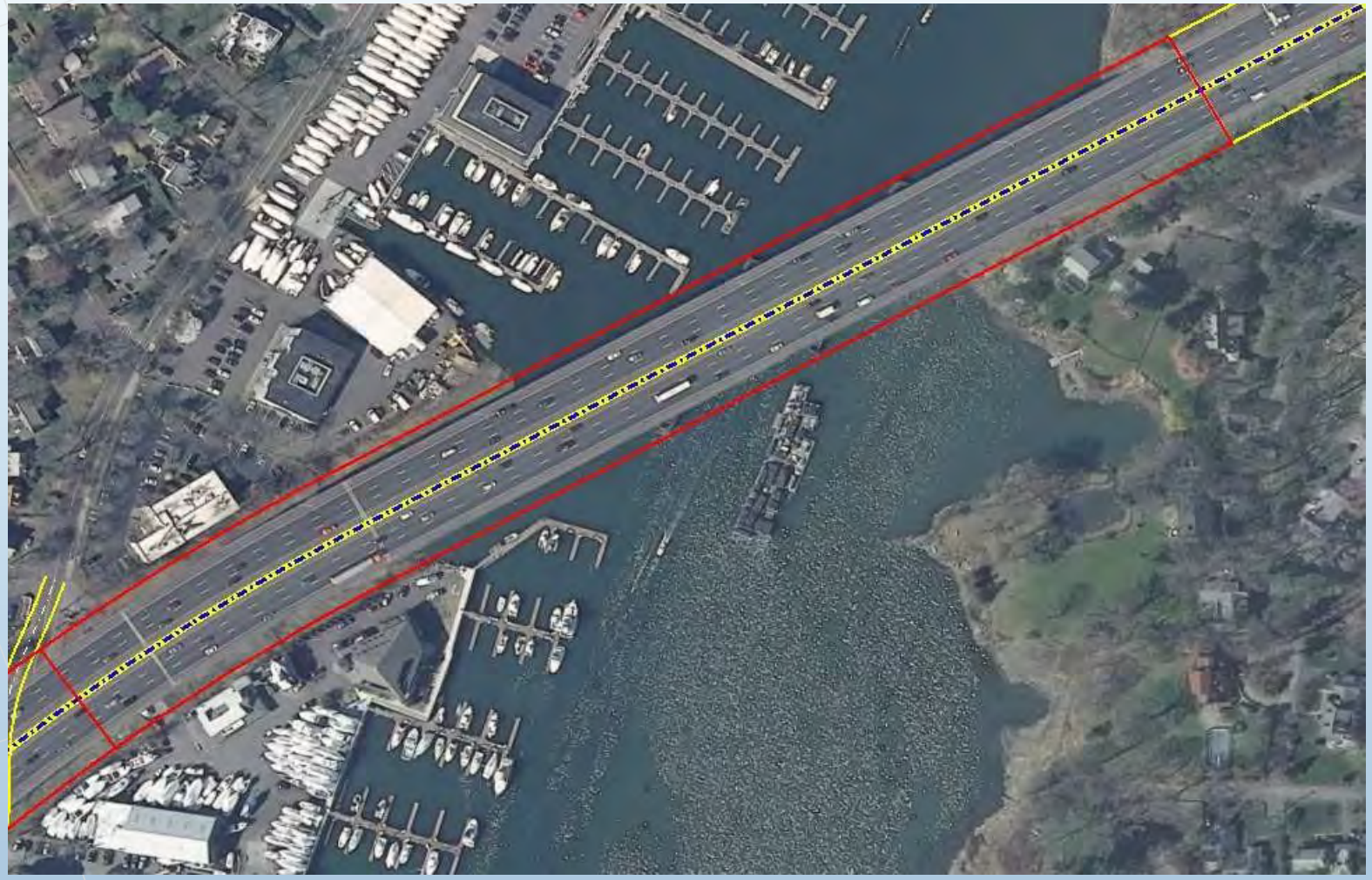

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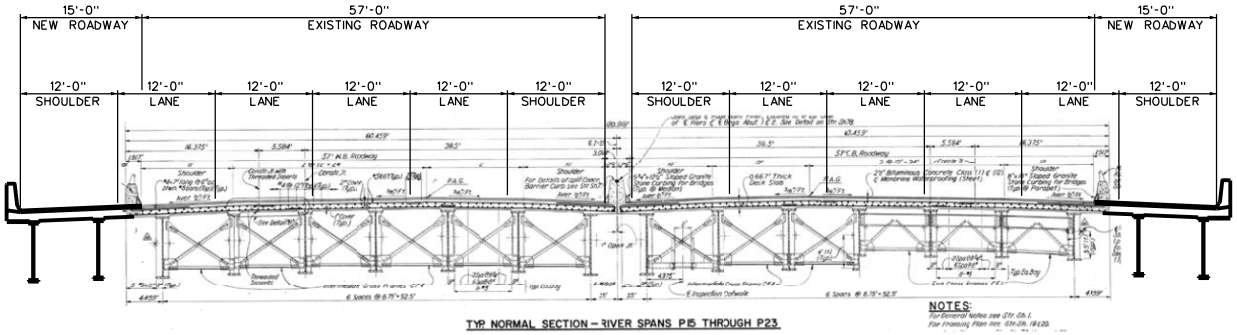
FIGURE 2

I-95 Over Mianus River - Cross Section



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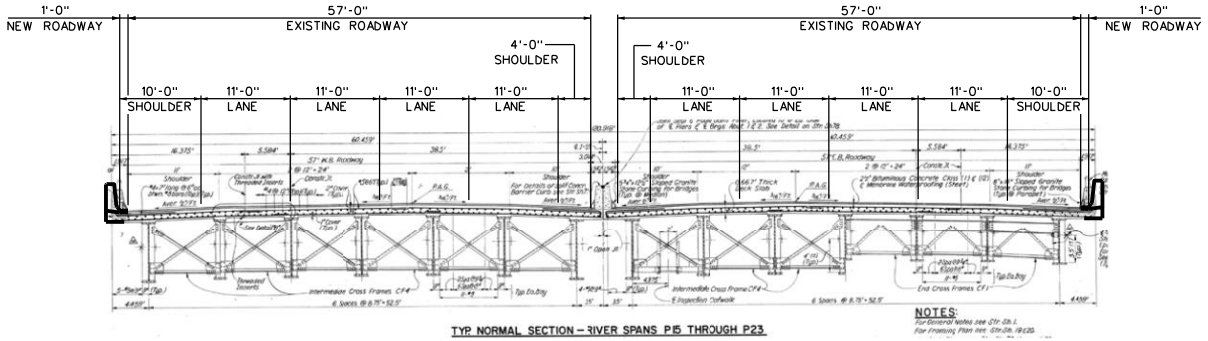

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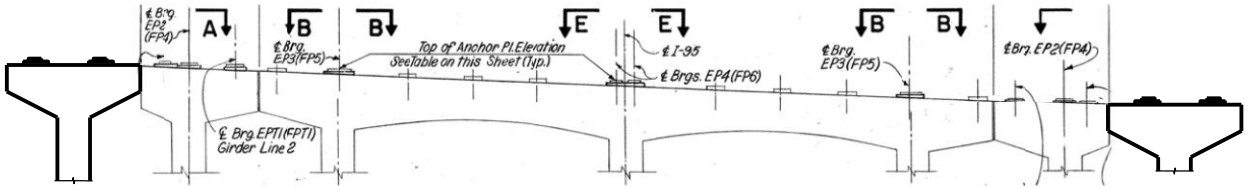
DEPARTMENT OF TRANSPORTATION

ROADWAY AND BRIDGE RECONSTRUCTION
I-95 FROM GREENWICH TO BRIDGEPORT

DRAWING: OF x
SHEET: OF x

I-95 Over Mianus River - Pier Section



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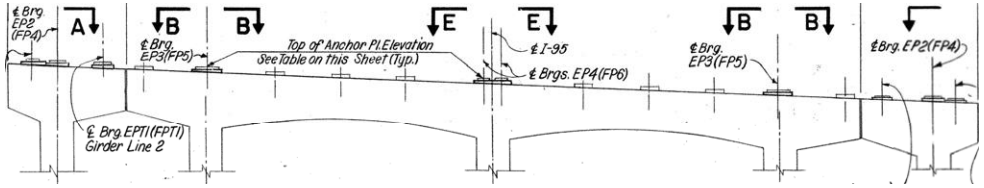

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I-95 FROM GREENWICH TO BRIDGEPORT

DRAWING: OF x
SHEET: OF x

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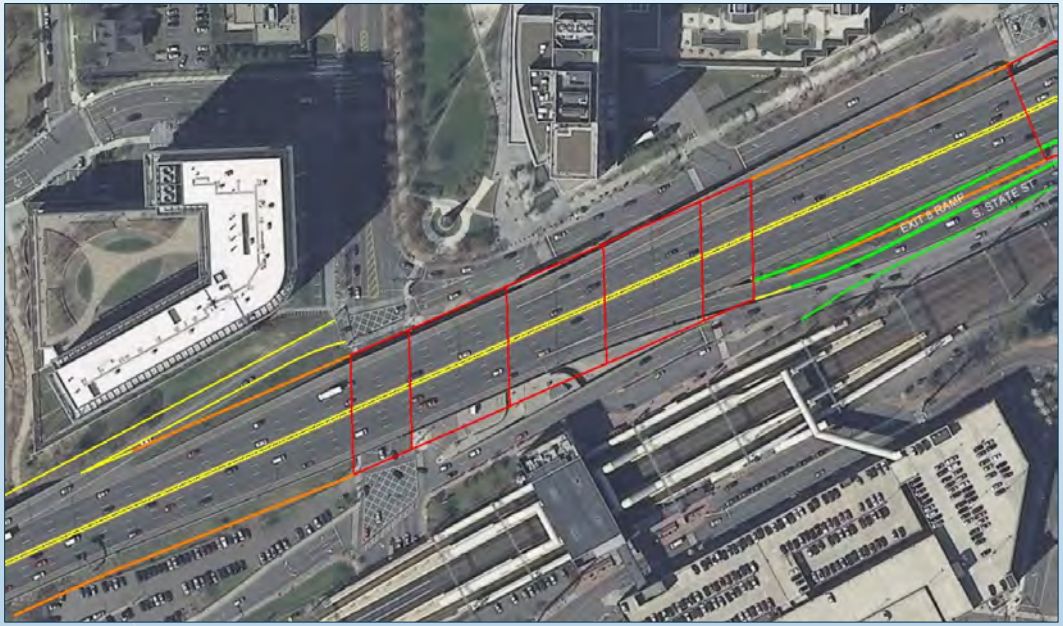
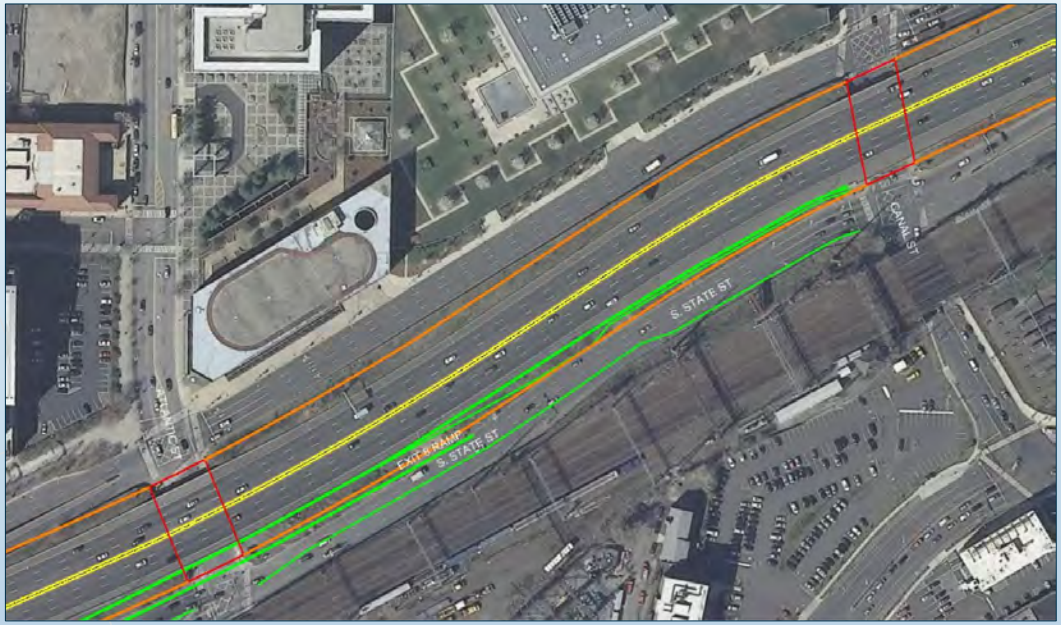
FIGURE 4

Washington Blvd. to Atlantic St.



- Pier columns to coordinate with bus terminal
- Unconstrained needs to eliminate SB on-ramp
- Washington Blvd:
  No-widening: 5ft of shoulder
  Constrained: Widen 9ft each dir.
  Unconstrained: Widen 24ft (w/ramp),
  12ft (w/o ramp)
- Retaining Wall:
  No widening: 4ft of shoulder
  Constrained: Widen 10ft each dir.
  Unconstrained: Widen 24ft each dir.

Atlantic St. to Canal St.

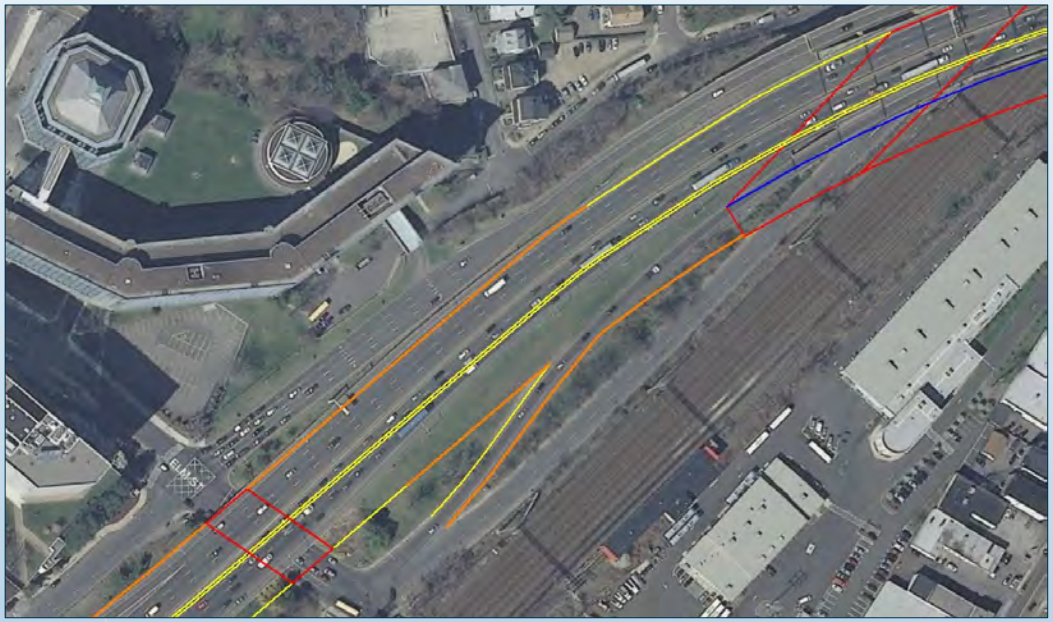


- Atlantic St:
  - No widening: 4ft NB, 6ft SB of shoulder
  - Constrained: Widen 10ft NB, 8ft SB
  - Unconstrained: Widen 24ft NB, 22ft SB
- Retaining Walls:
  - No Widening: 4ft shoulders
  - Constrained: Widen 10ft each dir.
  - Unconstrained: Widen 24ft each dir.

Canal St. to Elm St.

- Canal St.
  - No widening: 16ft NB, 4ft SB of shoulder
  - Constrained: Widen 0ft NB, 10ft SB
  - Unconstrained: Widen 12ft NB, 24ft SB
- Retaining Walls:
  - No widening: 4ft of shoulder
  - Constrained: Widen 10ft each dir.
  - Unconstrained: Widen 24ft each dir.
- Unconstrained needs to eliminate NB on-ramp and SB off-ramp

Elm St. to MNRR Bridge



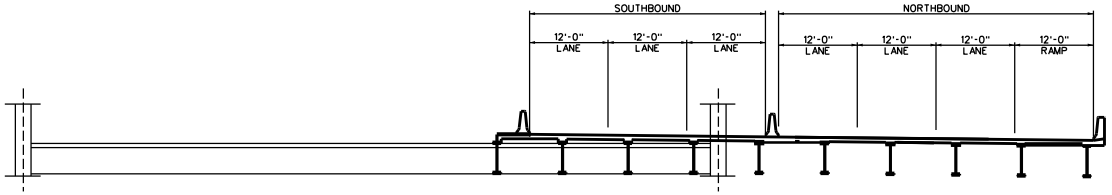
- Elm St. (parallel widening):
  No widening: 5ft of shoulder
  Constrained: Widen 9ft each dir.
  Unconstrained: Widen 12ft each dir. (no ramps)
- Elm St. (offset):
  Constrained: Widen 19-23ft NB, 0ft SB
  Unconstrained: Widen 35-39ft NB, 0ft SB

MNRR Bridge

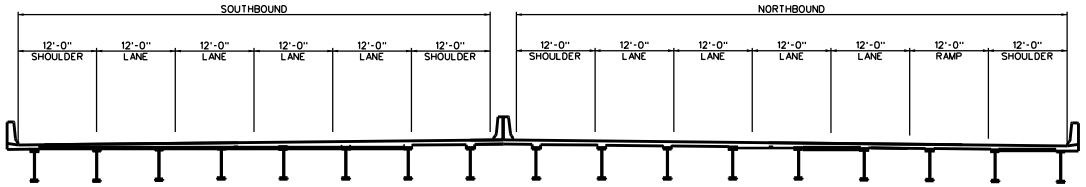
- Replace with 5 span bridge - 250’ main spans
- Widen to south to accommodate staged construction
- Maintain existing SB off-ramp
- Existing bridge has minimal shoulders

I-95 Over Metro North RR - Cross Section

STAGE 1



STAGE 2



FINAL

UNCONSTRAINED

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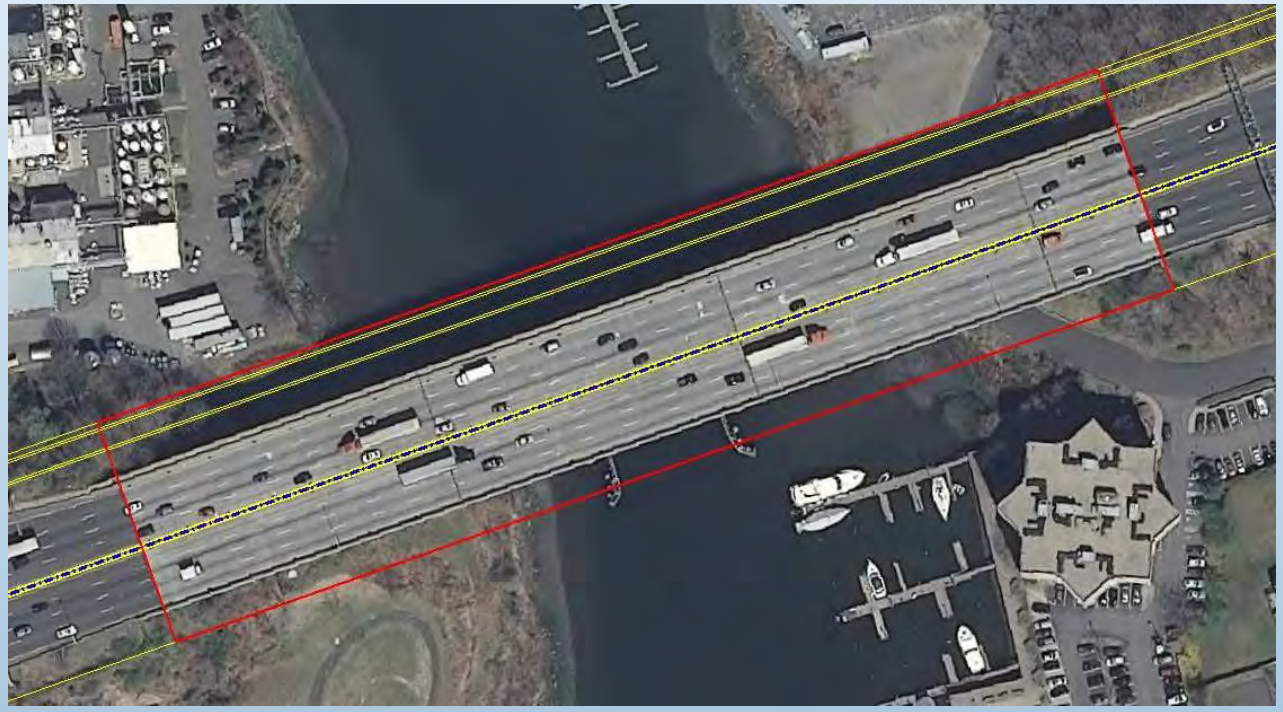
Norwalk River Bridge

- Existing Super Rating: 4, Existing Sub Rating: 5
- Add additional SB ramp lane for local traffic
- No widening: -2ft of shoulder
  Constrained: 16ft NB, 33ft SB
  Unconstrained: 31ft NB, 49ft SB



Norwalk River Bridge With Adjacent Ramps

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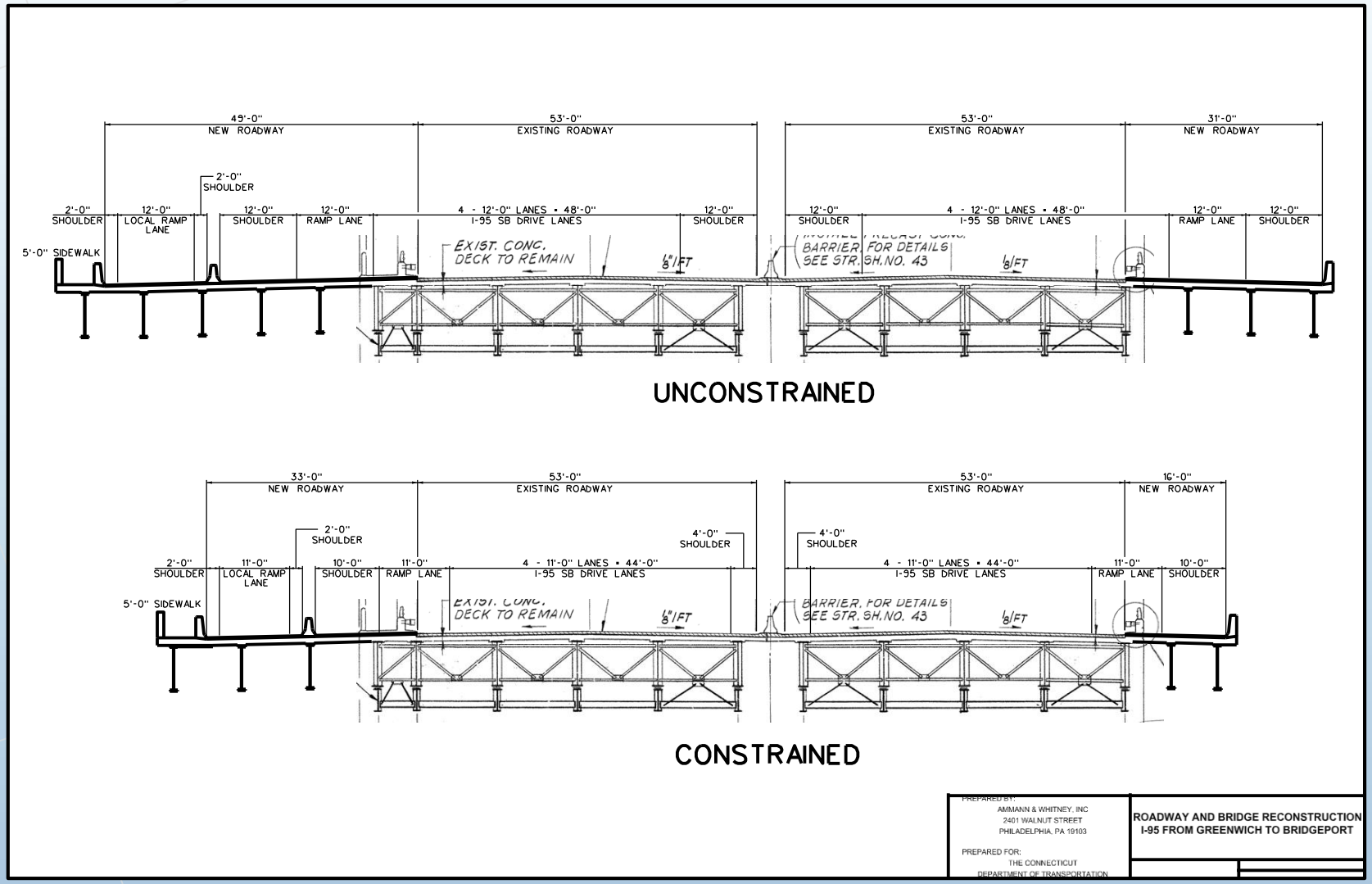
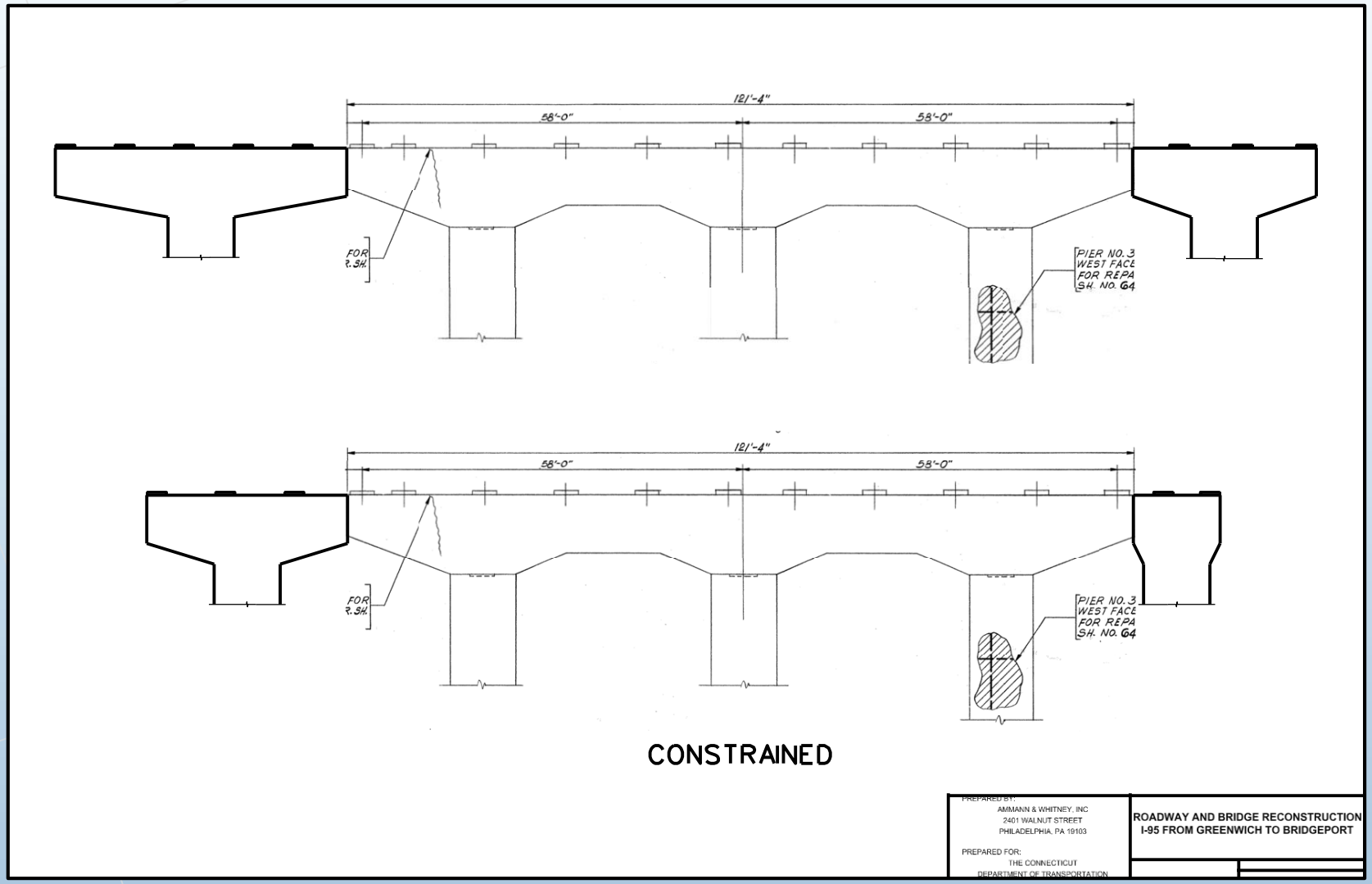
FIGURE 12

I-95 Over Norwalk River - Cross Section



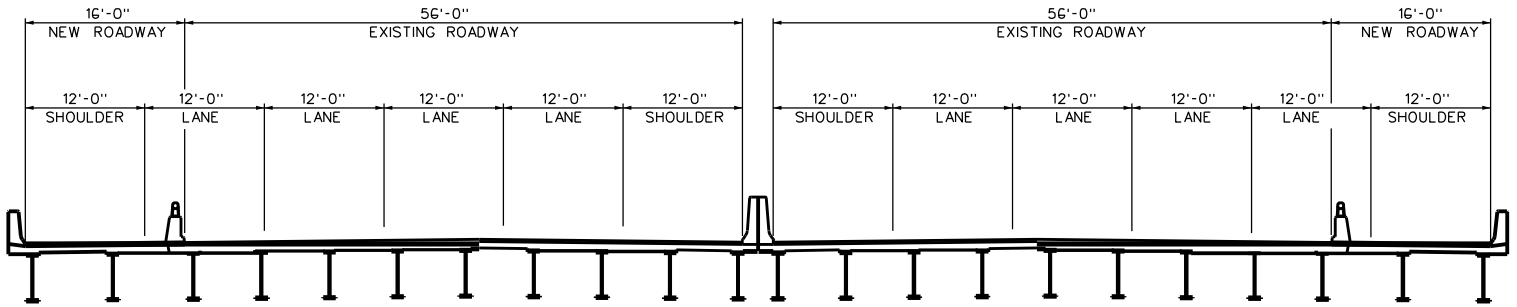
I-95 Over Norwalk River - Pier Section



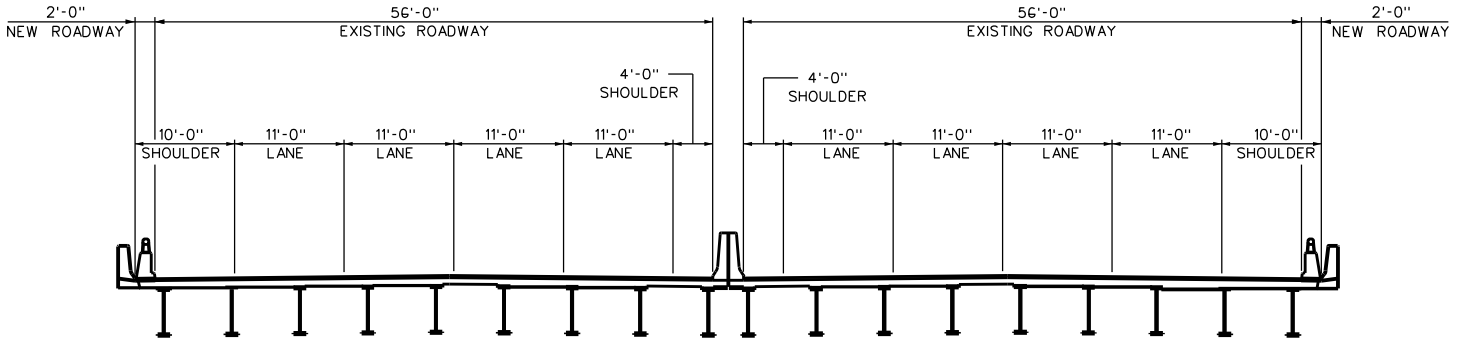
Saugatuck River Bridge

- Coordination with parking facilities on both river banks
- No widening: 12ft of shoulder
  Constrained: 2ft each dir.
  Unconstrained: 16ft each dir.

I-95 Over Saugatuck River - Cross Section



UNCONSTRAINED



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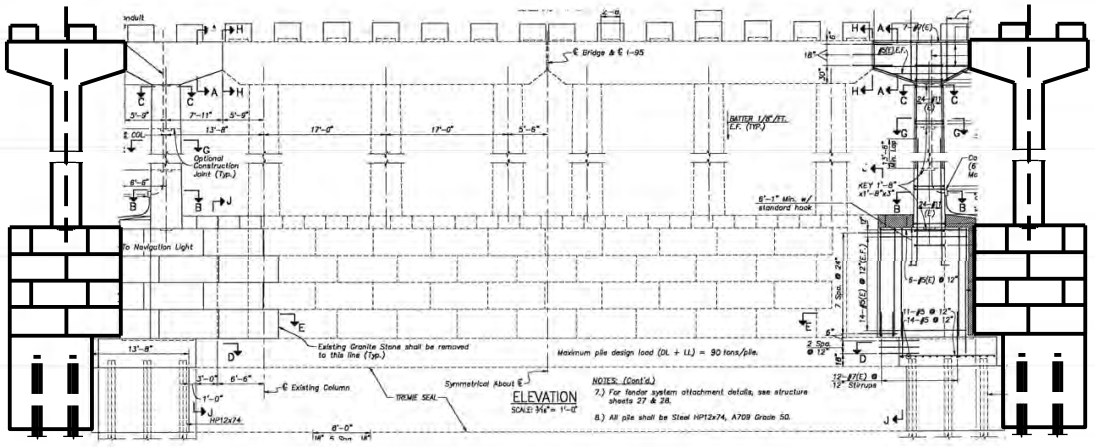
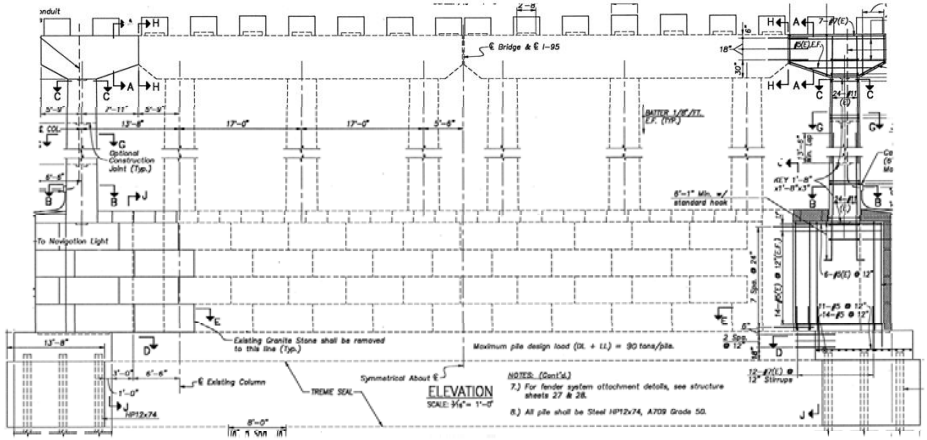
I-95 Over Saugatuck River - Pier Section



UNCONSTRAINED



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AMMANN & WHITNEY, INC
2401 WALNUT STREET
PHILADELPHIA, PA 19103

PREPARED FOR:
THE CONNECTICUT
DEPARTMENT OF TRANSPORTATION

ROADWAY AND BRIDGE RECONSTRUCTION
I-95 FROM GREENWICH TO BRIDGEPORT

CDM Smith

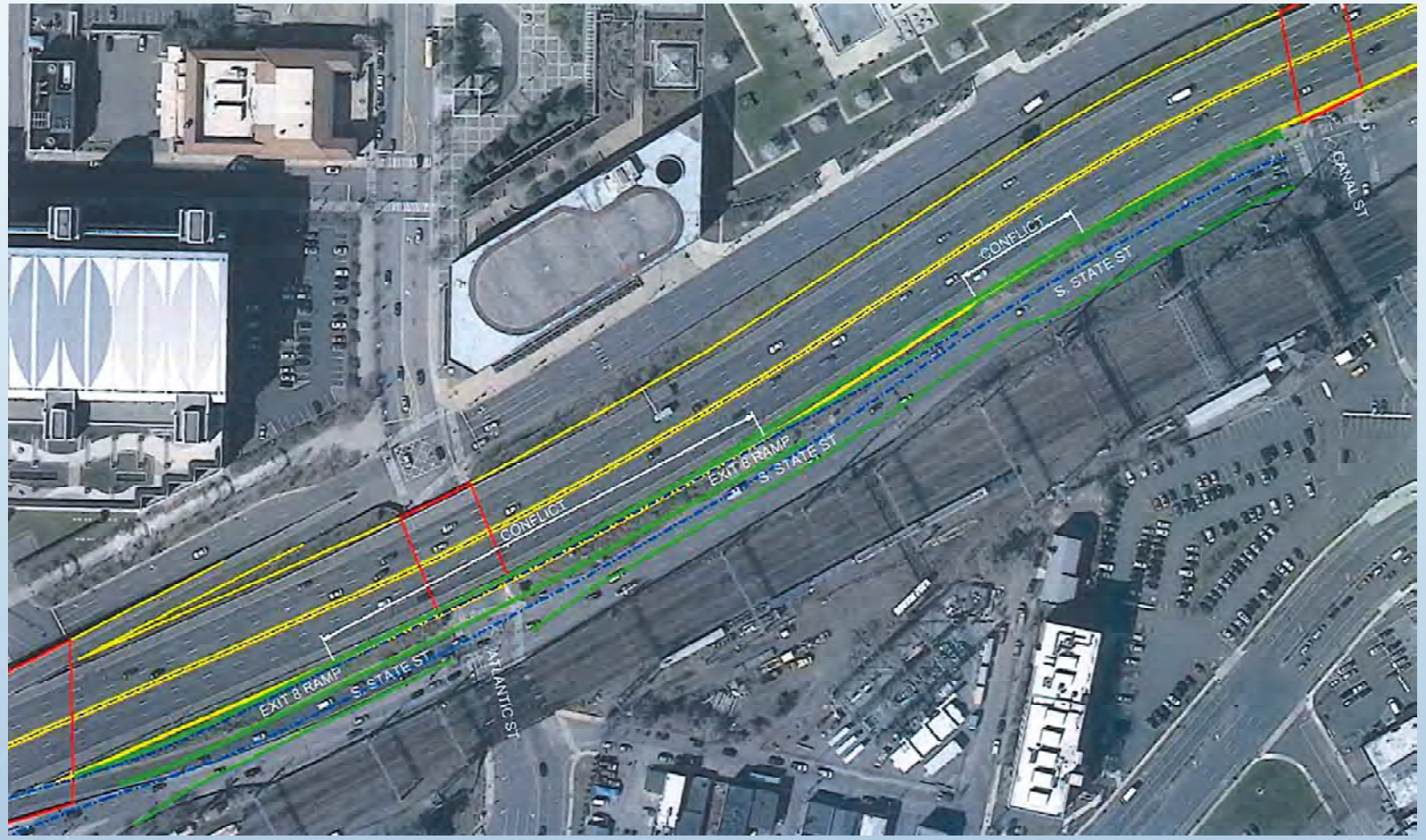
FIGURE 17

Stamford Area
Constrained Condition with New Exit 8

Stamford Area
Constrained Condition with New Exit 8

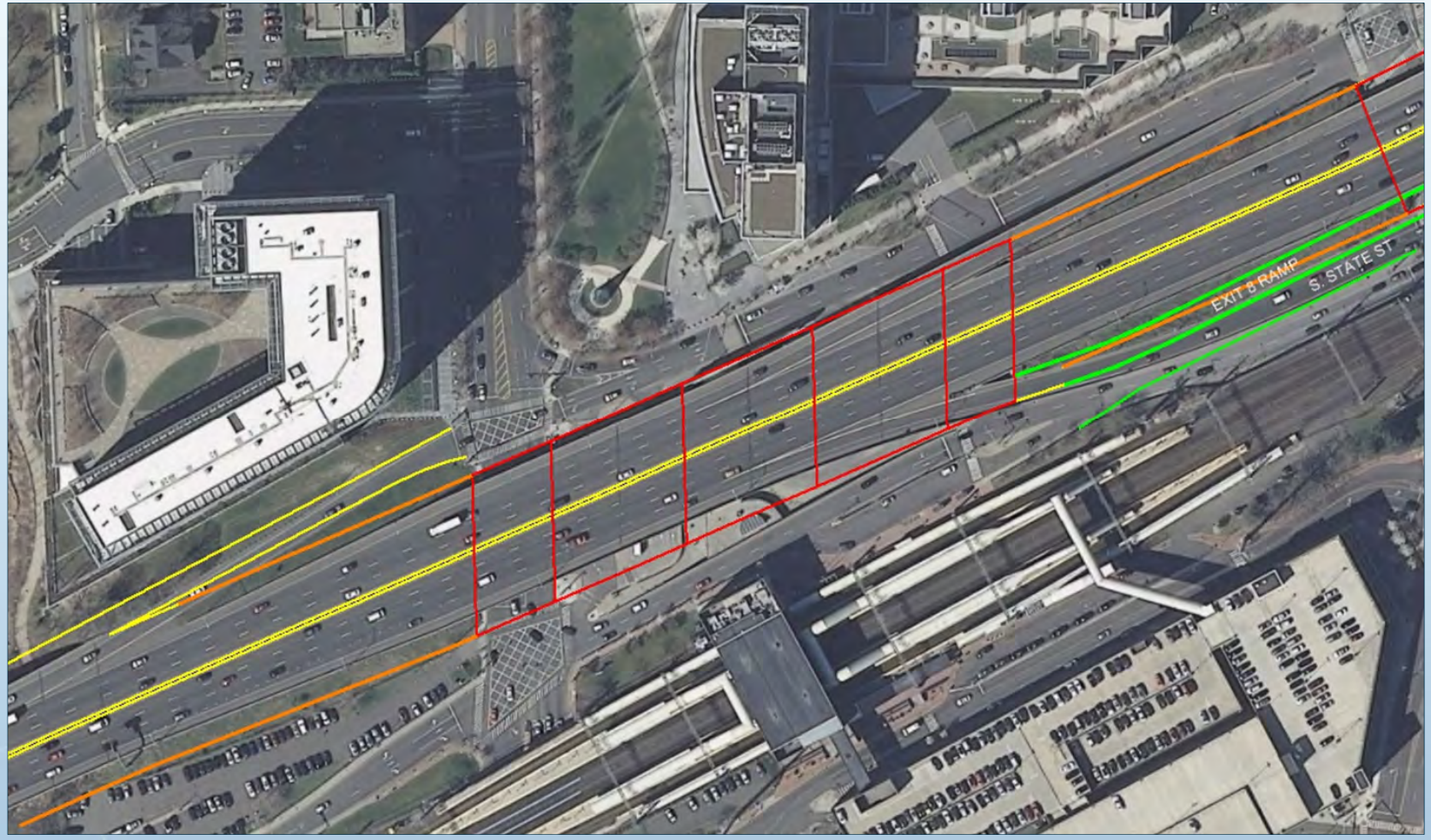
Stamford Area
Constrained Condition with New Exit 8

Stamford Area
Constrained Condition with New Exit 8

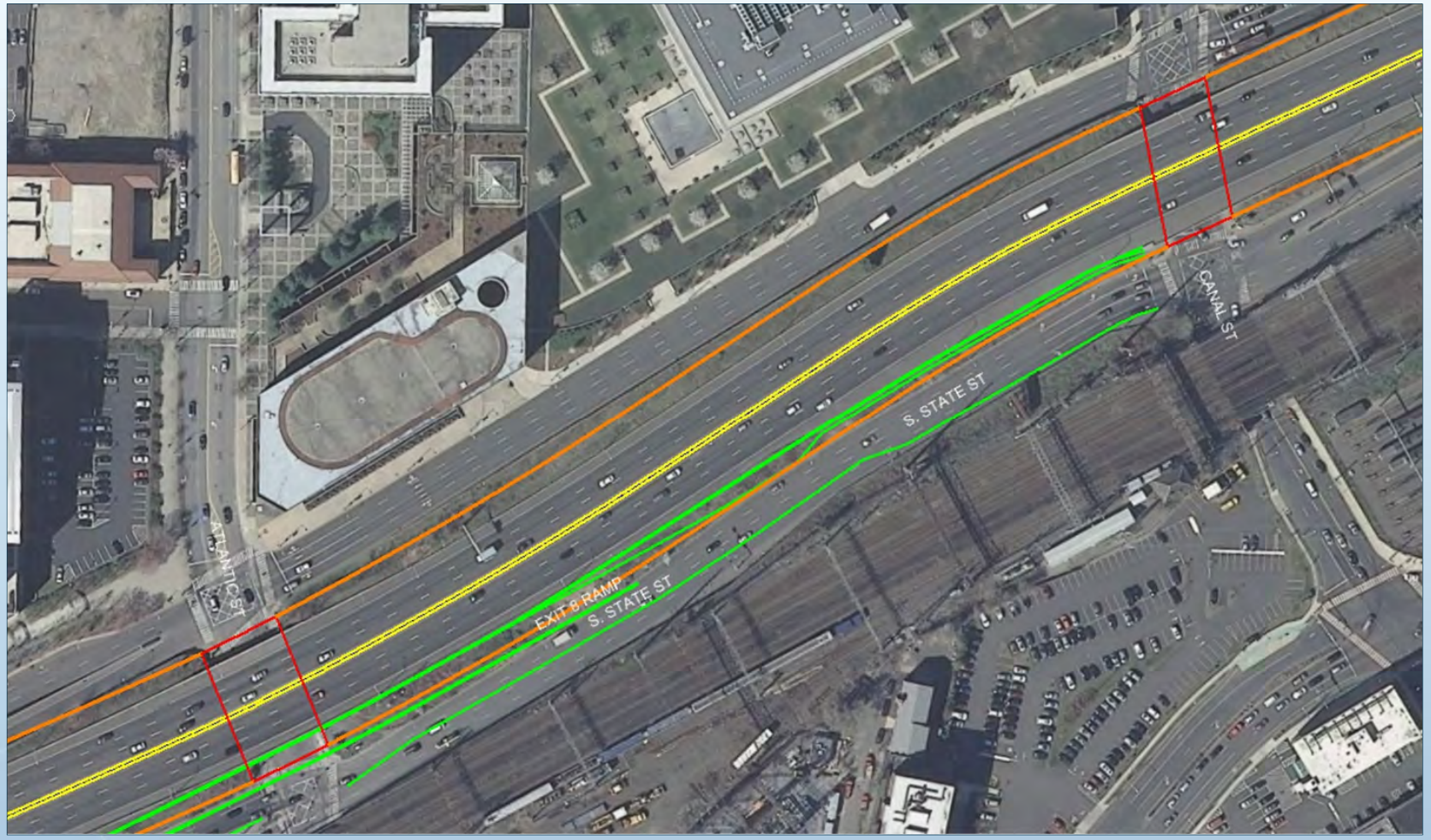


I-95 Feasibility Evaluation and Phasing Study
Greenwich to New Haven

Stamford Area
Unconstrained Condition with New Exit 8



Stamford Area
Unconstrained Condition with New Exit 8



I-95 Feasibility Evaluation and Phasing Study
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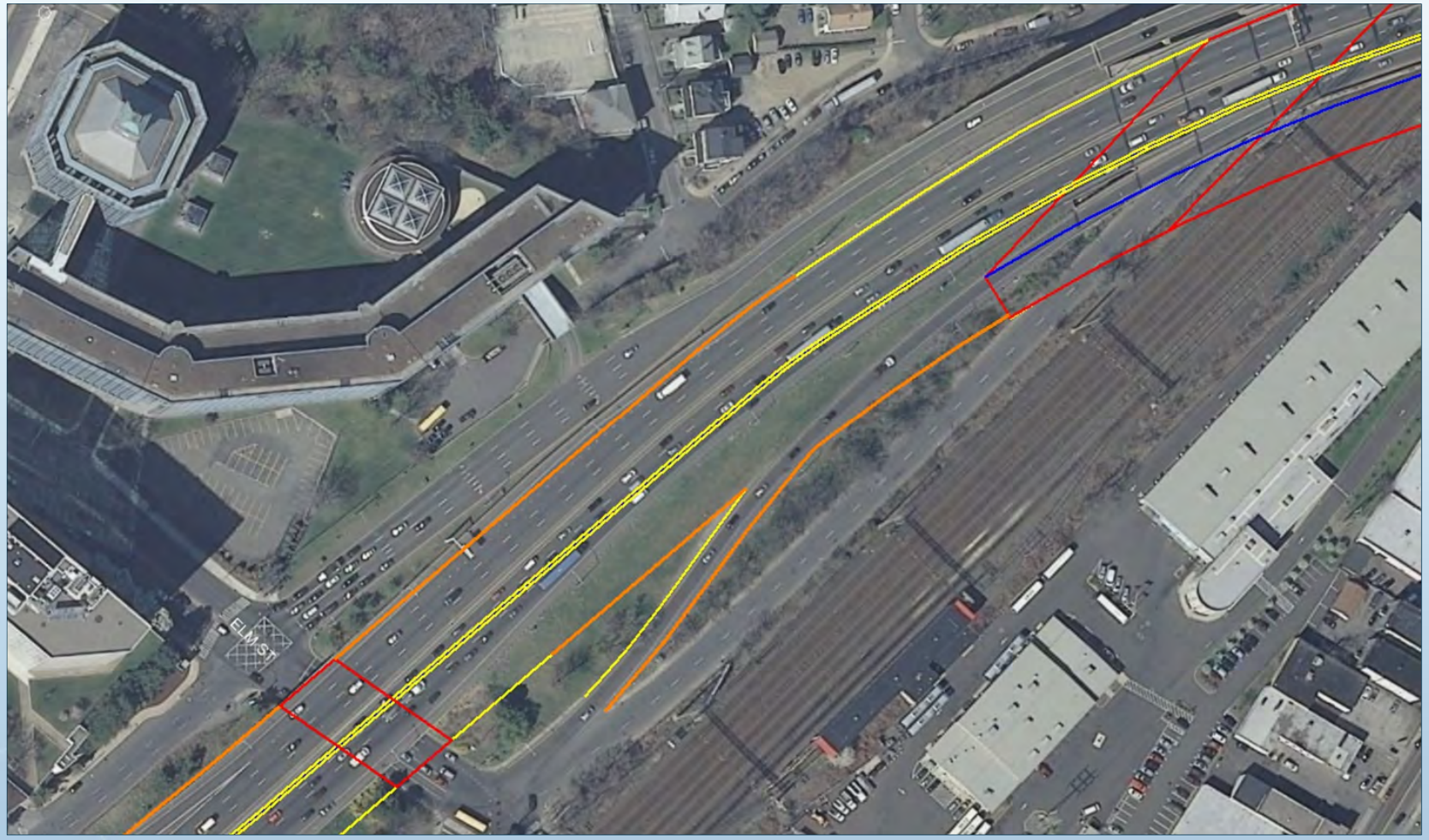
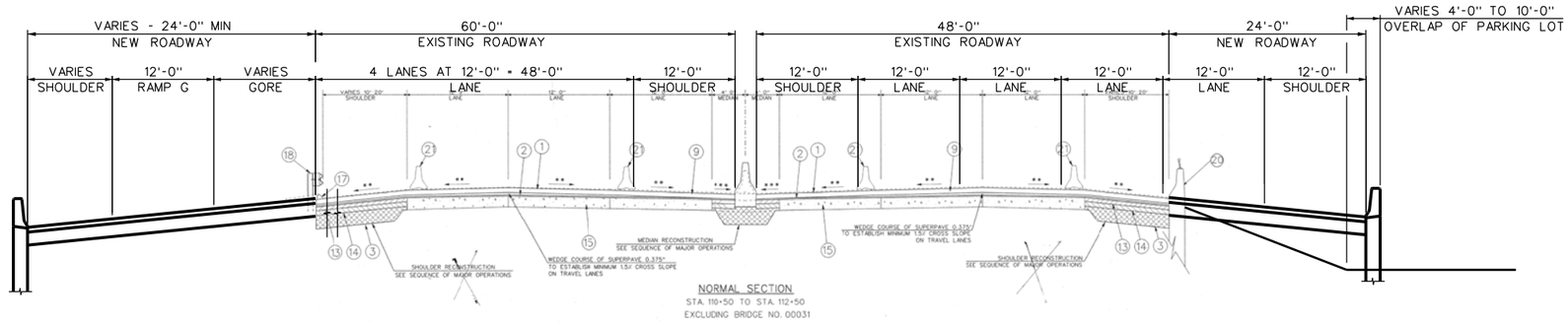
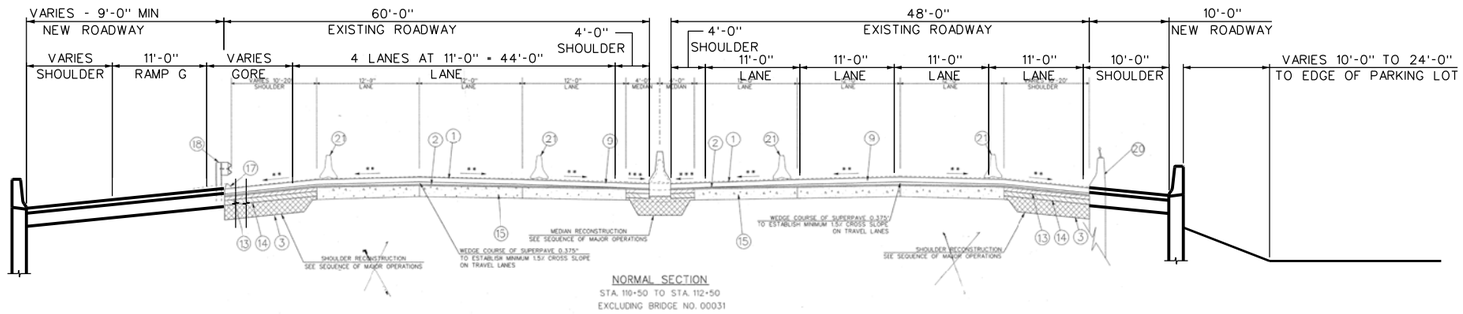




NORMAL SECTION
STA. 110+50 TO STA. 112+50
EXCLUDING BRIDGE NO. 00031

UNCONSTRAINED



NORMAL SECTION
STA. 110+50 TO STA. 112+50
EXCLUDING BRIDGE NO. 00031

CONSTRAINED

I-95 RETAINING WALLS THROUGH STAMFORD

PARKING LOT ADJACENT TO WASHINGTON AND STATE STREETS

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FIGURE 26

Appendix G

HOT SPOTS

"Hot Spot" Analysis
I-95/Route 8

Rt. 8/Rt. 25 Interchange

- Access to Route 8/25
- Southbound Issues
  - Heavy ramp and mainline volumes
- Northbound Issues
  - Heavy ramp and mainline volumes
  - Ramp Grade/Capacity
- Anticipated to get worse with increased growth

– Potential improvements

- Widen NB and SB Off-ramps
- Widen Rt.8 Mainline

FIGURE 1

“Hot Spot” Analysis

Milford Parkway Interchange

- Access to Route 15
- Partial Clover-leaf interchange
  - Southbound Issues
    - Heavy Off-ramp volume
  - Northbound Issues
    - Weaving
  - Anticipated to get worse with increased growth
- Potential Improvements
  - Improve ramp configuration (accel./decel. lanes)
  - Widen Milford Parkway

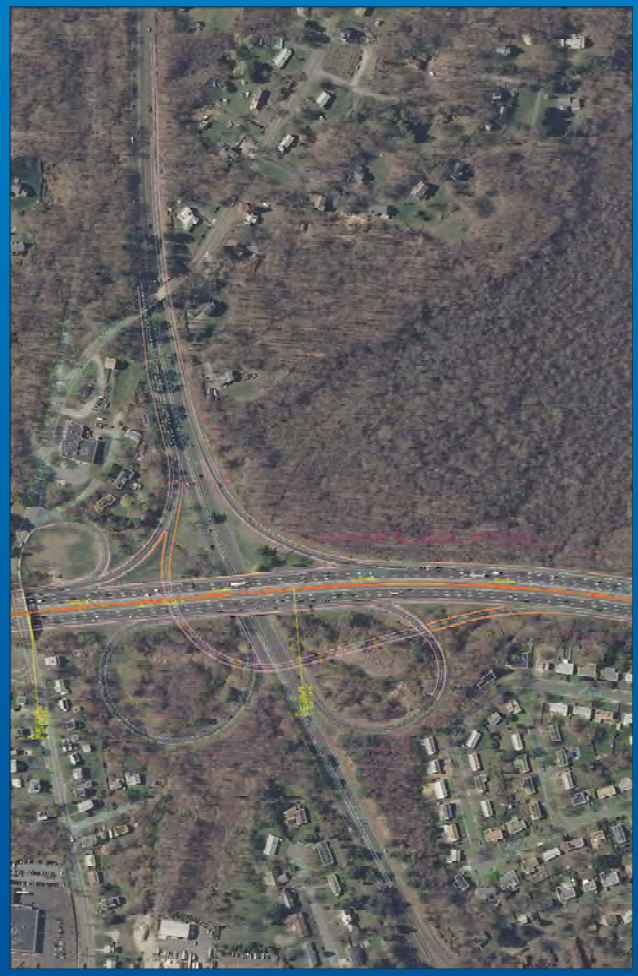

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FIGURE 2

“Hot Spot” Analysis

Route 1 Interchange, Milford

- Westfield Mall
- “Big-Box” Retail

– Clover-leaf interchange
  - Northbound and Southbound Issues
    – Weaving
  - Anticipated to get worse with increased growth

– Potential Improvements
  - Reconfigure Interchange
  - NB and SB Aux. lanes to Interchange 40 (Woodmont Rd.)