New Jersey Turnpike Authority
Newark Bay–Hudson County Extension
Interchange 14 to Interchange 14A / Newark Bay Bridge Replacement and Associated Improvements

APPENDIX B: Traffic Analysis Report

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Submitted to: **New Jersey Turnpike Authority**

NB-HCE Traffic Analysis Report
Interchange 14 to Interchange 14A

OPS No. T3820
New Jersey Turnpike
Newark Bay-Hudson County Extension
Bridge Replacements and Capacity Enhancements Program

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Excellence Delivered As Promised

In conjunction with:

WSP USA Inc.

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1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

The New Jersey Turnpike Authority (NJTA, or Authority) is proposing reconstruction of and capacity enhancements to the Newark Bay - Hudson County Extension (NB-HCE) from New Jersey Turnpike Interchange 14 (I-78, US Route 1&9 and Newark Airport) in Newark to Interchange 14A (NJ Route 440) in Bayonne and Jersey City (the Interchange 14 to Interchange 14A Project, or the Project). The Project is part of a long-term Program by the Authority to improve the entire NB-HCE between Interchange 14 and the NB-HCE's Eastern Terminus at the Jersey Avenue signalized intersections with 12th Street and 14th Street in Jersey City. While traffic forecasts were performed to determine the traffic volume demands for the full long-term Program limits (the length of the NB-HCE corridor), this **NB-HCE Traffic Analysis Report – Interchange 14 to Interchange 14A** focuses on the portion of the analysis of the proposed improvements between Interchange 14 and Interchange 14A as an independent project.

The purposes of the traffic study resulting in this Report are:

- To support the traffic-related elements of the Project's Purpose and Need;
- to assess the number of lanes needed on the roadway link along the NB-HCE between Interchange 14 and Interchange 14A based on future traffic demand;
- to assess the number of lanes needed on ramp roadways at Interchange 14 and Interchange 14A (between the toll plaza and the NB-HCE) based on future traffic demand;
- to confirm and/or adjust lane configurations at the Interchange 14 and Interchange 14A connections proposed as the Initially Recommended Alternative (IPA) in the previous Needs Assessment Study (2020) through alternatives analysis;
- to assess alternatives to the Project;
- to provide traffic-related data needed for the Project's air quality and noise analyses; and
- to assess independent utility of the Project from the other projects within the NB-HCE Program.

Intersections and roadways outside the Authority's roadway system that would not be impacted by a proposed change in ramp location are not included in this Report.

The Gannett Fleming (GF) Team has been tasked to provide Preliminary Design and Environmental Services for the Program. The main components of the overall Program include the following items:

- Replacement of bridges including the Newark Bay Bridge and capacity enhancements of the roadway to four lanes in each direction (with standard shoulders) between Interchange 14 and Interchange 14A

- Replacement of bridges and capacity enhancements of the roadway to three lanes in each direction (with standard shoulders) between Interchange 14A and the Columbus Drive (eastbound exit)/Merseles Street (westbound entrance) interchange ramps
- Replacement of viaduct structures and construction of standard shoulders while maintaining the existing two-lane configuration eastbound and westbound between the Columbus/Merseles ramps and the NB-HCE eastern terminus at the Jersey Avenue intersection.

This traffic study was conducted to assess the existing and forecast traffic volumes and operations along the NB-HCE, including interchange ramps, from Interchange 14 in Newark to Interchange 14A in Bayonne and Jersey City. Specifically, traffic analysis was performed for the Base Year (2021) and expected traffic Design Year 2050 No-Build and Build conditions. The Build geometry of the full corridor upon which analysis within the Project limits was initially based is the Initially Preferred Alternative (IPA). The main components of the overall Program are:

- Capacity enhancements of the NB-HCE roadway to four lanes in each direction (with standard shoulders) between Interchange 14 and Interchange 14A
- Capacity enhancements of the NB-HCE roadway to three lanes in each direction (with standard shoulders) between Interchange 14A and the Columbus Drive (eastbound exit)/Merseles Street (westbound entrance) interchange ramps
- Addition of standard shoulders to the NB-HCE roadway while maintaining the existing two-lane configurations both eastbound and westbound between the Columbus Drive/Merseles Street interchange ramps and the Jersey Avenue signalized intersection.
- Geometric improvement of ramps at the NB-HCE interchanges, including widening of Ramp WT (NB-HCE eastbound to Interchange 14A) and Ramp HS (NB-HCE westbound to Turnpike southbound) to two lanes and extension of the two-lane geometry of Ramp TW (Interchange 14A to NB-HCE westbound) onto the NB-HCE.

The IPA included assumptions that have been modified during Preliminary Design (PD) under this Program. For instance, the former Peter Stuyvesant Service Area, westbound between Interchange 14B and Interchange 14A (outside the limits of this project), was assumed to be reopened under the IPA, while the PD geometry does not include a reopened facility. The assessment also resulted in an adjustment to the IPA geometry within the Interchange 14 – Interchange 14A limits, which is discussed further in Section 9 of this Report.

1.2 TRAVEL DEMAND FORECASTING METHODOLOGY

Traffic data used for this study included historical data from the NJTA and other agencies, such as the New Jersey Department of Transportation (NJDOT) and Port Authority of New York and New Jersey (PANYNJ). Data provided by the NJTA included yearly toll transactions, hourly toll transaction origin-destination information, on-road sensor device puck data, crash records and crash rate data. PANYNJ data included traffic count data in the 12th Street and 14th Street corridors between the NB-HCE and the Holland Tunnel. Data on various proposed developments in Jersey City was also researched through the city's data portal. The Program team collected additional data, field traffic counts, to fill gaps in the information provided and to obtain more current and, in some cases, more refined, data. Because the field data collection occurred during a time period, Summer 2021, still impacted by the COVID-19 pandemic, pre-pandemic data of 2019 was obtained from NJTA Sensys pucks and toll plaza transaction data for comparison and assessment of the pandemic's impacts on traffic patterns and magnitudes.

For this traffic study, the most recent regional travel demand model (as of June 2022, when the initial project modeling began) — North Jersey Regional Travel Model Enhanced (NJTRM-E), developed and maintained by the North Jersey Transportation Planning Authority (NJTPA) — was obtained and used to ensure all land use development and planned highway and transit projects through 2050 were included in the traffic analysis. This is still the current regional model. The NJTPA is the federally authorized Metropolitan Planning Organization (MPO) for 7 million people in the 13-county northern New Jersey region. An MPO is a federally-mandated and federally-funded transportation planning agency made up of representatives from local government and key transportation agencies. Congress created MPOs to give local elected officials a stronger role in guiding federal transportation investment and to ensure that these decisions are based on a continuing, cooperative and comprehensive planning process. The NJTRM-E is used by NJTPA to support development and adoption of the federally-mandated Regional Transportation Plan (RTP). The most recent RTP - Plan 2050: Transportation. People. Opportunity - was approved by the NJTPA Board of Trustees on September 13, 2021. Also approved on that date were the Transportation Improvement Program (TIP), and Air Quality Conformity Determination. The NB-HCE Program was identified in the RTP and TIP and included in the NJTRM-E modeling supporting the RTP development and Air Quality Conformity Determination. The full NB-HCE Program was modelled which included:

- Four lanes in each direction between Interchanges 14 and 14A,
- Three lanes in each direction between Interchange 14A and Columbus Drive, and
- Maintaining two lanes in each direction between Columbus Drive and Jersey Avenue

The NJRTM-E's traffic forecast models were used to develop forecast traffic demand, both for no geometric improvements (No-Build) and with geometric improvements (Build), from the Base Year (2021) to a Design Year of 2050. The traffic forecasts were performed for the full length of the NB-HCE corridor for the 2050 Design Year No-Build and Build conditions. A traffic demand increase of 8.3% over Base Year is forecasted for the Design Year No-Build case, primarily due to anticipated growth in development in municipalities along the corridor. Design Year Build traffic demand will increase on the corridor by 21.9% over the No-Build, primarily because of changes in route choice. Section 5 of this Report provides more detail on this methodology.

Traffic volume profiles were developed from the various data collected and obtained. Per the NJTPA, the latest regional demand model has not been updated to incorporate pandemic-related traffic impacts; 2021 traffic counts, therefore, were adjusted to an equivalent pre-pandemic level based on comparisons with 2019 data in order to establish the Base Year traffic volume profile. Growth trends from the NJRTM-E, measured in 10-year increments, were applied to the Base Year traffic volume profile to establish Design Year 2050 traffic volume forecasts for No-Build and Build cases. Pre-pandemic truck and bus percentages were used for the traffic forecasts to avoid over- or underforecasting these vehicle components to the Design Year. These volume profiles were used in the lane configuration assessment. The proposed enhancements in the corridor serve increased travel demand due to forecasts of significant development in Jersey City (39% population and 26% employment) between the years 2020 and 2050. Regionally, the NB-HCE Program improvements, including the Interchange 14 to Interchange 14A Project, shifts traffic from overburdened parallel and alternate corridors such as the Pulaski Skyway and U.S. 1&9 Truck to the NB-HCE. Several ramps at Interchange 14, such as Ramp TN (from Interchange 14 toll plaza to Turnpike northbound), Ramp TS (from Interchange 14 toll plaza to Turnpike southbound) and Ramp SIT/Ramp SOT (from Turnpike northbound to Interchange 14 toll plaza), show small increases or decreases between 2050 Design Year Build and No-Build traffic forecasts for one or both weekday peak hours, indicative of forecasted changes in route choice. Section 7 of this Report further details the development of the traffic volume forecasts, and **Appendix A** shows traffic volume diagrams for each condition.

1.3 TRAFFIC ANALYSIS METHODOLOGY AND RESULTS

1.3.1 Traffic Analysis Methodology

Two types of analysis were performed in this Report. A static analysis compared geometries, specifically numbers of lanes, of NB-HCE and ramp roadways against the traffic demands anticipated to use them. *Highway Capacity Manual, 6th Edition,* procedures were used for this analysis, using input information including traffic volume, heavy vehicle percentages, number of lanes, presence of shoulders and vertical grades. Output of the analysis included roadway density, volume-to- capacity ratio and level of service. The purpose of this analysis was to confirm that the roadway or ramp lane would rate level of service D or better based on the number of lanes provided. Recognizing that roadway link flows are dependent on operational characteristics of facilities on either end of the link, an operational analysis looked at specific locations in the existing and proposed roadway system, such as ramp junctions and splits, to evaluate their impacts on the surrounding roadway links. VISSIM microsimulation models were created to simulate base year and forecast operations through these facilities. The models were calibrated using existing speed data from the Regional Integrated Transportation Information System (RITIS) and validated against Base Year traffic volumes for the weekday morning (AM) and evening (PM) peak hours. Performance measures, such as density, speed and queuing characteristics were used to evaluate the level of service of the facility – level of service D or better operation was targeted for Build geometric alternatives. Section 8 further details the methodologies for each type of analysis performed, while **Appendix D** provides validation reports for the models created.

Comparisons of performance between Base Year 2021, Design Year 2050 (No-Build) and Design Year 2050 (Build) conditions were made for the facilities studied, which included major ramp junctions and splits at Interchange 14 and Interchange 14A. In some cases, several Build alternatives were evaluated based on different geometric characteristics; benefits and drawbacks to traffic operation are summarized in this Report. Section 9 summarizes the static analysis, while Section 10 addresses the microsimulation analysis.

1.3.2 Crash Analysis

Crash records from the NJTA were reviewed to develop a safety assessment of the NB-HCE corridor. Pandemic impacts in 2020 and 2021 skewed crash trends because of the impacts of public health-related shutdowns and restrictions on traffic volume magnitudes and time-of-day distributions. Detour impacts of the Pulaski Skyway closure through mid-2018 diverted traffic to both US Route 1&9 Truck and the NB-HCE. The NB-HCE eastbound geometry was modified to accommodate the detoured traffic by using the right shoulder as a part-time lane. Crash trends, especially Same Direction and Fixed Object crashes, were skewed during this time because of the increased traffic and modified geometry. Only 18 months' data, specifically July 2018 (following reopening of the Pulaski Skyway and termination of peak-period shoulder use on the NB-HCE) through December 2019 (prior to the onset of COVID-19), therefore, was analyzed for crash trends, despite construction projects on the corridor during that time frame.

The crash listings were reviewed and analyzed in several different ways. The 794 total crashes were divided primarily into the following categories for analysis.

- NB-HCE Roadway Crashes – 332 crashes
- Interchange Ramp Crashes – 161 crashes
- Toll Plaza Crashes – 301 crashes

Each category was broken out further. NB-HCE crashes were further divided by direction (eastbound and westbound) and by area (Interchange 14, Interchange 14 to Interchange 14A, and Interchange 14A). Hotspot analysis identified locations along the NB-HCE where crashes were concentrated. Five clusters were identified in expected locations, at heavy merge locations and the upgrade to the top of the Newark Bay Bridge, where the combination of merge and upgrade proximity, congestion, queues, and speed differential between autos and heavy vehicles contributed to the concentrations of crashes in these locations. Crashes within the clusters accounted for almost 40% of the total crashes on the NB-HCE.

Interchange crashes were further divided by interchange, with more detailed analysis performed on higher-frequency ramps. Toll plaza crashes were further divided by interchange and direction (entry and exit). Section 6 and **Appendix C** provide further detail on the crash analysis.

Major findings of the crash analysis include:

- Most crashes resulted in No Apparent Injury. The highest rate for total injury crashes (Possible, Suspected Minor and Suspected Major Injury) was on the NB-HCE (20.2%, or 67 crashes). The corresponding crash rate at interchange ramps was 18.0% (29 crashes), while toll plaza injury crashes were at 5.0% (15 crashes). Since the NB-HCE roadway constituted a larger area than the other two categories, this finding is not unexpected. No fatalities were reported in the crash data set analyzed.
- The combined total of Same Direction (Rear End) and Same Direction (Sideswipe) crashes for all areas (NB-HCE, interchange ramps and toll plazas combined) comprised almost 90% of the total crashes. Sideswipe crashes were predominant at the toll plazas, while Rear End crashes predominated on the NB-HCE. Both types were prominent on interchange ramps. In most cases, the crash percentages for both crash types exceeded the 2019 Statewide Averages for Interstate Highways.
- Across all areas (NB-HCE, interchange ramps and toll plazas), most crashes occurred in under Dry surface conditions, Day lighting conditions, and Clear environmental conditions. Crashes on Wet surfaces and under Dark conditions, however, exceeded the Statewide Averages for one or more of the facility types.
- Crashes across all areas were more likely to occur on weekdays and during the seven hours comprising the weekday peak periods (AM or PM peak period). The mid-week days (Tuesday, Wednesday, and Thursday) were the peak days for crashes.
- Toll plaza area crashes at Interchange 14A heavily skew to the entry side of the plaza. This is likely influenced by downstream congestion and queuing at the Ramp TW merge with the NB-HCE westbound.
- High crash totals (greater than five per year) at interchange ramps at Interchange 14 were reported on Ramp TS (toll plaza to Turnpike southbound), Ramp TN (toll plaza to Turnpike northbound), Ramp NT (Turnpike southbound to toll plaza) and Ramp HS (NB-HCE westbound to Turnpike southbound). Improvements to Ramp TN are to be addressed under this Program but reported separately from this document.
- High crash totals at interchange ramps at Interchange 14A were reported on Ramp TW (toll plaza to NB-HCE westbound) and the Route 440 Connector Ramp (toll plaza to NJ Route 440).
- High-crash ramp locations exhibited similar crash characteristics to the other facility types studied.

Same Direction crashes are indicative of stop-and-go conditions in congested areas and unsafe merging and lane changes on roadways near or over capacity or with variable speeds. The study area does exhibit queuing and congestion on the NB-HCE, especially at existing merge areas at the interchanges and due to demand exceeding capacity. Capacity enhancements and bridge replacements on the NB-HCE, particularly widening to four lanes and full shoulders in each direction between Interchange 14 and Interchange 14A, will reduce crash potential on the Newark Bay Bridge crossing. Higher-capacity ramp connections and ramp roadways at the interchanges, especially continuing the existing two-lane geometry at Interchange 14A Ramp TW onto the NB-HCE westbound before merging one of the ramp lanes, will improve safety at these locations. Improved drainage and highway lighting systems, designed to current Authority standards, will also improve the crash trends on Wet pavement conditions and Dark lighitng conditions within the study area.

1.3.3 NB-HCE and Ramp Lane Assessment

Highway Capacity Manual (HCM), 6th Edition, procedures, along with the companion software HCS, were the primary method of evaluation and analysis of the number of lanes needed on roadways and ramps addressed in this Report. Section 9 details the analysis. Base Year and Design Year (No-Build) analyses showed Levels of Service (LOS) of E or F on roadway links between Interchange 14 and Interchange 14A in both directions during one or both weekday peak hours. Level of Service is an assessment of the quality of flow on a transportation facility and ranges from A, which is free-flow without congestion, to F, which is over-capacity with vehicle queues and stop-and-go conditions. Level of Service D or better is the target for acceptable operation for Project elements. The current NB-HCE lane configuration currently cannot and will not be able to efficiently accommodate acceptable traffic operations resulting from travel demands it is subjected to. These findings justify the need for capacity enhancements between Interchange 14 and Interchange 14A.

Design Year (Build) analyses, using the proposed four-lane per direction geometry and improvements recommended in the Initially Recommended Alternative (IPA, from the 2020 Needs Assessment study), showed acceptable levels of service (D or better) between Interchange 14 and Interchange 14A in both directions during both weekday peak hours. Therefore, these NB-HCE improvements were the starting point for the Preliminary Design phase evaluation.

A ramp lane assessment confirmed that the proposed ramp lanes at most locations are consistent with the operational need based on traffic demands. At Interchange 14, Ramp HS (NB-HCE westbound to the mainline Turnpike southbound) warrants two lanes based on Base Year and Design Year volumes. The two-lane ramp is included in the Preliminary Design.

Analysis of the NB-HCE roadway lane needs also included assessments of other alternatives (facility types or traffic operational improvement measures). These included the following.

- Three-Lane Newark Bay Bridge
- Rehabilitated Existing Newark Bay Bridge – Peak Period Shoulder Use
- Rehabilitated Existing Newark Bay Bridge – Reversible Lanes

- High-Occupancy Vehicle Facility – Separated or Continuous Access
- High-Occupancy Toll (HOT) Lanes
- Peak Period Bus Shoulder Use
- Separated Truck Roadway

The HOV lane facility assessment suggests that the current bus and HOV-eligible demand on the NB-HCE corridor is not sufficent to warrant a dedicated HOV lane as part of the proposed four-lane cross-section (i.e. one HOV and three General Purpose lanes), whether the HOV facility is separated or continuously accessible. General Purpose lane traffic demand cannot be adequately accommodatred in the remaining three lanes. Interchange spacing, required weaving, and the absence of HOV facilities further downstream at the Holland Tunnel, would not make an HOV lane facility attractive to NB-HCE patrons. Similar findings resulted from a cursory look at hard shoulder running for buses, high-occupancy toll (HOT) lanes and dedicated truck lanes. Future consideration of HOV trips to/from Manhattan or Jersey City, with a corresponding decrease in general purpose lane demand may encourage reconsideration of converting a general purpose lane to an HOV lane in the future. The operational improvement measures involving smaller Newark Bay Bridge footprints, whether three lanes with shoulders or a rehabilitated structure with operational flexibility within an existing footprint, would result in LOS E or worse operation in at least one direction during at least one of the weekday peak hours. None of these alternative facilities or operational improvements would meet the purpose and need of the Program improvements: improving the long-term integrity of the structures between Interchange 14 and Interchange 14A and improving mobility by providing level of service D or better traffic flow quality on the widened roadways.

1.3.4 Interchange Area Alternatives Analysis

Operational analysis was performed at key locations within the project area. VISSIM models were created and run for the Base Year 2021 and Design Year 2050 traffic volume/demands and geometric configurations. Analysis using these models were performed for the following locations.

- Interchange 14: Ramp TH/Ramp NH/Ramp SH Junction (Entrances to NB-HCE Eastbound from Toll Plaza, Turnpike Southbound and Turnpike Northbound, respectively)
- Interchange 14: Ramp HN/Ramp HLT and Ramp HS Diverges (Exits from NB-HCE Westbound to Turnpike Northbound, I-78 Westbound Local via Toll Plaza, and Turnpike Southbound, respectively)
- Interchange 14A: Ramp WT Diverge (Exit from NB-HCE Eastbound)
- Interchange 14A: Ramp TW Junction (Entrance to NB-HCE Westbound)

Because of the distance between Interchange 14 ramp merge/diverge areas and corresponding facilities at Interchange 14A (over 2.5 miles), impacts of weave-like lane changes were not considered to be over and above those of roadway links with no adjacent interchange ramp areas; therefore, separate models were generated for each facility shown above. Five Build alternatives were considered for the Ramp TH/Ramp NH/Ramp SH junction at Interchange 14, and two alternatives were considered for the Ramp WT diverge at Interchange 14A. The IPA geometry was analyzed for the two westbound locations.

VISSIM models for the Base Year 2021 and Design Year 2050 (No-Build) volume profiles showed the expected congestion, queuing, and unacceptable operation (LOS E or worse) on the NB-HCE and the various ramps studied. Design Year 2050 (Build) analysis generated the following conclusions.

- Of the five alternatives at the Interchange 14 Ramp TH/Ramp NH/Ramp SH junction, Alternative 5, which will consist of left entrance ramps with Ramp NH merging into the two-lane Ramp TH and Ramp SH adding two lanes to form the four-lane NB-HCE roadway, will provide the optimal combination of ramp orientation and lane balance to accommodate forecast traffic demands and patterns.
- The proposed Interchange 14 Ramp HS geometry will operate at level of service D or better with a two-lane loop ramp except during the weekday PM peak hour, where the ramp transition from two lanes to one. Queues that will generate at this location will not impede traffic flow on facilities upstream or downstream of this location.
- Both alternatives considered for the Interchange 14A Ramp WT diverge area will yield acceptable levels of service (LOS D or better) with no anticipated queues forming. Alternative 2 (with an option lane forming the second exit lane) will operate better than Alternative 1 (which forms both exit lane from the right lane of the approaching roadway), but the difference is small. The Preliminary Design reflects Alternative 1 and will operate well enough to remain; Alternative 2, however, can be revisited during Final Design if desired.
- The proposed geometry for the Interchange 14A Ramp TW junction will operate at acceptable level of service (D or better), such that it will adequately accommodate forecast traffic demands and patterns.

Two additional assessments were performed in the Interchange 14A area. A toll plaza capacity assessment comparing traffic demand with maximum processing rates based on toll collection method indicated the need to convert one E-ZPass-only toll lane from an exit lane to an entry lane. Two alternatives were also considered to address physical impacts of the NB-HCE capacity enhancements on the Connector Ramp between JFK Blvd. and Avenue C. The assessment of traffic pattern diversions was based on traffic count turning movements onto the Connector Ramp and impacts on Bayonne intersections suggest minimal increases in intersection delay and travel time for diverted traffic. As the Authority has not made a final determination for the

Connector Ramp area, further analysis during Final Design is warranted to refine the traffic diversions and revisit the traffic impacts.

1.3.5 Independent Utility Analysis

Additional analysis was performed to affirm the independent utility of the Program's improvements between Interchange 14 and Interchange 14A compared to the rest of the program, in the context of the implementation of the three projects east of Interchange 14A after completion of this Project and before the 2050 Design Year, as well as the planning horizon year of the NJTPA RTP and corresponding NJRTM-E forecast model. Section 11 details this analysis.

Coding modifications to the NJRTM-E were performed to model implementation of only the Interchange 14 to Interchange 14A improvements while maintaining existing geometries and numbers of lanes in other areas of the NB-HCE corridor, to assess the impact of this potential Build scenario. Level of service analysis, based on lane assessment, showed that a four-lane facility will still be warranted based on these revised traffic forecasts. Independent Utility is established because the project limits are at logical termini (Interchange 14 and Interchange 14A). The project improvements are usable and justifiable in that they address capacity and operational deficiencies between the two interchanges and will adequately serve increased truck traffic between the Turnpike/I-78 corridors and the port facilities in Bayonne and Jersey City. Construction of the project improvements can be performed independently of the other Program improvements, with geometry and pavement at the easterly project limit specified to not preclude the Authority from considering any improvement option or schedule for the NB-HCE further east.

1.3.6 Subregional VMT/VHT/Congested Speed Analysis

Assessments of the impacts of the full build of the proposed Program improvements (over the length of the NB-HCE) on regional vehicle miles traveled (VMT), vehicle hours traveled (VHT) and congested speeds were performed. A subregion was extracted from the NJRTM-E for use in this analysis. This subregion, bounded generally by I-287, I-80, the Hudson River, Kill Van Kull and Arthur Kill, generally defined the outer limits of impact of the proposed Program improvements. The analysis results showed minor differences between No-Build and Build conditions for daily VMT (+0.3%), reinforcing that traffic increases on the NB-HCE will result from changes in route choice. Minor differences in daily VHT (+1.0%) and no change in congested speeds also resulted from this analysis. Section 12 further details the analysis methodology and results.

1.4 CONCLUSION

This Report documented the analysis and assessments performed on roadways and ramps along the NB-HCE between Interchange 14 and Interchange 14A. Other elements, such as crash analysis, vehicle compositions, independent utility and subregional VMT/VHT analysis, are also documented.

The analysis confirmed, with minor adjustment, the proposed lane needs developed in the Initially Preferred Alternative that are now being advanced to Preliminary Design under this phase of the NB-HCE Program. The resulting description of roadway lane requirements for the project area are as outlined in the relevant section of the Introduction. Further analysis of critical merge and diverge areas within the project limits under forecast Build traffic demands yielded acceptable levels of service (D or better) for proposed geometries directly advanced or revised from the Initially Preferred Alternative which are reflected in the Preliminary Design plans.

The NJRTM-E regional demand model showed that most of the growth in the corridor is in the port areas of Bayonne and Jersey City and the significant land use redevelopments anticipated in Bayonne and Jersey City. The Program's enhancements do not address demand for additional trips to lower Manhattan, but rather accommodate the growing local neighborhoods, communities, and port facilities along the NB-HCE and in areas such as Bayonne, Port Jersey, Jersey City and Hoboken.

Independent Utility analysis demonstrated that this project's limits can be implemented irrespective of the content or schedule of other Program improvements proposed by the Authority. Sufficient footprint can be constructed such that future improvement alternatives outside the project area would not be precluded.

The proposed enhancements achieve the traffic purpose and need of the Program. They improve mobility between Interchange 14 and Interchange 14A by attaining level-of-service (LOS) D or better traffic flow quality and, in so doing, enhance access to communities, businesses, and multimodal facilities served by the NB-HCE interchanges, while improving safety and efficiently accommodating growing vehicular demand on this portion of the NB-HCE into the foreseeable future.

2. INTRODUCTION

The New Jersey Turnpike Authority (NJTA, or Authority) is proposing reconstruction of and capacity enhancements to the Newark Bay - Hudson County Extension (NB-HCE) from its Western Terminus at New Jersey Turnpike Interchange 14 (I-78, US Route 1&9 and Newark Airport) in Newark to Interchange 14A (NJ Route 440) in Bayonne and Jersey City (the Interchange 14 to Interchange 14A Project, or the Project). The Project is part of a long-term Program by the Authority to improve the entire NB-HCE between Interchange 14 and the NB-HCE's Eastern Terminus at the Jersey Avenue signalized intersections with 12th Street and 14th Street in Jersey City. While traffic forecasts were performed to determine the traffic volume demands for the full long-term Program limits (the length of the NB-HCE corridor), this **NB-HCE Traffic Analysis Report – Interchange 14 to Interchange 14A** focuses on the portion of the analysis of the proposed improvements between Interchange 14 and Interchange 14A as an independent Project.

The purpose and need for this Project are to:

- Improve the long-term integrity of the structures on the NB-HCE between Interchange 14 and Interchange 14A to maintain them in a state of good repair over a minimum 100-year service life to a goal of a 150-year service life by resolving the factors contributing to the deterioration of the structures and in so doing minimizing the frequency of disruptions to the roadway's users from maintenance and repair of the structures over the life cycle of the improvements.
- Improve mobility between Interchange 14 and Interchange 14A by attaining level of service (LOS) D or better traffic flow quality and, in so doing, enhance access to communities, businesses, and multimodal facilities served by the NB-HCE via the interchanges, while improving safety and efficiently accommodating growing vehicular demand on this portion of the NB-HCE into the foreseeable future.

These purposes are consistent with the goals of the NJTA's Strategic Plan.

The Gannett Fleming (GF) Team has been tasked to provide Preliminary Design and Environmental Services for the Program. The main components of the overall Program are:

- Replacement of bridges, including the Newark Bay Bridge, and capacity enhancements of the roadway to four lanes in each direction (with standard shoulders) between Interchange 14 and Interchange 14A (the Project)
- Replacement of bridges and capacity enhancements of the roadway to three lanes in each direction (with standard shoulders) between Interchange 14A and the Columbus Drive (eastbound exit)/Merseles Street (westbound entrance) interchange ramps
- Replacement of viaduct structures and construction of standard shoulders while maintaining the existing two-lane configurations both eastbound and westbound between

the Columbus Drive/Merseles Street interchange ramps and the Jersey Avenue signalized intersection.

Previous traffic studies of the corridor by others, most recently the Draft Needs Assessment and Alternative Study (Jacobs, July 17, 2020), have established the need for the stated improvements to address operational and capacity constraints and safety concerns that currently restrict traffic flow in the corridor. Future developments, notably the expansion of the port facilities in the region, will further exacerbate the impacts of the existing constraints. This **NB-HCE Traffic Analysis Report – Interchange 14 to Interchange 14A** is being developed to achieve the following goals:

- To support the traffic-related elements of the Project's Purpose and Need;
- to assess the number of lanes needed on the roadway link along the NB-HCE between Interchange 14 and Interchange 14A based on future traffic demand;
- to assess the number of lanes needed on ramp roadways at Interchange 14 and Interchange 14A (between the toll plaza and the NB-HCE) based on future traffic demand;
- to confirm and/or adjust lane configurations at the Interchange 14 and Interchange 14A connections proposed as the Initially Recommended Alternative (IPA) in the previous Needs Assessment Study (2020) through alternatives analysis;
- to assess alternatives to the Project;
- to provide traffic-related data needed for the Project's air quality and noise analyses; and
- to assess independent utility of the Project from the other projects within the NB-HCE Program.

Traffic analysis within the project limits was performed for the Base Year (2021) and expected traffic Design Year (2050) No-Build and Build conditions. The Build geometry of the full corridor upon which analysis within the project limits was initially based is the Initially Preferred Alternative (IPA), which included assumptions that have been modified during Preliminary Design (PD) under this Program. For instance, the former Peter Stuyvesant Service Area, westbound between Interchange 14B and Interchange 14A (outside the limits of this project), was assumed to be reopened under the IPA, while the PD geometry does not include a reopened facility. The assessment also resulted in an adjustment to the IPA geometry within the Interchange 14 – Interchange 14A limits, which is discussed further in Section 9 of this Report.

This Report does not address roadway capacity needs within anticipated maintenance and protection of traffic (MPT) layouts during construction staging. Construction staging and MPT are highly dependent on the number of construction contracts issued, the timing of those contracts and specific layouts needed within those contracts. These considerations have been addressed at a high level elsewhere in the Preliminary Design documents and will be developed in detail under the Final Design phase of the project.

3. STUDY AREA

The Study Area for the overall Program under OPS No. T3820 is the approximately 8.1-mile long NB-HCE, which extends from just east of the Turnpike Interchange 14 toll plaza, in Newark, to the signalized intersections with Jersey Avenue and 12th Street and 14th Street, at the end of Turnpike jurisdiction. This Jersey Avenue intersections are a quarter-mile west of the mount of the Holland Tunnel in Jersey City.

The Study Area for this Project includes the portion of the NB-HCE between and including Interchange 14 and Interchange 14A, comprised of the Newark Bay Bridge crossing and its approaches, ramps at Interchange 14 entering and exiting the NB-HCE, and ramps accessing the toll plaza at Interchange 14A. Interchanges along the NB-HCE within these project limits are listed below.

- Interchange 14 (Western Terminus and Interchange with I-95/New Jersey Turnpike), Milepost N0.10 to Milepost N0.60
- Interchange 14A (NJ Route 440/Bayonne) at Milepost N3.36

Project-specific traffic studies are a key component not only for determining the location, type, and timeframe of improvements required but also for clearly establishing the project's Purpose and Need and enabling key stakeholders to understand the mobility and safety-related issues involved. This Report addresses capacity and operational evaluations of the portion of the NB-HCE between Interchange 14 and Interchange 14A.

3.1 EXISTING NB-HCE ROADWAY CONFIGURATION

The NB-HCE is a tolled, divided highway throughout the overall Program area. There are two travel lanes in each direction, with 12-foot right/outside shoulders and a 4-foot center median. The NB-HCE provides access to one of the busiest airports in the country, Newark Liberty International Airport, runs adjacent to one of the busiest ports in the region, Port Newark, and serves as a direct feeder for the CMA CGM Container Terminal (formerly Global Container Terminal (GCT) Bayonne) at Port Jersey. The ports and port-area businesses (warehouse and distribution in nature) are the major sources of truck traffic on the NB-HCE, especially between Interchange 14 and Interchange 14A. The NB-HCE also provides access to the Liberty Science Center, Liberty State Park (LSP) and the LSP Park & Ride and Hudson-Bergen Light Rail Station. The highly urban areas that the NB-HCE connects and provides access to include Jersey City, Bayonne, Newark and New York City (via the Holland Tunnel).

This Report addresses NB-HCE roadways, interchange ramps and their connections at Interchange 14 and Interchange 14A. A Connector Ramp in Bayonne, not part of the Authority's roadway system, is directly impacted by the proposed improvements to the NB-HCE; assessment of alternatives is also included in this Report. A brief description of each element of the NB-HCE and several major roadways, including other facilities analyzed in this Report, is presented below.

3.2 INTERCHANGES AND TOLL PLAZAS ALONG THE NEWARK BAY-HUDSON COUNTY EXTENSION WITHIN THE STUDY AREA

3.2.1 Interchange 14 (Newark) Toll Plaza, Milepost N0.00 (I-78, M.P. 58.65)

Just west of the western end of the study area is the Interchange 14 toll plaza, with both E-ZPass and standard cash/ticket toll collection. The plaza is located at milepost (M.P.) 58.65 of Interstate 78 (I-78), which accesses the toll plaza from the west. This also marks the approximate western limits of the Authority's mileposting for the NB-HCE (M.P. N0.0). Immediately to the west of this toll plaza are access points to the US Route 1&9 interchange, Newark Liberty International Airport, Port Newark, and the extension of I-78 further west from Newark.

Figure 3-1 shows the locations of the ramps and roadways accessing the toll plaza to and from the west. Figure 3-2 shows locations of ramps and roadways accessing the toll plaza to and from the east. These ramps and roadways are described further below.

Traveling eastbound toward the Turnpike toll plaza, I-78 has eight total lanes, consisting of:

- Three lanes from the "Express" roadway on the left (WXT Roadway)
- Two lanes from US 1&9 and Port Street entrance ramps in the middle (Ramp ALT/Ramp ELT)
- Three lanes from the "Local" roadway on the right (WLT Roadway)

The eastbound (entry) toll plaza has 10 toll lanes, with a combination of seven E-ZPass Only lanes and three E-ZPass/Ticket lanes. Eastbound beyond the toll plaza, the Authority roadway splits into three sections:

- Two lanes continue east over the NJ Turnpike (I-95), becoming the NB-HCE HWE Roadway (Ramp TH)
- A two-lane ramp provides access to the northbound NJ Turnpike (I-95) (Ramp TN)
- One lane provides access to the NJ Turnpike (I-95) southbound (Ramp TS)

Traveling westbound toward the toll plaza to exit the Authority's system, there are four main approaching connections.

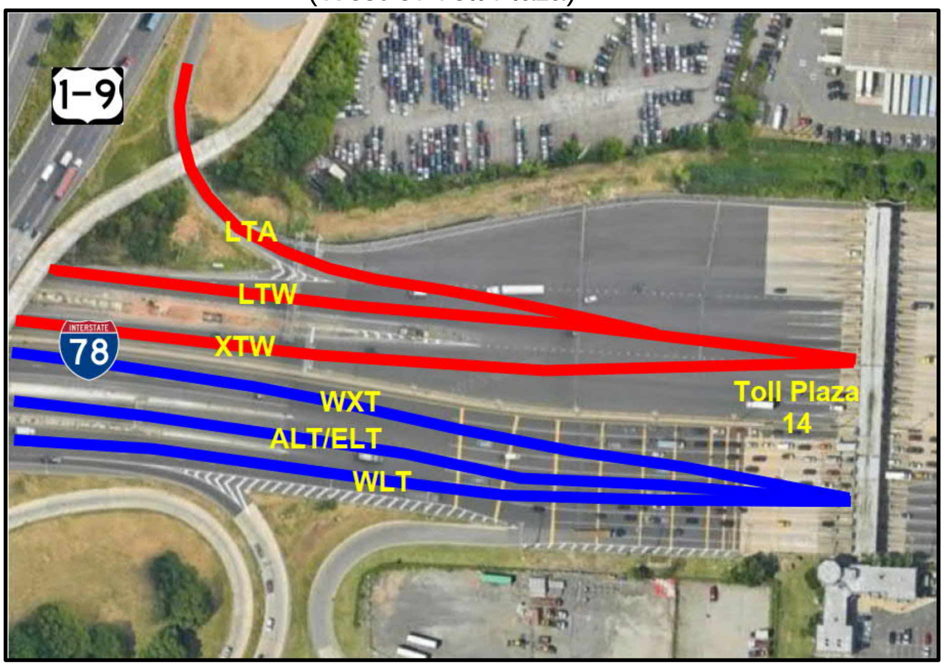
- Two lanes from NJ Turnpike (I-95) northbound (Ramp SIT and Ramp SOT)
- One lane for NB-HCE traffic to access to I-78 "Local" and exits beyond the Interchange 14 toll plaza (Ramp HLT)
- Two lanes from NJ Turnpike (I-95) southbound (Ramp NT)

- Two lanes from the NB-HCE westbound, expanding to three lanes before the toll plaza, for access to I-78 "Express" beyond the Interchange 14 toll plaza (Ramp HXT)

The westbound (exit) toll plaza has 17 exit toll lanes, with 10 E-ZPass Only lanes and seven full-service lanes. West beyond the toll plaza, the I-78 westbound roadway provides for the following traffic separation.

- One lane to US Route 1&9 northbound (Ramp LTA)
- Three lanes to I-78 "Local" (LTW Roadway) and immediate exits to Newark Liberty International Airport, US Route 1&9 southbound, US Route 22 and NJ Route 21
- Two lanes to I-78 "Express" (XTW Roadway)

Figure 3-1 - Interchange 14 Toll Plaza Ramp/Roadway Locations and Designations (West of Toll Plaza)



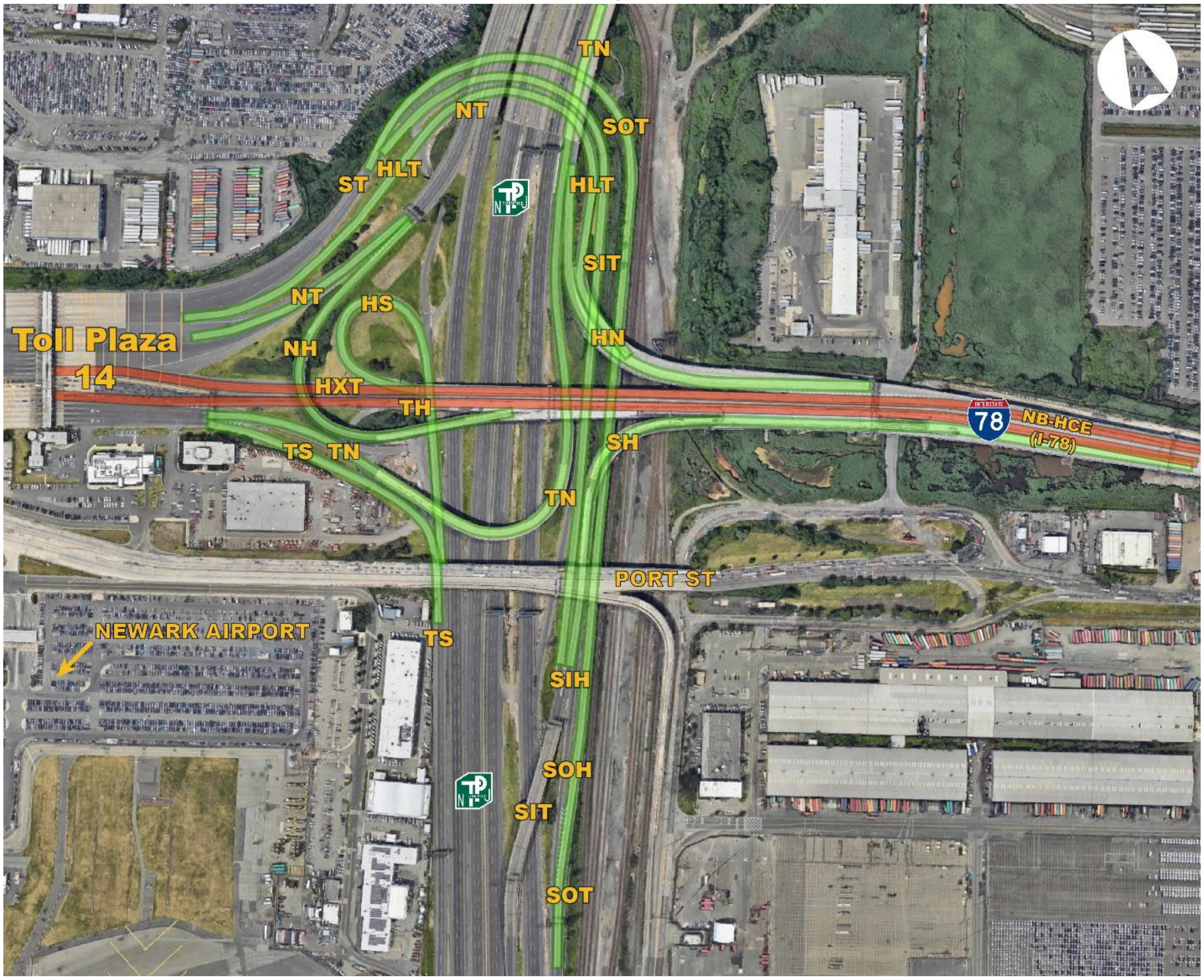
3.2.2 Interchange 14, Milepost N0.10 – N0.60 (I-78, M.P. 58.75 – 59.25)

The Interchange 14 ramp network is immediately east of the Authority's Interchange 14 (Newark) Toll Plaza. This freeway-to-freeway interchange connects the NJ Turnpike mainline (I-95) with the NB-HCE and I-78. The NJ Turnpike runs north-south, with each directional roadway consisting of a dual-roadway configuration (inner for cars only, outer for all vehicles). Interchange 14 ramps provide for entry to Southbound and exit from Northbound inner and outer Turnpike roadways. To and from the North, Interchange 14 ramps provide access to/from the Turnpike's Easterly and Westerly Alignments via separate roadways parallel to the inner and outer roadways. Most ramp connections at Interchange 14 are one-lane ramps except for Ramp

NT (from the Turnpike southbound Easterly and Westerly alignments to the toll plaza to I-78 westbound) and Ramp TN (from the toll plaza and I-78 eastbound to Turnpike northbound Easterly and Westerly alignments). The proposed NB-HCE improvements within this project's limits will impact several ramps in this interchange, specifically those that provide access to and from the NB-HCE. It should be noted that one Interchange 14 ramp, connecting the NJ Turnpike (I-95) southbound with the NB-HCE eastbound, is referenced as Ramp NOH in as-built documents used to develop Preliminary Design plans and reports. Some departments within the Authority also refer to this ramp as Ramp NH. The latter designation, Ramp NH, will be used consistently in this report to refer to this ramp.

Figure 3-2 shows the Interchange 14 geometry, ramp locations and ramp designations.

Figure 3-2 – Interchange 14 Geometry, Ramp Locations and Designations
(East of Interchange 14 Toll Plaza)



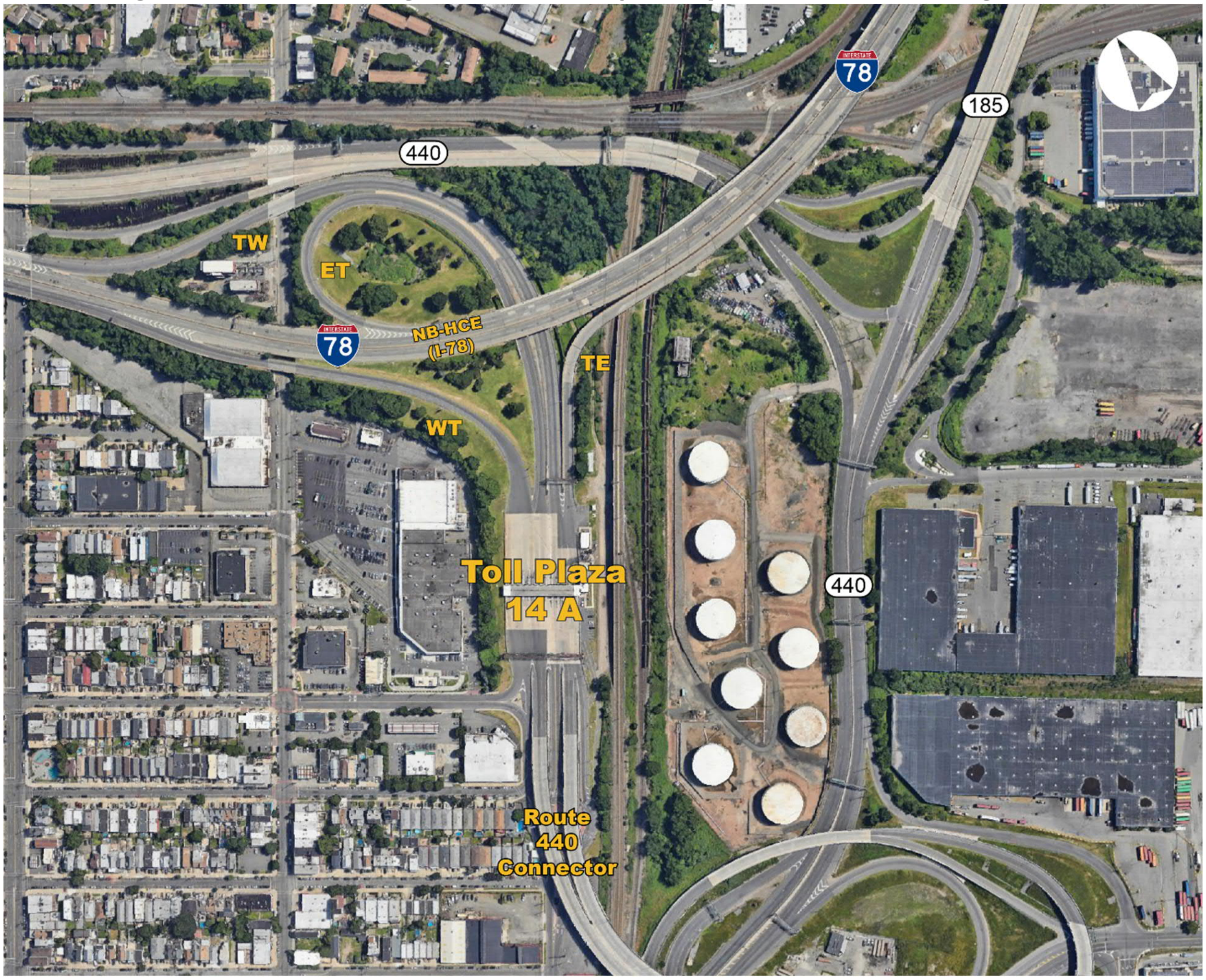
3.2.3 Interchange 14A, Milepost N3.36 (I-78, M.P. 62.01)

The NB-HCE crosses Newark Bay and curves northward at approximate milepost N3.36, at the structure known as the Southeast Viaduct. In the area of Interchange 14A, the NB-HCE is two lanes in each direction and has 12-foot right/outside shoulders with a 4-foot center median. Within this curve is Interchange 14A, which provides connections to NJ Route 440 (a four-lane, north-south route that parallels the NB-HCE west of the interchange) and the City of Bayonne (53rd Street, Avenue E, and Port Jersey) to the south. Single lane ramps provide connections between both directions of the NB-HCE and the toll plaza. Ramp TW, from the toll plaza to the NB-HCE westbound, exits the toll plaza as two lanes, then transitions to one lane prior to merging with the westbound roadway.

The Interchange 14A toll plaza consists of 13 total toll lanes, eight exit lanes and five entry lanes. The five entry lanes include three E-ZPass only lanes and two E-ZPass/Ticket lanes. The eight exit lanes consist of five E-ZPass only lanes and three E-ZPass/Cash toll lanes.

Figure 3-3 shows the Interchange 14A geometry, ramp locations and ramp designations.

Figure 3-3 – Interchange 14A Geometry, Ramp Locations and Designations



3.3 MAJOR HIGHWAYS AND FACILITIES WITHIN THE STUDY AREA

3.3.1 New Jersey Turnpike (I-95)

Interstate Route 95 (I-95) is the major interstate continuing from Florida to Maine, serving many major cities along the Eastern Seaboard. I-95 uses the Authority's roadway system from the Delaware River - Turnpike Toll Bridge to the George Washington Bridge. South of Interchange 6, the NJ Turnpike runs to the Delaware Memorial Bridge. In the project study area, the Turnpike mainline is a dual-dual roadway (separate carriageways for Cars Only and All-Vehicles, known as the inner and outer roadways, respectively) south of Interchange 14, with seven lanes in each direction and a 55-mph posted speed limit. North of Interchange 14, the dual-dual mainline Turnpike and Interchange 14 ramps feed into the Southern Mixing Bowl and the Eastern and Western alignment "spurs."

3.3.2 NJ Route 440

In the study area, NJ Route 440 is a New Jersey state route that is a bi-directional urban principal arterial with two lanes in each direction and a median that alternates between concrete barrier, striping, or grass within and west of the Interchange 14A area. NJ Route 440 crosses the NB-HCE in three places along the expressway section of the route: twice west of the interchange and once immediately east of the interchange ramps. Between these locations, NJ Route 440 runs parallel to the NB-HCE and has a grade-separated interchange with Avenue C. It connects the Bayonne Bridge and US Route 1&9 Truck corridors with the NB-HCE at Interchange 14A.

3.3.3 John F. Kennedy (JFK) Boulevard

In the study area, John F. Kennedy (JFK) Boulevard carries a 500-series County route designation (CR 501), traversing both Bayonne and Jersey City, and is a bi-directional arterial with two lanes in each direction and on-street parking on both sides of the roadway. South of 63rd Street, it is classified as an Urban Minor Arterial; north of there, it changes to an Urban Principal Arterial. In most places it is undivided, but has raised curb median areas between West 58th Street in Bayonne and Neptune Avenue in Jersey City. The roadway is posted at a 25-mph speed limit, and left turn lanes are generally not present south of the NB-HCE crossing. The NB-HCE and NJ Route 440 cross JFK Blvd. just south of the Bayonne/Jersey City corporate line. JFK Boulevard provides local connections between the Bayonne Bridge and residential/small business areas in Bayonne and similar facilities in Jersey City. Access is available to and from NJ Route 440, which has access to the NB-HCE at Interchange 14A.

3.3.4 US Routes 1&9 (Pulaski Skyway)

The Pulaski Skyway carries US Routes 1&9 on a 3.5-mile viaduct connecting Newark with Jersey City. It has connections to the Holland Tunnel via NJ Route 139, which meets the NB-HCE at the latter's terminus at the Jersey Avenue signalized intersections with 12th Street and 14th Street. An interchange with Tonnele Avenue provides major access to Secaucus and North Bergen further north on US Routes 1&9. A quadruple-carriageway US Route 1&9 roadway (local and express roadways in each direction) connects I-78, Newark Airport and the NJ Turnpike Interchange 14 area with the Pulaski Skyway. This roadway is an alternate route to access the Jersey City waterfront area and the Holland Tunnel. The Skyway generally carries two narrow lanes (nominally 11 feet) in each direction with little to no shoulders and is currently signed with a 45-MPH speed limit. Center ramps provide access to and from South Kearny and Jersey City via Newark Avenue and Broadway. Trucks are not permitted to use the Pulaski Skyway; they are diverted to US Routes 1&9 Truck at each end of the Skyway.

3.3.5 US Routes 1&9 Truck

US Routes 1&9 Truck is a signalized arterial roadway providing an alternate route to the Pulaski Skyway via the Lincoln Bridges for trucks, which are prohibited from the Skyway. This Urban Principal Arterial begins at the western end of the Pulaski Skyway near Turnpike Interchange 15E and ends at US Routes 1&9 (Tonnele Avenue) just north of the Tonnele Circle. Its geometry varies between divided and undivided and from two to three lanes in each direction over its length. Major access points along the route include Bayonne via NJ Route 440, South Kearny via Central Avenue, Jersey City via Communipaw Avenue and several other signalized cross-streets, waterfront areas via NJ Route 139 and Secaucus, North Bergen and the Lincoln Tunnel via Tonnele Avenue. Posted speed limits vary: 50 MPH, between Turnpike Interchange 15E and Communipaw Avenue; 40 MPH between Communipaw Avenue and Newark Avenue; and 30 MPH between Newark Avenue and Tonnele Avenue.

4. TRAFFIC DATA COLLECTION

Available traffic datasets were obtained from various sources to document existing conditions, assess impacts of the COVID-19 pandemic, and forecast future traffic patterns in the overall Program area. Traffic counts were obtained from NJTA, NJDOT, and PANYNJ in addition to a field data collection program performed in Summer 2021 to supplement the other available data. Additional obtained traffic data included NJTPA's NJRTM-E traffic model, traffic signal timings, physical inventory information, and crash data. Additionally, relevant reference documents were consulted, including these listed below.

- Draft Needs Assessment and Alternative Study, prepared by Jacobs, July 17, 2020
- Design Services for Contract No. T100.125: Bridge Deck Reconstruction and Miscellaneous Improvements, Newark Bay – Hudson County Extension, Milepost N6.0 to N8.20, Technical Memorandum – Traffic Operations Study, Greenman – Pederson, Inc., in association with Michael Baker, Jr., Inc., 2010
- Port Authority of New York and New Jersey (PANYNJ) Port Master Plan
- NJTPA and NJDOT Transportation Improvement Program (TIP)
- Jersey City Open Data Portal Planned Developments

Since the traffic data collected contributed to the derivation of traffic forecasts for the full Program area, the full inventory is reported here. It must be emphasized, however, that the analysis contained in this Report addresses only the project limits between Interchange 14 and Interchange 14A.

4.1 NJTA DATA

4.1.1 Yearly Toll Transaction Data

The NJTA's M47 Report summarizes annual toll transactions within the NJ Turnpike's ticket system by roadway link (mostly on mainline roadways between interchanges), by direction, and by NJTA's vehicle classifications. These reports were obtained for each year between 2013 and 2021. Average annual daily traffic (AADT) and vehicle composition data can be derived from the yearly reports.

4.1.2 Hourly Toll Transaction Data

Toll transaction data was obtained from the NJTA for the years 2019, 2020, and 2021 (through March). This data provides transactions by hour at each exit portal of the NJ Turnpike's ticket system, in a format that allows tracking of the entry portal and the path these trips would take within the NJ Turnpike system. This information was compiled, summarized, and analyzed to determine existing travel patterns in the study area. NB-HCE and Turnpike/I-95 mainline volumes, interchange entry/exit ramp volumes by direction, hourly profiles, vehicle composition, and seasonal factors were developed using this dataset. This information also provided insight into the impacts of the COVID-19 pandemic on travel in the Program area.

4.1.3 On-Road Sensor Data

Hourly traffic volumes, average speeds, and roadway density metrics (by lane) were obtained through the Authority's on-road sensor array devices, referred to as Sensys "pucks". Table 4-1 lists the location of Sensys sensors utilized.

Table 4-1 – On-Road Sensor Data Sites

Group ID	Facility	Section	Milepost	Roadway
T00440HWE-TDS	Turnpike	NB-HCE	N4.40	Eastbound (HWE)
T00440HWE-TDS	Turnpike	NB-HCE	N4.40	Westbound (HEW)
T00496HEW-TDS	Turnpike	NB-HCE	N4.96	Westbound (HEW)
T00496HWE-TDS	Turnpike	NB-HCE	N4.96	Eastbound (HWE)
T00110HWE-TDS	Turnpike	NB-HCE	N1.10	Eastbound (HWE)
T00110HWE-TDS	Turnpike	NB-HCE	N1.10	Westbound (HEW)
T10337SNO-TDS	Turnpike	Mainline	103.37	Mainline Outer NB (SNO)
T10338SNI-TDS	Turnpike	Mainline	103.38	Mainline Inner NB (SNI)
T10344NSI-TDS	Turnpike	Mainline	103.44	Mainline Inner SB (NSI)
T10345NSO-TDS	Turnpike	Mainline	103.45	Mainline Outer SB (NSO)
T10539NSI-TDS	Turnpike	Mainline	105.39	Mainline Outer SB (NSI)
T10539NT-TDS	Turnpike	Ramp	105.39	Int. 14 Exit Ramp SB (NT)
T10539NSI-TDS	Turnpike	Mainline	105.39	Mainline Inner SB (NSI)
T10540SNI-TDS	Turnpike	Mainline	105.40	Mainline Inner NB (SNI)
T10540SNO-TDS	Turnpike	Mainline	105.40	Mainline Outer NB (SNO)
T10540TN-TDS	Turnpike	Ramp	105.40	Int. 14 Entry Ramp NB (TN)

The information was provided for the full years of 2019 and 2020 and for January through March 2021. It should be noted that the sensors at MP N1.10 provided data only between January 2019 and July 2020. The locations on the NJ Turnpike Mainline (I-95) were used to examine existing traffic patterns on the mainline immediately north and south of Interchange 14 and the NB-HCE.

4.2 PORT AUTHORITY OF NEW YORK AND NEW JERSEY (PANYNJ) TRAFFIC DATA

4.2.1 Holland Tunnel Area Traffic Data

Data was obtained from the Port Authority of New York and New Jersey (PANYNJ) for existing traffic conditions on their infrastructure. This included maps of PANYNJ airports, roadways, bridges, and ramps. Traffic counts from 2019 and 2021 were obtained for signalized intersections on 12th Street and 14th Street between the NB-HCE/NJ Route 139 junction/split and the Holland Tunnel. Holland Tunnel annual toll plaza data since 2011 was also obtained from the PANYNJ website. Also included were signal timings for PANYNJ-maintained traffic signals along 12th and 14th Streets at the following intersecting streets in Jersey City.

- Jersey Avenue
- Erie Street
- Manila Avenue
- Marin Boulevard

Table 4-2 lists the locations and dates of turning movement counts (TMC) and automatic traffic recorder (ATR) counts on the 12th Street and 14th Street corridors obtained from the PANYNJ.

Table 4-2 – PANYNJ Traffic Count Locations

Count Type	Location	Year
ATR	12th St. eastbound between Erie St. and Manila Ave.	2019
ATR	Marin St. northbound south of 12th St.	2019
ATR	Marin St. southbound south of 12th St.	2019
TMC	12th St. at Marin Blvd.	2019
TMC	12th St. at Manila Ave.	2019
TMC	12th St. at Erie St.	2019
TMC	12th St. At Jersey Ave.	2019
ATR	12th St. eastbound between Erie St. and Manila Ave.	2021
ATR	14th St. westbound between Erie St. and Grove St.	2021
TMC	12th St. at Jersey Ave.	2021
TMC	12th St. at Erie St.	2021
TMC	12th St. at Manila Ave.	2021
TMC	12th St. at Marin Blvd.	2021
TMC	14th St. at Marin Blvd.	2021
TMC	14th St. at Manila Ave.	2021
TMC	14th St. at Erie St.	2021
TMC	14th St. at Jersey Ave.	2021

4.2.2 Port Facility Data

The PANYNJ's 2050 Port Master Plan was reviewed to gauge general development expected through 2050. This information was compared against the NJTPA's NJRTM-E model to confirm that trip generation and distribution from port facilities forecasted under the master plan were included in the regional model. However, this does not include port expansion projects, which at this time were speculative and therefore not included in the official NJTPA forecasts.

4.3 PROGRAM-SPECIFIC DATA COLLECTION

A comprehensive traffic data collection program was undertaken within the Program study area to collect corridor and intersection count data to supplement the information obtained from the NJTA and other sources. Automatic Traffic Recorder (ATR) machine counts were conducted across seven-day periods at 50 locations throughout the Program area. Manual Turning Movement Counts (TMC) were performed for three-hour periods during the weekday AM and weekday PM peak periods at 27 intersection locations throughout the Program area. Because, with limited exception, this Report focuses on highway and ramp links between Interchange 14 and Interchange 14A, inclusive, the associated, relevant locations surveyed are presented here. The remaining number of count locations cited above contributed data to other corridor-wide analyses and assessments. They are not cited in this Report but are addressed in separate reports covering the other projects in the Program.

4.3.1 Manual Turning Movement Counts

Single-day, mid-week (Tuesday, Wednesday, or Thursday) manual turning movement counts were conducted at key off-NB-HCE corridor locations where data was needed. Counts were performed for a total of six hours during the weekday morning and weekday evening peak periods, 6:00 to 9:00 AM and 3:00 to 6:00 PM, respectively. These peak timeframes match those considered in the NJTPA NJRTM-E model, which was to be used during subsequent analyses. This data was collected during the months of June, July, and September 2021. Intersection TMCs relevant to ramp and NB-HCE volumes were performed at the following locations.

- Jersey Avenue and 14th Street (Entering NB-HCE/Route 139 Westbound)
- NB-HCE/Route 139 Eastbound and Jersey Avenue
- NB-HCE Eastbound Exit Ramp (Ramp B)/Center Street and Montgomery Street

Additional TMCs were performed in the Interchange 14A area to support alternative analysis in the JFK Boulevard/Connector Ramp area. These locations include the following.

- JFK Boulevard and Connector Ramp
- Connector Ramp/NJ Route 440 SB Ramps and Avenue C

Many other count locations were surveyed to support the operations testing and forecasting of local roadway system traffic and impacts of the overall Program; these locations are not listed here.

4.3.2 Automatic Traffic Recorder Counts

Continuous (24-hour) directional Automatic Traffic Recorder (ATR) machine counts were conducted for seven-day periods in June, July, and September 2021. The locations of ATR counts on critical roadways and ramps are listed in Table 4-3.

Table 4-3 – Automatic Traffic Recorder Count Locations

I-78 EB to NB-HCE EB (Interchange 14 Ramp TH)	NB-HCE EB Ramp WT (Interchange 14A)
Turnpike Inner (I-95) NB to NB-HCE EB/I-78 WB (Interchange 14 Ramp SIH/T)	Ramp TW to NB-HCE WB (Interchange 14A)
Turnpike Outer (I-95) NB to NB-HCE EB (Interchange 14 Ramp SOH)	Ramp TE to NB-HCE EB (Interchange 14A)
I-78 EB Local to Interchange 14 Toll Plaza (WLT Roadway)	NB-HCE WB Ramp ET (Interchange 14A)
I-78 EB Express to Interchange 14 Toll Plaza (WXT Roadway)	NB-HCE EB Ramp WT (Interchange 14B)
US Route 1&9/Port St. Ramps to I-78 EB (Interchange 14 Ramps ALT/ELT)	NB-HCE WB Ramp ET (Interchange 14B)
Turnpike Outer (I-95) NB to I-78 WB/US Route 1&9 (Interchange 14 Ramp SOT)	Ramp TE to NB-HCE EB (Interchange 14B)
Turnpike Inner (I-95) NB to I-78 WB/US Route 1&9 (Interchange 14 Ramp SIT)	Ramp TW to NB-HCE WB (Interchange 14B)
NB-HCE WB to I-78 WB (Interchange 14 Ramp HXT)	NB-HCE EB Ramp TL to CR 612/Jersey City Blvd.
NB-HCE WB to US Route 1&9/Newark Airport (Interchange 14 Ramp HLT)	CR 612/Jersey City Blvd. Ramp LT to NB-HCE WB
NB-HCE WB to Turnpike (I-95) NB (Interchange 14 Ramp HN)	NB-HCE EB east of CR 612/Jersey City Blvd.
Turnpike (I-95) SB to I-78 WB (Interchange 14 Ramp NT)	NB-HCE WB east of CR 612/Jersey City Blvd.
Turnpike (I-95) SB to NB-HCE EB (Interchange 14 Ramp NH)	NB-HCE EB east of Columbus Drive
I-78 EB to Turnpike (I-95) SB (Interchange 14 Ramp TS)	NB-HCE EB Ramp B to Columbus Drive
I-78 EB to Turnpike (I-95) NB (Interchange 14 Ramp TN)	Merseles Street Ramp A to NB-HCE WB
I-78 WB Express from Interchange 14 Toll Plaza (XTW Roadway)	HEW Roadway, just west of Route 139 split
I-78 WB Local from Interchange 14 Toll Plaza (LTW Roadway)	HWE Roadway, west of Jersey Avenue intersection
I-78 WB Local to US 1&9 NB (Ramp LTA)	Route 139 WB Upper Roadway, west of NB-HCE split
NB-HCE WB to Turnpike (I-95) SB (Interchange 14 Ramp HS)	Route 139 WB Lower Roadway, west of NB-HCE split
NJ Route 440 NB, West of Avenue C	NJ Route 440 SB, West of Avenue C
US Route 1&9 (Pulaski Skyway) NB, South of Newark Ramp	US Route 1&9 (Pulaski Skyway) SB, South of Newark Ramp
NJ Route 440 SB Ramp to Avenue C	Connector Ramp, Between JFK Blvd. and Avenue C

4.4 NORTH JERSEY TRANSPORTATION PLANNING AUTHORITY (NJTPA) DATA

Demographic and traffic modeling data were obtained from the North Jersey Transportation Planning Authority (NJTPA). Demographic data included population, household, employment, and income figures for each municipality in the NJTPA region at five-year intervals between 2021 and 2050. Employment data was segregated by several industry categories, including manufacturing, retail, and wholesale.

Transportation projects from NJDOT and NJTPA's Transportation Improvement Program (TIP) were reviewed to verify that they had been incorporated into the travel demand model obtained. The TIP is a list of fiscally constrained, upcoming transportation projects covering a period of at least four years in the NJTPA region. It was found that all relevant projects were properly included by the NJTPA in the model runs received. Improvements verified included elements such as additional roadway connections, added lanes, or new ramps. Roadway and bridge rehabilitation and replacement alone are projects that typically are not incorporated in travel demand models, as they do not increase capacity.

In addition, a copy of NJTPA's latest Air Quality Conformity Determination on the Long Range Transportation Plan ("Plan 2050") and travel demand model inputs and outputs were obtained from the NJTPA. As discussed in more detail in Section 5, NJTPA's North Jersey Regional Transportation Model-Enhanced (NJRTM-E) was used to develop growth factors and understand future travel patterns, including origin-destination pairs, along the corridor and the impacts to the surrounding study area.

4.5 JERSEY CITY MUNICIPAL DATA

4.5.1 Jersey City Development Data

Development data from Jersey City's Open Data portal (data.jerseycitynj.gov) and recent Jersey City Planning Board meeting minutes were gathered and reviewed to identify planned future residential, commercial, and institutional land use development that could impact traffic patterns in the study area. Jersey City is experiencing an unprecedented level of growth in population and employment. For instance, population grew from 247,597 people in 2010 to 292,412 people in 2020, representing an 18.1% growth rate as per the United States Census. Applicable developments included those adding a substantial number of residential units, retail and office space, or regional cultural attractions. Data also included the number of new proposed and planned parking spaces for each development, provided in **Appendix B**.

4.5.2 Local Roadway Intersection Signal Timings

For traffic modeling and microsimulation purposes, signal phasing and timing plans were obtained for 21 intersections in Jersey City in the Program area. The phasing and timing plans were verified through collection of field timings. There were no signalized intersections within this Project area for which field signal phasing and timing information was collected.

4.6 PHYSICAL INVENTORY

Using the 2019 NJDOT Straight Line Diagrams, information obtained from the PANYNJ Traffic Division, and other sources, including field visits to the project area, key local roadways at Turnpike interchanges and intersections were inventoried to compile physical data such as number and width of travel lanes on each approach roadway, presence and width of shoulders, on-street parking regulations, and bus stop locations. Existing traffic signal timings were verified in the field.

4.7 CRASH DATA

Crash records were obtained from the NJTA for the two-year period of 2018 and 2019. Because traffic patterns in 2020 and 2021 were impacted by the reduced traffic volumes due to the COVID-19 pandemic shutdowns, crash data for these years was not considered relevant or indicative of typical crash trends along the NB-HCE corridor. In addition, prior to July 2, 2018, the closure of the Pulaski Skyway (US Route 1&9) northbound toward Jersey City impacted volumes and traffic patterns on the NB-HCE. While signed to use the parallel US Route 1&9 Truck arterial, detoured Pulaski traffic was also encouraged to use the eastbound NB-HCE; temporary use of the right shoulder was provided on the NB-HCE eastbound roadway to accommodate the detour traffic. Therefore, crash data between 2014 and mid-2018, during the Pulaski Skyway closure and detour, is also not indicative of typical crash trends in the NB-HCE corridor. While construction projects continued to occur in the NB-HCE corridor in the 18 months between mid-2018 and the end of 2019, this data was analyzed as the most recent data reflecting conditions closest to typical.

As detailed further in Section 6 and **Appendix C**, crashes were broken down by interchange or NB-HCE roadway location, roadway condition, weather, severity, pavement condition, and time of day. Crash records cover the length of the NB-HCE, interchange ramps, and toll plaza areas within the project limits.

The data was used to identify high-crash locations within the project area, prevailing trends, and where NB-HCE crash conditions are "over-represented" compared to Statewide Averages and time-of-day patterns.

5. TRAFFIC FORECASTING METHODOLOGY

This section of the report documents the traffic forecasting procedures used for determining future volumes and travel patterns on the NB-HCE and other study area/project area roads. The most current regional travel demand model version — the North Jersey Regional Travel Model Enhanced (NJTRM-E), developed and maintained by the North Jersey Transportation Planning Authority (NJTPA) — was obtained and used to ensure all officially recognized land use development, planned highway, and planned transit projects through 2050, were included in the NB-HCE traffic analysis.

The NJTPA is the federally authoritzed Metropolitan Planning Organization (MPO) for 7 million people in the 13-county northern New Jersey region. An MPO is a federally-mandated and federally-funded transportation planning agency made up of representatives from local government and key transportation agencies. Congress created MPOs to give local elected officials a stronger role in guiding federal transportation investment and to ensure that these decisions are based on a continuing, cooperative and comprehensive planning process.

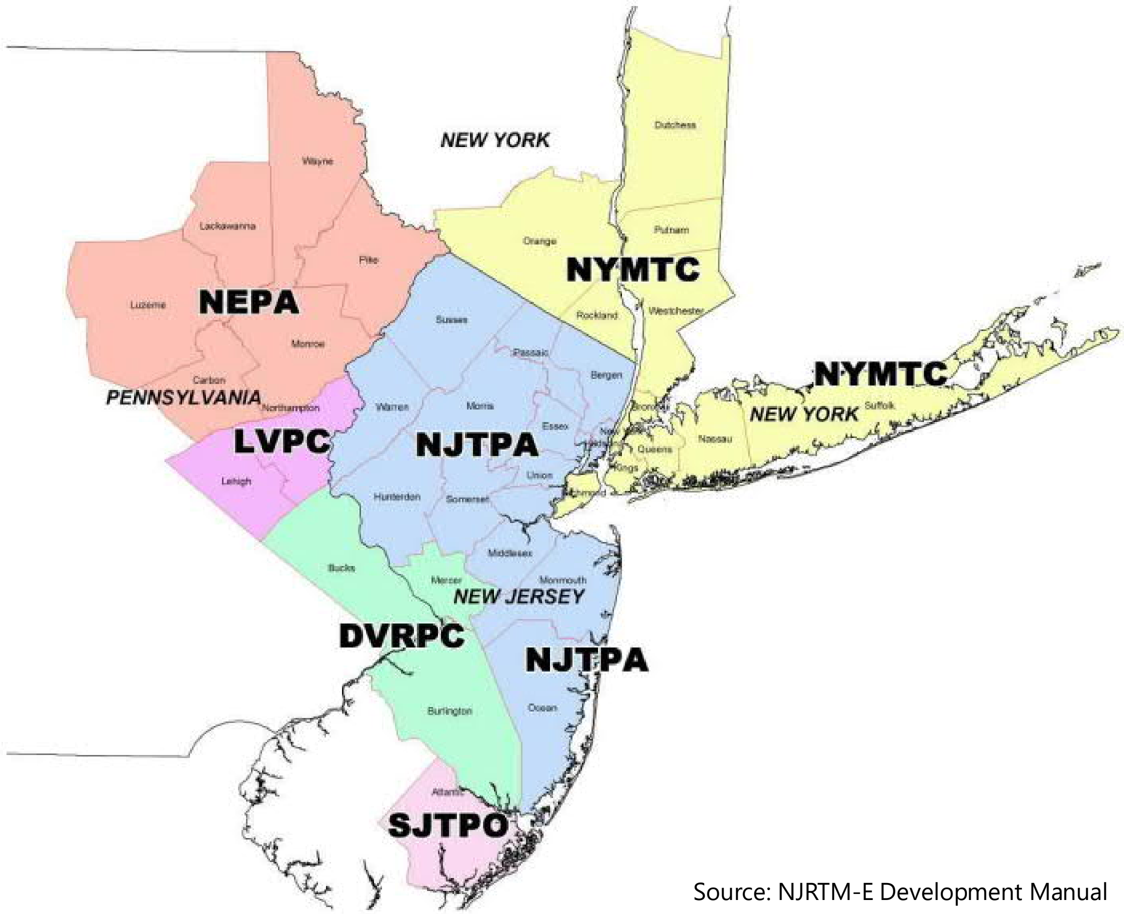
The NJTRM-E is used by NJTPA to support development and adoption of the federally-mandated Regional Transportation Plan (RTP). The most recent RTP - *Plan 2050: Transportation. People. Opportunity* - was approved by the NJTPA Board of Trustees on September 13, 2021. Also approved on that date were the Transportation Improvement Program (TIP), and Air Quality Conformity Determination. The NB-HCE Program was identified in the RTP and TIP and included in the NJTRM-E modeling supporting the RTP development and Air Quality Conformity Determination.

5.1 TRAVEL DEMAND MODEL

The model used in this study is the (NJRTM-E). This model includes the 13 counties of the NJTPA and appropriate surrounding counties in New York, Pennsylvania, and New Jersey, represented by over 2,900 Traffic Analysis Zones (TAZ). Figure 5-1 shows the geographical coverage of the model, including the NJTPA area and external areas from adjacent metropolitan planning organizations used in the model. After coordination with the NJTPA, the latest version of the model and model runs were obtained from the Air Quality and Conformity for the Fiscal Year 2022 program conducted in September 2021. The model obtained was still the latest version as of October 2021 when the first analysis was performed using this resource.

In this project the NJRTM-E was used to develop growth factors between the baseline traffic study year condition (2021) and the future (Year 2050) No-Build and Build conditions. These growth factors were applied to existing (2021) traffic count data to forecast traffic volumes specific to roadway sections, ramps, and locally affected intersections.

Figure 5-1 – North Jersey Regional Transportation Model - Enhanced (NJRTM-E) Geographical Coverage



Source: NJRTM-E Development Manual

Within the NJTPA region, the NJRTM-E's highway network includes most arterial roadways ("major" and "minor" classifications) and most county roads (500-level and 600-level county routes). Most collector and local roads are not included. Outside the NJTPA region, the highway network is more schematic, generally representing only major regional roadways in the National Highway System.

The model covers nine trip purposes ranging from home-based work, shopping, and work-based other to non-home-/non-work-based trips as well as airport trips, university trips made by students to and from regional colleges and universities, and truck trips (i.e., heavy, medium, and commercial). Six modes of travel are considered for most trip purposes, covering a range of automotive modes such as single-occupancy vehicles to an increasing degree of high occupancy vehicles, public transit-walk access, public transit-drive access, and trucks. The public transportation network includes NJ TRANSIT rail and bus systems, PANYNJ PATH, some private bus lines, and ferry services.

The 24-hour model is composed of four separate time periods.

- Weekday AM Peak (6:00 AM to 9:00 AM)
- Midday (9:00 AM to 3:00 PM)
- Weekday PM Peak (3:00 PM to 6:00 PM)
- Night (6:00 PM to 6:00 AM next day)

5.2 MODELING FUTURE CONDITIONS

To accurately forecast future travel patterns, the NJRTM-E model was verified to make sure it properly reflected the Transportation Improvement Program's (TIP) scheduled projects and other local known planned and approved land use development and infrastructure projects.

5.2.1 Future Projects

To ensure that the model incorporated all projects, the GF Team obtained a list of land use and transportation projects from the Jersey City Open Data database, the NJTPA current TIP projects, and the FY2020-2029 Statewide Transportation Improvement Program (STIP). Table 5-1 lists the projects verified to be included in the travel demand model.

Table 5-1 – Future Projects Included in the NJRTM-E Travel Demand Model

Project	Municipality	County	Description	Year Completion
Lincoln Tunnel Access Project (LTAP)	Jersey City/ Kearny/ Newark	Essex/Hudson	Route 7 bridge replacement and Route 1/9 rehabilitation and new extension	At least 2031
Route 280, WB Ramp over 1st & Orange Streets, Newark Subway & NJ Transit	Newark	Essex/Hudson	Replace the bridge deck, and widen the roadway to reduce congestion and crashes	2024
Clay Street Bridge over the Passaic River	Newark/ East Newark	Hudson/Essex	Widening from two travel lanes to two eastbound lanes and one westbound lane	At least 2031
Route 80, Riverview Drive (CR 640) to Polifly Road (CR 55)	Various	Passaic/Bergen	Reconstruction and widening in the westbound direction	At least 2031
South Amboy Intermodal Center	South Amboy	Middlesex	Construction of ferry building	2022
Route 3, Route 46, Valley Road and Notch/Rifle Camp Road Interchange, Contract B	Little Falls/ Clifton	Passaic	Widening and improvement along Route 46 and Route 3 to provide auxiliary lanes, acceleration, and deceleration lanes, and shoulders	2022
Kapkowski Road-North Avenue East Improvement Project	Elizabeth	Union	Improving road clearance under the rail bridge	2023
Route 1&9, Interchange at Route I-278	Linden	Union	Improving Route 1&9 and I-278 Interchange and nearby intersections	At least 2031
Portal Bridge North	Various	Various	Replace rail bridge	At least 2031
Construction of PATH Rail Extension to Newark Liberty Rail Link Station	Newark	Essex	Extend PATH to Newark Liberty International Airport	2030
Port Master Plan 2050	Newark	Essex	Expansion of PANYNJ's ports including better road connectivity, and express rail	Phase I - 2035 Phase II - 2050
Canal Crossing in the Carteret Avenue Area	Jersey City	Hudson	Redevelopment including school, 1K residential units, 11.1k sq.ft. of retail, 2.4K sq.ft. of office space, and 569 parking spaces	N/A

Project	Municipality	County	Description	Year Completion
SciTech City	Jersey City	Hudson	Development of site includes the Liberty Science Center, High School (400 students), 100K sq. ft. of research laboratory space, and two 12 story-high buildings for residential use, and a 30-acre campus	2024
Jersey Avenue Bridge over Mill Creek at the Morris Canal Tidal Basin Area	Jersey City	Hudson	Construction of a bridge to connect Jersey Avenue over the Mill Creek	2021
Johnston Avenue Redevelopment	Jersey City	Hudson	High-rise residential	by 2050
Bates Street Redevelopment	Jersey City	Hudson	100 residential units on Center Street, and 80 additional units on Brook Street	by 2050
Texas Eastern Pipeline	Jersey City	Hudson	Construction of the Texas Eastern Pipeline facilities in the project area	by 2050
Newark Avenue Area	Jersey City	Hudson	Redevelopment near Roy Motors/World Boxing Gym	by 2050
6^{th} Street Embankment	Jersey City	Hudson	Redevelop the 6^{th} Street Embankment into open space	by 2050
Redevelopment from 14th Street, Coles Street-18th Street	Jersey City	Hudson	Development to include 749 residential units, and 19K sq. ft. of retail space	by 2050
Grand Jersey Brownfield Redevelopment	Jersey City	Hudson	Redevelopment from residential to life science offices	by 2050
Bergen-Lafayette Development	Jersey City	Hudson	Development Proposal: 48 residential units, 2.5k sq. ft. retail, 10 parking spaces Approved Development: 1,548 residential units, 127k sq. ft. office, 137k sq. ft. retail, 492 parking spaces Under Construction: 1,934 residential units, 100k sq. ft. office, 41k sq. ft. retail, 887 parking spaces Recently Completed: 3,116 residential units, 156k sq. ft. office, 57k. sq. ft. retail, 1,812 parking spaces	by 2050

Project	Municipality	County	Description	Year Completion
Journal Square Development	Jersey City	Hudson	Development Proposal: 1,200 residential units, 44k sq. ft. retail, 630 parking spaces Approved Development: 11,437 residential units, 332k sq. ft. office, 379k sq. ft. retail, 5,097 parking spaces Under Construction: 3,276 residential units, 95k sq. ft. office, 94k sq. ft. retail, 1,532 parking spaces. Recently Completed: 2,484 residential units, 2.1M sq. ft. office, 63k sq. ft. retail, 1,056 parking spaces.	by 2050
Downtown Development	Jersey City	Hudson	Development Proposal: 7,573 residential units, 1.8M sq. ft. office, 154k sq. ft. retail, 6,217 parking spaces Approved Development: 10,750 residential units, 1.8M sq. ft. office, 522k sq. ft. retail, 9,566 parking spaces Under Construction: 4,515 residential units, 6k sq. ft. office, 160k sq. ft. retail, 2,318 parking spaces Recently Completed: 25,288 residential units, 8.6M sq. ft. office, 2.2M sq. ft. retail, 28,354 parking spaces.	by 2050
Westside Development	Jersey City	Hudson	Development Proposal: 1,180 residential units Approved: 663 residential units, 42k sq. ft. office, 114k sq. ft. retail, 834 parking spaces. Under construction: 1,183 residential units, 12k sq. ft. office, 17k sq. ft. retail, 747 parking spaces. Recently completed: 1,881 residential units, 11.4k sq. ft. retail, 737 parking spaces.	by 2050
GATEWAY PROGRAM * (See Note Below)	Various between Newark and Manhattan	Essex, Hudson, New York	Gateway is a comprehensive rail investment program, adding 2 new tunnels and upgrading the current 2 tunnels, which will improve reliability, resiliency, and redundancy for a critical section of the Northeast Corridor between Newark Pennsylvania Station and New York Pennsylvania Station.	TBD

* **Note:** The Gateway Program provides redundancy and reliability as it is currently proposed. Increases in service and capacity are not the intended purpose or need for the project; therefore, no capacity improvements are incorporated.

5.2.2 Future Demographics

NJTPA forecasted population and employment growth were drawn from their Plan 2050 Regional Transportation Plan update for the 13 counties under their jurisdiction. These were included in the NJRTM-E travel demand model. In Hudson County (see Table 5-2), the expected growth in population and employment from 2015 to 2050 is 0.74% and 0.75% per annum, respectively.[1] These growth rates were used to verify the land use and sociodemographic inputs required for the trip generation to ensure that the expected 2050-year model forecasts were as representative as possible.

Table 5-2 - County Population and Employment Forecasts for NJTPA Region

County	Population			Employment		
	2015	2050	Annualized Change 2015-2050	2015	2050	Annualized Change 2015-2050
Bergen	926,330	1,083,869	0.45%	421,284	483,298	0.39%
Essex	791,609	920,335	0.43%	368,662	432,645	0.46%
Hudson	662,619	856,947	0.74%	282,020	366,913	0.75%
Hunterdon	126,250	132,858	0.15%	53,115	56,243	0.16%
Middlesex	830,300	939,723	0.35%	388,309	444,502	0.39%
Monmouth	629,185	669,624	0.18%	262,372	293,290	0.32%
Morris	498,192	528,760	0.17%	291,622	323,287	0.29%
Ocean	583,450	727,653	0.63%	166,005	199,086	0.52%
Passaic	507,574	599,628	0.48%	181,477	206,083	0.36%
Somerset	330,604	363,486	0.27%	185,400	211,386	0.38%
Sussex	145,930	152,337	0.12%	41,935	46,703	0.31%
Union	548,744	652,581	0.50%	233,011	272,803	0.45%
Warren	107,226	115,320	0.21%	35,247	39,410	0.32%
NJTPA	6,688,013	7,743,120	0.42%	2,910,458	3,375,651	0.42%

5.2.3 COVID-Era Variations

Per the NJTPA, while severe, the COVID-19 pandemic's impacts were assumed not to be long-lasting; thus, no adjustments were made to the NJRTM-E forecast inputs. It should be noted that to forecast future traffic patterns, the NJTPA's travel demand model NJRTM-E was used, as discussed previously in this Methodology section.

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[1] From NJTPA Plan 2050: Transportation People Opportunity Appendix E – 2050 Demographic Forecasts, 2021; https://www.njtpa.org/NJTPA/media/Documents/Planning/Plans-Guidance/Planning%20for%202050/draft%20final/E-2050-Demographic-Forecasts.pdf Accessed: April 2022

The NJTPA determined that the lasting impacts due to COVID-19 may not be fully understood for quite some time. Data collection efforts during the COVID-19 pandemic have been of limited value and will continue to be problematic until pandemic-related influences subside and travel and work patterns settle into more traditional recognizable patterns. However, the NJTPA's travel demand model, NJRTM-E, is already validated through 2025, and for now, extending its life by accepting that pre-COVID-19 pandemic travel patterns will be applicable into the future enables the NJTPA model to continue to be a valid source to forecast developing conditions and future travel patterns.

5.3 TRAFFIC FORECASTS AND DIVERTED TRAFFIC

Traffic increases in the NB-HCE corridor for the Design Year 2050 under No-Build and Build conditions were estimated by traffic projections in the NJRTM-E. Traffic demand increases to 2050 under the No-Build condition (which assumes no geometric changes in the Program area) includes growth from demographic changes only. This increase is 8.3% over the Base Year 2021. The Design Year Build condition includes growth from demographic changes and full build of the Program improvements, as proposed in the IPA. Forecasted demand increases on the NB-HCE also include traffic diverted to the NB-HCE corridor from other roadways (i.e., Pulaski Skyway and US Route 1&9T) because of changes in route choice. This increase on the NB-HCE is 32.0% over the Base Year 2021 and 21.9% over the Design Year No-Build projections.

5.4 TRAFFIC FORECASTING SUMMARY

The North Jersey Regional Travel Model – Enhanced (NJRTM-E) was used to derive traffic forecasts into the Design Year 2050 for the NB-HCE corridor. The latest edition of the model, which includes model runs used in air quality and conformity for fiscal year 2022, was used for this traffic forecasting task. The NB-HCE project team verified that future projects identified by Jersey City, and NJDOT, including the PANYNJ Port Master Plan, were accommodated for in the model to address anticipated developments during from 2021 to 2050.

Model runs for the Base Year (2021) and the Design Year (2050) were compared to estimate the growth trends by time-of-day, direction of travel and roadway link. Interim years of 2030 and 2040 were also run to account for implementation of proposed developments during these interim years. Developments in these interim years included land developments in Jersey City as well as PANYNJ port facility capacities and operations changes, as extrapolated from port documents. Two geometric configurations were modeled for the Design Year: A No-Build case utilizing the existing NB-HCE condition geometry, and a Build case incorporating NB-HCE capacity enhancements proposed under Preliminary Design.

The forecasts showed that the NB-HCE corridor is projected to experience anticipated traffic increases of 8.3% in No-Build traffic demand, 32.0% in Build traffic demand over the Base Year (which is 21.9% higher than the No-Build traffic demand on the corridor). The traffic increases forecast by the regional models were used to develop the Base Year and Design Year traffic volume profiles in this Report’s Section 9 for analysis in Section 10.

6. CRASH SUMMARY

Crash records were obtained from the NJTA for the two-year period of 2018 and 2019. Because 2020 and 2021 crash data were assumed to be impacted by the reduced traffic volumes due to the COVID-19 pandemic shutdowns, this data was not considered relevant or indicative of typical crash trends along the NB-HCE corridor. In addition, prior to July 2, 2018, the closure of the Pulaski Skyway (US Route 1&9) northbound toward Jersey City impacted volumes and traffic patterns on the NB-HCE. While signed to use the parallel US Route 1&9 Truck arterial, detoured Pulaski traffic was also encouraged to use the eastbound NB-HCE; temporary use of the right shoulder was provided on the NB-HCE eastbound roadway to accommodate the detour traffic. Therefore, crash data between 2014 and mid-2018, during the Pulaski Skyway closure and detour, is also not indicative of typical crash trends in the NB-HCE corridor.

The crash listings were reviewed and analyzed in several different ways. The 794 total crashes were divided primarily into the following categories for analysis.

- NB-HCE Roadway Crashes – 332 crashes
- Interchange Ramp Crashes – 161 crashes
- Toll Plaza Crashes – 301 crashes

Each category was broken out further. NB-HCE crashes were further divided by direction (eastbound and westbound) and by area (Interchange 14, Interchange 14 to Interchange 14A, and Interchange 14A). Hotspot analysis identified locations along the NB-HCE where crashes were concentrated. Five clusters were identified in expected locations, at heavy merge locations and the upgrade to the top of the Newark Bay Bridge, where the combination of merge and upgrade proximity, congestion, queues, and speed differential between autos and heavy vehicles contributed to the concentrations of crashes in these locations. Crashes within the clusters accounted for almost 40% of the total crashes on the NB-HCE.

Interchange crashes were further divided by interchange, with more detailed analysis performed on higher-frequency ramps. Toll plaza crashes were further divided by interchange and direction (entry and exit).

The detailed crash analysis can be found in Appendix C. Major findings of the crash analysis include:

- Of the total of 794 crashes, 7.4% of the total identified a construction zone in the crash record.
- Most crashes resulted in No Apparent Injury. The highest rate for total injury crashes (Possible, Suspected Minor and Suspected Major Injury) was on the NB-HCE (20.2%, or 67 crashes. The corresponding crash rate on interchange ramps was 18.0% (29 crashes), while

toll plaza injury crashes were at 5.0% (15 crashes). Since the NB-HCE roadway constituted a larger area than the other two categories, this finding is not unexpected. No fatalities were reported in the crash data set analyzed.

- The combined total of Same Direction (Rear End) and Same Direction (Sideswipe) crashes for all areas (NB-HCE, interchange ramps and toll plazas combined) comprised almost 90% of the total crashes. Sideswipe crashes were predominant at the toll plazas, while Rear End crashes predominated on the NB-HCE. Both types were prominent on interchange ramps. In most cases, the crash percentages for both crash types exceeded the 2019 Statewide Averages for Interstate Highways.
- Across all areas (NB-HCE, interchange ramps and toll plazas), most crashes occurred in under Dry surface conditions, Day lighting conditions, and Clear environmental conditions. Crashes on Wet surfaces and under Dark conditions, however, exceeded the Statewide Averages for one or more of the facility types.
- Crashes across all areas were more likely to occur on weekdays and during the seven hours that comprise the two weekday peak periods (AM or PM peak period). The mid-week days (Tuesday, Wednesday, and Thursday) were the peak days for crashes.
- Toll plaza area crashes at Interchange 14A heavily skew to the entry side of the plaza. This is likely influenced by downstream congestion and queuing at the Ramp TW merge with the NB-HCE westbound.
- High crash totals (greater than five crashes per year) at interchange ramps at Interchange 14 were reported on Ramp TS (toll plaza to Turnpike southbound), Ramp TN (toll plaza to Turnpike northbound), Ramp NT (Turnpike southbound to toll plaza) and Ramp HS (NB-HCE westbound to Turnpike southbound). Ramp TN improvements are to be addressed under the Program but reported separately from this document.
- High crash totals at interchange ramps at Interchange 14A were reported on Ramp TW (toll plaza to NB-HCE westbound) and the Route 440 Connector Ramp (toll plaza to NJ Route 440).
- High-crash ramp locations exhibited similar crash characteristics to the other facility types studied.

Same Direction crashes are indicative of stop-and-go conditions in congested areas and unsafe merging and lane changes on roadways near or over capacity or with variable speeds. The study area does exhibit queuing and congestion on the NB-HCE, especially at existing merge areas at the interchanges and due to demand exceeding capacity. Capacity enhancements and bridge replacements on the NB-HCE, particularly widening to four lanes and full shoulders in each direction between Interchange 14 and Interchange 14A, will reduce crash potential on the Newark Bay Bridge crossing. Higher-capacity ramp connections and ramp roadways at the interchanges, especially continuing the existing two-lane geometry at Interchange 14A Ramp TW onto the NB-HCE westbound before merging one of the ramp lanes, will improve safety at these locations. A proposed second lane and increased design speed on Ramp HS (20 to 25 MPH) will address high crash trends at this location. The Ramp NT/Ramp NH split will be relocated to the north, resulting in more queue storage for the Ramp NT toll plaza approach and greater visibility of the dedicated ramp split. Ramp TS and the Route 440 Connector Ramp are not directly impacted by project improvements. Improved drainage and highway lighting systems, designed to current Authority standards, will also improve the crash trends on Wet pavement conditions and Dark lighitng conditions within the study area.

7. TRAFFIC VOLUMES

7.1 INTRODUCTION

As previously noted, the traffic forecasts developed for this Report covered the length of the NB-HCE corridor. The methodology for derivation of traffic volumes, as discussed in this section, uses data sources from the length of the NB-HCE within the Authority's ticket system, as far east as the Interchange 14C toll plaza, and references will be made to data outside the project limits of this Report. Traffic data presented in this section for use in the analysis summarized in later sections will, however, reflect the Interchange 14 to Interchange 14A project limits.

7.2 SYSTEM PEAK HOUR

To effectively assess the Initially Preferred Alternative for the NB-HCE program, peak traffic periods were determined on which to base the various traffic analyses. Sensys puck data provided by the Authority was reviewed for three locations along the NB-HCE.

- M.P. N1.10, between Interchange 14 and Interchange 14A
- M.P. N4.40, between Interchange 14A and Interchange 14B
- M.P. N4.96, also between Interchange 14A and Interchange 14B

This data was reviewed for two representative months, April, and August 2019, to determine peak traffic periods during weekdays and weekends. These months were chosen based on pre-pandemic traffic patterns and typical (April) and summer (August) traffic volumes. For each of the three locations in both months, weekday commuter peak period volume magnitudes exceeded peak hours and peak period hours during Saturdays and Sundays. It should also be noted, from Section 5.1, that traffic forecasts in the NJRTM-E regional model are based on weekday peak time periods, such that they would not be appropriate to use with weekend traffic patterns. Based on these findings, the weekday AM and PM peak periods were selected as the basis for the traffic analysis documented in this report.

Using Automatic Traffic Recorder (ATR) data and NJTA Turnpike toll plaza transaction data, localized peak hours were determined for the weekday morning and evening commuter peak periods for NB-HCE ramps and toll plaza areas in the project corridor. ATR data was gathered for June, July, and September 2021, with the peak hour defined using midday weekday data. The NJTA data was gathered and processed for this same period. Table 7-1 lists the locations used to develop the system peak hour and their local peak hours.

The localized weekday AM peak hours occurred as early as the 6:15 AM to 7:15 AM hour and as late as the 8:00 AM to 9:00 AM hour. The localized weekday PM peak hours occurred as early as the 4:00 PM to 5:00 PM hour and as late as the 5:00 PM to 6:00 PM hour. To develop consistent and balanced traffic flows for the overall corridor, these results were weighted using traffic volumes; this resulted in the following overall system weekday peak hours: 7:00 AM to 8:00 AM and 5:00 PM to 6:00 PM, for the weekday morning and evening peak hours, respectively.

Table 7-1 – Weekday Peak Hours on NB-HCE, at Toll Plazas and Ramps

NB-HCE or Ramp	Source	Weekday AM Peak	Weekday PM Peak
Eastbound, west of Ramp NH	A	7:15 AM - 8:15 AM	4:15 PM - 5:15 PM
Westbound, west of Ramp HS	A	7:30 AM - 8:30 AM	4:00 PM - 5:00 PM
Interchange 14 EB Ramp SH	A	6:45 AM - 7:45 AM	4:30 PM - 5:30 PM
Interchange 14 WB Ramp NH	A	7:45 AM - 8:45 AM	4:30 PM - 5:30 PM
Interchange 14 Toll Plaza Entry	T	7:00 AM - 8:00 AM	5:00 PM - 6:00 PM
Interchange 14 Toll Plaza Exit	T	7:00 AM - 8:00 AM	5:00 PM - 6:00 PM
Interchange 14A EB Off Ramp WT	A	6:15 AM - 7:15 AM	5:00 PM - 6:00 PM
Interchange 14A WB Off Ramp ET	A	7:45 AM - 8:45 AM	4:30 PM - 5:30 PM
Interchange 14A EB On Ramp TE	A	7:30 AM - 8:30 AM	4:30 PM - 5:30 PM
Interchange 14A WB On Ramp TW	A	7:30 AM - 8:30 AM	4:00 PM - 5:00 PM
Interchange 14A Toll Plaza Entry	T	7:00 AM - 8:00 AM	5:00 PM - 6:00 PM
Interchange 14A Toll Plaza Exit	T	8:00 AM - 9:00 AM	5:00 PM - 6:00 PM
Interchange 14B EB On Ramp TE	A	8:00 AM - 9:00 AM	4:00 PM - 5:00 PM
Interchange 14B WB On Ramp TW	A	7:45 AM - 8:45 AM	4:00 PM - 5:00 PM
Interchange 14B EB Off Ramp WT	A	7:30 AM - 8:30 AM	4:15 PM - 5:15 PM
Interchange 14B WB Off Ramp ET	A	8:00 AM - 9:00 AM	4:30 PM - 5:30 PM
Interchange 14A Toll Plaza Entry	T	8:00 AM - 9:00 AM	4:00 PM - 5:00 PM
Interchange 14A Toll Plaza Exit	T	8:00 AM - 9:00 AM	5:00 PM - 6:00 PM
Eastbound east of Ramp TC	A	6:15 AM - 7:15 AM	4:45 PM - 5:45 PM
Westbound east of Ramp CT	A	8:00 AM - 9:00 AM	4:45 PM - 5:45 PM
Interchange 14C Toll Plaza Entry	T	8:00 AM - 9:00 AM	5:00 PM - 6:00 PM
Interchange 14C Toll Plaza Exit	T	7:00 AM - 8:00 AM	5:00 PM - 6:00 PM
Overall Peak Hour	-	7:00 AM – 8:00 AM	5:00 PM – 6:00 PM

Note:
A – Automated Traffic Recorder Count
T – Toll Plaza Transaction Data
EB - Eastbound
WB - Westbound

7.3 SEASONAL AND COVID-19 ADJUSTMENTS

To assess the impacts of COVID-19 on travel patterns along the NB-HCE corridor and within the project area, toll plaza transactions from the Turnpike system were analyzed. This data set provided origin and destination information (by toll plaza entry and exit locations) within the Turnpike's ticket system; daily and hourly toll plaza transactions for 2019, 2020, and 2021 were used for this assessment. This information was used to derive traffic volumes along the NB-HCE between Interchanges 14 and 14A, Interchanges 14A and 14B, and at the Interchange 14C toll barrier. These traffic volumes were used to create hourly volume profiles to display and compare the changes in traffic from the pre-pandemic period (2019) through May 2021, during the COVID-19 pandemic.

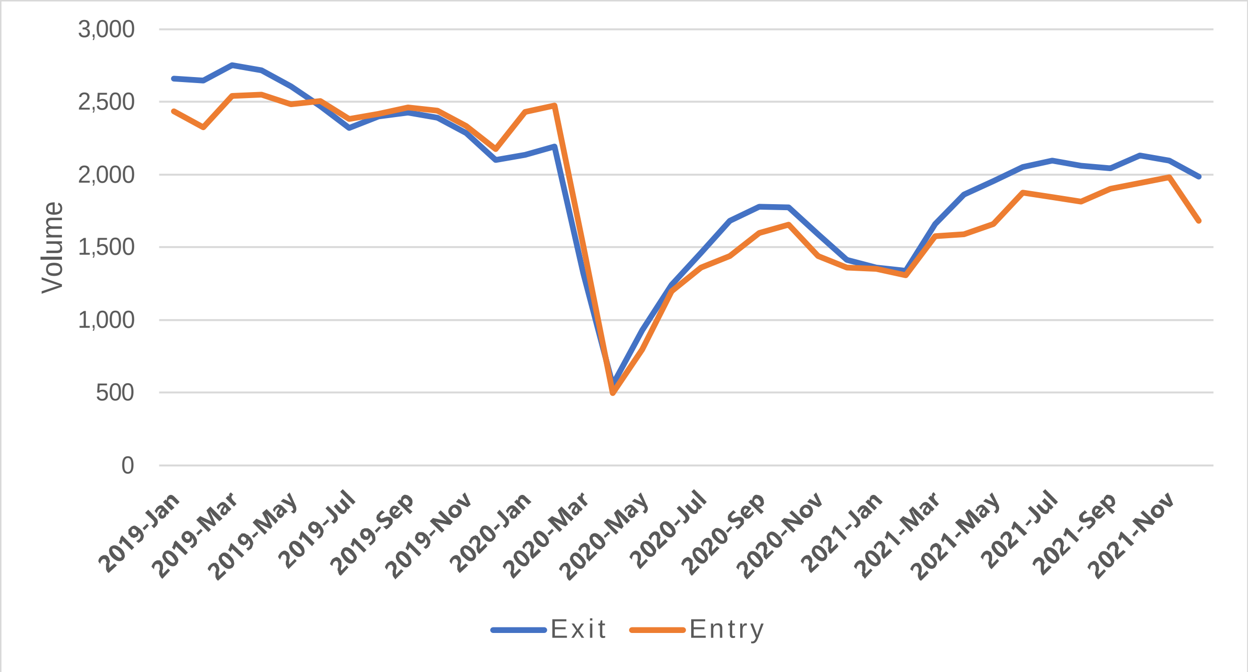
Figure 7-1– and Figure 7-2– display the profiles of average mid-week (Tuesday through Thursday) toll transactions at the Interchange 14C toll plaza for the weekday AM and PM peak hours. These charts display the seasonal variations in 2019 and the impacts of the COVID-19 pandemic, and subsequent travel restrictions on traffic during 2020 and early 2021. These charts illustrate the steep reduction in traffic from 2019 (pre-pandemic) to Spring 2020 (pandemic restrictions starting in March and April) and the gradual increase during the remainder of 2020 and into 2021 (lessening of restrictions). As displayed in these charts, from March to April of 2020, when lockdowns were in full force, there was a large reduction in traffic during the weekday peak hours, as employees in most business sectors worked from home.

From Summer 2020 through May 2021, however, traffic volumes generally started to rebound, despite a dip during the Winter 2020-2021 months due to a new spike in cases. By May 2021, traffic volumes had not fully recovered to pre-pandemic levels. Similar comparisons were performed for the other NB-HCE roadway links noted, with the resulting profiles showing similar trends. The Interchange 14C profiles in Figure 7-1–and Figure 7-2–are shown, therefore, to be representative of the NB-HCE corridor within the Turnpike's ticket system. These figures compare average weekday peak hour volumes for 2019 (pre-COVID), 2020 (during COVID), and 2021 (after COVID's peak). The data shows that 2021 volumes have rebounded above 2020 levels but are still short of 2019 volumes. These volume profiles helped to develop seasonal and COVID-19 factors to adjust existing 2021 traffic counts to create a traffic condition that compensates for the impacts of the pandemic.

Based on information obtained from the North Jersey Transportation Planning Authority (NJTPA), lasting changes in traffic forecasts due to the pandemic may not be fully understood for some time, until travel and work patterns settle into a recognizable post-pandemic pattern, which may not be known until the end of the current decade. While severe, pandemic impacts were assumed to not be long-lasting, so no adjustments were made to the future traffic forecasts. Adjustments to the 2021 traffic count data are warranted based on an anticipated return to pre-pandemic traffic levels and a resumption of the growth trends portrayed by the models. Forecasting of design year traffic directly based on unadjusted 2021 count data risks understating the future traffic magnitudes on which design of improvements should be based.

Figure 7-1– NJ Turnpike Interchange 14C – Toll Transactions – Weekday AM Peak Hour

Figure 7-2– NJ Turnpike Interchange 14C – Toll Transactions – Weekday PM Peak Hour



The monthly hourly profiles were also used to develop seasonal adjustment factors. The figures demonstrate the seasonal variation in the weekday peak hours. In a typical year like 2019, the summer seasonal effects can be seen in June through August when the lowest weekday morning peak hour volumes were observed; during the January through May weekday morning peak hours, volumes were at their highest. For the weekday evening peak hour, the maximum volumes can be observed during March and April, with lower volume levels during July through September. The variation over the year appears to be greater during the weekday AM peak hour, especially for exiting traffic at Interchange 14C.

Table 7-2 and Table 7-3 show factors reflecting differences between 2019 and 2021 traffic volumes by month for both the weekday AM peak hour and weekday PM peak hour for the NB-HCE roadway links between Interchange 14 and Interchange 14B, respectively. Factors reflect both typical seasonal variation, and variation based on the traffic impacts of COVID. The traffic volume data was weighted by annual average daily traffic (AADT). Given that 2021 traffic volumes are lower overall than 2019 volumes, the factors shown in the tables reflect both seasonal and pandemic impacts on traffic volumes. For the link between Interchanges 14 and 14A (Table 7-2), the combined monthly factor ranged between 1.133 and 1.662 in the weekday AM peak hour, and between 1.065 and 1.573 in the weekday PM peak hour, respectively.

For the link between Interchanges 14A and 14B (Table 7-3), the combined monthly factor ranged between 1.200 and 1.854 in the AM peak hour, and 1.059 and 1.720 in the PM peak hour.

The table’s grey highlighted months are the months that field traffic counts were taken in 2021: June, July, and September. Considering only these months, the ranges of factors narrow over the full year comparison. Between Interchange 14 and Interchange 14A (Table 7-2), the combined factor ranges between 1.165 and 1.242 during the weekday AM peak hour; between 1.110 and 1.118, during the weekday PM peak hour. Between Interchange 14A and Interchange 14B (Table 7-3), the combined factor ranges between 1.252 and 1.371 for the weekday AM peak hour; 1.115 to 1.160, for the weekday PM peak hour.

Table 7-2– 2021 Weekday Peak Hour COVID-19/Seasonal Factors (by Month)
For NB-HCE Between Interchange 14 and Interchange 14A

Month	Weekday AM Peak Hour			Weekday PM Peak Hour		
	COVID-19/Seasonal Adjustment Factor (Weighted by AADT)					
	Eastbound	Westbound	Combined	Eastbound	Westbound	Combined
Jan	1.615	1.486	1.557	1.619	1.314	1.462
Feb	1.674	1.646	1.662	1.712	1.437	1.573
Mar	1.424	1.350	1.392	1.375	1.192	1.284
Apr	1.378	1.309	1.348	1.276	1.159	1.219
May	1.283	1.249	1.268	1.198	1.141	1.171
Jun	1.251	1.228	1.242	1.139	1.094	1.118
Jul	1.194	1.203	1.198	1.127	1.099	1.114
Aug	1.204	1.203	1.204	1.086	1.081	1.084
Sep	1.163	1.167	1.165	1.132	1.086	1.110
Oct	1.164	1.094	1.133	1.090	1.037	1.065
Nov	1.288	1.144	1.223	1.094	1.107	1.100
Dec	1.326	1.215	1.277	1.103	1.146	1.122

Table 7-3 – 2021 Weekday Peak Hour COVID-19/Seasonal Factors (by Month)
For NB-HCE between Interchange 14A and Interchange 14B

Month	Weekday AM Peak Hour			Weekday PM Peak Hour		
	COVID-19/Seasonal Adjustment Factor (Weighted by AADT)					
	Eastbound	Westbound	Combined	Eastbound	Westbound	Combined
Jan	1.888	1.644	1.797	1.827	1.448	1.615
Feb	1.895	1.780	1.854	1.887	1.580	1.720
Mar	1.638	1.471	1.577	1.489	1.314	1.396
Apr	1.581	1.443	1.531	1.338	1.266	1.301
May	1.460	1.353	1.421	1.211	1.248	1.229
Jun	1.406	1.308	1.371	1.161	1.159	1.160
Jul	1.319	1.297	1.312	1.148	1.145	1.146
Aug	1.328	1.298	1.317	1.102	1.126	1.113
Sep	1.247	1.263	1.252	1.134	1.097	1.115
Oct	1.220	1.164	1.200	1.079	1.039	1.059
Nov	1.338	1.242	1.303	1.087	1.105	1.096
Dec	1.442	1.336	1.404	1.079	1.173	1.124

A weekday peak-hour analysis was also conducted to determine specific hourly adjustment factors to apply to field data collected in Summer 2021. Table 7-4, Table 7-5, and Table 7-6 show the changes in traffic volumes from 2019 to 2021 for each NB-HCE roadway link within the NJTA's ticket system. In each table, the average and maximum 2019 weekday volumes (i.e., Tuesday, Wednesday, and Thursday), derived from toll plaza origin-destination data provided by the NJTA, are compared to volumes from balanced 2021 traffic volume networks developed from field-collected traffic counts. Calculated differences ranged between 1.03 and 1.49. Weekday peak hour COVID/seasonal factors, by direction and both directions combined, were derived as weighted averages of the average and maximum comparisons, weighted on the 2019 figures.

Table 7-4 – Weekday Peak Hour COVID/Seasonal Factors
NB-HCE Between Interchange 14 and Interchange 14A

Hour	Volume	Eastbound			Westbound			Combined		
		2019	2021	Factor	2019	2021	Factor	2019	2021	Factor
Weekday AM Peak Hour										
7:00 AM	Avg.	3,761	3,238	1.16	2,917	2,600	1.12	6,678	5,838	1.14
7:00 AM	Max.	4,682		1.45	3,101		1.19	7,783		1.33
Weighted Average				1.32	Weighted Average		1.16	Weighted Average		1.24
Weekday PM Peak Hour										
5:00 PM	Avg.	3,480	3,211	1.08	3,062	2,975	1.03	6,542	6,186	1.06
5:00 PM	Max.	3,949		1.23	3,440		1.16	7,389		1.19
Weighted Average				1.16	Weighted Average		1.10	Weighted Average		1.13

Table 7-5 – Weekday Peak Hour COVID/Seasonal Factors
NB-HCE Between Interchange 14A and Interchange 14B

Hour	Volume	Eastbound			Westbound			Combined		
		2019	2021	Factor	2019	2021	Factor	2019	2021	Factor
Weekday AM Peak Hour										
7:00 AM	Avg.	3,422	2,647	1.29	1,935	1,443	1.34	5,357	4,090	1.31
7:00 AM	Max.	3,955		1.49	2,055		1.42	6,010		1.47
Weighted Average				1.40	Weighted Average		1.38	Weighted Average		1.39
Weekday PM Peak Hour										
5:00 PM	Avg.	2,548	2,354	1.08	2,654	2,375	1.12	5,201	4,729	1.10
5:00 PM	Max.	2,881		1.22	3,027		1.27	5,908		1.25
Weighted Average				1.15	Weighted Average		1.20	Weighted Average		1.18

Table 7-6 – Weekday Peak Hour COVID/Seasonal Factors
NB-HCE at Interchange 14C Toll Plaza

Hour	Volume	Eastbound			Westbound			Combined		
		2019	2021	Factor	2019	2021	Factor	2019	2021	Factor
Weekday AM Peak Hour										
7:00 AM	Avg.	3,214	2,425	1.33	1,873	1,335	1.40	5,087	3,760	1.35
7:00 AM	Max.	3,608		1.49	1,998		1.50	5,606		1.49
			Weighted Average	1.41	Weighted Average		1.45	Weighted Average		1.42
Weekday PM Peak Hour										
5:00 PM	Avg.	2,482	2,260	1.10	2,804	2,310	1.21	5,286	4,570	1.16
5:00 PM	Max.	2,757		1.22	3,111		1.35	5,868		1.28
			Weighted Average	1.16	Weighted Average		1.28	Weighted Average		1.22

To normalize the 2021 traffic count data based on seasonal and pandemic impacts, overall system factors of 1.4 and 1.2 for the weekday AM and PM peak hours, respectively, were proposed for use. These factors were estimated as the maximum of the weighted average factors for the combined eastbound/westbound volume factors in the tables above, rounded to the nearest tenth. These factors were applied to the 2021 balanced traffic counts to set a Base Year traffic volume profile that would not be influenced by the pandemic. This Base Year profile is used to derive Design Year traffic forecasts.

7.4 VEHICLE COMPOSITION

Using the NJTA's toll transaction data, vehicle compositions along NB-HCE roadway links within the project corridor were derived. The NJTA's toll collection system processes traffic by classes, which are generally based on vehicle size and the number of axles. There are six toll classes for cars and trucks, generally described below.

- Two-Axle Cars (Class 1)
- Two-Axle, Dual-Tire Trucks (Class 2)
- Trucks With 3 Axles Including Trailers (Class 3)
- Trucks With 4 Axles Including Trailers (Class 4)
- Trucks With 5 Axles Including Trailers (Class 5)
- Trucks With 6 Axles or More Including Trailers (Class 6)

There are also two toll classes for buses.

- Buses With 2 Axles (Class B2)
- Buses With 3 or More Axles (Class B3)

Anecdotally, the COVID-19 pandemic impacted regional traffic patterns due largely to the shutdown of most retail and other business and employment centers and the implementation of remote working arrangements. An increase in online and remote ordering of goods and services to maintain business and personal functions during the pandemic has resulted in the increase of goods movement via heavy vehicles (trucks) during the pandemic. Mass transit ridership, whether by train or bus, decreased during the pandemic due to the need to physically separate.

To support or refute these anecdotes, vehicle composition data on the NB-HCE for 2019 (pre-pandemic) and 2021 (during pandemic) were compared. Table 7-7 and Table 7-8 show vehicle compositions of eastbound and westbound roadway links between Interchange 14 and Interchange 14C. Since this data was derived from toll plaza transaction origin-destination data obtained from the NJTA, the data shown is limited to the toll ticket system (west of the Interchange 14C toll plaza). The results supported the anecdotes presented above: heavy truck percentages increased by as much as 40% over 2019 levels during both the weekday AM and PM peak hours, primarily due to lower total volume magnitudes. Bus percentages dropped significantly, despite the lower total volumes, indicating an expected reduction due to the pandemic.

Table 7-7 – Comparison of Vehicle Composition (2019 vs. 2021), Weekday AM Peak Hour

Year	Roadway Link	Direction	Car Class 1	Truck Class 2	Truck Class 3	Truck Class 4	Truck Class 5	Truck Class 6	Bus Class B2	Bus Class B3
2019	14 - 14A	WB	90.3%	3.2%	0.8%	0.7%	4.2%	0.1%	0.2%	0.5%
	14A - 14B		93.6%	3.0%	0.6%	0.5%	1.0%	0.0%	0.5%	0.8%
	14B - 14C		94.6%	2.5%	0.5%	0.4%	0.4%	0.0%	0.7%	0.9%
	14 - 14A	EB	88.9%	3.3%	1.0%	0.4%	4.4%	0.2%	0.2%	1.6%
	14A - 14B		93.9%	2.7%	0.6%	0.2%	0.7%	0.0%	0.3%	1.6%
	14B - 14C		94.6%	2.6%	0.5%	0.1%	0.3%	0.0%	0.3%	1.6%
2021	14 - 14A	WB	87.0%	3.9%	1.2%	1.1%	6.1%	0.2%	0.3%	0.2%
	14A - 14B		92.0%	3.6%	0.9%	0.6%	1.5%	0.0%	1.0%	0.4%
	14B - 14C		94.2%	2.7%	0.7%	0.4%	0.5%	0.0%	1.1%	0.4%
	14 - 14A	EB	87.5%	4.1%	1.2%	0.5%	5.9%	0.2%	0.1%	0.5%
	14A - 14B		88.9%	8.7%	0.0%	0.0%	0.9%	0.0%	0.2%	1.3%
	14B - 14C		94.4%	3.6%	0.5%	0.1%	0.4%	0.0%	0.4%	0.6%

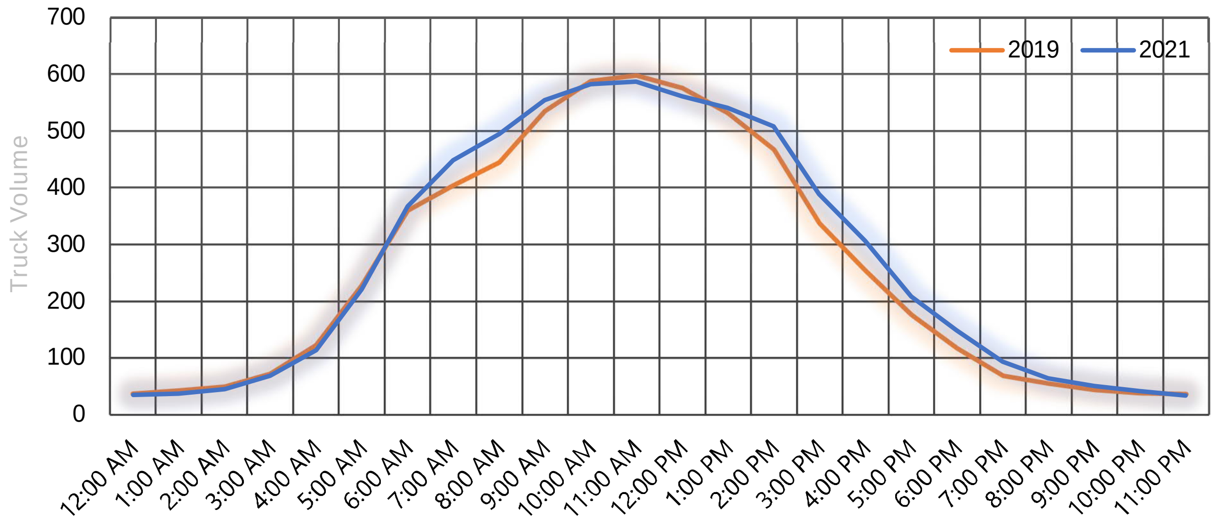
Table 7-8 – Comparison of Vehicle Composition (2019 vs. 2021), Weekday PM Peak Hour

Year	Roadway Link	Direction	Car Class 1	Truck Class 2	Truck Class 3	Truck Class 4	Truck Class 5	Truck Class 6	Bus Class B2	Bus Class B3
2019	14 - 14A	WB	95.3%	1.6%	0.3%	0.2%	1.5%	0.0%	0.1%	1.0%
	14A - 14B		96.4%	1.6%	0.2%	0.0%	0.3%	0.0%	0.3%	1.2%
	14B - 14C		96.4%	1.7%	0.2%	0.0%	0.1%	0.0%	0.5%	1.1%
	14 - 14A	EB	96.4%	1.2%	0.3%	0.2%	1.2%	0.1%	0.2%	0.4%
	14A - 14B		97.3%	0.9%	0.2%	0.1%	0.3%	0.0%	0.6%	0.6%
	14B - 14C		97.7%	0.7%	0.1%	0.0%	0.2%	0.0%	0.7%	0.6%
2021	14 - 14A	WB	94.2%	1.8%	0.4%	0.3%	2.5%	0.1%	0.2%	0.5%
	14A - 14B		96.4%	2.2%	0.2%	0.0%	0.3%	0.0%	0.3%	0.6%
	14B - 14C		96.4%	2.3%	0.2%	0.0%	0.1%	0.0%	0.4%	0.6%
	14 - 14A	EB	95.9%	1.5%	0.5%	0.3%	1.5%	0.0%	0.2%	0.1%
	14A - 14B		97.7%	1.3%	0.5%	0.0%	0.0%	0.0%	0.0%	0.5%
	14B - 14C		98.2%	0.6%	0.2%	0.0%	0.2%	0.0%	0.6%	0.2%

To further illustrate truck and bus volume trends, Figure 7-3 and Figure 7-4 show two-directional truck and bus volumes, respectively, between Interchange 14 and Interchange 14A by time of day during a typical weekday (Tuesday, Wednesday, or Thursday).

Figure 7-3 – Weekday Truck Activity by Time of Day (2019 and 2021)

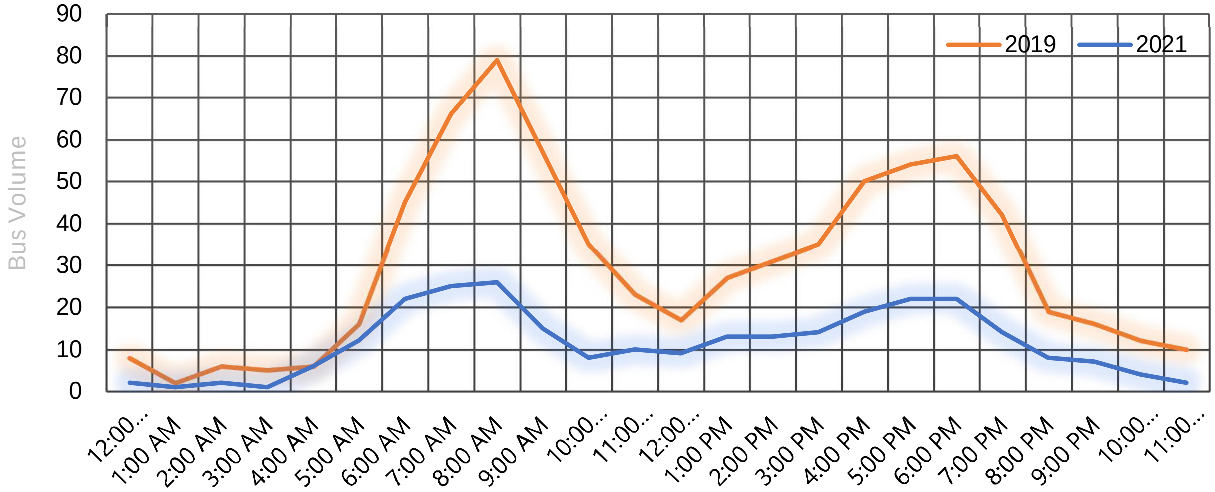
NB-HCE (Both Directions) Between Interchange 14 and Interchange 14A



Truck activity patterns show that weekday peak truck traffic does not occur during the same hours as the overall traffic weekday peak hours. Overnight truck traffic levels are low, increasing to a peak during the mid-morning hours (10:00 AM – 12:00 Noon) before steadily decreasing to overnight levels. As suggested by Figure 7-3 and Figure 7-4, both 2019 and 2021 truck volume trends show similar magnitudes and hourly distributions. On this basis, truck percentages for

2019 will be used for NB-HCE and ramp analyses in this report. The use of the higher 2021 truck percentages would be inconsistent with a Base Year condition that includes adjustments for pandemic impacts.

Figure 7-4 – Weekday Bus Activity by Time of Day (2019 and 2021)
NB-HCE (Both Directions) Between Interchange 14 and Interchange 14A



As suggested by Figure 7-4 –, bus activity along the corridor saw an overall reduction in 2021 because of the continuing impacts of the COVID-19 pandemic on bus (and overall mass transit) ridership. Health concerns, among them proximity to larger groups of non-familiar people, may have contributed to this downtrend. The overall trend of bus activity continues to show similar diurnal patterns with two peaks during the weekday morning and evening periods, despite the reduction in service. On this basis, bus percentages for 2019 will be used for NB-HCE and ramp analyses in this report. The use of the lower 2021 bus percentages would be inconsistent with a Base Year condition that includes adjustments for pandemic impacts.

7.5 DAILY TRUCK VOLUMES FOR STRUCTURAL ANALYSIS

Daily truck volumes and percentages were derived for roadway links along the NB-HCE corridor. The derivation of daily total traffic and truck traffic volumes for Base year and future years used a combination of traffic count data, NJTA toll plaza origin-destination data, and information from the NJRTM-E travel demand model, both for total traffic and heavy vehicle traffic. The days used to derive daily truck volumes are weekdays (Tuesday – Thursday), which present the worst-case heavy vehicle loads on the roadways.

This information is presented for use in structural fatigue design of the corridor bridges in lieu of one-way average daily truck traffic (ADTT) found in Section 3.1.3 of the current edition of the

NJTA Load Rating Manual. Truck volumes collected or obtained were not measured on a per-lane basis, so the derivation of a single-lane ADTT will need to employ the proportions of total truck traffic shown in Table 3.6.1.4.2-1 of the AASHTO LRFD Bridge Design Specifications.

Daily traffic volumes for the Base Year were derived from the traffic count data collected in Summer 2021. Adjustments to this data, for impacts of the pandemic on overall travel patterns, were made for consistency with the derivation of the 2021 Base Year weekday peak hour traffic volumes. The adjustment was based on a comparison of yearly toll transaction data by NB-HCE link within the Turnpike's toll ticket system for 2019 (pre-pandemic) and 2021 (Base year), provided by the NJTA through their M47 reports. Daily heavy vehicle percentages were estimated based on both NJTA toll transaction origin-destination data and the NJRTM-E regional demand model, which were in general accord for areas where the two data sources overlapped.

Daily traffic volumes and percentages for future years were derived using growth trends in daily traffic from the NJRTM-E, which differed slightly from those for the weekday peak periods. Truck percentages for the future years were taken directly from select-link analysis of NB-HCE and ramp roadways along the NB-HCE corridor. Models reflecting the proposed Build configuration were used to derive the future year daily total and truck volume profiles.

Using the data resources described above, balanced daily volume and truck volume networks were developed for the length of the NB-HCE corridor. In addition to the Base Year (2021) and Design Year (2050) profiles, an interim year profile was also developed. This interim year, 2040, is one for which forecast models were readily available for use but also can be reasonably used to approximate completion of the full proposed NB-HCE Program of improvements. It is more likely that daily truck growth beyond 2050 would occur on an annual rate based on the 10-year increment (2040 – 2050) of relatively consistent geometry on the corridor than the 29-year increment during which capacity enhancements are implemented along the way.

Table 7-9 summarizes the truck volumes by roadway link for the Base Year (2021), Design Year (2050), and Interim Year (2040). The table shows only roadway links between Interchange 14 and Interchange 14A. As noted, the latter two years assume a Build geometry with the full Program improvements. Also included in the table are daily truck percentages relative to average weekday traffic (AWDT) and the percentage changes (per annum) from Base Year to Design Year and from Interim Year to Design Year.

Table 7-9 – NB-HCE Daily Truck Volumes and Annual Trends - Interchange 14 to Interchange 14A

Direction	Roadway Link	2021 Base Year		2040 Build (Interim Year)		2050 Design Year (Build)		Percent Change 2021-2050 (per annum)	Percent Change 2040-2050 (per annum)
		Daily Trucks	% of AWDT	Daily Trucks	% of AWDT	Daily Trucks	% of AWDT		
Eastbound	Int. 14 – Int. 14A	2,982	6.0%	3,371	5.8%	3,468	5.7%	0.52%	0.28%
Westbound	Int. 14A – Int. 14	3,677	7.7%	3,962	6.7%	4,097	6.5%	0.37%	0.34%

As expected, truck volumes are forecast to grow faster annually over the full 29-year period (2021 – 2050), assuming compound growth, than during the shorter, 10-year period (2040 – 2050). Higher percent increases moving eastward on the corridor are the result of smaller Base Year volume figures as the basis for comparison.

Projection of truck volume trends over the proposed 150-design life of the new structure will be required as part of the fatigue design. Such projection is beyond the forecast horizons of the regional models used for this study. Extrapolation can be estimated using the 2040 – 2050 annual growth trends up to a practical capacity. This capacity is based on a physical daily capacity of the roadway, which the AASHTO LRFD Bridge Design Specifications guide suggests, in the commentary for Section 3.6.1.4.2, is 20,000 vehicles per day per lane for total traffic under normal conditions. Applying the Design Year 2050 truck percentages to this maximum value would derive an approximate practical maximum truck volume to use in the fatigue design.

7.6 2021 YEAR BASE TRAFFIC VOLUMES

The 2021 Base Year traffic volumes for weekday peak hours were estimated using a combination of data sources, including NJTA's origin-and-destination toll plaza transactions, field traffic counts, seasonal and pandemic adjustment factors and other historical data, as described in earlier sections

The full volume diagrams for the 2021 Base Year weekday morning (AM) and evening (PM) peak hours can be found in Appendix A.

Table 7-10 and Table 7-11 illustrate truck percentages and volumes for NB-HCE and ramp roadways between Interchange 14 and Interchange 14A. Table 7-12 and Table 7-13 provide similar bus information for NB-HCE and ramp roadways within these limits, respectively. Truck and bus percentages for the combined Ramp ST were derived from toll plaza origin-destination patterns; this data, however, does not distinguish truck and bus movements from the Turnpike inner roadway (via Ramp SIT) or from the outer roadway (via Ramp SOT). Based on normal operation of the dual configuration, with all trucks and buses in the outer roadway, Ramp ST trucks and buses were assumed to be on Ramp SOT, with Ramp SIT assumed to have 0% trucks and buses.

Table 7-10 – NB-HCE Truck Percentages and Volumes
2021 Base Year Traffic Volumes – Interchange 14 to Interchange 14A

Direction	Roadway Link	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Volume	% Trucks	Trucks	Volume	% Trucks	Trucks
Eastbound	Int. 14 – Int. 14A	4,533	9.3%	422	3,852	3.0%	116
Westbound	Int. 14A – Int. 14	3,640	9.0%	328	3,569	3.5%	126

Table 7-11 – NB-HCE Ramp Truck Percentages and Volumes
2021 Base Year Traffic Volumes – Interchange 14 to Interchange 14A

Direction	Ramp	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Volume	% Trucks	Trucks	Volume	% Trucks	Trucks
Eastbound	Interchange 14 Ramps						
	Ramp TS	727	15.0%	109	1,096	6.8%	74
	Ramp TN	2,738	4.3%	119	2,174	5.0%	108
	Ramp NH	655	13.1%	86	673	2.5%	17
	Ramp SH	1,848	4.4%	81	1,367	0.7%	9
	Interchange 14A Ramps						
	Ramp WT	1,696	16.2%	274	1,555	5.2%	81
	Ramp TE	870	0.9%	8	527	1.3%	7
Westbound	Interchange 14A Ramps						
	Ramp ET	369	4.3%	16	678	0.1%	1
	Ramp TW	1,989	12.1%	241	1,398	4.9%	69
	Interchange 14 Ramps						
	Ramp HN	739	10.7%	79	605	3.8%	23
	Ramp HLT	229	9.2%	21	190	1.6%	3
	Ramp HS	1,027	4.9%	50	1,492	1.7%	26
	Ramp SIT	393	0.0%	0	526	0.0%	0
	Ramp SOT	563	22.0%	124	720	20.1%	145
	Ramp NT	2,561	7.7%	196	2,631	3.2%	85

Table 7-12 – NB-HCE Bus Percentages and Volumes
2021 Base Year Traffic Volumes – Interchange 14 to Interchange 14A

Direction	Roadway Link	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Volume	% Buses	Buses	Volume	% Buses	Buses
Eastbound	Int. 14 – Int. 14A	4,533	0.7%	32	3,852	0.6%	23
Westbound	Int. 14A – Int. 14	3,640	0.7%	25	3,569	1.1%	39

Table 7-13 – NB-HCE Ramp Bus Percentages and Volumes
2021 Base Year Traffic Volumes – Interchange 14 to Interchange 14A

Direction	Ramp	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Volume	% Buses	Buses	Volume	% Buses	Buses
Eastbound	Interchange 14 Ramps						
	Ramp TS	727	0.1%	1	1,096	0.5%	5
	Ramp TN	2,738	1.9%	51	2,174	1.4%	30
	Ramp NH	655	0.2%	1	673	0.1%	1
	Ramp SH	1,848	1.1%	21	1,367	1.1%	15
	Interchange 14A Ramps						
	Ramp WT	1,696	0.1%	2	1,555	0.2%	3
	Ramp TE	870	2.1%	18	527	2.7%	14
Westbound	Interchange 14A Ramps						
	Ramp ET	369	1.9%	7	678	0.7%	5
	Ramp TW	1,989	0.3%	6	1,398	0.1%	1
	Interchange 14 Ramps						
	Ramp HN	739	0.7%	5	605	0.2%	1
	Ramp HLT	229	0.4%	1	190	0.5%	1
	Ramp HS	1,027	1.2%	12	1,492	1.7%	26
	Ramp SIT	393	0.0%	0	526	0.0%	0
	Ramp SOT	563	0.4%	2	720	0.3%	2
	Ramp NT	2,561	0.9%	23	2,631	1.6%	42

7.7 2050 DESIGN YEAR TRAFFIC VOLUME DEMAND

To develop traffic demand volumes for the 2050 Design Year, the NJRTM-E travel demand model was used to conduct the scenario alternative analysis. This process, including growth rates derived from the model's forecasts, is described in Section 5.

7.7.1 Design Year 2050 (No-Build)

The Design Year (No-Build) demand volume scenario assumes no Program-related geometric improvements on the NB-HCE or ramps. The NJRTM-E regional model was used to derive traffic demand forecasts and growth rates. The model includes short- and long-range infrastructure TIP projects, future demographics for the region, and study area projects which factored into the forecasts.

The full demand volume diagrams for the 2050 Design Year (No-Build) weekday morning (AM) and evening (PM) peak hours can be found in Appendix A. Table 7-14 and Table 7-15 illustrate truck percentages and volumes for the NB-HCE and ramp roadways between Interchange 14 and Interchange 14A. Table 7-16 and Table 7-17 provide similar bus information for the NB-HCE and ramp roadways within these limits, respectively. Truck and bus percentages for the combined Ramp ST were retrieved from select-link analysis in the NJRTM-E regional model; this data, however, does not distinguish truck and bus movements from the Turnpike inner roadway (via Ramp SIT) or from the outer roadway (via Ramp SOT). Based on normal operation of the dual configuration, with all trucks and buses in the outer roadway, Ramp ST trucks and buses were assumed to be on Ramp SOT, with Ramp SIT assumed to have 0% trucks and buses.

Table 7-14 – NB-HCE Ramp Truck Percentages and Volumes
2050 Design Year (No-Build) Demand Volumes – Interchange 14 to Interchange 14A

Direction	Roadway Link	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Demand	% Trucks	Trucks	Demand	% Trucks	Trucks
Eastbound	Int. 14 – Int. 14A	4,909	9.3%	457	4,172	3.2%	135
Westbound	Int. 14A – Int. 14	3,942	9.2%	362	3,866	4.0%	156

Table 7-15 – NB-HCE Ramp Truck Percentages and Volumes
2050 Design Year (No-Build) Demand Volumes – Interchange 14 to Interchange 14A

Direction	Ramp	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Demand	% Trucks	Trucks	Demand	% Trucks	Trucks
Eastbound	Interchange 14 Ramps						
	Ramp TS	854	15.2%	130	1,141	7.0%	80
	Ramp TN	2,842	4.3%	123	2,263	5.5%	125
	Ramp NH	710	13.5%	96	729	3.0%	22
	Ramp SH	2,001	4.3%	86	1,480	1.9%	28
	Interchange 14A Ramps						
	Ramp WT	1,837	16.4%	302	1,684	5.4%	91
	Ramp TE	942	2.7%	25	571	1.9%	11
Westbound	Interchange 14A Ramps						
	Ramp ET	400	4.8%	19	735	1.0%	7
	Ramp TW	2,154	12.5%	270	1,514	5.9%	90
	Interchange 14 Ramps						
	Ramp HN	801	11.5%	92	655	4.1%	27
	Ramp HLT	248	9.7%	24	205	1.0%	2
	Ramp HS	1,112	5.4%	60	1,616	2.0%	33
	Ramp SIT	354	0.0%	0	636	0.0%	0
	Ramp SOT	503	22.7%	114	867	20.8%	180
	Ramp NT	2,696	8.5%	229	2,703	3.6%	98

Table 7-16 – NB-HCE Bus Percentages and Volumes
2050 Design Year (No-Build) Demand Volumes – Interchange 14 to Interchange 14A

Direction	Roadway Link	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Demand	% Buses	Buses	Demand	% Buses	Buses
Eastbound	Int. 14 – Int. 14A	4,909	0.7%	34	4,172	0.6%	25
Westbound	Int. 14A – Int. 14	3,942	0.6%	23	3,866	0.8%	30

Table 7-17 – NB-HCE Ramp Bus Percentages and Volumes
2050 Design Year (No-Build) Demand Volumes – Interchange 14 to Interchange 14A

Direction	Ramp	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Demand	% Buses	Buses	Demand	% Buses	Buses
Eastbound	Interchange 14 Ramps						
	Ramp TS	854	0.1%	1	1,141	0.4%	5
	Ramp TN	2,842	1.9%	53	2,263	1.4%	31
	Ramp NH	710	0.1%	1	729	0.1%	1
	Ramp SH	2,001	1.1%	23	1,480	1.1%	16
	Interchange 14A Ramps						
	Ramp WT	1,837	0.1%	2	1,684	0.2%	3
	Ramp TE	942	2.0%	19	571	2.6%	15
Westbound	Interchange 14A Ramps						
	Ramp ET	400	1.8%	7	735	0.7%	5
	Ramp TW	2,154	0.3%	6	1,514	0.1%	2
	Interchange 14 Ramps						
	Ramp HN	801	0.7%	6	655	0.2%	1
	Ramp HLT	248	0.4%	1	205	0.5%	1
	Ramp HS	1,112	1.1%	12	1,616	1.5%	25
	Ramp SIT	354	0.0%	0	636	0.0%	0
	Ramp SOT	503	0.4%	2	867	0.3%	3
	Ramp NT	2,696	0.9%	25	2,703	1.7%	46

7.7.2 **Design Year 2050 (**Build**)**

The Design Year (Build) demand volume scenario assumed the same short- and long-range infrastructure TIP projects, future demographics for the region, and study area projects included in the NJRTM-E regional model as for the Design Year (No-Build) model. Additionally, the full Program improvements proposed in the Initially Preferred Alternative are included in the model. These improvements generally include the following lane configurations on the NB-HCE.

- Four lanes in each direction between Interchange 14 and Interchange 14A
- Three through lanes in each direction between Interchange 14A and Interchange 14B
- Four lanes (split toll plaza configuration) between Interchange 14B and Interchange 14C
- Four lanes eastbound, three lanes westbound between Interchange 14C and Columbus Drive
- Two through lanes in each direction between Columbus Drive/Merseles Street and Jersey Avenue

While this Report focuses on the Program improvements between Interchange 14 and Interchange 14A, traffic forecasts assuming the full Program build-out were produced by the regional model. Proposed improvements to ramp geometries, such as widening Interchange

14A Ramp WT to two lanes and extending the two-lane Ramp TW geometry onto the NB-HCE roadway, are also included in the regional model Build configuration. The Initially Preferred Alternative improvements also included an increase in design speed from an existing 55 mph (assumed based on the existing 50-mph speed limit) to 60 mph, as noted in the Preliminary Design Report. The NJRTM-E regional model was run with these proposed improvements to derive the forecast traffic demand analyzed in this section. The full demand volume diagrams for the 2050 Design Year (Build) weekday morning (AM) and evening (PM) peak hours can be found in Appendix A. Table 7-18 and Table 7-19 illustrate truck percentages and demand volumes for NB-HCE and ramp roadways between Interchange 14 and Interchange 14A. Table 7-20 and Table 7-21 provide similar bus information for NB-HCE and ramp roadways within these limits, respectively. Truck and bus percentages for the combined Ramp ST were retrieved from select-link analysis in the NJRTM-E regional model; this data, however, does not distinguish truck and bus movements from the Turnpike inner roadway (via Ramp SIT) or from the outer roadway (via Ramp SOT). Based on normal operation of the dual configuration, with all trucks and buses in the outer roadway, Ramp ST trucks and buses were assumed to be on Ramp SOT, with Ramp SIT assumed to have 0% trucks and buses.

Table 7-18 – NB-HCE Truck Percentages and Volumes
2050 Design Year (Build) Demand Volumes – Interchange 14 to Interchange 14A

Direction	Roadway Link	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Demand	% Trucks	Trucks	Demand	% Trucks	Trucks
Eastbound	Int. 14 – Int. 14A	5,986	9.4%	563	5,088	3.7%	187
Westbound	Int. 14A – Int. 14	4,806	9.4%	450	4,713	4.2%	196

Table 7-19 – NB-HCE Ramp Truck Percentages and Volumes
2050 Design Year (Build) Demand Volumes – Interchange 14 to Interchange 14A

Direction	Ramps	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Demand	% Trucks	Trucks	Demand	% Trucks	Trucks
Eastbound	Interchange 14 Ramps						
	Ramp TS	865	15.4%	133	690	8.4%	58
	Ramp TN	2,761	4.7%	131	2,361	6.5%	155
	Ramp NH	865	13.9%	120	889	3.4%	30
	Ramp SH	2,440	4.8%	116	1,805	2.0%	37
	Interchange 14A Ramps						
	Ramp WT	2,240	16.3%	366	2,053	7.0%	144
	Ramp TE	1,149	3.3%	38	696	3.3%	23
Westbound	Interchange 14A Ramps						
	Ramp ET	487	7.2%	35	896	1.8%	16
	Ramp TW	2,626	12.9%	340	1,846	6.4%	118
	Interchange 14 Ramps						
	Ramp HN	976	11.3%	110	799	4.3%	34
	Ramp HLT	303	9.9%	30	250	1.2%	3
	Ramp HS	1,356	5.5%	74	1,971	3.5%	69
	Ramp SIT	340	0.0%	0	559	0.0%	0
	Ramp SOT	500	22.2%	111	762	20.9%	159
	Ramp NT	2,968	9.1%	270	3,196	4.9%	156

Table 7-20 – NB-HCE Bus Percentages and Volumes -
2050 Design Year (Build) Demand Volumes – Interchange 14 to Interchange 14A

Direction	Roadway Link	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Demand	% Buses	Buses	Demand	% Buses	Buses
Eastbound	Int. 14 – Int. 14A	5,986	0.7%	42	5,088	0.6%	32
Westbound	Int. 14A – Int. 14	4,806	0.6%	29	4,713	0.8%	39

Table 7-21 – NB-HCE Ramp Bus Percentages and Volumes
2050 Design Year (Build) Demand Volumes – Interchange 14 to Interchange 14A

Direction	Ramps	Weekday AM Peak Hour			Weekday PM Peak Hour		
		Demand	% Buses	Buses	Demand	% Buses	Buses
Eastbound	Interchange 14 Ramps						
	Ramp TS	865	0.1%	1	690	0.4%	3
	Ramp TN	2,761	1.8%	51	2,361	1.4%	32
	Ramp NH	865	0.1%	1	889	0.1%	1
	Ramp SH	2,440	1.1%	28	1,805	1.1%	20
	Interchange 14A Ramps						
	Ramp WT	2,240	0.1%	3	2,053	0.2%	4
	Ramp TE	1,149	2.1%	24	696	2.6%	18
Westbound	Interchange 14A Ramps						
	Ramp ET	487	1.6%	8	896	0.7%	6
	Ramp TW	2,626	0.3%	8	1,846	0.1%	2
	Interchange 14 Ramps						
	Ramp HN	976	0.7%	7	799	0.3%	2
	Ramp HLT	303	0.3%	1	250	0.4%	1
	Ramp HS	1,356	1.1%	15	1,971	1.6%	31
	Ramp SIT	340	0.0%	0	559	0.0%	0
	Ramp SOT	500	0.4%	2	762	0.3%	2
	Ramp NT	2,968	0.9%	27	3,196	1.8%	56

7.8 REGIONAL TRAFFIC IMPACTS

Although the elements of the NB-HCE Bridge Replacements and Capacity Enhancements Program are proposed only along the NB-HCE, its interchange ramps, and affected local roadways, the impacts of the Program will be experienced regionally. This section examines the effect of the improvements on other major roadway travel routes and volumes in the region.

In addition to the NB-HCE, specifically the roadway link crossing Newark Bay, seven other regional roadways were assessed to measure the regional effects of the enhancements on traffic patterns:

- N.J. Turnpike (I-95) north of Interchange 14 – connects to the NB-HCE via Ramp NH
- N.J. Turnpike (I-95) south of Interchange 14 – connects to the NB-HCE via Ramp SH
- Pulaski Skyway (US Route 1&9) – parallel roadway corridor north of the NB-HCE connecting Newark to the Holland Tunnel corridor via NJ Route 139
- US Route 1&9 Truck – parallel roadway corridor north of the NB-HCE connecting Newark to the Holland Tunnel corridor via NJ Route 139. It is the designated truck corridor for the Pulaski Skyway, on which trucks are prohibited.
- Goethals Bridge (I-278) – crossing between New Jersey and Staten Island, south of the NB-HCE, which can be used as an alternate route to Bayonne, southern Brooklyn and Queens, and Long Island.
- Bayonne Bridge (NJ Route 440) – crossing further south of the NB-HCE connecting Staten Island to Bayonne providing a southern connection to the NB-HCE via Interchange 14A.
- Wittpenn Bridge (NJ Route 7) – parallel roadway north of the NB-HCE connecting parts of western New Jersey to the Holland Tunnel corridor via NJ Route 139

Base Year 2021 volumes on the New Jersey Turnpike north and south of Interchange 14 were derived from Authority Sensys puck data. Volumes on the Pulaski Skyway, US Route 1&9 Truck and the Wittpenn Bridge (NJ Route 7) were derived from historical NJDOT traffic volume data and field traffic counts. Traffic volume information on the Goethals Bridge and Bayonne Bridge were obtained from available New York State DOT traffic volume data at these crossings. Seasonal and COVID adjustments, described earlier in this chapter, were applied to the data to develop the Base Year 2021 volumes.

Using the methods described in the Traffic Forecasting Methodology section (Section 5), weekday peak hour volumes were forecasted on each of the roadway links listed above, including the NB-HCE crossing Newark Bay. Table 7-22 shows the volumes on each of these roadway links for the weekday AM (7:00-8:00 A.M.) and PM (5:00-6:00 P.M.) peak hours by direction for the Base Year (2021), Design Year (No-Build) (2050) and Design Year (Build) (2050) scenarios.

It should be noted that the only difference between the No-Build and Build scenarios is the capacity enhancement on the NB-HCE corridor. The socio-economic and demographic inputs remain the same and there are no major changes assumed to transit services such that significant mode choice differences would result in the future.

Table 7-22 – Existing Volume and Projected Demand on Nearby Regional Routes

Roadway	Direction	2021 Base Year Volume		2050 Design Year (No-Build) Demand		2050 Design Year (Build) Demand	
		AM	PM	AM	PM	AM	PM
New Jersey Turnpike (I-95) north of Int. 14	SB	7,829	8,861	7,763	10,747	7,611	10,444
	NB	8,299	6,738	9,318	6,963	9,195	7,048
New Jersey Turnpike (I-95) south of Int. 14	SB	6,330	8,845	7,366	9,391	7,357	9,459
	NB	7,780	5,837	7,970	6,755	8,112	6,693
Pulaski Skyway (US Route 1&9)	SB	2,833	3,184	2,669	3,167	2,646	2,831
	NB	2,946	2,640	3,156	3,032	2,608	2,934
US Route 1&9 Truck	SB	2,386	2,113	2,542	2,071	2,503	1,804
	NB	3,410	2,567	3,334	2,783	3,200	2,860
NB-HCE (Newark Bay Bridge)	WB	3,640	3,569	3,942	3,866	4,806	4,713
	EB	4,533	3,852	4,909	4,172	5,986	5,088
I-278 (Goethals Bridge)	WB	2,216	2,318	1,924	2,722	1,993	2,669
	EB	1,612	2,577	1,915	2,439	1,888	2,621
NJ/NY Route 440 (Bayonne Bridge)	SB	1,166	1,964	1,878	2,233	1,855	1,762
	NB	1,484	772	1,451	1,055	1,123	992
NJ Route 7 (Wittpenn Bridge)	SB	1,904	1,932	2,473	2,279	2,256	2,239
	NB	1,487	1,774	1,620	2,154	1,642	1,987

Table 7-23 shows the volume and percentage differences between the 2050 Design Year (No-Build) and 2021 Base Year scenarios and similar differences between the 2050 Design Year (Build) and No-Build scenarios. Comparing the Design Year (No-Build), volume growth (positive and negative) would vary across all roadways ranging from -13.2% to 61.1%. High negative and positive growth on some roadways reflects a change in roadway congestion causing commuters to use alternate roadways in the future.

This is an expected result over a 29-year period given the anticipated growth and changes in demographics over this time period.

Table 7-23 – Existing Volume and Projected Demand/Percentage Differences On Nearby Regional Routes

Roadway	Direction	2050 No-Build vs. 2021 Base Difference		2050 Build vs. 2050 No-Build Difference		2050 No-Build vs 2021 Base Percent Difference		2050 Build vs 2050 No-Build Percent Difference	
		AM	PM	AM	PM	AM	PM	AM	PM
New Jersey Turnpike (I-95) north of Int. 14	SB	-66	1,886	-152	-303	-0.8%	21.3%	-2.0%	-2.8%
	NB	1,019	225	-123	85	12.3%	3.3%	-1.3%	1.2%
New Jersey Turnpike (I-95) south of Int. 14	SB	1,036	546	-9	68	16.4%	6.2%	-0.1%	0.7%
	NB	190	918	142	-62	2.4%	15.7%	1.8%	-0.9%
Pulaski Skyway (US Route 1&9)	SB	-164	-17	-23	-336	-5.8%	-0.5%	-0.9%	-10.6%
	NB	210	392	-548	-98	7.1%	14.8%	-17.4%	-3.2%
US Route 1&9 Truck	SB	156	-42	-39	-267	6.5%	-2.0%	-1.5%	-12.9%
	NB	-76	216	-134	77	-2.2%	8.4%	-4.0%	2.8%
NB-HCE (Newark Bay Bridge)	WB	303	296	864	847	8.3%	8.3%	21.9%	21.9%
	EB	376	320	1,076	915	8.2%	8.3%	21.9%	21.9%
I-278 (Goethals Bridge)	WB	-292	404	69	-53	-13.2%	17.4%	3.6%	-1.9%
	EB	303	-138	-27	182	18.8%	-5.4%	-1.4%	7.5%
NJ/NY Route 440 (Bayonne Bridge)	SB	712	269	-23	-471	61.1%	13.7%	-1.2%	-21.1%
	NB	-33	283	-328	-63	-2.2%	36.7%	-22.6%	-6.0%
NJ Route 7 **(Wittpenn Bridge)**	SB	569	347	-217	-40	29.9%	18.0%	-8.8%	-1.8%
	NB	133	380	22	-167	8.9%	21.4%	1.4%	-7.8%

Comparing the Design Year (Build) to the No-Build in Table 7-3 shows the impact of the NB-HCE Program's capacity enhancements on the NB-HCE itself as well as other regional roadways. Volumes on the Newark Bay Bridge would increase by about 22% for the weekday AM and PM peak hours in both directions, while other roadways would show decreases, especially in the peak direction of travel. The Pulaski Skyway volumes would decrease by as much as 17.4%; US Route 1&9 Truck volumes would decrease by as much as 12.9%, and Bayonne Bridge volumes would decrease by as much as 22.6%. Furthermore, volumes crossing the Wittpenn Bridge would decrease by as much as 8.8%.

The results reflect a change in equilibrium of the traffic volume network that results from the introduction of the NB-HCE Program capacity enhancements. Looking regionally, the same traffic volumes are forecast to the Design Year, as the same developments and demographics are proposed in the region, but route choices are impacted through traffic shifts from parallel corridors and alternate routes to the NB-HCE. The primary traffic shifts appear to be from the Pulaski Skyway, US Route 1&9 Truck and NJ Route 7 corridors, which feed the NJ Route 139 approach to the tunnel. Traffic shifts also occur from the Goethals Bridge and Outerbridge

Crossing, which feed the Bayonne Bridge onto NJ Route 440 toward the port areas. These results suggest that the Program can be viewed as a benefit to mobility in the region as well as to the operations of the NB-HCE corridor.

8. TRAFFIC ANALYSIS METHODOLOGY

8.1 METHODOLOGY

The Traffic Analysis Methodology section explains the types of static and traffic analysis and microsimulation models used to create, evaluate and compare performance of the Base, No Build and Build Alternatives design geometries. The models were calibrated using existing speed data from the Regional Integrated Transportation Information System (RITIS) and validated against Base Year adjusted volumes for the morning (AM) and evening (PM) peak hours. Performance measures were used to evaluate whether each alternative would have acceptable operations (LOS D or better).

This section presents the methodology and models used to evaluate and compare performance of the existing level of service/operation and proposed improvements in the corridor. Two types of models were used to evaluate performance:

- Highway Capacity Manual (HCM), 6th Edition, and its companion software, Highway Capacity Software (HCS), was used to analyze basic freeway segments and selected intersection LOS. HCS is a static traffic model used to analyze LOS through volume density on freeway segments and average vehicle delays at intersections. The HCS basic freeway analysis was performed to determine the number of lanes required on each link at a high level.

- VISSIM microsimulation models were developed to analyze areas of complexity involving the interactions of freeways, ramp roadways and toll plaza impacts. Version 2021.0.12.0 was used in the creation and running of these models. The models were built following the guidelines presented in the Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, FHWA 2019. Capacity Analysis and Level of Service. The models were created to analyze operational characteristics, such as queuing and spillback, at ramp junction and diverge areas.

Detailed capacity and level of service (LOS) analyses were conducted at critical freeway sections using the analytical procedures described in the Highway Capacity Manual (HCM), 6th Edition, published by the Transportation Research Board, National Research Council, Washington, D.C.

Analysis inputs for basic freeway segments include: the number of lanes on each roadway link; percent grade; free flow speed, origin-destination data (for weaving sections), total demand volume and heavy vehicle (truck and bus) percentages. Analysis inluts for intersections include: approach volume and lane configuration; type of traffic control; heavy vehicle (truck and bus) percentages; clnflicting pedestrians and cyclists; parking maneuvers; and bus blockages.

Performance measures for Basic Freeway Segments, Ramp Merge/Diverge and Ramp Weaving Sections include vehicle density (passenger cars per mile per lane), volume-to-capacity ratio (v/c) and LOS (A through F).

Performance measures for Intersections (signalized or unsignalized include capacity (vehicles per hour), volume-to-capacity ratio (v/c), 95th percentile queue length (feet), delay by movement, approach and overall intersection (seconds per vehicle) and LOS by movement, approach and overall (A to F).

While Level of Service C is the desired operation condition for the New Jersey Turnpike facility in general, LOS D is the target operating condition for acceptable operation on the NB-HCE Capacity Enhancement Program because of the more urban characteristics of the NB-HCE corridor.

8.1.1 Basic Freeway Segments

Analysis inputs include number of lanes, percent grade, free flow speed for freeway and ramp segments, total demand volume and truck percentages. There are also a number of link adjustments that can be made to validate speeds and volumes which are explained in Model Validation section.

For basic freeway segments, the Level of Service (LOS) was calculated using procedures in HCM, 6th Edition, Chapter 12. LOS is estimated based on traffic volume density, a measure that quantifies the proximity of vehicles to each other within the traffic stream and indicates the degree of maneuverability within the traffic stream. Table 8-1 displays the LOS criteria used for basic freeway segments.

Table 8-1 – Basic Freeway Segments - Level of Service Criteria

LOS	DENSITY RANGE (passenger cars per mile per lane)
A	<= 11
B	> 11 to 18
C	> 18 to 26
D	> 26 to 35
E	> 35 to 45
F	> 45 (or demand exceeds capacity)

Source: Highway Capacity Manual, 6th Edition, Exhibit 12-15.

Performance measure outputs for basic freeway segments include density, average speed and LOS (A to F). LOS A describes completely free-flow conditions, with densities of up to 11 passenger cars per mile per lane (pcpmpl), while LOS F represents forced breakdown flow with densities in excess of 45 pcpmpl. The densities corresponding to LOS A, B, C, and D are equal to or less than 35 pcpmpl and are considered acceptable operating conditions.

8.1.2 Ramp Roadways

The traffic assessment of number of lanes for ramp roadways is based on the capacity of the ramp roadway. The capacity criteria for ramp roadways, as defined in the HCM, 6th Edition, are provided in Table 8-2.

Table 8-2 – Ramp Roadways – Capacity Based on Free Flow Speed

RAMP FREE FLOW SPEED (FFS) (miles per hour)	RAMP ROADWAY CAPACITY (passenger cars per hour per lane)
> 50	2,200
> 40 to 50	2,100
> 30 to 40	2,000
>= 20 to 30	1,900
< 20	1,800

(Source: Highway Capacity Manual, 6th *Edition*, Exhibit 14-12.)

For this assessment, the free flow speed (FFS) was estimated as the design speed of the ramp. Capacity in this table is expressed as passenger cars per hour per lane (pcphpl) so that traffic volume flow rates in vehicles per hour (vph) need to be converted to pcphpl using the peak hour factor and heavy vehicle adjustment factor as inputs. With Level of Service D or better considered to be acceptable for this assessment, an estimated volume-to-capacity ratio of 0.84 was applied to the capacity figures in Table 8-2 to define the thresholds against which to evaluate the Design Year ramp volumes. This value was approximated from Exhibit 12-37 in the HCM, 6th Edition, for basic freeway segments (using the 55 mph FFS) to estimate the maximum service flow rate at LOS D.

It should be noted that ramp roadway operations are controlled more by the quality of flow at either terminus: the freeway merge/diverge or the local roadway intersection (i.e., traffic signal, etc). The Highway Capacity Manual, 6th Edition, analysis in the previous section establishes the number of lanes needed on the ramp roadways, with qualitative consideration of operations based on current performance. Other analysis in this Report, performed through VISSIM modeling, addresss operational characteristics, such as ramp merge and diverge sections and the effects of spillback from toll plazas in more detail. Level of service criteria for these operational analyses are documented in the next subsection.

8.1.3 Ramp Junctions

The LOS for ramp junctions (merge and diverge areas) is determined based on the density (passenger car equivalents per mile per lane) in the influence area of the ramp. The LOS criteria for ramp-freeway junctions, as defined in the HCM, 6th Edition, are provided in Table 8-3.

Table 8-3 – Ramp Junctions - Level of Service Criteria

LOS	DENSITY RANGE (passenger cars per mile per lane)
A	<=10
B	>10 to 20
C	>20 to 28
D	>28 to 35
E	>35
F	Demand exceeds capacity

(Source: Highway Capacity Manual, 6th *Edition, Exhibit 14*-3)

LOS A through D represent stable operation at the merge or diverge influence areas without adversely disrupting through vehicles. LOS E and F represent breakdown conditions where the demand exceeds the capacity of upstream or downstream freeway sections or the capacity of an off-ramp. No density value is calculated for LOS F once the density exceeds 35 vehicles per mile per lane.

For ramp junctions (entrances or exits) that are lane drop or lane additions, the analysis defers to the density of the basic freeway segment upstream of the exit or downstream of the entrance since no lane changes are required within the influence area by ramp traffic.

8.1.4 Weaving Segments

A single LOS is calculated to characterize the total flow within a weaving section comprised of weaving and non-weaving vehicles. The LOS of the weaving segment is determined based upon density (passenger car equivalents per mile per lane), as defined by the HCM, 6th Edition, and is provided in Table 8-4.

Table 8-4 – Weaving Segments - Level of Service Criteria

LOS	DENSITY RANGE (passenger cars per mile per lane)
A	0 to 10
B	> 10 to 20
C	> 20 to 28
D	> 28 to 35
E	> 35 to 43
F	> 43, or demand exceeds capacity

Source: Highway Capacity Manual, 6th Edition, Exhibit 13-6.

LOS A through D represent stable operation within the weaving section without adversely disrupting through vehicles. LOS E and F represent breakdown conditions where the weaving demand exceeds the capacity of the weaving section or demand of entry or exit ramps exceed capacity of the ramp roadway. No density value is calculated for LOS F once the density exceeds 43 vehicles per mile per lane.

8.1.5 Unsignalized Intersections

Analysis of unsignalized intersections was performed using procedures from the HCM, 6th Edition, Chapter 20. Level of service (LOS) for an unsignalized intersection is determined by the control delay for each minor street movement and major street left turn movement. LOS is not defined for the major street through or right turn movements because delays for these movements are assumed to be zero. Level of service corresponds to the control delay ranges presented in Table 8-5.

Table 8-5 – Unsignalized Intersections - Level of Service Criteria

LOS	CONTROL DELAY (seconds per vehicle)
A	<=10
B	>10 to 15
C	>15 to 25
D	>25 to 35
E	>35 to 50
F	>50

(Source: Highway Capacity Manual, 6th *Edition, Exhibit 20*-2)

LOS A through D represent stable operation for the minor street movements and major street left turn movements. LOS E and F represents breakdown conditions where the demand exceeds the capacity of the movement or that the control delay exceeds 35 seconds per vehicle. Level of service D or better is considered acceptable for these movements.

8.2 MICROSIMULATION MODEL VALIDATION

Traffic models were developed, calibrated, and validated following the procedures found in the FHWA Traffic Analysis Toolbox Volume III: Guidelines for Applying Traffic Microsimulation Modeling Software, 2019 Update.

VISSIM models (version 2021.0.12.0) were developed for various alternatives considered for Interchange 14 and Interchange 14A ramp junction and diverge area geometries. Model link volumes were input as total vehicle volume with heavy vehicles (trucks plus buses) expressed as a percentage. The model analysis results are discussed in more detail in Section 10. The next sections below discuss the general process for validation of these models. Specific changes made during those processes, however, are identified in Section 10.

8.2.1 Speed Validation

Speed validation was accomplished by comparing model congested speeds with existing congested peak hour speeds downloaded from the Regional Integrated Transportation Information System (RITIS) platform. RITIS is a database and analysis platform that collects and fuses transportation and traffic data from public and private sector systems for use in planning activities. Figure 8-1 shows the RITIS average speeds by section of roadway/ramp for the weekday AM peak hour (7:00 – 8:00 AM) in 2019. Figure 8-2 shows the RITIS average speeds by section of roadway/ramp for the weekday PM peak hour (5:00 – 6:00 PM) in 2019.

Figure 8-1 – Existing Travel Speeds from RITIS for Weekday AM Peak Hour

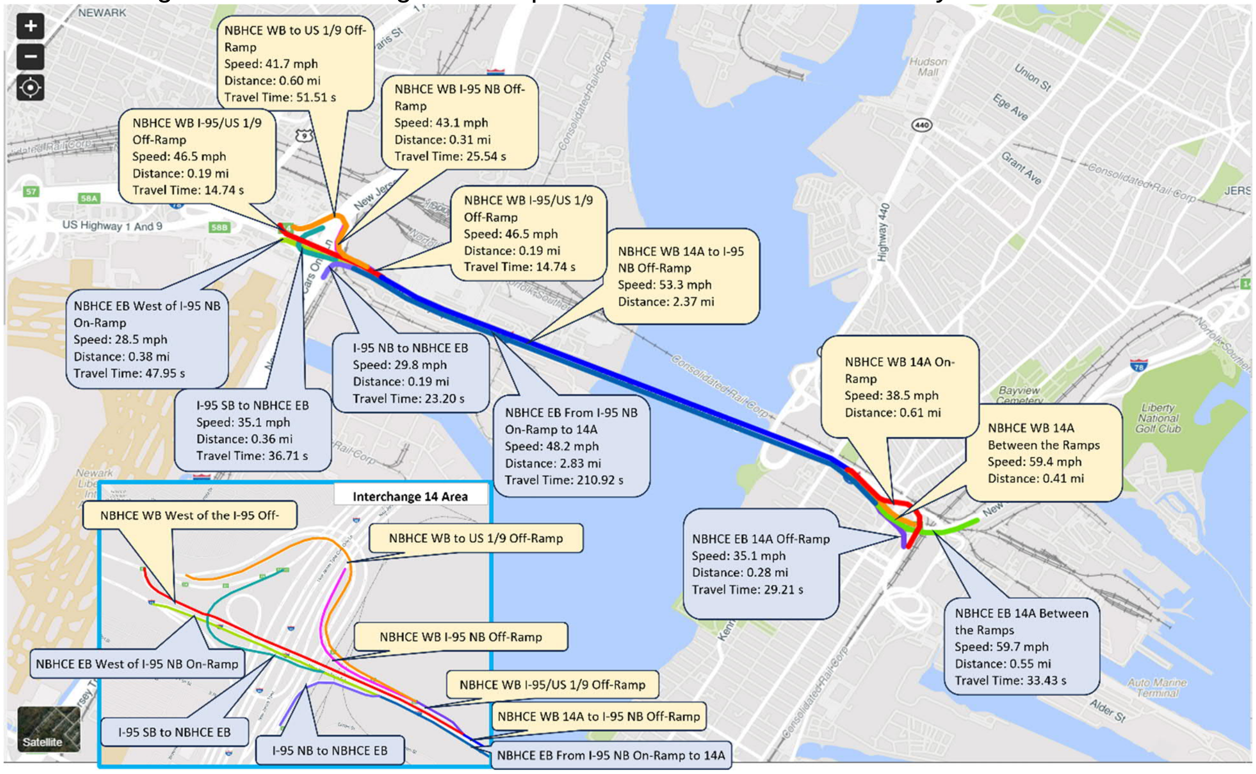
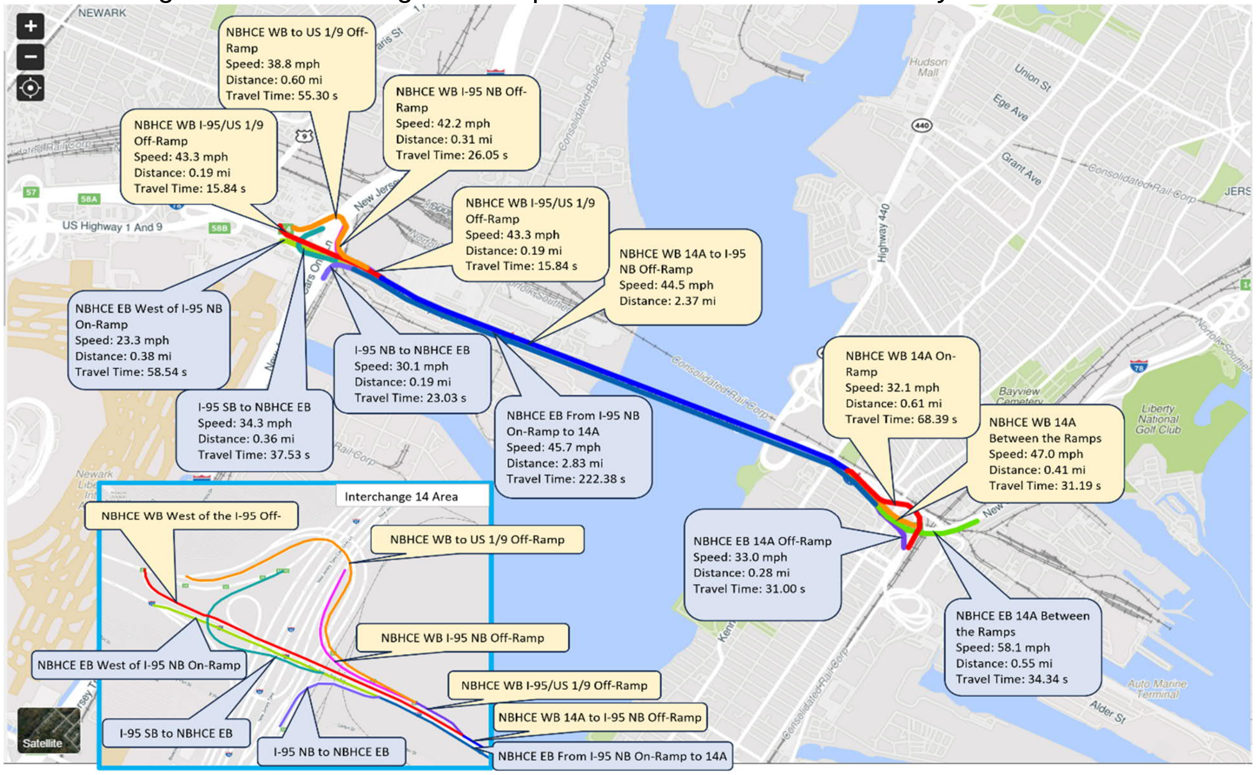


Figure 8-2 – Existing Travel Speeds from RITIS for Weekday PM Peak Hour



8.2.2 Volume Validation

Volume validation was accomplished using the GEH Statistic. The GEH Statistic is a formula (see Figure 8-3) used in traffic engineering, traffic forecasting, and traffic modeling to compare two sets of traffic volumes: those obtained from the forecasted traffic volumes (for the "base year" scenario) and the real-world traffic volumes. The equation is a method of determining an “Acceptable fit” for a project. It requires the vehicles per hour (vph) from the VISSIM simulation (m) and the volumes (c) from existing traffic volumes (or in this case, the 2021 Base Year Case volume). A GEH less than 5.0 for a single roadway link is considered acceptable, while an areawide GEH less than 4.0 is also considered acceptable.

Figure 8-3 - GEH Statistic Formula

$$GEH = \sqrt{\frac{2(m-c)^2}{m+c}}$$

Notes:
m = output traffic volume from the simulation model (vph)
c = input traffic volume (vph)

All roadway sections in the VISSIM models run for this project passed the acceptance criteria; validation reports are shown in Appendix D. Where multiple model links are to carry the same volume, the highest GEH statistic is shown for the traffic volume noted.

9. NB-HCE AND RAMP TRAFFIC LANE NEEDS ASSESSMENT

9.1 NB-HCE LANE NEEDS ASSESSMENT

9.1.1 Background

This section addresses lane configuration needs and assesses the lane configurations shown in the Initially Preferred Alternative (IPA). To fully understand the significance of traffic operations under the IPA, descriptions of both the existing and recommended geometries are summarized within the following sections, along with the results of the roadway link capacity analysis and levels of service for the volume scenarios studied.

It should be noted that the analysis performed in this section focuses on the NB-HCE roadway geometry. Ramp geometry, specifically number of lanes needed, is addressed in Section 9.2. Lane configurations at the interchanges, however, are addressed in the alternatives analysis in Section 10.

9.1.2 Summary of Existing Geometry

The existing NB-HCE carries two lanes in each direction over Newark Bay between Interchange 14 and Interchange 14A. The eastbound roadway (HWE Roadway) is formed by a two-lane roadway exiting the Interchange 14 toll plaza (Ramp TH), with a single-lane Ramp NH (from I-95 southbound) and a two-lane Ramp SH (from I-95 northbound) merging consecutively into Ramp TH. At Interchange 14A, a single-lane ramp (Ramp WT) departs the eastbound roadway, with two lanes continuing through the interchange. The westbound roadway (HEW Roadway) carries two lanes through Interchange 14A; a single-lane Ramp TW (which begins as two lanes exiting the toll plaza before narrowing to one lane) merges into the two-lane NB-HCE westbound crossing Newark Bay. On the west side of the bay and before the Turnpike mainline, the NB-HCE roadway expands to accommodate right-side exit ramps for I-95 northbound traffic (Ramp HN) and local traffic to the north portion of the Interchange 14 toll plaza to access US Route 1&9, US Route 22 and NJ Route 21 (Ramp HLT). Two lanes continue west over the Turnpike mainline to a loop ramp to I-95 southbound (Ramp HS) and beyond there Ramp HXT to access the south portion of the Interchange 14 toll plaza and the Express Lanes of I-78 westbound. A third lane opens west of Ramp HS on approach to the toll plaza.

To conservatively assess level of service for these roadway links, uphill sections in each direction leading to the crest of the Newark Bay Bridge were used in the analysis.

9.1.3 2021 Base Year Lane Needs Assessment

Table 9-1 summarizes the freeway roadway link performance (volume, density, volume-to-capacity ratio, and level of service) on the NB-HCE between Interchange 14 and Interchange 14A using the Base Year volumes derived in Section 7 and shown in Appendix A. Active construction projects and their construction staging layouts were not considered in the Base Year analysis, to provide a baseline "normal condition" for comparison with Design Year traffic volume scenarios. Traffic volumes in the table are expressed in vehicles per hour (vph), and density is expressed as passenger cars per mile per lane (pcpmpl). Grades within roadway links were considered in the analysis, especially between Interchange 14 and Interchange 14A, such that a worst-case performance is shown in the table.

Table 9-1 – 2021 Base Year NB-HCE Volume, Density, V/C and LOS for Weekday Peak Hours – Interchange 14 to Interchange 14A

Direction	Roadway Link (# Lanes)	Weekday AM Peak Hour				Weekday PM Peak Hour			
		Volume	Density	V/C	LOS	Volume	Density	V/C	LOS
Eastbound	Int. 14 – Int. 14A (2)	4,533	*	1.31	F	3,852	*	1.04	F
Westbound	Int. 14A – Int. 14 (2)	3,640	*	1.04	F	3,569	42.3	0.97	E

* Density is not calculated when v/c exceeds 1.00.

As seen in the table, both roadway links currently operate at unacceptable levels of service (E or worse) in both weekday peak hours. Three of the four cases show LOS F with volume-to-capacity (v/c) ratios greater than 1.00.

The results are consistent with congestion that, prior to the pandemic, routinely occurred on the Newark Bay Bridge area of the NB-HCE during the weekday peak hours, primarily due to the profile grades on the approach structures and the significant truck traffic volumes. Traffic merging from Ramp NH and Ramp SH, which feed the eastbound NB-HCE from the Turnpike mainline, and from Interchange 14A Ramp TW feeding the westbound NB-HCE, all of which are also carrying heavy truck volumes, exacerbate the operations on this link.

The existing two-lane configuration on the Newark Bay Bridge is not sufficient to accommodate current traffic loads at an acceptable level of service.

9.1.4 **2050 Design Year (No-Build)** Lane Needs Assessment

Table 9-2 summarizes the forecasted freeway performance - volume, density, volume-to-capacity ratio and level of service - on the NB-HCE between Interchange 14 and Interchange 14A using the Design Year (No-Build) volumes derived in Section 7 and shown in Appendix A. This scenario reflects design year forecast traffic volumes under the existing geometric configurations described in Section 9.1.2. As before, traffic volumes in the table are expressed in vph, while density is expressed as pcpmpl.

Table 9-2 – 2050 Design Year (No-Build) NB-HCE Demand, Density, V/C and LOS for Weekday Peak Hours – Interchange 14 to Interchange 14A

Direction	Roadway Link (# Lanes)	Weekday AM Peak Hour				Weekday PM Peak Hour			
		Demand	Density	V/C	LOS	Demand	Density	V/C	LOS
Eastbound	Int. 14 – Int. 14A (2)	4,909	*	1.41	F	4,172	*	1.13	F
Westbound	Int. 14A – Int. 14 (2)	3,942	*	1.10	F	3,866	*	1.06	F

* Density is not calculated when v/c exceeds 1.00.

As seen in the table, in the 2050 Design year (No-Build) condition, all four segments would operate at LOS F with volume-to-capacity (v/c) ratios greater than 1.00.

This analysis assumes the same geometry identified in the previous section describing the 2021 Base Year operations. With no change in geometry but increases in traffic volume demand, higher v/c ratios and continued LOS F operation would be expected under this scenario. The existing two-lane geometry between Interchange 14 and Interchange 14A will not accommodate Design Year 2050 traffic demands while maintaining acceptable levels of service on the Newark Bay Bridge crossing.

9.1.5 **2050 Design Year (Build) Lane Needs Assessment**

9.1.5.1. Summary of Initially Preferred Alternative **(IPA)** Geometry

The NB-HCE Initially Preferred Alternative (IPA) consists of the following proposed modifications to the existing link geometry between Interchange 14 and Interchange 14A.

The IPA will increase the number of NB-HCE lanes from two to four in each direction. The design speed on the NB-HCE will also increase from 55 mph to 60 mph, per the Preliminary Design Report. On the eastbound NB-HCE, two Ramp TH lanes (from the Interchange 14 Toll Plaza), would join with a single-lane Ramp NH to form the initial three-lane portion of the NB-HCE eastbound roadway. Downstream, a two-lane Ramp SH would join to form a short five-lane section before one lane drops to result in the four-lane NB-HCE eastbound configuration over Newark Bay. At Interchange 14A, two lanes would depart to Ramp WT, as the right lane of the approaching roadway opens to the two-lane exit, while three NB-HCE lanes continue through the interchange. The westbound roadway will consist of three NB-HCE lanes coming through Interchange 14A and one Interchange 14A entrance lane (Ramp TW), which results from the merge of the two ramp lanes departing the toll plaza. The four-lane section crosses Newark Bay before splitting into a one-lane combined ramp for Ramp HN (to Turnpike northbound) and Ramp HLT (to toll plaza) traffic, a one-lane loop ramp for Ramp HS (to Turnpike southbound) traffic, and a two-lane Ramp HXT for traffic accessing the Interchange 14 toll plaza.

9.1.5.2. IPA Lane Assessment

Table 9-3 summarizes the forecasted freeway performance (volume, density, volume-to-capacity ratio, and level of service) on the NB-HCE under the Design Year (Build) demand volumes derived in Section 7 and shown in Appendix A. This scenario reflects design year forecasted traffic volume demand using the geometric configurations of the IPA, including the proposed increase in design speed described in Section 9.1.5.1. As with the previous analysis tables, traffic volumes in the table are expressed in vph, and density is expressed as pcpmpl.

Table 9-3 – 2050 Design Year (Build) NB-HCE Demand, Density, V/C and LOS for Weekday Peak Hours (IPA Geometry) – Interchange 14 to Interchange 14A

Direction	Roadway Link (# Lanes)	Weekday AM Peak Hour				Weekday PM Peak Hour			
		Demand	Density	V/C	LOS	Demand	Density	V/C	LOS
Eastbound	Int. 14 – Int. 14A (4)	5,986	34.2	0.86	D	5,088	26.4	0.70	D
Westbound	Int. 14A – Int. 14 (4)	4,806	26.2	0.69	D	4,713	24.5	0.65	C

As seen in the table, each of the roadway links shown would operate at acceptable levels of service (D or better) in both the weekday AM and weekday PM peak hours. The lane configurations and proposed geometries improve operations between Interchange 14 and Interchange 14B from unacceptable levels of service under 2050 Design Year (No-Build) traffic conditions to acceptable LOS under the 2050 Design Year (Build).

9.1.6 Other NB-HCE Roadway Alternatives

9.1.6.1. Six-Lane Newark Bay Bridge Section.

An alternative studied for the Newark Bay Bridge cross-section provides three lanes in each direction between Interchange 14 and Interchange 14A. Because of the difference in proposed capacity enhancement from the IPA, the NJRTM-E regional model was used to develop the demand profile under Design Year 2050 traffic loads for this geometry. The forecast demands shown in Table 9-4 are less than that for the eight-lane section in the IPA, since the lesser increase in capacity on the Newark Bay Bridge would not encourage as much traffic to change route choice. The table summarizes the forecast demand, density, volume-to-capacity, and level of service for each direction during each weekday peak hour.

Table 9-4 – 2050 Design Year (Build) NB-HCE Demands, Density, V/C and LOS for Weekday Peak Hours – Three Lanes and Shoulders Each Direction

Direction	Roadway Link (# Lanes)	Weekday AM Peak Hour				Weekday PM Peak Hour			
		Demand	Density	V/C	LOS	Demand	Density	V/C	LOS
Eastbound	Int. 14 – Int. 14A (3)	5,222	*	1.00	F	4,439	31.5	0.81	D
Westbound	Int. 14A – Int. 14 (3)	4,192	31.0	0.80	D	4,113	28.7	0.75	D

* Density is not calculated when v/c exceeds 1.00.

As shown in the table, the eastbound NB-HCE would operate at LOS F with a volume-to-capacity ratio at 1.00 during the weekday AM peak hour, despite the lower forecasted vehicular demand. The weekday AM peak period westbound and both directions during the weekday PM peak hour would operate at LOS D.

The LOS F operation projected on the eastbound roadway under this geometry does not meet the purpose of this project, which is to "improve mobility between Interchanges 14 and 14A by attaining level-of-service (LOS) D or better traffic flow quality." This geometry was, therefore, eliminated from further consideration.

9.1.6.2. Rehabilitate Existing Bridge and Implement Operational Improvements.

Rehabilitation of the existing Newark Bay Bridge structure without widening would restrict operational improvements to the existing bridge footprint. The existing 76-foot deck width currently consists of two 12-foot lanes and one 12-foot outside shoulder in each direction. A four-foot median carries the median barrier with a minimal shoulder separating it from the left lane in each direction.

9.1.6.2.1. Peak Period Shoulder Use.

One operational improvement within the existing deck width could consist of part-time use of the outside shoulders as travel lanes, which would result in a peak period six-lane operation on the bridge. Outside the weekday peak periods, two lanes in each direction with outer shoulder would be in operation. For this case, the travel lanes would be narrowed to 11 feet to accommodate the three lanes in each direction with some buffer width (one to three feet) adjacent to the median barrier and outer parapet. This is less than the standard 12-foot lane width for Turnpike roadways. To assess the level of service of this geometric configuration, the forecast traffic demands derived above under the full-time six-lane cross-section alternative were tested on the narrowed geometry of this alternative. Table 9-5 summarizes the forecast demand, density, volume-to-capacity, and level of service for each direction during each weekday peak hour.

Table 9-5 – 2050 Design Year (Build) NB-HCE Demands, Density, V/C and LOS for Weekday Peak Hours – Peak Period Shoulder Use in Existing Footprint

Direction	Roadway Link (# Lanes)	Weekday AM Peak Hour				Weekday PM Peak Hour			
		Demand	Density	V/C	LOS	Demand	Density	V/C	LOS
Eastbound	Int. 14 – Int. 14A (3)	5,222	*	1.04	F	4,439	35.6	0.84	E
Westbound	Int. 14A – Int. 14 (3)	4,192	32.2	0.82	D	4,113	33.0	0.78	D

* Density is not calculated when v/c exceeds 1.00.

Conservatively, the analysis assumed 11-foot travel lanes and three-foot outer shoulders and incorporated the upgrade segment in each direction. As expected, densities and volume-to-capacity ratios would increase under this scenario because of the narrower lanes and shoulders. Eastbound level of service would deteriorate to LOS E during the weekday PM peak hour.

In addition to the level of service deficiencies, peak period shoulder operation would eliminate breakdown lanes for disabled vehicles and require the positioning of wrecker service on either side of the bridge to minimize the response time to an incident. The quality of operation would quickly deteriorate with a crash or disabled vehicle because of occupation of at least one travel lane with no lateral room to maneuver. This reduction in capacity may be lengthy because of the total length of the structure. Crash rates would likely rise because of the narrower cross-section and would be further exacerbated by the large proportion of heavy vehicles on this roadway link.

The narrower travel way would also ineffectively serve the heavy truck and bus demand on this roadway link, especially entering and exiting the port facilities at Interchange 14A.

Rehabilitation of the existing structure without widening it would not meet the stated purpose of safely and efficiently accommodating growing vehicular demand into the foreseeable future, with or without peak period shoulder use. As noted by the LOS assessment in Table 9-5, the rehabilitated structure, even with the part-time shoulder use, would not reduce congestion crossing the Newark Bay.

9.1.6.2.2. Reversible Lanes.

Another potential operational improvement within the existing bridge deck footprint is the use of reversible lanes, which, in concert with shoulder use, would increase capacity in the peak direction during weekday peak periods. For this case, the existing 76-foot deck width would carry four lanes in the peak direction and two lanes in the off-peak direction. During the weekday AM peak hour, eastbound is the peak direction and would carry four lanes, while westbound would carry four lanes during the weekday PM peak hour. A movable barrier system would shift the median during off-peak hours (midday or overnight hours). As with the six-lane section with peak period shoulder use, little to no outside shoulder width would be available for disabled vehicles and incident response. During the non-peak hours, the existing four-lane configuration with shoulders would continue to operate. A reversible lane operation works most effectively when there is a high degree of directionality in peak period traffic volumes or demands. If the six-lane Newark Bay Bridge were to be converted to a 4-lane peak direction/2-lane off-peak direction cross section, capacity is divided such that 67% of total capacity is provided in the peak direction and 33% provided in the off-peak direction. Using the traffic demands shown in Table 9-4, for example, the forecast directionality of traffic demand between Interchange 14 and Interchange 14A is as noted below.

- Weekday AM peak hour: 55.5% eastbound
- Weekday PM peak hour: 51.9% eastbound

The peak hour directionality is not as high as the distribution of capacity, which would likely constrain the operation in the off-peak direction. For reference, the level of service results under the six-lane configurations previously studied, shown in Table 9-4 and Table 9-5, reflect LOS D or worse for three-lane configurations in the off-peak direction. Under this logic, the off-peak hour traffic demands of 4,192 vehicles per hour (vph) westbound during the weekday AM peak hour and 4,439 vph eastbound during the weekday PM peak hour, would not be accommodated with acceptable operation by a restricted two-lane section that reduces off-peak capacity by 33%. Table 9-6 summarizes the analysis results.

Table 9-6 – 2050 Design Year (Build) NB-HCE Demands, Density, V/C and LOS for Weekday Peak Hours – Reversible Lane Configuration (Four in Peak Direction)

Direction	Roadway Link (# Lanes)	Weekday AM Peak Hour				Weekday PM Peak Hour			
		Demand	Density	V/C	LOS	Demand	Density	V/C	LOS
Eastbound	Int. 14 – Int. 14A (4/2)**	5,222	32.9	0.78	D	4,439	*	1.24	F
Westbound	Int. 14A – Int. 14 (2/4)**	4,192	*	1.27	F	4,113	24.7	0.59	C

* Density is not calculated when v/c exceeds 1.00.
** (X/Y) - Number of lanes in AM/PM peak period.

The analysis in this case assumed 12-foot lanes and no shoulders. Individual lane widths would vary to accommodate the placement of the movable barrier. The analysis results support the suggested outcome postulated above the table.

In addition to the unacceptable levels of service, the reversible configuration appears to be difficult logistically to implement, especially at the interchanges on either side. While the interchange tie-ins were not explored in detail, ramp merges to the off-peak direction geometry may have little to no distance available for acceleration and deceleration. The different entrance ramp configurations – no acceleration distance in the peak hour off-peak direction; lane additions in the peak direction; and merge during non-peak hours – occurring in the same weekday may cause motorist confusion, potentially violating driver expectation.

Based on the forecast level of service shown above this alternative would not meet the stated purpose of safely and efficiently accommodating growing vehicular demand into the foreseeable future, because of peak period shoulder use. As noted by the LOS assessment in Table 9-6, the rehabilitated structure, under reversible lane operation, would not reduce congestion crossing the Newark Bay, especially in the off-peak direction.

9.1.6.3. High-Occupancy Vehicle Lane Facility Assessment

Providing high-occupancy vehicle (HOV) lanes was considered for the NB-HCE corridor. An HOV lane would be reserved for use by buses and passenger vehicles such as autos, SUVs or vans carrying two or more occupants. The remaining NB-HCE lanes would be general purpose travel lanes available for all vehicles.

To assess the viability of HOV lanes in this corridor, peak period percentages of HOV-eligible traffic were extracted from the NJRTM-E and applied to Design Year 2050 (Build) traffic demand. Table 9-7 summarizes the total traffic demand and HOV-eligible traffic demand classifications between Interchange 14 and Interchange 14A. Bus figures shown in the table are taken from Table 7- and are considered HOV-eligible. As shown in the table, forecasted HOV-eligible traffic demand reaches a maximum total of 988 vehicles per hour (vph) eastbound during the weekday PM peak hour, made up of 956 multi-passenger vehicles and 32 buses.

Table 9-7 – Design Year 2050 (Build) NB-HCE Demand, By HOV-Eligible Vehicle Category Interchange 14 to Interchange 14A

Direction	Roadway Link	Total Demand	HOV Demand	Bus Demand	Percent HOV
Weekday AM Peak Hour					
Eastbound	Int. 14 – Int. 14A	5,986	740	42	13.1%
Westbound	Int. 14A – Int. 14	4,806	590	29	12.9%
Weekday PM Peak Hour					
Eastbound	Int. 14 – Int. 14A	5,088	956	32	19.4%
Westbound	Int. 14A – Int. 14	4,713	710	39	15.9%

Providing for HOV lanes on the NB-HCE corridor could take one of two forms:

9.1.6.3.1. Continuous Access HOV Lane.

This configuration would dedicate one or more lanes of the continuous multi-lane NB-HCE geometry to bus and HOV-eligible traffic either full time or during certain peak periods. HOV lanes would be identified with appropriate signs and pavement markings and separated from general purpose lanes by lane striping. Eligible vehicle motorists would be able to change lanes to enter or exit the HOV lanes at any point along the corridor length based on where they enter or exit the NB-HCE. This would operate similarly to the existing HOV lanes on the mainline Turnpike outer roadways between Interchange 11 and Interchange 14. As there, the NB-HCE HOV lane(s) would be the left lane(s) of the overall roadway.

The capacity of an HOV lane having continuous access is about 1,600 passenger cars per hour (pcph), based on Equation 12-14 and Exhibit 12-30 of the Highway Capacity Manual, 6th Edition, assuming a 60-mph design speed. Based on the maximum HOV-eligible traffic demands shown in Table 9-7 (988 vph), and assuming all this traffic would use it, the HOV lane traffic would make up about 65% of one lane's capacity. Lane shifting between interchange ramps (both entrance and exit ramps) and a left-lane HOV facility would reduce the distance in which the full complement of HOV-eligible traffic would effectively use the lane. Origin-destination patterns, especially between Interchange 14 and Interchange 14A, may also reduce the traffic demand for the HOV lane. Therefore, if HOV lane implementation is warranted, only one HOV lane per direction would be needed on the NB-HCE.

A summary of the forecast level of service for the resulting three-lane General Purpose (GP) Lane facility is summarized in Table 9-8 below.

Table 9-8 – 2050 Design Year (Build) NB-HCE Demands, Density, V/C and LOS for Weekday Peak Hours – General Purpose Lanes (Three in Peak Direction)

Direction	Roadway Link (# Lanes)	Weekday AM Peak Hour				Weekday PM Peak Hour			
		Demand	Density	V/C	LOS	Demand	Density	V/C	LOS
Eastbound	Int. 14 – Int. 14A (3 GP)	5,204	*	1.01	F	4,100	0.81	31.3	D
Westbound	Int. 14A – Int. 14 (3 GP)	4,187	0.74	28.3	D	3,964	0.73	27.7	D

* Density is not calculated when v/c exceeds 1.00.

It should be noted that this analysis is a best-case scenario, since it assumes that all HOV-eligible traffic would use the HOV lane along this crossing. For reasons identified above, this would be an unlikely outcome, with traffic demand magnitudes within the GP lanes higher than that shown in the table. As shown in the table, LOS F is predicted for the eastbound NB-HCE GP lane facility during the weekday AM peak hour. While the other direction/peak hour combinations yield LOS D, GP lane traffic increases based on the factors cited above may cause LOS to deteriorate to E or worse.

9.1.6.3.2. Separated HOV Lane Travelway.

This concept would consist of one or more dedicated lanes for bus and HOV-eligible vehicles along the length of the NB-HCE that are physically separated by barrier from the remaining general purpose lanes. To meet standards, the HOV travelway would have to be designed with shoulders, resulting in a wide cross section requirement. Access to an eastbound barrier-separated HOV lane would be available only at the west end of the corridor (just east of Interchange 14 ramps), while access to a westbound separated HOV lane would only be available at the eastern end of the corridor (just west of Jersey Avenue). If provided, access to and from intermediate interchanges would have to be introduced utilizing grade-separated ramps between the HOV travelway and the interchanges.

A hybrid facility, such as the Long Island Expressway (LIE) HOV facility, would provide physical separation between general purpose and HOV lane traffic via a striped buffer. Access to the HOV lane would be provided periodically along the corridor. On the LIE, entrances are provided about every 4 to 5 miles over the 40-mile length of the facility. Given that the length of the NB-HCE is only 8 miles, one access point at most would be practical. The effectiveness of this hybrid facility would likely be minimal because of the weaving required to reach the intermediate access point.

The capacity of a barrier-separated HOV lane is similar to that of a continuous access lane. Providing no direct access to and from the interchanges, however, would limit the utilization of the HOV facility only to through traffic traveling the full length of the NB-HCE. While providing direct ramp access at each interchange could increase the use of the HOV lane, new bridges would be required to separate entering and exiting HOV traffic from the general purpose lane traffic flows, significantly expanding the project footprint beyond the proposed alignment limits/geometry considered earlier in this section. This configuration was, therefore, not considered further.

9.1.6.3.3. Conclusion.

This HOV lane assessment has determined that there is no substantial benefit to HOV lanes being provided along the NB-HCE corridor based on the Design Year traffic projections, the population of HOV-eligible traffic, and the anticipated operation of the HOV lanes or the three (3) general purpose lanes. Any benefit would be offset by a larger geometric footprint to add HOV lanes in addition to the general purpose lanes required to maintain Level of Service D.

It is also important to note that the Port Authority of New York and New Jersey's Trans-Hudson Commuting Capacity Study (September, 2016) suggested rerouting some commuter bus routes to the Holland Tunnel to ease traffic congestion at the Lincoln Tunnel and the Port Authority Bus Terminal. The report estimated a potential for 30 peak-hour bus trips to divert to a Holland Tunnel route to access Manhattan. This small increase in HOV use, if these buses were routed over the Newark Bay Bridge, would not change the conclusion of the foregoing assessment.

Should opportunities for HOV trips to/from Manhattan or Jersey City materialize in the future due to increases in commuter behavior and HOV demand, such that the demand for general purpose lane use correspondingly decreases, the NJTA could reevaluate the potential of converting a general purpose lane to HOV use.

9.1.6.3.4. Other Managed Lane Configurations.

Other managed lane configurations that can be considered include hard shoulder running for buses, managed lanes such as high-occupancy toll (HOT) lanes, or a separated truck roadway. Hard shoulder running for buses would eliminate the availability of the shoulders for breakdowns and create potential safety concerns for the benefit of only a small number of vehicles (less than 2% of the total). The higher crash trends during eastbound NB-HCE shoulder use while the northbound Pulaski Skyway was closed bears this out. Separating this traffic from the general purpose lanes does not affect the number of lanes required for the remaining traffic during the eligible periods.

HOT Lanes have similar geometric concerns to separated HOV lane travelways – separate ramps to and from interchanges, larger overall footprint -- while potentially assessing an additional toll on top of the tolls already assessed west of Interchange 14C. As with the separated HOV lane travelway, HOT Lanes do not appear to be a viable strategy for the NB-HCE.

Separated Truck Lanes also have similar geometric concerns to separated HOV lane travelways and also would not attract enough traffic to reduce the number of lanes for the remaining traffic, as a maximum of 563 trucks of all types are forecast to cross Newark Bay during the weekday peak hours under Design Year 2050 (Build) traffic demands.

9.1.7 NB-HCE Roadway Lane Needs Assessment Findings

Under 2021 Base Year and 2050 Design Year (No-Build) weekday peak hour traffic volumes, both of which use the existing lane and geometric configurations, eastbound NB-HCE roadway links between Interchange 14 and Interchange 14A exhibit level of service (LOS) E or F operations during at least one of the weekday peak hours. Westbound also exhibits LOS E or F during both weekday peak hours. These operations are unacceptable based on the Authority's traffic operations objectives for the proposed Program. The existing two-lane geometry in each direction does not serve current (Base Year) traffic volumes at acceptable levels of service; increased traffic demands in the Design Year (2050) would also not be served by the existing geometry at acceptable levels of service. The improvements proposed in the IPA, accompanied by the proposed increase in design speed to 60 mph, result in levels of service that improve to acceptable levels (D or better), such that the proposed four-lane geometry in each direction would serve Design Year Build traffic demands under acceptable levels of service. This geometry will meet the Program's objectives to improve the long-term integrity of the structures between Interchange 14 and Interchange 14A (new four-lane structures) and improve mobility by providing level of service D or better traffic flow quality on the widened roadways.

Other Newark Bay Bridge crossing alternatives were tested against forecast traffic demand. A new six-lane bridge with full shoulders would not accommodate eastbound forecast demand during the weekday AM peak hour at level of service D or better operation. Rehabilitation of the existing bridge and implementing peak period shoulder use to provide three lanes in each direction would produce a deterioration in density and level of service with potentially narrowed lanes and little to no shoulder width. A reversible-lane operation on a rehabilitated bridge would acceptably accommodate traffic demand in the peak direction during each weekday peak hour but at the expense of LOS F operation and volume-to-capacity ratios over 1.00 in the off-peak direction. Each of the operational improvements on the rehabilitated bridge would result in the loss of the right shoulders for vehicle breakdowns or incident mitigation. None of these other alternatives would meet the Program's objectives to improve the long-term integrity of the structures between Interchange 14 and Interchange 14A (new four-lane structures) or improve mobility by providing level of service D or better traffic flow quality on the widened roadways.

9.2 NB-HCE RAMP LANE ASSESSMENT

9.2.1 Background

This section addresses NB-HCE ramp roadway lane needs at Interchange 14 and Interchange 14A and assesses the ramp lane configurations. Following is a description of the existing ramp lane configurations assessed in this section.

9.2.2 Summary of Existing Ramp Geometry

The existing ramps within the project area are generally either one or two lanes in width and provide connections between the NB-HCE and an interchange toll plaza. Several of the ramps in the Interchange 14 area connect the NB-HCE with the north-south Turnpike mainline (I-95). Listed below are the ramp roadways at Interchange 14 and Interchange 14A specifically assessed in this section.

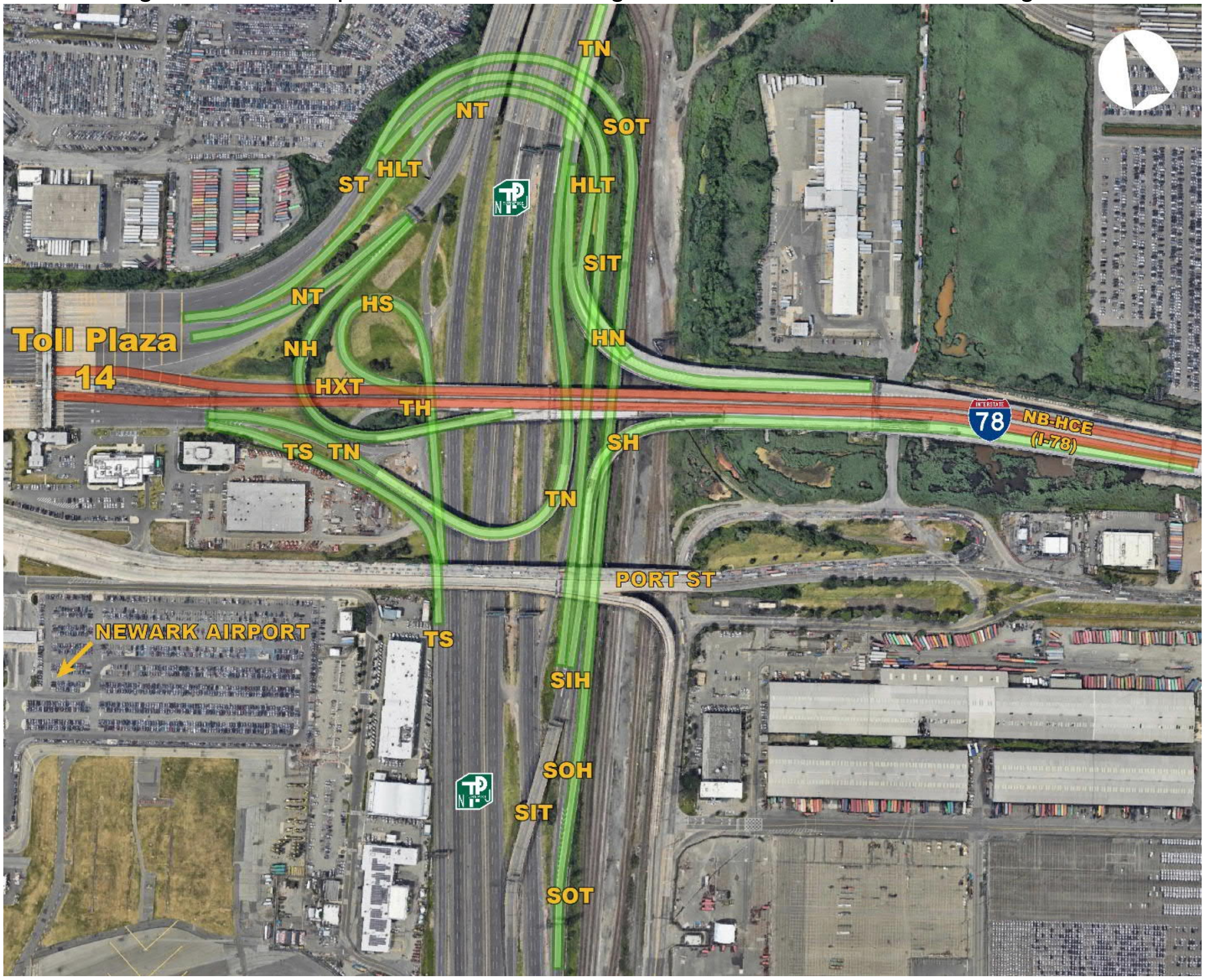
9.2.2.1. Interchange 14

Ten (10) ramps provide connections to or from the NB-HCE.

- Ramp TS - This single-lane ramp carries eastbound traffic from the Interchange 14 toll plaza to the Turnpike (I-95) southbound.
- Ramp TN - This two-lane ramp carries eastbound traffic from the Interchange 14 toll plaza to the Turnpike (I-95) northbound.
- Ramp NH - This single-lane ramp carries Turnpike (I-95) southbound traffic to the eastbound NB-HCE.
- Ramp SH - This two-lane ramp is formed from two single-lane ramps (Ramp SOH and Ramp SIH) from the Turnpike mainline northbound inner and outer roadways to the eastbound NB-HCE.
- Ramp HN - This single-lane ramp, which exits the westbound NB-HCE with Ramp HLT, carries traffic to the Turnpike (I-95) northbound, joining Ramp TN.
- Ramp HLT - Single-lane ramp connecting the NB-HCE westbound to the northern portion of the Interchange 14 toll plaza, which provides more direct access to US Route 1&9, US Route 22, NJ Route 21, and Newark Airport.
- Ramp HS - This single-lane loop ramp provides access from the westbound NB-HCE to the southbound Turnpike (I-95).
- Ramp SIT – This single-lane ramp connects the Turnpike (I-95) northbound inner roadway to the Interchange 14 toll plaza.
- Ramp SOT - This single-lane ramp connects the Turnpike (I-95) northbound outer roadway to the Interchange 14 toll plaza.
- Ramp NT - The two-lane ramp carries traffic from the Turnpike southbound to the Interchange 14 toll plaza.

Figure 9-1 shows the ramp locations and designations at Turnpike Interchange 14.

Figure 9-1 - Ramp Locations and Designations at Turnpike Interchange 14



9.2.2.2. Interchange 14A

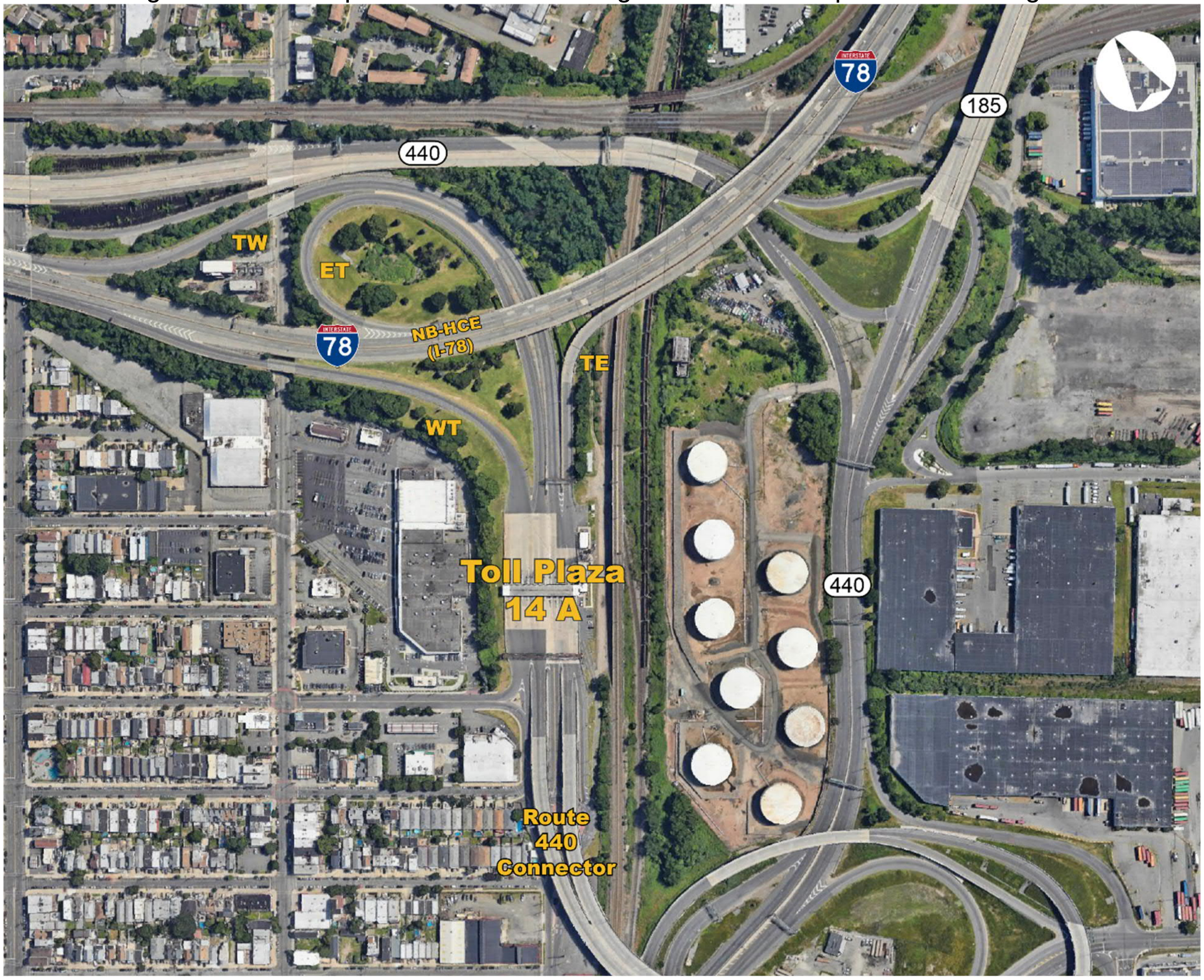
Four (4) ramps connect the NB-HCE with the Interchange 14A toll plaza in Bayonne.

- Ramp WT - This single-lane ramp exits the eastbound NB-HCE toward the Interchange 14A toll plaza.
- Ramp TE - The single-lane ramp carries traffic from the Interchange 14A toll plaza to the eastbound NB-HCE.
- Ramp ET - This single-lane loop ramp exits the westbound NB-HCE toward the Interchange 14A toll plaza.

- Ramp TW - This ramp carries two lanes of traffic from the Interchange 14A toll plaza to the NB-HCE westbound but drops to a single lane prior to merging with the NB-HCE westbound roadway.

Figure 9-2 shows the ramp locations and designations at Turnpike Interchange 14A.

Figure 9-2 - Ramp Locations and Designations at Turnpike Interchange 14A



9.2.3 2021 Base Year and 2050 Design Year (No-Build) Ramp Roadway Lane Assessment

Table 9-9 summarizes the ramp roadways assessed and the existing number of lanes. Weekday peak hour traffic volumes under the 2021 Base Year volume and 2050 Design Year (No-Build) demand scenarios are also shown in the table. The existing and forecast traffic, accounting for the vehicle composition of trucks and buses, was assessed against service flow rates at level of service D, estimated as noted in Section 8.2.2, to determine whether the existing lane configurations are sufficient for the existing or forecast traffic loads. Ramp free flow speeds were estimated as 5 mph greater than the posted ramp advisory speeds to determine maximum service flow rates from Table 8-2.

Table 9-9 - Traffic Volumes/Demands and Lanes for Existing NB-HCE Ramps Interchange 14 and Interchange 14A

Direction	Ramp	Existing Lanes	2021 Base Year Volume		Lanes at LOS D (Base)	2050 Design Year (No-Build) Demand		Lanes at LOS D (NB)
			AM	PM		AM	PM	
Eastbound	Interchange 14 Ramps							
	Ramp TS	1	727	1,096	1	854	1,141	1
	Ramp TN	2	2,738	2,174	2	2,842	2,263	3
	Ramp NH	1	655	673	1	710	729	1
	Ramp SH	2	1,848	1,367	2	2,001	1,480	2
	Interchange 14A Ramps							
	Ramp WT	1	1,696	1,555	2	1,837	1,684	2
	Ramp TE	1	870	527	1	942	571	1
Westbound	Interchange 14A Ramps							
	Ramp ET	1	369	678	1	400	735	1
	Ramp TW	2-1	1,989	1,398	2	2,154	1,514	2
	Interchange 14 Ramps							
	Ramp HN	1	739	605	1	801	655	1
	Ramp HLT	1	229	190	1	248	205	1
	Ramp HS	1	1,027	1,492	2	1,112	1,616	2
	Ramp SIT	1	393	526	1	354	636	1
	Ramp SOT	1	563	720	1	503	867	1
	Ramp NT	2	2,561	2,631	2	2,696	2,703	2

The Base Year figures shown in red and underlined in the table indicate the ramps that currently warrant more lanes than are provided for a LOS D operation, which include Ramp WT and Ramp TW at Interchange 14A and Ramp HS at Interchange 14. The Ramp TW finding indicates that a continuous two-lane ramp geometry is warranted through the merge area with the NB-HCE westbound.

The No-Build results, indicative of increased traffic volume demand with no change in ramp geometry, include one additional ramp location, Interchange 14 Ramp TN that would warrant an additional lane to maintain level of service D operation.

Lane assessments that do not change from the existing lanes provided will operate at level of service D or better for the existing ramp geometries under No-Build volume conditions.

9.2.4 Summary of Modifications for Proposed Ramp Geometry

The NB-HCE IPA consists of the following proposed modifications to the existing ramp configurations. The descriptions below focus on changes in number of lanes or access points.

9.2.4.1. Interchange 14

While many of the ramps are proposed to be realigned to accommodate the realigned NB-HCE, no changes are proposed to the number of lanes or access points of the ramps.

9.2.4.2. Interchange 14A

Two (2) ramps at this interchange are to be modified under the Initially Recommended Alternative.

- Ramp WT - This ramp is proposed to be widened to a continuous two-lane configuration between the diverge from the eastbound NB-HCE and the Interchange 14A toll plaza.
- Ramp TW - The two-lane ramp section is to be extended prior to the right lane dropping into the rightmost lane of the proposed four-lane NB-HCE westbound, so Ramp TW traffic will not be forced to merge into the NB-HCE westbound traffic stream.

9.2.5 Proposed Ramp Lane Assessment

Table 9-10 summarizes the ramp roadways assessed and the proposed number of lanes. The number of lanes shown in the table are the proposed lanes under the IPA. Forecasted traffic demand for the Design Year 2050 (Build) scenario is also included in the table. The forecast traffic, accounting for the vehicle composition of trucks and buses, was assessed against service flow rates at level of service D, estimated as noted in Section 8.2.2, to determine whether the proposed lane configurations are sufficient for the forecast Design Year 2050 (Build) traffic loads.

Proposed ramp design speeds were used to determine the maximum flow rate to use in Table 8-2.

Table 9-10 – Traffic Demand and Lanes for Proposed NB-HCE Ramps
Interchange 14 and Interchange 14A

Direction	Ramp	Proposed Lanes	2050 Design Year (Build) Demand		Lanes at LOS D (Build)
			AM	PM	
Eastbound	Interchange 14 Ramps				
	Ramp TS	1	865	690	1
	Ramp TN	2	2,761	2,361	2
	Ramp NH	1	865	889	1
	Ramp SH	2	2,440	1,805	2
	Interchange 14A Ramps				
	Ramp WT	2	2,240	2,053	2
	Ramp TE	1	1,149	696	1
Westbound	Interchange 14A Ramps				
	Ramp ET	1	487	896	1
	Ramp TW	2	2,626	1,846	2
	Interchange 14 Ramps				
	Ramp HN	1	976	799	1
	Ramp HLT	1	303	250	1
	Ramp HS	1	1,356	1,971	2
	Ramp SIT	1	340	559	1
	Ramp SOT	1	500	762	1
	Ramp NT	2	2,968	3,196	2

The Design Year figures shown in red and underlined in the table indicate the ramps that would warrant more lanes than are proposed for a LOS D operation, which includes only one ramp: Interchange 14 Ramp HS.

Lane assessments that do not change from the number of lanes proposed will operate at level of service D or better under forecast traffic loads under Build volume conditions.

For Ramp HS, the two-lane ramp geometry would form from a major split on the westbound NB-HCE (Ramp HXT at that location), with the three-lane approach roadway splitting to two lanes for the ramp and two lanes continuing toward the Interchange 14 toll plaza. The center lane would be an option lane permitting both movements. The two-lane ramp geometry would continue through the loop, with the right lane ending on the tangent section of the ramp prior to the junction with Ramp TS. This geometry is reflected in the Preliminary Design Plans for the project.

9.2.6 Interchange Ramp Lane Needs Assessment Findings

The assessment of NB-HCE ramp lane needs yielded three existing ramp geometries that do not accommodate the existing traffic volumes at level of service D or better. Forecast No-Build demand, generally at increased levels over Base Year volumes, would also not be accommodated at LOS D or better for the same locations – another location, Interchange 14 Ramp TN, is added under the forecast traffic demand. Design Year 2050 (Build) findings are generally consistent with the number of ramp lanes presented in the IPA. One ramp, Ramp HS at Interchange 14, will warrant two lanes based on forecast traffic demands. Interchange 14 Ramp TN traffic demand decreases under the Build forecast, such that the existing two lanes will be sufficient for LOS D operation on this ramp.

9.3 TRAFFIC ASSESSMENT FINDINGS

Weekday peak hour traffic volume and demand profiles developed in Section 7 were tested against the existing geometry for the NB-HCE for Base Year 2021 and Design Year 2050 (No-Build) scenarios. The Initially Preferred Alternative (IPA) developed in the previous NB-HCE study efforts provided the geometry against which to test the Design Year 2050 (Build) scenario. NB-HCE level of service analysis showed unacceptable LOS (E or F) during at least one of the weekday peak hours in both directions between Interchange 14 and Interchange 14A for both the Base Year 2021 and Design Year 2050 (No-Build) volume scenarios. The proposed four-lane geometry (each direction) between the two interchanges was determined to be sufficient for acceptable level of service (D or better) under Design Year (Build) traffic demands.

Other Newark Bay Bridge crossing alternatives were tested against forecast traffic demand. A new six-lane bridge with full shoulders would not accommodate eastbound forecast demand during the weekday AM peak hour at level of service D or better operation. Rehabilitation of the existing bridge and implementing peak period shoulder use to provide three lanes in each direction would produce a deterioration in density and level of service with narrowed lanes and little to no shoulder width. A reversible-lane operation on a rehabilitated bridge would acceptably accommodate traffic demand in the peak direction during each weekday peak hour but at the expense of LOS F operation and volume-to-capacity ratios over 1.00 in the off-peak direction. Each of the operational improvements on the rehabilitated bridge would result in the loss of the right shoulders for vehicle breakdowns or incident mitigation. None of these other alternatives would meet the Program’s objectives to improve the long-term integrity of the structures between Interchange 14 and Interchange 14A (new four-lane structures) or improve mobility by providing level of service D or better traffic flow quality on the widened roadways.

Ramp lanes were also tested against the projected ramp traffic demands. The ramp lanes proposed by the IPA were found to be consistent with the traffic demands except in one instance within the project limits. Ramp HS, linking the NB-HCE westbound to the mainline

Turnpike southbound, warrants two lanes if future traffic demands are realized. This two-lane geometry has been incorporated into the Preliminary Design plans.

It should be noted that operation and level of service of roadways and ramps are controlled by the terminal facilities, such as intersections, ramp merges and ramp diverges. This section provided static analysis to determine the number of lanes required on roadway and ramp links to accommodate Base Year and Design Year traffic demand. Section 10 documents more detailed analysis of the operation of critical link terminal facilities. Four such locations on the NB-HCE within the project limits were analyzed.

10. INTERCHANGE ALTERNATIVES ANALYSIS

10.1 INTRODUCTION

This section summarizes operational and supporting analyses performed on various interchange geometric configurations to assess measures of effectiveness and level of service for Base Year and Design Year traffic volumes and demands and confirm or modify the geometry proposed in the IPA for Design Year Build volume demands. In some cases, multiple alternatives were evaluated to identify benefits and deficiencies to different geometric configurations. Analysis was performed in the following areas.

- Interchange 14: Ramp TH/Ramp SH/Ramp NH Junction
- Interchange 14: Ramp HS/Ramp HXT Split
- Interchange 14A: Toll Plaza
- Interchange 14A: HWE Roadway/Ramp WT Split
- Interchange 14A: Ramp TW/HEW Roadway Merge
- Interchange 14A: JFK Blvd./Route 440 Connector Ramp

The next sections outline the analysis, summarize the results, and draw conclusions regarding the recommended alternative.

10.2 INTERCHANGE 14 ANALYSIS

10.2.1 Eastbound Ramp Junction Alternatives **(Ramp TH/Ramp SH/Ramp NH)**

The existing junction of Ramp NH, Ramp SH and Ramp TH consists of a merge of three ramp lanes (two on Ramp SH, one on Ramp NH) with the two-lane Ramp TH entering the NB-HCE from the Interchange 14 toll plaza. This merge of the five total lanes of ramps to the two-lane NB-HCE eastbound roadway Newark Viaduct occurs within an approximate 2,200-foot distance. Figure 10-1 illustrates the existing geometry.

Since the distance from the ramp SH merge to the Ramp WT exit ramp at Interchange 14A is approximately 2.75 miles, the NB-HCE roadway between the interchanges does not meet the definition of a weaving section. Lane changing consistent with weaving maneuvers still occurs, but the distance over which they occur minimizes impacts over that of lane changes in a basic freeway segment. The VISSIM model developed to analyze this area, therefore, focused only on the ramp junction area.

Figure 10-1 – Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)
Existing Geometry

10.2.1.1. Base Year 2021 Operation

Table 10-1 and Table 10-2 summarize the performance measures for Base Year 2021 traffic patterns. For ramps, there is not a formal reference to ramp roadway density level of service. The analysis discussion will reference equivalent levels of service as if the ramp roadway were a basic freeway segment, so that a basis for comparison can be established. Maximum queues are measured from the respective merge points.

Weekday AM peak hour operation (Table 10-1) shows Level of Service F operation through most of the ramp junction area. While Ramp NH operates at LOS C based on density, the queue shown is likely an extension of the queue length reported in the merge area. The NB-HCE roadway east of the ramp junctions operates at LOS F because traffic demand exceeds the maximum service rate for desired LOS D or better operation. Queues on Ramp TH approaching the ramp merge areas extend over 4,000 feet from the point the roadway narrows to the existing two-lane geometry, into and perhaps through the Interchange 14 toll plaza. The Ramp SH queue of 476 feet, which is a component of the overall NB-HCE eastbound queue, does not extend back to the junction of Ramp SIH and Ramp SOH, which carry NB-HCE-bound traffic from the Turnpike inner and outer roadways, respectively. This would, therefore, not impact the flow of traffic onto Ramp SIT and Ramp SOT, which bypass Ramp SIH and Ramp SOH en-route to the Interchange 14 toll plaza. Ramp NH queues over 400 feet from the ramp merge area but do not extend to the Ramp NT split.

Table 10-1 – Performance Measures – Base Year 2021 Weekday AM Peak Hour Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	347	87.8	5.6	2,030		F
Ramp TH	2	1,664	116.8	8.6	2,030	2,032(a)	F
Ramp NH Merge Area							
Ramp NH	1	1,968	21.0	31.2	655	411(a)	C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	370	94.8	8.9	2,685	406(b)	F
Ramp SH Merge Area							
Ramp SH	2	1,214	29.5	31.6	1,848	476(b)	D*
Ramp SIH	1	198	14.1	52.1	749		B*
Ramp SOH	1	1,447	23.5	46.7	1,099		C*
Ramp SIT	1	650	7.5	53.1	393		A*
Ramp SOT	1	1,559	10.1	54.5	563		A*
Ramp SIH/T	2	647	10.6	53.1	1,142		A*
Ramp SIH/T	1	1,307	23.6	48.0	1,142		C*
Ramp SOH/T	2	639	21.1	39.1	1,662	194(c)	C*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	4	1,085	124.0	8.7	4,533		F
NB-HCE EB	3	416	102.9	13.7	4,533	1,639(d)	F
NB-HCE EB	3	911	71.6	19.8	4,533		F
NB-HCE EB	2	1,628	45.7	46.7	4,533		F
NB-HCE EB	2	4,129	47.5	45.0	4,533		F

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from Ramp TH/Ramp NH merge point.
(b) Queue measured from Ramp TH/Ramp SH merge point.
(c) Queue measured from Ramp SOH/Ramp SOT split.
(d) Queue measured from the transition of NB-HCE EB to two-lane geometry.

Weekday PM peak hour operation (Table 10-2) shows Level of Service E or worse operation east of the Ramp SH merge area. The NB-HCE roadway east of the ramp junctions operates at LOS E because traffic demand exceeds the maximum service rate for desired LOS D or better operation. Minor queuing is reported on Ramp TH approaching the ramp merge areas and on Ramp SH entering the NB-HCE.

Table 10-2 – Performance Measures – Base Year 2021 Weekday PM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	348	13.8	26.6	1,812	33(a)	B
Ramp TH	2	1,664	35.2	26.0	1,812		E
Ramp NH Merge Area							
Ramp NH	1	1,967	20.5	32.9	673		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	370	24.1	34.4	2,485		C
Ramp SH Merge Area							
Ramp SH	2	1,214	21.8	31.2	1,367		C*
Ramp SIH	1	198	15.0	40.2	617		B*
Ramp SOH	1	1,446	18.1	41.5	750		C*
Ramp SIT	1	650	11.9	44.8	526		B*
Ramp SOT	1	1,559	16.4	42.7	720		B*
Ramp SIH/T	2	647	12.6	45.0	1,143		B*
Ramp SIH/T	1	1,307	26.4	43.0	1,143		D*
Ramp SOH/T	2	638	18.5	39.2	1,470	91(b)	C*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	4	1,084	22.2	43.5	3,852		C
NB-HCE EB	3	417	30.2	42.3	3,852	122(c)	D
NB-HCE EB	3	911	31.2	41.3	3,852		D
NB-HCE EB	2	1,629	44.4	43.6	3,852		E
NB-HCE EB	2	4,129	45.1	42.9	3,852		F

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from Ramp SOH/Ramp SOT split.
(c) Queue measured from the transition of NB-HCE EB to two-lane geometry.

10.2.1.2. **Design Year 2050 (No-Build) Operation**

Table 10-3 and Table 10-4 summarize the performance measures for the Design Year 2050 (No-Build) traffic patterns. No change was made to geometric features of the model links. Only traffic volume demands and heavy vehicle percentages were modified for this analysis.

Weekday AM peak hour operation (Table 10-3) on the existing geometry during the Design Year shows Level of Service F operation throughout the entire ramp junction area. Densities would increase while speeds would decrease with the additional traffic demand. Queue lengths increase as well. The NB-HCE roadway east of the ramp junctions would continue to operate at LOS F with the additional traffic demand. Queues on Ramp TH approaching the ramp merge areas will extend over 4,000 feet from the point the roadway narrows to the existing two-lane geometry, extending into and perhaps through the Interchange 14 toll plaza. Longer queues will occur on Ramp SH and Ramp NH. The longer Ramp SH queue will extend through the junction of Ramp SIH and Ramp SOH, which carry NB-HCE-bound traffic from the Turnpike inner and outer roadways, respectively, and onto the common ramps from the inner and outer roadways. This would, therefore, impact the flow of traffic onto Ramp SIT and Ramp SOT, which bypass Ramp SIH and Ramp SOH en-route to the Interchange 14 toll plaza. The Ramp NH queue, while longer, will not extend past the split from Ramp NT and impact the operation of Ramp NT approaching the split.

Table 10-3 – Performance Measures – Design Year 2050 (No-Build) Weekday AM Peak Hour Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	348	186.8	2.0	2,198		F
Ramp TH	2	1,665	157.4	5.8	2,198	2,031(a)	F
Ramp NH Merge Area							
Ramp NH	1	1,967	33.2	23.7	710	1,507(a)	D*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	370	116.2	7.2	2,198	406(b)	F
Ramp SH Merge Area							
Ramp SH	2	1,214	174.3	4.8	2,001	1,247(b)	F*
Ramp SIH	1	198	126.2	6.7	811	237(c)	F*
Ramp SOH	1	1,447	148.7	6.1	1,190	1,483(c)	F*
Ramp SIT	1	650	7.4	49.3	354		A*
Ramp SOT	1	1,558	8.8	42.9	503		A
Ramp SIH/T	2	647	45.5	20.6	1,165	1,215(d)	F*
Ramp SIH/T	1	1,307	25.5	45.8	1,165		C*
Ramp SOH/T	2	641	149.6	4.5	1,693	666(e)	F*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	4	1,085	141.2	7.4	4,909		F
NB-HCE EB	3	416	110.6	12.5	4,909	1,700(f)	F
NB-HCE EB	3	911	84.1	16.6	4,909		F
NB-HCE EB	2	1,628	47.1	44.4	4,909		F
NB-HCE EB	2	4,129	48.5	43.1	4,909		F

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from Ramp TH/Ramp NH merge point.
(b) Queue measured from Ramp TH/Ramp SH merge point.
(c) Queue measured from Ramp SIH/Ramp SOH junction.
(d) Queue measured from Ramp SIT/Ramp SIH split.
(e) Queue measured from Ramp SOT/Ramp SOH split.
(f) Queue measured from the transition of NB-HCE EB to two-lane geometry

Weekday PM peak hour operation (Table 10-4) under Design Year traffic demand on the existing geometry shows a deterioration in level of service east of the Ramp SH merge area. Level of Service F operation will extend further west than in the Base Year operation. The NB-HCE roadway east of the ramp junctions would operate at LOS F because traffic demand would exceed the maximum service rate for desired LOS D or better operation. While densities increase slightly and speeds decrease slightly, no queues are reported on Ramp TH approaching the ramp merge areas or on the ramps themselves entering the NB-HCE. Minor queuing, increased over the Base Year operation, will form on Ramp TH approaching the ramp merge areas and on Ramp SH entering the NB-HCE.

Table 10-4 – Performance Measures – Design Year 2050 (No-Build) Weekday PM Peak Hour Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	347	10.8	36.7	1,963		A
Ramp TH	2	1,664	21.1	47.0	1,963		C
Ramp NH Merge Area							
Ramp NH	1	1,963	21.1	34.8	729		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	370	20.4	44.3	2,692		C
Ramp SH Merge Area							
Ramp SH	2	1,214	21.8	33.5	1,480	131(a)	C*
Ramp SIH	1	198	12.3	52.5	668		B*
Ramp SOH	1	1,447	19.4	42.0	812		C*
Ramp SIT	1	650	12.2	52.7	636		B*
Ramp SOT	1	1,558	19.4	43.9	867		C*
Ramp SIH/T	2	647	12.2	52.8	1,304		B*
Ramp SIH/T	1	1,307	27.0	47.9	1,304	69(b)	D*
Ramp SOH/T	2	642	21.9	38.1	1,679		C*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	4	1,084	21.6	48.4	4,172		C
NB-HCE EB	3	416	32.6	43.0	4,172	468(c)	D
NB-HCE EB	3	911	35.2	39.8	4,172		E
NB-HCE EB	2	1,629	46.7	44.8	4,172	72(d)	F
NB-HCE EB	2	4,129	48.2	43.4	4,172		F

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from Ramp TH/Ramp SH merge point.
(b) Queue measured from Ramp SIH/Ramp SOH junction.
(c) Queue measured from the transition of NB-HCE EB to two-lane geometry.
(d) Queue measured from beginning of NB-HCE EB two-lane geometry.

10.2.1.3. **Design Year 2050 (Build) Alternatives**

Geometric alternatives were developed to connect proposed ramp geometries to the proposed four-lane NB-HCE roadway crossing Newark Bay. The previous section established that the three ramps continue to warrant the number of lanes they currently carry, so one of the ramp lanes would have to merge or drop into the proposed NB-HCE roadway.

Origin-destination patterns obtained from Authority toll plaza transaction data from April 2019 were used to estimate the proportion of traffic entering the eastbound NB-HCE and exiting at Interchange 14A Ramp WT. Applying the same distributions to the Design Year 2050 (Build) traffic demands yields the patterns shown in Table 10-5.

Table 10-5 – Origin-Destination Patterns: NB-HCE Eastbound Int. 14 to Int. 14A Ramp WT
Design Year 2050 (Build) Total Traffic Demand Profile

Interchange	Ramp	Total Demand (vph)	Demand to Int. 14A Ramp WT (vph)	% to Int. 14A Ramp WT	% of total Int. 14A Ramp WT Demand
Weekday AM Peak Hour					
Int. 14	Ramp TH	2,681	1,020	38.0%	45.6%
	Ramp NH	865	592	68.4%	26.4%
	Ramp SH	2,440	628	25.7%	28.0%
Int. 14A	Ramp WT	2,240	n/a	n/a	n/a
Weekday PM Peak Hour					
Int. 14	Ramp TH	2,394	823	34.4%	40.1%
	Ramp NH	889	726	81.7%	35.4%
	Ramp SH	1,805	504	27.9%	24.5%
Int. 14A	Ramp WT	2,053	n/a	n/a	n/a

The table shows that most of the traffic on Ramp NH will be destined for Interchange 14A, as using the NB-HCE for destinations further east are likely considered to be "backtracking" from origins to the north. At Interchange 14A Ramp WT, most traffic will come from Ramp TH during both weekday peak hours. Traffic distributions from the other two ramps would vary based on peak hour, with more Ramp SH traffic accessing Interchange 14A during the weekday AM peak hour, and more Ramp NH traffic accessing Interchange 14A during the weekday PM peak hour. To minimize weaving maneuvers on the Newark Bay Bridge between the interchanges, Ramp TH traffic entering the NB-HCE should be located on the right.

A similar analysis was performed for truck movements in the same area. Table 10-6Table 10-6 summarizes the corresponding truck patterns under Design Year 2050 (Build) demand profiles.

Table 10-6 – Origin-Destination Patterns: NB-HCE Eastbound Int. 14 to Int. 14A Ramp WT Design Year 2050 (Build) Truck Traffic Demand Profile

Interchange	Ramp	Total Demand (vph)	Demand to Int. 14A Ramp WT (vph)	% to Int. 14A Ramp WT	% of total Int. 14A Ramp WT Demand
Weekday AM Peak Hour					
Int. 14	Ramp TH	327	227	69.4%	62.0%
	Ramp NH	120	82	68.3%	22.4%
	Ramp SH	116	57	49.1%	15.6%
Int. 14A	Ramp WT	366	n/a	n/a	n/a
Weekday PM Peak Hour					
Int. 14	Ramp TH	120	89	74.2%	61.8%
	Ramp NH	30	28	93.3%	19.4%
	Ramp SH	37	27	73.0%	18.8%
Int. 14A	Ramp WT	144	n/a	n/a	n/a

Total truck demands on Ramp TH as well as truck demands destined for Interchange 14A will also be the highest of the three entry points to the eastbound NB-HCE during both weekday peak hours. Truck demands on Ramp NH are forecasted to be higher than those on Ramp SH during both weekday peak hours.

Five alternatives were developed for this ramp junction area, which reflect different combinations of left-side and right-side ramp entrances, and merge, lane drop and lane addition geometries. Design speeds on Ramp TH and the NB-HCE reflect the increase from 55 to 60 MPH, as noted in the Preliminary Design Report. The alternatives also considered geometric design standards, right-of-way and utility impacts and Newark Airport approach and departure flight path restrictions. The alternatives are shown and described in more detail, with the results of the supporting analysis included in the following sections.

10.2.1.3.1. Alternative 1

This alternative will maintain the right-side orientation of Ramp NH and Ramp SH relative to Ramp TH. Ramp NH will carry one lane, as it currently does, while Ramp SH will carry the same two lanes that it currently does. Ramp SH will join the NB-HCE separately from, and about 370 feet downstream of, Ramp NH. Each ramp will add lanes to the two-lane Ramp TH to form a short five-lane roadway section. The right lane will drop 830 feet downstream of the Ramp SH entrance to form the four-lane roadway that crosses over the Newark Bay Bridge. Figure 10-2 and Figure 10-3 show the westerly and easterly limits, respectively, of this alternative, which is from the Initially Preferred Alternative.

Figure 10-2 – Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)
Alternative 1 Alignment (Western Limit)

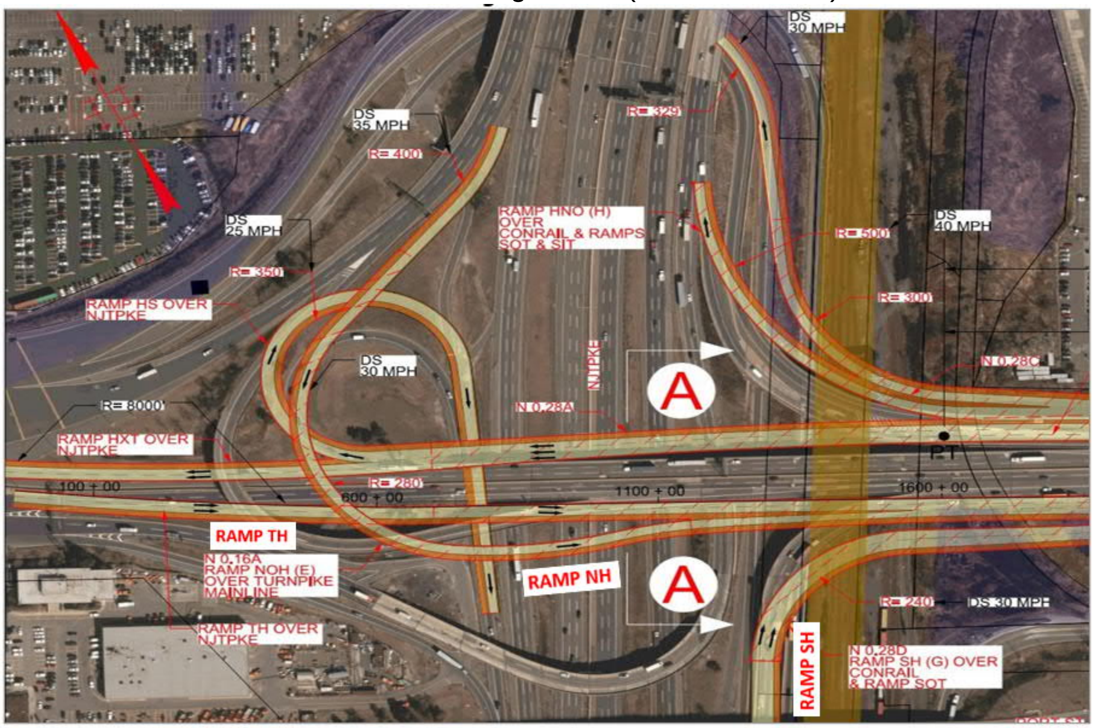


Figure 10-3 – Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)
Alternative 1 Alignment (Eastern Limit)

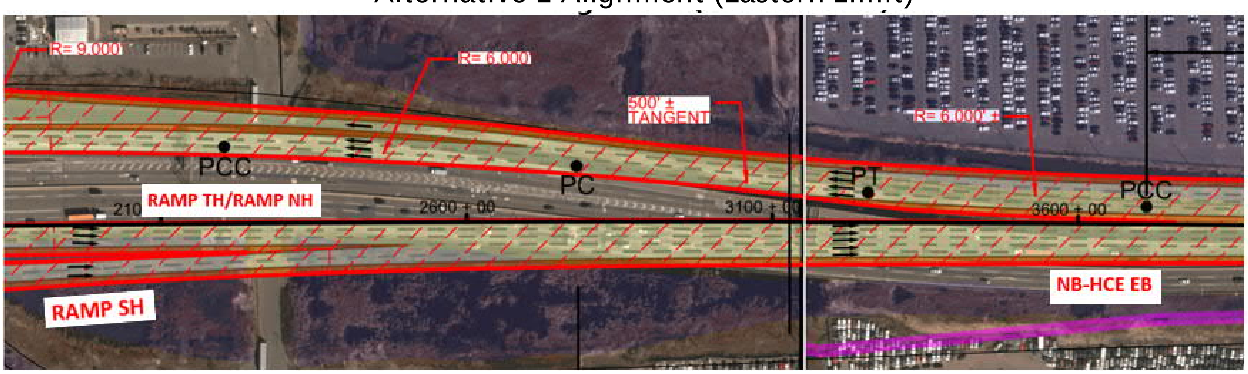


Table 10-7 and Table 10-8 show the performance measures for the Build geometry in Alternative 1. Ramp SH will operate at Level of Service E during the weekday AM peak hour under the Alternative 1 geometry. While the merge area would be improved by the lane additions, the vertical grade and tight ramp radius from the existing geometry will remain. Additionally, the downstream right lane drop is the extension of the right lane of the ramp. The volume imbalance between Ramp NH and Ramp SH will translate into a downstream lane imbalance.

Despite this imbalance, the NB-HCE segments east of Ramp SH, through the lane drop area, will operate at LOS D or better during both peak hours. Minor (maximum) queues will develop in the transition area from five lanes to four during the weekday PM peak hour. The Ramp TH roadway in advance of the Ramp SH junction will also operate at LOS D in both peak hours. In both cases, ramp lane additions, with more roadway lanes downstream than the existing geometry, would contribute heavily to the improvement in level of service.

Table 10-7 – Performance Measures – Design Year 2050 (Build) Weekday AM Peak Hour Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 1

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	346	16.7	31.6	2,681	208(a)	B
Ramp TH	2	168	31.8	42.2	2,681		D
Ramp TH	2	690	27.0	49.7	2,681		D
Ramp TH	2	804	25.9	51.8	2,681		C
Ramp NH Merge Area (Right)							
Ramp NH	1	1,753	23.8	36.6	865		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	1,006	21.0	55.7	3.546		C
Ramp SH Merge Area (Right)							
Ramp SH	2	1,787	36.0	33.5	2,440		E*
Ramp SIH	1	198	21.7	44.0	989		C*
Ramp SOH	1	1,446	33.9	42.8	1,451		D*
Ramp SIT	1	650	7.9	45.1	340		A*
Ramp SOT	1	1,558	9.8	51.1	500		A*
Ramp SIH/T	2	647	14.6	44.8	1,329		B*
Ramp SIH/T	1	1,307	30.7	42.8	1,329		D*
Ramp SOH/T	2	639	27.2	35.9	1,951		D*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	5	830	22.1	54.1	5,986	61(b)	C
NB-HCE EB	4	742	24.5	61.1	5,986		C
NB-HCE EB	4	1,800	23.8	62.8	5,986		C
NB-HCE EB	4	4,119	24.6	60.9	5,986		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from merge to NB-HCE four-lane geometry.

Table 10-8 – Performance Measures – Design Year 2050 (Build) Weekday PM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 1

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	348	13.9	34.5	2,394	69(a)	B
Ramp TH	2	168	25.9	46.0	2,394		C
Ramp TH	2	689	21.7	55.2	2,394		C
Ramp TH	2	805	20.3	58.9	2,394		C
Ramp NH Merge Area (Right)							
Ramp NH	1	1,753	23.7	37.9	889		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	1,006	18.3	59.3	3,283		C
Ramp SH Merge Area (Right)							
Ramp SH	2	1,787	25.3	35.4	1,805		C*
Ramp SIH	1	198	17.9	44.3	815		B*
Ramp SOH	1	1,447	20.9	47.5	990		C*
Ramp SIT	1	650	12.6	44.9	559		B*
Ramp SOT	1	1,558	13.7	54.5	762		B*
Ramp SIH/T	2	647	15.2	44.8	1,374		B*
Ramp SIH/T	1	1,308	31.9	42.8	1,374		D*
Ramp SOH/T	2	640	22.1	39.4	1,752		C*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	5	830	17.0	60.0	5,088	64(b)	B
NB-HCE EB	4	742	20.0	63.6	5,088		C
NB-HCE EB	4	1,800	19.9	64.2	5,088		C
NB-HCE EB	4	4,119	20.1	63.3	5,088		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from merge to NB-HCE four-lane geometry.

10.2.1.3.2. Alternative 2

This alternative, like Alternative 1, will maintain the right-side orientation of both ramps relative to Ramp TH. What differs in this alternative is the distance between ramp entry points – Ramp SH will join the NB-HCE further west (closer to Ramp NH) in this alternative than in Alternative 1, more like the existing geometry. The lane drop from five lanes to four will also occur further west than in Alternative 1. Figure 10-4 illustrates the westerly limit of this alternative. This ties in, conceptually, with the easterly limit depicted in Figure 10-3.

Figure 10-4 – Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)
Alternative 2 Alignment (Western Limit)

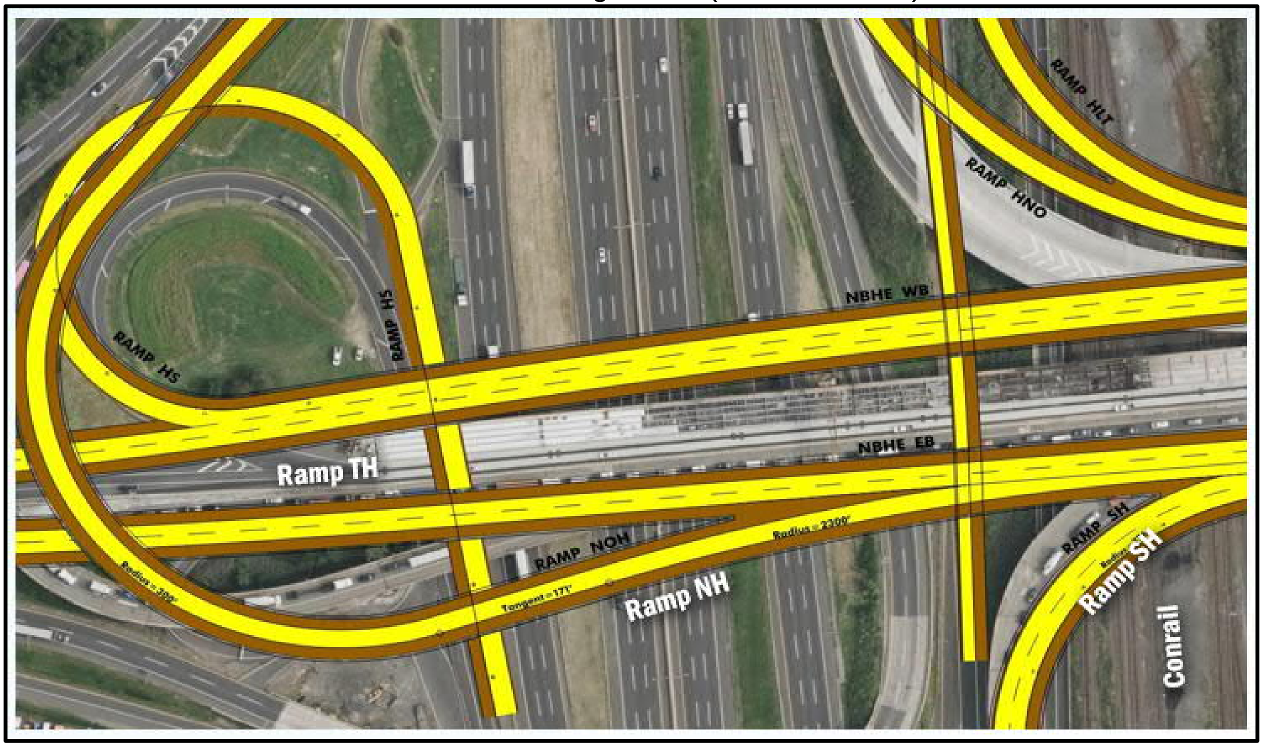


Table 10-9 and Table 10-10 show the performance measures for the Build geometry in Alternative 2. With the similar geometry to the previous alternative, similar results would be expected. Ramp SH will operate at Level of Service E during the weekday AM peak hour under this alternative geometry, with the vertical grade and tight ramp radius from the existing geometry remaining. The downstream right lane drop remains the extension of the right lane of the ramp, so volume and lane balance issues would persist. The NB-HCE segments east of Ramp SH, through the lane drop area, will continue to operate at LOS D or better in both peak hours. Minor (maximum) queues will form in the transition area from five lanes to four. The Ramp TH roadway in advance of the Ramp SH junction also will maintain acceptable operation at LOS D in both peak hours. The shorter distance between Ramp NH and Ramp SH will not result in a significant change in density or speed during the weekday peak hours.

Table 10-9 – Performance Measures – Design Year 2050 (Build) Weekday AM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 2

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	347	16.8	31.9	2,681	124(a)	B
Ramp TH	2	161	31.9	41.8	2,681		D
Ramp TH	2	569	26.5	49.4	2,681		D
Ramp TH	2	927	26.0	51.5	2,681		C
Ramp NH Merge Area (Right)							
Ramp NH	1	1,914	23.9	36.6	865		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	79	21.2	48.7	3.546		C
Ramp SH Merge Area (Right)							
Ramp SH	2	860	37.4	32.2	2,440		E*
Ramp SIH	1	198	21.7	44.0	989		C*
Ramp SOH	1	1,446	33.9	42.8	1,451		D*
Ramp SIT	1	650	7.9	45.1	340		A*
Ramp SOT	1	1,559	9.8	50.9	500		A*
Ramp SIH/T	2	647	14.6	44.8	1,329		B*
Ramp SIH/T	1	1,307	30.7	42.8	1,329		D*
Ramp SOH/T	2	639	27.3	35.7	1,951		D*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	5	1,760	21.5	55.4	5,986	47(b)	C
NB-HCE EB	4	742	24.1	62.1	5,986		C
NB-HCE EB	4	1,800	23.8	62.7	5,986		C
NB-HCE EB	4	4,119	24.7	60.6	5,986		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from merge to NB-HCE four-lane geometry.

Table 10-10 – Performance Measures – Design Year 2050 (Build) Weekday PM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 2

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	348	13.8	34.7	2,394	97(a)	B
Ramp TH	2	490	25.9	46.3	2,394		C
Ramp TH	2	809	20.3	59.1	2,394		C
Ramp TH	2	361	21.7	55.3	2,394		C
Ramp NH Merge Area (Right)							
Ramp NH	1	1,911	23.7	37.9	889		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	79	18.2	52.6	3,283		C
Ramp SH Merge Area (Right)							
Ramp SH	2	860	27.6	32.5	1,805		D*
Ramp SIH	1	198	17.9	44.3	815		B*
Ramp SOH	1	1,447	20.9	47.6	990		C*
Ramp SIT	1	650	12.6	44.9	559		B*
Ramp SOT	1	1,559	13.7	54.6	762		B*
Ramp SIH/T	2	647	15.2	44.8	1,374		B*
Ramp SIH/T	1	1,308	31.9	42.8	1,374		D*
Ramp SOH/T	2	639	22.1	39.4	1,752	133(b)	C*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	5	1,760	17.5	58.3	5,088		B
NB-HCE EB	4	742	20.0	63.7	5,088		C
NB-HCE EB	4	1,800	20.0	63.8	5,088		C
NB-HCE EB	4	4,119	20.2	63.1	5,088		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from Ramp SOT/Ramp SOH split.

10.2.1.3.3. Alternative 3

This alternative will realign Ramp SH such that it would join Ramp TH on the left side. The Ramp NH alignment will remain as a right-side junction with Ramp TH. The spacing between the ramp junctions will increase over the previous alternative to a distance more consistent with Alternative 1. Both ramps will remain as lane additions to the NB-HCE, and the right lane of the five-lane section will still merge into the NB-HCE roadway to form the four-lane section over the Newark Bay Bridge. The lane, in this case, would be considered a long acceleration lane for Ramp NH traffic. Figure 10-5 and Figure 10-6 illustrate the westerly and easterly limits, respectively, of this alternative.

Figure 10-5 – Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)
Alternative 3 Alignment (Western Limit)

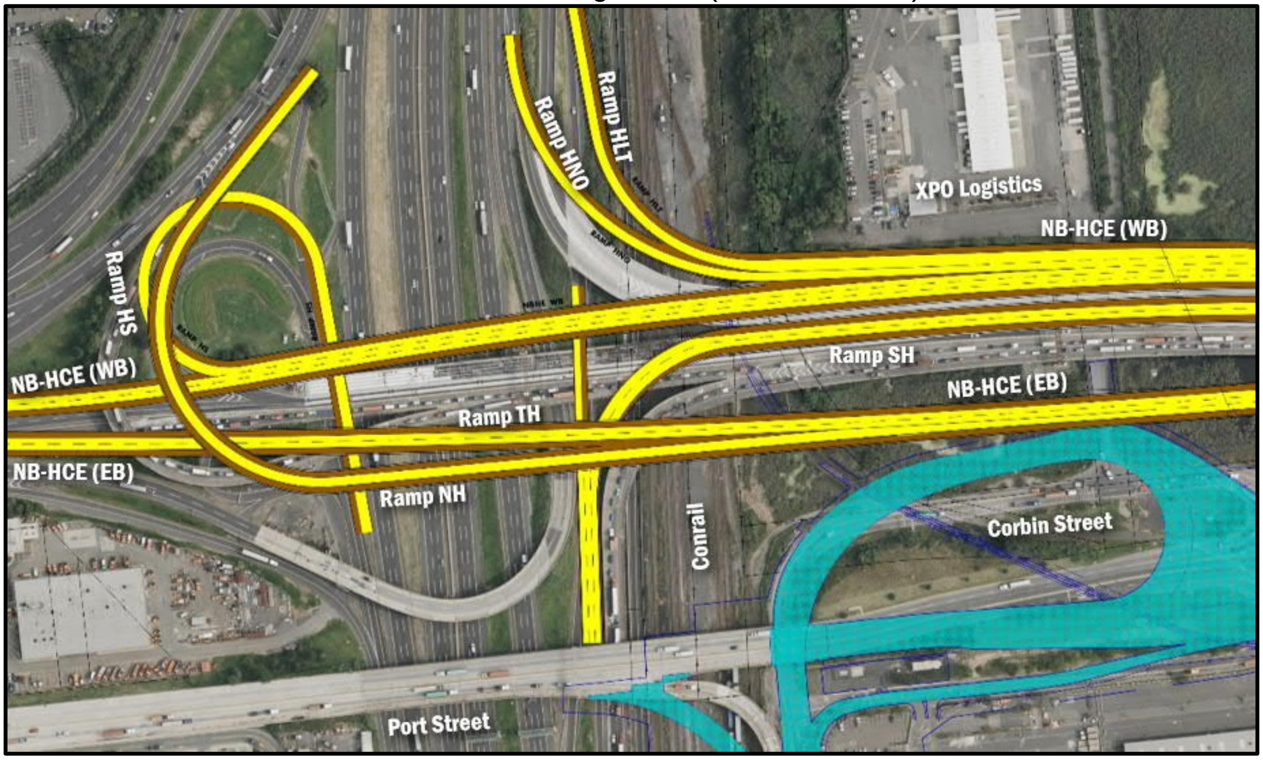


Figure 10-6– Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)
Alternative 3 Alignment (Eastern Limit)

Table 10-11 and Table 10-12 show the performance measures for the Build geometry under Alternative 3. The conversion of Ramp SH from a right-side entrance to a left-hand entrance improves the ramp geometry such that both the vertical grade and horizontal alignment would be more gradual for the left-hand entrance. This geometric enhancement would improve the level of service on Ramp SH to LOS D or better during both weekday peak hours. Ramp NH operation would also improve slightly because the influence of a same-side Ramp SH would no longer be present. The downstream right lane drop will become an extended acceleration lane for Ramp NH traffic, which reflects a more optimal traffic and lane balance in this area. While not necessarily borne out in the analysis results, this alternative will involve ramp volumes entering from both sides of the Ramp TH roadway within a ¼-mile distance, with downstream lane shifts occurring because of the right lane drop and Interchange 14A destination. Minor (maximum) queues, longer than in the previous alternatives, will form in the transition area from five lanes to four. Speeds increase slightly from Alternative 1 (with right-side ramp entrances spaced similarly), but this alternative may run counter to driver expectation.

Table 10-11 – Performance Measures – Design Year 2050 (Build) Weekday AM Peak Hour Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 3

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	347	16.3	32.8	2,681	249(a)	B
Ramp TH	2	157	31.1	42.9	2,681		D
Ramp TH	2	1,326	26.2	51.1	2,681		D
Ramp TH	2	1,021	25.7	51.9	2,681		C
Ramp NH Merge Area (Right)							
Ramp NH	1	2,620	20.9	41.8	865		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	1,654	20.0	58.6	3.546		C
Ramp SH Merge Area (Left)							
Ramp SH	2	3,429	30.3	39.8	2,440		D*
Ramp SIH	1	195	21.8	44.0	989		C*
Ramp SOH	1	1,443	34.0	42.8	1,451		D*
Ramp SIT	1	753	7.9	45.1	340		A*
Ramp SOT	1	1,559	9.8	50.8	500		A*
Ramp SIH/T	2	647	14.6	44.8	1,329		B*
Ramp SIH/T	1	1,309	30.7	42.8	1,329		D*
Ramp SOH/T	2	639	27.6	35.3	1,951	494(b)	D*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	5	1,354	20.7	57.5	5,986	153(c)	C
NB-HCE EB	4	162	23.9	60.8	5,986		C
NB-HCE EB	4	1,797	23.9	62.6	5,986		C
NB-HCE EB	4	2,672	24.4	61.5	5,986		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from Ramp SOT/Ramp SOH split.
(c) Queue measured from merge to NB-HCE EB four-lane geometry.

Table 10-12 – Performance Measures – Design Year 2050 (Build) Weekday PM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 3

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	347	13.8	34.6	2,394	95(a)	B
Ramp TH	2	157	25.9	46.2	2,394		C
Ramp TH	2	1,326	20.8	57.5	2,394		C
Ramp TH	2	1,021	20.1	59.7	2,394		C
Ramp NH Merge Area (Right)							
Ramp NH	1	2,618	20.8	43.3	889		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	1,654	17.3	62.9	3,283		B
Ramp SH Merge Area (Left)							
Ramp SH	2	3,429	21.4	41.8	1,805		C*
Ramp SIH	1	195	18.0	44.3	815		C*
Ramp SOH	1	1,443	21.0	47.5	990		C*
Ramp SIT	1	753	12.6	44.9	559		B*
Ramp SOT	1	1,558	13.7	54.6	762		B*
Ramp SIH/T	2	647	15.2	44.8	1,374		B*
Ramp SIH/T	1	1,307	31.9	42.8	1,374		D*
Ramp SOH/T	2	641	22.1	39.4	1,752	166(b)	C*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	5	1,354	16.6	61.2	5,088	97(c)	B
NB-HCE EB	4	162	19.6	63.4	5,088		C
NB-HCE EB	4	1,796	19.8	64.1	5,088		C
NB-HCE EB	4	2,671	20.0	63.6	5,088		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from Ramp SOT/Ramp SOH split.
(c) Queue measured from merge to NB-HCE EB four-lane geometry.

10.2.1.3.4. Alternative 4

Alternative 4 will realign Ramp NH such that it would also join Ramp TH on the left side. The Ramp SH alignment will remain as a left-side junction with Ramp TH, as in the previous alternative. The spacing between the ramp junctions will increase over the previous alternative to permit the same-side orientation of the ramp junctions. The order of ramp junctions will remain, with Ramp NH entering first and Ramp SH entering downstream. Both ramps will remain as lane additions to the NB-HCE, and the right lane of the five-lane section will still merge into the NB-HCE roadway to form the ultimate four-lane section. Under this alternative, the lane to drop would be the right lane of Ramp TH. Figure 10-7 and Figure 10-8 illustrate the westerly and easterly limits, respectively, of this alternative.

Figure 10-7 – Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)
Alternative 4 Alignment (Western Limit)

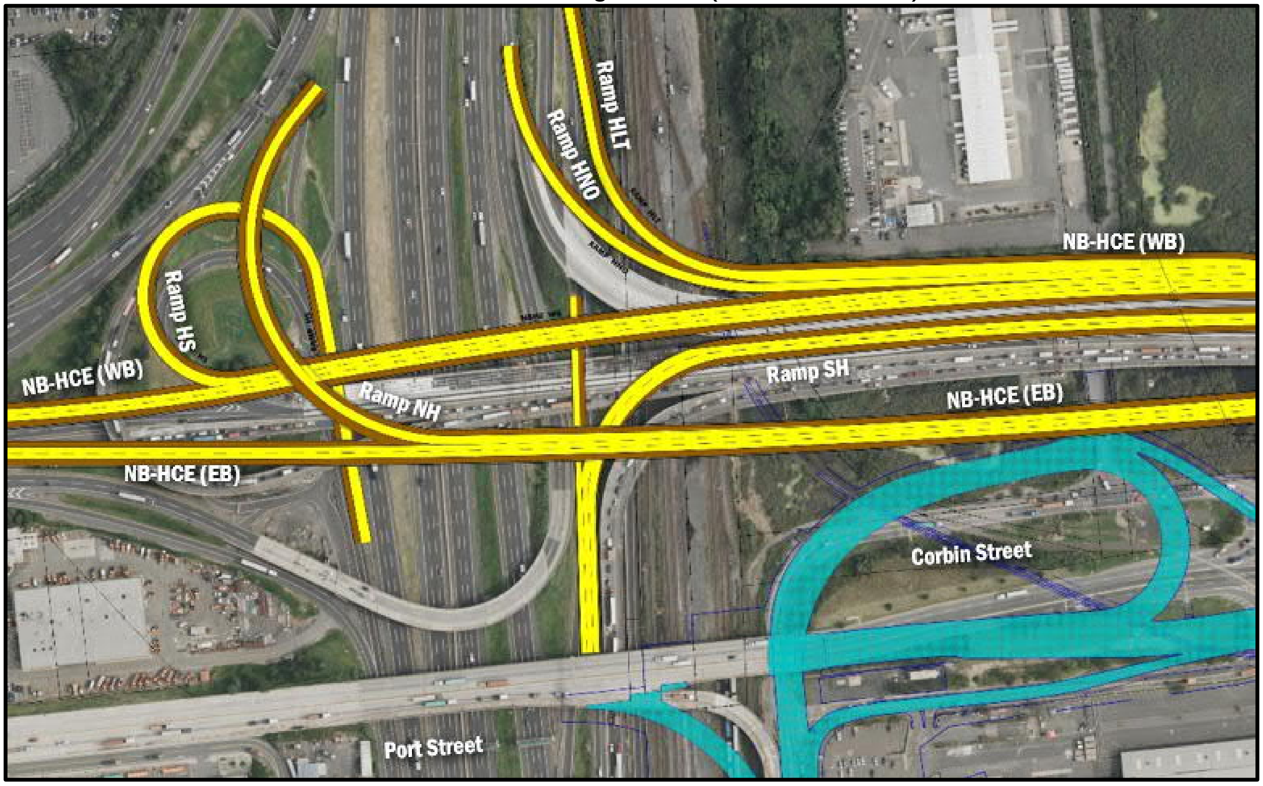


Figure 10-8 – Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14)
Alternative 4 Alignment (Eastern Limit)

The results do not vary significantly from the previous alternative. The left orientation of Ramp NH would result in minor increases in density and decreases in speed on the ramp during both weekday peak hours, compared to the previous alternative, perhaps due to the downstream influence of the same-side Ramp SH. The resulting changes in level of service, however, would remain within the range of acceptable operation. The right lane drop downstream of the ramp junctions poses a similar volume and lane balance issue as in Alternatives 1 and 2; in this case, the imbalance is between Ramp TH and Ramp NH. Minor (maximum) queues will form in the transition area from five lanes to four.

Table 10-13 – Performance Measures – Design Year 2050 (Build) Weekday AM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 4

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	348	16.8	32.0	2,681	196(a)	B
Ramp TH	2	150	32.0	41.9	2,681		D
Ramp TH	2	257	27.1	49.4	2,681		D
Ramp TH	2	800	26.1	51.4	2,681		D
Ramp NH Merge Area (Left)							
Ramp NH	1	920	23.3	37.4	865		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	1,500	20.6	57.4	3.546		C
Ramp TH	3	1,220	19.2	61.5	3,546	83(b)	C
Ramp SH Merge Area (Left)							
Ramp SH	2	3,198	30.8	39.2	2,440		D*
Ramp SIH	1	195	21.8	44.0	989		C*
Ramp SOH	1	1,443	34.2	42.6	1,451		D*
Ramp SIT	1	753	7.9	45.1	340		A*
Ramp SOT	1	1,558	9.8	51.0	500		A*
Ramp SIH/T	2	647	14.6	44.8	1,329		B*
Ramp SIH/T	1	1,307	30.7	42.8	1,329		D*
Ramp SOH/T	2	640	27.6	35.4	1,951	617(c)	D*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	5	1,000	21.0	56.6	5,986	99(d)	C
NB-HCE EB	4	501	24.4	61.1	5,986		C
NB-HCE EB	4	2,087	23.8	62.8	5,986		C
NB-HCE EB	4	2,651	24.3	61.7	5,986		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from Ramp TH/Ramp SH merge area.
(c) Queue measured from Ramp SOT/Ramp SOH split.
(d) Queue measured from merge to NB-HCE EB four-lane geometry.

Table 10-14 – Performance Measures – Design Year 2050 (Build) Weekday PM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 4

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	347	14.1	33.9	2,394	109(a)	B
Ramp TH	2	151	26.2	45.8	2,394		D
Ramp TH	2	257	21.9	54.9	2,394		C
Ramp TH	2	800	20.7	58.1	2,394		C
Ramp NH Merge Area (Left)							
Ramp NH	1	925	23.8	37.8	889		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	1,500	18.1	60.8	3,283		C
Ramp TH	3	1,220	17.2	63.9	3,283		B
Ramp SH Merge Area (Left)							
Ramp SH	2	3,198	21.6	41.5	1,805		C*
Ramp SIH	1	195	18.0	43.3	815		C*
Ramp SOH	1	1,443	21.0	47.5	990		C*
Ramp SIT	1	753	12.6	44.9	559		B*
Ramp SOT	1	1,558	14.7	50.8	762		B*
Ramp SIH/T	2	647	15.2	44.8	1,374		B*
Ramp SIH/T	1	1,307	31.9	42.8	1,374		D*
Ramp SOH/T	2	642	22.2	39.3	1,752	130(b)	C*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	5	1,000	16.6	60.9	5,088	78(c)	B
NB-HCE EB	4	501	20.0	63.4	5,088		C
NB-HCE EB	4	2,087	19.8	64.3	5,088		C
NB-HCE EB	4	2,651	20.0	63.7	5,088		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from Ramp SOT/Ramp SOH split.
(c) Queue measured from merge to NB-HCE EB four-lane geometry.

Table 10-13 and Table 10-14 shows the performance measures under the proposed geometry of Alternative 4. The results do not vary significantly from the previous alternative. The left orientation of Ramp NH would result in minor increases in density and decreases in speed on the ramp during both weekday peak hours, compared to the previous alternative, perhaps due to the downstream influence of the same-side Ramp SH. The resulting changes in level of service, however, would remain within the range of acceptable operation. The right lane drop downstream of the ramp junctions poses a similar volume and lane balance issue as in

Alternatives 1 and 2; in this case, the imbalance is between Ramp TH and Ramp NH. Minor (maximum) queues will form in the transition area from five lanes to four.

Table 10-13 – Performance Measures – Design Year 2050 (Build) Weekday AM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 4

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	348	16.8	32.0	2,681	196(a)	B
Ramp TH	2	150	32.0	41.9	2,681		D
Ramp TH	2	257	27.1	49.4	2,681		D
Ramp TH	2	800	26.1	51.4	2,681		D
Ramp NH Merge Area (Left)							
Ramp NH	1	920	23.3	37.4	865		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	1,500	20.6	57.4	3.546		C
Ramp TH	3	1,220	19.2	61.5	3,546	83(b)	C
Ramp SH Merge Area (Left)							
Ramp SH	2	3,198	30.8	39.2	2,440		D*
Ramp SIH	1	195	21.8	44.0	989		C*
Ramp SOH	1	1,443	34.2	42.6	1,451		D*
Ramp SIT	1	753	7.9	45.1	340		A*
Ramp SOT	1	1,558	9.8	51.0	500		A*
Ramp SIH/T	2	647	14.6	44.8	1,329		B*
Ramp SIH/T	1	1,307	30.7	42.8	1,329		D*
Ramp SOH/T	2	640	27.6	35.4	1,951	617(c)	D*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	5	1,000	21.0	56.6	5,986	99(d)	C
NB-HCE EB	4	501	24.4	61.1	5,986		C
NB-HCE EB	4	2,087	23.8	62.8	5,986		C
NB-HCE EB	4	2,651	24.3	61.7	5,986		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from Ramp TH/Ramp SH merge area.
(c) Queue measured from Ramp SOT/Ramp SOH split.
(d) Queue measured from merge to NB-HCE EB four-lane geometry.

Table 10-14 – Performance Measures – Design Year 2050 (Build) Weekday PM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 4

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	347	14.1	33.9	2,394	109(a)	B
Ramp TH	2	151	26.2	45.8	2,394		D
Ramp TH	2	257	21.9	54.9	2,394		C
Ramp TH	2	800	20.7	58.1	2,394		C
Ramp NH Merge Area (Left)							
Ramp NH	1	925	23.8	37.8	889		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	1,500	18.1	60.8	3,283		C
Ramp TH	3	1,220	17.2	63.9	3,283		B
Ramp SH Merge Area (Left)							
Ramp SH	2	3,198	21.6	41.5	1,805		C*
Ramp SIH	1	195	18.0	43.3	815		C*
Ramp SOH	1	1,443	21.0	47.5	990		C*
Ramp SIT	1	753	12.6	44.9	559		B*
Ramp SOT	1	1,558	14.7	50.8	762		B*
Ramp SIH/T	2	647	15.2	44.8	1,374		B*
Ramp SIH/T	1	1,307	31.9	42.8	1,374		D*
Ramp SOH/T	2	642	22.2	39.3	1,752	130(b)	C*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	5	1,000	16.6	60.9	5,088	78(c)	B
NB-HCE EB	4	501	20.0	63.4	5,088		C
NB-HCE EB	4	2,087	19.8	64.3	5,088		C
NB-HCE EB	4	2,651	20.0	63.7	5,088		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from Ramp SOT/Ramp SOH split.
(c) Queue measured from merge to NB-HCE EB four-lane geometry.

10.2.1.3.5. Alternative 5

A variation of Alternative 4 was analyzed with Ramp NH traffic entering Ramp TH using a left acceleration lane and merge. Two lanes of the combined Ramp NH/Ramp TH will join the two-lane Ramp SH to form the four-lane NB-HCE eastbound on the Newark Bay Bridge crossing. Since Ramp TH will carry a higher per-lane volume under the Design Year 2050 (Build) profile than Ramp NH – 1,340 vphpl vs. 865 vphpl in the weekday AM peak hour and 1,197 vphpl vs. 889 vphpl in the weekday PM peak hour – merging Ramp NH traffic into Ramp TH would have a lesser impact on traffic flow than dropping the right lane of the combined five-lane NB-HCE section downstream of the Ramp TH/Ramp SH junction. In addition, the overall footprint for the structure will be reduced in this area, since no five-lane section or downstream lane drop would be included in this proposed geometry. Figure 10-9 and Figure 10-10 illustrate the westerly and easterly limits (respectively) of this alternative.

Figure 10-9 – Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) Alternative 5 Alignment (Western Limit)

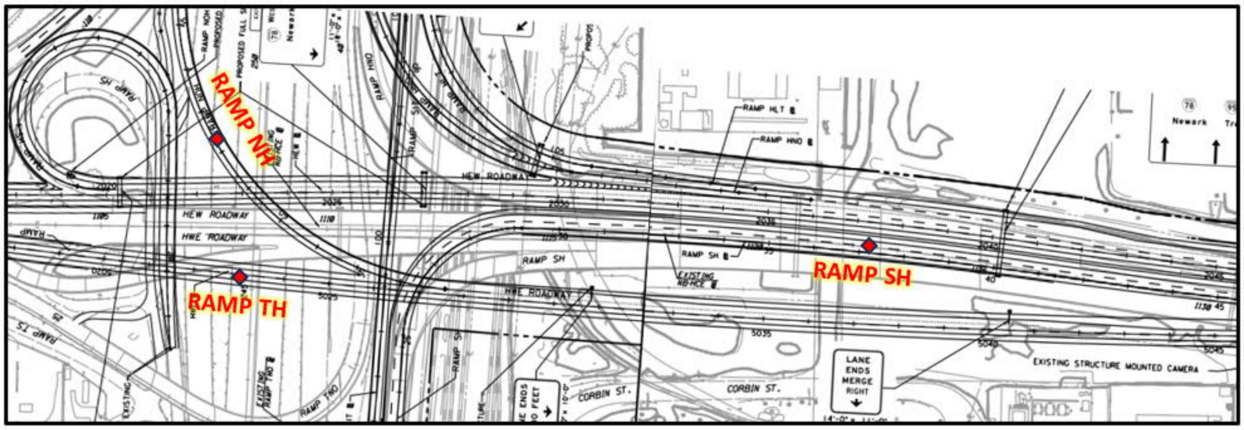


Figure 10-10 – Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) Alternative 5 Alignment (Eastern Limit)

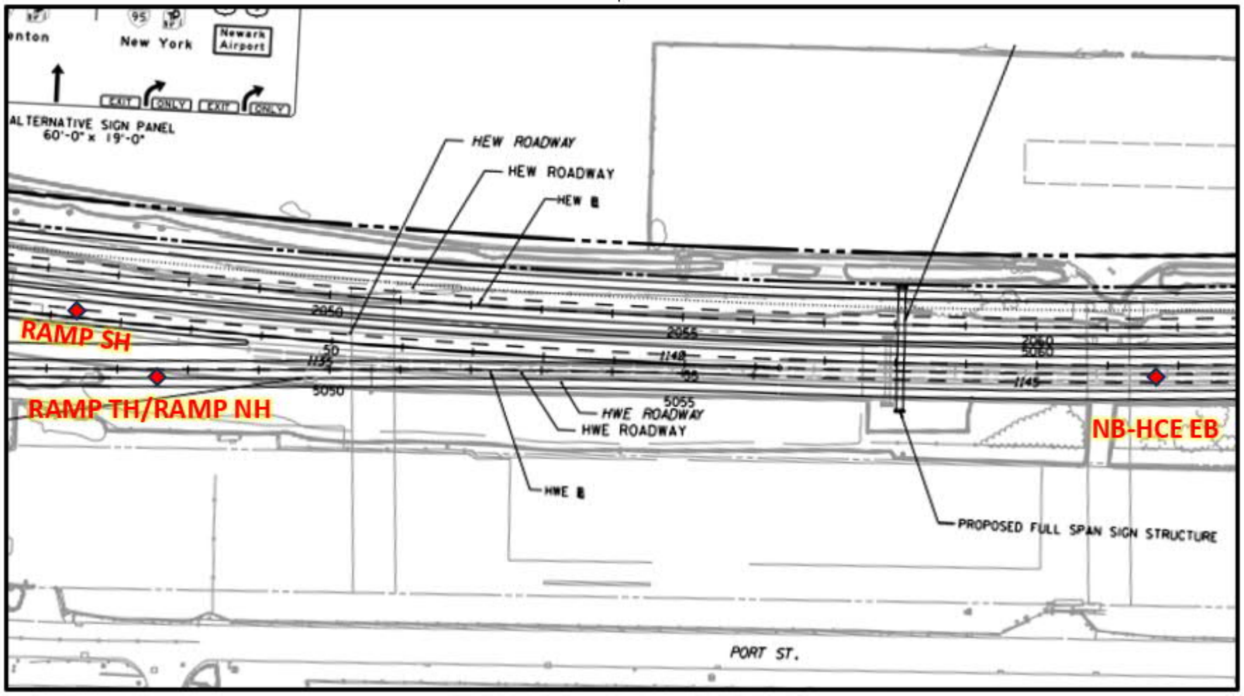


Table 10-15 and Table 10-16 summarize the performance measures for the proposed geometry under Alternative 5. The results indicate that converting the Ramp NH junction to a merge with acceleration lane would not adversely impact the operation of the junction area. The combination of merging traffic and shorter length between Ramp NH and Ramp SH would contribute to minor increases in density and decreases in speed for both weekday peak hours. These changes, however, would not change the level of service for this roadway link. Minor queuing will also occur, with maximum queue lengths of under 100 feet anticipated. Other roadway and ramp links within this junction area will operate at Level of Service D or better during both weekday peak hours.

Table 10-15 – Performance Measures – Design Year 2050 (Build) Weekday AM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 5

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	347	16.7	32.1	2,681	211(a)	B
Ramp TH	2	151	31.8	42.1	2,681		D
Ramp TH	2	257	27.1	49.3	2,681		D
Ramp TH	2	1,190	26.0	51.5	2,681		C
Ramp NH Merge Area (Left)							
Ramp NH	1	1,324	23.5	37.1	865		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	1,252	23.1	51.2	3.546	92(b)	C
Ramp TH	2	250	32.1	54.1	3,546		D
Ramp TH	2	1,233	30.6	58.2			D
Ramp SH Merge Area (Left)							
Ramp SH	2	3,641	30.3	39.8	2,440		D*
Ramp SIH	1	189	21.8	44.0	989		C*
Ramp SOH	1	1,442	34.1	42.7	1,451		D*
Ramp SIT	1	753	7.9	54.1	340		A*
Ramp SOT	1	1,559	9.8	50.9	500		A*
Ramp SIH/T	2	647	14.6	44.8	1,329		B*
Ramp SIH/T	1	1,308	30.7	42.8	1,329		D*
Ramp SOH/T	2	641	27.6	35.5	1,951	462(c)	D*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	4	559	26.1	56.9	5,986		D
NB-HCE EB	4	941	24.4	61.2	5,986		C
NB-HCE EB	4	1,644	23.9	62.7	5,986		C
NB-HCE EB	4	2,651	24.5	61.3	5,986		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from Ramp TH/Ramp NH merge area.
(c) Queue measured from Ramp SOT/Ramp SOH split.

Table 10-16 – Performance Measures – Design Year 2050 (Build) Weekday PM Peak Hour
Ramp TH/Ramp NH/Ramp SH Junction (Interchange 14) – Alternative 5

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
Ramp TH, Exiting Interchange 14 Toll Plaza							
Ramp TH	5	348	14.0	34.2	2,394	112(a)	B
Ramp TH	2	150	26.1	45.9	2,394		D
Ramp TH	2	257	21.8	54.8	2,394		C
Ramp TH	2	1,190	20.4	58.7	2,394		C
Ramp NH Merge Area (Left)							
Ramp NH	1	1,324	24.0	37.5	889		C*
Ramp TH, Between Ramp NH and Ramp SH							
Ramp TH	3	1,252	19.2	57.3	3,283	88(b)	C
Ramp TH	2	249	26.8	60.7	3,283		D
Ramp TH	2	1,233	26.6	62.2	3,283		D
Ramp SH Merge Area (Left)							
Ramp SH	2	3,641	21.0	42.6	1,805		C*
Ramp SIH	1	189	18.0	44.3	815		C*
Ramp SOH	1	1,442	21.0	47.5	990		C*
Ramp SIT	1	753	12.6	44.9	559		B*
Ramp SOT	1	1,559	14.7	50.8	762		B*
Ramp SIH/T	2	647	15.2	44.8	1,374		B*
Ramp SIH/T	1	1,307	31.9	42.8	1,374		D*
Ramp SOH/T	2	640	22.1	39.4	1,752	153(c)	C*
NB-HCE, East of Ramp NH/Ramp SH Merge							
NB-HCE EB	4	559	20.8	60.7	5,088		C
NB-HCE EB	4	942	20.1	66.3	5,088		C
NB-HCE EB	4	1,645	19.9	64.1	5,088		C
NB-HCE EB	4	2,651	20.0	63.6	5,088		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Queue measured from beginning of Ramp TH two-lane geometry.
(b) Queue measured from Ramp TH/Ramp NH merge area.
(c) Queue measured from Ramp SOH/Ramp SOT split.

10.2.1.4. Eastbound Ramp Junction Alternative Analysis Conclusion

Origin-destination patterns for ramps entering the eastbound NB-HCE at Interchange 14 indicate that most traffic destined for Interchange 14A Ramp WT would from Ramp TH during both weekday peak hours. A larger percentage of total Ramp NH traffic is destined for the same location, but the volume figure is larger than the Ramp SH component during the weekday PM peak hour and smaller during the weekday AM peak hour. Similar patterns occur with truck traffic as well. VISSIM models for this merge area show level of service F operation and queuing under the existing geometry for Base Year 2021 and Design Year 2050 (No-Build) conditions, as five lanes of traffic merge into two lanes as traffic ascends the Newark Bay Bridge. Build alternatives varied the position and spacing of the ramp junctions with the NB-HCE. Each will show improvement over the existing geometry, as five lanes would merge into four proposed lanes on the NB-HCE, but one lane still must merge to reach the proposed section. Right orientations of Ramp SH (Alternatives 1 and 2) require a sharp upgrade to the NB-HCE and similarly sized curve radii as in the existing geometry. Ramp SH is the more easterly ramp junction, so one of the two ramp lanes would drop to form the proposed section. This results in densities equivalent to LOS E on freeways on Ramp SH, despite acceptable operation (LOS C or D) on the downstream NB-HCE. Left orientation of Ramp SH, which allows both a more gradual vertical grade and a larger curve radius, would improve the ramp LOS to the equivalent of D, while also maintaining the acceptable NB-HCE LOS. Maintaining the right orientation of Ramp NH with the left orientation of Ramp SH (Alternative 3) would maintain the ramp lane merge into the proposed four-lane section but would encourage lane shifting from both sides of the combined roadway because of the different entering ramp orientations. Switching the Ramp NH orientation to the left and allowing it to enter its own lane (Alternative 4) would force the right lane of Ramp TH to merge into the four-lane section, a violation of lane balance due to the relative ramp volumes. Alternative 5, which would merge Ramp NH from the left prior to the Ramp SH junction, would provide the optimal lane balance with respect to ramp volume, would not require a downstream lane drop to the proposed four-lane section, and orients the ramps to minimize weave-like lane changes toward the downstream Interchange 14A exit Ramp WT. Alternative 5, therefore, is the recommended ramp junction configuration in this area.

10.2.2 Proposed Westbound Ramp Diverge Geometry (Ramp HLT/Ramp HN and Ramp HS)

The westbound NB-HCE (HEW Roadway) approaching Interchange 14 consists of two major diverge points. East of the crossing of the Turnpike mainline, Ramp HN and Ramp HLT depart the NB-HCE to the Turnpike northbound and the “local” side of the Interchange 14 toll plaza, respectively. The “local” side of the plaza facilitates access to US Routes 1&9, NJ Route 22, Newark Airport, Port Newark, and the I-78 westbound local roadway. These ramps depart the two-lane NB-HCE roadway in a wide diverge area opening to both ramps simultaneously. West of the Turnpike mainline, Ramp HS departs the NB-HCE roadway (also called Ramp HXT here) for the Turnpike southbound. A deceleration lane opens for Ramp HS immediately after the Ramp HLT/Ramp HN diverge, using the existing shoulder, before the single-lane loop ramp departs Ramp HXT. The two-lane Ramp HXT continues beyond this point toward the “express” side of the Interchange 14 toll plaza, which facilitates access to the I-78 westbound express roadway. To fully consider impacts on traffic operation on the Ramp HXT/Ramp HS split, both diverge areas were modeled for analysis. Figure 10-11 illustrates the existing geometry of this area.

Figure 10-11– NB-HCE Westbound at Interchange 14 Existing Geometry

10.2.2.1. Base Year 2021 Operation

Table 10-17 illustrates the Base Year 2021 weekday AM peak hour performance along the NB-HCE westbound approaching the Ramp HN/Ramp HLT diverge and downstream Ramp HS diverge. The analysis shows a Level of Service D operation on the NB-HCE westbound approaching the ramps. This is different from the density and LOS reported in Table 9-1 in that the eastern limit of the model was set on the downgrade on the existing Newark Bay Bridge. As traffic exits the roadway, density decreases and level of service improves, though a short queue (as much as 316 feet) forms in advance of the Ramp HN/Ramp HLT diverge as traffic aligns to the proper lanes for the downstream diverge movements. A maximum queue length of 236 feet is reported extending from the Interchange 14 toll plaza, which is not of sufficient length to impact the operation of the upstream ramp diverge areas. Ramp roadways report densities within acceptable level of service ranges (D or better), except on the loop segment on Ramp HS, which operates at LOS E. A short queue length of 109 feet forms along Ramp HXT approaching Ramp HS as traffic negotiates the existing loop ramp, which is posted with a 20-mph advisory speed. This queue does not extend onto the ramp itself. It should be noted that the queues reported are not necessarily sustained but do occur up to the maximum lengths reported during the analysis period.

Table 10-17 – Performance Measures – Base Year 2021 Weekday AM Peak Hour
NB-HCE Westbound at Ramp HLT/Ramp HN and Ramp HS Splits (Interchange 14)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp HLT/Ramp HN Diverge							
NB-HCE WB	2	498	32.5	55.9	3,640	-	D
NB-HCE WB	2	1,499	32.1	56.7	3,640	-	D
NB-HCE WB	3	526	21.7	55.5	3,640	316(a)	C
Ramp HN/Ramp HLT Diverge Area							
Common Ramp	2	960	10.5	46.6	968	-	A*
Ramp HLT	1	1,607	5.1	45.1	229	-	A*
Ramp HN	1	1,424	16.6	44.4	739	-	B*
Ramp HXT, between Ramp HN/Ramp HLT and Ramp HS							
Ramp HXT	2	909	25.6	51.6	2,672	-	C
Ramp HXT	2	425	25.7	51.6	2,672	-	C
Ramp HXT	3	1,077	17.2	51.3	2,672	109(b)	B
Ramp HS Diverge Area							
Ramp HS	1	1,092	35.4	28.4	1,027	-	E*
Ramp HS	1	286	26.2	37.9	1,027	-	D*
Ramp TS	1	889	22.7	32.2	727	-	C*
Ramp TSI/O	2	877	18.5	47.0	1,754	-	C*
Ramp HXT, Approaching Interchange 14 Toll Plaza							
Ramp HXT	2	443	15.7	52.3	1,645	-	B
Ramp HXT	3	386	15.2	36.1	1,645	-	B
Toll Plaza	5	251	52.7	6.1	1,645	236(c)	F

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp HLT/Ramp HN diverge area.
(b) Measured from Ramp HS diverge area.
(c) Measured from Interchange 14 toll plaza.

Table 10-18 illustrates the Base Year 2021 weekday PM peak hour performance along the NB-HCE westbound approaching the Ramp HN/Ramp HLT diverge and downstream Ramp HS diverge. The analysis also shows a Level of Service E operation on the NB-HCE westbound approaching the ramps. As with the weekday AM peak hour analysis, as traffic exits the roadway, density decreases and level of service improves. A maximum queue length of 204 feet is reported extending from the Interchange 14 toll plaza, which is not of sufficient length to impact the operation of the upstream ramp diverge areas. A maximum queue length of 185 feet forms during the analysis period as traffic maneuvers into the proper lanes for the downstream diverge areas. Ramp roadways report densities within acceptable level of service ranges (D or better) for Ramp HLT and Ramp HN. Densities on the Ramp HS links, however, are at LOS E and F. A short queue length of 154 feet forms approaching Ramp HS as traffic negotiates the existing loop ramp, which is posted with a 20-mph advisory speed. This queue does not extend onto the ramp itself. As with the weekday AM peak hour analysis, the queues reported are not necessarily sustained but do occur up to the maximum lengths reported during the analysis period.

Table 10-18 – Performance Measures – Base Year 2021 Weekday PM Peak Hour
NB-HCE Westbound at Ramp HLT/Ramp HN and Ramp HS Splits (Interchange 14)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp HLT/Ramp HN Diverge							
NB-HCE WB	2	498	42.0	42.4	3,569	0	E
NB-HCE WB	2	1,499	40.9	43.5	3,569	0	E
NB-HCE WB	3	525	27.2	43.1	3,569	185(a)	D
Ramp HN/Ramp HLT Diverge Area							
Common Ramp	2	960	8.9	44.9	795	0	A*
Ramp HLT	1	1,607	4.5	42.2	190	0	A*
Ramp HN	1	1,424	13.5	44.6	605	0	B*
Ramp HXT, between Ramp HN/Ramp HLT and Ramp HS							
Ramp HXT	2	910	28.0	49.2	2,774	0	D
Ramp HXT	2	425	26.9	51.5	2,774	0	D
Ramp HXT	3	1,077	18.4	50.0	2,774	154(b)	C
Ramp HS Diverge Area							
Ramp HS	1	1,092	52.8	28.0	1,492	0	F*
Ramp HS	1	286	38.7	37.6	1,492	0	E*
Ramp TS	1	889	28.9	38.1	1,096	0	D*
Ramp TSI/O	2	877	26.3	49.1	2,588	0	D*
Ramp HXT, Approaching Interchange 14 Toll Plaza							
Ramp HXT	2	443	12.1	52.6	1,282	0	B
Ramp HXT	3	386	11.8	36.0	1,282	0	B
Toll Plaza	5	251	41.7	6.0	1,282	204(c)	E

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp HLT/Ramp HN diverge area.
(b) Measured from Ramp HS diverge area.
(c) Measured from Interchange 14 toll plaza.

10.2.2.2. **<u>Design Year 2050 (No-Build) Operation</u>**

Table 10-19 illustrates the Design Year 2050 (No-Build) weekday AM peak hour performance along the NB-HCE westbound approaching the Ramp HN/Ramp HLT diverge and downstream Ramp HS diverge. The analysis predicts similar results to the Base Year analysis, with densities increasing due to the increase in traffic demand. Level of service on the NB-HCE approaching the diverge areas deteriorates to LOS E. Speeds along the length of the NB-HCE and Ramp HXT will be minimally affected under the increased traffic demand. Queues at the Interchange 14 toll plaza and approaching Ramp HS will persist, for the reasons cited above; these queues, however, will not impact the operation of upstream facilities or extend further downstream onto Ramp HS.

Table 10-19 – Performance Measures – Design Year 2050 (No-Build) Weekday AM Peak Hour NB-HCE Westbound at Ramp HLT/Ramp HN and Ramp HS Splits (Interchange 14)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp HLT/Ramp HN Diverge							
NB-HCE WB	2	498	39.4	50.2	3.942	-	E
NB-HCE WB	2	1,499	35.8	55.1	3,942	-	E
NB-HCE WB	3	525	23.2	56.2	3,942	347(a)	C
Ramp HN/Ramp HLT Diverge Area							
Common Ramp	2	960	11.4	46.5	1,049	-	B*
Ramp HLT	1	1,607	5.5	45.1	248	-	A*
Ramp HN	1	1,424	18.2	44.4	801	-	C*
Ramp HXT, between Ramp HN/Ramp HLT and Ramp HS							
Ramp HXT	2	909	27.8	51.6	2,893	-	D
Ramp HXT	2	425	27.8	51.5	2,893	-	D
Ramp HXT	3	1,077	18.7	51.2	2,893	88(b)	C
Ramp HS Diverge Area							
Ramp HS	1	1,092	38.4	28.4	1,112	-	E*
Ramp HS	1	286	28.4	37.8	1,112	-	D*
Ramp TS	1	889	22.7	38.4	854	-	C
Ramp TSI/O	2	877	20.1	48.8	1,966	-	C
Ramp HXT, Approaching Interchange 14 Toll Plaza							
Ramp HXT	2	445	16.9	52.3	1,781	-	B
Ramp HXT	3	386	16.4	36.1	1,781	-	B
Toll Plaza	5	251	57.7	6.1	1,781	263(c)	F

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp HLT/Ramp HN diverge area.
(b) Measured from Ramp HS diverge area.
(c) Measured from Interchange 14 toll plaza.

Table 10-20 illustrates the Design Year 2050 (No-Build) weekday PM peak hour performance along the NB-HCE westbound approaching the Ramp HN/Ramp HLT diverge and downstream Ramp HS diverge. The analysis predicts similar results to the Base Year analysis, with densities increasing due to the increase in traffic demand. The NB-HCE approaching the ramp diverge area deteriorates to LOS F because of the increased travel demand. Speeds along the length of the NB-HCE and Ramp HXT will be minimally affected under the increased traffic demand. Queues at the Interchange 14 toll plaza will persist, for the reasons cited above; these queues, however, will not impact the operation of upstream facilities.

Table 10-20 – Performance Measures – Design Year 2050 (No-Build) Weekday PM Peak Hour
NB-HCE Westbound at Ramp HLT/Ramp HN and Ramp HS Splits (Interchange 14)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp HLT/Ramp HN Diverge							
NB-HCE WB	2	498	46.9	41.2	3,866	-	F
NB-HCE WB	2	1,499	44.7	43.2	3,866	-	E
NB-HCE WB	3	525	29.7	42.9	3,866	373(a)	D
Ramp HN/Ramp HLT Diverge Area							
Common Ramp	2	960	9.7	44.9	860	-	A*
Ramp HLT	1	1,607	4.8	42.2	205	-	A*
Ramp HN	1	1,424	14.8	44.6	655	-	B*
Ramp HXT, between Ramp HN/Ramp HLT and Ramp HS							
Ramp HXT	2	909	30.7	48.7	3,006	-	D
Ramp HXT	2	425	29.2	51.1	3,006	-	D
Ramp HXT	3	1,077	20.0	49.8	3,006	112(b)	C
Ramp HS Diverge Area							
Ramp HS	1	1,092	57.4	27.8	1,616	-	F*
Ramp HS	1	286	41.8	37.6	1,616	-	E*
Ramp TS	1	889	29.9	38.1	1,141	-	D*
Ramp TSI/O	2	877	27.9	49.1	2,757	-	D*
Ramp HXT, Approaching Interchange 14 Toll Plaza							
Ramp HXT	2	443	13.1	52.6	1,390	-	B
Ramp HXT	3	386	12.8	36.1	1,390	-	B
Toll Plaza	5	251	45.6	6.0	1,390	192(c)	F

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp HLT/Ramp HN diverge area.
(b) Measured from Ramp HS diverge area.
(c) Measured from Interchange 14 toll plaza.

10.2.2.3. **Design Year 2050 (Build) Operation**

Figure 10-12 illustrates the proposed geometry for analysis. The four-lane NB-HCE (HEW Roadway) approaches the Ramp HLT/Ramp HN split, where one approach lane would access both ramps. A second ramp lane would open alongside the dedicated exit lane to facilitate movements to Ramp HLT, while the exit lane from the NB-HCE would continue as Ramp HN. Three lanes would continue onto Ramp HXT beyond the initial split to cross the Turnpike mainline. The Ramp HXT/Ramp HS split would provide two lanes to each ramp, with the center lane of the three-lane approach roadway providing an option lane to either ramp.

Ramp HS would carry a significant proportion of the traffic approaching Interchange 14 on the westbound NB-HCE. Based on Design Year 2050 (Build) forecast demand, 28.2% of the total NB-HCE approach traffic (1,356 of 4,806 vph) will exit at Ramp HS during the weekday AM peak hour. The percentage increases to 41.8% (1,971 of 4,713 vph) during the weekday PM peak hour. For comparison, the forecast traffic continuing to the Interchange 14 toll plaza via Ramp HXT will be 2,171 vph and 1,693 vph during the weekday AM and PM peak hours, respectively. Alternatives were considered to convert Ramp HS from a loop ramp to a semi-directional ramp; these were dismissed due to additional right-of-way impacts, impacts to Port Street and access to Authority State Police and Maintenance facilities, and conflicts with Newark Airport aircraft glide planes. The geometry shown in Figure 10-12, therefore, maintains the loop ramp geometry.

Figure 10-12 – NB-HCE Westbound at Interchange 14
Proposed Geometry

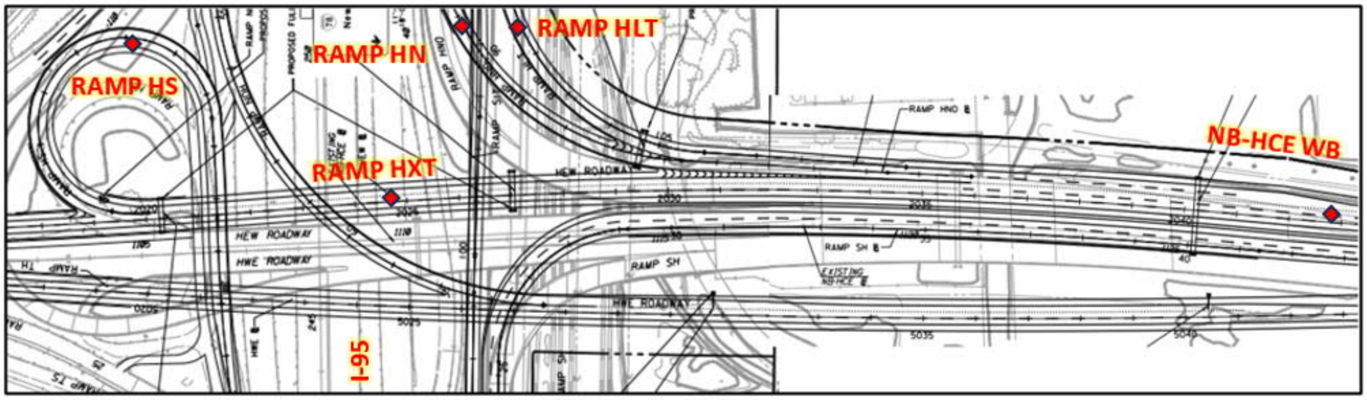


Table 10-21 illustrates the Design Year 2050 (Build) weekday AM peak hour performance along the NB-HCE westbound approaching the Ramp HN/Ramp HLT diverge and downstream Ramp HS diverge. The analysis shows improved level of service and higher speeds along the NB-HCE westbound and Ramp HXT approaching Ramp HS. Queues at the Interchange 14 toll plaza will persist, extending 52 feet, as the proposed geometry will narrow to a two-lane approach into the five toll plaza lanes accessible from this approach; this queue, however, will not impact the operation of upstream facilities such as the Ramp HS diverge area. The improved level of service would likely occur because of reduced lane changing due to the narrower approach geometry. Ramp HS will operate at LOS D within the single-lane distance. A small queue (up to 196 feet) will continue to form on Ramp HXT approaching the Ramp HS split; while the loop radius will be increased (with design speed increasing from 20 to 25 MPH, per the Preliminary Design Report), the loop ramp geometry would continue to be constrained. The reported queue approaching the Ramp HLT/Ramp HN diverge will be a non-sustained queue that forms as approaching traffic moves to the proper lanes to negotiate the diverge area.

Table 10-21 – Performance Measures – Design Year 2050 (Build) Weekday AM Peak Hour NB-HCE Westbound at Ramp HLT/Ramp HN and Ramp HS Splits (Interchange 14)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp HLT/Ramp HN Diverge							
NB-HCE WB	4	1,738	18.5	65.0	4,806	-	C
NB-HCE WB	4	956	18.7	64.4	4,806	-	C
NB-HCE WB	5	545	15.5	61.8	4,806	218(a)	B
Ramp HN/Ramp HLT Diverge Area							
Common Ramp	2	239	11.9	54.0	1,279	-	B*
Ramp HLT	1	1,309	6.6	45.3	303	-	A*
Ramp HN	1	1,136	22.5	44.2	976	-	C*
Ramp HXT, between Ramp HN/Ramp HLT and Ramp HS							
Ramp HXT	3	120	18.8	61.9	3,527	-	C
Ramp HXT	3	1,501	19.2	61.0	3,527	196(b)	C
Ramp HS Diverge Area							
Ramp HS	2	1,234	20.0	33.3	1,356	-	C*
Ramp HS	1	286	31.2	42.2	1,356	-	D*
Ramp TS	1	854	23.0	38.4	865	-	C*
Ramp TSI/O	2	877	21.8	50.8	2,221	-	C*
Ramp HXT, Approaching Interchange 14 Toll Plaza							
Ramp HXT	2	401	18.1	60.0	2,171	-	C
Ramp HXT	2	397	27.8	37.5	2,171	-	D
Toll Plaza	5	251	28.6	15.2	2,171	52(c)	D

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp HLT/Ramp HN diverge area.
(b) Measured from Ramp HS diverge area.
(c) Measured from Interchange 14 toll plaza.

Table 10-22 illustrates the Design Year 2050 (Build) weekday PM peak hour performance along the NB-HCE westbound approaching the Ramp HN/Ramp HLT diverge and downstream Ramp HS diverge. The analysis shows improved level of service and higher speeds along the NB-HCE westbound and Ramp HXT approaching Ramp HS. Queues at the Interchange 14 toll plaza will persist as the proposed geometry will narrow to a two-lane approach into the toll plaza area and the improved traffic operations upstream would remove constraints on flow; this queue, however, will not impact the operation of upstream facilities such as the Ramp HS diverge area. Ramp HS will operate at LOS F within the single-lane distance, with a maximum queue of 678 feet forming because of the friction of lane reduction on Ramp HS from two lanes to one. The total ramp demand will also be greater than the capacity of the ramp roadway. For reasons outlined above, the loop ramp geometry was maintained as the proposed geometry. This ramp queue will not extend into the diverge area on Ramp HXT. A small queue will continue to form on Ramp HXT (up to 187 feet) approaching the Ramp HS split; this queue is separate from the queue downstream on the ramp and will likely form because of the improved, but still constrained loop ramp geometry. The reported queue approaching the Ramp HLT/Ramp HN diverge will be a non-sustained queue that forms as approaching traffic moves to the proper lanes to negotiate the diverge area.

Table 10-22 – Performance Measures – Design Year 2050 (Build) Weekday PM Peak Hour NB-HCE Westbound at Ramp HLT/Ramp HN and Ramp HS Splits (Interchange 14)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp HLT/Ramp HN Diverge							
NB-HCE WB	4	1,738	22.1	53.5	4,713	-	C
NB-HCE WB	4	956	18.5	63.8	4,713	-	C
NB-HCE WB	5	545	14.7	63.5	4,713	162(a)	B
Ramp HN/Ramp HLT Diverge Area							
Common Ramp	2	239	9.4	56.0	1,049	-	A*
Ramp HLT	1	1,309	5.4	45.3	250	-	A*
Ramp HN	1	1,136	18.3	44.4	799	-	C*
Ramp HXT, between Ramp HN/Ramp HLT and Ramp HS							
Ramp HXT	3	120	19.0	63.7	3,664	-	C
Ramp HXT	3	1,498	20.3	60.1	3,664	187(b)	C
Ramp HS Diverge Area							
Ramp HS	2	1,234	34.6	28.4	1,971	678(c)	D*
Ramp HS	1	286	49.5	39.1	1,971	-	F*
Ramp TS	1	854	18.1	37.8	690	-	C*
Ramp TSI/O	2	877	25.6	51.7	2,661	-	C*
Ramp HXT, Approaching Interchange 14 Toll Plaza							
Ramp HXT	2	401	14.3	59.1	1,693	-	B
Ramp HXT	2	396	22.9	36.7	1,693	-	C
Toll Plaza	5	251	46.9	7.3	1,693	153(d)	F

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp HLT/Ramp HN diverge area.
(b) Measured from Ramp HS diverge area.
(c) Measured from Ramp HS merge from two lanes to one.
(d) Measured from Interchange 14 toll plaza.

10.2.2.4. Ramp HLT/Ramp HN and Ramp HS Diverge Conclusion

The westbound NB-HCE on the west side of the Newark Bay Bridge (approaching the Interchange 14 ramps) operates at level of service D or worse under Base Year traffic conditions. Queues forming at the Interchange 14 toll plaza do not affect operations at the ramp diverge areas, which operate under acceptable levels of service (D or better) as traffic leaves the NB-HCE westbound. Minor queuing occurs approaching Ramp HS as motorists, including numerous heavy vehicles, negotiate the tight loop-ramp geometry. Traffic volume levels on Ramp HS approach capacity, especially during the weekday PM peak hour. Design Year 2050 (No-Build) increased traffic demands will exacerbate operations, with some facilities, including Ramp HS, deteriorating to LOS F during the weekday PM peak hour. The proposed geometry, with Ramp HS further enhanced from the IPA, will improve operations on the NB-HCE and at the ramps. The single-lane portion of Ramp HS will remain at LOS F as, consistent with the static analysis, the single lane will not be able to accommodate the traffic demand. A queue will form where the ramp transitions from two lanes to one; its length, however, will not impede traffic flow along Ramp HXT at the Ramp HS diverge point. Factors such as additional right-of-way impacts, impacts to Port Street, access to Authority State Police and Maintenance facilities, and conflicts with Newark Airport aircraft glide planes precluded further improving the ramp geometry.

The proposed geometry, with the one exception noted above, would provide acceptable operation at Level of Service D or better. Where LOS F persists during the weekday PM peak hour, the impacts are minimized such that traffic flow is not impeded on upstream or downstream facilities.

10.3 INTERCHANGE 14A ANALYSIS

10.3.1 Interchange 14A Toll Plaza Capacity Assessment

Entering and exiting traffic at the Interchange 14A toll plaza under Base Year volumes and Design Year forecast demands were evaluated against the total maximum processing rate of the entry and exit plazas. This total maximum processing rate is defined as the sum of the maximum processing rates of the existing toll lanes at the plaza. While the Authority continually assesses the efficiency and operations of its toll plazas, since there are currently no definite, identified modifications planned, for the Design Year assessment, it was assumed that the existing Interchange 14A toll lane configuration will remain.

Maximum processing rates differ based on the toll collection method. Typical maximum processing rates, as supplied by the Authority's Tolls Department, are summarized in Table 10-23.

Table 10-23 – Maximum Processing Rates by Toll Collection Method

Mode of Operation	Maximum Processing Rate (vph)
E-ZPass Only Toll Lane	800
High-Speed E-ZPass Lane	1,800
DATIM/E-ZPass Entry Toll Lane	300
Cash/E-ZPass Exit Toll Lane	250

The toll plaza lane configuration at Interchange 14A consists of a total of 13 toll lanes, broken out as shown below in Table 10-24. For this analysis, all toll lanes were assumed to be open during the peak hours studied.

Table 10-24 – Interchange 14A Toll Lane Configuration and Processing Rates

Lane No.	Mode of Operation	Entry Maximum Processing Rate (vph)	Exit Maximum Processing Rate (vph)
1	E-ZPass Only Toll Lane	800	
2	DATIM/E-ZPass Entry Toll Lane	300	
3	E-ZPass Only Toll Lane	800	
4	E-ZPass Only Toll Lane	800	
5	DATIM/E-ZPass Entry Toll Lane	300	
6	E-ZPass Only Toll Lane		800
7	Cash/E-ZPass Exit Toll Lane		250
8	E-ZPass Only Toll Lane		800
9	E-ZPass Only Toll Lane		800
10	Cash/E-ZPass Exit Toll Lane		250
11	E-ZPass Only Toll Lane		800
12	Cash/E-ZPass Exit Toll Lane		250
13	E-ZPass Only Toll Lane		800
Total Maximum Processing Rate		3,000	4,750

Toll plaza transaction data at Interchange 14A, provided by the Authority for June, August, and September 2021, established the E-ZPass penetration rate of the traffic stream exiting the Turnpike at this interchange. This information, summarized in Table 10-25, is only available for exiting traffic, since the transaction type is recorded at the point of exit. With E-ZPass users also able to use DATIM lanes, entry side E-ZPass penetration rates are not readily available. For this assessment, the exit side penetration rate was also used for the entry side. This E-ZPass penetration rate was also applied to the 2050 Design Year volume demand.

Table 10-25 – Interchange 14A Monthly E-ZPass Penetration Rates

Month	E-ZPass Penetration Rate
June 2021	88.5%
August 2021	88.4%
September 2021	88.9%
Average	88.6%

Table 10-26 and Table 10-27 compare maximum processing rates to the traffic volumes or demands at the Interchange 14A toll plaza. Total plaza figures as well as E-ZPass and Cash users are summarized in the tables. Table 10-26 summarizes the exit traffic assessment, while Table 10-27 summarizes the entry traffic assessment.

Table 10-26 – Interchange 14A Exit Toll Plaza Assessment
Volume/Demand versus Maximum Processing Rate

Volume Scenario	Total Traffic (vph)	E-ZPass Users (vph)	Cash Users (vph)
Processing Rate	4,750	4,000	750
Weekday AM Peak Hour			
2021 Base Year	2,065	1,830	235
2050 Design Year (No Build)	2,237	1,982	255
2050 Design Year (Build)	2,727	2,416	311
Weekday PM Peak Hour			
2021 Base Year	2,233	1,978	255
2050 Design Year (No Build)	2,419	2,143	276
2050 Design Year (Build)	2.949	2,613	336

Table 10-26 shows that the total processing capacity of the exit toll plaza adequately serves the Base year exiting traffic demands for both weekday peak hours. When considering toll collection type, both total E-ZPass Only Toll Lane processing capacity and Cash/E-ZPass Exit Toll Lane processing capacity also adequately serve the respective Base Year traffic demands. Forecast traffic demands for the 2050 Design Year, both for No-Build and Build volume profiles, would also be adequately served by the toll plaza exiting lane configuration. This finding applies to both total processing capacity and to the processing capacities of the individual toll collection types.

Table 10-27 – Interchange 14A Entry Toll Plaza Assessment
Volume/Demand versus Maximum Processing Rate

Volume Scenario	Total Traffic (vph)	E-ZPass Users (vph)	Cash Users (vph)
Processing Rate	3,000	2,400	600
Weekday AM Peak Hour			
2021 Base Year	2,859	2,533	326
2050 Design Year (No Build)	3,096	2,743	353
2050 Design Year (Build)	3,775	3,345	430
Weekday PM Peak Hour			
2021 Base Year	1,925	1,706	219
2050 Design Year (No Build)	2,085	1,847	238
2050 Design Year (Build)	2,542	2,252	290

Table 10-27 shows that the total processing capacity of the entry toll plaza adequately serves the Base year entering traffic demands for the weekday PM peak hour. If all E-ZPass users were to use the E-ZPass only lanes, there is not enough capacity to process them in the weekday AM peak hour. For the weekday AM peak hour, however, since E-ZPass users can also use the DATIM/E-ZPass, the overflow E-ZPass demand can be adequately served by the reserve capacity of the DATIM/E-ZPass Entry Toll Lane.

Forecast traffic demands for the 2050 Design Year, both for No-Build and Build volume profiles, are adequately served by the toll plaza entering lane configuration for the weekday PM peak hour. This finding applies to both total processing capacity and to the processing capacities of the individual toll collection types. For the weekday AM peak hour, however, total demand and demand of E-ZPass users are not completely served by the current toll plaza lane configuration.

It is recommended that Lane 6, which is an E-ZPass Only Toll Lane serving exiting traffic, be converted to serve entering traffic in the same toll collection mode. Table 10-28 and Table 10-29 repeat the toll plaza processing rate comparisons to traffic demands, incorporating this proposed change. Only the Design Year 2050 traffic demands are shown in these tables.

Table 10-28 – Interchange 14A Exit Toll Plaza Assessment
Volume/Demand versus Maximum Processing Rate
Lane 6 Converted to Entry Lane

Volume Scenario	Total Traffic (vph)	E-ZPass Users (vph)	Cash Users (vph)
Processing Rate	3,950	3,200	750
Weekday AM Peak Hour			
2050 Design Year (No Build)	2.237	1,982	255
2050 Design Year (Build)	2,727	2,416	311
Weekday PM Peak Hour			
2050 Design Year (No Build)	2,419	2,143	276
2050 Design Year (Build)	2,949	2,613	336

Table 10-29 – Interchange 14A Entry Toll Plaza Assessment
Volume/Demand versus Maximum Processing Rate
Lane 6 Converted to Entry Lane

Volume Scenario	Total Traffic (vph)	E-ZPass Users (vph)	Cash Users (vph)
Processing Rate	3,800	3,200	600
Weekday AM Peak Hour			
2050 Design Year (No Build)	3,096	2,743	353
2050 Design Year (Build)	3,775	3,345	430
Weekday PM Peak Hour			
2050 Design Year (No Build)	2,085	1,847	238
2050 Design Year (Build)	2,542	2,252	290

The revised assessment continues to show that the exiting toll plaza lanes would serve Design Year traffic demands, for both No-Build and Build traffic profiles and during both weekday peak hours, even with Lane 6 converted to an entry toll lane. This lane conversion would provide the additional processing capacity on the entry side to serve entering traffic demands. The total Build demand would be served by the revised plaza configuration during the weekday AM peak hour. Although the E-ZPass only lanes alone would not serve all E-ZPass demand by themselves, overflow E-ZPass user demand would be served by the reserve processing capacity of the DATIM/E-ZPass Entry Toll Lanes.

10.3.2 NB-HCE Eastbound/Ramp WT Diverge Alternatives

Approaching Interchange 14A, the two-lane NB-HCE eastbound (HWE Roadway) currently expands to include a deceleration lane leading to Ramp WT exiting the highway. The ramp includes heavy truck traffic that is bound for port facilities in Bayonne that are accessible from this interchange. The length of the ramp, between the painted gore and the entry area to the

Interchange 14A toll plaza, is approximately 1,700 feet. Figure 10-13 shows the diverge area geometry.

Figure 10-13 – NB-HCE Eastbound/Ramp WT Diverge (Interchange 14A) Existing Geometry

10.3.2.1. Base Year 2021 Operation

Table 10-30 illustrates the Base Year 2021 weekday AM peak hour performance under the existing geometry of the eastbound NB-HCE at Ramp WT. The model analysis reflects a maximum queue of 483 feet approaching the Ramp WT diverge area. This queue likely influences traffic flow through this diverge area. The static analysis in the previous section showed that Base Year volumes warrant two lanes. This finding is supported by the density level on the ramp, which is equivalent to LOS E for basic freeway segments. Total volume on the NB-HCE approaching the ramp exceeds the service flow rate for LOS D, as also noted in the static analysis, and results in the LOS E finding. The NB-HCE roadway LOS improves to an acceptable LOS C beyond the Ramp WT diverge area.

Table 10-30 – Performance Measures - Base Year 2021 Weekday AM Peak Hour
NB-HCE Eastbound at Ramp WT (Interchange 14A)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE EB Approaching Ramp WT Diverge							
NB-HCE EB	2	5,916	52.9	43.1	4,533		F
NB-HCE EB	2	723	46.9	48.4	4,533		F
NB-HCE EB	3	779	29.9	50.6	4,533	483(a)	D
Ramp WT Diverge Area							
Ramp WT	1	1,288	43.6	38.0	1,696		E*
Ramp WT	2	109	18.0	37.3	1,696		C*
Ramp WT	3	112	9.3	34.8	1,696		A*
Toll Plaza	8	190	13.7	16.2	1,696	77(b)	B*
NB-HCE EB, East of Ramp WT							
NB-HCE EB	2	2,865	25.5	56.6	2,837		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from NB-HCE EB/Ramp WT diverge area.
(b) Measured from Interchange 14A toll plaza.

Table 10-31 illustrates the Base Year 2021 weekday PM peak hour performance under the existing geometry of the eastbound NB-HCE at Ramp WT. The analysis shows similar results to the weekday AM peak hour analysis, though the maximum queue of 271 feet approaching the ramp diverge area is less than that in the weekday AM peak. As noted before, the static analysis in the previous section showed that Base Year volumes warrant two lanes; the density level on the ramp, which is equivalent to LOS F for basic freeway segments, supports this finding. Total volume on the NB-HCE approaching the ramp exceeds the service flow rate for LOS D, as also noted in the static analysis, and results in the LOS E finding. The NB-HCE roadway LOS improves to an acceptable LOS C beyond the Ramp WT diverge area.

Table 10-31 – Performance Measures - Base Year 2021 Weekday PM Peak Hour
NB-HCE Eastbound at Ramp WT (Interchange 14A)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE EB Approaching Ramp WT Diverge							
NB-HCE EB	2	5,915	38.4	50.3	3,852		E
NB-HCE EB	2	723	38.4	50.2	3,852		E
NB-HCE EB	3	778	25.2	50.8	3,852	271(a)	C
Ramp WT Diverge Area							
Ramp WT	1	1,288	48.4	32.1	1,555		F*
Ramp WT	2	109	20.0	31.4	1,555		C*
Ramp WT	3	112	9.8	31.0	1,555		A*
Toll Plaza	8	190	15.9	15.5	1,555	57(b)	B*
NB-HCE EB, East of Ramp WT							
NB-HCE EB	2	2,859	20.2	56.9	2,297		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from NB-HCE EB/Ramp WT diverge area.
(b) Measured from Interchange 14A toll plaza.

10.3.2.2. **Design Year 2050 (No-Build) Operation**

Table 10-32 illustrates the No Build 2050 AM performance for Ramp WT as it splits from HWE and approaches the Interchange 14A toll plaza. For this model, the input peak hour demand (4,909 vph) would exceed the capacity of the network. Of this total demand, 375 vehicles would not be able to make it onto the simulation network during the peak hour. This would be considered additional queuing on the ramp and on the NB-HCE eastbound beyond that reported by the model. This additional queue length is defined by the number of vehicles of unmet demand and the average vehicle headway. The average vehicle headway accounts for the proportion of trucks in the traffic stream.

Additional Queue = (375 vehicles) * (28 feet/vehicle) = 10,500 feet

This queue would be distributed over both the ramp and the approaching NB-HCE eastbound roadway. This distribution is approximated based on the distribution of traffic at the ramp diverge. Based on traffic demands presented in Section 7, 63% of the approach traffic on the NB-HCE will continue eastbound past the Ramp WT diverge, while the remaining 37% will exit to Ramp WT. Assuming that the full length of the ramp between the painted gore and the Interchange 14A toll plaza (1,700 feet, as previously reported) is part of this queue, the remaining queue would extend approximately 0.8 miles on the approach NB-HCE roadway. Table 10-32 reflects these values.

Table 10-32 – Performance Measures - Design Year 2050 (No-Build) Weekday AM Peak Hour NB-HCE Eastbound at Ramp WT (Interchange 14A)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE EB Approaching Ramp WT Diverge							
NB-HCE EB	2	5,915	54.2	42.0	4,909		F
NB-HCE EB	2	720	46.4	49.9	4,909		F
NB-HCE EB	3	779	29.9	50.5	4,909	4,400(a)	D
Ramp WT Diverge Area							
Ramp WT	1	1,288	43.5	38.0	1,837		E*
Ramp WT	2	109	18.0	37.3	1,837		B*
Ramp WT	3	112	9.3	34.8	1,837		A*
Toll Plaza	8	190	14.0	16.2	1,837	1,700(b)	B*
NB-HCE EB, East of Ramp WT							
NB-HCE EB	2	2,860	25.4	56.6	3,072		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Assumed from NB-HCE EB/Ramp WT diverge area, calculated based on unmet demand.
(b) Assumed from Interchange 14A toll plaza, calculated based on unmet demand

Table 10-33 illustrates the Design Year 2050 (No-Build) weekday PM peak hour performance under the existing geometry of the eastbound NB-HCE at Ramp WT. The analysis shows expected increases in density and decreases in speed. The single-lane Ramp WT will operate at LOS F (based on the ramp density). Increased traffic demand on the NB-HCE will result in a deterioration to LOS F operation approaching the ramp diverge. The NB-HCE roadway LOS will improve to an acceptable LOS C beyond the Ramp WT diverge area.

Table 10-33 – Performance Measures - Design Year 2050 (No-Build) Weekday PM Peak Hour
NB-HCE Eastbound at Ramp WT (Interchange 14A)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE EB Approaching Ramp WT Diverge							
NB-HCE EB	2	5,916	49.7	42.1	4,172		F
NB-HCE EB	2	723	48.7	42.9	4,172		F
NB-HCE EB	3	779	31.9	43.8	4,172	210(a)	D
Ramp WT Diverge Area							
Ramp WT	1	1,288	53.4	31.4	1,684		F*
Ramp WT	2	109	21.7	31.4	1,684		C*
Ramp WT	3	112	10.6	30.9	1,684		A*
Toll Plaza	8	190	17.2	15.5	1,684	56(b)	B*
NB-HCE EB, East of Ramp WT							
NB-HCE EB	2	2,862	23.0	54.3	2,488		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from NB-HCE EB/Ramp WT diverge area.
(b) Measured from Interchange 14A toll plaza.

10.3.2.3. **Design Year 2050 (Build) Operation** – Alternative 1

The IPA geometry reflects a four-lane NB-HCE roadway, warranted by forecast traffic demand, approaching Interchange 14A, with a two-lane Ramp WT, again warranted by forecast traffic demand, exiting the highway. This geometry, referred to as Alternative 1 for this analysis, opens the second exit ramp lane from the right side of the approach roadway. Both exit lanes would be served directly by the right lane of the NB-HCE roadway (and indirectly by lane changes from the adjacent lane). Three lanes extend east of Ramp WT on the eastbound NB-HCE. Figure 10-14 shows the proposed geometry under the IPA.

The design speed for the NB-HCE roadway will be increased from 55 to 60 MPH, as identified in the Preliminary Design Report.

Figure 10-14 – NB-HCE Eastbound at Ramp WT (Interchange 14A)
Proposed Geometry – Alternative 1 (IPA)

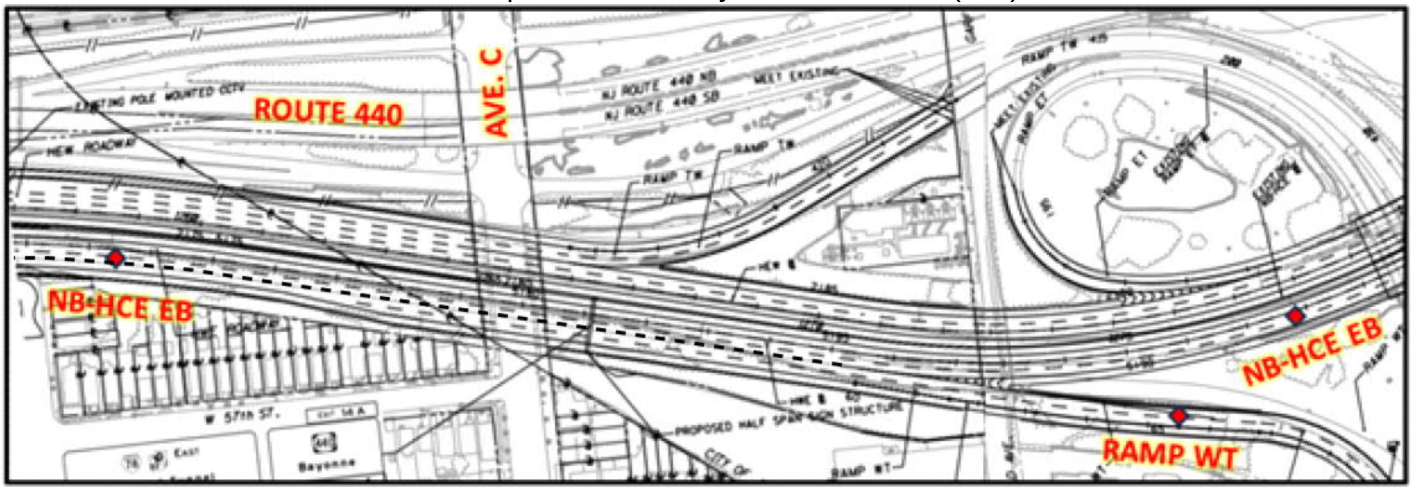


Table 10-34 illustrates the Design Year 2050 (Build) weekday AM peak hour performance under the Alternative 1 geometry on the eastbound NB-HCE at Ramp WT. The analysis shows significant improvements in roadway densities and travel speeds on the NB-HCE and Ramp WT over the No-Build operation. The increased design speed and additional travel lanes on both the NB-HCE and Ramp WT serve the traffic demand through this geometry at Level of Service C or better, which is considered acceptable. The ramp density would be equivalent to LOS C if on a basic freeway segment. Queues forming approaching the diverge area and approaching the toll plaza will be shorter than those under the No-Build condition; the latter will not further impact operation of the NB-HCE at the ramp diverge.

Table 10-34 – Performance Measures - Design Year 2050 (Build) Weekday AM Peak Hour
NB-HCE Eastbound at Ramp WT (Interchange 14A) – Alternative 1 (IPA)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE EB Approaching Ramp WT Diverge							
NB-HCE EB	4	6,205	21.6	69.7	5,986		C
NB-HCE EB	4	704	22.3	66.5	5,986		C
NB-HCE EB	5	797	18.1	66.2	5,986	288(a)	C
Ramp WT Diverge Area							
Ramp WT	2	960	24.7	44.5	2,240		C*
Ramp WT	2	109	24.0	37.4	2,240		C*
Ramp WT	3	112	12.8	33.7	2,240		B*
Toll Plaza	8	190	18.7	15.9	2,240	69(b)	C*
NB-HCE EB, East of Ramp WT							
NB-HCE EB	3	2,563	21.2	59.2	3,746		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from NB-HCE EB/Ramp WT diverge area.
(b) Measured from Interchange 14A toll plaza.

Table 10-35 illustrates the Design Year 2050 (Build) weekday PM peak hour performance under the Alternative 1 geometry on the eastbound NB-HCE at Ramp WT. As with the weekday AM peak hour analysis, these results also show significant improvements in roadway densities and travel speeds on the NB-HCE and Ramp WT over the No-Build operation. The increased design speed and additional travel lanes on both the NB-HCE and Ramp WT will serve the traffic demand through this geometry at LOS D or better, which is considered acceptable. The ramp density would be equivalent to LOS D if on a basic freeway segment. Queues that do form on the ramp from the toll plaza will not impact operation of the NB-HCE at the ramp diverge. Queuing approaching the diverge will be minimal.

Table 10-35 – Performance Measures - Design Year 2050 (Build) Weekday PM Peak Hour
NB-HCE Eastbound at Ramp WT (Interchange 14A) – Alternative 1 (IPA)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE EB Approaching Ramp WT Diverge							
NB-HCE EB	4	6,195	20.1	63.7	5,088		C
NB-HCE EB	4	704	21.5	58.4	5,088		C
NB-HCE EB	5	797	16.4	62.0	5,088	21(a)	B
Ramp WT Diverge Area							
Ramp WT	2	960	27.7	37.0	2,053		D*
Ramp WT	2	109	26.1	31.8	2,053		D*
Ramp WT	3	112	13.1	30.4	2,053		B*
Toll Plaza	8	190	21.2	15.3	2,053	65(b)	C*
NB-HCE EB, East of Ramp WT							
NB-HCE EB	3	2,563	17.1	59.6	3,035		B

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from NB-HCE EB/Ramp WT diverge area.
(b) Measured from Interchange 14A toll plaza.

10.3.2.4. **Design Year 2050 (Build) Operation** – Alternative 2

An alternative geometry, depicted in Figure 10-15 below, revises the access to the two-lane Ramp WT. In this alternative, the right two lanes of the approaching NB-HCE eastbound will provide access the two exiting lanes of Ramp WT. The right-center lane of the NB-HCE eastbound will become an option lane, such that motorists in that lane have the choice of remaining on the NB-HCE or exiting via Ramp WT. The benefit of this option lane is to spread exiting traffic onto more lanes of the approaching roadway and make more efficient use of the capacity of the ramp diverge area.

Figure 10-15 – NB-HCE Eastbound at Ramp WT (Interchange 14A)
Proposed Geometry – Alternative 2 (Option Lane)

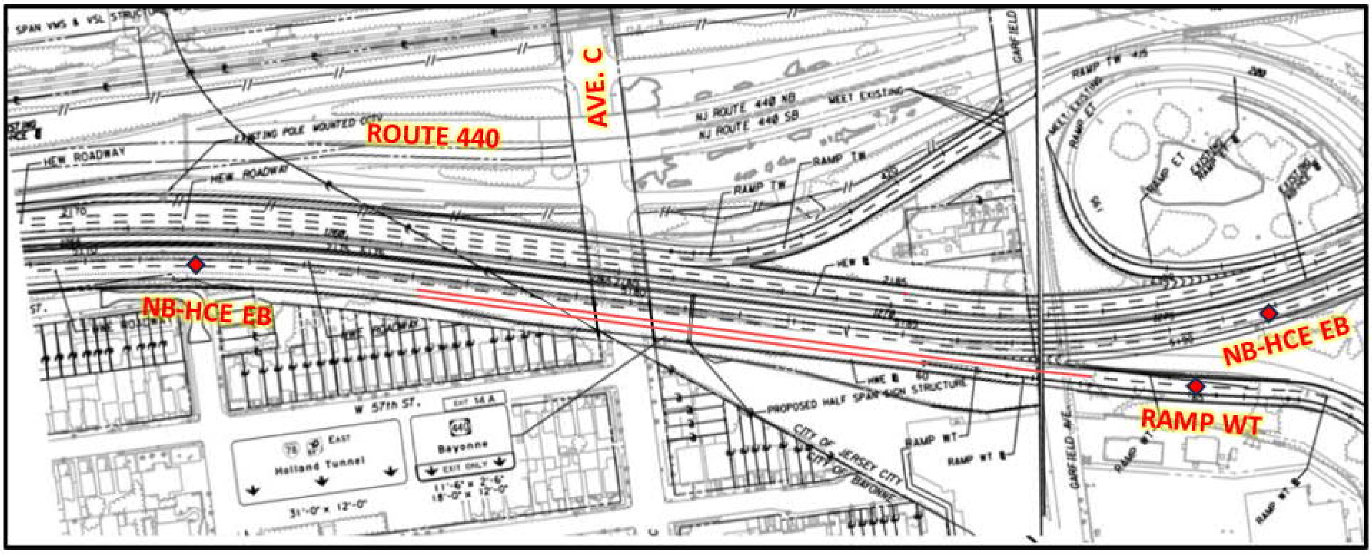


Table 10-36 illustrates the Design Year 2050 (Build) weekday AM peak hour performance under the Alternative 2 geometry on the eastbound NB-HCE at Ramp WT. The analysis shows minor improvements in roadway density and travel speed on the NB-HCE approach to Ramp WT relative to Alternative 1. Queues from the Interchange 14A toll plaza would improve over Alternative 1, likely because of the distribution of ramp traffic approaching the toll booths. While modest, the results indicate the desired impact of the option lane configuration. Similar improvements would be realized on Ramp WT and on the NB-HCE beyond the ramp diverge. Levels of Service will be C or better for this proposed geometry. The ramp density would be equivalent to LOS C if on a basic freeway segment. Queues that do form on the ramp from the toll plaza will not impact operation of the NB-HCE at the ramp diverge.

Table 10-36 – Performance Measures - Design Year 2050 (Build) Weekday AM Peak Hour
NB-HCE Eastbound at Ramp WT (Interchange 14A) – Alternative 2 (Option Lane)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE EB Approaching Ramp WT Diverge							
NB-HCE EB	4	6,179	21.4	70.0	5,986		C
NB-HCE EB	4	1,501	21.8	68.7	5,986	203(a)	C
Ramp WT Diverge Area							
Ramp WT	1	949	25.2	44.3	2,240		C*
Ramp WT	2	109	24.2	37.1	2,240		C*
Ramp WT	3	112	13.1	33.1	2,240		B*
Toll Plaza	8	190	18.9	15.7	2,240	65(b)	C*
NB-HCE EB, East of Ramp WT							
NB-HCE EB	2	2,557	21.2	59.4	3,746		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from NB-HCE EB/Ramp WT diverge area.
(b) Measured from Interchange 14A toll plaza.

Table 10-37 illustrates the Design Year 2050 (Build) weekday PM peak hour performance under the Alternative 2 geometry on the eastbound NB-HCE at Ramp WT. As with the weekday AM peak hour analysis, this analysis also shows minor improvements in roadway density and travel speed on the NB-HCE approach to Ramp WT relative to Alternative 1. Queues from the Interchange 14A toll plaza would not differ substantially over Alternative 1. While modest, the results indicate the desired impact of the option lane configuration. Similar improvements are realized on Ramp WT and on the NB-HCE beyond the ramp diverge. Levels of Service are D or better for this proposed geometry. The ramp density would be equivalent to LOS D if on a basic freeway segment. Queues that do form on the ramp from the toll plaza will not impact operation of the NB-HCE at the ramp diverge.

Table 10-37 – Performance Measures - Design Year 2050 (Build) Weekday PM Peak Hour
NB-HCE Eastbound at Ramp WT (Interchange 14A) – Alternative 2 (Option Lane)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE EB Approaching Ramp WT Diverge							
NB-HCE EB	4	6,197	19.9	64.1	5,088		C
NB-HCE EB	4	1,505	20.5	61.8	5,088	87(a)	C
Ramp WT Diverge Area							
Ramp WT	2	949	28.6	35.3	2,053		D*
Ramp WT	2	86	29.2	31.6	2,053		D*
Ramp WT	3	112	13.2	30.2	2,053		B*
Toll Plaza	8	190	21.4	15.2	2,053	67(b)	C*
NB-HCE EB, East of Ramp WT							
NB-HCE EB	3	2,558	17.0	59.4	3,035		B

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from NB-HCE EB/Ramp WT diverge area.
(b) Measured from Interchange 14A toll plaza.

10.3.2.5. NB-HCE Eastbound/Ramp WT Diverge Alternative Analysis Conclusion

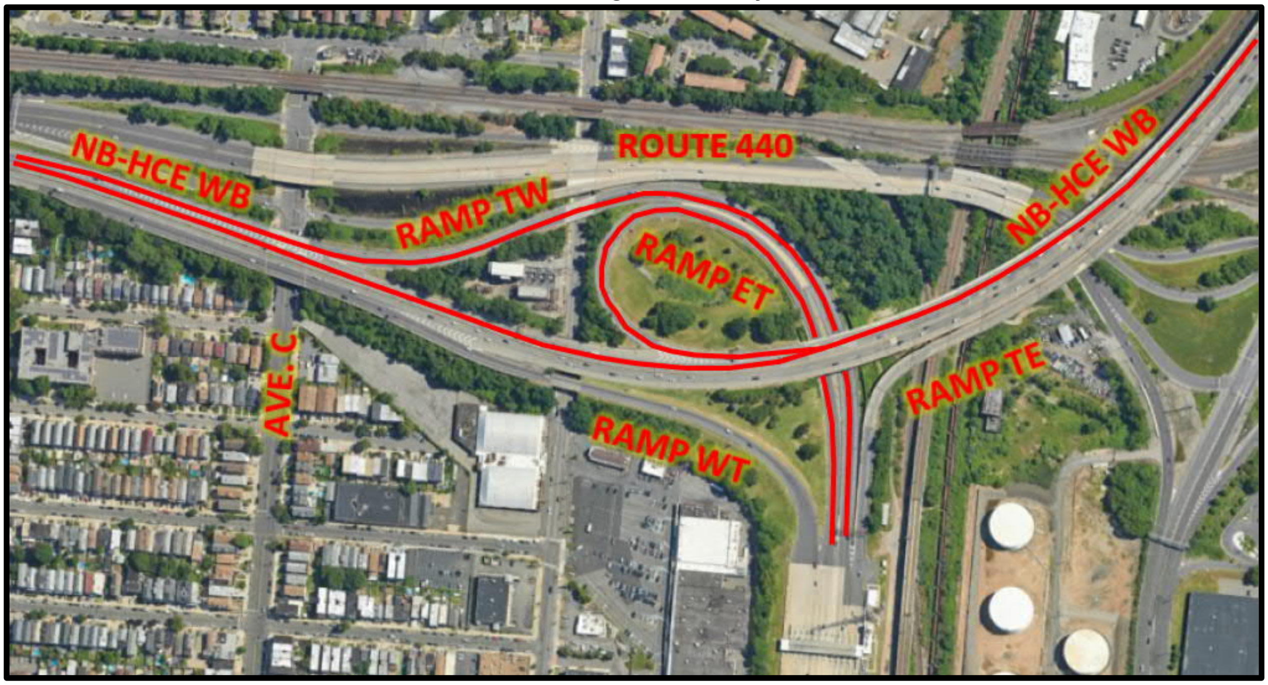
Base Year and Design Year (No-Build) models of the Ramp WT diverge from the NB-HCE eastbound at Interchange 14A show densities at Level of Service E or worse on the two-lane roadway approaching Ramp WT because of inadequate capacity on both the NB-HCE and the ramp. The static analysis in Section 9 had noted that each facility warranted more lanes than provided in the existing geometry. Ramp queues from the Interchange 14A toll plaza exacerbate the deficient diverge area operation. Both Design Year (Build) alternatives will improve operation to LOS D or better through higher design speeds and more travel lanes. Queues from the Interchange 14A toll plaza will be reduced by the introduction of the second ramp lane. While Alternative 1 (with the right lane expanding to the two exiting lanes) is documented in the Preliminary Design plans, Alternative 2 (with the option lane geometry) would provide better operational characteristics through the more optimal distribution of traffic at the exit. Alternative 2’s anticipated smaller footprint would likely yield a smaller construction cost. Alternative 2, therefore, is warranted for consideration by the Authority during the Final Design phase.

10.3.3 Proposed NB-HCE Westbound/Ramp ET/Ramp TW Geometry

At Interchange 14A, a single-lane Ramp ET diverges from the two-lane westbound NB-HCE while the roadway’s horizontal alignment transitions from a southwesterly orientation to a northwesterly one. The exit occurs just west of the roadway crossing of the interchange ramps.

A single-lane Ramp TW merges with the continuing two-lane NB-HCE westbound prior to crossing JFK Blvd. and NJ Route 440 and entering the Newark Bay Bridge. The spacing between ramps ia approximately 2,100 feet. Departing the Interchange 14A toll plaza, Ramp TW is a two-lane ramp over a 1,630-foot distance before the two lanes merge to one. Ground-mounted signing provides warning of this lane reduction. This one-lane ramp geometry, including the lane drop transition area, extends for another 1,300 feet prior to the merge with the westbound NB-HCE. The total distance from the toll booths to the merge with the NB-HCE is about 3,190 feet. The tapered merge area is on a curve and extends for about 600 feet. A striped gore area extends about 1,000 feet from the physical ramp nose to the beginning of the merge. Figure 10-16 shows the full interchange, with the westbound ramp geometry under study highlighted. The Ramp ET geometry was included in the operational models to assess the impacts of downstream congestion and queuing at the Ramp TW merge area on this ramp operation.

Figure 10-16 – NB-HCE Westbound/Ramp ET/Ramp TW (Interchange 14A)
Existing Geometry



10.3.3.1. Base Year 2021 Operation

Table 10-38 illustrates the Base Year 2021 weekday AM peak hour performance of the Ramp ET diverage area and Ramp TW merge area on the westbound NB-HCE. The on-ramp operates at LOS F, with queues extending from both merge points. The total queue length of approximately 2,700 feet extends almost the full length of the ramp, but does not enter the toll plaza area. The westbound NB-HCE approaching the Ramp TW merge operates at LOS B with no queuing noted on this roadway. The loop Ramp ET operates at LOS A with no queuing concerns approaching the toll plaza. Minor queues form on the NB-HCE ini the deceleration lane area.

Table 10-38 – Performance Measures - Base Year 2021 Weekday AM Peak Hour
NB-HCE Westbound at Ramp ET and Ramp TW (Interchange 14A)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp ET Diverge							
NB-HCE WB	2	1,726	17.0	59.2	2,020		B
NB-HCE WB	2	700	17.1	58.8	2,020		B
NB-HCE WB	3	800	11.4	59.0	2,020	70(a)	B
Ramp ET Diverge Area							
Ramp ET	1	2,017	6.3	59.0	369		A*
Ramp ET	2	71	1.1	56.7	369		A*
Toll Plaza	8	190	0.8	54.8	369		A*
NB-HCE WB, between Ramp ET and Ramp TW							
NB-HCE WB	2	2,134	15.6	52.5	1,651		B
Ramp TW Merge Area							
Ramp TW	2	1,632	28.9	34.9	1,989		D*
Ramp TW	1	1,298	49.6	40.1	1,989	2,717(b)	F*
NB-HCE WB, West of Ramp TW							
NB-HCE WB	3	438	33.6	36.3	3,640	390(c)	D
NB-HCE WB	2	1,063	36.5	49.7	3,640		E
NB-HCE WB	2	4,216	35.1	51.8	3,640		E

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp ET diverge area.
(b) Measured from Ramp WT/NB-HCE WB merge area.
(c) Measured from beginning of two-lane NB-HCE WB geometry.

Table 10-39 illustrates the Base Year 2021 weekday PM peak hour performance of the Ramp ET diverage area and Ramp TW merge area on the westbound NB-HCE. The one-lane portion of the ramp operates at LOS F, with a queue extending from the merge with the NB-HCE westbound. The total queue length of approximately 2,000 feet extends into the two-lane portion of the ramp. Exiting the toll plaza, the two-lane portion of the ramp operates at LOS C prior to back of queue. The westbound NB-HCE approaching the Ramp TW merge operates at LOS C with no queuing noted on this roadway. Beyond the merge, LOS E operation occurs because of traffic demand exceeding service rate at LOS D. The loop Ramp ET operates at LOS C with minor queuing on the NB-HCE in the deceleration lane area.

Table 10-39 – Performance Measures - Base Year 2021 Weekday PM Peak Hour
NB-HCE Westbound at Ramp ET and Ramp TW (Interchange 14A)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp ET Diverge							
NB-HCE WB	2	1,726	27.2	52.3	2,849		D
NB-HCE WB	2	700	27.3	51.7	2,849		D
NB-HCE WB	3	800	18.0	52.2	2,849	70(a)	C
Ramp ET Diverge Area							
Ramp ET	1	2,017	14.4	46.8	678		B*
Ramp ET	2	71	2.8	40.8	678		A*
Toll Plaza	8	190	1.7	46.1	678		A*
NB-HCE WB, between Ramp ET and Ramp TW							
NB-HCE WB	2	2,135	21.2	50.8	2,171		C
Ramp TW Merge Area							
Ramp TW	2	1,632	22.3	31.1	1,398		C*
Ramp TW	1	1,298	49.1	28.6	1,398	1,735(b)	F*
NB-HCE WB, West of Ramp TW							
NB-HCE WB	3	438	38.8	30.5	3,569	405(c)	E
NB-HCE WB	2	1,063	40.1	44.1	3,569		E
NB-HCE WB	2	4,216	40.3	43.9	3,569		E

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp ET diverge area.
(b) Measured from Ramp WT/NB-HCE WB merge area.
(c) Measured from beginning of two-lane NB-HCE WB geometry.

10.3.3.2. Design Year 2050 (No-Build) Operation

Table 10-40 illustrates the Design Year 2050 (No-Build) weekday AM peak hour performance of the Ramp ET diverge area and Ramp TW merge area on the westbound NB-HCE. With no change in the geometry and increased traffic demand in the Design Year, the expected result of higher densities, lower speeds and longer queue lengths are borne out by the results. The total length of ramp queue will approach the Interchange 14A toll booths. The westbound NB-HCE approaching the Ramp TW merge will operate at LOS B with no queuing noted on this roadway. Beyond the merge, LOS E operation would occur because of traffic demand exceeding service flow rates at LOS D. The loop Ramp ET will operate at LOS A with minor queuing anticipated approaching the toll plaza or on the NB-HCE in the deceleration lane area.

Table 10-40 – Performance Measures - Design Year 2050 (No-Build) Weekday AM Peak Hour
NB-HCE Westbound at Ramp ET and Ramp TW (Interchange 14A)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp ET Diverge							
NB-HCE WB	2	1,726	18.5	59.1	2,188		C
NB-HCE WB	2	700	18.5	58.7	2,188		C
NB-HCE WB	3	800	12.3	58.9	2,188	23(a)	B
Ramp ET Diverge Area							
Ramp ET	1	2,017	6.9	58.9	400		A*
Ramp ET	2	71	1.2	56.4	400		A*
Toll Plaza	8	190	0.9	54.3	400	44(b)	A*
NB-HCE WB, between Ramp ET and Ramp TW							
NB-HCE WB	2	2,134	16.9	52.5	1,788		B
Ramp TW Merge Area							
Ramp TW	2	1,632	145.9	6.6	2,154		F*
Ramp TW	1	1,298	71.6	26.8	2,154	2,992(c)	F*
NB-HCE WB, West of Ramp TW							
NB-HCE WB	3	438	52.4	23.3	3,942	405(d)	F
NB-HCE WB	2	1,063	38.4	48.0	3,942		E
NB-HCE WB	2	4,216	36.9	50.0	3,942		E

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp ET diverge area.
(b) Measured from Ramp WT/NB-HCE WB merge area.
(c) Measured approaching Interchange 14A toll plaza.
(d) Measured from beginning of two-lane NB-HCE WB geometry.

Table 10-41 illustrates the Design Year 2050 (No-Build) weekday PM peak hour performance of the Ramp ET diverge area and Ramp TW merge area on the westbound NB-HCE. With no change in the geometry and increased traffic demand in the Design Year, the expected result of higher densities, lower speeds and longer queue lengths are borne out by the results. The total length of ramp queue will approach the Interchange 14A toll booths. The westbound NB-HCE approaching the Ramp TW merge will operate at LOS D with minor queuing noted on this roadway. The loop Ramp ET will operate at LOS A with minor queuing anticipated approaching the toll plaza or on the NB-HCE within the deceleration lane area.

Table 10-41 – Performance Measures - Design Year 2050 (No-Build) Weekday PM Peak Hour
NB-HCE Westbound at Ramp ET and Ramp TW (Interchange 14A)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp ET Diverge							
NB-HCE WB	2	1,726	29.7	52.0	3,087		D
NB-HCE WB	2	700	29.9	51.5	3,087		D
NB-HCE WB	3	800	19.9	51.5	3,087	153(a)	C
Ramp ET Diverge Area							
Ramp ET	1	2,017	10.6	52.5	735		A*
Ramp ET	2	71	1.8	51.7	735		A*
Toll Plaza	8	190	1.2	51.4	735	47(b)	A*
NB-HCE WB, between Ramp ET and Ramp TW							
NB-HCE WB	2	2,135	26.1	48.3	2,352	108(c)	D
Ramp TW Merge Area							
Ramp TW	2	1,632	128.2	6.0	1,514		F*
Ramp TW	1	1,298	121.3	11.7	1,514	2,992(c)	F*
NB-HCE WB, West of Ramp TW							
NB-HCE WB	3	438	77.0	16.9	3,866	405(d)	F
NB-HCE WB	2	1,063	43.4	45.1	3,866		E
NB-HCE WB	2	4,216	40.5	48.4	3,866		E

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp ET diverge area.
(b) Measured from Ramp WT/NB-HCE WB merge area.
(c) Measured approaching Interchange 14A toll plaza.
(d) Measured from beginning of two-lane NB-HCE WB geometry.

10.3.3.3. Design Year 2050 (Build) Operation

The proposed geometry will maintain the two-lane Ramp TW geometry departing the Interchange 14A toll plaza and extend it to the junction with the westbound NB-HCE. The two-lane ramp will join a three-lane NB-HCE to form a 900-foot length of five-lane roadway, before the right lane would drop into the four-lane NB-HCE roadway that will cross the Newark Bay Bridge. Ramp ET will remain a single-lane loop ramp with a deceleration lane from the three-lane NB-HCE westbound. Figure 10-17 and Figure 10-18 illustrate the proposed geometry, split for clarity of view. Figure 10-17 shows the Ramp TW geometry, while Figure 10-18 is to the east, focusing on the Ramp ET geometry. The design speed of the NB-HCE will be raised from 55 to 60 MPH, while the Ramp TW design speed will be 40 MPH and the Ramp ET design speed, 25 MPH, per the Preliminary Design Report.

Figure 10-17 – NB-HCE Westbound/Ramp ET/Ramp TW (Interchange 14A)
Proposed Geometry (IPA) – Western Segment

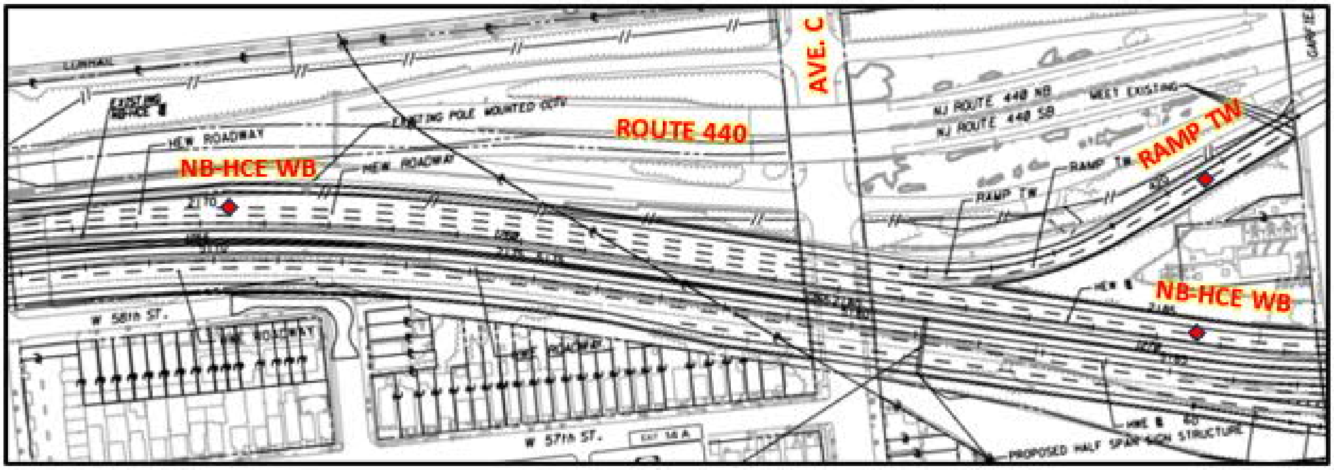


Figure 10-18 – NB-HCE Westbound/Ramp ET/Ramp TW (Interchange 14A)
Proposed Geometry (IPA) – Eastern Segment

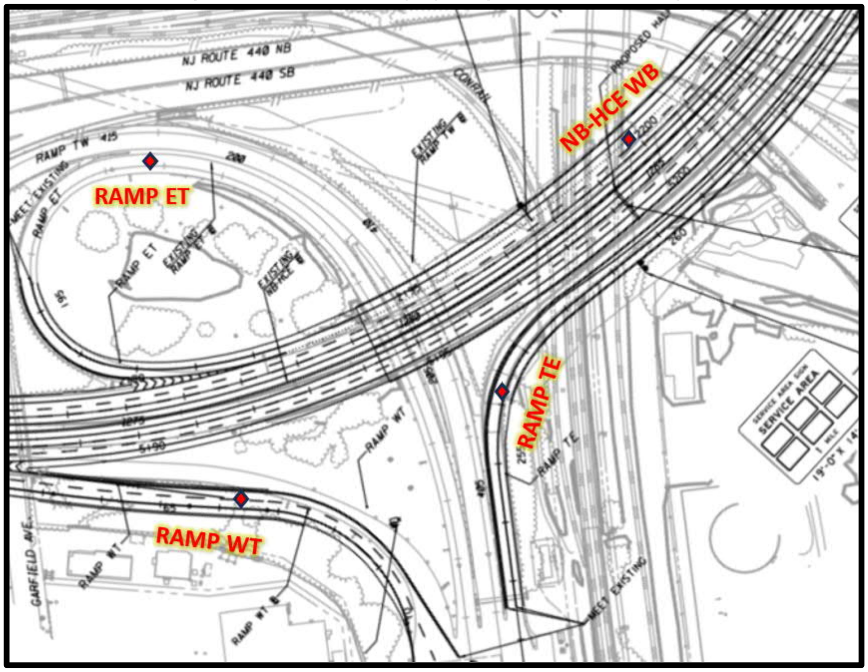


Table 10-42 illustrates the Design Year 2050 (Build) weekday AM peak hour performance of the Ramp ET diverge area and Ramp TW merge area on the westbound NB-HCE. The analysis forecasts Level of Service D or better operation both on Ramp TW and through the junction. The 900-foot length of five-lane roadway downstream of the junction will be sufficient for ramp traffic to enter the four-lane NB-HCE to cross Newark Bay. No queues will be expected within this section. Ramp ET will operate at LOS B or better, with no queues anticipated at the toll plaza and minor queuing predicted in the ramp deceleration lane area.

Table 10-42 – Performance Measures - Design Year 2050 (Build) Weekday AM Peak Hour
NB-HCE Westbound at Ramp ET and Ramp TW (Interchange 14A)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp ET Diverge							
NB-HCE WB	3	1,792	19.6	45.1	2,667		C
NB-HCE WB	3	570	19.6	45.0	2,667		C
NB-HCE WB	4	930	14.7	45.1	2,667	46(a)	B
Ramp ET Diverge Area							
Ramp ET	1	1,891	12.4	39.1	487		B*
Ramp ET	2	71	2.2	37.0	487		A*
Toll Plaza	8	190	1.4	40.0	487		A*
NB-HCE WB, between Ramp ET and Ramp TW							
NB-HCE WB	3	1,374	13.1	54.8	2,180		B
Ramp TW Merge Area							
Ramp TW	2	2,300	29.3	44.6	2,626		D*
NB-HCE WB, West of Ramp TW							
NB-HCE WB	5	901	16.1	58.8	4,806		B
NB-HCE WB	4	600	18.5	63.9	4,806		C
NB-HCE WB	4	4,884	19.1	62.7	4,806		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp ET diverge area.

Table 10-43 illustrates the Design Year 2050 (Build) weekday PM peak hour performance of the Ramp ET diverge area and Ramp TW merge area on the westbound NB-HCE. Similar results to the weekday AM peak hour are forecast, with Level of Service D or better operation expected both on Ramp TW and through the junction. No queues will be expected within this section. Ramp ET will operate at LOS B or better, with no queues anticipated at the toll plaza and minor queuing predicted in the ramp deceleration lane area.

Table 10-43 – Performance Measures - Design Year 2050 (Build) Weekday PM Peak Hour
NB-HCE Westbound at Ramp TW (Interchange 14A)

Roadway	Lanes	Length (feet)	Density (pcpmpl)	Speed (mph)	Volume (vph)	Queue (feet)	LOS
NB-HCE Approaching Ramp ET Diverge							
NB-HCE WB	3	1,792	19.4	65.0	3,763		C
NB-HCE WB	3	570	19.4	64.8	3,763		C
NB-HCE WB	4	930	14.5	65.0	3,763	51(a)	B
Ramp ET Diverge Area							
Ramp ET	1	1,891	16.9	52.3	896		B*
Ramp ET	2	71	3.1	48.4	896		A*
Toll Plaza	8	190	1.9	53.1	896		A*
NB-HCE WB, between Ramp ET and Ramp TW							
NB-HCE WB	3	1,379	14.7	65.3	2,867		B
Ramp TW Merge Area							
Ramp TW	2	2,304	20.6	44.9	1,846		C*
NB-HCE WB, West of Ramp TW							
NB-HCE WB	5	901	15.1	62.0	4,713		B
NB-HCE WB	4	601	18.0	64.8	4,713		C
NB-HCE WB	4	4,885	18.4	64.1	4,713		C

* Equivalent LOS based on basic freeway segment criteria.
(a) Measured from Ramp ET diverge area.

10.3.3.4. NB-HCE Westbound/Ramp ET/Ramp TW Conclusion

Base Year and Design Year (No-Build) models of the Ramp TW merge with the NB-HCE westbound at Interchange 14A show densities at Level of Service E or F on the two-lane roadway departing the Ramp TW merge area. The static analysis in Section 9 indicated LOS E and F while incorporating the upgrade to the Newark Bay Bridge; the section analyzed here is at a flatter grade and is upstream of the location in the static analysis, but the same outcome – unacceptable LOS – results. Ramp TW operates at LOS F due to the combination of the ramp roadway merge from two lanes to one and the downstream merge into the NB-HCE westbound. Heavy truck percentages on this ramp exacerbate the operational deficiencies. Queues from the latter merge extend as far as the Interchange 14A toll plaza area. The Build geometry, which extends the two-lane Ramp TW geometry onto the NB-HCE, allows ramp traffic to enter the NB-HCE in its own lanes, and provides more lanes on the NB-HCE than the existing geometry, serves the traffic demand at Level of Service D or better for both weekday peak hours. This geometry results in acceptable traffic operations for the vehicle demands.

Ramp ET currently operates at Level of Service B or better during both weekday peak hours. With the proposed geometry not changing substantially from the existing, little change in level of service will result under the Design Year traffic loads.

10.3.4 JFK Boulevard – Avenue C Connector Ramp Assessment

To avoid impacts to residential neighborhoods in Bayonne, construction of the proposed NB-HCE roadway between Newark Bay and Interchange 14A, consisting of eight lanes and full shoulders, will impact adjacent roadway facilities to the north, specifically a ramp connection between John F. Kennedy (JFK) Blvd. and Avenue C. The existing Connector Ramp uses a signalized intersection with Avenue C to provide a connection to NJ Route 440 southbound. The Connector Ramp itself is defined as the ramp roadway between the JFK Blvd. intersection and the merge with a NJ Route 440 southbound off-ramp, just west of the Avenue C intersection.

A high-level assessment was performed on alternatives that would maintain, relocate, or remove the Connector Ramp, with supporting analysis at critical locations provided to assess impacts. Appendix A contains traffic volumes, including intersection and ramp volumes, along this Connector Ramp for Base Year (2021) volumes and Design Year (2050) forecasts.

10.3.4.1. Existing Traffic Volumes and Patterns

Figure 10-19 shows the distribution of existing weekday peak hour traffic volumes along the Connector Ramp. Based on traffic counts collected at the JFK Blvd. - Connector Ramp intersection, the distributions shown in the figure represent the average for both the weekday AM and weekday PM peak hours. Each individual peak hour distribution differs but is within 1%-2% of the averages shown in the figure. The distribution shown in the figure approximates each weekday peak hour.

Figure 10-19 - JFK Blvd. – Avenue C Connector Ramp:
Existing Weekday Peak Hour Volume Distribution

The following can be noted regarding existing traffic volumes and distributions.

- The Connector Ramp carries traffic volumes ranging between 190 and 240 vehicles per hour (vph) during the weekday commuter peak hours.
- The distributions shown in Figure 10-19 approximate each weekday commuter peak hours.
- Turning traffic from JFK Blvd. southbound accounts for approximately 85% of the total traffic on the Connector Ramp. Most of this traffic (approximately 69%) passes through the Avenue C intersection and continues onto NJ Route 440 southbound. Avenue C southbound is also a significant destination.
- Traffic turning from JFK Blvd. northbound is largely destined for either Route 440 southbound or Avenue C northbound.

10.3.4.2. <u>Intersection Level of Service **Analysis (Base Year and No-Build)**</u>

HCS analysis of the existing intersection was performed to assess the Base Year 2021 and forecast Design Year 2050 (No-Build) operations. Table 10-44 and Table 10-45 summarize the intersection analysis for the Base Year and No-Build volume profiles, respectively.

Table 10-44 - JFK Blvd – Avenue C Connector Ramp
Unsignalized Intersection Analysis Results – Base Year 2021

Movement	Weekday AM Peak Hour				Weekday PM Peak Hour			
	Volume (vph)	LOS	V/C Ratio	Delay (sec./veh.)	Volume (vph)	LOS	V/C Ratio	Delay (sec./veh.)
NB T	692	**	**	**	652	**	**	**
NB R	27	**	**	**	37	**	**	**
SB L	167	B	0.22	10.5	198	B	0.25	10.6
SB T	406	**	**	**	732	**	**	**

East Leg is one-way away from the intersection.
**Major-street through and right-turn movements are assumed to experience zero delay.

Table 10-45 – JFK Blvd – Avenue C Connector Ramp
Unsignalized Intersection Analysis Results – Design Year 2050 (No-Build)

Movement	Weekday AM Peak Hour				Weekday PM Peak Hour			
	Volume (vph)	LOS	V/C Ratio	Delay (sec./veh.)	Volume (vph)	LOS	V/C Ratio	Delay (sec./veh.)
NB T	749	**	**	**	706	**	**	**
NB R	29	**	**	**	40	**	**	**
SB L	180	B	0.25	11.1	214	B	0.29	11.2
SB T	440	**	**	**	793	**	**	**

East Leg is one-way away from the intersection.
**Major-street through and right-turn movements are assumed to experience zero delay.

The analysis shows level of service B or better for the southbound left turn from JFK Blvd. This establishes that the need for alternative analysis regarding the Connector Ramp is not based on an existing traffic operational deficiency.

10.3.4.3. Connector Ramp Alternatives

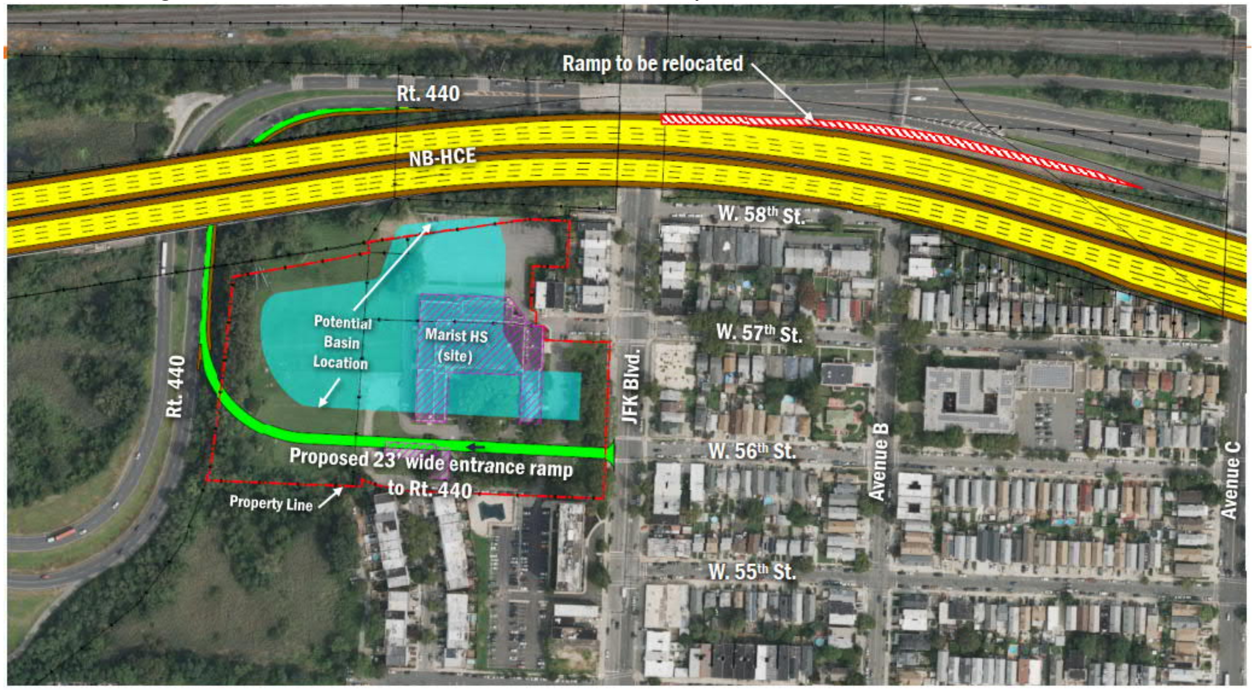
Several alternatives were considered that maintained this ramp connection with the construction of the proposed NB-HCE. Traffic operations for these alternatives would not differ significantly from the operations with the existing geometry, as this connection would be maintained. These alternatives were removed from consideration based on requiring residential property acquisitions.

Two additional alternatives were considered that would require the removal of the ramp connector. Traffic impacts were assessed for both alternatives.

10.3.4.3.1. Relocation of Connector Ramp

Figure 10-20 shows an alternative that removes the existing Connector Ramp and relocates the ramp to an existing intersection with JFK Blvd. south of the NB-HCE crossing. The unsignalized intersection with West 56th Street was chosen as the potential location for the relocated connector, to maximize the area of re-use of the former Marist High School property. The relocated Connector Ramp would form the fourth leg (a traffic departure leg only) of this existing intersection.

Figure 10-20 - Relocated Connector Ramp at West 56th Street Intersection



The following is noted regarding the Design Year 2050 (Build) traffic forecasts and expected traffic distributions.

- Connector Ramp volumes range between 250 and 310 vehicles per hour (vph) during the Design Year (Build) weekday commuter peak hours.
- The distributions shown in Figure 10-20 were assumed to be applicable for the Design Year (Build) time periods.
- About 59% of the total ramp traffic, which would originate from the north on JFK Blvd., would use the Connector Ramp, while 26%, the remainder of the traffic originating from the north, would use the local street system to access Avenue C. West 56th Street, which is one-way eastbound, was assumed to be the cross street used, as it is the closest to the original Connector Ramp location, though West 54th and West 53rd Streets, also one-way eastbound, could also be used depending on motorists' ultimate Avenue C travel destination.

- Of the 15% of the total ramp traffic originating from the south, 10% would make the left turn onto the relocated Connector Ramp, while the other 5% would use local streets to access Avenue C.
- The total traffic anticipated to use the local streets to access Avenue C would range from 80 to 90 vph during the weekday commuter peak hours. Most of this traffic is likely Bayonne-area circulation.

An HCS analysis was performed for the JFK Blvd. - West 56th Street intersection to confirm that the additional traffic diverted by the relocation of the Connector Ramp under Design Year 2050 (Build) traffic demand can be accommodated by the existing geometry during each weekday peak hour. Because the Connector Ramp would be one-way westbound and West 56th Street is one-way eastbound, only the two JFK Blvd. approaches would be impacted by the additional intersection traffic. Analyses for the Base Year 2021 traffic volumes and Design Year 2050 (No-Build) volume demand are also included. Table 10-46, Table 10-47, and Table 10-48 summarize the weekday peak hour analysis for the Base Year 2021, Design Year 2050 (No-Build) and Design Year 2050 (Build) volume scenarios, respectively.

Table 10-46 – JFK Blvd - West 56th Street – Relocated Connector Ramp
Unsignalized Intersection Analysis Results – Base Year 2021
Existing Geometry

Movement	Weekday AM Peak Hour				Weekday PM Peak Hour			
	Volume (vph)	LOS	V/C **Ratio**	Delay (sec./veh.)	Volume (vph)	LOS	V/C **Ratio**	Delay (sec./veh.)
NB L	0*	-	-	-	0*	-	-	-
NB T	848	**	**	**	562	**	**	**
NB R	72	**	**	**	42	**	**	**
SB L	28	B	0.04	10.5	58	A	0.07	9.2
SB T	294	**	**	**	726	**	**	**
SB R	0*	-	-	-	0*	-	-	-

*This movement does not exist in Base Year.
**Major-street through and right-turn movements are assumed to experience zero delay.
East Leg is one-way away from the intersection.

Table 10-47 – JFK Blvd - West 56th Street
Unsignalized Intersection Analysis Results – Design Year 2050 (No-Build)
Existing Geometry

Movement	Weekday AM Peak Hour				Weekday PM Peak Hour			
	Volume (vph)	LOS	V/C Ratio	Delay (sec./veh.)	Volume (vph)	LOS	V/C Ratio	Delay (sec./veh.)
NB L	0*	-	-	-	0*	-	-	-
NB T	918	**	**	**	601	**	**	**
NB R	78	**	**	**	45	**	**	**
SB L	30	B	0.05	10.9	63	A	0.08	9.4
SB T	318	**	**	**	775	**	**	**
SB R	0*	-	-	-	0*	-	-	-

*This movement would not exist in Design Year (No-Build).
**Major-street through and right-turn movements are assumed to experience zero delay.
East Leg is one-way away from the intersection.

Table 10-48 – JFK Blvd - West 56th Street
Unsignalized Intersection Analysis Results – Design Year 2050 (Build)
Relocated Connector Ramp

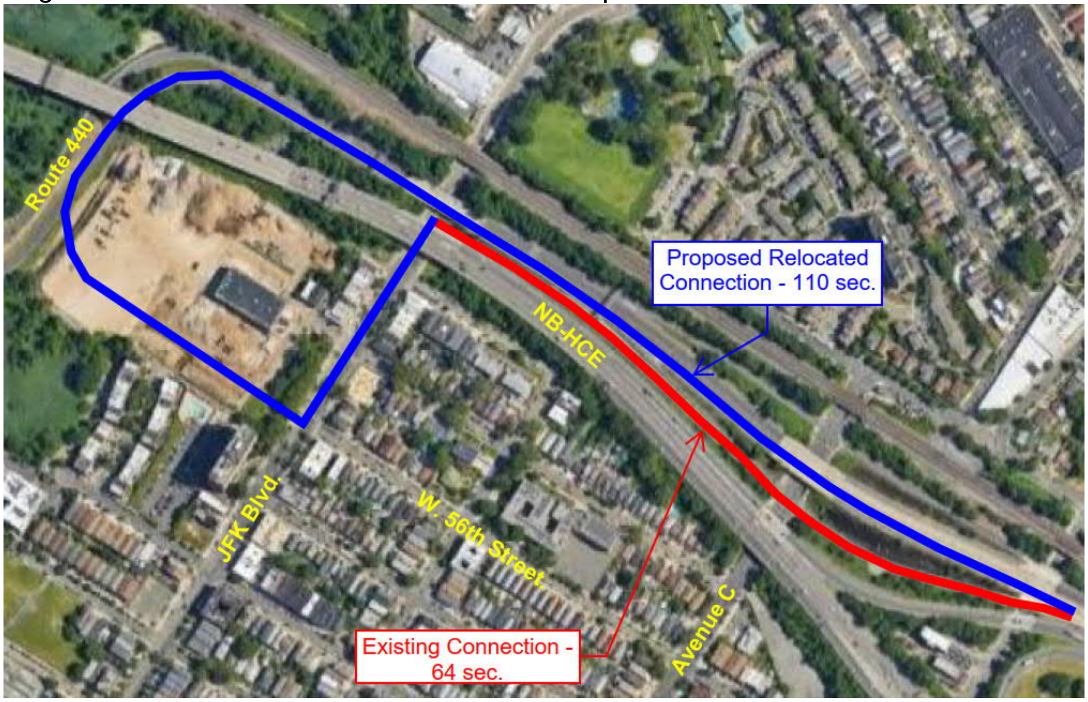
Movement	Weekday AM Peak Hour				Weekday PM Peak Hour			
	Volume (vph)	LOS	V/C Ratio	Delay (sec./veh.)	Volume (vph)	LOS	V/C Ratio	Delay (sec./veh.)
NB L	24	A	0.03	8.6	32	B	0.06	11.8
NB T	1,083	**	**	**	684	**	**	**
NB R	107	**	**	**	72	**	**	**
SB L	101	B	0.21	13.5	160	B	0.22	10.7
SB T	389	**	**	**	945	**	**	**
SB R	155	**	**	**	178	**	**	**

East and West Legs would be one-way away from the intersection.
**Major-street through and right-turn movements are assumed to experience zero delay.

The analysis showed Design Year 2050 (Build) control delays of up to 11.8 seconds/vehicle for the northbound left turn movement (weekday PM peak hour), which is a new movement at the intersection directing traffic from the south to the relocated Connector Ramp. Design Year 2050 (Build) control delays of up to 13.5 seconds/vehicle are predicted for the southbound left turn movement in the weekday AM peak hour, an increase of 4 seconds over the anticipated delay under the No-Build condition. The increased traffic on this movement is that from the north that would have used the existing Connector Ramp to access Avenue C. Both delays correspond to level of service B, representing very good operations.

The total travel time for traffic using the relocated Connector Ramp between the existing JFK Blvd. - Connector Ramp intersection to Route 440 southbound at the Avenue C on-ramp would increase from 64 seconds to 110 seconds, a difference of 46 seconds. This estimate assumes travel at the speed limit with no traffic signal delays. Both routes pass through one signalized intersection. See Figure 10-21.

Figure 10-21 – Travel Route and Time Comparison – Relocated Connector Ramp



At the signalized Avenue C - Connector Ramp intersection, a decrease in total traffic on the ramp approach to the intersection (about 50% in the weekday AM peak hour and 40% in the weekday PM peak hour) under the Design Year 2050 (Build) volume profile would occur with the relocation of the Connector Ramp. While a formal analysis was not performed on this intersection, the removal of this traffic would be expected to improve intersection operations.

The proposed relocation of the Connector Ramp would result in a weaving section on NJ Route 440 southbound between the relocated Connector Ramp and the Avenue C exit ramp. Table 10-49 shows the results of HCS analysis of this section.

Table 10-49 – Weaving Section Analysis
NJ Route 440 Southbound, Connector Ramp On-Ramp to Avenue C Off-Ramp
Design Year 2050 (Build) – Relocated Connector Ramp

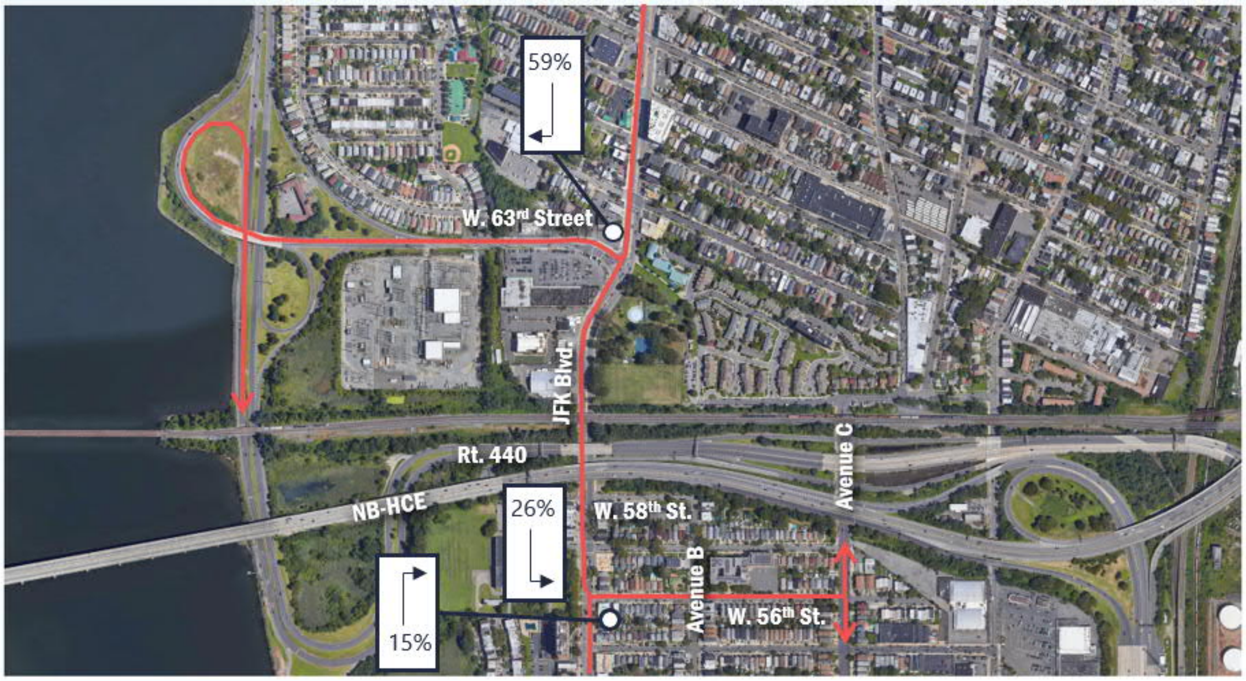
Movement	Weekday AM Peak Hour			Weekday PM Peak Hour		
	Volume (vph)	LOS	Density (pc/mi/ln)	Volume (vph)	LOS	Density (pc/mi/ln)
Configuration: 2/1 -> 3 -> 2/1, L = 1,900 feet						
F – F	1,242	B	15.6	1,168	B	17.5
F – R	264			445		
R – F	179			210		
R - R	0			0		

F – Freeway
R – Ramp
F – R: Freeway to Ramp, etc.

10.3.4.3.2. Removal of Connector Ramp

The second alternative to address impacts to the existing JFK Blvd. Connector Ramp involved removal of the Connector Ramp without replacement, such that affected traffic would use other existing roadways in the Jersey City and Bayonne street network to access NJ Route 440 and Avenue C. Figure 10-22 shows an estimated distribution of traffic to other existing roadways due to the Connector Ramp removal. As with the previous table, the distributions shown in the figure represent the average for both the weekday AM and weekday PM peak hours. Each individual peak hour distribution differs but is within 1%-2% of the averages shown in the figure. The distribution shown in the figure approximates each weekday peak hour.

Figure 10-22 - Estimated Weekday Peak Hour Traffic Distribution – Removal Only of Connector Ramp



For traffic originating from the north on JFK Blvd., the closest major access point to NJ Route 440 is West 63rd Street, a signalized intersection about 1,100 feet north of the existing Connector Ramp intersection. For conservative analysis purposes, for this assessment it was assumed that the full estimated 59% of traffic destined for NJ Route 440 southbound would use this intersection for alternative access. The remainder, as before, would use local streets to access Avenue C.

For traffic originating from the south on JFK Blvd., NJ Route 440-bound traffic would not be expected to travel to the West 63rd Street intersection, as this would involve some backtracking. Since no relocated access is contemplated under this alternative, the full 15% of total Connector Ramp traffic would use the local street system to access NJ Route 440 or Avenue C. West 56th Street, one of the one-way eastbound roadways connecting JFK Blvd. with Avenue C, is one of several eastbound roadway options for this traffic.

Since the total traffic anticipated to use local streets to access Avenue C or NJ Route 440 ranges from 100 to 130 vph during both weekday peak hours, it is expected that this traffic would be distributed across several parallel eastbound roadways between the two arterials. For the traffic analysis, the West 56th Street intersection was assumed to be the access point. Base Year 2021 and Design Year 2050 (No-Build) analyses were previously summarized in Table 10-46 and Table

10-47. Table 10-50 summarizes the Design Year 2050 (Build) operations under the removal of the Connector Ramp.

Table 10-50 – JFK Blvd - West 56th Street
Unsignalized Intersection Analysis Results – Design Year 2050 (Build)
Removed Connector Ramp

Movement	Weekday AM Peak Hour				Weekday PM Peak Hour			
	Volume (vph)	LOS	V/C **Ratio**	Delay (sec./veh.)	Volume (vph)	LOS	V/C **Ratio**	Delay (sec./veh.)
NB L	0*	-	-	-	0*	-	-	-
NB T	1,083	**	**	**	684	**	**	**
NB R	131	**	**	**	104	**	**	**
SB L	101	B	0.21	13.8	160	B	0.22	10.9
SB T	389	**	**	**	945	**	**	**
SB R	0*	-	-	-	0*	-	-	-

*This movement does not exist in this Design Year (Build) alternative.
**Major-street through and right-turn movements are assumed to experience zero delay.
East Leg is one-way away from the intersection.

The analysis shows that removal of the Connector Ramp will result in level of service B operation at the JFK Blvd. - West 56th Street intersection. The primary differences from the previous alternative are the removal of traffic from the north destined for NJ Route 440 southbound. Traffic from the south destined for NJ Route 440 southbound, rather than turning left onto the relocated Connector Ramp, would turn right onto West 56th Street.

At the signalized Avenue C - Connector Ramp intersection, a decrease in total traffic on the ramp approach to the intersection (about 50% in the weekday AM peak hour and 40% in the weekday PM peak hour) under the Design Year 2050 (Build) volume profile would also occur with the removal of the Connector Ramp. While a formal analysis was not performed on this intersection under this scenario, the removal of this traffic would be expected to improve intersection operations.

10.3.4.4. Connector Ramp Alternative Conclusion

The traffic distributions used to derive the analyses presented above were based on traffic volume turning movements at the existing JFK Blvd. - Connector Ramp intersection. The analyses indicated acceptable delays and levels of service (B or better) for the unsignalized intersections studied. Additional regional model runs using the NJRTM-E would be appropriate to refine the distribution of traffic diversions associated with the removal of the Connector Ramp and define the additional traffic using key intersections to access NJ Route 440 and

Avenue C. These model runs and refined analysis would be performed during Final Design based on the final determination of the plan for the Connector Road.

10.4 ALTERNATIVES ANALYSIS CONCLUSION

Operational analysis was performed at key locations within the project area. VISSIM models were created and run for the Base Year 2021 and Design Year 2050 traffic volume/demands and geometric configurations. Analysis using these models were performed for the following locations.

- Interchange 14: Ramp TH/Ramp NH/Ramp SH Junction (Eastbound)
- Interchange 14: Ramp HN/Ramp HLT and Ramp HS Diverges (Westbound)
- Interchange 14A: Ramp WT Diverge (Eastbound)
- Interchange 14A: Ramp TW Junction (Westbound)

Five Build alternatives were considered for the Ramp TH/Ramp NH/Ramp SH junction at Interchange 14, and two alternatives were considered for the Ramp WT diverge at Interchange 14A. The IPA geometry was analyzed for the two westbound locations.

Base Year 2021 and Design Year 2050 (No-Build) models showed the expected congestion, queuing, and unacceptable operation (LOS E or worse) on the NB-HCE and the various ramps studied. Design Year 2050 (Build) analysis generated the following results.

- Of the five alternatives at the Interchange 14 Ramp TH/Ramp NH/Ramp SH junction, Alternative 5, which will consist of left-hand entrance ramps with Ramp NH merging into the two-lane Ramp TH and Ramp SH adding two lanes to form the four-lane NB-HCE roadway, will provide the optimal combination of ramp orientation and lane balance to accommodate forecast traffic demands and patterns.
- The proposed Interchange 14 Ramp HS geometry will operate at level of service D or better with a two-lane loop ramp except during the weekday PM peak hour, where the ramp transition from two lanes to one. Queues that will generate at this location will not impede traffic flow on facilities upstream or downstream of this location.
- Both alternatives considered for the Interchange 14A Ramp WT diverge area will yield acceptable levels of service (LOS D or better) with no anticipated queues forming. Alternative 2 (with an option lane forming the second exit lane) will operate better than Alternative 1 (which forms both exit lane from the right lane of the approaching roadway), but the difference is small. The Preliminary Design reflects Alternative 1 and will operate well enough to remain; Alternative 2, however, can be revisited during Final Design if desired.

- The proposed geometry for the Interchange 14A Ramp TW junction will operate at acceptable level of service (D or better), such that it will adequately accommodate forecast traffic demands and patterns.

Two additional assessments were performed in the Interchange 14A area. A toll plaza capacity assessment comparing traffic demand with maximum processing rates based on toll collection method indicated the need to convert one E-ZPass-only toll lane from an exit lane to an entry lane. Two alternatives were also considered to address physical impacts of the NB-HCE capacity enhancements on the Connector Ramp between JFK Blvd. and Avenue C. The assessment of traffic pattern diversions was based on traffic count turning movements onto the Connector Ramp and impacts on Bayonne intersections suggest minimal increases in intersection delay and travel time for diverted traffic. As the Authority has not made a final determination for the Connector Ramp area, further analysis during Final Design is warranted to refine the traffic diversions and revisit the traffic impacts.

11. INDEPENDENT UTILITY

11.1 BACKGROUND

This section addresses, from a traffic perspective, the feasibility of implementation of the Program improvement components in distinct projects and staggered implementation of these projects over time in a yet-to-be determined order. This Independent Utility analysis focuses on the project limits between Interchange 14 and Interchange 14A.

The concept of Independent Utility is utilized in this assessment to determine whether a project serves a distinct need independent of the adjacent component. A project is considered to have independent utility if it meets the following conditions.

- It has logical termini with a defined broad scope between the termini (i.e., from one interchange to another or to a toll plaza).
- It would be usable and have a benefit to justify the expenditure independent of adjacent projects.
- It does not preclude or require specific options to be considered in adjacent projects.

Projects that do not adversely impact adjacent roadway links such that an acceptable operation (i.e. LOS D or better) would become an unacceptable operation (i.e. LOS E or worse) can be considered to have independent utility, even if the operation degrades within the acceptable or unacceptable range. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Although this Program is being presented for review in its entirety, the NJTA views the Program from a planning perspective, as multiple stand-alone independent Projects. Each Project is capable of functioning properly and addressing a specific need independently of the others. Each Project has independent urgency of need in terms of operational needs and safety conditions. Each individual Project is neither expected to nor needs to be constructed in the order of Project numbering. When completed, each Project would be opened to the public and used independently of the other Projects. In addition, it should be noted that the completion of each Project does not require, or irretrievably commit, the NJTA to undertake or complete any of the remaining Projects.

11.2 ANALYSIS

For this assessment, the project limits are defined as between Interchange 14 and Interchange 14A, including associated improvements on ramps at each interchange.

To assess the traffic impacts of completion of only this project, the NJRTM-E regional model was used to develop traffic volume demand profiles under Design Year 2050 traffic loads which illustrate the implementation of this project. This scenario will generate a different demand volume profile than the full Program Build because the varying distribution of new capacity on the corridor will have different impacts on route choices both on the corridor and in the region. For this scenario, which can be considered a Build scenario, level of service analyses were performed on the freeway links between the interchanges, as was previously performed and presented in Section 9 for the IPA. For comparison, the Design Year (No-Build) level of service results, previously summarized in Table 9-2, are reproduced here as Table 11-1.

Table 11-1 – 2050 Design Year (No-Build) NB-HCE Traffic Demand, Density, V/C and LOS For Weekday Peak Hours – Interchange 14 to Interchange 14A

Direction	Roadway Link (# Lanes)	Weekday AM Peak Hour				Weekday PM Peak Hour			
		Demand	Density	V/C	LOS	Demand	Density	V/C	LOS
Eastbound	Int. 14 – Int. 14A (2)	4,909	*	1.41	F	4,172	*	1.13	F
Westbound	Int. 14A – Int. 14 (2)	3,942	*	1.10	F	3,866	*	1.06	F

* Density is not calculated when v/c exceeds 1.00.

This scenario evaluates the construction of improvements only to the roadway link of the NB-HCE crossing the Newark Bay Bridge, i.e., from Interchange 14 to Interchange 14A. The improvements would include all ramp connections being re-established at both interchanges.

Table 11-2 presents the traffic demands and analysis results for the roadway link between Interchange 14 and Interchange 14A with four lanes in each direction on the NB-HCE and Bay Bridge. The additional lanes on the Newark Bay Bridge will accommodate traffic demands under acceptable levels of service (LOS C or D)..

Table 11-2 – 2050 Design Year (Build) NB-HCE Demands, Density, V/C and LOS for Weekday Peak Hours – Four Lanes on Newark Bay Bridge Only

Direction	Roadway Link (# Lanes)	Weekday AM Peak Hour				Weekday PM Peak Hour			
		Demand	Density	V/C	LOS	Demand	Density	V/C	LOS
Eastbound	Int. 14 – Int. 14A (4)	5,299	29.1	0.76	D	4,504	23.4	0.62	C
Westbound	Int. 14A – Int. 14 (4)	4,254	23.2	0.61	C	4,173	21.7	0.57	C

* Density is not calculated when v/c exceeds 1.00.

A previous analysis (Section 9.1.6.2) established that providing six lanes (three in each direction) on this link would not result in acceptable operation on the eastbound NB-HCE in this area – level of service F with a volume-to-capacity ratio of 1.00 would ensue on a three-lane roadway.

This result and the table above suggest that no less than four lanes on the NB-HCE/Newark Bay Bridge crossing in the eastbound direction would fully address the purpose and need within this project area, to improve mobility by attaining LOS D or better traffic flow. While the analysis indicates that the westbound roadway would operate at LOS D under a three-lane geometry, the proposed westbound bridge will need enough width to accommodate maintaining the existing two lanes in each direction during construction. While this may not require four travel lanes and a full right shoulder, this geometry is justified by the potential expansion of the CMA CGM Container Terminal facility.

The physical construction of improvements between Interchange 14 and Interchange 14A can be performed independently of the rest of the Program. The analysis in the previous section at Interchange 14A assumed that with the full Build geometry with three lanes and full shoulders on the NB-HCE east of the interchange, acceptable operation is forecast under this geometric condition. Since it is unclear what geometry will be progressed east of Interchange 14A, construction of this geometric configuration up to the easterly Interchange 14 to Interchange 14A project limit does not preclude the Authority from considering any improvement option or schedule. This project geometry provides sufficient pavement width so that a transition to whatever alternative is selected can be constructed.

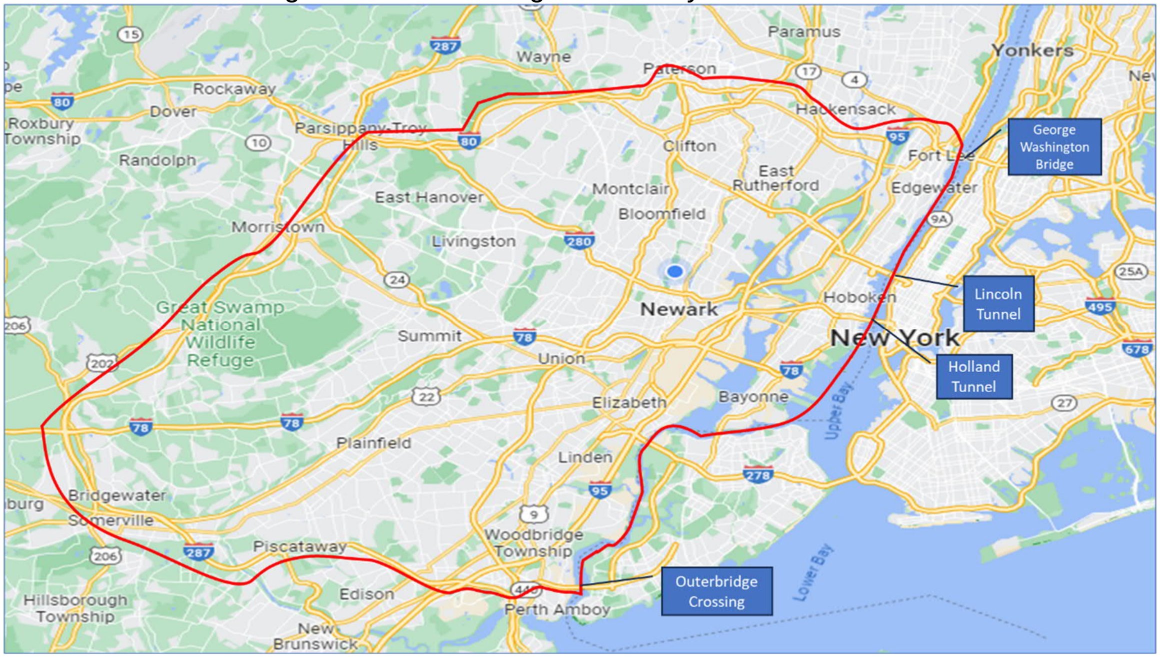
12. SUBREGIONAL VMT/VHT/CONGESTED SPEED ANALYSIS

This section evaluates the impacts of full build of the proposed Program improvements (over the length of the NB-HCE) on regional vehicle miles traveled (VMT), vehicle hours traveled (VHT) and congested speeds. A subregion was extracted from the NJRTM-E for use in this analysis. This subregion generally defines the outer limits of impact of the proposed Program improvements.

12.1 SUBREGIONAL STUDY AREA

The subregion extends beyond both the project area and Program study area. As displayed in Figure 12-1, the subregional study area boundaries follow I-287 south of I-80 on the west, I-287 on the south to the Outerbridge Crossing, I-80 and I-95 to the George Washington Bridge to the north and the Hudson River and Arthur Kill on the east. The study area covers parts of Bergen, Essex, Hudson, Middlesex, Morris, Passaic, Somerset and Union Counties.

Figure 12-1 – Subregional Study Area Boundaries



12.2 DEMOGRAPHICS AND INFRASTRUCTURE PROJECTS

As detailed in *Section 5 – Traffic Forecasting Methodology*, the NJRTM-E was used to create Base Year 2021 and Design Year 2050 No-Build scenarios (i.e., no improvements on the NB-HCE corridor) and a Design Year 2050 Build scenario that includes full build of the Program improvements. The No-Build and Build scenarios both include NJTPA forecasted 2050 demographics, projects from the Jersey City Open Data database and other municipalities in the region, the current NJTPA TIP projects, and projects on the FY2020 - 2029 Statewide Transportation Improvement Program (STIP).

12.3 PERFORMANCE MEASURES

Three performance measures were extracted from the NJRTM-E:

- Vehicle Miles of Travel – Vehicle miles of travel, or VMT, is the total distance (in miles) traveled by all vehicles.
- Vehicle Hours of Travel – Vehicle hours of travel, or VHT is the total time (in hours) elapsed in travel by all vehicles.
- Congested Speed – Congested speed is the average prevailing speed under congested conditions, in miles per hour (MPH).

Table 12-1 shows daily vehicle miles traveled within the subregional study area for the Base Year 2021, Design Year 2050 (No-Build) and Design Year 2050 (Build) scenarios. As previously noted, the Build case assumes full build of the Program improvements. Percent differences noted in the table reflect comparisons to the previous line, such that the 10.5% difference listed in the No-Build row is the increase over the Base Year figures. Noteworthy is the minor change (+0.3%) in VMT from the No-Build to the Build scenario.

Table 12-1 – Daily Vehicle Miles Traveled for Base Year 2021 and Design Year 2050 Traffic Demand Scenarios

Scenario	Daily VMT (miles)	Difference	% Difference
Base Year 2021	24,860,300	n/a	n/a
Design Year 2050 (No-Build)	27,462,357	2,602,057	10.5%
Design Year 2050 (Build)	27,556,659	94,302	0.3%

Table 12-2 shows daily vehicle hours of travel within the subregional study area for the Base Year 2021, Design Year 2050 (No-Build) and Design Year 2050 (Build) scenarios. As previously noted, the Build case assumes full build of the Program improvements. Percent differences noted in the table reflect comparisons to the previous line, such that the 18.3% difference listed in the No-Build row is the increase over the Base Year figures. Noteworthy is the minor change (+1.0%) in VHT from the No-Build to the Build scenario.

Table 12-2 – Daily Vehicle Hours of Travel for Base Year 2021 and Design Year 2050 Traffic Demand Scenarios

Scenario	Daily VHT (hours)	Difference	% Difference
Base Year 2021	966,636	n/a	n/a
Design Year 2050 (No-Build)	1,143,786	177,150	18.3%
Design Year 2050 (Build)	1,154,714	10,928	1.0%

Table 12-3 shows daily congested speeds within the subregional study area for the Base Year 2021, Design Year 2050 (No-Build) and Design Year 2050 (Build) scenarios. As previously noted, the Build case assumes full build of the Program improvements. Percent differences noted in the table reflect comparisons to the previous line, such that the -1.3% difference listed in the No-Build row is the increase over the Base Year figures. Noteworthy is that there is no change (0.0%) in average congested speed from the No-Build to the Build scenario.

Table 12-3 – Daily Average Congested Speeds for Base Year 2021 and Design Year 2050 Traffic Demand Scenarios

Scenario	Daily Average Congested Speed (MPH)	Difference	% Difference
Base Year 2021	32.0	NA	NA
Design Year 2050 (No-Build)	31.6	-0.4	-1.3%
Design Year 2050 (Build)	31.6	0.0	0.0%

The information summarized in the above tables indicates expected increases in vehicle miles traveled and vehicle hours of travel within the subregional study area defined above from the Base Year to the Design Year (No-Build) traffic demand profiles. Associated decreases in average congested speeds are also noted between the two time periods. Minor changes are forecasted between the No-Build and Build traffic demand profiles, suggesting that the Program improvements will not generate significant additional traffic within this subregion. As previously discussed, on a weekday peak hour level, the Program improvements result in changes in regional route choices for motorists.

The data summarized here is to be used in air quality analyses performed separately for this project and the overall Program.

13. TRAFFIC REPORT CONCLUSIONS

This Report documented the analysis and assessments performed on roadways and ramps along the NB-HCE between Interchange 14 and Interchange 14A. Other elements, such as crash analysis, vehicle compositions, independent utility and subregional VMT/VHT analysis, are also documented.

The analysis confirmed, with minor adjustment, the proposed lane needs developed in the Initially Preferred Alternative that are now being advanced to Preliminary Design under this phase of the NB-HCE Program. The resulting description of roadway lane requirements for the project area are as outlined in the relevant section of the Introduction. Further analysis of critical merge and diverge areas within the project limits under forecast Build traffic demands yielded acceptable levels of service (D or better) for proposed geometries directly advanced or revised from the Initially Preferred Alternative which are reflected in the Preliminary Design plans.

The NJRTM-E regional demand model showed that most of the growth in the corridor is in the port areas of Bayonne and Jersey City and the significant land use redevelopments anticipated in Jersey City. The Program's enhancements do not address demand for additional trips to lower Manhattan, but rather accommodate the growing local neighborhoods, communities, and port facilities along the NB-HCE and in areas such as Bayonne, Port Jersey, Jersey City and Hoboken.

Independent Utility analysis demonstrated that this project's limits can be implemented irrespective of the content or schedule of other Program improvements proposed by the Authority. Sufficient footprint can be constructed such that future improvement alternative outside the project area would be precluded.

The proposed enhancements achieve the traffic purpose and need of the project. They accommodate the Authority's need to upgrade the operations and physical conditions of the NB-HCE corridor, to ensure a state of good repair condition and a facility capable of serving redevelopment activity taking place along the corridor in the communities of Bayonne and Jersey City, and beyond. They improve mobility between Interchange 14 and Interchange 14A by attaining level-of-service (LOS) D or better traffic flow quality and, in so doing, enhance access to communities, businesses, and multimodal facilities served by the NB-HCE interchanges, while improving safety and efficiently accommodating growing vehicular demand on this portion of the NB-HCE into the foreseeable future.

Appendix A – Traffic Volumes

OPS No. T3820
New Jersey Turnpike
Newark Bay-Hudson County Extension
Bridge Replacements and Capacity Enhancements Program

Appendix A – Traffic Volumes

2021 AM Peak Hour Volumes (Interchange 14)
2021 AM Peak Hour Volumes (Interchange 14A)

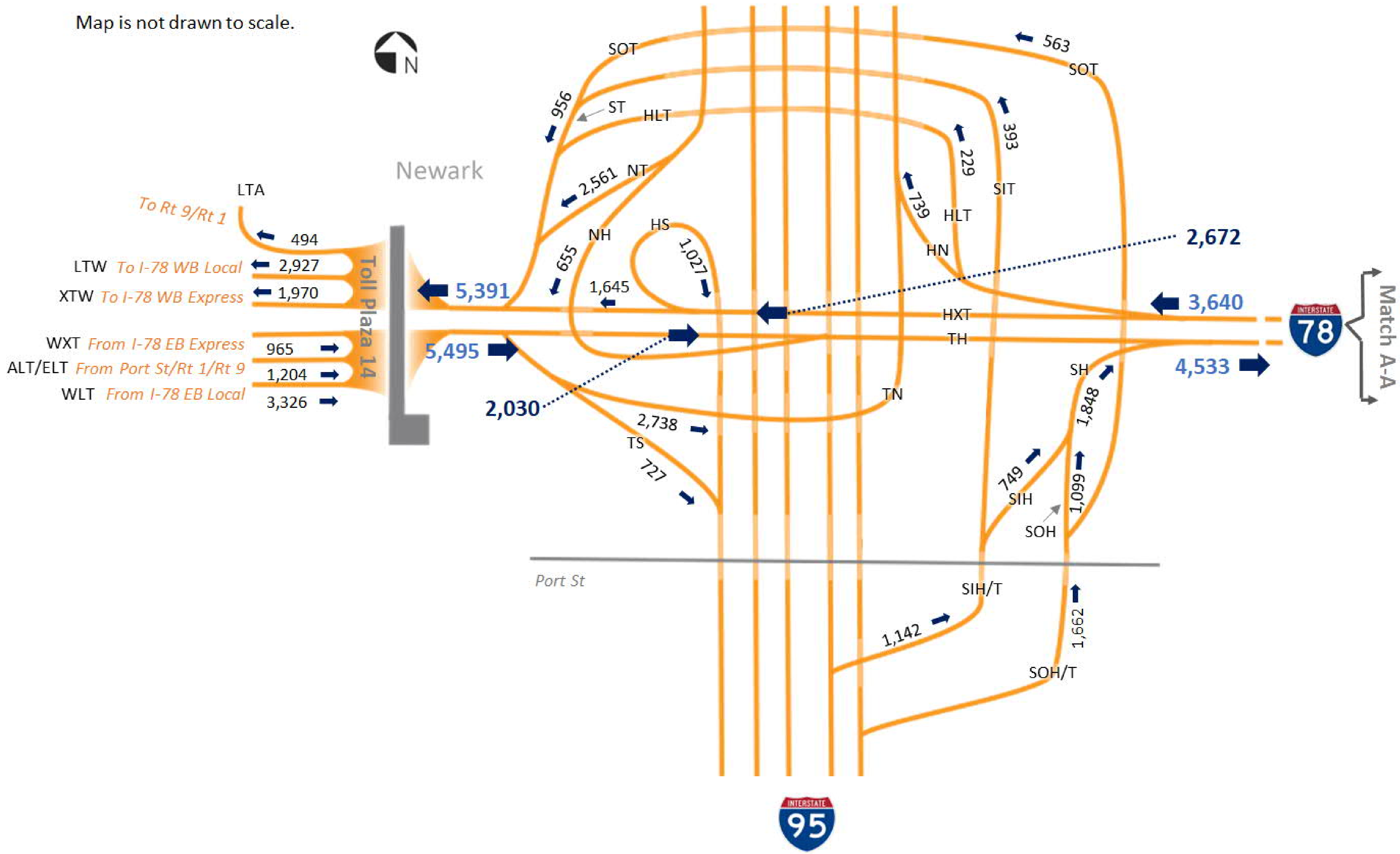
2021 PM Peak Hour Volumes (Interchange 14)
2021 PM Peak Hour Volumes (Interchange 14A)

2050 No-Build AM Peak Hour Volumes (Interchange 14)
2050 No-Build AM Peak Hour Volumes (Interchange 14A)

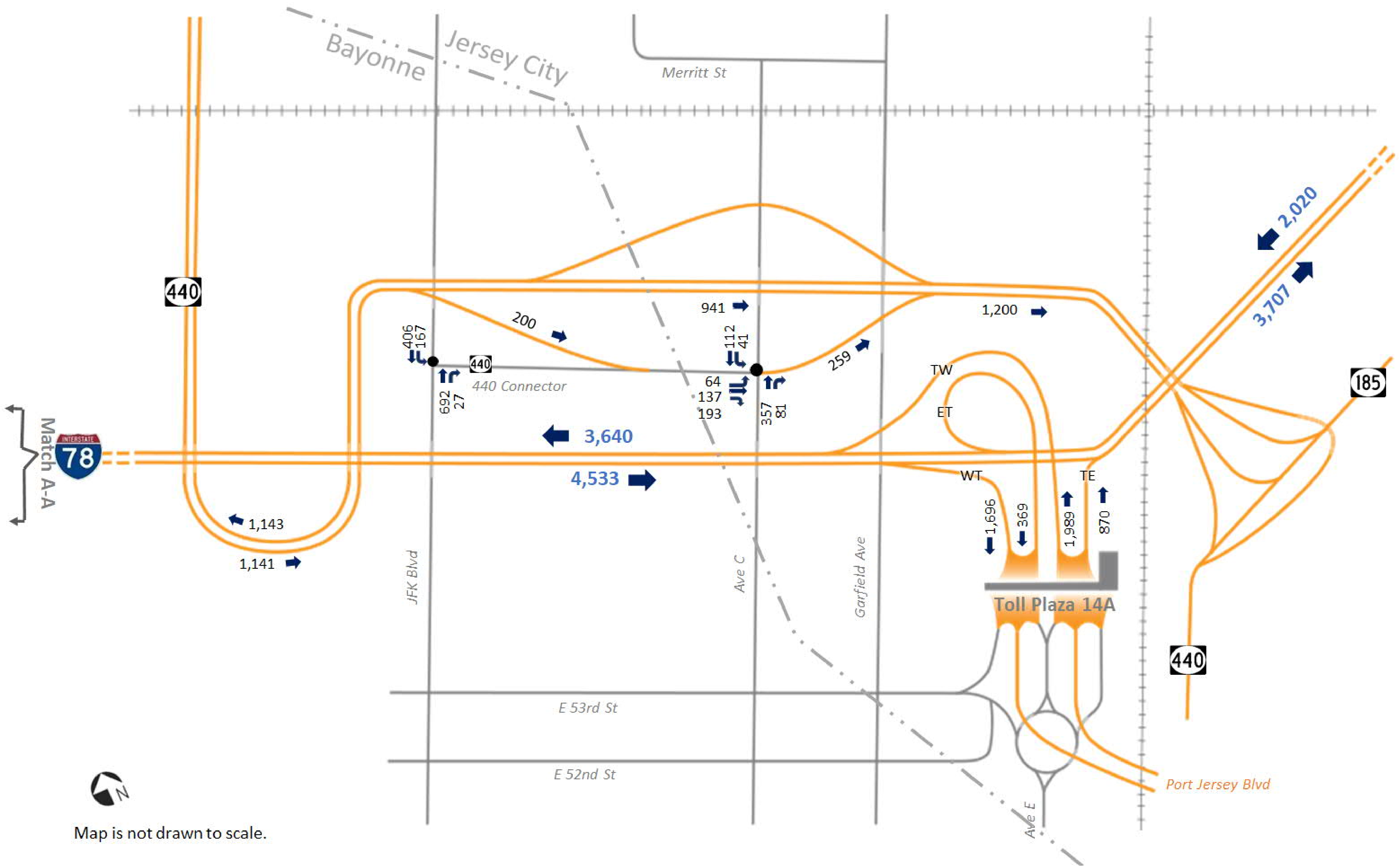
2050 No-Build PM Peak Hour Volumes (Interchange 14)
2050 No-Build PM Peak Hour Volumes (Interchange 14A)

2050 Build AM Peak Hour Volumes (Interchange 14)
2050 Build AM Peak Hour Volumes (Interchange 14A)

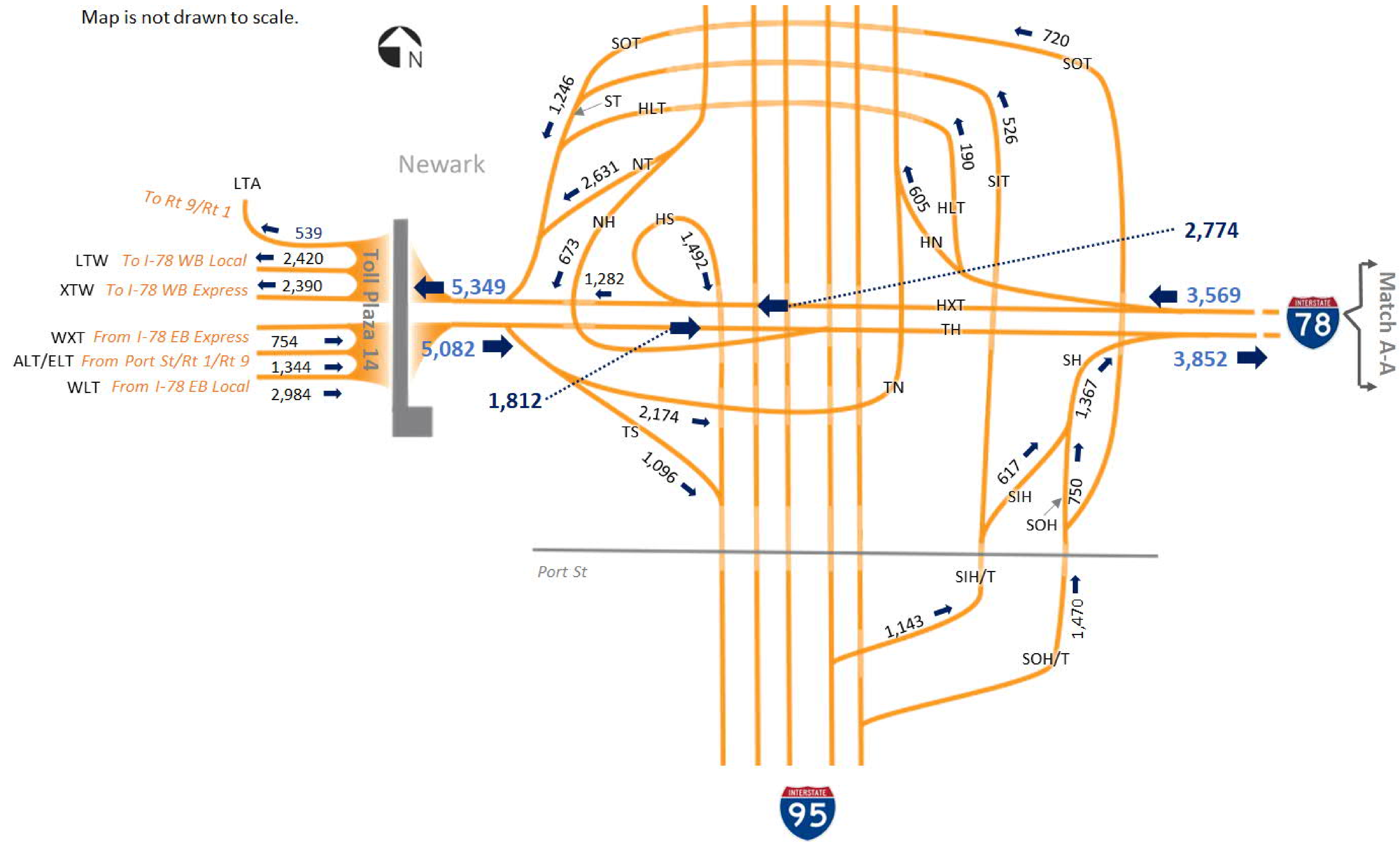
2050 Build PM Peak Hour Volumes (Interchange 14)
2050 Build PM Peak Hour Volumes (Interchange 14A)



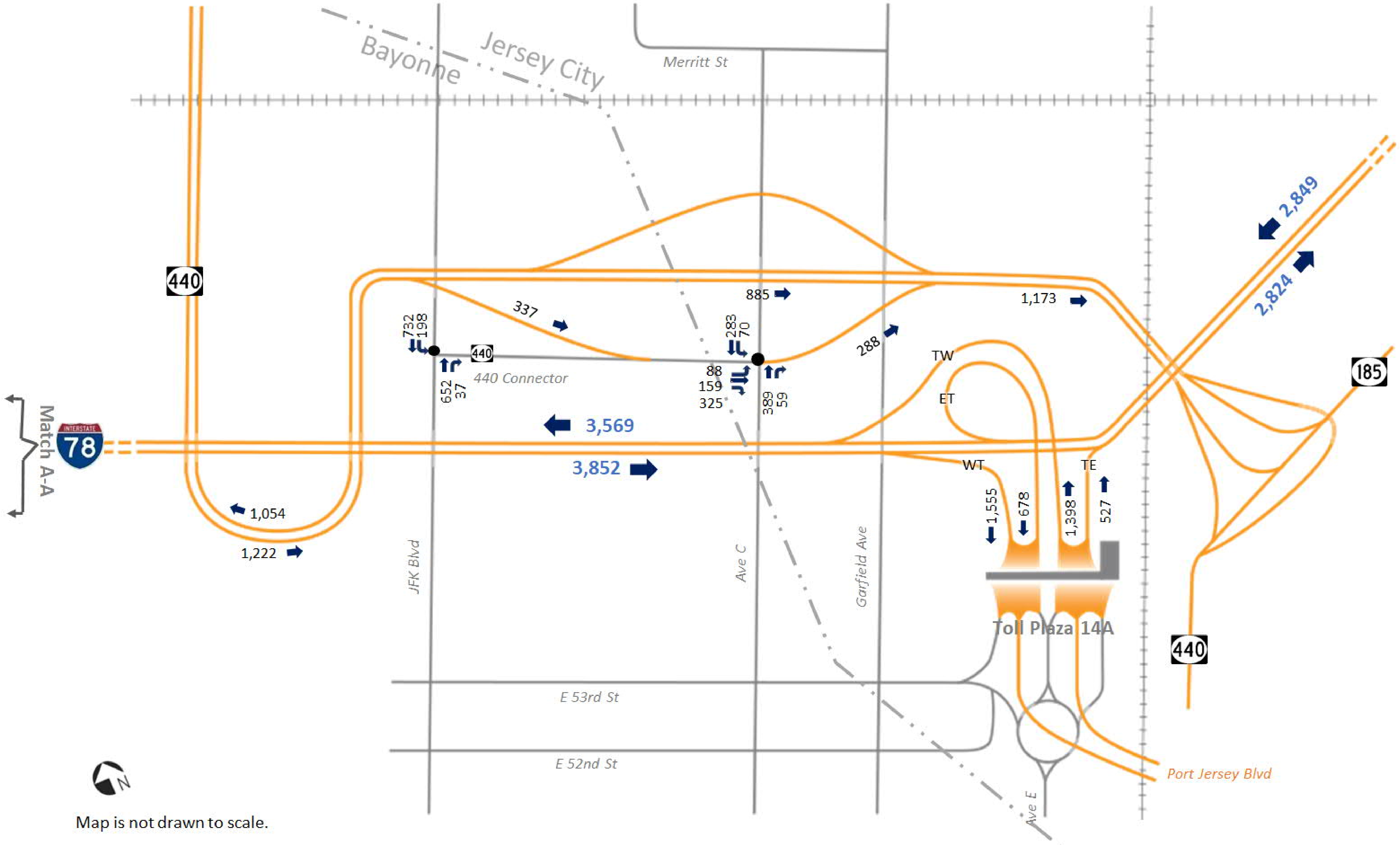
2021 AM Peak Hour Volumes (Interchange 14)



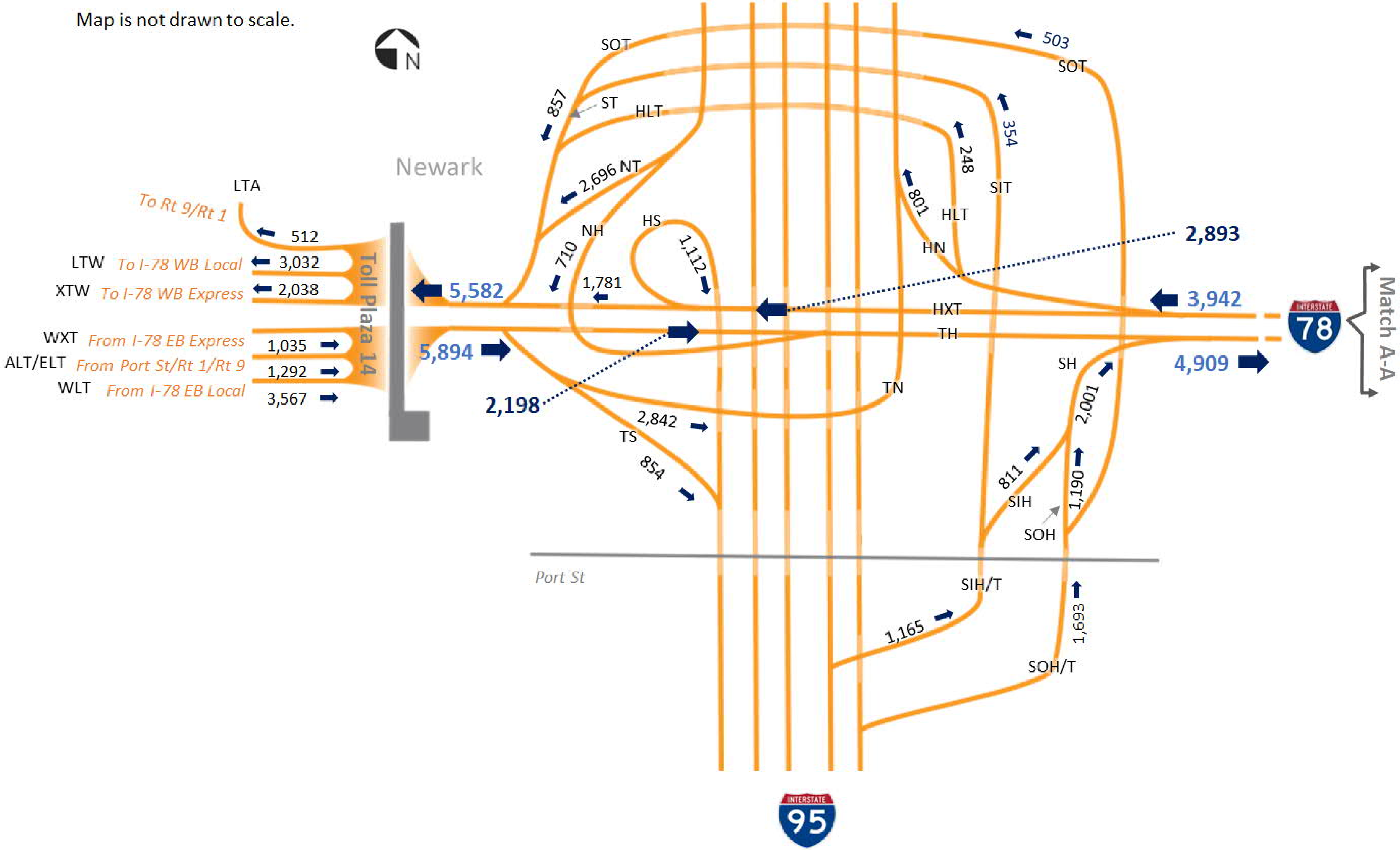
2021 AM Peak Hour Volumes (Interchange 14A)



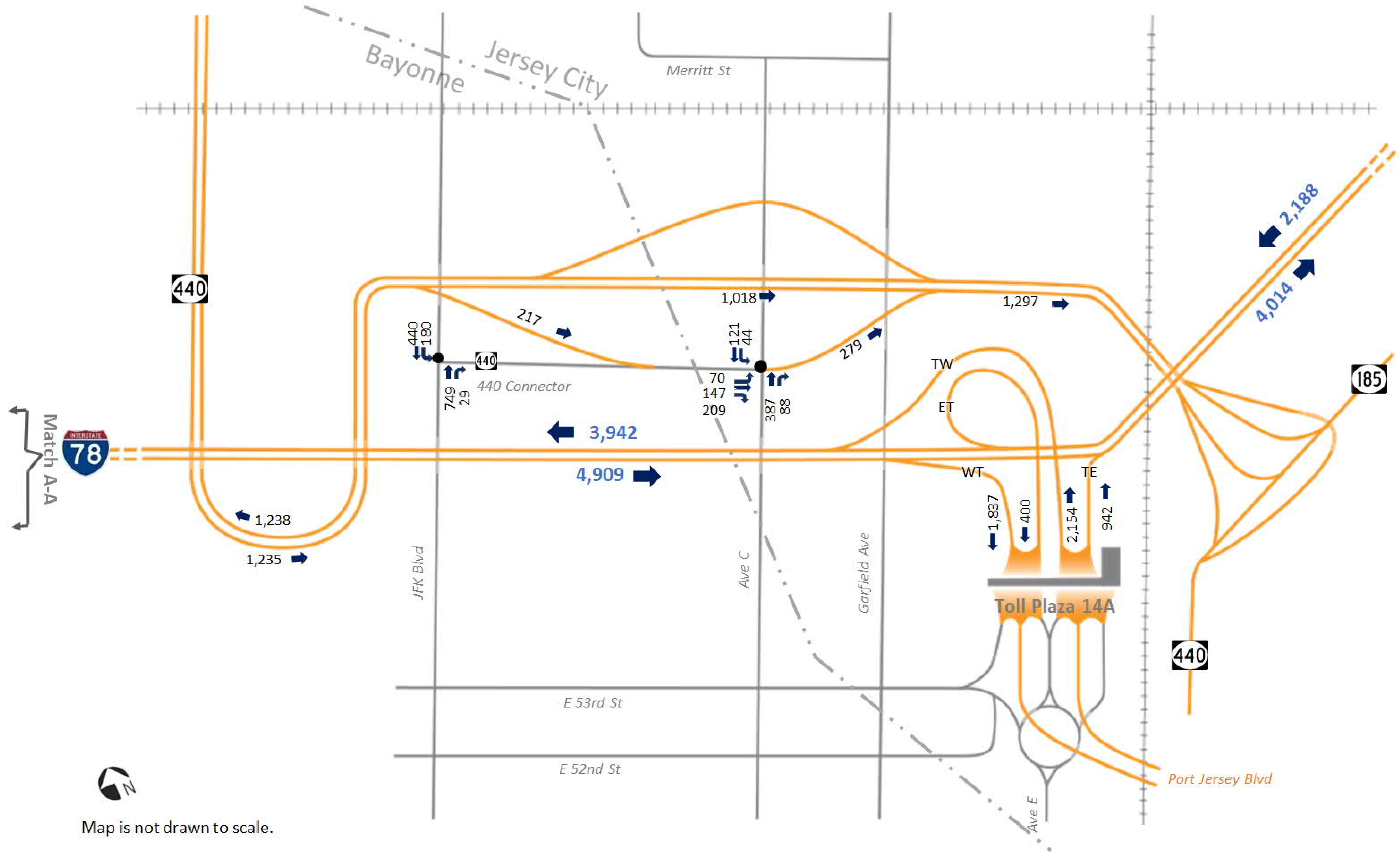
2021 PM Peak Hour Volumes (Interchange 14)



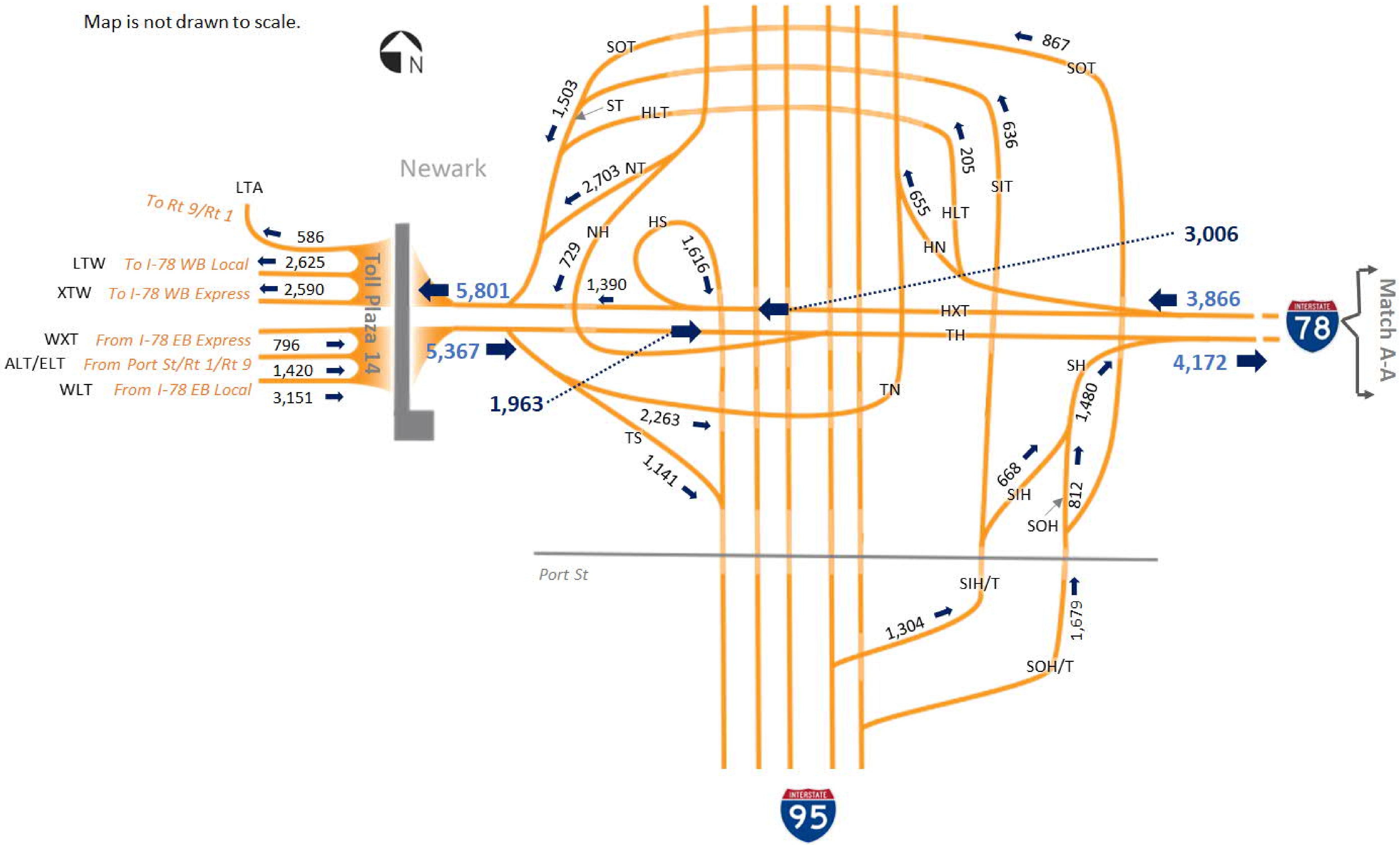
2021 PM Peak Hour Volumes (Interchange 14A)



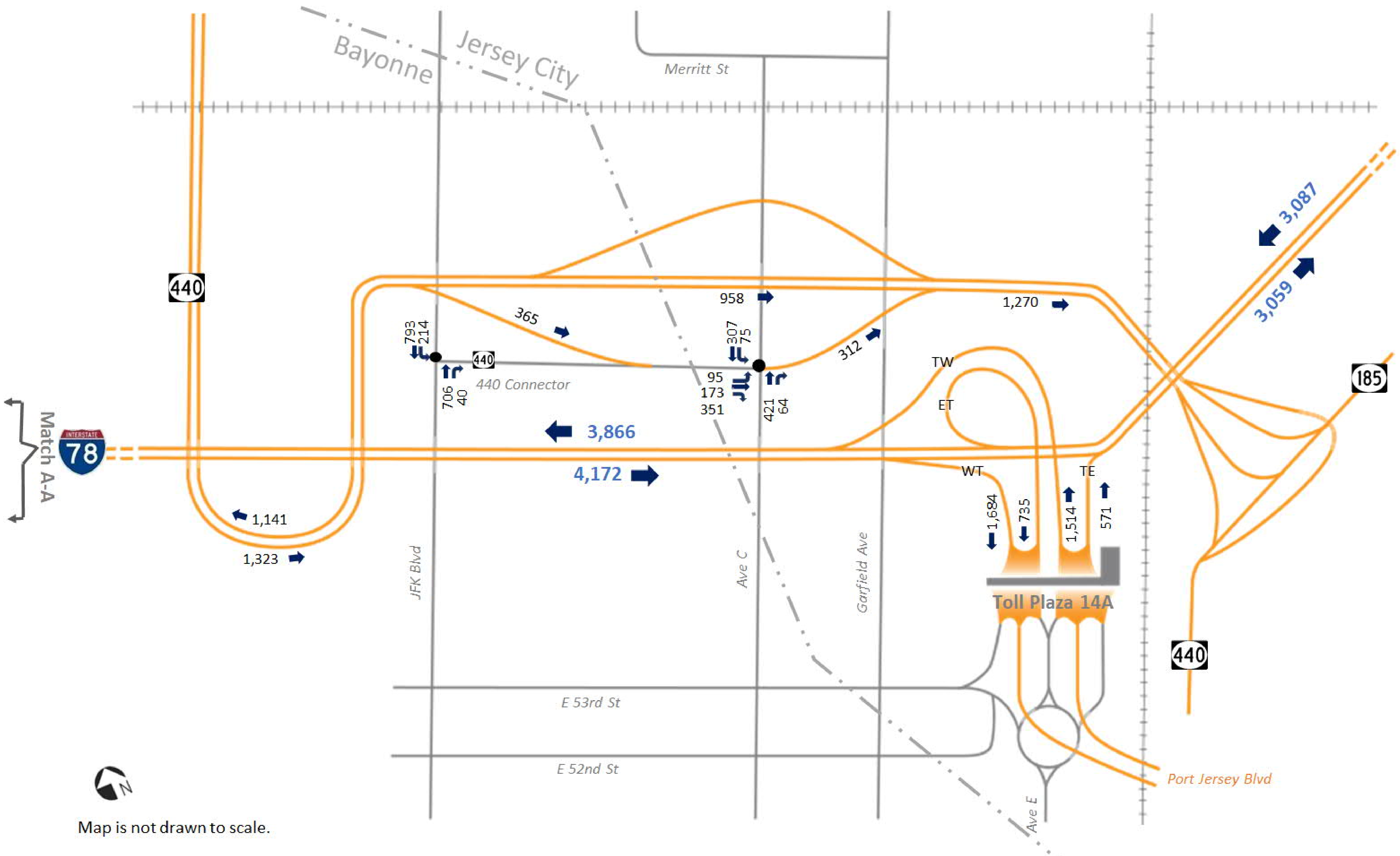
2050 No-Build AM Peak Hour Volumes (Interchange 14)



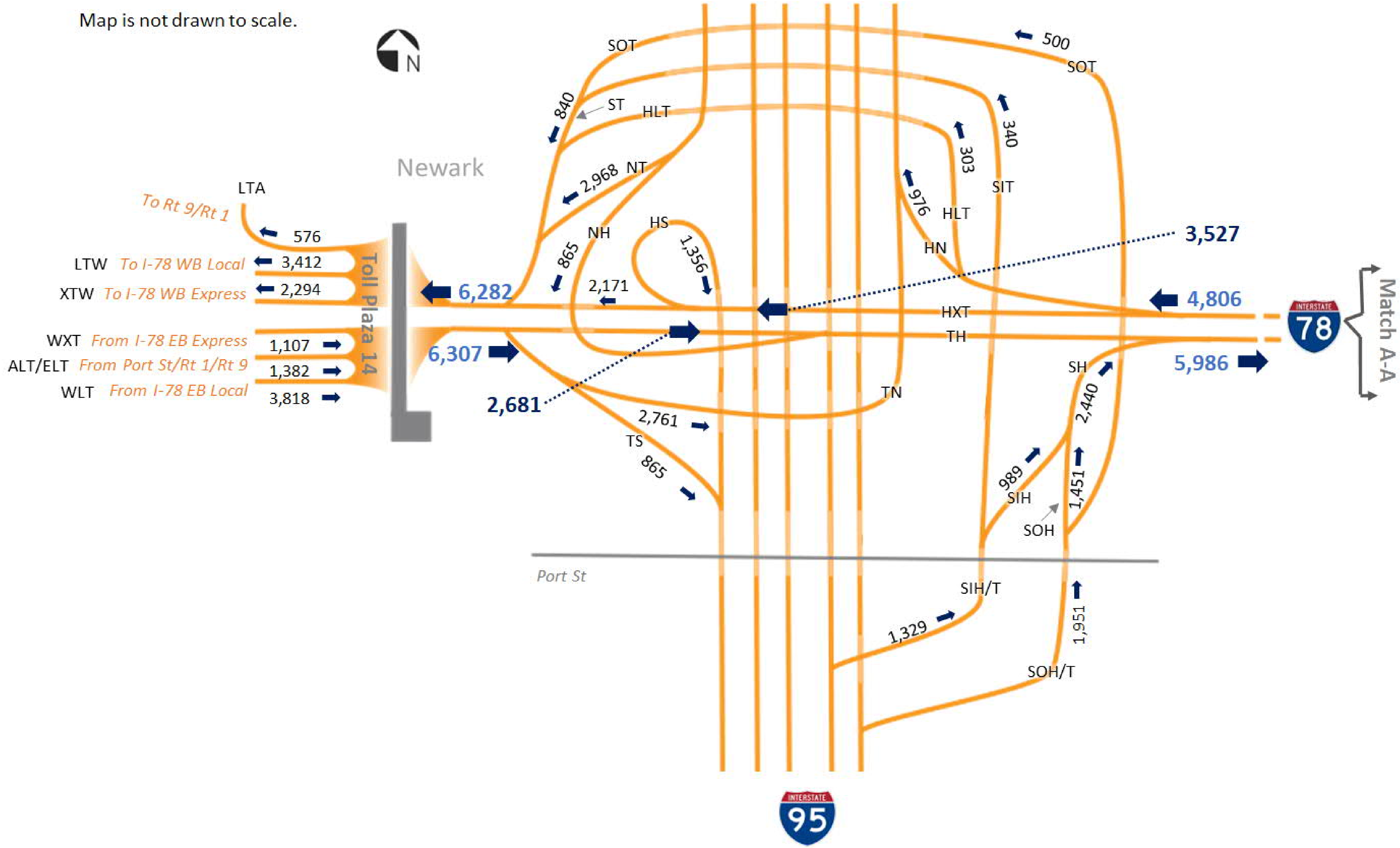
2050 No-Build AM Peak Hour Volumes (Interchange 14A)



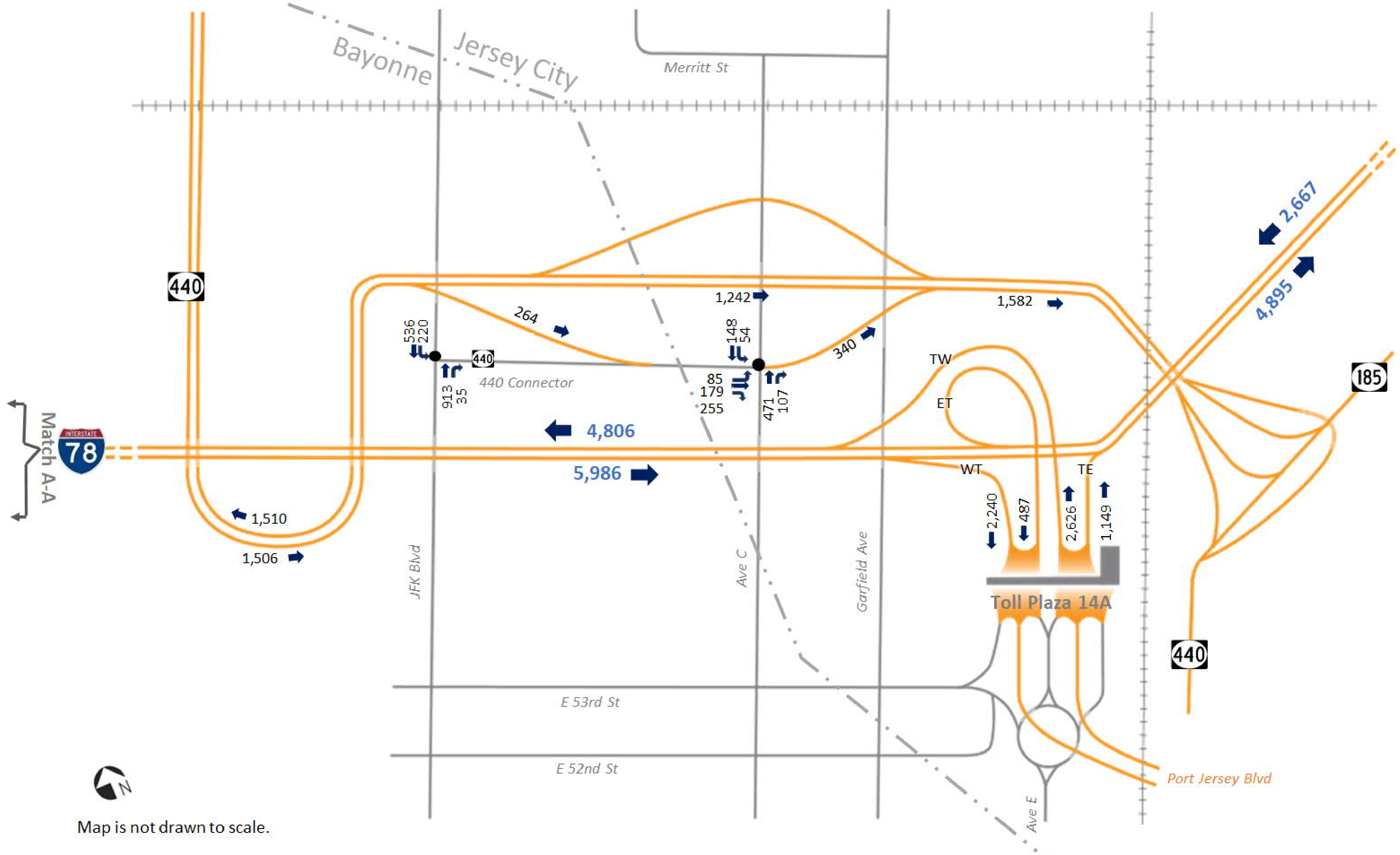
2050 No-Build PM Peak Hour Volumes (Interchange 14)



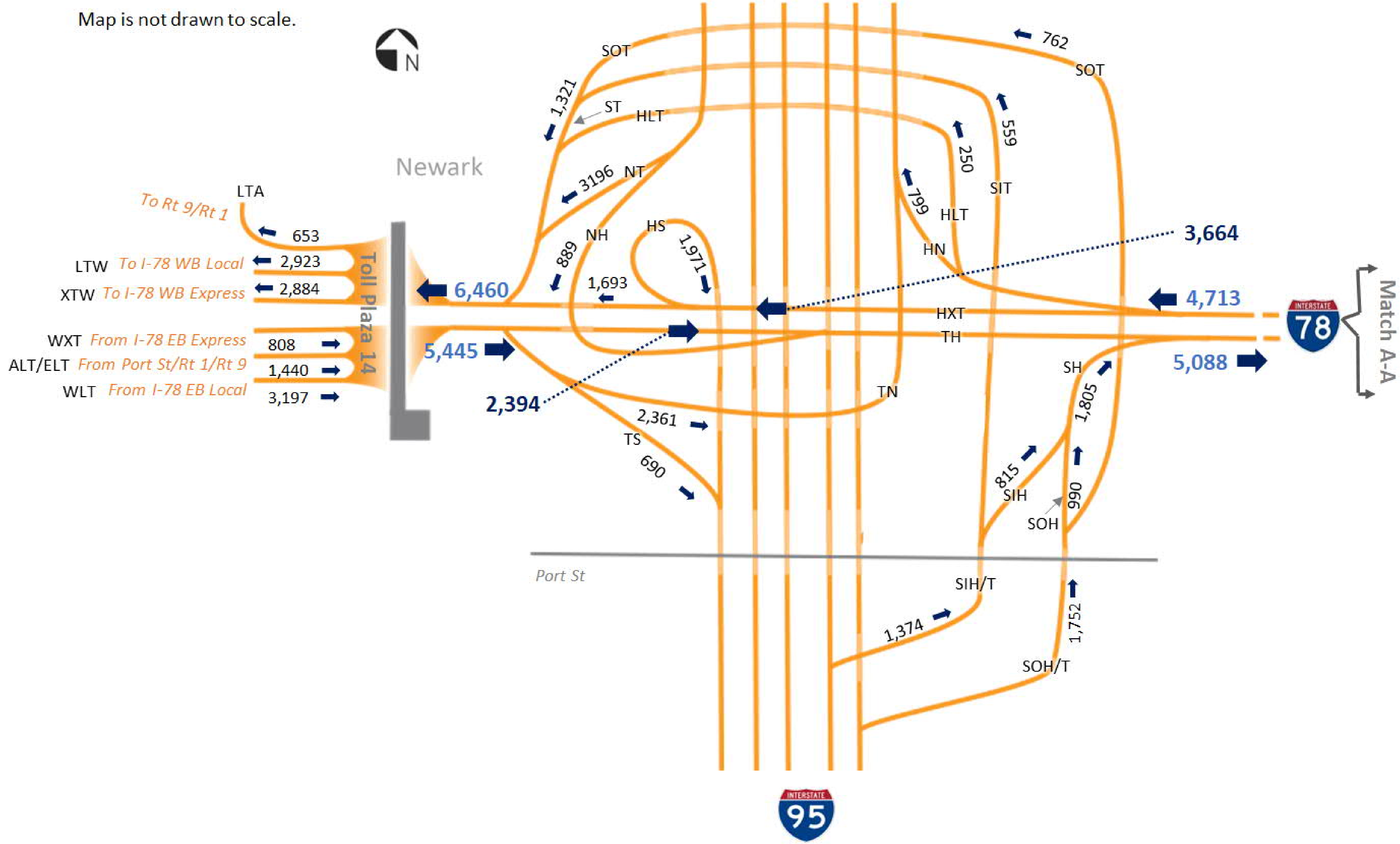
2050 No-Build PM Peak Hour Volumes (Interchange 14A)



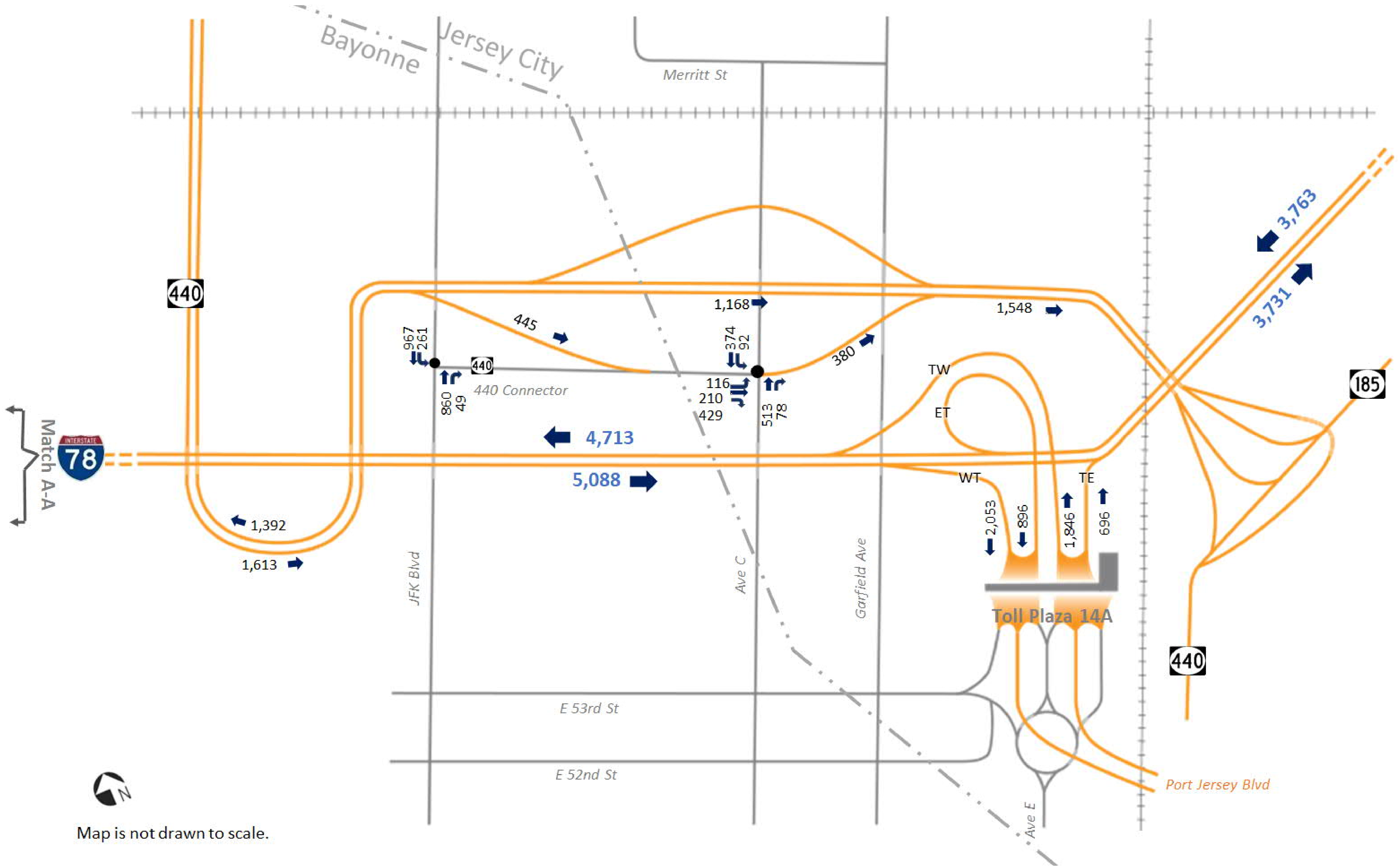
2050 Build AM Peak Hour Volumes (Interchange 14)



2050 Build AM Peak Hour Volumes (Interchange 14A)



2050 Build PM Peak Hour Volumes (Interchange 14)



2050 Build PM Peak Hour Volumes (Interchange 14A)

Appendix B – Jersey City Development Data

OPS No. T3820
New Jersey Turnpike
Newark Bay-Hudson County Extension
Bridge Replacements and Capacity Enhancements Program

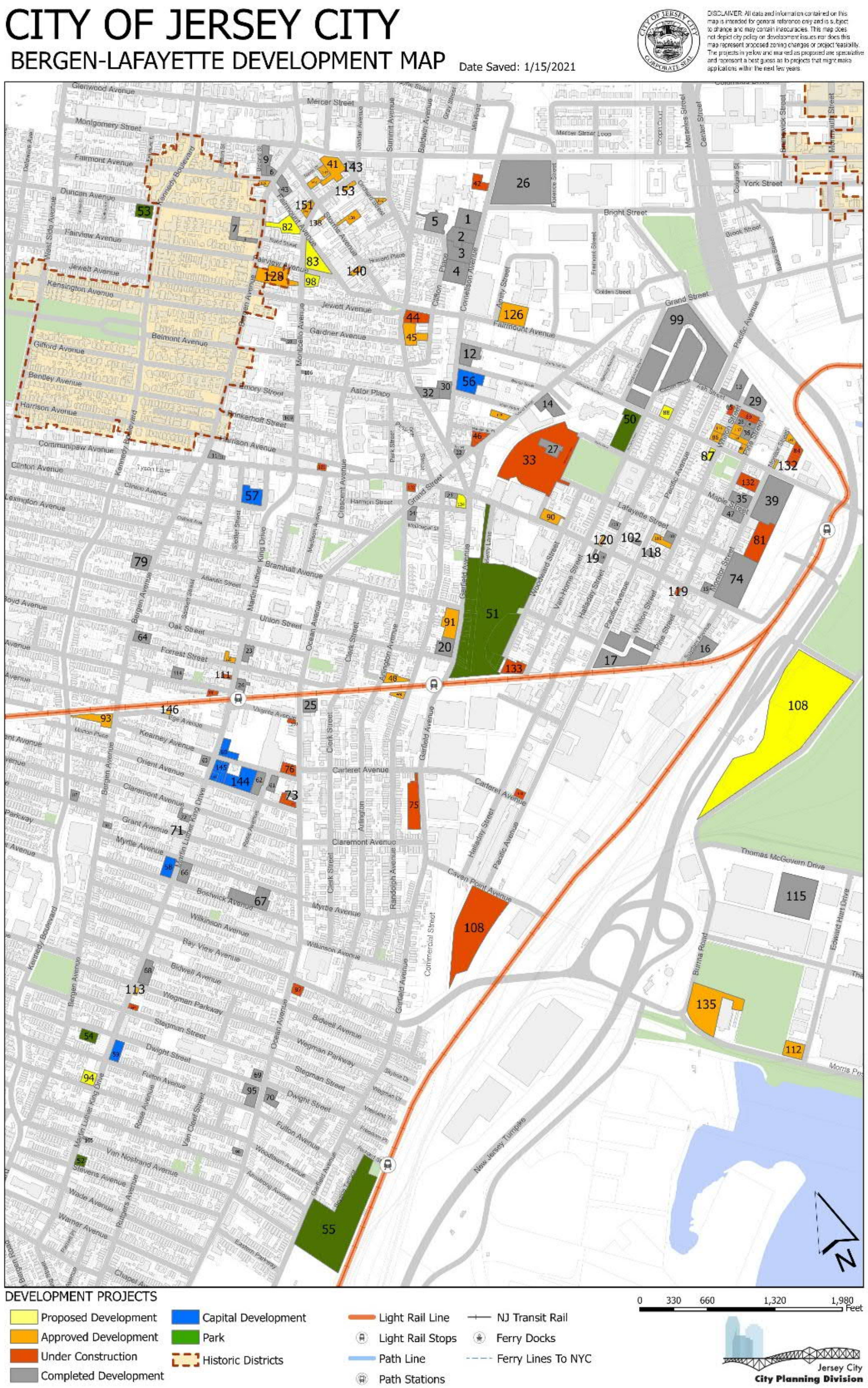
Appendix B – Jersey City Development Data

Bergen-Lafayette Development - A

Downtown Development - B

Journal Square Development - C

Westside Development - D



Bergen Lafayette Development Map – A1

CITY OF JERSEY CITY

BERGEN-LAFAYETTE DEVELOPMENT

Date Saved: 1/15/2021

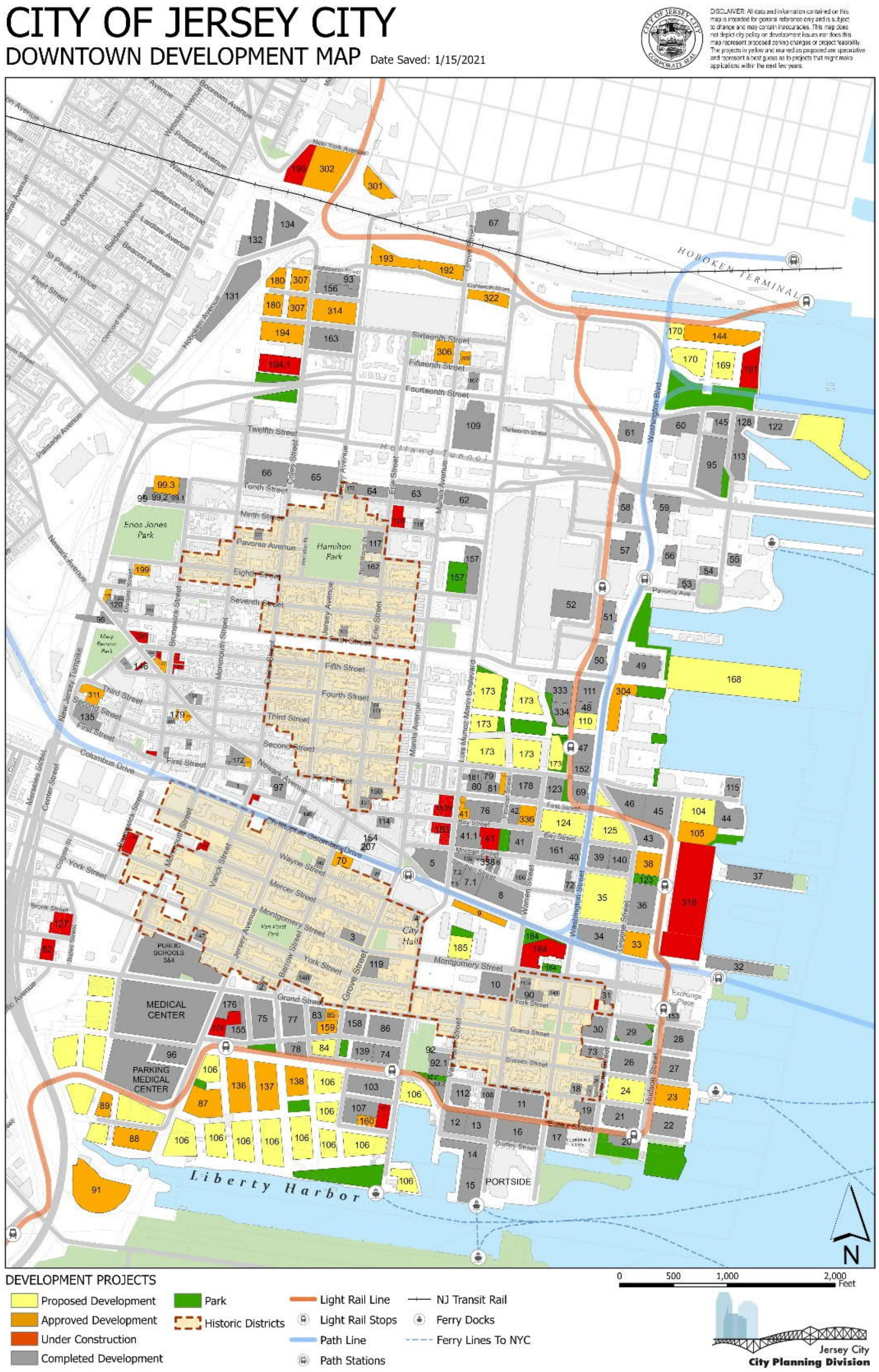
DISCLAIMER: All data and information contained on this map is intended for general reference only and is subject to change and may contain inaccuracies. This map does not depict city policy on development issues nor does this map represent proposed zoning changes or project feasibility. The projects in yellow and marked as proposed are speculative and represent a best guess as to projects that might make applications within the next few years.

SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING	SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
	DEVELOPMENT PROPOSALS						**SUMMARY:**	**48**	**0**	**2,500**	**10**
82	241 FAIRMOUNT	0	0	0	0						
83	221 MONTICELLO AVE	0	0	0	0						
87	381 WHITON ST	30	0	1,000	10						
88	378 JOHNSTON AVE	18	0	1,500	0						
92	68 ORIENT AVE	0	0	0	0						
97	123 MLK DRIVE	0	0	0	0						
98	215 MONTICELLO AVE	0	0	0	0						
SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING	SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
	APPROVED DEVELOPMENT PROJECTS						**SUMMARY:**	**1,548**	**127,238**	**137,131**	**492**
41	711 MONTGOMERY ST	285	0	5,077	120	129	43-49 FAIRVIEW AVE & 654 BERGEN AVE (10)	340	0	11,006	47
44	136 SUMMIT AVE	78	0	945	46	131	306 JOHNSTON AVE	8	0	0	0
45	118 SUMMIT AVE	47	0	0	31	134	475 COMMUNIPAW AVE (6)	40	0	9,746	23
49	201 RANDOLPH AVE (3)	10	0	0	7	135	14-16 BURMA RD (2)	0	124,608	0	31
78	59 VIRIGINIA AVE (4)	12	0	0	0	136	401-405 WHITON ST (8)	49	0	0	5
86	342 JOHNSTON AVE (8)	56	0	2,246	13	138	87 STORMS AVE (4)	11	0	0	0
90	409 COMMUNIPAW AVE (5)	47	0	5,393	27	140	37 STORMS AVE (4)	12	0	0	12
91	975 GARFIELD AVE	91	0	0	0	141	132 MONITOR ST (6)	48	0	0	5
93	311 BERGEN AVE	0	0	0	0	142	882 GRAND ST (4)	15	0	0	8
96	409 OCEAN AVE	16	0	1,431	0	146	102-104 ECE AVE (3)	4	0	0	0
101	328 PACIFIC AVE (6)	20	0	0	2	147	16-20 NEVIN ST (6)	20	0	0	13
112	1 EDWARD HART DR	0	0	31,283	0	148	116 STORMS AVE (5)	20	0	0	14
113	181 MLK DRIVE	6	0	2,177	0	149	89 STORMS AVE & 259 MONTICELLO (8)	50	0	2,892	5
114	90 VIRGINIA AVE	10	0	0	0	150	78 STORMS AVE (5)	35	0	0	19
116	725-727 BERGEN AVENUE (5)	18	0	2,889	0	151	101 STORMS AVE (4)	10	0	0	0
123	425-430 WHITON & 327-331 PINE (5)	36	0	0	49	152	18 ORCHARD ST & 227 SUMMIT AVE (6)	19	0	0	5
124	166-172 MLK DRIVE (5)	16	0	4,733	0	153	254-284 MONTICELLO AVE & 35 ORCHARD ST (8)	35	0	1,968	6
125	431-433 MLK DRIVE (6)	23	0	2,776	0						
126	20 AMITY STREET (2)	0	2,539	51,720	0						
SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING	SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
	PROJECTS UNDER CONSTRUCTION						**SUMMARY:**	**1,934**	**100,000**	**41,269**	**887**
26	561 MONTGOMERY ST	126	0	0	107	95	451-467 OCEAN AVE (5)	64	0	2,276	24
27	170 LAFAYETTE ST (1)	46	0	0	50	97	521-530 OCEAN AVE	20	0	0	0
30	37-39 CORNELISON AVE (5)	37	0	0	37	108	SCITECH SCITY	410	100,000	0	0
33	160 LAFAYETTE AVE	330	0	0	224	110	719-721 OCEAN AVE (4)	8	0	967	0
42	201 CORNELISON AVE	52	0	2,000	0	111	421-423 MLK DRIVE (4)	9	0	1,546	0
43	720 BERGEN AVE	58	0	3,219	32	119	327 COMMUNIPAW (5)	18	0	2,015	0
45	684 GRAND ST (5)	50	0	1,293	65	120	374-380 COMMUNIPAW AVENUE (5)	40	0	2,600	0
75	224 GARFIELD AVE (5)	108	0	10,819	75	121	556-572 COMMUNIPAW (2)	18	0	1,578	0
76	683 OCEAN AVE (5)	42	0	0	15	122	533-539 COMMUNIPAW (5)	40	0	1,427	0
77	659 OCEAN AVE (5)	29	0	750	9	130	101-105 PACIFIC AVE	0	0	8,441	0
78	59 VIRGINIA AVE (4)	12	0	0	0	132	95 MONITOR STREET	114	0	0	0
79	429-437 BERGEN AVE (5)	72	0	2,150	50	133	87 VAN HORNE STREET (7)	170	0	0	120
81	303 COMMUNIPAW - PHASE 3	20	0	0	55						
85	17A-19 ASH ST	25	0	0	5						
SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING	SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
	COMPLETED DEVELOPMENT PROJECTS						**SUMMARY:**	**3,116**	**155,652**	**56,997**	**1,812**
1	44 BEACON PLACE (6)	0	0	0	613	47	65 MONITOR ST	72	0	525	26
2	26 BEACON PLACE (18)	120	0	0	0	48	296-298 ARLINGTON AVE (3)	21	0	0	30
3	103 CLIFTON PLACE (22)	271	0	0	0	61	438 ROSE AVE	8	0	0	8
4	20 CLIFTON PLACE (17)	241	0	0	0	62	145 ROSE AVE	16	0	0	14
5	105 CLIFTON PLACE (23)	200	0	0	0	63	351 MLK DRIVE (4)	0	0	1,500	0
6	729 BERGEN AVE (1)	0	0	6,000	0	64	376 BERGEN AVE (6)	43	0	0	36
7	23-25 DUNCAN AVE (5)	24	0	0	24	65	242 BERGEN AVE (4)	16	0	0	0
8	673 BERGEN AVE (5)	19	0	2,111	0	66	296 MLK DRIVE (2)	8	0	0	16
9	769 MONTGOMERY ST (4)	36	0	5,176	31	67	30 & 50 BOSTWICK AVE (3)	69	0	0	0
10	187-189 MONTICELLO AVE (3)	7	0	2,170	0	68	196 MLK DRIVE (4)	39	0	5,500	39
11	615 BERGEN AVE (4)	18	0	3,332	0	69	451 OCEAN AVE (4)	32	0	0	10
12	88-94 BISHOP ST (industrial)	0	7,500	0	0	70	480 OCEAN AVE (4)	27	0	0	8
13	445 WHITON ST (4)	24	0	0	24	71	301 MLK DRIVE (3)	5	0	1,000	0
14	631 GRAND ST	0	31,017	0	32	72	315 MLK DRIVE (4)	10	5,011	3,382	0
15	6 MONITOR ST (4)	16	0	2,000	16	73	650 OCEAN AVE (3)	9	0	0	0
16	216 SUYDAM AVE	63	0	0	37	74	300 COMMUNIPAW - PHASE 1 & 2 (4)	117	0	0	127
17	PACIFIC COURT	72	0	0	70	94	121 GARABRANT ST (7)	60	0	0	26
18	373 COMMUNIPAW AVE (3)	0	7,184	0	6	89	327 PINE ST (6)	58	0	0	49
19	381 COMMUNIPAW AVE	0	0	957	0	99	JCHA LAFAYETTE COMPLEX	283	0	0	190
20	2 UNION ST (3)	34		0	15	100	305 WHITON ST (4)	25	0	0	24
21	487 COMMUNIPAW (3)	8	0	0	0	102	317-319 PACIFIC AVE (3)	8	1,132	0	0
22	704 GRAND ST (4)	12	0	0	12	103	291-297 HALLADAY ST (3)	8	0	0	8
23	460 MARTIN LUTHER KING DRIVE (5)	40	0	6,200	0	105	78 MLK DRIVE	0	0	0	0
24	418 MARTIN LUTHER KING DRIVE (4)	16	0	0	16	106	150 MONTICELLO AVE (3)	2	0	1,000	0
25	744 OCEAN AVENUE	44	0	0	23	109	113-115 MONTICELLO AVE (1)	0	0	5,908	0
28	420-424 WHITON ST (6)	30	0	0	13	114	90 VIRGINIA AVE	10	0	0	0
29	2-16 ASH STREET (5)	93	0	0	65	115	79 THOMAS MCGOVERN RD.	0	95,808	0	57
31	644 COMMUNIPAW AVE	16	0	0	0	117	170-172 GRANT AVE (5)	20	0	0	19
32	70 SUMMIT AVE (3)	17	0	0	17	118	312-314 PACIFIC AVE	14	0	1,064	0
34	747 GRAND ST (5)	36	0	0	29	137	412-418 WHITON ST (8)	56	0	0	24
35	74 MAPLE ST (8)	104	0	3,099	35	143	52 ORCHARD STREET RENO (6)	12	0	1,000	0
36	313-321 PINE ST (6)	44	0	0	29						
38	328-330 JOHNSTON AVE (5)	20	0	2,000	0						
39	100 MONITOR ST (5)	306	8,000	2,980	85						
40	323-325 PINE ST (6)	20	0	0	7						
	PARKS / PLAZAS			**STATUS**			**PUBLIC FACILITIES**			**STATUS**	
50	LAFAYETTE POOL AND BASKETBALL COURT			COMPLETED 2011		56	JC OFFICE OF EMERGENCY MANAGEMENT			COMPLETED 2011	
51	BERRY LANE PARK			COMPLETED 2016		57	JERSEY CITY POLICE DEPARTMENT: WEST DISTRICT			COMPLETED 2016	
52	VENETER WATSON PARK RENOVATIONS			COMPLETED 2015		58	GLENN CUNNINGHAM LIBRARY			COMPLETED 2001	
53	BOYD MCGUINESS PARK RENOVATIONS			COMPLETED 2015		59	MARY BETHUNE CENTER			COMPLETED 2001	
54	FULTON AVENUE PARK			SLATED 2017		60	1 JACKSON SQUARE - CITY HALL ANNEX			COMPLETED 2018	
55	BAYSIDE PARK RENOVATIONS			COMPLETED 2012		143	3 JACKSON SQUARE			COMPLETED 2019	
						144	4 JACKSON SQUARE - CITY PARKING DECK / OFFICE SPACE (5)			COMPLETED 2020	
						145	2 JACKSON SQUARE			UNDER CONSTRUCTION	
								UNITS	OFFICE	RETAIL	PARKING
							TOTAL:	**6,646**	**382,890**	**237,897**	**3,201**

AFFORDABLE HOUSING PRODUCTION SINCE 2013

SITE	PROJECT NAME	AFFORDABLE UNITS	TOTAL UNITS	SITE	PROJECT NAME	AFFORDABLE UNITS	TOTAL UNITS
45	118 SUMMIT AVE	17	47	111	421-423 DR. MARTIN LUTHER KING DR.	6	9
128	43-49 FAIRVIEW AVE	50	92	114	90 VIRGINIA AVE	10	10
129	654 BERGEN AVE	117	117	78	59-67 VIRGINIA AVE	6	12
33	160 LAFAYETTE ST	230	330	110	719-721 OCEAN AVE	6	6
131	306 JOHNSTON AV	1	8	76	683-689 OCEAN AVENUE	18	42
85	17-19 ASH STREET	4	25	77	659-661 OCEAN AVE AND 8-10 ORIENT AVE	20	29
86	342 JOHNSTON AVE	9	56	75	829-843 GARFIELD AVENUE	10	110
35	268 PINE STREET AKA 74 MAPLE ST	5	104	97	530 OCEAN AVE	9	20
132	95 MONITOR ST	6	114	95	445-457 OCEAN AVE AND 79-81 DWIGHT ST	64	64
47	65-71 MONITOR STREET	3	72	41	711 MONTGOMERY ST	57	285
91	975 GARFIELD AV	9	91				
133	87 VAN HORNE ST	18	170				
90	409-420 COMMUNIPAW AVE	10	47				
119	327 COMMUNIPAW AVE	1	16				
					TOTAL:	**686**	**1,875**

Bergen Lafayette Development Figures – A2



Downtown Development Map – B1

CITY OF JERSEY CITY

DOWNTOWN DEVELOPMENT MAP Date Saved: 1/15/2021

DISCLAIMER: All data and information contained on this map is intended for general reference only and is subject to change and may contain inaccuracies. This map does not depict city policy on development issues nor does this map represent proposed zoning changes or project feasibility. The projects in yellow and marked as proposed are speculative and represent a best guess as to projects that might make applications within the next few years.

SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING	SITE	PROJECT NAME (STORIES)	UNITS
	DEVELOPMENT PROPOSALS							
24	65 HUDSON STREET (65)	0	500,000	17,500	654	159	101 (AKA 221) GROVE ST (13)	198
35	EVERTRUST II	0	550,000	80,000	0	166	6TH STREET PIER	510
64	250 MORRIS BOULEVARD	0	0	0	0	169	NEWPORT PARCEL 4	882
104	HARBORSIDE PLAZA 8 (Future Development)	0	0	0	0	170	NEWPORT PARCEL 5	992
106	LIBERTY HARBOR NORTH RDP (Future Development)	0	0	0	0	173	HARSIMUS COVE STATION WEST	4,617
110	455 WASHINGTON BOULEVARD	119	0	6,025	200	185	PROPOSED DEVELOPMENT	0
124	111 FIRST STREET	500	0	0	0	209	336 NEWARK AVENUE	37
125	POWERHOUSE BUILDING (Future Development)	0	0	0	0	308	GRAND JERSEY RDP (Future Development)	0
	APPROVED DEVELOPMENT PROJECTS							
9	275 MARIN BOULEVARD (20) (20)	420	0	40,452	0	165	144 FIRST STREET (11)	84
23	60 HUDSON STREET	0	731,050	20,000	1,473	177	318-328 NEWARK AVENUE (7)	90
33	HARBORSIDE PLAZA 4 (5)	0	1,057,300	8,730	615	179	351 THIRD STREET (4)	12
38	200 GREENE ST II - PLAZA 6	501	0	0	0	180	296-360 COLES STREET (11 & 15)	905
41	PROVOST SQUARE (33)	288	0	13,172	350	192	690 GROVE ST.	139
70	143 CO DRIVE / 72 WAYNE STREET	58	0	5,900	45	193	854 JERSEY AVENUE	115
84	LIBERTY HARBOR NORTH	102	0	0	100	195	500 MARIN BOULEVARD	367
85	LIBERTY HARBOR NORTH	18	0	0	18	196	400 NEWARK AVENUE (7)	25
87	THE PARK AVENUE	305	0	44,764	144	199	387-389 8TH ST & 34-40 DIVISION ST (8)	72

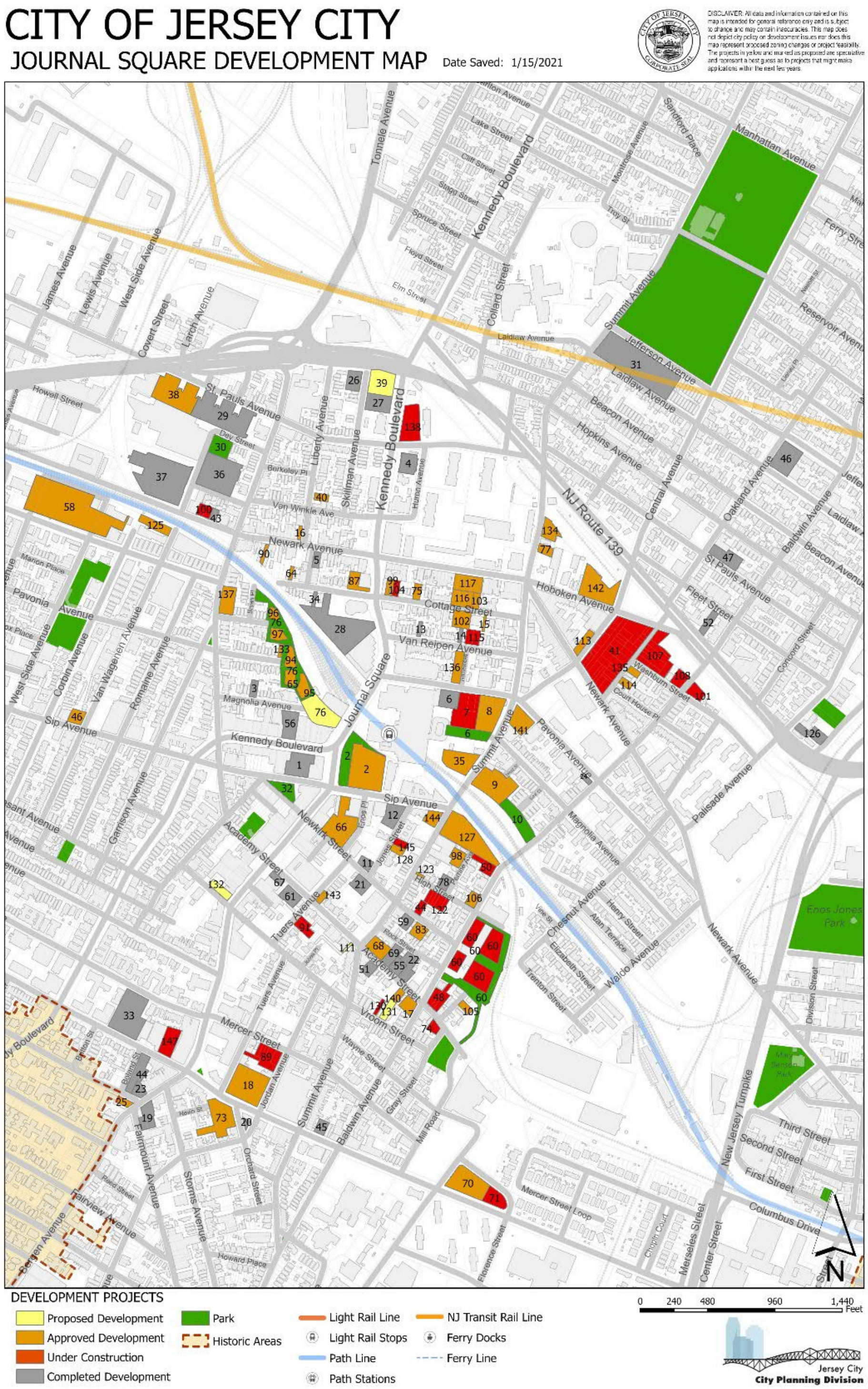
PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
DEVELOPMENT PROPOSALS SUMMARY:	7,573	1,755,300	154,165	6,217
APPROVED DEVELOPMENT PROJECTS SUMMARY:	10,750	1,813,386	521,804	9,566
PROJECTS UNDER CONSTRUCTION SUMMARY:	4,515	5,595	159,628	2,318
RECENTLY COMPLETED DEVELOPMENT PROJECTS SUMMARY:	28,289	8,663,847	2,274,543	28,354
PRE 1997 COMPLETED PROJECTS SUMMARY:	4,863	6,474,735	1,376,026	9,572
TOTAL:	52,989	18,712,663	4,406,166	56,027

SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
	PRE 1997 COMPLETED PROJECTS				
	JEFFERSON				
	WASHINGTON (21)	808	0	28,300	320
	ADAMS (21)				
	MONROE (34)	443	0		456
	EAST HAMPTON (12)	441	0	6,883	779
	NEWPORT MALL (3)	0	0	916,020	4,061
	RIVERSIDE (32)	340	0	4,125	615
	ATLANTIC (35)	444	0	0	

AFFORDABLE HOUSING PRODUCTION SINCE 2013

SITE	PROJECT NAME	AFFORDABLE UNITS	TOTAL UNITS
80	160 FIRST STREET	15	159
165	144 FIRST STREET	0	84
181	175 SECOND STREET	17	159
125	100 FIRST STREET	17	441
121	430 MARIN BLVD AKA 444 WARREN ST	58	432
161	350 WARREN ST	15	377
156	321 331 WARREN ST	15	150
164	25 CHRISTOPHER COLUMBUS DRIVE	38	750
174	100 MONTGOMERY ST	308	300
148	28 BRIGHT ST	8	31
	TOTAL:	623	2,921

Downtown Development Figures – B2



Journal Square Development Map – C1

CITY OF JERSEY CITY

JOURNAL SQUARE DEVELOPMENT

Date Saved: 1/15/2021

SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING	SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
	DEVELOPMENT PROPOSALS						**SUMMARY:**	**1,200**	**0**	**44,416**	**630**
65	HARWOOD (50) (50)	1,200	0	15,000	600	39	3085 KENNEDY BLVD / CORNUCOPIA MRKT (3)	0	0	29,418	30
76	LOWES THEATRE RENOVATION	0	0	0	0						
SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING	SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
	APPROVED DEVELOPMENT PROJECTS						**SUMMARY:**	**11,437**	**331,789**	**378,684**	**5,097**
2	1 JOURNAL SQUARE (84)	1,723		41,227	863	106	167-169 BALDWIN & 44-48 NEWKIRK (12)	140	0	4,595	14
8	JOURNAL SQUARED PHASE 3 /KRE (60)	600	0	14,000	245	109	827 PAVONIA AVENUE (3)	4	0	0	0
9	ROBINHOOD PLAZA (42)	900	0	5,000	250	110	830-832 PAVONIA AVENUE (5)	21	0	0	0
15	23 COTTAGE STREET (3)	3	0	0	0	111	213 ACADEMY STREET (4)	8	0	0	0
16	804 NEWARK AVE (5)	9	0	3,450	0	112	40 VROOM STREET (4)	9	0	0	0
17	165-173 ACADEMY ST (18)	176	17,220	3,560	0	113	626-632 NEWARK AVENUE (27)	538	28,186	8,211	0
18	688-700 MONTGOMERY ST / SPU (21)	507	0	100,146	717	114	14-16 OAKLAND (4)	20	0	0	0
35	501 SUMMIT AVE / SOCIAL SECURITY (4)	0	41,400	6,300	34	116	30-40 COTTAGE STREET	0	0	0	0
38	CANCO LOFTS PHASE 2 (8)	327	0	0	335	117	693 701, 703 707 NEWARK AV (HOTEL)(25)	263	0	6,000	100
40	22 LIBERTY AVE (5)	24	0	0	0	118	18 PERRINE (3)	7	0	0	0
46	232 SIP AVE (14)	129	15,950	1,590	0	120	14 VAN REIPEN (4)	6	0	0	0
58	1072 & 1075 WEST SIDE AVE (8)	486	0	25,452	384	121	51, 55, 57 NEWARK (6)	45	0	0	0
64	134 COTTAGE(3)	8	0	0	0	123	396 SUMMIT AVENUE (3)	4	0	948	0
65	808 PAVONIA BUILDING 2 (2)	0	10334(other)	0	0	125	161 VAN WAGENEN (13)	124	0	0	39
66	30 JOURNAL SQUARE (72)	741	96,602	15,030	741	127	438 SUMMIT AVE (3)	0	0	0	138
68	362 SUMMIT (12)	120	0	5,000	70	128	30-32 JONES ST (5)	19	0	0	0
70	580 MONTGOMERY (3)	0	17,093	11,541	62	130	36 VROOM ST (4)	8	0	0	0
75	60 COTTAGE STREET (5)	21	0	0	0	131	30-32 VROOM ST (6)	30	0	0	0
77	614-616 SUMMIT AVE (8)	32	0	5,491	0	132	150 VROOM ST (5)	16	0	2,735	0
81	PROPOSED NEW 6 STORY STRUCTURE	0	0	0	0	133	810 PAVONIA AVE (4)	12	0	0	0
84	37-47 HIGH ST (6)	65	0	1,310	8	134	622-628 SUMMIT AVE (25)	209	0	2,950	0
87	2973 KENNEDY (20)	79	18,654	6,770	0	135	26 OAKLAND AVE (6)	26	0	0	0
88	78 COTTAGE STREET (5)	18	0	0	0	136	33-35 VAN REIPEN / 618 PAVONIA AVE (27)	432	0	28883	0
90	823 NEWARK AVE (4) HOTEL	21	1,976	1,839	0	137	96-110 TONNELE AVE (12)	202	0	6,575	10
91	96-100 TUERS AVE (6)	30	6,930	7,757	0	139	311-319 SIP AVE (5)	42	0	700	23
92	783 NEWARK AVE (5) HINDU TEMPLE	1	8,350	0	0	140	177 ACADEMY ST (6)	50	0	0	0
90	823 NEWARK AVE (4) HOTEL	21	1,976	1,839	0	141	532 SUMMIT AVE (25)	340	0	4394	0
91	96-100 TUERS AVE (6)	30	6,930	7,757	0	142	414-432 HOBOKEN AVE (28)	524	0	36,000	143
92	783 NEWARK AVE (5) HINDU TEMPLE	1	8,350	0	0	143	248-250 ACADEMY ST (5)	60	0	0	0
94	808 PAVONIA BUILDING-3 (1)	0	0	3,510	0	144	425-435 SUMMIT AVE (27)	349	34,031	3559	51
95	808 PAVONIA BUILDING-1 (51)	598	0	3,750	400	146	253 ACADEMY ST (5)	79	0	0	0
96	808 PAVONIA BUILDING 5 (1)	0	5,064	0	0						
97	808 PAVONIA BUILDING-4 (57)	591	0	0	450						
98	19 PERRINE AVENUE (5)	48	0	0	0						
102	35 COTTAGE STREET (27)	329	10,379	815	0						
103	26-28 COTTAGE STREET (20)	166	12,608	0	0						
105	18 FRONT STREET (5)	28	0	0	0						
SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING	SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
	PROJECTS UNDER CONSTRUCTION						**SUMMARY:**	**3,276**	**94,669**	**94,102**	**1,532**
7	JOURNAL SQUARED PHASE 2 / KRE (70)	700	0	18,000	522	107	32 OAKLAND AVENUE (15)	297	59,822	7,220	161
41	12 COOK ST (8)	106	0	2,350	53	104	74-76 COTTAGE STREET (9)	42	1,010	0	0
44	60-62 NEWKIRK ST (5)	20	0	0	0	101	348 BALDWIN AVENUE (6)	45	0	0	21
48	156-160 ACADEMY ST (9)	91	0	1,128	30	108	345 BALDWIN AVENUE (13)	118	0	1,945	21
50	205 BALDWIN (6)	42	0	0	15	115	28-32 VAN REIPEN (27)	235	7,723	7,562	0
60.1	180 BALDWIN AVE (7)	158	0	16,000	0	122	51-53 HIGH STREET (4)	19	0	0	0
60	180 BALDWIN AVE (25)	824	0	21,000	490	138	3060 JOHN F. KENNEDY BLVD (6)	99	0	4930	50
71	530 MONTGOMERY MOSQUE (2)	0	18,722	0	0	145	34-36 JONES ST (5)	10	0	870	0
74	147 ACADEMY (8)	48	0	1,000	10	147	762 MONTGOMERY ST (6)	72	0	0	0
88	78 COTTAGE ST (5)	18	462	0	0						
89	55 JORDAN AVE (16)	282	0	4,310	112						
91	96-100 TUERS AVE (6)	30	6,930	7,757	0						
100	854-860 NEWARK AVE (5)	24	0	0	27						
SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING	SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
	RECENTLY COMPLETED DEVELOPMENT PROJECTS						**SUMMARY:**	**2,484**	**2,091,576**	**62,598**	**1,056**
1	2854 KENNEDY BLVD / SATE SQUARE (12)	130	0	14,000	395	37	888 NEWARK AVE / MANA FINE ARTS (3 & 6)	0	2,000,000	0	39
3	300 MAGNOLIA AVE / CHOSEN ESTATES (4)	15	0	0	0	43	850-852 NEWARK AVE (4)	11	0	3,266	0
4	SCHOOL RENOVATION	0	0	0	0	45	650-654 MONTGOMERY ST (5)	22	0	900	23
5	789 NEWARK AVE / HOTEL (4)	27	0	4,000	0	47	76 ST. PAULS AVE (5)	55	0	0	60
6	JOURNAL SQUARED PHASE 1 / KRE (54)	540	0	4,000	153	51	197 ACADEMY ST	20	0	0	15
11	100 NEWKIRK ST / KENNEDY LOFTS (8)	56	0	0	0	52	63-65 FLEET ST (3 & 5)	16	0	0	14
12	HCCC LIBRARY - 112K SF (6)	0	0	0	0	54	148 OAKLAND AVE (4)	95	0	0	103
13	60 VAN REIPEN AVE (3)	8	0	0	0	55	190 ACADEMY ST (6)	122	0	0	0
14	38 VAN REIPEN AVE (3)	4	0	0	0	56	2851-53 KENNEDY BLVD (6)	40	0	0	0
21	87-97 NEWKIRK (14)	132	21,506	5,006	0	59	61-65 NEWKIRK ST (5)	29	0	0	0
22	182 ACADEMY ST / TOVASTE (7)	56	0	0	35	61	257 ACADEMY HCCC STEM (6)	0	70,070	0	0
24	287 BALDWIN AVE (5)	6	0	0	0	67	680 BERGEN (10)	55	0	3,337	11
26	665-67 SKILLMAN AVE (5)	46	0	0	22	69	362 SUMMIT (6)	69	0	1,740	18
27	3075 KENNEDY BLVD (6)	83	0	3,700	19	83	51-57 NEWKIRK (6)	80	0	0	0
28	2 JOURNAL SQUARE/ PHM II (13)	240	0	0	0	78	3 PERRINE AVE. (6)	37	0	0	0
29	50 DEY ST - CANCO LOFTS PHASE 1 (8)	224	0	17,082	0	126	76 PALISADES AVE (4)	15	0	0	15
31	PUBLIC SCHOOL - ELEMENTARY	0	0	0	0						
33	ST. PETER'S UNIVERSITY STUDEN CTR (6)	0	0	0	3						
34	119 COTTAGE ST (4)	3	0	0	3						
36	25 SENATE PLACE (6)	266	0	5,587	128						
SITE	PROJECT NAME (STORIES)					SITE	PROJECT NAME (STORIES)				
	NEW OPEN SPACE AND PUBLIC AMENITIES										
2	RENOVATED JOURNAL SQUARE PLAZA					60.2	PLAZA AND PROMENADE				
6	NEW PATH PLAZA BY KRE										
10	NEW PARK										
30	CANCO LOFTS PARK										
32	NEW PLAZA										
								UNITS	OFFICE	RETAIL	PARKING
							TOTAL:	**18,397**	**2,518,034**	**579,800**	**8,315**

AFFORDABLE HOUSING PRODUCTION SINCE 2013

SITE	PROJECT NAME	AFFORDABLE UNIT	TOTAL UNITS
89	55 JORDAN AVE	56	282
18	688-700 MONTGOMERY ST	88	507
73	711 MONTGOMERY ST	57	285
TOTAL:		**201**	**1,074**

Journal Square Development Figures – C2

Westside Development Map – D1

CITY OF JERSEY CITY

WESTSIDE DEVELOPMENT MAP

Date Saved: 1/12/2021

DISCLAIMER: All data and information contained on this map is intended for general reference only and is subject to change and may contain inaccuracies. This map does not depict city policy on development issues nor does this map represent proposed zoning changes or project feasibility. The projects in yellow and marked as proposed are speculative and represent a best guess as to projects that might make applications within the next few years.

SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
DEVELOPMENT PROPOSALS	**SUMMARY:**	**1,180**	**0**	**0**	**0**
17	LIGHT RAIL EXTENSION	0	0	0	0
30	BAYFRONT (FUTURE DEVELOPMENT)	0	0	0	0
31	NJ TRANSIT BLOCK (FUTURE DEVELOPMENT)	0	0	0	0
32	PARK BLOCK / OPEN SPACE (FUTURE DEVELOPMENT)	0	0	0	0
33	BAYFRONT PHASE 1 - PARK BLOCK P9	0	0	0	0
34	BAYFRONT PHASE 1 - PARK BLOCK P10	0	0	0	0
35	BAYFRONT PHASE 1 - BLOCK 15 (12)	320	0	0	0
36	BAYFRONT PHASE 1 - BLOCK 16 (12)	250	0	0	0
37	BAYFRONT PHASE 1 - BLOCK 21 (12)	320	0	0	0
38	BAYFRONT PHASE 1 - BLOCK 22 (12)	290	0	0	0
SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
APPROVED DEVELOPMENT PROJECTS	**SUMMARY:**	**663**	**42,000**	**113,656**	**834**
15	74 POLLOCK	60	0	2,000	30
22	70 FISK ST (8)	46	0	0	26
20	340-348 WESTSIDE AVE	60	0	1,205	30
24	985 COMMUNIPAW - SELF STORAGE (6)	0	0	0	0
25	407 EGE AVE (STARBUCKS)	0	0	2,365	24
39	49 FISK ST (6)	338	0	0	144
47	NJCU WEST CAMPUS (BLOCK 7) PARKING LOT	0	0	0	145
48	NJCU WEST CAMPUS (BLOCK 6) SUPERMARKET	0	0	96,000	209
49	NJCU WEST CAMPUS (BLOCK 4/4A) PERFORMING ARTS CENTER (11)	159	42,000	12,086	226
SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
PROJECTS UNDER CONSTRUCTION	**SUMMARY:**	**1,183**	**12,044**	**17,451**	**747**
6	100 WATER ST (5)	112	0	0	160
19	151 WEST SIDE AVE	116	0	0	118
23	400 CLAREMONT AVE (6)	631	12,044	0	279
44	NJCU WEST CAMPUS (BLOCK 1)	157	0	5,709	23
45	NJCU WEST CAMPUS (BLOCK 2)	167	0	11,742	167
46	NJCU WEST CAMPUS (LOT 4C) PARK	0	0	0	0
SITE	PROJECT NAME (STORIES)	UNITS	OFFICE	RETAIL	PARKING
RECENTLY COMPLETED DEVELOPMENT PROJECTS	**SUMMARY:**	**1,881**	**0**	**11,483**	**737**
1	55 MALLORY AVE	172	0	0	142
2	319-323 GRANT (6)	27	0	0	22
3	20 FISK ST (2)	2	0	0	0
4	172-178 CULVER (6)	39	0	0	41
5	366 WEST SIDE AVE	32	0	1,435	16
7	190 CULVER (4)	16	0	0	18
9	196-198 STEVENS AVE	300	0	0	76
12	NJCU VISUAL ARTS BUILDING	0	0	0	0
13	SOCIETY HILL (PHASE 3)	242	0	0	0
16	353-363 CLAREMONT AVE	14	0	0	14
18	148-152 CLARK STREET & 16 BENNETT ST (5)	63	0	0	57
21	SOCIETY HILL (PHASE 1 & 2)	500	0	0	0
27	170-172 GRANT AVE (5)	20	0	0	19
28	235 ORIENT AVE (2)	9	0	0	6
41	NJCU WEST CAMPUS (BLOCK 3)	183	0	10,048	175
42	NJCU WEST CAMPUS (BLOCK 5B)	149	0	0	151
43	NJCU WEST CAMPUS (BLOCK 5A)	113	0	0	0
	TOTAL:	**4,907**	**54,044**	**142,590**	**2,318**

AFFORDABLE HOUSING PRODUCTION

SITE	PROJECT NAME	AFFORDABLE UNITS	TOTAL UNITS
18	148-152 CLARK ST & 16 BENNETT ST (5)	6	63
26	52 UNIVERSITY (5)	24	343

Westside Development Figures – D2

Appendix C – Crash Analysis

OPS No. T3820
New Jersey Turnpike
Newark Bay-Hudson County Extension
Bridge Replacements and Capacity Enhancements Program

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C.1. INTRODUCTION

Crash records for the NB-HCE and interchange ramps were obtained from NJTA and NJDOT for 2018 and 2019. Typically, the most recent three years of data would be used to perform crash analysis. However, years 2020 and 2021 were largely impacted by the COVID-19 pandemic; crash trends in this period would not be considered typical.

Construction on the Pulaski Skyway, which closed the bridge to northbound traffic until July 2018, resulted in traffic detours that included affected traffic using the NB-HCE. The right shoulder eastbound was converted to a peak-period traffic lane to accommodate the additional traffic. Crash trends during Pulaski Skyway construction were also not considered to be typical. Thus, crashes occurring before July 9, 2018, were excluded from the analysis. The study period became the 18-month period between July 2018 and December 2019.

It should also be noted that construction on the NB-HCE and interchanges also affected the crash history during the 18-month time period selected for analysis. Authority Contract No. T100.381 performed shoulder and ramp bridge deck reconstruction and other miscellaneous improvements between MP N0.00 and N6.00. Contract No. T100.184 also performed bridge deck reconstruction and miscellaneous structural improvements on various structures between MP N0.00 and N6.00. To account for construction and maintenance and protection of traffic (MPT) activities, the analysis identified crashes that occurred in construction areas. Contract No. T300.311 and No. T300.312, Interchange 14A Improvement Projects, were substantially completed at the end of 2018. With construction traffic patterns of improvement and maintenance projects continually affecting traffic patterns on the NB-HCE and the pandemic years since 2020, there is no substantial period of time in recent years reflecting typical geoometric and/or traffic conditions. The 18-month period selected for analysis is the most recent period reflecting conditions closest to typical.

Using the crash records for the 18 months of available data (July 2018 through December 2019), crash listings were analyzed for their frequency, location, type, and conditions in which they occurred. This analysis included a hotspot assessment along with summary statistics.

C.2. CRASH STATISTICS AND HOTSPOT ANALYSIS

A total of 794 total crashes were studied from the 18-month period referenced above. The crash listings were broken out into the following categories for analysis.

- NB-HCE Roadway Crashes – 332 crashes
- Interchange Ramp Crashes – 161 crashes
- Toll Plaza Crashes – 301 crashes

Each category was broken out further. NB-HCE crashes were further divided by direction (eastbound and westbound) and by area (Interchange 14, Interchange 14 to Interchange 14A, and Interchange 14A). Interchange crashes were further divided by interchange, with more detailed analysis performed on higher-frequency ramps. Toll plaza crashes were further divided by interchange and direction (entry and exit). Where data is available, crash statistics are compared to 2019 NJDOT Statewide Averages for Interstate Highways. While ramp and toll plaza crash trends likely do not correlate directly to mainline Interstate highway crash trends, this is the closest facility type for comparison; in these cases, the comparison to statewide averages is provided as a guide.

Crash records indicated where a construction zone influenced the crash. The proportion of crashes where a construction zone was cited in the record are as follows.

- Of the 332 total crashes on the NB-HCE, 49 (14.8%) were coded as being within a construction zone. Most of these crashes (34, or 69% of the total construction zone crashes) were located between Interchange 14 and Interchange 14A.
- Of the 161 total interchange ramp crashes, 5 (3.1%) were identified as within a construction zone.
- Of the 301 toll plaza area crashes, 5 (1.7%) cited a construction zone within the record.

Based on the statistics above, 59 of the 794 total crashes (7.4%) involved a construction zone. Because of the small percentage of crashes related to a construction zone, the full data set was considered for further study of key factors such as crash type, severity, lighting conditions, environmental conditions, day of week and time of day.

As shown in Table C-1, there were 262 and 532 total crashes in 2018 and 2019, respectively in the study area. Crashes were more likely to occur on the NB-HCE Roadway, accounting for 42.0% (110 of 262) of total study area crashes for the second half of 2018 and 41.7% (222 of 532) of total crashes in 2019.

It should be noted that the limits of the areas defined in the table are based on mileposts assigned to the boundaries. Interchange 14 area crashes included those between M.P. N0.00 and N0.50. Interchange 14A area crashes included those between M.P. N3.1 and N4.1. Crashes between the interchanges encompassed those between M.P. N0.5 and N3.1. Crashes at the toll plazas are organized by entry and exit, which are not necessarily defined by cardinal directions. At Interchange 14, entry crashes are considered eastbound in Table C-1, while exit crashes are considered westbound. This is consistent with the directionality of I-78 entering and exiting the Authority’s roadway system.

Table C-1 – Study Area Crashes by Year and Direction
Interchange 14 to Interchange 14A

Roadway Facility	Location	2018			2019			Total
		E	W	% of Total	E	W	% of Total	
Interchange 14	NB-HCE	9	10	7.3%	28	14	7.9%	**61**
	Ramps	44		16.8%	67		12.6%	**111**
	Toll Plaza	37	16	20.2%	133	31	30.8%	**217**
Interchange 14 - Interchange 14A	NB-HCE	30	49	30.2%	78	78	29.3%	**235**
Interchange 14A	NB-HCE	1	11	4.6%	6	18	4.5%	**36**
	Ramps	21		8.0%	29		5.5%	**50**
	Toll Plaza	30	4	13.0%	41	9	9.4%	**84**
Total		262		**100.0%**	532		**100.0%**	**794**

C.2.1. NB-HCE Roadway Crash Analysis

The following tables and analysis review crash trends along the NB-HCE between Interchange 14 and Interchange 14A. A total of 332 crashes occurred on the NB-HCE roadways during the 18-month study period. Eastbound crashes accounted for 45.8% (152) of the NB-HCE crashes, while the remaining 54.2% (180) crashes were in the westbound direction. Overall statistics and hotspot analyses are presented in the following sections.

C.2.1.1. Overall Statistics

Crash records were analyzed and sorted by the following categories

- Severity
- Crash Type
- Surface Condition
- Lighting Condition
- Environmental Condition
- Day of Week
- Time of Day (Weekday)

As noted in Table C-2, 79.8% of the 332 total crashes on the NB-HCE resulted in No Apparent Injury. Possible Injury crashes accounted for 14.2% of the crashes. An additional 6.0% of the NB-HCE crashes resulted in a Suspected Minor Injury; zero crashes resulted in a Suspected Serious Injury or Fatality. Most NB-HCE crashes occurred between the two interchanges (70.8%). Severity rates are similar to the 2019 Statewide Averages, with a slight overrepresentation in total Injury crashes (Possible, Suspected Minor and Suspected Major).

Table C-2 – NB-HCE Crashes by Severity
Interchange 14 to Interchange 14A

Severity Category	Interchange 14		Interchange 14 - Interchange 14A		Interchange 14A		Total	% of NB-HCE Crashes	2019 Statewide Average
	E	W	E	W	E	W			
No Apparent Injury	33	21	89	91	5	26	**265**	**79.8%**	80.4%
Possible Injury	4	3	11	26	2	1	**47**	**14.2%**	19.4%
Suspected Minor Injury	0	0	8	10	0	2	**20**	**6.0%**	
Suspected Serious Injury	0	0	0	0	0	0	**0**	**0.0%**	
Fatality	0	0	0	0	0	0	**0**	**0.0%**	0.2%
Total	**37**	**24**	**108**	**127**	**7**	**29**	**332**		
% of NB-HCE Crashes	**11.1%**	**7.2%**	**32.5%**	**38.3%**	**2.1%**	**8.8%**	100.0%		

Table C-3 summarizes the NB-HCE crashes by Crash Type. Same Direction crashes (Rear End or Sideswipe) accounted for 93.4% of the crashes on the NB-HCE roadway. Same Direction (Rear End) crashes are significantly overrepesented compared to the Statewide Averages. Same Direction (Side Swipe) crashes are also overrepresented.

A significant contributor to Same Direction crashes is the merging condition on the eastbound NB-HCE where Ramp NH and Ramp SH join Ramp TH – five lanes of ramps merge to form the two-lane NB-HCE east of there. On the westbound side, Ramp TW merges into the NB-HCE. Heavy traffic volumes on this ramp and speed differentials in the merge area with also heavy NB-HCE westbound traffic contribute to the occurrence of Same Direction crashes. In both directions, speed differentials, particularly between cars and heavy vehicles, on the existing uphill climbs on the Newark Bay Bridge may also contribute to the frequency of Same Direction crashes.

Table C-3 – NB-HCE Crashes by Type

Interchange 14 to Interchange 14A

Crash Type	Interchange 14		Interchange 14 - Interchange 14A		Interchange 14A		Total	% of NB-HCE Crashes	2019 Statewide Average
	E	W	E	W	E	W			
Same Direction (Rear-End)	13	14	71	97	2	20	**217**	**65.4%**	44.2%
Same Direction (Side Swipe)	21	10	30	24	2	6	**93**	**28.0%**	25.6%
Right Angle	0	0	1	0	0	0	**1**	**0.3%**	0.4%
Opposite Direction (Head on, Angular)	0	0	0	0	0	0	**0**	**0.0%**	0.2%
Opposite Direction (Side Swipe)	1	0	0	1	0	0	**2**	**0.6%**	0.0%
Stuck Parked Vehicle	0	0	0	1	0	0	**1**	**0.3%**	0.9%
Left Turn/U-Turn	0	0	0	0	0	0	**0**	**0.0%**	0.0%
Backing	0	0	1	0	0	0	**1**	**0.3%**	0.3%
Encroachment	0	0	0	0	0	0	**0**	**0.0%**	0.0%
Overturned	0	0	0	0	0	0	**0**	**0.0%**	1.6%
Fixed Object	1	0	5	3	3	2	**14**	**4.2%**	18.0%
Animal	0	0	0	0	0	0	**0**	**0.0%**	3.9%
Pedestrian	0	0	0	0	0	0	**0**	**0.0%**	0.1%
Pedalcyclist	0	0	0	0	0	0	**0**	**0.0%**	0.0%
Non-Fixed Object	1	0	0	1	0	1	**3**	**0.9%**	4.4%
Total	**37**	**24**	**108**	**127**	**7**	**29**	**332**		
% of NB-HCE Crashes	**11.1%**	**7.2%**	**32.5%**	**38.3%**	**2.1%**	**8.8%**	100%		

The Program IPA proposes four-lane NB-HCE roadways with full shoulders between Interchange 14 and Interchange 14A, which will address congestion due to heavy traffic flows on the NB-HCE. Interchange ramps with improved design speeds and improved merge and diverge termini will address these maneuvers. Both measures will reduce the potential for Same Direction crashes.

Table C-4 shows interchange area crash distributions by Surface Condition. Crashes occurred predominantly under Dry surface conditions (85.8%). Crashes under Wet conditions accounted for an additional 13.0% of NB-HCE crashes. Crashes occuring in Dry conditions are significantly overrepresented and crashes in wet conditions significantly underrepresented compared to Statewide Averages.

Table C-4 – NB-HCE Crashes by Surface Condition
Interchange 14 to Interchange 14A

Surface Condition	Interchange 14		Interchange 14 - Interchange 14A		Interchange 14A		Total	% of NB-HCE Crashes	2019 Statewide Average
	E	W	E	W	E	W			
Dry	29	22	93	113	6	22	**285**	**85.8%**	75.1%
Wet	7	2	13	13	1	7	**43**	**13.0%**	20.1%
Slush	1	0	0	0	0	0	**1**	**0.3%**	1.1%
Snowy	0	0	2	1	0	0	**3**	**0.9%**	2.8%
Icy	0	0	0	0	0	0	**0**	**0.0%**	0.9%
Total	**37**	**24**	**108**	**127**	**7**	**29**	**332**		
% of NB-HCE Crashes	**11.1%**	**7.2%**	**32.5%**	**38.3%**	**2.1%**	**8.8%**	100.0%		

Program improvements include a drainage system designed to current NJTA standards, which may reduce the potential for crashes under Wet conditions.

Crashes by Lighting Condition are summarized in Table C-5. Crashes occurred primarily (79.2%) during Daylight hours. Nearly 20% of crashes occurred under Dark conditions, with most of these occurring in properly lighted areas. Only 13.8% (9 of 65) crashes under Dark conditions occurred with inadequate lighting, either due to lack of street lights or ineffective street lights. Crash trends in categories other than Daylight are lower than the 2019 Statewide Averages.

Table C-5 – NB-HCE Crashes by Lighting Condition
Interchange 14 to Interchange 14A

Lighting Condition	Interchange 14		Interchange 14 - Interchange 14A		Interchange 14A		Total	% of NB-HCE Crashes	Statewide Average
	E	W	E	W	E	W			
Daylight	30	18	84	104	4	23	**263**	**79.2%**	69.5%
Dawn	0	0	1	1	1	0	**3**	**0.9%**	2.0%
Dusk	0	0	0	1	0	0	**1**	**0.3%**	2.5%
Dark (Total)	7	6	23	21	2	6	**65**	**19.6%**	26.0%
Dark (No Street Lights)	*1*	*0*	*1*	*3*	*0*	*2*	*7*	*2.1%*	
Dark (Street Lights Off)	*1*	*0*	*0*	*0*	*0*	*1*	*2*	*0.6%*	
Dark (Street Lights On, Cont.)	*5*	*3*	*21*	*14*	*2*	*2*	*47*	*14.2%*	
Dark (Street Lights On, Spot)	*0*	*3*	*1*	*4*	*0*	*1*	*9*	*2.7%*	
Total	**37**	**24**	**108**	**127**	**7**	**29**	**332**		
% of NB-HCE Crashes	**11.1%**	**7.2%**	**32.5%**	**38.3%**	**2.1%**	**8.8%**	100.0%		

Program improvements include lighting systems designed to current NJTA standards, which will reduce the potential for crashes under Dark conditions.

Table C-6 summarizes interchange area crashes by Environmental Condition. Crashes occurred predominantly under Clear conditions (86.7%), which corresponds well with the finding regarding Dry surface condition crashes noted in Table C-4. Crash trends in categories other than Clear conditions are lower than the 2019 Statewide Averages.

Table C-6 – NB-HCE Crashes by Environmental Condition

Interchange 14 to Interchange 14A

Environmental Condition	Interchange 14		Interchange 14 - Interchange 14A		Interchange 14A		Total	% of NB-HCE Crashes	Statewide Average
	E	W	E	W	E	W			
Clear	29	22	95	114	6	22	**288**	**86.7%**	83.5%
Rain	6	2	8	8	1	5	**30**	**9.0%**	12.0%
Snow	1	0	2	2	0	2	**7**	**2.1%**	2.3%
Overcast	1	0	2	3	0	0	**6**	**1.8%**	1.8%
Other (Fog, Sleet, Hail, Freezing Rain)	0	0	1	0	0	0	**1**	**0.3%**	0.4%
Total	**37**	**24**	**108**	**127**	**7**	**29**	**332**		
% of NB-HCE Crashes	**11.1%**	**7.2%**	**32.5%**	**38.3%**	**2.1%**	**8.8%**	100.0%		

Crashes on the NB-HCE between Interchange 14 and Interchange 14A were more likely to occur on weekdays, as shown in Table C-7. Weekday figures averaged approximately 57 crashes for each weekday (Monday through Friday), with peak totals on Tuesday and Thursday, which are mid-week days that are considered typical and used as the basis for other traffic analysis. Weekend totals averaged 23 crashes per weekend day (Saturday or Sunday).

Table C-7 – NB-HCE Crashes by Day of Week
Interchange 14 to Interchange 14A

Day of Week	Interchange 14		Interchange 14 - Interchange 14A		Interchange 14A		Total	% of NB-HCE Crashes
	E	W	E	W	E	W		
Sunday	4	2	8	0	0	0	14	**4.2%**
Monday	6	2	14	18	2	4	46	**13.9%**
Tuesday	8	5	23	22	0	5	63	**19.0%**
Wednesday	6	2	16	19	1	6	50	**15.1%**
Thursday	9	6	17	33	1	5	71	**21.4%**
Friday	4	4	18	21	2	7	56	**16.9%**
Saturday	0	3	12	14	1	2	32	**9.6%**
Total	**37**	**24**	**108**	**127**	**7**	**29**	**332**	
% of NB-HCE Crashes	**11.1%**	**7.2%**	**32.5%**	**38.3%**	**2.1%**	**8.8%**	**100.0%**	

Of the weekday NB-HCE crashes, more than half (61.2%) of the crashes occurred during the weekday AM or PM peak period, as shown in Table C-8. During the peak hour of these periods, 30.9% of the weekday peak period crashes occurred (18.9% of the total weekday crashes). A significant percentage of crashes (38.8%) also occurred during the weekday off-peak hours.

Table C-8 – NB-HCE Crashes by Time of Day (Weekdays)
Interchange 14 to Interchange 14A

Weekday Time Period	Interchange 14		Interchange 14 - Interchange 14A		Interchange 14A		Total	% of Weekday NB-HCE Crashes
	E	W	E	W	E	W		
AM Peak Period (6:00 AM – 9:00 AM)	13	3	34	29	2	6	**87**	**30.4%**
AM Peak Hour (7:00 AM – 8:00 AM)	*5*	*1*	*11*	*11*	*1*	*5*	*34*	*11.9%*
PM Peak Period (3:00 PM – 7:00 PM)	5	4	21	44	0	14	**88**	**30.8%**
PM Peak Hour (5:00 PM – 6:00 PM)	*2*	*1*	*4*	*12*	*0*	*1*	*20*	*7.0%*
Weekday Off Peak	15	12	33	40	4	7	**111**	**38.8%**
Total	**33**	**19**	**88**	**113**	**6**	**27**	**286**	
% of Weekday NB-HCE Crashes	**11.5%**	**6.6%**	**30.8%**	**39.5%**	**2.1%**	**9.5%**	**100.0%**	

C.2.1.2 Hotspot Analysis

A hotspot analysis identifies locations within a project limit where crashes cluster in higher concentrations than in other locations. The analysis of the study area between Interchange 14 and Interchange 14A identified two eastbound clusters and three westbound clusters on the NB-

HCE Roadway between the two interchanges. These are shown in Figure C-1and Figure C-2, respectively. Additional figures are close-up views of the cluster locations defined below. Figure C-3shows Cluster A near Interchange 14 eastbound and Figure C-4 shows Cluster B between Interchanges 14 and 14A eastbound. Near the Interchangee 14A Area, Clusters C, D, and E are shown in Figure C-5.

The approximate location for each cluster is identified below.

- Cluster A (Figure C-3) – NB-HCE eastbound at the merges with Ramp NH and Ramp SH.
- Cluster B (Figure C-4) – NB-HCE eastbound, west of the Doremus Avenue crossing.
- Cluster C (Figure C-5) – NB-HCE westbound, over the east shore of Newark Bay and the westerly crossing of NJ Route 440.
- Cluster D (Figure C-5) – NB-HCE westbound, just west of the JFK Blvd. crossing.
- Cluster E (Figure C-5) – NB-HCE westbound at the merge with Interchange 14A Ramp TW.

These clusters are in expected locations. Clusters A and E are located in merge areas where queuing and congestion frequently occur. The other clusters are on both sides of the Newark Bay Bridge, close to the merging areas where the combination of existing vertical grade slowing down traffic, especially trucks, and remaining merging maneuvers may contribute to the crash history.

The number of crashes in each cluster ranges from 12 (Cluster B) to 58 (Cluster C).

The subsequent tables provide a summary of crash type and severity, respectively, for the five identified crash clusters between Interchange 14 to Interchange 14A. The data is also summarized in the bullet points below:

- Same Direction (Sideswipe) crashes is the primary crash type for Clusters A and D while Same Direction (Rear-End) is the primary crash type for all other clusters.
- The injury rate for the six clusters ranges from 8% for Cluster D to 38% for Cluster C.
- The majority of crashes in all clusters occurred in Dry, Daylight, and Clear conditions. Cluster E had the highest rate of crashes in Wet roadway conditions and Rain environmental conditions at 29%. Cluster A and Cluster D had 23% of crashes occur under Dark conditions.
- Many of these crash statistics exceed the 2019 Statewide Average for Interstate Highways.

Figure C-1 - Crash Clusters in Project Limits
Interchange 14 to Interchange 14A – Eastbound

Figure C-2 - Crash Clusters in Project Limits
Interchange 14 to Interchange 14A – Westbound

Figure C-3 - Crash Clusters in Project Limits
NB-HCE Eastbound at Interchange 14

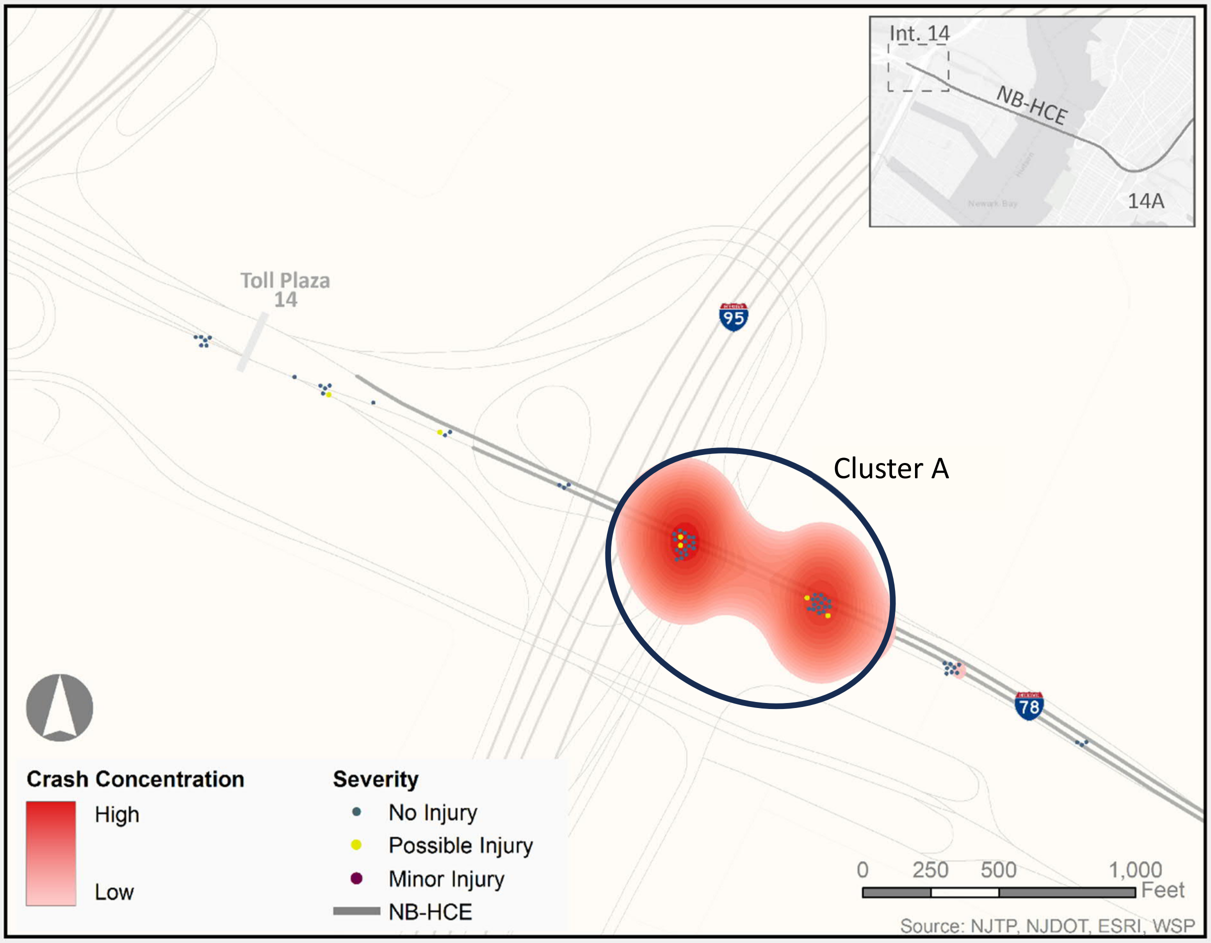


Figure C-4 - Crash Clusters in Project Limits
NB-HCE Between Interchange 14 and Interchange 14A - Eastbound

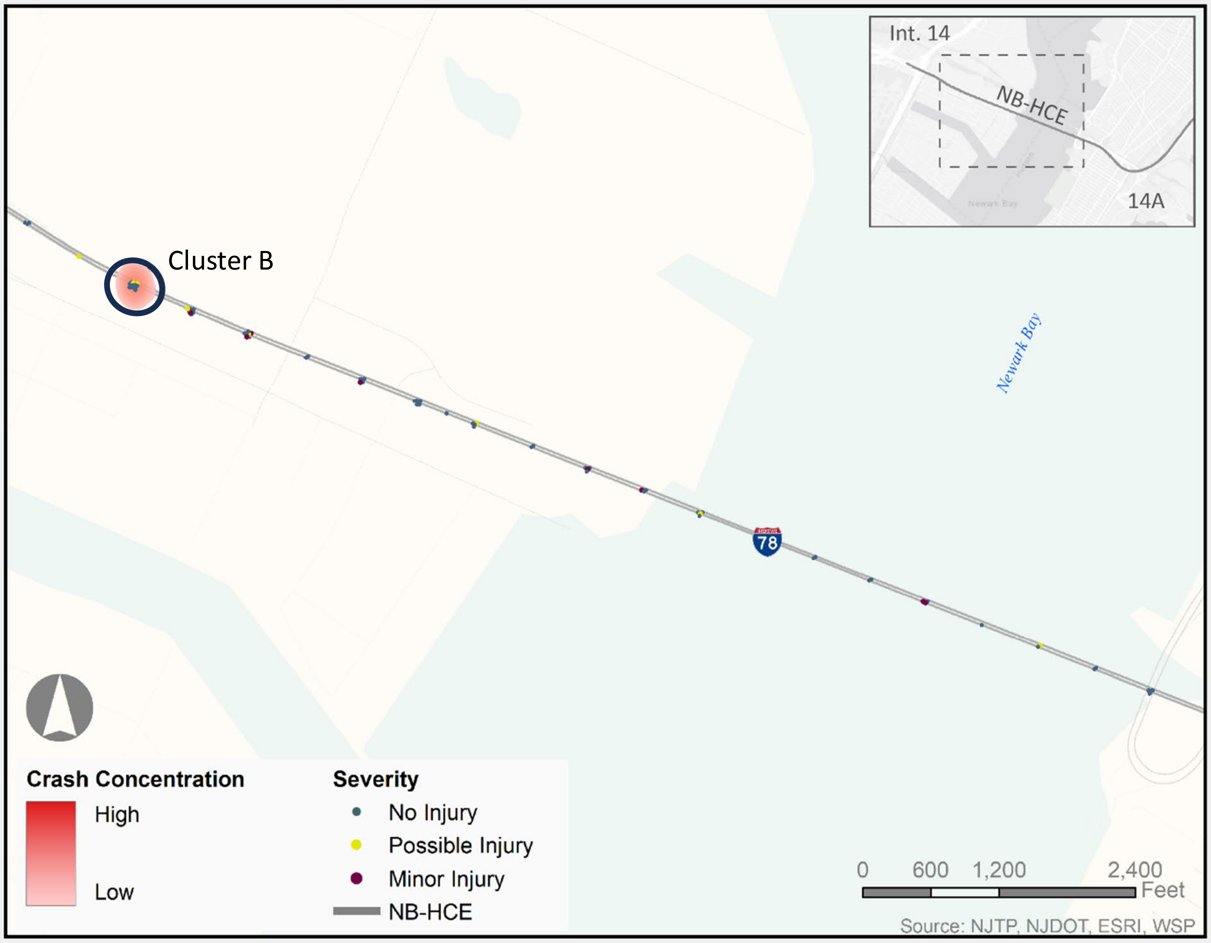


Figure C-5 - Crash Clusters in Project Limits
NB-HCE Westbound at Interchange 14A

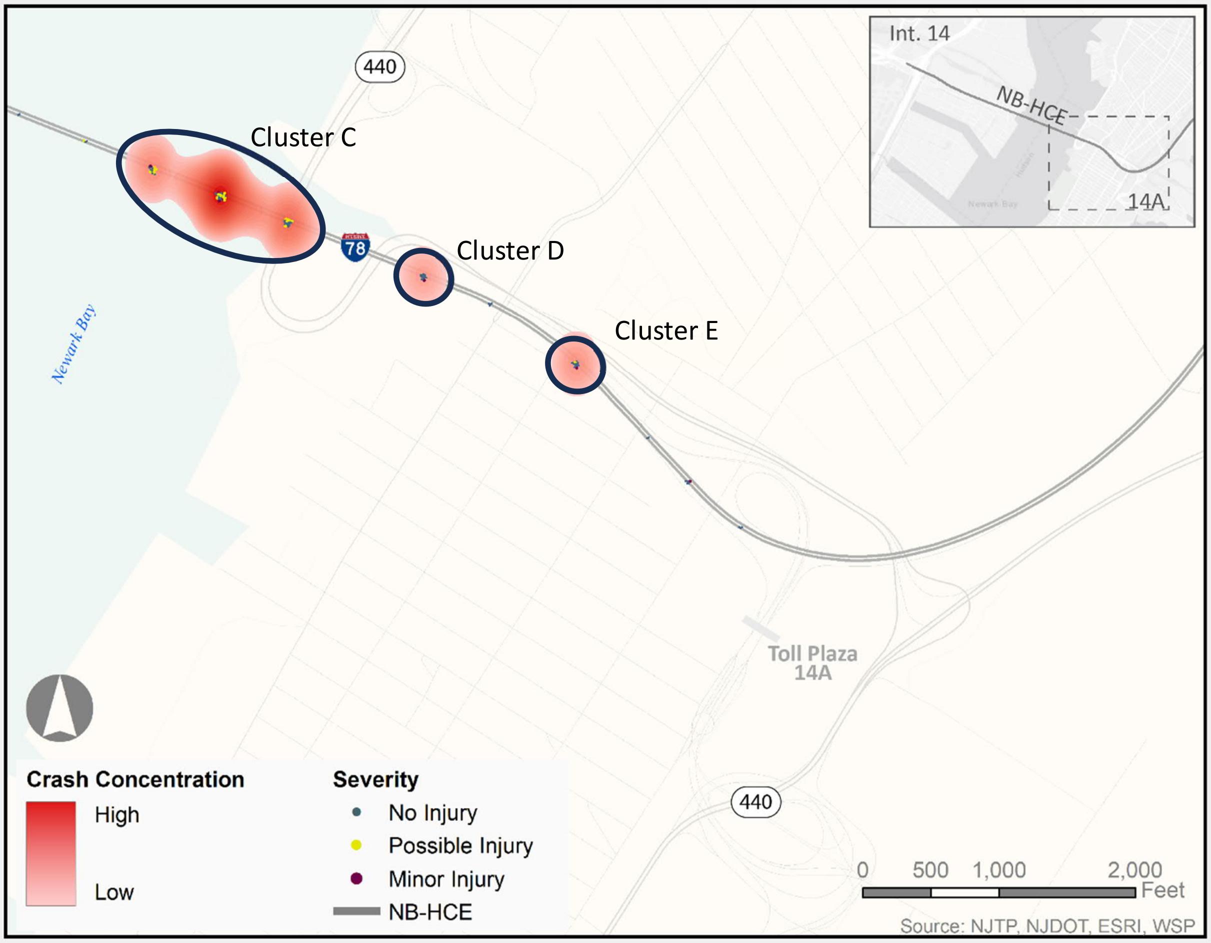


Table C-9 – Hotspot Analysis - Cluster Crashes by Type
Interchange 14 to Interchange 14A

Crash Type	Cluster A		Cluster B		Cluster C		Cluster D		Cluster E	
	#	%	#	%	#	%	#	%	#	%
Animal	0	0%	0	0%	0	0%	0	0%	0	0%
Backing	0	0%	0	0%	0	0%	0	0%	0	0%
Overturned	0	0%	0	0%	0	0%	0	0%	0	0%
Right Angle	0	0%	0	0%	0	0%	0	0%	0	0%
Fixed Object	0	0%	1	8%	0	0%	0	0%	0	0%
Left Turn/U-Turn	0	0%	0	0%	0	0%	0	0%	0	0%
Non-Fixed Object	0	0%	0	0%	0	0%	0	0%	0	0%
Opposite Direction (Head On)	0	0%	0	0%	0	0%	0	0%	0	0%
Pedestrian	0	0%	0	0%	0	0%	0	0%	0	0%
Same Direction (Rear-End)	15	43%	6	50%	53	91%	6	46%	11	79%
Same Direction (Side Swipe)	20	57%	5	42%	5	9%	7	54%	3	21%
Stuck Parked Vehicle	0	0%	0	0%	0	0%	0	0%	0	0%
Total	**35**		**12**		**58**		**13**		**14**	

Table C-10 – Hotspot Analysis – Cluster Crashes by Severity
Interchange 14 to Interchange 14A

Severity	Cluster A		Cluster B		Cluster C		Cluster D		Cluster E	
	#	%	#	%	#	%	#	%	#	%
No Apparent Injury	31	89%	10	83%	36	62%	12	92%	12	86%
Possible Injury	4	11%	2	17%	18	31%	0	0%	1	7%
Suspected Minor Injury	0	0%	0	0%	4	7%	1	8%	1	7%
Total	**35**		**12**		**58**		**13**		**14**	

Table C-11 – Hotspot Analysis – Cluster Crashes by Roadway Condition
Interchange 14 to Interchange 14A

Roadway Condition	Cluster A		Cluster B		Cluster C		Cluster D		Cluster E	
	#	%	#	%	#	%	#	%	#	%
Dry	32	91%	11	92%	51	88%	10	77%	10	71%
Wet	3	9%	0	0%	7	12%	3	23%	4	29%
Slush	0	0%	0	0%	0	0%	0	0%	0	0%
Snowy	0	0%	1	8%	0	0%	0	0%	0	0%
Icy	0	0%	0	0%	0	0%	0	0%	0	0%
Total	**35**		**12**		**58**		**13**		**14**	

Table C-12 – Hotspot Analysis – Cluster Crashes by Lighting Condition
Interchange 14 to Interchange 14A

Lighting Condition	Cluster A		Cluster B		Cluster C		Cluster D		Cluster E	
	#	%	#	%	#	%	#	%	#	%
Daylight	27	77%	10	84%	51	88%	10	77%	12	86%
Dawn	0	0%	0	0%	1	2%	0	0%	0	0%
Dusk	0	0%	0	0%	0	0%	0	0%	0	0%
Dark (Total)	8	23%	2	16%	6	10%	3	23%	2	14%
Dark (No Street Lights)	*0*	*0%*	*0*	*0%*	*0*	*0%*	*1*	*8%*	*1*	*7%*
Dark (Street Lights Off)	*0*	*0%*	*0*	*0%*	*0*	*0%*	*0*	*0%*	*1*	*7%*
Dark (Street Lights On, Cont.)	*8*	*23%*	*1*	*8%*	*2*	*3%*	*2*	*15%*	*0*	*0%*
Dark (Street Lights On, Spot)	*0*	*0%*	*1*	*8%*	*4*	*7%*	*0*	*0%*	*0*	*0%*
Total	**35**		**12**		**58**		**13**		**14**	

Table C-13 – Hotspot Analysis - Cluster Crashes by Environmental Condition
Interchange 14 to Interchange 14A

Environmental Condition	Cluster A		Cluster B		Cluster C		Cluster D		Cluster E	
	#	%	#	%	#	%	#	%	#	%
Clear	32	91%	11	92%	51	88%	10	77%	10	72%
Rain	3	9%	0	0%	5	9%	2	15%	3	21%
Snow	0	0%	1	8%	0	0%	0	0%	1	7%
Overcast	0	0%	0	0%	2	3%	1	8%	0	0%
Other (Fog, Sleet, Hail, Freezing Rain)	0	0%	0	0%	0	0%	0	0%	0	0%
Total	**35**		**12**		**58**		**13**		**14**	

C.2.2. Toll Plaza Crash Analysis

The following tables and analysis review crash trends at the toll plazas at Interchange 14 and Interchange 14A. It should be noted that since the project limit does not extend west of the Interchange 14 toll plaza, crashes "outside toll" (on the I-78 and local roadway side of the toll plaza) are not included with the statistics.

As noted in Table C-14, toll plaza areas accounted for 301 crashes in the second half of 2018 and 2019. Crashes occurred with greater frequency at Interchange 14 (72.1%) than at Interchange 14A. Based on the size of the Interchange 14 toll plaza, along with the magnitude and type of traffic volumes it processes, this is not an unexpected result. At both toll plazas, crashes on entry outnumbered crashes on exit nearly fourfold.

Table C-14 – Toll Plaza Crashes by Location and Direction
Interchange 14 and Interchange 14A

Toll Plaza	Total Crashes	% of Toll Plaza Crashes
Interchange 14	217	72.1%
Inside Entry	170	56.5%
Inside Exit	47	15.6%
Interchange 14A	84	27.9%
Inside Entry	44	14.6%
Inside Exit	11	3.6%
Outside Entry	27	9.0%
Outside Exit	2	0.7%

As noted in Table C-15, the majority (95.0%) of the crashes in the toll plaza areas resulted in No Apparent Injury. Under 5% of the toll plaza crashes resulted in a Possible Injury. One crash resulted in a Suspected Minor Injury and zero crashes resulted in a Suspected Serious Injury or Fatality. None of the severity categories outside of No Apparent Injury are overrepresented compared to the 2019 Statewide Averages.

Table C-15 – Toll Plaza Crashes by Severity
Interchange 14 and Interchange 14A

Severity Category	Interchange 14		Interchange 14A		Total	% of Toll Plaza Crashes	2019 Statewide Average
	Entry	Exit	Entry	Exit			
No Apparent Injury	161	43	70	12	**286**	**95.0%**	80.4%
Possible Injury	9	4	0	1	**14**	**4.7%**	19.4%
Suspected Minor Injury	0	0	1	0	**1**	**0.3%**	
Suspected Serious Injury	0	0	0	0	**0**	**0.0%**	
Fatality	0	0	0	0	**0**	**0.0%**	0.2%
Total	**170**	**47**	**71**	**13**	**301**		
% of Toll Plaza Crashes	**56.5%**	**15.6%**	**23.6%**	**4.3%**	100.0%		

Table C-16 summarizes the interchange area crashes by type. Same Direction crashes (Rear End or Side Swipe) accounted for 92.7% of the crashes at the toll plazas. Same Direction (Side Swipe) crashes are overrepresented compared to the Statewide Averages and are reflective of the weaving and merging maneuvers required within the expanded pavement areas to traverse between the approach, proper toll lane, and departure areas of the plaza. Backing crashes accounted for 3.6% of crashes; while this is overrepresented when compared to the Statewide Averages, this would be expected more for a toll plaza than for an open highway. This finding should be considered carefully. Fixed Object crashes accounted for 3.0% of toll plaza crashes.

Table C-16 – Toll Plaza Crashes by Type
Interchange 14 and Interchange 14A

Crash Type	Interchange 14		Interchange 14A		Total	% of Toll Plaza Crashes	2019 Statewide Averages
	Entry	Exit	Entry	Exit			
Same Direction (Rear-End)	25	10	12	3	**50**	**16.6%**	44.2%
Same Direction (Side Swipe)	139	31	52	7	**229**	**76.1%**	25.6%
Right Angle	1	0	1	0	**2**	**0.7%**	0.4%
Opposite Direction (Head on, Angular)	0	0	0	0	**0**	**0.0%**	0.2%
Opposite Direction (Side Swipe)	0	0	0	0	**0**	**0.0%**	0.0%
Stuck Parked Vehicle	0	0	0	0	**0**	**0.0%**	0.9%
Left Turn/U-Turn	0	0	0	0	**0**	**0.0%**	0.0%
Backing	3	3	4	1	**11**	**3.6%**	0.3%
Encroachment	0	0	0	0	**0**	**0.0%**	0.0%
Overturn	0	0	0	0	**0**	**0.0%**	1.6%
Fixed Object	2	3	2	2	**9**	**3.0%**	18.0%
Animal	0	0	0	0	**0**	**0.0%**	3.9%
Pedestrian	0	0	0	0	**0**	**0.0%**	0.1%
Pedalcyclist	0	0	0	0	**0**	**0.0%**	0.0%
Non-Fixed Object	0	0	0	0	**0**	**0.0%**	4.4%
Total	**170**	**47**	**71**	**13**	**301**		
% of Toll Plaza Crashes	**56.5%**	**15.6%**	**23.6%**	**4.3%**	100.0%		

Table C-17 shows toll plaza crash distributions by surface condition. Crashes occurred predominantly under Dry surface conditions (89.4%). No surface condition categories apart from Dry exceeded the 2019 Statewide Averages.

Table C-17 – Toll Plaza Crashes by Surface Condition
Interchange 14 and Interchange 14A

Surface Condition	Interchange 14		Interchange 14A		Total	% of Toll Plaza Crashes	2019 Statewide Average
	Entry	Exit	Entry	Exit			
Dry	152	41	65	11	**269**	**89.4%**	75.1%
Wet	18	6	6	1	**31**	**10.3%**	20.1%
Slush	0	0	0	0	**0**	**0.0%**	1.1%
Snowy	0	0	0	1	**1**	**0.3%**	2.8%
Icy	0	0	0	0	**0**	**0.0%**	0.9%
Total	**170**	**47**	**71**	**13**	**301**		
% of Toll Plaza Crashes	**56.5%**	**15.6%**	**23.6%**	**4.3%**	100.0%		

Crashes by lighting condition are summarized in Table C-18. Crashes occurred primarily during Daylight hours (76.7%). No lighting condition category apart from Daylight exceeded the 2019 Statewide Averages. Nearly 19% of crashes occurred under Dark conditions, with most of these occurring under lighted conditions. Only 12.3% (7 of 57) of total crashes under Dark conditions occurred under inadequate lighting, which could include wither the lack of street lights or the inadequacy of existing street lights.

Table C-18 – Toll Plaza Crashes by Lighting Condition
Interchange 14 and Interchange 14A

Lighting Condition	Interchange 14		Interchange 14A		Total	% of Toll Plaza Crashes	2019 Statewide Averages
	Entry	Exit	Entry	Exit			
Daylight	137	29	58	7	**231**	**76.7%**	69.5%
Dawn	3	1	1	1	**6**	**2.0%**	2.0%
Dusk	2	0	4	1	**7**	**2.3%**	2.5%
Dark (total)	28	17	8	4	**57**	**18.9%**	26.0%
Dark (No Street Lights)	*5*	*0*	*1*	*0*	*6*	*2.0%*	
Dark (Street Lights Off)	*1*	*0*	*0*	*0*	*1*	*0.3%*	
Dark (Street Lights On, Cont.)	*20*	*16*	*6*	*3*	*45*	*14.9%*	
Dark (Street Lights On, Spot)	*2*	*1*	*1*	*1*	*5*	*1.7%*	
Total	**170**	**47**	**71**	**13**	**301**		
% of Toll Plaza Crashes	**56.5%**	**15.6%**	**23.6%**	**4.3%**	100.0%		

Table C-19 summarizes toll plaza crashes by environmental condition. Crashes occurred predominantly (89.7%) under Clear conditions, which corresponds well with the finding regarding Dry surface condition crashes in Table C-17.

Table C-19 – Toll Plaza Crashes by Environmental Condition
Interchange 14 and Interchange 14A

Environmental Condition	Interchange 14		Interchange 14A		Total	% of Toll Plaza Crashes
	Entry	Exit	Entry	Exit		
Clear	153	43	64	10	**270**	**89.7%**
Rain	13	3	6	1	**23**	**7.6%**
Snow	0	0	0	1	**1**	**0.3%**
Overcast	4	1	1	1	**7**	**2.3%**
Other (Fog, Sleet, Hail, Freezing Rain)	0	0	0	0	**0**	**0.0%**
Total	**170**	**47**	**71**	**13**	**301**	
% of Toll Plaza Crashes	**56.5%**	**15.6%**	**23.6%**	**4.3%**	100.0%	

Toll plaza crashes were more likely to occur on weekdays, as shown in Table C-20. Weekday figures averaged about 53 crashes for each weekday (Monday through Friday), with peak totals on Tuesdays, Wednesdays and Thursdays, mid-week days that are considered typical and used as the basis for other traffic analysis. The distribution over these days is almost equal. Weekend totals averaged 19 crashes per weekend day (Saturday or Sunday).

Table C-20 – Toll Plaza Crashes by Day of Week
Interchange 14 and Interchange 14A

Day of Week	Interchange 14		Interchange 14A		Total	% of Toll Plaza Crashes
	Entry	Exit	Entry	Exit		
Sunday	6	6	0	1	**13**	**4.3%**
Monday	24	6	14	3	**47**	**15.6%**
Tuesday	25	12	16	4	**57**	**18.9%**
Wednesday	38	3	16	2	**59**	**19.6%**
Thursday	38	5	14	1	**58**	**19.3%**
Friday	23	8	11	0	**42**	**14.0%**
Saturday	16	7	0	2	**25**	**8.3%**
Total	**170**	**47**	**71**	**13**	**301**	
% of Toll Plaza Crashes	**56.5%**	**15.6%**	**23.6%**	**4.3%**	100.0%	

Of the weekday toll plaza crashes, the peak periods accounted for 65.4% of crashes, as shown in Table C-21. The AM and PM peak hours accounted for 37.2% of the peak period crashes (24.3% of the total weekday crashes). The weekday off-peak period accounted for 34.6% of the crashes.

Table C-21 – Toll Plaza Crashes by Time of Day (Weekdays)
Interchange 14 and Interchange 14A

Weekday Time Period	Interchange 14		Interchange 14A		Total	% of Weekday Toll Plaza Crashes
	Entry	Exit	Entry	Exit		
AM Peak Period (6:00 AM – 9:00 AM)	61	3	18	1	**83**	**31.6%**
AM Peak Hour (7:00 AM – 8:00 AM)	*30*	*0*	*8*	*1*	*39*	*14.8%*
PM Peak Period (3:00 PM – 7:00 PM)	33	12	41	3	**89**	**33.8%**
PM Peak Hour (5:00 PM – 6:00 PM)	*10*	*3*	*11*	*1*	*25*	*9.5%*
Weekday Off Peak	54	19	12	6	**91**	**34.6%**
Total	**148**	**34**	**71**	**10**	**263**	
% of Weekday Toll Plaza Crashes	**56.3%**	**12.9%**	**27.0%**	**3.8%**	87.4%	

C.2.3 Interchange Ramp Crash Analysis

The following tables and analysis review crash trends on the interchange ramps at Interchange 14 and Interchange 14A. Figure C-7 and Figure C-8 show interchange ramp geometry, locations and designations at Interchange 14 and Interchange 14A, respectively.

As noted in Table C-22, crashes on interchange ramps accounted for 161 crashes between July 2018 and the end of 2019. Most (68.9%) of these crashes, as expected, occurred at the Interchange 14, given the number of ramps, traffic volumes that they carry, and regional traffic characteristics. High crash ramps at these interchanges include Ramp TN, Ramp TS, Ramp NT and Ramp HS at Interchange 14. Ramp TW and the Route 440 Connector Ramp are high-crash locations at Interchange 14A.

Table C-22 – Interchange Ramp Crashes by Location
Interchange 14 to Interchange 14A

Interchange Ramp	Total Crashes	% of Ramp Crashes
Interchange 14	111	**68.9%**
Ramp HLT	3	1.9%
Ramp HN	3	1.9%
Ramp HS	9	5.6%
Ramp NH	7	4.3%
Ramp NT	16	9.9%
Ramp SH	2	1.2%
Ramp TN	41	25.5%
Ramp TS	30	18.6%
Interchange 14A	50	**31.1%**
Route 440 Connector Ramp	12	7.5%
Ramp ET	1	0.6%
Ramp TE	2	1.3%
Ramp TW	28	17.4%
Ramp WT	7	4.3%

As noted in Table C-23, most ramp crashes (82.0%) resulted in No Apparent Injury. Ten crashes resulted in a Suspected Minor Injury. No ramp crashes resulted in a Suspected Serious Injury or Fatality. None of the various Injury severity categories exceeded the 2019 Statewide Averages.

Table C-23 – Interchange Ramp Crashes by Severity
Interchange 14 and Interchange 14A

Severity Category	Interchange 14	Interchange 14A	Total	% of Ramp Crashes	2019 Statewide Average
No Apparent Injury	89	43	**132**	**82.0%**	80.4%
Possible Injury	15	4	**19**	**11.8%**	19.4%
Suspected Minor Injury	7	3	**10**	**6.2%**	
Suspected Serious Injury	0	0	**0**	**0.0%**	
Fatality	0	0	**0**	**0.0%**	0.2%
Total	**111**	**50**	**161**		

Table C-24 summarizes interchange ramp crashes by type. Most ramp crashes (75.7%) were Same Direction crashes (Rear End or Side Swipe). An additional 14.3% of the crashes involved a Fixed Object. Same Direction (Side Swipe) crashes are overrepresented compared to the Statewide Averages. This may reflect merging and lane shifting maneuvers at the ramp termini, whether at the toll plaza or NB-HCE roadway. Right Angle, Struck Parked Vehicle and Overturn crashes are also overrepresented relative to the Statewide Averages, though the frequencies are small. High truck volumes on these ramps may contribute to the frequency of these crash types. No other crash type is overrepresented against the Statewide Averages.

Table C-24 – Interchange Ramp Crashes by Type
Interchange 14 and Interchange 14A

Crash Type	Interchange 14	Interchange 14A	Total	% of Ramp Crashes	2019 Statewide Averages
Same Direction (Rear-End)	38	16	**54**	**33.5%**	44.2%
Same Direction (Side Swipe)	37	31	**68**	**42.2%**	25.6%
Right Angle	3	0	**3**	**1.9%**	0.4%
Opposite Direction (Head on, Angular)	0	1	**1**	**0.6%**	0.2%
Opposite Direction (Side Swipe)	0	1	**1**	**0.6%**	0.0%
Stuck Parked Vehicle	2	0	**2**	**1.2%**	0.9%
Left Turn/U-Turn	0	0	**0**	**0.0%**	0.0%
Backing	0	0	**0**	**0.0%**	0.3%
Encroachment	0	0	**0**	**0.0%**	0.0%
Overturn	5	0	**5**	**3.1%**	1.6%
Fixed Object	22	1	**23**	**14.3%**	18.0%
Animal	0	0	**0**	**0.0%**	3.9%
Pedestrian	0	0	**0**	**0.0%**	0.1%
Pedalcyclist	0	0	**0**	**0.0%**	0.0%
Non-Fixed Object	4	0	**4**	**2.5%**	4.4%
Total	**111**	**50**	**161**	**100%**	

Table C-25 shows interchange area crash distributions by surface condition. Crashes occurred predominantly on Dry surface conditions (73.3%), though crashes on Wet surfaces are overrepresented relative to the Statewide Averages. No other surface condition categories are overrepresented compared to the Statewide Averages.

Table C-25 – Interchange Ramp Crashes by Surface Condition
Interchange 14 and Interchange 14A

Surface Condition	Interchange 14	Interchange 14A	Total	% of Ramp Crashes	2019 Statewide Averages
Dry	79	39	**118**	**73.3%**	75.1%
Wet	31	11	**42**	**26.1%**	20.1%
Slush	1	0	**1**	**0.6%**	1.1%
Snowy	0	0	**0**	**0.0%**	2.8%
Icy	0	0	**0**	**0.0%**	0.9%
Total	**111**	**50**	**161**		

Crashes by lighting condition are summarized in Table C-26. Crashes occurred primarily during Daylight hours (70.8%). Crashes under Dark conditions exceeded the 2019 Statewide Averages. Nearly 29% of crashes occurred under Dark conditions, with most of these occurring with street lights turned on. Only 17.4% (8 of 46) of crashes under Dark conditions occurred with inadequate lighting – either due to the lack of street lights or with street lights not functioning properly.

Table C-26 - Interchange Ramp Crashes by Lighting Condition
Interchange 14 and Interchange 14A

Lighting Type	Interchange 14	Interchange 14A	Total	% of Ramp Crashes	2019 Statewide Averages
Daylight	73	41	**114**	**70.8%**	69.5%
Dawn	1	0	**1**	**0.6%**	2.0%
Dusk	0	0	**0**	**0.0%**	2.5%
Dark (Total)	37	9	**46**	**28.6%**	26.0%
Dark (No Street Lights)	*6*	*1*	*7*	*4.4%*	
Dark (Street Lights Off)	*1*	*0*	*1*	*0.6%*	
Dark (Street Lights On, Cont.)	*24*	*6*	*30*	*18.6%*	
Dark (Street Lights On, Spot)	*6*	*2*	*8*	*5.0%*	
Total	**111**	**50**	**161**		

Table C-27 summarizes interchange area crashes by environmental condition. Crashes occurred predominantly (75.8%) under Clear conditions, which corresponds well with the finding regarding Dry surface condition crashes in Table C-25.

Table C-27 – Interchange Ramp Crashes by Environmental Condition
Interchange 14 and Interchange 14A

Surface Condition	Interchange 14	Interchange 14A	Total	% of Ramp Crashes
Clear	82	40	**122**	**75.8%**
Rain	25	9	**34**	**21.1%**
Snow	0	0	**0**	**0.0%**
Overcast	3	1	**4**	**2.5%**
Other (Fog, Sleet, Hail, Freezing Rain)	1	0	**1**	**0.6%**
Total	**111**	**50**	**161**	

Interchange ramp crashes were more likely to occur on weekdays, as shown in Table C-28. Weekday figures averaged about 27 crashes for each weekday (Monday through Friday), with peak totals on Fridays. Weekend totals averaged 13 crashes per weekend day (Saturday or Sunday).

Table C-28 – Interchange Ramp Crashes by Day of Week
Interchange 14 and Interchange 14A

Day of Week	Interchange 14	Interchange 14A	Total	% of Ramp Crashes
Sunday	11	1	**12**	**7.5%**
Monday	12	10	**22**	**13.7%**
Tuesday	16	14	**30**	**18.6%**
Wednesday	15	6	**21**	**13.0%**
Thursday	15	10	**25**	**15.5%**
Friday	28	9	**37**	**23.0%**
Saturday	14	0	**14**	**8.7%**
Total	111	50	**161**	

Of the weekday interchange ramp crashes, the peak periods accounted for 57.0% of crashes, as shown in Table C-29. The weekday AM and PM peak hours accounted for 28.6% of the peak period crashes (16.3% of the total weekday crashes). The weekday off-peak period accounted for 43.0% of the crashes.

Table C-29 – Interchange Ramp Crashes by Time of Day (Weekdays)
Interchange 14 and Interchange 14A

Weekday Time Period	Interchange 14	Interchange 14A	Total	% of Weekday Ramp Crashes
AM Peak Period (6:00 AM – 9:00 AM)	13	12	**25**	**18.5%**
AM Peak Hour (7:00 AM – 8:00 AM)	*4*	*3*	*7*	*5.2%*
PM Peak Period (3:00 PM – 7:00 PM)	29	23	**52**	**38.5%**
PM Peak Hour (5:00 PM – 6:00 PM)	*9*	*6*	*15*	*11.1%*
Weekday Off Peak	44	14	**58**	**43.0%**
Total	**86**	**49**	**135**	

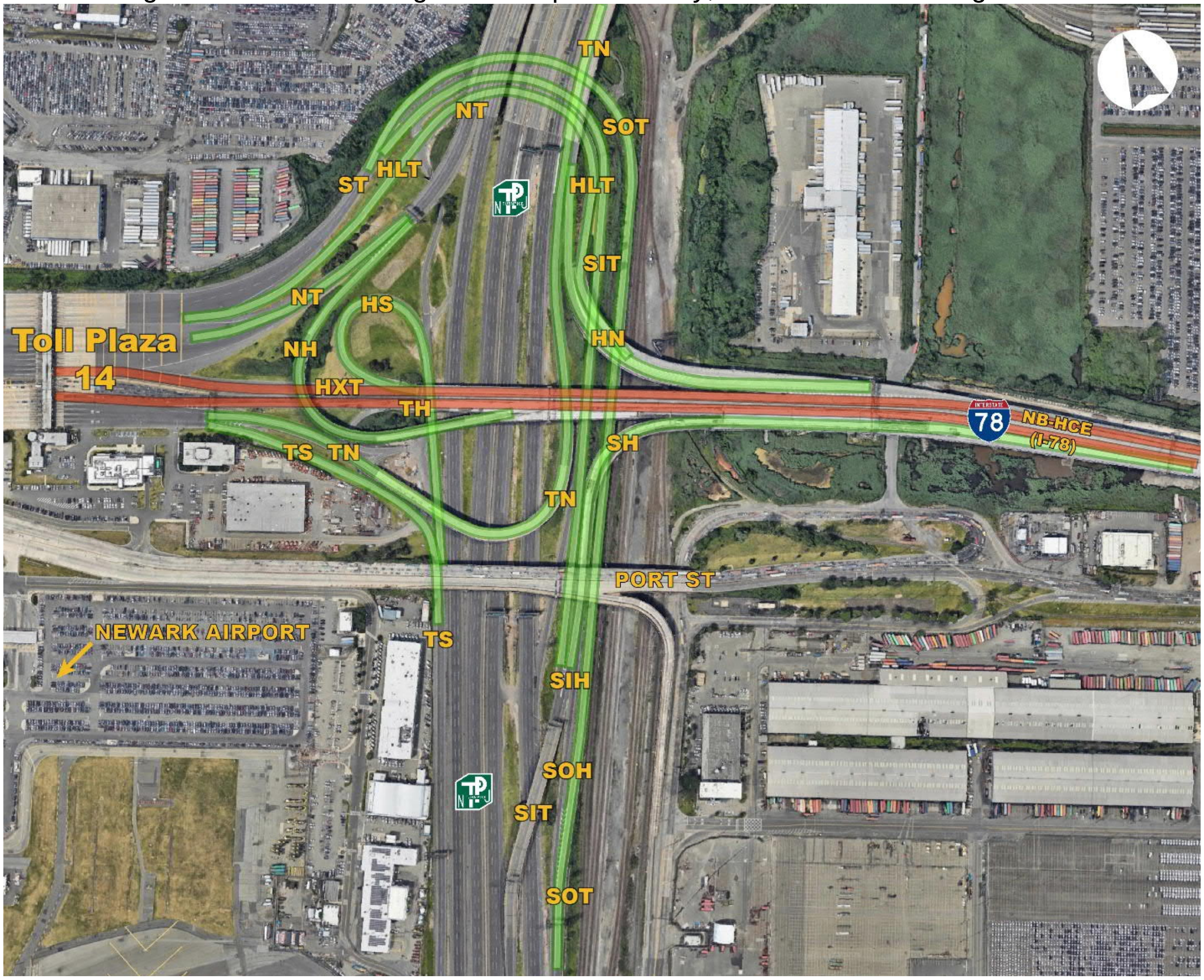
C.2.3.1. Interchange 14 High-Crash Ramp Location Analysis

Table C-22 summarizes the crash totals for select ramps within the study area at Interchange 14. Of those ramps, four exhibited crash magnitudes over five crashes per year (or 8 crashes during the 18-month period studied), such that further study is warranted on these ramps. These ramps include the following.

- Ramp TN – 41 crashes
- Ramp TS – 30 crashes
- Ramp NT – 16 crashes
- Ramp HS – 9 crashes

Figure C-6 shows interchange geometry, locations and designations for ramps at Interchange 14, including those above selected for more detailed study.

Figure C-6 – Interchange 14 Ramp Geometry, Locations and Designations



The following tables, Table C-30 through Table C-36, summarize crash statistics for the four ramps selected for further study. The analysis is consistent with the analysis format for facilities previously studied in this Section.

Table C-30 – Select Interchange 14 Ramp Crashes by Severity

Ramp TN, Ramp TS, Ramp NT, and Ramp HS

Severity Category	Ramp TN		Ramp TS		Ramp NT		Ramp HS		2019 Statewide Averages
	#	%	#	%	#	%	#	%	
No Apparent Injury	33	80.4%	23	76.7%	11	68.8%	8	88.9%	80.4%
Possible Injury	4	9.8%	6	20.0%	3	18.7%	1	11.1%	19.4%
Suspected Minor Injury	4	9.8%	1	3.3%	2	12.5%	0	0.0%	
Suspected Serious Injury	0	0.0%	0	0.0%	0	0.0%	0	0.0%	
Fatality	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.2%
Total	**41**	100.0%	**30**	**100.0%**	**16**	**100.0%**	**9**	**100.0%**	

Table C-31 – Select Interchange 14 Ramp Crashes by Type
Ramp TN, Ramp TS, Ramp NT, and Ramp HS

Crash Type	Ramp TN		Ramp TS		Ramp NT		Ramp HS		2019 Statewide Averages
	#	%	#	%	#	%	#	%	
Backing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0.3%
Fixed Object	10	24.4%	0	0.0%	3	18.7%	2	22.2%	18.0%
Non-Fixed Object	2	4.9%	0	0.0%	1	6.3%	0	0.0%	4.4%
Overturned	4	9.8%	0	0.0%	0	0.0%	1	11.1%	1.6%
Right Angle	0	0.0%	1	3.3%	0	0.0%	2	22.2%	0.4%
Same Direction (Rear End)	6	14.6%	20	66.7%	5	31.2%	3	33.4%	44.2%
Same Direction (Side Swipe)	19	46.3%	9	30.0%	6	37.5%	0	0.0%	25.6%
Struck Parked Vehicle	0	0.0%	0	0.0%	1	6.3%	1	11.1%	0.9%
Total	**41**	100.0%	**30**	**100.0%**	**16**	**100.0%**	**9**	**100.0%**	

Table C-32 – Select Interchange 14 Ramp Crashes by Surface Condition
Ramp TN, Ramp TS, Ramp NT, and Ramp HS

Surface Condition	Ramp TN		Ramp TS		Ramp NT		Ramp HS		2019 Statewide Average
	#	%	#	%	#	%	#	%	
Dry	26	63.4%	24	80.0%	12	75.0%	7	77.8%	75.1%
Slush	0	0.0%	1	3.3%	0	0.0%	0	0.0%	1.1%
Wet	15	36.6%	5	16.7%	4	25.0%	2	22.2%	20.1%
Total	**41**	100.0%	**30**	**100.0%**	**16**	**100.0%**	**9**	**100.0%**	

Table C-33 – Select Interchange 14 Ramp Crashes by Lighting Condition
Ramp TN, Ramp TS, Ramp NT, and Ramp HS

Lighting Condition	Ramp TN		Ramp TS		Ramp NT		Ramp HS		2019 Statewide Average
	#	%	#	%	#	%	#	%	
Daylight	29	70.7%	21	70.0%	11	68.7%	4	44.4%	69.5%
Dark (Total)	12	29.3%	9	30.0%	5	31.3%	5	55.6%	26.0%
Dark (No Street Lights)	*3*	*7.3%*	*1*	*3.3%*	*2*	*12.5%*	*0*	*0.0%*	
Dark (Street Lights Off)	*0*	*0.0%*	*1*	*3.3%*	*0*	*0.0%*	*0*	*0.0%*	
Dark (Street Lights On, Cont.)	*6*	*14.7%*	*5*	*16.7%*	*3*	*18.8%*	*5*	*55.6%*	
Dark (Street Lights On, Spot)	*3*	*7.3%*	*2*	*6.7%*	*0*	*0.0%*	*0*	*0.0%*	
Total	**41**	100.0%	**30**	**100.0%**	**16**	**100.0%**	**9**	**100.0%**	

Table C-34 – Select Interchange 14 Ramp Crashes by Environmental Condition
Ramp TN, Ramp TS, Ramp NT, and Ramp HS

Environmental Condition	Ramp TN		Ramp TS		Ramp NT		Ramp HS	
	#	%	#	%	#	%	#	%
Clear	28	68.3%	26	86.7%	11	68.8%	7	77.8%
Overcast	1	2.4%	0	0.0%	1	6.2%	1	11.1%
Rain	12	29.3%	3	10.0%	4	25.0%	1	11.1%
Sleet/Hail	0	0.0%	1	3.3%	0	0.0%	0	0.0%
Total	**41**	100.0%	**30**	**100.0%**	**16**	**100.0%**	**9**	**100.0%**

Table C-35 – Select Interchange 14 Ramp Crashes by Day of Week
Ramp TN, Ramp TS, Ramp NT, and Ramp HS

Day of Week	Ramp TN		Ramp TS		Ramp NT		Ramp HS	
	#	%	#	%	#	%	#	%
Sunday	5	12.2%	0	0.0%	0	0.0%	3	33.3%
Monday	6	14.6%	1	3.3%	5	31.2%	0	0.0%
Tuesday	3	7.3%	5	16.7%	5	31.2%	0	0.0%
Wednesday	6	14.6%	7	23.3%	1	6.3%	0	0.0%
Thursday	5	12.2%	8	26.7%	0	0.0%	1	11.1%
Friday	11	26.9%	7	23.3%	3	18.8%	4	44.5%
Saturday	5	12.2%	2	6.7%	2	12.5%	1	11.1%
Total	**41**	100.0%	**30**	**100.0%**	**16**	**100.0%**	**9**	**100.0%**

Table C-36 – Select Interchange 14 Ramp Crashes by Time of Day (Weekdays)
Ramp TN, Ramp TS, Ramp NT, and Ramp HS

Weekday Time Period	Ramp TN		Ramp TS		Ramp NT		Ramp HS	
	#	%	#	%	#	%	#	%
AM Peak Period (6:00 AM – 9:00 AM)	8	25.8%	1	3.6%	3	21.4%	0	0.0%
AM Peak Hour (7:00 AM – 8:00 AM)	*2*	*6.5%*	*0*	*0.0%*	*2*	*14.3%*	*0*	*0.0%*
PM Peak Period (3:00 PM – 7:00 PM)	3	9.7%	18	64.3%	3	21.4%	2	40.0%
PM Peak Hour (5:00 PM – 6:00 PM)	*0*	*0.0%*	*7*	*25.0%*	*1*	*7.1%*	*1*	*20.0%*
Weekday Off Peak	20	64.5%	9	32.1%	8	57.2%	3	60.0%
Total	**31**	**100.0%**	**28**	**100.0%**	**14**	**100.0%**	**5**	**100.0%**

The following observations can be made regarding crash trends on Ramp TN.

- Most crashes resulted in No Apparent Injury (80.4%). Total Injury crashes (Possible and Suspected Minor) (19.6%) exceeded the Statewide Average of 19.4%.
- Predominant crash types were Same Direction (Side Swipe) (46.3%) or Fixed Object (24.4%). Overturned crashes accounted for 9.8% of the crashes. All three crash types exceeded the Statewide Averages of 25.6%, 18.0% and 1.6%, respectively. In addition, Non-Fixed Object crashes (4.9%) exceeded the Statewide Average of 4.4%.
- Most crashes occurred on Dry surfaces (63.4%), under Daylight conditions (70.7%), and under Clear (68.3%) conditions. Crashes on Wet surfaces (36.6%) and under Dark conditions (29.3%) exceeded the Statewide Averages of 20.1% and 26.0%, respectively.

- Crashes were more likely to occur on Weekdays (75.6%). An average of six crashes occurred on each weekday (Monday through Friday), peaking on Fridays. An average of five crashes occurred per weekend day (Saturday or Sunday).
- More than half of weekday crashes (64.5%) occurred during the weekday off-peak periods. Of the weekday peak period crashes, 18.2% (2 of 11) occurred during the peak hours.

The following observations can be made regarding crash trends on Ramp TS.

- Most crashes resulted in No Apparent Injury (76.7%). Total Injury crashes (Possible and Suspected Minor) (23.3%) exceeded the Statewide Average of 19.4%.
- Predominant crash types were Same Direction (Rear End) (66.7%) and Same Direction (Side Swipe) (30.0%). Both crash types exceeded the Statewide Averages of 44.2% and 25.6%, respectively. In addition, Right Angle crashes (3.3%) exceeded the Statewide Average of 0.4%.
- Most crashes occurred on Dry surfaces (80.0%), under Daylight conditions (70.0%), and under Clear (86.7%) conditions. Crashes under Dark conditions (30.0%) exceeded the Statewide Average of 26.0%.
- Crashes were more likely to occur on Weekdays (93.3%). An average of six crashes occurred on each weekday (Monday through Friday), peaking on Thursdays. An average of one crash occurred per weekend day (Saturday or Sunday).
- Less than half of weekday crashes (32.1%) occurred during the weekday off-peak periods. Of the weekday peak period crashes, 36.8% (7 of 19) occurred during the peak hours.

The following observations can be made regarding crash trends on Ramp NT.

- Most crashes resulted in No Apparent Injury (68.8%). Total Injury crashes (Possible and Suspected Minor) (31.3%) exceeded the Statewide Average of 19.4%.
- Predominant crash types were Same Direction (Rear End) (31.3%), Same Direction (Side Swipe) (37.5%) and Fixed Object (18.7%). Same Direction (Side Swipe) and Fixed Object crash types exceeded the Statewide Averages of 25.6% and 18.0%, respectively. In addition, Non-Fixed Object and Struck Parked Vehicle crashes (6.3% each) exceeded the Statewide Averages of 4.4% and 0.9%, respectively.
- Most crashes occurred on Dry surfaces (75.0%), under Daylight conditions (68.8%), and under Clear (68.8%) conditions. Crashes on Wet surfaces (25.0%) and under Dark conditions (31.3%) exceeded the Statewide Averages of 20.1% and 26.0%, respectively.
- Crashes were more likely to occur on Weekdays (87.5%). An average of three crashes occurred on each weekday (Monday through Friday), peaking on Mondays and Tuesdays. An average of one crash occurred per weekend day (Saturday or Sunday).
- More than half of weekday crashes (57.2%) occurred during the weekday off-peak periods. Of the weekday peak period crashes, 50.0% (3 of 6) occurred during the peak hours.

The following observations can be made regarding crash trends on Ramp HS.

- Most crashes resulted in No Apparent Injury (88.9%).
- Predominant crash types were Same Direction (Rear End) (33.3%), Right Angle (22.2%) and Fixed Object (22.2%). Right Angle and Fixed Object crash types exceeded the Statewide Averages of 0.4% and 18.0%, respectively. In addition, Overturned and Struck Parked Vehicle crashes (11.1% for each) exceeded the Statewide Averages of 1.6% and 0.9%, respectively. The high frequencies of Overturned, Right Angle, and Struck Parked Vehicle crashes are due to the tight geometry of this loop ramp.
- Most crashes occurred on Dry surfaces (77.8%), under Dark conditions with adequate light (55.6%) and under Clear (77.8%) conditions. Crashes on Wet surfaces (22.0%) and under Dark conditions (55.6%) exceeded the Statewide Averages of 20.1% and 26.0%, respectively.
- Crashes were more likely to occur on Weekdays (55.6%). An average of one crash occurred on each weekday (Monday through Friday), peaking on Fridays. An average of two crashes occurred per weekend day (Saturday or Sunday).
- More than half of weekday crashes (60.0%) occurred during the weekday off-peak periods. Of the weekday peak period crashes, 50.0% (1 of 2) occurred during the peak hours.

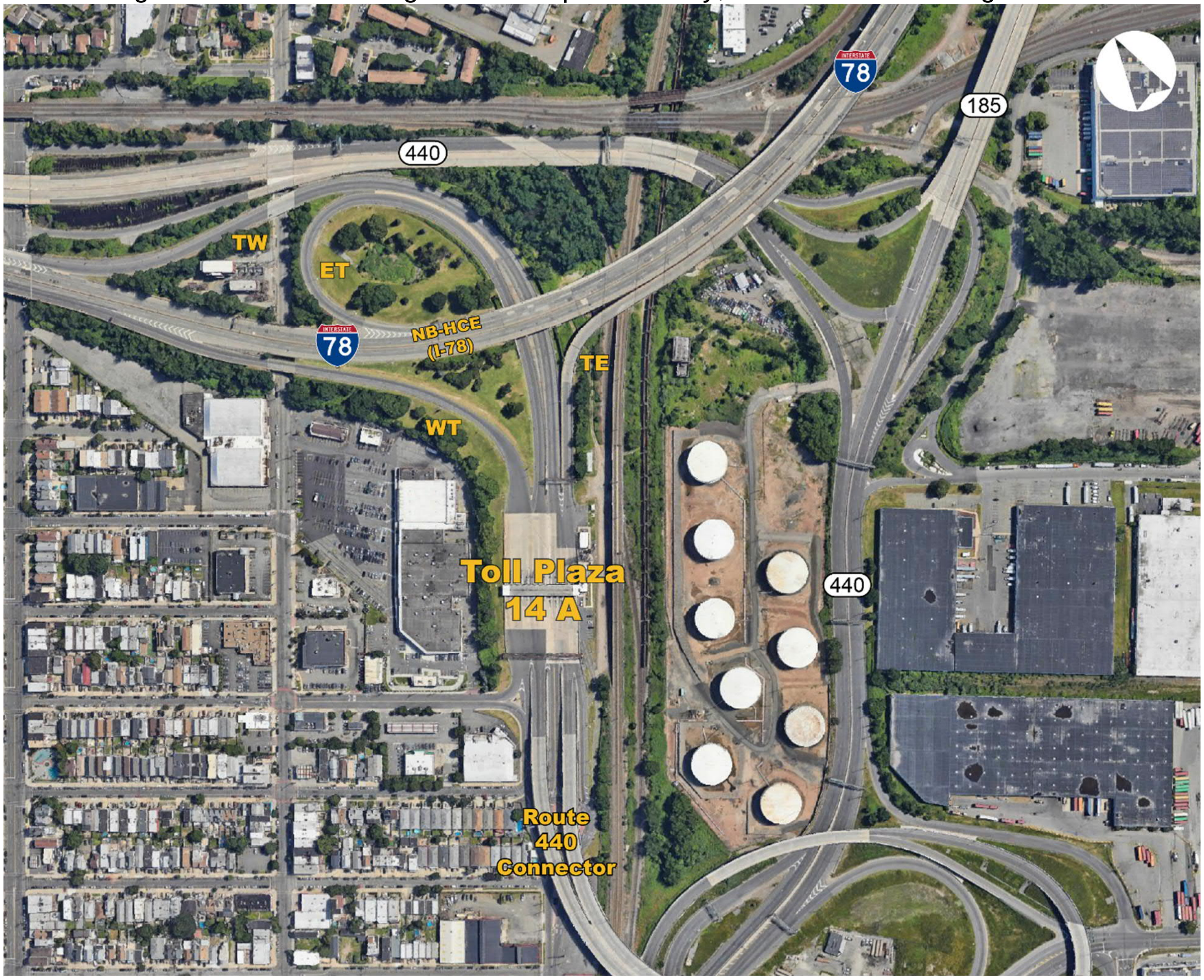
C.2.3.2. Interchange 14A High-Crash Ramp Location Analysis

Table C-22 summarizes the crash totals for several ramps within the study area at Interchange 14A. Of those ramps, two exhibited crash magnitudes over five crashes per year (or 8 crashes during the 18-month period studied), such that further study is warranted on these ramps. These ramps include the following.

- Ramp TW – 28 crashes
- Route 440 Connector Ramp – 12 crashes

Figure C-7 shows interchange geometry, locations and designations for ramps at Interchange 14, including those above selected for more detailed study.

Figure C-7 – Interchange 14A Ramp Geometry, Locations and Designations



The following tables, Table C-37 through Table C-43, summarize crash statistics for the four ramps selected for further study. The analysis is consistent with the analysis format for facilities previously studied in this Section.

Table C-37 – Select Interchange 14A Ramp Crashes by Severity
Ramp TW and Route 440 Connector Ramp

Severity Category	Route 440 Connector Ramp		Ramp TW		2019 Statewide Averages
	#	%	#	%	
No Apparent Injury	11	91.7%	25	89.3%	80.4%
Possible Injury	1	8.3%	2	7.1%	19.4%
Suspected Minor Injury	0	0.0%	1	3.6%	
Suspected Serious Injury	0	0.0%	0	0.0%	
Fatality	0	0.0%	0	0.0%	0.2%
Total	12	100.0%	**28**	**100.0%**	

Table C-38 – Select Interchange 14A Ramp Crashes by Type
Route 440 Connector Ramp and Ramp TW

Crash Type	Route 440 Connector Ramp		Ramp TW		2019 Statewide Average
	#	%	#	%	
Fixed Object	0	0.0%	1	3.6%	18.0%
Opposite Direction (Side Swipe)	1	8.3%	0	0.0%	0.0%
Same Direction (Rear-End)	4	33.3%	9	32.1%	44.2%
Same Direction (Side Swipe)	7	58.4%	18	64.3%	25.6%
Total	12	100.0%	**28**	**100.0%**	

Table C-39 – Select Interchange 14A Ramp Crashes by Surface Condition
Route 440 Connector Ramp and Ramp TW

Surface Condition	Route 440 Connector Ramp		Ramp TW		2019 Statewide Average
	#	%	#	%	
Dry	11	91.7%	21	75.0%	75.1%
Wet	1	8.3%	7	25.0%	20.1%
Total	12	100.0%	**28**	**100.0%**	

Table C-40 – Select Interchange 14A Ramp Crashes by Lighting Condition

Route 440 Connector Ramp and Ramp TW

Lighting Condition	Route 440 Connector Ramp		Ramp TW		2019 Statewide Averages
	#	%	#	%	
Daylight	10	83.3%	25	89.3%	69.5%
Dark (Total)	2	16.7%	3	10.7%	26.0%
Dark (Street Lights On, Cont.)	*2*	*16.7%*	*2*	*7.1%*	
Dark (Street Lights On, Spot)	*0*	*0.0%*	*1*	*3.6%*	
Total	12	100.0%	**28**	**100.0%**	

Table C-41 – Select Interchange 14A Ramp Crashes by Environmental Condition

Route 440 Connector Ramp and Ramp TW

Environmental Condition	Route 440 Connector Ramp		Ramp TW	
	#	%	#	%
Clear	11	91.7%	22	78.6%
Rain	1	8.3%	6	21.4%
Total	12	100.0%	**28**	**100.0%**

Table C-42 – Select Interchange 14A Ramp Crashes by Day of Week

Route 440 Connector Ramp and Ramp TW

Day of Week	Route 440 Connector Ramp		Ramp TW	
	#	%	#	%
Sunday	0	0.0%	0	0.0%
Monday	4	33.3%	5	17.8%
Tuesday	2	16.7%	11	39.3%
Wednesday	0	0.0%	5	17.9%
Thursday	4	33.3%	4	14.3%
Friday	2	16.7%	3	10.7%
Saturday	0	0.0%	0	0.0%
Total	12	100.0%	**28**	**100.0%**

Table C-43 – Select Interchange 14A Ramp Crashes by Time of Day (Weekdays)
Route 440 Connector Ramp and Ramp TW

Weekday Time Periods	Route 440 Connector Ramp		Ramp TW	
	#	%	#	%
AM Peak Period (6:00 AM – 9:00 AM)	1	8.3%	9	32.2%
AM Peak Hour (7:00 AM – 8:00 AM)	*0*	*0.0%*	*3*	*10.7%*
PM Peak Period (3:00 PM – 7:00 PM)	5	41.7%	16	57.1%
PM Peak Hour (5:00 PM – 6:00 PM)	*0*	*0.0%*	*6*	*21.4%*
Weekday Off Peak	6	50.0%	3	10.7%
Total	**12**	**100.0%**	**28**	**100.0%**

The following observations are made regarding crash trends on the Route 440 Connector Ramp.

- Most crashes resulted in No Apparent Injury (91.7%). Possible Injury crashes (8.3%) did not exceed the Statewide Average.
- Predominant crash types were Same Direction (Side Swipe) (58.3%) and Same Direction (Rear End) (33.3%). Same Direction (Side Swipe) crashes exceeded the Statewide Averages of 25.6%. In addition, Opposite Direction (Side Swipe) crashes (8.3%) exceeded the Statewide Average of 0.0%.
- Most crashes occurred on Dry surfaces (91.7%), under Daylight conditions (83.3%), and under Clear (91.7%) conditions. No surface condition or lighting condition category exceeded the Statewide Averages.
- All crashes occurred on Weekdays (100.0%). An average of two crashes occurred on each weekday (Monday through Friday), peaking on Mondays and Thursdays.
- Half of the weekday crashes (50.0%) occurred during the weekday off-peak periods. Of the weekday peak period crashes, 0.0% (0 of 6) occurred during the peak hours.

The following observations are made regarding crash trends on Ramp TW.

- Most crashes resulted in No Apparent Injury (89.3%). Total Injury crashes (Possible and Suspected Minor) (10.7%) did not exceed the Statewide Average.
- Predominant crash types were Same Direction (Side Swipe) (64.3%) and Same direction (Rear End) (32.1%). Same Direction (Side Swipe) crashes exceeded the Statewide Average of 25.6%.
- Most crashes occurred on Dry surfaces (75.0%), under Daylight conditions (89.3%), and under Clear (78.6%) conditions. Crashes on Wet surfaces (25.0%) exceeded the Statewide Average of 20.1%.
- All crashes occurred on Weekdays (100.0%). An average of six crashes occurred on each weekday (Monday through Friday), peaking on Tuesdays.

- Less than half of weekday crashes (10.7%) occurred during the weekday off-peak periods. Of the weekday peak period crashes, 36.0% (9 of 25) occurred during the peak hours.

C.3. CONCLUSION

Major findings of the crash analysis include:

- Most crashes resulted in No Apparent Injury. The highest rate for total injury crashes (Possible, Suspected Minor and Suspected Major Injury) was on the NB-HCE (20.2%, or 67 crashes. The corresponding crash rate at interchange ramps was 18.0% (29 crashes), while toll plaza injury crashes were at 5.0% (15 crashes). Since the NB-HCE roadway constituted a larger area than the other two categories, this finding is not unexpected. No fatalities were reported in the crash data set analyzed.
- Same Direction (Rear End) and Same Direction (Sideswipe) crashes for all areas (NB-HCE, interchange ramps and toll plazas combined) comprised almost 90% of the total crashes. Sideswipe crashes were predominant at the toll plazas, while Rear End crashes predominated on the NB-HCE. Both types were prominent on interchange ramps. In most cases, the crash percentages for both crash types exceeded the 2019 Statewide Averages for Interstate Highways.
- Across all areas (NB-HCE, interchange ramps and toll plazas), most crashes occurred under Dry surface conditions, Day lighting conditions, and Clear environmental conditions. Crashes on Wet surfaces and under Dark conditions exceeded the Statewide Averages for one or more of the facility types.
- Crashes across all areas were more likely to occur on weekdays and during one of the two weekday peak periods (AM or PM peak period). The mid-week period (Tuesday, Wednesday, and Thursday) were the peak days for crashes.
- High crash totals (greater than five per year) at interchange ramps were reported on Ramp TS, Ramp TN, Ramp NT, and Ramp HS at Interchange 14.
- High crash totals at interchange ramps were reported on Ramp TW and the Route 440 Connector Ramp at Interchange 14A.
- High-crash ramp locations exhibited similar crash characteristics to the other facility types studied.

Same Direction crashes are indicative of stop-and-go conditions in congested areas and unsafe merging and lane changes on roadways near or over capacity or with variable speeds. The study area does exhibit queuing and congestion on the NB-HCE, especially at existing merge areas at the interchanges and due to demand exceeding capacity. Capacity enhancements and bridge replacements on the NB-HCE, particularly widening to four lanes and full shoulders in each direction between Interchange 14 and Interchange 14A, will reduce crash potential on the Newark Bay Bridge crossing. Higher-capacity ramp connections and ramp roadways at the interchanges, along with drainage and highway lighting systems designed to current Authority standards, will also improve the crash trends within the study area.

Table C-44 compares the most common crash characteristics observed for the different categories of roadway facilities studied: NB-HCE roadway, toll plazas, and interchange ramp. Each of the percentages are calculated for the specific roadway type. For instance, 95.0% of crashes at toll plazas resulted in No Apparent Injury. As shown in the table, most crashes resulted in No Apparent Injury, though this rate was lower for NB-HCE roadway and interchange ramp crashes. Same Direction crashes comprised the majority of crashes in all three facility types, though the lowest share of these crashes occurred on interchange ramps. Additionally, more than 70% of crashes occurred on Dry roadway surfaces, under Clear conditions, and during Daylight hours. Most crashes also occurred on weekdays, and weekday crashes tended to occur during peak periods.

Table C-44 – Overall Crash Comparison
Interchange 14 to Interchange 14A

Category	NB-HCE		Toll Plazas		Interchange Ramps		Total	
No Apparent Injury	265	79.8%	286	95.0%	132	82.0%	**683**	**86.0%**
Same Direction (Rear-End)	217	65.4%	50	16.6%	54	33.5%	**321**	**40.4%**
Same Direction (Side Swipe)	93	28.0%	229	76.1%	68	42.2%	**390**	**49.1%**
Dry	285	85.8%	269	89.4%	118	73.3%	**672**	**84.6%**
Daylight	263	79.2%	231	76.7%	114	70.8%	**608**	**76.6%**
Clear	288	86.7%	270	89.7%	122	75.8%	**680**	**85.6%**
Weekdays	286	86.1%	263	87.4%	135	83.9%	684	86.1%
Peak Periods	175	61.2%	172	65.4%	77	57.0%	424	53.4%
Total	332	-	301	-	161	-	794	-

Appendix D – VISSIM Model Validation Reports

OPS No. T3820
New Jersey Turnpike
Newark Bay-Hudson County Extension
Bridge Replacements and Capacity Enhancements Program

Appendix D – VISSIM Model Validation Reports

Interchange 14A Eastbound: Ramp WT Diverge Area

Interchange 14 Westbound: Ramp HS Diverge Area

Interchange 14A Westbound: Ramp TW Merge Area

Interchange 14 Eastbound: Ramp TH/Ramp SH/Ramp NH Merge Area

Interchange 14A Eastbound – Ramp WT Diverge Area
VISSIM Model Validation Reports (1 of 2)
2021 Base Year

Volume Validation

	Weekday A.M. Peak Hour Volume Validation Metrics Interchange 14A: NB-HCE/Ramp WT Diverge				
Roadway Link	Count (vph)	Model (vph)	GEH	Difference (vph)	% Difference
NB-HCE EB	4,533	4,547	0.31	14	0.31%
Ramp WT	1,696	1,656	0.97	-40	-2.36%
NB-HCE EB*	2,837	2,881	0.82	44	1.55%

* East of Ramp WT

	Weekday P.M. Peak Hour Volume Validation Metrics Interchange 14A: NB-HCE/Ramp WT Diverge Area				
Roadway Link	Count (vph)	Model (vph)	GEH	Difference (vph)	% Difference
NB-HCE EB	3,852	3,840	0.19	-12	-0.31%
Ramp WT	1,555	1,551	0.09	-4	-0.26%
NB-HCE EB*	2,297	2,302	0.10	5	0.22%

* East of Ramp WT

Interchange 14A Eastbound – Ramp WT Diverge Area
VISSIM Model Validation Reports (2 of 2)
2021 Base Year

Speed Validation

	Weekday A.M. Peak Hour Speed Validation Metrics Interchange 14A: NB-HCE/Ramp WT Diverge Area			
Roadway	RITIS (mph)	Model (mph)	Difference (mph)	% Difference
NB-HCE EB	48.2	43.1	-5.1	-10.6%
Ramp WT	35.1	38.0	2.9	8.3%
NB-HCE EB*	59.7	56.6	-3.1	-5.2%

* East of Ramp WT

	Weekday P.M. Peak Hour Speed Validation Metrics Interchange 14A: NB-HCE/Ramp WT Diverge Area			
Roadway	RITIS (mph)	Model (mph)	Difference (mph)	% Difference
NB-HCE EB	45.7	50.2	4.5	9.8%
Ramp WT	33.0	31.0	-2.0	-6.1%
NB-HCE EB*	58.1	56.9	-1.2	-2.1%

* East of Ramp WT

Interchange 14 Westbound - Ramp HS Diverge Area
VISSIM Model Validation Reports (1 of 2)
2021 Base Year

Volume Validation

	Weekday A.M. Peak Hour Volume Validation Metrics Interchange 14: NB-HCE WB/Ramp HS Diverge Area				
Roadway Link	Count (vph)	Model (vph)	GEH	Difference (vph)	% Difference
NB-HCE WB	3,640	3,613	0.45	-27	-0.74%
Ramp HXT*	2,672	2,652	0.39	-20	-0.75%
Ramp HS	1,027	992	1.10	-35	-3.41%
Ramp HLT	229	231	0.12	2	0.87%
Ramp HN	739	739	0.01	0	0.00%
Ramp TS	727	732	0.19	3	0.69%
Ramp TS**	1,754	1,736	0.44	-18	-1.03%
Ramp HXT***	1,645	1,643	0.05	-2	-0.12%

* East of Ramp HS
** South of Ramp TS/Ramp HS Junction
*** West of Ramp HS

	Weekday P.M. Peak Hour Volume Validation Metrics Interchange 14: NB-HCE WB/Ramp HS Diverge Area				
Roadway Link	Count (vph)	Model (vph)	GEH	Difference (vph)	% Difference
NB-HCE WB	3,569	3,511	0.97	-58	-1.63%
Ramp HXT*	2,774	2,753	0.40	-21	-0.76%
Ramp HS	1,492	1,458	0.88	-34	-2.28%
Ramp HLT	190	191	0.07	1	0.52%
Ramp HN	605	605	0.02	0	0.00%
Ramp TS	1,096	1,101	0.15	5	0.46%
Ramp TS**	2,588	2,582	0.12	-6	-0.23%
Ramp HXT***	1,282	1,256	0.72	-26	-2.03%

* East of Ramp HS
** South of Ramp TS/Ramp HS Junction
*** West of Ramp HS

Interchange 14 Westbound - Ramp HS Diverge Area
VISSIM Model Validation Reports (2 of 2)
2021 Base Year

Speed Validation

	Weekday A.M. Peak Hour Speed Validation Metrics Interchange 14: NB-HCE WB/Ramp HS Diverge Area			
Roadway Link	RITIS (mph)	Model (mph)	Difference (mph)	% Difference
NB-HCE WB	53.3	56.7	3.4	6.4%
Ramp HXT*	46.5	51.6	5.1	11.0%
Ramp HS	No Observed Data Collected			
Ramp HLT	41.7	45.1	3.4	8.2%
Ramp HN	43.1	44.4	1.3	3.0%
Ramp TS	No Observed Data Collected			
Ramp TS**	No Observed Data Collected			
Ramp HXT***	46.5	52.3	5.8	12.5%

* East of Ramp HS
** South of Ramp TS/Ramp HS Junction
*** West of Ramp HS

	Weekday P.M. Peak Hour Speed Validation Metrics Interchange 14: NB-HCE WB/Ramp HS Diverge Area			
Roadway Link	RITIS (mph)	Model (mph)	Difference (mph)	% Difference
NB-HCE WB	44.5	42.4	-2.1	-4.7%
Ramp HXT*	43.3	51.5	8.2	18.9%
Ramp HS	No Observed Data Collected			
Ramp HLT	38.8	42.2	3.4	8.8%
Ramp HN	42.2	44.6	2.4	5.7%
Ramp TS	No Observed Data Collected			
Ramp TS**	No Observed Data Collected			
Ramp HXT***	43.3	52.6	9.3	21.5%

* East of Ramp HS
** South of Ramp TS/Ramp HS Junction
*** West of Ramp HS

Interchange 14A Westbound: Ramp TE/Ramp TW Geometry
VISSIM Model Validation Reports (1 of 2)
2021 Base Year

Volume Validation

	Weekday A.M. Peak Hour Volume Validation Metrics Interchange 14A: Ramp ET/Ramp TW Geometry				
Roadway Link	Count (vph)	Model (vph)	GEH	Difference (vph)	% Difference
NB-HCE WB***	2,020	2,007	0.29	-13	-0.64%
Ramp ET	369	369	0.01	0	0.00%
NB-HCE WB*	1,651	1,644	0.17	-7	-0.42%
Ramp TW	1,989	1,997	0.17	8	0.40%
NB-HCE WB**	3,640	3,611	0.48	-29	-0.80%

* East of Ramp TW
** West of Ramp TW
*** East of Ramp ET

	Weekday P.M. Peak Hour Volume Validation Metrics Interchange 14A: Ramp ET/Ramp TW Geometry				
Roadway Link	Count (vph)	Model (vph)	GEH	Difference (vph)	% Difference
NB-HCE WB***	2,849	2,820	0.55	-29	-1.02%
Ramp ET	678	673	0.20	-5	-0.74%
NB-HCE WB*	2,171	2,150	0.46	-21	-0.97%
Ramp TW	1,398	1,385	0.34	-13	-0.93%
NB-HCE WB**	3,569	3,516	0.90	-53	-1.49%

* East of Ramp TW
** West of Ramp TW
*** East of Ramp ET

Interchange 14A Westbound: Ramp TW Merge Area
VISSIM Model Validation Reports (2 of 2)
2021 Base Year

Speed Validation

	Weekday A.M. Peak Hour Speed Validation Metrics Interchange 14A: Ramp TW Merge Area			
Roadway Link	RITIS (mph)	Model (mph)	Difference (mph)	% Difference
NB-HCE WB***	No Observed Data Collected			
Ramp ET	No Observed Data Collected			
NB-HCE WB*	59.4	52.5	-6.9	-11.6%
Ramp TW	38.5	34.9	-3.6	-9.4%
NB-HCE WB**	53.3	51.8	-1.7	-3.2%

* East of Ramp TW
** West of Ramp TW
*** East of Ramp ET

	Weekday P.M. Peak Hour Speed Validation Metrics Interchange 14A: Ramp TW Merge Area			
Roadway Link	RITIS (mph)	Model (mph)	Difference (mph)	% Difference
NB-HCE WB***	No Observed Data Collected			
Ramp ET	No Observed Data Collected			
NB-HCE WB*	47.0	50.8	3.8	8.1%
Ramp TW	32.1	28.6	-3.5	-10.9%
NB-HCE WB**	44.5	43.9	-0.6	-1.3%

* East of Ramp TW
** West of Ramp TW
*** East of Ramp ET

Interchange 14 Eastbound: Ramp TH/Ramp NH/Ramp SH Merge Area
VISSIM Model Validation Reports (1 of 2)
2021 Base Year

Volume Validation

	Weekday A.M. Peak Hour Volume Validation Metrics Interchange 14 Eastbound: Ramp TH/Ramp NH/Ramp SH Merge Area				
Roadway Link	Count (vph)	Model (vph)	GEH	Difference (vph)	% Difference
Ramp TH	2,030	1,862	3.80	-168	-8.28%
Ramp NH	655	655	0.01	0	0.00%
Ramp TH*	2,685	2,460	4.44	-225	-8.38%
Ramp SH	1,848	1,839	0.22	-9	-0.49%
Ramp SOH	1,099	1,097	0.05	-2	-0.18%
Ramp SIH	749	732	0.61	-17	-2.27%
Ramp SOH/T	1,662	1,649	0.31	-13	-0.78%
Ramp SIH/T	1,142	1,130	0.36	-12	-1.05%
NB-HCE EB**	4,533	4,227	4.62	-306	-6.75%

* Between Ramp NH and Ramp SH
** East of Ramp SH

	Weekday P.M. Peak Hour Volume Validation Metrics Interchange 14 Eastbound: Ramp TH/Ramp NH/Ramp SH Merge Area				
Roadway Link	Count (vph)	Model (vph)	GEH	Difference (vph)	% Difference
Ramp TH	1,812	1,828	0.38	16	0.88%
Ramp NH	673	674	0.05	1	0.15%
Ramp TH*	2,485	2,488	0.06	3	0.12%
Ramp SH	1,367	1,359	0.22	-8	-0.59%
Ramp SOH	750	752	0.07	2	0.27%
Ramp SIH	617	603	0.58	-14	-2.27%
Ramp SOH/T	1,470	1,453	0.44	-17	-1.16%
Ramp SIH/T	1,143	1,131	0.34	-12	-1.05%
NB-HCE EB**	3,852	3,834	0.30	-18	-0.47%

* Between Ramp NH and Ramp SH
** East of Ramp SH

Interchange 14 Eastbound: Ramp TH/Ramp NH/Ramp SH Merge Area
VISSIM Model Validation Reports (2 of 2)
2021 Base Year

Speed Validation

	Weekday A.M. Peak Hour Speed Validation Metrics Interchange 14 Eastbound: Ramp TH/Ramp NH/Ramp SH Merge Area			
Roadway Link	RITIS (vph)	Model (vph)	Difference (vph)	% Difference
Ramp TH	28.5	8.6	-19.9	-69.9%
Ramp NH	35.1	31.2	-3.9	-11.1%
Ramp TH*	No Observed Data Collected			
Ramp SH	23.3	9.3	-14.0	-60.1%
Ramp SOH	No Observed Data Collected			
Ramp SIH	No Observed Data Collected			
Ramp SOH/T	No Observed Data Collected			
Ramp SIH/T	No Observed Data Collected			
NB-HCE EB**	48.2	45.0	-3.2	-6.6%

* Between Ramp NH and Ramp SH
** East of Ramp SH

	Weekday P.M. Peak Hour Speed Validation Metrics Interchange 14 Eastbound: Ramp TH/Ramp NH/Ramp SH Merge Area			
Roadway Link	RITIS (vph)	Model (vph)	Difference (vph)	% Difference
Ramp TH	23.3	26.0	2.7	11.6%
Ramp NH	34.3	32.9	-1.4	-4.1%
Ramp TH*	No Observed Data Collected			
Ramp SH	30.1	31.2	1.1	3.7%
Ramp SOH	No Observed Data Collected			
Ramp SIH	No Observed Data Collected			
Ramp SOH/T	No Observed Data Collected			
Ramp SIH/T	No Observed Data Collected			
NB-HCE EB**	45.7	41.3	-4.4	-9.6%

* Between Ramp NH and Ramp SH
** East of Ramp SH