INTERSTATE 95

I-95 Road Safety and Operations Audit (RSOA)

DELAWARE COUNTY

DECEMBER 2011

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

pennsylvania DEPARTMENT OF TRANSPORTATION

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The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals, and the public with a common vision of making a great region even greater. Shaping the way we live, work, and play, DVRPC builds consensus on improving transportation, promoting smart growth, protecting the environment, and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region — leading the way to a better future.

The symbol in our logo is adapted from the official DVRPC seal and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey.

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Executive Summary

Safety is the first order of business in a Road Safety Audit (RSA). Transportation operations cannot be separated from safety concerns. But how do you bring them together?

The Delaware Valley Regional Planning Commission's (DVRPC's) I-95 Delaware County Road Safety and Operations Audit (RSOA)—a hybrid of the standard RSA and DVRPC's US 202, Section 200 Transportation Operations Audit format—is an innovative evolution of the RSA format, designed to make efficient use of resources and of the team members' limited time. An RSOA is an effective way of identifying crash-causing trends, operations concerns, and brainstorming appropriate countermeasures, utilizing a nontraditional approach that promotes transportation safety while maintaining mobility.

Early in 2010, DVRPC was asked by the Federal Highway Administration (FHWA) - Philadelphia Metropolitan Office and the Pennsylvania Department of Transportation's (PennDOT's) District 6-0 Office to conduct a first-ever hybrid audit combining road safety and operations, focused on an interstate. According to our federal partners, this was also to be the first-ever safety audit on an interstate facility; no U.S. example was available to model. The study corridor is a 10-mile stretch of I-95 in Delaware County, Pennsylvania.

This document is the final report for the I-95 Delaware County RSOA. This project represents a step toward implementation of DVRPC's *Safety Action Plan* and PennDOT's Strategic Highway Safety Plan (SHSP).

I-95 in Delaware County was identified as a priority location based on several factors. First was its inclusion on the PennDOT District 6-0 2008 high-crash location list. Of the 377 high-crash locations identified statewide by PennDOT's Bureau of Highway Safety and Traffic Engineering (BHSTE), 209 were within District 6-0, 12 were on interstate highways, and four of those 12 were on I-95 in Delaware County.

Another driving force behind this audit was the FHWA's desire to assess the Delaware County section of I-95 in advance of the multi-decade I-95 Corridor Reconstruction Project currently underway. PennDOT has developed a strategy to address the 51 miles of I-95 through Pennsylvania by dividing it into five, smaller and more manageable sub-sections. These subsections are identified as sectors A through E according to priority, with A being the highest priority. Because the Delaware County portion of I-95 is the third priority sector (C) and not slated for work to begin until 2030 or later, an audit was recommended as a proactive strategy to identify and address as many immediate safety and operational issues as possible.

The I-95 Delaware County RSOA was conducted on Thursday and Friday, June 3 and 4, 2010. The audit team of 23 participants included representation from FHWA (Harrisburg, Pennsylvania, Philadelphia, Maryland Resource Center, and the Washington D.C. Headquarters), Chester Township Police Department, City of Chester, Delaware County Planning Department, Ridley

Park Fire Company #1, PennDOT District 6-0 (Traffic Safety, Traffic Freeway Management, and Maintenance), the Southeastern Pennsylvania Transportation Authority (SEPTA), PennDOT Emergency Service Patrol, Pennsylvania State Police, Delaware County Transportation Management Association (TMA), and DVRPC. See Appendix A for the list of audit team members.

One location the audit team discussed at length is the 1.7-mile long (northbound and southbound) I-95 segment at the US 322/Commodore Barry Bridge interchanges. This stretch of I-95 is of interest because of a larger interchange project which is slated to begin in the near term.

Another location of special concern is the one-mile segment of I-95 northbound in the vicinity of the I-476 interchange. This segment was chosen for further analysis because it contains the two highest crash segments on the corridor, has recurring congestion, and is a high-volume interchange.

Forty-eight site-specific safety and operational issues were identified by the team during the audit. They are organized by aerial panel map and discussed in the Findings and Recommendations chapter. Each panel is represented graphically on an aerial-view map and has a corresponding table on the opposite page. This layout is designed to assist the reader in locating identified safety and operations issues and implemented improvements.

Many of the recommended improvements have been implemented since the completion of the audit event, and can be attributed to the hard work and collaboration between the various PennDOT District 6-0 offices. Each of the following low-level improvements is listed in the table in Chapter 3 and identified on the corresponding maps: repainted line striping, missing signs that have been replaced, repaired guide rail, vegetation obscuring sight distance trimmed, and sun glare screens installed. Long-term issues identified include: inadequate shoulders, insufficient off-ramp storage capacity, merge area problems, closely spaced exits and on-ramps, and recurring peak-period congestion.

CHAPTER 1

Introduction

As the final report for the I-95 Delaware County Road Safety and Operations Audit (RSOA), this document represents a step towards implementation of DVRPC's Safety Action Plan. The RSOA process utilizes a nontraditional approach to address crash and operations problems through an intensive, collaborative forum. With assistance from the PennDOT District 6-0 Office, DVRPC utilized crash data summaries and crash record resumes from the Pennsylvania Crash Data Analysis and Retrieval Tool (CDART) for the crash analysis portion of the audit.

State departments of transportation are required to develop an SHSP in order to draw on federal safety funds according to the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), the most recent federal transportation legislation. In Pennsylvania, each PennDOT district office is required to develop its own safety plan to be incorporated in the state's SHSP.

Over the last four fiscal years, DVRPC has been coordinating with PennDOT District 6-0 to conduct road safety audits on corridors identified on their Section 148 Highway Safety Improvement Program (HSIP) that are eligible for dedicated funding but not already programmed. To date, over 20 corridors in the region have been addressed in urban, suburban, and rural settings. The I-95 Delaware County RSOA is the first event on an interstate highway.

What is an RSOA?

An RSOA is a formal safety and operations performance examination of an existing or future road or intersection by a multi-disciplinary audit team. Road safety and operations audits can be used on any size project, from minor maintenance to mega-projects, and can be conducted on facilities with a history of crashes, or during the design phase of a new roadway or planned upgrade. This is the first time DVRPC has incorporated transportation operations elements into a traditional RSA to create an RSOA.

In terms of safety, an RSOA is conducted to generate improvement recommendations and countermeasures for roadway segments demonstrating a history of, or potential for, a high frequency of motor vehicle crashes, or an identifiable pattern of crash types. The emphasis is placed on identifying low-cost, quick-turnaround safety and operations improvements to address issues where possible, though not excluding more complex strategies. Implementation of improvement strategies identified through this process may be eligible for HSIP Funds or other federal safety monies. Because the RSOA process is adaptable to local needs and conditions, recommendations can be implemented incrementally as time and resources permit.

With the addition of operations elements in an RSA, it is necessary to consider the management and operations of identified roadway segments. DVRPC has performed operations studies on I-95 in Delaware County, creating the opportunity for operations to be incorporated into the RSA process. Prior studies include the US 202, Section 200 Transportation Operations Audit (2009) and the Transportation Systems Management and Operations (TSM&O) study for I-95 in Delaware County (2008). Outcomes of the TSM&O study, such as the establishment of official PennDOT detour routes and the Incident Management Task Force (IMTF), are discussed in Chapter 2.

Prior to the two-day audit event, DVRPC collected and analyzed relevant data, including: crash cluster and corridor-wide crash summary analyses, daytime and nighttime video of the roadway, traffic volume data, congestion management data, and aerial photographs. DVRPC staff also conducted a pre-audit field visit to examine conditions while driving through both the interchanges and the main sections.

The audit event has three basic components in which the audit team participates:

- Pre-audit: the study team reviews location characteristics and crash analysis;
- Field visit: the study team examines conditions along the corridor via windshield survey; and
- Post-audit: the study team shares findings, and develops a list of problems and potential strategies.

Following the event, DVRPC staff compiled the identified problems and potential strategies into a matrix which is then sent back to the audit team for verification. Upon approval from the team, the matrix is incorporated into a technical report. This is then distributed to all audit participants and coordinating agencies for advancement to the implementation stage.

The I-95 RSOA matrix also includes the roadway owner's response to each of the identified issues and recommended strategies. All items have been responded to, and many improvements have already been implemented thanks to the high level of coordination between departments at PennDOT District 6-0, and the opportunity to utilize maintenance funds and existing contracts to implement the improvements.

The I-95 Audit Event

The two-day audit was conducted on Thursday, June 3, 2010, and Friday, June 4, 2010. The pre-audit and post-audit meetings were held at the Chester City Community Room in Chester City Hall, Chester, Pennsylvania. The audit team of 23 participants included representation from local, county, regional, state, and federal levels. See Appendix A for the list of audit team members. The pre-audit meeting—an overview of the study area and an examination of crash history—began at 8:30 AM. Next was the field visit, when the audit team drove through the corridor and examined conditions to identify safety issues. The next day, the team returned for the post-audit session where problems were defined and countermeasures discussed.

CHAPTER 2

Corridor Description and Analysis

Study Location

The study area consists of approximately 10 miles of I-95 from the Delaware state line northeast to the county line with the City of Philadelphia. This stretch of I-95 is an important link between Philadelphia, Chester City, and Wilmington, Delaware. Heavy volumes and recurring peak-period congestion are characteristic of this stretch, as it provides access to many trip generators and industrial facilities including the Philadelphia International Airport, Boeing, and the Sunoco Inc. oil refinery, in addition to through traffic seeking destinations located beyond the Delaware Valley region.

Roadway Characteristics

I-95 is classified as an urban interstate. The corridor study section has three basic cross-section types. From the airport to I-476, the roadway is an eight-lane configuration: four travel lanes per direction with on- and off-ramps. The second type is where I-476 interchanges with I-95: a four-lane configuration with two lanes in each direction. The third is from I-476 to the Delaware state line: a six-lane configuration consisting of three travel lanes per direction with on- and off-ramps. There are cable and guide rail median barriers along the roadway; shoulders are intermittent. The alignment of I-95 includes both horizontal and vertical curves. The speed limit is posted at 55 MPH. Within the study area there are 10 interchanges, including full clover leaf to partial interchanges.

Traffic Volumes

Existing volume counts from Traffic.com were utilized for the audit and normalized by DVRPC to determine annual average daily traffic (AADT). The data shows traffic volumes along the corridor

to be in the range of 55,000—85,000 vehicles per direction per day on average. A 2008 AADT count on I-95 between Chichester Avenue and Market Street recorded just over 55,000 vehicles per direction. Further north between US 322/Commodore Barry Bridge and Kerlin Street, a 2009 AADT count of just over 85,000 vehicles was recorded in the northbound direction. The increase at this location is due in part to motorists crossing the bridge from New Jersey en route to points north.

Operations Studies

In 2008, DVRPC completed a Transportation Systems Management and Operations (TSM&O) study for the Delaware County section of I-95. The objective of the TSM&O study was to optimize the performance of existing and programmed infrastructure by implementing multimodal, intermodal, and often cross-jurisdictional systems, services, and projects. It is designed to preserve capacity and improve the security, safety, and reliability of transportation systems. One of the major issues identified in the study was that during incidents, there was lack of coordination and communication between PennDOT, local emergency responders, Pennsylvania State Police, local municipalities, tow companies, SEPTA, Delaware Department of Transportation and Delaware State Police. The study also identified problems in identifying incident locations and the lack of intelligent transportation systems (ITS) equipment and detour routes. Several outcomes of the study have had a positive impact on operations management along I-95. The TSM&O study produced a report with a matrix highlighting goals and improvement strategies, many of which have been implemented, such as creation of an Incident Management Task Force (IMTF), official PennDOT detour routes, and installation of ITS devices.

DVRPC's 2009 Transportation Operations Master Plan outlines a long-range vision of transportation operations for the DVRPC region. The plan includes an operations vision that establishes where ITS infrastructure, emergency service patrols, and IMTFs should be deployed in the region. For I-95 in Delaware County, the following operational strategies have been identified in the vision:

- Primary Coverage for ITS Infrastructure—Includes full Closed Circuit Television (CCTV) coverage, Dynamic Message Signs (DMS), incident detection and travel time detectors;
- Full Coverage for Emergency Service Patrol—24 hours / 7 days a week coverage;
- Continuance of IMTF; and
- Integrated Corridor Management for Freeways—Optimizing travel in a corridor by coordinating traffic and transit on expressways and arterials.

The most recent Congestion Management Process (CMP) also addresses operations on the Delaware County section of I-95. The CMP is a systematic way to analyze the multimodal regional transportation network with the goal of managing congestion. It identifies congested corridors, subdivides them into subcorridors, and recommends strategies. The Delaware County section of I-95 was identified as a priority subcorridor in the 2011 CMP. Recommended strategies based on CMP analysis include ITS/integrated corridor management for freeways,

incident management, traveler information services, advanced transit system management, park-and-ride lots, and major reconstruction projects, with attention also given to safety improvements and programs.

Incident Management

Established in April 2008 as a result of the TSM&O study, the Delaware County IMTF holds quarterly meetings that focus on I-95 and I-476. The aim of the IMTF is to improve coordinated incident management response, foster interaction among emergency responders, identify and address critical incident management needs, and give other organizational perspectives. Its current activities include emergency detour route guidelines and post-incident reviews.

PennDOT has established 12 official detour routes for I-95 in Delaware County. These are generally interchange-to-interchange detours that include primary and secondary routes. Four of the routes utilize PA 291 to bypass the entire corridor. To access detour route information and maps, emergency responders and operating agencies may use the Interactive Detour Route Mapping (IDRuM) web-based application developed by DVRPC.

There are multiple entities responsible for incident management in the study section. The Pennsylvania State Police patrols I-95, except in Tinicum Township where there are local police patrols. Other responders include the Delaware County Emergency Management Agency, 12 local fire, police (traffic safety), and emergency medical service (EMS) departments, the PennDOT Regional Traffic Management Center (RTMC), PennDOT Maintenance, and local towing companies.

PennDOT also deploys expressway service patrols (ESP) that cover two sections of I-95. The ESP's are a fleet of service trucks used to assist motorists, free of charge, when their vehicles have suffered a mechanical failure, flat tire, or a minor incident. ESP operators also remove small debris from the highway and provide vital assistance to local law enforcement at crash scenes by relocating the involved vehicles and using arrow boards for traffic control. Along I-95 from the Delaware state line to Exit 9/Essington, one ESP truck patrols during the morning and evening rush hours, while another ESP truck patrols the roadway from Exit 9 to Girard Avenue from 5:00 AM to 8:00 PM.

ITS Infrastructure

The 2009 American Recovery and Reinvestment Act (ARRA) included an ITS infrastructure deployment project on I-95, from the Delaware state line to Broad Street in Philadelphia. The ARRA project includes fiber optic communication systems and video sharing through the Delaware County Emergency Operations Center (EOC), which includes video display in the 911 dispatch center and a video wall in the EOC. On I-95, the ARRA project provides CCTV cameras, DMS, and incident/travel-time detectors along the roadside to help determine travel times which are posted on the DMS signs. On I-476, the project also includes infilling I-476 with additional CCTV, DMS, and tag readers.

These ITS devices were operational as of summer 2011 (post-audit) and include 15 CCTV cameras evenly distributed along I-95 and six DMS.

These devices are operated by PennDOT staff located at RTMC in King of Prussia which serves the five southeastern counties in Pennsylvania. The center is staffed 24 hours a day, 7 days a week, with operators utilizing these technologies to monitor traffic conditions, assist in incident management, and disseminate traveler information to the public.

Crash Findings

According to the PennDOT crash database, there were 1,076 reportable crashes during the three-year study period of 2007 to 2009 along the study area section of I-95. Reportable crashes are crashes that result in a fatality, injury, and/or require a vehicle to be towed from the scene. A comprehensive summary of the corridor-wide crash data is shown in Appendix C. Of the three-year total, 403 crashes occurred in 2007 (37 percent), 322 in 2008 (29 percent), and 351 in 2009 (32 percent). The number of total crashes was evenly distributed in both directions.

When analyzing crash frequency by month, the fewest crashes occurred in January (73), March had the highest number (102), and the remainder of the year was fairly consistent with 80 or 90 crashes per month on average. Crash numbers by weekday depict Monday and Tuesday with the lowest crash totals, with 126 and 122 total average crashes, respectively. Friday had the highest number with 208, and Saturday the next highest with 171, and the remaining three days had average crash totals hovering around 150. Total crashes by weekday were evenly distributed by direction except on Sunday, which had 89 southbound crashes and 59 northbound crashes. When considering crashes by time of day, the distribution favors typical rush-hour periods, with a spike in crashes occurring between 4:00 PM and 7:00 PM.

Crash distributions by road surface and weather condition showed no anomalies, as 77 percent of the crashes occurred on dry road surface and 80 percent during clear weather conditions. Fifty-seven percent of the crashes occurred under daylight conditions, and 18 percent with street lights on.

Regarding severity, there were seven fatal crashes that claimed seven lives, 508 injury crashes, and 561 property damage-only crashes. Of the injury crashes, 19 were major, 81 were moderate, 282 were minor, 100 were considered “unknown severity,” and 26 were coded as “unknown if injured.” The confirmed injured person count by direction was 291 northbound, and 277 southbound.

The three highest collision type concentrations were rear end (40 percent), hit fixed object (33 percent), and angle crashes (10 percent), which, when combined, account for approximately 83 percent of the collision total. In the southbound direction, there were 148 crashes involving a hit guide rail, whereas there were only 90 hit guide rail crashes in the northbound direction.

The Delaware County section of I-95 contained four roadway segments that were identified on the 2008 PennDOT District 6-0 high-crash list. These high crash segments provided a starting

point for more detailed analysis to supplement the corridor-wide analysis. The team examined the distribution of fatal and major injury crashes, and those road segments that had the highest concentration of total crashes.

Two concentration areas were identified. The first was the 1.7-mile stretch that encompasses the two interchanges that comprise US 322's connection with I-95. This roadway segment had a combined northbound and southbound three-year crash total of 195 crashes. There were three fatal crashes and four major injury crashes. The most interesting finding was the number of HFO crashes in the southbound lanes at 48, and only 29 northbound. Rear-end crashes at this location were evenly split at 34 (northbound) and 35 (southbound).

The second location examined was the 1.08-mile segment along I-95 northbound (only) which included the I-476 on-ramp. Involving only a single interchange and only one direction of travel, this segment had a crash total of 128 and comprised the two highest crash frequency segments of the corridor. Rear-end crashes were by far the most common collision type at 80 crashes, 63 percent of the 128 total. Two major injury crashes occurred here, but no fatal crashes were recorded.

CHAPTER 3

Findings and Recommendations

The following section summarizes the findings, potential strategies, and priorities of the I-95 RSOA in Delaware County, Pennsylvania. The table for each section shows site-specific safety issues and corresponding potential strategies, general ratings for difficulty to implement, proposed safety and operational benefits, plus the road owner's response. A corresponding aerial map indicating the relative location of each identified issue (where possible), and implemented improvements, is provided opposite each table.

Regarding difficulty to implement, PennDOT uses the following general descriptions to characterize each of the three ratings:

- Low—can be accomplished through maintenance;
- Medium—requires use of existing or new contract, and some engineering; funding may be readily available;
- High—longer-term project; full engineering; may require right-of-way acquisition and new funding.

It is expected that implementing these recommendations will improve the overall safety and operations of the roadway. Note that potential strategies which call for further study do have a safety benefit in that they are the next step toward a more detailed and appropriate safety improvement. Given fiscal constraints, recommendations may have to be considered one at a time or in small groups.

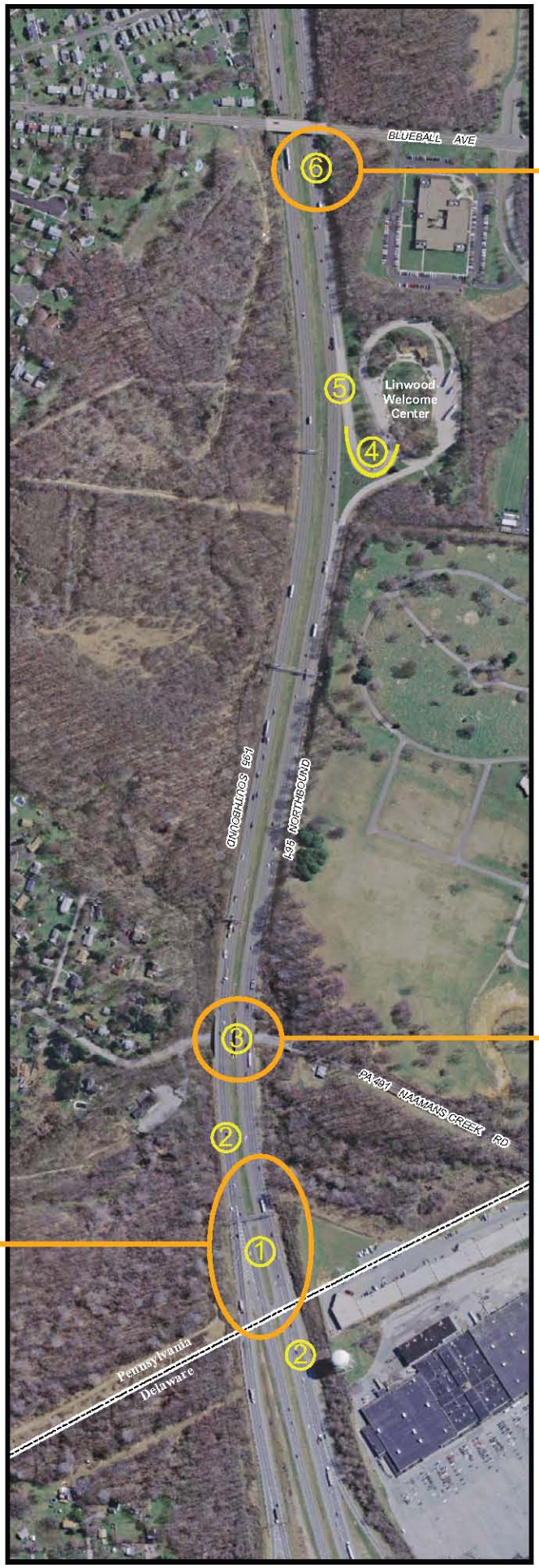
Being the roadway owner, PennDOT District 6-0 uses the findings of the RSOA as a guide for designing improvements to address these issues. Whereas the RSOA findings are numerous, PennDOT uses its experience in safety engineering to determine which issues from the table will yield the highest safety benefit when addressed using the limited safety funds available.

Please note that no safety issues were identified on the corridor segment represented in aerial panel 11 during the audit event, thus no figure or table is provided for that segment of the study corridor in the final report.

I-95 Road Safety and Operations Audit

Figure 1

Panel 1 (Delaware state line to Blueball Avenue)



Dynamic Message Sign under construction, will be operable in 2011 and will provide travel time and incident information
Completed Post-Audit 2010

Aluminum rail on bridge over Naamans Creek Road replaced
Completed Post-Audit 2010

Second emergency U-turn area closed
Completed Post-Audit 2010

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0 300 600
Feet

Aerial Imagery: DVRPC, 2005

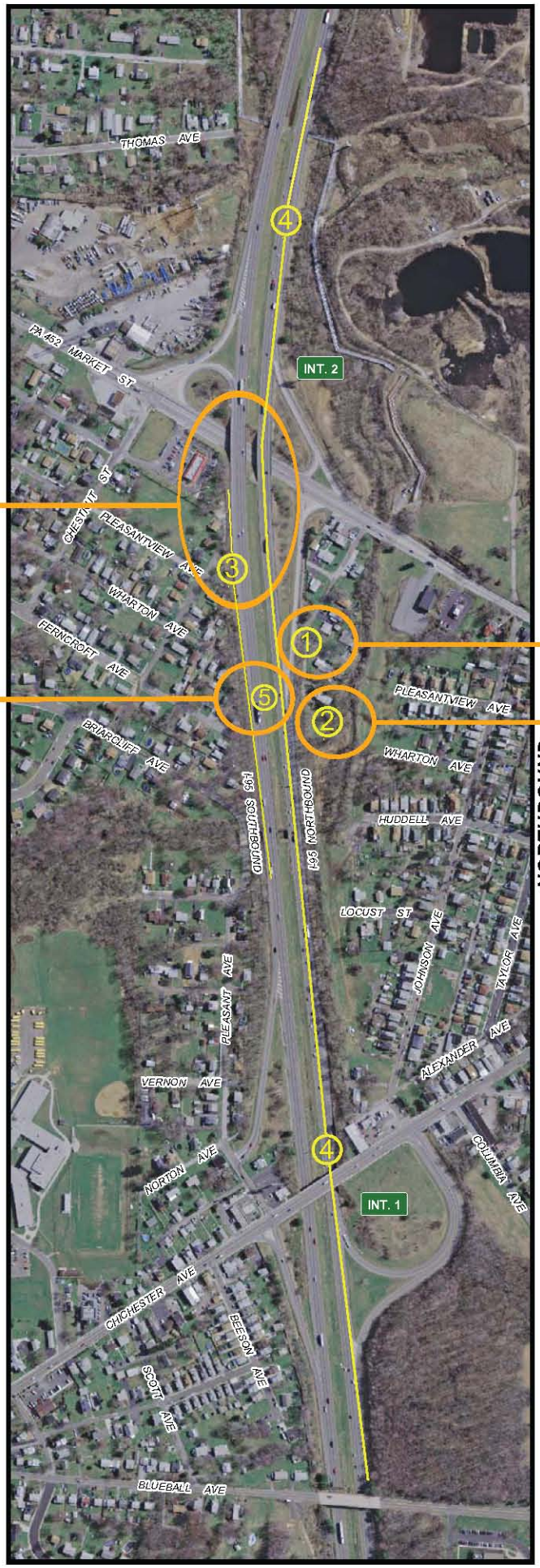
Table 1: Panel 1 (Delaware state line to Blueball Avenue)

Site-Specific Issue	Potential Strategy	Difficulty to Implement	Estimated Safety Benefit	Estimated Operational Benefit	Road Owner Response
Panel 1					
1. Need to formalize u-turn location for emergency access only; currently two openings exist that are duplicative of one another;	1. Further formalize the northern opening which is properly designed, then close the southern opening (duplicative);	*Medium*	*High*	*Low*	Implemented post-audit 2010;
2. Motorists are making u-turns at the emergency access median opening near the Delaware state line;	2. Provide signs which direct motorists where to exit in order to turn around safely (provides an alternative to making unlawful and unsafe use of the emergency access median opening);	*Low*	*Medium*	*Low*	Properly signed for emergency vehicles only according to the American Association of State Highway and Transportation Officials (AASHTO) standard—no further action;
3. Bridge rail missing (aluminum rail) at bridge over Naamans Creek Road;	3. Replace missing rail;	*Low*	*Medium*	*N/A*	Implemented post-audit 2010;
4. Guide rail around welcome center seems unnecessary and potentially hazardous;	4. Investigate the safety implications of this guide rail design and determine if warranted; remove or adjust as needed;	*Low*	*N/A*	*N/A*	Issue will be looked at as part of welcome center work;
5. Length of merge coming out of welcome center may be too short;	5. Investigate adequacy of merge length;	*Low*	*N/A*	*Low*	Meets AASHTO Standard, no further action;
6. The section of I-95 through Chester City experiences recurring congestion due to volumes, and a significant number of weave sections spaced closely together—this contributes to the high crash rates on the corridor.	6. Install additional signage in northbound direction to indicate new traffic patterns, weave movements, closely spaced exits, and to prepare motorists for stopped traffic ahead.	*Low*	*Medium*	*High*	DMS under construction will be operable in 2011 and will provide travel time and incident information.

I-95 Road Safety and Operations Audit

Figure 2

Panel 2 (Interchanges 1 and 2)



Guiderails have been adjusted
Completed Post-Audit 2010

Exit 2 sign replaced
Completed Post-Audit 2010

Cable barrier repaired
Completed Post-Audit 2010

Vegetation Trimmed
Completed Post-Audit 2010

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0 300 600
Feet

Aerial Imagery: DVRPC, 2005

Table 2: Panel 2 (interchanges 1 and 2)

Site-Specific Issue	Potential Strategy	Difficulty to Implement	Estimated Safety Benefit	Estimated Operational Benefit	Road Owner Response
Panel 2					
1. Missing exit sign in gore area at Exit 2;	1. Replace exit sign;	*Low*	*Med*	*Low*	Implemented post-audit 2010;
2. Vegetation blocking signs on off-ramps of Exit 2;	2. Trim vegetation;	*Low*	*High*	*Low*	Implemented post-audit 2010;
3. Low guide rails southbound between Exits 2 and 1;	3. Replace guide rail;	*Low*	*Medium*	*N/A*	Implemented post-audit 2010;
4. Shoulders are narrow in northbound direction;	4. Increase shoulder width using existing right-of-way;	*High*	*High*	*High*	Will be investigated as part of a future reconstruction or preservation project;
5. Top cable on median barrier is sagging at Exit 2.	5. Repair cable barrier.	*Low*	*High*	*N/A*	Implemented post-audit 2010.

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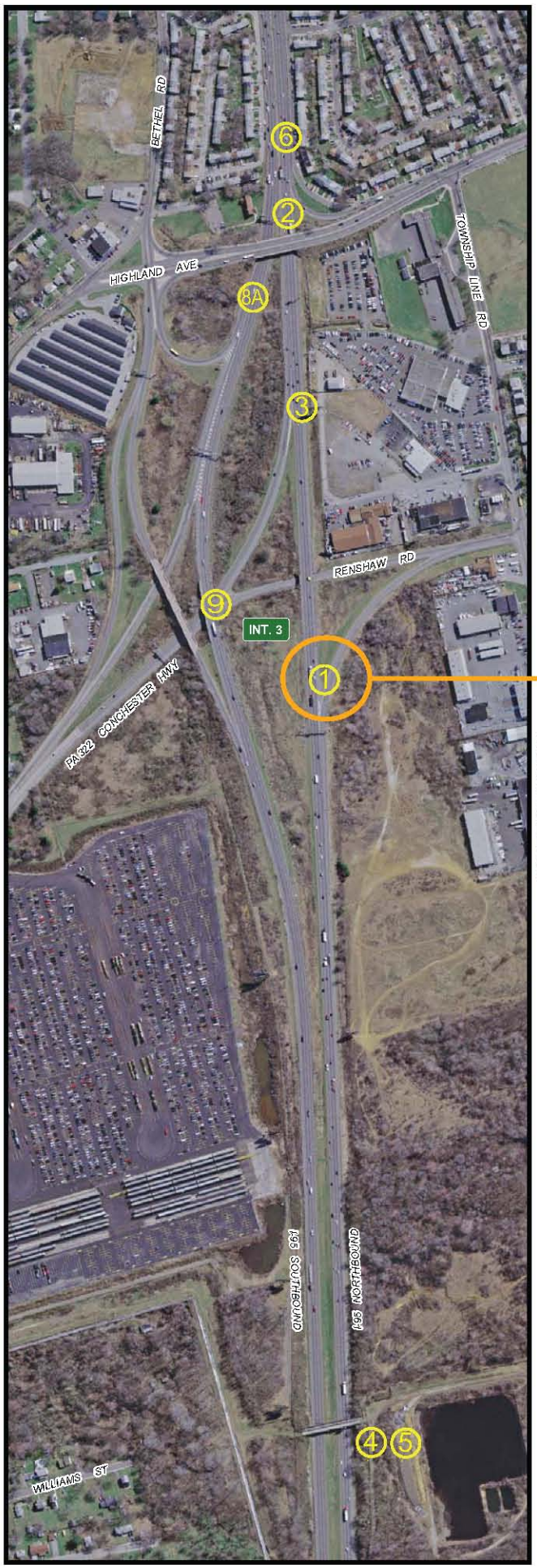
Figure 3

Panel 3 (Interchange 3, Williams Street to Highland Avenue)



Note:
#7 not shown on panel
#8B not shown on panel
#10 not shown on panel
#11 not shown on panel

Exit 3 sign replaced
Completed Post-Audit 2010

0 300 600
Feet

Aerial Imagery: DVRPC, 2005

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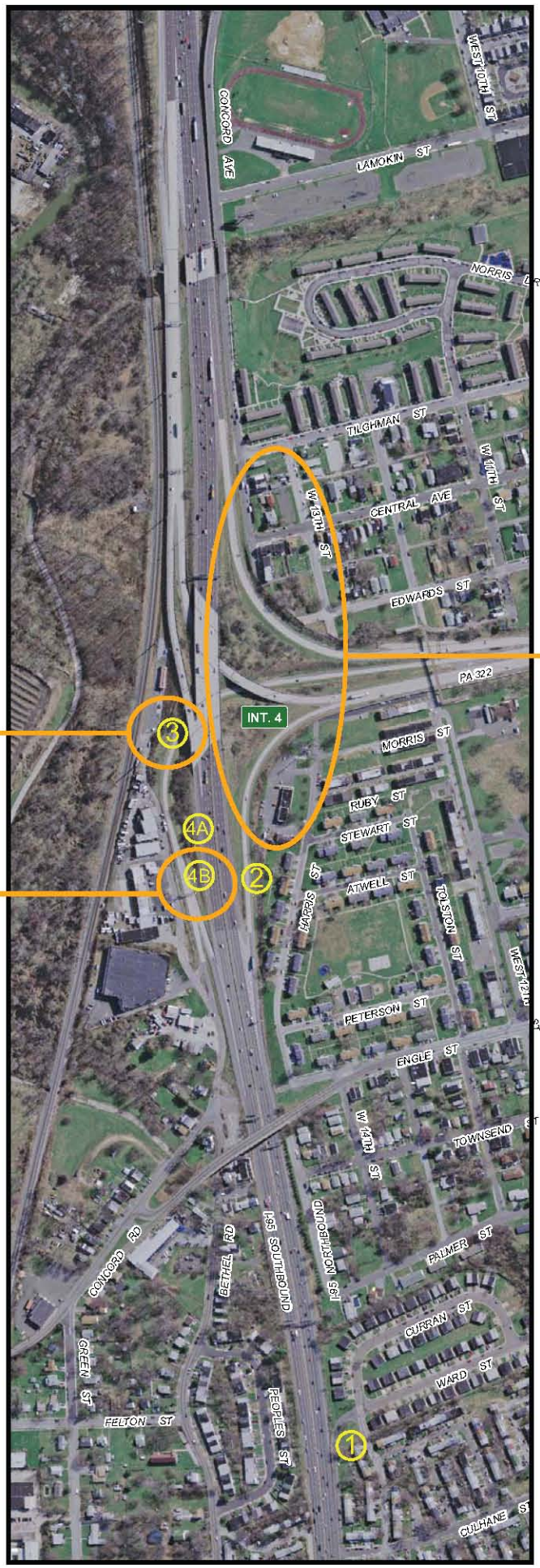
Table 3: Panel 3 (interchange 3, Williams Street to Highland Avenue)

Site-Specific Issue	Potential Strategy	Difficulty to Implement	Estimated Safety Benefit	Estimated Operational Benefit	Road Owner Response
Panel 3					
1. Missing exit sign in gore area at Exit 3;	1. Replace exit sign;	*Low*	*Medium*	*Low*	Implemented post-audit 2010;
2. Existing weave area warning signage is too small;	2. Increase size or change sign for increased effectiveness;	*Low*	*High*	*High*	New sign to be installed pending FHWA approval;
3. Existing merge provides short acceleration lane making it a difficult movement;	3. Investigate I-95 northbound lane shift to better accommodate the US 322 merge; look at left shoulder on merge ramp to extend the lane and add gore area;	*Low*	*N/A*	*High*	Will be investigated as part of the planned US 322/I-95 Realignment Project;
4. Investigate applicability of the "increased fines" jurisdiction;	4. Remove "fines doubled" sign if found to be in noncompliance;	*Low*	*N/A*	*N/A*	Will be removed in 2011;
5. Merging traffic from US 322 enters directly onto I-95 northbound without an acceleration lane, and motorists are provided little notice;	5. Install warning signs to alert motorists of approaching merge, possible placements: vicinity of Williams Street overpass, in median and/or at existing weave area signage near Exit 3;	*Low*	*High*	*High*	New sign to be installed pending FHWA approval;
6. US 322 traffic also needs to merge to the far right to get onto the Commodore Barry Bridge, a difficult move;	6. Add signs on US 322 at the merge point to warn of the upcoming off-ramp to bridge and the need to merge to far right (include distance to bridge, if not currently posted);	*Low*	*High*	*High*	Will be addressed as part of the planned US 322/I-95 Realignment Project;
7. Highland Avenue exit is short and sharply curved;	7. Add chevrons on loop ramps to guide Highland Avenue off-ramp traffic;	*Low*	*High*	*Medium*	PennDOT Maintenance will fund/install chevrons and Freeway Operation will issue notification to proceed;
8. The combination US 322/Highland Avenue exit presents three options to I-95 southbound motorists which they come upon abruptly due to compromised sight distance caused by the overpass;	8. A: Add US 322 pavement legends to identify lane options, after overpass once on ramps from US 322; B: Improve signage on I-95 southbound approaching this interchange to get unfamiliar motorists into correct lane;	*Low*	*High*	*High*	8A: PennDOT Maintenance has agreed to fund and Traffic Operations is making arrangements to install legends on pavement; 8B: Will be addressed in the US 322/I-95 Realignment Project lane (not on map);
9. Southbound over US 322 structure (carries local traffic entering I-95 southbound), left lane too close to guide rail, low parapet, and drop off;	9. To be addressed as part of the guide rail and drop-off work recommended in the Corridor-wide section;	*Medium*	*Medium*	*N/A*	Guide rail drop-off will be addressed in meeting with PennDOT maintenance; parapet will be addressed in the planned US 322/I-95 Realignment Project;
10. Foliage blocking Neuman University sign along southbound I-95;	10. Remove foliage;	*Low*	*Medium*	*N/A*	Implemented post-audit 2010;
11. Foliage and vegetation in median clear zone is potential fixed object hazard.	11. Remove foliage.	*Low*	*Medium*	*N/A*	Implemented post-audit 2010.

I-95 Road Safety and Operations Audit

Figure 4

Panel 4 (Interchange 4, Culhane Street to Lamokin Street)



Striping on ramps repainted
Completed Post-Audit 2010

Vegetation trimmed
Completed Post-Audit 2010

Guide rail repaired
Completed Post-Audit 2010

dvrpc

JULY 2011

Aerial Imagery: DVRPC, 2005

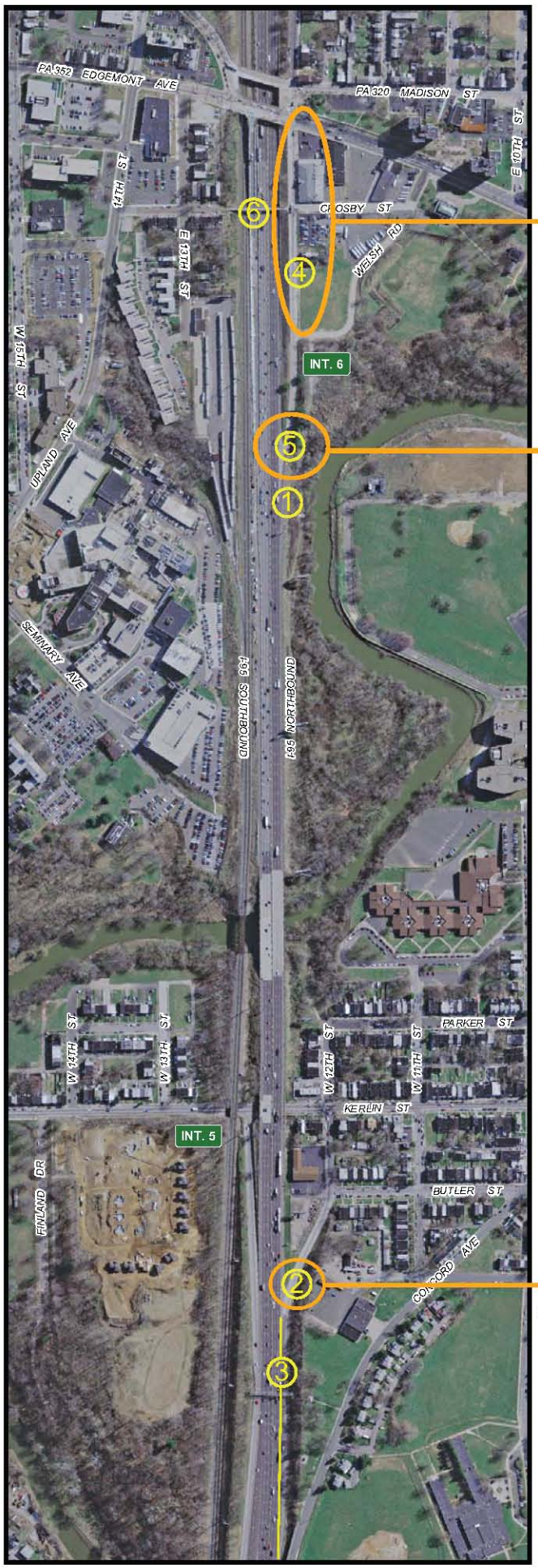
Table 4: Panel 4 (interchange 4, Culhane Street to Lamokin Street)

Site-Specific Issue	Potential Strategy	Difficulty to Implement	Estimated Safety Benefit	Estimated Operational Benefit	Road Owner Response
Panel 4					
1. Guide rail/fence northbound at Ward Street between the ramp and local road appear to be inadequate for conditions;	1. Investigate and repair if necessary; consider a barrier design that provides a higher degree of protection and "zero" dynamic deflection;	*Low*	*Medium*	*N/A*	Repair implemented post-audit 2010;
2. Northbound ramp to bridge may or may not be super elevated—may explain why trucks are rolling over;	2. Perform a ball-bank study of the curve and install appropriate warning to cars and trucks about the severity of the curve;	*Low*	*High*	*Medium*	District 6-0 Traffic will address in summer 2011, perform study and add sign if warranted;
3. Foliage obstructs sight distance on I-95 southbound approaching US 322.	3. Trim foliage.	*Low*	*High*	*Low*	Foliage trimmed post-audit 2010 by PennDOT Maintenance;
4. Short acceleration lane from Kerlin Street on ramp to I-95 southbound; guide rail is damaged.	4. A: Investigate using pavement marking to extend shoulder for Kerlin Street southbound on-ramp (check shoulder thickness and pavement conditions);	*Medium*	*Medium*	*Medium*	4A: Investigation field visit scheduled for summer 2011;
	B: Repair guide rail.	*Medium*	*Medium*	*N/A*	4B: Guide rail repair completed by PennDOT maintenance.

I-95 Road Safety and Operations Audit

Figure 5

Panel 5 (Interchanges 5 and 6, Kerlin Street to PA 302)



Additional trailblazer signs placed at Edgemont Ave to NB Exit 6
Completed Post-Audit 2010

Exit 6 sign replaced
Completed Post-Audit 2010

Guiderail at Exit 5 repaired
Completed Post-Audit 2010

0 300 600
Feet

Aerial Imagery: DVRPC, 2005

dvrpc
JULY 2011

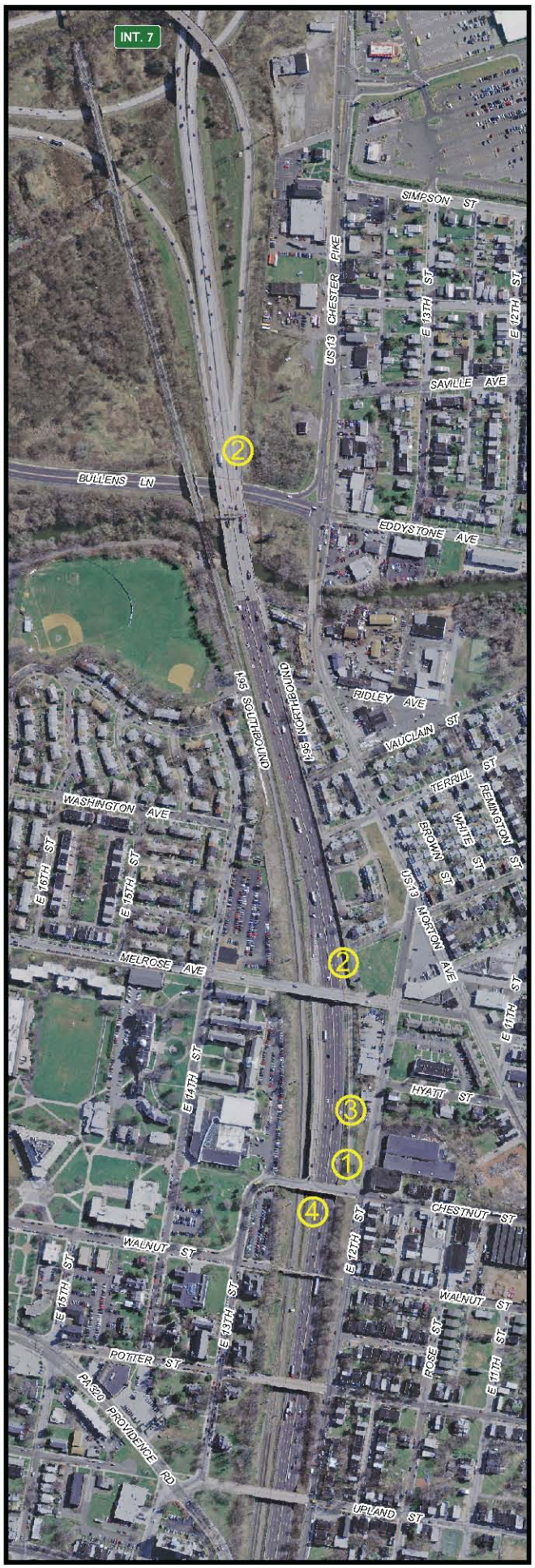
Table 5: Panel 5 (interchanges 5 and 6, Kerlin Street to PA 320)

Site-Specific Issue	Potential Strategy	Difficulty to Implement	Estimated Safety Benefit	Estimated Operational Benefit	Road Owner Response
Panel 5					
1. Exit 6 Edgemont Street off-ramp from northbound I-95 is a short, uphill exit;	1. Use pavement markings to extend shoulder at Edgemont Street northbound off-ramp to ease transition;	*Medium*	*Medium*	*Medium*	Freeway Operations and PennDOT Maintenance will conduct field investigation summer 2011;
2. Approaching Exit 5 Kerlin Street from I-95 northbound the guide rail end treatment is damaged;	2. Repair guide rail end treatment;	*Medium*	*Medium*	*N/A*	Implemented post-audit 2010;
3. Far right lane is not a through lane between Commodore Barry Bridge and Kerlin Street;	3. Add an 8" wide dotted extension line or an 8" auxiliary lane line on right lane between Commodore Barry Bridge approach and Kerlin Street ramp in order to provide motorists a better warning; add warning sign also;	*Low*	*Medium*	*High*	District 6-0 Traffic will address in summer 2011;
4. Lack of trailblazer signs at Edgemont Avenue off-ramp indicating where the I-95 northbound on-ramp is (several blocks ahead);	4. Install trail-blazer signage to guide motorists back onto I-95 northbound at the Chestnut Street on-ramp;	*Low*	*High*	*High*	Implemented post-audit 2010;
5. Missing exit sign in gore area of Exit 6 Edgemont Avenue from I-95 northbound.	5. Replace exit sign in gore area.	*Low*	*Medium*	*Low*	Implemented post-audit 2010;
6. The I-95 southbound gore area at Edgemont Avenue contains hazards, including significant slopes and an unprotected bridge pier.	6. Install the appropriate attenuating device that meets field condition and provide adequate shielding of the bridge pier.	*Medium to High*	*Medium to High*	*N/A*	PennDOT Maintenance will conduct field investigation summer 2011.

I-95 Road Safety and Operations Audit

Figure 6

Panel 6 (Interchange 7, Upland Street to Simpson Street)



Aerial Imagery: DVRPC, 2005

dvrpc

JULY 2011

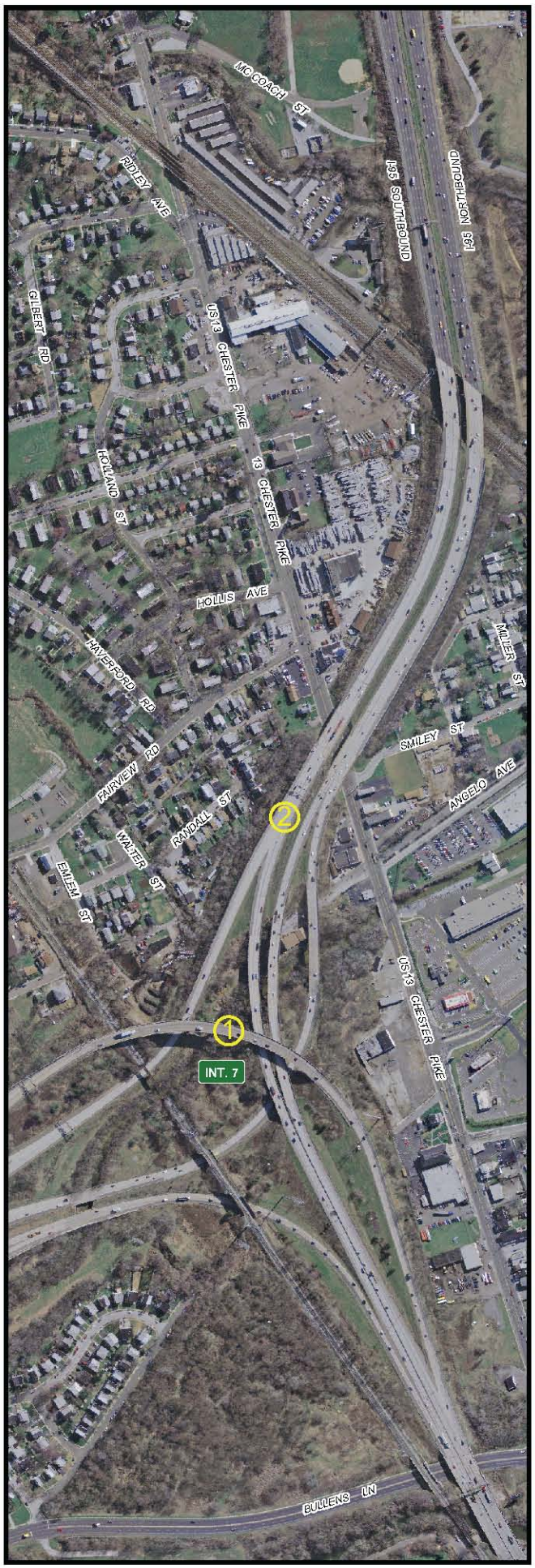
Table 6: Panel 6 (interchange 7, Upland Street to Simpson Street)

Site-Specific Issue	Potential Strategy	Difficulty to Implement	Estimated Safety Benefit	Estimated Operational Benefit	Road Owner Response
Panel 6					
1. Insufficient warning of impending merge / weave area at Chestnut Street on-ramp for I-95 northbound through traffic;	1. Install additional advance warnings of the approaching Chestnut Street on-ramp merge/weave area for I-95 northbound traffic;	*Low*	*Medium*	*High*	District 6-0 Traffic will install additional merge warning sign;
2. The Chestnut Street on-ramp to I-95 northbound has a short acceleration lane, and puts motorists directly into the I-476 off-ramp lane, forcing them to merge immediately in order to continue on I-95 northbound;	2. Further study needed at this interchange; ideas for consideration include: • closing the exit; • using shoulder to extend the merge lane and/or gore area; • add signs to reinforce need to merge quickly so as to not get stuck in the I-476 northbound off ramp; • add pavement markings to both I-95 and I-476. *Note: Scoping study of the I-95/I-476 interchange and vicinity scheduled to begin during Fiscal Year 2010. Roadway owner must coordinate with this effort.*	*Low to High*	*Medium to High*	*High*	District 6-0 will install additional merge warning sign; all other issues will be considered during the 2011 DVRPC I-95/I-476 Interchange Improvements Feasibility Study;
3. Truck traffic uses Chestnut Street on-ramp which is not ideal for large trucks and presents a safety issue;	3. Prohibit truck traffic at this on-ramp and promote use of alternate routes to I-95 (e.g., Exit 8 Stewart Avenue) that are more accommodating to large trucks (see DVRPC publication #07024 *National Highway System Connectors to Freight Facilities in the Delaware Valley*);	*High*	*High*	*Low*	Will be considered during the 2011 DVRPC I-95/I-476 Interchange Improvements Feasibility Study;
4. On I-95 southbound near Chestnut Street there is a guide rail end treatment that may need repair.	4. Investigate guide rail end treatment and repair if necessary (Delaware County Maintenance).	*Low*	*Medium*	*N/A*	PennDOT Maintenance will conduct field investigation summer 2011.

I-95 Road Safety and Operations Audit

Figure 7

Panel 7 (Interchange 7, Bullens Lane to MC Coach Street)



Aerial Imagery: DVRPC, 2005

dvrpc

JULY 2011

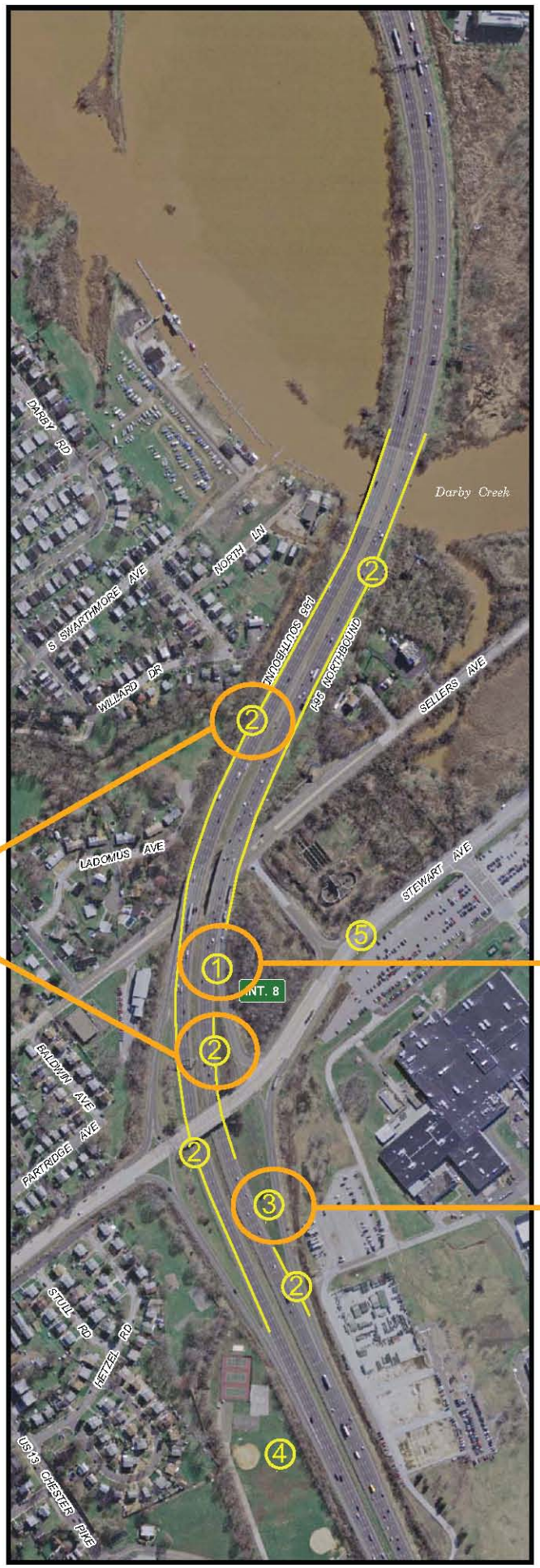
Table 7: Panel 7 (interchange 7, Bullens Lane to MC Coach Street)

Site-Specific Issue	Potential Strategy	Difficulty to Implement	Estimated Safety Benefit	Estimated Operational Benefit	Road Owner Response
Panel 7					
1. Off-ramp from I-95 northbound to I-476 northbound opens from one lane to two lanes, then narrows back to one lane before feeding into the main line;	1. Further study needed to determine possibility of eliminating second lane on ramp bridge; conduct a simulation to compare existing conditions with proposed improvements;	*Low*	*Medium*	*Medium*	Will be considered during the 2011 DVRPC I-95/I-476 Interchange Improvements Feasibility Study;
2. The I-95 southbound/I-476 northbound split lacks adequate delineation causing some motorists to weave abruptly.	2. Improve warning to motorists: • add yellow exit only signage for I-476 northbound exit from I-95 southbound; • add pavement marking legends at interchange; • investigate gore area extension between the two roads; • investigate use of shoulder as a choice lane for I-95 southbound motorists.	*Low* *Low* *Medium* *Medium*	*High* *High* *Medium* *Medium*	*High* *High* *Medium* *Medium*	All issues will be considered during the 2011 DVRPC I-95/I-476 Interchange Improvements Feasibility Study.

I-95 Road Safety and Operations Audit

Figure 8

Panel 8 (Interchange 8, north over Darby Creek)



Guide rails repaired, reflectors added
Completed Post-Audit 2010-2011

Guide rail addressed
Completed Post-Audit 2010

Exit 8 sign replaced
Completed Post-Audit 2010

dvrpc

May 2011

0 300 600
Feet

Aerial Imagery: DVRPC, 2005

Table 8: Panel 8 (interchange 8, north over Darby Creek)

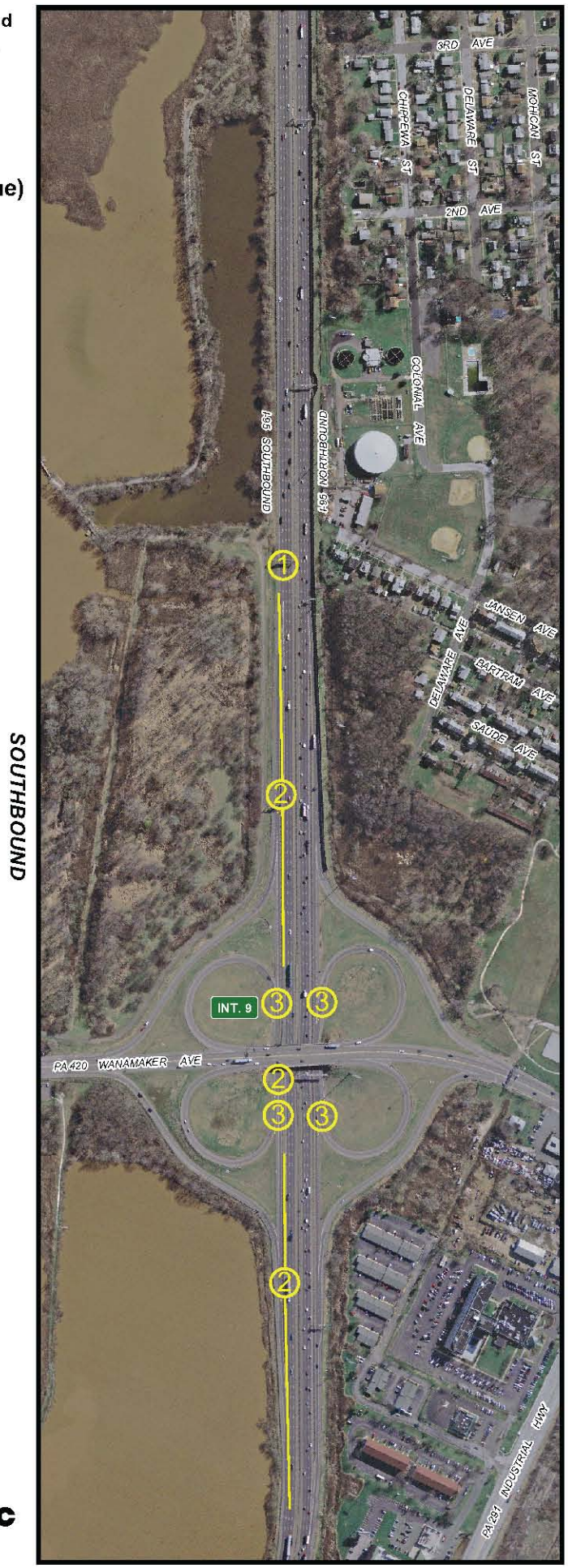
Site-Specific Issue	Potential Strategy	Difficulty to Implement	Estimated Safety Benefit	Estimated Operational Benefit	Road Owner Response
Panel 8					
1. Northbound on-ramp from Exit 8 Stewart Ave. has guide rail, but I-95 northbound traffic faces back of guide rail;	1. Add backside to guide rail for I-95 through traffic;	*Low*	*Medium*	*N/A*	Implemented post-audit 2010-2011;
2. Missing reflectors on damaged guide rails;	2. Add missing reflectors and repair guide rail;	*Low*	*Medium*	*Low*	Implemented post-audit 2010-2011;
3. Exit signage on I-95 northbound at Exit 8 on-ramp is damaged;	3. Repair exit sign;	*Low*	*Medium*	*Low*	Implemented post-audit 2010;
4. Signs for Chester waterfront along I-95 northbound approaching Exit 8 may be unnecessary;	4. Remove existing signs for Chester waterfront and add to Exit 4 US 322/Commodore Barry Bridge signs when new ramps are completed. Determine need for Exit 8 signs for Eddystone/Ridley waterfront;	*Low*	*Low*	*Low*	Issue will be revisited upon completion of the US 322/I-95 Realignment Project;
5. Connector road between Stewart Avenue and Sellers Avenue near the I-95 on-ramp could easily be mistaken for the on-ramp.	5. Add street signs to the connector road between Sellers Avenue and Stewart Avenue.	*Low*	*Low*	*Low*	Will be implemented in 2011.

Figure 9: Panel 9 (interchange 9, north to 3rd Avenue)

I-95 Road Safety and Operations Audit

Figure 9

Panel 9 (Interchange 9, north to 3rd Avenue)



dvrpc

JULY 2011

Table 9: Panel 9 (interchange 9, north to 3rd Avenue)

Site-Specific Issue	Potential Strategy	Difficulty to Implement	Estimated Safety Benefit	Estimated Operational Benefit	Road Owner Response
Panel 9					
1. Missing reflectivity on first advance overhead guide sign for Exit 9 Essington/Prospect along I-95 southbound;	1. Add missing reflectivity to sign;	*Low*	*High*	*Low*	Will be measured with retroreflectometer in summer 2011 and appropriate action taken depending on results;
2. Investigate rub rail on I-95 southbound guide rail through Exit 9;	2. If rub rail is not needed, mitigate as appropriate;	*Low*	*Low*	*N/A*	Work will be completed under I-95 Section PM8 scheduled to start fall 2011;
3. Guide rail end treatments hit frequently both northbound and southbound within gore area at Exit 9.	3. Replace missing tubular delineators, consider adding curb treatment (e.g. Quick Curb), and stripe the gore area.	*Low*	*High*	*N/A*	Work will be completed under I-95 Section PM8 scheduled to start fall 2011.

Figure 10: Panel 10 (vicinity of interchange 10)

I-95 Road Safety and Operations Audit

Figure 10

Panel 10 (vicinity of Interchange 10)

dvrpc

july 2011

Table 10: Panel 10 (vicinity of interchange 10)

Site-Specific Issue	Potential Strategy	Difficulty to Implement	Estimated Safety Benefit	Estimated Operational Benefit	Road Owner Response
Panel 10					
1. Faded arrow markings to I-95 southbound from Bartram Avenue on-ramp;	1. This location is slated for repainting;	*Low*	*Medium*	*Medium*	Despite not being required by Manual on Uniform Traffic Control Devices (MUTCD), District 6-0 Traffic will investigate in summer 2011 and address appropriately;
2. The emergency access just north of Exit 10 is located between a sign structure and a dual bridge structure and prevents the installation of guide rail to address the Length of Need (LON) issue; also, not enough room to properly protect errant vehicles. Estimated need is for about 470 feet of guide rail protection.	2. Relocate and formalize emergency responder median opening farther south in a straighter section of I-95.	*Medium*	*High*	*High*	Work will be completed under I-95 Section PM8 scheduled to start fall 2011.

CHAPTER 4

Conclusions

The RSOA is conducted to generate improvement recommendations and countermeasures for interstate segments demonstrating a history of, or potential for, motor vehicle crashes. The safety recommendations, identified during the audit and documented in this report, were designed to improve safety for users of the highway. Many of the strategies identified can be implemented through routine maintenance. The full impact of the improvement strategies will be realized when they are combined, but time and budget constraints will dictate the implementation schedule.

Engineering strategies alone will not eliminate the traffic safety issues identified along the study corridor. Education, with support from a targeted enforcement campaign, is an effective approach for addressing the driver behaviors that lead to crashes. Policy or legislative actions can provide the legal weight needed to motivate people to be safer, more conscientious drivers. Thus, employing a multi-pronged approach and engaging the appropriate stakeholders will be the most effective course of actions to advance the goal of improved safety on I-95 in Delaware County.

APPENDIX A

Audit Team

Name	Agency
Capt. Kenneth Coalson	Chester Township Police Department
Bill Payne	City of Chester Planning Department
Lou Hufnagle	Delaware County Planning Department
Veronika Foltynova	Delaware County Planning Department
Kara Rahn	Delaware County Transportation Management Assoc.
Kevin Murphy	DVRPC - Safety and Congestion Management
Chris King	DVRPC - Transportation Operations Management
Zoe Neaderland	DVRPC - Safety and Congestion Management
Bob Murphy	PennDOT Emergency Service Patrol
Mike Castellano	FHWA - PA
Carmine Fascina	FHWA - Philadelphia
John McFadden	FHWA - Resource Center
Amy Fox	FHWA - Philadelphia
Rosemarie Anderson	FHWA - Headquarters
Joe Fiocco	McMahon Associates
Lou Belmonte	PennDOT District 6-0 Traffic
Larry Bucci	PennDOT District 6-0 Traffic
Steve Sansoni	PennDOT District 6-0 Maintenance (Del)
Mike Murphy	PennDOT District 6-0 Maintenance (Del)
Manny Anastasiadis	PennDOT District 6-0 Traffic Freeway Management
Matt Miele	PennDOT District 6-0 Traffic Freeway Management
Sgt Dave Shaffer	Pennsylvania State Police - Troop K - Media
Chief Ned Donkin	Ridley Park Fire Company # 1

APPENDIX B

Background Data and Maps

- Study Area Map
- Average Daily Traffic Volumes Map
- ITS Equipment & Traffic Signals Map
- Field Visit Itinerary Map

I-95 Road Safety and Operations Audit
Study Area

Study Corridor

MIDDLETOWN
Rose Valley
Swarthmore
SPRINGFIELD
RIDLEY
NETHER PROVIDENCE
ASTON
Brookhaven
Parkside
Upland
CHESTER
UPPER CHICHESTER
LOWER CHICHESTER
Trainer
Marcus Hook
Chester
Eddystone
Ridley Park
Prospect Park
Norwood
Glenolden
Folcroft
DARBY
PHILADELPHIA
TINICUM
GREENWICH
LOGAN
Harrah's Chester
CITY HALL
Philadelphia International Airport
Delaware River
PA
NJ
DE
Delaware Co.
Gloucester Co.
New Castle Co.
Commodore Barry Bridge
476
95
291
322
452
352
320
252
491
13
44
130
295
INT. 1
INT. 2
INT. 3
INT. 4
INT. 5
INT. 6
INT. 7
INT. 8
INT. 9
INT. 10
MACDADE BLVD
PROVIDENCE RD
EDGMONT AVE
CONCHESTER RD
MARKET ST
CHICHESTER AVE
TOWNSHIP LINE RD
RIDGE RD
POST RD
NAAMANS RD
KERLIN ST
UPLAND ST
MADISON ST
HIGHLAND AVE
ENGLE ST
9TH ST
2ND ST
INDUSTRIAL HWY
STEWART AVE
WANAMAKER AVE
SEPTA R2
SEPTA R1
Darby Creek
Marcus Hook
Highland Avenue
Crum Lynne
Ridley Park
Prospect Park - Moore
Norwood
Glenolden
Folcroft
Eddystone
Chester
ppl park

N

0 0.25 0.5
Miles

DELAWARE VALLEY
dvrpc
REGIONAL PLANNING COMMISSION

I-95 Road Safety and Operations Audit
Average Daily Traffic Volumes

Study Corridor

64,000 2008 AADT

64,000 2009 AADT

Source: Traffic.com

MIDDLETOWN
Rose Valley
Swarthmore
SPRINGFIELD
NETHER PROVIDENCE
RIDLEY
Glenolden
DARBY
Folcroft
PHILADELPHIA
Prospect Park
Norwood
Ridley Park
ASTON
Brookhaven
Parkside
Upland
CHESTER
Eddystone
Harrah's Chester
Chester
CITY HALL
TINICUM
Philadelphia International Airport
UPPER CHICHESTER
LOWER CHICHESTER
Trainer
Marcus Hook
GREENWICH
LOGAN
Delaware River
PA
NJ
DE
Delaware Co.
Gloucester Co.
New Castle Co.

MACDADE BLVD
PROVIDENCE RD
EDGMONT AVE
INDUSTRIAL HWY
STEWART AVE
WANAMAKER AVE
KERLIN ST
UPLAND ST
MADISON ST
9TH ST
ENGLE ST
2ND ST
HIGHLAND AVE
CONCHESTER RD
MARKET ST
TOWNSHIP LINE RD
CHICHESTER AVE
RIDGE RD
POST RD
NAAMANS RD
CONCORD RD
SEPTA R1
SEPTA R2
Commodore Barry Bridge

INT. 1
INT. 2
INT. 3
INT. 4
INT. 5
INT. 6
INT. 7
INT. 8
INT. 9
INT. 10

56,383 SB
60,668 NB
58,899 SB
58,090 NB
73,437 SB
75,437 SB
76,267 NB
72,284 NB
64,445 SB
66,658 SB
64,765 SB
75,423 NB
83,943 NB
85,771 NB
73,464 SB
72,628 NB
80,387 SB
84,180 SB
80,761 NB
83,934 NB
65,282 SB
68,938 SB
66,045 NB
68,091 NB
76,500 SB
79,979 SB
79,767 NB
82,523 NB
77,856 SB
78,051 SB
66,242 NB
67,936 NB

N
0 0.25 0.5
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

I-95 Road Safety and Operations Audit
ITS Equipment & Traffic Signals

Study Corridor

Traffic Signal

ITS Equipment:

- Closed Circuit TV Camera
- Closed Circuit TV Camera (under construction)
- Dynamic Message Sign
- Dynamic Message Sign (under construction)

Sources: DVRPC, NJDOT, PennDOT

MIDDLETOWN
Rose Valley
Swarthmore
SPRINGFIELD
NETHER PROVIDENCE
RIDLEY
Ridley Park
Prospect Park
Norwood
Glenolden
DARBY
Folcroft
PHILADELPHIA
TINICUM
Philadelphia International Airport
ASTON
Brookhaven
Parkside
Upland
Eddystone
CHESTER
Chester
Harrah's Chester
UPPER CHICHESTER
LOWER CHICHESTER
Trainer
Marcus Hook
GREENWICH
LOGAN
Delaware River
PA
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Delaware Co.
Gloucester Co.
New Castle Co.
DE
MACDADE BLVD
PROVIDENCE RD
EDGMONT AVE
INDUSTRIAL HWY
STEWART AVE
WANAMAKER AVE
Darby Creek
SEPTA R1
SEPTA R2
CONCHESTER RD
MARKET ST
CHICHESTER AVE
TOWNSHIP LINE RD
RIDGE RD
POST RD
NAAMANS RD
KERLIN ST
MADISON ST
UPLAND ST
ENGLE ST
HIGHLAND AVE
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2ND ST
Commodore Barry Bridge
INT. 1
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INT. 5
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INT. 10
476
95
252
352
320
452
322
491
291
13
44
130
295

N

0 0.25 0.5 Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

I-95 Road Safety and Operations Audit
Field Visit Itinerary

Study Corridor
Northbound Route
Southbound Route
Stop Location

MIDDLETOWN
Rose Valley
Swarthmore
SPRINGFIELD
RIDLEY
NETHER PROVIDENCE
ASTON
Brookhaven
Parkside
Upland
CHESTER
UPPER CHICHESTER
LOWER CHICHESTER
Trainer
Marcus Hook
Eddystone
Chester
Harrah's Chester
CITY HALL
Ridley Park
Prospect Park
Norwood
Glenolden
Folcroft
DARBY
PHILADELPHIA
TINICUM
Philadelphia International Airport
GREENWICH
LOGAN
Delaware River
PA
NJ
DE
Delaware Co.
Gloucester Co.
New Castle Co.

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491
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95
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130
295

MACDADE BLVD
SEPTA R2
Ridley Park
Prospect Park - Moore
Norwood
Glenolden
Folcroft
WANAMAKER AVE
Crum Lynne
STEWART AVE
INDUSTRIAL HWY
Eddystone
PROVIDENCE RD
EDGMONT AVE
KERLIN ST
MADISON ST
UPLAND ST
9TH ST
2ND ST
ENGLE ST
Chester
CONCHESTER RD
MARKET ST
TOWNSHIP LINE RD
CHICHESTER AVE
HIGHLAND AVE
Highland Avenue
RIDGE RD
POST RD
Marcus Hook
NAAMANS RD
Commodore Barry Bridge
ppl park

N
0 0.25 0.5
Miles

DELAWARE VALLEY
dvrpc
REGIONAL PLANNING COMMISSION

APPENDIX C

Crash Data

- PennDOT 2008 High Crash Locations Comparison: Major Injuries and Fatalities Map
- Crashes by Segment Map
- Crash Summaries
  - Northbound (total crashes, Flag report)
  - Southbound (total crashes, Flag report)
  - Fatal and Major Injuries – Entire Corridor

I-95 Road Safety and Operations Audit

PennDOT 2008 High Crash Locations Comparison: Major Injuries and Fatalities

2003 - 2007 Data:
Major Injuries: 13
Fatalities: 7

2007 - 2009 Data:
Major Injuries: 6
Fatalities: 2

2003 - 2007 Data:
Major Injuries: 2
Fatalities: 4

2007 - 2009 Data:
Major Injuries: 1
Fatalities: 0

2003 - 2007 Data:
Major Injuries: 8
Fatalities: 4

2007 - 2009 Data:
Major Injuries: 4
Fatalities: 0

2003 - 2007 Data:
Major Injuries: 2
Fatalities: 4

2007 - 2009 Data:
Major Injuries: 1
Fatalities: 0

INT. 1
INT. 2
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INT. 6
INT. 7
INT. 8
INT. 9
INT. 10

MIDDLETOWN
SPRINGFIELD
Swarthmore
NETHER PROVIDENCE
RIDLEY
ASTON
Brookhaven
Parkside
Upland
CHESTER
Chester
UPPER CHICHESTER
LOWER CHICHESTER
Trainer
Marcus Hook
Ridley Park
Prospect Park
Norwood
Glenolden
Folcroft
DARBY
PHILADELPHIA
TINICUM
Eddystone
Harrah's Chester
GREENWICH
LOGAN
Philadelphia International Airport
Delaware River
PA
NJ
Delaware Co.
Gloucester Co.
New Castle Co.
DE
MD

MACDADE BLVD
PROVIDENCE RD
EDGMONT AVE
CONCHESTER RD
MARKET ST
CHICHESTER AVE
TOWNSHIP LINE RD
RIDGE RD
POST RD
NAAMANS RD
INDUSTRIAL HWY
STEWART AVE
WANAMAKER AVE
ENGLE ST
HIGHLAND AVE
9TH ST
2ND ST
CITY HALL
Commodore Barry Bridge
SEPTA R2
SEPTA R1
Creek
Darby

252
352
320
452
322
491
476
95
291
13
44
130
295

N
0 0.25 0.5
Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

I-95 Road Safety and Operations Audit

Crashes by Segment

Data Years: 2007 - 2009

- 2 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 75

Swarthmore
Rose Valley
MIDDLETOWN
SPRINGFIELD
RIDLEY
NETHER PROVIDENCE
ASTON
Brookhaven
Parkside
Upland
CHESTER
Eddystone
Glenolden
DARBY
Folcroft
PHILADELPHIA
Prospect Park
Norwood
Ridley Park
TINICUM
Philadelphia International Airport
Harrah's Chester
Chester
CITY HALL
UPPER CHICHESTER
LOWER CHICHESTER
Trainer
Marcus Hook
GREENWICH
LOGAN
Delaware River
PA
NJ
DE
Delaware Co.
Gloucester Co.
New Castle Co.

252 352 320 452 322 476 95 291 13 491 44 130 295

INT. 1 INT. 2 INT. 3 INT. 4 INT. 5 INT. 6 INT. 7 INT. 8 INT. 9 INT. 10

MACDADE BLVD
PROVIDENCE RD
EDGMONT AVE
INDUSTRIAL HWY
STEWART AVE
WANAMAKER AVE
CONCHESTER RD
MARKET ST
TOWNSHIP LINE RD
CHICHESTER AVE
RIDGE RD
POST RD
NAAMANS RD
HIGHLAND AVE
EAGLE ST
9TH ST
2ND ST
COMMODORE BARRY BRIDGE
SEPTA R1
SEPTA R2
Creek
Darby

N

0 0.25 0.5 Miles

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

I-95 DELAWARE CO RSOA - NB

Date Range: 1/1/2007 to 12/31/2009

Area of Interest: (In County 23 On State Route 0095(P) Between Segment 0002 Offset 0 and Segment 0110 Offset 1157)

USER_ID/QUERY ID: lbucci/ 0620100517011

MONTH OF YEAR

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
CRASHES	42	42	53	40	41	44	43	41	43	54	40	51	534
PCT	7%	7%	9%	7%	7%	8%	8%	7%	8%	10%	7%	9%	100%

DAY OF WEEK

	SUN	MON	TUE	WED	THR	FRI	SAT	
CRASHES	59	60	68	72	75	116	84	534
PCT	11%	11%	12%	13%	14%	21%	15%	100%

HOUR OF DAY

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
CRASHES	18	13	10	12	13	15	17	27	31	22	25	29	18	14	20	42	29	52	27	22	23	21	20	14	534
PCT	3%	2%	1%	2%	2%	2%	3%	5%	5%	4%	4%	5%	3%	2%	3%	7%	5%	9%	5%	4%	4%	3%	3%	2%	100%

YEAR

	CRASHES	PCT
2007	192	35%
2008	160	29%
2009	182	34%
TOTAL	534	100%

COLLISION TYPE

	CRASHES	PCT
REAR END	226	42%
HIT FIX OBJ	166	31%
SAME DIR SS	59	11%
ANGLE	54	10%
NON COLL	15	2%
UNKNOWN	8	1%
PEDESTRIAN	3	0%
HEAD ON	2	0%
OPP DIR SS	1	0%
TOTAL	534	100%

CRASH SEVERITY LEVEL

	CRASHES	PCT
FATAL	4	0%
MAJOR	6	1%
MODERATE	43	8%
MINOR	141	26%
UNK SEVERITY	53	9%
UNK IF INJURED	13	2%
PDO	274	51%
TOTAL	534	100%

SEVERITY COUNT

	PERSONS
FATALITIES	4
MAJOR	8
MODERATE	49
MINOR	234
UNK SEVERITY	75
UNK IF INJURED	52

DRIVER ACTIONS

	ACTIONS	PCT
NO CONTRIBUTING ACTION	516	43%
TOO FAST FOR CONDITION	197	16%
TAILGATING	137	11%
CARELESS PASS/LN CHNG	97	8%
OTHER IMPROPER DRIVING	56	4%
SUDDEN SLOWING/STOP	39	3%
DRIVER WAS DISTRACTED	35	2%
AFFECTED PHYSICAL COND	34	2%
UNKNOWN	23	1%
SPEEDING	19	1%
FAILR MAINT PROP SPEED	6	0%
ILLEGAL STOPPED ON RD	6	0%
OTHERS	32	2%
TOTAL	1197	100%

VEHICLE TYPE

	VEHICLES	PCT
AUTOMOBILE	675	65%
SUV	150	14%
SMALL TRUCK	76	7%
LARGE TRUCK	66	6%
VAN	47	4%
UNK VEHICLE	10	0%
MOTORCYCLE	9	0%
BUS	4	0%
OTHER VEHICLE	1	0%
TOTAL	1038	100%

ROAD CONDITION

	CRASHES	PCT
DRY	423	79%
WET	74	13%
SNOW	16	2%
WATER	8	1%
ICE	4	0%
ICE PATCH	4	0%
SLUSH	4	0%
OTHER	1	0%
TOTAL	534	100%

ILLUMINATION

	CRASHES	PCT
DAYLIGHT	319	59%
DARK	97	18%
STREET LIGHTS	92	17%
DUSK	14	2%
DAWN	6	1%
UNK LIGHTING	5	0%
OTHER	1	0%
TOTAL	534	100%

WEATHER

	CRASHES	PCT
CLEAR	438	82%
RAIN	64	11%
SNOW	20	3%
SLEET	7	1%
RAIN/FOG	3	0%
FOG	1	0%
UNK	1	0%
TOTAL	534	100%

ENVIR/ROADWAY FACTORS

	FACTORS	PCT
NONE	463	85%
OTHER WEATHER COND	24	4%
SLIPPERY ICE/SNOW	23	4%
OTHER RDWY FACTOR	7	1%
OBSTACLE ON RDWY	5	0%
DEER IN ROADWAY	4	0%
OTHER ENVIR FACTOR	4	0%
WORK ZONE RELATED	4	0%
SUBSTANCE ON RDWY	3	0%
ANIMAL IN RDWY	2	0%
WINDY CONDITIONS	2	0%
SUDDEN WEATHER COND	1	0%
OTHERS	1	0%
TOTAL	543	100%

CDART - CRASH SUMMARY REPORT (09-06)

NOTES:

1

The data available in this application is dynamic and should be used with care. Please take note of the following data alerts:

2 2010 crash records are incomplete

Data for the current year, 2010, is not fully represented in CDART. Crashes will be added for this year as they are made available to the Department. Include this year in queries with caution.

3 Complete data years

Complete records of reportable crashes are available in CDART for the following years: 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009

REPORT PARAMETERS:

Query ID:	0620100517011
User ID:	lbucci
Area of Interest:	(In County 23 On State Route 0095(P) Between Segment 0002 Offset 0 and Segment 0110 Offset 1157)
Date Range:	1/1/2007 to 12/31/2009
Criteria:	

I-95 DELAWARE CO RSOA - NB

Date Range: 1/1/2007 to 12/31/2009

USER ID / QUERY ID: lbucci/ 0620100517011

Area of Interest: (In County 23 On State Route 0095(P) Between Segment 0002 Offset 0 and Segment 0110 Offset 1157)

CRASH EVENTS (number of crashes)

	2007	2008	2009	TOTAL
HIT_FIXED_OBJECT	57	47	62	166
HIT_TREE_SHRUB	1	1	2	4
HIT_POLE	0	0	1	1
HIT_GDRAIL	31	24	35	90
HIT_GDRAIL_END	5	3	3	11
HIT_BRIDGE	5	3	1	9
HIT_EMBANKMENT	6	1	5	12
HIT_BARRIER	29	39	38	106
DEER_RELATED	1	0	3	4
REAR_END	81	73	72	226
HO_OPPDIR_SDSWP	1	1	1	3
SV_RUN_OFF_RD	69	53	69	191
OVERTURNED	16	6	12	34
VEHICLE_FAILURE	7	10	4	21
PHANTOM_VEHICLE	1	7	2	10
PSP_REPORTED	160	128	153	441

DRIVER / PERSON (number of crashes)

	2007	2008	2009	TOTAL
DRINKING_DRIVER	14	7	16	37
ALCOHOL_RELATED	14	7	16	37
UNBELTED	11	17	17	45
AGGRESSIVE_DRVG	145	119	124	388
SPEEDING	5	6	7	18
NHTSA_AGG_DRIVING	30	8	16	54
SPEEDING_RELATED	88	52	56	196
TAILGATING	44	34	43	121
CURVE_DVR_ERROR	0	1	2	3
DISTRACTED	10	9	17	36
FATIGUE_ASLEEP	4	3	5	12
NO_CLEARANCE	2	1	0	3
UNLICENSED	2	1	1	4
CELL_PHONE	3	1	0	4
RUNNING_RED_LT	0	0	0	0
RUNNING_STOP_SIGN	0	0	0	0
UNDERAGE_DRNK_DRV	1	0	0	1
DRIVER_16YR	1	0	2	3
DRIVER_17YR	5	2	2	9
DRIVER_65_74YR	12	8	14	34
DRIVER_75PLUS	2	2	1	5
PEDESTRIAN	1	1	2	4

Print Date: 5/17/2010

I-95 DELAWARE CO RSOA - NB

Date Range: 1/1/2007 to 12/31/2009

Area of Interest: (In County 23 On State Route 0095(P) Between Segment 0002 Offset 0 and Segment 0110 Offset 1157)

USER ID / QUERY ID: lbucci/ 0620100517011

ROAD / WEATHER (number of crashes)

	2007	2008	2009	TOTAL
NON_INTERSECTION	173	139	166	478
INTERSECTION	19	21	16	56
SIGNALIZED_INT	0	0	0	0
UNSIGNALIZED_INT	19	21	16	56
STOP_CONTR_INT	1	0	0	1
CROSS_MEDIAN	0	0	0	0
SHLDR_RELATED	0	0	0	0
WORK_ZONE	15	0	1	16
LIMIT_65MPH	0	0	0	0
WET_ROAD	27	26	21	74
ICY_ROAD	3	5	0	8
SNOW_SLUSH_ROAD	7	0	13	20
ILLUMINATION_DARK	67	56	71	194

VEHICLE (number of crashes)

	2007	2008	2009	TOTAL
HVY_TRK_RELATED	27	17	16	60
MOTORCYCLE	5	2	2	9
TRAIN_TROLLEY	0	0	0	0
BICYCLE	0	0	0	0
SCHOOL_BUS	0	2	2	4
COMM_VEHICLE	25	20	17	62

SEVERITY (number of crashes)

	2007	2008	2009	TOTAL
FATAL	2	0	2	4
FATAL_OR_MAJ_INJ	4	2	4	10
INJURY	86	78	80	244
PROPERTY_DAMAGE_ONLY	101	81	100	282

Print Date: 5/17/2010

CDART - CRASH FLAG SUMMARY REPORT (10-06)

Print Date: 5/17/2010

CDART - CRASH FLAG SUMMARY REPORT (10-06)

NOTES:

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3 Complete data years

Complete records of reportable crashes are available in CDART for the following years: 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009

REPORT PARAMETERS:

Query ID: 0620100517011
User ID: lbucci

Area of Interest: (In County 23 On State Route 0095(P) Between Segment 0002 Offset 0 and Segment 0110 Offset 1157)

Date Range: 1/1/2007 to 12/31/2009

Criteria:

I-95 DELAWARE CO RSOA - SB

Date Range: 1/1/2007 to 12/31/2009

Area of Interest: (In County 23 On State Route 0095(S) Between Segment 0003 Offset 0 and Segment 0111 Offset 471)

USER_ID/QUERY ID: lbucci/ 0620100517012

MONTH OF YEAR

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
CRASHES	31	55	49	39	42	52	44	47	53	41	49	40	542
PCT	5%	10%	9%	7%	7%	9%	8%	8%	9%	7%	9%	7%	100%

DAY OF WEEK

	SUN	MON	TUE	WED	THR	FRI	SAT	
CRASHES	89	66	55	78	75	92	87	542
PCT	16%	12%	10%	14%	13%	16%	16%	100%

HOUR OF DAY

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
CRASHES	20	27	21	17	17	13	25	31	24	23	17	17	18	14	20	30	40	49	29	22	18	17	10	23	542
PCT	3%	4%	3%	3%	3%	2%	4%	5%	4%	4%	3%	3%	3%	2%	3%	5%	7%	9%	5%	4%	3%	3%	1%	4%	100%

YEAR

	CRASHES	PCT
2007	211	38%
2008	162	29%
2009	169	31%
TOTAL	542	100%

COLLISION TYPE

	CRASHES	PCT
REAR END	211	38%
HIT FIX OBJ	195	35%
ANGLE	54	9%
SAME DIR SS	47	8%
NON COLL	23	4%
UNKNOWN	10	1%
HEAD ON	2	0%
TOTAL	542	100%

CRASH SEVERITY LEVEL

	CRASHES	PCT
FATAL	3	0%
MAJOR	13	2%
MODERATE	38	7%
MINOR	141	26%
UNK SEVERITY	47	8%
UNK IF INJURED	13	2%
PDO	287	52%
TOTAL	542	100%

SEVERITY COUNT

	PERSONS
FATALITIES	3
MAJOR	15
MODERATE	55
MINOR	207
UNK SEVERITY	87
UNK IF INJURED	76

DRIVER ACTIONS

	ACTIONS	PCT
NO CONTRIBUTING ACTION	527	43%
TOO FAST FOR CONDITION	159	13%
TAILGATING	100	8%
CARELESS PASS/LN CHNG	99	8%
OTHER IMPROPER DRIVING	73	6%
SUDDEN SLOWING/STOP	53	4%
UNKNOWN	46	3%
AFFECTED PHYSICAL COND	45	3%
DRIVER WAS DISTRACTED	25	2%
SPEEDING	22	1%
FAILR MAINT PROP SPEED	13	1%
OVER/UNDER COMP CURVE	13	1%
OTHERS	31	2%
TOTAL	1206	100%

VEHICLE TYPE

	VEHICLES	PCT
AUTOMOBILE	690	65%
SUV	155	14%
SMALL TRUCK	87	8%
LARGE TRUCK	55	5%
VAN	35	3%
UNK VEHICLE	19	1%
MOTORCYCLE	8	0%
BUS	1	0%
OTHER VEHICLE	1	0%
TOTAL	1051	100%

ROAD CONDITION

	CRASHES	PCT
DRY	408	75%
WET	91	16%
SLUSH	12	2%
SNOW	8	1%
WATER	7	1%
ICE	6	1%
ICE PATCH	6	1%
OTHER	4	0%
TOTAL	542	100%

ILLUMINATION

	CRASHES	PCT
DAYLIGHT	302	55%
DARK	114	21%
STREET LIGHTS	107	19%
DAWN	8	1%
UNK LIGHTING	6	1%
DUSK	5	0%
TOTAL	542	100%

WEATHER

	CRASHES	PCT
CLEAR	433	79%
RAIN	74	13%
SNOW	15	2%
OTHER	6	1%
SLEET	6	1%
RAIN/FOG	4	0%
UNK	2	0%
FOG	1	0%
SLEET/FOG	1	0%
TOTAL	542	100%

ENVIR/ROADWAY FACTORS

	FACTORS	PCT
NONE	440	78%
SLIPPERY ICE/SNOW	39	7%
OTHER WEATHER COND	31	5%
OBSTACLE ON RDWY	11	1%
OTHER RDWY FACTOR	9	1%
DEER IN ROADWAY	6	1%
UNKNOWN	5	0%
OTHER ENVIR FACTOR	4	0%
WORK ZONE RELATED	4	0%
SUDDEN WEATHER COND	3	0%
GLARE	2	0%
SUBSTANCE ON RDWY	2	0%
OTHERS	1	0%
TOTAL	557	100%

CDART - CRASH SUMMARY REPORT (09-06)

NOTES:

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3 Complete data years

Complete records of reportable crashes are available in CDART for the following years: 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009

REPORT PARAMETERS:

Query ID:	0620100517012
User ID:	lbucci
Area of Interest:	(In County 23 On State Route 0095(S) Between Segment 0003 Offset 0 and Segment 0111 Offset 471)
Date Range:	1/1/2007 to 12/31/2009
Criteria:	

I-95 DELAWARE CO RSOA - SB

Date Range: 1/1/2007 to 12/31/2009

USER ID / QUERY ID: lbucci/ 0620100517012

Area of Interest: (In County 23 On State Route 0095(S) Between Segment 0003 Offset 0 and Segment 0111 Offset 471)

CRASH EVENTS (number of crashes)

	2007	2008	2009	TOTAL
HIT_FIXED_OBJECT	73	52	70	195
HIT_TREE_SHRUB	0	1	1	2
HIT_POLE	0	0	0	0
HIT_GDRAIL	57	42	49	148
HIT_GDRAIL_END	9	3	4	16
HIT_BRIDGE	1	1	1	3
HIT_EMBANKMENT	6	5	2	13
HIT_BARRIER	36	29	28	93
DEER_RELATED	1	2	3	6
REAR_END	83	66	62	211
HO_OPPDIR_SDSWP	0	2	0	2
SV_RUN_OFF_RD	86	58	82	226
OVERTURNED	9	4	9	22
VEHICLE_FAILURE	10	9	10	29
PHANTOM_VEHICLE	7	6	4	17
PSP_REPORTED	166	123	118	407

DRIVER / PERSON (number of crashes)

	2007	2008	2009	TOTAL
DRINKING_DRIVER	20	20	16	56
ALCOHOL_RELATED	20	21	16	57
UNBELTED	22	20	15	57
AGGRESSIVE_DRVG	148	106	99	353
SPEEDING	12	5	5	22
NHTSA_AGG_DRIVING	25	11	10	46
SPEEDING_RELATED	74	48	49	171
TAILGATING	53	20	23	96
CURVE_DVR_ERROR	8	3	2	13
DISTRACTED	7	10	9	26
FATIGUE_ASLEEP	3	5	3	11
NO_CLEARANCE	0	0	0	0
UNLICENSED	1	1	2	4
CELL_PHONE	1	1	0	2
RUNNING_RED_LT	0	0	0	0
RUNNING_STOP_SIGN	0	0	0	0
UNDERAGE_DRNK_DRV	0	1	2	3
DRIVER_16YR	0	1	0	1
DRIVER_17YR	1	3	4	8
DRIVER_65_74YR	12	7	9	28
DRIVER_75PLUS	3	4	4	11
PEDESTRIAN	1	1	0	2

Print Date: 5/17/2010

I-95 DELAWARE CO RSOA - SB

Date Range: 1/1/2007 to 12/31/2009

Area of Interest: (In County 23 On State Route 0095(S) Between Segment 0003 Offset 0 and Segment 0111 Offset 471)

USER ID / QUERY ID: lbucci/ 0620100517012

ROAD / WEATHER (number of crashes)

	2007	2008	2009	TOTAL
NON_INTERSECTION	197	151	156	504
INTERSECTION	14	11	13	38
SIGNALIZED_INT	1	0	0	1
UNSIGNALIZED_INT	13	11	13	37
STOP_CONTR_INT	1	0	0	1
CROSS_MEDIAN	0	0	0	0
SHLDR_RELATED	0	0	0	0
WORK_ZONE	13	2	1	16
LIMIT_65MPH	0	0	1	1
WET_ROAD	29	23	39	91
ICY_ROAD	7	3	2	12
SNOW_SLUSH_ROAD	7	4	9	20
ILLUMINATION_DARK	88	69	70	227

VEHICLE (number of crashes)

	2007	2008	2009	TOTAL
HVY_TRK_RELATED	25	14	13	52
MOTORCYCLE	6	1	1	8
TRAIN_TROLLEY	0	0	0	0
BICYCLE	0	0	0	0
SCHOOL_BUS	1	0	0	1
COMM_VEHICLE	22	16	13	51

SEVERITY (number of crashes)

	2007	2008	2009	TOTAL
FATAL	2	0	1	3
FATAL_OR_MAJ_INJ	8	4	4	16
INJURY	99	75	67	241
PROPERTY_DAMAGE_ONLY	100	85	102	287

Print Date: 5/17/2010

CDART - CRASH FLAG SUMMARY REPORT (10-06)

Print Date: 5/17/2010

CDART - CRASH FLAG SUMMARY REPORT (10-06)

NOTES:

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REPORT PARAMETERS:

Query ID: 0620100517012
User ID: lbucci

Area of Interest: (In County 23 On State Route 0095(S) Between Segment 0003 Offset 0 and Segment 0111 Offset 471)

Date Range: 1/1/2007 to 12/31/2009

Criteria:

I-95 DELAWARE CO RSOA - ENTIRE CORRIDOR (Fatal & MI)

Date Range: 1/1/2007 to 12/31/2009

Area of Interest: (In County 23 On State Route 0095(P) Between Segment 0002 Offset 0 and Segment 0110 Offset 1157) or (In County 23 On State Route 0095(S) Between Segment 0003 Offset 0 and Segment 0111 Offset 471)

USER_ID/QUERY ID: lbucci/ 0620100517018

MONTH OF YEAR

	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	NOV	
CRASHES	2	3	3	3	2	6	3	3	1	26
PCT	7%	11%	11%	11%	7%	23%	11%	11%	3%	100%

DAY OF WEEK

	SUN	MON	TUE	WED	THR	FRI	SAT	
CRASHES	3	4	5	5	2	1	6	26
PCT	11%	15%	19%	19%	7%	3%	23%	100%

HOUR OF DAY

	00	01	03	04	05	06	08	10	12	15	16	17	18	19	20	
CRASHES	2	3	2	2	1	2	1	2	1	2	2	2	1	1	2	26
PCT	7%	11%	7%	7%	3%	7%	3%	7%	3%	7%	7%	7%	3%	3%	7%	100%

YEAR

	CRASHES	PCT
2007	12	46%
2008	6	23%
2009	8	30%
TOTAL	26	100%

COLLISION TYPE

	CRASHES	PCT
HIT FIX OBJ	11	42%
SAME DIR SS	4	15%
NON COLL	3	11%
REAR END	3	11%
UNKNOWN	2	7%
ANGLE	1	3%
HEAD ON	1	3%
PEDESTRIAN	1	3%
TOTAL	26	100%

CRASH SEVERITY LEVEL

	CRASHES	PCT
FATAL	7	26%
MAJOR	19	73%
TOTAL	26	100%

SEVERITY COUNT

	PERSONS
FATALITIES	7
MAJOR	23
MODERATE	4
MINOR	4
UNK SEVERITY	1
UNK IF INJURED	1

DRIVER ACTIONS

	ACTIONS	PCT
NO CONTRIBUTING ACTION	22	38%
AFFECTED PHYSICAL COND	8	14%
UNKNOWN	5	8%
CARELESS PASS/LN CHNG	4	7%
TOO FAST FOR CONDITION	4	7%
SPEEDING	3	5%
OTHER IMPROPER DRIVING	2	3%
OVER/UNDER COMP CURVE	2	3%
TAILGATING	2	3%
DRIVER INEXPERIENCED	1	1%
DRIVER WAS DISTRACTED	1	1%
FAILURE TO RESPOND TCD	1	1%
OTHERS	2	3%
TOTAL	57	100%

VEHICLE TYPE

	VEHICLES	PCT
AUTOMOBILE	21	51%
SUV	8	19%
LARGE TRUCK	7	17%
MOTORCYCLE	3	7%
SMALL TRUCK	2	4%
TOTAL	41	100%

ROAD CONDITION

	CRASHES	PCT
DRY	23	88%
WET	2	7%
OTHER	1	3%
TOTAL	26	100%

ILLUMINATION

	CRASHES	PCT
DAYLIGHT	13	50%
STREET LIGHTS	7	26%
DARK	6	23%
TOTAL	26	100%

WEATHER

	CRASHES	PCT
CLEAR	24	92%
RAIN	2	7%
TOTAL	26	100%

ENVIR/ROADWAY FACTORS

	FACTORS	PCT
NONE	23	79%
OBSTACLE ON RDWY	2	6%
OTHER RDWY FACTOR	2	6%
WORK ZONE RELATED	2	6%
TOTAL	29	100%

CDART - CRASH SUMMARY REPORT (09-06)

NOTES:

1

The data available in this application is dynamic and should be used with care. Please take note of the following data alerts:

2 2010 crash records are incomplete
Data for the current year, 2010, is not fully represented in CDART. Crashes will be added for this year as they are made available to the Department. Include this year in queries with caution.

3 Complete data years
Complete records of reportable crashes are available in CDART for the following years: 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009

REPORT PARAMETERS:

Query ID:	0620100517018
User ID:	lbucci
Area of Interest:	(In County 23 On State Route 0095(P) Between Segment 0002 Offset 0 and Segment 0110 Offset 1157) or (In County 23 On State Route 0095(S) Between Segment 0003 Offset 0 and Segment 0111 Offset 471)
Date Range:	1/1/2007 to 12/31/2009
Criteria:	FATAL OR MAJOR INJURY

APPENDIX D

Presentation

DVRPC – Delaware Valley Regional Planning Commission

- Metropolitan Planning Organization of the Delaware Valley serving 9 counties:
  - Bucks, Chester Delaware, Montgomery, Philadelphia
  - Burlington, Camden, Gloucester, Mercer
- Transportation Improvement Program (TIP)
  - DVRPC facilitates regional body to oversee allocation of federal transportation funds

The Aim of an RSOA is to Answer the Following Questions…

- What elements of the road may present safety and operations concerns
  - To what extent?
  - To which road users?
  - Under what circumstances?
- What opportunities exist to eliminate or mitigate identified safety and operations concerns?

I-95 Delaware County RSOA Corridor Selection

- Why I-95 in Delaware County?
  - Corridor identified on the District 6-0 high crash location list
  - Seven fatal crashes – seven people killed
  - 4 segments from 2008 Dist 6-0 high crash list
  - Transportation operations elements
- Collaboration between:
  - PennDOT District 6-0
  - FHWA
  - DVRPC Office of Safety and Congestion Management
  - DVRPC Office of Transportation Operations Management

DVRPC: RSA + Operations = RSOA

- Conducted US 202, Section 200 Transportation Operations Audit - December 2009
- Completed Transportation Systems Management and Operations Study for I-95, Delaware County in 2008
- Developed the Delaware County Incident Management Task Force in 2008
- Created a unique opportunity for operations to be incorporated into the RSA process for this corridor

RSOA Schedule

- Pre-Audit Meeting – 8:30 AM
  - What are Road Safety Audits (RSA) – video
  - Analyze and discuss crash data and other safety issues
- Field Visit
  - Windshield survey of the corridor to identify safety issues and examine conditions
- Post-Audit Meeting – Friday June 4, 2010
  - Define problems
  - Brainstorm improvement ideas
  - Wrap up by 12 Noon

What is a Road Safety Audit?

➔ Federal Highway Administration Road Safety Audit Video

History of RSAs

➔ First used in the United Kingdom in 1980s

➔ Australia and New Zealand have used RSAs since the 1990s

➔ Formal practice in the United States began in 1997 when the Federal Highway Administration sponsored a pilot program in 13 states

RSOA Benefits

- Adaptable to local needs and conditions
- Short term
- Recommendations can be implemented in small stages as time and resources permit
- Can be performed during any stage of a project
- Collaborative efforts from a team with members of varying backgrounds and expertise

Audit Team

- FHWA Harrisburg, Pennsylvania, Philadelphia, Maryland Resource Center, Headquarters-DC
- PennDOT District 6-0 Traffic – Safety
- PennDOT District 6-0 Traffic – Freeway Management
- PennDOT District 6-0 Maintenance, Delaware County
- Delaware County Planning Commission
- Ridley Park Fire Company #1
- Chester Township Police Department
- I-95 Emergency Service Patrol
- Pennsylvania State Police
- Delaware County TMA
- DVRPC

PennDOT 2008 High Crash Locations

Bureau of Highway Safety and Traffic Engineering (BHSTE)

- Identified locations with most severe highway safety needs
- List comprises top 377 crash locations statewide, 209 in Dist 6-0
- Criteria
  - At least 5 fatal or major injury crashes over 5 years (2003-2007)
  - 5000ft segment or 500ft radius intersection

Goal for District 6-0 is to address as many of the 209 locations as possible by 2011, based on priority ranking

- One of the priority areas is the section of I-95 in Delaware County

2008 High Crash Locations on I-95: Delaware County

State Rank	County	Route	Total Fatal + Major Injury Crashes	Fatal Count
71	Delaware	I-95	20	7
94	Philadelphia	I-95	15	5
98	Bucks	I-95	16	5
118	Delaware	I-95	12	4
192	Philadelphia	I-95	7	4
210	Delaware	I-95	6	4
213	Delaware	I-95	6	4
262	Philadelphia	I-95	7	2
367	Bucks	I-95	5	1

District 6-0: 2008 High Crash Locations, I-95 Delaware County

Transportation Operations Elements

Chris King

Office of Transportation Operations Management

Transportation Operations Elements: Delaware County I-95 Transportation Systems Management and Operations (TSM&O) Study

- TSM&O Purpose
  - Optimize the Performance of Existing and Programmed Infrastructure by:
    - Implementing Multimodal, Intermodal, and often Cross-jurisdictional Systems, Services, and Projects
    - Preserving Capacity
    - Improving Security, Safety, Reliability
    - Collaborating and Coordinating Operations
- Typical TSM&O Activities
  - Traffic Signal & Arterial Management, Traffic Detection and Surveillance, Traffic Incident Management, Transit Management Systems, Traveler Information, Work Zone Management, Maintenance and Construction Coordination

Transportation Operations Elements: Delaware County I-95 TSM&O Study

- Major Issues
  - Lack of Coordination
    - Local Municipalities
    - SEPTA
    - Tow Companies
    - Larger Employers (Boeing, Airport, Crozer-Chester Hospital)
    - DelDOT, Delaware State Police
  - Identifying Location of Incidents
  - Lack of Detour Routes
  - Lack of ITS equipment

Transportation Operations Elements: Delaware County I-95 TSM&O Study

- Study Results
  - Published report with a matrix highlighting goals and improvement strategies
  - Established Incident Management Task Force (IMTF)
    - Developing Detour Route Protocol Document
  - Established official PennDOT detour routes
    - Included in IDRuM
  - Implementing ITS
    - PennDOT CCTV cameras feeds to Delaware County 911

Transportation Operations Elements: DVRPC Transportation Operations Master Plan

- Overview – Developed July 2009
  - Operations Goals & Objectives
  - Transportation Operations Vision
  - Projects & Programs
  - Financial Plan
- Transportation Operations Vision
  - ITS Infrastructure – *I-95 identified for primary coverage*
  - Emergency Service Patrols – *I-95 identified for full coverage*
  - Incident Management Task Forces – *Continue Delaware Co. IMTF*
  - Integrated Corridor Management Plan – *I-95 is potential corridor*
  - Regional Communications Network

Study Area

Operational Characteristics

- Functional classification
  - Urban Interstate
- Speed limit
  - 55 mph
- Interchanges
  - 10 interchanges
- Interchanges
  - Full clover leaf to partial interchanges

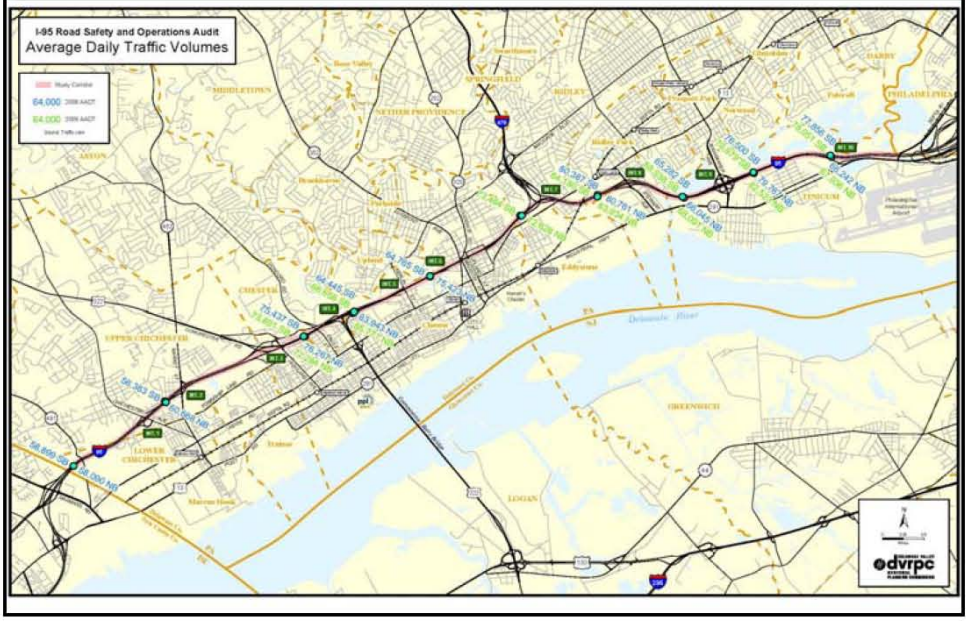
Operational Characteristics

- Cross Section Geometry
  - Airport to I-476: 4 lanes per direction with on and off ramps
  - I-476 Interchange: 2 lanes
  - I-476 to Delaware State Line: 3 lanes per direction with on and off ramps
- Cable and guide rail barriers
- Horizontal and vertical curves
- Intermittent shoulders

Land Use

- Generally Heavy / Light Manufacturing and Commercial
  - Philadelphia International Airport
  - Boeing
  - Sunoco Oil Refinery
- Residential
  - Neighborhoods front corridor in Chester
- Other Features/Trip Generators
  - Widner University
  - Harrah's Casino and Racetrack
  - PPL Park – Philadelphia Union Soccer Team
  - John Heinz National Wildlife Refuge

Average Annual Daily Traffic



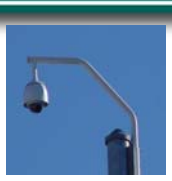
ITS Infrastructure

American Recovery and Reinvestment Act (ARRA) Project

- I-95 Section ITC
  - ITS from the Delaware State Line to Broad St
- Project includes
  - Fiber optic communication systems
  - I-95: CCTV Cameras, DMS, Vehicle Detectors, and Tag Readers
  - I-476: DMS & Tag Readers
  - Delaware County Emergency Operation Center Video Sharing
    - Video Display in 911 Dispatch Center, Video Wall in EOC
- Project Schedule
  - Operational Spring 2011

Base ITS Infrastructure

- Closed Circuit TV (CCTV) Cameras
- Dynamic Message Signs (DMS)
- Incident / Travel Time Detectors



Traffic Management Systems

- PennDOT District 6 – Regional Traffic Management Center

Incident Management

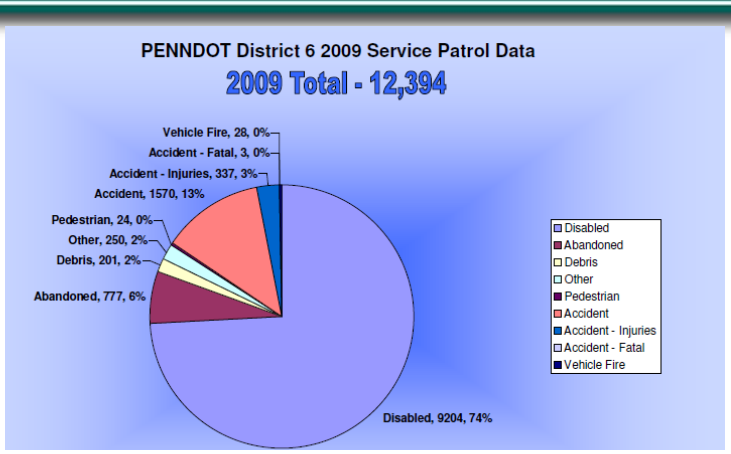
- PA State Police patrols I-95
  - Excluding Tinicum & Chester Township where local police patrols
- Delaware County Emergency Management Agency
- Local Fire Departments (12 Fire Companies)
- Local Police Departments
  - Traffic Safety
- Local EMS Departments
- PennDOT TMC
- Local Towing Companies

PennDOT Emergency Service Patrol (ESP)

- 95-1 Covers from Delaware State line to Exit 9-Essington
  - 1 Truck equipped with tow dollies
    - Operates Monday to Friday
    - 5:30 AM to 09:30 AM
    - 3:30 PM to 7:30 PM

- 95-2 Covers from Exit 9 to Girard Ave.
  - 1 Truck with no tow dollies
    - Operates M-F, 5:00 AM to 12:30 PM
  - 1 Truck equipped with tow dollies
    - Operates M-F, 12:30 PM to 2:00 PM

PennDOT ESP Incident Data



- 2009 Entire Program Data

pennsylvania
DEPARTMENT OF TRANSPORTATION

Delaware County Incident Management Task Force

- Established April 2008
  - Quarterly Meetings
- Focus on I-95 & I-476
- Purpose
  - Improve Coordinated IM Response
  - Foster Interaction Among IM Stakeholders
  - Identify and Address Critical IM Needs
  - Give Other Organizational Perspectives
- Current Activities
  - Emergency Detour Route Guidelines
  - Post Incident Reviews

PennDOT Official Detour Routes

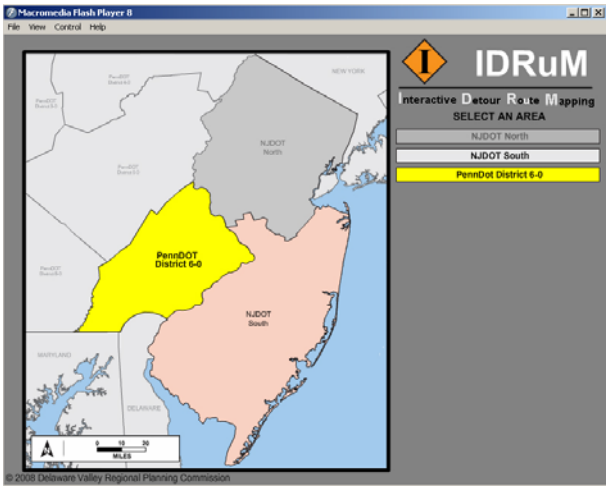
- 12 Detour Routes for I-95 in Delaware County
  - Generally interchange to interchange
  - 4 routes utilize PA 291 to bypass entire corridor
  - Includes primary & secondary routes
  - Potential control points
- IMTF is developing Detour Route Protocol Document

IDRuM
Interactive Detour Route Mapping

DVRPC effort to create an Internet application for accessing PennDOT & NJDOT detour routes

- **Simple, easy to use, "point-and-click" application**
  - **4-clicks to map!**
- **Centralized location for all Official DOT detours for PA & NJ**

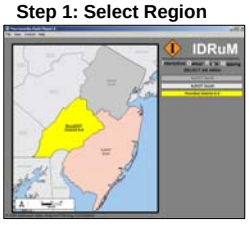
idrum.us



IDRuM
Interactive Detour Route Mapping

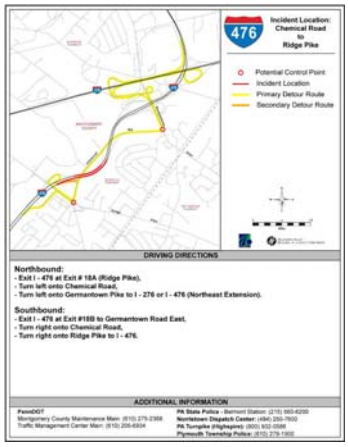
Accessing detour routes for Pennsylvania

Step 1: Select Region



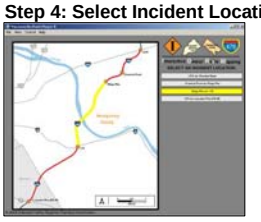
Step 2: Select County

Step 5: View/Download/Print/Email Map



Step 3: Select Highway

Step 4: Select Incident Location



Traveler Information Systems

511 Travel Information

➔ www.511PA.com

Private Information Service Providers

➔ Navteq: www.traffic.com

➔ SmarTraveler: www.smartraveler.com

I-95 Background from CMP

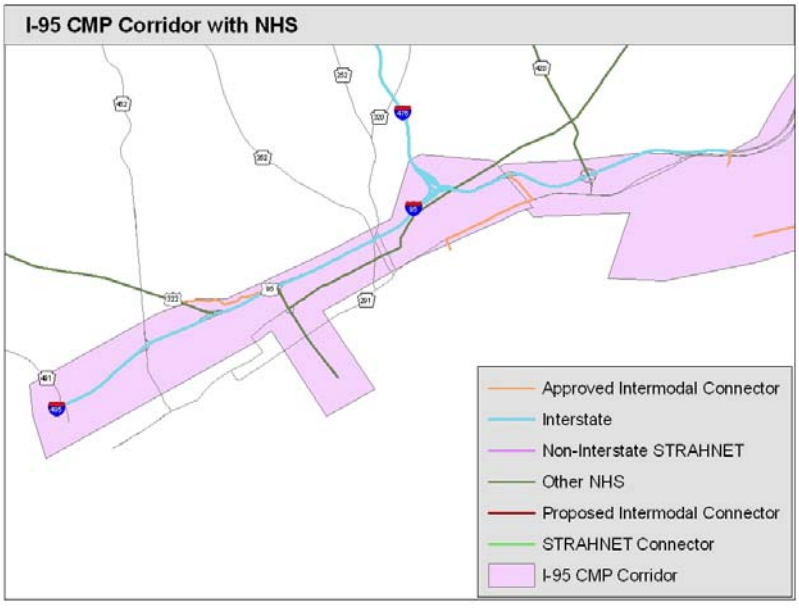
CMP CONGESTION MANAGEMENT PROCESS

Zoe Neaderland
Office of Safety and Congestion Management

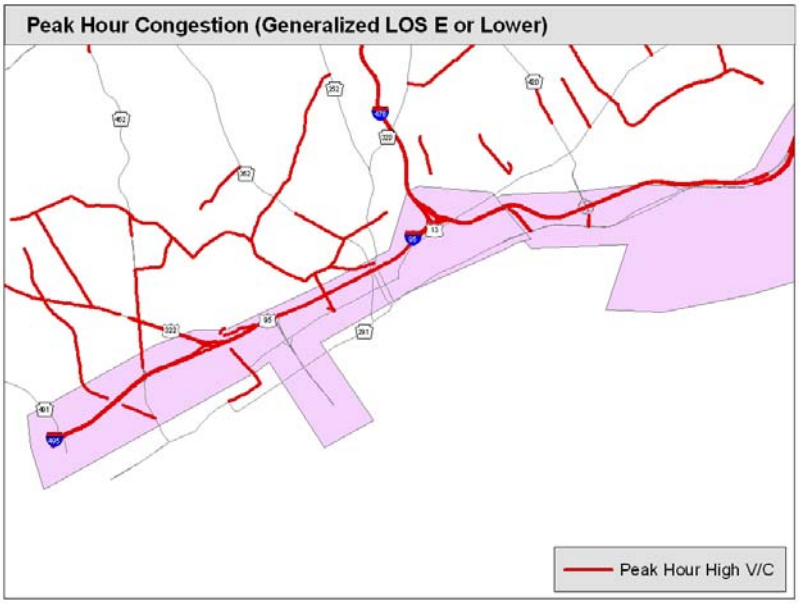
What is the CMP?

- The Congestion Management Process is a systematic way to analyze the multimodal regional transportation network and manage congestion
- It identifies congested corridors, subdivides them into subcorridors, and recommends strategies

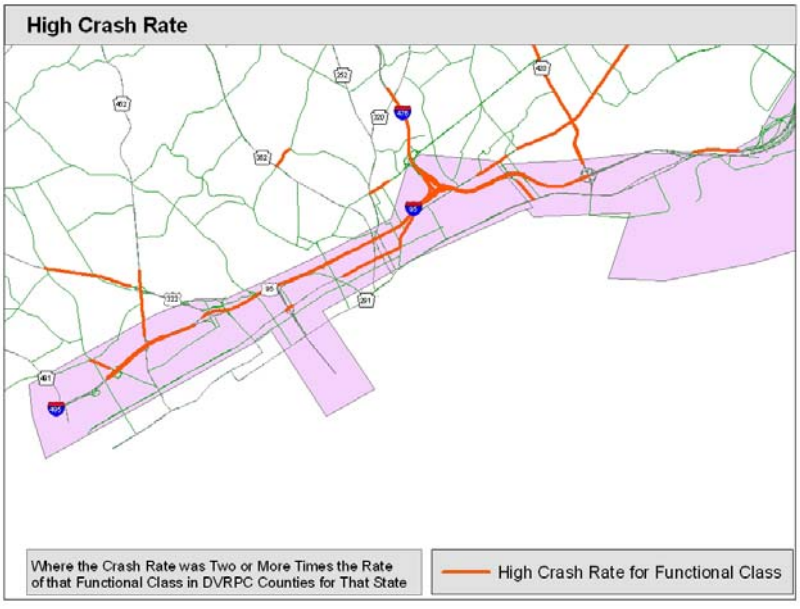
I-95 RSOA: CMP



I-95 RSOA: CMP

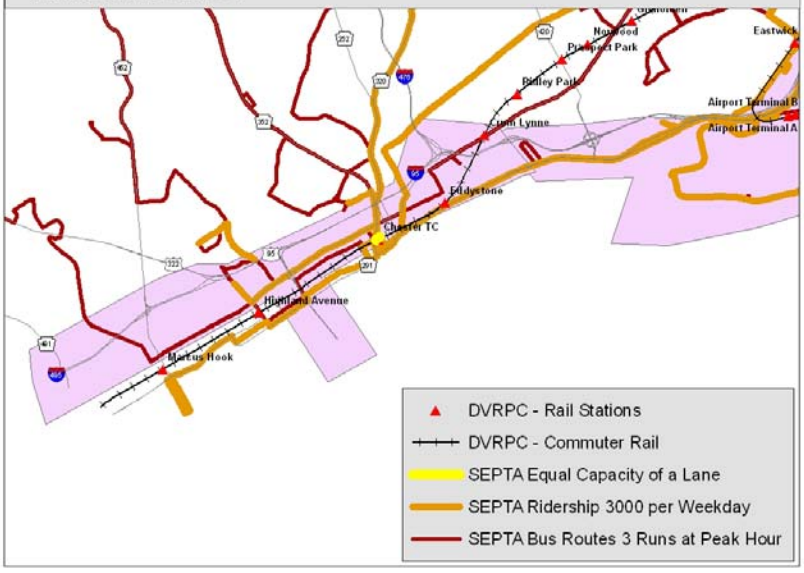


I-95 RSOA: CMP



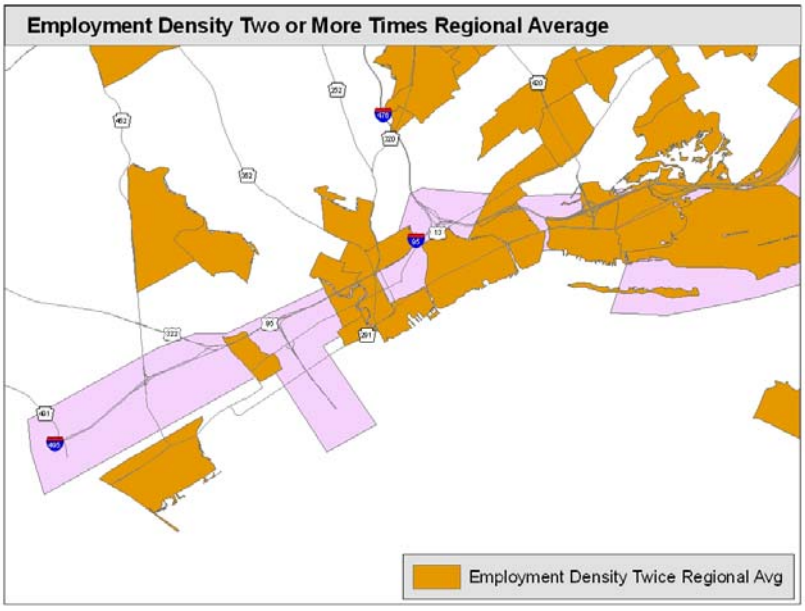
I-95 RSOA: CMP

Transit in the Corridor

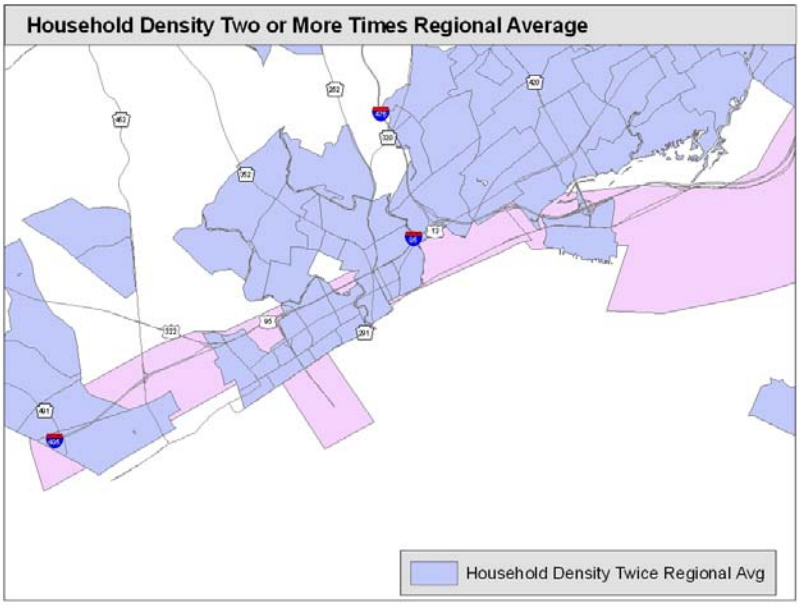


I-95 RSOA: CMP

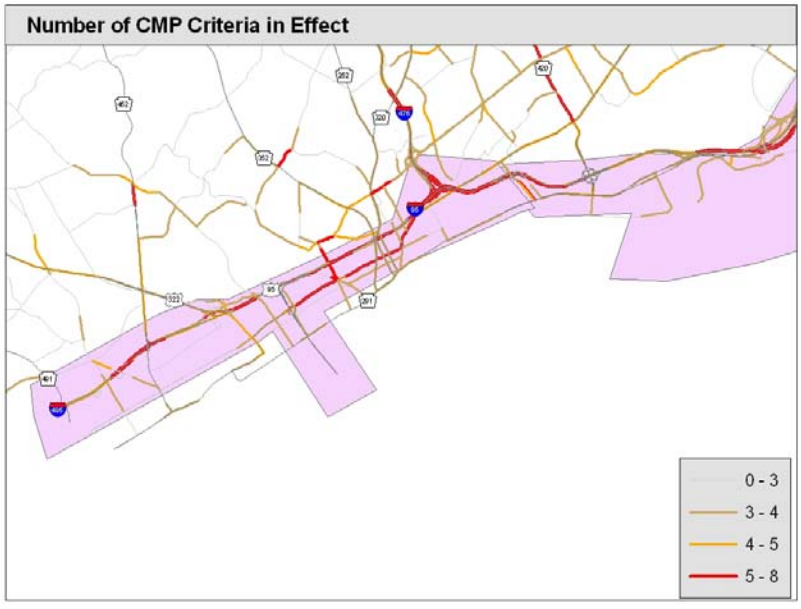
Employment Density Two or More Times Regional Average



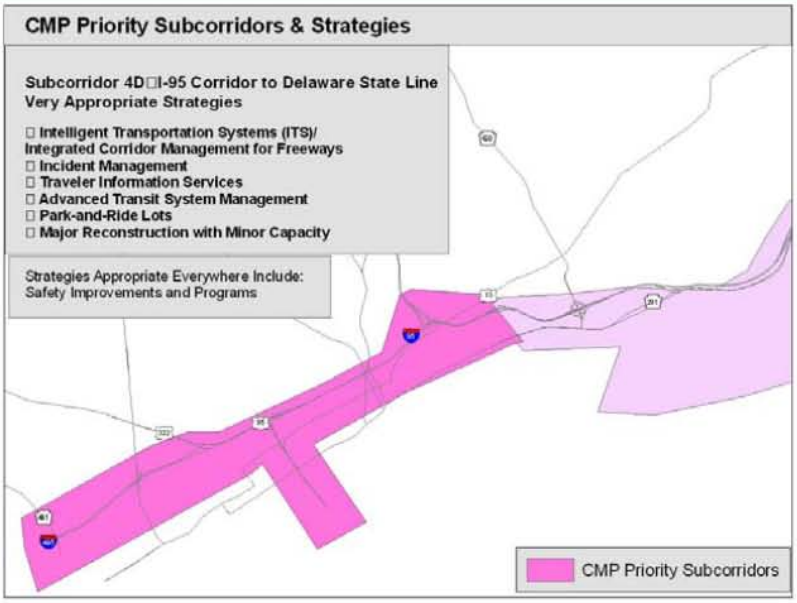
I-95 RSOA: CMP



I-95 RSOA: CMP



I-95 RSOA: CMP



Crash Analysis

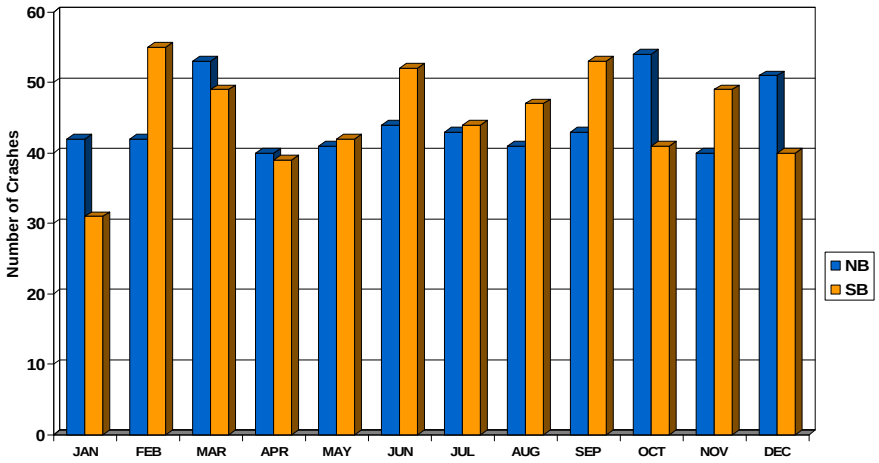
Corridor-wide Crash Findings: Crash Data

- Utilized PennDOT Crash Database
- Three years of data: 2007 - 2009
- 1075 reportable crashes (percentages rounded)
  - 2007 403 37%
  - 2008 322 29%
  - 2009 350 32%
- Northbound: 534 crashes (49.6%)
- Southbound: 542 crashes (50.4%)

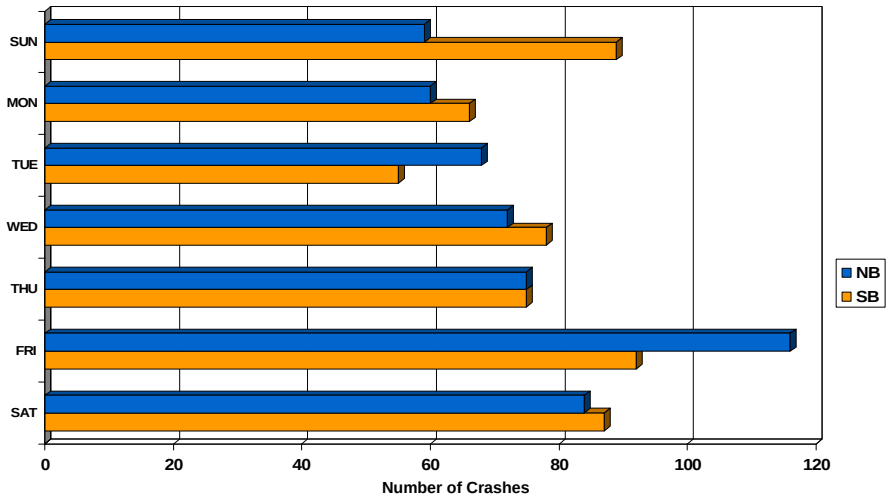
Corridor-wide Crash Findings: Collision Type

	Northbound Total Crashes	Southbound Total Crashes	Percentage
Rear end	226	211	40%
Hit fixed object	166	195	33%
Angle	54	54	10%
Same direction sideswipe	59	47	9%
Non collision	15	23	3%
Unknown	8	10	1%
Head-on	2	2	<1%
Pedestrian	3	0	<1%
Opposite direction sideswipe	1	0	<1%

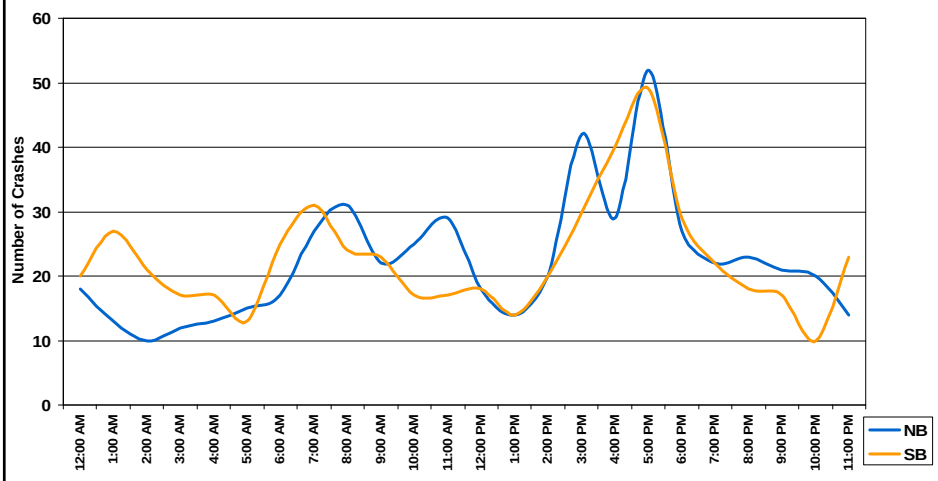
Corridor-wide Crash Findings: Month of Year



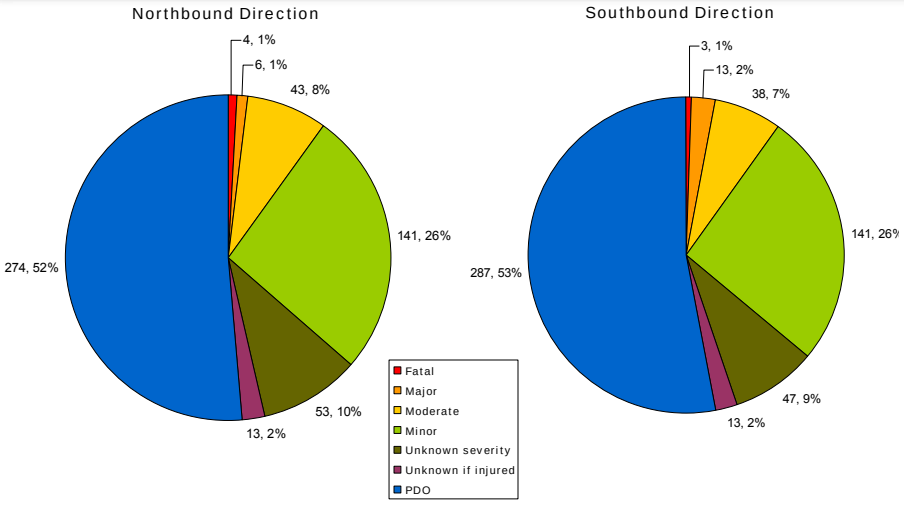
Corridor-wide Crash Findings: Day of Week



Corridor-wide Crash Findings: Time of Day



Corridor-wide Crash Findings: Crash Severity Level



Corridor-wide Crash Findings: Road Surface, Weather, Illumination

- Road Surface Conditions

	NB	SB
Dry:	423 (79%)	408 (75%)
Wet:	74 (13%)	91 (16%)

- Weather

Clear:	438 (82%)	433 (79%)
Rain:	64 (11%)	74 (13%)

- Illumination

Daylight:	319 (59%)	302 (55%)
Dark:	97 (18%)	114 (21%)
Street Lts:	92 (17%)	107 (19%)

Corridor-wide Crash Findings: Predominant Driver Actions

- Predominant Driver Actions

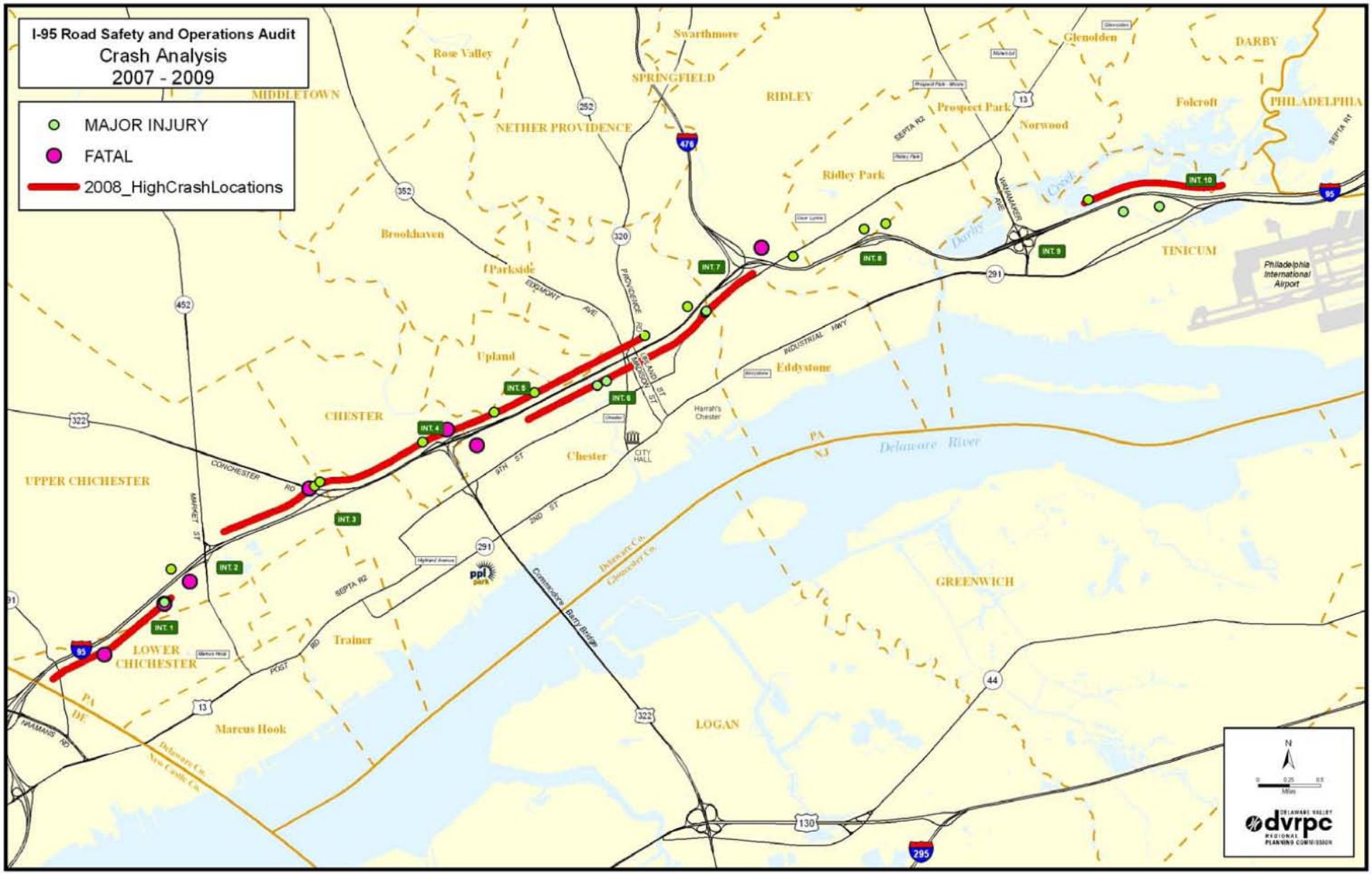
	NB	SB
No contributing action:	516 (43%)	527 (43%)
Too fast for conditions:	197 (16%)	159 (13%)
Tailgating:	137 (11%)	100 (8%)
Careless passing/lane change:	97 (8%)	99 (8%)
Other improper driving:	56 (4%)	73 (6%)

Corridor-wide Crash Findings: CDART-Crash Flag Summary Report

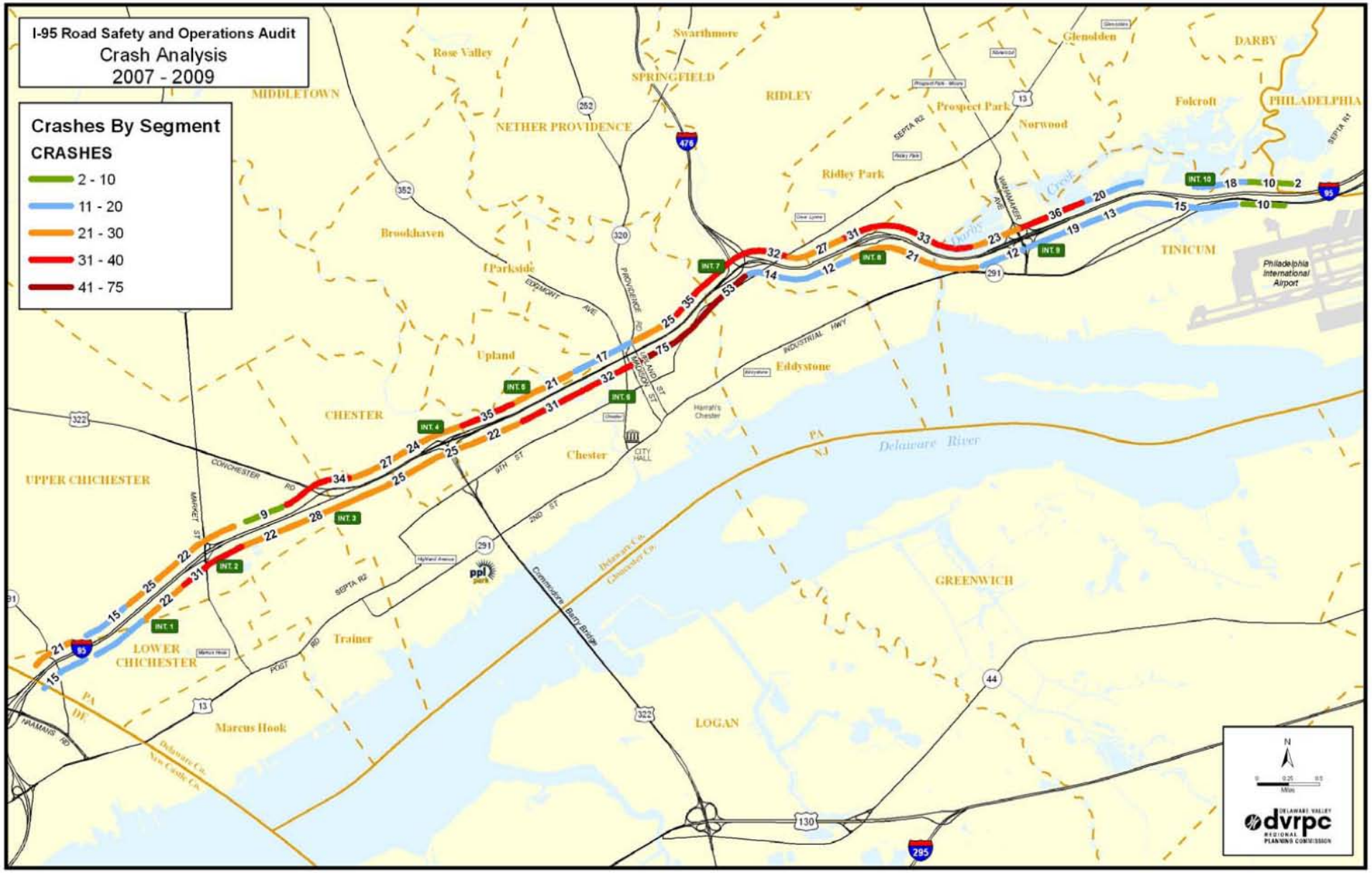
➔ Crash Flag Summary Report, Number of Crashes

	NB	SB
➔ Hit guide rail:	90	148
➔ Hit guide rail end:	11	16
➔ Hit embankment:	12	13
➔ Unbelted:	45	57
➔ Fatigue/Asleep:	12	11
➔ Driver 75+ years:	5	11
➔ Driver 65-74 years:	34	28
➔ Driver 16-17 years:	12	9
➔ Work Zone	16	16
➔ Heavy truck related	60	52

Crash Analysis:
08 High Crash Locations with 07-09 MI & Fatals



Crash Findings: Segment Analysis



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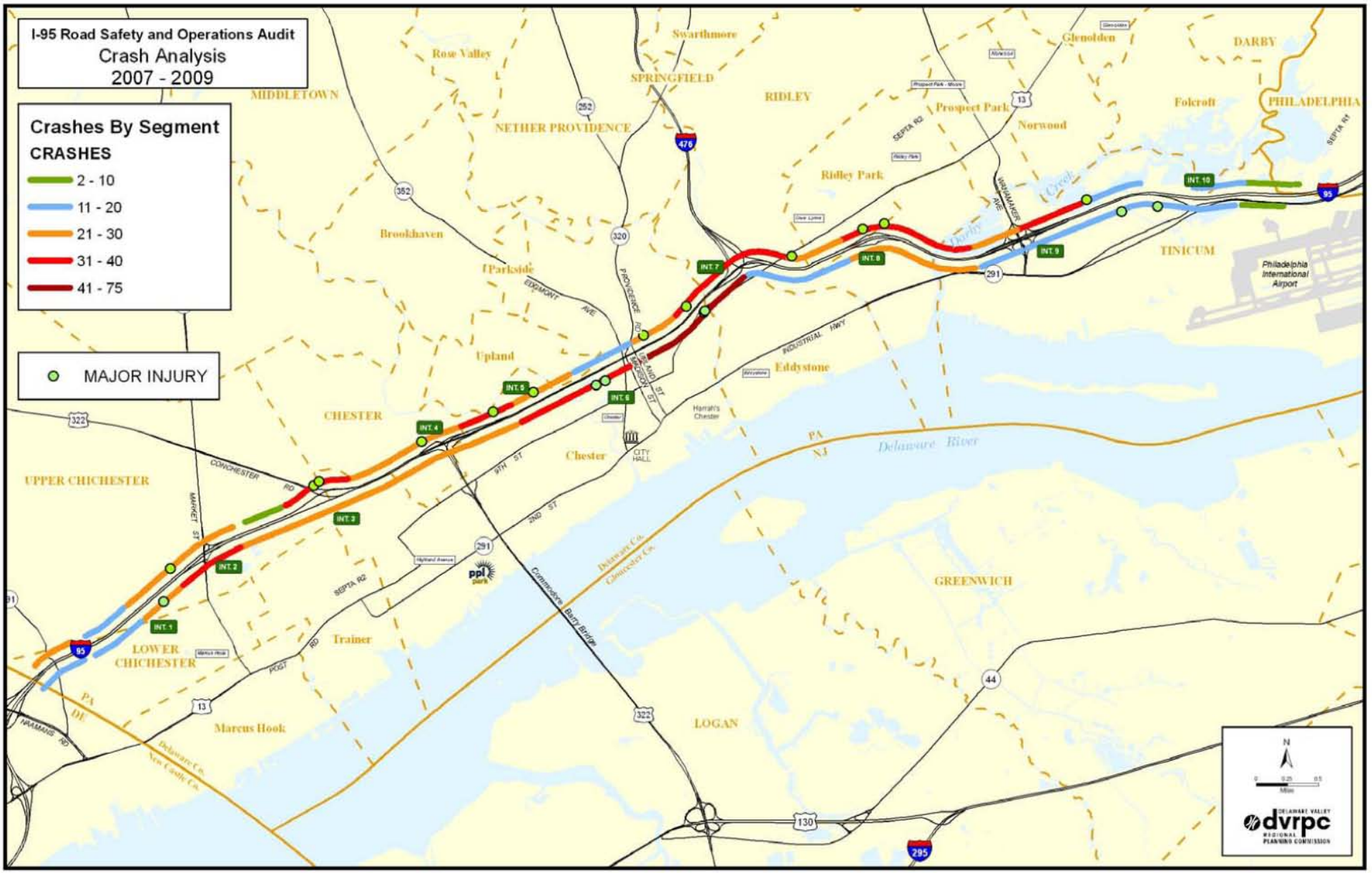

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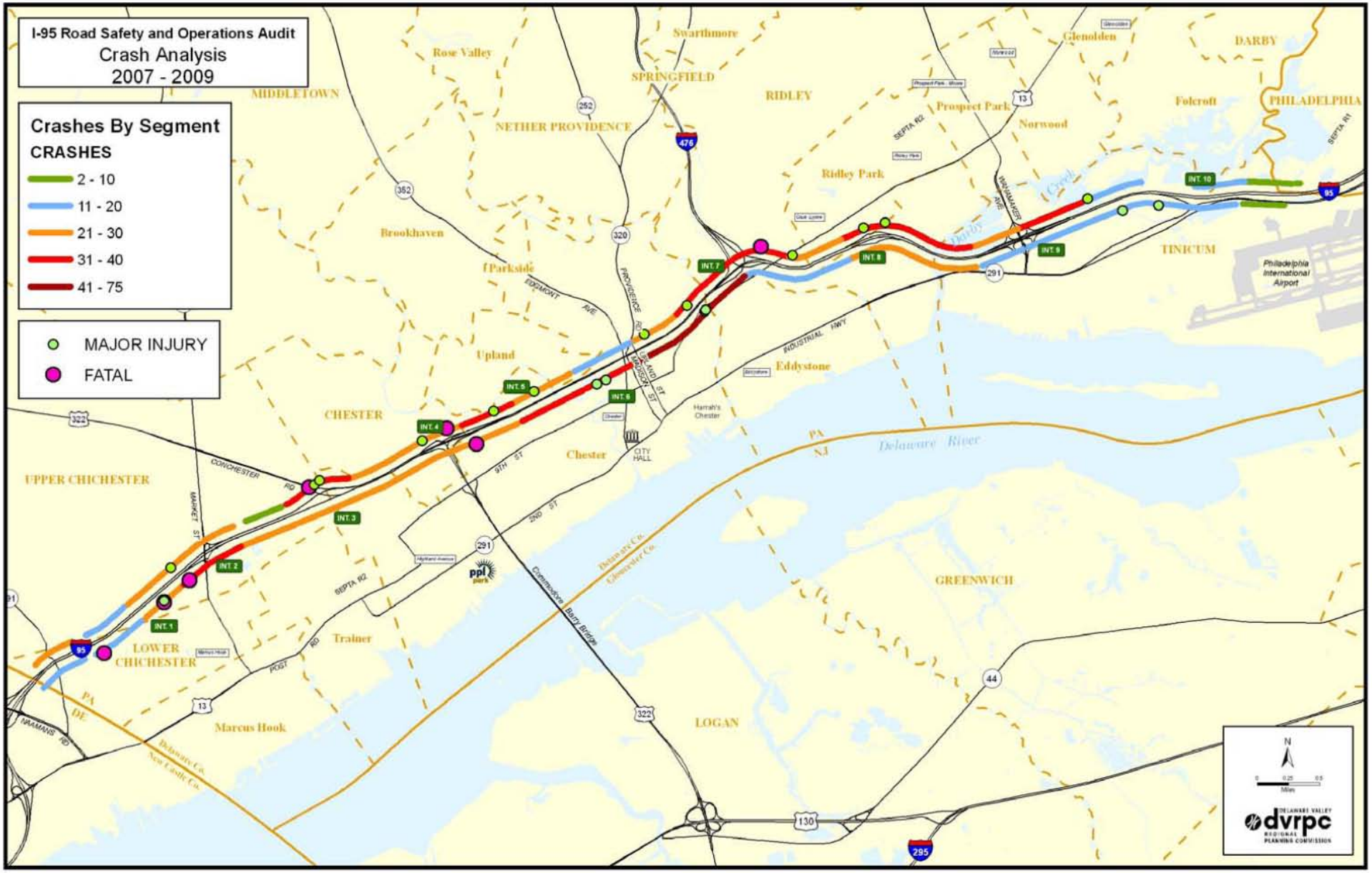
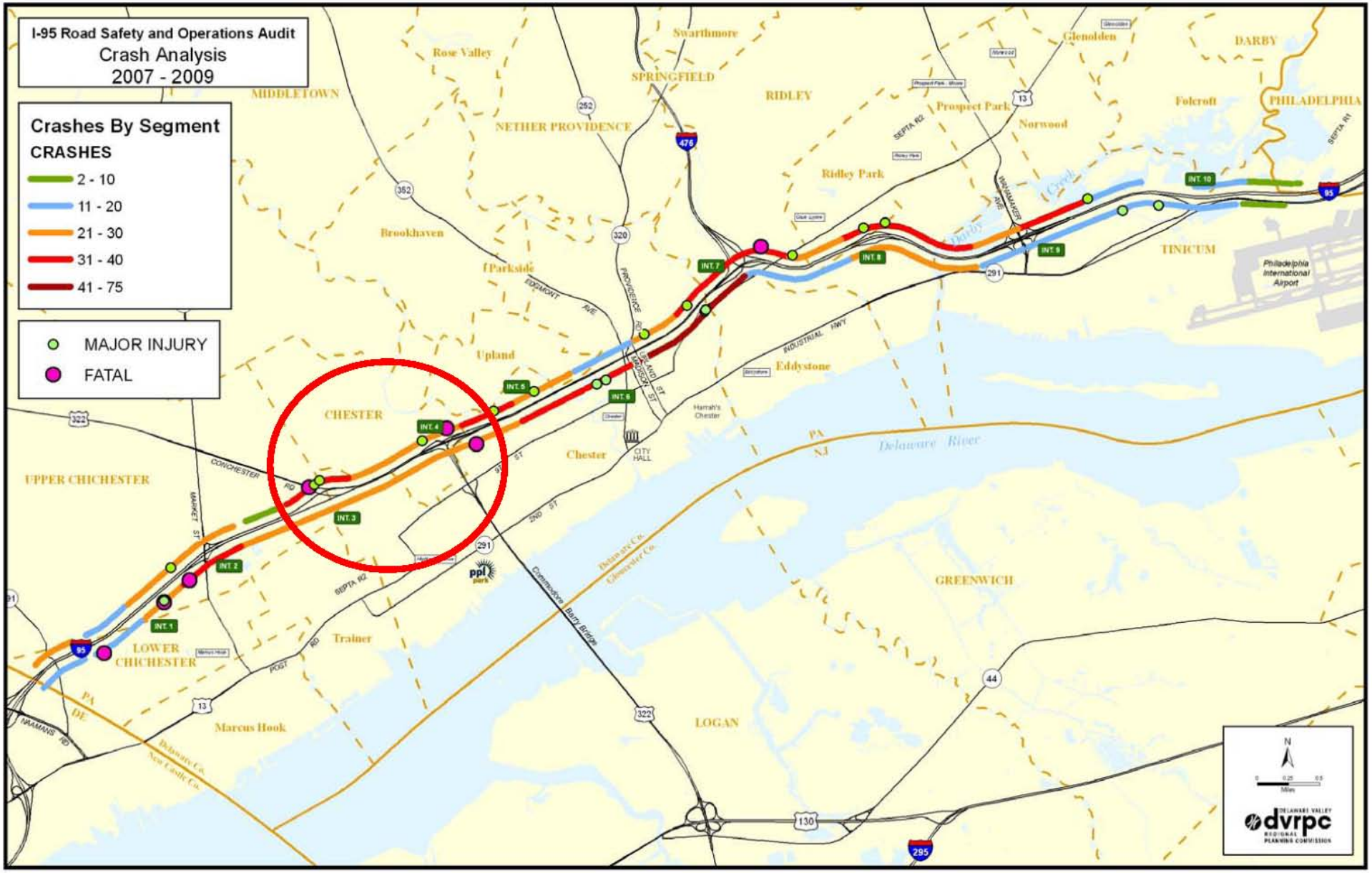
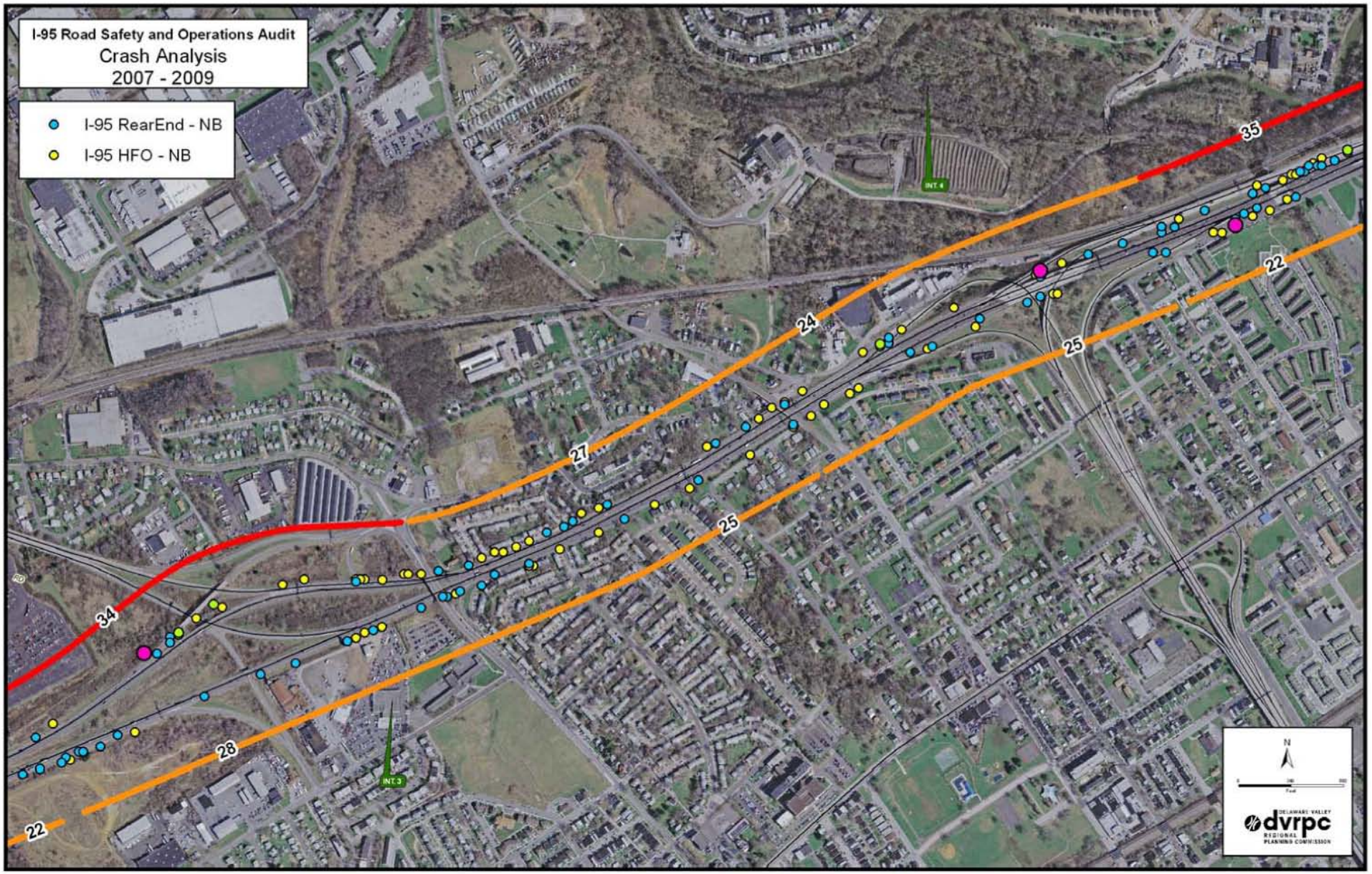


Crash Findings: Segment Analysis

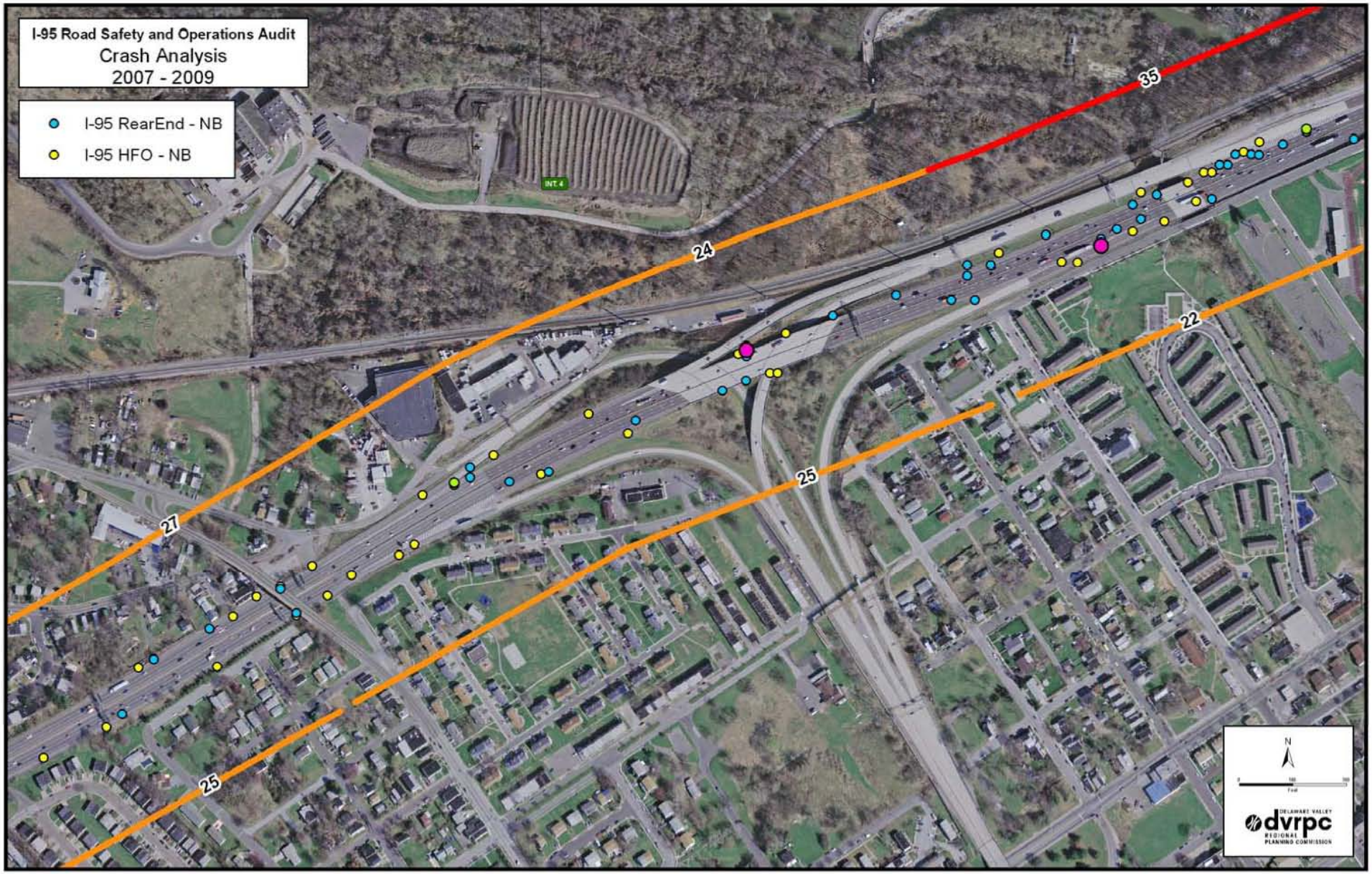


Crash Analysis



Crash Analysis

Crash Analysis



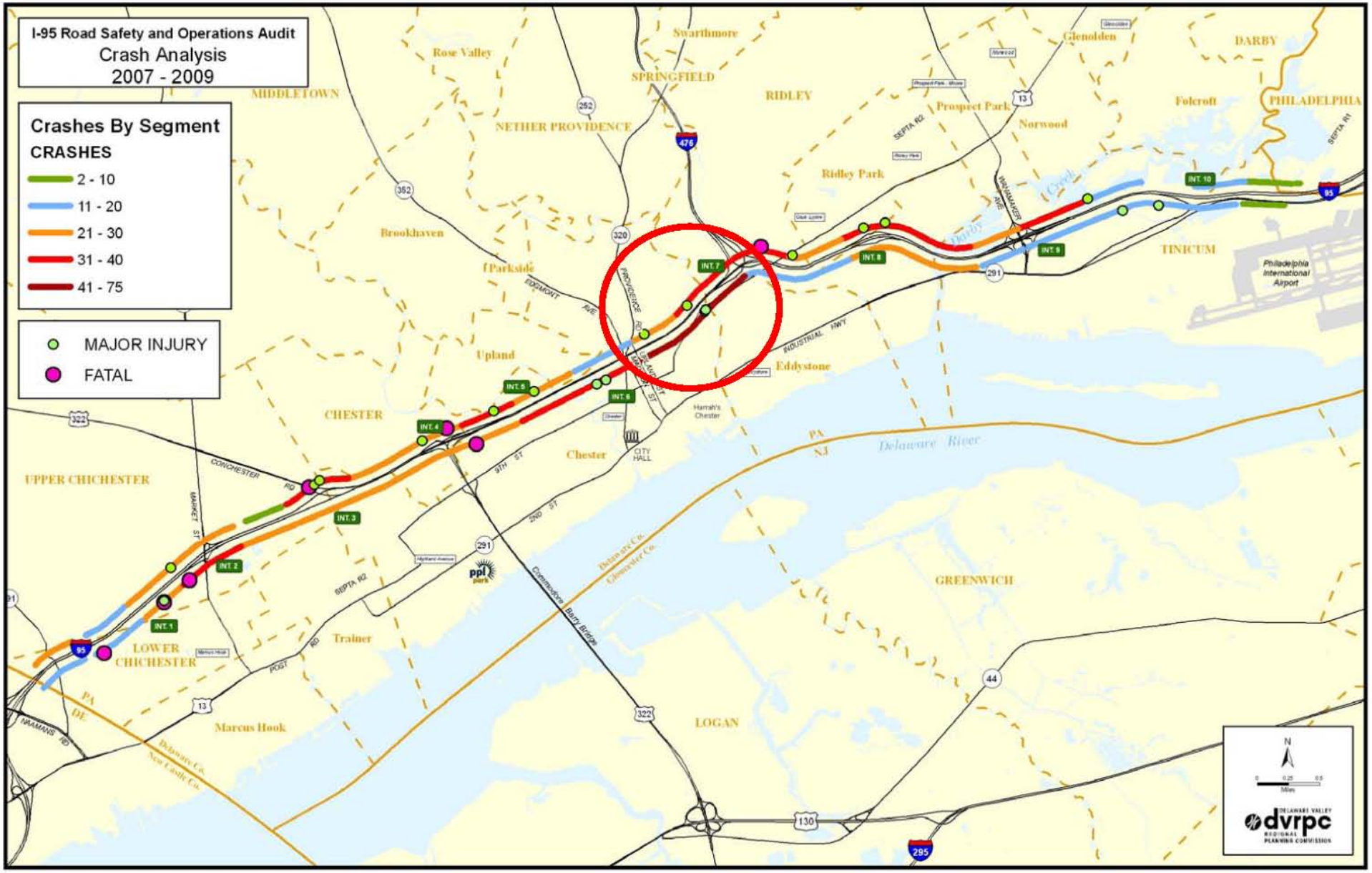
Crash Findings: Segment Analysis

I-95 NB/SB at the US322/Commodore Barry Bridge Interchanges

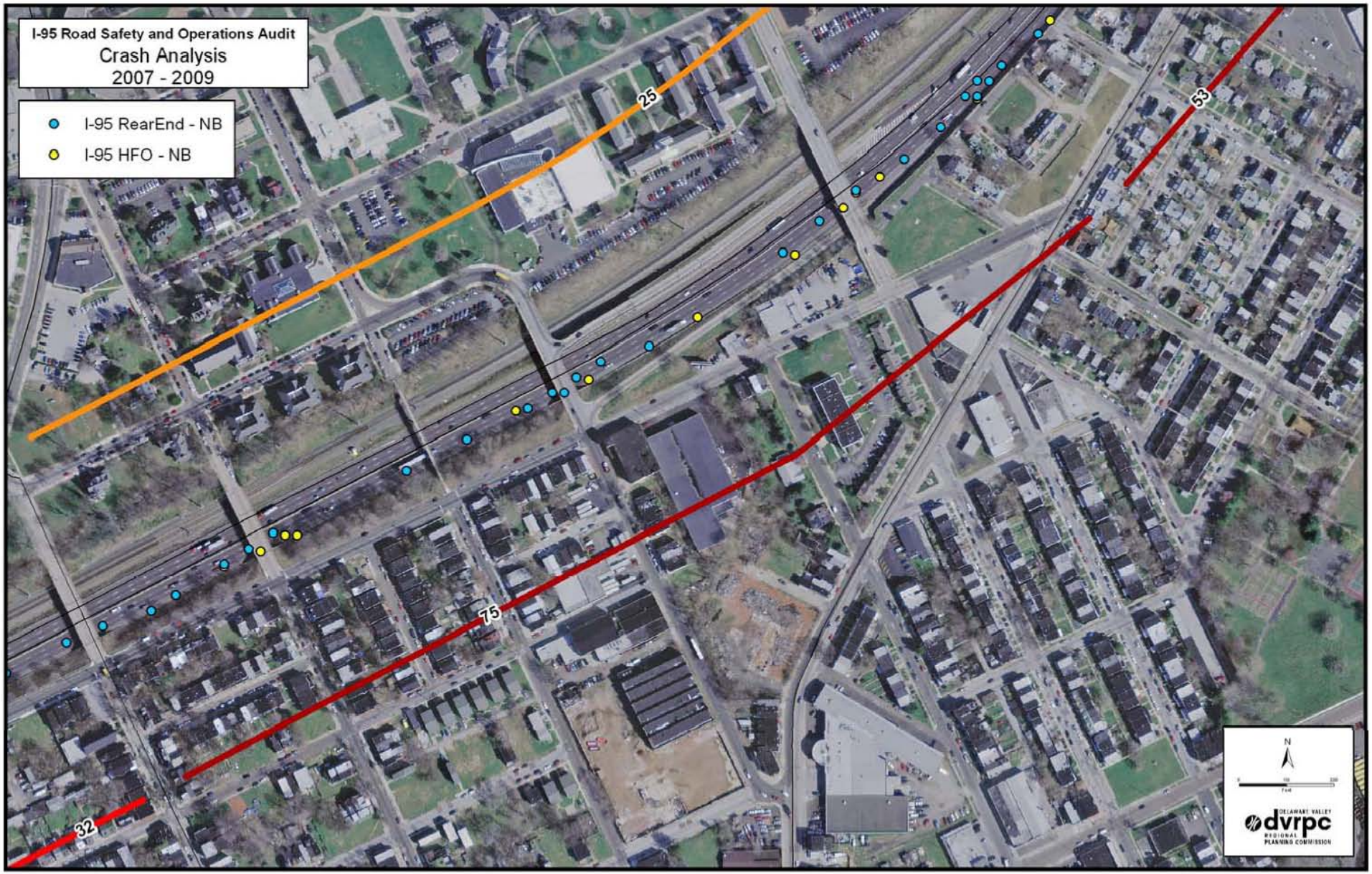
- Aprx. 1.7 miles long
- Involves 2 interchanges
- Combined NB & SB total: 195 crashes

	NB	SB
HFO	29	48
Rear end	34	35
Fatal	1	2
Major injury	0	4

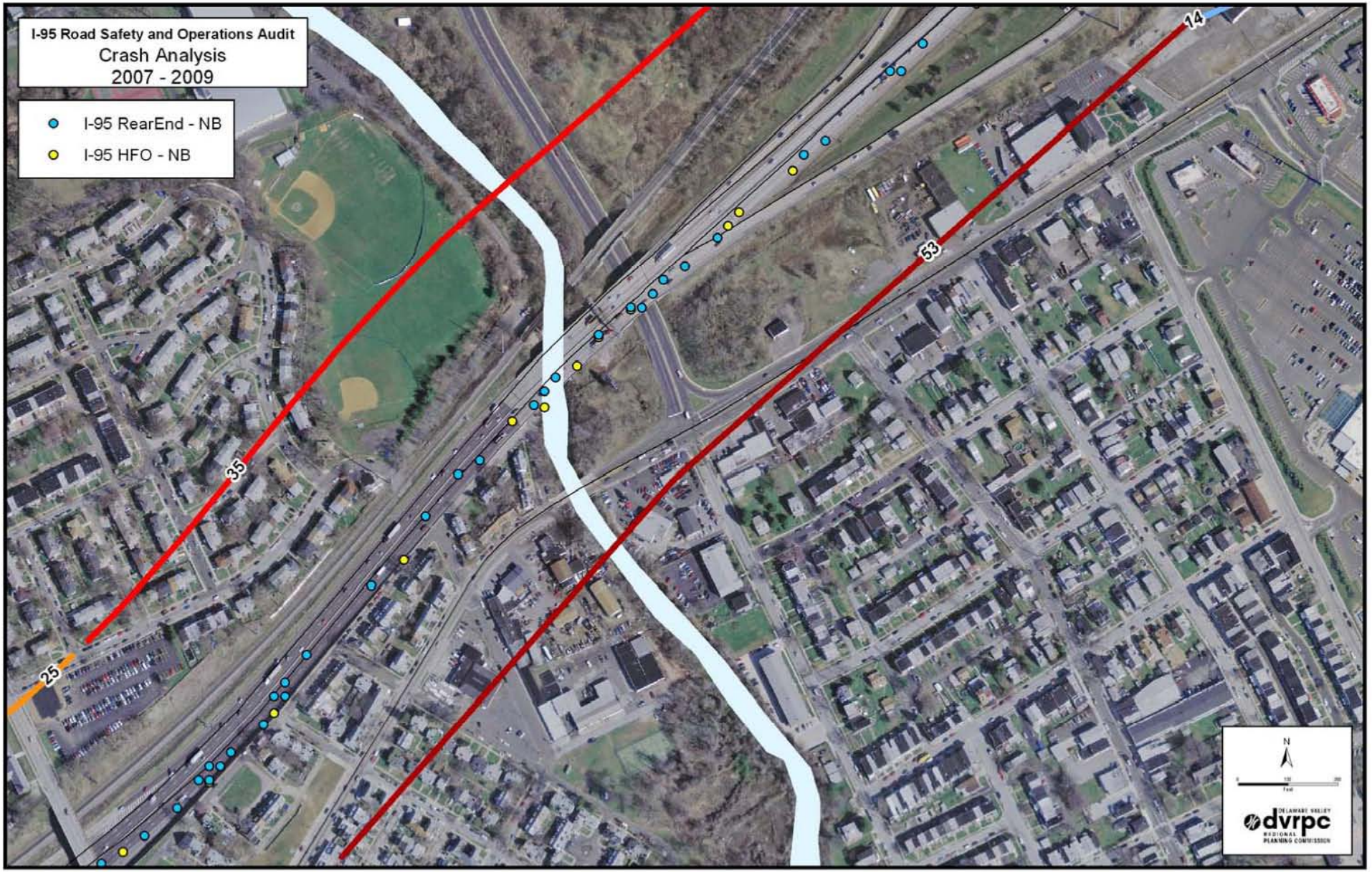
Crash Findings: Segment Analysis



Crash Findings: Segment Analysis



Crash Findings: Segment Analysis



Crash Findings: Segment Analysis

I-95 NB Vicinity of I-476 Interchange

- Aprx. 1.08 miles long
- Two highest crash segments on the corridor
- Combined segment total: 128 crashes
- HFO = 27
- Rear end = 80
- Fatal = 0
- Major injury = 2

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Abstract: This report documents the process and findings of the I-95 Bucks County Road Safety and Operations Audit undertaken by the Delaware Valley Regional Planning Commission (DVRPC). The report details safety and operational issues identified by the audit team at the study location and remedial strategies to address them. Emphasis is placed on identifying low-cost, quick-turnaround improvements and safety projects to address the identified issues where possible. This project represents a step toward implementation of DVRPC's *2012 Transportation Safety Action Plan: Improving Transportation Safety in the Delaware Valley* (August 2012, #12030), and considers guidance from the *Transportation Operations Master Plan* (July 2009, #09049).

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