



REHABILITATION OF I-95 FROM I-495 TO NORTH OF BRANDYWINE RIVER BRIDGE

TRAFFIC MANAGEMENT PLAN:
USING ITS DEVICES TO PREDICT TRAFFIC IMPACTS

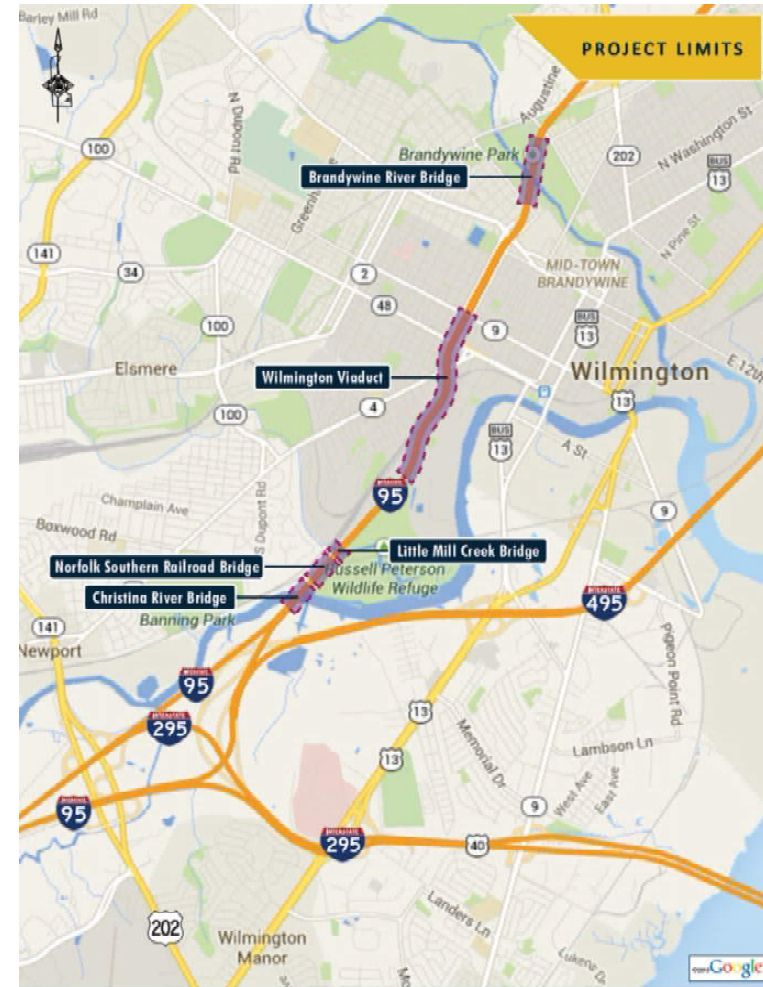
STEVE HARR, P.E., PTOE

MASITE ANNUAL CONFERENCE
SEPTEMBER 27, 2019



PROJECT OVERVIEW

- Extends from I-495 / I-95 split to US 202 (Concord Pike)
- Rehabilitation of 19 bridges
- Rehabilitation of over 3 miles of pavement
- Reconstruction of 11 exit / entrance ramps
- New on-ramp from 2nd Street to I-95 SB
 - Safety enhancement
- Multiple construction contracts (i.e., breakout contracts)
- Ensures a 30-year service life extension
 - Avoid more costly and traffic-disrupting repairs



PROPOSED BRIDGE REPAIRS

- Replace the existing protective bridge roadway overlay
- Reconstruct exterior roadway barriers
- Replace or eliminate roadway joints
- Other miscellaneous structural repairs

Hydrodemolition



Post-Hydrodemolition



New Protective Overlay





PROJECT TIMELINE

SEPTEMBER 2014

Project Design Begins

**JULY 2015 –
OCTOBER 2016**
Preliminary /
Concept Plans

MARCH 2017
Value
Engineering
Study

**DECEMBER 2019 –
MAY 2021**
2nd Street, Bearings &
Sign Structure Breakout
Contracts Constructed

**JUNE 2023 –
JUNE 2025**
Underbridge
Repair Contract
Constructed

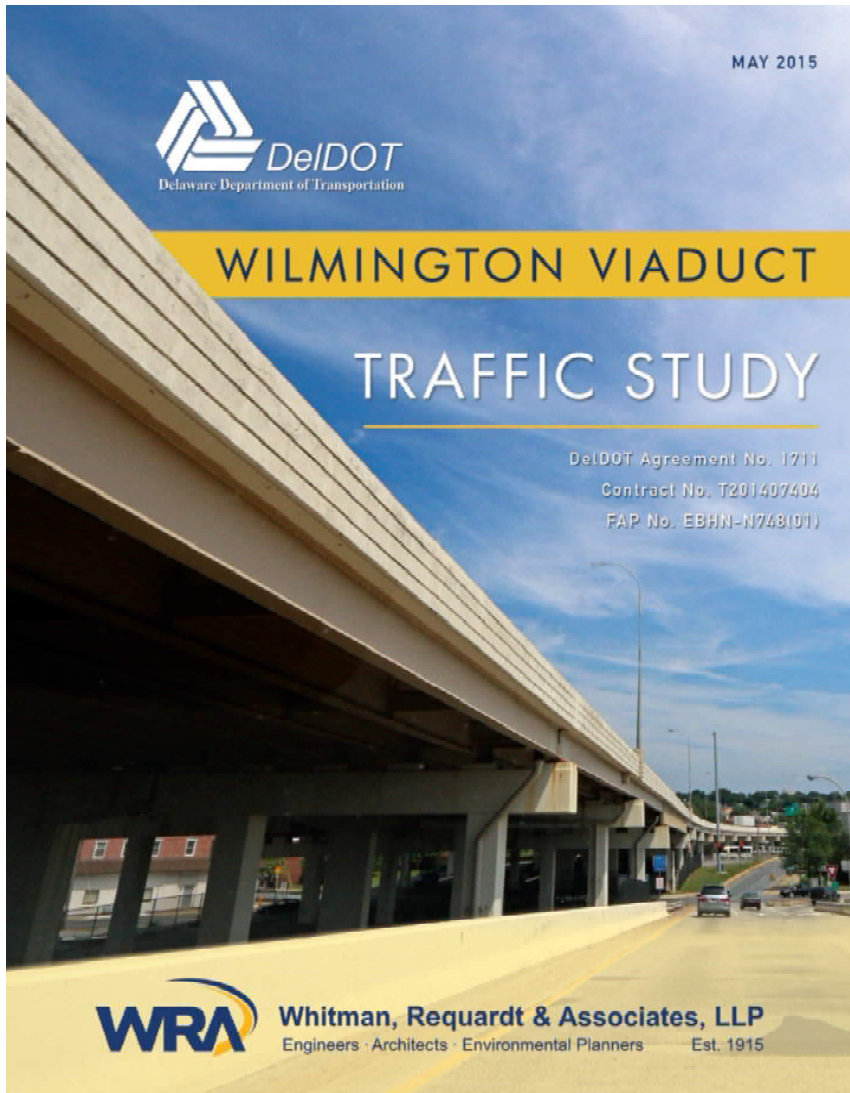
**SEPTEMBER 2014 –
JULY 2015**

Inspection and
Testing Phase

**OCTOBER 2016 –
PRESENT**
Final Design
Phase

**JULY 2018 –
PRESENT**
Public Outreach
Campaign

**MARCH 2021 –
JUNE 2023**
I-95 Corridor Project
Constructed



- Understand existing traffic
 - Volumes
 - Origin/Destination
 - Diversion Routes
- Compare MOT alternatives
 - Half road closure
 - Contraflow
 - Single-lane closure
- Quantify estimated traffic impacts
- Create traffic mitigation strategies



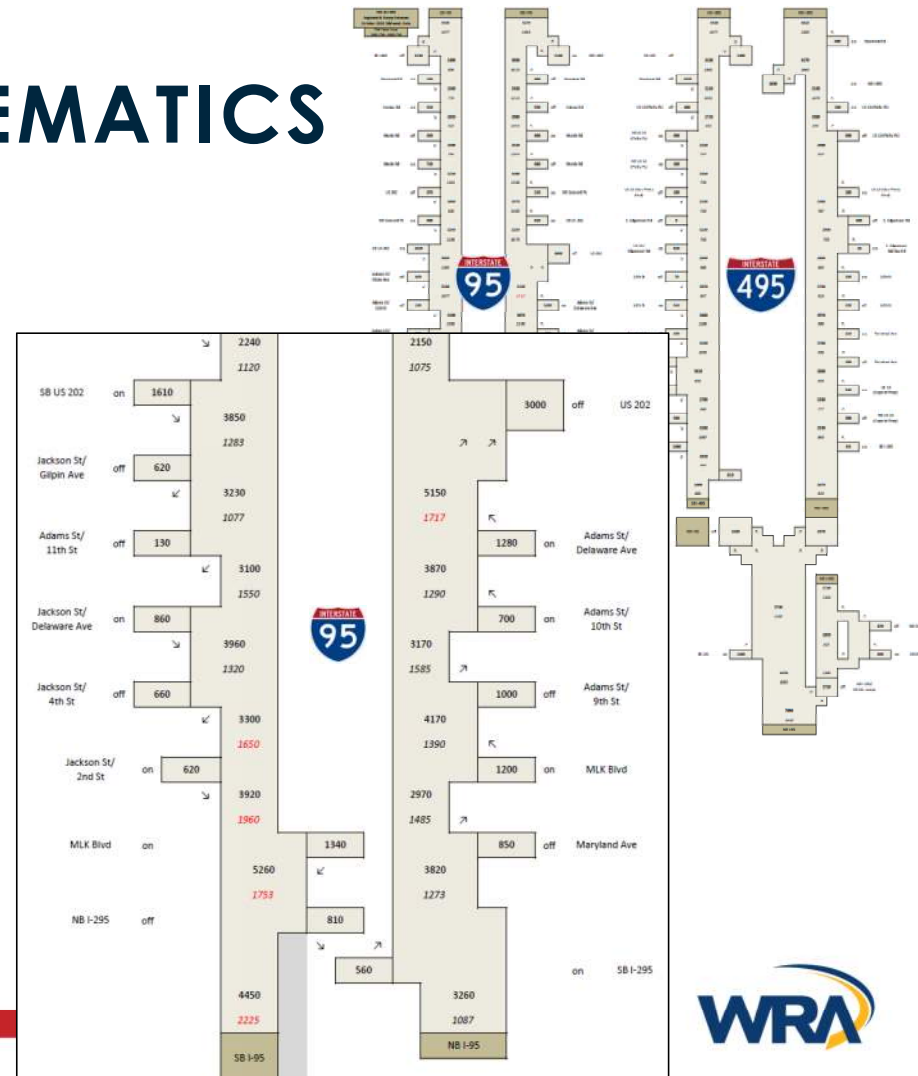
EXISTING VOLUMES

- Extensive Wavetronix data available along I-95 and I-495
- Obtained 30 complete days of data at all sites (October 2014)
 - "Typical" midweek peak hours
 - 24-hr diurnal directional volumes
- Virtually all ramps within the project area had ramp data or had up/downstream data
- Classification data also available

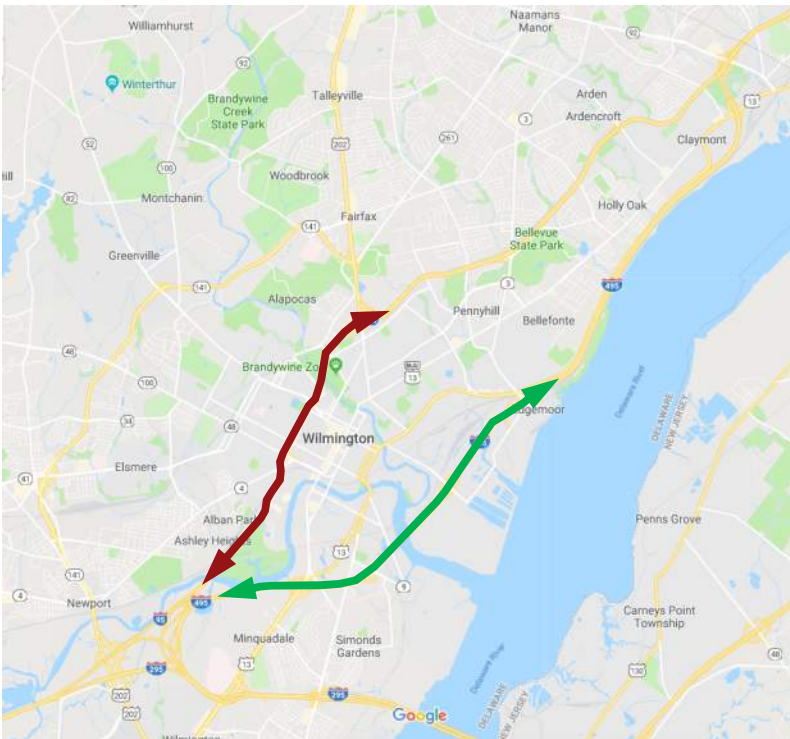
- 
- EXISTING WAVETRONIX DEVICE
 - PROPOSED WAVETRONIX DEVICE

VOLUME SCHEMATICS

- AM, PM, and Weekend peak hours
- Average hourly volume for every link and ramp
- Helps visualize near- or over-capacity areas
 - 1,600 to 1,800 vphpl
- Used to analyze:
 - Ramp closures
 - Mainline traffic diversions



BLUETOOTH DEPLOYMENT



- Significant capacity available on I-495
- How many trips can “just go around?”
- Need some understanding of origin/destination along I-95
 - I-95 travel between PA line & south of Wilmington → EASY diversion to I-495
 - I-95 travel to/from US 202 and/or downtown Wilmington → I-495 not viable alternative
- Portable Bluetooth devices deployed

BLUETOOTH FINDINGS

I-95 ORIGIN/DESTINATION DATA

US 202 north of I-95



I-95 north of PA State Line

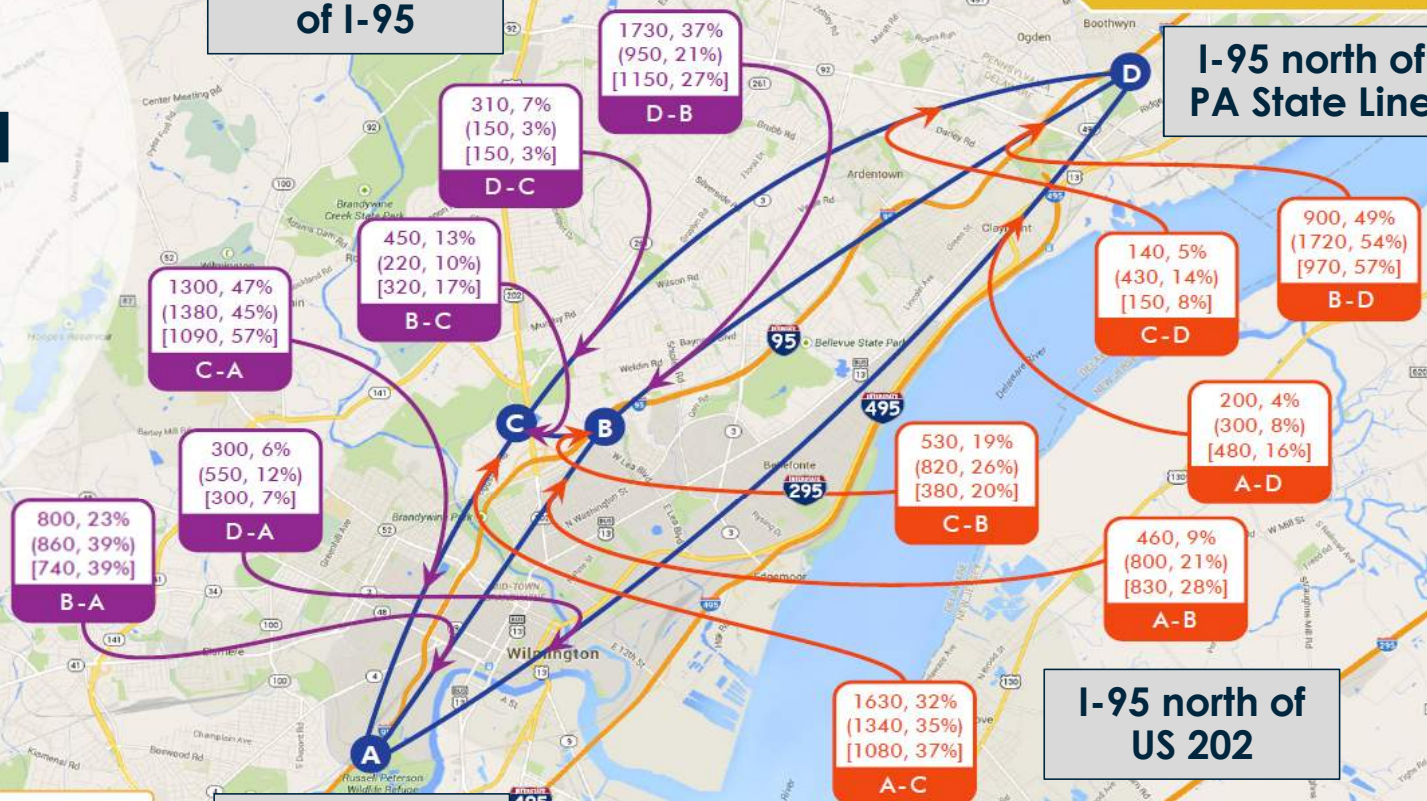
I-95 north of US 202

I-95 south of Wilmington

LEGEND

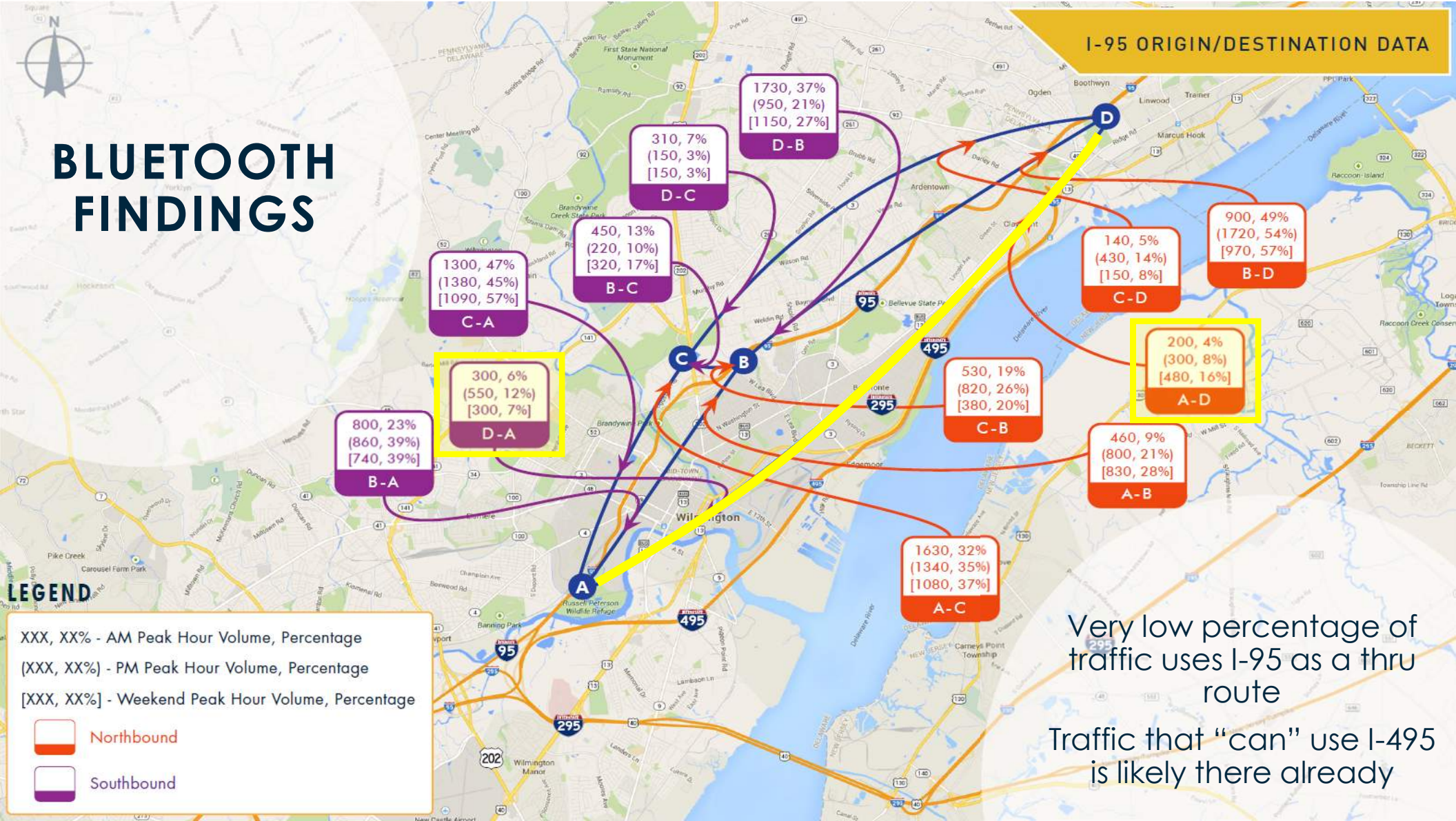
XXX, XX% - AM Peak Hour Volume, Percentage
 (XXX, XX%) - PM Peak Hour Volume, Percentage
 [XXX, XX%] - Weekend Peak Hour Volume, Percentage

 Northbound
 Southbound





BLUETOOTH FINDINGS

I-95 ORIGIN/DESTINATION DATA



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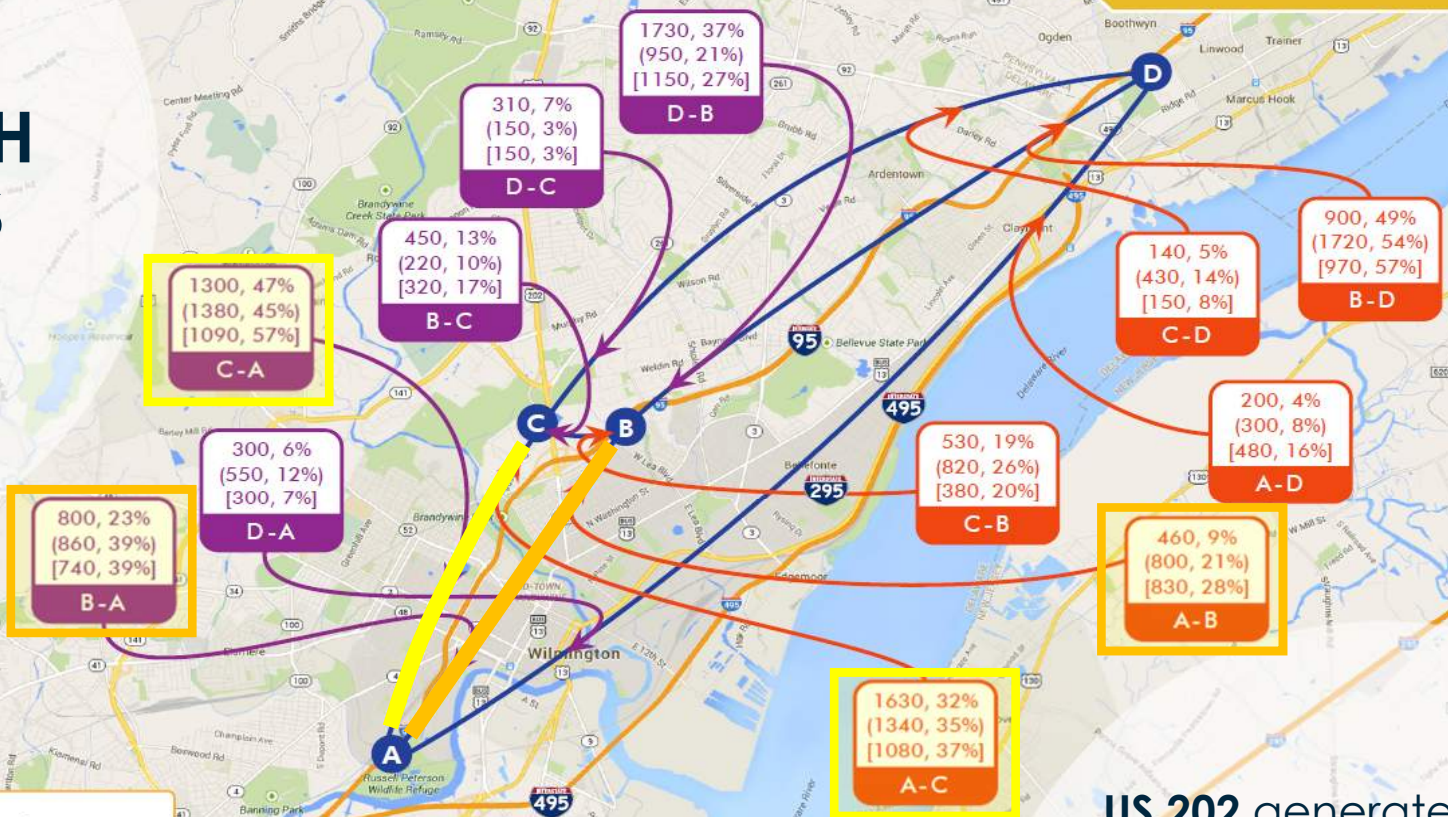
 Northbound
 Southbound

Very low percentage of traffic uses I-95 as a thru route

Traffic that "can" use I-495 is likely there already



BLUETOOTH FINDINGS

I-95 ORIGIN/DESTINATION DATA



LEGEND

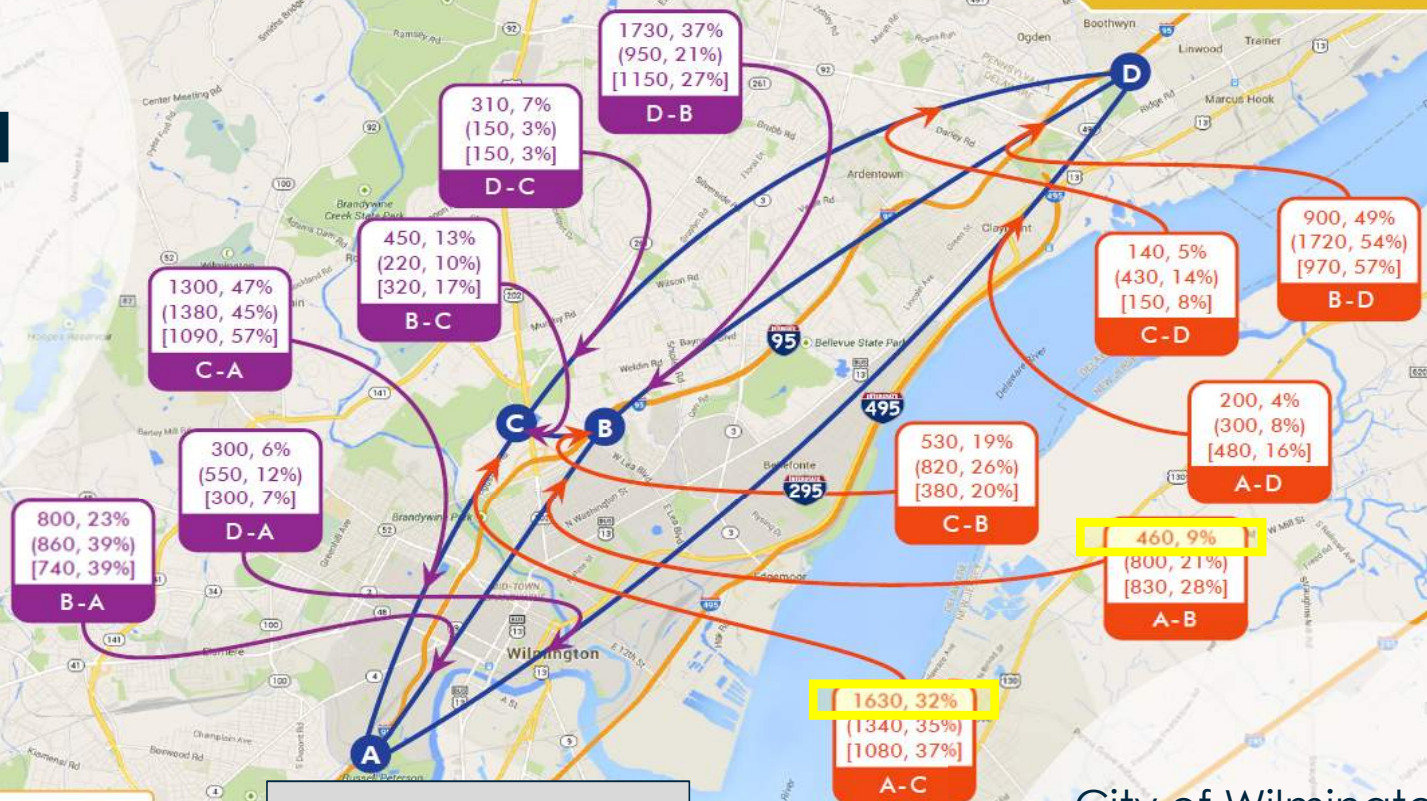
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 Northbound
 Southbound

US 202 generates more traffic thru Wilmington (C-A & A-C, **yellow**) than **I-95** north of US 202 does (B-A & A-B, **orange**)

BLUETOOTH FINDINGS

I-95 ORIGIN/DESTINATION DATA



5,000+ NB AM Peak Hour Vehicles

City of Wilmington is the largest traffic generator along I-95

e.g., NB AM Peak – data suggests that 3,000 vph use a ramp to enter the City

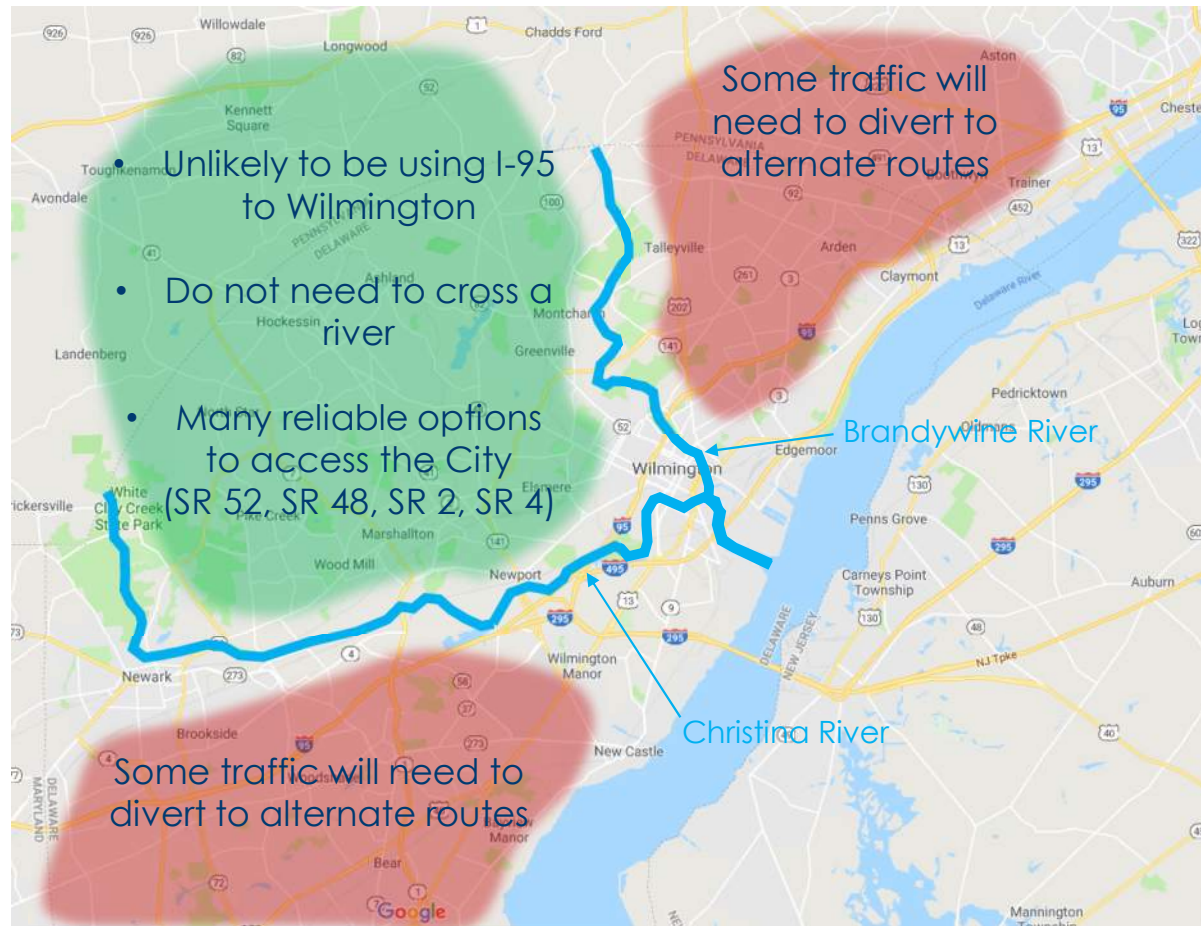
LEGEND

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Northbound
 Southbound

CONSTRAINTS

- Many crossings of the Brandywine and Christina Rivers (including I-95) are already capacity-constrained during peaks
- Diversions primarily needed between City and
 - East of Brandywine River
 - South of Christina River
- **US 202 “thru” traffic must cross both!**



AM PEAK HOUR — INBOUND

DIVERSION ROUTES

← Northbound I-95 Diversions
 → Southbound I-95 Diversions
 ■ Project Limits

Additional Capacity on Diversion Routes

| Road Name | Available Capacity |
|-------------------|--------------------|
| Route 2 | 400 |
| Route 4 | 500 |
| US Business 13 NB | 900 |
| US Business 13 SB | 400 |
| US 13 | 1200 |
| E. 12th Street NB | 700 |
| E. 12th Street SB | 600 |
| Baynard Blvd. | 1000 |
| Dupont St | 150 |
| Route 100 | 600 |
| Augustine Cut Off | 300 |
| Route 48 | 500 |
| Route 141 | 200 |



AM PEAK HOUR — INBOUND

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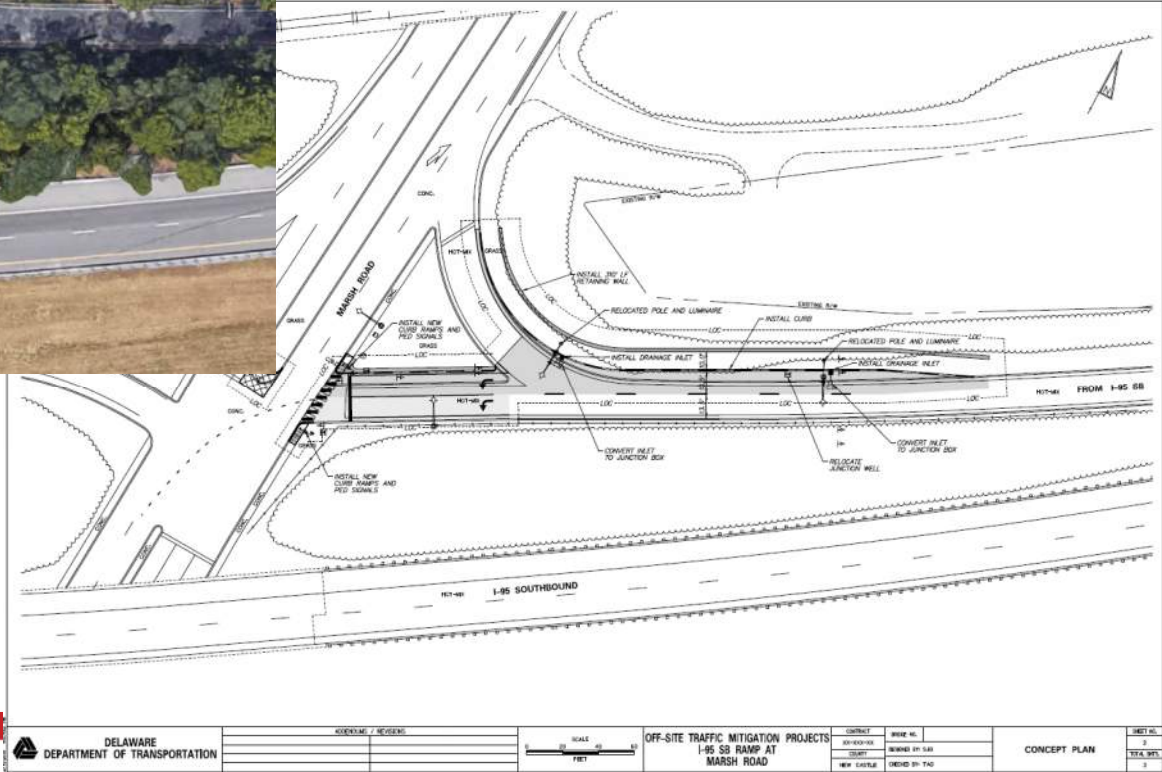
Wilmington
Corridor
 Rehabilitation



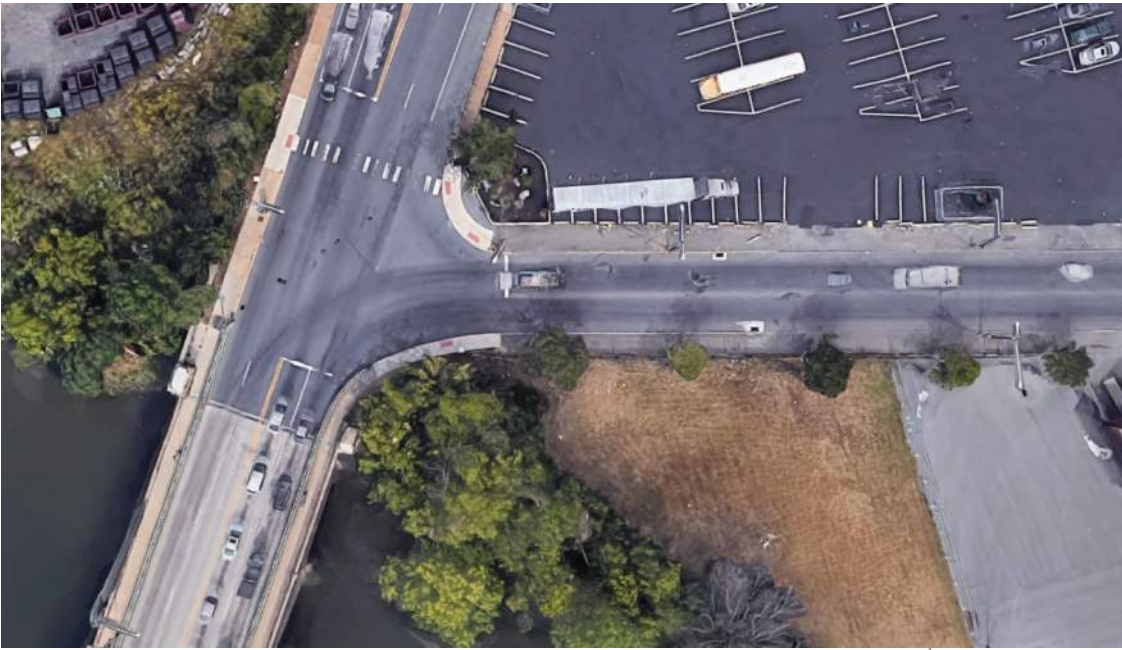
MITIGATION PROJECTS



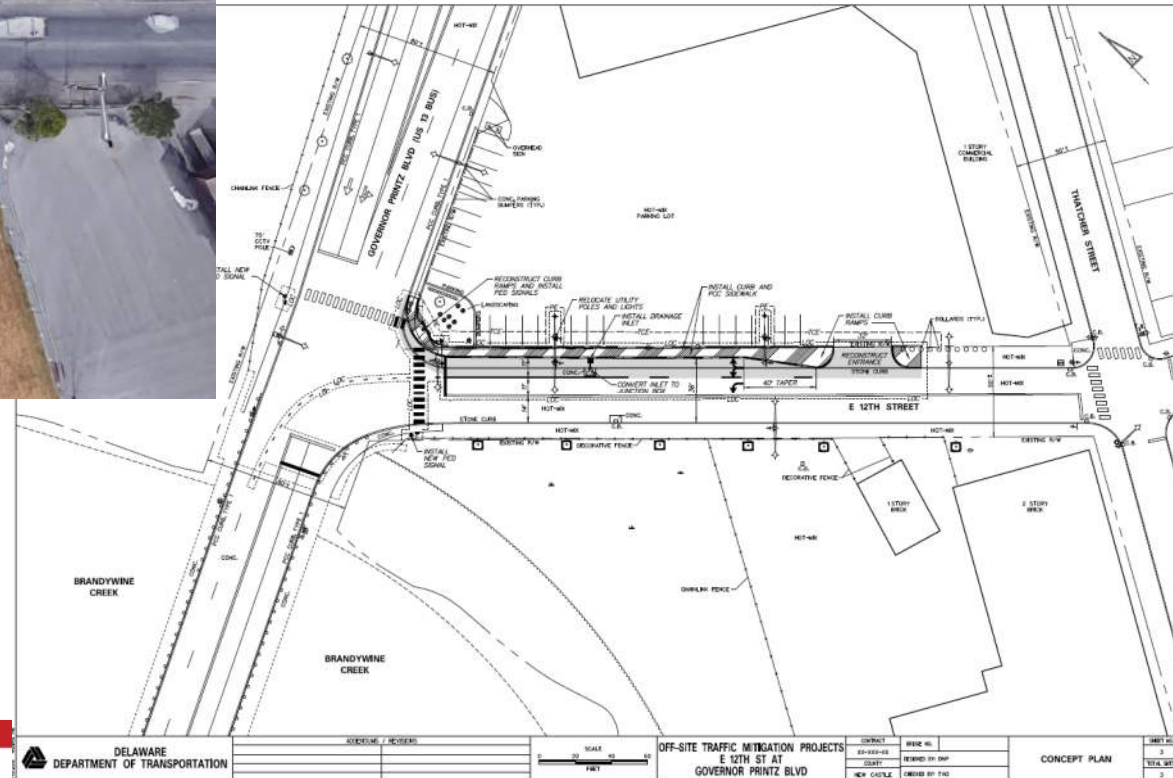
- Construct 2nd left-turn lane at I-95 SB off-ramp at SR 3
- Good connectivity to alternate routes



MITIGATION PROJECTS



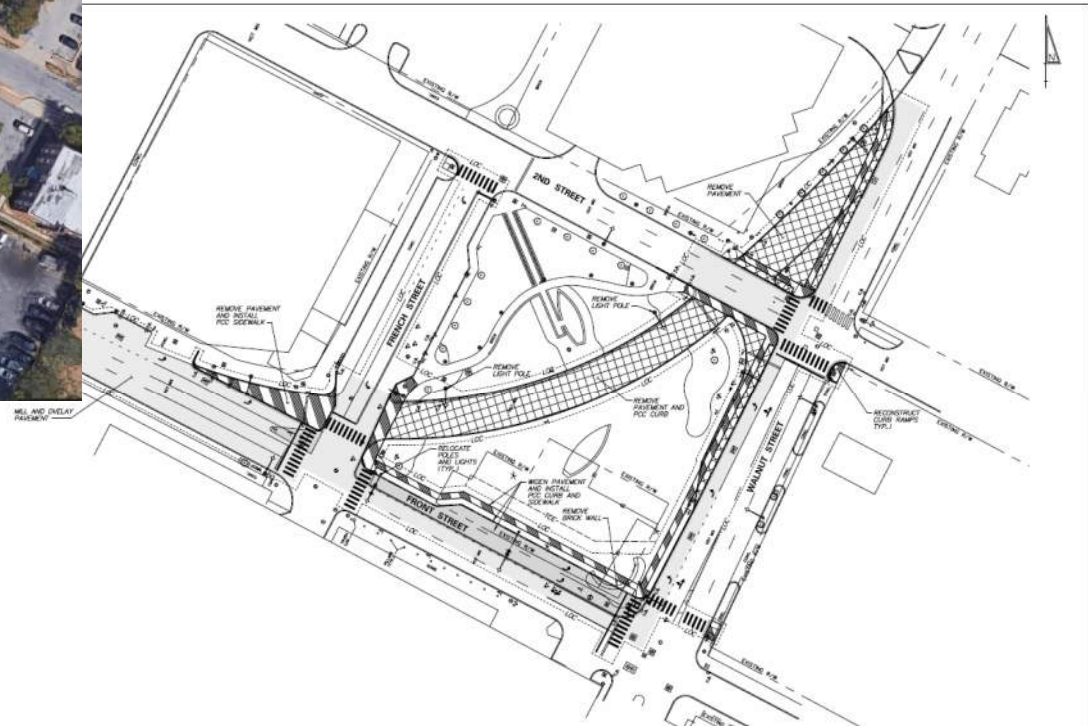
- Construct 2nd left-turn lane on 12th St at Northeast Blvd
- Direct connection to/from I-495
- NB & SB diversion route





MITIGATION PROJECTS

- Remove MLK Blvd "sweep"
- 3-phase to 2-phase operation at 2nd St
- +900 peak hour NB capacity gain



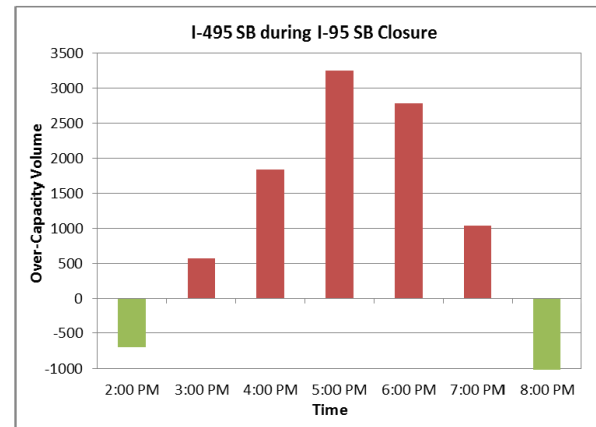
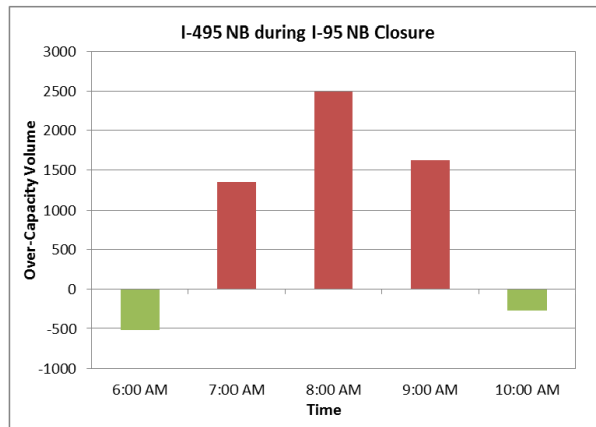


ALTERNATIVES COMPARISON

- Half Road Closure
 - Close & fully reconstruct NB lanes and all ramps, then SB
 - Faster & higher-quality construction, only impacts one direction at a time
 - Extreme impacts to traffic
- Contraflow
 - Close & fully reconstruct NB lanes and all ramps, then SB
 - Allow one lane of traffic on “wrong side” of road
 - Faster & higher-quality construction
 - Major impacts to both directions of traffic
- Single-Lane Closures
 - More manageable traffic impacts
 - Longer & more difficult construction phasing

ALTERNATIVES COMPARISON

- Half Road Closure
 - 5- to 7-mile queues on I-495, lasting 3 to 5 hours
 - 6,500 peak-hour diversions required
 - Where does US 202 traffic go?
 - Significant full-day delays expected on SR 141, most-likely alternate route
 - City streets & two-lane bridges inundated with traffic





ALTERNATIVES COMPARISON

- Contraflow
 - 8,000 peak-hour diversions required
 - I-495 remains significantly over-capacity
 - US 202 traffic in one direction would still have no logical diversion
 - Logistical concerns with crossovers and one contraflow ramp into City

- Single-Lane Closures
 - 2,000 peak-hour diversions required
 - I-495 remains at or below capacity
 - With 10% to 15% reduction in peak demand (and logical diversions), I-95 experiences delays/queues similar to existing conditions

I-495 CLOSURE PERSPECTIVE

- Summer 2014 closure for emergency repairs
- Primary diversion to I-95
- Significant volume increases on “local” network
 - Mainly during peak periods, avoid I-95 delay
- **10% to 30% of motorists significantly altered or eliminated their trips**



I-495 CLOSURE PERSPECTIVE

- So...let's (half) close I-95?!



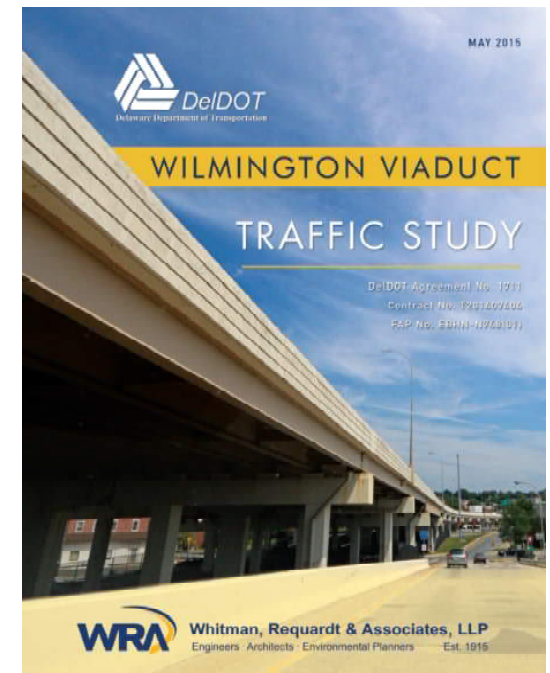
| I-495 Bridge over Christina River Emergency Closure – 2014 | I-95 South of US 202 Viaduct and BRB |
|---|--|
| AADT (2013) – 84,000 (6 lanes) | AADT (2013) – 94,000 (6 lanes) |
| Weekday peak-hour diversions: 2,700 – 3,200 per direction mainline 100 – 600 per direction on-ramp | Weekday peak-hour diversions: 3,800 – 5,100 per direction mainline 1,300 – 3,200 per direction on-ramp |
| Primary diversion route, I-95, at/near 100% capacity before closure | Primary diversion route, I-495, presently utilizing 60% capacity |
| Approx. 30%-50% "pass-thru" traffic ² Some likely to take "regional" bypass; some need "local" diversions with available capacity | 9%-22% "pass-thru" traffic ³ Less likely to take "regional" bypass More likely to need "local" diversions with available capacity |
| Logical diversions with available capacity (US 13/Spruce St/Church St, US 13 Bus., Gov. Printz Blvd, SR 9) | Logical diversions lack available capacity (SR 141, SR 202/Concord Ave, King St/Walnut St) |
| 1.9-mile closure over river; O/D within work zone is zero | 5.2-mile closure through city; O/D within work zone is very high |

- Lesson 1: Reasonable to assume minor demand reductions
- Lesson 2: Mainline delays reach an "equilibrium" as drivers alter behaviors (routes, modes, TOD) to achieve acceptable travel times



FINAL SELECTION

“The extent of the roadway user costs associated with the **half roadway closure** and **contraflow** alternatives, including the overwhelming and frequent burden on primary and secondary alternate routes and the City of Wilmington’s intramobility, are significantly more severe than those **using conventional, single lane closures** and most likely intolerable to motorists for any extended period of time.”





BUT WAIT!

“The extent of the roadway user costs associated with the **half roadway closure** and **contraflow** alternatives, including the overwhelming and frequent burden on primary and secondary alternate routes and the City of Wilmington’s intramobility, are significantly more severe than those **using conventional, single lane closures** and most likely intolerable to motorists for any extended period of time.”

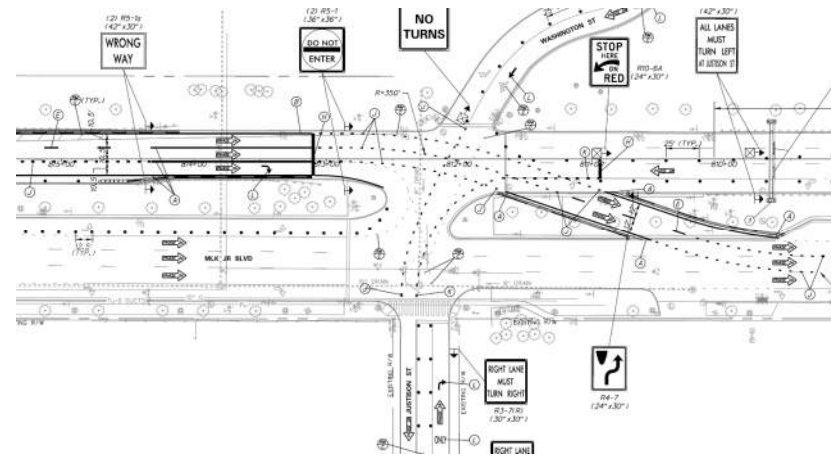


Concerns with project duration and construction quality utilizing single lane closure MOT plan

MOT WIZARDRY



- All cars on one side then the other still not feasible
- Two requirements to make a contraflow MOT more feasible:
 - SB on-ramp from MLK Blvd (merges from left) must be able to operate in contraflow; also involves constructing new crossover on MLK Blvd





MOT WIZARDRY

- All cars on one side then the other still not feasible
- Two requirements to make a contraflow MOT more feasible:
 - SB on-ramp from MLK Blvd (merges from left) must be able to operate in contraflow; also involves constructing new crossover on MLK Blvd
 - Service to/from ramps on “closed side” must be partially maintained to provide City ingress/egress
 - Crossovers
 - Collector/Distributor Roads
- **TWO YEAR** limit for sustained mainline lane closure impacts – help to sell public and legislators

MOT/TMP THEORY – EXISTING



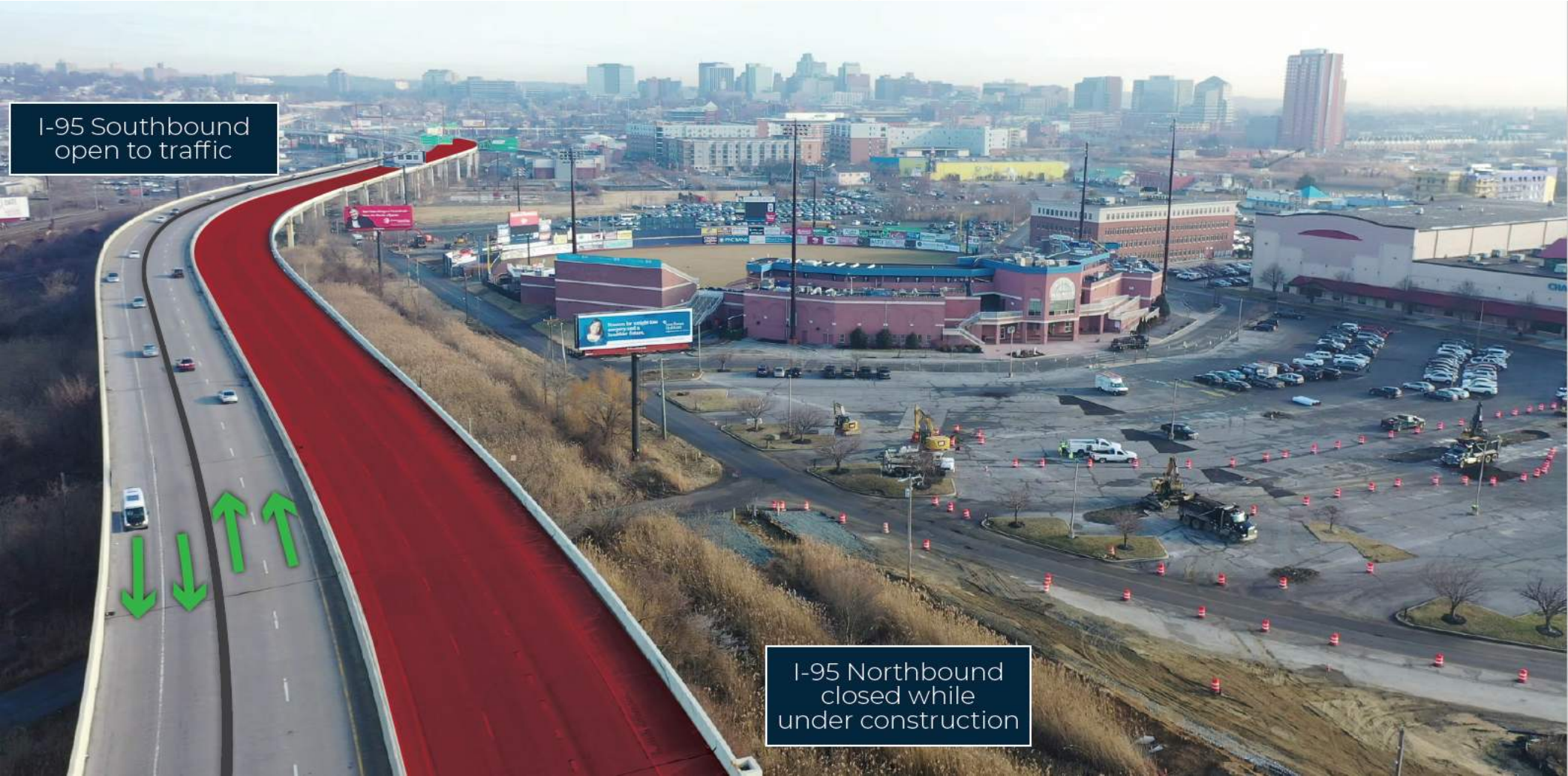
MOT/TMP THEORY – DURING PROJECT



95 Wilmington
Corridor
Rehabilitation

I-95 Southbound
open to traffic

I-95 Northbound
closed while
under construction



95 Wilmington
Corridor
Rehabilitation



I-95 Southbound
open to traffic

I-95 Northbound
closed while
under construction

95 Wilmington
Corridor
Rehabilitation

I-95 Southbound
open to 1 lane SB
local traffic only

I-95 Northbound
open to 2 lanes NB and
1 lane SB (through)



95 Wilmington
Corridor
Rehabilitation

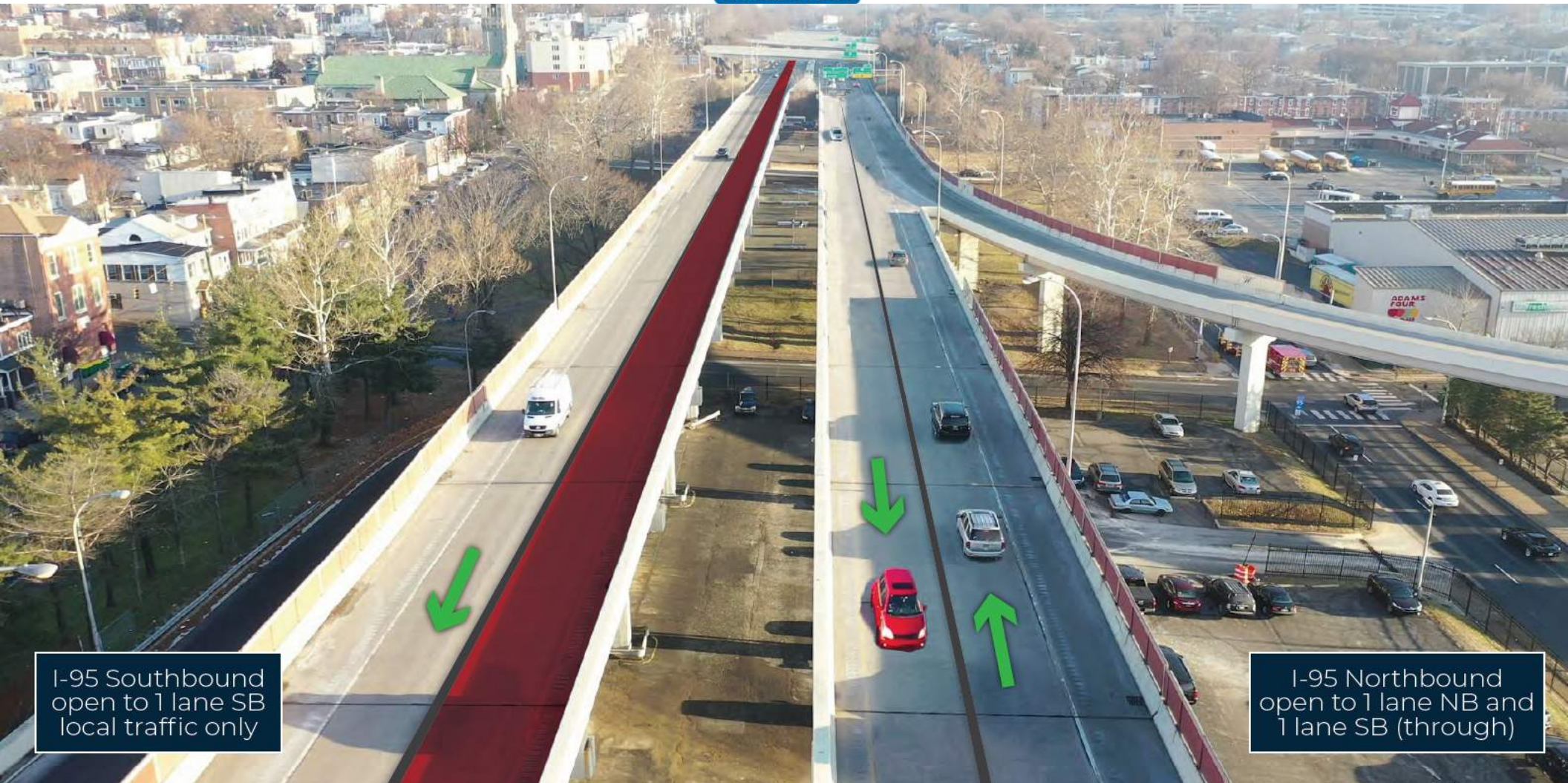
I-95 Southbound
open to 2 lanes SB
local traffic only



I-95 northbound
open to 2 lanes NB and
1 lane SB (through)



95 Wilmington
Corridor
Rehabilitation



I-95 Southbound
open to 1 lane SB
local traffic only

I-95 Northbound
open to 1 lane NB and
1 lane SB (through)

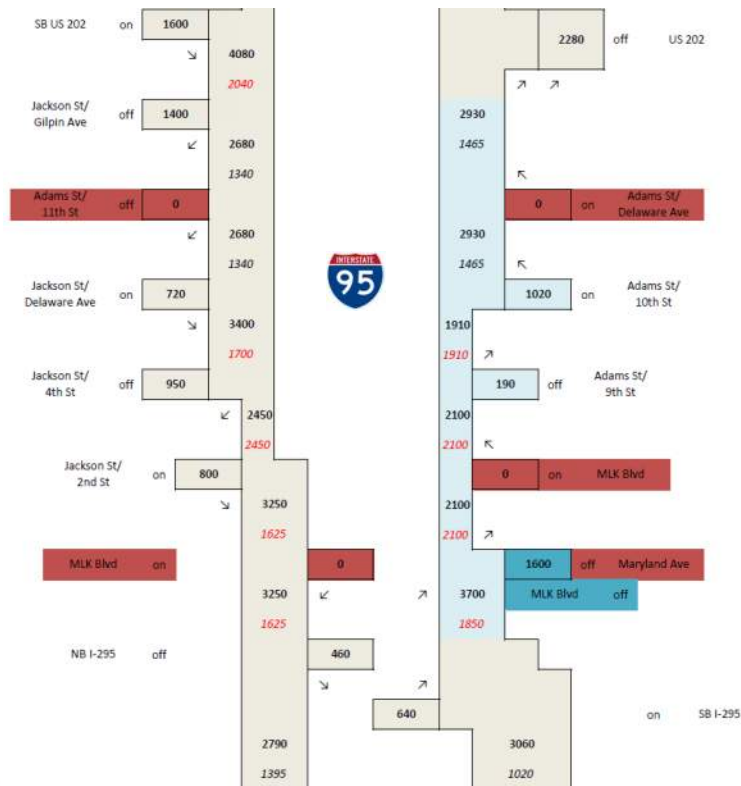
95 Wilmington
Corridor
Rehabilitation



I-95 Southbound
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local traffic only

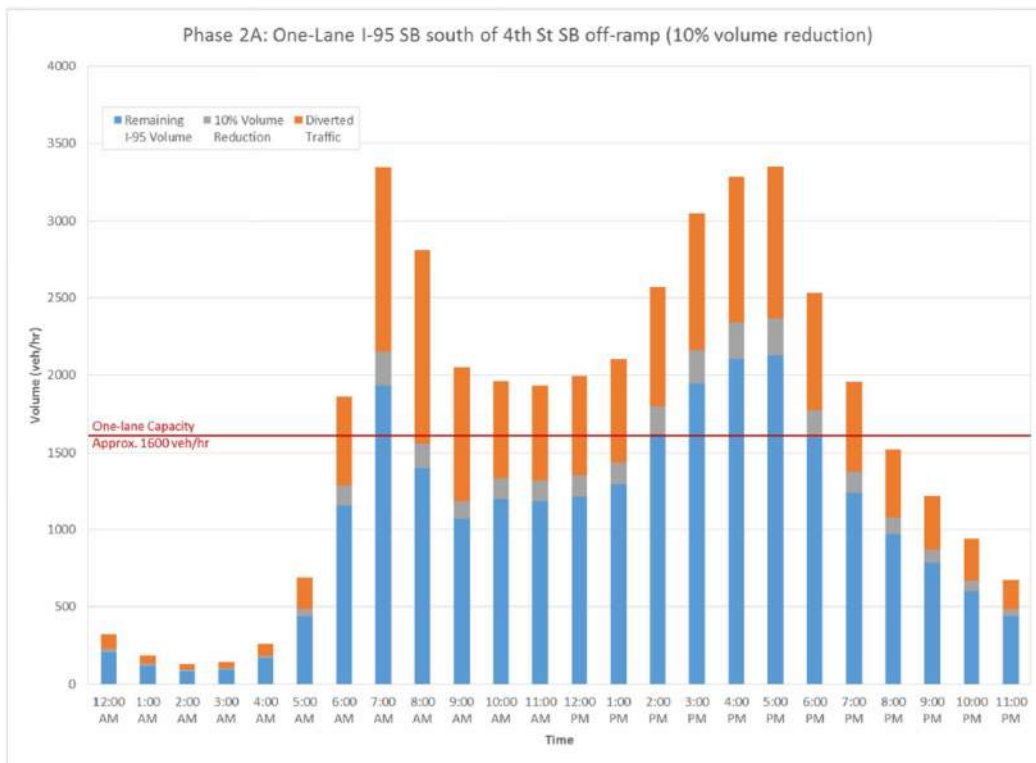
I-95 Northbound
open to 1 lane NB and
1 lane SB (through)

ESTIMATING IMPACTS



- Original Study
 - Existing volumes
 - Basic O/D understanding
 - Diversion route capacities
- MOT Plan
 - Mainline lane closures
 - Sequenced ramp closures
- Use schematic to divert volumes around the network
 - What “pinch points” remain?

ESTIMATING IMPACTS



- Daily Wavetrax data at pinch points of each MOT phase
- Consider scenarios with only logical/necessary diversions and with an additional 10% volume reduction
- Simple queue buildup/clearance analysis to provide initial estimate of delays and queue lengths
 - Expected AM peak delay: 13 to 21 minutes
 - Expected AM peak queue: 0.8 to 1.3 miles
 - Expected PM peak delay: 52 to 92 minutes
 - Expected PM peak queue: 3.3 to 5.8 miles

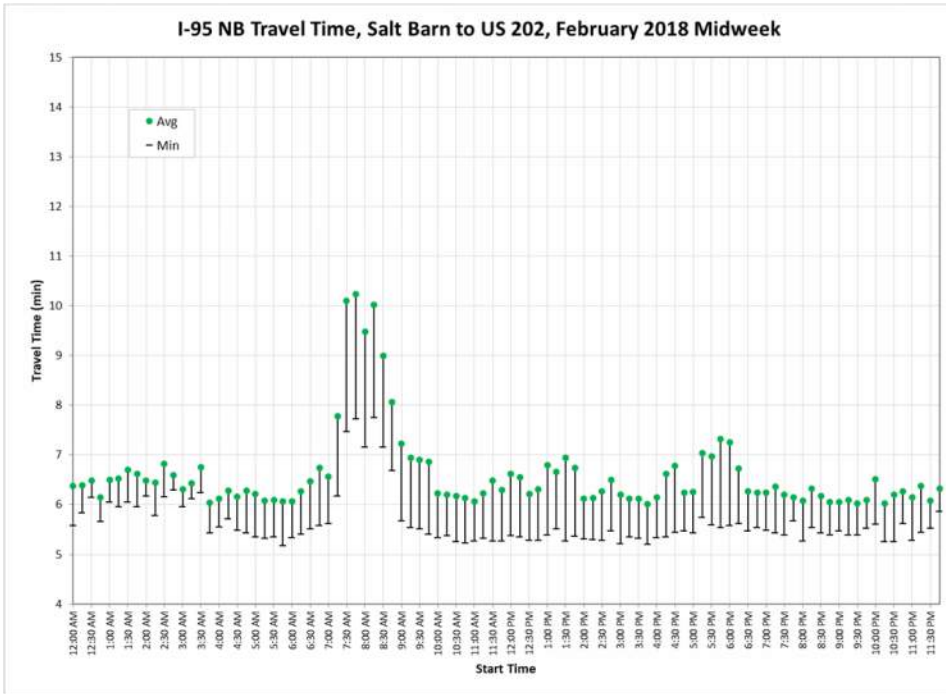


ESTIMATING IMPACTS

| Phase | Duration (months) | Northbound I-95 | | | | Southbound I-95 | | | |
|-----------------|-------------------|-----------------|------------|-------------|------------|-----------------|------------|-------------|------------|
| | | AM Peak | | PM Peak | | AM Peak | | PM Peak | |
| | | Delay (min) | Queue (mi) | Delay (min) | Queue (mi) | Delay (min) | Queue (mi) | Delay (min) | Queue (mi) |
| <i>Existing</i> | - | 3 - 8 | 0.3 - 0.8 | | | 3 - 6 | 0.5 - 0.9 | 8 - 17 | 1.1 - 2.0 |
| 1A | 3 | 10 - 24 | 0.9 - 1.8 | 4 - 11 | 0.6 - 1.4 | | | | |
| 1B | 2 | 10 - 24 | 0.9 - 1.8 | 4 - 11 | 0.6 - 1.4 | 47 - 65 | 2.9 - 4.1 | 0 - 18 | 0.0 - 1.2 |
| 1C | 1 | 10 - 24 | 0.9 - 1.8 | 4 - 11 | 0.6 - 1.4 | 47 - 65 | 2.9 - 4.1 | 0 - 18 | 0.0 - 1.2 |
| 2A | 6 | 0 - 4 | 0.0 - 0.6 | | | 13 - 21 | 0.8 - 1.3 | 52 - 92 | 3.3 - 5.8 |
| 2B | 3 | 0 - 4 | 0.0 - 0.6 | | | 14 - 27 | 1.0 - 1.8 | 65 - 95 | 4.2 - 6.1 |
| 3A | 3 | 15 - 30 | 1.0 - 1.9 | 18 - 34 | 2.3 - 4.2 | 18 - 22 | 1.0 - 2.8 | 22 - 44 | 2.0 - 3.4 |
| 3B | 3 | 25 - 41 | 2.0 - 3.0 | 38 - 76 | 2.8 - 5.2 | 22 - 37 | 2.7 - 4.7 | 20 - 55 | 2.5 - 6.9 |
| 4 | 3 | | | | | | | | |

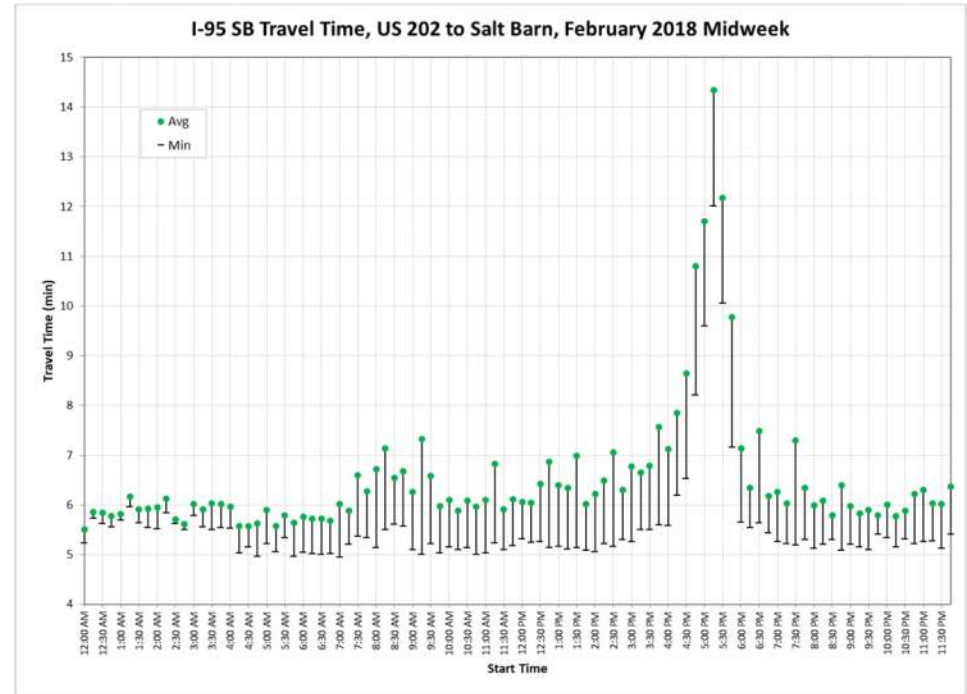
I-95 BLUETOOTH TRAVEL TIMES

I-95 NB Travel Time, Salt Barn to US 202, February 2018 Midweek



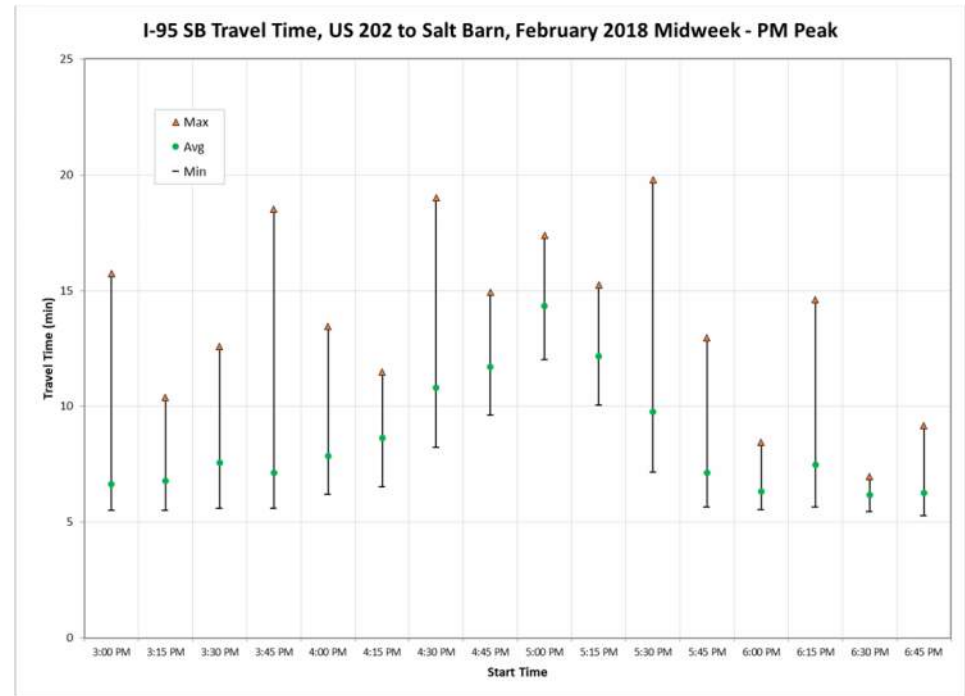
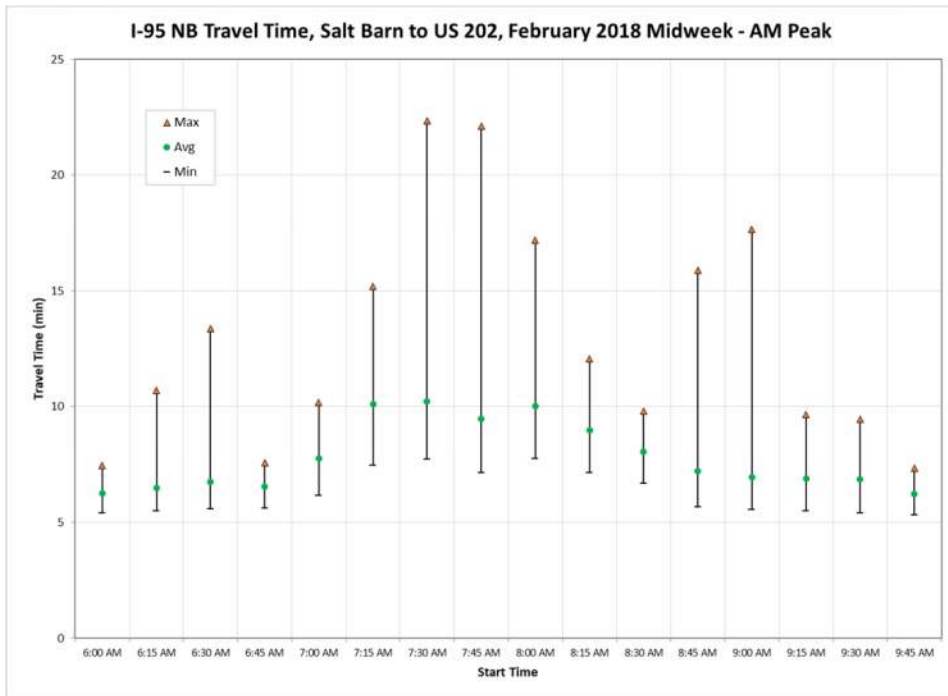
- NB AM Avg Delay = 4-5 min

I-95 SB Travel Time, US 202 to Salt Barn, February 2018 Midweek



- SB PM Avg Delay = 5-10 min

I-95 BLUETOOTH TRAVEL TIMES



- I-95 Max Delays (avg. of midweek days) = ~15 min
 - 20-25 min delays on some individual days

MITIGATING IMPACTS

- If 20-minute mainline I-95 peak period delay is maximum “tolerable,” how much additional traffic must “disappear” from I-95?
 - Peak spreading
 - Mode choice (bus, train, bike, etc.)
 - Telecommuting
 - Ride sharing
 - Additional/regional diversions

- **COMMUNICATION**

- **OUTREACH**

| Phase | Duration (months) | Northbound I-95 | | Southbound I-95 | |
|-------|-------------------|-----------------|---------------|-----------------|---------------|
| | | AM Peak | PM Peak | AM Peak | PM Peak |
| | | Diversion (%) | Diversion (%) | Diversion (%) | Diversion (%) |
| 1A | 3 | 5% | 0% | 0% | 0% |
| 1B | 2 | 5% | 0% | 25% | 0% |
| 1C | 1 | 5% | 0% | 25% | 0% |
| 2A | 6 | 0% | 0% | 5% | 25% |
| 2B | 3 | 0% | 0% | 10% | 30% |
| 3A | 3 | 10% | 10% | 10% | 15% |
| 3B | 3 | 15% | 20% | 15% | 15% |
| 4 | 3 | 0% | 0% | 0% | 0% |



PUBLIC OUTREACH

- deldot.gov/projects for project information



[YouTube Video](#)

PUBLIC OUTREACH

- deldot.gov/projects for project information
- [YouTube Video](#)
- DeIDOT App
- Community Advisory Group (CAG)

- Advanced Traffic Management System
 - Real-time delay/alt route information





THANK YOU

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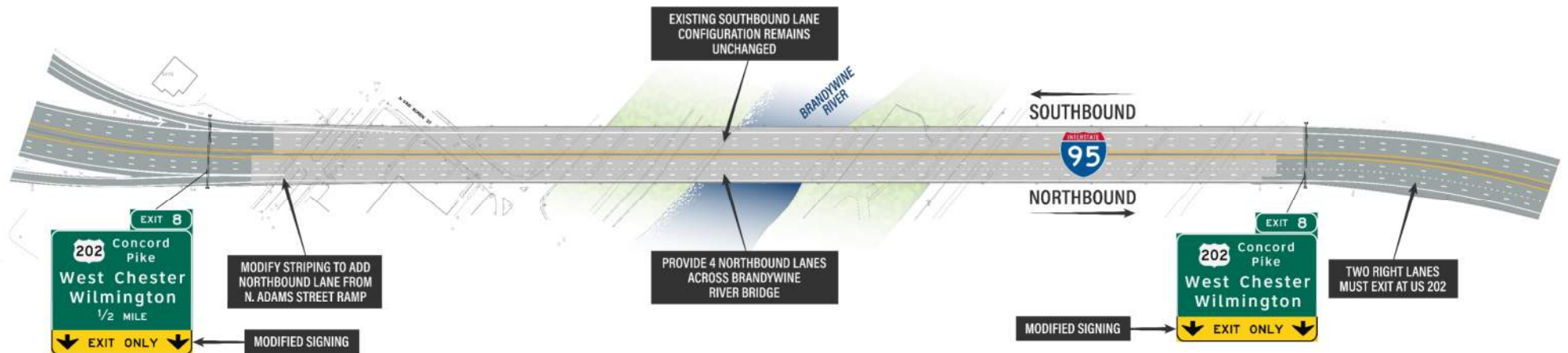
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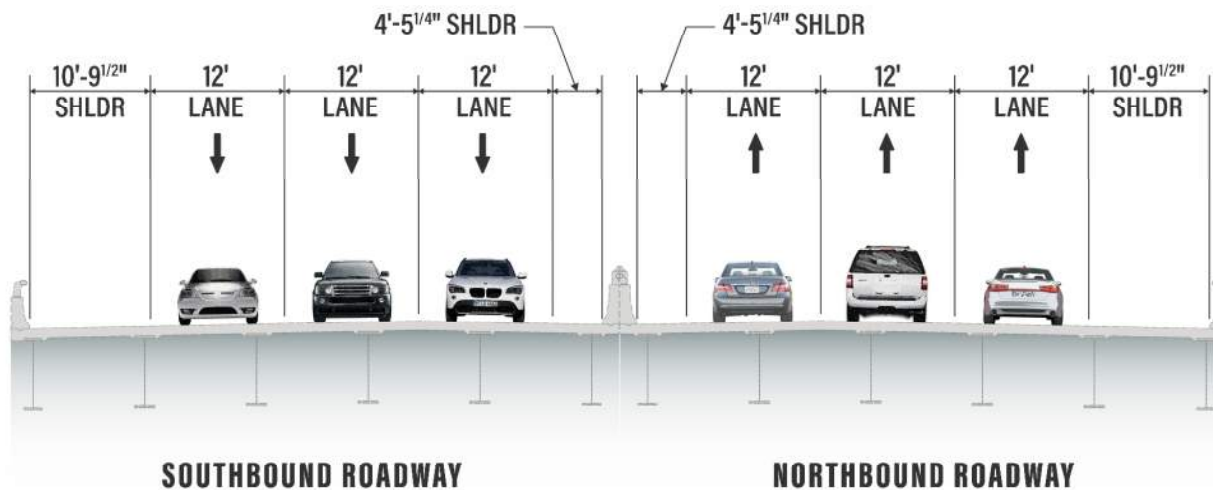
SAFETY IMPROVEMENTS

SAFETY IMPROVEMENTS TO BRANDYWINE RIVER BRIDGE

- Eliminates substandard merge condition = reducing crash potential
- Reduces overall network delay
- Improves Level of Service from D to A along I-95

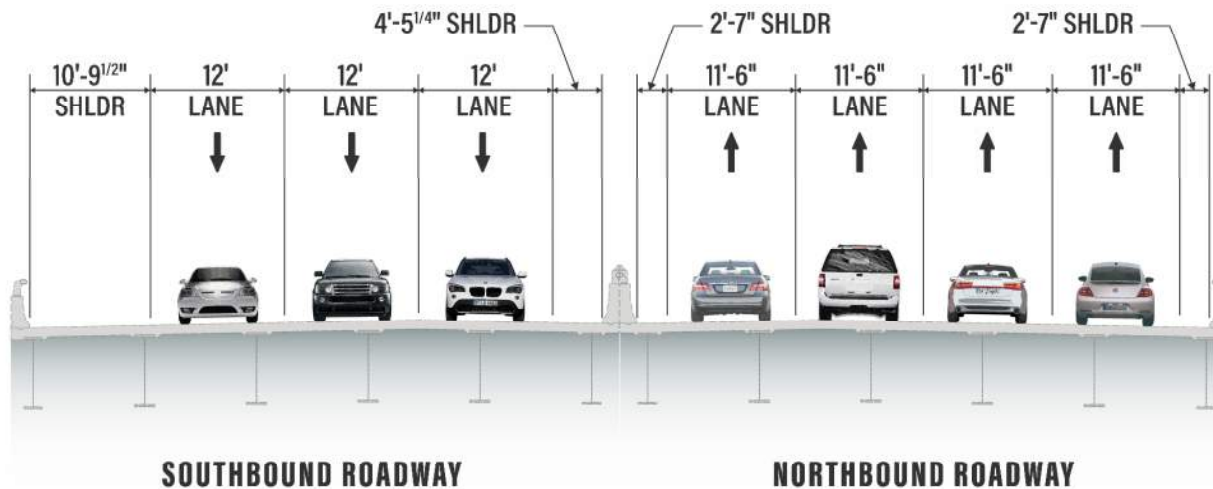


SAFETY IMPROVEMENTS TO BRANDYWINE RIVER BRIDGE



EXISTING TYPICAL SECTION

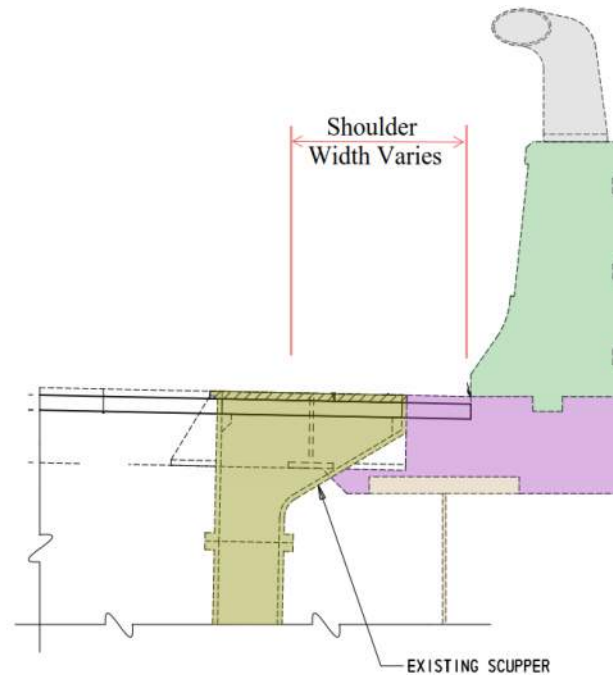
SAFETY IMPROVEMENTS TO BRANDYWINE RIVER BRIDGE



PROPOSED TYPICAL SECTION

SAFETY IMPROVEMENTS TO BRANDYWINE RIVER BRIDGE

- Some engineering challenges are still under evaluation
 - Scupper grates
 - Drainage



SAFETY IMPROVEMENTS @ S. JACKSON STREET

- S. Jackson Street on-ramp to I-95 southbound
- 85 accidents in 5-year period
- Substandard acceleration and merge lane
- Breakout Contract
 - T201907402 – Rehabilitation of I-95, 2nd Street On-Ramp Improvements (*Ramp 'D'*)
 - Construction spring 2020 – summer 2021 (*estimated*)





RECONFIGURATION OF S. JACKSON STREET RAMP (RAMP 'D')

- Remove ramps from S. Jackson Street and 2nd Street
- Construct new ramp from 2nd Street (Ramp 'D')
- Widen the Wilmington Viaduct bridge (7-spans)
- Provide standard merge and acceleration lane onto I-95 southbound
- Construct improvements to City streets
 - Lancaster Avenue
 - N. Adams Street
 - 2nd Street

95 Wilmington
Corridor
Rehabilitation



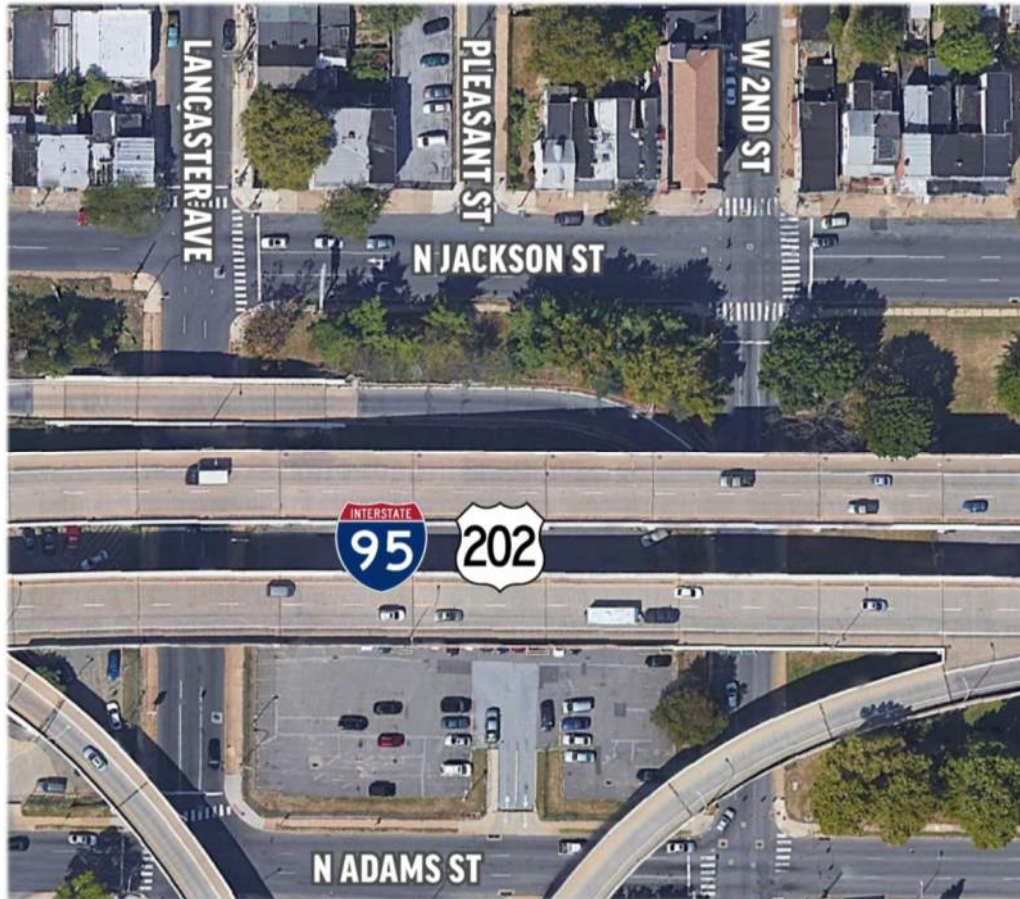
95 Wilmington
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