

# REBUILDING I-95



DANIEL GLEASON

DISTRICT 6 INTERSTATE ACE

# I-95 TANKER FIRE & BRIDGE COLLAPSE



Philadelphia, PA

FLETCHER VIA STORYFUL



# DIVIDE AND CONCORE

Going to present this from 4 different viewpoints

\*Overview/ Press/ Briefings

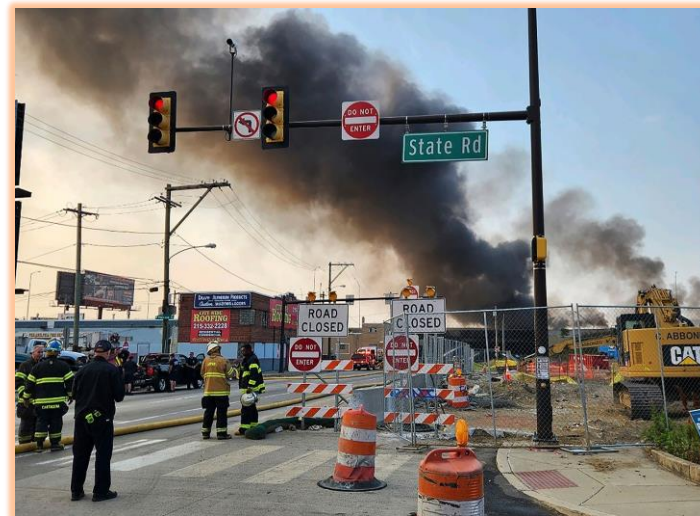
\*Design/ Engineering/ Next steps

\*Operations/ Ever changing detours and MPT

\*Construction/ Day by day



# I-95 TANKER FIRE & BRIDGE COLLAPSE



# I-95 BRIEFINGS



# I-95 BRIEFINGS



# I-95 BRIEFINGS



# I-95 BRIEFINGS





# BRIDGE DATA:

**Year Built:** 2016

**Structure Type:**

Welded Steel I-Beams

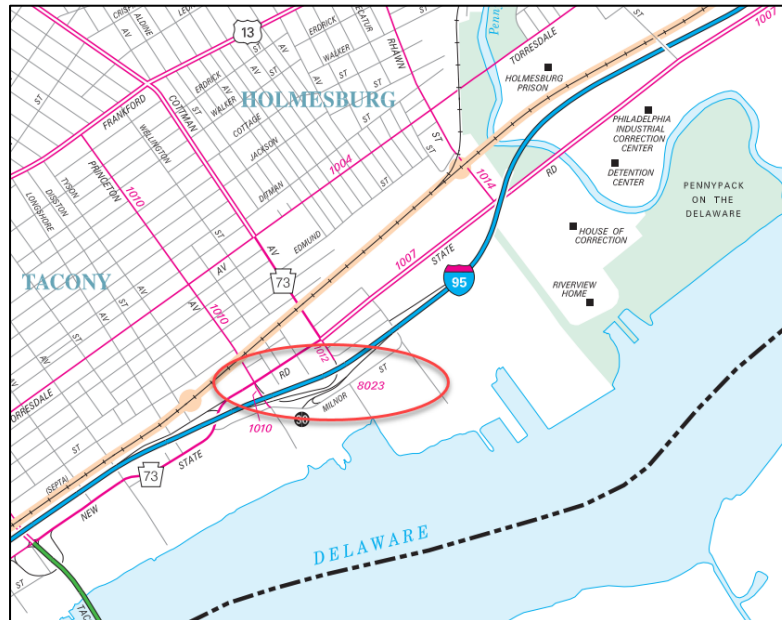
**Span(s):** 1

**Length:** 104

**Width:** 149'

**Skew:** 57°

**Vertical Clearance:** 14'-7"



# BRIDGE DATA (CONT):

## 16 Beam Cross Section

Beams 1-8 (SB); 9-16 (NB)

## Welded Plate Girders:

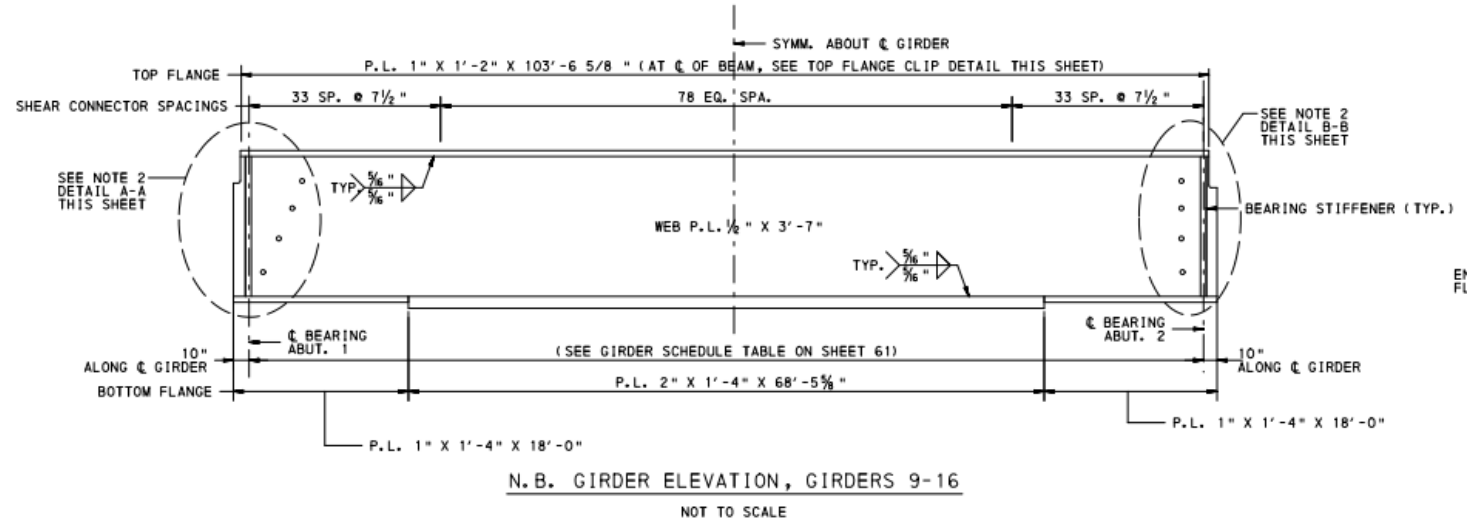
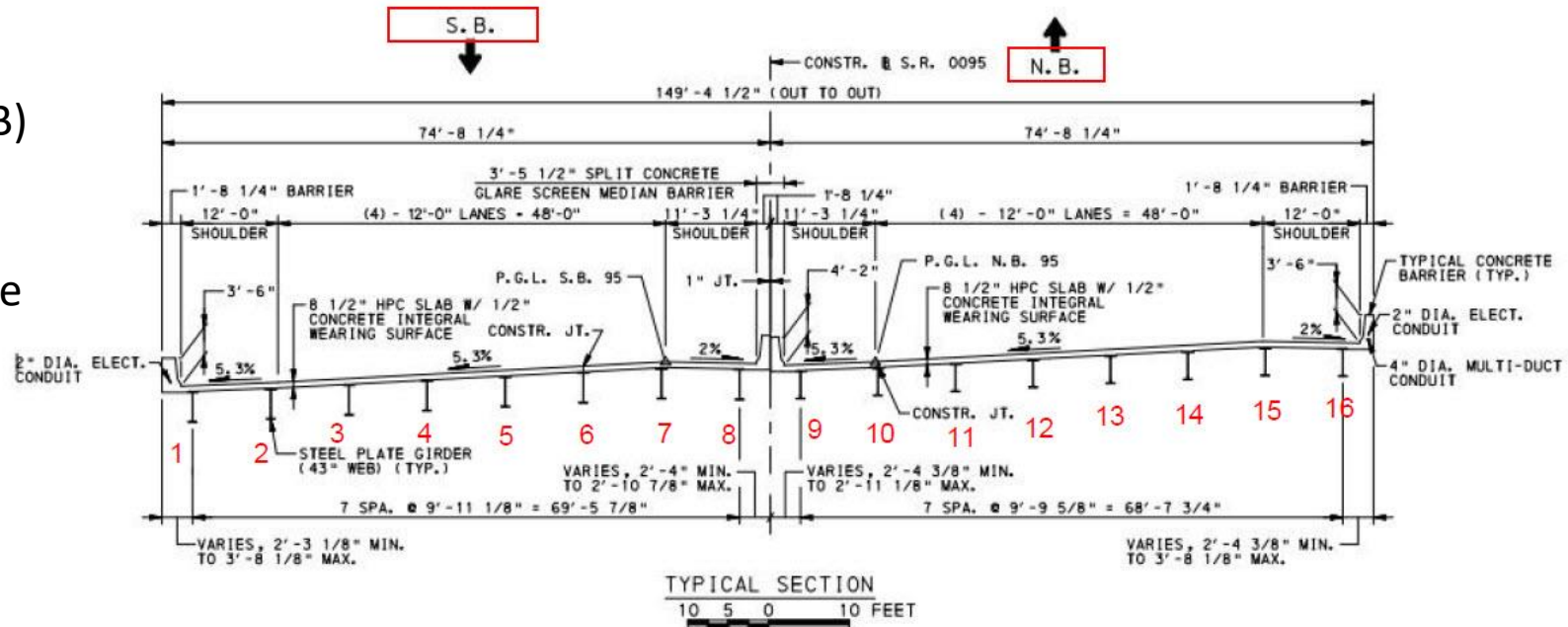
1" thick x 1'-2" top flange  
43" deep x 1/2" thick web  
2" thick x 1'-4" bottom flange

## Bearings:

Laminated Elastomeric  
Bearing Pads

## Joints:

Strip Seal 3" Movement  
Classification on Type 3  
Approach Slab



# BRIDGE DAMAGE ASSESSMENT (CONT.)

Question became what was the serviceability of SB portion (beams 1 to 8) of the structure?

**Each girder suffered distortion throughout.** The worst being beam 8 which was closest to the fuel source. East end of beam 8 bottom flange exhibited lateral and vertical distortion.



# BRIDGE DAMAGE ASSESSMENT (CONT.)

Question became what was the serviceability of SB portion (beams 1 to 8) of the structure?



Steel deck SIP visibly distorted throughout all bays.



Intermediate cross frame diaphragms severe distortion throughout.



All elastomeric bearings at the far abutment had shifted to the left. Bearing not fully bearing on the pads.



# BRIDGE DAMAGE ASSESSMENT (CONT.)

## SB showed significant elastic deformation

Videos shared on social media of public driving over the I-95 SB structure during the height of the fire showed a significant dip in the bridge deck. At time of inspection, the I-95 SB structure did not appear to exhibit this sag and rebounded back to near original profile.



# BRIDGE DAMAGE ASSESSMENT (CONT.)

## Inspection Findings:

- Underside exhibited severe damage from the heat of the fire, paint loss and soot staining to all superstructure and substructure components. **Heavy soot staining did not permit detailed inspection of connections for the presence of displacement-induced cracking.**
- **All beams exhibited web distortion.** Beam 8 was largest at 2 ½" at end and 2" at mid-span. Beam 1 had ½" at end and ½" at mid-span.
- Steel deck SIP visibly distorted throughout all bays.
- Intermediate cross frame diaphragms severe distortion throughout.
- All elastomeric bearings at the far abutment had shifted to the left. Bearing not fully bearing on the pads.
- **Southbound Superstructure Damage Concluded beyond Use or Repair.**



# TEMPORARY SOLUTION

**On Sunday, the primary objective that we established was to come up with a solution that would re-open I-95 mainline as soon as possible.**

Discussion took place on site, between the Contractor and Department personnel discussing how to do that. After discussions throughout the day and into Monday morning. It was decided that filling the location in and constructing a **Temporary Mechanically Stabilized Earth wall system** would provide the quickest solution. The contractor began making arrangements to acquire materials to have on hand immediately after demolition.

## Considerations:

Surcharge on underground utilities. Philadelphia Water Department has facilities beneath the Ramp that were impacted from the fire and would be subject to loading from proposed solution.

Outside bridge barriers and median barrier.

How would the temporary solution staging would be integrated into our permanent repairs?





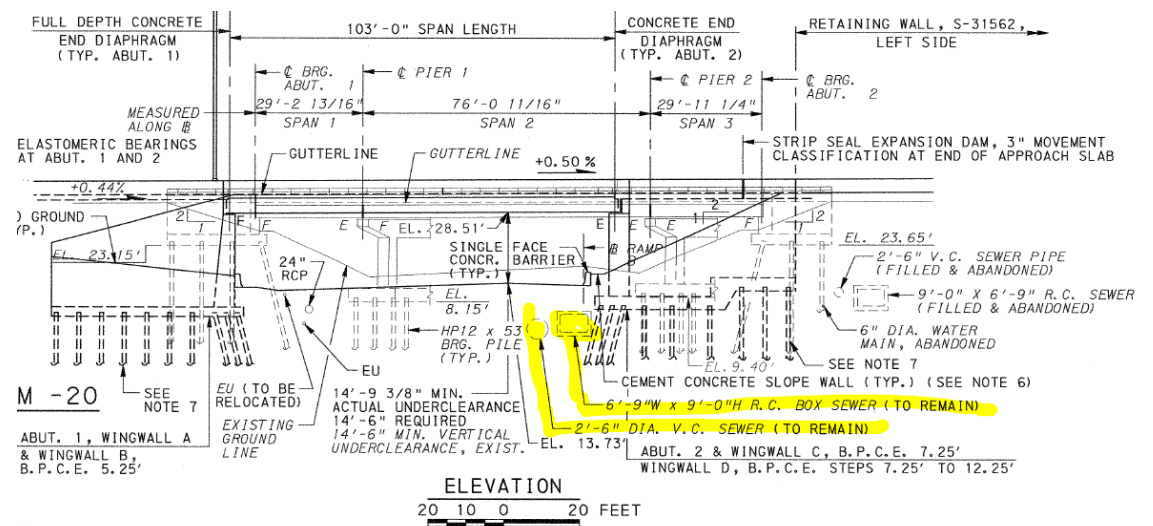
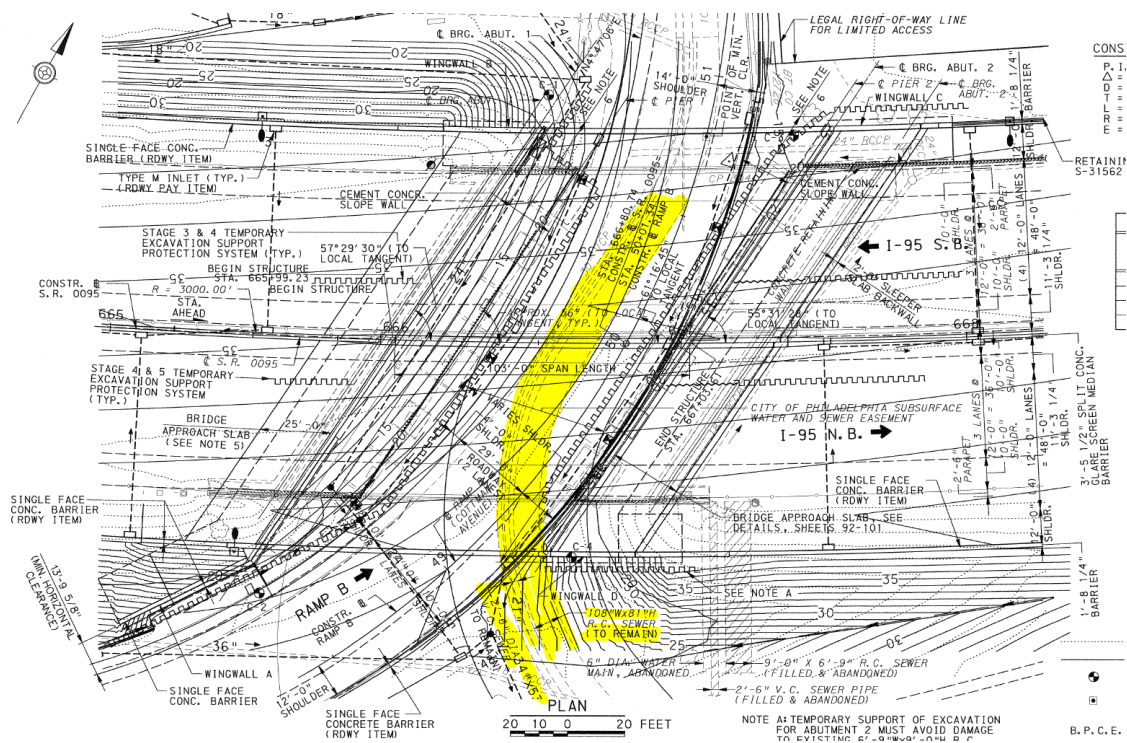


# TEMPORARY SOLUTION

Surcharge on underground utilities beneath Cottman Avenue Off Ramp (Philadelphia Water Department)

30" Vitrified Clay Pipe Sewer

6'-9" W x 9'-0" H Reinforced Concrete Box Sewer

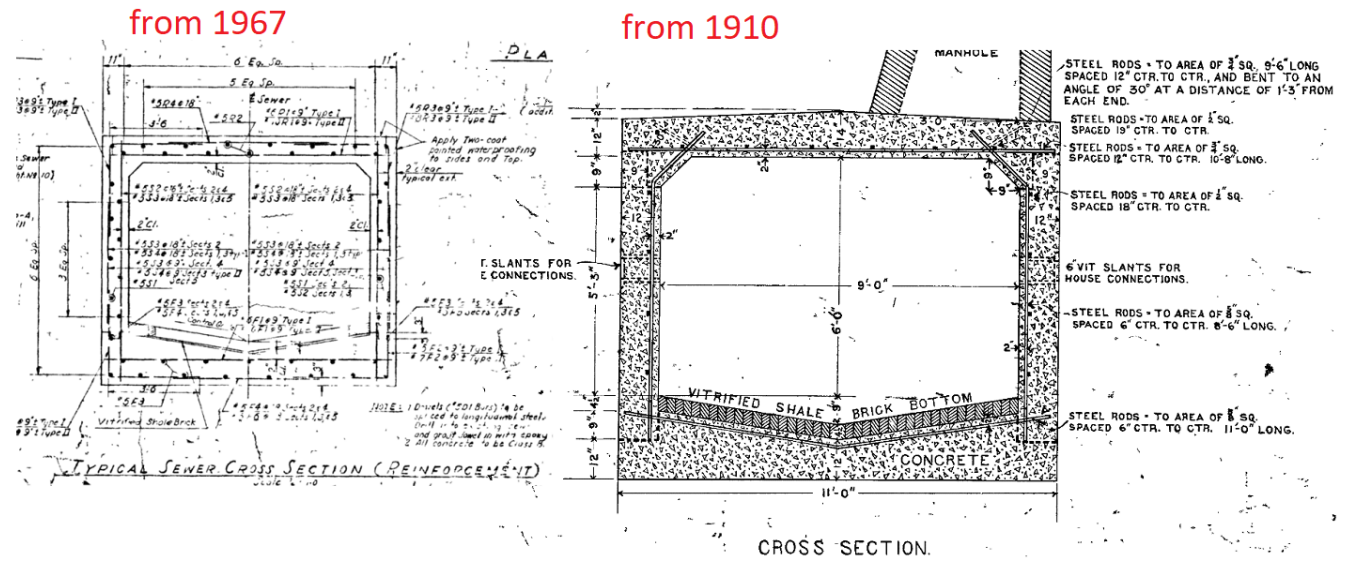
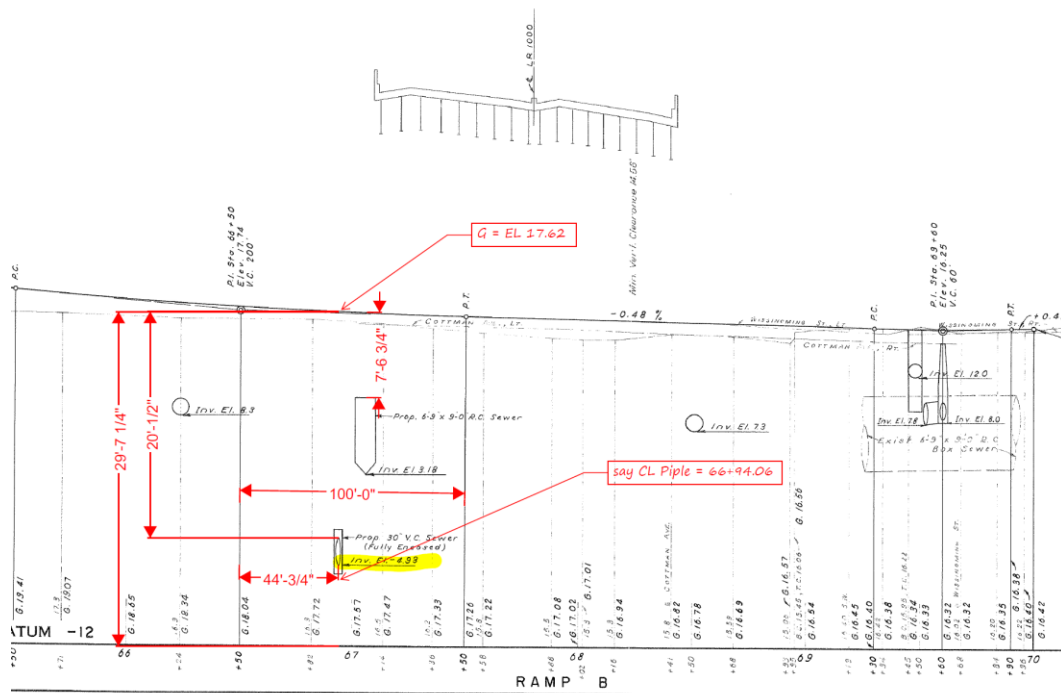


# TEMPORARY SOLUTION

Surcharge on underground utilities beneath Cottman Avenue Off Ramp (Philadelphia Water Department)

30" Vitrified Clay Pipe Sewer, built 1960s ≈ 20' deep below concrete roadway on Ramp B/Cottman Ave

6'-9" W x 9'-0" H Reinforced Concrete Box Sewer, two segments, one built 1967, other 1910, ≈ 7.5' below concrete roadway on Ramp B/Cottman Ave



# TEMPORARY SOLUTION

Coordination took place with the Philadelphia Water Department discussing their facilities and the potential impact to them from our proposed temporary solution. We wanted to assure that we exercised extreme care and proper due diligence before proceeding.

As part of our analysis for the feasibility of the temporary repair, we assessed the potential effect of placement of fill on the strength of the underground PWD 108" x 81" RC Box Sewer and the 30" VCP Pipe, as well as the effect the fill could pose on settlement of the culvert and pipe.

Performed a BXLRFD run comparing existing condition with live load and minimal fill and compared to temporary fill condition. The rating results indicated that the culvert rating is controlled by the existing condition of live load on Cottman Avenue prior to the bridge collapse.

At request of PWD, we also performed an ACI 350 analysis of the RC box sewer, and similar to the BXLRFD run the box culvert is controlled by the rating prior to bridge collapse.

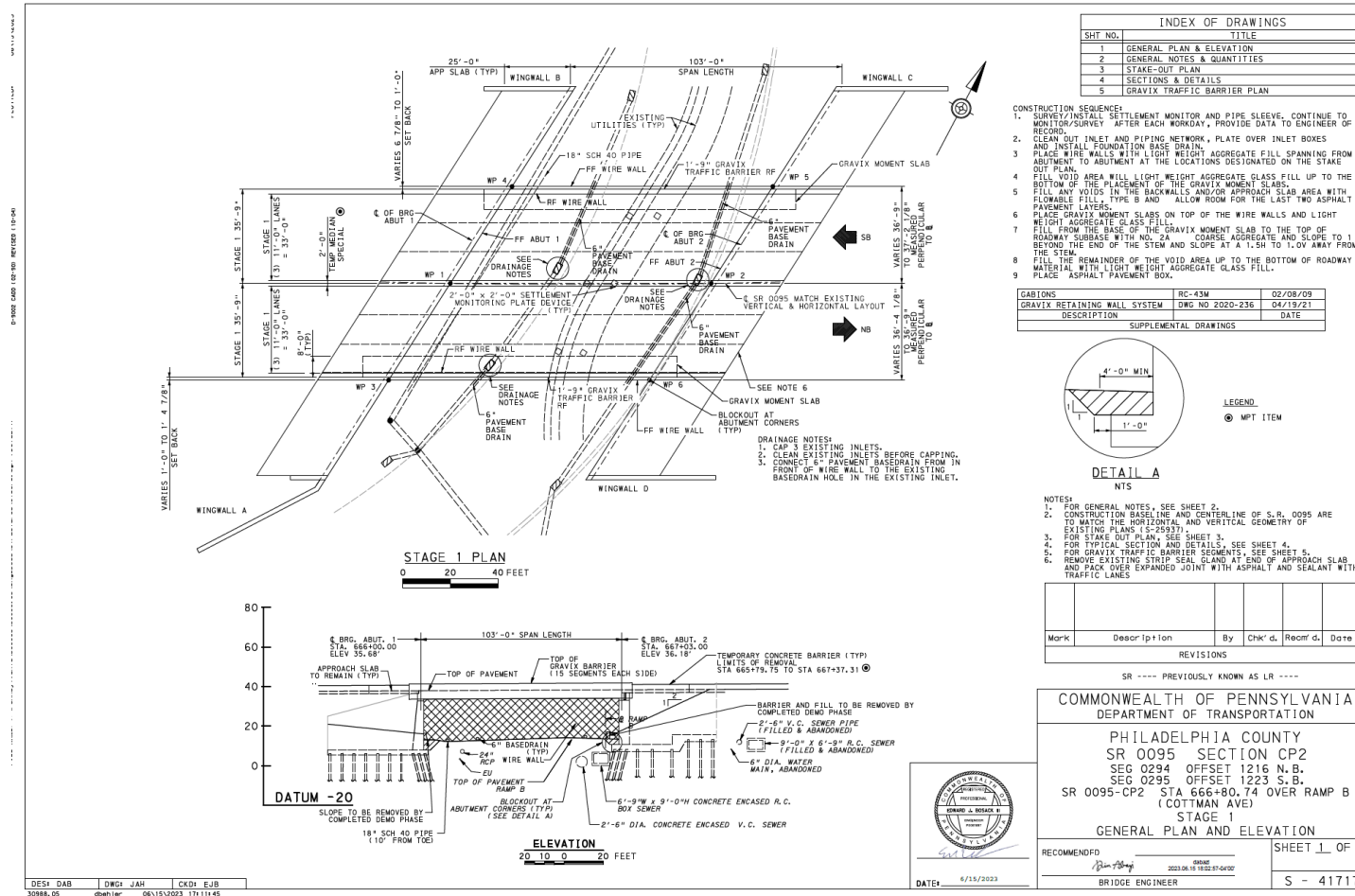
Performed a load comparison of 30" VCP analyzing pre and post conditions, calculations showed that the proposed condition was satisfactory for the concrete encased 30" vitrified clay pipe.

Computed elastic settlements for the proposed fill-in condition, between 0.25" and 0.5" for dead load. Recommended the implementation of settlement monitoring during the construction of the fill.



# TEMPORARY SOLUTION

Type, Size and Location was provided to Aero Aggregate/Schnabel Engineering . They then provided shop drawings and external stability analysis for review and approval. Our permanent staging guided our decision making for the temporary solution.



# MATERIAL PROPERTIES AND AVAILABILITY

In order to address the loading concerns on the underground facilities, we needed to use an ultra lightweight fill. We have successfully used Aero Aggregates along the I-95 Corridor. Aero Aggregates is located in Eddystone, PA approximately 20 miles South of the bridge collapse.

## Aero Aggregates Material Properties:

Compacted density is approximately **20 lb/ft<sup>3</sup>** compared to **120 lb/ft<sup>3</sup>** for traditional backfill , **6x lighter**

Produced from 100% recycled glass, the material is free draining, waterproof, rot resistant, acid and chemical resistant and non-combustible.

I-95 SEC: CAP requires approximately 85,000 CY to be supplied by Aero Aggregates. Material was readily available to accommodate the repair. We needed approximately 8000 CY.

Delivered in 100 CY tractor trailers.



# UTILITIES REQUIRE LITE WEIGHT MATERIAL



## FAST FACTS

**140**  
MILLION



### GLASS BOTTLES

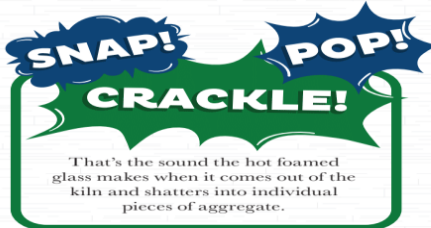
The equivalent of how much glass AeroAggregates plans to take from curbside recycling bins in the Delaware Valley and turn into a construction material made from 100% recycled glass that will be used to build roads and infrastructure.

**32,000** TONS

The amount of glass AeroAggregates estimates will be kept out of area landfills per year (the equivalent of 140 million beer bottles).

### ANY SIZE COLOR TYPE OF GLASS

The biggest challenge in glass recycling is sorting the glass by color and size. Mixed color and small pieces often go straight to the landfill. The process used by AeroAggregates can take any size and mixed colored glass that does NOT need sorting. We foam the glass so the end product is 100% recycled glass.



WEIGHS **85%** LESS

Our Ultra-lightweight aggregates weigh 85% less than traditional quarried aggregates and 65% lighter than other "lightweight" aggregates.

### HOW WE GO FROM SHARDS OF GLASS TO ROCK

We clean the glass cullet (defined as recycled broken or waste glass), mill it into a powder, and process it through a kiln. While in the kiln, the foaming agent reacts and the glass powder forms into a cake. When the foam cake moves out of the kiln and hits the ambient air, it breaks into aggregate pieces approximately two inches in diameter. It's really cool to watch.



**ONE**  
DUMP TRUCK OF  
ULTRA-LIGHT-  
WEIGHT ROCK



vs.

**EIGHT**

DUMP TRUCKS OF STANDARD WEIGHT

Since dump trucks that transport quarried rock are filled by weight not capacity, and since quarried rock weighs about 7 times as much as Ultra-lightweight rock made from 100% recycled glass, it takes 8 dump trucks to deliver the same load by volume versus just one truck of recycled glass rock. That means just by using Ultra-lightweight rocks made from 100% recycled glass in a road or construction project, we are taking 7 trucks off the road. That's good for traffic, good for roads, and good for the environment.

### WHY IT'S A BIG DEAL FOR THE NORTHEAST REGION



Think about how roads are constructed in the Northeast, where coastal soils are soft and compressible. Road construction often requires major ground improvement so that the roads on that soft soil do not settle too much. AeroAggregates is able to offer engineers a unique product for consideration in their designs that was never before available in the region. There are no other products on the market that are ultra-lightweight, insulating, sustainable, and have a high friction angle like foamed glass aggregate.

### WHERE WE USE IT

We create Ultra-lightweight aggregate that looks like pumice stone. These Ultra-lightweight rocks are used as embankment or retaining wall fill in highway, railway, and airport construction. Our ultra-light rocks can also be used in building construction as an insulator or drainage material.

### & ONE MORE THING:

Our 100K square foot factory sits on the 10-acre site of a former brownfield. Not only are we cleaning up the glass in the Delaware Valley, but we cleaned up the site where we work, creating a fully sustainable business model. We're pretty proud of that.



# I-95 DEMOLITION

Abbonizio Construction started  
June 11 around 4:00 PM.

Approximately 783 CY or 1,585 tons of  
concrete was removed.

Approximately 139,059 lbs. of bridge  
deck reinforcing steel was removed.

Approximately 400,000 lbs. of structural  
steel was removed.

Photo of the last beam removed  
June 15 around 4:00 PM.

Bridge was removed in 5 days so Buckley  
& Co. could start the structural fill Friday  
morning June 16.



# SUNDAY - JUNE 11

June 11, northbound collapsed.

Firemen are on the scene to keep the smoldering down.

Crash was on the east side north abutment corner.

The fuel truck hit the corner of the abutment and instantly exploded.

Fuel had leaked into the sewer system but didn't catch fire right away.

Once the fuel hit the outlet near the river, air circulated and caused an explosion, all the manhole lids popped in the air.





# SUNDAY - JUNE 11

A shot of the back wall and collapse on the northbound side.

You can see this still smoldering.

Fire crews stayed on scene as we continued to demo.



# MONDAY - JUNE 12

Northbound side  
demolition, burned  
beams, and the tanker.



# MONDAY - JUNE 12

Assessing the scene.

Making sure there were no other vehicles.

The camera showed a vehicle entering in front of the tanker.

The camera didn't show the vehicle exiting.

Carefully demoed to see if they could find the other vehicle.

No other vehicle was found.



# I-95 CLOSED

Eerie not seeing any traffic on I-95.



# SELFIE

How often can you stand in the middle of an interstate with no traffic on it and take a selfie???



# DETOUR ROUTE

CCTV cameras were used for situational awareness of traffic throughout region during initial and ongoing response.

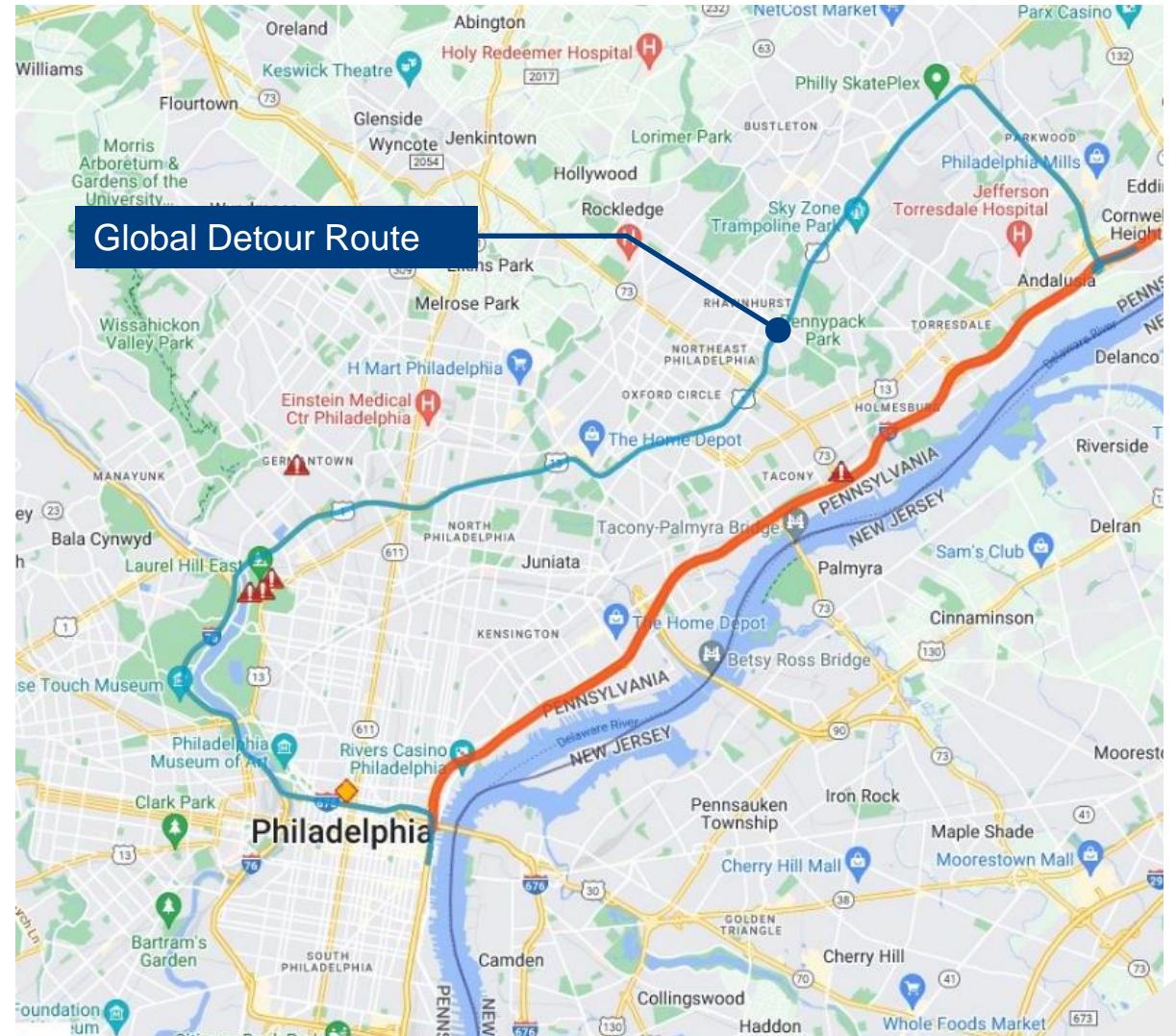
Dynamic Message Signs were used to provide information to drivers.

Nearby construction projects deferred lane closures to aide detoured traffic.

Freeway Service Patrol trucks were dispatched to Roosevelt Boulevard for detoured traffic.

Travel times were monitored using INRIX crowd-sourced data.

Portable cameras were utilized to maintain views of worksite.

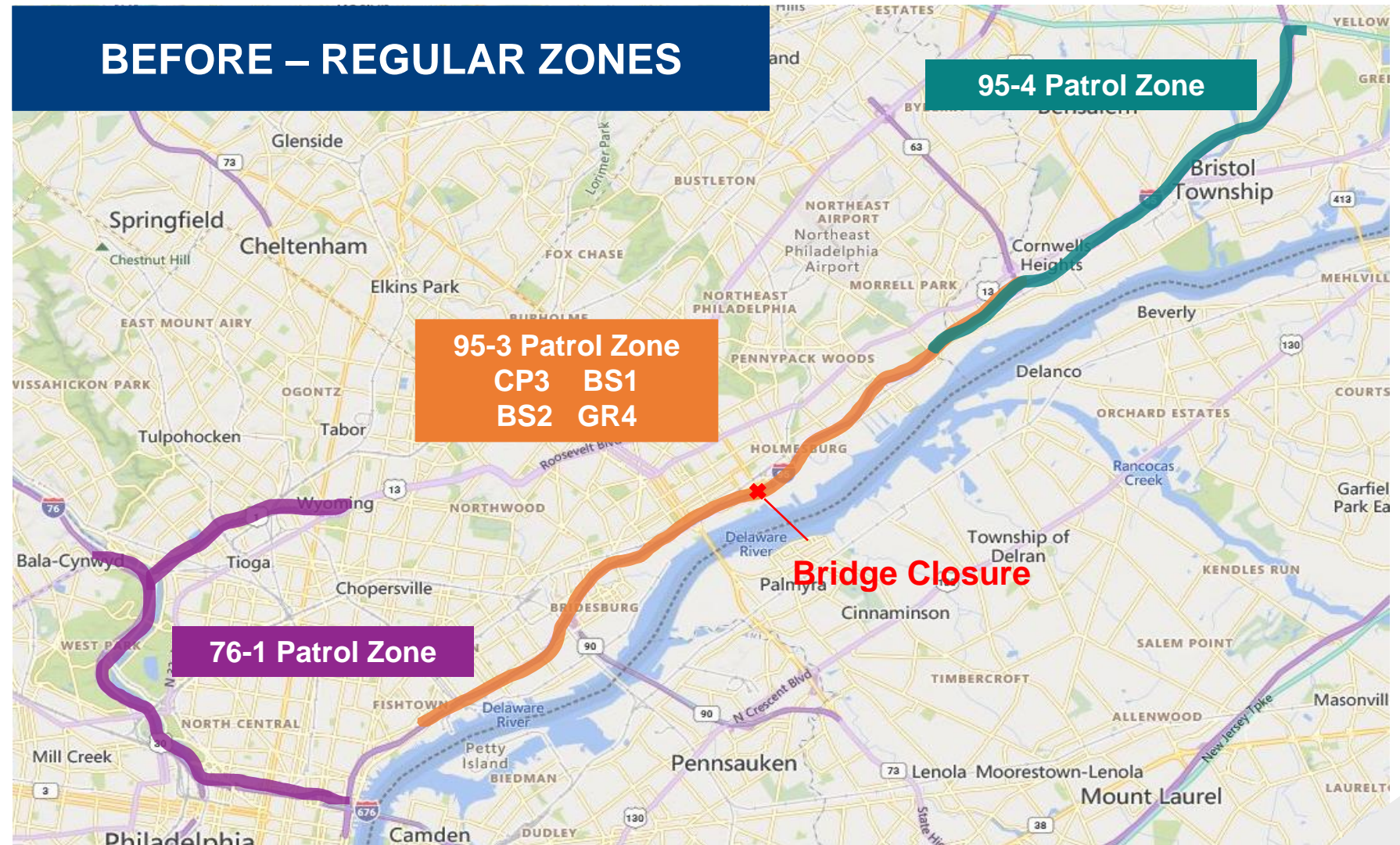


# FREEWAY SERVICE PATROL

## Project Specific Zones

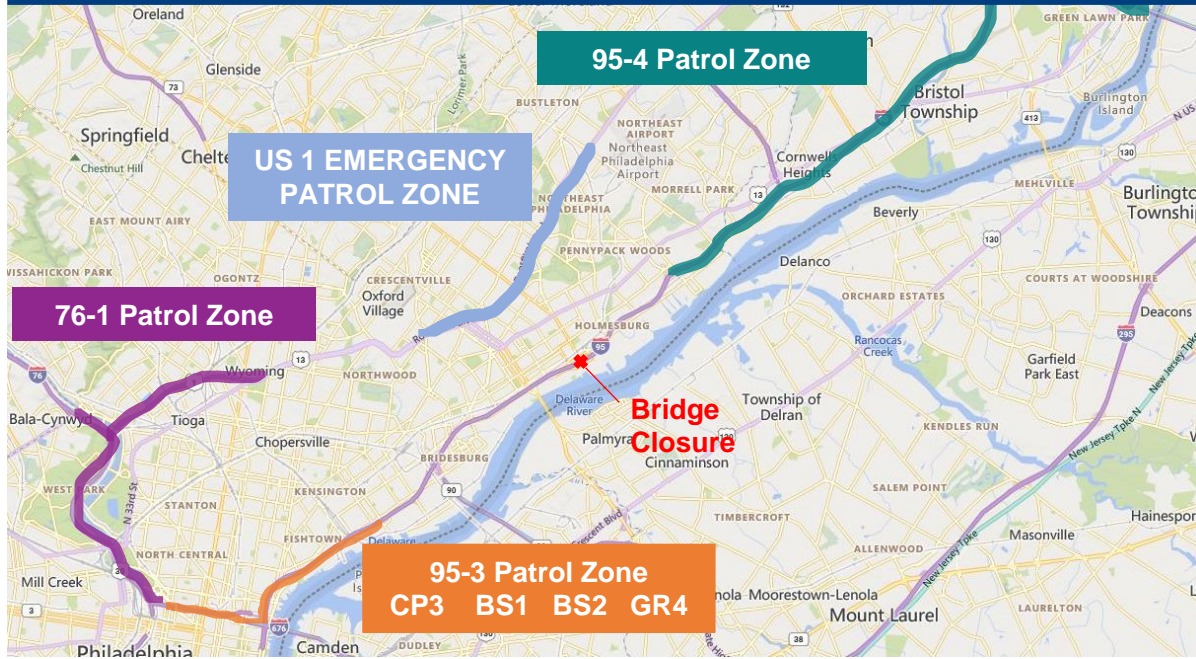
- **CP3** covers 95 NB from Cottman Ave to Academy Rd and 95 SB from Academy Rd to Cottman Ave
- **BS1** covers 95 NB from Bridge Street to Cottman Ave & 95 SB from Cottman Ave to Bridge St
- **BS2** covers 95 NB and SB between Castor Ave and Comly St.
- **GR4** covers 95 NB and SB from Allegheny Ave to I-676

## BEFORE – REGULAR ZONES



# FREEWAY SERVICE PATROL

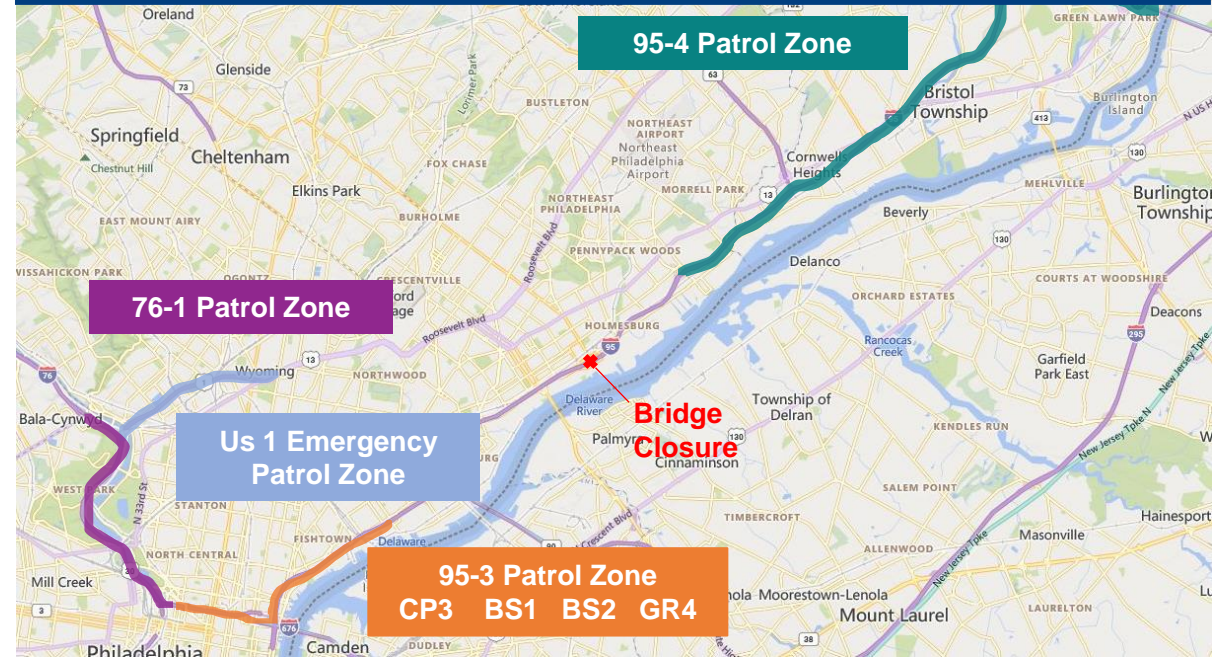
## AFTER – FIRST MODIFICATION



76-1 patrol covered usual section of 76 and added US 1 Emergency Truck to US 1 based on observations.

95-3 Patrol Zone was shortened and added the length of I-676 to support 76-1 Patrols.

## AFTER – SECOND MODIFICATION



95-4 Patrol Zone was slightly lengthened to include coverage south to Academy Road.

76-1 Patrol Zone relocates truck to further south on US 1 between Roosevelt Extension and 9<sup>th</sup> Street.





# LOCAL DETOUR

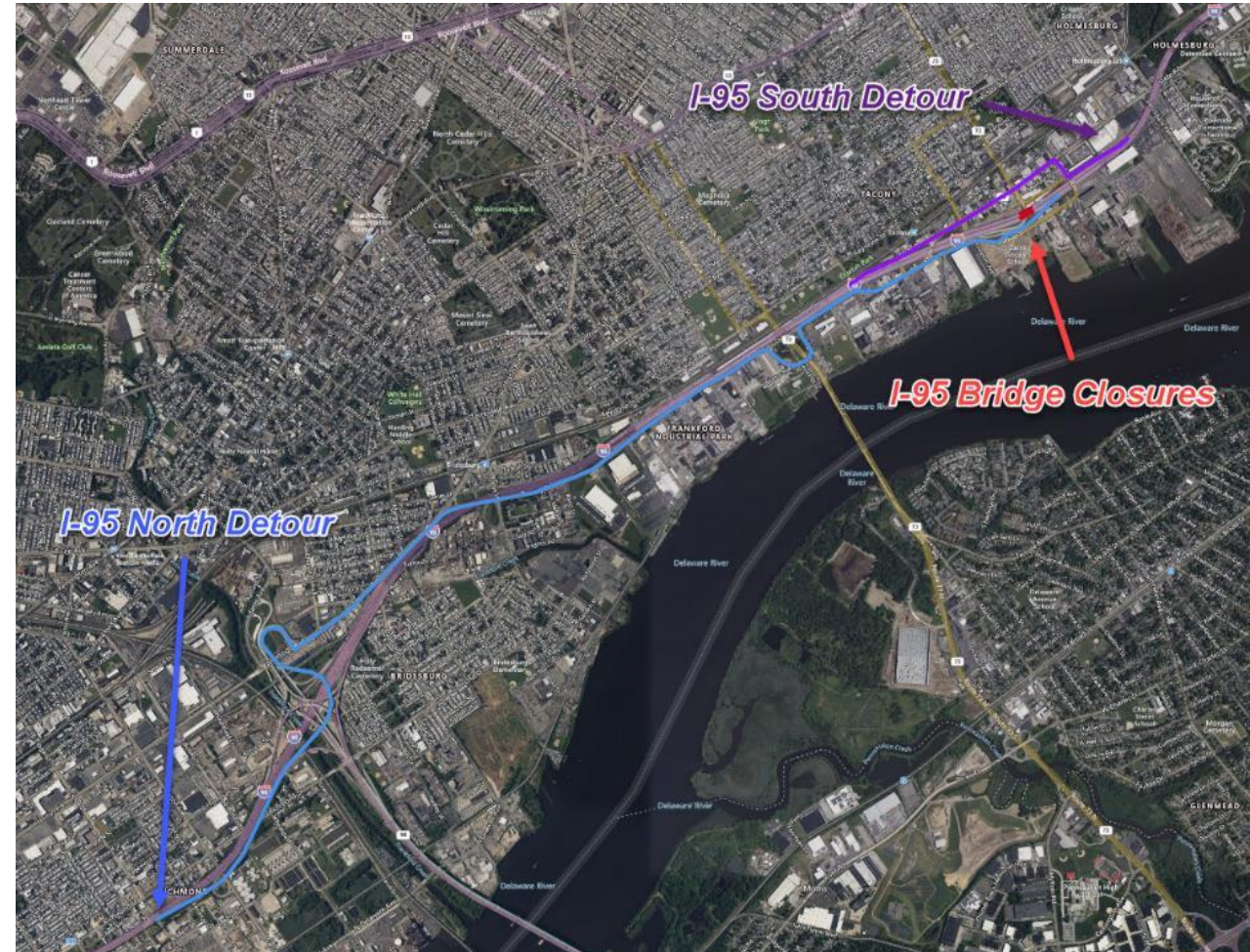
City police directed traffic 24/7.

Traffic control placed to reduce lanes and speed in advance of off-ramps.

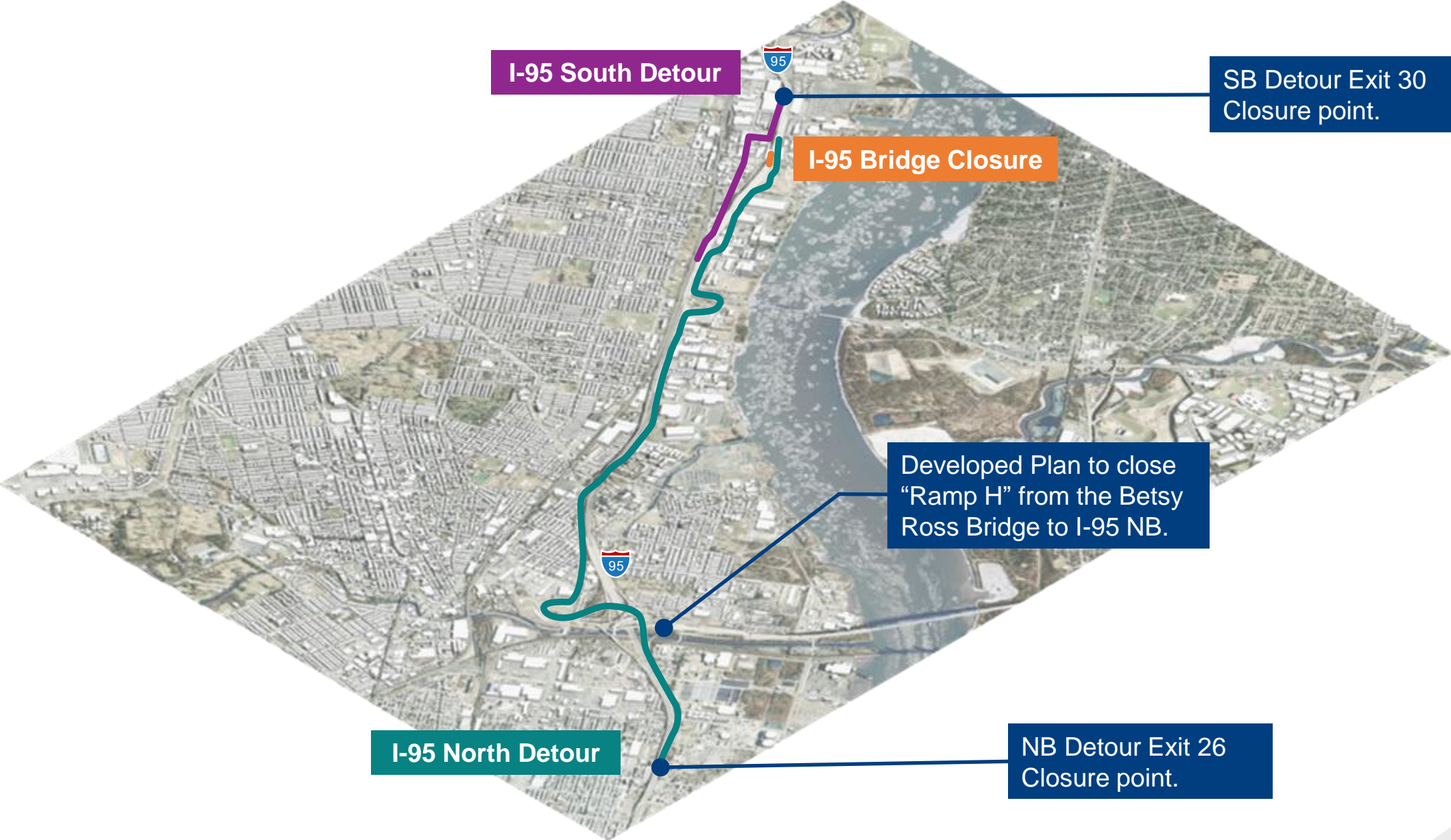
Various pavement marking improvements made to improve traffic flow.

Coordination with City key to improving conditions.

Portable cameras set up to view key points.



# IMPROVEMENTS TO LOCAL DETOUR



I-95 South Detour

SB Detour Exit 30 Closure point.

I-95 Bridge Closure

Developed Plan to close "Ramp H" from the Betsy Ross Bridge to I-95 NB.

I-95 North Detour

NB Detour Exit 26 Closure point.



# IMPROVEMENTS TO LOCAL DETOUR

Modified Island on State Road to provide space for two lanes.

Added 2 lanes to I-95 SB on ramp from State Road.

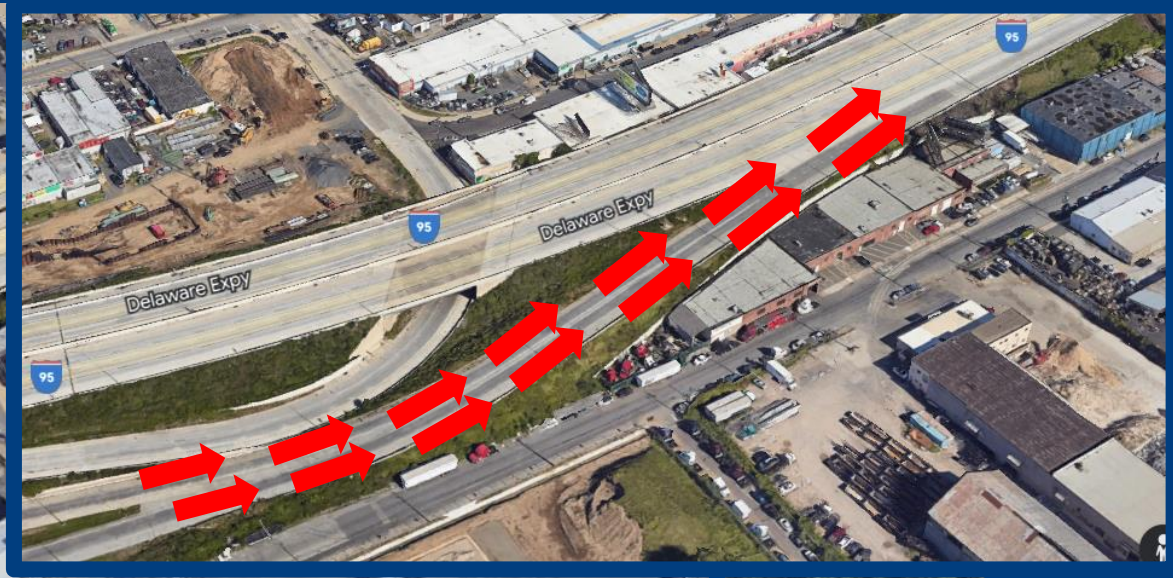
Striped two lanes on I-95 NB on-ramp.

I-95 South Detour

SB Detour Exit 30 Closure point.

I-95 Bridge Closure

Striped two lanes on SB I-95 off-ramp to Bleigh Ave.



# BRIAN GIFFORD JBC

Teamwork. There were so many people working behind the scene that didn't get the recognition that they deserve.



# TUESDAY - JUNE 13

Cleaning the northbound side. Deck removals of the southbound side begin.

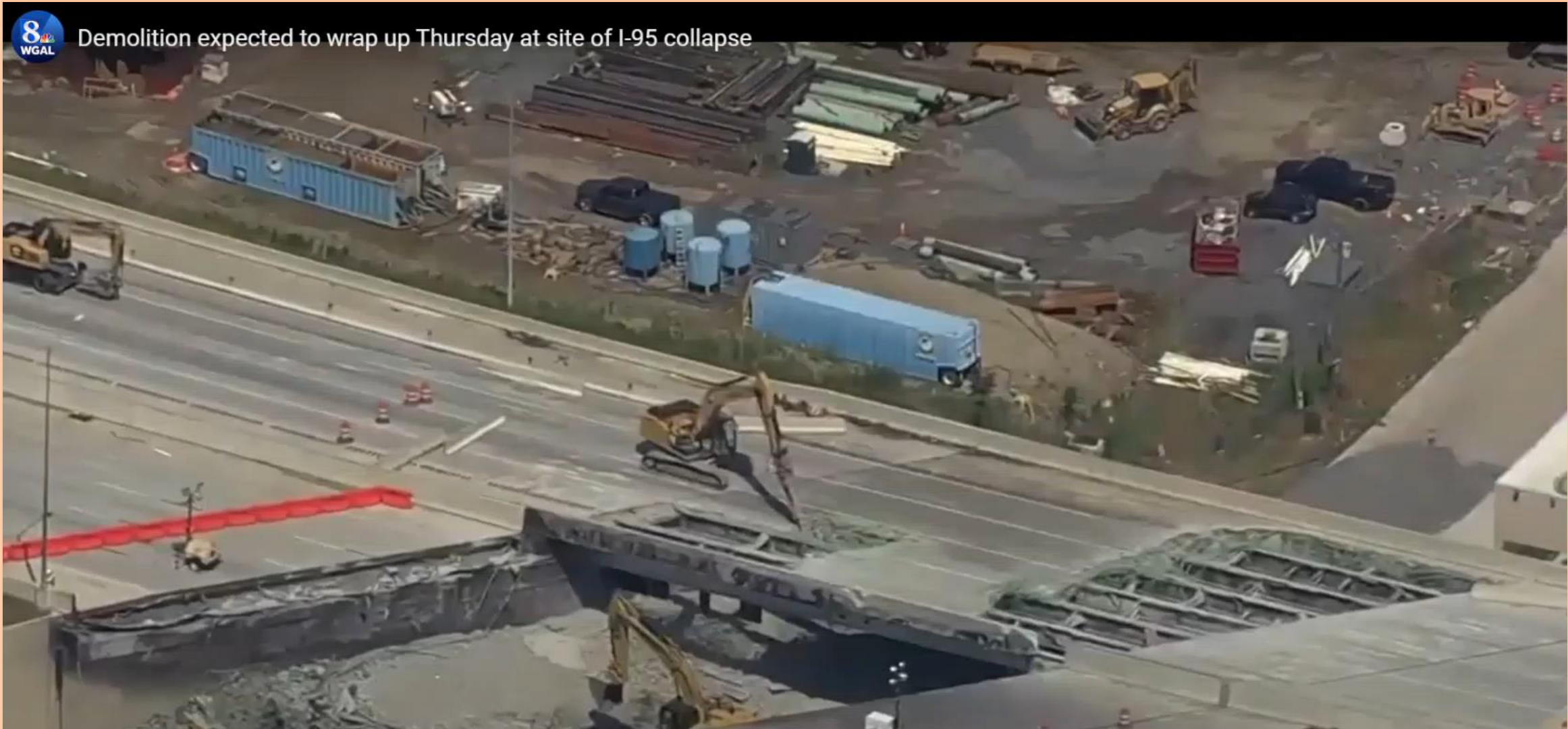


# WEDNESDAY - JUNE 14

Southbound side deck removal. The contractor elected to peck and remove the deck from the top side.



# I-95 DEMOLITION



Demolition expected to wrap up Thursday at site of I-95 collapse



# WEDNESDAY - JUNE 14

Deck is being cleaned.  
Beam 1 getting ready to be picked.





# THURSDAY - JUNE 15

Beam 3 is being removed.



# THURSDAY - JUNE 15

Dirt was hauled in to protect the underground utilities during the demo.



# THURSDAY - JUNE 15

Beams continue to be picked. Gather up the rebar to be hauled away.



# THURSDAY – JUNE 15

The first of many loads of the lightweight stone was delivered.



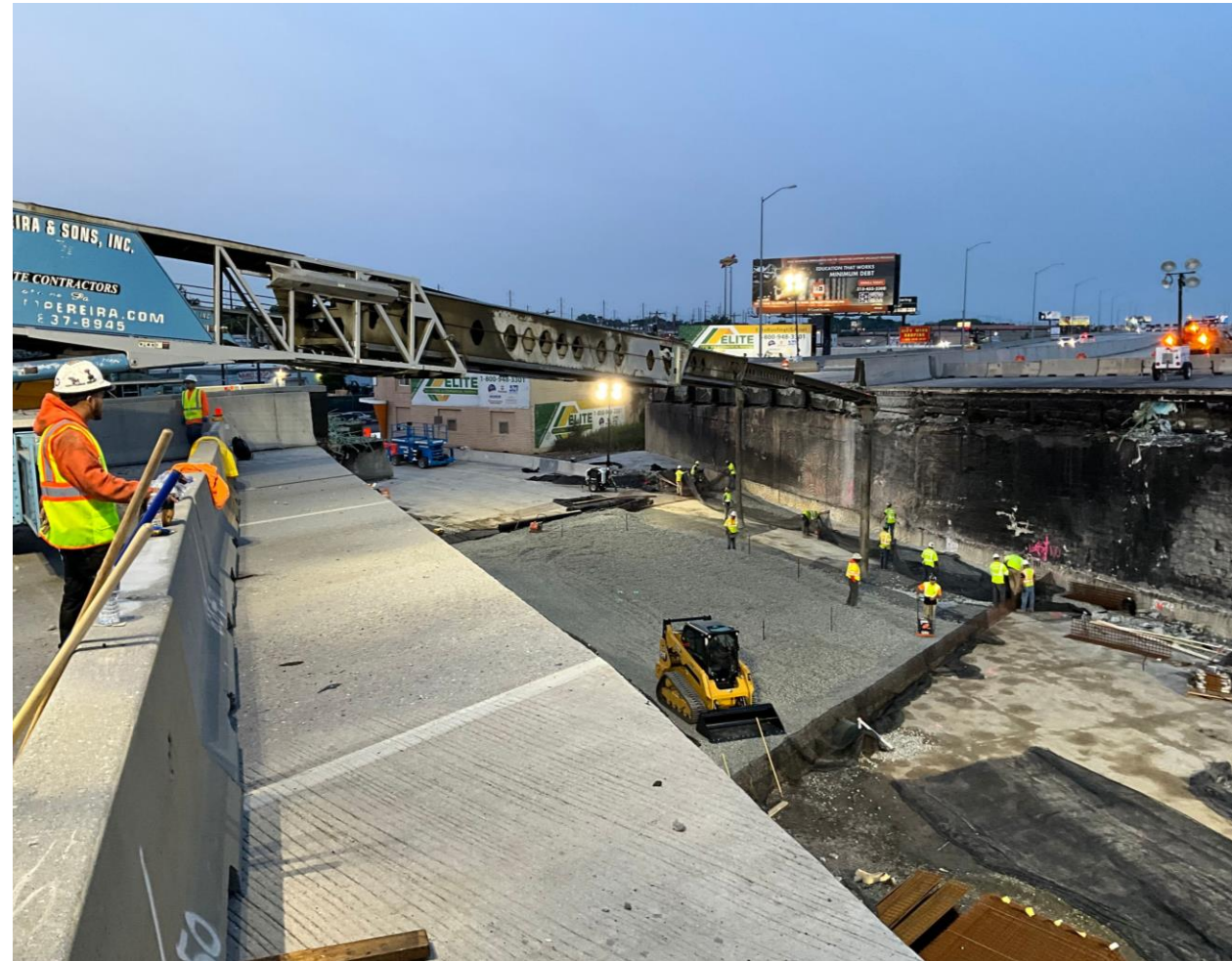
# GLASS AGGREGATE

Crews started Friday, June 16, in preparation for installing glass aggregate.

This photo shows the night of June 16 using a conveyor system to install aggregate.

By noon Monday, June 19, crews were close to the grade elevation for the slab concrete barrier.

Total amount of Lite Weight Glass aggregate for structural fill was 7,796.88 CY.



# THURSDAY - JUNE 15

The three amigos. Jaffar from PennDOT and Paul from JBC were borrowed from our 95 BR2 project to help run the emergency work.



# FRIDAY - JUNE 16

Crash on a local road. A vehicle hit a pole, closing down the intersection. This was a major detour route and had to close temporarily. Just some of the challenges off-site we had to deal with.



# FRIDAY - JUNE 16

A 24-hour camera was relocated to open up the slip ramp once used for staging.





# FRIDAY - JUNE 16

Demo completed.

Used regular 2A modified to level out the superelevation of this off-ramp.

Geo fab was installed.

Cores were taken in a grid pattern to assess the abutment wall integrity.

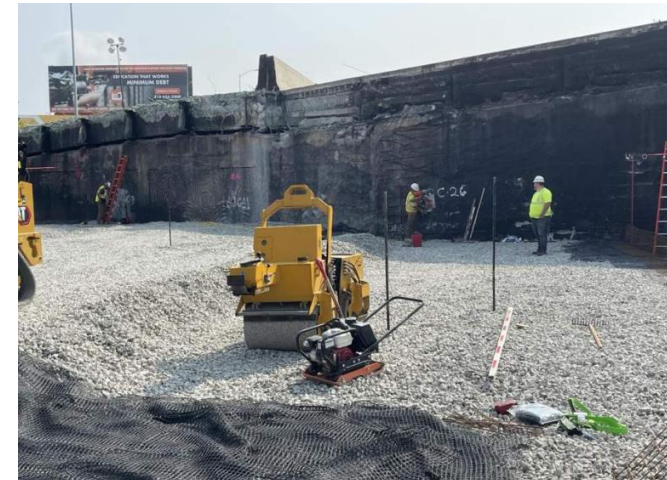
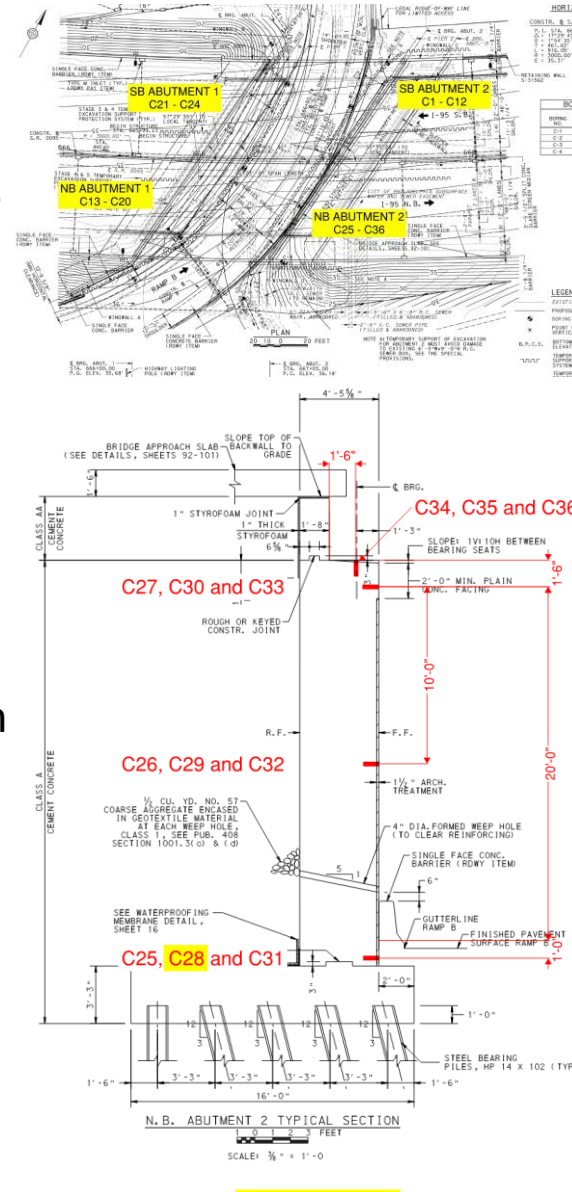


# CONCRETE CORING AND MATERIAL TESTING

While we were constructing the temporary MSE wall, we developed a concrete coring plan for the abutments to determine extent of damage. 36 cores were taken. The North East Abutment, was the location closest to the fire and where most intense heat was located (core locations C25-C36). We requested that C25-C36 cores be tested first. At that location the post fire concrete loss was up to 5.5". Original abutment stem thickness > 4.5'.

Testing included petrographic examination to determine depth of distress beneath exposed surface (i.e. cracking, discoloration, softening of paste, alterations, etc.). Examination showed that cracking was present to a maximum depth of 1 ½", thusly we would be required to remove approximately 6 ½" from the form liner face. This supported reuse of the existing abutments.

Compressive strength testing results ranged from 5070 psi to 6610 psi well in excess of Class A strength requirements.



# FRIDAY - JUNE 16

Backfilling of the lightweight aggregate begins. A 24" bypass pipe was installed. This was preventative maintenance in case the water line under the ramp was compromised from the construction.



# FRIDAY - JUNE 16

Backfilling was done with 2 telescoping conveyer belts with tremies.

18" +/- lifts were installed.

This material does not get compacted, it gets consolidated.

Rubber tracked Skidsteers ran over the material 3 to 4 times to knit the material in.

Mike and Archie on-site during most of this process.



# FRIDAY - JUNE 16

The unsung hero of this process was the wire wall and geogrid.

The wire wall was installed at the ends with angle bars to keep the 90 intact.

The geogrid was installed up the sides and along the bottom.

This created a cradle for the stone and its where its strength comes from.



# FRIDAY - JUNE 16

Manhole lids replaced.

These were blown off in the explosion.

The gas leaked down the storm sewer and out to the river.

It didn't ignite until it reached the river and oxygen was introduced.

This caused a back draft sending our manholes straight up in the air.

Nobody was injured.



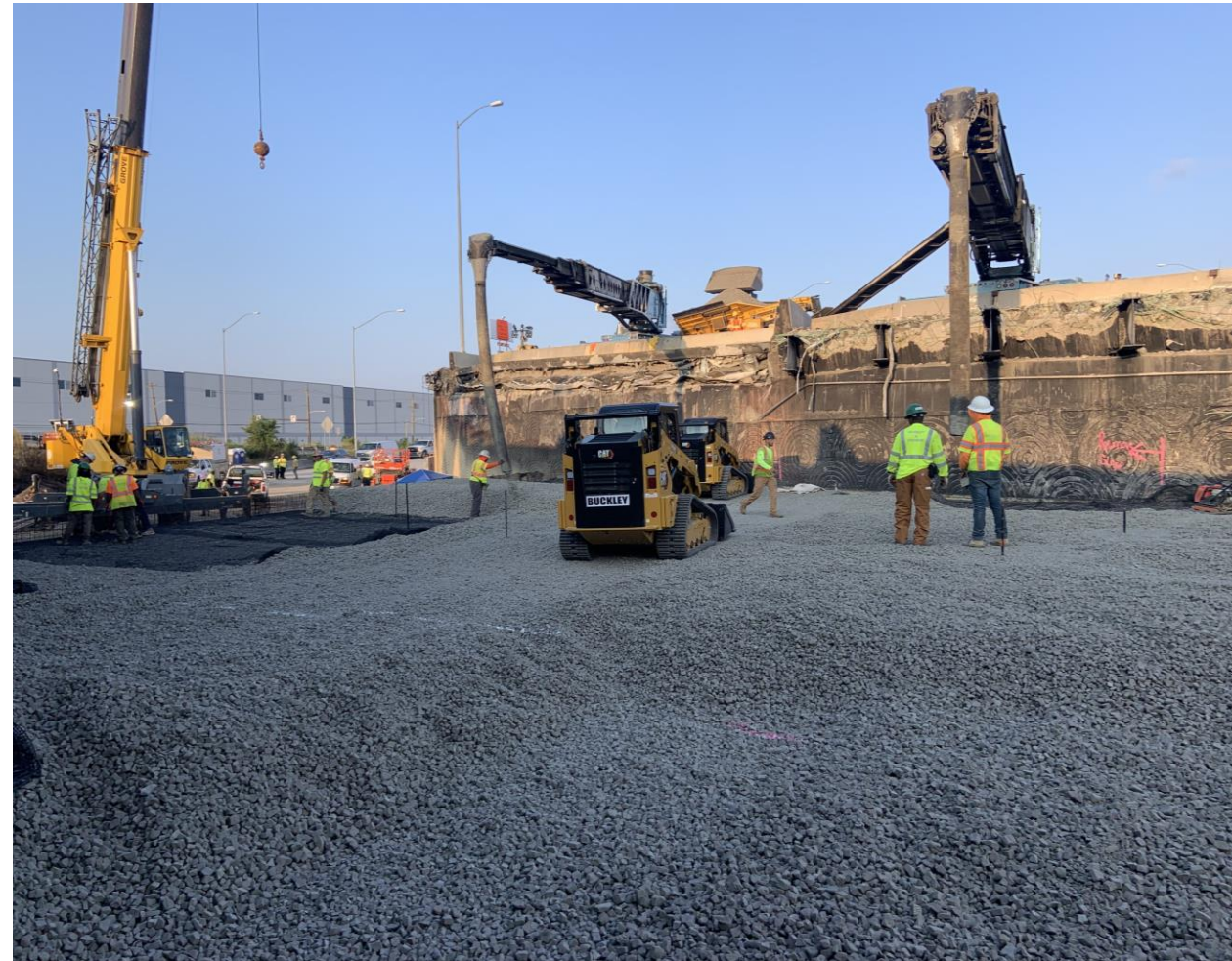
# SATURDAY - JUNE 17

Apx layer 5. Due to the superelevation, the first few layers took longer to install. Once level, we gained production.



# SATURDAY - JUNE 17

Settlement rods were installed. They were shot a few times a day. This was to see if there was any settlement to the roadway underneath as we placed this stone.





# SATURDAY - JUNE 17

Settlement rods extended.  
Skidsteer consolidating.



# SATURDAY - JUNE 17

Everyone was a laborer. Including our own Secretary of Transportation, Mike Carroll.



# SUNDAY - JUNE 18

Nearing the top. Production slowed down. Going from level baskets to now match existing roadway.



# MONDAY - JUNE 19

Existing deck and median barrier demoed to tie in the prefab median going across the temporary roadway.



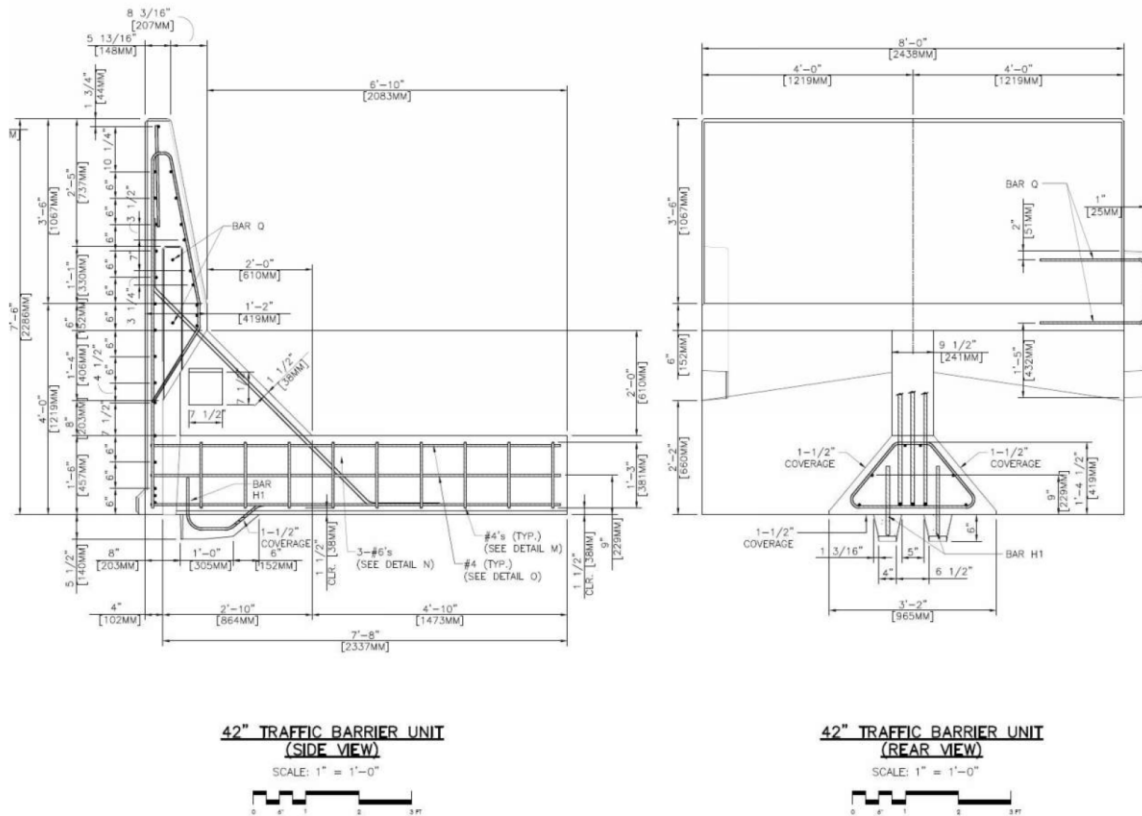
# MONDAY - JUNE 19

Gravix walls were delivered and staged.



# PRECAST ELEMENTS

The outside of our Temporary MSE system required a crash worthy barrier. Without having a concrete deck, a precast moment slab barrier was required. **Earth Wall Products, Gravix Moment Slab barrier offers an FHWA Mash TL-4 rated system that is approved for use by PennDOT.**



# TUESDAY - JUNE 20

The first piece is set. These pieces were already made and borrowed from another job.



# TUESDAY - JUNE 20

Six pieces were installed on the northbound side. The crew is starting to pick up the production now. Backfilling as we go.





# WEDNESDAY - JUNE 21

The northbound side is complete.  
This is the southbound side.



# GRAVIX PRECAST BARRIER

A big key to getting the project done in the time frame was the use of the pre-cast barriers.

They were borrowed from another project.

These units are designed by Gravix Wall Barrier Systems.

This allowed installation within a 24-hour period of all barriers.

Any other method would have taken weeks to install



# WEDNESDAY - JUNE 21

A concert leveling pad was installed for the median barrier.

Backfilling with modified continues.

Down to the bottom right, survey markers are being put on the wall.

These were also being shot to measure any of the outside wall settlement .



# WEDNESDAY - JUNE 21

Median barrier being installed.



# THURSDAY - JUNE 22

Paving continues.



# THURSDAY - JUNE 22

Wearing course paved and rolled.

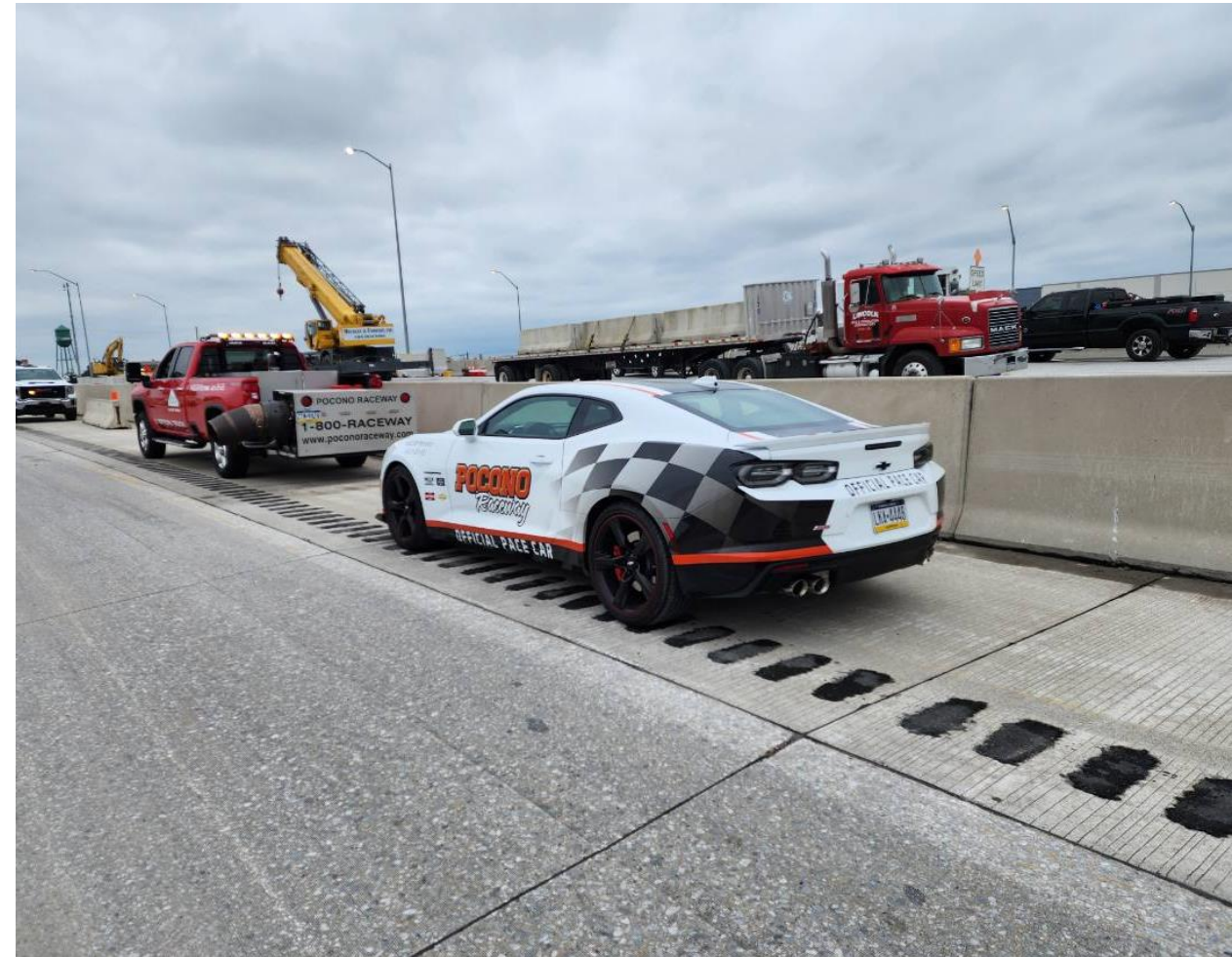


# THURSDAY - JUNE 22

Pocono Raceway even came down to help.

The threat of rain at the very end would make the road unable to paint.

So, the jet dryer came down to lend a hand.



# THURSDAY - JUNE 22

Line stripping begins as the wearing course cools.





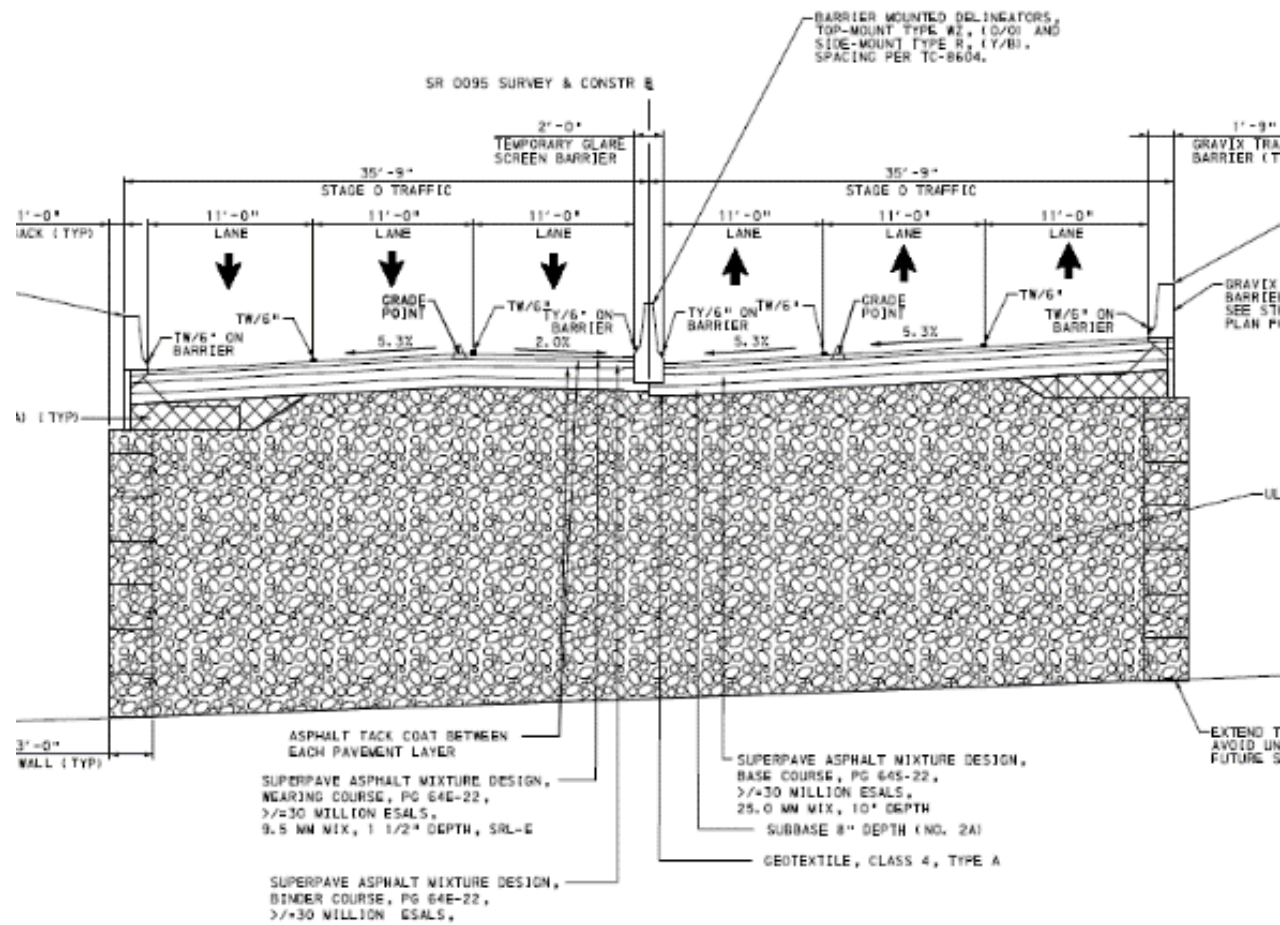
# TEMPORARY STRUCTURE TRAFFIC CONTROL

Required a shift and narrowing of lanes.

Speed restriction to 45mph implemented.

VSL trailer with flasher used to draw attention to speed along with legend markings and signs.

Trucks restricted to center lane.



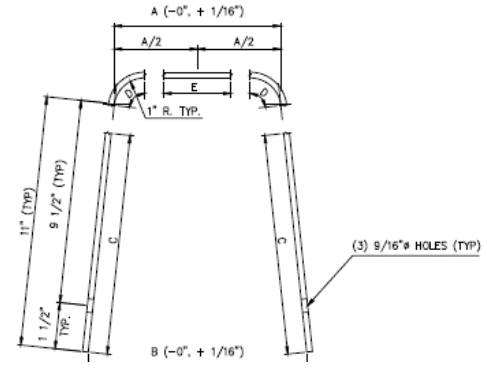
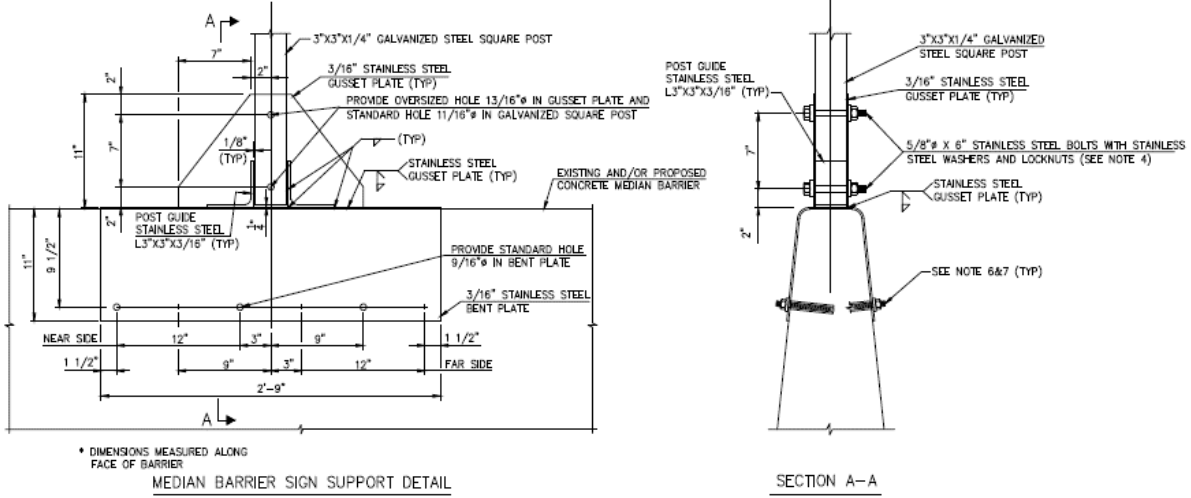
# TEMPORARY STRUCTURE TRAFFIC CONTROL



# TEMPORARY STRUCTURE TRAFFIC CONTROL

Creative locations for mounting signs.

Brackets required for mounting on median barrier.



# FRIDAY - JUNE 23

Today is the day! Metal barrier installed and transition pieces installed.



# FRIDAY - JUNE 23

Tacked down the inlet grates, and used a pendulum inside.



# FRIDAY - JUNE 23

Lines striped.  
Lights back working.  
Flag hoisted.



# FRIDAY JUNE 23

It's raining, but here is the look of a guy who hasn't slept in 12 days. Happy that we are close to the finish line.



# FRIDAY - JUNE 23

The first vehicles over the temporary road.





# FRIDAY - JUNE 23

A celebratory day!

Thank you to all our first responders!

12 days later, we are open!



# SOME OF THE CREW

In one photo you see everyone from the Governor's office to the contractors to the inspection team to the press. Couldn't have done it without everyone's help.





**THANK YOU**

# FOLLOW PENNDOT



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