



2023 Fall Conference at Ashore Resort & Beach Club
Ocean City, Maryland

**Interstate 95 Emergency Rebuild
Using Ultra-Lightweight Foamed Glass Aggregate**

Theresa Andrejack Loux, Ph.D., P.E., ENV SP
September 29th, 2023

BIOGRAPHY

- Theresa Loux is the Chief Technical Officer for Aero Aggregates of North America where her primary responsibilities include overseeing Aero's research and development activities, technical documentation, engineering support, quality control program, and education and outreach efforts. Theresa brings to Aero over fifteen years of combined industry and academic experience. In the past, she has been involved in and managed a variety of civil, geotechnical, and geoenvironmental consulting and construction projects in the Mid-Atlantic United States. Additionally, Theresa has taught geotechnical and other civil engineering courses at Rowan, Drexel, Temple, and Bucknell Universities and is the current chair of the Geo-Institute's Delaware Valley Chapter. In 2022, Theresa was awarded the Robert and Mitchell Landreth "Steward of the Environment" Award from the Geosynthetic Institute.



ABSTRACT

Interstate 95 Emergency Rebuild Using Ultra-Lightweight Foamed Glass Aggregate

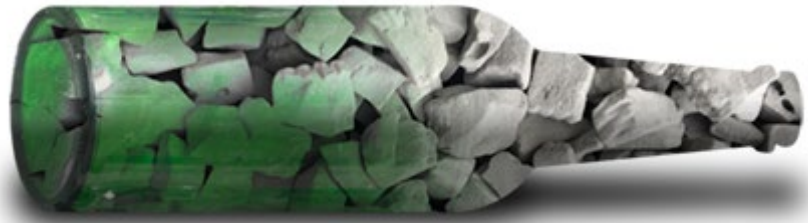
Presentation Overview

- I-95 in Philadelphia Rebuilt in 12 days using UL-FGA
- Primary Design Considerations: Underlying Utilities and Fast Construction
- UL-FGA Benefits: Low Density, Highly frictional, Permeable, Durable, Compatible with MSE, Quick Delivery/Install, No weather delays
- 1.0 PDH



AERO [®]
AGGREGATES

I-95 Emergency Repair
Philadelphia, PA



made from **100% RECYCLED**
container glass



UL-FGA[®]

Ultra-Lightweight

240 kg/m³ (15.0 pcf)

Good Insulator

**High Friction
Angle** 54°

Seismic Designs



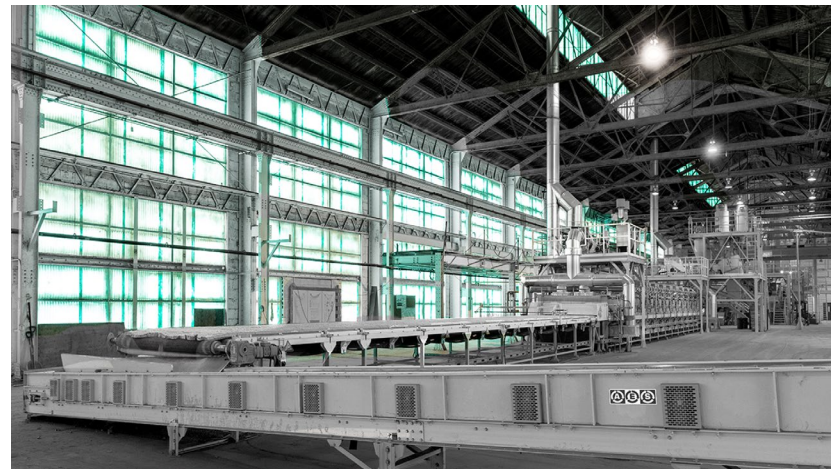
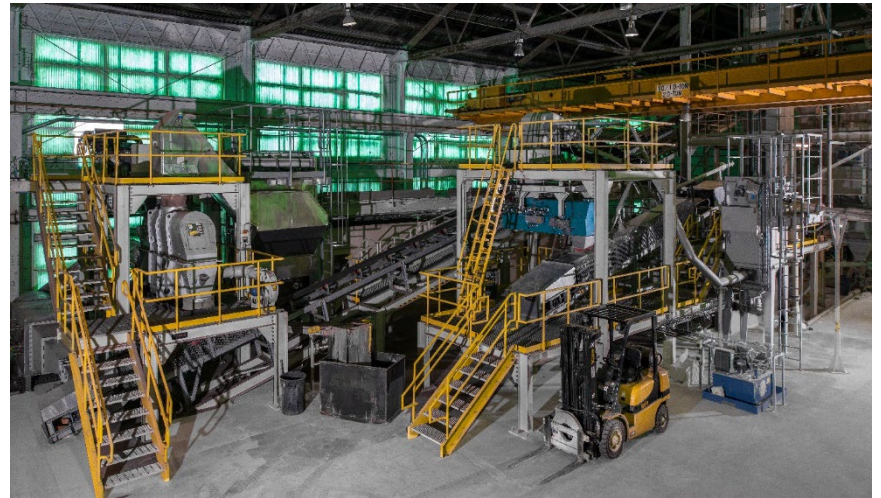
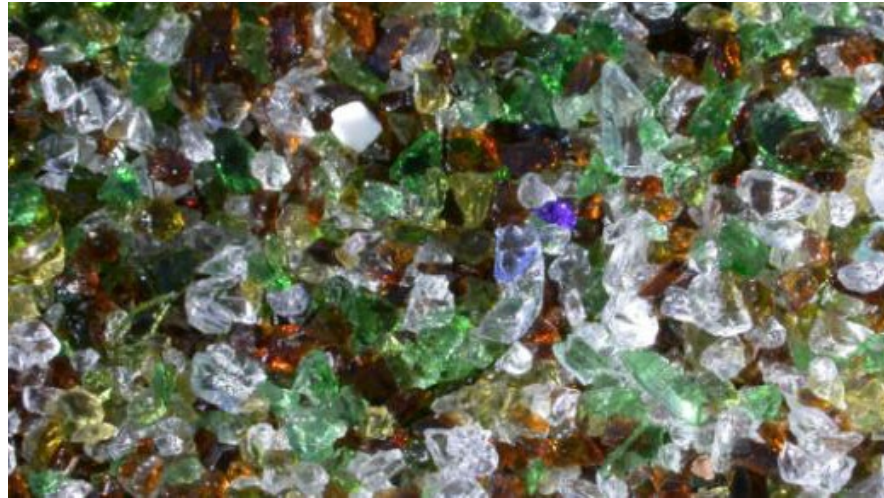
Frost Resistant

Capillary Break

Free-Draining

Load-Bearing

Manufacturing

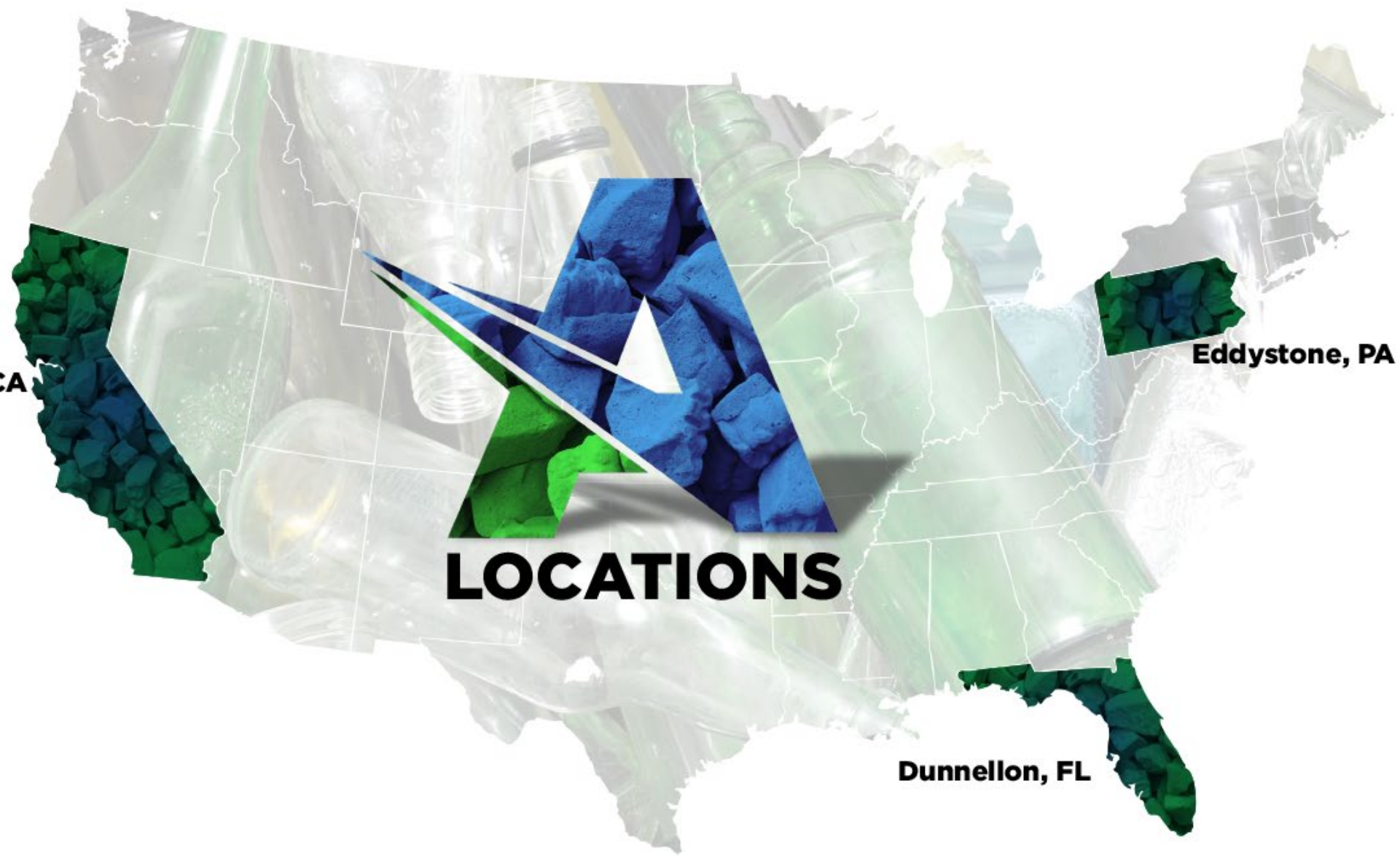


Modesto, CA

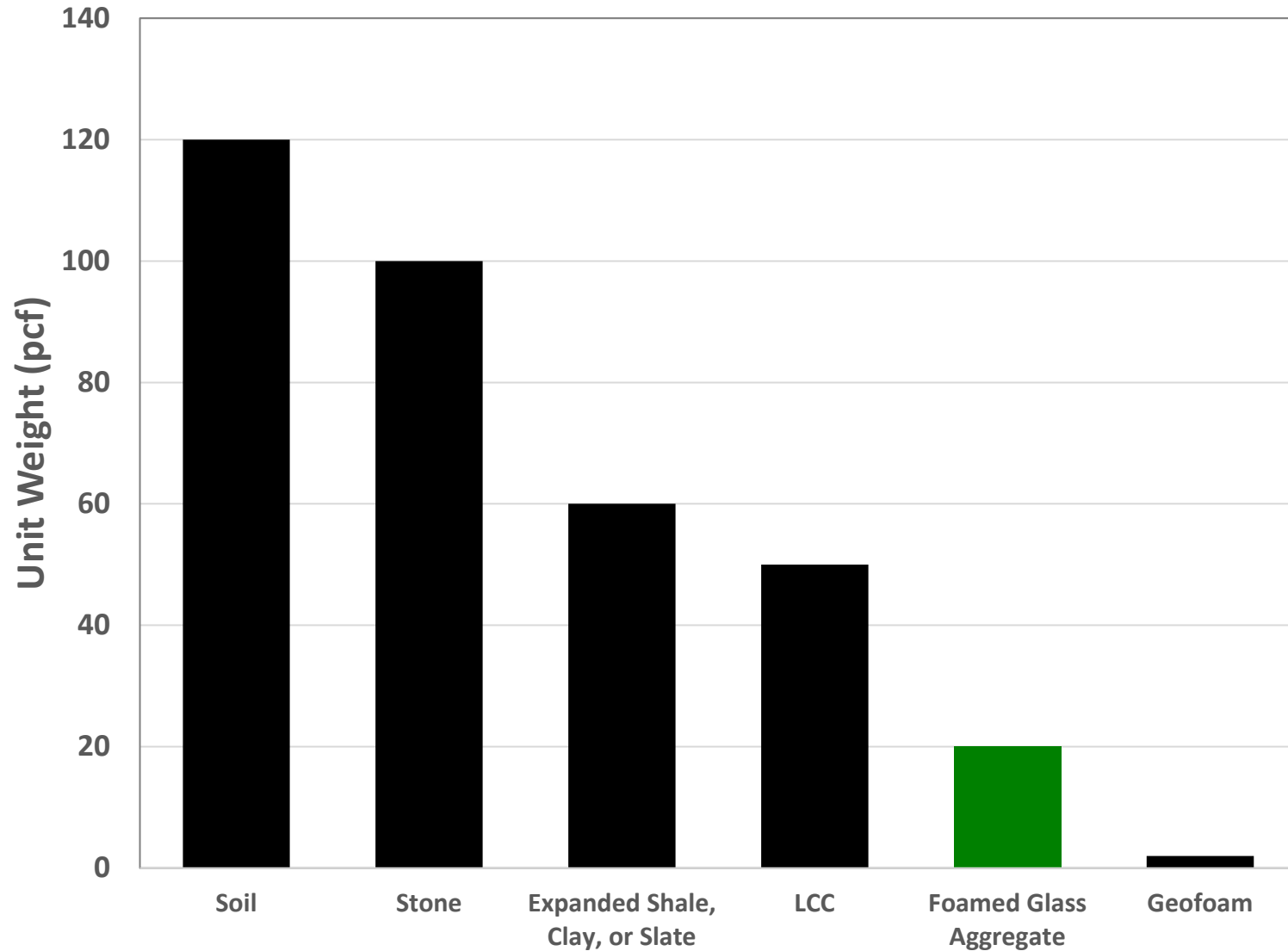
Eddystone, PA

LOCATIONS

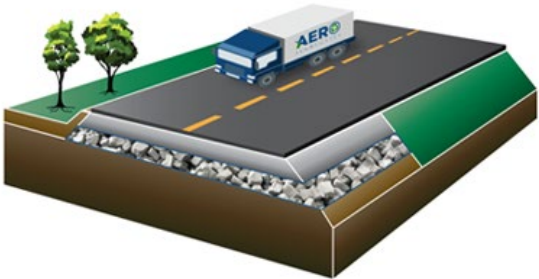
Dunnellon, FL



In-Place Density



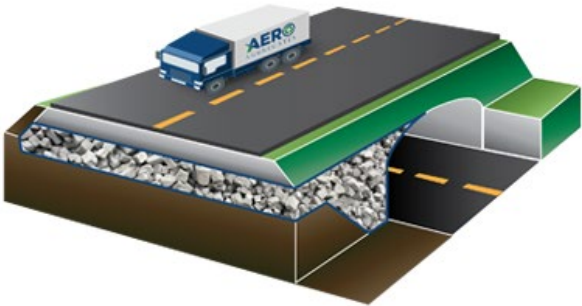
INFRASTRUCTURE



Embankments



Retaining Walls & Bridge Abutments



Tunnels & Culverts

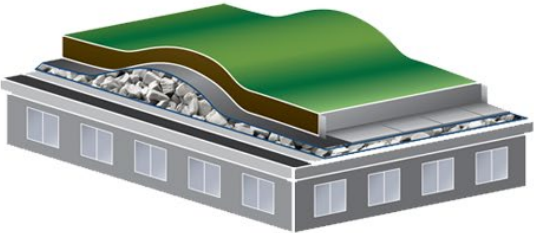


Utilities

COMMERCIAL AND RESIDENTIAL CONSTRUCTION



Foundation Walls & Slabs



Greenroofs

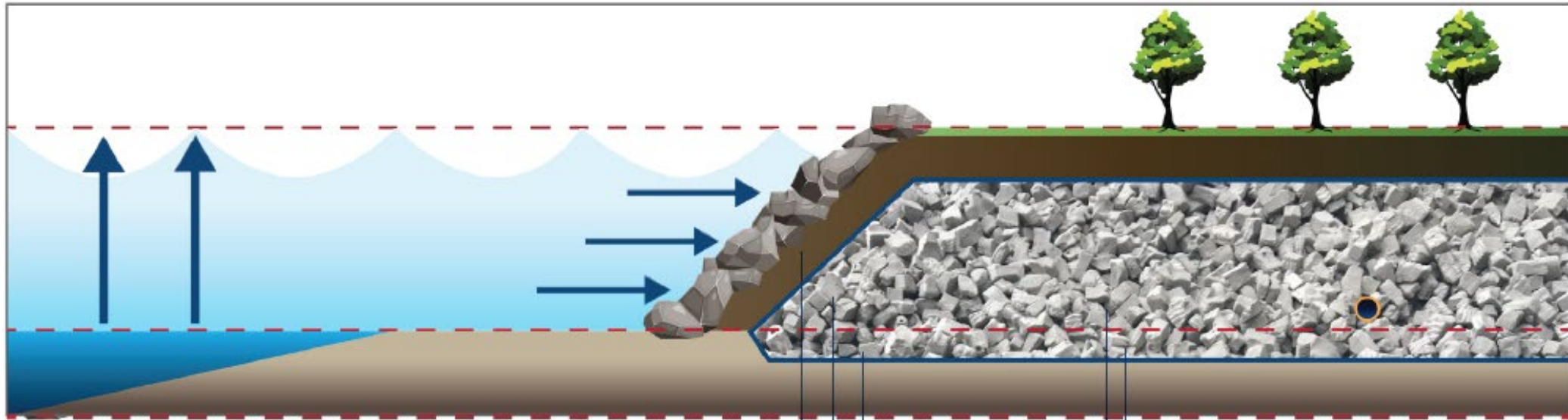


Plaza Decks



Sea Levels & Severe Weather

Application Areas - Resiliency



UL-FGA BENEFITS

- Quick & easy to install
- Ultra-lightweight
- Frost proof
- Stability
- Excellent drainage properties
- Not weather sensitive

STABILITY
Designs up to 45°
without additional
reinforcement

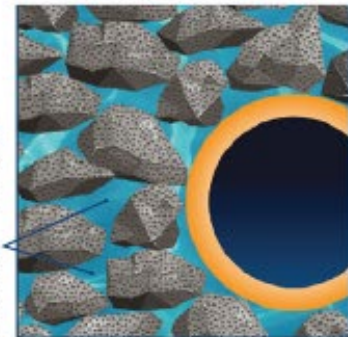
ULTRA-LIGHTWEIGHT
80% lighter than gravel.
No foundation required

LOAD CARRYING CAPACITY
Can be used for all load classes

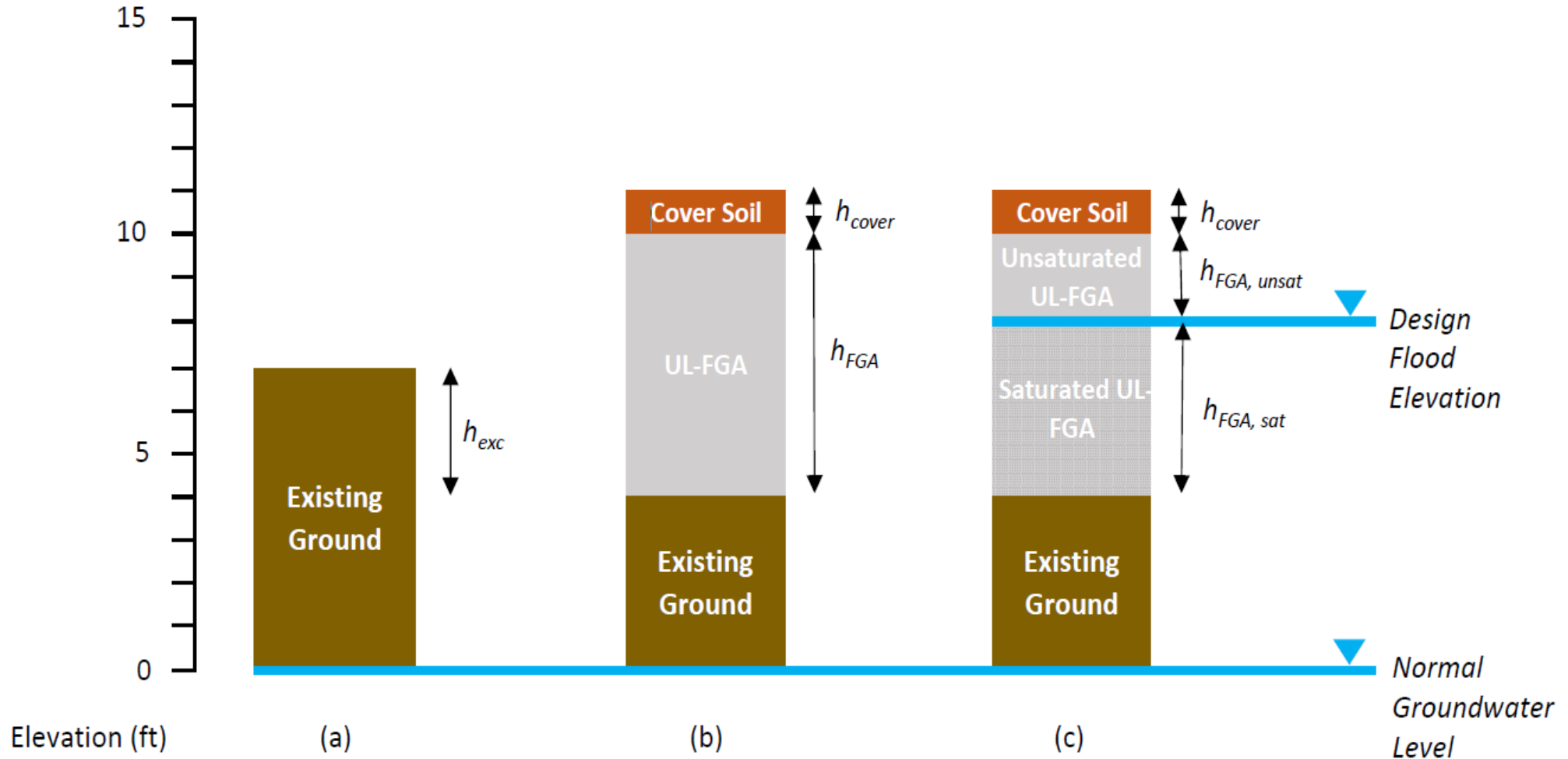


RODENT RESISTANT
Resists burrowing
animals and insects

STORMWATER STORAGE
40% void space for additional
stormwater storage
and promotes infiltration



Surcharge and Buoyancy Calculations





Installation



Method Spec

Tracked Excavator or Dozer 625 - 1,025 psf

- 4 passes over the UL-FGA layer
- 24 inch maximum lift thickness

Plate Compactor 110-220 lbs

- 4 passes over the UL-FGA layer
- 12 inch maximum lift thickness

- Nonwoven Geotextile as separator
- Compaction typically 10-20% of a given lift thickness

Scandinavian Installation Guides



Swedish Geotechnical Institute (SGI) Handbook

- Tracked equipment ≤ 50 kPa (1044 psf)
 - Lift thickness max. 0.8 m (2.6 ft)
 - Minimum of two (2) passes
- Plate compactor weighing 100 to 200 kg (220 to 440 lbs)
 - Lift thickness max. 0.5 m (1.6 ft)
 - Minimum of four (4) passes



Norwegian Roadway Authority

- Tracked equipment ≤ 50 kPa (1044 psf)
 - Lift thickness max. 1 m (3.3 ft)
 - Lift thickness max. 0.6 m (2.0 ft) landscaping and retaining walls
- Vibroplate for landscaping and retaining walls

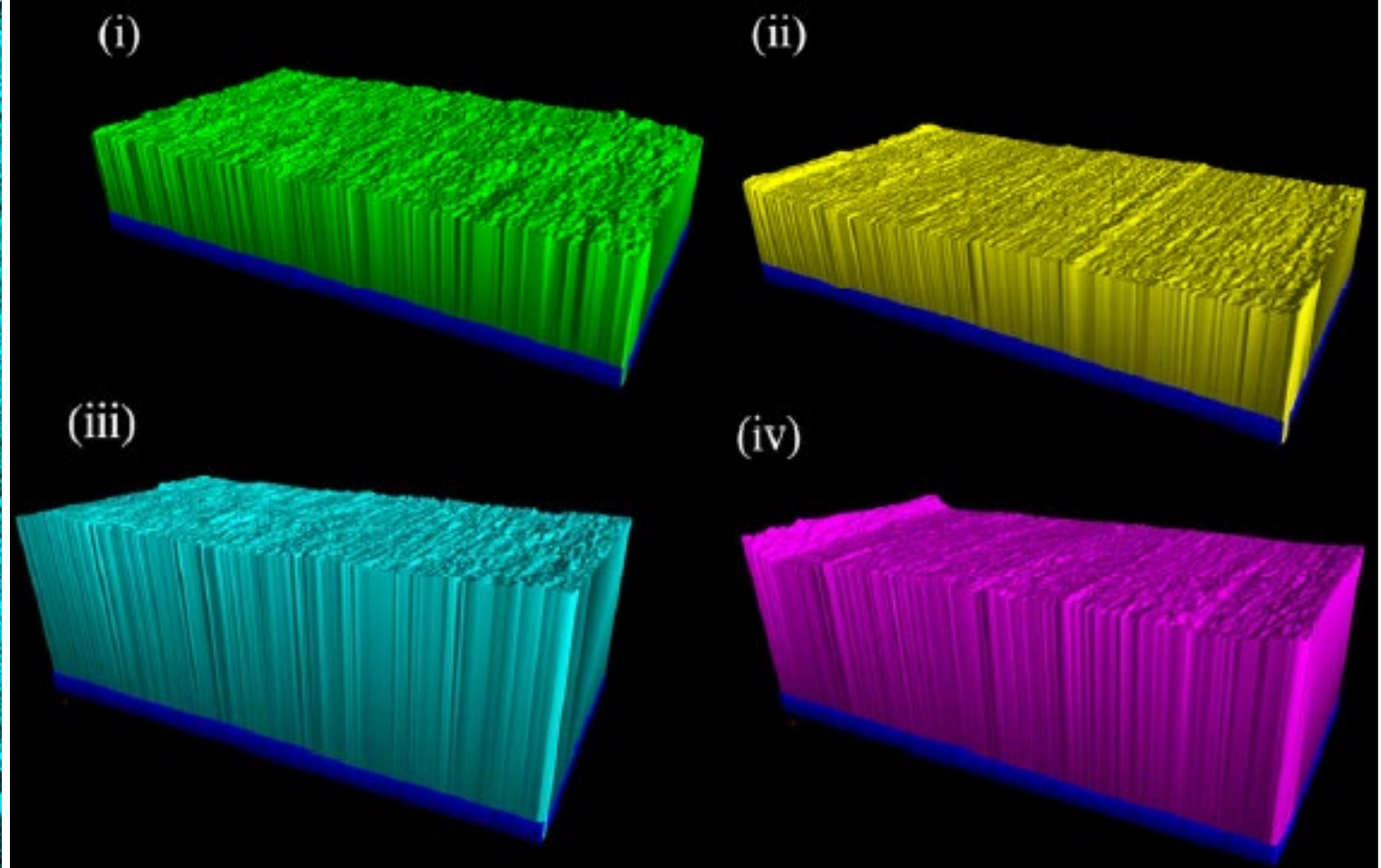
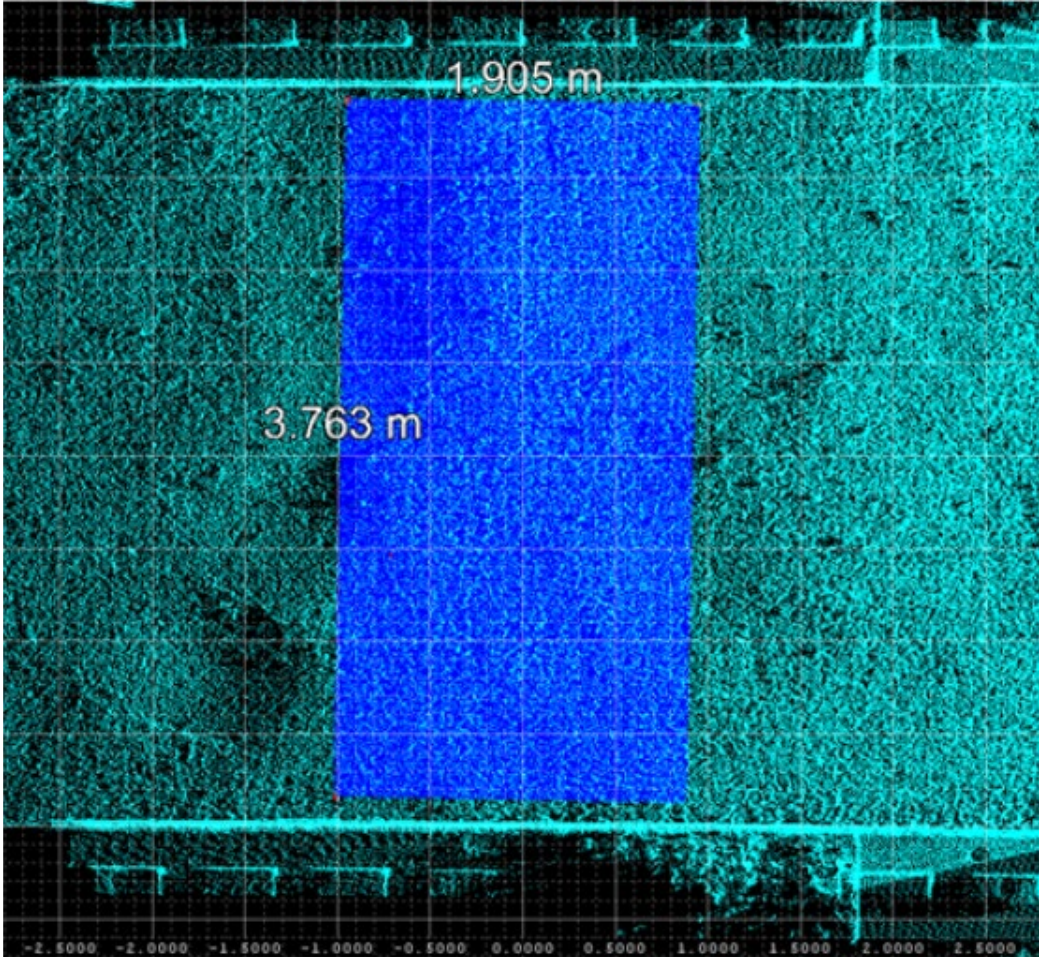


Finland - National Roadway Guideline (InfraRYL 2006)

- Tracked equipment 30 - 50 kPa (627 - 1044 psf)
 - Lift thickness max. 0.6 m (2.0 ft)
 - Lift thickness max. 0.9 m (3.0 ft) lowest lift on soft subgrade
 - Minimum of two (2) passes
- Vibratory plate compactor weighing 50 to 200 kg (110 to 440 lbs)
 - Lift thickness max. 0.4 m (1.3 ft)
 - Minimum of two (2) passes

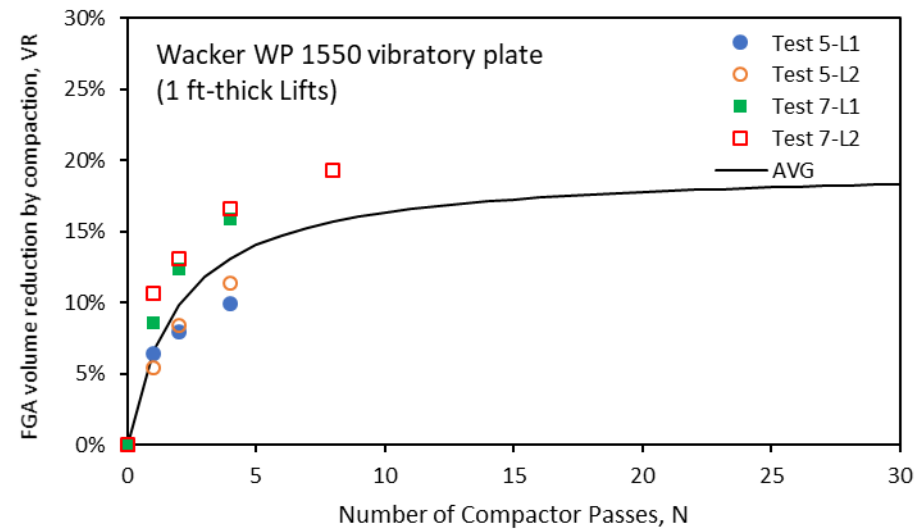
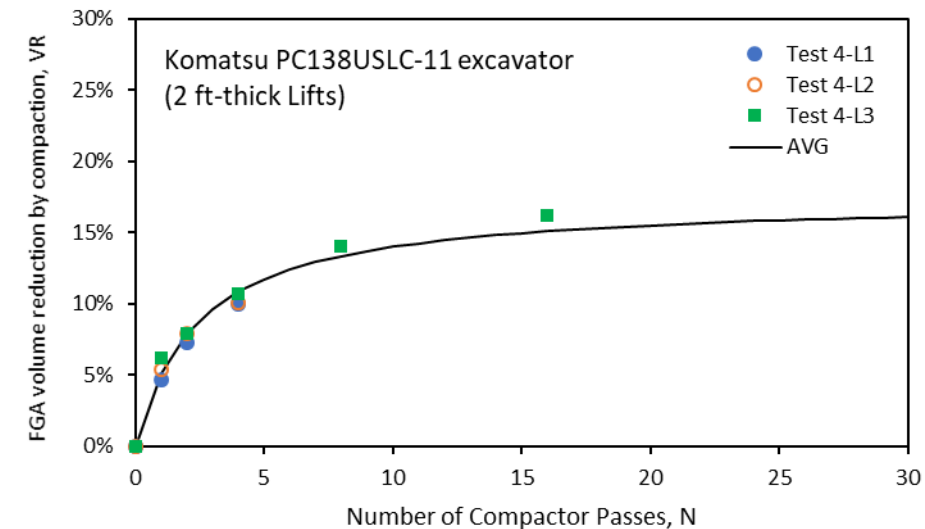
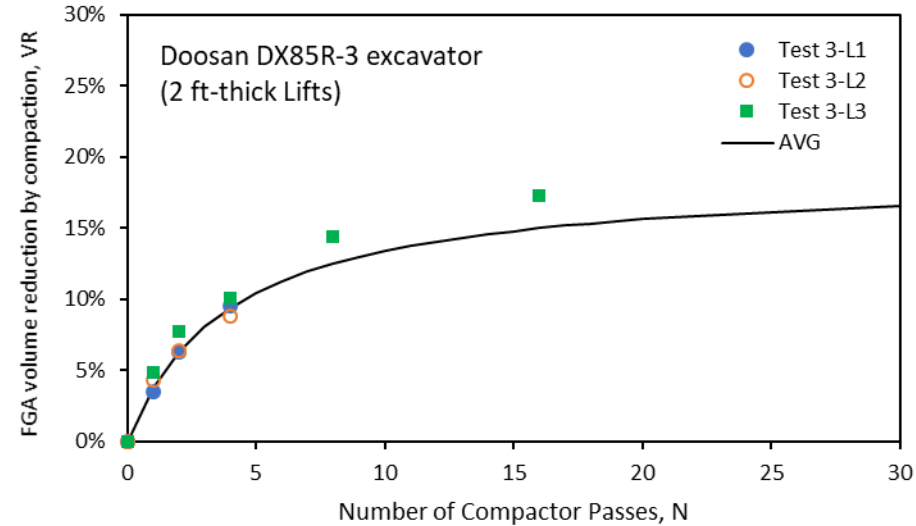
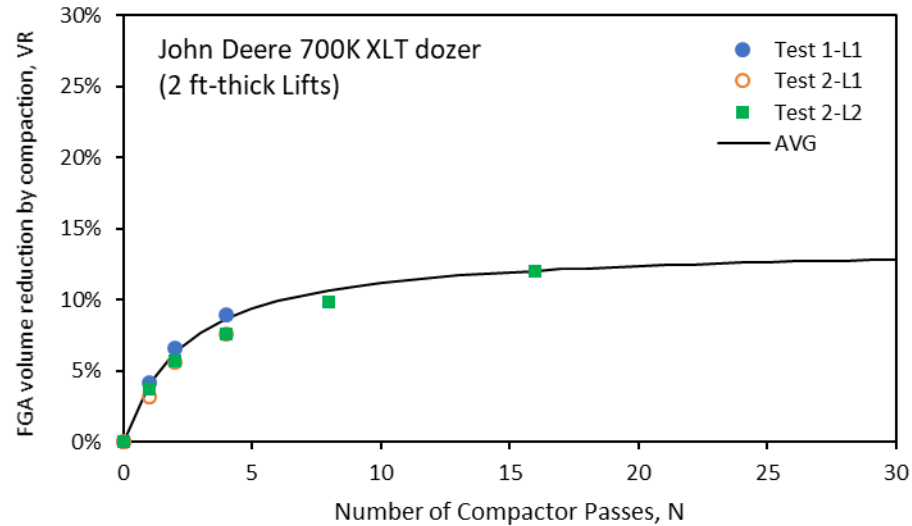


Compaction Research with Lafayette College



Compaction Research with Lafayette College

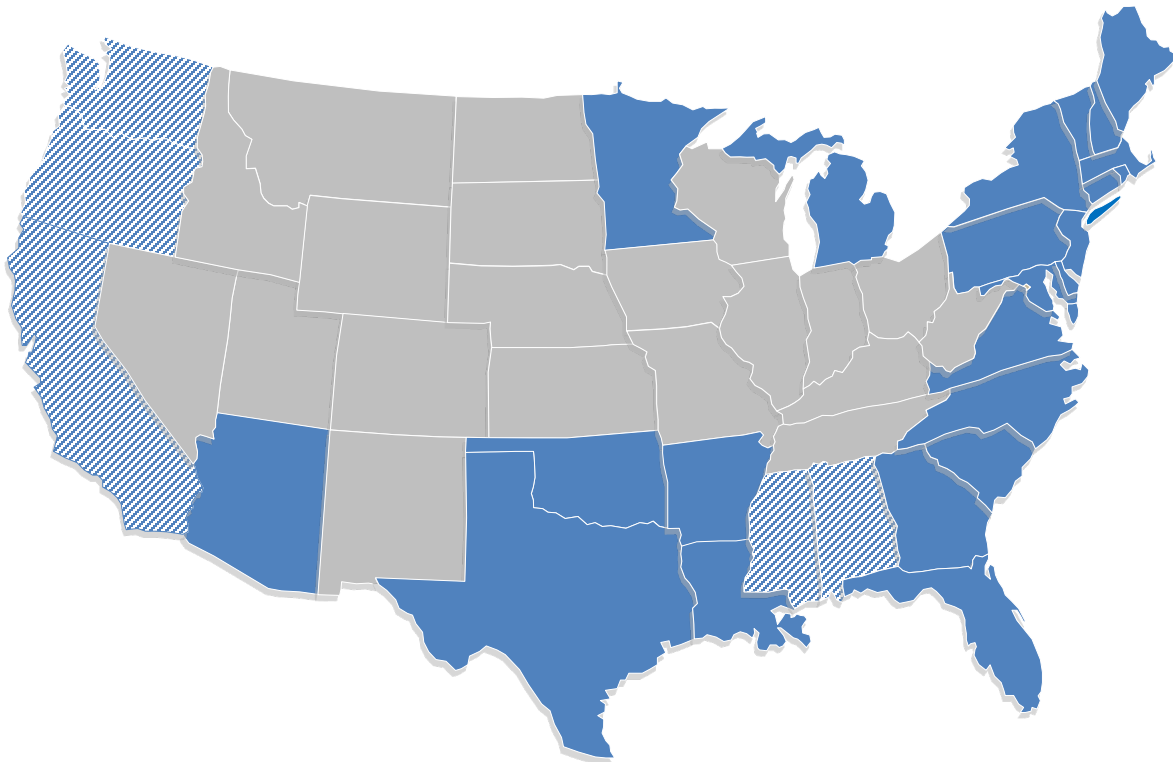
Compaction Research with Lafayette College



Verified by Test Strip Installation with Several DOTs

McGuire, M.P., Loux, T.A., and VandenBerge, D.R. (2021). "Field-Scale Tests to Evaluate Foamed Glass Aggregate Compaction." IFCEE 2021, GSP 326, ASCE.

State DOT Approvals



- FHWA Approval
- Federal Lands
- FAA Approval
- AASHTO
- NYNJ Port Authority
- MBTA
- SEPTA
- Port Authority of San Francisco



PHL – RON Apron



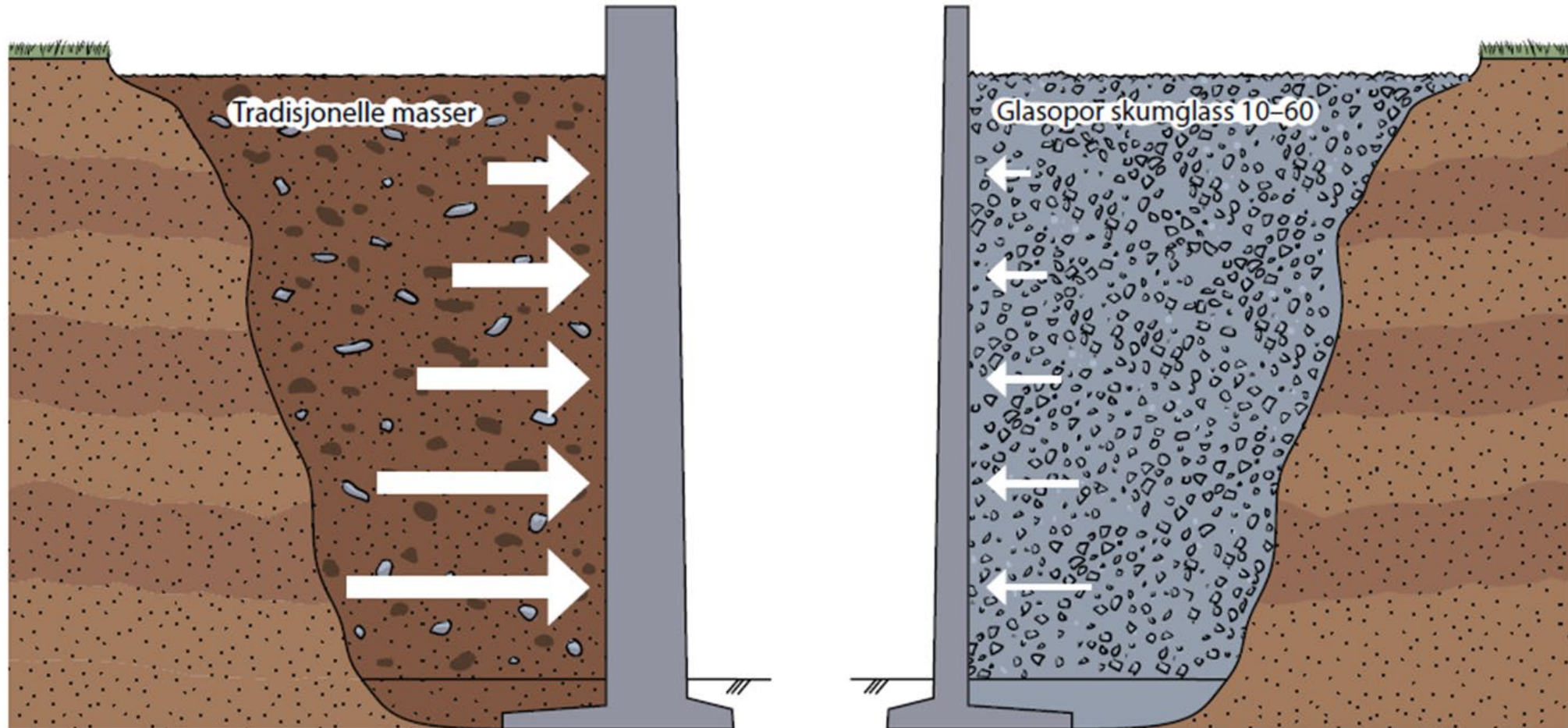
PHL - RON Apron

**Accelerated
Construction:
Delivered up to
3,200 cy/day**



PHL - RON Apron

Structural Optimization





Route 7 Corridor Improvements

Fairfax, VA



Route 7 Corridor Improvements

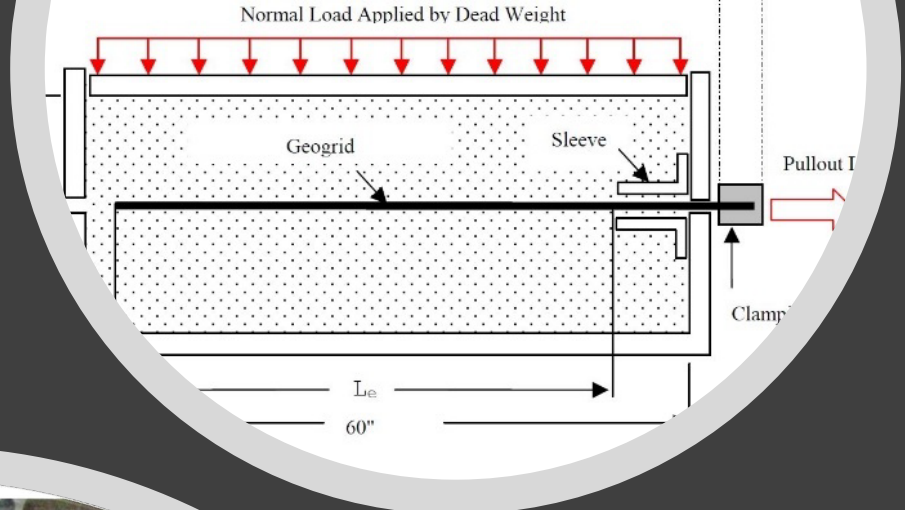
Fairfax, VA



Rehabilitation of 178th & 179th Street Ramps
GW Bridge
NYC, NY



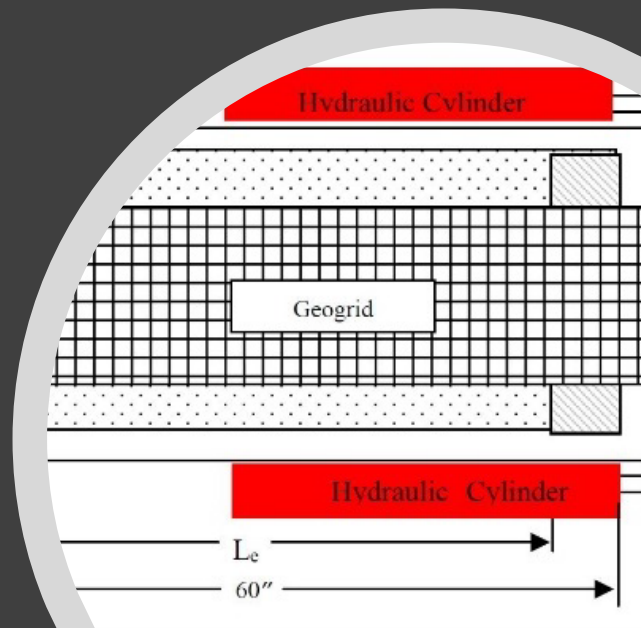
**Rehabilitation of 178th & 179th Street Ramps
GW Bridge
NYC, NY**



Steel & Poly Straps

PET & HDPE Geogrids

Pullout Testing of Geogrids and Straps for MSE



Images courtesy of SGI Lab, Atlanta, GA



I-485 Express Lanes

Charlotte, NC



I-485 Express Lanes

Charlotte, NC



I-485 Express Lanes

Charlotte, NC



Ultra-lightweight Foamed Glass Aggregate

I-95 EMERGENCY REPAIR

Philadelphia, PA

Made in USA from 99% Recycled Container Glass





**Section of overpass
that collapsed**

Southbound I-95

Northbound I-95

Sunday AM, June 11th, 2023

Philadelphia, PA

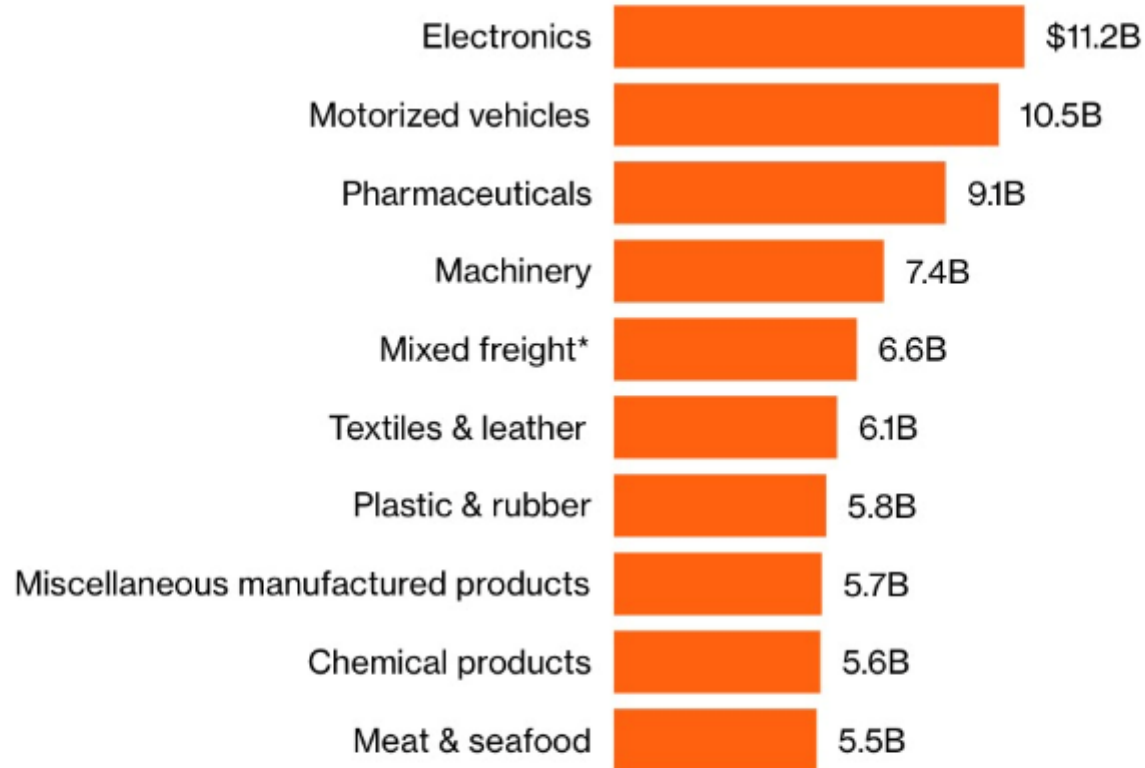


I-95 Emergency Repair

Philadelphia, PA

I-95 Carries Freight Through Northeast US

In 2021, trucks carried 21 million tons of freight worth \$104 billion through the Philadelphia region, largely over I-95. The top categories:



Source: Bureau of Transportation Statistics

Note: Mixed freight includes office supplies, hardware, restaurant supplies, etc.



Post-collapse/ Pre-Demo
Philadelphia, PA



Demo



Underground Utilities

86" sewer line and 36" water line



Solution for Rapid Repair

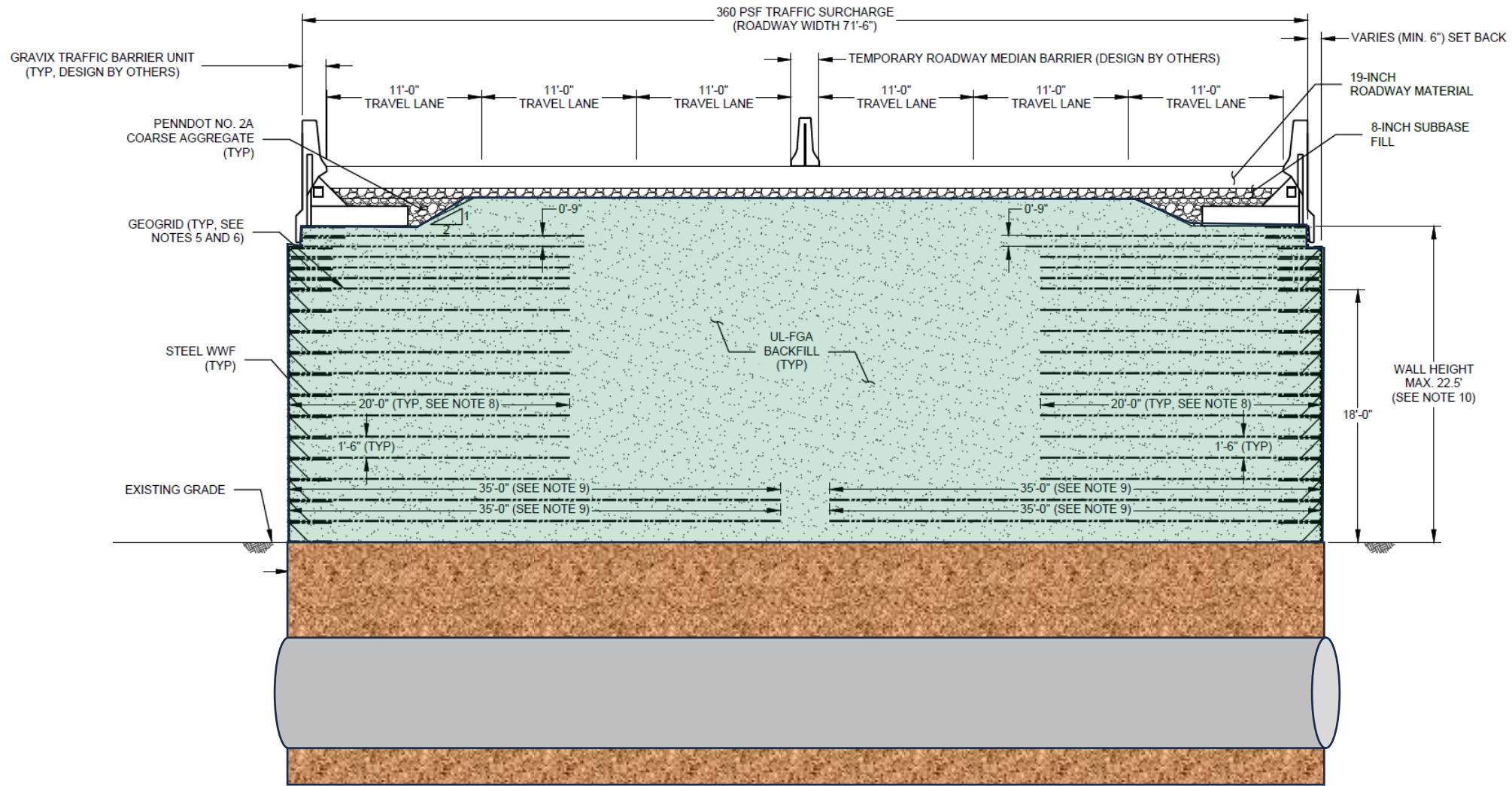


Solution for Rapid Repair



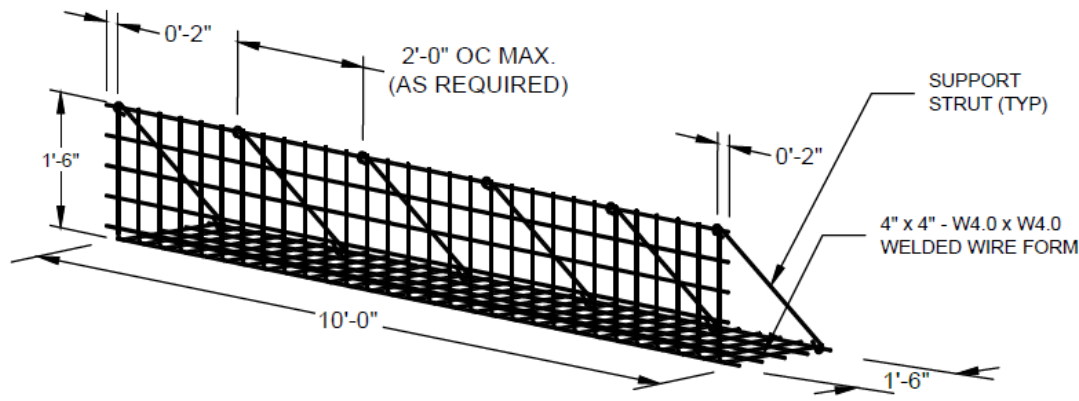
Foamed Glass Aggregate Briefing

Philadelphia, PA

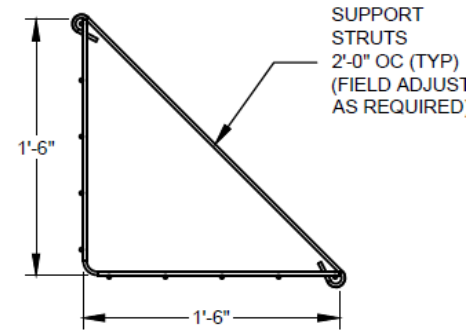


- ✓ **Protects the 86" (2.2m) dia. Sewer Main**
- ✓ **Fast Delivery and Construction**
- ✓ **No Weather Delays**
- ✓ **Permeable/Minimize Stormwater Issues**

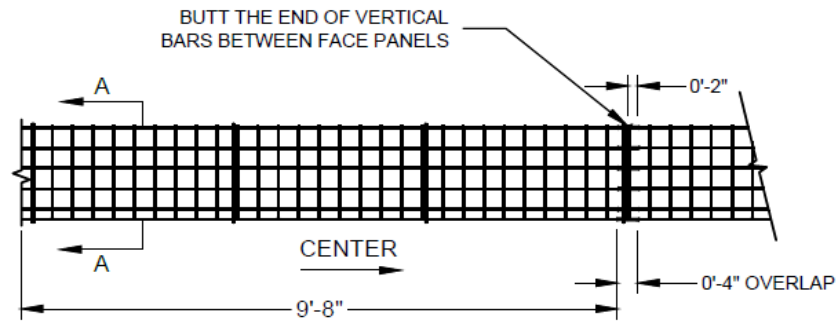
Temporary MSE Wall Typical Section



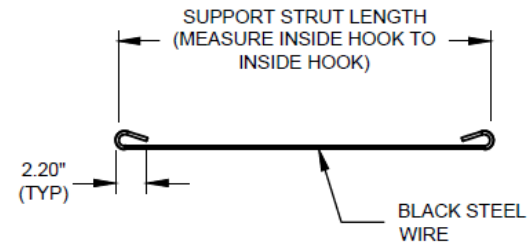
ISOMETRIC



VIEW A-A



PROFILE



SUPPORT STRUT

I-95 Emergency Repair

Philadelphia, PA



First Lift - MSE Wall Construction

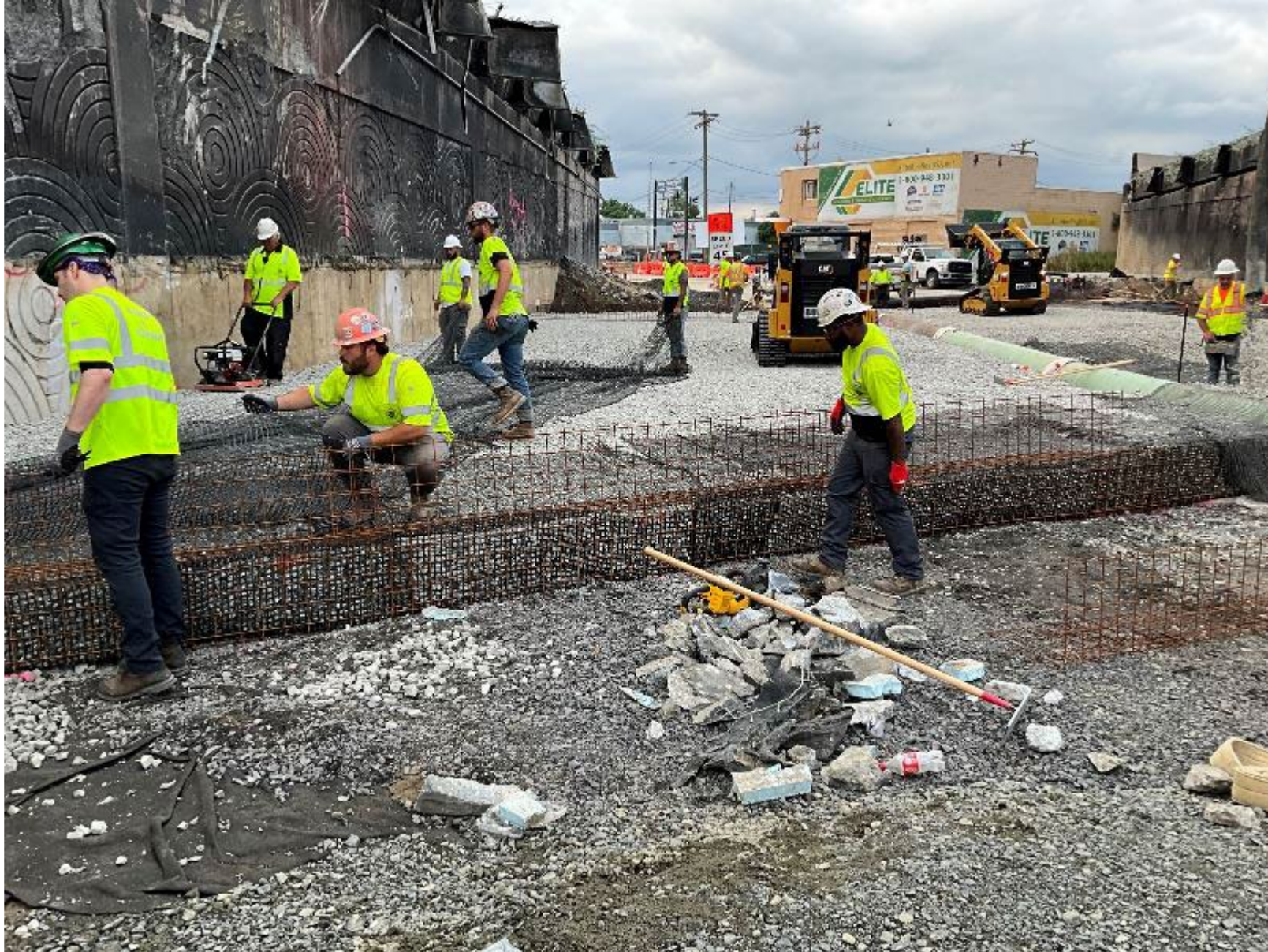




I-95 Emergency Repair

Philadelphia, PA





MSE Wall Construction



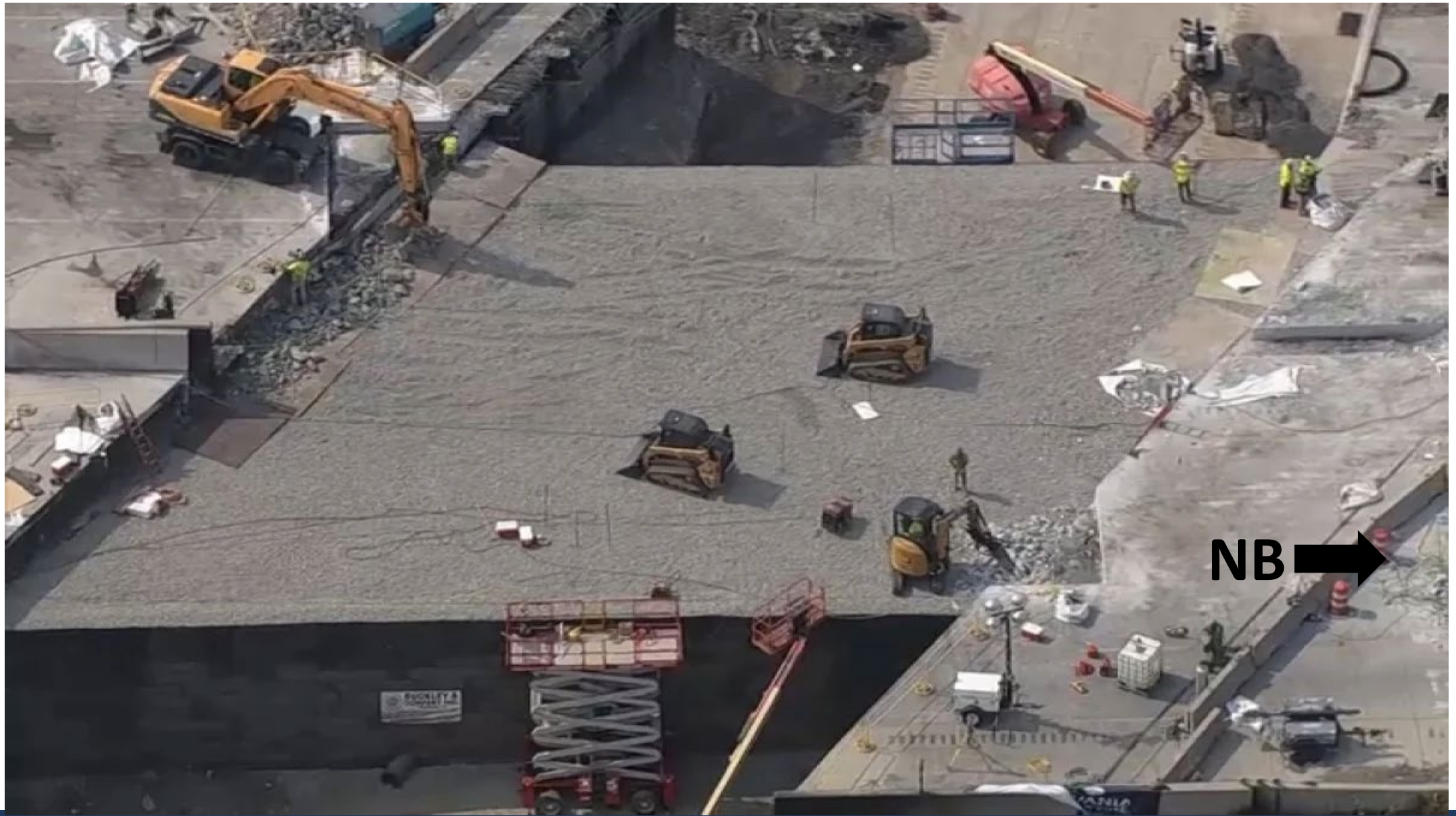
Compaction
Skid Steer



Geogrid Placement and Overlap



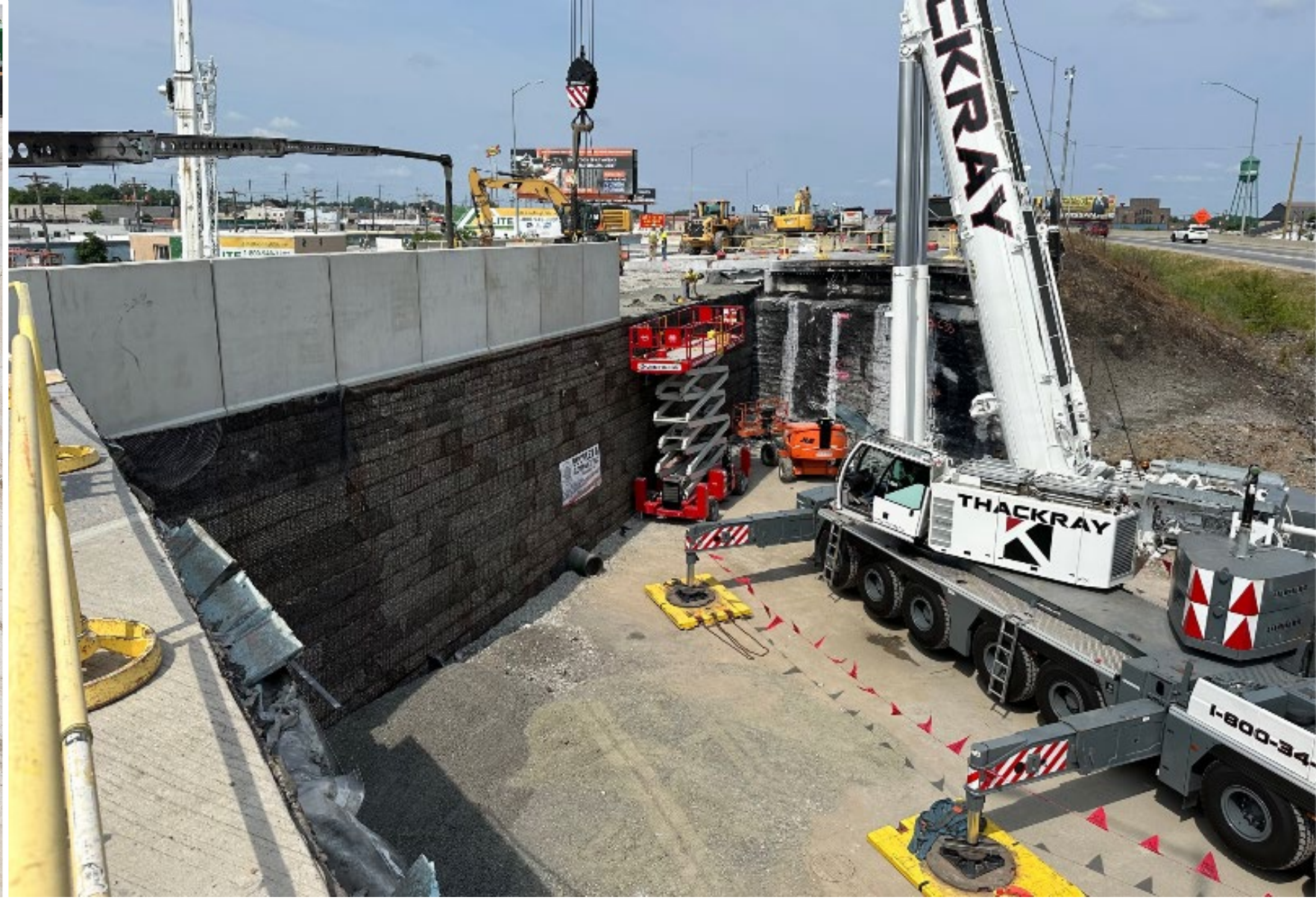
MSE Wall Construction



Prior to Subbase and Paving



Prior to Subbase and Paving



Precast Barrier Staging/ Placement



Subbase



Subbase

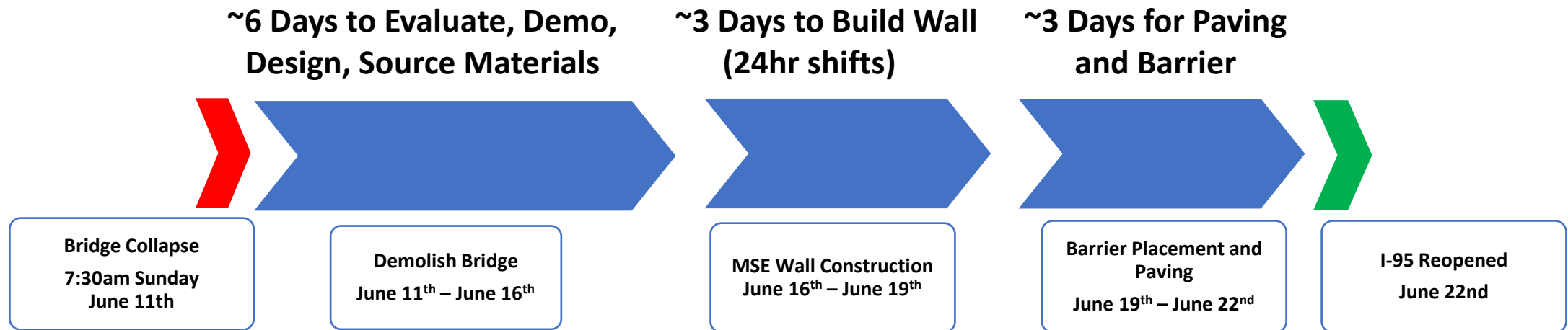


Wall Facing



I-95 Emergency Repair In-Service

Timeline



I-95 Re-opened on 12th day Post-Collapse





Reuse of FGA on PADOT CAP Project

Opinion We fixed I-95 in 12 days. Here are our lessons for U.S. infrastructure.

By Josh Shapiro

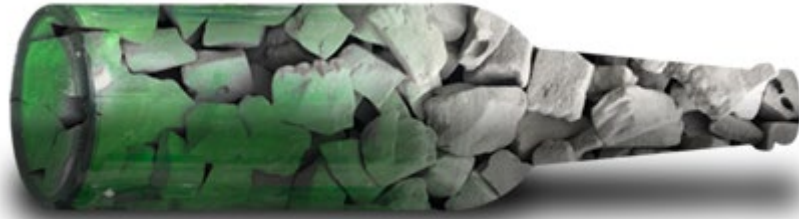
July 16, 2023 at 7:00 a.m. EDT

Source:

Washington Post

- 1 Empower strong leadership
- 2 Speed up the bureaucracy
- 3 Encourage creativity
- 4 Work together

UL-FGA



made from **100% RECYCLED**
container glass



- **Ultra-Lightweight**
- **Highly frictional**
- **Free-draining/ high porosity**
- **Closed-cell/frost resistant**
- **30+ Year History in Europe/ Established in USA in 2017**
- **High recycled content/ low carbon footprint**
- **Compatible with MSE Reinforcement**
- **Easy/Quick Delivery + Install**
- **No weather delays**

QUESTIONS?

Contact:

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