Mechanical Stabilization of Unsuitable Subgrade Soils During Interstate 95 Lane Widening

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Project Background

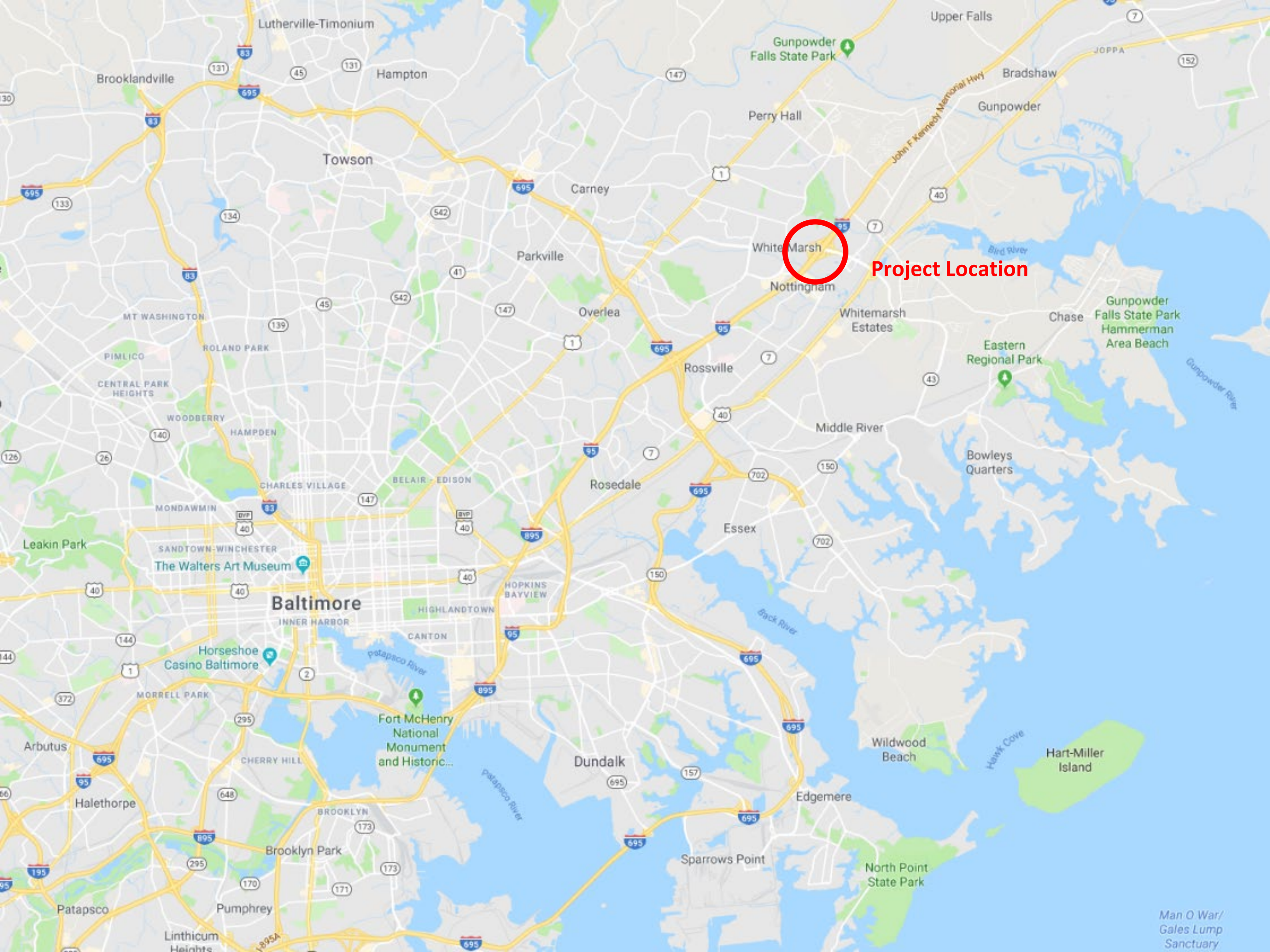
- The Maryland Transportation Authority (MDTA) is responsible for constructing, managing, operating, and improving the State's toll facilities

- MDTA currently has eight toll facilities: 2 turnpikes, two tunnels, and four bridges

- MDTA completed this project as part of a multi-year, multi-phase project to add Express Toll Lanes (ETLs) to Interstate 95, providing significant congestion relief in one of the most heavily-trafficked corridors in the United States

    - Two ETLs in each direction
    - Eight existing General Purpose Lanes maintained
    - For the subject phase of the project, ETLs and ETL exit ramps were located in the center of the right-of-way

- The northernmost design contract was for the Interstate 95 / MD 43 interchange



Project Location
White Marsh
Nottingham
Perry Hall
Upper Falls
Gunpowder Falls State Park
Bradshaw
Gunpowder
Joppa
Lutherville-Timonium
Hampton
Brooklandville
Towson
Carney
Parkville
Overlea
Rossville
Whitemarsh Estates
Chase
Gunpowder Falls State Park Hammerman Area Beach
Eastern Regional Park
Middle River
Bowleys Quarters
Rosedale
Essex
Mt Washington
Roland Park
Pimlico
Central Park Heights
Woodberry
Hampden
Charles Village
Belair - Edison
Mondawmin
Leakin Park
Sandtown-Winchester
The Walters Art Museum
Baltimore
Inner Harbor
Hopkins Bayview
Highlandtown
Canton
Horseshoe Casino Baltimore
Morrell Park
Fort McHenry National Monument and Historic...
Arbutus
Cherry Hill
Halethorpe
Brooklyn
Brooklyn Park
Dundalk
Edgemere
Wildwood Beach
Hart-Miller Island
Sparrows Point
North Point State Park
Patapsco
Pumphrey
Linthicum Heights
Bird River
Back River
Gunpowder River
Hawk Cove
Patapsco River
Man O War/ Gales Lump Sanctuary
John F Kennedy Memorial Hwy


Perry Hall High School
Indian Rock Park
Ebenezer Rd
Honeygo Blvd
Cowenton Ave
Honeygo Run
E Joppa Rd
Cargill
I-95 Express Toll (Toll road)
Silver Spring Rd
Philadelphia Rd
The Crossings at White Marsh Apartments
Perry Hall Blvd
An-Nur Foundation of MD
Republic Services Honey Go Run...
The Go Kart Track
Southfield Apartments
Burnam Woods Apartments
J. Gibson McIlvain Company
WHITE MARSH STATION
White Marsh Blvd
White Marsh
Ebenezer Rd
Garden Italian
JCPenney
White Marsh Mall
IKEA
Macy's
TGI Fridays
Best Buy
Honeygo Blvd
AMC White Marsh 16
Target
Whitemarsh Run
Lowe's Home Improvement
Koons White Marsh Chevrolet
Campbell Blvd
Nottingham
Texas Roadhouse
Xfinity Store by Comcast
Chipotle Mexican Grill
CarMax
FedEx Ground
Pulaski Hwy
The Apartments at Cambridge Court
Google

Site Conditions

- Northbound ETLs were in the area of the northbound shoulder and embankment from the original construction in the 1960s

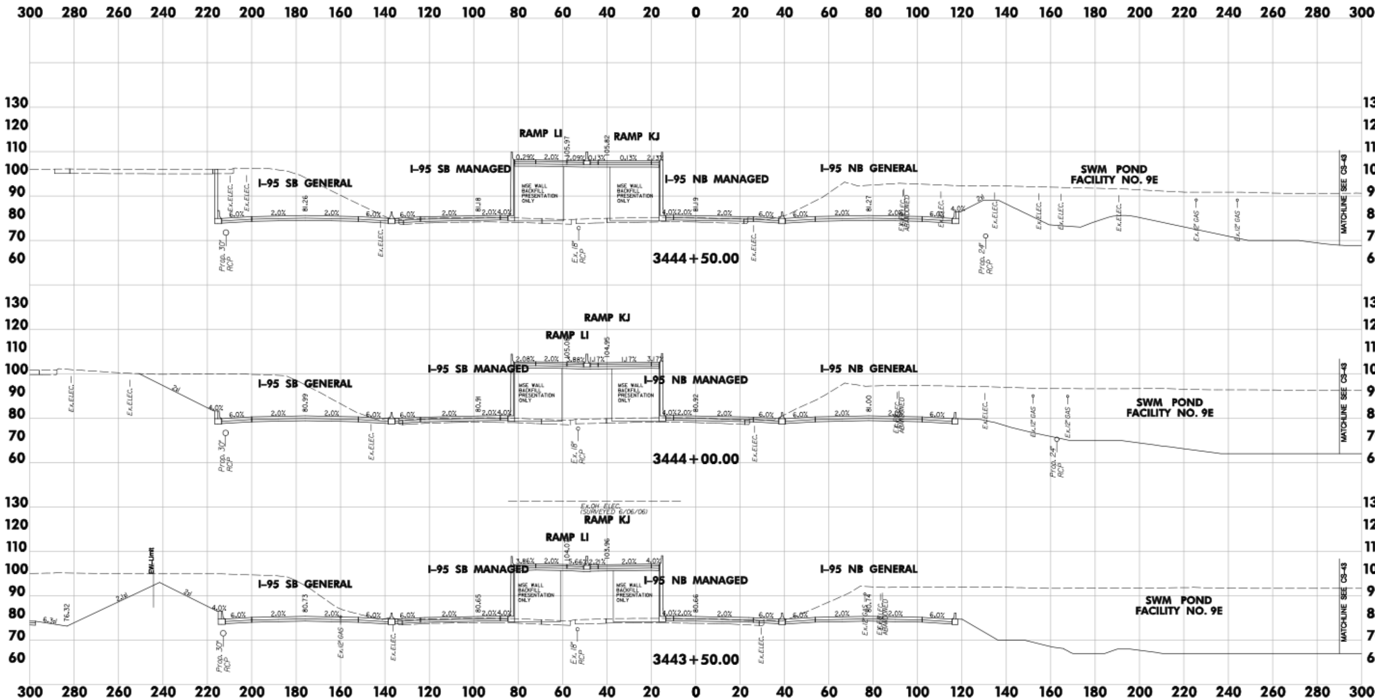
- In the project area, unsuitable material extended 1.8 m (6 ft) deep or more

- Extent of unsuitable subgrade soils was not initially known in design – problem was assumed to be isolated, which had been true during earlier phases of the project

- CBR values varied:
  - Laboratory CBR values were typically over 10
  - Much weaker areas, with measured CBRs of 0.1 to 0.5, were present along the entire project
  - In this area, CBR values were verified using a dynamic cone penetrometer (DCP)

- Contract documents allowed lime/fly ash treatment for larger areas of unsuitable soils – this had not been used to date on the project, and the project schedule could not accommodate this solution so close to completion

- Default solution was to remove and dispose of 1.8 – 2.5 m (6 - 8 ft) of unsuitable material and replace it with suitable fill



CROSS SECTION

PROJECT MD 43 INTERCHANGE OVER I-95 CONTRACT NO. KH 1402-000-006R
SCALE HORIZ. 1" = 20' DESCRIPTION ℄ CONSTR. I-95 NB MANAGED: STA. 3443+50.00 TO STA. 3444+50.00
SCALE VERT: 1" = 20'

ROADWAY SECTIONS: I-95

RUMMEL, KLEPPER & KAHL, LLP / URS CORPORATION
A JOINT VENTURE
BALTIMORE, MARYLAND

MARYLAND TRANSPORTATION AUTHORITY
Engineering Division

ADDENDUMS & REVISIONS			
NO.	DESCRIPTION	BY	DATE

I-95 EXPRESS TOLL LANES: MD 43 INTERCHANGE FROM CAMPBELL BLVD. TO HONEYGO RUN
JOHN F. KENNEDY MEMORIAL HIGHWAY
BALTIMORE COUNTY
CROSS SECTIONS

DESIGNED BY TTS/MVS | DRAWN BY TTS/CJB | CHECKED BY MVS
CONST. REVIEW BY | DATE JUNE, 2011 | SCALE

CONTRACT NO. KH 1402-000-006R
DRAWING NO. CS – 42
SHEET NO. 43 OF 349

Issues and Constraints

- Construction area was between existing active General Purpose Lanes and ETL exit ramps in center of right-of-way
- Limited access points to remove and import material
- ETL exit ramps supported by Mechanically Stabilized Earth structures appx. 7.6 m (25 ft) tall
- Active travel lanes immediately adjacent to area to be excavated – depth would require excavation support
- Extremely limited room for excavation equipment
- Required construction sequence with complete undercutting would delay completion past scheduled opening date
- Increased cost

General Purpose Lanes
Express Toll Lanes
ETL Exit Ramp
White Marsh Blvd
White Marsh Blvd
White Marsh Blvd
I-95 Express Toll
I-95 Express Toll (Toll road)
I-95 Express Toll (Toll road)
John F Kennedy Memorial Hwy
Postal Service
Baltimore White Marsh
4980 Mercantile Rd Parking
Dunbar Armored
Resco Electronics
Whitemarsh Run
Better Engineering
White Marsh Psychiatric Associates
TEAM Staffing
Nottingham Dr
First Home Mortgage Corporation
Allstate Insurance Regional Office

Solution Development

- Initial design was based on developing an effective section for the haul road into the site
- Giroud-Han design methodology was used for initial design of subgrade stabilization section
- Pavement section design was verified using AASHTO 1993 methodology via SpectraPave4-PRO software.
- Two test strips were built:
  - Two 305 mm (12 in) layers of graded aggregate base (GAB), two layers multi-axial geogrid
  - One 610 mm (24 in) layer of No. 2 stone, choked with GAB at surface, one layer multi-axial geogrid
- Second test section was used for haul road and results were used in final design
- Design also considered variability in soil strength across the site, ground water, and drainage

Final Design Approach

- Layer thicknesses, number of layers, and number of geogrid layers chosen to maintain full confinement of aggregate
- Geogrid aperture sizes matched to aggregate gradation
- Open graded aggregate used in lower layer to provide capillary break
- Non-woven geotextile used above the capillary break to maintain separation and prevent contamination of upper aggregate layer
- Drainage details modified to accommodate pavement section

Final Design Approach

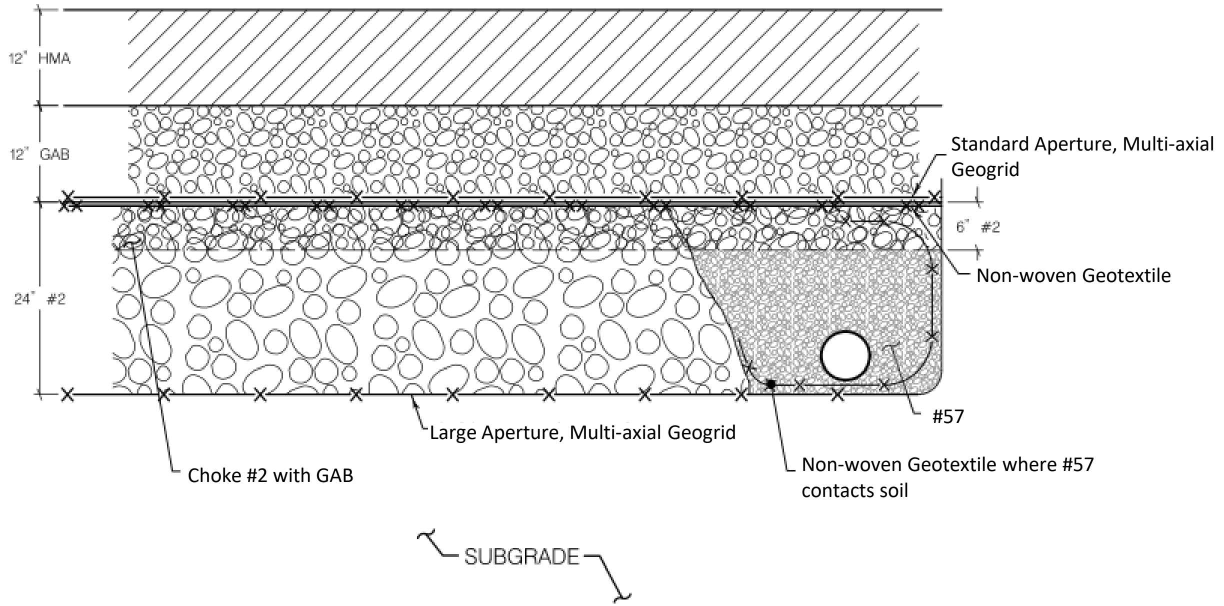
Original Design

- 12 in. HMA
- 12 in. GAB
- 12 in. sand subbase with separation geotextile
- Excavate and replace all unsuitable soil

Final Design

- 12 in. HMA
- 12 in. GAB
- 24 in. MSL
- Remove soil only as needed

Final Design Section



Results

- MSL design successfully addressed unsuitable soil issues
- Project schedule was maintained
- Significant cost savings over conventional solution
- Pavement design was enhanced using MSL in compliance with AASHTO 1993 methodology

Acknowledgements

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