massDOT Transportation Innovation CONFERENCE

Application of Ultra-Light Foamed Glass Aggregate in Bridge Approach Design

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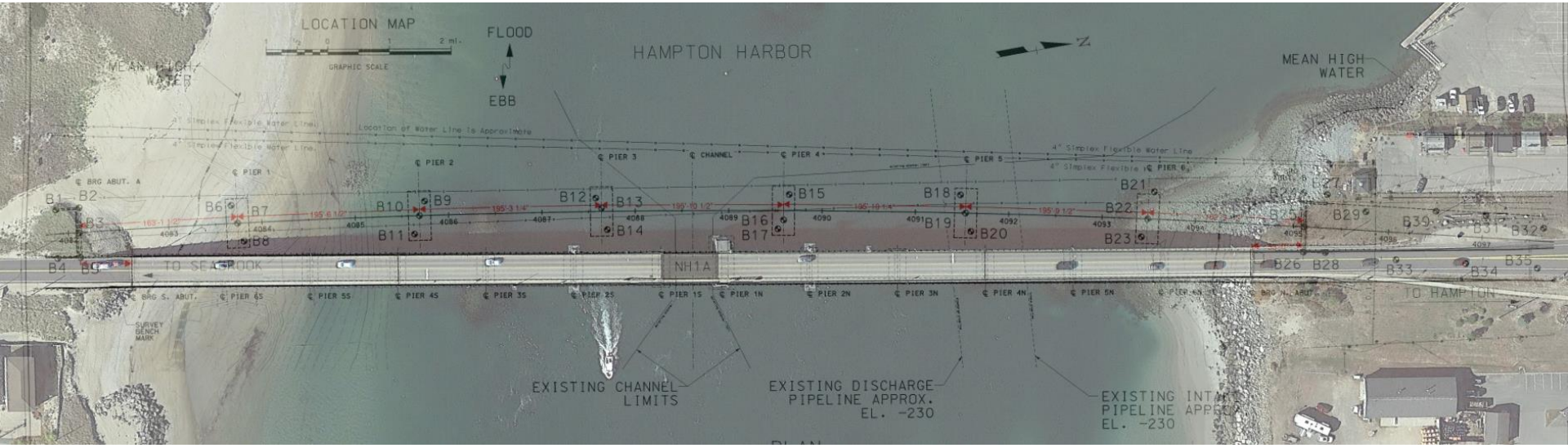
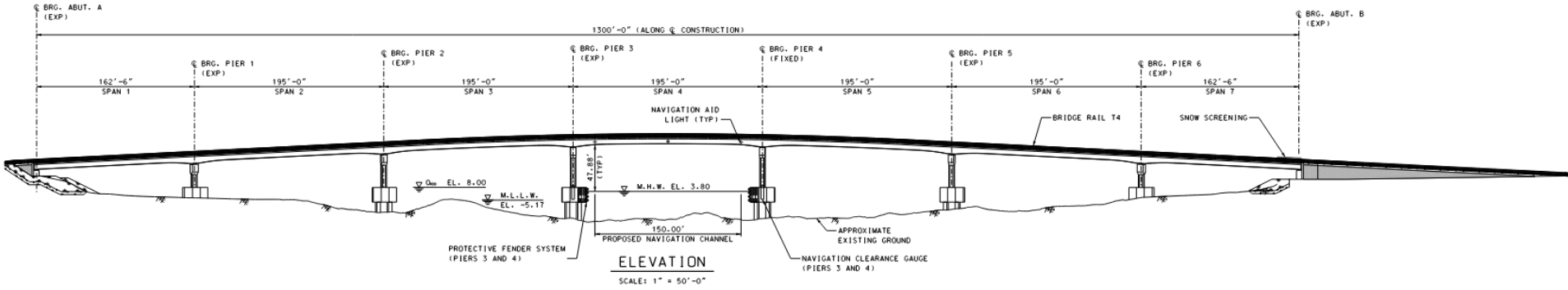
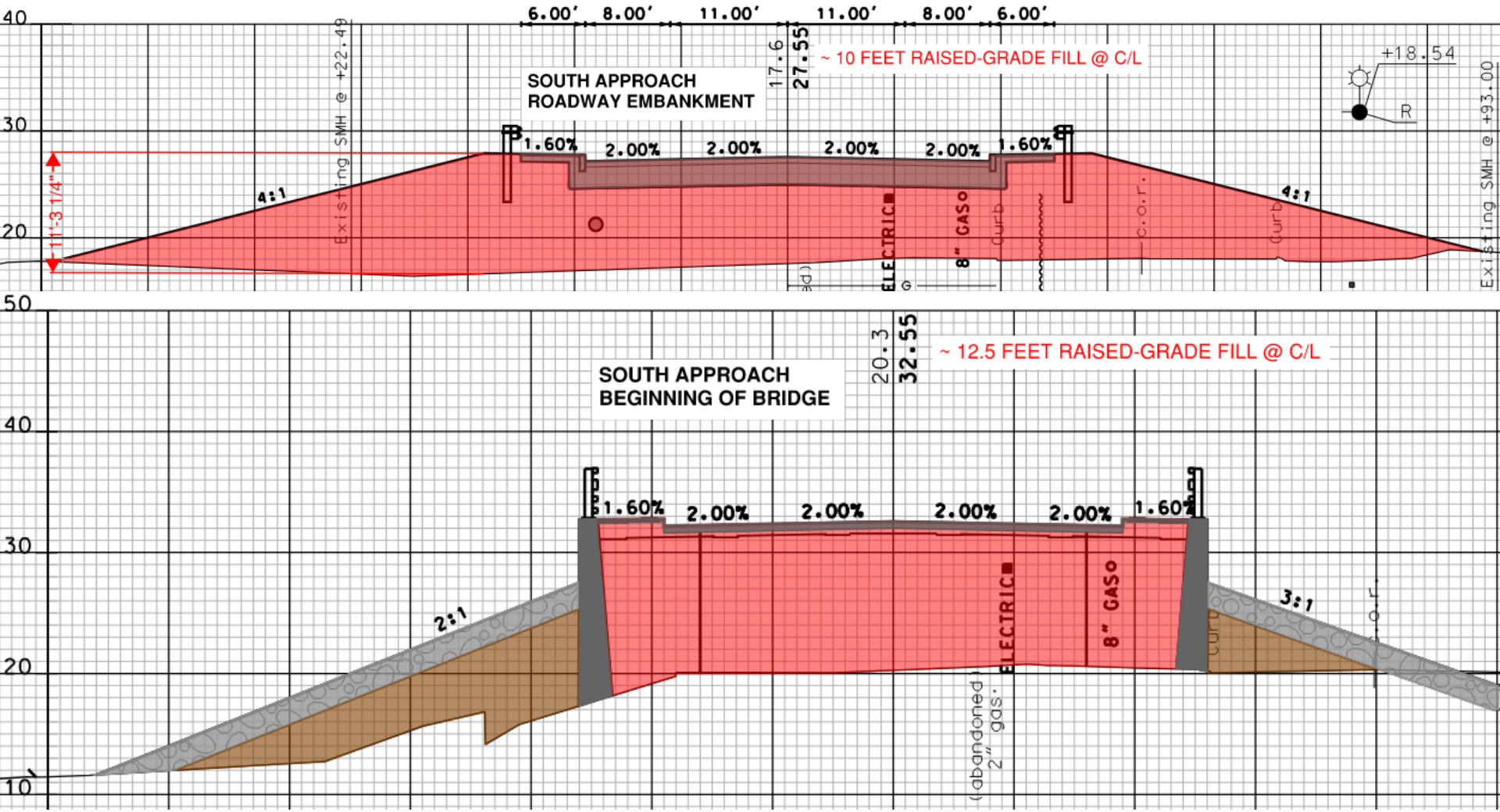
HAMPTON HARBOR BRIDGE

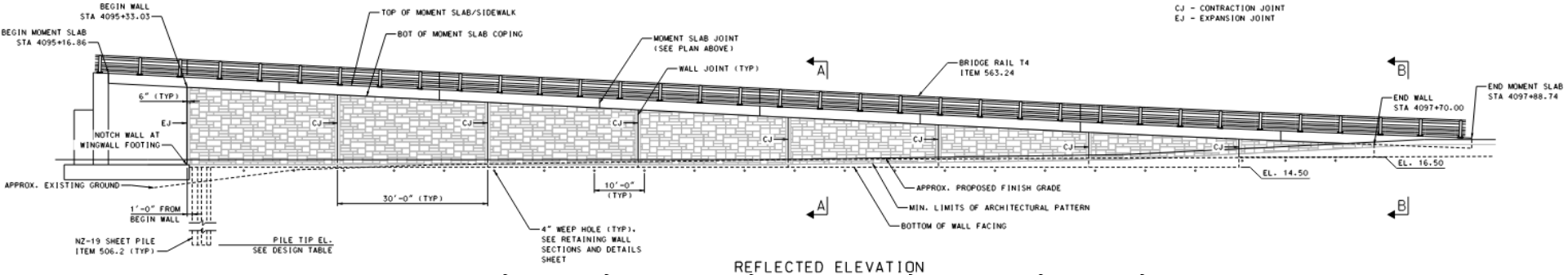


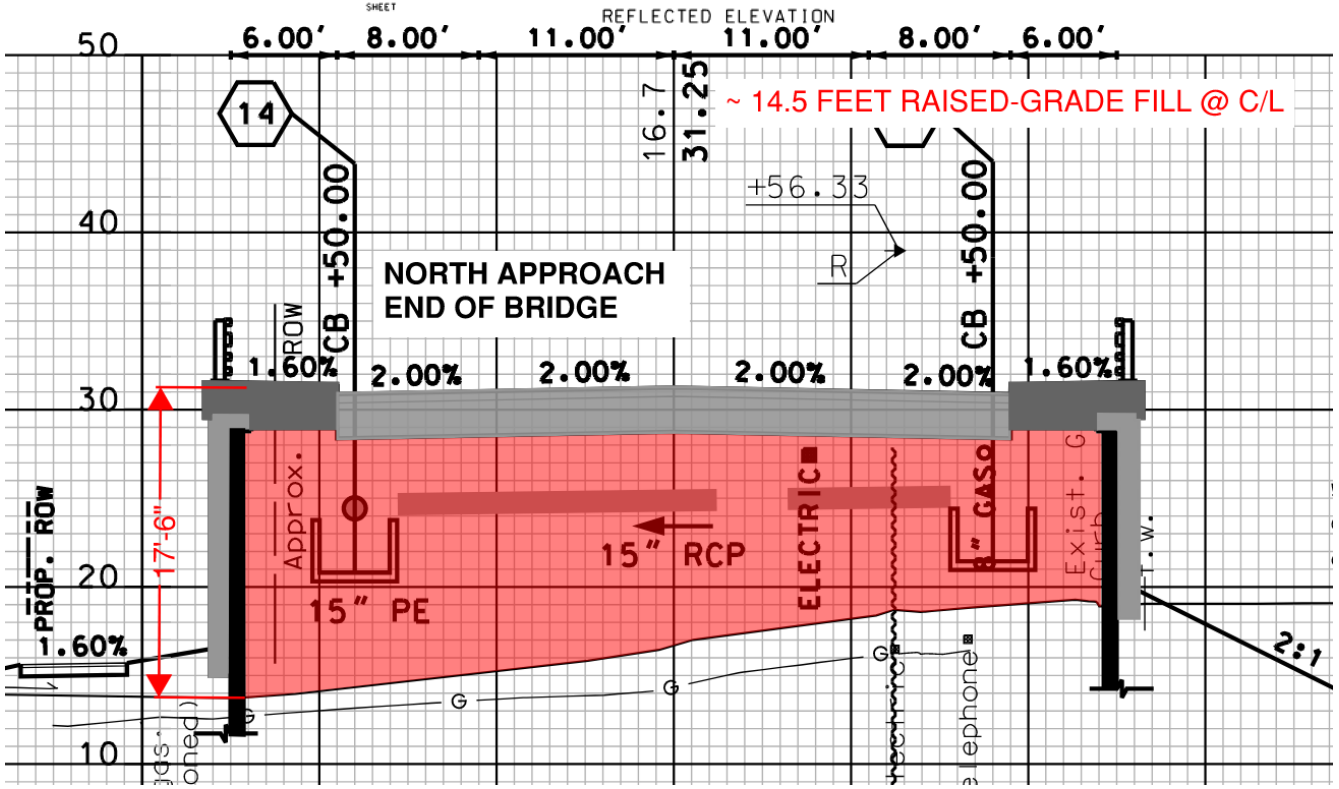


Proposed Bridge Approach Sections

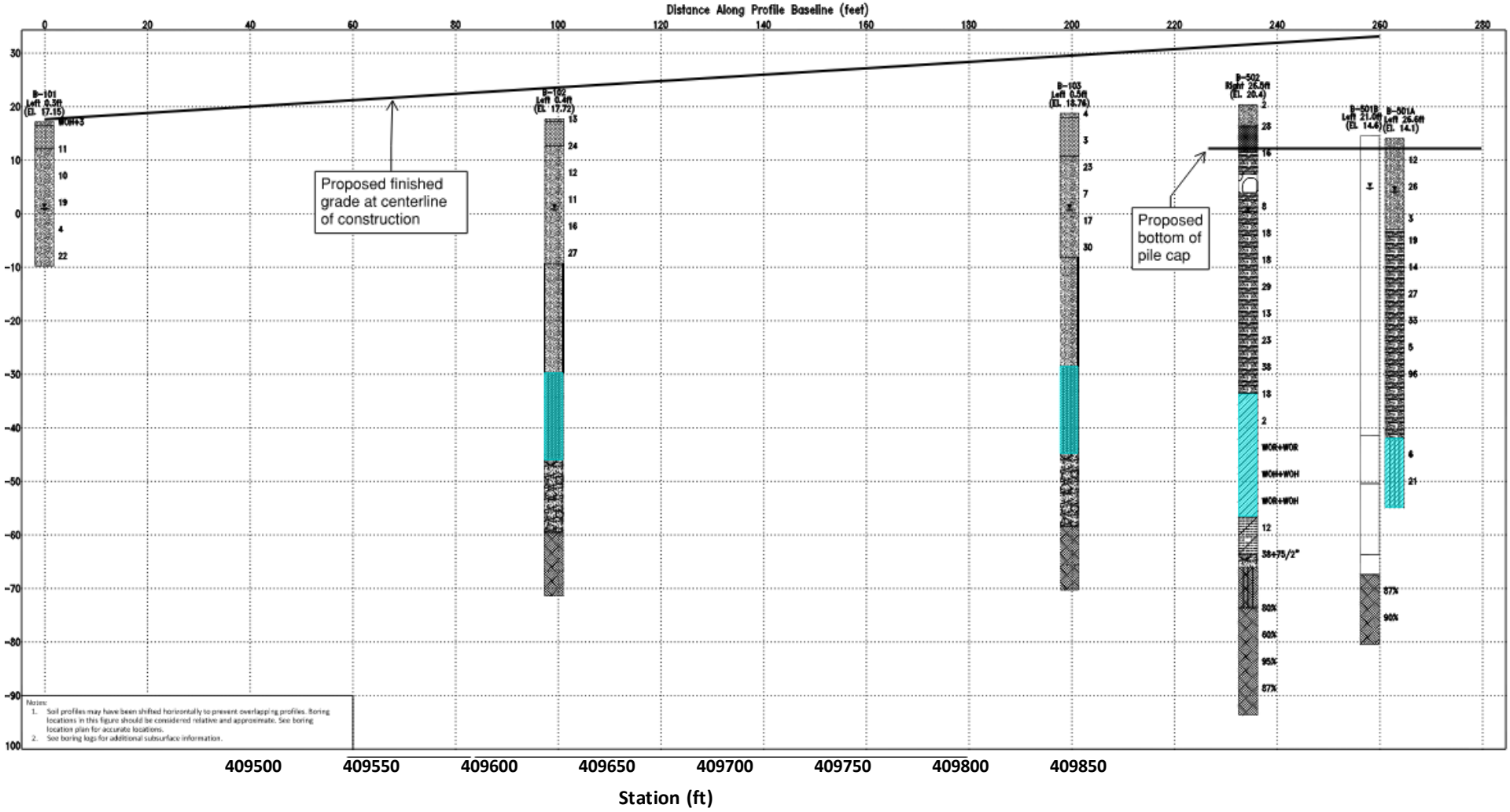


Proposed Bridge Approach Sections





Induced Consolidation Settlement



Project Constraints for Settlement Mitigation

Limitations to Settlement Mitigation Approaches

- Preloading and Surcharging w/o wick drains
  - Project construction phasing
  - Time required for settlement dissipation
- Preloading and Surcharging w/ wick drains
  - Dense sands and presence of boulders and riprap
- Ground Improvement (Rammed Aggregate Piers / Rigid Inclusions)
  - Depth of marine clays 50'+
  - Expensive alternative / more complex solution

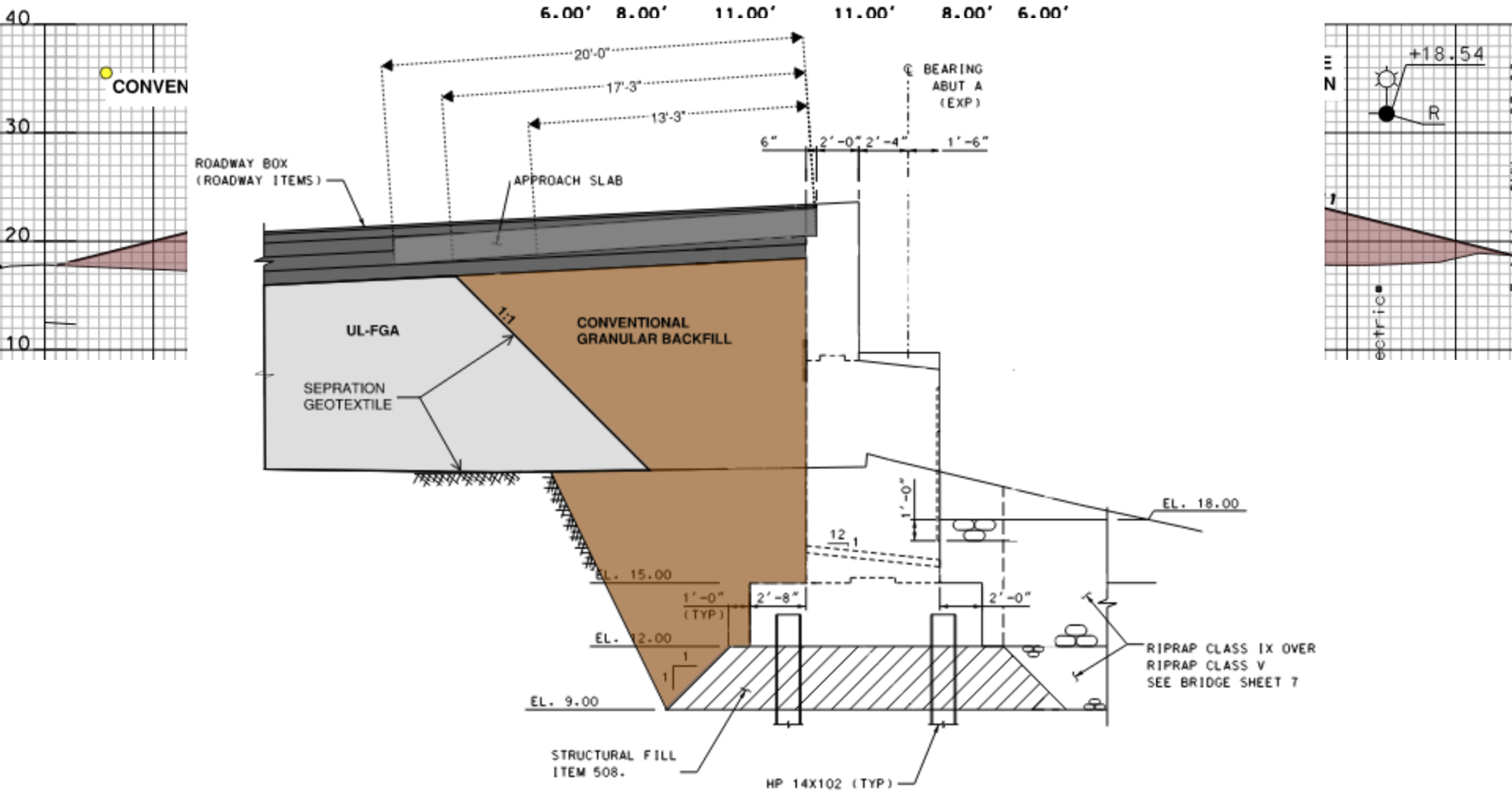
Lightweight Fill - Geofoam

PER-ASTM D6	-39	EPS-46
Density[1], min.	40	2.85
Compressive Resist min. @ 1% deform	.0 60)	18.6 (2680)
Compressive Resist min. @ 5% deform	.0 40)	43.5 (6260)
Compressive Resist min. @ 10% deform	.0 60)	50.0 (7200)
Flexural Strength[1]	.0	75.0
Elastic Modulus[1],	00	1860
Oxygen Index[1], m	.0	24.0
Buoyancy Forc	.0	59.5
Water Absorption total immersion, n	0	2.0
R-value[1], Thermal Resistanc Inch, ASTM-C518	0	5.1
	8	4.9
	4	4.5

Lightweight Fill – UL-FGA

[1]Modified test method due to particle size/density

Proposed UL-FGA Approach Sections



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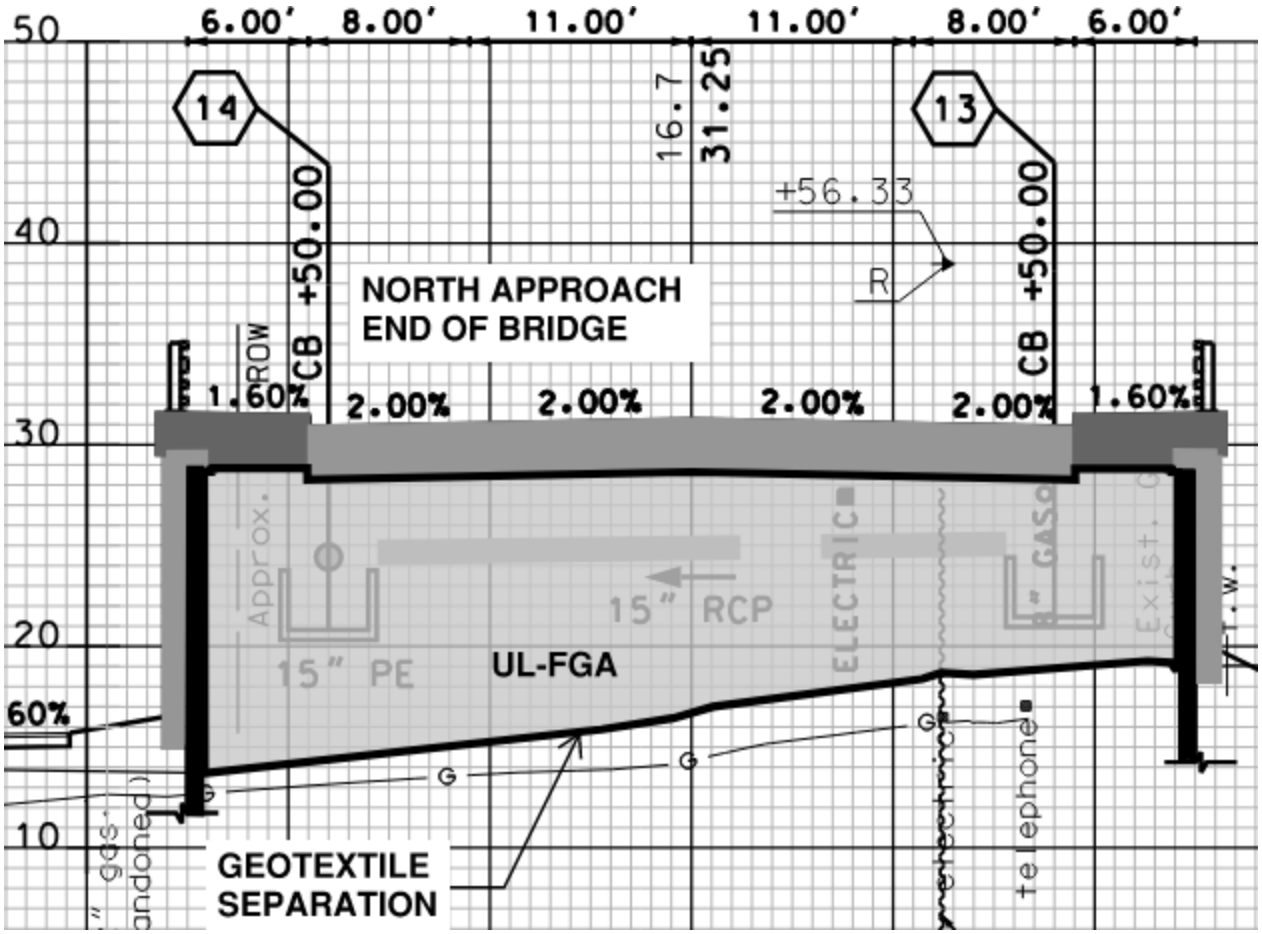
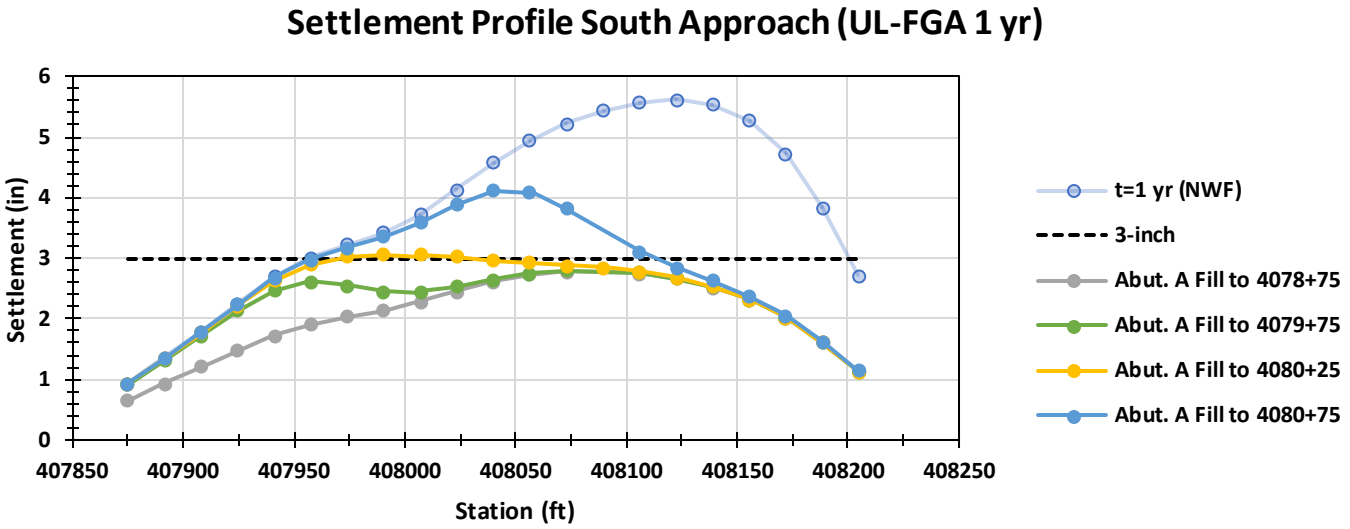
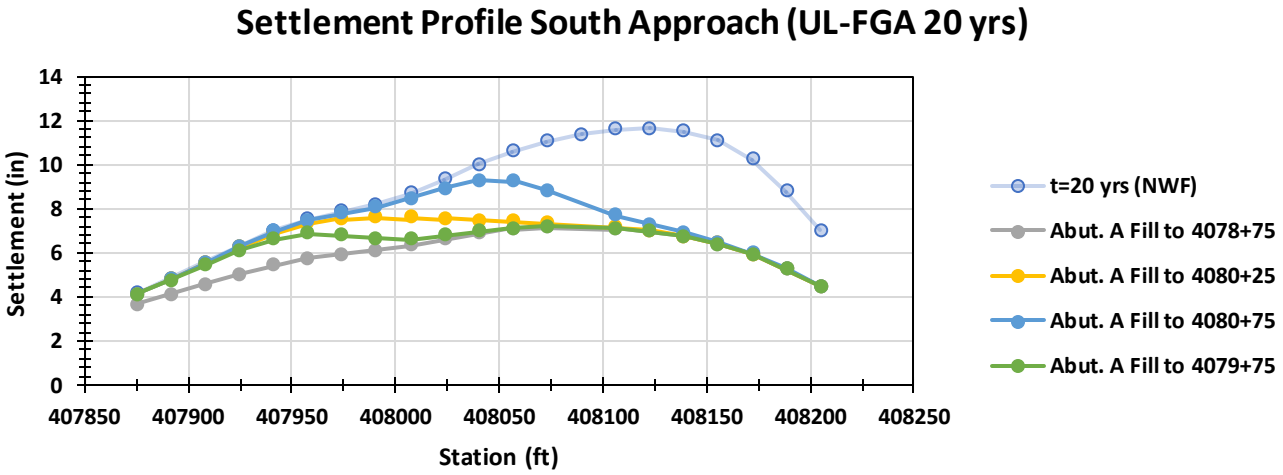
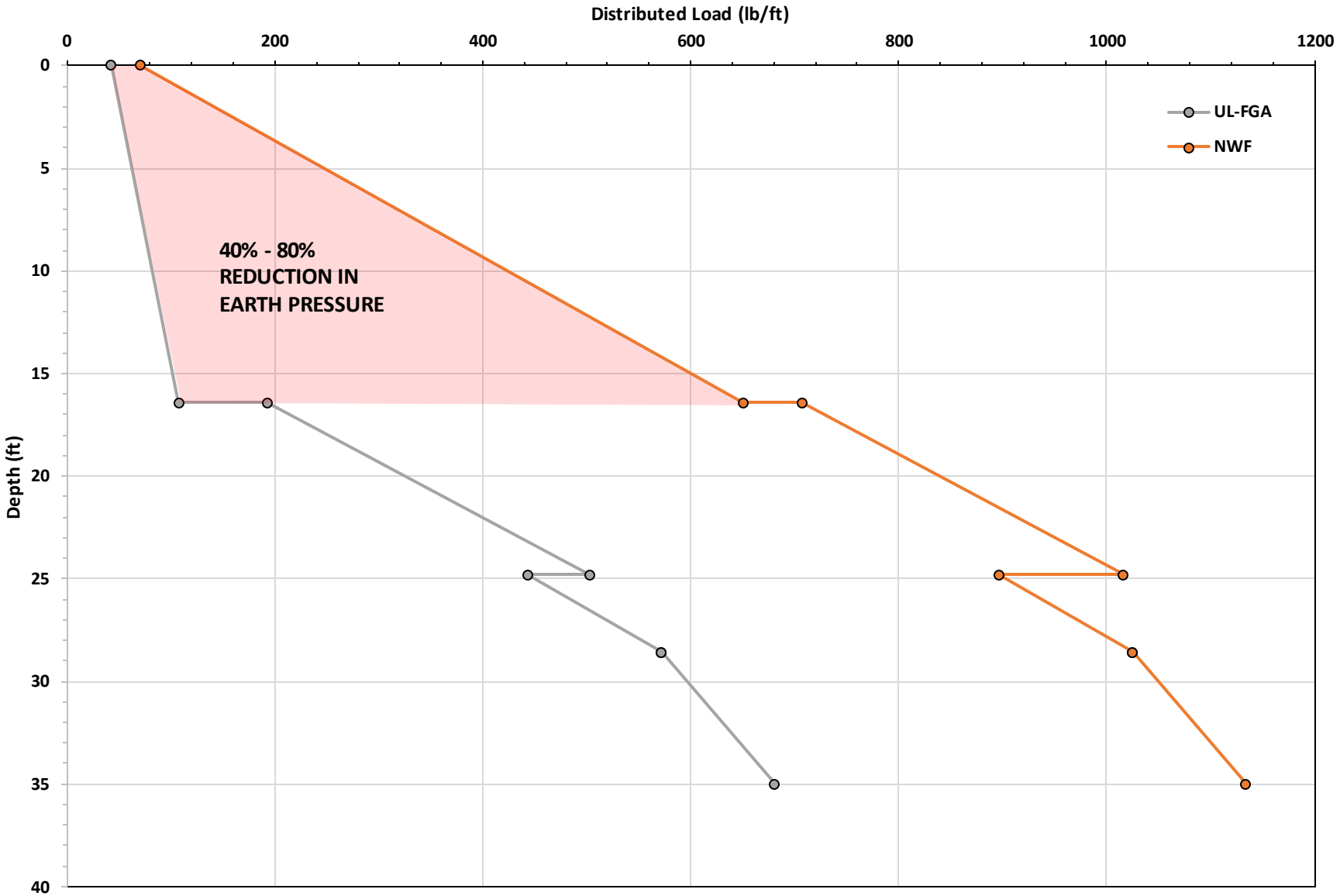


Settlement Mitigation – UL-FGA

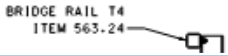




Retaining Wall – Earth Pressure Reduction



Retaining Wall Optimization – UL-FGA



Backfill Material	Unit Weight (pcf)	Friction Angle (deg)	Wall Section	Comments
UL-FGA	23.5	45	NZ19	20-foot embedment
NWF	125	34	NZ19 + Tiebacks	Tiebacks @ 5-0 feet spacing
UL-FGA	23.5	45	SPL HP14X89	20-foot embedment Piles @ 5-10 feet spacing
NWF	125	34	SPL HP18X181 + concrete shaft	35-foot embedment Piles @ 5-10 feet spacing 36” diameter shaft

Conclusions

- UL-FGA is an effective settlement mitigation solution where application of traditional approaches is limited

- Better alternative than Geofoam for the current project:
  - Simpler earthwork (no need for specialty contractor)
  - Flexibility for utility routings (current and future)
  - Better buoyancy
  - More cost effective (UL-FGA: $150/cy vs Geofoam $190/cy)

- Effective for control of differential settlement at the approach – approach slab interface

- Strength properties greatly improve retaining wall stability by reduction of earth pressures