Route 37 EB & WB Bridges over Barnegat Bay *Superstorm Sandy Emergency Repairs to Scour damaged Piers*

Township of Toms River, County of Ocean, New Jersey

PRESENTED APRIL 2018

BY

RAMA KRISHNAGIRI, PE AND STEVE ESPOSITO, PE

OWNER: **NEW JERSEY DEPARTMENT OF TRANSPORTATION**

DESIGNER: **WSP USA (FORMERLY PARSONS BRINCKERHOFF)**

Bridge Location & Status

Status: Mathis Bridge Rehabilitation currently under construction

Mathis Bridge

- Constructed in 1950
- Length = 4,877’
- Spans = 66
- Low-level Bridge
- Hammerhead Piers Founded on Untreated Timber Piles

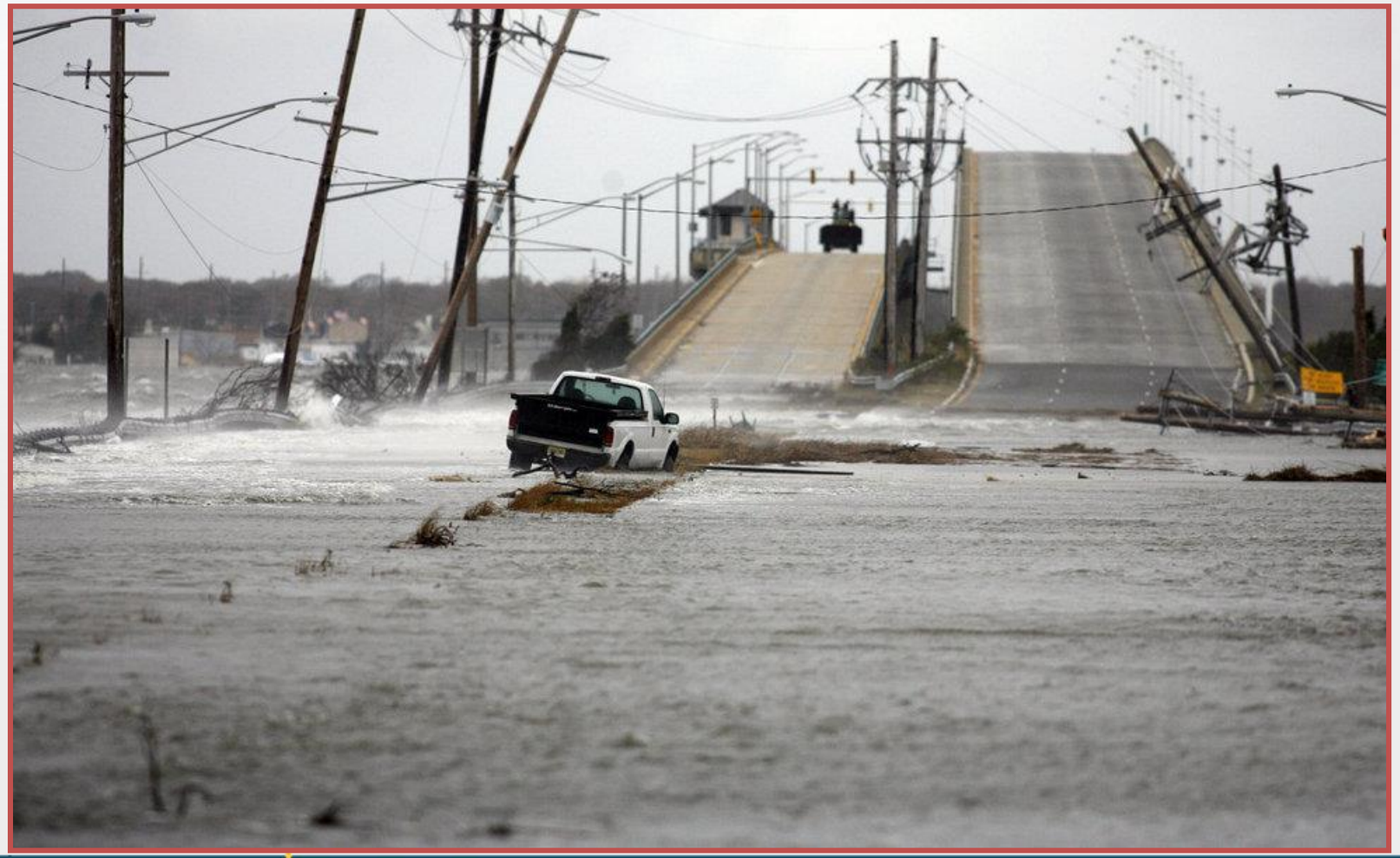
Tunney Bridge

- Constructed in 1972
- Length = 4,878’
- Spans = 50
- High-level Fixed Bridge
- Hammerhead Piers or P/C bents Founded on Treated Timber Piles

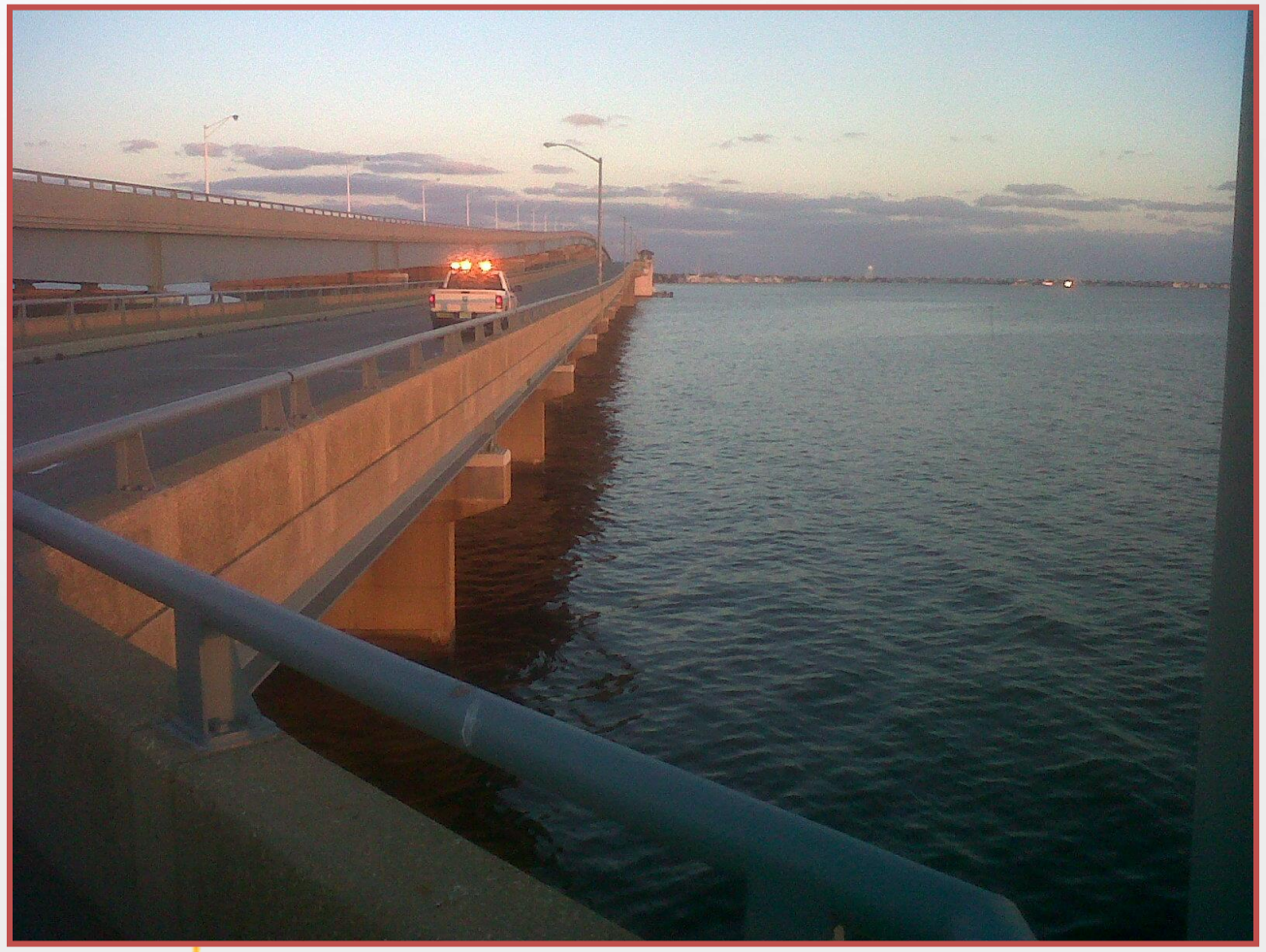
Rehabilitation details

- Deck and Bearing Replacement
- Substructure Repairs
- Mechanical/Electrical Replacement and Upgrades
- Safety: Gates, Traffic Signals, Catwalks
- Underwater Inspection (August 2012)
  - Substructure inspection below the water level
  - Detailed Bay Bottom Surveyed in Easterly Portion
- No scoured areas were noted at the time of the inspection/survey

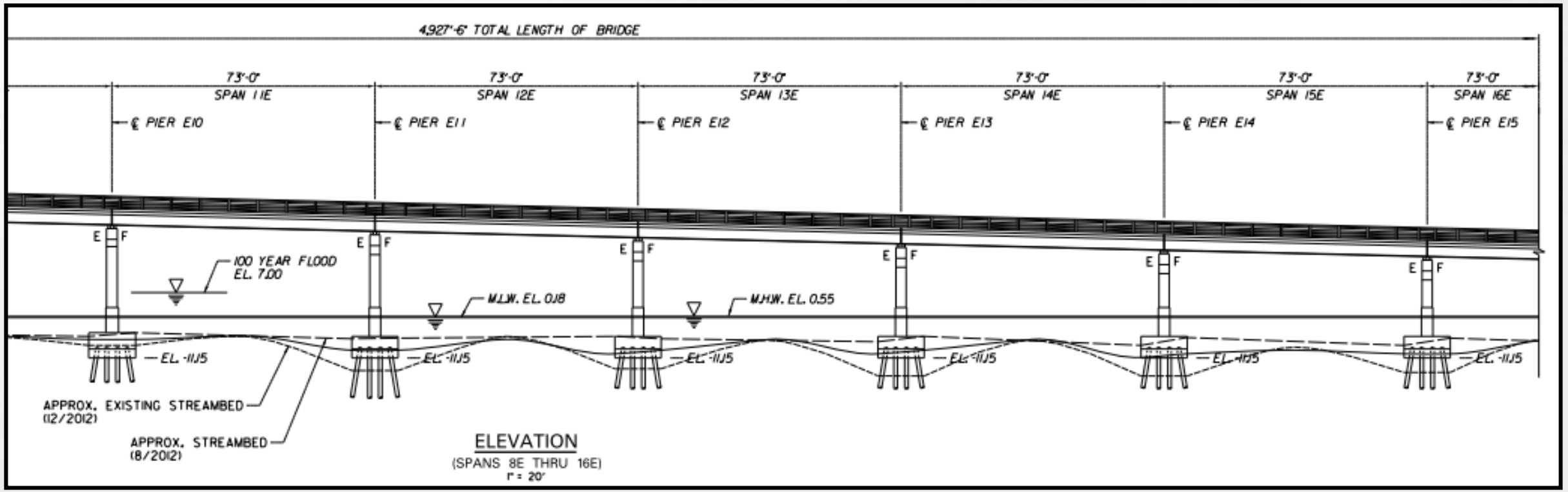
Superstorm Sandy | October 29, 2012



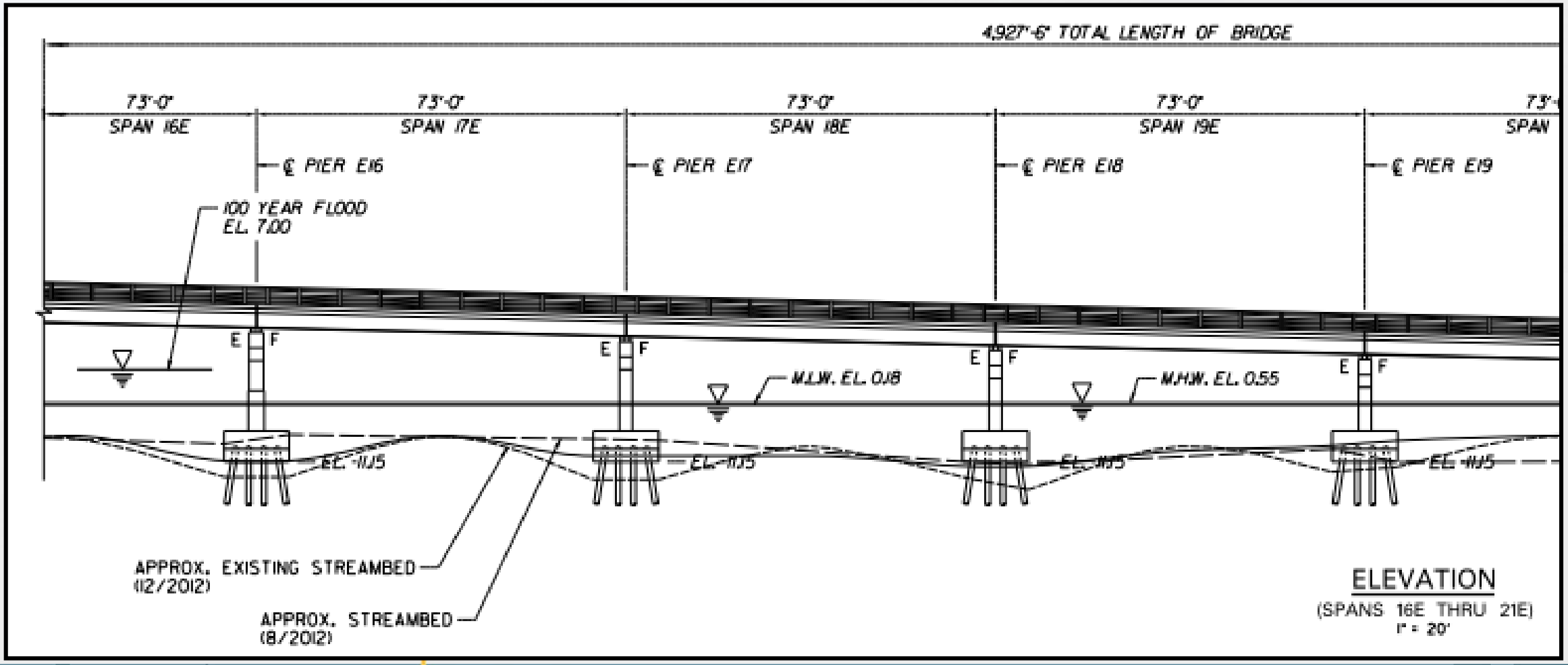
Post Sandy Emergency Inspection



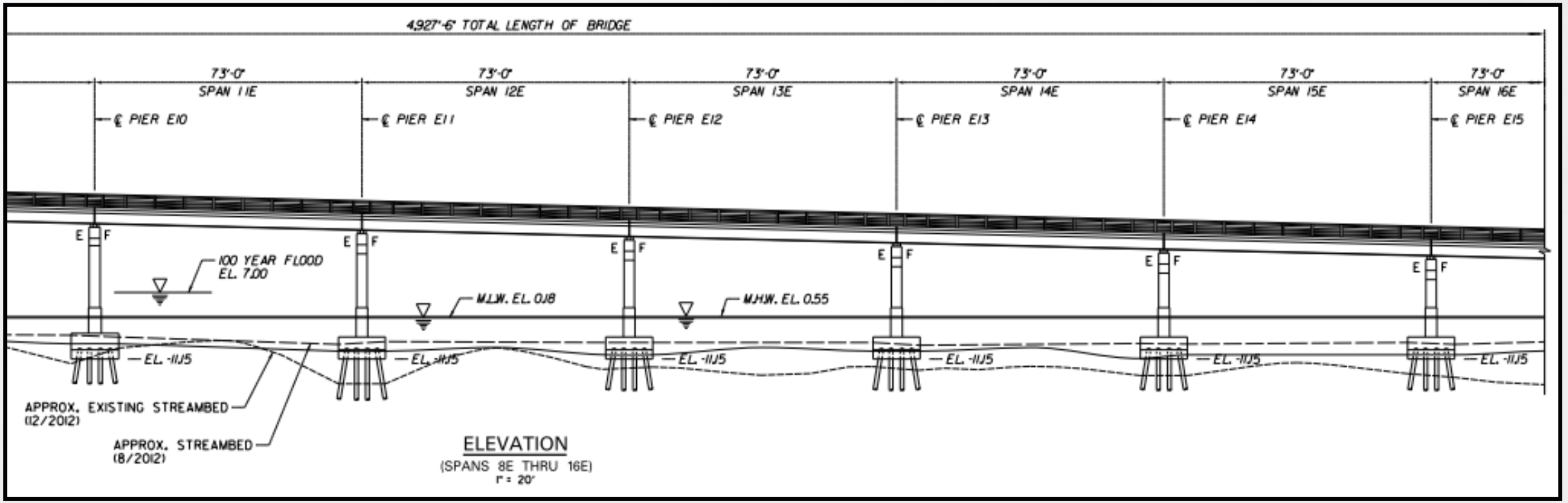
Pre- and post- sandy
BAY SOUNDINGS – SOUTH FASCIA



PRE- AND POST- SANDY BAY SOUNDINGS – SOUTH FASCIA



PRE- AND POST- SANDY BAY SOUNDINGS - CENTERLINE



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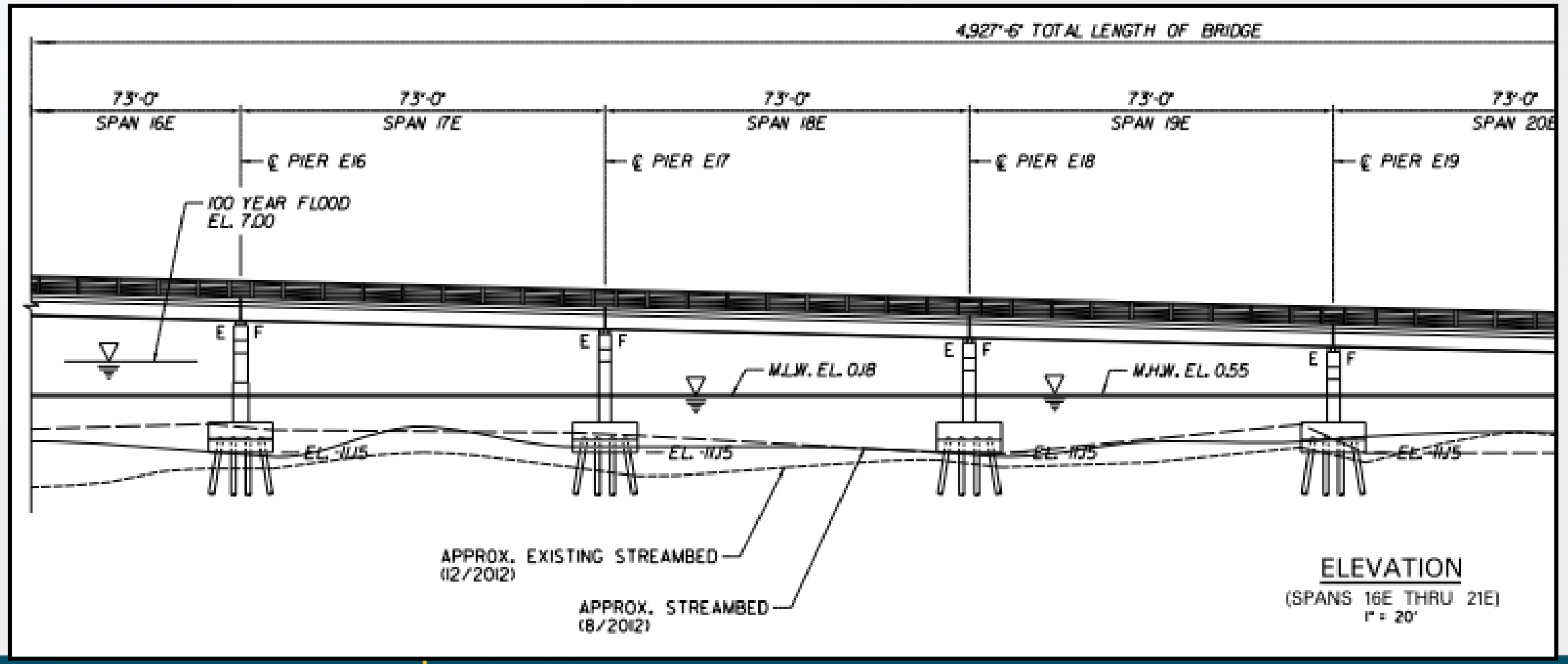
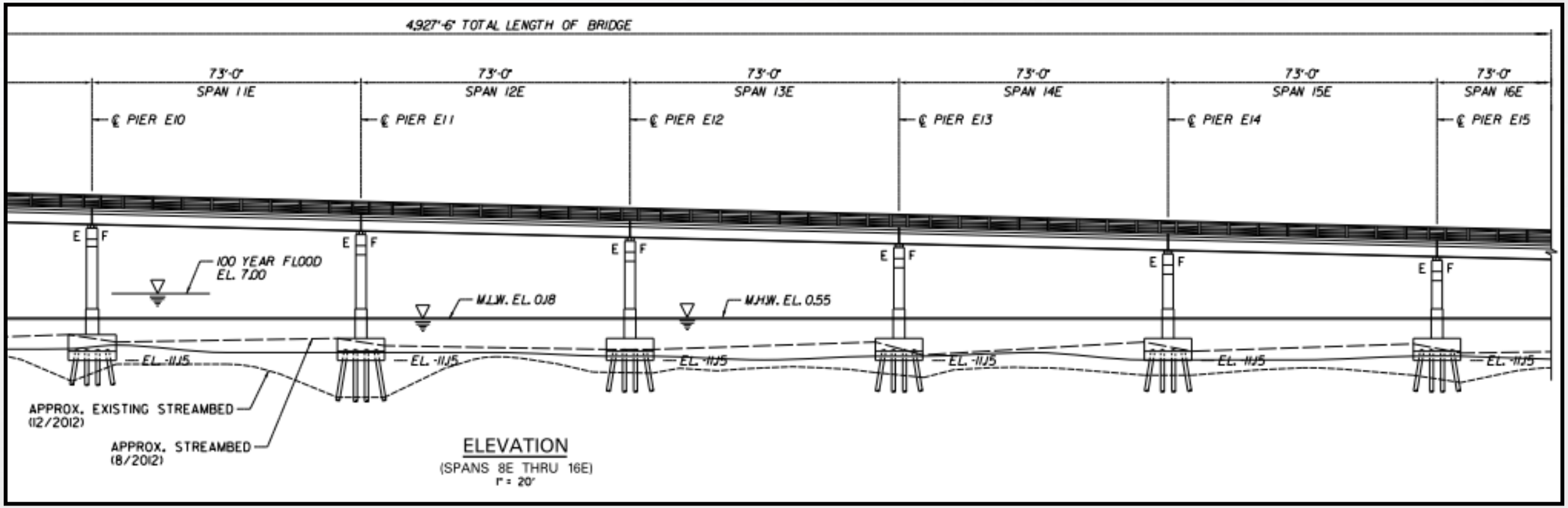
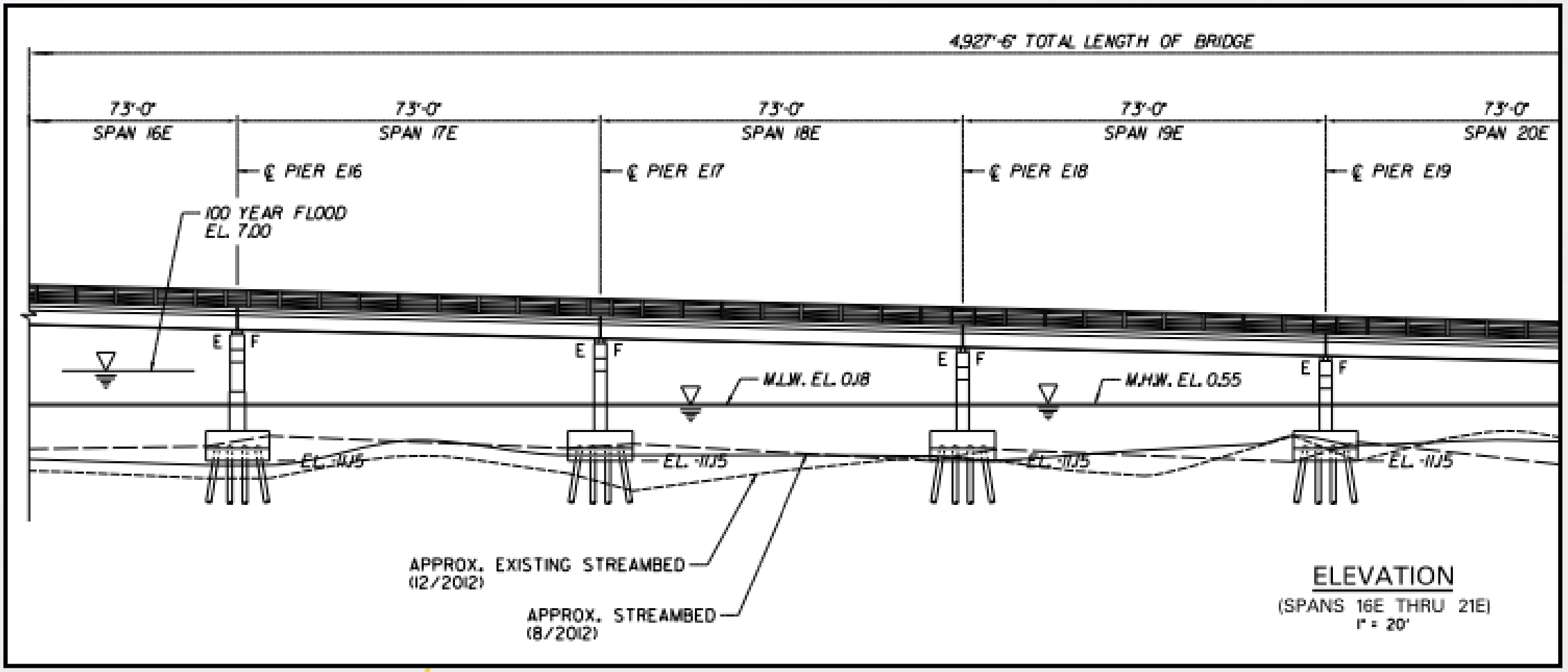


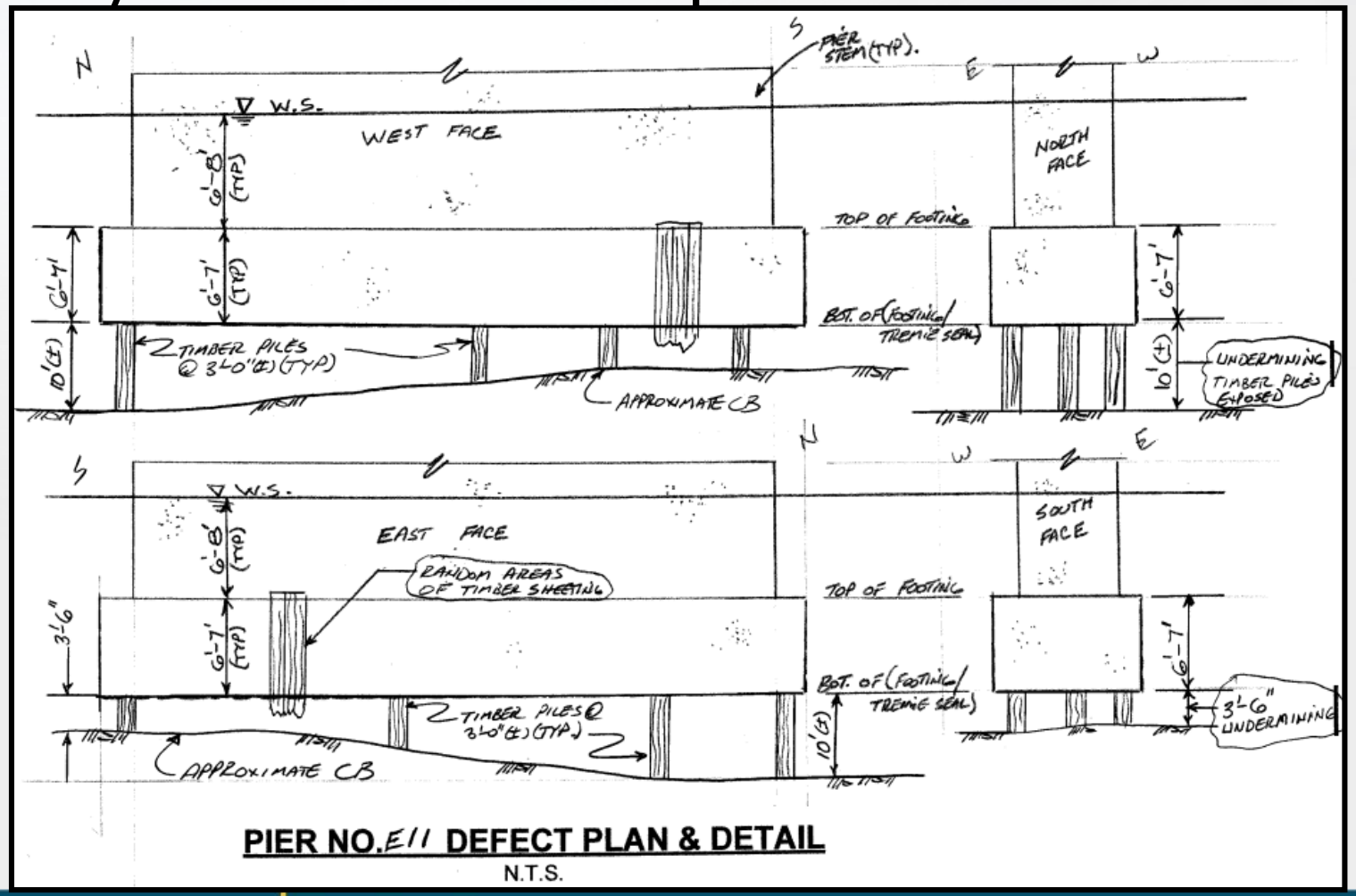
PRE- AND POST- SANDY BAY SOUNDINGS – NORTH FASCIA



PRE- AND POST- SANDY BAY SOUNDINGS – NORTH FASCIA



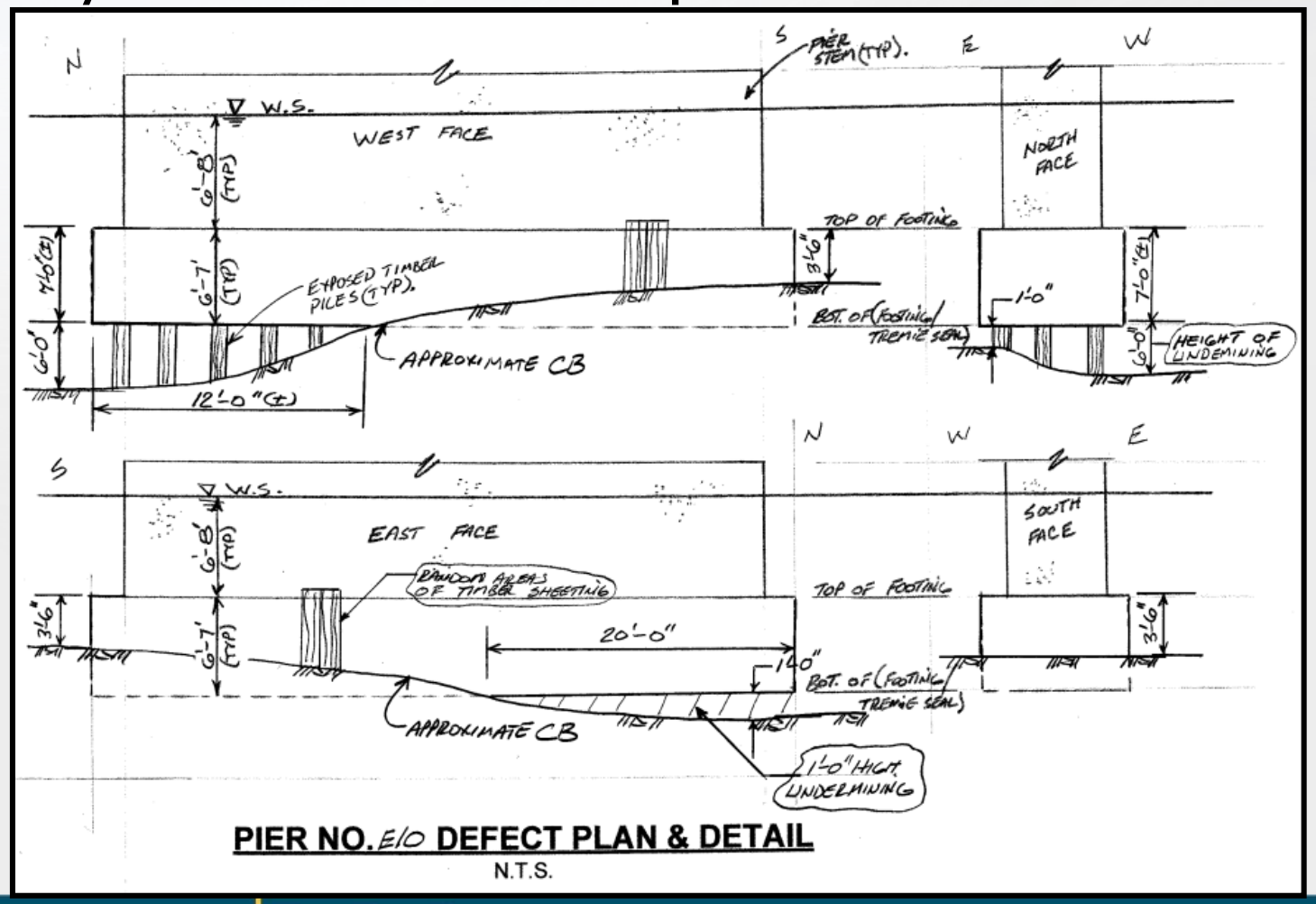
Post-sandy underwater inspection sketches



PIER NO. E11 DEFECT PLAN & DETAIL

N.T.S.

Post-sandy underwater inspection sketches



Geotechnical analysis

- Team's Familiarity with Project Site
- As-built Bridge Plans Included Subsurface Information
  - Length of pier timber piles were estimated from as-built quantities
- Analysis Included:
  - Post-Sandy scoured condition – Dec. 2012 inspection data used
  - Post-construction condition with scour repairs installed
    - Determined ultimate geotechnical axial capacity of single pile for critical pier
    - Analyzed pile group for pile cap deflection, axial load, shear, and bending
  - Critical Pier 11– fully undermined, 10' max. pile exposure, 15' scour

Structural analysis

- Analysis of Scoured Condition
- Analyses indicated that the scoured substructure and piles could support HS20 Live Load.
- Bridge could remain open, allowing critical transport of materials and emergency responders into the Barrier Island
- Analysis of Proposed Scour Repairs
- Assessed loading on timber piles from grout fill
  - Field Inspections Performed
  - Bearing inspection
  - Checked piers for plumbness
  - Deck Joint openings

Emergency inspection

General view of south railing during emergency inspection

No dips or kinks to indicate immediate damage incurred

Scour repair alternatives evaluated

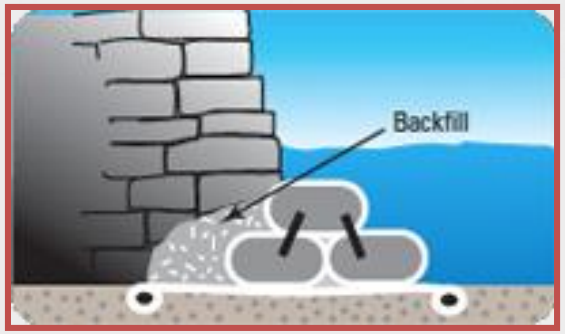
- Rock Riprap Option Eliminated
  - HEC-23 considers riprap as temporary countermeasures at piers
- Initial Repair Options based on Emergency/Priority Letters
  - Steel sheeting around piers with grout pumped under pile caps
  - Timber sheeting around piers with grout pumped under pile caps
- Challenges
  - Limited vertical underclearance
  - Existing battered piles
  - Lateral clearance
  - Vibration

Scour repair alternatives evaluated *(continued)*

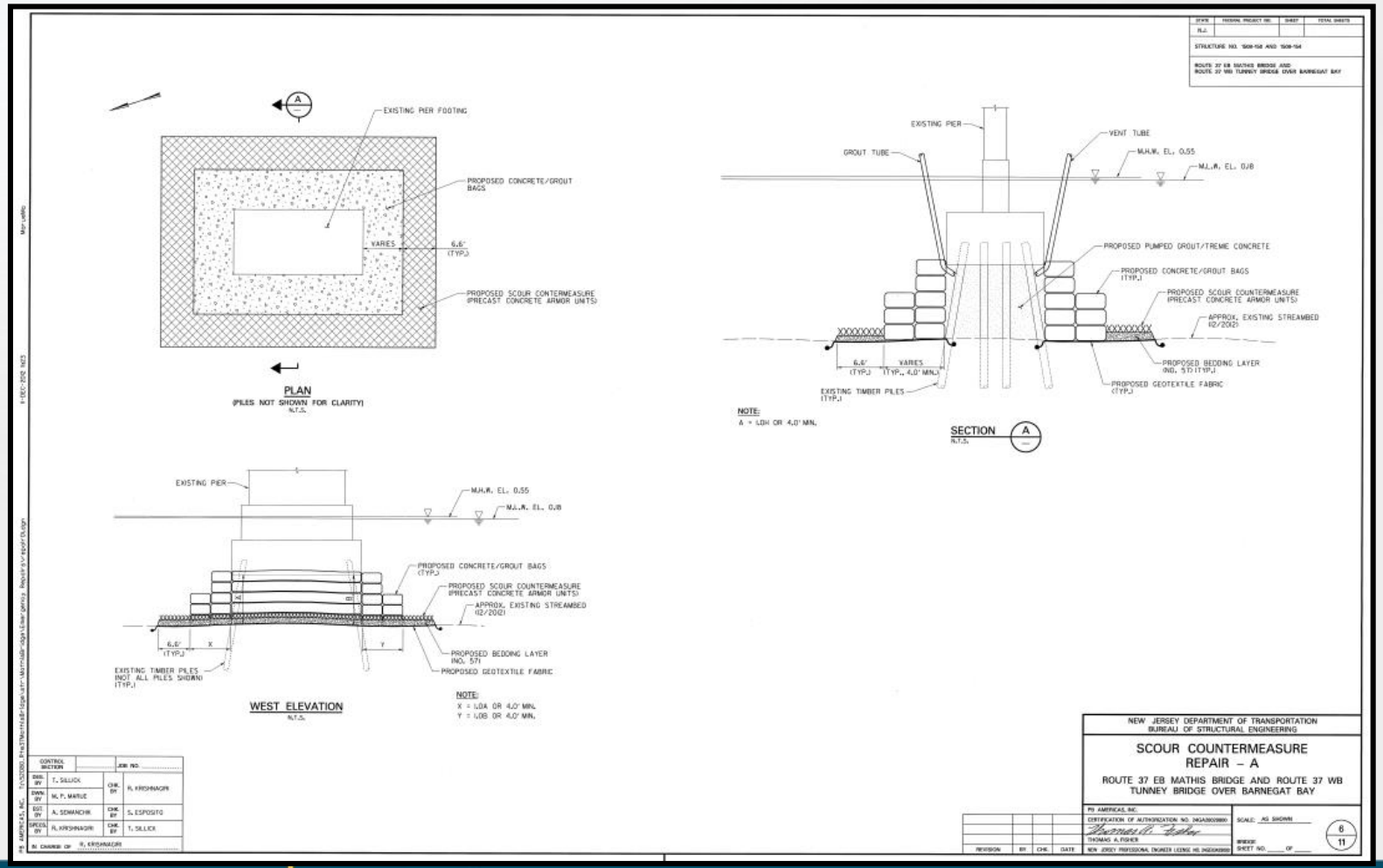
- Additional Repair Options
  - Pre-grouted/sandbags placed under pile caps
  - Fabric formed bags installed in-situ around pile caps filled with grout to form sides and grout pumped under pile caps
- Repair Options for Long-term, Resilient Scour Protection
  - Precast solid armoring around toe of Fabriform bags

- Challenges
  - Repetitious construction
  - Availability of materials
  - Standard construction equipment
  - Constructibility

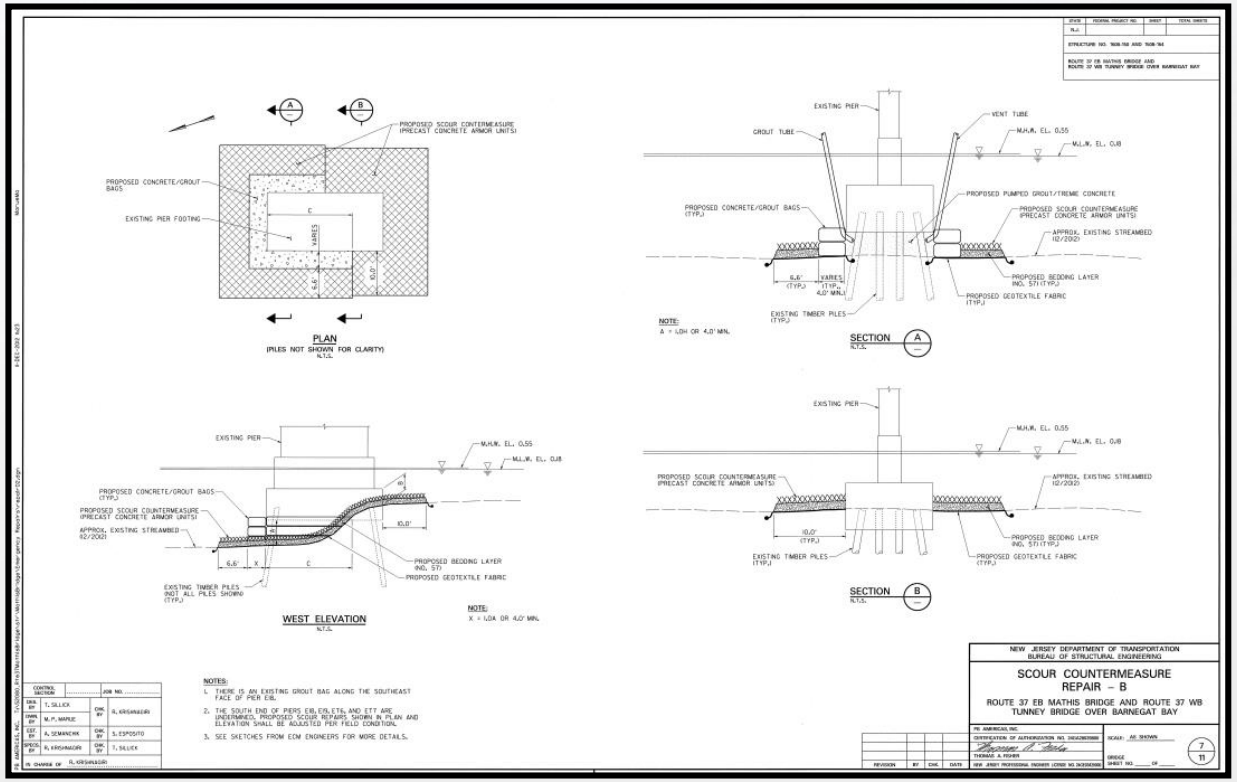
Fabriform grout bags

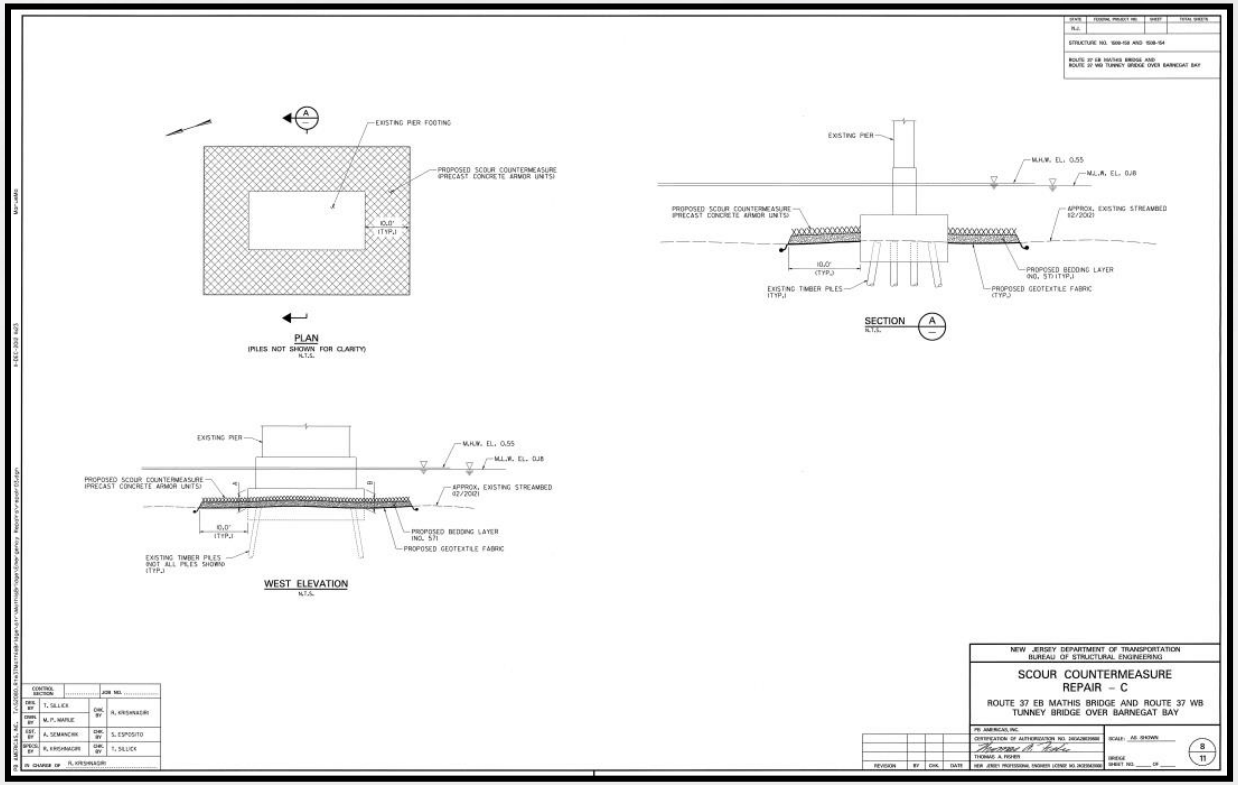


Repair type A

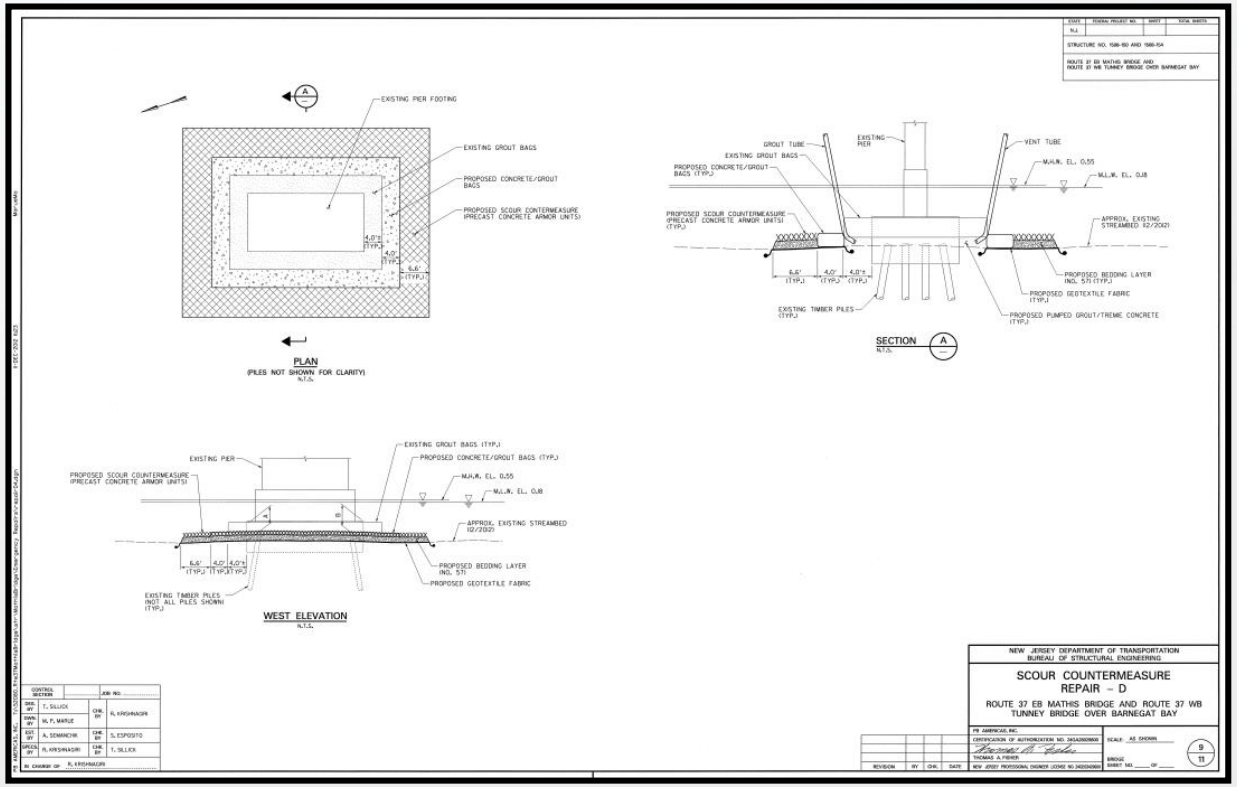


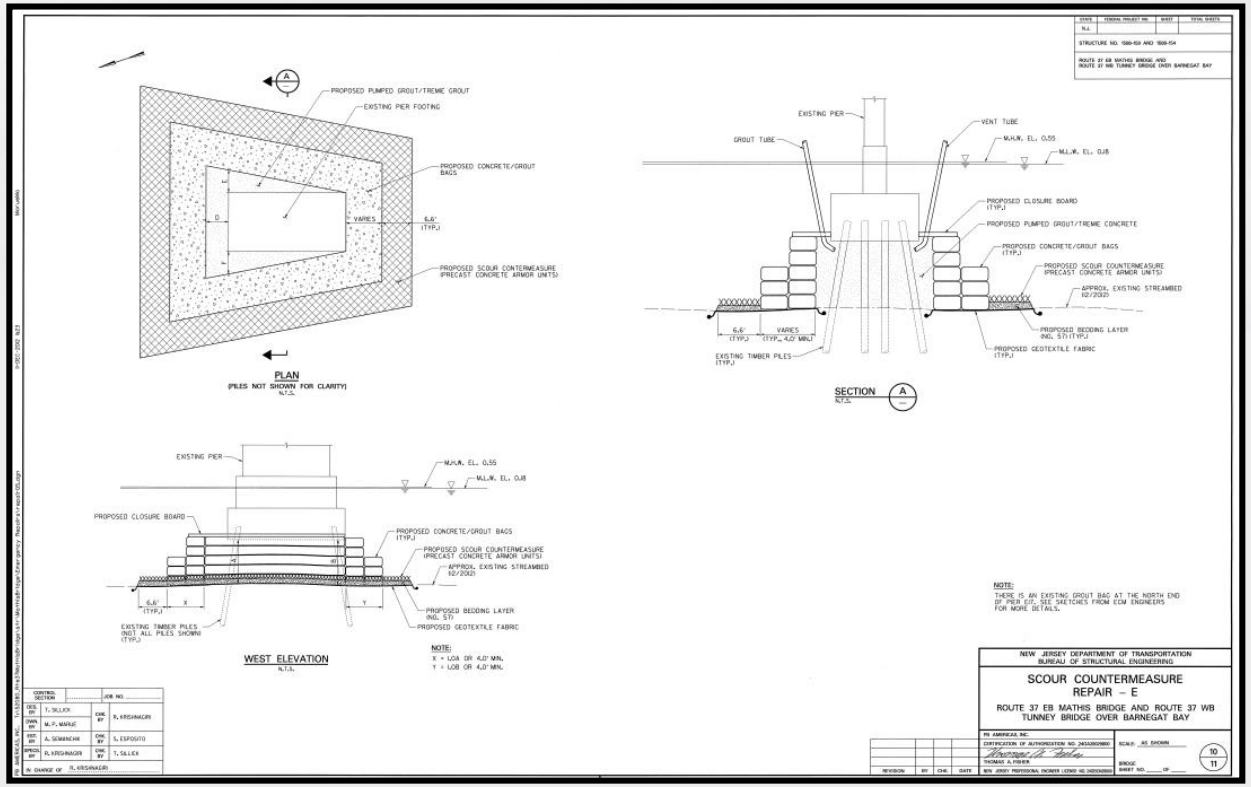
Repair types B &C



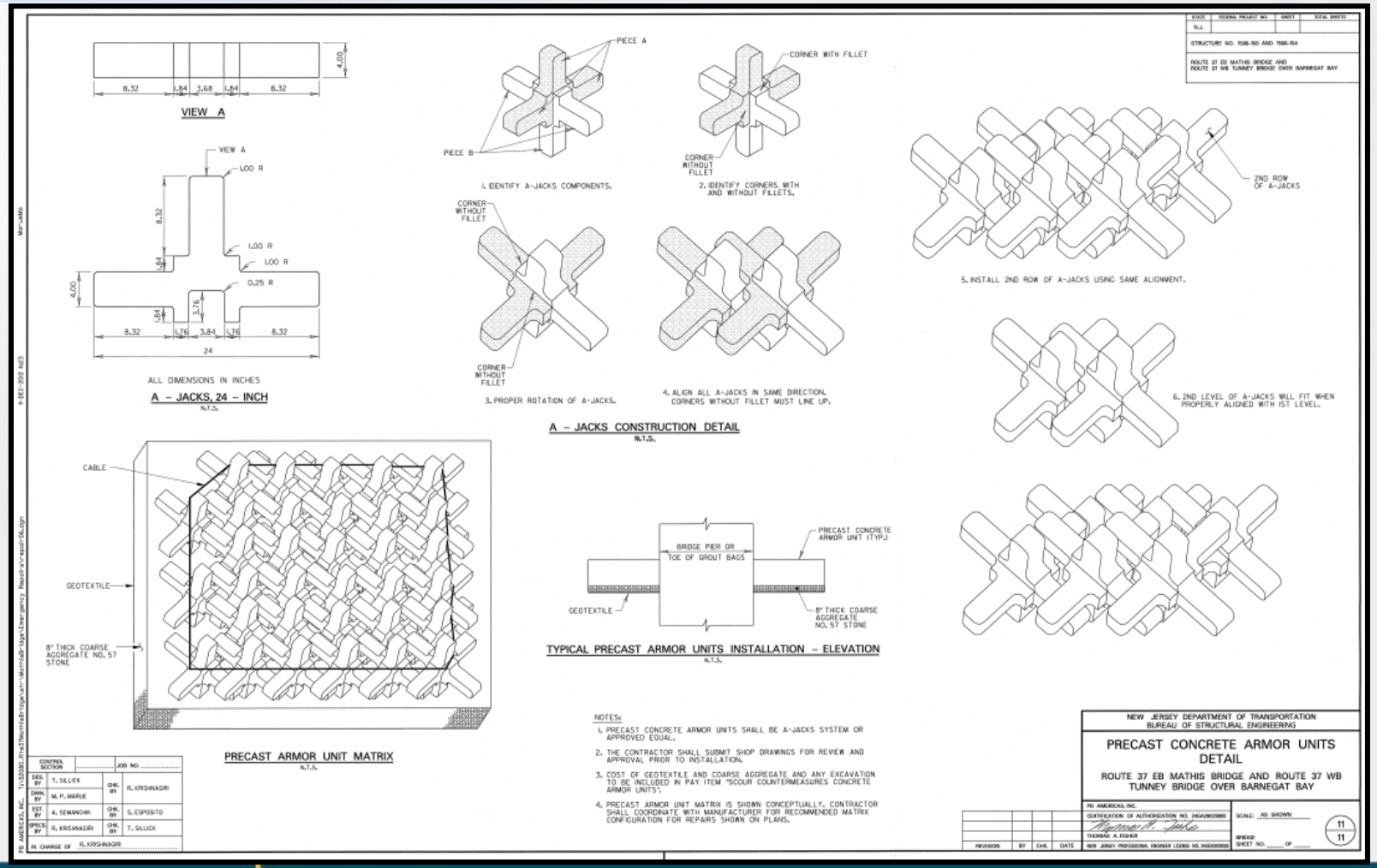


Repair types D & E





Precast concrete armor



ROUTE 37 EB MATHIS BRIDGE REPAIR QUANTITIES

PIER	GROUT BELOW FOOTING OR EXISTING SCOUR COUNTERMEASURE	GROUT IN BAGS (ADJACENT TO FOOTING)	TOTAL GROUT VOLUME	#57 STONE VOLUME	GEOTEXTILE	SCOUR COUNTERMEASURES
	CY	CY	CY	CY	SF	SY
E2	24	31	55	29	2066	130
E3	14	19	33	28	1761	123
E4	21	28	49	28	1867	123
E5	-	-	-	30	1204	132
E6	-	-	-	30	1204	132
E7	-	-	-	34	1388	152
E8	1	7	8	34	1441	152
E9	3	13	16	26	1095	114
E10	27	61	88	28	1264	125
E11	156	205	361	35	2843	156
E12	68	100	168	31	2225	137
E13	71	123	194	32	2351	140
E14	57	63	120	31	2214	136
E15	64	105	169	31	2246	137
E16	41	46	87	29	1963	128
E17	65	91	156	30	2117	133
E18	38	73	111	30	1508	133
E19	18	20	38	32	1340	141

ROUTE 37 WB TUNNEY BRIDGE REPAIR QUANTITIES

PIER	GROUT BELOW FOOTING OR EXISTING SCOUR COUNTERMEASURE	GROUT IN BAGS (ADJACENT TO FOOTING)	TOTAL GROUT VOLUME	#57 STONE VOLUME	GEOTEXTILE	SCOUR COUNTERMEASURES
	CY	CY	CY	CY	SF	SY
ET3	-	-	-	41	1673	183
ET5	-	-	-	35	1428	156
ET6	10	16	26	44	1891	196
ET7	34	30	64	37	1814	164

Contractor access

Contractor's main work barge

Grout pumping

Grout pumping from bridge –
1st: Fill Fabriform bags
2nd: Fill Scour holes beneath pile caps below water

A-jacks assembly / wrap

A nearby marina on Pelican Island served as Contractor's material staging area.

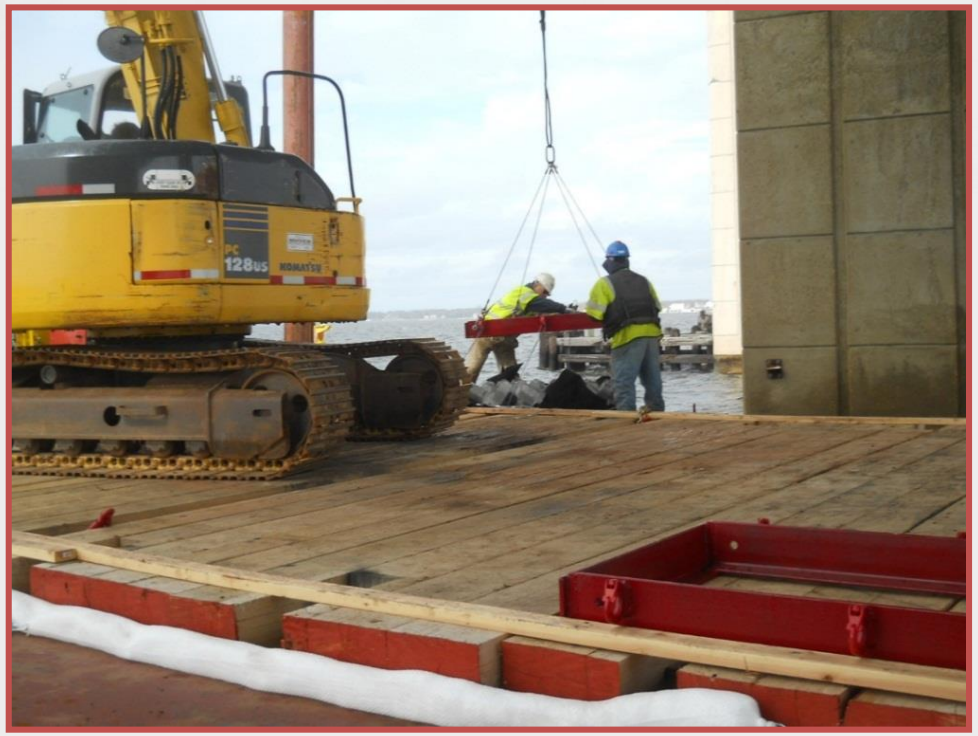
A-Jacks were assembled in 3'x5' bundles and wrapped in 2 layers of geotextile prior to installation.

A-jacks delivery

Tug/barges were used to transport materials from staging area to the bridge.

A-jacks installation

A-Jacks bundle were unloaded using spreader beams.



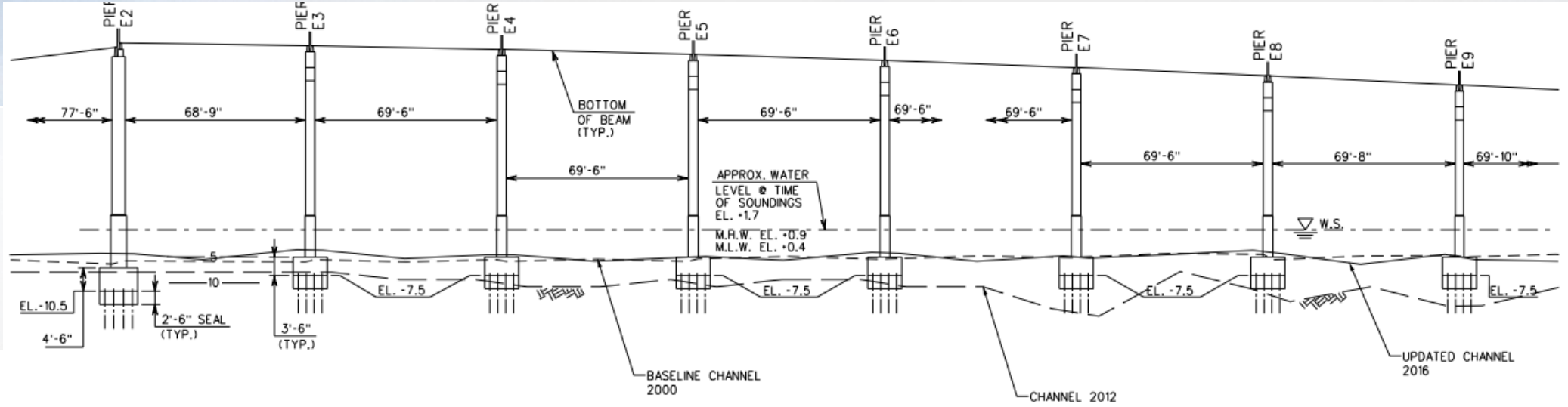
a-jacks installation

After being lowered in the water, A-Jacks bundles were placed with diver assistance.

Construction Challenges

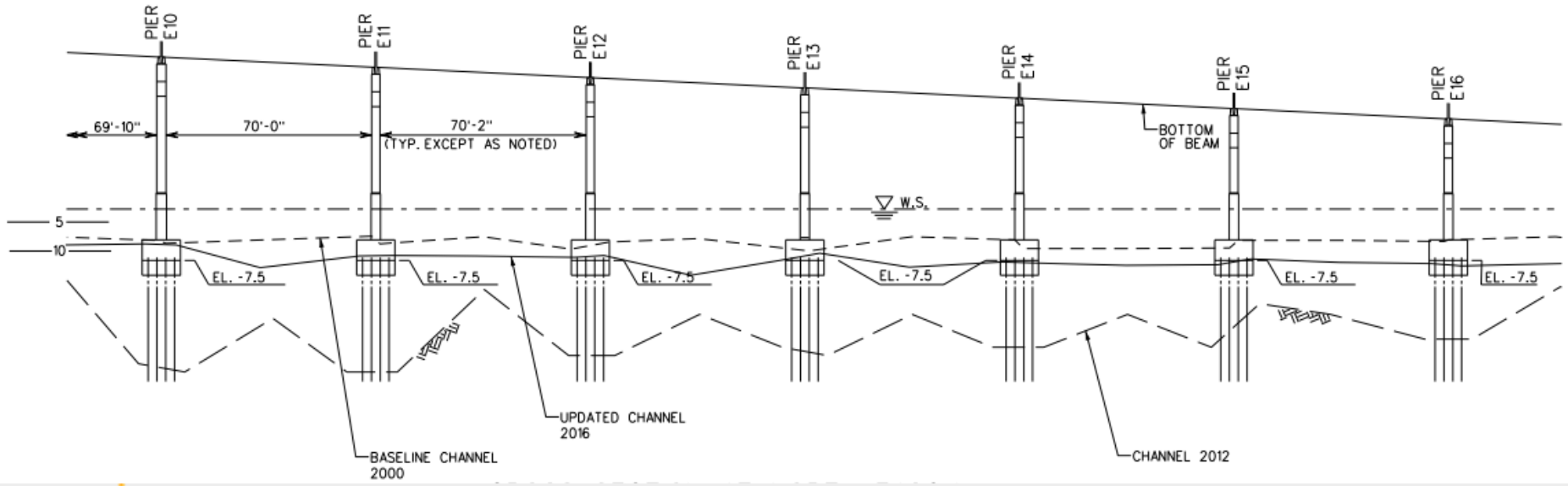
- Weather Fluctuations/Work Interruption
- Changes in Bay Bottom
- Larger uneven areas than anticipated in design
- Localized Leveling - #57 Stone
- Periodic Siltation of Previous Work
- Installation of Geotextile – Pre-installation
- Grout Mix Changes

Recent Channel bed profiles – North side



LEGEND:

- 2000 CHANNEL
- 2012 CHANNEL
- 2016 CHANNEL
- 2016 WATER SURFACE



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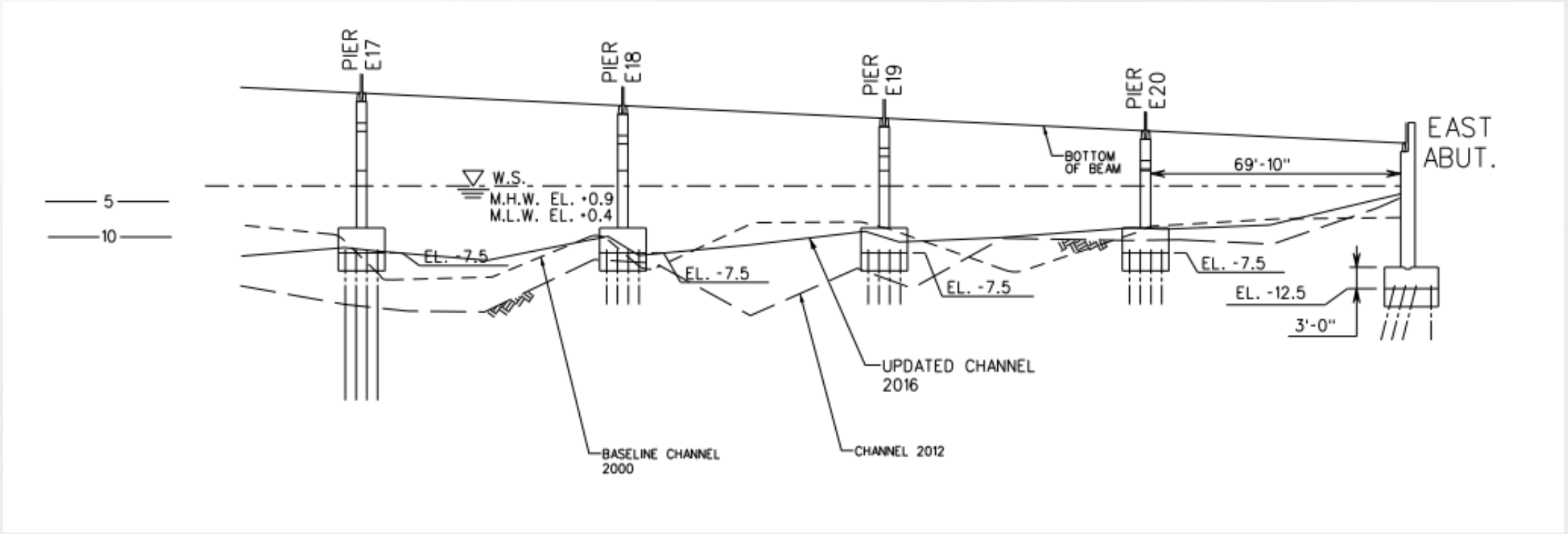
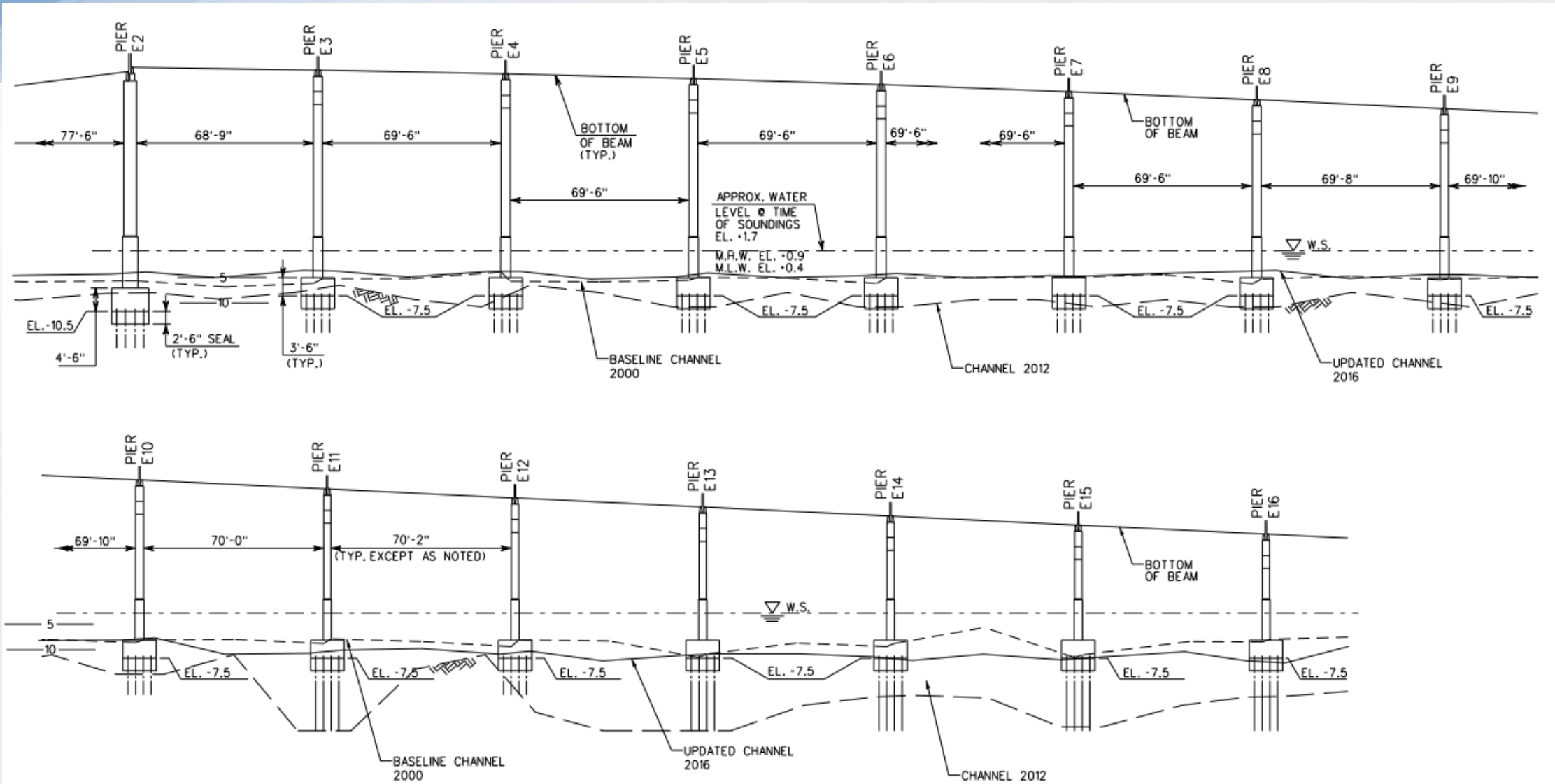
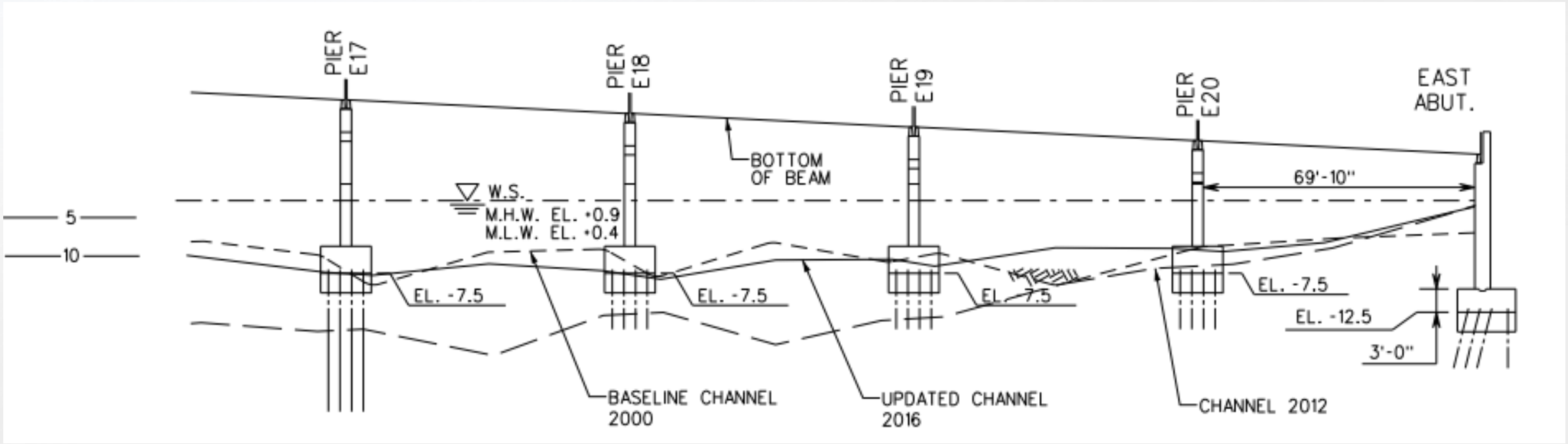


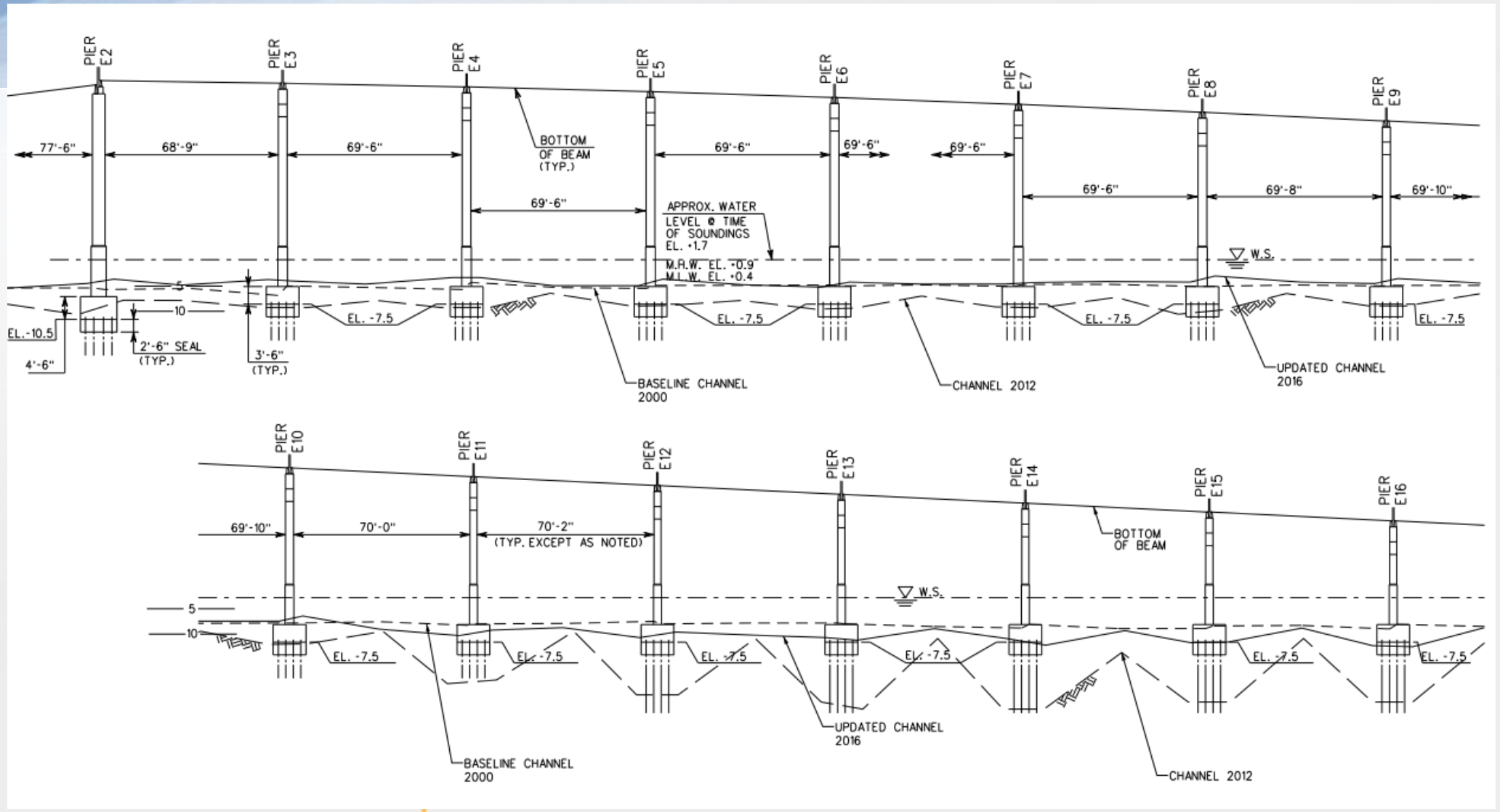
Recent Channel bed profiles – center



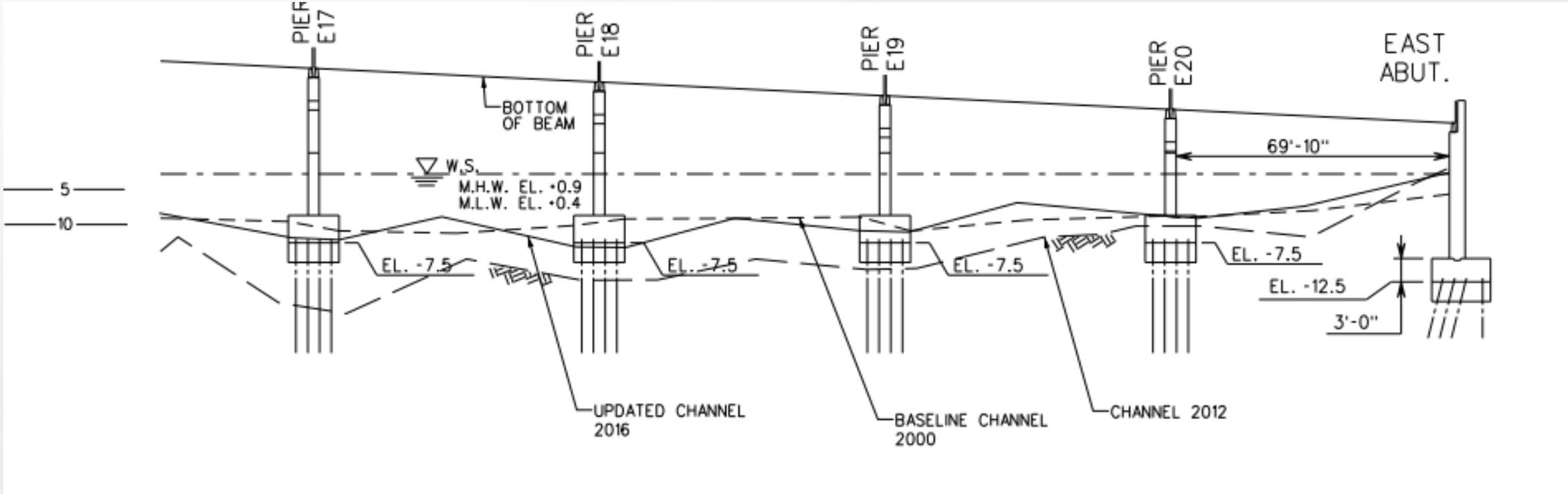
Recent Channel bed profiles – center



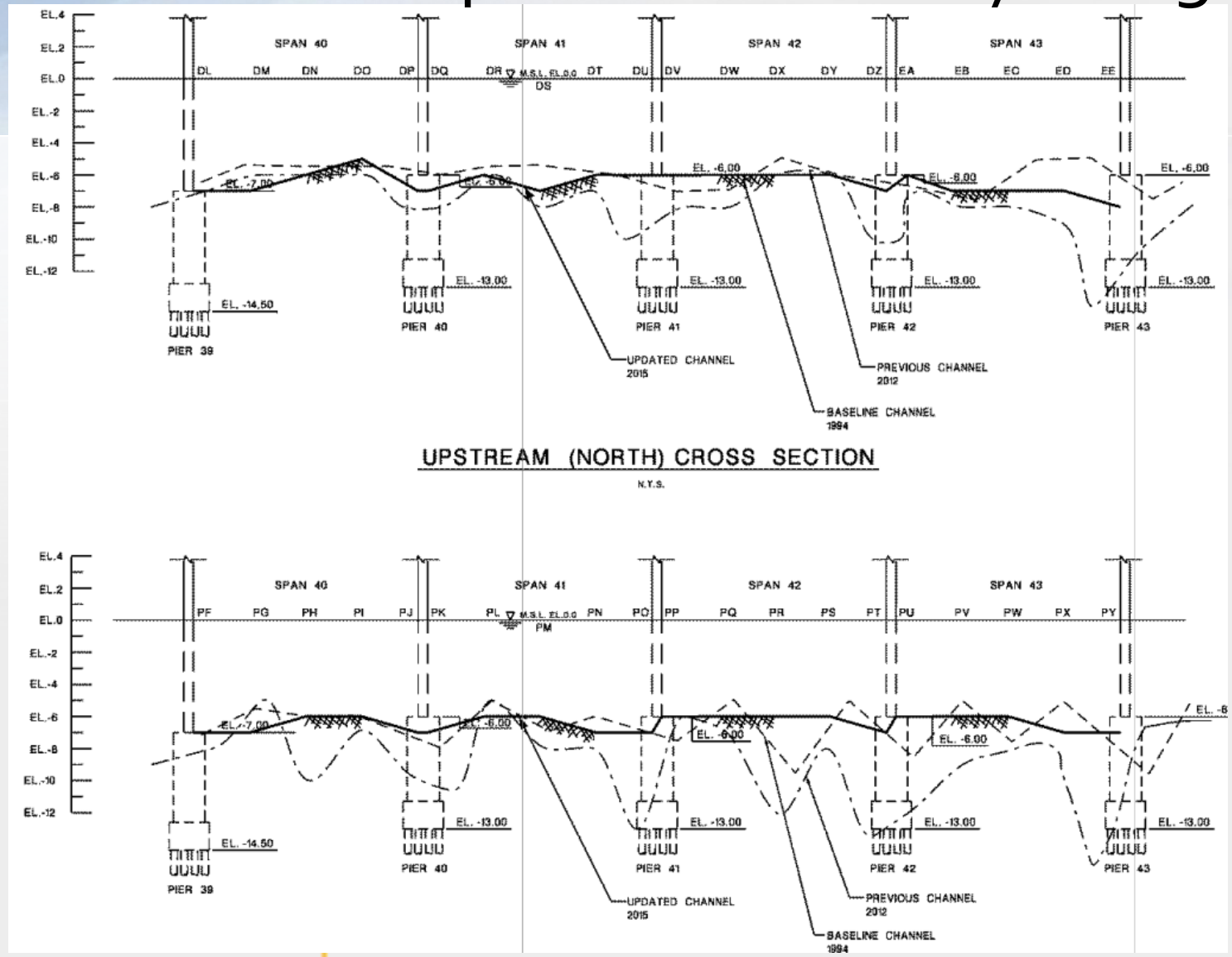
Recent Channel bed profiles – South side



Recent Channel bed profiles – South side



Recent Channel bed profiles – Tunney Bridge



Conclusion

- Six year performance – favorable
- Material deposition encouraged by repairs
- Multi-disciplinary Effort with Extensive Coordination
- Design Team & Client Coordination
  - Response Time
  - Hands-on Approach
- Fast Track Reviews/Approvals of Shop Submittals
- Very Favorable Response from Construction Team

Acknowledgements

- Owner: NJDOT
- Designer: WSP USA, Prime Consultant
- Subconsultants:
  - U/W Inspections - Churchill Consulting Engineers
    - ECM Engineers
- Contractor: IEW Construction Group
- Materials: Contech – (A-Jacks/Geotextile)
  Fabriform (grout bags)