

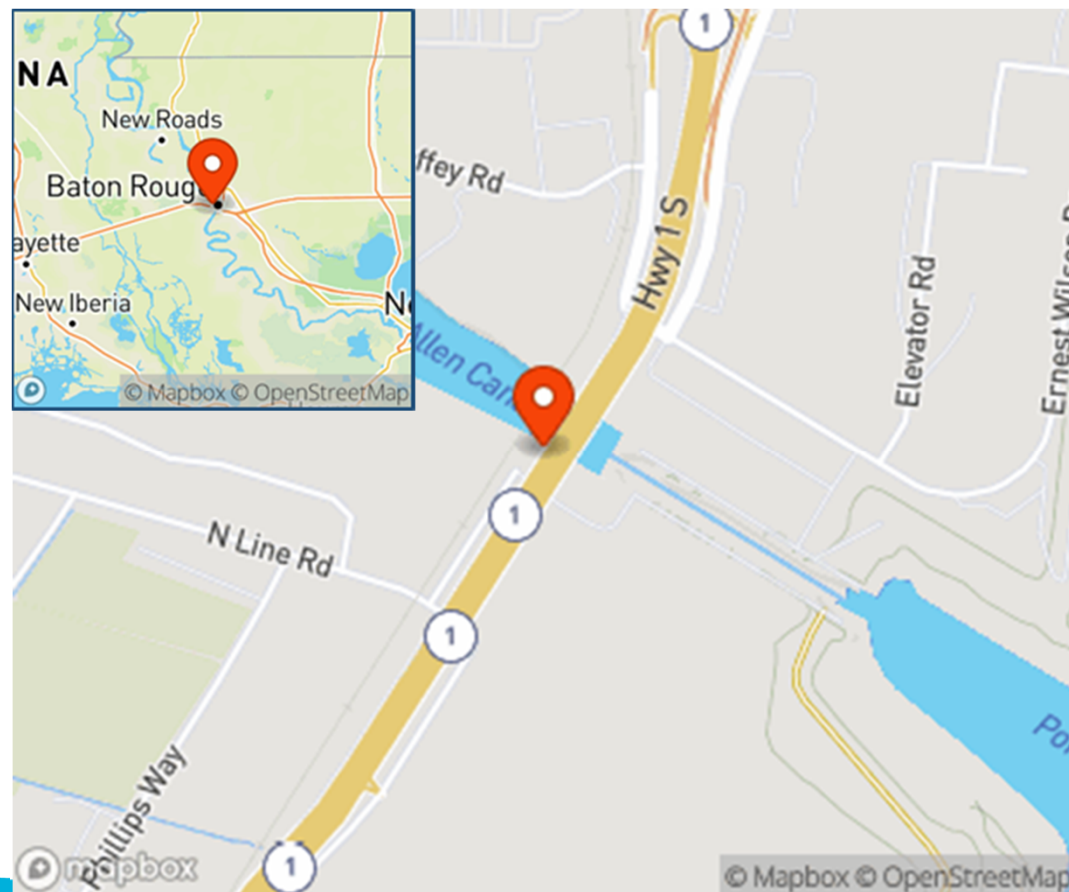
Low Mobility Grouting on the LA 1 Port Allen Canal Bridge

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Location of Project

- Project Location: Port Allen, LA
 - Right outside of Baton Rouge



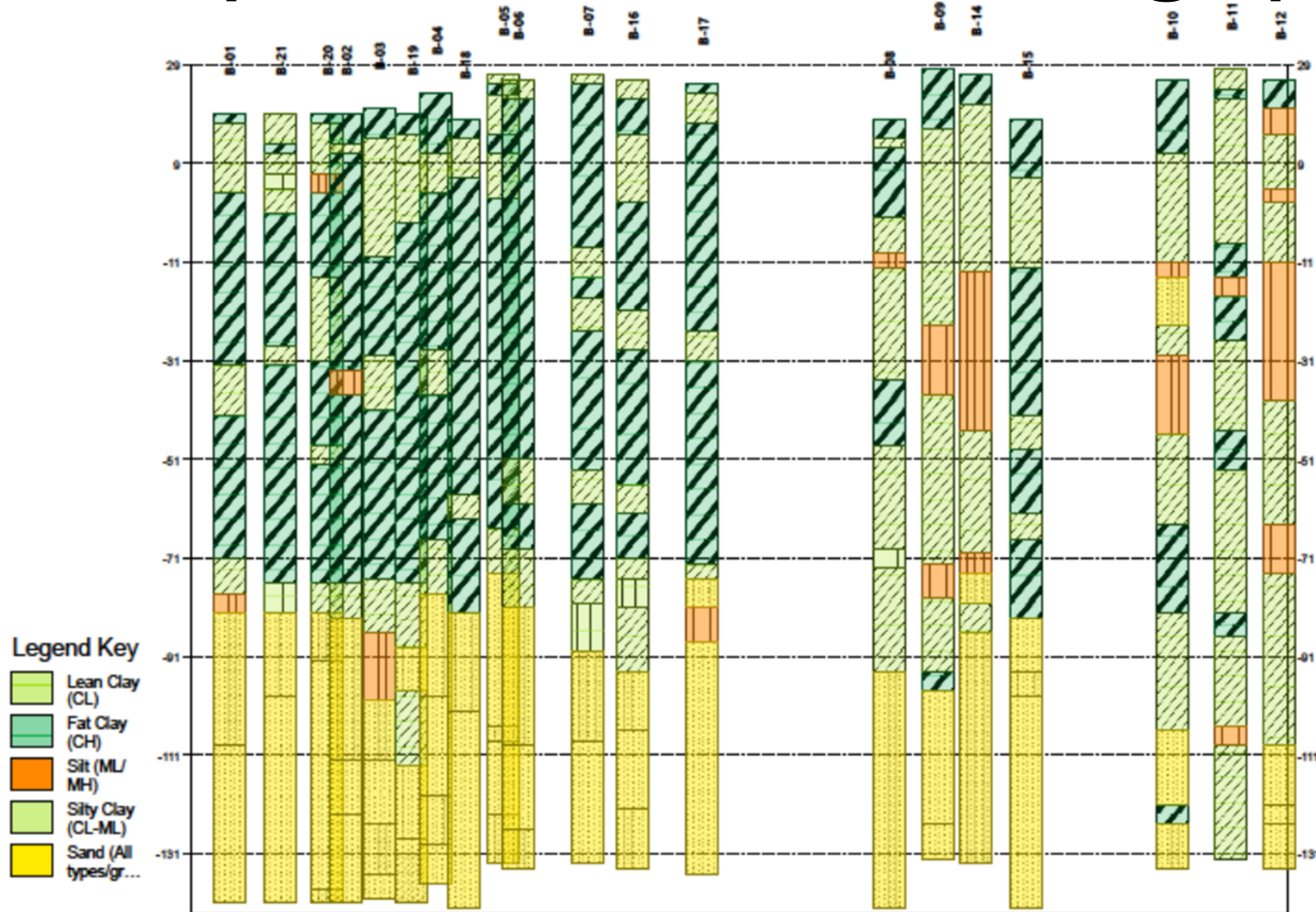
Structure Features

- Featured 15 Bents supported by pile groups
 - Smallest: 16' x 16' with about 900 ton load
 - Largest: 62' x 44' with about 6,000 ton load
 - Piles were 18" and 24" sq. PPC
 - Lengths were up to 85'

Explorations and Site Stratigraphy

- 21 Deep borings were taken (depths were 160')
- 25 CPT soundings were also taken (depths ranged from 98' to 123')
- General stratigraphy of site was Medium Stiff Clay from elevation +30' to -80' underlain by Medium to Dense Sands from -80' to the end of exploration depths.

Explorations and Site Stratigraphy



Design Considerations

- During design it was determined that pile group settlement would be the governing condition for pile lengths.
 - Stress distribution for settlement analysis was predicted using two methods, the equivalent footing method outlined in AASHTO section 10.7.2.3.1 and Mindlin's and Geddes' elastic solutions.

Design Considerations

- We did not have any consolidation testing available at the time of design so empirical correlations were used to establish a settlement model.
- Between the two stress distribution methods used, we saw general agreement and all footings were designed to have one inch or less of settlement.

Pile Test Plan

- Our test pile program for this project included utilizing 4 test piles.
 - 4 static load tests were done (2 on 18” piles and 2 on 24” piles)
 - Each test pile was also monitored with PDA for initial drive, 1-day restrike, and after load test restrike.
- The piles either reached or exceeded the required nominal resistance so piles were not lengthened and there was no cause for concern moving forward.

Construction

- During construction, it was discovered that Bent 10 and Bent 11 piles had moved out of tolerance while driving and the footings required a redesign. Both footings increased in length and width. Service loads increased about 1500 tons for each group.
- Geotech revised our original settlement calculations based on new footing size and estimated up to 2.5 inches. The structural designer had no concerns at the time.

Notification of Settlement

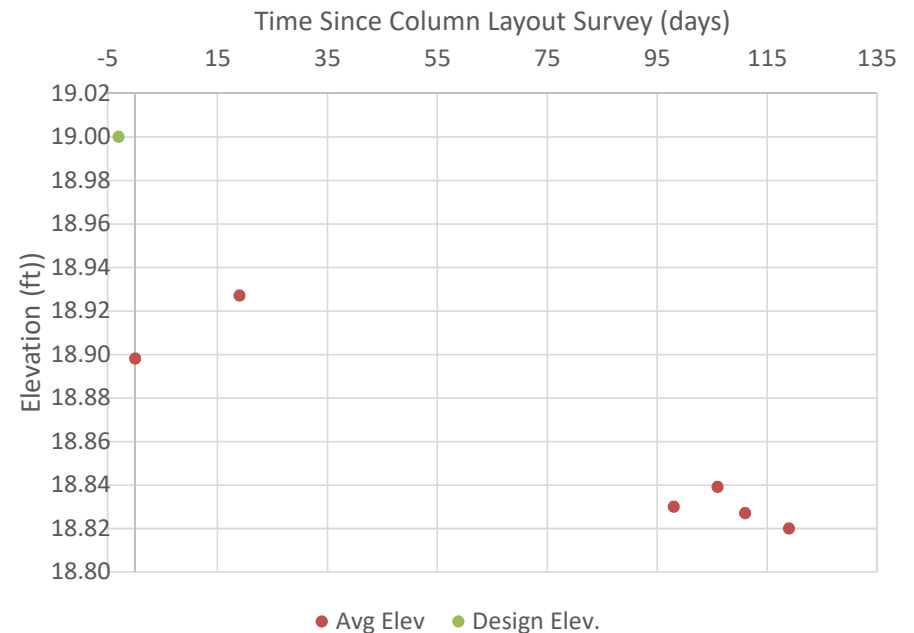
- Contractor notifies DOTD of settlement of piers in September 2022.
- This was about 4 months after construction on the piers had started.
- The piers were in various stages of construction.

| Construction Elements | Bents 2-5 | Bents 6-8 | Bent 9 | Bent 10-11 | Bent 12 | Bent 13-15 | Bent 16 | Notes |
|-----------------------|-----------|-----------|--------|------------|---------|------------|---------|--|
| Pile Cap | X | X | X | X | X | X | X | |
| Column | X | X | X | X | X | X | X | |
| Cap Backfilled | X | X | X | | X | X | X | |
| Girders | X | X | X* | | X* | X | | *Bents 9 & 12 partially loaded with girders from only one span |
| Bridge Deck | X | | | | | | | |

Notification of Settlement

- No surveys were taken at the time of completion of the pour of footing.
- Column layout shots were taken typically within a few days of the footing pour.
 - One of these suggested settlement of over 1" in three days
- Footings were not typically surveyed again for several months.

Bent 10: Surveyed Elevations of Top of Cap



Notification of Settlement

- DOTD's Geotechnical section had questions about the surveying and a third party surveying consultant was brought in to verify the survey.
 - Several sources of error found and one of the footings could not be verified.
 - Accuracy of $\sim 3/4"$.
 - Found to be adequate for its general intent.
- At this time, Contractor also had brought on a 3rd party Geotechnical consultant that reported the bridge could have as much as 9" of additional settlement to come once final loads were in place.

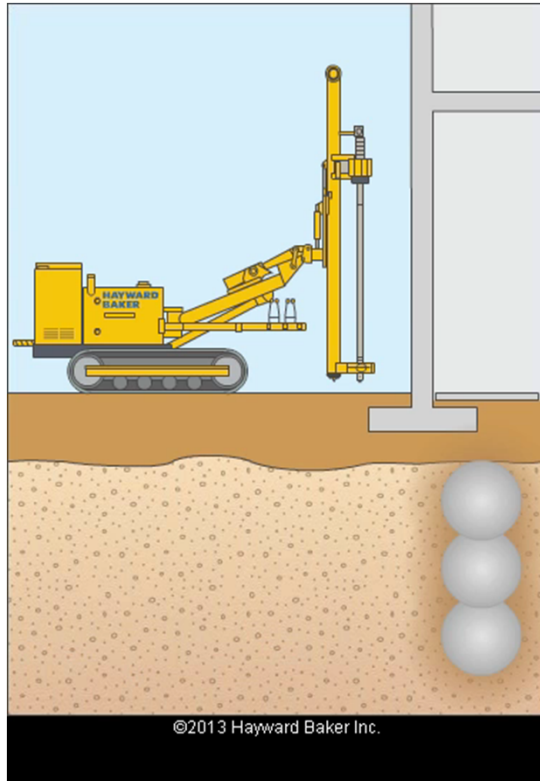
What do we do now?

- Many attempts were made to take our existing settlement models and modify them to match the survey.
- Additional borings were taken and consolidation testing was performed at locations below pile tips.
- A geotechnical engineering consultant was brought on to aid the department in additional analysis of settlement.

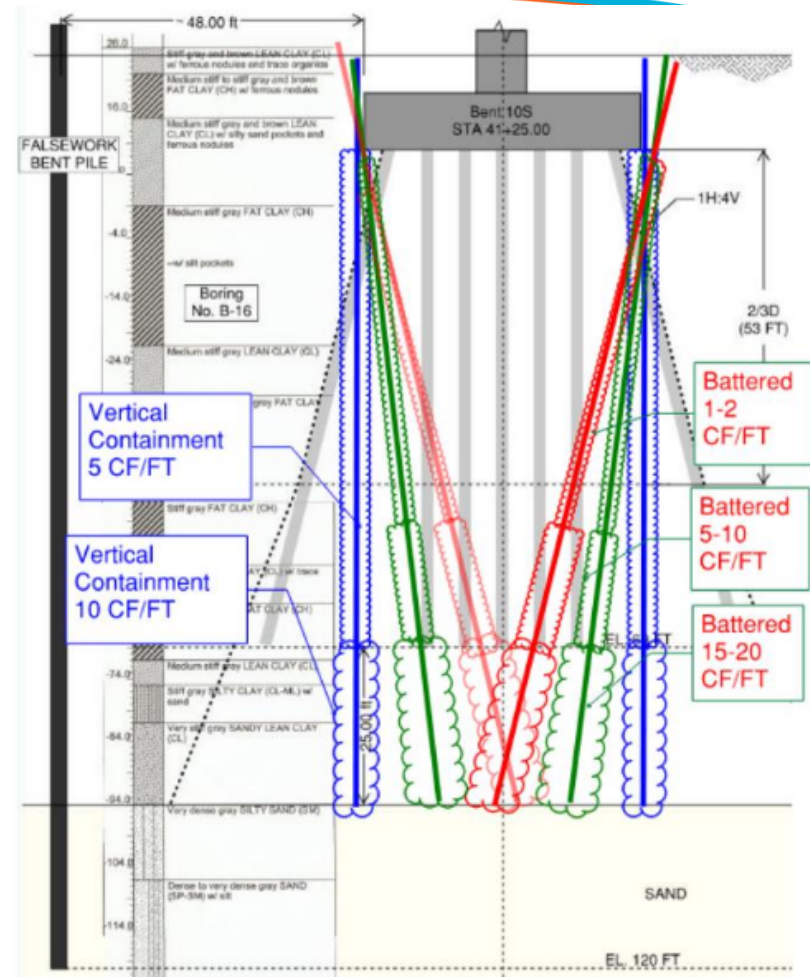
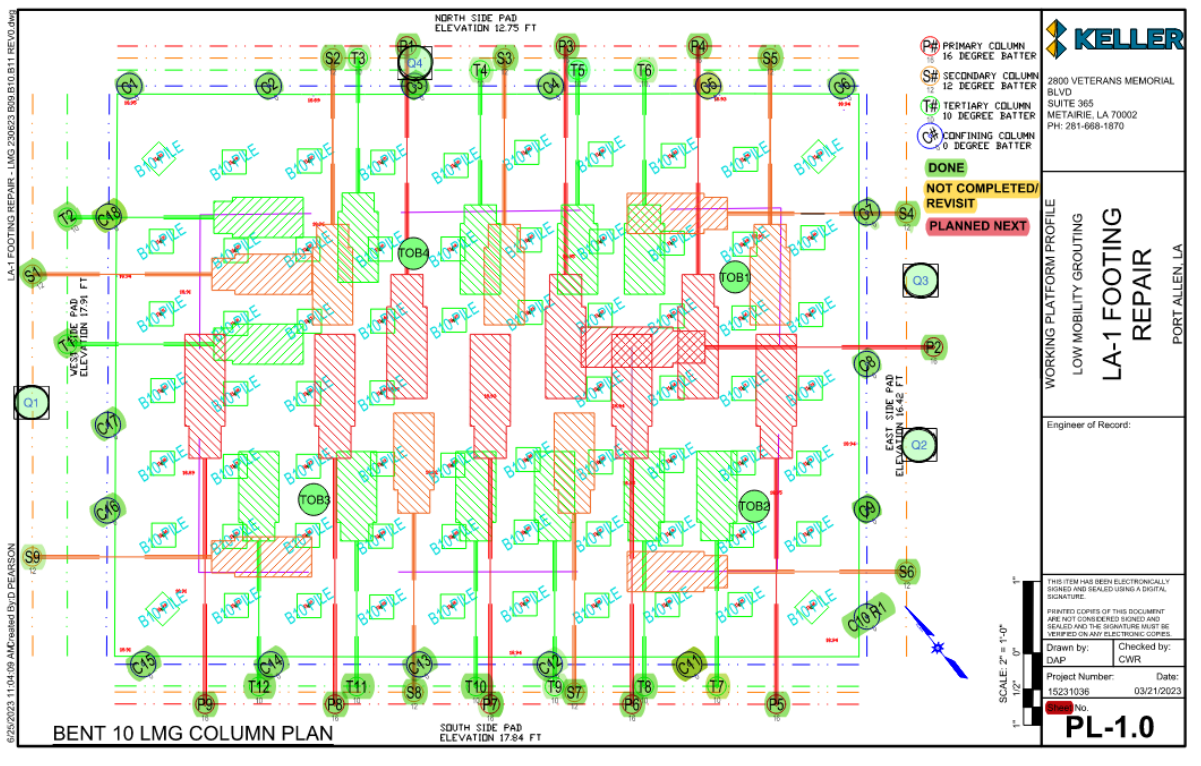
What do we do now?

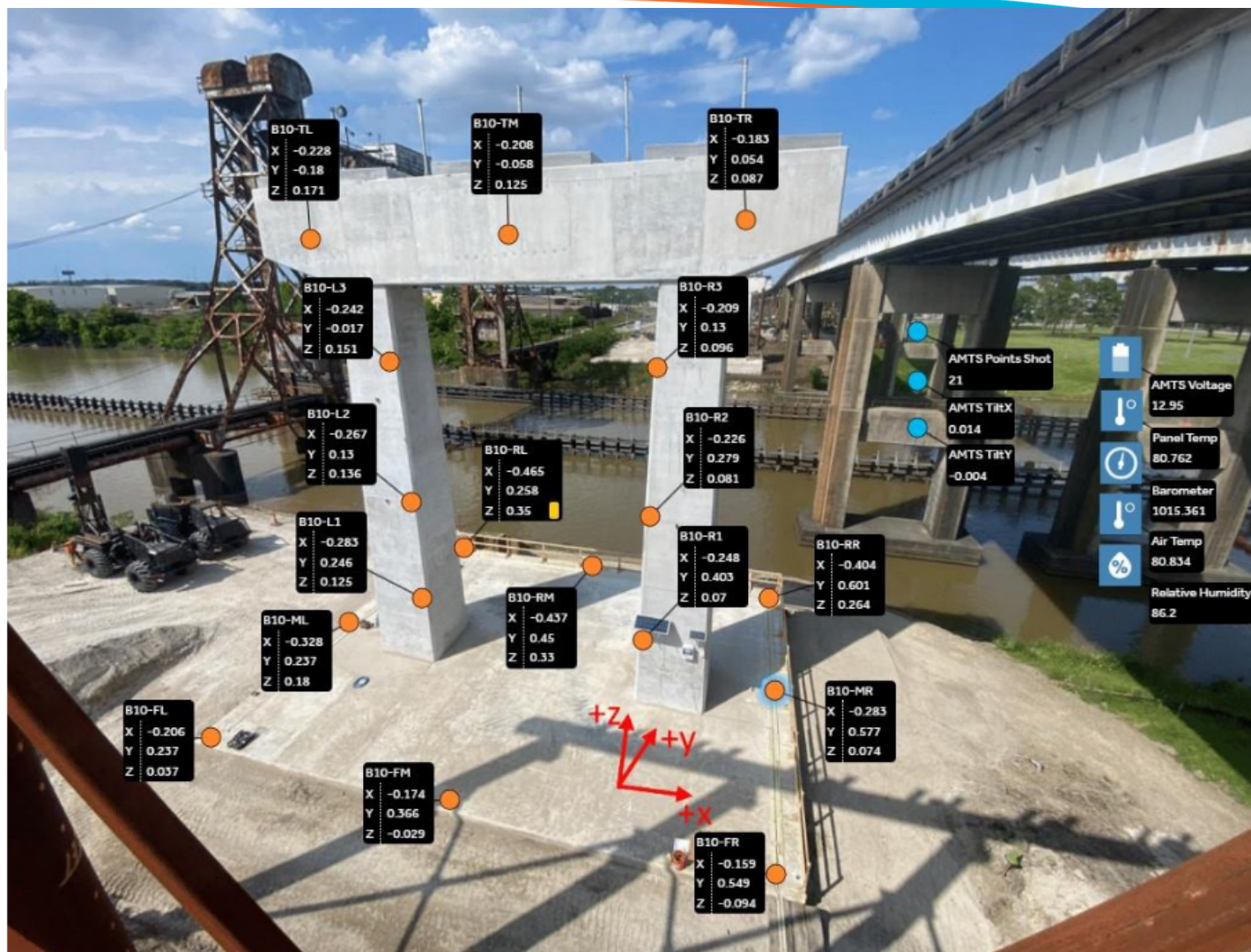
- Many ideas were explored:
 - Preloading footings
 - Allowing the structure to settle with high quality surveys to better analyze the structure and refine the models
 - Ground improvement methods to remediate soils under footing

Low Mobility Grouting (LMG)



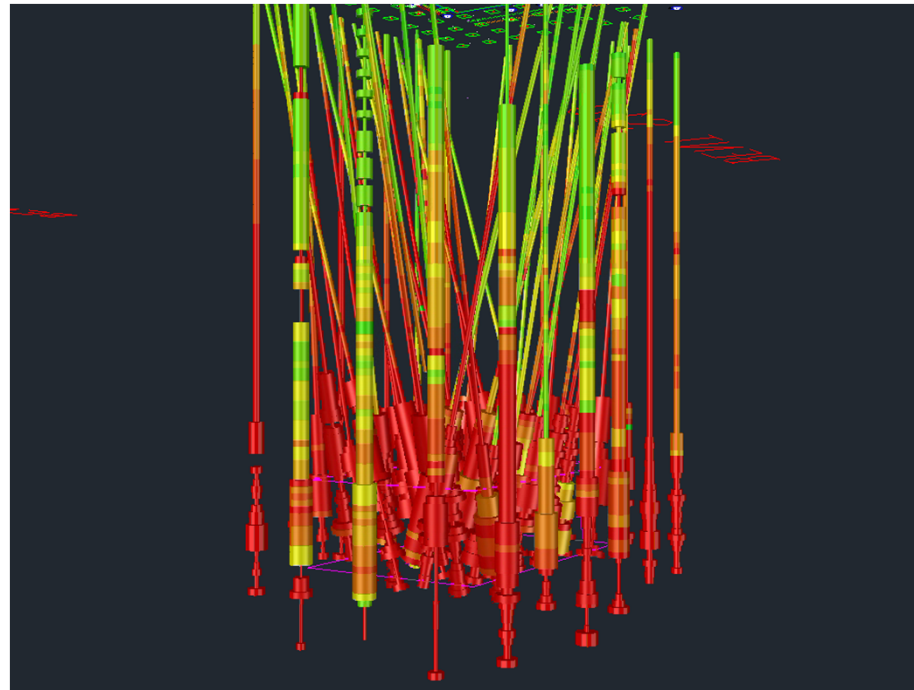
- Low mobility grouting improves ground conditions by using a low mobility grout to pump in-situ to displace and consolidate the surrounding soils.
- Casing is set to the bottom of treated area and grout is pumped. Once predetermined volume/pressures criteria is met, the casing is retracted to the next increment and grouting continues.





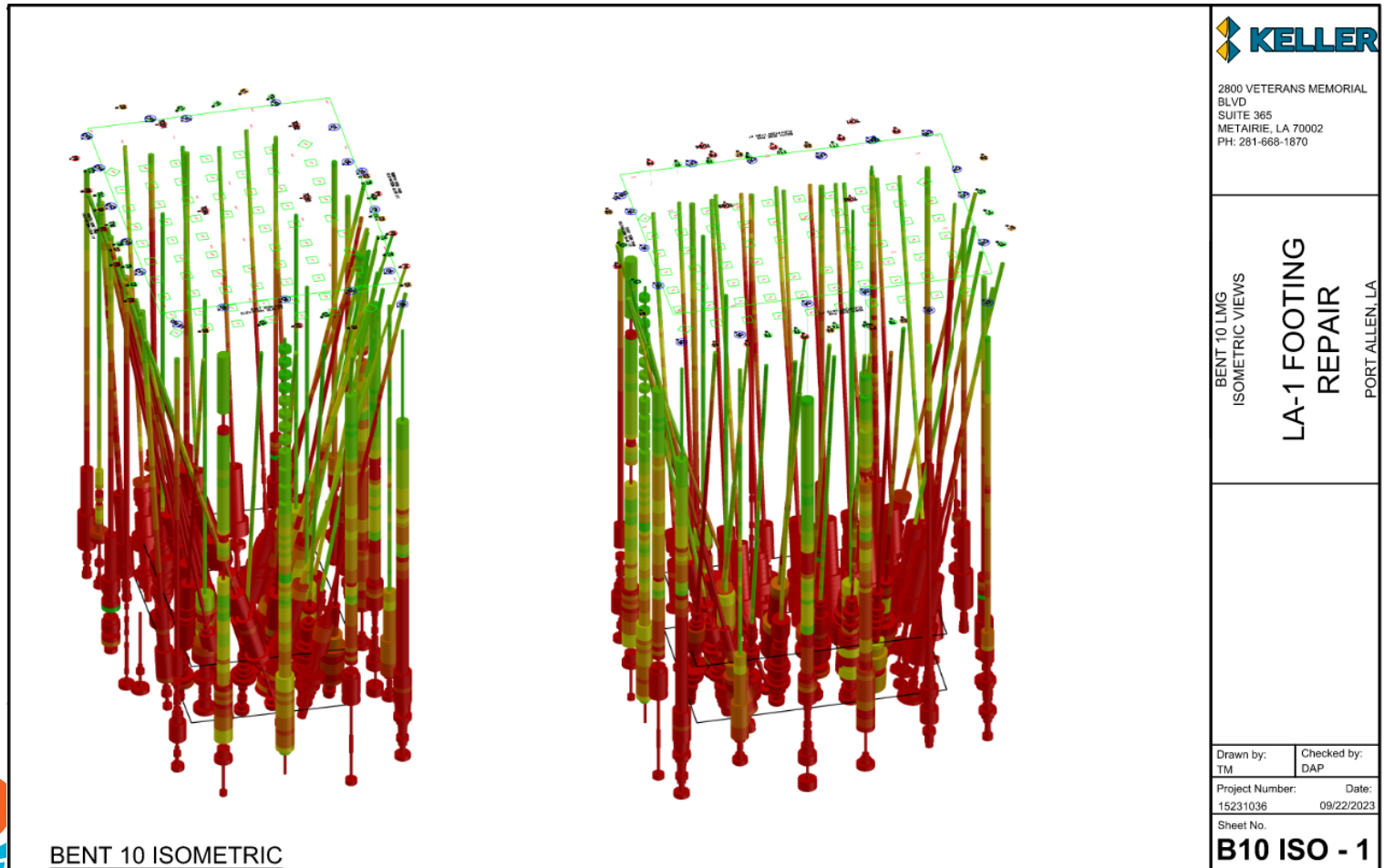


Bent 10



3D CAD model of LMG locations provided by Keller

Bent 10



Pressuremeter Testing

- Pressuremeter testing (PMT) is a volumetric strain test.
- A total of 26 pressuremeter tests were performed under and adjacent to the newly remediated Bent 10.
 - 4 boreholes were taken through the footing
 - 3 boreholes were taken outside of the influence of the LMG

Pressuremeter Testing



Post-LMG Analysis

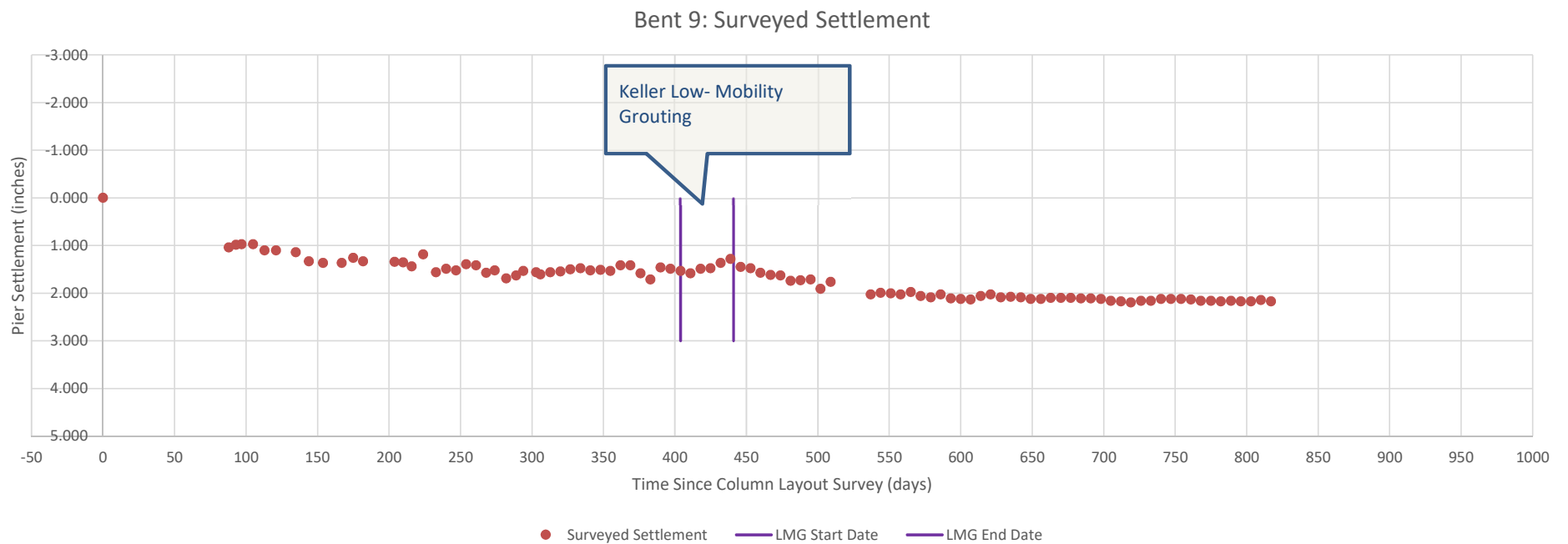
- Geotechnical Consultant hired by LA DOTD analyzed the results of the testing program.
 - It was seen that the PMT modulus inside the LMG zone was almost 3 times higher than those outside the LMG zone.
- Consultant concluded potential future settlements could be approximately 2 inches once girders and deck were placed based on results of the PMT.

Performance Post LMG

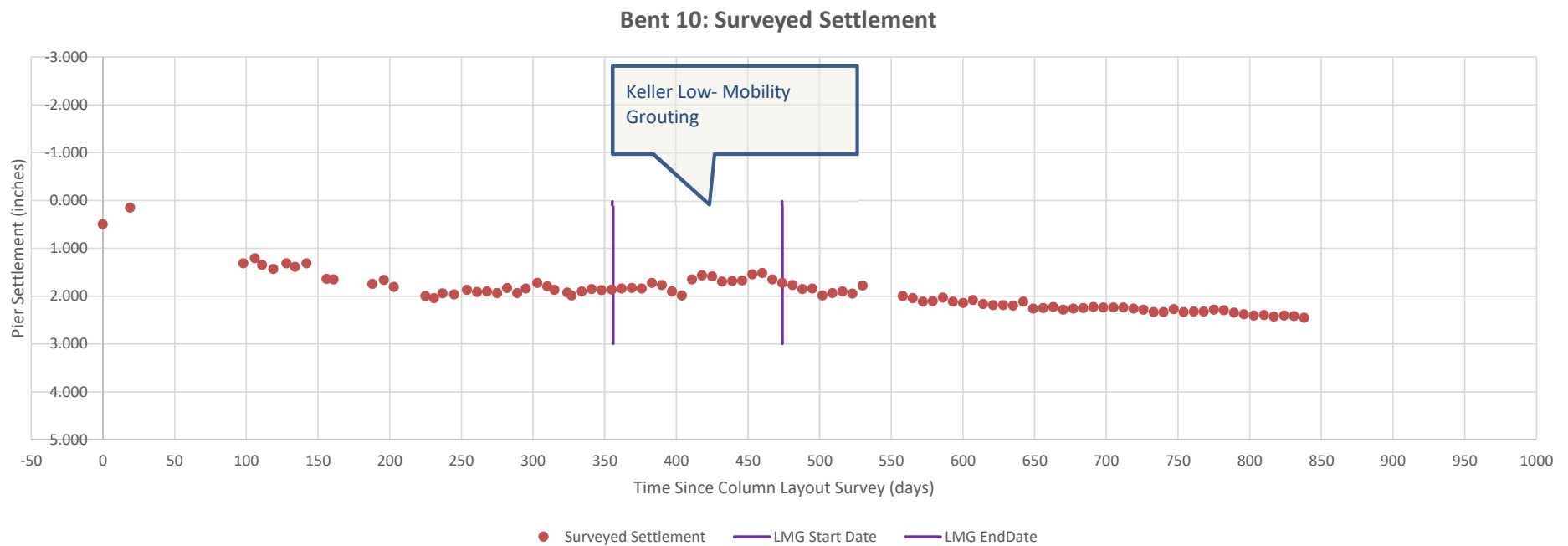
- Grouting was completed October 2023
- The bridge construction on these four treated piers resumed February 2024
- Currently, the bridge is partially open to traffic while the project is being completed

| Treated Bent | Settlement after LMG prior to additional loading (in) | Settlement after additional loading (in) | Total Settlement after LMG (in) |
|--------------|---|--|---------------------------------|
| Bent 9 | 0.8 | 0.1 | 0.9 |
| Bent 10 | 0.5 | 0.3 | 0.8 |
| Bent 11 | 1.0 | 0.3 | 1.3 |
| Bent 12 | 0.5 | 0.1 | 0.6 |

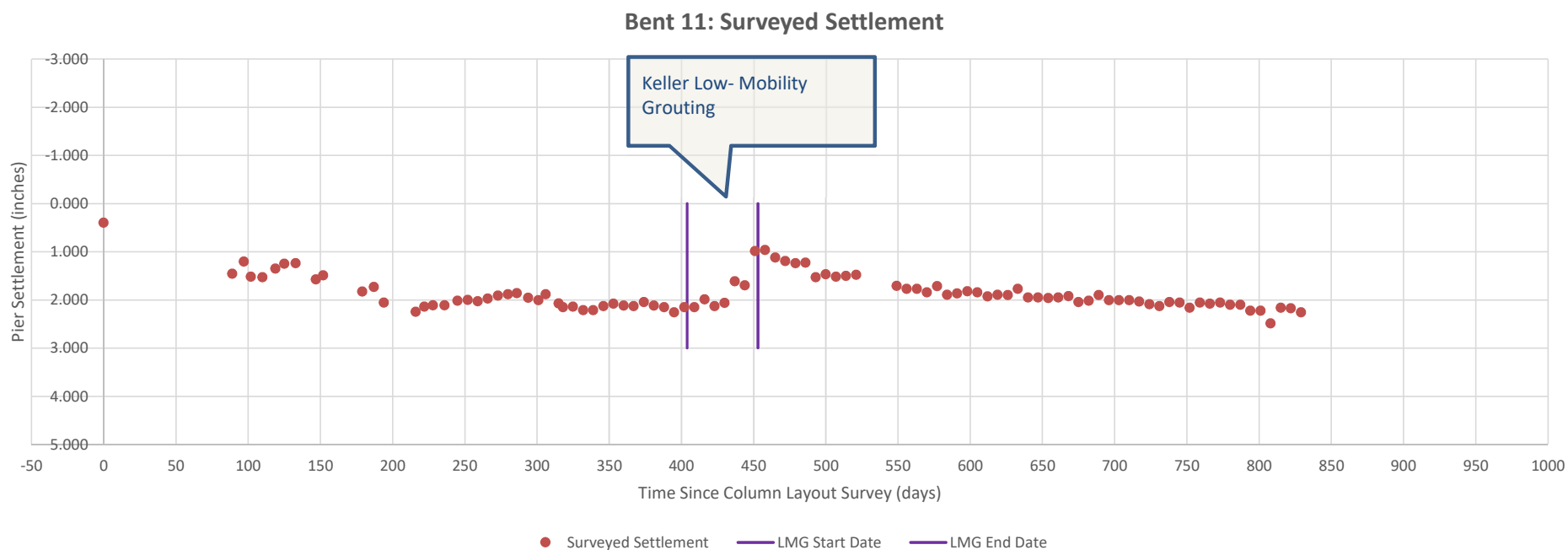
Survey of Bent 9



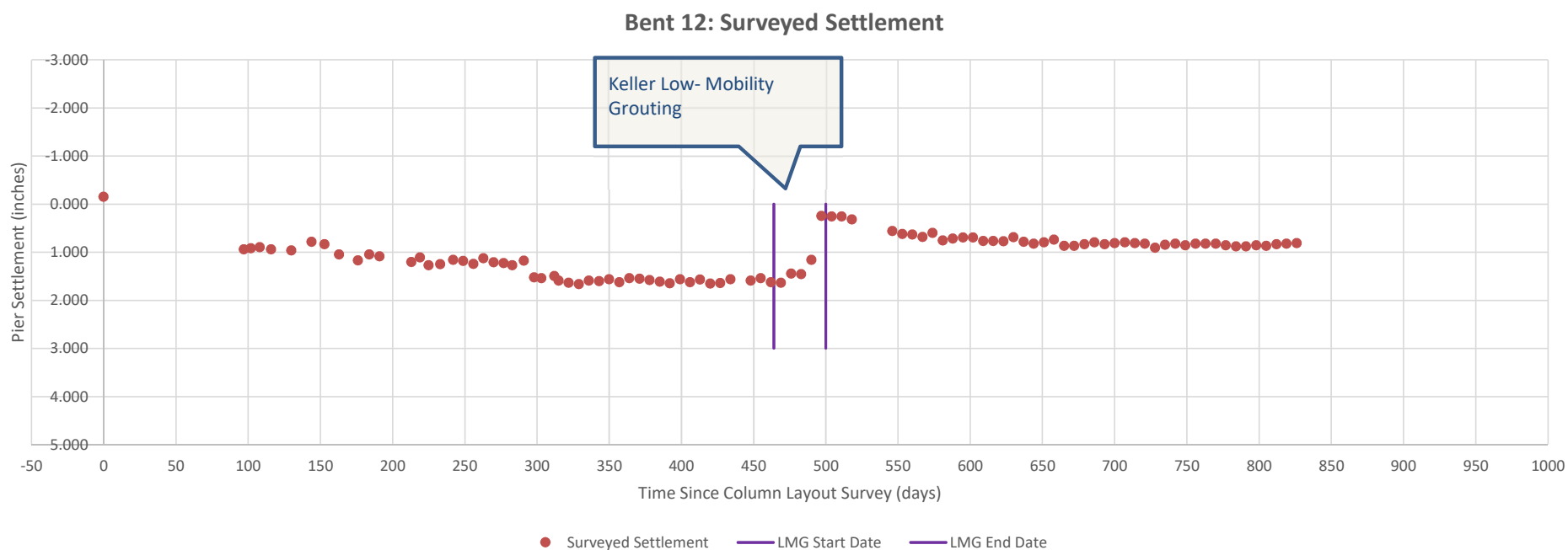
Survey of Bent 10



Survey of Bent 11



Survey of Bent 12



Questions?

