Creating Value …

… Delivering Solutions

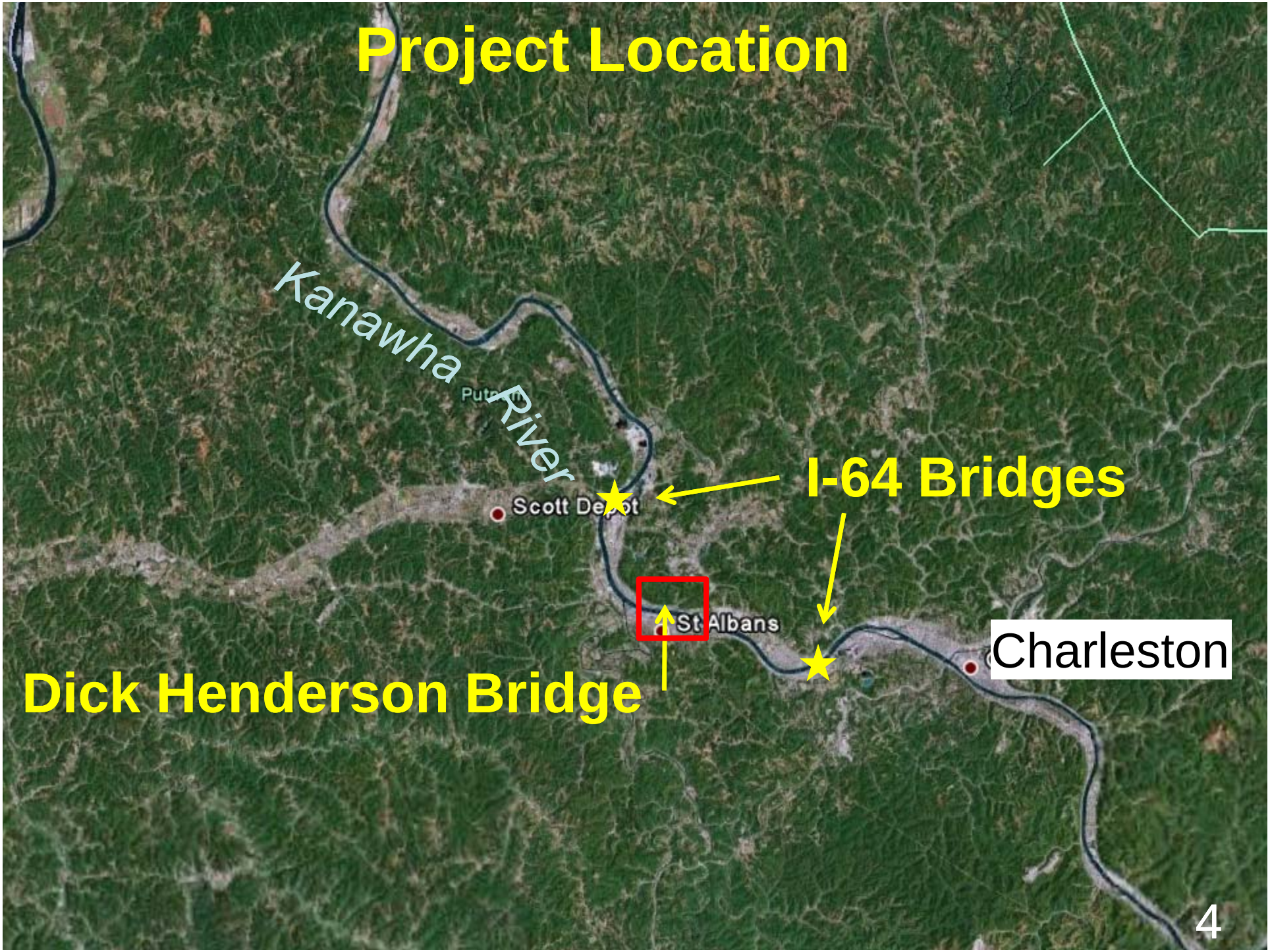
Rehabilitation of Existing River Piers for Dick Henderson Bridge, West Virginia

Joe Carte, P.E.
W.V. Department of Transportation

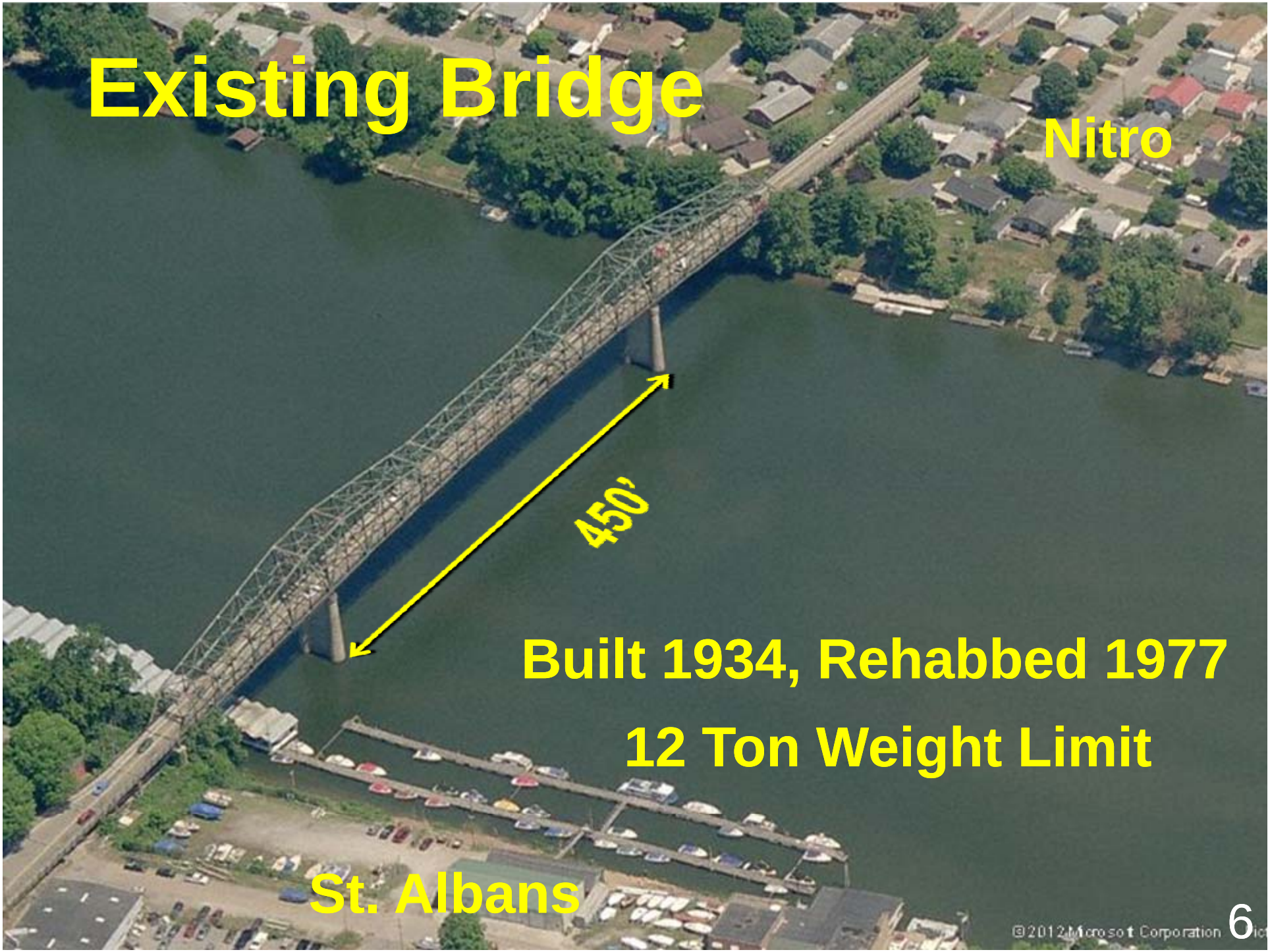
Scott Zang, P.E.
Michael Baker Jr., Inc.


Extreme Makeover
Bridge Pier Edition

Project Location

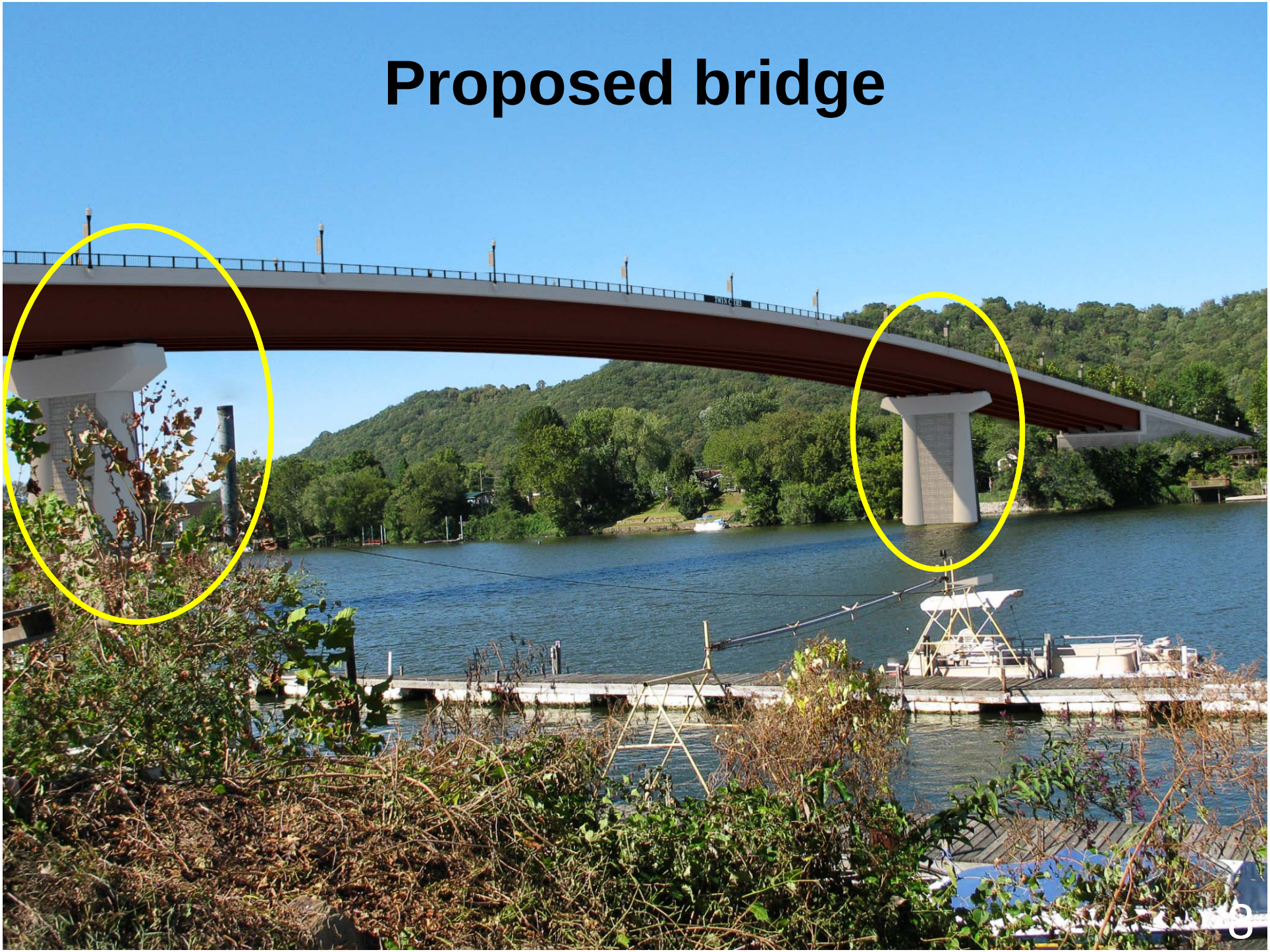

Project Location
Kanawha River
Scott Depot
I-64 Bridges
St Albans
Charleston
Dick Henderson Bridge


Nitro
St. Albans
© 2012 Google


Existing Bridge
Nitro
450'
Built 1934, Rehabbed 1977
12 Ton Weight Limit
St. Albans
© 2012 Microsoft Corporation


Existing Bridge
20’
ADT 17000 (2007)
Functionally Obsolete
Sufficiency rating 42.5 out of 100

Proposed bridge




Why reuse the piers?
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Nitro
Residential
Must use existing alignment
Residential
School Fields
Marina/ docks
Car Dealer
St. Albans
© 2012 Google

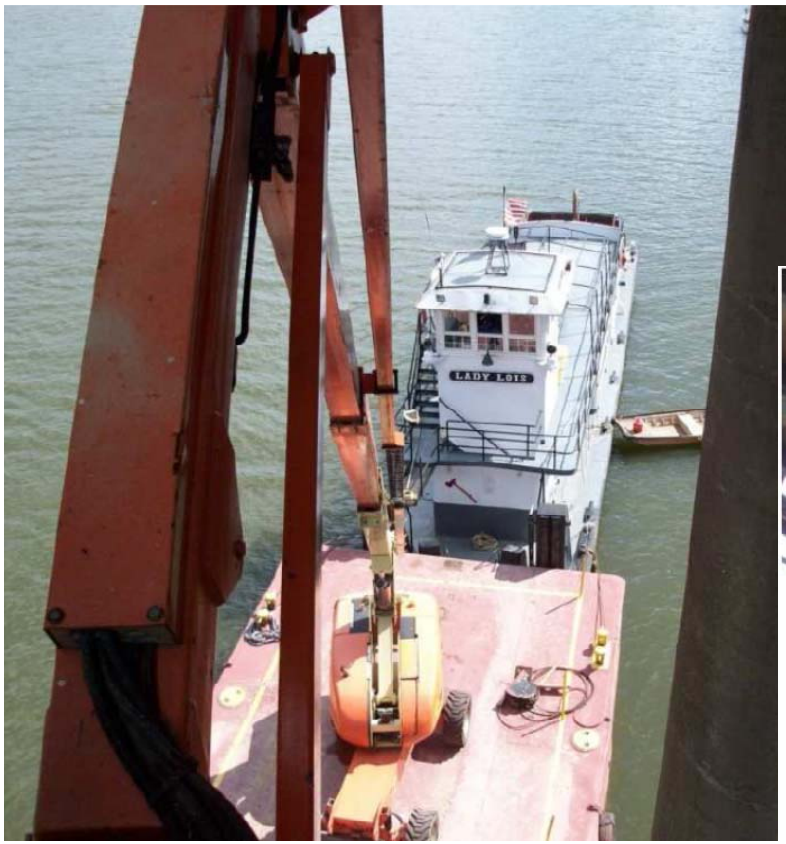
Schedule


Reusing existing piers shortens the time the bridge is out of service
BRIDGE CLOSED


Permitting
Permitting for new piers not required

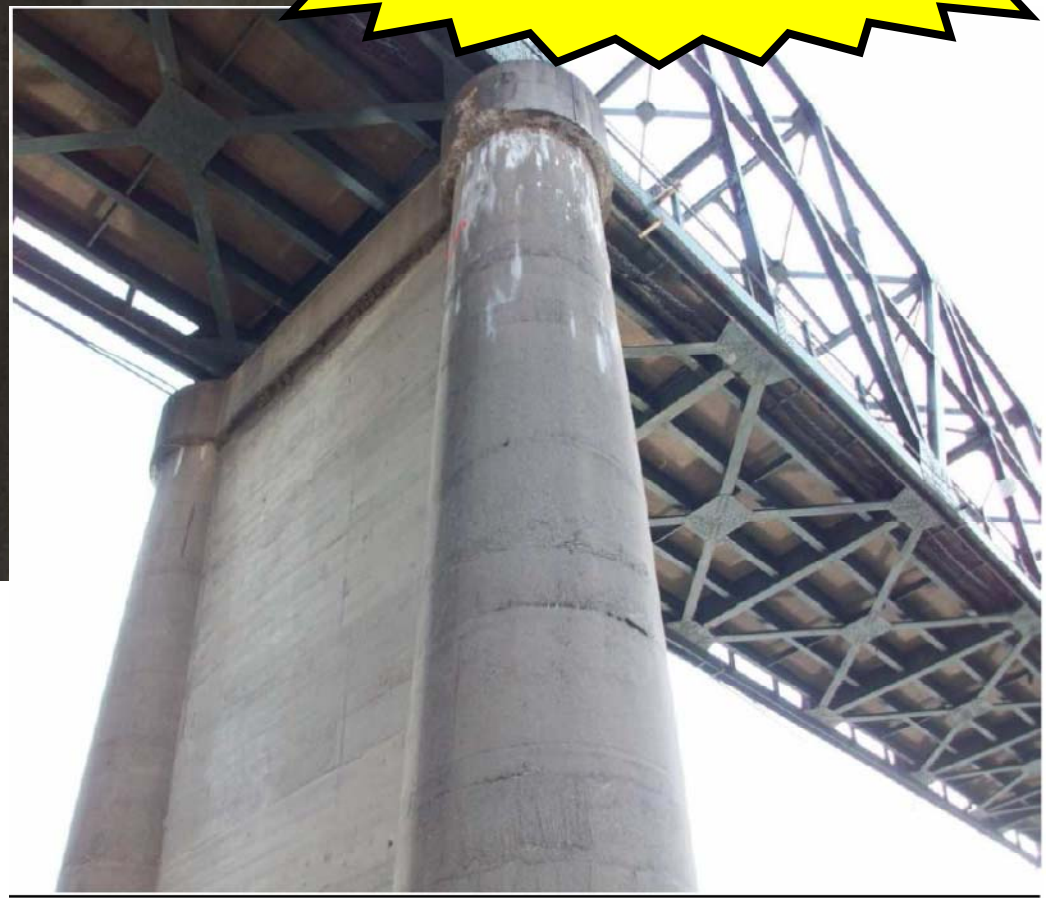
Span Length and Grade

Condition of Existing Main Piers



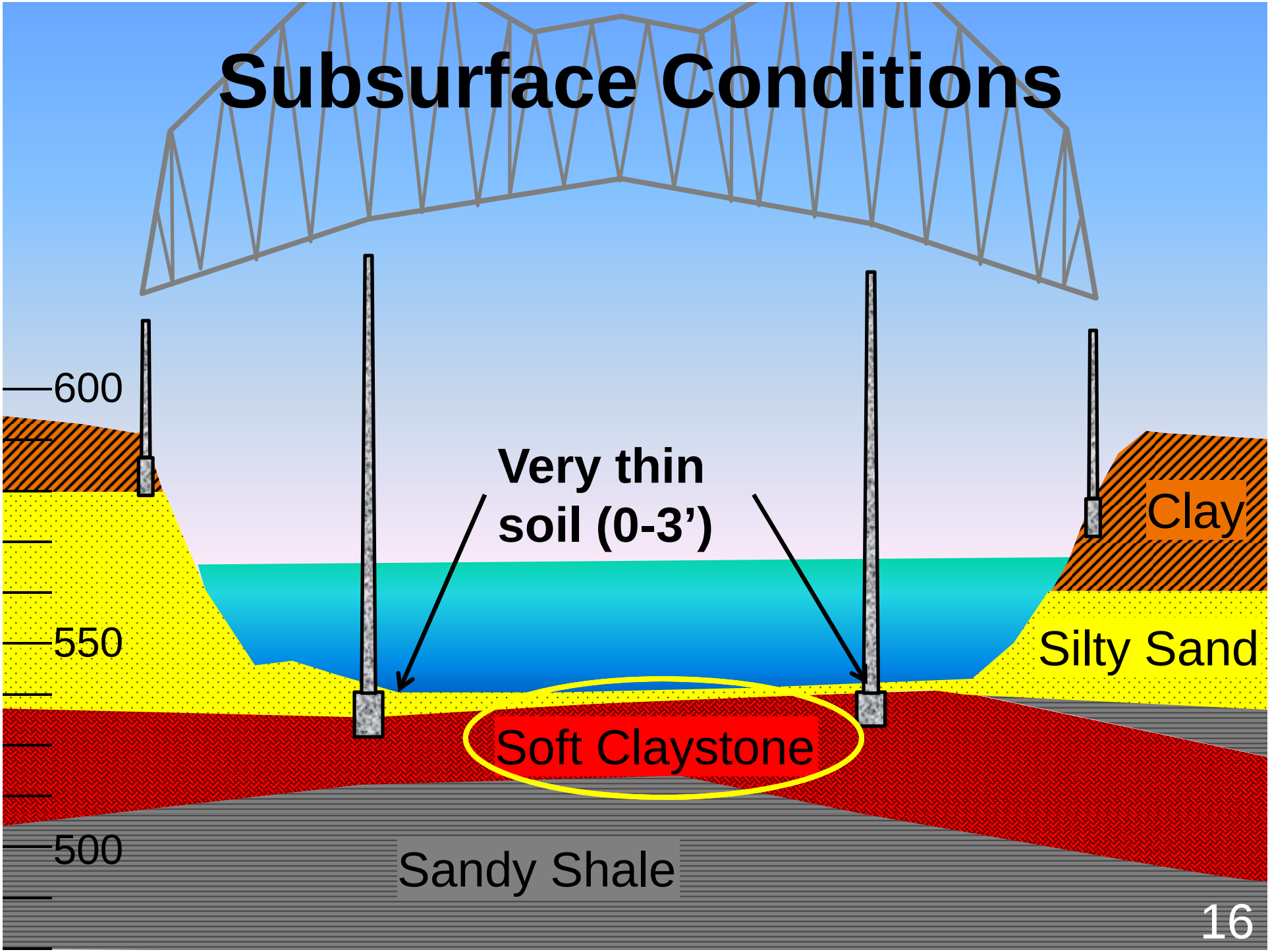
In Depth Inspection

Sound except at very top

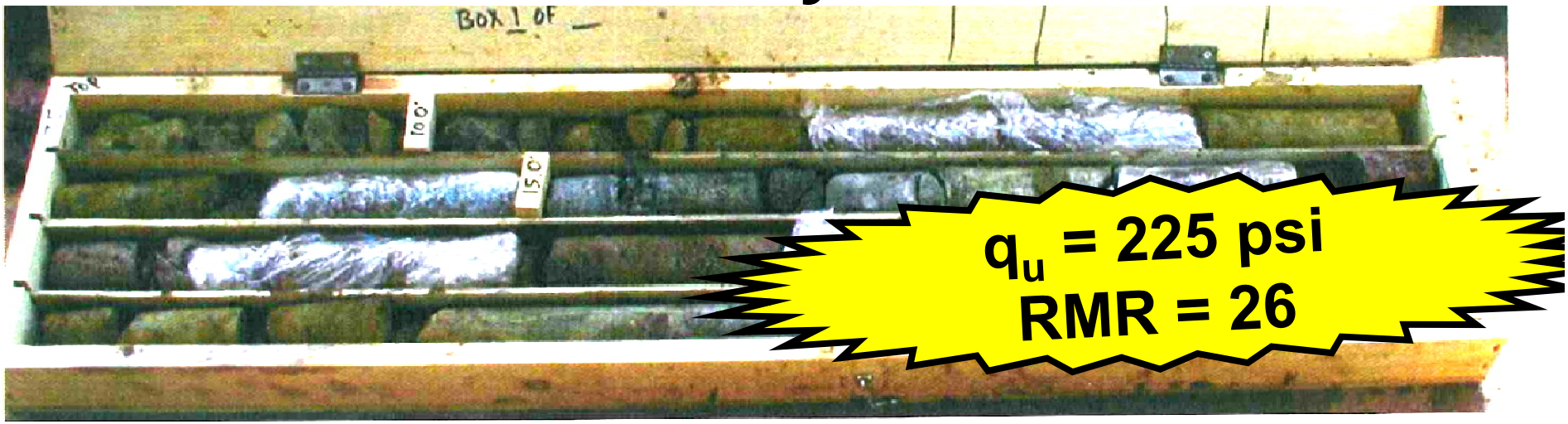


Condition of Existing Main Piers

Subsurface Conditions

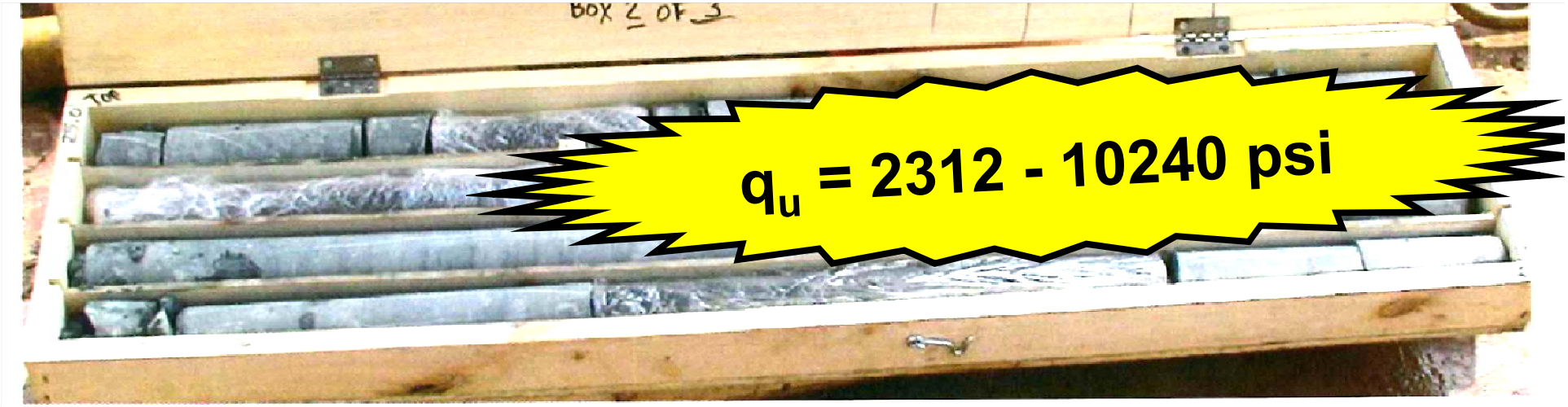


Soft Claystone



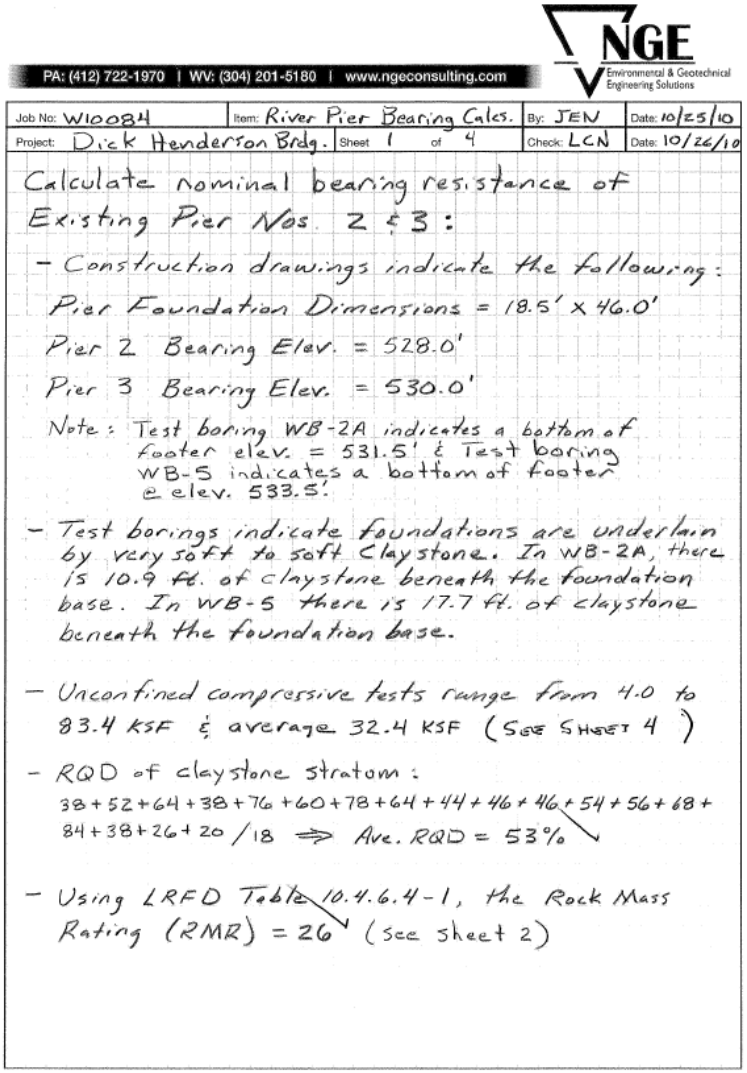
Boring WB-5/Box 1 of 3

Sandy Shale



Boring WB-5/Box 2 of 3

Evaluation of Existing Spread Footing



NGE Environmental & Geotechnical Engineering Solutions

PA: (412) 722-1970 | WV: (304) 201-5180 | www.ngeconsulting.com

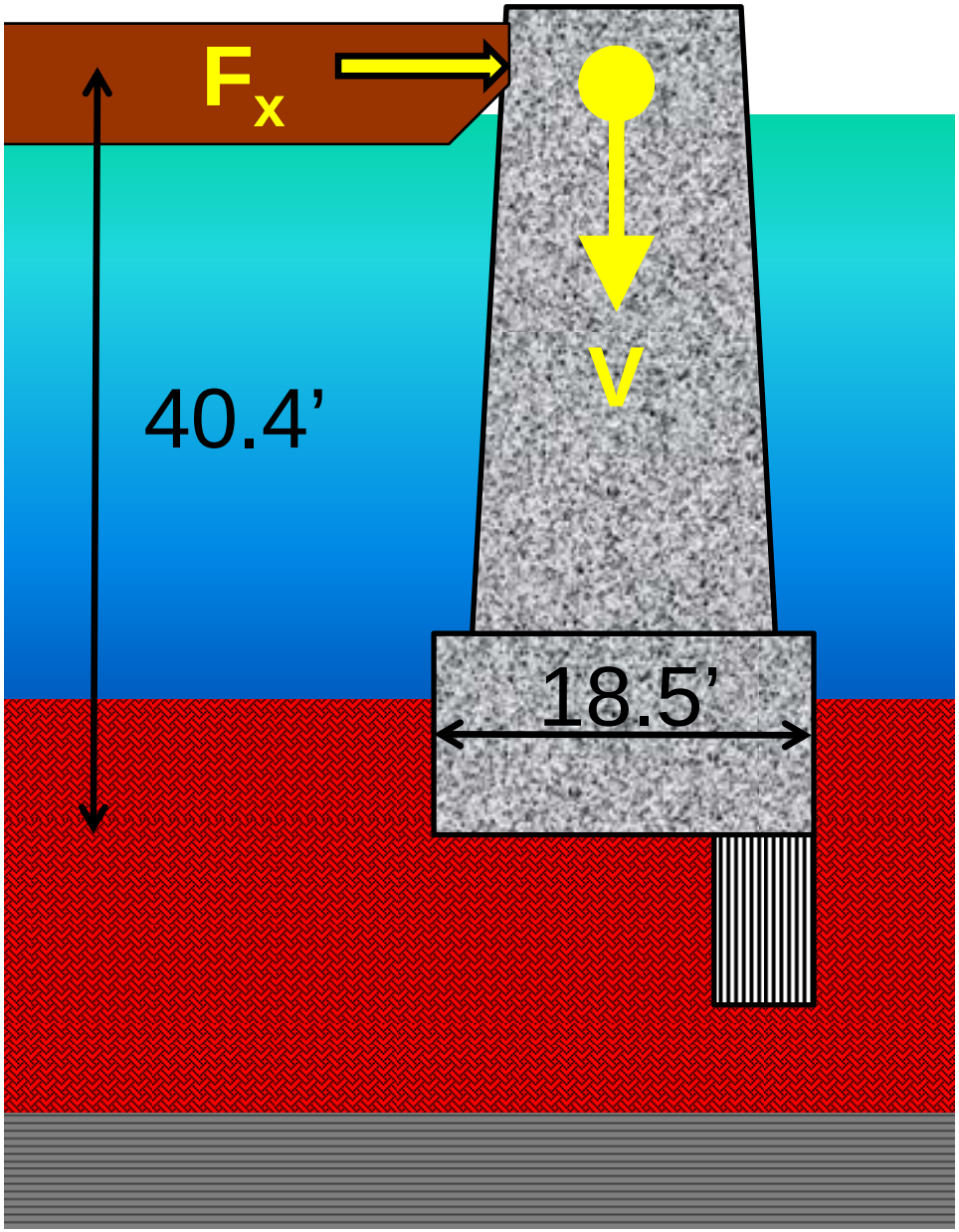
Job No: W10084	Item: River Pier Bearing Calcs.	By: JEN	Date: 10/25/10
Project: Dick Henderson Brdg.	Sheet 1 of 4	Check: LCN	Date: 10/26/10

Calculate nominal bearing resistance of Existing Pier Nos. 2 & 3:

- Construction drawings indicate the following:
  - Pier Foundation Dimensions = 18.5' x 46.0'
  - Pier 2 Bearing Elev. = 528.0'
  - Pier 3 Bearing Elev. = 530.0'
  - Note: Test boring WB-2A indicates a bottom of footer elev. = 531.5' & Test boring WB-5 indicates a bottom of footer @ elev. 533.5'.
- Test borings indicate foundations are underlain by very soft to soft Claystone. In WB-2A, there is 10.9 ft. of claystone beneath the foundation base. In WB-5 there is 17.7 ft. of claystone beneath the foundation base.
- Unconfined compressive tests range from 4.0 to 83.4 KSF & average 32.4 KSF (See Sheet 4)
- RQD of claystone stratum:
  38+52+64+38+76+60+78+64+44+46+46+54+56+68+84+38+26+20 / 18 ⇒ Ave. RQD = 53%
- Using LRFD Table 10.4.6.4-1, the Rock Mass Rating (RMR) = 26 (see sheet 2)

B' (ft)	q_R Strength Limit State ϕ = 0.45 (KSF)	q_R Extreme Limit State ϕ = 1.0 (KSF)
4.5	-	59.6
7	27.7	61.5
10	28.8	64.0
18	31.4	69.8

Evaluation of Existing Spread Footing



Extreme II – Barge Impact

F_x = 1377 kips

V = 6758 kips

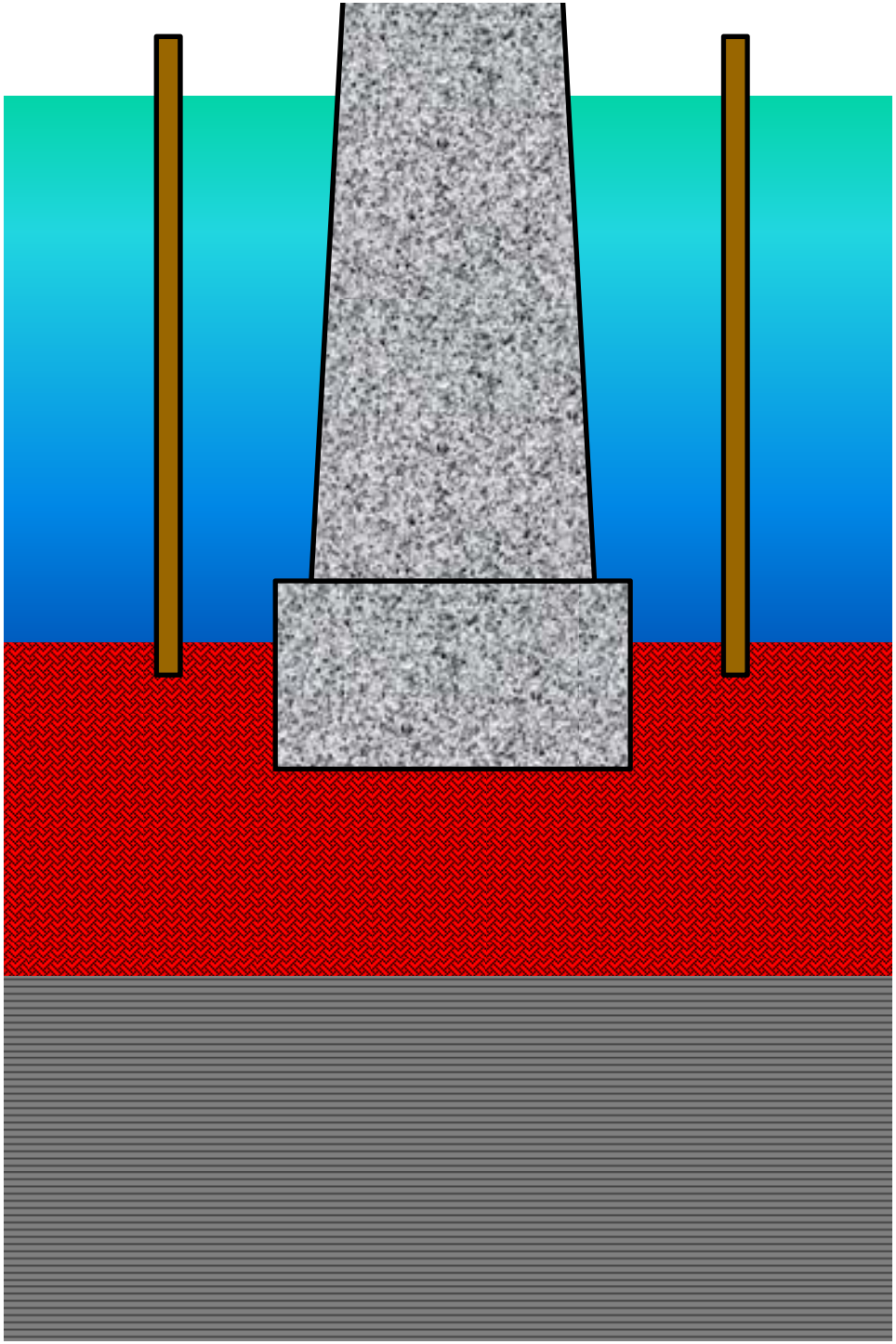
e = 8.2 ft.

B’ = 2.1 ft.

σ = 74.4 ksf

74.4 ksf > 59.6 ksf

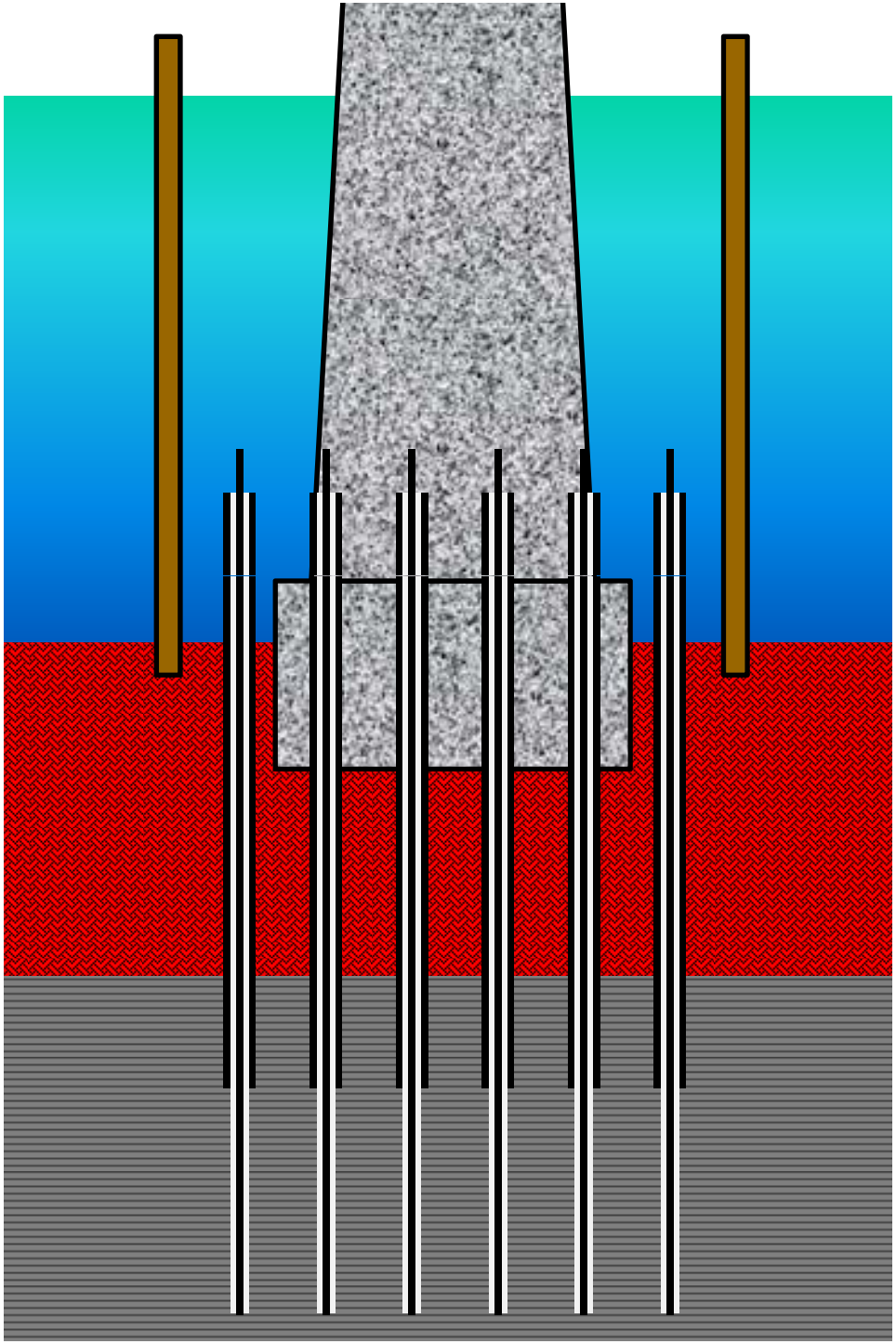
No Good!



Micropile Concept

Construction Sequence

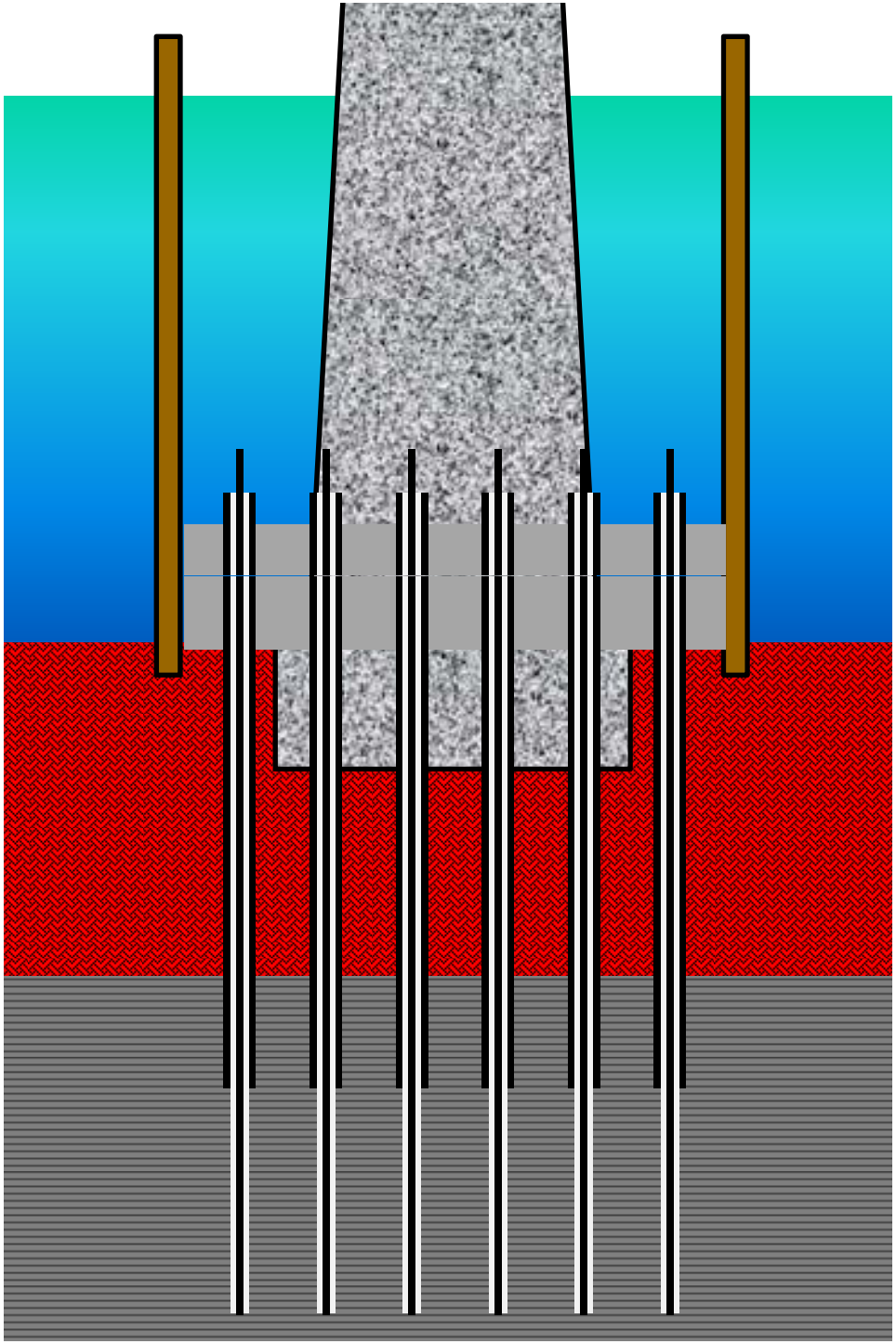
1. Install cofferdam



Micropile Concept

Construction Sequence

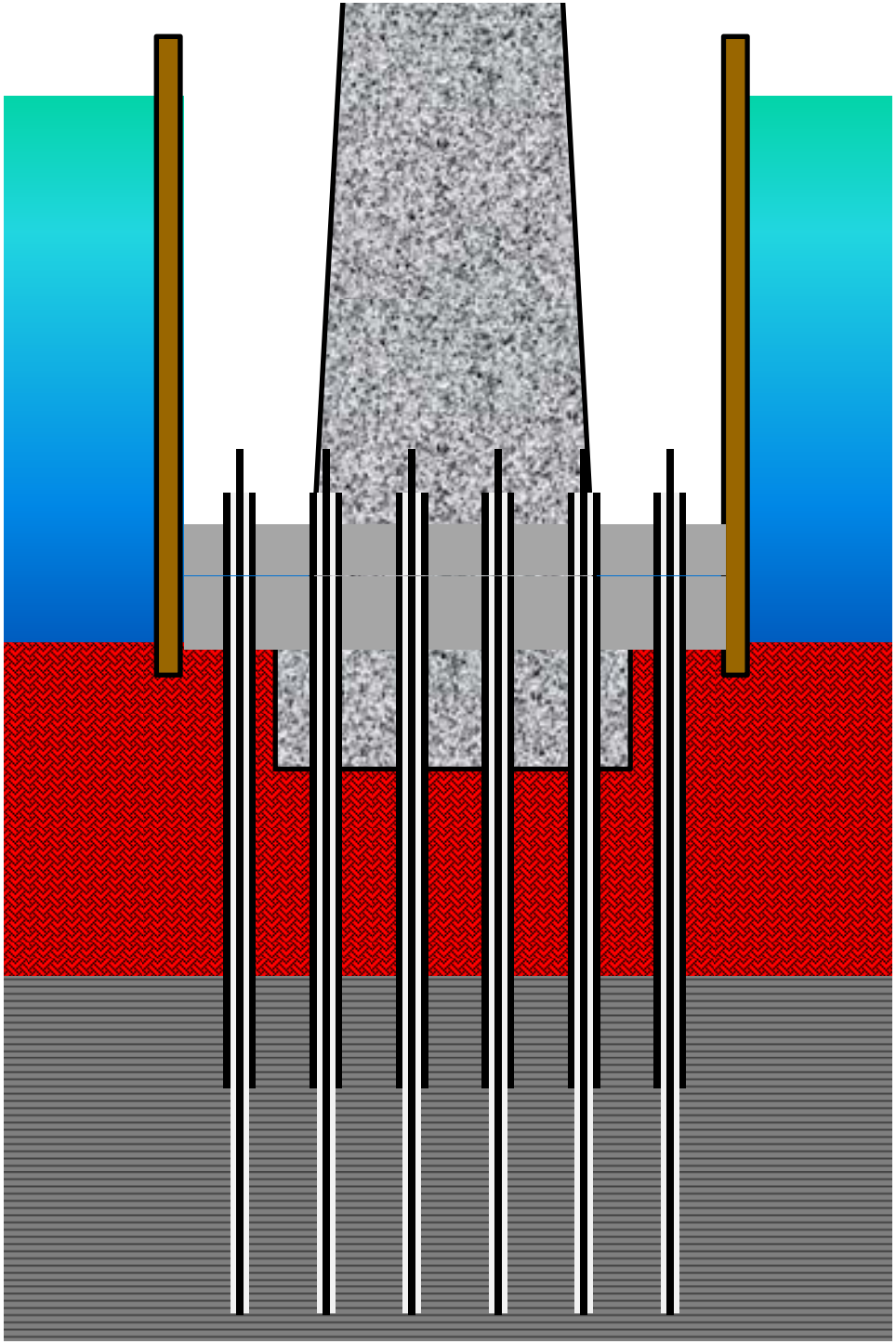
2. Install micropiles



Micropile Concept

Construction Sequence

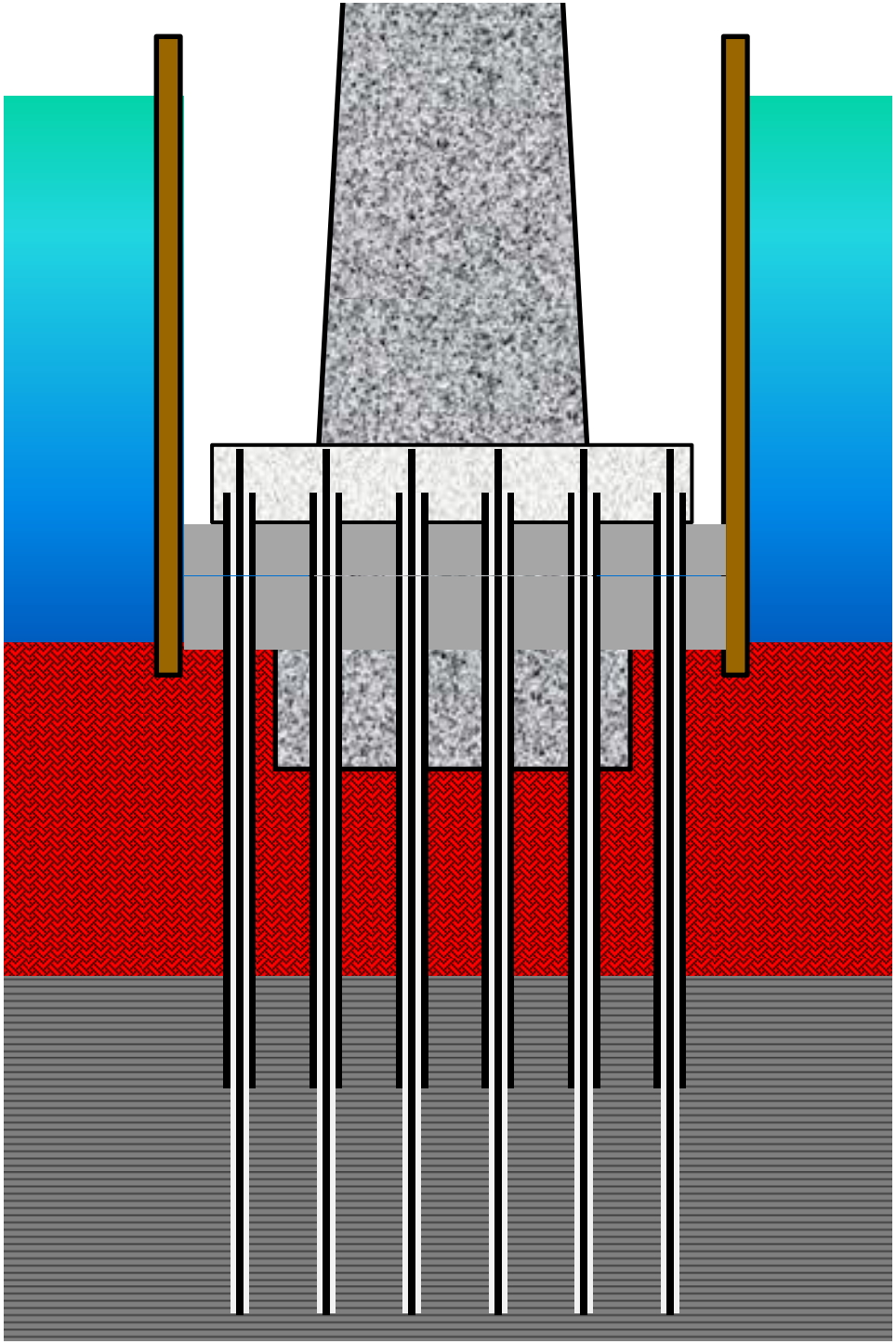
3. Place tremie seal



Micropile Concept

Construction Sequence

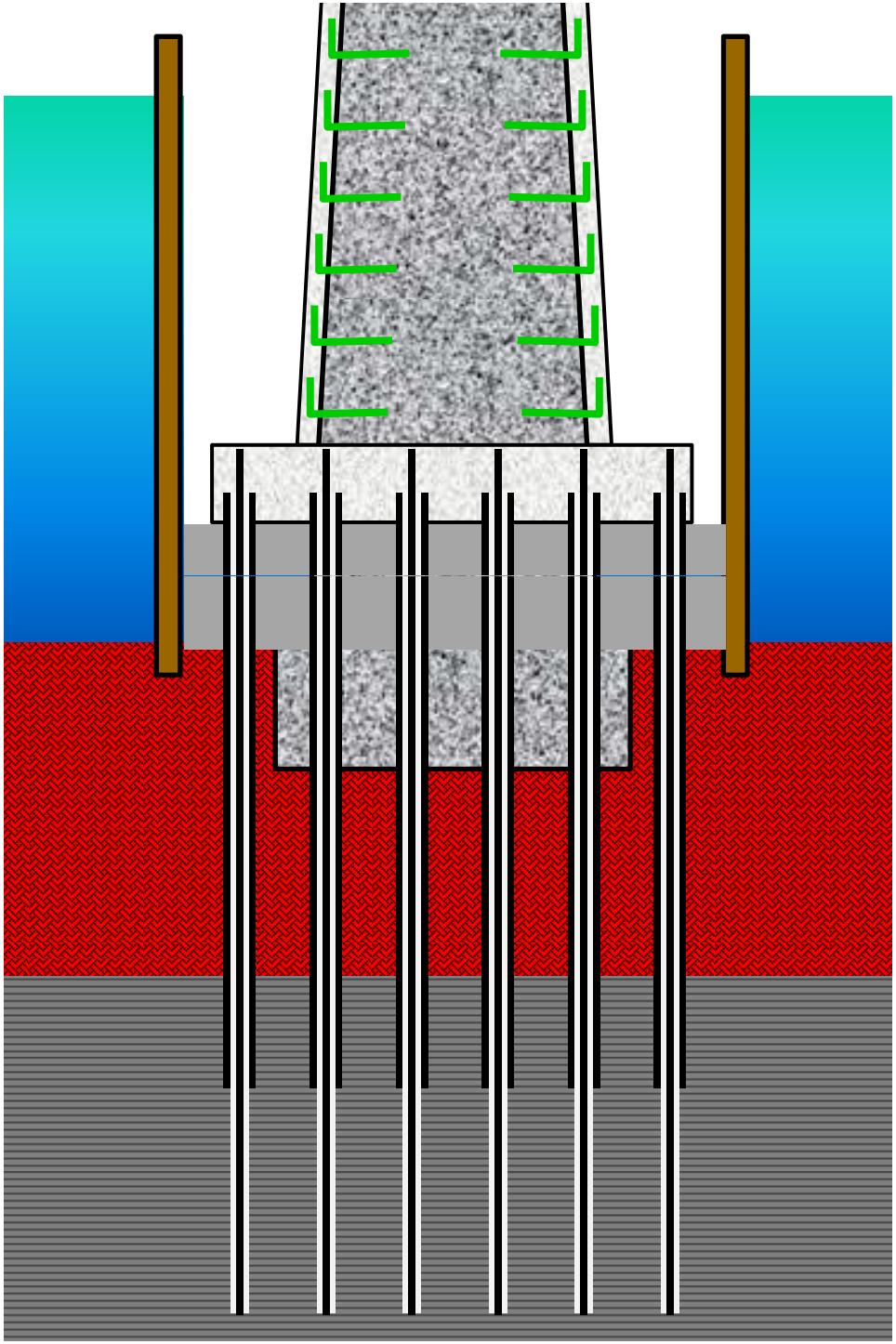
4. Dewater cofferdam



Micropile Concept

Construction Sequence

5. Cast new footing

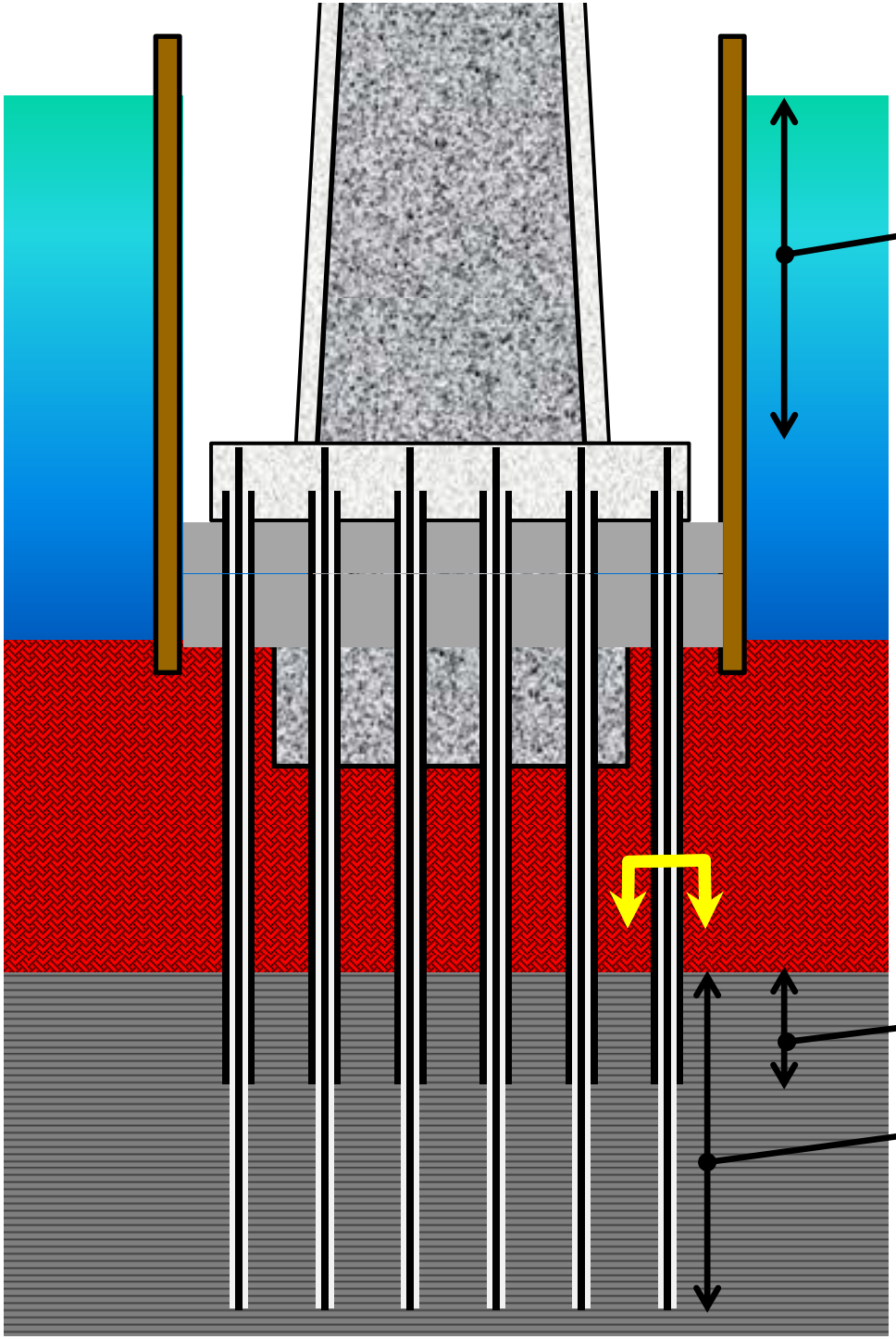


Micropile Concept

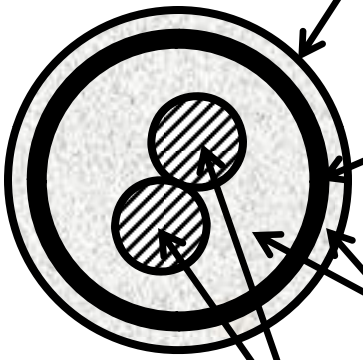
Construction Sequence

6. Cast stem encasement

Micropile Concept



12’ clear to new footing



10 ¼” Hole

9 5/8 OD x 0.5 wall N80 pipe

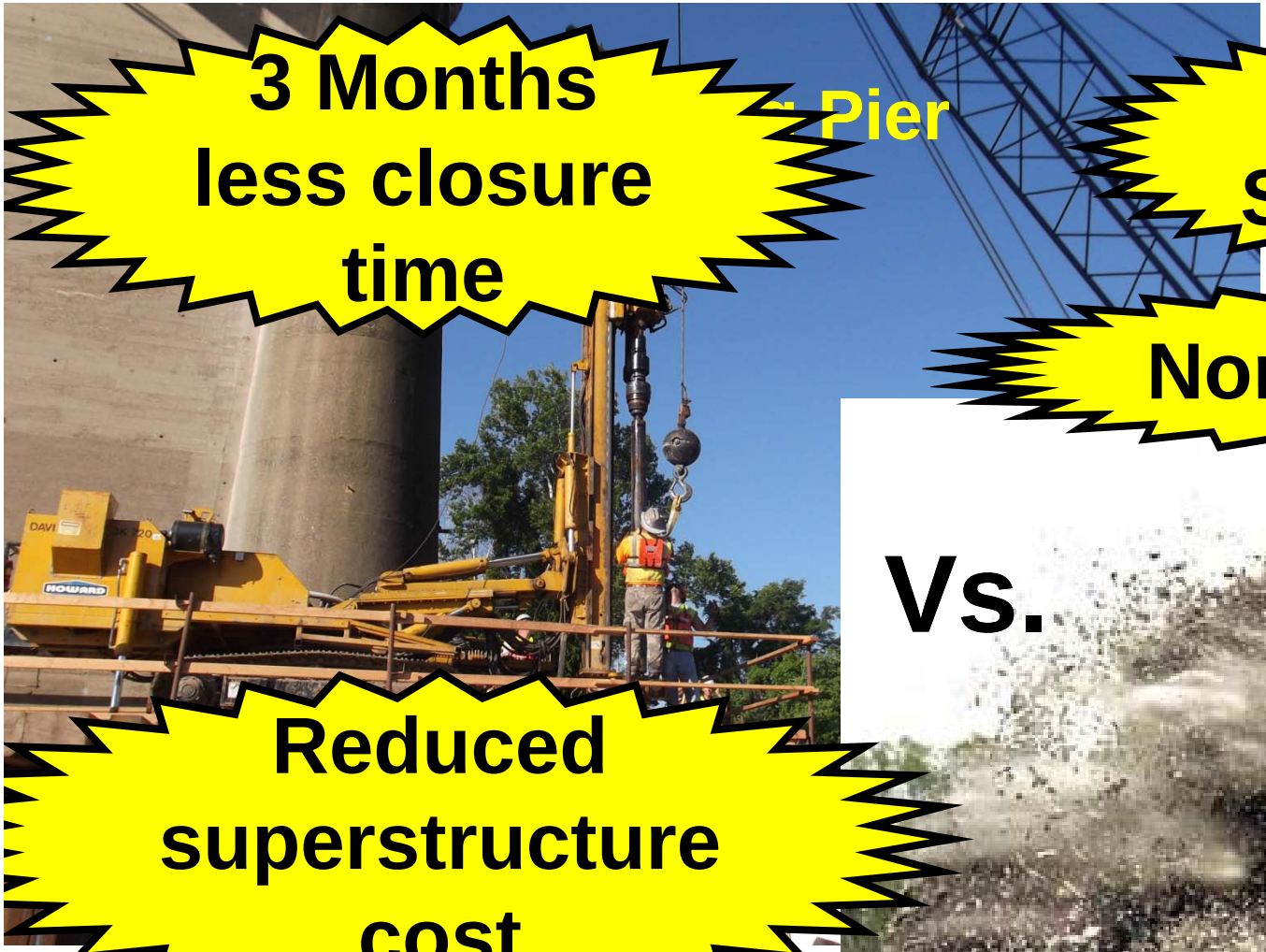
5000 psi grout

2 x #18 Gr 75

10’ Casing embedment

28’ Bond zone

q_r = 526 kips



3 Months less closure time

Time Savings?

None overall

Vs.

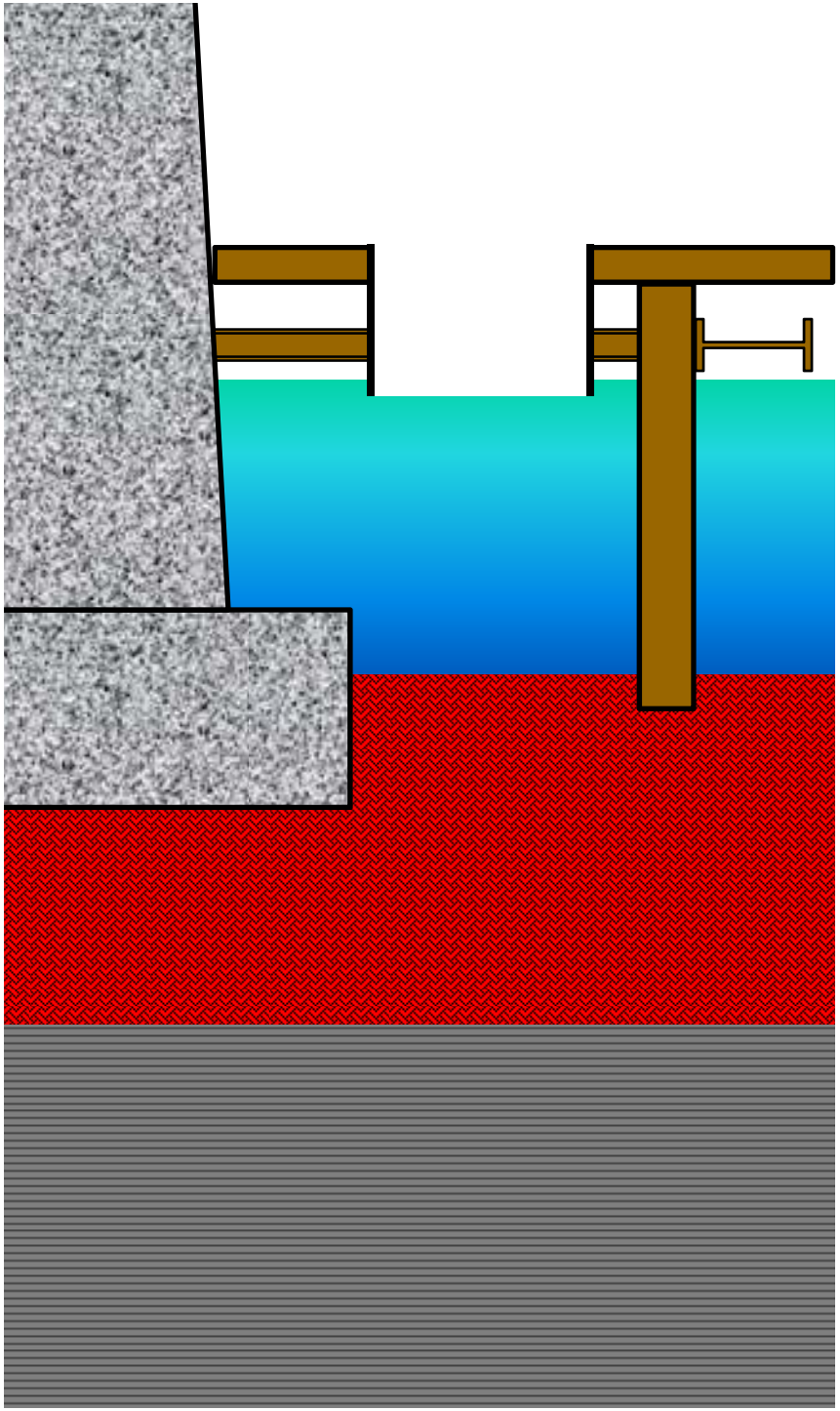
Reduced superstructure cost

Cost Savings?

None for pier

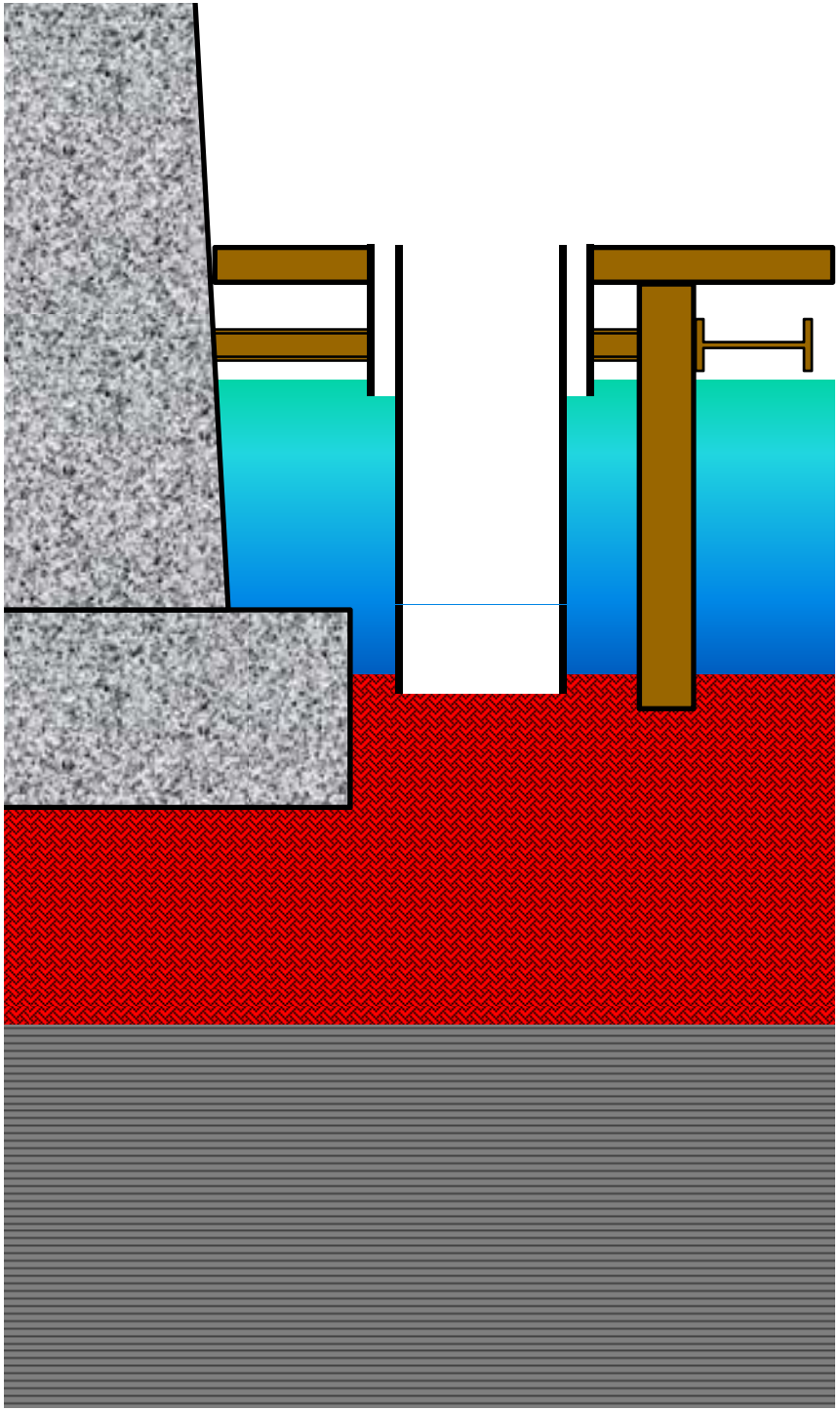
Demolish and Build New Pier

Construction



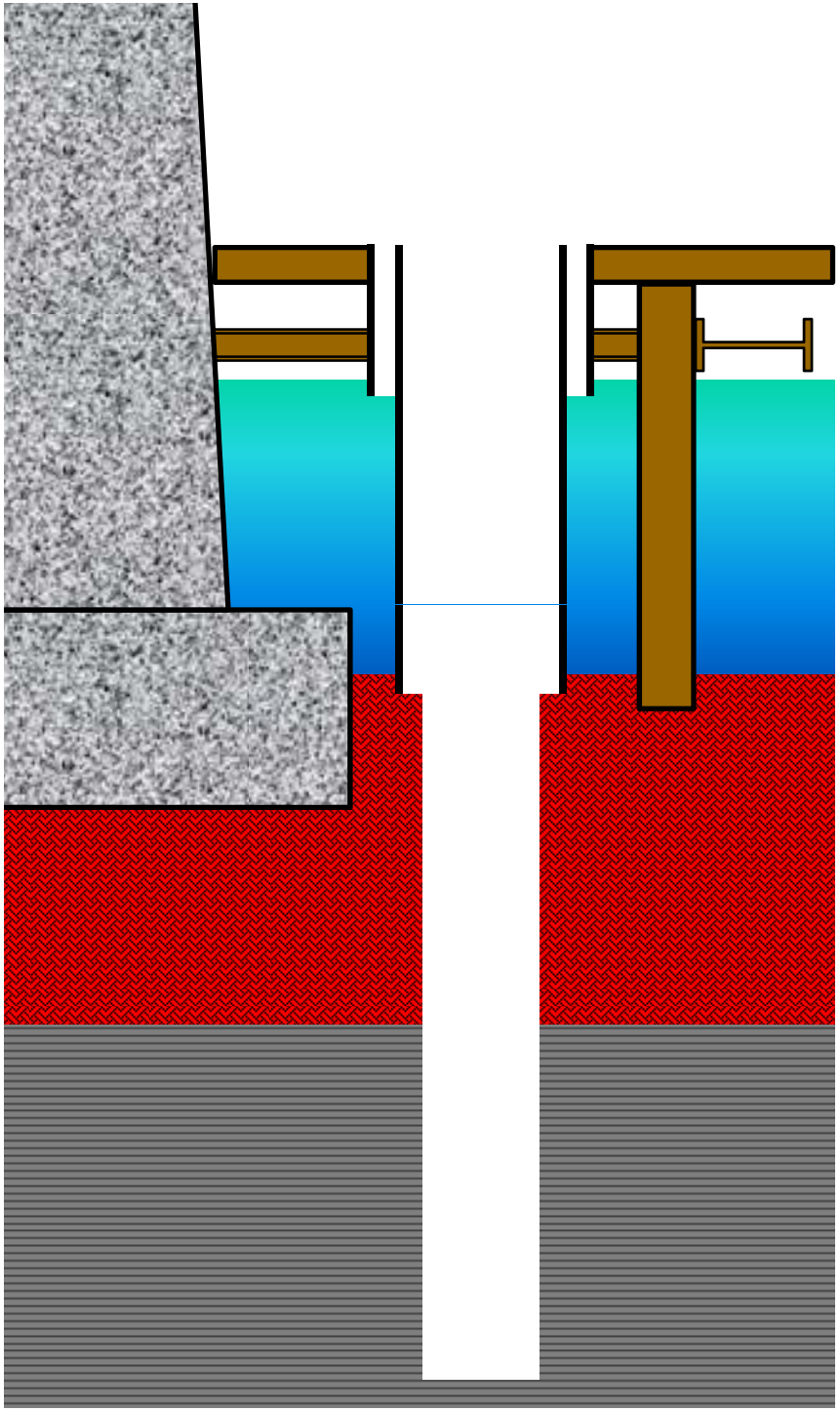
Contractor's Proposed Pile Construction Method

1. Place drilling deck with 14" guide pipes



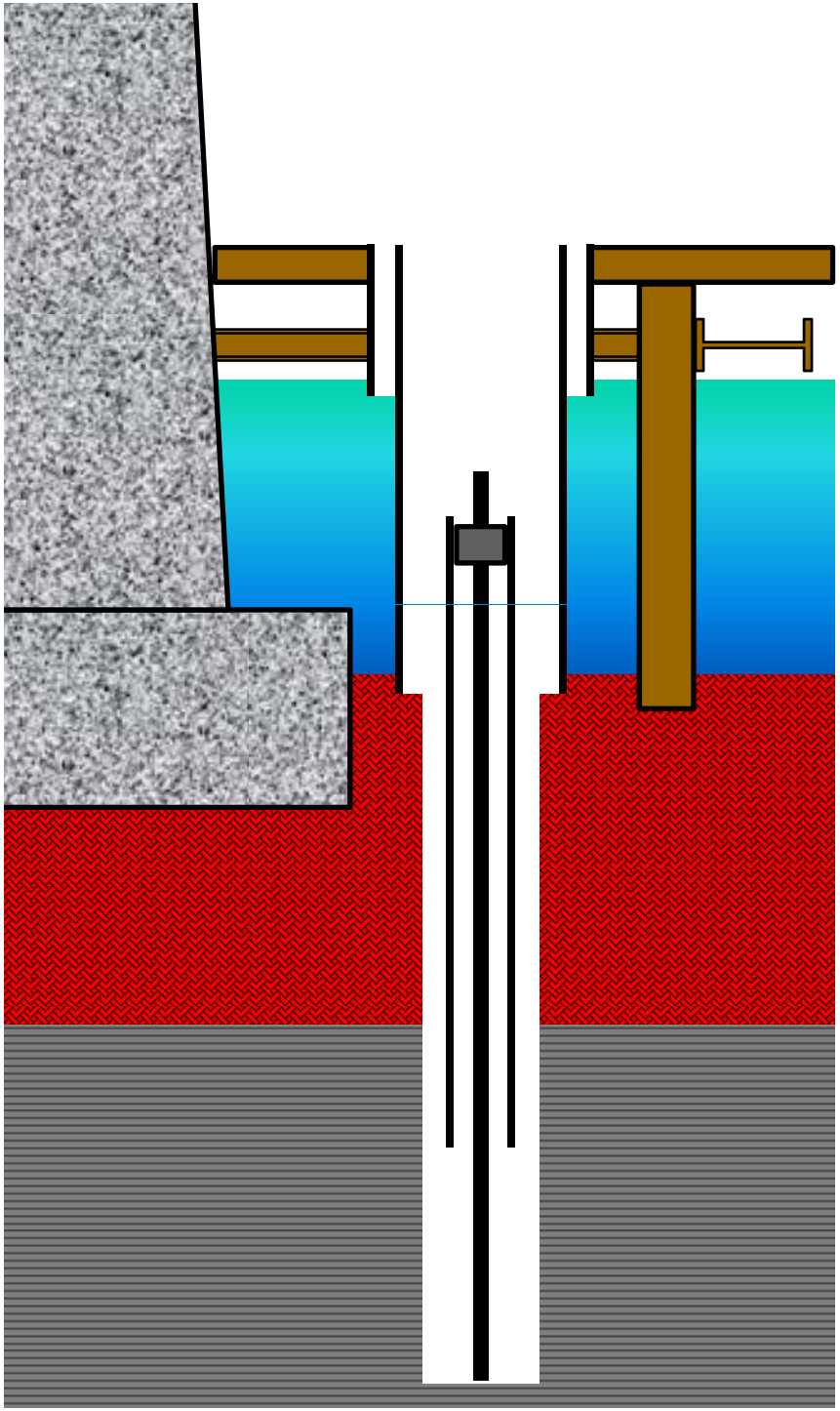
Contractor's Proposed Pile Construction Method

2. Install temporary 11" pipe into competent rock or top of existing footing



Contractor's Proposed Pile Construction Method

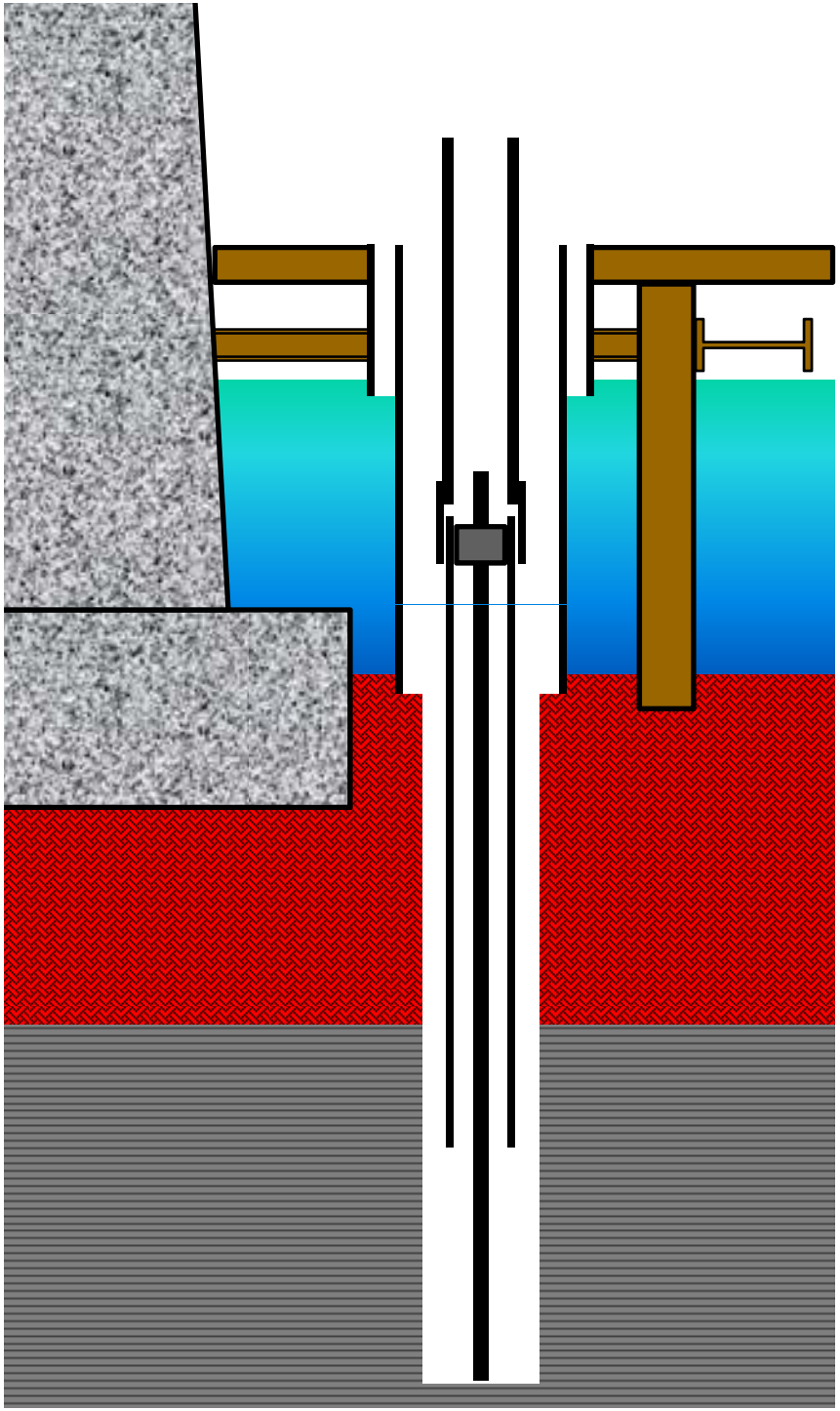
3. Drill 10.25" hole to final tip elevation



Contractor's Proposed Pile Construction Method

4. Lower permanent 9.625" N80 casing and center reinforcing bar to bottom of hole

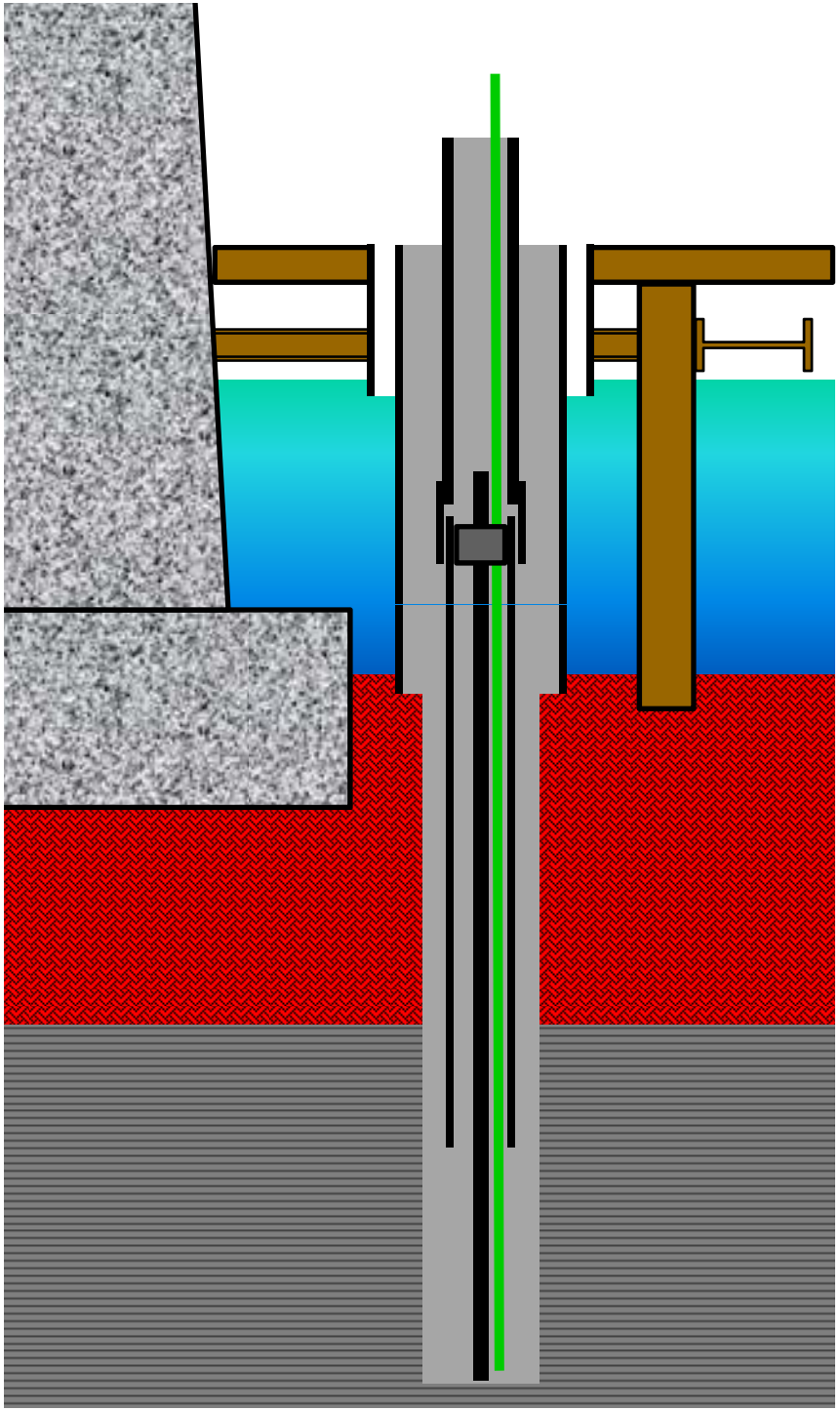
NOTE: permanent casing is coupled to reinforcing bar with custom bracket that suspends it at the proper height in the hole



Contractor's Proposed Pile Construction Method

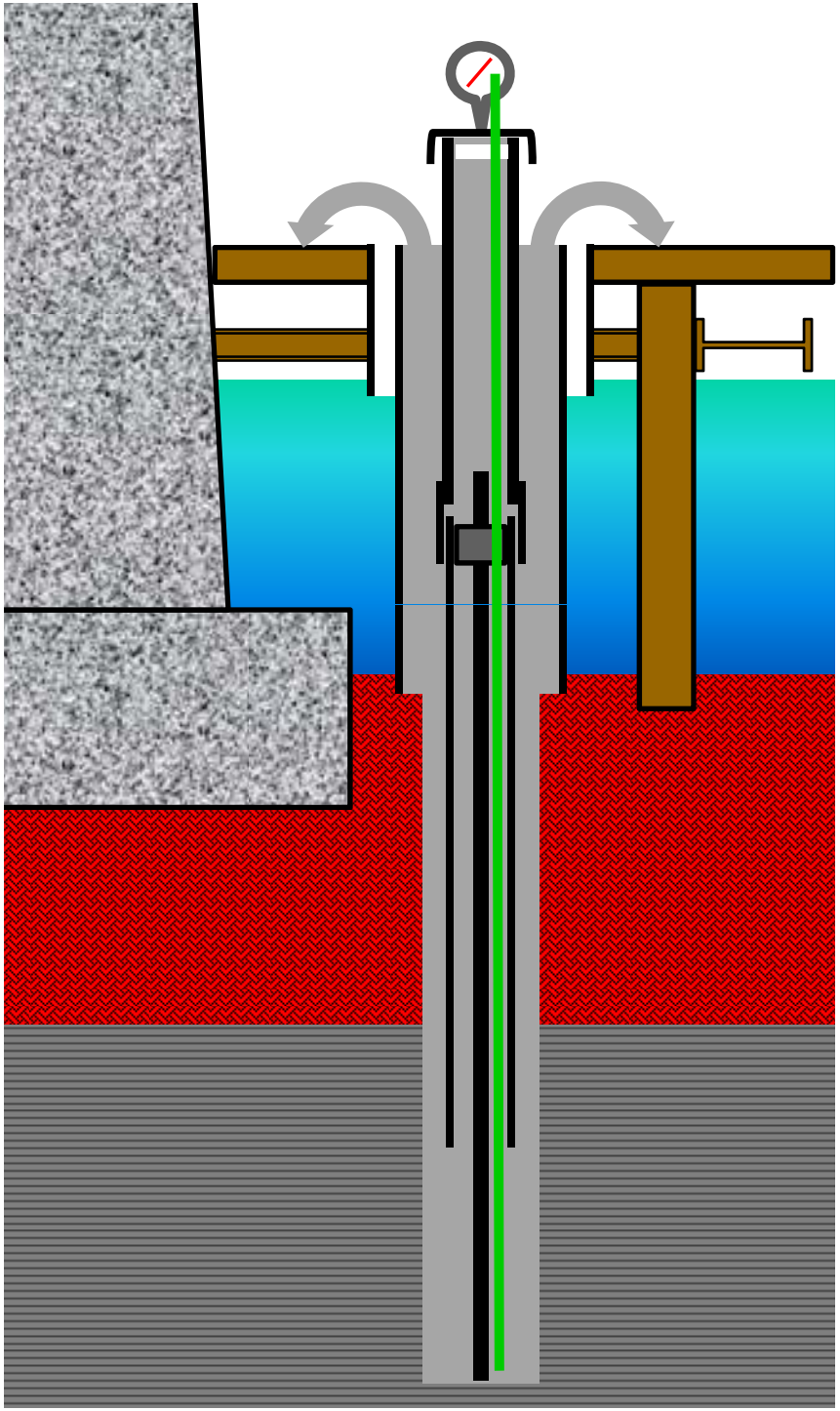
5. Lower grout standpipe over top of permanent casing.

NOTE: Grout standpipe seals to top of permanent casing with a rubber compression seal and is held down by drill rig



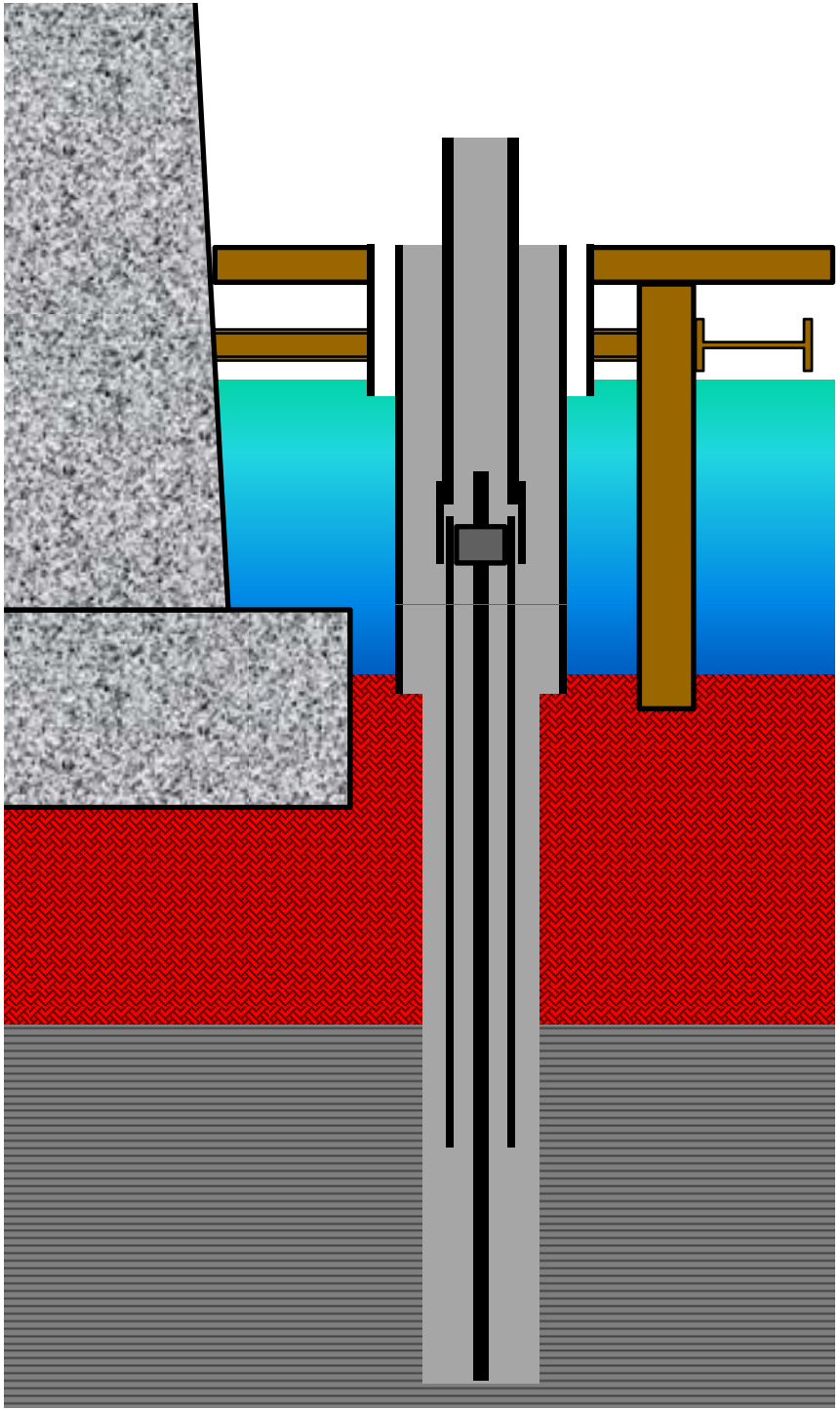
Contractor's Proposed Pile Construction Method

6. Insert grout tremie tube to bottom of pile
7. Place grout till return is observed in outside pipe



Contractor's Proposed Pile Construction Method

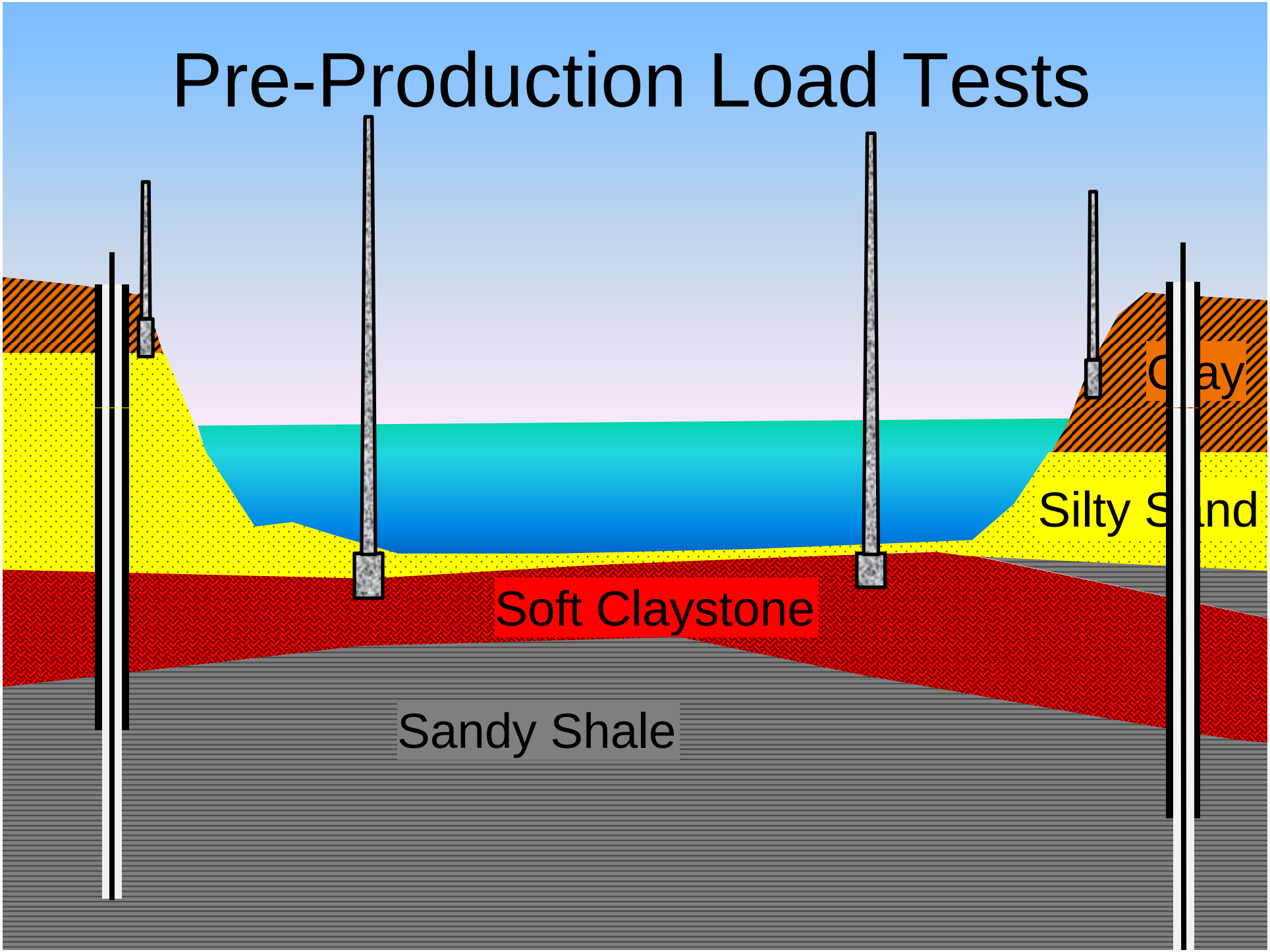
8. Remove tremie tube
9. Install pressure cap and pressurize till grout returns or 100 psi



Contractor's Proposed Pile Construction Method

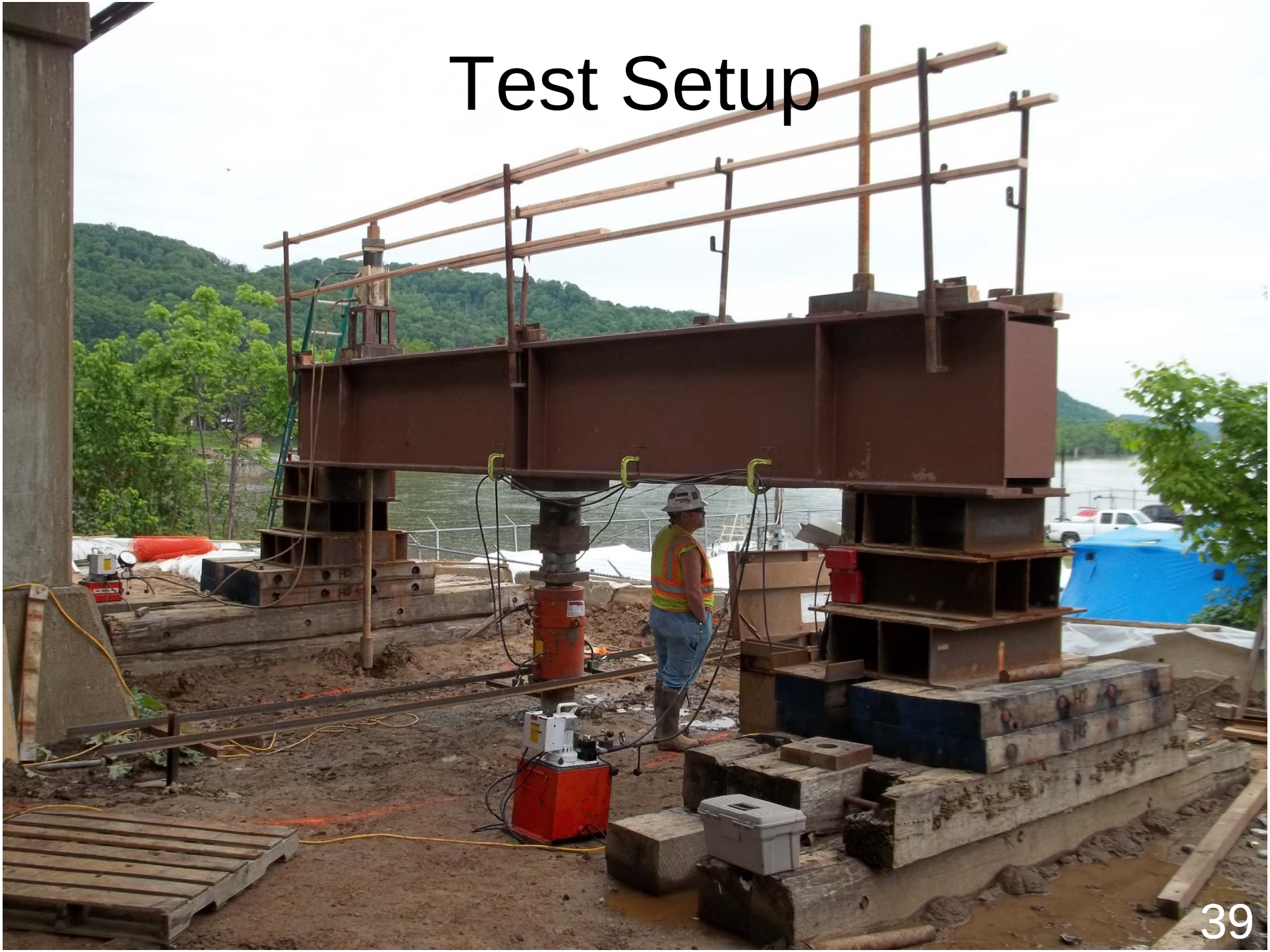
10. Remove standpipe
11. Remove temporary casing pipe

Pre-Production Load Tests

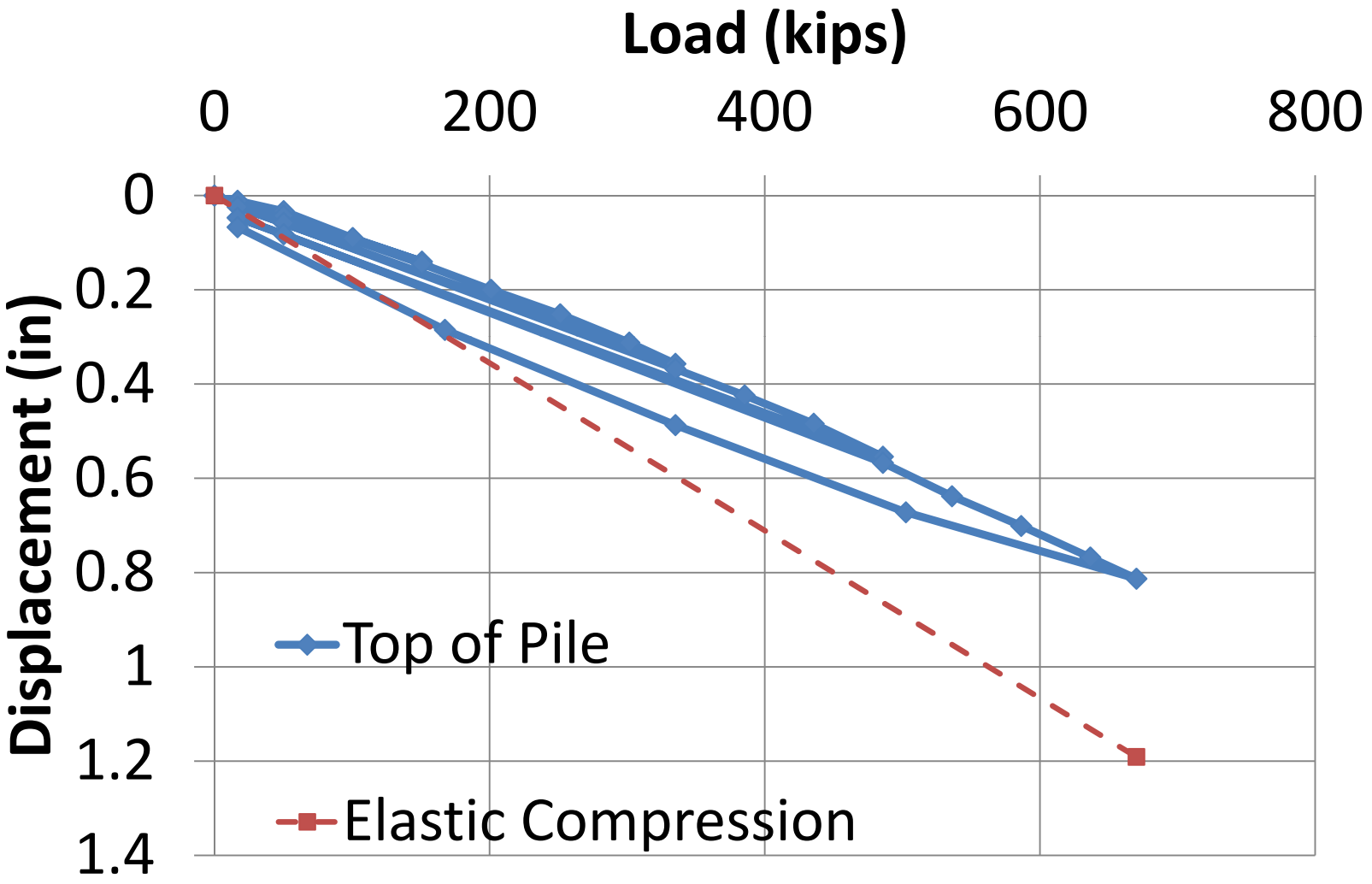


Test Pile Installation

Test Setup



St. Albans - Results



Approx. Max. bond stress mobilized = 62.1 psi

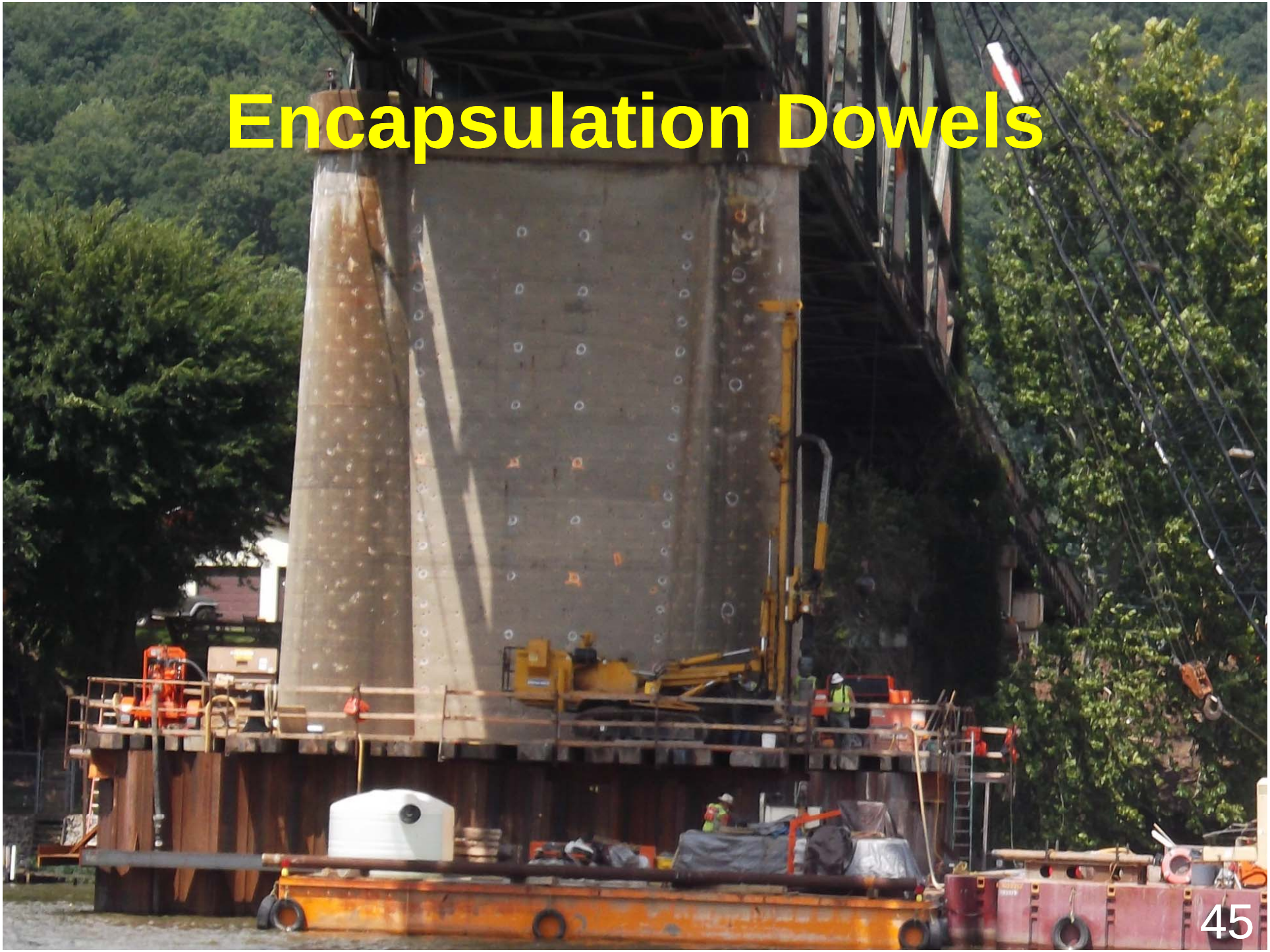

Drilling Piles
MANITOWOC
180

Installing Reinforcing and Casing


Tremie Grouting
Grout Return

Grout Pressurization

Encapsulation Dowels



Excess Grout Cleanout by Divers


Dewatering Cofferdam


Dewatered Cofferdam


Dowel Holes and Piles

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… Delivering Solutions

Questions?

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