Design, Permitting of Trenchless Crossings in USACE Flood Control Projects

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GeoEngineers

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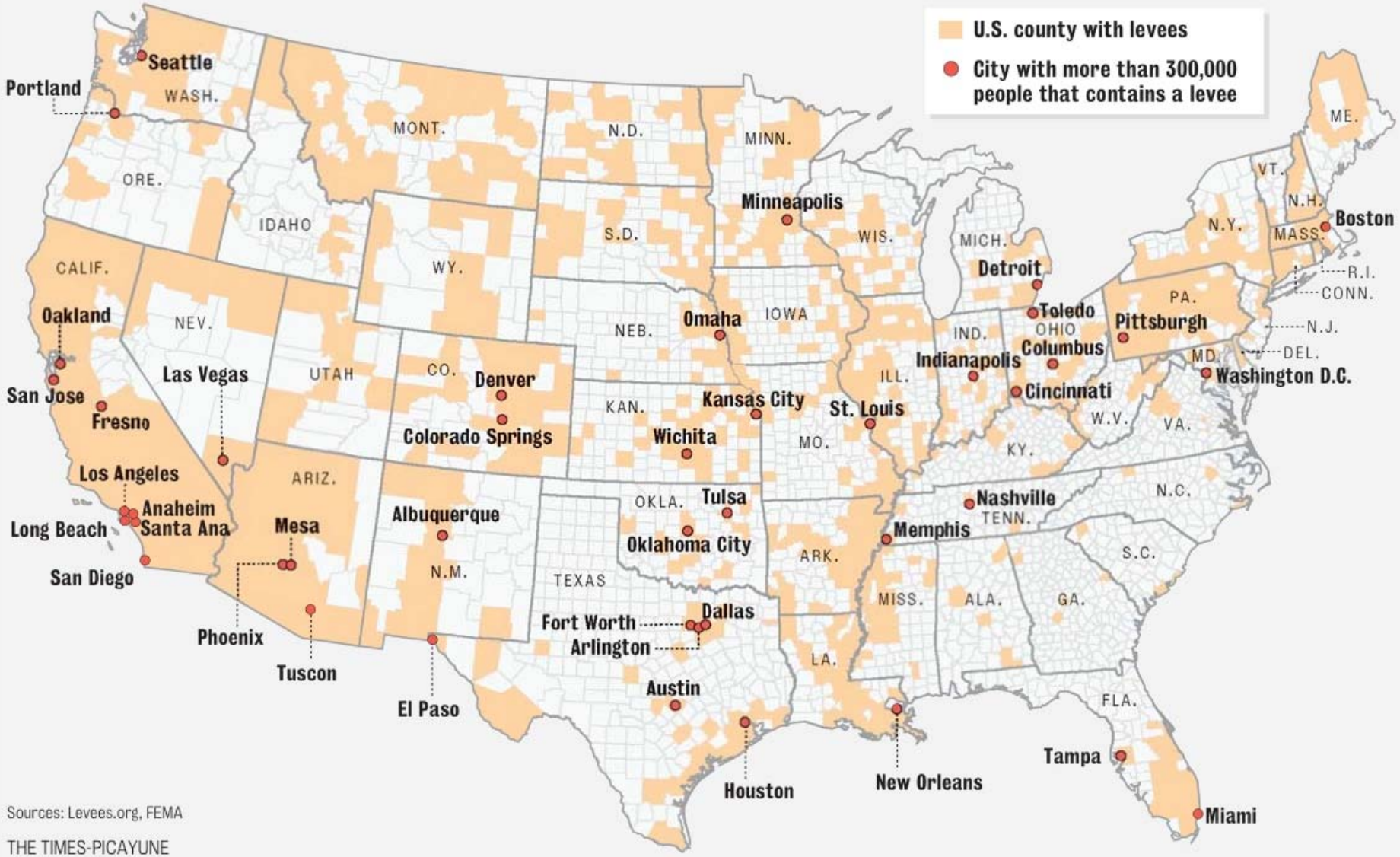
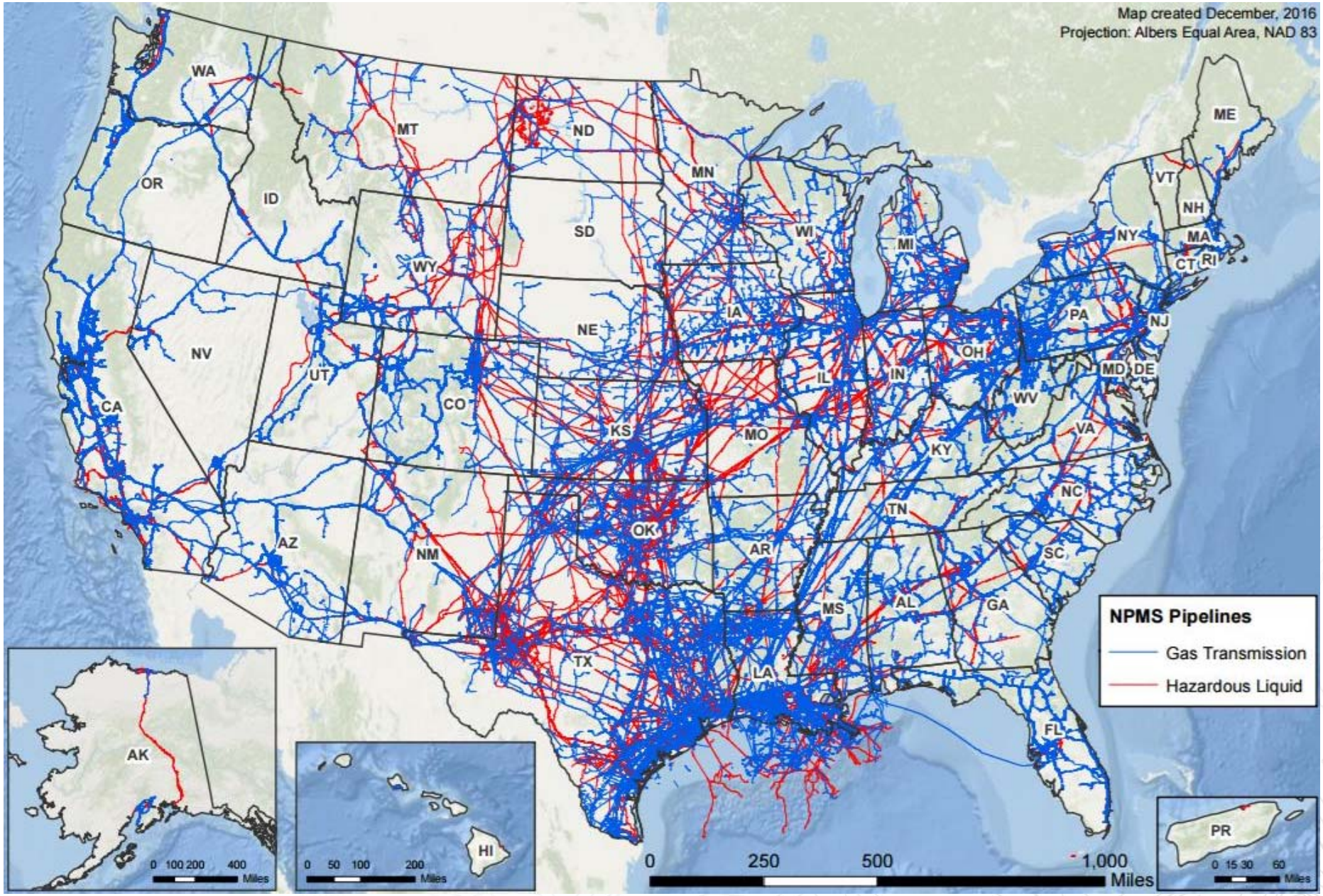
LEVEES EVERYWHERE

There are 881 counties in the U.S. with levees. Those counties contain more than 50 percent of the nation's population.



Sources: Levees.org, FEMA

THE TIMES-PICAYUNE


Map created December, 2016
Projection: Albers Equal Area, NAD 83
WA
OR
CA
ID
NV
MT
WY
UT
AZ
CO
NM
ND
SD
NE
KS
OK
TX
MN
IA
MO
AR
LA
WI
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KY
TN
AL
OH
WV
GA
FL
SC
NC
VA
PA
NY
MD
DE
NJ
CT
RI
MA
VT
NH
ME
AK
HI
PR
NPMS Pipelines
Gas Transmission
Hazardous Liquid
0 250 500 1,000 Miles
0 100 200 400 Miles
0 50 100 200 Miles
0 15 30 60 Miles

About USACE Levees

- FEMA estimated levees located in 22% of nation's 3,147 counties
- Estimated 43% of US population lives in counties with levees
- 85% of nation's estimated 100,000 miles of levees locally owned & maintained—reliability unknown
- Increased development behind levees = increase in risk to public
- Rough estimates >$100 billion to repair & rehabilitate nation's levees
- Water & environment levees 2009 grade = D-


WHERE WE ARE – U.S. ARMY CORPS OF ENGINEERS
Alaska
Seattle
Portland
Walla Walla
Northwestern Division
Great Lakes & Ohio River Division
North Atlantic Division
St. Paul
Rock Island
Chicago
Detroit
Buffalo
Pittsburgh
New York
Concord
Philadelphia
Baltimore
Winchester
Norfolk
Omaha
Kansas City
St. Louis
Cincinnati
Louisville
Huntington
Nashville
Memphis
Wilmington
Charleston
Atlanta
Savannah
Jacksonville
Mobile
Sacramento
San Francisco
Los Angeles
Albuquerque
South Pacific Division
Tulsa
Little Rock
Southwestern Division
Ft. Worth
Dallas
Galveston
Vicksburg
New Orleans
Mississippi Valley Division
South Atlantic Division
Transatlantic Division and Middle East District
Honolulu
Pacific Ocean Division
Korea
Japan
Other Organizations
Engineer Research and Development Center (7 Labs)
Engineering and Support Center, Huntsville
Army Geospatial Center
USACE Finance Center
USACE Logistics Activity
Marine Design Center
Institute for Water Resources
249th Engineer Battalion
LEGEND
Division HQ Location
District HQ Location
District and Division Co-located
Division Boundary
District Boundary
State Boundary
Transatlantic Division
Middle East District
Afghanistan Engineer Districts
North
South
Europe District

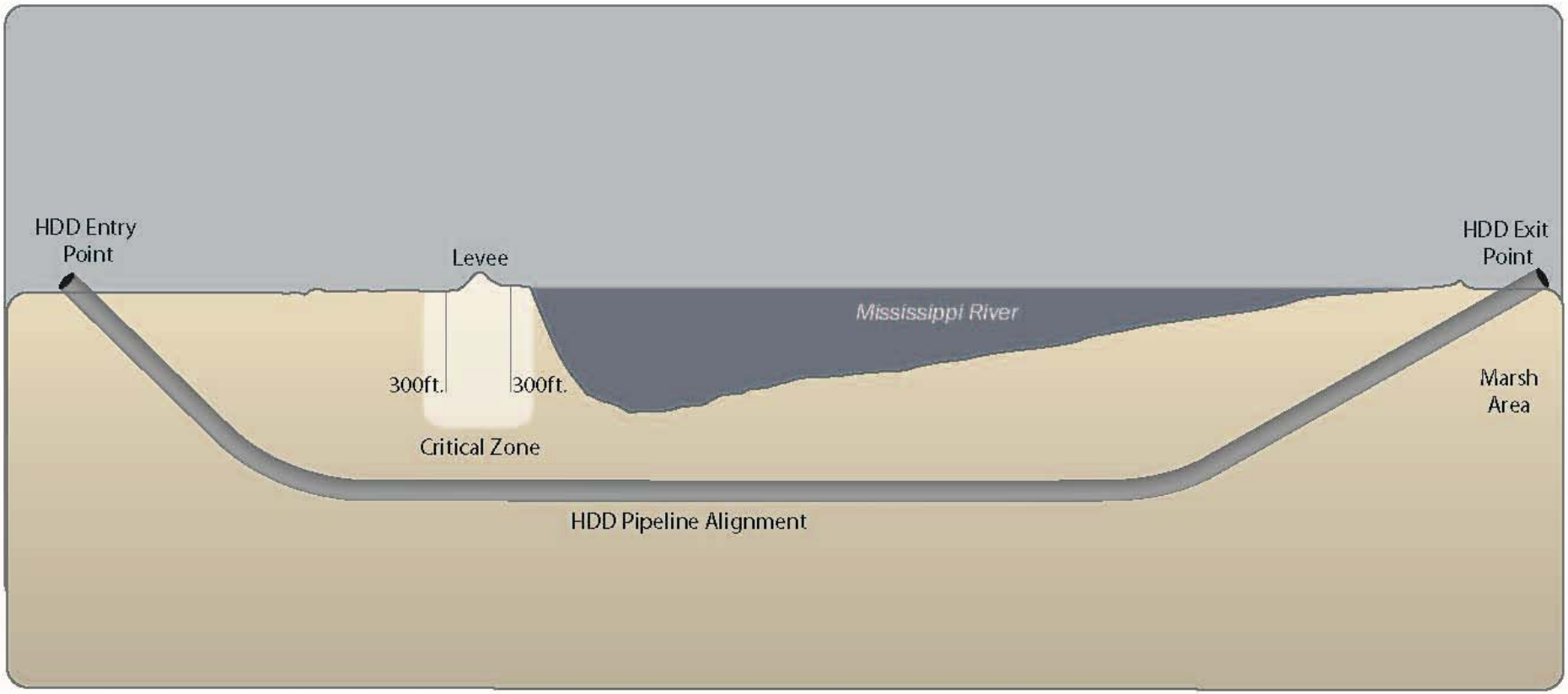
Over or Under

Over the Top of Levee

Between the Levees

Under the Levee

Under the Levee



Direct Pipe Under the Levee

Threats to Flood Protection

- Slope stability & settlement

Threats to Flood Protection

- Slope stability & settlement

Table 3.1 – Slope Stability Design Factors of Safety.

Analysis Condition	Required Minimum Factor of Safety	
	Spencer Method[1]	MOP[2]
End of Construction[3]	N/A	N/A
Design Hurricane[4] (SWL)	1.5	1.3
Water at Project Grade (levees)[5]	1.4 (1.5)[6]	1.2
Water at Construction Grade (levees)[5]	1.2	N/A
Extreme Hurricane (water @ top of I-Walls)[5]	1.4 (1.5)[6]	1.3
Extreme Hurricane (water @ top of T-Walls)[5a]	1.4 (1.5)[6]	1.2
Low Water (hurricane condition)[7]	1.4	1.3
Low Water(non-hurricane condition)[8] S-case	1.4	1.3
Water at Project Grade Utility Crossing[9]	1.5 (1.4)	1.3 (1.2)

NOTES:

1. Spencer method shall be used for circular and non-circular failure surfaces since it satisfies all conditions of static equilibrium and because its numerical stability is well suited for computer application. These factors of safety are based on well defined conditions where: (a) available records of construction, operation, and maintenance indicate the structure has met all performance objectives for the load conditions experienced; (b) the level of detail for investigations follow EM 1110-1-1804, Chapter 2, for the PED phase of design; and (c) the governing load conditions are established with a high level of confidence. Poorly defined conditions are not an option, and the Independent Technical Review must validate that the defined conditions meet the requirements in this footnote.

2. Method of Planes shall be used as a design check for verification that levee and floodwall designs satisfy historic district requirements. Analysis shall include a full search for the critical failure surface per stratum since it may vary from that found following the Spencer method.

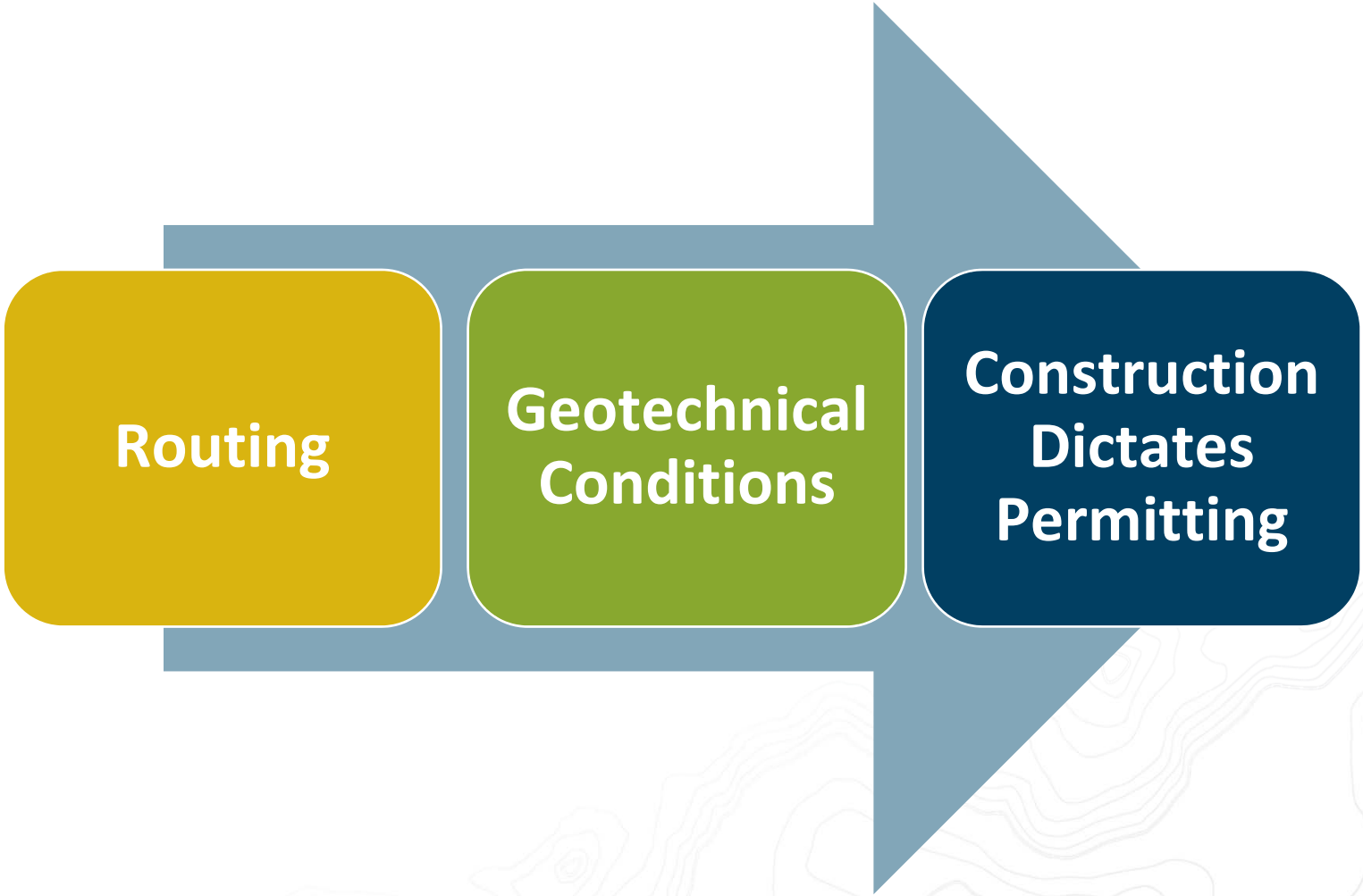
Threats to Flood Protection

- HDD Drilling fluid release & flow through the annulus

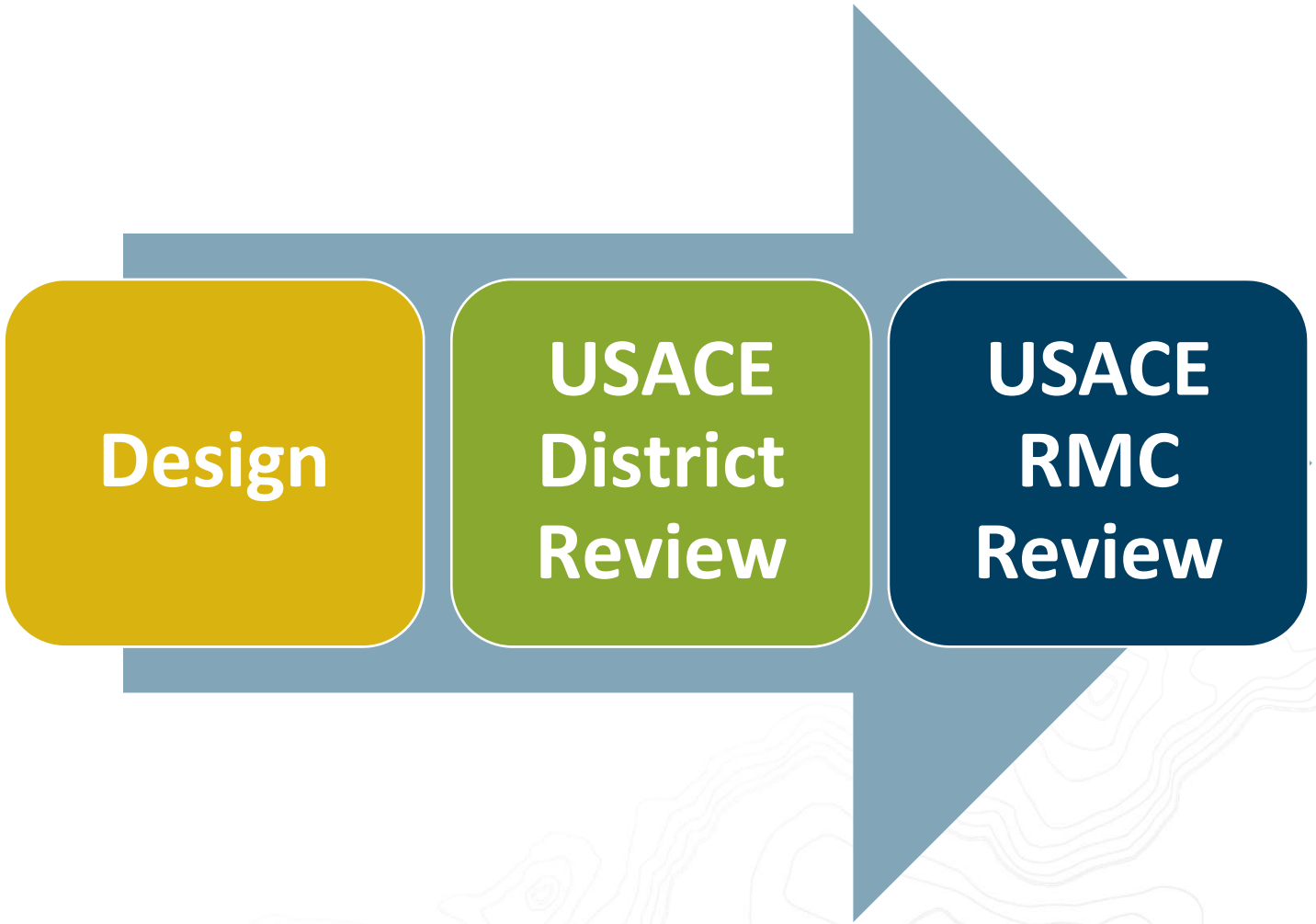
Know Early

- First, check routing
- Avoidance best solution for cost, schedule, risk
- Longest lead time for permitting
- Soil conditions control design & construction
- Meet local USACE District early to discuss levee concerns
- Most rigorous construction requirements
- Most expensive design & construction option

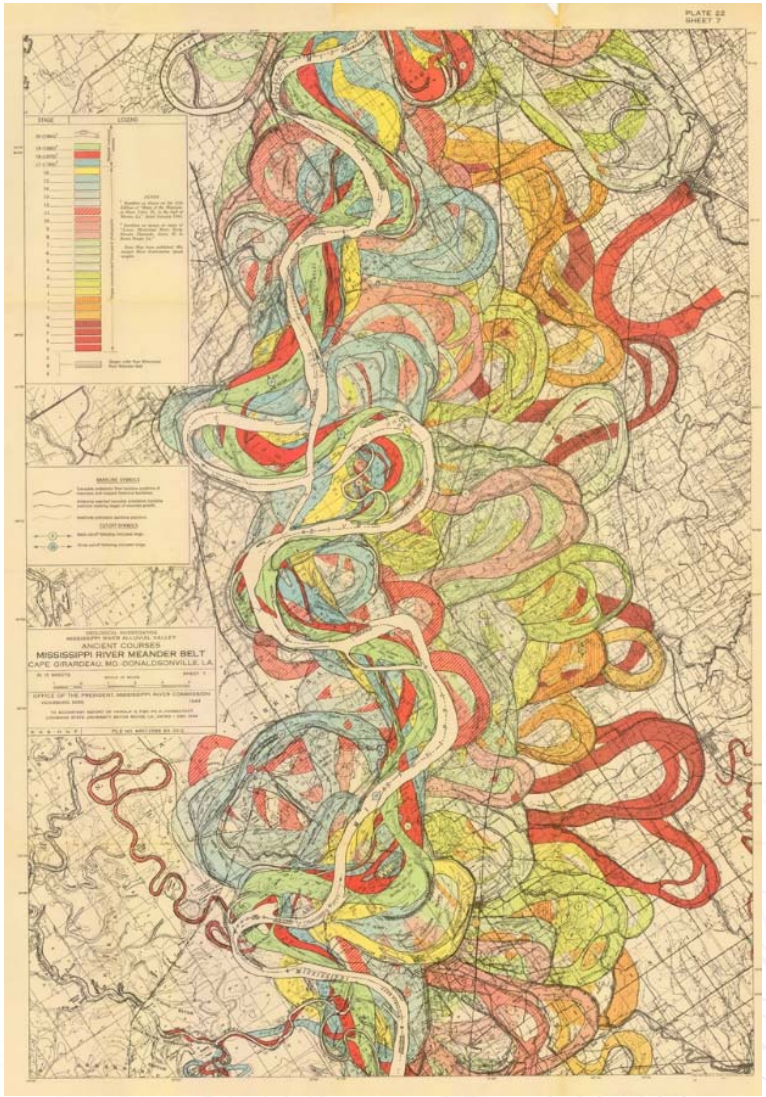
Permitting – Year or More



Permitting – Year or More

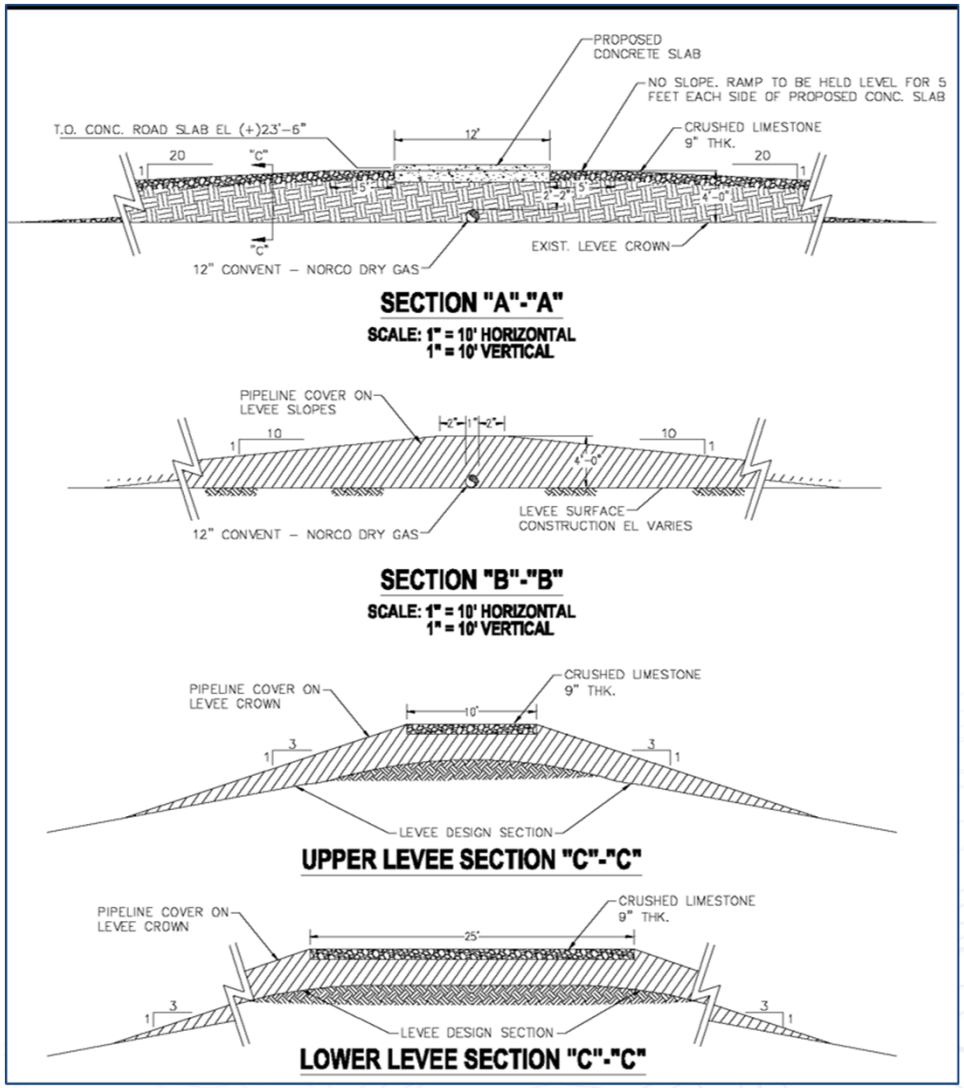


Know Soil Conditions Before Route Finalized



Historical Map of Mississippi River Channels

Over the Top Requirements



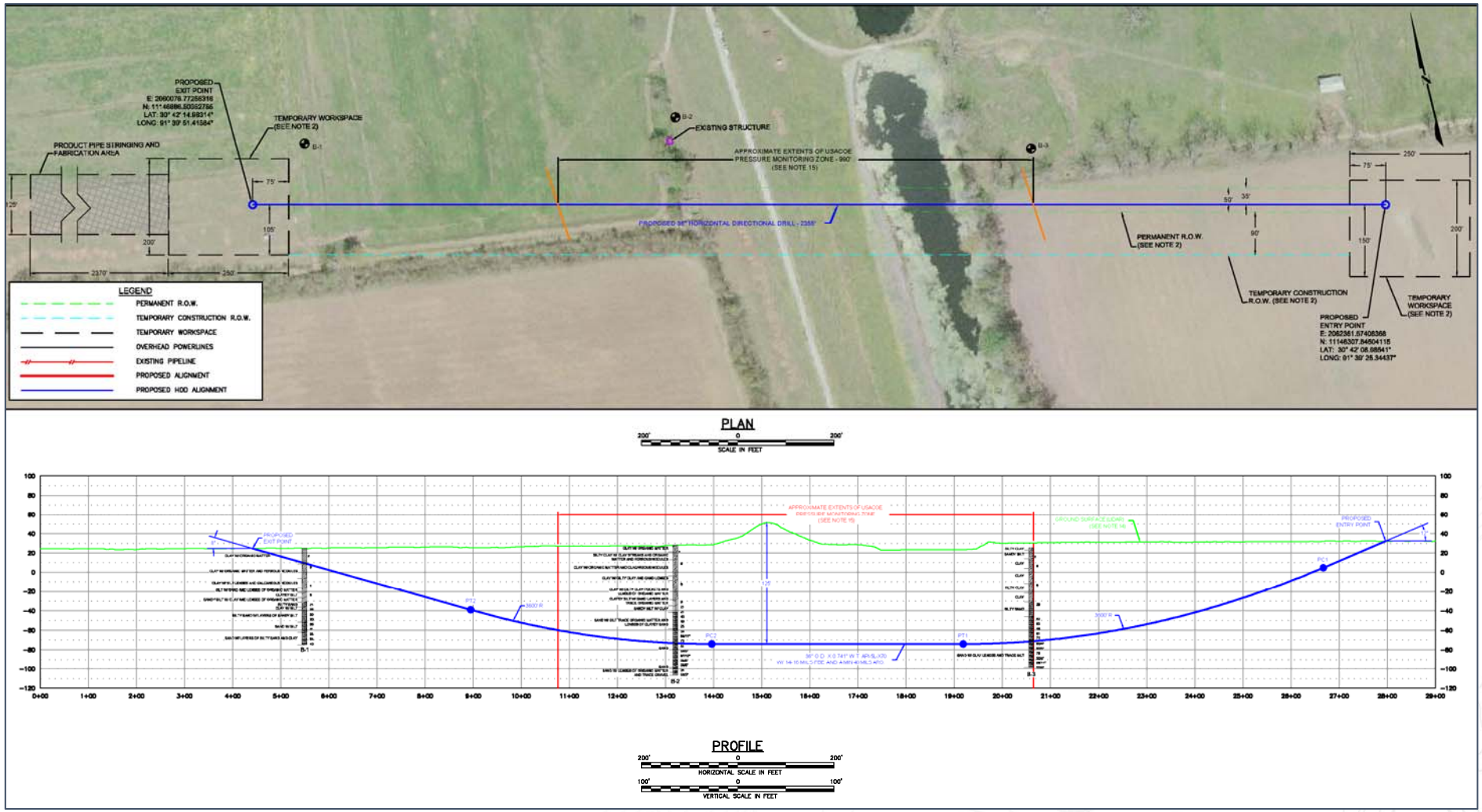
Over the Top Requirements

HDD Concerns

- Some soils will not meet USACE requirements against hydraulic fracture
- Risk may be reduced with pilot hole intersect
- Risk of inadvertent returns also depends on contractor performance
- Direct Pipe might become option

Direct Pipe Limitations

- Diameter & length



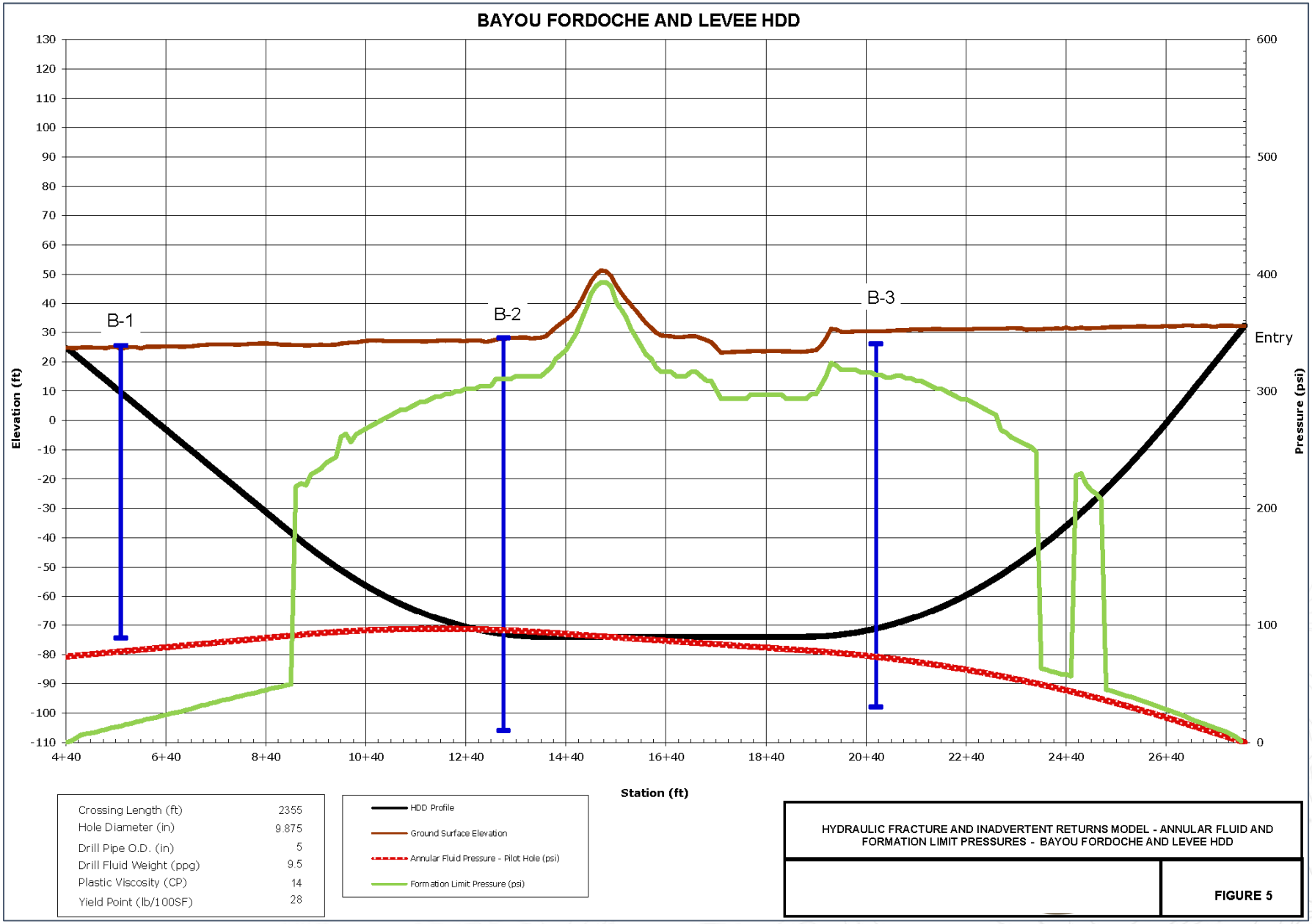
PLAN

200' 0 200'
SCALE IN FEET

PROFILE

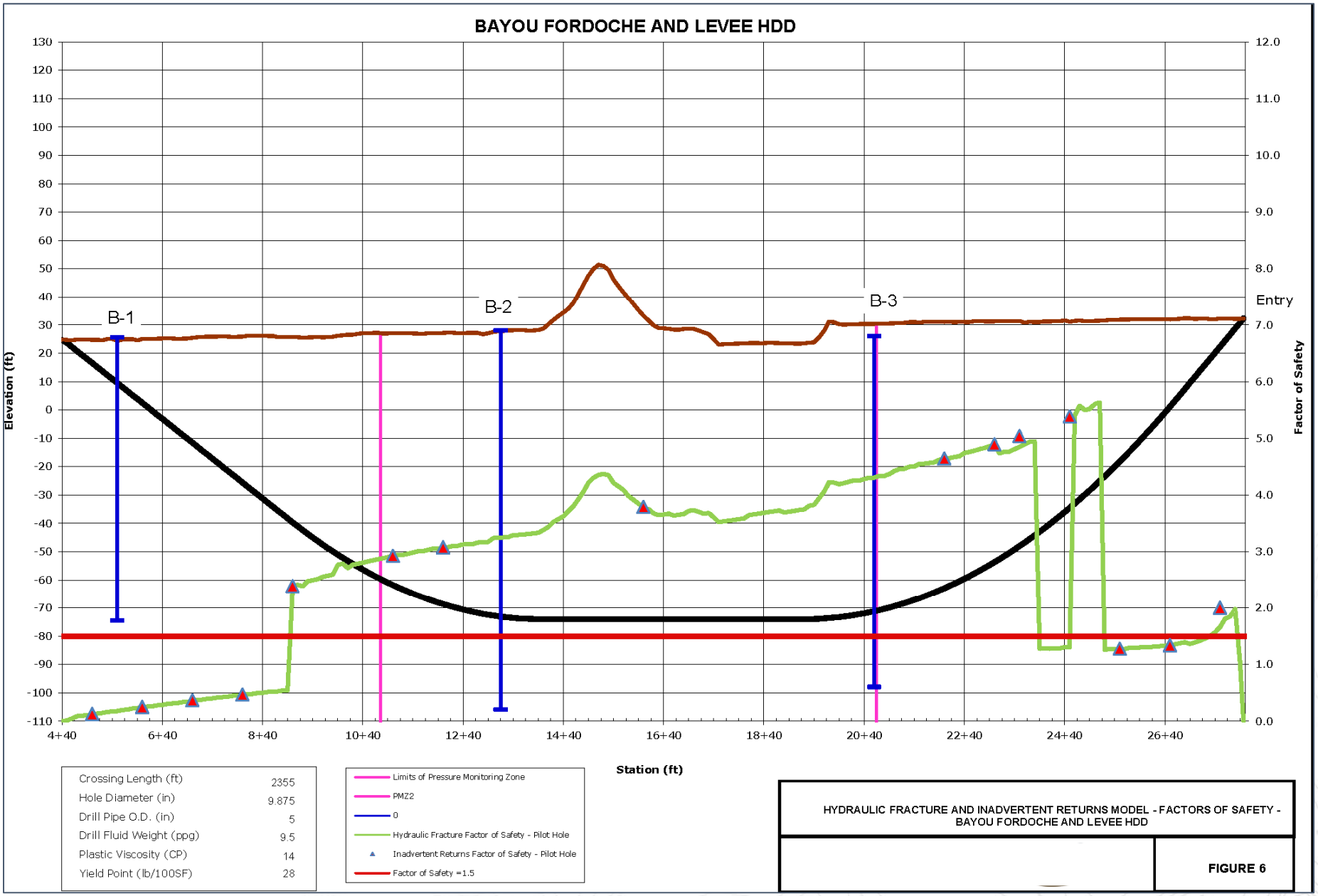
200' 0 200'
HORIZONTAL SCALE IN FEET

100' 0 100'
VERTICAL SCALE IN FEET



HYDRAULIC FRACTURE AND INADVERTENT RETURNS MODEL - ANNULAR FLUID AND FORMATION LIMIT PRESSURES - BAYOU FORDOCHE AND LEVEE HDD

FIGURE 5



HYDRAULIC FRACTURE AND INADVERTENT RETURNS MODEL - FACTORS OF SAFETY - BAYOU FORDOCHE AND LEVEE HDD

FIGURE 6

References

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Questions?

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