HERBERT HOOVER DIKE REHABILITATION PROJECT

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US Army Corps of Engineers
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Herbert Hoover Dike

Overview

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- Lake Okeechobee covers 730 square miles
- Basin exceeds 5,600 square miles
- Average water depth is 9 feet
- One foot of rainfall runoff from the basin can result in a three to four-foot rise on the lake

Herbert Hoover Dike
Overview





- Hurricanes in 1926 and 1928
- Several thousand fatalities

- Impact to numerous towns around the lake

Herbert Hoover Dike
Overview

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- 143 miles of embankment around Lake Okeechobee
  - 32 federal culverts
  - 5 spillway inlets
  - 5 spillway outlets
  - 9 navigation locks
  - 9 pump stations
- Constructed between 1932 and 1938
- Embankment built by hydraulic dredge and fill methods, unacceptable by today's construction standards



Herbert Hoover Dike Rehabilitation

Purpose: Review the Herbert Hoover Dike (HHD) Rehabilitation Project including background, ongoing work and path forward to project completion.

Project Goals: Safeguarding human life while reducing the risk of adverse social, economic and environmental impacts to South Florida and the Everglades ecosystem due to failure of the Dike.

- Dam Safety Action Classification (DSAC) Level 1 - assigned 2006
- $1.70B estimated Total Project Cost with implementation of the Dam Safety Modification Report (DSMR)
- Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) – HHD accreditation
- State and local interest in completing the project

Herbert Hoover Dike
Dam Safety Modification Study

Existing Condition Risk Assessment

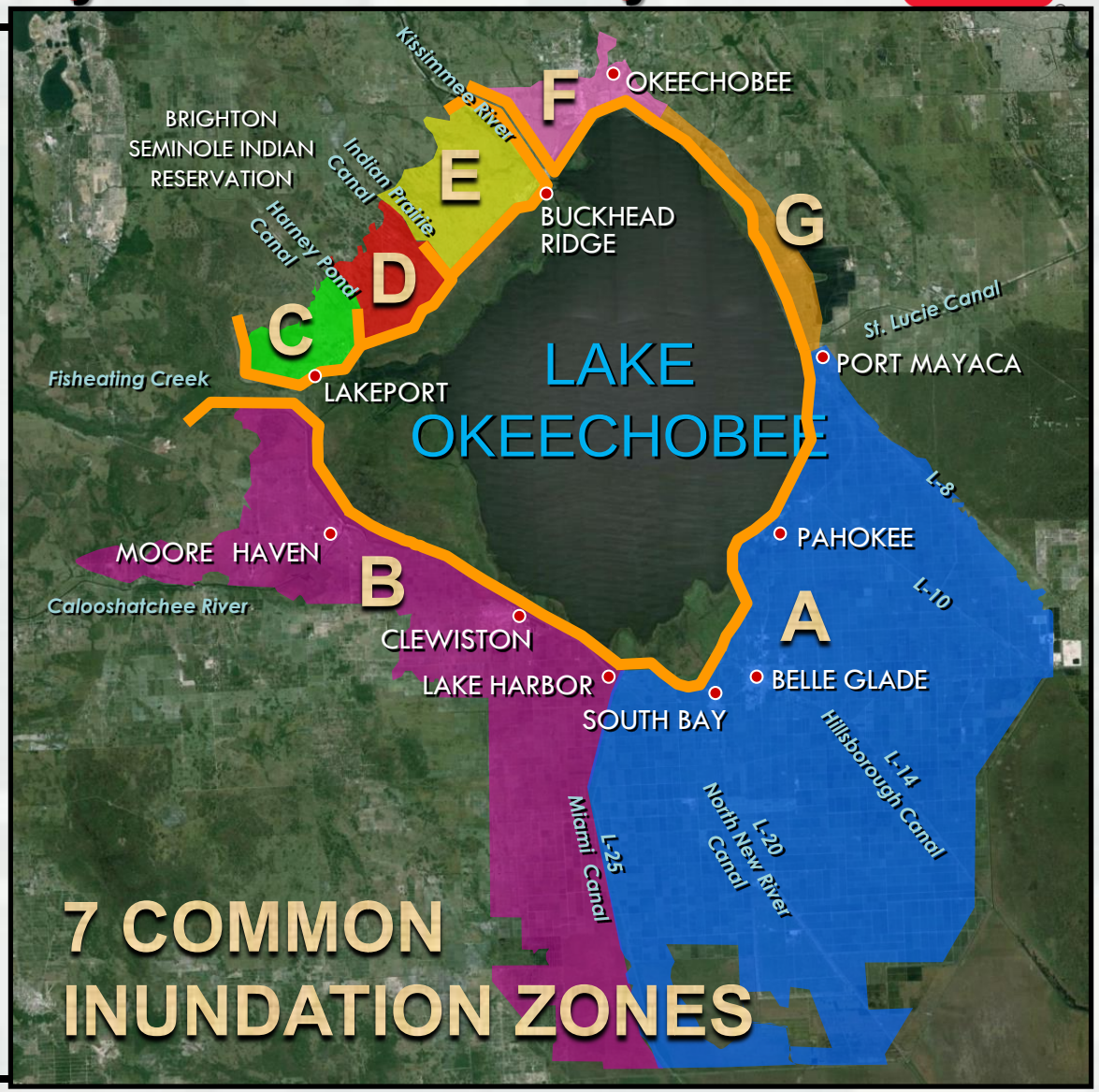
- Established 7 common inundation zones (SPF breach containment)
- Analysis performed on 32 dam segments within inundation zones to identify and prioritize remediation

Dam Safety Modification Report

- Recommends final HHD system repairs to reduce risks to within tolerable levels
- DSMR was approved 30 Aug 2016

Path Forward

- Construction project implementation planned through 2025
- Recommendation for FEMA accreditation by inundation zone began in 2016 with zones C-F

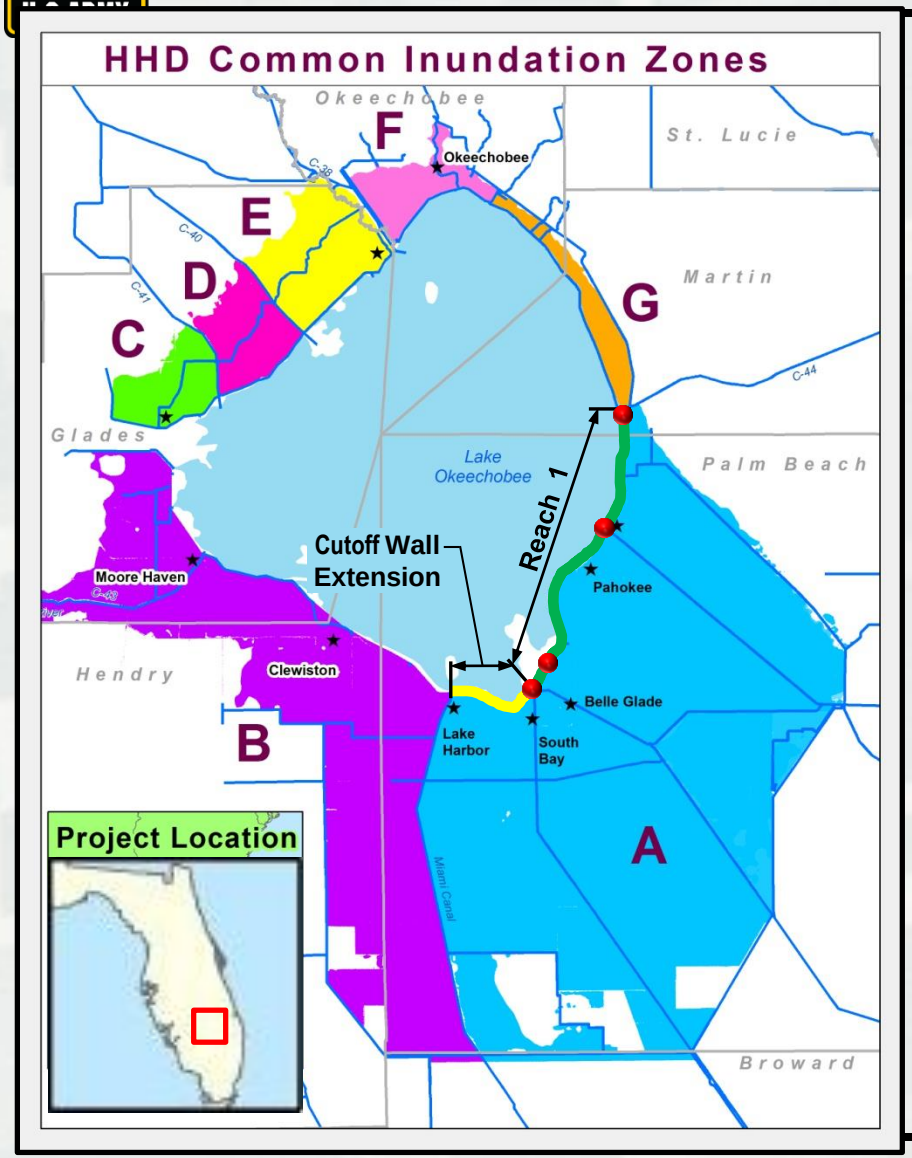


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Common Inundation Zone A

Cutoff Wall Construction

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Completed:

- Reach 1 Cutoff Wall – 21.4 miles of cutoff wall installed between 2007 and 2013

Ongoing:

- Cutoff Wall Gap Closures – existing structure tie-ins at 4 locations

Planned:

- Cutoff Wall Extension – contract award in FY17 for 6.6 miles of cutoff wall

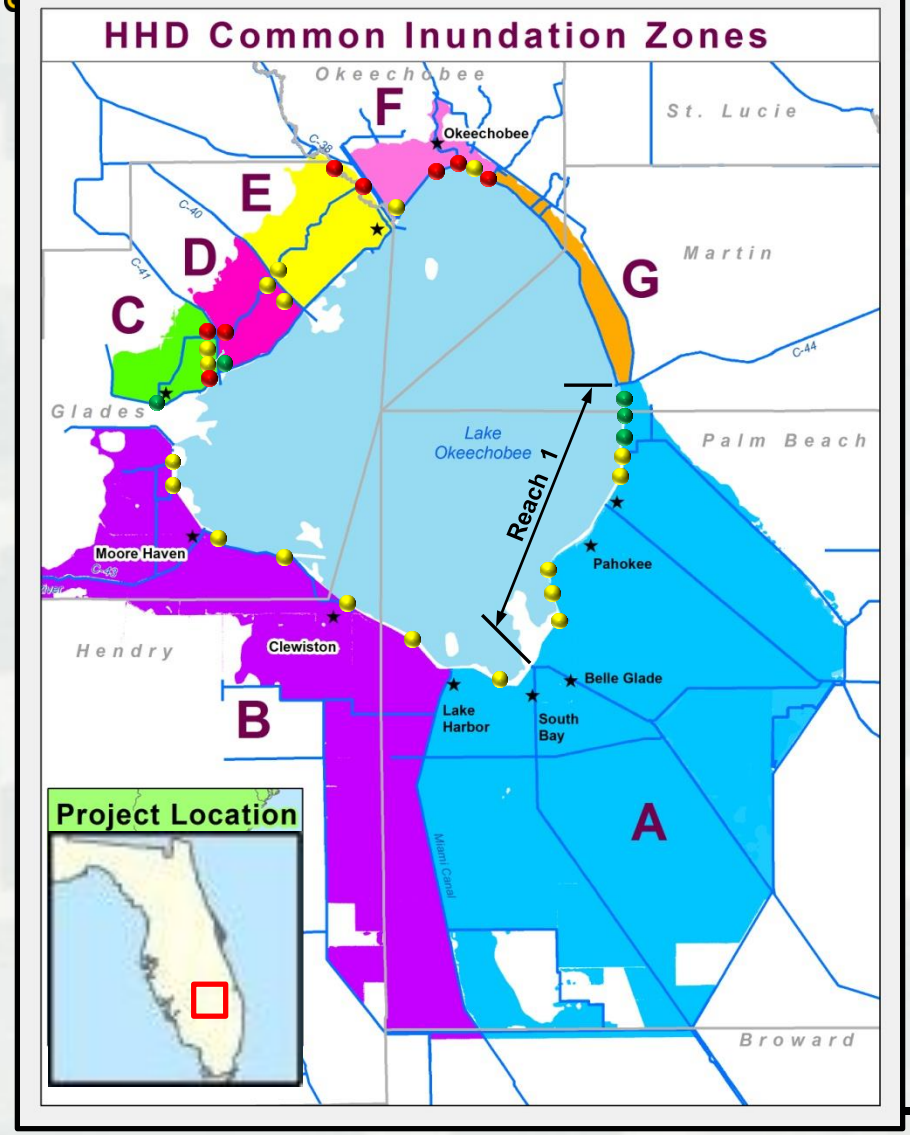
Impact – Complete the continuous seepage barrier through Inundation Zone A providing flood risk reduction benefits and accreditation recommendation to FEMA adjacent lands

Zone A Cutoff Wall Status

- Cutoff Wall Installation Complete
- Cutoff Wall Gap Closures Ongoing
- Cutoff Wall Installation Planned

Common Inundation Zones A-G

Water Control Structure Replacements



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Completed:

- 4 structure replacements
- 1 culvert removal

Ongoing:

- 11 construction contracts
- 19 structure replacements

Planned:

- 5 construction contracts
- 5 structure replacements
- 3 culvert abandonments

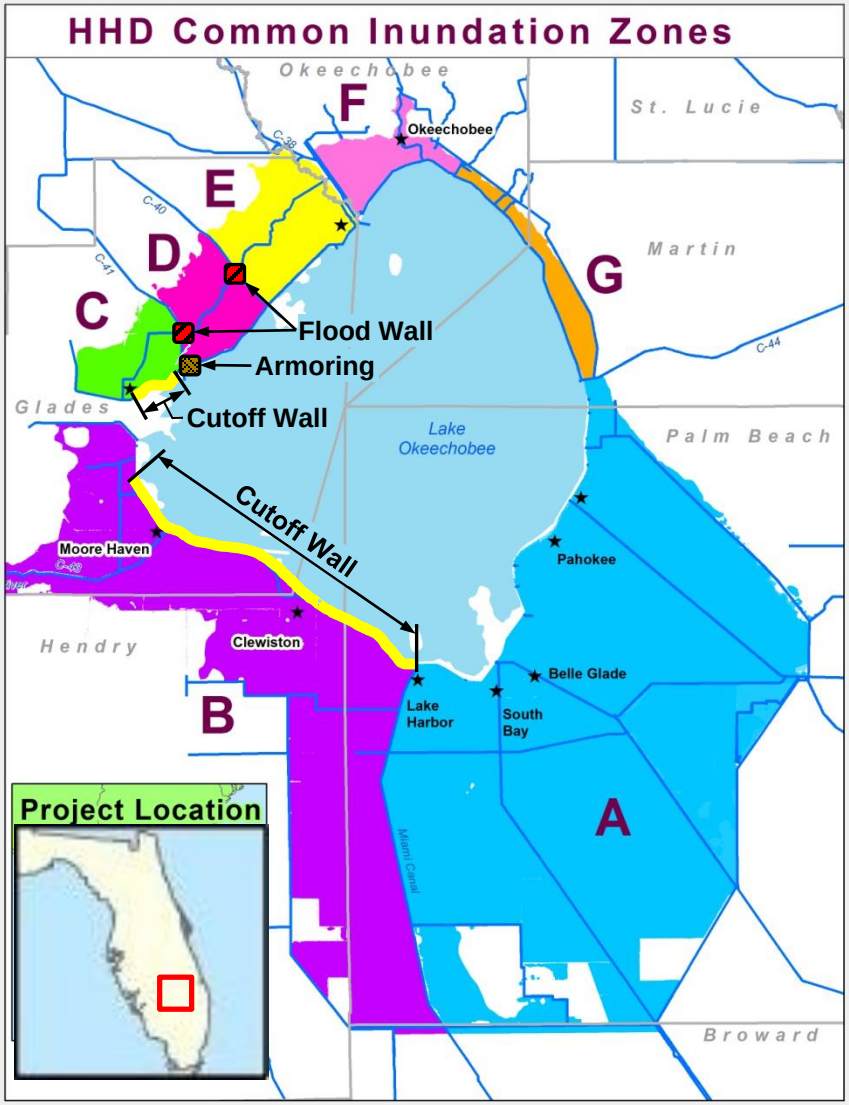
Impact – Complete repairs at the highest points of failure throughout the system

Construction Contract Complete	
Construction Contract Ongoing	
Construction Contract Planned	

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Common Inundation Zones B-D

Future Planned Dam Modifications



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Completed:

- Dam Safety Modification Report in 2016

Planned:

- 28.6 miles of cutoff wall installation
- Armoring abutments of the SR78 bridge across the Harney Pond Canal
- Embankment raising and flood wall construction near Structures S-71 & S-72
- Construction from 2019 through 2025

Impact – Complete the remaining repairs to the HHD system achieving the risk reduction goals for the project and allow a recommendation for accreditation to FEMA for remaining areas of HHD

Cutoff Wall Locations
Embankment Armoring Locations
Embankment Flood Wall Locations

HHD Megaproject Designation

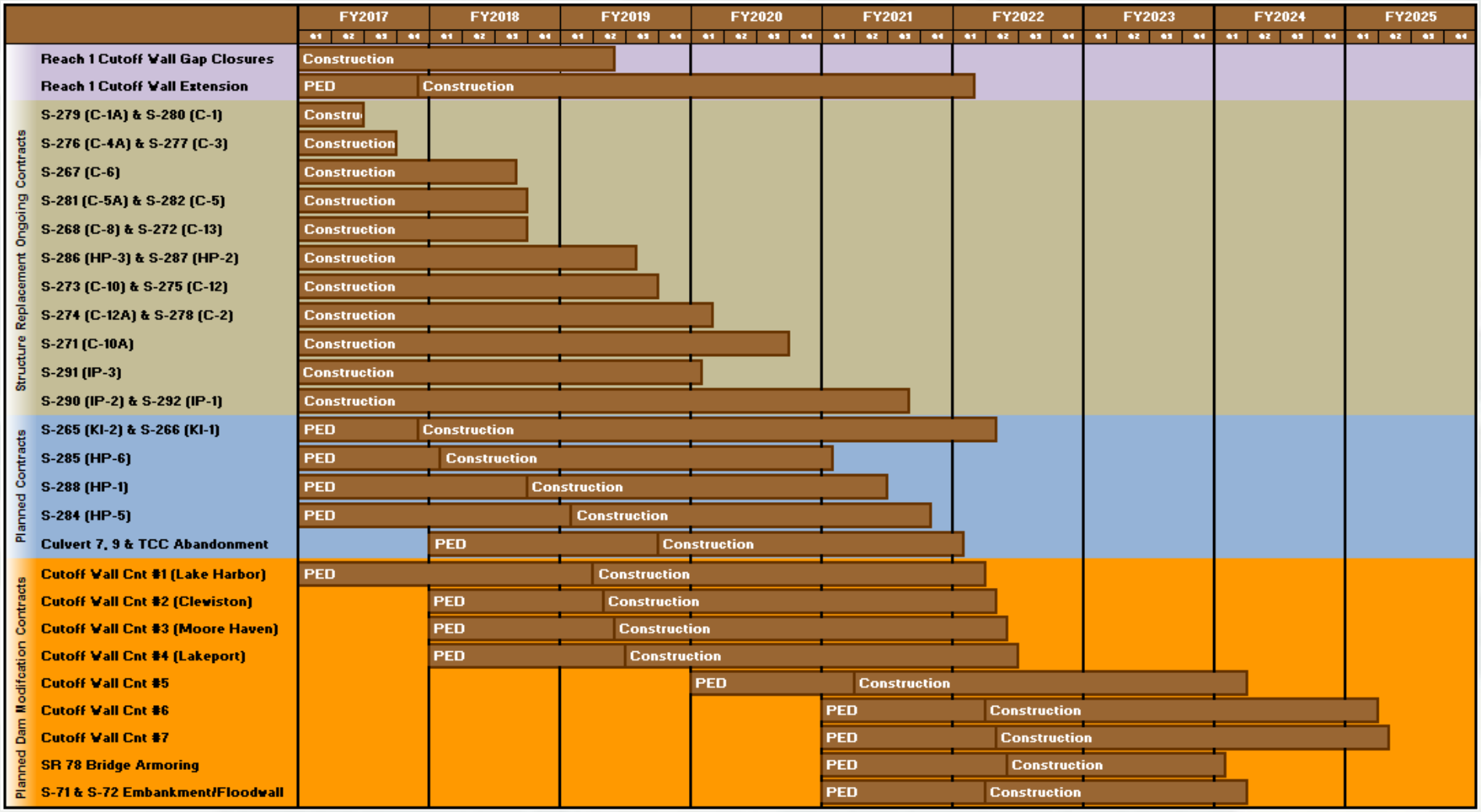
- Continued designation by ECB 2016-16 as 1 of 13 Civil Works Megaprojects
- Some Additional Requirements:
  - Enhanced Recruitment and Staffing of Project Team, “the best and brightest from across the Command should be recruited”
  - Established Supplemental 3-Tiered Governance Structure
  - Facilitated Partnering and Use of Lessons Learned
  - HQ Led Mega Design and Construction Evaluations (DCE)

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Implementation Plan

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Implementation Timeline

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Water Control Structures (Culverts)

- Southern part of HHD completed by 2020
- Northern part of HHD completed by 2022



Common Inundation Zone A

- 1 culvert removal completed
- 2 culvert replacements completed
- 6 culvert replacements completed by 2020
- Reach1 cutoff wall gap closures completed by 2018
- Reach 1 cutoff wall extension completed by 2021



Common Inundation Zones B, C and D

- Construction start in 2019 with expected completion by 2025 (prioritization and funding dependent)
- Completes final repairs to HHD



Active Contracts

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Project	Current Cost ($ Million)
C-1/1A	$50.58
C-11/16	$46.09
C-3/4A	$26.08
C-5/5A	$32.91
C-10/12	$38.11
C-8/13	$36.36
C-2/12A	$45.30
HP-2/3	$24.67
C-10A	$50.16
C-6	$16.17
IP-3	$16.87
IP-1/2	$27.71
GAP Closure	$18.51

Grand Total (Complete and Active): $666.28M

Construction Management

Juan Sanchez-Bulted, P.E.
Resident Engineer, HHD South Office

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Agenda

- Types of Projects
- Phases of Construction
- Tracking Progress
- Safety Program

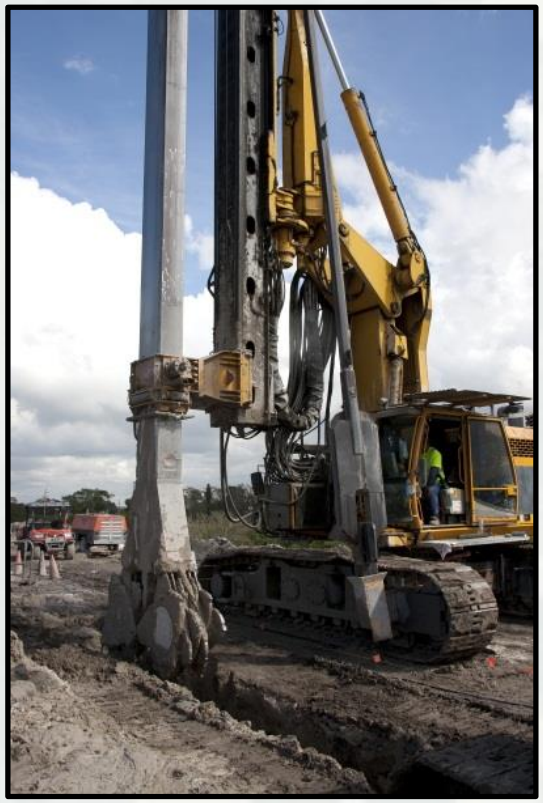
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Reach 1 Cutoff Wall Construction

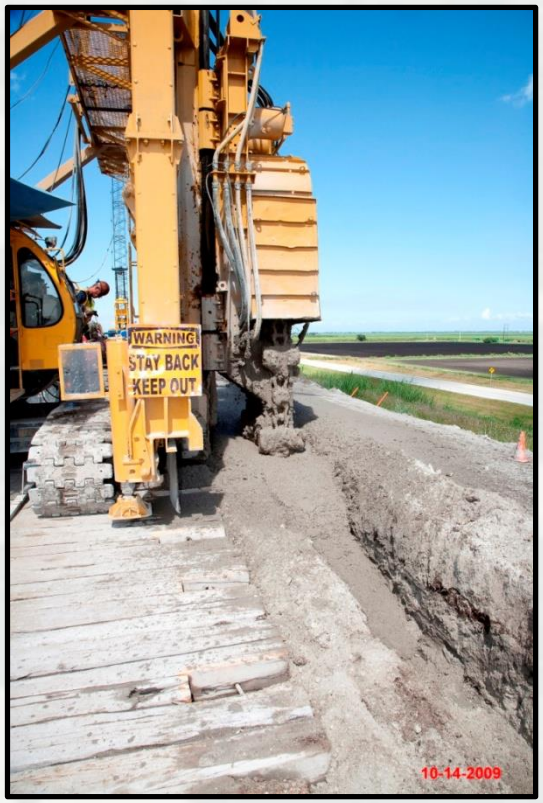
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Hydromill



Cutter Soil Mixer (CSM)



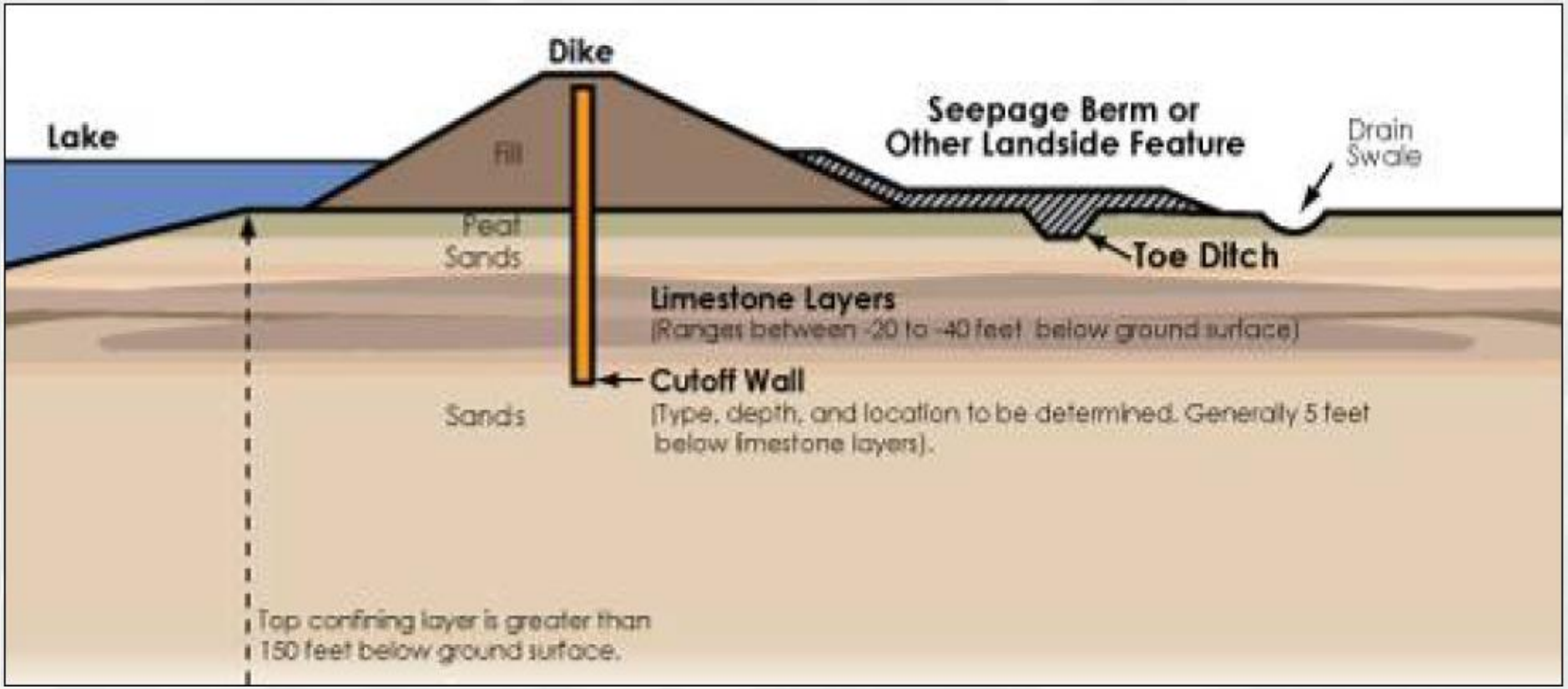
Trench Remix Deep (TRD)

Three different contractor methods achieved the same performance criteria for completed cutoff wall in Reach 1

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Reach 1 Cutoff Wall Construction

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Water Control Structure Replacement

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Original Structure



New Water Control Structure

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Reach 1 Cutoff Wall Construction Phases

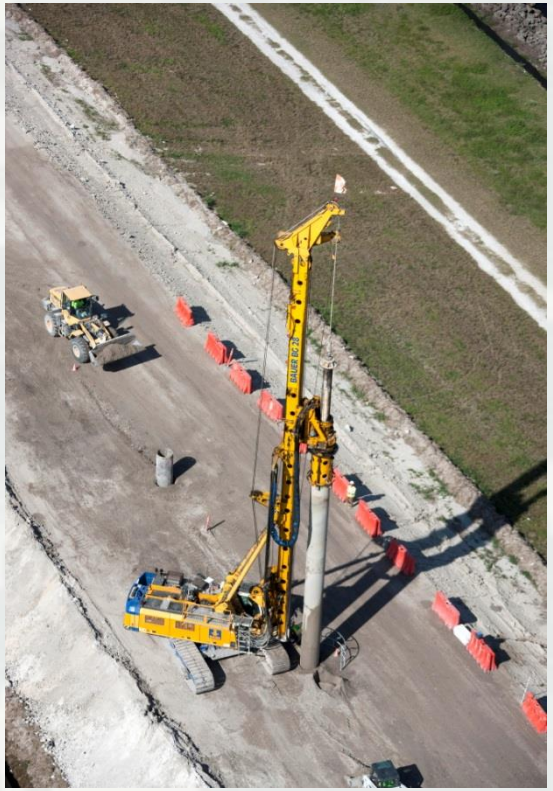
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Work Platform



Batching Plant



Cutoff wall installation

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Water Control Structure Replacement Phases

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Existing Water Control Structure

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Water Control Structure Replacement Phases

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PHASE 1: Build Access, Bypass Pumping, and Cofferdam Installation

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Water Control Structure Replacement Phases

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PHASE 2: Excavation and Structure Demolition

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Water Control Structure Replacement Phases

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PHASE 3: Foundation Preparation

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Water Control Structure Replacement Phases

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PHASE 4: Structure Reconstruction

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Water Control Structure Replacement Phases

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PHASE 5: Embankment Reconstruction

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Water Control Structure Replacement Phases

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PHASE 6: Final Restoration

Herbert Hoover Dike Tracking Progress

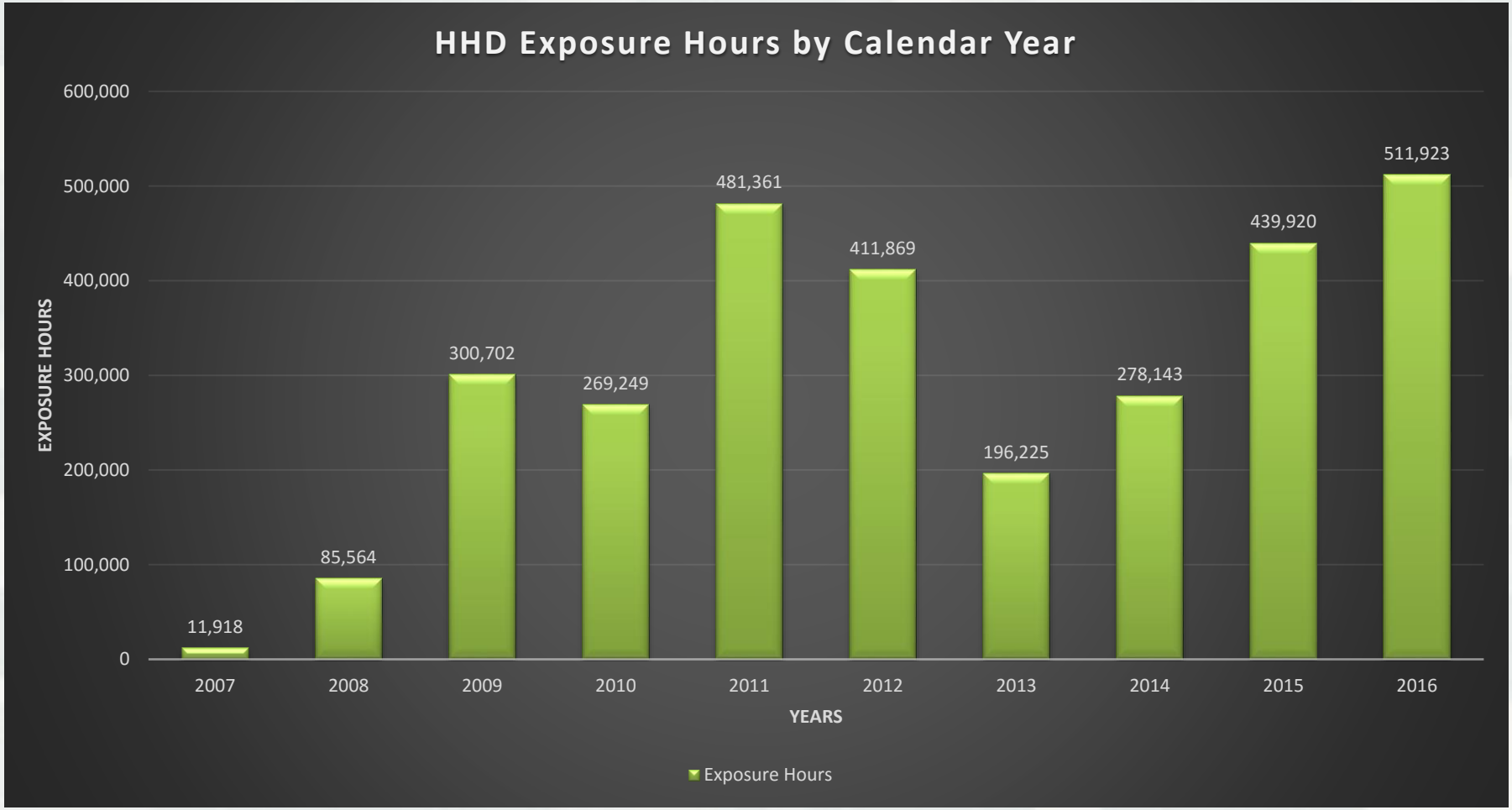
- Weekly progress meetings
- Periodic schedule updates
- 3-Phase QC system meetings
- Off-site fabrication inspections
- Partnering regroup sessions
- Performance evaluations
- Aerial pictures

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Safety Program

- Contractors' Weekly "Tool Box" and Monthly Supervisory meetings.
- HHD has over 1.6 million exposure hours without a lost time accident.

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Exposure Hours History

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Construction Information & Challenges

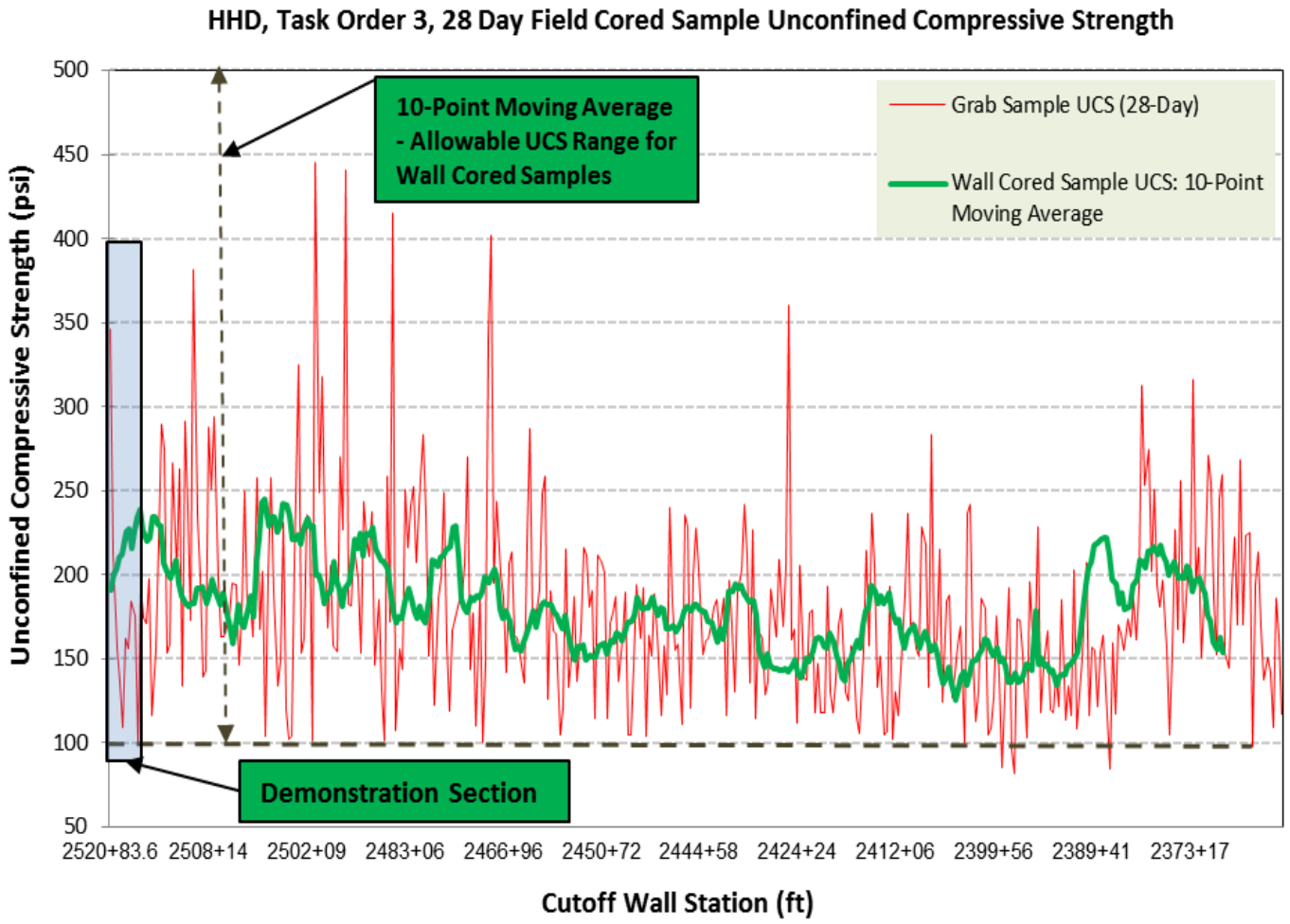
Mario Fuquene, P.E.
Senior Geotechnical Engineer

- **Acceptance Criteria**

- Strength
- Permeability
- Continuity
- Homogeneity

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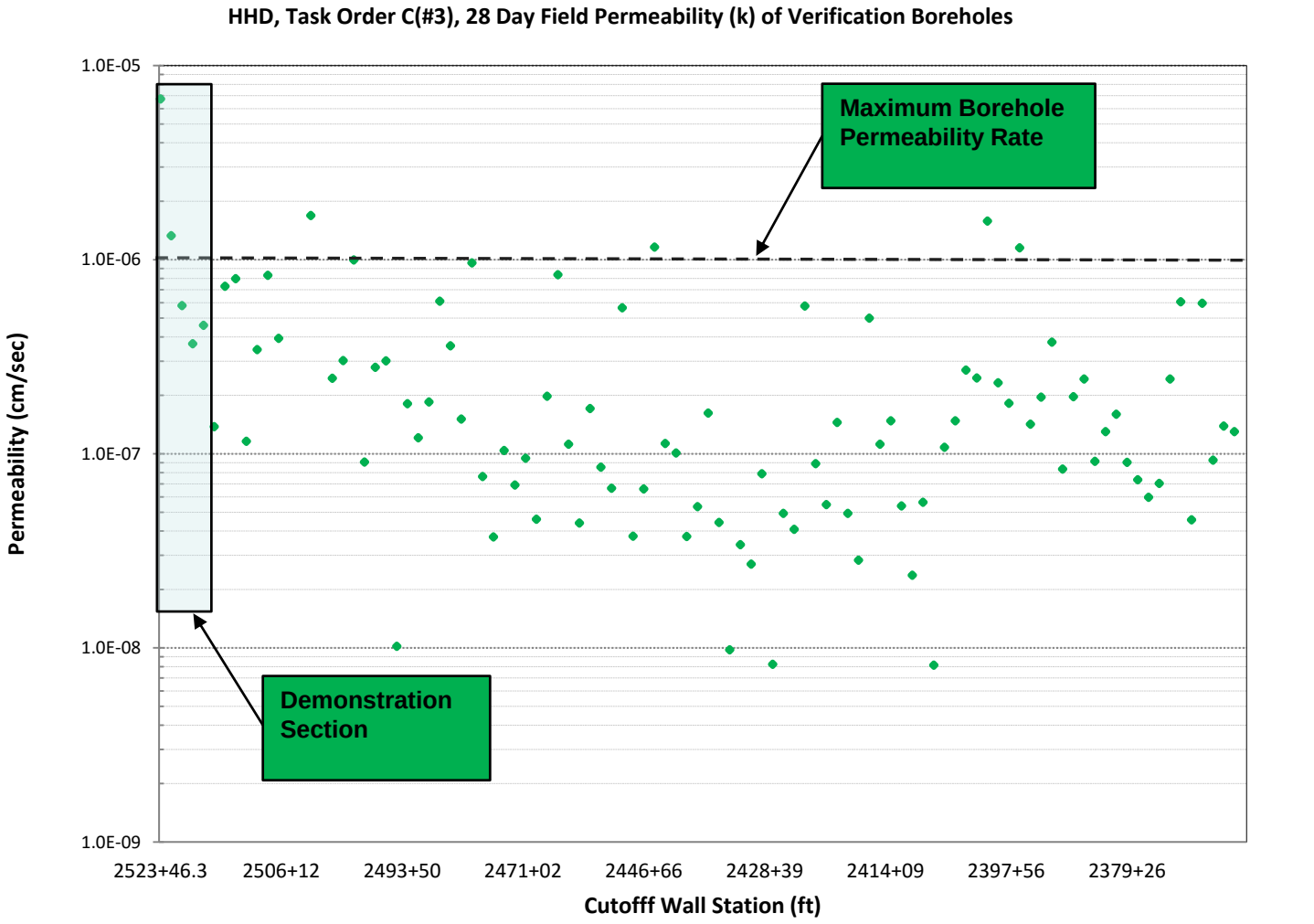
Soil-Cement-Bentonite Cutoff Wall, Strength



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Soil-Cement-Bentonite Cutoff Wall, Permeability

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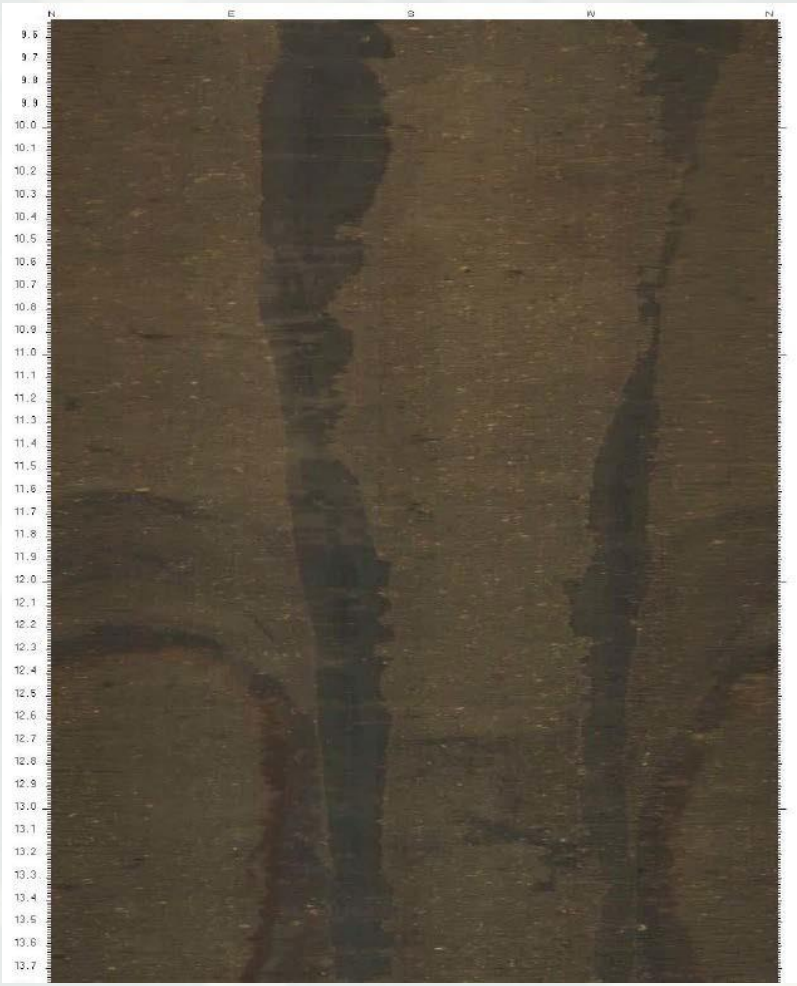
Cutoff Wall, Continuity & Homogeneity

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- Demonstrated thru
  - Cores (>95% recovery)
  - Optical televiewer logs
- Cores required every 200 feet of Wall





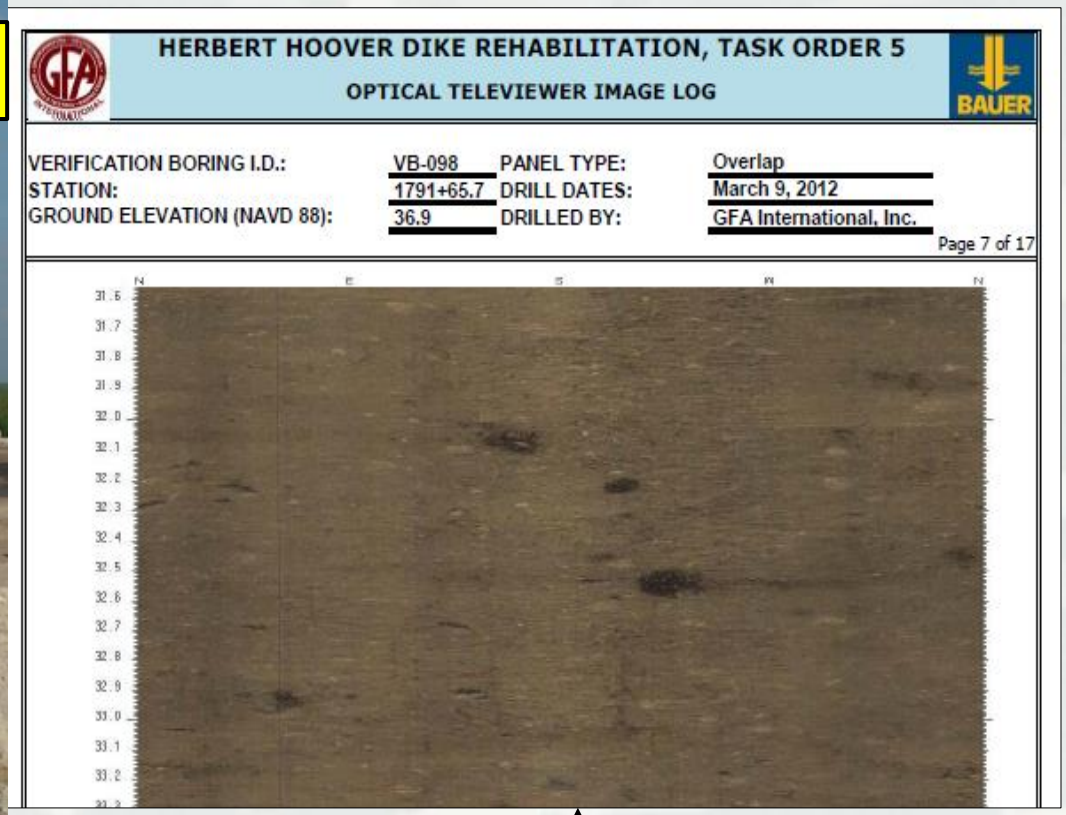


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Soil-Cement-Bentonite Cutoff Wall

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Optilog Produced Using Downhole Geologger Tool

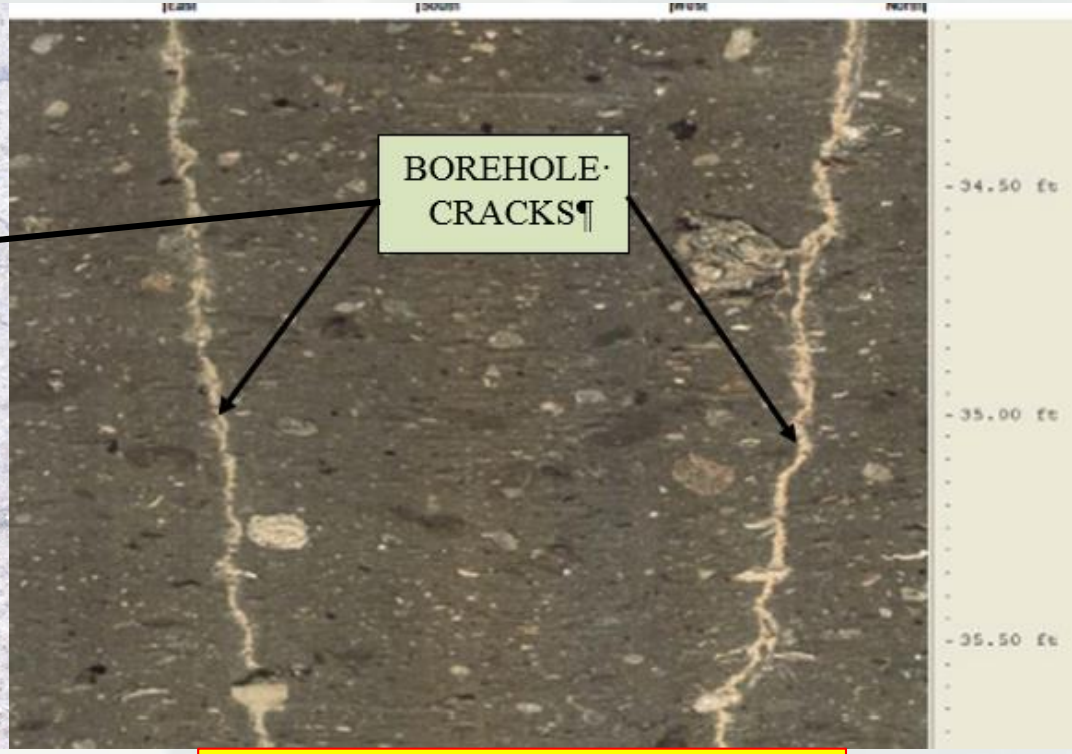
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Soil-Cement-Bentonite Cutoff Wall

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- HHD, Reach 1, Seepage Cutoff Wall,
- Task Order #4, 2009

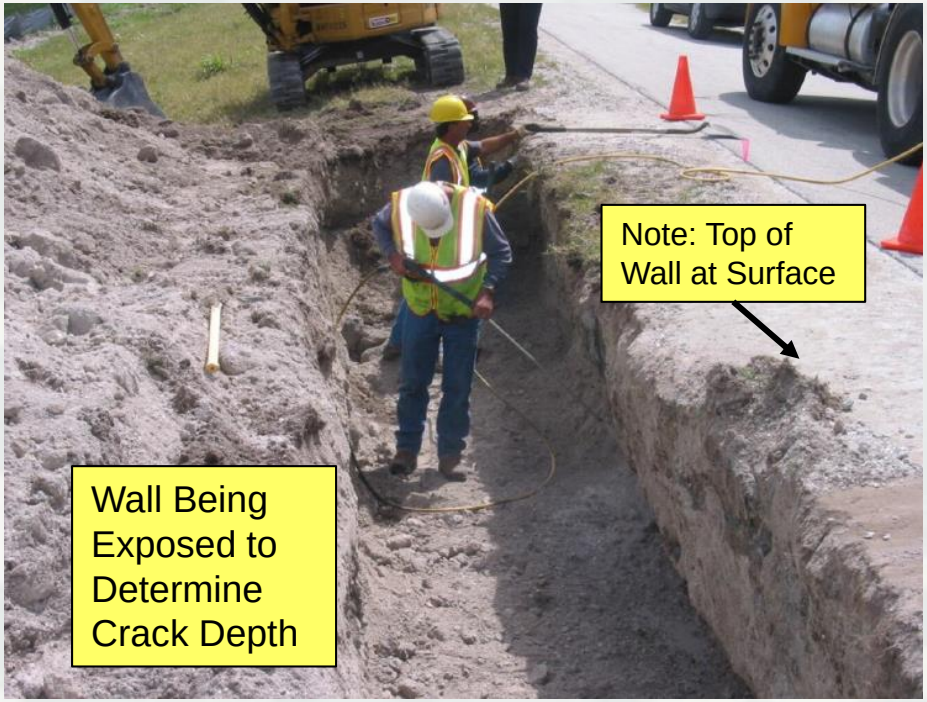


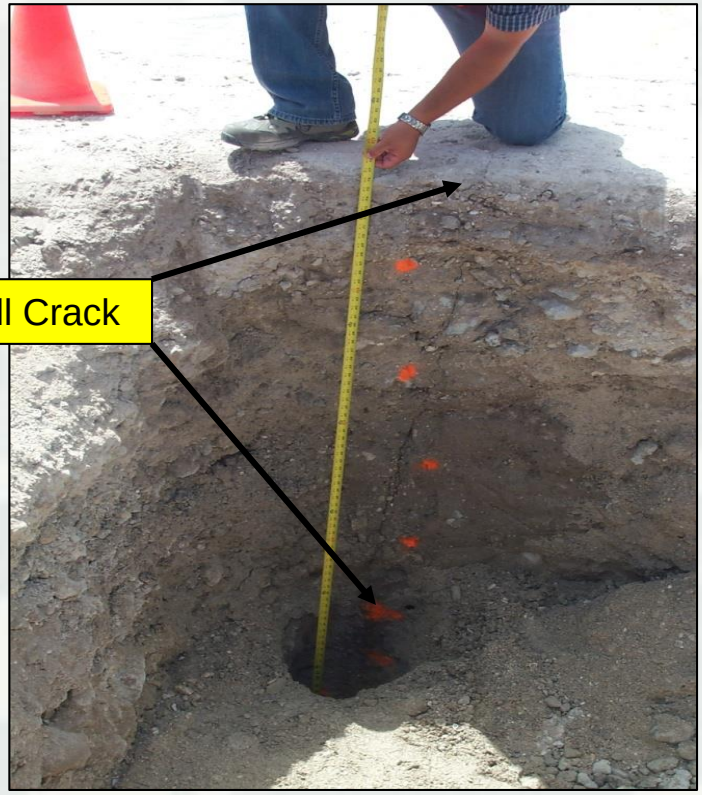
Cracks detected in borehole video log.
HHD, Reach 1, Seepage Cutoff Wall,
Task Order #5, 2010

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Soil-Cement-Bentonite Cutoff Wall

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Water Control Structure Replacement, Dewatering



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Water Control Structure Replacement, Dewatering



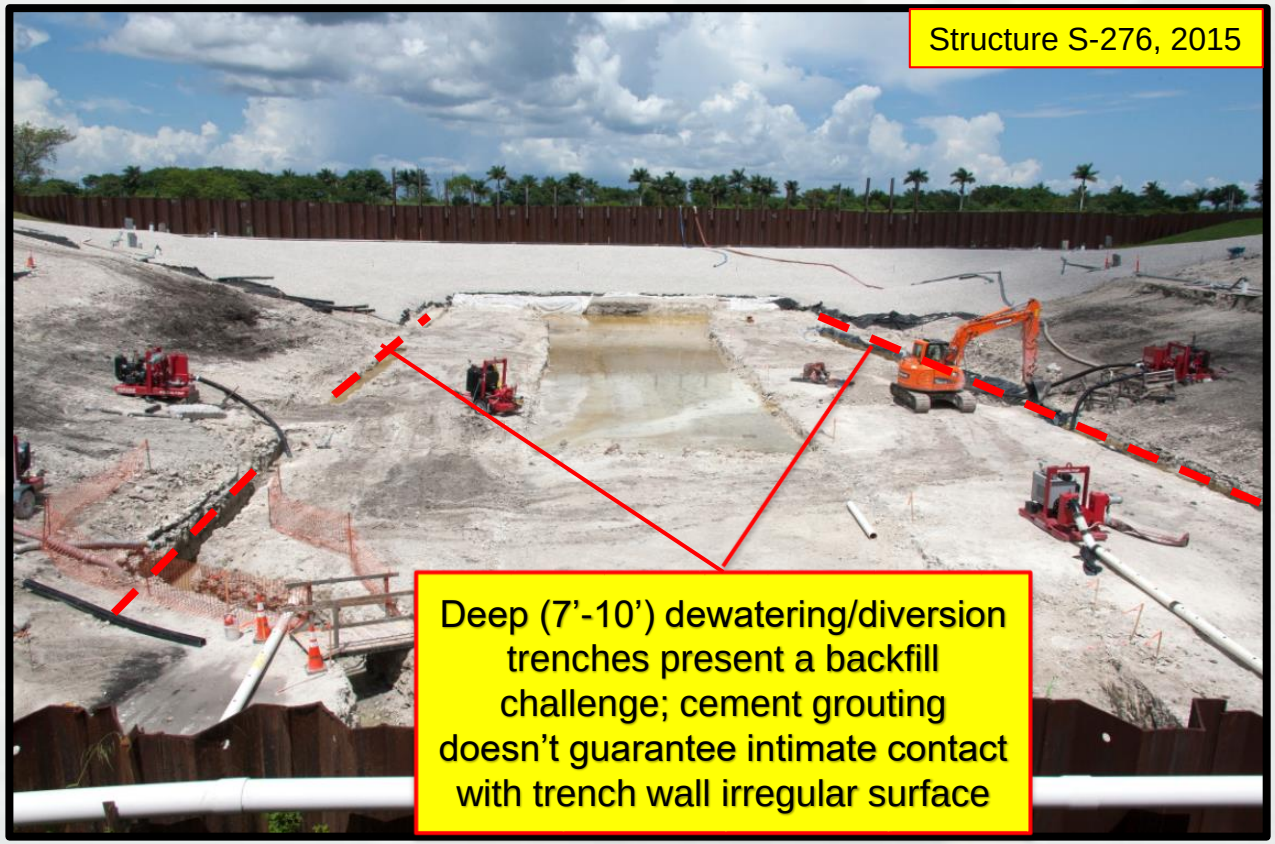
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Water Control Structure Replacement, Dewatering

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- Transverse penetrations through the HHD structure are concerning as they can lead to soil piping that increases embankment failure.



Laboratory capability:

- Field Testing:
  - Soils: Sampling and sand cone density
  - Concrete: slump, air content, temperature, unit weight, and specimen molding

- Lab Testing:
  - Soils: soil classification, proctor, relative density, Atterberg limits, permeability, specific gravity, unconfined compressive strength, carbonate content
  - Concrete: Curing and compressive strength

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Questions?