New Directions in Horizontal Remediation Wells

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Overview

- **HDD Technology Review**
- **Advanced Tooling and Methods**
- **New Project Developments - ISTR**

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HDD Double-End Well Installation

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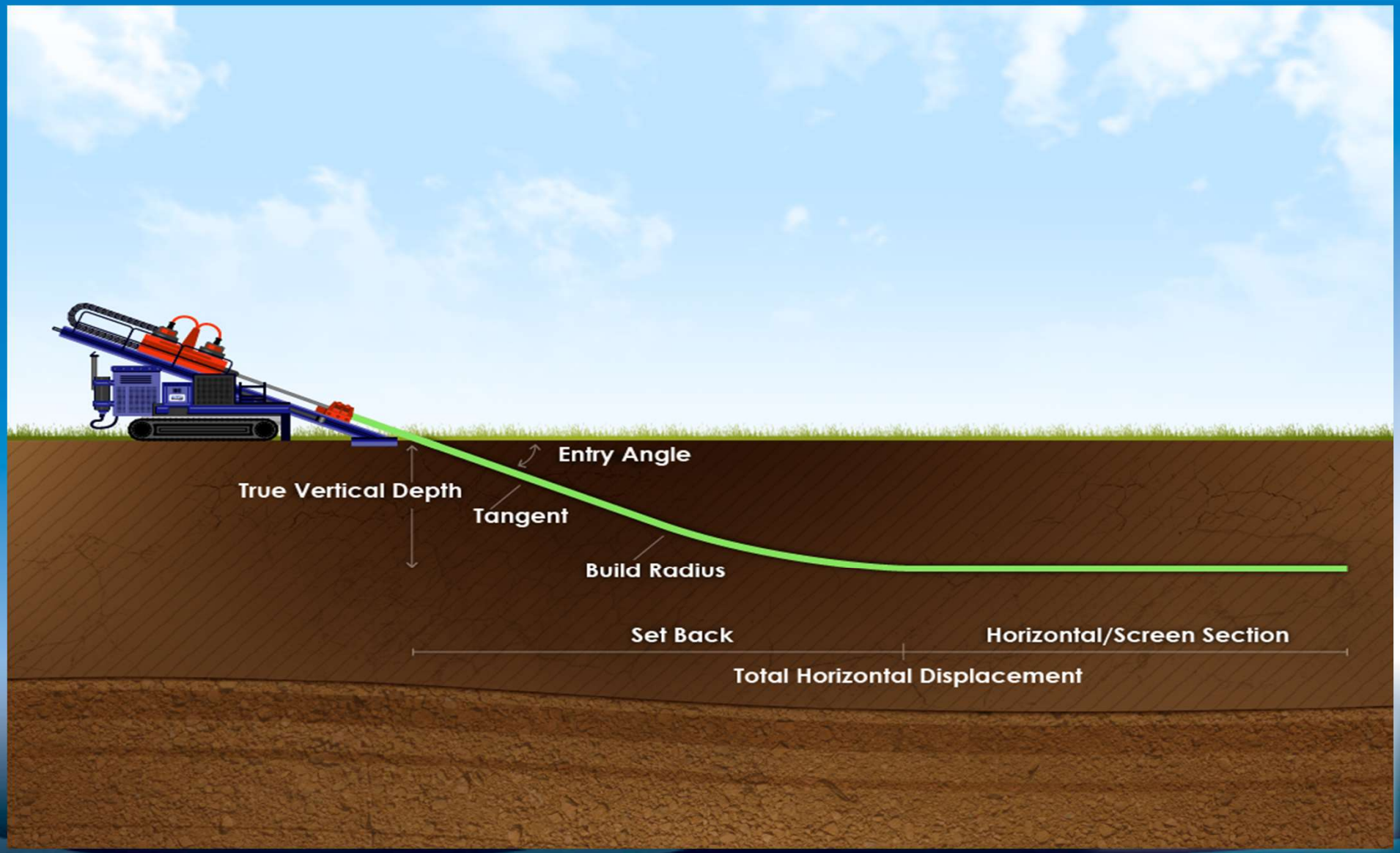
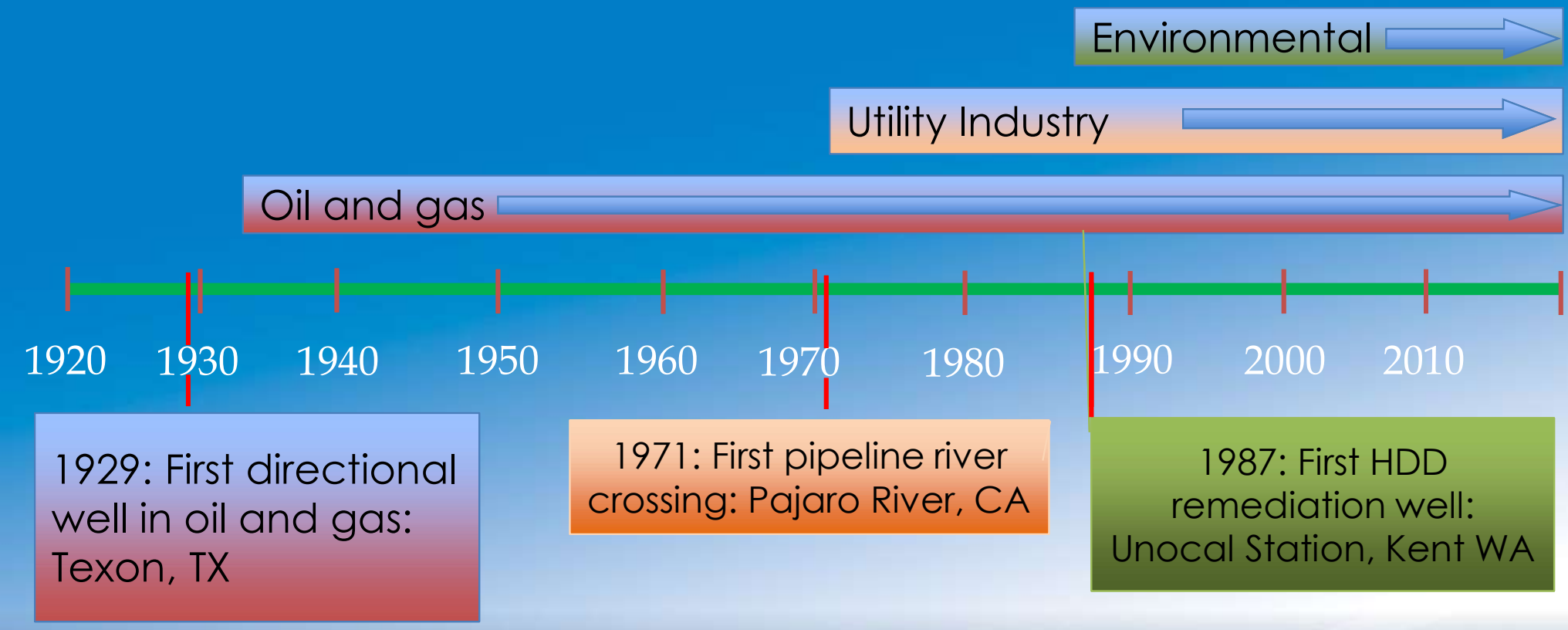
HDD Technology Review

- **Single or double-ended wells guided along a predetermined path**
- **Mud rotary, steerable drilling method**
- **Well placements in inaccessible areas**
- **High screen to casing ratio in long, thin plumes**

Borepath/Well Geometry



The History of Horizontal Wells… mirrors a lot of modern technology



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Past v. Current Capabilities

Horizontal Directional

- **Mid-1990's – 300-500 ft. extraction wells were the norm**
- **2009 – 1,800 ft. D-E GW extraction wells**
  [*DTD* – Pt. Loma, CA]
- **2021 – 4 in. - 1,800 ft. *Blind* sub basin drainage**
  [*Ellingson* – Colstrip, MT]
- **2021 – 4 in. SS – 2,937 ft. D-E coal ash drainage**
  [*Ellingson* – Jim Bridger, WY]

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Tooling and Methods

Wide Range of Rig Sizes/Types

- **Rigs range in capacity from 10,000 to 1M+ pullback range.**
- **All terrain - rock drilling capability**

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Knock-Off technology

- **Blind well installation in unstable formations**
- **Assures precise placement of blind wells in soft material**
- **4”Ø wells currently, 6”Ø possible**
- **Currently installed lengths up to 1,800 ft.**

Blind Well Knock Off

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Knock off technology

- **Drill pilot bore with K-O assembly**
- **Install well materials inside rods**
- **Remove drill bit**
- **Pull rods back, leaving well materials in place**

Navigation

Improvements in locating systems enable precise drilling in more challenging environments, at greater depths:

- **Walkover Systems – Need physical access over bore path**
- **Wireline Systems – All locating occurs at the rig**

Walkover Locating Systems

- **Higher powered sondes; greater depths (80-100')**
- **Low frequency, spread spectrum frequency to avoid interference**
- **Data logging capabilities: pitch, position, depth, metadata**

Gyroscopic Steering Tool

- **No over-bore requirements**
- **No depth or length limitations**
- **Not affected by electro-magnetic interference**
- **Accuracy 0.04° Azimuth; 0.02° Inclination**
- **Compact systems now available**

1200' bore, diatomite, uphill, endangered flora

Small rigs
Bores 150-500' long

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Case Studies in ISTR

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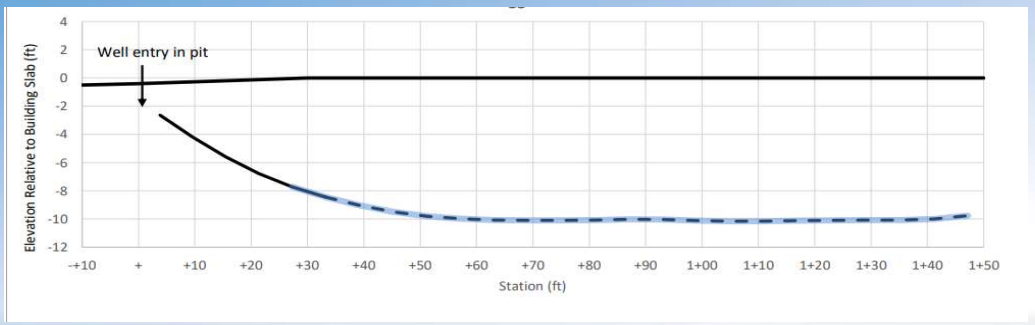
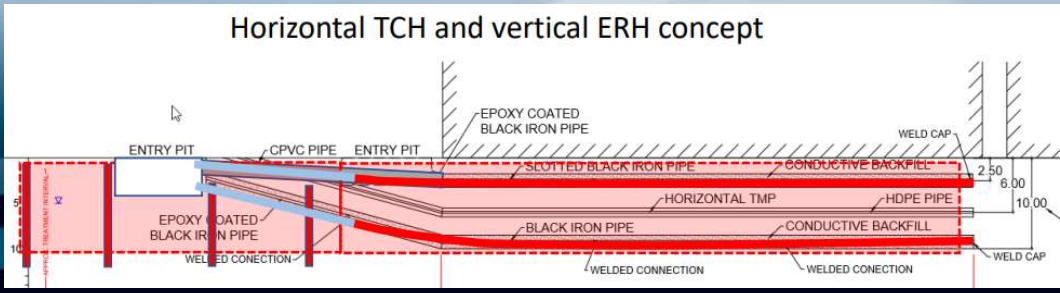
ERH Project - California

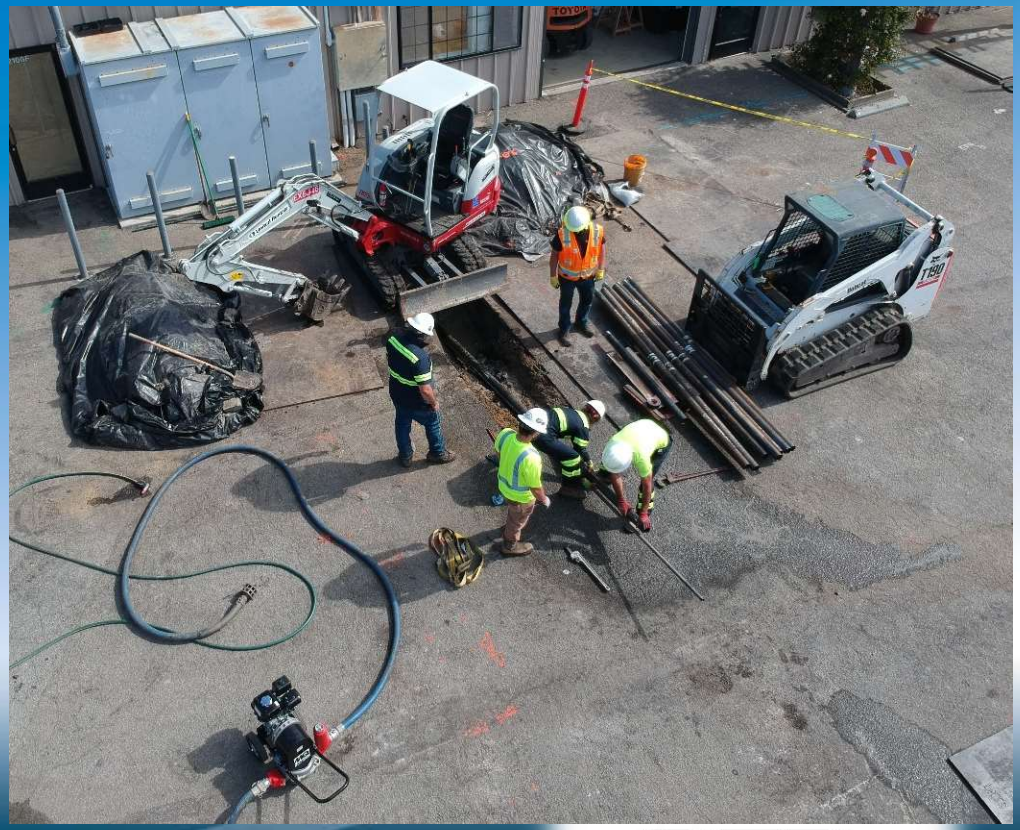
- **Solvent contamination under commercial complex (including ice cream factory!)**
- **Electrode installation included:**
  - **Deep electrodes [16] ~ 2250'**
  - **Shallow electrodes [15] ~1730'**
  - **Vapor recovery [~8] ~1020'**
  - **Temp probes [3] ~350'**





ERH Project - California

- **Conductive carbon backfill**
- **Thermal grout**
- **“Weeper” tubing**



ERH Project - California

Walkover Locating

Conductive Backfill

TCH Project - California

- **Contamination on DOD site, combined vertical and horizontal TCH remedy**
- **Six angled TCH wells in two arrays**
- **83-90 feet long**
- **Assembly includes 3” steel heater can, welded stainless liner, 1” SS SVE in mesh prepack SVE line, grout tremie pipe, sand tremie pipe**

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TCH Project - California

Summary

Since its inception as a treatment tool, HDD has evolved significantly.

Wells can now be installed:

- **Longer**
- **Deeper**
- **More Accurately**
- **Wider Range of Treatment Options**
- **Often less expensively**

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Questions and Contact Info

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