APPENDIX D

Energy & Environmental Research Center

UPDATE ON LEGACY BRINE PIT PROJECT

Tuesday, August 30, 2016

Energy Development and Transmission Committee Meeting
Bismarck, ND

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Critical Challenges. Practical Solutions.

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Original Goals and Supporting Objectives

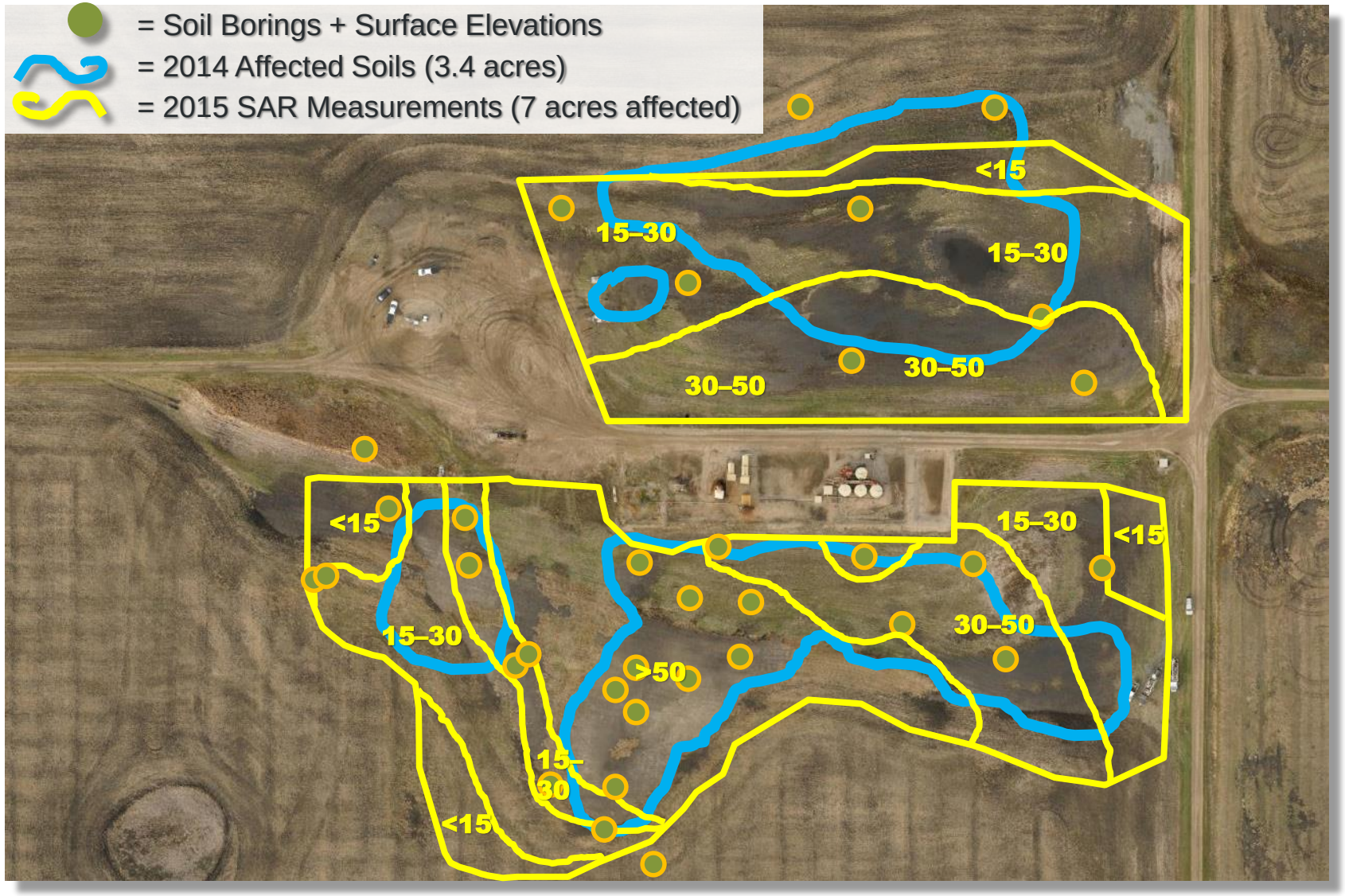
- Goal
  - Apply a best practice, a common practice, and a novel remediation approach to a representative field site with distinct and separated areas to facilitate direct comparison of alternatives. Validate each approach for efficacy and cost.
- Objectives
  - Site characterization to determine areal and vertical extent of brine contamination
  - Site remediation system design *(drain tile, sumps, wells, irrigation, deep hydraulic delivery)*
  - Site preparation
  - Extensive site irrigation at the best practice site area
  - Hydraulic delivery of amendments at the novel technique site area
  - Periodic, regular soil sampling until threshold levels are met

Need for a New Approach at Bull B1 Site

- Results of site characterization, soil sampling, and dramatic changes within the site operator's organization made the proposed approach infeasible.

- Conoco Phillips/TriHydro 2014 report:
  - ≈3.4 acres impacted by produced brine water, distributed among 3 distinct lobes.
  - Brine pit measured to 24".
- EERC fall 2015 field sampling:
  - ≈7 acres impacted, individual lobes less distinct.
  - Brine pit down to >15 ft. below surface.
  - Brine pit larger, deeper than expected (migration + incomplete previous analysis).

New Understanding of Selected Site



Site Photos

Challenges to Original Plan

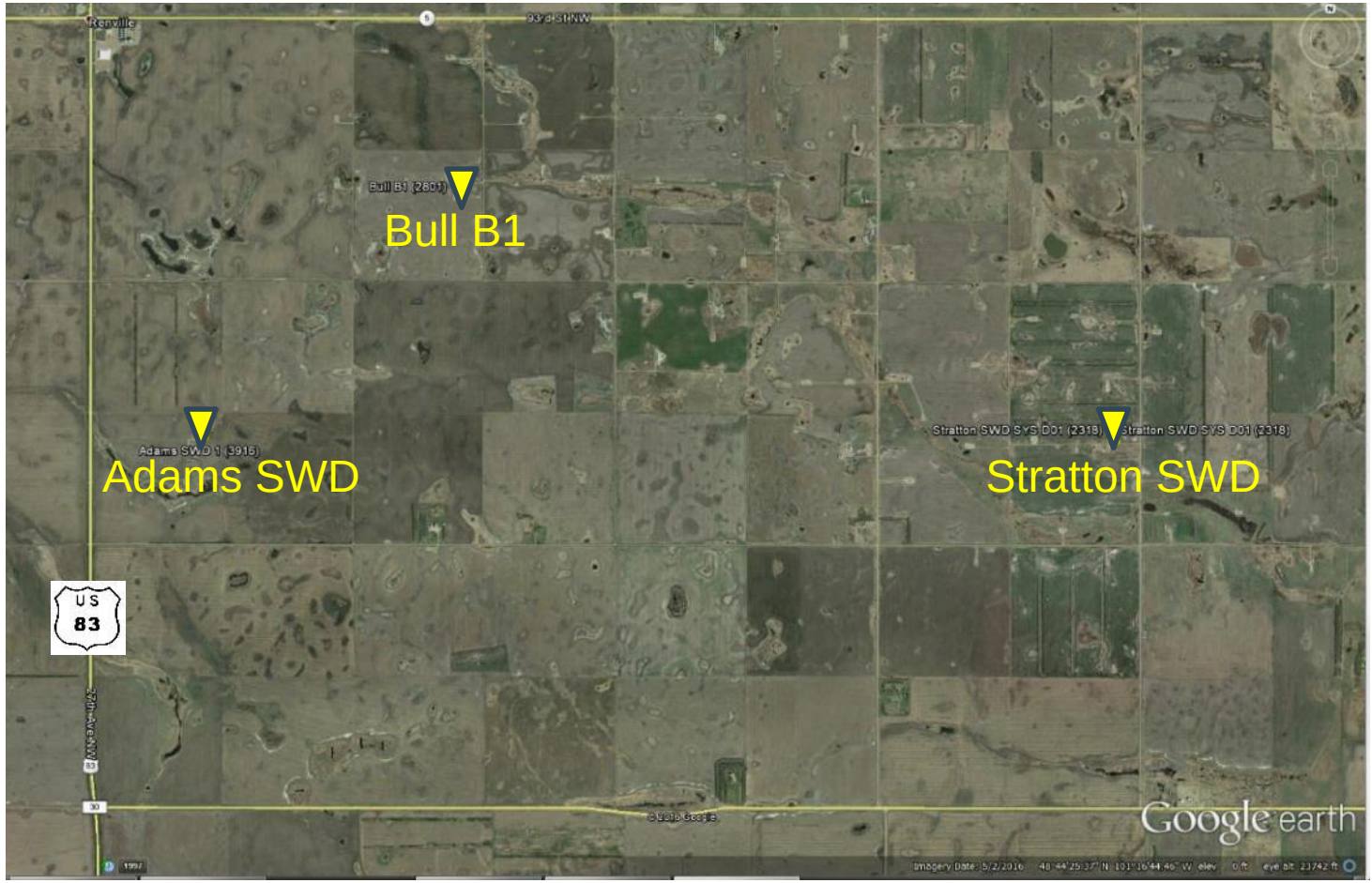
- Deeper and wider contamination tripled the volume of soil needing treatment.
- Test wells to 210’ and 320’ produced sufficient water quality, but insufficient flow rate for irrigation.
- Extremely shallow current water table sits 2’–3’ below surface, immersing nearly the entire concentrated pit.
- Current site operator has shut in all OG and SWD wells in the area due to oil price environment, and has laid off workers, leaving no convenient disposal options.
- Long-term leachate disposal needs created by scope adjustment create a post-project liability.

New Scope of Work – Requested by OGRP in April

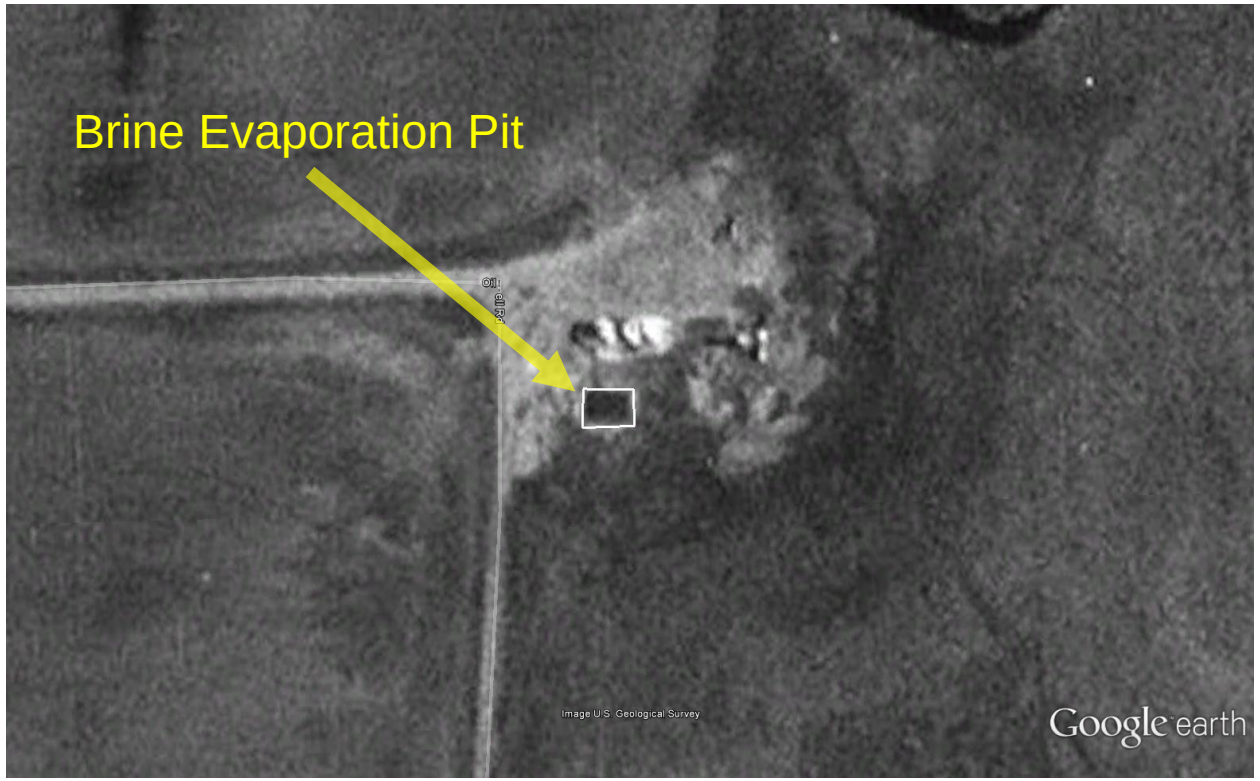
- Perform tests at Bull B1 site to determine water table recharge rates, thus providing further guidance to any subsequent specific remediation.
- Perform site characterization identical to that achieved at Bull B1 at two other nearby legacy evaporation pit sites – Adams and Stratton
  - Hydrology
  - Soil permeability
  - SAR (sodium adsorption ratio) and conductivity
  - Chloride levels
- Report to the North Dakota Industrial Commission (NDIC) to frame the larger issue and estimate costs for widespread remediation efforts in this unique region.

New Sites to Be Evaluated

- Bull B1 will be compared with:
  - Adams SWD 1
    - Spud: 7/21/65
    - Previously studied: *NO*
    - Operator: Ram Oil Co.
    - Landowner: Bryan Adams
    - Approval: *YES*
  - Stratton SWD SYS D01
    - Spud: 5/7/59
    - Previously studied: *YES (NDGS)*
    - Operator: Denbury *(sale in process)*
    - Landowner: Fossum Foundation *(NDSU)*
    - Approval: *YES, last week*



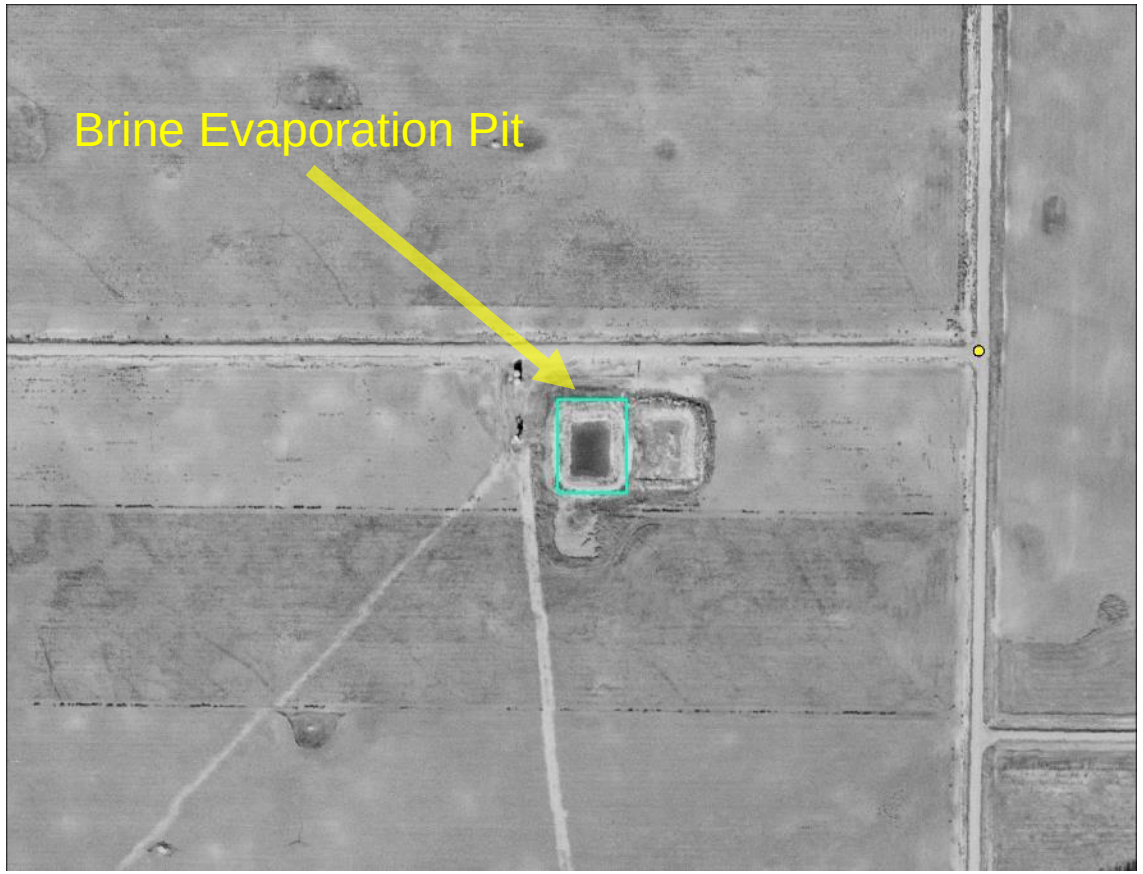
Adams Historical Comparison



1995

2015

Stratton Historical Comparison



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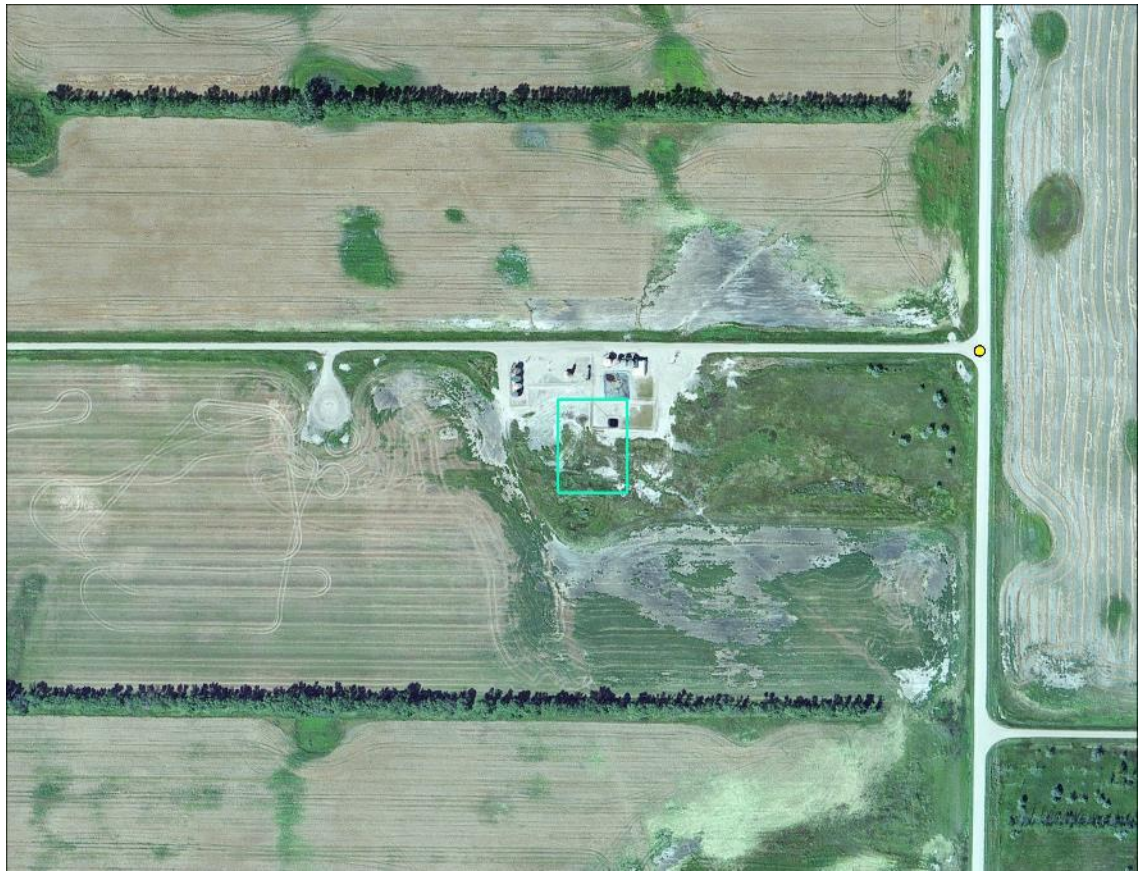
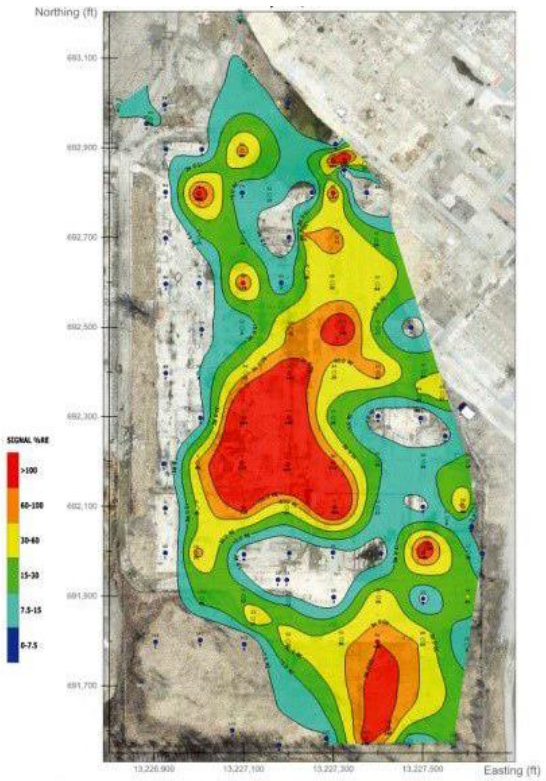
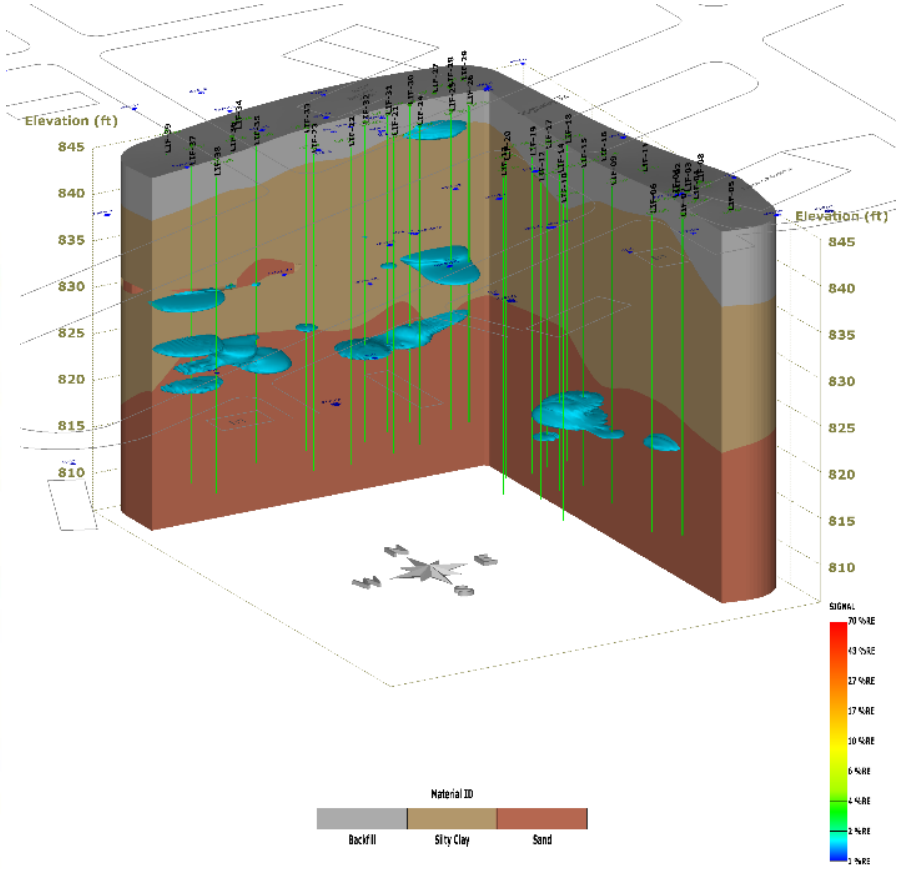
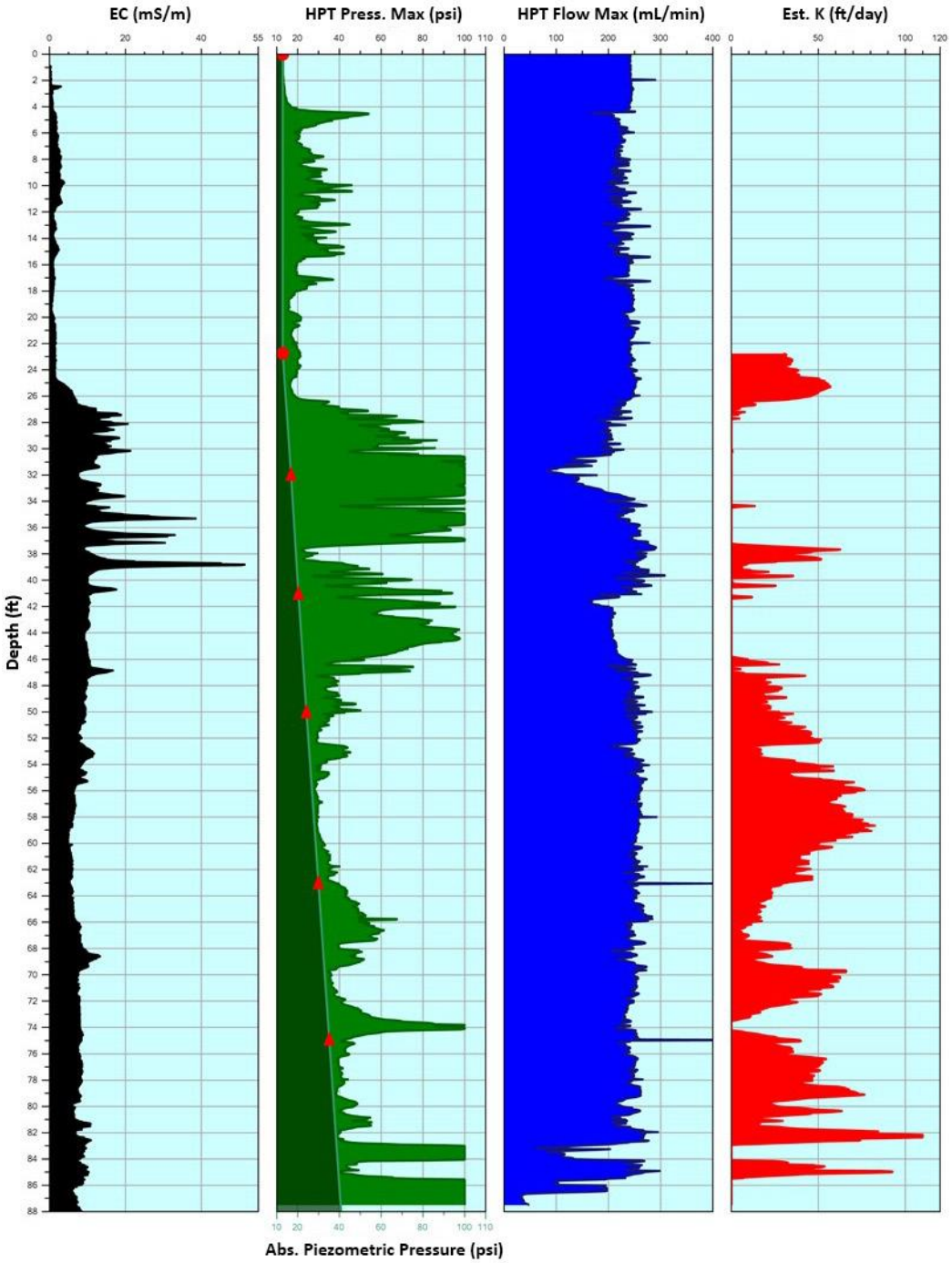


2015

Advanced Site Characterization







Images Courtesy of Dakota Technologies

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