

Design and Installation of Electrical Resistance Heating System using Horizontal Directional Drilling

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Project Background

- **Superfund site in York, Nebraska:**
 - PCE above MCLs in private wells due to prior dry cleaner
 - Potential vapor intrusion in local restaurant
 - Expedited response due to immediate human risks
- **Electrical Resistance Heating (ERH) remedy**
 - Vertical, angled, and horizontal installations
- **Project Team**
 - Ayuda – overall design and project management
 - MC² – design and install Electro Thermal – Dynamic Stripping Process (ET-DSP)
 - Ellingson-DTD – HDD and materials installation

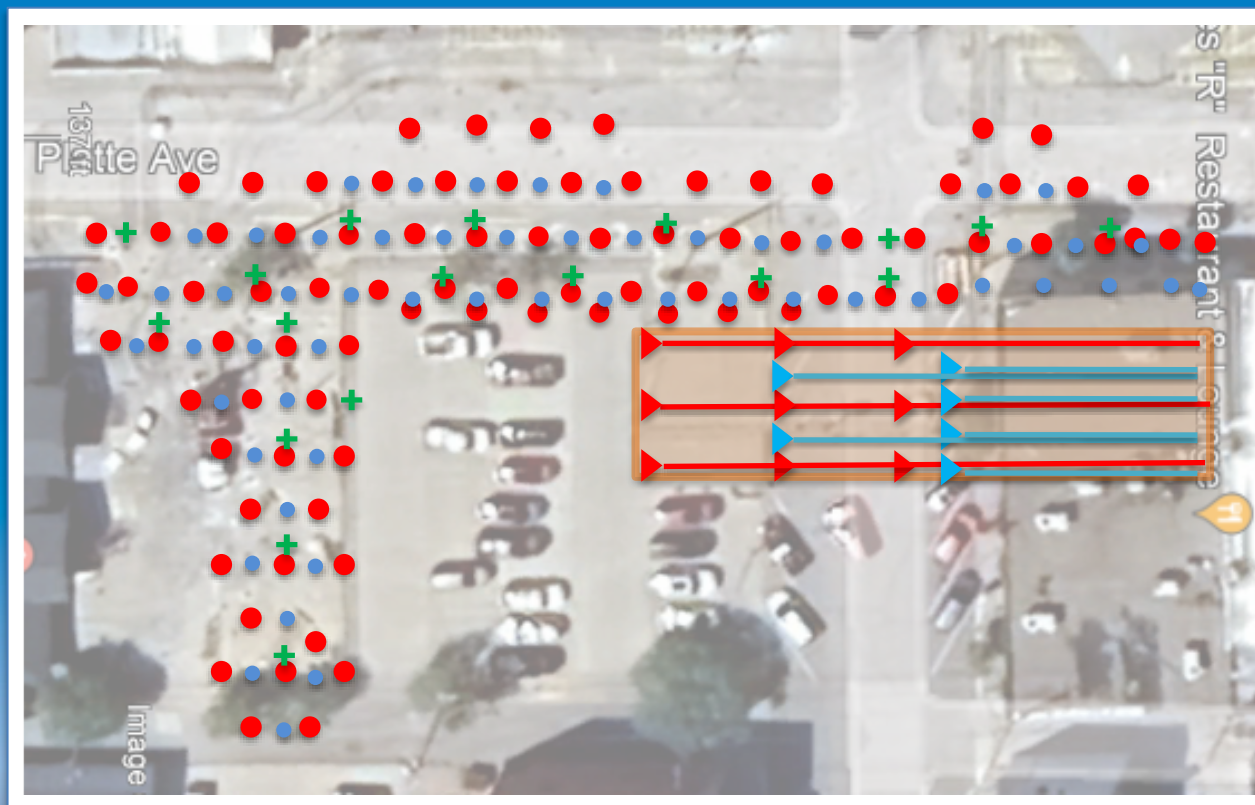
MC² Electro Thermal Dynamic Stripping Process

- **McMillan-McGee patented method**
- **Segmented, electrically isolated electrodes**
 - Design based on soil conductivity
- **Multiple current pathways through soil increases coverage; eliminates stagnant zones and stray current**
 - Design process models current flow through soil
- **Real time monitoring of current, temperature, App-based tuning at the individual electrode level**
- **Automated, computer-controlled switching**

MC² Electro Thermal Dynamic Stripping Process

- Water injection to enhance convective heat transfer and electrical conductivity
- Quench lines under building to prevent hot spots
- Vapor recovery through separate wells
- Closely-spaced VR wells under building to prevent vapor intrusion

Site ERH Layout



Vertical

Electrodes
Sensors
Extraction Wells

Horizontal

Electrodes
Sensors
VR Wells



Vertical ERH Details

- 89 vertical and angled electrodes
- 54 VR wells
- 15 temperature sensors

Vertical ERH Details



Vertical Installation



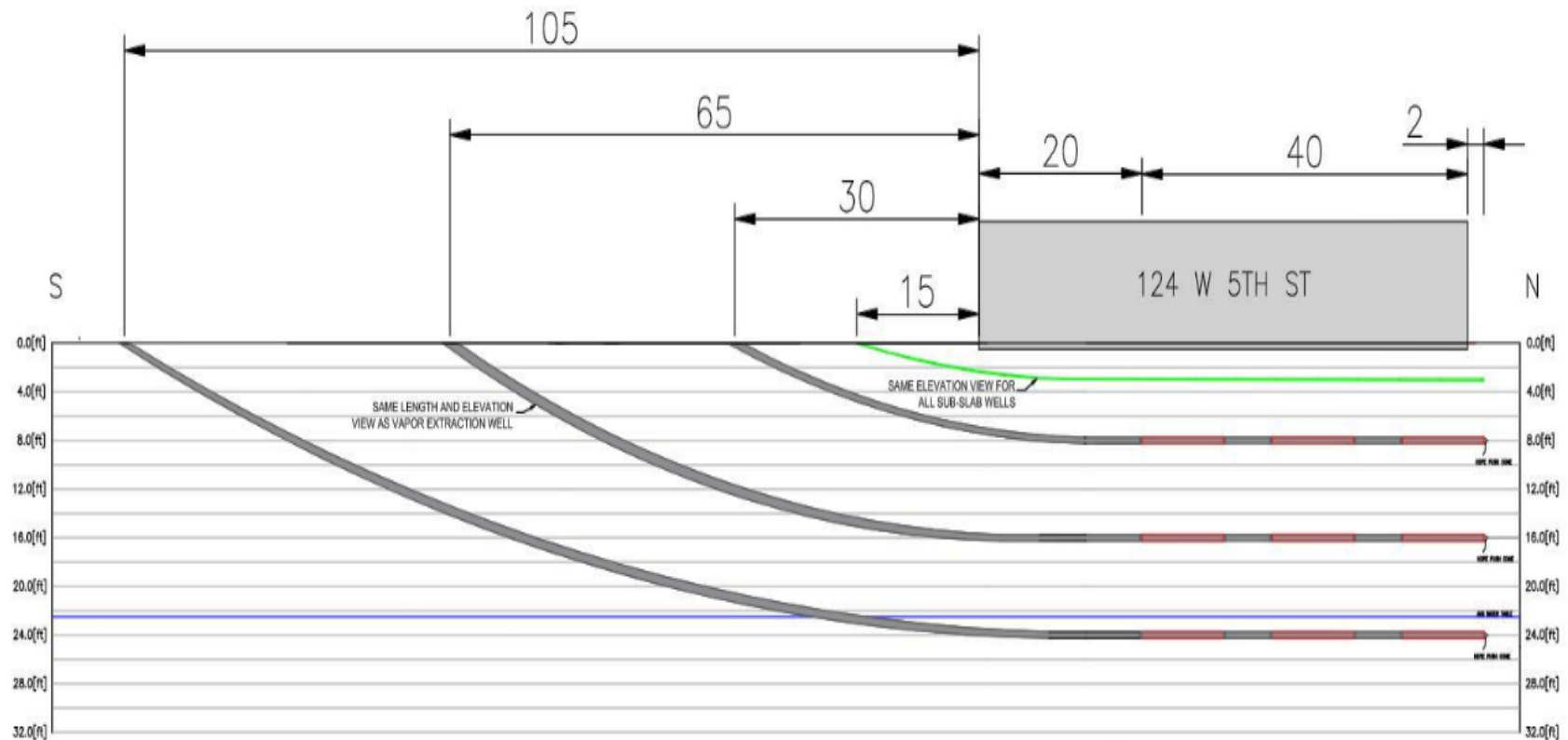
Horizontal ERH Details

- **ERH electrodes (9 x 3)**
 - Segmented electrodes
 - Power cabling
 - Water supply lines
- **Vapor recovery wells (6)**
- **Temperature sensors (4)**
- **Quench lines (9)**

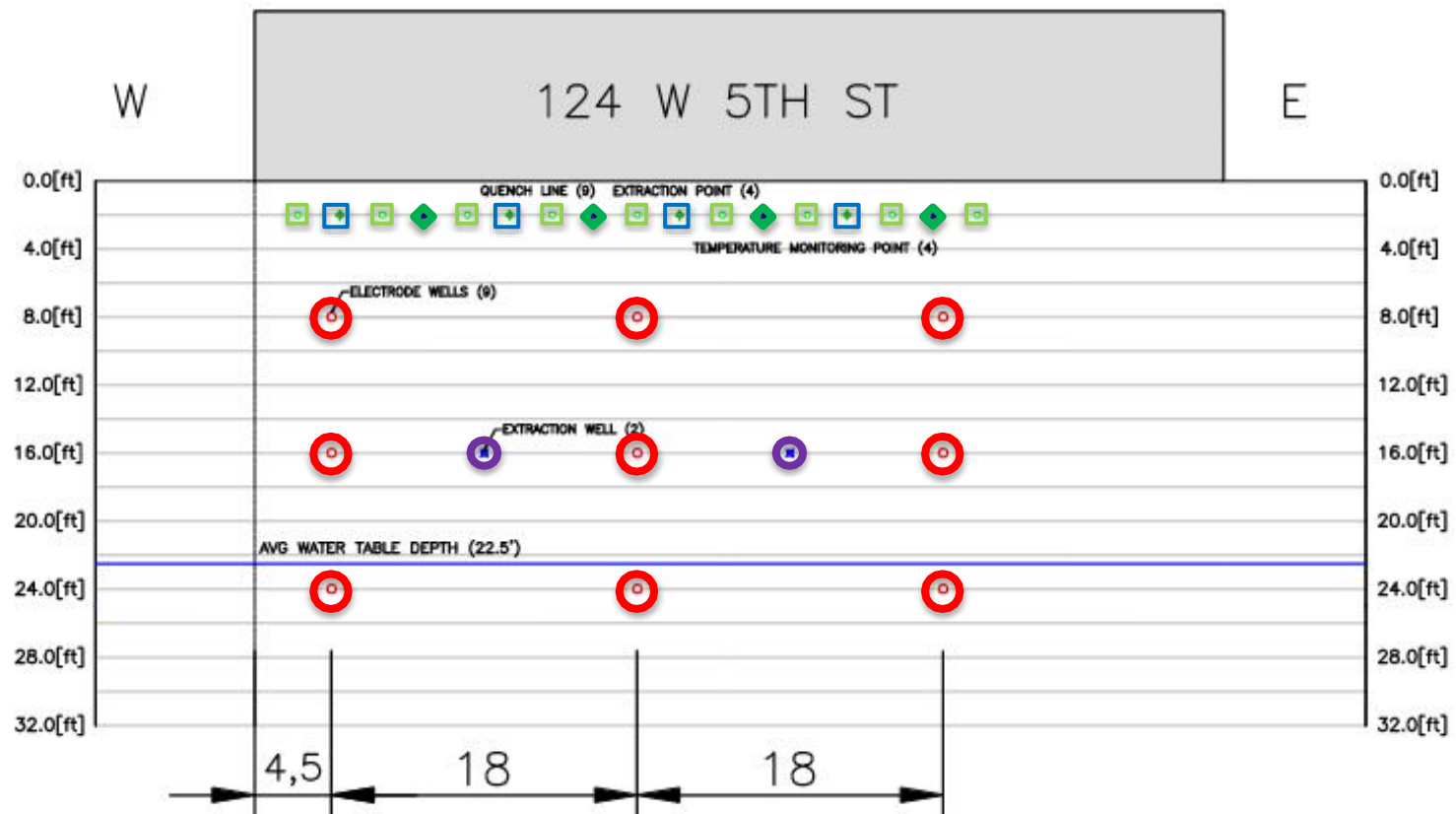
Supporting Functions

- Vapor Treatment
- Temperature and Current Monitoring
- Current Phasing and Duration Control

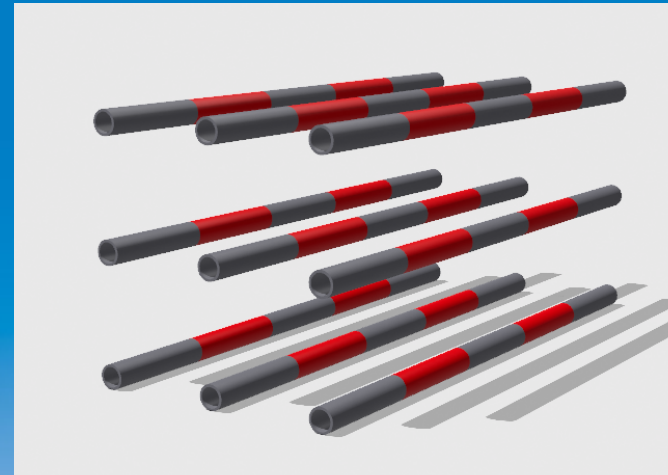
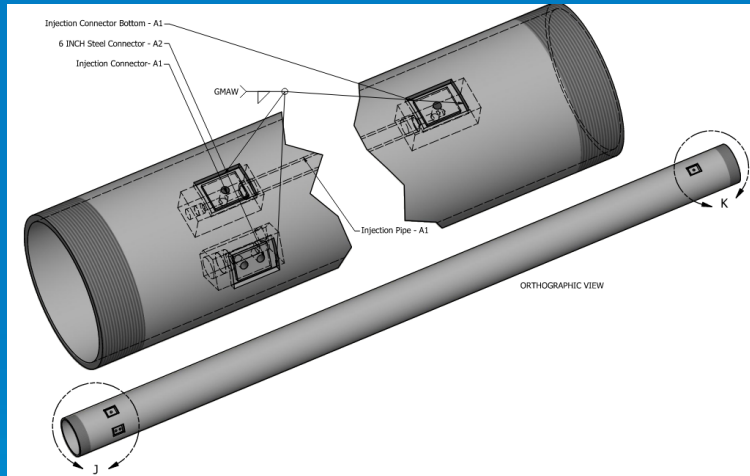
HDD Profile View



HDD Facing View



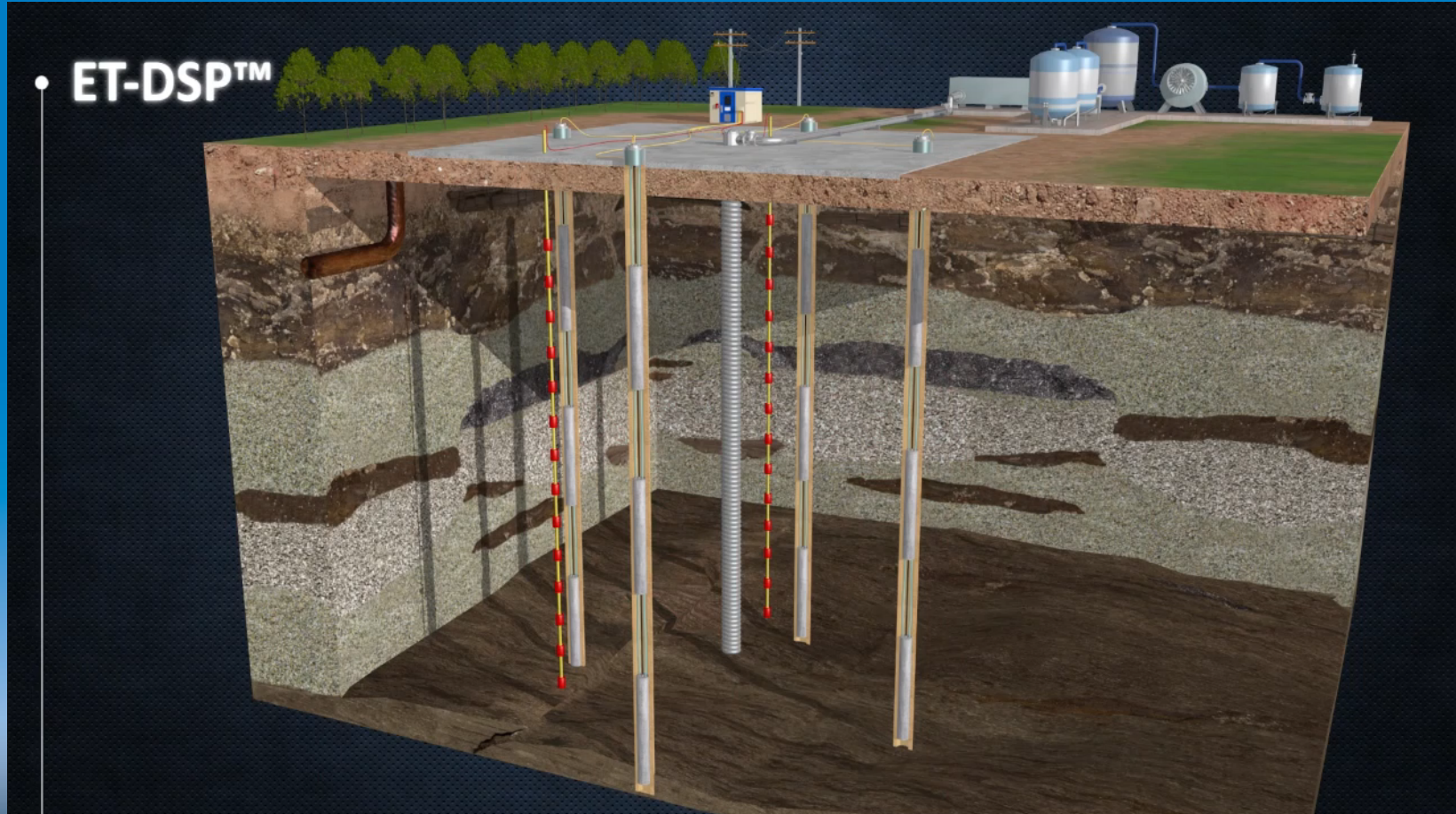
Electrode Assembly Detail



Each electrode installation:
3 each 6"x10' steel electrodes
3 power cables
3 water supply lines
2 each 6"x6' HDPE spacers
4 HDPE to Steel transitions



Electro-Thermal Dynamic Stripping



Installation Details: Drill, Locate, Assemble, Install



System Installation



Shallow HDD Beneath Restaurant



Power and Water Connections



Lessons Learned

- HDD is well-suited for horizontal electrode placement
- Single-ended installations of large diameter electrodes is feasible
- Methods for horizontal sand pack and other requirements were successfully developed
- Vertical electrode assemblies can be adapted to horizontal applications

Contact Information



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