South Dakota Triad Challenge

Demonstration Project for Small Sites

SD Petroleum Release Compensation Fund

&

Columbia Technologies, LLC

The Challenge

- Five “legacy” UST Sites
- Mostly gas stations
- Some sites over 10 years old!
- Approach – Use Triad to manage uncertainty & move toward closure
  - Systematic Planning
  - Real-Time Measurement Systems
  - Dynamic Work Strategies

Background

- Five sites selected across central & eastern South Dakota
- Sites consisted of four that were previously assessed, and one with no previous assessment
- Avg. costs incurred at sites prior to study (3 sites) = $111,588.06 / site.

Background (cont.)

- Selected Direct-Push and Direct Sensing technology for the rapid field analysis.
- Membrane Interface Probe (MIP) for data measurements.
- Team Members consisted of personnel from PRCF, DENR, Consulting firms, Columbia Tech. and Matrix Environmental.

Systematic Planning Meeting

- All Team Members met and discussed the general objectives and principals of the Triad Process.
- A brief history of each case was given. Information previously gathered from the site was distributed.
- Assisted by independent facilitator.

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Systematic Planning Meeting (cont.)

- Data gaps and other uncertainties were discussed.
- Specific objectives for each release site were clearly established and written down.
- A clear chain-of-command was established.

Systematic Planning Meeting (cont.)

- Some apprehension was apparent during the Systematic Planning Meeting.
- This was primarily due to the reliance on field analyses and only limited “quality assured lab data”.

Systematic Planning (cont.)
The "Commitment"

- Team members agreed to stay on site until they got all the data they needed to address objectives in the work plan.
- No one leaves until all are "happy".
- No disputes on the need for additional data.

Field Work using Real-Time Measurements

- Direct-push technology and direct sensing methods.
- Real-time Logs were used to decide next boring location.
- Data was uploaded into 3-dimensional maps at the end of each day.

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Real-Time Measurement Tools

- **Direct Sensing**
  - **Membrane Interface Probe w/ Electrical Conductivity**
- **SmartData Solutions®**
  - **Internet link to the field**
  - **Frequent data uploads**
  - **3D graphics**
  - **Measurement of uncertainty**
- **SmartScan™ screen**
  - **MtBE, TBA, and EDB**
- **Confirmatory soil & groundwater samples**
- **"Real time" lab analyses**

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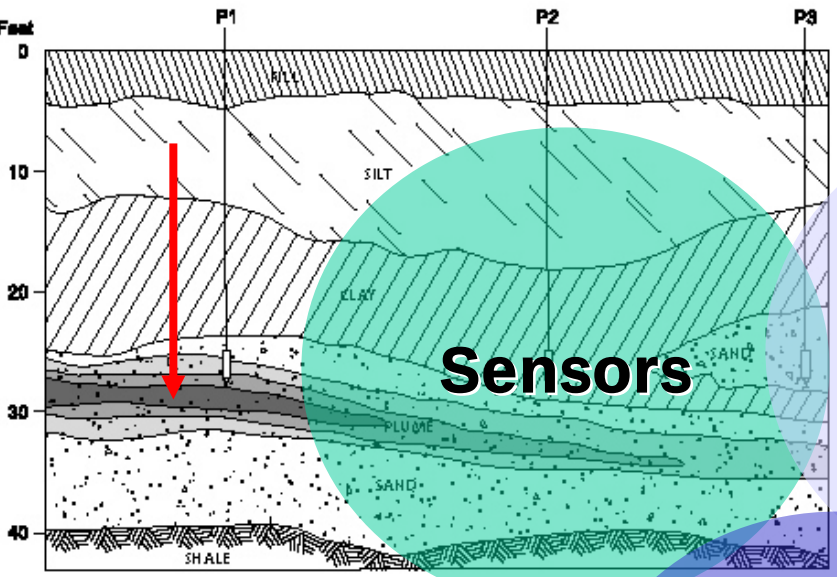
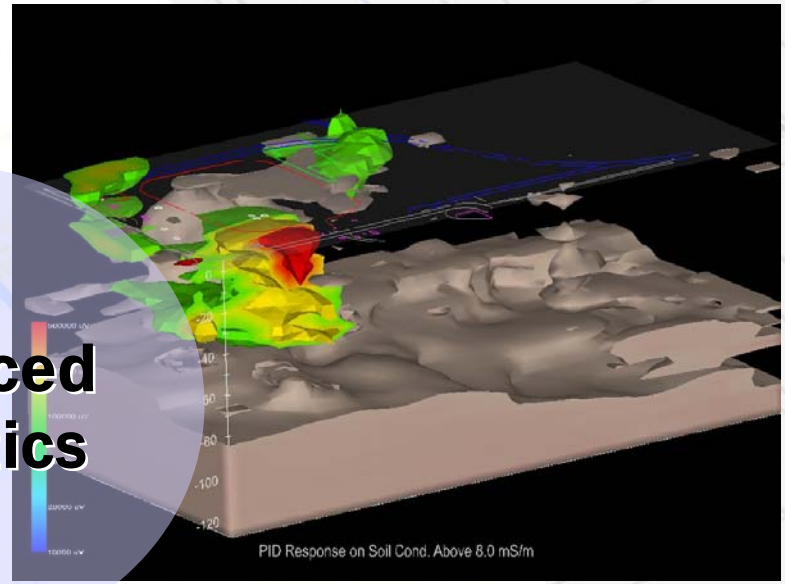
SmartData Solutions® (Patent Pending)



Sensors

Advanced Analytics



Internet Delivery

Cycle Time = Hours

Slice 1 - Center of Alley
Slice 2 - Center of 7th Street
View From Southwest

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Membrane Interface Probe

- <u>Continuous</u> vertical profile of subsurface
- High data density – 20 data points/ft
- Real time information
- Responds to VOCs at sub-ppm levels
- Electrical conductivity provides a measurement of soil characteristics

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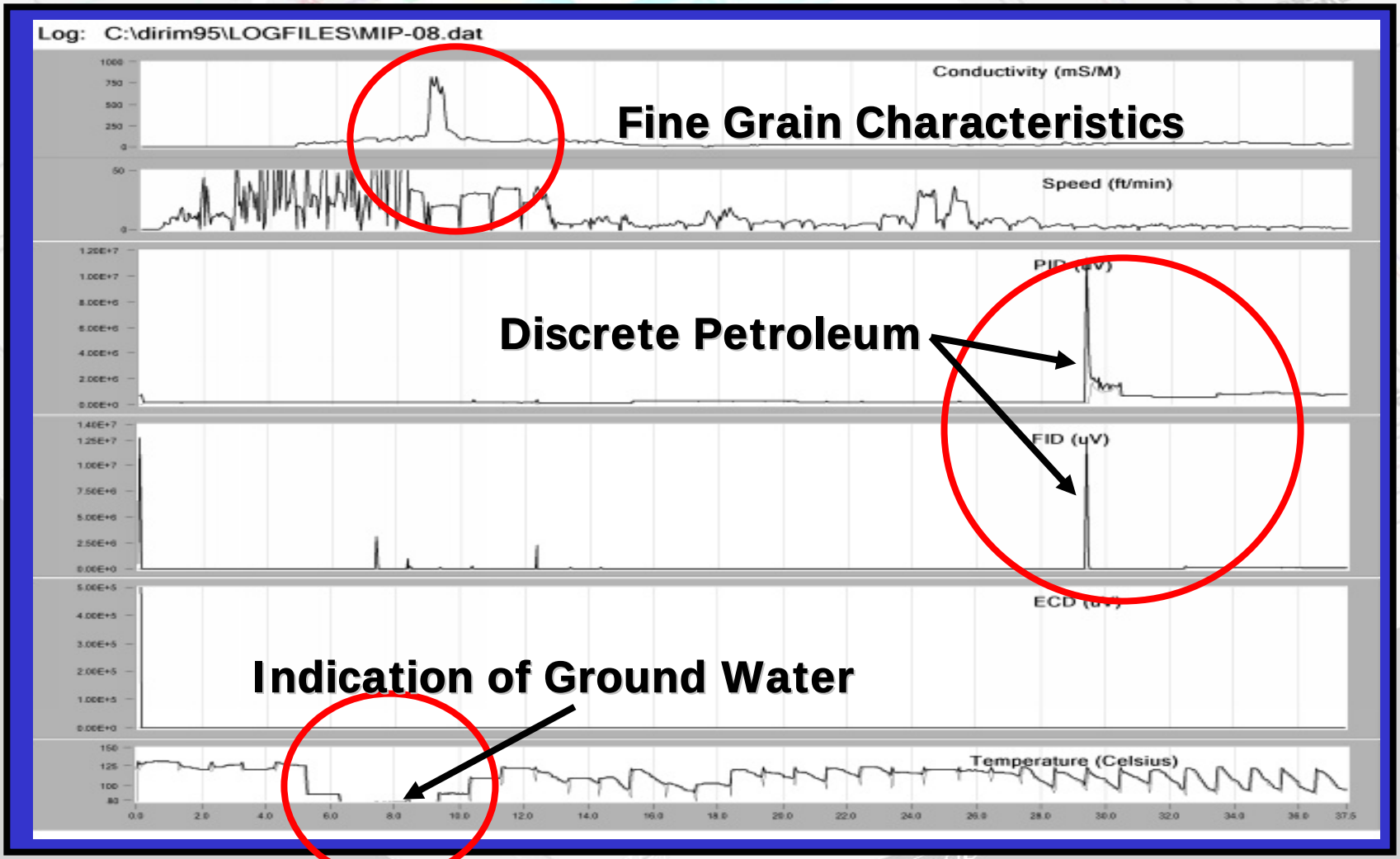
Real Time Data



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Generic Protocol

1. In-situ performance check of sensors in known source area
2. Verification of background
3. Rapid vertical and horizontal delineation of contaminant plume – approx 300-ft of data each day
4. Determine any impact to receptors
5. Confirmatory soil and groundwater sampling
6. Screen for MtBE, TBA, and EDB
7. Daily update of 2D/3D maps via Internet link to support decision making in the field
8. Off-site laboratory analyses

All Triad project team members present in the field

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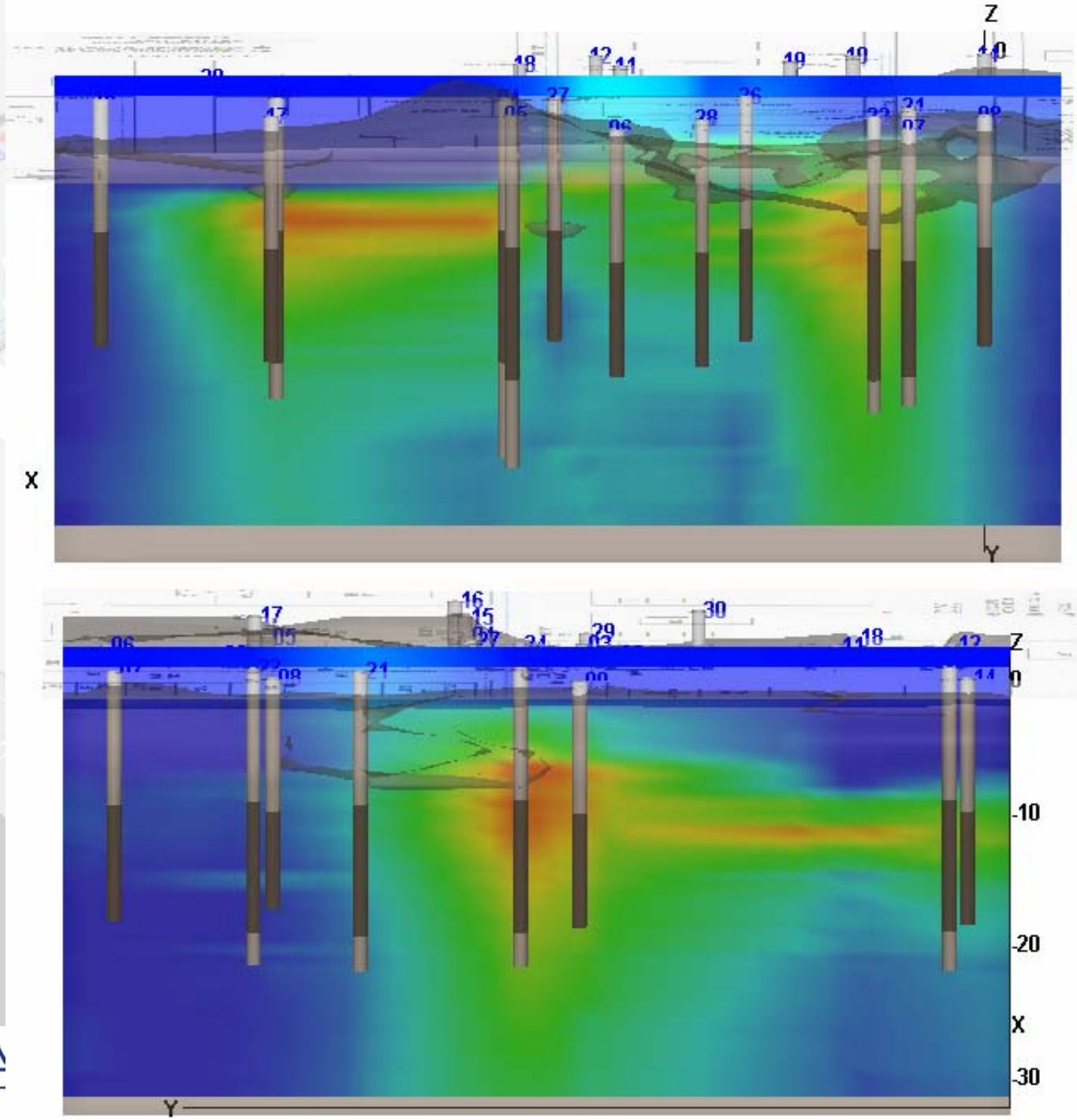
Field Work using Real-Time Measurements

- **Team members met every morning to discuss the results of the previous day's data assessment and to review the objectives for the site.**


Z
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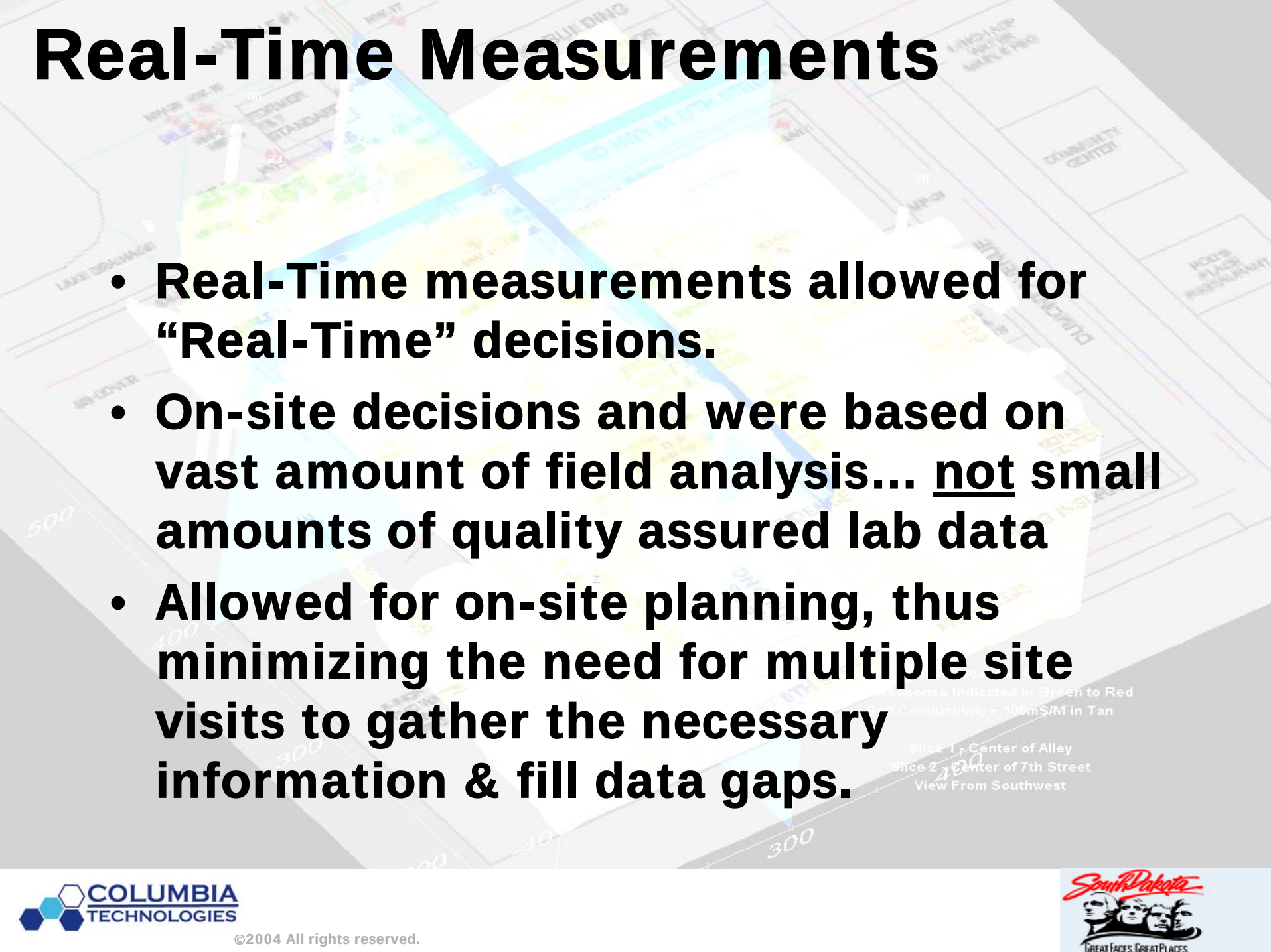
-10
-20
X
-30
Y

Real-Time Measurements

- **Real-Time measurements allowed for "Real-Time" decisions.**
- **On-site decisions and were based on vast amount of field analysis… not small amounts of quality assured lab data**
- **Allowed for on-site planning, thus minimizing the need for multiple site visits to gather the necessary information & fill data gaps.**



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Real Time Measurements Using Direct Push and Direct Sensing

- Provided a more detailed site conceptual model (SCM) or “picture” of what has or is occurring at a site.

- Analogy….

SCM using conventional methods

SCM using real-time measurements

Dynamic Work Plan

- Based on the results of field analyses, quick, on-site decisions were made as needed.
- Each morning, the results from the previous day were evaluated by team members and compared to objectives.
- Changes were made as necessary.

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Team Decision Making

T&T Standard

Assessment Planning

- Team meeting (conference call) to set site specific objectives and concerns
- Establish site specific website
  - Password protected
  - Load site maps
  - Load location of existing wells
  - Load known historical data
  - Load know underground utilities
- Build initial 3D Site Conceptual Model

UST Tier I Requirements

- ✓ Standardized scope of work
- ✓ Locate all private and public water wells
- ✓ Note current use of the site
- ✓ Provide copy of applicable portion of tax map
- ✓ Locate all underground utilities

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Day 01 – Initial Screening

- Site H&S Briefing
- Verification
  - Underground utilities
  - Receptors
  - Site use
- Direct Sensing Operations
  - UST Area: 2 borings
  - Piping & Dispenser Area: 5 borings
  - Background: 2-4 borings
  - Total: 7-10 borings ~ 300 ft of data
  - Borehole closure
- SmartData Operations
  - GPS all boreholes
  - MIP logs uploaded 2X daily
  - Update 3D model
  - Update website and field

UST Tier I Requirements

- ✓ Screen identified receptors for hydrocarbons
- ✓ UST Area: 2 borings to 25-ft or to groundwater table
- ✓ Piping & Dispenser Area: 5 borings to 10-feet or to groundwater table
- ✓ Background: 1 boring to 10-ft or to groundwater table
- ✓ Describe lithology for each soil sample
- ✓ Screen for organic vapors
- ✓ Prepare soil boring logs

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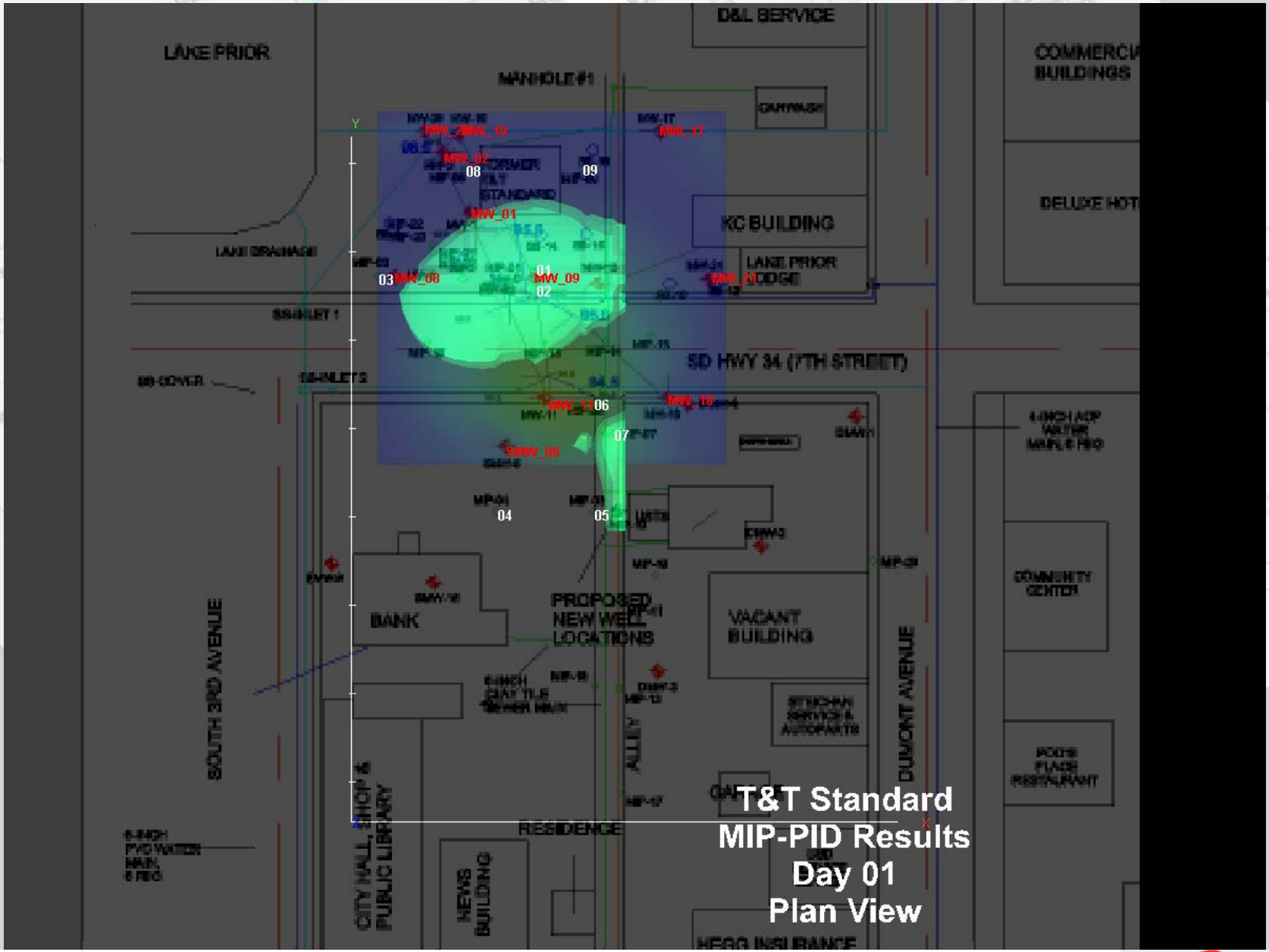

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Day 02 - Receptors

- Site H&S Briefing
- Direct Sensing Operations
  - Evaluate impact to receptors
  - Determine if receptors are conduits for HCs
  - 7-10 borings ~ 250 ft

  SmartData Operations
  - GPS all boreholes
  - MIP logs uploaded 2X daily
  - Update 3D model
  - Update website and field
- Triad team review receptor impact and select sample locations

- **<u>UST Tier I Requirements</u>**

✓ Screen identified receptors for hydrocarbons

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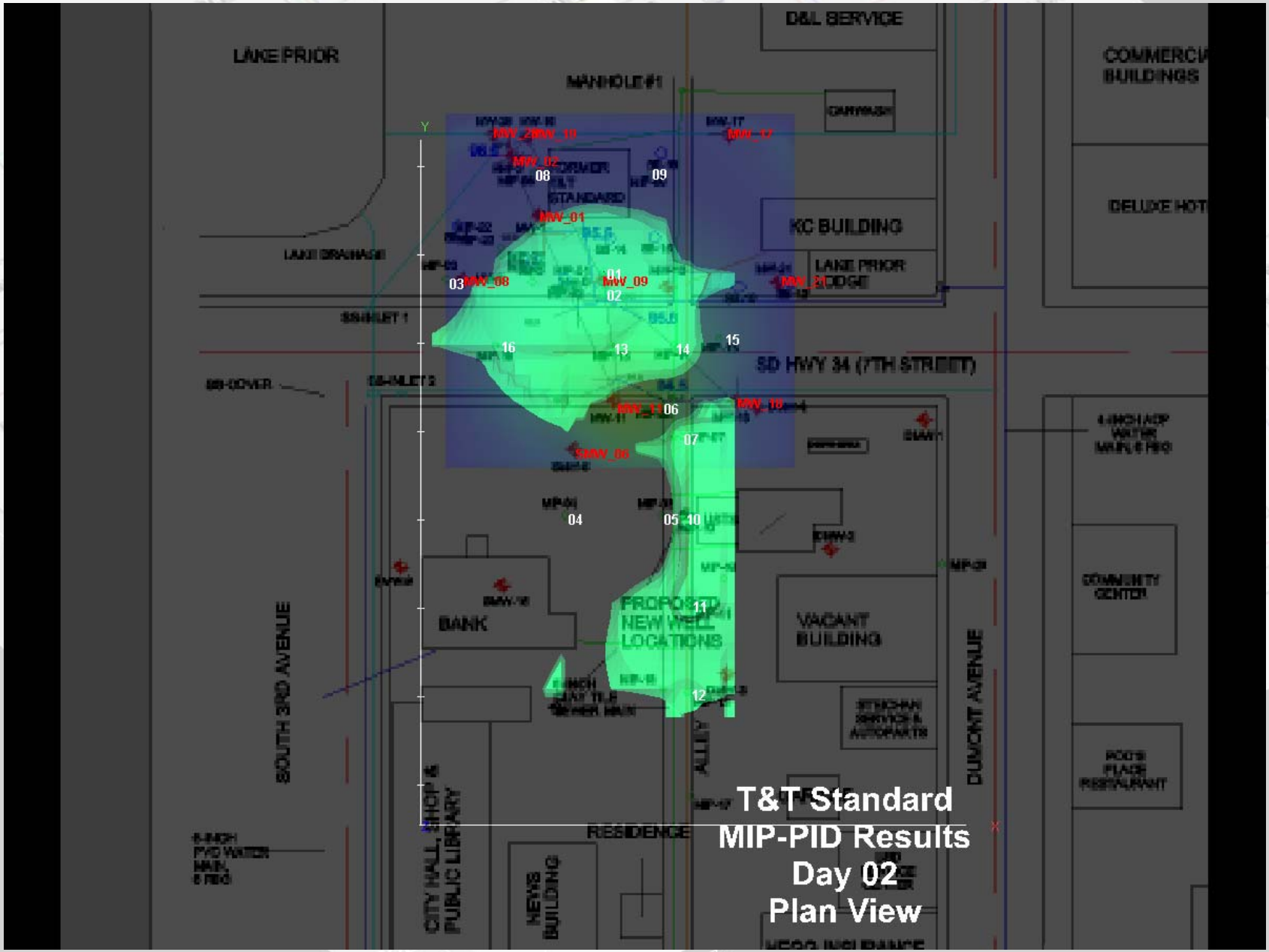

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Day 03 –Verification

- Site H&S Briefing
- Direct Sensing Operations
  - SmartScan™ analysis
- SmartData Operations
  - Update images & model
- Soil Sampling
  - UST Area: 2 borings
  - Piping/Dispenser: 5 borings
  - Background: 1 boring
- Groundwater Sampling
  - All impacted water supply wells within 500-ft
  - Install 3 micro-wells and sample (optional)
- Vapor Sampling
  - Receptor areas with potential for explosive conc
  - Install vapor monitoring implants (optional)

UST Tier I Requirements

- ✓ UST Area: 2 soil borings to 25-ft or to groundwater table
- ✓ Piping & Dispenser Area: 5 borings to 10-feet or to groundwater table
- ✓ Background: 1 soil boring to 10-ft or to groundwater table
- ✓ Describe lithology for each soil sample
- ✓ Screen for organic vapors
- ✓ Prepare soil boring logs

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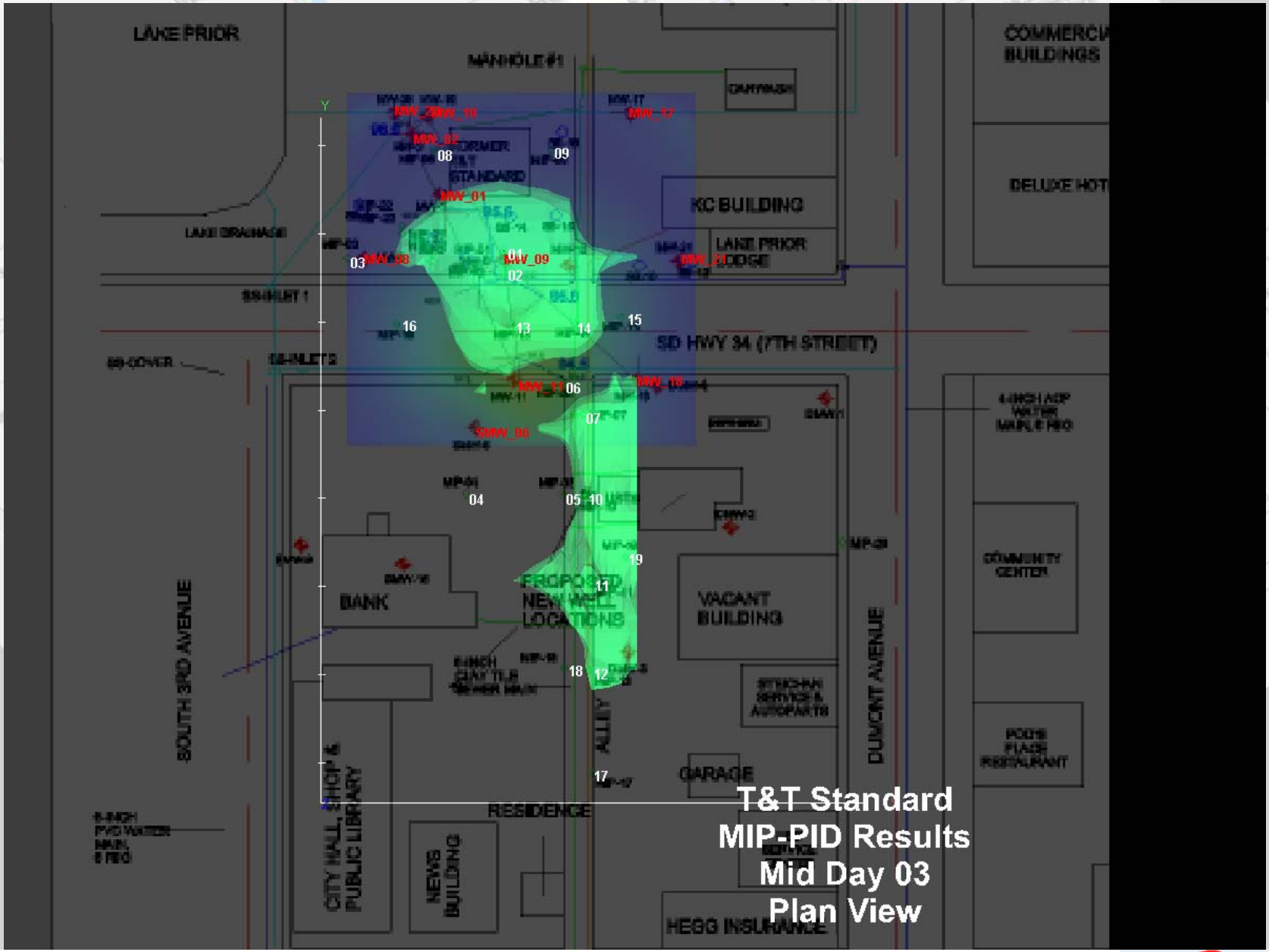

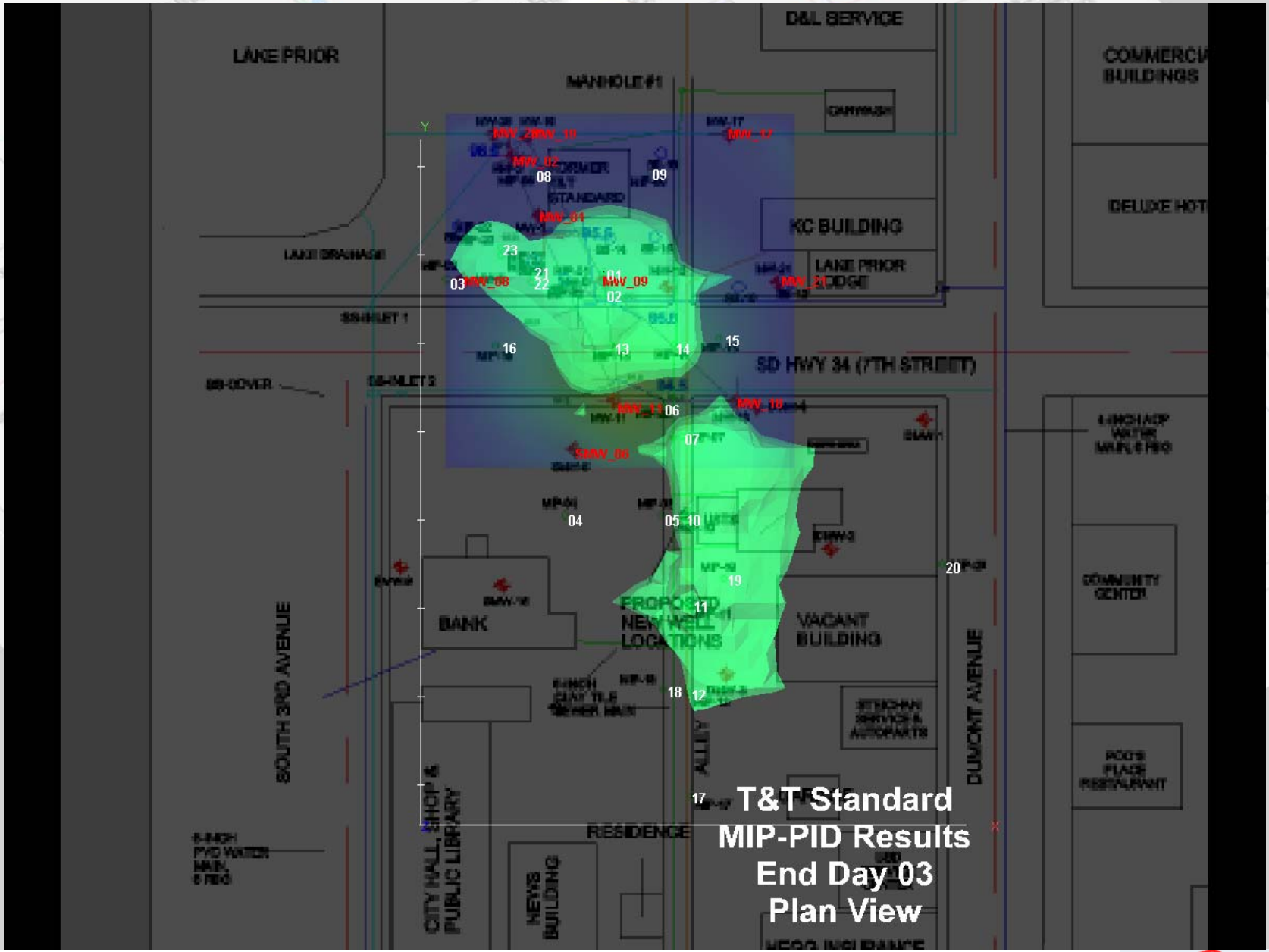

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Day 04 –Ground-Water Wells (Optional)

- Site H&S Briefing
- Installation of Monitoring Wells

UST Tier I Requirements

- ✓ Total of three 2-inch PVC casing wells with 10-ft screens
- ✓ Boring with highest organic vapor response
- ✓ Background soil boring
- ✓ 1 Additional well in a position on the site to determine the direction of ground-water flow AND concentrations of CoC in the source area

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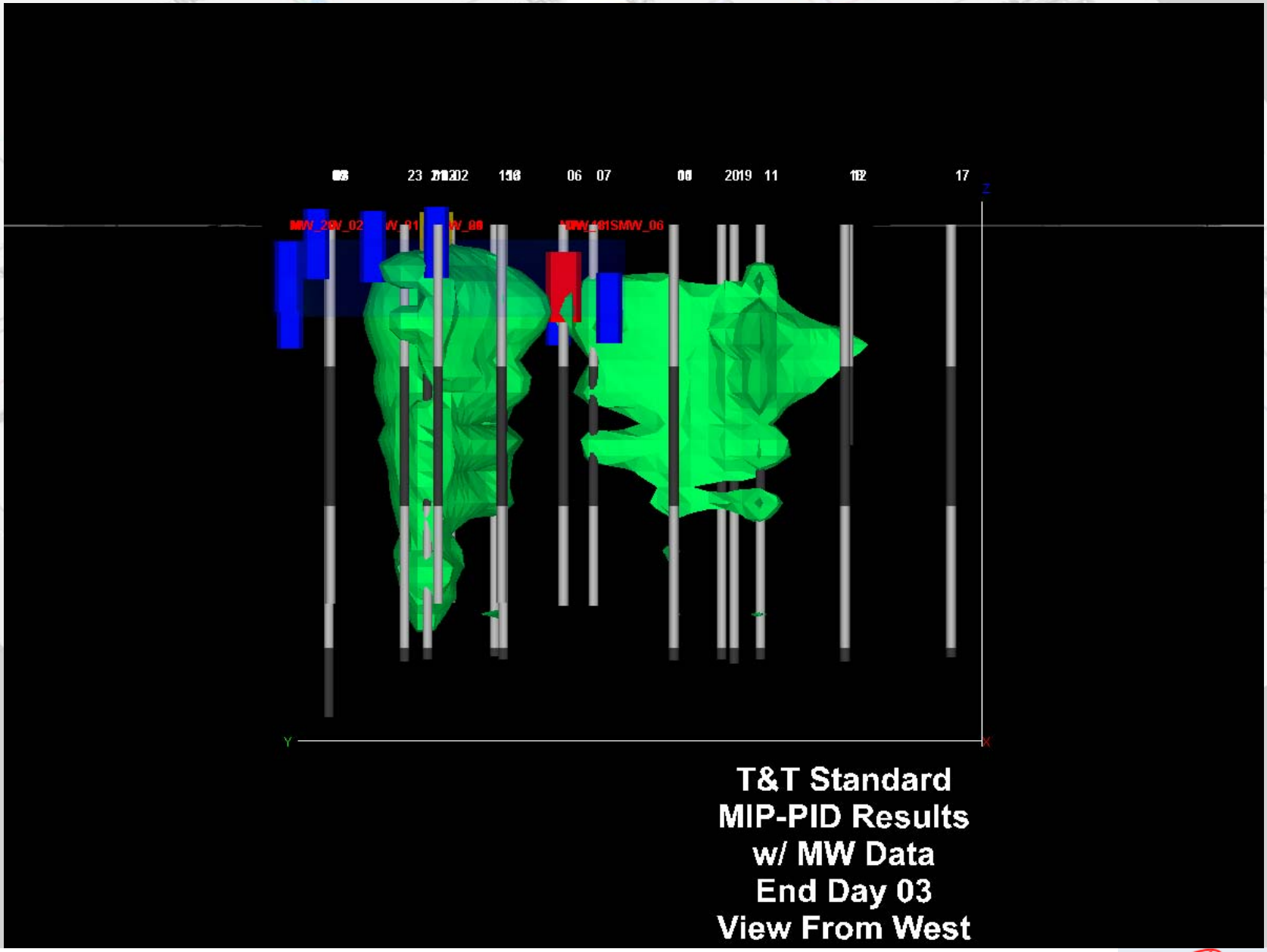

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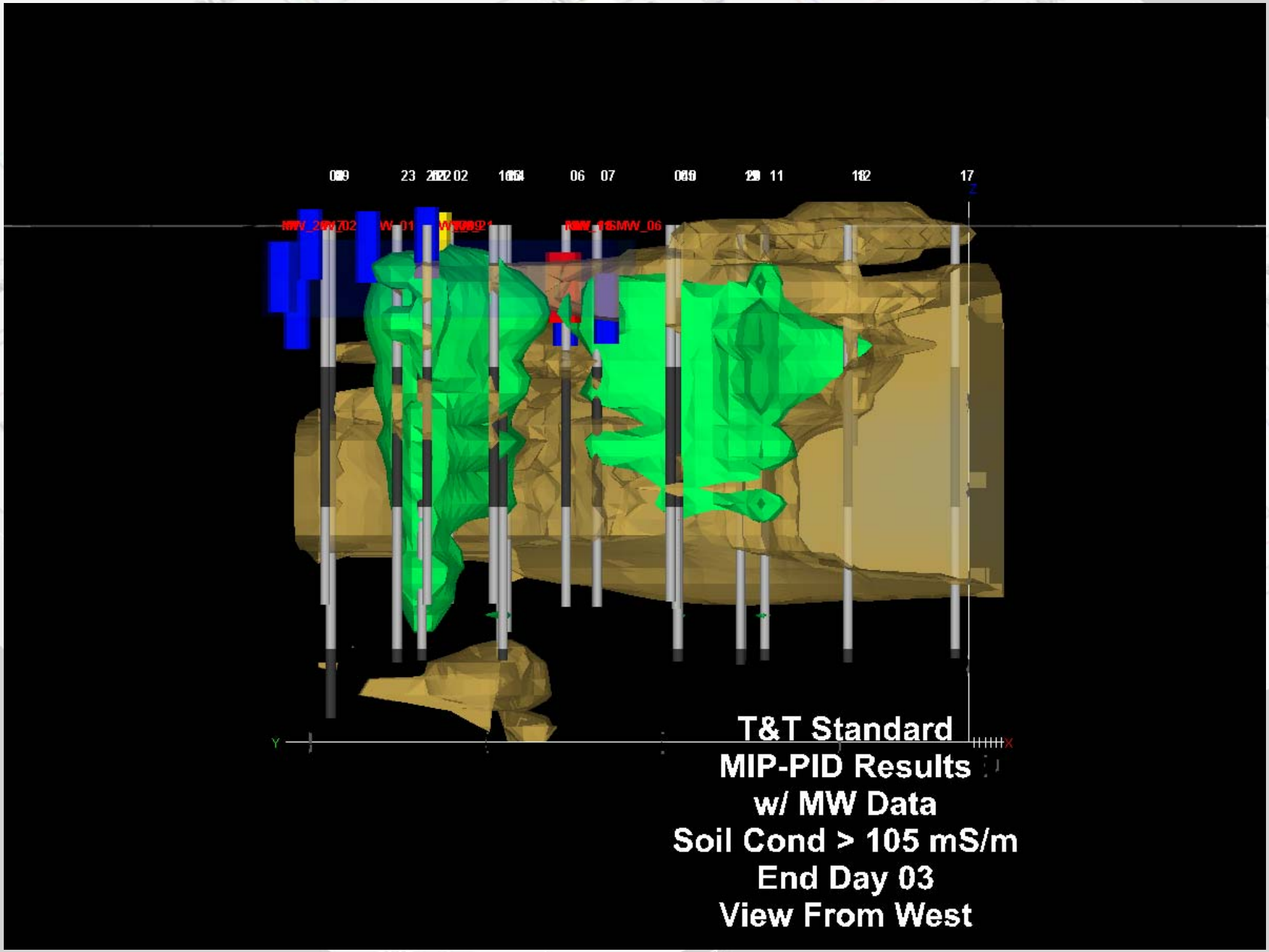

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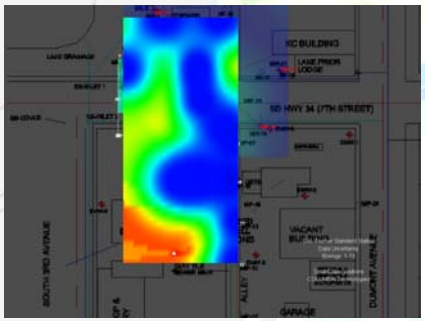
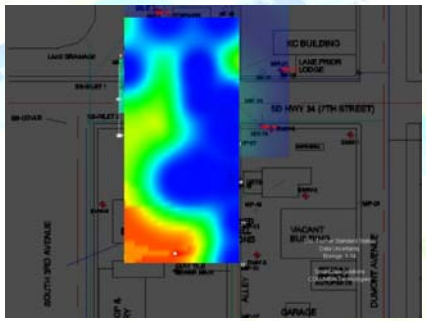
Managing Uncertainty



MIP-13



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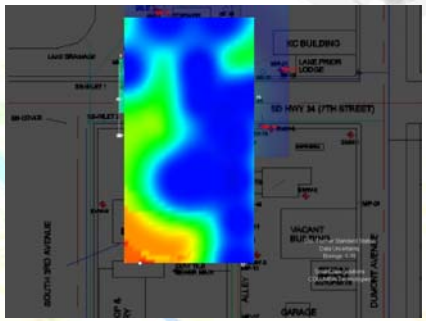

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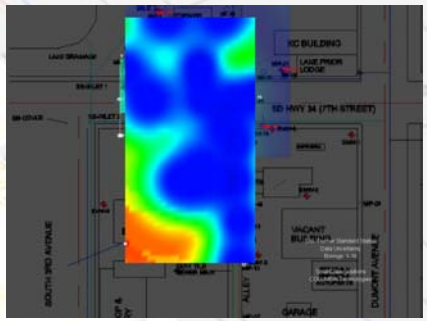
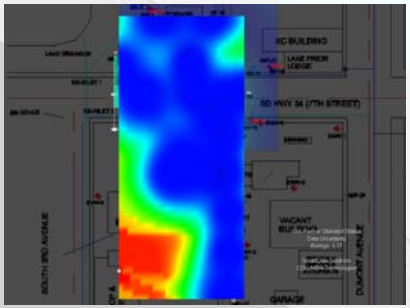
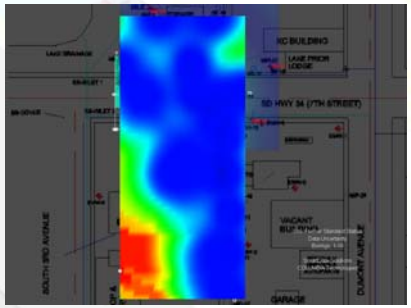


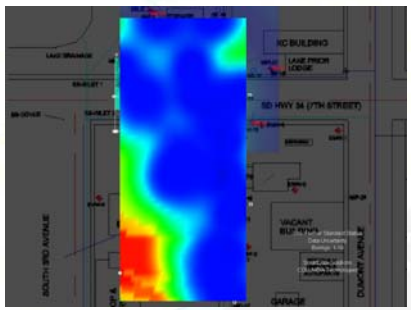
MIP-16



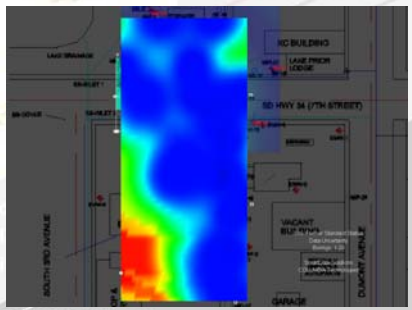
MIP-17



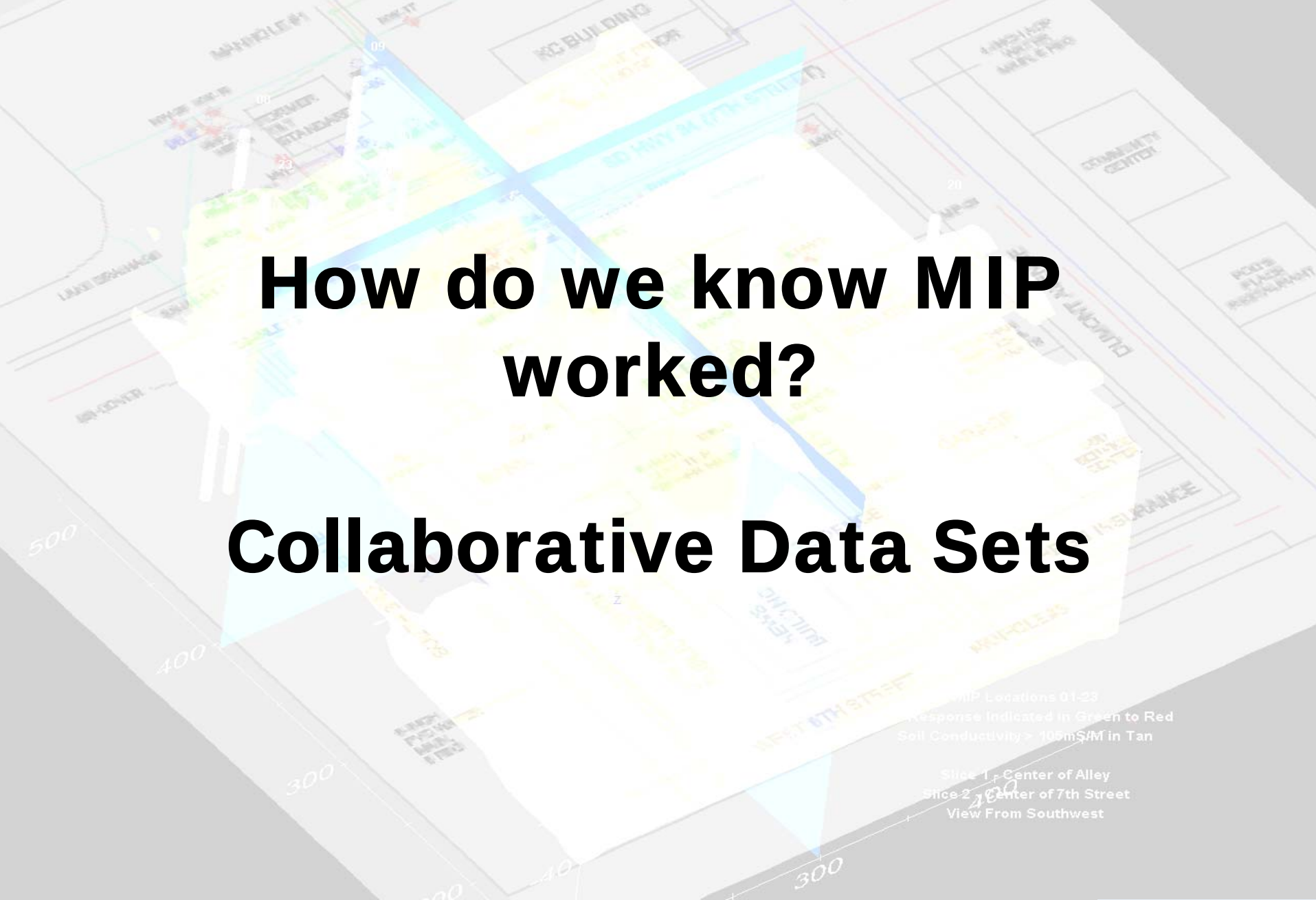
MIP-18



MIP-19



MIP-20



How do we know MIP worked?

Collaborative Data Sets

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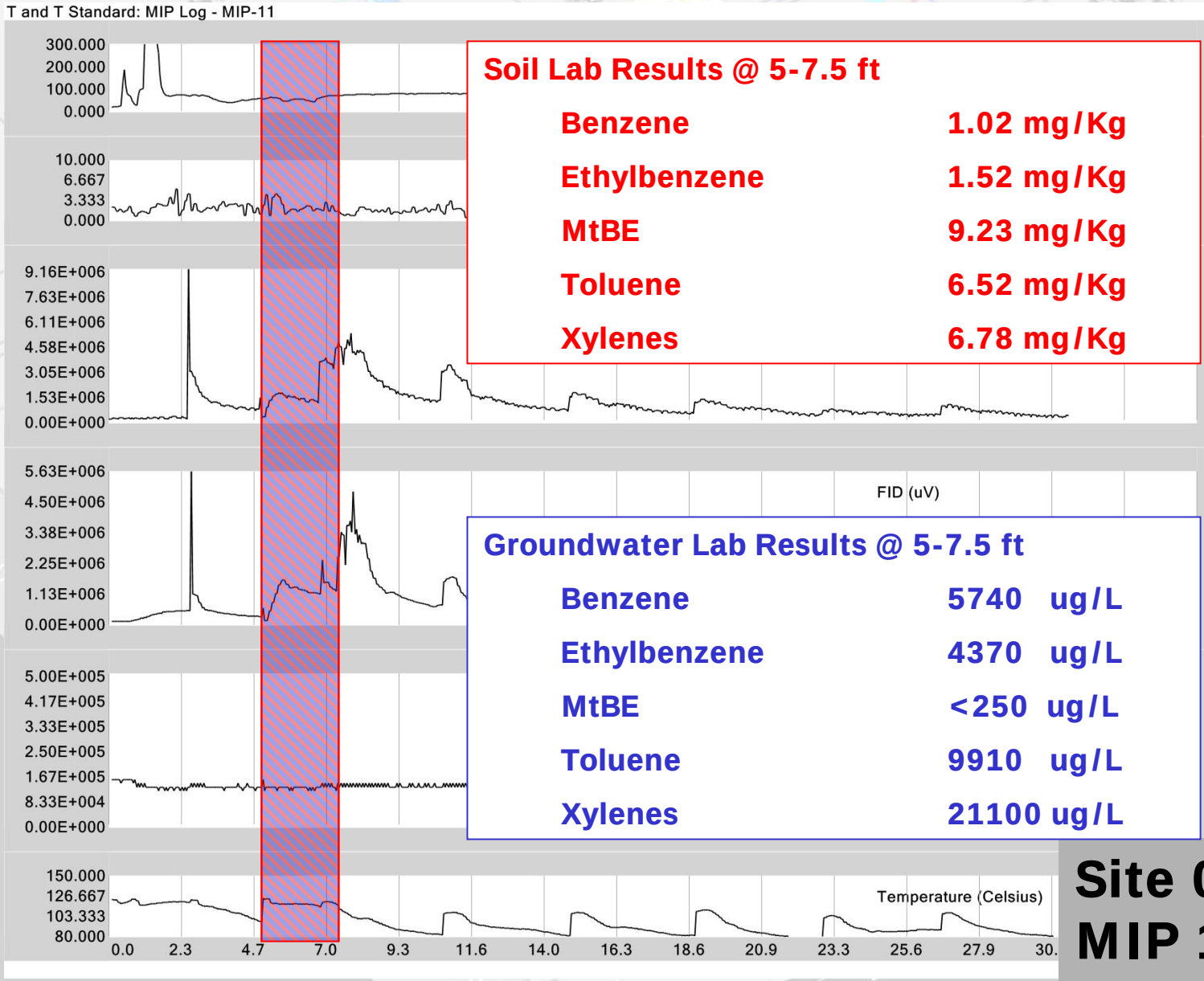

Soil Lab Results @ 5-7.5 ft

Benzene	1.02 mg/Kg
Ethylbenzene	1.52 mg/Kg
MtBE	9.23 mg/Kg
Toluene	6.52 mg/Kg
Xylenes	6.78 mg/Kg

Groundwater Lab Results @ 5-7.5 ft

Benzene	5740 ug/L
Ethylbenzene	4370 ug/L
MtBE	<250 ug/L
Toluene	9910 ug/L
Xylenes	21100 ug/L

Site 02
MIP 11

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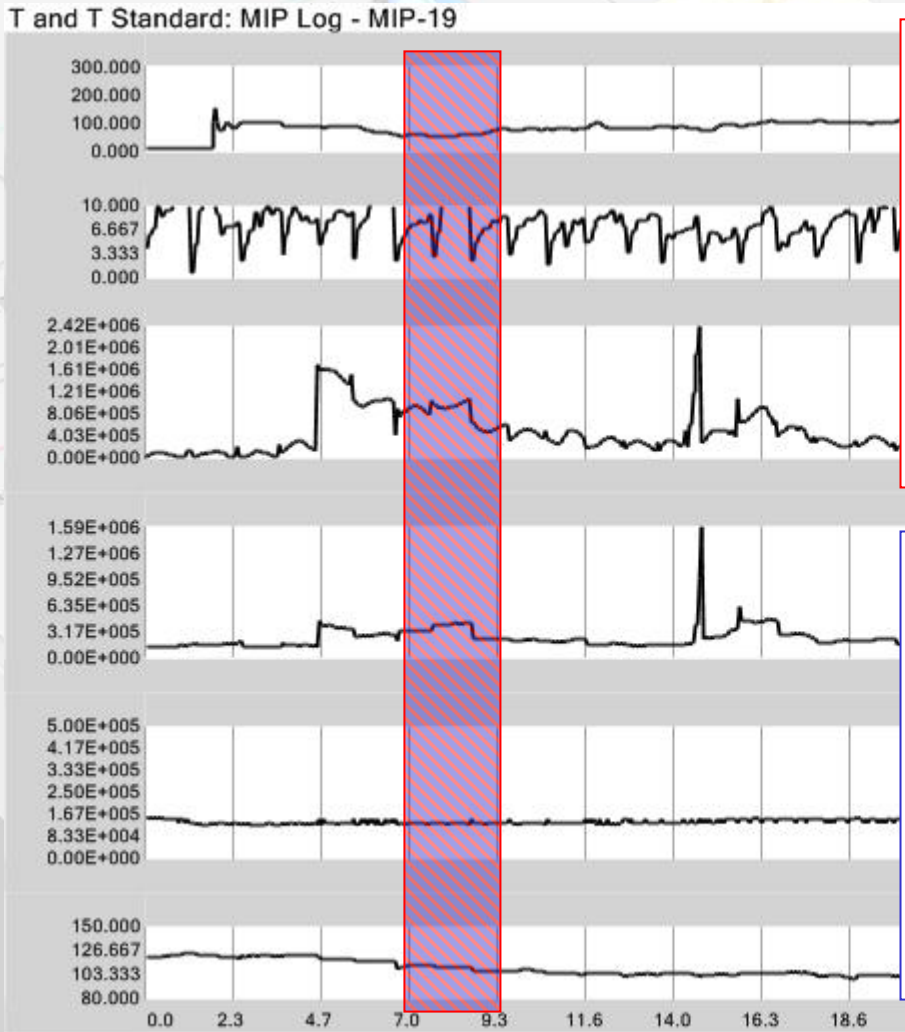

Soil Lab Results @ 7-9 ft

Benzene	<.1 mg/Kg
Ethylbenzene	23.5 mg/Kg
MtBE	<.1 mg/Kg
Toluene	.968 mg/Kg
Xylenes	105 mg/Kg
TPH – Gas	1810 mg/Kg

Groundwater Lab Results @ 7-9 ft

Benzene	496 ug/L
Ethylbenzene	1760 ug/L
MtBE	<5 ug/L
Toluene	170 ug/L
Xylenes	7600 ug/L
TPH – Gas	41400 ug/L

10-20X Variation between soil & gw

Site 02
MIP 19

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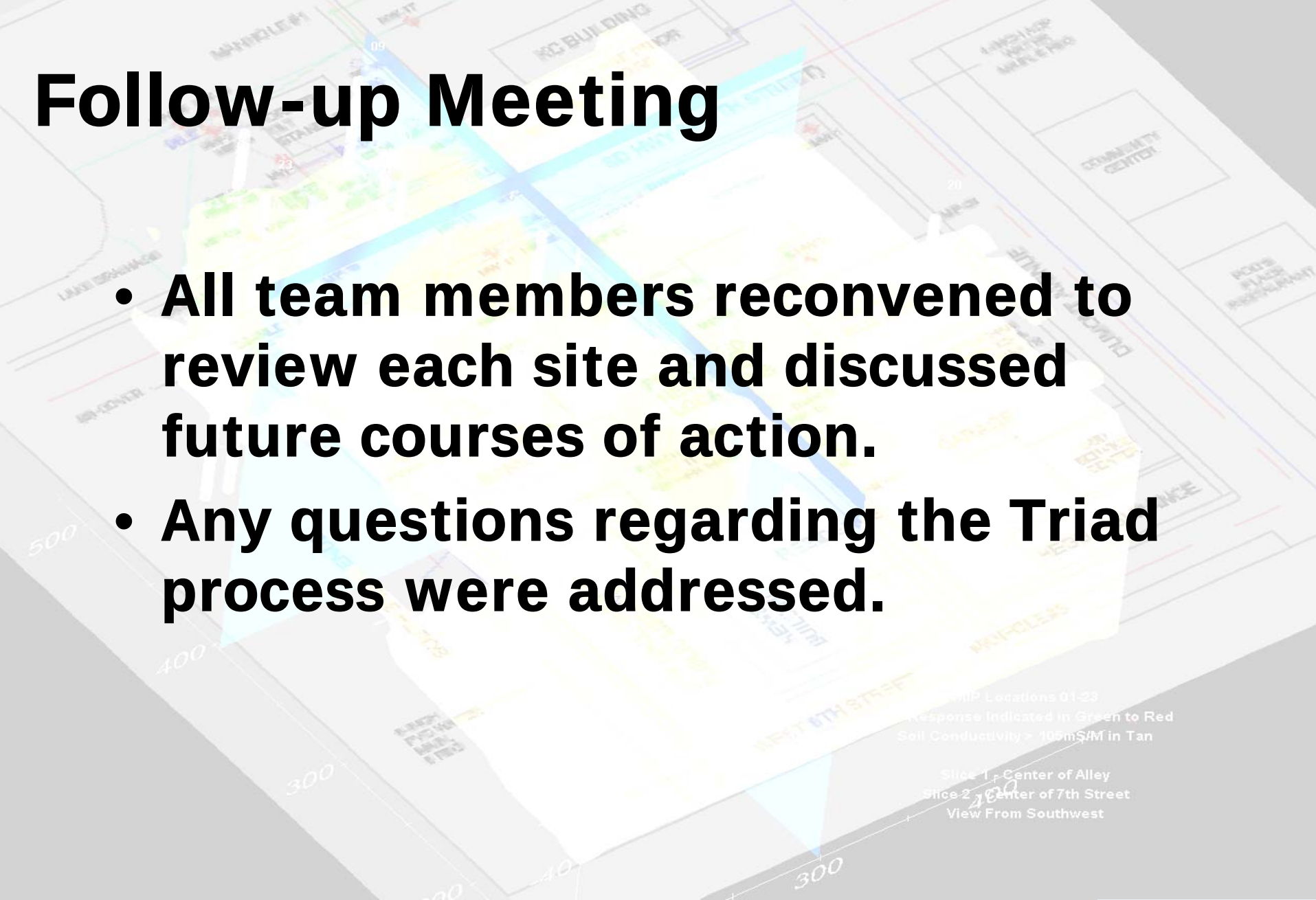
Follow-up Meeting

- All team members reconvened to review each site and discussed future courses of action.
- Any questions regarding the Triad process were addressed.



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What's next?

- A CAP has been established for each of the five sites.
- It is anticipated at least one site will be granted No Further Action by mid-summer.
- The level of uncertainty at each site has been greatly reduced.

Lessons Learned - Triad

- **Takes cooperation *and* commitment by all stakeholders.**
- **Good communications is essential.**
- **Real-time measurements provide a much more clear and concise SCM.**
- **Direct-push and direct sensing methods can be great tools**
- **Systematic Planning pays off in dividends!**

Conclusions

- General impressions of the Triad were very positive.
- Majority of team members felt that Triad could be implemented into nearly every release case in South Dakota.
- Use of Triad was successful in reducing uncertainty and moving sites ahead.

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Recommendations

- Best if limited conventional testing done first.
- Need commitment from all parties.
- Facilitator is beneficial.
- Lots of field analytical data is better than a little lab data.
- Avoid working weekends!

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