ARCADIS Design & Consultancy for natural and built assets

AUTOMATED BAILDOWN TESTS

Better, Cheaper, Safer Data

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LNAPL Baildown Tests – Easy, Right?

Baildown tests are hard –

- Use field time efficiently
- Document complete NAPL recovery
- Collect enough data to identify confined or perched conditions
- And do it all safely!

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Manual Data Collection Problems

- Missing key data overnight
- Cutting test short for budget/efficiency reasons
- Sparse data for very fast recovering wells
- Repeated access to well locations

"Things got back to equilibrium sometime before 7 AM…"

Should I stay out here another day to get one more measurement?"

"I'm gauging as fast as I can!"

"I need to block off this roadway for 5 minutes every hour…"

Good Data Supports Risk-Based LNAPL Management

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Improving the Measurement Concept

Can we build a datalogger to measure LNAPL thickness, and…

- Get better, more continuous data?
- Avoid field inefficiencies?
- Reduce access and safety concerns?

Less Staff Time in High-Risk Areas

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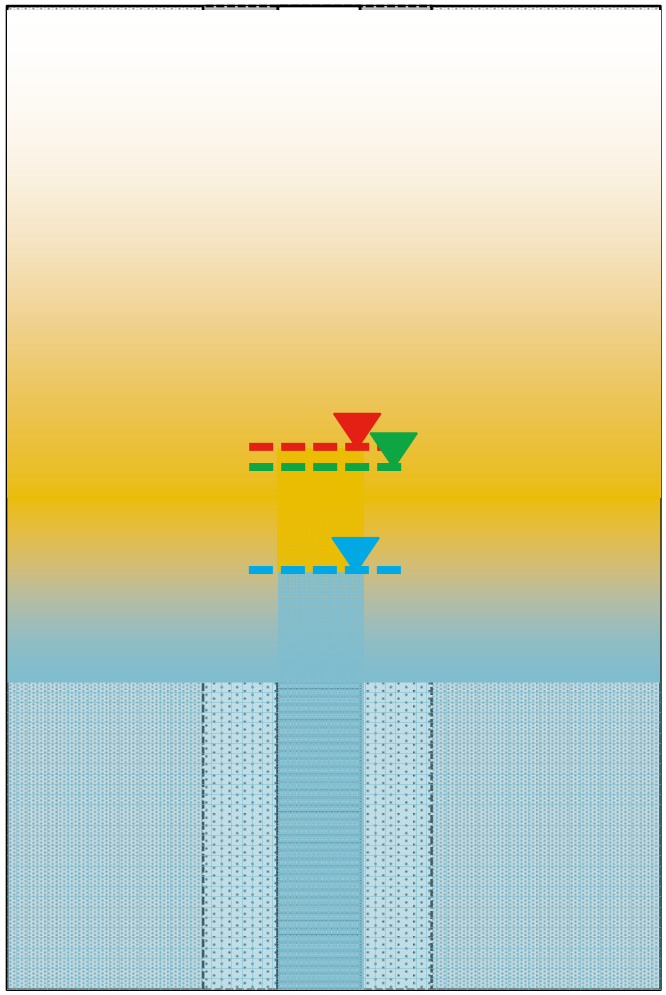
Resolving In-Well LNAPL Thickness



Three related data points:

- Air-NAPL Interface
- NAPL-Water Interface
- Potentiometric Surface

We can reliably measure:

- Potentiometric Surface
- LNAPL density

Measured

One interface + Potentiometric Surface + LNAPL Density

Calculated

Second Interface + LNAPL Thickness

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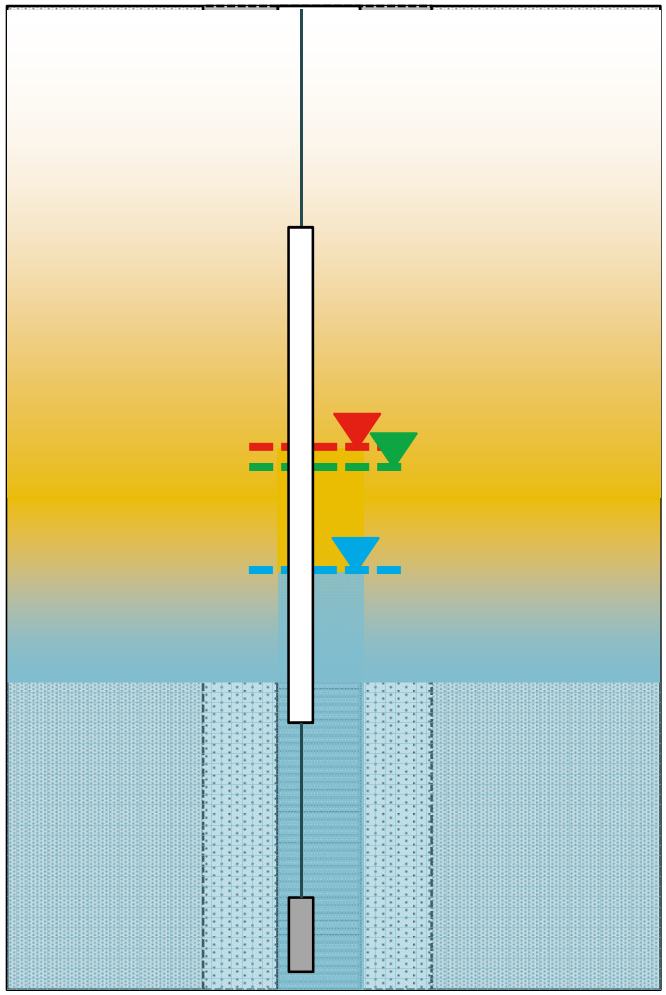
Measurement Concept



- Pressure-Sensitive Tape (eTape) measures Air-LNAPL Interface ▼
  - Hang in well at a fixed depth
  - Electrical resistance of eTape changes with fluid pressure (LNAPL or water) on PTFE envelope
- Transducer measures potentiometric surface ▼
- Programmable datalogger collects readings and saves to SD card
- NAPL thickness and NAPL-water interface calculated using LNAPL density ▼

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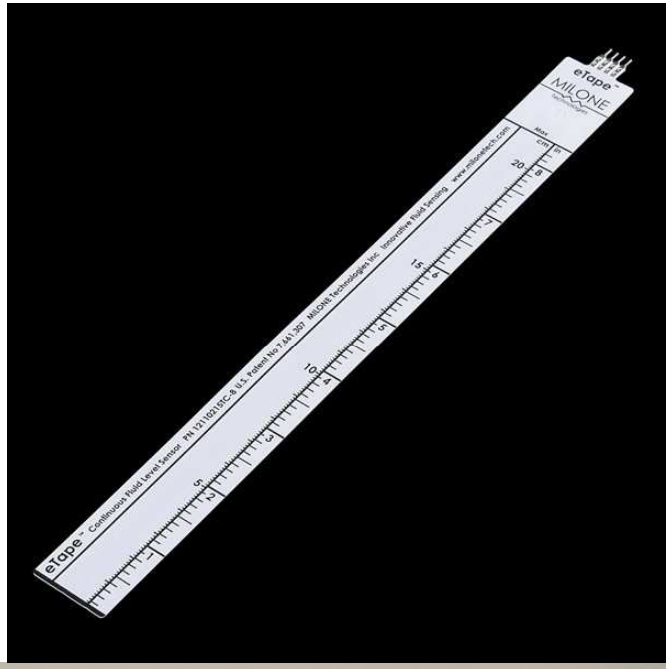
Equipment

Waterproof case with:

- Electronic datalogger
- Intrinsic safety barriers
- Wireless router
- Internal or external 12V battery

Metal frame for down-well equipment



Field Trial

- Baildown testing program in June 2015 – 8 wells
  Some key wells in high-traffic/difficult to access areas
- Wells with large initial thickness, slow recovery
- Built three automated data collection units

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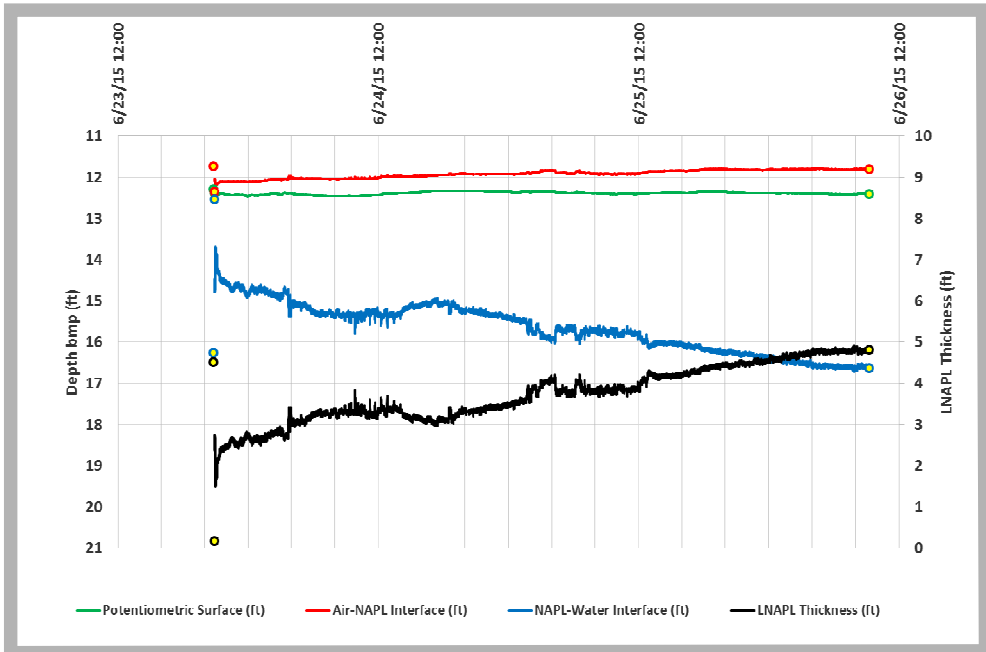
Results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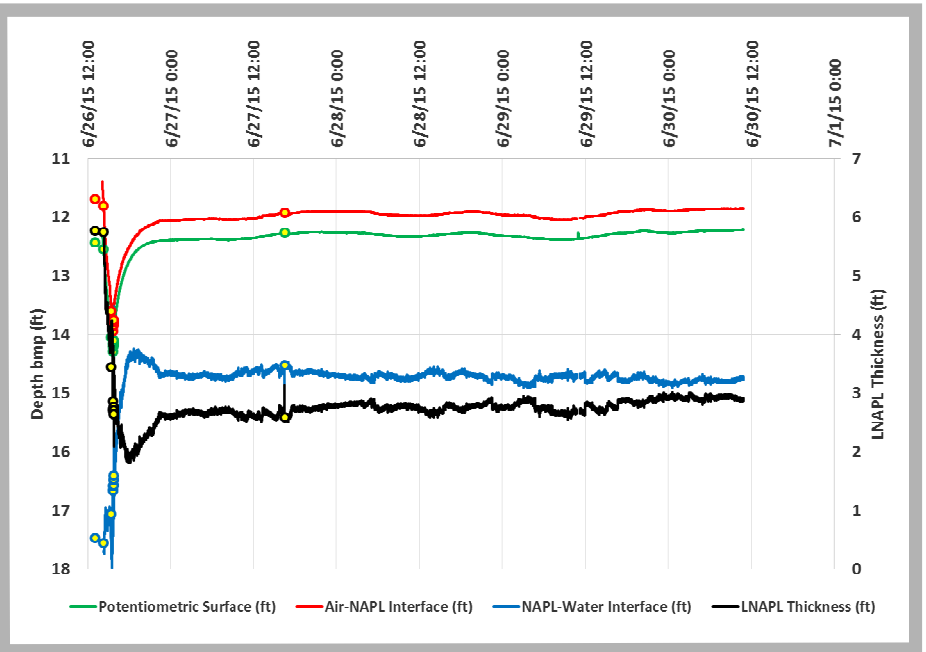
6/24/15 12:00
6/25/15 12:00
6/26/15 12:00
Depth bmp (ft)
LNAPL Thickness (ft)
Potentiometric Surface (ft)
Air-NAPL Interface (ft)
NAPL-Water Interface (ft)
LNAPL Thickness (ft)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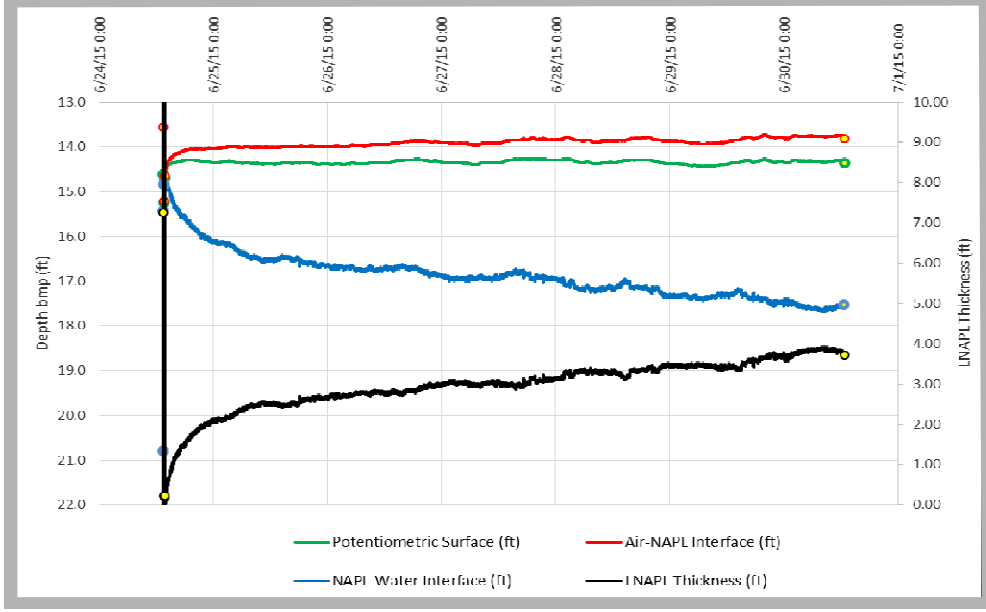
6/30/15 0:00
6/30/15 12:00
7/1/15 0:00
Depth bmp (ft)
LNAPL Thickness (ft)
Potentiometric Surface (ft)
Air-NAPL Interface (ft)
NAPL-Water Interface (ft)
LNAPL Thickness (ft)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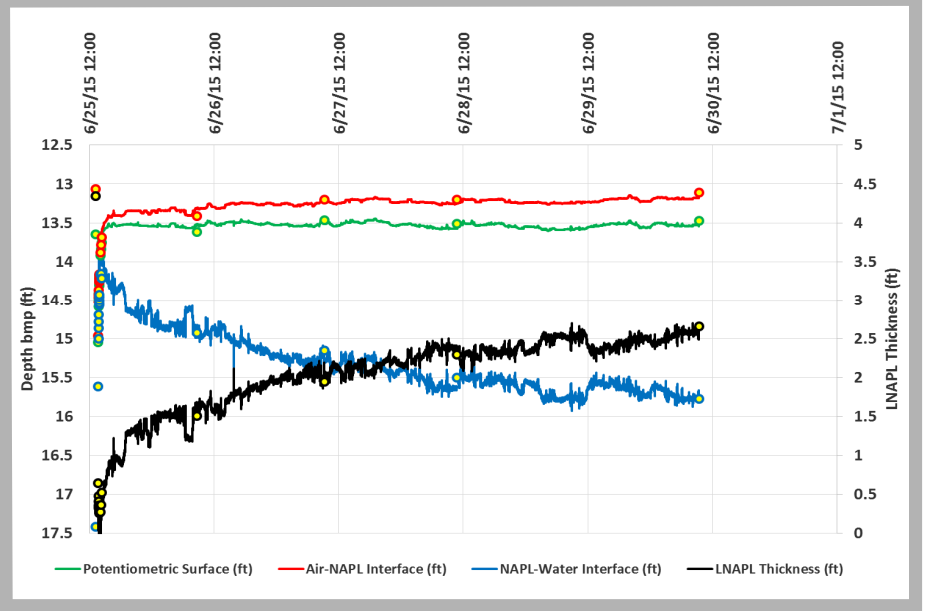
7/1/15 0:00
Depth bmp (ft)
LNAPL Thickness (ft)
Potentiometric Surface (ft)
Air-NAPL Interface (ft)
NAPL-Water Interface (ft)
LNAPL Thickness (ft)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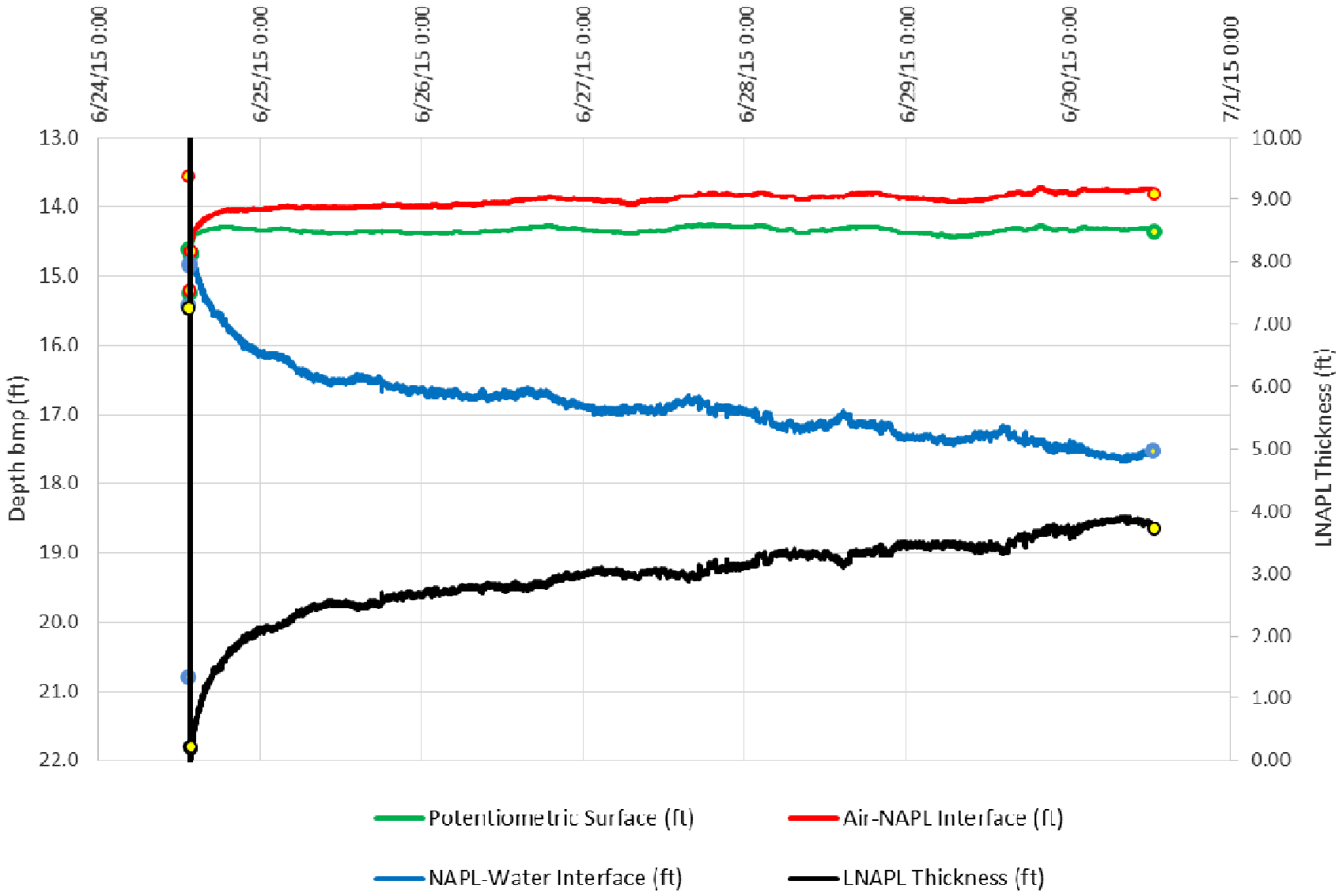
6/28/15 12:00
6/29/15 12:00
6/30/15 12:00
7/1/15 12:00
Depth bmp (ft)
LNAPL Thickness (ft)
Potentiometric Surface (ft)
Air-NAPL Interface (ft)
NAPL-Water Interface (ft)
LNAPL Thickness (ft)

Well 1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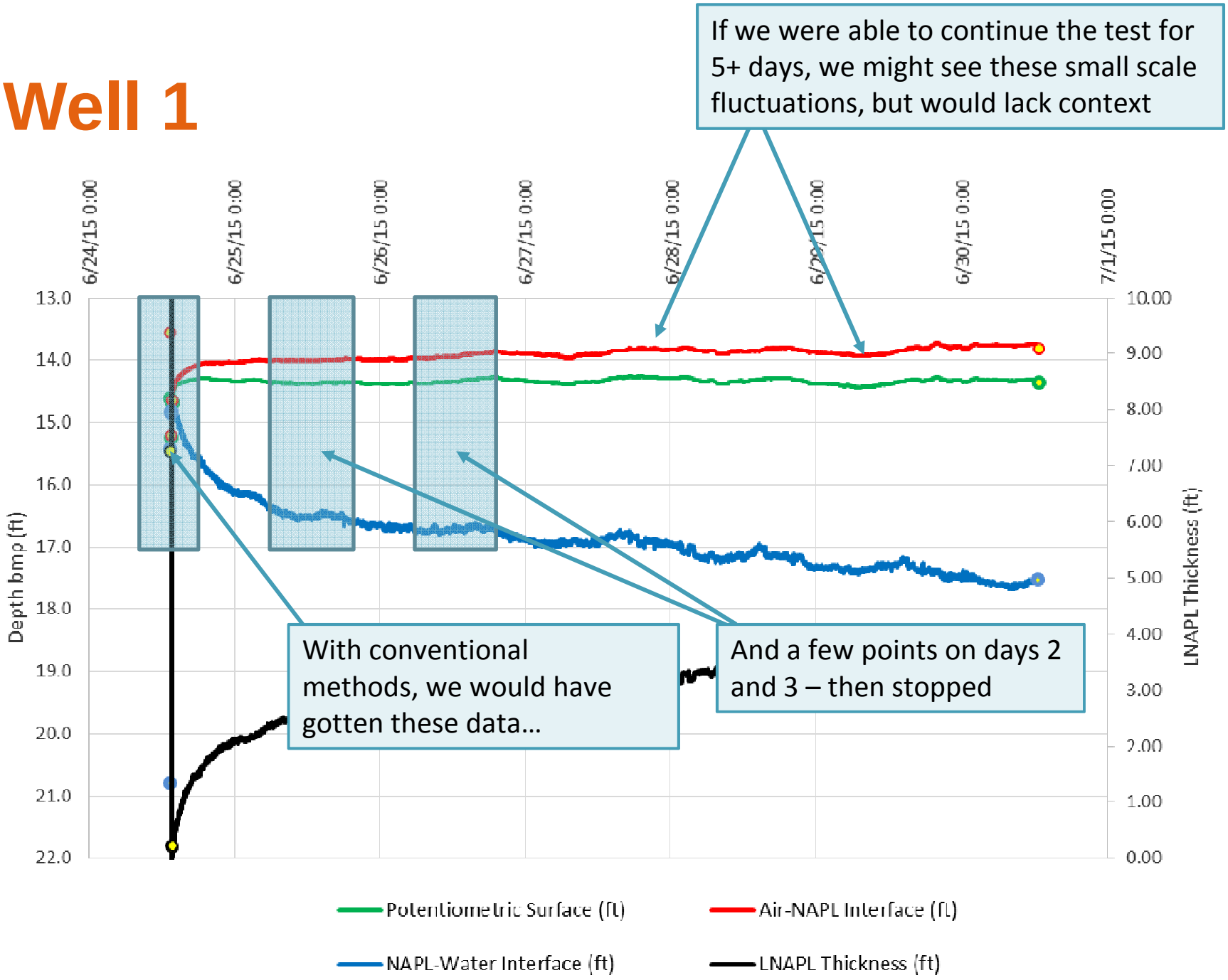
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
Depth bmp (ft)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Thickness (ft)
Potentiometric Surface (ft)
Air-NAPL Interface (ft)
NAPL-Water Interface (ft)
LNAPL Thickness (ft)

Well 1


If we were able to continue the test for 5+ days, we might see these small scale fluctuations, but would lack context
6/24/15 0:00
6/25/15 0:00
6/26/15 0:00
6/27/15 0:00
6/28/15 0:00
6/29/15 0:00
6/30/15 0:00
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13.0
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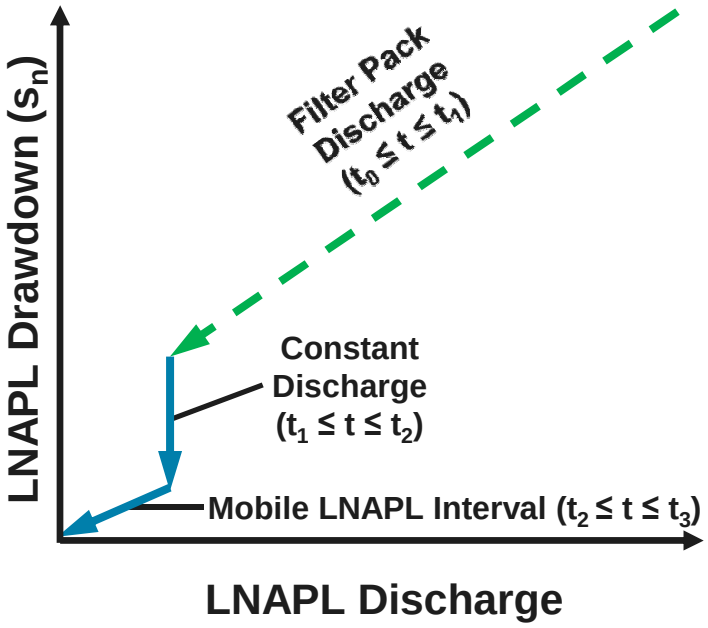
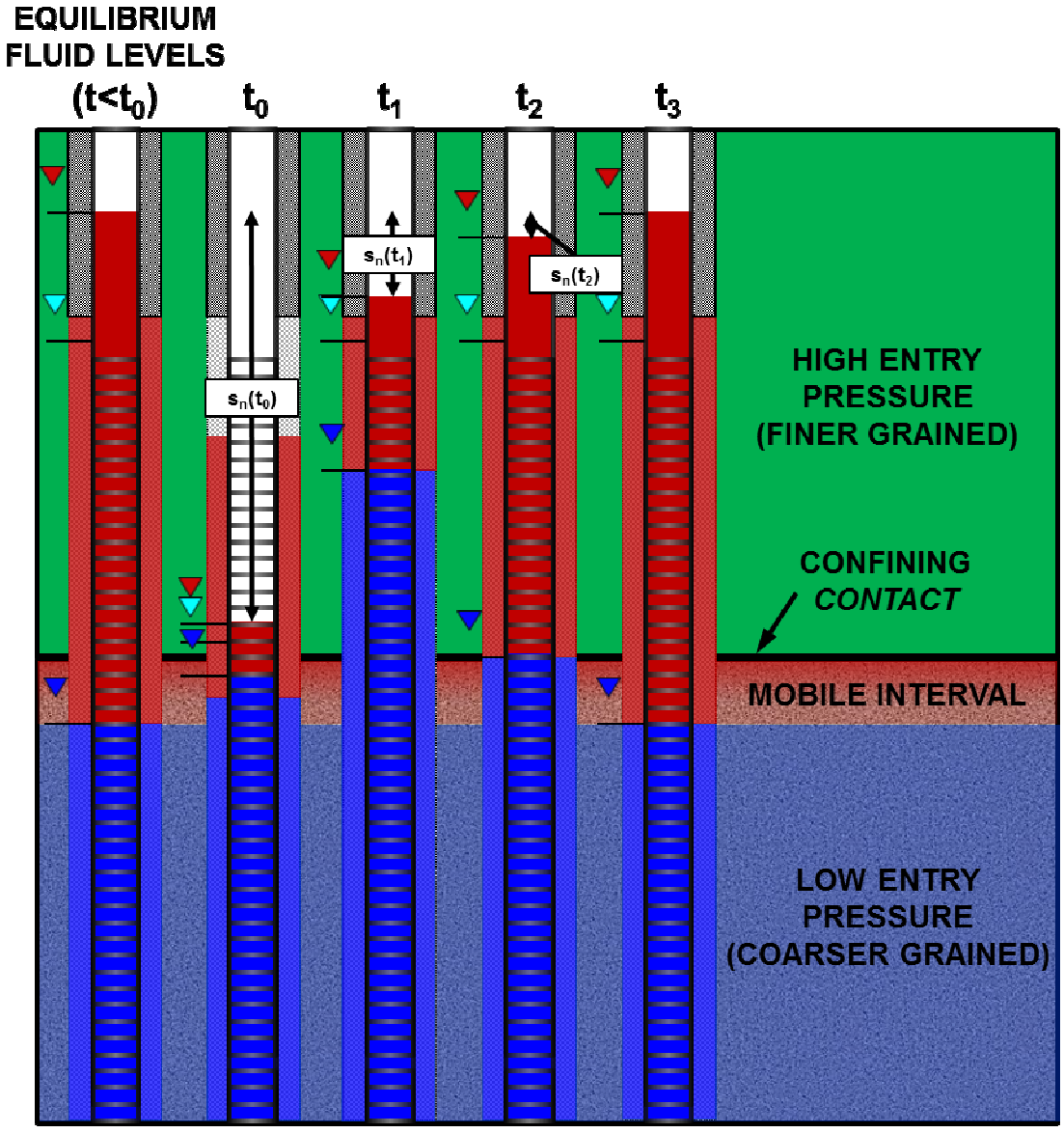
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
Depth bmp (ft)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
LNAPL Thickness (ft)
With conventional methods, we would have gotten these data…
And a few points on days 2 and 3 – then stopped
Potentiometric Surface (ft)
Air-NAPL Interface (ft)
NAPL-Water Interface (ft)
LNAPL Thickness (ft)

Better Data

- Dense data points can help confirm confined LNAPL conditions (verifying CSM)





Modified from Kirkman (2012), ASTM International (2014)

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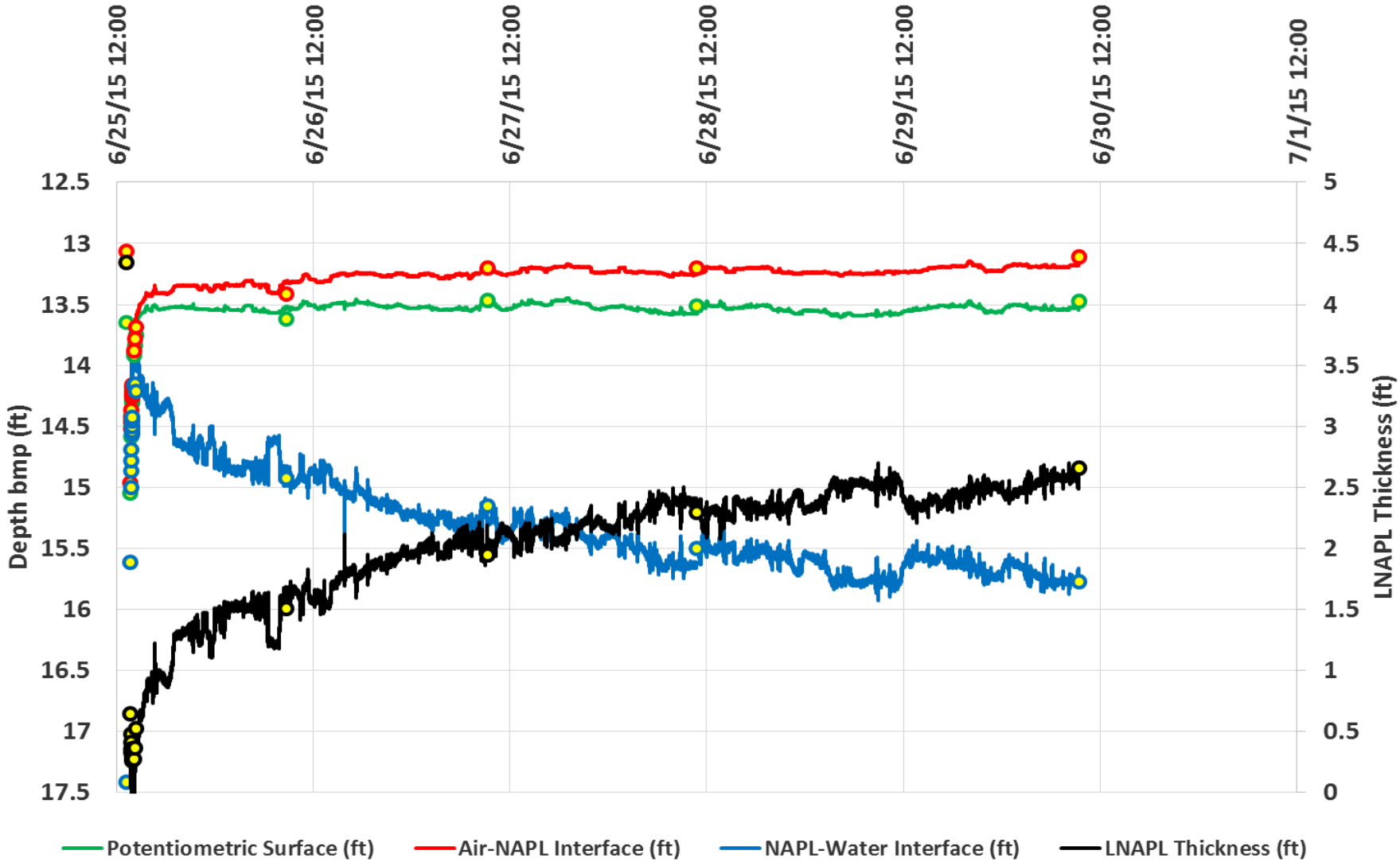
Well 2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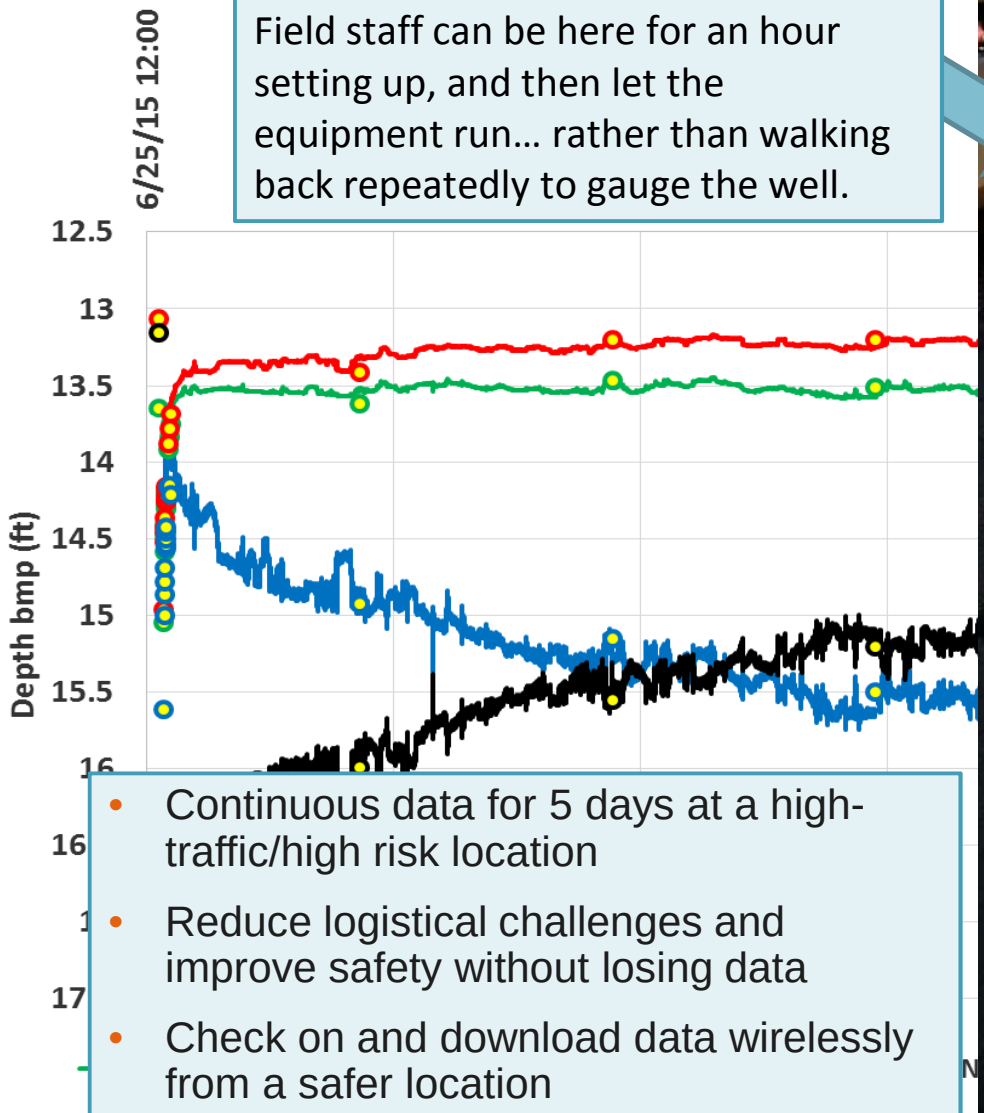
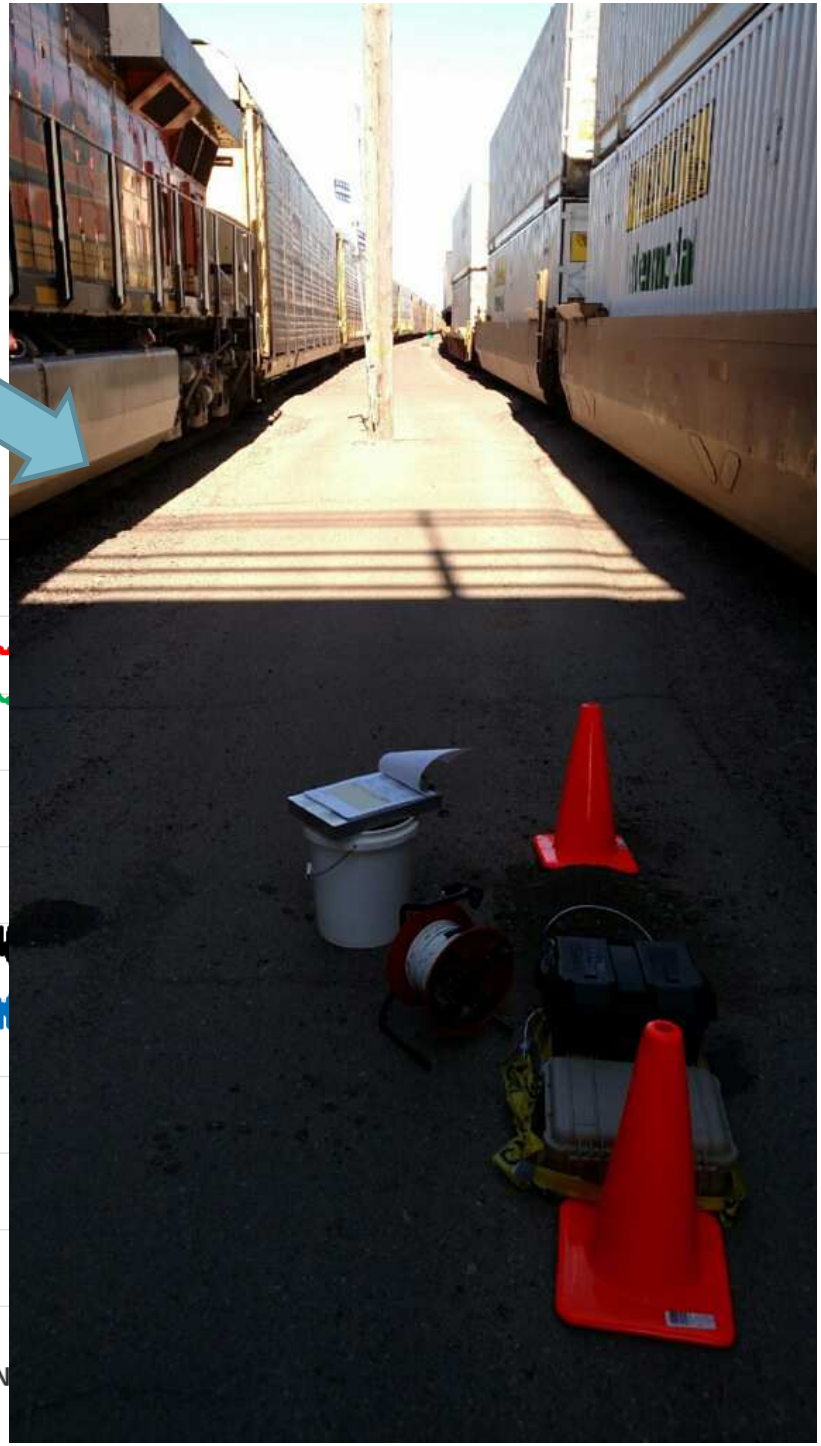
6/27/15 12:00
6/28/15 12:00
6/29/15 12:00
6/30/15 12:00
7/1/15 12:00
Depth bmp (ft)
12.5
13
13.5
14
14.5
15
15.5
16
16.5
17
17.5
LNAPL Thickness (ft)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Potentiometric Surface (ft)
Air-NAPL Interface (ft)
NAPL-Water Interface (ft)
LNAPL Thickness (ft)

Well 2

Field staff can be here for an hour setting up, and then let the equipment run… rather than walking back repeatedly to gauge the well.

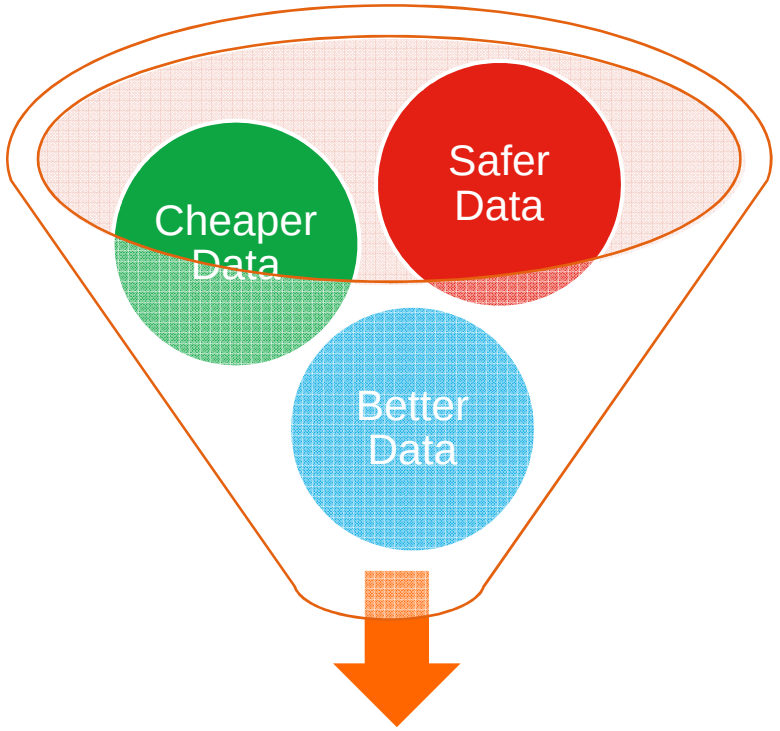


- Continuous data for 5 days at a high-traffic/high risk location
- Reduce logistical challenges and improve safety without losing data
- Check on and download data wirelessly from a safer location



Summary & Questions

- High-density data sets
- More confidence in results
- More efficient field time
- Safer work in high-risk areas



Continuous Improvement in LNAPL Management

Arcadis is pursuing a US patent and more field trials

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