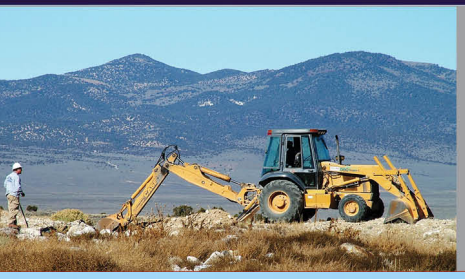



# The Mineral Wool Site

Daniel B. Stephens & Associates, Inc.

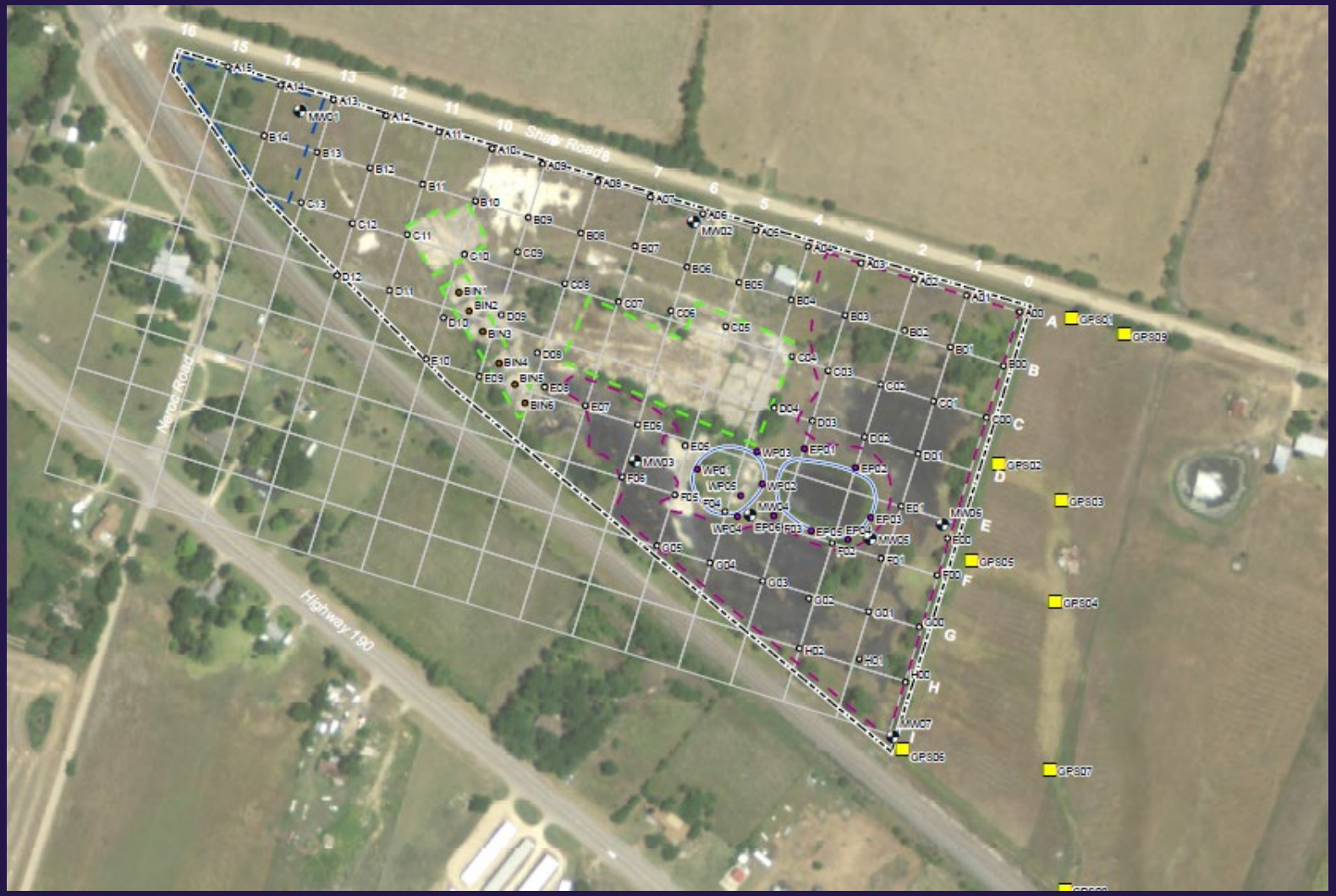
# Mineral Wool Site (1981-1986)

- Blow wool and batt wool manufactured using blast furnaces using copper and antimony slags, limestone, coke and basalts.
  - Wastes consist of cooling waters and slag deposits
  - COCs antimony, copper, lead
- aerial deposition, waste water, surface water runoff
- Initial investigation complete

# Site Features


MINERAL WOOL INSULATION MANUFACTURING
**Site Features Map**

# One way to look at things



# Objective:

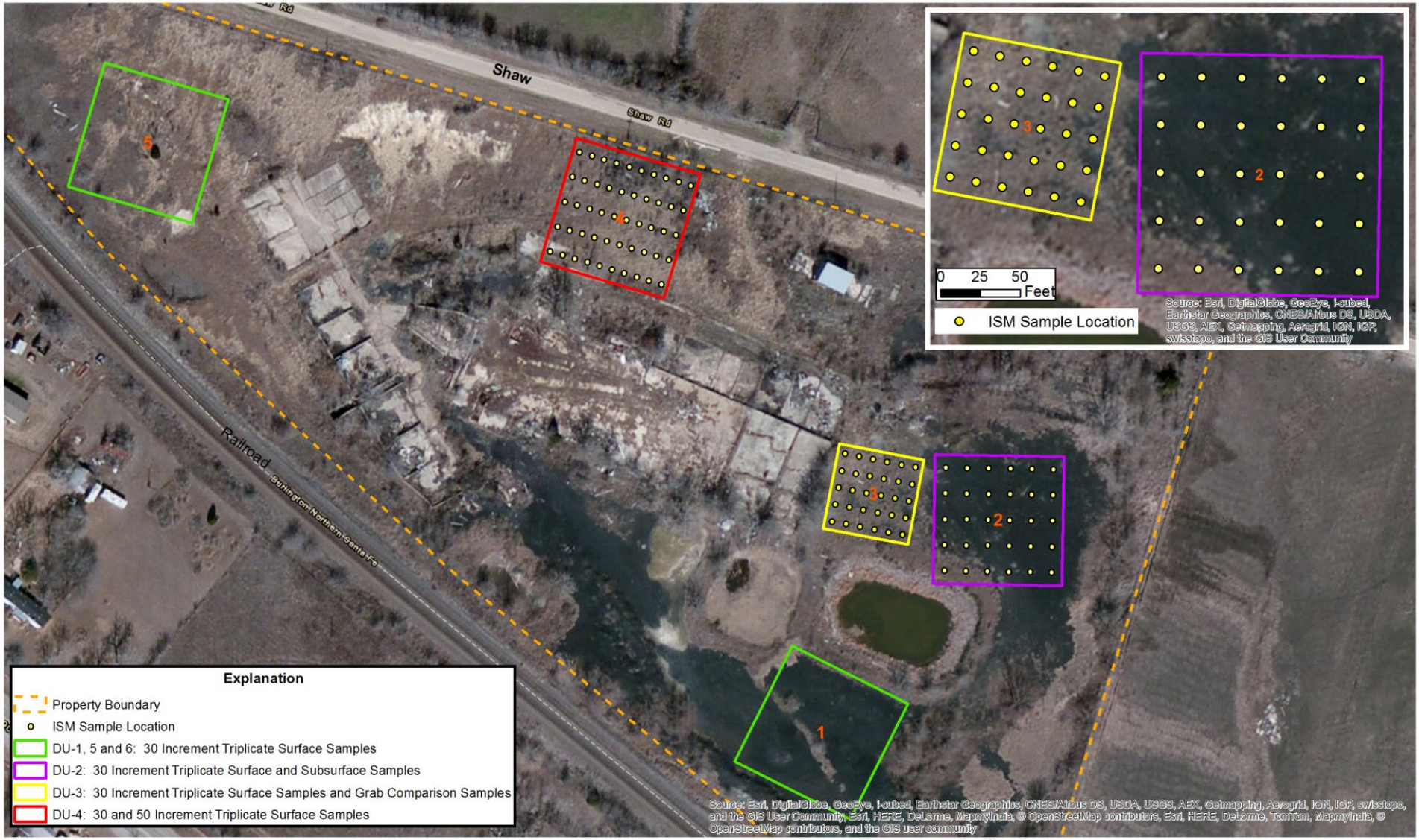
- Compare ISM results with standard investigation results
- Compare ISM results based on number of increments.
- Compare costs from ISM and Standard techniques

*Is ISM better, cheaper, and faster?*

# Decision Units - selection criteria

- Impacted soils identified during the initial RI;
- Locations of stockpiled waste;
- Transition zones between undisturbed soil and waste material;
- Historical Site operations
- Accessibility

# Decision Units



| | Media | Samples | Objective |
|---|---|---|---|
| **DU-1** | Waste | ✓ 3 replicate ISM samples | ✓ Determine representative metal concentrations across DU |
| **DU-2** | Waste, underlying soils | ✓ 3 replicate ISM surface samples<br>✓ 3 replicate ISM subsurface samples | ✓ Determine representative metal concentrations across DU<br>✓ Use subsurface samples to assess vertical migration |
| **DU-3** | On-Site Soils | ✓ 3 replicate ISM samples<br>✓ 30 grab samples | ✓ Determine representative metal concentrations across DU<br>✓ Compare ISM sample with results from 30 grab samples |
| **DU-4** | On-Site Soils | ✓ 3 replicate ISM samples- 30 aliquots<br>✓ 3 replicate ISM samples -50 aliquots | ✓ Collection of 30 aliquot ISM and 50 aliquot sample to assess sample size |
| **DU-5** | On-Site Soils | ✓ 3 replicate ISM samples | ✓ Determine representative metal concentrations across DU s |
| **DU-6** | Background Soil | ✓ 3 replicate ISM samples<br>✓ 16 grab samples (prev. consultant) | ✓ Develop Site Background<br>✓ Compare with previous background calculation |

# How we go about it

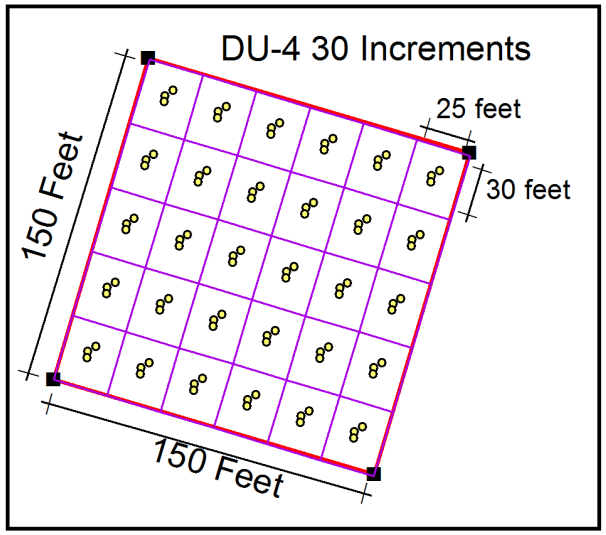
- ISM takes a bit more up - front planning
  - Laying out the DUs
  - Gridding, staking
  - Soil density testing
- More time in field
  - Each sample includes 30 aliquots (1 Kg)
  - 3 replicate samples per DU - 90 increments total per DU
  - Field sieving (homogenize the soil sample)

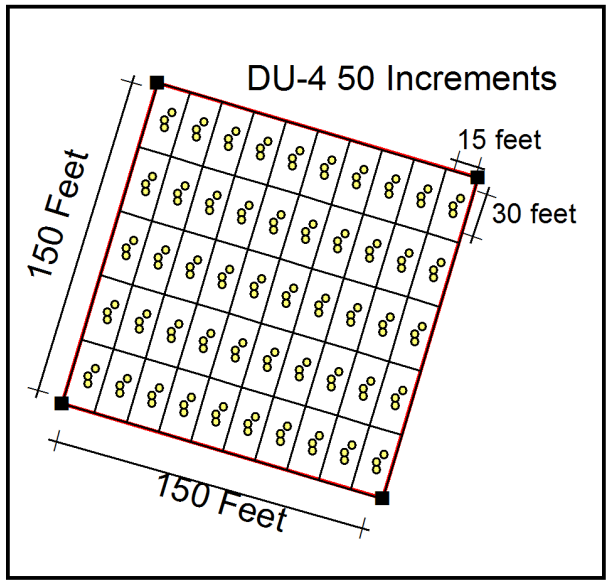
# Setting up the Grid

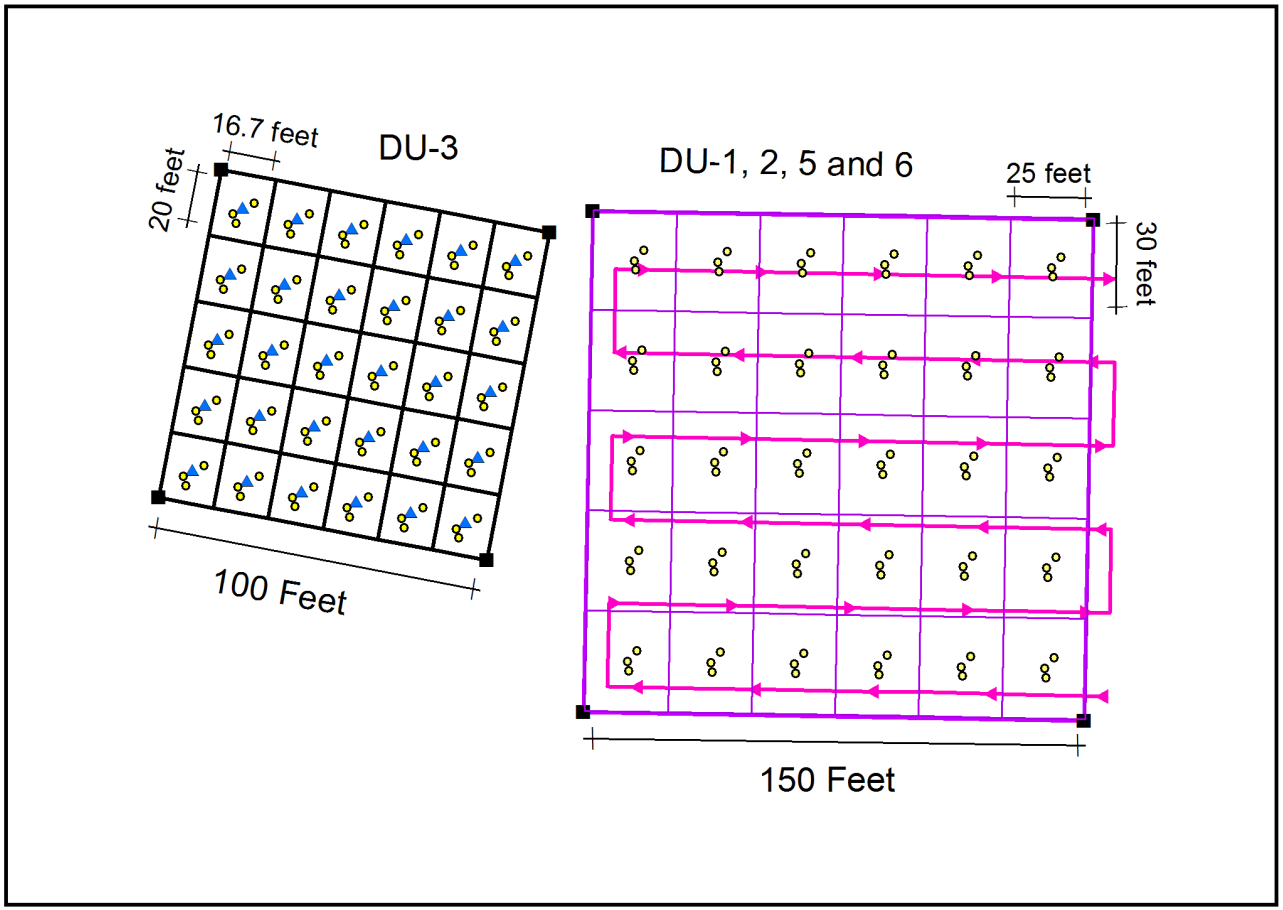
- Pin flags at center of each cell
- Red and green tape represent the cell boundary.

# Selected ISM Sample Tool

# Sampling Methodology




ISM Sample (Triplicate)
Grab Sample
Sample Collection Path

N

MINERAL WOOL INSULATION MANUFACTURING
**Sampling Grid Layout Map**

# Waste vs. Undisturbed Soil

# Grab Samples - Diverse Soils at DU-3

# Selecting the laboratory

- Not as easy as you think
- Best if they've done ISM sample analysis in the past
  - Sample size is larger
  - Grinding / sieving may be necessary
  - Sub-sampling involved
  - Additional laboratory prep costs
- Don't surprise a lab with unexpected ISM samples - everyone loses

# Sample Prep

- 1-2 Kg Sample
  - Sieved
  - Mixed
  - Flattened
  - Quartered
  - 30 lab sub-samples

# Looking at the data

- Individual DUs
- 30 vs. 50  increment (DU-4)
- 30 increment (DU-3) vs. 30 grab samples
- 30 increment Background (DU-6) vs. 16 background grab samples

# Individual DUs

- Comparison based on relative percent difference (RPD):
- $RPD(\%) = \frac{|Result1 - Result2|}{(Result1 + Result2)/2} \times 100\%$
- Keeping the test method in mind, we want an RPD <25%

*With the exception of the COCs, Pb and Sb, pretty good results*

# Background ISM vs. Grab samples

- Using the previously collected data, an upper confidence level ($UCL_{95}$) was calculated and compared to ISM results
- ISM concentrations higher than the $UCL_{95}$ values

*ISM did a better job addressing variance than grab samples 16 samples*

# 30 increments vs. 50 increments

- Compared RPDs for both data sets
- RPDs for 30 increments comparable with 50 increments
- No benefit from the additional samples

# 30 Grab Samples vs ISM

- Straight average of 30 grab samples compared to ISM (30 increments).
- The arithmetic average of grab samples improves as the number of grab samples increases.

*Approximately 30 grab samples or more would be needed to characterize DU-3*

# Grab Samples

- Don’t address site heterogeneity
- Are not cheaper if you collect enough to be statistically representative
- Do not adequately define site risks

# ISM vs Grab Samples per DU

| Stage | Activities | ISM (n=90) | Grab (n=30) | Grab (n=15) | Grab |
|---|---|---|---|---|---|
| **Mobilization** | Sample Prep<br>Equipment<br>Site Visit | $190 | $62 | $36 | $3 |
| **Field** | Surveying<br>Sampling<br>Labeling | $157 | $328 | $146 | $10 |
| **Laboratory** | Sample Prep<br>Sample Analysis<br>QC Samples | $825 | $5,155 | $2,635 | $341 |
| | Total | **$1,173** | **$5,055** | **$2,817** | **$354** |

# Cost Evaluation

- Labor costs higher for ISM sampling
- Labor costs converge as the number of grab samples increases.
- The true costs savings lie in the lab costs, where ISM is significantly less expensive than multiple grab samples

# Conclusions

- 30 increment ISM samples appear to be sufficient for adequately determining concentrations within a DU at the Site when comparing ISM samples, an equal number of grab samples, and a smaller background data set.
- ISM results were reproducible and eliminate site heterogeneity as an issue in decision-making
- For the cost of 3 ISM samples per DU, defensible data can be collected