Schipper's Crossing

Case Study: Incremental Sampling for a Former Small Arms Practice Range

Environmental Remediation and Risk Management Conference

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Agenda

- Overview of Incremental Sampling (IS)
- Site History
- Project Objectives
- Sampling Plan Design
- Implementation and Results
- Lessons Learned
- Questions?

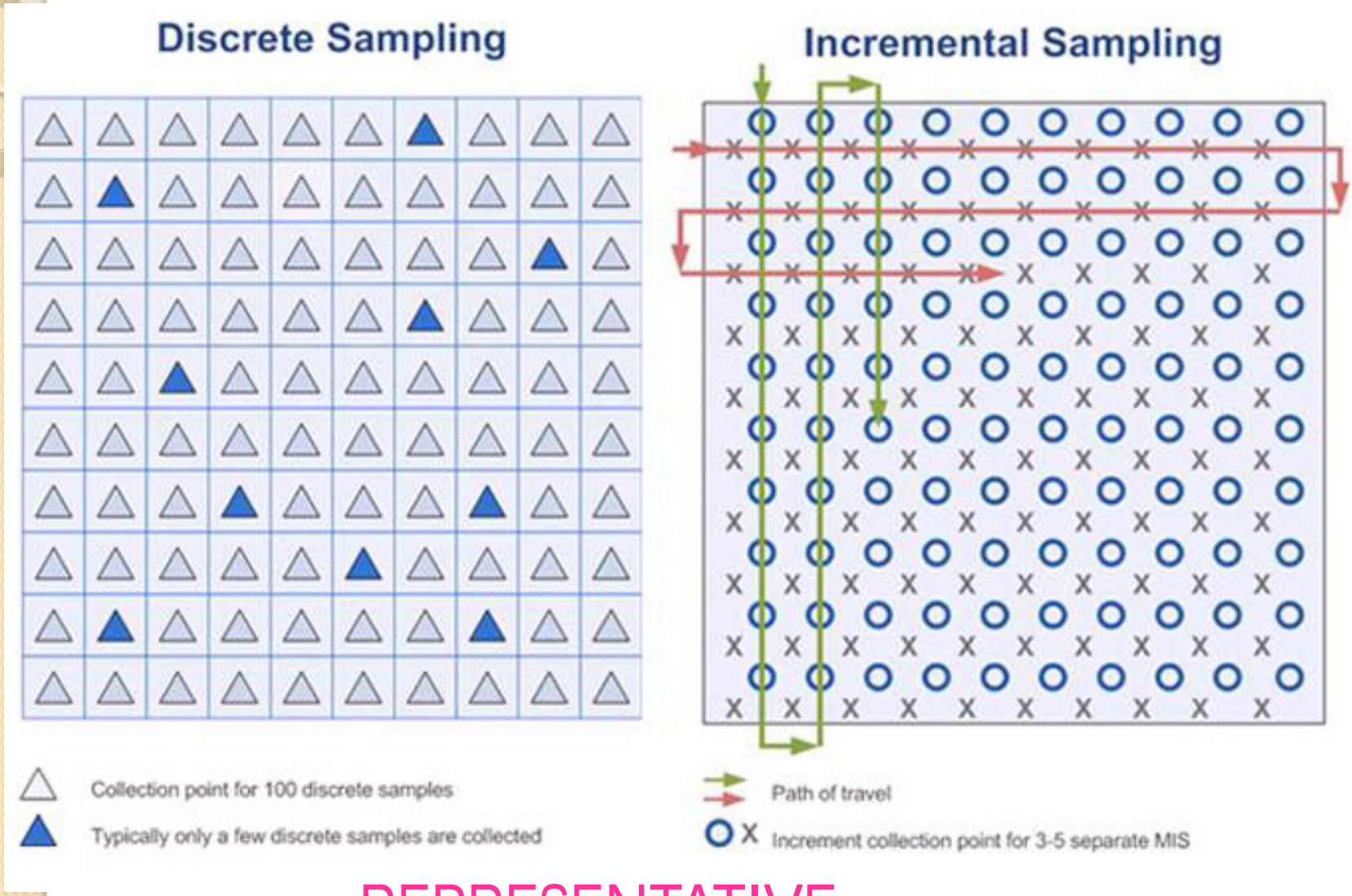
Overview: Incremental Sampling Methodology (ISM)

- Provides representative, reproducible, and defensible data
- Reduces sampling and laboratory error
- Reduces chances of missing or underestimating significant contamination
- Provides an accurate average concentration for any constituent in an area
  - Discrete sampling: Calculation of the average concentration from multiple samples
  - Incremental sampling: Measurement of the average concentration from a single sample

IS is **not** Composite Sampling

Quality	IS	Composite
DQO process	Yes	Should
Increments	Min 30 – 50	Undefined
Decision Unit	Yes	Undefined
Sample mass considered	Yes	Generally Not
Acceptable error considered	Yes	Generally Not
Reduce heterogeneity	Yes	Generally Not
Subsampling	Yes	No
Aliquot mass considered	Yes	Generally Not
Encouraged within RRD	Yes	No

Discrete vs. Incremental



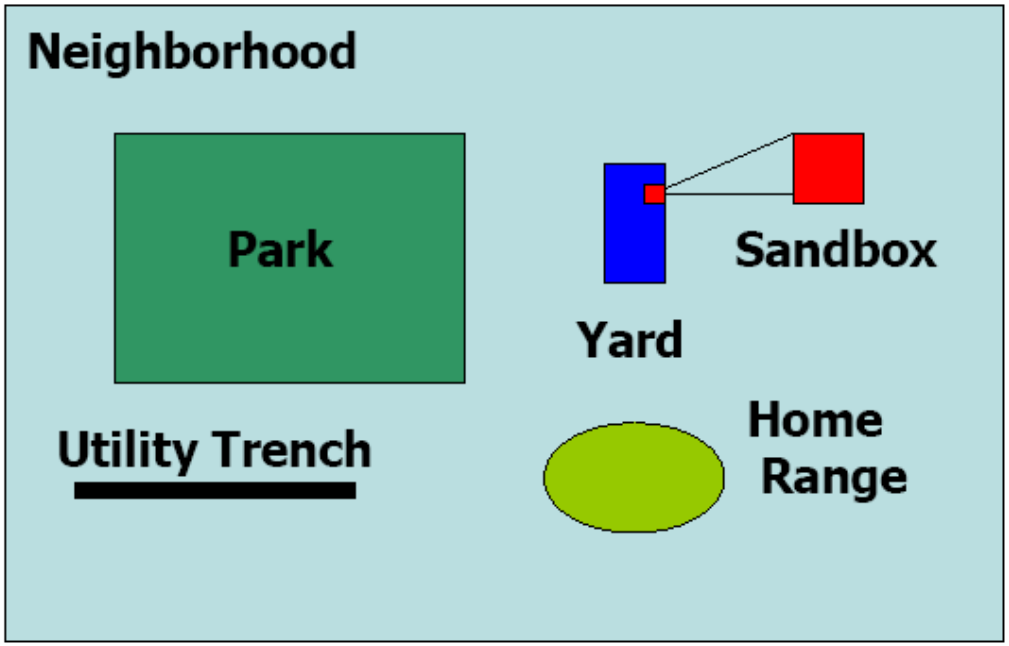
REPRESENTATIVE

IS Methodology

- Part 1: Define Project Objectives (applies to all sampling methods)
- Part 2: Field Implementation
- Part 3: Laboratory Preparation and Analysis

IS Methodology

- Part 1: Define Project Objectives
  - Develop Conceptual Site Model
  - Establish Data Quality Objectives (i.e. EPA Seven Step DQO Process)
  - Identify Potential Exposures
  - Define Decision Units
  - Develop Sampling Plan

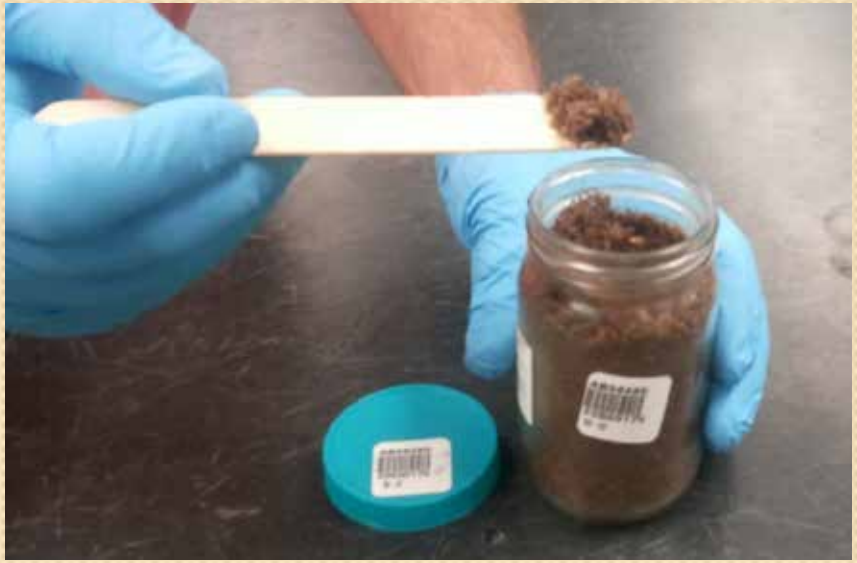


IS Methodology

- Part 2: Field Implementation
  - Collect multiple (>30 to 100) increments of uniform size from the entire decision unit
  - Combine increments into a single 1 to 2 kilogram sample
- Part 3: Laboratory Processing and Analysis
  - Air drying and sieving entire sample
  - Particle size reduction (grinding) of entire sample (if required. May not be appropriate for malleable metals.)
  - Increment sub-sampling (>30 increments) to provide representative aliquot for analysis

Part 3: Laboratory Processing and Analysis

IS Laboratory Processing is designed to <u>retain representation</u> of the sample collected in the field.



IS Program Applicability

- ü Part 201
- ü Part 213
- ü Superfund
- ü Brownfields
- ü Due Care
- ü Solid Waste

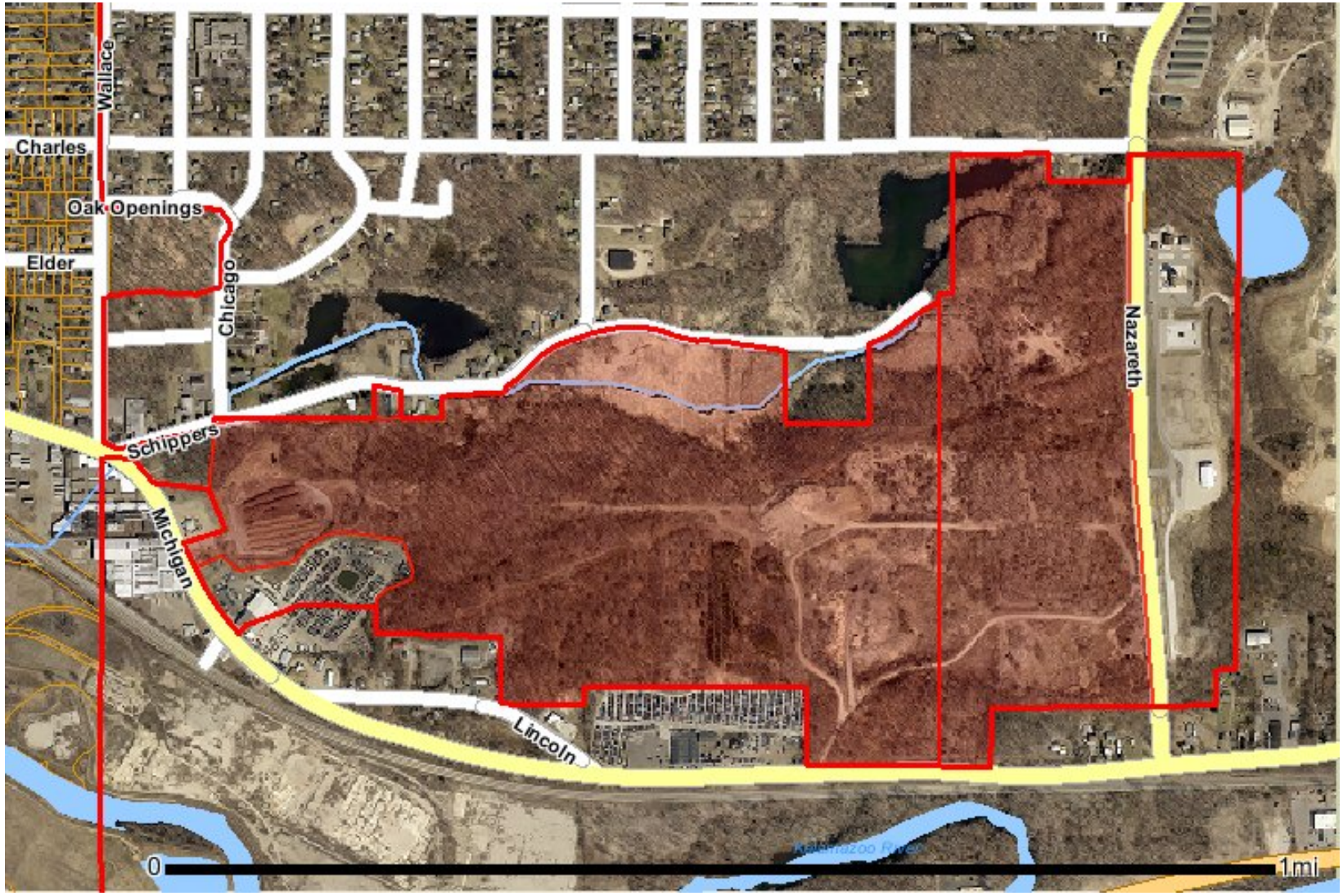
IS Site Applicability

- ü Shooting ranges
- ü Spill areas
- ü Airborne deposition to soils
- ü Historic pesticide uses (orchards)
- ü Wetland, stream, river, lake shore sediments
- ü Excavation sidewalls and floors
- ü Soil borings and cores
- ü Utility trenches
- ü Waste Piles
- ü Can be used for all types of contaminants

Schipper's Crossing: Site History

- Approximately 160 acres of land located on Kalamazoo's east side.
- Historical Operations Include:
  - Wastewater Solids Disposal Area
  - PSTA Small Arms Range
- Currently used for wood chip storage
- Sampling presented is in support of NFA

Schipper's Crossing: Aerial View



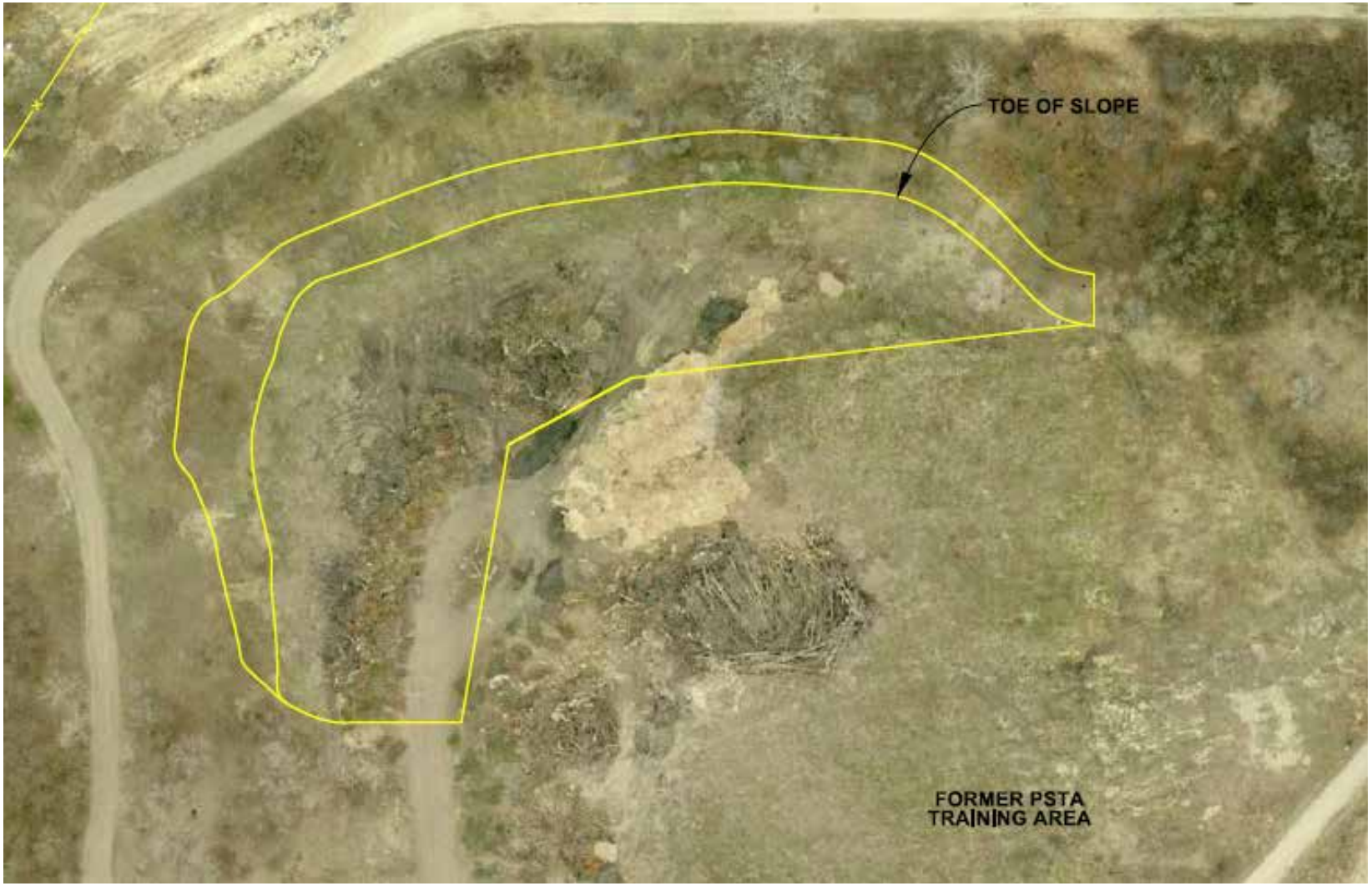
Schipper's Crossing: Former Small Arms Training Area

Current Use

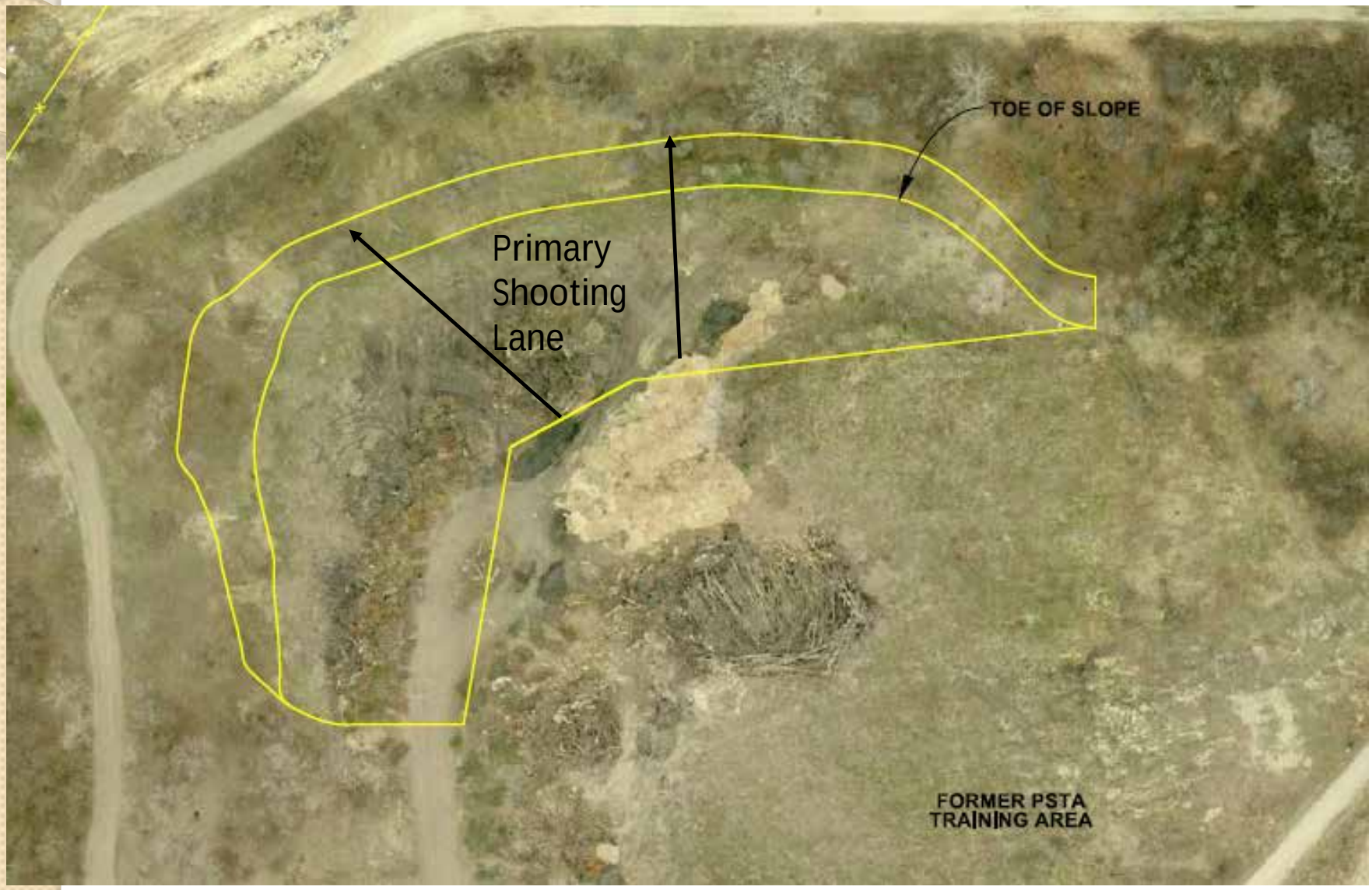
Historical Limitations

- Known small arms range.
- Layout of targets and firing line unknown.
- Position of firing line interpreted from a linear object in an old low resolution aerial photo.
- Primary firing direction believed to be to the north
- Some evidence that the west wall had also be used to a lesser extent.

Sampling Objective: Does Lead Exceed Non-Res Direct Contact (900 mg/kg) Criteria



Primary Shooting Lane



Backstop Along Shooting Line

Looking South From Backstop

Historical Lead Soil Data (Discrete)

- A total of 17 soil samples previously analyzed
- Results Ranged from 2.3 to 94 mg/kg
- Average: 23.3 mg/kg
- Standard Deviation: 28.6
- Coefficient of Variance (COV): 1.22
- Non-Residential Direct Contact Criteria: 900 mg/kg

Sampling Methods

- ISM vs Discrete
- Floor and backstop are 70,000 sq. ft. each
- Calculated Sample Grid for discrete of approximately 35 feet
- Similar to grid for ISM
- Assuming 25% = minimum of 72 discrete samples
- With ISM = Proposed 27 incremental samples (30 to 50 increments/sample)
- ISM Selected for maximum coverage

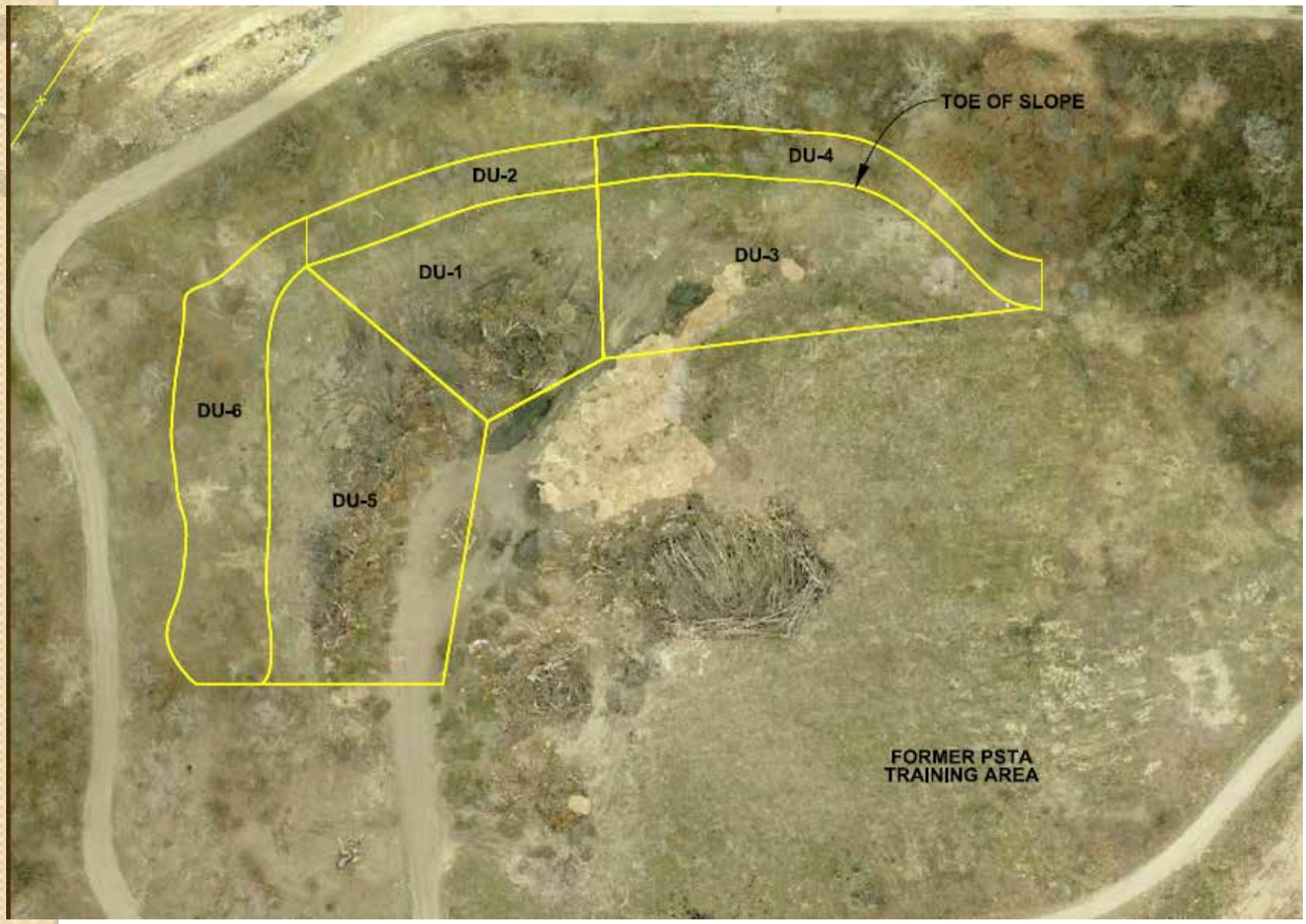
Sampling Plan Design Process

- Conceptual Site Model
- Determined Data Quality Objectives
- Developed Sampling Plan
- Sampling Plan Reviewed by DEQ
- Optimized Sampling Plan
- Post-IS: Share and discuss results with City of Kalamazoo and DEQ

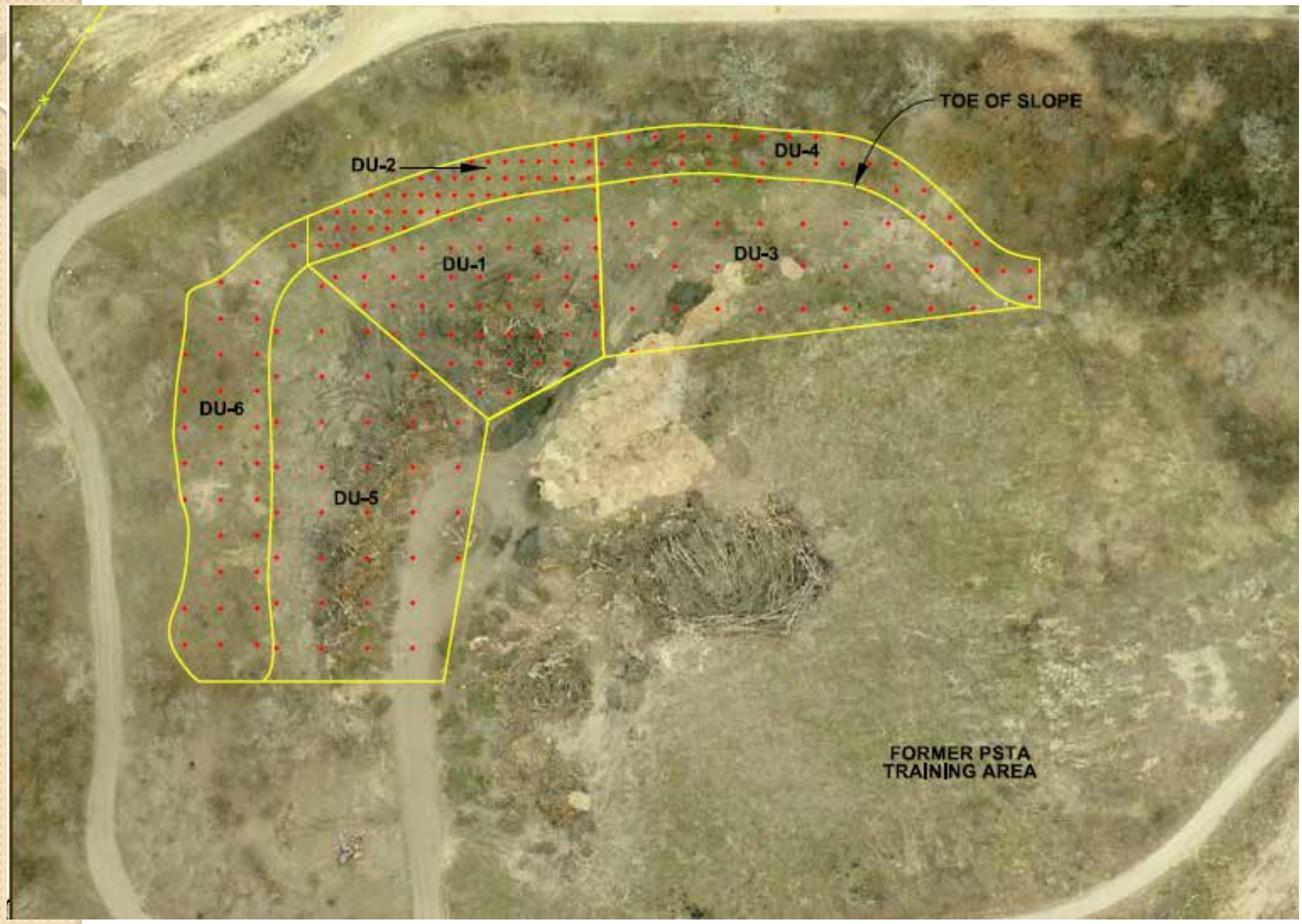
Nine Decision Units

- Six Surficial Units
- Three Sub-surface Units
- Three surficial samples (triplicates) were obtained at each decision unit.
- Three additional samples were obtained from a depth of 1.25 to 2.0 ft into the backstop to account for bullet penetration (each sub-surface unit).

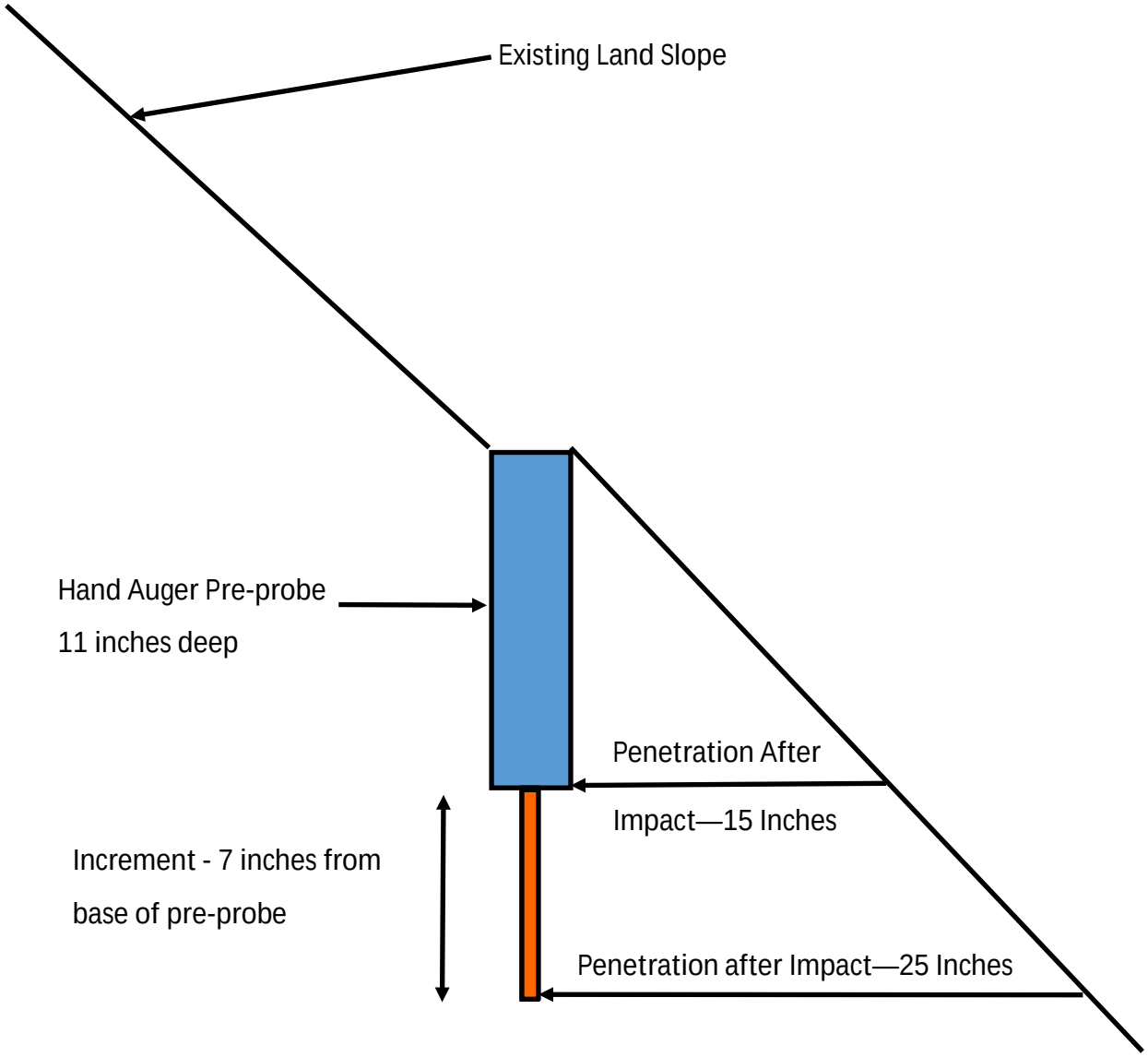
Area Divided Into Decision Units

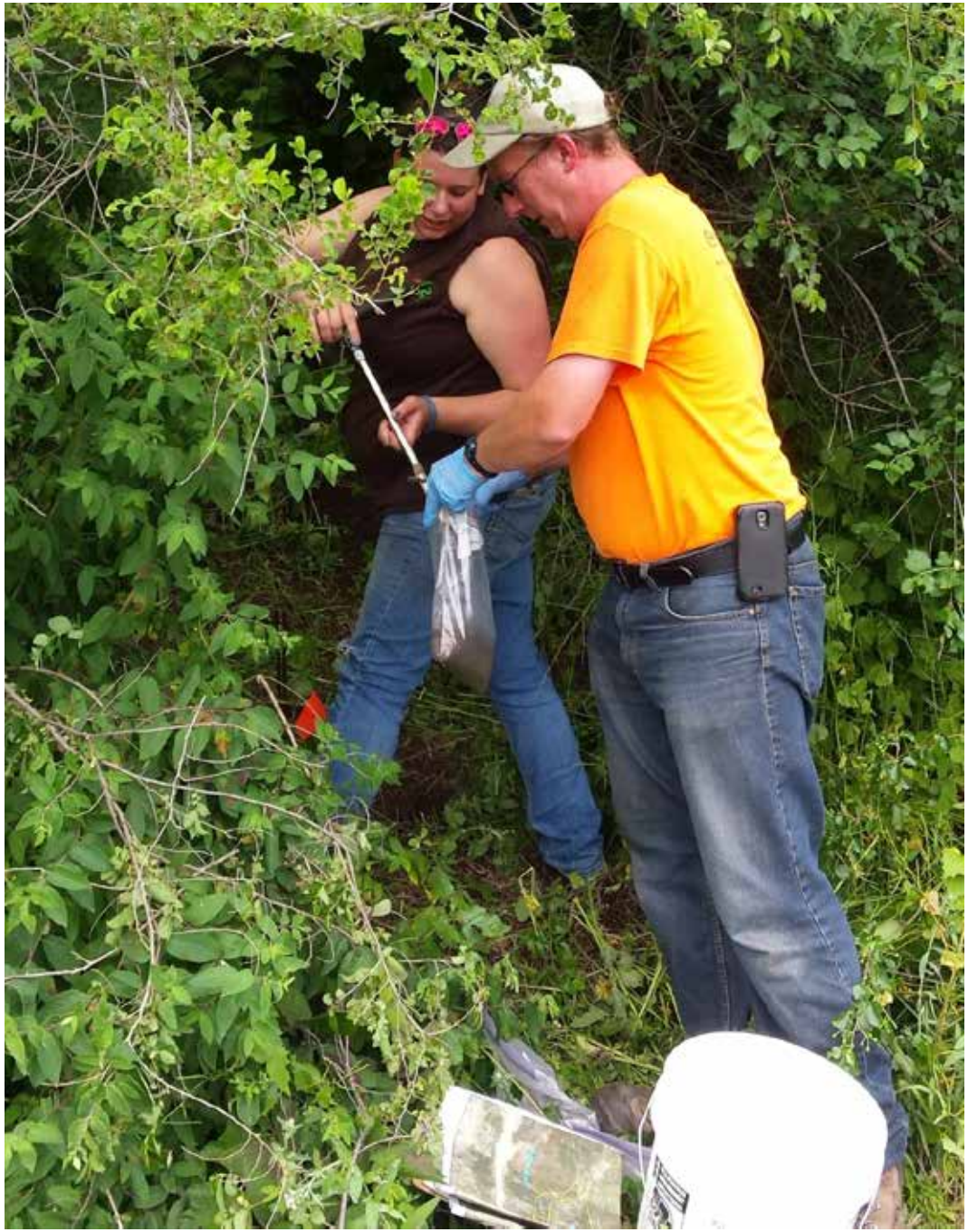


Increment Locations



Vertical Sampling in Backstop





Floor Surficial Soil Samples

Decision Unit	Sample ID	Result (ug/kg)	Average	Standard Deviation	Coefficient of Variance
DU-3					
	DU-3A	51,000	47,333	4,726	0.10
	DU-3B	49,000			
	DU-3C	42,000			
DU-1					
	DU-1A	440,000	197,000	210,450	1.07
	DU-1B	77,000			
	DU-1C	74,000			
DU-5					
	DU-5A	30,000	36,000	5,292	0.15
	DU-5B	40,000			
	DU-5C	38,000			

Backstop Surficial Soil Samples

Decision Unit	Sample ID	Result (ug/kg)	Average	Standard Deviation	COV
DU-2 Shallow					
	DU-2A	57,000	56,000	11,533	0.21
	DU-2B	44,000			
	DU-2C	67,000			
DU-4 Shallow					
	DU-4A	30,000	193,333	202,567	1.05
	DU-4B	420,000			
	DU-4C	130,000			
DU-6 Shallow					
	DU-6A	42,000	72,000	42,000	0.58
	DU-6B	120,000			
	DU-6C	54,000			

Backstop 1.25 to 2.0 Feet Deep

Decision Unit	Sample ID	Result (ug/kg)	Average	Standard Deviation	Coefficient of Variance
DU-2 Deep					
	DU-2A	39,000	34,667	8,386	0.24
	DU-2B	40,000			
	DU-2C	25,000			
DU-4 Deep					
	DU-4A	22,000	31,333	14,468	0.46
	DU-4B	48,000			
	DU-4C	24,000			
DU-6 Deep					
	DU-6A	31,000	37,000	11,269	0.30
	DU-6B	50,000			
	DU-6C	30,000			

Lessons Learned

- There may still be considerable variation in samples, especially when dealing with particulates.
- Additional sample preparation (milling) would have been helpful to reduce variability, especially if this had been a residential application.
- ISM is cost effective in comparison to discrete sampling methods.

Contact Information

- Questions?
- Contacts:

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Thank you!