Leveraging Data-Driven Decision Making in a Large-Scale Field Study Simulating a Biological Contamination Incident

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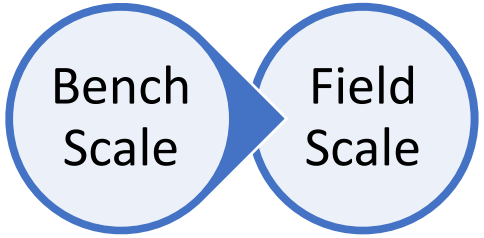
CENTER FOR THE REMEDIATION OF COMPLEX SITES
@PNNL

November 13-17, 2023

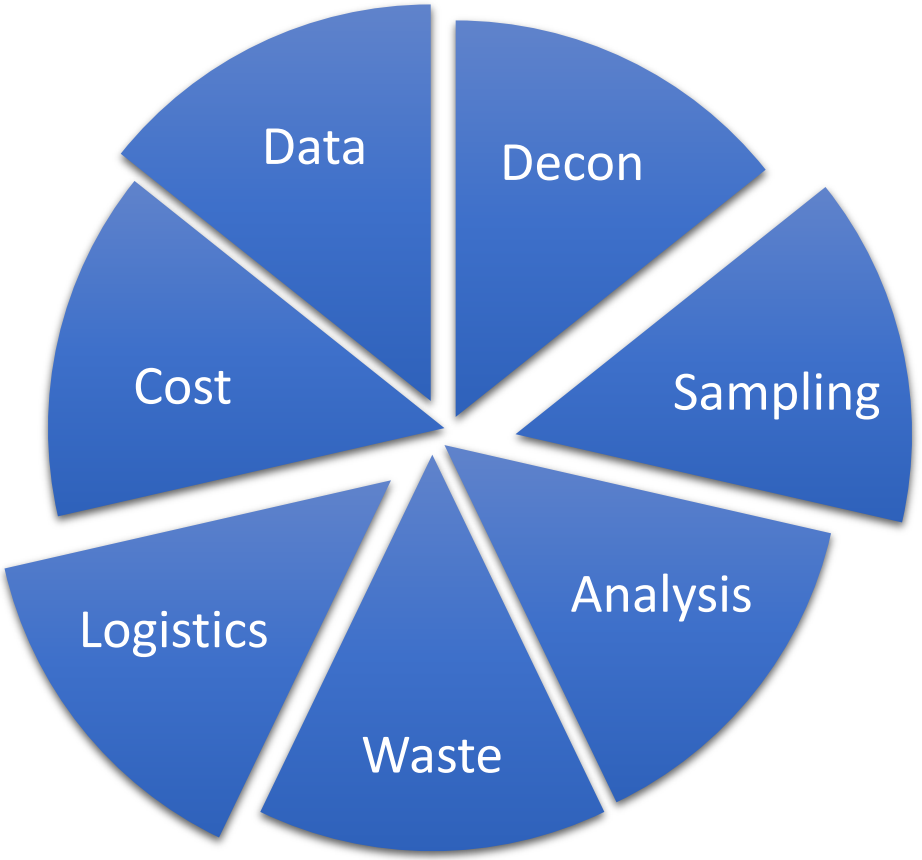
AnCOR Program

- **An**alysis for **C**oastal **O**perational **R**esiliency
- Interagency effort involving the EPA, Department of Homeland Security Science and Technology Directorate (DHS S&T), and the United States Coast Guard (USCG)
- Develop and demonstrate capabilities and strategic guidelines to prepare the U.S. for a wide-area release of a biological agent, including mitigating impacts to USCG facilities and assets
- Provide guidance and tools to USCG to respond to a biological agent incident

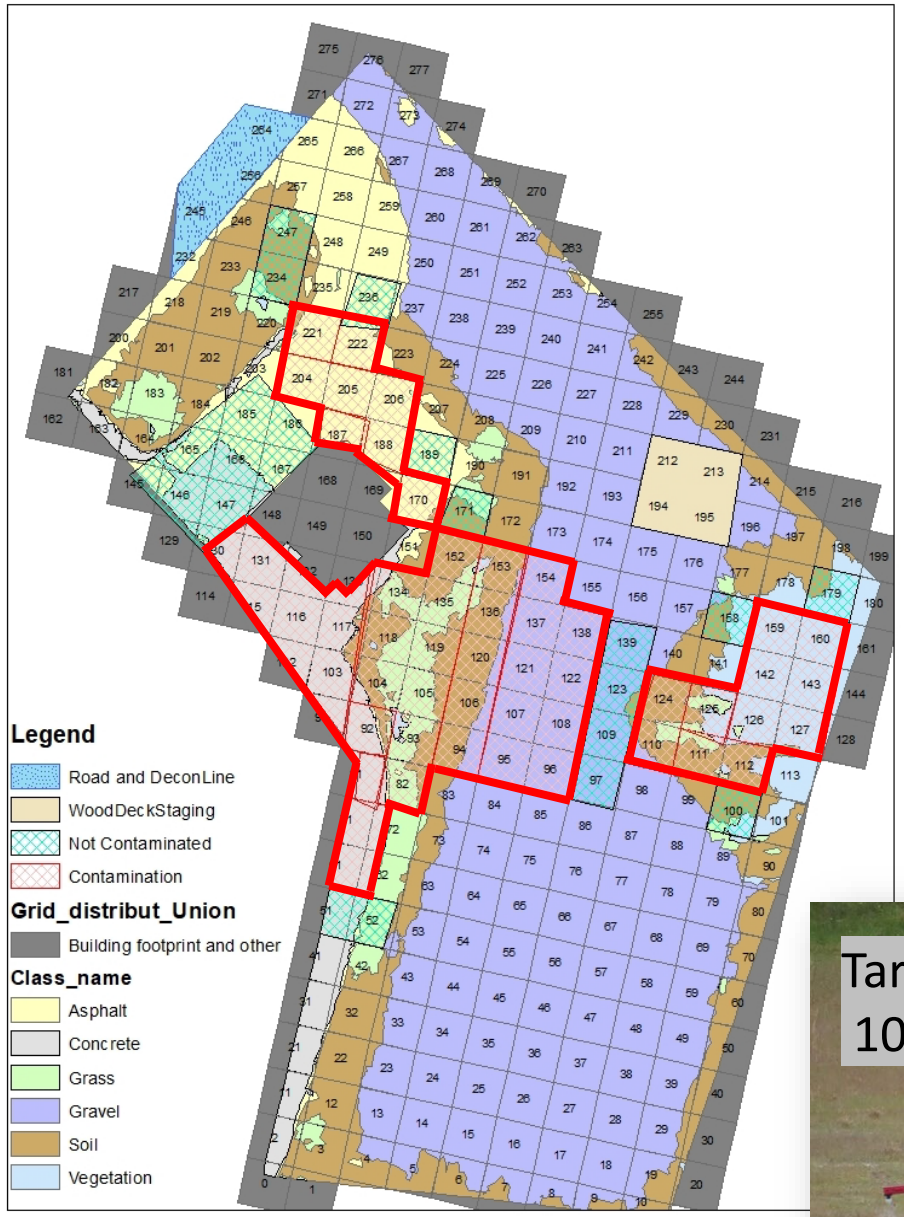


AnCOR Wide-Area Demonstration

- Large field-scale exercise at Fort AP Hill, Virginia
- May 2022
- Incorporate components of emergency response:
  - Decontamination (Decon)
  - ***Sampling and Analysis***
  - PPE Donning and Doffing
  - Personnel Decon
  - Waste Management
  - ***Data Collection and Management***
  - Cost and Effort

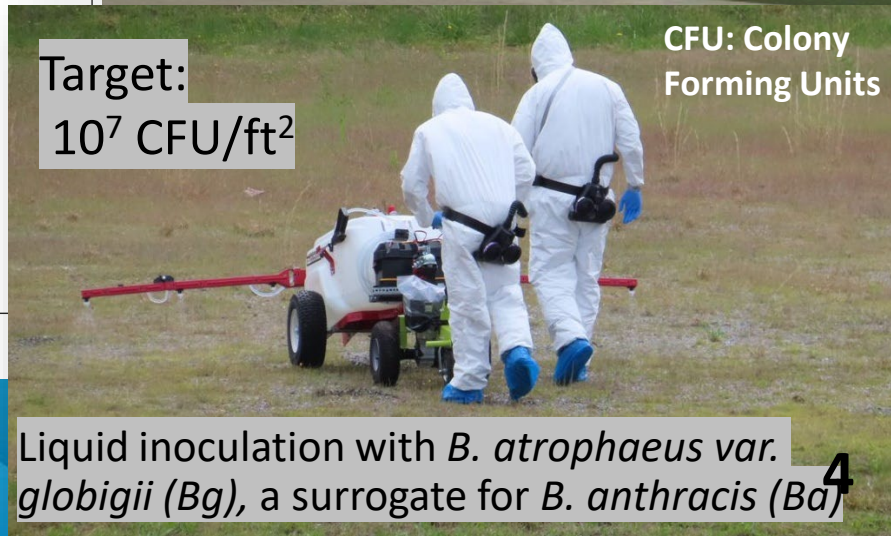


- 2.2-acre footprint
- 20x20 ft grid cells over study area
- Not all areas were inoculated, but everything was decontaminated



GIS used to define ground surface type to inform sampling plan

60’ Tall Concrete Building



Liquid inoculation with *B. atrophaeus var. globigii (Bg),* a surrogate for *B. anthracis (Ba)*

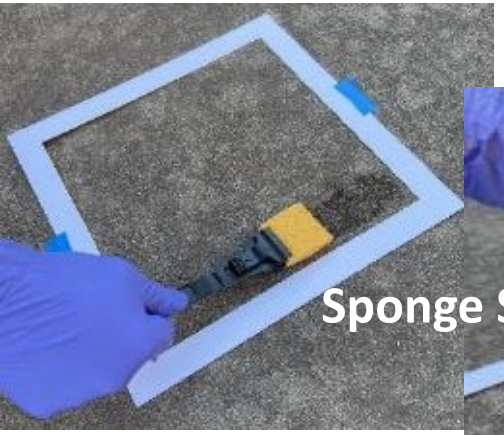
Sampling Objectives

- **Demonstrate the ability to scale-up traditional biological sampling methods in an outdoor setting**
- **Test newly developed and/or non-traditional sampling methods in an outdoor setting**

Three rounds of sampling:

- ***Background:*** Determine the presence of background concentrations of *Bg* spores prior to inoculation
- ***Pre-Decon:*** Characterize the magnitude of *Bg* contamination following inoculation
- ***Post-Decon:*** Determine if application of the decontamination chemicals (peracetic acid (**PAA**) for vegetative soft surfaces and high-test hypochlorite (**HTH**) for hard surfaces) effectively reduced contamination compared to pre-decon levels

Biological Sampling Methods



Sponge Sticks

Grab: Grass
(new/experimental)

Air: Dry Filter Unit (DFU)

Grab: Ground Litter

Grab:
Leaves

Grab: Gravel

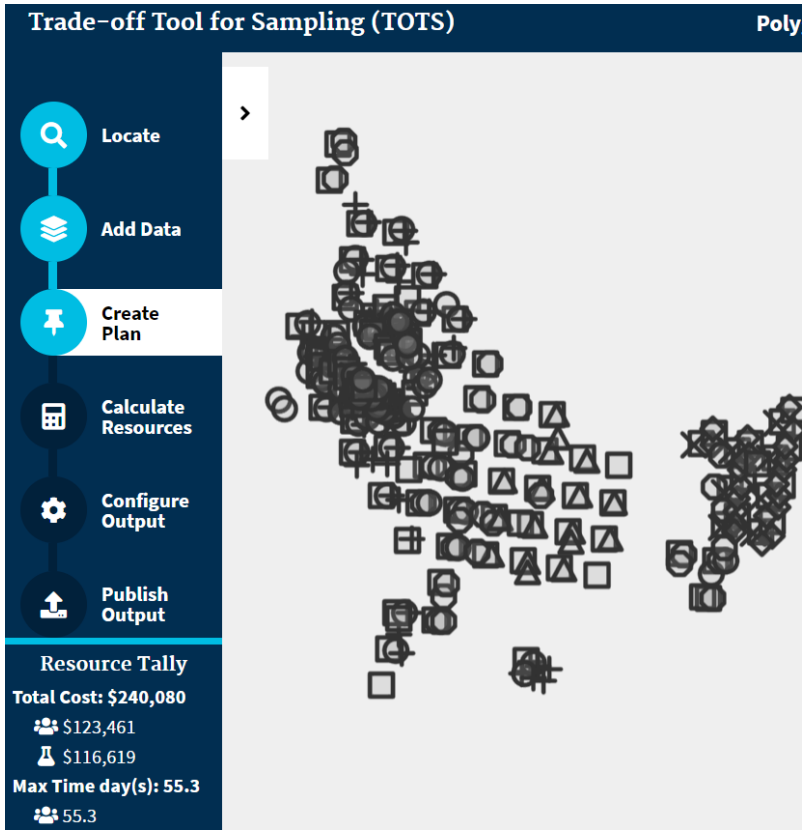
37-mm filter cassette
(microvacuum)

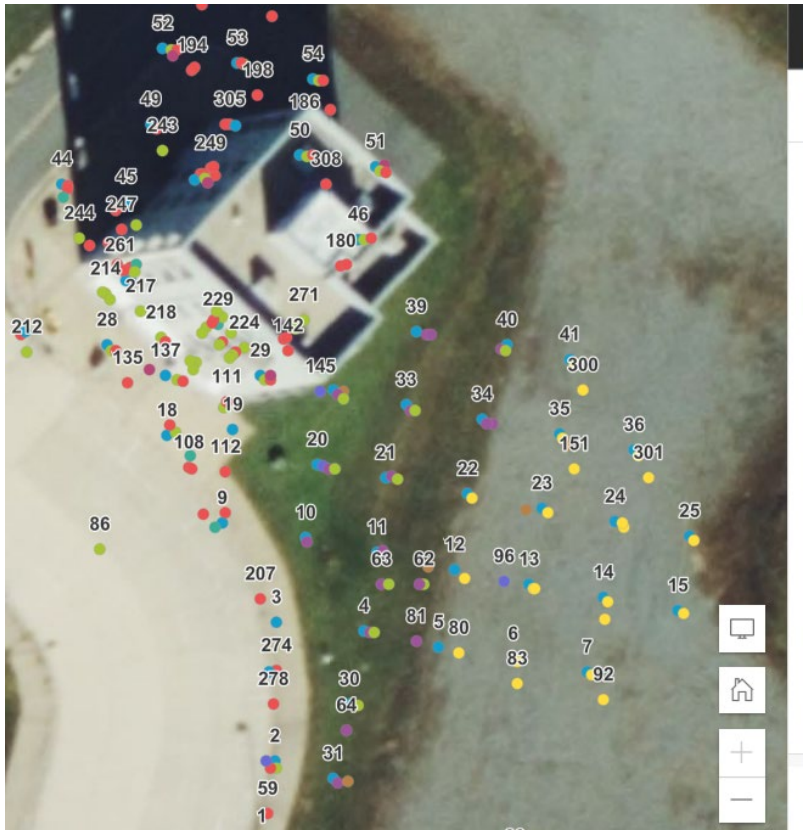
(new/experimental)

CBR Data Management

- Chemical, Biological, or Radiological (CBR) incidents can introduce many challenges when managing data
- A substantial amount of data will need to be collected, checked for quality, and maintained to support decision-making
- Depending on the size and scope of the incident, such an undertaking could continue for many years or decades
- Data collected during a response could include sample location, sample description, and analysis results

Sample Plan Design





Determine Cost/Time Feasibility
Trade-off Tool for Sampling

Assign **Location IDs** & Instructions
ESRI Cloud

Align Vertical Samples
ESRI Cloud

Grab, 37-mm Filter Cassette, and Sponge Stick Samples

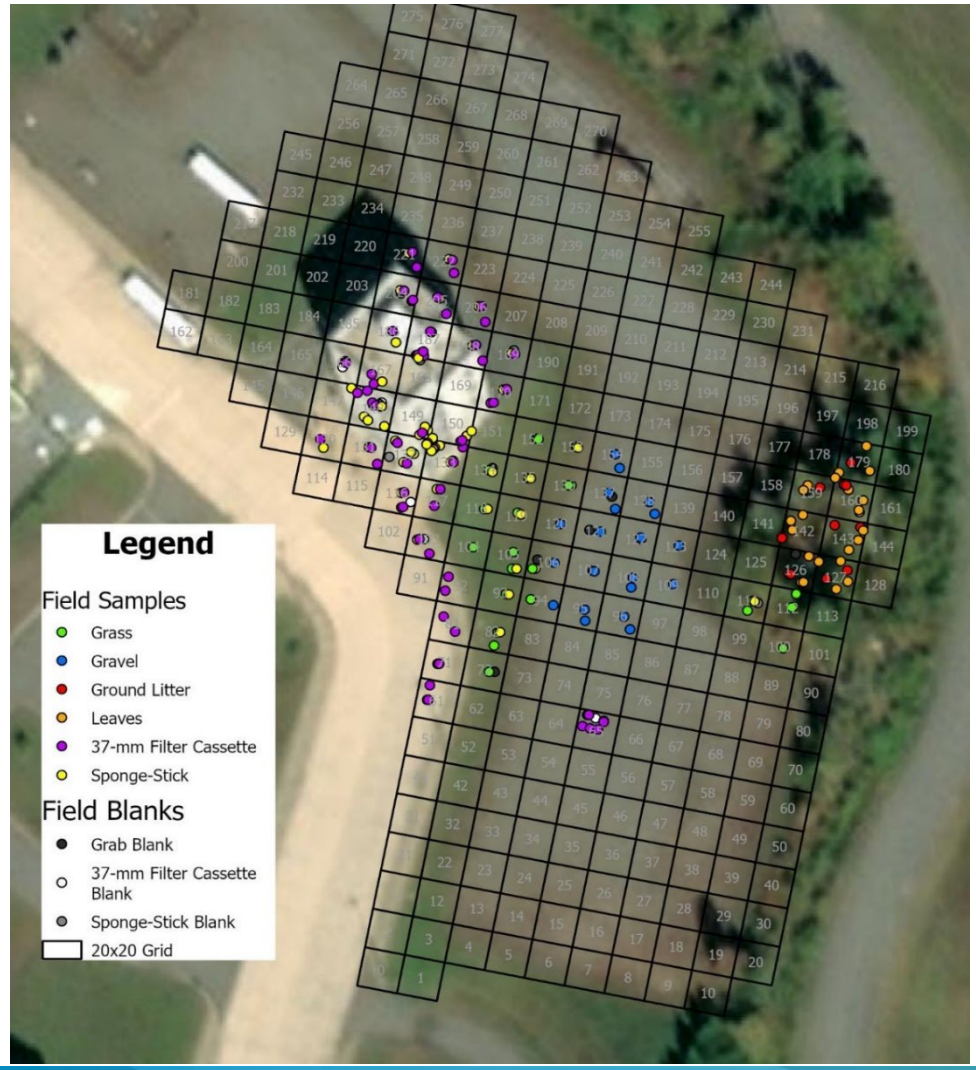
Background Sampling

- **35** field samples and **6** field blanks
- **9** media blanks
- Samples were collected in a subset of the WAD study area

Pre- and Post-Decon Sampling

- **200** field samples and **20** field blanks *each*
- **11** media blanks *each*
- Pre- and Post-Decon Samples were paired to compare results before and after decontamination
- A subset of the samples were collected outside the contamination zone

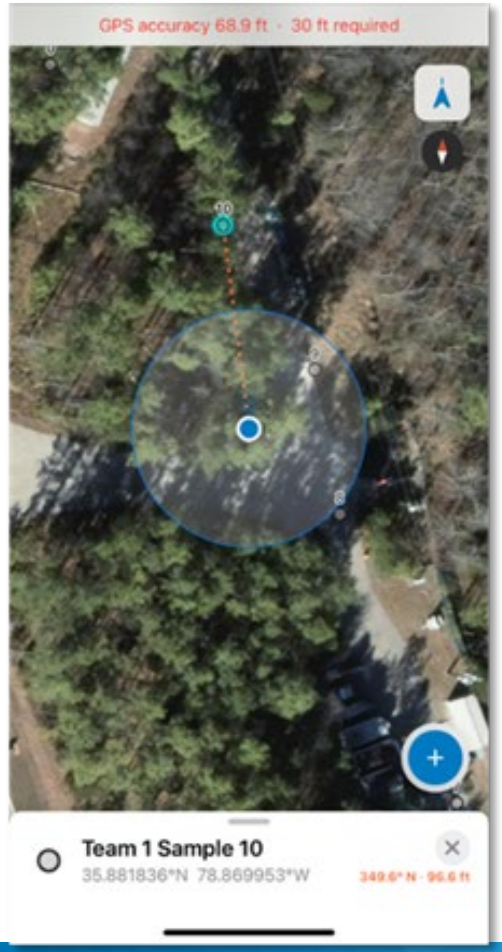
879 total samples collected



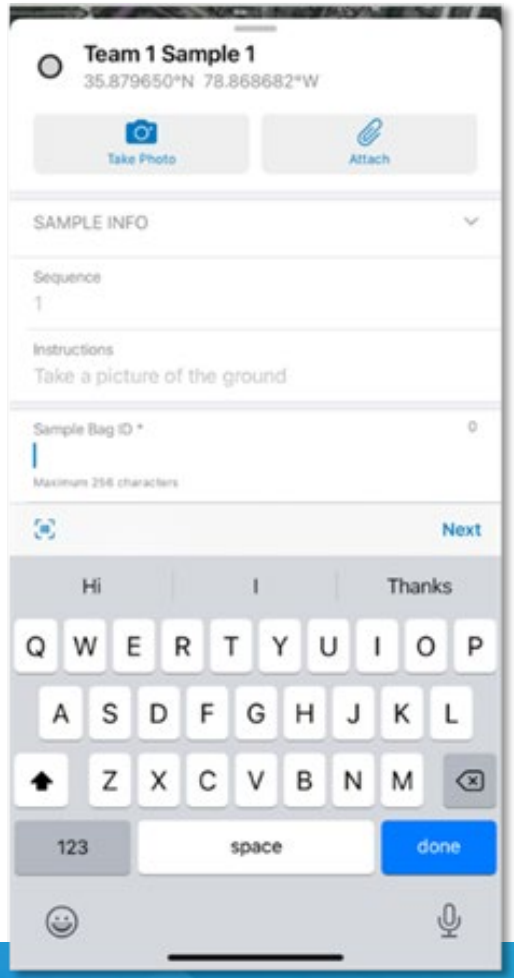
Data Acquisition Forms

Sequencing

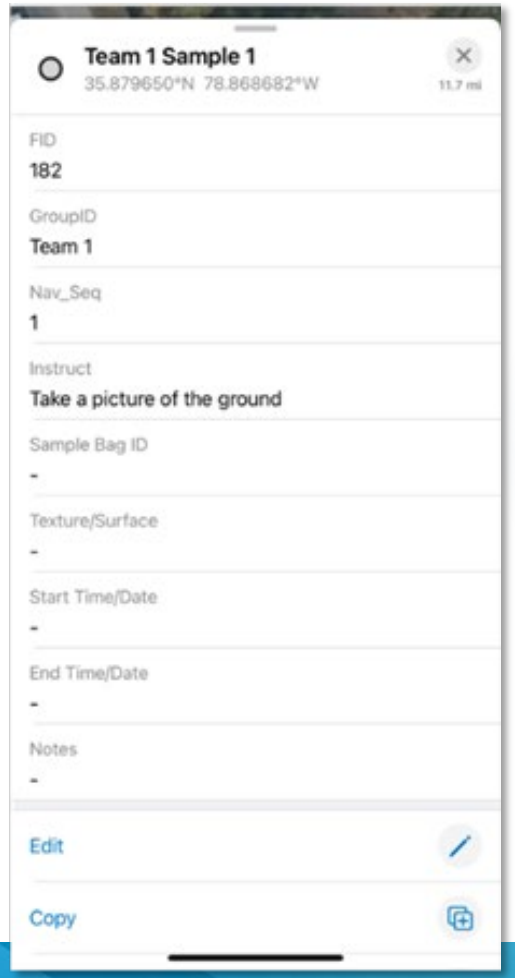
Navigation



Data Entry

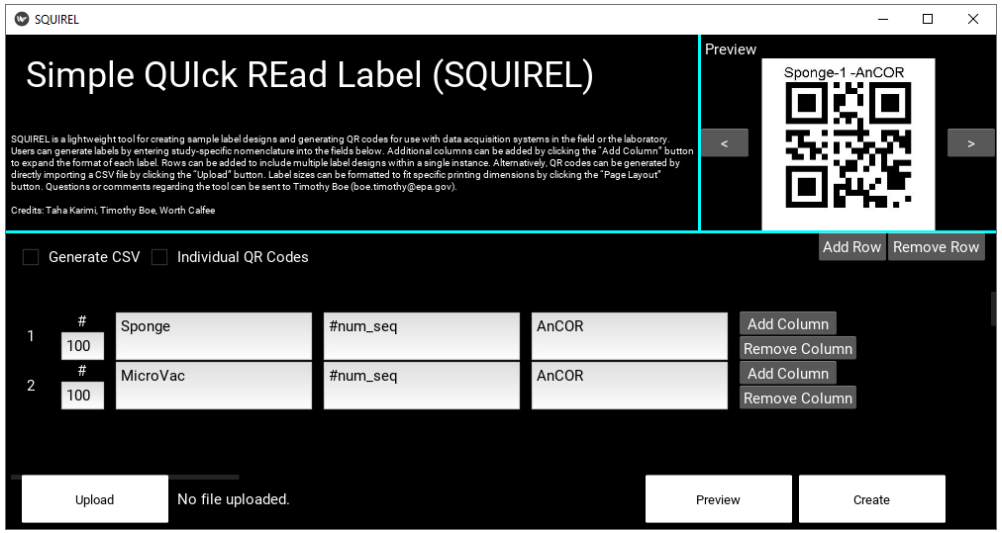


Error Checking



The Cloud

Sample Kit Preparation & Simple QUIck REad Label (SQUIREL)

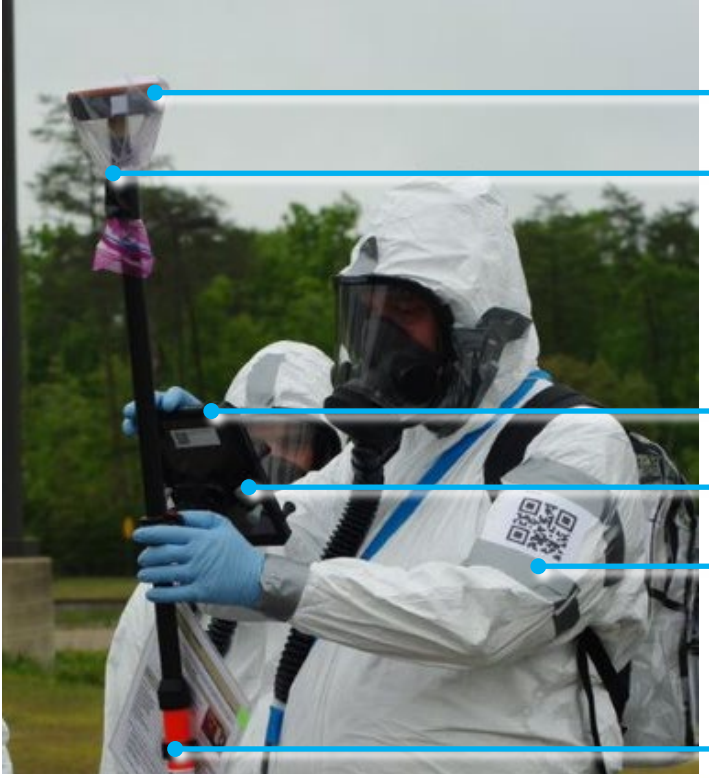


Create Numbering Scheme for Sample Type

Export & Print Labels

- Sampling kits were pre-assembled at EPA-RTP
- Each kit was enclosed in an overpack bag and pre-labeled with a QR-code

Hardware Deployment & Management



Sampling and Data Management Support Groups assisted ***3-person sampling teams*** with entry preparation.

GPS Bin

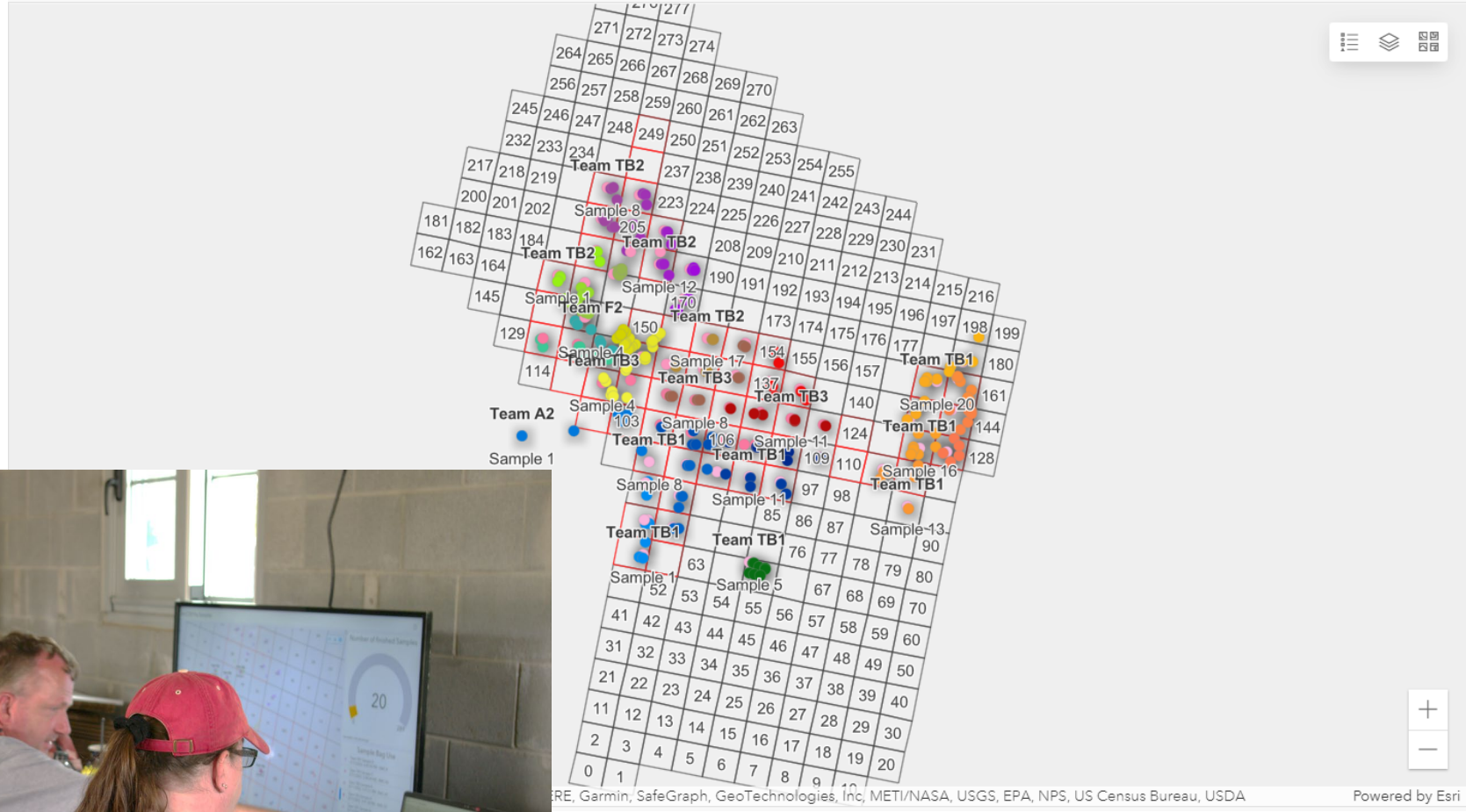
Tablet Setup and Charging Station

Monitoring Station

Data Management Station

Realtime Monitoring of the Sample Dashboard

AnCOR Pre Samples



Number of finished Samples

289

0 289

Last update: 12 seconds ago

Sample Bag Use

- Team B4 Sample 8: 5/13/2022, 11:15:23 AM - Sponge-29
- Team B3 Sample 7: 5/13/2022, 11:14:44 AM - Sponge-28
- Team B4 Sample 7: 5/13/2022, 11:12:07 AM - Sponge_FB-5
- Team T7 Sample 5: 5/13/2022, 11:09:19 AM - Leaves-25
- Team B3 Sample 6: 5/13/2022, 11:09:13 AM - Sponge-27
- Team B4 Sample 6: 5/13/2022, 11:06:44 AM - Sponge-30

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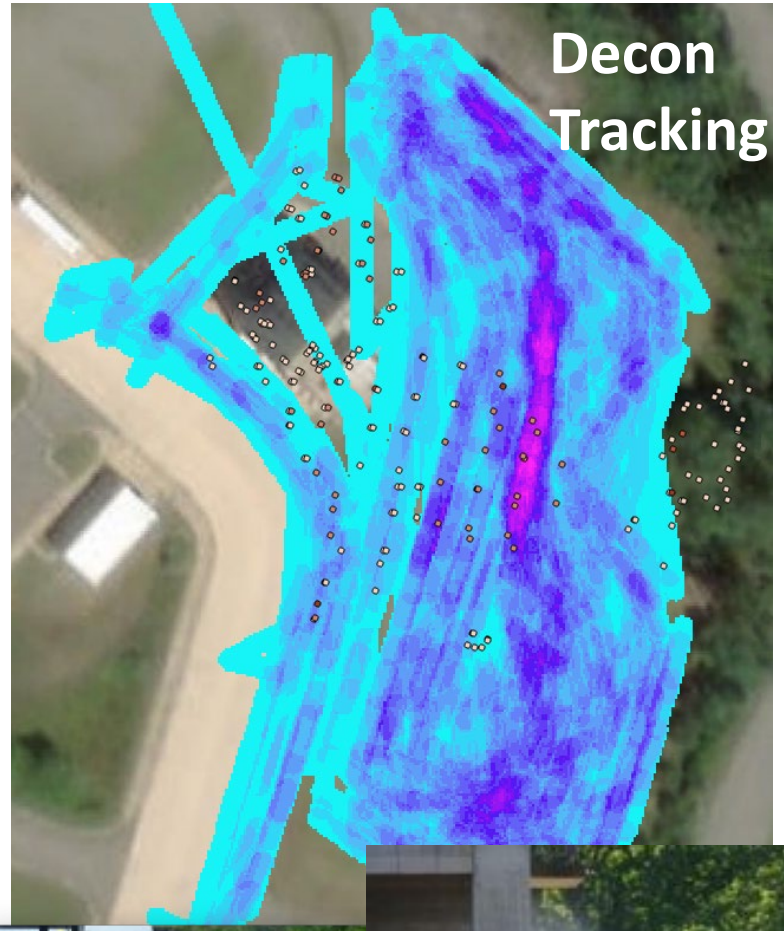
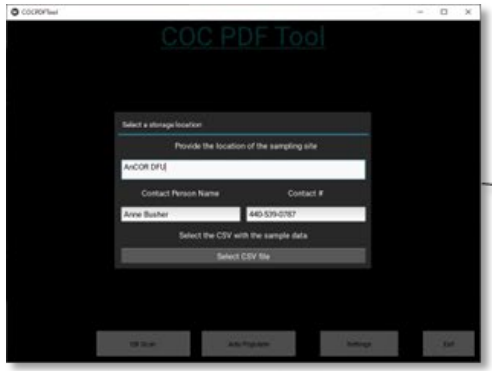
Sampling and Decon – Data in Motion

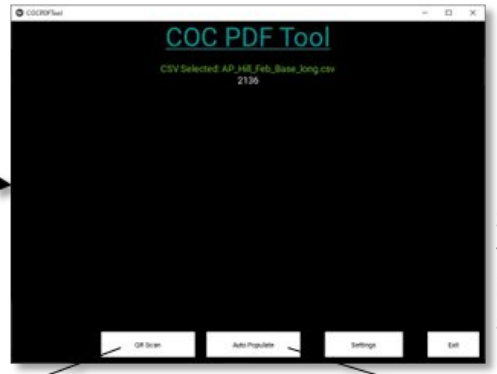
- Sampling:
  - Identify optimal sampling locations
  - Visualize extent of contamination and level of contamination
  - Support additional rounds of sampling according to analysis results
- Decontamination:
  - Identify decontamination boundary areas
  - Track the progress of decon efforts and inform the effectiveness of decon methods



Chain of Custody



Launch COC PDF Tool, fill out site details, and select sample csv



Select mode for adding individual samples

Select lab then open camera for QR Scanner

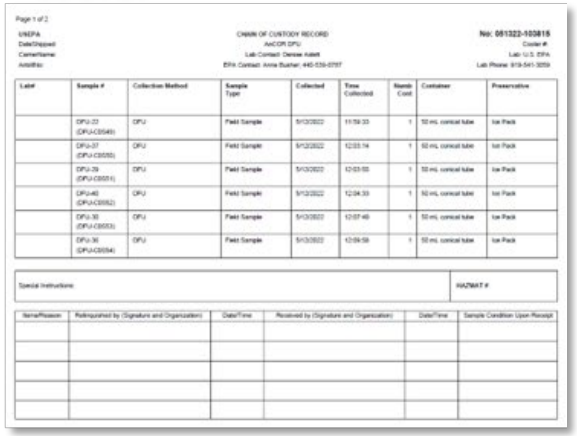
Select lab then fill out details for samples to auto-populate into tool

The tool recalls which samples have been used, ensuring they can't be scanned or auto-populated again

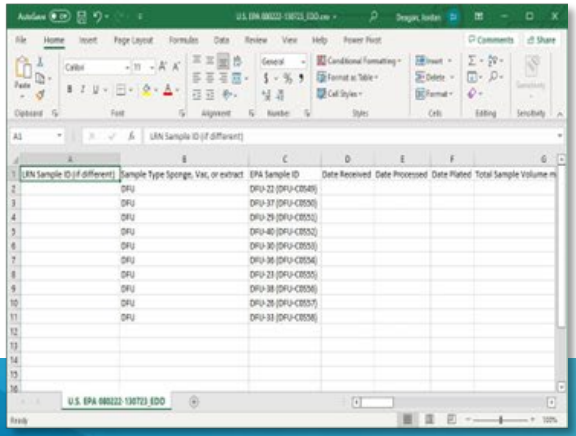
Once all samples are added, generate the forms

Results:

COC PDF



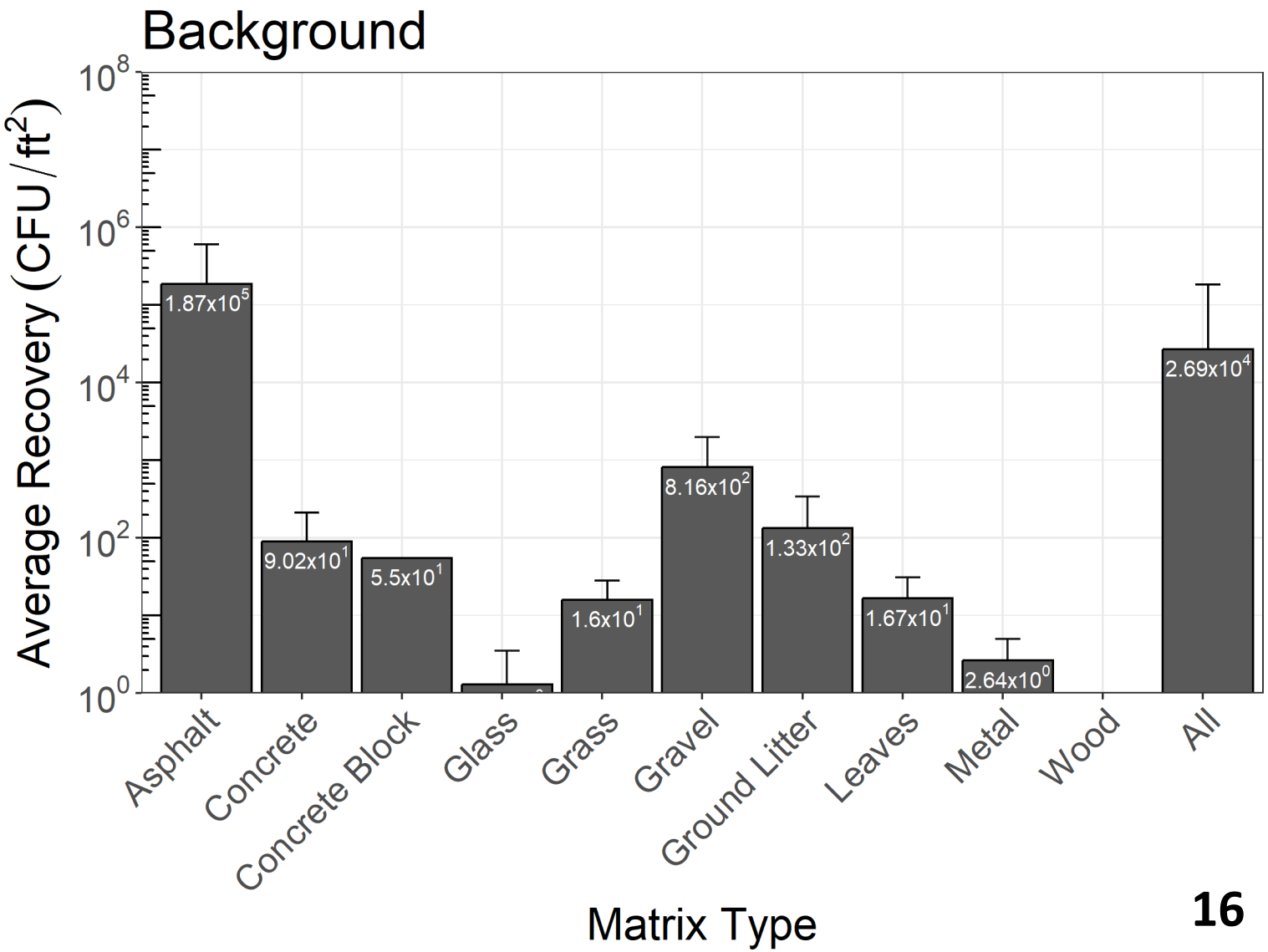
EDD CSV



Background Sample Results

- 34% (12/35) of samples had detectable spores
- Asphalt had the highest recoveries from sponge sticks
- Gravel and ground litter next highest, but 8/12 grab indeterminate

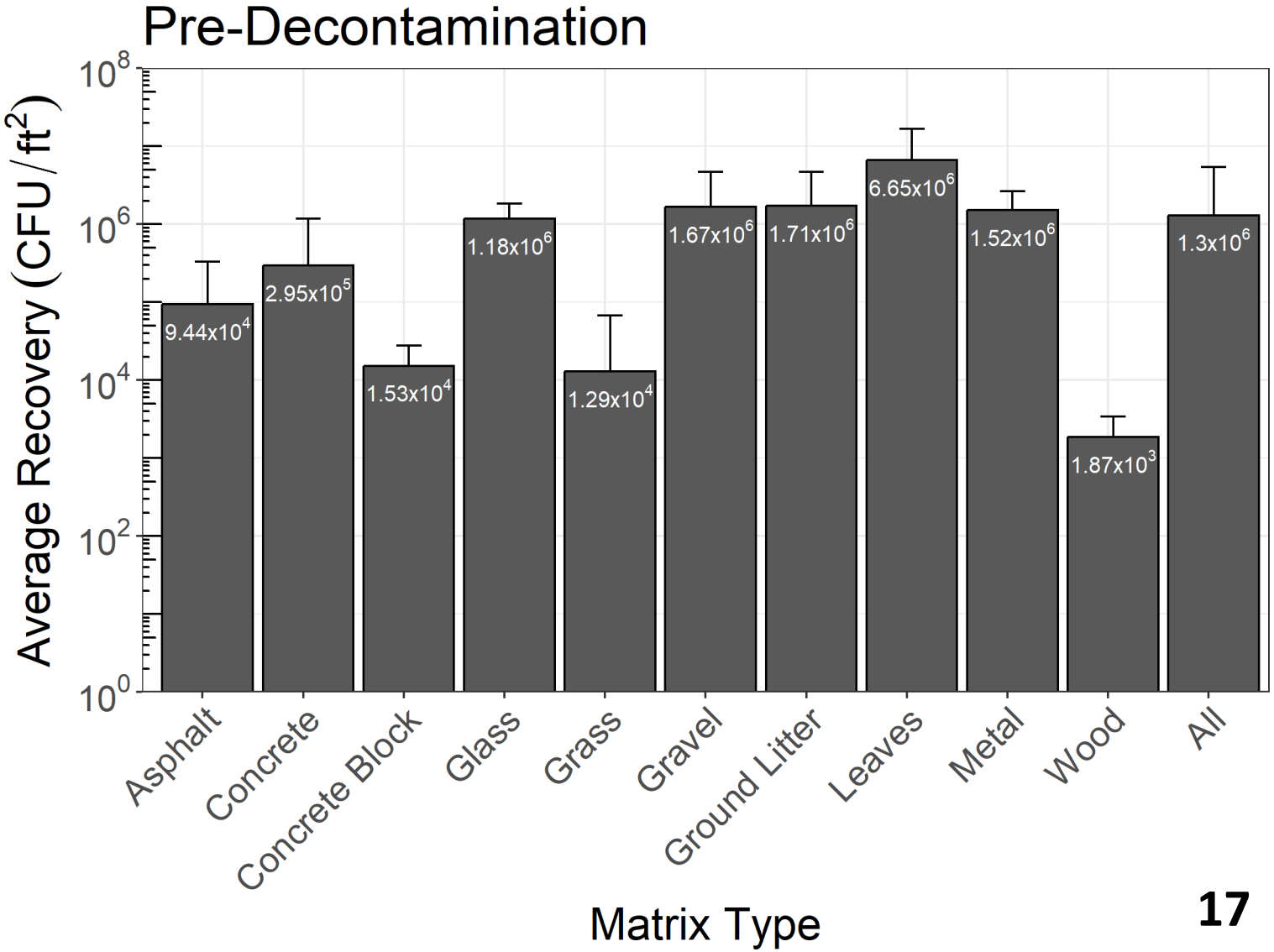
Category	# Samples	Percent
Detect	5	14%
Adjusted Detect	7	20%
Indeterminate	13	37%
Non-Detect	10	29%



Pre-Decon Sample Results

- 92% (184/200) had detectable spores
- Highest recoveries from glass, gravel, ground litter, leaves, and metal (10^6 CFU/ft^2)
- Only 1 non-detect from microvac

Category	# Samples	Percent
Detect	137	68.5%
Adjusted Detect	47	23.5%
Indeterminate	15	7.5%
Non-Detect	1	0.5%

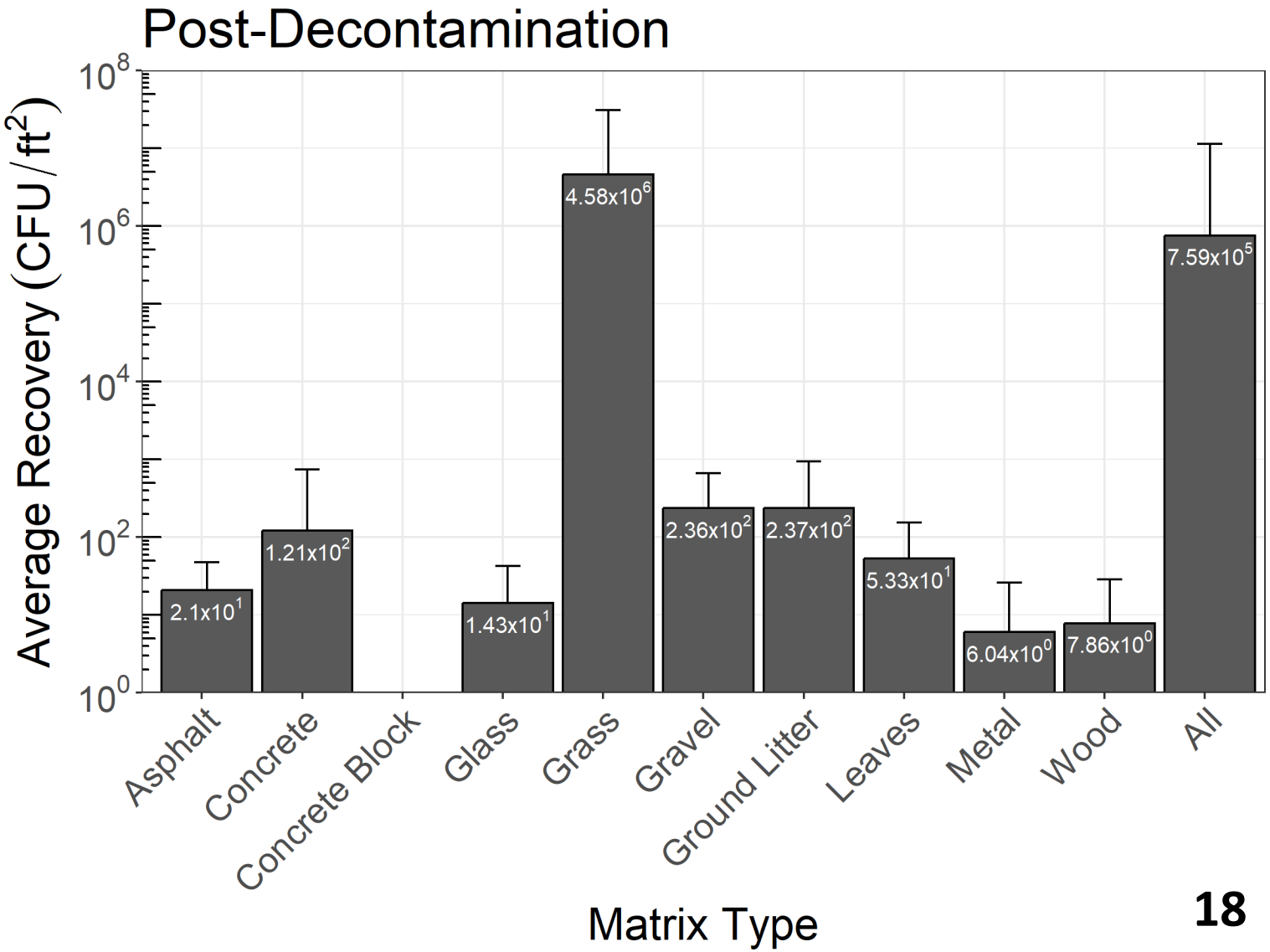


Post-Decon Sample Results

***1 post-decon sponge-stick did not make it back to the lab….**

- 19% (38/199) had detectable spores
- Grass samples had the highest detectable recoveries (10^6 CFU/ft^2)
- Remaining sample matrices had much lower recoveries post-decon (10^0-10^2 CFU/ft^2)
- 71 out of 79 of grab samples were indeterminate

Category	# Samples	Percent
Detect	4	2%
Adjusted Detect	34	17%
Indeterminate	89	45%
Non-Detect	72	36%



Final Thoughts

- Data goes beyond record keeping
- Plan/implement left of the “boom”
- Share examples, experiences, solutions
- Contamination incidents (especially CBR) complicate the data management process
- Research and technology are constantly evolving
- Guidance documents, frameworks, and tools are your friends
- At the AnCOR WAD, the decon technologies reduced magnitude of contamination between ~10^2-10^4 CFU/ft^2 depending on surface type
- Grab samples will need to be further processed prior to analysis to reduce the number of background organisms
  - New laboratory research underway at EPA

Thanks for your attention!

Contact Info:

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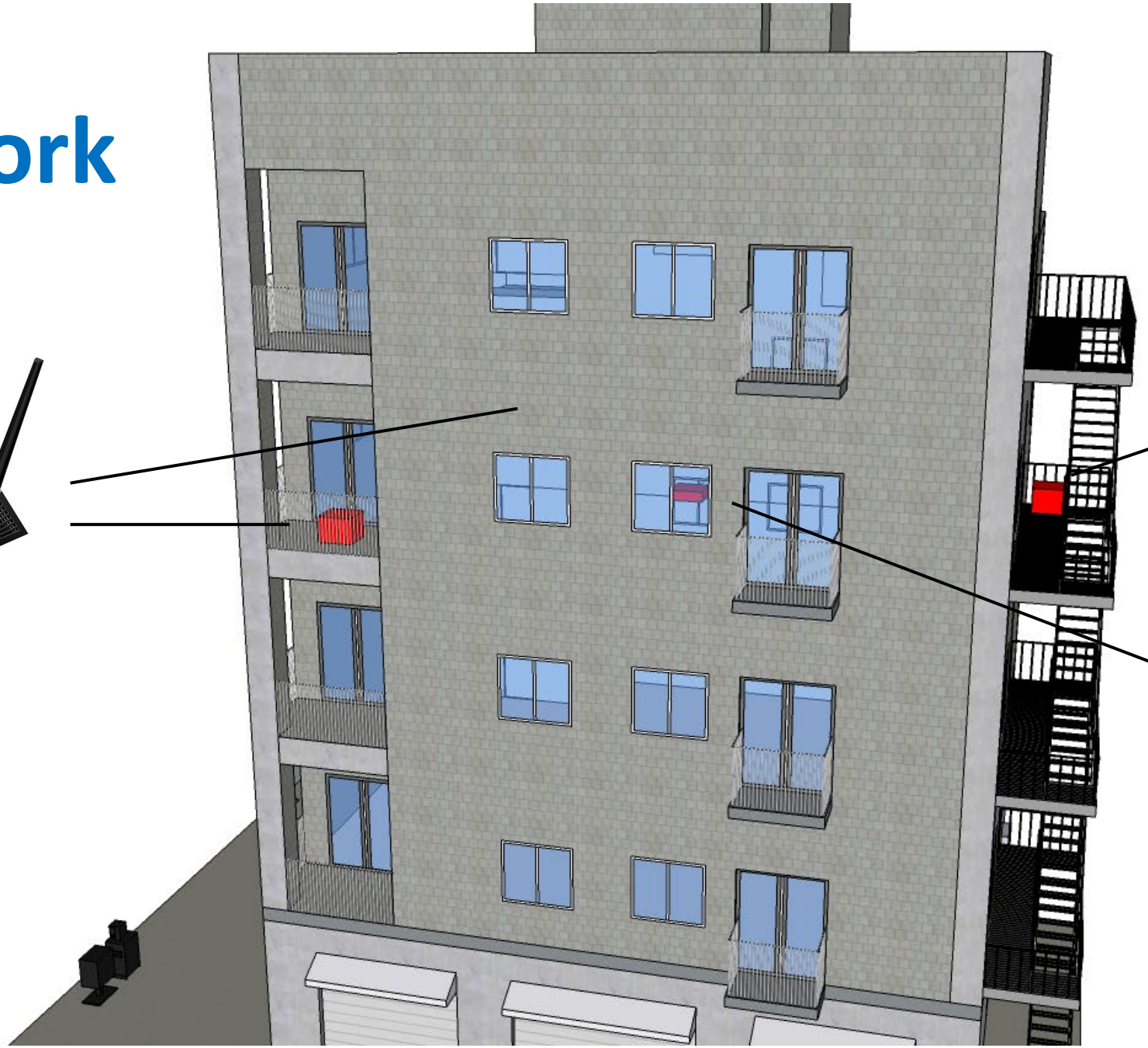
Additional Slides

WAD Network



Plum Case
Wide area WiFi network

Team Roles

Collection Teams consist of 3 members: (Do not switch roles!)

1. The **Collector** collects the samples and never touches the “clean” backpack or sampling kit bag. The Collector carries the “analysis” backpack containing completed samples.
2. The **Supplier** provides the Collector with sample materials from the “clean” backpack carried by the Data Manager and opens bags for the Collector. The Supplier does not touch any of the materials that will come in direct contact with the sample.
3. The **Data Manager** carries the “clean” backpack and directs the team to the samples. They are is responsible for radio communication and sample documentation on the tablet.

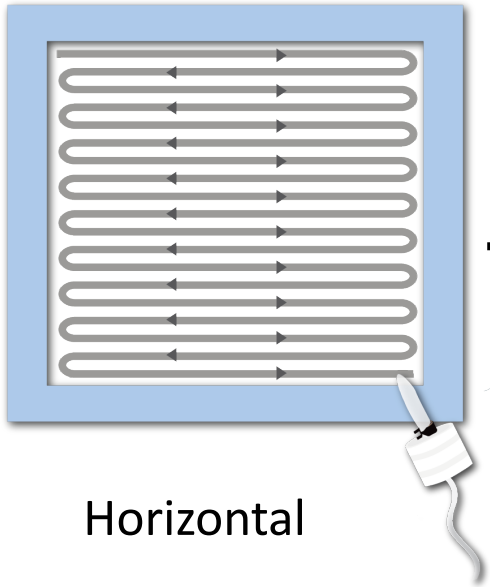
Each person has these specific roles to maintain sample integrity and prevent cross-contamination

Microvacuum Sample Collection

Collector

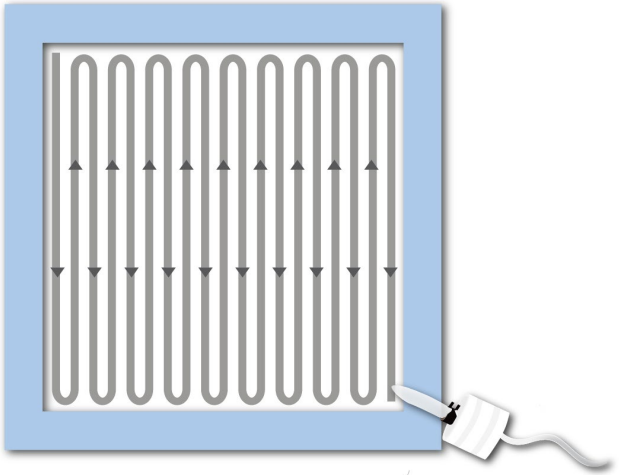
Collector

Collector



Horizontal

Collector



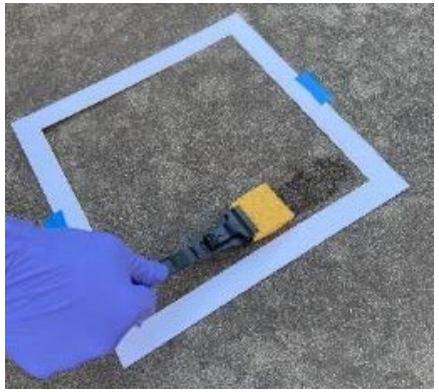
Vertical

Gently move nozzle over surface

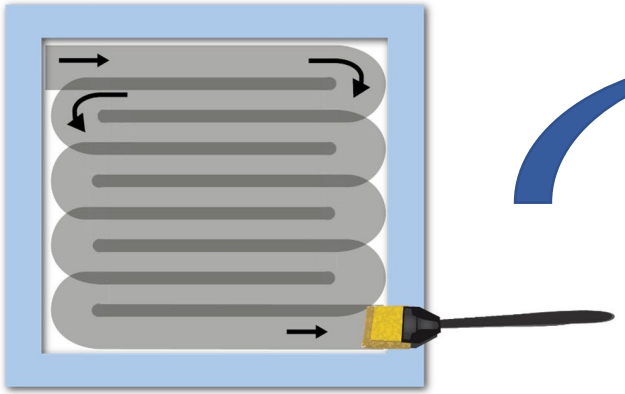
Collection time: 5 minutes

Sponge Stick Sample Collection

Collector

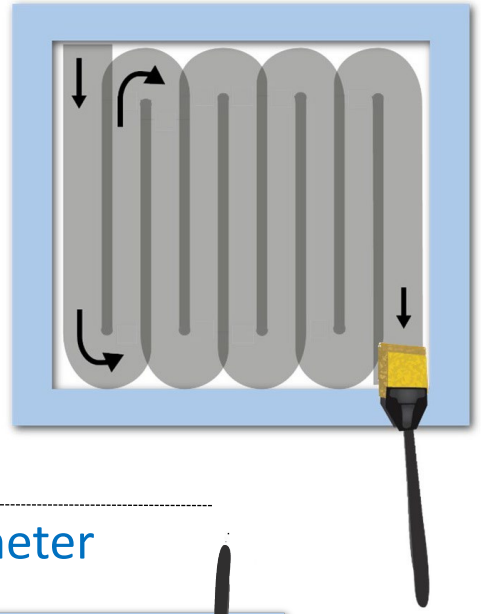


1. Horizontal



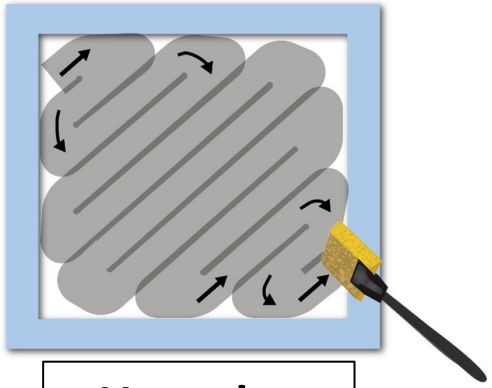
Turn sponge over

2. Vertical



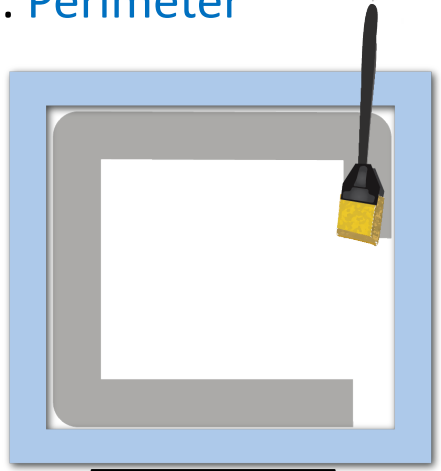
Collector

3. Diagonal



Use edge

4. Perimeter



Use tip

Grab Sample Collection

Supplier and Collector don a new pair of nitrile gloves before collecting each sample

Supplier

Supplier

Supplier

Collector

Gravel
(fill to line)

Ground Litter
(fill to top)