



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

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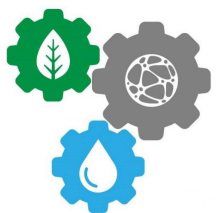
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³US EPA Region 5

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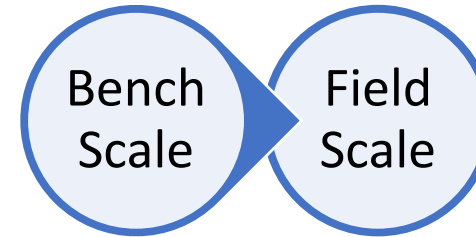
REMPLEX
CENTER FOR THE REMEDIATION
OF COMPLEX SITES
@PNNL

November 13-17, 2023



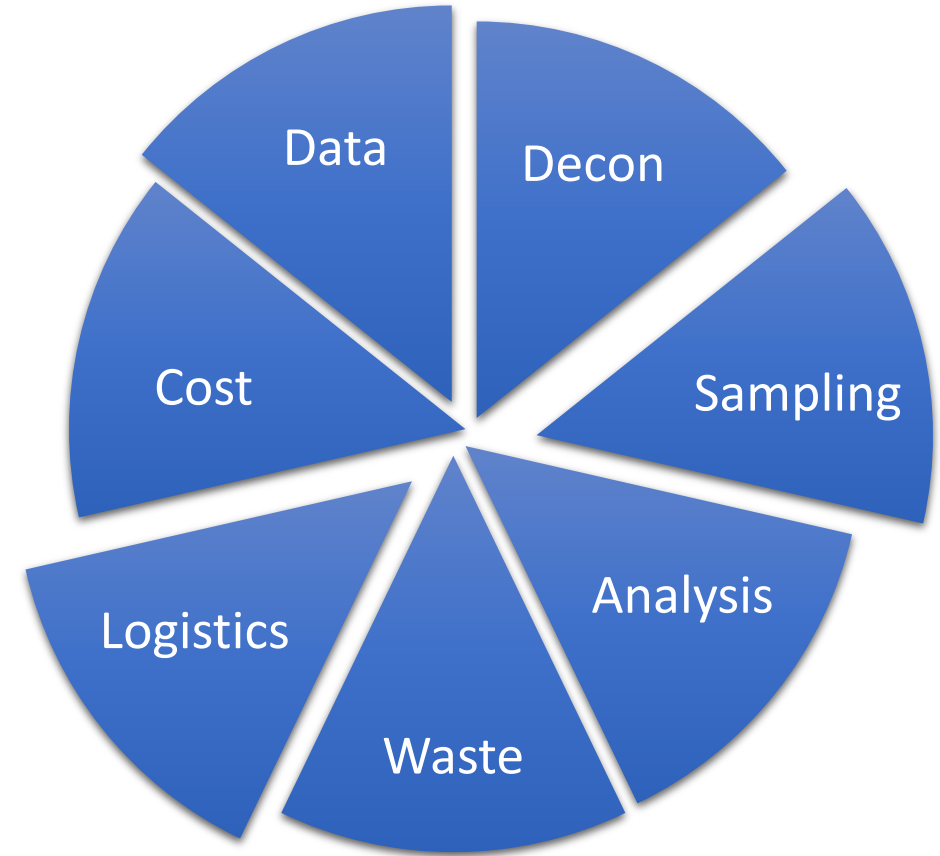
AnCOR Program

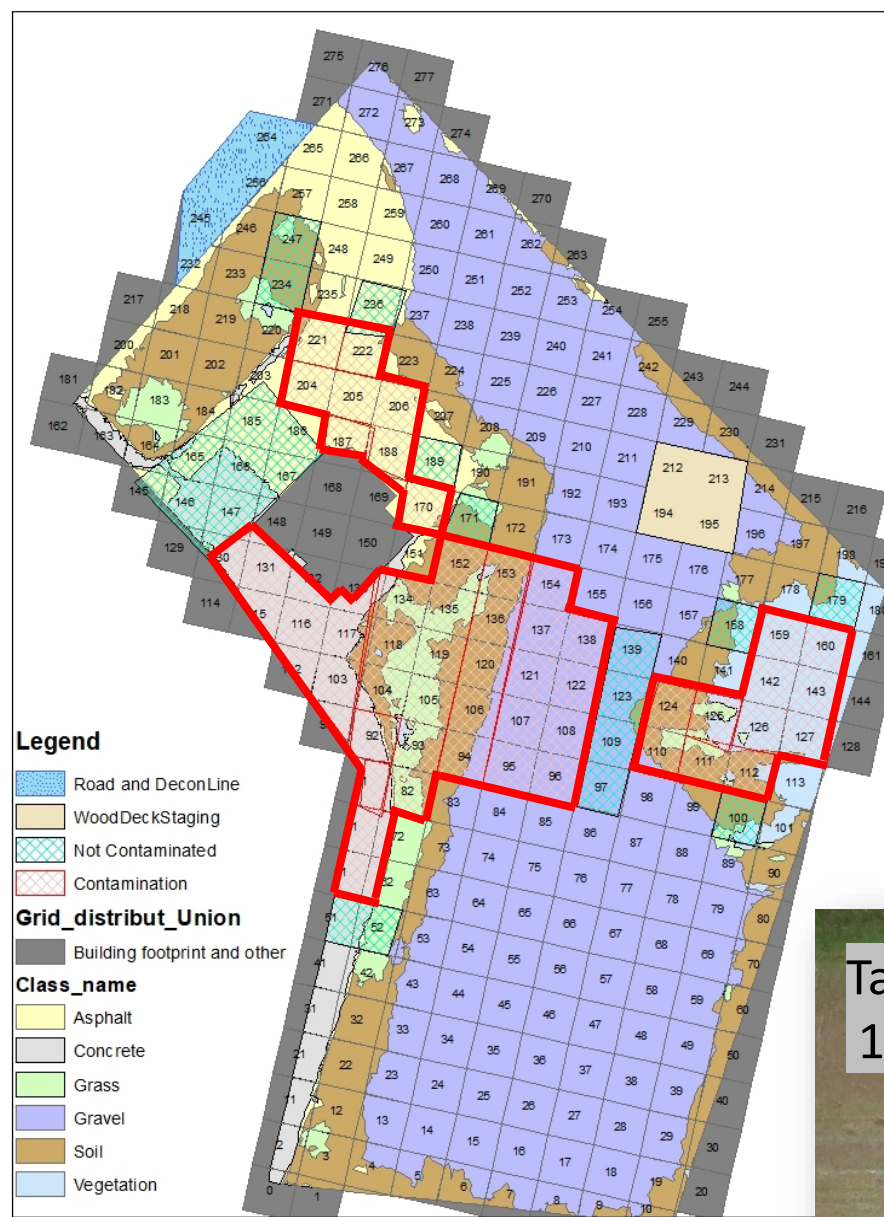
- Analysis for Coastal Operational Resiliency
- Interagency effort involving the EPA, Department of Homeland Security Science and Technology Directorate (DHS S&T), and the United States Coast Guard (USCG)
- Develop and demonstrate capabilities and strategic guidelines to prepare the U.S. for a wide-area 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

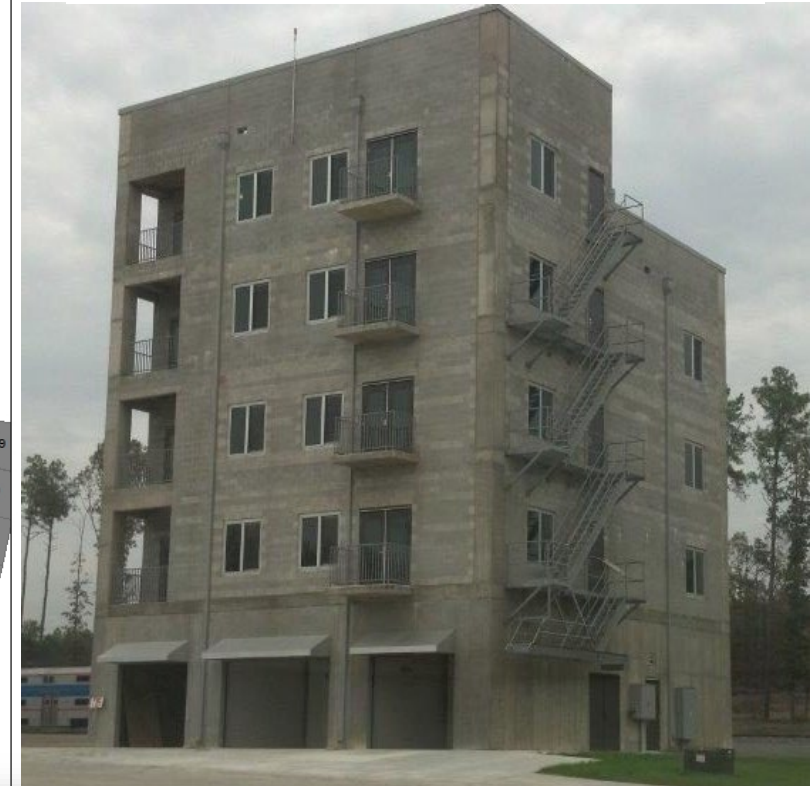
- Large field-scale exercise at Fort AP Hill, Virginia
- May 2022
- Incorporate components of emergency response:
 - Decontamination (Decon)
 - **Sampling and Analysis**
 - PPE Donning and Doffing
 - Personnel Decon
 - Waste Management
 - **Data Collection and Management**
 - Cost and Effort





GIS used to define ground surface type to inform sampling plan

60' Tall Concrete Building



Target:
 10^7 CFU/ft²

CFU: Colony Forming Units



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

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



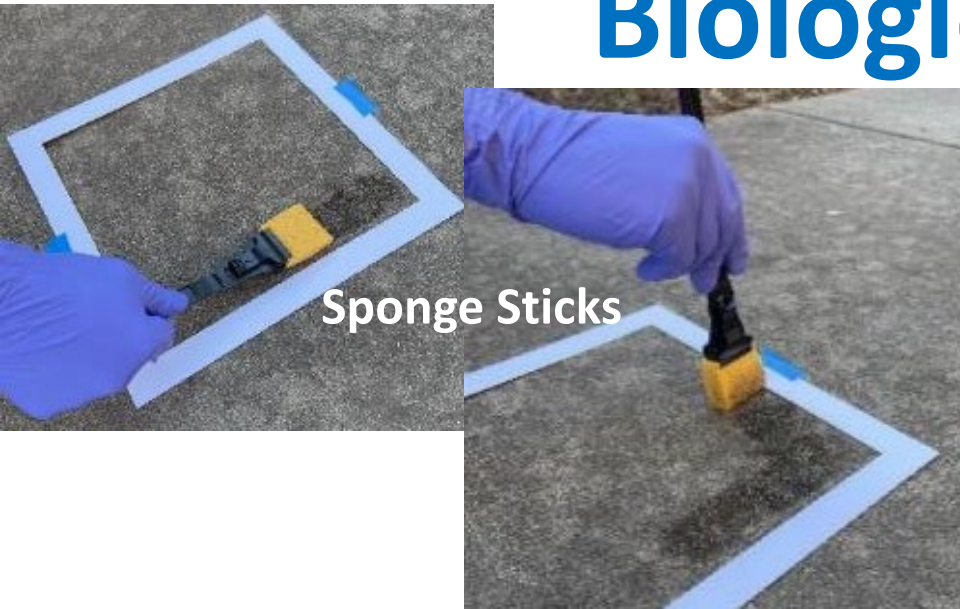
Sampling Objectives

- 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

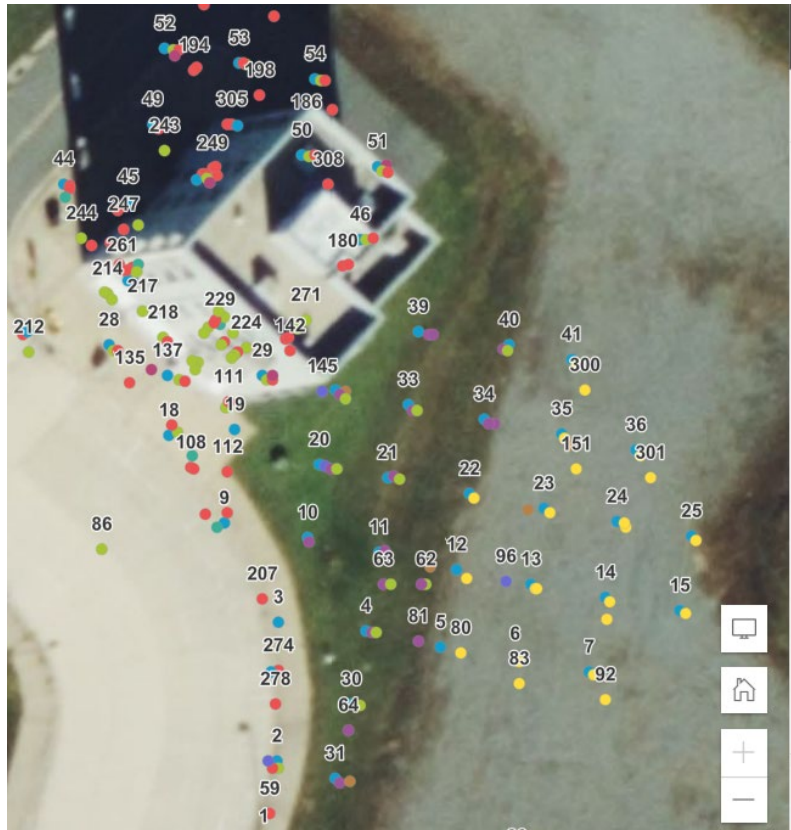
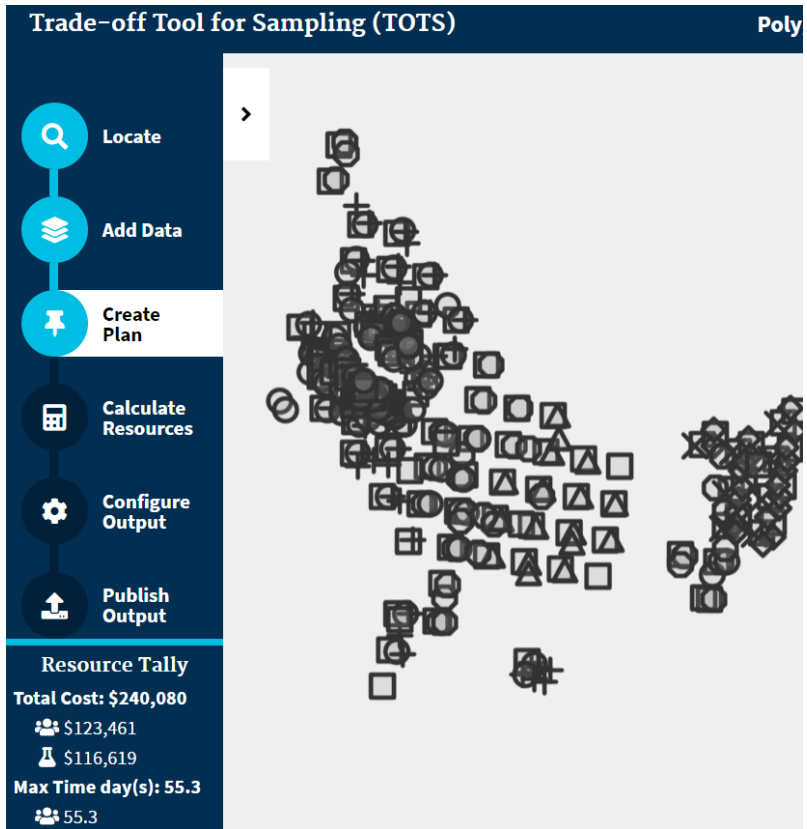


CBR Data Management

- 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

Align Vertical Samples

ESRI Cloud

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

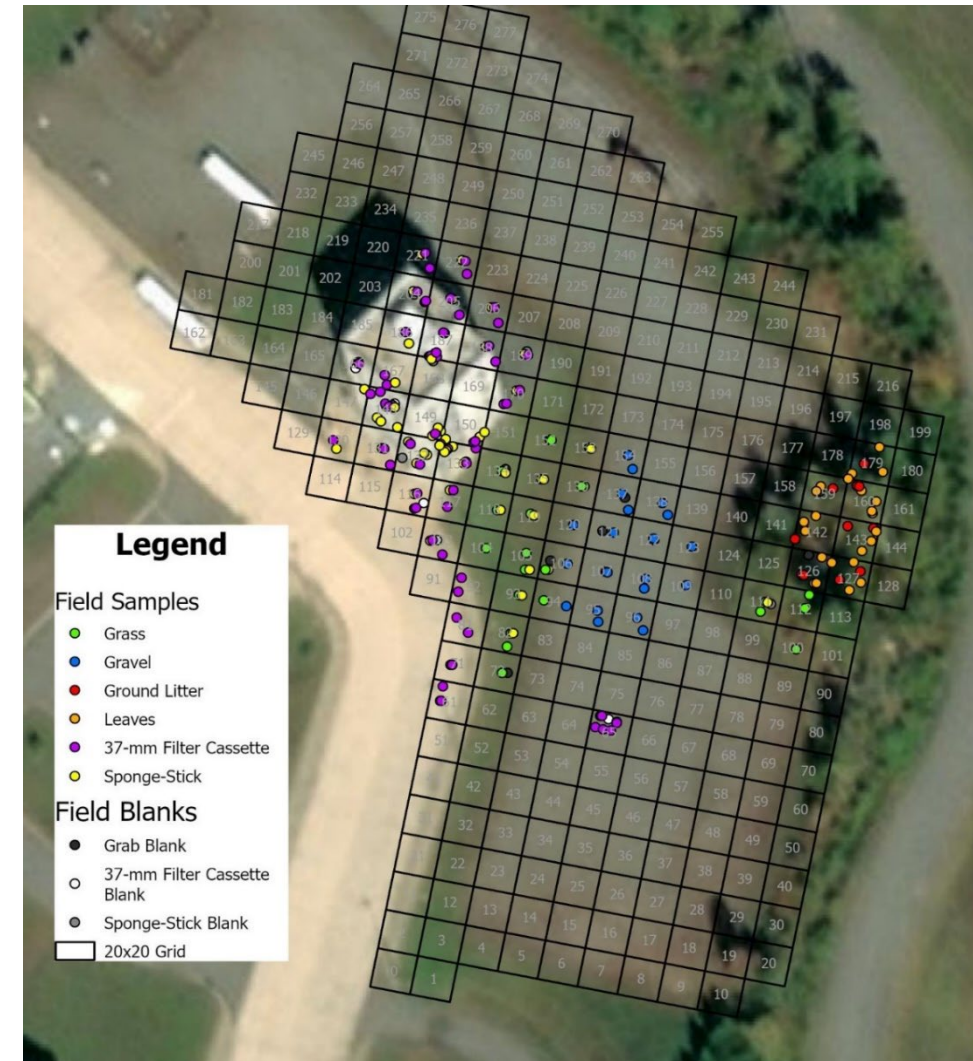
Background Sampling

- **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

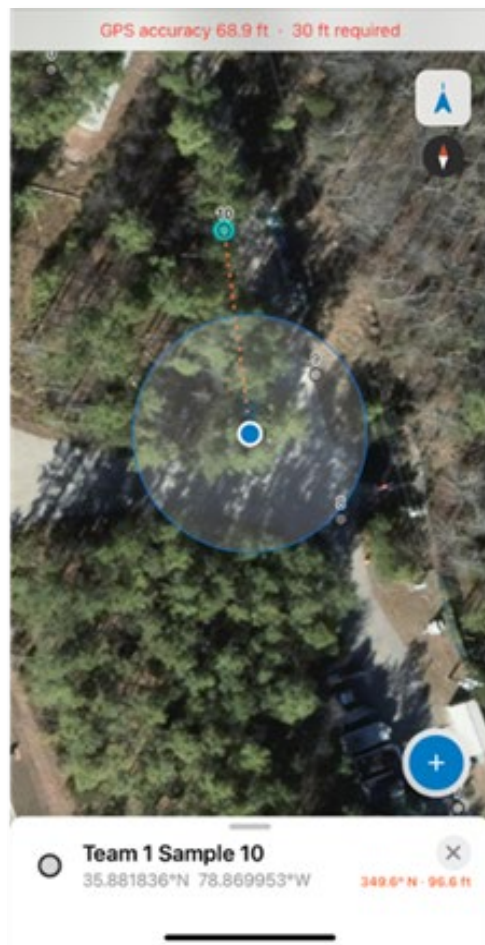


Data Acquisition Forms

Sequencing



Navigation



Data Entry

A screenshot of a mobile application interface for data entry. The form is titled 'Team 1 Sample 1' with coordinates '35.879650°N 78.868682°W'. It includes a 'Take Photo' button and an 'Attach' button. The 'SAMPLE INFO' section has a dropdown menu. The 'Sequence' field contains '1'. The 'Instructions' field contains 'Take a picture of the ground'. The 'Sample Bag ID' field is empty, with a note 'Maximum 256 characters'. A 'Next' button is at the bottom right. A keyboard is visible at the bottom.

Error Checking

A screenshot of a mobile application interface for error checking. The form is titled 'Team 1 Sample 1' with coordinates '35.879650°N 78.868682°W' and a distance of '11.7 mi'. It includes fields for 'FID' (182), 'GroupID' (Team 1), 'Nav_Seq' (1), 'Instruct' (Take a picture of the ground), 'Sample Bag ID' (-), 'Texture/Surface' (-), 'Start Time/Date' (-), 'End Time/Date' (-), and 'Notes' (-). An 'Edit' button is at the bottom left, and a 'Copy' button is at the bottom right.

The Cloud



Sample Kit Preparation & Simple QUIck REad Label (SQUIREL)

The screenshot shows the SQUIREL web application. The title is "Simple QUIck REad Label (SQUIREL)". Below the title is a brief description: "SQUIREL is a lightweight tool for creating sample label designs and generating QR codes for use with data acquisition systems in the field or the laboratory. Users can generate labels by entering study-specific nomenclature into the fields below. Additional columns can be added by clicking the 'Add Column' button to expand the format of each label. Rows can be added to include multiple label designs within a single instance. Alternatively, QR codes can be generated by directly importing a CSV file by clicking the 'Upload' button. Label sizes can be formatted to fit specific printing dimensions by clicking the 'Page Layout' button. Questions or comments regarding the tool can be sent to Timothy Boe (boe.timothy@epa.gov). Credits: Taha Karim, Timothy Boe, Worth Calfee".

Below the description are two checkboxes: "Generate CSV" and "Individual QR Codes". To the right of these are "Add Row" and "Remove Row" buttons.

The main input area is a table with 4 columns: "#", "Sample Name", "#num_seq", and "AnCOR". There are two rows of data:

#	Sample Name	#num_seq	AnCOR
1	Sponge		AnCOR
2	MicroVac		AnCOR

Each row has "Add Column" and "Remove Column" buttons to its right. At the bottom of the table are "Upload" and "No file uploaded." buttons. To the right of the table is a "Preview" button. At the bottom of the interface are "Preview" and "Create" buttons.

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





Submeter GPS
Protective Covering

Hardware Deployment & Management

iPad mini

Pole Mount & iPad Case

QR Code

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

GPS Pole



GPS
Bin

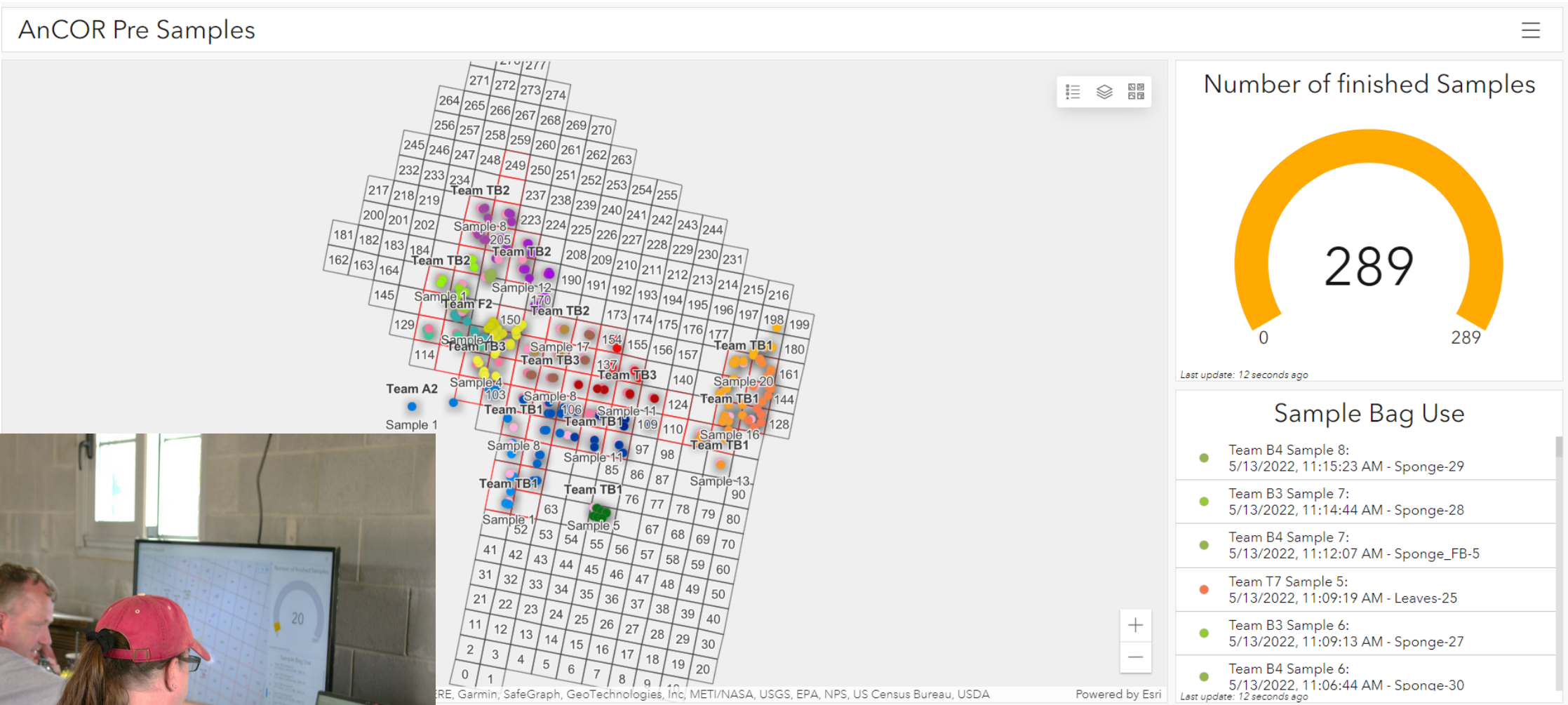
Tablet Setup and Charging
Station

Monitoring
Station

Data
Management
Station

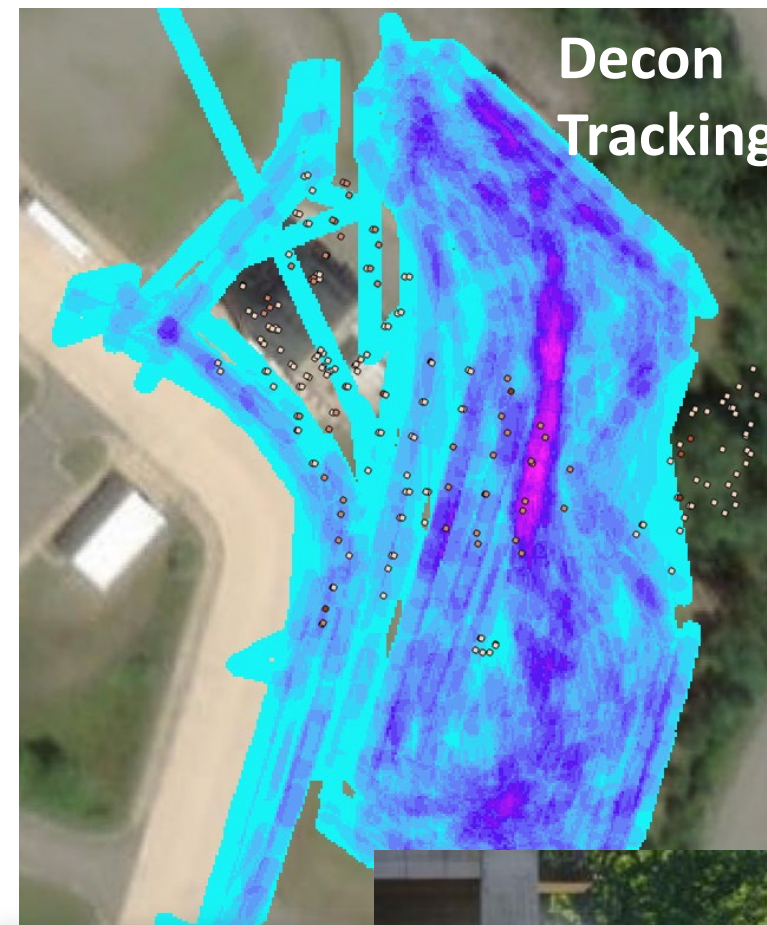


Realtime Monitoring of the Sample Dashboard



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

COC PDF Tool

Select a storage location

Provide the location of the sampling site

AVCOR DPU

Contact Person Name: Aimee Buscher Contact #: 845-579-0787

Select the CSV with the sample data

Select CSV file

QR Scan Auto Populate Settings Exit

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

COC PDF Tool

CSV Selected: APJ_HL_Feb_Base_long.csv 2136

QR Scan Auto Populate Settings Exit

Select mode for adding individual samples

COC PDF Tool

CSV Selected: DPU May 12.csv 12

Select the lab for the selection of data

Select from the dropdown below

Select Lab

- SPHS - Jacksonville
- SHL University of Iowa
- NYSDH - Wadsworth Center
- VA DCLS
- CDC/ODD/NCEZD/OSR
- CDC/ODD/NCEZD/SPEI
- U.S. EPA
- CDC/ODD/NCEZD/GHCP (Inhouse)

QR Scan Auto Populate Settings Exit

Select lab then open camera for QR Scanner

COC PDF Tool

CSV Selected: DPU May 12.csv 12

Select the lab for the selection of data

Select from the dropdown below

U.S. EPA

Select Collection Method

Submit Cancel

QR Scan Auto Populate Settings Exit

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

COC PDF Tool

CSV Selected: DPU May 12.csv 12

Sample ID: DPU-22 Name: Sample

Sample ID: DPU-37 Name: Sample

Sample ID: DPU-29 Name: Sample

Sample ID: DPU-40 Name: Sample

Sample ID: DPU-30 Name: Sample

Sample ID: DPU-36 Name: Sample

Sample ID: DPU-23 Name: Sample

QR Scan Auto Populate Settings Exit

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

COC PDF Results:

Page 1 of 2

USEPA
Date/Version: 10/13/2019
Customer: EPA
Address: EPA Contract: 6805-010-0001

NO: 091323-00019
Order #: 091323-00019
Lab: U.S. EPA
Lab Phone: 815-541-3000

Lab	Sample #	Collection Method	Sample Type	Collected	Time Collected	Reqs	Condition	Preservative
DPU-22	DPU-22	CPU	Field Sample	5/13/2012	11:34:33	1	50 ml, cool, tube	Ice Pack
DPU-37	DPU-37	CPU	Field Sample	5/13/2012	12:05:14	1	50 ml, cool, tube	Ice Pack
DPU-29	DPU-29	CPU	Field Sample	5/13/2012	12:05:05	1	50 ml, cool, tube	Ice Pack
DPU-40	DPU-40	CPU	Field Sample	5/13/2012	12:04:33	1	50 ml, cool, tube	Ice Pack
DPU-30	DPU-30	CPU	Field Sample	5/13/2012	12:07:40	1	50 ml, cool, tube	Ice Pack
DPU-36	DPU-36	CPU	Field Sample	5/13/2012	12:04:58	1	50 ml, cool, tube	Ice Pack

Special Instructions: VOTWAT #

Sample/Phase	Redesignated by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition (Open/Sealed)

EDD CSV

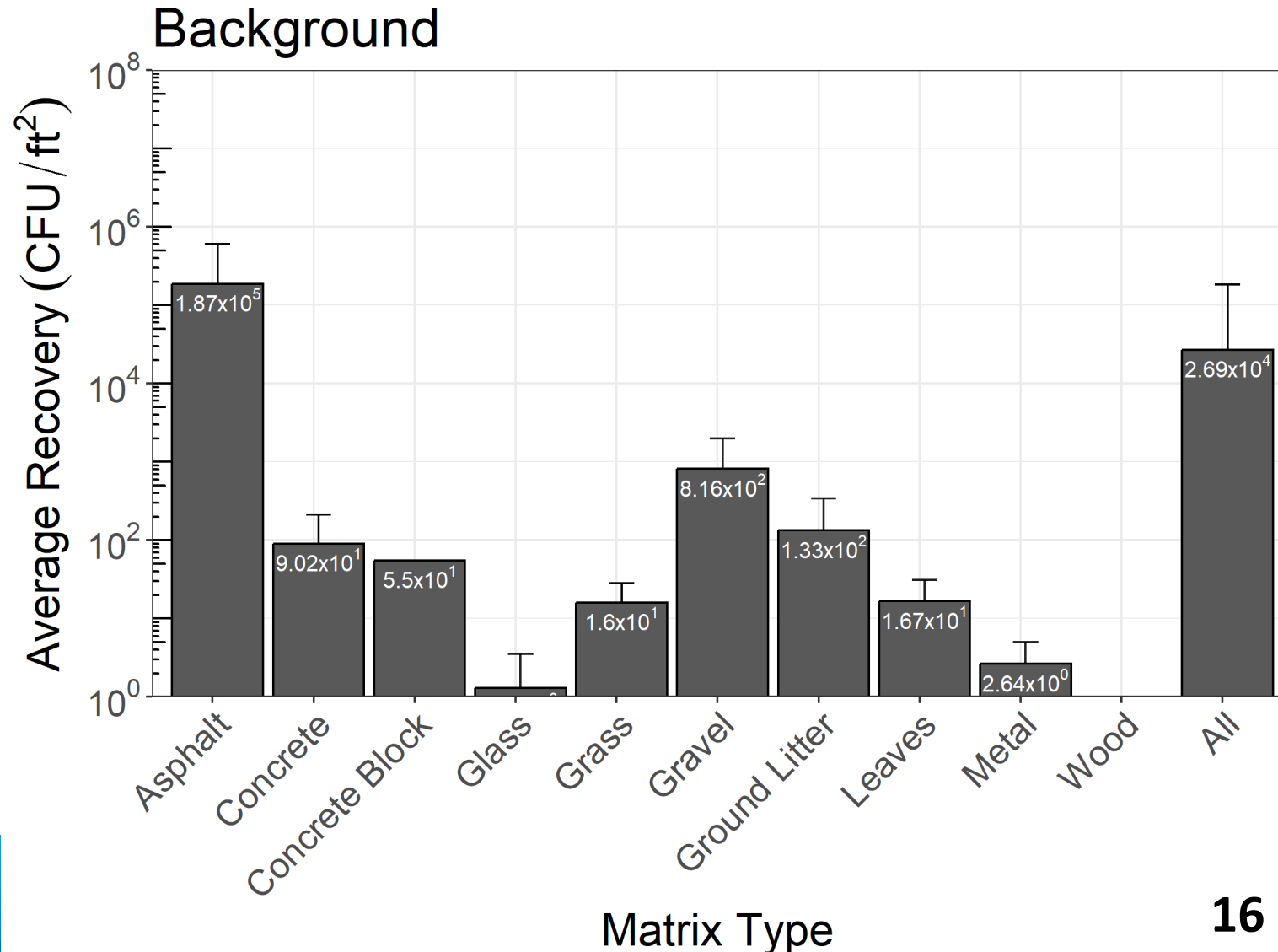
AutoSave: U.S. EPA 081323-136723 EDD

LN	Sample ID (if different)	Sample Type	Sponge, Vac, or extract	EPA Sample ID	Date Received	Date Processed	Date Placed	Total Sample Volume (ml)
1	DPU-22	DPU		DPU-22 (DPU-CR048)				
2	DPU-37	DPU		DPU-37 (DPU-CR050)				
3	DPU-29	DPU		DPU-29 (DPU-CR051)				
4	DPU-40	DPU		DPU-40 (DPU-CR052)				
5	DPU-30	DPU		DPU-30 (DPU-CR053)				
6	DPU-36	DPU		DPU-36 (DPU-CR054)				
7	DPU-23	DPU		DPU-23 (DPU-CR055)				
8	DPU-38	DPU		DPU-38 (DPU-CR056)				
9	DPU-28	DPU		DPU-28 (DPU-CR057)				
10	DPU-33	DPU		DPU-33 (DPU-CR058)				
11								
12								
13								
14								
15								
16								

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

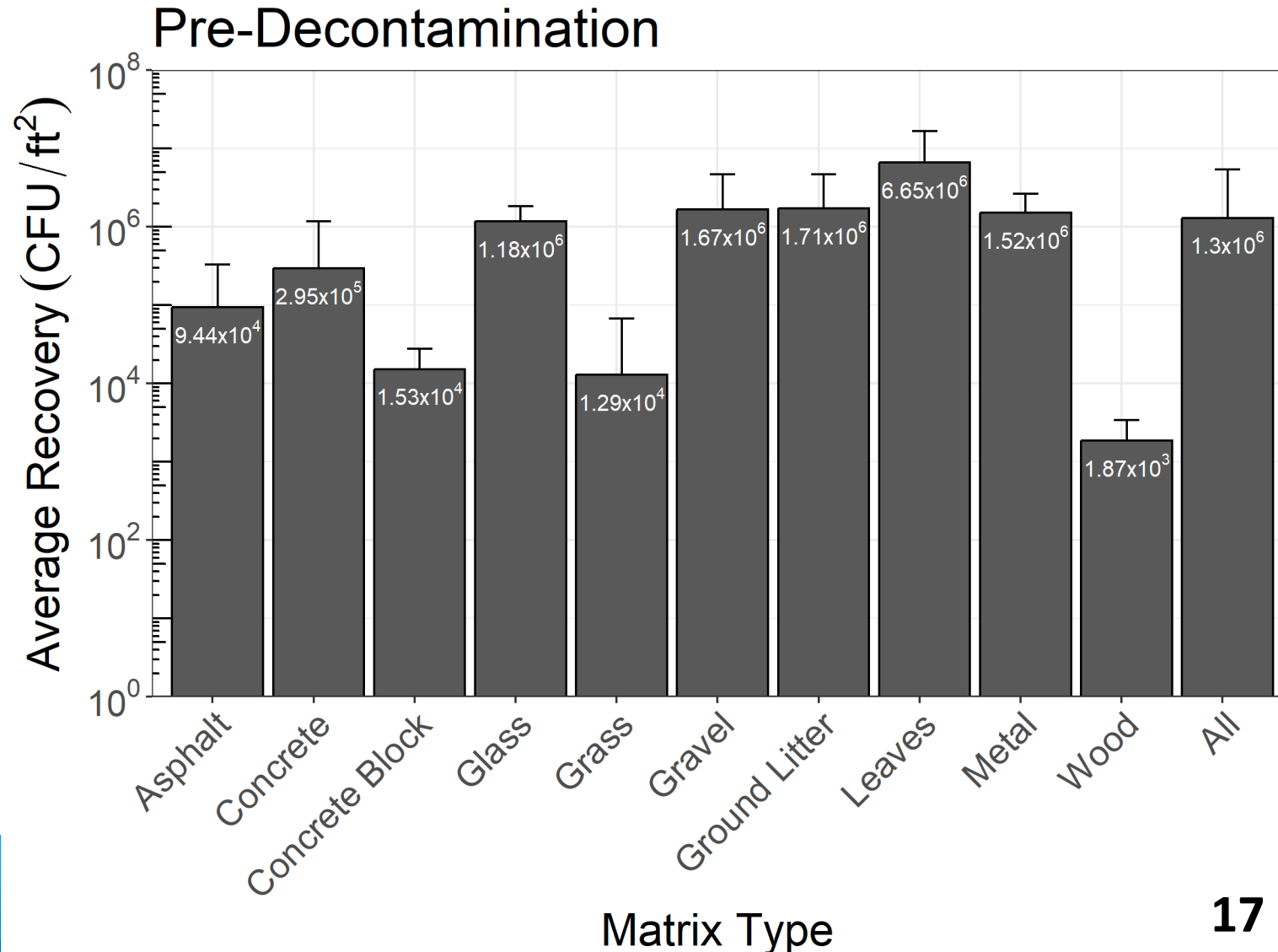
Category	# Samples	Percent
Detect	5	14%
Adjusted Detect	7	20%
Indeterminate	13	37%
Non-Detect	10	29%



Pre-Decon Sample Results

- 92% (184/200) had detectable spores
- Highest recoveries from glass, gravel, ground litter, leaves, and metal (10^6 CFU/ft²)
- 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%

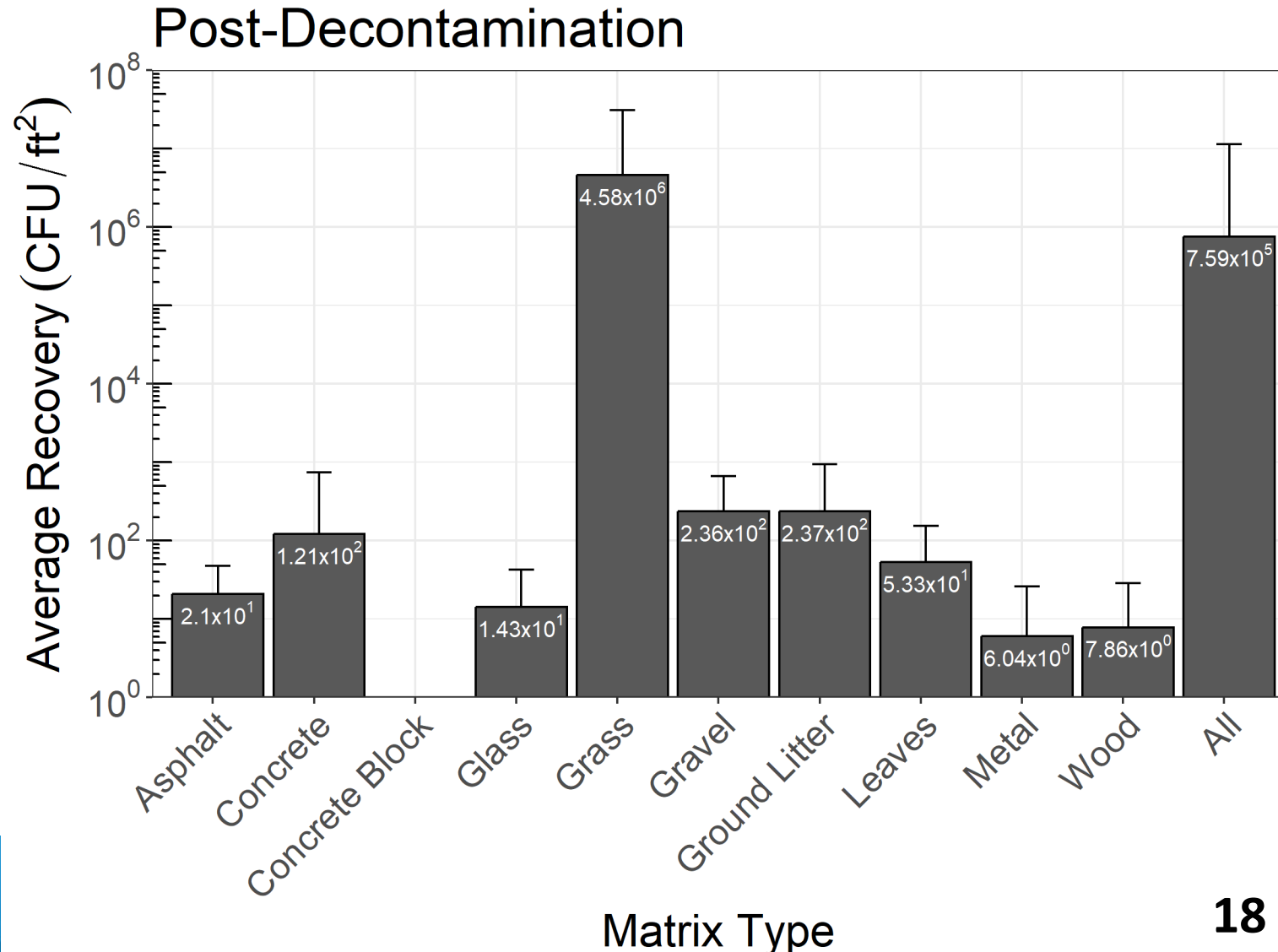


Post-Decon Sample Results

**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/ft²)
- Remaining sample matrices had much lower recoveries post-decon (10^0 - 10^2 CFU/ft²)
- 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 $\sim 10^2$ - 10^4 CFU/ft² 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:

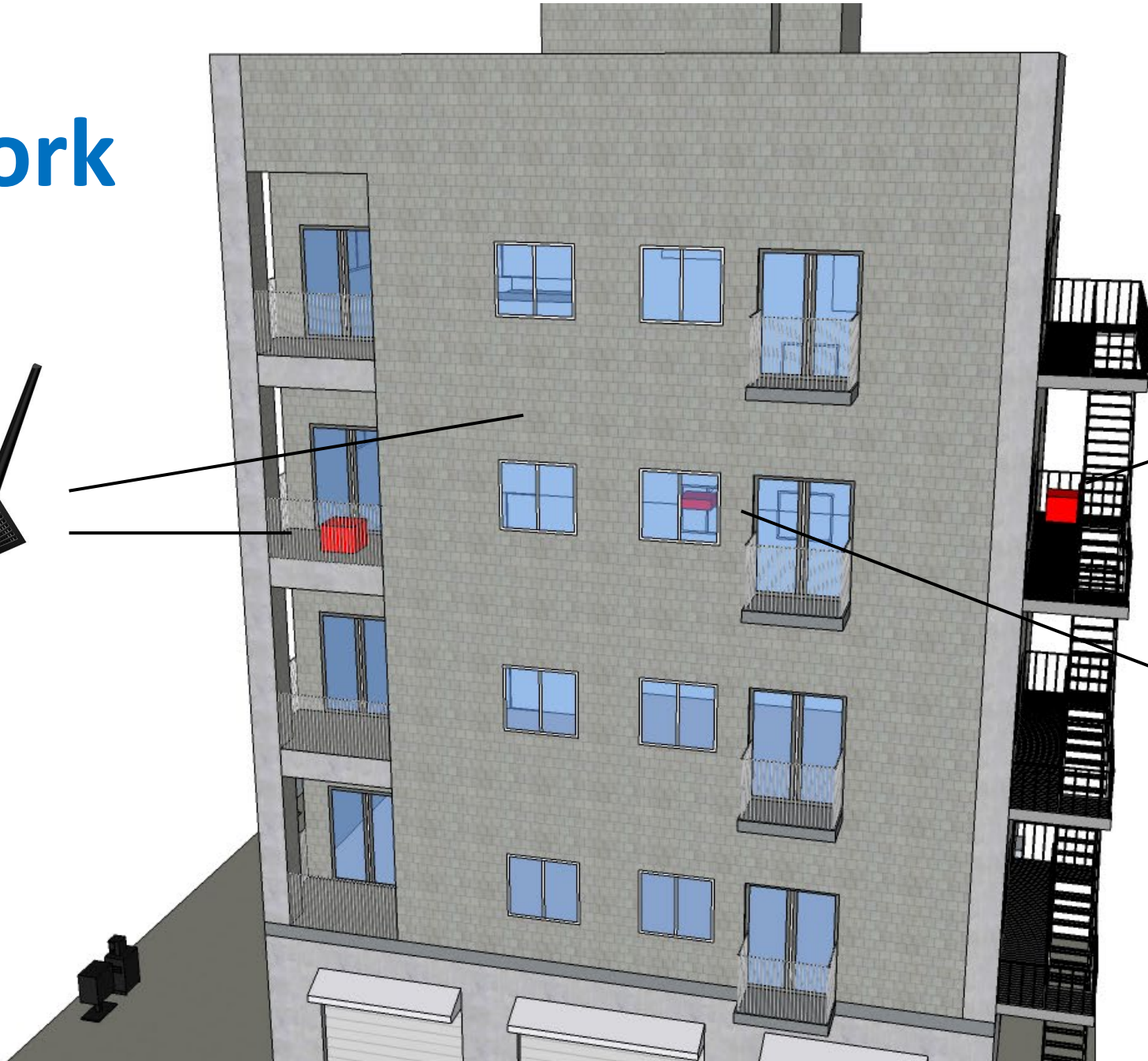
- Michael Pirhalla; pirhalla.michael@epa.gov
- Timothy Boe; boe.timothy@epa.gov





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 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

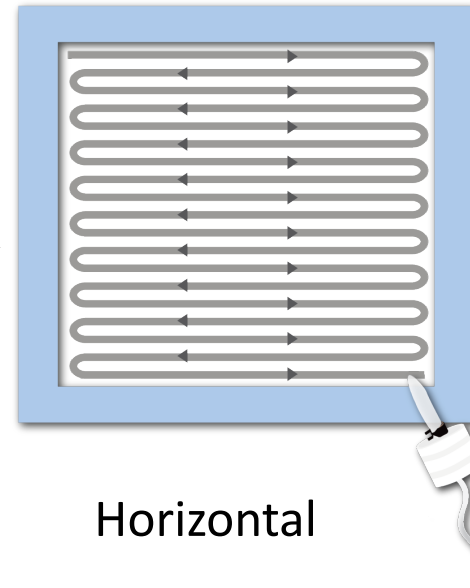


Gently move nozzle over surface

Collector

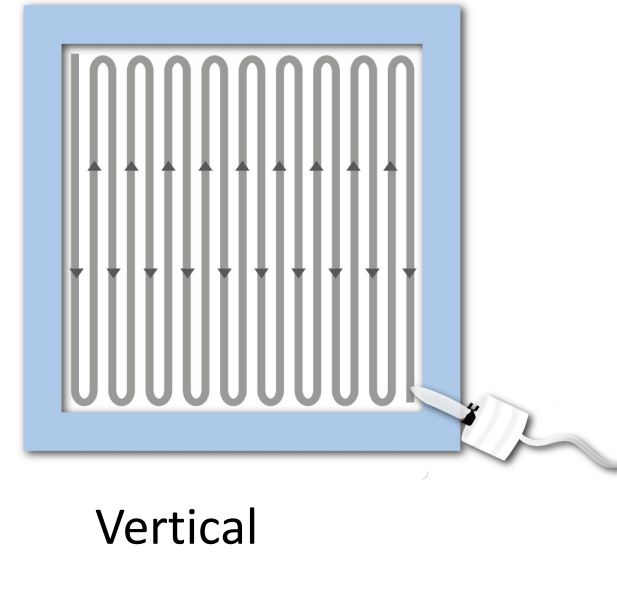


Collector



Horizontal

Collector

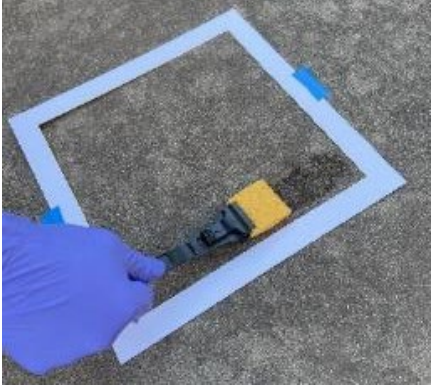


Vertical

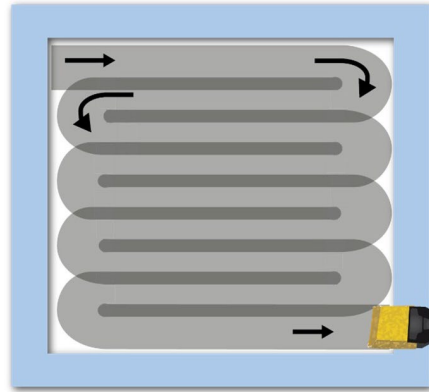
Collection time: 5 minutes

Sponge Stick Sample Collection

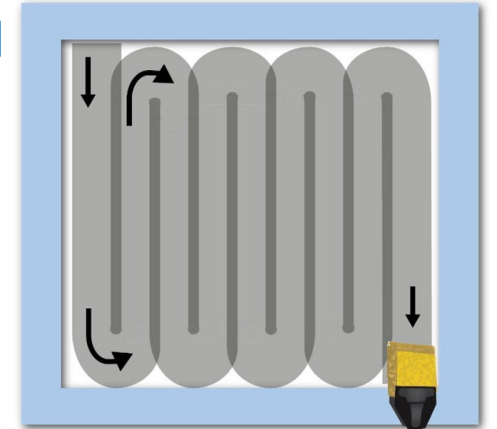
Collector



1. Horizontal

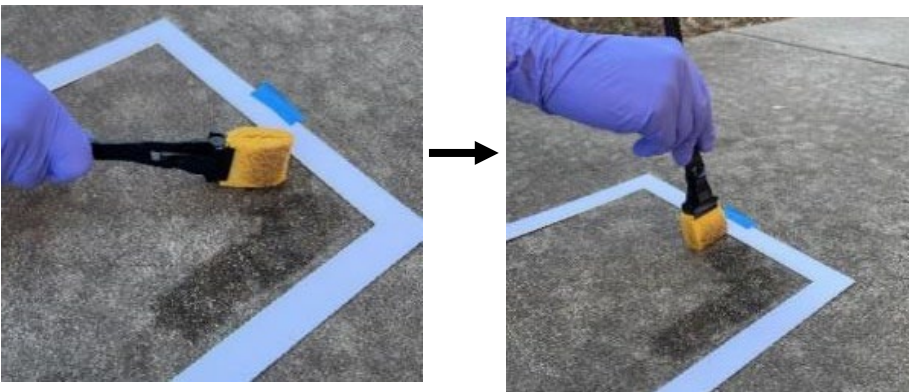


2. Vertical

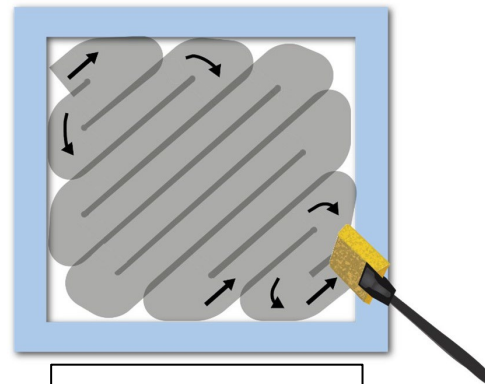


Turn sponge over

Collector

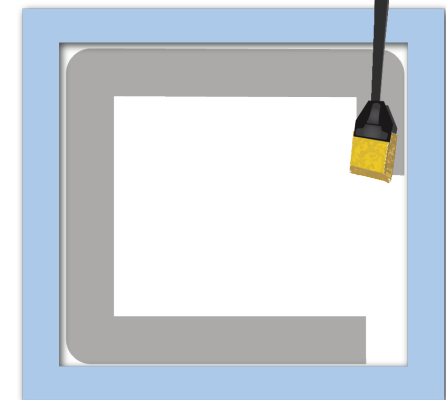


3. Diagonal



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)