AREA B GROUNDWATER INVESTIGATION

Progress Report to the RAB
January 11 2012

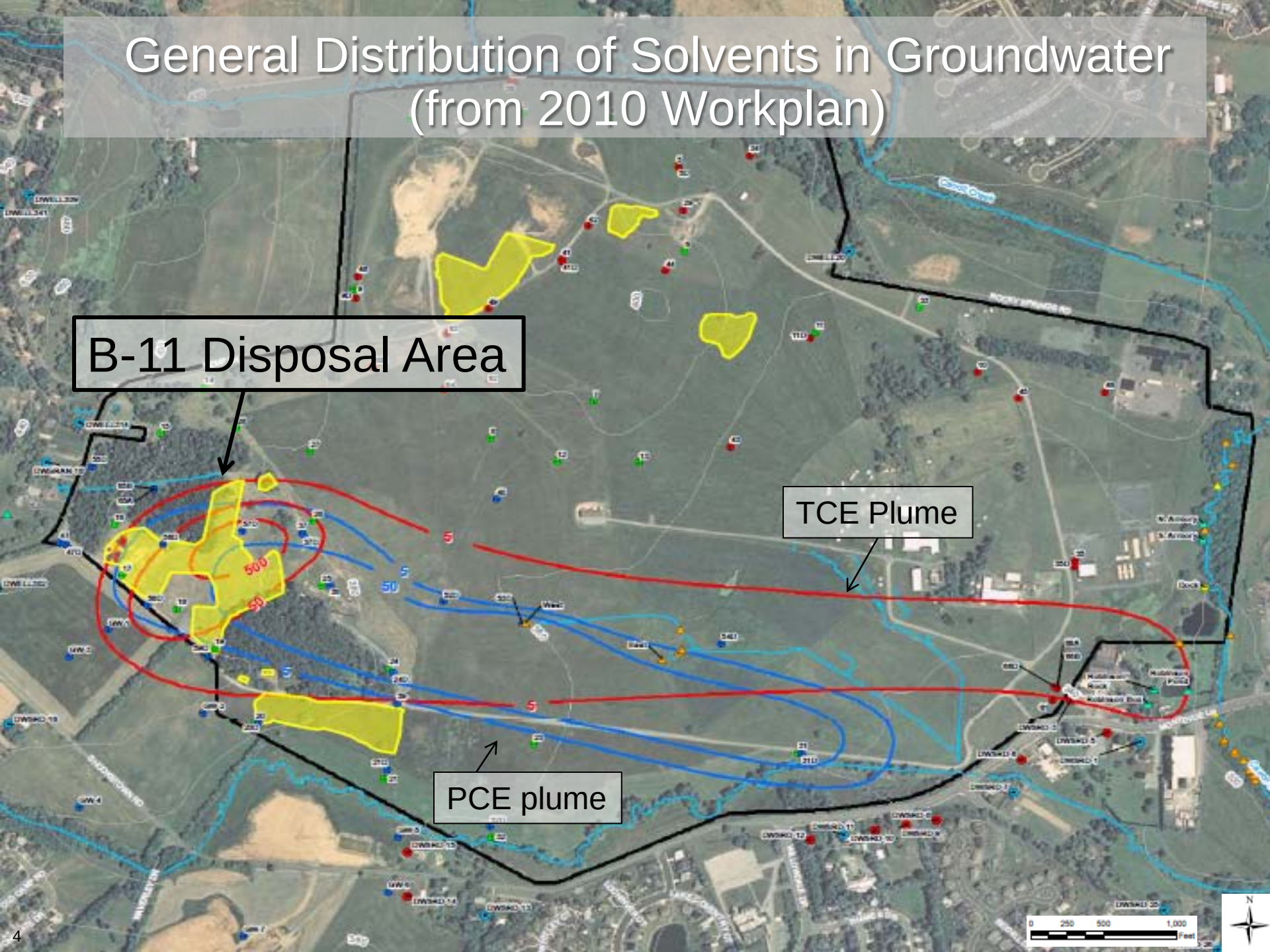
ARCADIS MALCOLM PIRNIE

Overview of Topics

- Background/objectives of the current phase of work
- Summary of on-site work including safety protocols
- Summary of Quarterly Sampling Data
- Status of off-site work--rights-of-entry/planned work
- Summary and anticipated path forward

Background/ Study Objectives

General Distribution of Solvents in Groundwater (from 2010 Workplan)



Objectives of Current Study

1. Further assess the depth and extent of contamination
2. Further assess the full range of possible chemical compounds
3. Further assess groundwater flow directions including potential deep groundwater flow under Carroll Creek
4. Further assess the potential for vapor intrusion into on and off site buildings

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Planned Work

▶ Existing well assessment and repair	Feb 2011 to Apr 2011
▶ New well installation	April 2011 to Jan 2012
▶ Direct Push Investigation	February 2012
▶ Spring and Seep Surveys	Winter/Spring 2012
▶ Vapor Intrusion Sampling	Spring 2012
▶ Groundwater/Surface Water Sampling	March 2012/Sept 2012
▶ Dye trace study	Spring/Summer 2012

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Partnering/Oversight

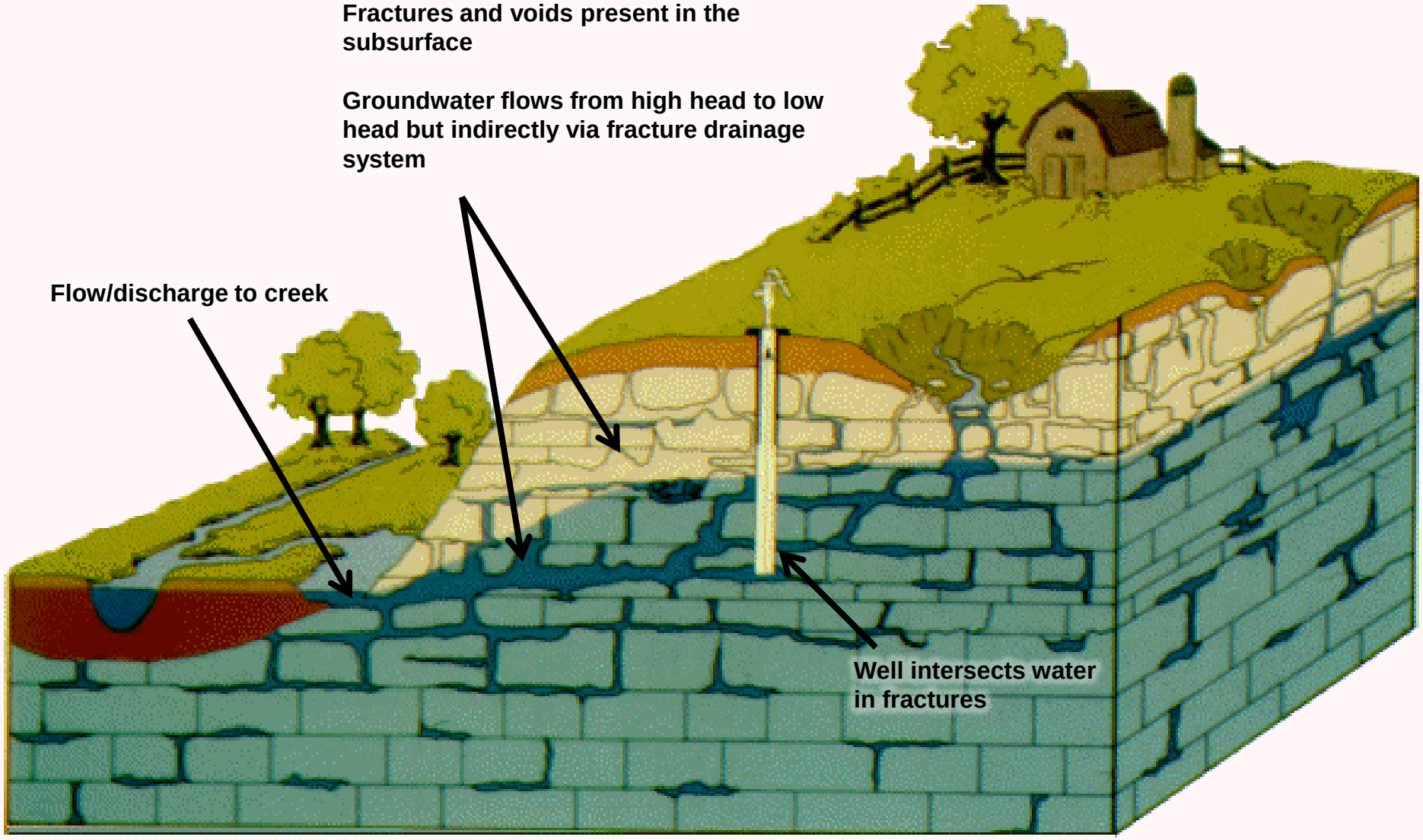
- Army worked with EPA and MDE in all aspects of fieldwork and decisions
- Bi-weekly conference calls with EPA, MDE, Arcadis, and the Army (16 to date) to discuss field data and path forward
- At the request of the Army, MDE collected groundwater samples simultaneously with Arcadis in November (split samples) for comparative independent analysis

WELL DRILLING
Progress to date

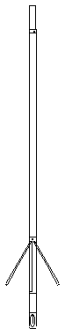
- Two drill rigs/crews operating simultaneously
- 10 day on/ 4 day off work schedule
- Currently in 19th 10-day drilling shift

Continuous Air Monitoring During Drilling

General Groundwater Flow in Limestone/Karst



- **Geophysical logging between each drilling interval.**

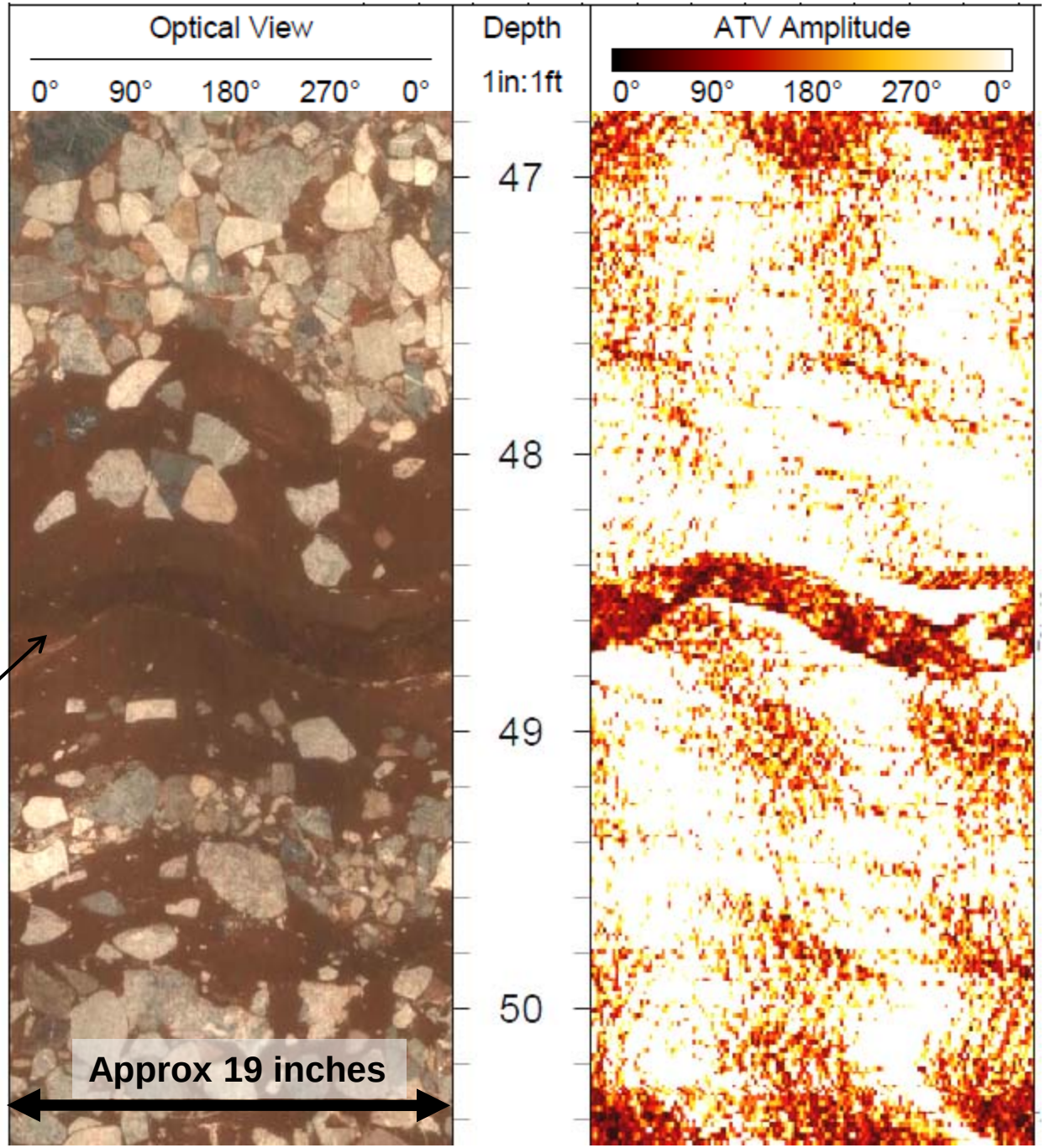


Multiple tools used to collect data at each boring.

Geophysical Logging

Multiple tools used to help characterize the subsurface:

- **Identify water-bearing zones,**
- **Select intervals for sampling, and**
- **Determine zones for screening permanent wells.**

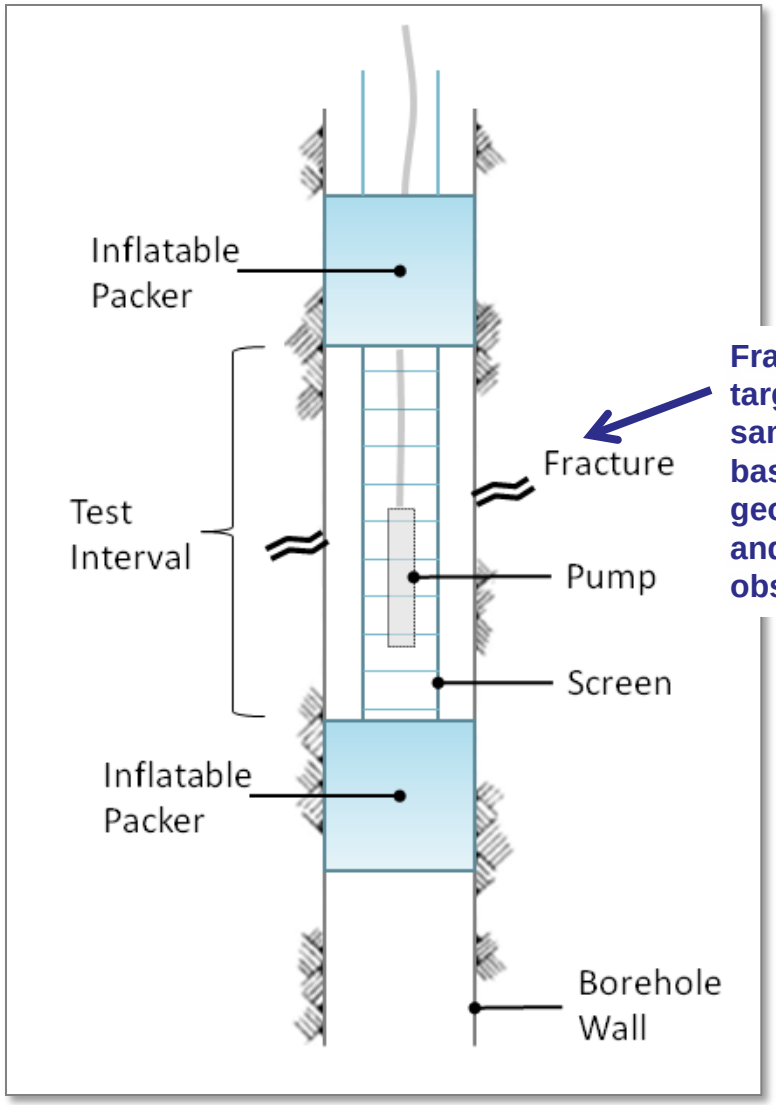


Fracture clearly visible on the Optical and Acoustical Televiewer Logs

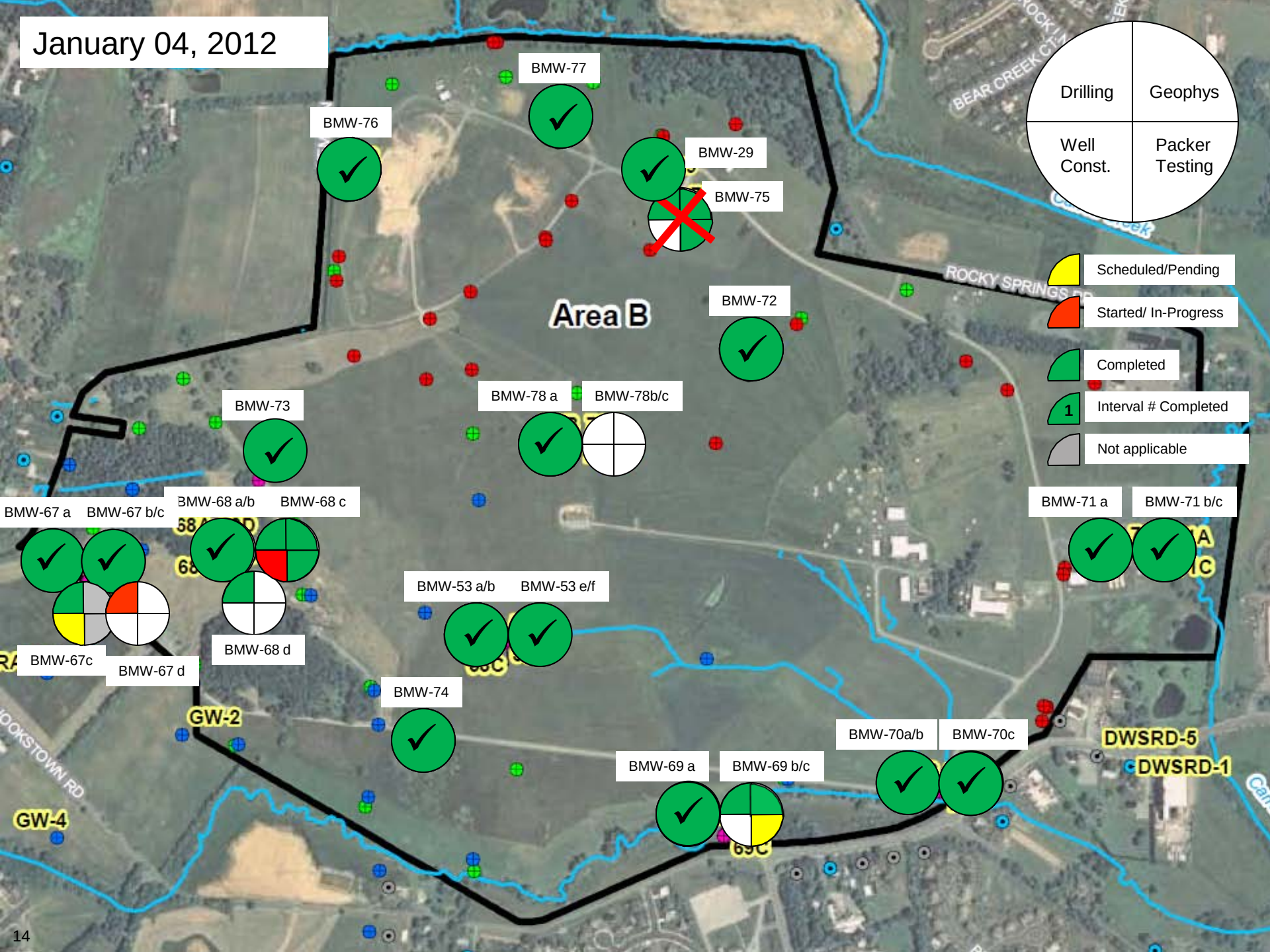
Boring ID: BMW-72

Packer Testing

(Groundwater Sampling at Targeted Zones)



Fracture targeted for sampling based on geophysics and other observations.


January 04, 2012
Drilling
Geophys
Well Const.
Packer Testing
Scheduled/Pending
Started/ In-Progress
Completed
1
Interval # Completed
Not applicable
BMW-77
BMW-76
BMW-29
BMW-75
BMW-72
Area B
BMW-73
BMW-78 a
BMW-78b/c
BMW-67 a
BMW-67 b/c
BMW-68 a/b
BMW-68 c
BMW-71 a
BMW-71 b/c
BMW-53 a/b
BMW-53 e/f
BMW-67c
BMW-67 d
BMW-68 d
BMW-74
GW-2
BMW-70a/b
BMW-70c
DWSRD-5
DWSRD-1
BMW-69 a
BMW-69 b/c
GW-4
ROCKY SPRINGS RD
BEAR CREEK CT
HOOKSTOWN RD

Status of Drilling Program

- 23 borings completed or in progress
- 24 new monitoring wells installed (100 wells total)
- 3,966 linear feet of drilling completed
- 3,028 linear feet of geophysical logging completed
- 37 packer test intervals completed
- Continuous air monitoring for Volatile Organic Compounds (VOCs) at all borings

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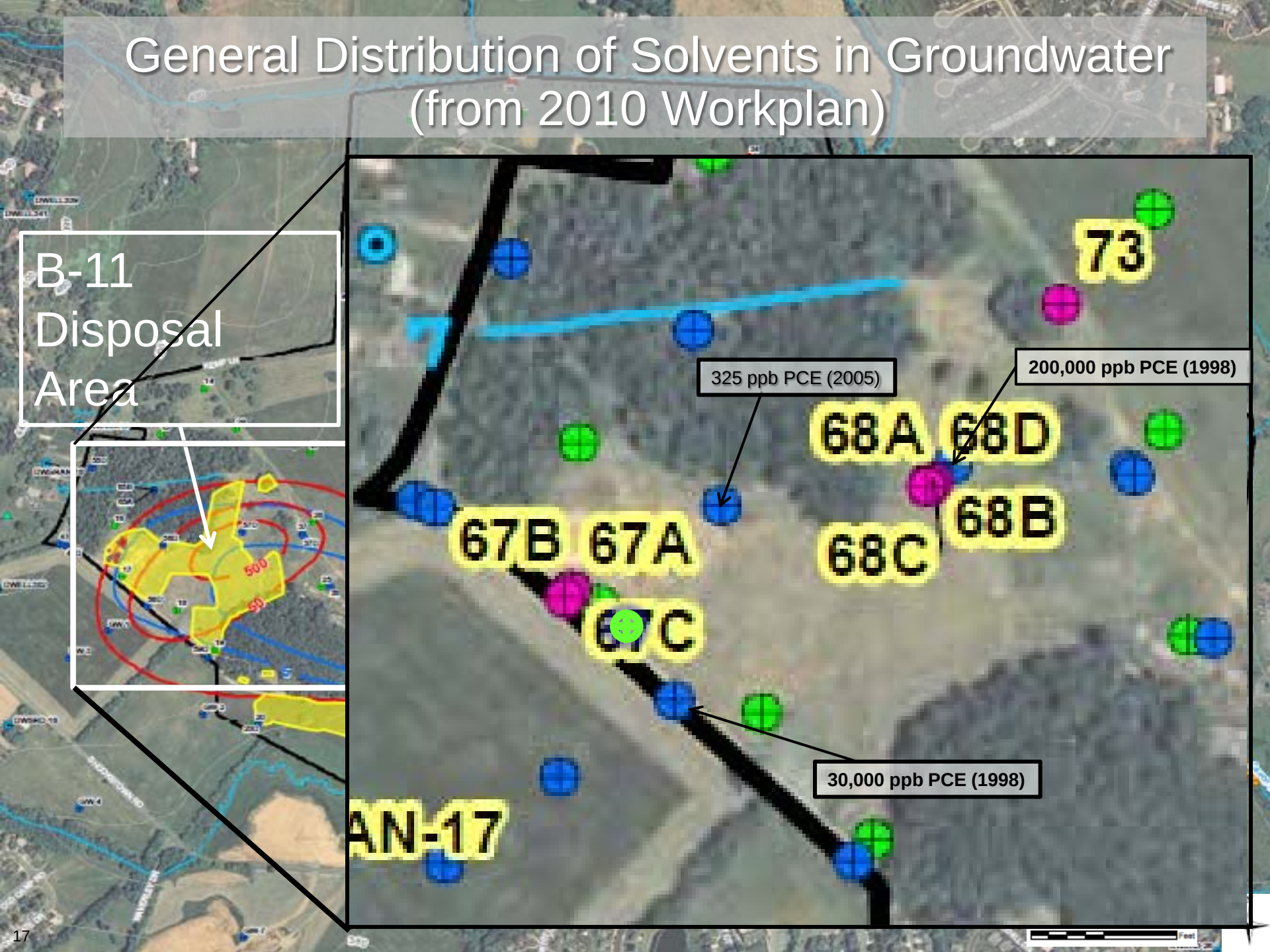
2011 drilling around the B-11 disposal area

General Distribution of Solvents in Groundwater (from 2010 Workplan)



HASP Procedures

- Health and Safety Plan in place (approved January 2011)
- Site Safety Officers on-site at all times during all work
- Daily safety briefings conducted (standard procedure)
- Air monitoring conducted at each drill-site for vapors (VOCs) and other parameters—VOCs; CO2; CO; O2; H2S
- Additional air monitoring to be implemented if action levels exceeded including monitoring 100 ft downwind of the drilling site and/or at the property line (coordination with County Health Dept)

Worker Protection Action Levels

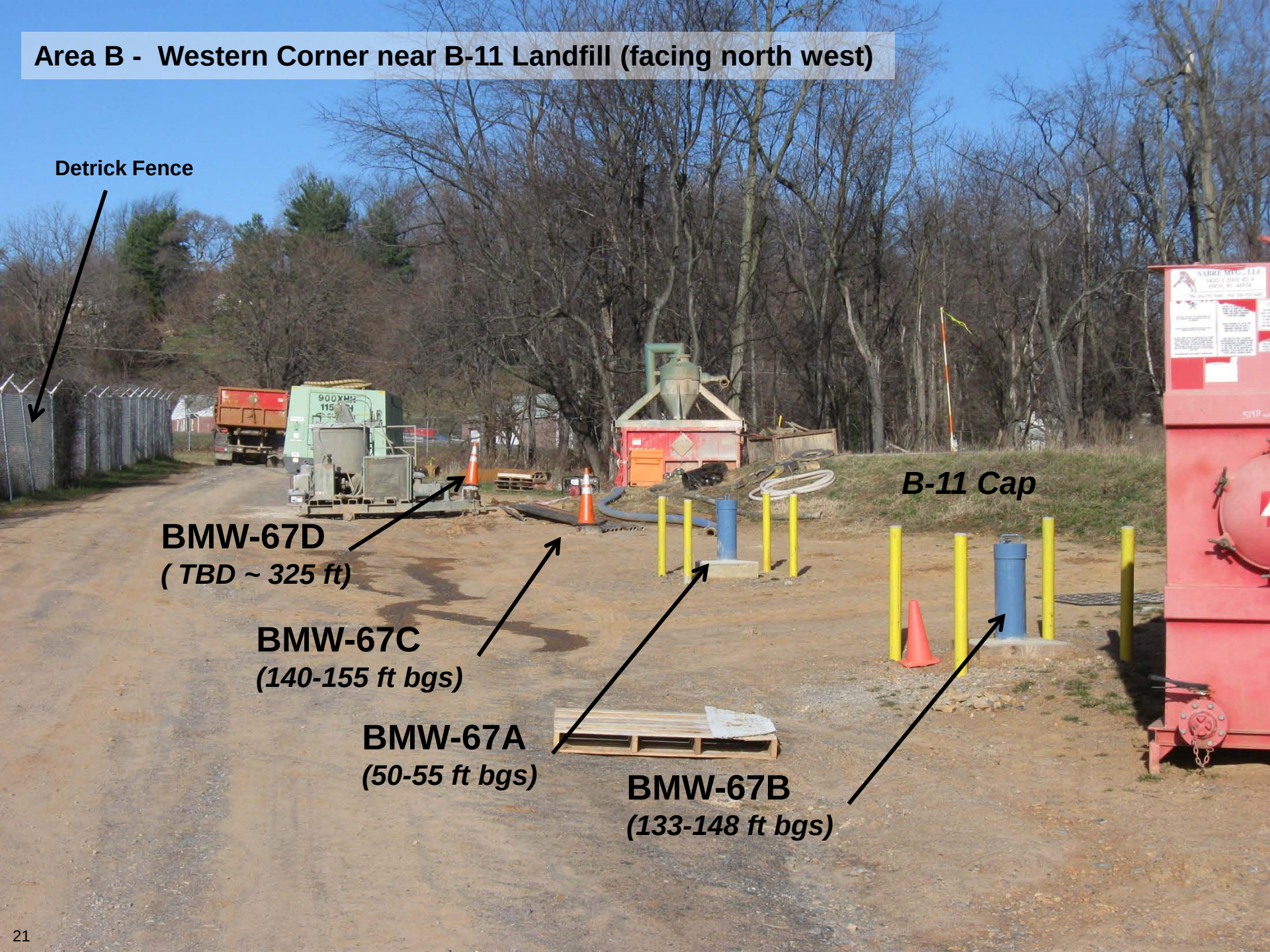
- Sustained above 0.5 ppm--additional air monitoring
- Sustained above 5 ppm--continued work requires Level C protection
- Below 5 ppm Level C not required
    - Respirators are un-necessary
    - Create a greater hazard working around heavy equipment
    - Limit communication, mobility, vision
    - Create heat stress conditions in hot weather
    - OSHA/EPA recommends a layered approach to worker protection

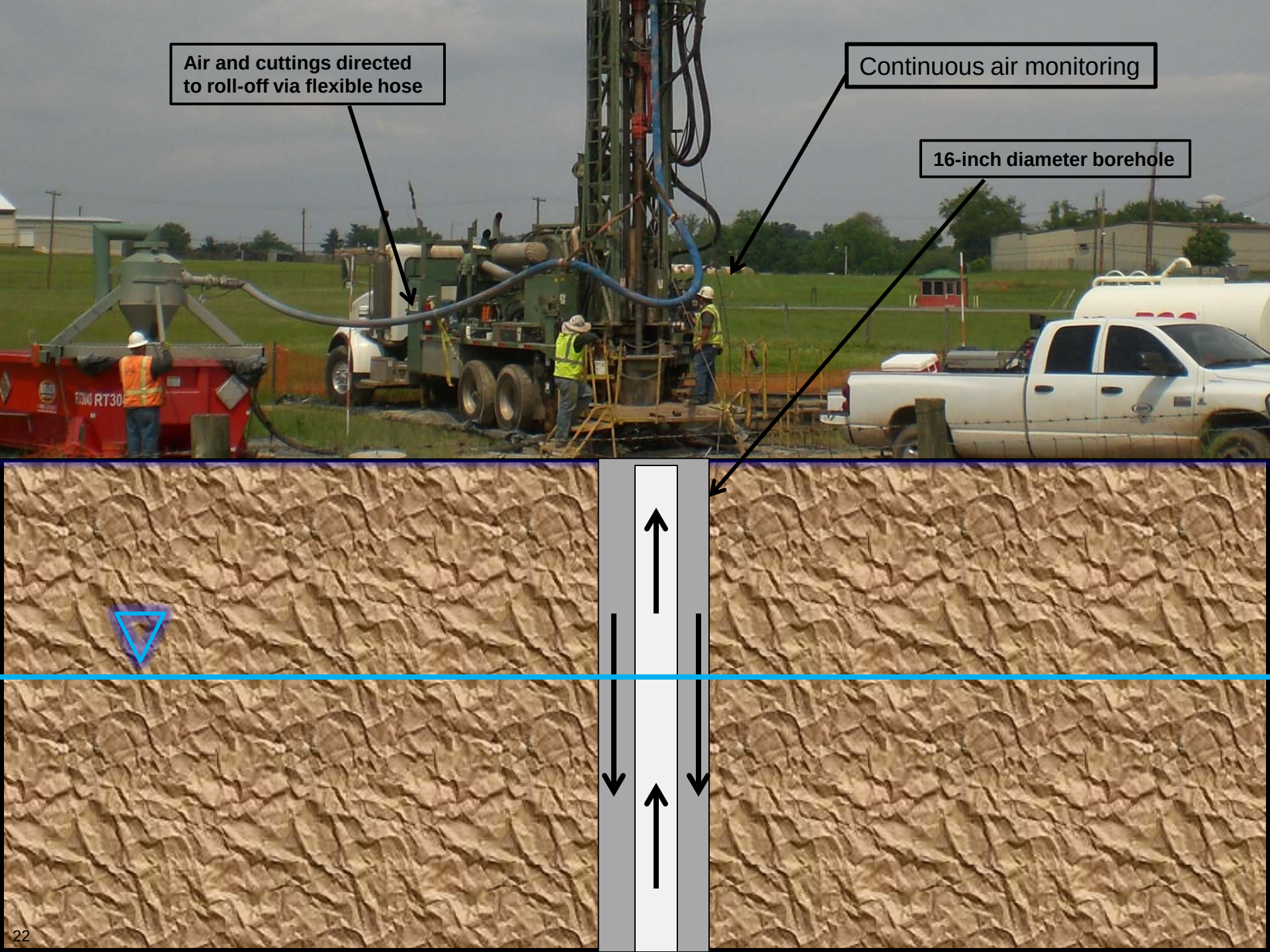
HASP Procedures

- Action levels requiring Level C had not been encountered at any location to date at Area B prior to the single event at BMW-67C near the B-11 Disposal Area

- Drilling crews trained/certified to use air respirators and equipped for filtered air respirators (Level C) should vapors above action levels be detected

Area B - Western Corner near B-11 Landfill (facing north west)




Air and cuttings directed to roll-off via flexible hose
Continuous air monitoring
16-inch diameter borehole

BMW-67C drilling chronology

- 155 feet bgs—water filled fracture encountered
- Water sufficiently contaminated for drilling process (mixes water and air) to vaporize solvents and trigger action levels at the surface in the immediate vicinity of the drill rig
- VOCs were background/non-detect 10 ft from the borehole
- Drilling was ceased and the readings returned to background
- While ready and prepared to continue drilling--decision made to install a well at this depth

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BMW-67C drilling chronology

- BMW-67C well screen installed at 155 ft
- BMW-67D added to provide vertical delineation
- As an added precaution water and air samples from BMW-67C and the nearby BMW-67B collected (in Level C) to verify safe conditions
  - VOCs, SVOCs, and “Tentatively Identified Compounds”
- BMW-67B also analyzed for the full suite of parameters
- Concentrations were consistent with expectations and the existing safety protocols applicable

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Supplemental Sampling -Air

Results

- VOC detections in air similar to the known VOC in groundwater around B-11
- Only 4 TICs were identified at low concentrations– no unknowns of concern
- Primary VOCs: TCE; freons; 1,1-DCE; c1,2-DCE; chloroform; PCE

			Comparison Criteria	
Max Detects of Key Compounds	**Units**	**Sample Result**	ACGIH Threshold Limit Level	OSHA Permissible Exposure Limit
TCE (Trichloroethylene)	ppm(v)	1.7	10	100
PCE (Tetrachloroethylene)	ppm(v)	0.02	25	100
1,1DCE (Dichloroethylene, 1,1-)	ppm(v)	0.37	100	100
cis-1,2-DCE(Dichloroethylene, cis1,2-)	ppm(v)	0.16	200	200
Chloroform	ppm(v)	1.2	10	50
Freon (i.e.,trichlorofluoromethane)	ppm(v)	2.3	1,000	1,000

No Exceedances

Notes:
• Analysis by TO-15 (SUMMA Canister)
• ppm(v) = part per million by volume

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Supplemental Sampling –Groundwater

Groundwater Sampling

- BMW-67B was tested for VOCs/SVOCs + TICs, inorganics, pesticides, herbicides, PCBs, dioxins/furans, radionuclides.

Results

- The list of VOC detections in air matched the VOC detections in groundwater known for this area.
- No VOC TICs
- 8 SVOC TICs were identified at low concentrations – no unknowns of concern.

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Supplemental Sampling –Groundwater

- Sample results for comprehensive analysis at BMW-67B (133-148 ft bgs)
- The following 5 compounds exceeded Federal drinking water standards

	Units	**Sample Result**	**Drinking Water Standard (MCL)**
Trichloroethylene (TCE)	ug/l	820	5
Tetrachloroethylene (PCE)	ug/l	28	5
Dichloroethylene, 1,1-	ug/l	30	7
Dichloroethane, 1,2-	ug/l	6.8	5
Chloroform	ug/l	580	80

** MCL = Federal Drinking Water Standard*

- No other VOCs, SVOCs, inorganics, pesticides, herbicides, PCBs, dioxins/furans, or radionuclides were detected at concentrations above Federal drinking water standards.

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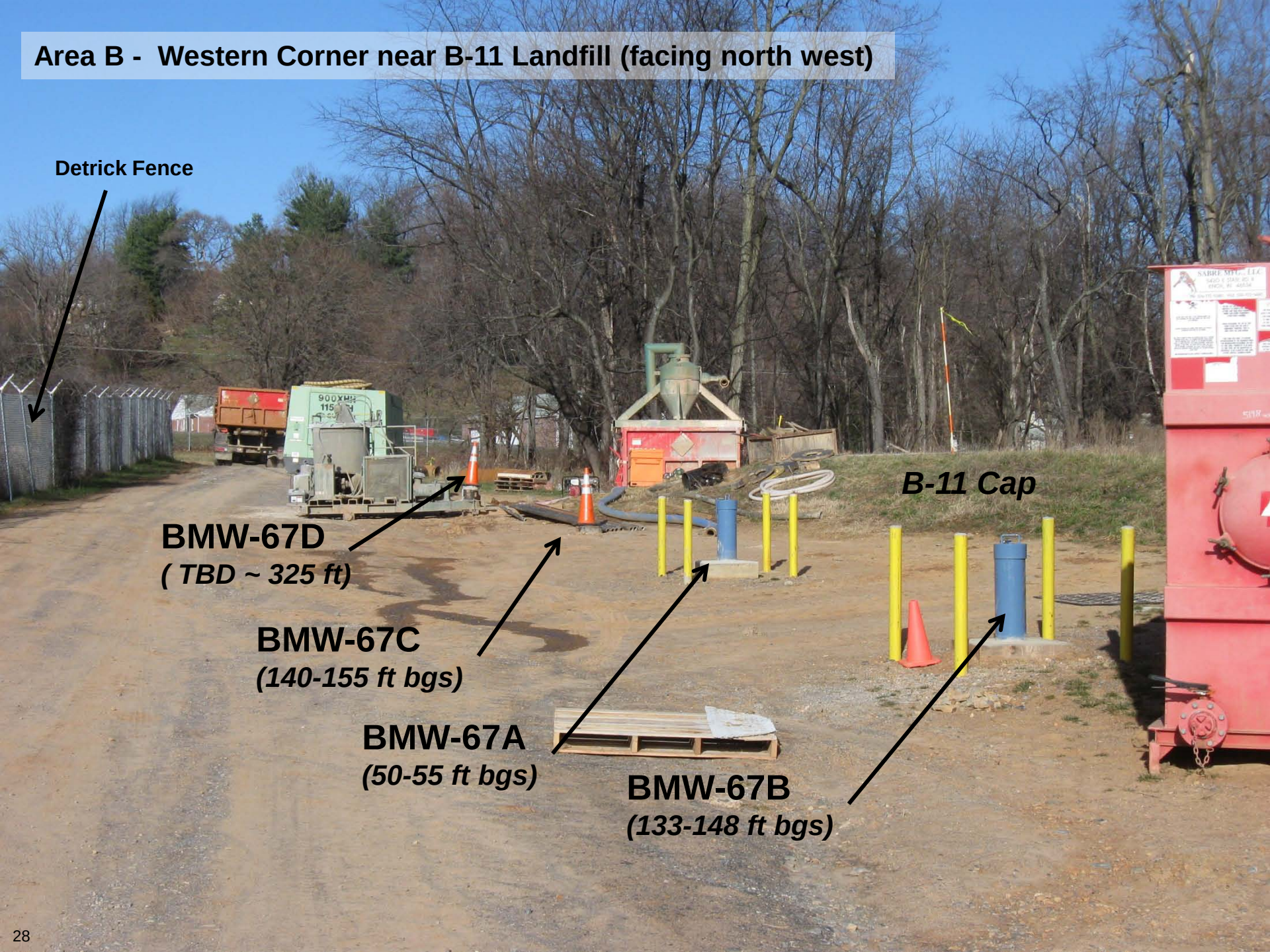
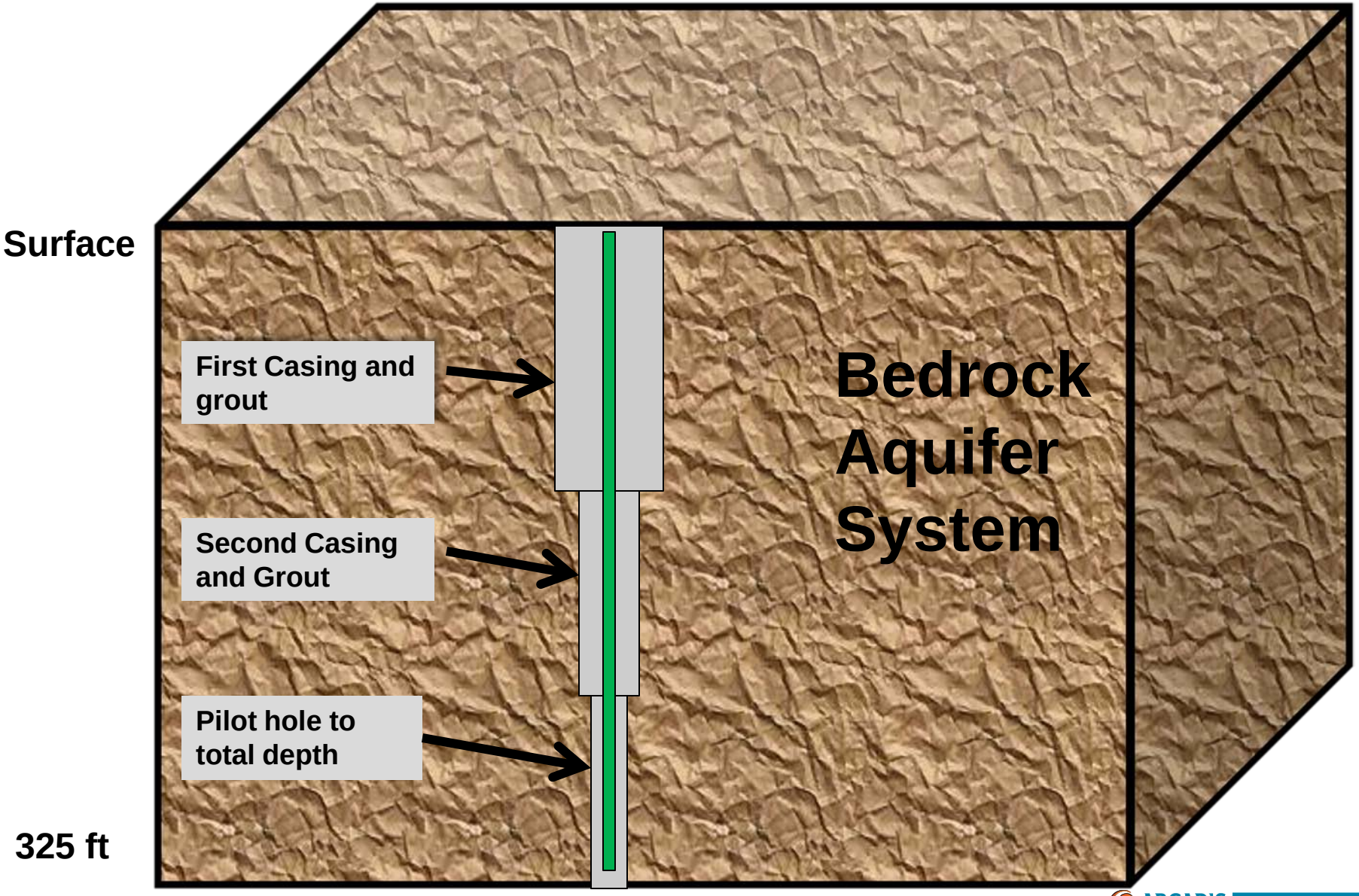

Area B - Western Corner near B-11 Landfill (facing north west)
Detrick Fence
B-11 Cap
BMW-67D
(TBD ~ 325 ft)
BMW-67C
(140-155 ft bgs)
BMW-67A
(50-55 ft bgs)
BMW-67B
(133-148 ft bgs)

Deep Well Installation Method



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Current Status

- BMW-67C was installed at 155 feet bgs
- BMW 67D is currently being drilled to a depth of 325 ft
- These wells met their intended purpose—to provide additional data on contaminant distribution and will provide useful data on groundwater conditions in the future
- Action levels necessitating Level C have not been exceeded during the installation of BMW-67C or during the drilling of BMW-67D

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November Quarterly GW Sampling Results

November 2011 Sampling

- Quarterly sampling of a sub-set of on-site wells initiated to continue to build data set
- 15 Area B wells included in data set
  - Tested a mix of new and existing wells, including wells near B-11 and along the property boundary.
- 1 spring and 5 residential properties also tested
- Sampled for VOCs only
- MDE collected split samples for independent analysis at the request of the Army
- More comprehensive groundwater sampling rounds planned after on-going drilling activities are completed.

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November 2011 Sampling Results Summary

- ✓ Good correlation between Army test results and MDE test results
- ✓ Identified VOCs were similar to prior test results – no surprises

<u>Off-Post Groundwater</u>

- ✓ PCE/TCE or other site related VOCs were not been detected in residential wells.
- ✓ Federal drinking water standards (MCLS) were not been exceeded in the residential wells
- ✓ MTBE (gasoline additive) was detected in residential wells below state guidance number
- ✓ MTBE not detected on Ft Detrick Area B property

November 2011 Sampling Results Summary

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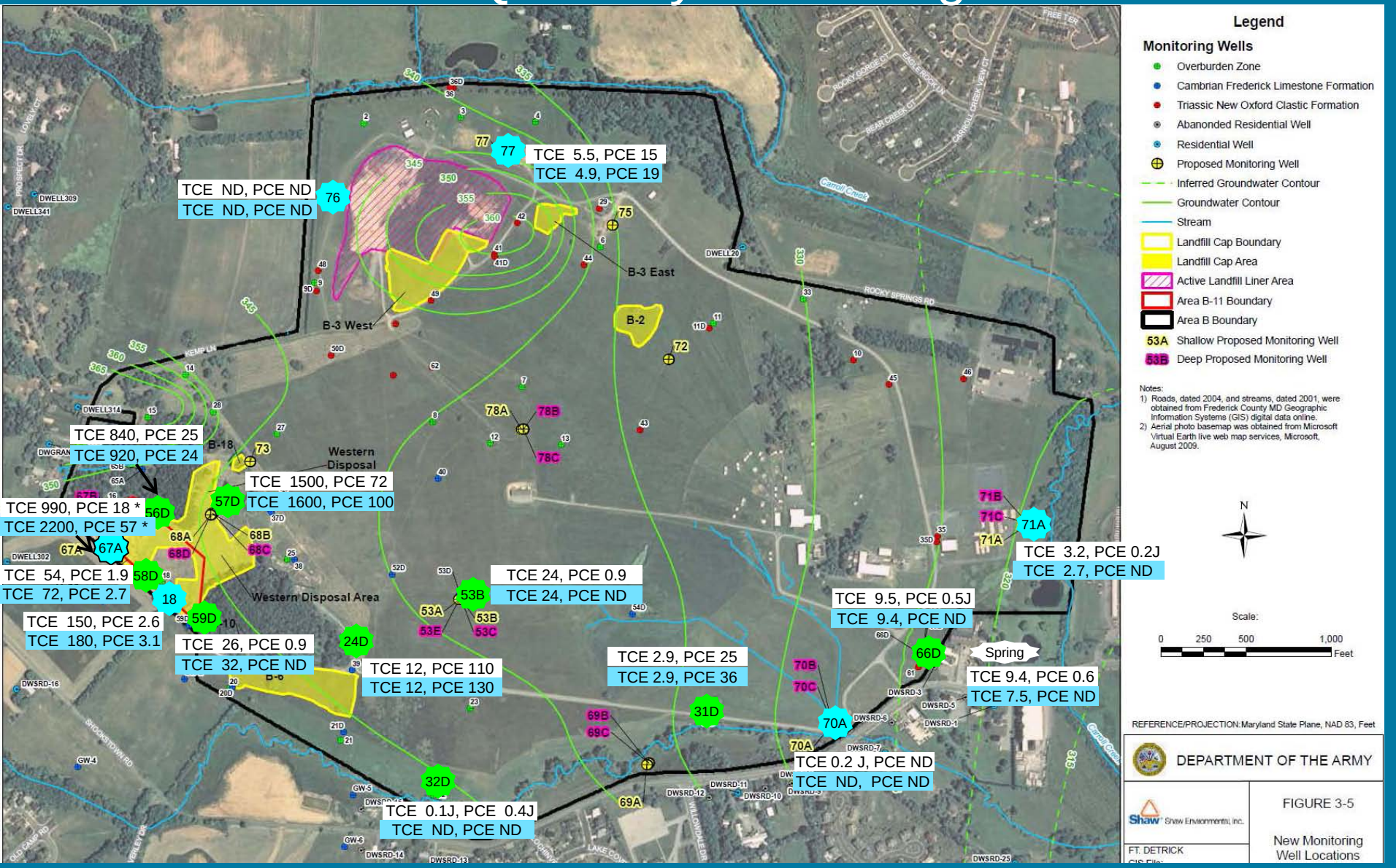
On-Post Groundwater

- ✓ Maximum concentrations detected in the vicinity of B-11.
- ✓ Max concentrations 2,200 ppb much lower than historical maximum (200,000 ppb in 1998), but still above drinking water standards
- ✓ Lower concentrations to the east B-11

Spring Sample

- TCE detected at 9.4 ppb in off-post spring. Similar to recently detected concentrations; much lower than historical max detection.

November 2011 Quarterly Monitoring – TCE & PCE



32D Deep wells

18 Shallow wells

TCE 24 ARCADIS Sample Results ug/L

TCE 24 MDE Split Sample Results – ug/L

TCE = Trichloroethene PCE = Tetrachloroethene

Drinking Water Standard for TCE & PCE = 5 ug/L

* Difference in results for sample 67A attributed to 10x lab dilution for ARCADIS sample and 50x lab dilution for MDE sample .

Comments—On-Site Work

- Data collected generally consistent with past data

- Deeper borings (up to 325 ft) generally indicate fewer water bearing fractures below 300 ft and lower contaminant levels except one well near B-11

- Full groundwater sampling events (approx 100 on-site wells) will provide a clear picture of the nature and extent of contamination at Area B

Off-site work

Future Work

Direct Push Drilling

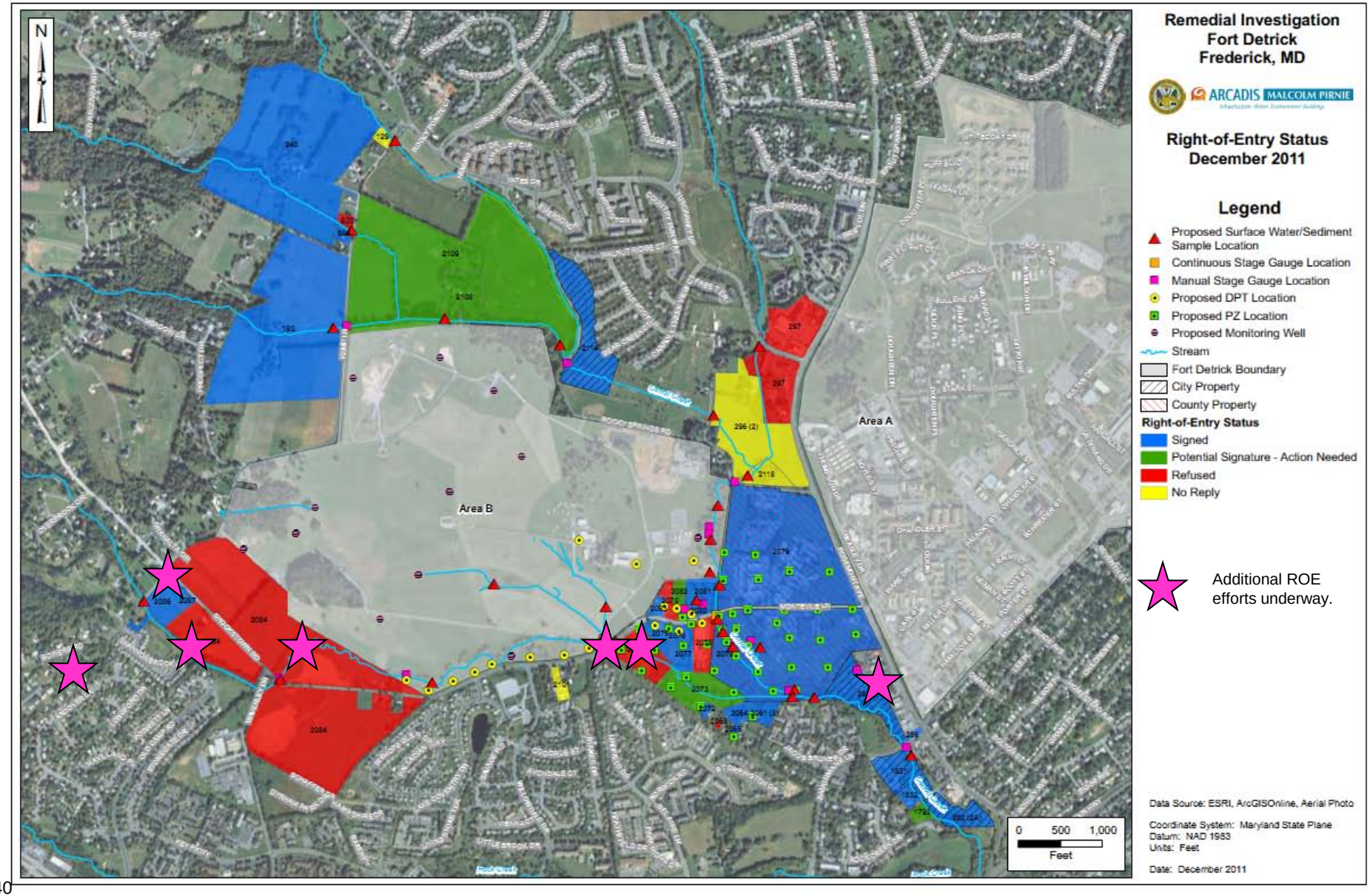
Spring and Seep Survey/Sampling

Vapor Intrusion Sampling

Dye Trace Sampling

On-site and Off-Site GW Sampling

ROE Status – 01/04/12



Direct Push Drilling

1. A light weight drilling rig is used to push sampling rods into the ground using hydraulic pressure
2. Soil samples can be collected to identify soil type with depth
3. Groundwater samples can be collected to identify any contaminants in the subsurface
4. Small diameter shallow wells can be installed to provide longer term sampling location

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Purpose of this study

1. Assess the depth to rock
2. Collect groundwater samples to determine if contaminants are present in the shallow groundwater overlying the limestone bedrock
3. Results will be used to guide future work if required including additional vapor intrusion sampling

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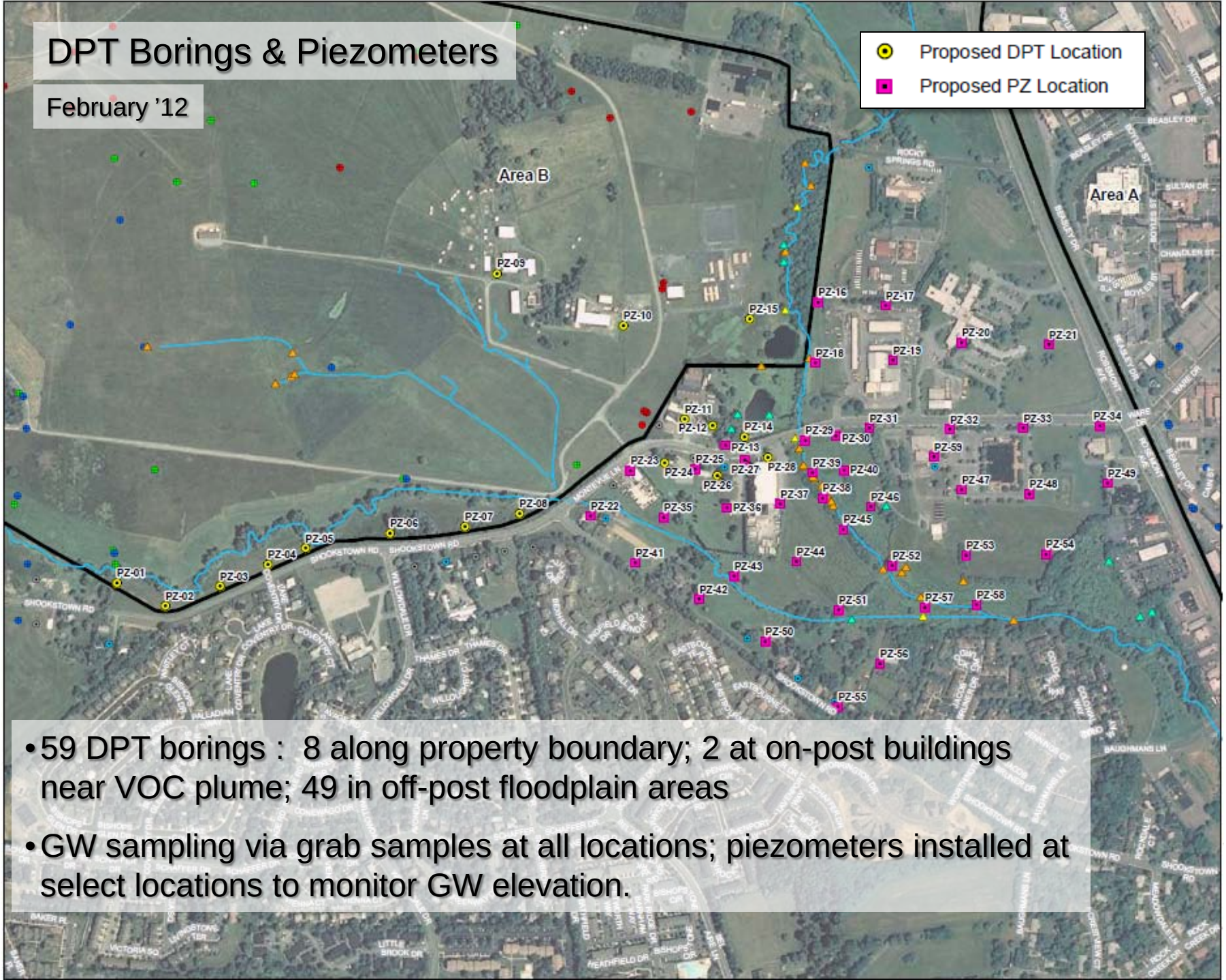
DPT Borings & Piezometers

February '12



- 59 DPT borings : 8 along property boundary; 2 at on-post buildings near VOC plume; 49 in off-post floodplain areas
- GW sampling via grab samples at all locations; piezometers installed at select locations to monitor GW elevation.

Stream and Seep Sampling

1. Groundwater from Area B is discharging to Carroll Creek and Steam 2

2. Seeps and Springs are known to be present in the creek and its banks

3. Re-locate known springs, look for additional springs and seeps, and establish/ re-establish sampling points to be monitored

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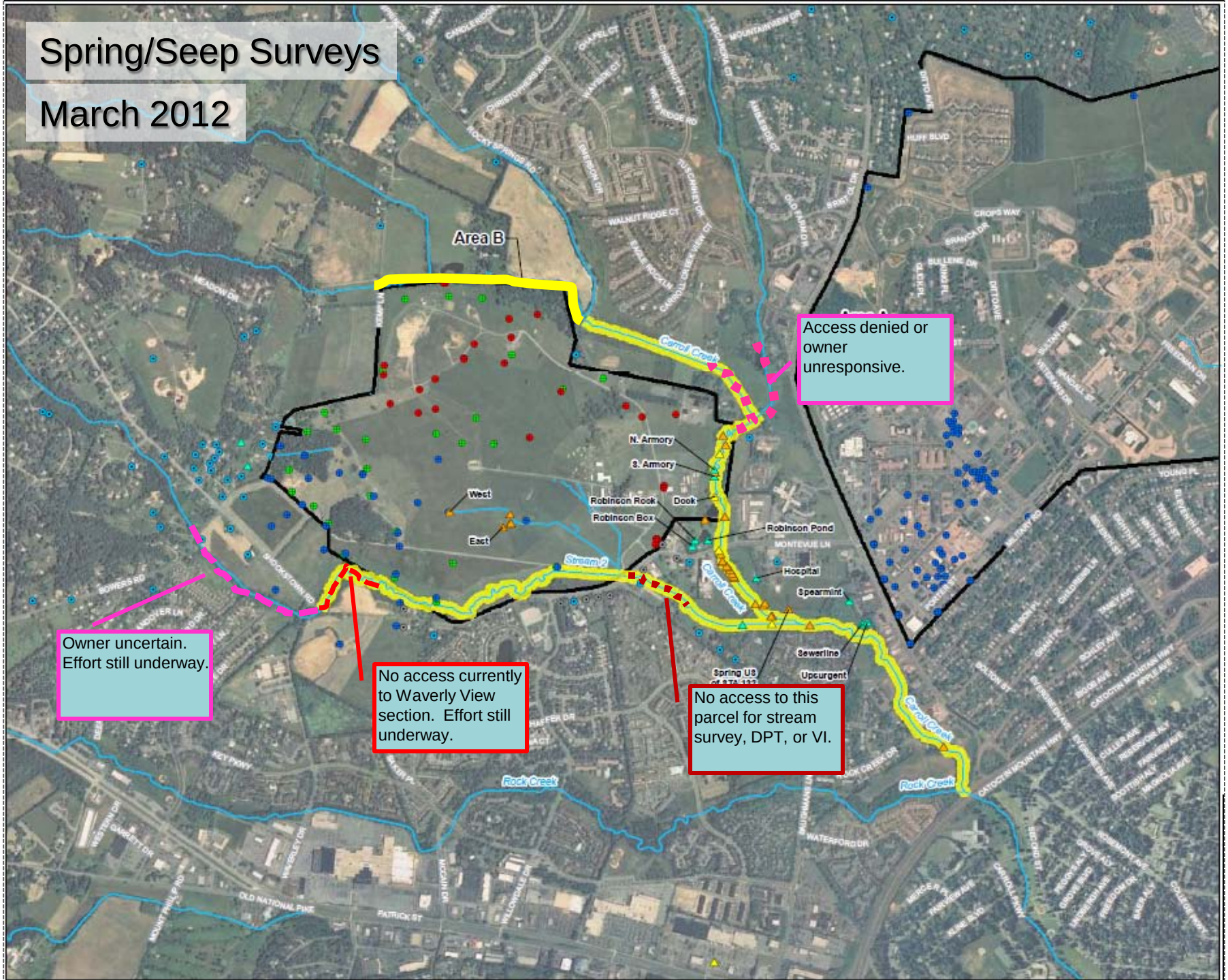
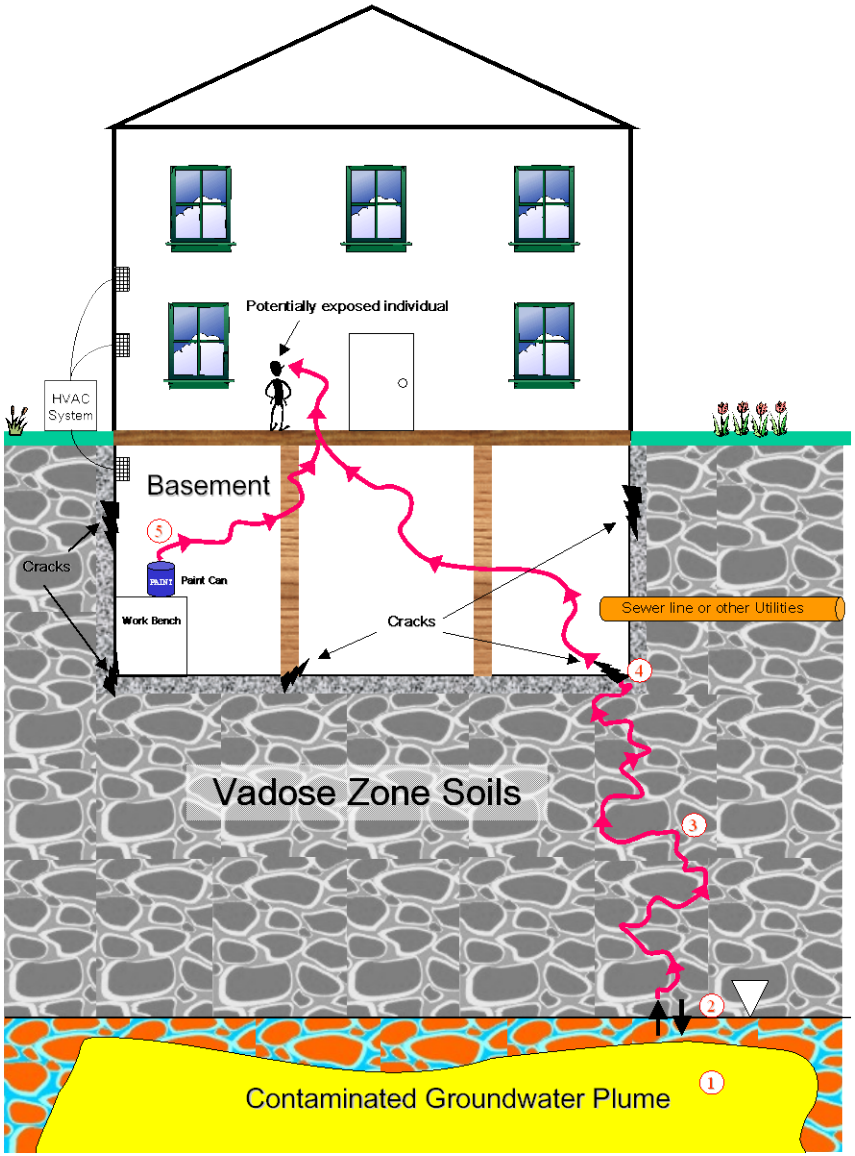

Spring/Seep Surveys
March 2012
Area B
Carroll Creek
Stream 2
Rock Creek
N. Armory
S. Armory
West
East
Robinson Rock
Dook
Robinson Box
Robinson Pond
Hospital
Spearmint
Sewerline
Upcurgent
Spring U8
Access denied or owner unresponsive.
Owner uncertain. Effort still underway.
No access currently to Waverly View section. Effort still underway.
No access to this parcel for stream survey, DPT, or VI.

Vapor Intrusion Samping

- Vapors from chemicals in groundwater that may rise up and infiltrate a building via cracks or sumps in the slab
- Movement is from groundwater through soil pore spaces (soil gas)
- Indoor background sources



Purpose of this Work

1. Determine if buildings over or near the plume of solvents in groundwater are impacted
2. Air samples will be collected from beneath the building slab to assess if vapors are present beneath the slab
3. Air samples will also be collected within the buildings to see if vapors are present there

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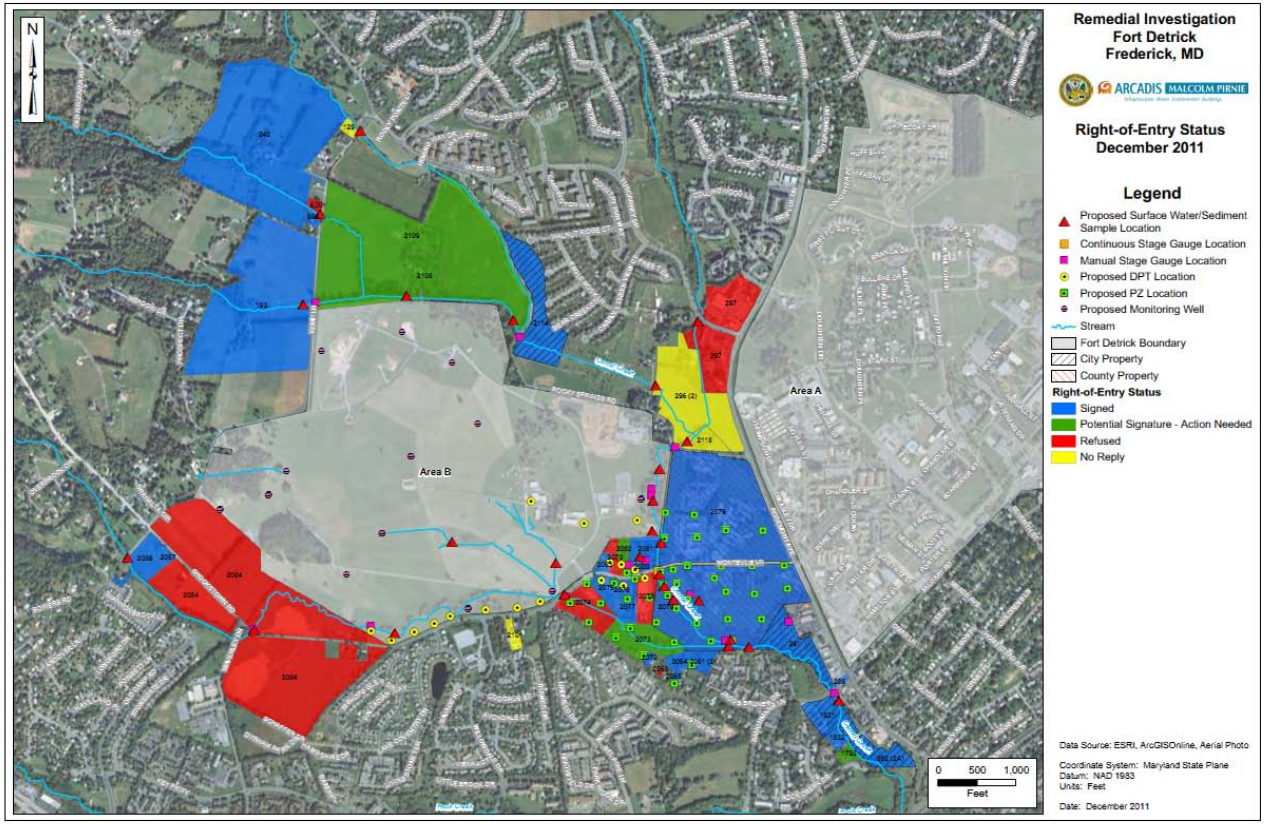
Vapor Intrusion Assessment

- Sampling planned at five buildings for VOC analysis
  - sub-slab samples
  - indoor & ambient air samples
- Scheduled for spring 2012



Dye Trace Testing

1. In order to help determine groundwater flow directions a non-toxic colored dye is released at a known point in the subsurface (monitoring well)
2. Locations downgradient including wells, seeps, and springs are sampled on a regular basis for evidence of the dye
3. The locations the dye appears indicates groundwater flow directions and the time taken to arrive indicates flow rates

Purpose of the Work

1. Previous dye tests conducted by the Army have indicated that most groundwater from Area B discharges to Carroll Creek

2. This study will inject dye at a deeper interval to determine if deeper groundwater is passing under Carroll Creek and moving off-site

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Summary

Summary

- On-site drilling complete in January 2012 (9 month effort)
- 100 monitoring points on-site
- Deep (300 ft +) groundwater flow assessed
- Comprehensive groundwater sampling planned for all these wells Spring and Fall 2012

- Off-site rights-of-entry obtained
- Off-site work will start this month and into the Spring 2012

- All data will be analyzed and the Conceptual Site Model updated
- CSM will be used to guide future work

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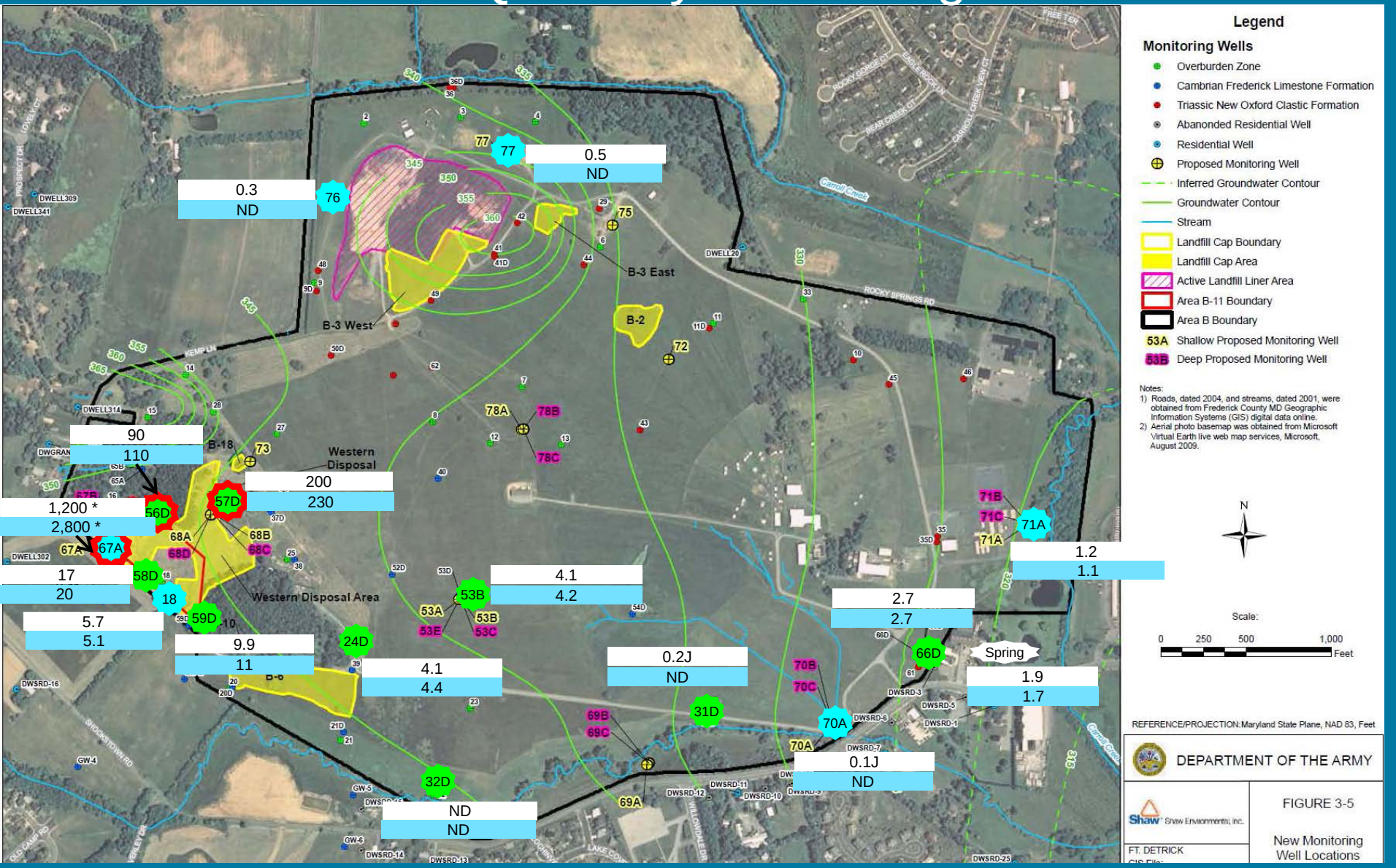
Questions/ Conversation

November 2011 Quarterly Monitoring – Chloroform



Legend

Monitoring Wells

- Overburden Zone
- Cambrian Frederick Limestone Formation
- Triassic New Oxford Clastic Formation
- Abanonded Residential Well
- Residential Well
- Proposed Monitoring Well
- Inferred Groundwater Contour
- Groundwater Contour
- Stream
- Landfill Cap Boundary
- Landfill Cap Area
- Active Landfill Liner Area
- Area B-11 Boundary
- Area B Boundary
- 53A Shallow Proposed Monitoring Well
- 53B Deep Proposed Monitoring Well

Notes:
1) Roads, dated 2004, and streams, dated 2001, were obtained from Frederick County MD Geographic Information Systems (GIS) digital data online.
2) Aerial photo basemap was obtained from Microsoft Virtual Earth live web map services, Microsoft, August 2009.

N

Scale: 0 250 500 1,000 Feet

REFERENCE/PROJECTION:Maryland State Plane, NAD 83, Feet

DEPARTMENT OF THE ARMY

Shaw Shaw Environmental, Inc.

FT. DETRICK

FIGURE 3-5

New Monitoring Well Locations

32D Deep wells

18 Shallow wells

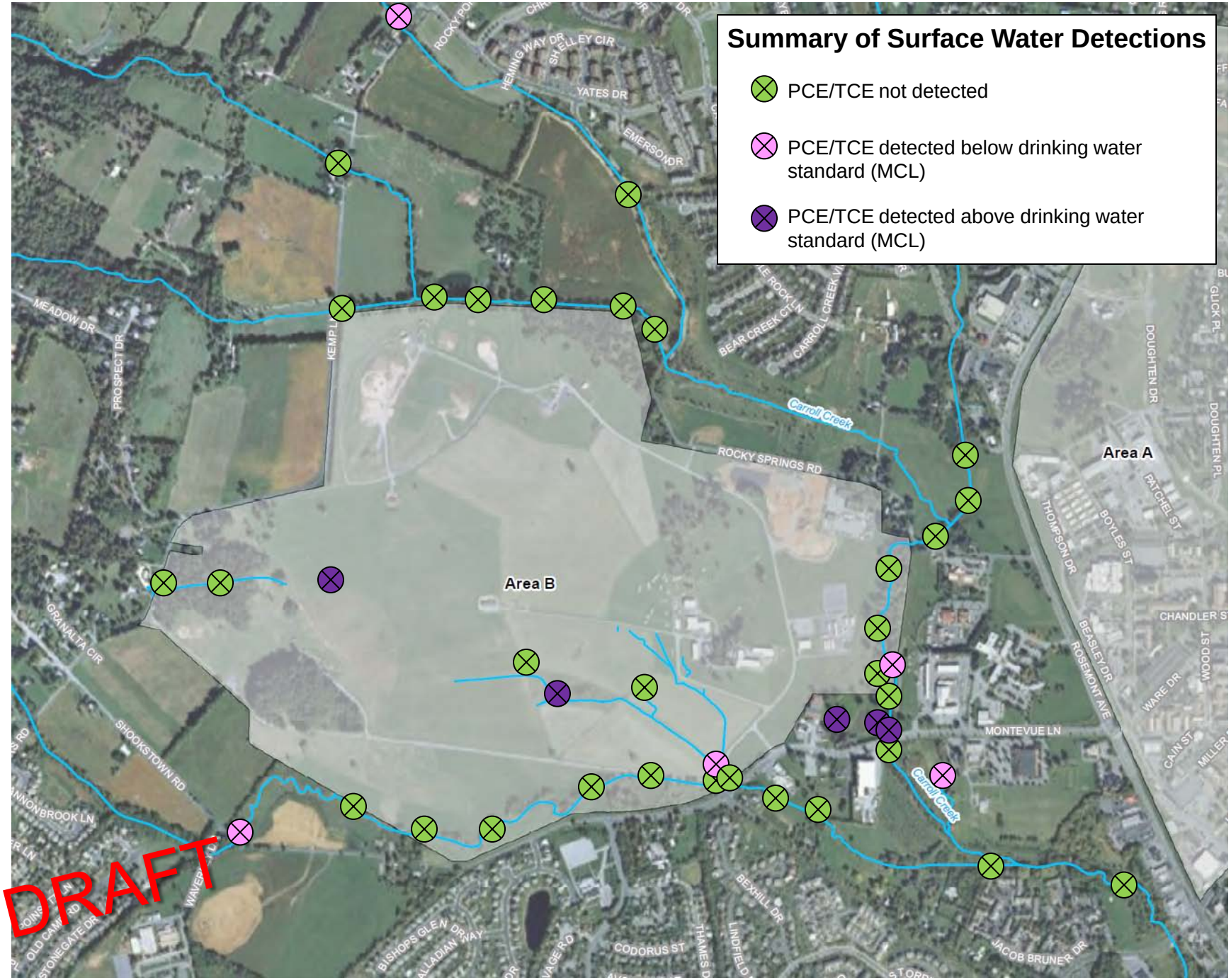
24 ARCADIS Sample Results ug/L

24 MDE Split Sample Results – ug/L

Drinking Water Standard for Chloroform = 80 ug/L

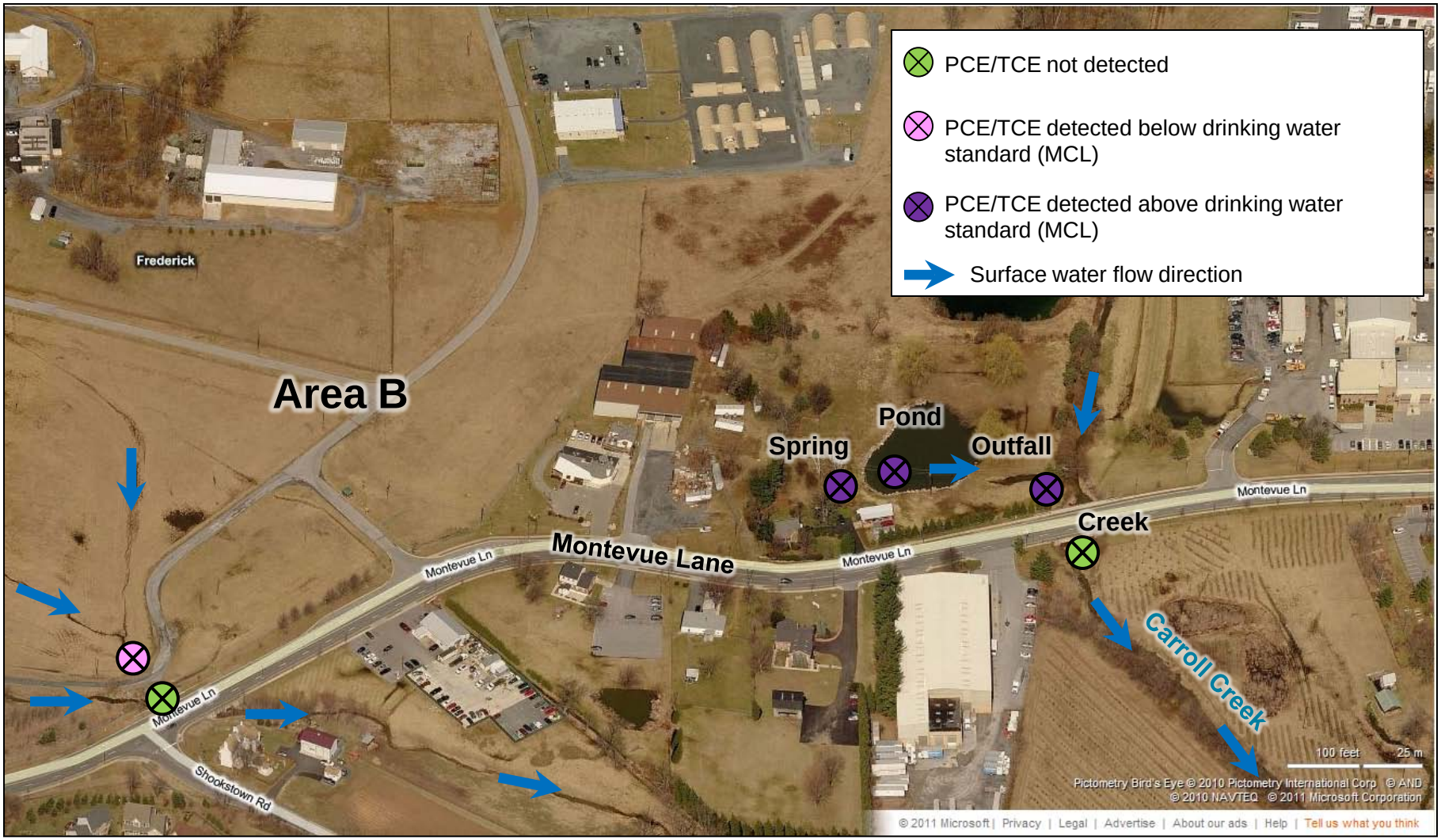
67A = well where the chloroform detection exceeded the Drinking Water Standard for Chloroform

* Difference in results for sample 67A attributed to 10x lab dilution for ARCADIS sample and 50x lab dilution for MDE sample .



Aerial Source: ESRI, ArcGISOnline, Aerial Photo

VOCs Dilute/Volatilize Rapidly In Surface Water



Aerial Source: Pictometry Birdseye (c) 2010 Pictometry International Corp (c) and (c) 2010 NAVTEQ (c) 2010 Microsoft Corp.

- Low or non-detect concentrations found downstream of detections.