

Area B Groundwater Investigation Fort Detrick

Progress Report to the RAB

March 5, 2014

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ARCADIS

Overview of Topics

- ❑ Groundwater Tracer Study Update
- ❑ Update on Additional On- and Off-Post Drilling

Work Completed Since the Last RAB

- Completed the nine month groundwater tracer study.
- One new monitoring well completed on adjacent off-post property.
- Three additional borings in progress on off-post property.
- Interim packer sample data collected from three of the boreholes for well construction decision-making purposes.
- Four decision-making discussion calls with EPA/MDE since January '14

Status of Original RI Work Plan Activities

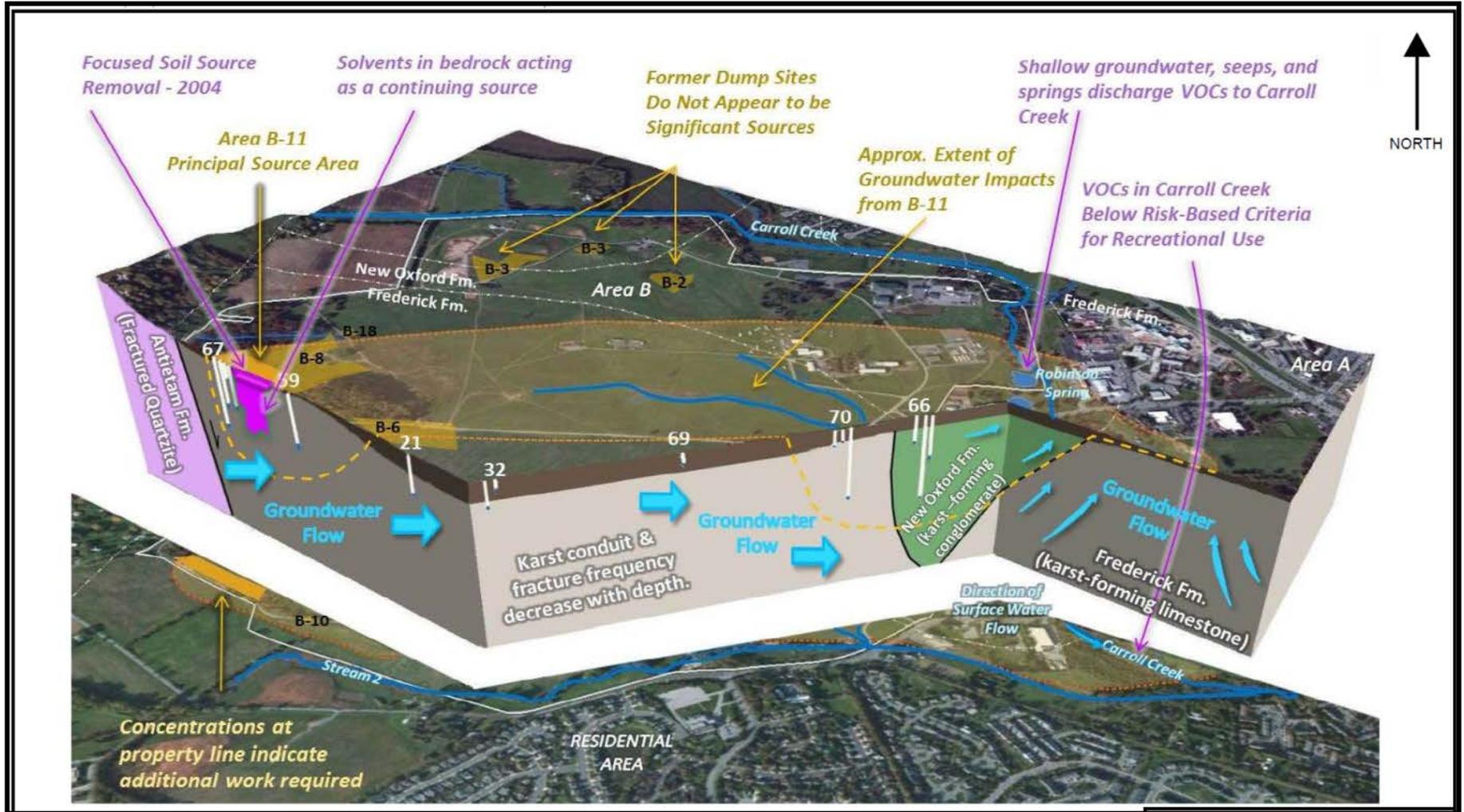
- ✓ Existing well assessment and repair Feb 2011 to Apr 2011
- ✓ New well installation (onsite) April 2011 to Mar 2012
- ✓ Direct Push Investigation March 2012
- ✓ Spring and Seep Surveys March 2012
- ✓ Groundwater/Surface Water Sampling April 2012 /Sept 2012
- ✓ Vapor Intrusion Sampling (2 rounds) Jan/Aug 2013
- ✓ Groundwater tracer study Spring 2013 to Fall 2013

Additional On- and Off-Post Drilling

Through **May/June 2014**

Grey = completed

Area B Conceptual Site Model Review



Legend

-  Streams
-  Spring
-  B-11 Boundary
-  Trichloroethene in Groundwater
-  Groundwater Flow Direction
-  Geologic Contact

Aerial Source: ArcGIS Online Bing Imagery accessed 6/13/2012 via ArcGIS 10.

Groundwater Tracer Study Update



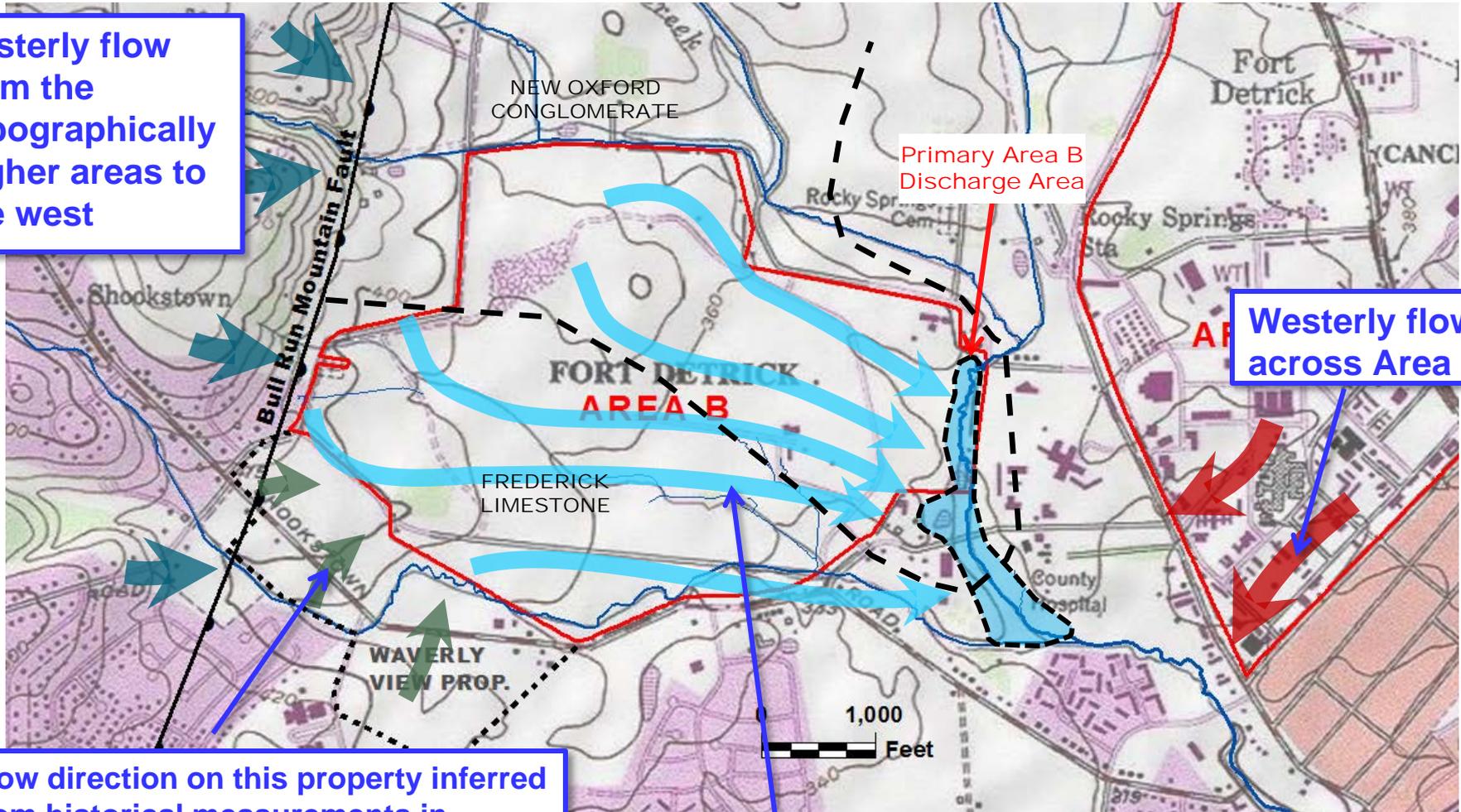
Groundwater Tracer Study

- What is a groundwater tracer study?
 - A tracer is introduced to the groundwater and monitored over time to see where and when the tracer appears at other monitoring points in the study area (e.g. wells, springs, surface water bodies).
 - Useful for evaluating the groundwater flow velocity and direction of groundwater movement.



Generalized Patterns of Groundwater Flow

Easterly flow from the topographically higher areas to the west



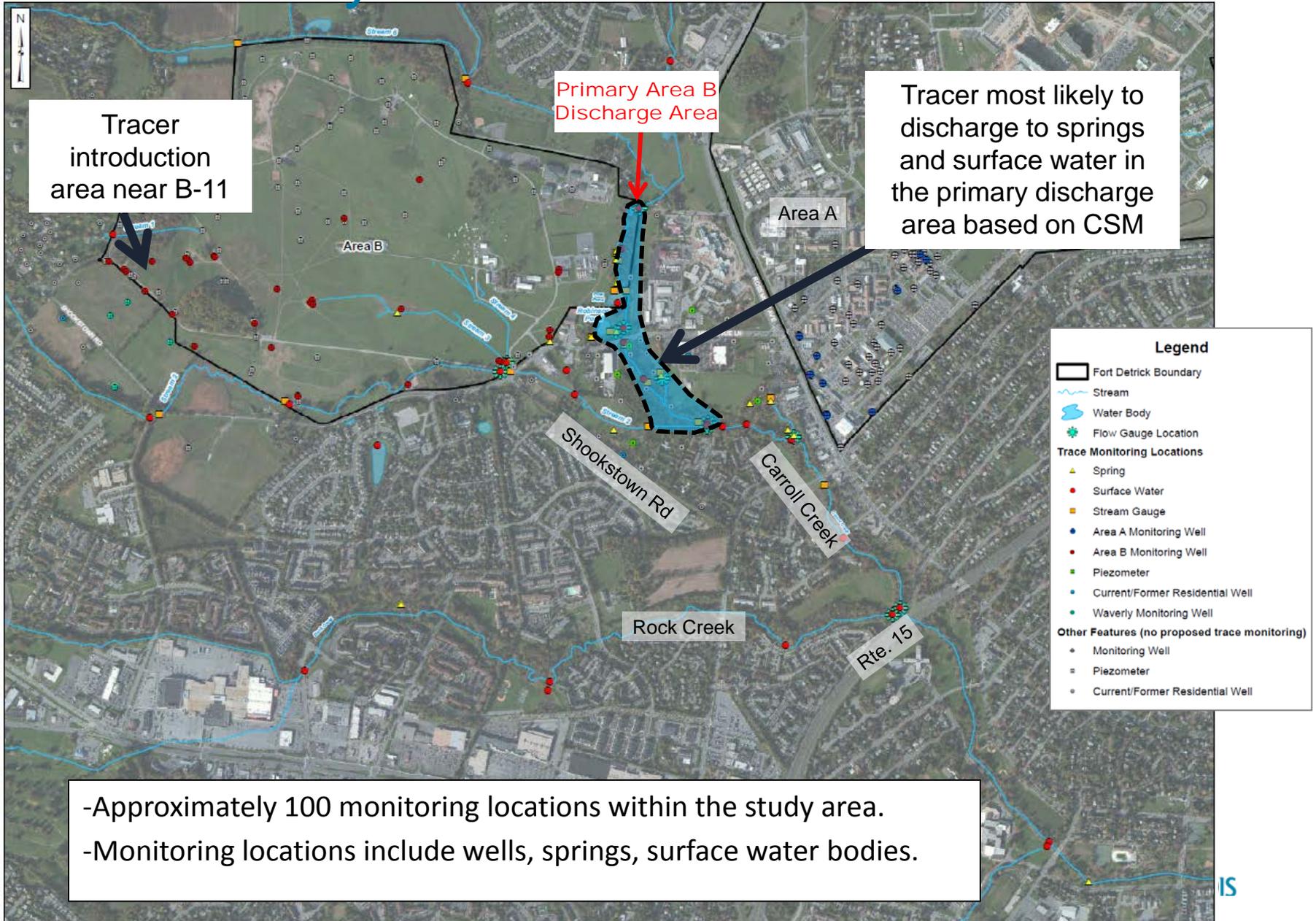
Primary Area B Discharge Area

Westerly flow across Area A

Flow direction on this property inferred from historical measurements in existing monitoring wells; on-going drilling will confirm.

Easterly flow across Area B

Tracer Study Area



- Approximately 100 monitoring locations within the study area.
- Monitoring locations include wells, springs, surface water bodies.

Groundwater Tracer Study Updates

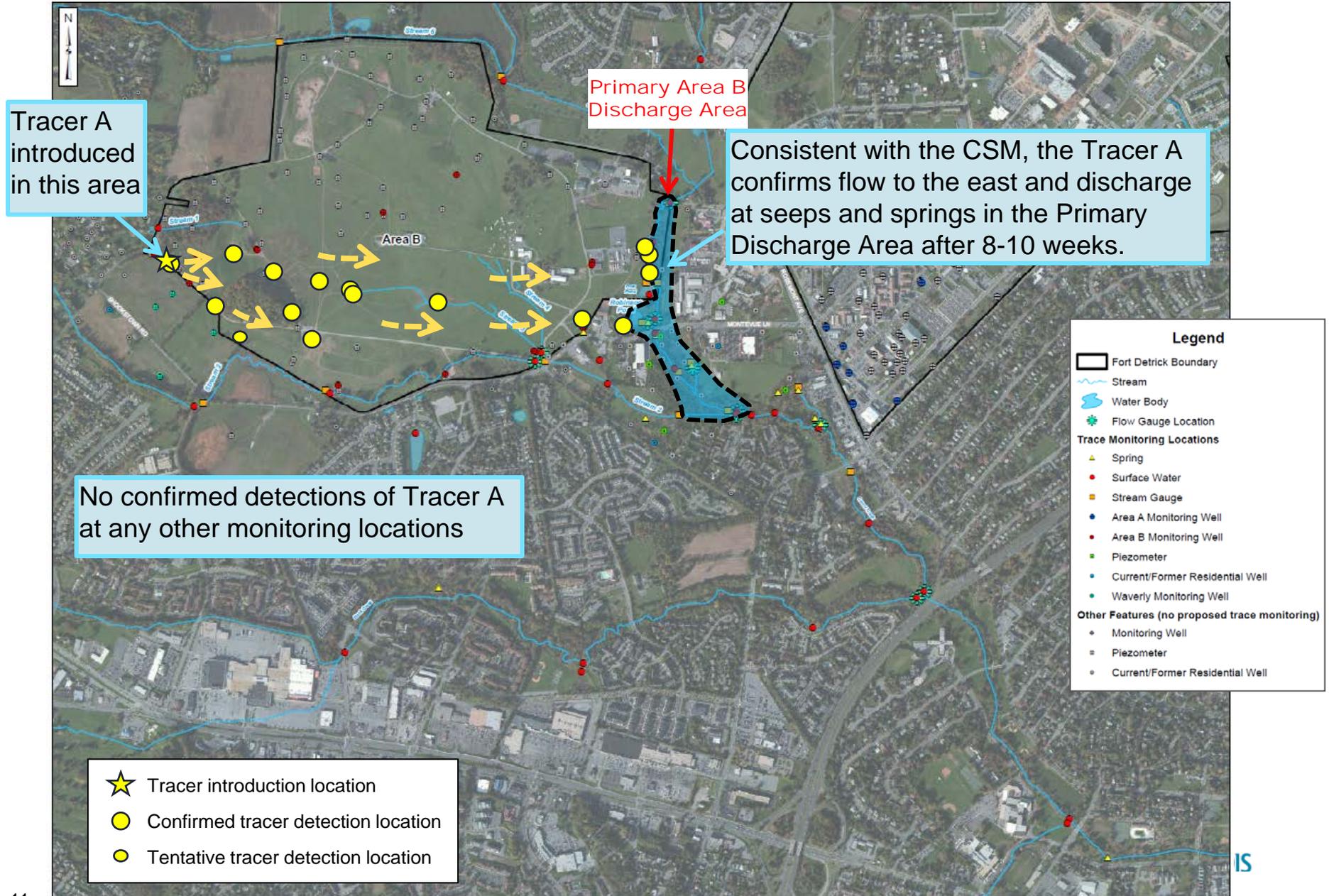
- Two tracers introduced in deep wells in May '13 at these depths:
 - Tracer A: 140-155 feet deep
 - Tracer B: 313-328 feet deep

- Tracer A:
 - In 2-3 weeks Tracer A was detected in springs in the center of Area B.
 - In 5-7 weeks, Tracer A detected in on-post monitoring wells east/southeast of the introduction area.
 - After 8-10 weeks Tracer A was detected in springs in the primary discharge area.
 - Detections are consistent with the conceptual site model for Area B groundwater and contaminant migration east/south east across Area B.

 - Data evaluation and reporting is on-going and these are preliminary observations.

Preliminary Study Observations for Tracer A

(Results through 1/30/14 spanning 8 months after the tracer introduction)



Groundwater Tracer Study Updates

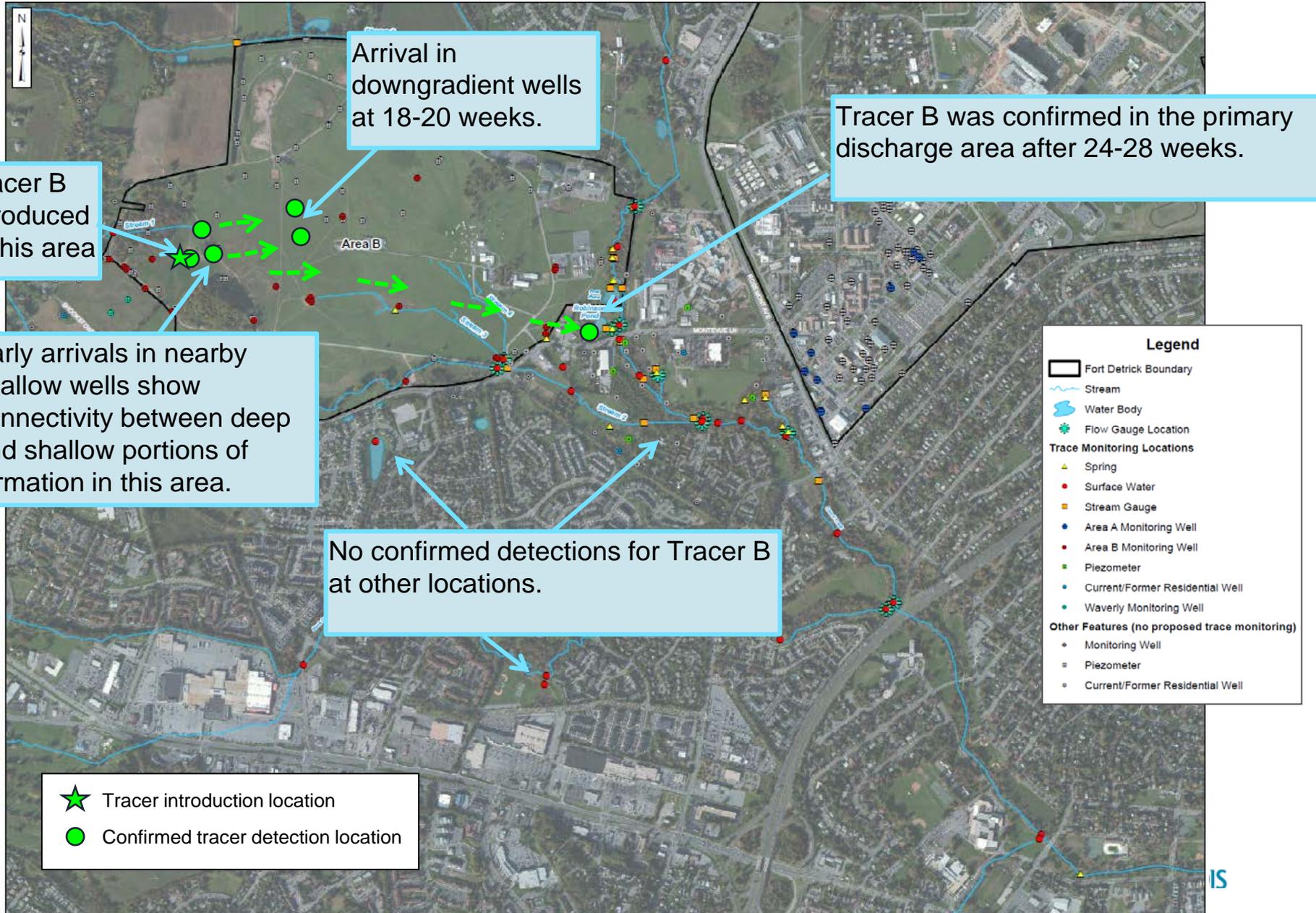
- Two tracers introduced in deep wells in May '13 at these depths:
 - Tracer A: 140-155 feet deep
 - Tracer B: 313-328 feet deep

- Tracer B:
 - In 2-3 weeks Tracer B was detected in shallow monitoring wells very close to the introduction area.
 - After 18-20 weeks, Tracer B was detected in downgradient wells on Area B.
 - New** ➤ After 28 weeks, Tracer B was detected in the primary discharge area.
 - Detections are consistent with the conceptual site model for Area B groundwater and contaminant migration east/south east across Area B.

 - Data evaluation and reporting is on-going and these are preliminary observations.

Preliminary Study Observations for Tracer B

(Results through 1/30/14 spanning 8 months after the tracer introduction)



Preliminary Study Observations for Tracer B

(Results through 1/30/14 spanning 8 months since the tracer introduction)

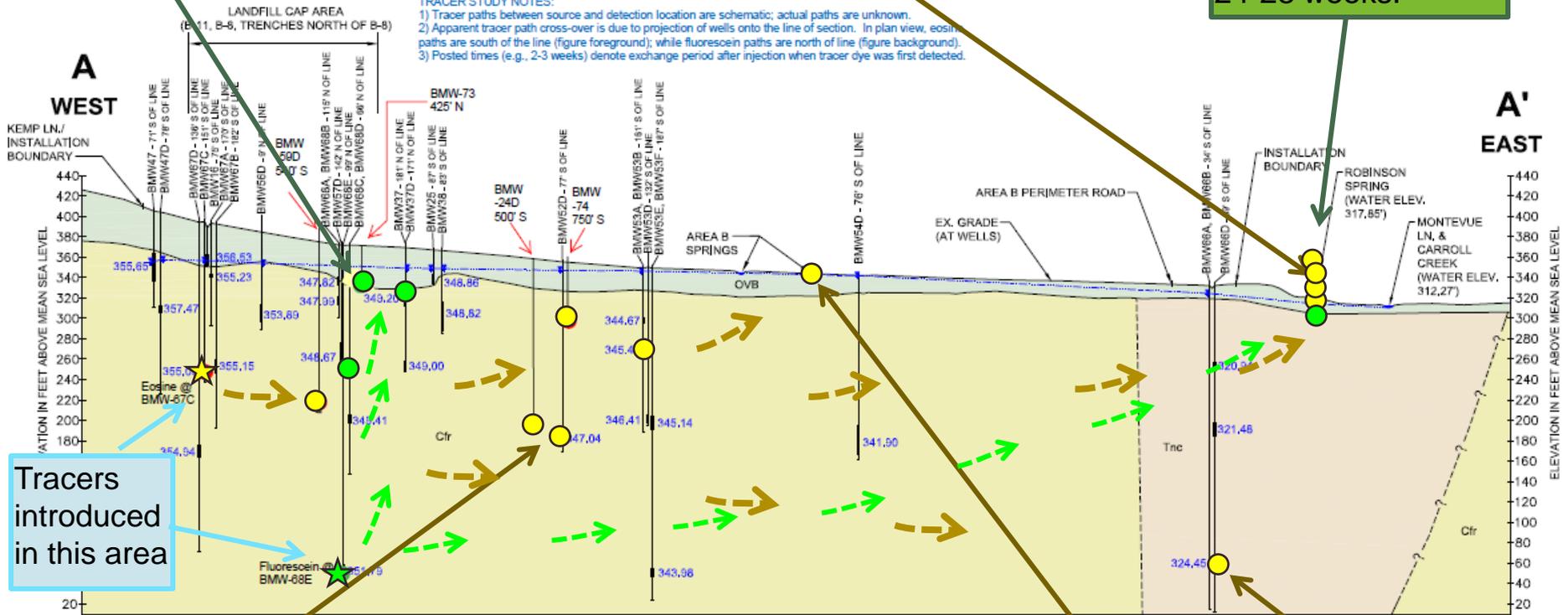
Tracer B only detected early in shallow wells near introduction location

8-10 Weeks: Tracer A detected in primary discharge area.

Tracer B only detected in primary discharge area after 24-28 weeks.

TRACER STUDY NOTES:

- 1) Tracer paths between source and detection location are schematic; actual paths are unknown.
- 2) Apparent tracer path cross-over is due to projection of wells onto the line of section. In plan view, eosin paths are south of the line (figure foreground); while fluorescein paths are north of line (figure background).
- 3) Posted times (e.g., 2-3 weeks) denote exchange period after injection when tracer dye was first detected.



Tracers introduced in this area

5-7 Weeks: Tracer A detected in multiple monitoring wells across Area B.

2-3 Weeks: Tracer A detected at the ground surface in a spring on Area B.

20 Weeks: Tracer A detected at property boundary.

CROSS SECTION A-A'



Groundwater Tracer Study Schedule

- EPA and MDE oversight:
 - Status discussions with EPA and MDE to review laboratory results and observations to date.:
 - August 7, 2013
 - September 30, 2013
 - January 15, 2014

- All tracer sampling rounds completed as of January 30, 2014

- Final data analysis and preparation of the tracer study report is underway. Report will be submitted to EPA, MDE, and the RAB.

- Preliminary conclusion is that the dye trace study supports the overall CSM.

Update on Additional On- and Off-Post Drilling



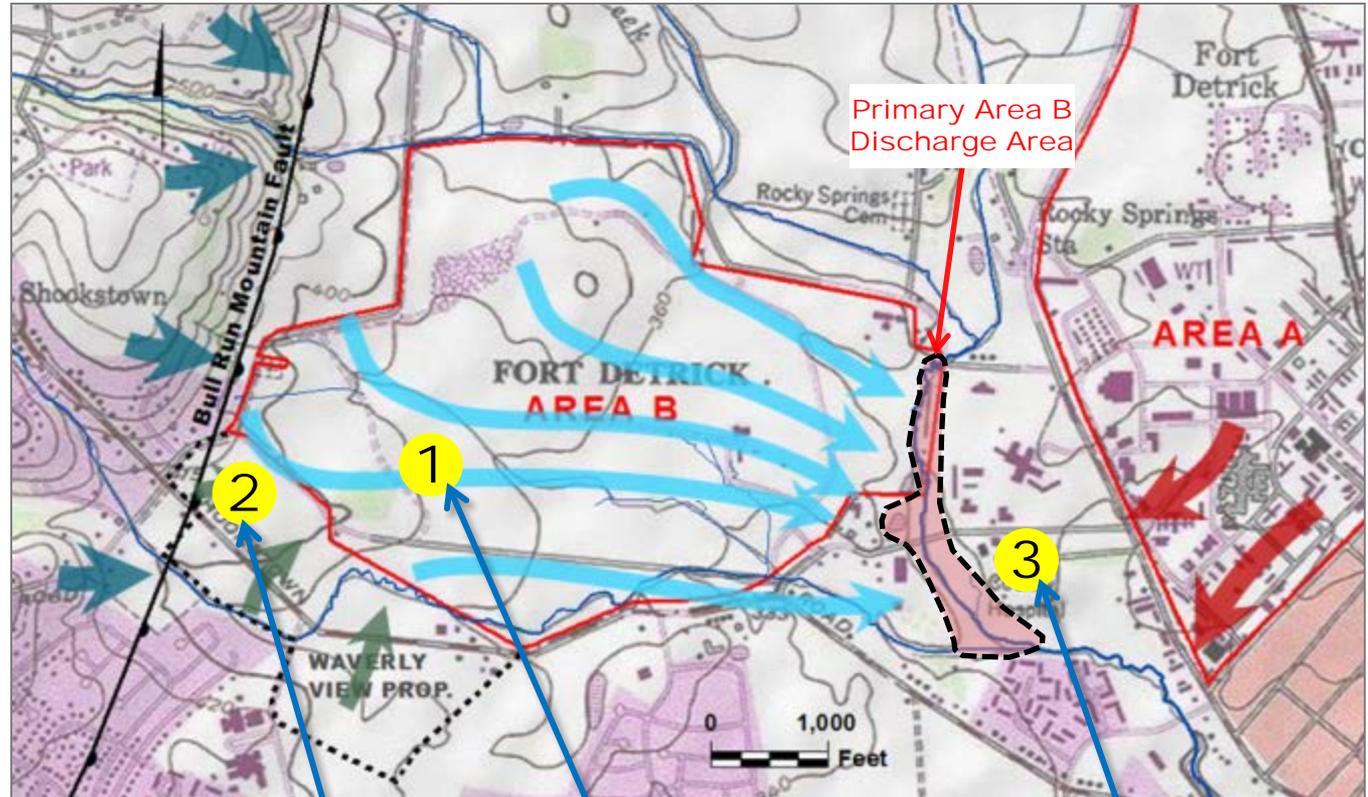
Additional Deep On-Post & Off-Post Drilling

- Scope calls for approximately 7 new borings with installation of up to 11 wells.
- Drilling methodology is following the same techniques employed during the 2011/2012 drilling program (including geophysical logging and packer testing).
- Maximum drilling depths anticipated to be ~400-500 feet below ground surface at some new locations.
- Drilling commenced December 6, 2013 and is projected to continue through May 2014.
- Work has continued through particularly challenging weather conditions this winter.



Supplemental Deep Drilling Locations

1. Vertical delineation downgradient of B-11 to depths greater than 325 ft. (~ 2 nested wells)
2. Delineation south of B-11 area (Waverley Property) (~7 shallow/deep wells)
3. Horizontal delineation east of Carroll Creek (underflow) (~ 2 nested wells)



Arrows = Generalized patterns of groundwater flow

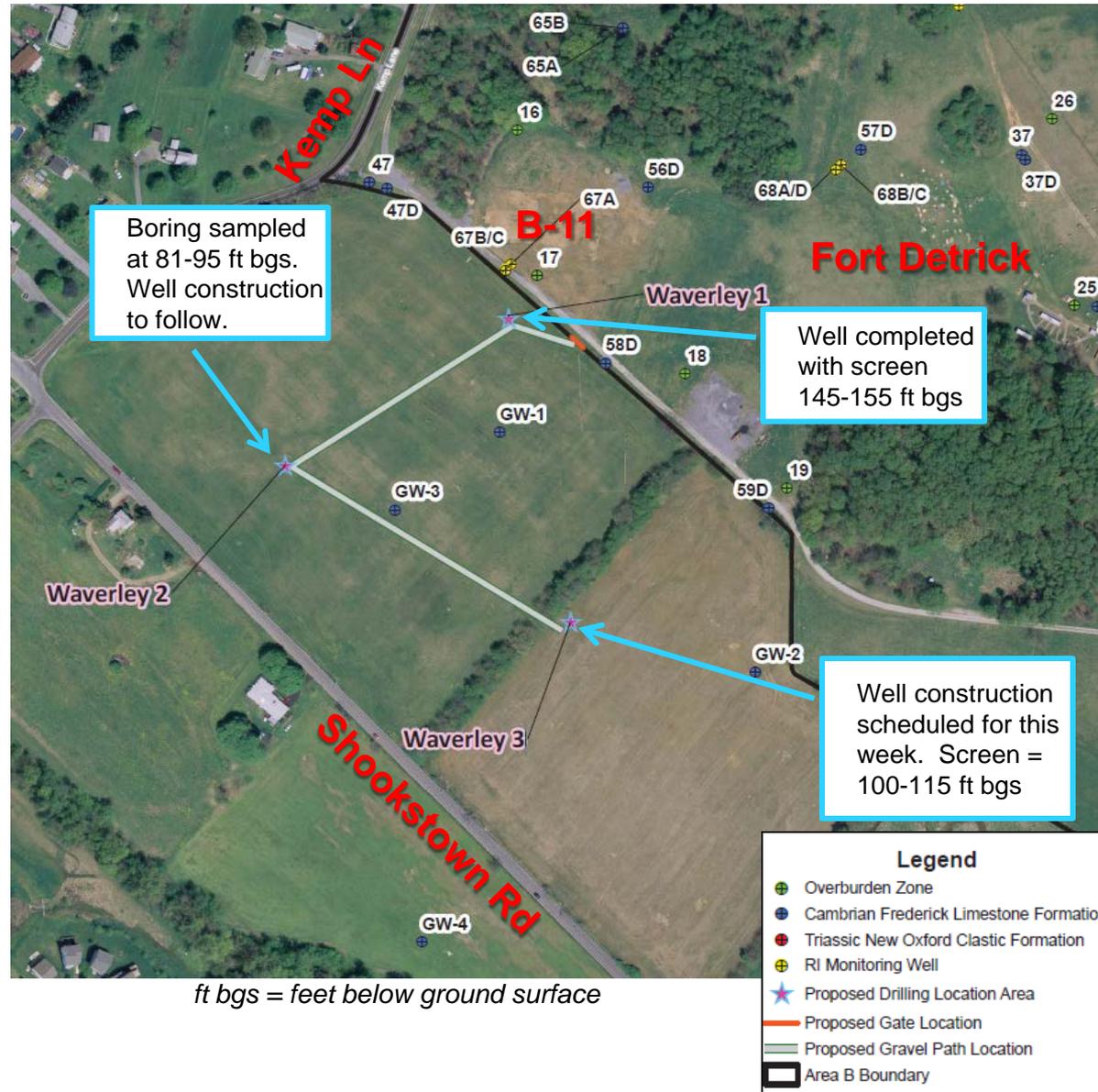
**Drilling on-going
(current priority)**

**Drilling started but
on-hold currently**

**Drilling scheduled
for later this Spring**

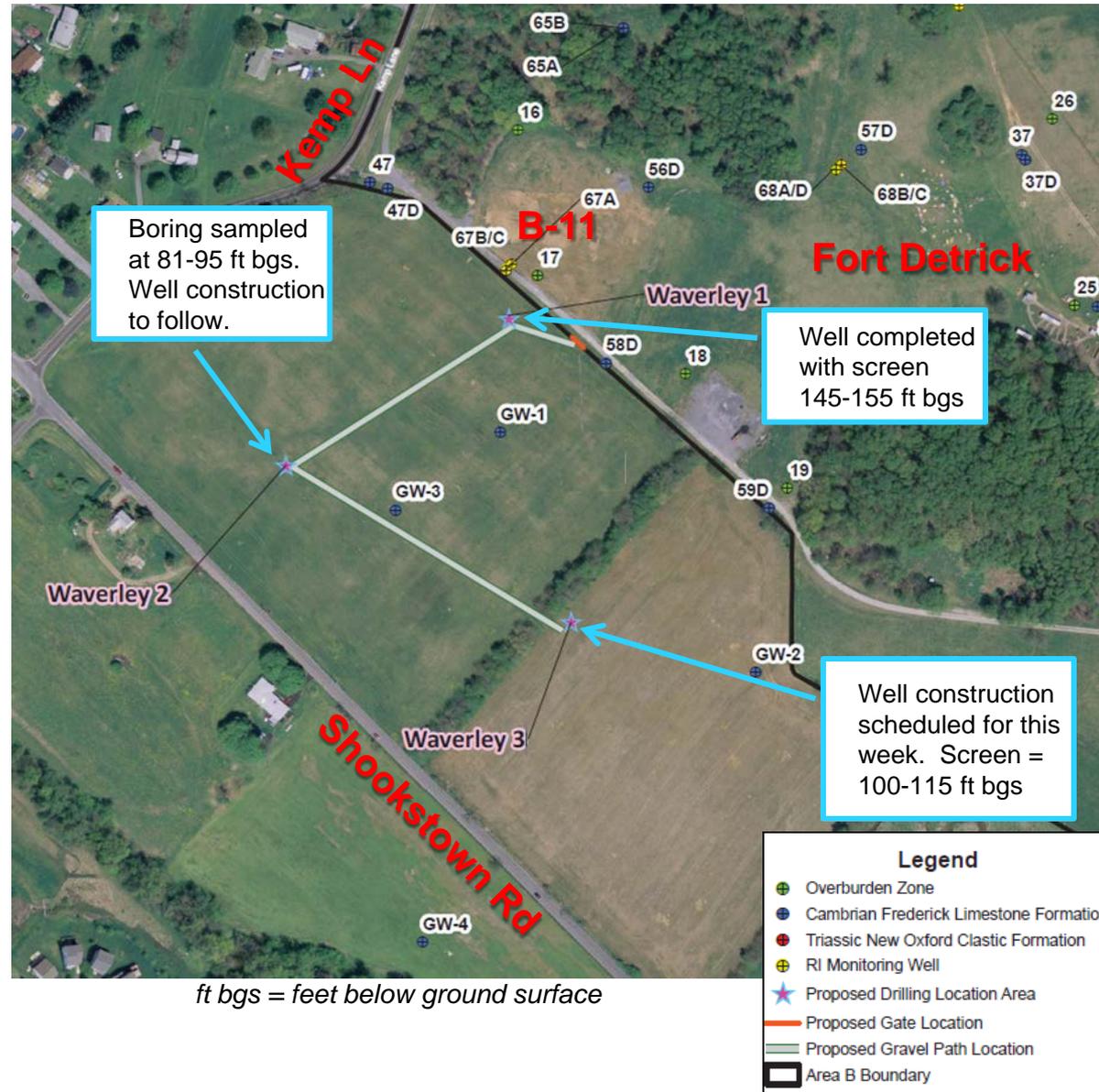
Drilling Status (through 3/5/14)

- Three shallow borings completed on the Waverley property:
 - Waverley-1: New shallow monitoring well completed near Area B fence line.
 - Waverley-2: Sampling completed and well construction expected this week.
 - Waverley-3: Geophysical logging and packer sampling completed. Well construction this week.



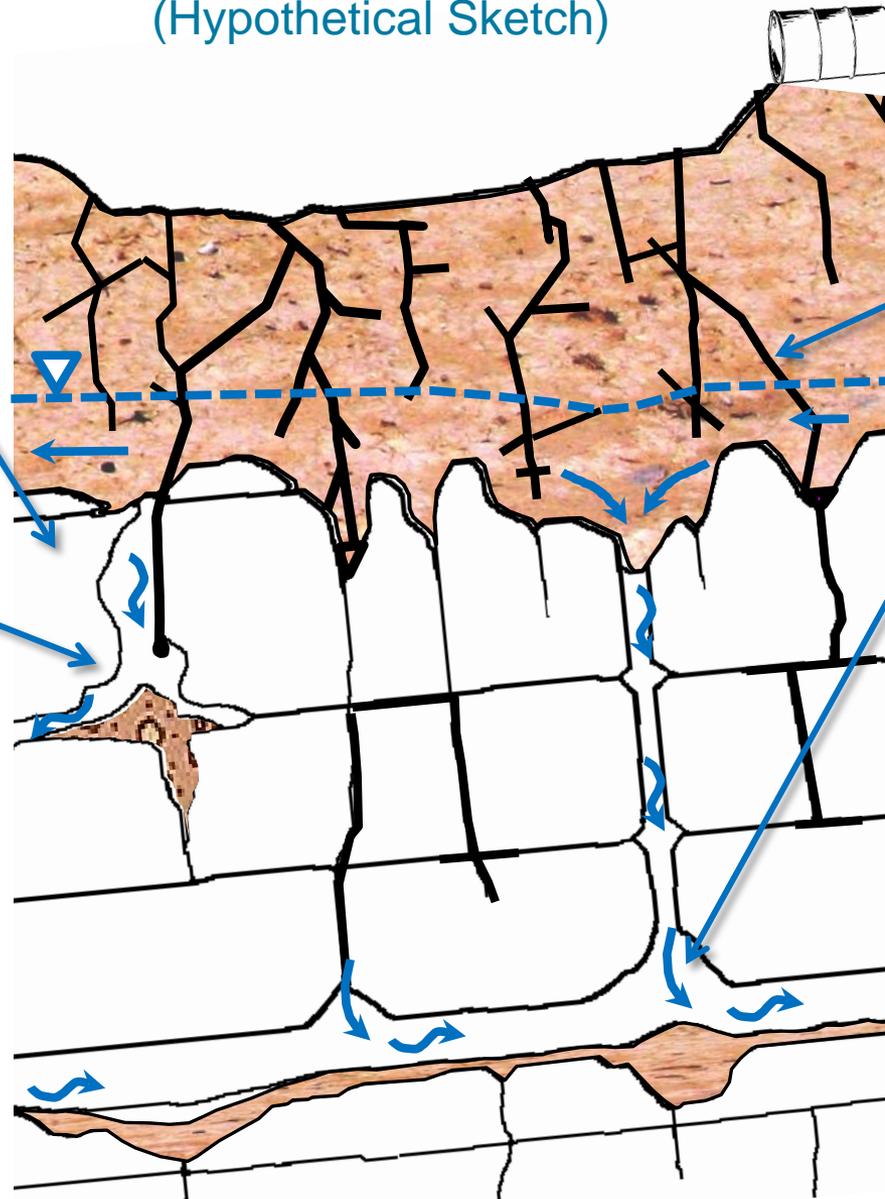
Drilling Observations (through 3/5/14)

- Slower than anticipated drilling so far through the karst geology.
- Drillers have encountered difficulties with volumes of water and sediment generation associated with large fracture/void zones.
- Deeper drilling efforts are underway this week on Waverley property (targeting depths to 400 ft) at two locations.



Karst Geology – A Quick Refresher

(Hypothetical Sketch)



Limestone geology

Water infiltrates from the surface and drains through the system.

Dissolution along fractures and bedding planes can lead to small and large conduits

Water flows through interconnected fractures and conduits

EXPLANATION

▽ = WATER TABLE

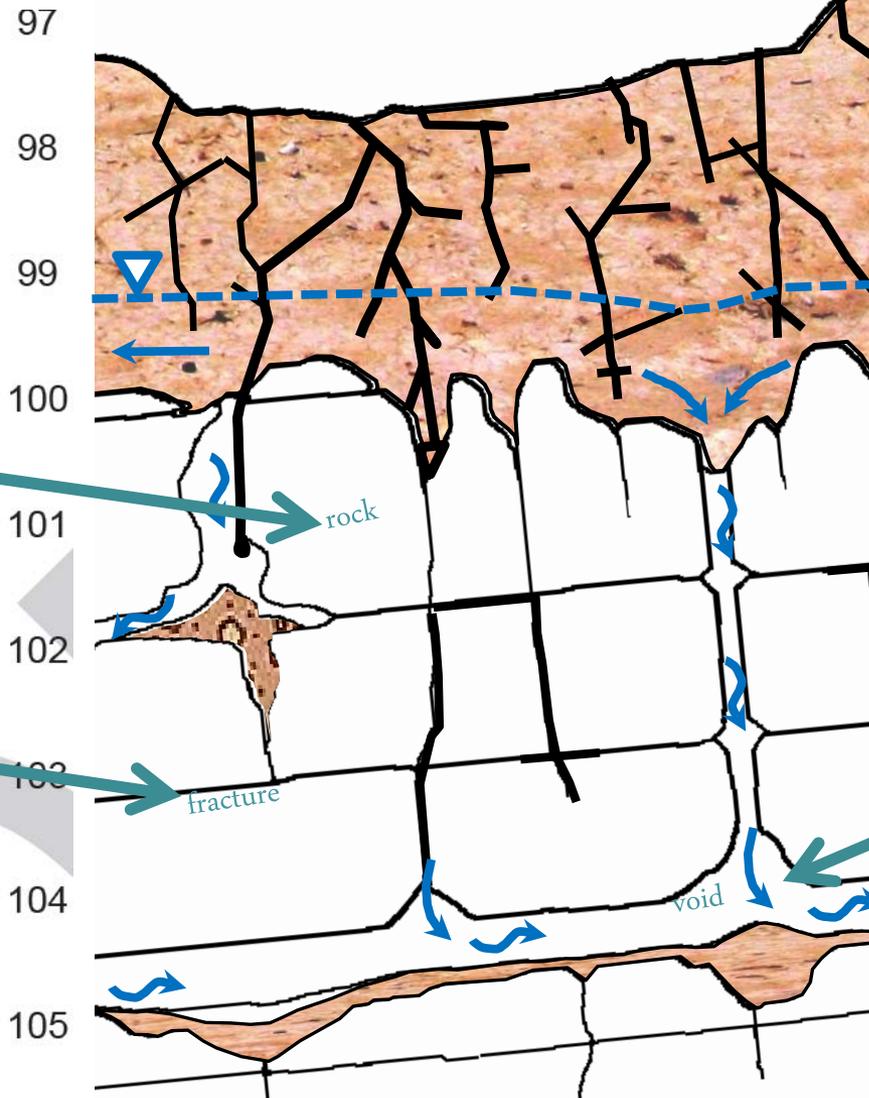
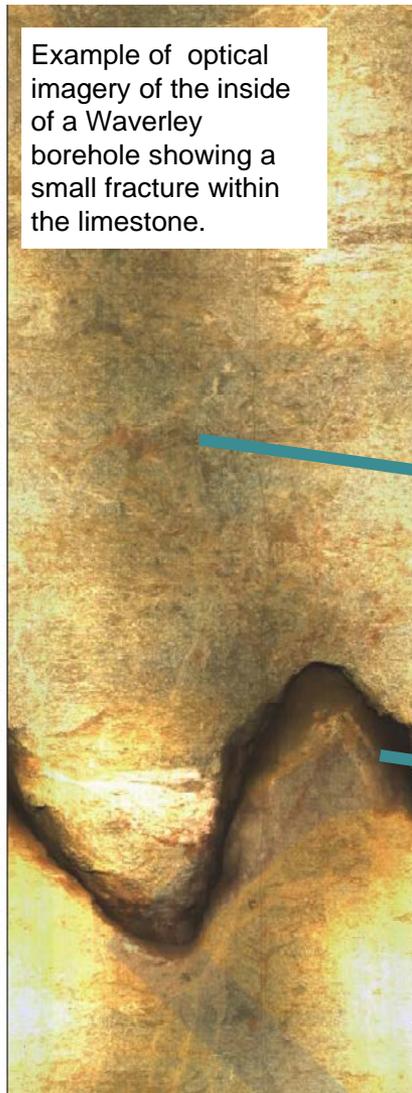
← = GROUNDWATER MOVEMENT

✚ = MACROPORES

■ = SOIL OR SEDIMENT

Understanding Karst Geology

(Hypothetical Sketch)



41
42
43
44

Understanding How Contamination Behaves in Karst

(Hypothetical Sketch)

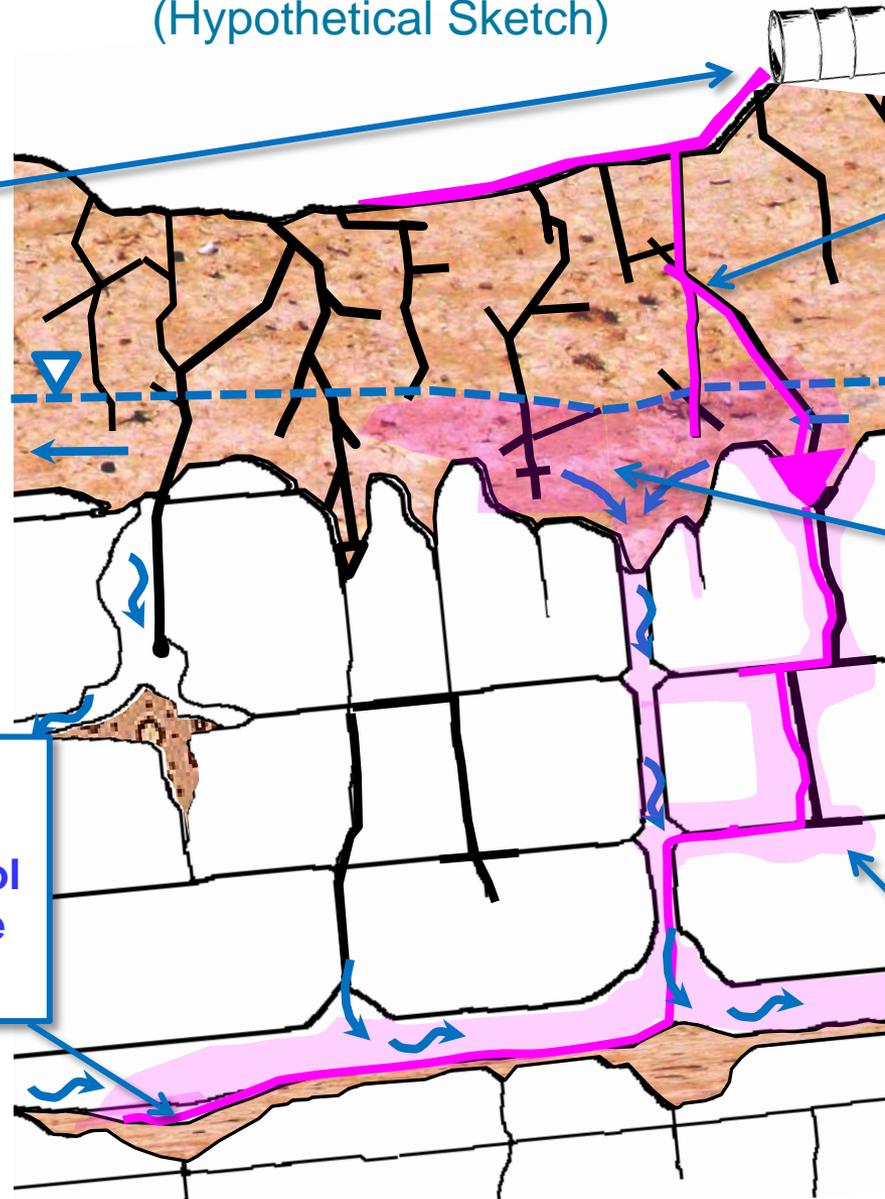
Assume a hypothetical DNAPL release

DNAPL release migrates downward into the subsurface

Dissolves into groundwater creating a dissolved contaminant plume that migrates with groundwater flow

DNALP migrates downward through fractures and can pool in depressions in the rock surface

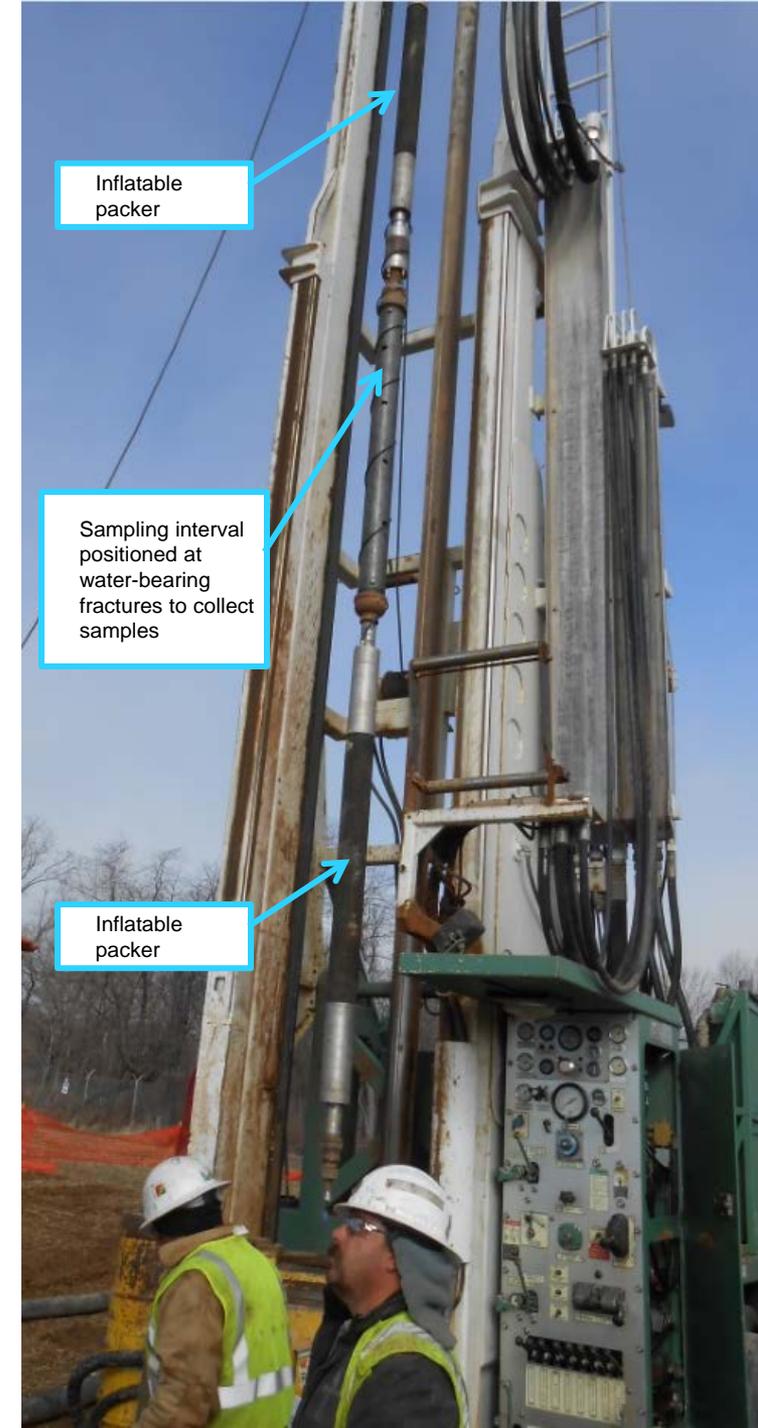
DNAPL diffuses into the soil/rock matrix



Packer Sampling During Drilling & Interim Borehole Results

Note: Sampling of the new wells will not be conducted until after all the new wells are completed and properly developed (likely in May/June).

- In the interim, we have screening-level packer sample data that is collected during drilling operations.
- Laboratory results from packer samples are reviewed with EPA and MDE to reach concurrence on well construction decisions for each borehole.
- Since early January, we've had 4 biweekly calls with EPA and MDE to review drilling progress, geophysical logs, and interim packer sample data for collaborative decision-making purposes.



Packer Sampling versus Monitoring Well Sampling

Packer sampling

- Conducted during drilling activities using inflatable packers to isolate fractures, purge test intervals, and collect groundwater samples for laboratory analysis.
- Results are considered “screening level” suitable for deciding well construction specifications, but not as reliable as data from a completed monitoring well.

Monitoring well sampling

- Once a well is built and the grout is allowed to set, the well is pumped and surged to “develop” the well. This removes silt and fine-grained material from the vicinity of the well screen to establish a reliable monitoring point.
- The well is allowed to settle for a week before sampling to allow the groundwater to return to steady-state conditions.
- Wells provide reliable and reproducible data that can be validated and used to characterize nature and extent of contamination and evaluate risks.

Packer sample and monitoring well results can vary significantly (sometimes higher and sometimes lower) so we default to presenting data from monitoring wells and discuss packer sample data in general terms.



Packer Sampling - Interim Borehole Results (pre-monitoring well construction)

1 Waverley-1

- Located approximately 100 feet from the Detrick property boundary.
- TCE detected above the MCL but significantly below levels detected in the B-11 monitoring wells.

2 Waverley-2

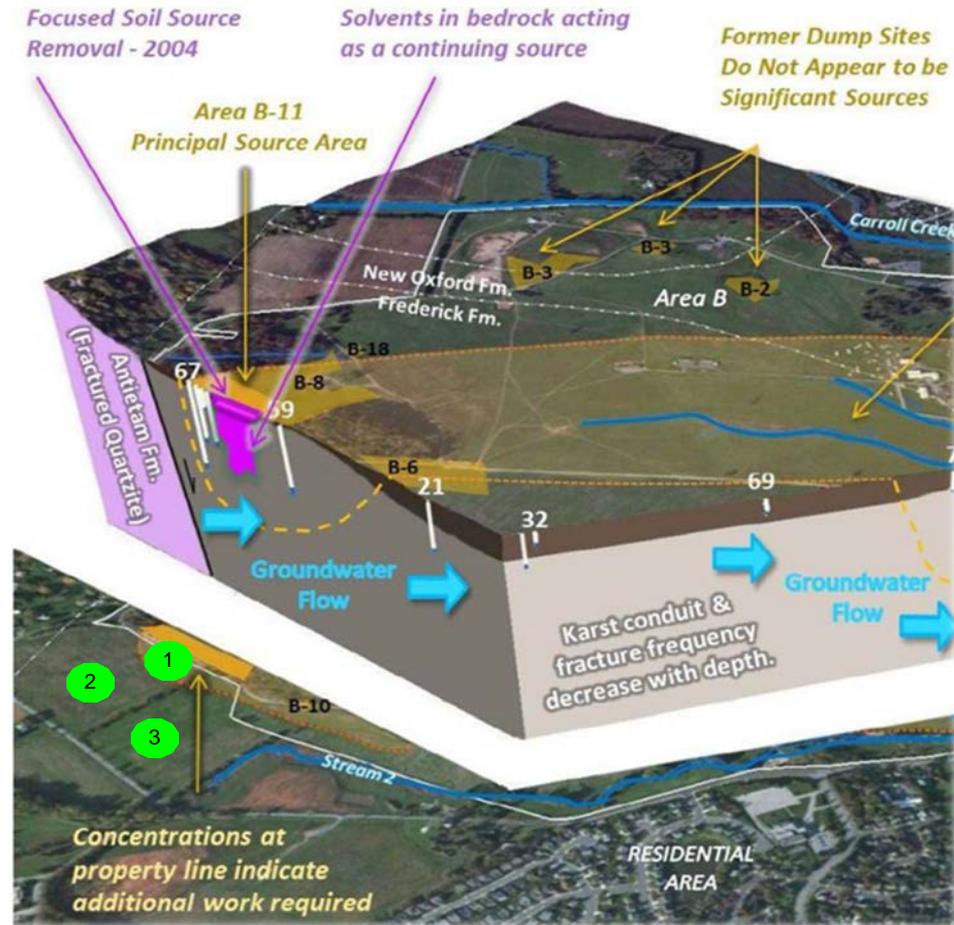
- TCE non-detect.

3 Waverley-3

- Trace TCE detections reported at low estimated concentrations well below the MCL.

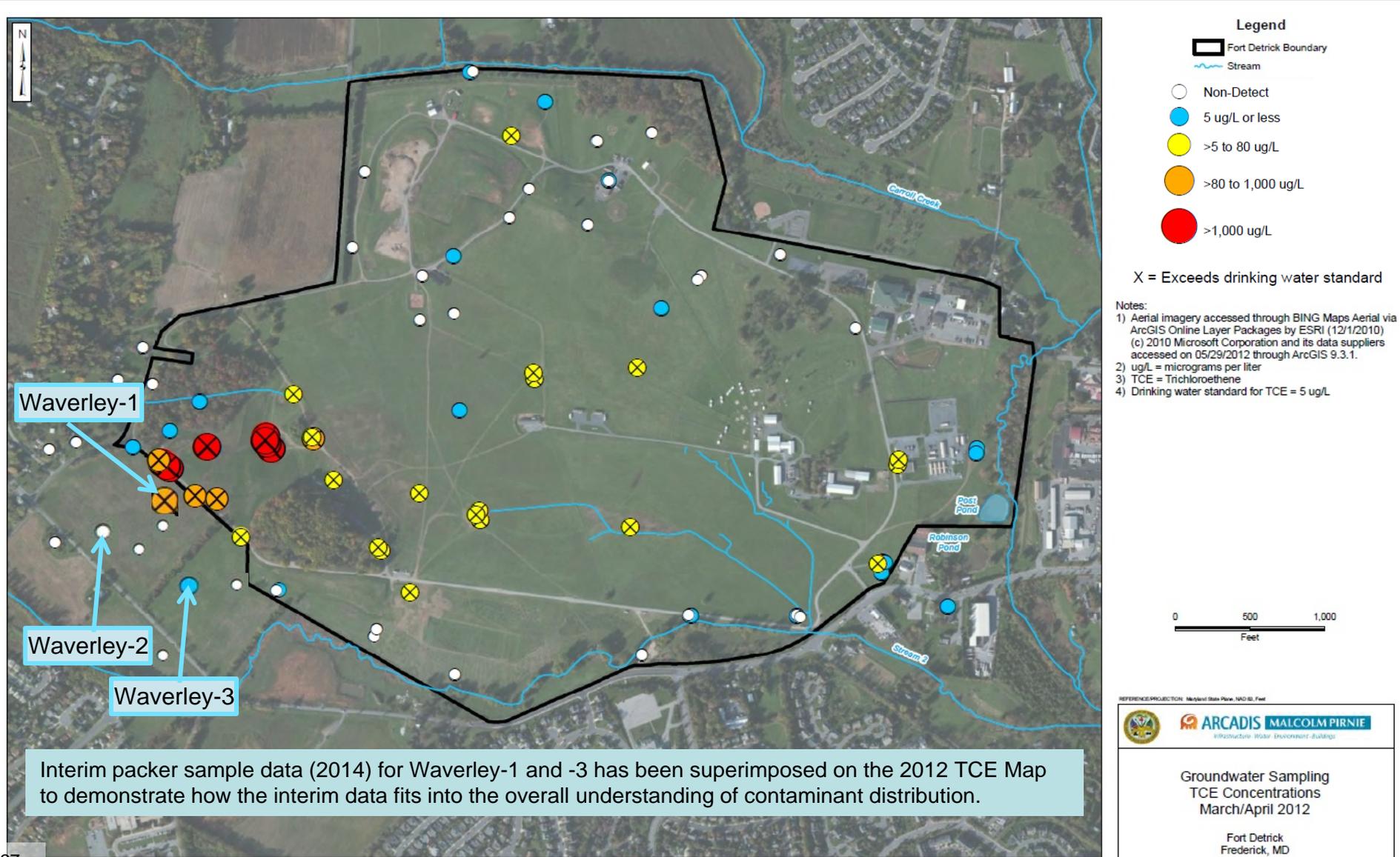
Initial observations are consistent with original conceptual site model:

- Groundwater impacts south of the Detrick fence do not extend far beyond the property line and concentrations drop off quickly in this direction by orders of magnitude.



TCE in Groundwater

Recent interim packer test results shown with TCE data from comprehensive 2012 sampling event



Next Steps

Next Steps

- Complete data evaluation and report for the dye trace study and submit for regulatory review.
- Continue with on-going drilling activities at Waverley property and then move to the two remaining locations (one on Area B and one on the County Montevue Campus).
- Complete drilling and sample new wells (May/June 2014)

Regular updates to be provided during community RAB meetings.

Questions and Discussion