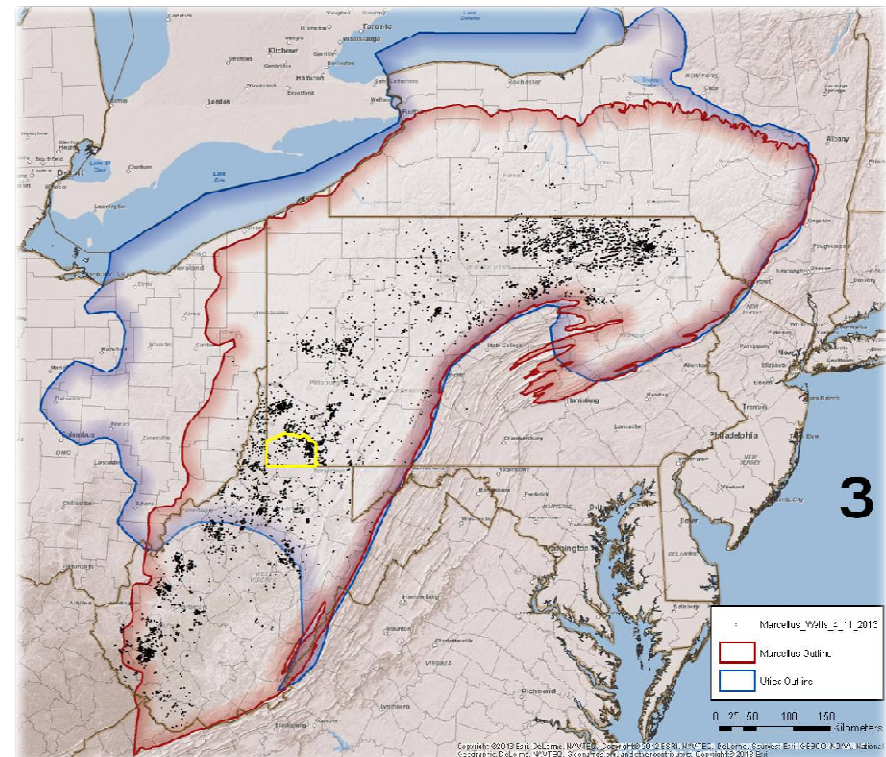




Use of Perfluorocarbon Tracers to Detect the Migration of Gas from Hydraulically Fractured Marcellus Shale Wells.

Greene County Site

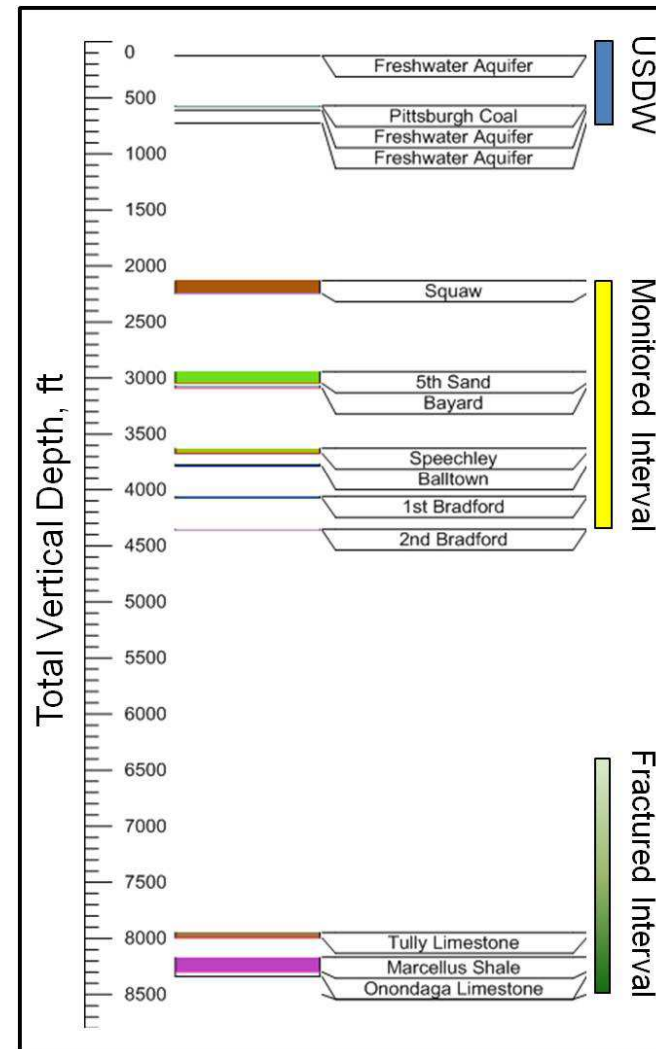
- Monitoring Objectives:
 - air quality,
 - induced seismicity,
 - fracture growth,
 - **fluid/gas migration**



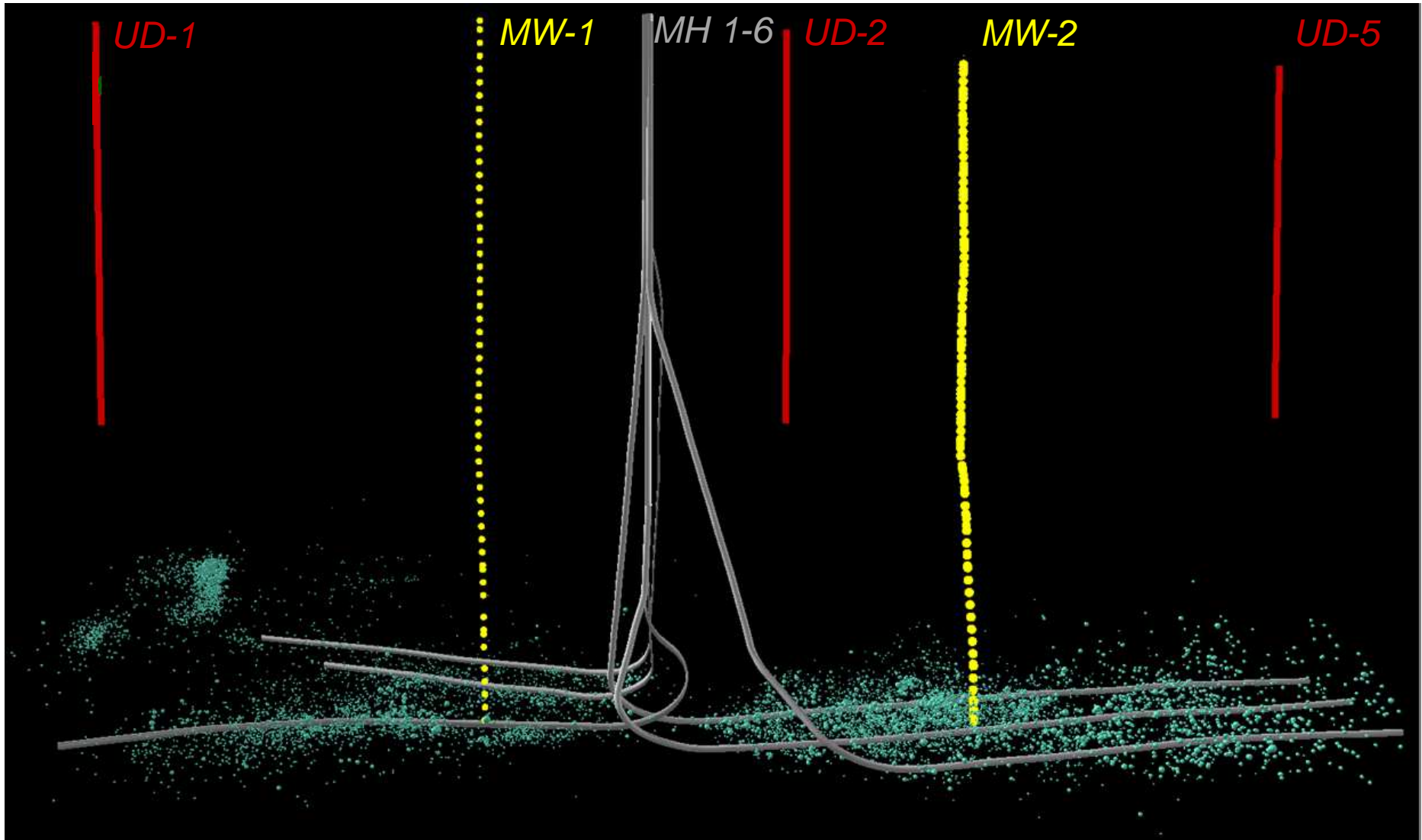
Greene County Site

- **Fluid/Gas Migration:**

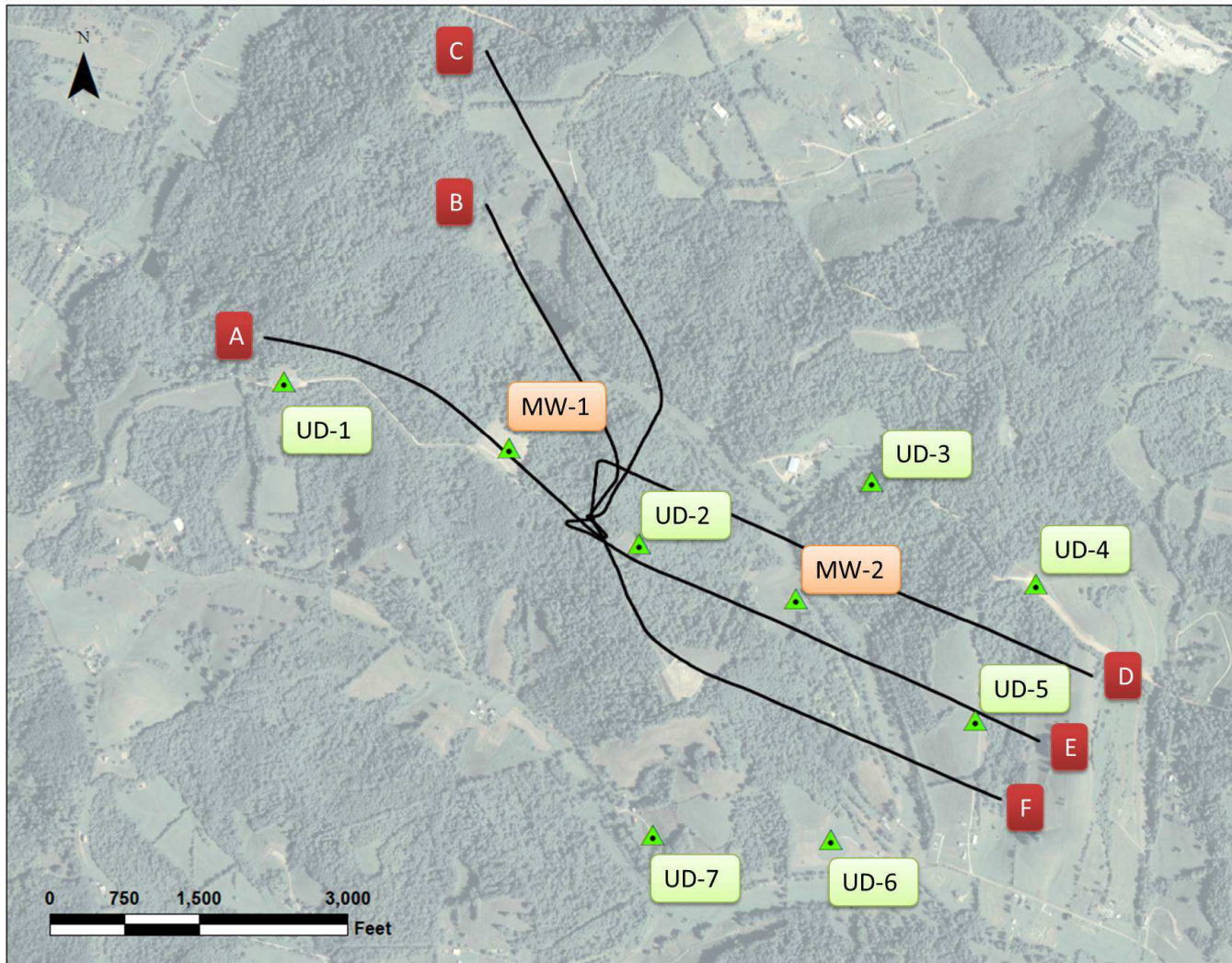
- Fractured Zone
 - Marcellus Shale
- Monitored Zone
 - Upper Devonian
- Protected Zone
 - USDW



Greene County Site



Greene County Site



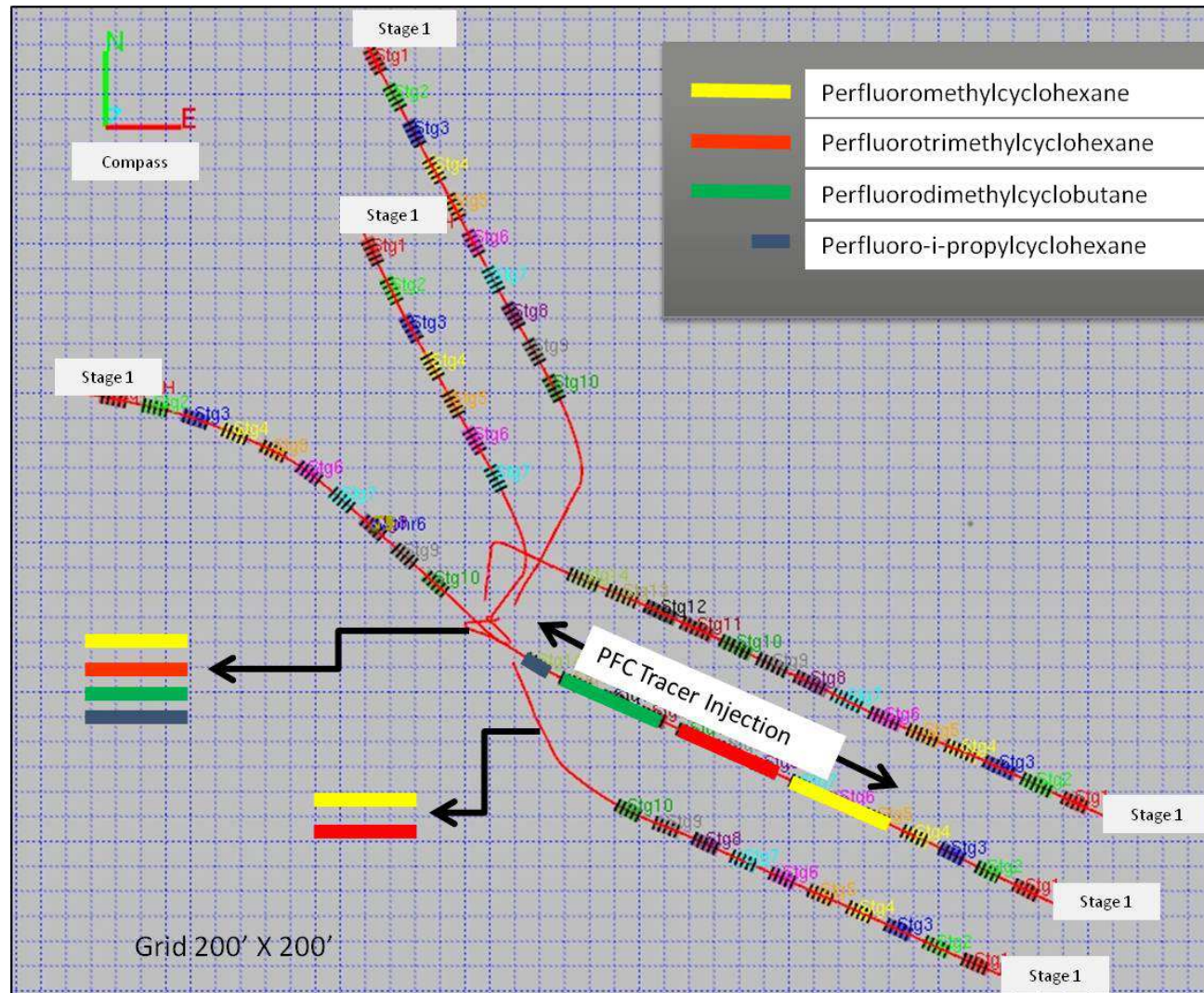
Fluid/Gas Migration

Fluid/Gas Migration:

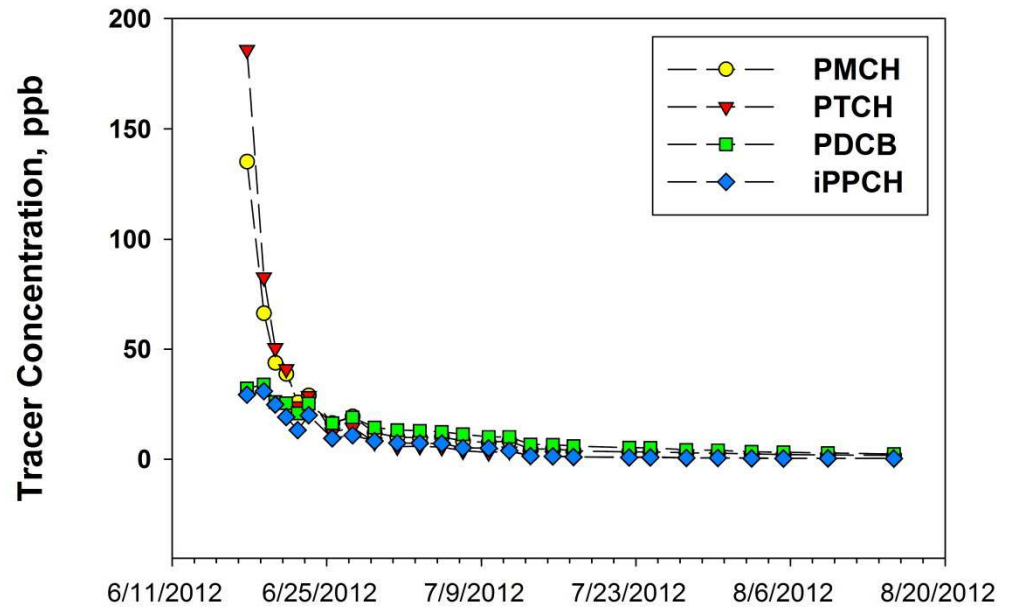
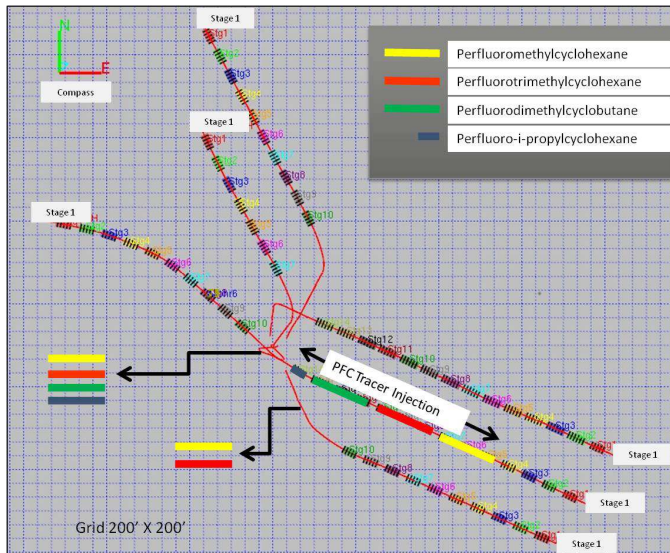
- Production/Pressure History
- Gas Isotopes
- Produced Water Isotopes
- **Perfluorocarbon Tracers**



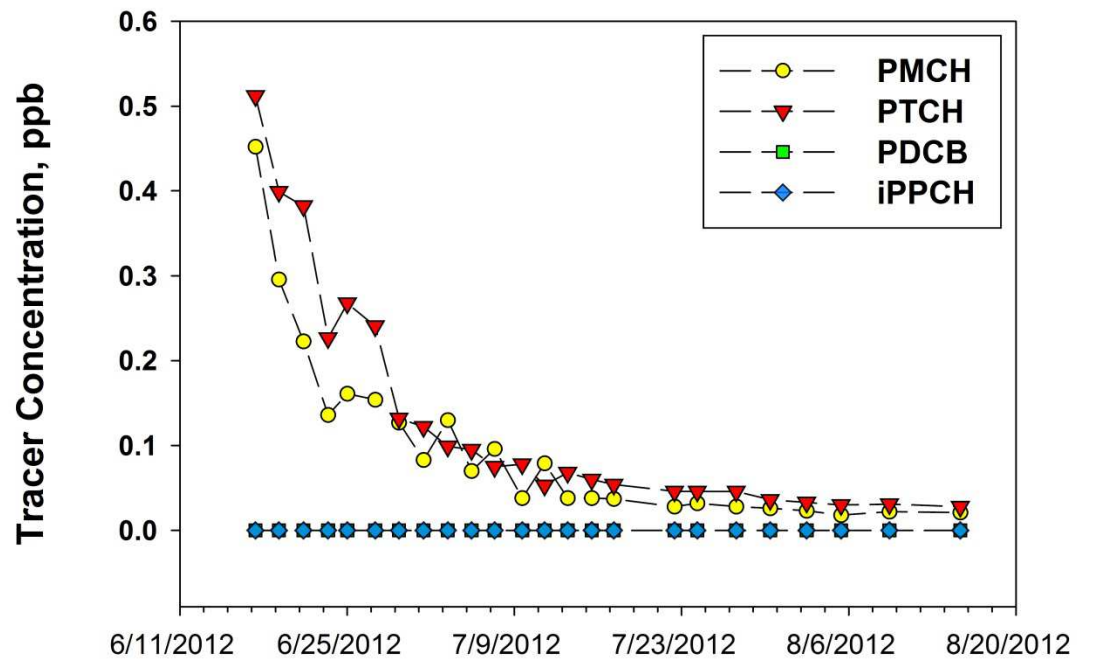
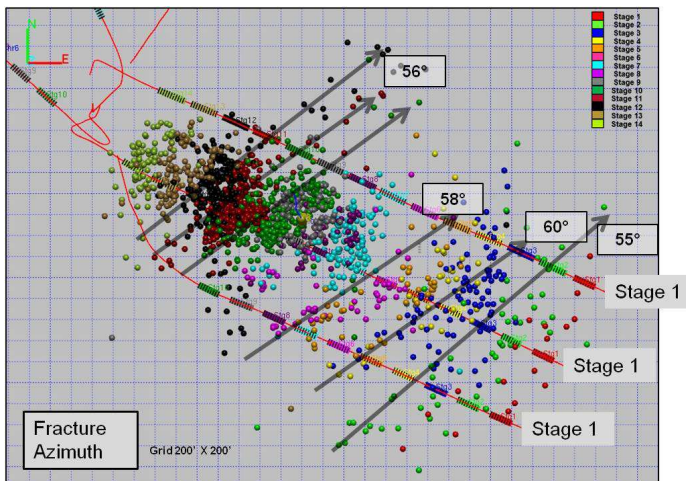
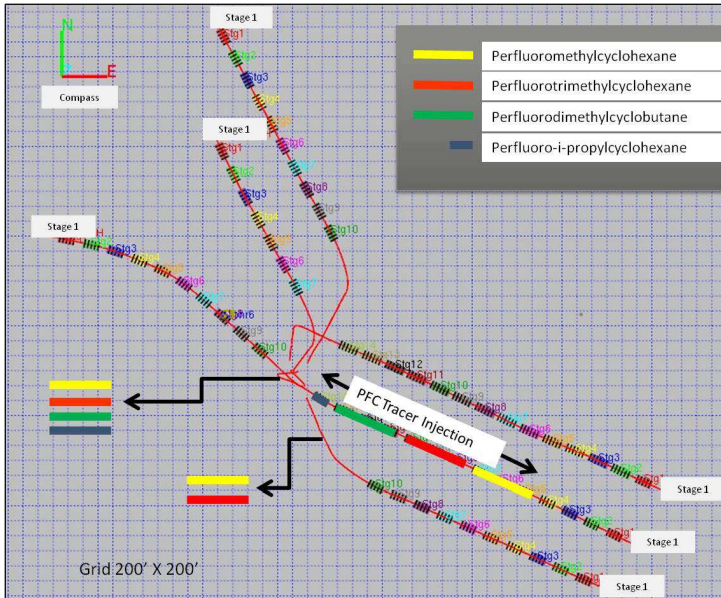
Perfluorocarbon Tracers



PFC in Injection Well



PFC in Offset Well



PFC in Upper Devonian Wells

Active Gas Sampling:

- Two UD wells sampled
- Every 2-5 days
- Two months post frac
- **No tracer detected (ppt)**



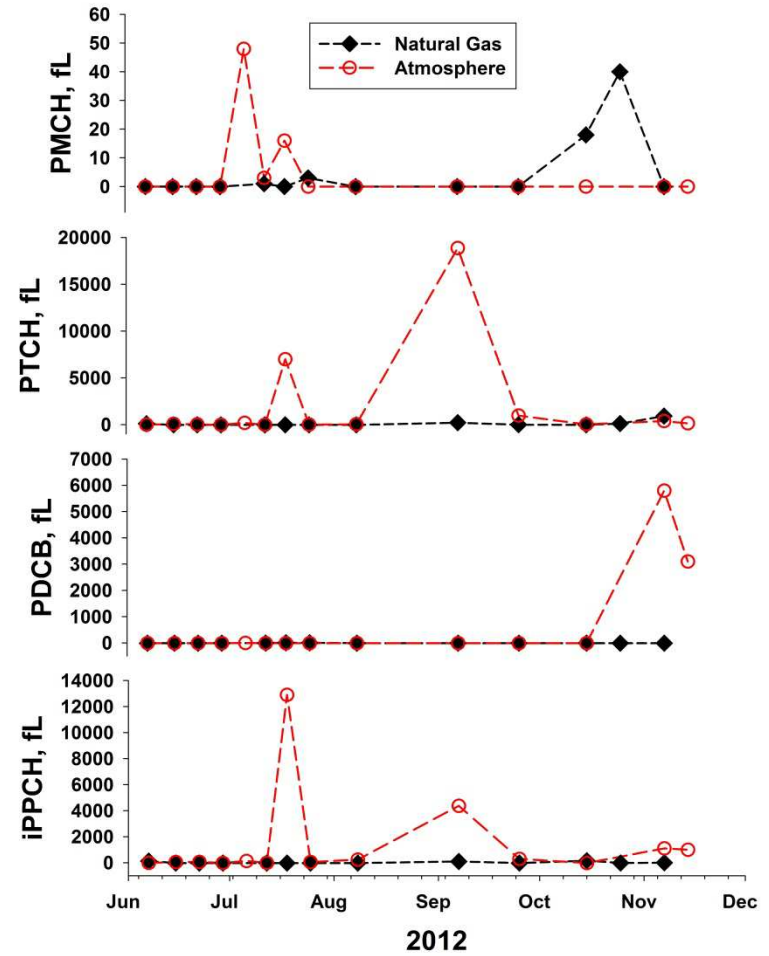
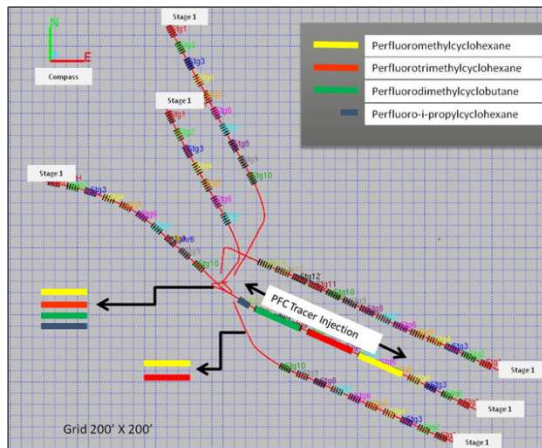
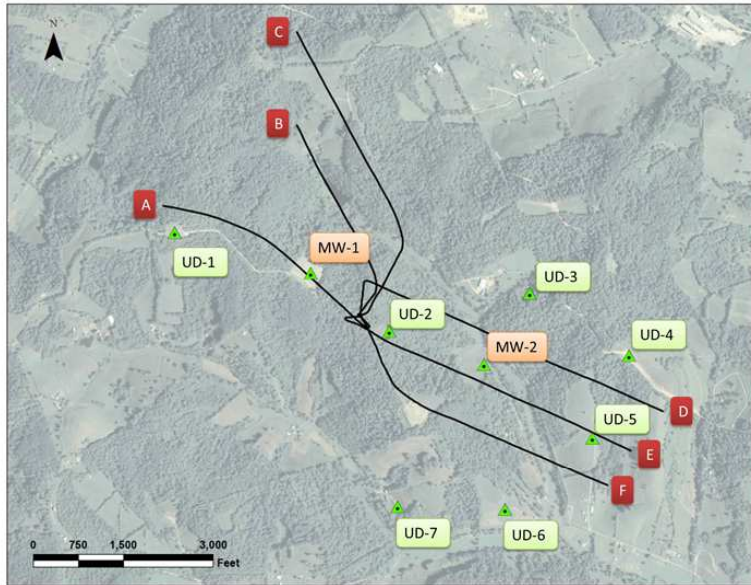
PFC in Upper Devonian Wells

Passive Sampling

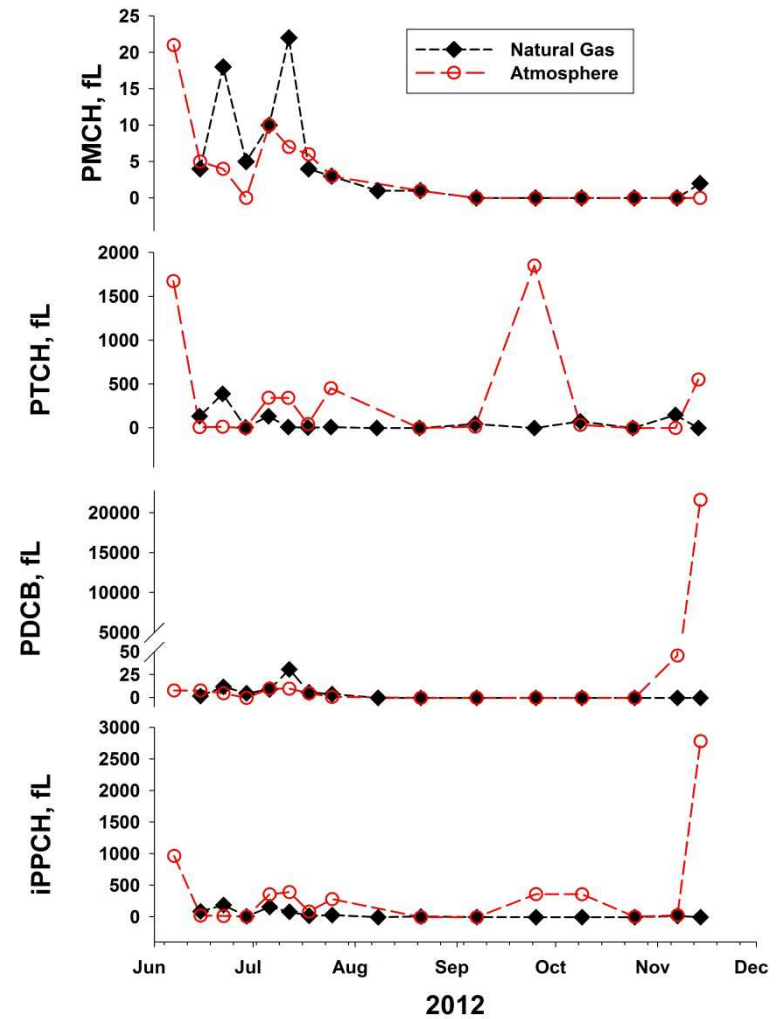
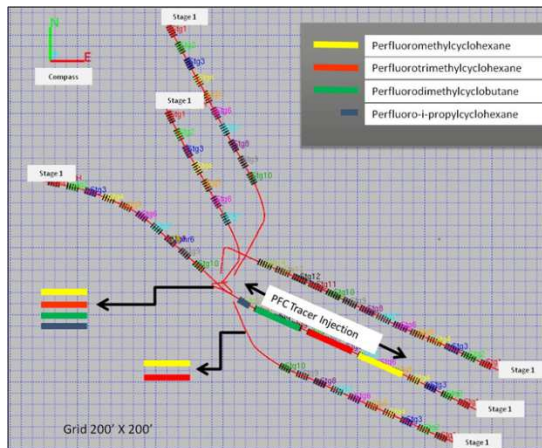
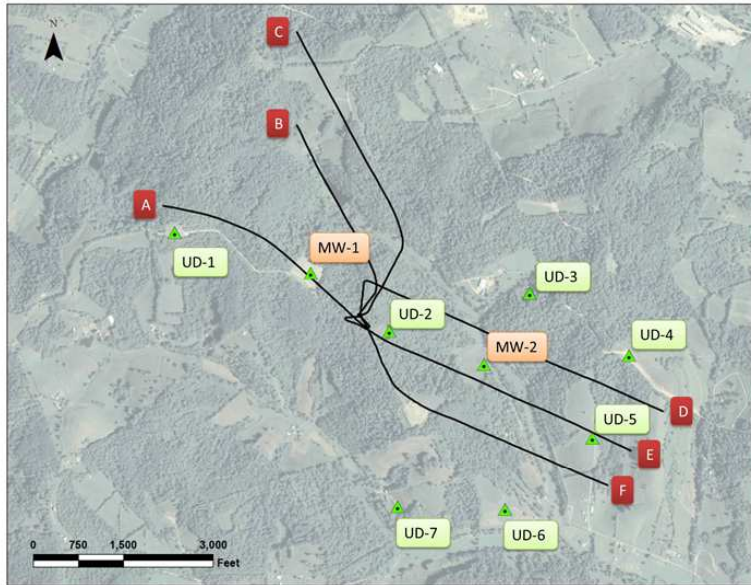
- Sorbent tube
- Placed in gas line
- One end open to gas
- Replaced weekly or monthly
- **Continuous monitoring**
- **Sources of error**
 - **Atmosphere exposure**
 - **Condensate**



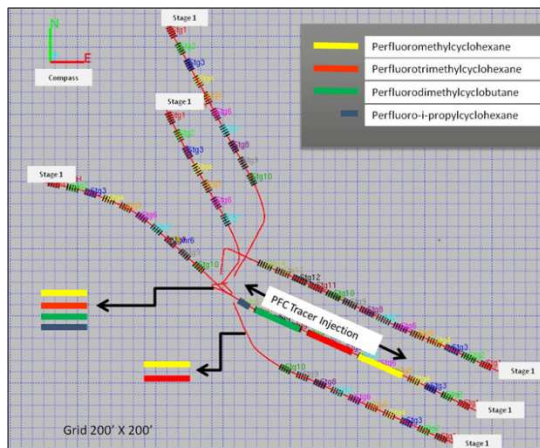
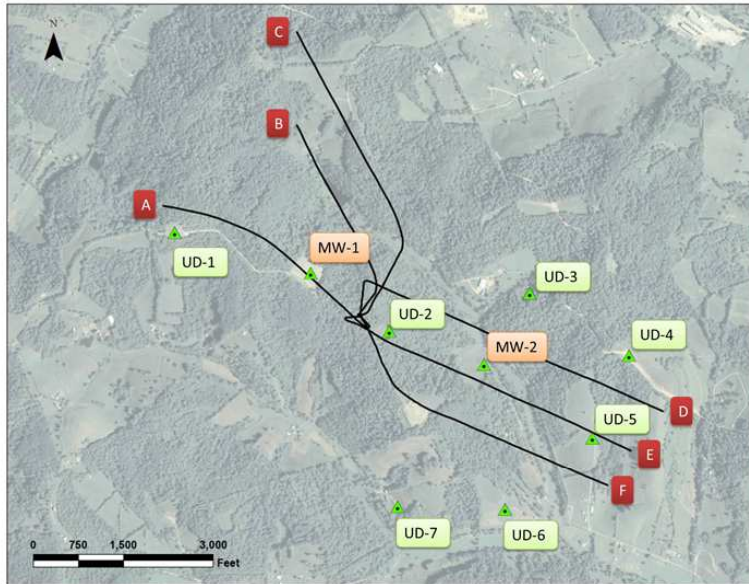
Passive Sampling (UD-2)



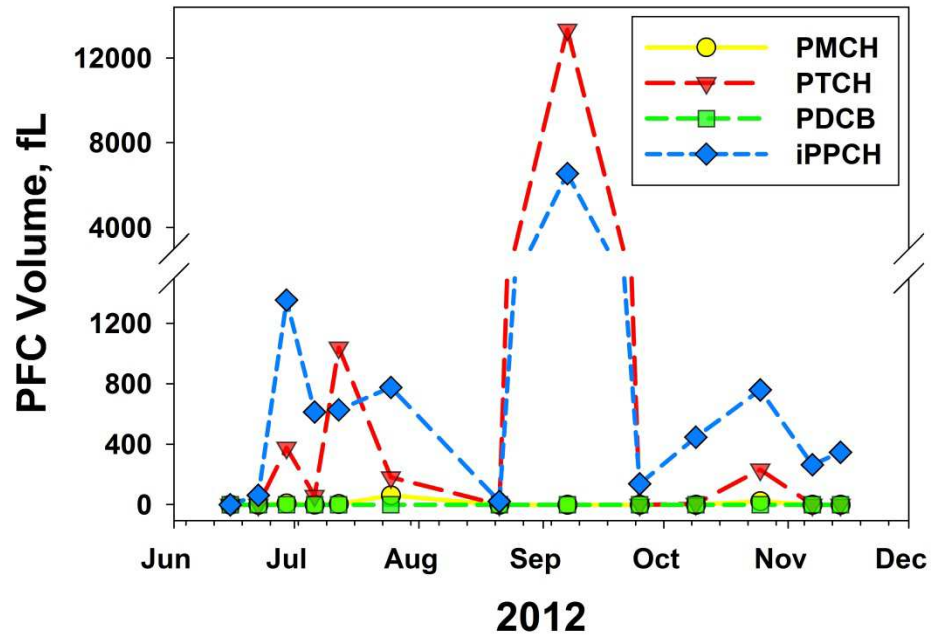
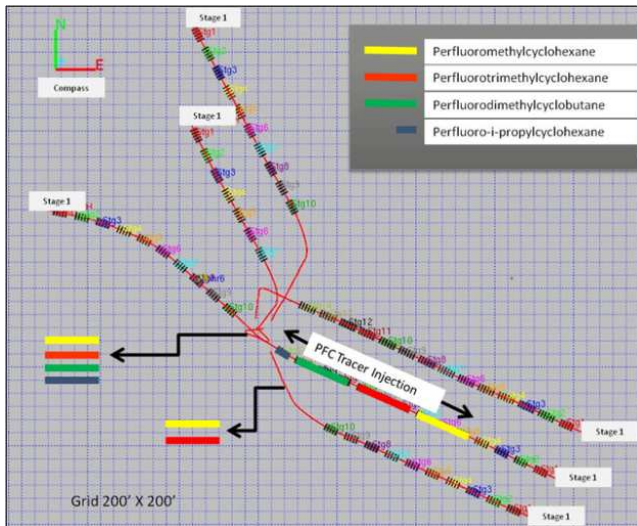
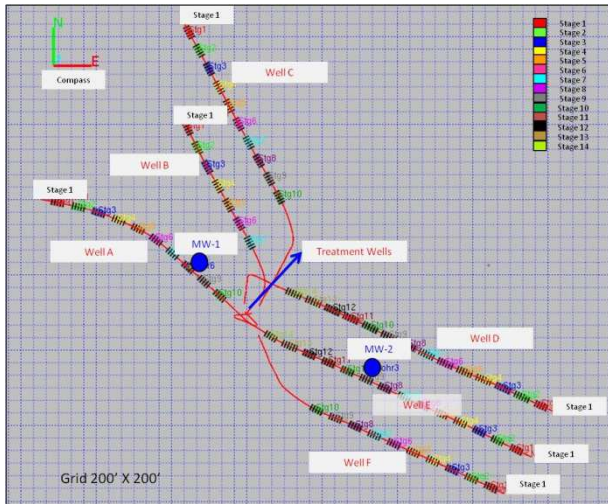
Passive Sampling (UD-5)



Active Sampling (MW-2 annulus)

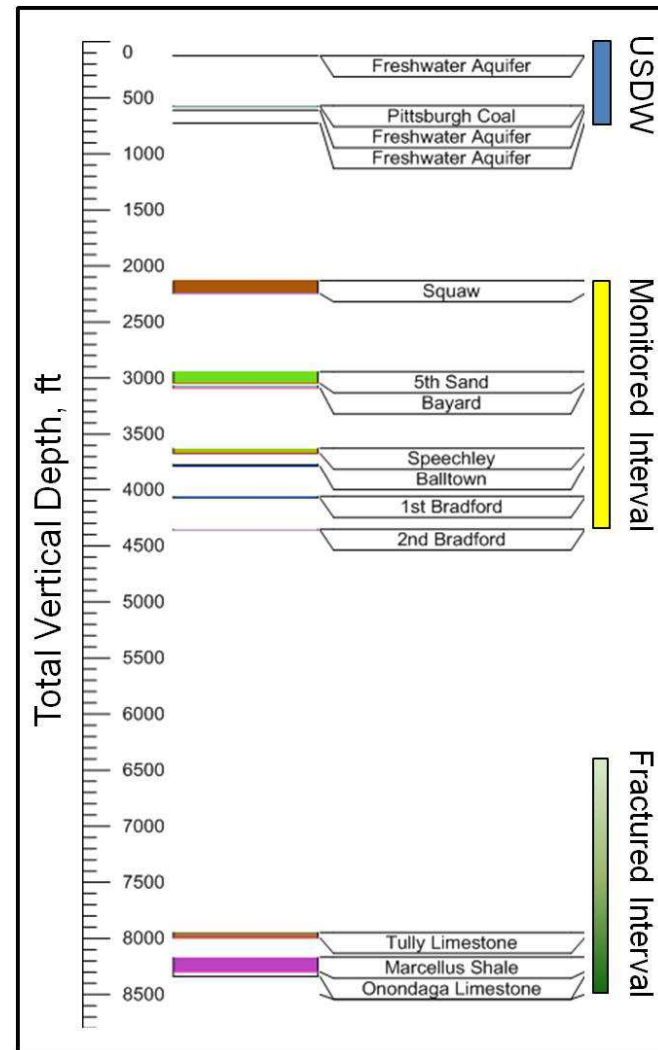


PFC Tracer (MW-2 annulus)



Summary

- PFC Tracer Monitoring:
 - Injection Marcellus Well
 - All tracers detected
 - Offset Marcellus Well
 - Expected tracers detected
 - Upper Devonian Wells
 - No tracers detected
 - Marcellus well annulus
 - Two tracers detected



Contact Information

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