



Deployable Sondes in West Virginia: Lessons Learned

Program Highlights:

Need help? Call 1-800

#42

WVDEP Deployable Program

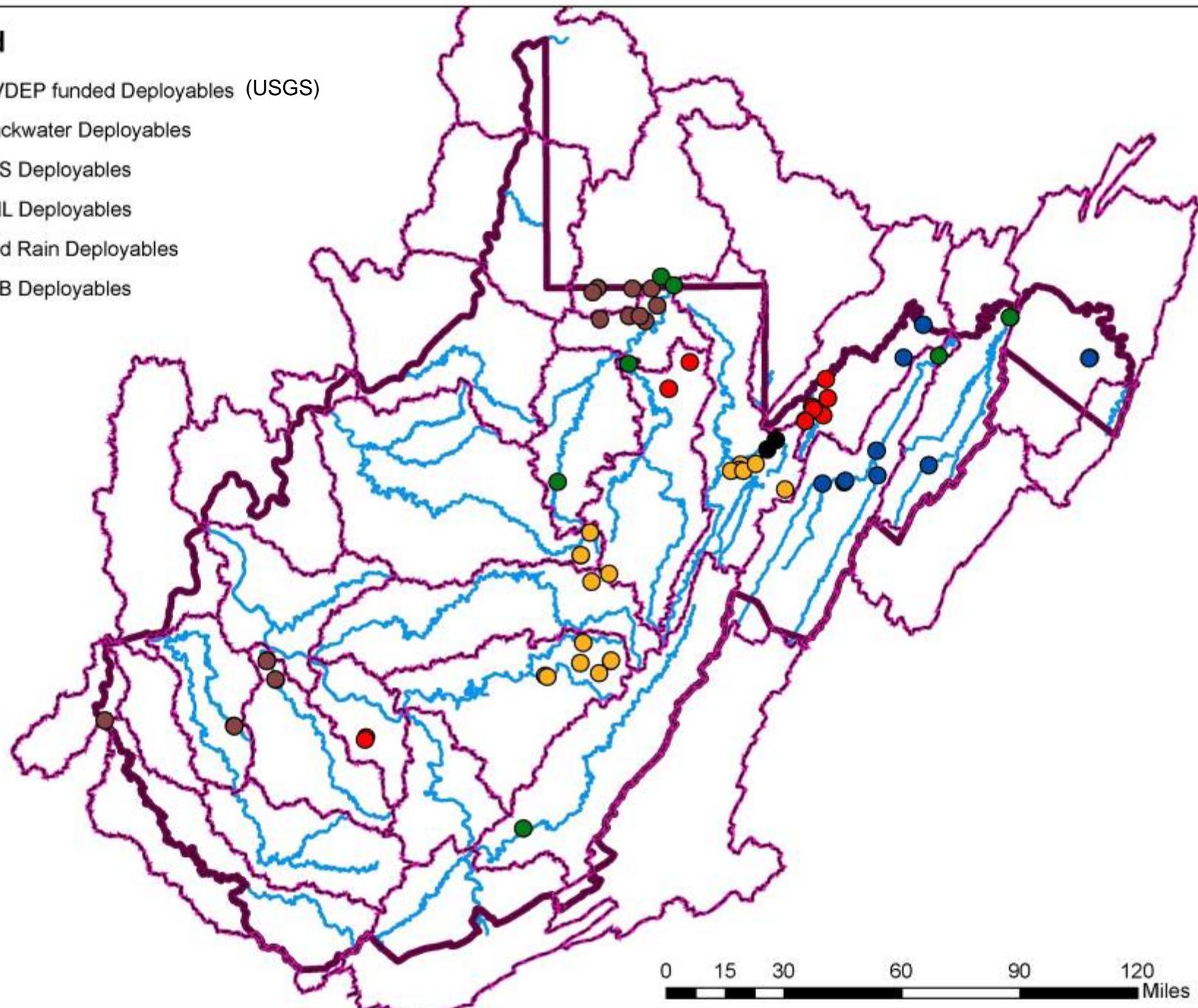
- Deployable WQ sondes collect hourly Temp., pH, Specific Conductance, & D.O. data
- Typically deployed for 30 days between battery changes, calibration, cleaning, & data downloads
- Fleet of 36 sondes by 3 manufacturers
- 32 active deployable sites (frequent additions & subtractions due to program objectives)

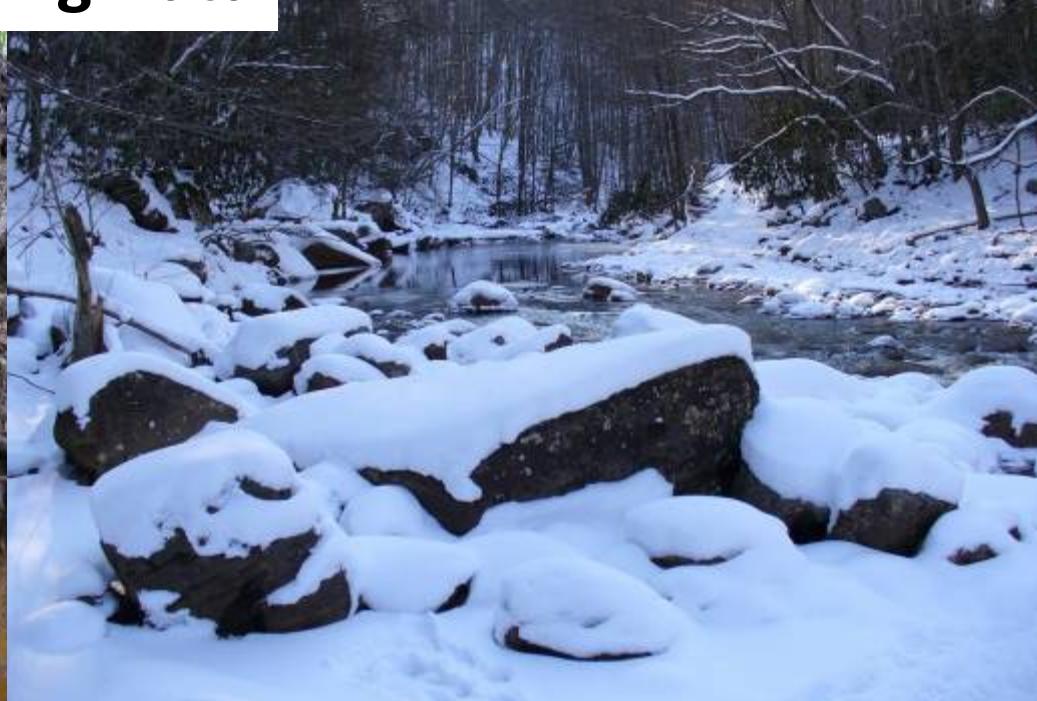
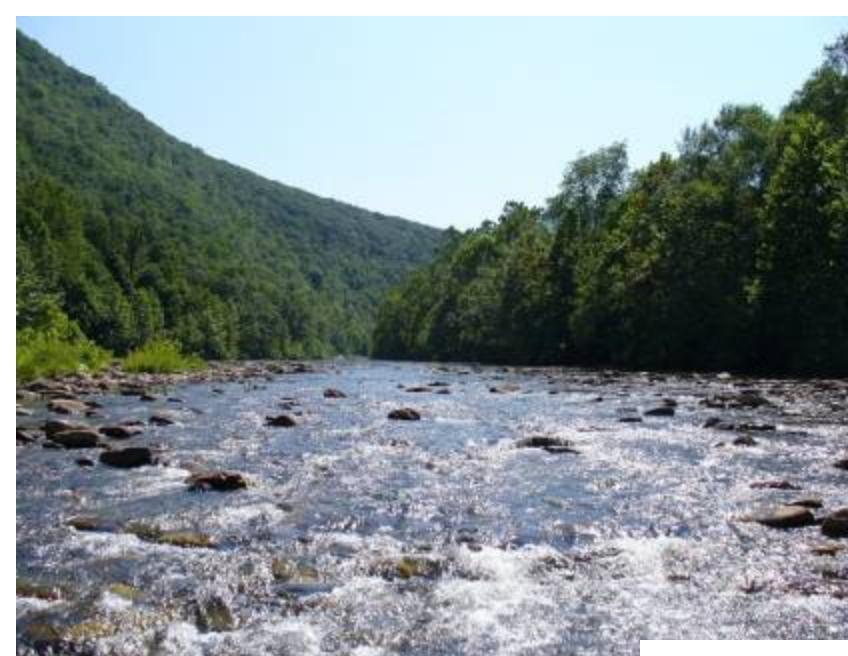
Project Types:

- **Abandoned Mine Lands Limestone Sand and Ammonia Treatment**
 - Monitor pH and Specific Conductance to determine effectiveness of various AML treatment techniques on AMD impacted streams.
 - Completed pretreatment monitoring in 2009, treatments to begin in 2010
- **South Branch/Potomac Fish Kill**
 - Long-term Temp., pH, D.O., & Specific Conductance data on mainstem, tributaries, & similar regional streams (North Branch, Opequon Ck, etc.) to develop a better understanding of daily/seasonal patterns
- **Total Dissolved Solids (TDS)**
 - Interest spawned by natural gas drilling in Marcellus Shale region & TDS impacts in Monongahela drainage. Expanded after Dunkard Fish kill to similar streams in the area, pump stations, & ionic stressed streams statewide.
 - Monitoring Specific Conductance trends in high TDS streams
- **WVDNR Limestone Sand Treatment to Acid Deposition Streams**
 - Capture baseline and post-treatment pH data in acid deposition-impacted streams that previously supported or could potentially support brook trout
 - Provide feedback to WVDNR authorities about pH trends, allowing pertinent adjustments to treatment regimes

Legend

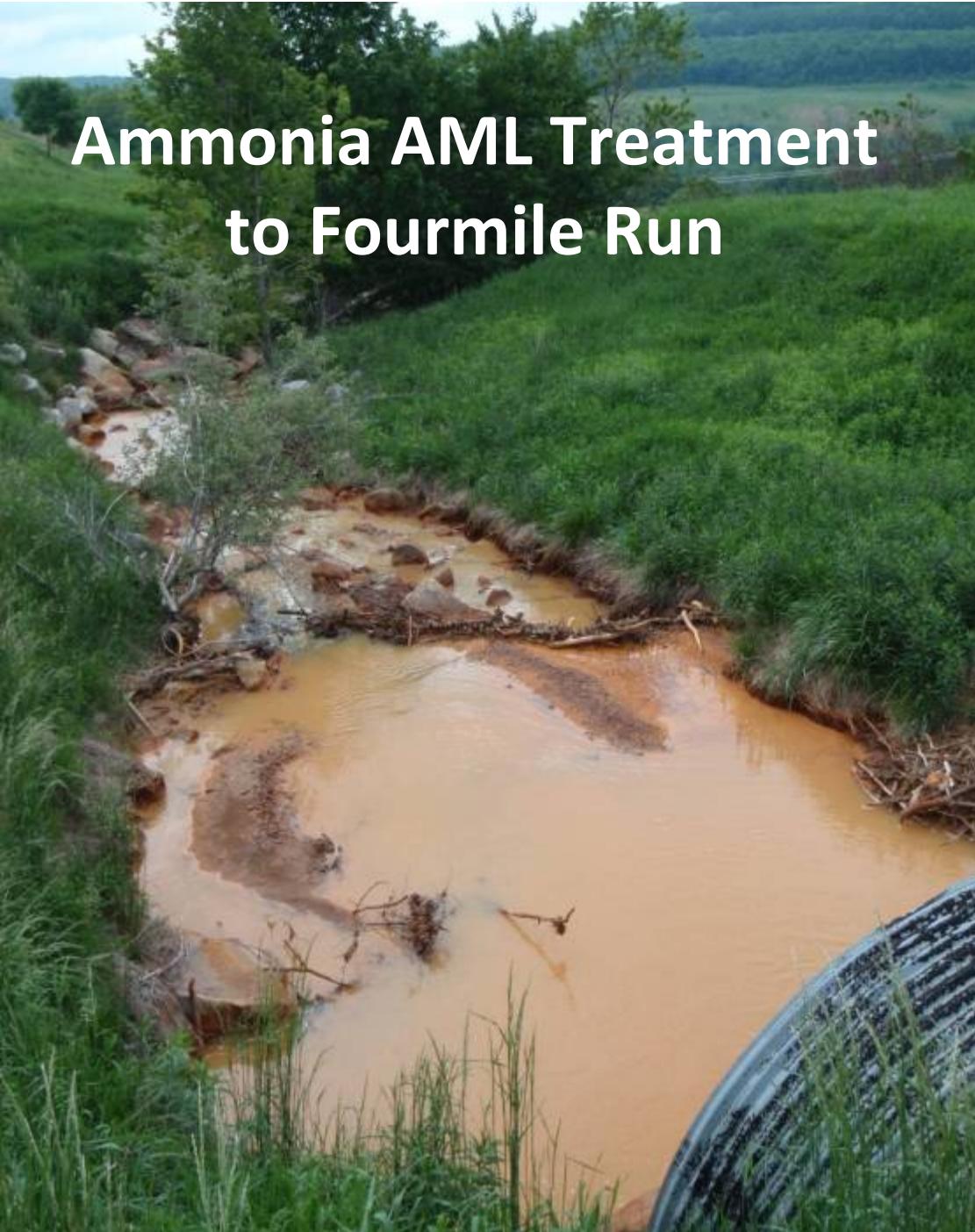
- WVDEP funded Deployables (USGS)
- Blackwater Deployables
- TDS Deployables
- AML Deployables
- Acid Rain Deployables
- PSB Deployables



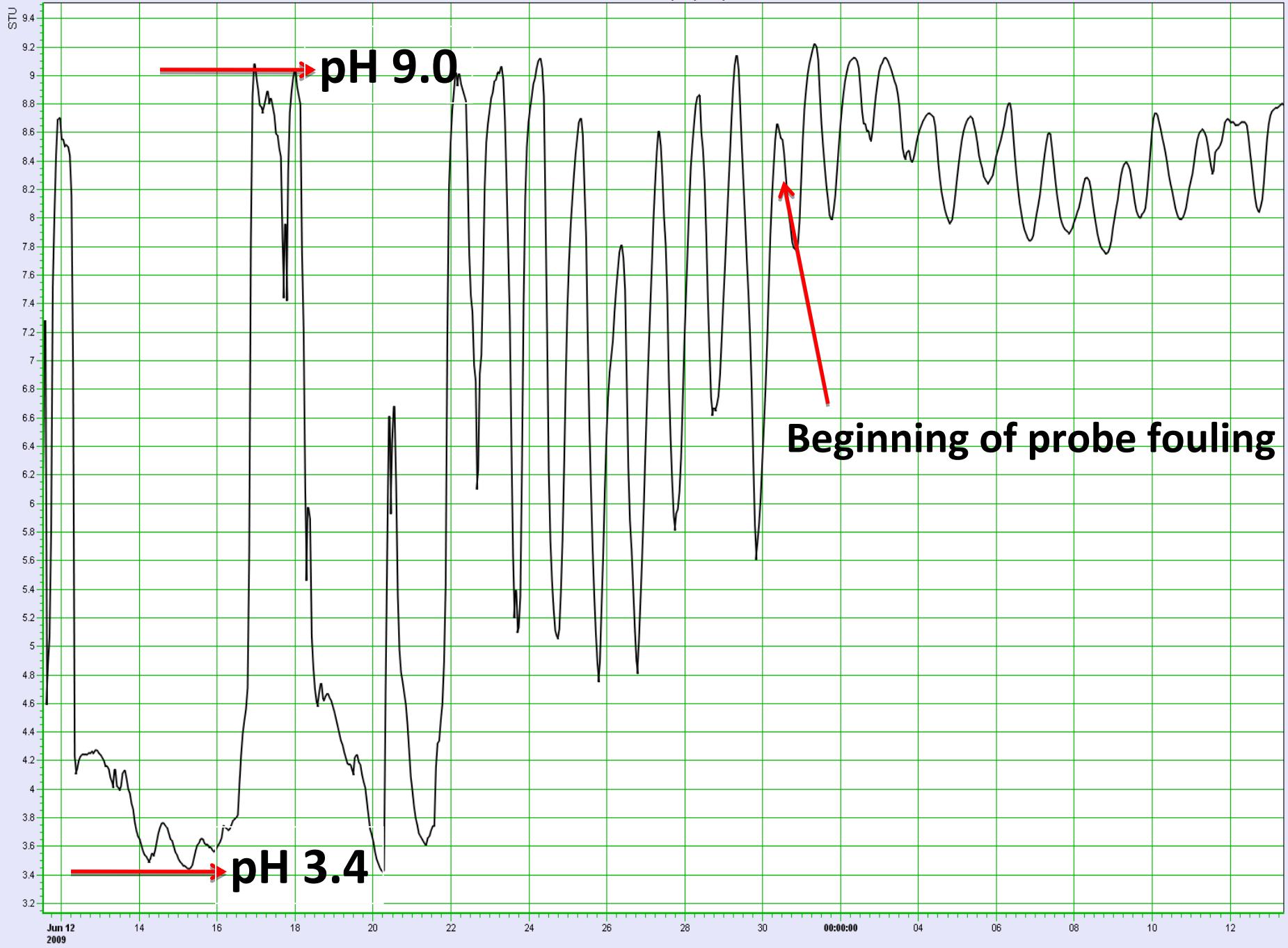


Intriguing Data

Ammonia AML Treatment to Fourmile Run



Fourmile Run - pH (STU)



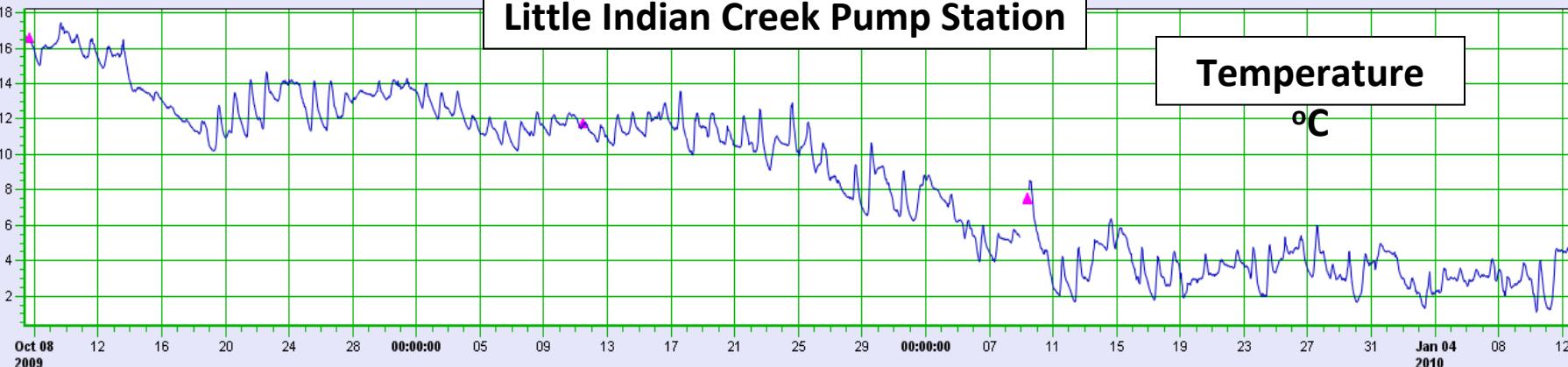
Deep Mine Pump Station Sites



Little Indian Creek Pump Station

Temperature

°C



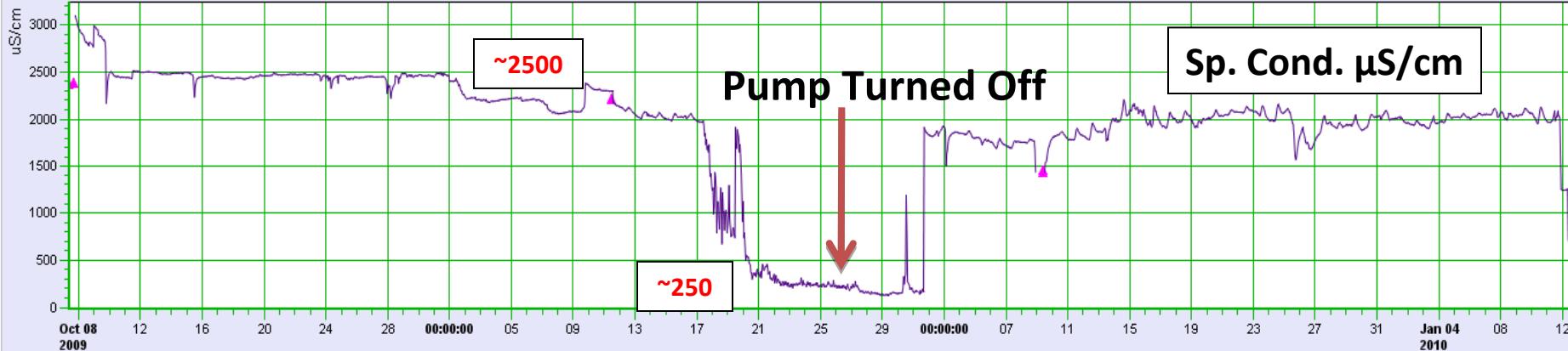
SpCond ($\mu\text{S}/\text{cm}$)

Sp. Cond. $\mu\text{S}/\text{cm}$

~2500

Pump Turned Off

~250

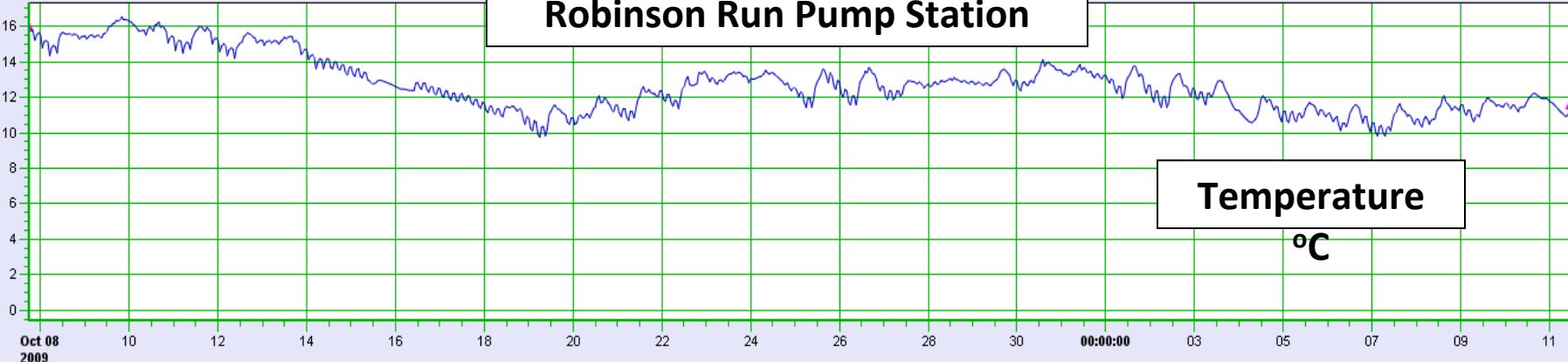


pH (STU)

pH

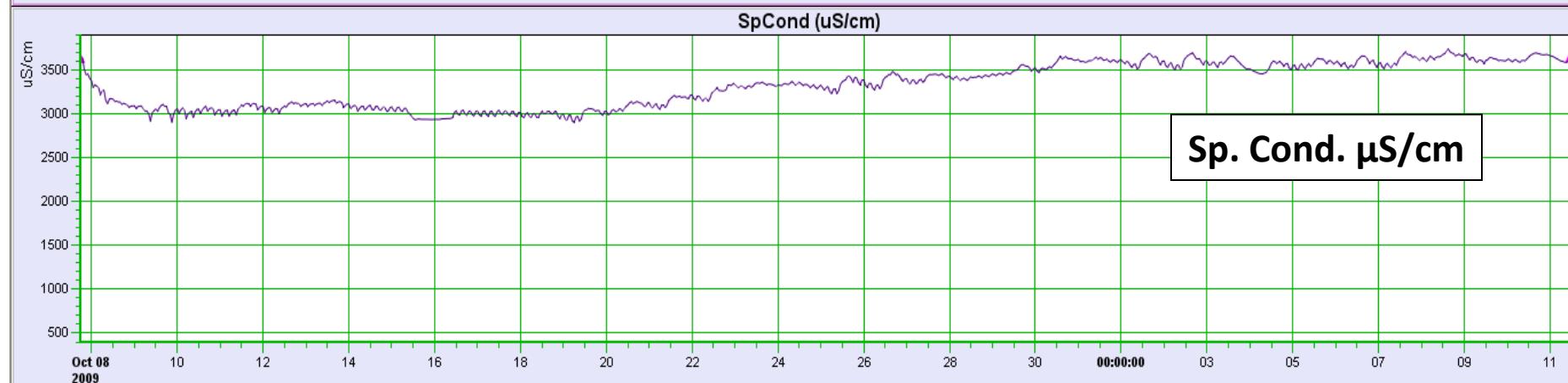


Robinson Run Pump Station

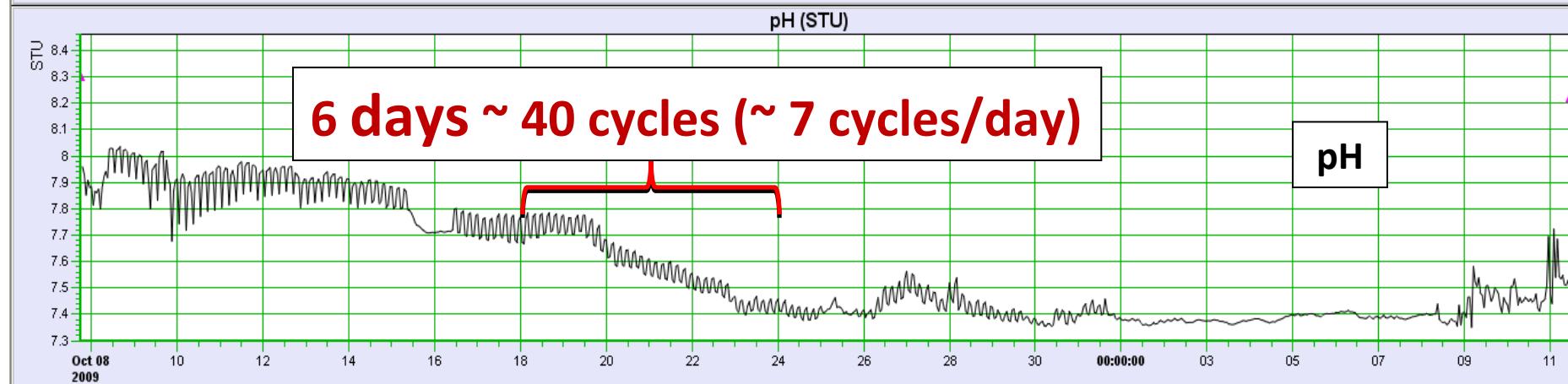


Temperature

°C



Sp. Cond. $\mu\text{S}/\text{cm}$



6 days ~ 40 cycles (~ 7 cycles/day)

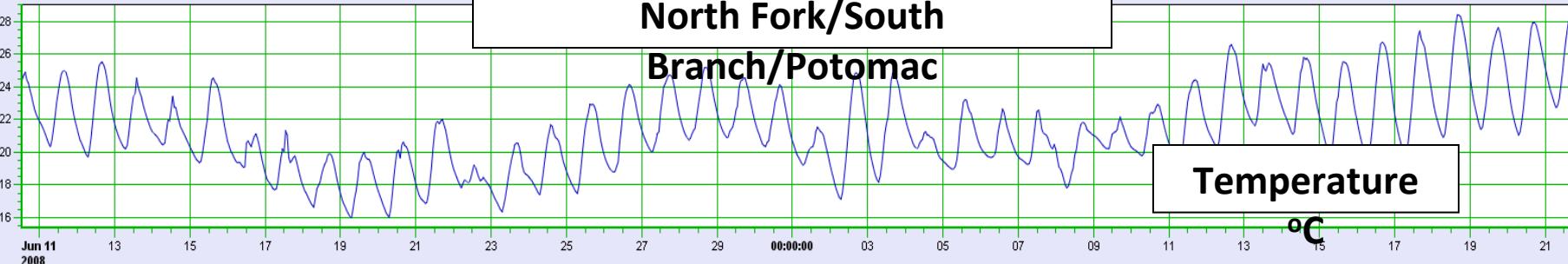
pH

South Branch Potomac

Daily pH Swings



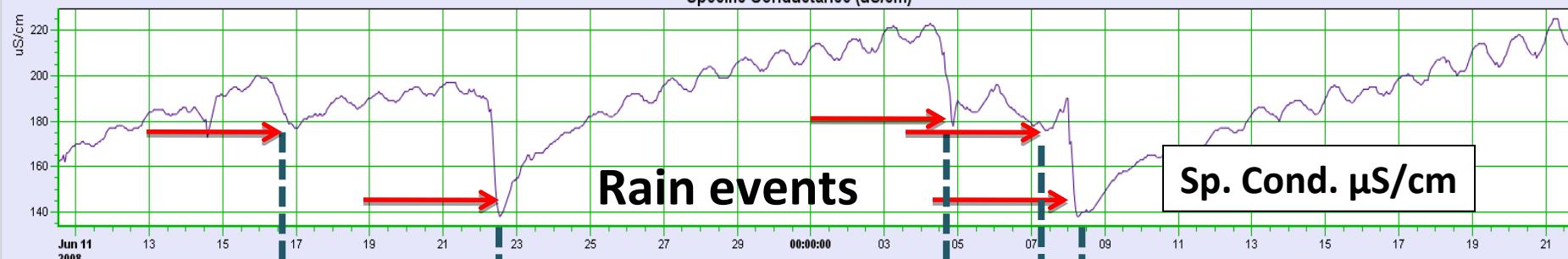
North Fork/South Branch/Potomac



Temperature

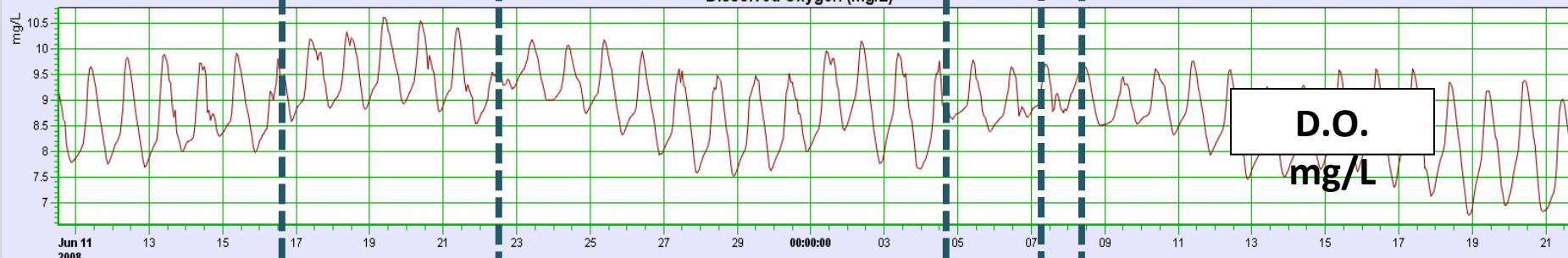
$^{\circ}\text{C}$

Specific Conductance ($\mu\text{s}/\text{cm}$)

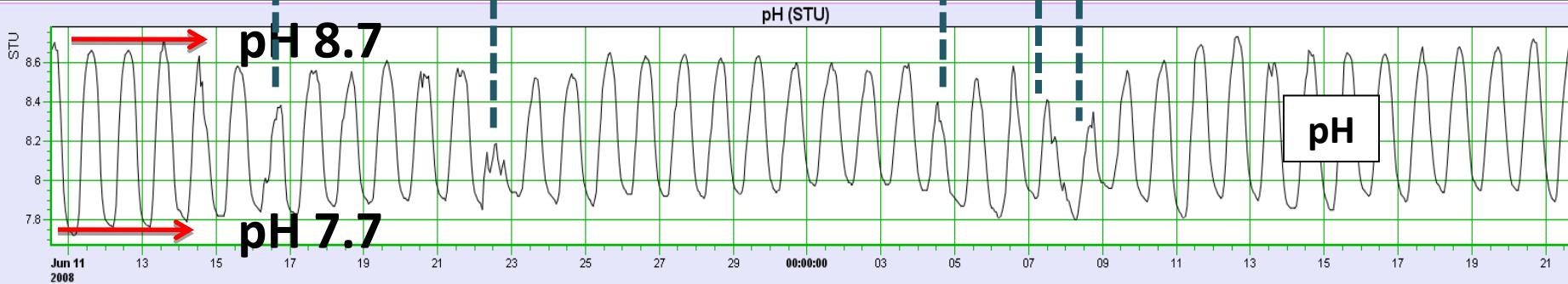


Rain events

Dissolved Oxygen (mg/L)



D.O.
mg/L

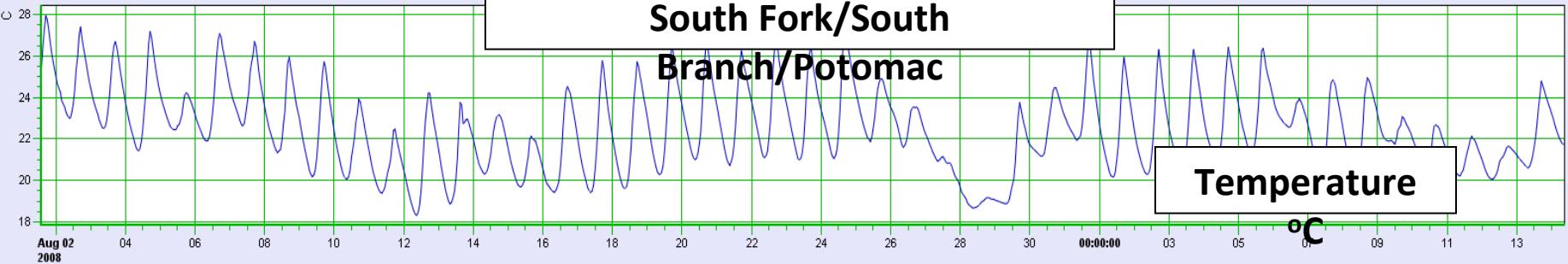


pH 8.7

pH 7.7

pH

**South Fork/South
Branch/Potomac**



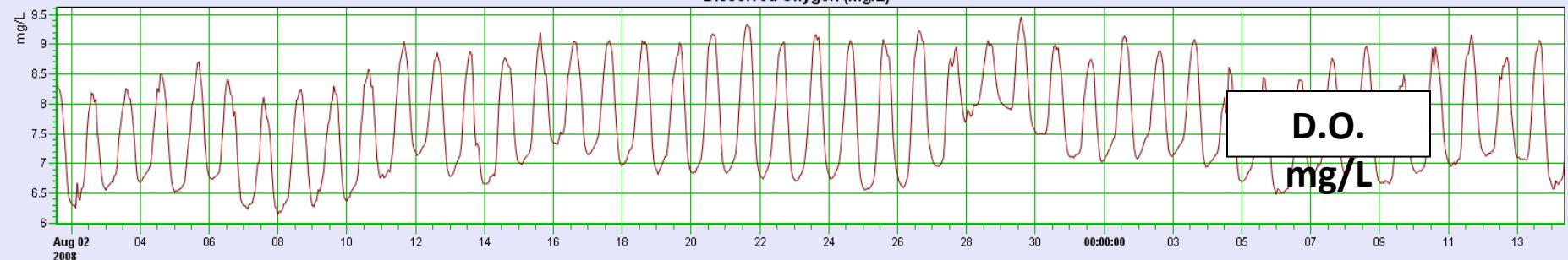
Temperature
°C

Specific Conductance ($\mu\text{S}/\text{cm}$)



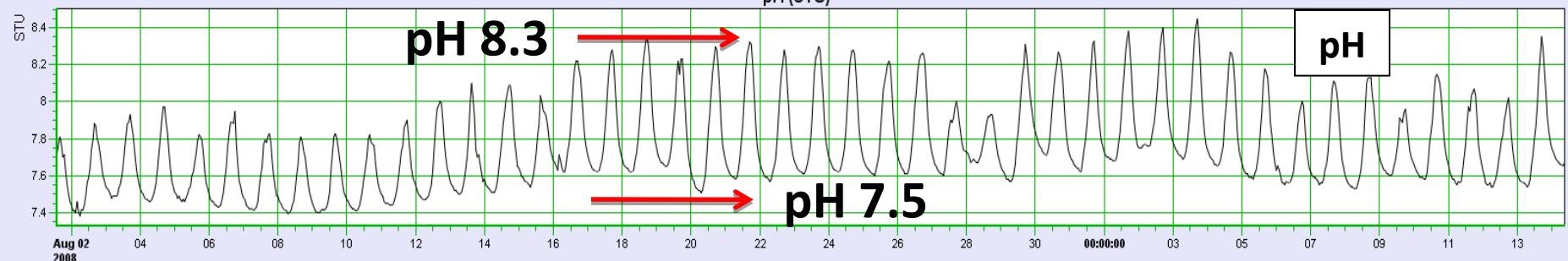
Sp. Cond. $\mu\text{S}/\text{cm}$

Dissolved Oxygen (mg/L)



D.O.
mg/L

pH (STU)



pH 8.3

pH 7.5

pH

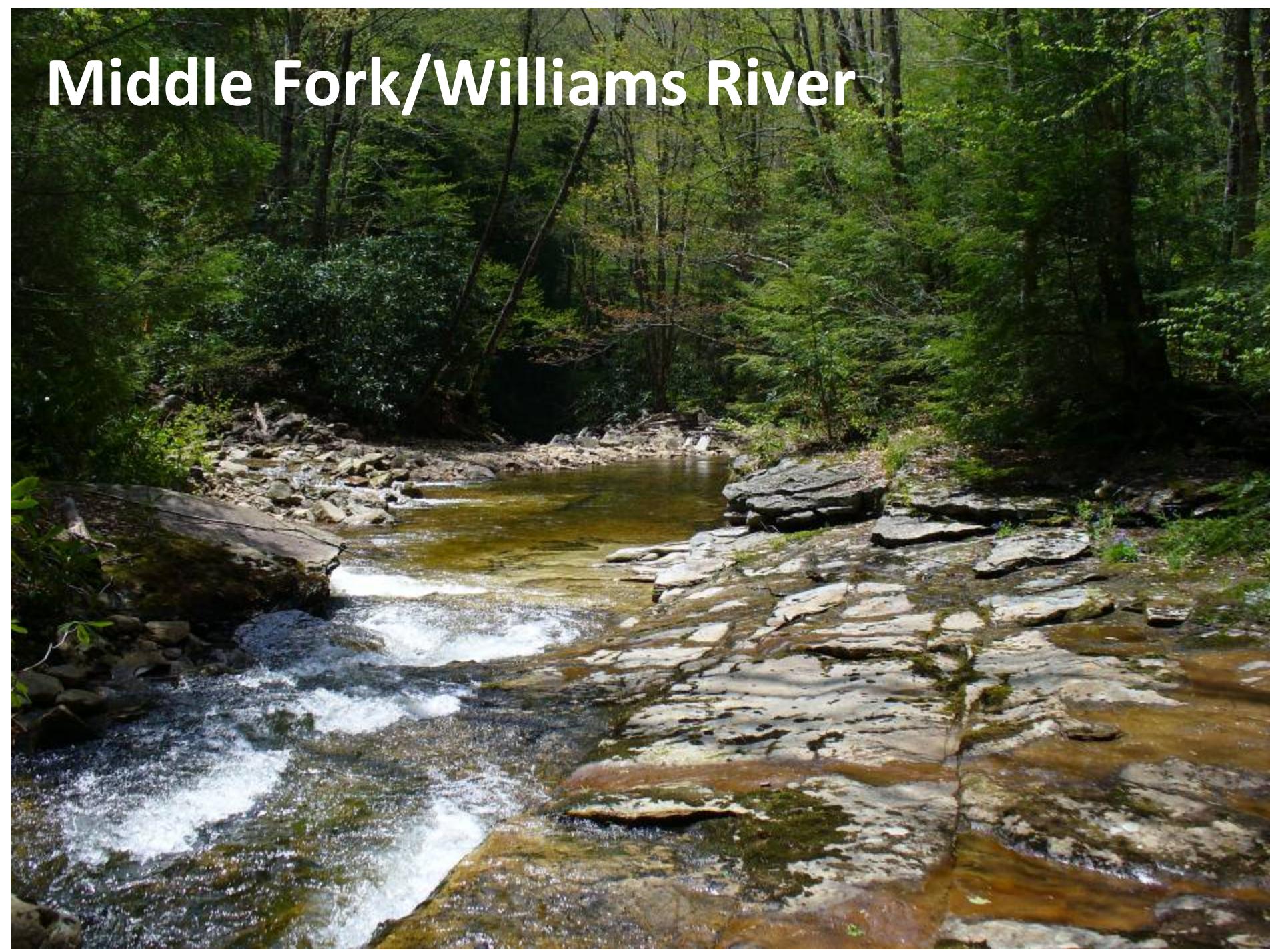


**Acid Precipitation Streams +
Limestone Sand**

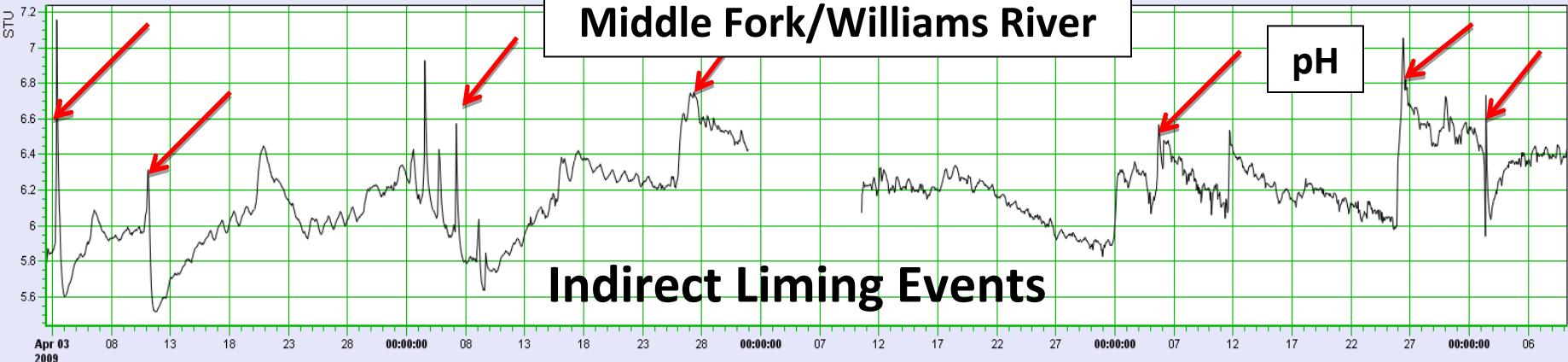




Middle Fork/Williams River



Middle Fork/Williams River

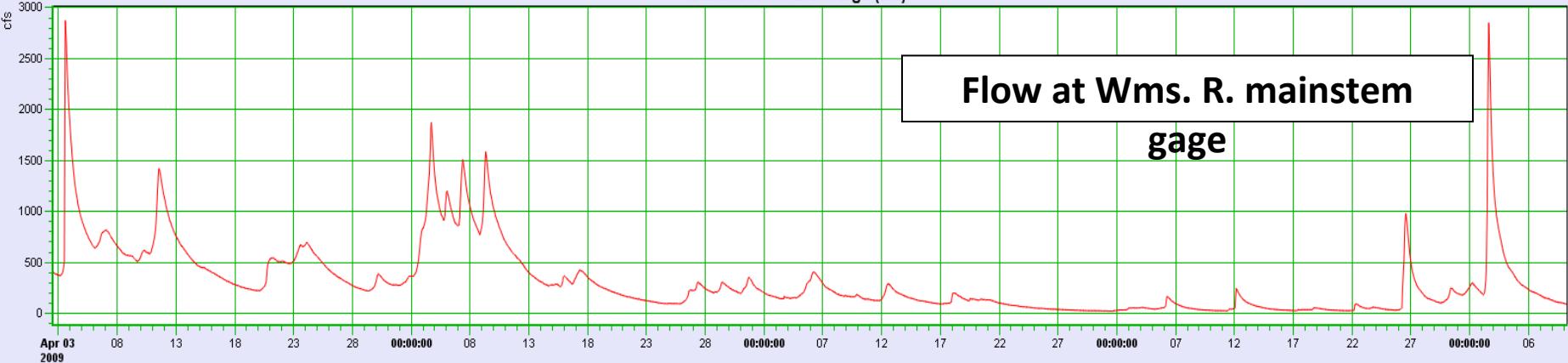


Specific Conductance ($\mu\text{S}/\text{cm}$)

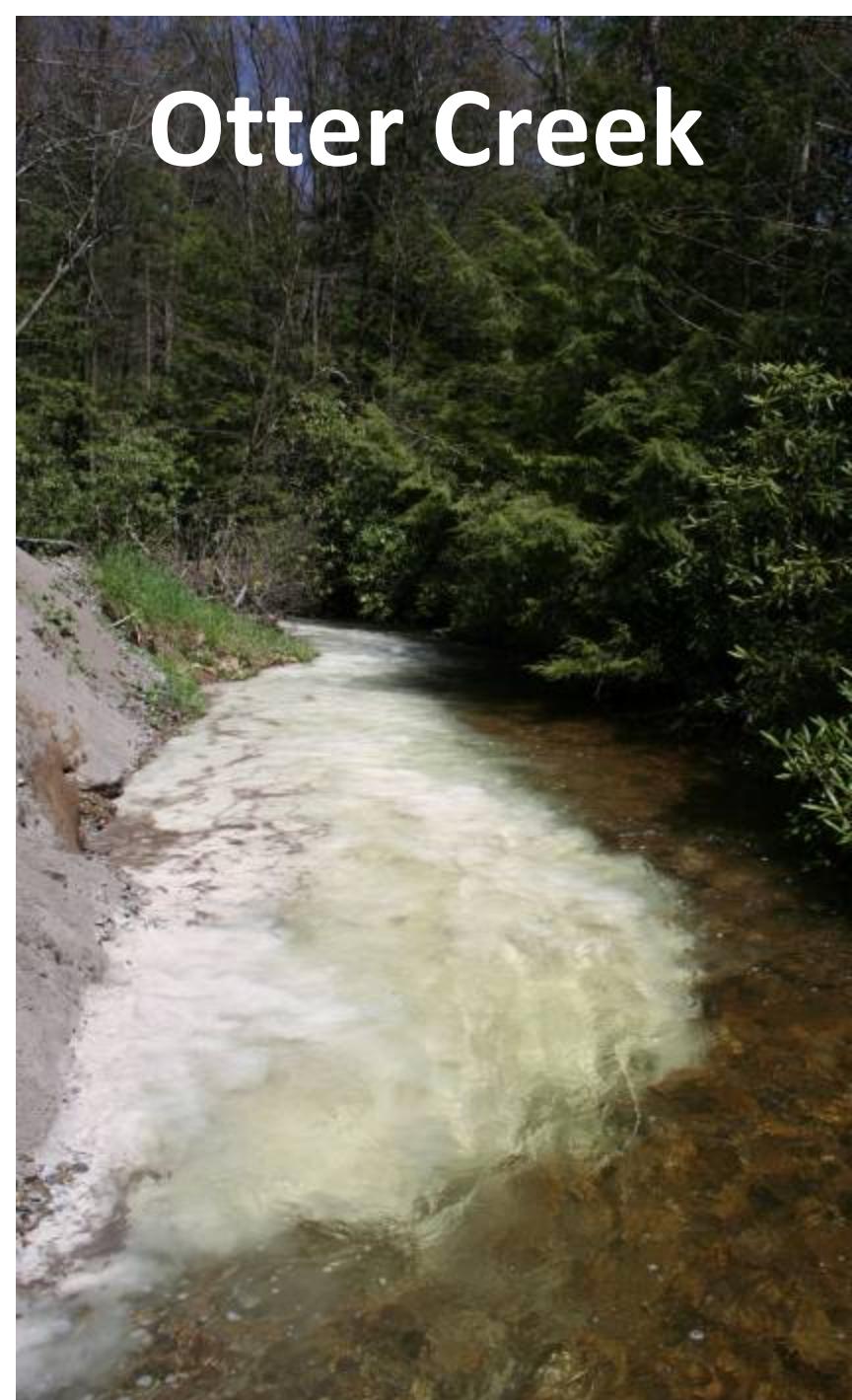


Williams River Discharge (cfs)

Flow at Wms. R. mainstem
gage

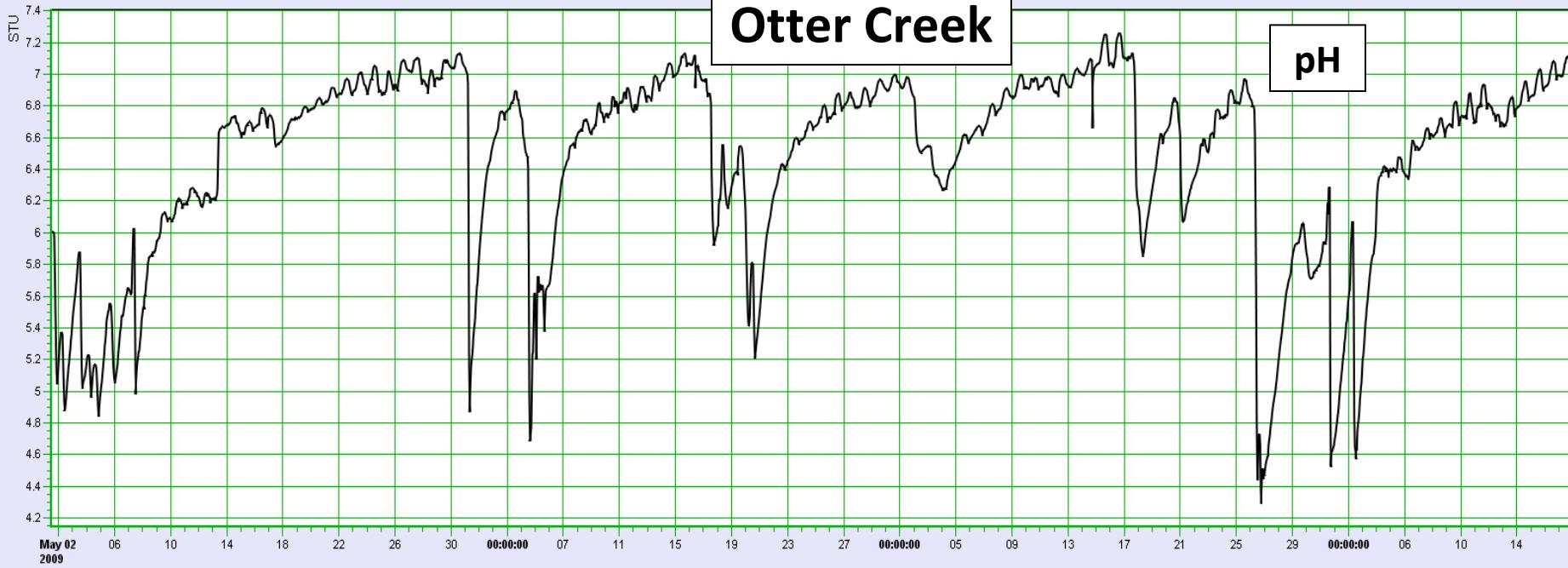


Otter Creek



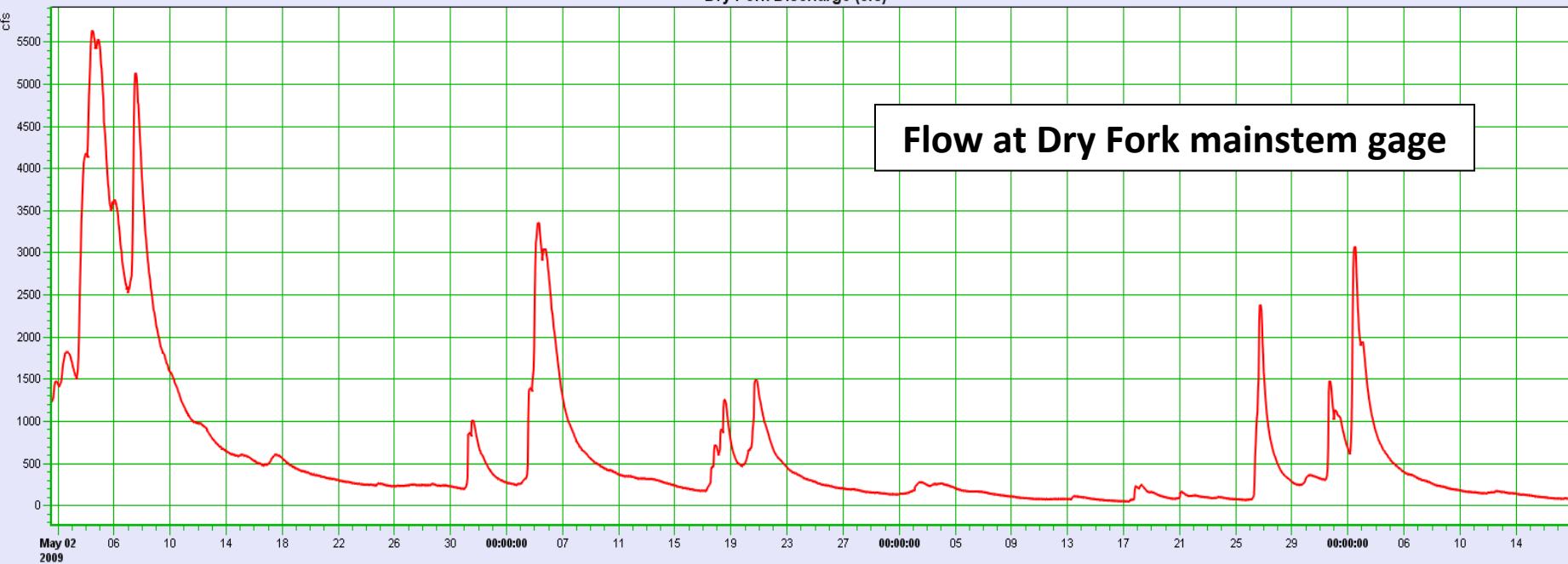
Otter Creek

pH



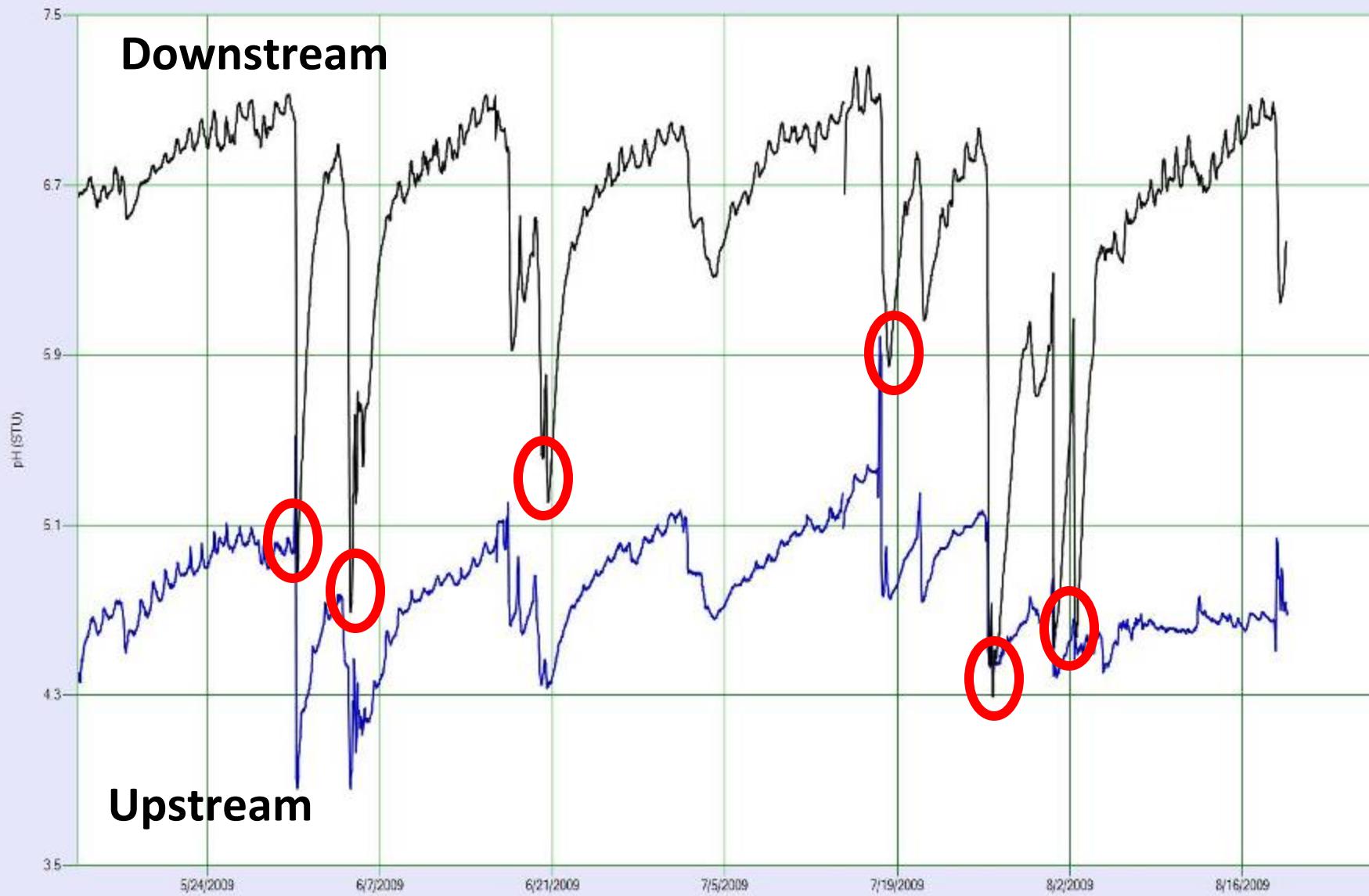
Dry Fork Discharge (cfs)

Flow at Dry Fork mainstem gage



Otter Creek pH

Otter Creek US Otter Creek DS



Middle Fork/Williams River pH

Middle Fork DS Middle Fork US



Lessons Learned:

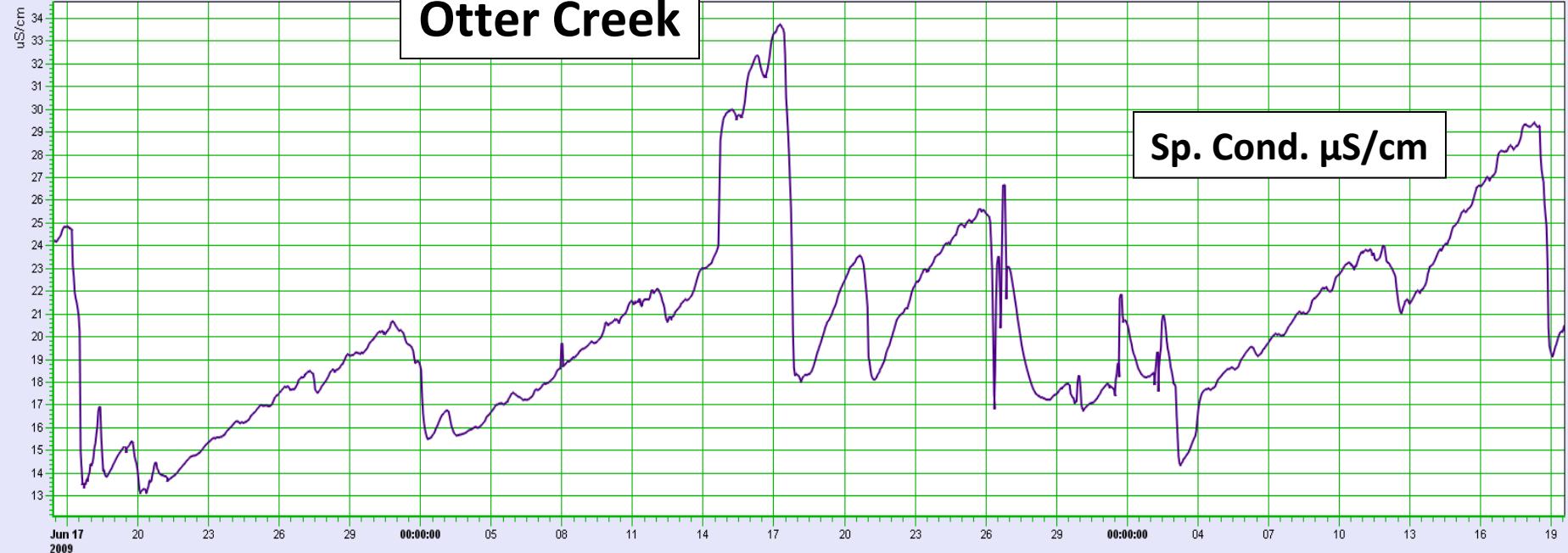
- Sonde placement is critical to gathering quality data & to retrieving sonde at the termination of deployment.
- In >250,000 deployment hours, WVDEP has lost only two sondes (one to high flow, one to theft). Keeping deployables hidden from view, visualizing high flow, & removing sondes when ice cover is present are keys to minimizing losses.
- Multiple instances of anchor failure have, nonetheless, resulted in successful retrieval by a careful survey of the nearest downstream pool or shallow riffle.
- High gradient streams + high flow = death to electronic equipment. Five sondes have been critically damaged by Otter Creek (1) and Red Creek (4).

...Lessons Learned continued:

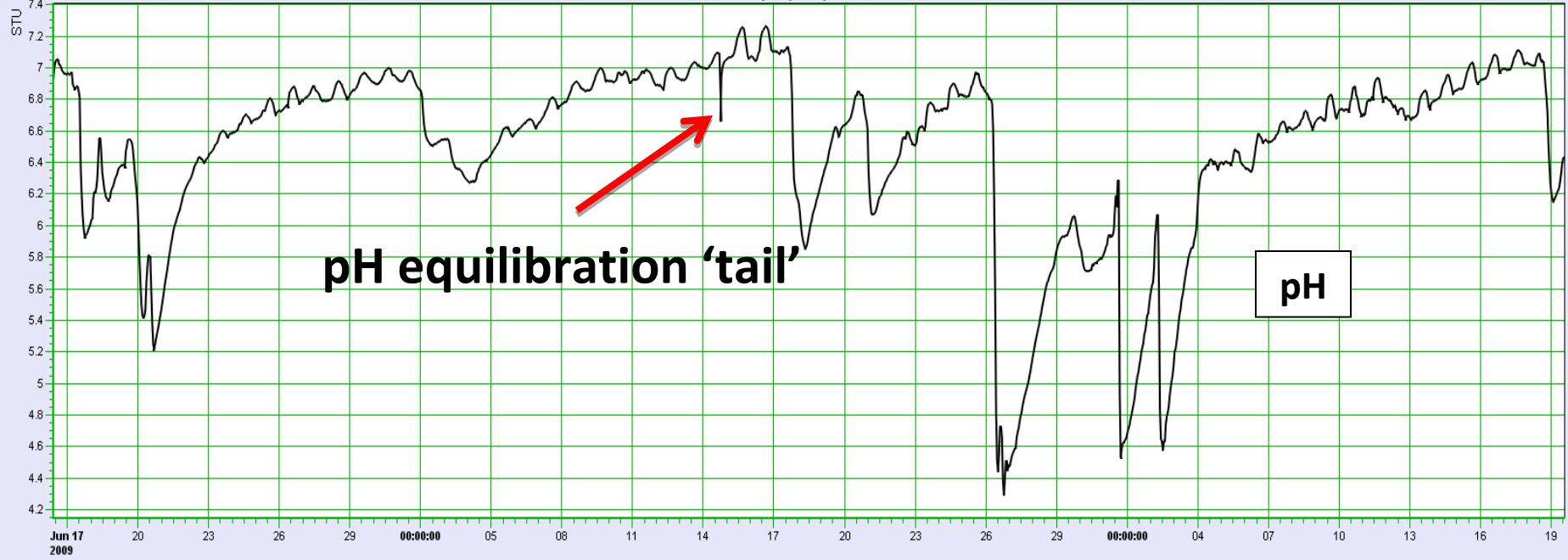
- Months/Years of properly collected hourly data are very powerful in characterizing stream chemistry. However, there are limitations due to sonde technology and quality of maintenance.
- Streams with very low conductance significantly affect pH values. Freshly calibrated sondes require time to equilibrate, sometimes exceeding 30 minutes.
- You never know what you might see out there, so be observant and open to potential adventure, you might learn something new or see something rare.

Otter Creek

Otter Creek - SpCond ($\mu\text{S}/\text{cm}$)



pH (STU)





South Fork Red Creek: Water + Gradient = Power

May 2006



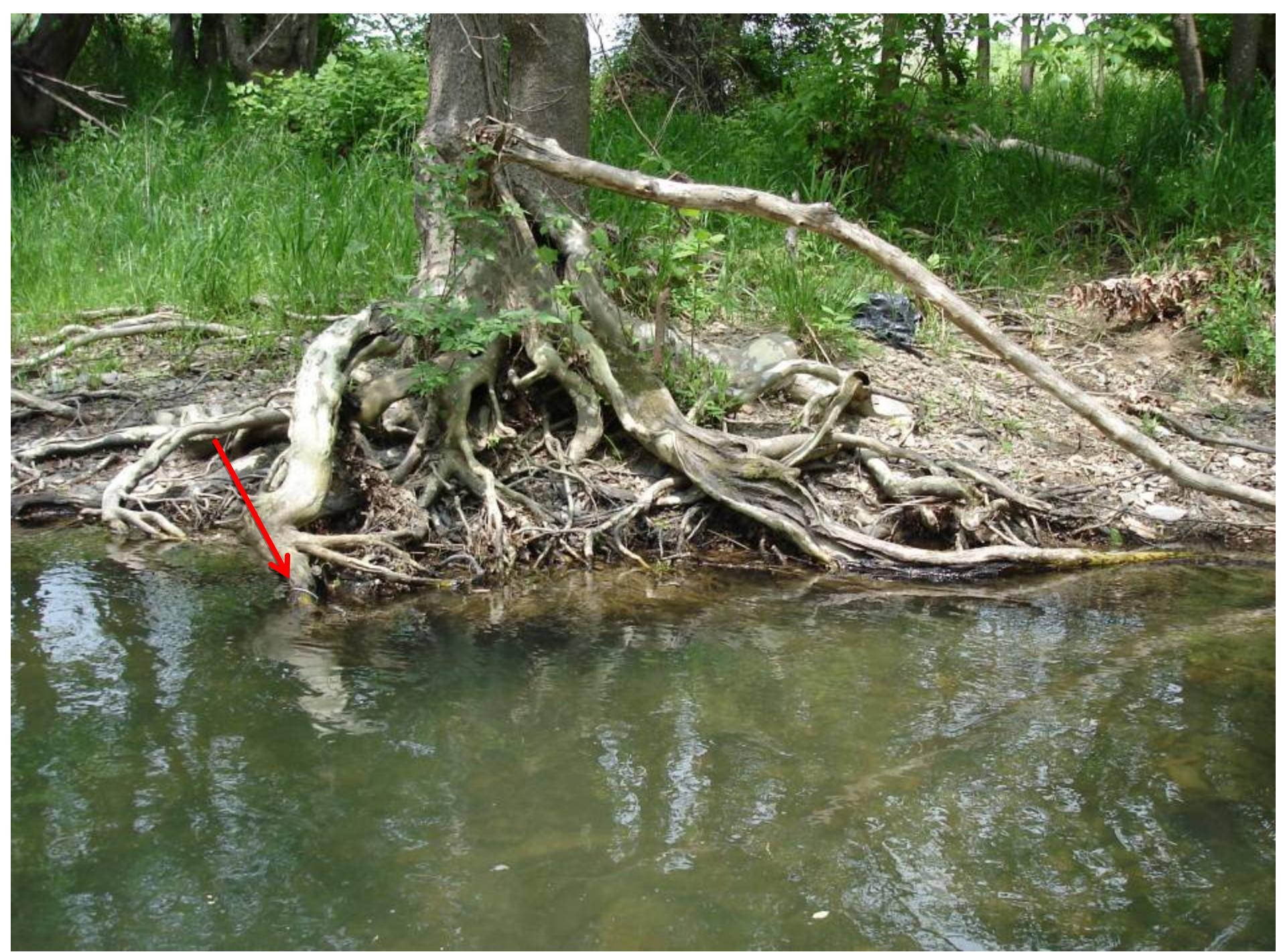
July 2008







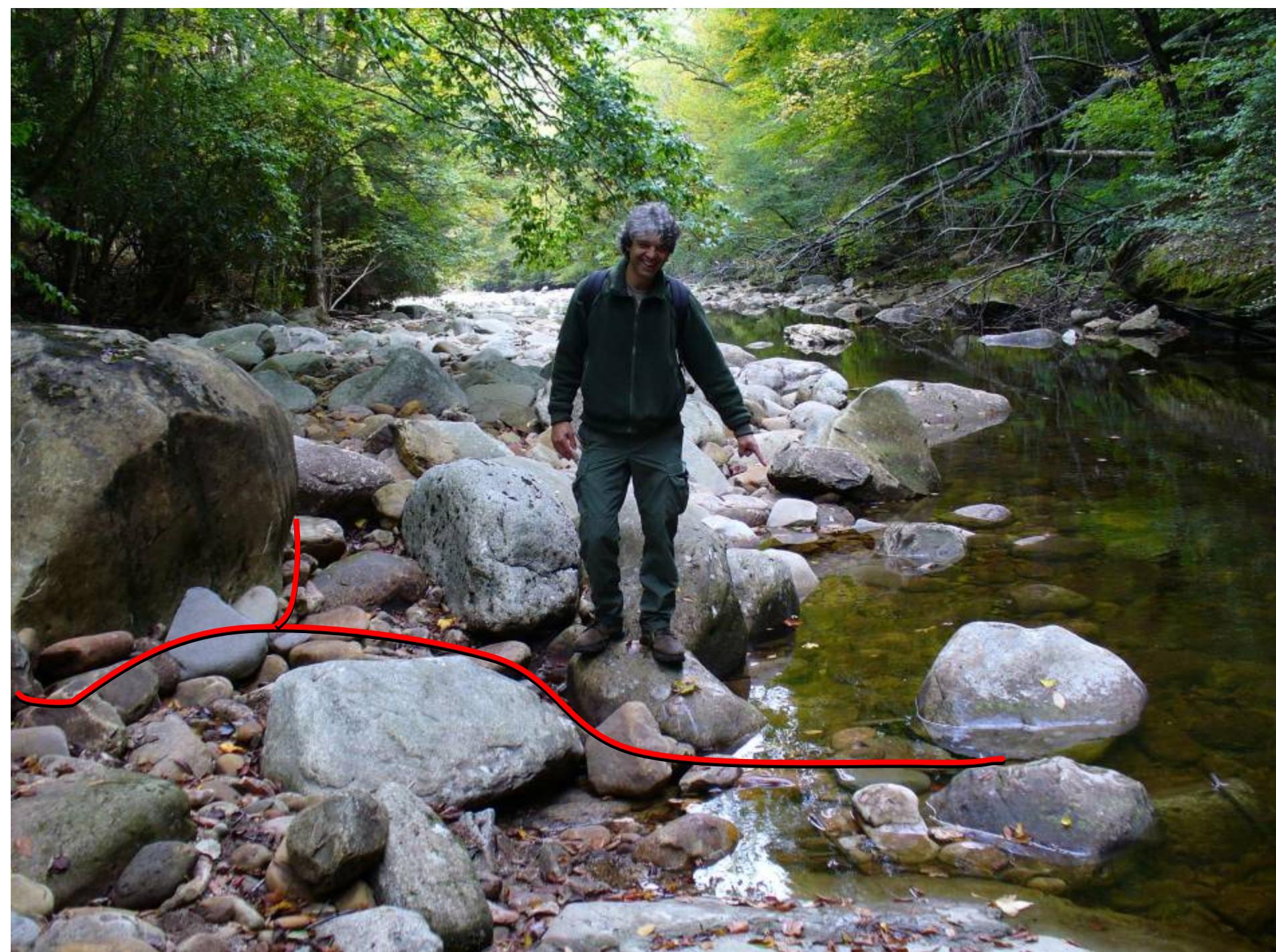




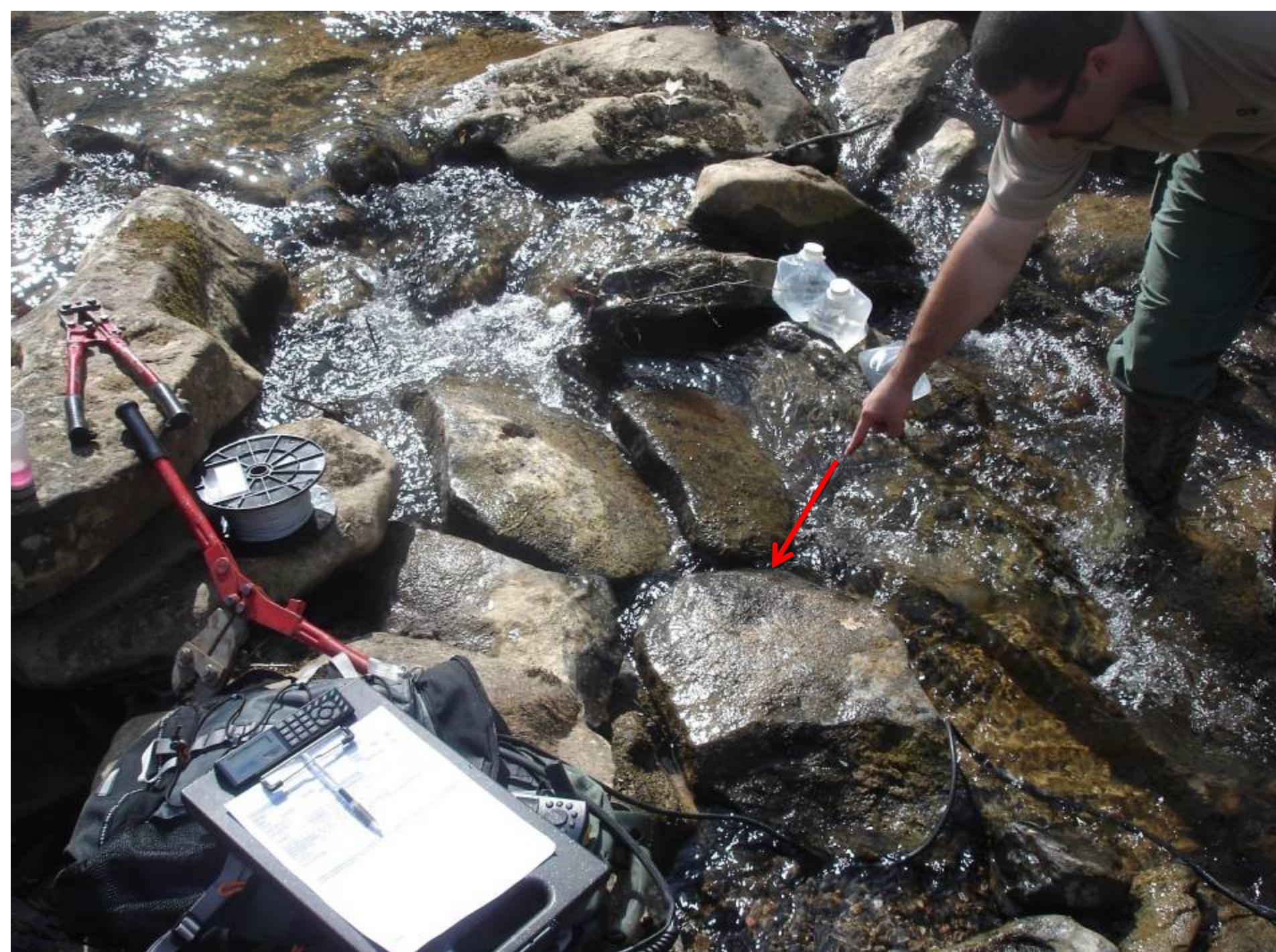










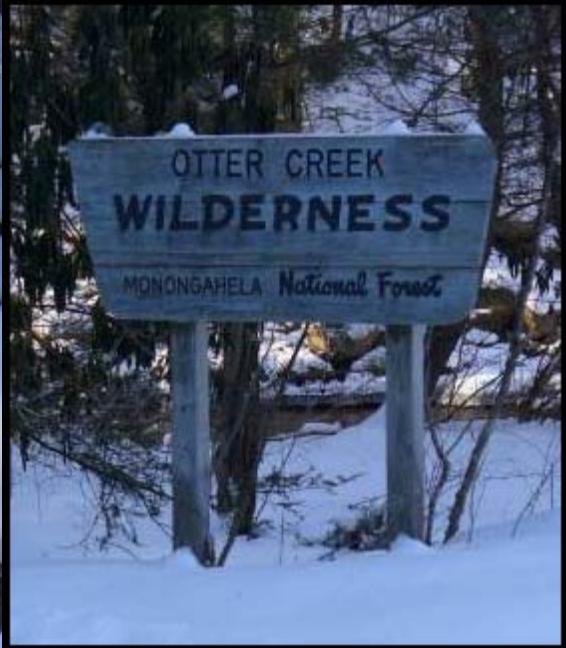












OTTER CREEK
WILDERNESS

MONONGAHELA National Forest





The End