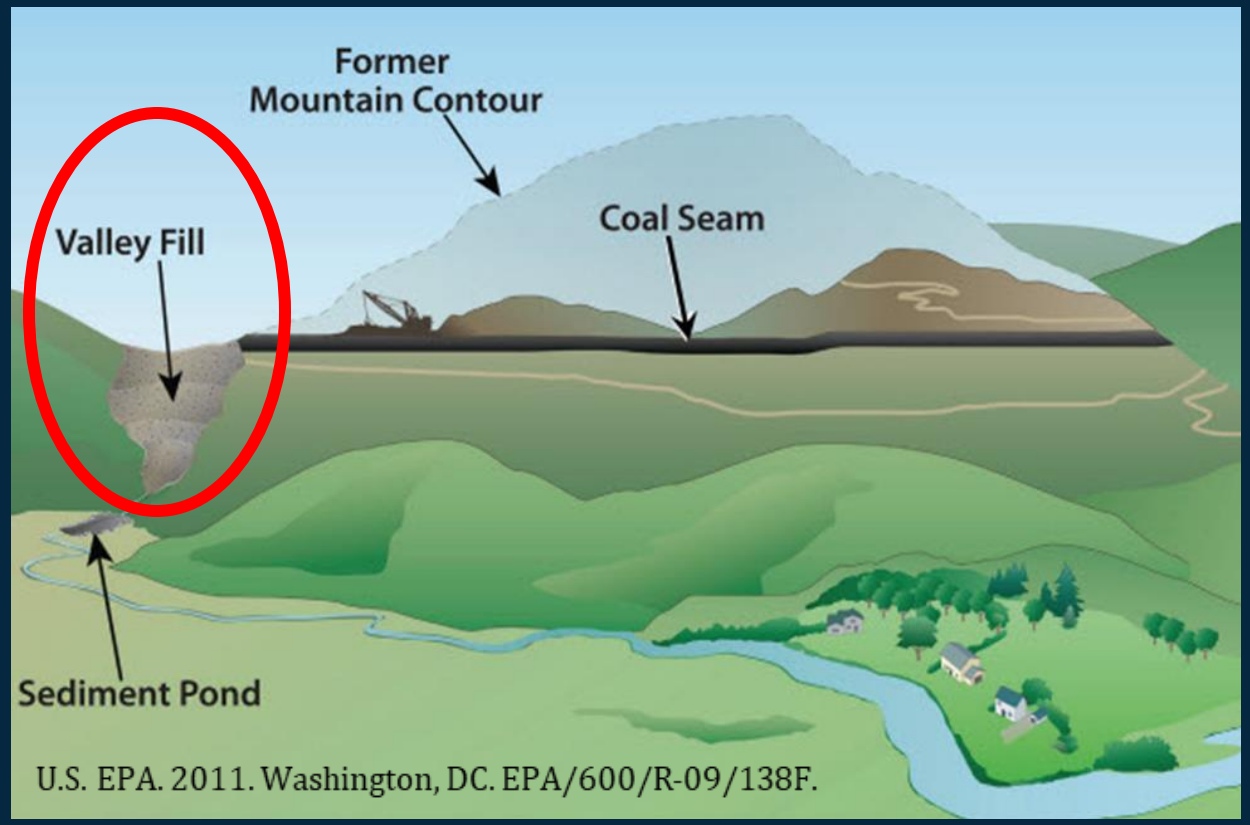
EFFECTS OF SEDIMENT POND ON THE HYDROCHEMISTRY OF HEADWATER STREAMS IN RECLAIMED SURFACE MINE SITES OF CENTRAL APPALACHIA

MIKAYLA DEMATT, GERMAN BANDA, ROBERT CANTRELL, FERNANDO ROJANO, AMIR HASS

WEST VIRGINIA STATE UNIVERSITY

American Society of Reclamation Sciences 2026 Annual Conference
Laramie, Wyoming
June 9, 2026

Mountaintop Removal Mining Valley Fill Reclamation (MTR-VF)



Appalachian Stream Specific Conductance (µS/cm)

Undisturbed headwater: 20 - 200

MTR-VF headwater: 500 – 3,000

Aquatic Benchmarks (µS/cm)

Impairment: 500

Aquatic Life: 300

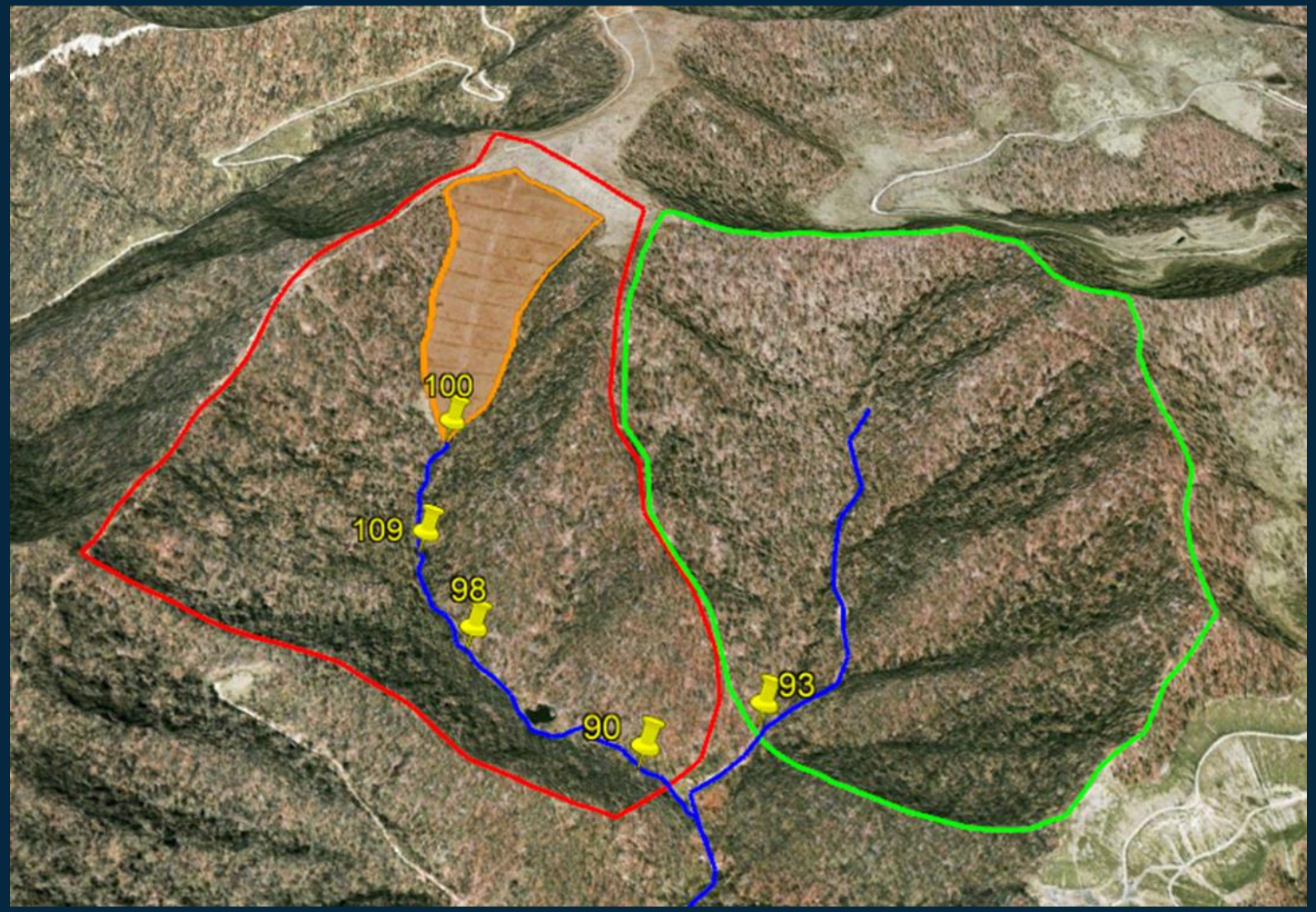
Sensitive Species: 175

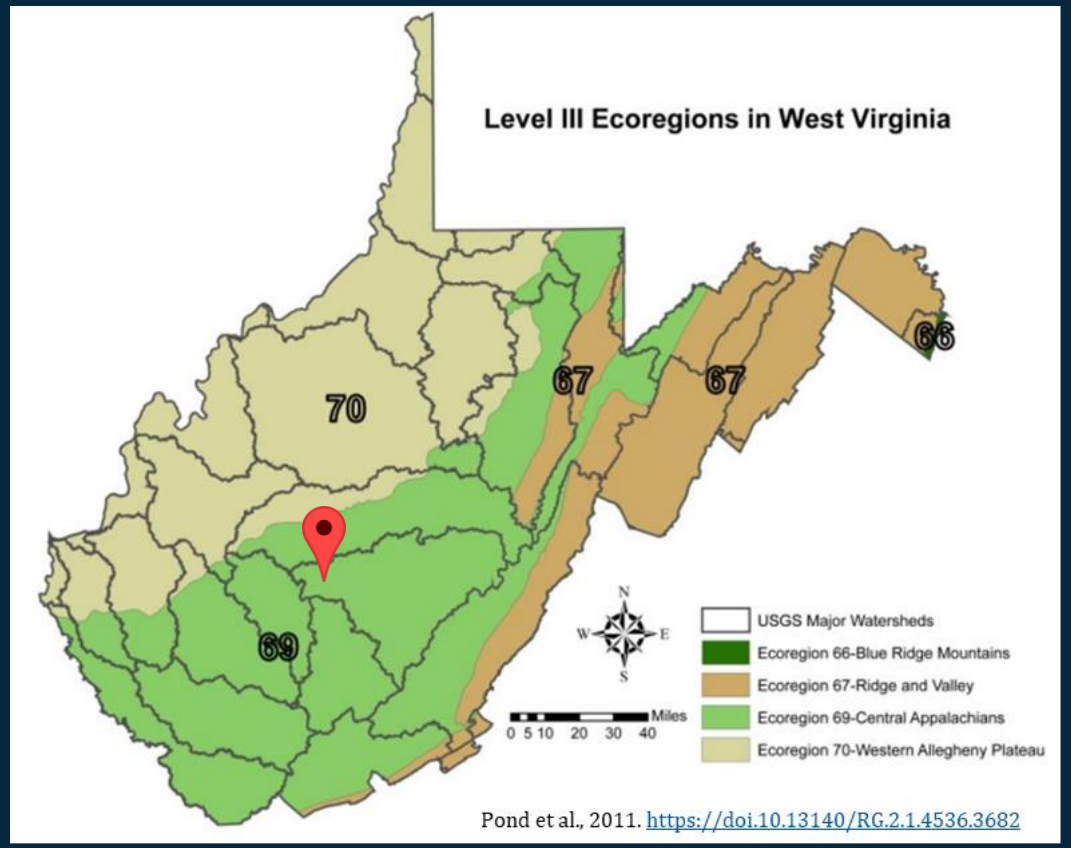
Research Objectives:

Evaluate long-term impacts of MTR-VF on spatial and temporal hydrochemistry trends in headwater streams

Evaluate impact of in-stream sediment ponds on hydrochemistry trends in headwater streams

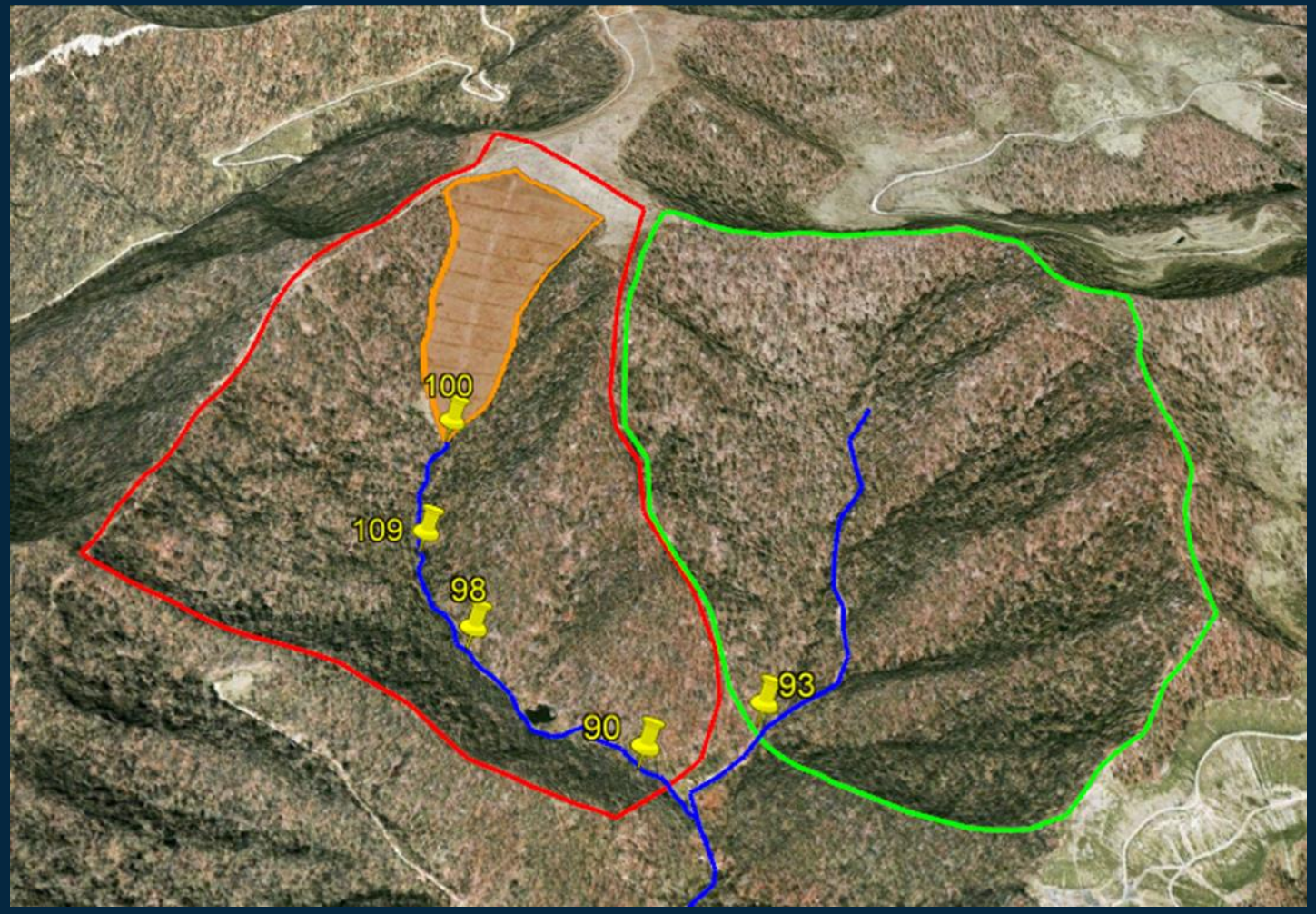
Swiss, WV Site





Pond et al., 2011. https://doi.10.13140/RG.2.1.4536.3682

Swiss, WV Site



1988 – 1993: Mining activity

1996: Reclamation completed

2005: Final bond release

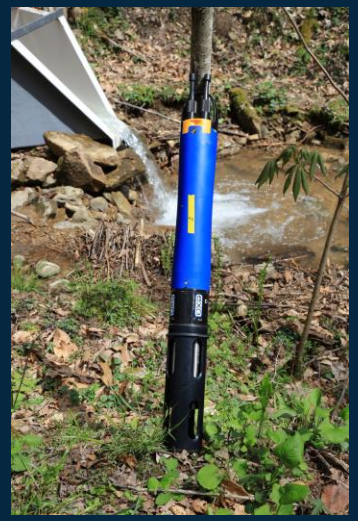
2019: Instrumented site

~ 30 years post reclamation

Field Data Collection & Sampling

Continuous Monitoring

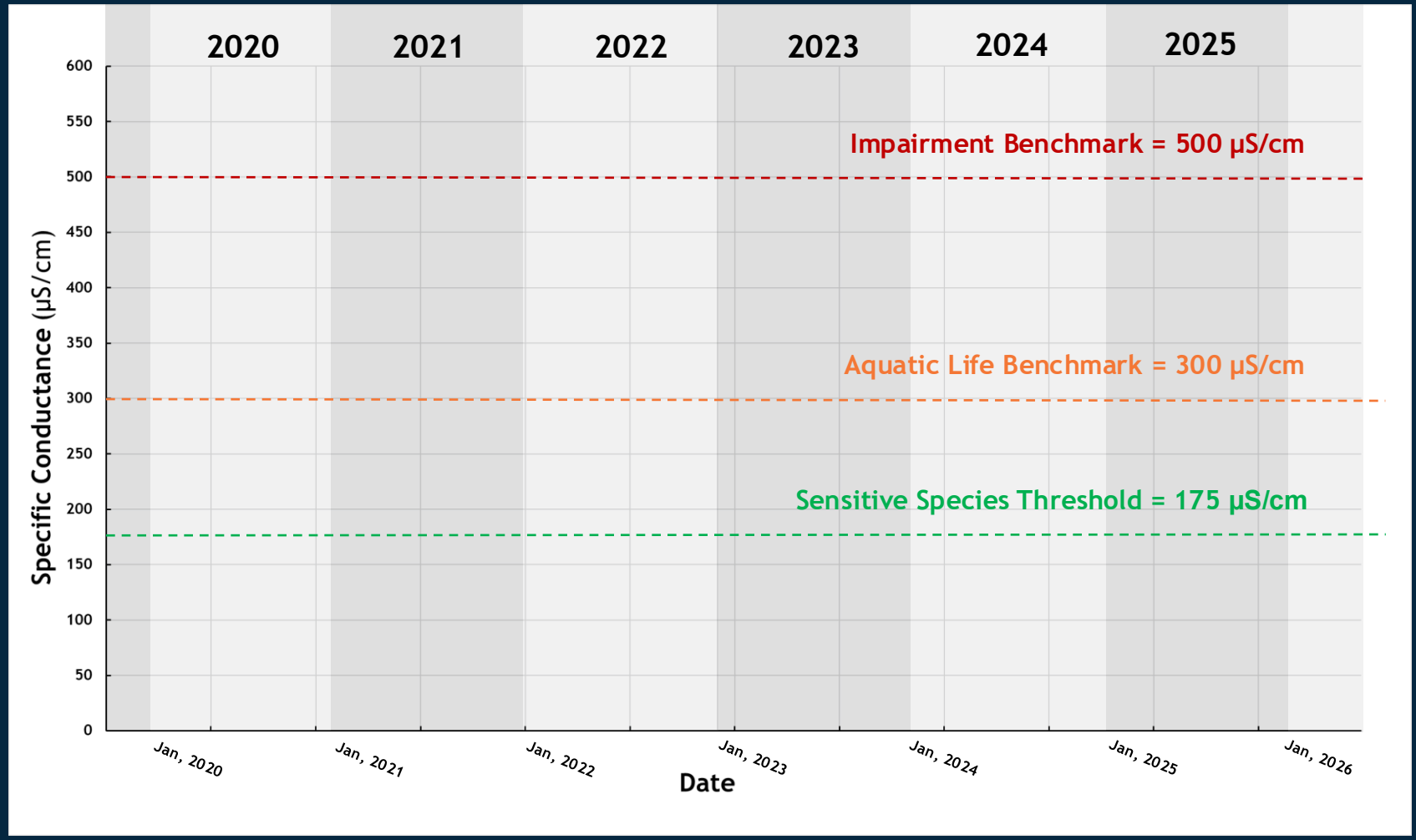
- Conductivity loggers
- Weather station
- Water chemistry (sonde)
- Level & bara loggers w/ flume

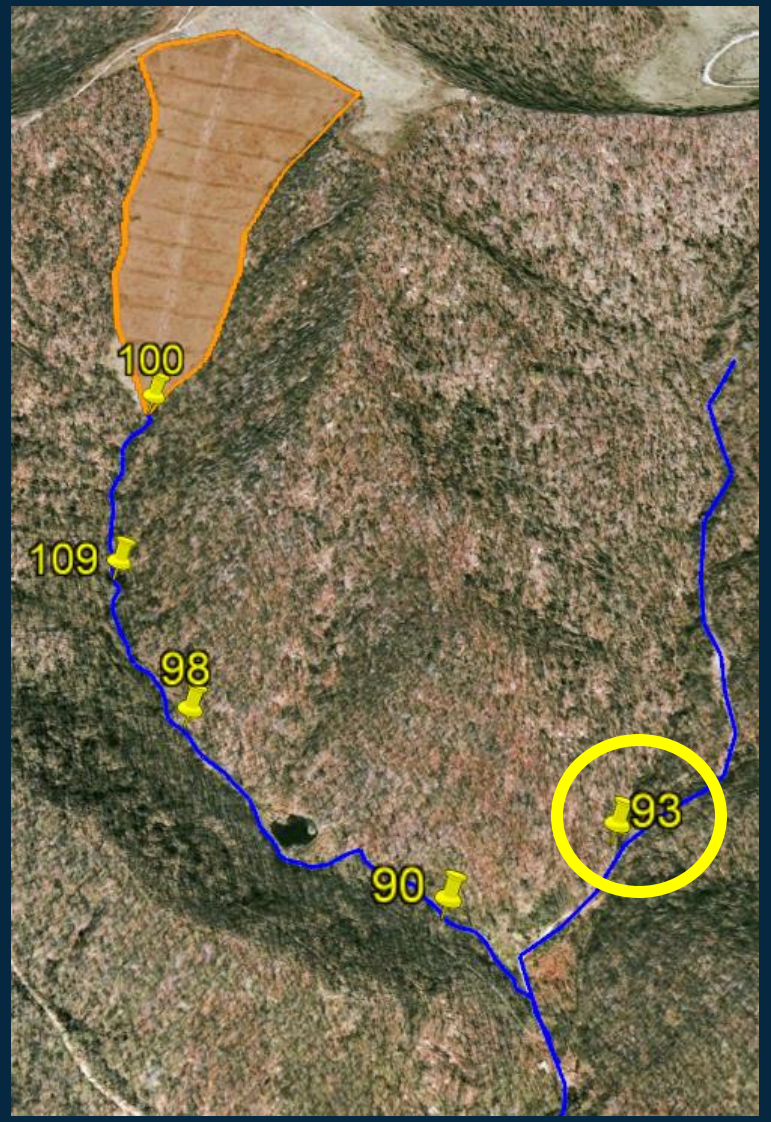


Grab Sampling

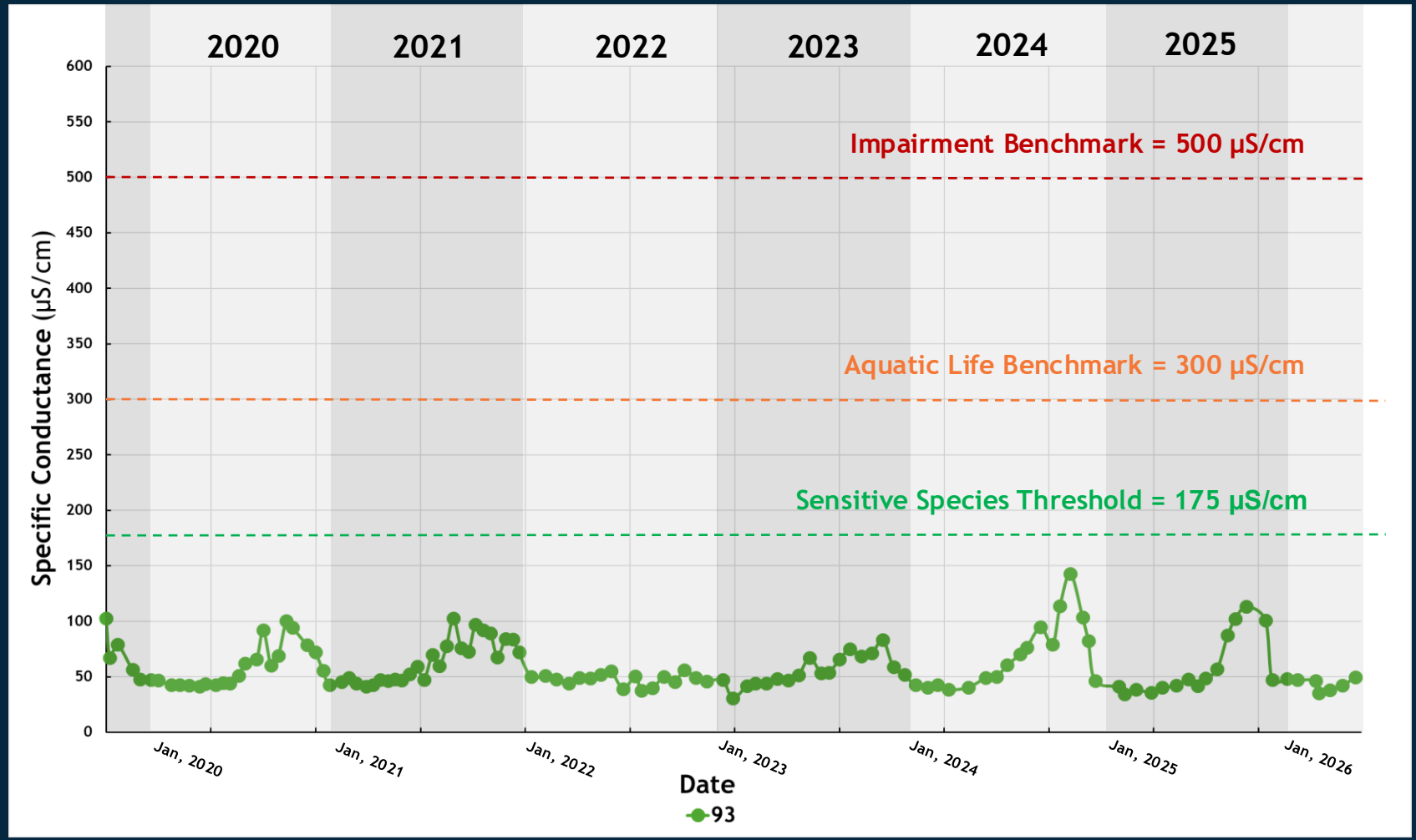
- Ionic composition, metal composition, TOC, & alkalinity
- In-situ measurements (YSI multiprobe)

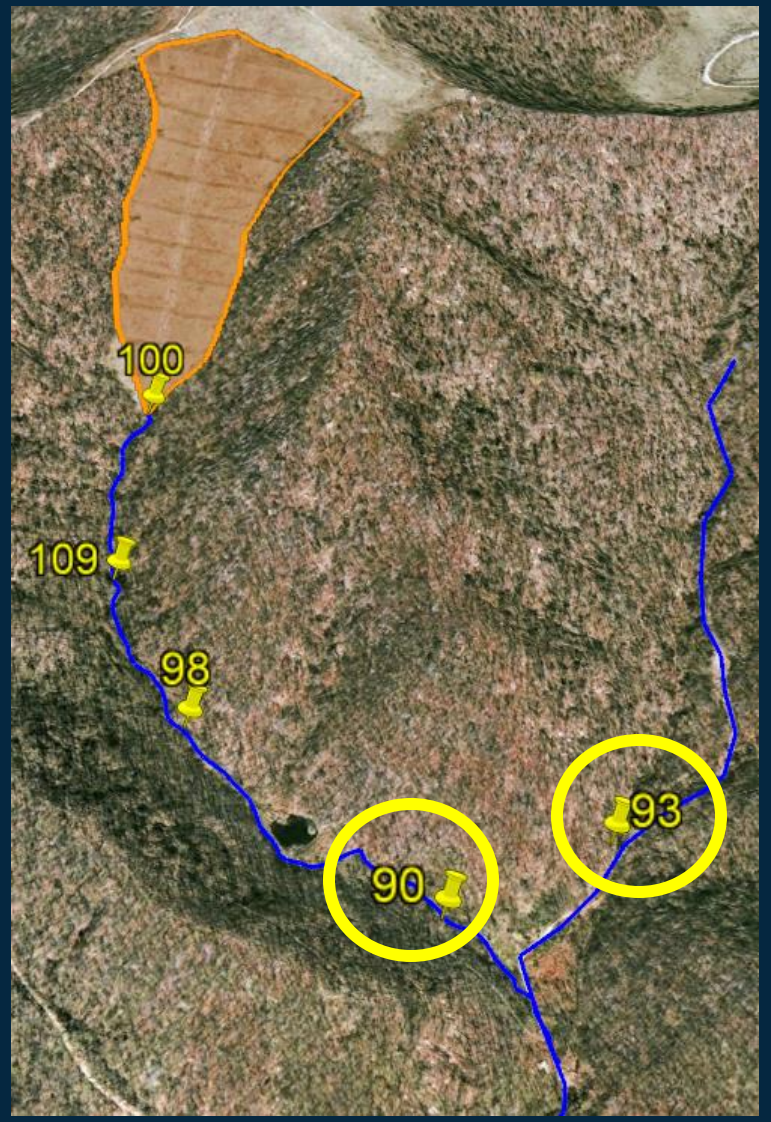
Spatio-temporal Analysis



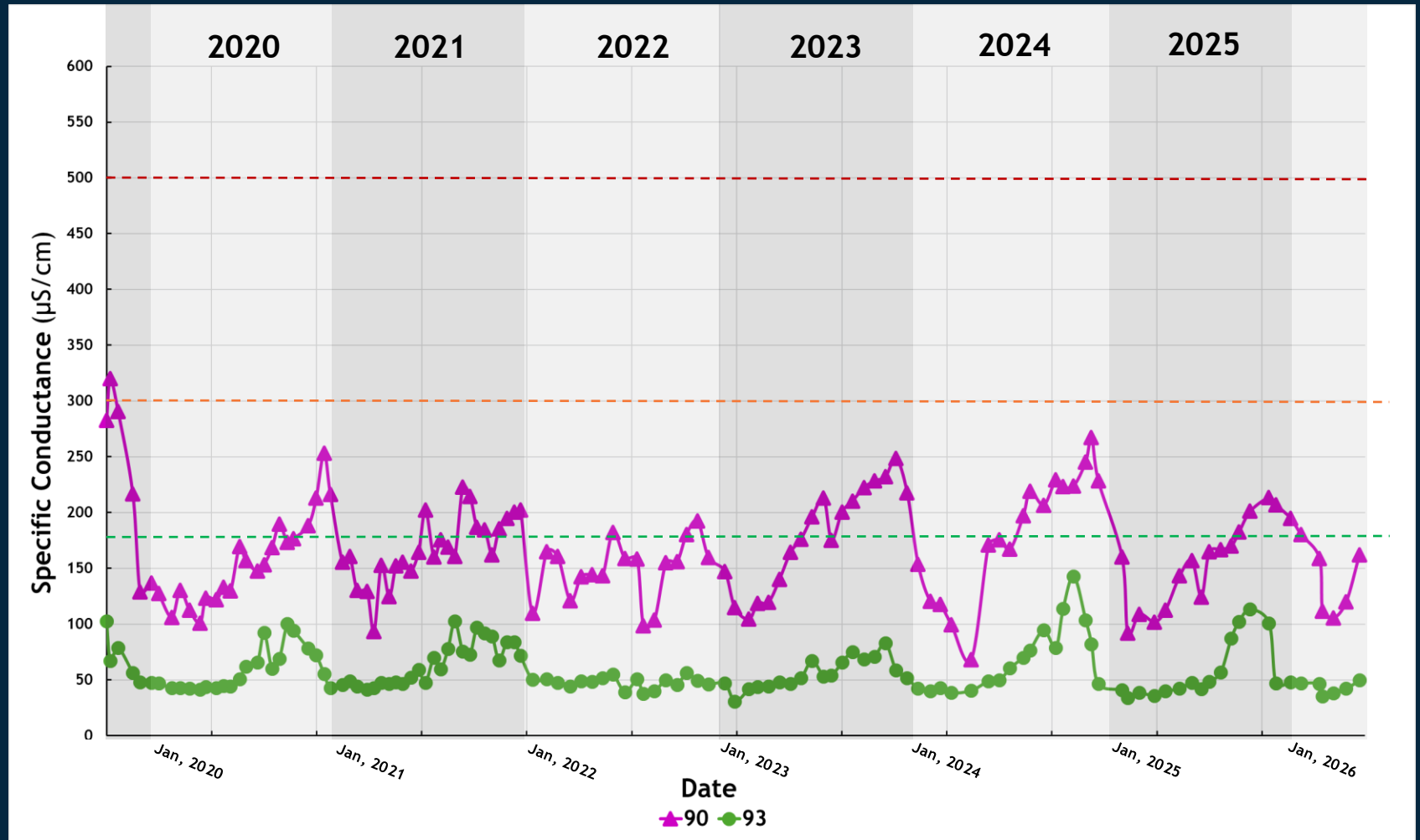


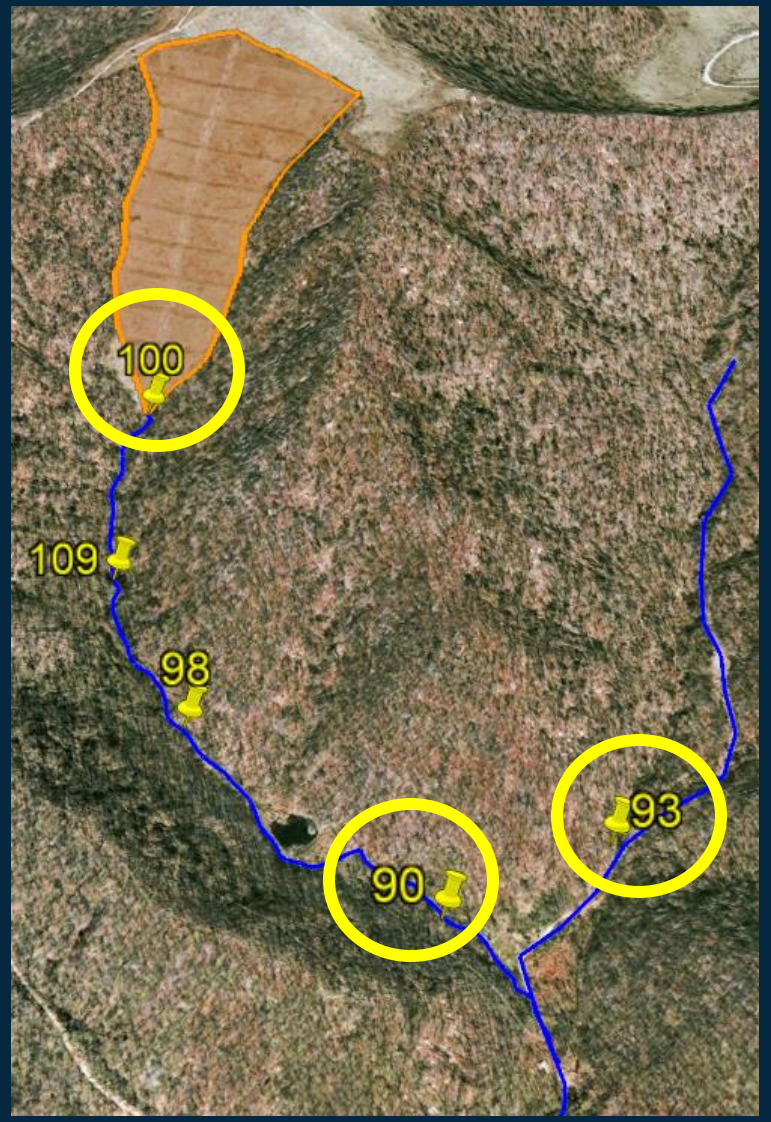
Undisturbed Stream



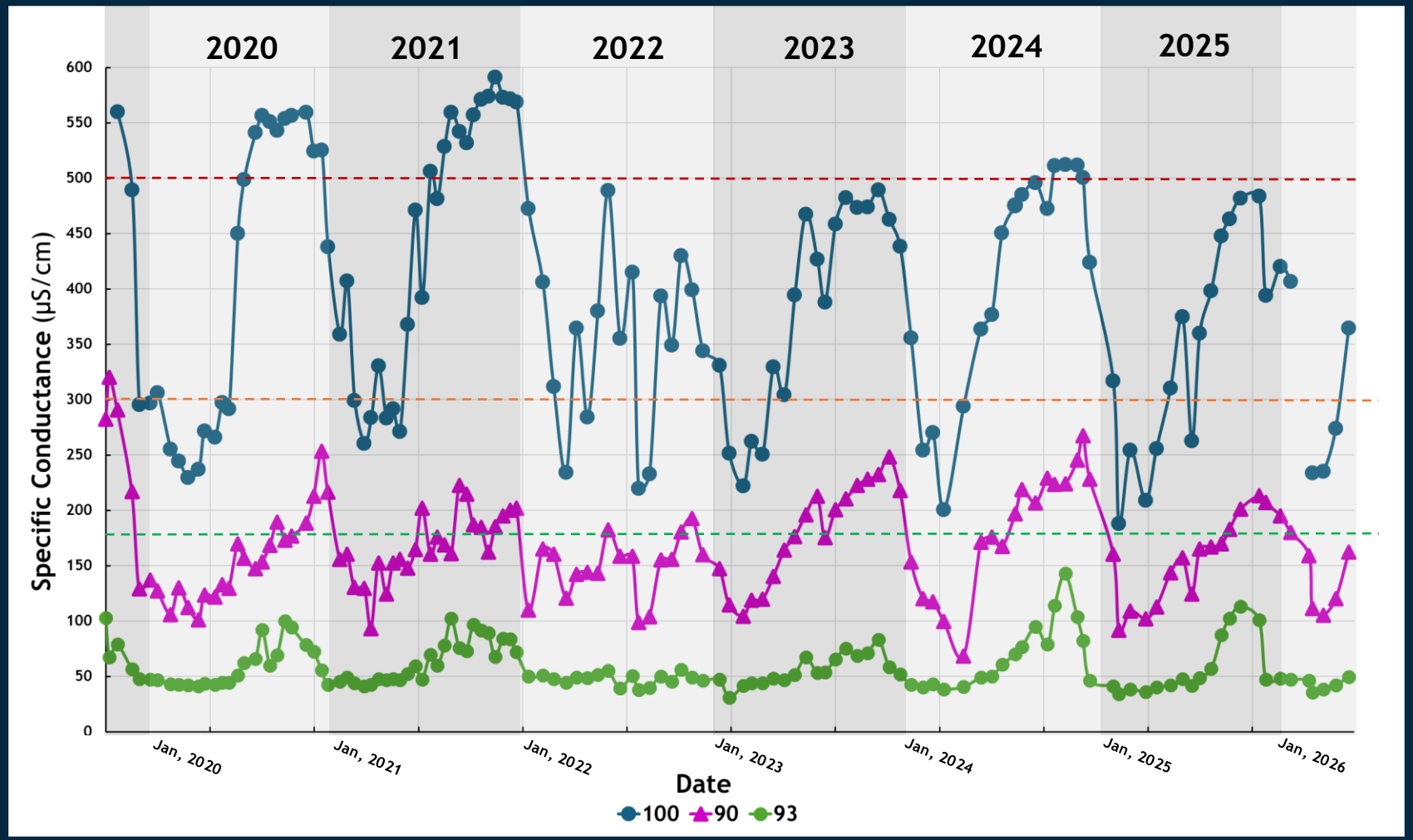


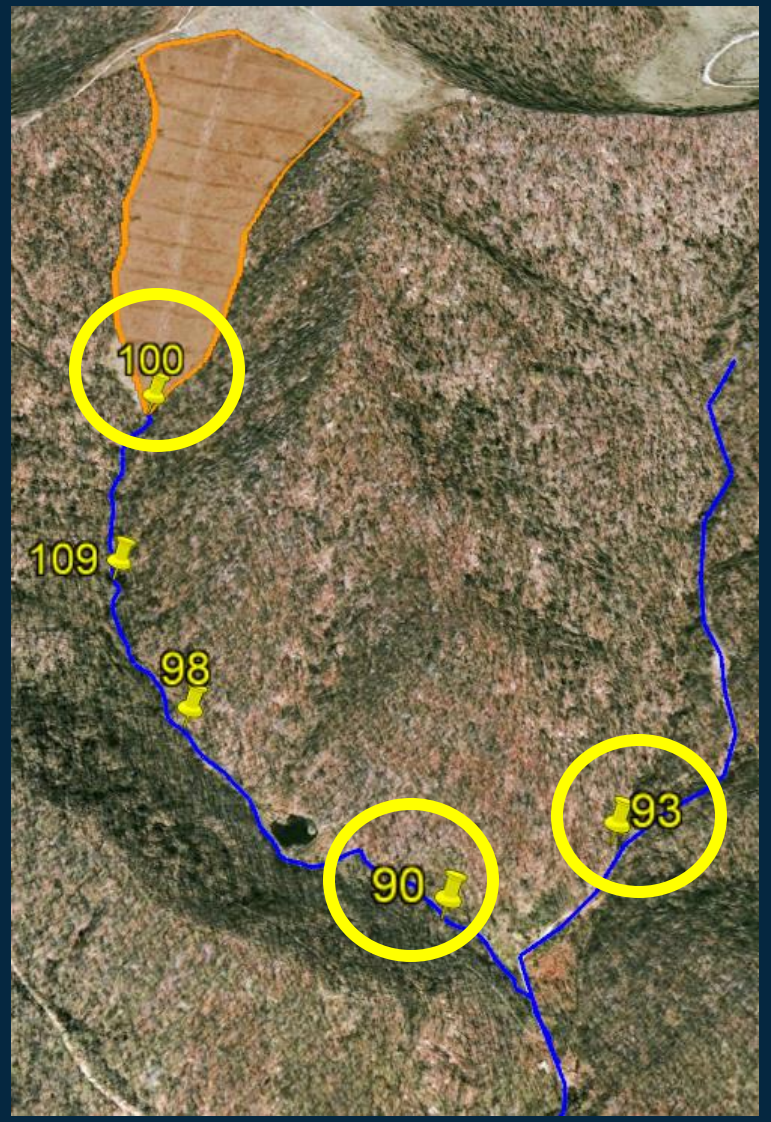
Undisturbed vs VF-impacted Stream





Undisturbed vs VF-impacted Stream





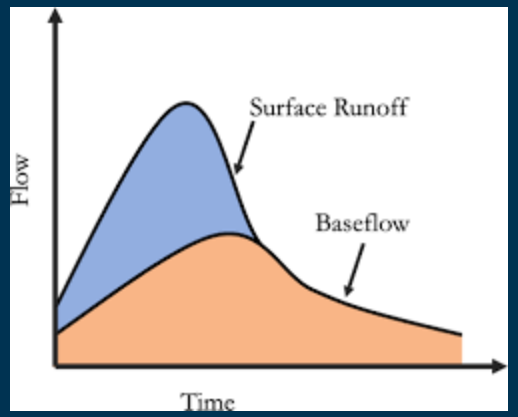
Two Main Components of Streamflow

Baseflow

- Stable source of streamflow
  - Sustains throughout year
- Gradual or minimal variation in flow and composition
- Groundwater discharge

Runoff

- Non-constant source of streamflow
- Quick or high variation in flow and composition
- Precipitation events
  - Surface event water
  - Direct stream infiltration



Hydrograph of a precipitation event with runoff and baseflow component contributions

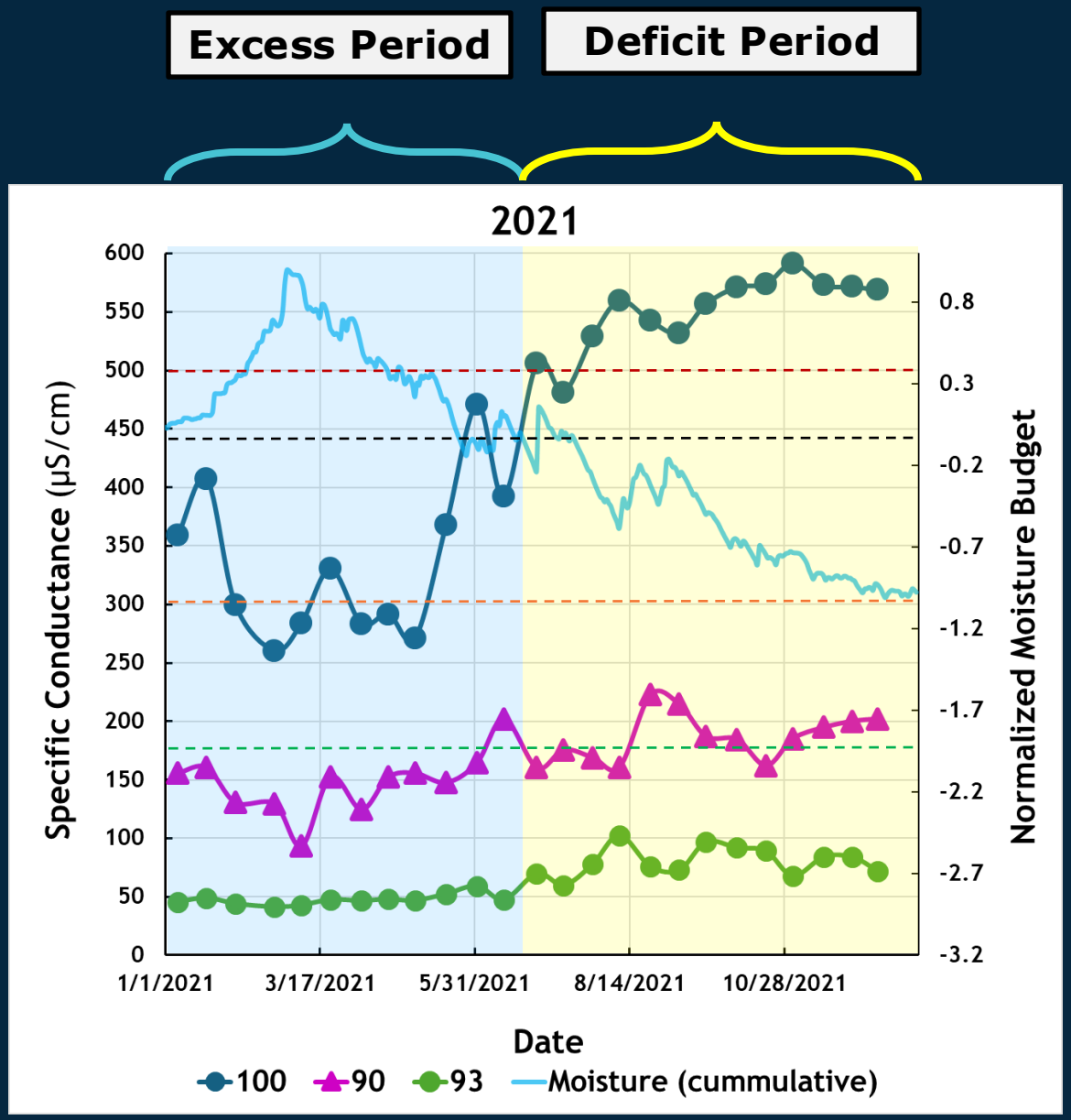
*** Precipitation Event → Runoff Inputs → Alters Stream Composition & Flow**

Moisture Budget

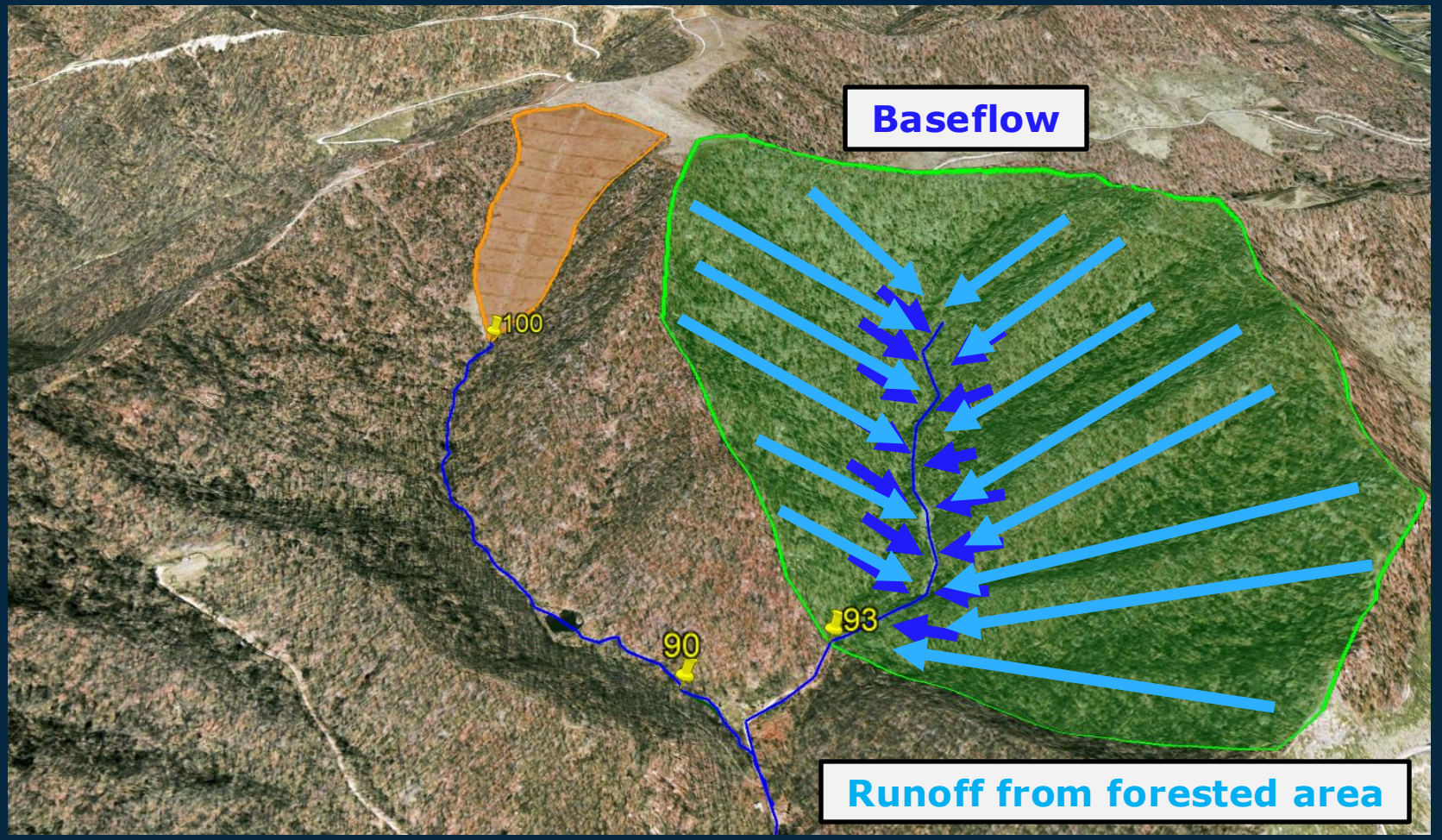
$$MB_{cumm.i} = \sum_{i=x}^{x-1}(P_i - ET_i)$$

P = daily precipitation (mm)
ET = daily evapotranspiration (mm)
i = calendar Julian day

- Moisture availability changes seasonally
- Excess period → Runoff dominance
- Deficit period → Baseflow dominance



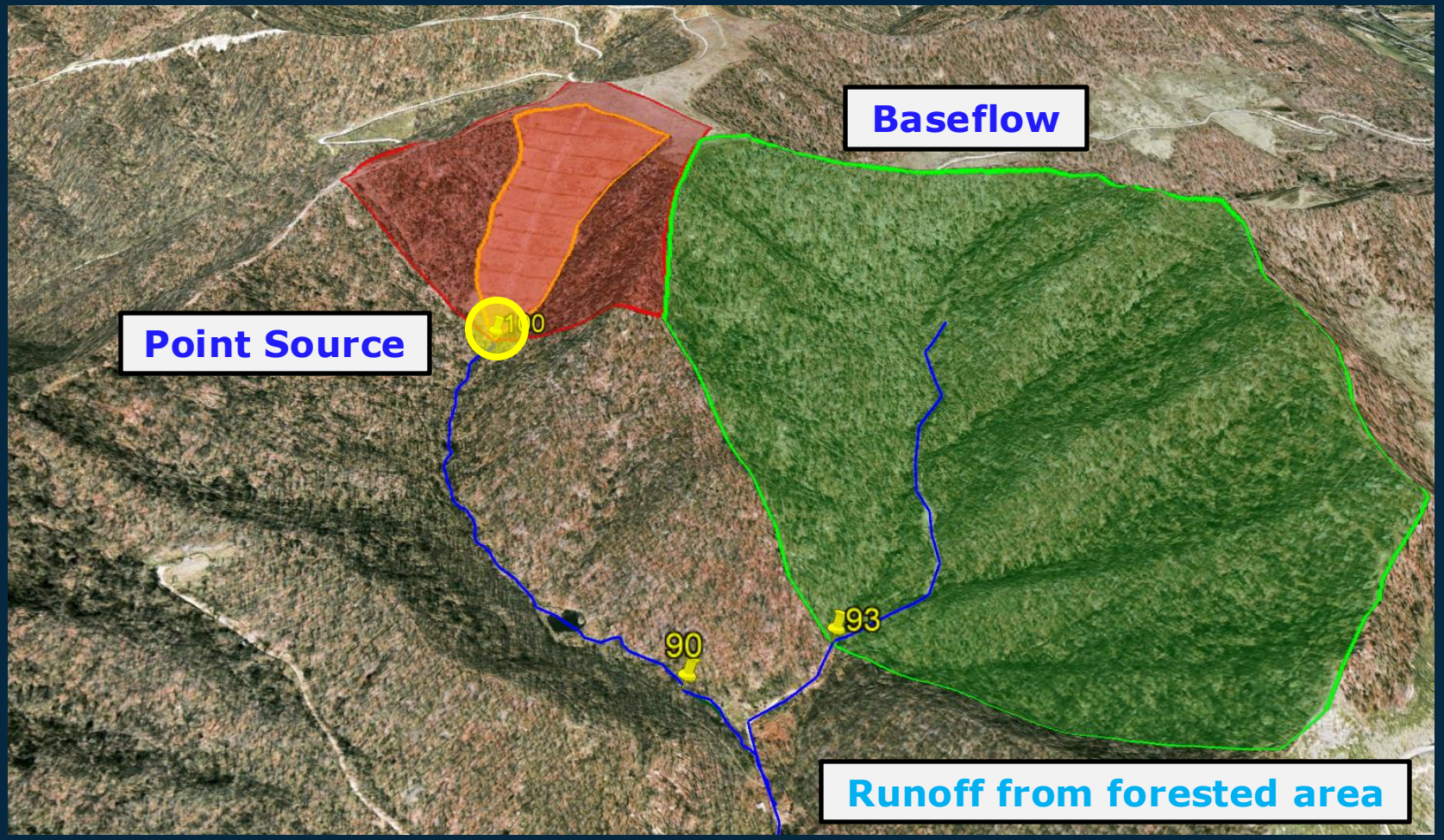
Undisturbed vs VF-impacted Stream

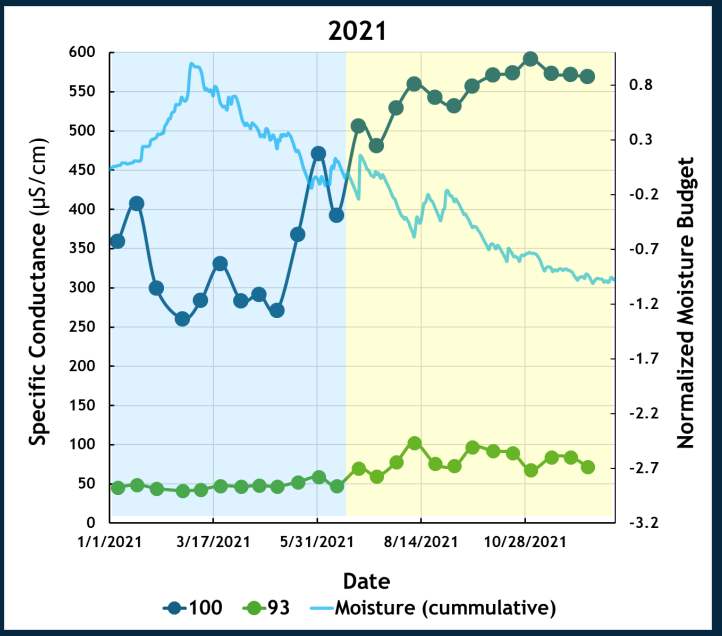


- **Location 93:**

  Baseflow TDS ≈ Runoff TDS

Undisturbed vs VF-impacted Stream





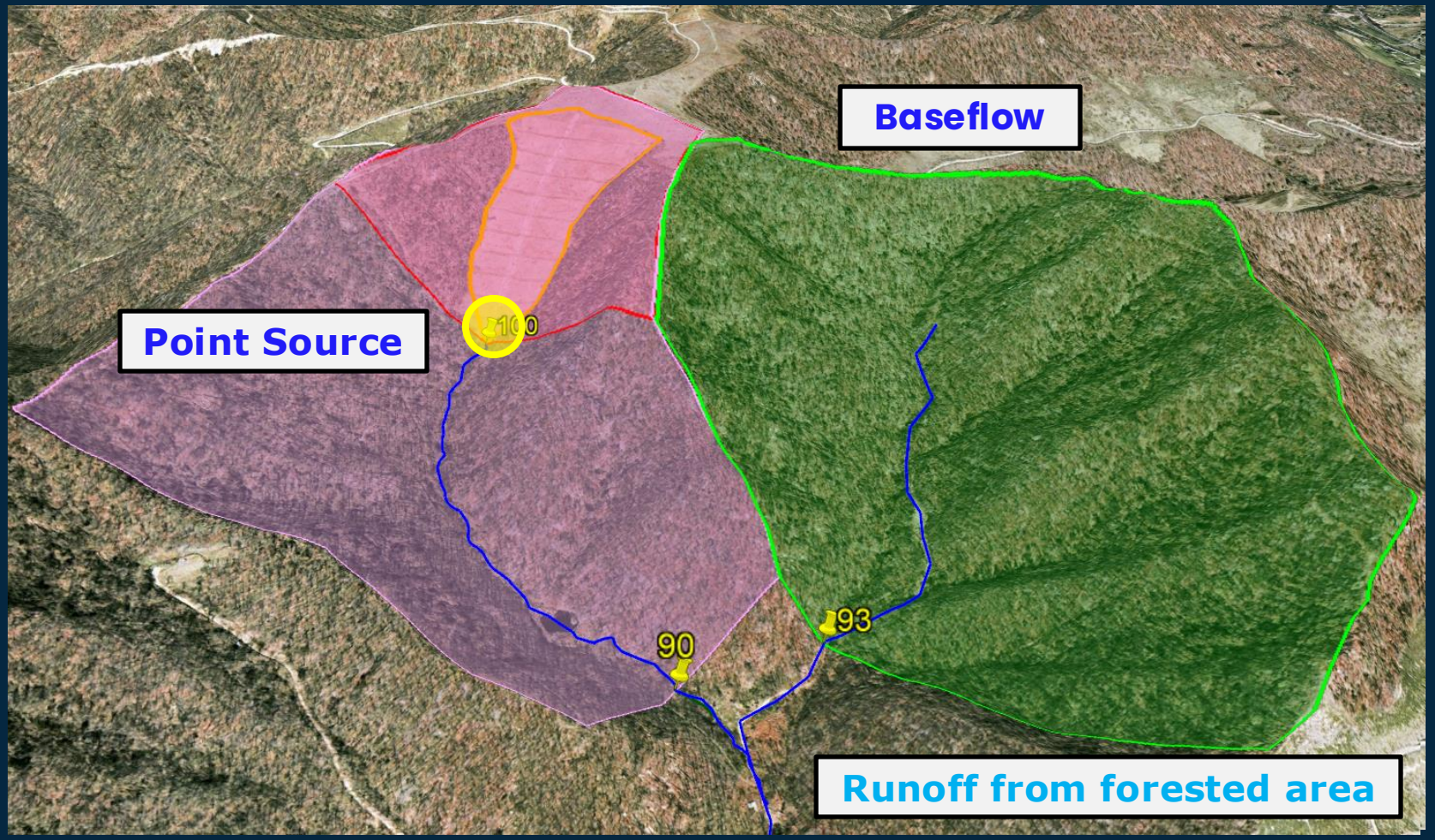
- **Location 93:**

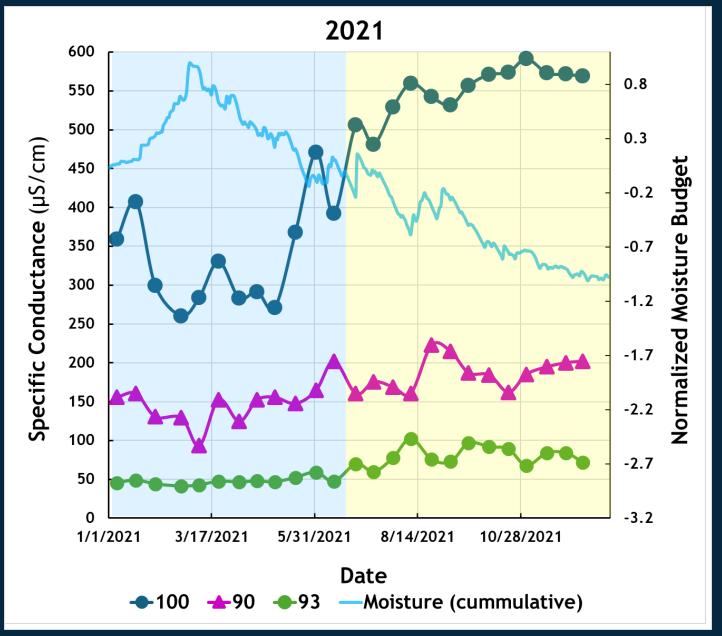
  Baseflow TDS ≈ Runoff TDS

- **Location 100:**

  Baseflow TDS > Runoff TDS

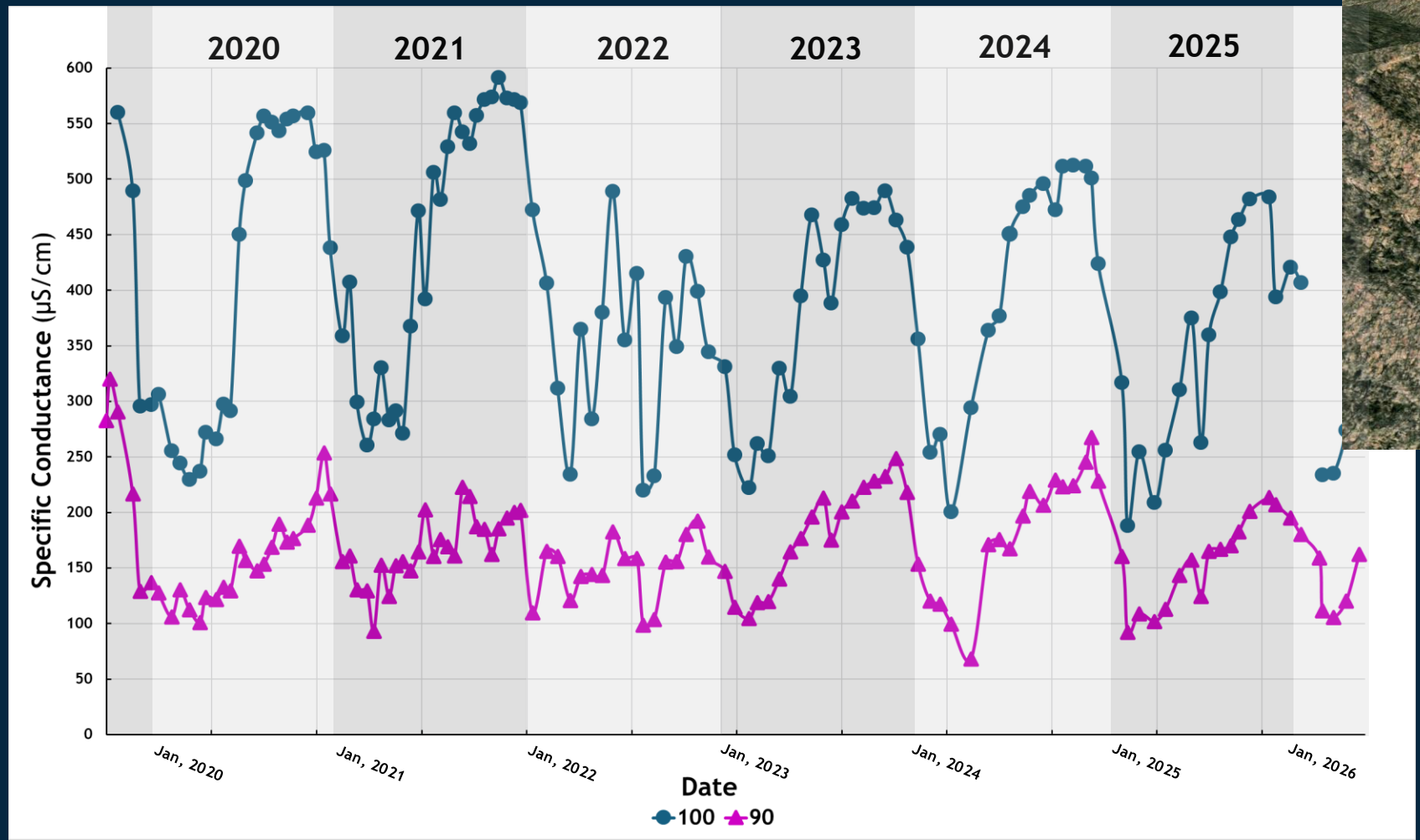
Undisturbed vs VF-impacted Stream



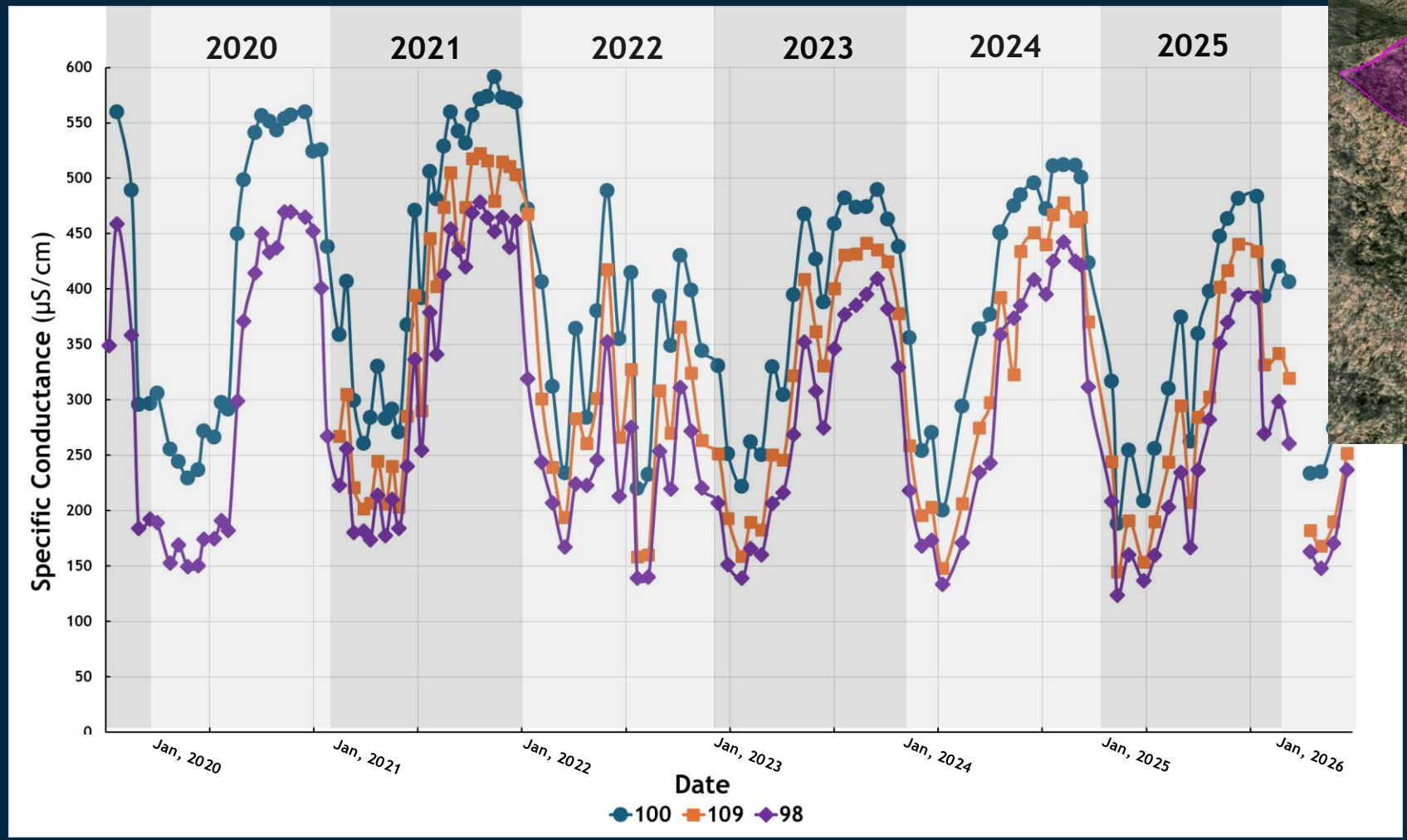


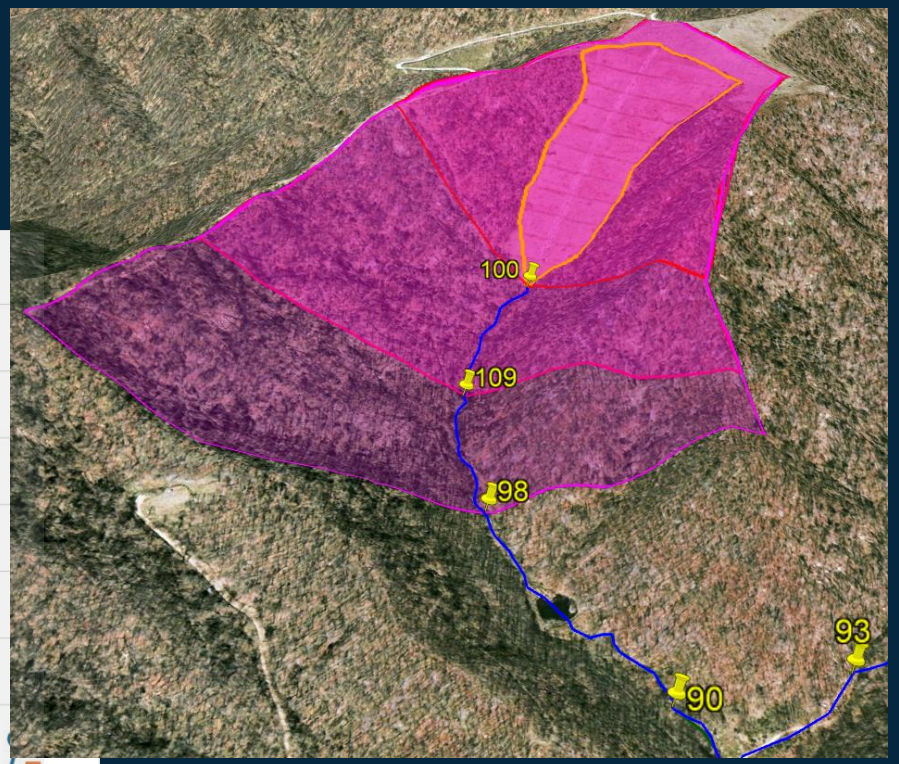
- **Location 93:**
  Baseflow TDS ≈ Runoff TDS
- **Location 100:**
  Baseflow TDS > Runoff TDS
- **Location 90:**
  Baseflow TDS ≈ Runoff TDS
- **Why is there less seasonal fluctuation at location 90?**

VF-impacted Stream

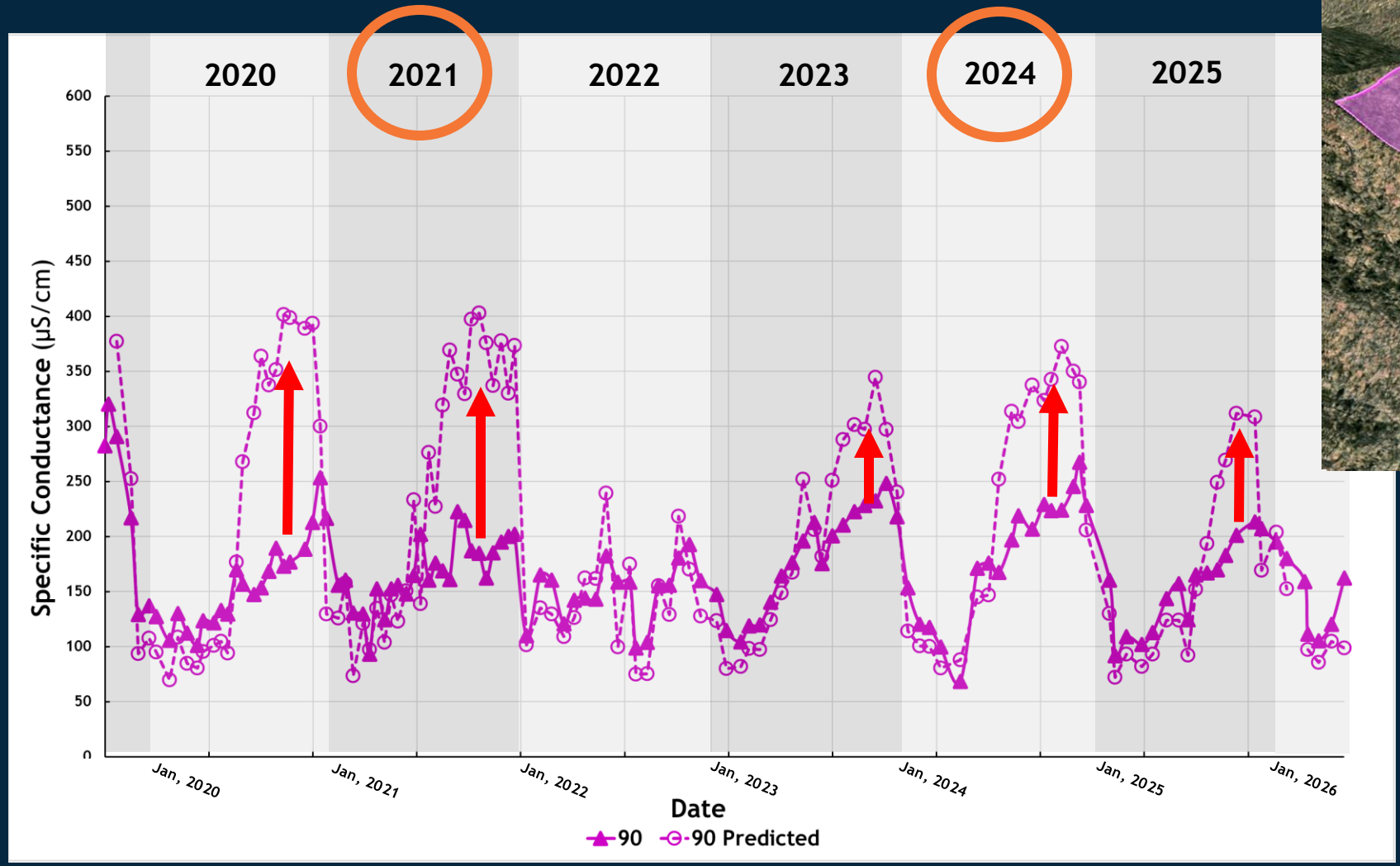


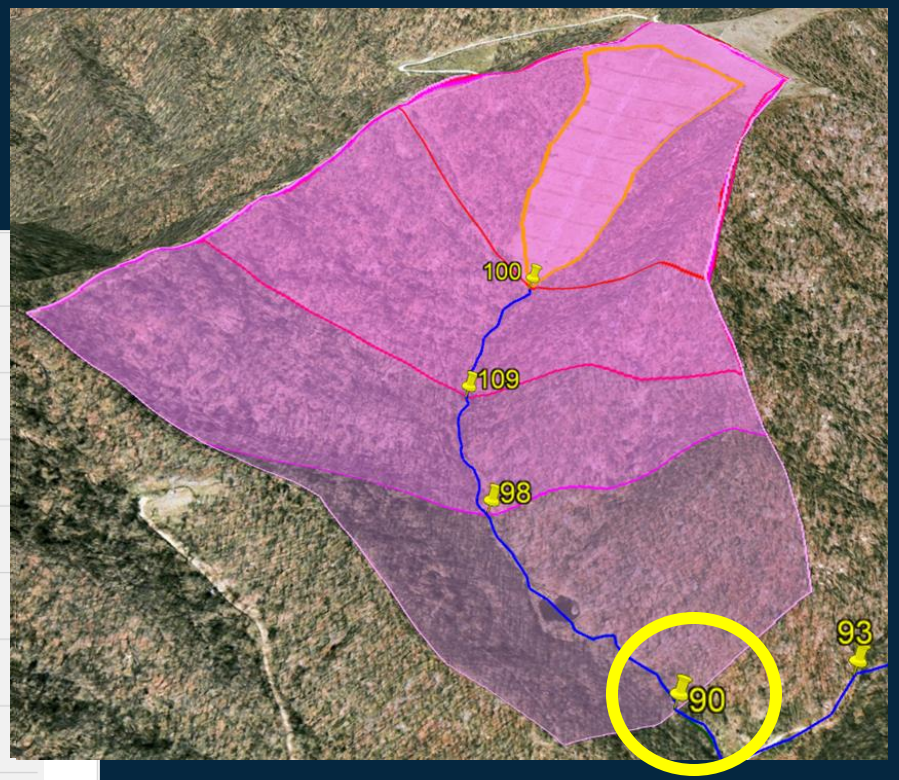
VF-impacted Stream





Location 90


2020
2021
2022
2023
2024
2025
Specific Conductance (µS/cm)
600
550
500
450
400
350
300
250
200
150
100
50
0
Jan, 2020
Jan, 2021
Jan, 2022
Jan, 2023
Jan, 2024
Jan, 2025
Jan, 2026
Date
90
90 Predicted

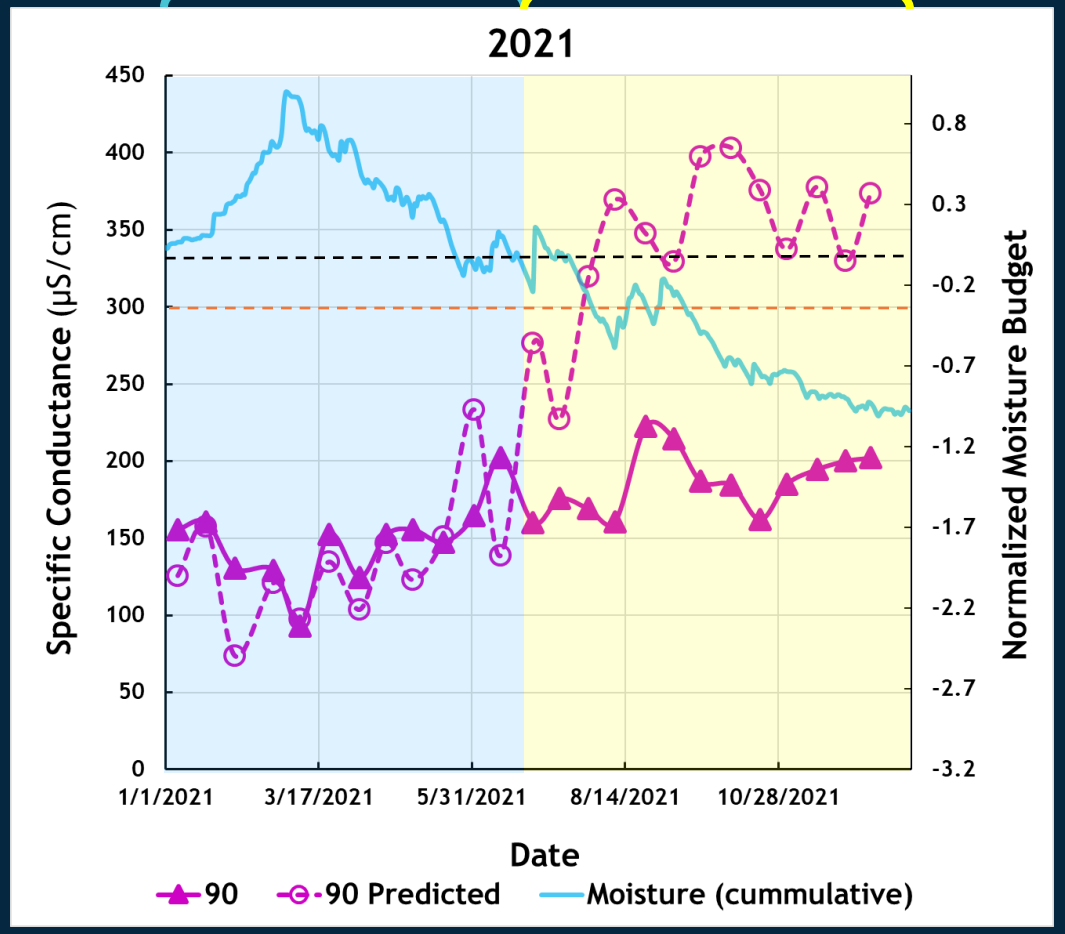

100
109
98
90
93

Location 90 Moisture Availability

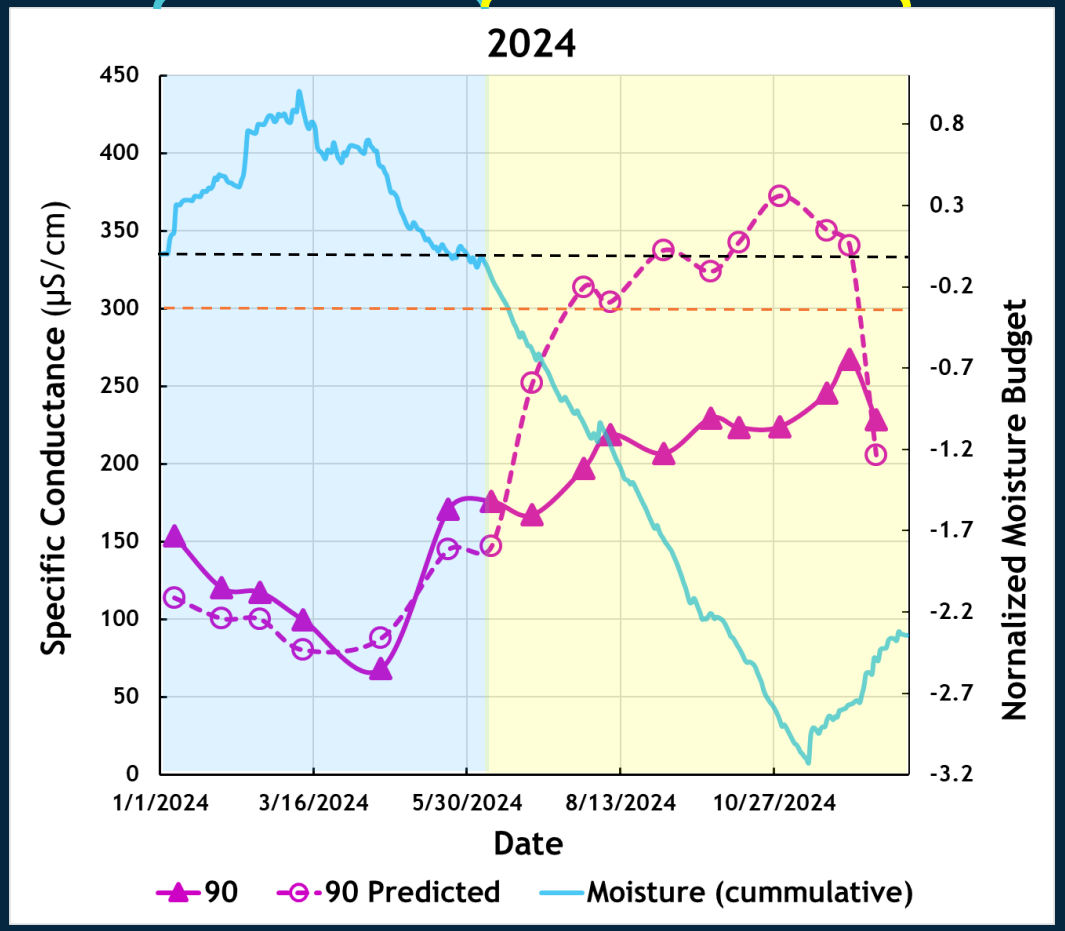
$$MB_{cumm.i} = \sum_{i=x}^{x-1}(P_i - ET_i)$$

P = daily precipitation (mm)
ET = daily evapotranspiration (mm)
i = calendar Julian day

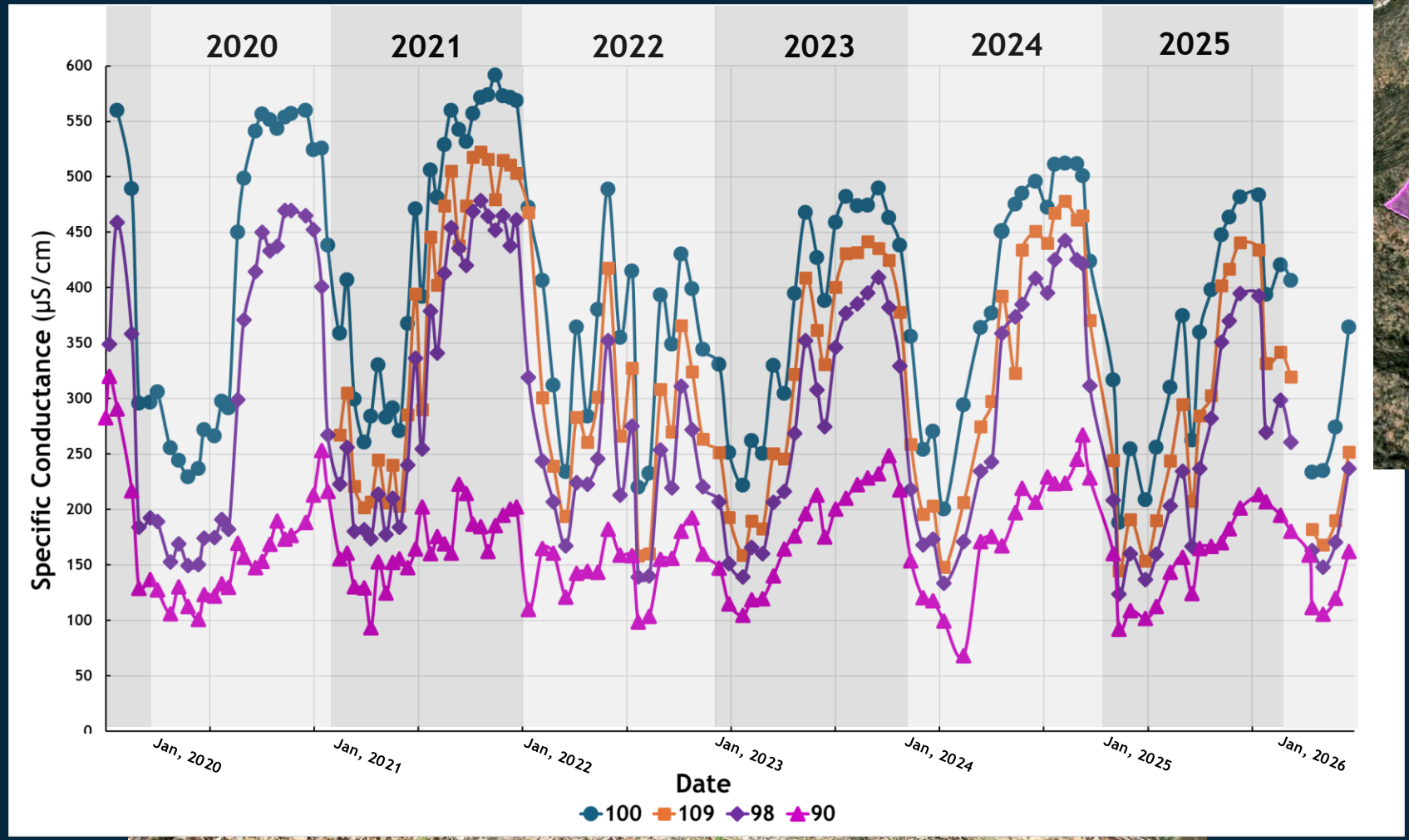
Excess Period | Deficit Period

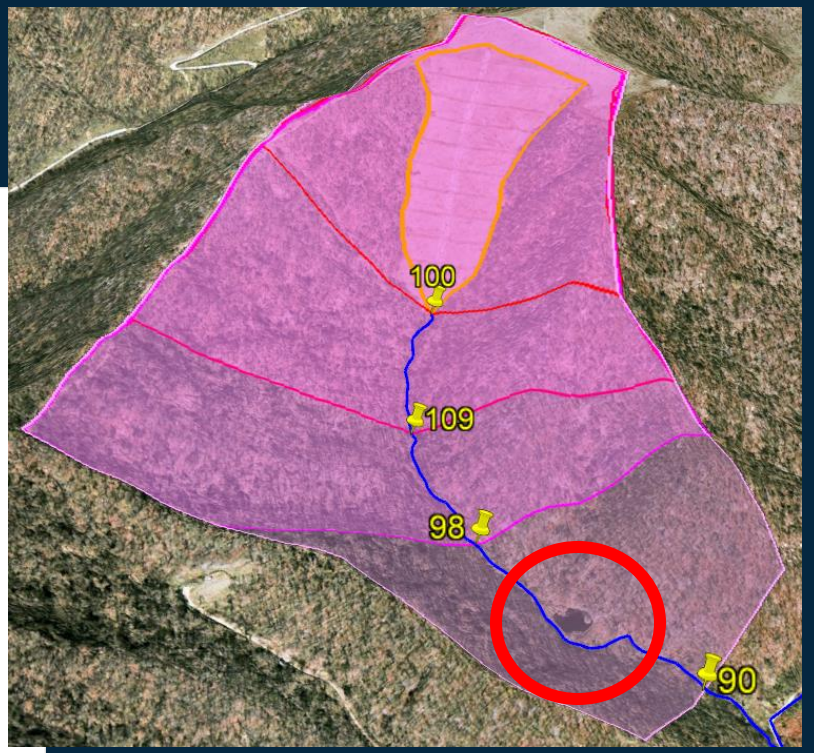


Excess Period | Deficit Period

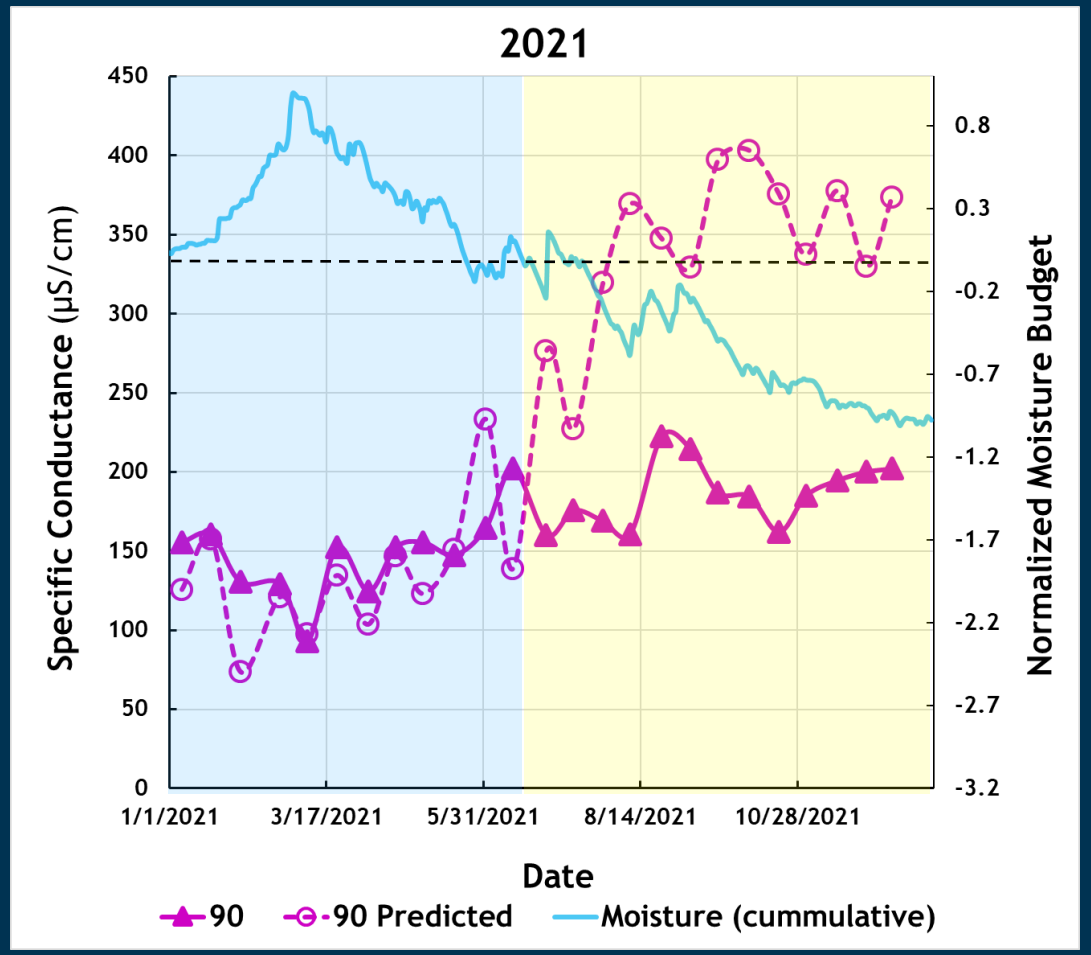


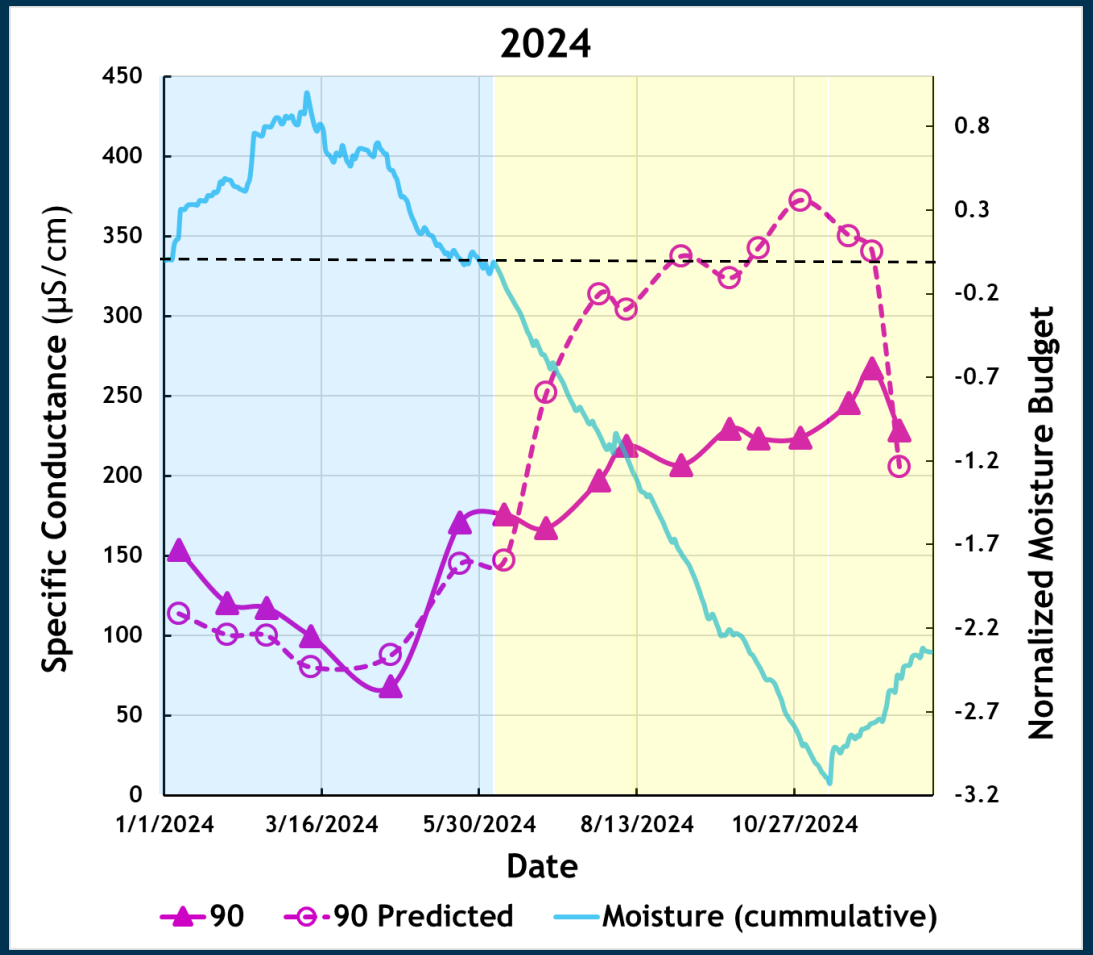
Why?


2020
2021
2022
2023
2024
2025
Specific Conductance (µS/cm)
600
550
500
450
400
350
300
250
200
150
100
50
0
Jan, 2020
Jan, 2021
Jan, 2022
Jan, 2023
Jan, 2024
Jan, 2025
Jan, 2026
Date
100
109
98
90

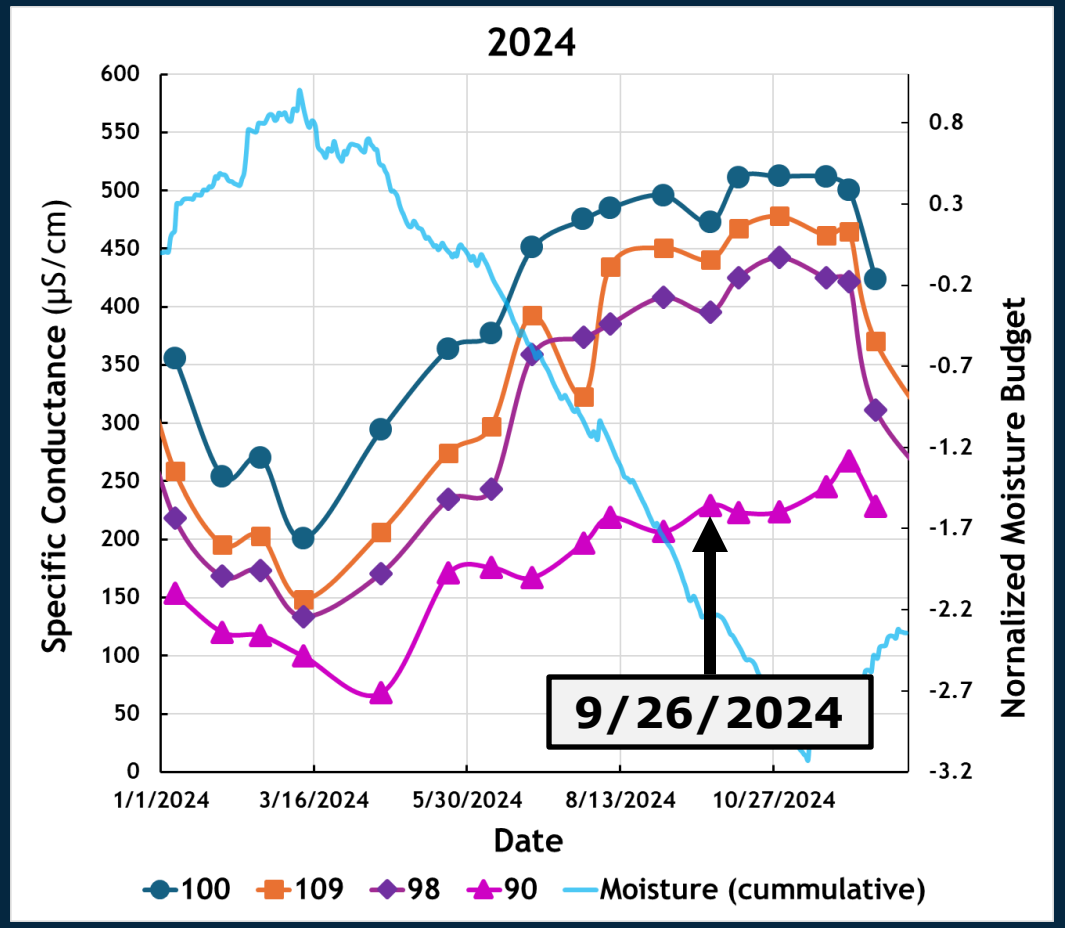

100
109
98
90

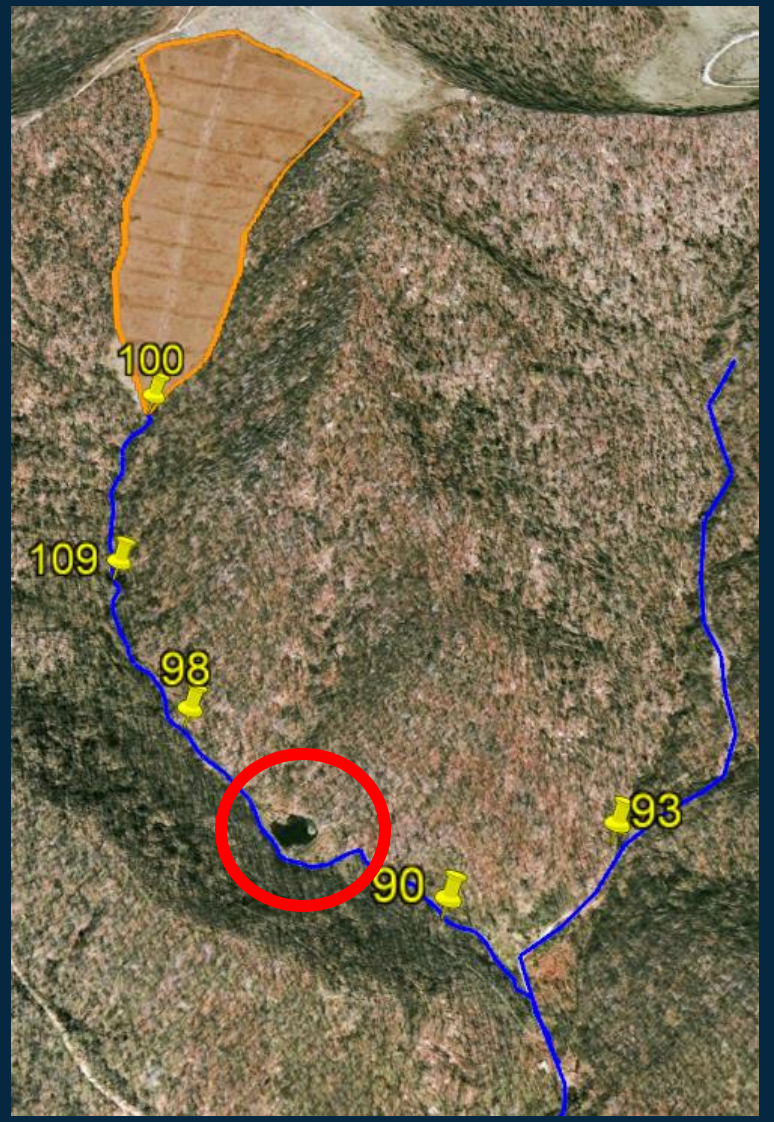
Proposed Pond Effect



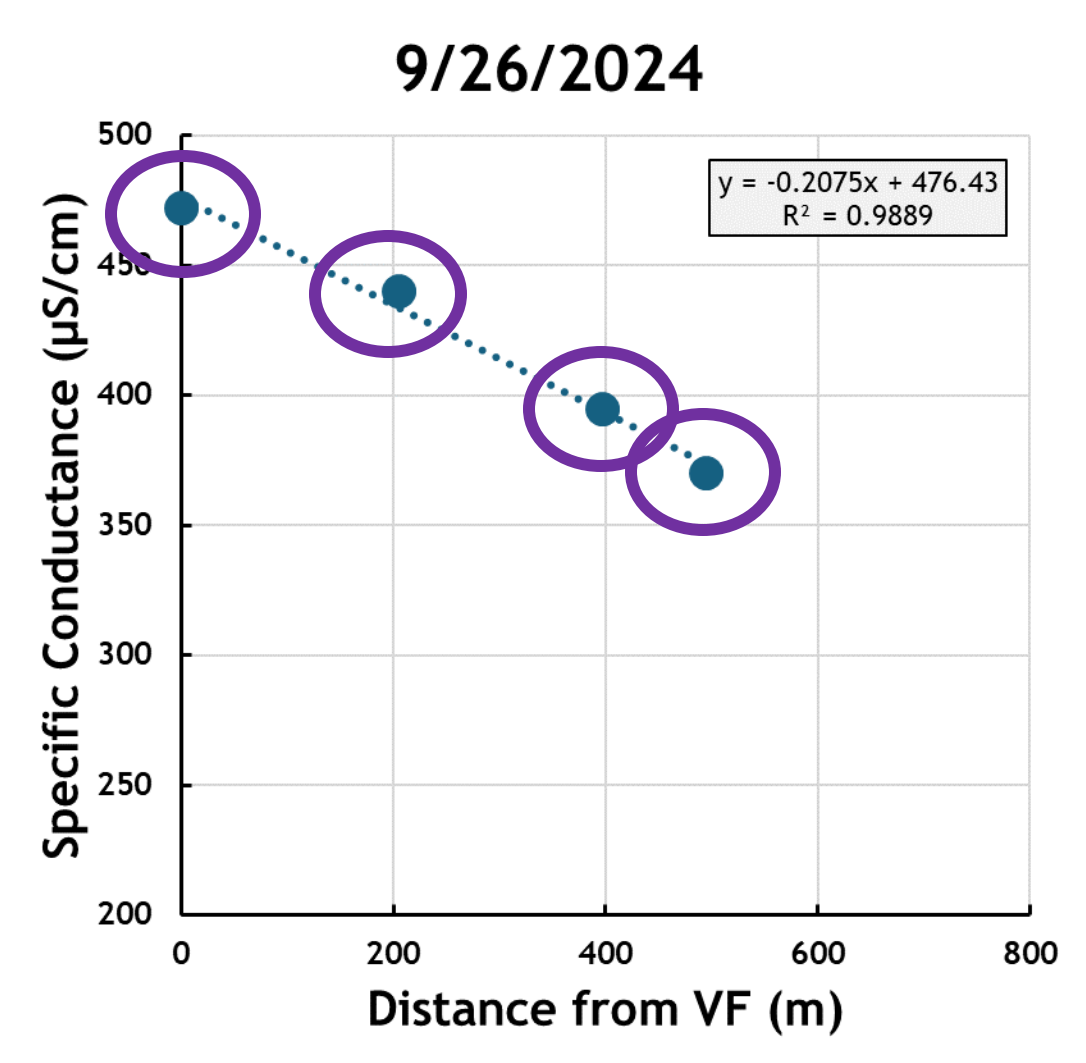


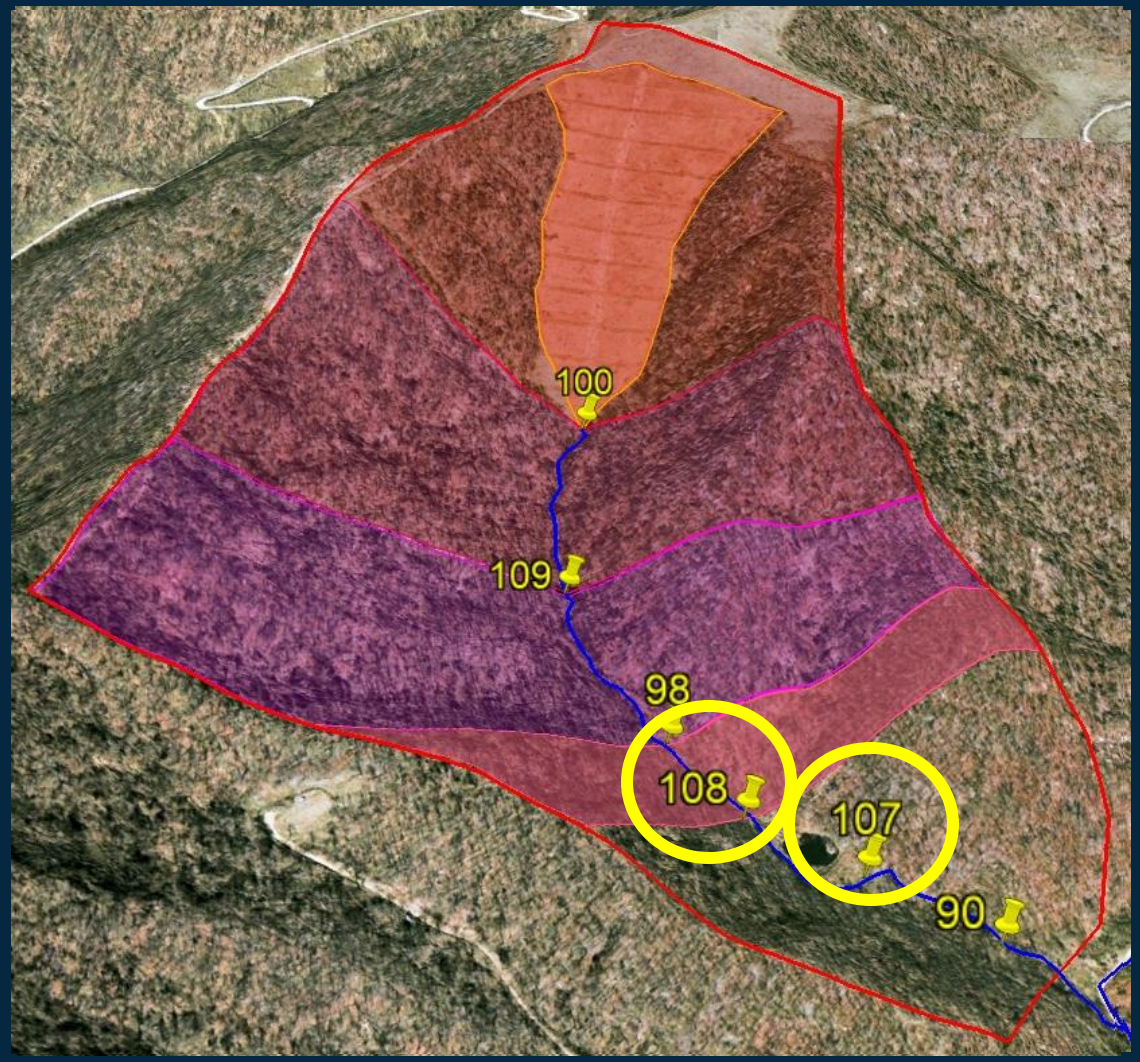
Seasonal Attenuation



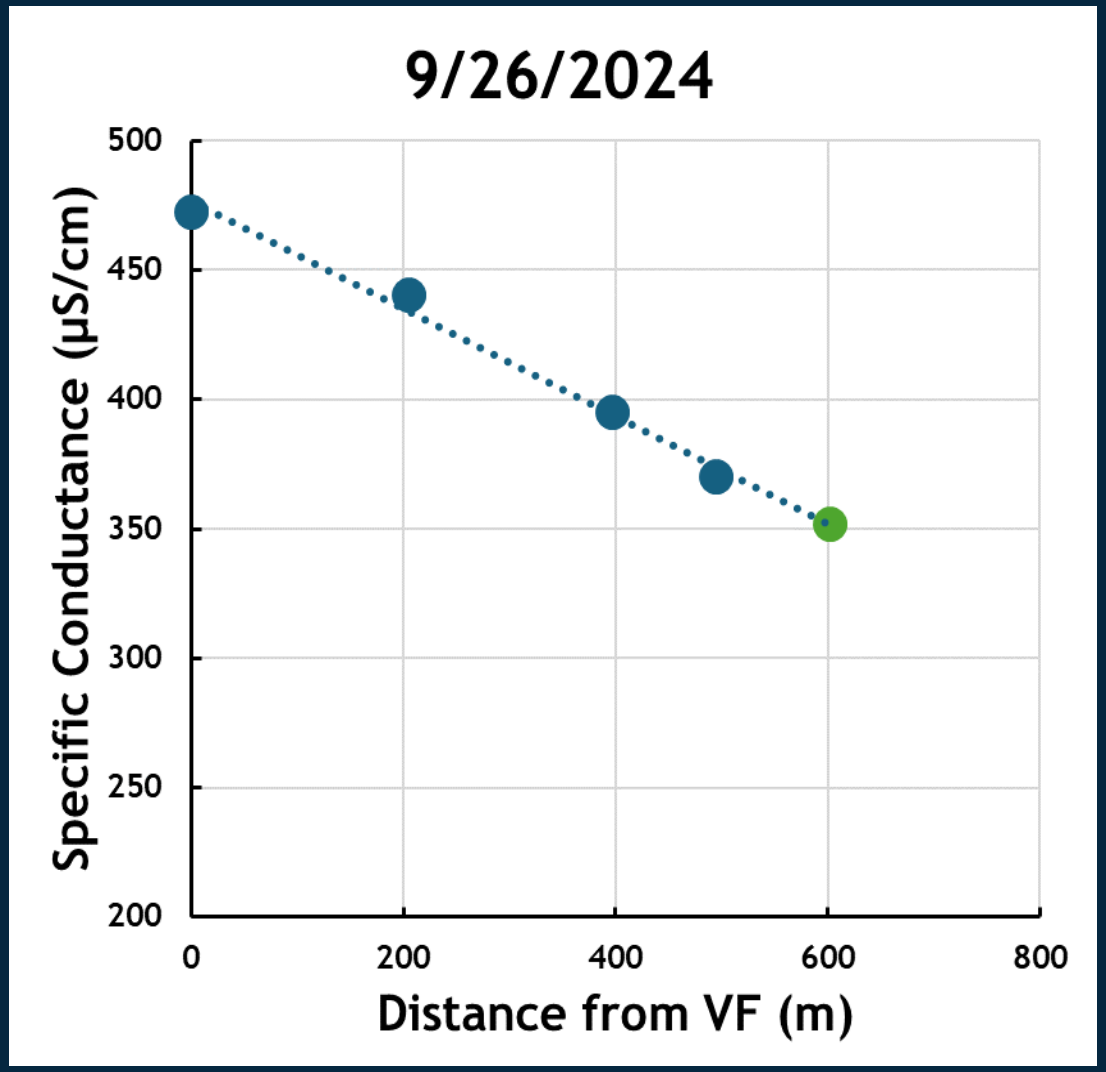


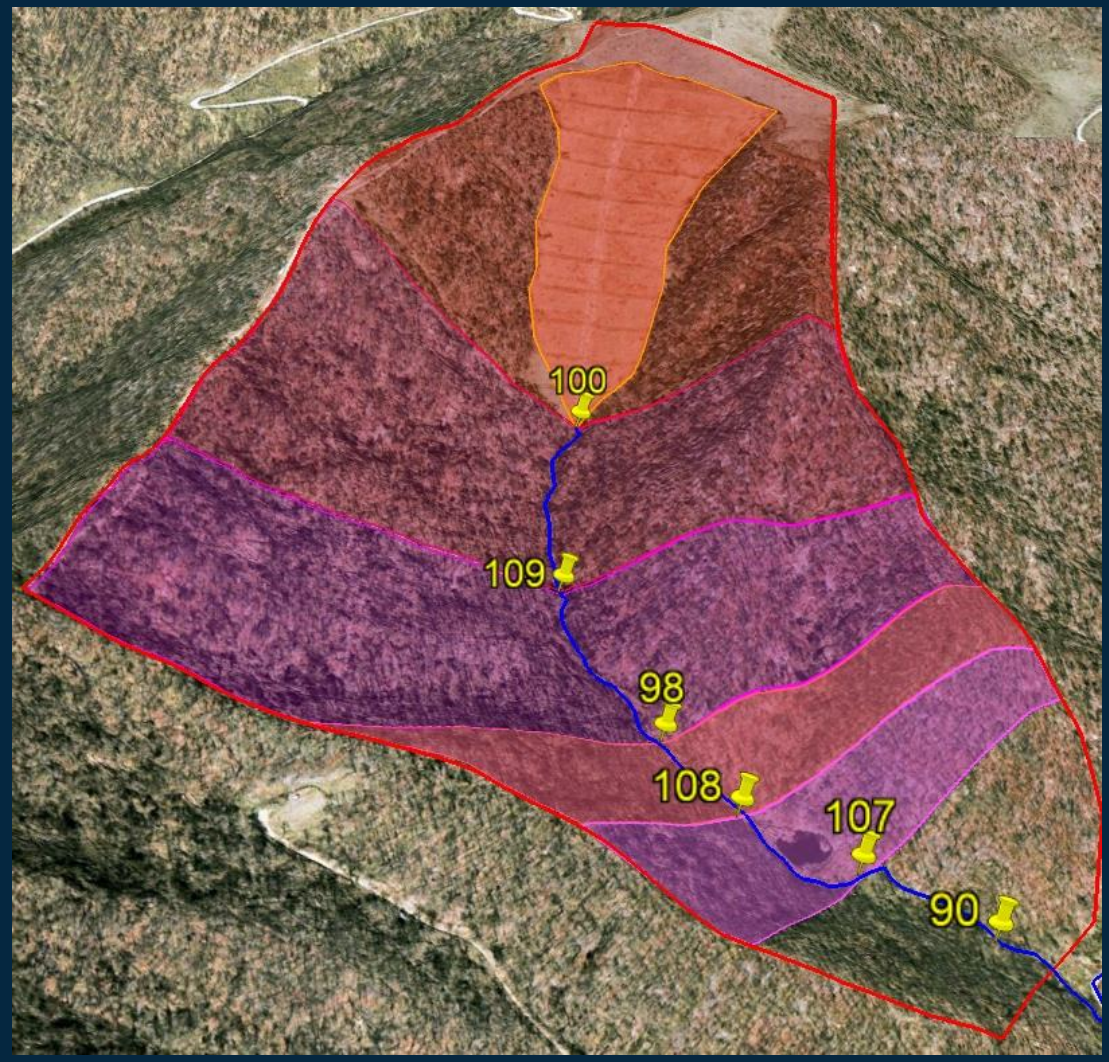
Swiss Pond Disruption



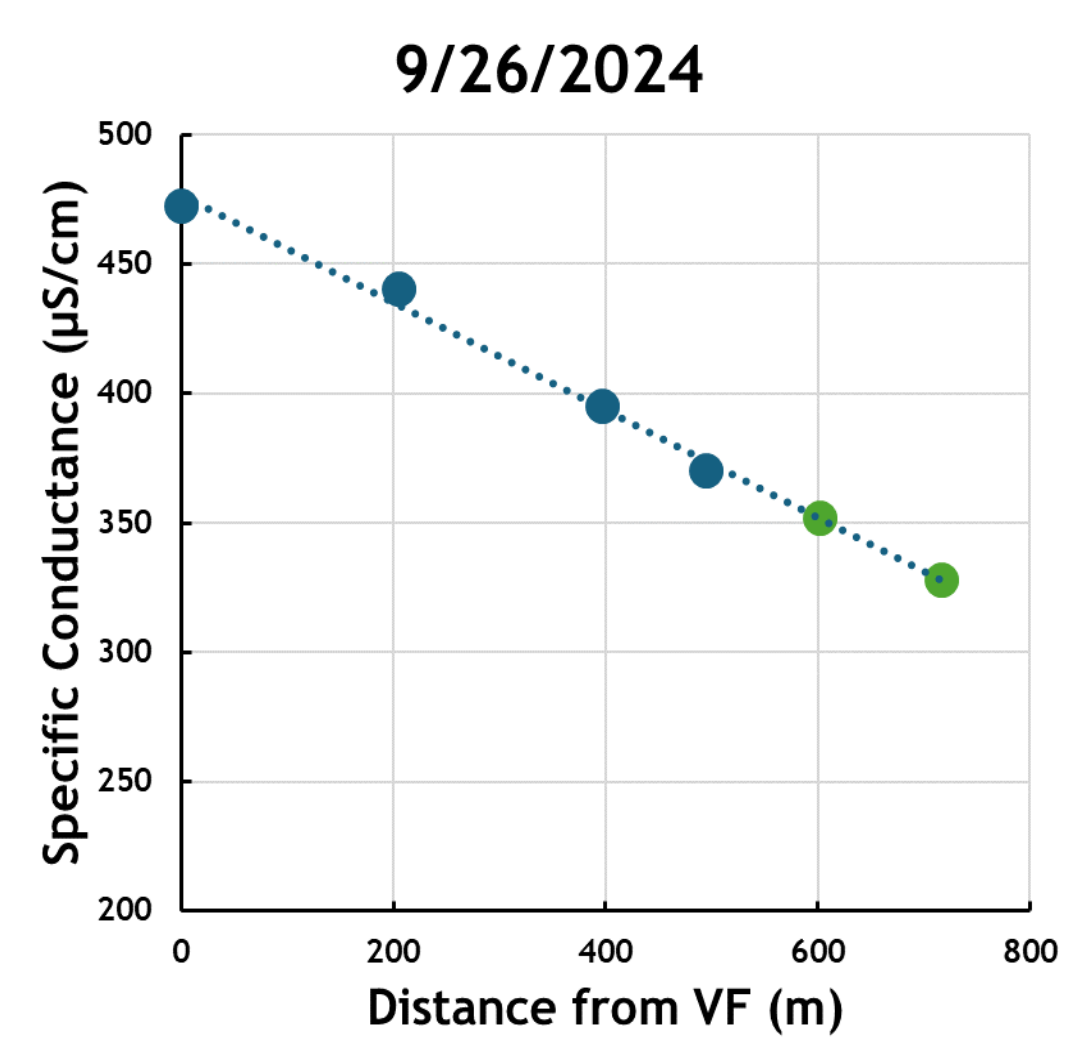


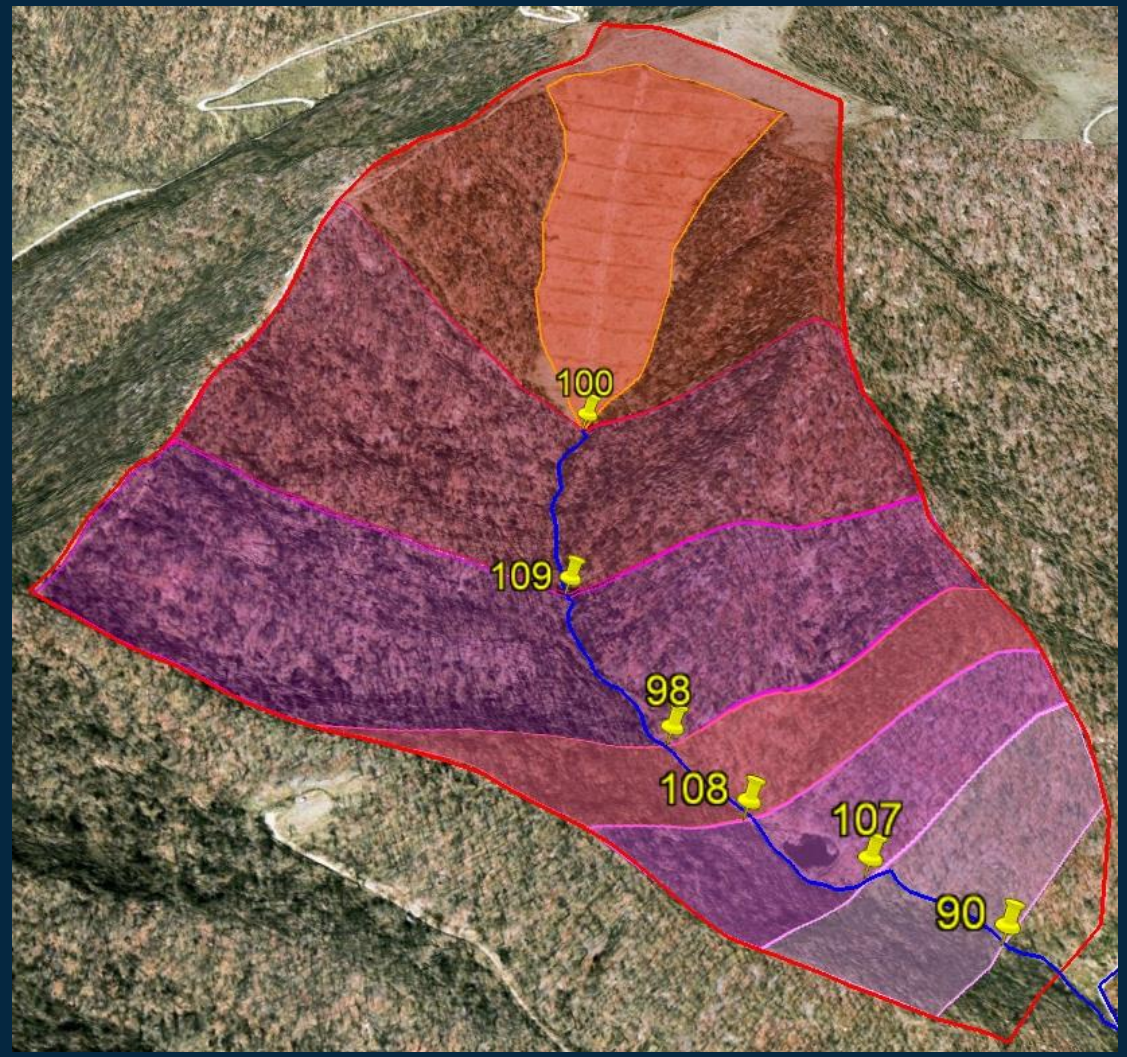
Swiss Pond Disruption



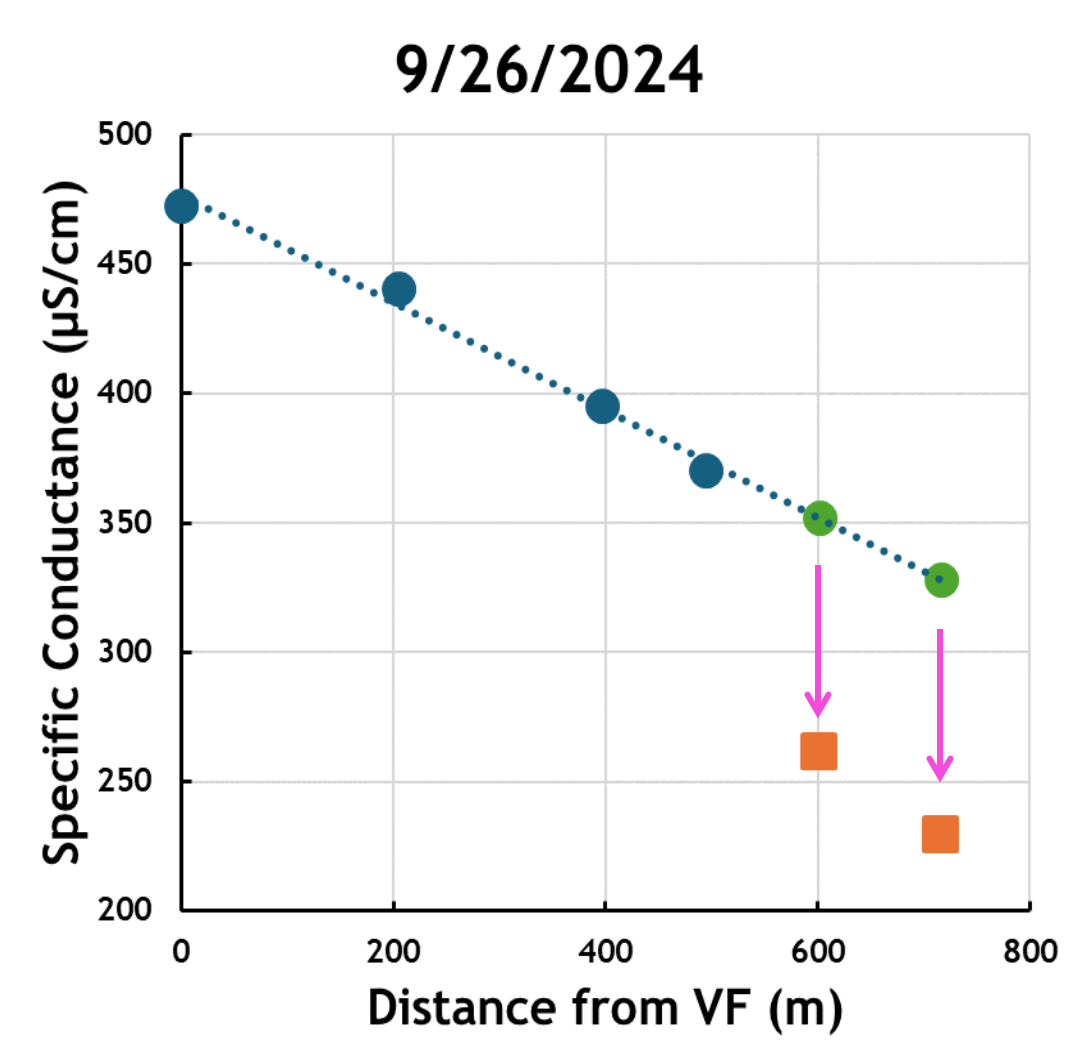


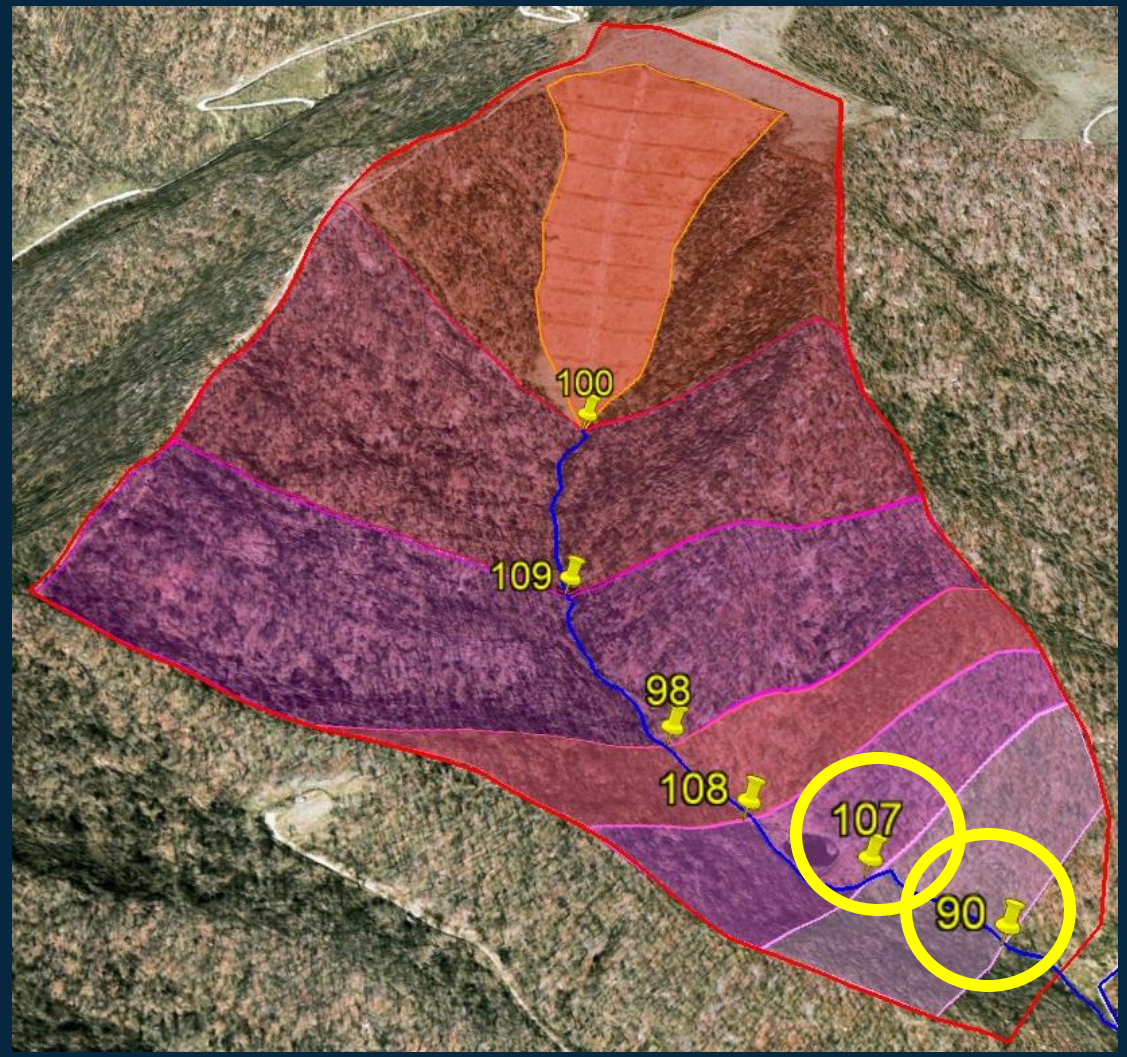
Swiss Pond Disruption



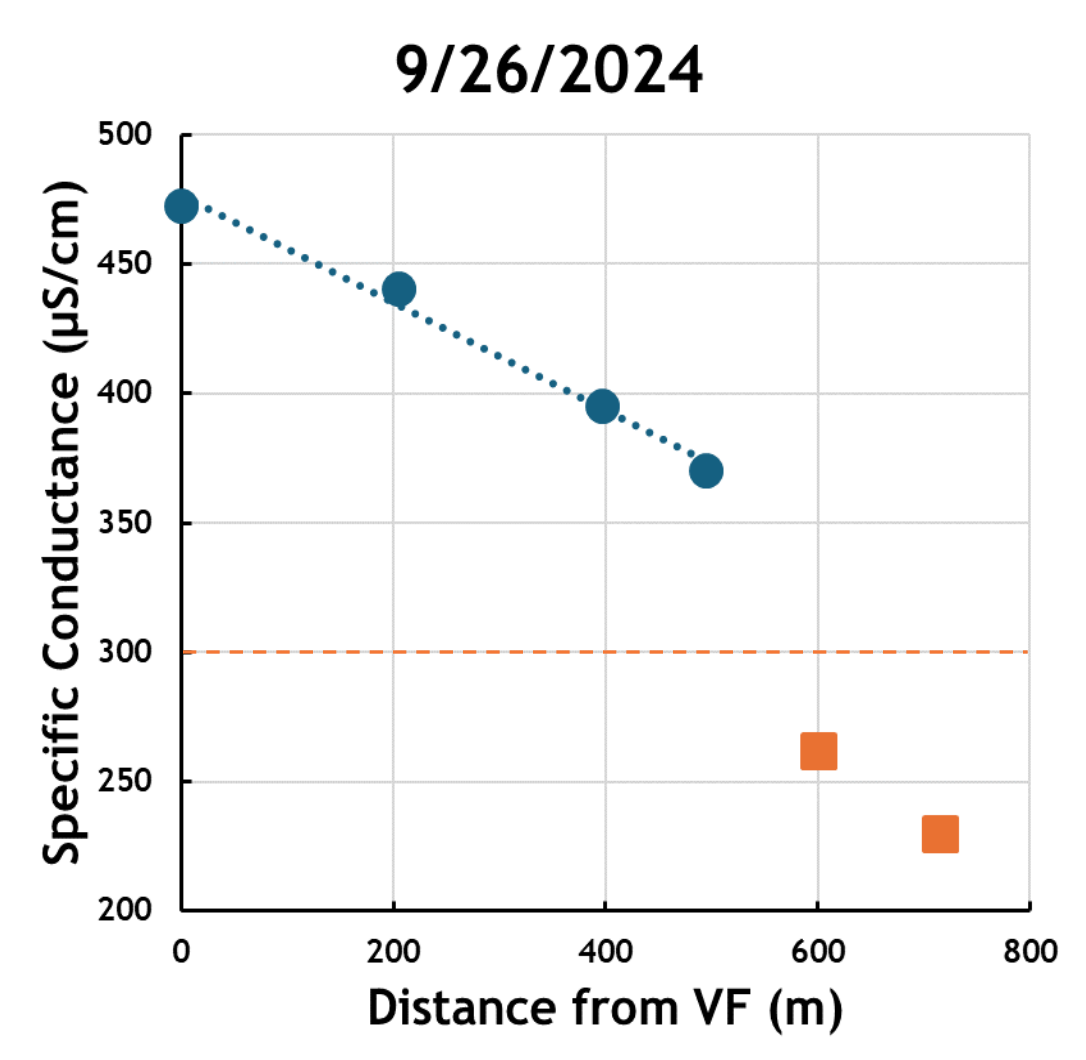


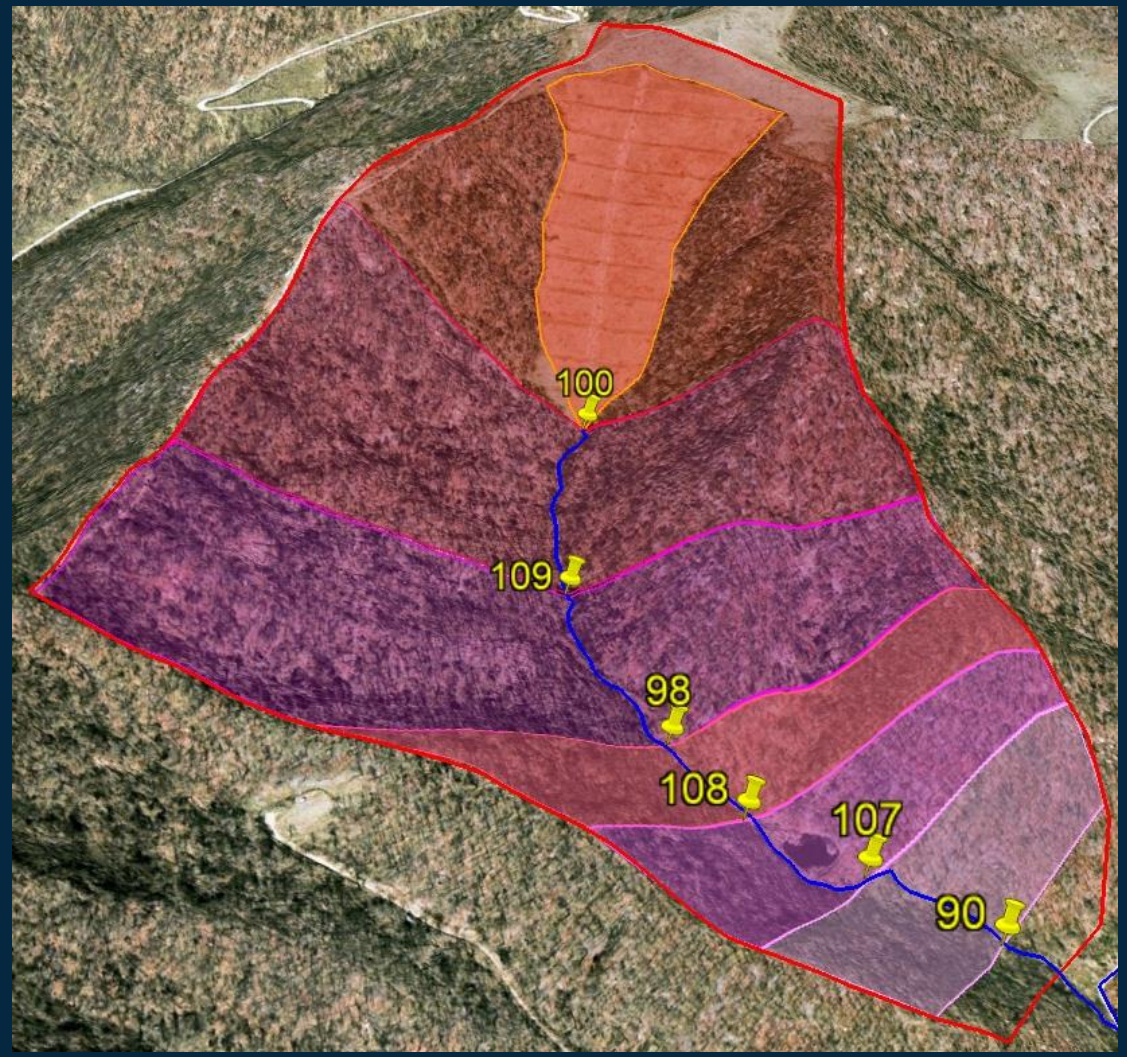
Swiss Pond Disruption



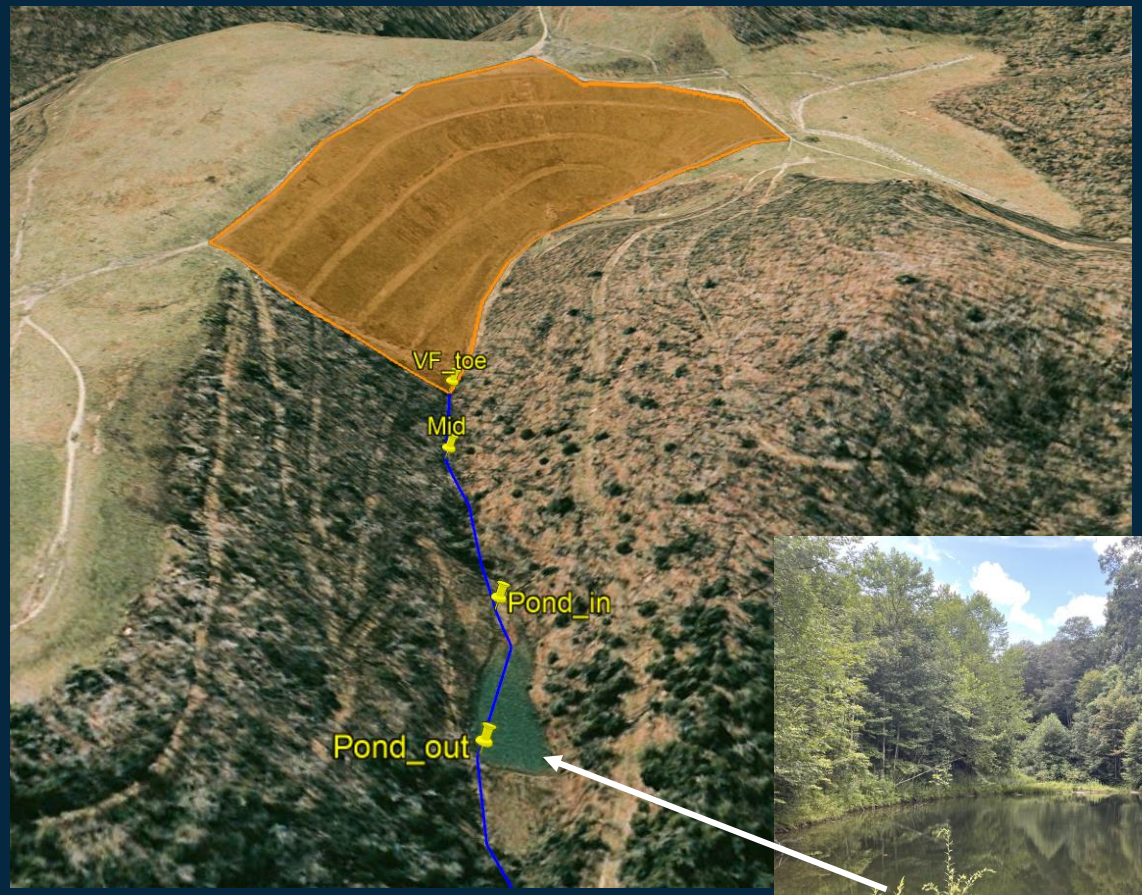


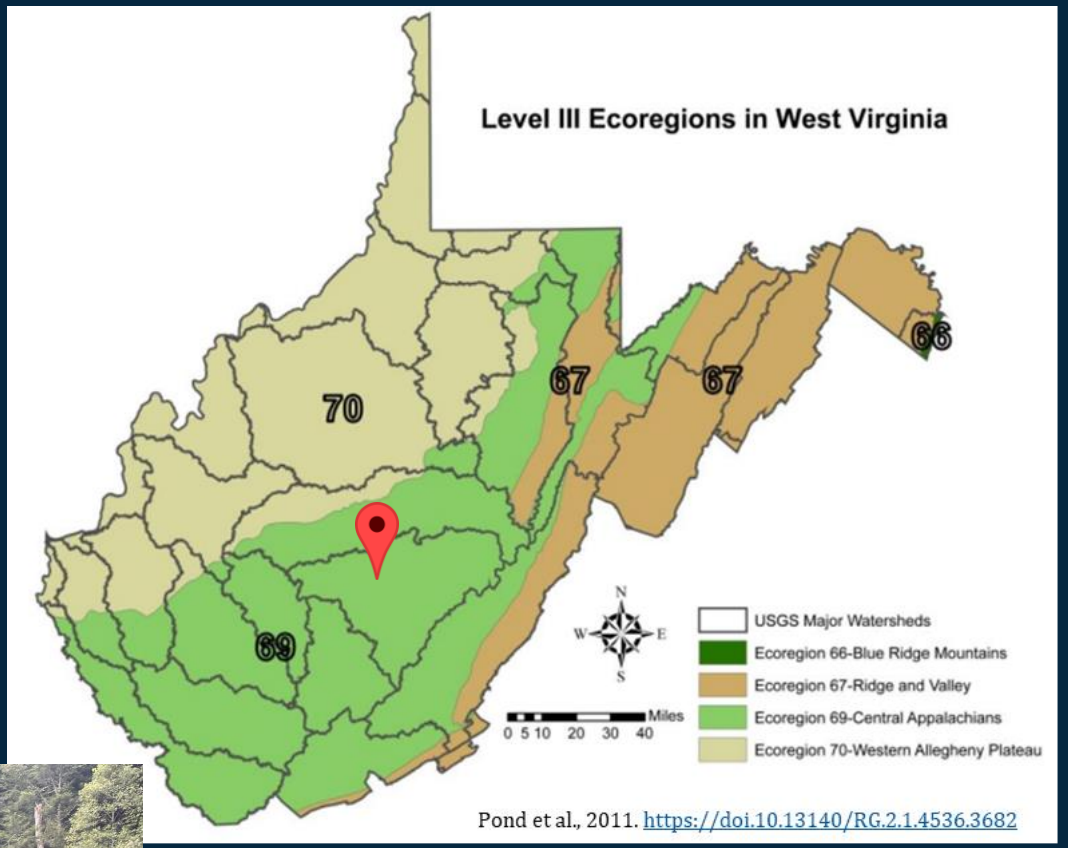
Swiss Pond Disruption





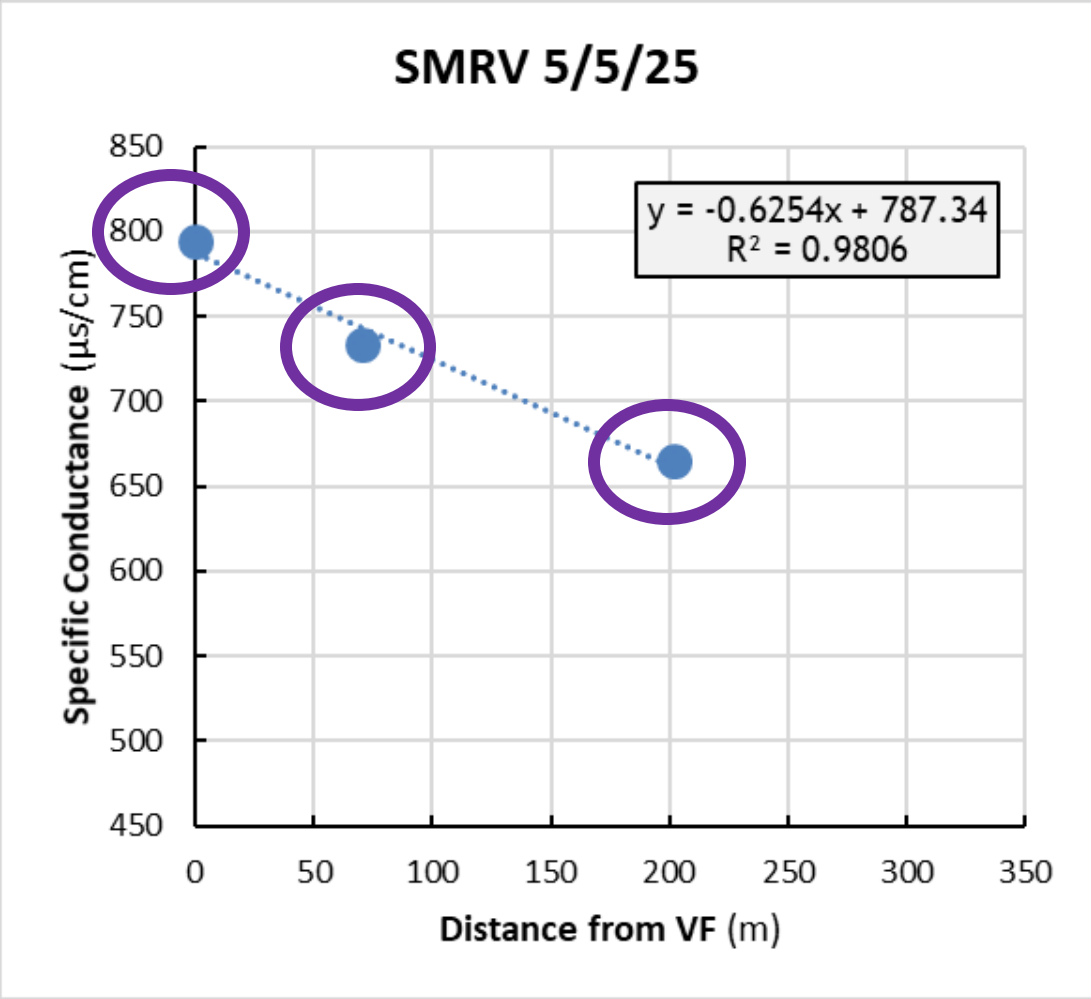
Summersville, WV Site

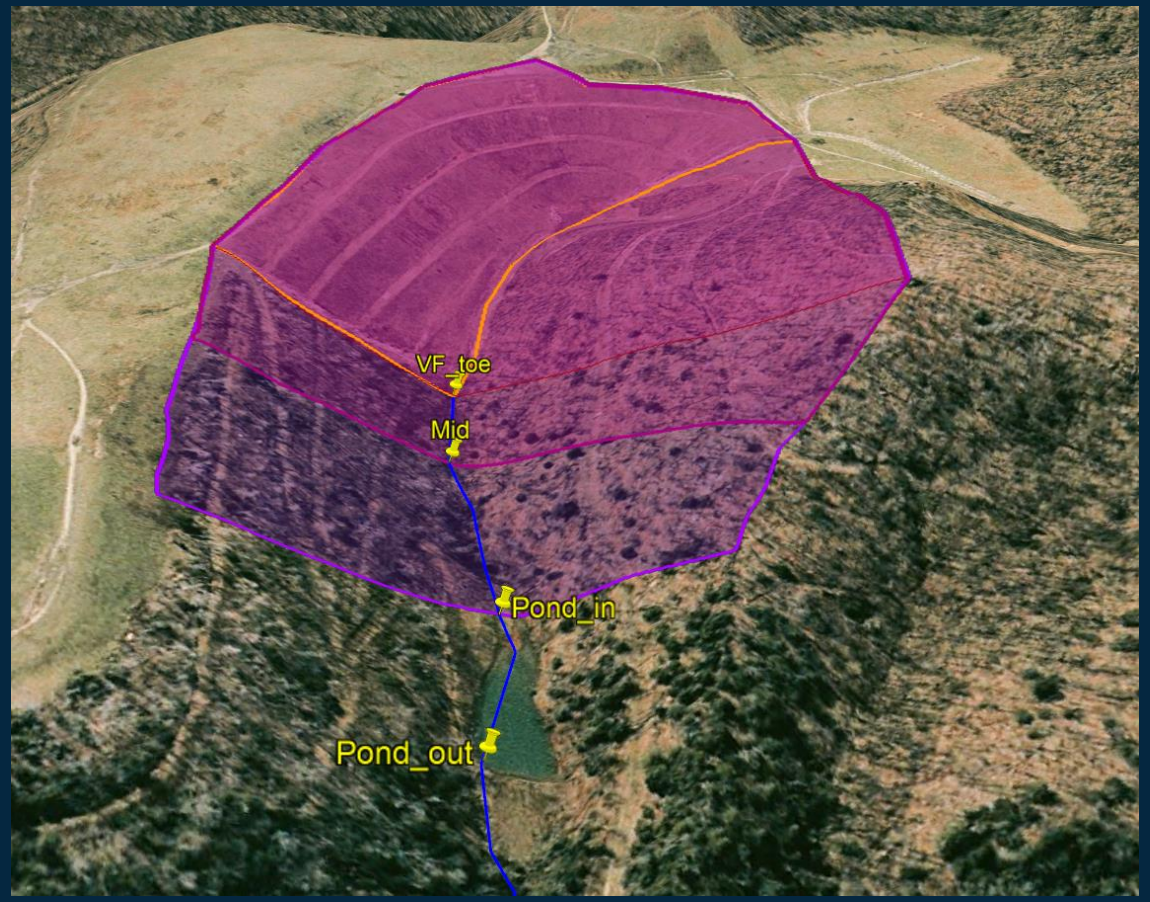




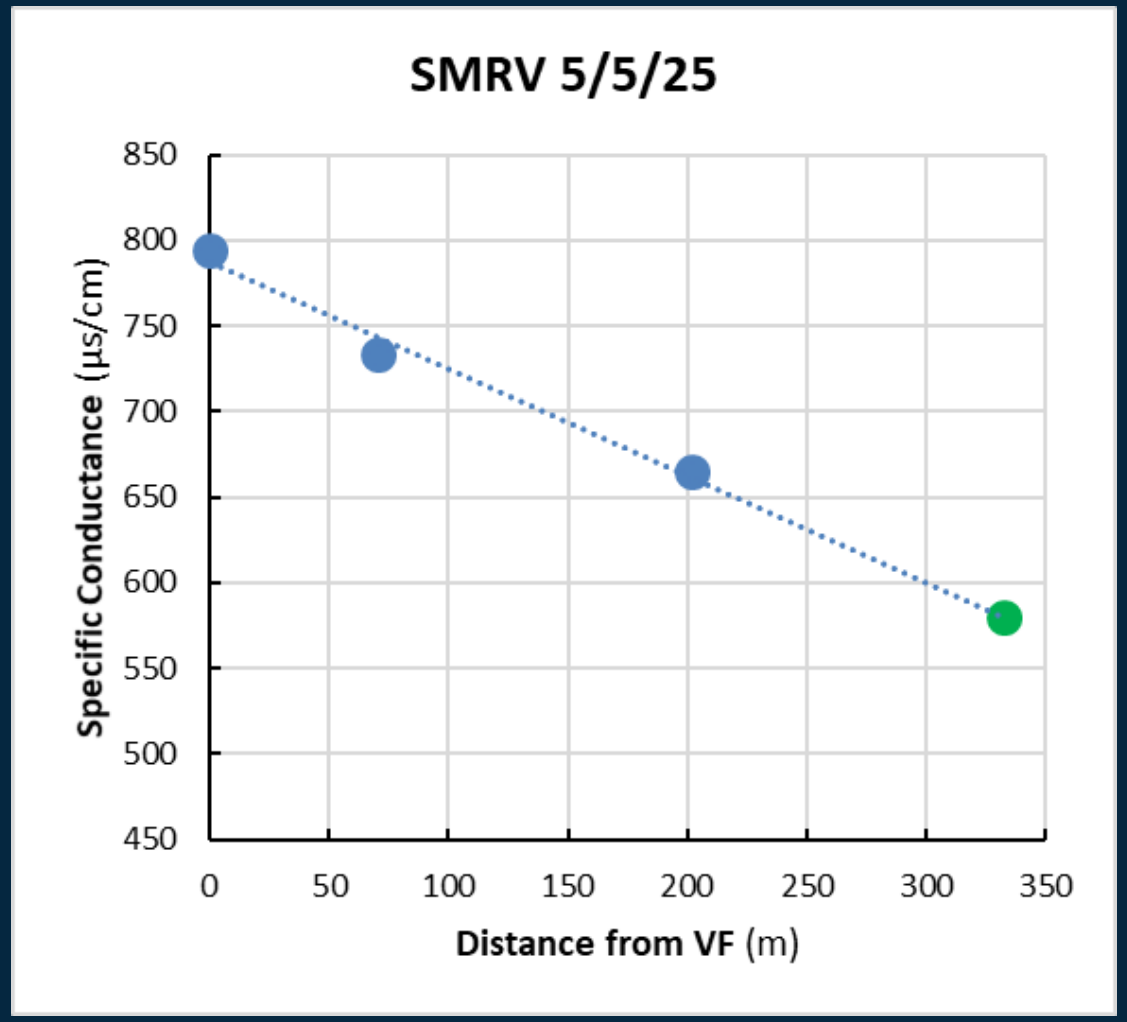
Pond et al., 2011. https://doi.10.13140/RG.2.1.4536.3682

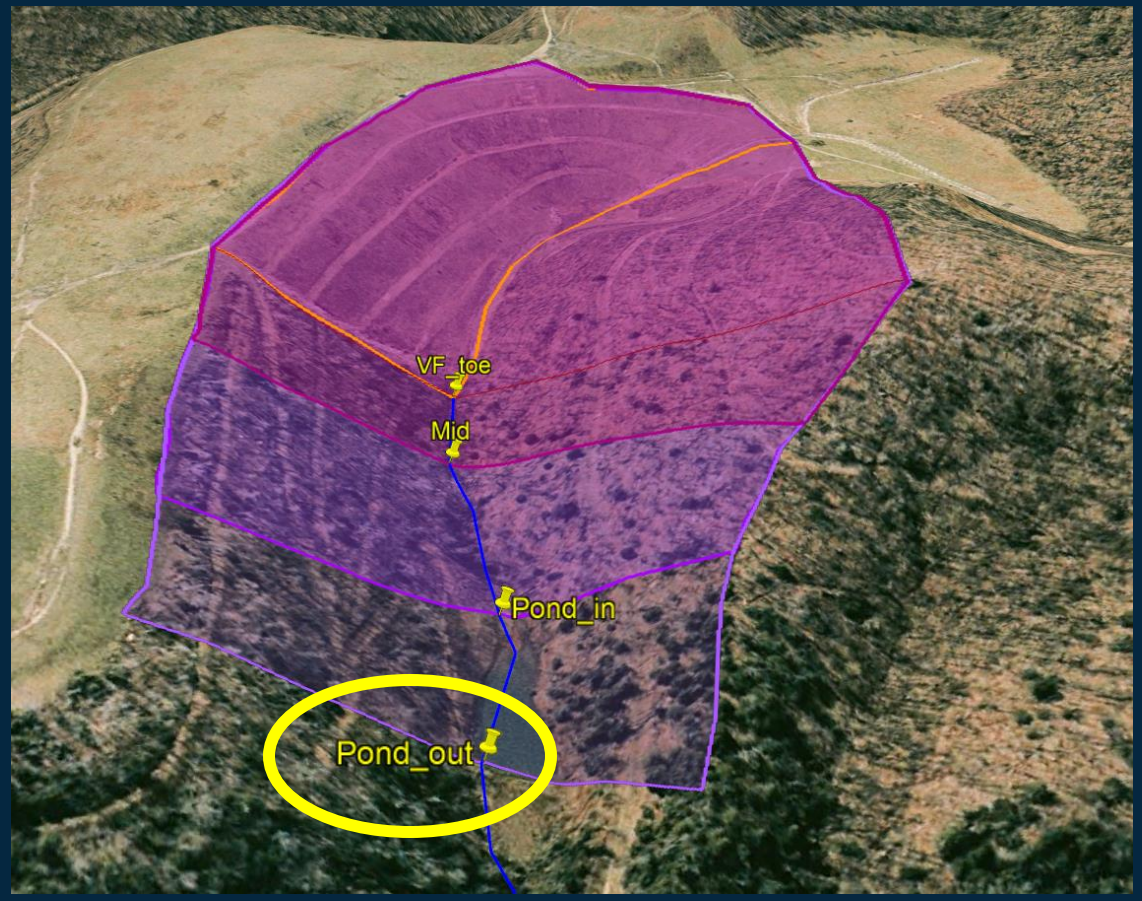
Summersville Pond Disruption



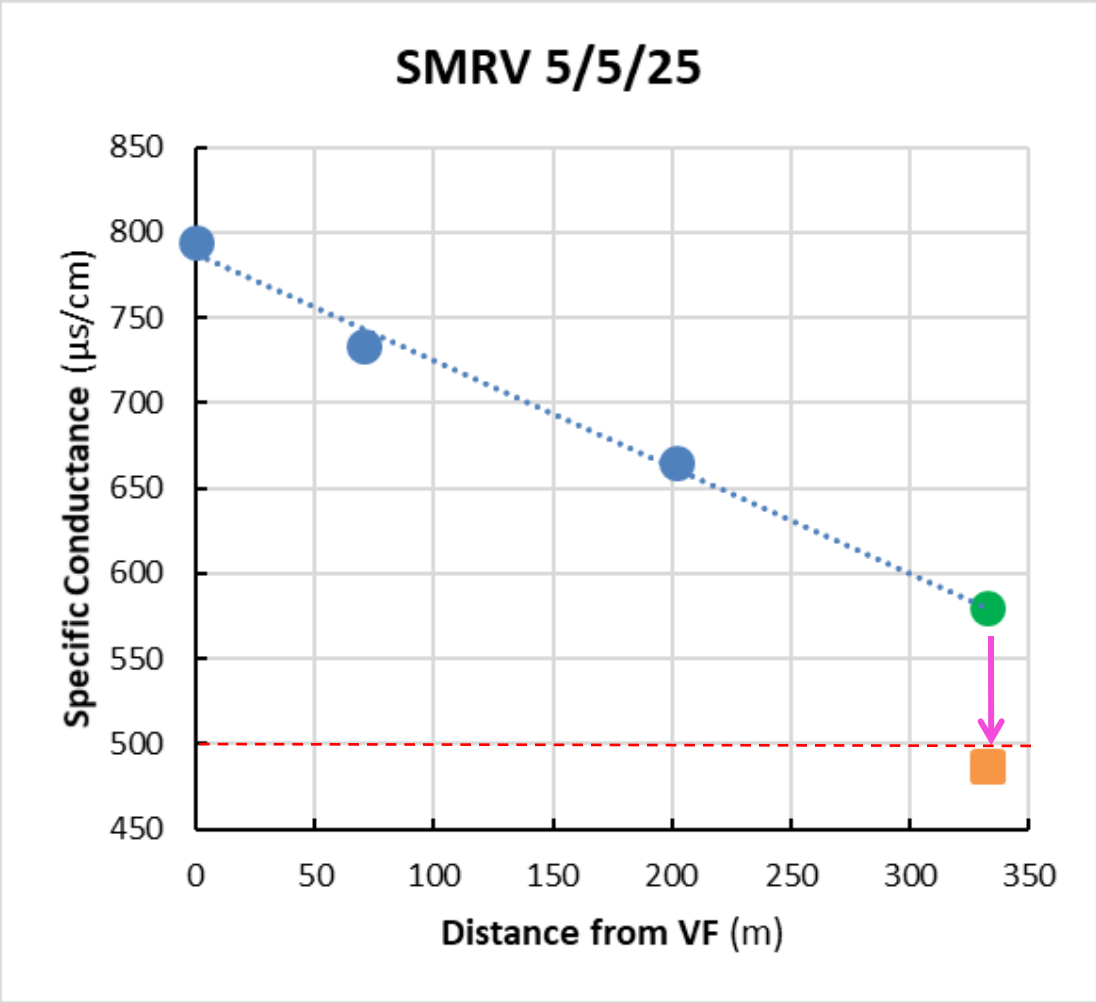


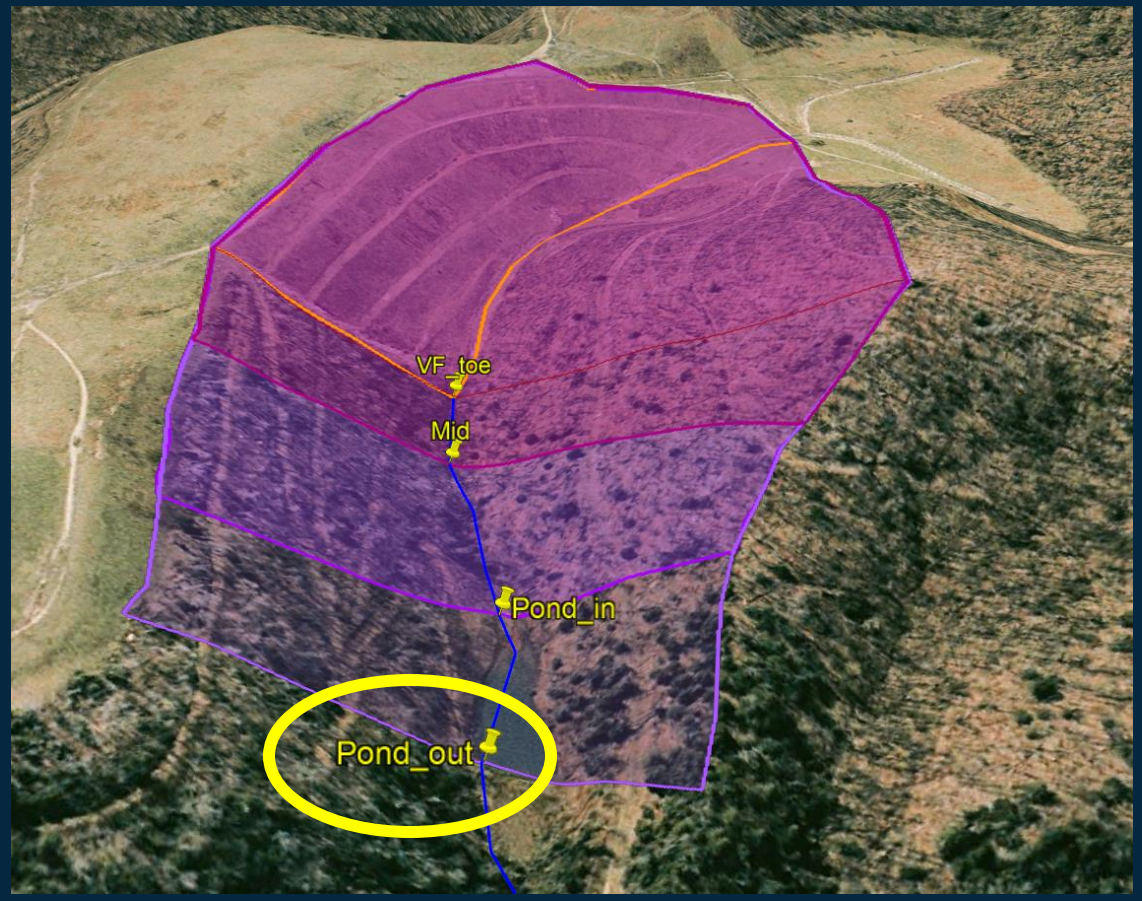
Summersville Pond Disruption





Summersville Pond Disruption





Conclusions

- Elevated levels of TDS persisted in VF-impacted stream 25+ years post reclamation
- Seasonal variation in specific conductance may negatively impact aquatic life
- Pond appears to disrupt spatial and temporal trends of TDS
- Pond attenuated levels of TDS at its outflow
- Attenuation capacity depends on baseflow, runoff, evapotranspiration, volume of pond, and other factors
- Future outlooks for mitigation practices

Thank You!

Contact Information

Mikayla DeMatt
NSF RaMP One Health Mentee
West Virginia State University
mikayla.dematt@wvstateu.edu

Dr. Amir Hass
Associate Professor of Soil Water and Natural Resources Management
West Virginia State University
amirhass@wvstateu.edu

Funding

USDA McIntire-Stennis Cooperative Forestry Program (Accession #1021744)

NSF RaMP One Health Program (Award #2319718)