ECOSYSTEM SERVICES

ECOSYSTEM PLANNING & RESTORATION

CENTER FOR WATERSHED PROTECTION

Work in the Wet Versus Work in the Dry for Stream Restoration: A Comparison of Downstream Turbidity and Sediment Loads

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Pooled Monitoring Forum: Restoration Research to Make Science and Regulatory Connections

Project Hypothesis

H1. The turbidity resulting from Wet Construction will be higher during active construction, but turbidity will not be completely eliminated during Dry Construction, with an expected spike in turbidity when the stream flow is released for the night and elevated levels of turbidity expected for both cases after construction ends for the day.

•H1A. The observed average Turbidity (Average NTU) will be higher during the Wet Construction Period.

•H1B: The estimated hours exceeding Maryland's turbidity standards for Wet Construction are less than 50% greater than the exceedance time for Dry Construction.

H2. The suspended sediment load associated with Dry Construction will not be meaningfully different than the load associated with Wet Construction, such that absolute difference between total suspended solids loads (lbs.) is less than 25% of the average suspended sediment load between the two methods.

H3. The sediment load associated with the Construction in the Wet or Construction in the Dry will be significantly less than the sediment load associated with the 1.25-year storm for the watershed.

Site Selection

Criteria

Construction within Study Timeframe

Minimum project length

Use of Natural Channel Design

Reliable baseflow for consistent data collection

Confirmed funding

Administrative feasibility and stakeholder cooperation

Process and Selection

Developed a site evaluation form to screen potential projects

Applied Structure ranking system to ensure alignment with research objectives.

Initial pool = 40 sites/ 7 sites met key study requirements/ 3 met study and schedule requirements

Natural Channel Design

Natural Channel Design Priority 2 Restoration

Stream is relocated to a new, stable meandering alignment at the existing floodplain (bankfull) elevation

Constructed within the incised valley, without major regrading of the floodplain

Re-establishes natural stream functions, including:

Floodplain connection during high flows

Sediment transport continuity

Aquatic and riparian habitat enhancement

Structures Used in this Study

Riffle Grade Control

Cascade Structures & Log Cascades

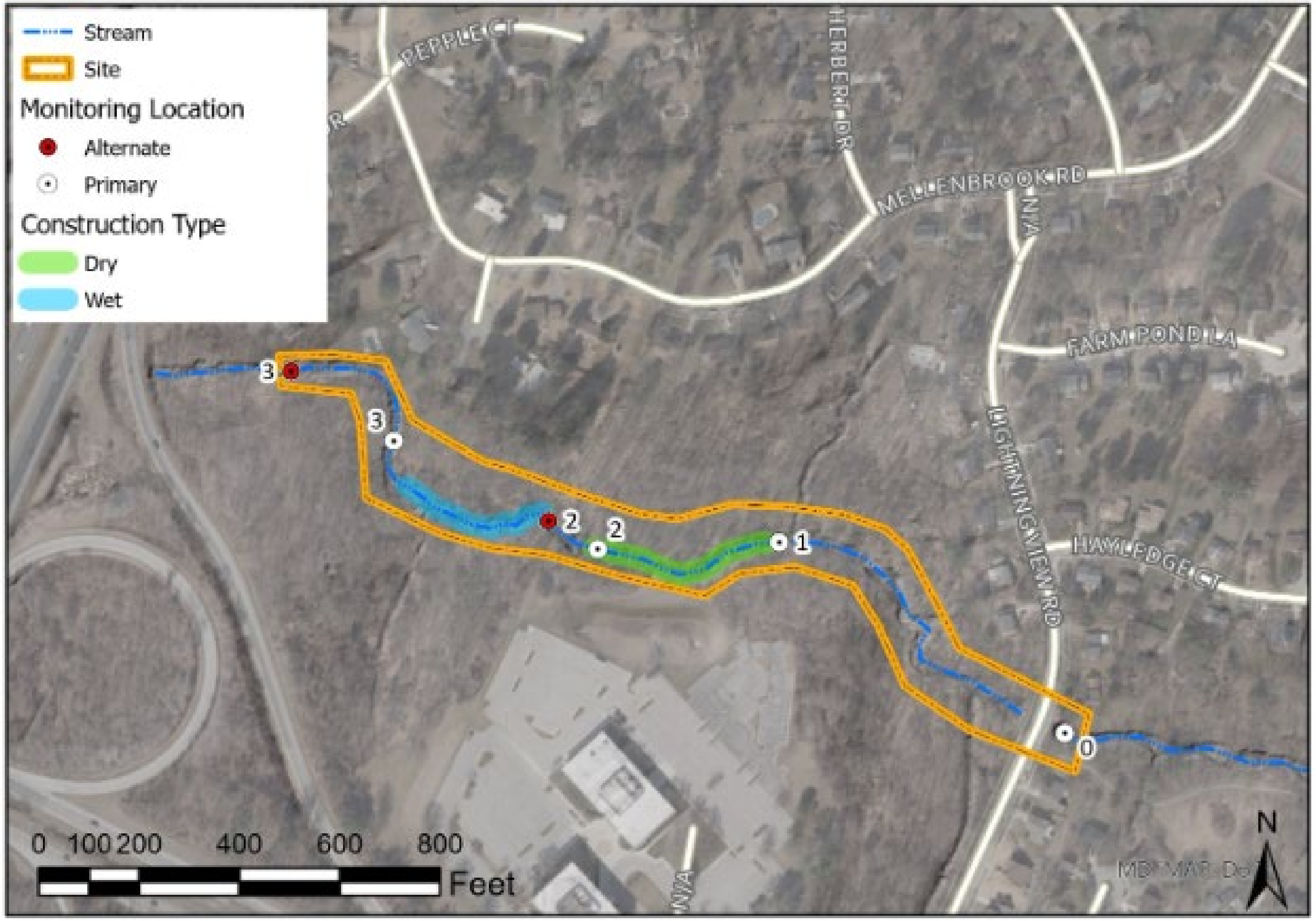
Rock Toe & Boulder Toe

Log Toe & Wood Toe

Pool Enhancements

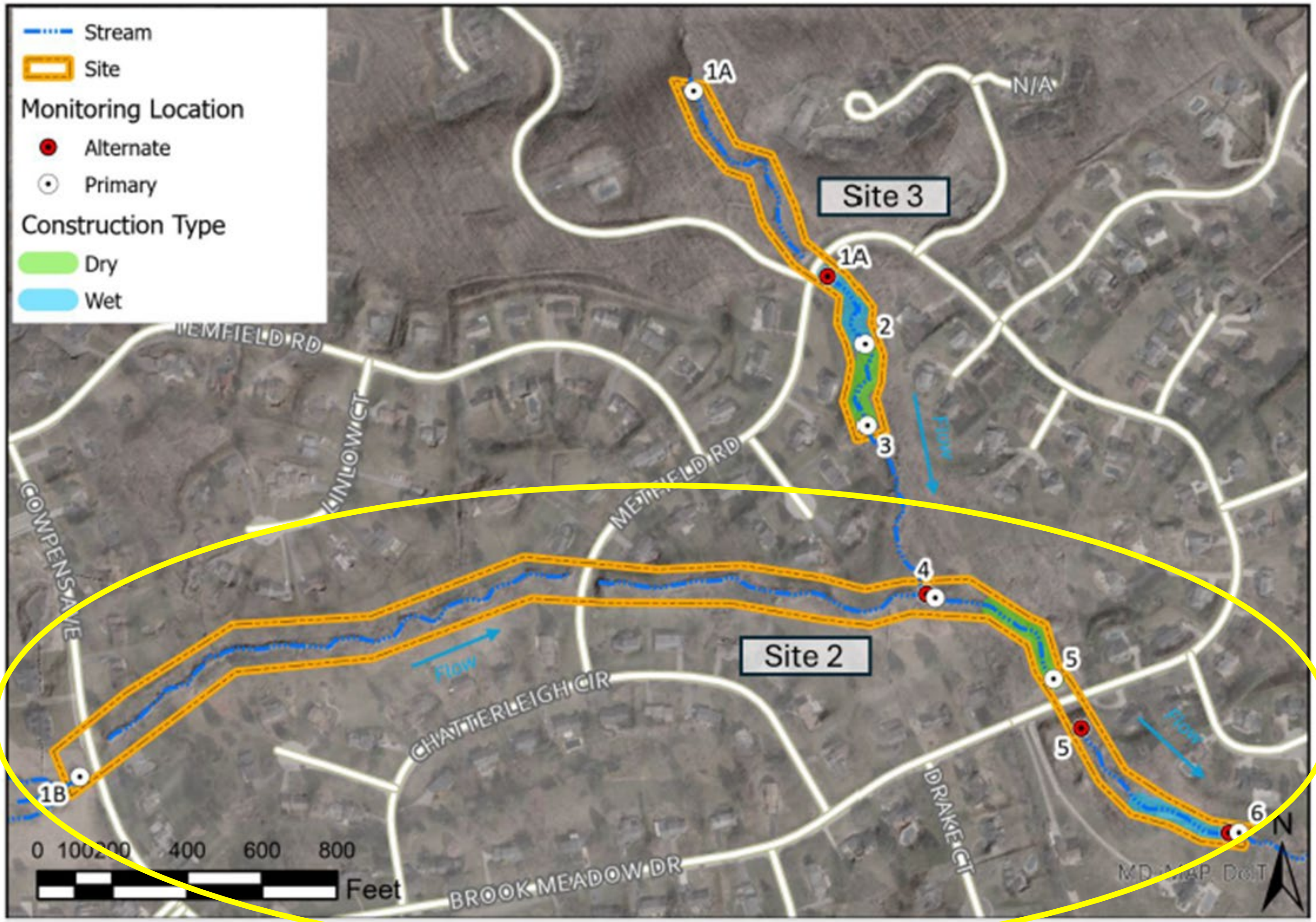
Site 1: Mellen Court

- Project length= 3022 ft
- Study reach = 500 ft
- Channel width= 14 ft
- Stream Order= 3rd Order
- Drainage Area= 0.8 sq. Mi.
- Stream Bed Material = Gravel Cobble
- NCD Priority 2 Design



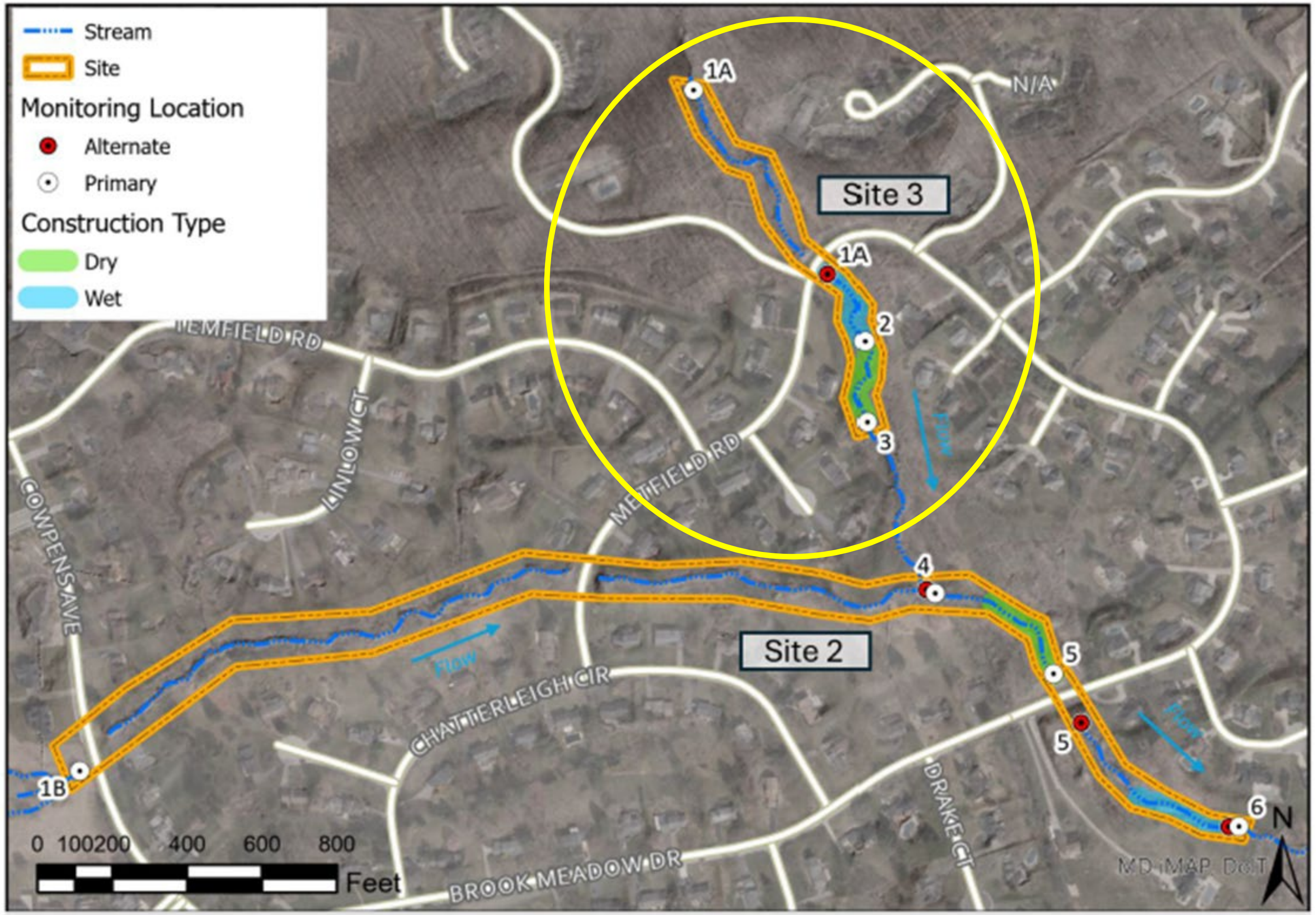
Site 2: Minebank Run At Metfield - Beeches Lower (Minebank Upstream)

- Project length= 4719 ft
- Study reach = 370 ft
- Channel width= 20 ft
- Stream Order= 2nd Order
- Drainage Area= 0.53 sq. Mi.
- Stream Bed Material = Gravel Cobble
- NCD Priority 2 Design

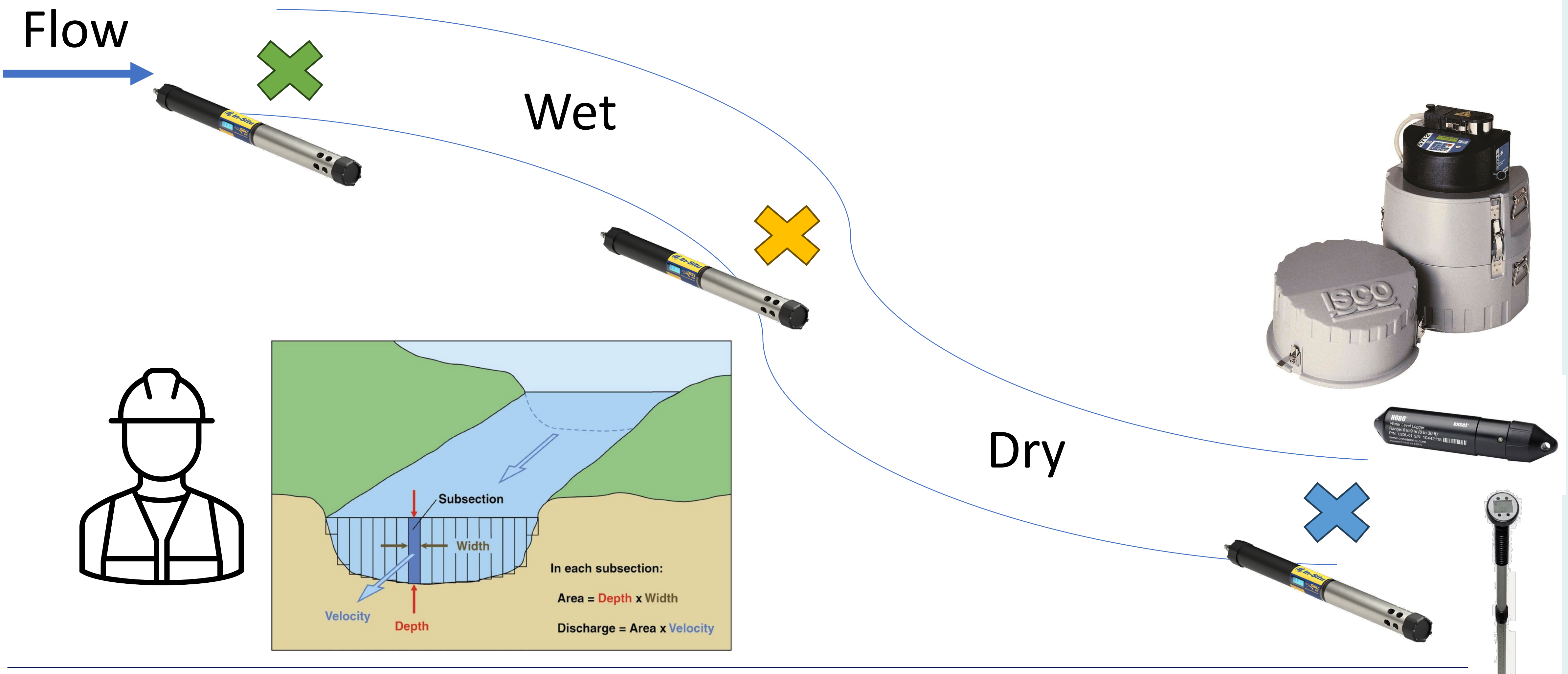


Site 3: Minebank Run At Metfield- Cowpens Lower (Minebank Downstream

- Project length= 1396 ft
- Study reach = 430 ft
- Channel width= 9 ft
- Stream Order= 1st Order
- Drainage Area= 0.13 sq. Mi.
- Stream Bed Material = Gravel Cobble
- NCD Priority 2 Design

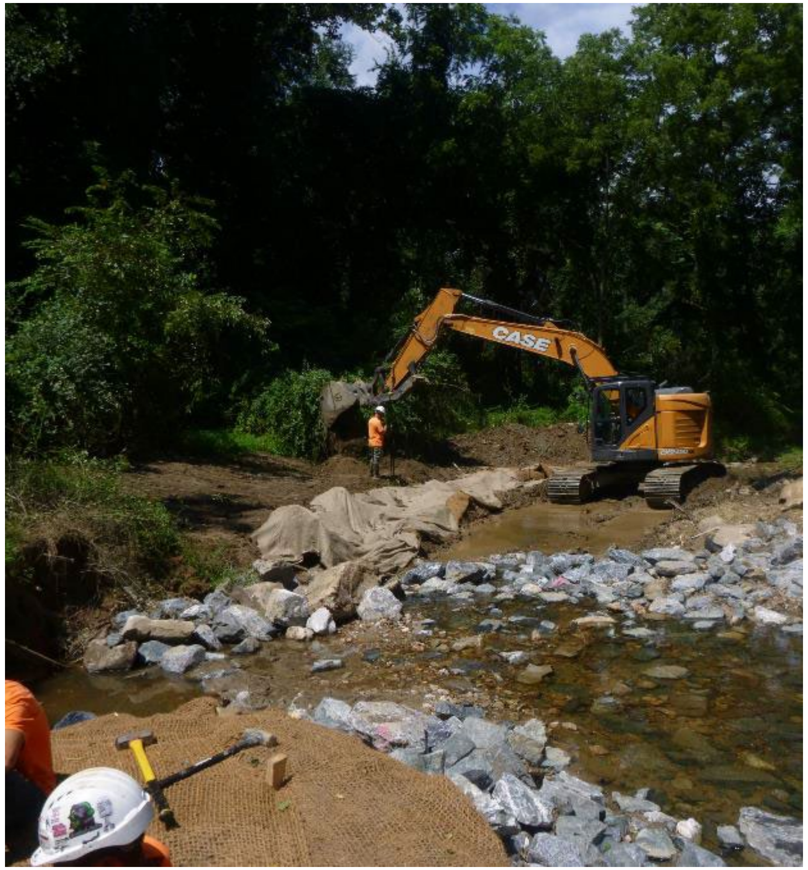


Study Design



Site 1: Mellen Ct. Setup

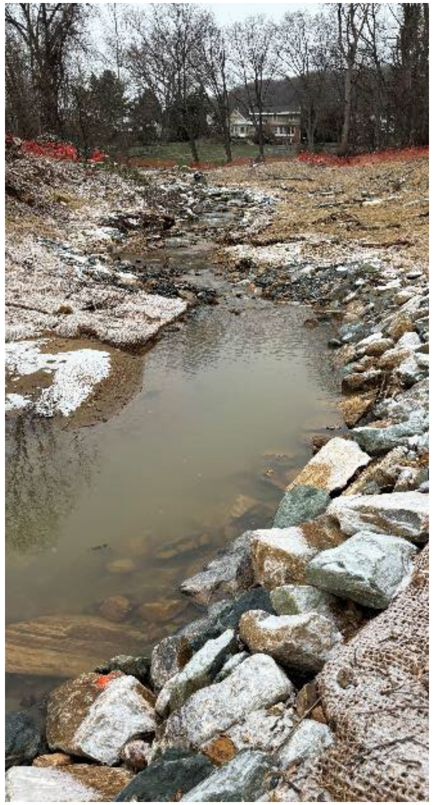
Site 1: Mellen Ct. Work in the Dry



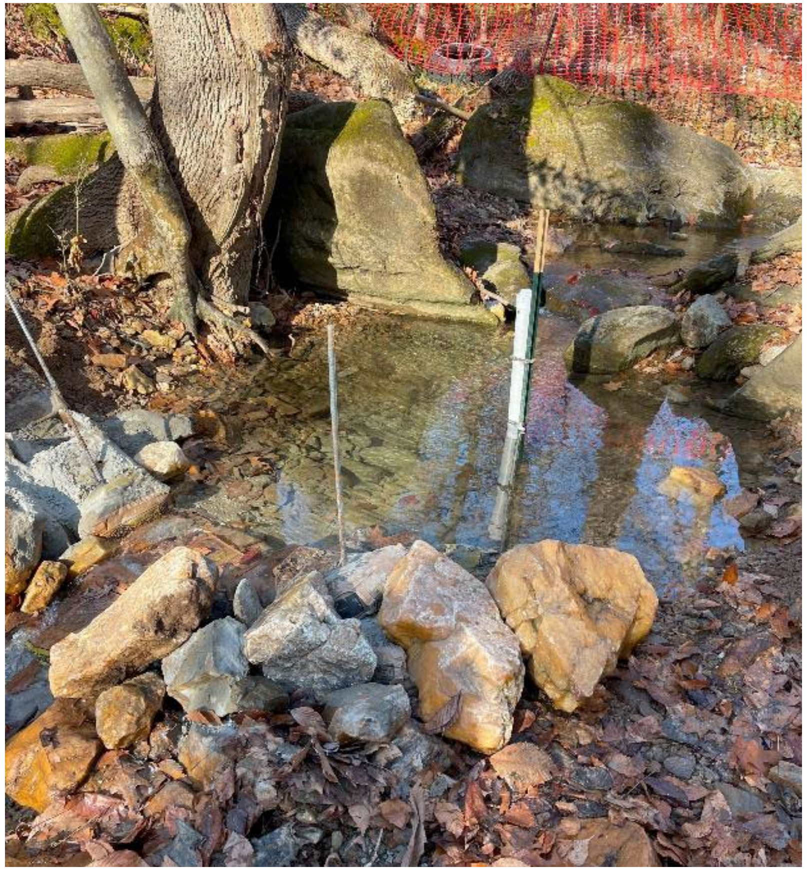
Site 1: Mellen Court Work in the Wet

Site 2: Minebank (Downstream) Setup

Site 2: Minebank (Downstream) Work in Wet



Site 2: Minebank (Downstream) Work in Dry

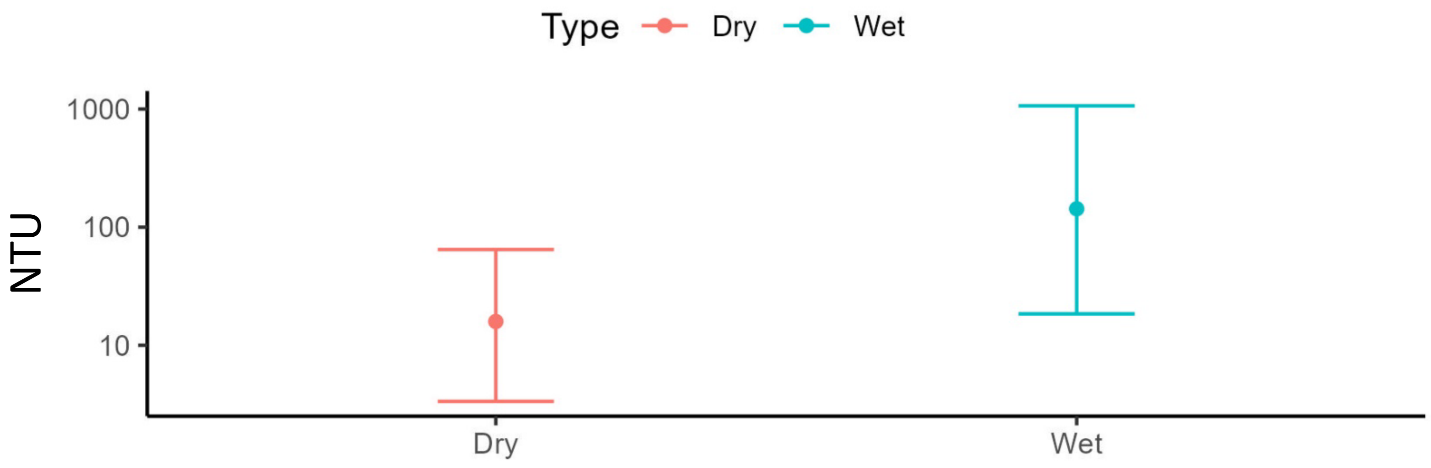


Site 3: Minebank (Upstream) Setup

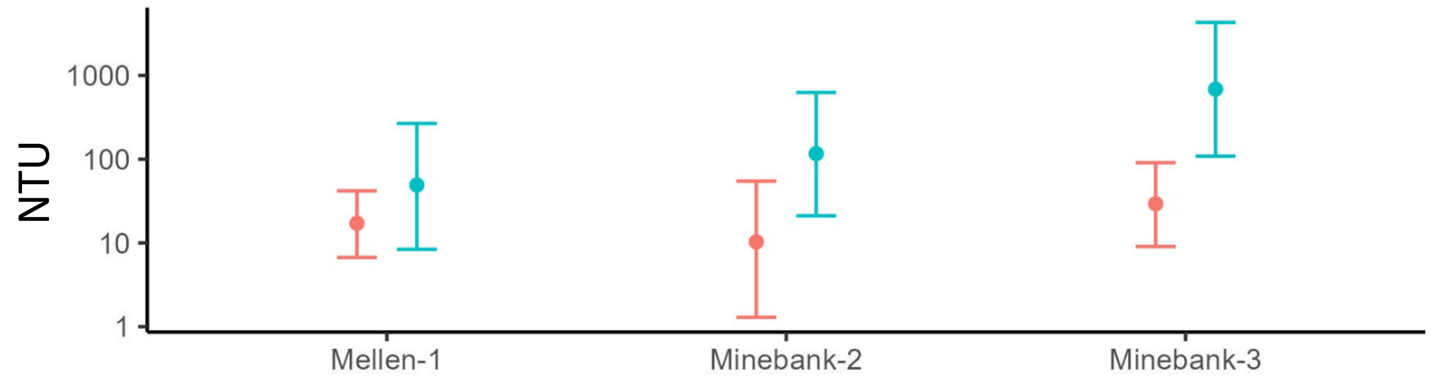



Site 3: Minebank (Upstream) Work in Wet

Average Turbidity (Hourly)

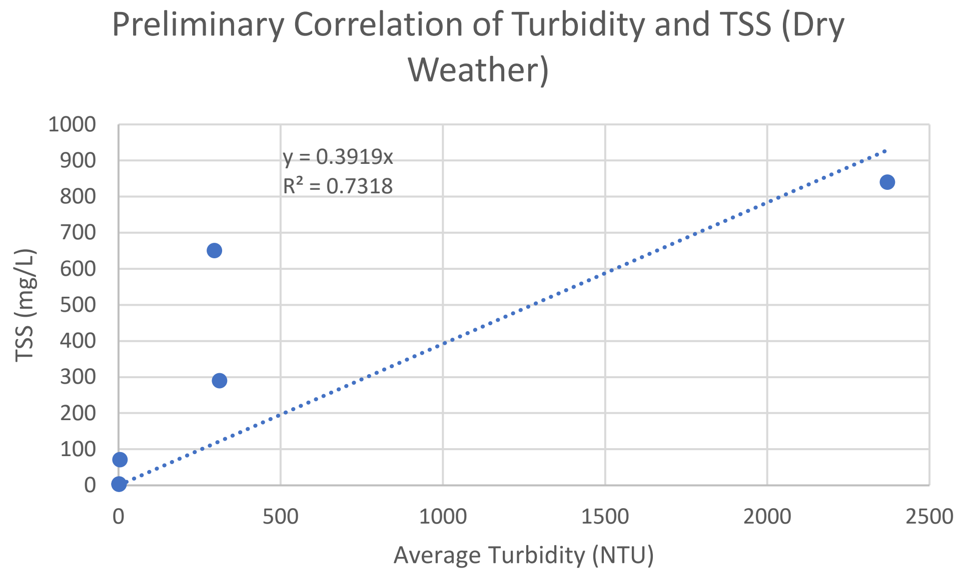


With all sites combined, graph to the left shows average hourly turbidity during construction in the wet and the dry. Note: the y-axis is in log scale.

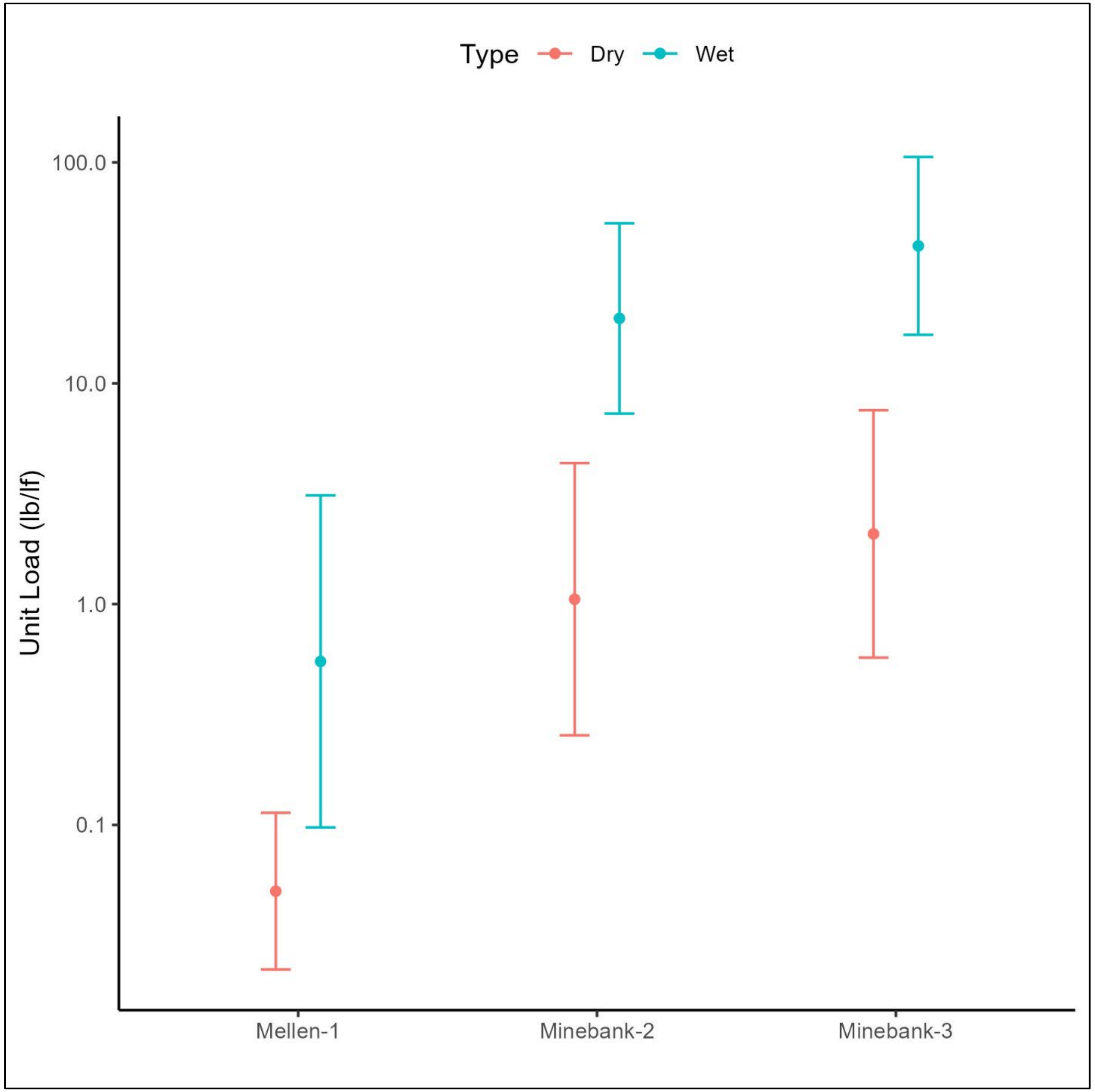


The same information as above and broken down by site. Red is construction in dry stream and blue is construction in a wet stream. Note: the y-axis is in log scale.

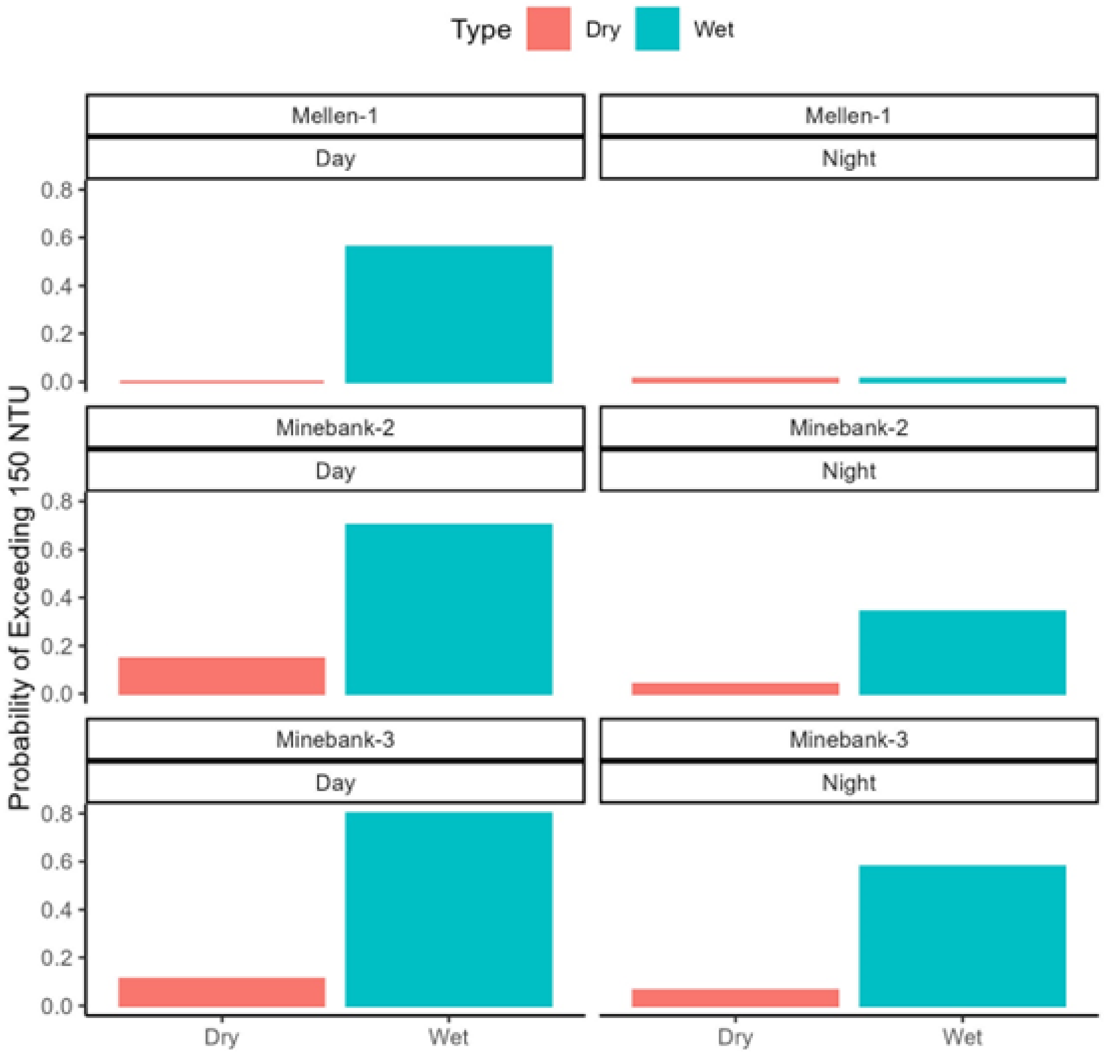
Total Sediment Load (lb)



The graph to the right is comparing the total sediment per linear foot at each site, separated by dry construction and wet construction. Total load was calculated used the turbidity data, the correlation curve (above) and flow

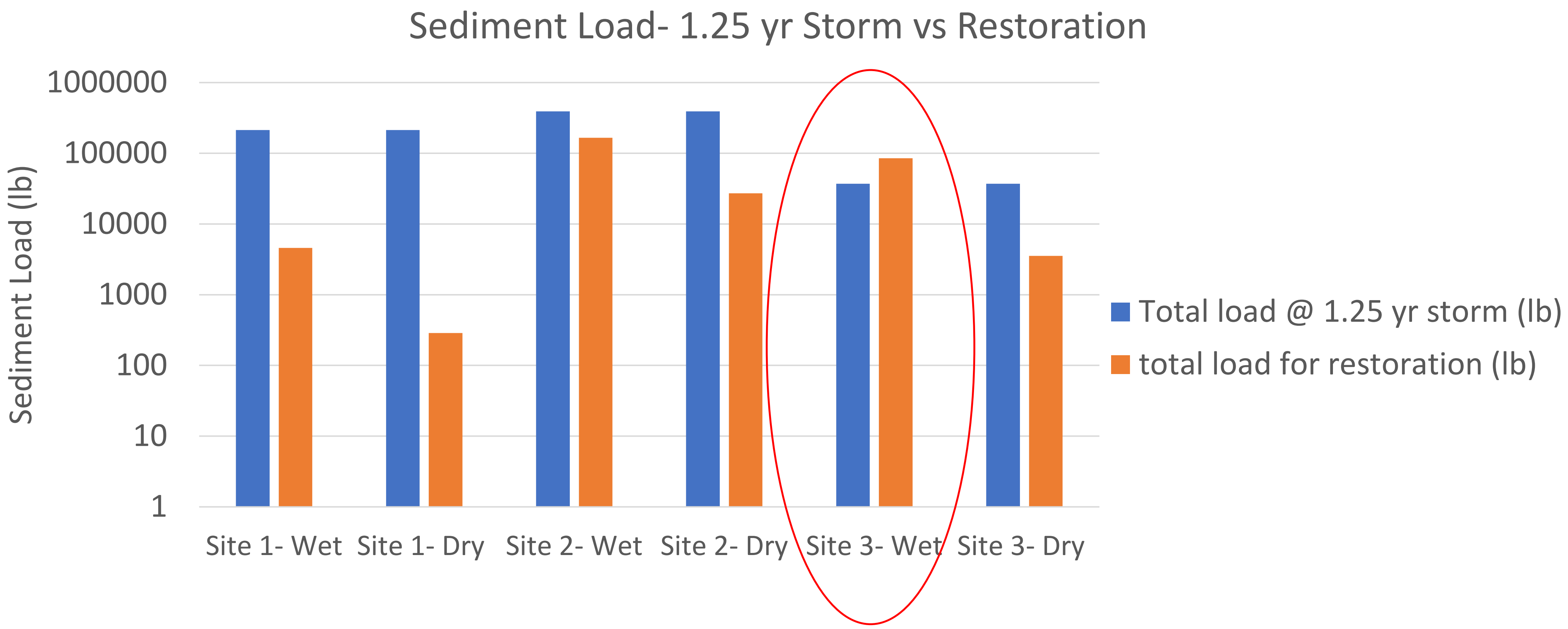


Percent Exceedance of 150 NTU for Dry and Wet Construction



The probability of exceeding the benchmark of 150 NTU at each site, divided by type of construction (dry or wet) and time of day (day or note).

Sediment Load- 1.25 year storm



Take Home Summary

- **Hypothesis 1A – Turbidity Levels:**
Wet construction significantly increases turbidity downstream compared to dry construction (avg. 5.7x higher; $p < 0.001$).

- **Hypothesis 1B – Regulatory Exceedance:**
Probability of exceeding Maryland's 150 NTU turbidity standard is ~16.6x higher during wet construction ($p < 0.001$).

- **Hypothesis 2 – Suspended Sediment Load:**
Suspended sediment load from wet construction is ~16x higher than from dry construction ($p < 0.001$), far exceeding the 25% difference threshold.

- **Hypothesis 3 – Comparison to 1.25-Year Storm:**
At two of three sites, construction (wet or dry) contributed less sediment than the 1.25-year storm. Site 3 is an outlier—wet construction exceeded storm load, cautioning against broad generalizations.

Construction pace differences between wet and dry methods ranged from 9% to 15% across sites. Sites 1 and 3 were completed more quickly using dry methods, while Site 2 was faster with wet construction.

Thoughts and Lessons Learned

- **Monitoring location**
  - Turbidity changes based on distance from construction
  - Incomplete mixing during monitoring in 1st order steams due to low flow
- **Construction efficiency**
  - Difficult to capture differences between different work crews which can impact the efficiency or general pace of a project
  - Difficult to gage crew efficiency due to smaller streams and short reaches
- **Construction sequence**
  - Sediment storage capacity at new reaches and sediment travel
- **Study methodology**
  - Equipment maintenance and inspection frequency
  - Weir design needs careful consideration to allow for proper mixing
  - Standardized, detailed construction log during monitoring
  - Limit relocation of monitoring equipment

Acknowledgments

THANK YOU!

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Translation

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- Stream restoration projects are complex.
  - **Only 8% of potential sites were available for this study.**
- There is a process in place that can be utilized in future research to expand this dataset.
  - **Incentives for future participation?**
- Regarding varying subwatershed characteristics: Greater understanding of these research questions could add another tool to the toolbox.
  - **Provide more opportunities for implementing our projects and better serving our communities.**