Got Bugs? A Biological Monitoring Plan for Evaluating NC Mitigation Projects

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WILDLANDS
ENGINEERING

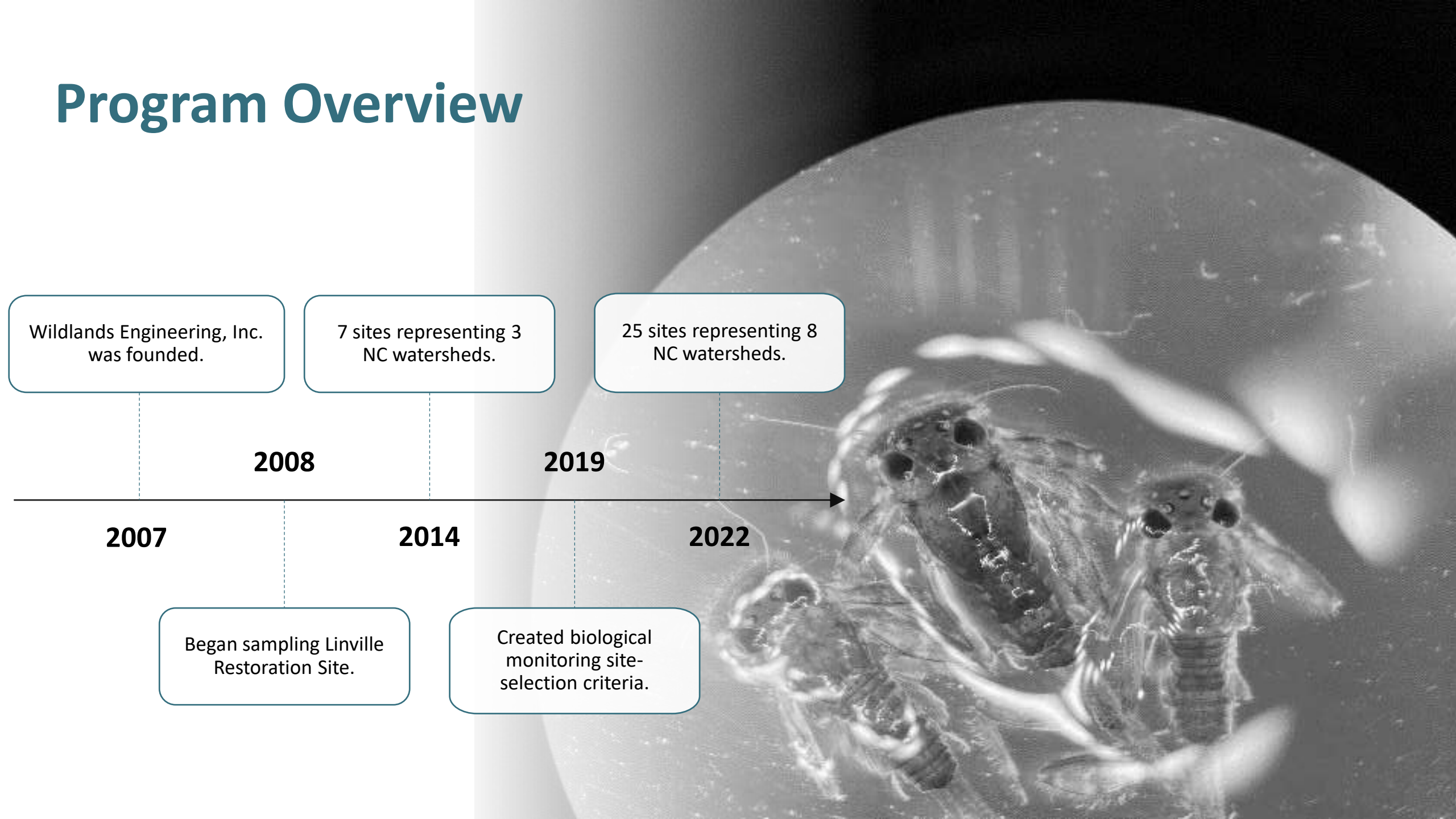
Wildlands Engineering, Inc.

Creating ecological solutions through innovative engineering

- **Founded in 2007 in Charlotte, North Carolina**
- **Specialize *exclusively* in mitigation, ecological restoration, watershed planning, and water quality management**
- **83 employees**
  - Engineers, Scientists, Real Estate Brokers, GIS specialists

Charlotte, NC • Raleigh, NC • Asheville, NC • Charleston, SC • Fairfax, VA

Program Overview



2007 — Wildlands Engineering, Inc. was founded.

2008 — Began sampling Linville Restoration Site.

2014 — 7 sites representing 3 NC watersheds.

2019 — Created biological monitoring site-selection criteria.

2022 — 25 sites representing 8 NC watersheds.

Wildlands Biological Monitoring Sites

Wildlands Objectives

- Establish a statewide dataset clearly documenting pre-restoration biological conditions in small to medium drainage areas.
- Collect consistent long-term biological monitoring data at replicable sampling locations within the same season.
- Understand long-term effects of ecological restoration on benthic and fish communities based on project goals and designs.

How do we measure biological improvement in impaired watersheds?

Wildlands Biological Monitoring Criteria

- Hydrology
- Stream Length
- Sampling Locations
- Temporal Frequency
- Proximity

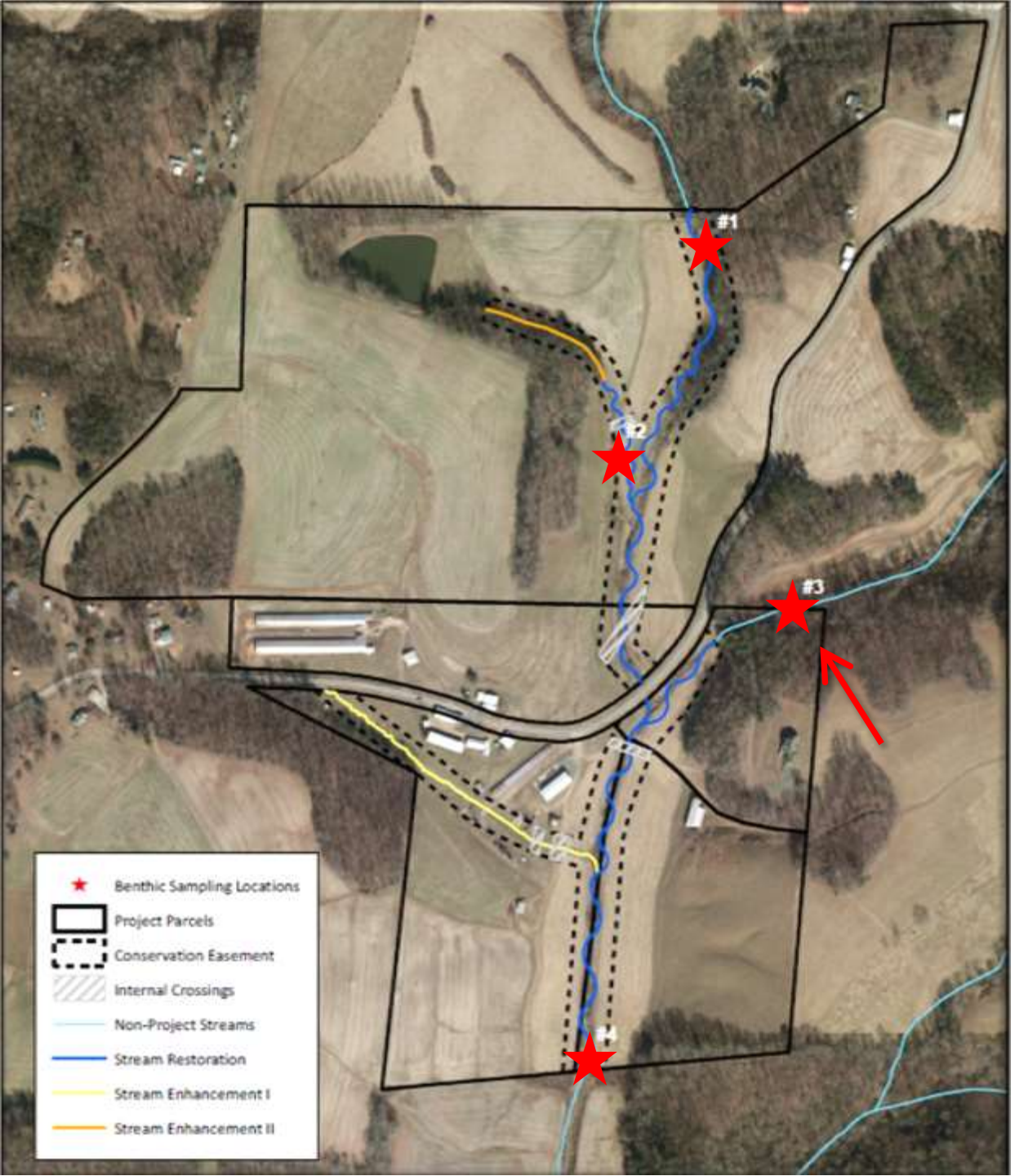
Methods

Benthos - North Carolina Qual 4 Sampling Methodology to find NC Biotic Index and EPT (NCDWQ 2016).

NCDWR Habitat Assessment Method for Mountain/Piedmont and Coastal Streams (NCDWQ 2016).

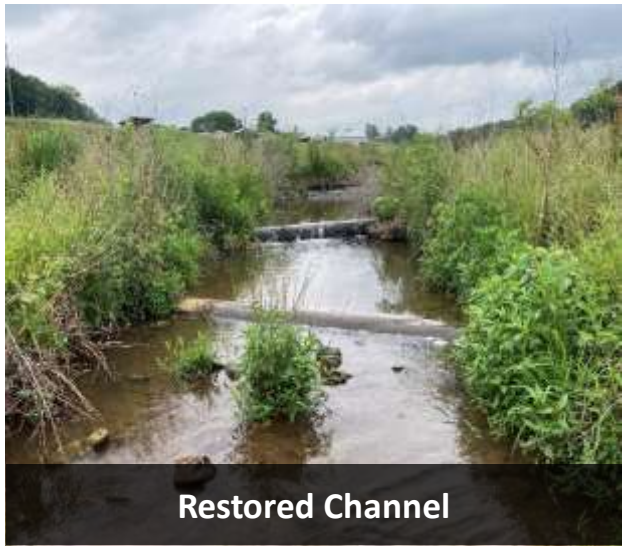
Water quality parameters: DO, PH, Temperature, Conductivity

IDs completed by a licensed taxonomist to the species level.



On-Site Control Sampling Location

On-Site Control



Restored Channel

Reference Data

Often small streams are unrated or unsampled

Sampling methodologies may change over time

Data collection frequency varies

Selected reference watersheds contain restored sampling sites

Collected annually

Similar drainage area to restored sites

Data Analysis: North Carolina Biotic Index

Equation 1. Biotic Index

$$B = \frac{\sum(T_i)(n_i)}{N}$$

Where:

B = the Biotic Index (BI)

T_i = the Tolerance Value (TV) for the i^{th} taxon

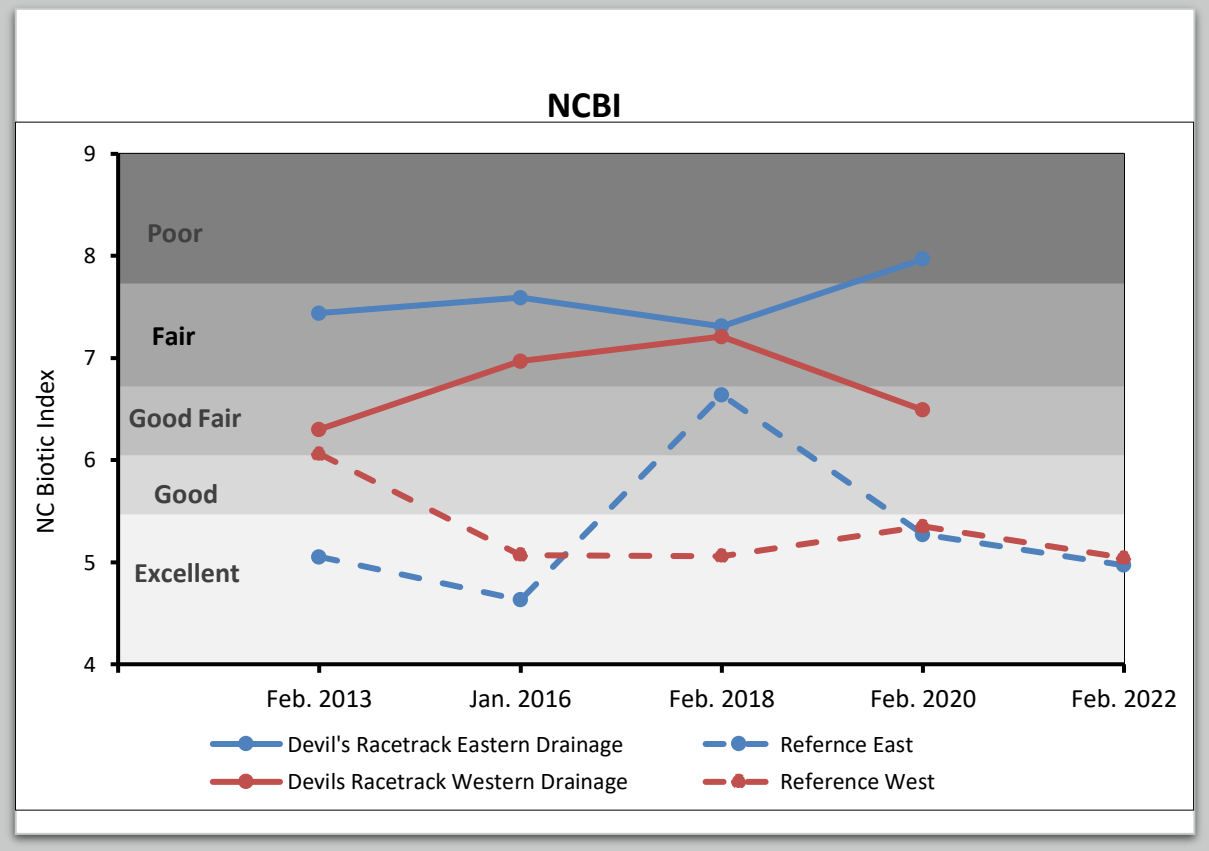
n_i = the abundance category value (1, 3, or 10) for the i^{th} taxon

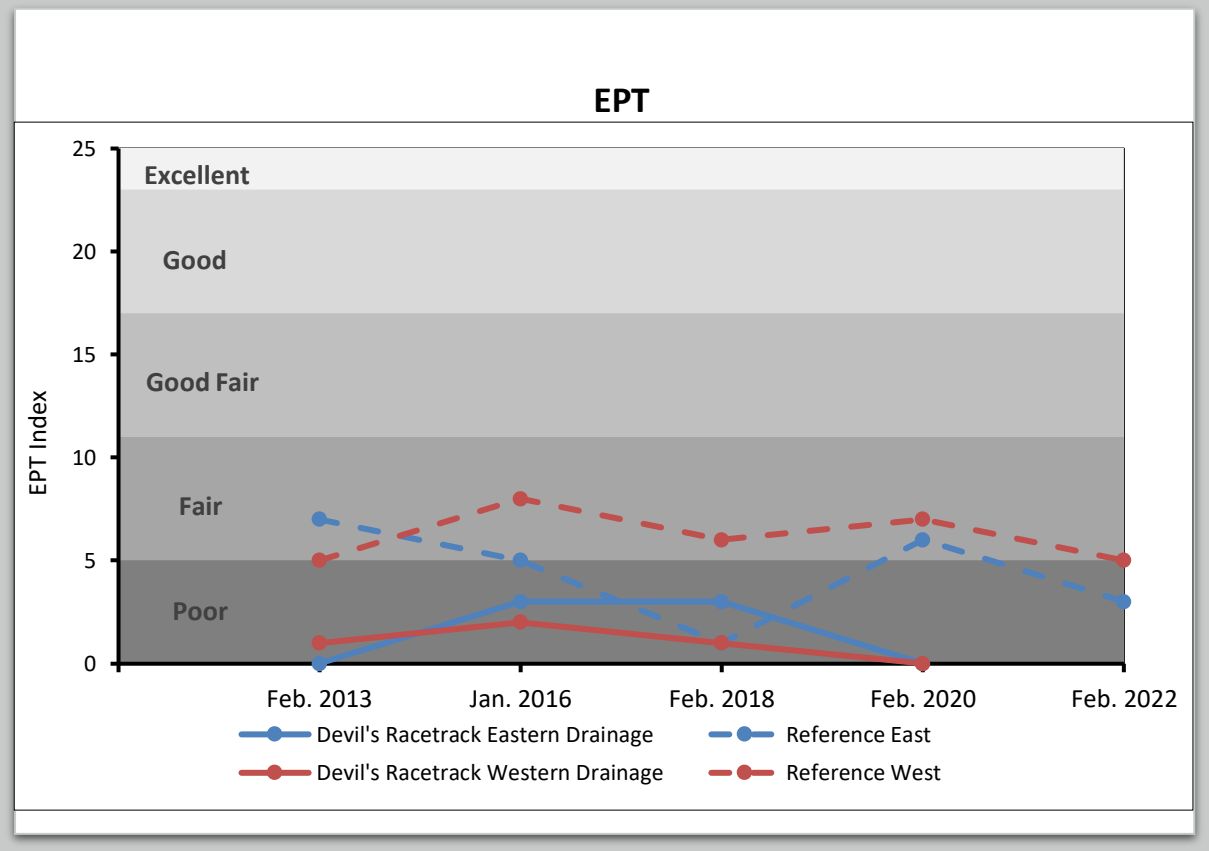
N = sum of all abundance category values

Criteria for NC Bioclassification:

- ✓ Stream size
- ✓ Flow regime
- ✓ Season of collection
- ✓ Sample method

Internal Long Term Reference Data



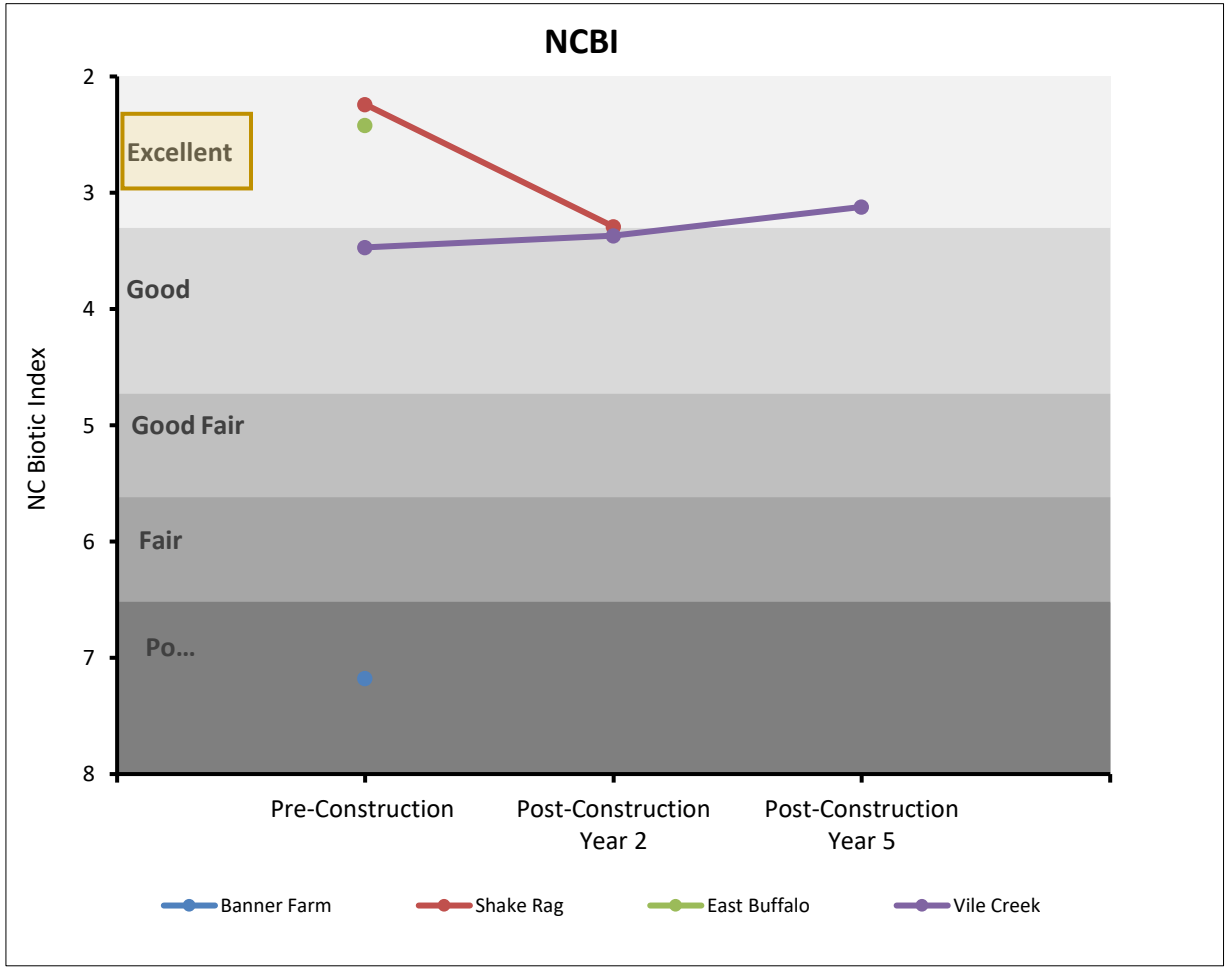


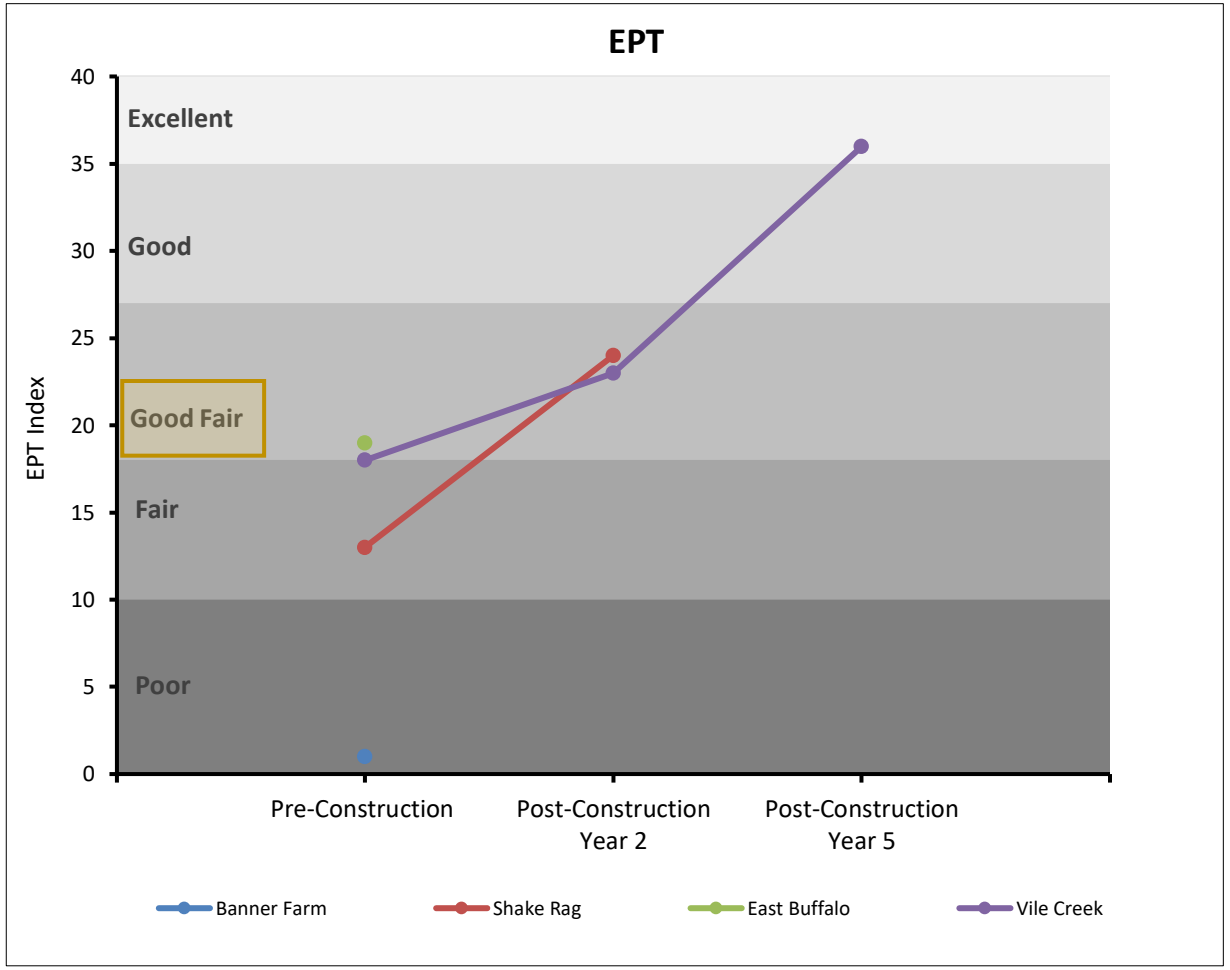
Achievable Success Criteria?

Ecological uplift is defined as an increase of one unit of bioclassification using the protocols of the Division of Water Resources (DWR, 2016).

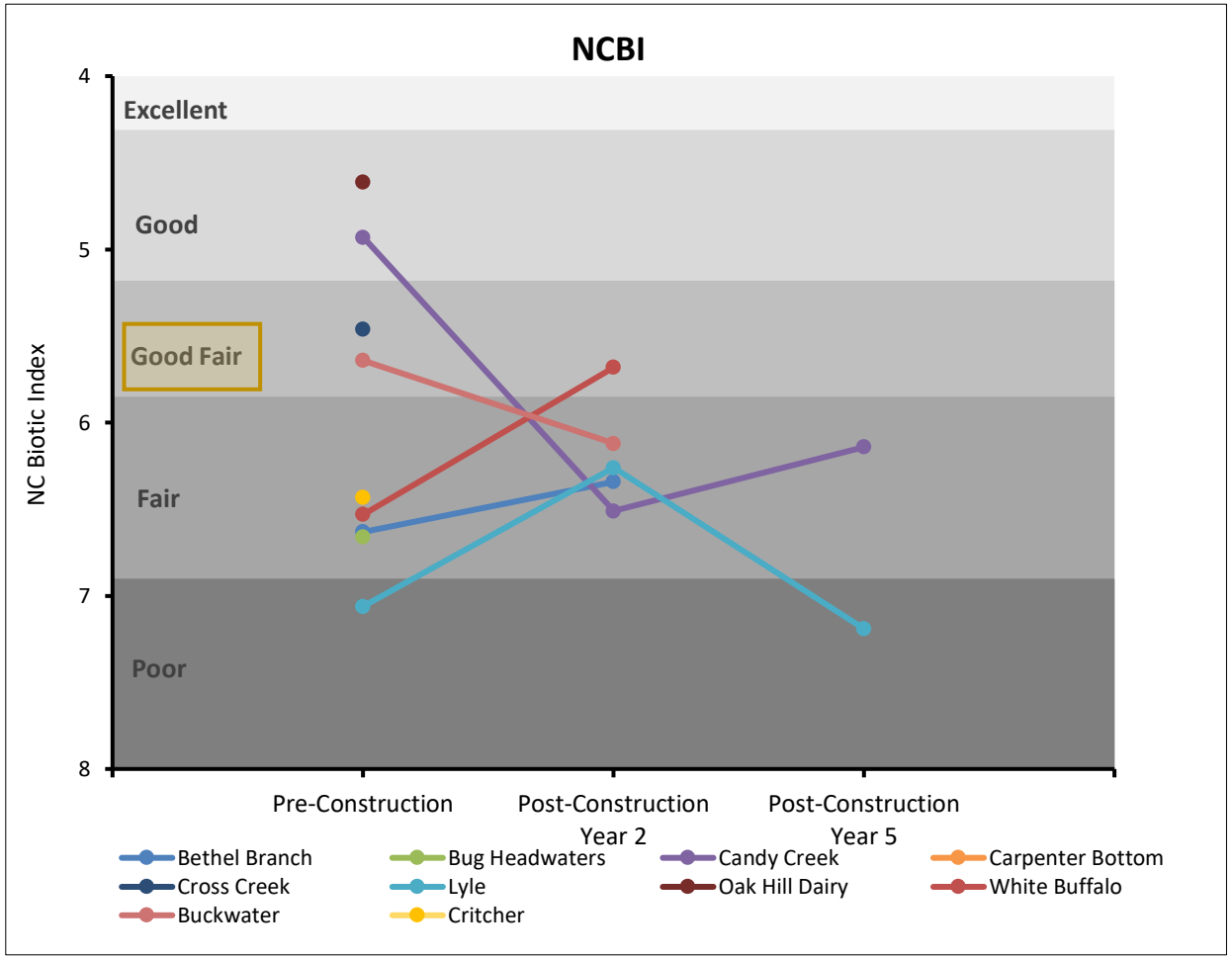
Bioclassification using Small Stream Criteria		
Bioclassification	Mountain	Piedmont
Excellent	< 3.30	< 4.31
Good	3.30 – 4.73	4.31 – 5.18
Good/Fair	4.74 – 5.62	5.19 – 5.85
Fair	5.63 – 6.52	5.86 – 6.91
Poor	> 6.52	> 6.91

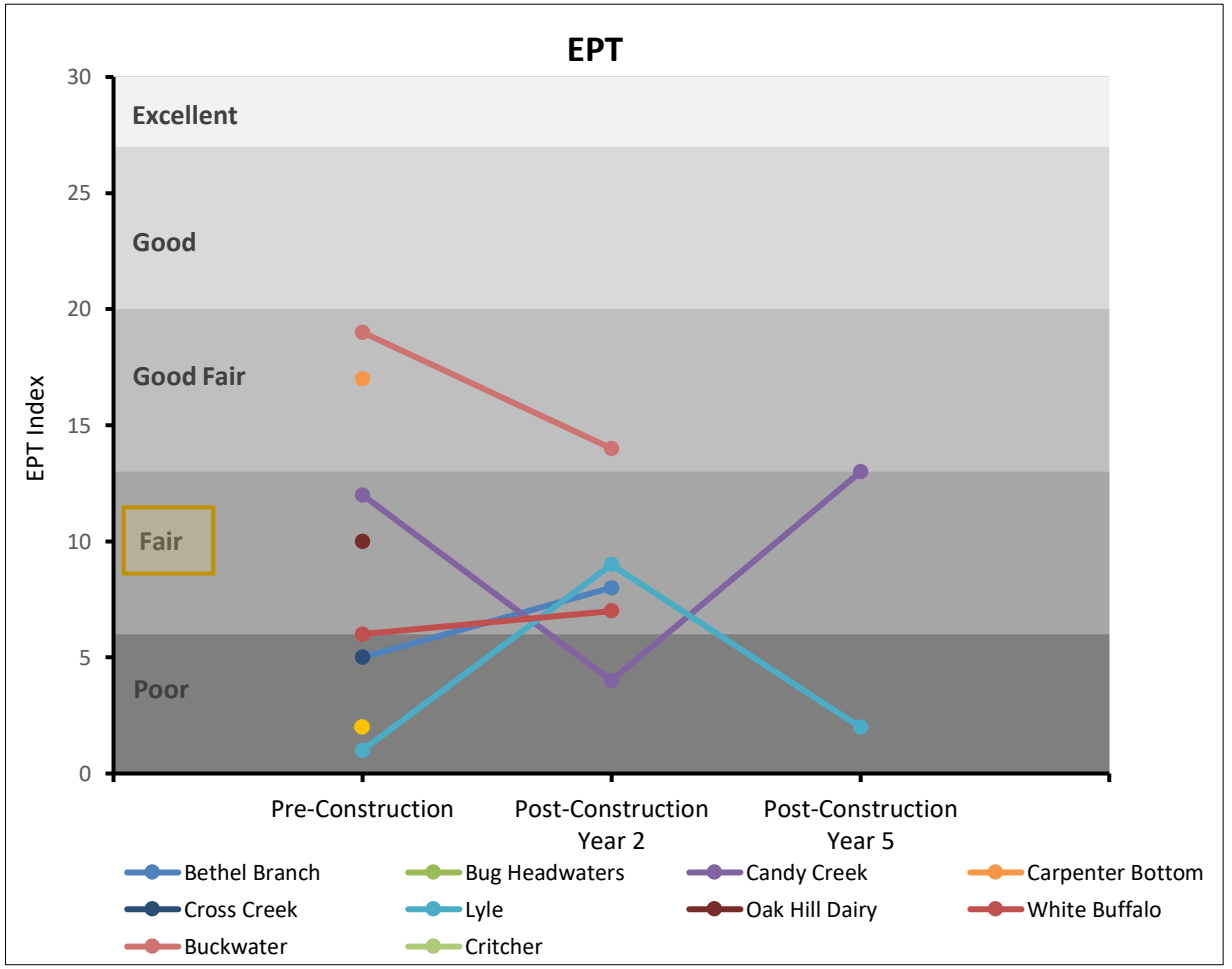
Preliminary Results - Mountains



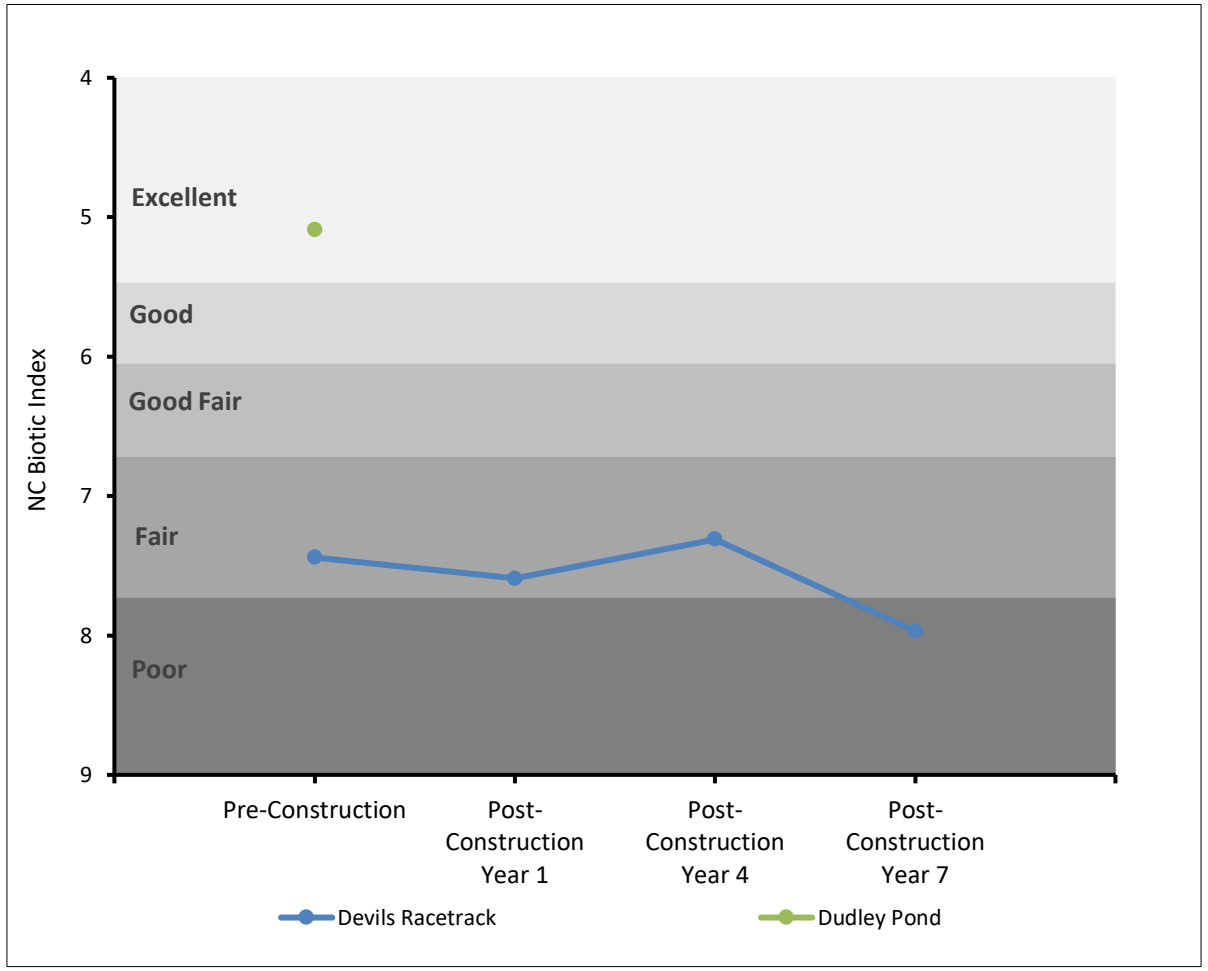


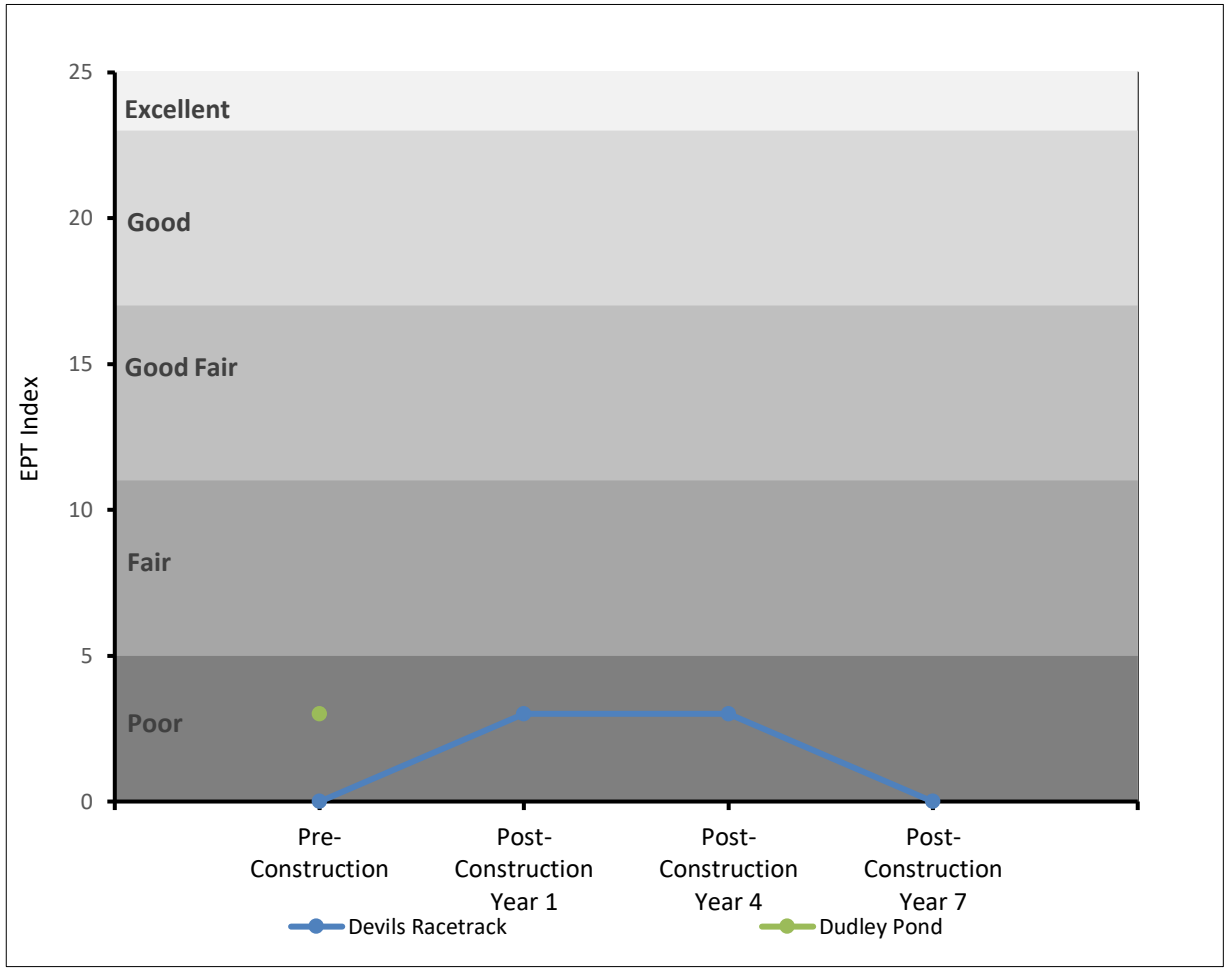
Preliminary Results – Piedmont





Preliminary Results – Coastal Plains





Next Steps:

- Expand number of internally sampled sites in each region.
- Increase sampling time frame post-restoration and look for trends.
- Establish internal, consistent, long-term data collection methods and standardize data analysis.
- Compare restored data to internal reference sites using an expected: observed ratio.
- Discuss how we define ecological uplift as restoration practitioners and mitigation providers.

Overall Research Question:

Can we demonstrate the long-term ecological success of Wildlands restoration projects using pre- and post-construction data?

References

NCDEQ. 2022. Benthos Sample Results. NC Department of Environmental Quality, Division of Water Resources. February 2022.

NCDWQ. 2009. Biocriteria for the Small Streams of the North Carolina Mountains and Piedmont. Memorandum. NC Dept. of Environment and Natural Resources, Division of Water Quality. May 29, 2009.

NCDWR. 2013. Division of Water Resources Environmental Sciences Section. Standard Operating Procedure Biological Monitoring Stream Fish Community Assessment Program. NC Dept. of Environmental Quality, Division of Water Resources. December 1, 2013.

NCDWR. 2016. Standard Operating Procedures for the Collection of Analysis of Benthic Macroinvertebrates. NC Department of Environmental Quality, Division of Water Resources. February 2016.

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