Stream Mitigation Performance Standards
Ecological Process – Not Engineering Success

Bob Siegfried - June 2024

NATIONAL STREAM RESTORATION CONFERENCE

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Stream Channel Mitigation Performance Standards

- Engineering versus ecological success
- What is required by the 2008 mitigation rule?
- Moving from engineering to ecological based performance standards
- What should be the role as-built documentation?

Engineering versus Ecological Success

Historically, channel performance has been emphasized Engineering Success

Going forward, we should emphasize ecological performance of the channel

Traditional Concept of Engineering Success

- Design follows Standard of Practice
- Design minimizes risk
- Construction follows design plan
- As-built focused on compliance with design
- Finished project should not change over time
- Any change is sign of potential failure
- Failure is safety issue
- React to Change to prevent Failure

Many Performance Standards For Streams Are **Based On Engineering Concept Of Success**

Ecological Success (Biotic and Abiotic)

- Design is starting point, risk is inherent
- Stream must change over time
  - Vegetative succession expected
  - Channel adjustments should also be expected
- Change is required to achieve maximum ecological success
  - Ecological succession
  - Messy Rivers – dynamic alluvial valley
  - Resiliency to climate change

Many Performance Standards For Streams **Prohibit Change Thus Prevent Maximum Ecological Success**

Engineering vs Ecological Standards

Engineering Standards

Focused on detecting change = failure

- Compare to design or as-built
- Limited change in channel geometry
- Leads to harden channel to prevent change
- Lack of change limits ecological success

When to use engineering standards

- Grade control structures at DS Termini to protect against headcut
- Grade control at dam removal site
- At utility crossings

Ecological Standards

Focused on allowing ecological success

- Change is expected and required
- Accept channel evolution (i.e. C – E)
- Focus on ecologically relevant monitoring
- Define trend toward ecological success

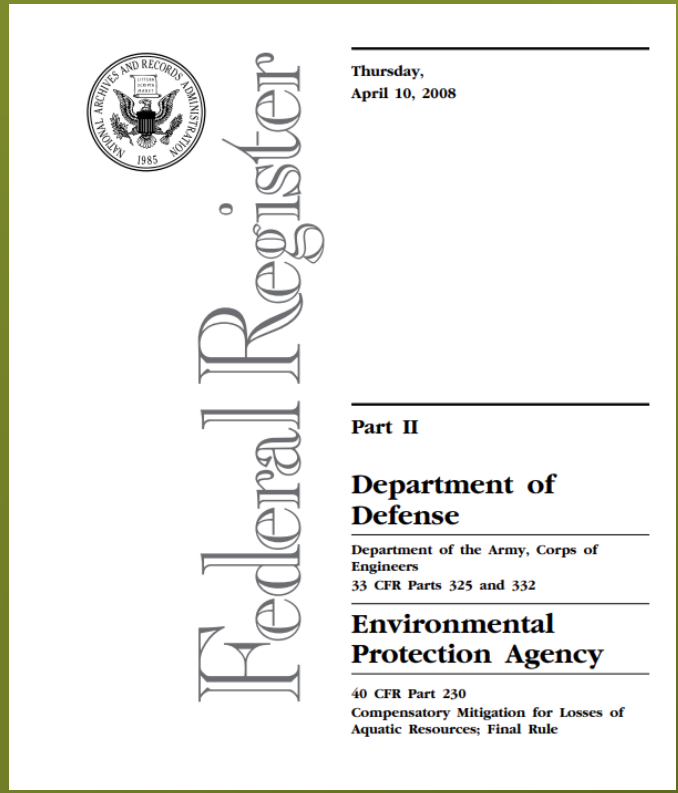
When to use ecological standards

- Ecological standards for all channels
- All bedforms (riffles, pools, steps) are primarily habitat features

What Does The 2008 Mitigation Rule Require?

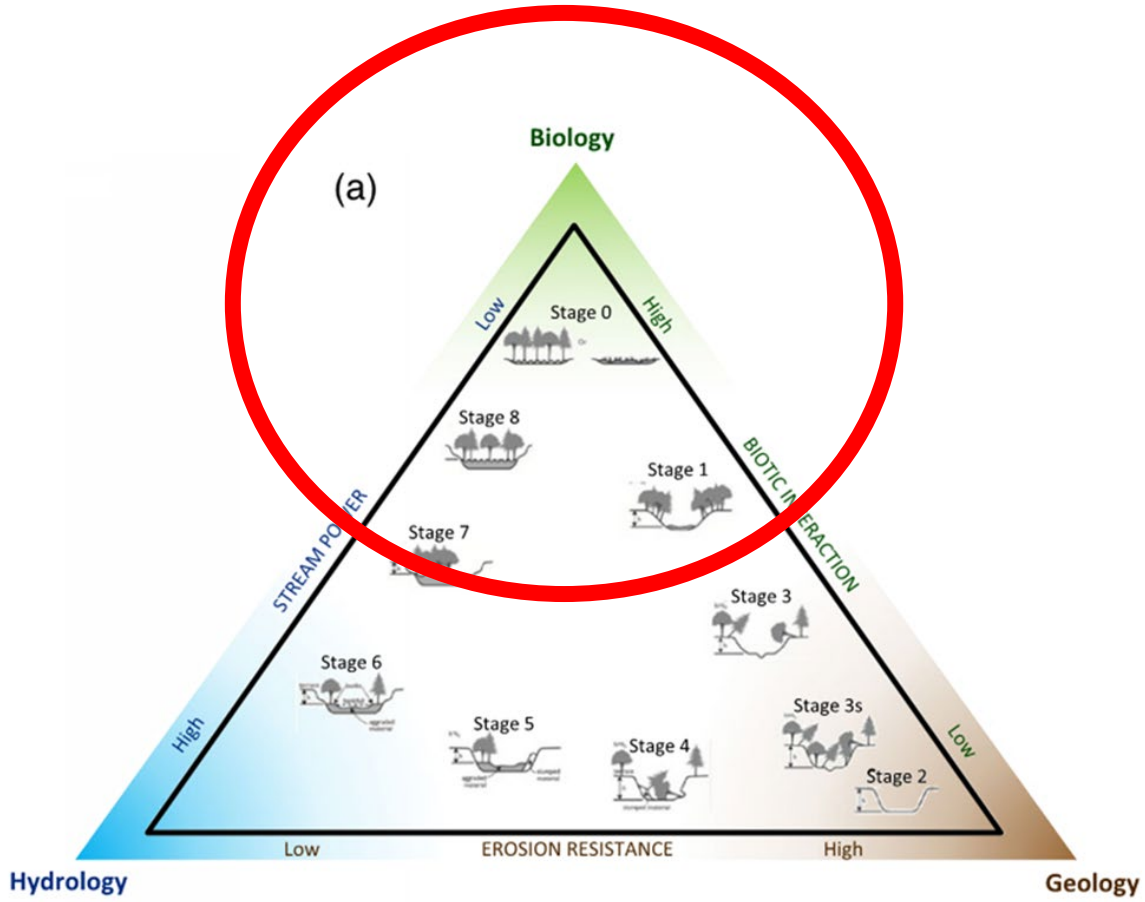
The focus is on ecological performance

No mention of stability or engineering performance



332.5 Ecological Performance Standards

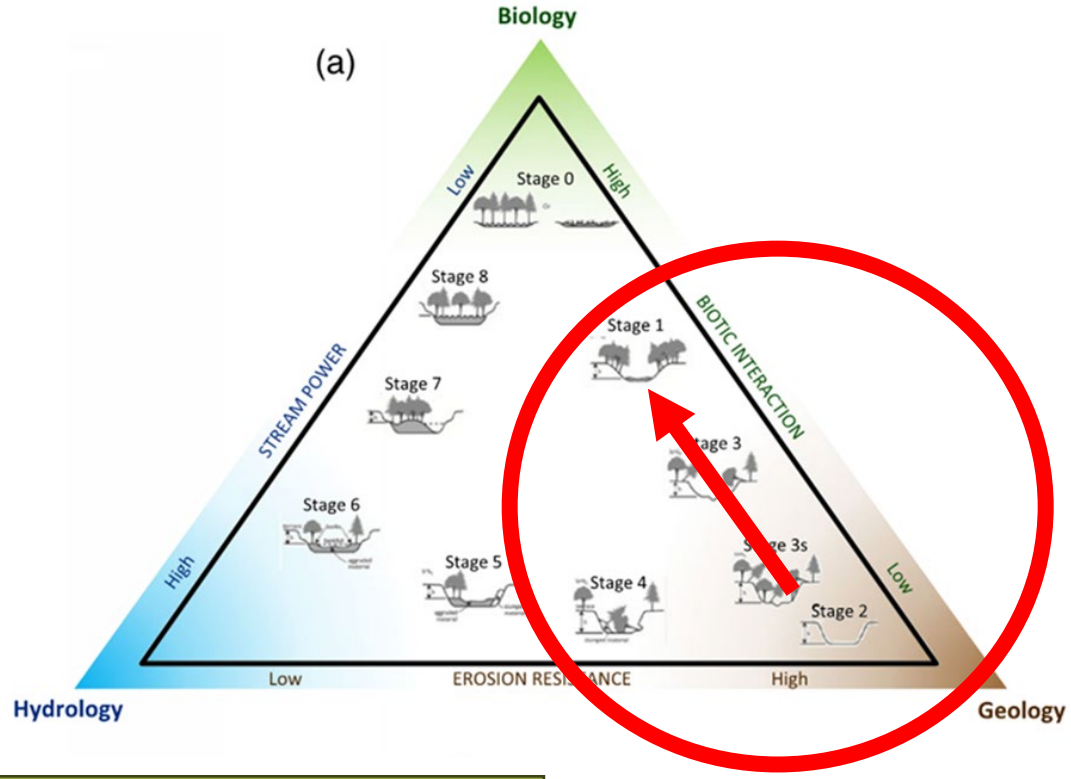
- "Ecologically base standards that will be used to determine whether the compensatory mitigation project is achieving its objectives. "
- "Based on the best available science that can be assessed in a practicable manor"
- "Performance standards should take into account the expected stages of the aquatic resources development process "(i.e. successional change)



Highest Ecological Outcome when stream is driven by it's Biology

Actual Focus of Channel Performance Standards

- "Annual monitoring will focus on changes in the morphology of channel from the final stream design"
- "Performance standard achieved means the channel has not significantly deviated from the final design "
- "The stream Performance Standards should demonstrate that the stream channels …..meet the intended objectives and functions of the Bank and attain dynamic equilibrium."



These Standard ASSUME that the original Design is "Correct", follows Channel Evolution Model and; is a Transport Reach

Comparing Underlying Approach to Performance

Engineering Performance

Assumes failure is common, release credit after proving success

- One endpoint for engineering success
- Engineering success = minimal change
- Failure = Change
- Credit release based on proving success
- Ecological success poorly measured
- Long review times to confirm success
- Credit release often delayed pending approval of success

Ecological Performance

Assumes ecological success is common, hold credits if failure

- Many endpoints for ecological success
- Ecological success can mean many different things, have different outcomes
- Credit release should presume ecological success
- Monitoring clearly identifies when ecological success is no achieved
- Shorter review time
- Failure results in credit withholding

Moving from Engineering to Ecological based Performance Standards

Performance Standard for Floodplain Connection

Engineering Standard

Bank Height Ratio (BHR) <1.2

- BHR is design or assessment criteria, not ecological metric.
- Tertiary measure of potential for connection
- Based on subjective bankfull determination
- Unreliable in new constructed channel – defaults to design
- Measuring change from design

Ecological Standard

# of Floods per Year

- Direct measure floodplain connection
- Objective and verifiable
- Bankfull event often required for credits
- Use stream gages & wells
  - Evidence Based / Data Rich
  - How many floods per year
  - Duration of Floods
  - Seasonality of floods
  - Flood extent across floodplain

BHR and ER do NOT measure floodplain connection or ecological performance

Performance Standards for Channel Cross Section

Engineering Success

Cross section geometry within 10-20% of the final stream design (or as-built)

- Designs based on regional curves have +/- 50% margin of error
- *Roper et al 2002* shows measurement error is 20% for channel dimensions
  - Subjectivity of BKF
- Devoid of biotic information

Measure bank erosion potential instead of geometry of channel

Ecological Success

Bank erosion should not exceed natural levels of erosion

- Research supports about 10-20% of banks in health streams are eroding
- BEHI / NBS surveys to document severity and extent of bank erosion
- Biotic & Abiotic Information
- Narrowing/widening often response to site specific hydrology/sediment loads
- Narrowing /widening often response to changes in vegetation

Performance Standards for Bank Erosion

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Performance Standards for Profiles

Engineering Standard

Stream Profile

- Designs are often very uniform
- Construction creates uniformity
- Monitoring profile is error prone
- Analysis of profile data is problematic

Only Use Profiles to:

- Assess critical grade control structures
- Track headcuts over time

Ecological Standard

Habitat Assessment (HA)

- Conduct regionally appropriate HA
- Evaluates biotic and abiotic elements
- Ecology improves as uniform as-build condition becomes more diverse
- Ecology improves as vegetation matures
- Compare pre-restoration to restored condition

Performance Standards for Habitat

Engineering Standard

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- Construction creates uniformity
- Monitoring profile is error prone
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Performance Standards

Engineering Standards

BHR or ER

Cross Sections

Profiles

- Abiotic data, no biotic data
- "Slice" data – not continuous
- Lots of data, difficult to properly interpret
- Not holistic or transparent

Sterile Story Of Channel Stability

Ecological Standards

Stream Gage Data

Erosion Potential Monitoring (BEHI)

Habitat Assessment (HA)

- Assessments Integrate Of Biotic And Abiotic
- Continuous data, rich in information
- Holistic & Transparent Understanding Of Site

Data Rich Story about Ecological Condition

Role of As-built Documentation

Use as an engineering tool leads down the road of engineering performance standards

What Should be Role of As-Built

Engineering Performance

- As –built demonstrates:
  - Project was built
  - Project followed approved design
  - Documents any deviations from design
  - Acres and LF achieved = Crediting
- As-Built used for credit release.
- Used for Grade Critical Elements
- Use for evaluation of systemwide failure / major storm damage
- Should not be used for ecological performance

Grade Critical Element

- Utility Crossing
- Dam breach zones
- Head cut control structure

Baseline for Ecological Performance Standards

Pre-restoration baseline is compared to Post-Restoration Condition

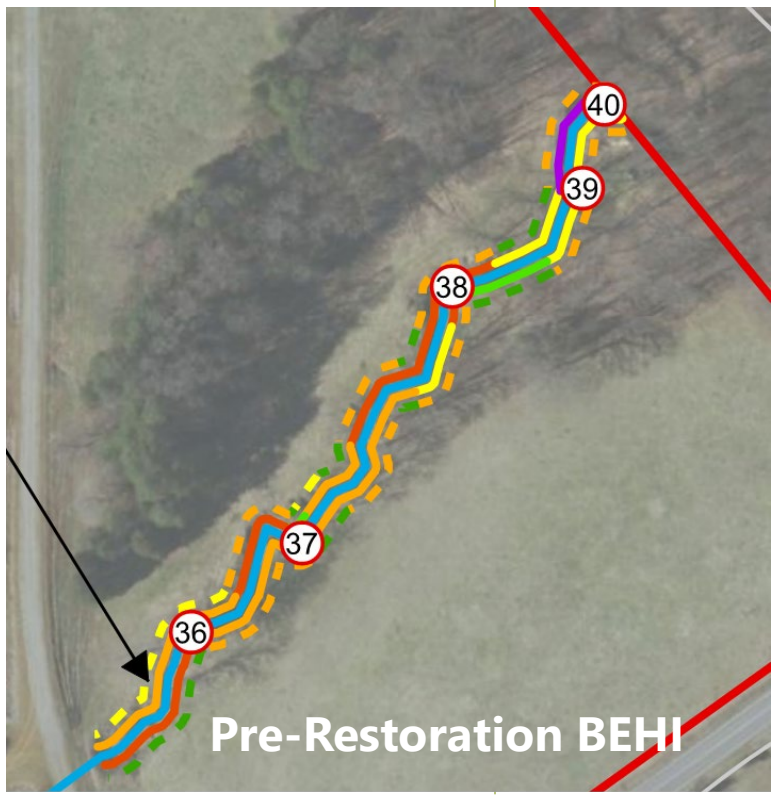
Demonstrates ACTUAL <u>ecological uplift</u>

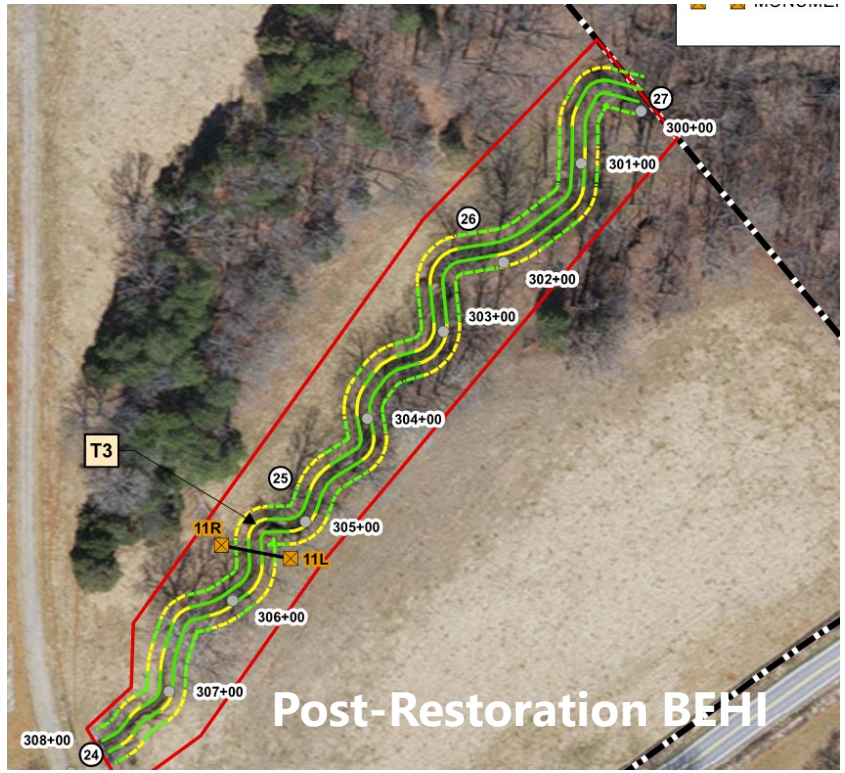
- Flood frequency
- Habitat assessments
- Bank erosion
- Biological data

For IRT

- Much Easier to Review
- Transparent
- Holistic

Comparison of BEHI before and after restoration





Thank you

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