Political and Economic Geomorphology: The Effect of Market Forces on Stream Restoration Designs

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Presentation Overview

1. Background on stream mitigation banking
2. Project objectives
3. Mixed methods approach
4. Physical results
5. Interpretation of physical results with social findings
6. Implications for other states
What is Stream Mitigation Banking?

- Corps of Engineers
- Bank approvals
- Bank applications
- Mitigation bank
- Permit to impact
- Permit applications with mitigation credits
- Impactors
- Mitigation credits for completed projects
- Money ($) and liability for project failure
Project Objectives

• Employ a mixed-methods approach to understand:
Study Design and Methods

• North Carolina as study site

• Physical Study
  – Three stream types:
    1. Non-restored streams
    2. Streams restored for mitigation credits
    3. Streams restored through other funding sources
  – Standard geomorphic surveys for non-restored sites
  – As-built surveys, monitoring reports for restored sites

• Social Science Investigations
  – Interviews with (1) regulators, (2) mitigation bankers, (3) stream designers and (4) academic researchers
North Carolina’s Three Regions
Site Selection – Watershed Size

The graph shows the proportion of sites based on drainage area in square kilometers, categorized into three ranges: 0-1, 1-10, and >10 square kilometers. The data is broken down by three conditions: Non Restored, Mitigation, and Non Mitigation. The bars indicate a higher proportion of sites in the 0-1 and 1-10 square kilometer ranges, with the Non Mitigation category showing the highest proportion in the 1-10 range.
Mitigation Influences on Site Selection
Valley Slope at Project Sites

- **Mountains**
- **Piedmont**

**Box plots for Valley Slope (m/m):**
- **Stream type**
  - **Non Restored**
  - **Mitigation**
  - **Non Mitigation**
Example of Large Mitigation Site

LEGEND
- STREAM RESTORATION
- STREAM PRESERVATION
- STREAM ENHANCEMENT
- WETLANDS
- FORD
- CONSERVATION EASEMENT
- PROPERTY BOUNDARY
- GAS PIPELINE
Example of a Non-Mitigation Site
Total Restoration Length Per Project

![Box plot showing total restoration length per project type](image)

- **Mitigation**
  - Median: 1,000 meters
  - Range: 500 to 3,000 meters

- **Non-Mitigation**
  - Median: 3,000 meters
  - Range: 2,000 to 4,000 meters
Relative amount of main channel and tributaries contributing to project sites.
Planform Results - Sinuosity

The graph shows box plots comparing sinuosity across different restoration types. The categories are Non Restored (19), Mitigation (43), and Non Mitigation (17). The box plots indicate the distribution of sinuosity values for each category, with the green box representing Non Restored, blue for Mitigation, and orange for Non Mitigation.
Planform Examples
Planform Results – Radius of Curvature

Piedmont

Radius of curvature (m)

Stream reach

Non Restored
Mitigation
Non Mitigation
Channel Form Results – W/D Ratio

The image shows a box plot comparing the W/D ratios (stream width to depth ratio) for different restoration types: Non Restored (18), Mitigation (32), and Non Mitigation (4). The box plot indicates the distribution of W/D ratios for each group, with the median, interquartile range, and potential outliers shown. The restoration types are categorized under Piedmont.
“Typically we are looking for smaller streams, headwaters... because it's more cost-effective.... It's just the nature of the game, the economy. You can't do a third order river for the same [price].... If you can do a channel this big [holds hands a meter apart] it's a lot cheaper than [makes a sweeps hands apart], you know. So you will see that a lot of the mitigation work has been smaller streams. Now luckily that jives with some of the research about headwater streams being so important. So a lot of it is focused in the headwaters.” [Mitigation Banker, 7/11/2012]
Interview Results – Total Project Length

“To do a mitigation project you have got to do a mitigation plan, you have got to do all your monitoring, you have got to do your permitting, you have got to get a conservation easement. All these things have a lot of fixed cost to them, and so you really need your product to be of a certain size ... so you can spread those fixed costs over more credits or more length. So that is important for the economics of it.... ” [Mitigation Banker]
“We typically won’t do anything less than 2,500 feet. I mean ... how much good are we doing these postage stamp sites? I mean a half a mile? I prefer to work on 1st and 2nd order streams. I don’t want to work on a 3rd, or 4th, or 5th order system because we’re not really being able to make any contributions to improving water quality. Because when systems become that big they’re basically conduits for stormwater..... [I]f you want to have impacts to water quality, you need to be working in the headwaters.”

[Mitigation Banker, 7/9/2012]
“I’ve seen people try to maximize their length... You know, if credit is tied to footage, then add as much footage as they can and put in a lot of sinuosity. However, I think you have to weigh that with if you get too far outside of your design parameters is that you risk failure. To me that risk is not worth the reward of the additional credit. Nature will let you know if you make that mistake! [laughs] ... You’d have to go back and make that repair [or lose credits] ... The market kind of has a way to self-correct itself ... if you’re being a little greedy on the front end, as far as trying to push the site beyond what credits it can really yield.”
[Stream designer, 12/7/12]
“When we wrote these [stream mitigation guidelines] we didn't have good assessment tools, ... And so a lot of decisions were made purely based on what the stream appeared to look like, stability-wise, ... as kind of a proxy.” [Regulator]

“[The] mitigation component, as you are probably familiar with, in North Carolina is based on a lot of geomorphic measurements and otherwise to gain stability. Stability equals success...” [Regulator]
Interview Results – Stability

“So the bar in North Carolina pretty much up to current [times] ... was that that channel ... is going to be stable and for that monitoring period it's not going to move. There's going to be zero bank erosion, there's going to be no migration, there's going to be no incision. And so with those success criteria in mind I think there very well could be a tendency to design more conservatively....when somebody is financially on the line for that system performing and somebody is going to have a scorecard in year five or seven when you did it or didn't do it.” [Stream designer, 12/7/12]
North Carolina Findings

1. Site selection and project design are influenced by (1) science, (2) markets/economics, and (3) regulations.

2. Site selection differs between mitigation and non-mitigation projects while designs are fairly similar.

3. NC stream credit is a linear foot.

4. Success criteria based on stability.
   - Mitigation sites target headwater locations.
   - Designed streams have:
     a) moderate sinuosity
     b) homogenized planform
     c) greater W/D ratios

5. ‘Credit-chasing’ is generally not present.
Implications for Other States

1. The unit of stream restoration credits and the regulatory success criteria drive both site selection and project designs.

2. The “free market” will often generate exactly what is required by success criteria, at an increased pace and economy of scale, and often nothing more.

3. Adaptable regulations can provide valuable flexibility to address unexpected outcomes from mixing regulations with the “free market.”
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