Stream Restoration – Integration of Engineering and Science

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Education

- Phase 1 – Undergraduate Work
  - Civil Engineering: Environmental Focus
    - Not all what it seemed
    - Coop. Experience
  - Conservation and Environmental Science: Water
    - Additional Perspective
Education

- Phase 2 – Graduate Work
  - Biology – Fish Habitat Modeling
    - Diverse Committee
  - Soccer
  - Courses
  - Work Experience with Advisor/Stream Lab
  - Teaching Assistant
  - Thesis
Education

- BS Civil Engineering: Environmental Focus
- Coop Experience
- 2nd Major - Conservation and Environmental Science: Water
- MS Biology – Thesis and Fish Habitat Modeling
- Soccer
- Work Experience with Advisor/Stream Lab
- Teaching Assistant

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- Transportation Structures
- Communications Infrastructure
- Strategic Planning - Driverless Car Infrastructure
- Natural Resources
What is Stream Restoration

- Integrated field of:
  - Engineering (Hydrology, Hydraulics, Sediment Resistance and Mobility)
  - Science (Fish Identification and Habitat, Native and Invasive Plant Species)

- Assessment of streams to determine how to return ecological function and stable hydraulics to a flowing water body
What Stream Restoration is NOT

- Trash/Stream Cleanup
- Fish Hatchery/Stocking
- Recycling
Stream Processes

River Continuum Concept

Mountain headwater streams flow swiftly down steep slopes and cut a deep V-shaped valley. Rapids and waterfalls are common.

Low-elevation streams merge and flow down gentler slopes. The valley broadens and the river begins to meander.

At an even lower elevation a river wanders and meanders slowly across a broad, nearly flat valley. At its mouth it may divide into many separate channels as it flows across a delta built up of riverborne sediments and into the sea.

Zone 1 Headwaters

Zone 2 Transfer Zone

Zone 3 Depositional Zone

25% shallow infiltration
25% deep infiltration
21% shallow infiltration
21% deep infiltration

10% run off
20% run off

Natural Ground Cover

25% shallow infiltration
25% deep infiltration

10%-20% Impervious Surface

All figures from USDC - NRCS Federal Stream Corridor Restoration Handbook

[Diagram showing river continuum concept with various organisms and processes illustrated]
Additional Disruption

Livestock and Strip mining photos from USDA-NRCS technical manual Stream corridor Restoration.
Parameters of Restoration

All figures from USGS-NRCS Federal Stream Corridor Restoration Handbook
Stream Features

- Riparian Corridor
- Baseflow
- Thalweg
- Topographic floodplain
- Hydrologic floodplain (bankfull width)
- Bankfull elevation

Figure from USDE-USDA Federal Stream Corridor Restoration Handbook
Stream Features

- (a) Pool and riffle
- (b) Thalweg line and riffle or cross over

Symbols:
- $L$: meander wavelength
- $M_L$: meander arc length
- $w$: average width at bankfull discharge
- $M_A$: meander amplitude
- $r_c$: radius of curvature
- $\Theta$: arc angle

All figures from USDA- NRCS Federal Stream Corridor Restoration Handbook.
Electro Fishing
KCI’s restoration site of “Elmmede” in Howard County MD
KCI’s restoration of “Elmmede” in Howard County MD
KCI’s restoration of “Elmmede” in Howard County MD
Assessment Tools/Skills

- Surveying
- GIS
- Stream Walk
- Vegetation Identification
- Constraints Analysis
- Critical Thinking
  - How/Why
  - If/Then

Harmon et al. 2012
Design Tools/Skills

- Cross Section Sizing
- Profile (Algebra)
- Planform (Geometry)
- Model (HEC-RAS) Evaluation
- Cost Estimates (Geometry, Algebra)
- CADD/Drafting
- Report Writing
- Excel
Habits and Hobbies

- Have a river habit
  - Fishing
  - Kayaking/Canoeing
  - Volunteer (e.g. River RAT)
- Be someone you want on the team
- Follow through
- Curiosity
- Personal responsibility
- Diverse interests and experience
- Internships and part time jobs
Resources

- James River Association – Student of the James
  - [https://jrava.org/students-of-the-james/](https://jrava.org/students-of-the-james/)

- Virginia Lakes and Watershed Association
  - Wetland and Watershed Model (for Elementary – 6th graders)

- [https://www.sciencefriday.com/educational-resources/stream-table/](https://www.sciencefriday.com/educational-resources/stream-table/)
  - For 6-8 graders – additions to talk about more topics
    - Add houses, utilities
    - Add a dam – discuss what will happen.

- [https://www.youtube.com/watch?v=4LxMHmw3Z-U](https://www.youtube.com/watch?v=4LxMHmw3Z-U)

- [http://damnationfilm.com](http://damnationfilm.com)