Session C7 - Regenerative design applications to sustain baseflow to enhance fish passage in urban channels

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Applications of regenerative design to sustain baseflow in urban channels

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Outline

- Overview of problems with urban channels
- Discussions of traditional and regenerative design approaches
- Present a regenerative design approach for urban channels
- Review monitoring data
- Discuss other applications for this regenerative design approach
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Overview – What we know

Disappearing headwaters: patterns of stream burial due to urbanization

Andrew J Elmore* and Sujay S Kaushal


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Figure 2. Stream burial extent for the Gunpowder–Patapsco watershed in eastern Maryland, expressed as a probability of burial based on the distribution of impervious surfaces (shown in shades of gray) in the vicinity of each stream reach.
RELATIONSHIP BETWEEN IMPERVIOUS COVER AND SURFACE RUNOFF

- Impervious cover in a watershed results in increase surface runoff.
- As little as 10 percent impervious cover in a watershed can result in stream degradation.
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Overview – What we know

URBAN HYDROGRAPH

A - Pre-Urbanized Condition
B - Post Urbanized Condition
C - Post Urbanized with Stormwater Management

DISCHARGE (cfs)
Disturbance to a stream corridor system typically results in an increasingly negative spiral of degradation to stream structure and function.

- Changes in land and stream corridor use
- Changes in geomorphology and hydrology
- Changes in stream hydraulics
- Changes in function such as habitat, sediment transport and storages
- Changes in population composition and distribution, eutrophication, and lower water table elevations
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Overview – What we know

Our urban streams are getting hammered!
The timing, delivery and quality of water in our river systems is significantly altered in urban systems
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Overview – What we know

**Impacts to fish passage**

- Baseflow decreases
- Runoff increases
- Habitat destabilizes
- Water temperature increases
- Turbidity increases
- Water quality impacted
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Overview – Traditional approaches

Ecological Restoration:
• reestablish an ecosystem’s structure and function, *usually bringing it back to its original (pre-disturbance) state* ... (National Park Service)
• ...the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. (Society for Ecological Restoration)
• Typically imposes an ideal channel form consistent with contemporary baselines – sinuous, single threaded
• Focuses on *channel* stability and conveyance of a single or limited range of design discharges
Regenerative Design – Moving Beyond Restoration

A design paradigm where human activities are deeply integrated with living systems, continuously building biological diversity, resilience and community spirit.

In severely degraded urban systems

- Focus on the design of a resilient systems that function to meet the ecological and societal needs.
- These systems may not fit our contemporary baseline.
Decide a living system that is stable in the context of an urban watershed that:

- Sustains baseflow
- Buffers runoff events
- Creates persistent habitat
- Stabilizes temperature
- Decreases turbidity
- Enhances ability of channel to process nutrients
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Approach – Natural analogs
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Approach – Cross-section
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Approach - Profile
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Approach - Profile
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Approach – low gradient sites

Set weirs to maintain base flow water surface at or slightly above floodplain elevation.
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Approach – higher gradient sites

Set weirs to contain design storm and force flood flows overbank.

Before (dry weather)

Photos provided by Underwood & Associates

After (during runoff event)
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Approach

Adaptive to site constraints

- Small construction footprint
- Ability to save mature trees
Results – Sustains baseflow

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Source: Palmer and Filoso, 2009

Hydro-Modification
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Results – Buffers runoff

Source: Solange Filoso, University of Maryland
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Results – Persistent habitat
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Results – Stabilizes temperature

Source: Solange Filoso, University of Maryland
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Results – Decreases turbidity

Source: Solange Filoso, University of Maryland
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Results – Enhanced ability to process nutrients

Source: Solange Filoso, University of Maryland
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Other Applications

• Replacing closed storm drain networks and traditional BMPs?

• Dam removal?
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Other applications – replacement for closed stormdrain systems
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Other Applications – Dam Removal
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Alternative Approach – Dam Removal

Photo simulation
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Other Applications – Dam Removal

Seepage berm
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Other Applications – Dam Removal

Constructed seepage berm
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Other Applications – Dam Removal

Vegetated seepage berm
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Take home message

- Regenerative design solutions may require a shift in our baseline of stream restoration projects, but employ familiar techniques
- This regenerative approach restores natural functions of a stream system
- Working from the top down in an watershed, we expect marked improvements in our receiving waters
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Thank you…

questions?

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