Big Spring Run Restoration Project Background

Pennsylvania
Department of Environmental Protection

Pennsylvania Legacy Sediment Workgroup

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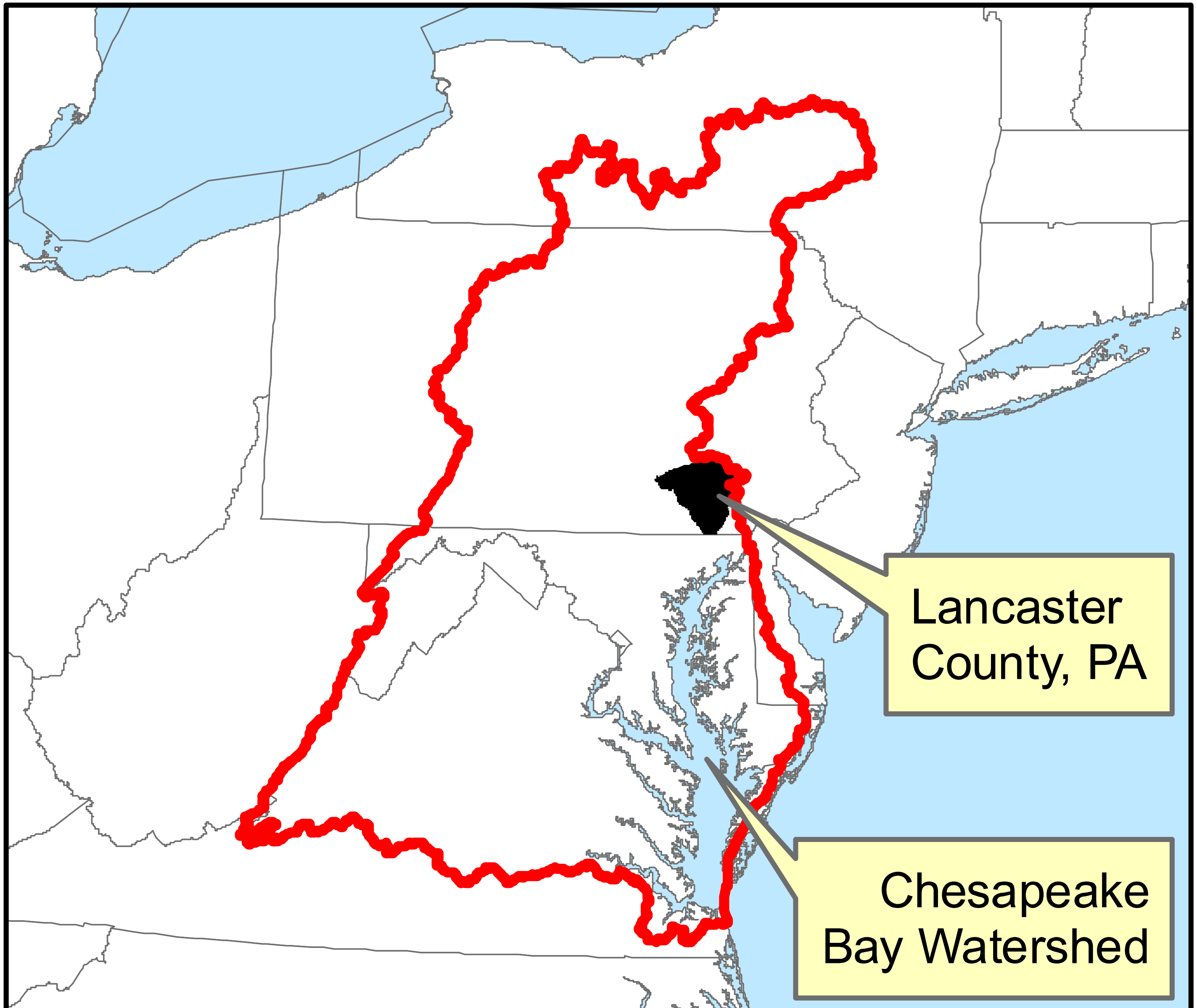
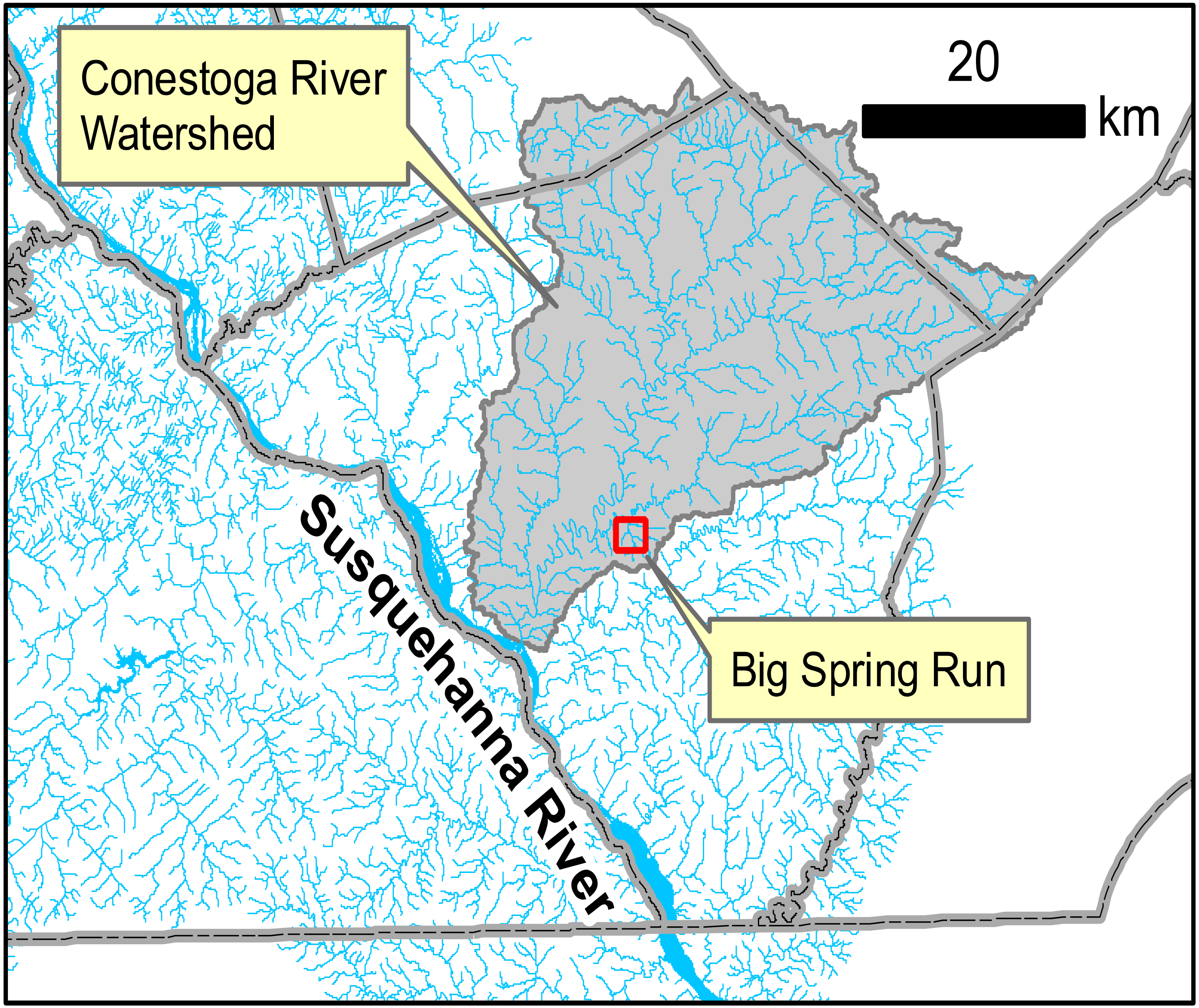


Courtesy Franklin & Marshall College



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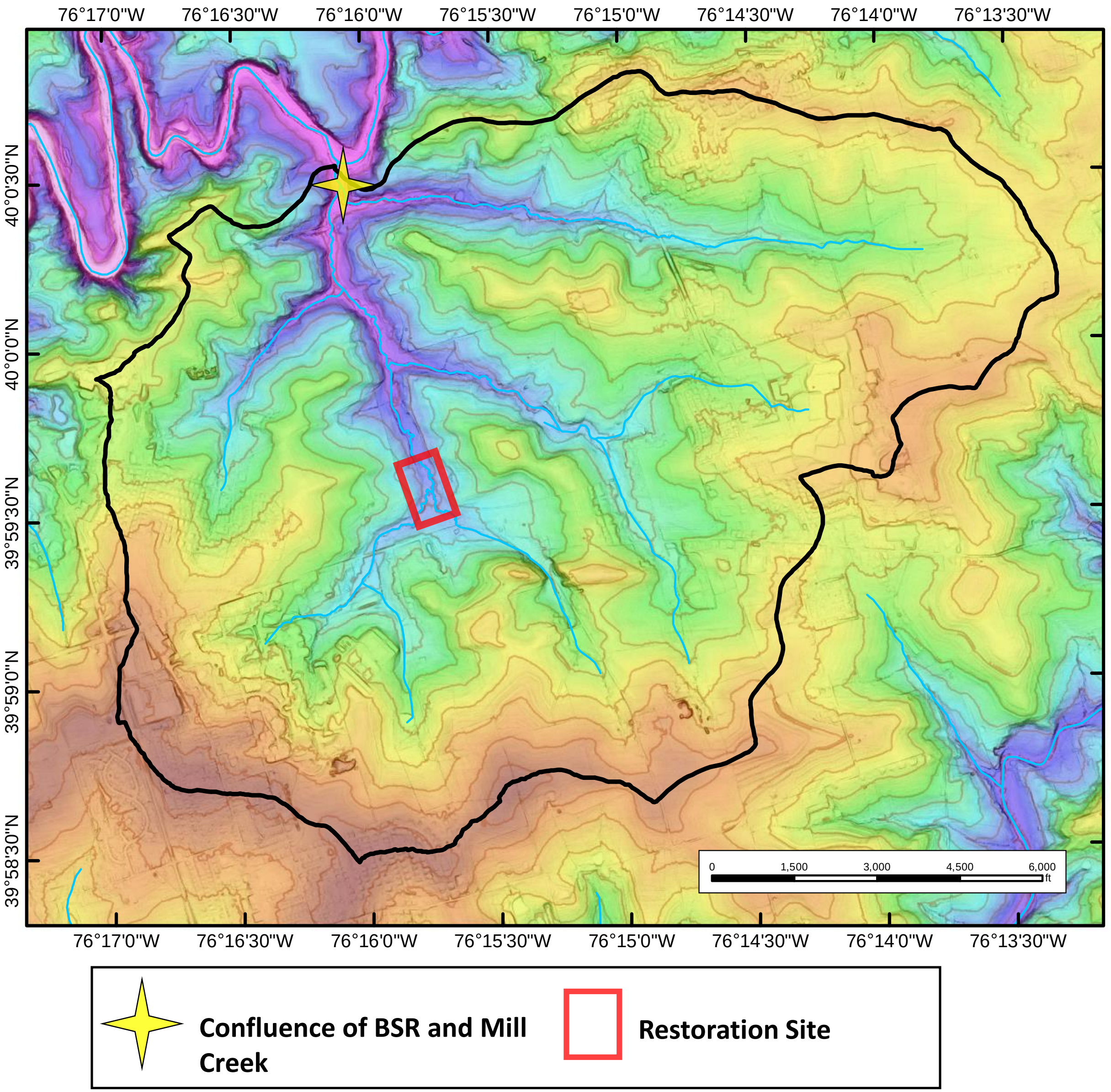
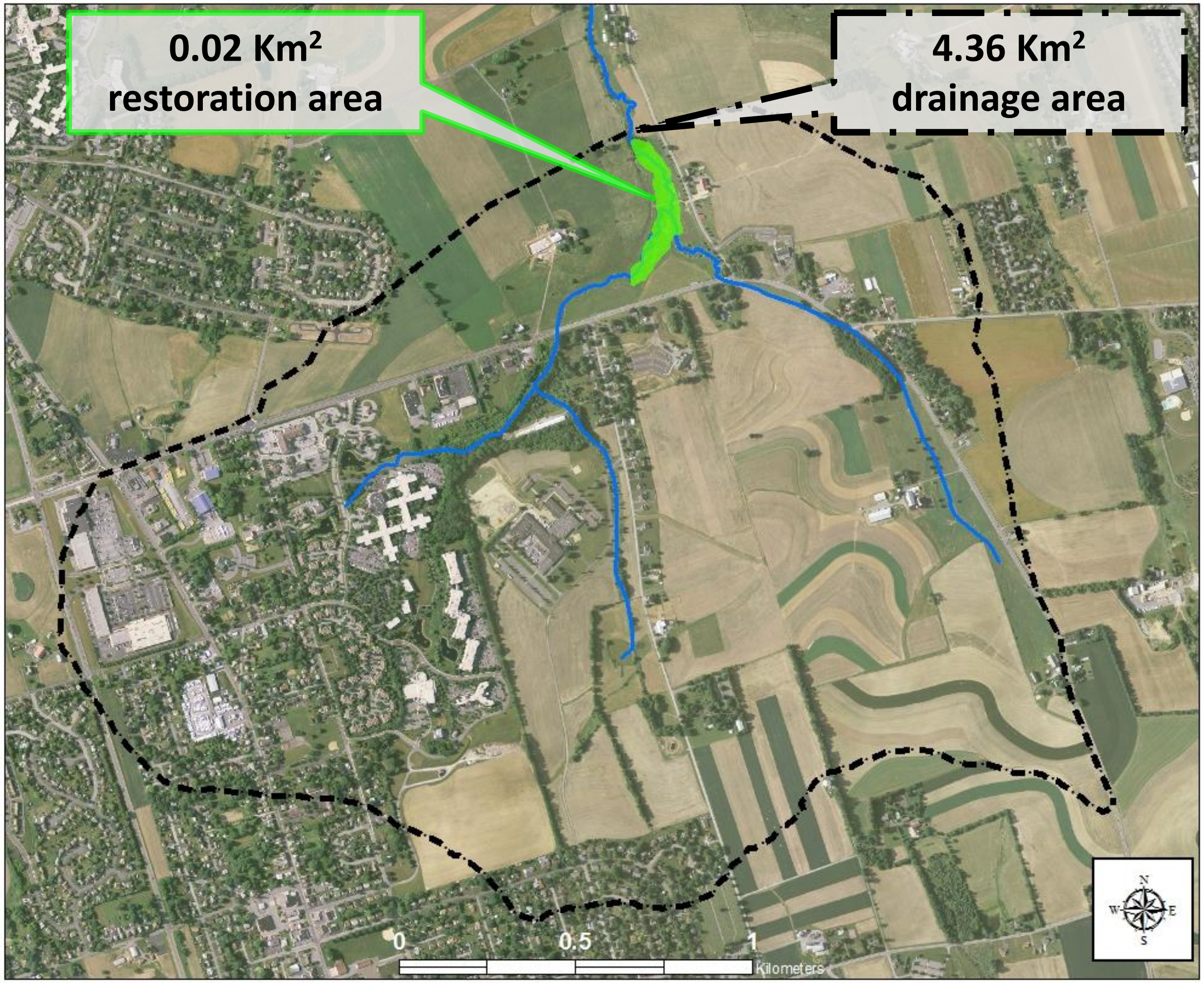
Big Spring Run Watershed



Walter, et al., 2013 PA DEP Report

Watershed Landuses



2013 NAIP Imagery – the ratio of restoration area to drainage area < 1%

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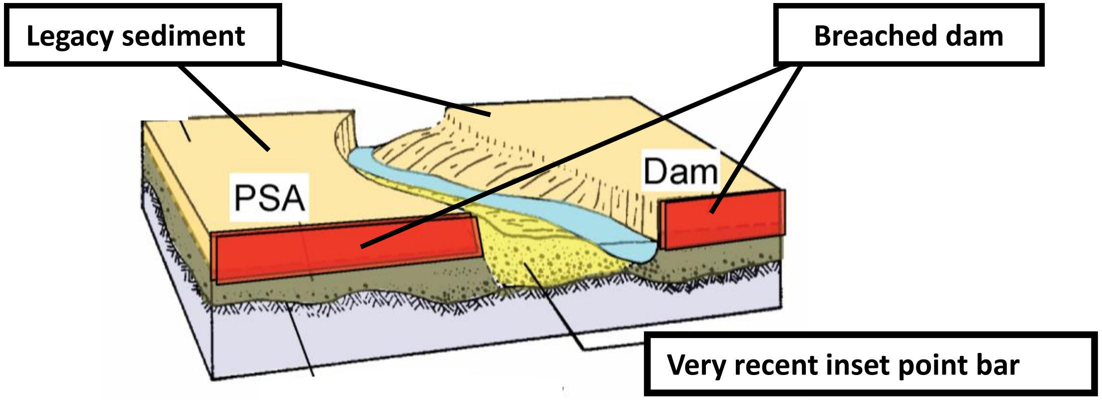


Modified from Jacobson and Coleman, 1986 after Walter and Merritts, 2008

Principles for the Ecological Restoration of Aquatic Resources (EPA841-F-00-003)

**US Environmental Protection Agency
Washington, DC. 2000.**

- Identifies principles that are critical to the success of restoration projects
- Intended for use by a wide variety of people
- Specific to aquatic ecosystem restoration projects

http://www.epa.gov/owow/wetlands/restore/

Guiding Principles

Involve the skills and insights of a multi-disciplinary team

- Restoration can be a complex undertaking that integrates a wide range of disciplines
- Universities, government agencies, and private organizations may be able to provide useful information and expertise
- Complex projects require effective leadership to bring viewpoints, disciplines and styles together as a functional team

Big Spring Run Legacy Sediment Removal and Aquatic Ecosystem Restoration Project

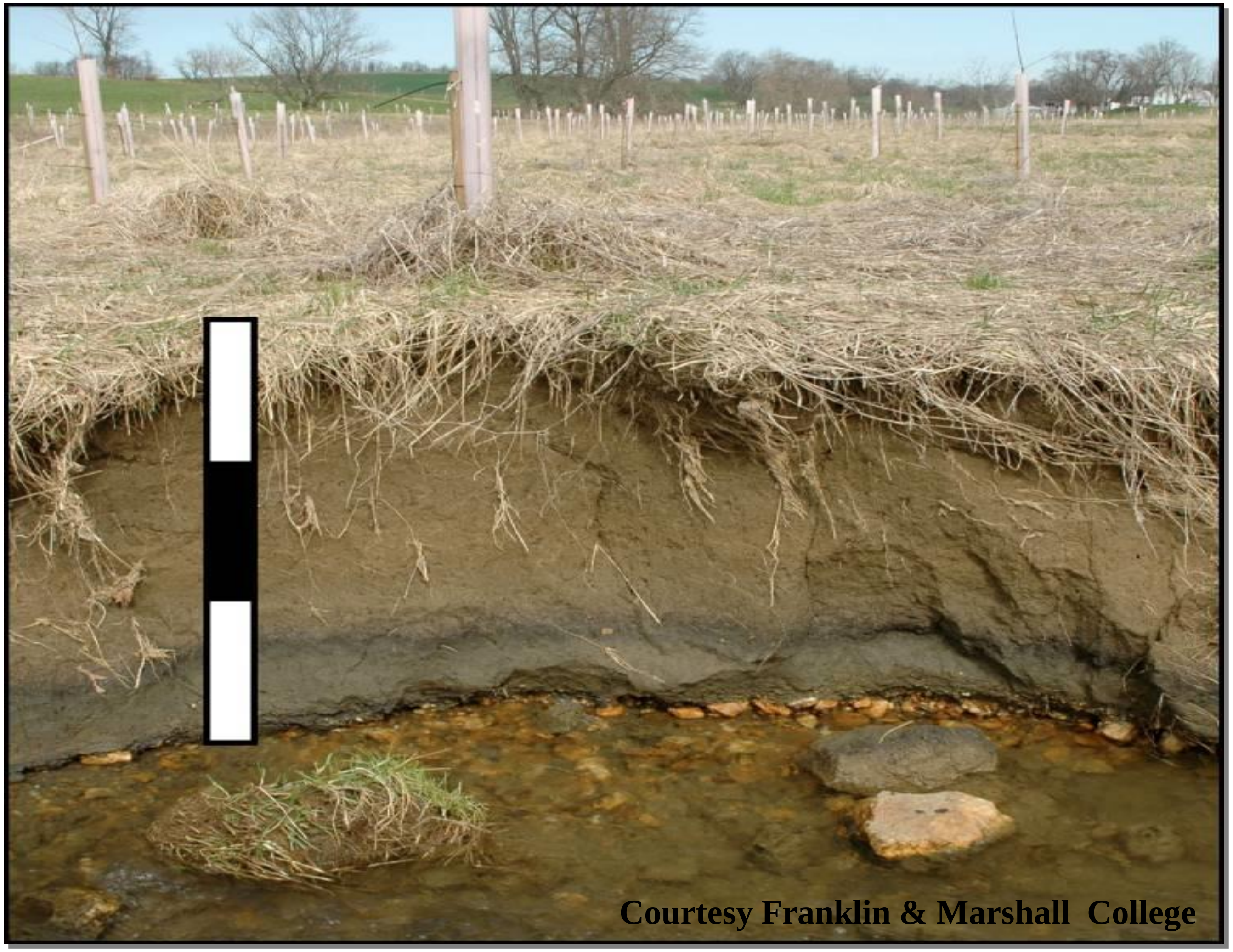
We have employed a multidisciplinary team to plan, design, construct and monitor this restoration project. These included scientists, engineers, construction workers, administrators, and educators. Funding partners included governments, non-profits, academic institutions, landowners and other private entities.

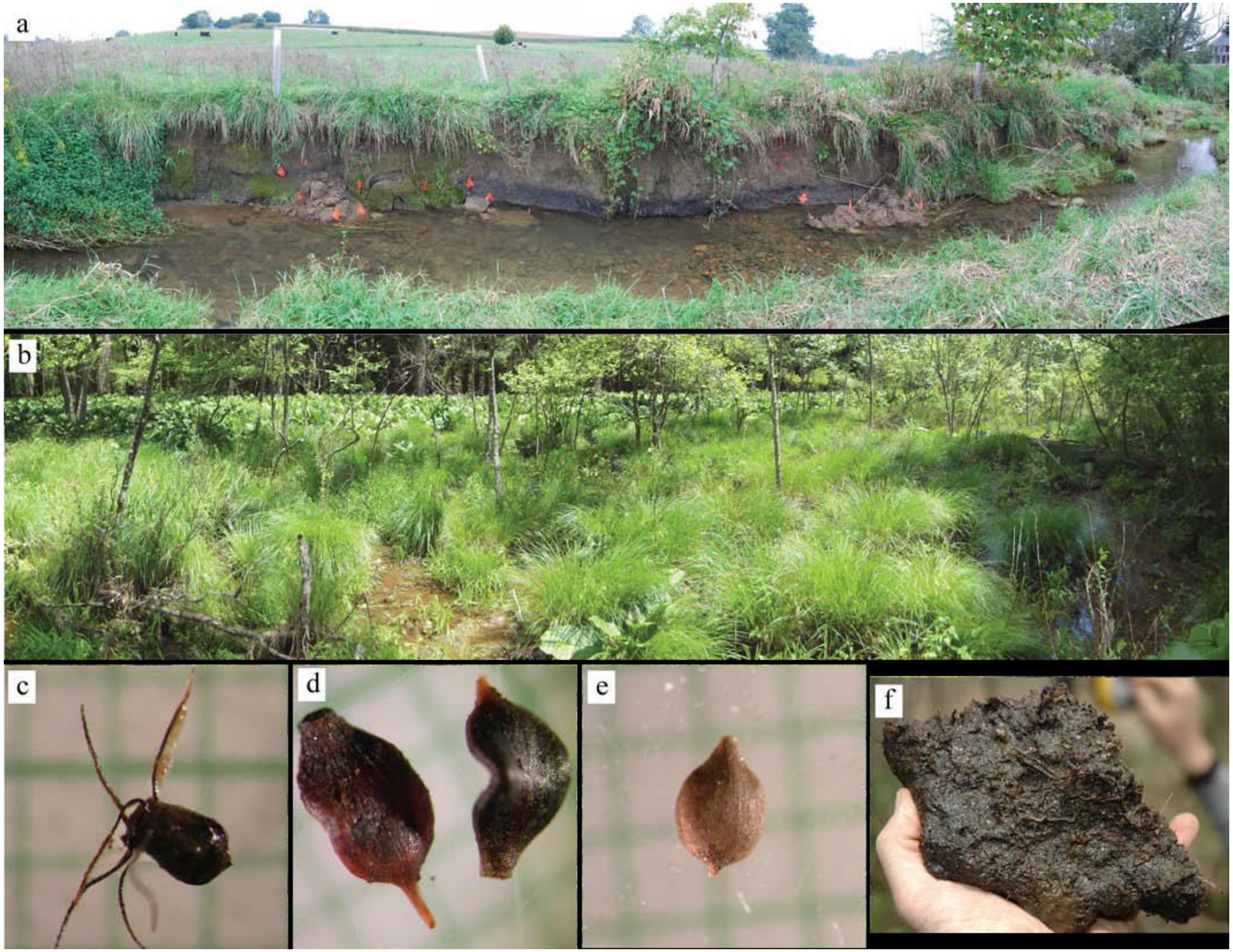
http://www.bsr-project.org/

Utilize a reference condition

- **Identifying natural reference conditions are essential to ensure project success**
- Channels incised through legacy sediment, are not natural analogs in the non-glaciated mid-Atlantic Region
- **Use historic information on altered sites**

Big Spring Run - Type Section





Adapted from Merritts, et al. 2011

Guiding Principles

Address ongoing causes of degradation.

- Restoration efforts are likely to fail if the sources of degradation persist.
- Understanding an ecosystem's evolutionary trajectory is relevant to correctly diagnosing the problem, as well as to developing restoration approaches that are likely to be sustainable.

"… understanding the legacy sediment problem is the first step in proposing a fix."

Bay Journal, March, 2007. Alliance for the Chesapeake Bay.

Guiding Principles

Restore Natural Structure – Physical

- **Natural valley morphology**
- Address channel alterations – incision, relocation, etc.
- Essential to the success of other aspects like hydrology, soils, bio-geochemical processes, plant communities, and other natural functions and services

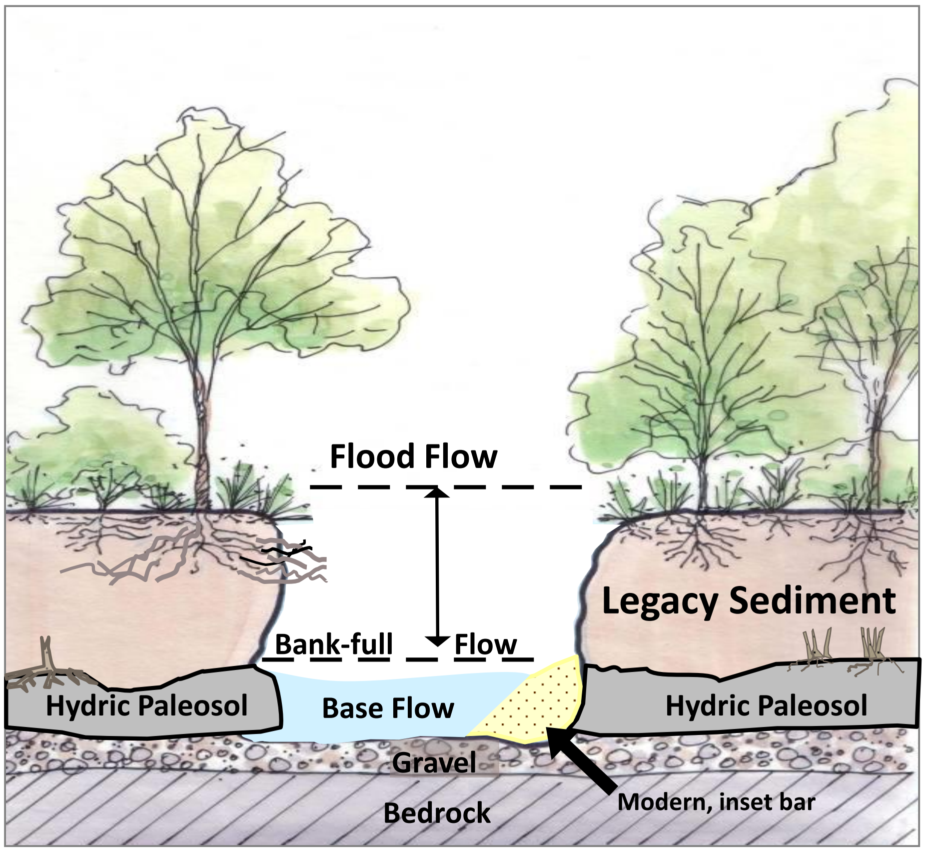
Restore Natural Function.

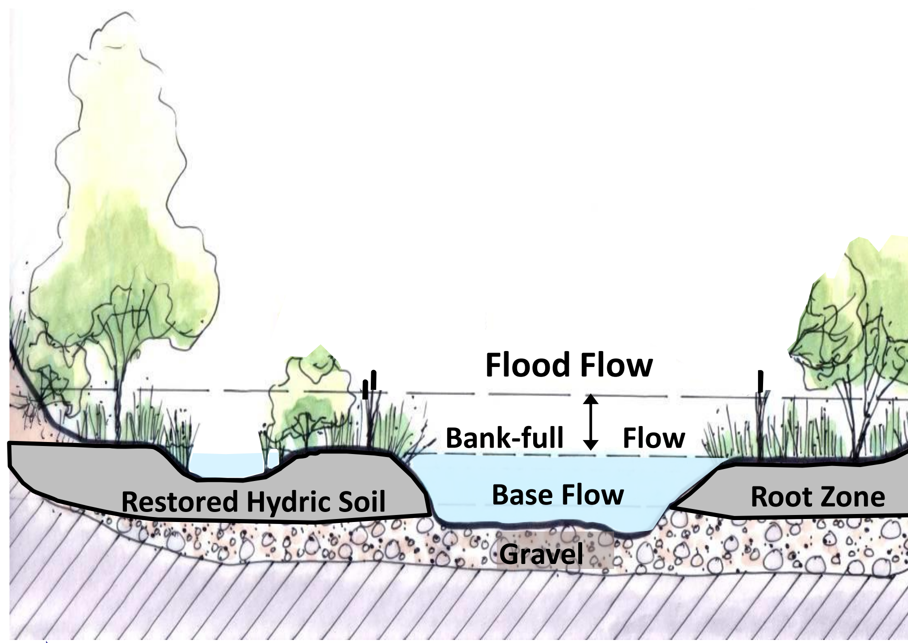
- Natural function and natural structure of aquatic resources are closely linked.

Legacy Sediment Removal and Aquatic Ecosystem Restoration Best Management Practice

Conceptual Design

Typical Existing Conditions → Proposed Restoration





→ **Biological & Bio-geochemical**

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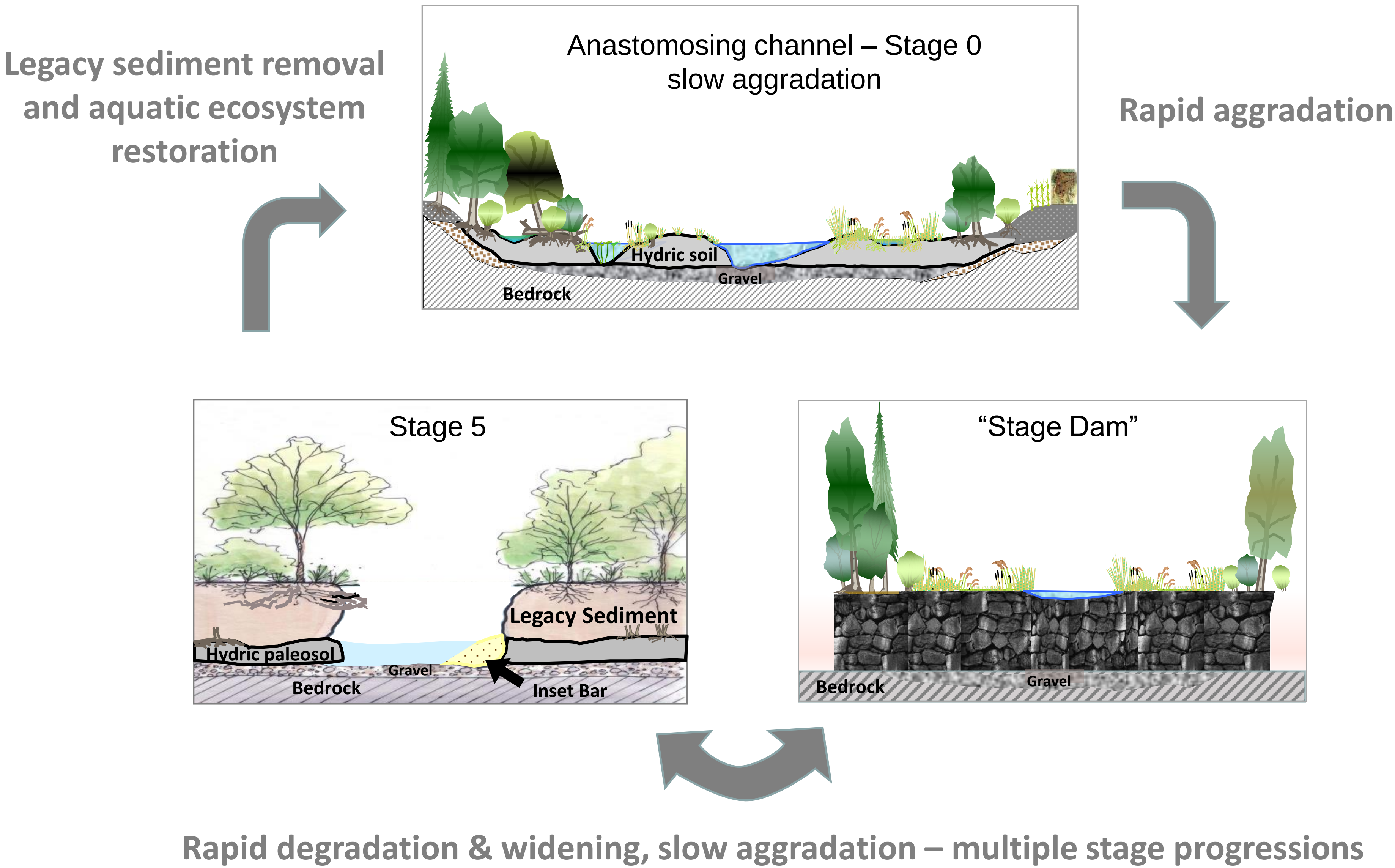
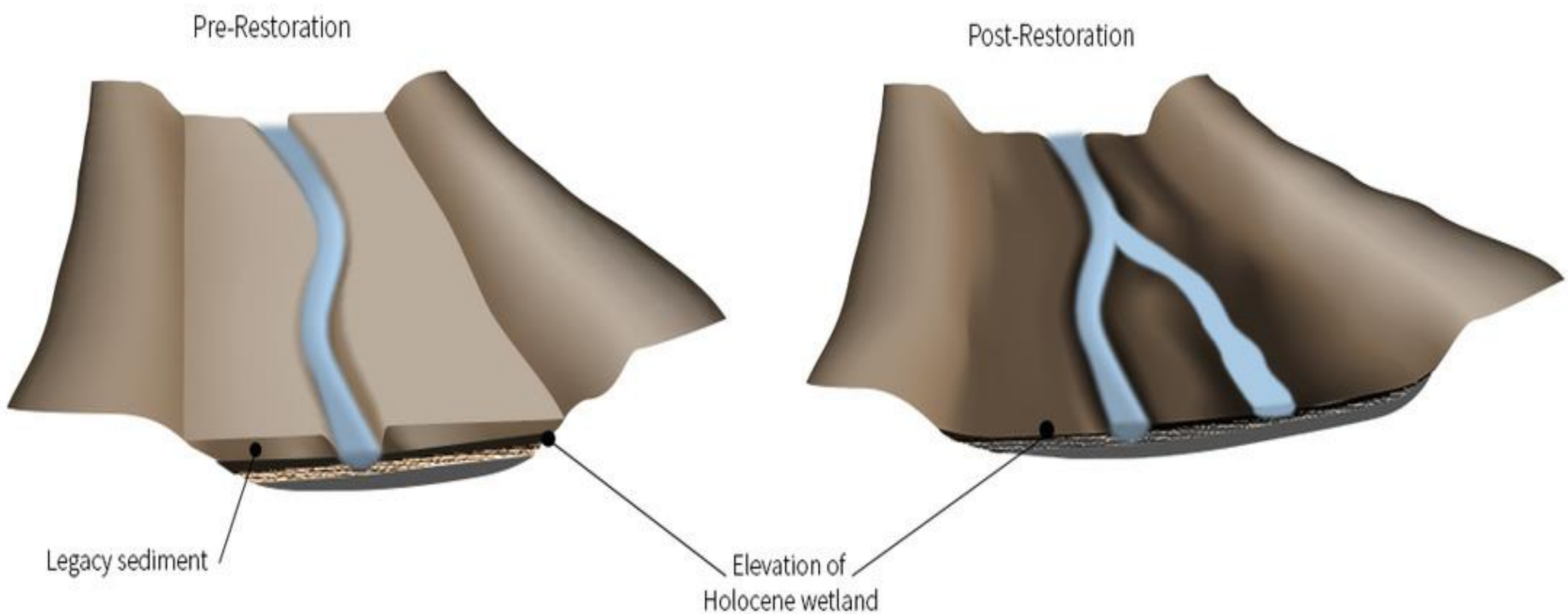


Adapted from Cluer and Thorne, 2012

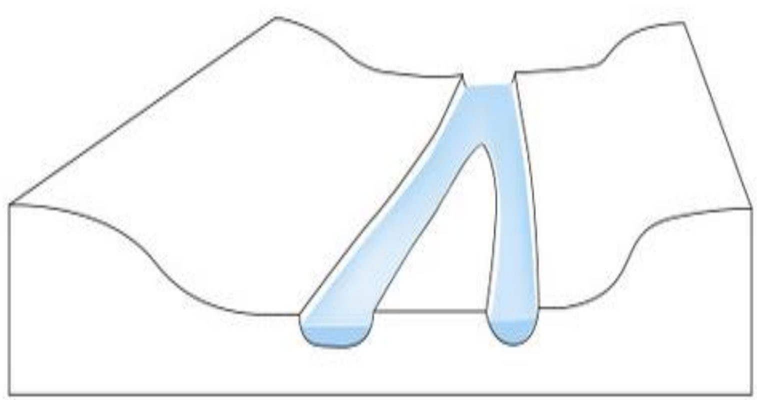
6 Engineering Technical Criteria & Objectives

1. Legacy sediments are excavated and removed to the maximum extent, re-establishing the elevations of buried aquatic ecosystem components that remain in-tact like hydric soils and channels underlain by valley basal gravels and bedrock. The restored hydrologic regime is heterogenous and driven by fluctuating groundwater and surface water inputs that provide varying degrees of wetness across the restoration area.

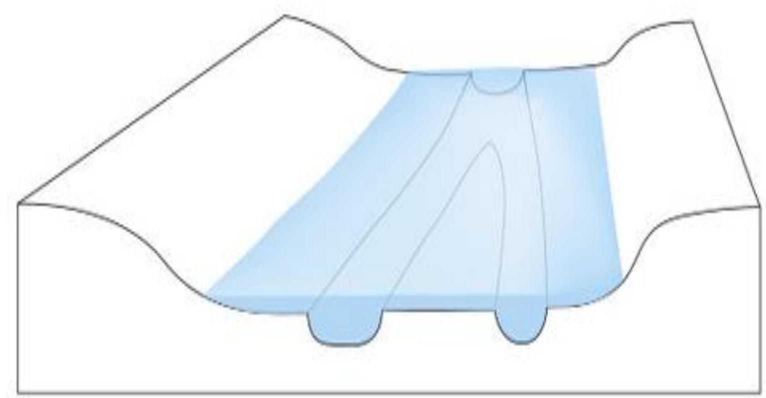


http://www.bsr-project.org/

2. Channel flows greater than base flows are conveyed through the entire restored valley bottom width.



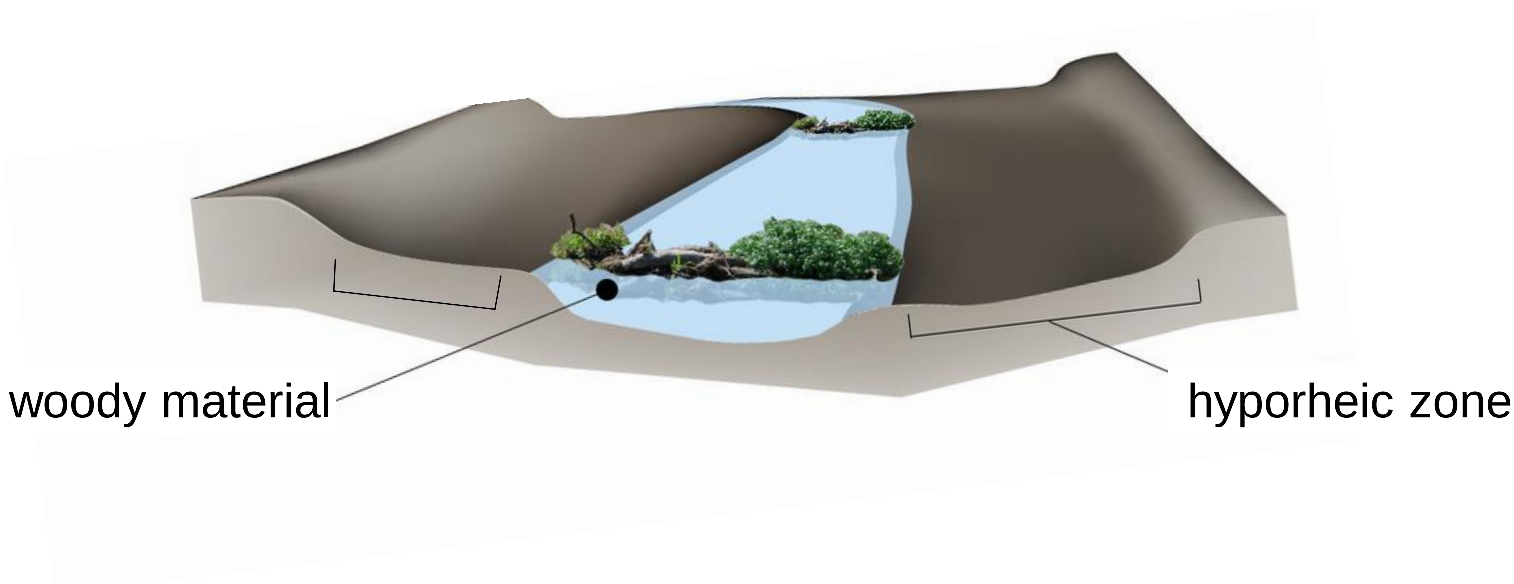
Base Flow



Overbank Flow

http://www.bsr-project.org/

3. Woody material placed within channels increases the base flow water surface elevation and promotes surface water and groundwater hyporheic exchange.



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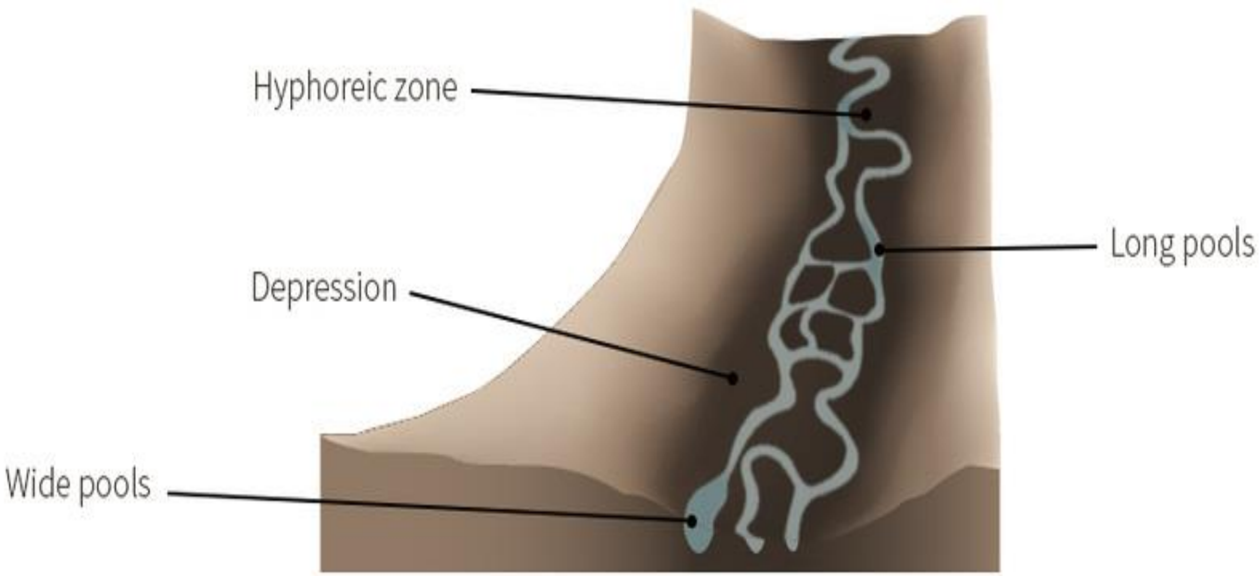
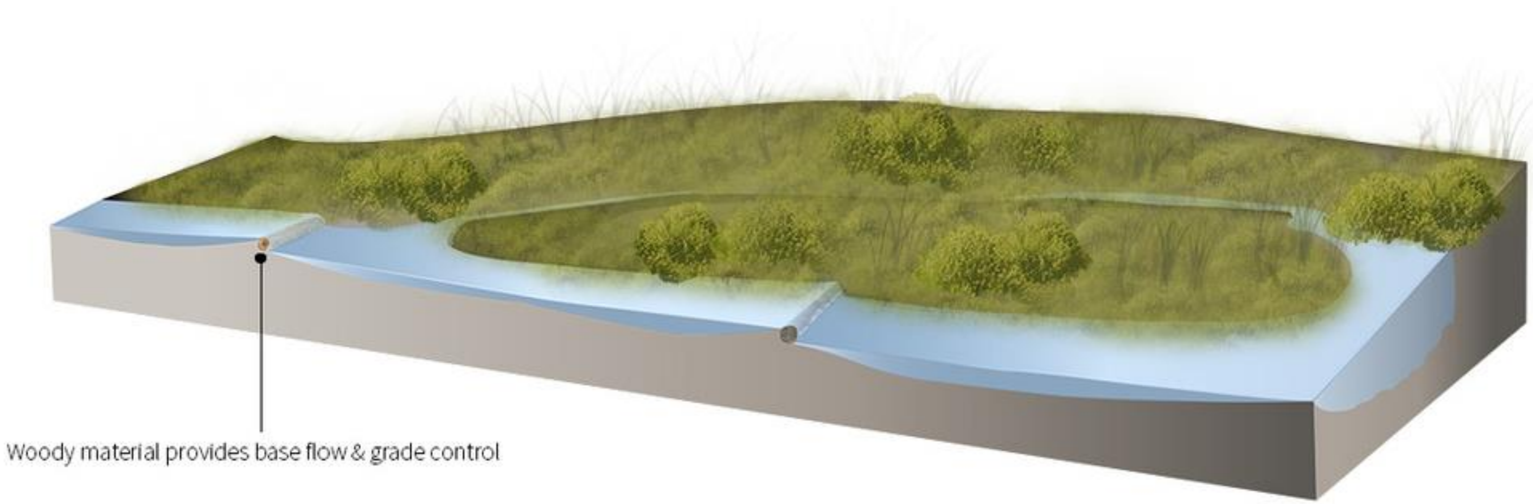
4. The channel plan form design, with characteristic large meanders, small channel widths and depths, and developing multiple flow pathways, results in increased groundwater and surface water flow retention, as well as increased exchange between stream channels and adjacent hyporheic zones.



A variety of channel forms (short steep run/riffles, long pools, narrow pools, etc.) and slight depressions are sited across the restored area.

http://www.bsr-project.org/

5. Small channel width and depth characteristics and a varying streambed profile maintain a low overall channel gradient. These design characteristics reduce flow shear stresses so that basal gravels in the channel and wetland soils in the floodplain are not transported and eroded by flood flows.



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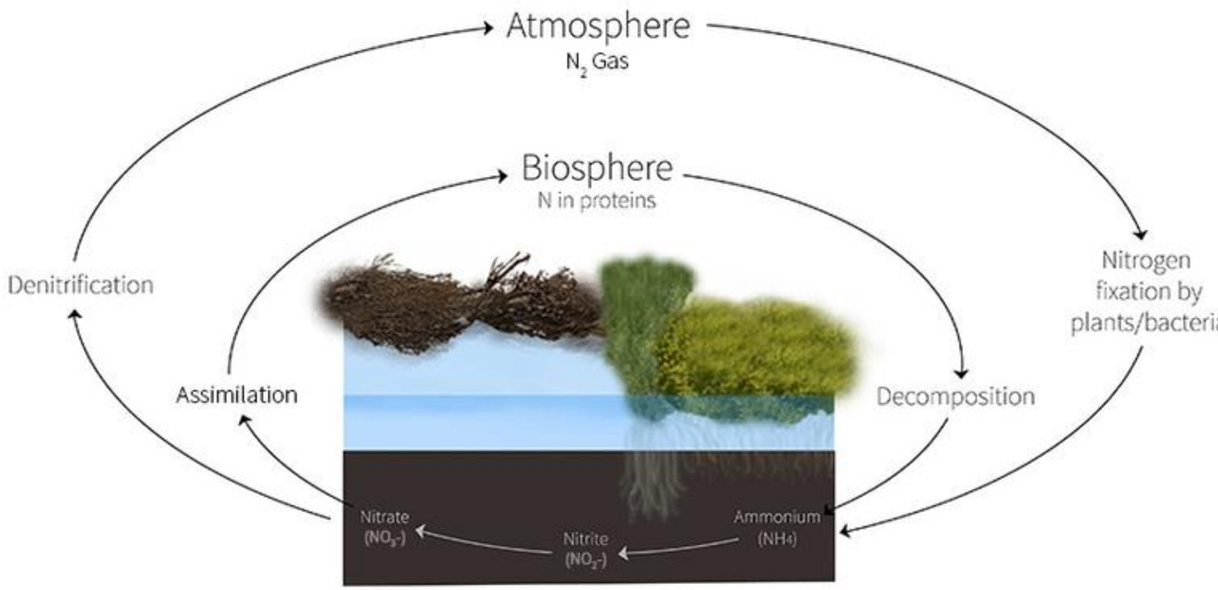
6. To provide additional denitrification potential and other habitat benefits, stumps and woody material placed in restored floodplain areas increases roughness during flooding and promotes trapping of additional organic debris during high flows.



Extensive native plant seeding and live plant installations re-establishes natural plant communities, promotes nutrient processing during low flow, and restores self-sustaining biological and biogeochemical ecosystem functions.

http://www.bsr-project.org/

Big Spring Run

Typical Existing Conditions → **Restoration**

9/13/2011 **07/27/2012**

→ **Biological and Bio-geochemical**

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October 2011

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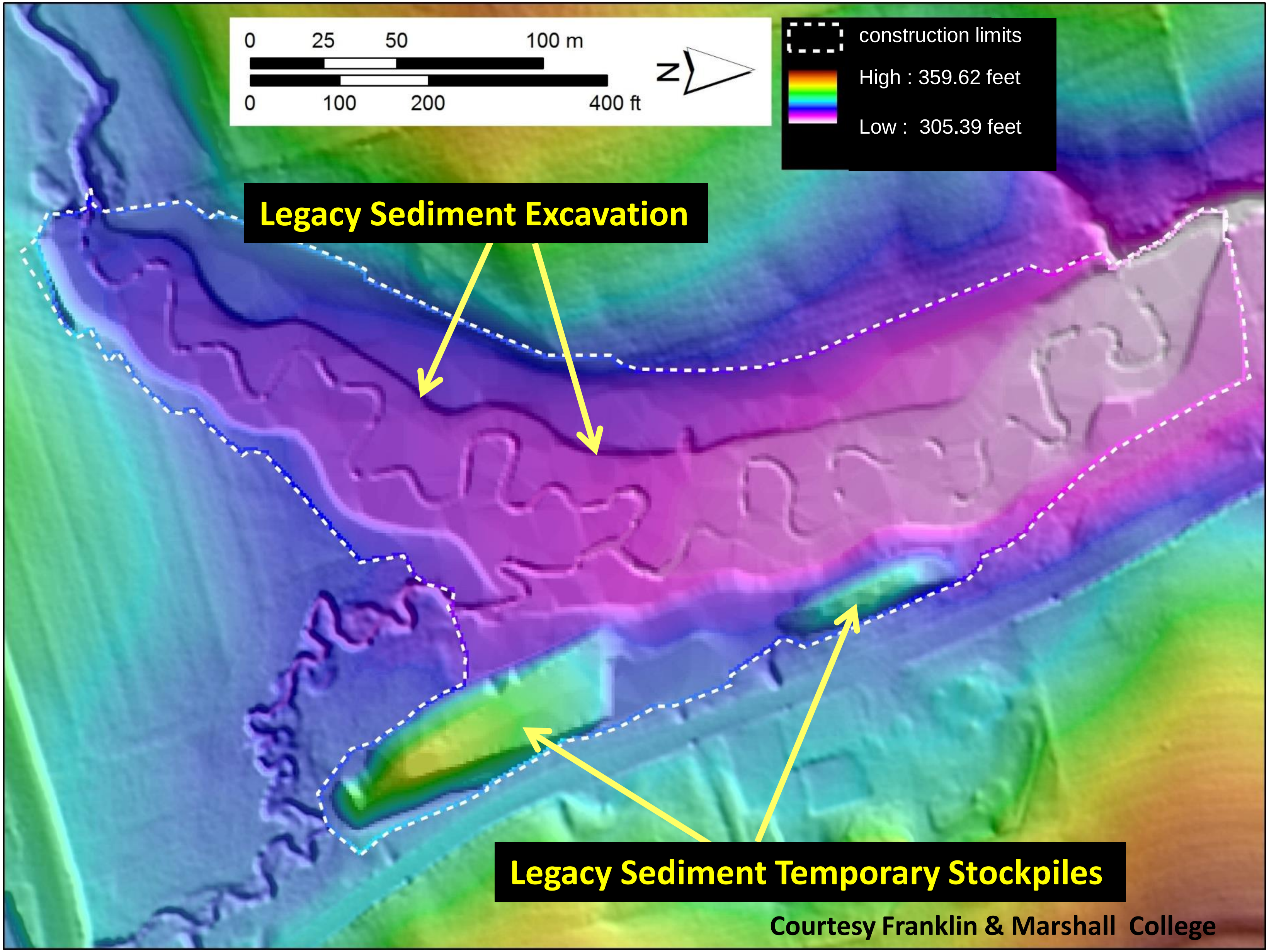
Big Spring Run, Lancaster County PA
As-Built - Hillshade Elevation Rendering



Courtesy Franklin & Marshall College

Guiding Principles

Monitor

- Before, during, and after project monitoring is used to evaluate goal achievement
- **Continuous at Big Spring Run from 2008 through 2017**
- Post implementation monitoring may provide useful information for future restoration efforts
- Data gathered may be useful for model development and predicting results when scaling up in size

1. **developing and defining a new BMP**
2. **estimating nutrient reductions**
3. **cost : benefit analysis**

Multidisciplinary Team

Funding:
PA Department of Environmental Protection, Franklin & Marshall College, USGS, USEPA, Chesapeake Bay Commission, National Science Foundation, Lancaster Farmland Trust, Suburban Lancaster Area Sewer Authority, Rocky Knoll Farms

Professional Collaborators:
Mike Rahnis (F&M), Karen Mertzman (F&M), Jeff Hartranft, Scott Cox (PA DEP), Bill Hilgartner (JHU), Mike Langland, Dan Galeone, Allen Gellis, Milan Pavich, Chris Bernhardt (USGS), Ward Oberholtzer, Mark Gutshall, Andrew Donaldson, and Drew Altland (Landstudies, Inc.), Rob Sternberg (F&M), Jerry Ritchie (deceased, USDA), Noel Potter (Dickinson College), Art Parola (Univ. Louisville), Paul Mayer, Ken Forshay (USEPA), H. Jantzi, C. Grand Pre (F&M), David Bowne (Elizabethtown College), John Wallace (Millersville University), Laurel Larson (Berkeley)

Student Collaborators:
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Design & Construction
Landstudies, Inc, B.R. Kreider and Sons, D.H. Funk and Sons, Inc.

Landowners
J. Sweeney, Kirchner Family, Fry Family, Keener Family, Houser Family & Groff Family