

Webinar Training Series

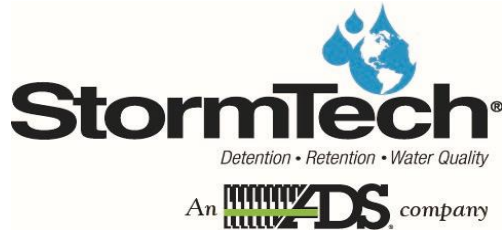


Re-wilding Streams and Floodplains to Enhance Ecosystem Services

January 21, 2021 | 10:30 a.m. – 11:30 a.m. (Eastern)

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Today's Presenter



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Re-wilding Streams and Floodplains to Enhance Ecosystem Services

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January 2021



Learning Objectives:

- Understand components of re-wilding projects for stream and floodplain ecosystems.
- Understand how to plan and implement successful re-wilding projects.
- Communicate with stakeholders regarding ecological benefits of re-wilding projects.

Beeson Creek Stream and Floodplain Restoration, Kernersville, NC



What is Re-wilding?

- First defined in 1998 by American conservation biologists Michael Soulé and Reed Noss, as an approach focusing on “cores, corridors, and carnivores.”
- A form of environmental conservation and ecological restoration that increases biodiversity, creates self-sustainable environments, and mitigates climate change.
- Focused on restoring natural processes and wilderness areas, providing connectivity between such areas, and reintroducing keystone species.



THE QUAGGA

Science Blog of the SciComm Students @ Natural History Museum, Zoological Society of London & University College London

N NATURAL HISTORY MUSEUM

[about](#) [scicomm students](#)

REINTRODUCTION OF THE BEAVER TO BRITAIN: DAMMED IF YOU DO, DAMNED IF YOU DON'T?

SCIENCE BLOG POSTS

December 16, 2015 by mccabe3891 in 2015 MRes Students, Biodiversity

Translocation (Trophic) Re-wilding:

- Enhances a species population in an ecosystem by either:
 1. Adding reinforcements to a current species to enhance viability and survival; or
 2. Reestablishing a species population in an area after local extinction.

Example:

Reintroduction of Wolves to Yellowstone NP in 1995

<https://youtu.be/ysa50BhXz-Q>



Passive Re-wilding:

- Transforms a disturbed ecosystem back to nature with the goal of restoring natural ecosystem processes and reducing human influence on landscapes.

Example:

Floodplain Buyout Program in Flood Hazard Zones

<https://charlottenc.gov/StormWater/Flooding>



BENEFITS TO OUR COMMUNITY

- Less money spent on emergency rescues
- Less money spent on disaster relief
- Restoration of the natural floodplain to enhance water quality and the ecosystem
- Increased opportunities for recreation and interaction with nature, such as creek-side greenways

Charlotte-Mecklenburg Police or Fire Department crews conduct training exercises at buildings that have been acquired through the Floodplain Buyout Program.

WHAT HAPPENS TO BUYOUT PROPERTIES?

The intent of the buyout program is to restore the natural functions of the floodplain. Some of the final uses of the buyout properties include:

- Greenway trails
- Community gardens
- Reforested natural areas
- Storm Water wetlands and retention
- Informal recreational areas

FLOODPLAIN BUYOUT PROGRAM

Storm Water Services Engineering & Mitigation Program identifies properties in the floodplain that may be acquired to reduce the potential loss of life and property damage due to flooding.

For more information:
Call 311
Or go to our website:
Stormwater.charmeck.org

Re-wilding Streams and Floodplains to Enhance Ecosystem Services:

- Systematic adjustment of physical, biological, and chemical conditions in the riparian corridor and watershed.
- Shifting the trajectory of a stream ecosystem toward improved ecological functions and services, with enhanced connectivity.

Beeson Creek Stream and Floodplain Restoration, Kernersville, NC



Ecosystem Services:

- “benefits people and businesses obtain from ecosystems”
(*Millennium Ecosystem Assessment, 2005*)
- Streams and floodplains provide:
 - Water supply and storage
 - Food
 - Habitats
 - Biodiversity
 - Pollutant assimilation
 - Recreation and education



Re-wilding to Enhance Connectivity in Stream Ecosystems:

- Longitudinal: upstream – downstream
- Floodplain: overbank flows and stormwater management
- Groundwater: hyporheic exchange
- Daylighting: returning a piped stream to nature

Dam!



Longitudinal Connectivity: *Road Crossing Replacement*

- Remove AOP Barrier to Open Upstream Habitat for Endangered Mussels
- Facilitate Vehicle Crossing over Wet Ford

Savannah Lilliput
Toxolasma pullus
Contributor: Jennifer Price

DESCRIPTION

Taxonomy and Basic Description



Vented Ford Crossing Removal with Boulder Cascade on Densons Creek, Troy, NC



Longitudinal Connectivity: *Road Crossing Replacement*

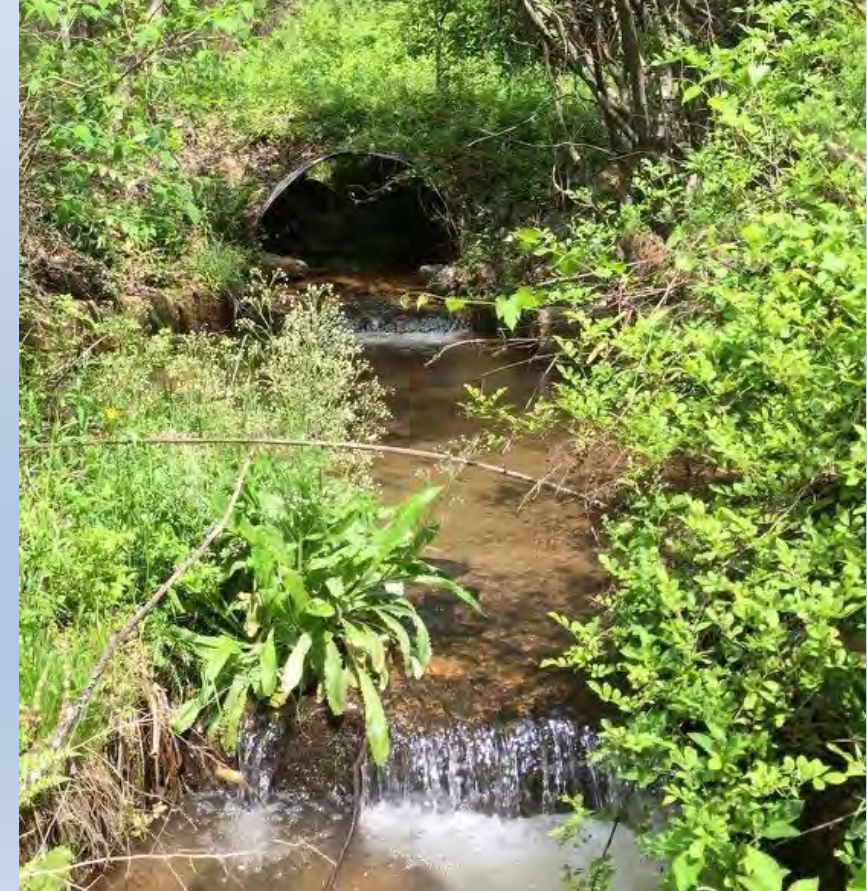
- Facilitate AOP
- Facilitate Vehicle Crossing



Longitudinal Connectivity: *Road Culvert Replacement*

- Replace perched culvert with larger buried bottom pipe

Culvert Replacement on UT Purlear Creek, Wilkes County, NC



Longitudinal Connectivity: *Removal of Dams and Barriers*

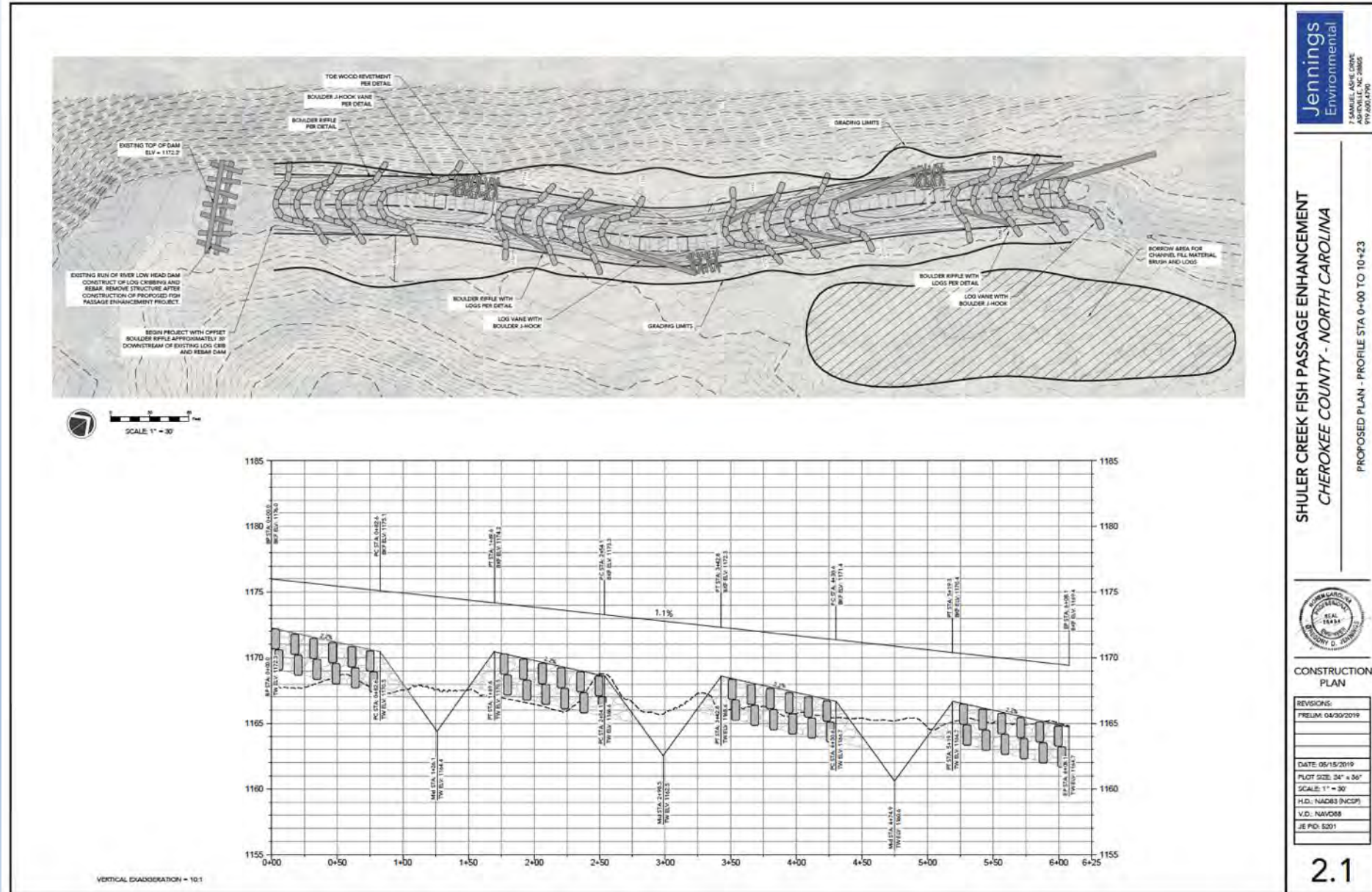
- Aquatic Organism Passage (AOP)
- Sediment Transport

Dam Removal and Boulder Cascade Construction on Shuler Creek, Graham County, NC



Longitudinal Connectivity: *Removal of Dam on Shuler Creek*

- Remove dam structure
- Replace vertical drop with boulder cascades and pools that support AOP



Longitudinal Connectivity: *Removal of In-line Pond*

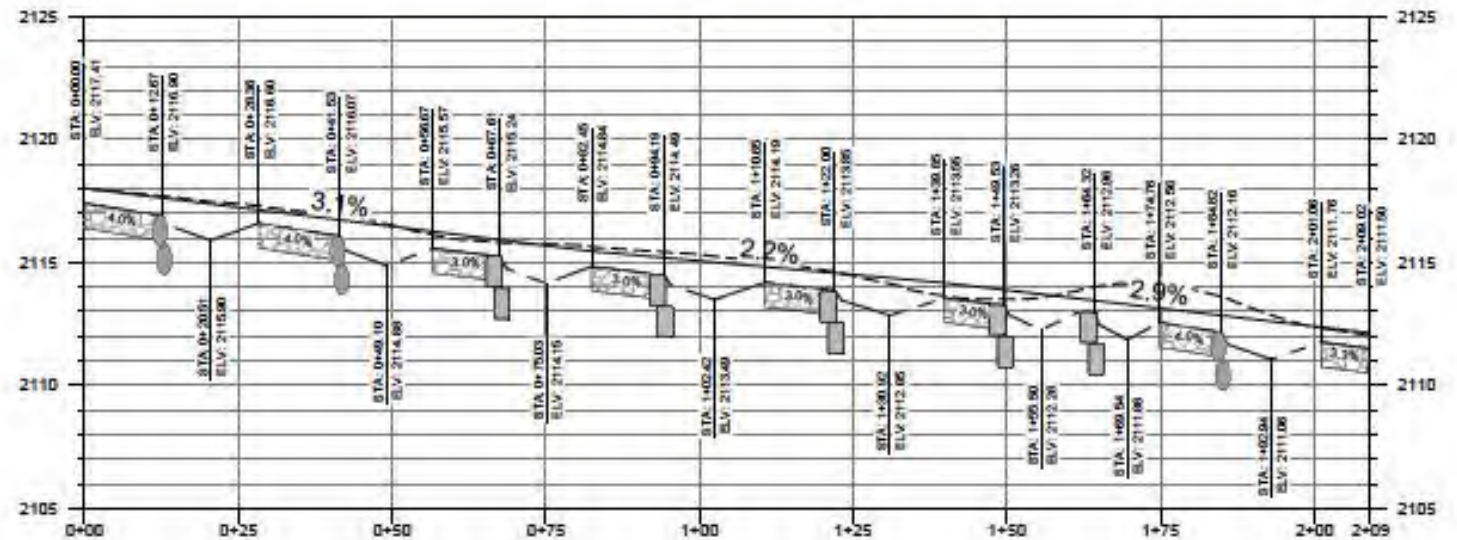
- Fish Habitat and Water Quality
- Sediment Transport

Pond Removal and Stream Restoration on UT Sentell Creek, Henderson County, NC



Longitudinal Connectivity: *Removal of Pond on UT Sentell Creek*

- Remove earth dam
- Replace pond and dam with riffles and pools that support AOP



Floodplain Connectivity: *Restoring Floodplain Functions*

- Hydraulic Energy Balance
- Sediment and Nutrient Retention and Processing
- Riparian Habitats

Stream and Floodplain Restoration on UT Crabtree Creek, Morrisville, NC



Floodplain Connectivity: *UT Crabtree Creek Floodplain Restoration*

- Excavate new channel alignment and floodplain surface at lower elevation (Priority 2)
- Plant forested floodplain



Floodplain Connectivity: *Restoring Floodplain Functions*

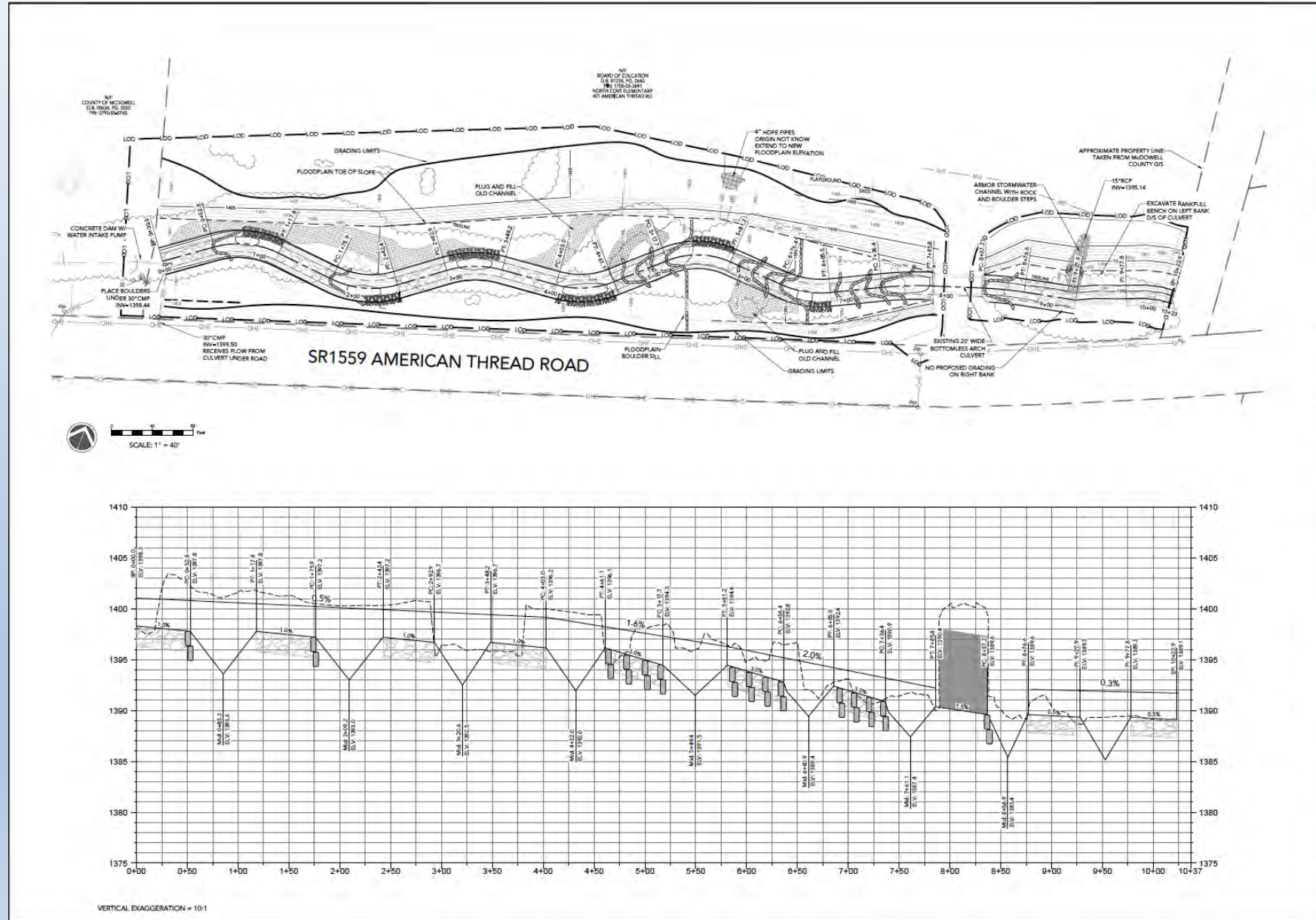
- Hydraulic Energy Balance
- Sediment and Nutrient Retention and Processing
- Riparian Habitats

Stream and Floodplain Restoration on Limekiln Creek, McDowell County, NC



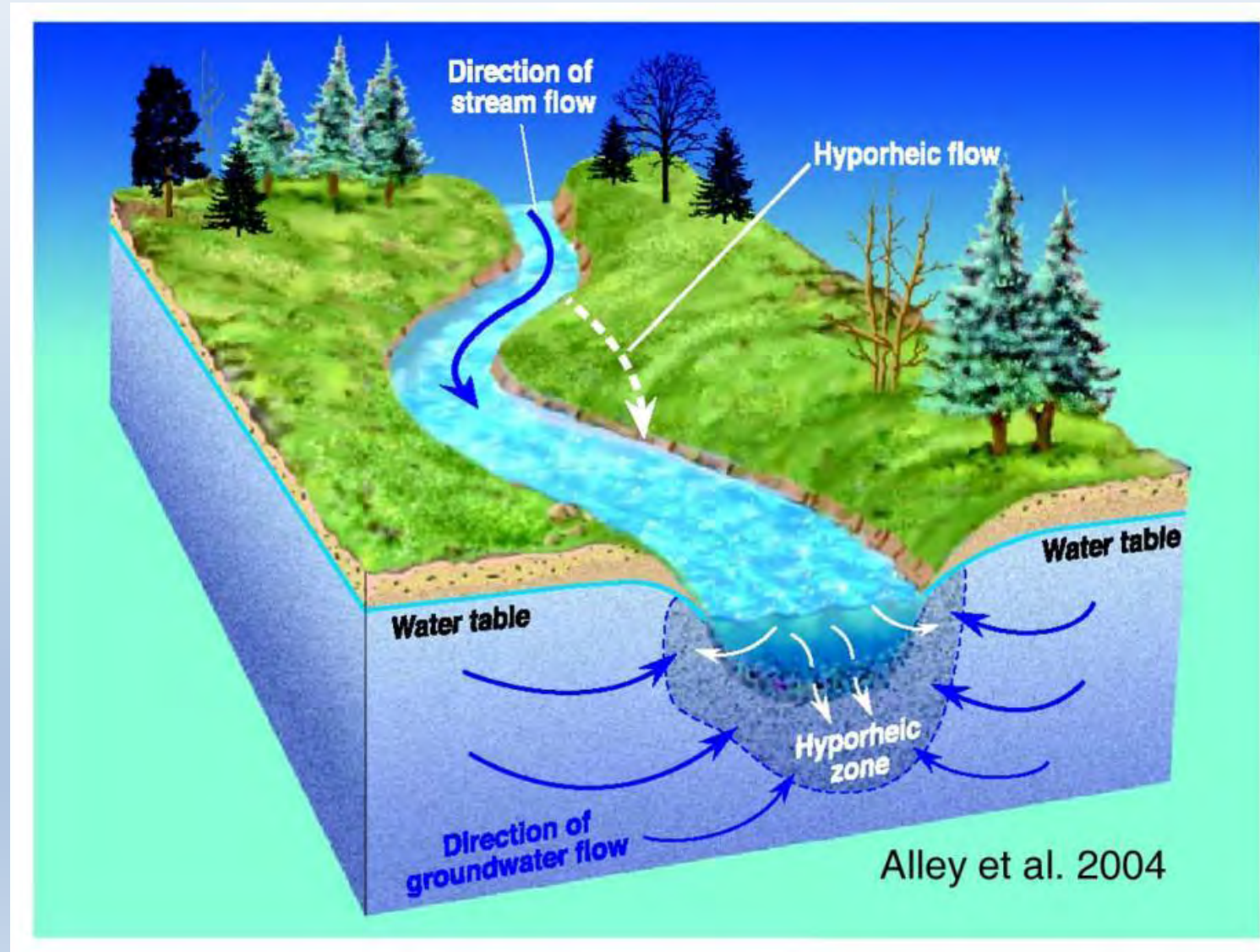
Floodplain Connectivity: Limekiln Creek Floodplain Restoration

- Excavate new channel alignment and floodplain surface at lower elevation (Priority 2)
- Plant forested floodplain with habitat pools



Groundwater Connectivity: *Hyporheic Exchange*

- Aquatic Habitat
- Water Quality



Daylighting a Piped Stream:

- Restored Ecosystem Functions and Services
- Community Connectivity to Nature

Daylighting a Parking Lot on Rocky Branch, Raleigh, NC



**Daylighting a Piped Stream:
*Rocky Branch***

2007



2018



Components of Stream and Floodplain Restoration Projects:

- Fluvial Geomorphology: Channel & Floodplain Forms and Processes
- In-stream Structures (grade control, bank protection, bedform)
- Streambank Bioengineering and Riparian Buffers

Stream and Floodplain Restoration on Rocky Branch, Raleigh, NC



Fluvial Geomorphology:

- Study of how stream systems are shaped by flowing water and sediment
- Equilibrium conditions determined by dimension, pattern, profile, substrate
- Departure from equilibrium results in erosion, deposition, migration, headcutting



Reference Streams:

- Basis of Design for Restoring Equilibrium in Disturbed Stream System
- Template for Equilibrium Stream Morphology in Similar Watershed



In-Stream Structures:

- Natural Materials (Logs and Rocks)
- Support Bedform Diversity, Sediment Transport, Energy Dissipation



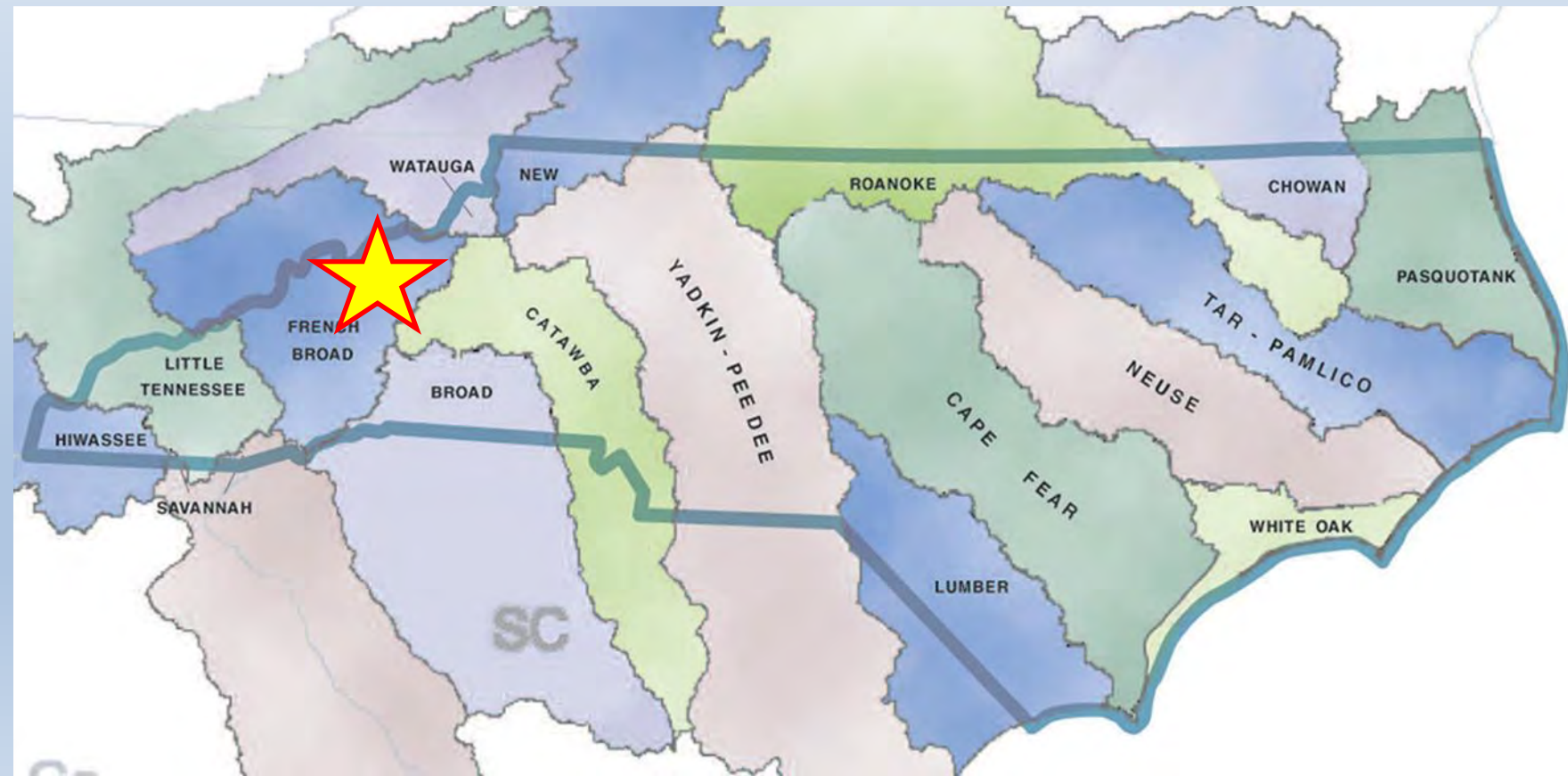
Streambank Bioengineering and Riparian Buffers:

- Native woody and herbaceous plants appropriate for floodplain
- Healthy roots for soil strengthening
- Habitat enhancements: Shade, Food, Shelter, Woody Debris



Case Study: Grassy Creek Restoration, Spruce Pine, NC

- French Broad River Basin, Blue Ridge Ecoregion 65
- 3,000 feet of Stream with Urban Constraints
- DA = 9.4 sq mi
- 2016 Implementation
- Design-Build Team



Grassy Creek Restoration

- Habitat Enhancement Opportunity for Fish and Salamanders
- Grant Funding from NCDEQ, NCCWMTF, USFWS, NCWRC

Before



After



Grassy Creek Problems

- Streambank Erosion
- Incised Channel with Plane Bed and Poor Habitats
- Poor Riparian Buffer with Utility Crossings
- Stormwater Runoff from Shopping Center



Grassy Creek Constraints

- Surrounding Land Uses and Utilities
- Floodplain Permit Requiring “No-Rise/No-Impact” Design

As-built Aerial Photo 3 Years After Construction



Grassy Creek Opportunities

- Trout Fishing and Nature Trail
- Habitat for Eastern Hellbender Salamander (*Cryptobranchus a. alleganiensis*)
 - Need fast flow for DO absorption
 - Need shelter rocks, deep pools
 - Need food supply (crayfish)



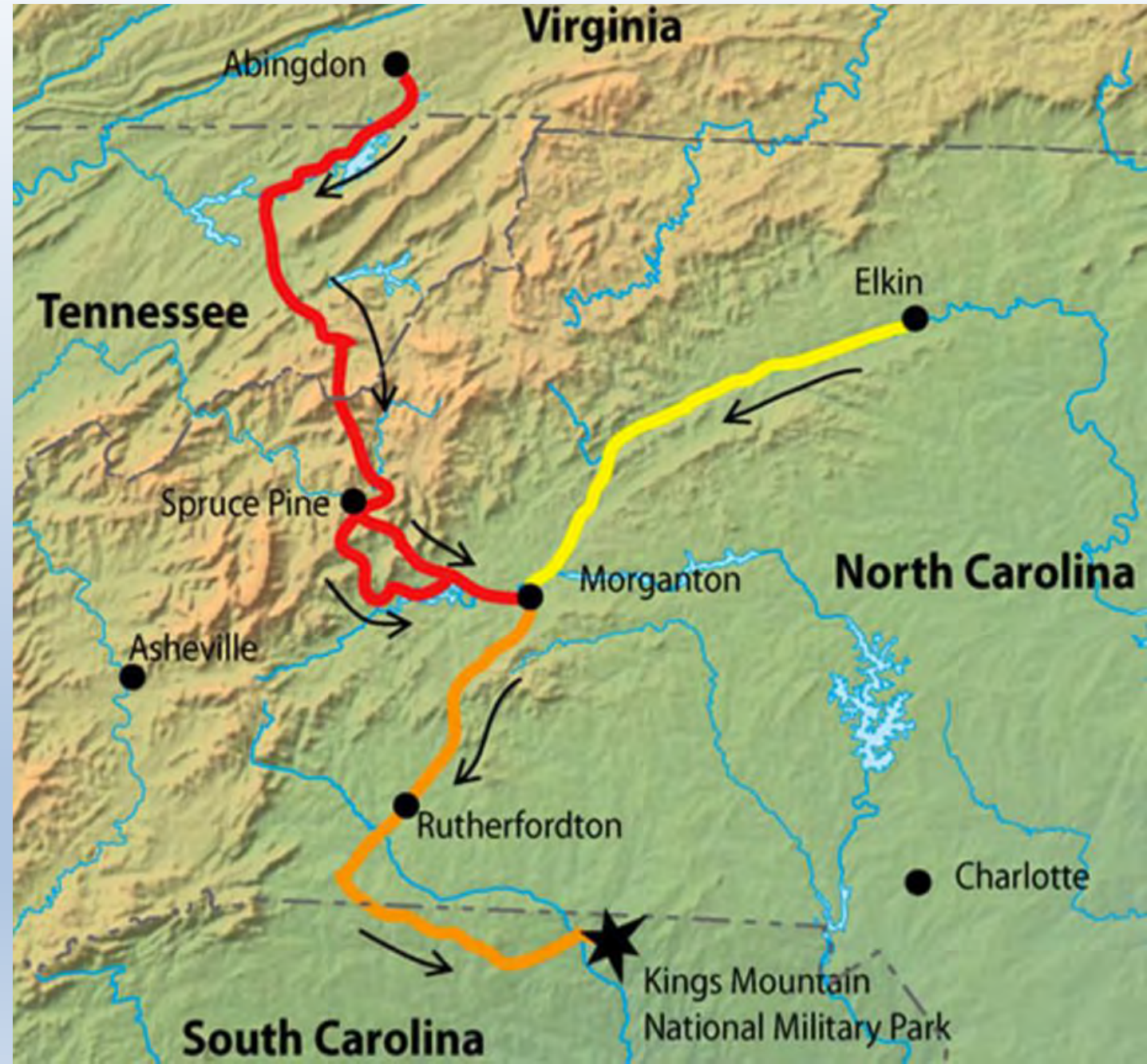
Grassy Creek Restoration Objectives

- Improve water quality by reducing sediment & nutrients
- Improve aquatic and terrestrial habitats
- Provide educational opportunities for community
- Connect Overmountain Victory Trail



Overmountain Victory Trail

- Route of the Overmountain Men march to the Battle of Kings Mountain, October 7, 1780
- Community Walking & Fishing Trail



Grassy Creek Restoration: *Upstream Reach*

- Bank stabilization
- In-stream habitat structures
- Grade control at utility crossing
- Native riparian vegetation



Log J-Hook Vane

Meander bend streambank protection and scour pool maintenance

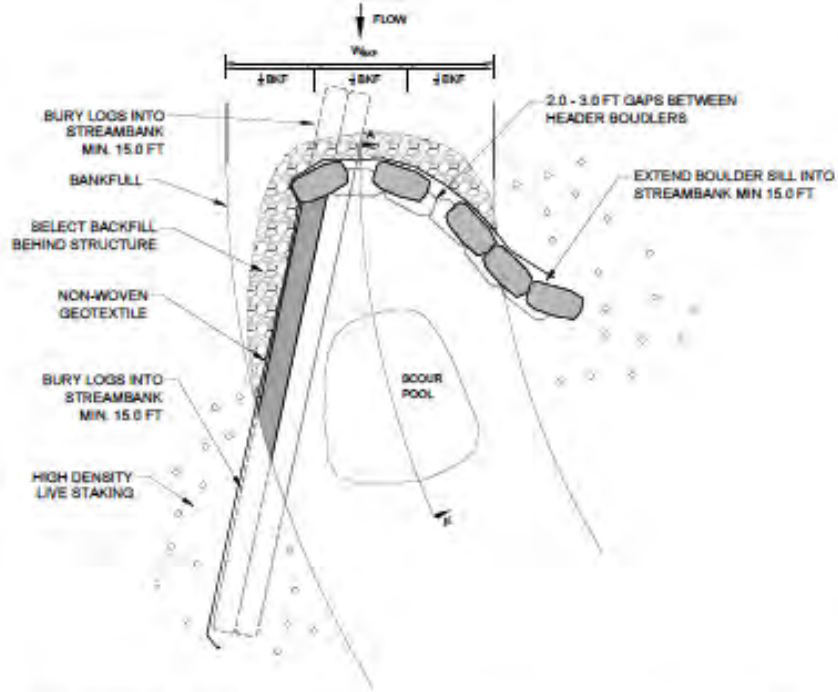
Before



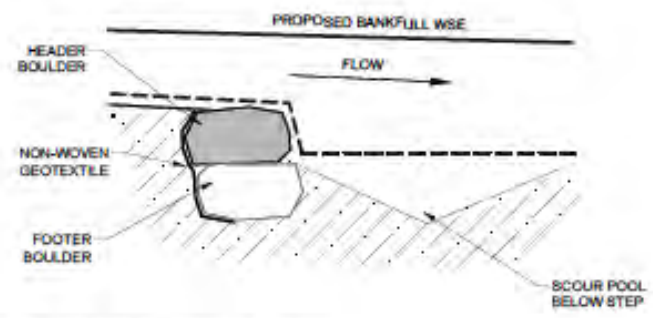
After



Log J-hook Vane for flow direction & habitat



**LOG J-HOOK WITH BOULDERS
DETAILED PLAN** NOT TO SCALE

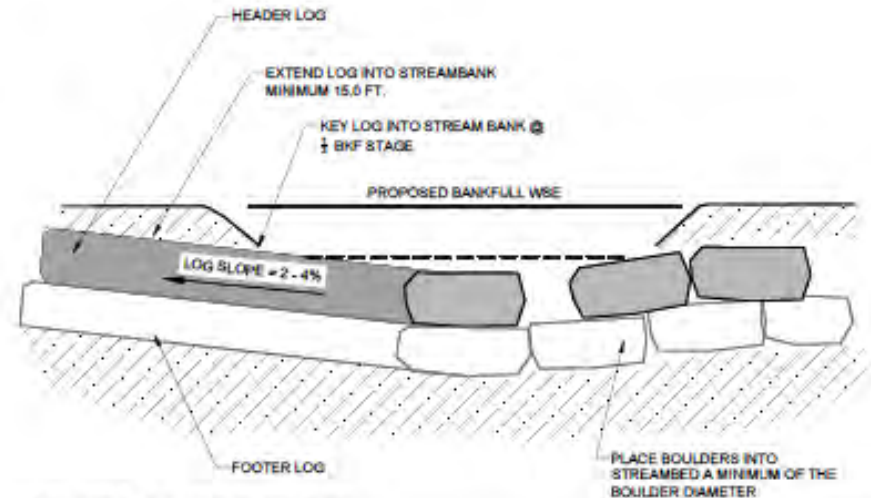


**LOG J-HOOK WITH BOULDERS
SECTION A - A'** NOT TO SCALE

LOG J-HOOK WITH BOULDERS

NOTES

1. THE LOG J-HOOK WITH BOULDERS IS A DESIGN FEATURE USED TO PROVIDE ENERGY DISSIPATION, FLOW DIRECTION CONTROL AND TO REDUCE NEAR BANK STRESS. THIS STRUCTURE WILL ALSO ENCOURAGE POOL MAINTENANCE AND CREATE A DIVERSITY OF AQUATIC HABITAT THROUGH SCOUR OF THE RIVER BED. THE LOG J-HOOK WITH BOULDERS IS COMPOSED OF A BOULDER SILL, WHICH IS A ROW OF BOULDERS SET AT AN ELEVATION PROVIDED IN THE PROPOSED PROFILE THAT SPANS PERPENDICULAR TO AND SLIGHTLY ARCED ACROSS THE CHANNEL. THE BOULDER SILL EXTENDS FROM A LOG VANE ARM INTO THE OPPOSITE STREAMBANK. THE LOG VANE ARM EXTENDS UP AND TOWARDS THE OUTSIDE STREAMBANK, EVENTUALLY KEYING INTO THE BANK AT AN ELEVATION HIGHER THAN THE SILL BOULDERS.
2. ALL BOULDERS USED FOR THE BOULDER SILL SHALL BE STRUCTURAL STONE, CUBICAL OR RECTANGULAR IN SHAPE. BOULDERS AVAILABLE ONSITE MAY BE USED IF APPROVED BY THE ENGINEER.
3. DIMENSIONS AND SLOPES OF STRUCTURES DESCRIBED IN THE DETAIL MAY BE ADJUSTED BY DESIGN ENGINEER TO FIT CONDITIONS ONSITE.
4. CONTRACTOR WILL BE REQUIRED TO FIT LOGS AND BOULDERS TOGETHER TIGHTLY. ALL LOGS AND BOULDERS SHALL BE INSTALLED WITH FOOTERS.
5. HEADER BOULDERS SHALL HAVE 2.0 FT - 3.0 FT GAPS BETWEEN EACH BOULDER TO MAINTAIN SEDIMENT TRANSPORT FUNCTIONS AND FISH PASSAGE.
6. GAPS BETWEEN LOGS AND FOOTER BOULDERS SHALL BE MINIMIZED BY FITTING BOULDERS TOGETHER AND PLUGGING WITH NC DOT CLASS A, WOODY DEBRIS AND SELECT MATERIAL OR CHINKING STONE APPROVED BY DESIGN ENGINEER, AND LINING WITH FILTER FABRIC.
7. THE LOG VANE SHALL EXTEND INTO THE OUTSIDE STREAMBANK AND STREAMBED A MINIMUM OF 15.0 FT ON EACH END.
8. THE BOULDER SILL SHALL EXTEND A MINIMUM OF 15.0 FT INTO THE INSIDE STREAMBANK.
9. BOULDERS SHALL BE 3.0 FT X 4.0 FT X 2.0 FT +/- 0.5 FT. MINIMUM LOG DIAMETER IS 2.0 FT.
10. NON-WOVEN GEOTEXTILE SHALL BE PLACED ON THE UPSTREAM SIDE OF THE STRUCTURE TO PREVENT WASHOUT OF SEDIMENT THROUGH FOOTER BOULDER GAPS. FILTER FABRIC SHALL EXTEND FROM THE BOTTOM OF THE FOOTER BOULDER TO THE FINISHED GRADE ELEVATION AND SHALL BE PLACED THE ENTIRE LENGTH OF THE STRUCTURE.



**LOG J-HOOK WITH BOULDERS
CROSS-SECTION** NOT TO SCALE

Bank Grading and Planting

Sloping streambanks to 2:1 or flatter slopes and planting native vegetation

Before



After



Grassy Creek Restoration: *Downstream Reach*

- Realign channel away from parking lot
- Excavate floodplain down to bankfull stage
- In-stream habitat structures
- Native riparian vegetation



Channel Relocation (900 feet)

- Realign channel away from parking lot
- Transplant bed substrate and fauna from old channel to new channel

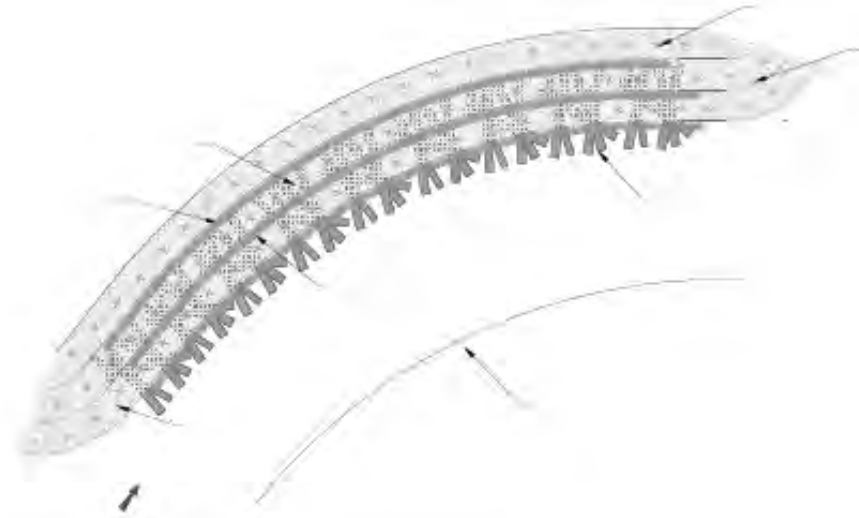


Toe Wood Revetment

Buried green wood to protect streambank and support meander pool habitat

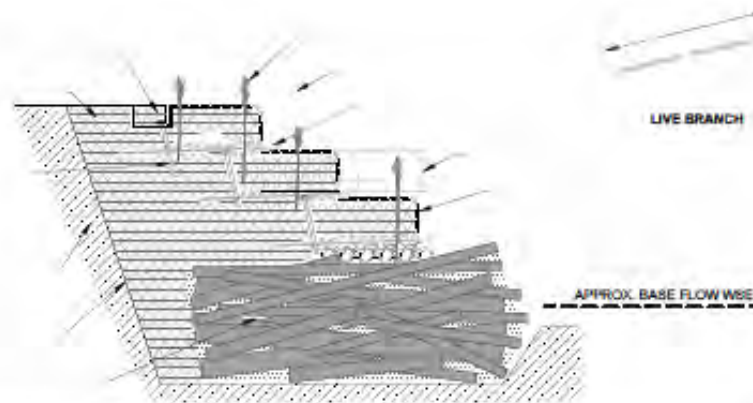


Toe Wood Revetment for Bank Protection, Roughness, Habitat



TOE WOOD REVETMENT WITH SOIL GEOLIFT
DETAILED PLAN

NOT TO SCALE



TOE WOOD REVETMENT WITH SOIL GEOLIFT
DETAILED PROFILE - SECTION A - A'

NOT TO SCALE

TOE WOOD REVETMENT WITH SOIL GEOLIFT NOTES

1. COARSE WOODY DEBRIS SHALL CONSIST OF LOGS, ROOTWADS, AND LARGE BRANCHES NOT SUITABLE FOR CONSTRUCTION OF LOG STRUCTURES. ALL MATERIALS ARE TO BE APPROVED BY THE ENGINEER.
2. COARSE WOODY DEBRIS SHALL BE CONSTRUCTED WITH THE LARGEST MATERIAL PLACED FIRST, NO LOGS SHALL BE PLACED PARALLEL TO THE FLOW OF WATER, UNLESS DIRECTED BY THE ENGINEER. LOGS SHALL BE PLACED IN A CROSSING PATTERN OR WEAVE SUCH THAT EACH LOG IS ANCHORED BY ANOTHER LOG.
3. SMALLFINE WOODY DEBRIS SHALL CONSIST OF MEDIUM TO SMALL LIMBS, BRANCHES, BUSHES, AND/OR LOGS. INVASIVE SPECIES SHALL NOT BE USED.
4. SMALLFINE WOODY DEBRIS SHALL BE PLACED ABOVE THE COARSE WOODY DEBRIS WITH THE LARGEST MATERIAL BEING PLACED FIRST AND THE SMALLEST MATERIAL PLACED LAST.
5. ALL WOODY DEBRIS SHALL BE COMPACTED WITH THE EXCAVATOR BUCKET IN ORDER TO REDUCE THE PRESENCE OF VOIDS IN THE SMALLFINE WOODY DEBRIS LAYER.
6. THE HORIZONTAL LOCATIONS OF ALL WOODY DEBRIS ARE LOCATED ON THE PLAN AND PROFILE SHEETS AND WILL BE PROVIDED TO THE CONTRACTOR AS A 2004 FORMAT DWG FILE AND LAG FILE. NO LOCATIONS OF WOODY DEBRIS SHALL VARY FROM THE PLAN LOCATIONS WITHOUT DIRECTION FROM THE ENGINEER.
7. GRAVEL LEVELING BASE SHALL BE INSTALLED ABOVE THE HIGHEST ELEVATION OF THE WOODY DEBRIS BEFORE THE SOIL LIFTS ARE INSTALLED.
8. THE SOIL BACKFILL USED FOR LIFTS AND TOPSOIL USED FOR LAYERING WITH THE LIVE BRANCHES SHALL BE FREE OF ANY LARGE ROOTS OR WOODY DEBRIS AND SHALL GENERALLY BE FREE FROM ANY GRAVEL OR COBBLE MATERIAL.
9. SOIL BACKFILL SHALL BE COMPACTED SUCH THAT FUTURE SETTLING WILL BE KEPT TO A MINIMUM, YET, NOT SUCH THAT THE UNDERLYING BRUSH IS DISPLACED OR DAMAGED.
10. THE TOP OF THE BACKFILL FOR THE FIRST LIFT SHALL BE SLOPED AT APPROXIMATELY 5% AWAY FROM THE STREAM.
11. PLACE A LAYER OF TOPSOIL AND LIVE BRANCHES ON TOP OF EACH SOIL LIFT SUCH THAT APPROXIMATELY 8 INCHES TO 1 FOOT OF EACH LIVE BRANCH WILL BE EXPOSED AND THE REMAINDER (2 TO 4') OF EACH LIVE BRANCH WILL BE COVERED BY THE NEXT SOIL LIFT.
12. LIVE BRANCHES SHALL BE OF THE SPECIES SPECIFIED FOR LIVE STAKES OR APPROVED BY THE ENGINEER.
13. PLACE A LAYER OF 8.5 FEET WIDE GEOTEXTILE DEKOWE 705 EROSION CONTROL BLANKET, OR EQUIVALENT, ON TOP OF THE TOPSOIL AND LIVE BRANCHES SUCH THAT 2.5 FEET OF THE BLANKET WILL BE BURIED BELOW THE NEXT SOIL LIFT. ALLOW THE REMAINING 4.5 FEET OF BLANKET TO HANG OVER THE PRECEDING SOIL LIFT OR COIR FIBER LOGS.
14. PLACE A LAYER OF 8.5 FEET WIDE NON-WOVEN COIR MATTING OVER THE EROSION CONTROL BLANKET TO THE SAME LIMITS.
15. SOIL CAN BE COMPACTED BY STACKING A PIECE OF 2 X 6 SAWN LUMBER EDGWAYS UP TO THE LIFT HEIGHT SPECIFIED IN THE STRUCTURE TABLE AND SECURING WITH WOODEN STAKES TO PROVIDE A RIGID BACKSTOP FOR COMPACTING SOIL LIFT.
16. PLACE SOIL BACKFILL UP TO THE LIFT HEIGHT SPECIFIED OF NO GREATER THAN 1.0 FT BEING CAREFUL NOT TO PUSH/PULL OR TEAR THE FABRIC PREVIOUSLY PLACED.
17. THE TOP OF THE SOIL BACKFILL SHALL BE FLAT WITHIN THE LIFT SETBACK DISTANCE SPECIFIED IN THE STRUCTURE TABLE. BEYOND THE LIFT SETBACK DISTANCE, THE SOIL BACKFILL SHALL BE SLOPED AT AN APPROXIMATE 5% SLOPE AWAY FROM THE STREAM.
18. TOP DRESS THE SOIL LIFT WITH TOPSOIL FROM THE FACE OF THE SOIL LIFT BACK INTO THE FLOODPLAIN AT LEAST 4FT.
19. REMOVE THE SAWN LUMBER AND WOODEN STAKES FROM THE FACE OF THE SOIL LIFT AND WRAP THE FACE AND TOP OF THE SOIL LIFT USING THE WOVEN AND NON-WOVEN COIR MATTING HANGING OVER THE PREVIOUS LIFT/COIR FIBER LOGS.
20. THE EROSION CONTROL FABRIC SHALL BE PULLED AS TIGHT AS POSSIBLE WITHOUT TEARING OR EXCESSIVELY DISTORTING THE FABRIC.
21. SECURE THE EROSION CONTROL AND NON-WOVEN MATTING IN PLACE BY STAKING THE END OF THE EROSION CONTROL FABRIC WITH WOODEN STAKES ON 1.5-FOOT CENTERS.
22. BEGIN CONSTRUCTION OF THE NEXT SOIL LIFT BY REPEATING THE PREVIOUS NOTES STARTING WITH NOTE 11.
23. THE OVERALL SLOPE CREATED BY THE LIVE BRUSH LAYERING SHALL MATCH THE PROPOSED CROSS SECTION SHAPE FOR THE OUTER BANK OF THE TYPICAL POOL CROSS-SECTION FOR EACH REACH.
24. THE COIR BLANKETS AND GEOTEXTILE FABRIC USED FOR THE UPPER MOST SOIL LIFT WILL BE SECURED WITHIN A 8 INCH DEEP TRENCH AS SHOWN IN DETAIL TRENCH AS SHOWN IN THE DETAIL.
25. THE SURFACE OF THIS STRUCTURE SHALL BE FINISHED TO A SMOOTH AND COMPACT SURFACE IN ACCORDANCE WITH THE LINES, GRADES, AND CROSS-SECTIONS OR ELEVATIONS SHOWN ON THE DRAWINGS. THE DEGREE OF FINISH FOR ELEVATIONS SHALL BE WITHIN 0.1 FT OF THE GRADES AND ELEVATIONS INDICATED OR APPROVED BY THE ENGINEER.
26. RE-DRESSING OF CHANNEL AND BANKFULL BENCH/FLOODPLAIN WILL LIKELY BE REQUIRED FOLLOWING INSTALLATION OF IN-STREAM STRUCTURES AND SHALL BE CONSIDERED INCIDENTAL TO CONSTRUCTION.

Sewer Line Crossing

Stream realignment for perpendicular crossing with bank protection

Before



After



Habitat Structures

Flat boulders in glides tilted up on downstream end



Habitat Structures

Log vanes for scour pools



Constructed Stormwater Wetlands

Collecting and treating parking lot runoff



Riparian Vegetation

- Native grasses, shrub, trees
- Invasive exotic plant control



Education and Recreation

- Workshops and Tours
- Overmountain Victory Trail



Monitoring for Hellbender Salamanders

- eDNA and photographic evidence of Hellbender in Spring, 2017
- Live specimens found since 2018



Lessons Learned at Grassy Creek

➤ Focus on Habitats:

- Natural Materials: Rocks & Wood
- Diversity: Riffles, Pools, Glides, Steps
- Plants: Roots, Detritus, Shade

➤ Provide Connectivity:

- Floodplain: Overbank Flows
- Ground Water: Hyporheic Connection

➤ Understand Urban Constraints:

- Limited space for stream corridor
- Flashy flow conditions



Re-wilding of Stream and Floodplains:

- Improve water quality and habitats
- Improve resilience during extreme weather
- Improve community stewardship

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