Organic Amendment Restoration of Degraded Upland Landscapes in the Chestatee-Yahoola Watershed

Presenters
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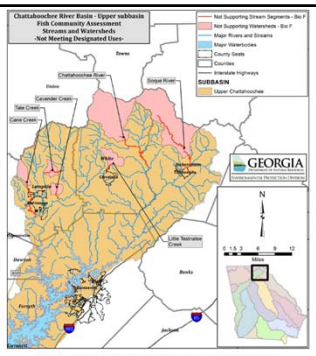

Figure 4. Fish Community Not Supporting Stream Segments and their Associated Watersheds - Upper Chattahoochee Subbasin

3 Watersheds in Chestatee Watershed Have Impaired Fish Biota Due to Sedimentation

- Chestatee River Watershed in Lumpkin County provides 28% of the annual average inflow (568 cfs) to Lake Sydney Lanier
- Home to 3 out of the 6 watersheds in the Upper Chattahoochee that **fail to support native FISH DIVERSITY** due to sedimentation.
- 14 miles of stream are impaired due to sedimentation
  - Cane Creek = 8 miles
  - Cavenders Creek = 2 miles
  - Tate Creek = 4 miles

OUR GOAL
Watershed Scale Restoration

Sediment Impacts on Fish

- During heavy rains, **turbid water clogs fish gills** increasing the release of stress hormones.
- As sediment settles, it fills all the **interstitial spaces** in the stream bed (all the openings around the cobbles and pebbles).
- Interstitial spaces is where most **fish food (benthic macroinvertebrates ie. aquatic insects**) lives underneath the rocks.

- Once this interstitial habitat has been destroyed, it **prevents fish from laying their eggs** in rock crevices or in the spaces between gravel.

Step #1 – Recognize sediment impacts

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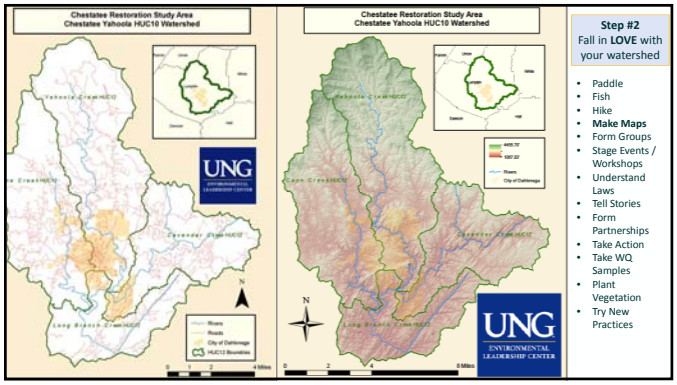

Step #2
Fall in **LOVE** with your watershed

- Paddle
- Fish
- Hike
- **Make Maps**
- Form Groups
- Stage Events / Workshops
- Understand Laws
- Tell Stories
- Form Partnerships
- Take Action
- Take WQ Samples
- Plant Vegetation
- Try New Practices

Traditional E&S BMPs at the Watershed Landscape Scale may be impractical and don't address underlying deficiencies

- Vegetation is cited as the most efficient and economic soil erosion control.
- However, for **DEGRADED LANDSCAPES** vegetative re-establishment is extremely challenging.
- Soils lack pore space, organic matter, nutrients, water holding capacity, and soil organisms that cycle nutrients back to the roots of plants.
- I.e. Soils are bare, compacted, with low pH, often red, and eroding.

Softening "Brick-like" landscapes into Green Spongy ones

For degraded landscapes additions of organic amendments (often leaf and chipped wood mulch) are the most efficient way to **stop erosion** and **kickstart secondary succession** processes.

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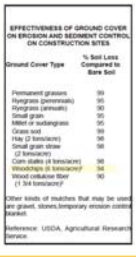
Additional Benefits of Using Organic Mulch



After vegetation, mulch is the 2nd most effective erosion control technique after compost.

Effectiveness of mulch for erosion control relative to bare soil.

Tons to the acre	C-factor
7	.08
12	.05
25	.02

Faucette, 2006

Mulch and compost provide many additional benefits other than erosion control.

- **ACTS like a SPONGE** - increasing rainfall infiltration
- **Increased vegetative productivity** due to increased nutrients, water holding capacity, and >pH (depending on feedstocks)
- **Enhanced soil ecology** which improves nutrient cycling and soil physical properties.
- Overtime, **improves soil porosity** and bulk density (due to increased activity of soil organisms).
- Increased **carbon sequestration** potential.

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2

The Revised Universal Soil Loss Equation

Step #3
Develop a **TOOL** to prioritize restoration

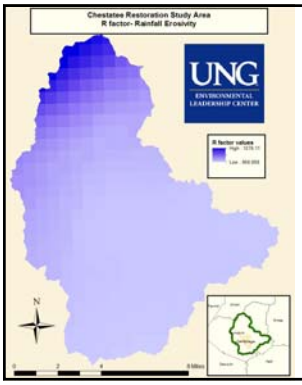
$$A = R*K*L*S*C*P$$

where A = **soil loss** (tons/acre/year)

6 factors yield a SOIL LOSS estimate
Measured in tons per acre per year

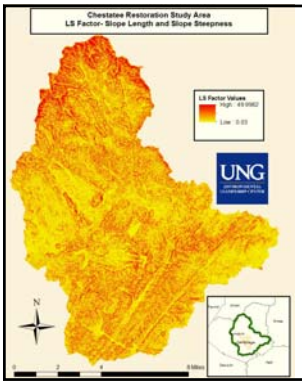
R = rainfall **erosivity** factor
K = soil **erodibility** factor
L = **slope length** factor
S = **slope gradient** factor
C = **crop/vegetation and management** factor
P = **support practice** factor (1 for watershed)
(contour farming, strip cropping, cross slope, etc.)

OUR GOAL
Demonstrate **RUSLEs** applicability for Watershed Assessment and Prioritization
GIVE to other Watersheds for ADOPTION



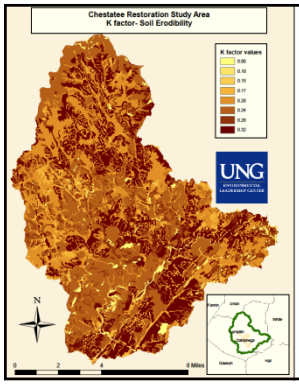
Rainfall Erosivity factor (R)

- R is defined as the average annual sum of individual storm erosion index values, EI_{30}, where E is the storm kinetic energy per unit area and I_{30} is the maximum 30 minutes rainfall intensity
- R-factor calculation is complex as it involves collection of years of storm (precipitation) intensity data
- Data used- NOAA GIS Grid Atlas Precipitation freq estimates (I_{30})
- Calculate $R = I_{30} * (331*\log_{10}(I_{30})+916)$



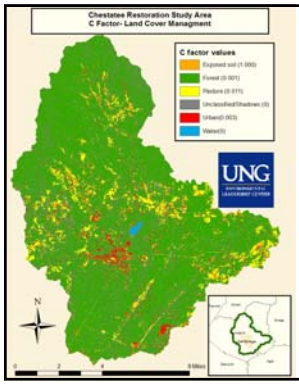
Length Slope factor (LS)

- **L- Slope Length**- ratio of soil loss to slope length
- **S- Slope Steepness**- ratio of soil loss to slope steepness
- Derived from a Digital Elevation Model (DEM)
  - Use GIS tools to get layers for Slope and Flow Accumulation
- Conditional formulas relative to standard erosion plot and slope of 22.1m at 9% slope



Soil Erodibility factor (K)

- Represents a soils susceptibility for particles to be detached by water
- Sourced from gSSURGO database
  - Field called *Kffact*
- Low K values = soils resistant to detachment (High in Clay)
- High K values = soils prone to detachment (High in Sand/Silt)



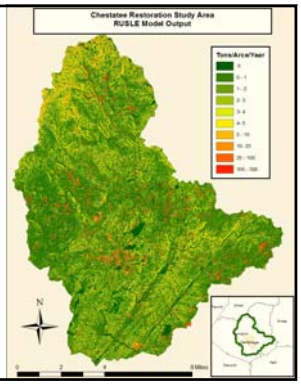
Land Cover Management factor (C)

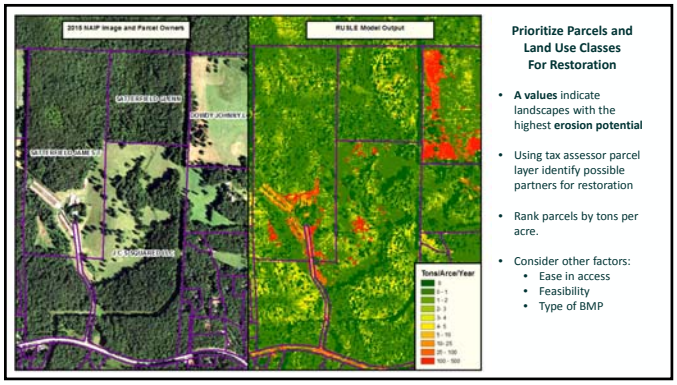
- Ratio of soil loss from a specific type of vegetation cover
- When RUSLE is done at the plot scale, precise values are associated with many different species of crops
- For the watershed scale, a few broader classes are used and the values are less precise
- We used 1m resolution imagery (4 band NAIP)
  - Supervised classification into 6 classes
- Other potential sources include LiDAR data or National Land Cover Database (30m resolution)

The Revised Universal Soil Loss Equation

$$A = R*K*L*S*C*P_{(1)}$$

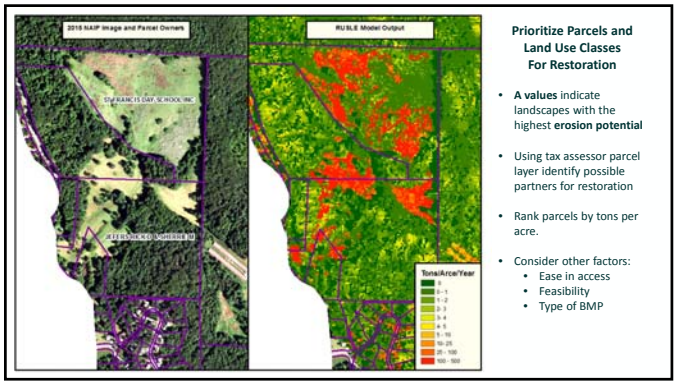
A(model output) is in Tons/Acre/Year





Prioritize Parcels and Land Use Classes For Restoration

- **A values** indicate landscapes with the highest **erosion potential**
- Using tax assessor parcel layer identify possible partners for restoration
- Rank parcels by tons per acre.
- Consider other factors:
  - Ease in access
  - Feasibility
  - Type of BMP



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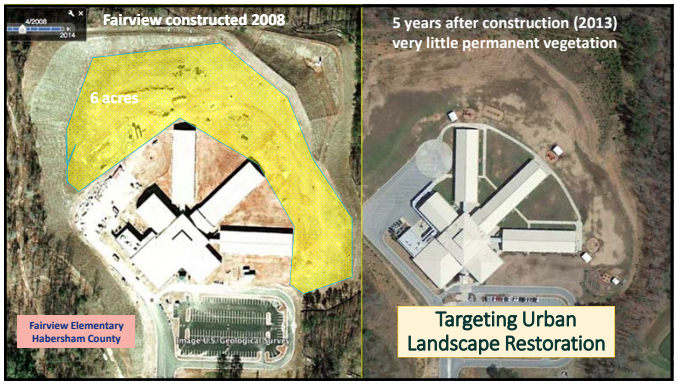



Restoration efforts began in 2013 – started with lime followed by trees


Before 2010
After 2015
Step #4
Add Organic Matter
Before 2010
After 2015


Before 2010
After 2015
Before 2010
After 2015

6

Developing Partnerships with Mulch Providers

Mulch Availability
Every county in the state of Georgia generates 100's to 1000's of tons of organic matter each and every year.

Targeting this material to priority areas has the potential to transform catchment hydrology.

Mulch Partners
Sources and partners for mulch:
- Municipal Leaf and Limb pickup
- Electric Utility right of way crews
- Tree Service companies
- DOT right of way maintenance

Straightforward Implementation

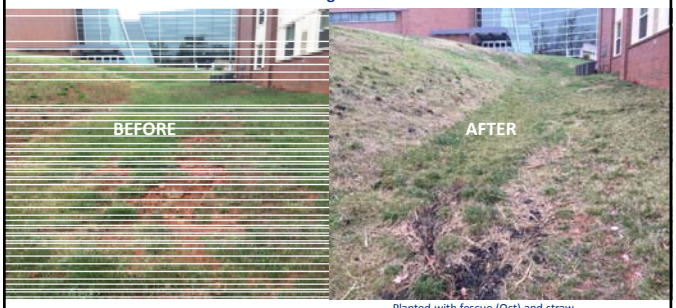

After


Stockpiled Materials to be spread in March
BEFORE


Organic amendment restoration of the Commons Residence Dorms
BEFORE
BEFORE

8

For more rapid vegetative establishment in high aesthetic areas – we utilized **aged leaf mold material**



Planted with fescue (Oct) and straw

Upland Pasture Restoration and Cattle Exclusion

Isolate cattle from sensitive areas with installation of **Temporary exclusion fencing** until full vegetative re-establishment is achieved.

Leaf mulch is an ideal organic amendment in these settings to allow more rapid decomposition and grass seed re-establishment. Wood mulch in areas that can remain untouched for 2-3 yrs.

Permanent exclusion fencing, followed by streamside plantings in the riparian buffer for bank stability.
CHALLENGE – upland watering

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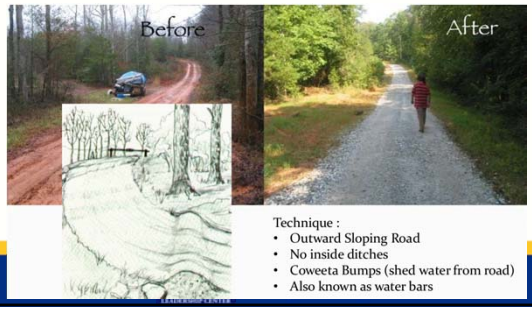
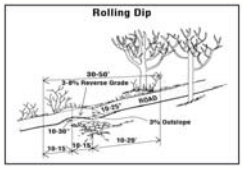
Dirt Road / Right of Way Improvement



Technique :
- Outward Sloping Road
- No inside ditches
- Coweeta Bumps (shed water from road)
- Also known as water bars

Broad-based Dips & Outward Sloped Roads



General Rule for Spacing of Dips

Road Grade, percent	Distance between dips and turnouts, feet
3	235
4	200
5	180
6	165
7	155
8	150
9	145
10	140
12	135

Source: Adapted from Georgia's Best Management Practices for Forestry

Broad-based Dips (or rolling dip)
A surface drainage diversion built into the bed of a road to intercept and divert surface water out of the road while allowing vehicles to maintain normal speeds.

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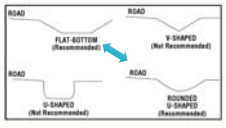
Road Side Ditches / Road Right of Ways

Ditch bottom at least **2' wide, flat, parabolic, or rounded-U** shaped, **but NOT** straight U-shaped or V-shaped.

Grade ditch and bank side slopes at **2:1 maximum slope**, i.e., 2 feet horizontal for each 1-foot vertical rise.

- Vegetated Ditches where possible
- Maintain "sheet flow" by controlling ditch shape
- Where water is concentrated - use turn-outs to to stable, mature vegetated areas.
- Avoid in-sloping roads when possible



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Sediment Loss from Utility Right of Ways

- As the RUSLE model is refined, we anticipate UTILITY Right of Ways represent a unique land class for sediment losses
- This is due to the frequent disturbance required and the steepness of slope.
- **Illegal ATV use** is an additional factor.
- We plan to work with Right of Way managers and local municipalities and law enforcement on new recommendations to address these areas.

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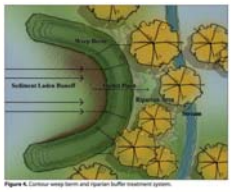
Application of New BMPs – Seep/Weep Berms



Weep berms are a type of earthen berm that slowly releases upslope runoff into a riparian area. This water is cleaner, and increased holding time of upslope water increases the productivity of riparian trees.

Slow release of water from weep berm outlet to grassed riparian zone.

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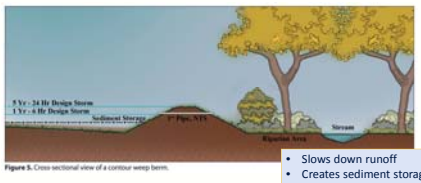
Benefits of Seep/Weep Berms



- Slows down runoff
- Creates sediment storage above a streamside area
- Reduces sediment delivery to streams
- Enhances water storage (groundwater recharge)
- Enhances streamside forests
- Captures lost upslope toposoils for reuse. It's a win, win!

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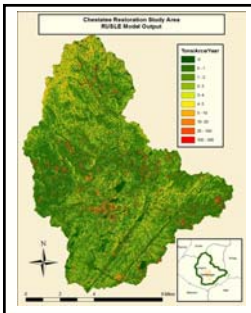

Moving Forward

- Georgia is still developing mechanisms for addressing many non-point source controls, especially in more rural counties.
- TMDLs are written but not fully implemented
- Most GA County Governments and other municipalities have GIS personnel and resources.
- RUSLE input parameters are readily available and with some guidance erosion potential priority maps can be generated at the county or sub-watershed level.

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Moving Forward

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- Mobilization of mulch resources is possible in every county of the State. Prioritizing sites for restoration using RUSLE is the first step.
- Costs for spreading mulch are miniscule.
- The potential for restoration of the majority of degraded landscapes in a watershed over a period of years (decades) is significant with dramatic improvement to catchment hydrology, water quality, and ecosystems services.

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