



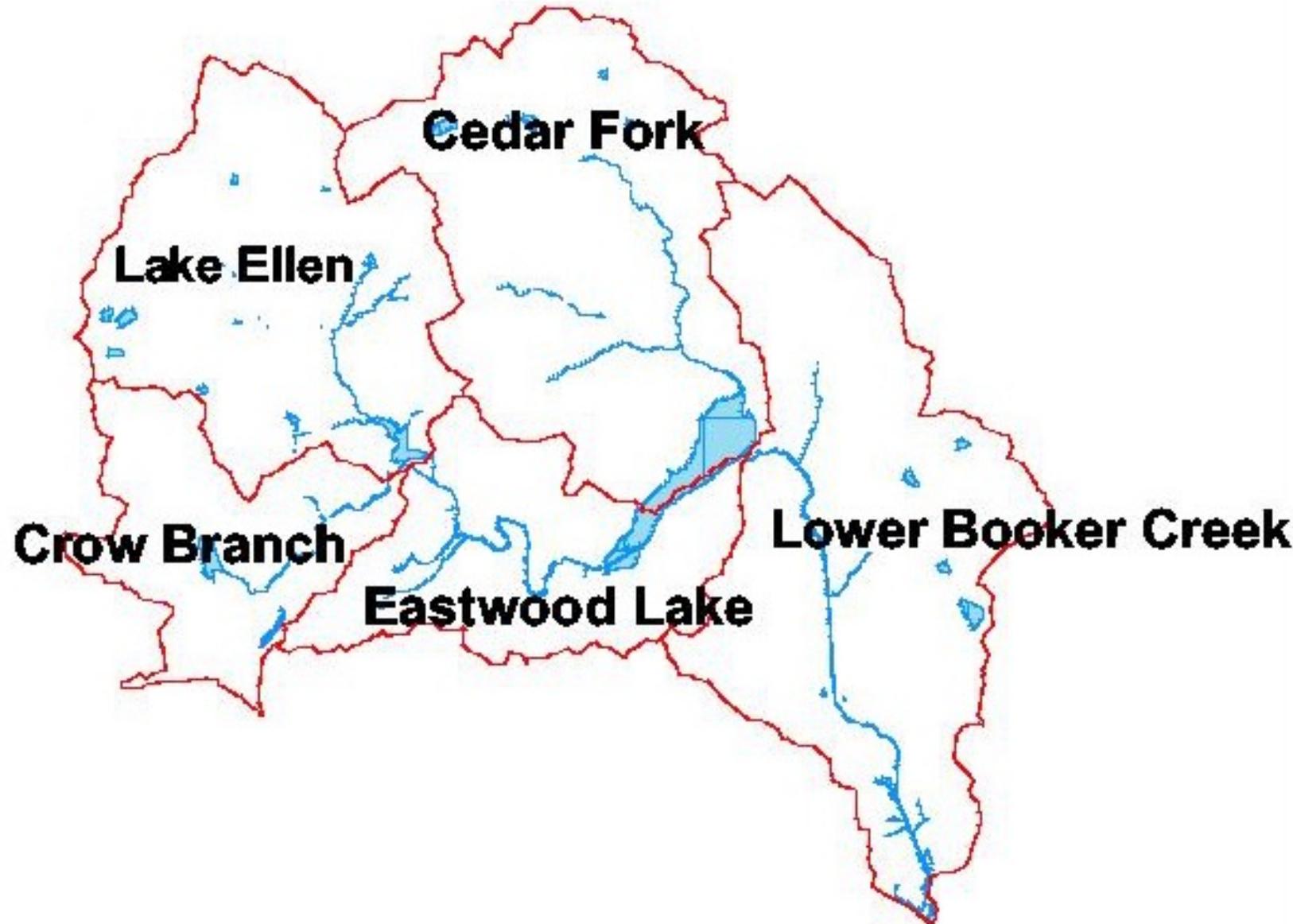
THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Todd BenDor
bendor@unc.edu

Wuhan 2017

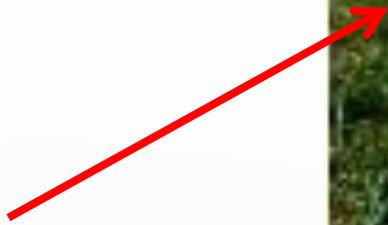
Sub-Watershed and Stream Evaluation

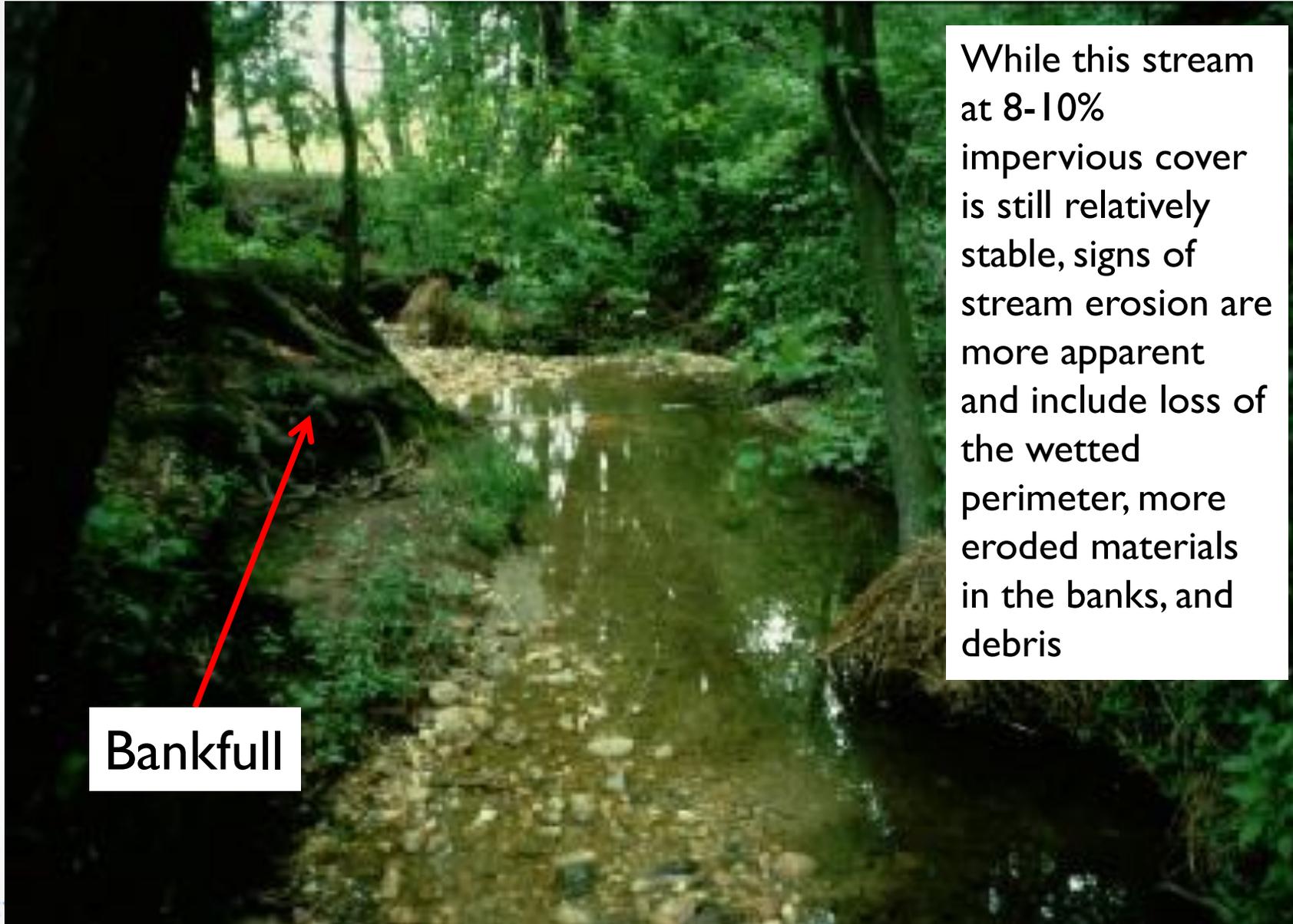
Thinking about Sub-watersheds



In watersheds with less than 5% impervious cover, streams are typically stable and pristine, maintaining good pool and riffle structure, a large wetted perimeter during low flow, and a good riparian canopy coverage

Bankfull



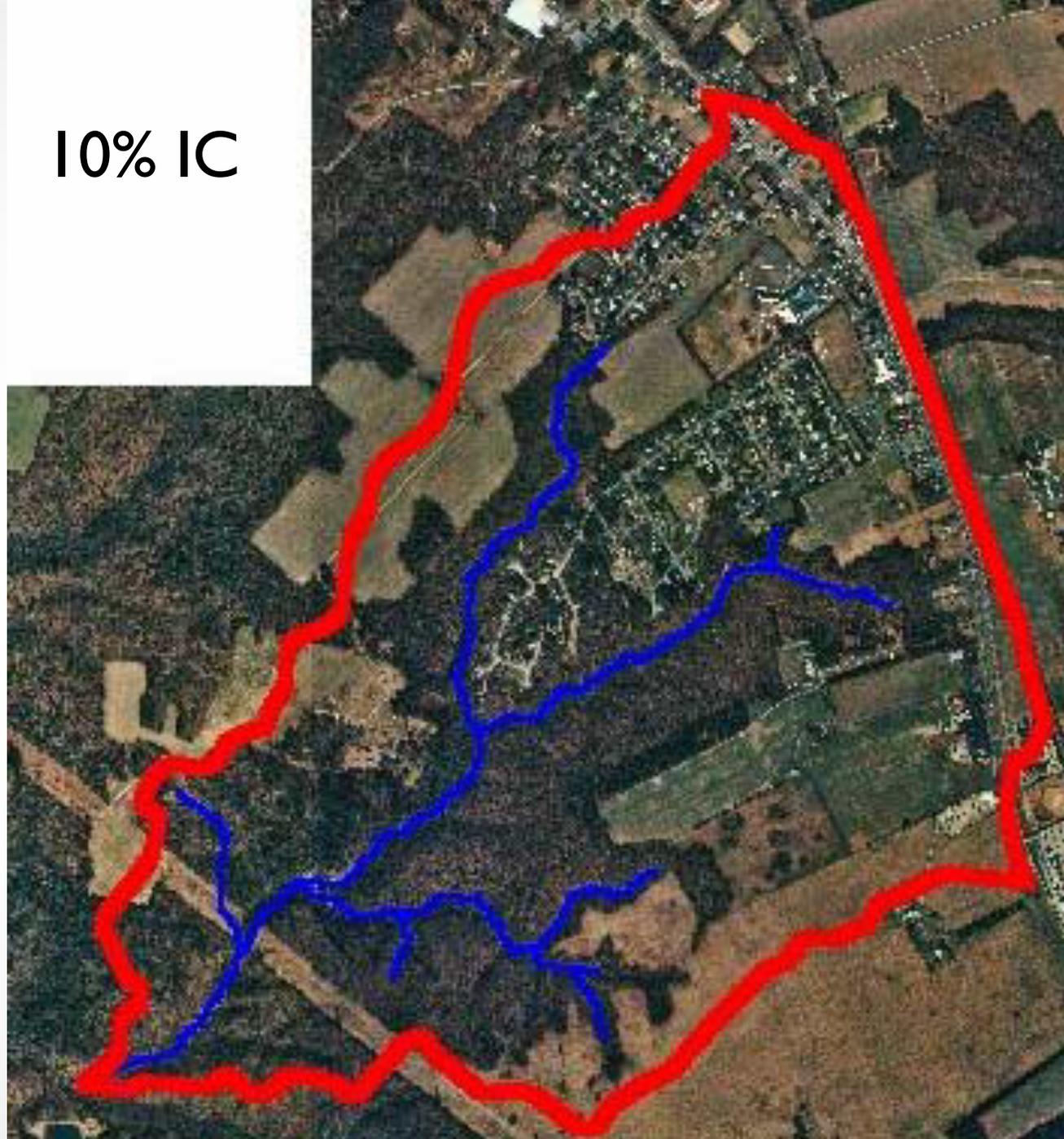


While this stream at 8-10% impervious cover is still relatively stable, signs of stream erosion are more apparent and include loss of the wetted perimeter, more eroded materials in the banks, and debris

Bankfull



10% IC



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

At 10%, impervious cover, the stream is slightly more visibly impacted. The stream shown here has approximately doubled its original size, tree roots are exposed, and the pool and riffle structure seen in sensitive streams is lost.



Bankfull



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

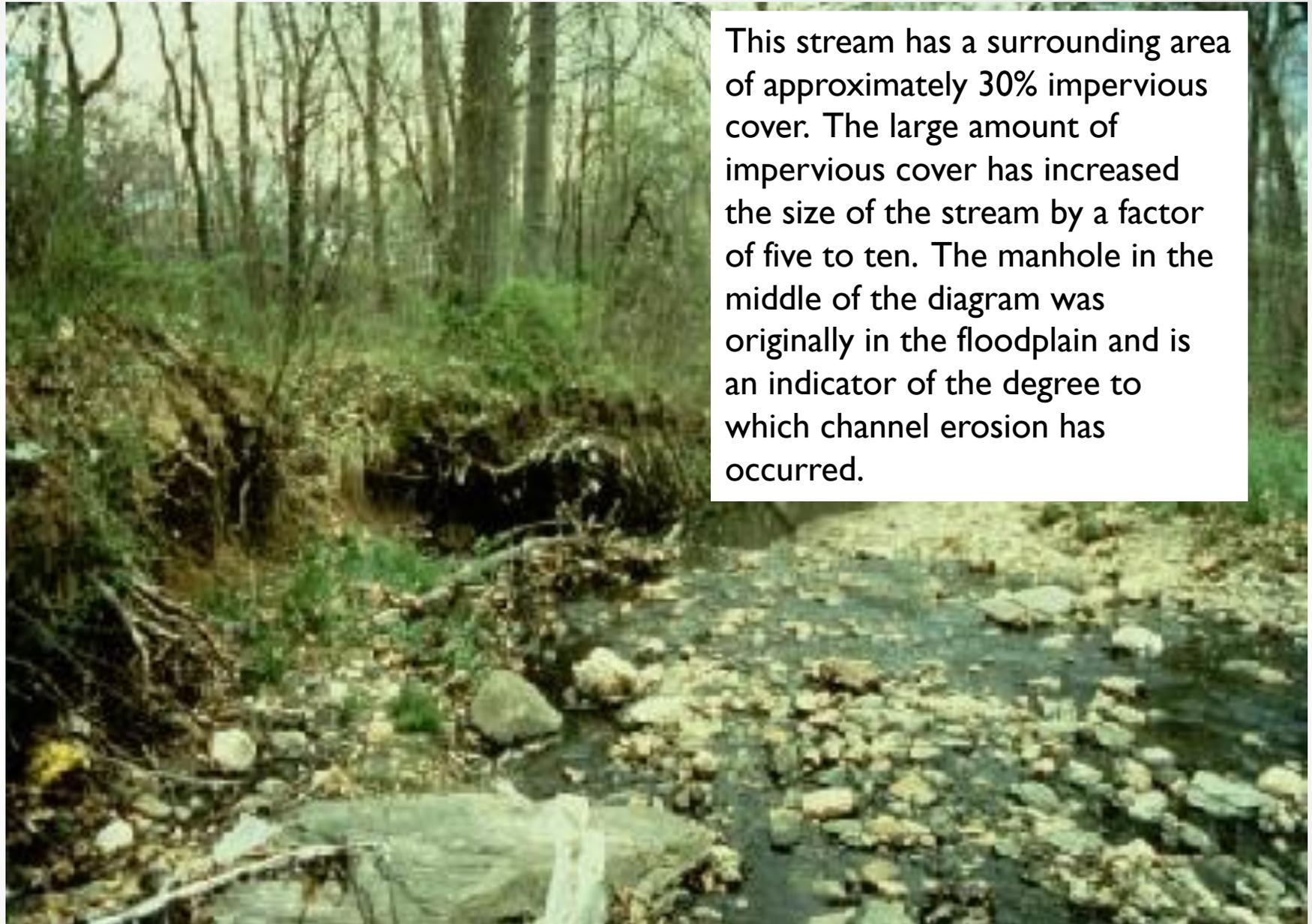


Active erosion becomes much more evident at 20% impervious cover with decreased substrate quality due to more material 'flushing' through the system



The surrounding area of this stream is also approximately 20% impervious cover and shows stream erosion that is much worse than in the previous slide due to an absence of vegetation to hold together bank structure.

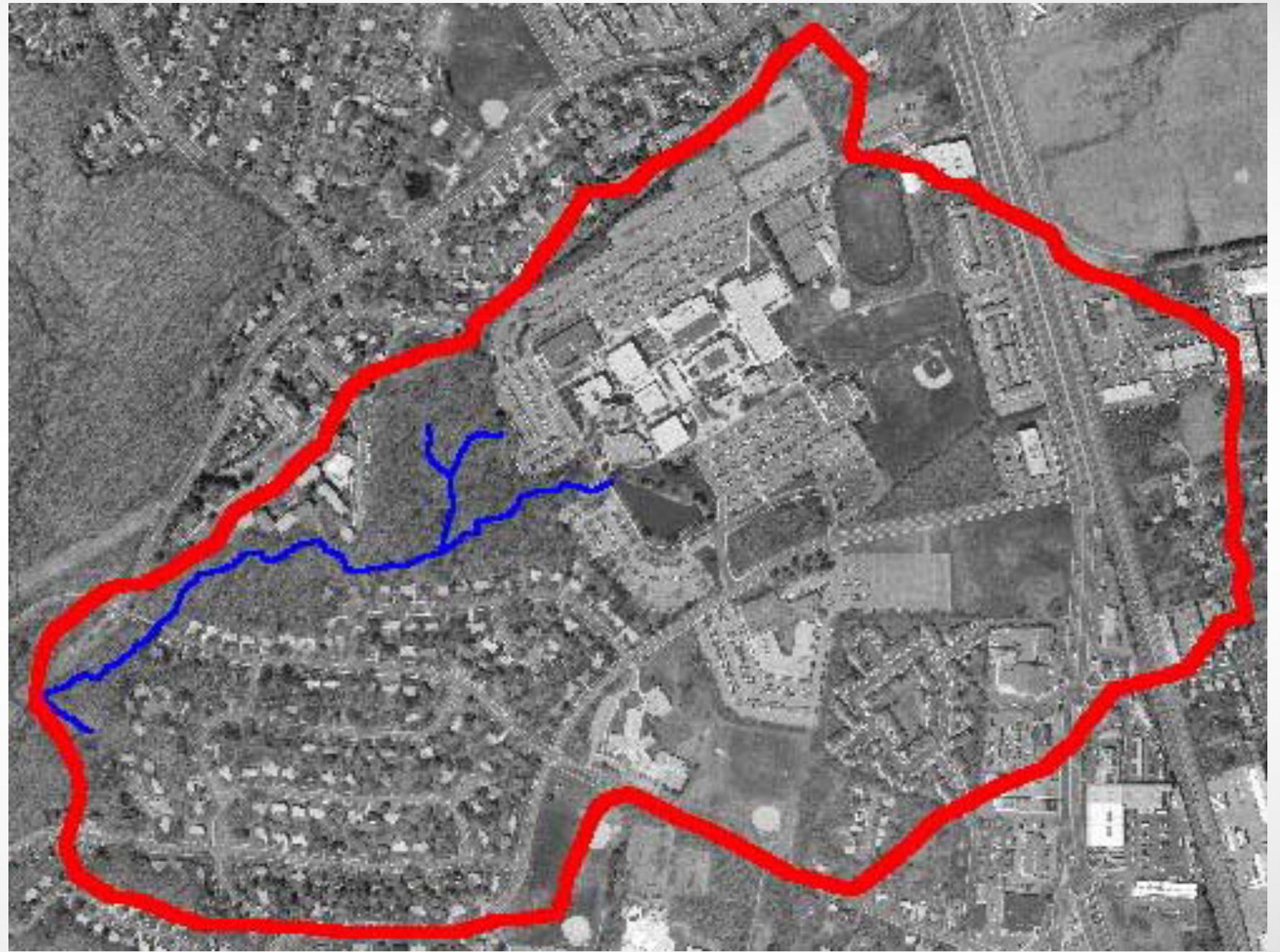




This stream has a surrounding area of approximately 30% impervious cover. The large amount of impervious cover has increased the size of the stream by a factor of five to ten. The manhole in the middle of the diagram was originally in the floodplain and is an indicator of the degree to which channel erosion has occurred.



30% IC



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

25-60% Impervious Surface



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

60% IC



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL



The Surrounding area of this stream is approximately 50% impervious cover and in these situations streams are often piped.



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

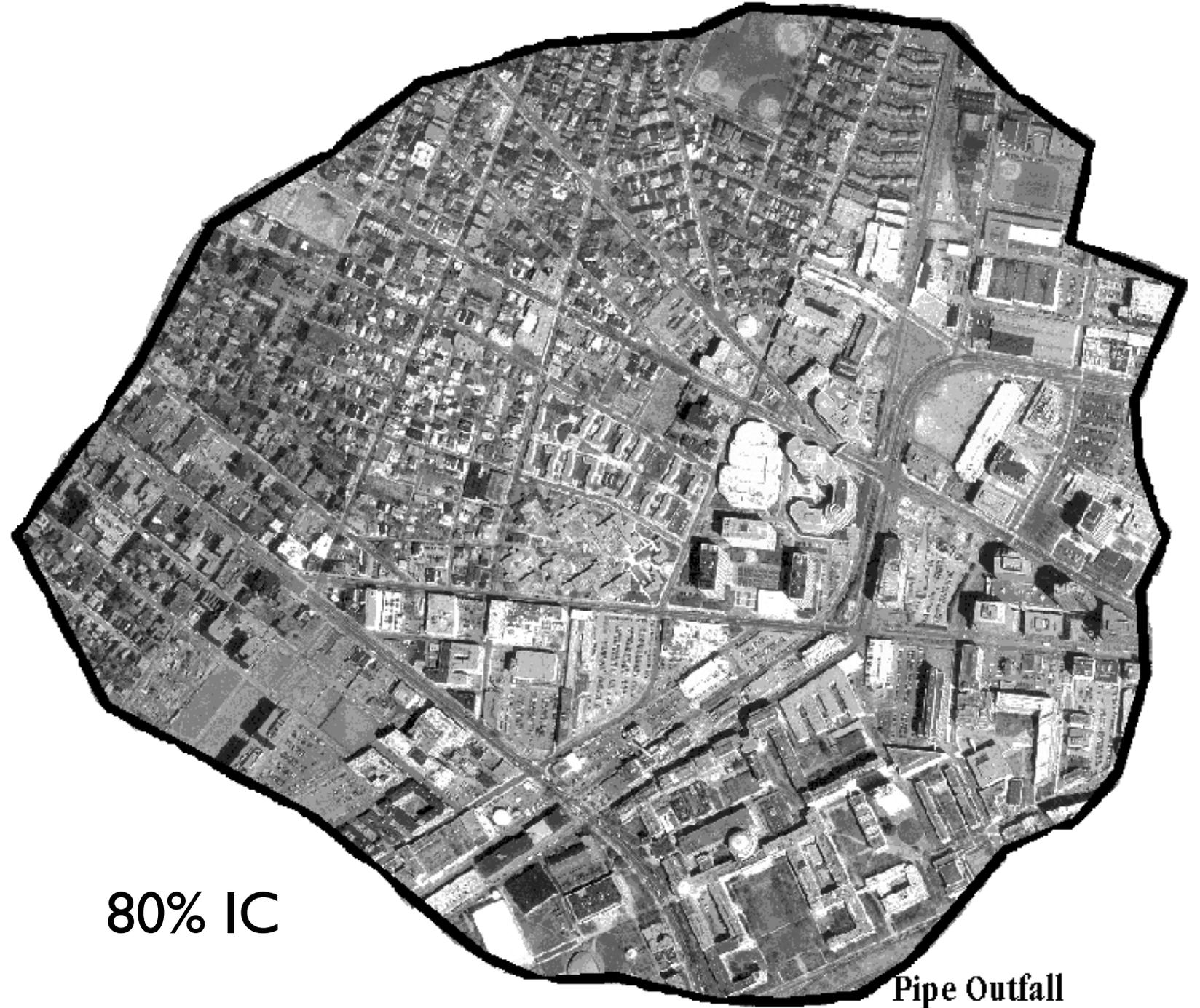
60-90% Impervious Surface



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL



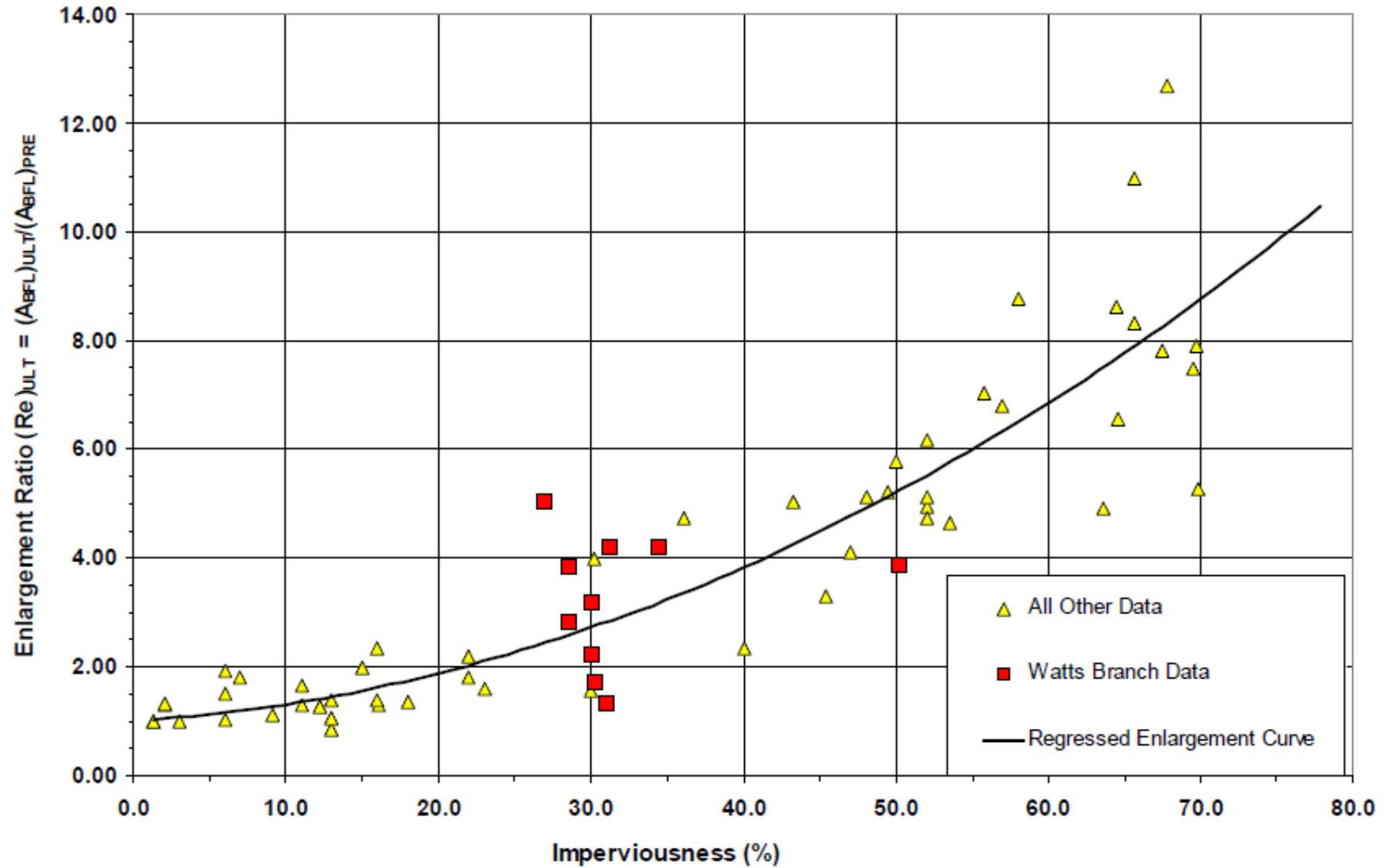
THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL



80% IC

Pipe Outfall

Enlargement Ratio as a Function of Impervious Cover



Urban Watershed Field Evaluations

- Different types of field evaluations

- Water chemistry

- <https://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=dcb44280272e4ac49d9a86b999939fec>

- Critter counts

- Visual assessment

- <https://www.thefreshwatertrust.org/case-study/streambank/>



Please refer to the Save Our Streams Monitor's Guide and laminated Stream Insect & Crustacean card for detailed instructions.

Macroinvertebrate Count

Check one:

Rocky Bottom Sampling - Select a riffle where the water is not running too fast, the streambed consists of cobbled-sized stones or larger, and the water depth is between 3 - 12 inches. Take three samples in the same general area using the kick net. Check all indicator species found and calculate the water quality rating (see below).

Muddy Bottom Sampling - Take the indicated number of scoops with your D-frame net from each habitat:

1. Banks & vegetated edge - 10 scoops.
2. Woody debris with organic matter - 4 scoops.
3. Silt/sand/gravel substrate - 3 scoops.
4. Silty bottom with organic matter - 3 scoops.

Check the boxes (below) beside each species found, and write the letter code in the blank space to record the number of each species found in your sample: A = 1 - 9 / B = 10 - 99 / C = 100+
These numbers will be used to track populations, but are not used in the water quality rating calculation.

Sensitive to Pollution

- _____ Caddisfly larvae
- _____ Hellgrammite
- _____ Mayfly nymph
- _____ Gilled snails
- _____ Riffle beetle adult
- _____ Stonefly nymph
- _____ Water penny larvae

of Boxes checked x 3 = _____
Index value 1

Somewhat sensitive

- _____ Beetle larvae
- _____ Clams
- _____ Crane fly larvae
- _____ Crayfish
- _____ Damselfly nymph
- _____ Dragonfly nymph
- _____ Scuds
- _____ Sowbugs
- _____ Fishfly larvae
- _____ Alderfly larvae
- _____ Watersnipe larvae

of Boxes checked x 2 = _____
Index value 2

Tolerant of Pollution

- _____ Aquatic worms
- _____ Blackfly larvae
- _____ Leeches
- _____ Midge larvae
- _____ Pouch & other snails

of Boxes checked x 1 = _____
Index value 3

WATER QUALITY RATING

Index values 1 + 2 + 3 = Total Index Value _____

- EXCELLENT (>22) GOOD (17 - 22) FAIR (11 - 16) POOR (<11)

Other observations and comments (attach additional pages if needed): _____

Thank you for being an Eno River Watcher!

Please return this form to: Eno River Association, 4419 Guess Rd, Durham, NC 27712



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Urban Watershed Field Evaluation

- Different types of field evaluations
 - Water chemistry
 - Critter counts
 - Visual assessment



USDA Stream Visual Assessment Protocol (Nine Sections)

- Channel conditions
- Hydrologic alteration
- Riparian zone
- Bank stability
- Water appearance
- Nutrient enrichment
- Barriers to fish
- Instream fish cover
- Water Appearance



Convergence of Booker Creek (turbid) and Crow Branch Creek



Turbidity even with treatment by temporary erosion control detention pond



Lake Ellen: Downstream Effects of Construction Even With Erosion Control



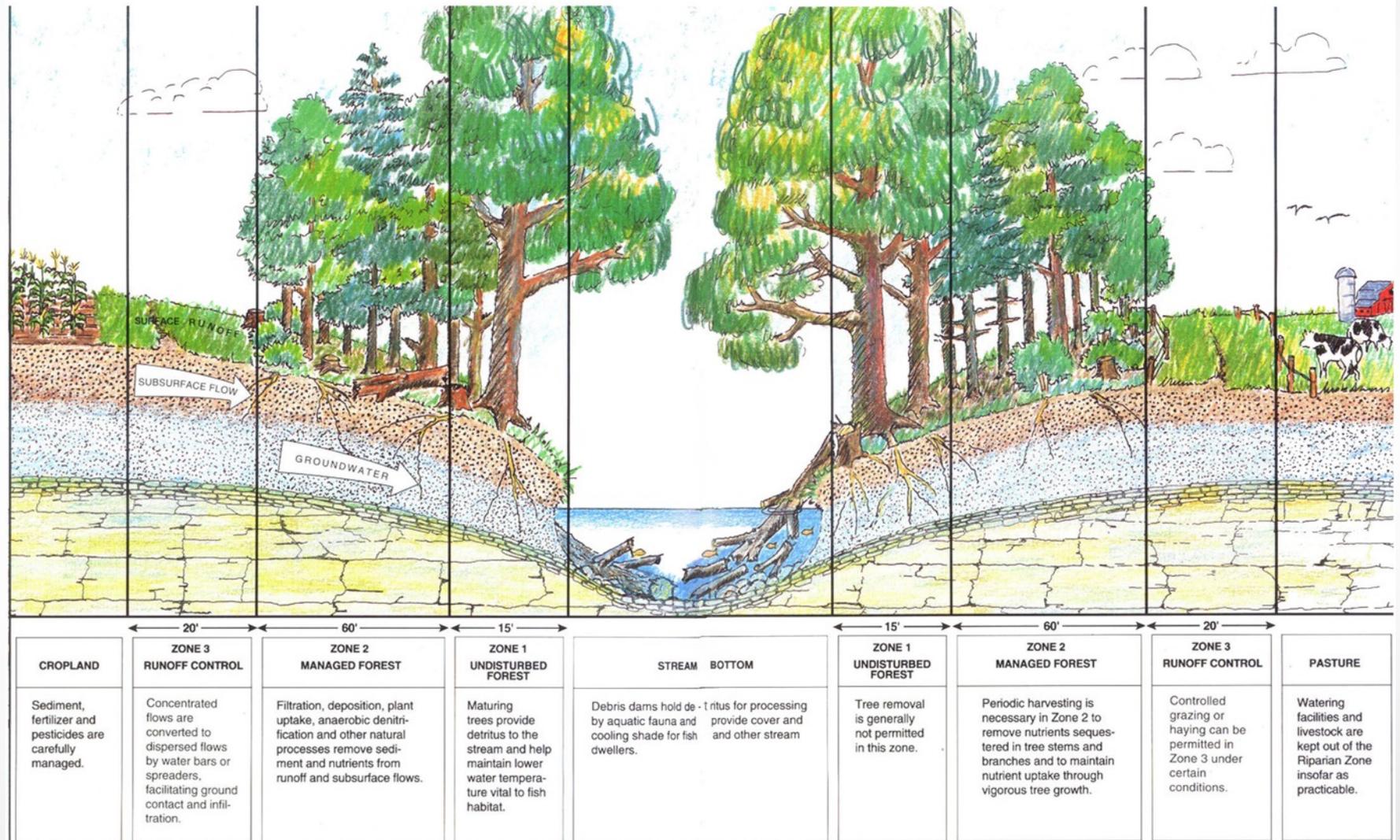


THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Debris Along Booker Creek Downstream of Eastgate Mall After Flood



Riparian Zone, Bank Stability



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Is this buffer high quality? Consider Width and Canopy



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

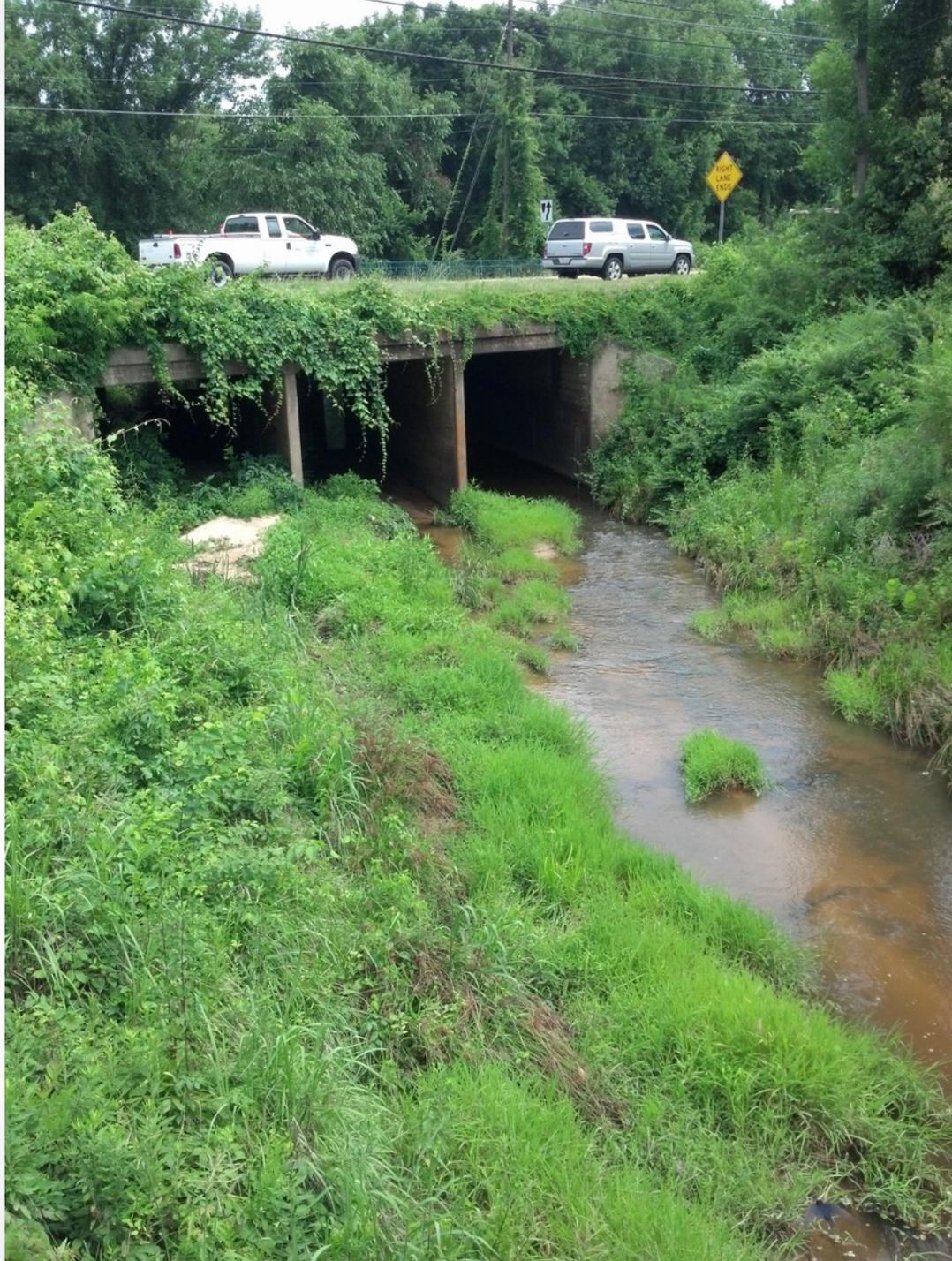
Intermittent Tributary to Booker Creek: Loss of Vegetation in Riparian Zone, Exposed Roots, Upward Gullying (note: erosion control fences)



Nutrient Enrichment

Channel Near Southern Village
Choked with Vegetation. Too
Much Sunlight and Sedimentation





THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Nutrient enrichment: where it can eventually lead...



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

In-stream fish cover

Properly positioned natural debris in channel: supports habitat and minimizes back flow



Physical Characteristics of the Stream Channel

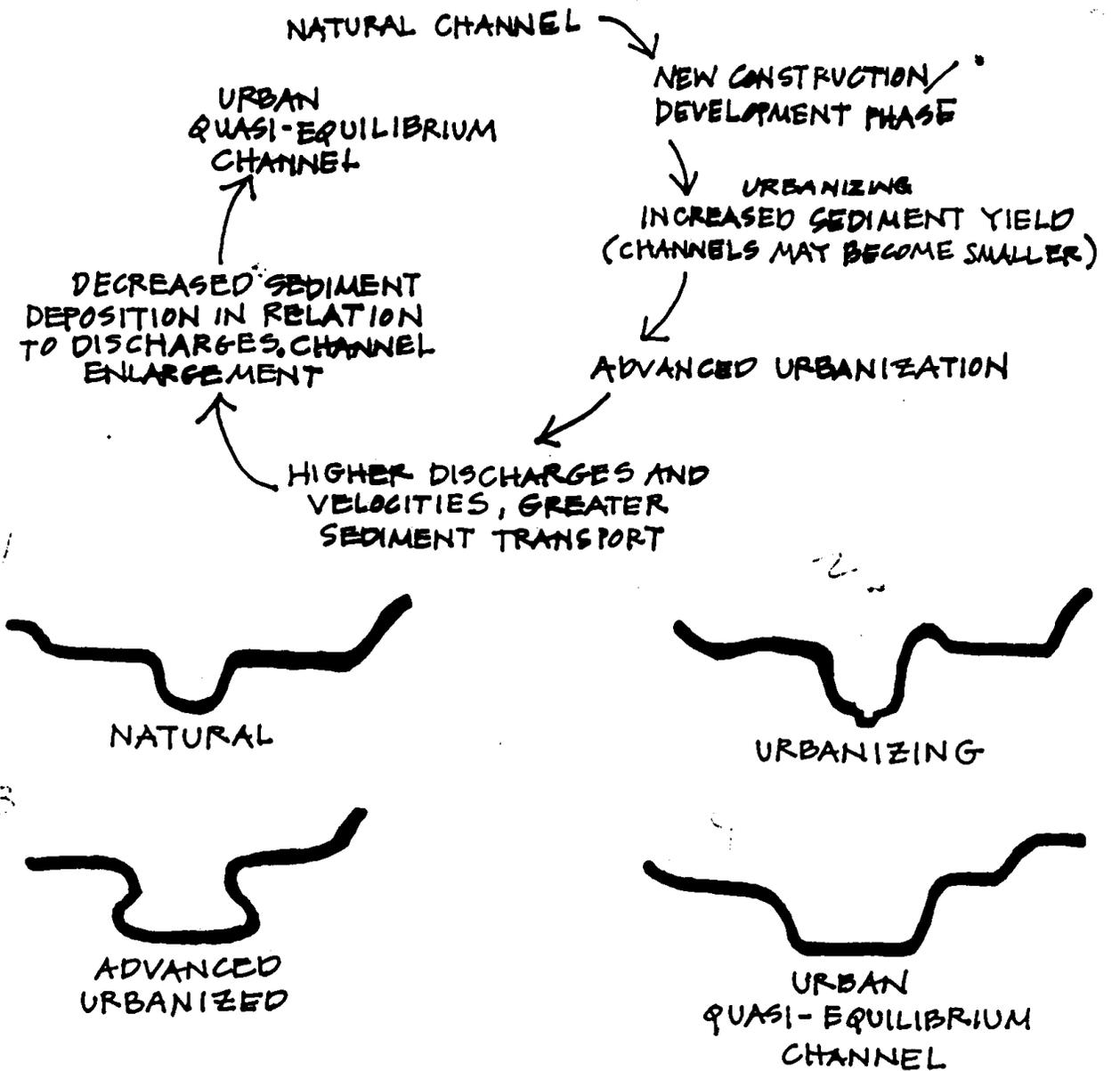
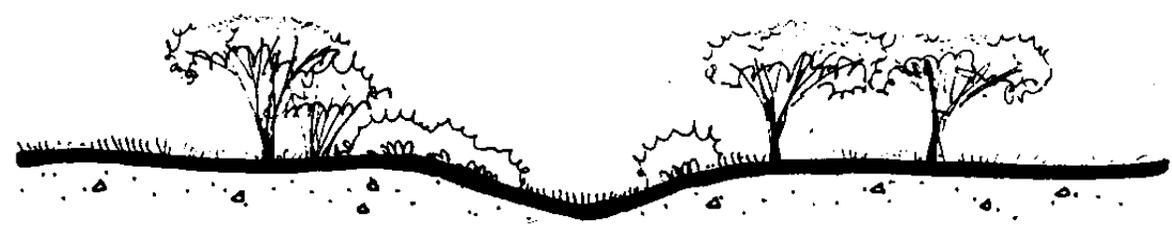


FIGURE 4.8. A TYPICAL CYCLE OF STREAM CHANNEL ADJUSTMENTS TO URBANIZATION.



Successive stages in gully formation from runoff increases



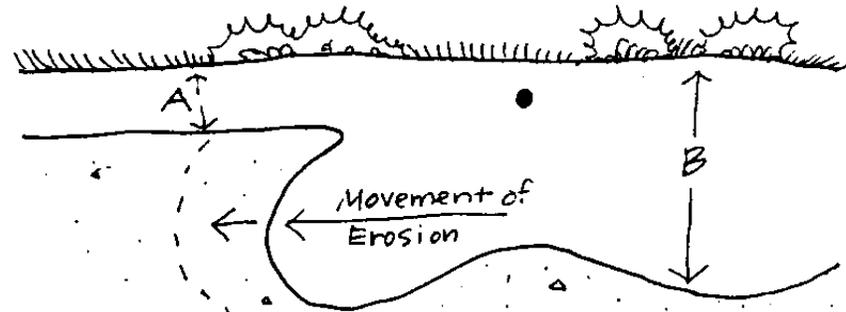
Trough of valley in natural state. Protected by grass and vegetation.



Gully formed in trough of valley by increase in rate of runoff associated with the decline of vegetative cover.



Second-stage gully, causing greater depletion of vegetative cover in valley because of the lowering of the water table.



Gully depth "A" increases to depth "B" as the gully erosion moves up slope.



Advanced state of erosion in cycle of stream bank adjustment: grand canyon downstream of Lake Ellen dam



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Early state of erosion cycle: Effects of stormwater pipe outfall from new road in southern village



Stormwater pipe outfall under shoreline drive: signs of stream bank instability



Sediment buildup in culvert under Franklin street near Eastgate shopping center



OWASA sewer pipe across Bolin creek: note cleared buffer due to easement for sewer



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Upland land use

violation of stormwater erosion control ordinance: curb and gutter on Longmont street along Booker creek



Vegetation island between street and sidewalk in Southern Village: could be improved if island converted to gentle sloping swale



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Flat (not raised) curbs used to promote sheet flow off streets onto grassy swales or into bioretention area in Carpenter Village, North Carolina.



Failed Erosion Control Fences



What is good/bad in this photo for watershed protection?

Ransom Street: Downtown Chapel Hill



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

Erosion Control Devices

Rip Rap



Check Dam



Floodplain Development

Elevated Pod on Clenon



Elevated Building on I5-501



Social Environment: Restoration Project Below Sunrise Biscuit along Bolin Creek

