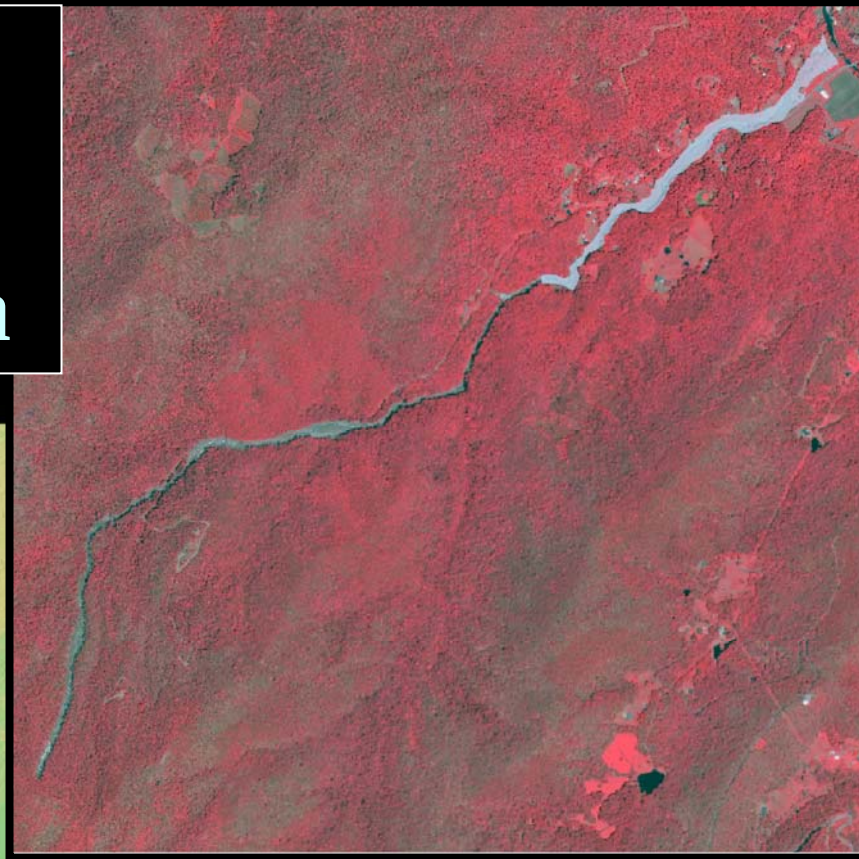
Debris Flow Hazards in Western North Carolina

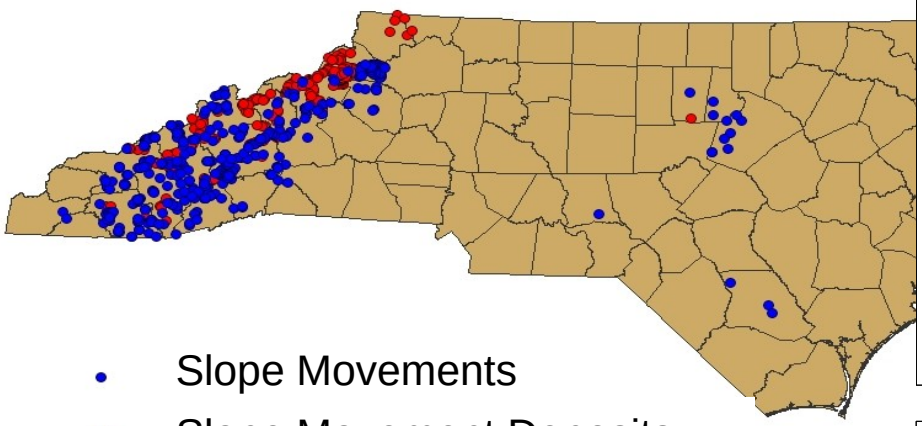


Rick Wooten – Rebecca Latham – Anne Witt

North Carolina Geological Survey

- Landslides
- High Hazard Dams
- Abandoned Mines
- Arsenic
- Sinkholes
- Earthquakes
- Coastal Hazards

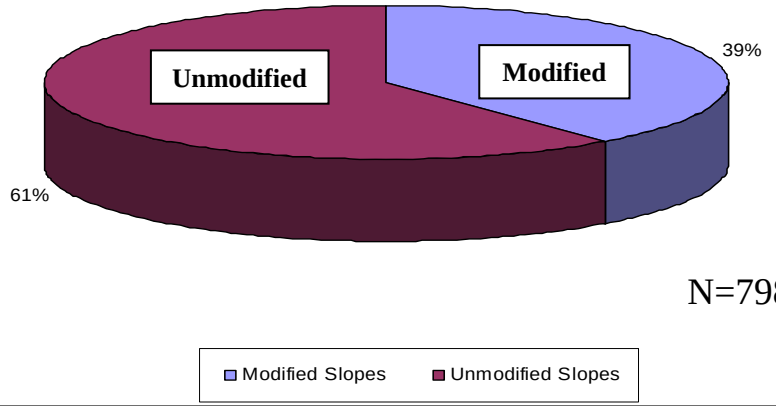
N.C. Slope Movement – Slope Movement Deposit Database



June 2006 - 2000+ Entries

Slope Movement vs. Slope Configuration

(including 409 Aug. 1940 Deep Gap Debris Flows/Slides)



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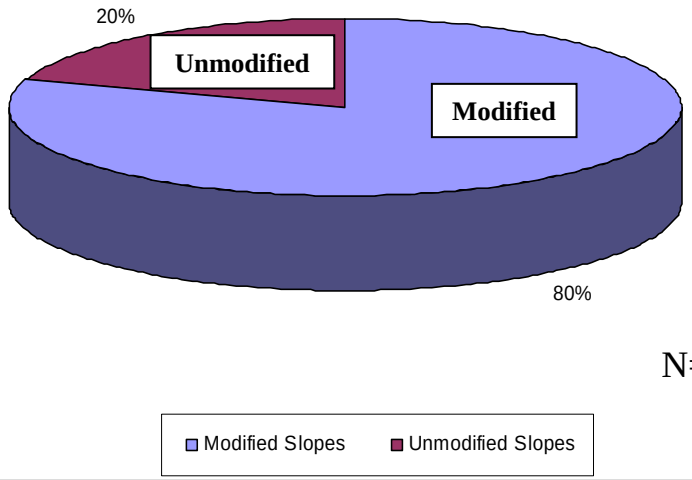
Slope Movement vs. Slope Configuration

(excluding 409 Aug. 1940 Deep Gap Debris Flows/Slides)



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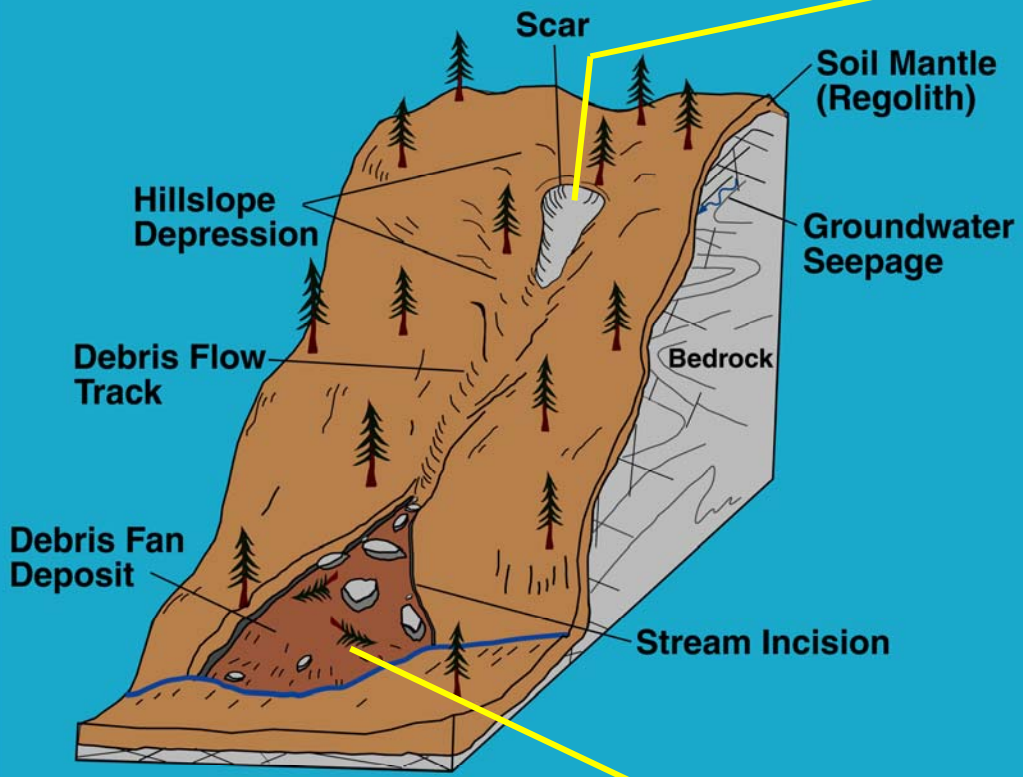
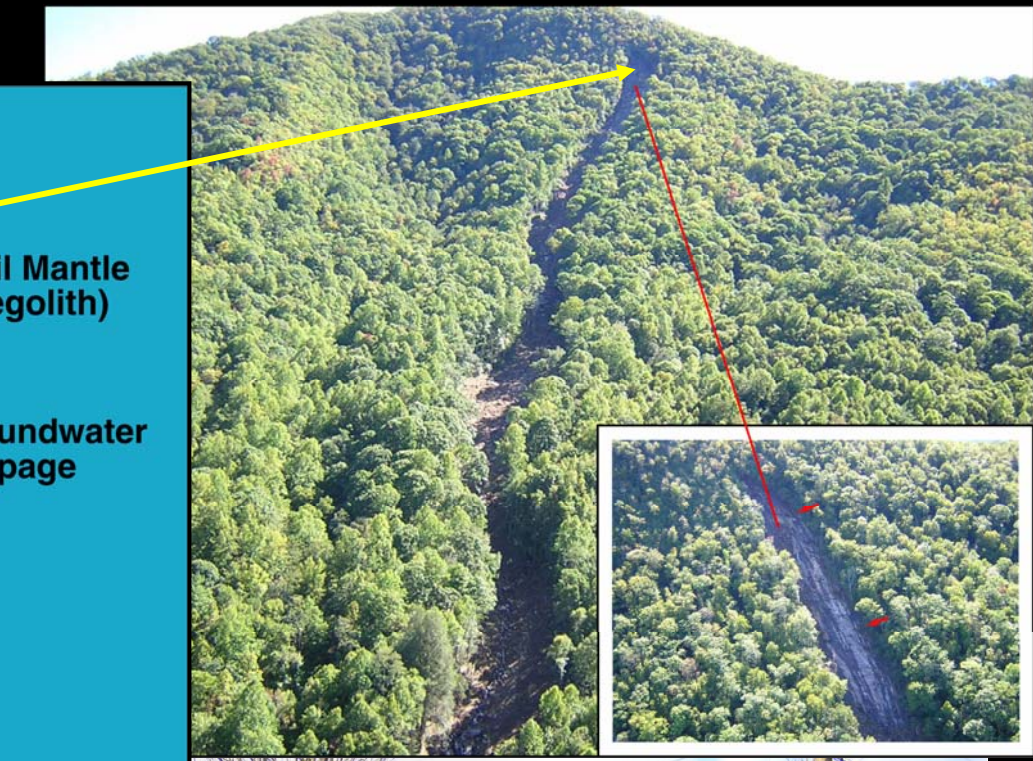
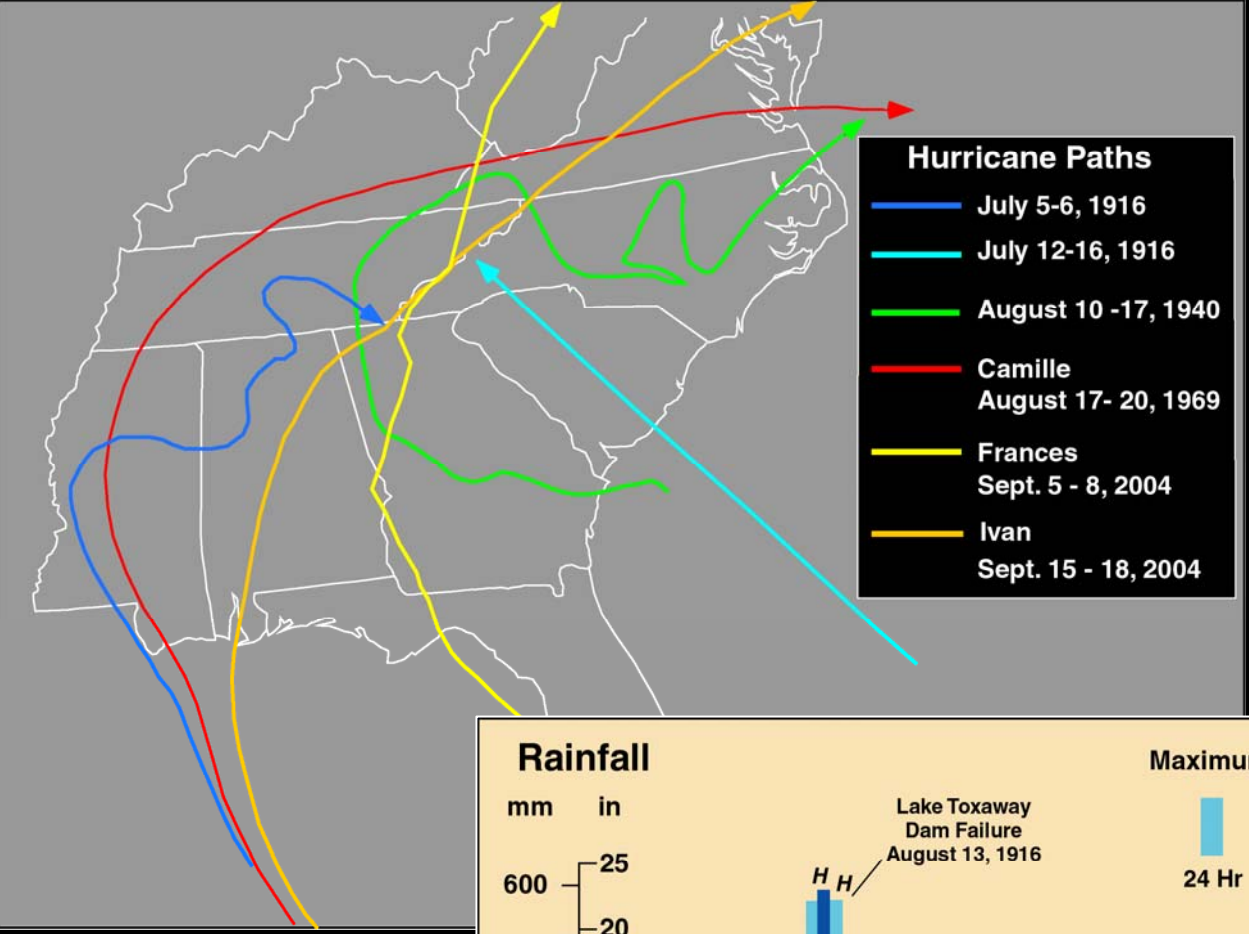
Online at:

http://www.nconemap.com

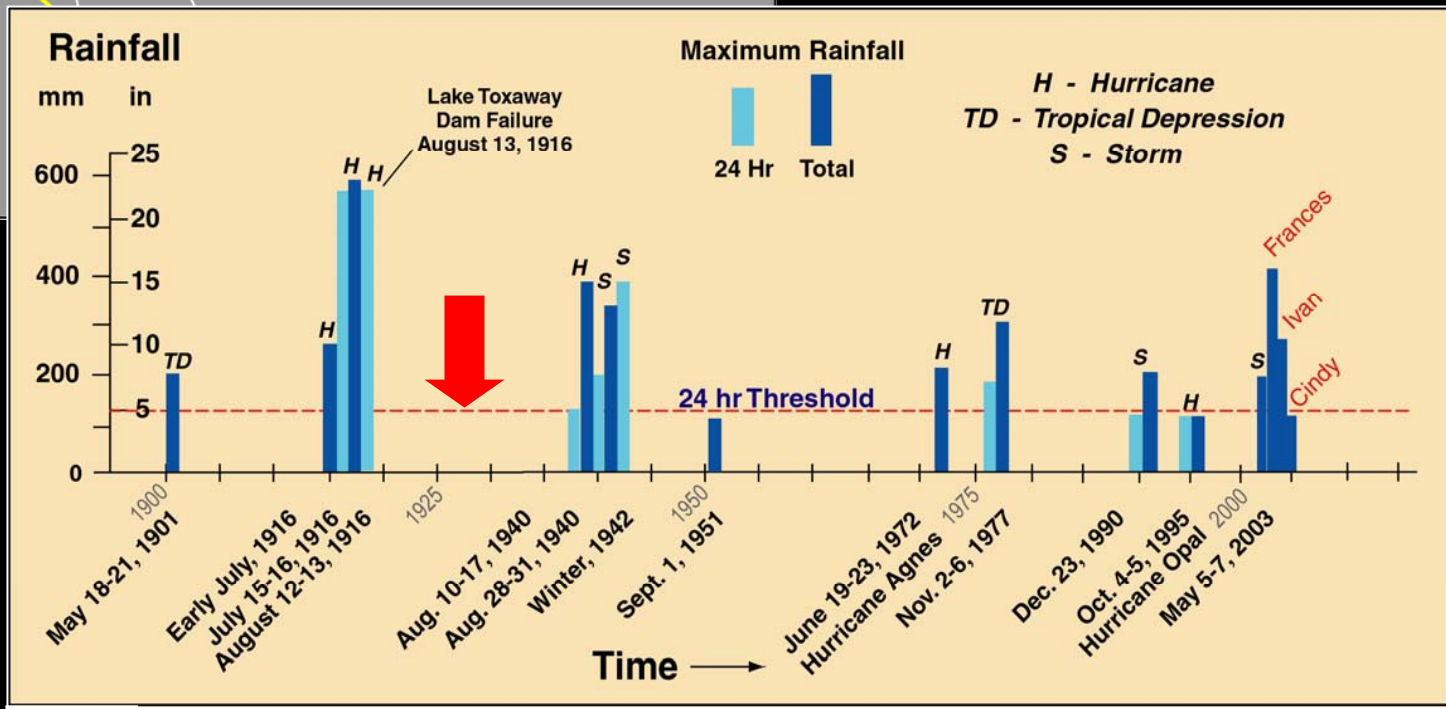
Typical Debris Flow



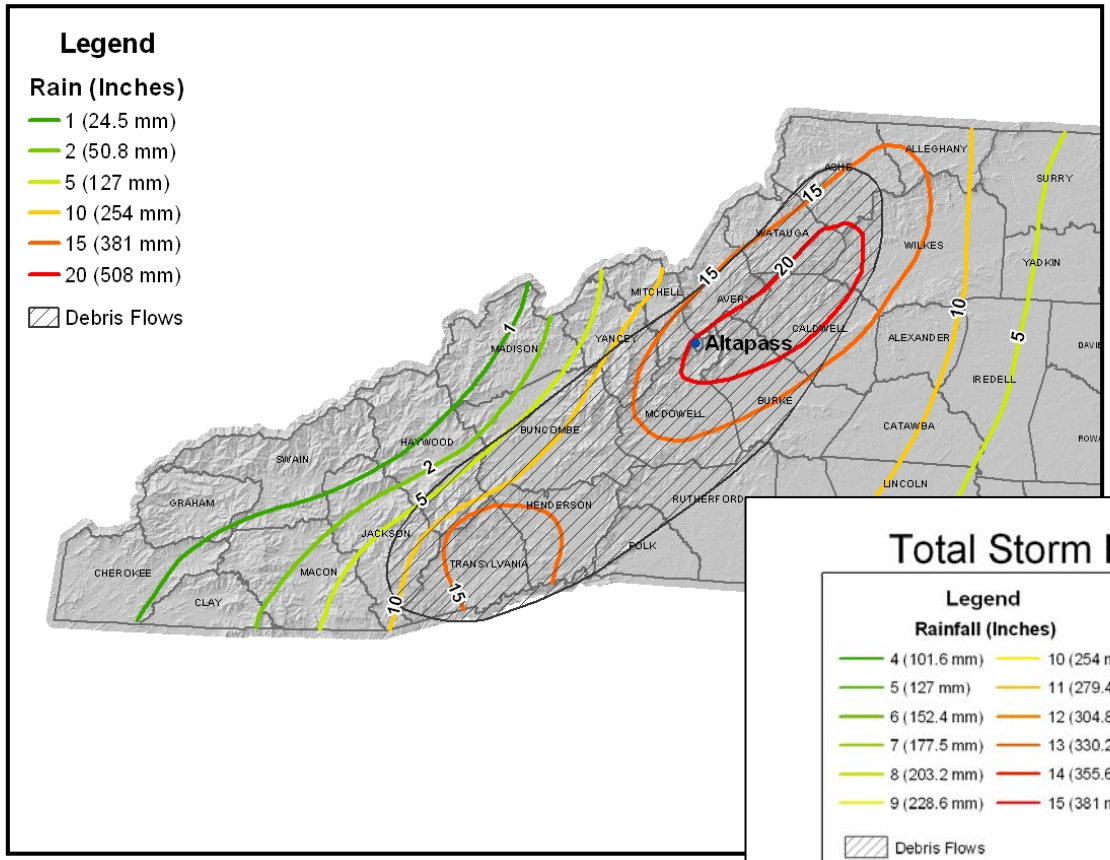




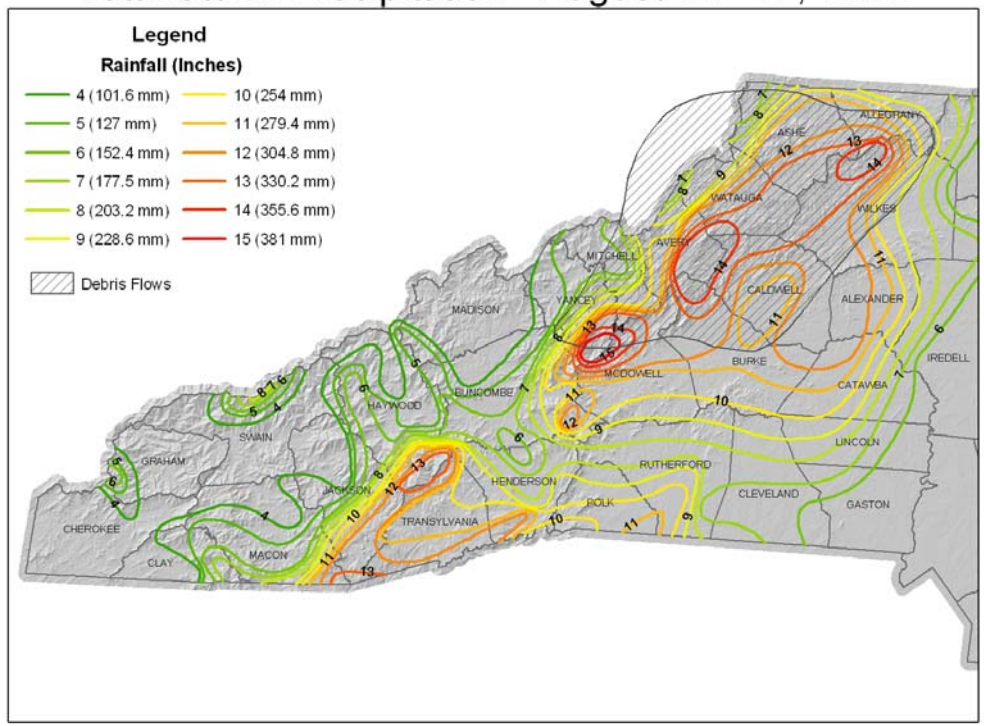
Recurring Weather Patterns

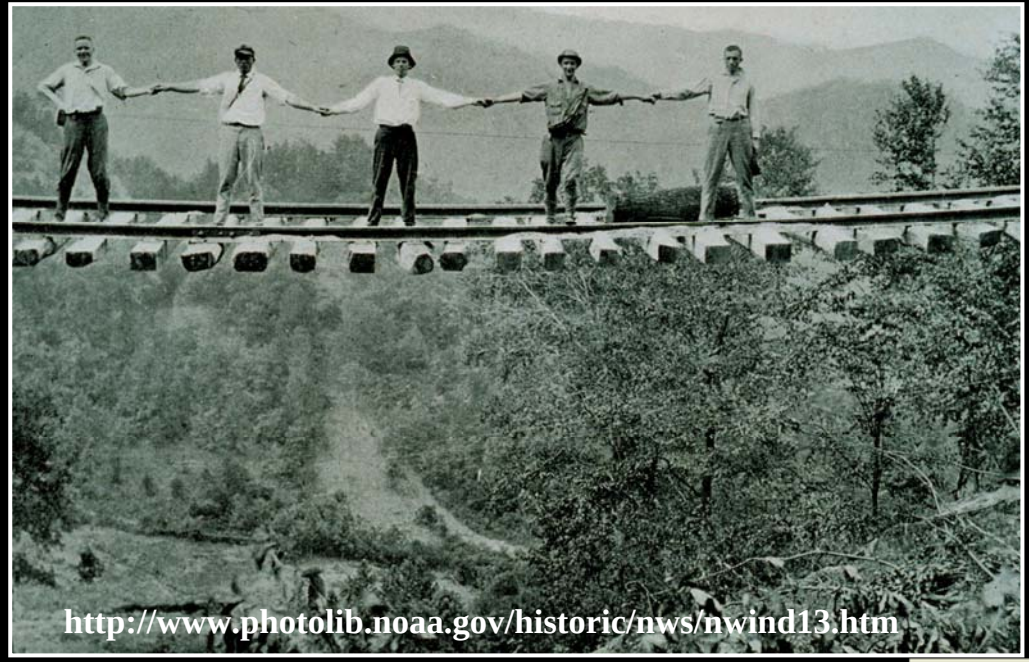


Total Storm Precipitation - July 15 - 16, 1916



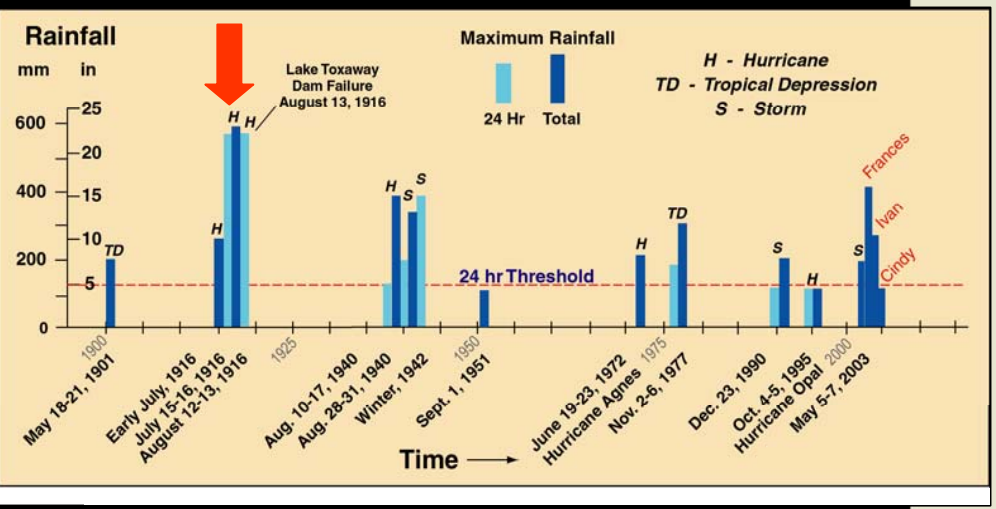
Total Storm Precipitation - August 10 - 17, 1940



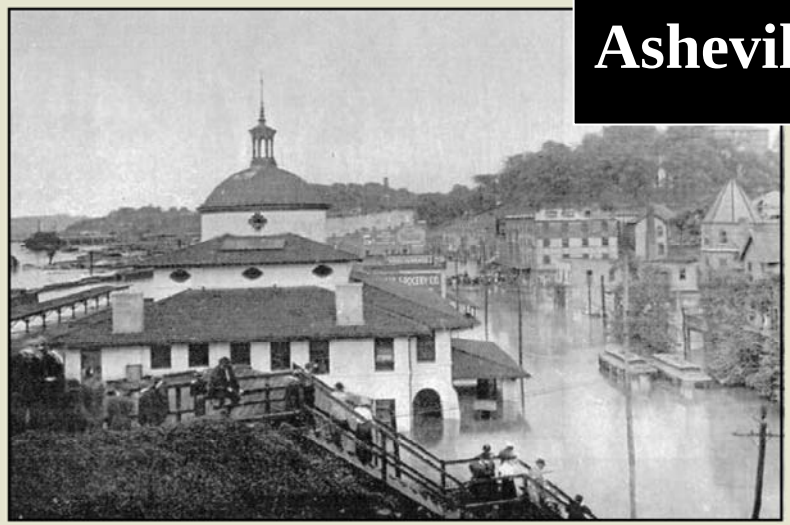


http://www.photolib.noaa.gov/historic/nws/nwind13.htm

July 15-16, 1916 Flood



Asheville



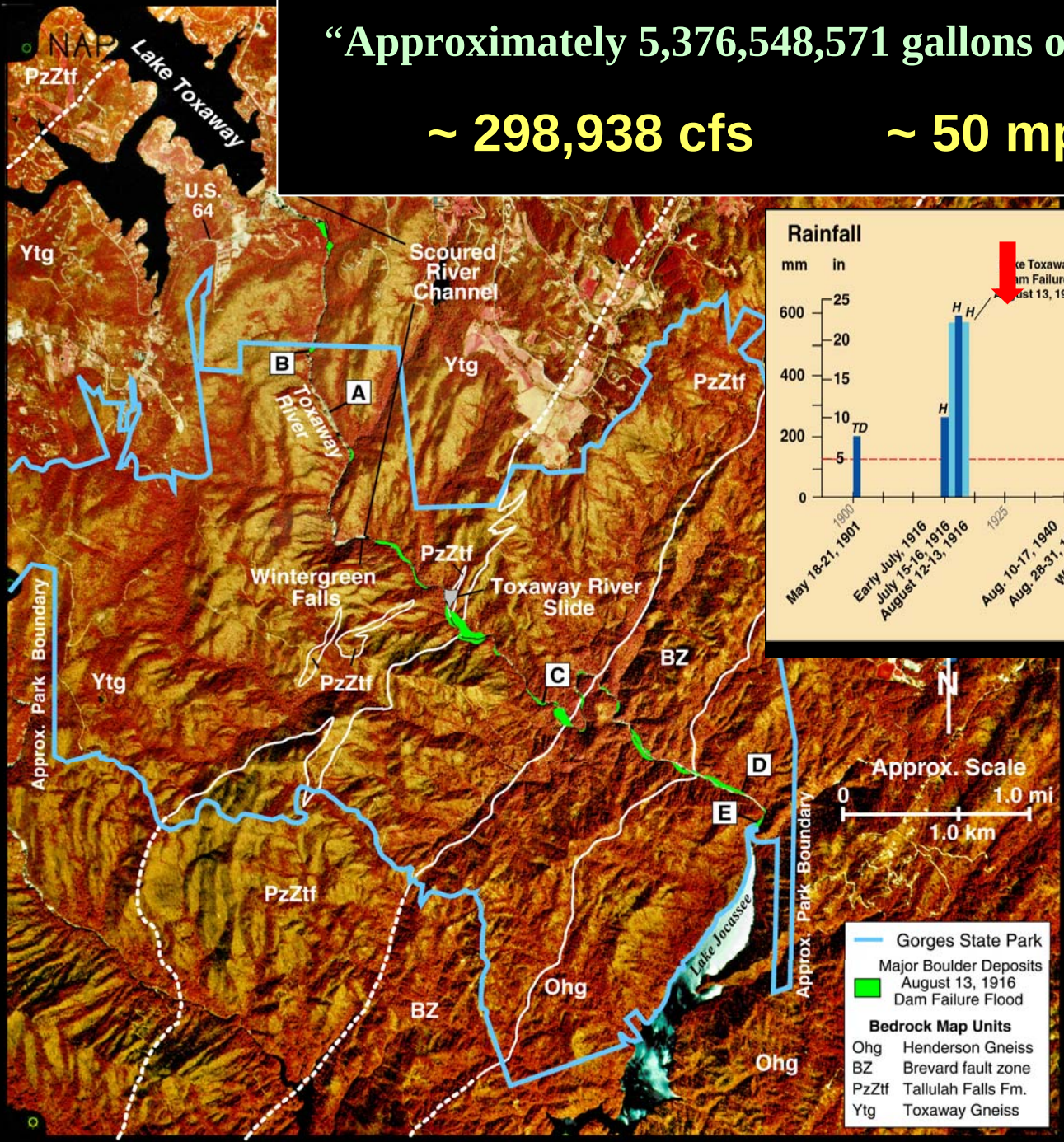
ASHEVILLE, UNDER WATER: THE GREAT FLOOD OF 1916
A major flood of the French Broad River leaves 5 feet of water and mud in the Southern Railway depot July 16, 1916. Six died in Asheville, and damage exceeded $3 million.

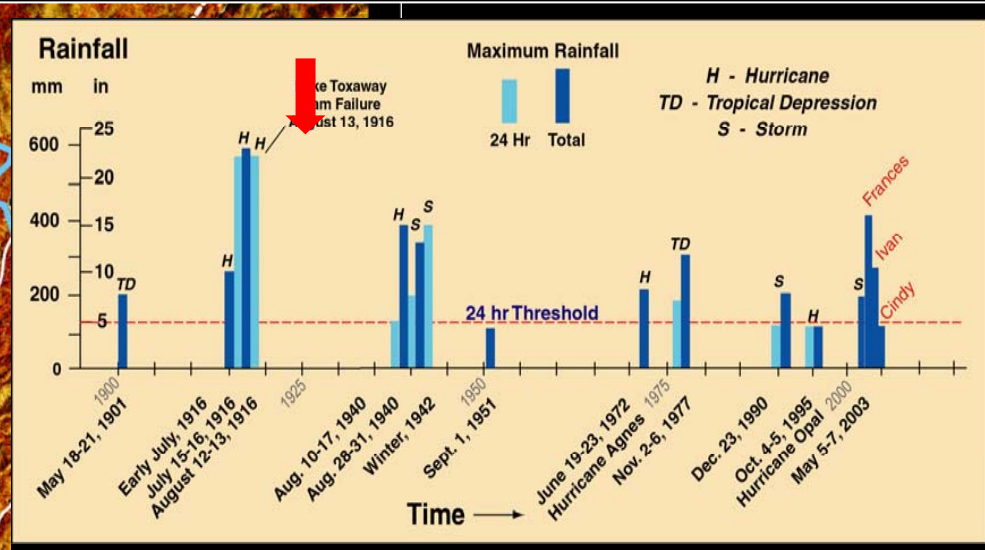
NORTH CAROLINA COLLECTION, UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

"Approximately 5,376,548,571 gallons of water changed hands."

S.W. McCallie

~ 298,938 cfs ~ 50 mph

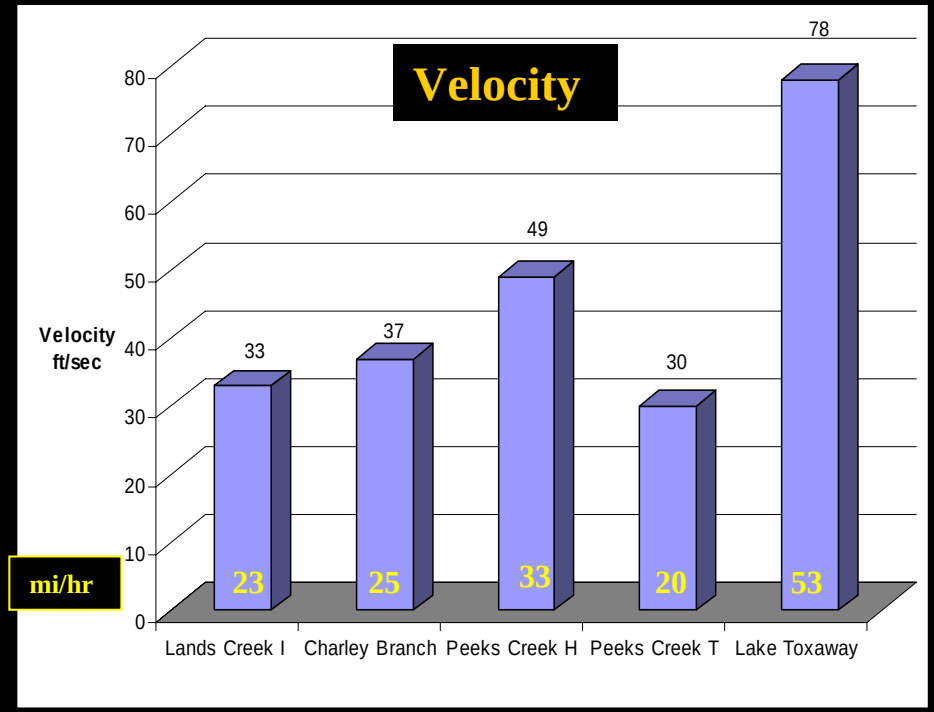


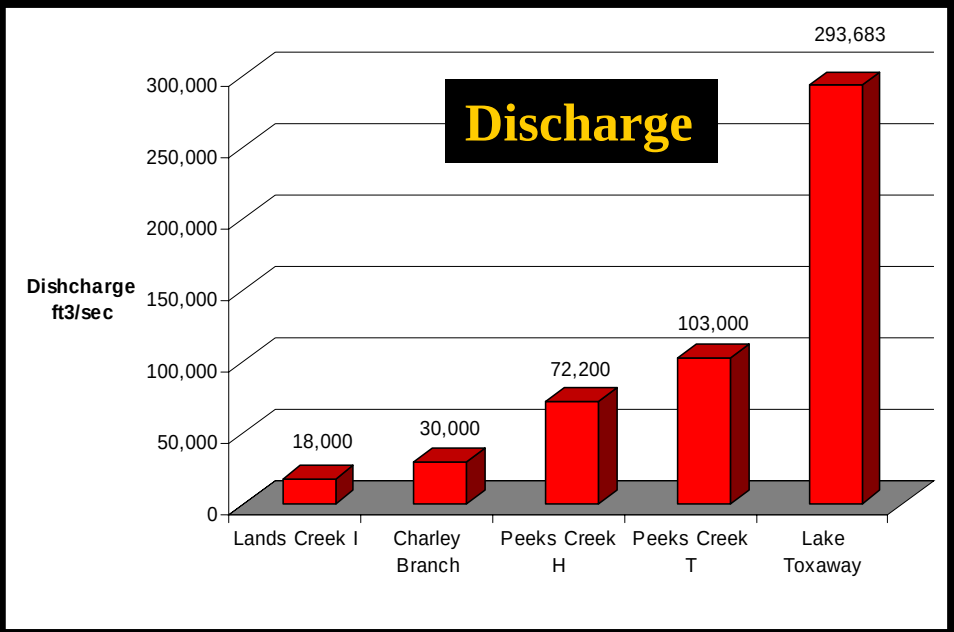


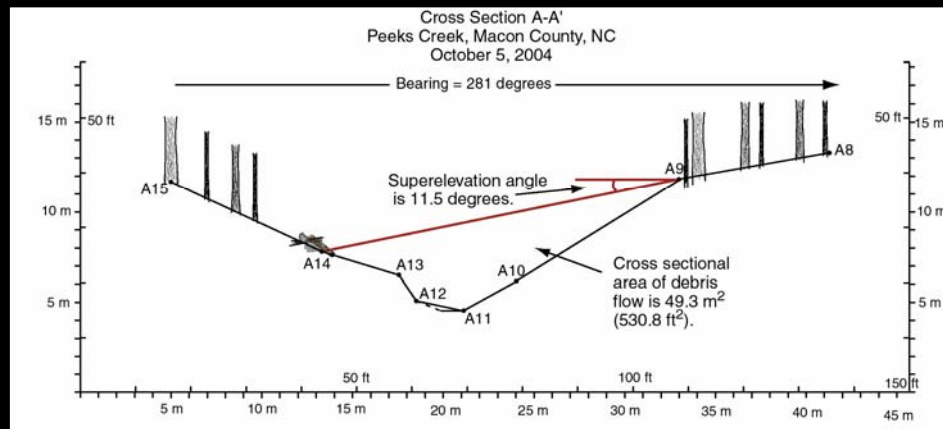
2.1 mi. - Wintergreen Falls

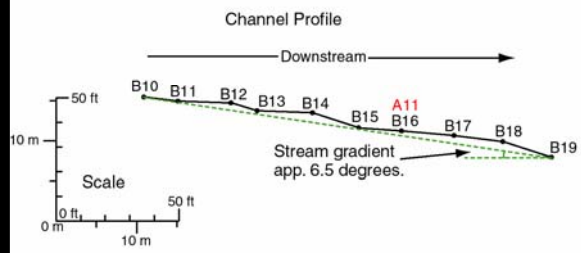
5.7 mi - Lake Jocassee

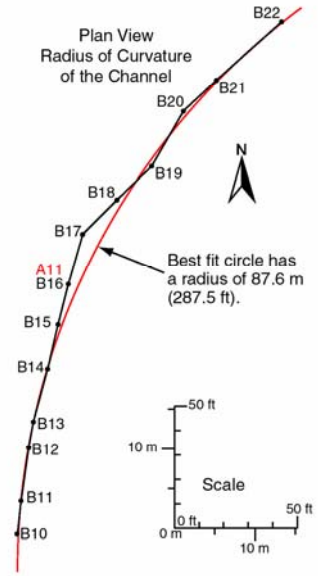
6.9 mi - N.C. / S.C. Line











To calculate velocity (Chen, 1987):

$$v = [g\, r_c \tan \beta \cos \delta]^{1/2}$$

where:

v = mean velocity in direction of flow
g = gravitational acceleration
r_c = centerline radius of curvature
β = superelevation angle
δ = channel gradient

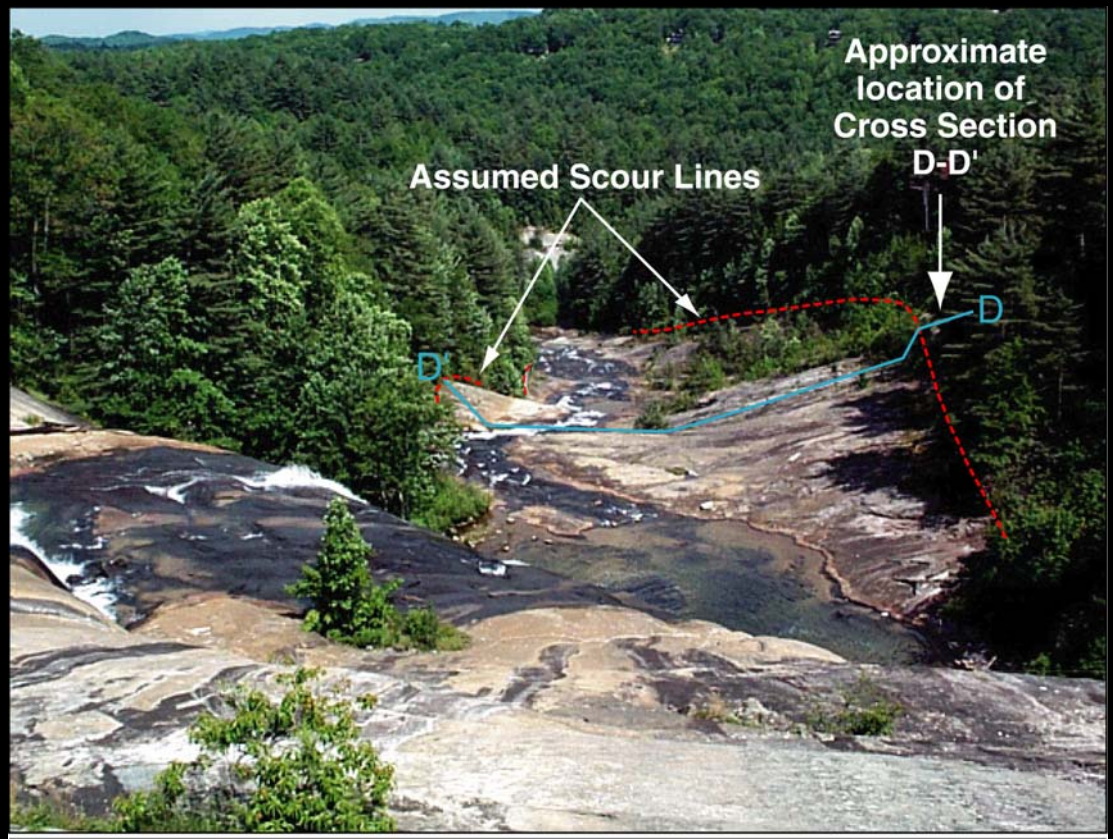
To calculate discharge (Fetter, 1994):

$$d = v\, A$$

where:

d = discharge
v = mean velocity in direction of flow
A = cross sectional area of debris flow

Calculated Estimates



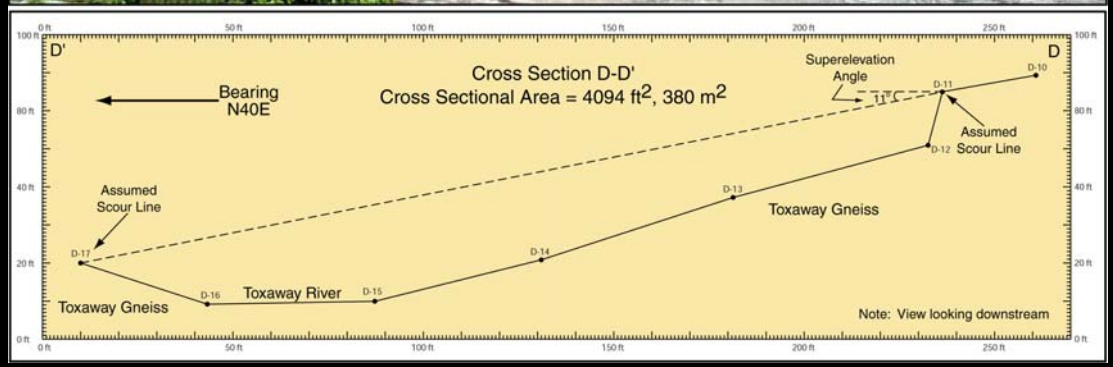
OUTFLOW

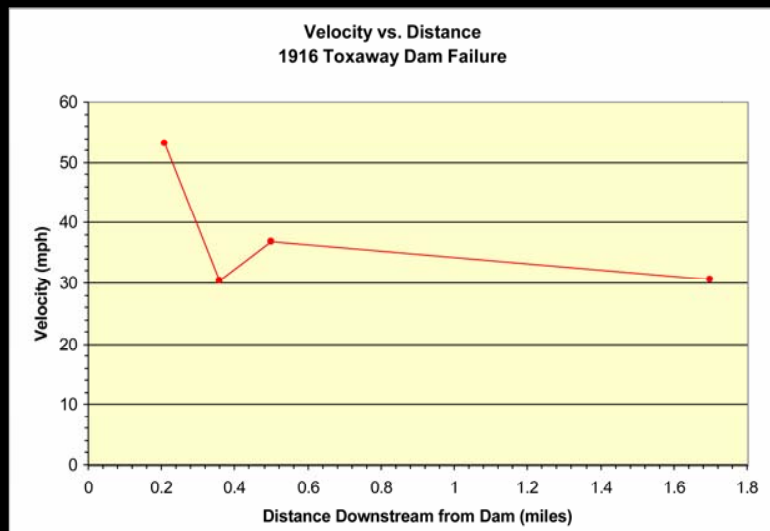
Velocity

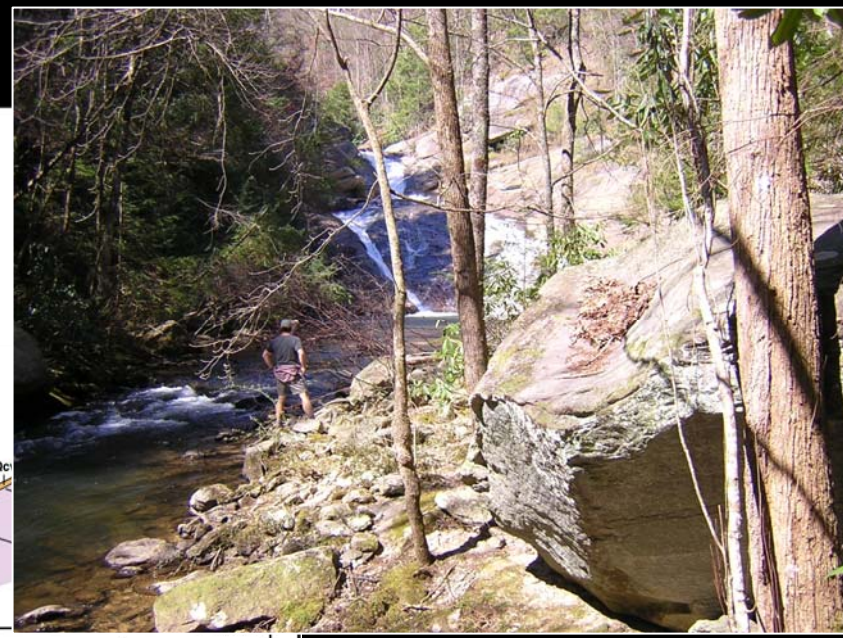
~50 mph

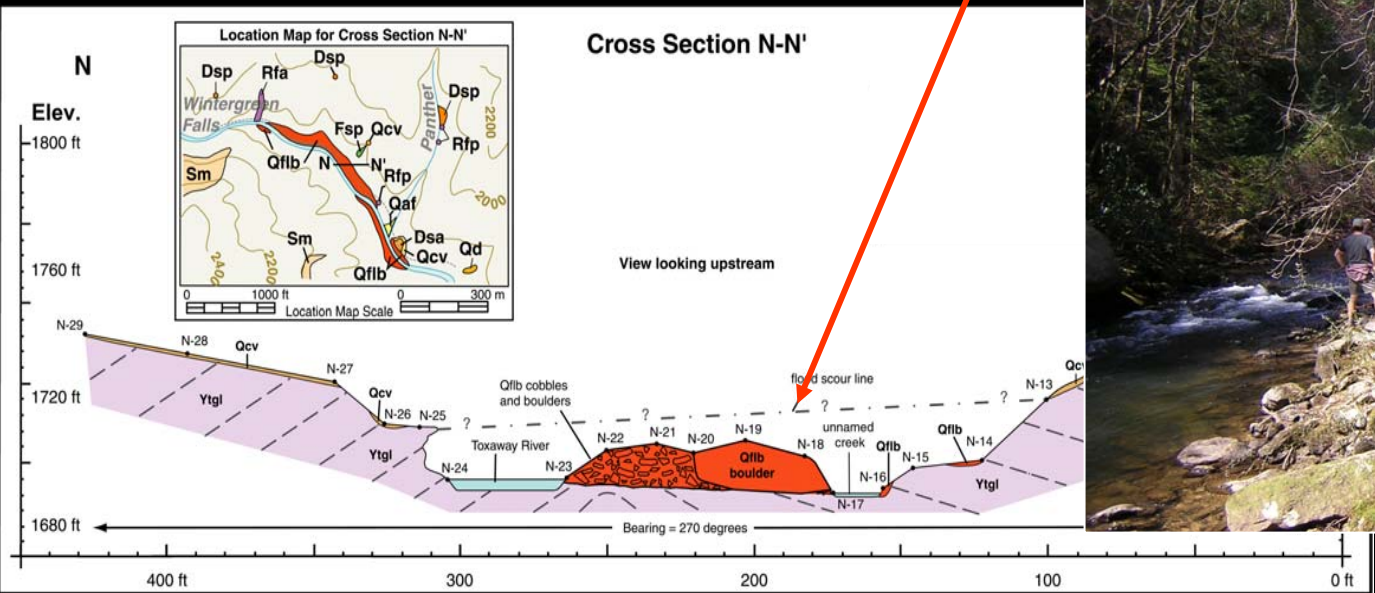
Discharge

~298,938 cfs



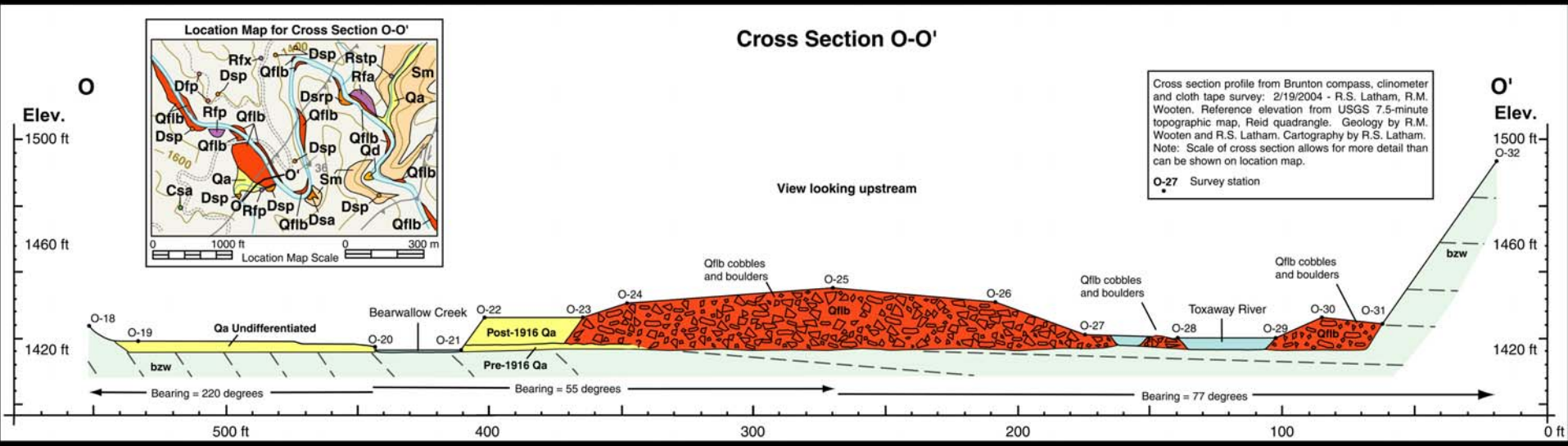





Location Map for Cross Section N-N'
Dsp
Rfa
Dsp
Wintergreen Falls
Dsp
Panther
Fsp
Qcv
Rfp
2200
Qflb
N
N'
Sm
Rfp
Qaf
Sm
Dsa
Qcv
Qd
Qflb
0
1000 ft
0
300 m
Location Map Scale
Cross Section N-N'
N
Elev.
1800 ft
1760 ft
1720 ft
1680 ft
View looking upstream
N-29
N-28
Qcv
N-27
Qcv
N-26
N-25
Ytgl
Ytgl
Toxaway River
N-24
N-23
Qflb cobbles and boulders
N-22
N-21
N-20
N-19
Qflb boulder
flood scour line
N-18
unnamed creek
N-16
N-17
Qflb
N-15
Qflb
N-14
N-13
Qcv
Ytgl
Bearing = 270 degrees
400 ft
300
200
100
0 ft

erosional contacts

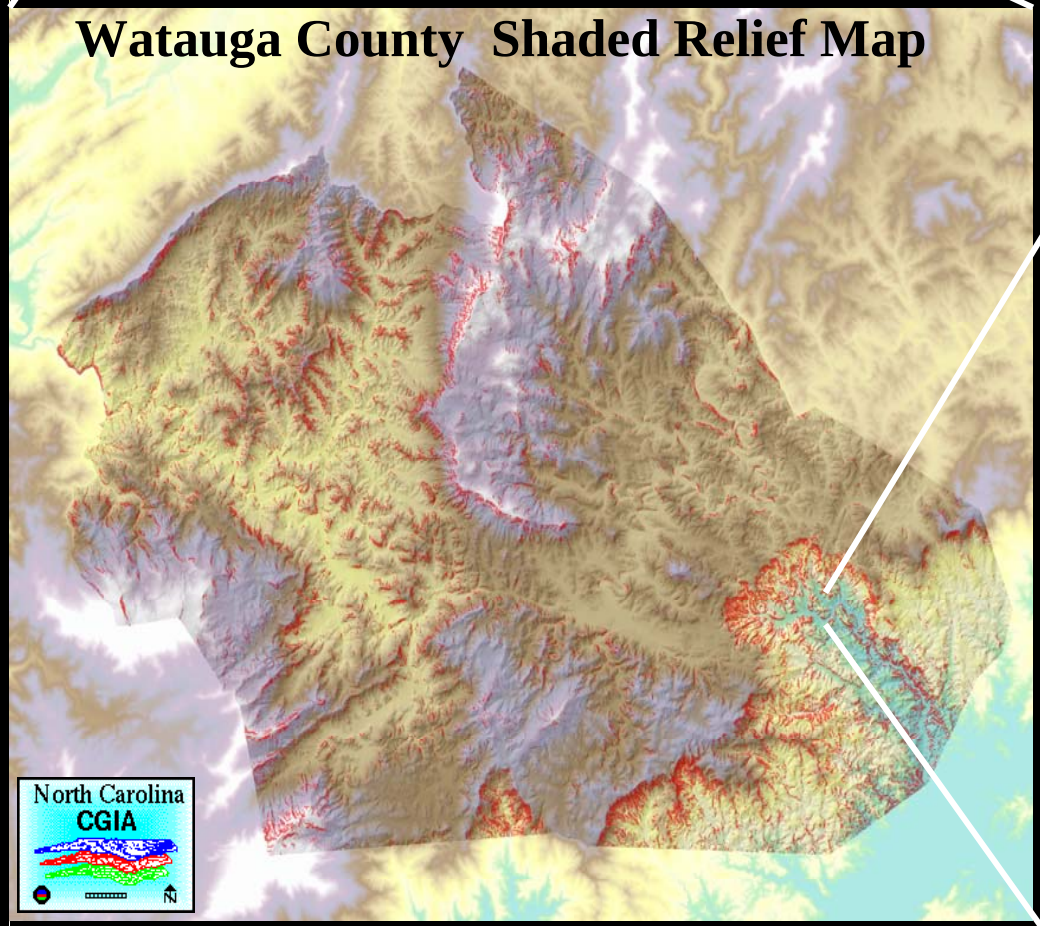
imbricated boulders

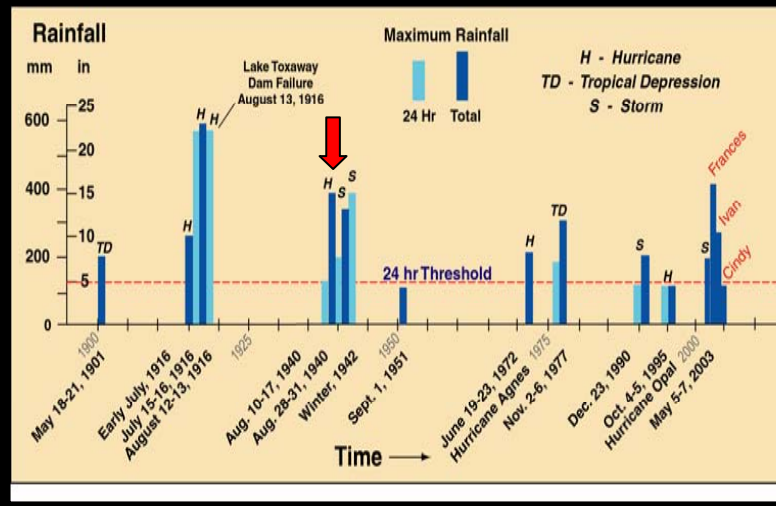


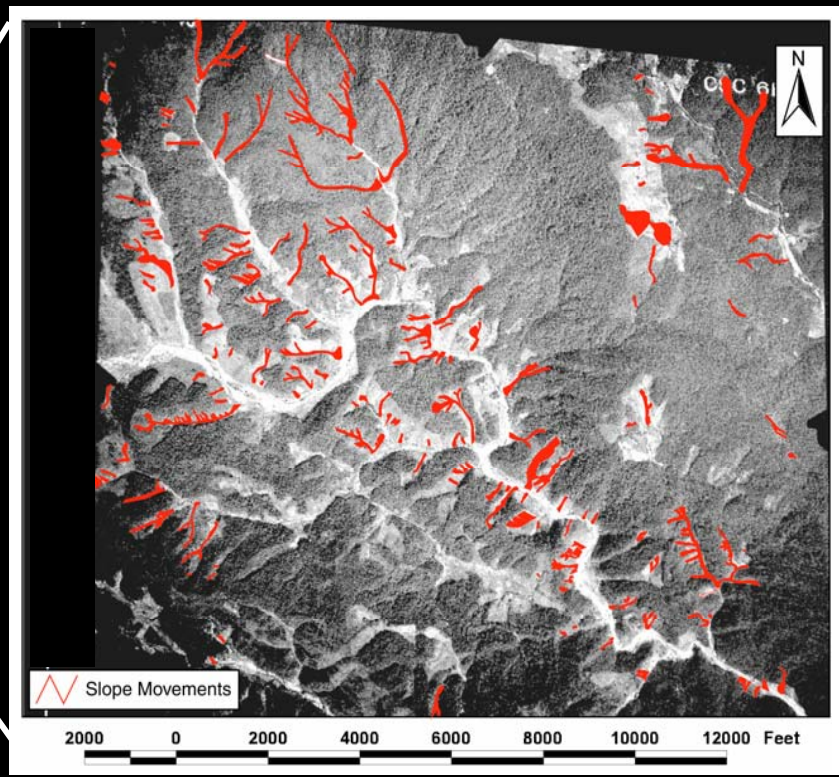
87,500 yd^3 boulder deposit

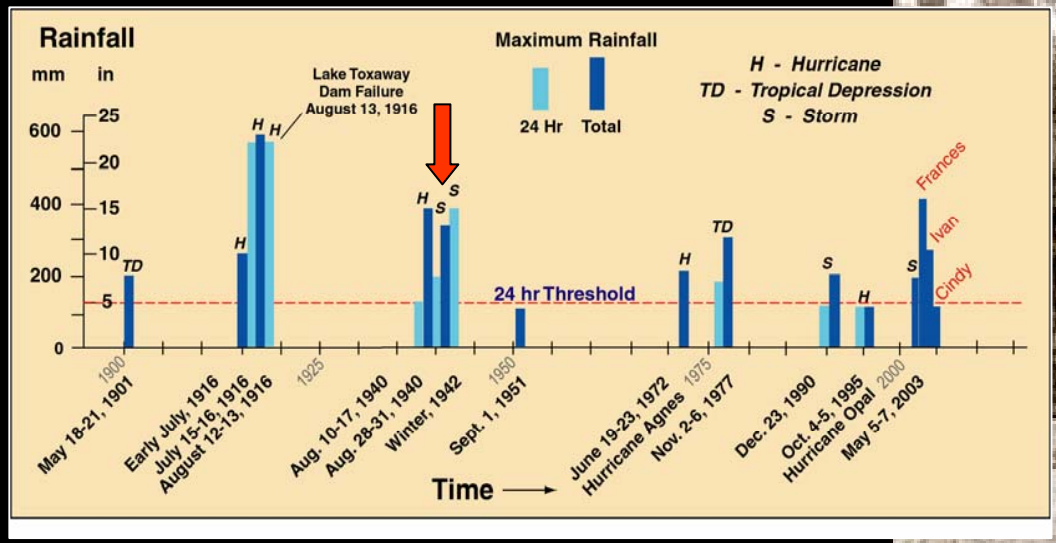
Deep Gap Debris Flows Watauga County

August 10-17, 1940









August 28-31, 1940

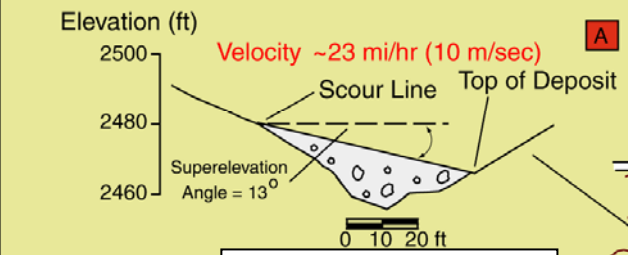
Cullowhee, Caney Fork, Canada – Jackson County

Landslide Fatalities:

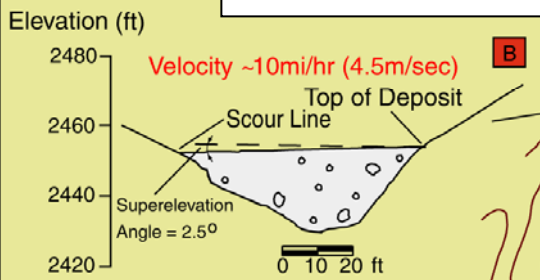
Albert McCall and two children, Vessie Mathis

Sylva Herald – Lynn Hotaling

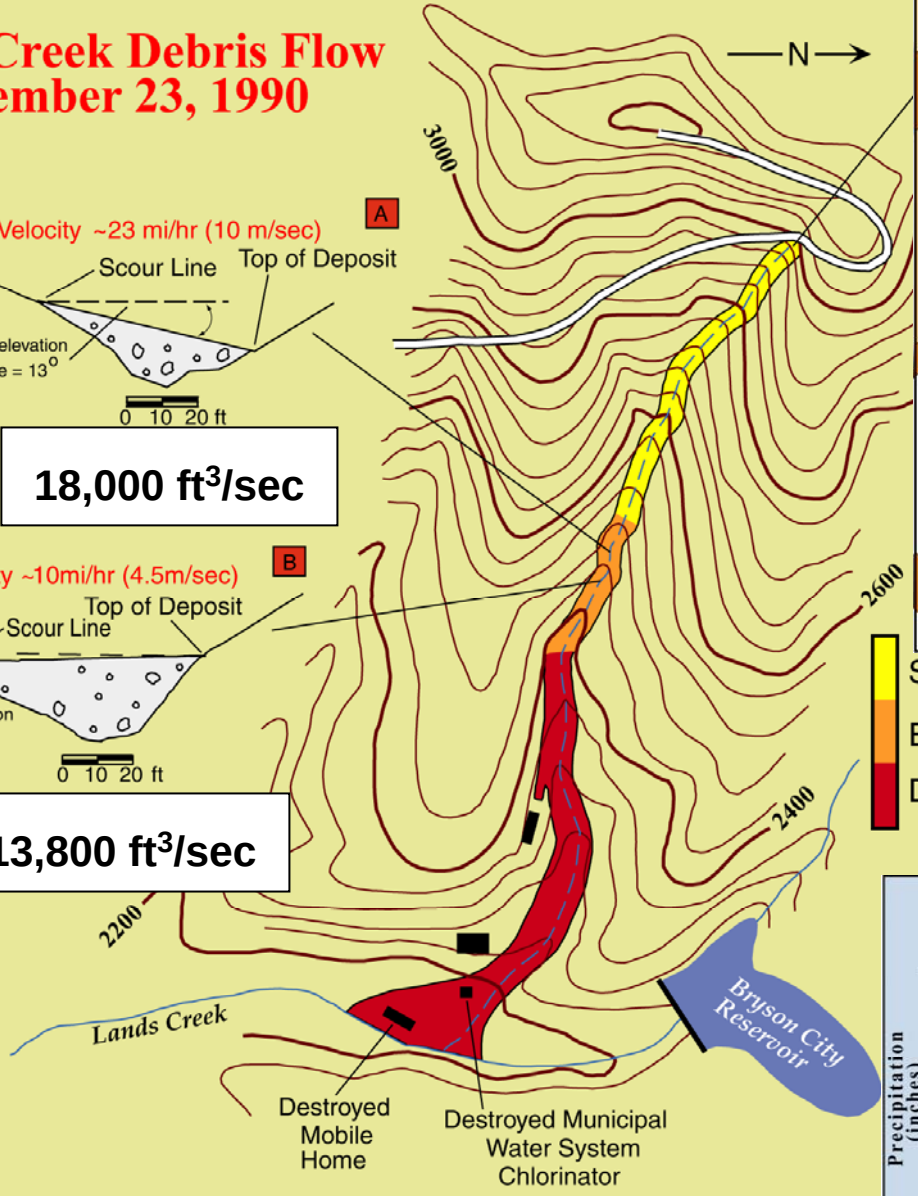
Lands Creek Debris Flow
December 23, 1990

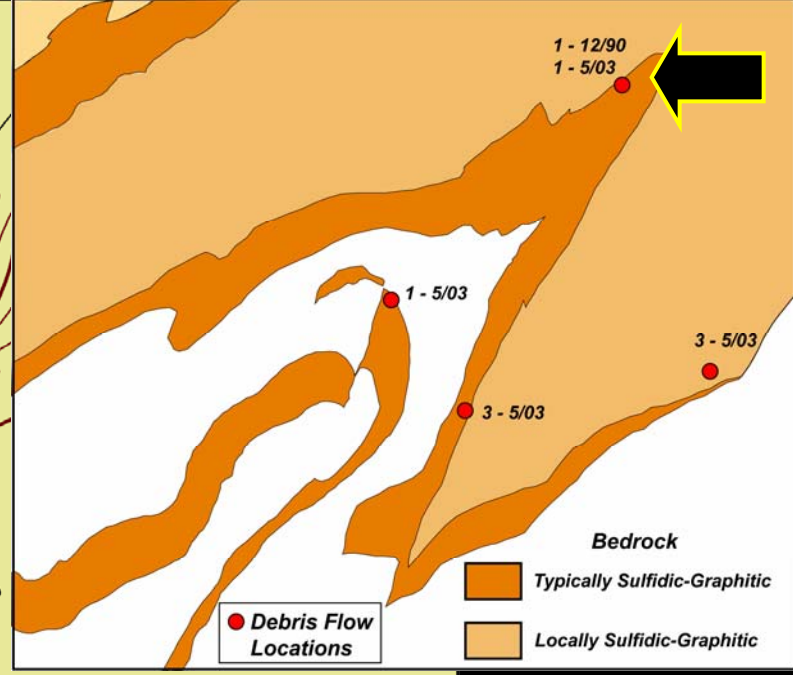


18,000 ft³/sec



13,800 ft³/sec



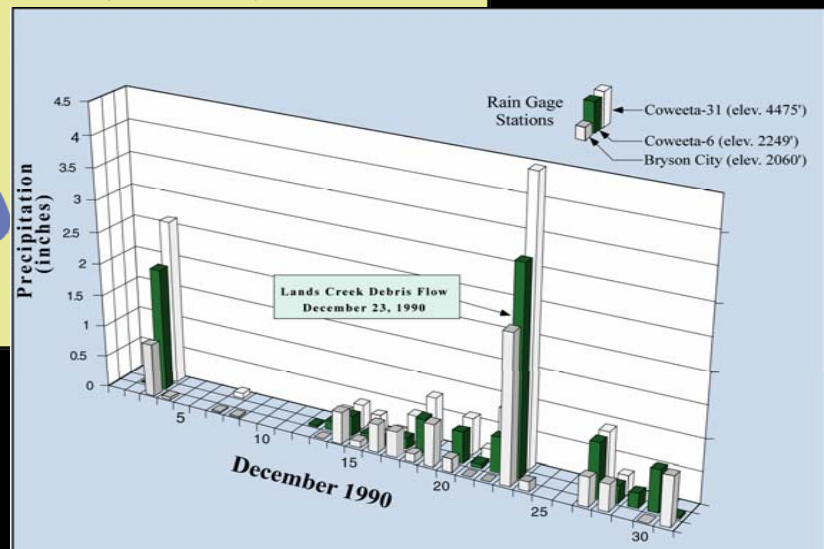


Scour - Erosion

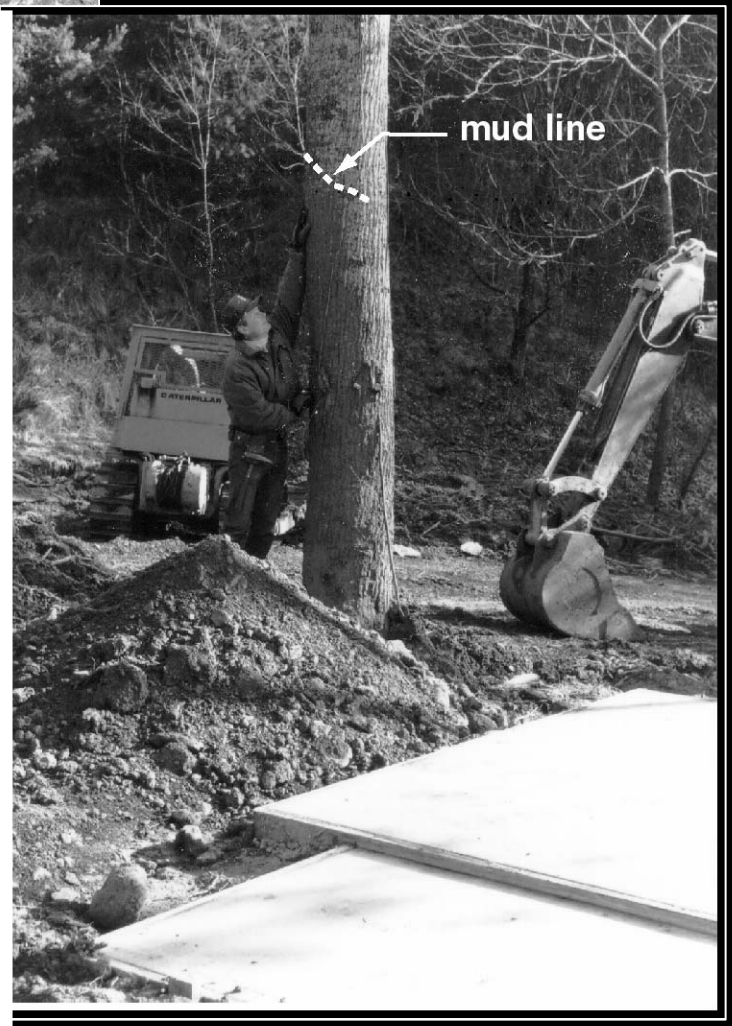
Erosion > Deposition

Deposition > Erosion

(~10,000 cubic yards of transported debris)



Lands Creek Debris Flow I

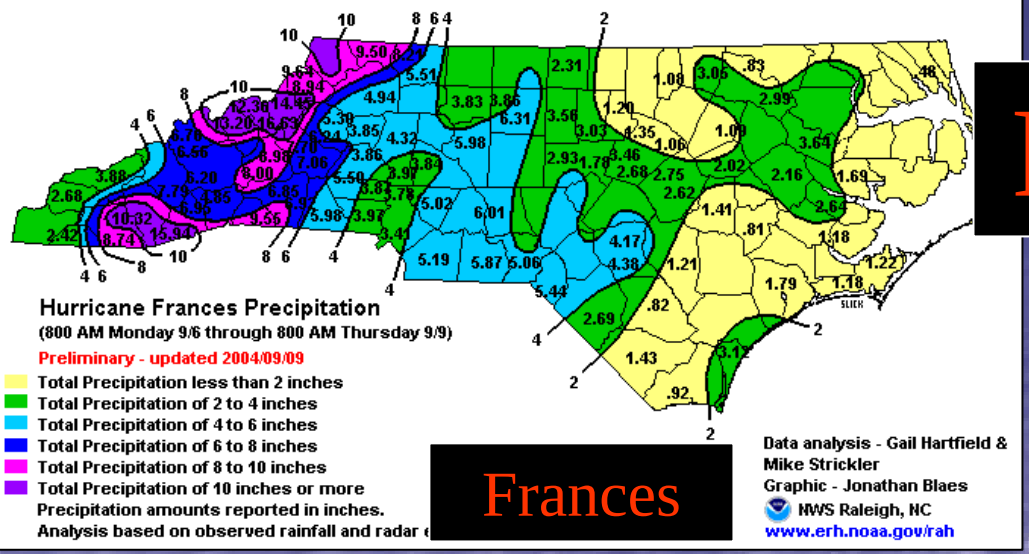


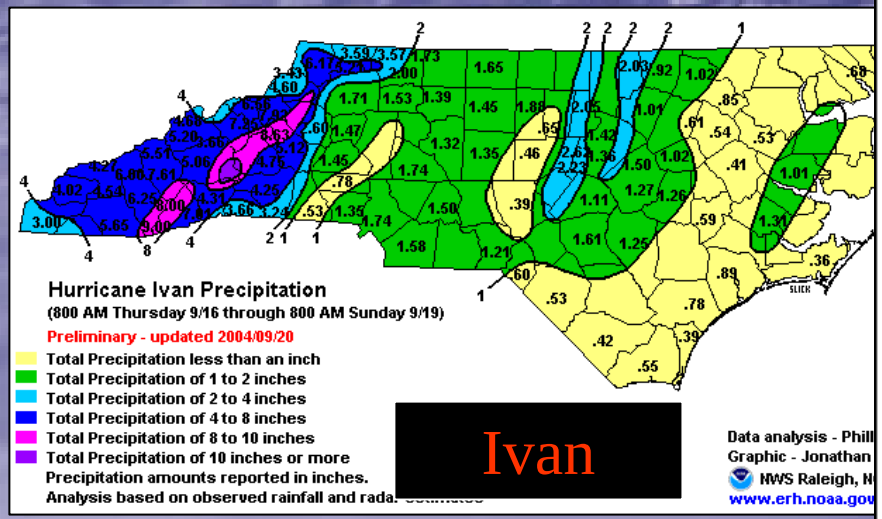
Dec. 23, 1990

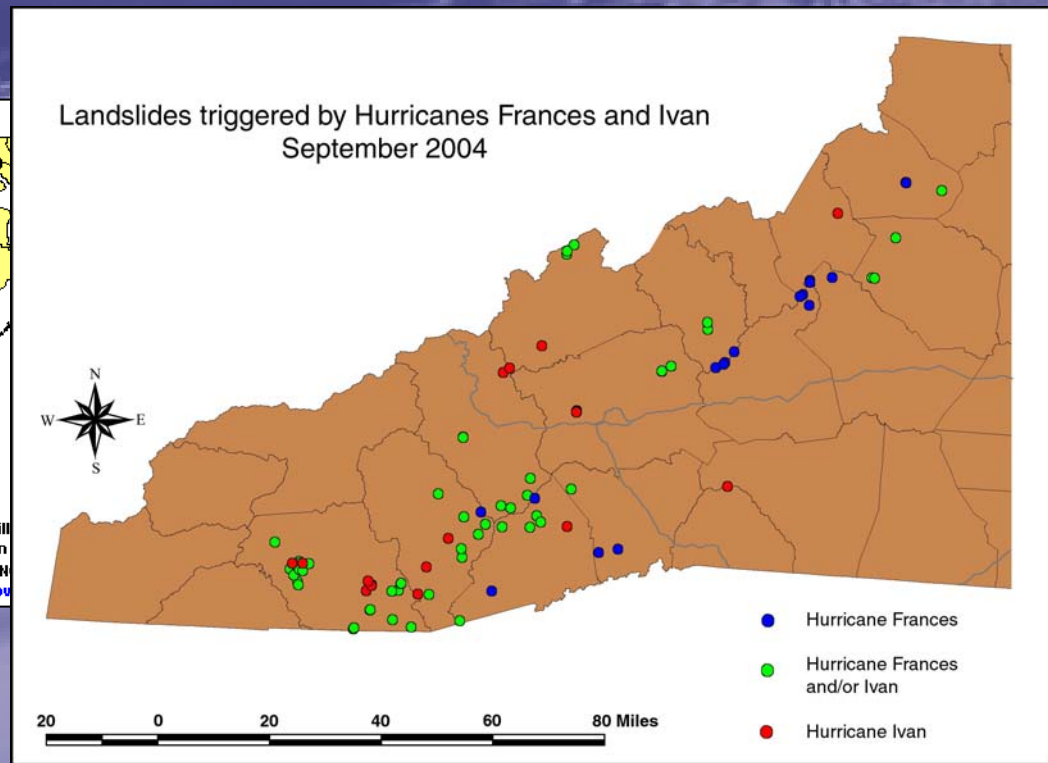
Swain County

Frances & Ivan

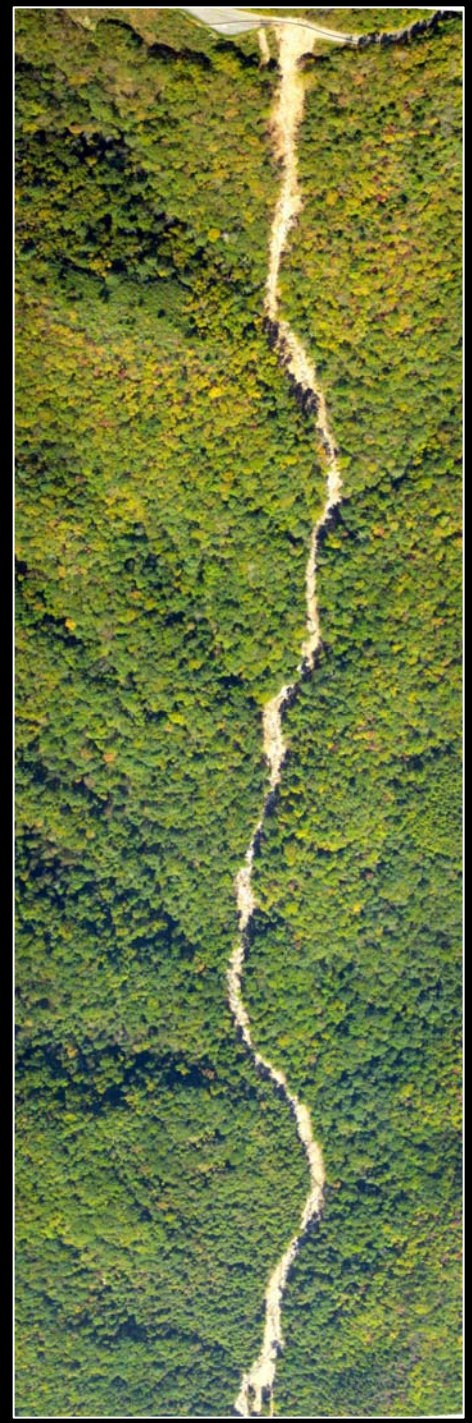
- 140+ Slope Movements
- 5 Fatalities
- 27 Homes Destroyed





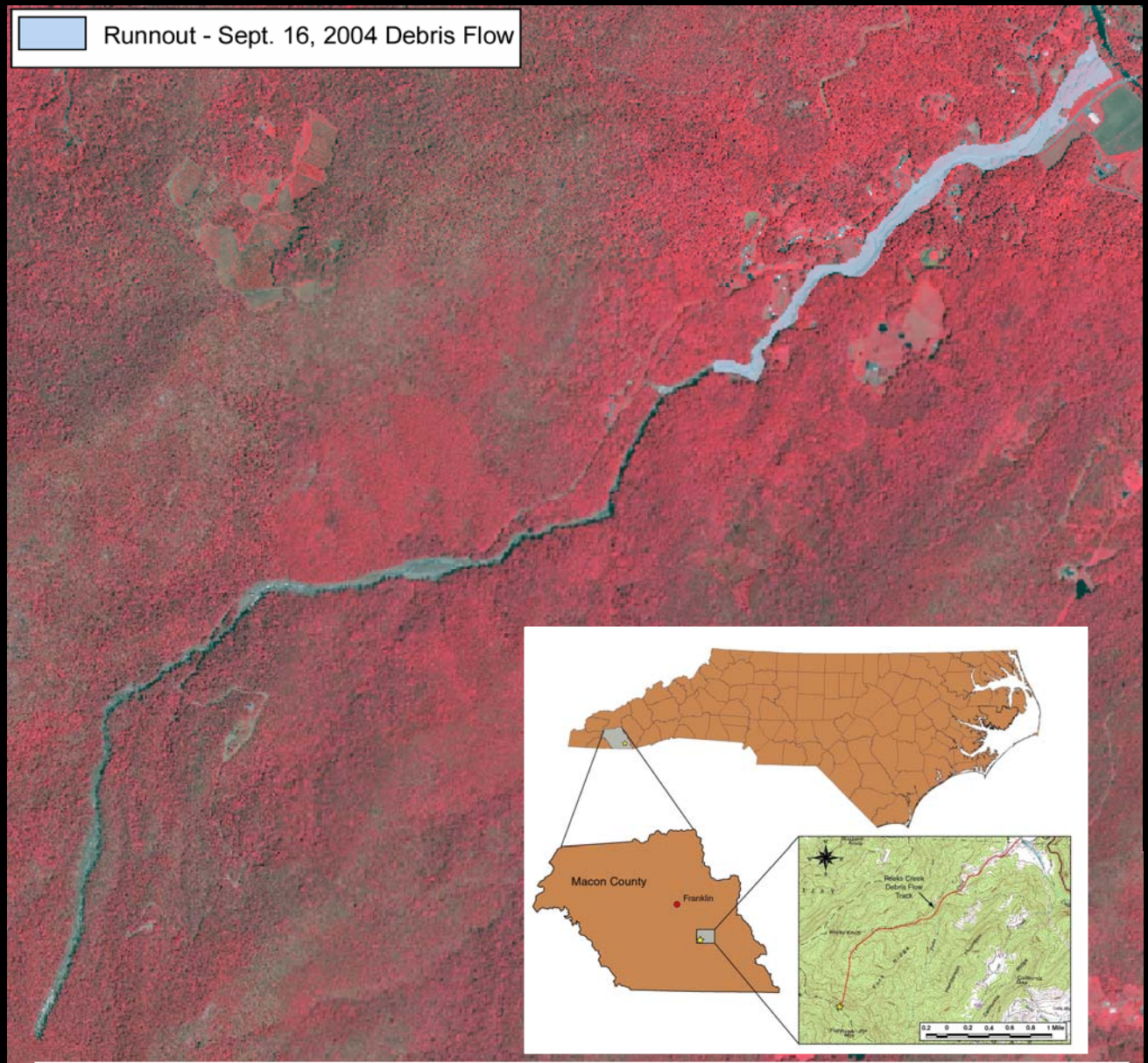


Blue Ridge Parkway Hurricane Frances Embankment Failure– Debris Flow



Photos Courtesy

USFS and NPS



Peeks Creek Debris Flow

- Debris slide began near top of Fishhawk Mtn. (elev 4,420').

- Mobilized into debris flow.

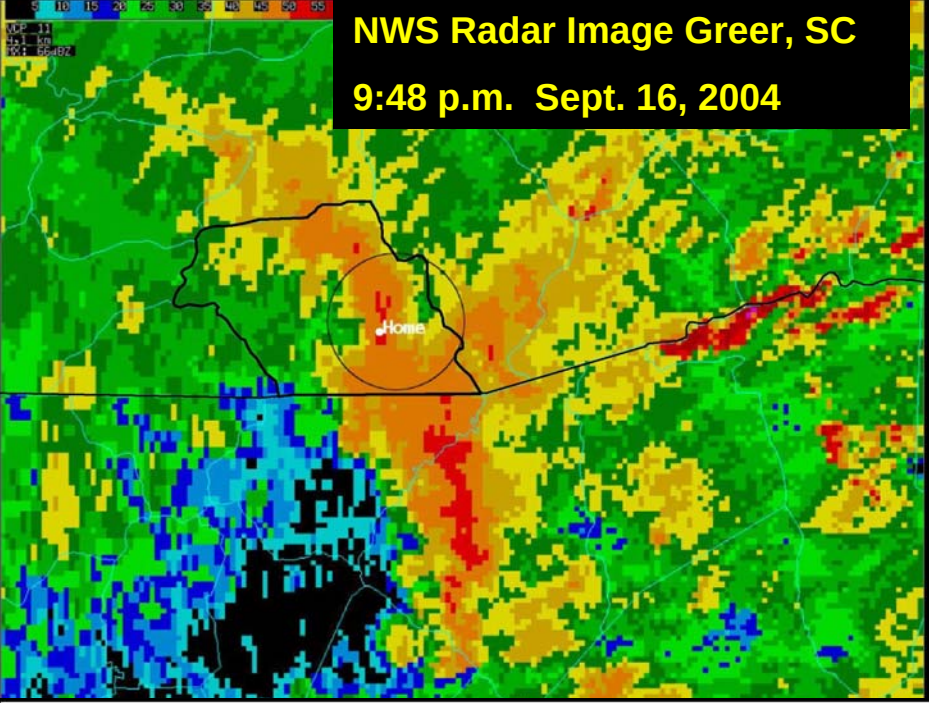
- Traveled ~2.25 mi to the Cullasaja River.

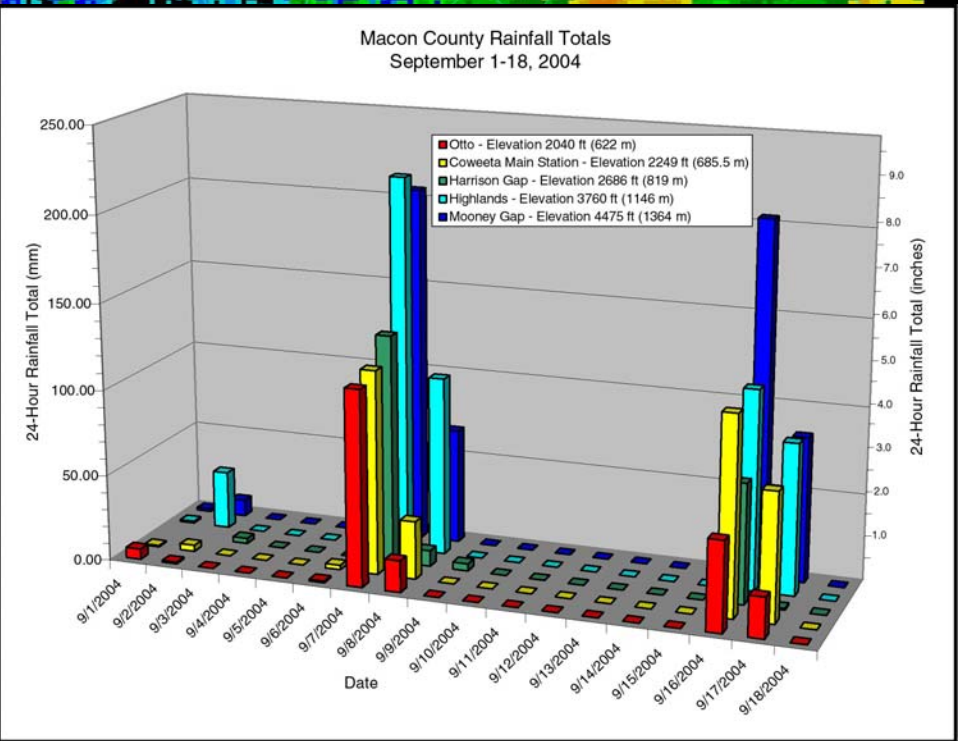
When:
10:10 p.m. Sept. 16, 2004 Hurricane Ivan.

Damage:
- 5 people killed
- 2 seriously injured
- 16 homes destroyed
- Bridge and road destroyed

Cost Share Post-2004 Hurricane Imagery

* Macon County * Buncombe County





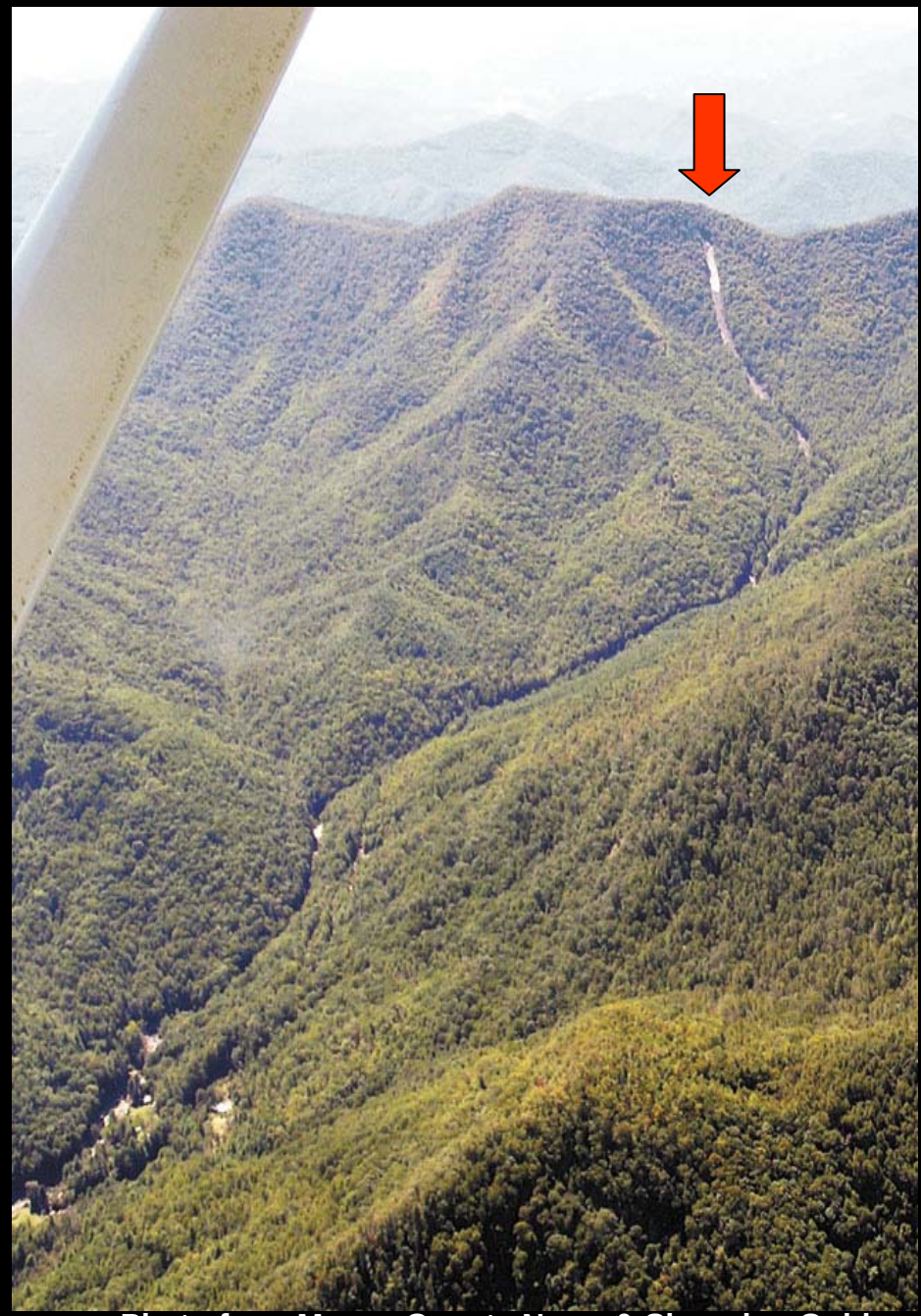
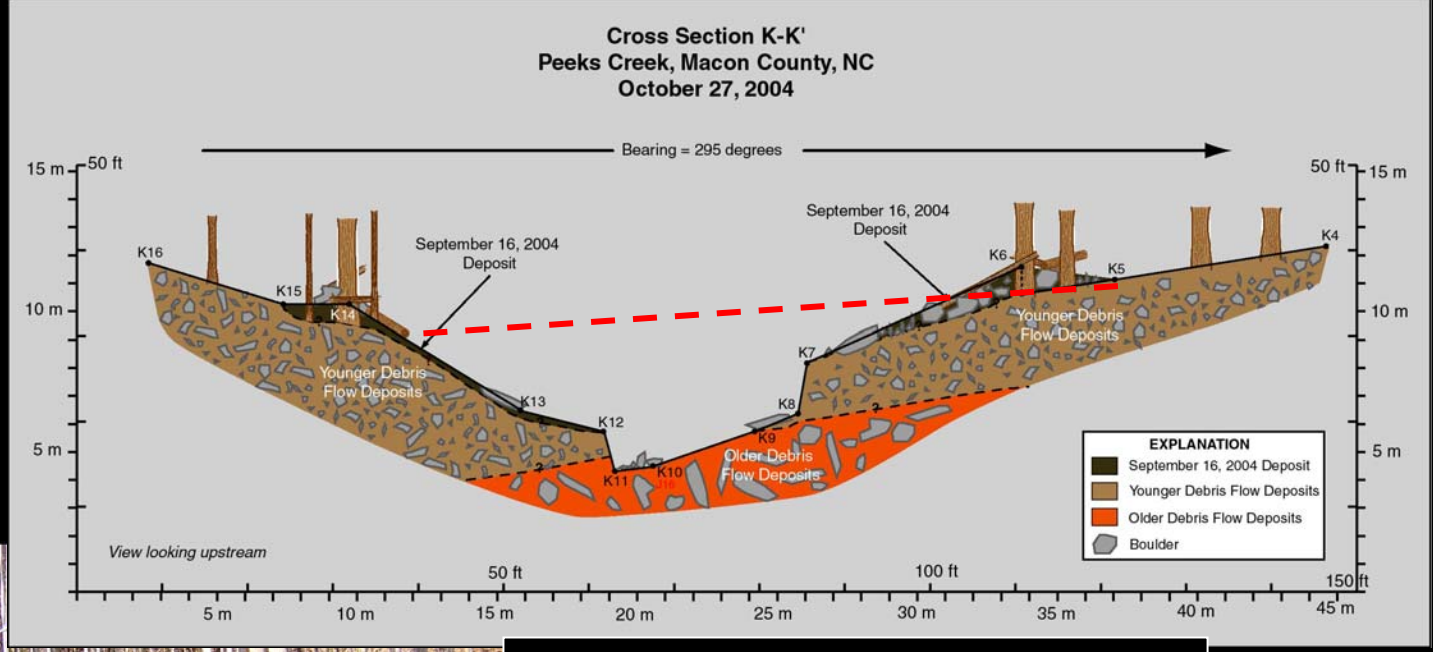
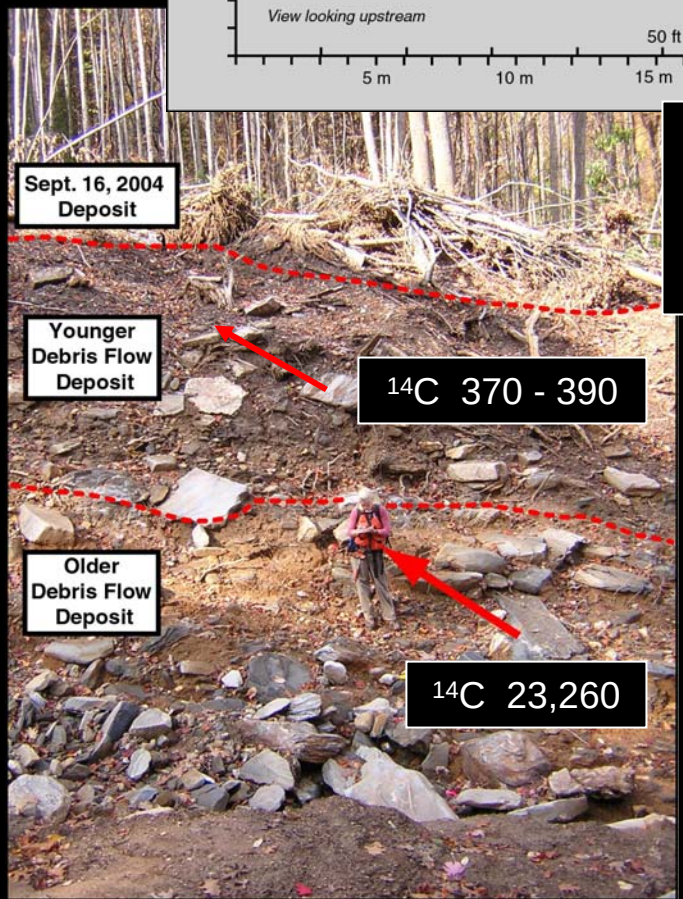


Photo from Macon County News & Shopping Guide
September 23, 2004 edition

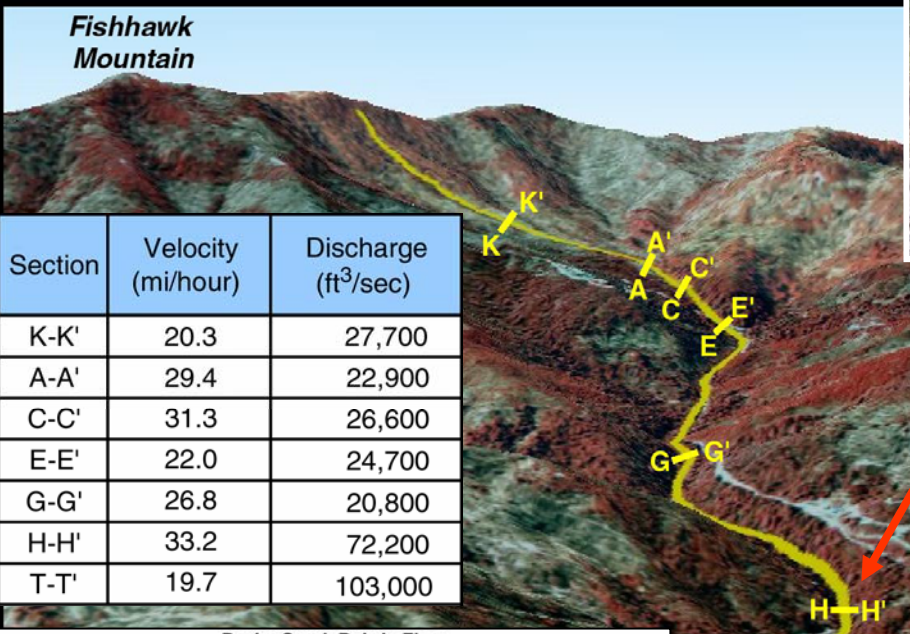


Debris Flow Deposits

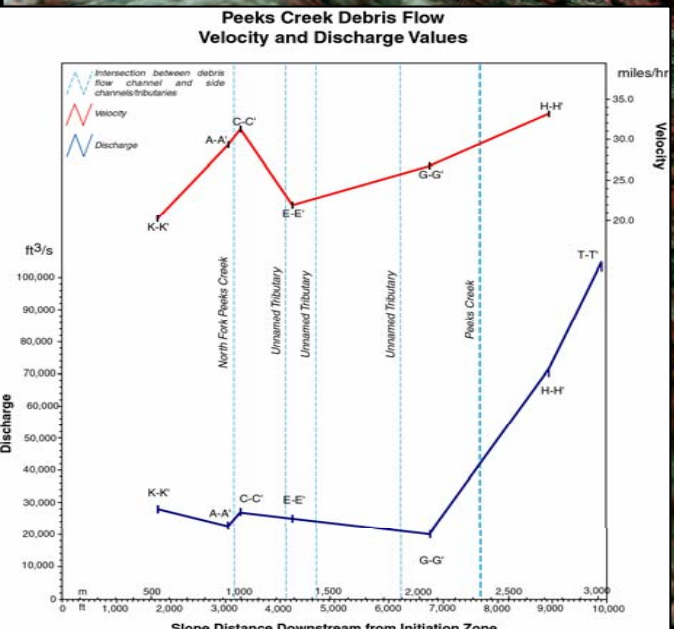
New and Old

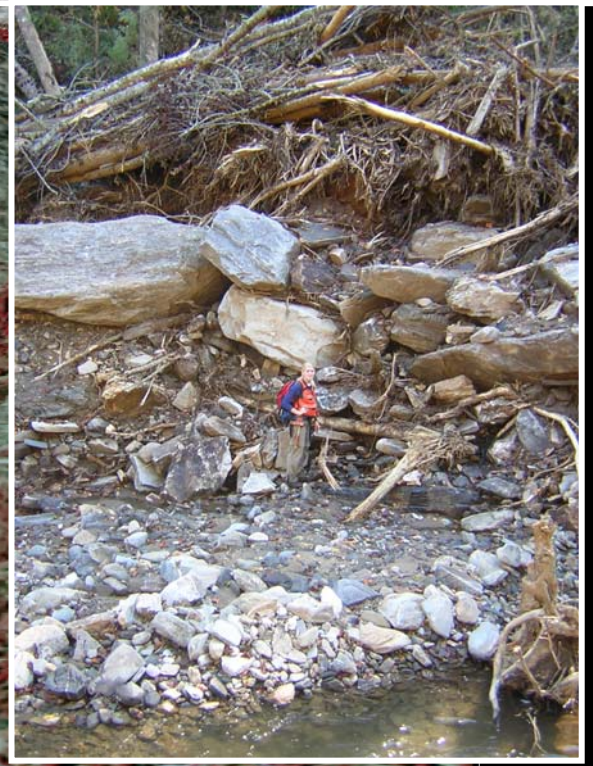


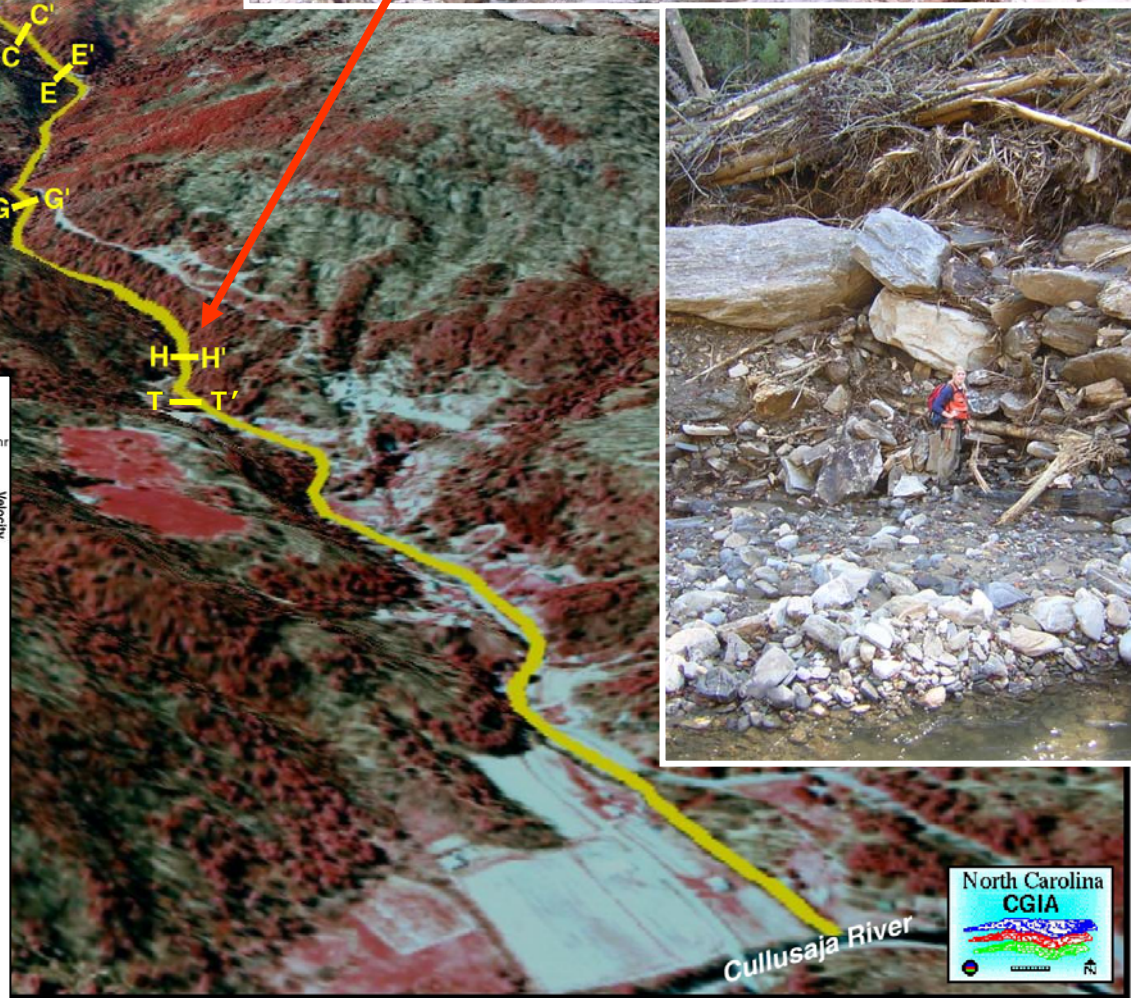
Velocity and Discharge



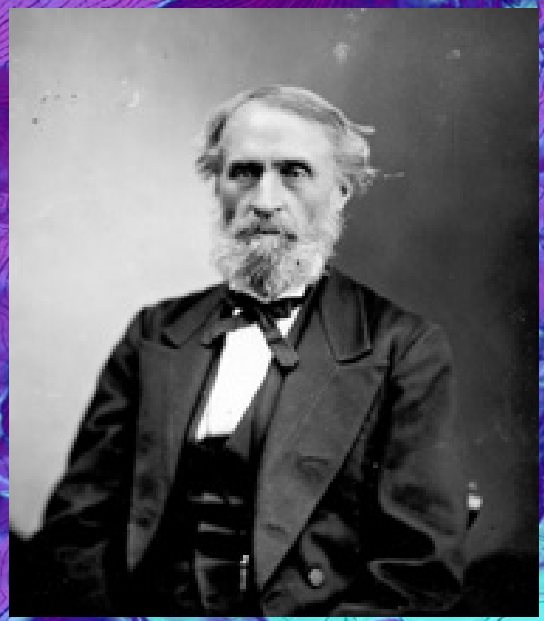
Section	Velocity (mi/hour)	Discharge (ft^3/sec)
K-K'	20.3	27,700
A-A'	29.4	22,900
C-C'	31.3	26,600
E-E'	22.0	24,700
G-G'	26.8	20,800
H-H'	33.2	72,200
T-T'	19.7	103,000







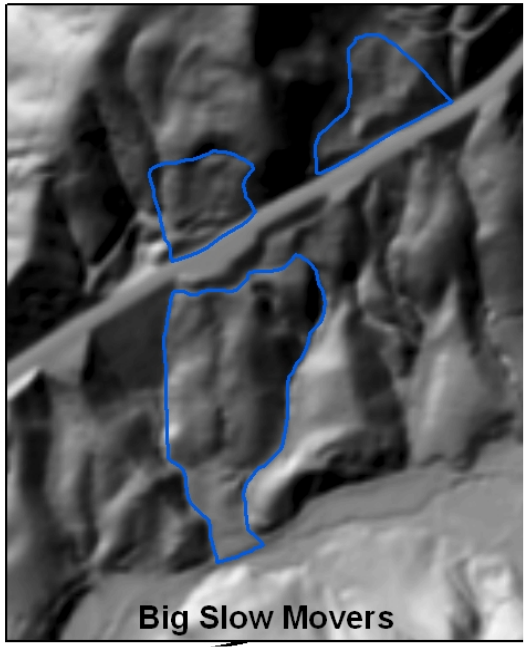
Fishhawk Mountain
June 15, 1876

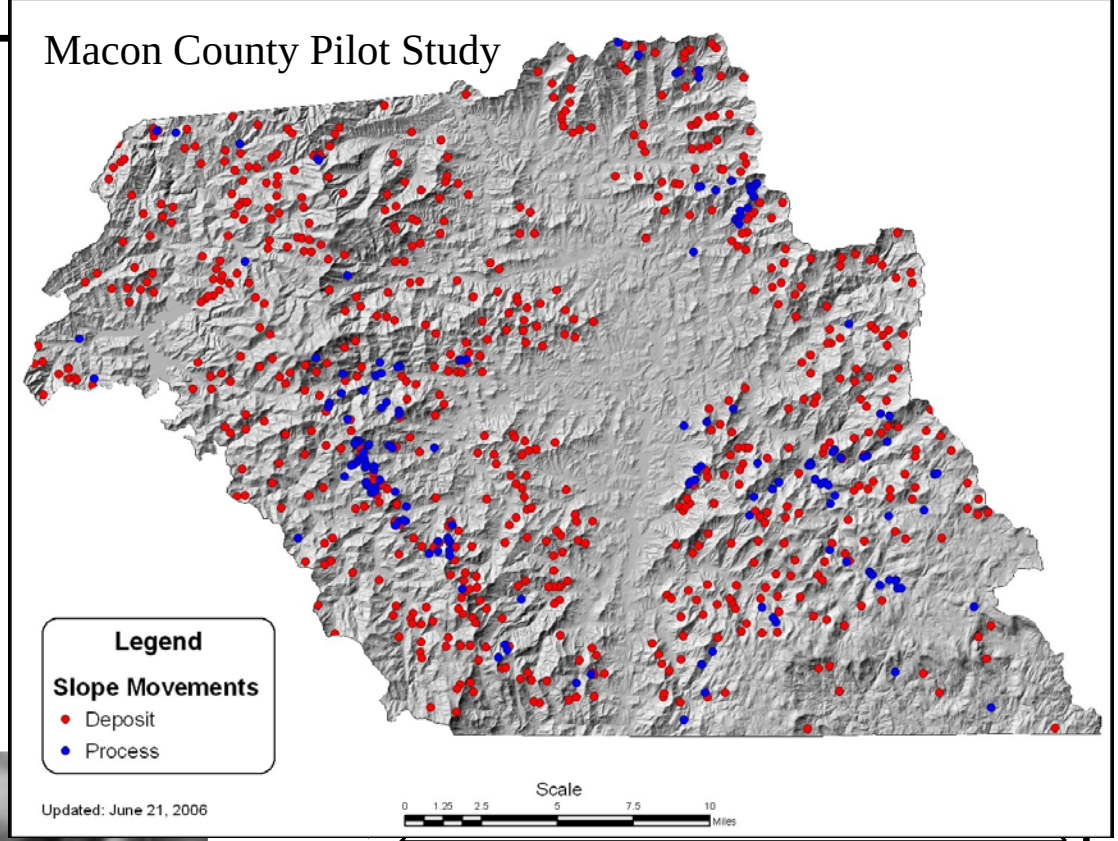


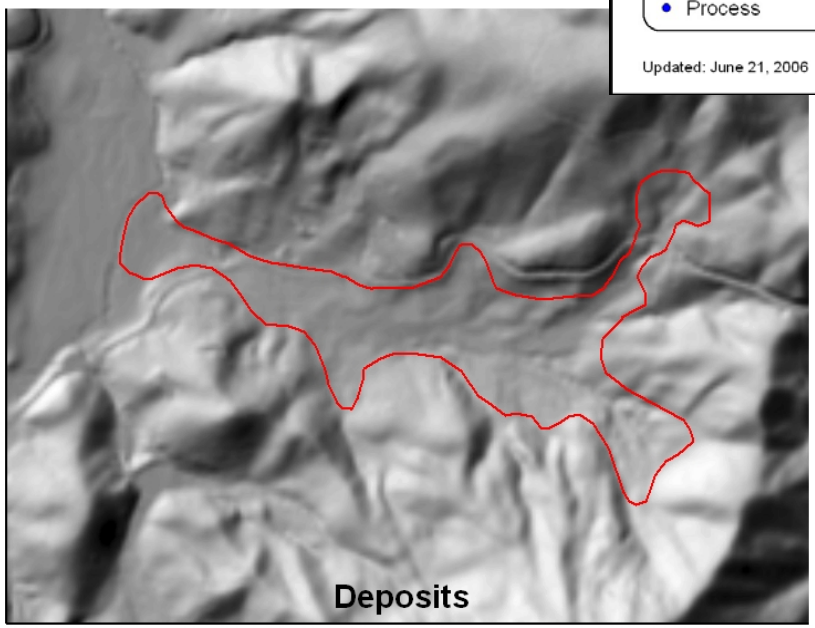
LiDAR

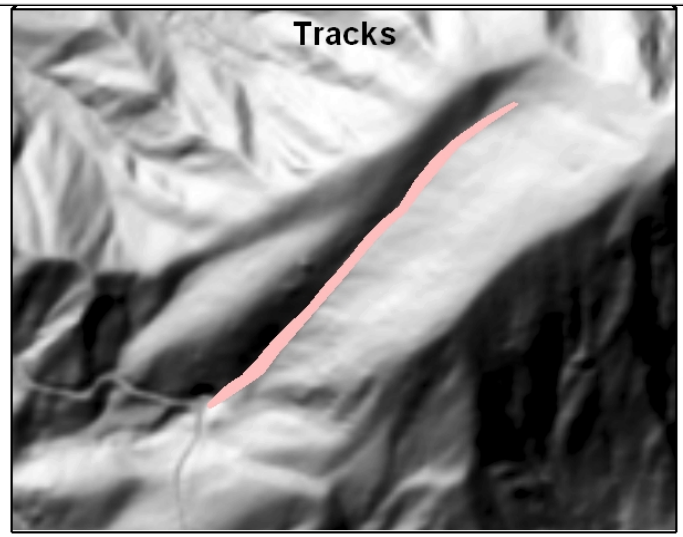
Light Detecting And Ranging

6m pixel resolution

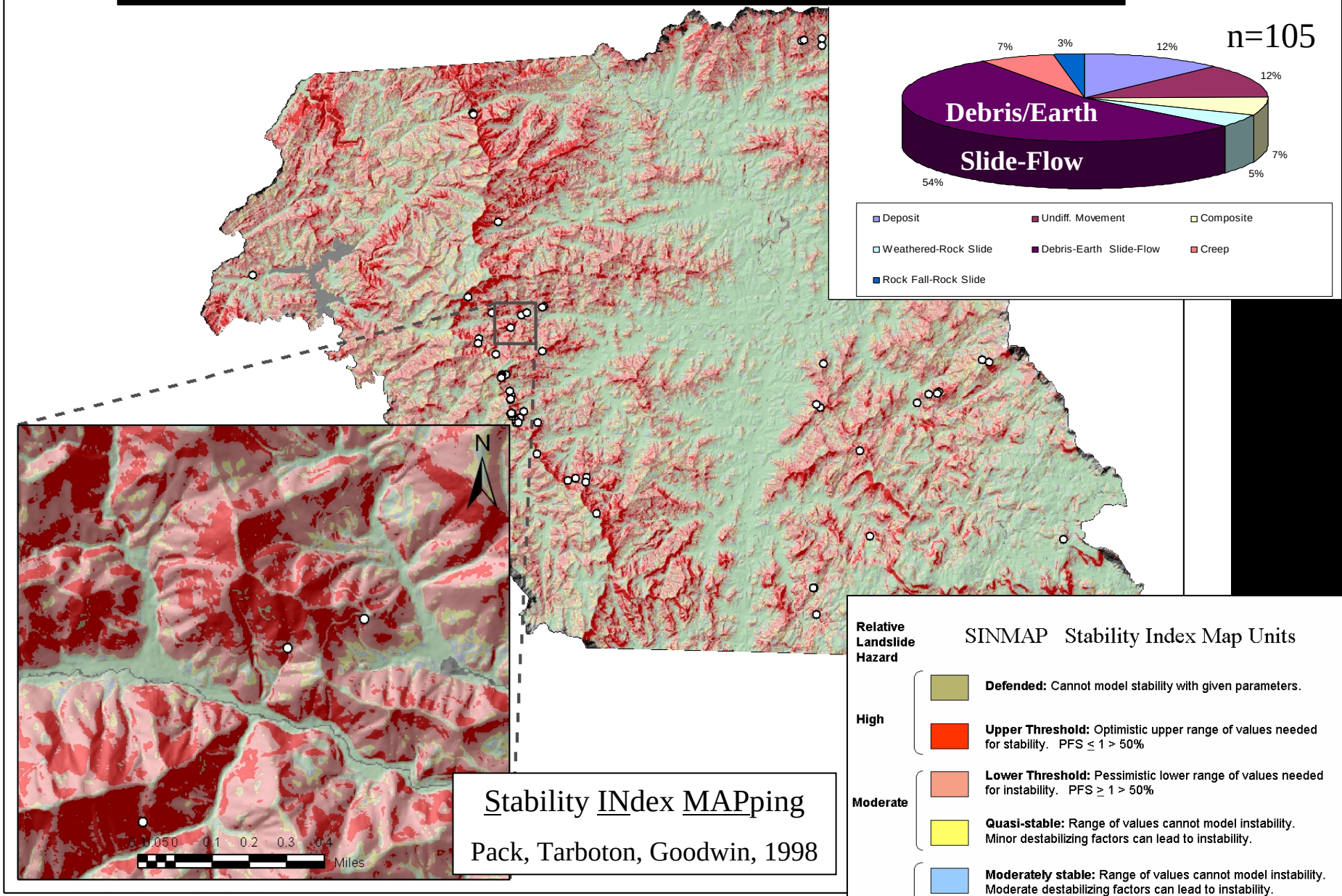

Big Slow Movers


Macon County Pilot Study
Legend
Slope Movements
Deposit
Process
Updated: June 21, 2006
Scale
0 1.25 2.5 5 7.5 10
Miles


Deposits

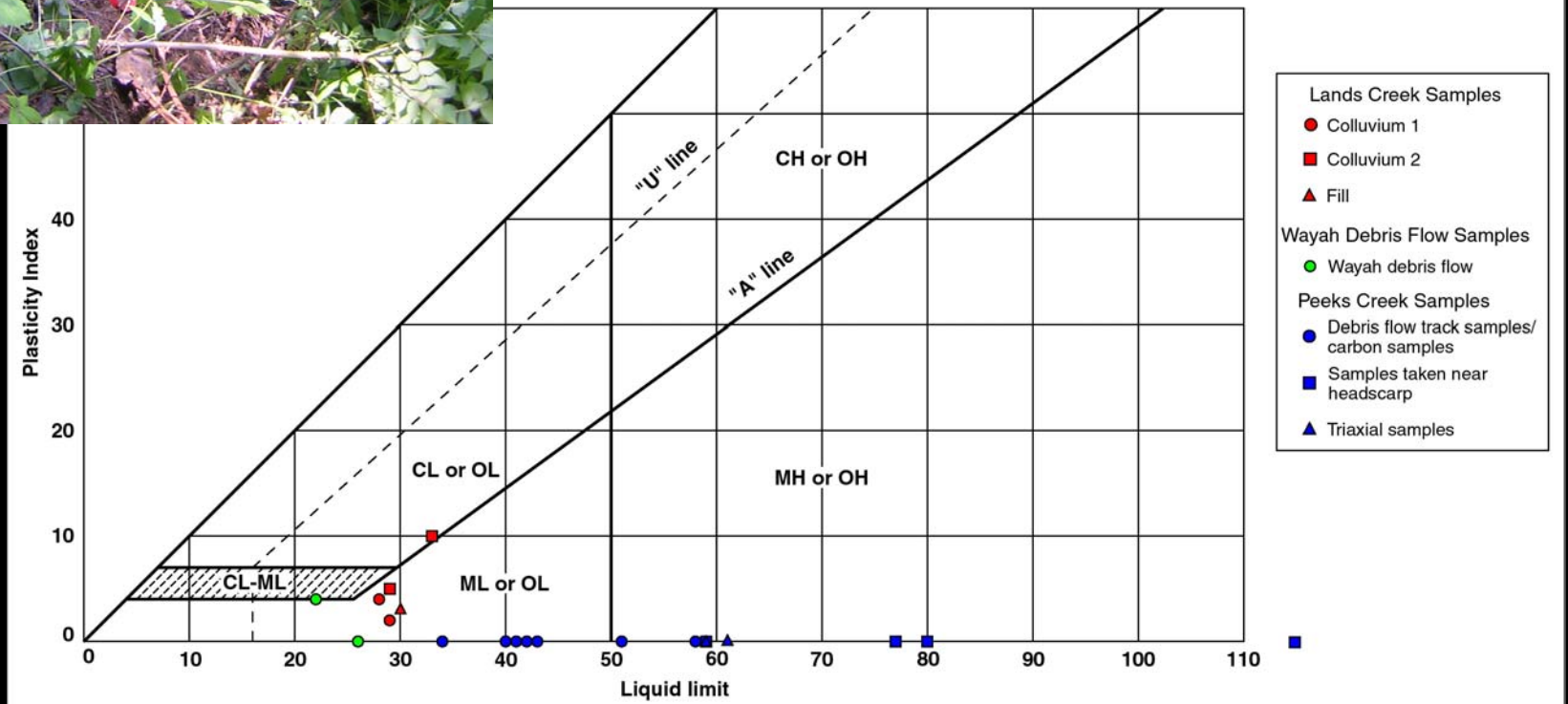

Tracks

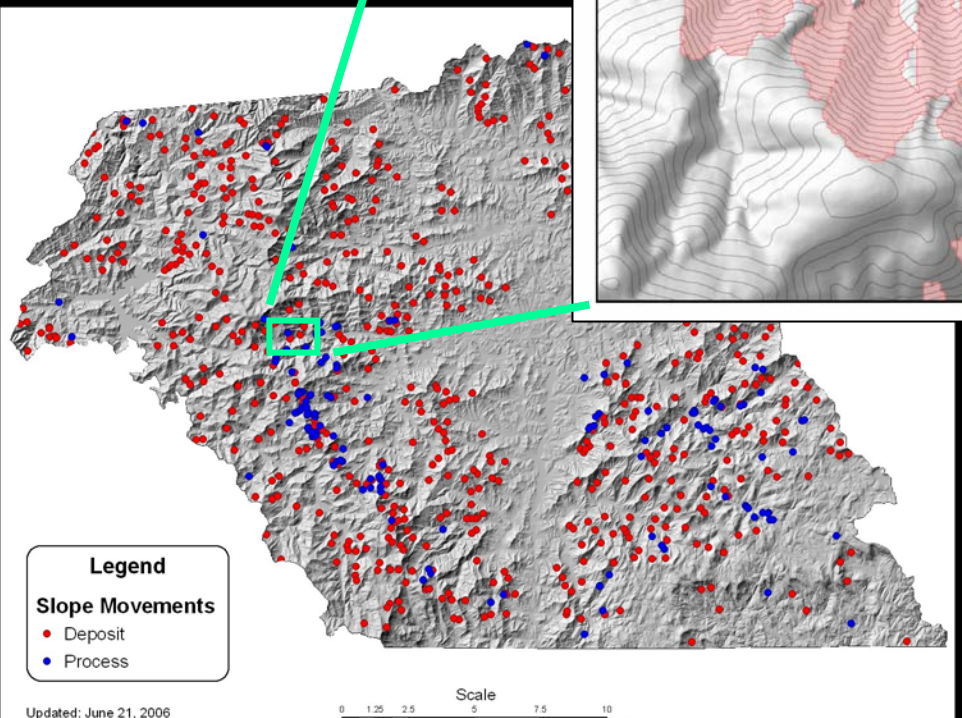
Macon County SINMAP Rev.2 - LiDAR

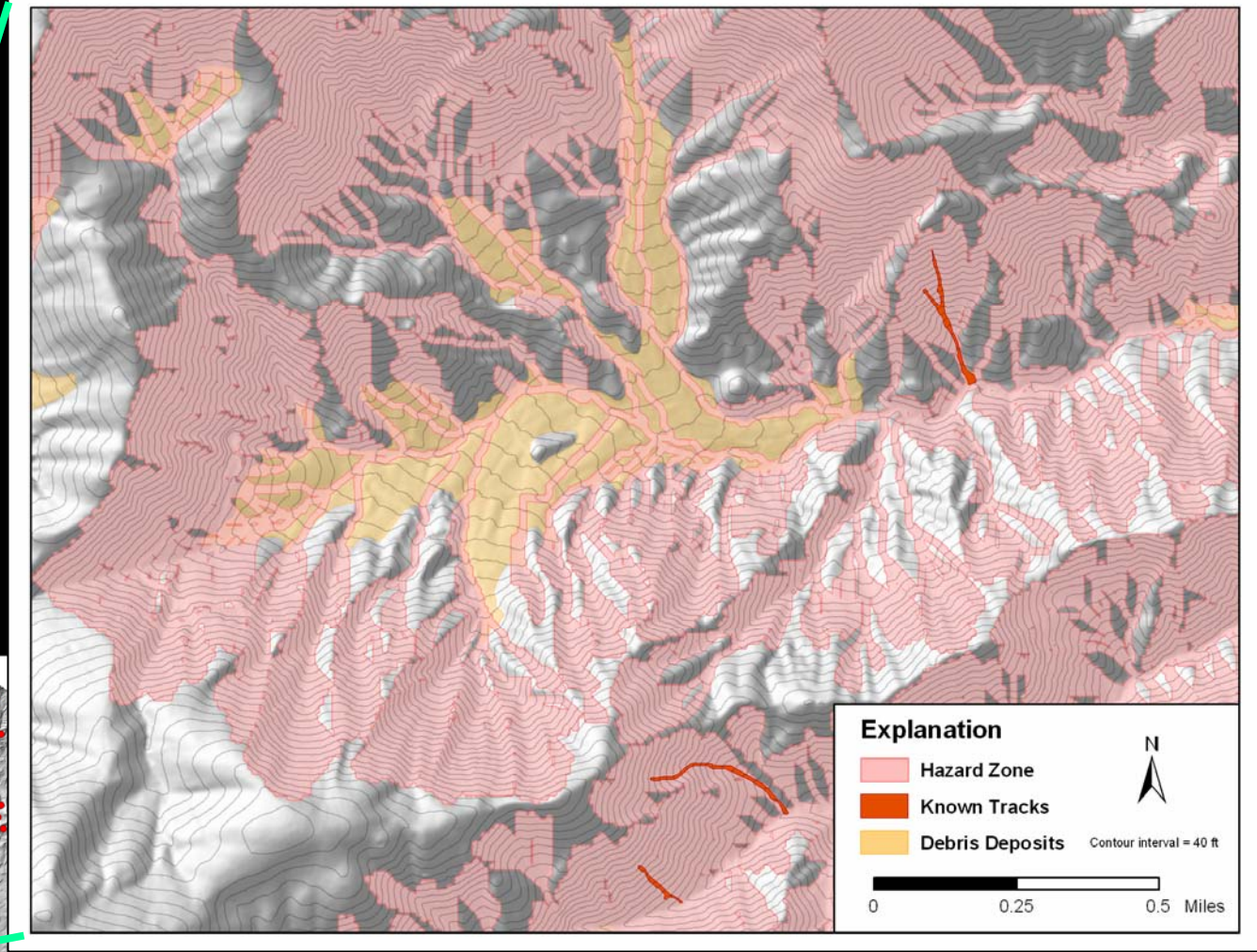


Soil Properties in Debris Flow Initiation Zones

Plasticity Chart







Debris Flow Hazard Zone Map

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- County Planning – GIS Groups
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- N.R.C.S.
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Questions ??

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http://www.geology.enr.state.nc.us

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http://www.nconemap.com