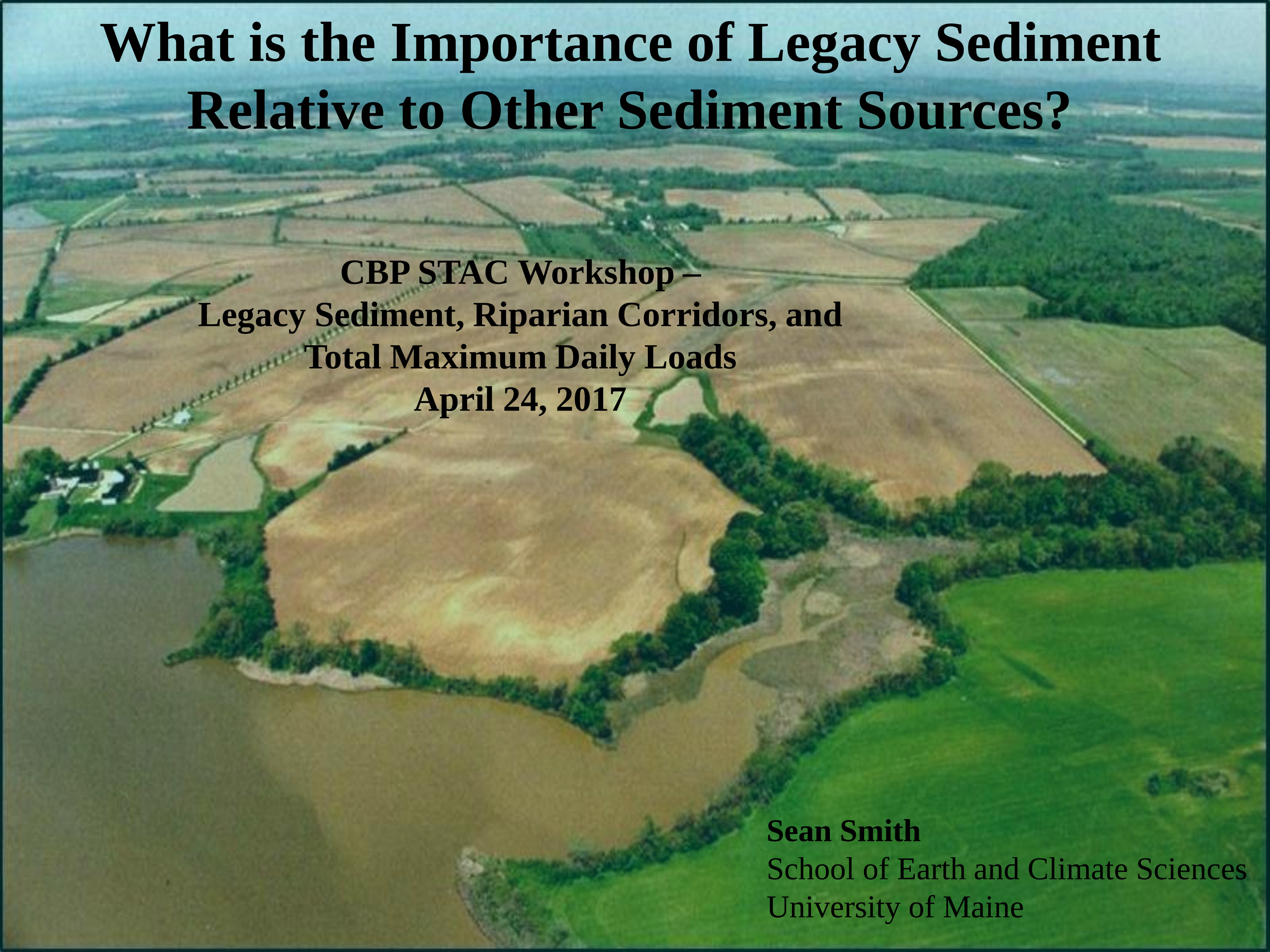
What is the Importance of Legacy Sediment Relative to Other Sediment Sources?



CBP STAC Workshop –
Legacy Sediment, Riparian Corridors, and Total Maximum Daily Loads
April 24, 2017

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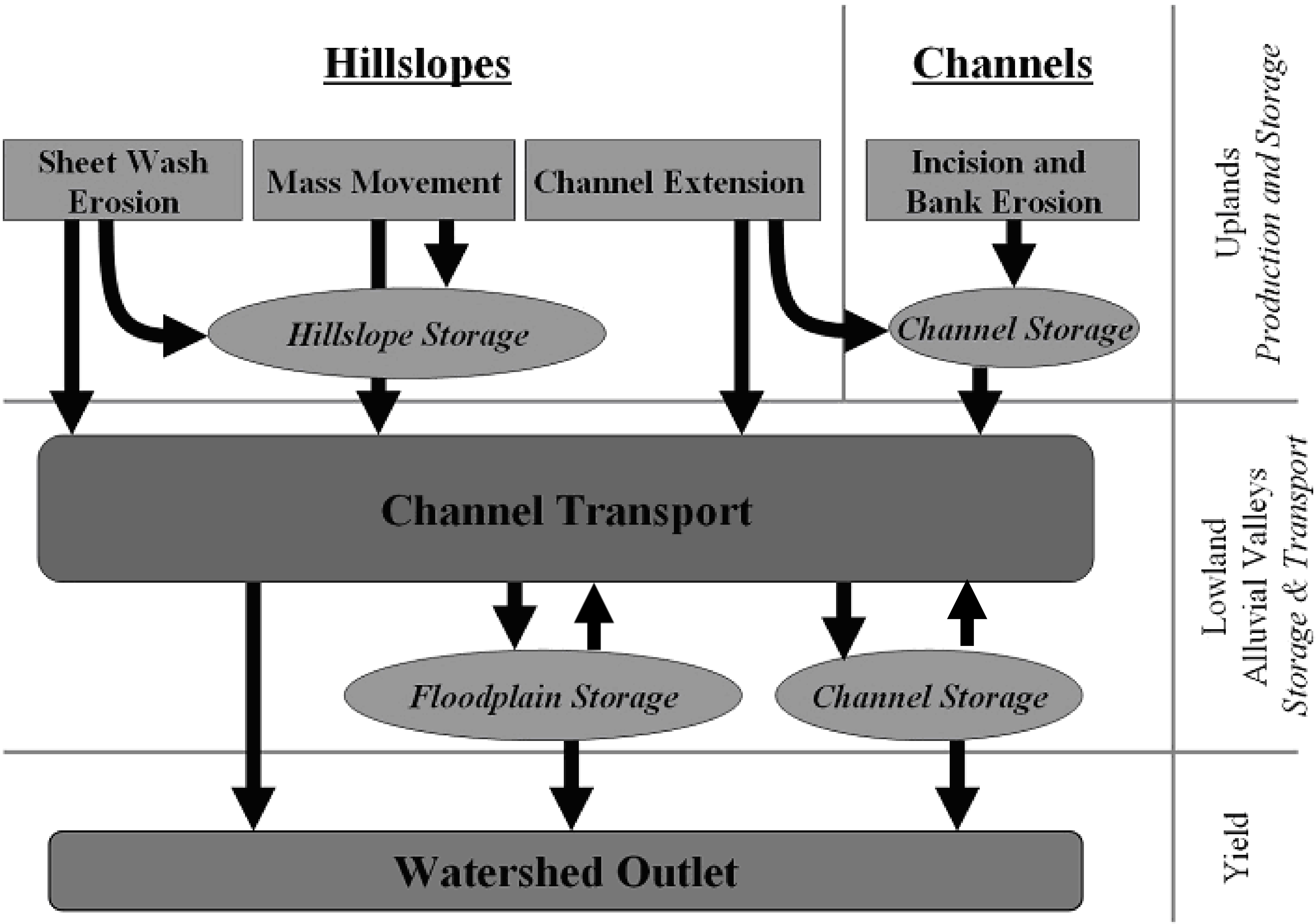
School of Earth and Climate Sciences
University of Maine


Hillslopes
Channels
Sheet Wash Erosion
Mass Movement
Channel Extension
Incision and Bank Erosion
Hillslope Storage
Channel Storage
Uplands
Production and Storage
Channel Transport
Floodplain Storage
Channel Storage
Lowland
Alluvial Valleys
Storage & Transport
Watershed Outlet
Yield

Piedmont Geomorphology

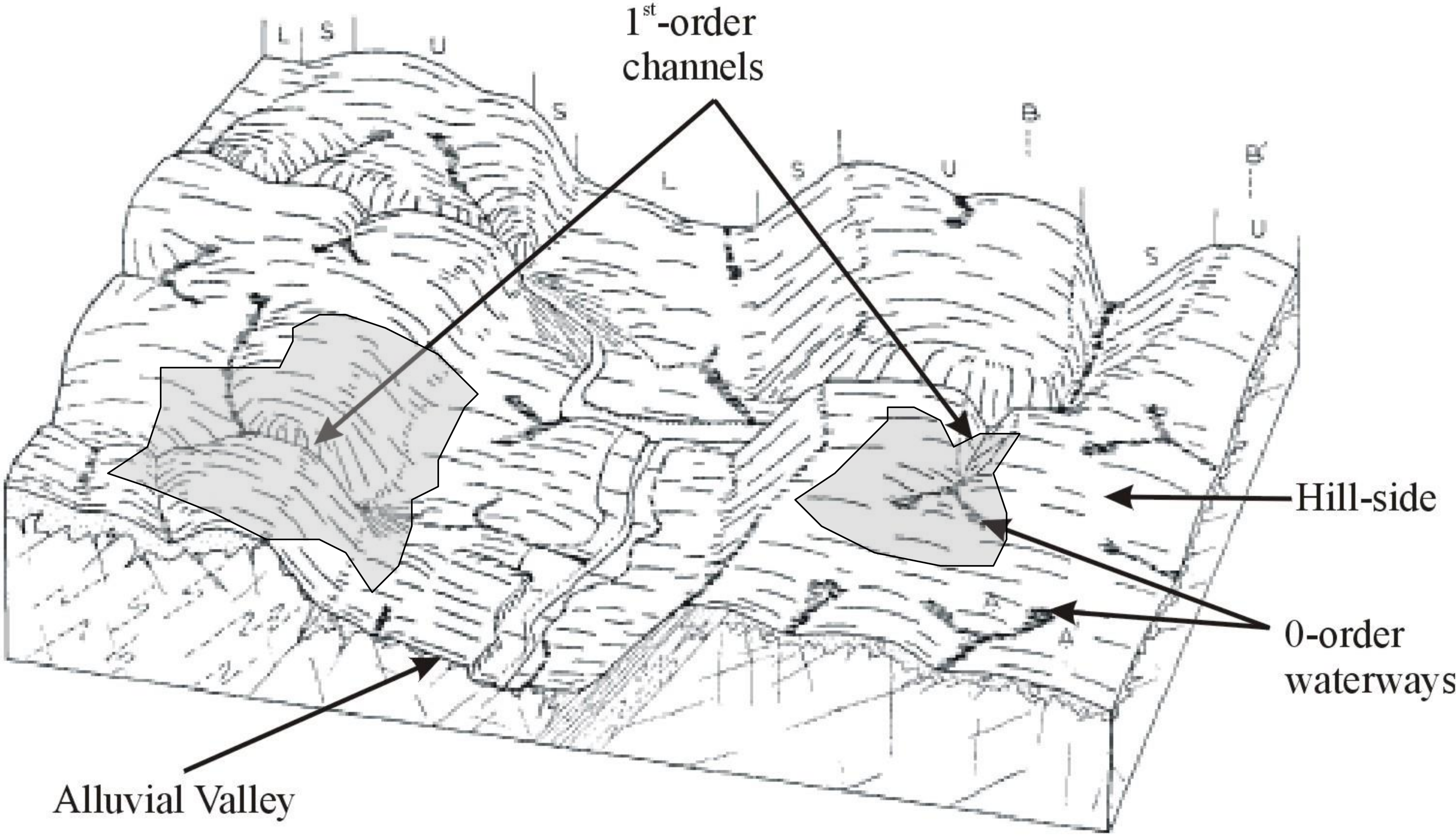


Figure 5: Sketch illustrating relationships of landforms, overburden, and stream valleys in the Maryland Piedmont. Abbreviations: U=uplands; S=slopelands, and L=lowlands. In cross section, stipple patterns represents saprolite and modern soil, diagonal lines represent jointing; dashed lines represent foliation. Note truncation of saprolite on hillslopes.

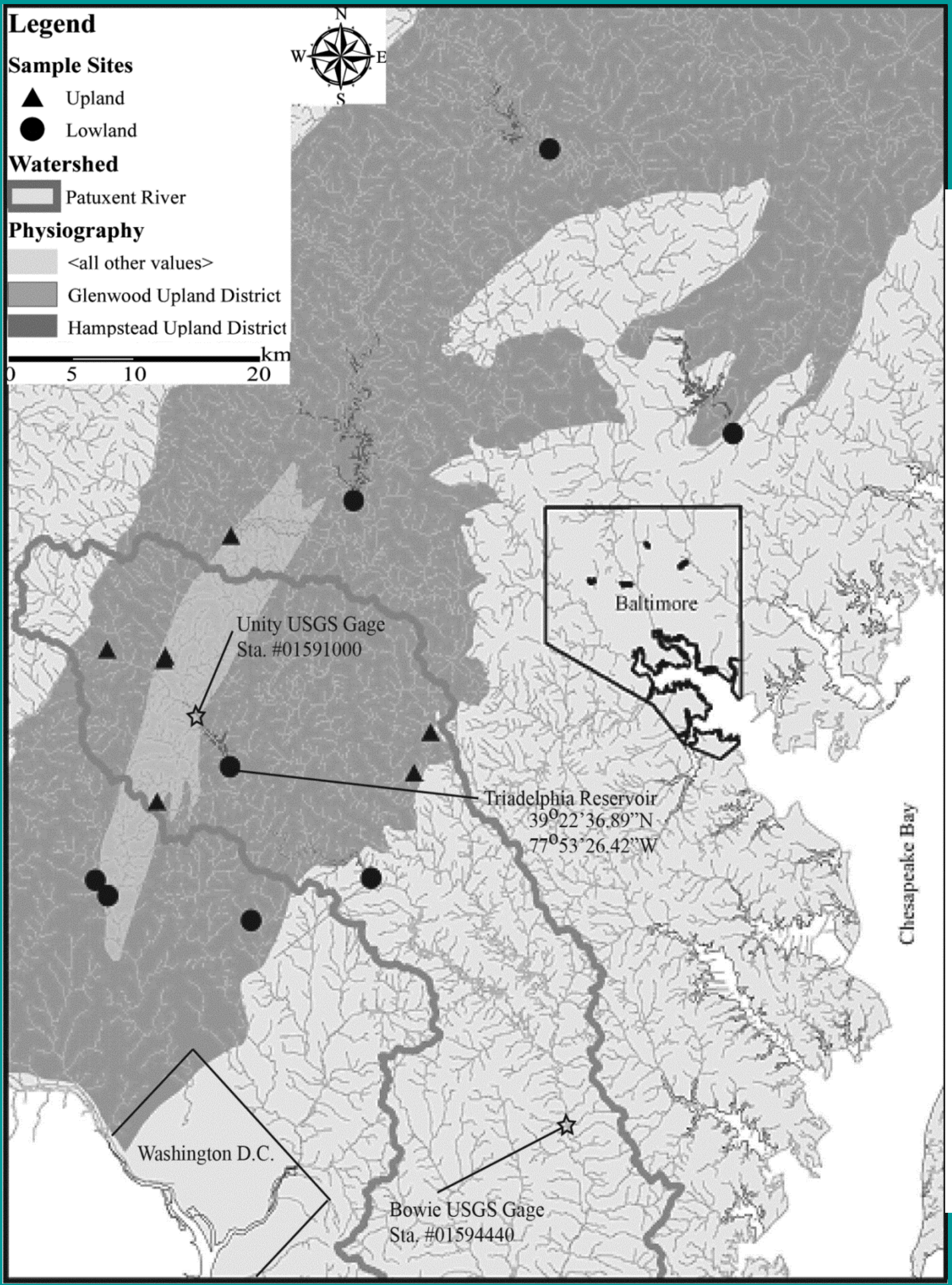
Costa and Cleaves, 1984

TABLE 1. LOCATION OF AGRICULTURAL SEDIMENT

	Percentage	Volume ($10^{-3} hm^3/km^2$)
Flood plains	14	18
Out of system (sediment yield)	34	45
Colluvial-sheetwash deposits	52	67
Total	100	130

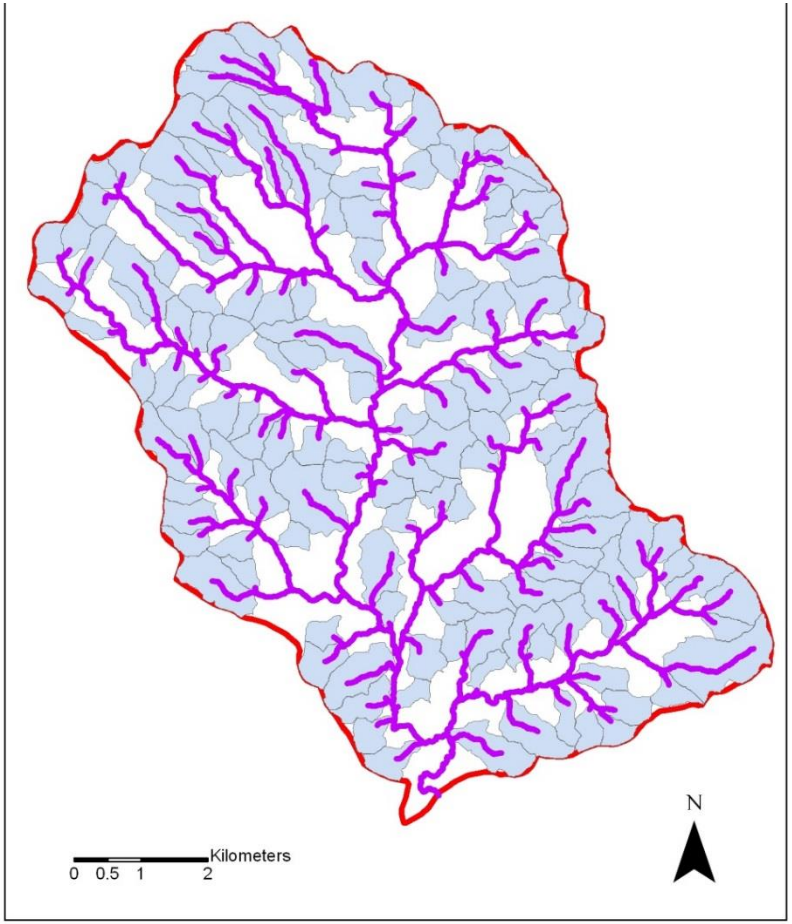
Note: 150 yr of intensive agricultural land use; 15.2 cm of soil erosion; 155 km^2 drainage area.

Costa, 1975

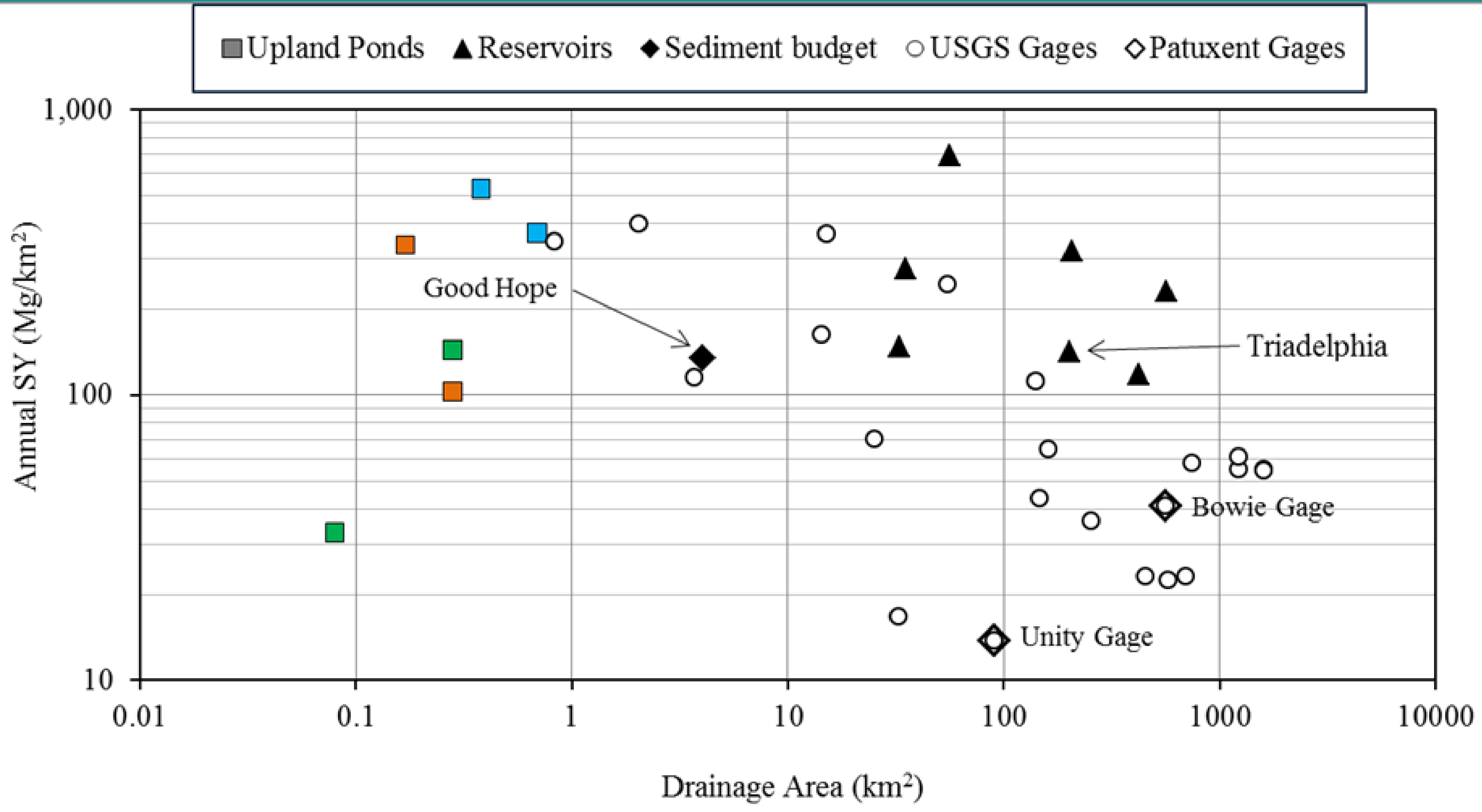


Piedmont Plateau

1 order = 62% of 4^{th} order DA, 49% of of total stream length (17 km added)



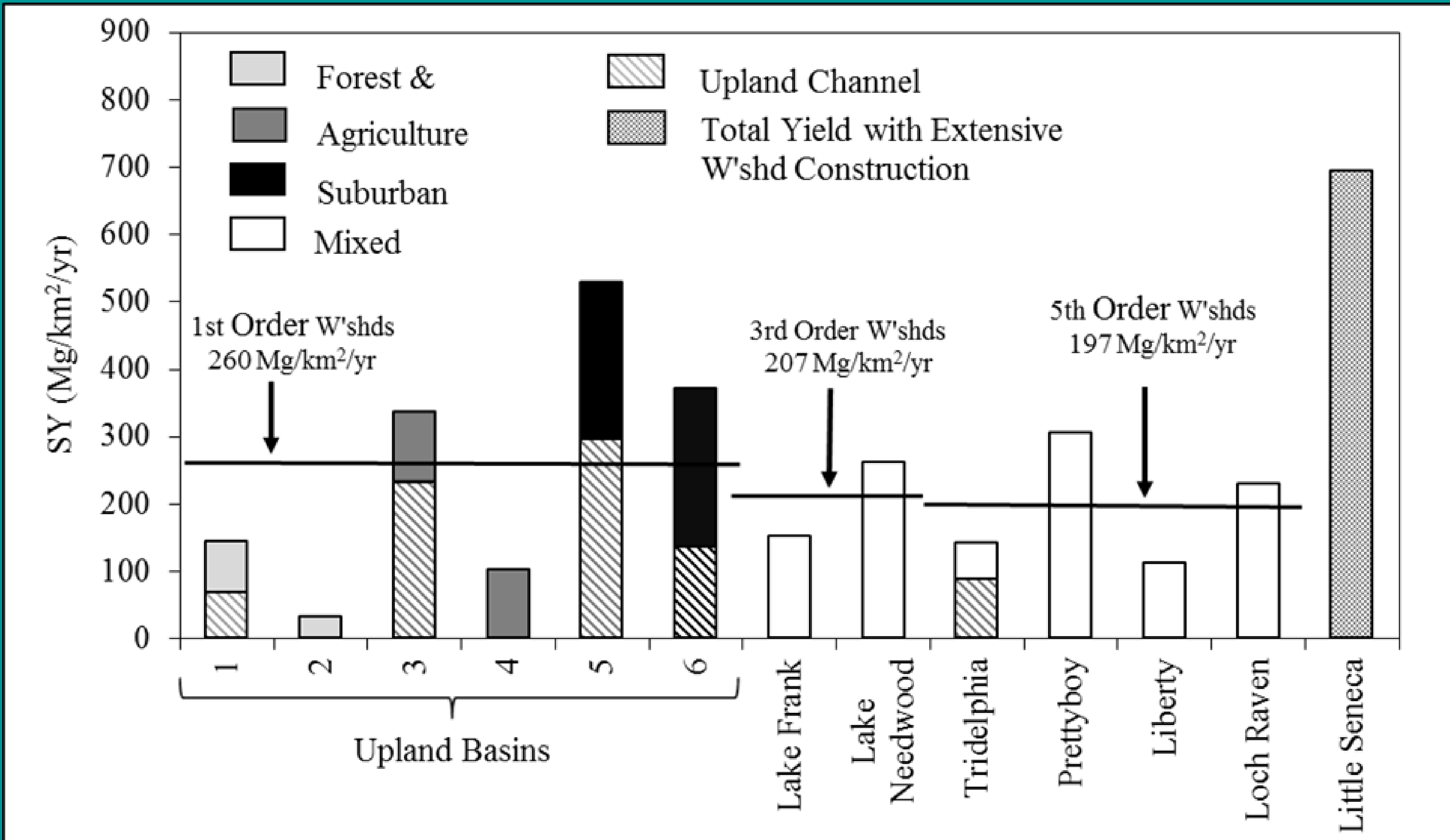
Sediment Yield Across Scales

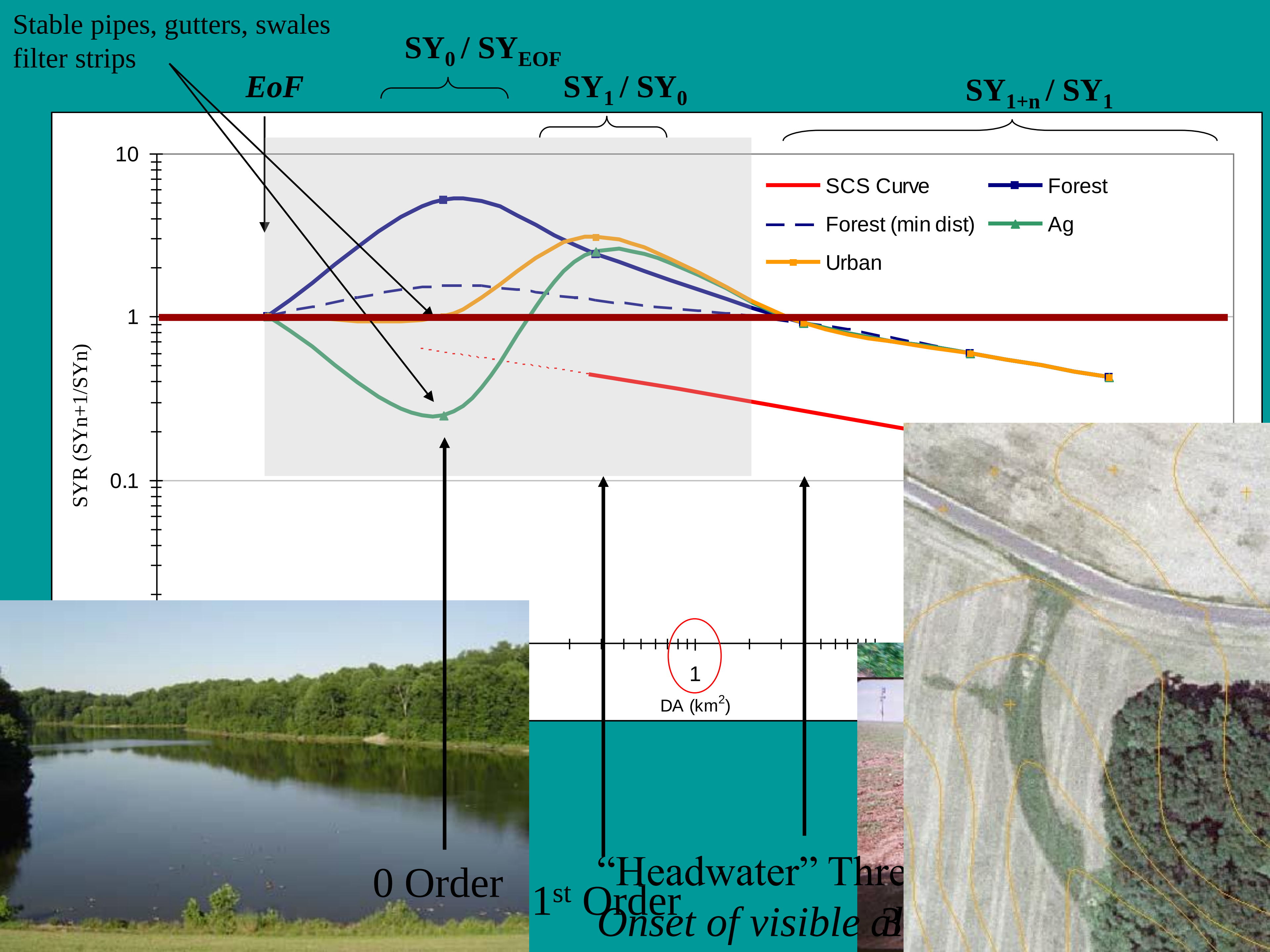


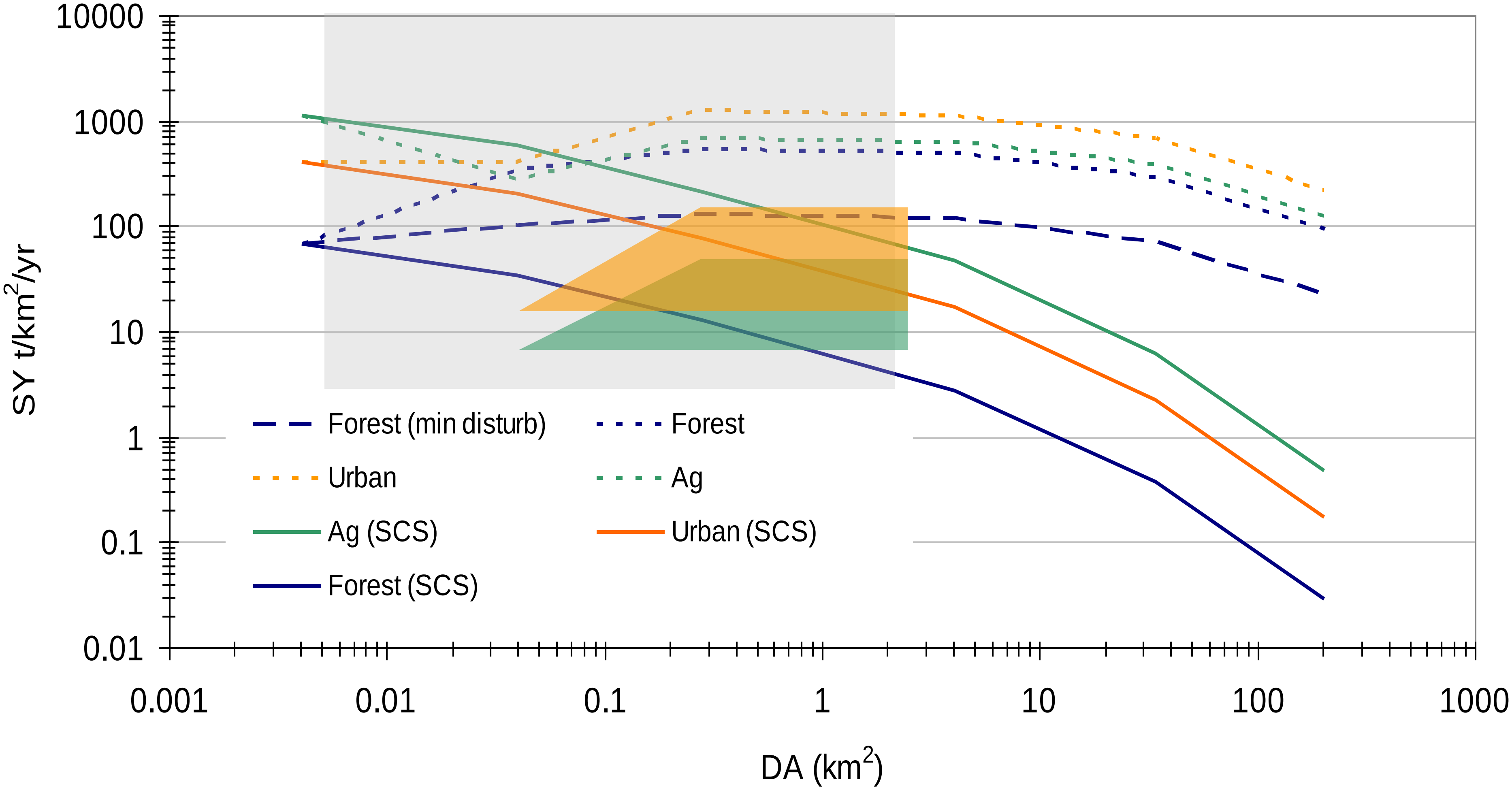
$$SDR = \frac{SY}{E}$$

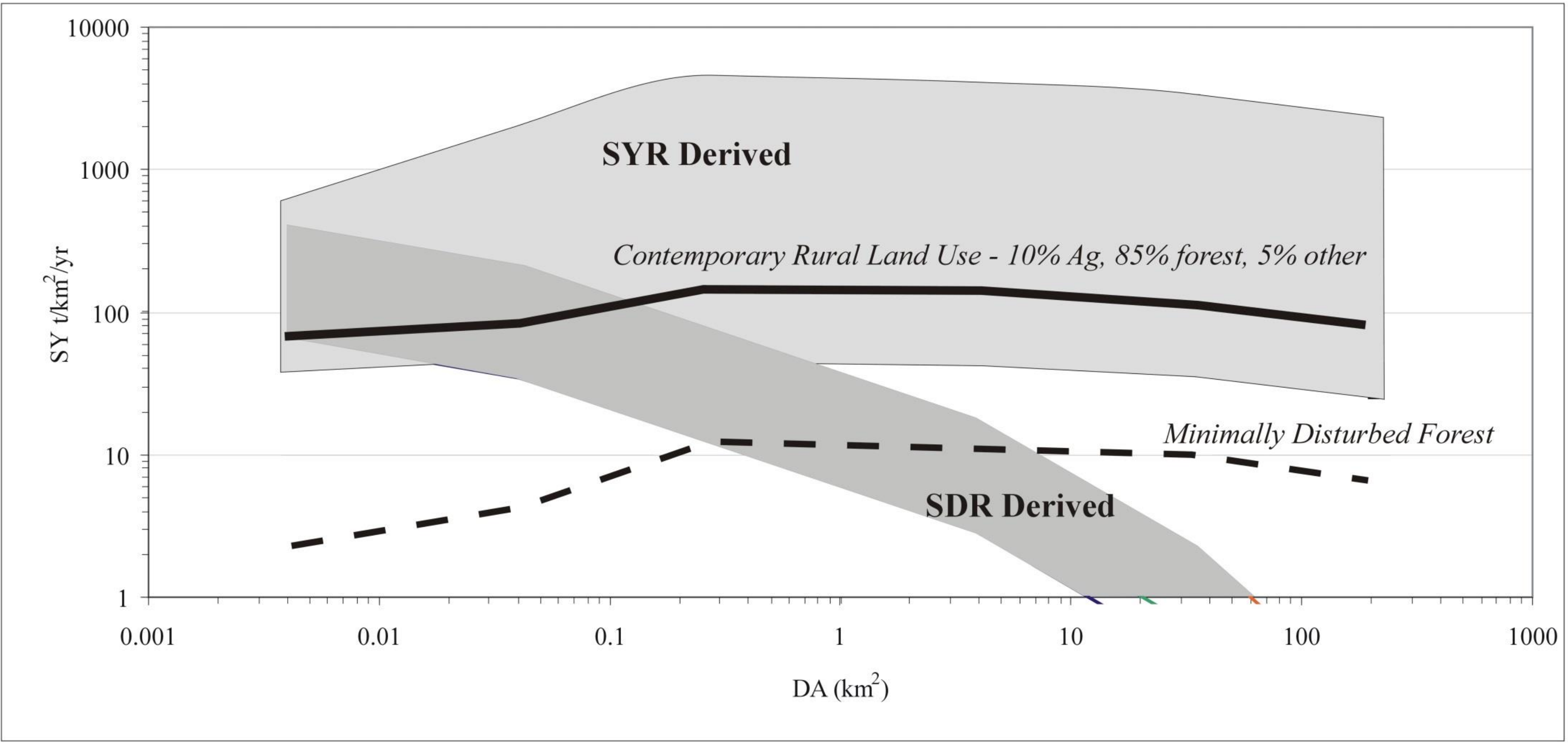
$$SYR_n = \frac{SY_n}{SY_{n-1}}$$

Land Condition / Setting	Watershed (%)	Sediment Yield Zero Order ($Mg/km^2/yr$)	Sediment Yield First Order ($Mg/km^2/yr$)
Agricultural	52	103	336
Forest	33	66	119
Suburban	15	234	427
Construction	0.2	2,102	2,102




Stable pipes, gutters, swales
filter strips
SY_0 / SY_{EOF}
EoF
SY_1 / SY_0
SY_{1+n} / SY_1
10
1
0.1
SYR (SYn+1/SYn)
SCS Curve
Forest
Forest (min dist)
Ag
Urban
1
DA (km^2)
0 Order
1st Order
“Headwater” Thre
Onset of visible


10000
1000
100
10
1
0.1
0.01
SY t/km²/yr
0.001
0.01
0.1
1
10
100
1000
DA (km²)
Forest (min disturb)
Forest
Urban
Ag
Ag (SCS)
Urban (SCS)
Forest (SCS)



$$SYR_n = \frac{SY_5}{SY_1} = \frac{142}{215} = 0.66$$

ONE THIRD of Upland Sediment Supply has been Stored in Alluvial Valleys over the past 50 years.

Floodplain aggradation ~2.6mm/yr

Sediment Transport (mg/s) = Q (L^3/s) x C (mg/L^3)

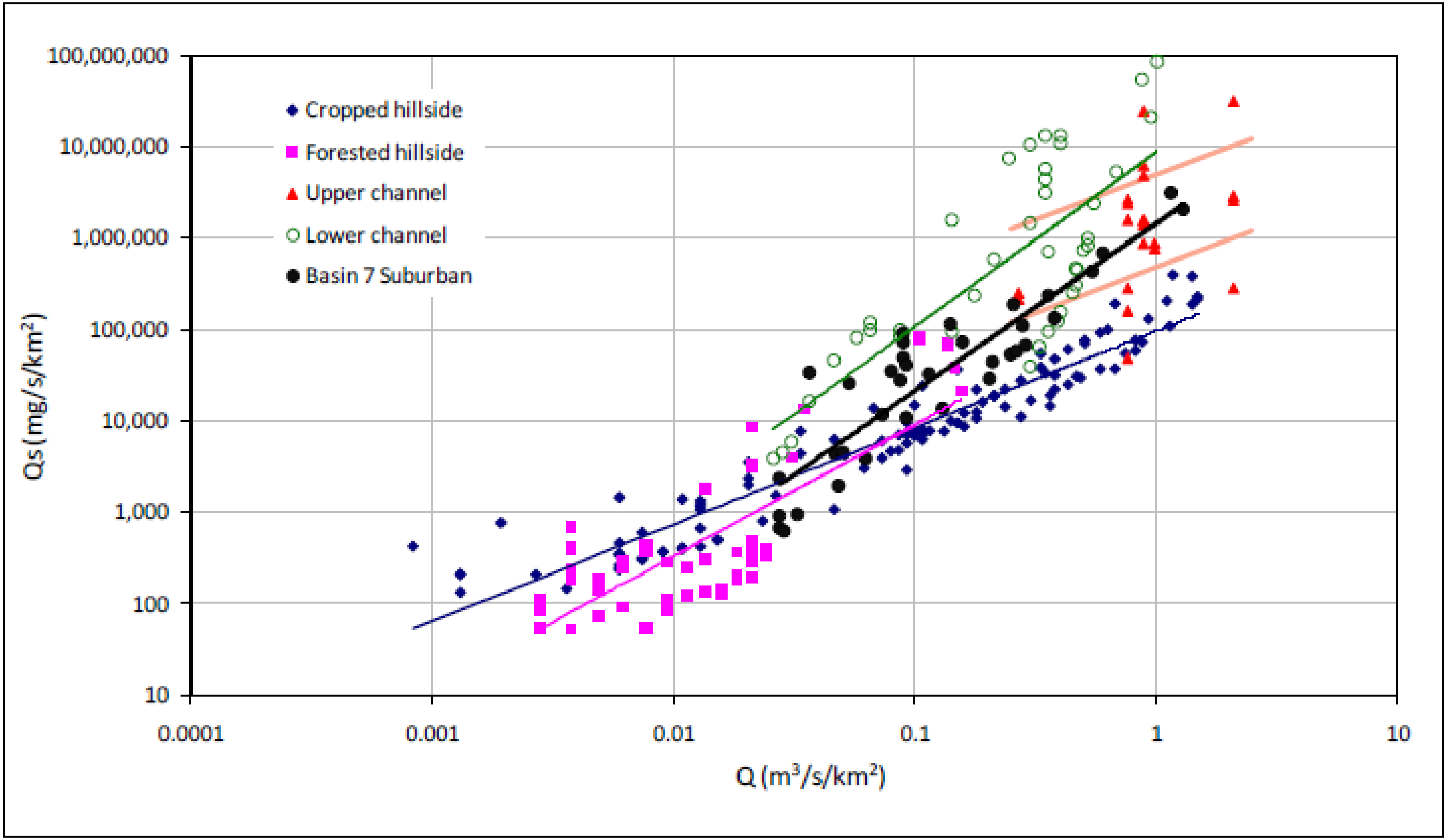


Figure 4.11. Sediment discharge as a function of discharge in Basin 7.

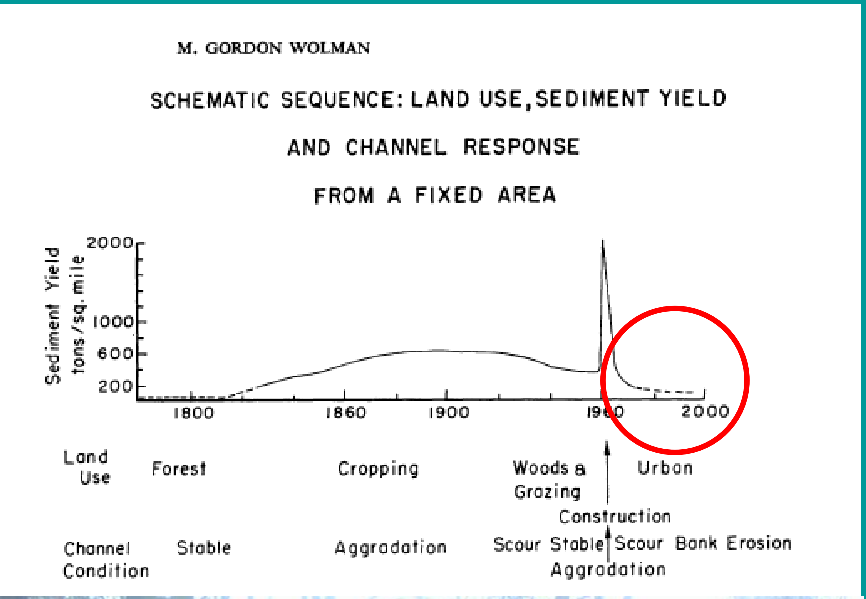
Upland Valley Erosion

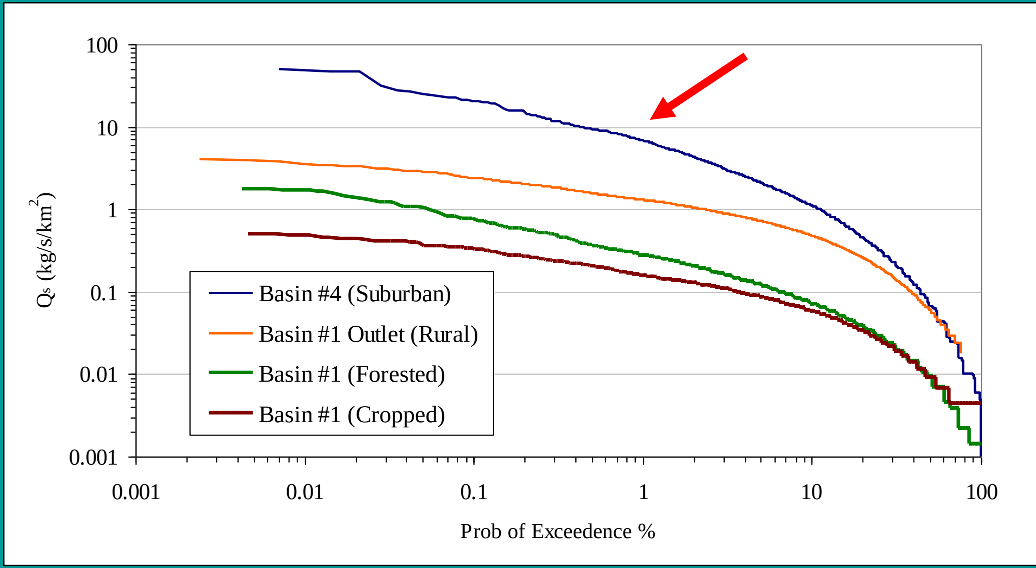
(Primary Non-Channeled Upland Contributor)

Upland Channel Erosion

(1/3 to 2/3 of the Total Upland Load)

Suburban Sediment Yield Can be VERY High





Upland Disturbances Still Matter

<u>Construction Disturbances Persist</u>

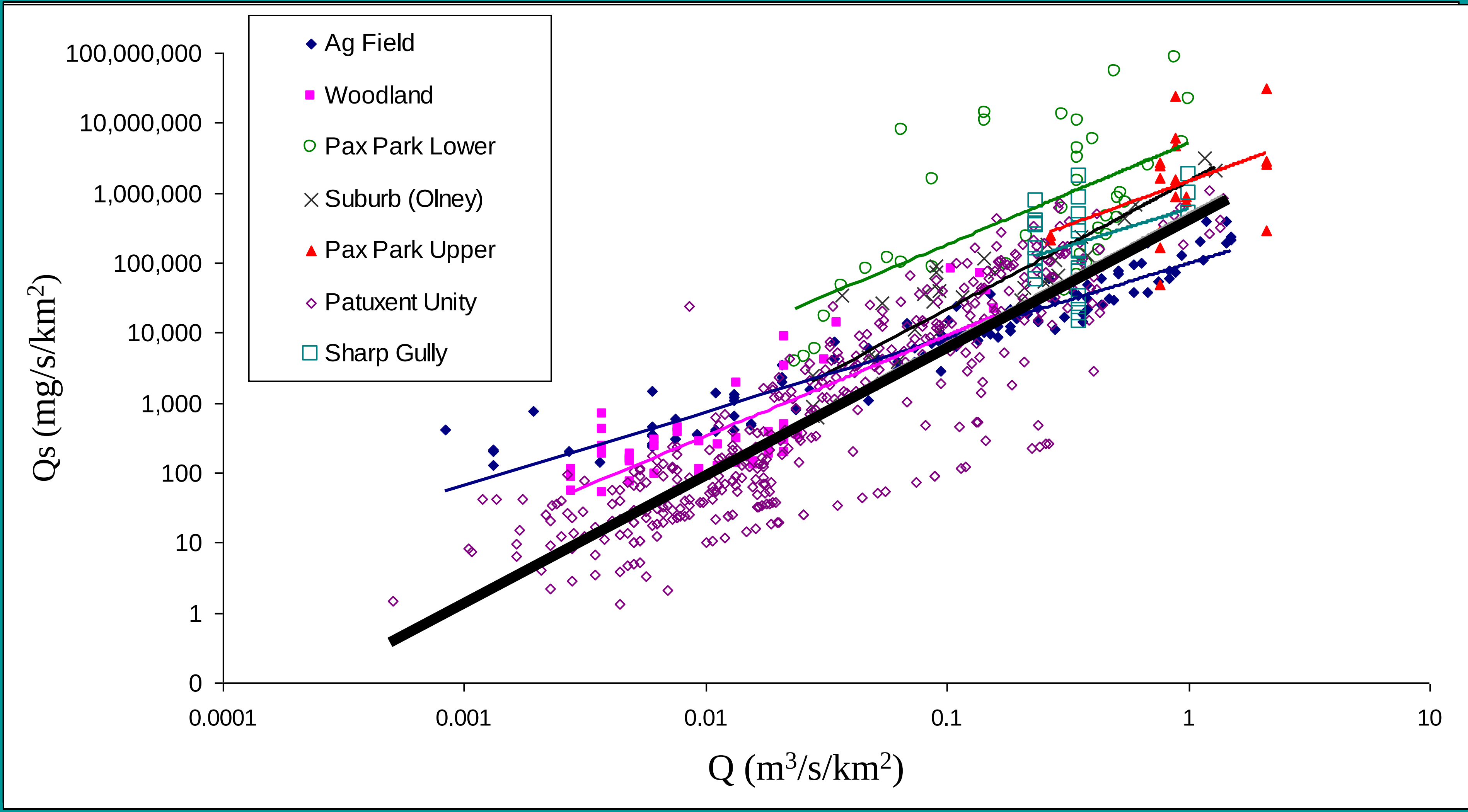
Wolman and Schick, '67 : 0.24 km^2 - - 8,406 $Mg/km^2/yr$

<u>Mixed Land Uses</u>

York and Herb, '78: 50% (Urban, 10% Constr.),

1.22 km^2 - - 1,139 $Mg/km^2/yr$

Gullies > Ag Up > Urban Up >Forest Up > Rivers



Gullies = Urban Up > Rivers > Forest Up = Ag Up

Summary Points

- Modern UPLAND sediment yield remains very high relative to estimated regional background levels.

- Erosion of 0 and 1^{st} order upland waterways is pervasive, even in forests. Urban areas are not sediment “starved”.

- Upland Culprits (why is this happening):
  - Intense disturbances
  - High surface runoff rates (urban and rural)
  - Efficient delivery

- Modern LOWLAND valleys are storing (regulating) upland sediment delivery ($SY_5 < SY_{0-1}$)

- If valley-bottom rates of sedimentation exceed erosion as indicated by recent studies, then the proportion of watershed sediment delivery derived from stream banks is necessarily small.