Geomorphology Progress: Updated Sediment Budget and Mud Mapping

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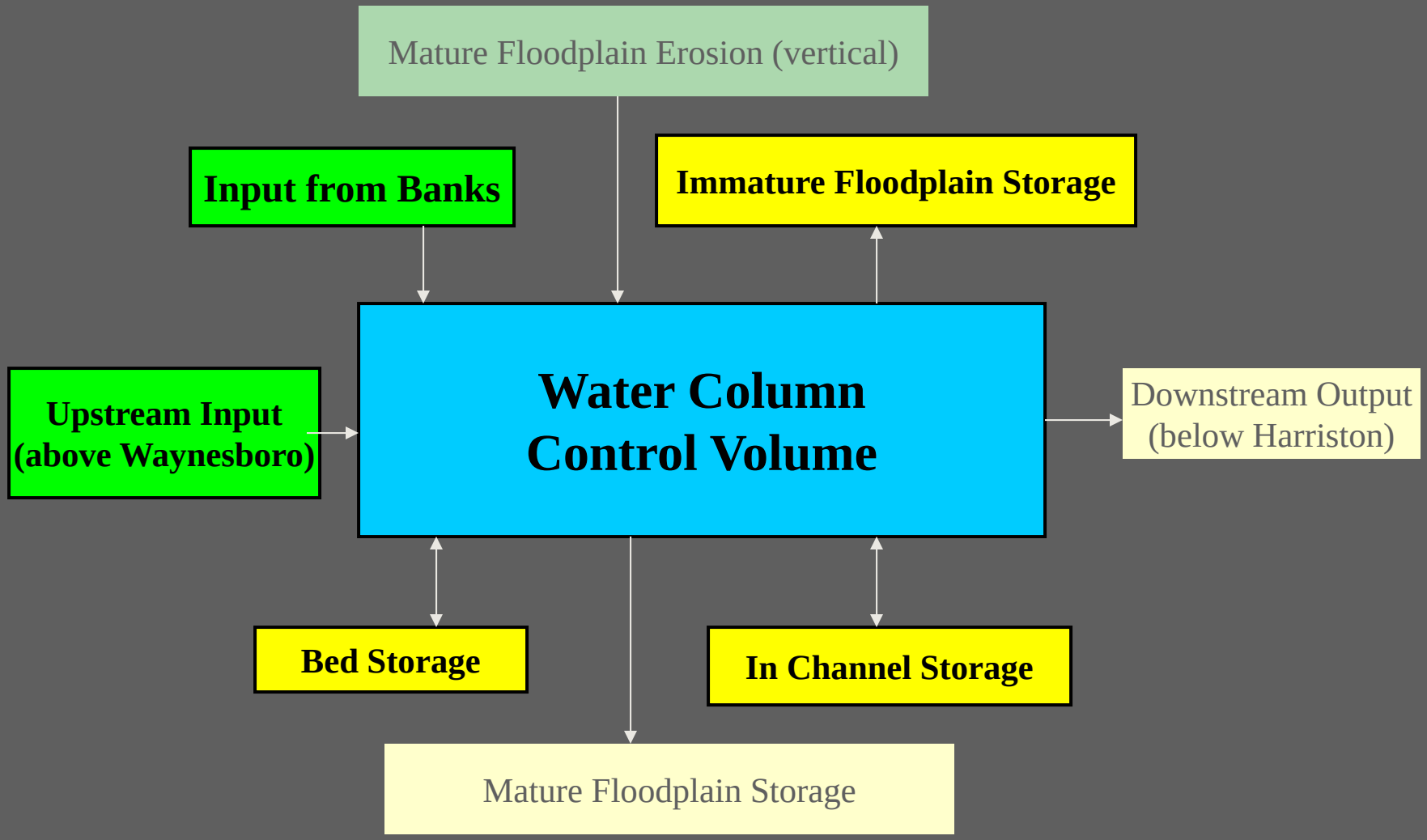
Sediment Budget



Upstream Inputs

- Constructed a dimensionless sediment rating curve using data from nearby watersheds
- Fit a power function to the data
- Used 2 years of discharge data for South River at Waynesboro as input to the empirical rating curve to estimate sediment annual sediment inputs.

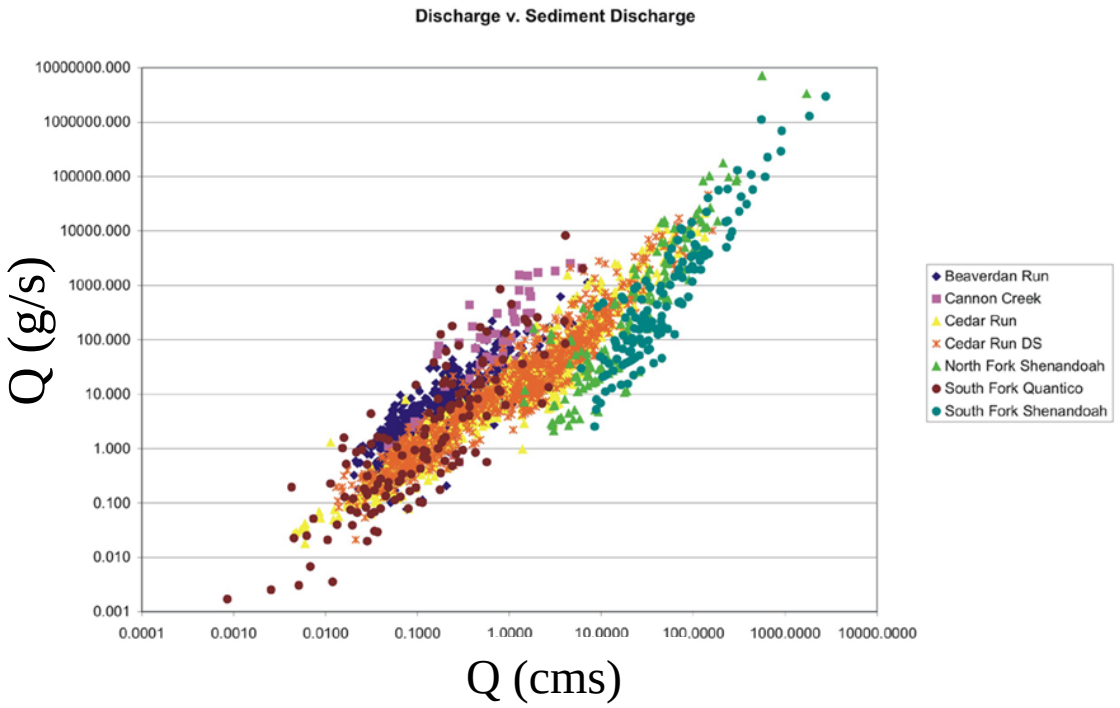
Dimensionless Sediment Rating Curves

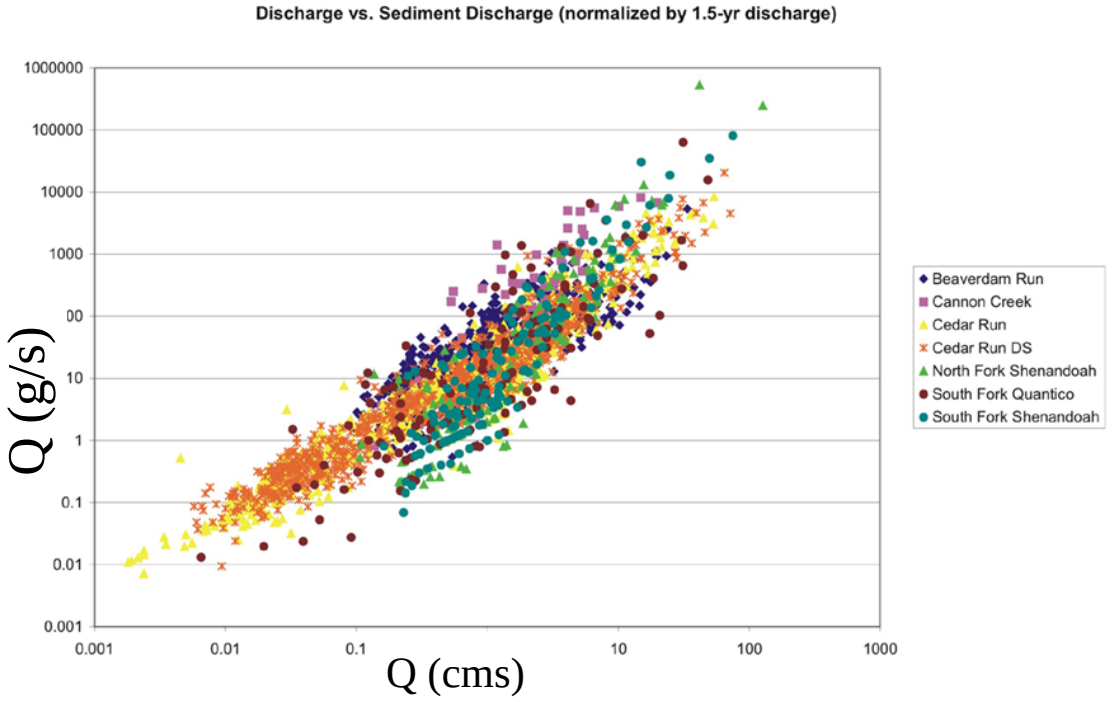
-Constructed using USGS data for nearby sites

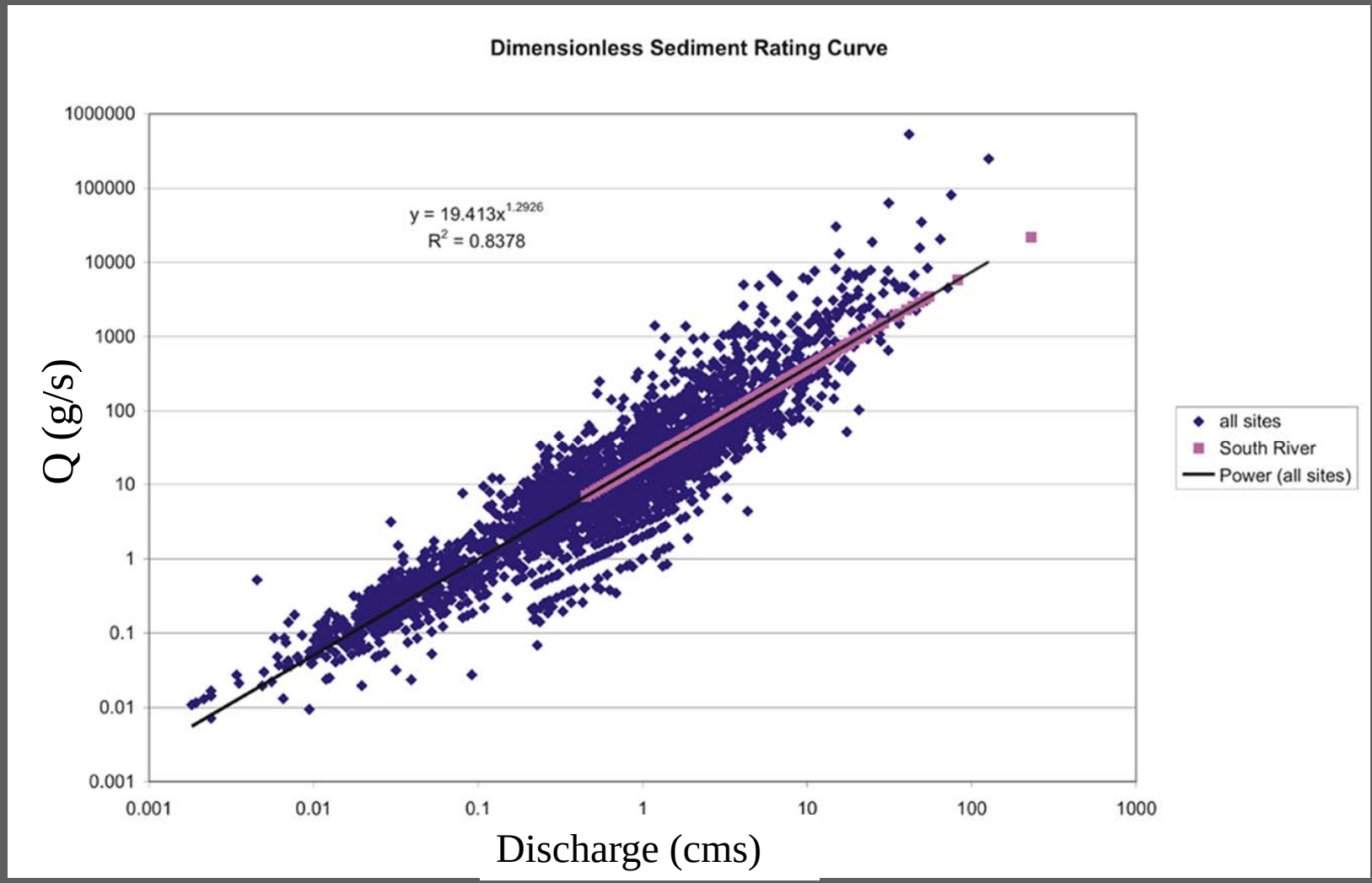
-Suspended Sediment Discharge (g/s) vs Water Discharge (cubic meters/s)

-top curve is data for all sites

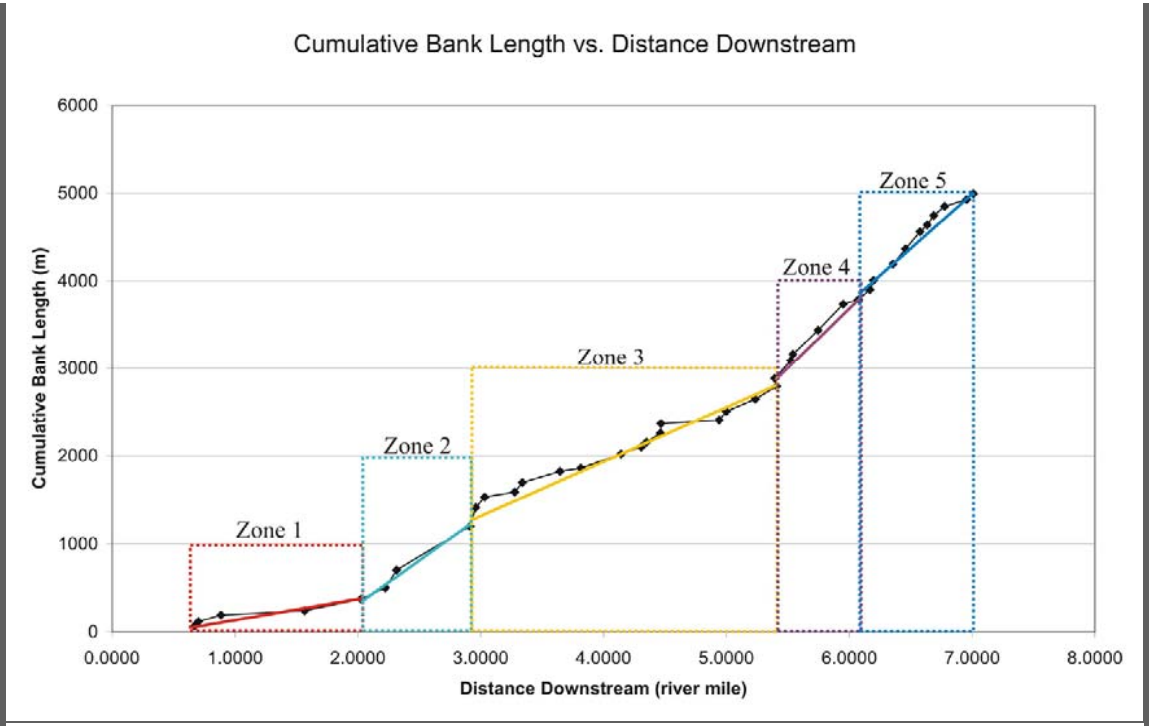
-bottom curve is data normalized by the 1.5-year discharge

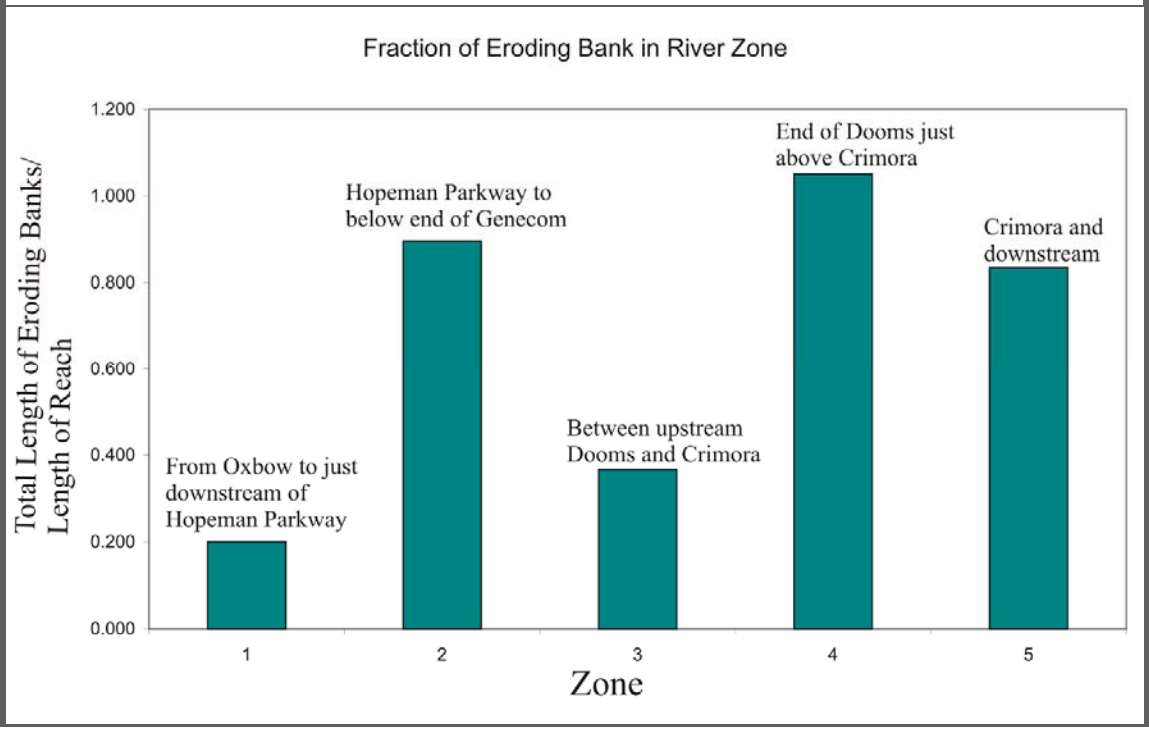





Dimensionless Sediment Rating Curve
y = 19.413x^1.2926
R^2 = 0.8378
Q (g/s)
1000000
100000
10000
1000
100
10
1
0.1
0.01
0.001
0.001
0.01
0.1
1
10
100
1000
Discharge (cms)
all sites
South River
Power (all sites)

Bank Erosion Inputs





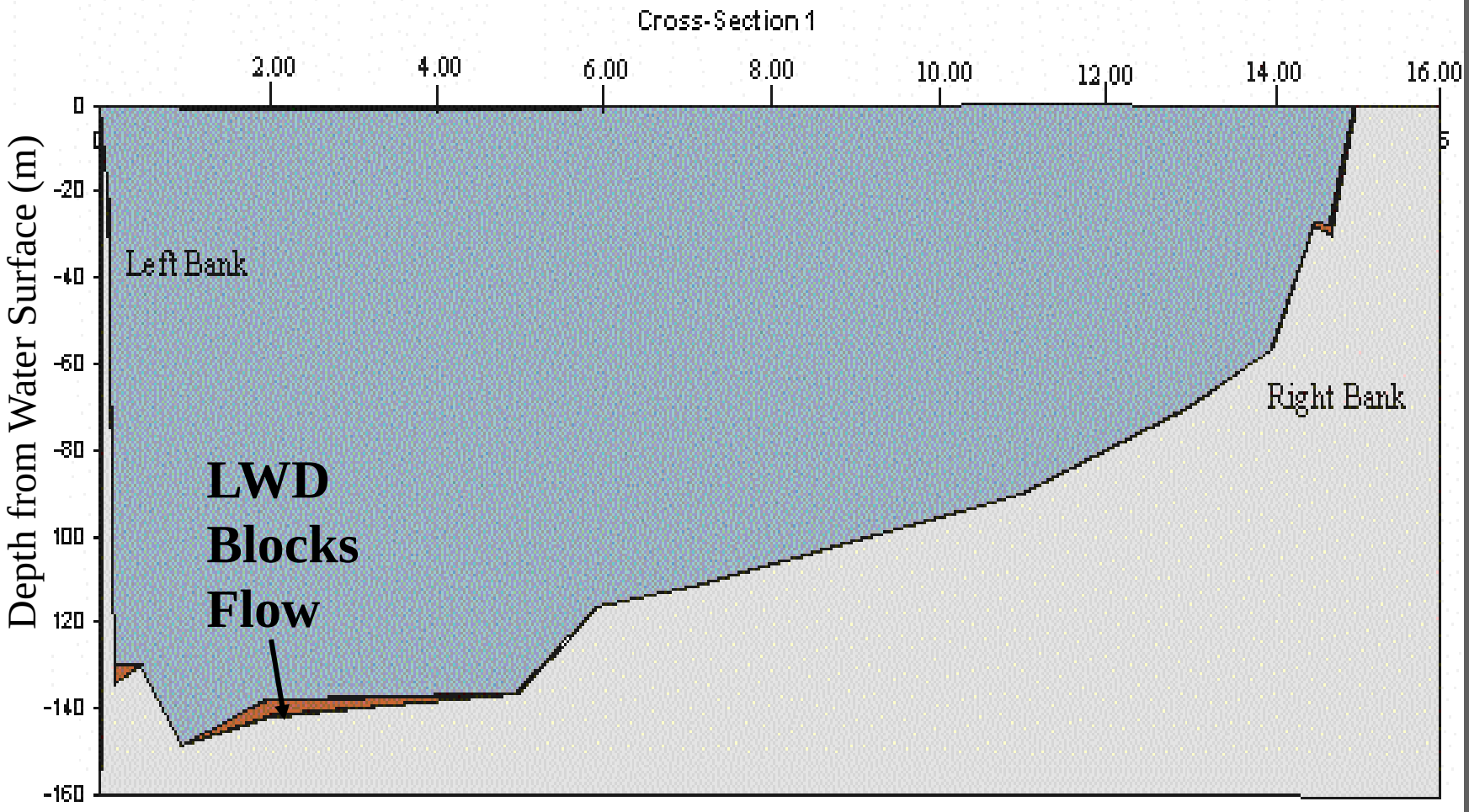
Bank Erosion

- Rates obtained from 1937 and 1994 aerial photos at 4 locations near Crimora (a first crude estimate)
- Multiplied by fraction of reach with eroding banks
- Assumed height of 2 m, reach length of geomorphic maps
- Assumed 50% silt-clay

Bed Storage

- Assumed an active layer thickness of 0.2 m
- Assumed a fraction of silt and clay of 5%
- Channel width 20 m
- Bed storage was assumed to have a residence time of one year, therefore is neglected in an annual sediment budget
- Refers to interstitial fine-grained storage

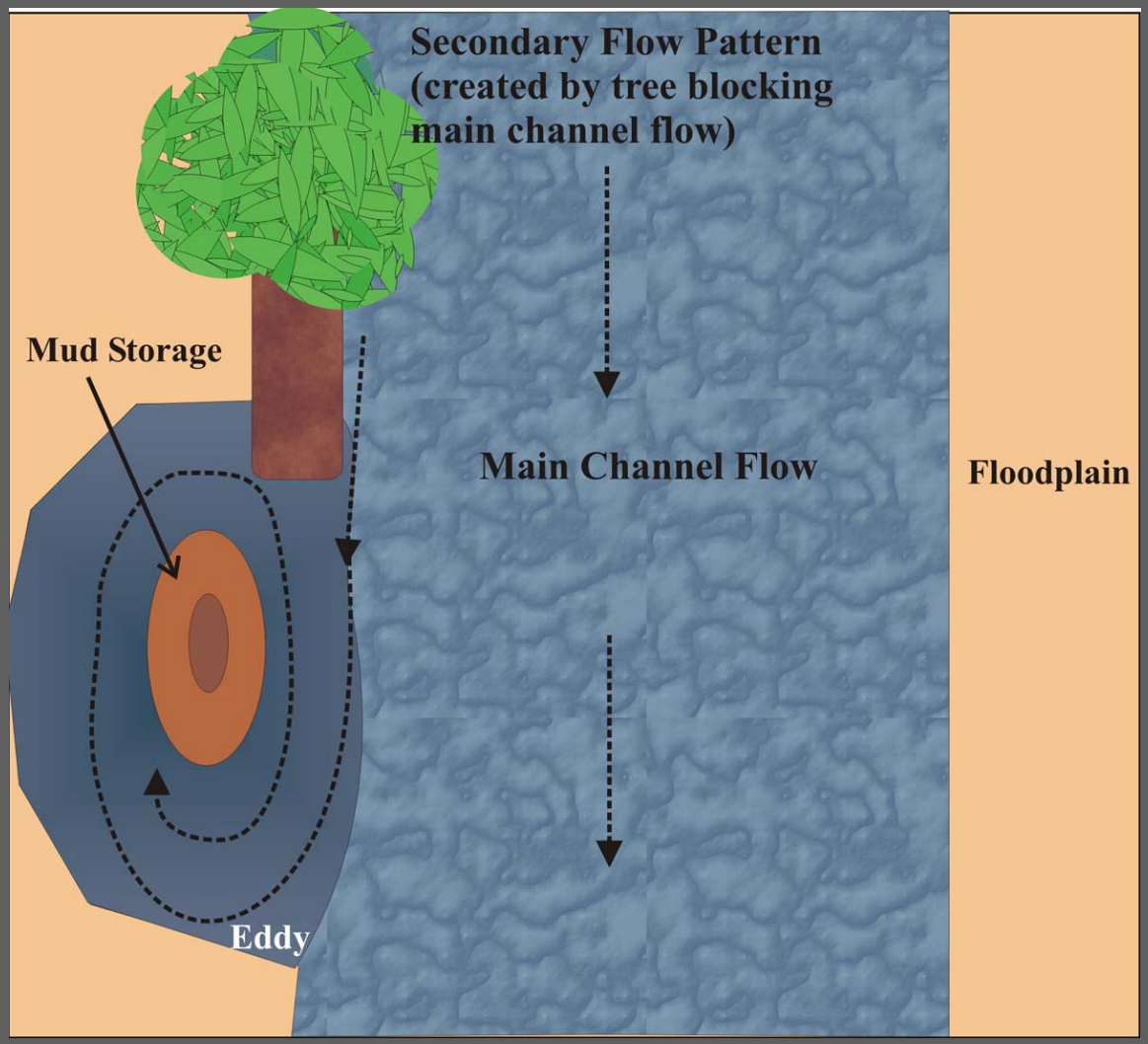
In Channel Storage



In Channel storage

- Refers to all storage in channel except interstitial bed storage
- Estimated area from the 7 cross-sections
- NOTE: cannot assign a residence time for most of this, need a tracer (i.e. cosmogenic radionuclide)!!

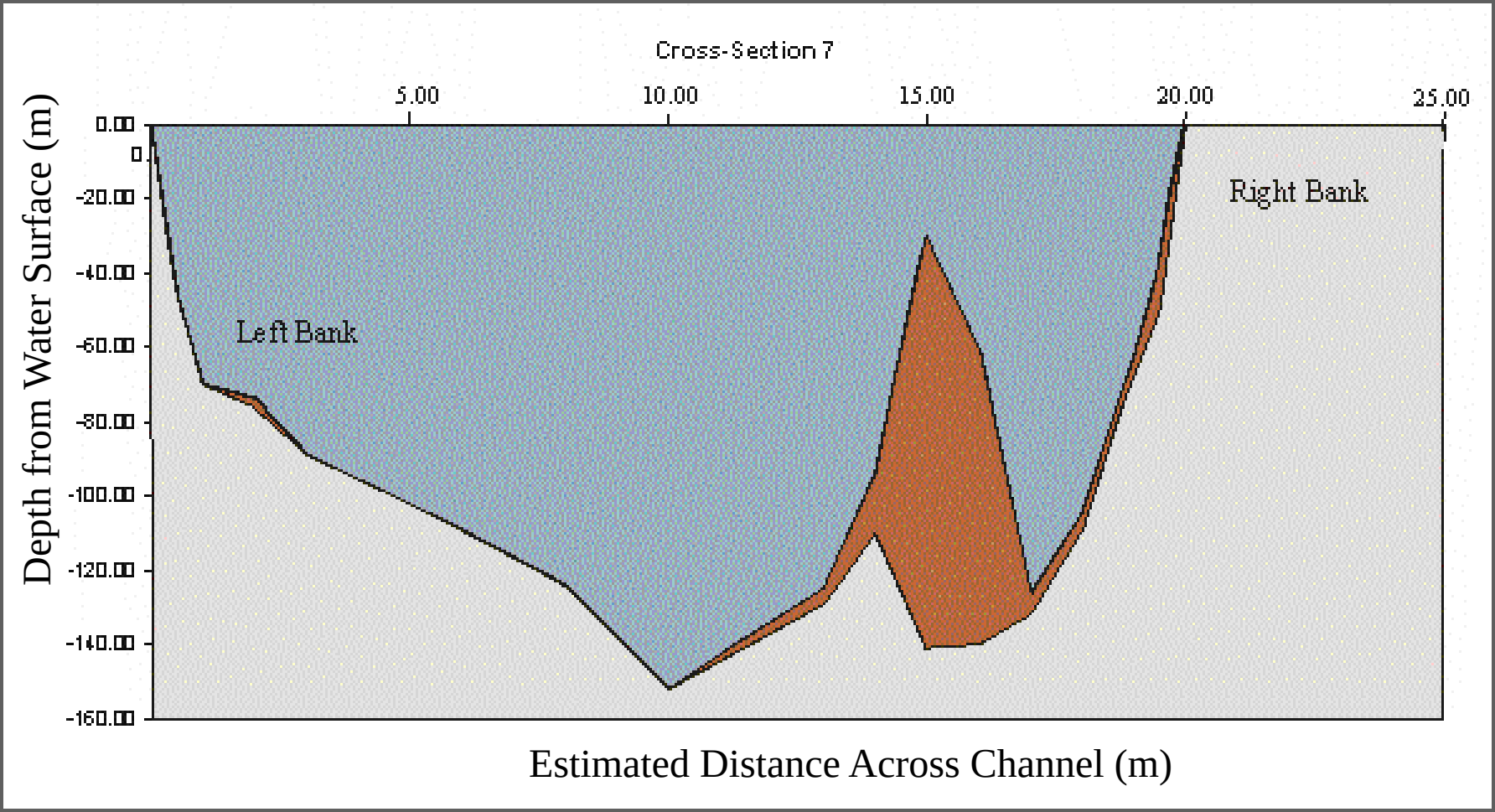
Cartoon of an Eddy



In Channel Storage (Eddies only)

- Determined volume from cross-sections (assuming cone-shaped)
- Assumed continuous distribution of eddies
- Randomly generated volumes
- Assumed 10-yr residence time (previous studies)

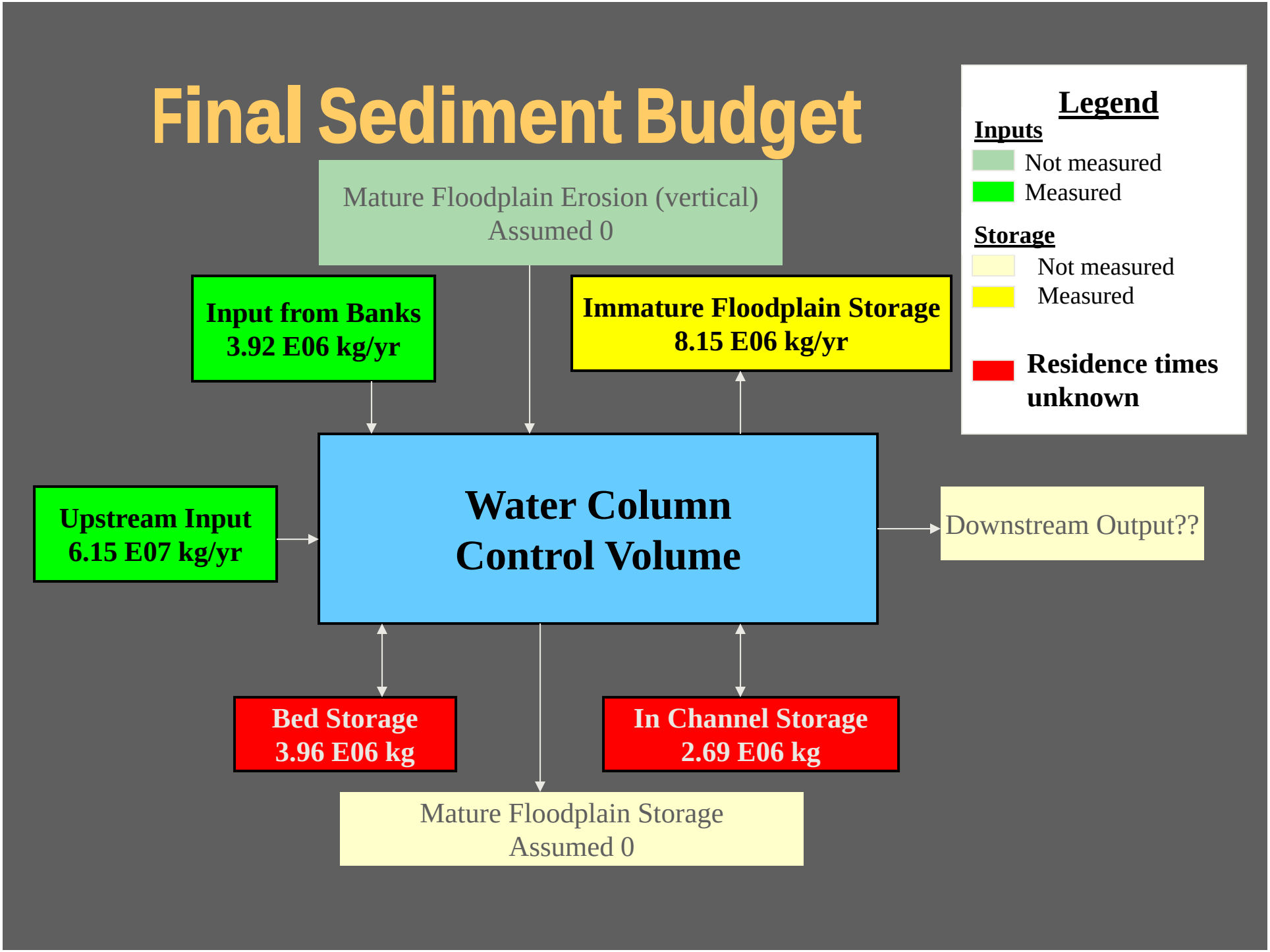
In Channel Storage



Immature Floodplain Storage

1. Accretion rate = bank erosion rate
2. Height above bed is 1.5 m
3. Percent silt and clay is 10
4. Quantified from geomorphic maps
5. Mature floodplain storage (and erosion) assumed to be 0

Final Sediment Budget

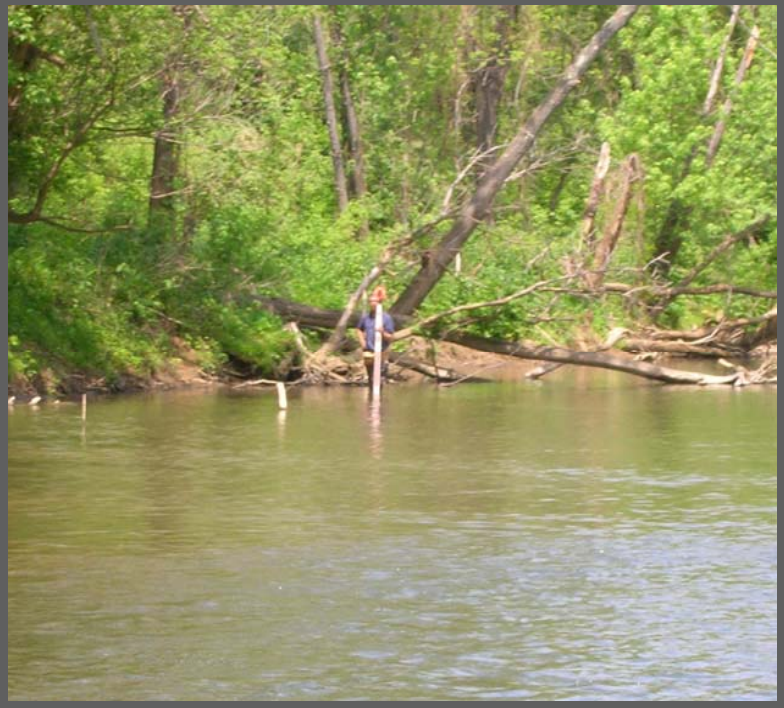


Mud Mapping in South River

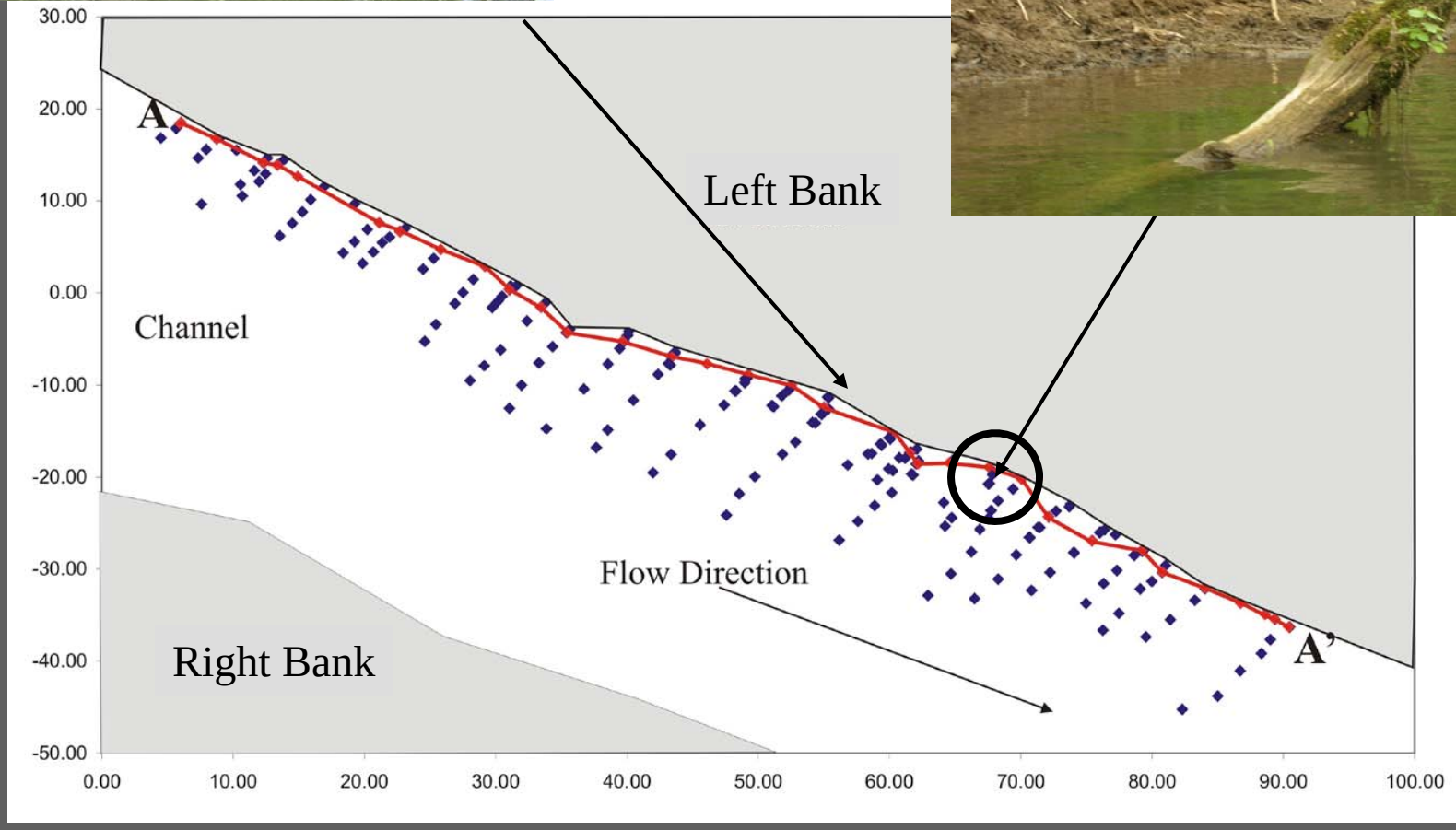
- Mapped mud deposits just below Hopeman Parkway on both sides of the river

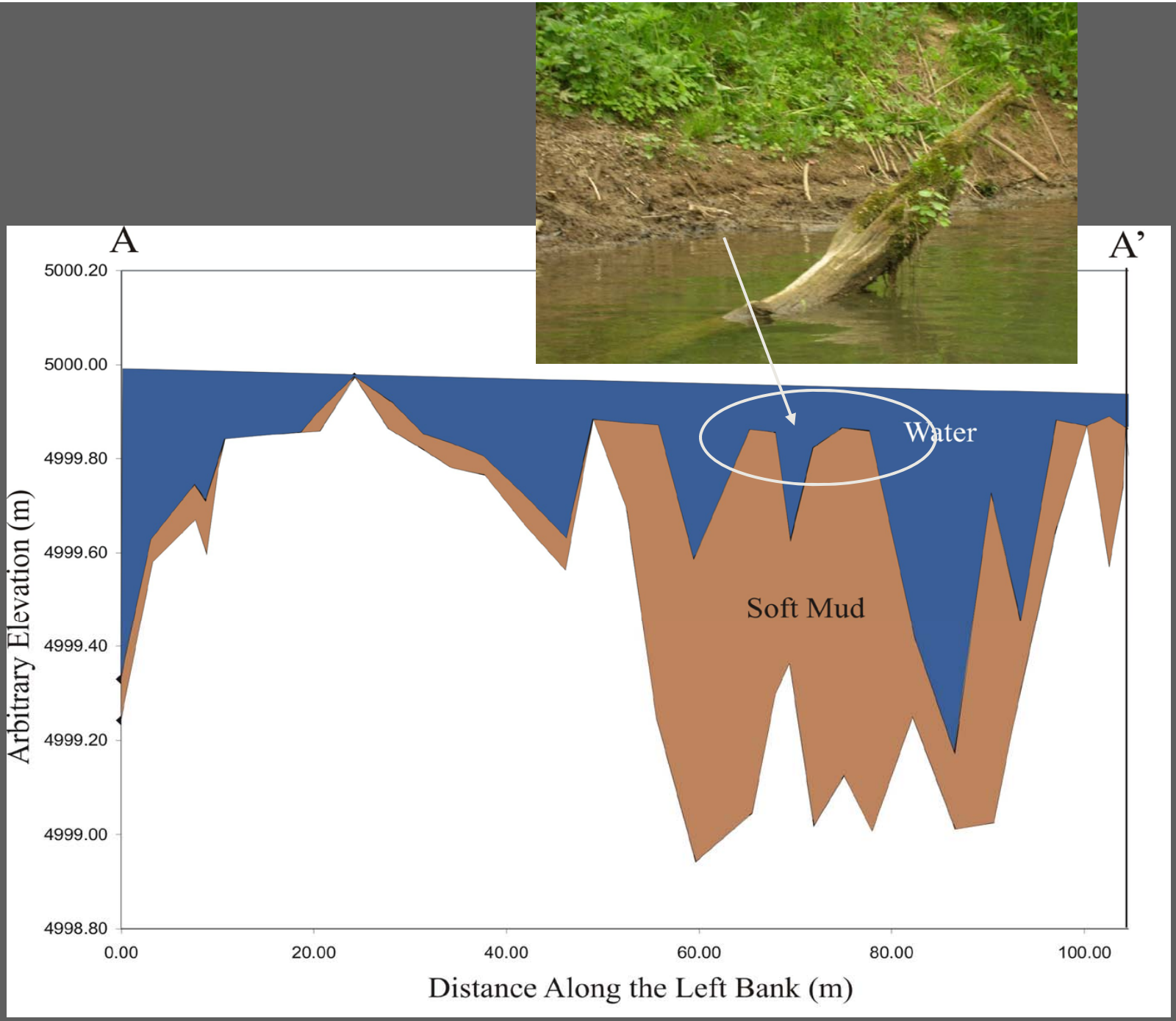
  - used transect tape and laser distance meter

  - used Total Station to create 3-D map (including topography and mud thickness)



Mud Mapping Survey




A
A'
5000.20
5000.00
4999.80
4999.60
4999.40
4999.20
4999.00
4998.80
Arbitrary Elevation (m)
Water
Soft Mud
0.00
20.00
40.00
60.00
80.00
100.00
Distance Along the Left Bank (m)

Future Studies of Channel Mud Deposits

- Map mud deposits using Total Station at 10 locations
  - Determine controlling variables on mud accumulation and storage in the study area
- Core: determine grain size, organic content, Hg concentration, primary sedimentary structures
- Residence times, dynamics of erosion and deposition
  - Determine extent of erosion and deposition caused by individual storms (sediment traps, detailed surveys)
  - Determine Hg concentration profile
  - Isotopic dating
  - Design flume study?

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Other Ongoing Studies

- Propose accessible eroding banks for Hg sampling
  - Any new info about sampling banks adjacent to private property???
- Refine estimates of bank erosion rates based on new LIDAR data and 1935 aerial photos
- Measure mud content of bed sediments
- Core sections of the floodplain to test assumptions
- Improve dimensionless sediment rating curve and further refine estimate of upstream sediment input
- Finish geomorphic mapping of rest of South River

Thank you!!!
Questions? Comments?