

# Sediment Core Data Update

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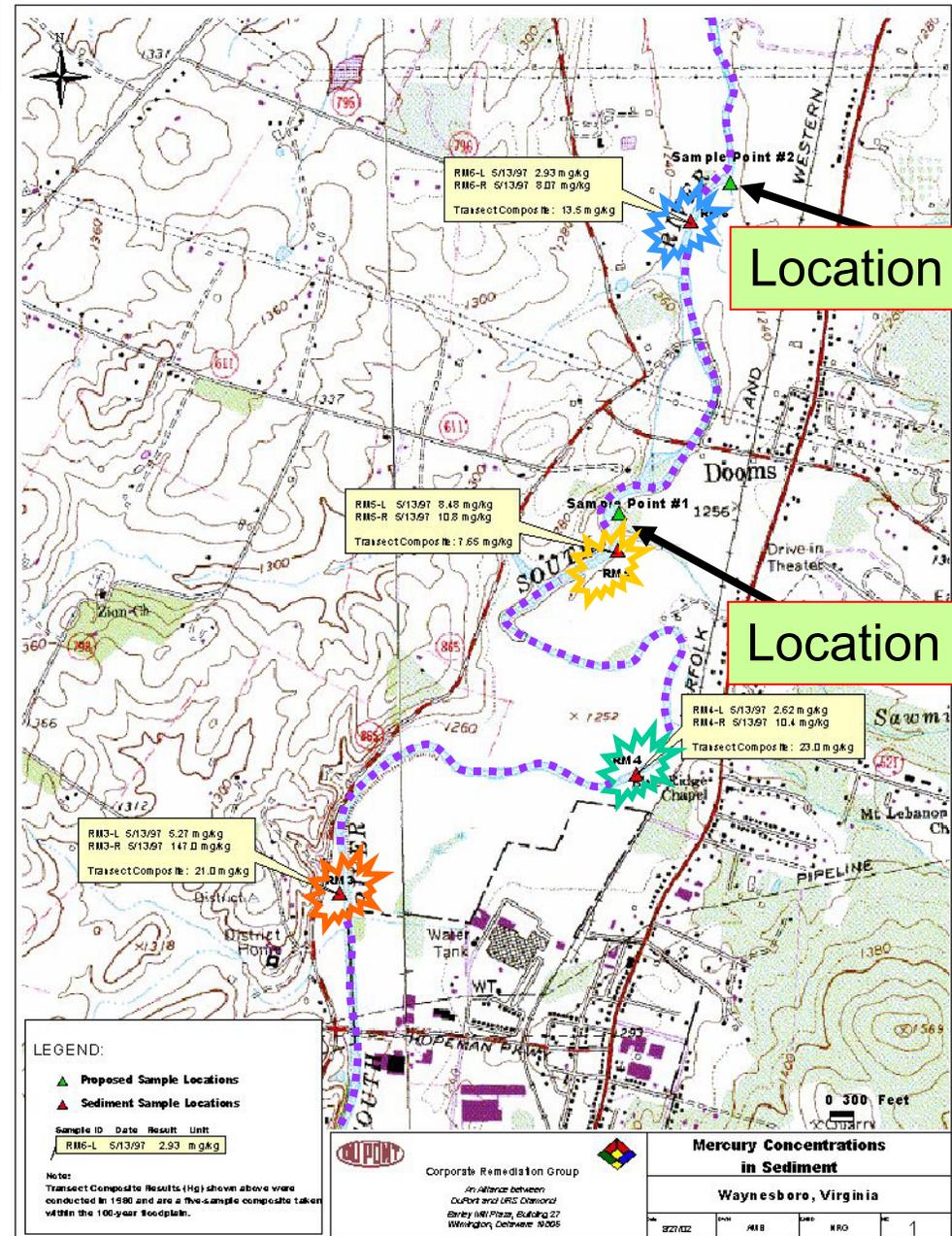
# Outline

- 137 Cs Data
- Expert Comments on Cs - data
- Expert Comments on Ongoing Sources
- Path Forward on Core Dating
- Proposed Storm Event Sampling

# Sampling Locations

## Sediment Hg (ppm)

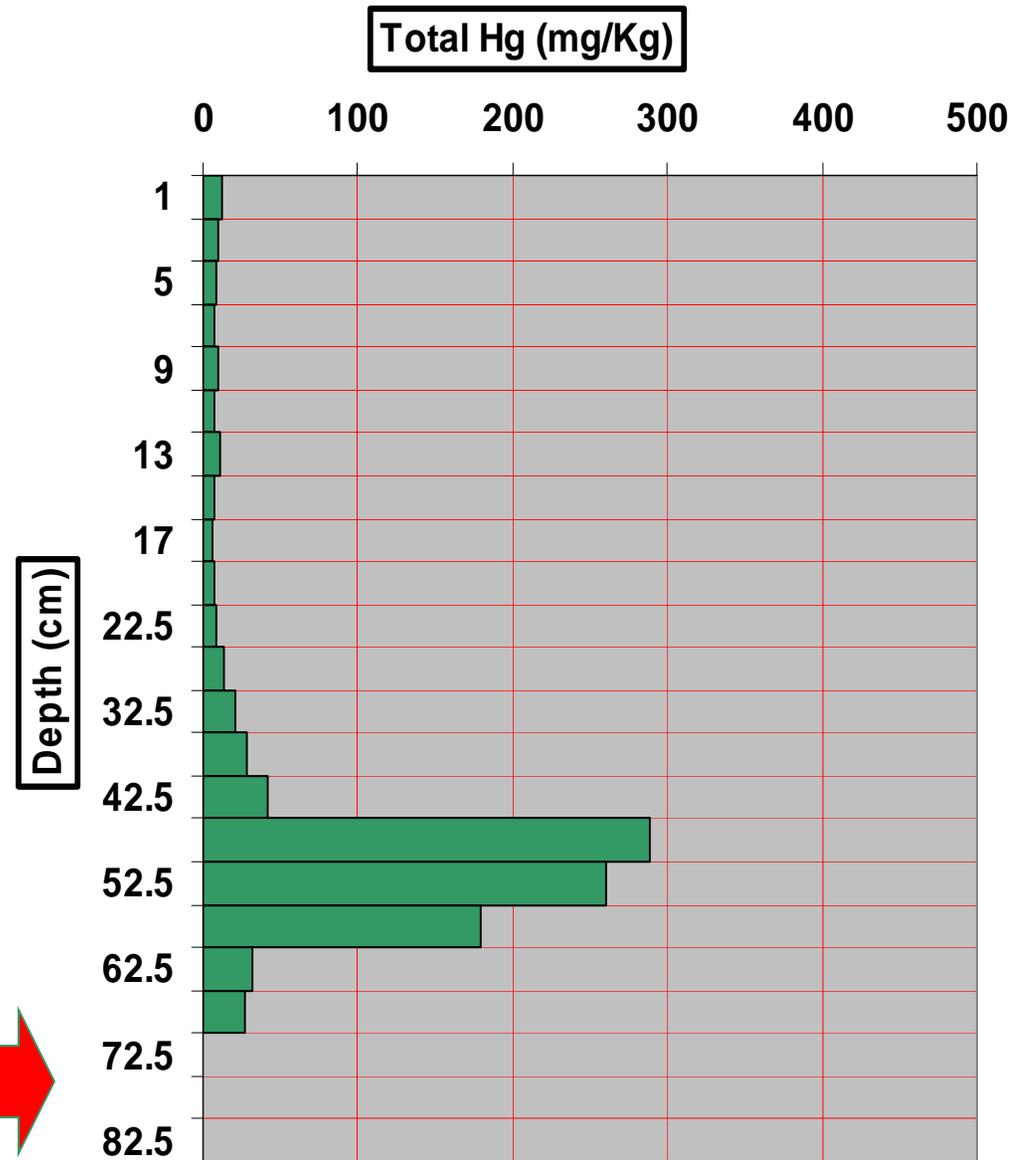
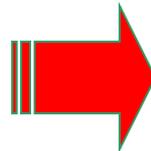
Left Bank	Right Bank	100 Yr Floodplain
2.93	8.07	13.5
8.48	10.8	7.65
2.62	10.4	23.0
5.27	147.0	21.0



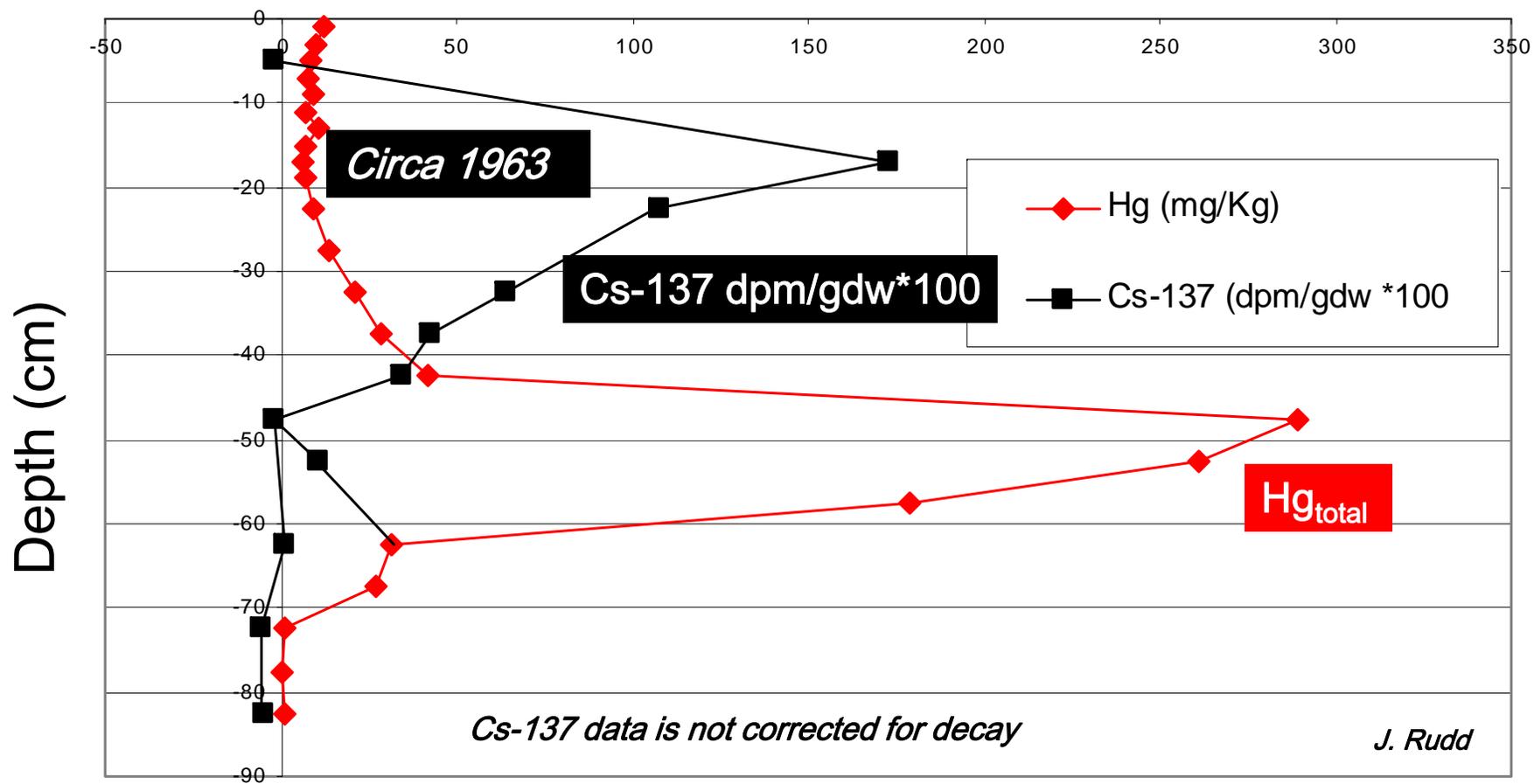
# Site 1 (Dooms' Dam) – Core 4

- Distinct horizon of elevated total Hg at 32 to 65 cm.
- Below 65 cm Hg total decreases significantly.

- Between 70 and 85 cm Total Hg = 0.23 – 1.2 ppm



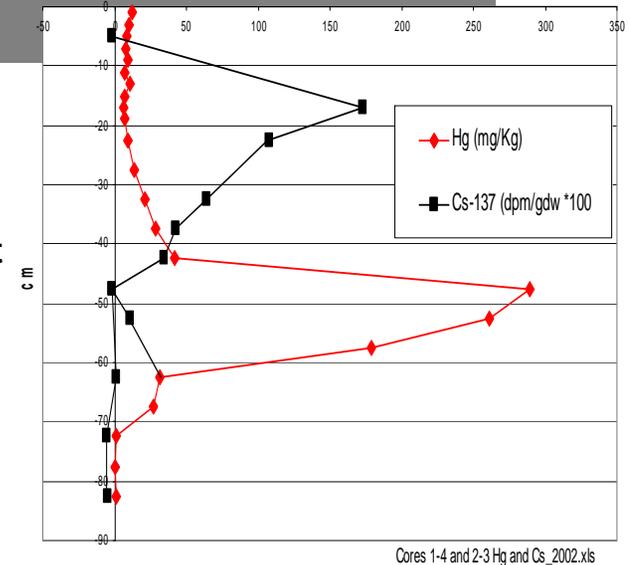
# Cs and Hg<sub>total</sub> Data: Core 1-4



Cores 1-4 and 2-3 Hg and Cs\_2002.xls

## Cs and Hg<sub>total</sub> Data: Core 1-4

- **Turner:**
  - Approximate chronology:
    - Cs-137 → 18cm is ~1963 → ~0.5 cm/yr sedimentation rate. Thus Hg deposition around 1900 (Assuming constant deposition - too old).
  - Proceed with Pb-210
    - allow better dating of deeper sediments
    - deposition of upper unit was gradual or event related.
- **Rudd:**
  - With further data collection this core may represent robust data indicating a modern ongoing source of Hg.
  - Approximate Chronology:
    - Hg peak below Cs peak → Hg input to river was before 1963-1964 (consistent with our conceptual model).
    - Observed Hg increase is below the estimated 1950 depth (34 cm) → higher historic sedimentation rates?
  - Deep Cs peak → Hg in surficial layers is not associated with deep historical Hg deposits. To support this hypothesis:
    - Complete Cs 137 analysis in 0-16 cm.
    - Pb-210 analyses to establish whether all depths are unmixed and to determine stability of sedimentation rate. GET EXPERT ISOTOPE PERSON TO INTERPRET Pb-210 DATA

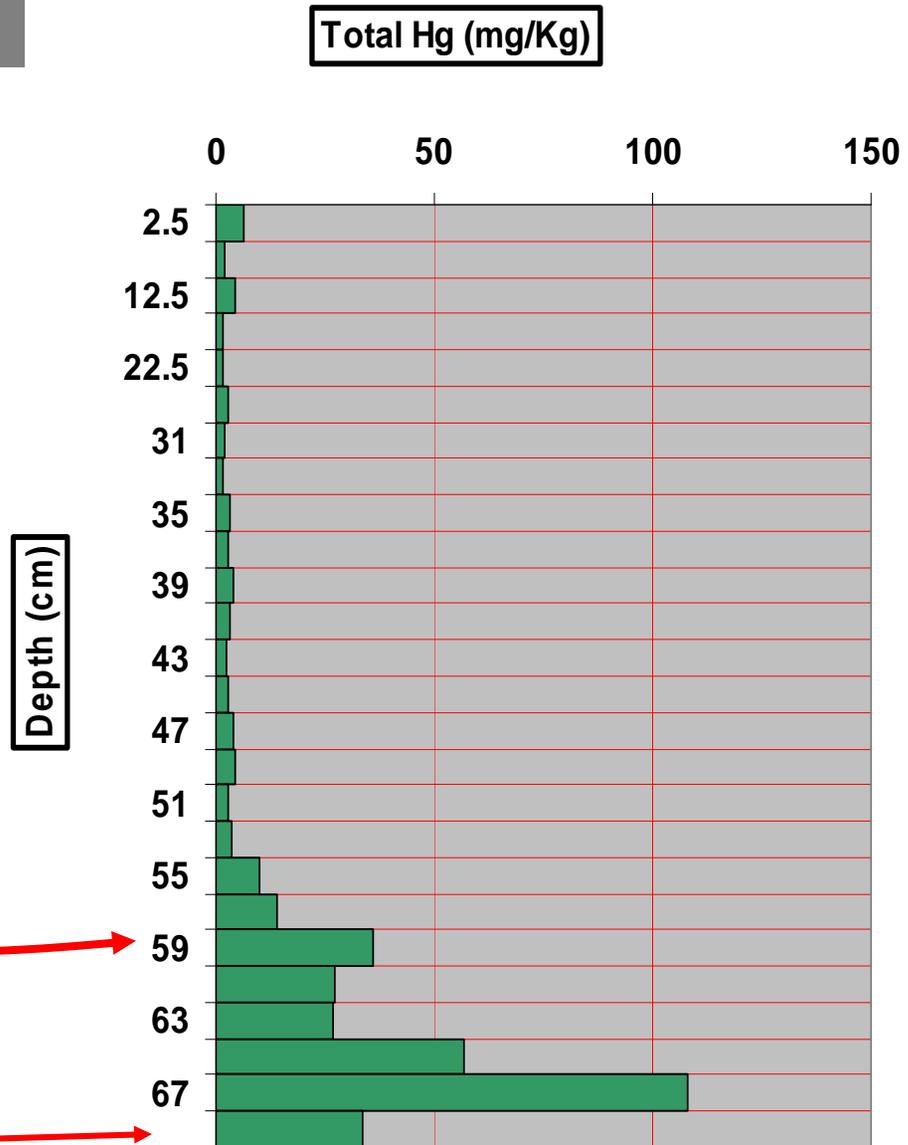


*Cs-137 data is not corrected for decay*

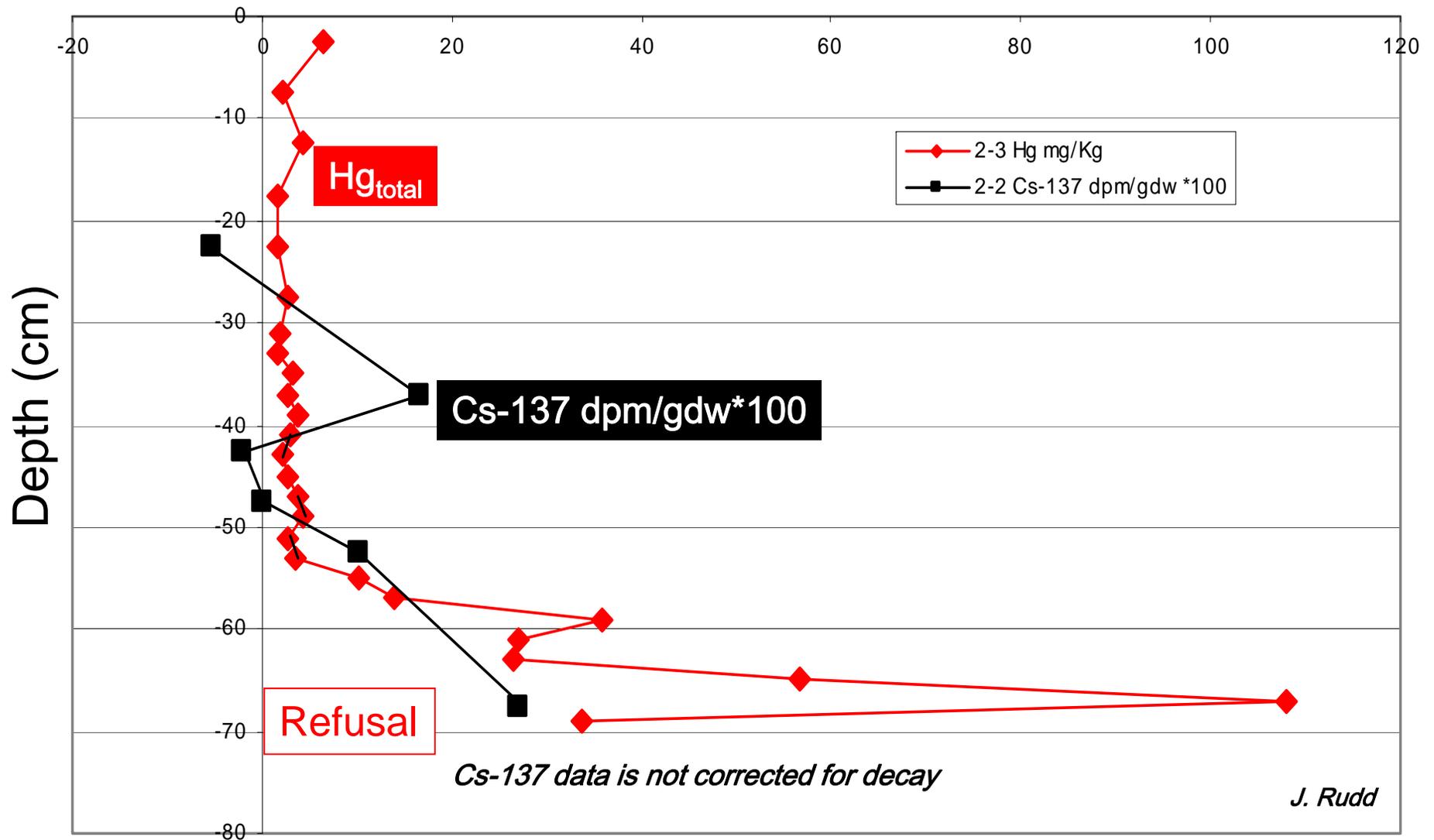
- **Flett:**
  - Recommend analysis of remaining 0-60cm sections to fix Cs-137 peak
  - Preliminary indications are that sediments below 55 cm are pre-1950.

# Site 2 (Tributary) – Core 2

- Uppermost site on tributary
- Surface soils are dry and covered with vegetation
- Core collected by driving with mallet
- Note significant decrease in Hg total above ~ 59 cm
- Refusal



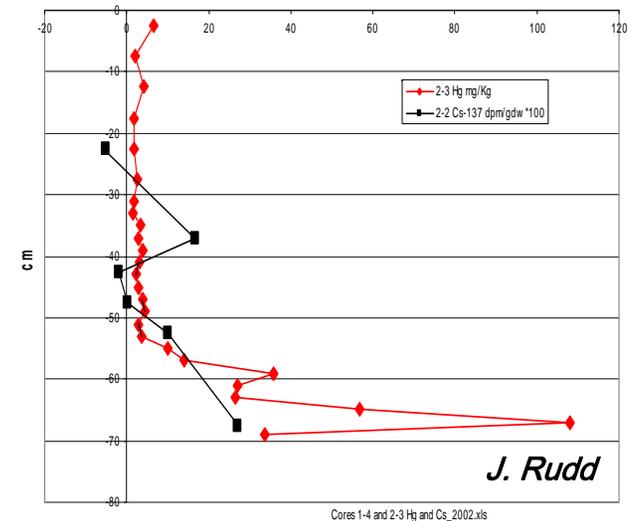
# Cs and Hg<sub>total</sub> Data: Cores 2-3 and 2-2



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Cores 2-3 and 2-2

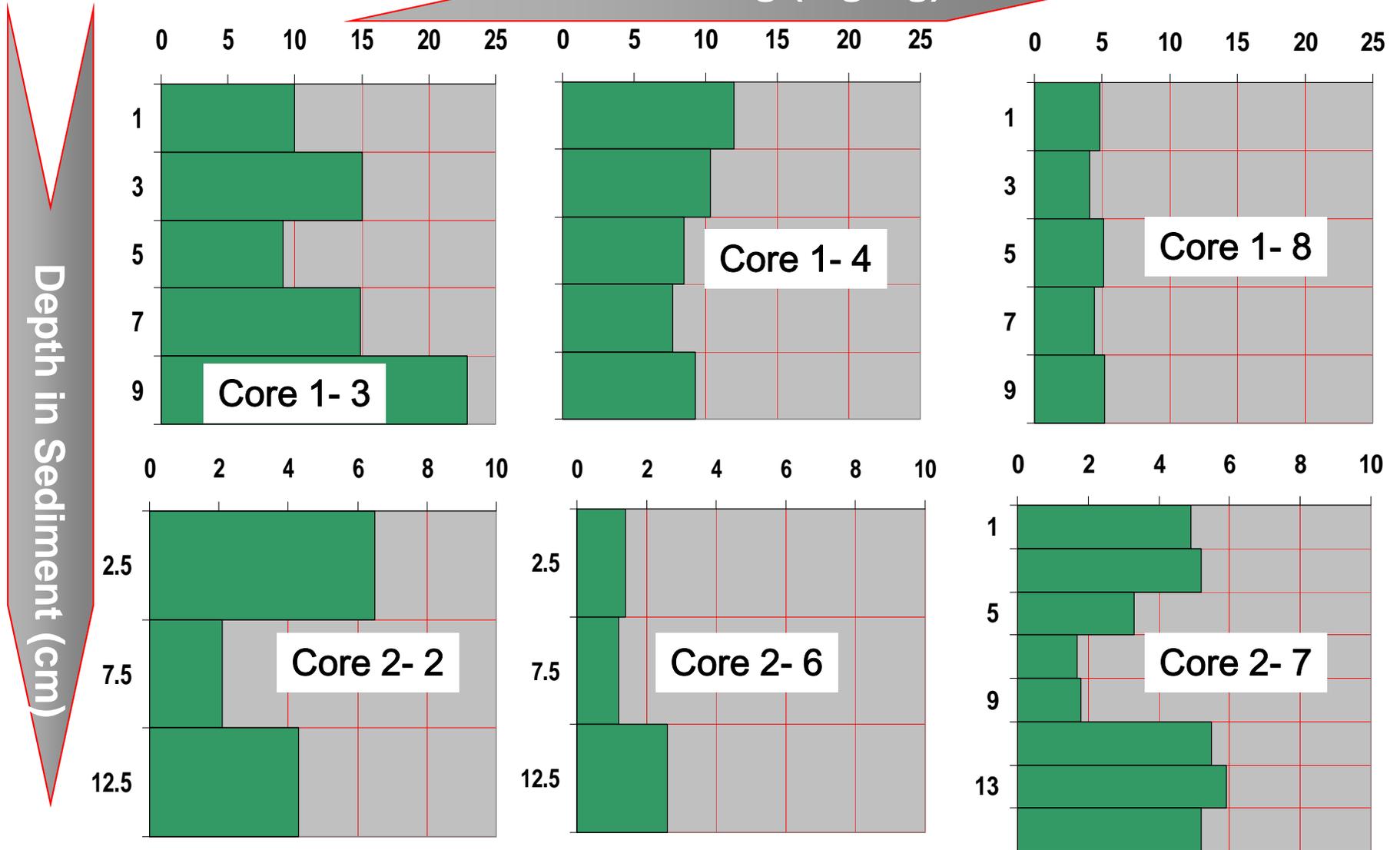
- **Turner:**
  - Complete Cs-137 profile to see if peak exists.
    - If yes, carry out Pb-210 regardless of agreement with Hg data.
  - Some useful data regarding mixing and range of dates where Hg is elevated can be obtained from isotope data even if core is not datable.
- **Rudd:**
  - Hg and Cs-137 both increase towards the bottoms of these cores. This is puzzling and “don’t really know what useful conclusions can be made with these data”
  - For cores at site 2 “it is still my opinion that these data are not giving us a clear or useful picture with respect to ongoing sources, and I don’t think that it is worth pursuing analyses of these cores further to answer this question.”
- **Erin/Dick:**
  - Two large sand depositions on top. Probably from two major events.
  - Surficial sediments may be very dynamic.



*Cs-137 data is not corrected for decay*

# Hg Total in Surficial Sediments

Total Hg (mg/Kg)



# Core Data Conclusions / Path Forward

- Conclusions:
  - In depositional areas of S. River:
    - Historic deposits of Hg are buried by 20-30 cm of sediment
    - Less Hg is present as MeHg in deep sediments suggesting low bioavailability.
    - Hg inputs have decreased significantly but surficial sediments still contain elevated levels of Hg.
    - Elevated Hg in surficial sediments suggests an ongoing source.
- Path Forward:
  - Complete Cs137 and begin Pb-210 dating on core 1-4.
    - Determine history of surficial sediments.
    - Gain knowledge of degree of mixing in surficial sediments.
  - Develop research plan to identify possible ongoing sources.

# Expert Comments Re: Ongoing Sources -1

- **Turner:**

- **Overall:** Evidence that Hg inputs decreased quickly in the past but have since remained elevated over background
- Hg contaminated sediments in “within channel cores” may vary greatly in depth/age because Hg source may be either 1<sup>0</sup> (historic) or 2<sup>0</sup> (redistributed).
- Key question: “is Hg in surficial layers at Dooms site 1<sup>0</sup> or 2<sup>0</sup>?”
  - Attack:
    - isotope data:
      - » if no buried Cs-137 peak or no Cs-137 above background in surficial layers then deposit is older than 1950 and 1<sup>0</sup>.
      - » if no unsupported Pb-210 than sediment is old (1<sup>0</sup>).
- Possible ongoing sources:
  - Significant source of dissolved GW Hg that quickly adsorbs to particles
    - look for a low flow input with high dissolved Hg or high flow input with at least 10ppb
  - Episodic erosion of banks or floodplain associated with storm events.
- Can possibly benefit from mass balance calculations to bracket magnitude and character of source.

# Expert Comments Re: Ongoing Sources -1

- **Rudd:**
  - Key question: Are elevated Hg concentrations in surficial sediments the result of an ongoing Hg source to the Dooms site or the result of mixing processes moving Hg into the upper layers?
    - Cs data suggest that surficial Hg is not derived from deeper, historical Hg deposits. Need more data to confirm.
  - If ongoing source, some possibilities:
    - Export from immediate area of Waynesboro plant
    - Export from contaminated flood plain
    - Sediment upstream of Dooms is elevated in Hg and transported to Dooms. (Little upstream sediment present.)
      - Attack:
        - » Sample river over short distance intervals to look for gw inflows of Hg (in progress between plant and Dooms)
        - » Take storm water samples from intermittent streams during storm events and look for significant amounts of Hg, either dissolved or on particles.

# Storm Event Sampling - Hypothesis

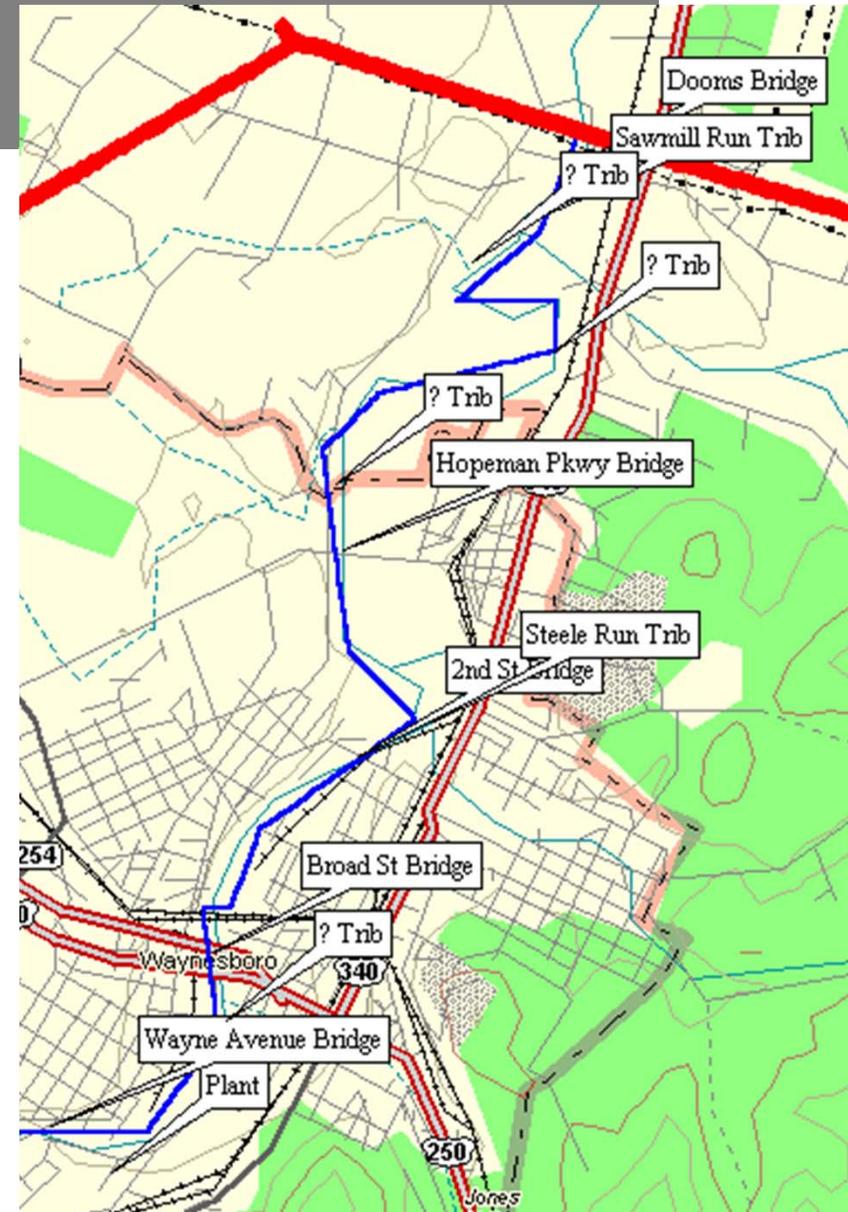
- Hypothesis:
  - There is an on-going source of Hg (1<sup>o</sup> or 2<sup>o</sup>) to the S. River system that maintains surficial sediment Hg levels at 5-10 ppm.
    - Potential 1<sup>o</sup> or “fresh” sources
      - plant site,
      - sewage treatment plant,
      - groundwater,
      - atmospheric deposition.
    - Potential 2<sup>o</sup> or “remobilized” sources
      - floodplain erosion
      - overland / tributary transport of floodplain derived Hg rich particles
      - resuspension and transport of in-stream Hg

## Storm Event Sampling – Specific Questions

- **Are secondary sources significant contributors of Hg to the S. River?**
- **Can we identify the relative importance of different secondary sources of Hg to the river by sampling during high flow / high suspended solids events?**

# Storm Event Sampling – Preliminary Details

- “Rapid Response” sampling of river channel and tributaries during storm event.
- Sites:
  - Bridges:
    - Wayne Ave.
    - DuPont Footbridge
    - Broad St.
    - 2nd St.
    - Hopeman Pkwy.
    - Doods
  - Tributaries
    - Major
    - Minor (transient, storm related)
- Sample Analysis:
  - Total Hg
  - Filtered Hg (practicality and need to be discussed)
  - Total Suspended Solids
  - Total Organic Carbon
  - Basic Water Chemistry



# Storm Event Sampling – Discussion Points

- Practicality?
- What is a “good enough storm”?
- When in the storm should we sample?
- What tribs might be most interesting and accessible?
- Collection of filtered vs. unfiltered Hg samples
- Supplies and equipment
- Team support

## Path Forward for 2003

- Storm event sampling
- Additional cores in floodplain and riverbed
- Sediment traps in small tribs draining broad floodplain units
- Other thoughts?
  
- *More discussion at April meeting*