Potomac Fall Line Monitoring Program: Update & Discussion

MWCOG Regional Water Quality Monitoring Subcommittee

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History of the Station - I

- Late 1970's to 1983, station operated by USGS
  - Difficulty in maintaining automatic sampler operations
  - Manual sampling (cross-section integrated method), although very difficult to use during high flow events

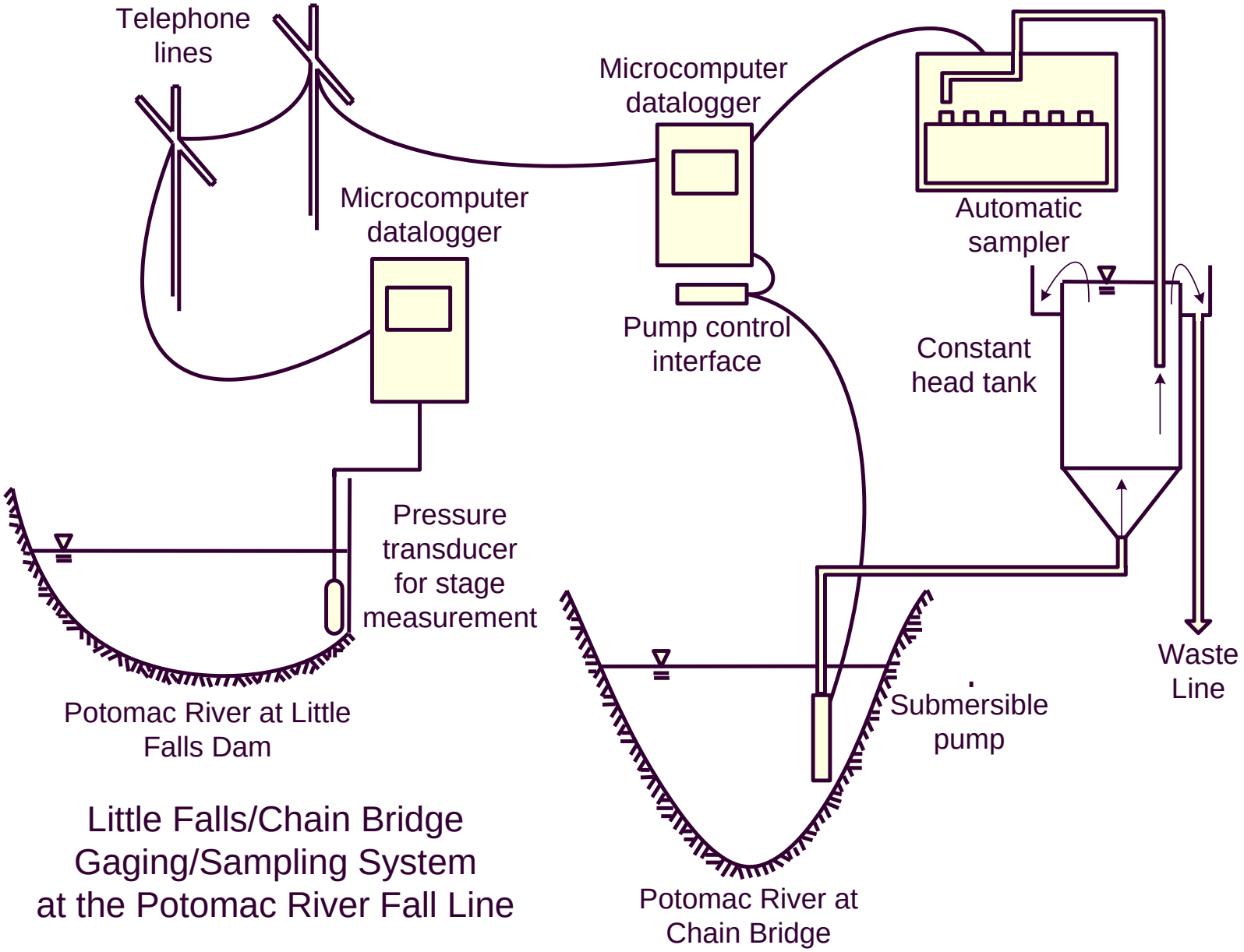
- 1983 – present, MWCOG/OWML operation
  - Shared funding with MDE prior to 2005
  - Funded by MWCOG jurisdictions 2005 – present
  - Automated storm sampling
    - Point intake assumes well-mixed flow regime at Chain Bridge due to narrowing of Potomac River cross section
  - Flows measured at Little Falls Dam and Chain Bridge sampler activated based on incremental storm flow volume
    - No backwater at Little Falls

Historical Objectives

- Instrument and operate a stream gaging and water quality monitoring station for the Potomac River fall line
  - Record ambient water quality
  - Measure constituent loads delivered to the Potomac Estuary
  - Enable trend analysis of point/nonpoint source loads
- Develop and deploy a composite sampling program for all storm events and a regular time series of non-storm conditions
- Retrieve discrete storm samples to support future analysis of sample frequency effects on regression load estimates
- Maintain a robust automated system with reliable performance
  - Link to Little Falls gage
  - Line power
  - Submersible pump with delivery to constant head tank
  - Refrigerated samplers


Little Falls Gaging Station
Chain Bridge Sampling Station
Google earth
Image © 2012 Commonwealth of Virginia
38°56'25.19" N 77°07'06.76" W elev 68 ft
Eye alt 15178 ft

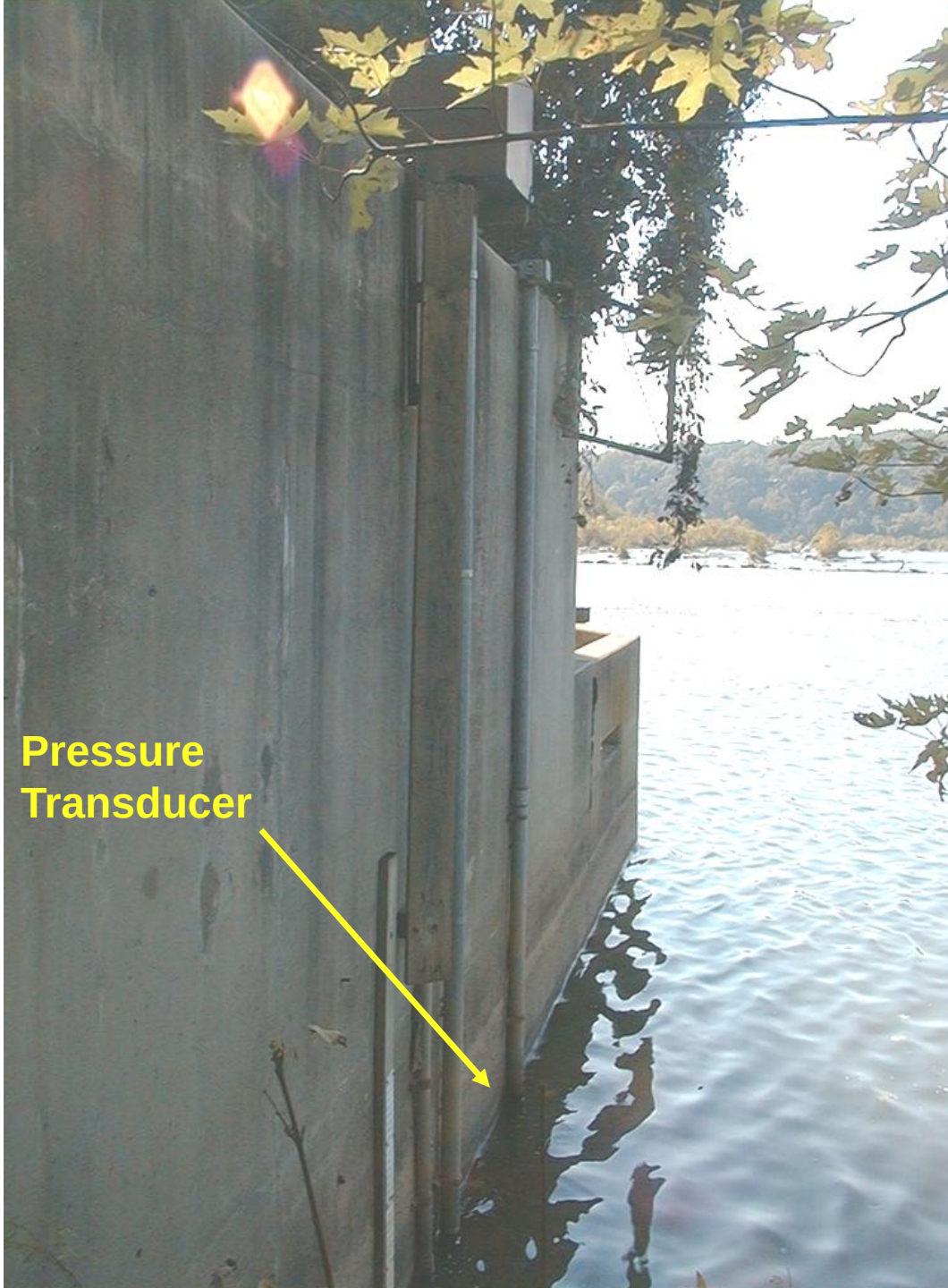
Schematic of Little Falls – Chain Bridge Sampling System



Little Falls/Chain Bridge Gaging/Sampling System at the Potomac River Fall Line


Little Falls Dam Looking South
from WAD Pump Station

Pressure Transducer Installation at Little Falls Pump Station



Virginia Tech
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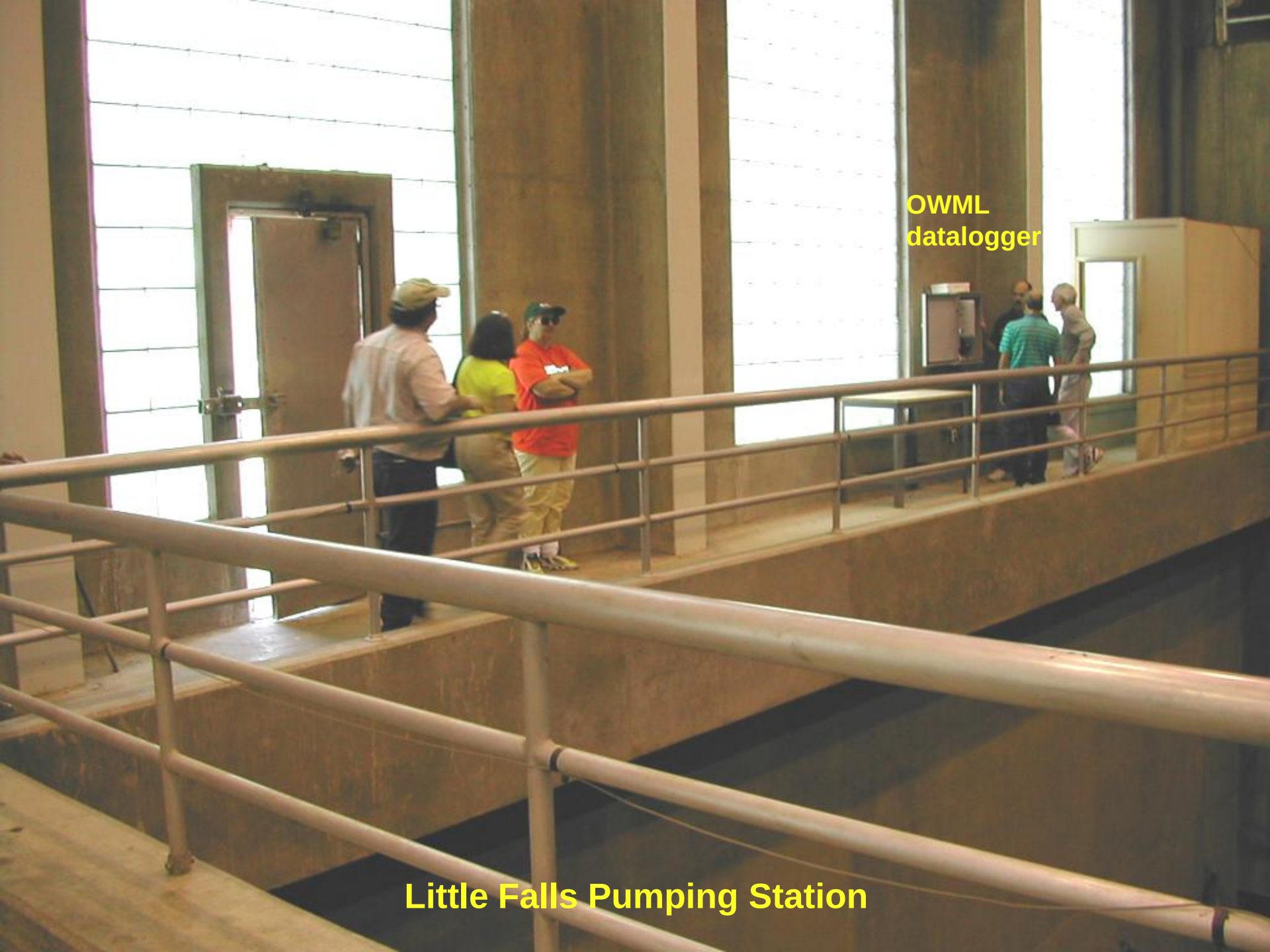
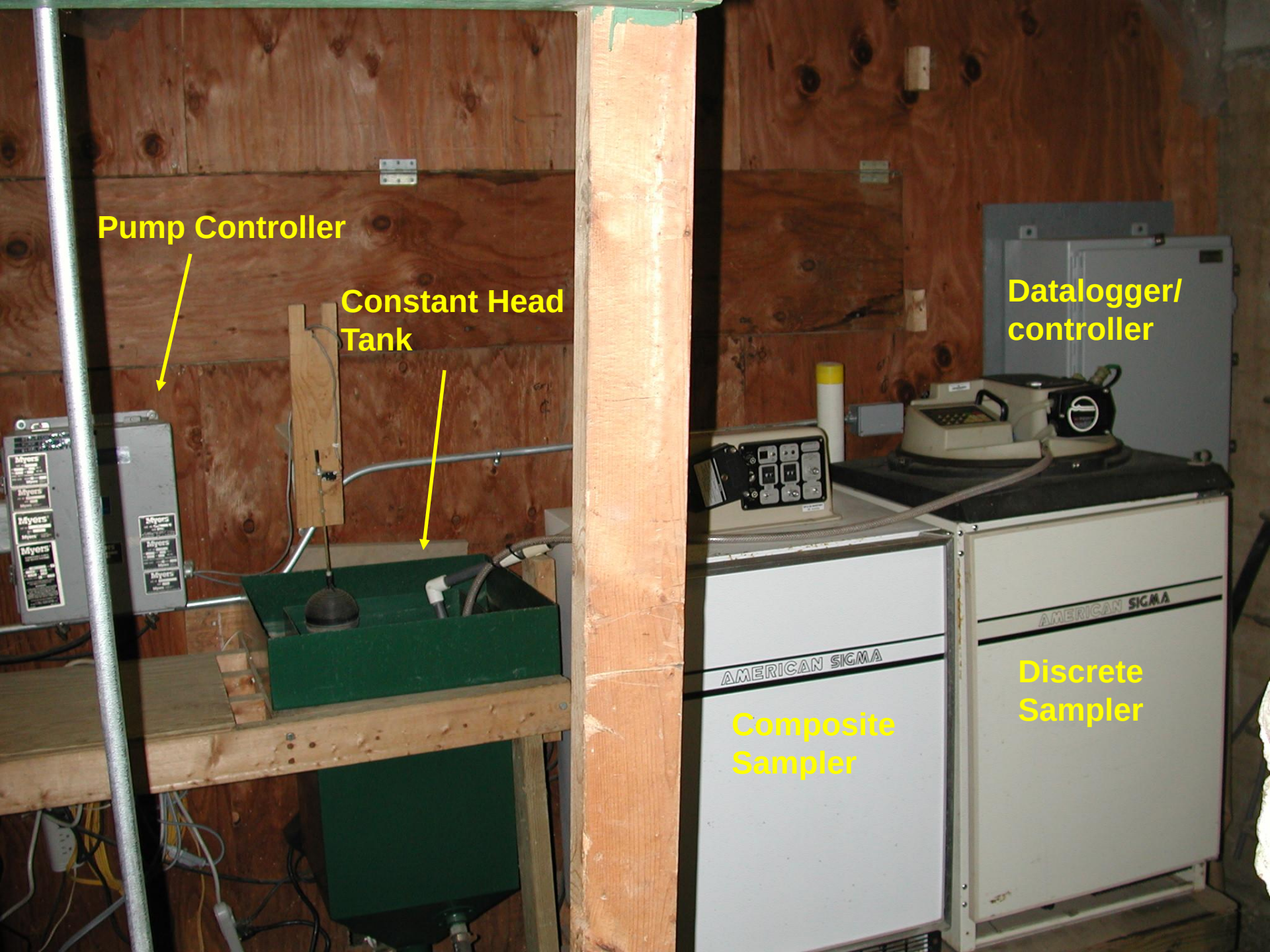


Little Falls Pumping Station


SUTRON 8210
DATA RECORDER / TRANSMITTER
SET
ON
OFF
PCMCIA MEMORY CARD
SUTRON
MADE IN THE USA
OWML Datalogger

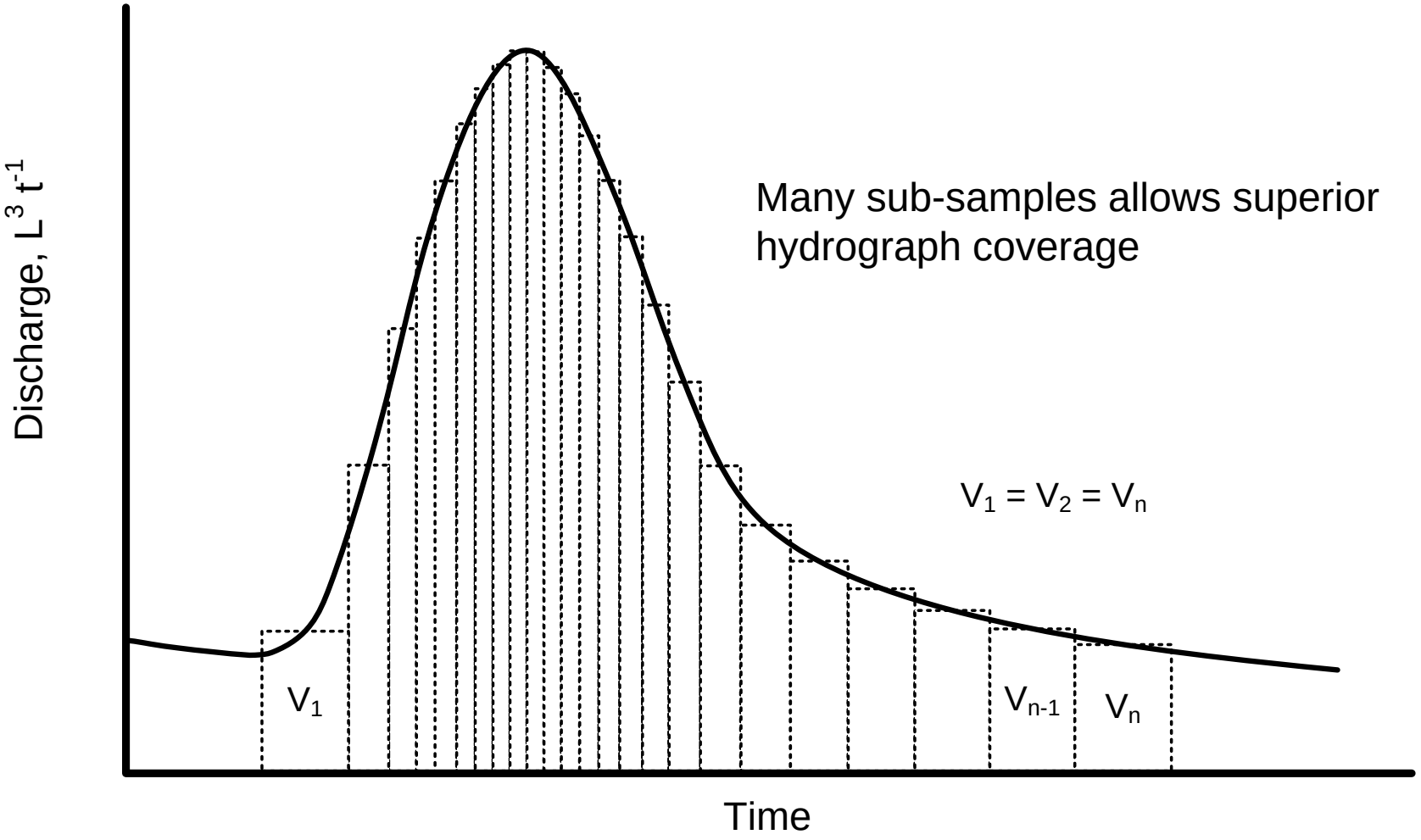

Submersible pump and
flexible intake line


Pump Controller
Constant Head Tank
Datalogger/ controller
AMERICAN SIGMA
Composite Sampler
AMERICAN SIGMA
Discrete Sampler

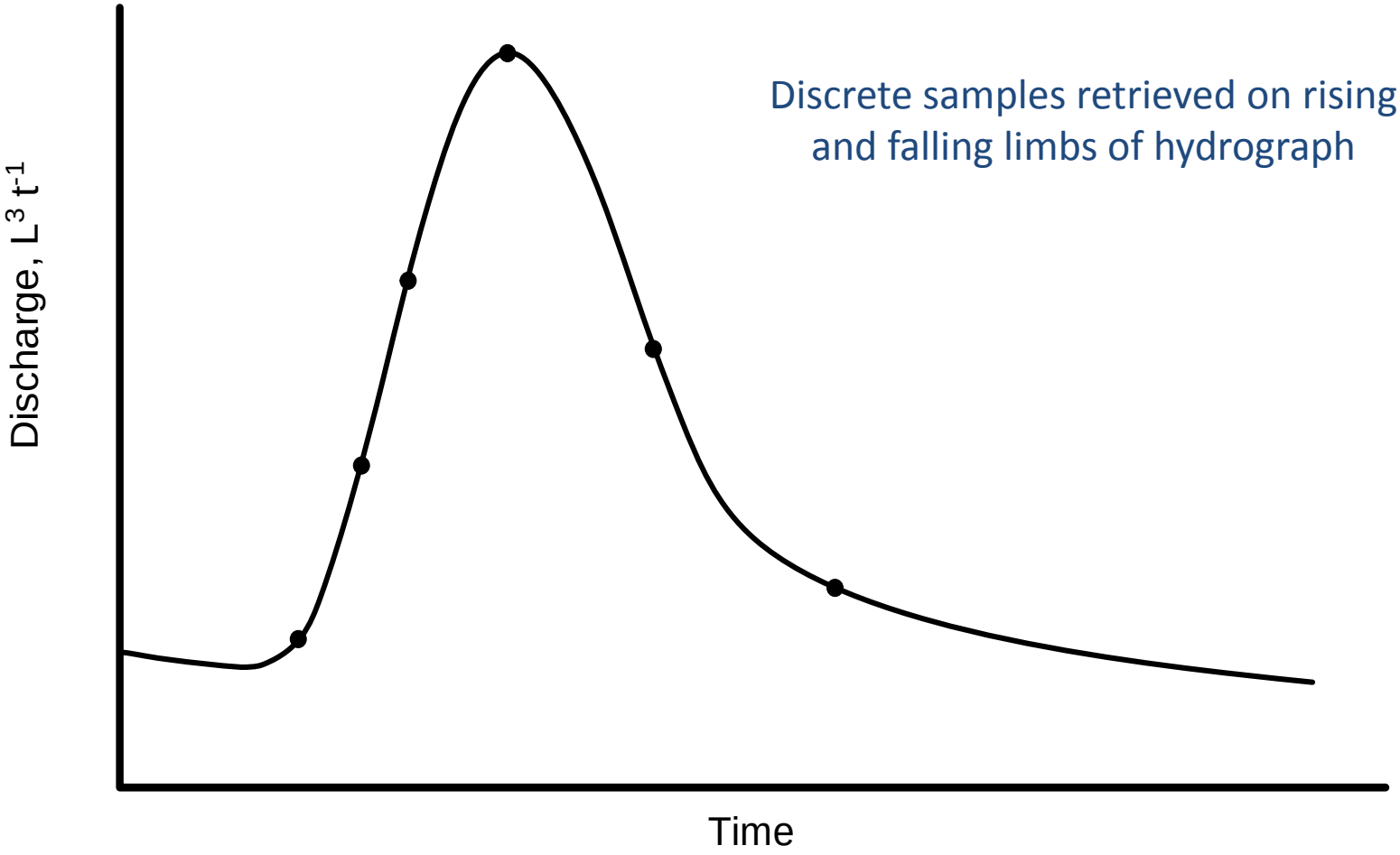

Composite and Discrete Samplers


6000
Environmental Monitoring System
YSI Water Quality Systems
Multiparameter Probe

Variable Time – Equal Volume ($t_V v_C$) Approach to Compositing



Schematic of Discrete Storm Sampling



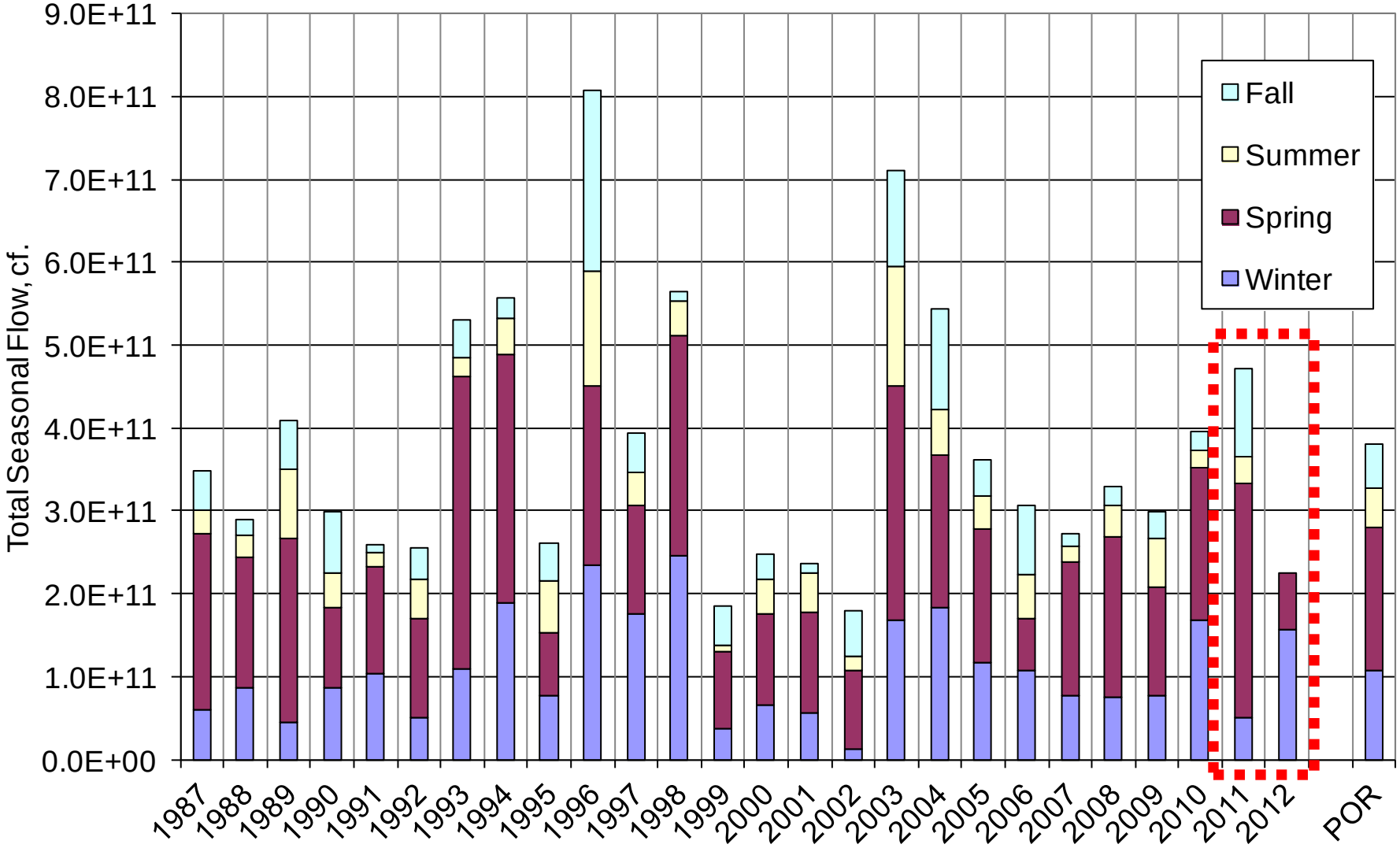
Fall Line Monitoring: Current Parameter List

Flow	Temperature	Conductivity
Dissolved oxygen	pH	Total alkalinity
Total hardness	Turbidity	Fecal coliform and E. coli
TOC	DOC	COD
Suspended solids	Nitrate + nitrite N	Ammonium N
Total nitrogen	Total soluble N	Total P
Total soluble P	Soluble reactive P	Soluble reactive Silica

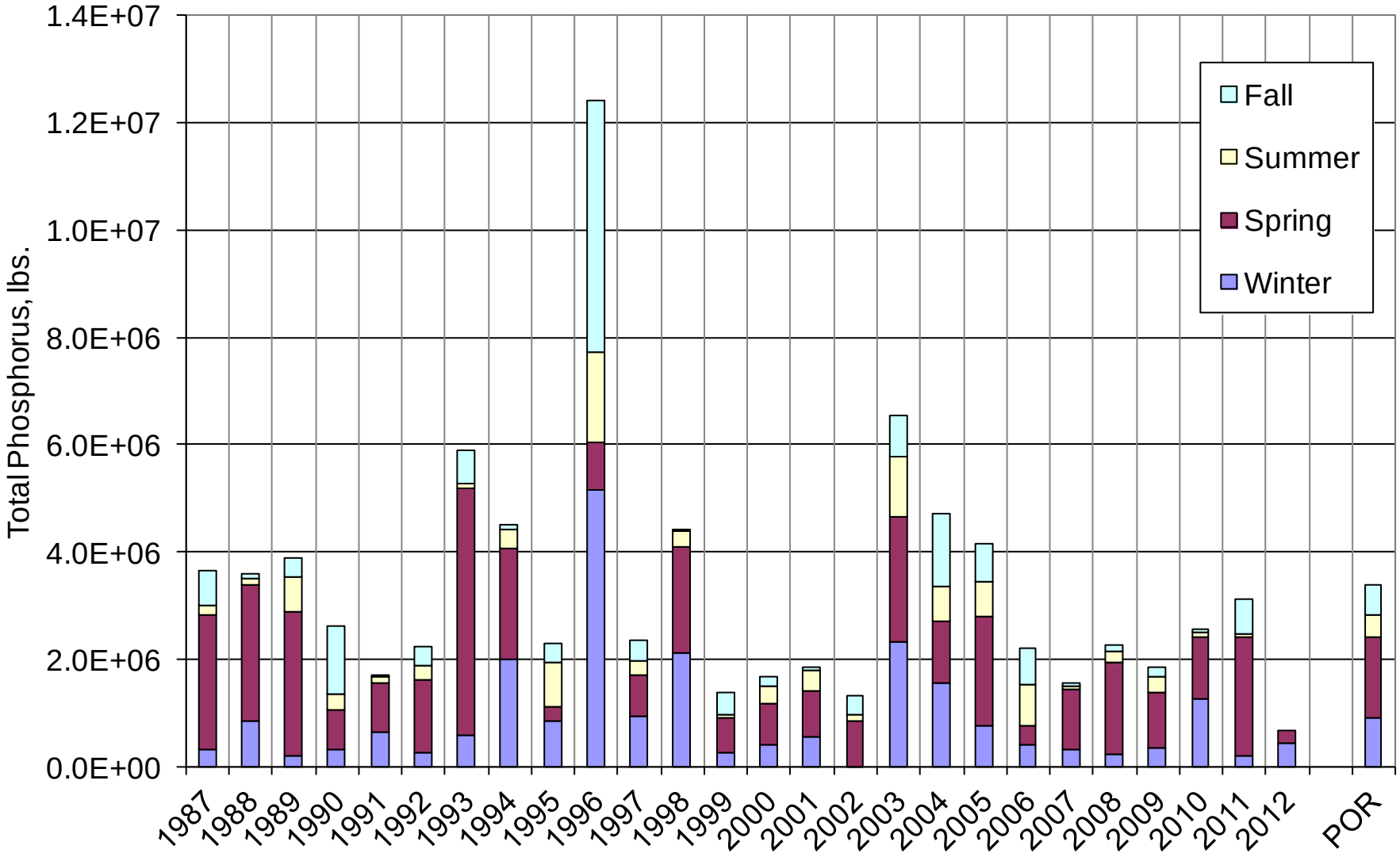
Chain Bridge Discrete and Composite Sampling Summary

MWCOG - OWML Potomac River Fall Line Monitoring				
	Composite Storm Events	Discretely Sampled Storm Events		Non-Storm Sampling
Year	# Storms	# Storms	# Samples	# Samples
1995	8	2	13	37
1996	24	9	51	29
1997	7	3	15	42
1998	10	8	38	38
1999	7	7	26	40
2000	6	5	21	35
2001	9	6	24	43
2002	11	5	24	39
2003	14	6	28	37
2004	15	10	48	34
2005	8	6	26	39
2006	13	7	31	36
2007	6	5	22	41
2008	14	6	28	39
2009	10	5	24	37
2010	7	2	8	42
2011	15	5	22	41
2012	5	1	5	24
Median:	9.5	5.5	24	38
Total	189	98	454	673

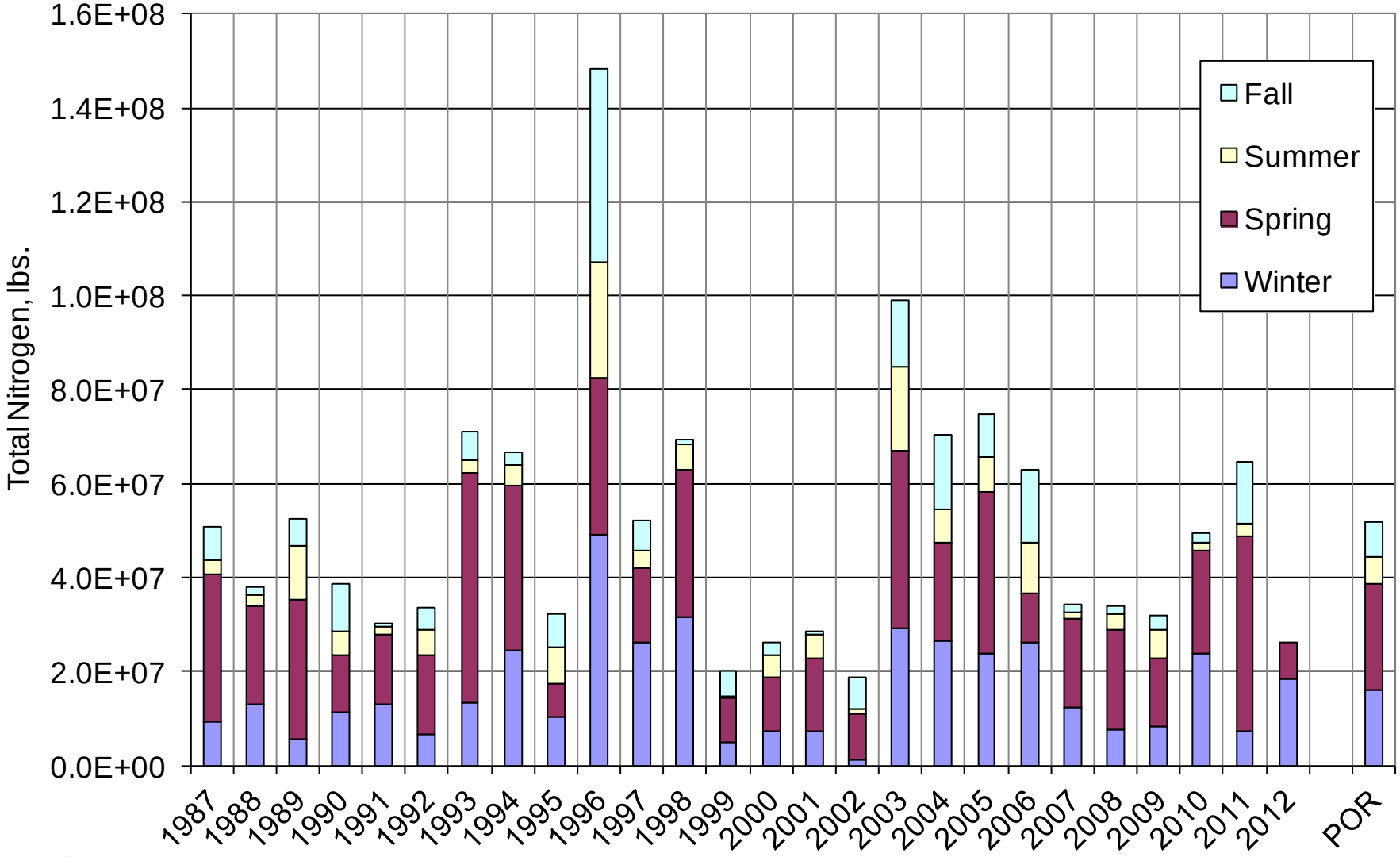
Observed Annual Flow Volume at Potomac Fall Line



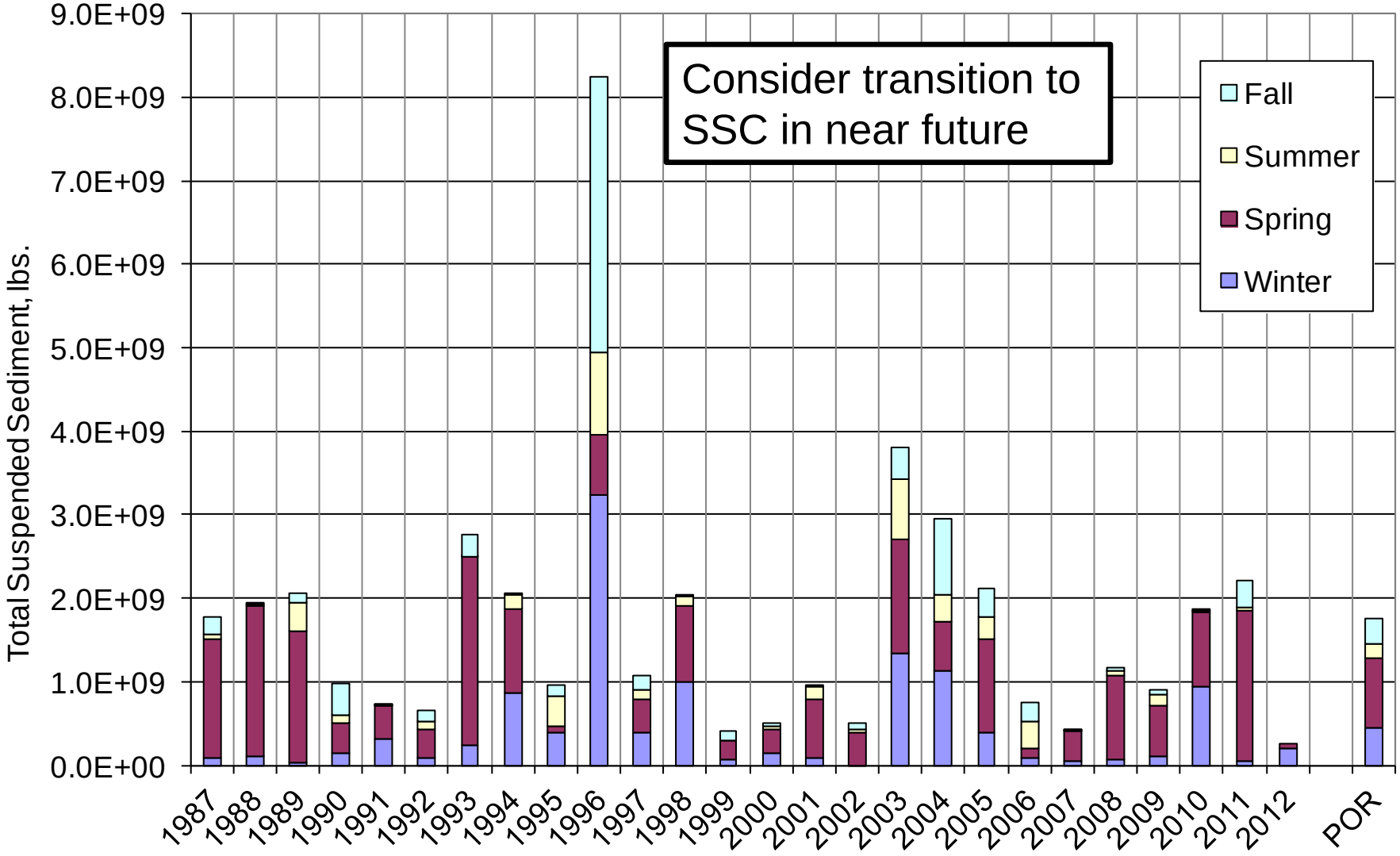
Observed Annual Phosphorus Loads at Potomac Fall Line



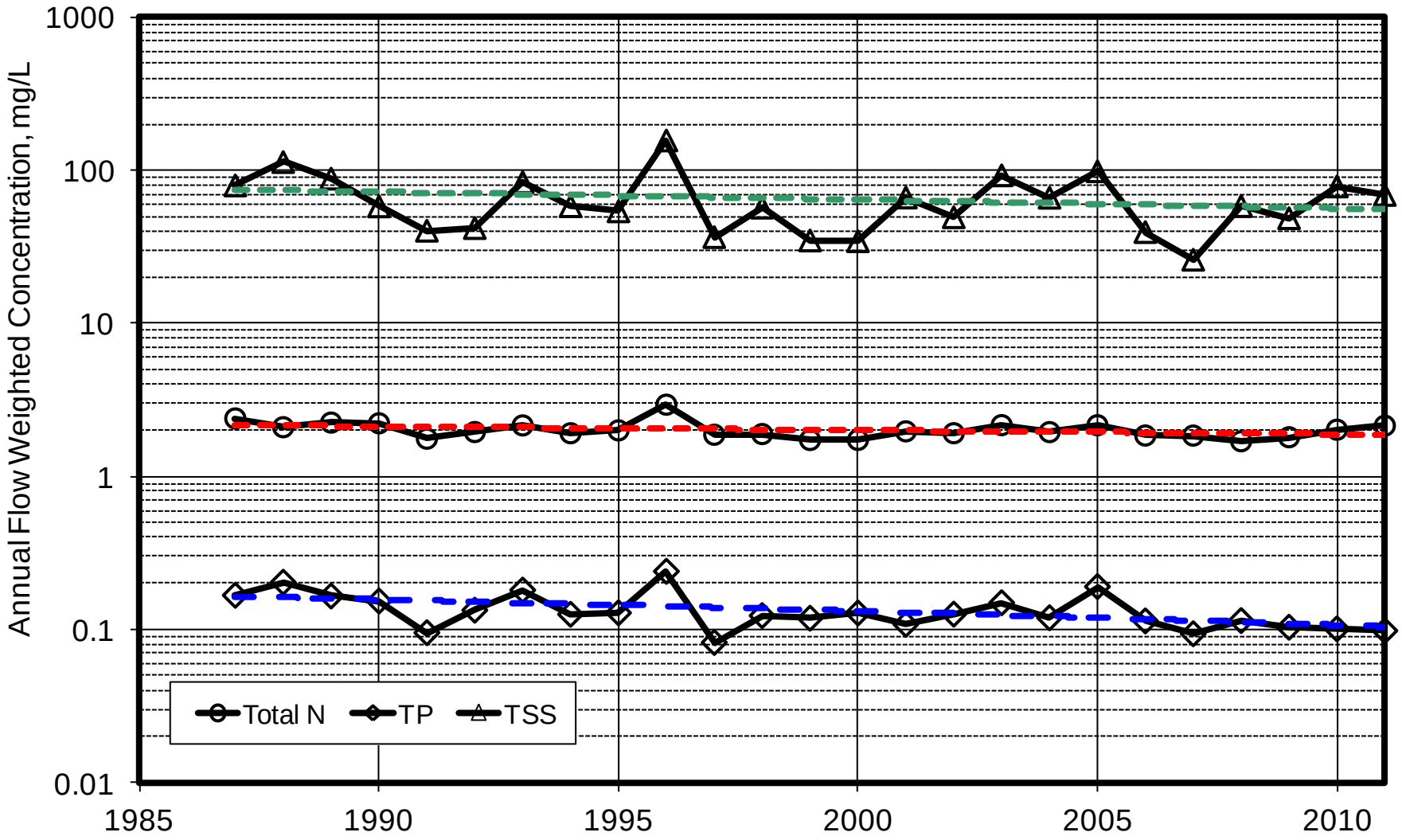
Observed Annual Nitrogen Loads at Potomac Fall Line



Observed Annual Sediment Loads at Potomac Fall Line



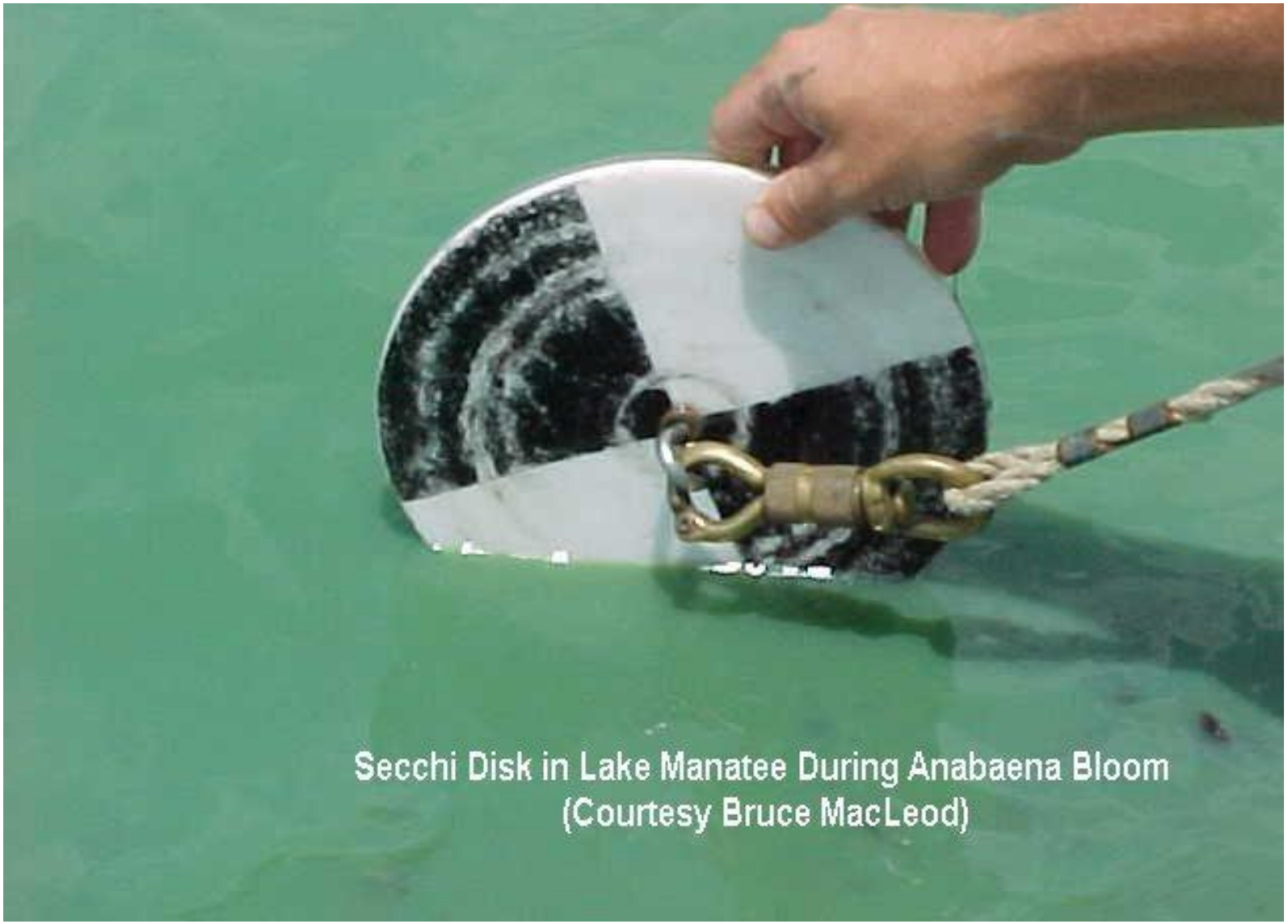
Flow Adjusted Concentration Trends at Potomac Fall Line



Discussion of Current and Evolving Objectives

- Continue the **only** source of observed constituent loading data at a principal tributary to the Bay
- Analyze impacts of MWCOG jurisdiction load reductions on observed fall line loads
- Use observed data in evaluation of Phase 5.3 Watershed Model load predictions for the Potomac
- Use discrete and composite sampling data to evaluate effects of sample frequency on regression load estimates
- Contribute to understanding of chemical/biological processes in the tidal Potomac

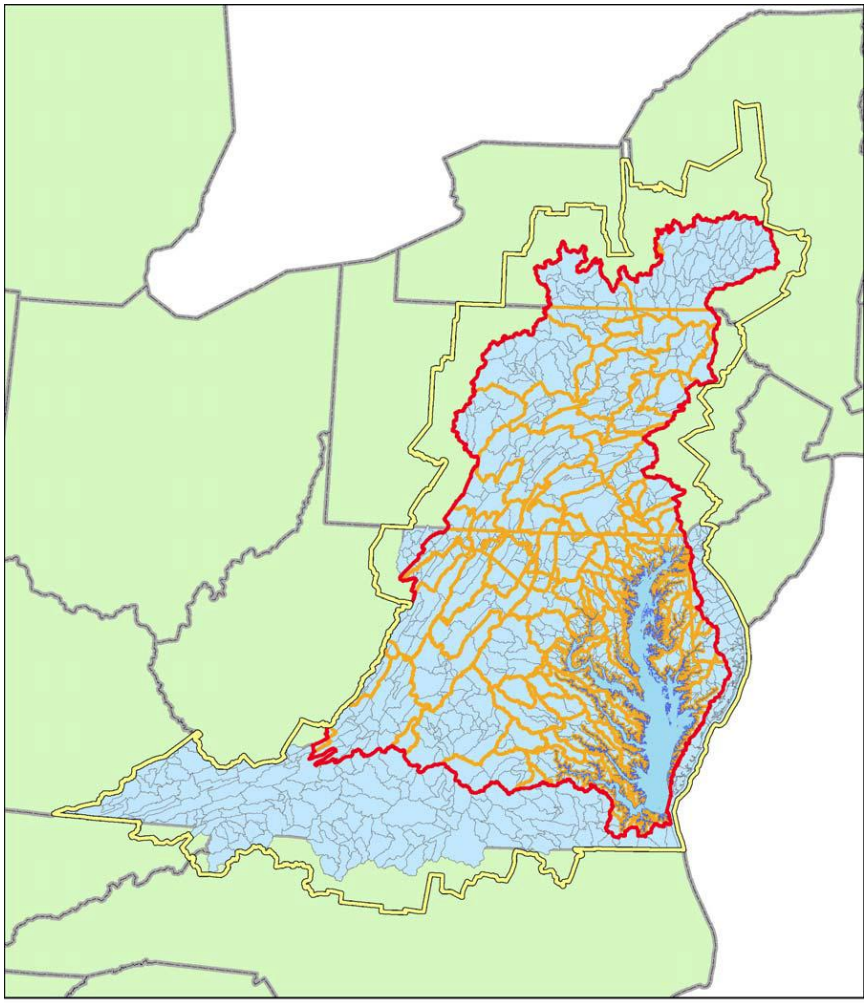
Discussion


Secchi Disk in Lake Manatee During Anabaena Bloom
(Courtesy Bruce MacLeod)

Dead Crocodile in Toxic Algae Bloom in Australia

Courtesy Dr. Justin Brookes, Water Quality Research Centre, South Australia

Phase 5 Chesapeake Bay Watershed Model Segmentation



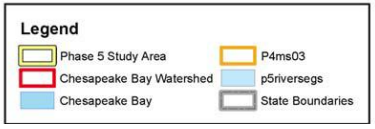


Figure 1.6. Phase 5 domain and segmentation compared to Phase 4.3.

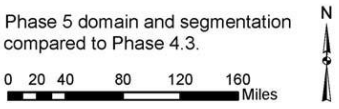
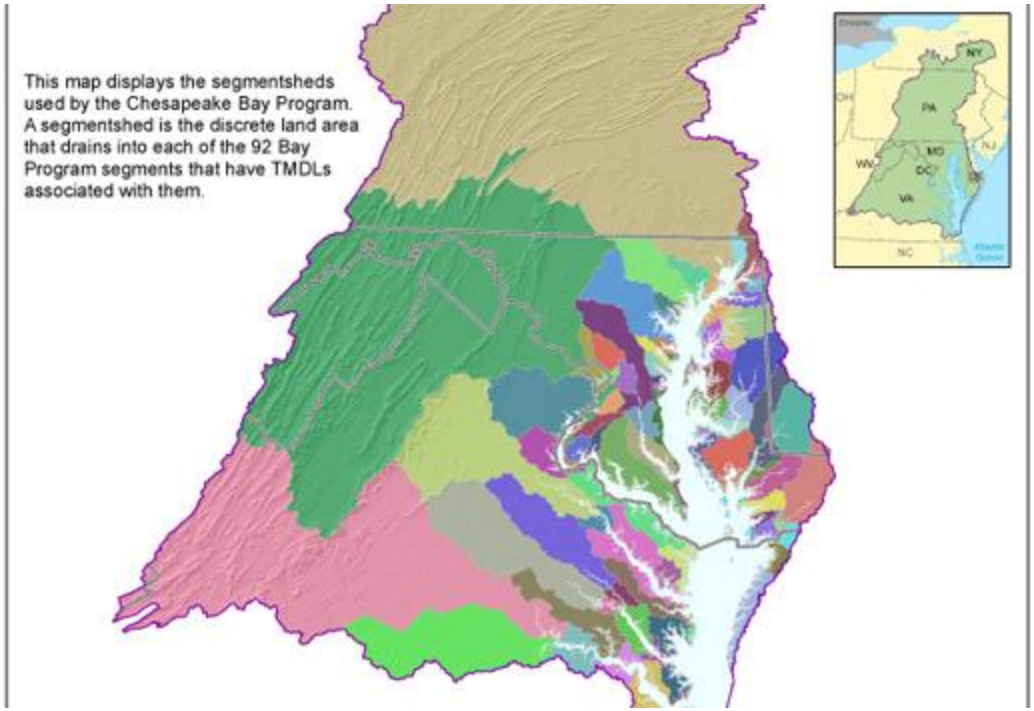


Figure 1. *Chesapeake Bay watershed and surrounding area.*


This map displays the segmentsheds used by the Chesapeake Bay Program. A segmentshed is the discrete land area that drains into each of the 92 Bay Program segments that have TMDLs associated with them.
NY
PA
NJ
MD
WV
DC
DE
VA
NC

USGS TSS – SSC Comparison

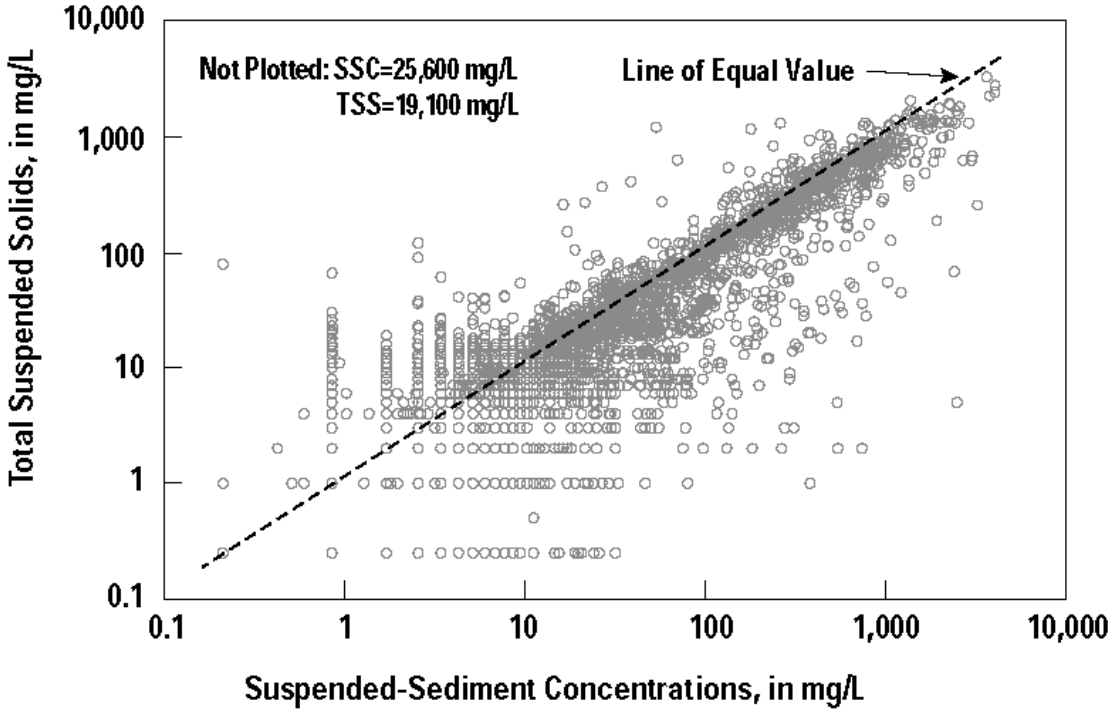


Figure 3. Relation between the base-10 logarithms of suspended-sediment concentration (SSC) and total suspended solids (TSS) for 3,235 data pairs in the scattergrams plotted. All SSC and TSS values less than 0.25 mg/L were set equal to 0.25 mg/L to enable plotting the data on logarithmic coordinates.

Source: Gray, J.R. et al. 2000. *Comparability of Suspended Sediment Concentration and Total Suspended Solids Data.* USGS Water Resources Investigations Report 00-4191

USGS TSS – SSC Comparison

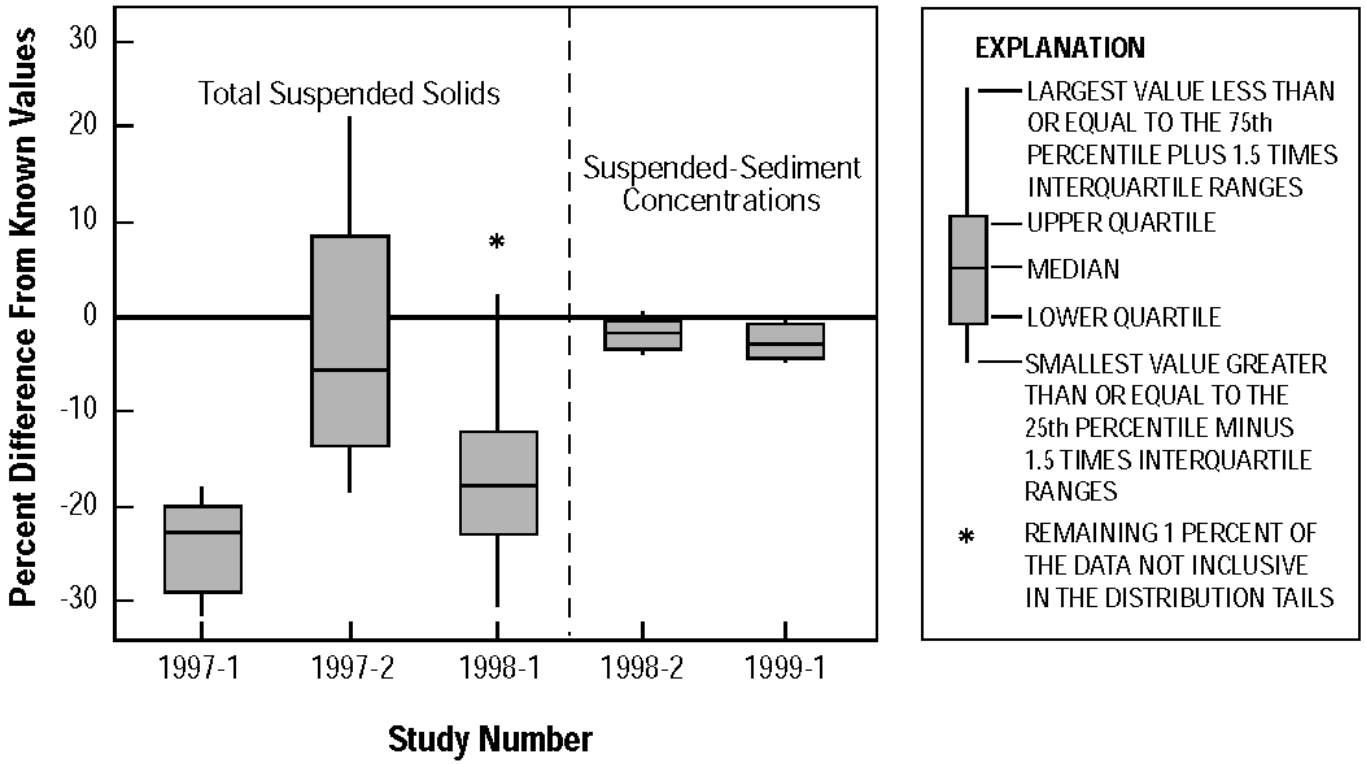
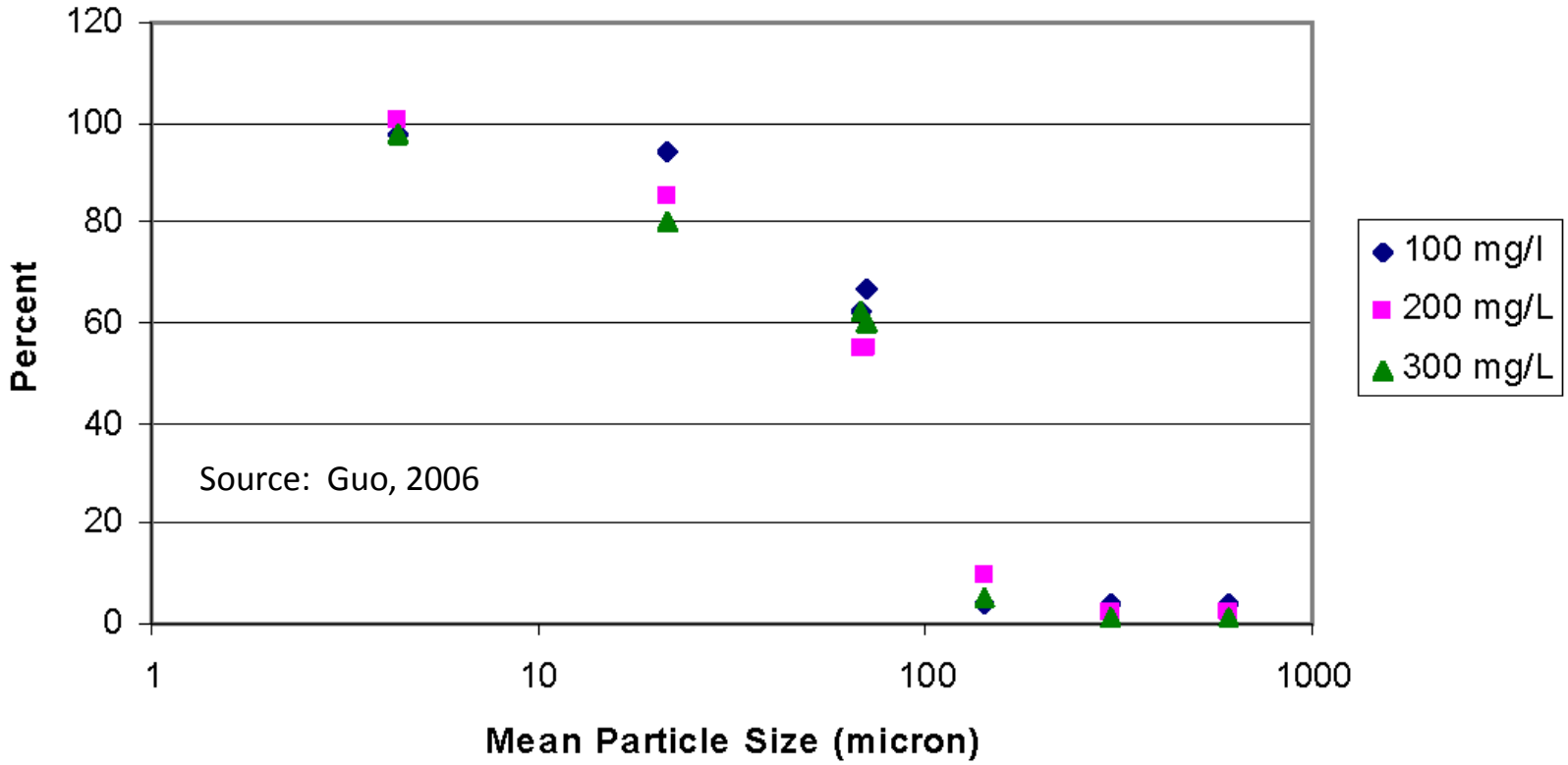


Figure 8. Variability in results of suspended-sediment concentrations and total suspended solids analytical methods in quality-control water samples analyzed by a co-operator laboratory. (John D. Gordon, U.S. Geological Survey, written commun., 2000).

Source: Gray, J.R. et al. 2000. *Comparability of Suspended Sediment Concentration and Total Suspended Solids Data.* USGS Water Resources Investigations Report 00-4191

Particle Size Effects on TSS-SSC Relationship



Suspended Sediment Concentration (SSC)

- "Gold" standard for suspended material measurement
  - Includes the "heavy" sediments largely responsible for low bias in TSS measurements

- ASTM Method D 3977-97 (1999):
  - Method A: Evaporation
  - Method B: Filtration
  - Method C: Wet-Seiving
  - All methods require processing of entire sample

- Problems: Method requires entire sample volume
  Volume not available for other analyses