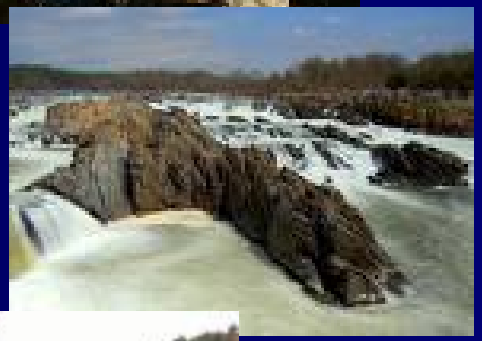


Update on Potomac River Water Quality

Briefing to the
Water Resources Technical Committee
May 6, 2009

Topics for Today

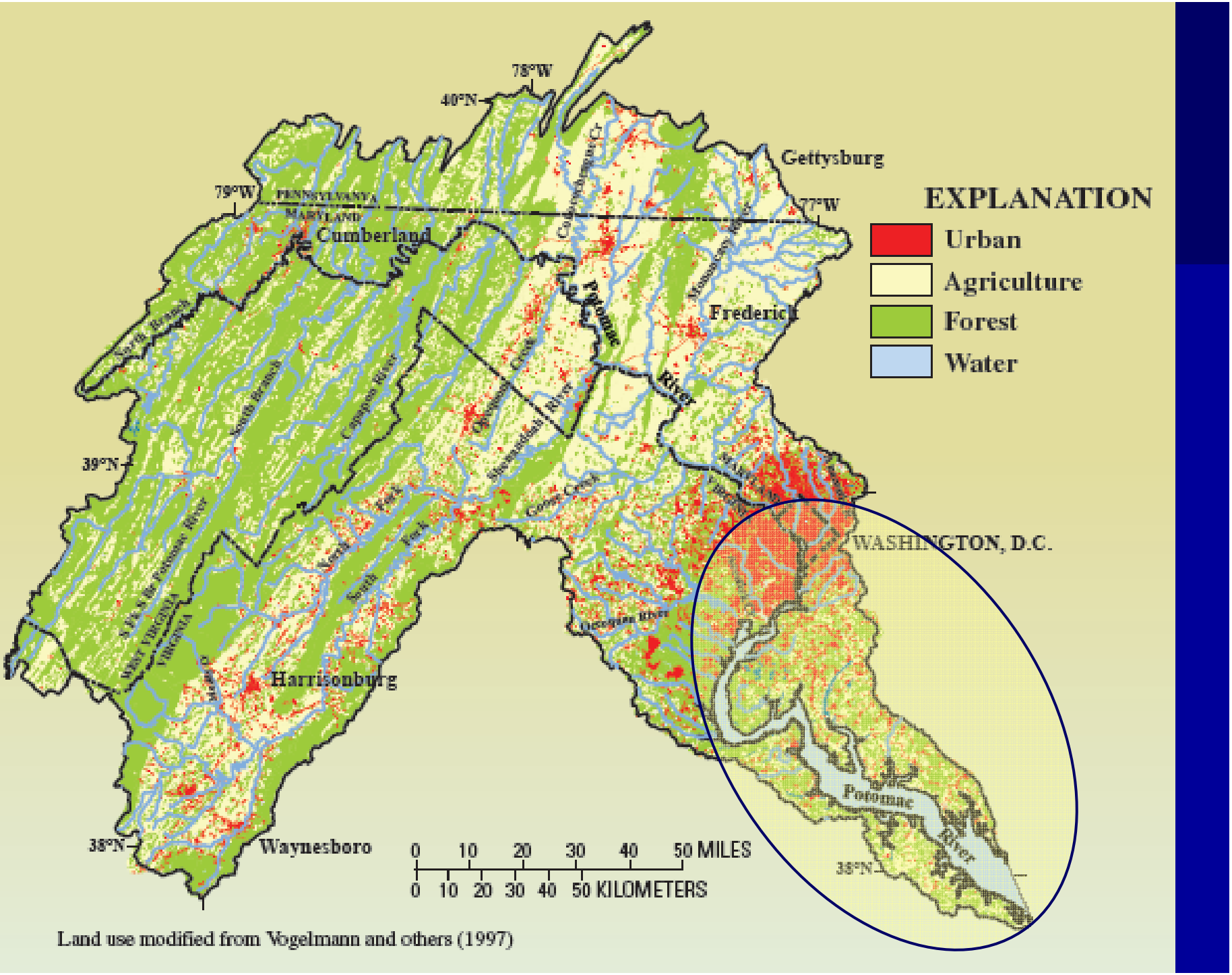
- Description of report.
- Potomac Estuary water quality improvements.
- Public Health Considerations.
- Local water quality case studies.

Report Description

- Foundational report for formulating policy recommendations.
- Three broad report parts:
  - Potomac Estuary water quality improvements;
  - Public Health Considerations;
    - Pathogens
    - Persistent toxic contaminants
    - Emerging contaminants
  - Local water quality case studies;
    - Sligo Creek
    - Occoquan Watershed

Potomac Estuary water quality and wastewater treatment improvements

- Take home points for today:
  - Water quality in the tidal fresh Potomac Estuary has improved greatly over the past several decades.
  - These water quality improvements are the result of better wastewater treatment.
  - As a result, key living resources have rebounded:
    - SAV
    - Fish
    - Wildfowl
  - Water quality in the lower (mesohaline) Potomac Estuary shows less signs of improvement.



Land use modified from Vogelmann and others (1997)

A little history…

- A little more than 100 years ago, infectious, water-related diseases (e.g., typhoid, cholera, etc.) were a major cause of death in the Washington Region.
- Improved water and wastewater treatment ended the disease threat, but:
  - The amount of raw and partially treated sewage entering the Potomac from Metropolitan Washington region in 1956 was double 1932 levels;
  - Water quality problems included:
    - Dense mats of algae covering the water;
    - Bacterial contamination;
    - Low dissolved oxygen;
    - Loss of submerged aquatic plants;
    - Declining waterfowl and fish abundance
- President Lyndon Johnson to declared the Potomac a “national disgrace” in 1965.

Dock at Mt. Vernon - 1972

Skiers on Potomac Warned of Filth
07/02/61 WP

Potomac Can't Escape Sewer Waste, Auld Says
01/24/64 WP

"Pollution infinite in nauseous variety permeates the Potomac River" Dr. Robert Reyburn to the Medical Society of this city 12/22/05 WP.

Potomac Cleanup 'Possible' At High Cost to Taxpayers
04/03/69 WP

The Washington Post

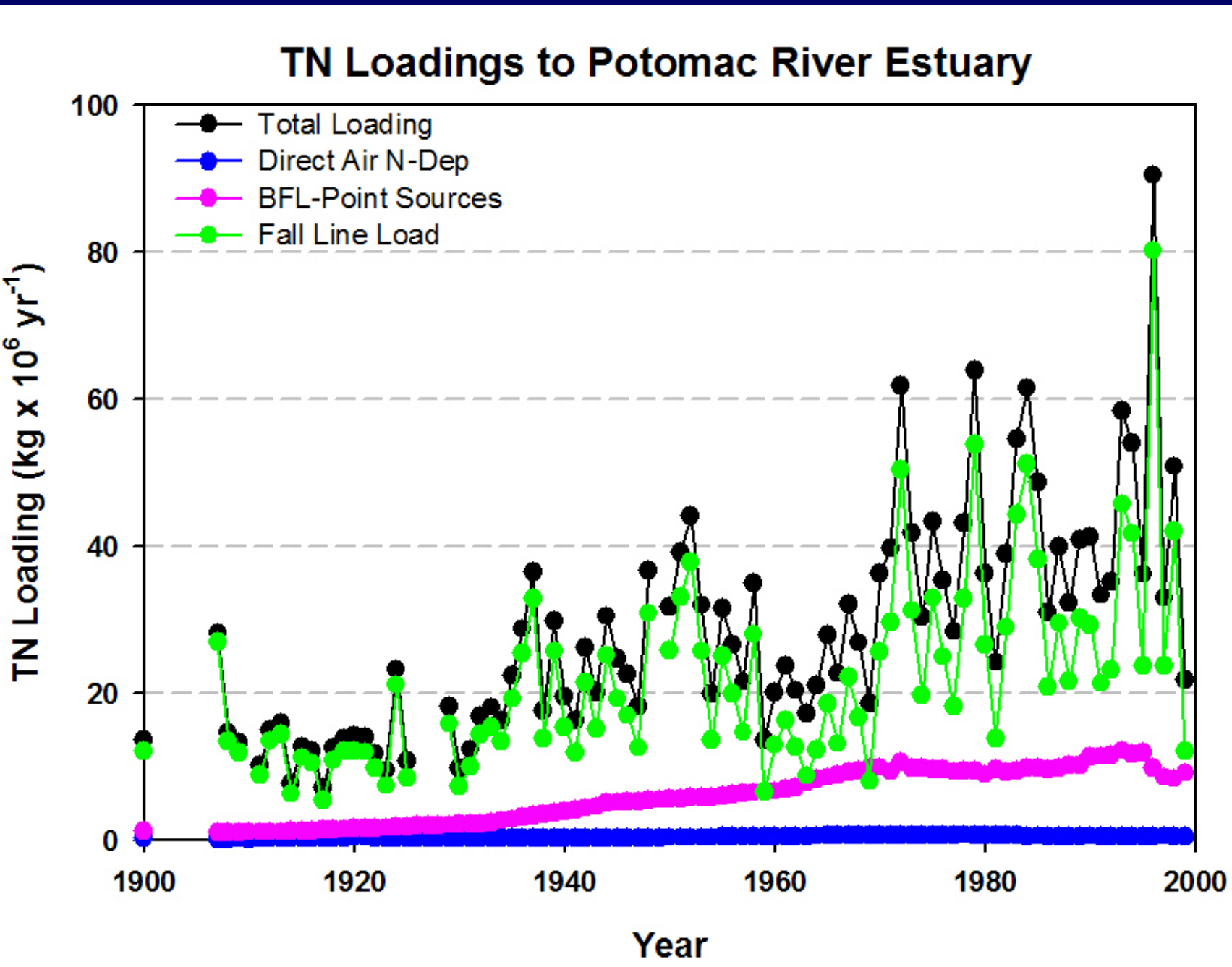
Potomac Called Cleaner Now Than It Was in 'Teddy's' Day
11/07/69 WP

Can We Afford the Price of a Swimmable Potomac?
06/16/77 WP

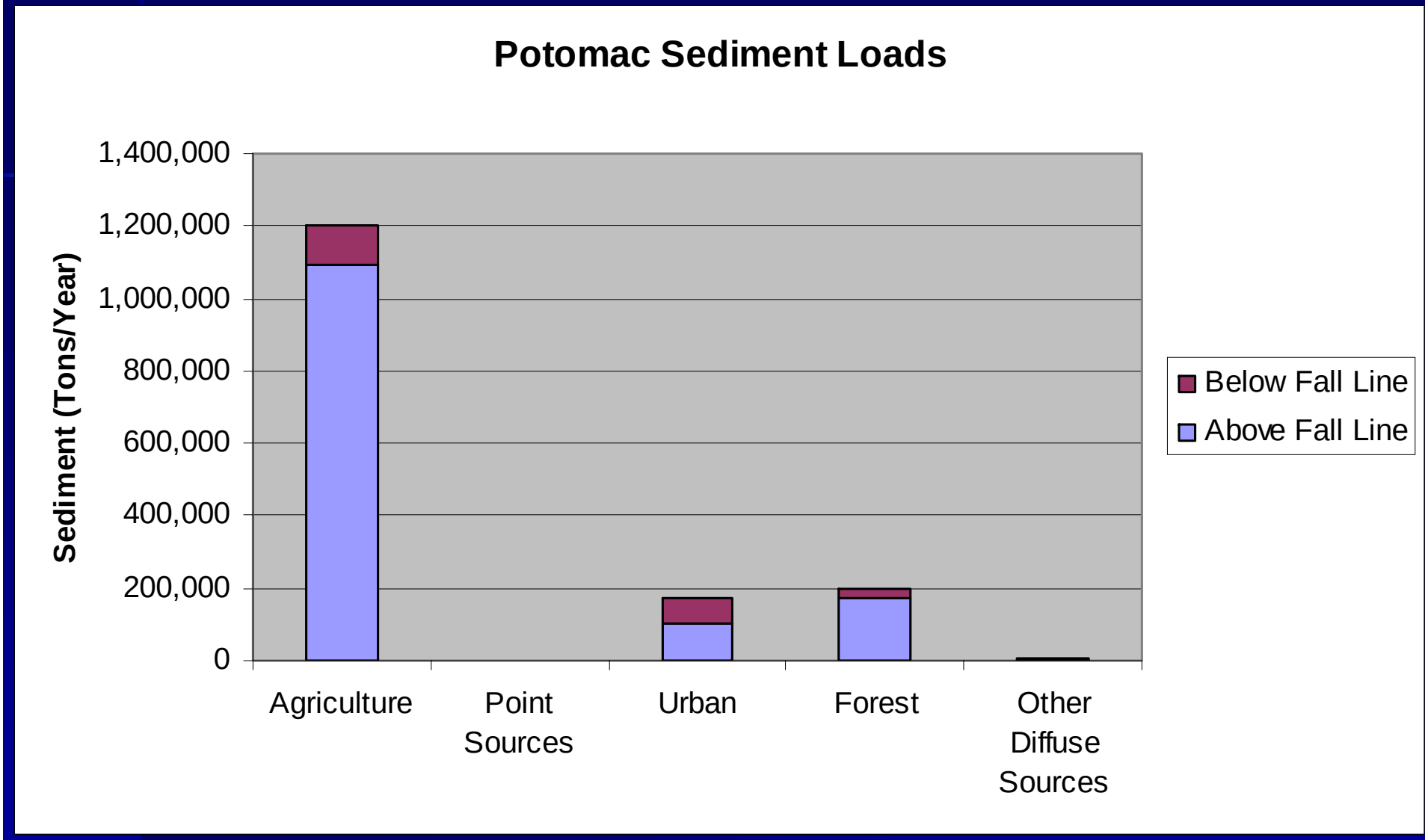
EPA Says D.C., Maryland Sewage Efforts a Failure
01/21/83 WP

Noman Cole Is Convinced He Knows Why Blue-Green Algae Have Returned to River - *Cole Sounds the Alarm as Algae Return* 08/07/83 WP


Elodea Cove (River Mile 20)
September 8, 1983

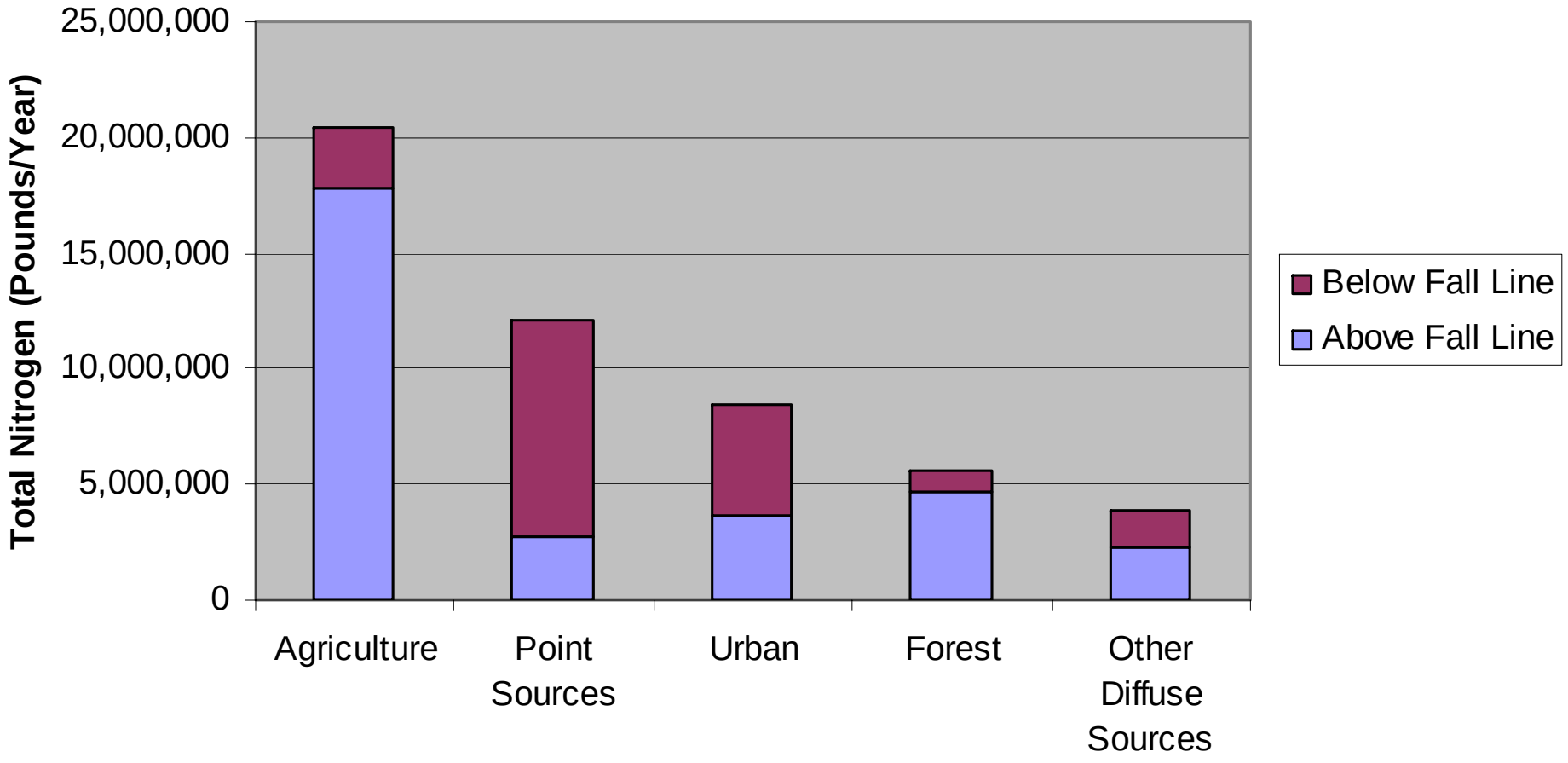


(N. Jaworski 2007)



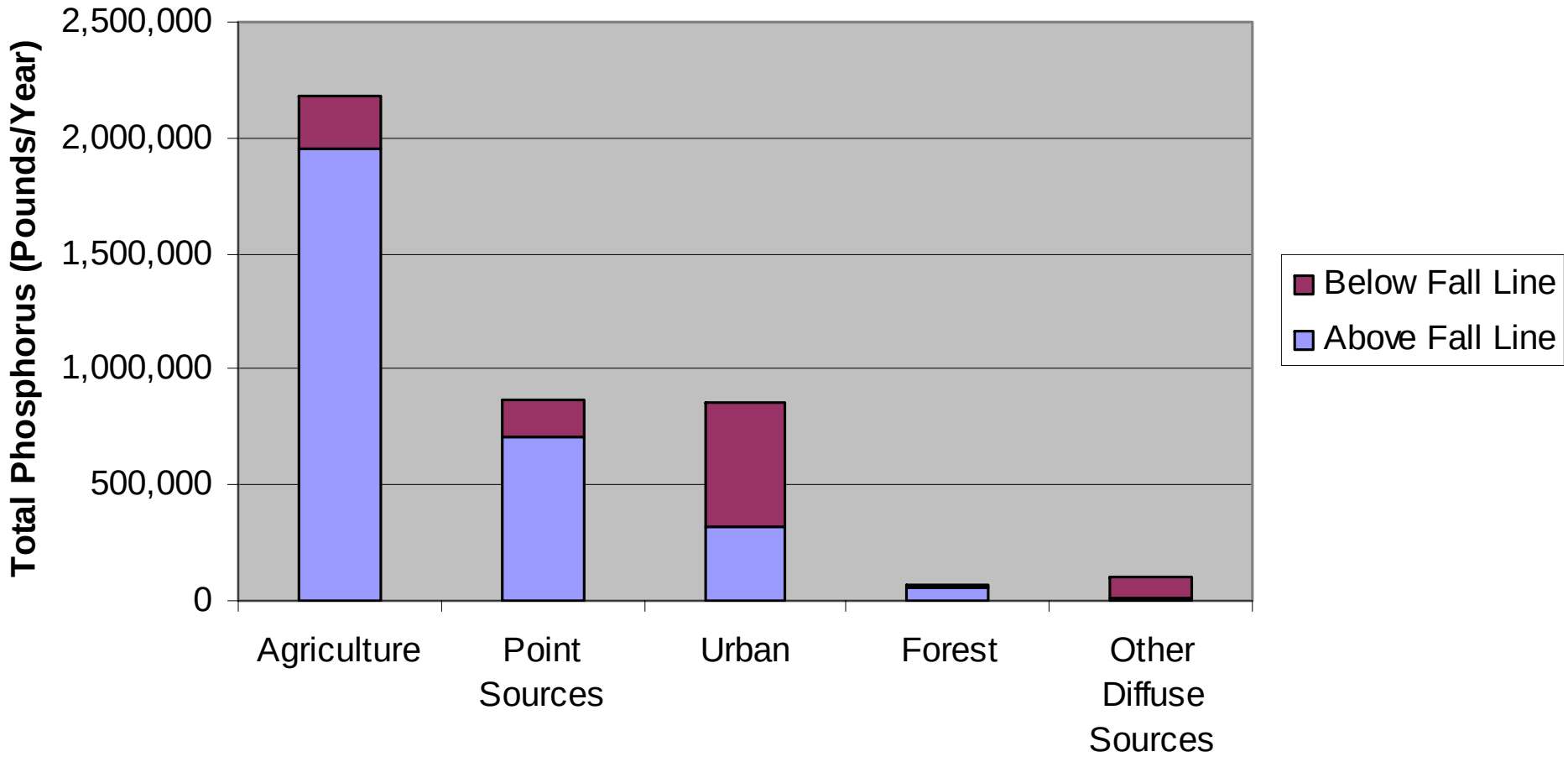
(Note: data for these charts is from the Chesapeake Bay Model: 2007 Inputs_Outputs_022508 for SB 090308)

Potomac Nitrogen Loads

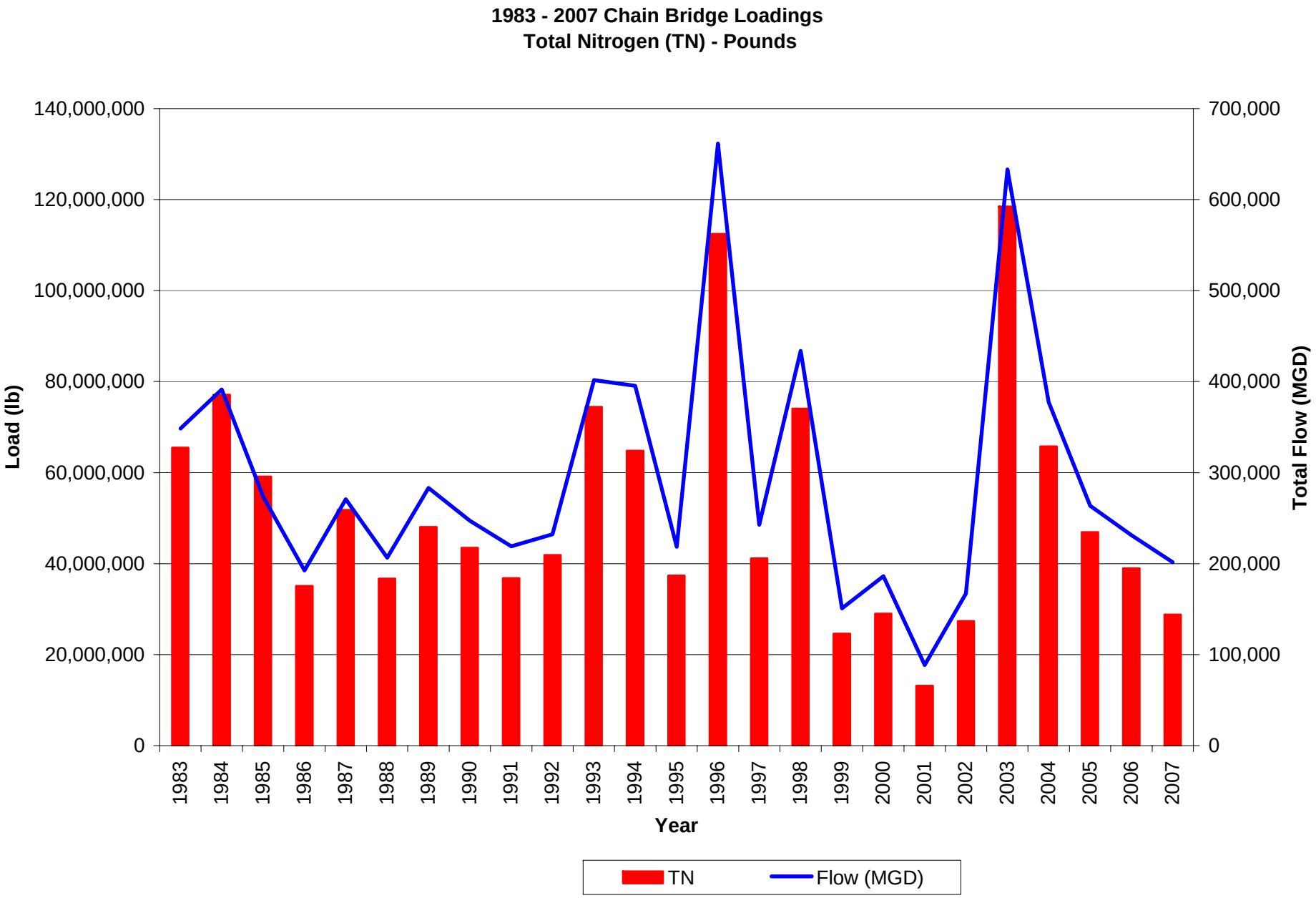


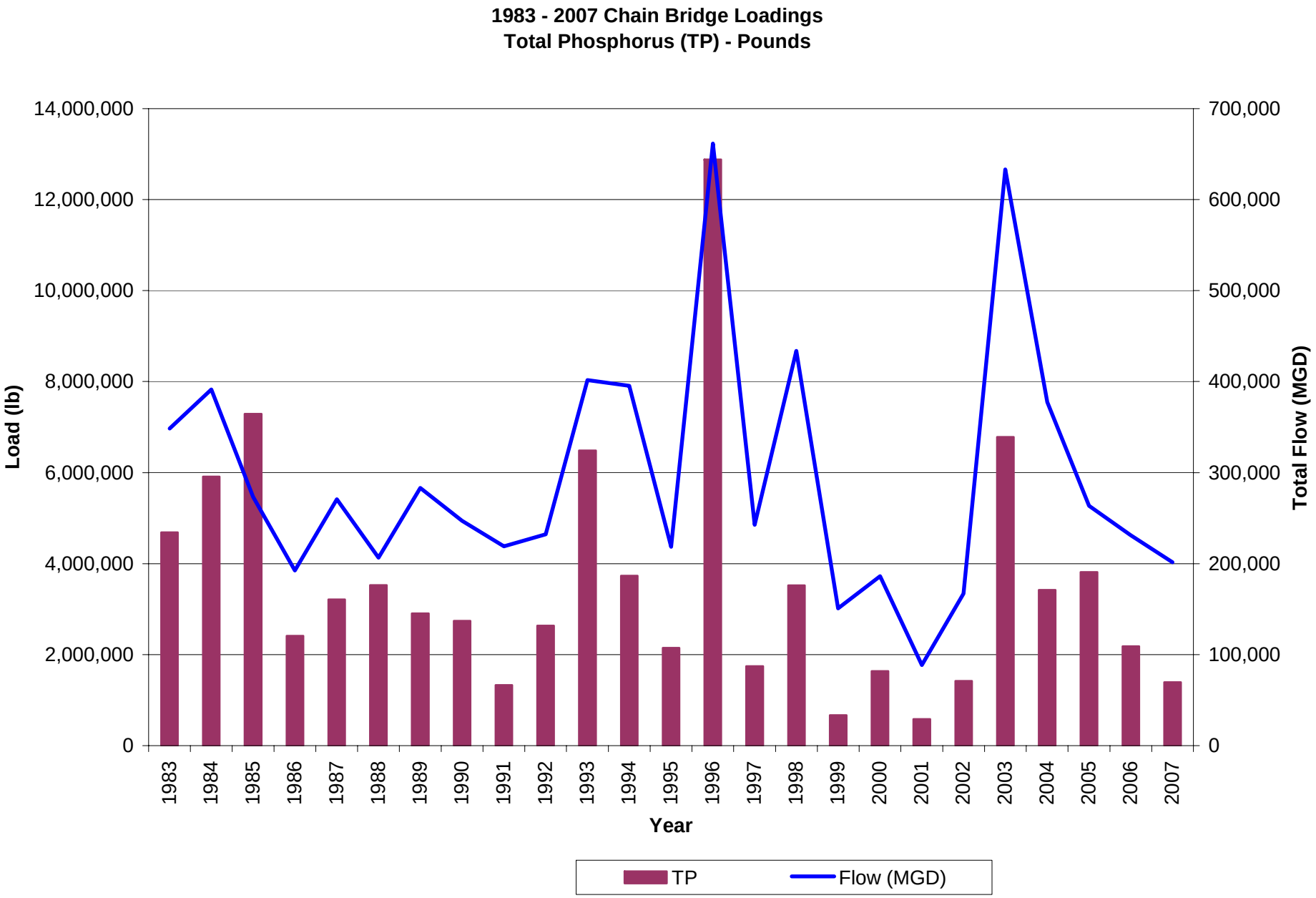
(Note: data for these charts is from the Chesapeake Bay Model: 2007 Inputs_Outputs_022508 for SB 090308)

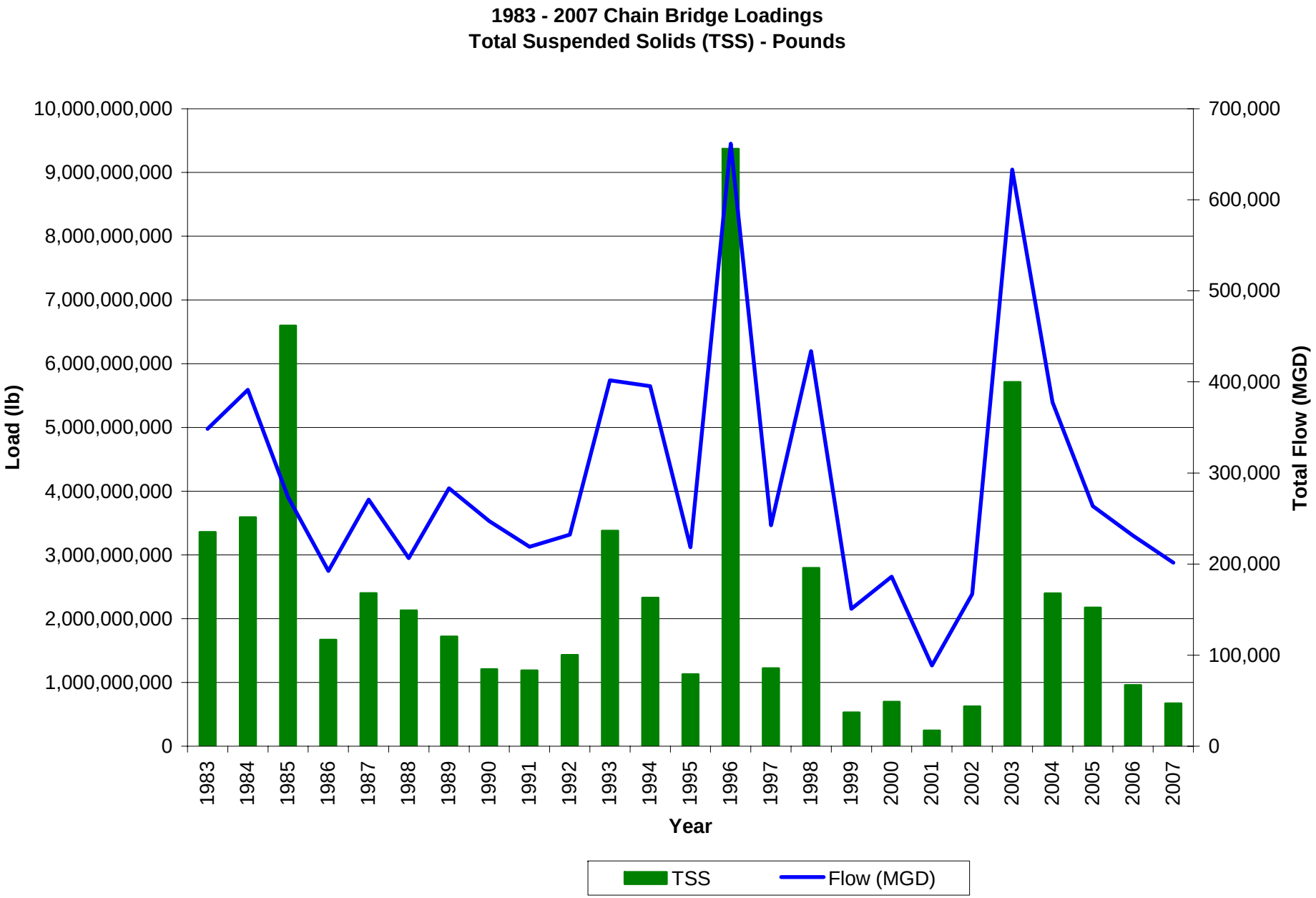
Potomac Phosphorus Loads



(Note: data for these charts is from the Chesapeake Bay Model: 2007 Inputs_Outputs_022508 for SB 090308)


1983 - 2007 Chain Bridge Loadings
Total Nitrogen (TN) - Pounds
Load (lb)
140,000,000
120,000,000
100,000,000
80,000,000
60,000,000
40,000,000
20,000,000
0
Total Flow (MGD)
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year
TN
Flow (MGD)


1983 - 2007 Chain Bridge Loadings
Total Phosphorus (TP) - Pounds
Load (lb)
Total Flow (MGD)
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year
TP
Flow (MGD)


1983 - 2007 Chain Bridge Loadings
Total Suspended Solids (TSS) - Pounds
Load (lb)
10,000,000,000
9,000,000,000
8,000,000,000
7,000,000,000
6,000,000,000
5,000,000,000
4,000,000,000
3,000,000,000
2,000,000,000
1,000,000,000
0
Total Flow (MGD)
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Year
TSS
Flow (MGD)

Potomac WWTP Treatment History

1938 Blue Plains opens as 130 mgd primary treatment plant

1957-8 First Potomac Enforcement Conference sets goal of secondary treatment for Potomac wastewater plants.

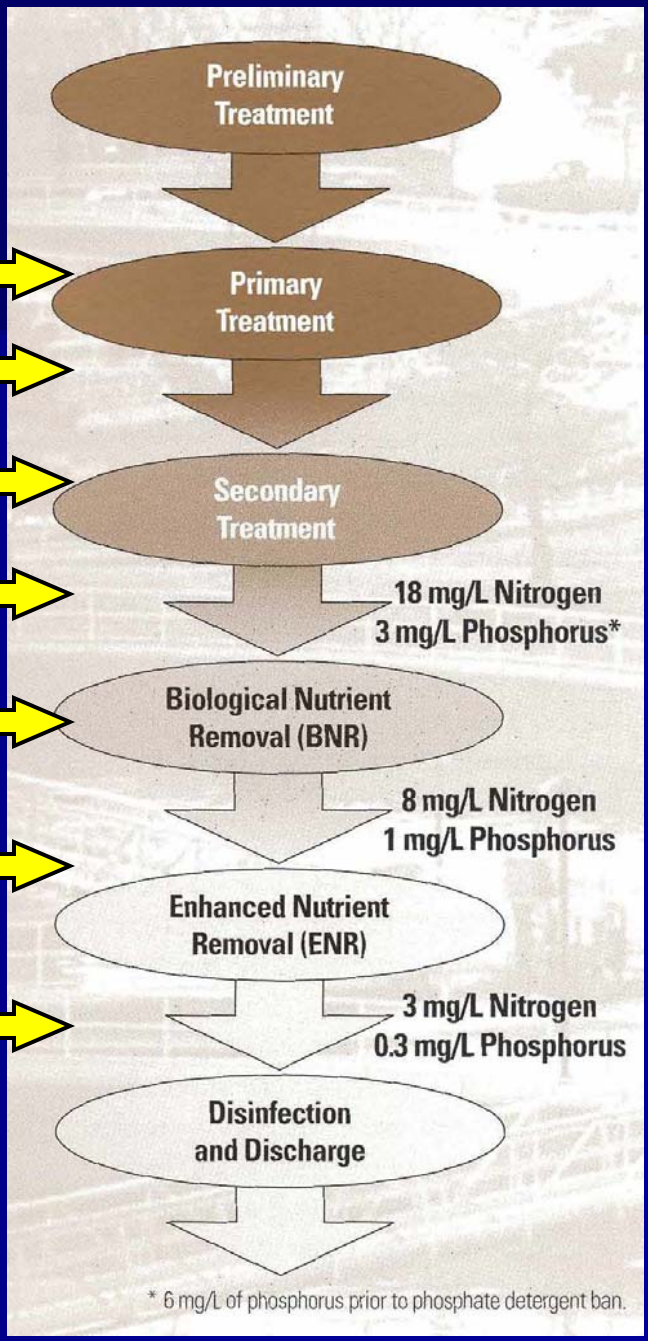
1969 Second Potomac Enforcement Conference; strict effluent limits for Potomac wastewater plants (TP ~ 0.4 mg/L)

1980 – All local wastewater treatment plants achieve secondary treatment.

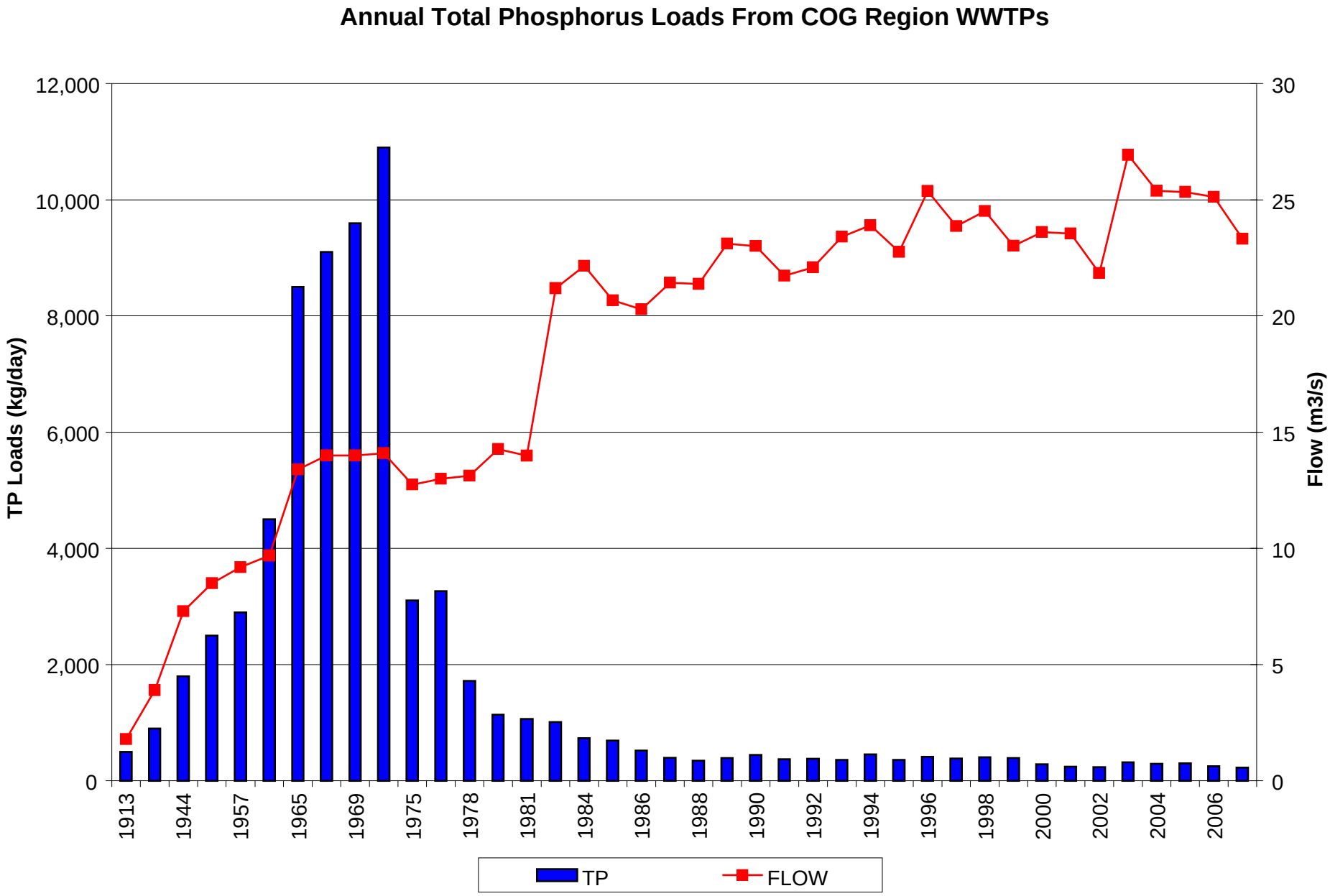
Late 1980s – BNR program starts. TN goal 8 mg/L (55% reduction); TP at 0.18 mg/L (96% reduction)

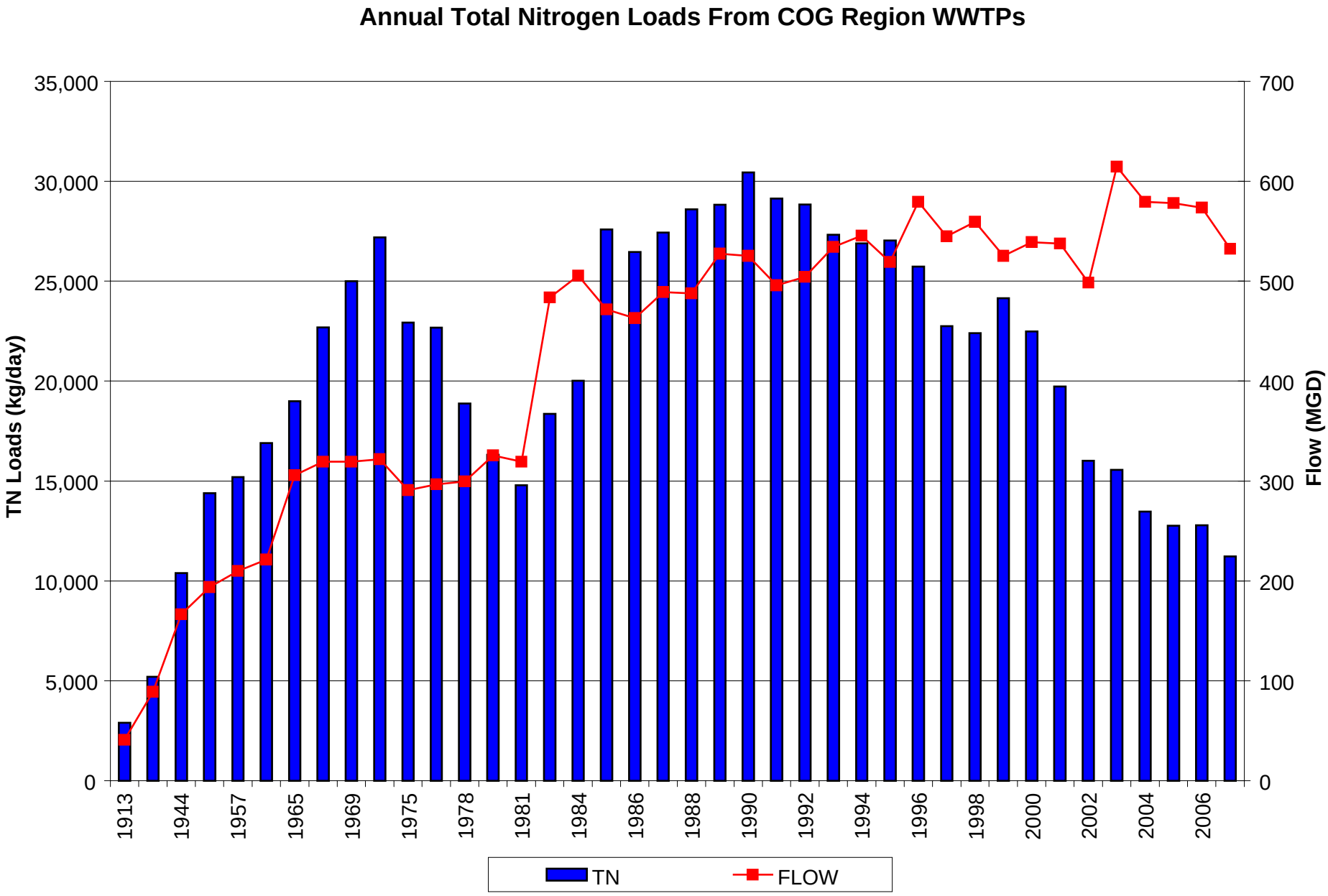
Today – TN ~ 5 mg/L (~ 70% reduction); TP at 0.18 mg/L (96% reduction)

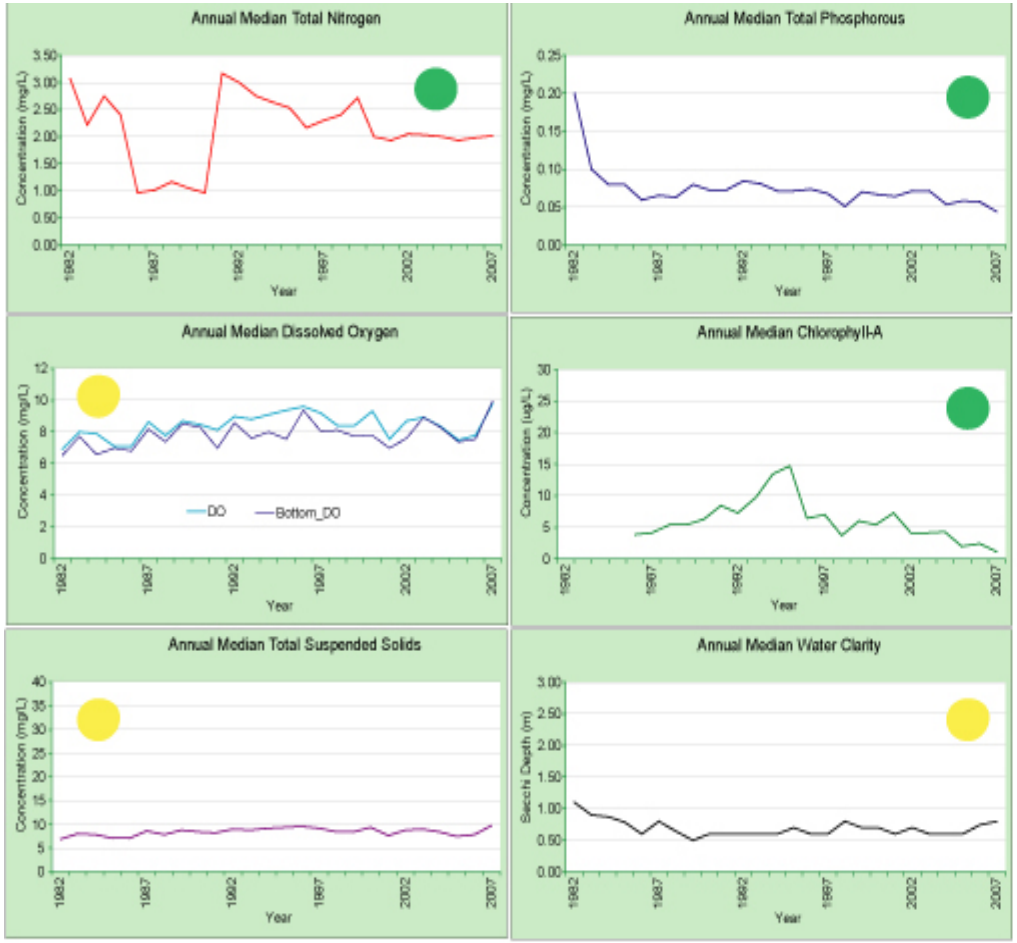
Future – TN ~ 3 mg/L (~ 83% reduction); TP at 0.18 mg/L (96% reduction)



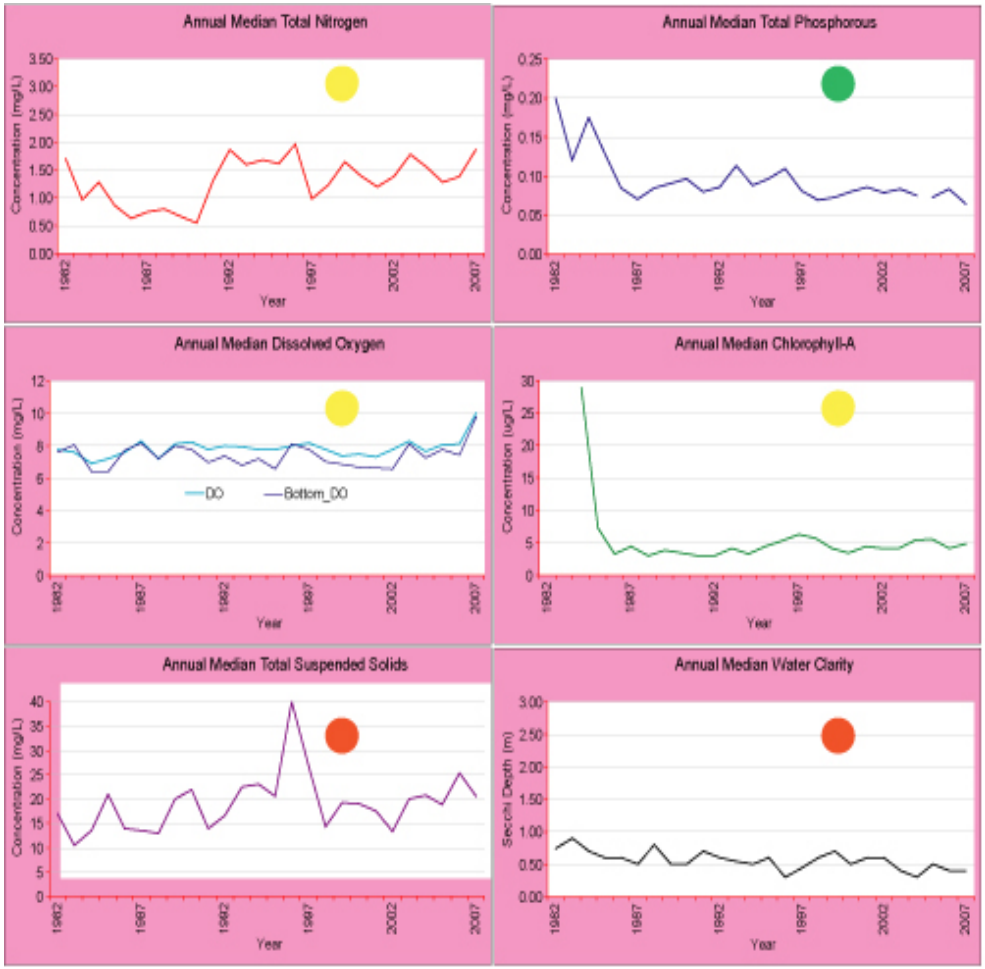
(SOURCE:CHESAPEAKE BAY COMMISSION 2007)


Annual Total Phosphorus Loads From COG Region WWTPs
TP Loads (kg/day)
Flow (m3/s)
12,000
10,000
8,000
6,000
4,000
2,000
0
30
25
20
15
10
5
0
1913
1944
1957
1965
1969
1975
1978
1981
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
TP
FLOW


Annual Total Nitrogen Loads From COG Region WWTPs
TN Loads (kg/day)
Flow (MGD)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
700
600
500
400
300
200
100
0
1913
1944
1957
1965
1969
1975
1978
1981
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
TN
FLOW

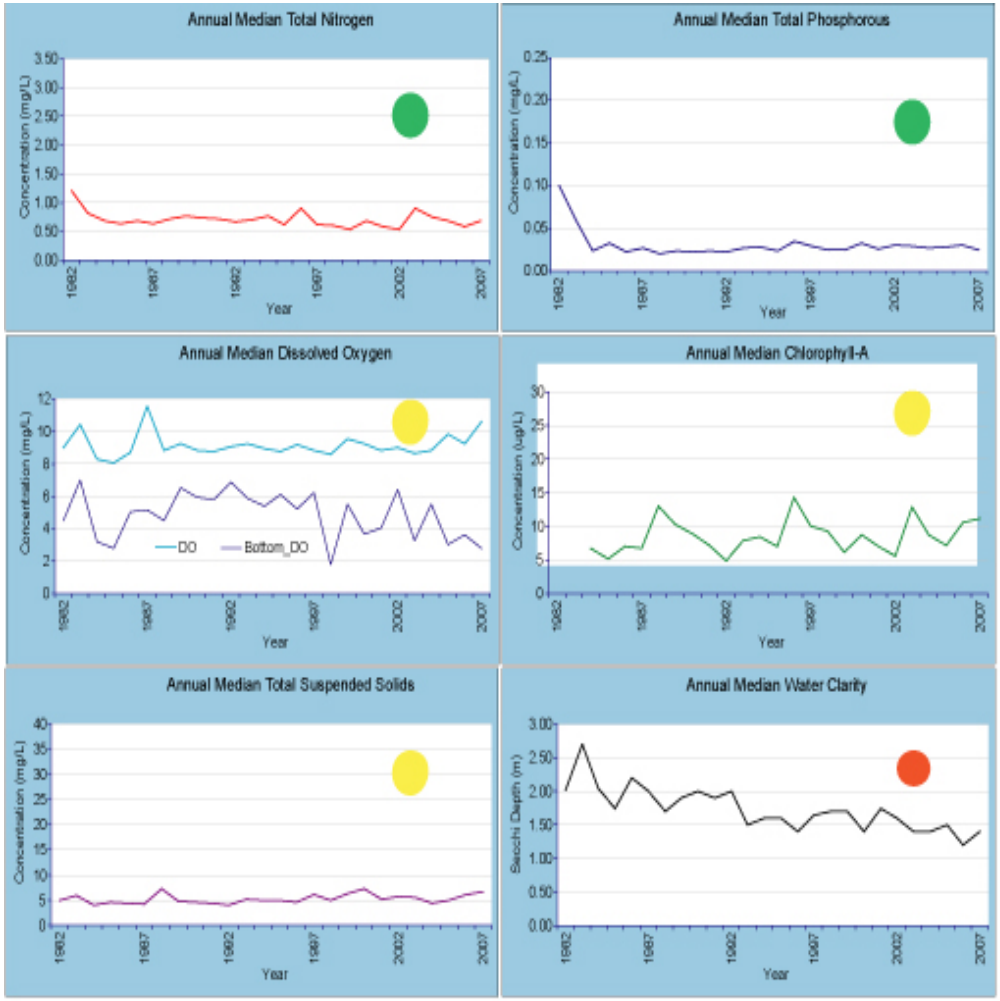


Upper Potomac Estuary – water quality conditions in the upper portion of the Potomac Estuary have shown the most dramatic water quality improvements of any place in the Potomac watershed, primarily in response to reductions of pollutant loads from wastewater treatment plants. In particular, as shown in figure 4, concentrations of both nitrogen and phosphorus have declined significantly since the mid-1980s. As nutrient concentrations declined, algae (measured as chlorophyll a) responded and also declined significantly. Perhaps most significantly, the extreme algae blooms such as the one pictured in figure 2 have become a very rare occurrence rather than a routine annual event. Because huge algae blooms are no longer dying and sinking to the bottom, dissolved oxygen concentrations have increased significantly too, now supporting a healthy and diverse balance of fish and other aquatic life.



Middle Potomac Estuary – water quality conditions have improved also, but not to the extent they have in the upper estuary. In particular, phosphorus concentrations have declined significantly and nitrogen concentrations are low too. As nutrient concentrations have dropped, so have chlorophyll concentrations, meaning fewer algae blooms and healthy levels of dissolved oxygen. Decades ago, average dissolved oxygen concentrations were consistently below 5 mg/l in this region – an amount generally recognized as being supportive of fish and other aquatic life. Today, dissolved oxygen levels are always above this benchmark on average. Although water quality has generally improved in this area over the past few decades, one indicator of concern is an apparent increase in total suspended solids (e.g., dirt, clay and other particles in the water). Due to these increases in dirt and other particles, the clarity of the water has gone down. This is important because underwater plants that provide important habitat for fish and crabs need light to grow. If the water becomes too cloudy, the plants are not able to get enough light and they can die.

Monitoring Stations representing Segments of the Tidal Potomac River and the Potomac Estuary



Lower Potomac Estuary – water quality conditions in the lower portion of the Potomac Estuary – below the Route 301 Bridge – are not quite as good, most likely because this area of the Potomac is greatly influenced by water quality conditions in the Chesapeake Bay. Although nutrient concentrations have declined, and total suspended solids and algal abundance have stayed about the same, data from the lower Potomac show that water clarity is getting worse. It is not obvious what is causing the decline in water clarity, but as mentioned previously, clear water is needed to support a healthy ecosystem of underwater plants, fish and shellfish. In addition, dissolved oxygen concentrations near the bottom of the river during the warmer months are often too low to support healthy populations of fish, crabs, and other bottom-dwelling animals.

Monitoring Stations representing Segments of the Tidal Potomac River and the Potomac Estuary

Underwater Grasses Increase

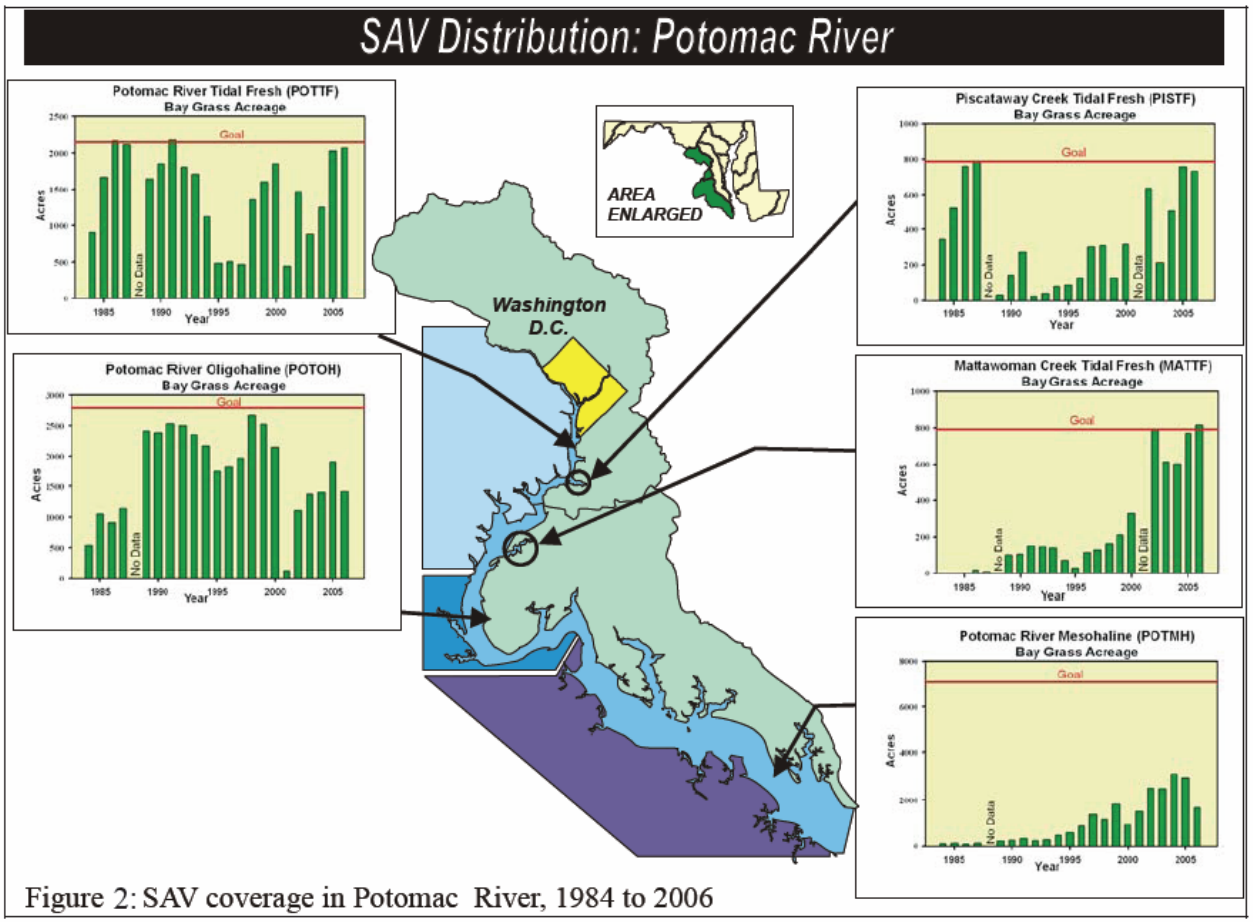
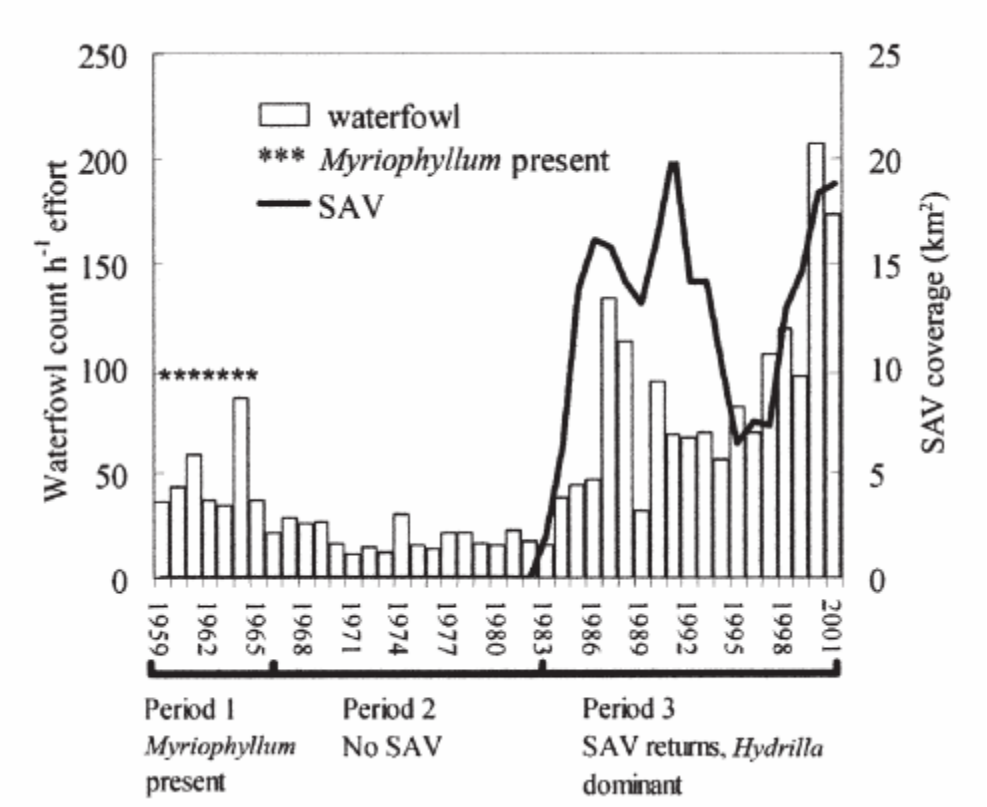


Figure 2: SAV coverage in Potomac River, 1984 to 2006

- Bay grasses in the upper Potomac River have increased from essentially zero acres in 1982 to 6,517 acres in 2008.
- The upper Potomac has exceeded its restoration goal by 41 percent.

Waterfowl Abundance and Diversity Increase

- As SAV returned, waterfowl abundance and diversity also increased.
- 29 of 35 species more than doubled.
- 17 of 35 species increased by greater than a 10-fold measure.



(Rybicki and Landwehr, 2007).

Bass and other fish increase.

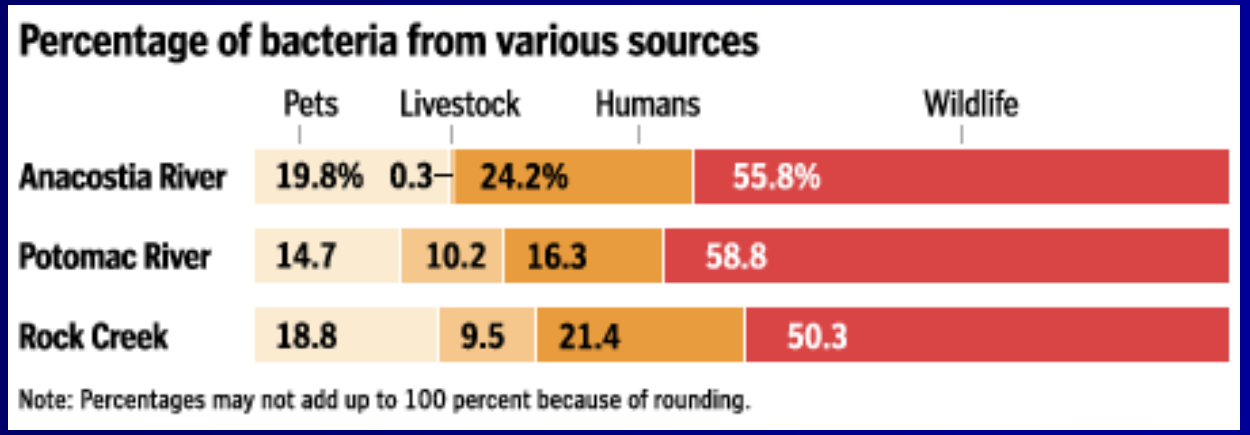
- Largemouth bass began returning to the Potomac near DC in the late 1970s.
- In 1987, the Bassmasters held the Maryland Top 100 tournament on the Potomac, marking the return of championship fishing to the Potomac River.

Public Health Considerations: Pathogens, Toxics, and Emerging Contaminants

March 28, 2005

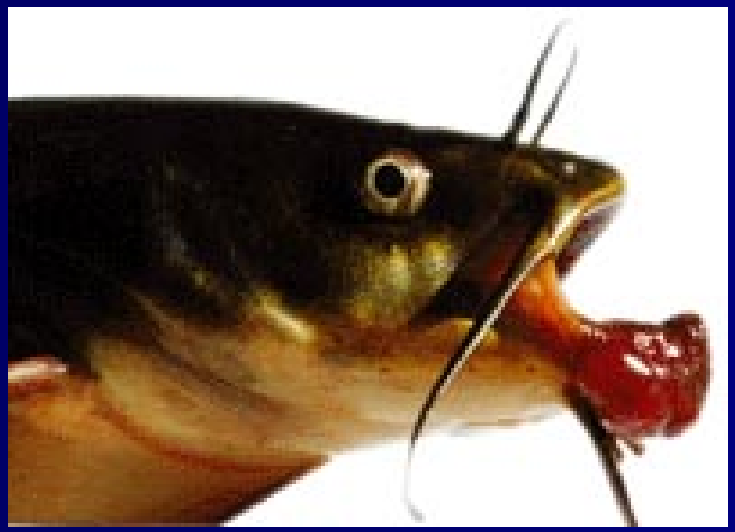
Pathogens

SOURCE: Prof. Charles Hagedorn, Virginia Tech | The Washington Post - September 03, 2006



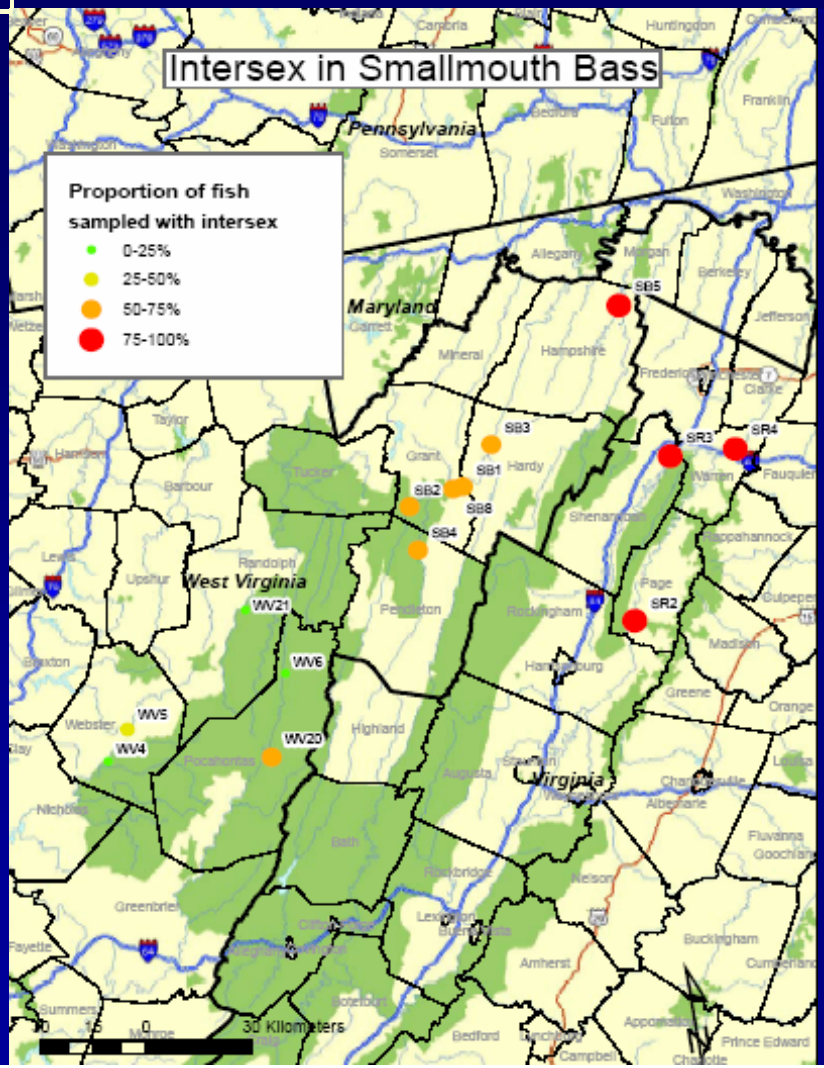
- Common waterborne pathogens include:
  - *Cryptosporidium, Giardia, E. coli, Shigella,* norovirus, and Hepatitis A.
- Data from the Potomac River near Washington, DC indicated that bacteria levels were higher than federal guidelines about one third of the time.
- More than half of the bacteria causing these violations come from wildlife.

Toxic Compounds



- Fish consumption advisories
  - PCB
  - Mercury
  - DDT
  - Chlordane
  - Dieldrin
  - Dioxin
- The most highly impacted area of the Potomac watershed is the Anacostia River, which has been designated a “Region of Concern” by the Chesapeake Bay Program.

Trace Organic Compounds



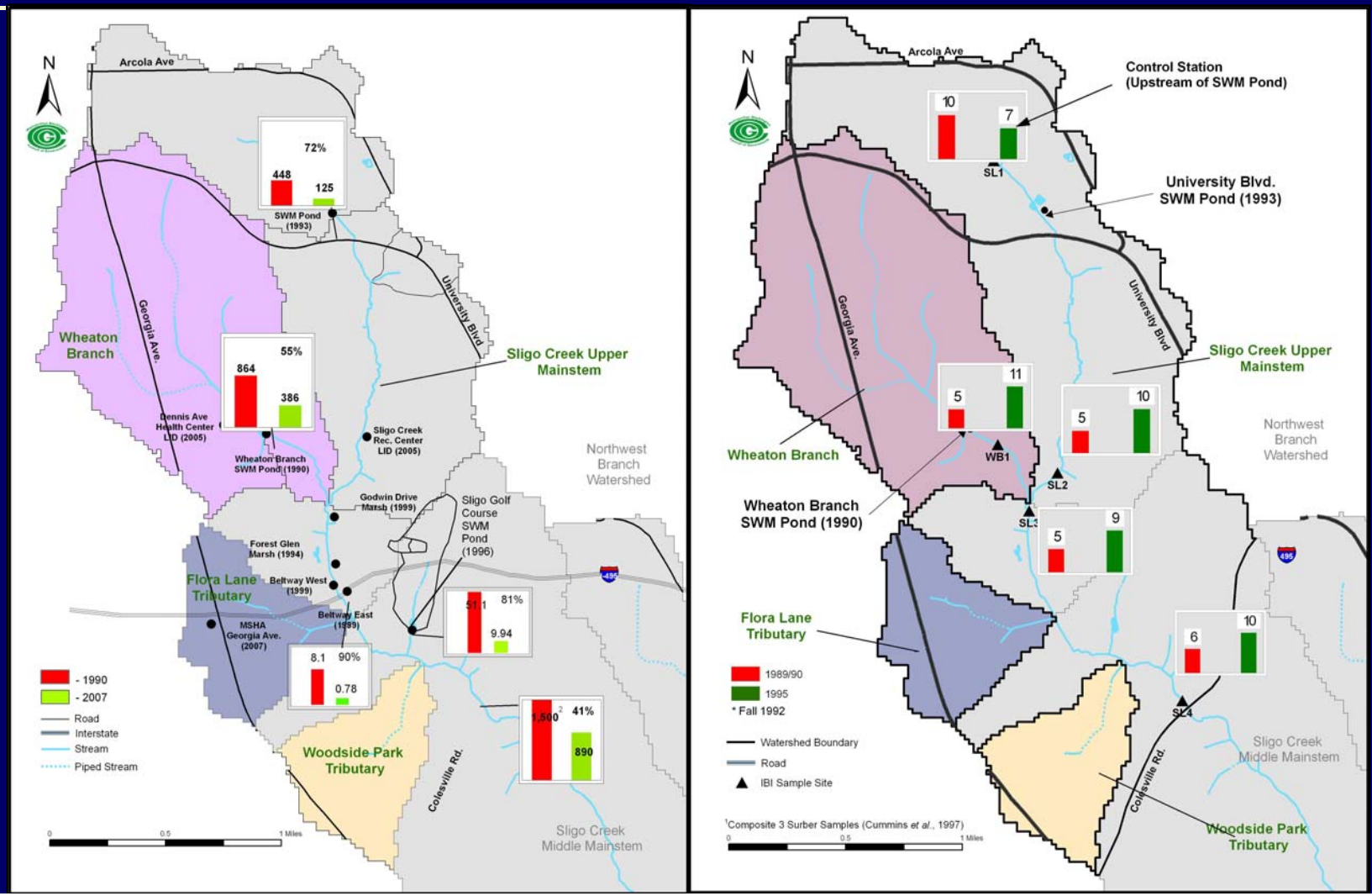
- Increasing publicity regarding reports of organic compounds, pharmaceuticals, personal-care and domestic-use products in the Potomac.
- Detection of compounds at remarkably low concentrations – at the part per billion and part per trillion levels.

(source: Vicki Blazer, USGS presentation at COG 2008 Potomac Monitoring Forum)

Protecting Local Watersheds

- Local governments in the Metropolitan Washington region have some of the best programs in the Bay watershed for addressing local watershed issues.
- Sligo Creek and the Occoquan Watershed are two representative examples.

Upper Sligo Creek Restoration Case Study



Occoquan Watershed Policy

- Occoquan Reservoir is an irreplaceable drinking water source for the citizens of Northern Virginia.
- Policy for Waste Treatment and Water Quality Management in the Occoquan Watershed adopted in 1971 to address:
  - Growing population
  - Increasing urban runoff
  - Increasing agriculture
- Discharge Limits:
  - COD (mg/l) - 10.0
  - Suspended solids (mg/l) - 1.0
  - Nitrogen (mg/l) - 1.0 (as TKN)
  - Phosphorus (mg/l) - 0.1 (i.e., the limit of technology)
  - MBAS (mg/l) - 0.1
  - Turbidity (NTU) - 0.5
  - Coliform per 100 ml Sample - less than 2.0

Next steps

- Identify key water quality messages for CBPC & COG Board
- Potomac Water Quality & Bay Program Update Briefings:
  - Chesapeake Bay and Water Resources Policy Committee: Friday, May 15th
  - June 10th COG Board Meeting
- Complete draft report this summer.
- Use Potomac report and data as a foundation for policy recommendations regarding:
  - Bay TMDL & load allocations
  - WWTP & MS4 permit implications
  - Bay monitoring program “rebalancing”
  - COG’s proposed "Futures Forum"