A Review of Delaware's Total Maximum Daily Loads (TMDL) Program

Listing, Development, Implementation, and Tracking

Hassan Mirsajadi

Watershed Assessment Section
DNREC Division of Watershed Stewardship

Center for the Inland Bays - STAC
October 7, 2011

Outline

- DNREC's water quality management tools
- What is a TMDL?
- When and how a TMDL is developed?
- TMDL implementation Plan (Pollution Control Strategy-PCS)
- Tracking TMDL implementation and Post TMDL monitoring
- A few monitoring results

Some of DNREC's Water Quality Management Tools

- Water quality standards
- Water quality monitoring
- Water quality assessment
- Listing of impaired waters (303(d) List)
- Establishing Total Maximum Daily Loads (TMDLs)
- TMDL implementation Plan – PCS

Water Quality Standards

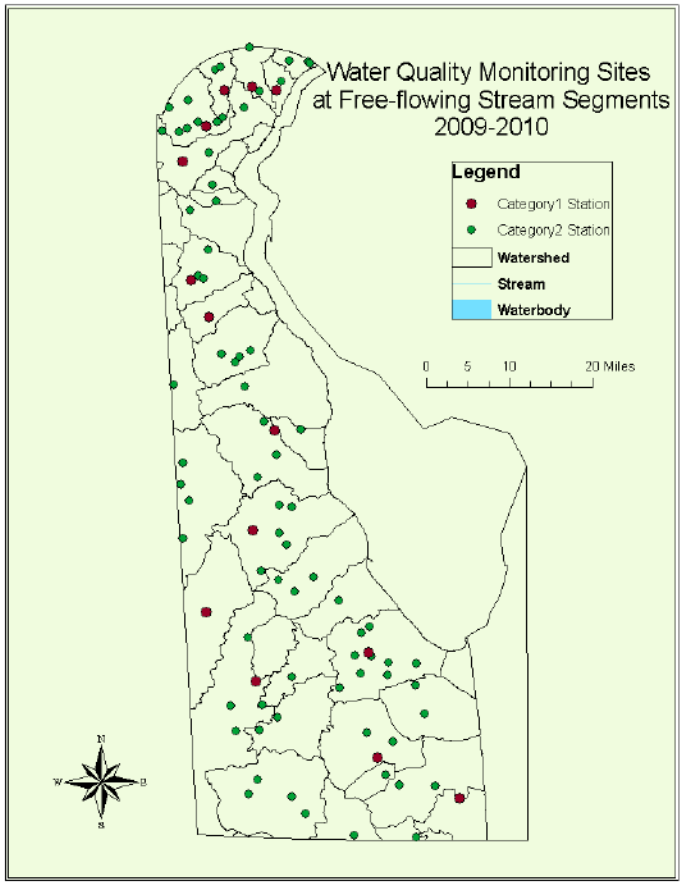
- Water quality standard for each water body includes:
  - Designated use (fishable, swimmable, etc.)
  - Narrative and/or numeric criteria to support designated use
- Generally DNREC reviews and, if necessary, updates Water Quality Standards once every 3 years

Water Quality Monitoring

- DNREC's surface water quality monitoring program includes:
  - Grab sampling
  - Continuous monitoring
  - Special surveys

Surface Water Quality Program (Grab samples)

- More than 130 monitoring sites
- Monitoring frequency:
  - Monthly at C1 sites (22 sites)
  - Monthly or bi-monthly at C2 sites (111 sites) based on 5-year rotating basin schedule
    - 2 Years monthly
    - 3 years bi-monthly

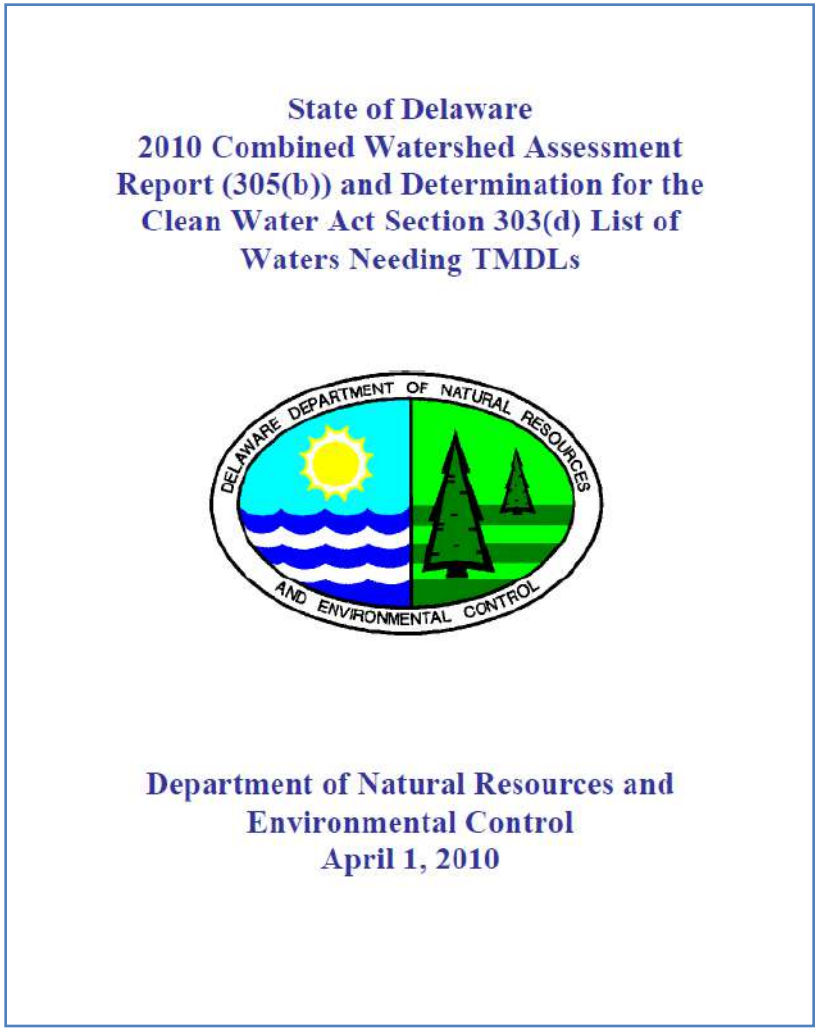


Water Samples are Analyzed for:

- **Nutrients**
  - Phosphorus (dissolved, total)
  - Soluble Ortho-phosphorus
  - Nitrogen (dissolved, total)
  - Ammonia Nitrogen (dissolved, total)
  - Nitrite + Nitrate N (dissolved, total)
- **Carbon and Organics**
  - Organic Carbon (dissolved, total)
  - BOD_5, N-Inhib (CBOD5)
  - BOD_{20}, N-Inhib (CBOD20)
  - Chlorophyll-a
- **Bacteria**
  - Enterococcus
- **General**
  - Dissolved oxygen
  - Total Suspended Solids
  - Alkalinity
  - Hardness
  - pH
  - Specific Conductance
  - Salinity
  - Temperature
  - Secchi Depth
  - Light Attenuation
  - Turbidity
- **Metals (dissolved and total)**
  - Copper
  - Lead
  - Zinc

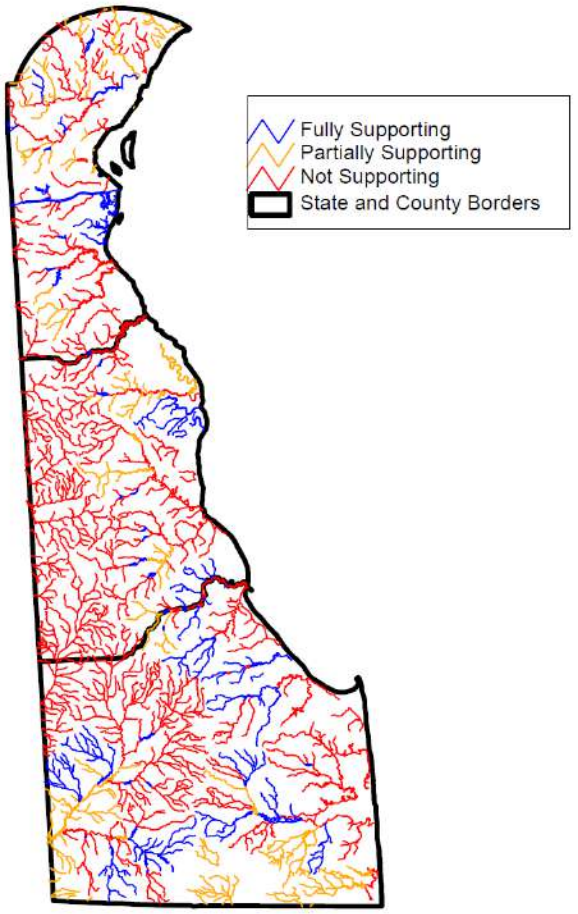
Water Quality Assessment

- Water quality data collected by DNREC is used to assess water quality condition of the State's waters and to prepare bi-annual Assessment Reports (per Section 305(b) of the Federal Clean Water Act).



Listing of Impaired Waters

- If the result of monitoring shows that a stream is not meeting its applicable water quality standards, the stream is placed on the list of impaired waters (303(d) List) and is targeted for TMDL development

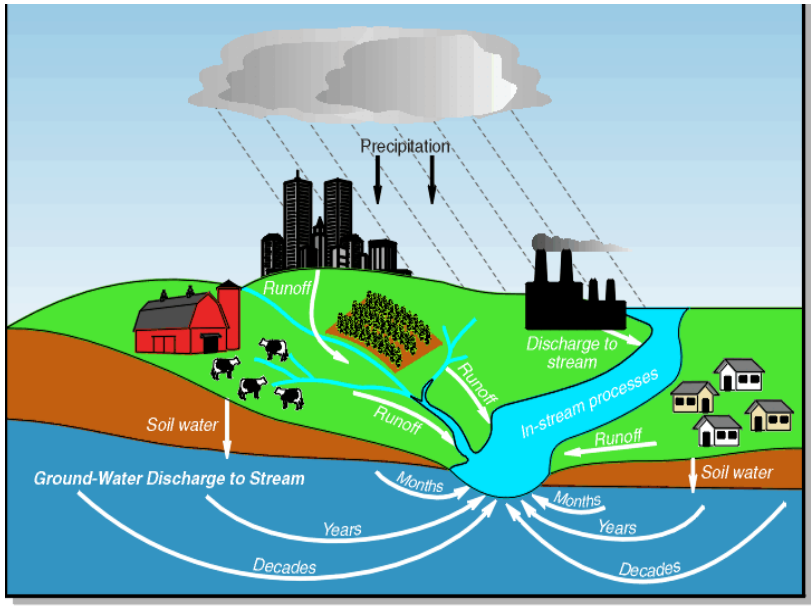


What is a TMDL?

- When the amount of pollutants in a waterbody exceeds its natural assimilative capacity, it becomes impaired.
- TMDL is the maximum amount of a pollutant that a water body can receive and still meet water quality standards
- Establishment of TMDL is required under Federal and State Laws and Regulations

To Develop a TMDL

- A multi-year intensive monitoring is conducted
- A computer model of the watershed and receiving water is prepared. The model relates pollutant loads to water quality conditions
- Using the model, a loading condition is determined that would result in meeting the water quality standards



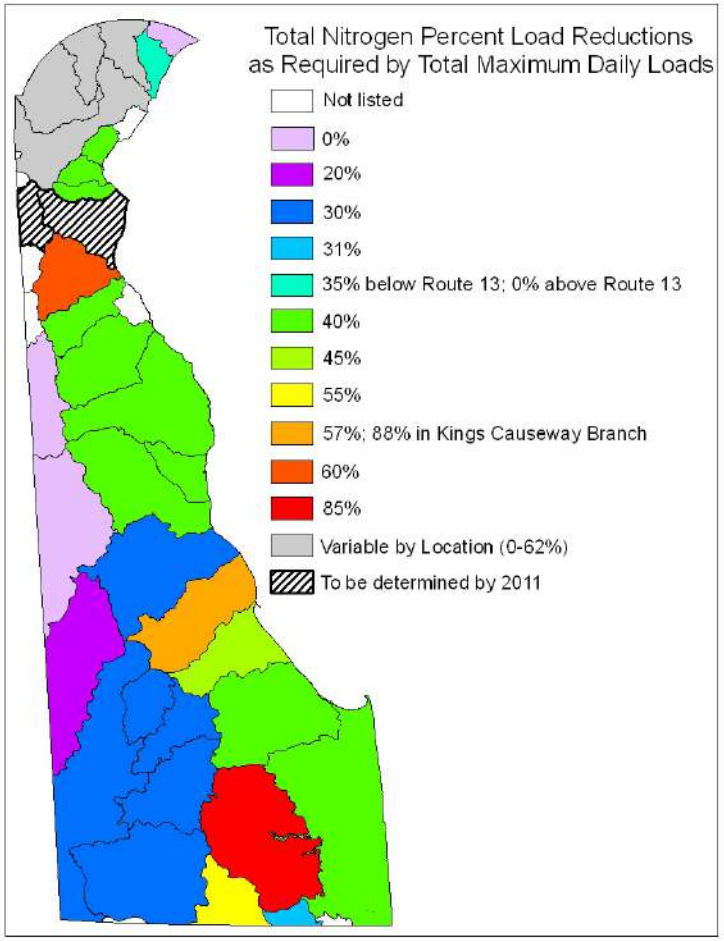
TMDL

- A TMDL generally has 3 parts:
  - Load allocation for point sources (WLA)
  - Load allocation for nonpoint sources (LA)
  - Margin of Safety

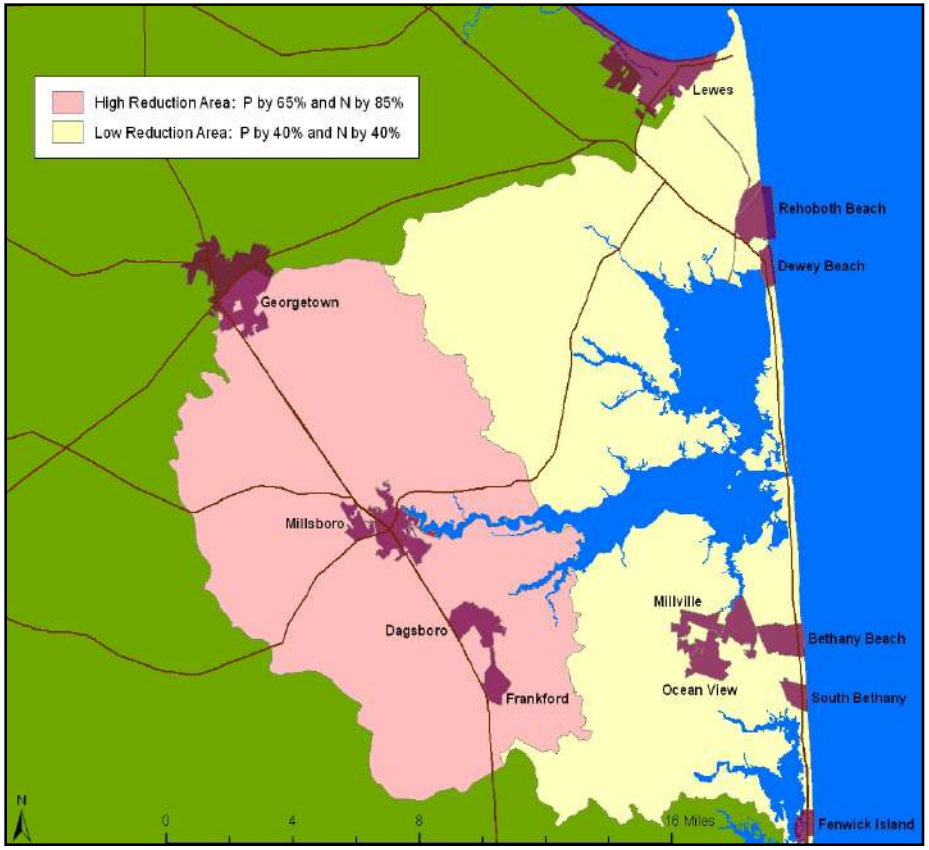
$$TMDL = WLA + LA + MOS$$

Established TMDLs in Delaware

- In 1998, DNREC started development of TMDLs for all waters of the State that were impaired because of high nutrients, low DO, or high bacteria.
- Establishment of nutrient and bacteria TMDLs were completed by 2006



The Inland Bays TMDL



Inland Bays TMDL

- Was adopted in 1998 for tidal portions of the Rehoboth Bay, Indian River, and Indian River Bay
- In 2005, the TMDL was expanded to cover the entire watershed.
- Requirements of the Inland Bays TMDL:
  - Systematic elimination of all point sources of nutrients
  - Reduction of nonpoint source nitrogen load by 40-85%
  - Reduction of nonpoint source phosphorus load by 40-65%
  - Reduction of atmospheric deposition of N by 20%

How TMDLs Are Implemented?

- TMDLs are implemented through development of Pollution Control Strategies (PCS).
- PCS for the Inland Bays was adopted in 2008
- Currently, PCS for several other watersheds within the State are under development.
- In addition, DE is involved in a multi-state effort to implement the requirements of anewly established TMDL for the Chesapeake Bay through a Watershed Implementation Plan (WIP)

The Inland Bays Pollution Control Strategy

- Addresses:
  - Point Sources (via regulatory means)
  - Nonpoint Sources (via voluntary & regulatory means)
    - Wastewater
    - Urban/Suburban
    - Stormwater
    - Agriculture

The PCS "Technical Document"

- Introduction & Background
  - Sources of Pollutants
  - PCS Development Process
- Progress to date
  - Point Source
  - Nonpoint Source
- Recommendations for future actions
- How the PCS should achieve the TMDL
- Costs
- Implementing Organizations
- Appendices

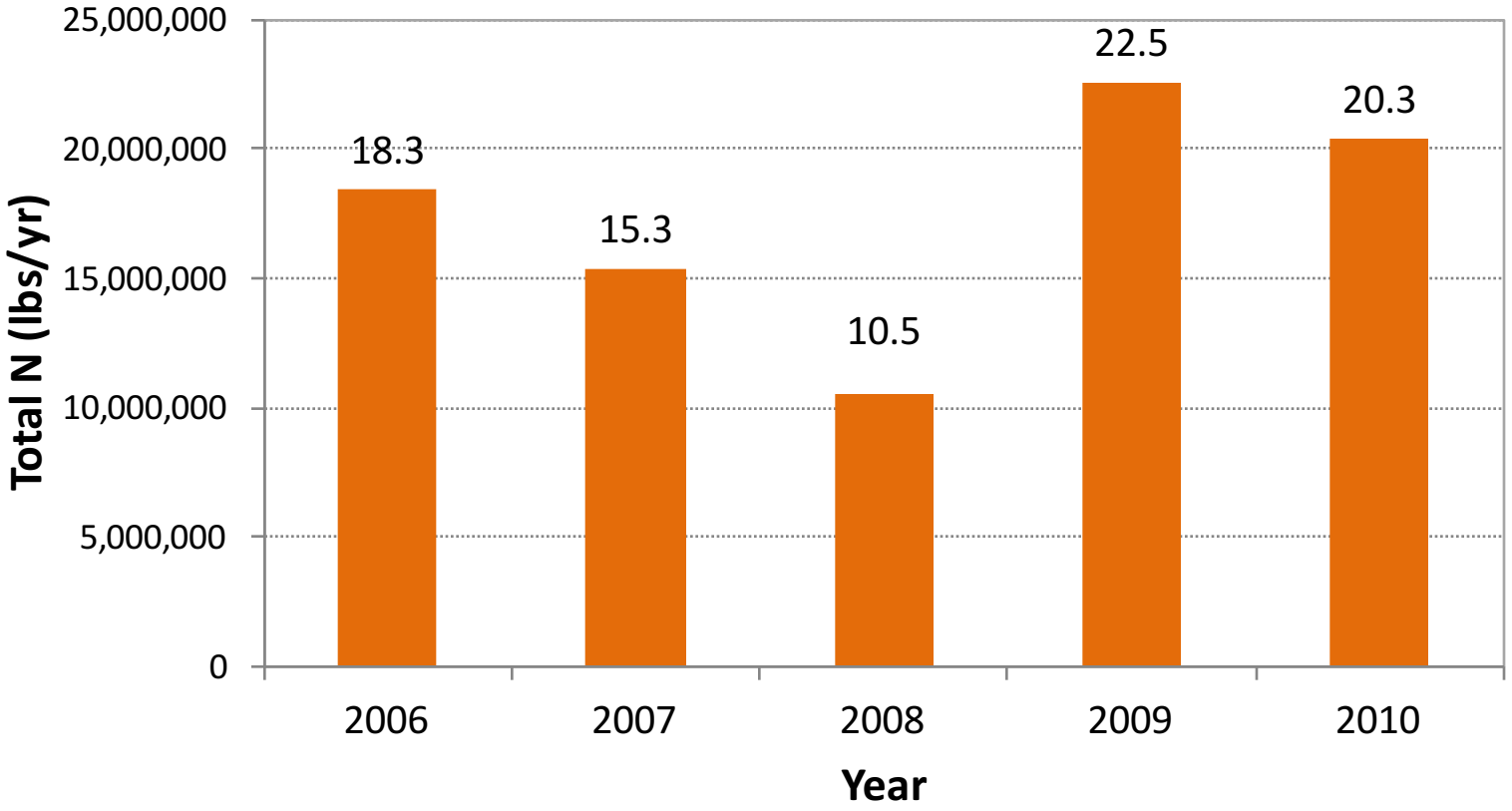
http://www.dnrec.delaware.gov/swc/wa/Pages/InlandBaysPCS.aspx

Tracking TMDL Implementation

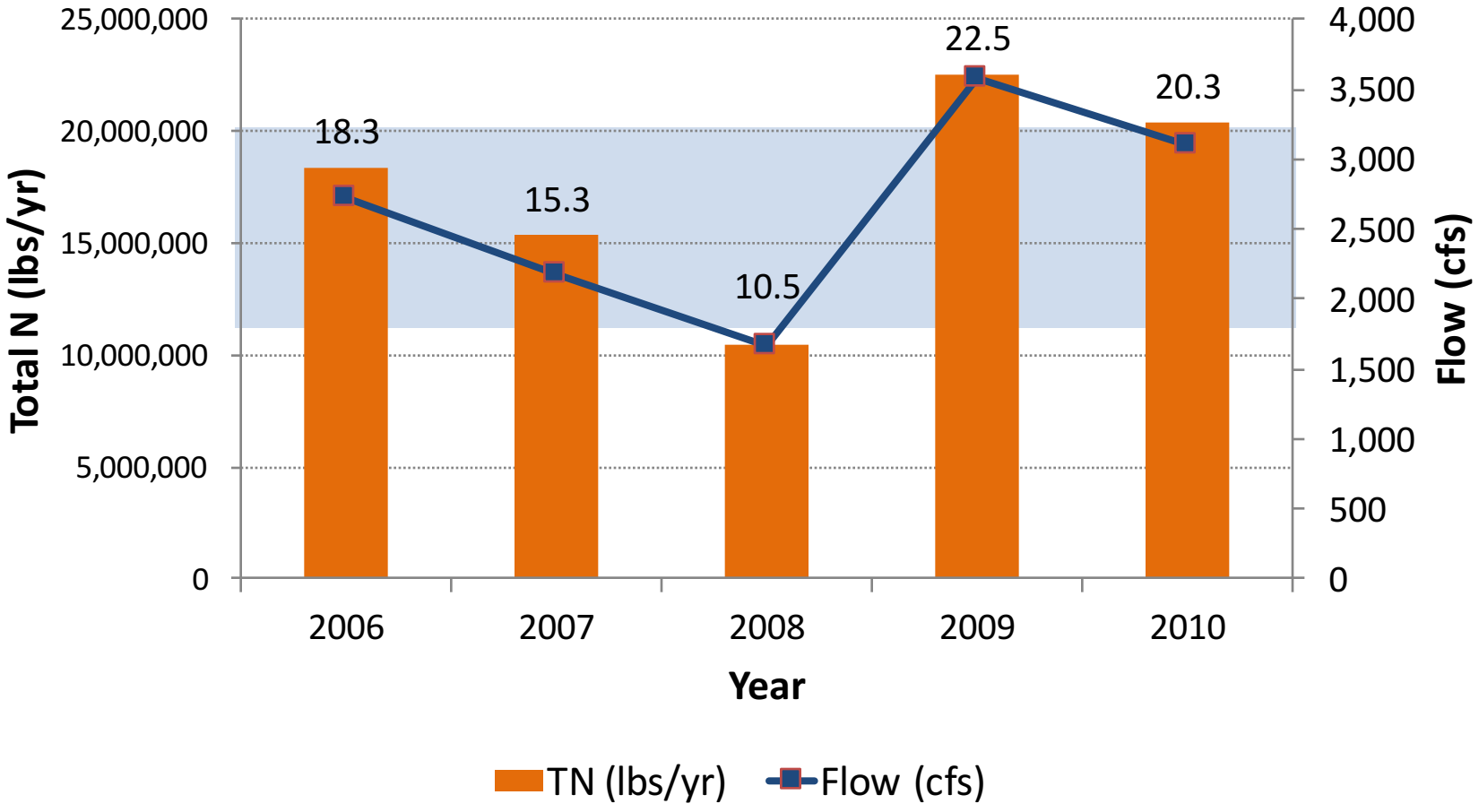
- Programmatic tracking
- Tracking changes in water quality conditions and annual pollutant loads through post TMDL monitoring

Some Results re. annual nitrogen and phosphorus loads

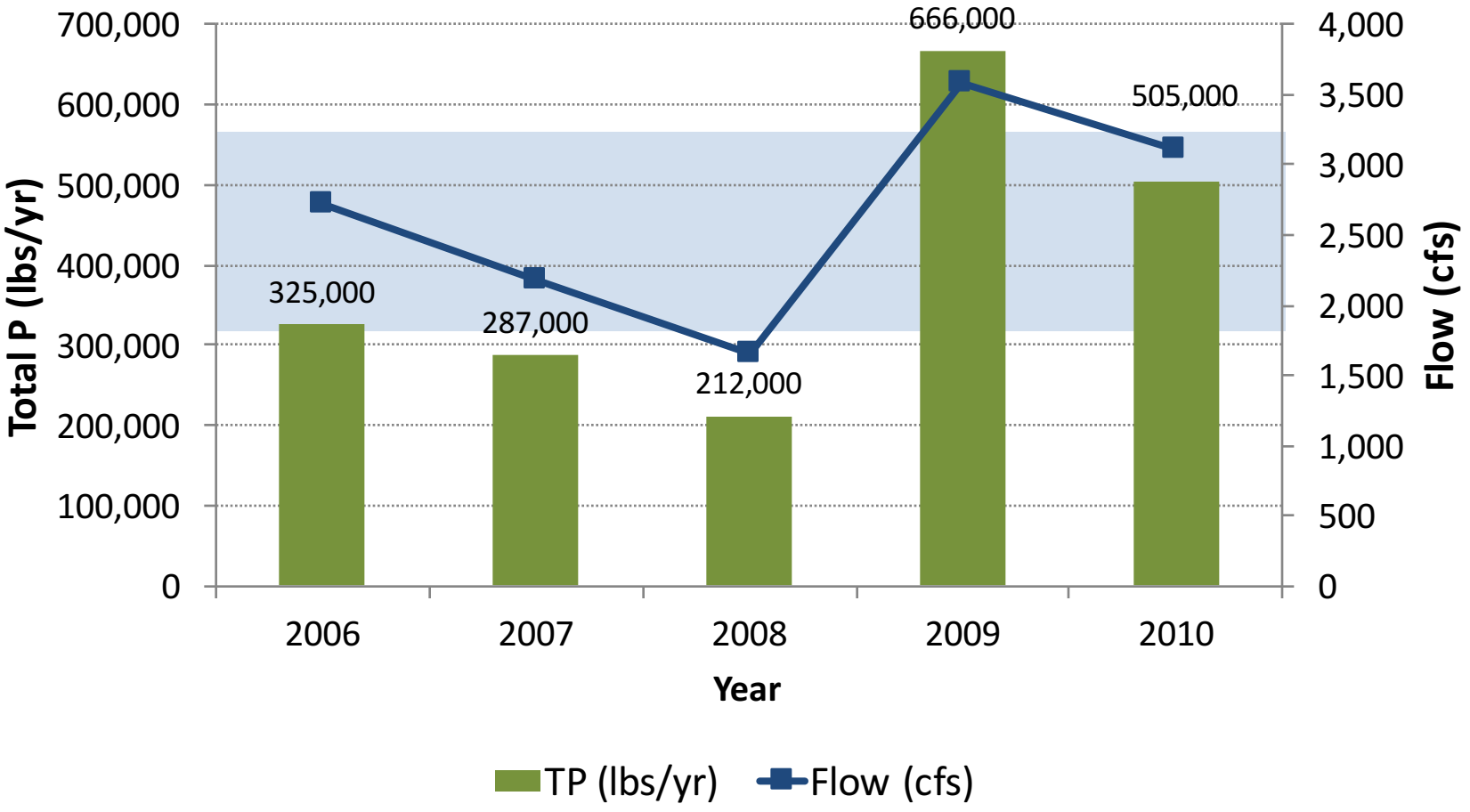
State-wide Annual Nitrogen Load (2006-2010)



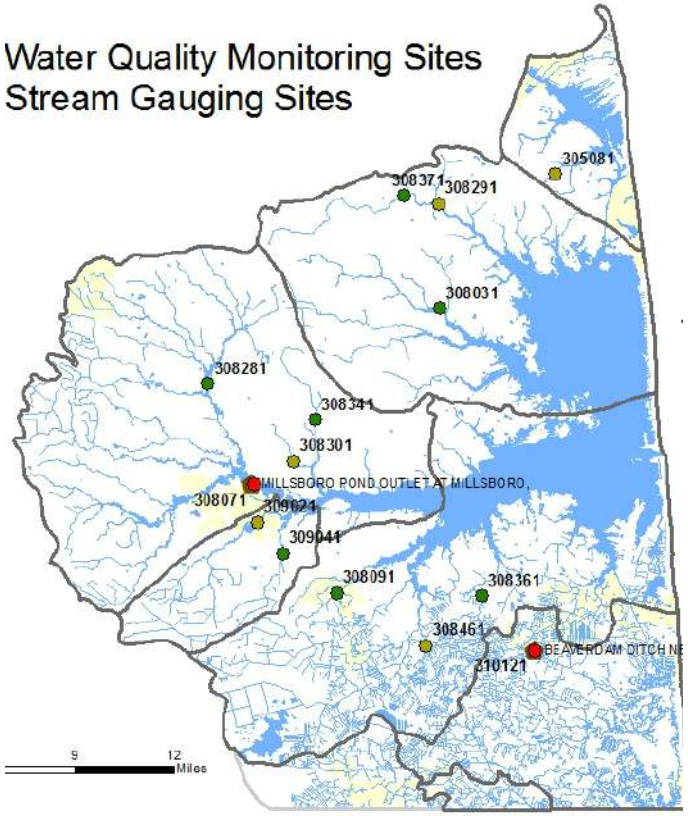
State-wide Annual Nitrogen Load and Flow (2006-2010)

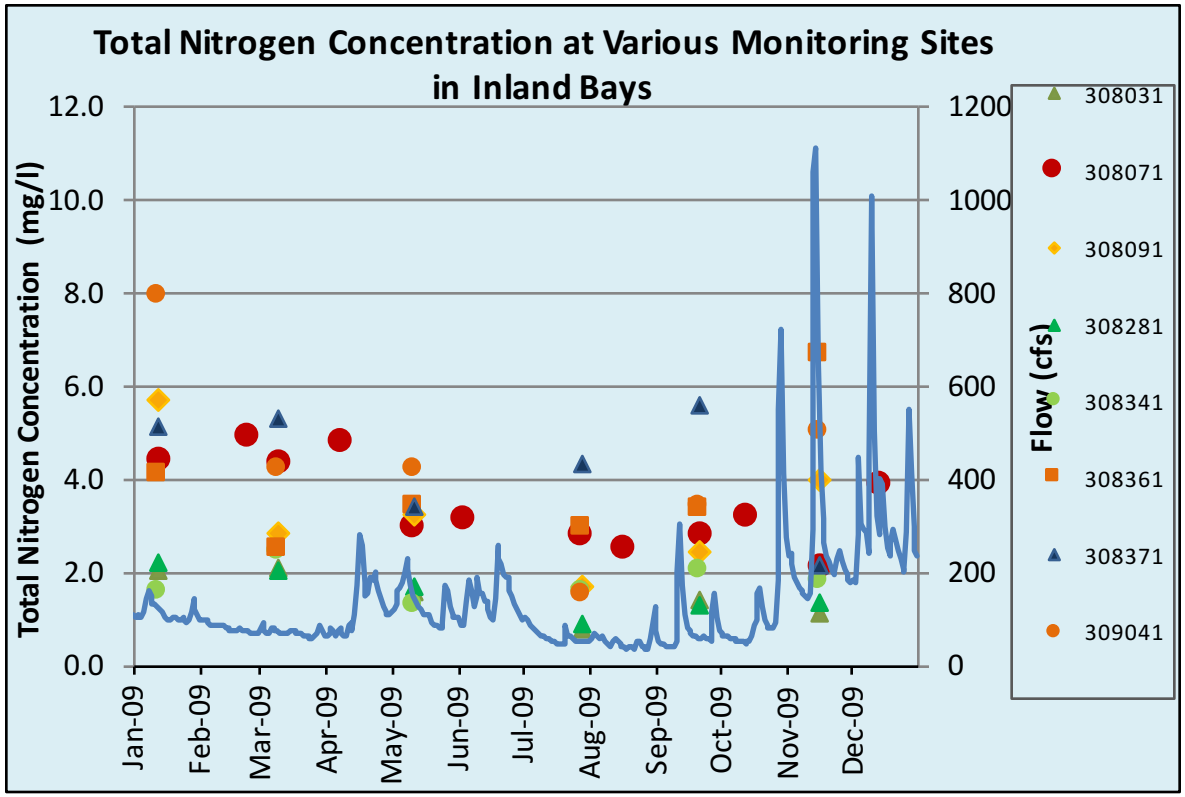


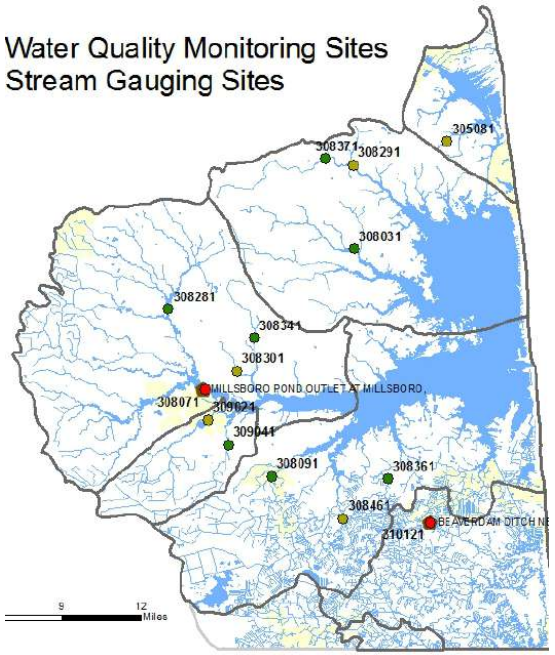
State-wide Annual Phosphorus Load



Review of Water Quality Data and Nutrient Loads in the Inland Bays Watershed (2006-2010)

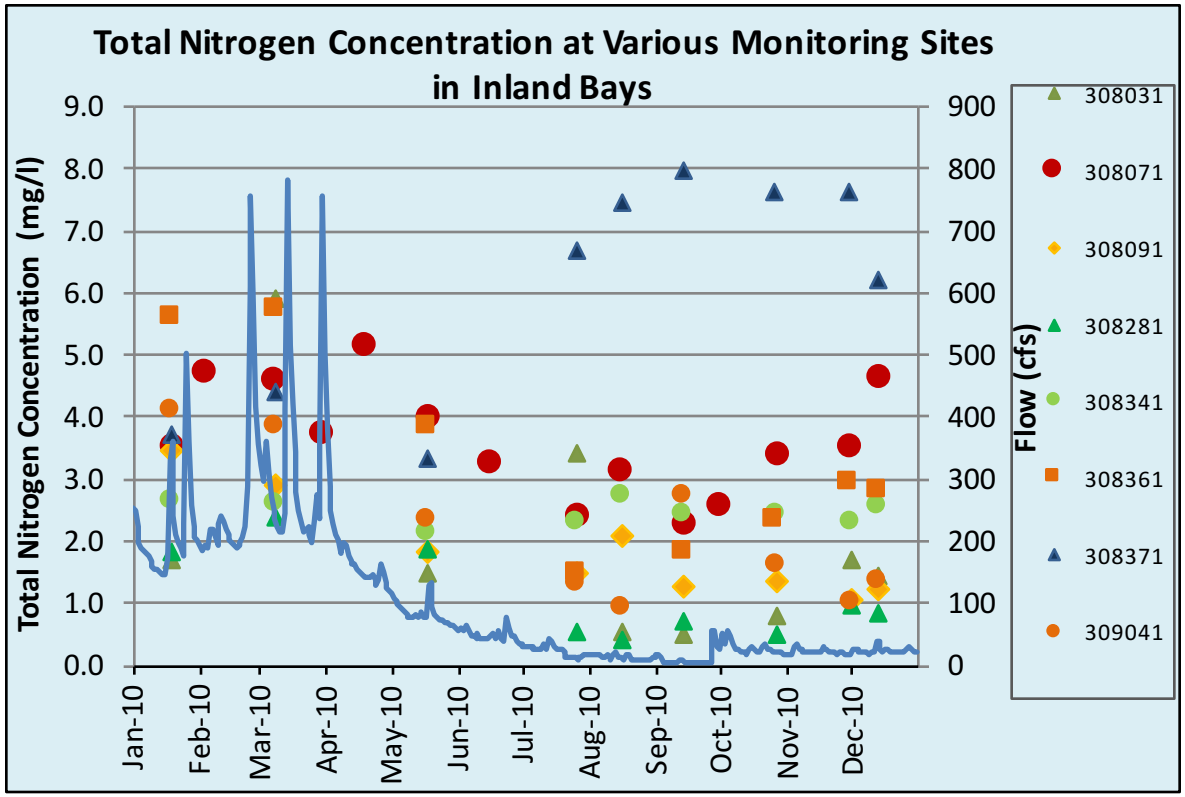


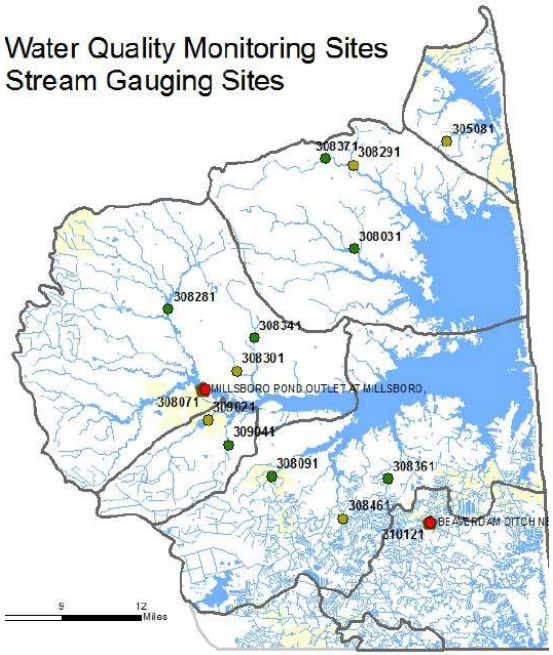




Bundick's Branch - 308371

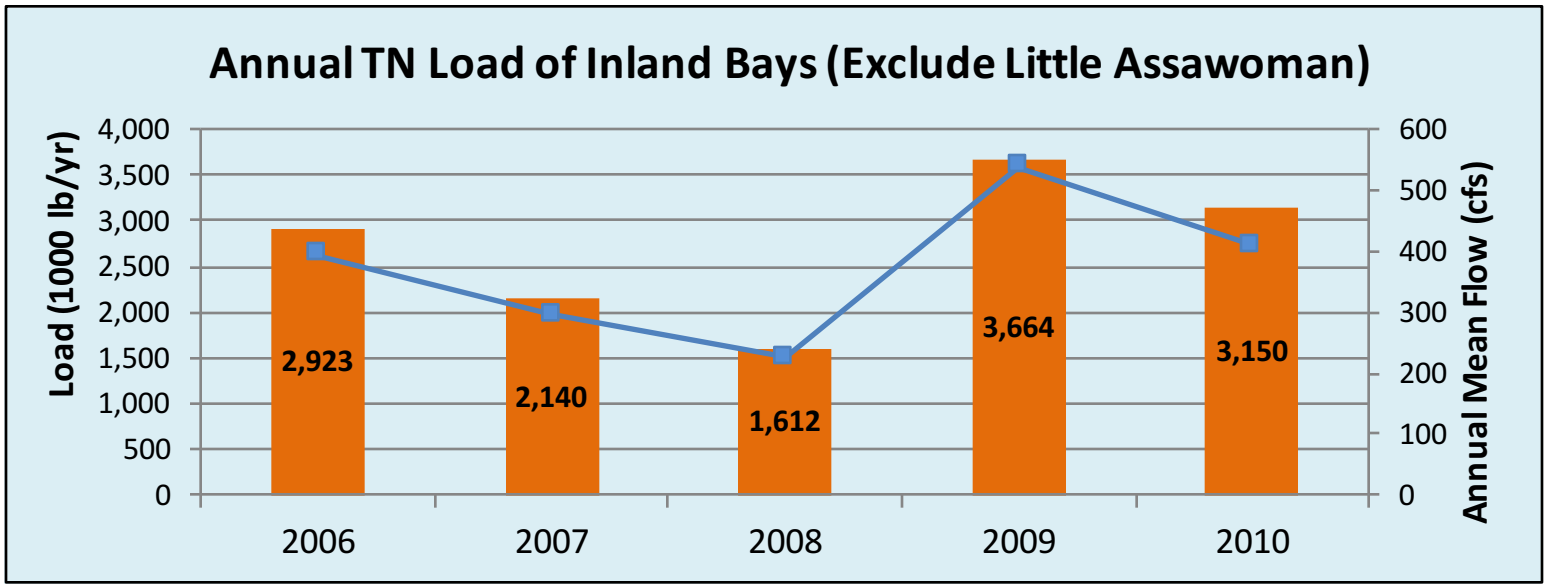
Wharton Branch - 309041

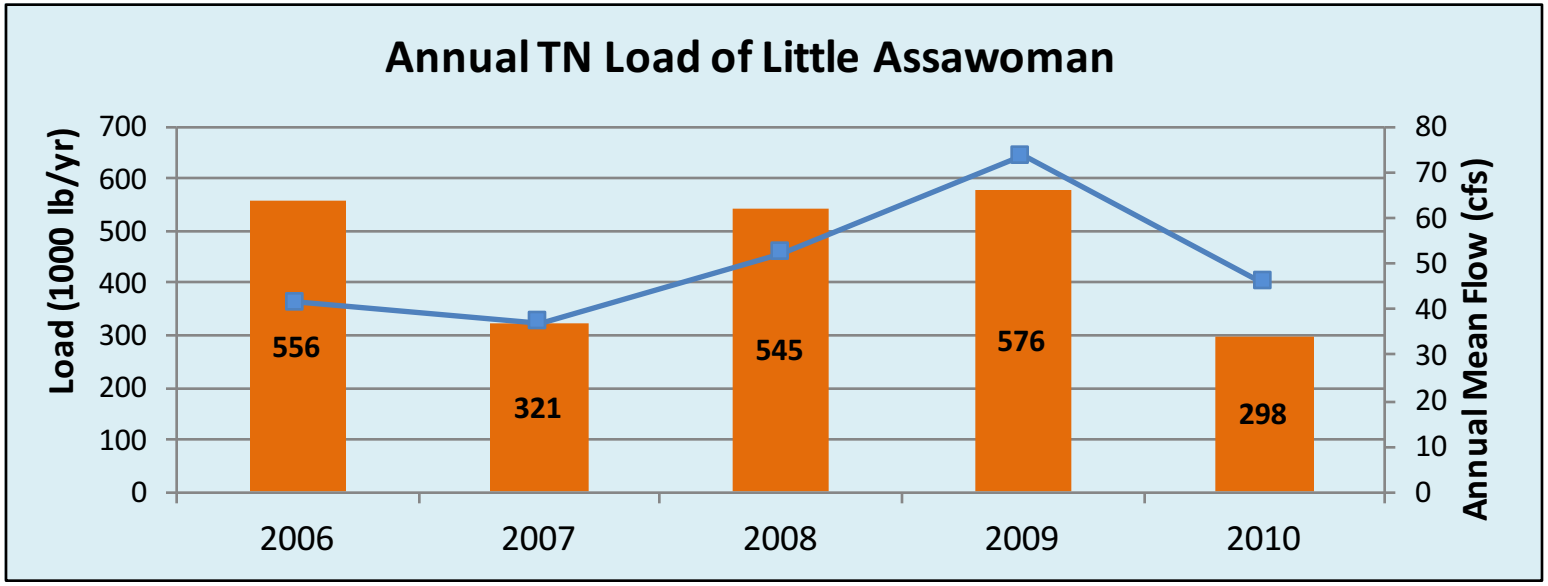


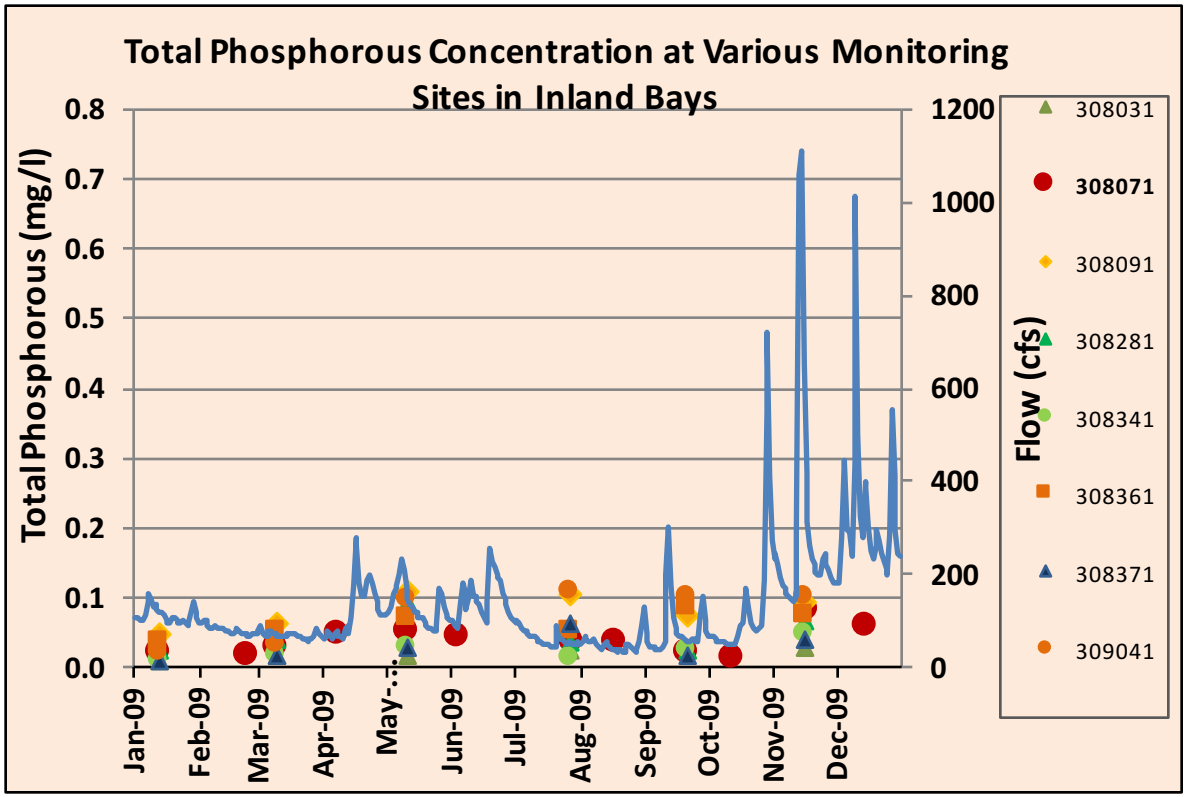


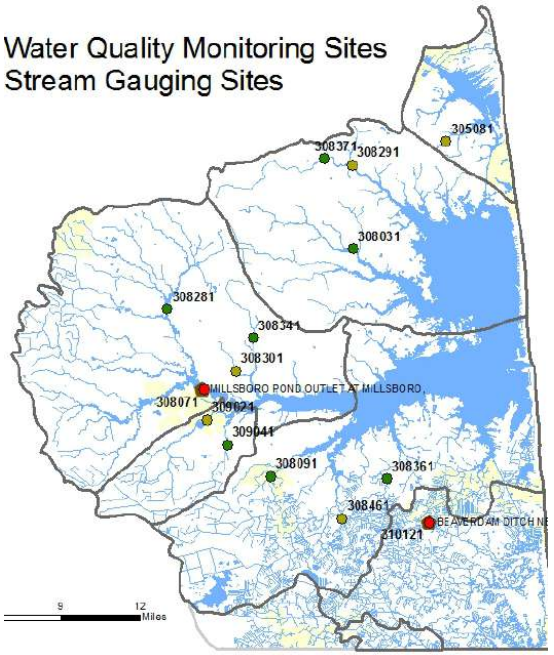
Blackwater Creek - 308361

Millsboro Pond, 308071

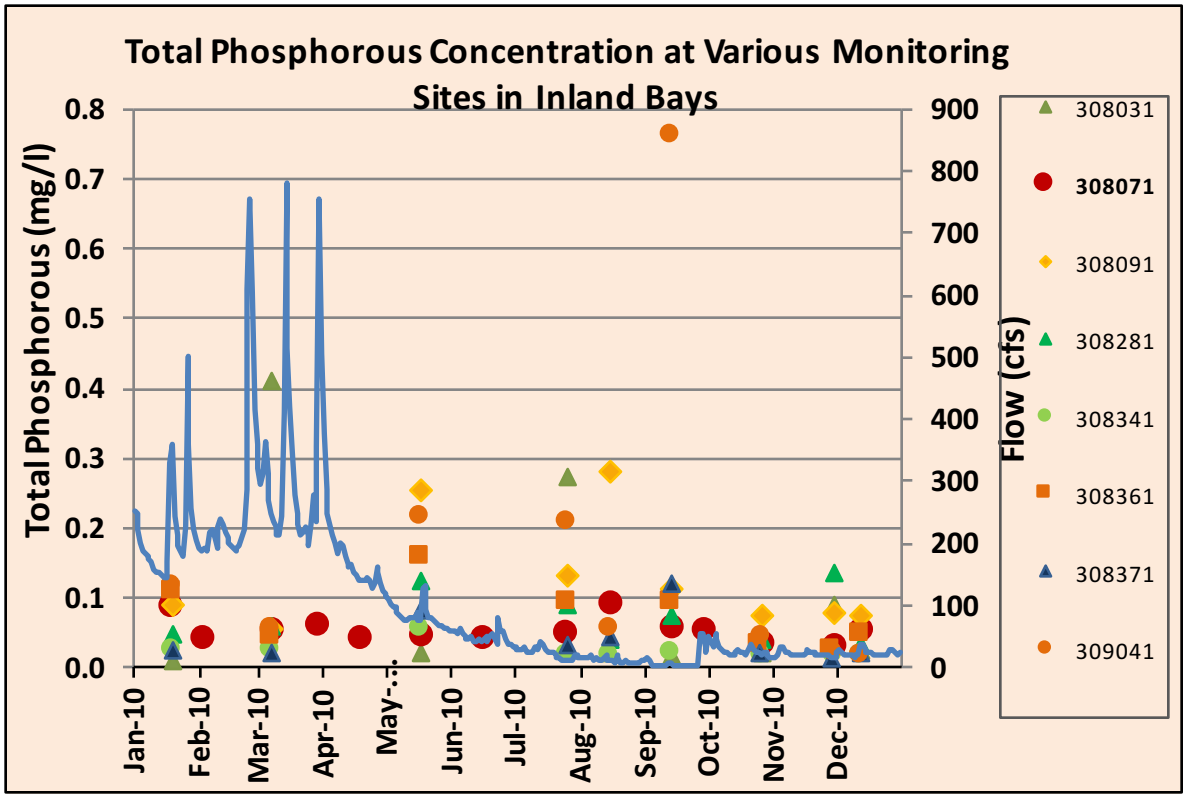

Annual TN Load of Inland Bays (Exclude Little Assawoman)
Load (1000 lb/yr)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
600
500
400
300
200
100
0
Annual Mean Flow (cfs)
2,923
2,140
1,612
3,664
3,150
2006
2007
2008
2009
2010

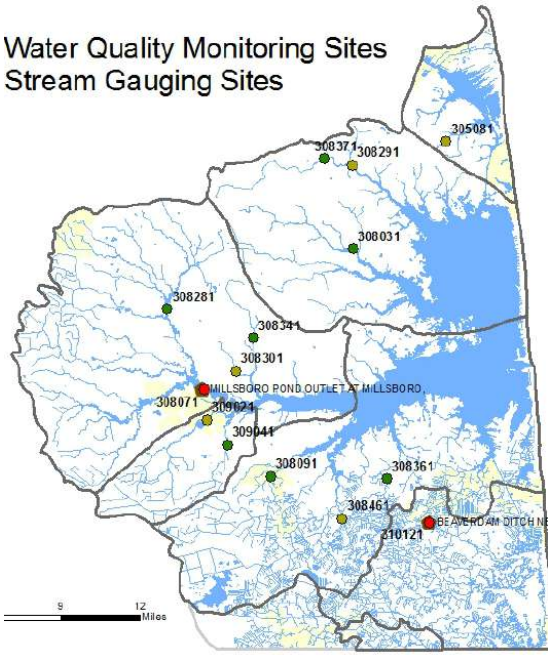

Annual TN Load of Little Assawoman
Load (1000 lb/yr)
700
600
500
400
300
200
100
0
80
70
60
50
40
30
20
10
0
Annual Mean Flow (cfs)
556
321
545
576
298
2006
2007
2008
2009
2010



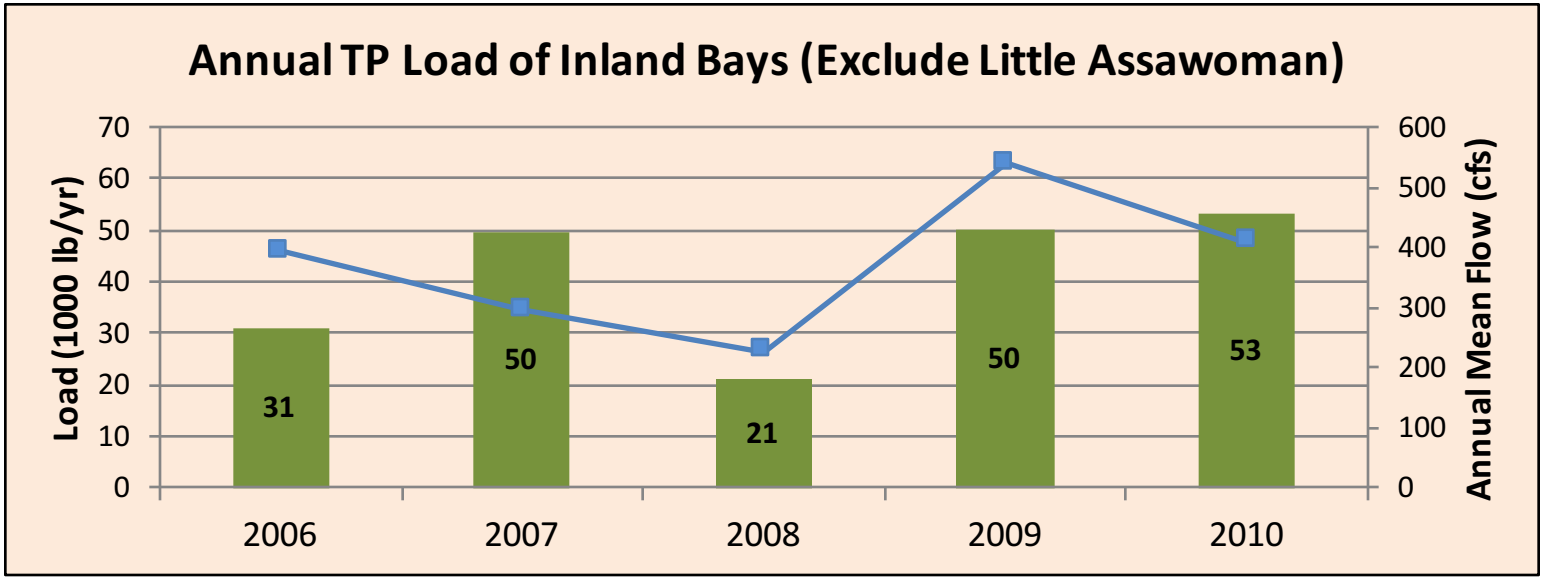


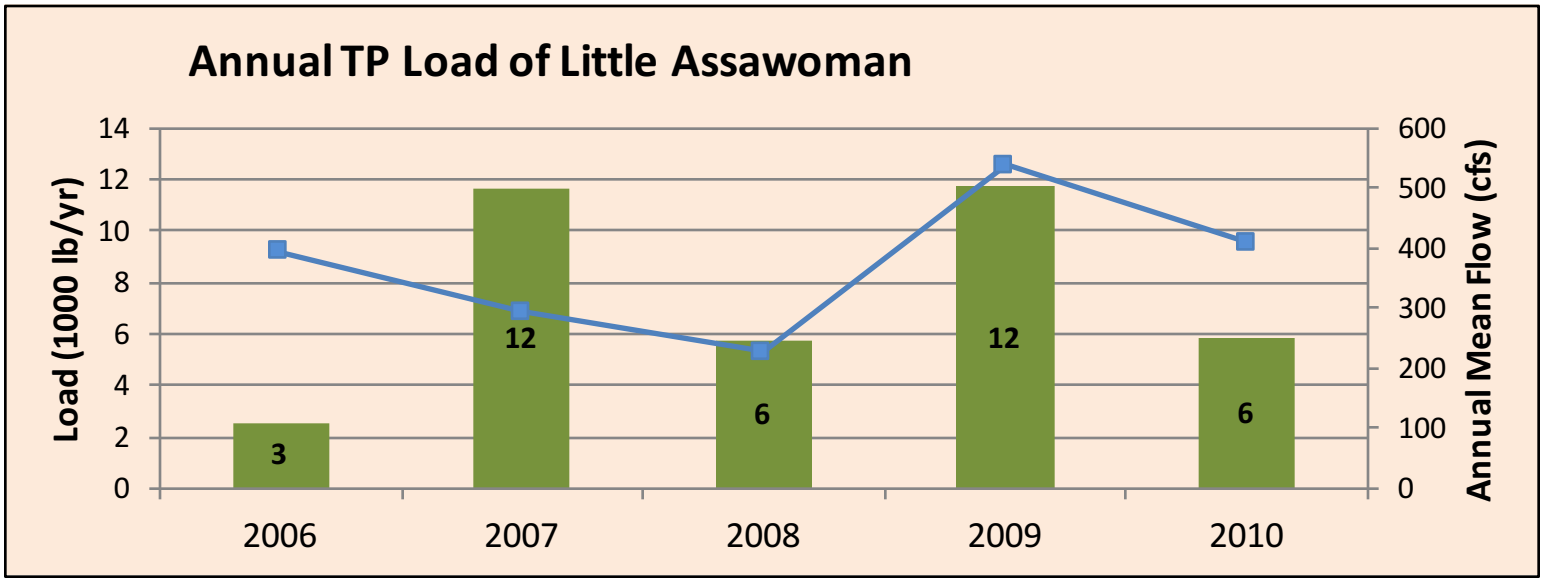
Wharton Branch - 309041





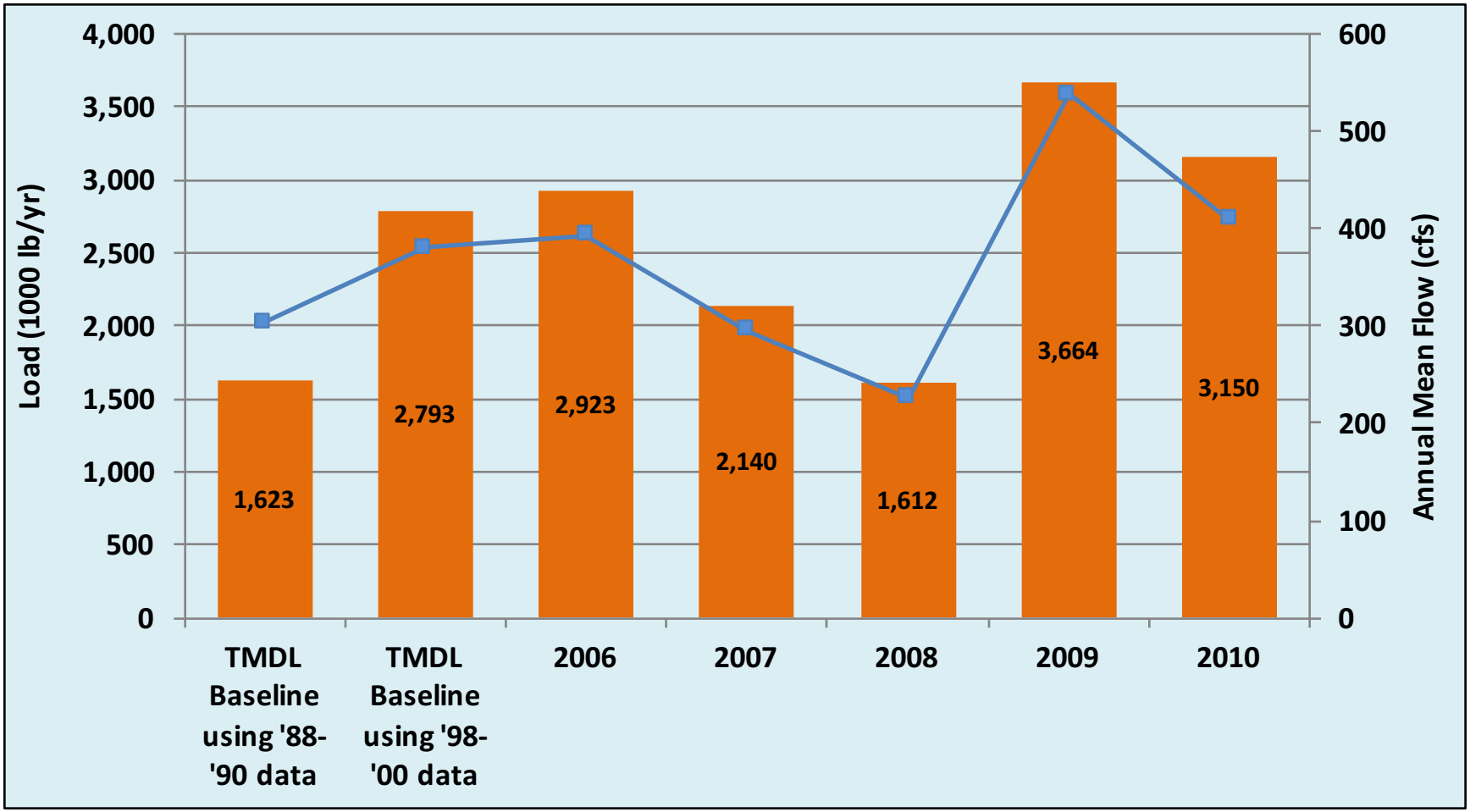
Pepper Creek @ Rt. 26 Bridge - 308091


Annual TP Load of Inland Bays (Exclude Little Assawoman)
Load (1000 lb/yr)
70
60
50
40
30
20
10
0
600
500
400
300
200
100
0
Annual Mean Flow (cfs)
31
50
21
50
53
2006
2007
2008
2009
2010

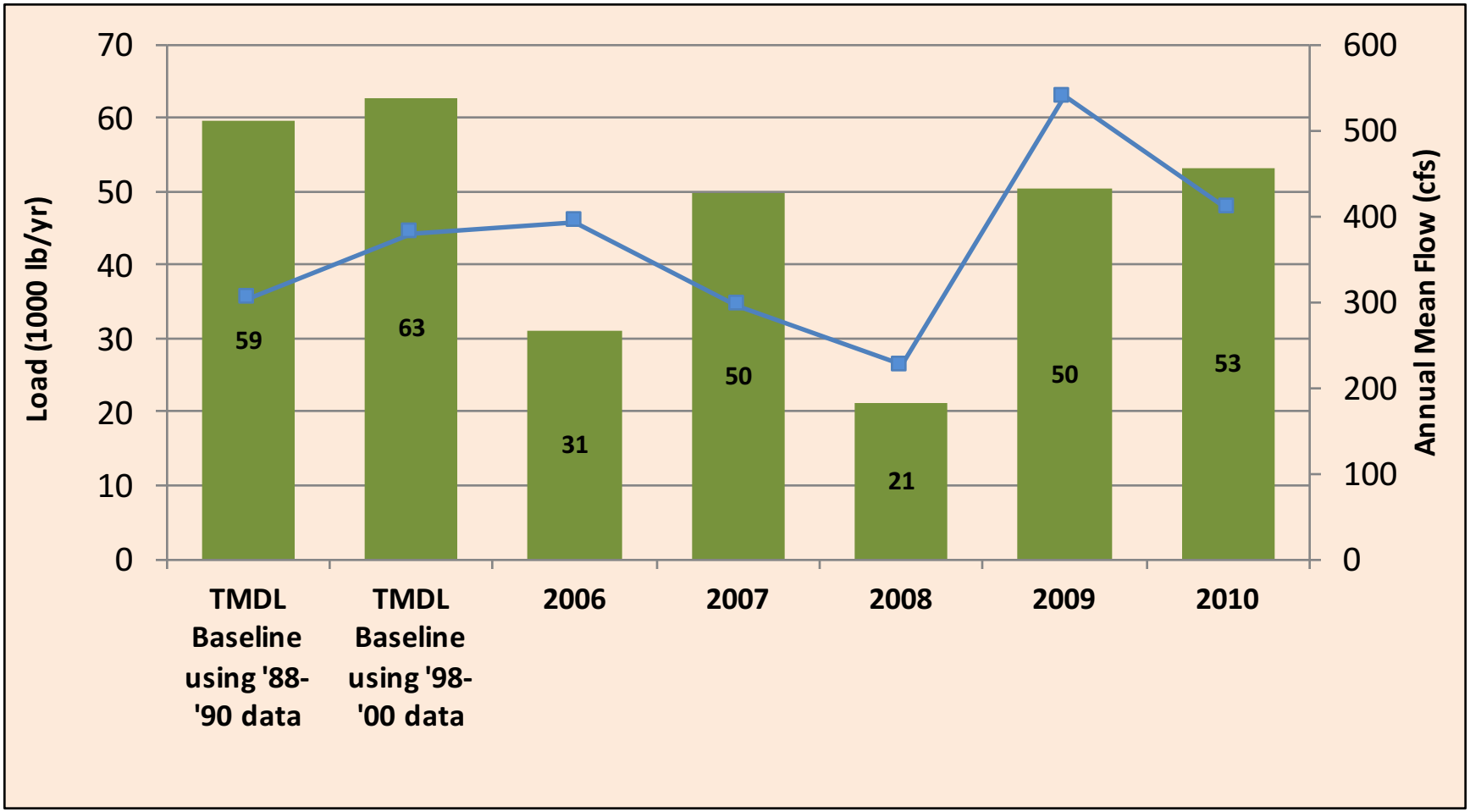

Annual TP Load of Little Assawoman
Load (1000 lb/yr)
14
12
10
8
6
4
2
0
600
500
400
300
200
100
0
Annual Mean Flow (cfs)
3
12
6
12
6
2006
2007
2008
2009
2010

How are we doing compare to nutrient load estimates for late 80’s and late 90’s?

Annual Nitrogen Load over the Years



Annual Phosphorus Load over the Years



To Summarize

- TMDL is an important water quality management tool that DNREC uses to address State's water quality impairments
- Requirements of the TMDLs are implemented through PCS or WIP (Ches. Bay)
- Post TMDL monitoring tracks water quality and loading changes
- From the available data, it appears that we are making some progress with regard to P control and holding the line with regard to N

Thank You!
and
Questions?

For additional information:

Watershed Assessment Section

DNREC Division of Watershed Stewardship

302-739-9939

Hassan.mirsajadi@state.de.us