Maine Ocean Acidification Study Commission

DEP Briefing on Wastewater Issues
9/18/14

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Facilities:[1]

- 208 licensed point source dischargers that discharge to surface water.
  - 138 Publicly Owned Treatment Works (POTWs)
    - Range in size from 20 million gallons per day (MGD) to <0.002 MGD.
  - 170 non-POTWs (Commercial and Industrial, e.g., pulp and paper, food processing, fish hatcheries, non-contact cooling water, etc.)
    - Range in size from 51 MGD to very small intermittent discharges.

- Approximately 1,100 small residential and commercial overboard discharges (OBDs).
  - Most are 300 gallons per day or less and discharge to marine waters. Total nitrogen loadings would be insignificant.

Location:

- Facilities in all areas of the state.
  - Approximately 59 POTWs discharge directly to marine/estuarine waters.
  - Approximately 79 POTWs discharge to rivers and streams at varying distances from marine/estuarine waters.

Treatment:[2]

- POTWs – There are a variety of designs for POTWs. The vast majority use a combination of physical settling, aerobic biological treatment, and disinfection with chlorine or UV light. Biological treatment may be accomplished by lagoons, activated sludge, rotating biological contactors, trickling filters or other means.

- POTWs are generally not designed or operated for nitrogen reduction. While some nitrogen reduction may be achieved in the typical treatment processes currently used, it is incidental to the primary focus of reducing biochemical oxygen demand and total suspended solids.

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[1] See DEP legislative report, *Status of Licensed Discharges*, April 2014, for detailed information on all Maine licensed discharges. http://www.maine.gov/dep/legislative/reports.html

[2] See DEP legislative report, *Development of Nutrient Criteria for Maine's Coastal Waters,* June 2008, for more detailed information on nitrogen treatment technologies and estimated costs. http://www.maine.gov/dep/water/nutrient-criteria/index.html

- In order to achieve purposeful nitrogen reductions in wastewater, changes to wastewater facility infrastructure and operations would be necessary. The most common methods of nitrogen reduction are referred to as Biological Nutrient Removal (BNR). BNR typically involves creating conditions within the treatment facility whereby specific bacteria can convert soluble nitrogen to a nitrogen gas that is removed from the wastewater.

- BNR systems are more complex than typical secondary systems and consequently they require more operator experience to operate successfully.

- Costs for retrofitting existing POTWs for nitrogen treatment can be significant and can vary greatly based on many factors. Average per unit capital costs for BNR upgrades in Maryland and Connecticut ranged from $588,000 to $6.9 million per MGD based on the relative size of the facility.[2]

- The limit of technology for treatment of nitrogen in a POTW is generally considered to be 3 mg/L total nitrogen (TN).

- POTWs are typically funded through user rates. Capital improvements are typically funded through a mixture of loans and grants from various federal and state sources and increases in user rates.

- Current known POTW infrastructure upgrade needs in Maine for treatment facilities, pump stations, sewers and combined sewer overflow abatement is in excess of $1 billion.[1]

Effluent Quality:

- There is limited data for Maine discharges for nitrogen. Nitrogen is typically not a currently regulated parameter in wastewater discharge licenses. It is expected that nitrogen discharges may be limited in the future for certain discharges based on the development of a nitrogen water quality criteria.

- Literature value for total nitrogen from secondary treated wastewater from POTWs is approximately 20 mg/L for TN.

- <u>2008 Southern Maine study:</u>
  - Seven facilities[3] discharging to Casco Bay conducted nitrogen monitoring.
    - Five POTWs averaged between 14.2 mg/L - 16.9 mg/L TN.
    - One POTW[4] averaged 7.9 mg/L TN.
    - S.D. Warren averaged 3.0 mg/L total TN.

[3] Portland Water District-East End, Portland Water District-Westbrook, South Portland, Falmouth, Yarmouth, Freeport, S.D. Warren.
[4] Falmouth

- In July of 2014, the DEP requested all freshwater dischargers (N=109) voluntarily monitor their effluent and receiving waters for total phosphorus and total nitrogen. This data should be received by the Department in late October. This data is being collected to help determine if water quality based limits are needed for certain phosphorus discharges to freshwater, and to help characterize nitrogen loading from rivers and streams to marine waters.

CSOs: [5]

- A CSO is the discharge of untreated wastewater from municipal sewer systems that carry a mixture of sanitary sewage, stormwater and sometimes commercial or industrial wastewater.

- 33 municipal and quasi-municipal entities have licensed combined sewer overflows (CSO).

- There is very limited data for TN for CSO discharges. The June 2008 DEP Legislative report[2] listed CSO discharges at a Total Kjeldahl Nitrogen at 5 mg/L.

- CSOs are regulated with existing requirements to abate the CSOs based on facility specific Long Term Control Plans.

- All progress metrics for CSO abatement[6] show a steady and significant decline.

Bypasses and Sanitary Sewer Overflows:

- A bypass is the diversion of wastewater around some portion of the treatment plant. Bypasses may occur due to malfunctions at the treatment plant.

- A sanitary sewer overflow (SSO) is the discharge of untreated wastewater from a sewer system due to a malfunction such as a broken line, clog, or malfunctioning pump station.

- Bypasses and sanitary sewer overflows occur infrequently and when they do occur, they are of limited duration. Total bypass and SSO volume discharged would be insignificant as a percentage of any licensed discharge.

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[5] See DEP report, *Maine Combined Sewer Overflow 2013 Status Report*, June 2014, for detailed information on CSOs. http://www.maine.gov/dep/water/cso/index.html

[6] Number of CSO points, numbers of CSO events, volume discharged and volume discharged per inch of precipitation.

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DEP Briefing on Nutrient Criteria Issues
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Overview of Nutrient Criteria Actions:

- Based on authority provided by the Clean Water Act, the Environmental Protection Agency (EPA) created the National Nutrient Criteria program in 1998 to form national and regional nutrient programs. In 2004, the EPA defined expectations for states to develop numeric nutrient criteria for nitrogen and phosphorus in jurisdictional waters, and required states to demonstrate annual progress. For information about EPA actions relative to nutrient policy, see http://www2.epa.gov/nutrient-policy-data/what-epa-doing
- Nutrient criteria are numeric thresholds and/or response indicator thresholds that protect designated and existing uses in the marine environment including recreation, fishing, aquaculture, **propagation and harvesting of shellfish**, and habitat for fish and other estuarine and marine life.
- DEP freshwater criteria development (total phosphorus [TP]): Freshwater criteria incorporate a seasonal mean TP concentration criterion for each waterbody classification and seasonal biological response indicator criteria for appropriate waterbody types (lakes, streams, rivers). DEP worked with EPA to draft Chapter 583. DEP has since placed Ch. 583 on hold until discharge and ambient phosphorus data collected as part of the 2014 voluntary monitoring are available for Reasonable Potential analysis. Ch. 583 allows flexibility to set site-specific nitrogen limits.
- DEP marine waters criteria development (total nitrogen [TN]): The 123rd Maine Legislature enacted Resolve 2007, Chapter 49, requiring the DEP to initiate development of water quality criteria for nutrients in Maine's coastal waters by creating 1) a conceptual plan to establish nutrient criteria, 2) a workplan and timeline leading to approved nutrient criteria, 3) a report on technological approaches to nutrient reduction in wastewater, and 4) an inventory of significant point and non-point sources of nutrients to Casco Bay. The outcome of these charges was reported in June 2008[1].
    - 2008 report provided projected timeline for development of nutrient criteria for coastal waters of five to 11 years, with effects-based criteria requiring a much greater amount of time. Given this, a preliminary deadline of 2012 was established. The deadline has since been revised to December 2015.

Possible Marine Nitrogen Criteria Approaches:

- The EPA has published guidance on the use of stressor-response (effects-based) relationships to derive numeric nutrient criteria. Such a relationship would measure the response of an indicator, biological or chemical, to a range of nitrogen concentrations within the aquatic environment. States including New Hampshire, Rhode Island, Florida, Oregon and California, are investigating or currently utilizing indicators and/or mechanistic modeling for nitrogen criteria.
    - For the development of nitrogen criteria, bioassessment involves the characterization of particular aquatic community responses to varying concentrations of nitrogen. Mechanistic modeling involves the use of mathematical predictions based on real monitoring data from representative

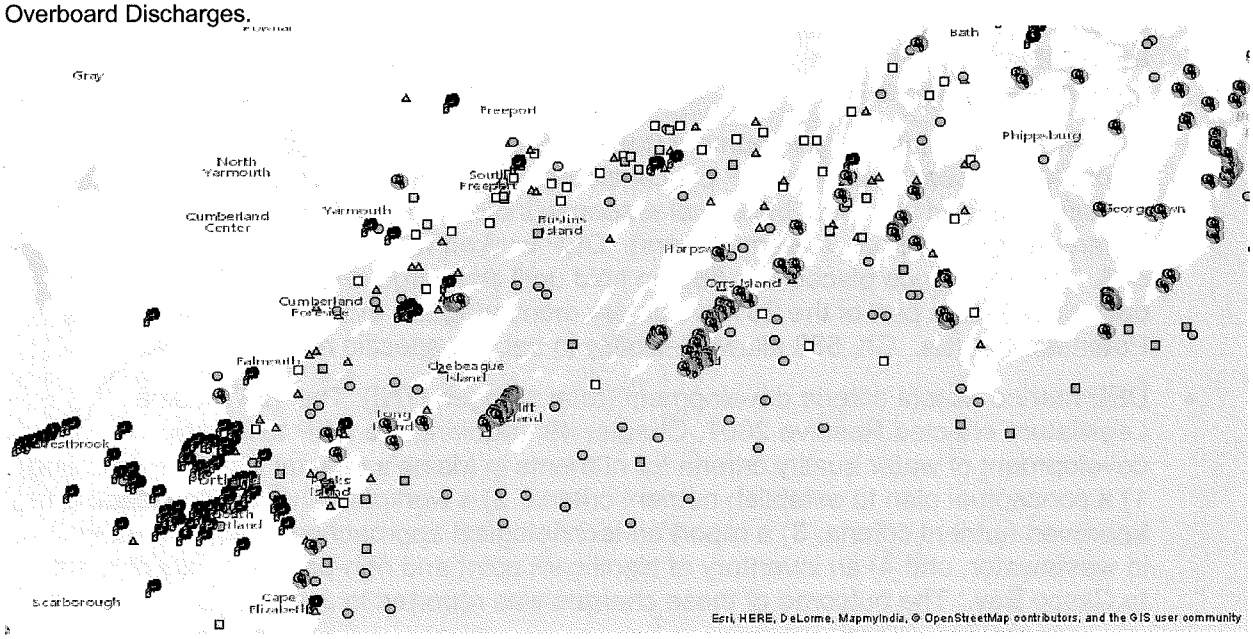
[1] Maine Department of Environmental Protection. 2008. Development of Nutrient Criteria for Maine's Coastal Waters. Report to the Legislature. http://maine.gov/dep/water/nutrient-criteria/nutrient_criteria_report_2008.pdf

systems to assess watershed and oceanic nitrogen loading to particular catchments. The use of bioassessment and/or mechanistic modeling often strengthens stressor-response relationships and allows a more complete picture of nutrient sources and loads affecting particular waterbodies as well as biological responses of indicator communities. One or a combination of these approaches will be necessary to create defensible nitrogen criteria for Maine's marine waters.

Available Data and Gaps:

- Available:
  - Statewide, thousands of ambient nitrogen data points and associated physical and chemical data from several organizations/agencies (Friends of Casco Bay, DEP, EPA, others), with focus on Casco Bay—data mostly from 1990s-present

Figure 1. Example of ambient data locations in colored symbols within Casco Bay relative to point source discharges. Black outfall symbols represent regulated discharges (treated and untreated) and red outfall symbols represent active Overboard Discharges.



- Gaps:
  - Nitrogen concentrations and paired biological indicator data, including chlorophyll *a*, opportunistic benthic macroalgae, eelgrass and epiphytes
  - High resolution data that capture behavior of nitrogen species and response indicators over tidal cycles and days as opposed to months or years
  - Data from lower salinity portions of estuaries
  - Confounding factors (circulation, optical water column properties, invasive species, eg.)
  - Efforts to connect nitrogen loading, ambient nitrogen concentrations, uptake and burial in sediments, biological response (where it exists)

[2] Moore, R.B., C.M. Johnston, R.A. Smith, and B. Milstead, 2011. Source and Delivery of Nutrients to Receiving Waters in the Northeastern and Mid-Atlantic Regions of the United States. *Journal of the American Water Resources Association (JAWRA)* 1-26.

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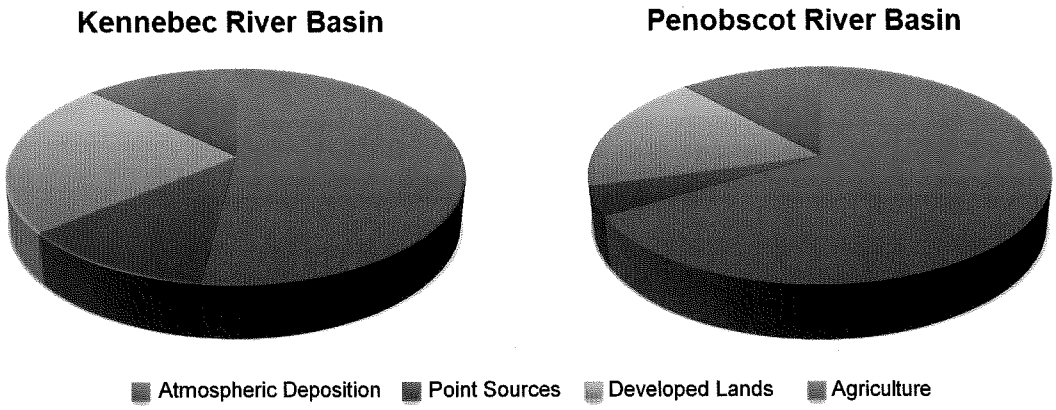
Nutrient Loads and Reduction Examples:

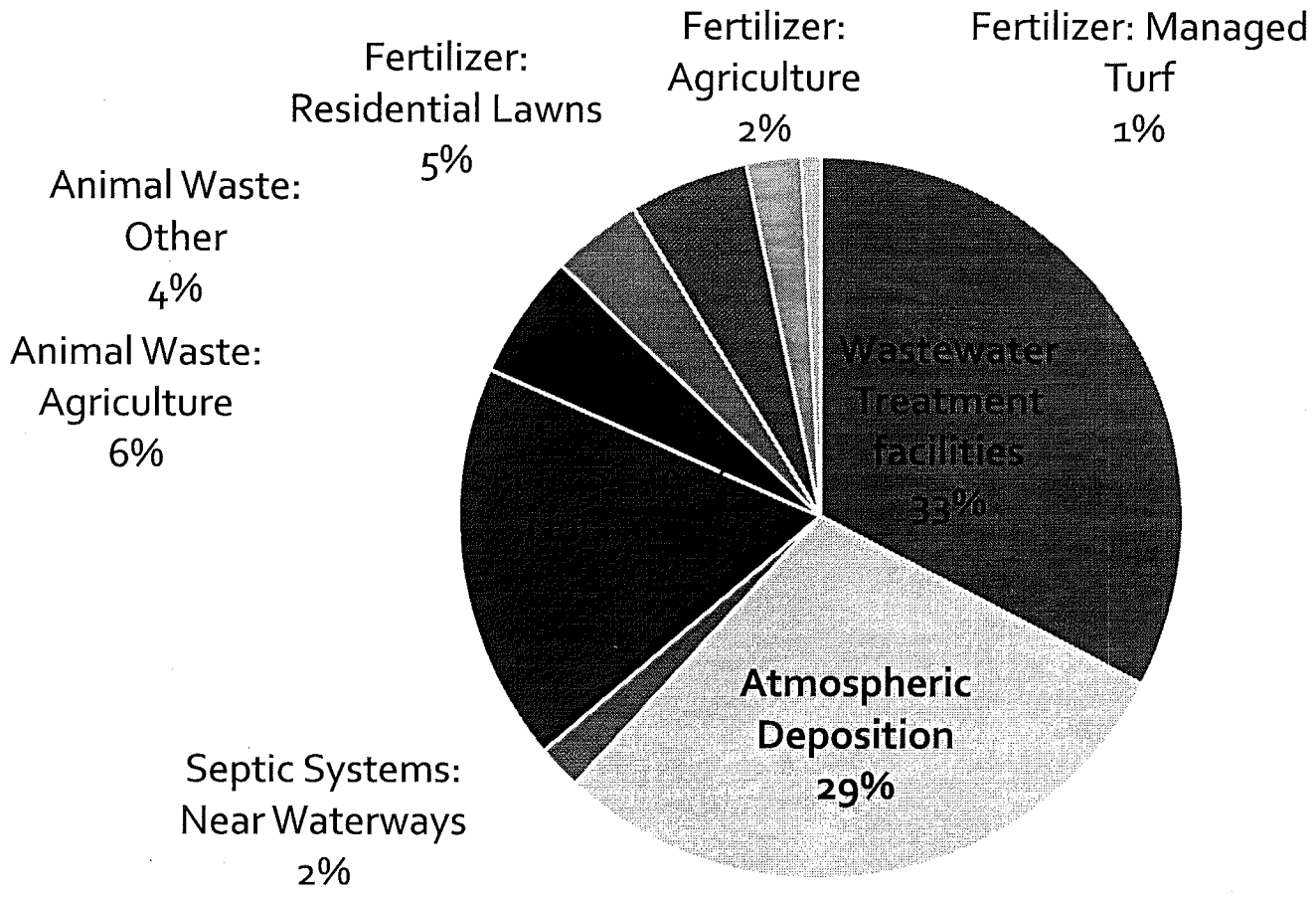
- SPAtially Referenced Regressions on Watershed attributes (SPARROW) used to estimate source and delivery of nitrogen to receiving waters[2]

Figure 2. Predicted percent nitrogen contributions from various sources in the Kennebec and Penobscot River Basins. Plots created from data in Moore et al. (2011)[2].



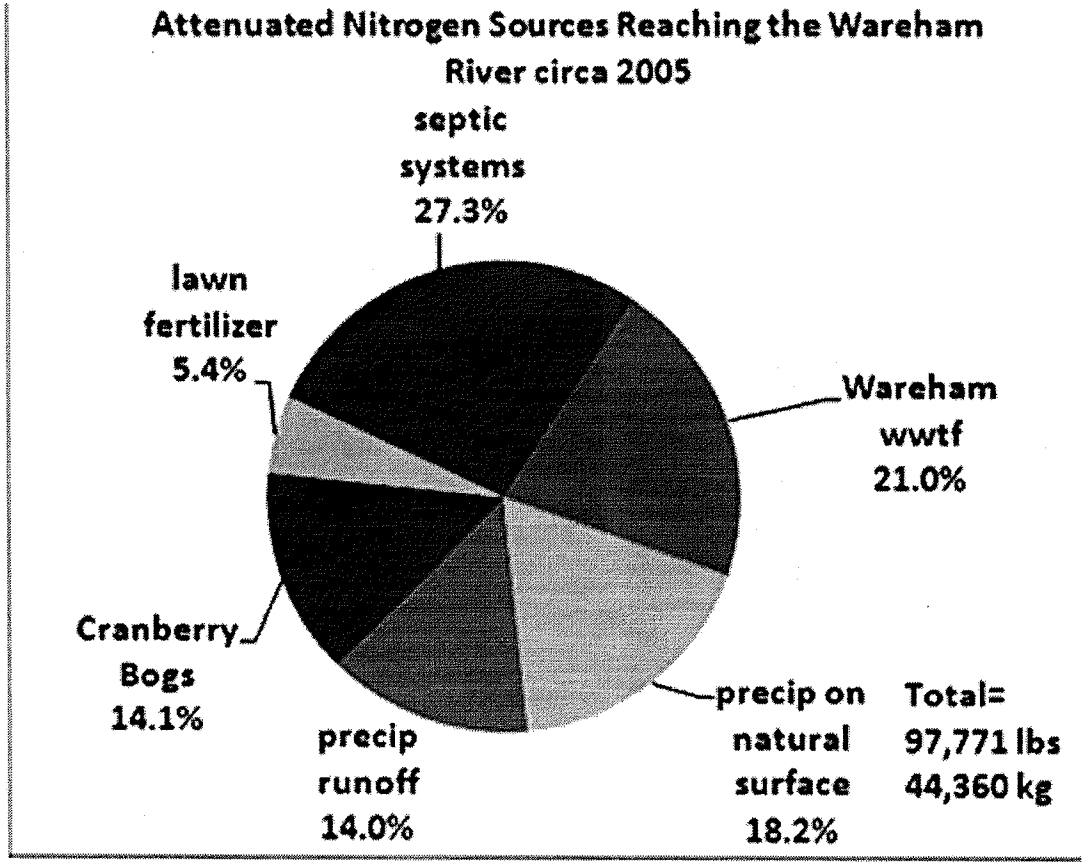
- Via Total Maximum Daily Loads (TMDLs) to reduce point and non-point nitrogen loads:
  - Long Island Sound: http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/long_island_sound.cfm
  - Massachusetts Bays: http://buzzardsbay.org/mep-made-simple.html
  - Chesapeake Bay: http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/FinalBayTMDL/CBayFinalTMDLExecSumSection1through3_final.pdf

Nitrogen Loads to Great Bay (NH)



Source: New Hampshire Department of Environmental Services "Great Bay Nitrogen Non-Point Source Study", June 16, 2014
Link: http://des.nh.gov/organization/divisions/water/wmb/coastal/documents/gbnnpss-report.pdf

Nitrogen Loads to the Wareham River (MA)



Source: Buzzards Bay National Estuary Program . "Wareham River Subwatershed: Land Use and Nitrogen Loading. October 19, 2011
Link: http://buzzardsbay.org/wareham-river-subwatershed.htm

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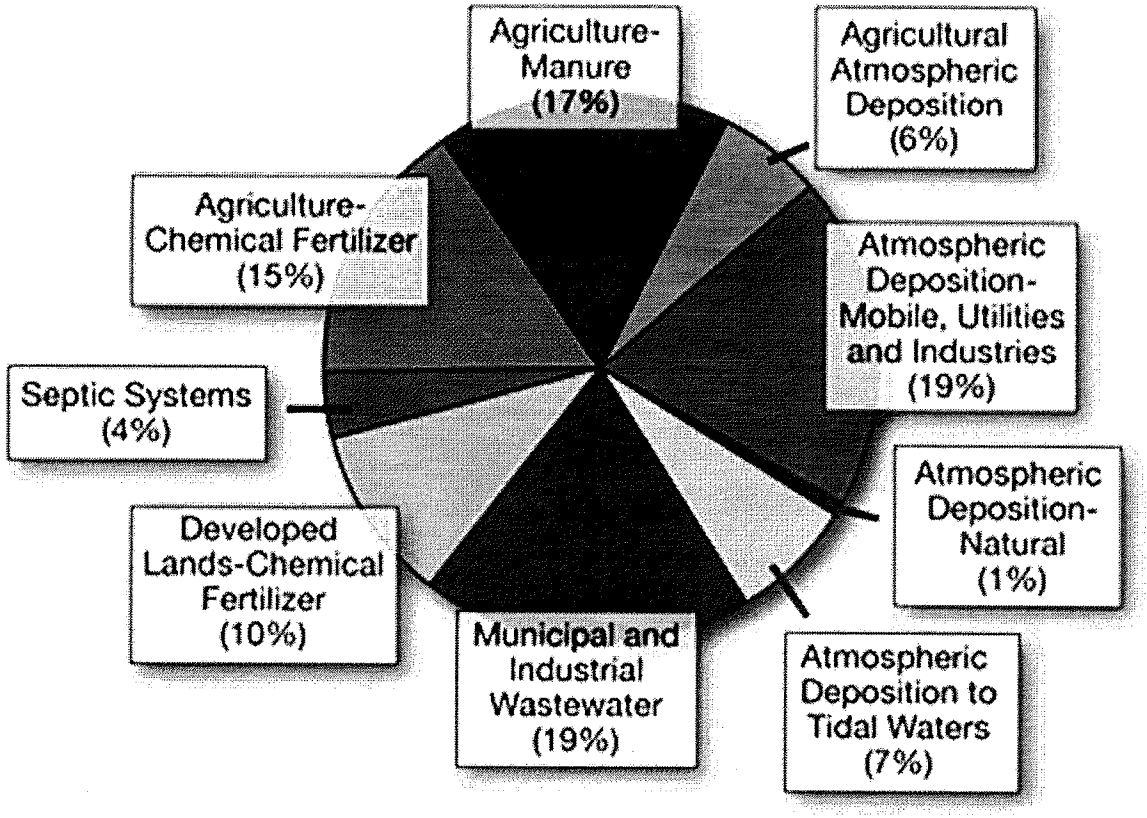
Nitrogen Loads to the Chesapeake Bay



Source: United States Environmental Protection Agency, "Our Nation's Air: Status and Trends Through 2008". EPA-454/R-09-002. February 2010. Contract No. EP-D-05-004 Work Assignment No. 5-7
Link: http://www.epa.gov/airtrends/2010/