DRAFT Great Bay Nitrogen Non-Point Source Study

by
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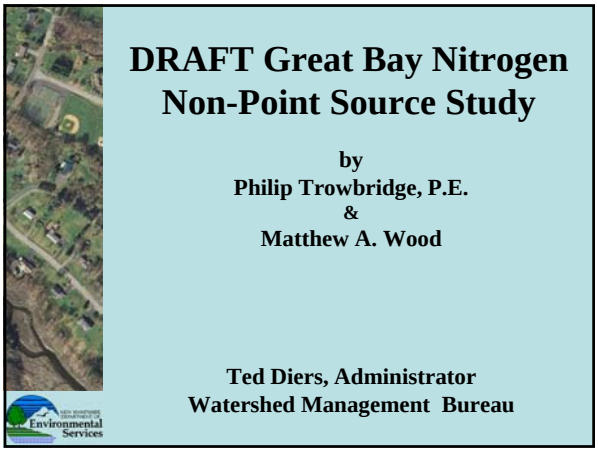
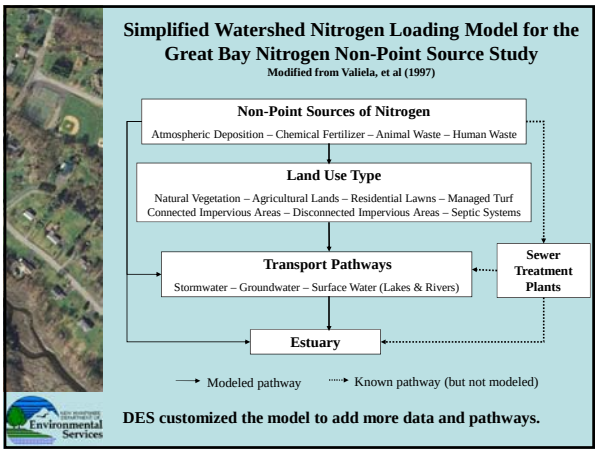
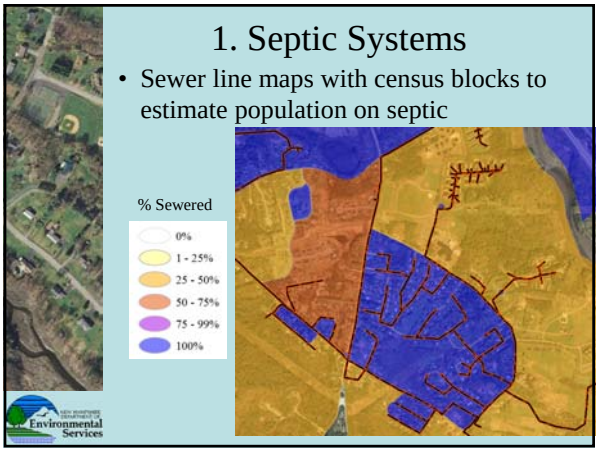
Watershed Management Bureau

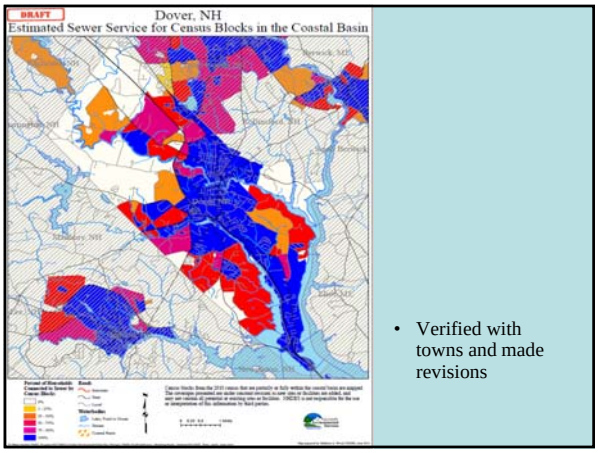


Open up the "black box"

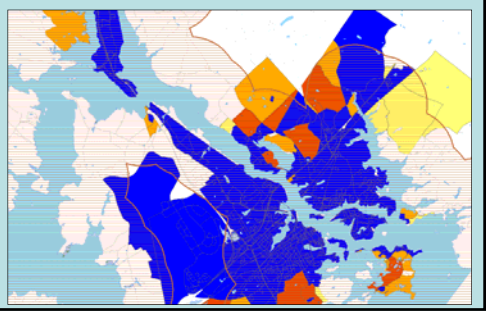
Non-Point Sources of Nitrogen


Simplified Watershed Nitrogen Loading Model for the Great Bay Nitrogen Non-Point Source Study
Modified from Valiela, et al (1997)
Non-Point Sources of Nitrogen
Atmospheric Deposition – Chemical Fertilizer – Animal Waste – Human Waste
Land Use Type
Natural Vegetation – Agricultural Lands – Residential Lawns – Managed Turf
Connected Impervious Areas – Disconnected Impervious Areas – Septic Systems
Transport Pathways
Stormwater – Groundwater – Surface Water (Lakes & Rivers)
Sewer Treatment Plants
Estuary
Modeled pathway
Known pathway (but not modeled)
DES customized the model to add more data and pathways.


1. Septic Systems
• Sewer line maps with census blocks to estimate population on septic
% Sewered
0%
1 - 25%
25 - 50%
50 - 75%
75 - 99%
100%


DRAFT
Dover, NH
Estimated Sewer Service for Census Blocks in the Coastal Basin
• Verified with towns and made revisions

- 200-meter buffer around estuaries and large rivers
- Estimated population on septic in the buffer



Delivery Factors

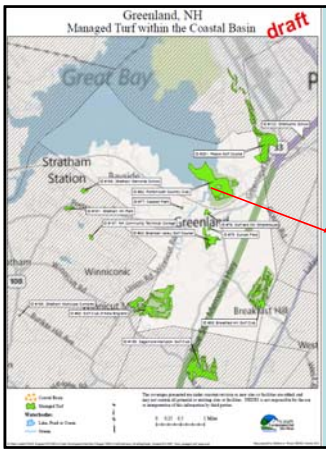
Delivery Factors for N Sources to Estuary through Septic Systems				
Septic System Location	Delivery Factor			
	Septic Tank and Leach Field	Groundwater Plumes	Groundwater to Embayment	Total
Outside 200M buffer	**60%**	**66%**	**65%**	**26%**
Inside 200M buffer	**60%**	**100%**	**100%**	**60%**

Nitrogen delivery vehicle

Results of Analysis

Town	Estimated Total Population within the Coastal Watershed[1]	Estimated Population within the Coastal Watershed[1] Served by WWTFs	Estimated Population within the Coastal Watershed[1] Served by Septic Systems	Estimated Population within 200-m of the Estuaries[2] Served by WWTFs	Estimated Population within 200-m of the Estuaries[2] Served by Septic Systems
Total NH	273,078	127,816	145,262	15,525	5,896
Total ME	47,822	17,902	29,920	4,334	2,045
Total MA	4,875	2,510	2,365	18	2
Grand Total	325,775	148,227	177,548	19,877	7,943

10 lbs of N per person per year



2. Managed Turf

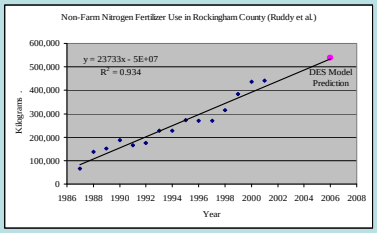
Digitized aerial photos of ball fields, parks, and golf courses.

- ~ 2500 acres
- Survey of managers

3. Residential Lawns

Developed Land Use Types			
High Density	Medium Density	Low Density	Open Space
2% lawn	24% lawn	45% lawn	8% lawn

~ 42,000 acres

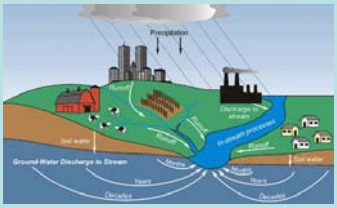


4. Connected & Disconnected Impervious Area

22,000 acres

42,000 acres

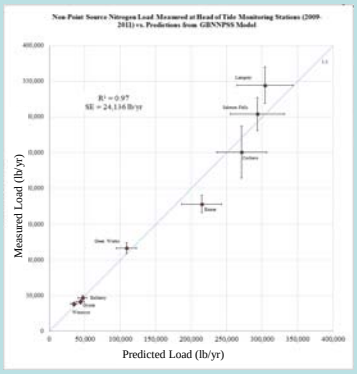
5. Stormwater/Surface Water Pathway



Accounts for transport through runoff and surface waters

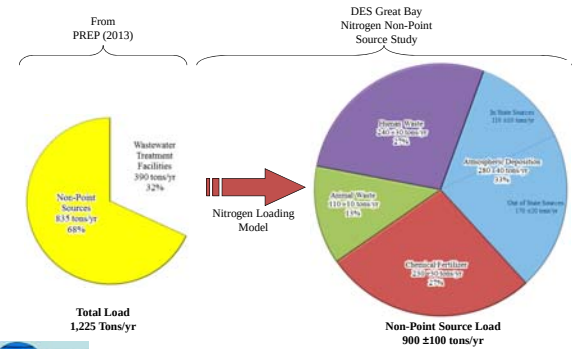
Original NLM assumed 100% to groundwater

NLM - Validation



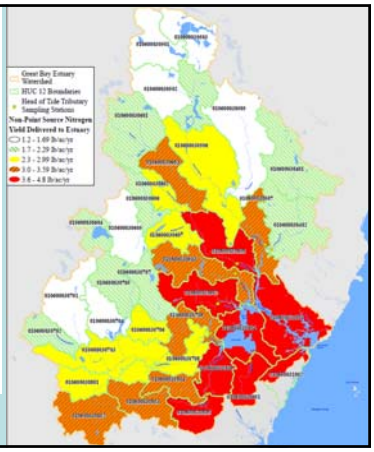
+ External QA of model by Valiela

Summary of Non-Point Source Nitrogen Loads to the Great Bay Estuary



Summary

- Hot spots nearest the estuary
- Atmospheric deposition, fertilizer, and human waste contribute equal amounts to non-point source.
- Animal waste is a small contributor.
- Results by town and watershed



Public Comments

(May-Aug. 2013)

Recurring Themes

- Overestimated the N from hay fields (87% of crop land) and agriculture in general
- Underestimated the N contribution from stormwater
- Local atmospheric and/or transportation derived N was not included

1. Agriculture

- Consider change from 50% of hay fields were fertilized each year to 10%
- Add cycling of N in milk/meat products and manure to model

Effect =

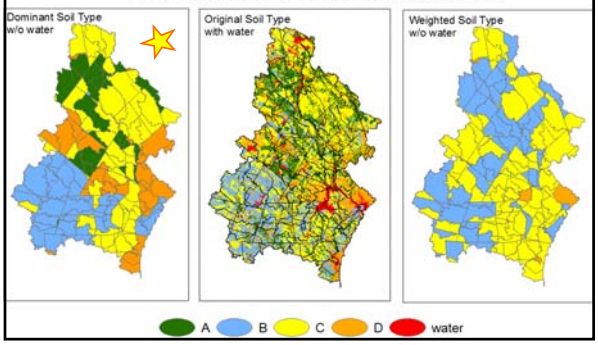
Decrease N from agriculture

2. Stormwater/Groundwater

- Model assumed 12% runoff of N deposited on paved, lawns, turf, and agricultural
- Use Curve Number Approach
  - Soils based runoff model from NRCS
  - Account for "run-on" from pavement onto pervious land uses

Step 1 – Determine Soil Type for Each GBNNPSS Polygon

Blanks (non-water), A/D and C/D soil types converted to D soil type for analysis



Step 2 – Assign CN to Each Land Use Type

Table 9–5 Runoff curve numbers for urban areas 1/

Cover description cover type and hydrologic condition	Average percent impervious area 2/	-- CN for hydrologic soil group -- A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) 3/					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89

Step 3 – Determine Runoff for Pervious Areas

- EPA's SWMM -- 10yr daily rainfall from Durham

LU Types	Runoff for hydrologic soil type			
	A	B	C	D
Natural Vegetation	1%	5%	10%	14%
Agriculture	1%	6%	10%	15%
Lawn	2%	6%	12%	17%
Managed Turf	2%	6%	12%	17%
DCIA	100%	100%	100%	100%
Lake	100%	100%	100%	100%
Estuary	100%	100%	100%	100%

Developed LU Types	Runoff for hydrologic soil type			
	A	B	C	D
High (10:1)	74%	74%	74%	74%
Medium (1:1)	58%	62%	65%	68%
Low (1:4)	36%	47%	55%	60%
Open (1:21)	20%	34%	45%	52%

Effect

- Natural vegetation pathway added (> 0)
- Higher accuracy in runoff from impervious surfaces
- Net increase in N from stormwater

3. Atmospheric Deposition

- Originally used the same deposition rate for the entire watershed
  - Considering different rates for different regions.
  - Considering local hotspots in urban areas

Effect uncertain

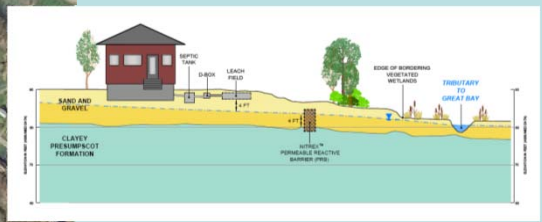
How will this report be used?

- Non-regulatory, planning document
- Stimulate thoughts on NPS planning
- Identify priorities for more detailed study

So what about septic systems?

- Need more science – technologies and attenuation
- Focus on areas closest to water bodies and estuary (ie. 200 meters)
- Look at community systems – economies of scale
- Costs/Funding/Benefits
- Monitoring

Permeable Reactive Barrier (PRB)



- Rockingham and Strafford County Conservation Districts – DES $$
- 2 pilot sites – Durham and Brentwood
- Pre and post installation monitoring – Field seasons 2014-2016

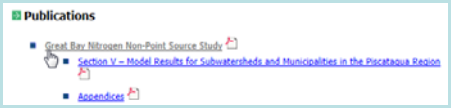
Need more studies in glaciated soils with different technologies – third party reviews are critical to adopting new technologies

How to Access the Report

The Report, Section V and the Appendices are available at:

http://des.nh.gov/organization/divisions/water/wmb/coastal/documents/gbnnpss-report.pdf

(or Go To A-Z List and Select “Great Bay Estuary”)



Questions