Groundwater & Nitrogen Modeling to Prioritize Management Strategies for Suffolk County's Estuaries

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NGWA Groundwater Summit 2017

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WATER + ENVIRONMENT + TRANSPORTATION + ENERGY + FACILITIES

Suffolk County, New York

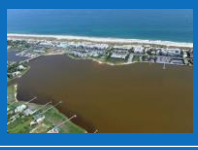
- Sole Source Aquifer for >1.5 million people
- > 800 community public supply wells
- 74% of Suffolk County is un-sewered
  - Risk of elevated nitrogen & other contaminants
  - Drinking water and surface water concerns

Subwatersheds Wastewater Plan

- Establish first order nitrogen load reductions for surface water restoration
- Protection of groundwater (drinking water)


TOP STORIES

LI nitrogen troubles



Project Components

- Delineate subwatersheds
  - Groundwater flow model
  - Baseflow contribution by travel time
  - Highlight areas of particular concern (depth to water, SLOSH)
- Estimate nitrogen load
- Surface water modeling for residence times
- Establish tiered priority areas and rank watersheds
- Nitrogen load reduction requirements
- Evaluate wastewater alternatives & pilot areas
- Simulate 200 year "equilibrium" nitrogen concentrations based on existing and future conditions
- Develop subwatershed wastewater plan

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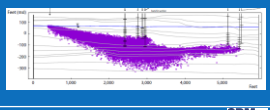
Groundwater Model Code Suite

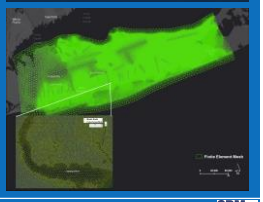
- DYNSYSTEM – finite element
  - DYNFLOW
    - DYNSWIM
  - DYNTRACK
- DYNTRACK
  - Random walk-method
  - Dispersive particles
- Codes modified for this application
  - > 500,000 model nodes
  - 200,000,000 particles

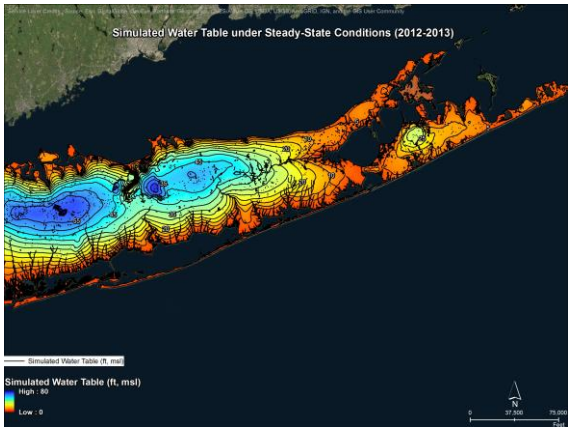
dynsystem.com



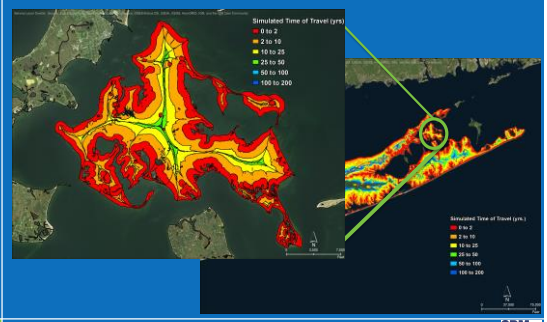
Subwatershed Simulations

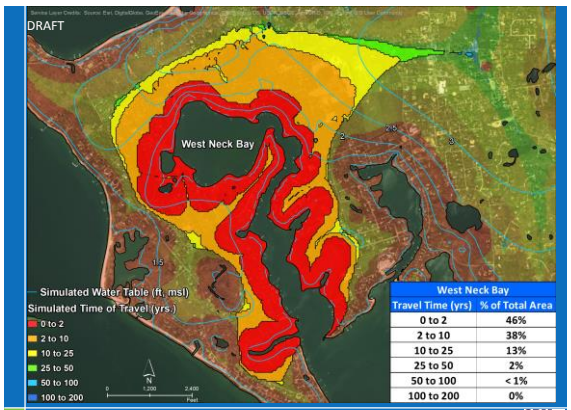
- 191 Water bodies
  - 134 estuaries
  - 19 lakes
  - 38 streams
- Refine regional groundwater models
- Node discretization on the order of 50-100 feet near waterbodies





Delineate Subwatersheds

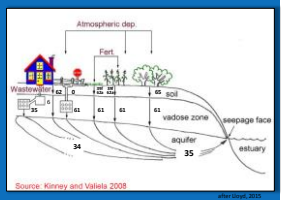


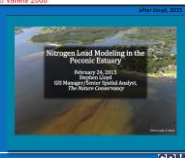


West Neck Bay	
Travel Time (yrs)	% of Total Area
0 to 2	46%
2 to 10	38%
10 to 25	13%
25 to 50	2%
50 to 100	< 1%
100 to 200	0%

Nitrogen Load Estimates

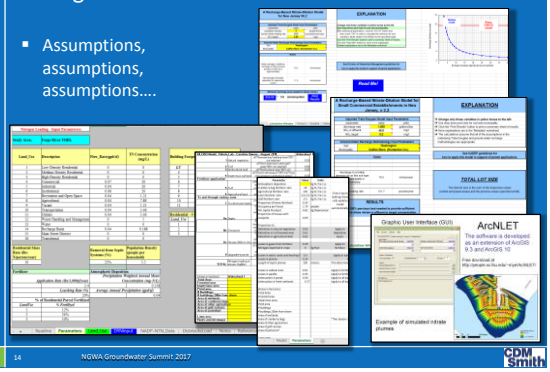
- Nitrogen loading calculated using spreadsheet "models"
- Nitrogen Loading Model (NLM)
- NJ Nitrate Dilution Model
- Others…





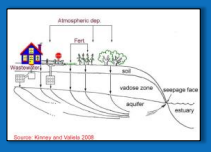
Nitrogen Load Estimates

- Assumptions, assumptions, assumptions….



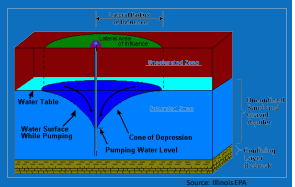
Major Assumptions

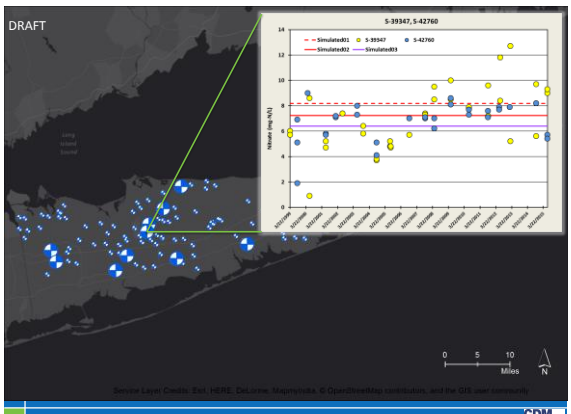
- Vetted through Committee
  - SCDHS, NYSDEC, USGS, Stony Brook University, CDM Smith
- On-Site Wastewater Systems
  - Residential, Non-Residential
  - Attenuation factors (through tank, plume, aquifer)
- Fertilizer
  - Application rates, losses, leaching rates
  - Agriculture, turf (golf, residential, rec fields)
- Animals (dogs, cats)
- Atmospheric Deposition
  - NOAA station
- Geology
  - Till vs Outwash

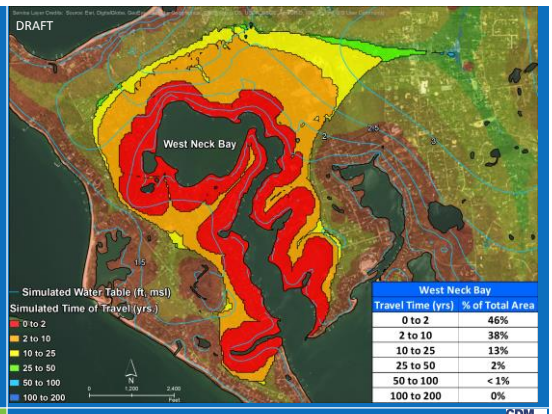


Verification of N Loading Parameters

- Need to validate assumptions
  - Monitoring wells?
  - Community water supply wells
- Run nitrogen loading simulations and compare to observed [N] in shallow water supply wells








West Neck Bay
Simulated Water Table (ft, msl)
Land Use
Low Density Residential
Medium Density Residential
High Density Residential
Commercial
Industrial
Institutional
Recreation & Open Space
Agricultural
Vacant
Transportation
Waste Handling Management
Water
19
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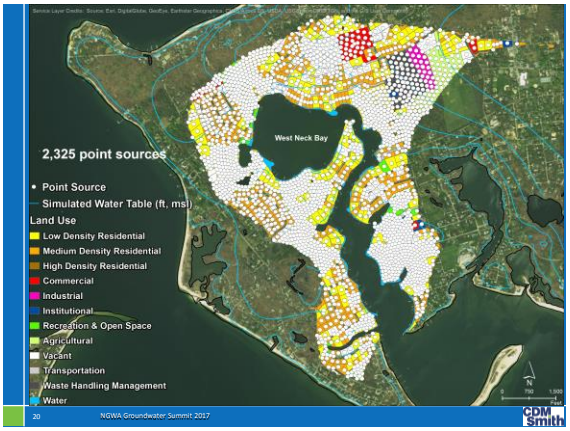
West Neck Bay
2,325 point sources
Point Source
Simulated Water Table (ft, msl)
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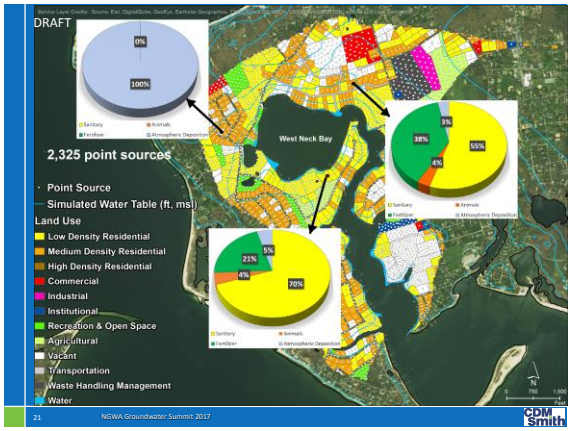
DRAFT
0%
100%
West Neck Bay
2,325 point sources
Point Source
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Water
3%
38%
55%
4%
5%
21%
4%
70%
21
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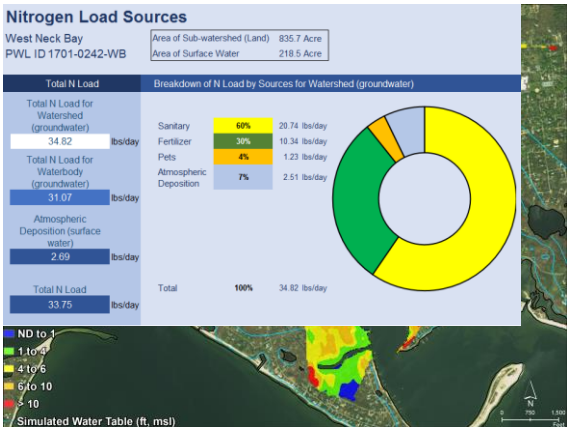
Nitrogen Load Sources
West Neck Bay
PWL ID 1701-0242-WB
Area of Sub-watershed (Land) 835.7 Acre
Area of Surface Water 218.5 Acre
Total N Load
Breakdown of N Load by Sources for Watershed (groundwater)
Total N Load for Watershed (groundwater)
34.82 lbs/day
Total N Load for Waterbody (groundwater)
31.07 lbs/day
Atmospheric Deposition (surface water)
2.69 lbs/day
Total N Load
33.75 lbs/day
Sanitary 60% 20.74 lbs/day
Fertilizer 30% 10.34 lbs/day
Pets 4% 1.23 lbs/day
Atmospheric Deposition 7% 2.51 lbs/day
Total 100% 34.82 lbs/day
ND to 1
1 to 4
4 to 6
6 to 10
> 10
Simulated Water Table (ft, msl)


25 Year Contributing Area
Depth to Water (ft)
Less than or equal to 10
> 10
SLOSH
Simulated Water Table (ft, msl)
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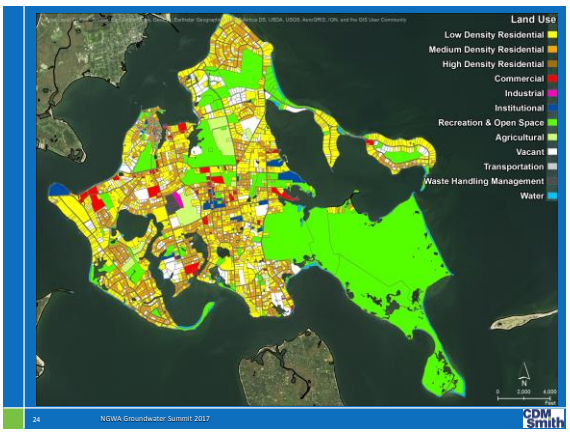
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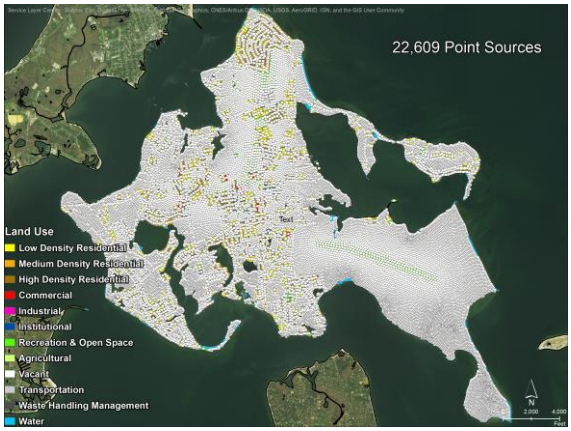
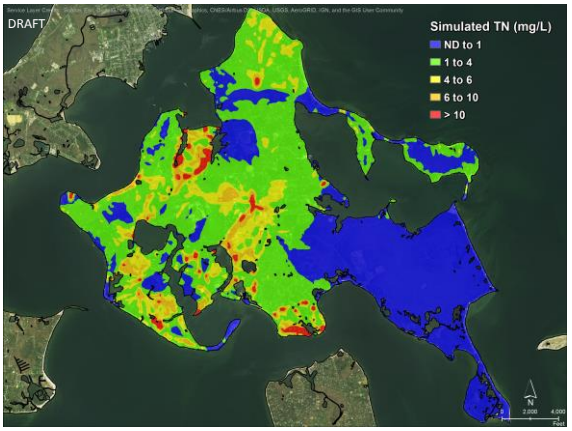




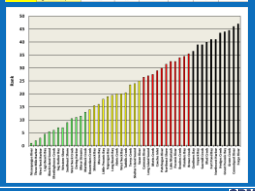
Summary

- Nitrogen load calculations using spreadsheet models OK for first approximation
- Models allow for better evaluation of management strategies, especially for complex systems
  - Allow for incorporation of hundreds of thousands of point sources
  - Account for intertwined hydraulics (water supply wells, all water bodies that receive groundwater baseflow)
  - Evaluate management scenarios & time to benefit
- Assumptions need to be vetted by stakeholders and validated, preferably with supply wells

Next Steps

- Complete subwatershed and nitrogen load modeling for all 191 subwatersheds
- Rank subwatersheds county-wide using:
  - N load
  - Residence time
  - Water quality data
- Run scenarios

EXAMPLE for ILLUSTRATIVE PURPOSES ONLY



Thank You

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