Urine Diversion & Re-Use

Opportunities to Address Nutrient TMDL
In Accordance with the Cape Cod Commission – 208 Plan

Tufts University
WSSS Practicum
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Introduction and Outline

Meet our Team

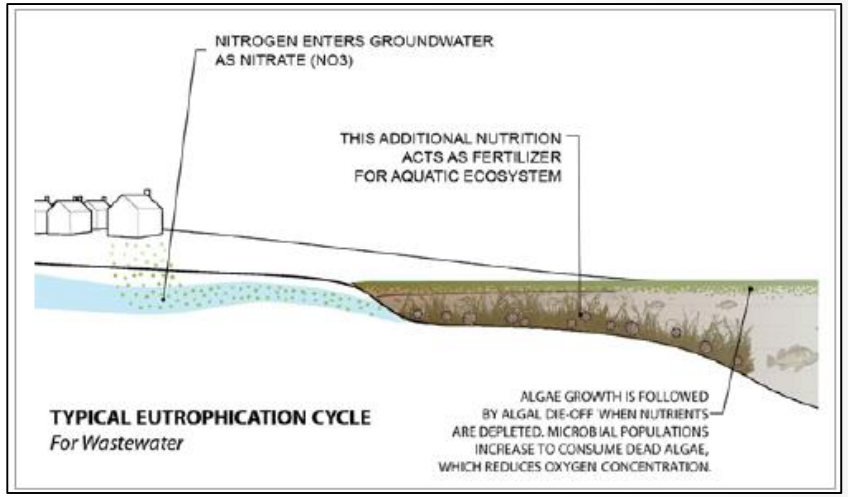
- James Goodman
  - MS Student CEE '18
  - Lab Technician
- Ken Nugent
  - Tufts Gordon Institute MSEM '17
  - Weston & Sampson Services, Inc.

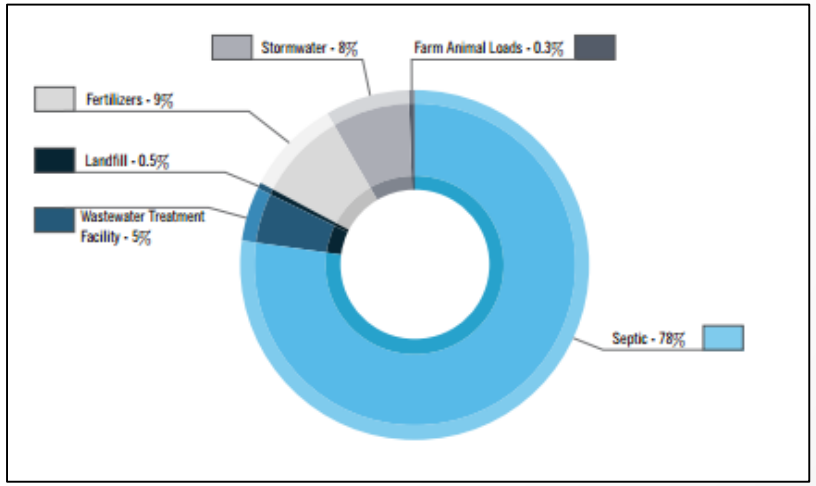
Outline

- Cape Cod Commission
  - History and Strategy
- Urine Diversion
  - Overview and Applications
- Three Bays Watershed
  - Identifying Practical Approach
- TMDL Reduction Strategies
  - Obstacles and Opportunities
- Conclusion

Cape Cod Commission – 208 Plan

- Brief Description
  - Identifying increasing resident density on the Cape
  - Revised in August 2014
  - Engaging Stakeholder interest in Nutrient Reduction
  - **Technical and Social/Cultural Solutions**
- TMDL Nutrient Crisis
  - Symptoms of Nutrient Overloading
    - Eutrophication/Watershed Vitality
    - Soil Quality Degradation and Erosion
  - Sources/Contributions of Nutrients
    - Wastewater
    - Agriculture
    - Landscaping



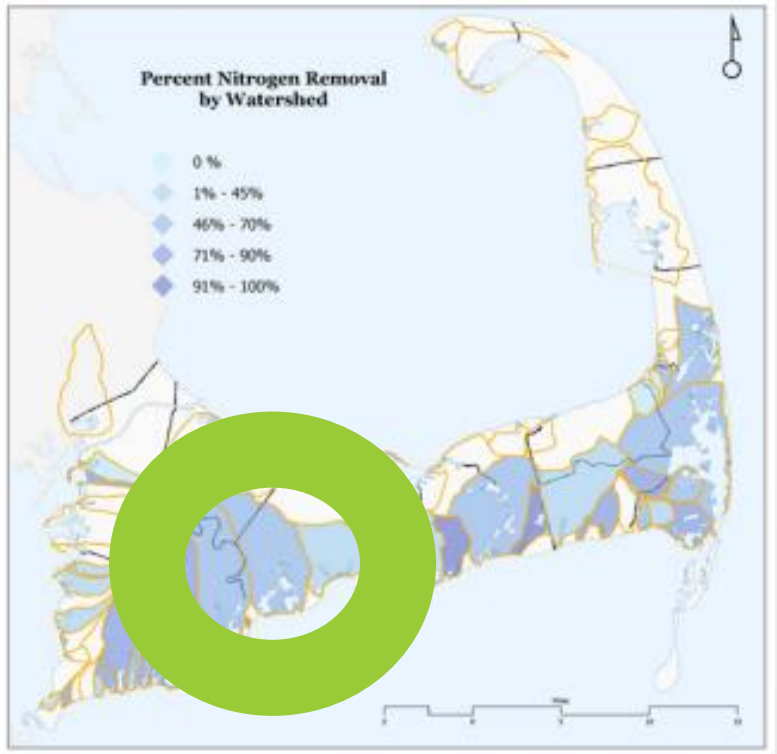


Urine Diversion - Overview

- Physically Separate Conventional Waste Streams
  - Used in areas unserved by traditional wastewater treatment
  - On the Cape – Used to mitigate introduction of Nitrogen
- Allows for Collection of Urine and Solid Waste
  - Either diversion to composting or storage alternative
  - Varies by application and intended utilization
- Collected Urine can be Recycled
  - Fermenting/Sterilization removes pathogens and precipitates
  - Composting/Concentration can occur via solar dehydration
  - Direct application as fertilizer or transport to processing center

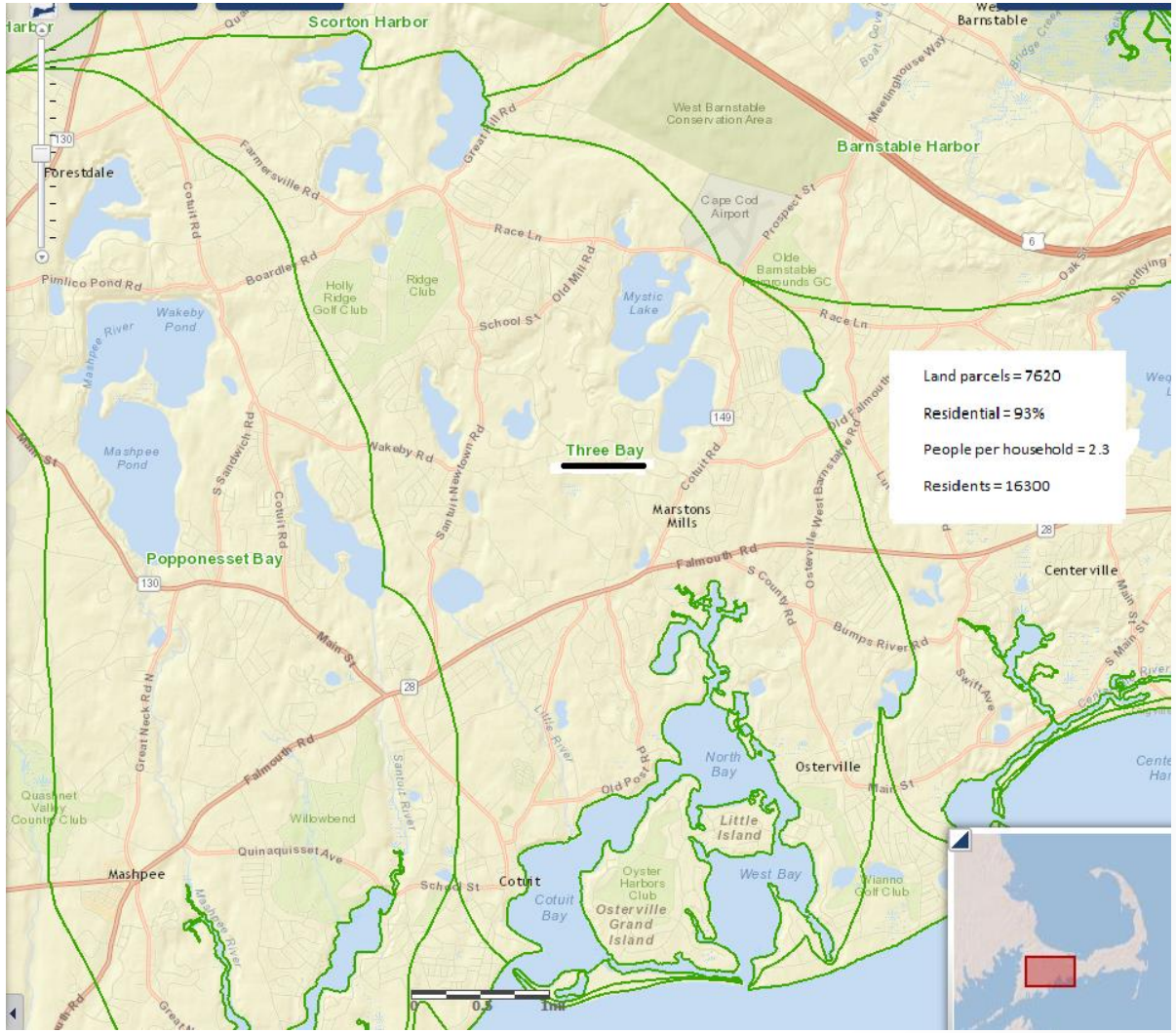
Three Bays Watershed Determining Impact Potential

- Located in the South Side of the "Upper Cape"
- Encompasses 3 Separate Towns
  - Cotuit
  - Marstons Mills
  - Osterville
- LARGELY Residential (~92% of buildings)
- Identified ~100 Non-Residential Producers
  - Categorized by Type (e.g. Commercial/Retail)
  - Major Representation of Hospitality/Services
  - 4 Marinas
  - **4 Golf Courses**
- Public Buildings
  - Libraries
  - Museums
  - **Fire Departments (2)**
  - **Schools (3)**



Three Bays Watershed - Methodology

- Watershed MVP
  - Proprietary GIS Layer
  - Outlines Watershed
- Identifying Sources
  - Varying Contributors
  - Varying Contributions
- Assumptions
  - Urine Accounts for 80% N
  - Water Use/Loading



Findings – Three Bays

required 1 urinal per 15 students	
toilets needed	51.6666666
$ (material + installation)	13278.3333
Benefits -	
reduce water	
reduce urine transport (less diluted)	

	nitrogen kg/yr	water use gl/day
	44	14400
	44	14400
	7	212
	95	29012

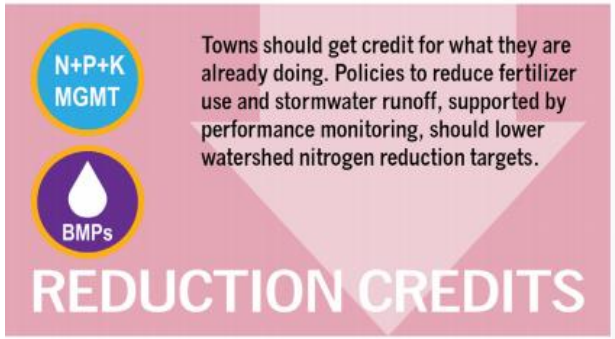
- Target Goal

1-5 gallons per flush	
average 2.5 gallons	
3 uses a day per student	
gallons used per day (2.5 gl)	5812.5
per year	1046250
gallon per day (1 gl)	2325
per year	418500

schools	urinal using pop
west village elementary	221
barnstable united elementary	443
cape cod academy	111
	775

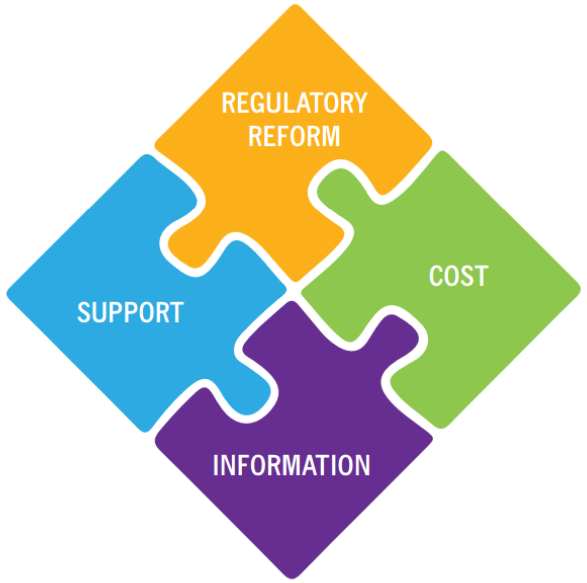
Implementation - Regulation

- Cape Cod Commission Charter
  - Authority to recommend and require sanitation programs
  - MassDEP recognizes Cape concerns distinct from Commonwealth
- Title V / Innovative-Alternative Programs
  - Septic systems w/ advanced treatment technologies
  - Direct groundwater discharge – localized nutrient loading
- Effect of Nutrient Source-Removal
  - Traditional WWTFs are biologically active and break down nutrients
  - Process Control includes optimization of waste stream
  - Removal of nutrients may have unintended consequences



Implementation – Marketing

- Customer/Stakeholder Involvement is Critical
  - Obvious "Ick" Factor re: Wastewater
  - Urine for Landscaping is
- How do we influence <u>without</u> authority?
  - Schools and Public Buildings
  - Obviate need for Community Improvements
  - Lead by Demonstrable Example
  - Create spaces for people to discuss sanitation issues
- No time for NIMBY

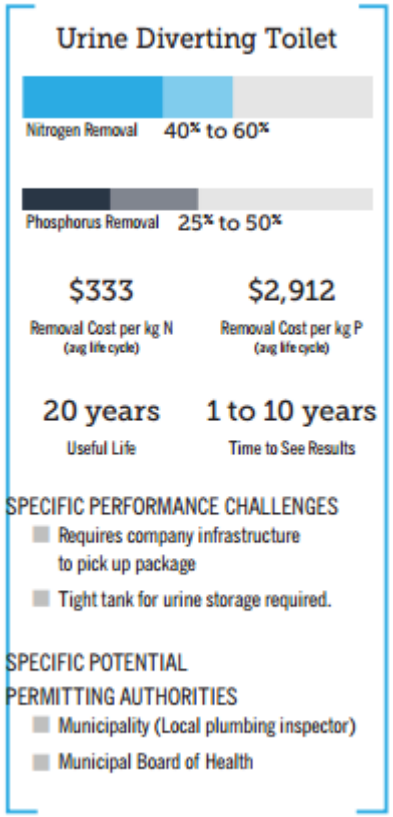


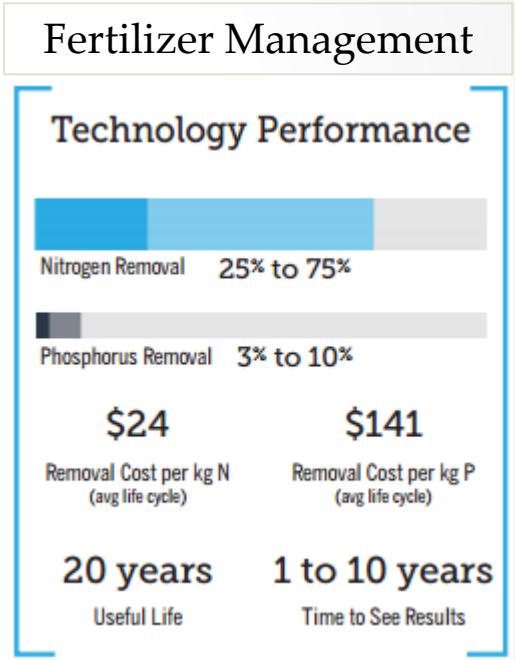
Combined Approach

Urine Diversion

AND

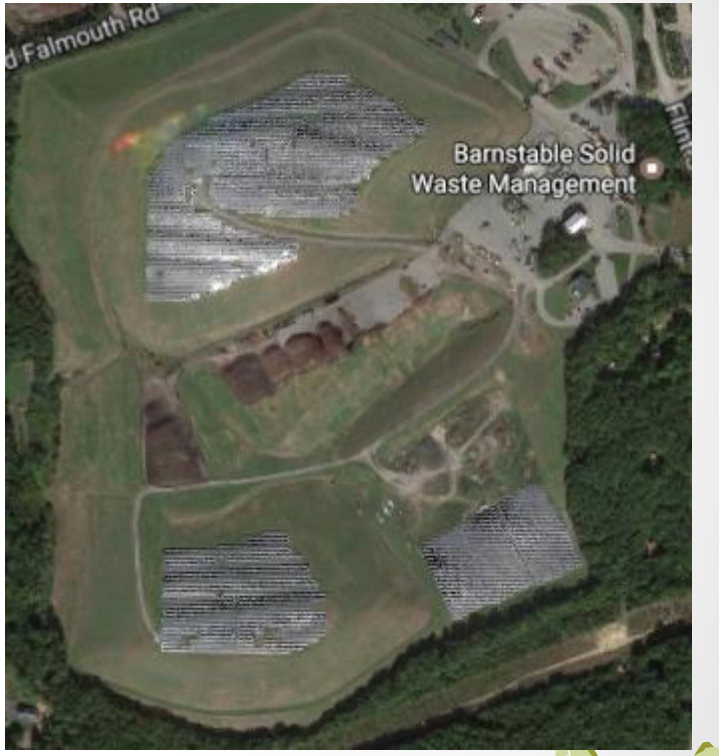
Fertilizer Management





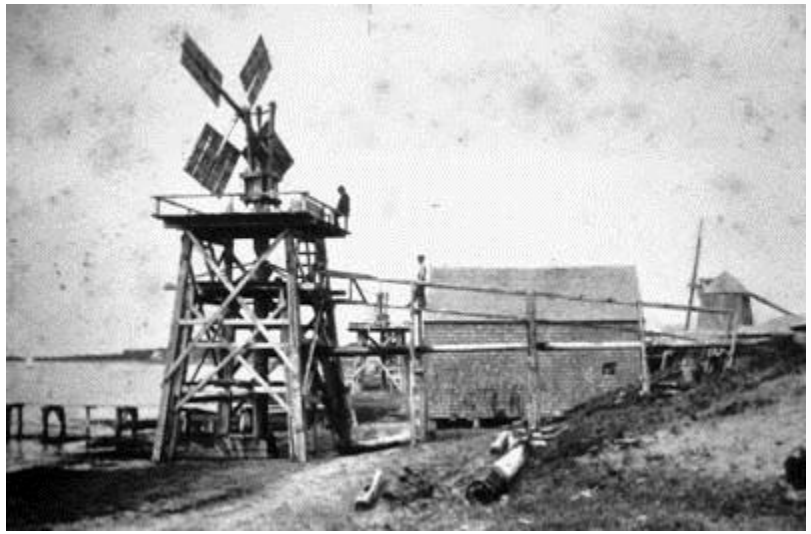
Building Systemic Sustainability

- Landscaping is Necessary
  - Provides Erosion Control
  - Habitat and Real Estate
- Importing Nitrogen Isn't
  - Generating Nitrogen On the Cape
  - Close the Loop
- Stakeholders can Contribute
  - Cooperation with"Nitrogen Recapture"
  - Marketing the solution to TMDL



Precedent for Approach

- Local, Sustainable Fertilizer
- "Wastewater as a Resource"
  - Deer Island Pelletized Fertilizer – Florida
  - Newburyport/Ipswich Solid Waste Recycling
- Nutrient Export a Possibility



Thank You

Questions?