ECO-TOILET DEMONSTRATION PROJECT

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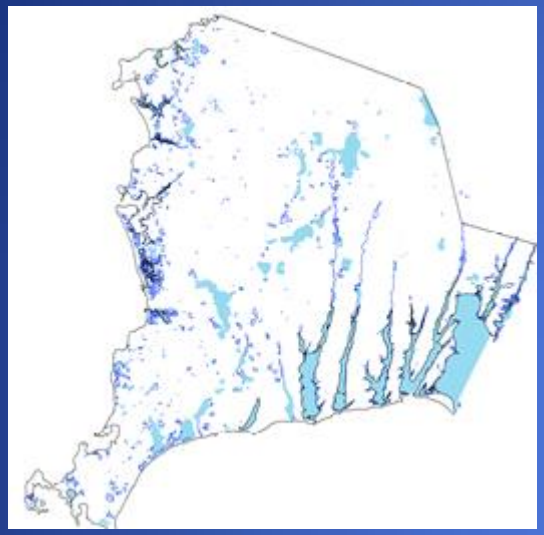
The Value of Falmouth's Estuaries



Falmouth has more estuaries than any other town in Massachusetts (15 total)

Home to a wide variety of marine life

A focal point for community recreation - fishing, boating, passive enjoyment

Our Estuaries are in Trouble

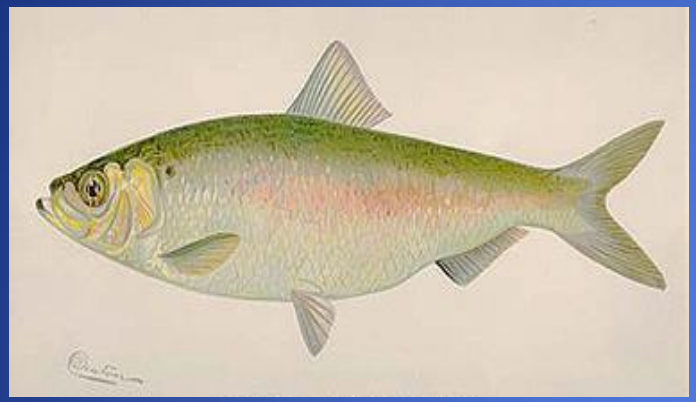
50 years of development:

- **Excess nitrogen is the main cause of the decline of our estuaries**
- **At least 75% of the controllable nitrogen input comes from septic systems (MA DEP)**

Little Pond, 1950

Little Pond, 2009

Why Remove Nitrogen?



Fish Kills
Loss of Habitat

Algae Blooms
Loss of Recreation
Odors

What is Falmouth Doing?

- April 2011 Town Meeting unanimously passed Article 17, appropriating **$2.7 million** to proceed with sewer design and alternative demonstration projects

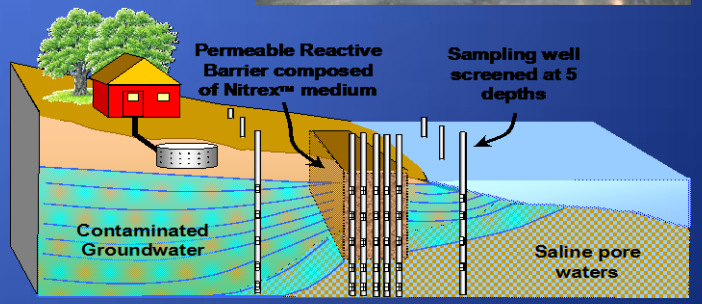
- Voters approved this measure on a town-wide ballot, by a 2 – 1 margin in every precinct

The Vision

- Bays become cleaner in year five of project. Shellfish and fish populations are up.
- Local plumbing businesses are thriving.
- New businesses transform residuals to saleable green products and create new jobs.
- Residents find work in revived building trades and shellfish industries.
- Neighborhoods remain stable and diverse.

Included in Plan Approved by Selectmen and Town Meeting

- ✓ Sewer Lower Little Pond
- ✓ Widen Bournes Pond Inlet
- ✓ Non-traditional Solutions:
  - **<u>Eco-toilets</u>**
  - I/A septic systems
  - Shellfish Cultivation
  - Road Runoff Remediation
  - Permeable Reactive Barriers



Eco-Toilet Research Project

RESEARCH OBJECTIVES:

- Scientifically validate the amount of nitrogen removed from household effluent when human waste is removed. *Required by MaDEP for assignment of N-removal credit to "eco-toilets"*
- Determine the real cost of retrofits into existing homes
- Document the technical feasibility of retrofits
- Study whether urine diverting fixtures function properly

What the Studies Say:

Table 5.2
Volume and Constituent Concentrations of Domestic Sewage Wastestreams for a Four Person Household in the U.S.

HAZEN AND SAWYER
Environmental Engineers & Scientists
In association with
SCHOOL OF MINES 1874 COLORADO
AET Applied Environmental Technology
OTIS ENVIRONMENTAL CONSULTANTS, LLC

Description	Components	Daily Volume (gallons	Constituent concentration (mg/L)				% of Total Constituent Mass			
			$C\text{-}BOD_5$	TSS	Total N (as N)	Total P (as P)	$C\text{-}BOD_5$	TSS	Total N (as N)	Total P (as P)
Domestic Sewage	A+B+C+D	241	277	542	63	8.8	100	100	100	100
Greywater	A	128	94	43	6	1.2	18	4	5	8
Black Water	B+C+D	113	483	1,105	128	17	82	96	95	93
Domestic Sewage w/o Urine	A+B+C	239	261	547	16	3.5	93	100	25	40
Black Water w/o Urine	B+C	111	453	1,128	27	6.2	75	96	19	33
Urine	D	2.4	1,838	35	4,808	528	7	0.065	75	60

(Mayer, DeOreo et al. 1999; Günther 2000; Lens and Lettinga 2001; Lens, Zeeman et al. 2001; USEPA 2002; Tchobanoglous, Burton et al. 2003; Memon 2005; Lowe, Rothe et al. 2006; Magid, Eilersen et al. 2006; Makropoulos, Natsis et al. 2008; Benetto, Nguyen et al. 2009)

The Questions

Intuitively, eco-toilets sound like a good idea.

- Less expensive, better for the environment, provide jobs for local people and no inconveniences for businesses and transportation.
- Will people accept them, will they cost less to retrofit and how much N will be removed?
- Demonstration project.

How we get there… objectives

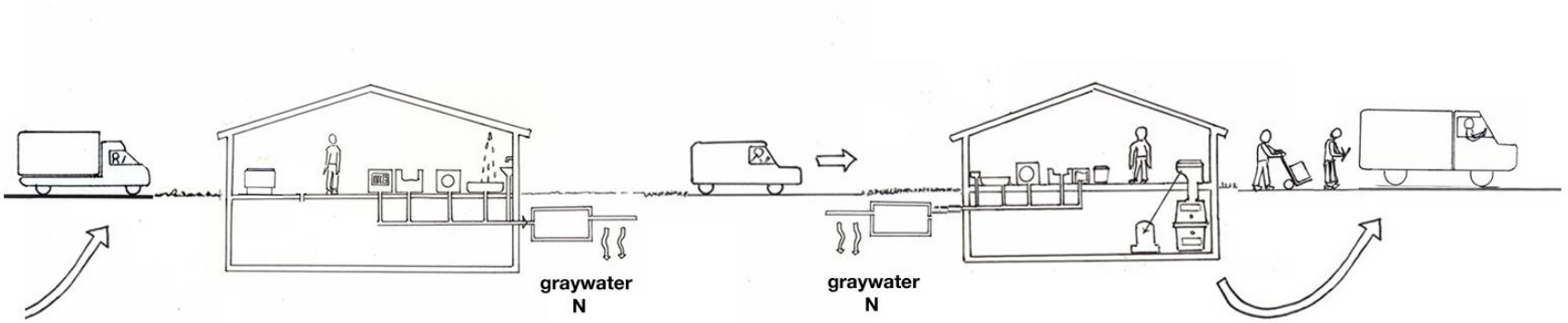
- Verify nitrogen removal factors and get DEP approval by monitoring grey water.
- Calculate public acceptance rates.
- Estimate average installation costs for different types of homes.
- Set up residuals recycling and management.
- Estimate lifetime cost/unit of N removed for each type of eco-toilet.

Packaging Toilets

Human waste is directed into a biodegradable package, sealed after each use.

Composting Toilets

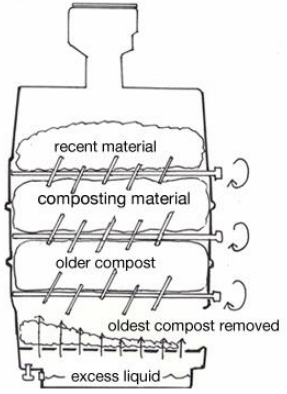
Human waste is directed into an aerated compost chamber, where over several years it decomposes, losing 90% of its original volume as gases out a chimney vent.



Simplest & Fastest Option to Divert 88% of Nitrogen From House

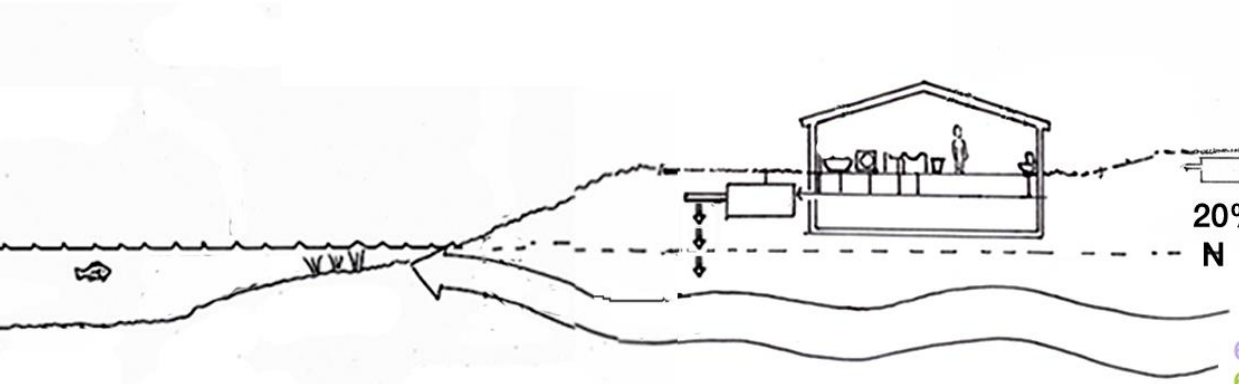
No water
No plumbing
No electricity
Movable
Installs immediately, anywhere
Water use in house is reduced 30-40%

A urine-diverting toilet can be added to a compost toilet to efficiently recover nitrogen in urine.



Earle Barnhart
The Green Center

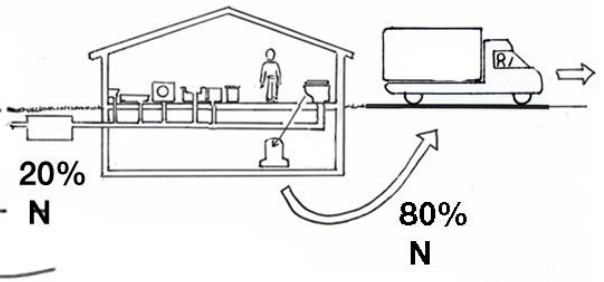
Flush Toilets
Near Coastal Pond



Nitrogen goes through septic tank
and moves in groundwater to coastal ponds.

Urine-Diverting Toilets

80% of total nitrogen
from house is in urine.



6% Bath, Shower, Sinks, Laundry
6% Kitchen Sink
8% Feces
===
20%

House without
Garbage Disposal

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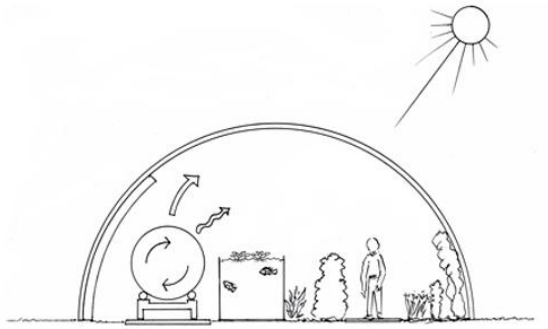
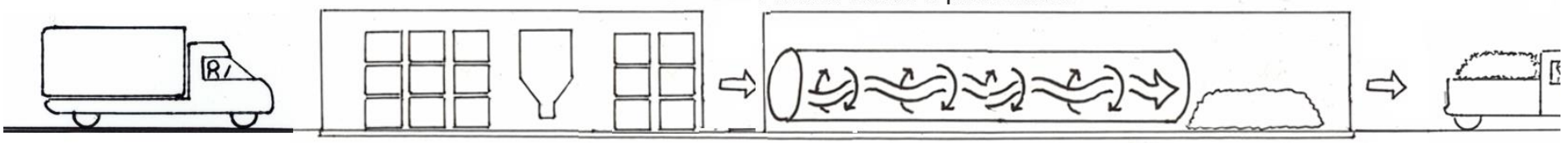
Nutrient Recovery from Eco-Toilets



Composting in a greenhouse

Urine transport and storage

urine, aged compost-toilet material, and toilet packages
+ added leaves & plant wastes



urine stored 6 months
becomes pathogen-free

compost-toilet
compost aged
2 years becomes
pathogen-free

compost moves to end
as composter turns

heat during composting
can kill pathogens

aging
compost

IBC
container

Struvite Fertilizer Reactors

urine can be
processed to
produce safe
granular fertilizer

Ecodrum Composter

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The Demonstration Project

62 installations needed by DEP to determine N removal rate and certification.

Incentives:

- $5,000 incentive to cover purchase, installation and $300 pump out;
- If desired, exemption from future sewer connection.
- Possible qualification for 40% state tax credit.

Criteria for Participation

- Must be approved ET system. Only eco-toilets can be used in home;
- Septic tank must be pumped and sampling port brought to grade;
- Water records made available for previous year and subsequent years.
- Residuals must be removed by licensed liquid waste hauler (septage trucks);
- Access for testing .

Demo Project Collaboration?

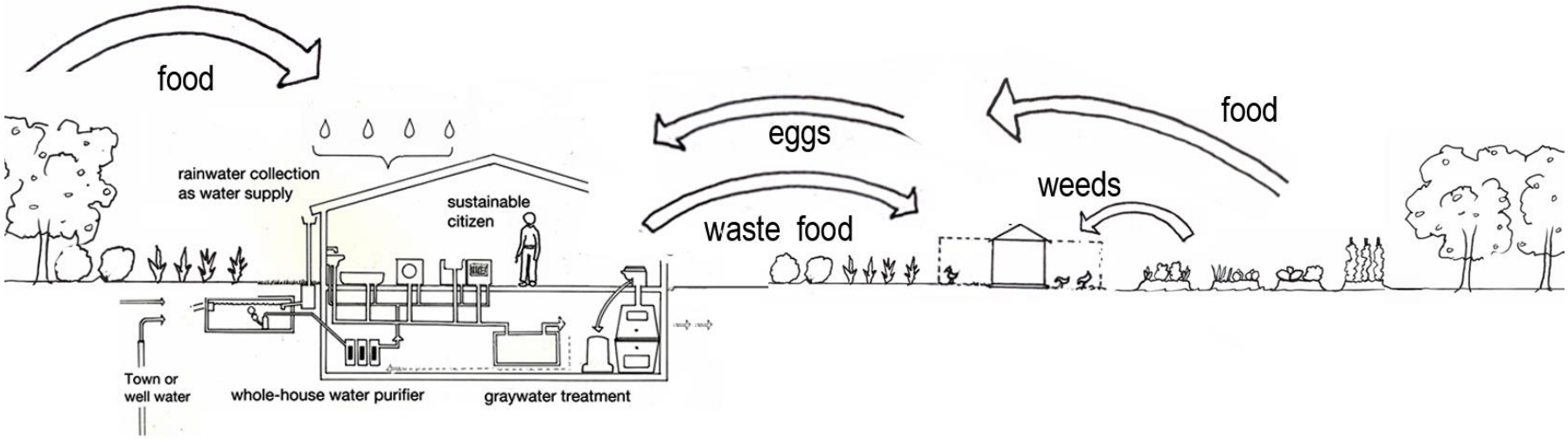
- Project expansion to other Cape and South Coast Towns;
- Barnstable County Health Dept. and WRWA share Project Manager and Outreach/Marketing coordinator; **HANDS-ON EDUCATION IS ESSENTIAL FOR SUCCESS**

Ideal Sustainable House & Landscape

Rainwater Collection and Use

Chickens to Recycle Food Wastes

Intensive Local Food Production



Graywater treatment with peat bed

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Time Frame

- Program Development: 12/5/11 – 6/29/12
- Data Gathering: 7/2/12 – 7/3/14
- Installations: 8/31/12 – 7/31/13
- Phase II major installs start 5/1/14 – 7/31/15