Preview of 10/28 Agenda

Select Watershed Analyses and Adaptive Management Discussion
208 Watershed Solution
Conventional Approaches
Bookends to Targeted Solutions

Oct 10, 2013
## Technology Matrix

<table>
<thead>
<tr>
<th>Group</th>
<th>Technology/Strategy</th>
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<tbody>
<tr>
<td><strong>Green Infrastructure</strong></td>
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<tr>
<td></td>
<td>Constructed Wetlands - Surface Flow</td>
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<td>Constructed Wetlands - Subsurface Flow</td>
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<td></td>
<td>Constructed Wetlands - Cluster Subsurface Flow (SSD)</td>
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<tr>
<td></td>
<td>Eco-Machines &amp; Living Machines</td>
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<td></td>
<td>Phytoremediation/Phytostabilizers</td>
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<td></td>
<td>Stormwater: Bioretention/Soil Media Filters</td>
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<td></td>
<td>Stormwater: Constructed Wetlands</td>
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<tr>
<td><strong>Innovative and Resource-Management Technologies</strong></td>
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<td></td>
<td>Aquaculture/Shellfish</td>
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<td></td>
<td>Phytoremediation</td>
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<td></td>
<td>Permeable Reactive Barriers (PRBs)</td>
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<td>Fertigation Wells</td>
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<tr>
<td><strong>Waste Reduction Toilets</strong></td>
<td>Toilets: Composting</td>
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<td>Toilets: Packaging</td>
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<td>Toilets: Urine Diverting</td>
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<tr>
<td><strong>Non-Structural Technologies</strong></td>
<td>Fertilizer Management</td>
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<td>Stormwater BMPs</td>
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<td>Remediation of Existing Development</td>
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<td></td>
<td>Compact Development/OSRD</td>
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<td>Transfer of Development Rights</td>
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<tr>
<td><strong>System Alterations</strong></td>
<td>Inlet/Culvert Widening</td>
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<td>Surface Water Remediation Wetlands</td>
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<td></td>
<td>Pond and Estuary Dredging</td>
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<td><strong>Gray Infrastructure</strong></td>
<td>Wastewater Treatment</td>
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<td>Title 5 Replacement (Baseline Condition)</td>
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<td></td>
<td>Innovative/Alternative (IA) Systems</td>
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<td></td>
<td>Innovative/Alternative (IA) Enhanced Systems</td>
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<td></td>
<td>Cluster Treatment System - Single-stage</td>
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<td></td>
<td>Cluster Treatment System - Two-stage</td>
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<td></td>
<td>Conventional Treatment</td>
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<td>Advanced Treatment</td>
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<td>Satellite Treatment</td>
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<td>Satellite Treatment - Enhanced</td>
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<tr>
<td><strong>Onsite-Decentralized and Cluster Systems</strong></td>
<td>Next Generation On-site System Technologies (currently under development)</td>
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<td>BUSSE Green Technologies Inc. - Small Scale MBR (currently under development)</td>
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<td>On-Site Grey Water Treatment</td>
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<tr>
<td><strong>Other</strong></td>
<td>Digester and Combined Heat Power Unit</td>
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<td></td>
<td>Switch from Fuels that Deliver Nitrogen to Watersheds</td>
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</table>
Watershed Management Solution Approach

Conventional Solutions
- Total Watershed
  - Centralized
  - Decentralized

Green Technology
- Constructed Wetlands
- Waste Reduction Toilets

Technology Matrix

Infrastructure Reduction Solutions
- Non-Structural Management
- Innovative and Resource Mngt
- System Alterations
  - (Fertilizer and Stormwater Mngt)
  - (PRB, Aquaculture, ...)
  - (Inlet widening and Dredging)

Targeted Solutions
- Disposal Inside and Outside

MVP

Panel on Technologies - October 10, 2013
Three Bay Scenario #1 - Centralized Inside Watershed for TMDL Compliance (3 Disposal Sites)
Three Bay Scenario #1 – Fertilizer & Stormwater Reduction with Centralized Inside Watershed for TMDL Compliance (3 Disposal Sites)
### Three Bay Scenarios Achieving TMDL Compliance

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Annual Cost Total (Capital and O&amp;M)</th>
<th>Sewered Wastewater Flow (g/day)</th>
<th>Percent above TMDL Compliance</th>
<th>Remaining Excess (kg-N/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centralized Inside Treatment (5 ppm)</td>
<td>$12,987,000</td>
<td>667,380</td>
<td>2%</td>
<td>473</td>
</tr>
<tr>
<td>50% Reduction in Fertilizer and Stormwater Contribution with Centralized Inside Treatment (5 ppm)</td>
<td>$7,988,000</td>
<td>440,019</td>
<td>3%</td>
<td>601</td>
</tr>
</tbody>
</table>
Targets/ Goals

Present Load: \( X \) kg/day = Target: \( Y \) kg/day = Reduction Required: \( N \) kg/day

Composite Target Areas
A. High Nitrogen Reduction Areas
B. Pond Recharge Areas
C. Title 5 Problem Areas

Low Barrier to Implementation
A. Fertilizer Management
B. Stormwater Mitigation

Watershed/Embayment Options
A. Permeable Reactive Barriers
B. Inlet/Culvert Openings
C. Constructed Wetlands
D. Dredging

Alternative On-Site Options
A. Eco-toilets (UD & Compost)
B. I/A Technologies
C. Enhanced I/A Technologies
D. Shared Systems

Priority Collection/High-Density Areas
A. Greater Than 1 Dwelling Unit/acre
B. Village Centers
C. Economic Centers
D. Growth Incentive Zones

Supplemental Sewering
Preview of 11/6 Agenda

3VS Model Preview and GI Screening Criteria
Systems Thinking is a Sustainability Assessment Tool

Sustainable Development

Economic Prosperity  Environmental Protection  Social Justice
Systems Models Support Decision Making by Bridging Science, Policy, and Human Values

What do we know today, and what are the unknowns?

What are our goals and options?

What do we care about most?

How should we proceed given the uncertainties and ambiguities?
“Triple Value” Framework

Economy
- agriculture, fishing, industrial, and commercial uses

Environment
- ecological resource base

Society
- drinking water, recreation, and cultural uses

Runoff and wastewater
- economic value
Potential Interventions to Improve Sustainability of Water Resources

- Water conservation and stewardship
- Full cost accounting

Climate change adaptation
- Treatment technologies
  - Water reuse

Best practices for integrated water resource management
- Green infrastructure
- Behavior change
- Investment

Environment
- Groundwater
- Surface water
- Coastal areas
- Fish & shellfish

Economy
- Built environment
- Energy
- Tourism

Society
- Public agencies
- Communities
- Recreation

Panel on Technologies - October 10, 2013
Modeling the Cape Cod System with a Triple Value Simulation (3VS) Model

Economic Activities
- Tourism
- Commercial Fisheries
- Energy & Transportation
- Land Development
- Wastewater Facilities

Environmental Resources
- Coastal areas
- Fish & shellfish habitat
- Inland ponds
- Ground water
- Regional ecosystems
- Atmosphere & climate

Community Stakeholders
- Consumers & residents
- State & municipal agencies
- Water & energy utilities
- Regional businesses
- Septic and cesspool users
- Part-time residents

Runoff and wastewater

Industrial & commercial uses

Recreational and cultural uses
Cape Cod 3VS Schematic: Initial Model

**Economy**

- GDP
- Tourist expenditures
- Energy use & emissions
- Wastewater treatment
- Economic development
- Treatment costs

**Society**

- Inland property tax revenue
- Cape population
- Beach visits
- Coastal property values

**Environment**

- Water clarity
- Nitrogen loadings via groundwater, surface water, air
- Microalgal blooms (Chl A)
- Eel grass abundance

**Interventions**

- A: LID and GI
- B: Advanced Wastewater Treatment
- C: Advanced Septic Systems
- D: Fertilizer Reductions
- E: Aquaculture
- F: Alternative Plumbing Systems

**Legend**

- Sustainability Indicators
- Amplifies
- Diminishes
- Not Modeled

**Indicators**

- Precipitation events
- Atmospheric deposition
- Climate change
- Ulva growth rate
- Nitrogen concentrations
- Infaunal habitat

**Panel on Technologies - October 10, 2013**
Developing a Green Infrastructure
Site Selection Methodology

Goal: Develop a siting criteria matrix to use in GIS analysis

Task: Identify siting criteria for individual green technologies and apply these to GIS analysis
Treatment Options Evaluated

- Constructed wetlands
- Phyto-technology
- Permeable Reactive Barriers (PRBs)
# GI Siting Criteria

<table>
<thead>
<tr>
<th>GI Technologies Siting Criteria</th>
<th>Notes</th>
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<tbody>
<tr>
<td>x = all parcels which contain these positive siting criteria (desirable for project siting)</td>
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<tr>
<td><strong>Mandatory siting criteria</strong></td>
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<tr>
<td><strong>Bonus siting criteria</strong></td>
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## Siting Criteria
- outside 100 year floodplain
- 100 - 50 ft buffer to wetland
- Zone II's - wellhead protection areas
- Soils: disturbed
- Soils: well drained
- Soils: poorly drained, clay (per soil survey)
- not protected open space
- outside priority habitat
- depth to groundwater > 4'
- depth to groundwater <10'
- parcels >5 acres
- municipally owned, not protected open space

### GI Technologies
- GI - Wastewater
  - Constructed Wetlands
  - Permeable Reactive Barriers
  - Phyto technology
Potential Constructed Wetlands