Presentation of Findings
To
Mass. Department of Environmental Protection (MA DEP)
And
UMASS Dartmouth School of Marine Science and Technology (SMAST)

Town of Orleans
Wastewater Management Validation and Design Committee

June 10, 2009
Review of The Health of Eelgrass and Benthic Community in Pleasant Bay

Wastewater Management Validation & Design Committee

June 10, 2009
BENTHONIC HEALTH OF PLEASANT BAY

• Physiographic-Oceanographic Setting
• Health of Eelgrass Habitats
• Health of Benthic Fauna
• Nutrient-Related Health Issues
• Summary Questions
EELGRASS STUDIES IN PLEASANT BAY

• 1990-91, Frederick Short, UNH

• 1995 & 2001, Charles Costello, DEP

• 2006, results of latest survey by DEP?

• 2003-2009, USGS & NPS
## EELGRASS DISTRIBUTION IN PLEASANT BAY

### Acreage of Coverage [as % of submerged area]

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SMAST Analysis</td>
<td>2,390 Ac.</td>
<td>1,899 Ac.</td>
<td>1,807 Ac.</td>
</tr>
<tr>
<td>MEP 2006[3]</td>
<td>[64%]</td>
<td>[50%]</td>
<td>[48%]</td>
</tr>
<tr>
<td>Bioactive Nitrogen at PBA12[4]</td>
<td>NO DATA</td>
<td>NO DATA</td>
<td>0.128 mg/l</td>
</tr>
</tbody>
</table>

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[4] DEP/MEP maximum threshold concentration for bioactive N at the Pleasant Bay Sentinel Station should not exceed 0.16 mg/l.
SMAST Pleasant Bay Eelgrass History

Source: Pleasant Bay Report, May 6, 2006, p 188.
Threshold Criteria

Eelgrass Specification

Error bands: 1995 and 2001: = +/- 10%

Source: Pleasant Bay Report, May 6, 2006, p 188.
Tier 2: Status 2006

Tier 2: Status 2007

DETRIMENTS TO EELGRASS HEALTH IN PLEASANT BAY

- Shading by phytoplankton blooms
- Burial by storms & over-wash deposits
- Exhumation by mobilized substrate
- Commercial shellfish harvesting
- Infection by pathogens & epibionts
- Grazing by herbivores
- Recreational boating
Threshold Criteria  Eelgrass Specification

Error bands:  1995 and 2001: = +/- 10%

Source:  Pleasant Bay Report, May 6, 2006, p 188.
FINDINGS ON EELGRASS

• No reliable basis for claiming significant declines in distribution or quality over past several decades.

• No ecologic basis for ranking probable causes of presumed declines and claiming septic effluent is to blame.

• Codification of “sentinel species” is at odds with basic ecosystem concepts.
## Shellfish Harvest Booms

<table>
<thead>
<tr>
<th>Year</th>
<th>Product</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>Quahogs</td>
<td>11,000 bushels</td>
</tr>
<tr>
<td>1981</td>
<td>Steamers</td>
<td>4,000 bushels</td>
</tr>
<tr>
<td>1983</td>
<td>Scallops</td>
<td>70,000 bushels</td>
</tr>
<tr>
<td>1987</td>
<td>Steamers</td>
<td>1,500 bushels</td>
</tr>
<tr>
<td>1996</td>
<td>Razor Clams</td>
<td>475,000 pounds</td>
</tr>
<tr>
<td>1997</td>
<td>Steamers</td>
<td>1,800 bushels</td>
</tr>
<tr>
<td>2004</td>
<td>Razor Clams</td>
<td>675,000 pounds</td>
</tr>
<tr>
<td>2005</td>
<td>Steamers</td>
<td>3,000 bushels</td>
</tr>
</tbody>
</table>

Namequoit Point Station


June 10, 2009
Arey’s Pond Station

<table>
<thead>
<tr>
<th>Environmental Attribute</th>
<th>Open Bays &amp; Lagoons</th>
<th>Drowned Kettles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substrate</td>
<td>well washed sand</td>
<td>fetid black mud</td>
</tr>
<tr>
<td>Organic Matter</td>
<td>low concentration</td>
<td>high concentration</td>
</tr>
<tr>
<td>Turbidity</td>
<td>low throughout</td>
<td>increases with depth</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>&gt;6 mg/l, Class SA</td>
<td>altern. hypoxic-oxic</td>
</tr>
<tr>
<td>Groundwater N</td>
<td>comparable</td>
<td>comparable</td>
</tr>
<tr>
<td>Residence Time</td>
<td>approx. 1 day</td>
<td>approx. 1 day</td>
</tr>
<tr>
<td>Eelgrass</td>
<td>widespread ~50%</td>
<td>not significant</td>
</tr>
<tr>
<td>Benthic Fauna &amp; Other Factors</td>
<td>healthy &amp; diverse shellfish harvests</td>
<td>stressed &amp; depleted &gt;330 boat moorings</td>
</tr>
</tbody>
</table>
FINDINGS ON BENTHIC FAUNA

• Major lagoonal embayments have healthy and diverse faunal communities.

• Deep bottoms of drowned kettles are stressed and hypoxic with depaupered communities.

• Relationship between anthropogenic or natural causes of stress is unresolved and moot.
PBA12 Namequoit Point

Nitrogen Data

- Total Nitrogen
- Bioactive Nitrogen
- DEP Specification, 0.16 Mg/liter

Source: Pleasant Bay Resource Management Alliance
PBA12 Namequoit Point  Data Extrapolation

FINDINGS ON NUTRIENT-RELATED HEALTH

• Assumption that health controlled by bioactive nitrogen levels is not evaluated or supported by factual evidence.
• Nitrogen threshold levels are arbitrary and without empirical foundation.
• No evidential basis for evaluating relative health of benthic communities in drowned kettles through time.
1. Where is the Y2006 eelgrass measurement data?
2. Why are eelgrass declines mainly in more shallow and cleaner southern and eastern areas of Pleasant Bay?
3. How can one species be proxy for influence of only one environmental parameter?
4. Why are drowned kettles relatively “impaired”?
5. Is this “impairment” amenable to remediation?
6. Where is the evidence for defining optimal nitrogen levels in marine ecosystems?