Coastal septic systems — threatened by rising groundwater tables and storms

Climate change and sea level rise will affect the functioning of coastal onsite wastewater treatment systems (OWTS; i.e. septic systems). Increased frequency and magnitude of precipitation events, in addition to sea level rise, are expected to raise coastal groundwater tables, which reduces the available volume of soil below the drainfield and impairs the system’s ability to renovate wastewater.

To quantify how groundwater tables have changed over the past half century along the southern Rhode Island coast, we are collecting data on historic and current groundwater table heights. Comparing the relative positions of the groundwater table height to the infiltrative surface of drainfields will help us understand how these systems are currently being impacted by climate change.

Another threat to coastal systems are storms, which are expected to become stronger and more frequent events in the coming decades. To quantify damage to systems arising from a large event, we are modeling how storms of different magnitudes are likely to impact affect systems along the southern Rhode Island coast.

Coastal groundwater tables are rising, compromising drainfields’ abilities to treat wastewater

- OWTS drainfields require adequate separation distance between the infiltrative surface and the groundwater table, since a certain volume of soil is required to adequately treat septic tank effluent before it reaches groundwater.
- As groundwater tables rise (as a result of sea level rise, increased precipitation and out-of-basin groundwater imports), coastal OWTS may no longer be functioning optimally — perhaps contributing to the degradation of coastal aquifers and estuaries through nutrient and pathogen loading.
- We analyzed historic groundwater table height data submitted to the RI Dept. of Environmental Management as part of the OWTS permitting process since 1964. The data indicate that groundwater tables along the southern Rhode Island coast are rising at a rate of about ½ inch (1.4 cm) per year. This means that in the past half century, groundwater tables may have risen by as much as 27 inches (70 cm) overall.
- To quantify current groundwater table behavior and separation distance under OWTS in coastal Rhode Island, we are pairing ground-penetrating radar (GPR) surveys of drainfields with long-term groundwater monitoring wells at 11 sites. We are comparing this data to information from OWTS plans submitted to the RI Dept. of Environmental Management to understand how systems are positioned relative to today’s groundwater table dynamics.
COASTAL STORMS FORECAST TO WREAK HAVOC ON COASTAL SEPTIC SYSTEMS

- Coastal storms of increasing size and frequency are expected to strike the coast over the next several decades. Storm events put coastal OWTS at risk, as fast-moving storm surge scours away sand and soil, and long-term flooding inundates drainfields and causes buoyant components to shift.
- We used flood maps together with properties’ elevation to estimate whether OWTS would suffer serious, moderate or ephemeral effects of any given storm type.
- Any storm (except Category 1 hurricane) is likely to cause damage to around 2,000 OWTS along the southern RI coast. Before this damage is repaired, these homes will not have adequate wastewater treatment, likely contributing to human and environmental health problems.
- Current resiliency planning and OWTS policy in RI is not focused on improving OWTS’ ability to withstand major storm events, nor do current plans address how to mitigate public and environmental health risks in the aftermath of a storm.

<table>
<thead>
<tr>
<th>Impact Category</th>
<th>Consequences for System</th>
<th>Duration of Impairment</th>
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</thead>
<tbody>
<tr>
<td>Serious</td>
<td>Major Repairs / Replacement</td>
<td>During Storm &amp; Weeks – Months Later</td>
</tr>
<tr>
<td>Moderate</td>
<td>Minor Repairs</td>
<td>During Storm &amp; Days – Weeks Later</td>
</tr>
<tr>
<td>Ephemeral</td>
<td>No Long-term Effects</td>
<td>During Storm</td>
</tr>
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</table>

**During a Storm:**
Flooding and fast-moving water inundates septic systems (especially low-lying and near-shore systems)

**After a Storm:**
Septic systems may be damaged from long-term flooding or scouring action of fast-moving water

**Monitoring Current Groundwater Tables**

**Right:** Diagram of a groundwater monitoring well, and the ground-penetrating radar (GPR) unit above a GPR cross-section of a drainfield showing trenches (red box) and the water table (blue line)

**Below:** Performing GPR survey of a drainfield

**Storm impacts on septic systems along southern RI coast**

**Hurricane impacts on septic systems along southern RI coast**

**Impact category**
- Ephemeral
- Moderate
- Serious
- Unknown