

## Consequences, Seen and Unseen

### Increasing Air Temperature

In Rhode Island, increased air temperatures will extend the length of the shipping season and allow for higher volumes of goods to be shipped at lower costs due to less severe cold weather. Air temperature increases will decrease the incidence and severity of icing in waterways and on vessels and infrastructure. On vessels, less icing will decrease the need for lowering freeboard to increase stability, not to mention lessen the calls of “Man overboard!” on fishing vessels.

On the down side, work on vessels and at shoreside infrastructure will have to plan for extreme heat to protect workers in higher temperatures. Higher temperatures of both air and water will increase invasive species survival rates in local waters from ballast discharge (hello, zebra mussels?) There is also the threat of more rapid deterioration of paved areas in and around all types of access areas and greater energy needed—and higher costs—to cool stored goods, freight, warehouse spaces, and offices. Marine transportation workers also may experience more frequent heat related injuries.



Barge traffic in the Port of Providence Photo Credit: RI Sea Grant

### Rising Sea Level

The creep of ongoing sea level rise will reduce the effectiveness and decrease the life of existing coastal structures such as seawalls and revetments, docks, roads, and bridges. Sea level rise will result in a shrinking amount of land available for activities associated with marine transportation as coastal areas find themselves underwater.

One of the more insidious effects of sea level rise is how it could compromise onsite wastewater treatment systems, municipal sewage treatment plants, and stormwater infrastructure. This in turn begs a number of questions with cascading economic impacts:

- Do we need to move an expanding municipal wastewater treatment system inland?
- How much will that cost?
- Who will pay for it, those who use it or the state as a whole? (Think of the Providence metro area's combined sewer overflow tunnel project and the fact that the Field's Point facility is right at the edge of Narragansett Bay, but absolutely must expand, conceivably inland, to be viable in future years.)
- Whose neighborhood gets the unexpected joy of having a new wastewater treatment plant as part of the scenery?

Although mitigated by improved public drinking water systems in recent years, the risks associated with sea level rise include salt intrusion into aquifers and higher water tables that could also compromise individual sewage disposal systems. Salt in well water renders it as unusable for human consumption as effectively as would poison. Cheers.

### Flooding

Higher sea levels increase the likelihood of flooding and inundation of coastal

lands and infrastructure. Future storm surge levels will be even higher as sea levels rise and storms intensify.

This can affect the use of infrastructure in ports and harbors both over the short term (during a flooding event) and long term (extensive damage from inundation), and impact vessels access to the coast (for example, to unload cargo or pick up passengers).

One of the most overlooked consequences of RI's Great Flood of 2010 was the amount of pollution that entered the state's waterways, and in some cases, drinking water supplies.

Higher flood levels and storage-area inundation may also overrun contaminated (or potentially contaminated) lands, and/or infrastructure not designed to withstand flooding. These areas could require new containment methods to prevent leaching.

When flooding overtops ports, there is large area of inland inundation because ports are typically built in flat, low-lying areas. Options for protection include elevating facilities, filling land, and/or installing shoreline protection structures. Each of these options would need to be analyzed on a case-by-case basis. Sand and gravel for armoring and fill is limited in Rhode Island due to municipal policies on sand and gravel mining and lack of publicly or privately owned land alternatives.

Finally...Duck! Increased sea level will reduce overhead clearance between the superstructure of ships and bridges in Narragansett and Mount Hope Bays, thereby limiting operations.

But it is not all bad. The potential positive impact of sea level rise may be increased navigability of waterways and a decreased need for dredging to accommodate larger-draft vessels. This could positively benefit ships that pass through Rhode Island waters due to currently significant demands for dredging in several parts of Narragansett and Mount Hope Bays. Increased ease of navigability may also lead to an increase in shipping of goods to and from Rhode Island ports. That's money in the pocket of local businesses.

## Increasing Storm Intensity

A signature element of climate change in the progressive increase in storm intensity. This can have a range of economic impacts, both direct and indirect. And unless you are in the port or marine trade-related industries, they might never occur to you or any other average American who doesn't hang around the waterfront. For example, Increased storm intensity will increase the likelihood of debris that is washed into the water or uprooted from its moorings inhibiting navigation and/or anchoring at ports and harbors.

*Slowing down the chain of supply.* Increased storm intensity may lead to decreased regularity of port functions and increased need for storage capacity at

container terminals. This may increase shipping delays due to suspended operations during intense storms and could decrease the reliability of marine shipping, impacting business of shippers and receivers of shipped goods.

*Loading/unloading.* Heightened intensity in storms will produce periods of high waves, decreasing time for ships to unload at terminals and increasing berthing time for ships at terminals and delayed departures. Increased time needed to unload cargo may result in the need for more area for anchoring of waiting vessels in port areas. Additionally, offshore loading and unloading between vessels can only occur with waves below a certain height and longer than a certain wave period. With increased storm intensity, wave heights too large and with too short a wave period for transfer of goods (and personnel) will occur more frequently. This is

critical since demand for natural gas in winter in Providence can be a bottleneck for distribution.

*Sediment.* More intense storms can affect sediment movements due to increased wave heights, which can cause changes in erosion and accretion patterns. These differing sediment movements can affect needs for dredging, preferred shipping routes and port operations. Increased storm intensity will also

increase degradation and vulnerability of associated infrastructure. Movements of sediment due to increased storminess may also decrease safety of structures and increase probability of flooding through erosion of coastal land.

*Port security.* In the world of homeland security emphasis, shipping could be adversely impacted by increasingly intense storms and could result in less security (for example, malfunctioning video cameras, radar equipment, and perimeter fencing).

*Technology and stupidity both cost money.* Unsafe conditions and poor visibility due to increased storm intensity may increase shipping delays and damage vessels. Using additional and enhanced aids to navigation — such as more buoys with higher-intensity lights, more sound and electronic signals — one can attempt to mitigate these impacts, but at a high cost. This may also increase the need for emergency planning and rescues, which will also incur considerable economic costs to the associated industries. There is a government trend today to turn



MV Block Island

rescue costs back on to those saved, simply because of their failure to properly prepare for or anticipate trouble.

## Ocean Acidification

Decreasing acidity levels and the corresponding increase in carbonic acid in the seas may increase the rate of corrosion on vessels and infrastructure associated with marine transportation, navigation, and ports and harbors. Existing structures and vessels may experience a shorter lifespan due to more corrosion

However, increased corrosiveness is also dependent on other environmental factors that will likely be affected by climate change, including some that may have mitigating effects on corrosiveness.

## Unseen Economic Consequences

As energy—and its varied sources—become a political and societal issue, there are ramifications that silently extend into everyday life...and the economy.

Warmer temperatures may change the seasonality of energy demands, with less energy for heating needed in winter, and more energy for cooling in summer. Plan your household and business budgets accordingly.

The net effect on energy demand is not known, but it may influence the mix of energy needed and the seasonality and amount of regional marine oil and gas shipping through the local waters.

The insurance industry and its clients are currently thrashing around trying to make sense of the situation even now. People who never expected to be told that they were technically in a floodplain are finding out the financial implications of that new designation they received. Ask any only vaguely “coastal” homeowner after the Great Flood of 2010.

Climate change may affect insurance coverage, and could increase premiums on insured property and vessels with combined impacts from increased sea level and storm intensity.

Currently, the marine transportation insurance industry is very concerned about rising costs associated with climate change. In response, they are exploring other strategies for insuring vessels and infrastructure including shifting some of the risk to customers and providing technical support and price incentives for customers to decrease exposure to risks.

It has been suggested that as insurance premiums rise, reflecting increasing risk, there will be greater incentive to incorporate adaptation measures to infrastructure.

As the mean high water mark moves inland due to sea level rise, the legal boundary between private and state-owned land also moves. This may affect issues of ownership at ports in Rhode Island and complicate issues of planning for future impacts of climate change on coastal infrastructure if ownership of the lands upon which they lie is in question.



*Höegh Berlin* delivering cars to Rhode Island

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