Assessing the Economic Impacts of Climate Change Events to Marine Industries in Long Beach, California

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Policy Question

What are the economic impacts of climate change events, specifically rising sea levels and low-probability storm events, to coastal marinas in Long Beach, California?

Results

A respective 1.0 m and 1.4 sea level rise in 2050 and 2100, will not result in measurable impacts to Long Beach's marinas in 2050 or 2100. However, a 2.0 m rise in sea level by 2100 will result in year-round, inundation-related closure to Shoreline Marina and Rainbow Harbor Marina. A **one-year** closure to these marinas will result in lost sales totaling $35.8 million. The annual direct and secondary effects from a closure to these marinas amounts to a loss of 420 jobs for the local economy, $12.4 million in lost labor income and $20.7 million in lost value added

A respective 1.0, 1.4 and 2.0 m sea level rise accompanied by a **single** 100-year storm event in 2050 or 2100 will result in a loss of sales totaling approximately $2.6 to $4.4 million in 2050 and $3.4 to $7.2 million in 2100. Total direct and secondary effects amount to a loss of approximately 34 to 57 jobs in 2050 and 45 to 95 jobs in 2100, lost labor income of $0.95 to $1.6 million in 2050 and $1.3 to $2.7 million in 2100, and lost value added of $1.5 to $2.6 million in 2050 and $2.0 to $4.3 million in 2100. The capital cost of structural adaptation measures to increase resiliency of Long Beach's marinas is approximately $106.3 million, with additional annual maintenance costs totaling $2.7 million.

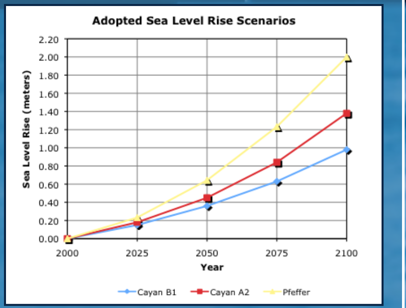
Conclusion and Recommendations

This study illustrates the potential climate change impacts to municipal marinas in Long Beach, CA In the coming century, a large number of marinas on the California coast will also be presented with similar reductions in economic output due to rising sea levels and extreme storm events. It is imperative that additional analyses be conducted at high-profile marinas along the California coast. Such studies will provide policymakers with the necessary information to make decisions that will bolster California's boating industry, which currently plays a key role in the State economy. If policymakers plan accordingly for projected climatic changes, boating and supporting industries will continue to play a significant role in the California economy. If adaptation strategies are not incorporated in a timely manner, the recreational boating industry, as well as the California economy, could experience significant impacts.

Climatic Scenarios

This study models a respective sea level rise of 1.0, 1.4 and 2.0 meter (m) in 2050 and 2100. Sea level rise projections were extracted from a series of scientific consensus reports that were most applicable to the California coast.

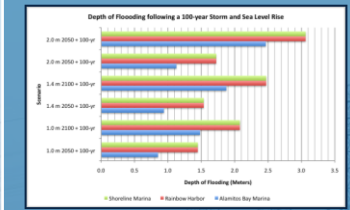
Respective sea level rise scenarios were modeled into the existing 100-year storm models, adopting the assumption that as sea level rises, the 100-year storm plain will increase.



Sea Level Rise and 100-Year Storm Modeling

GIS methods were used to identify areas inundated by a future rise in sea level and a 100-year storm. To delineate areas vulnerable to sea level rise and a 100-year storm, digital elevation models (DEM) base flood elevation (BFE) models were analyzed. Spatial analyst tools, were used to produce inundation plains that conform to the dynamics of flooding.

Sea Level Rise & 100-Year Storm Plain

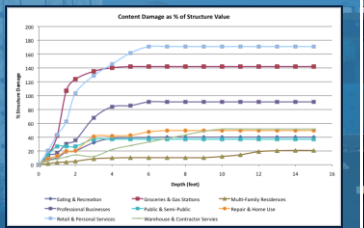


Depth of Flood Modeling

After establishing the respective sea level rise and 100-year inundation plain for 2050 and 2100 scenarios, a combination of zonal statistic techniques were used to calculate the mean depth of flooding at each of Long Beach's municipal marinas.

Infrastructure Loss Modeling

To calculate the damages to Long Beach Marine Bureau infrastructure, parcel data was overlaid on the inundation plain. Utilizing GISs attribute fields, the depth of flooding at each parcel was linked to supplemental depth damage curves in order to calculate total losses to infrastructure and their contents .



Protective Structure Needs

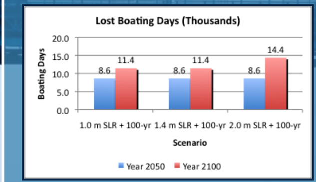
Structural Adaptation Modeling

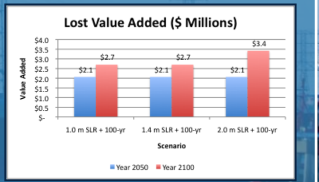
To evaluate potential losses as they relate to the cost of increasing the resiliency of Long Beach's marine industries, existing protective structures, specifically bulkheads and levees were evaluated. GIS layers were created to map existing structures and calculate the cost of raising such structures to address rising sea levels.

Economic Impact Modeling

To estimate a reduction in economic impacts to Long Beach's marinas, the mean flood depth at Long Beach's marinas were parameterized and translated into lower, mid-range and upper bound restoration rates that evaluate the time needed to address structural damage, salt water intrusion, natural gas and electric damage, fuel and pump station damage, limited contractor availability and inspections and permitting. Within GISs attribute fields, restoration timetables were linked to daily economic output values to calculate the total economic losses for the various climatic scenarios.

Mid-Range Cumulative Economic Losses ($ Thousands) for 100-year Storm Following a Rise in Sea Level at Long Beach's Marinas





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