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Chairman Maloney, Ranking Member Gibbs, and Members of the Subcommittee:

Thank you for the opportunity to appear before you today. I am pleased to be here to discuss some of the challenges facing the Coast Guard, our ports, and other public agencies as they try to make sure our coastal infrastructure is resilient to emerging risks relating to coastal change. The views I express in this testimony are my own, and not the views of UCLA School of Law.

For over ten years, I have studied the ways private and public institutions address emerging climate-change related risks to infrastructure and communities. I have followed closely the ways local, state, and federal coastal managers address climate change in their planning. I have also analyzed climate change's interactions with the insurance sector, which holds much of the world's weather- and climate-related financial risk.

Managers of coastal properties and infrastructure, including federal agencies, have to make strategic choices about where and how to invest. Federal management and investment decisions also influence downstream infrastructure investments in the public and private sector. These decisions necessarily involve consideration of all relevant risks. With that in mind, the challenges faced by global risk managers like reinsurers hold lessons for the federal government.

Coastlines, by their nature, undergo constant changes as well as occasional serious disruptions. The stability of our coastal infrastructure has always required careful attention to the physical conditions and the risks these conditions pose. But the evidence is clear: sea-level rise and increased storm-related coastal risk present new challenges that our infrastructure isn't designed for. Scientists have measured sea-level rise over the past century at an average of 6-8 inches already, with evidence the rate of rise is accelerating. A combination of factors, including changes in storm dynamics and the impact of rising seas on king tides along with increased urbanization and infrastructure on our coastlines, will result in more rapid coastal change and more vulnerability than we've seen in the past.

This will affect communities throughout the U.S. The National Oceanic and Atmospheric Administration (NOAA) found in a 2018 report that "While the rate and overall amount of [relative sea-level] rise over this century (and beyond) is uncertain, as it is linked to future amounts of emissions and global temperature rise, it is nearly certain that high tide flooding will

become increasingly chronic within coastal communities over the next several decades simply under current rates of local [relative sea-level] rise."[1]

Future chronic high-tide flooding in previously safe communities illustrates a key point. We built our infrastructure around a historical range of conditions—knowing that there may be extreme conditions at times. But it's clear the past is no longer a reliable indicator of the future, and the conditions we view as extreme today may become more ordinary, or at least more frequent. Moreover, we do not know what the magnitude or pace of the change will be, since that depends on complex physical systems as well as on how much we reduce greenhouse gas emissions. It is increasingly challenging to plan effectively for the future in a literal climate of uncertainty.

Federal agencies have a responsibility to ensure resilience to coastal change in the management of federal assets. In light of the foreseeable direction and probable magnitude of change, planning and investment will reduce the economic and social costs of sea-level rise, storm surge, and other impacts, compared with reacting when the hazard materializes. Vulnerability assessments and adaptation planning help agencies to understand and evaluate the risks under a range of future scenarios, and then to strategically invest in resilience accordingly.

I want to note here that adaptation planning is increasingly common at the state and local level, in addition to federal efforts. California's Coastal Commission, which administers California's Coastal Zone Management Act program, has been particularly forward-thinking in planning for coastal resilience. Other agencies have also had to address coastal change in the context of asset management. For example, the Port of Los Angeles, in Rep. Lowenthal's district, recently developed a Sea Level Rise Adaptation Plan. That plan evaluates physical assets' exposure, sensitivity to change, and adaptive capacity, as well as potential economic, social, and environmental vulnerabilities. It projects serious consequences if the Port fails to adapt.

The private sector is also focusing on adaptation more and more. Corporations are taking steps to assess and address vulnerabilities in their assets. Significantly, insurance executives, underwriters, and actuaries, who drive decisionmaking by the companies that hold the most financial risk across the world economy, are increasingly concerned with climate-related risks.

The Department of Defense has called climate change a "threat multiplier" to national security, and for good reason. The type and level of disruption and uncertainty that climate change will cause makes it challenging to plan, and increases the likelihood of chaotic outcomes. Similarly, because climate change increases the uncertainty of risks, it is a threat to risk managers and their clients.[2] Insurers cannot insure where they can't predict risks over time. The major international

[1] William V. Sweet et al., Patterns and Projections of High Tide Flooding Along the U.S. Coastline Using a Common Impact Threshold (NOAA Technical Report NOS CO-OPS 086 2018) (citation omitted), *available at* https://tidesandcurrents.noaa.gov/publications/techrpt86_PaP_of_HTFlooding.pdf.

[2] See Sean B. Hecht, Climate Change and the Transformation of Risk: Insurance Matters, 55 UCLA L. Rev. 1559 (2008), for a more comprehensive discussion of the strategic risks climate change poses for the insurance sector. *Available at* https://www.uclalawreview.org/pdf/55-6-3.pdf.

insurers, which hold the most risk, are particularly concerned, and are investing heavily in better understanding climate risk—as they sound the alarm within their industry and more generally. Officials at both Lloyd's of London and Munich Re noted, after Hurricane Sandy, the likely connections between climate change and future increases in storm damage.[3] The projected rise in sea level will further increase the risk of storm surge.

The most recent annual survey of emerging risks by three major actuarial societies—the professionals whose job it is to evaluate financial risks for the private sector—named climate change as both the top emerging risk and the top current risk.[4] The most sobering assessments within the sector focus on the uncertainty that climate change has injected into insurers' business model, and the strategic challenges it creates for risk management. The International Association of Insurance Supervisors recently noted "the potential for physical climate risks may change in non-linear ways, such as a coincidence of previous un-correlated events, resulting in unexpectedly high claims burdens," and concluded that "[a]t the macro-economic level, uninsured losses from physical risks may affect resource availability and economic productivity across sectors, the profitability of firms and individual assets, pose supply chain disruptions, and ultimately impact insurance market demand."[5]

Within U.S. insurance markets, flood insurance has long been a special case among weather-related risks, independent of climate change risk. Private insurers largely pulled out of the flood insurance market in the mid-20th century. This was the result of massive, correlated losses from hurricanes that made insurers view flood risk as uninsurable. Most insurable risks are spread over a large area, and occur more or less randomly across a large number of insureds. Think about auto insurance: not every drive will have an accident the same day. Instead, they are well-dispersed, enabling insurers to price the risks and to maintain sufficient capital to pay claims. Storm-related losses, and flood-related losses generally, are different. Insurers can't spread these risks effectively. The National Flood Insurance Program fills the gap in private flood insurance. Of course, that program has its own challenges that are out of the scope of this hearing.

One might suspect that availability of private coastal flood insurance will only get worse under emerging conditions. But recent research instead provides reason for optimism. Private flood insurance availability is improving as insurers develop more and better information about coastal risks through research, modeling, and data analysis, and as planners and infrastructure managers

[3] Munich Re, Natural catastrophe statistics for 2012 dominated by weather extremes in the USA (January 3, 2013), https://www.munichre.com/en/media-relations/publications/press-releases/2013/2013-01-03-press-release/index.html.
[4] Max J. Rudolph, 12th Annual Survey of Emerging Risks: Key Findings (Casualty Actuarial Society et al. 2019), *available at* https://www.soa.org/globalassets/assets/files/resources/research-report/2019/12th-emerging-risk-survey.pdf.
[5] International Association of Insurance Supervisors, Issues Paper on Climate Change Risks to the Insurance Sector (July 2018), *available at* https://www.insurancejournal.com/research/research/success/climate-change-risks-to-the-insurance-sector/.

work actively to address those risks.[6] Insurers have made clear that more robust information and analysis about emerging risks, and evidence of community-scale risk mitigation planning, are crucial. The value of anticipating the need for elevation of structures across an entire area, or maintaining a wetland that protects structures from king tides or storm surges[7], can be quantified and considered. And over time, insurers' decisions may also signal practices that make assets so vulnerable that new investment should be avoided.

What does this mean for the Coast Guard, and for Port infrastructure?

Federal planners can draw lessons from the insurance sector. First, more information and analysis to clarify and assess site-specific and programmatic risks is crucial. Risk is inevitable. But where agencies understand risks, they can plan for them. Developing and using tools to assess the vulnerability of their infrastructure and personnel can help federal agencies to reduce risk, and to anticipate practices for adapting even to catastrophic events by managing risk more effectively. And agencies don't need to reinvent the wheel. Other agencies, academic researchers, and insurers have developed tools that can assist with modeling of physical conditions, assessment of economic and social vulnerability, and analysis of other parameters.

Second, planning for resilience will reduce uncertainty and facilitate better investment and prioritization by federal agencies. Just as insurance underwriters are willing to address even very difficult risks where loss prevention measures are in place, federal agencies can decrease vulnerability through sound planning. New infrastructure should avoid the most vulnerable areas, and agencies should evaluate the adaptability of what they've already built. A range of strategies will be necessary, including retrofitting existing structures, rebuilding smarter after disasters, using natural infrastructure to mitigate risks, and avoiding building in the most vulnerable places.

The most crucial action is to integrate resilience planning and governance into federal actions at every step, to ensure that climate change's impacts are considered in decisionmaking about how and where we build and rebuild, and that agencies understand the reasonable range of possible futures. This process will enable agencies to plan effectively for a range of scenarios. This type of planning can inform asset investment by agencies like the Coast Guard, and also may inform other programs, like grantmaking under the Port Infrastructure Development Grant and Port Security Grant programs. Investing early to reduce risk and protect assets will pay off.

Thank you for your consideration and I look forward to your questions.

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[6] Carolyn Kousky et al., The Emerging Private Residential Flood Insurance Market in the United States (Wharton 2018) , *available at* https://riskcenter.wharton.upenn.edu/wp-content/uploads/2018/07/Emerging-Flood-Insurance-Market-Report.pdf.

[7] Lloyd's of London, Coastal Wetlands Save Hundreds of Millions of Dollars in Flood Damages During US Hurricanes (October 25, 2016), https://www.lloyds.com/news-and-risk-insight/press-releases/2016/10/coastal-wetlands-save-hundreds-of-millions-of-dollars-in-flood-damages-during-us-hurricanes.