

D I A L O G U E

COASTAL IMPACTS OF CLIMATE CHANGE

SUMMARY

The collapse of the Champlain Towers South condominium complex in Surfside, Florida, raised questions about how climate change and environmental impacts may cause damage to coastal buildings. Independent structural issues are suspected to be a major factor in the collapse, but scientists and legal researchers posit that environmental factors also played a role. On December 20, 2021, the Environmental Law Institute hosted a panel of experts that explored the climate risks to coastal communities and buildings in Florida, California, and elsewhere. Below, we present a transcript of that discussion, which has been edited for style, clarity, and space considerations.

Amy Reed (moderator) is a Senior Attorney at the Environmental Law Institute.

Dr. Tayebah TajalliBakhsh is an Ocean Engineer and Team Lead at the RPS Group.

Liz Klebaner is a Partner at Nossaman LLP.

Daniel O. Suman is a Professor of Environmental Science and Policy at the Rosenstiel School of Marine and Atmospheric Science, University of Miami, and Adjunct Faculty at the University of Miami School of Law.

Jon Paul “J.P.” Brooker is the Director of Florida Conservation at the Ocean Conservancy.

Amy Reed: This event was partially inspired by the discussions that followed the tragic collapse of the Champlain Towers South condominium complex in Surfside, Florida, in June 2021,¹ which brought a renewed sense of urgency to questions about how climate change and its environmental impacts can cause structural damage to coastal buildings.

While independent structural problems and issues were suspected to have been a major factor in that building’s collapse, experts and researchers across disciplines also raised questions about whether environmental factors played a contributing role. Our panelists will be discussing the science behind sea-level rise and the impacts of climate change on coastal infrastructure, touching on some key national trends we are seeing. We’ll also be taking a deeper look at California and Florida specifically, analyzing some of the regional and local challenges emerging from climate change, regulatory developments, and possible policy solutions.

Our first panelist is Tayebah TajalliBakhsh. She has a Ph.D. in ocean engineering and is a principal scientist with

RPS North America, where she leads a team of numerical modelers focusing on extreme coastal hazards—including sea-level rise, tsunamis, and storm surges—that affect natural resources, coastal infrastructure, and industries. Her team is also responsible for complex numerical modeling of coastal processes, metocean analysis, and design criteria for offshore wind. Coastal resilience and climate change solutions are her main interests.

Tayebah TajalliBakhsh: Since we are discussing the coastal impacts of climate change, I’m first going to talk about what climate change is and how it affects our coastal resilience and coastal infrastructure. We all are aware of weather. We know weather changes hour to hour, day to night, and also season to season. But at the same time, there are long-term patterns that we are familiar with and expect to see in specific geographies of the world, as well as in the whole globe as a unit.

When these long-term patterns shift and change, we are talking about climate change. In general, climate change is not something new. It happened previously. But when these shifts occur with higher frequency, it’s concerning. We’ve already experienced the consequences of climate change. For example, although many parts of the world experience hurricanes and storms in certain seasons, we now see them occurring with higher intensity and higher frequency.

So, why does climate change happen and how does it happen? It is a natural process. We have greenhouse gases (GHGs) in the environment already. Some of them are naturally occurring, while others are from human impacts. They usually have a long lifetime, like carbon dioxide. These layers of GHGs protect us, and at the same time they re-emit heat when they absorb solar energy.

When the re-emission of heat and radiation gets stuck in the environment and atmosphere of the earth, we have an increase in temperature—a climate change effect. As I mentioned, some of these GHGs are naturally occurring,

1. Vanessa Romo, *The Search for Victims Comes to an End at the Florida Condo Collapse Site*, NPR (July 23, 2021), <https://www.npr.org/2021/07/23/1018164946/search-ends-victims-florida-condo-collapse-site>.

such as water evaporation in the atmosphere. But based on the Intergovernmental Panel on Climate Change (IPCC) report that came out a few months ago,² we see that human impacts exert a great deal of influence on global warming by increasing the amount of carbon dioxide and methane in the atmosphere.

In the United States, GHGs typically come from commercial and residential heating systems, agriculture, transportation, and electricity production—and there are some industrial sources like transportation and generation of heat when fuel is burned for manufacturing. Different parts of the world have different ratios of sources, and different reasons for this production of GHGs. I will focus mainly on the United States and specifically residential GHG sources, such as burning oil to generate heat.

When climate change happens, what scales are we talking about and what impacts do we see? First, we see temperature changes happening on a global scale, including extreme heat and cold weather. We saw shellfish boiling in British Columbia in 2021, and we saw snow in Texas in 2020.³ As I said, changes are not new. We have seen this pattern before. But now, the frequency is higher than before, and that's what we mean when we talk about climate change.

Climate change accelerates the meltdown of the glaciers and ice sheets. We also have more wildfires and drought, and because of these environmental changes, we see impacts on animals and insects, as well as human disease. Immigration will increase because parts of the world will not be suitable for living or agriculture. At the same time, other parts of the world will become warmer, which may lead to production and agriculture in those areas.

Global warming will affect our oceans as well. Oceans have their own patterns of circulation, and many currents are formed based on these temperature differences. Global warming will change the stratification of the ocean, regions of upwelling, nutrients in the water, ocean salinity, and acidification. In general, it will affect marine organisms and their geographic distribution, which impacts the fishery industry too.

Climate change will also increase sea levels. Whatever we used to have as the mean value for the sea level will rise. And we will have more sea-level rise in some areas of the world. For example, the mid-Atlantic region, where I'm at, will have more sea-level rise than other parts of the Atlantic. Consequently, we will have coastal flooding from these rising sea levels. On top of that, we will have more extreme storms, which will cause even more coastal flooding. It will change our shoreline and coastal areas. Higher sea levels will intrude into our freshwater and groundwater.

To summarize, we will have an increase in the temperature of the global surface. And because we have different scenarios, we cannot predict and project these changes very accurately. Higher-resolution global climate models and more satellite data give us a better understanding of climatic changes, but we will need to consider constantly changing data and different scenarios for those emissions.

Consequently, depending on the amount of change in the temperature of the ocean, climate change will affect sea ice and ocean acidity in a number of different scenarios. With all of these possible changes, we'll see different scenarios of sea-level rise in the future. The National Oceanic and Atmospheric Administration (NOAA) report⁴ and IPCC report⁵ say we can have in an extreme scenario up to nine feet of sea-level rise in some areas of the Atlantic, including ones close to Florida, which is concerning. And there will definitely be many impacts to coastal infrastructure.

What are some solutions? The first solution that people discussed in the previous Conference of the Parties was mitigation. We considered if we can reach net-zero emissions, even though we cannot stop burning oil immediately because our heating and electricity systems still depend on it. Meanwhile, renewable energy systems have their own limitations, since they rely heavily on the season and geography. For example, if I'm in cloudy New England, we cannot use solar systems that much, so we cannot get rid of fossil fuels. But if we're generating carbon dioxide, we need to remove this GHG. People are thinking of putting more taxes on emissions, while at the same time promoting innovations and renewable energy. So, mitigation policy options exist.

We should also prepare for adaptation. This involves accepting that these risks exist and conducting the necessary risk management. For example, the nuclear power plant in Fukushima, Japan, was impacted by a tsunami in 2011.⁶ The Nuclear Regulatory Commission then started looking at the impacts of tsunamis on coastal nuclear power plants and updated regulations.⁷ We will see the same thing happen with coastal infrastructure with regard to climate change. We need to implement adaptation strategies around our infrastructure and our agriculture, through tools like new innovations, policies, and regulations.

In terms of adapting our coastal areas, we expect the Federal Emergency Management Agency (FEMA) to update its flood maps. We need to look at the structural codes that the American Society of Civil Engineers (ASCE) has already established. And we need to consider that every state has its own regulations. For example, in Rhode Island, the state's Coastal Resources Management Council

2. IPCC, CLIMATE CHANGE 2021: THE PHYSICAL SCIENCE BASIS (2021), <https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/>.

3. Sammy Westfall & Amanda Coletta, *Crushing Heat Wave in Pacific Northwest and Canada Cooked Shellfish Alive by the Millions*, WASH. POST (July 8, 2021), <https://www.washingtonpost.com/world/2021/07/08/canada-sea-creatures-boiling-to-death/>; Alexandra Villarreal & Erum Salam, *Two Die in Texas as Winter Storm Brings Snow and Ice Across Southern US*, GUARDIAN (Feb. 16, 2021), <https://www.theguardian.com/us-news/2021/feb/15/winter-storm-snow-ice-hits-southern-us>.

4. NOAA, GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES (2017), https://tidesandcurrents.noaa.gov/publications/techrpt83_Global_and_Regional_SLR_Scenarios_for_the_US_final.pdf.

5. IPCC, *supra* note 2.

6. News Release, National Centers for Environmental Information, NOAA, On This Day: 2011 Tohoku Earthquake and Tsunami (Mar. 11, 2021), <https://www.ncei.noaa.gov/news/day-2011-japan-earthquake-and-tsunami>.

7. U.S. Nuclear Regulatory Commission, *Backgrounder on NRC Response to Lessons Learned From Fukushima*, <https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/japan-events.html> (last updated Sept. 17, 2018).

has requested that when designing coastal structures, the extreme scenarios and conditions of the area must be considered and acknowledged.⁸

Regulations should focus on soft solutions, including living shorelines and plant-based barriers. We also need to stabilize our hard shorelines and infrastructure, and we need to look at the intrusion of seawater and salt water into groundwater and dams. Green infrastructure, beach nourishment, and vegetation should also be incorporated in policies. We should also keep in mind that coastal flooding is usually compounded by river flooding and upstream flooding as well—this is the new science that experts are discussing.

Amy Reed: Our next panelist is Liz Klebaner. Liz is a partner in Nossaman’s Environment and Land Use Practice Group. She advises public agency and private-sector clients on a variety of complex land use and environmental matters under federal and state law, including the National Environmental Policy Act (NEPA),⁹ the Endangered Species Act (ESA),¹⁰ the Clean Air Act (CAA),¹¹ the Federal Land Policy and Management Act (FLPMA),¹² the California Environmental Quality Act, which is California’s environmental impact analysis law, the California Coastal Act, and planning and zoning law compliance and litigation matters.

Liz Klebaner: I’m here to provide California’s perspective on sea-level rise challenges and adaptation strategies. My perspective is that of a lawyer. I’ll focus on the key statutes and court decisions that address the governmental response to sea-level rise when regulating coastal development.

What is at stake? California and Florida have at least one thing in common. With the exception of Alaska, California and Florida have more linear miles of coastline than any other U.S. state or territory. Over the course of this century, the effects of sea-level rise will be felt by thousands of coastal residents and businesses. Governments and utilities will be affected, too, as the California coast hosts essential power generation infrastructure, utility infrastructure, and hundreds of miles of highways, roads, and rail, as well as world-famous beaches and parks. We’re not going to be able to address all of these sectors today. Given that the Surfside condo collapse is our prompt, I’ll focus on the regulation of private residential development on the coast.

What’s happening in California? California enacted legislation in 2006 to regulate GHG emissions.¹³ The state initially focused on regulating the largest contributors of GHGs. That’s the transportation sector, the energy generation sector, and the heavy industrial sector. But we’ve also made inroads into land use management. The California

Natural Resources Agency is charged with developing and updating on a three-year time line a statewide climate adaptation strategy that affects all sectors.

Most recently, and in response to recent extreme weather events in California, Gov. Gavin Newsom signed Executive Order No. N-82-20.¹⁴ In relevant part, the Executive Order declares that the climate crisis is happening now. It directs state agencies to undertake certain measures to reduce the impact of sea-level rise in addition to other adaptation strategies on the coast, balancing public resources and the interests of economic sustainability and continued growth in California.

The state, as I mentioned, also adopted a climate adaptation strategy. The 2021 version of the strategy is currently in draft form.¹⁵ It identifies the state’s Coastal Commission as the key agency for regulating sea-level rise impacts on development on the coast. In addition to the California Coastal Commission, the strategy identifies local coastal jurisdictions as important to regulating coastal development and ensuring that adaptation occurs to protect and sustain existing coastal resources.

The California Coastal Act¹⁶ is our key statute for today’s discussion. It is the primary statute for regulating development on the coast. The Coastal Commission administers the statute, in addition to local jurisdictions. Local jurisdictions administer the Coastal Act through their local coastal programs that are adopted pursuant to the Coastal Act and made part of the local jurisdiction’s land use planning documents, such as general plans and zoning ordinances.

There are other statutes that also deal with sea-level rise that I’m not going to address today. Those are the general environmental review statutes like NEPA and, in California, the California Environmental Quality Act. Other agencies that have a role in managing sea-level rise impacts on development include the State Lands Commission in California, which I’ll address briefly. And of course there’s the role of the federal government as a property owner and regulator in California.

Back to the Coastal Commission. The Commission is primarily responsible for implementing the California Coastal Act. It is also the state coastal zone planning and management agency for purposes of the federal Coastal Zone Management Act (CZMA).¹⁷ It has been delegated that function under federal law. The Commission reviews and certifies the consistency of local coastal programs with the state Coastal Act. The Commission also hears and may institute appeals from local government actions on coastal development permits.

What is the role of local government? The local government also implements the Coastal Act. It prepares and

8. Rhode Island Coastal Resources Management Council, *STORMTOOLS Design Elevation (SDE) Map Training Session*, http://www.crmc.ri.gov/news/2018_1004_stormtools.html (last visited Feb. 14, 2022).

9. 42 U.S.C. §§4321-4370h, ELR STAT. NEPA §§2-209.

10. 16 U.S.C. §§1531-1544, ELR STAT. ESA §§2-18.

11. 42 U.S.C. §§7401-7671q, ELR STAT. CAA §§101-618.

12. 43 U.S.C. §§1701-1785, ELR STAT. FLPMA §§102-603.

13. California Global Warming Solutions Act of 2006, ch. 488.

14. California Executive Department, Executive Order N-82-20 (Oct. 7, 2020).

15. California Natural Resources Agency, *2021 California Climate Adaptation Strategy*, <https://resources.ca.gov/Initiatives/Building-Climate-Resilience/2021-State-Adaptation-Strategy-Update> (last visited Jan. 26, 2022).

16. CAL. PUB. RES. CODE §§30001 et seq. (West 2016).

17. 16 U.S.C. §§1451-1466, ELR STAT. CZMA §§302-319.

adopts local coastal programs for the portion of the coastal zone that is within the government's jurisdiction. Once the Commission has certified a local coastal program, the local government is then delegated the duty to issue permits for development. One thing that we should keep in mind is that "development" is defined very broadly under the Coastal Act. Modification of the existing environment could very likely constitute development that requires a coastal development permit.

There is much more on the Coastal Act than what I'll cover today, but this particular provision goes to the heart of our discussion: §30235. The relevant part states that seawalls "shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion, and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply."¹⁸

There's another provision in the Coastal Act—§30253—that is relevant for our discussion. The Coastal Act really attempts to balance the interests of private-property owners under the U.S. and state constitutions and the interest of the public in preserving coastal resources. This provision, I think, highlights that tension in the Act. It states that new development shall "[a]ssure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs."¹⁹

This provision could very well be interpreted to allow shoreline protective devices so long as their adverse impacts have been mitigated or avoided. However, as we shall see in the era of sea-level rise, the Coastal Commission has taken the interpretation that private development that requires a shoreline protective device is not the least environmentally damaging alternative and should not proceed for that reason.

I want to make a quick shout-out to another state agency that I referenced earlier, the State Lands Commission. The State Lands Commission manages land that is held in public trust by the state of California. The state owns in public trust—for the benefit of all people—land from the ocean up to the mean high tide line. Today, this includes about four million acres of tide and submerged lands.

This is a key concept for our discussion. As the sea level rises and the coastline recedes, new public land is created landward. This is often used to argue, by the Commission and other parties, that shoreline protective devices should not be allowed because in an era of sea-level rise and receding coastline, they will erode the public trust. Another way to look at it is that the public trust is eroding private-property rights as that mean high tide line creeps into the coast and landward.

Let's take a look at implementation. The Commission has adopted interpretive guidelines for addressing sea-level

rise impacts in local coastal programs and coastal development permits.²⁰ The guidelines include model policies that can be adopted into local coastal programs. The guidelines cover a broad range of topics, addressing the science and law that is relevant for sea-level rise adaptation.

The guidelines also discuss a range of regulatory approaches, including accommodating existing development, coastal retreat, the protection of the coastline, as well as hybrid approaches that take from all of these models. I encourage those that are interested in this topic to take a look at the guidelines because they are a fascinating piece of administrative material.

The one thing to remember about the document is that it's not a formal regulation. Courts are not required to defer to it or its interpretation of the Coastal Act. But in practice, it is a key document in the way we're managing development on the coast of California today.

So, to take it from the abstract to the specific, I thought we could take a look at a few recent decisions. The first one is *Capistrano Shores Property v. California Coastal Commission*.²¹ This is not a published decision. The homeowner prevailed in the trial court in 2016 and there was no subsequent appeal. So this is not necessarily something you could cite in a brief, but it shows how the courts are addressing conditions that limit development on the coasts in order to address the impacts of sea-level rise.

The case involved a mobile home park built in 1960. The mobile home park also included a rocky revetment that was built at the same time. Both the revetment and the park predate the Coastal Act, which was enacted in the 1970s. The seawall is owned by the park owner and other folks can lease lots in the park to site their mobile homes.

The property owner was leasing a lot and wanted to replace an old mobile home with a new smaller mobile home on the site. The Commission interpreted this as development under the Coastal Act and required the lessee to obtain a coastal development permit for the project. In issuing the permit, the Commission required the property owner to submit a geological study of the site hazards based on the expected sea-level rise.

The study found that the expected life of the new mobile home was 37 years and that the existing revetment was adequate to support that home during this lifetime. So the proposed development did not require reinforcement or more protection. The Commission imposed a special condition requiring the lessee to waive any rights to shoreline protective devices that may exist under the Coastal Act to protect the new mobile home. The lessee challenged the condition as unconstitutional.

The court sided with the mobile homeowner in this case. The court found that the condition was unreasonable

18. CAL. PUB. RES. CODE §30235 (West 2016).

19. *Id.* §30253(b).

20. CALIFORNIA COASTAL COMMISSION, CALIFORNIA COASTAL COMMISSION SEA LEVEL RISE POLICY GUIDANCE: INTERPRETIVE GUIDELINES FOR ADDRESSING SEA LEVEL RISE IN LOCAL COASTAL PROGRAMS AND COASTAL DEVELOPMENT PERMITS (2018), https://documents.coastal.ca.gov/assets/slr/guidance/2018/0_Full_2018AdoptedSLRGuidanceUpdate.pdf.

21. No. 30-2015-00785032-CU-WM-CJC (Sup. Ct. of Cal., Orange County filed Apr. 28, 2015).

because it lacked a nexus to the proposed development, since the modification of the revetment was not part of the proposal and the mobile home could be protected by the existing revetment for its expected life. The court also noted that a coastal development permit would be required in the event that anyone sought permission to modify or reinforce the seawall. At that point, the Commission could attempt to impose a similar condition, assuming that the record supported this sort of waiver.

The next case, *Whalers Village Club v. California Coastal Commission*,²² involves another existing development called Whalers Village. Whalers Village consists of 29 single-family homes built in 1969, and is located on the Pacific Coast Highway in Ventura. When the homes were built, the beach extended at least 100 feet seaward. Each home was protected by friction-bearing caissons and a load-bearing foundation wall of 20 feet landward, supporting each home.

However, repeated storm events washed away sand and eventually exposed and damaged the foundation. The homeowners built a seawall to protect their homes, and then later sought an after-the-fact permit from the Commission for that seawall. The Commission imposed a special condition on the permit requiring the owners to dedicate an easement for public access and passive recreation from the toe of the new seawall seaward to the mean high tide line, effectively requiring the property owners to dedicate their private beach for public use.

The homeowners challenged this condition as a taking, and the court denied the challenge. The court held that the condition was reasonable and that the property owners did not have an absolute right to protect their home, and that they did not have an absolute right to a seawall under the Coastal Act. The court observed that the Act enunciates a clear policy in favor of preserving public access.

The record supported the Commission's finding that the seawalls and revetments tend to cause sand loss from beach areas in front of and adjacent to them, even if they protect immediate structures. The court was persuaded that by artificially building up the slope of the shore area, seawalls tend to cause landward retreat of the mean high tide line, potentially affecting the boundary between public and private lands along the beaches adjacent to the project as well as on the project site.

The court also reasoned that, while the removal of a private beach would reduce the value of the homes, it would not result in the owners losing all the reasonable economic value of their properties. In fact, the new seawall increased the value of the homes for obvious reasons. But the court struck down a separate condition in the permit that required the owners to submit a deed restriction assuming liability for hazard from erosion and waiving claims of liability against the Commission or other public agencies from such hazards.

The deed restriction would have required the owners to acknowledge that they were proceeding at their own risk

and may be ineligible for disaster funding in the event that erosion damaged the home. The court struck down this second condition, concluding the Coastal Act did not support such a broadly warranted condition.

The next couple of cases take us to the beautiful city of Encinitas and its local coastal program. The program requires coastal development permits proposed in the coastal bluff overlay zone to include a geotechnical report certifying that development will be safe from failure without shoreline stabilization. The program also requires a slope failure analysis to be included in the development application, demonstrating that the development meets a specified factor of safety over the course of 75 years.

The program includes a required setback of 40 feet from the top edge of a bluff for all development proposed in the coastal bluff overlay zone. This is a really interesting point. The slope failure analysis has to make assumptions regarding the rate of erosion of the bluff over 75 years. That takes into account projected sea-level rise rates in that specific location. This is a complex issue that requires some speculation. The cases reveal that there is wide disagreement among the experts on the likely rate of sea-level rise in particular locations. At least here in California, where there are competing expert views presented by the project applicant and the regulator, the courts have generally deferred to the expert agency in defending agency action.

Another interesting point is, as applied, the program's development setback of 40 feet will in most cases exceed 40 feet because sea-level rise will cause the top of the bluff to move landward over 75 years. Thus, if you're required to maintain a minimum setback of 40 feet from the top of the bluff edge, as the bluff edge moves landward, that setback has to be greater than 40 feet. For property owners, this means that they can't develop as large of a portion of the lot as they might have expected they could.

We'll take a look at two cases that deal specifically with this program. *Lindstrom v. California Coastal Commission* was decided by the California Court of Appeal in 2019.²³ It involved the proposal for development of a new home of around 3,500 square feet. The home was proposed on an ocean bluff on a vacant lot. The Commission imposed a 62-foot setback requirement for the home and required the property owner to also waive the right to a shoreline protective device for the duration of the home's existence. The Commission also imposed a condition requiring the property owner to remove the structure if any governmental agency declared the home to be a hazard and ordered it to not be occupied.

The court upheld the first two conditions, but struck down the last one. The court reached its conclusion with respect to the setback by taking a look at the local coastal program and interpreting it consistently with the Commission. In other words, the court concluded that the local coastal program is interested in two things: ensuring that the home is safe, but also ensuring against erosion impacts. This means that the 40-foot setback has to be in effect for

22. 173 Cal. App. 3d 240 (1985).

23. 40 Cal. App. 5th 73 (2019).

the duration of the home in light of the amount of erosion we anticipate over that time. So, the 62-foot setback was supported by the local coastal program and substantial evidence in the record, even though it exceeded the 40-foot setback set out in the program.

With respect to the waiver of the right to shoreline protection, as in other cases, the court reached the conclusion that the waiver was not a taking. The Commission didn't take a property interest, but only restricted the use of the property. There is a further condition here. The court concluded that the property owner did not have an absolute right to protect his home with shoreline revetment, and that the Coastal Act supported the condition in light of the risk that the revetment would adversely impact coastal bluffs and accelerate the impacts of sea-level rise.

A second case involving the same local coastal program, *Martin v. California Coastal Commission*, is very similar.²⁴ It involved the proposal for development of a home of about 3,000 square feet on a bluff top. The court upheld a Commission condition requiring a 79-foot setback from the bluff's edge and barring a basement as part of the home design. The court essentially upheld its reasoning in the *Lindstrom* case with respect to how the local coastal program setback requirement should be interpreted.

And with respect to the basement, the court noted that the local coastal program requires that structures be easily removed in the event of increased erosion and hazard to the home. So, the condition barring a basement was consistent with that policy, and therefore reasonable. It was also consistent with the Coastal Act.

Finally, I want to take a look at another local coastal program that was recently adopted by the city of Solana Beach and challenged in court.²⁵ The city initially prepared the program in 2011. The Commission rejected it and substantially modified the program. The city ultimately adopted the Commission's modifications and approved the program in 2013.

Beach and Bluff Conservancy challenged the plan and several policies of the plan related to a private-property owner's right to construct beaches. Those policies broadly prohibited construction of new stairways to a private beach. The policies also required private stairways to be phased out at the end of their economic life or converted to a public access way where the stairway actually touched upon public trust land. The program also required new development to waive the right to a seawall, as we've seen in other jurisdictions in California. The plan further disallowed a seawall solely for purposes of protecting accessory structures to the main structure.

Beach and Bluff Conservancy challenged these policies on two grounds: their constitutionality under state law and under federal law. The plaintiff argued that these policies amounted to a taking. They also challenged the policies as inconsistent with the Coastal Act, because petitioners

interpreted the Act as giving a right to property owners to protect existing development with shoreline reinforcement devices. The Court of Appeal disagreed in that regard. The court held that petitioners failed to meet their standards to demonstrate that the facial challenges to the policies would effect a taking in all or most cases.

In other words, the court concluded that the policies were written with enough flexibility to allow their application in a way that did not offend the U.S. or state constitutions and the prohibition on takings. The court also noted that the unconstitutional conditions doctrine—which relates to the principle that when a government imposes a permit condition or an exaction on property, that condition has to have a nexus to the proposed development and the adverse impact that the government is trying to address, and that the condition be in addition to having a nexus proportional in economic hardship to the impact that is being addressed—invoked by the plaintiffs did not apply to a facial challenge to a plan because there was no specific development being proposed, nor a specific condition being challenged. In essence, the court wasn't ready to address that challenge because the facts hadn't been developed yet. And so, the court allowed for the possibility of future challenges to the implementation of the plan in the event of specific permanent decisions.

Amy Reed: Thank you. It's great to hear about what's happening in a jurisdiction that, in your words, is more aggressive than some in their regulatory approach, and how the courts are responding.

Now, we will focus on another region as we hear from Prof. Daniel Suman. Daniel is a professor of environmental science and policy at the Rosenstiel School of Marine and Atmospheric Science at the University of Miami. He is also an adjunct professor at the School of Law there. His research and project areas focus on coastal management, adaptation to climate change, governance of marine resources, and management of mangroves and coastal wetlands and marine protected areas, particularly in Latin America.

Daniel Suman: We'll move across the country, from California to south Florida. Miami is surrounded by the Everglades to the west and the Atlantic to the east. We face very serious climate change and sea-level rise issues. Most of Miami-Dade County is less than 20 feet above sea level. We are also exposed and highly vulnerable to hurricanes and resulting storm surges. Moreover, our substrate is porous limestone, which of course would reduce the utility of hard-structured seawalls, for instance, or floodgates.

Much of the area is very, very low. In fact, our barrier islands of Miami Beach, Key Biscayne, and Virginia Key are all extremely low and extremely vulnerable to sea-level rise. Vast areas of our county are FEMA flood zones—AE zones (1% annual chance of flooding or a 30% chance of flooding during a 30-year mortgage), some V zones (1% annual-chance of flooding with additional hazards associated with storm-induced waves), and AH zones (area of

24. 66 Cal. App. 5th 622 (2021).

25. *Beach & Bluff Conservancy v. City of Solana Beach*, 28 Cal. App. 5th 244 (2018). [Editor's note: Liz Klebaner represented Solana Beach in this case.]

shallow flooding (1-3 feet) with 25% chance of flooding during a 30-year mortgage) in the western part.²⁶

Our four-county region has developed the Southeast Florida Regional Climate Change Compact.²⁷ Together, our four counties—Broward, Miami-Dade, Monroe, and Palm Beach—have agreed on unified sea-level rise projections. These have evolved three times now. For instance, in 2015, the projection for 2030 was about six to 10 inches of sea-level rise. But the most recent projection now for 2040 is 10 to 17 inches of sea-level rise. And of course, we have uncertainty as we move into the future.

We can expect increased flooding. The Miami-Dade County Sea Level Rise Strategy includes a map that indicates the number of days of flooding per year with a two-foot sea-level rise.²⁸ That would be about 24 inches, which we would expect in the future according to our unified sea-level rise projections. A great concern of course will be the Miami Beach area and Key Biscayne on our barrier islands, as well as all the shorefront of the mainland and especially the south part of our county.

As we've already discussed, we expect numerous threats from sea-level rise, from storm surges of hurricanes, increasing shoreline erosion, coastal erosion, and all sorts of flooding from groundwater, from canals, from rainfall and stormwater, and of course sunny-day flooding or king-tide flooding during high tides. We are already experiencing these in Miami-Dade County just from high tides, even if it's a week in which we are not having rain and there are no storms.

Our county is highly vulnerable to climate change. One study considers a sea-level rise of half a meter, so about two feet, by 2070 for more than 100 major coastal cities in the world.²⁹ Miami occupies first place in terms of future exposed assets, and ninth place in terms of population exposed to coastal flooding. Many people could be displaced, and the value of infrastructure under threat is astronomical.

We all know that Miami is in the path of hurricanes. We expect a return time for hurricanes of any category to be about five years, and strong hurricanes about 18 years. Of course, we're also concerned about the resulting storm surge. The barrier islands of Key Biscayne and Miami Beach are highly vulnerable to storm surge even from a Category 1 or Category 2 hurricane, much less a major hurricane like a Category 3, 4, or 5.

What are we doing in our county right now? What adaptive measures have we implemented here? For one, we have living shorelines and mangrove restoration sites. We have many, many mangrove restoration sites around the county. The initial purpose of these was not to protect against sea-level rise, but to create habitat. Certainly today, we are recognizing the importance of living shorelines as an adaptive measure to sea-level rise.

Miami has been engaged in beach nourishment projects for about 40 years now. The initial project occurred in 1976.³⁰ Along Miami Beach, the mean high waterline was reaching the properties of the hotels. The U.S. Army Corps of Engineers (the Corps) paid for an extensive beach nourishment project, which has been fairly successful. Of course, we do have continual spot renourishment of all of our beaches in the county, addressing erosion hot spots.

In numerous cities in Miami-Dade County and Broward County, we have begun to elevate roads. The city of Miami Beach now has a new building ordinance requiring that new seawalls be elevated.³¹ This doesn't solve the problem of existing seawalls. In Miami Beach, we now have installed between 40 and 50 one-way pumps to remove stormwater from our low-lying streets. This has an additional impact of increasing the water pollution in Biscayne Bay from stormwater runoff.

The city of Miami Beach also has a new ordinance that the freeboard area in new structures must be increased; the first-floor living space has to be higher than in previous, older structures.³² This only applies to new structures.

One very interesting development in Miami has been a new proposal called the Miami-Dade Back Bay Proposal.³³ This was initiated by the Corps. Last year, they released a draft feasibility report and programmatic environmental impact statement about this study.³⁴ It involves a number of structural and non-structural components. The structural components are floodwalls and storm surge barriers in three of our rivers. The non-structural components are some mangrove restoration projects and acquisition of properties, floodproofing of some properties, as well as relocation of valuable and important critical infrastructure. The cost is shared: two-thirds federal and one-third the local sponsor, which is the county, at a total of \$4.6 billion. It's very controversial.

There was strong local opposition to the draft feasibility study from many of our 34 municipalities in our county and from residents. There was great concern about the floodwalls because some of them would be located in Biscayne Bay, which could be a violation of some of the provisions of the Biscayne Bay Aquatic Preserves, a state marine protected area.³⁵ And in the north part of the county, the

26. Miami-Dade County, *Flood Zones*, <https://mdc.maps.arcgis.com/apps/webappviewer/index.html?id=685a1c5e03c947d9a786df7b4ddb79d3> (last visited Jan. 26, 2022); FEMA, *Glossary*, <https://www.fema.gov/about/glossary> (last visited Jan. 26, 2022).

27. Southeast Florida Regional Climate Change Compact, *Home Page*, <https://southeastfloridaclimatecompact.org/> (last visited Jan. 26, 2022).

28. Miami-Dade County, *Sea Level Rise Strategy*, <https://www.miamidade.gov/global/economy/resilience/sea-level-rise-strategy.page> (last visited Jan. 26, 2022).

29. ROBERT J. NICHOLLS ET AL., RANKING OF THE WORLD'S CITIES MOST EXPOSED TO COASTAL FLOODING TODAY AND IN THE FUTURE (2007); U.S. GLOBAL CHANGE RESEARCH PROGRAM, CLIMATE CHANGE IMPACTS IN THE UNITED STATES: THE THIRD NATIONAL CLIMATE ASSESSMENT (Jerry M. Melillo et al. eds., 2014), <https://doi.org/10.7930/J0Z31WJ2>.

30. John Finotti, *The Beach Issue—Renourishment*, FLA. TREND (June 1, 2003), <https://www.floridatrend.com/print/article/12356>.

31. MIAMI BEACH, FLA., CODE OF ORDINANCES §54-62 (2021).

32. *Id.* §§54-35, 54-45, 54-47, 54-48, 54-51 (2016).

33. U.S. Army Corps of Engineers, *Miami-Dade Back Bay Coastal Storm Risk Management Feasibility Study*, <https://www.saj.usace.army.mil/MiamiDade-BackBayCSRFeasibilityStudy/> (last visited Jan. 26, 2022).

34. *Id.*

35. FLA. STAT. §258.397.

walls would be located several blocks inland and would divide neighborhoods.

There seemed to be greater support among the comments for increased use of nature-based solutions. Our county formally rejected the proposal a few months ago. Now, the county is developing a locally prepared plan that would be acceptable to all parties. Of course, this will result in a great delay—a delay in years and a delay in the funding cycle for any projects that are eventually approved.

What are some of our weaknesses and strengths? We have begun initial planning efforts among our four southeast Florida counties. We have a new county sea-level rise adaptation strategy. I think that Miami and southeast Florida will be or already are a hub for innovative adaptation strategies to sea-level rise. Compared to most urban areas in the world, we have large financial resources that will be available to address the issue. Of course, we have high real estate values that are worth protecting. We also have talented technical resources and a relatively high level of awareness of climate change impacts compared to most areas of the country.

Recently, Miami-Dade County published a sea-level rise strategy looking at five different pillars.³⁶ This includes building up houses, roads, and infrastructure; building up on stilts like in the Florida Keys; trying to concentrate development around the higher elevation areas along our major transportation hubs like our metro rail system; and increasing the use of green spaces, blueways, and greenways. The strategy would also create numerous projects on a neighborhood-level scale to increase the ability to store water—things like bioswales, spaces for water in parks, and many other examples.

Yale University released a study in which they surveyed the percentage of adults who think that global warming is happening.³⁷ Southeast Florida is one of the areas in the country with the highest levels of awareness of global warming. I would assume that also translates into a high awareness of the risks of sea-level rise in our neighborhoods.

What are our weaknesses? We've already destroyed many of our natural coastal systems, mangroves, and wetlands. They could have helped and protected us. We recognize this, and we're beginning to restore and create mangrove ecosystems. Of course, our low elevation and high vulnerability to hurricanes and storm surge are very serious issues, as is our porous limestone substrate. We have historically developed inappropriately on our barrier islands, Miami Beach and Key Biscayne. It's too late now, so we need to protect what we already have developed there.

Although times have changed, our federal and state governments in past administrations had not given the appropriate consideration to our vulnerabilities here in Florida to climate change and sea-level rise. Of course, governmental fragmentation—not only at the national and state levels, but also between and within our regional, county, and

municipal governments—certainly presents grave and serious challenges to coordinated action on this issue.

And then, our environmental justice issues are very serious. I'm beginning to understand the implications of this in Miami. For instance, higher areas are targeted by speculators now, and property values are increasing significantly in higher elevation areas. In the northern part of our county, the higher elevated areas are low-wealth communities with people-of-color residents.

We certainly have to recognize that gentrification could be a serious impact of climate change and sea-level rise in Florida. We must do everything possible to protect our low-income communities from these threats.

Amy Reed: Our final panelist is J.P. Brooker, director of Florida conservation at Ocean Conservancy. J.P. has deep experience on federal fisheries issues in the southeastern United States and on Capitol Hill. His expertise in coastal and conservation issues in Florida includes state fisheries, water quality and quantity, sea-level rise, ocean acidification, marine debris, oil and gas, and ocean plastics.

J.P. Brooker: When I think of coastal resilience in Florida, I think of a twofold problem. This has become the mantra of my organization—Florida is facing a calamity of water quality and rising, warming waters. It's those two things combined that are potentially bringing about an ecological collapse in Florida.

Professor Suman focused a lot on south Florida. I'll dial it back and look at all of Florida's 67 counties and try to give some perspective about things that are going on elsewhere around the state, particularly in terms of climate impacts and compromised water quality on our wildlife.

Florida has an iconic wilderness. It has the Florida Coral Reef Tract, which spans 300 miles down the east coast, from Martin County down to Dry Tortugas. We've got the Everglades. We've got our tremendous springs resources. Florida has 800-plus miles of beaches and it's shot through with water. It's truly an ocean and aquatic state. These pristine environments and wildlife attract a thousand people to move to the state every day. But this changing demographic and increased population is also having a tremendous impact on our wildlife resources.

The iconic wilderness is facing existential threats that we've all highlighted in this discussion, including rising waters but also warming water temperatures. I think that the canary in the coal mine is really the Florida manatee. It's the species that should indicate to all of us that compromised water quality and warming waters are working together to have a completely tragic effect on the iconic environment that Florida is known for.

There should be about 6,000 manatees in the wild in any given year over the past half dozen years. In the past year alone, we've lost more than 1,000 manatees. That's 15% of the population. They're starving to death because the food source that they rely on, seagrass, has been lost to the tune of tens of thousands of acres over the past year. That's due to compromised water quality caused by increased nutrient pollution in the form of nitrogen and

36. Miami-Dade County, *supra* note 28.

37. Yale Program on Climate Change Communication, *Yale Climate Opinion Maps 2020*, <https://climatecommunication.yale.edu/visualizations-data/ycom-us/> (last visited Jan. 26, 2022).

phosphorus from agricultural sources and from residential sources such as septic tanks, along with municipal sources such as stormwater and other discharges from cities. All of this nutrient pollution has been fueling harmful algal blooms around the state—whether that’s a red tide on the west coast and southwest coast of Florida, or brown algal events in the Indian River Lagoon, or blue-green algal events in the Indian River Lagoon, St. Lucie River, Caloosahatchee River, and Lake Okeechobee itself.

That excess nutrient pollution from human-borne sources causes these harmful algal blooms to grow, which in turn occludes the water column and chokes out the seagrass that the manatees need in order to survive. Manatees eat as much as 100 pounds of seagrass per day. So, there’s a tremendous amount of seagrass needed to sustain these creatures. Warming water due to the changing climate is causing those harmful algal blooms to bloom even more. It’s like pouring gasoline on a fire that’s already happening.

I think we’re at 1,038 lost manatees as of the latest reporting,³⁸ a lot of them in the Indian River Lagoon. But they’re everywhere around the state. They’re even inland in the springs ecosystems along the St. Johns River and the Ocklawaha River in the Ocala National Forest, where manatees migrate to from the coast, looking for warmer water when it’s cold and there are fewer food sources, but even this far inland they’re starving to death.

Like I said, we’re seeing water quality crises mounting in the state. We’re seeing not just the blue-green algal events that are choking out seagrasses in the Indian River Lagoon or the red tide events in west central Florida, but also novel events like the Piney Point crisis that occurred in April 2021, where a phosphogypsum stack failed.³⁹ This type of stack is a storage facility for wastewater from the phosphate mining industry, holding hundreds of millions of gallons. These elevated stacks are predominantly located right along Tampa Bay, stored in aging infrastructure. There are currently three along the bay. The wastewater is filled with nitrogen and phosphorus, and other potentially toxic compounds. It’s also likely radioactive from naturally occurring minerals, like uranium phosphate, that are mined out.

Piney Point was one such infrastructure that failed and ended up dumping 400 million gallons of this toxic, nitrogen-rich, phosphorus-rich, potentially radioactive wastewater directly into Tampa Bay. There’s still an additional 400 million gallons or so in the reservoir. It’s been blocked off using a giant steel plate. But the facility is still there and it’s crumbling. It’s highly susceptible to increasingly severe and more frequent tropical weather. Any time it rains, even during a normal summer rain event, these phosphogypsum stacks like Piney Point will spill over occasionally and dump wastewater into the bay. If you have a direct hit from a hurricane, you stand a great chance of compromising

these facilities. And Tampa Bay is 80 years overdue for a direct hit from a major hurricane.

This is just one of many examples of infrastructure along the coast that is in need of attention to prevent these kinds of spills. Modeling done by the University of South Florida College of Marine Science shows that the spill from Piney Point doesn’t just stay right near the point source; it goes out into the bay.⁴⁰

There’s been a lot of suspicion that the nutrient inputs in April from Piney Point helped to fuel the red tide event in Tampa Bay, which was the most severe one since 1971 and killed 1,500 tons of marine wildlife in the bay and in St. Petersburg, including, for example, the goliath grouper. It’s a fish that gets up to 800 pounds and eight feet long. Animals like this succumbing to red tide or hypoxia because of red tide is a tragic loss of iconic wildlife. And it wasn’t just the goliath grouper. We saw dolphins succumb, in addition to countless pounds of dead fish.

Florida’s the sportfishing capital of the world, and 200,000 jobs in Florida alone are sustained by a healthy fishery.⁴¹ When you have these red tide impacts devastating the fishery, you’re also devastating the coastal economy and community. And Florida’s economy is a blue economy. So, these red tide events and other harmful algal blooms have severe impacts to our pocketbooks as well as to our wildlife. But of course it’s not just the marine mammals. It’s also reptiles.

Piney Point seemed like an isolated event. Many folks probably didn’t even hear about it, or if they did, it was a flash in the pan, a hot news story in April. But the fact is we’ve been dealing with the fallout from Piney Point for many months and we will continue to do so for many more months. It remains a looming threat on the bay, in the face of increasingly severe tropical weather and warming waters. The Gulf of Mexico is running three degrees warmer on average.⁴² Again, that creates a ripe ecosystem for the red tide events to bloom. So, you have a perfect storm, a smorgasbord of ecosystem and human factors, ultimately causing the death of this iconic wildlife.

But there are other water quality crises that we’re seeing statewide. I mentioned blue-green algae in the St. Lucie River. The hydrology of the state has been fundamentally altered to accommodate development and to accommodate those 1,000 people moving to Florida every day. That means we’ve created vast agricultural estates on the south side of Lake Okeechobee. We’ve developed a great deal of south Florida. We’ve altered the plumbing of the water coming from the Kissimmee River Valley into Lake

38. Ana Faguy, *Agencies Will Feed Manatees in Unusual Bid to Stem Die-Off*, *E&E NEWS* (Dec. 8, 2021), <https://www.eenews.net/articles/agencies-will-feed-manatees-in-unusual-bid-to-stem-die-off/>.

39. NASA Applied Sciences Program, *Piney Point Florida Wastewater Leak 2021* (Apr. 8, 2021), <https://appliedsciences.nasa.gov/what-we-do/disasters/disasters-activations/piney-point-florida-wastewater-leak-2021>.

40. Jorja Roman, *USF Researchers Use Models to Predict Piney Point Wastewater Spread*, *BAY NEWS 9* (Apr. 13, 2021), <https://www.baynews9.com/fl/tampa/news/2021/04/13/usf-researchers-use-models-to-predict-piney-point-wastewater-spread>.

41. Douglas Hanks, *Oil Spill Disaster Could Cost Florida 200,000 Jobs*, *MIAMI HERALD* (June 9, 2010), www.miamiherald.com/2010/06/09/167269/oil-disaster.

42. Matthew Cappucci, *Abnormally Warm Gulf of Mexico Could Intensify the Upcoming Tornado and Hurricane Seasons*, *PHILA. INQUIRER* (Apr. 1, 2020), <https://www.inquirer.com/wires/wp/weather-hurricanes-tornados-20200331.html>.

Okeechobee. That water should naturally flow through the Everglades and out into Florida Bay as clean freshwater.

In order to accommodate this agriculture and development in south Florida, we have stored water in Lake Okeechobee and are releasing it out through the west in the Caloosahatchee River and to the east in the St. Lucie River, and ultimately it's reaching our coastal estuaries, which are taking the full brunt of nutrients that get stored in Lake Okeechobee. The same nutrient load that should have been filtered out through the Everglades now resides in the lake. Ultimately, when discharged into the St. Lucie and Caloosahatchee, it fuels these blue-green algal events that cause massive fish kills and have huge impacts to human health. They can create a toxin called microcystin, which harms human respiratory systems and can even act as a neurotoxin. So, there are really grievous impacts coming from this issue of nutrients that's made worse by warming waters.

We're seeing the same kind of blue-green algal events not just in the associated Lake Okeechobee and Everglades systems, but even in northeast Florida. The St. Johns River flows from around Brevard County on the east coast of Florida up through Jacksonville. We've seen a blue-green algal event there late this fall that contributed to fish kills and potential animal distress. It's been impacting manatees as well.

Touching a little bit on Professor Suman's points about sea-level rise and climate resilience in south Florida, even during sunny days we have flooding. That is impacting wildlife as well. It's a testament to the fact that Florida is surrounded by this wild ocean, and this wild ocean is creeping in and creeping upon us. We need to do everything that we can in order to accommodate it while also protecting the human environment.

As we experience increasingly frequent and severe tropical weather, we're also seeing impacts on the natural green infrastructure that exists to buffer against these storms. For example, a mangrove forest in Monroe County, in the Florida Keys, was shredded by Hurricane Irma. Within a year, 80% or so of the mangrove had returned and had regrown. But if you're getting more frequent and more severe tropical weather, that rebound may not happen.

For the past two years in a row, we've run out of named storms. If we have storm after storm after storm, the mangroves aren't going to have a chance to recover. They won't have an opportunity to provide that coastal buffering service that mangroves provide. The same goes for impacts to the coral reefs. Reefs provide significant coastal buffering. If they are hammered multiple times in a year, and year after year, those ecosystem services are at risk.

These impacts will reach even our forestry resources. For example, the Panhandle in Blountstown is a little town that's about 45 miles in from the Florida Gulf Coast, from Mexico Beach, which is where Hurricane Michael made landfall a few years back. Even 45 miles in from the coast, the hardwood forest there was basically leveled. The damage to Florida's coastal resources is real, but even inland there are severe impacts.

Hurricane Michael even impacted inland freshwater fisheries. The Chipola River shoal bass, for example, became pushed to the point of threatened. The Florida Fish and Wildlife Conservation Commission (FWC) acted to protect the stock after Hurricane Michael. It shows the reach that tropical weather can have in a state like Florida. Non-coastal ecosystems are going to be impacted as our weather continues to become more severe.

I want to highlight a few policy and regulatory updates that touch on some of these issues. Our state legislature has a conservative majority. But because of how important many of these issues are for the state, we are seeing the conservatives act to address some of them. We're constantly pushing them to take on more in the face of significant challenges.

We're looking at adding a permanent state chief resilience officer who will tie together the various plans that the 67 counties and municipalities have come up with to address adaptation and mitigation. We're working on enhancements for green infrastructure investments to protect some of our existing Florida Coral Reef Tract, which provides protections against a changing climate. But there's also this water quality issue that will be perpetually interwoven with the climate piece.

Without addressing nutrient inputs, warming water will continue this trend of ecological collapse in Florida. There's an urgent need to address these nitrogen and phosphorus inputs from various sources. We plan to help enhance the basin management action plans and create plans for ecosystems like Biscayne Bay, implement recommendations from our Blue-Green Algal Bloom Task Force, and so on.

At the regulatory level, there are many actions being taken by the Florida Department of Environmental Protection and the FWC. For purposes of this conversation, the most interesting is a set of best management practices for agricultural wastewater, which is getting agricultural producers to commit to reducing inputs from their agricultural sources into our coastal watersheds.

We obviously would like to see something that's more toothsome than just a commitment. But we're working as hard as we can to try to get everyone, from across political spectrums and across user groups, to address the critical water quality challenges that the state is facing. As Professor Suman noted, there is a high uptick in regions within the state to acknowledge the impacts of climate change and the need for resilience. We are seeing that awareness spread throughout the state. Florida is very much at the front lines when it comes to climate change. Even in some of the more rural and certainly less progressive areas of the state, people are taking up adaptation efforts and increasingly being drawn toward mitigation as well.

Amy Reed: I'm going to start with a question from the audience. Thinking back to our prompt about the condo collapse, what do you all see as the role for building codes as a policy tool to help guide coastal development? The audience member is wondering if there are model initiatives that could be taken up nationally. Are there

prospects for using building codes to help protect our coastal infrastructure?

Tayebeh TajalliBakhsh: What happened is that the Champlain Towers South condominium complex in Surfside, Florida, received a warning. They knew that they were not in compliance with building codes and they needed to do some development. But they were behind and taking their sweet time to comply. We are going to see an increase in these types of scenarios because of sea-level rise in the area, which will affect the base and infrastructure on the coastline.

Building codes, like those the ASCE has already developed and the flood maps from FEMA, need an update in engineering designs that civil engineers have to follow. We need to see an increase in regulations to comply with, updates on the codes, or a more frequent checking and testing of older infrastructure. We need a change in the design and flood-proofing, or an increase in the elevation of the base level of infrastructure on the coastline and close to the shoreline. We may even need to retreat buildings or move them further inland in areas where there is no way to flood-proof.

Daniel Suman: I would add that not only will we need to increase the elevation of buildings, but in south Florida, we also see new structures must be built up on a mound. Another requirement might be increasing the elevation of seawalls for properties that are on the bay, for instance. It could also be important to increase the percentage of permeable land on the property. Other standards could include increasing use of bioswales and tree cover on properties.

Also, a high number of septic tanks in Miami are not hooked up to our central wastewater treatment system. They should be. Sea-level rise will decrease the effectiveness of septic tanks and lead to more pollution of our bays and coastal waters.

Liz Klebaner: I think we're talking about two things. We're talking about land use controls and building codes, which are related but distinct concepts. Land use controls say where you can and cannot build. And we're going to be seeing more of that. California has already, as you've seen, adopted models of land use controls by requiring setbacks from sensitive coastal resources. We're requiring geotechnical studies to be incorporated into development applications that demonstrate the integrity of the structure as conditions change, and as geologic conditions and sea-level rise change.

Building codes are important tools and can be developed from a top-down model. We have that model in the energy-efficiency sector. The U.S. Department of Energy has promulgated regulations that are like model regulatory best practices that can be emulated by the states.⁴³ Califor-

nia has a robust energy-efficiency building program and code.⁴⁴ Those building code requirements could be incorporated into conditions of approval for a project. They really should, at a minimum, be mitigation measures, if not assumed in the project design.

Amy Reed: Liz, something occurred to me when you were talking about one of the cases—specifically, the requirement that the structure be easily removable. Does that effectively preclude any future multifamily or multistory big developments, like we've seen with these condo buildings?

Liz Klebaner: I think we have yet to see how that particular condition will play out and what it really means. I don't think that it precludes multifamily structures. That's not the intent of the provision. There's a recognition on the part of the state that the communities that will be most affected by climate change are perhaps not the most well-off property owners, but folks that would be living in multiunit apartments.

As you may have noted, we're trying to figure out how to deal with removal and relocation, but we haven't quite figured out how to do it. It is debatable whether existing tools like the Coastal Act are adequate to address that particular type of approach. We might need a new statute or regulation that will address the economic and political ramifications of relocation.

Amy Reed: Yes, I don't think anyone's quite figured out how coastal relocations in the United States are going to work. Please keep us posted if you crack the case in California first. We have another audience question: Will Miami Beach need to be abandoned, and what would that look like?

J.P. Brooker: We're already seeing, as Professor Suman mentioned, some issues of climate gentrification in Miami-Dade County. Wealthier people who have the means to do so are leaving the beach communities, Miami Beach in particular, and moving to neighborhoods like Little Haiti and fundamentally changing the fabric of those neighborhoods.

But that being said, Miami Beach is spending at least \$400 million by 2030 on infrastructure improvements, including raising their roads and other projects. They continue to make those investments. I suspect that they continue to do so because they intend to continue to live there.

There are other places, like in the Keys for example, where abandonment is already happening. It has led to the abandonment of some highway projects in the Florida Keys. So, it's possible that this phenomenon could creep up to the coast. But it seems like Miami Beach is doubling down on their investments for now.

43. Office of Energy Efficiency and Renewable Energy, Department of Energy, *Building Energy Codes Program*, <https://www.energy.gov/eere/buildings/building-energy-codes-program> (last visited Jan. 26, 2022).

44. California Energy Commission, *2022 Building Energy Efficiency Standards*, <https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/2022-building-energy-efficiency> (last visited Jan. 26, 2022).

Daniel Suman: I agree with J.P. Miami Beach is too big to fail. But if, for instance, we suffer the impact of a major hurricane, that could send property values spiraling down. Of course, without the tax base to implement measures to adapt to climate change, we could have these problems in Miami Beach and Key Biscayne.

Amy Reed: I have another question related to the Miami area, which is directed at Professor Suman, but I'd be interested in everyone's perspective. You mentioned that there's a four-county compact and they've unified their sea-level rise projections, which is very interesting to me from the perspective of intergovernmental coordination. I was wondering if you could tell us more about how that initiative arose, how they came together, and the conditions that allowed this effort to progress.

Daniel Suman: I believe it began well over 10 years ago. We have the Southeast Florida Regional Planning Council, which is an advisory council composed of representatives from the four southeast Florida counties. I believe the climate change compact began as an initiative of our regional planning council. The unified projection for sea-level rise takes into account IPCC projections, as well as NOAA projections.

J.P. Brooker: I would agree that it would have started from the regional planning council. A similar effort has been underway in west central Florida, in Tampa Bay. That started from the Tampa Bay Regional Planning Council. I don't think that it has made as much progress as the southeast Florida compact has, but there are other efforts in the state underfoot.

Amy Reed: Could you each tell me, in your opinion, one or two critical policy goals we should focus on as we try to reduce the coastal impacts of climate change in the next few decades?

Tayebeh TajalliBakhsh: The first change that I think we need to see is in FEMA's flood maps. Questions have been raised over the accuracy of their flood maps—whether they are outdated⁴⁵ and whether they consider sea-level rise at all.⁴⁶ The other thing that we need to consider is storm pattern changes. We consider storm surges and different periods for different events, but we don't consider that there are changes in the overall patterns as well. That will affect the building codes that the ASCE provides and the design of the infrastructure.

Every state has its own regulations. I think it makes sense to have different policies because different coastal areas will

experience unique impacts of climate change. I think the states that are more vulnerable to climate change should strengthen their regulations at least as a warning. Maybe you don't want to expect every design or every structure to comply with a 400-year event, but at least people should know, based on the extreme emission scenarios, the water level in the future that would affect selling or buying in that area, and the future flooding scenarios that might impact them.

Daniel Suman: I agree. Adding to that, I think that we still have a way to go in exploring living shorelines. This includes wetlands, mangroves, seagrass, oyster beds, oyster reefs, and so on. There are many other types of living shorelines around the country and different biogeographical habitats. We need to explore and take advantage of all of the possibilities for living shorelines because they also provide many ecosystem benefits.

Another point is establishing measures to protect the most vulnerable populations—addressing the environmental justice issue too. Because more affluent coastal residents and neighborhoods have many more resources to adapt to these changes, we have to protect the most vulnerable populations.

J.P. Brooker: In Florida, our focus on climate really has arrived in just the past couple of years. Under the previous administration, even saying the words “climate change” was actually prohibited by the state government. Now, there's been a focus on adaptation, which is great and much needed in Florida.

But there needs to also be a shift toward mitigation. Our governor said in a recent public press conference that we're going to do adaptation,⁴⁷ but “we're not doing any left-wing stuff”—that's the way he put it. That might be pandering to his base. When he says that, he's likely referring to the mitigation piece, or at least that's what we've interpreted him as saying.

But the reality is we're going to have to do mitigation. It's an inevitability in a state like Florida. Some of the things that you're going to have to invest in in terms of mitigation are going to be carbon sinks and blue carbon. And investments in living shorelines, or seagrasses as carbon sinks, or mangrove reforestation as a carbon sink, are mitigation actions that we can institute in Florida that will yield results. Those measures can avoid the pitfall for the governor on that “left-wing stuff,” but also have some meaningful impacts.

Liz Klebaner: We are in an era of changing norms on what it means to be a property owner. Sending clear and consistent messages to the private sector on what is permissible and what may not be sustainable is really key. What that means is you have to have well-reasoned policies that

45. Darryl Fears & Lori Rozsa, *The Price of Living Near the Shore Is Already High. It's About to Go Through the Roof*, WASH. POST (Oct. 1, 2021), <https://www.washingtonpost.com/climate-environment/2021/10/01/price-living-near-shore-is-already-high-its-about-go-through-roof/>.

46. *New Data Reveals Hidden Flood Risk Across America*, N.Y. TIMES (June 29, 2020), <https://www.nytimes.com/interactive/2020/06/29/climate/hidden-flood-risk-maps.html>.

47. David Fleshler, *Florida Gov. DeSantis Proposes Plan to Fight Rising Seas Without Any “Left-Wing Stuff”*, S. FLA. SUN SENTINEL (Dec. 7, 2021), <https://news.yahoo.com/florida-gov-desantis-proposes-plan-232500861.html>.

are supported by existing statutory schemes and the Constitution. Because otherwise, if there's a crack in the armor, it's going to fail. That's my first thought.

The other important piece of this is, to overcome political pushback to some of these measures, the federal government should identify funding sources that local

jurisdictions can avail themselves of. To encourage local investment in adaptation energy strategies, our local and state sources of funding will be key in helping jurisdictions to identify creative and science-based solutions to sea-level rise.