
ARTICLE

DOES THE U.S. GOVERNMENT REALIZE THAT THE SEA IS RISING? HOW TO RESTRUCTURE FEDERAL PROGRAMS SO THAT WETLANDS AND BEACHES SURVIVE

BY James G. Titus*

How far into the future does your responsibility extend? If our institutions are likely to protect the coastal environment for the next twenty to thirty years, but eliminate wetlands and beaches fifty to 200 years hence, do you say: “Not on my watch, not in my lifetime, not my problem.” Do we have a duty to take actions that would lead future generations to look back at us and say, “at the turn of the millenium, people were thinking of us. They made mistakes, but given what they knew, they did the right thing, and we are better off because they did.” Is the future something that we discount by three percent per year so that the next century is worth a few cents on the dollar? Does our responsibility extend for as long as the greenhouse gases that we release today are likely to stay in the atmosphere?¹

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¹ See, e.g., WORKING GROUP 1, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 1995: THE SCIENCE OF CLIMATE CHANGE, 78, 84-85 (1996) (showing that even if emissions of carbon dioxide are cut in half, the atmospheric concentration of CO₂ will double the pre-industrial concentration and remain at such an elevated level for at least the next 400 years) [hereinafter IPCC 1995].

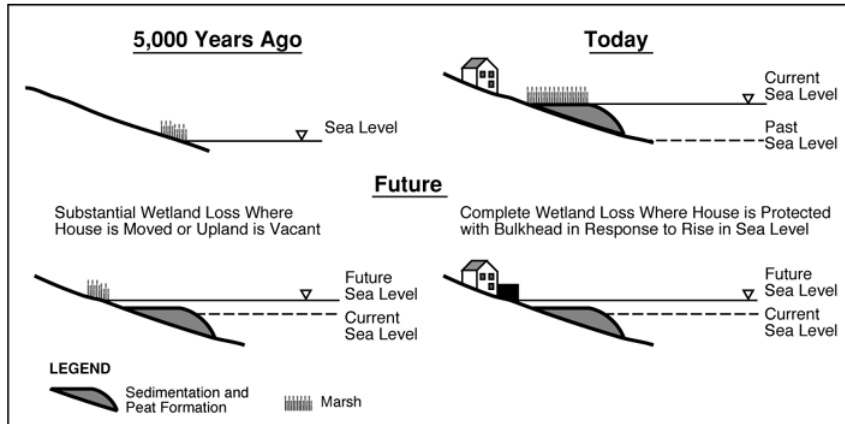


Figure 1. *Evolution of the Marsh as Sea Level Rises.* Through sedimentation and peat formation, coastal marshes have kept pace with the slow rate of sea level rise that has characterized the last several thousand years. Thus, the area of marsh has expanded as new lands were inundated, and the area of wetlands is much greater than the area of dry land just above sea level. If sea level rises faster than the ability of the wetlands to keep pace, a net loss of wetlands could approximate the net gain that resulted from the historic ability of wetlands to keep pace with rising sea level. Moreover, if bulkheads and other coastal protection structures are built along the shore, the wetlands could be eliminated.



Figure 2. *The Transitory Success of Current Tidelands Policies.* The public trust doctrine and wetland-protection policies prevent people from filling wetlands and beaches. As a result, new construction is generally set back inland from the high water mark. Because these policies do not consider shoreline erosion, however, the shore will eventually erode up to the development, leaving us with the same situation that would have resulted had developers been allowed to fill the wetlands in the first place.

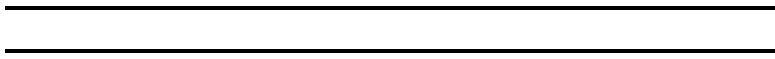
lem as long as the construction that made it inevitable happened during a previous administration.¹¹

Current policies are a reasonable implementation of a policy that says, in effect, "wetlands and beaches are important resources that must be preserved for the duration of this generation, but whether they survive for the next fifty to 200 years is not our problem." Recent efforts devoted to reducing greenhouse gas emissions suggest, however, that the Clinton Administration believes that, at least to some extent, we do have a responsibility to posterity.¹² Recent Administrations have only focused on the causes of global warming, but their rationale for reducing emissions has generally been the need to avert adverse effects, such as the impacts of sea level rise.¹³ Given President Clinton's willingness to commit resources to avoid the expected adverse effects of global warming by reducing CO₂ emissions, he ought

¹¹ See discussion *infra* Part III.

¹² See, e.g., UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, KYOTO PROTOCOL, ART. 3.1 (last modified Apr. 5, 2000) <<http://www.unfccc.org/resource/docs/convkp/kpeng.pdf>> (requiring Annex 1 nations to limit emissions of greenhouse gases, on average, to five percent below the emissions during the year 1990). See also *id.* at Annex B (requiring a seven percent reduction in emissions from the United States). The United States signed the convention in 1998, but has yet to ratify it. See UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, KYOTO PROTOCOL STATUS OF RATIFICATION (last modified Apr. 5, 2000) <<http://www.unfccc.org/resource/kpstats.pdf>>. REMARKS BY THE PRESIDENT, INTERNATIONAL CORAL REEF INITIATIVE EVENT (Nov. 22, 1996) (last modified Jan. 14, 2000) <http://www.epa.gov/globalwarming/news/speeches/clinton_112296.html> ("If we work together [to reduce emissions of greenhouse gases] ... we can preserve our environment for our children, for their children, for generations beyond.")

¹³ See WILLIAM JEFFERSON CLINTON, REMARKS BY THE PRESIDENT TO COMMUNITY MEMBERS ON CLIMATE CHANGE (May 4, 1998) (last modified Jan. 14, 2000) <http://www.epa.gov/globalwarming/news/speeches/clinton_050498.html> (discussing a new program to cut greenhouse gas emissions from homes). See also WILLIAM JEFFERSON CLINTON, REMARKS BY THE PRESIDENT AT BIO-ENERGY CLIMATE CHANGE EVENT (Aug. 12, 1999) (last modified Jan. 14, 2000) <http://www.epa.gov/globalwarming/news/speeches/clinton_081299.html> (referring to bioenergy as a key way to meet the challenge of global warming). As of October 1, 1999, the EPA Global Warming Site provided full text for eighteen speeches by President Clinton and Vice President Gore related to the global warming issue. These speeches discuss measures to reduce greenhouse gas emissions, but fail to discuss measures to prepare for or adapt to the consequences of global warming. See U.S. EPA, SPEECHES AND PRESS RELEASES (last modified Jan. 14, 2000) <<http://www.epa.gov/globalwarming/news/speeches/index.html>>.



Typical Barrier Island System Profile

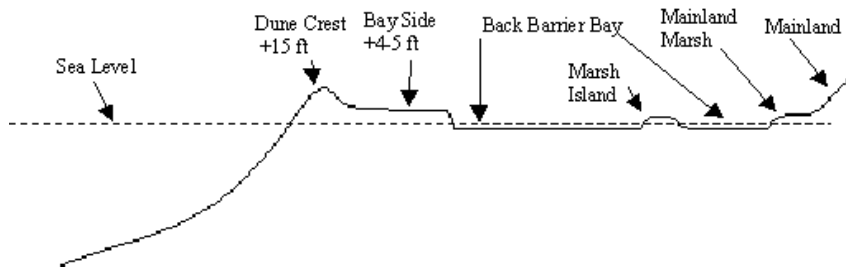


Figure 4. *Typical Barrier Island System Profile (based on Long Beach Island, New Jersey).*

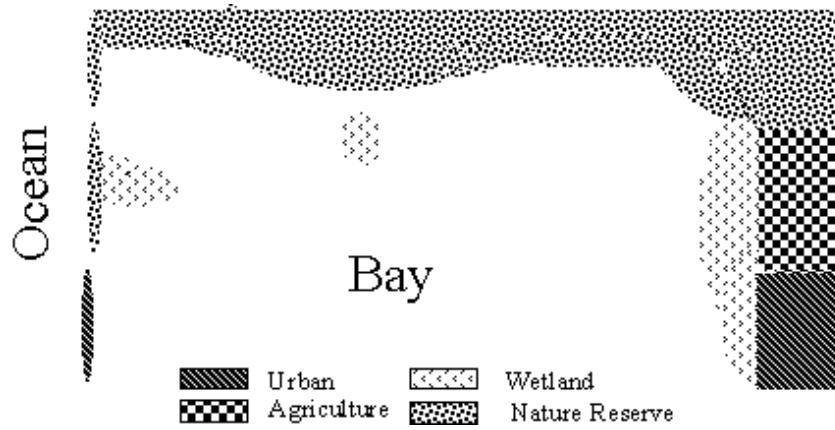


Figure 5. *Generic Map illustrating the primary land categories in the coastal zone.*

Although the five-foot contours provide an indication of the land vulnerable to sea level rise, they do not depict where the shore would be if the sea rose five feet, for several reasons. Some coastal wetlands are able to grow upward as the sea rises by trapping sediment and forming peat, so many areas below the five-foot contour might still be wetland if the sea rose five feet.⁴⁸ On the other hand, the five-foot contour is only three feet above mean high water in the typical area with a three-foot tidal range. The sea has already risen six inches since 1929 when the benchmark for the contours was established, and mean high water is eighteen inches above mean sea level in such an area.⁴⁹ A study by EPA that considered all of these factors estimated that without human intervention, a one-meter rise in sea level would inundate 7700 square miles of dry land, of which 2600 square miles would be converted to wetlands and the remainder to open water.⁵⁰ The creation of 2600 square miles of new wetlands would partly offset the inundation of 8700 square miles of existing wetlands, for a net loss of about 6000 square miles.⁵¹ Currently, about 19,500 square miles of dry land are vulnerable to occasional coastal flooding. If the sea rises three feet, the floodplain would expand to 26,000 square miles,⁵² and all of the existing floodplain would experience another three feet of flooding.

A more immediate concern in many areas is coastal erosion. In addition to the direct inundation of low land, higher sea level

⁴⁸ See Richard A. Park et al., *The Effects of Sea Level Rise on U.S. Coastal Wetlands*, in THE POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE ON THE UNITED STATES app. B at 1-7, 1-19 (Joel Smith & Dennis A. Tirpak eds., 1989) (discussing wetland accretion and listing accretion rates at 46 coastal sites dispersed throughout the contiguous United States) [hereinafter SMITH & TIRPAK].

⁴⁹ See James G. Titus & Michael Greene, *An Overview of the Nationwide Impacts of Sea Level Rise*, in Smith & Tirpak *supra* note 48, at app. B 5-10, n. 8 and accompanying text (explaining why the five-foot contour was only about four and one half feet above mean sea level) [hereinafter Titus & Greene].

⁵⁰ See *id.* at 5-27.

⁵¹ See *id.* at 5-26 (reporting estimate that if all shores are protected, a one-meter rise in sea level implies a loss of 8673 square miles of wetlands, whereas if no shores are protected, the net loss is only 6046).

⁵² See FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA), FEDERAL INSURANCE ADMINISTRATION, PROJECTED IMPACT OF RELATIVE SEA LEVEL RISE ON THE NATIONAL FLOOD INSURANCE PROGRAM (1991).

easement, the homeowner might use fill to elevate the back yard, and possibly install a bulkhead as well. A rolling easement prevents these shore protection options, which would impair the ability of wetlands to migrate inland. To keep the property useful, the homeowner is allowed to haul in gravel or otherwise elevate the driveway. When the sea rises enough for spring high tide to flood much of the yard, high marsh vegetation takes over, but the property is still privately owned.⁸⁴ Assuming that the house is on pilings or otherwise elevated, it continues to be useful. Finally, enough of the property is inundated by mean high tide for the house to be on public land.⁸⁵ The homeowner is free to move the house and clean up the site.

The situation would be similar along estuarine beaches and relatively large bodies of water, where property is more likely to be lost to erosion than to a gradual inundation and conversion to marsh. As with the wetland prototype, the existence of the rolling easement would discourage reinvestment as the shore approaches. The primary restriction of the rolling easement would be the prohibition of bulkheads. Fill is less of an issue because these shores are often well above sea level.⁸⁶ As the shore erodes, eventually the house will be, at least partly, on the public beach. If access along the shore is extremely important, the owner could be required to move the house at that point.

⁸⁴ See Kana, et al., *Charleston Case Study*, in GREENHOUSE EFFECT, SEA LEVEL RISE, AND COASTAL WETLANDS 39-40 (James G. Titus ed., 1987) (reporting that high marsh is found in those areas that are above mean high water but below mean spring high water). See *id.* at 48-51 (showing how wetland zonation could migrate inland in Charleston area as sea level rises).

⁸⁵ In Maine, Massachusetts, Pennsylvania, Delaware and Virginia, where the public only owns up to mean low water, ownership does not shift until the sea rises enough for the house to be inundated at low tide. See David C. Slade et al., *Lands, Waters and Living Resources Subject to the Public Trust*, in PUTTING THE PUBLIC TRUST DOCTRINE TO WORK 69 n. 22, 70 n. 23 (1990).

⁸⁶ As a result, property owners might be allowed to hold back the sea with beach nourishment. Along wetland shores, elevating the land with fill—even without a bulkhead—prevents new areas from being flooded and new marsh from forming inland as sea level rises. Elevating land causes a net loss of wetlands unless the marshes are elevated as well (which never happens). By contrast, along sandy beaches, the beach will tend toward a characteristic shape and return to that shape even if it is disrupted through the addition of sandy material or rising sea level. See MARINE BOARD, *supra* note 55, at 75-76.

The net result of all these factors is that under current trends, our ocean beaches seem likely to survive, but our bay beaches will be eliminated, and over time our coastal wetlands may gradually dwindle. Currently, the only exceptions are Maine, Rhode Island, and at least parts of Massachusetts, all of which have explicitly considered the possibility that sea level rise could squeeze ecosystems, and have responded with regulations designed to enable wetlands to migrate inland as the sea rises.⁹⁶

This is not to say that all wetlands will be eliminated. The one key difference between ocean and bay that favors retaining bay shores is the fact that much of our bayfront lands are still farms and forests. Figure 9 *infra* illustrates a likely outcome. The developed barrier island is simply raised in place, while the undeveloped island narrows and migrates landward. The wetlands in front of the development are lost, as are some of the wetlands in front of the farm as a result of subsequent development. The remaining farmland, as well as the wildlife refuge, is inundated, allowing new wetlands to form. Moreover, the tidal wetlands replace the freshwater nontidal wetlands in the generic swamp. Even if sea level rises too rapidly for wetlands to keep pace through vertical accretion, the higher water levels are unlikely to eliminate all wetlands, just a large fraction.

C. DO WE NEED TO CHANGE OUR POLICIES?

Would the net loss of wetlands be too great if sea level rises more than one meter and existing policies continue? That question has never been formally addressed by the studies that have analyzed wetland loss due to sea level rise. Ultimately, one might answer such a question by considering the functional contributions of wetlands and beaches to the environment, and by comparing those benefits with the cost of ensuring that wetlands

⁹⁶ See TABLE III *supra*, and accompanying notes, *infra*.

TABLE IV: AREA OF MANAGED LANDS CLOSE TO SEA LEVEL¹²¹

State	Percentage of Low Lands			
	Managed by Elevation		Managed for Conservation	
	0-1.5 meters	1.5-3.5 meters	0-1.5 meters	1.5-3.5 meters
DC	0.0	0.1	0	7
DE	79.3	13.7	53	21
MD	132.3	30.9	22	10
NC	578.9	125.5	26	8
NJ	139.6	41.8	33	17
NY	2.8	6.8	3	7
VA	39.6	8.7	11	2
Totals	972.5	227.5	25	9

The USF&W is not yet seriously preparing for the consequences of sea level rise. Thus far, the Service does not appear to have a single land or easement acquisition in anticipation of accelerated sea level rise, nor has it taken any action to anticipate sea level rise. In spite of the agency's failure to consider sea level rise, however, its refuge system contains wetland ecosystems that are more likely to be able to migrate inland than ecosystems outside their system. The reason for this is that USF&W would allow the wetlands to migrate inland, whereas private owners would often choose to armor their shores.

The portion of the coastal zone incorporated into the national refuge system did not result from a rigorous analysis of the costs and benefits. Rather, it resulted from a combination of the federal commitment to preserve ecosystems and opportunities to acquire undeveloped land at a reasonable cost. Therefore, it is difficult to make a compelling argument for any particular level of wetland protection. As discussed in Part II, a goal of "no net loss" of wetlands would be consistent with other environmental policies on wetlands. However, in the context of a large rise in

¹²¹ See RICHMAN & BALASSIANO EMAIL *supra* note 47.

