

Preparing for Rising Water Along Our Coastlines

Bruce Babbitt

The onset of global warming is reshaping the face of the land from mountains heights, through river basins and along the coasts of our country, affecting forests, wetlands, prairies and agriculture. Precipitation patterns are changing. Storm events are becoming more extreme, generating more frequent and intense flooding along river channels. However, the most extensive changes in the land wrought by climate change are now occurring along our coastlines.

Sea levels are rising more or less uniformly across the planet, driven by thermal expansion of ocean water and increased volumes of water reaching the oceans from melting ice caps in Greenland and Antarctica, as well as terrestrial glaciers. Along our coasts these rising sea levels are steadily encroaching upon lowland regions, and inevitably coastal flooding will require major adjustments in land-use patterns.

Scenario planning in response to rising sea levels and consequent coastal

inundation has scarcely begun. Yet even a cursory look at the data suggests the magnitude of the changes that will be visited upon the coastal states. Projections for sea-level rise in this century are now clustering around a minimum increase of three feet, sufficient to submerge large areas of the Atlantic coast, extending from Maine to Florida and along the Gulf of Mexico to Texas, with massive encroachment throughout Chesapeake Bay, loss of the Outer

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Banks off the coast of North Carolina, significant losses in Florida and across the Mississippi River Delta.

The Pacific Coast, where the clash of tectonic plates has produced a sharply defined and relatively elevated coastline will be less affected; nonetheless there will be areas of major inundation in the California Delta at the head of San Francisco Bay and along the estuary of the Columbia River in the Northwest.

Rising waters will require redesigning and relocating roads, bridges, rail corri-

dors, pipelines, levee systems, water and wastewater facilities, and in some cases the relocation of entire communities.

Even as rudimentary planning scenarios take form, two contrasting response patterns are emerging. One, which might be called the fortress model, advocates defensive lines consisting of massive levees and sea walls to hold back the waters and salvage the land even as it goes below sea level. The experience of the Netherlands in reclaiming land from the North Sea is frequently put forth in favor of this approach.

An alternative consists of adapting to, rather than seeking to prevent, the changes in coastal land patterns. Adaptation encompasses a mixture of responses, including designing elevated structures, raising highways and bridges, and relocating infrastructure and settlement to higher ground as a form of managed retreat. In recent years these measures have increasingly been used as a response to recurrent flooding along inland river channels.

Louisiana, in the wake of Hurricane Katrina, has moved to the center of this debate about future management of our coastlines. Most vulnerable is the Louisiana Delta at the mouth of the Mississippi River, where more than 5,000 square miles of land lie less than three feet above sea level.

To complicate matters, the land surface in the Delta region is sinking at the rate of one to three feet per century from causes independent of sea rise. Adding together these two figures, three feet of sea-level rise and another one to three

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feet of land subsidence yields a stark conclusion—much of the Louisiana delta region is likely to disappear beneath four to six feet below water by the end of this century.

From earliest settlement in the 17th century, Louisiana has struggled to control flooding along the Mississippi River by constructing extensive systems of levees. As levees repeatedly failed, in 1963 the Corps of Engineers raised the ante by constructing a massive complex, called the Old River Control Structure, designed to tame the river for all time by diverting flood waters westward into the Atchafalaya River basin. At last it seemed, the delta was completely engineered and protected.

Then Hurricane Katrina came along, shifting attention to threats coming from another direction—the ocean waters of the Gulf. Facing the onset of global warming and rising sea levels, local leaders again turned to the Corps of Engineers and ultra-large construction projects as the best guide to coping with ocean waters. And that history is leading us toward what has become known as The Great Wall of Louisiana.

The Great Wall is nothing less than a sea wall along the entire coastline. The first step toward construction of this coastal wall is known as Morganza to the Gulf, a seventy mile coastal levee in the delta region west of New Orleans. Close behind is planning for a second segment, called Donaldsonville to the Gulf. Ultimately, Great Wall advocates propose to incorporate these levees into a continuous sea wall all the way along the Louisiana coastline, anchored on the west at the Texas border and on the east in Mississippi.

The cost of building The Great Wall, which has not been projected in any detail, would surely run to hundreds of billions of dollars. The real costs, however, would eventually be toted up in destruction of the coastal wetlands and the death of the Louisiana fishing industry. Sea walls destroy wetlands, creating a clean, impenetrable line of

separation between land and sea. Then as the protected inland side of the walls fills in and the seaward side yields to the open ocean, wetlands shrink and disappear and the natural salinity gradients from sea water to fresh water that nurture oysters, crabs, crayfish, shrimp and other shell fish will also disappear.

The alternative to sea walls and wholesale elimination of coastal wetlands is to plan for strategic retreat and adaptation, a process that concedes some land to the sea, while allowing adjacent wetlands space to migrate inland, adjusting naturally to changing conditions that will maintain habitat and fisheries. Adaptation planning provides

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for protecting population concentrations through construction of ring levees, use of resilient structures, and some movement and relocation toward higher ground.

Proponents of adaptation also suggest that some portion of the delta can be restored through better management of the Mississippi River. Scientists tell us that in the past the natural land subsidence in the delta was counterbalanced as the river continually deposited new sediment as it meandered across the delta region. In modern times much of the sediment formerly spread across the delta by the river has been lost, trapped behind hundreds of dams on the upstream tributaries of the Mississippi.

Adaptation advocates now seek to divert increasing amounts of water from the main river channel in controlled

flows across the delta, hoping to restart at least some of the natural land building processes. Delta restoration through partial diversion of river waters is hardly a complete answer, for the river no longer carries enough sediment to fully replicate historic processes. Moreover the necessity of maintaining a fixed channel open for navigation with sufficient water depth for ocean going vessels sharply limits the amount of water that can be diverted upstream to spread across the delta lands. Given these limitations on the natural restoration processes, large areas of delta land and wetlands will continue to be irretrievably lost as the sea advances.

In all adaptive planning scenarios, greater New Orleans will be preserved by continually raising and strengthening the sea walls and levees that presently surround the city. Eventually though, New Orleans will transition into an American Venice, a richly historic and cultural island surrounded by Gulf waters, connected to the mainland by a causeway paralleling the bank levees of the Mississippi river. Other delta communities, including Lafayette, Morgan City and Houma can similarly be protected by surrounding them with rings of high levees.

However, outside the protected urban areas, in the other ninety-five percent of the delta region, choices will have to be made at finer resolution about where to stand and where to retreat. Land use alternatives will tightly link to the decisions made about the design and location of infrastructure for flood protection and realigning transportation and utility routes to connect with the protected centers. In some areas a delta land-use plan can also identify limited areas of higher ground along the natural levees left by abandoned river channels as appropriate spaces for industry and agriculture.

Ultimately these decisions will require regional land-use plans, showing in detail what can and cannot be saved, what can be relocated and how coastal

wetlands will be allowed to migrate. Those choices will be best made in the context of land-use plans that incorporate the best hydrology, social science, ecosystem science, resource economics, and strong community participation. Delta residents will be well served if this process gets underway soon, while there is still a generation or two of lead time to adjust.

And if the Louisiana delta futures were not sufficiently complex, that state is only the first of twenty-three coastal states that will be affected by rising sea levels. California is a case in point—probably the next state about to demand federal assistance for coastal reconstruction.

In that state, rising sea levels are encroaching upon the low lying lands at the head of San Francisco Bay where the Sacramento and San Joaquin rivers flow together to form a vast marshland that originally extended inland toward Sacramento and Modesto. Like Louisiana, this region is threatened by both rising sea levels and subsidence resulting from oxidation and drying of organic soils formed from the tule marshes that formerly covered this delta landscape.

Today these delta lands are maintained by an extensive system of levees built to reclaim the area for agriculture. Fields and orchards, however, are now being rapidly transformed into suburban developments radiating outward from Sacramento and other communities.

The California Delta is also the center of the infrastructure that transfers water from across the state from north to south through a complex of pumping stations and canals. Rising sea levels are pushing saline seawater inland toward the pumps, threatening to contaminate water delivered to urban areas as far south as Los Angeles and San Diego. To avoid drawing saltwater through the system, massive new diversion works will be required to take water from sources higher upstream on the Sacramento River.

Through decades of controversy, California has yet to settle upon a plan

for reconfiguring and reconstructing the water system. Legislators have been unable to agree upon a land-use plan to effectively control the spread of suburban development into low-lying areas inadequately protected by ancient levees. Whatever plan is eventually agreed upon, California is lining up, right behind Louisiana, to petition the congress for large funding commitments. Other states will soon be joining in that line.

In the present fiscal environment, the prospects for a nationally led, adequately funded coastal infrastructure program may seem less than promising. Yet recognition of the need is increasing

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as evidenced by highway and high-speed rail and mass transit appropriations in the recent stimulus legislation and by proposals, endorsed in concept by President Obama, for longer-term commitments in the form of a national infrastructure bank. Three ideas on the table could eventually lead toward a coastal infrastructure program: 1) fines and penalties from the BP oil spill, as well as future oil royalties from the Gulf oil production 2) extension of the Build America Bonds program and 3) a national infrastructure bank.

The BP oil spill has once again drawn national attention to the plight of the Louisiana Delta. President Obama, in a televised speech to the nation, pledged

not only to clean up the oil damage, but also to reverse the decades of degradation that occurred prior to the spill. Congressional proposals to devote some portion of the expected penalties from the BP spill to Gulf restoration have also been endorsed in concept by the administration.

The BP disaster has also revived discussion of federal offshore oil royalties as a financing source for gulf restoration. The federal government presently collects approximately \$10 billion annually in revenues from offshore oil and gas development in federal waters (which in most states lie more than three miles offshore). A portion of this royalty income is already rebated to the coastal states as revenue sharing with no limitations as to use. In the wake of the BP spill, the Gulf states are requesting that an even larger share of these federal royalties be distributed to them in the form of unrestricted revenue sharing.

Future penalties and offshore royalties, however, are national income, and would more appropriately be used to advance clearly defined national objectives. Rather than writing checks to the states, these revenues provide an opportunity for the congress to establish a national fund for coastal restoration, to be shared equitably by all coastal states, with distributions to be conditioned on states producing realistic plans that acknowledge the effects of rising sea levels and which contain an appropriate mix of reconfigured coastal infrastructure and managed retreat measures.

How to best structure and finance a federal-state coastal restoration program with meaningful land-use plans will be a complex task. A good starting point would be to look back and review our experience with national infrastructure programs.

Of the many programs that the congress has established over the years for such diverse infrastructure needs as railroads, highways, airports, and water management, one effort stands out for its clarity of purpose and effective ex-

ecution. The Interstate Highway Act of 1956 could serve as a useful benchmark for comparing contemporary infrastructure financing proposals and programs.

The Interstate Highway Act of 1956 authorized construction of a network of more than 40,000 miles of highways, built to uniform standards throughout the nation. The design and location of the component highways was worked out in advance of legislation in a federal-state negotiation among highway administrators at both levels of government. In result the legislation produced a clearly focused, technically-sound product. This procedure stands in sharp contrast to the way congress operates today. All too often authorizing infrastructure projects are cluttered with earmarks and leave too much discretion to agency administrators—who are in turn subject to still more special interest influence.

The financing of the Interstate Highway System was not left to the vagaries of the annual appropriation cycle. Project financing to completion was assured in advance by user fees in the form of a federal gas tax, an approach that seems beyond reach in today's political climate. Although it is not easy to characterize the mood of the electorate in that distant time, support for a gas tax was surely related to a clear public perception of the benefits that would flow from use of a project related user fee.

Such clarity of public purpose and cost-benefit relationships is not a distinguishing feature of our newest federal infrastructure program: Build America Bonds, created as part of the 2009 stimulus legislation. These BAB bonds make no pretense of defining or even suggesting national priorities; these bonds are designed solely to expand the existing municipal bond market by of-

fering states and municipalities a federal subsidy of 35% of the interest obligation on municipal bonds issued as taxable obligations.

BAB bonds have been very successful at enabling municipalities to expand their market for capital improvement bonds. To date more than 100 billion of these bonds have been marketed. Yet, with no federal guidance for allocation and use of the revenues, taxpayer dollars are subsidizing projects, such as the construction of a sports stadium in Indianapolis, lacking in any national purpose.

Initially promoted as a temporary short-term stimulus, the BAB program has proven so popular within the states

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and on Wall Street, that the congress is considering extending the program. BAB reauthorization could provide an opportunity for progress toward a national infrastructure program. Congress need only limit and redirect the use of these funds to support defined national priorities for investment in essential infrastructure.

Farther out on the horizon, another opportunity for a comprehensive infrastructure program could come in the form of a national infrastructure bank.

The idea has been endorsed by President Obama and has appeared in several legislative variants; of which the legislative proposal by Senator Dodd can be taken as a representative starting point for consideration.

The Dodd bill would create an independent government corporation governed by a five member board of directors appointed by the President. The corporation would be vested with broad discretion to choose among proposals submitted by state and local governments from a menu of roads, bridges, water and wastewater, and public housing. The strength of this approach is that it would presumably eliminate the practice of congressional earmarking. However, the bill lacks delineation of national priorities, and it does not provide for multistate projects or coordination across state lines.

The Dodd bill is equally vague as to financing; there are no dedicated revenue sources; it contains general language allowing, but not mandating, user fees; the only designated revenue source is an authorization for annual appropriations. Overall, this legislation, like similar infrastructure bank proposals, presents a sharp contrast to the clarity and focus of the Interstate Highway Act.

For all these deficiencies in current legislative form, the infrastructure bank concept seems to be gaining visibility and support. If in the present fiscal environment, a renewed national infrastructure commitment may seem a bit far off, another Katrina or more collapsing bridges could stimulate some much needed political climate change. And when the moment does come, we must be ready with a clear framework for action. Let the discussion begin.