Sinking Tax Base

Land & Property at Risk from Rising Seas

A new analysis by Climate Central delivers an assessment of sea level rise impact on the tax base of hundreds of coastal U.S. counties—specifically, the potential loss of taxable properties caused by shifting tidal boundaries.

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CLIMATE CENTRAL

Summary

A new analysis by Climate Central delivers an assessment of sea level rise impact on the tax base of hundreds of coastal U.S. counties—specifically, the potential loss of taxable properties caused by shifting tidal boundaries.

Coastal flooding caused by sea level rise is shifting the tide lines that many coastal states use to delineate boundaries between public and private property. Changes in property boundaries can have significant implications for both property owners and local property tax revenues—a primary source of funding for schools and services provided by local governments.

The analysis takes into account the state-specific boundary definitions, allowing for a clearer assessment of the potential loss of private (taxable) property in the coastal U.S. Climate Central generated this national-level report as well as more than 250 individual county-level reports providing data on the acreage, improvements, and number of parcels potentially affected by rising seas.

This summary of key findings reveals what's at risk for coastal counties and their tax bases:

> By mid-century, more than 648,000 individual tax parcels, totaling as many as 4.4 million acres, are projected to be at least partly below the relevant tidal boundary level. Of those, more than 48,000 properties may be entirely below the relevant boundary level. Florida, Louisiana, and Texas have the largest number of affected parcels.
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> Buildings may be concentrated at historically-safe elevations along the coast; when rising seas breach a certain threshold, these densely-developed elevation bands reach a tipping point and the number of affected buildings sharply increases.
>
> At least $108 billion of assessed value is at risk from rising seas by 2100, and because complete values were not available for all counties, the actual total is likely to be far higher.

Coastal flooding is an increasingly severe problem in much of the United States, with consequences for the value of coastal properties–and on the local property tax base that funds schools, emergency services, and more. Property lost to coastal flooding also risks the tax revenue it represents.

Flooding is worsened by climate change, which is accelerating the rates of sea level rise as ocean waters warm (warmer water occupies more volume) and as melting glaciers and ice sheets flow into the sea. Major floods, such as those resulting from hurricanes, and smaller ones that occur more frequently are occurring on top of the rising sea.

As a result, properties and buildings that experienced floods in the past are likely to experience more severe floods in the future. It also means that higher flood waters are reaching further inland, flooding properties and buildings that have never flooded before.

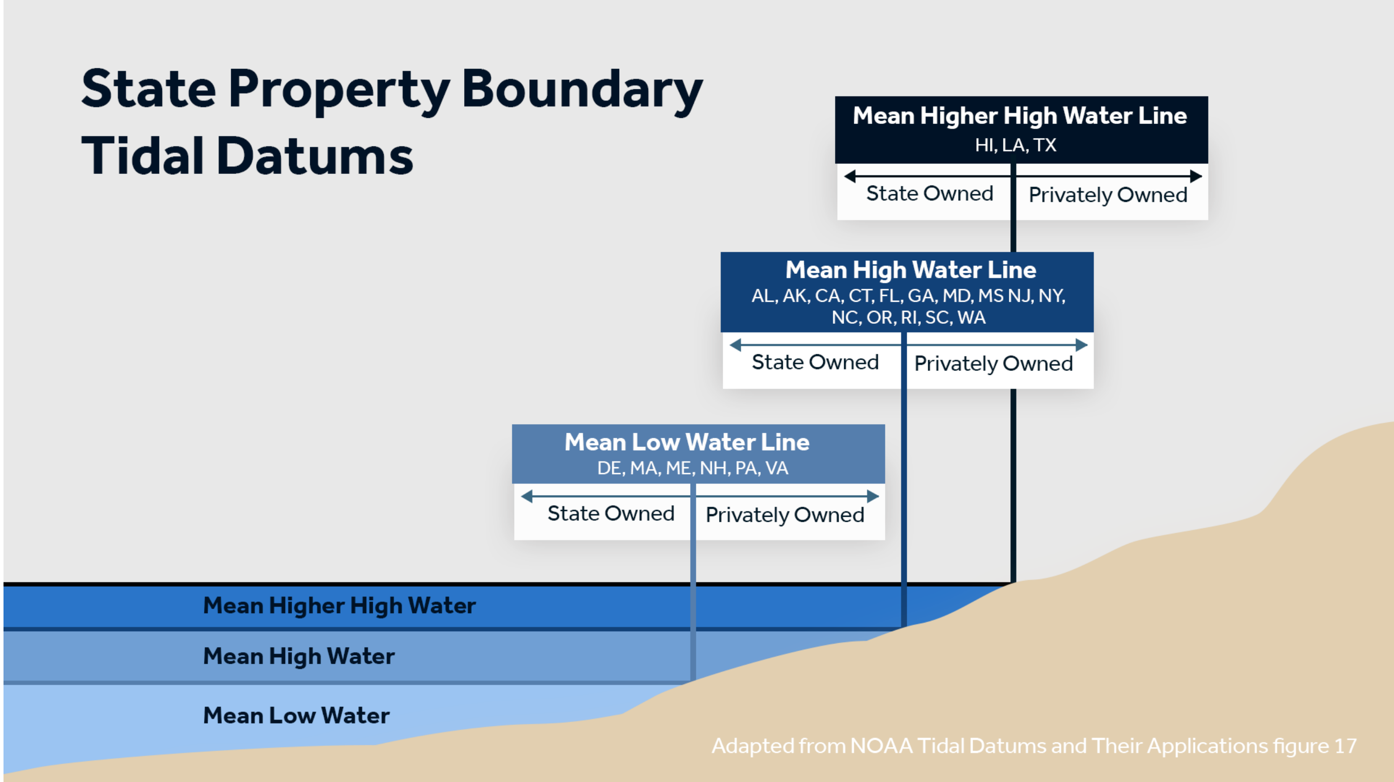
Coastal flooding can be devastating to homeowners, particularly where homes represent a significant fraction of their net worth. As sea level rise accelerates the increase in coastal floods, property values are impacted–exposing homeowners and businesses to financial risk from eroding property values.[1] That risk extends to the cities, counties, and school systems that rely on property taxes for funding.

This report summarizes the risks for individual coastal properties in the U.S.–and to the local tax base that those properties comprise—due to essentially permanent coastal floodings.

Shifting property boundaries

To generate this analysis, Climate Central used the relevant tidal boundary level for each state. The boundary between private property and public waters is defined by individual state law which can be complex and nuanced. Essentially, each state designates a land elevation based on different average tidal levels—such as average high tide or low tide lines—to set the boundary. Formally, these averages are known as tidal datums, and they are derived from NOAA data.[2] In some states, the boundary lines are less clearly defined—in those instances, Climate Central used the closest tidal boundary approximation, as identified by NOAA.

The analysis takes into account the state-specific tidal boundary definitions, allowing for a clearer assessment of the potential loss of private (taxable) property in the coastal U.S. as sea level inexorably rises in response to climate change.



In general, a datum is a base elevation used as a reference from which to reckon heights or depths. A tidal datum is a standard elevation defined by a certain phase of the tide. NOAA has identified particular datums as the best approximations of each state's boundary between public and private property, including mean low tide, mean high tide, and mean higher high tide (the higher of the two high tides each day).

How, when, and whether legal boundaries will be adjusted in response to physical changes in the behavior of tides is very much an open question. As Steve Ivey for the Land Surveyors Association of Washington noted in a 2012 report, "Because the land/water interface is dynamic, attempts to precisely locate water boundaries become a complex and legal quagmire." The accelerating pace of sea level rise in coming decades is likely to exacerbate these complexities, particularly as their implications for tax revenues, infrastructure maintenance, and shoreline cleanup become more evident.

To begin to put this issue into context, Climate Central calculated the land area within each property that will newly fall below each state's tidal boundary level as seas rise through 2100, and reported the totals by county. For convenience, this report refers to these as "affected" areas.

In addition, for counties where tax-valuation data are available, we calculated the exposed tax-assessed value for affected properties and their improvements (buildings). For parcels (properties), we multiplied their assessed value by the fraction below the tidal boundary level. (The terms "parcels" and "properties" are used interchangeably in this report). For improvements, which we assume to be buildings, we report the entire assessed value if any portion of the building's footprint is at or below the tidal boundary level.

More than 250 county-specific reports are available. For counties with tax-assessment value data available, those figures are included along with parcel-area (acreage) totals; for counties lacking such information, only parcel-area totals are provided.

The national report includes figures from counties for which at-risk acreage could be determined from tax records—this dataset includes more counties than are available for county-specific reports. For some counties, tax assessment values could not be obtained, so totals are likely to underestimate the aggregate tax base at risk.

Although the analysis presents data through the century, much of this summary is framed around findings for 2050—a period currently within the range of a typical 30-year mortgage—to emphasize the imminent risks for homeowners and coastal communities.

Properties at risk from permanent coastal flooding

Climate Central conducted this analysis at the individual parcel level, obtaining data on more than 51 million properties. Many of these parcels are owned by families or individuals—people who will experience the consequences as the sea encroaches on their property.

The analysis indicates as many as 649,000 parcels with a hydrological pathway to the ocean may have some elevation below the tidal boundary level by 2050, relative to 2000. More than 48,000 parcels may be entirely below the tidal boundary level by 2050, with greatest exposure for properties in Florida, Louisiana, and Texas.

Figure 1. **Parcels with any area below boundary tideline - 2050**

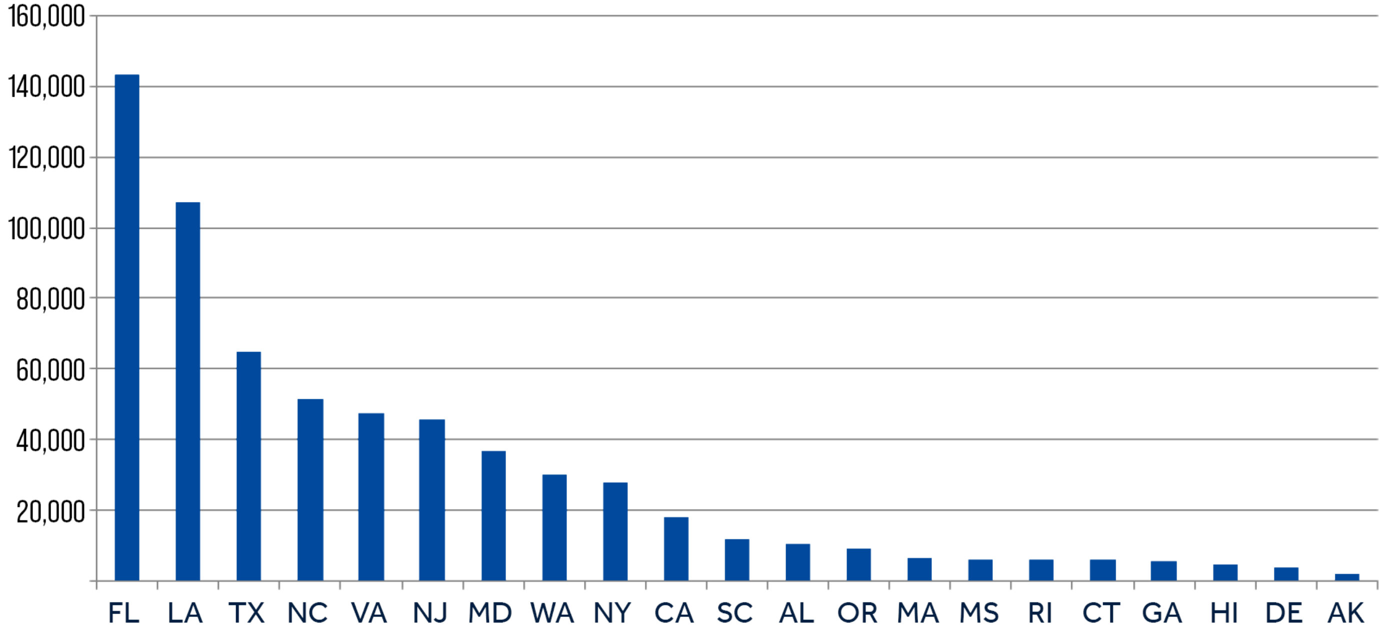


Figure 2. Parcels wholly below boundary tideline - 2050

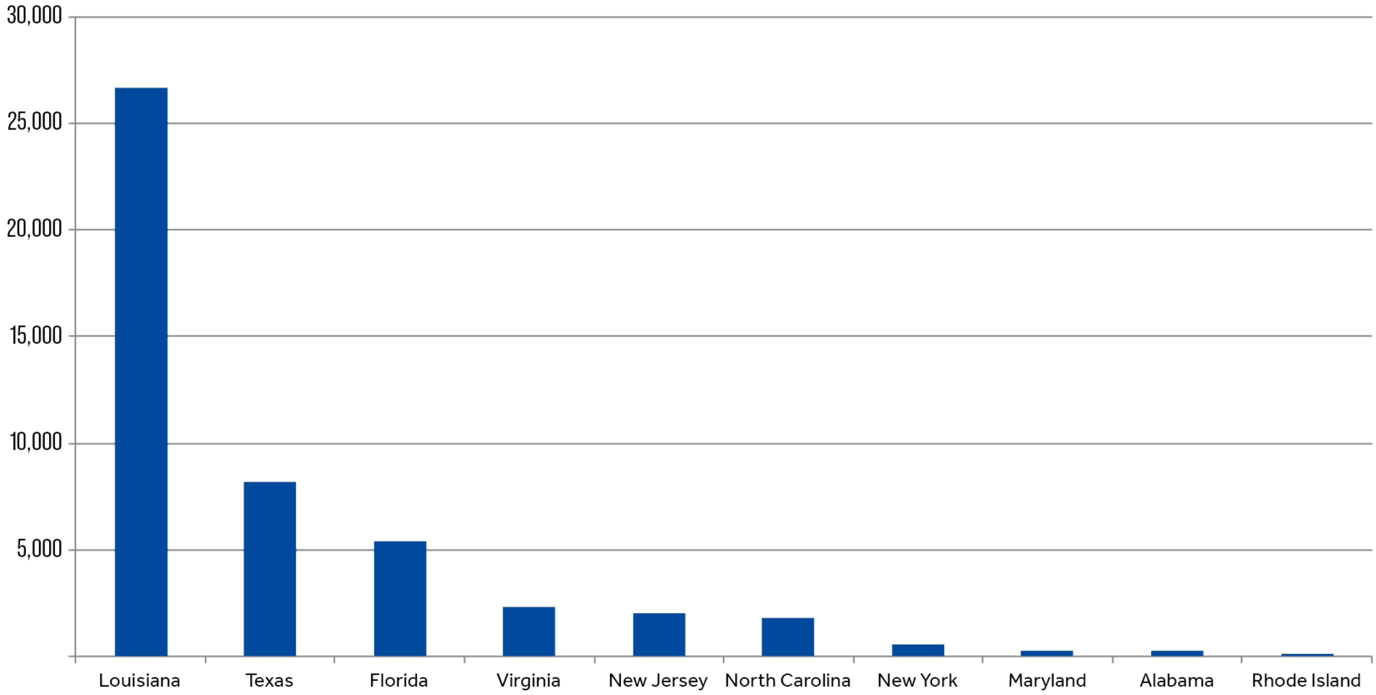
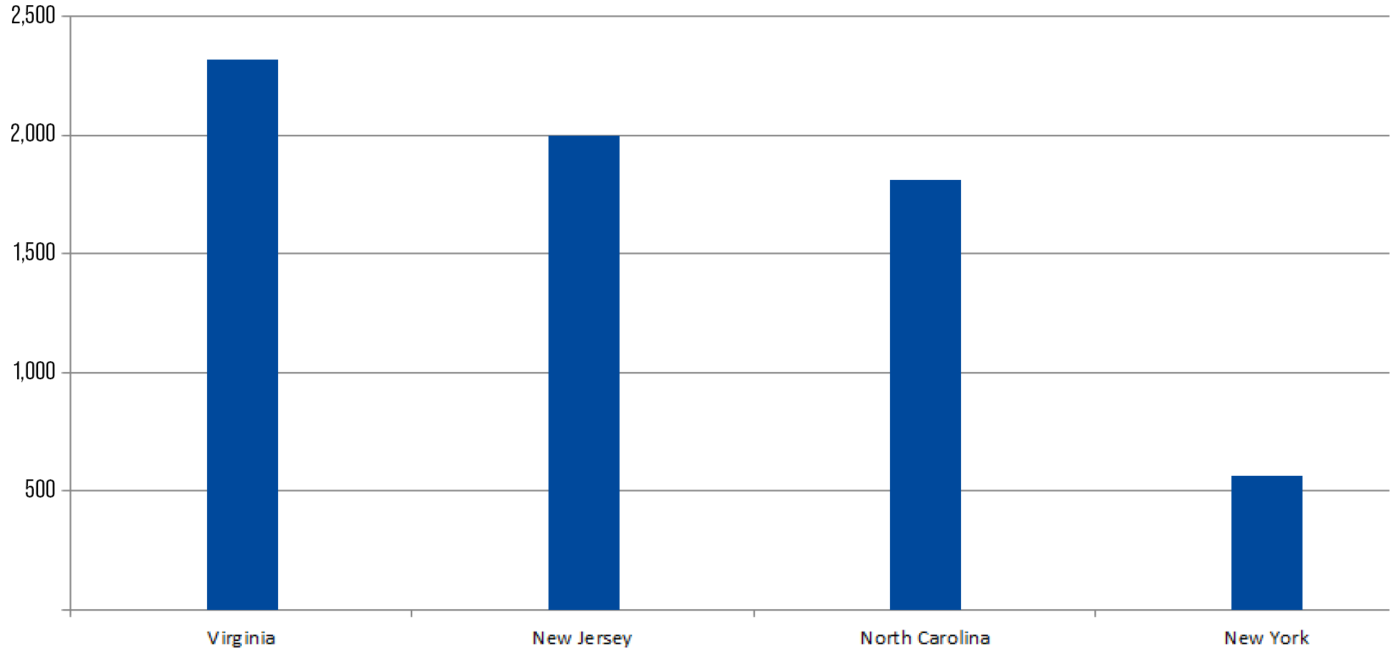


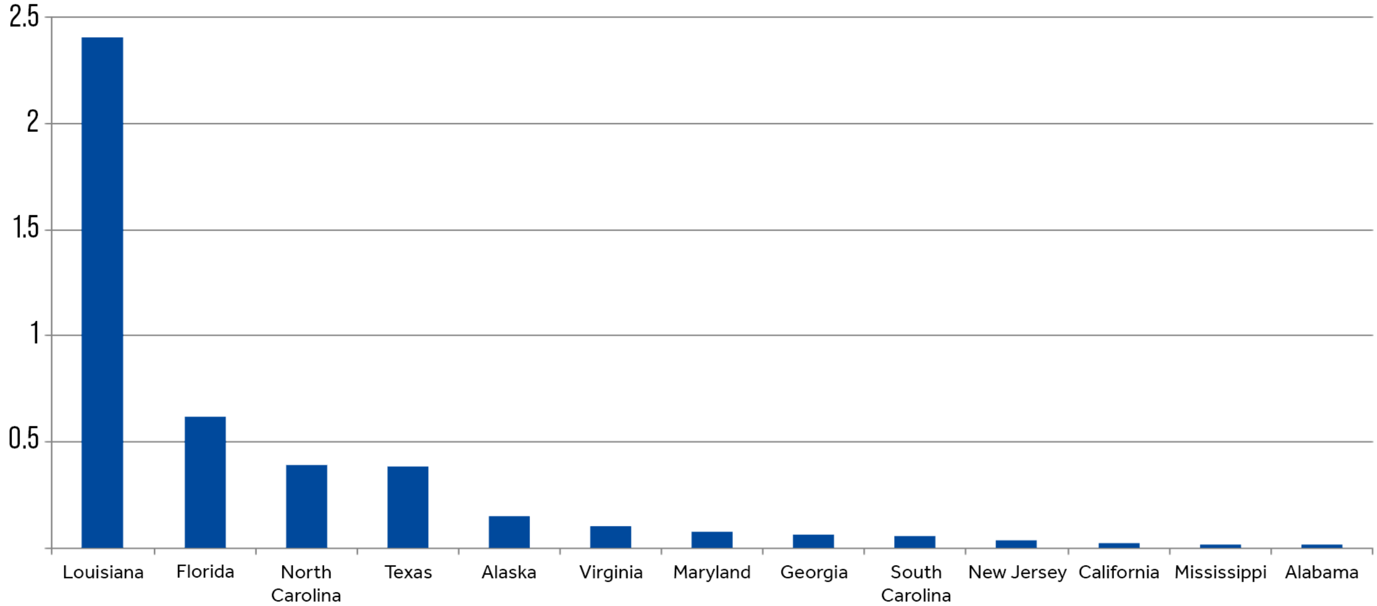
Figure 3. Top four states after LA, TX, and FL with parcels wholly below boundary tideline - 2050



Taxable acres shifting below tidal boundary levels

Across the coastal counties, as many as 4.4 million acres (6,800 square miles) may shift beneath tidal boundary levels by 2050—an area roughly three-quarters the size of New Jersey.[4] By 2100, the affected area rises to 9.1 million acres (13,900 square miles).

Figure 4. Land area by state (acres, millions) - 2050



Four states—Louisiana, Florida, North Carolina, and Texas—may lose 3.8 million acres, a potential loss that constitutes 87% of the total affected area by 2050. To put into context the relative burden this represents for the individual states, consider the percentage of each state's total land area affected by 2050.

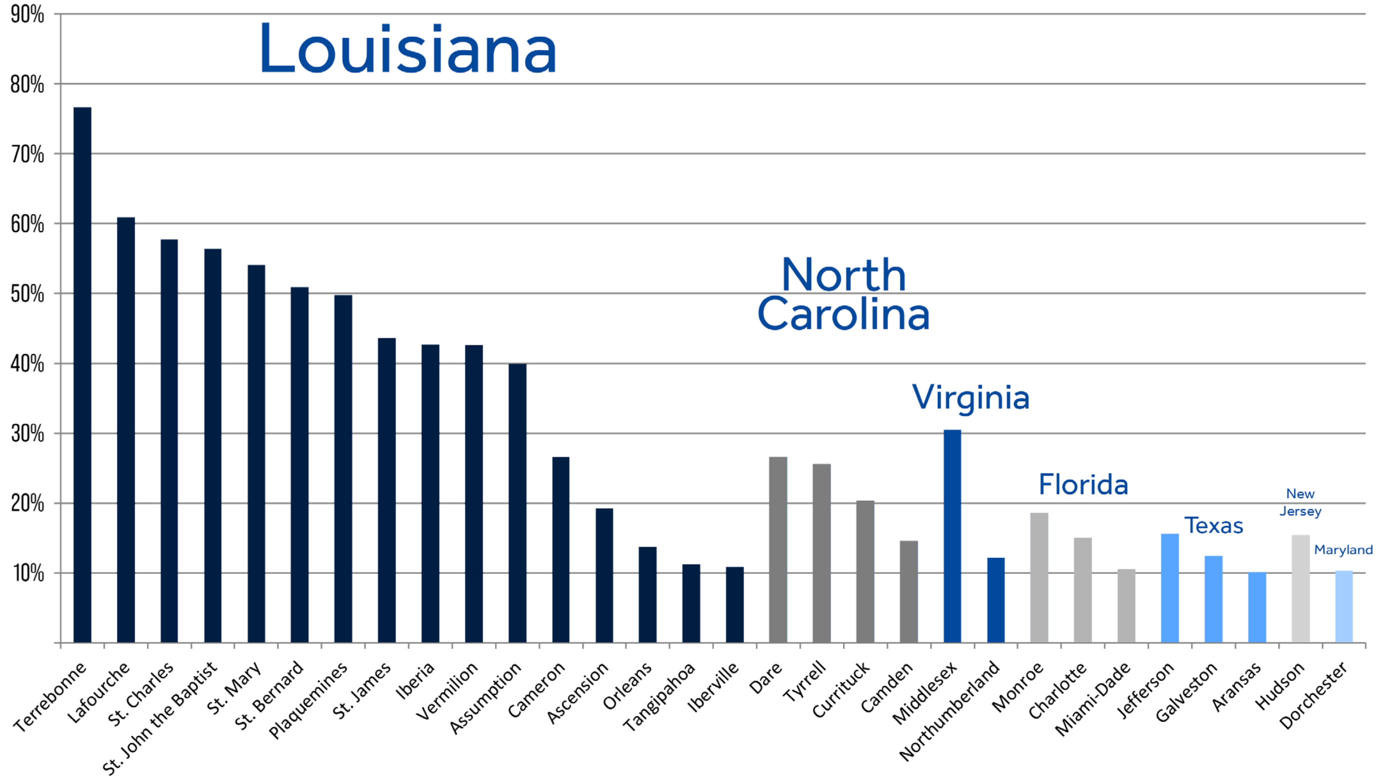
Table 1. Percent of state land area affected at 2050

Louisiana	8.7%
Florida	1.8%
North Carolina	1.3%
Texas	0.2%

Because schools and other local government operations are funded by local property taxes, we considered the impact at the county level. Counties range considerably in size, so it is helpful to examine the percentage of a county's land area that may be affected to assess relative impact.

By 2050, thirty counties have more than 10% of their land area affected, totalling more than 3 million acres. This subset of counties and their acreage represents 69% of the total potentially affected area by 2050.

Figure 5. **Percent of county land area - 2050**



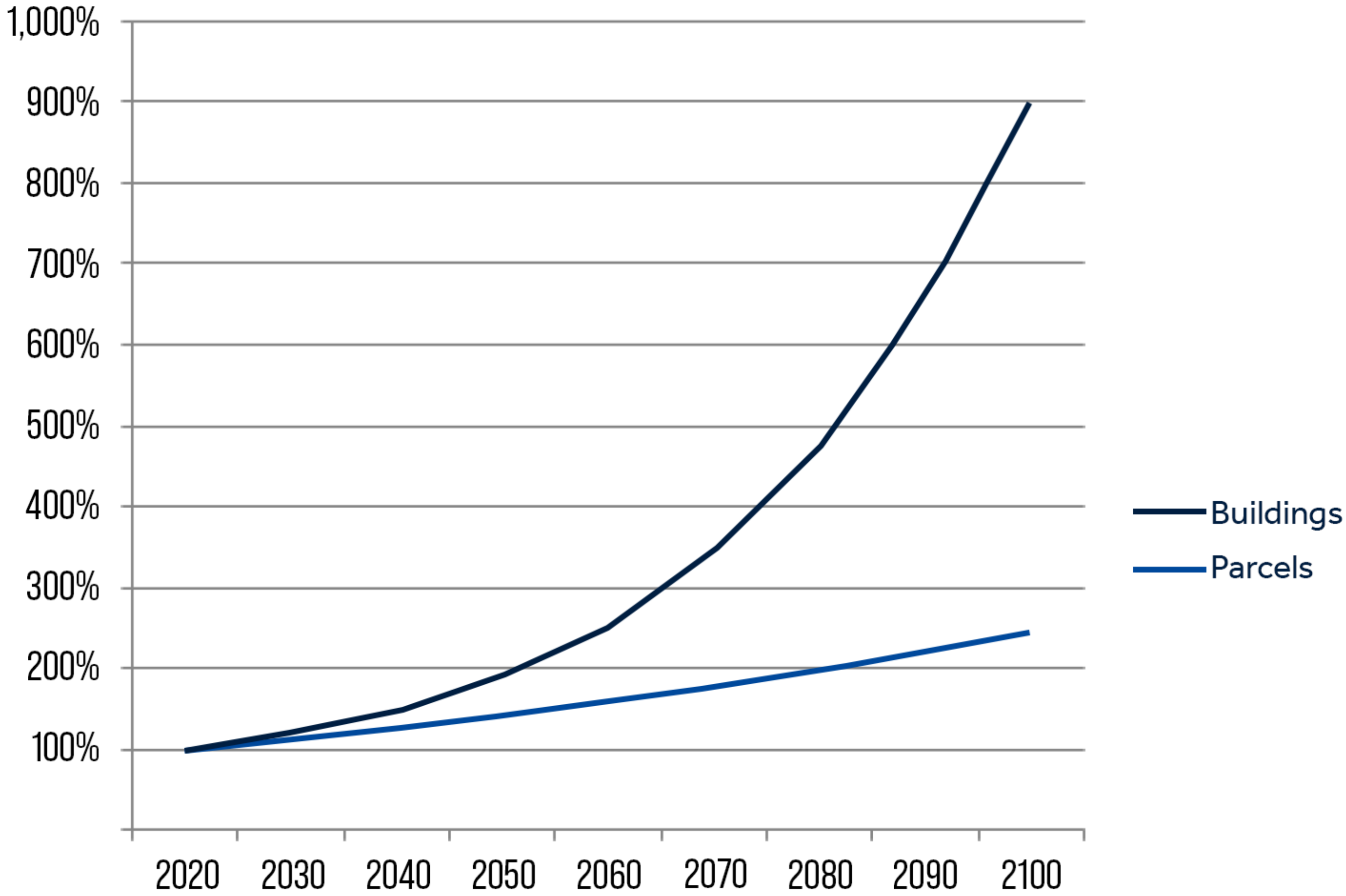
If we expand the list to include counties that have at least 5% of their respective area affected, the number rises to 3.6 million acres—83% of the total area potentially affected by 2050 is concentrated in these 54 counties.

Tipping point: buildings historically safe from flooding will be at risk

Tax authorities generally consider an "improvement" to be a permanent change to a property to enhance its value or prolong its useful life. For this analysis, we assume that improvements are buildings. We use a building footprint database to assess the number of buildings that may be situated partially or completely on or below the relevant state tidal boundary level, as the boundary shifts over time along with rising seas.[5]

There is a rapid increase in the number of potentially affected buildings in the latter half of this century—40,200 for 2030; 84,500 for 2050; and 302,000 for 2100. This acceleration is particularly evident when graphed alongside parcel counts, with each compared to their respective 2020 values.

Figure 6. **Buildings and parcels affected compared to 2020**



The different curves reflect different realities for each variable. Parcel counts climb slowly because the ocean will generally need to traverse the entire width of an initially affected parcel before reaching another one.

The most notable pattern is the sharp acceleration over time in the number of buildings affected. A plausible explanation is that people have historically built as close to the ocean as possible while remaining above the observed tides—an outdated strategy based on the assumption that the sea level remains stable. Once rapidly rising seas breach a certain threshold, these densely-developed landscapes reach a tipping point—where flooding was once the exception, it becomes the rule.

This pattern sends a critical warning: while change might seem relatively slow and manageable in many places today, we are soon headed for a very different world. Planning, preparation, and prevention will be required to avoid a lot of pain.

State-level summary data for affected parcels, land area, and buildings for the year 2050 are included as an appendix.

Potential implications for tax valuations

To calculate the taxable value of affected parcels and buildings, Climate Central used land and improvement tax valuation data from Regrid.com, land parcel and location context data company. Improvements (such as buildings) assessment value data were not available for some flood-exposed jurisdictions that would be expected to have high overall tax-assessed values. Notable among this group are Los Angeles, New Orleans, the five boroughs of New York City, and a dozen counties in Virginia, including some in the immediate Washington, DC area. Accordingly, this report provides only a partial financial picture of the overall threat to local tax bases nationwide.

Each county determines its own tax valuation basis, so comparing valuation numbers between counties is not necessarily on an apples-to-apples basis. Nevertheless, summing available valuation numbers gives some insight into the coming challenges for local governments and schools that levy property taxes on their valuations to generate tax revenue.

Across the dataset, at least 230 counties with more than 10 acres affected by 2100 had available tax-assessment valuation data for land and improvements. For those counties, the total affected valuations climbs substantially over the course of the century.

For this analysis, we considered four states with the largest affected area to demonstrate potentially affected tax valuations. Only counties with more than 10 acres affected by 2050 are considered in these totals, and all assessment values are for 2020.

Table 2. Florida - More than $7 billion by 2050, based on 44 counties with tax assessment values.

Florida - 2050 potentially affected valuations (44 of 44 affected counties)	
Land	$5.83 billion
Improvements	$1.22 billion
Total	$7.01 billion
Tax assessment values available for all 44 affected counties.	

Table 3. Texas - Nearly $5 billion by 2050—underestimated, since valuation data was only available for 9 of 20 affected counties.

Texas - 2050 potentially affected valuations (9 of 20 affected counties)	
Land	$8.65 million
Improvements	$4.02 billion
Total	$4.89 billion
Land and improvement tax assessment values not available for Aransas, Calhoun, Chambers, Hardin, Jackson, Jefferson, Kennedy, Kleberg, Nueces, Refugio, and Victoria counties.	

Table 4. North Carolina - Approximately $4.5 billion by 2050 based on valuation data for 21 of 24 affected counties.

North Carolina - 2050 potentially affected valuations (21 of 24 affected counties)	
Land	$2.83 billion
Improvements	$1.64 billion
Total	$4.47 billion
Land and improvement tax assessment values not available for Halifax, Martin, and Perquimans counties.	

In **Lousiana,** 29 counties have more than 10 acres affected by 2050. However, tax assessment land and improvement value data are available for only two of those counties—too few for making state-level comments.

Loss of tax base

The legal and political ramifications of these changes are complex, and will likely vary among locations. Those ramifications extend well beyond loss of tax revenue as property owners object to paying taxes on submerged land. Significant costs will be incurred for removing structures, removing septic systems, or remediating underground storage tanks or other toxic sources before a property becomes part of the marine environment. When properties are abandoned, these costs are likely to fall to the government, adding new expenses not covered by revenue. Failing to address these issues hurts other property values and hence property tax revenues.

Before the water boundary migrates that far, local government will face increased expenses associated with street and road repair, storm water system alterations, and sewer, water and other utility system interventions. Some locations are incurring expenses for sand and beach replenishment. These increased expenses will occur alongside downward pressure on property values and tax revenue.

Implications: Lower revenues, higher expenses

Property taxes fund local government operations, which typically include services such as K-12 schooling, roads and other infrastructure, police and fire protection, water, waste management, sewers, public transit, parks, and public housing. Quality public services at competitive tax rates are key to attracting and retaining residents and businesses, which in turn support local tax revenues. Diminished property values and a smaller tax base can lead to lower tax revenues and reduced public services–a potential downward spiral of disinvestment and population decline, reduced tax base and public services, and so on.

Seawater flooding damages crops, landscaping, roads, stormwater systems, vehicles, communications and utility systems, and interferes with commuting, jobs, commerce, deliveries, and other activities on which a local economy depends. These direct and indirect damages adversely impact local government expenses (e.g., increased road repair costs, emergency management expenses, etc.) and revenues (e.g., loss of sales tax from closed businesses). How city and county management teams respond to these risks, or if they respond at all, is material to the city's and county's future ability to repay debt and protect its credit rating.

Sea-flooded business assets may experience what accountants call impairment. Impairment exists when an asset's fair value is less than its carrying value on the balance sheet. Since land is commonly not depreciated on balance sheets, recognizing impairment results in a cost charged as an expense and reduces net income. As businesses recognize these asset devaluations for a property, they will likely petition tax authorities to have the property's assessed values reduced.

What can be done

To increase resilience and reduce risks to property and lives, communities, counties, and states have several options. They can:

- Adjust land use policies to encourage development outside the risk zones, and to limit new growth in the risk zones.
- Participate in the National Flood Insurance Program and the Community Rating System incentives to help improve financial resilience for residents, indirectly supporting the tax base.
- Use science-based analysis to inform investments in infrastructure interventions, such as improving stormwater systems, raising roadways, building levees, or improving coastal wetlands, that will, at least for a time, help protect the tax base.
- Educate and inform taxpayers so that they may constructively participate in adapting the local economy and tax base to the rising sea.

Ultimately, reducing and eventually eliminating carbon pollution will prevent the problems identified in this report from getting much worse.

Methodology

To prepare this analysis as well as the county-specific analyses, Climate Central used well-established projections of local sea level rise and local relationships between flood elevation and frequency. We used this information to delineate current and projected future submergence , and cross-referenced these against spatial data on land parcels and improvements inside the county. Each of these components is described below.

Quantifying future sea level rise

The future trajectory of sea level rise is determined by rising temperatures, which in turn result from activities–chiefly the combustion of fossil fuels–that release carbon dioxide and other heat-trapping gasses into the atmosphere. Future emission levels will dramatically affect the rate and extent of sea level rise, mainly after the year 2050. Scenarios for future emissions are described by a set of standard pathways agreed upon by scientists and governments around the world. These standard pathways, formally called Shared Socioeconomic Pathways (SSPs), are used as key inputs for scientific models of warming and sea level rise.

For this analysis, Climate Central uses one of these standard pathways, SSP3-7.0, for evaluating future exposure to rising seas and thus to coastal floods. The SSP3-7.0 pathway represents a continuation of our current emissions trends, or the carbon pollution pathway that approximately tracks society's emissions performance so far.

Local sea level projections are based on projections the Intergovernmental Panel on Climate Change's (IPCC) published in 2021, the most scientifically up-to-date as of this writing.[6] The sea level model was run for thousands of simulations for SSP3- 7.0. Median projections under each scenario for the years 2030, 2040, 2050, 2060, 2070, 2080, 2090 and 2100 are used, reflecting mid-range (50th percentile) sea level sensitivity to climate pollution. Lesser or more severe outcomes are possible, with 5th and 95th percentile results available from Climate Central.

Affected areas

To identify affected areas, we start with projections of local sea level rise, as described above, and overlay them onto local land-elevation data. We then identify land whose elevation is lower than or equal to the projected height of water at the tide level (Mean Higher High Water - MHHW, Mean High Water - MHW, or Mean Low Water - MLW) NOAA has indicated most closely approximates each state's boundary between private property and public tidelands and waters.[2,3]

Initial delineations of affected areas are refined by removing low-lying areas that appear to be protected from the ocean by natural topography or by levees. This approach is called a modified still water or bathtub model, since it relies only on how still water would fill a landscape, like water filling a bathtub, without accounting for factors such as wind, waves, or rain that give actual floods dynamic and uneven surfaces. Still water models are appropriate for mapping sea level and high tide projections.

Levees, walls, dams, or other features may protect some areas, especially at lower elevations. Data limitations, such as an incomplete inventory of levees and a lack of levee height data, make assessing the protection afforded by levees difficult. Levees are particularly prevalent in Louisiana and in the San Francisco Bay Area and San Joaquin delta region of Northern California. Missing or mischaracterized levee data in these areas may have important effects on results, including known overestimates of exposure due to missing levee data in Northern California. Climate Central uses data from the FEMA/USACE Midterm Levee Inventory for our national flood control structure dataset, and supplement this with local data from Louisiana and Massachusetts. This analysis does not account for future erosion, marsh migration, or construction. As is a general best practice, local detail should be verified with a site visit.

We assume for purposes of this analysis that levees are always high and strong enough for flood protection. However, the US Army Corp of Engineers estimated in 2021 that "$21 billion is needed to improve and maintain the moderate to high-risk levees in its portfolio, which represents only about 15% of the known levees in the U.S."[7] Thus, some areas and assets that appear to be protected by levees, may not actually be protected. In addition, areas may have hidden connections through porous bedrock geology, as is common in South Florida, another area with plentiful levees that line drainage channels and canals. Low-lying areas may also be connected by channels, breaks in seawalls, or drainage passages that are not captured by the elevation data, such as storm water drains and sewers. There is further no guarantee that existing levees will be maintained through 2050 or 2100. On the other hand, new defenses could also be built within these timeframes.

Land parcel and buildings data

In this analysis, only those portions of land parcels that are at or below the projected flood level are considered to be in the risk zone. For buildings, if any portion of the building footprint is at or below the projected flood level, then the building is considered to be in the risk zone. NOAA elevation data used in this analysis is ground elevation and this analysis assumes buildings are on the ground. If a building is elevated above the ground on pilings, for example, it may be at lower risk than indicated in this analysis.

To calculate the taxable value of at-risk parcels and buildings, we used land and improvement tax valuation data from Regrid.com, land parcel and location context data company. Regrid.com data used in this report were updated by Regrid from county tax records that were accessed in 2020 and 2021.

For our analysis, if any of the buildings present on a property are determined to be affected,the total value of improvements to that property is considered to be affected (this is consistent with the widespread practice of assigning a single value for improvements to a property regardless of the number of separate structures on the property).

To calculate the land area of affected parcels, we determine the percentage of each parcel that is exposed. Assessed land value exposed to flood is the fraction of each parcel in the risk zone multiplied by the total assessed tax value of the land.

As the baseline for this analysis–i.e., to define where the current coastline lies–we use the most recent data available through NOAA's local tide datums based on the National Tidal Datum Epoch (1983-2001). A tidal epoch is the 19-year tide cycle over which tide and chart datums are calculated. NOAA typically updates the NTDE a few years after the end of each epoch, and plans to do so for 2002-2020 in late 2023.

Migrating boundary between private property and public tidelands and waters

The laws of individual states define the boundaries between private property and public tidelands and waters. Implementation of these laws locally can be tedious and may lag the sea level rise-induced movement of the boundary waterline. For this analysis, we use the NOAA tide datums that NOAA has indicated best approximate the boundary for each state and assess how the waterlines scribed by those datums move inland at each individual property according to the sea level rise models and scenarios. [2,3] The additional time for NOAA datum updates, local land surveys, property assessments, appraisals, appeals, and possible condemnation is not considered.

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Appendix

State-level data for affected buildings, parcels, and land area by 2050, using the boundary elevation for each respective state.

Affected by 2050

		Total parcel count with % area affected				Land area		Total state land area
State	Buildings	Any	At least 25%	At least 50%	100%	% of state	Sq. miles	Sq. miles[5]
Alaska	47	2,229	305	227	114	0.0%	238.2	570,641
Alabama	865	10,579	1,628	792	254	0.0%	21	50,645
California	8,395	18,334	1,428	825	-	0.0%	31.4	155,779
Connecticut	855	6,032	552	226	-	0.1%	2.4	4,842
District of Columbia	57	149	17	9	6	0.4%	0.2	61
Delaware	106	3,872	307	80	5	0.6%	11.7	1,949
Florida	6,484	142,928	23,892	14,541	5,399	1.8%	969	53,625
Georgia	816	5,835	747	292	16	0.2%	97.2	57,513
Hawaii	138	4,909	228	73	21	0.0%	2.5	6,423
Louisiana	19,041	106,919	62,088	52,001	26,619	8.7%	3758.4	43,204
Massachesetts	18	6,801	490	228	121	0.0%	2.6	7,800
Maryland	2,576	37,079	2,112	898	286	1.2%	113.8	9,707
Maine	3	52	10	8	4	0.0%	0.1	30,843
Mississippi	643	6,315	1301	553	95	0.1%	27.2	46,923
North Carolina	6,815	51,468	16,346	8,062	1,813	1.3%	611.9	48,618
New Hampshire	3	223	22	16	11	0.0%	0.1	8,953
New Jersey	6,125	45,966	7,698	4,519	1,996	0.7%	52.9	7,354
New York	1,725	27,861	2,695	1,513	568	0.0%	12.7	47,126
Oregon	0	9,507	338	139	50	0.0%	2.8	95,988
Pennsylvania	44	722	262	164	23	0.0%	3.4	44,743
Rhode Island	45	6,139	572	306	141	0.1%	1.4	1,034
South Carolina	92	12,141	978	403	61	0.3%	84.5	30,061
Texas	8,358	65,017	24,198	15,243	8,156	0.2%	595	261,232
Virginia	1,173	47,615	5,471	3,464	2,313	0.4%	164.6	39,490
Washington	12	30,045	437	230	99	0.0%	2.6	66,456

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