When Retreat is the Better Part of Valor: A Legal Analysis of Strategies to Motivate Retreat from the Shore

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Abstract: Flooding represents Connecticut's most prevalent, serious and expensive natural hazard. Accelerated sea level rise, in combination with increasingly frequent extreme weather events caused by global warming-induced climate change, is very likely to result in increased inundation, flooding, and erosion of coastal lands. However, FEMA's Flood Insurance Rate Maps (FIRMs) rarely account for the projected effects of climate change and therefore significantly underestimate the risk of flooding and erosion. This article describes the projected effects of global warming-induced climate change on coastal flooding and flood-related risks in Connecticut in order to emphasize the scope and magnitude of the risk to coastal communities, and the resulting economic risk to the state. The authors present a heuristic tool to describe an array of regulatory, information, and market-based strategies that could be used to govern development in the coastal zone and conclude that Connecticut and its municipal governments have several independent bases of legal authority to regulate current and future development in high hazard areas. The article concludes with recommendations on regulatory, information, and market-based strategies to motivate retreat from the shore.

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I. Introduction

There is broad scientific consensus that anthropogenic emissions of greenhouse gases (GHG) since the Industrial Revolution have caused a measureable increase in global average temperature, and that global warming is very likely to affect climate and hydrological processes in spite of efforts to reduce

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GHG emissions in the short term.[3] Global warming-induced climate change may result in climate extremes and disasters depending on interactions between climate, the environment, and a variety of human factors that affect exposure and vulnerability.[4] As a result, it is widely agreed that coastal states like Connecticut should proactively attempt to adapt and reduce their exposure and vulnerability to the more likely effects of climate change in order to increase their resilience to climate extremes, while continuing to mitigate GHG emissions.[5] The challenge for Connecticut and similarly situated coastal states is at least two-fold:

(1) To effectively reduce risks to people, property, critical ecosystems and ecosystem services associated with existing development in coastal and riparian areas by (a) protecting existing development where necessary,[6] (b) accommodating to changing environmental conditions, or (c) retreating from and abandoning the shoreline or floodplain.[7]

(2) To effectively manage or prevent *new* development in high-risk coastal and riparian areas by accommodating to changing environmental conditions or promoting retreat from and abandonment of the shore.[8]

The objective of this article is to examine the viability of legal challenges to state and local efforts that anticipate and attempt to address the projected effects of climate change on public and private property, public trust interests, the environment, and ecosystem services in the coastal zone. This article considers the extent to which the State and local governments, in cooperation with the private sector, can prohibit development in the coastal zone and/or compel coastal property owners to retreat from the shore.

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[3] INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), CLIMATE CHANGE 2007: SYNTHESIS REPORT 51 (2007); THOMAS R. KARL ET AL., GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 9 (2009); PETER FRUMHOFF ET AL., CONFRONTING CLIMATE CHANGE IN THE U.S. NORTHEAST: SCIENCE, IMPACTS, AND SOLUTIONS 19 (2007); CONN. DEP'T OF ENVTL. PROT., CONNECTICUT'S 2010 NATURAL HAZARDS MITIGATION PLAN UPDATE 26 (2010).

[4] *See* IPCC, SUMMARY FOR POLICY MAKERS IN MANAGING THE RISKS OF EXTREME EVENTS AND DISASTERS TO ADVANCE CLIMATE CHANGE ADAPTATION 4 (2012). Climate extremes refers to both extreme weather and extreme climate events.

[5] *See* NAT'L ACAD. OF SCI., ADAPTING TO THE IMPACTS OF CLIMATE CHANGE 19 (2010) (Adaptation is defined as "adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects."); CONN. DEP'T. OF ENERGY & ENVTL PROT., COASTAL HAZARDS IN CONNECTICUT: COASTAL HAZARDS PRIMER (2012).

[6] *See* LESLEY KATZ GENOVA ET AL., THE LIKELIHOOD OF SHORE PROTECTION ALONG THE ATLANTIC COAST OF THE UNITED STATES VOL 1: MID-ATLANTIC 67-72 (James Titus et al. eds., 2010) (Authors conclude that "most of the State's densely developed areas, public facilities, and tribal lands are certain to be protected" and that "affluent lower density residential areas are also assumed to be almost certainly protected because of residents' ability to personally finance protection and also to influence local and state authorities to allow or fund the necessary structures." However, protection is uncertain or unlikely for military property, agricultural lands, undeveloped areas and open space).

[7] *See* J. DRONKERS ET AL., IPCC, STRATEGIES FOR ADAPTATION TO SEA LEVEL RISE iv (1990) ("Retreat involves no effort to protect the land from the sea. The coastal zone is abandoned and ecosystems shift landward… Accommodation implies that people continue to use the land at risk but do not attempt to prevent the land from being flooded. This option includes erecting emergency flood shelters, elevating buildings on piles, converting agriculture to fish farming, or growing flood or salt tolerant crops. Protection involves hard structures such as sea walls and dikes, as well as soft solutions such as dunes and vegetation, to protect the land from the sea so that existing land uses can continue").

[8] *Id*.

Part I briefly summarizes the most recent and best available information about the projected effects of climate change on Connecticut's coastal communities. Parts II and III are directed primarily to state and local officials since much of the responsibility for land use, risk prevention, emergency response, and post-disaster remediation is likely to fall on state and local governments. Part II presents a framework to describe a spectrum of policy options to enable Connecticut to prepare for some of the most probable and severe consequences of climate change in the coastal zone. Part III presents a user-friendly "takings" test and considers the extent to which the policy options presented in Part II are likely to expose state and local governments to successful "takings" claims pursuant to the U.S. and Connecticut Constitutions. Part IV offers some recommendations to better position the State and local governments to respond to climate change-induced risks to development in high-risk areas of the coastal zone.

II. Projected Climate Change Impacts in Connecticut

Anthropogenic emissions of carbon dioxide (CO_2) and other greenhouse gases (GHGs) are widely understood to have resulted in an observable increase in global average temperature over the past 50 years.[9] The Intergovernmental Panel on Climate Change's 2007 *Synthesis Report Summary for Policymakers* states that "[m]ost of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations" and that human influences have:

- *Very likely* contributed to sea level rise during the latter half of the 20th century;
- *Likely* contributed to changes in wind patterns, affecting extra-tropical storm tracks and temperature patterns;
- *Likely* increased temperatures of extreme hot nights, cold nights and cold days; and
- *More likely than not* increased risk of heat waves, area affected by drought since the 1970s, and frequency of heavy precipitation events."[10]

A number of agencies and highly respected climate scientists also warn about "dangerous interference with climate"[11] and inevitable and potentially "unpleasant surprises."[12]

In Connecticut and southern New England, global warming and its effects on climate are likely to result in:

- **Rising sea levels, which will be amplified by land subsidence**. Rising sea level is likely to result in loss of coastal property related to inundation, erosion, and storm surge; saltwater intrusion into drinking water supplies and septic fields; tidally driven surcharge into

[9] IPCC, *supra* note 3, at 51.

[10] *Id. See also* U.S. ENVTL. PROT. AGENCY, CLIMATE CHANGE INDICATORS IN THE UNITED STATES 4-7 (2010) (The EPA reports measurable effects of anthropogenic greenhouse gas emissions on U.S. and global temperature extremes including heat waves, drought and precipitation; sea surface temperature and sea level rise, snow cover; and change in growing season).

[11] James Hansen et al., *Dangerous Human-Made Interference with Climate: A GISS Model E Study*, 7 ATMOSPHERIC CHEMISTRY & PHYSICS 2287 (2007); *see also* James Hansen, *Game Over for the Climate*, N. Y. TIMES, May 9, 2012, http://www.nytimes.com/2012/05/10/opinion/game-over-for-the-climate.html; William Anderegg et al., *Expert Credibility in Climate Change*, 107 PROCEEDINGS OF THE NAT'L ACAD. OF SCI. 12107 (2010).

[12] Wallace Broecker, *Unpleasant Surprises in the Greenhouse?,* 328 NATURE 123 (1987).

municipal wastewater treatment systems and other water quality problems; and loss of barrier beaches, coastal dunes, tidal wetlands and their associated ecological services.[13]

- **Increased frequency of coastal storms and extreme weather events**. Increased frequency of extreme weather events is likely to result in coastal erosion, loss of barrier beaches, dunes, dune buffers, and wetlands; wind and flood damage to public and private structures in floodplains; contamination of drinking water supplies; and coastal water quality problems related to untreated wastewater and storm runoff.[14]

- **Increased air and water temperature resulting in increased frequency and duration of precipitation and droughts**. These hydrologic changes are likely to drive warmer winters, more days over 100°F, higher fire risk, and shifting plant and animal phenology that will cause public health, economic, environmental and ecological problems.[15] Increased frequency and/or intensity of rain or snow events will result in increased risk of flooding, erosion and environmental problems related to storm runoff.

These effects, combined with the expectation that climate change will accelerate until GHG emissions stabilize and are mitigated,[16] will likely lead to repetitive losses of private property and infrastructure—especially in littoral and riparian floodplains where development and population are concentrated. Although Long Island physically shields most of Connecticut's shoreline from strong coastal storms, an estimated five million people in New York and Connecticut currently live within 15 miles of the Long Island coastline and associated river systems and are therefore potentially at risk of coastal inundation and flooding.[17] The non-profit, non-partisan *Climate Central Project* reports that over 8,000 Connecticut homes currently lie less than one foot above sea level, which puts them at over a 15% risk of flooding by inundation or storm surge by 2020 based on conservative estimates of sea level rise.[18]

The population in Connecticut that is actually at risk may be significantly larger, however, than *Climate Central*'s estimate for several important reasons:

- The best available U.S. Geological Survey (USGS) maps of elevation above sea level for Connecticut are based on digital elevation models, which are "frequently inaccurate" and generate maps at 10-foot contours (+/– 5 feet).[19] Reliance on these maps to identify the properties that lie at one foot above sea level could seriously underestimate the risk of exposure to inundation or storm surge-based flooding. In the absence of more accurate LIDAR maps or Federal Emergency Management Agency (FEMA) Flood Insurance Rate

[13] FRUMHOFF ET AL., *supra* note 3, at 19.
[14] *Id.*
[15] *Id.*; NAT'L ACAD. OF SCI., ADVANCING THE SCIENCE OF CLIMATE CHANGE: SEA LEVEL RISE AND THE COASTAL ENVIRONMENT 235 (2010) [hereinafter ADVANCING THE SCIENCE OF CLIMATE CHANGE]; *See* CONN. DEP'T OF ENVTL PROT., COASTAL HAZARDS IN CONNECTICUT: THE STATE OF KNOWLEDGE AND MANAGEMENT IN 2009 38 (2010). Readers may also refer to Connecticut's Official Climate Change Website for updated information and reports on Connecticut's response to climate change.
[16] IPCC, *supra* note 3, at 51.
[17] KATZ GENOVA, *supra* note 6, at 5.
[18] BEN STRAUSS ET AL., SEA LEVEL RISE, STORMS & GLOBAL WARMING: A CLIMATE CENTRAL REPORT 6 (2012); *See* Climate Central, Surging Seas: Connecticut, http://sealevel.climatecentral.org/surgingseas/place/states/CT (last visited June 27, 2012) for additional maps and related information.
[19] KATZ GENOVA, *supra* note 6, at 9.

Maps (FIRMs), the U.S. Environmental Protection Agency's 2007 study mapped all properties within 1,000 feet of the shore to approximate the 500-year floodplain.[20]

- King tides or extratidal high water events – where the daily high tide exceeds the highest predicted high tide – are occurring more frequently. This is happening in part because the National Oceanic and Atmospheric Administration's (NOAA) long-term mean sea level (MSL) predictions are based on tidal averages for the 19-year period from 1983 through 2001,[21] which do not reflect *actual* sea level or the current trend in the rate of sea level rise. NOAA uses a running monthly mean of actual sea level to partly correct for this[22] but the risk of erosion and flooding of coastal properties may be underestimated to the extent that regulators rely on NOAA's long term record of Mean High Water (MHW) to govern development in the coastal zone.

- The IPCC projected that global average sea level could rise 0.2 to 0.6 meters (0.6 to 1.9 feet) above present by 2100.[23] However the U.S. National Academy of Science (NAS) reports that sea level could rise by 0.6 to 1.6 meters (1.9 to over 5 feet) by 2100[24] based on the observed rate of ice melt from the Greenland ice shelf and the Antarctic.[25] Using climate change scenarios published by the New York Panel on Climate Change (NPCC) and the Northeast Climate Impacts Assessment (NECIA),[26] the Adaptation Subcommittee to Governor Malloy's Steering Committee on Climate Change estimated that sea level could rise along Connecticut's coast by 1.04 to 1.4 meters (3.4 to 4.6 feet) by 2100 under the "rapid ice melt" scenario.[27] (See Figure 1, which presents projected trends in sea level rise in Bridgeport and New London based on current low and high GHG emissions scenarios, relative to the background rate of sea level rise).[28]

- Flood heights related to inundation and storm surge could range from 10 to 15 feet above the observed MHW in Connecticut by 2020 depending on location and category of storm.[29] In addition, the 2007 Northeast Climate Impacts Assessment study projected that the

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[20] *Id*.
[21] Va. Inst. of Marine Sci., Extratidal Water Levels, http://www.vims.edu/bayinfo/tidewatch/background/index.php (last visited July 1, 2012).
[22] *Id*.
[23] IPCC, *supra* note 3, at 51.
[24] ADVANCING THE SCIENCE OF CLIMATE CHANGE, *supra* note 15, at 7-10.
[25] NASA, *Arctic Sea Ice Continues Decline, Hits 2nd-Lowest Level,* Oct. 4, 2011, http://www.nasa.gov/topics/earth/features/2011-ice-min.html (last visited July 1, 2012); NASA, *Is Antarctica Melting?*, Jan. 12, 2010, http://www.nasa.gov/topics/earth/features/20100108_Is_Antarctica_Melting.html (last visited July 1, 2012).
[26] *See* ADAPTATION SUBCOMM. TO THE CONN. GOVERNOR'S STEERING COMM. ON CLIMATE CHANGE, THE IMPACTS OF CLIMATE CHANGE ON CONNECTICUT AGRICULTURE, INFRASTRUCTURE, NATURAL RESOURCES, AND PUBLIC HEALTH 2 (2010) [hereinafter ADAPTATION SUBCOMMITTEE REPORT.] (The Subcommittee on Adaptation was established to advise the Governor's Steering Committee on Climate Change pursuant to Connecticut's Global Warming Solutions Act (2008 Conn. Pub. Acts No. 08-98, § 7)).
[27] *Id*. at 8.
[28] ADVANCING THE SCIENCE OF CLIMATE CHANGE, *supra* note 15, at 235.
[29] VIVIEN GORNITZ ET AL., ENVTL DEF. FUND, BRACING FOR CLIMATE CHANGE IN THE CONSTITUTION STATE: WHAT CONNECTICUT COULD FACE 22 (2004); TONY DUTZIK & NATHAN WILCOX, ENVTL CONN. RESEARCH & POLICY CTR., GLOBAL WARMING AND EXTREME WEATHER: THE SCIENCE, FORECAST, AND THE IMPACTS ON AMERICA 8 (2010).

current 100-year flood and 100-year coastal flood will occur in Connecticut every 56 to 61 years and every 32 years, respectively, as a result of global warming-induced changes in the hydrological cycle.[30]

- The FEMA National Flood Insurance Program (NFIP) uses "statistical analyses of records of river-flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses" to map the areal extent of historical 100-year floods or Special Flood Hazard Areas (SFHAs) where there is at least a 1 in 4 chance of flooding during a 30-year mortgage.[31] The SFHAs, or "A-zones," and areas at risk from high velocity waves due to storm surge (V-zones) are then mapped on the FIRMs showing the risk premiums for each zone.[32] However, the FIRMs are likely to misrepresent the risk of flooding to the extent they rely on historically averaged USGS, NOAA, or Meteorological Service data instead of digital and/or ground-truthed data as noted above. More importantly, many of the FIRMs seriously underestimate the risks of inundation and storm surge flooding since they "fail to incorporate information about future development, coastal erosion, inundation zones above and below dams, or climate change,"[33] including the projected frequency of the 100 year flood based on climate change.

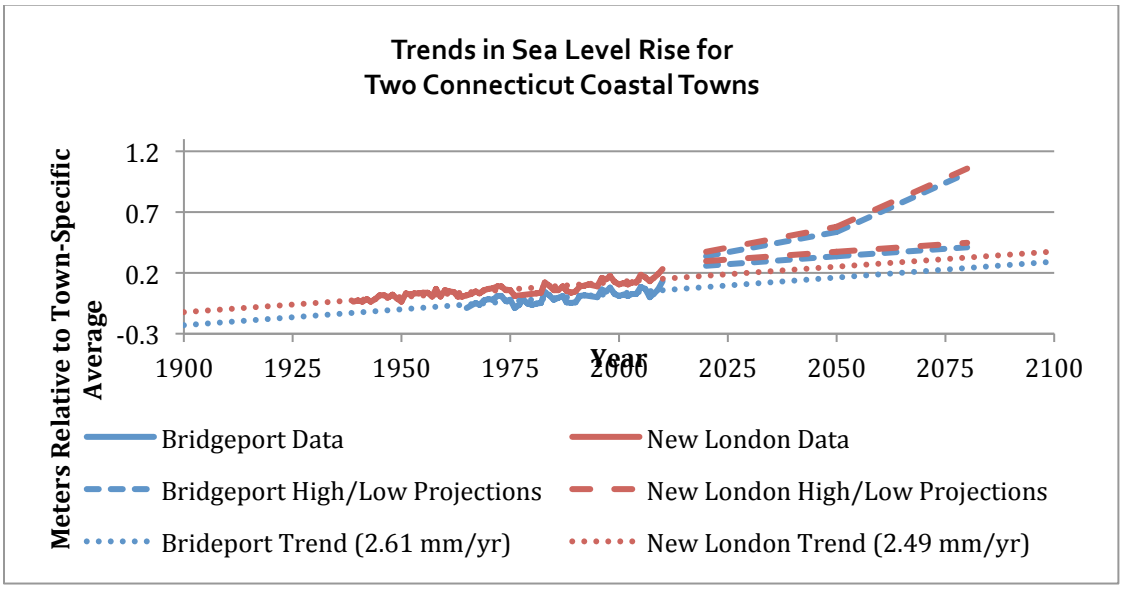

Fig. 1: Trends in Sea Level Rise for Bridgeport and New London, Connecticut.[34]

[30] FRUMHOFF ET AL., *supra* note 3, at 19.

[31] FloodSmart.gov, Defining Flood Risks, http://www.floodsmart.gov/floodsmart/pages/flooding_flood_risks/defining_flood_risks.jsp (last visited July 1, 2012).

[32] FEMA, Flood Insurance Rate Maps, http://www.fema.gov/hazard/map/firm.shtm (last visited July 1, 2012) (The SFHA or "A zone" is defined as an area subject to inundation by a flood that has a ≥1% chance of being equaled or exceeded during any given year. A "base flood" has a 26% chance of occurring during a 30-year period…the length of many mortgages. A "V zone" is in the 100-year flood zone with additional risk due to high-velocity waves associated with storm surge.).

[33] WILL HEWES & ANDREW FAHLUND, AMERICAN RIVERS, WEATHERING CHANGE: POLICY REFORMS THAT COST LESS AND MAKE COMMUNITIES SAFER 3 (2011).

[34] *See* Permanent Service for Mean Sea Level, http://www.psmsl.org/ (last visited July 1, 2012) (Sea level data for Bridgeport and New London were obtained from psmsl.org, which is overseen by National Oceanography Centre

In addition, there is compelling empirical evidence that Connecticut should use a precautionary approach to estimate the population exposed to erosion and flooding risk based on the number of properties that *actually* suffered flood damage from the March 2010 floods[35] and Tropical Storm Irene,[36] noting that the population living in Connecticut's coastal zone is predicted to increase by 15% to 20% by 2020.[37] More specifically, note that an estimated 66 percent of the 387,813 properties in Long Island, New York were actually at risk of storm surge-related flooding during Topical Storm Irene although they were not located in a SFHA.[38] In Bridgeport, Connecticut, 45% of the Town's properties were actually at risk of flooding from Hurricane Irene although they were not located in a SFHA.[39]

In sum, climate-related disasters are likely to become increasingly destructive and increasingly expensive for coastal states because of increased development, population density, and embedded wealth in the coastal zone.[40] Although no trend can be inferred from two consecutive years, twelve natural disasters costing over $1 billion each occurred in the United States in 2011, which represents a 30% increase over similar events in 2010.[41] Lloyd's of London and Risk Management Solutions, Inc. recently predicted that insurable flood losses along the Gulf and Atlantic coastlines would increase 80% by 2030 with a one-foot rise in the sea level.[42]

The economic consequences for Connecticut and other coastal states are potentially extremely serious. Tropical Storm Irene, which was *one* of Connecticut's three federally declared disasters in 2011, cost the State at least $235 million[43] or over $65 per person—far higher than the $4.56 per person reported in FEMA's Preliminary Damage Assessment.[44] Since there are only 40,000 NFIP policies in

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(NOC), which is a component of the UK Natural Environment Research Council (NERC). Additionally, plotted values are relative to the most recent Mean Sea Level data, a methodology used by NOAA); *See* GORNITZ ET AL., *supra* note 29, at 6 (Projections for both cities were based on general predictions of sea level rise for Connecticut from this paper).

[35] *See* THE ASSOCIATED PRESS, *CT Flood Victims Facing Tuesday Deadline*, Jul. 25, 2010 (Over 3,600 people had filed flood-related claims with FEMA related to the March 2010 storms as of July 25, 2010, and over $4 million had been disbursed for home repairs and temporary housing. Governor J. Rell's office reported that only 7% of residents reporting damage were fully insured).

[36] Matthew Sturdevant, *The CT Claims Tally For Irene: $235M*, HARTFORD COURANT, May 25, 2012 (Over 60,000 claims were reportedly filed for damage related to Hurricane Irene as of May 2012 according to the Connecticut Insurance Agency).

[37] KATZ GENOVA, *supra* note 6, at 5.

[38] CoreLogic, *Hurricane Irene - Flood Risks Outside FEMA High-Risk Flood Zones*, http://www.corelogic.com/landing-pages/hurricane-irene-flood-risks-outside-fema-high-risk-flood-zones.aspx (last visited July 1, 2012).

[39] *Id.*

[40] *See* U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2012 33 (2012) (Refer to Table 25: Population in Coastal Counties 1980 to 2010, which reports that 48% of the U.S. population currently lives in a coastal watershed county as of the 2010 census and that almost 50% of the nation's gross domestic product ($4.5 trillion in 2000) is generated in these Gulf and Atlantic coastal areas)

[41] HOMELAND SECURITY NEWS WIRE, *2011: Costliest Ever Year for Earthquakes, Weather-related Disasters*, Jan. 19, 2012, http://www.homelandsecuritynewswire.com/dr20120119-2011-costliest-ever-year-for-earthquakes-weatherrelated-disasters.

[42] LLOYD'S OF LONDON AND RISK MANAGEMENT SOLUTIONS, COASTAL COMMUNITIES AND CLIMATE CHANGE: MAINTAINING INSURABILITY (2008).

[43] Sturdevant, *supra* note 36.

[44] FEMA, PRELIMINARY DAMAGE ASSESSMENT, CONNECTICUT—TROPICAL STORM IRENE, FEMA 4023-DR (2011).

Connecticut[45] based on 2010 data, a significant portion of the State's flood-related losses was probably uninsured. In fact, Governor Malloy's Two Storm Panel estimated that Tropical Storm Irene in August 2011 and the Halloween Nor'easter eight weeks later in October 2011 could cost the State over $1 billion including the cost of underwriting uninsured losses.[46] Considering the damage associated with these two storms – which earned the State the dubious distinction of being ranked eighth of "the top ten states ravaged by extreme weather in 2011"[47] – it is important to note that FEMA estimated that a 100-year storm in Connecticut could result in almost $19 billion in property losses and business interruptions associated with just the 32,000 properties located in SFHAs.[48] The Adaptation Subcommittee to the Governor of Connecticut's Steering Committee on Climate Change recognized that "the FEMA HAZUS analysis does not take into account the climate change-induced, synergistic effects of increased groundwater tables and sea level rise on future flooding, which could increase the 100-year flood property losses and business interruptions."[49]

Although Connecticut's economic exposure to climate change-related risks in the coastal zone may be large,[50] Connecticut's *vulnerability* and *resilience* depend on a variety of linked environmental, structural, social, and institutional factors that vary across space and time[51] Connecticut is well

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[45] EQECAT, INC., *Hurricane Irene Loss Estimate: A Closer Look*, Sept. 13, 2010, http://www.eqecat.com/catwatch/hurricane-irene-loss-estimate-closer-look-2011-09-13/. Note that NOAA reports that Connecticut had 22,885 NFIP-insured properties as of 2010. *See* NOAA, State of the Coast, *Federally Insured Assets Along the Coast,* http://stateofthecoast.noaa.gov/insurance/welcome.html (last visited July 1, 2010).

[46] EQECAT, *supra* note 45.

[47] CLIMATE CENTRAL, *Texas Top 10 States Ravaged by Extreme Weather in 2011*, Dec. 20, 2011, http://www.climatecentral.org/news/top-ten-states-hit-hardest-by-2011s-extreme-weather/; JOE MCGEE ET AL., REPORT OF THE TWO STORM PANEL PRESENTED TO: GOVERNOR DANNEL P. MALLOY 3 (2012) [hereinafter REPORT OF THE TWO STORM PANEL.]

[48] *Adaptation Subcommittee Report*, *supra* note 26, at 18; *See* Benjamin Strauss et al., *Tidally Adjusted Estimates of Topographic Vulnerability to Sea Level Rise and Flooding for the Contiguous United States*, 7 ENVTL. RES. LETTERS 021001 (2012). (Authors conservatively estimate that almost 12,000 housing units are currently located less than one meter above local mean high water in Connecticut, which ranks the State at 12th in the U.S. in terms of population at risk).

[49] ADAPTATION SUBCOMMITTEE REPORT, *supra* note 26, at 18.

[50] *Id.*; Surging Seas, *supra* note 18; Hewes & Fahlund, *supra* note 33. *See* James Titus & Charlie Richman, *Maps of Lands Vulnerable to Sea Level Rise: Modeled Elevations Along the U.S. Atlantic and Gulf Coasts*, 18 CLIMATE RESEARCH 205 (2001) for more information regarding the possible impacts of climate change on Connecticut in terms of public health, the economy, agriculture, and the environment.

[51] *See* W. Neil Adger et al., *Social-Ecological Resilience to Coastal Disasters*, 309 SCI. 1036 (2005) ("Resilience means the capacity of linked social-ecological systems to absorb recurrent disturbances so as to retain essential structures, processes and feedbacks… Hazards in coastal areas often become disasters through erosion of resilience"). Physiographic or environmental factors include but are not limited to elevation above sea level, river drainage and geomorphology, angle of exposure to wind and tides, wetlands protection, vegetative buffering of littoral and riparian areas, and habitat and biological diversity. Structural factors include but are not limited to land use/land cover, amount of impervious surface and the extent and type of coastal armoring and its effects on erosion and accretion. Some social factors that affect resilience include population density, demographics, economic and livelihood diversity, recognition of ecosystem services provided by the natural environment and the public's attitudes toward land use regulation, allocation of risk and distributional equity. (*See* Neil Adger et al., *Are There Social Limits to Adaptation to Climate Change?* 9 CLIMATIC CHANGE 335 (2009) for discussion of the roles that values, knowledge, risk perception and culture play in adaptability). Institutional factors, which are the focus of this paper, include but are not limited to public/private investment in mitigation and adaptation; existence of legal and market-based incentives that promote reduction of risk; and ability of public and private institutions to interact to govern human activities and protect human, social, manmade and natural capital and ecosystem services.

positioned to address some aspects of its exposure to climate change-related risk but it is vulnerable in some key respects—as are most societies. By way of illustration, the Two Storm Panel reported that over 750,000 residents lost power during Tropical Storm Irene in August 2011 and 880,000 lost power eight weeks later during the Halloween Nor'easter in October 2011, some for over two weeks. [52]

Connecticut is also vulnerable in terms of its pattern of development in the coastal zone and the extent to which Connecticut business and property owners protect themselves against foreseeable climate change related risk. For instance, Connecticut ranks 8th among the 23 coastal states in the contiguous U.S. in terms of absolute population living at or close to sea level.[53] However the State ranks 5th among the 23 coastal states in terms of population density located less than one vertical meter above sea level.[54] Urbanization and congestion greatly affect vulnerability in terms of emergency response and ability to escape. Cities and towns may also experience more extreme physical damage due to loss of natural coastal ecosystems, shoreline engineering, and the close proximity of many structures and associated infrastructure.[55] Demographics and socio-economic status also affect the State's ability to respond to and recover from risk. For instance, 23% of the State's 2010 population currently lives in coastal floodplains, 9% of which lives at or below the poverty level.[56] However, there are over 9,000 people per square mile in Bridgeport and 4,900 people per square mile in New London, 21% and 17% of whom live at or below the federal poverty level, respectively,[57] compared to a population density of approximately 1,000 people per square mile in the Long Island Sound watershed as a whole.[58] Poverty, owner occupancy, and cultural differences regarding perception of risk can affect investment in risk avoidance, and language barriers can complicate emergency response efforts.[59]

Connecticut is also vulnerable to the extent that property owners do not comply with the NFIP's mandatory insurance requirement and/or do not self-insure against flooding and other potential extreme climate and weather-related risks that are not covered by standard homeowners' insurance policies.[60] A 2006 study indicated that approximately 49% of single-family homes located in SFHAs carried mandatory flood insurance compared to 1% of properties outside of SFHAs,[61] which leaves the property owner and the state and federal governments to absorb uninsured losses. Connecticut is vulnerable as well to repetitive loss properties (RLPs) because of historic settlement patterns on coastal

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[52] REPORT OF THE TWO STORM PANEL, *supra* note 47, at 3.

[53] Strauss et al., *supra* note 48, at 10.

[54] *Id.* at 11. (*See* Table A.5 *Coastal state dry land population density within various TIDEL intervals:* 716 (CT) comp. to 1811 (NY) people per km^2 between 0-1 m above sea level.).

[55] William Donner & Havidán Rodríguez, *Population Composition, Migration and Inequality: The Influence of Demographic Changes on Disaster Risk and Vulnerability*, 87 SOCIAL FORCES 1094 (2011).

[56] NOAA, STATE OF THE COAST: POPULATION IN COASTAL FLOODPLAINS 1970-2010 (2011). *See* BEN WISNER.ET AL., AT RISK: NATURAL HAZARDS, PEOPLE'S VULNERABILITY AND DISASTERS 11 (2d. ed. 2004)

[57] U.S. Census Bureau, State & County QuickFacts, http://quickfacts.census.gov/qfd/index.html (last visited July 10, 2012).

[58] NOAA, POPULATION TRENDS ALONG THE COASTAL UNITED STATES: 1980-2008, 24 fig. 20 (2008).

[59] Donner & Rodríguez, *supra* note 55.

[60] FloodSmart.gov, When Insurance is Required, http://www.floodsmart.gov/floodsmart/pages/about/when_insurance_is_required.jsp (last visited June 27, 2012) (The NFIP requires homes and buildings located in SFHAs that have mortgages from federally regulated or insured lenders to carry federal flood insurance. The NFIP also strongly recommends flood insurance to owners and renters who live outside FEMA-designated SFHAs because they "file over 20% of NFIP claims and receive one-third of disaster assistance for flooding.")

[61] RAWLE O. KING, CONG. RES. SERV., NATIONAL FLOOD INSURANCE PROGRAM: BACKGROUND, CHALLENGES, AND FINANCIAL STATUS 10, 19 (2011).

and riparian floodplains prior to 1974.[62] Nationally, RLPs represent 1% of the properties located in SFHAs but over a third of the claims paid,[63] 90 percent of which were built before 1974 and therefore receive insurance premium discounts and are also exempt from the NFIP's floodplain management standards.[64] Although mandatory insurance has not worked very well in terms of reaching the regulated community for various reasons,[65] the existence of federal flood insurance and federally subsidized disaster assistance may also have the perverse effect of encouraging development in high flood and erosion hazard areas by subsidizing the cost of flood insurance and grandfathering in properties that are exempt from flood management plans.[66] Similarly, federal disaster assistance may create a *charity hazard* to the extent it indemnifies property owners' uninsured losses and fails to promote internalization of risk.[67]

There is compelling evidence that the business community is not well prepared for this future either. For example, New Haven's railroad station and airport, as well as many of Bridgeport's bridges, turnpike interchanges, sewage disposal plants, and oil tanks lie in high-risk flood zones.[68] In addition, a 2007 survey of Connecticut businesses conducted by the Ad Council found that among 100 businesses with 2-999 employees, 91% said it was important to take steps to prepare for disasters, while only 38% actually had a disaster management plan in place.[69]

III. Preparing for Climate Change in the Coastal Zone

This section presents a framework to describe a spectrum of policy options to enable Connecticut to prepare for some of the most probable and severe consequences of extreme climate- and weather-related risks based on its recent experience from the March 2010 flood, Tropical Storm Irene, and the two winter storms of 2011. This analysis of policy options assumes that climate change-related acceleration in sea level rise and increasing frequency of extreme storm events will occur and are likely to result in:

- Increased number of properties exposed to tide and storm-related flooding, erosion and wind and water damage;
- Increased pressure on natural coastal features such as wetlands, barrier beaches, and dunes that currently protect man-made structures and provide important provisioning, supporting, regulating, and cultural ecosystem services; and

[62] Connecticut had 1,467 RLPs responsible for 4,384 claims totaling over $50 million as of January 2011. *See id.* at Appendix A.
[63] *Id.* at 17-18. (*See also* NOAA, *supra* note 45, reporting that Connecticut's total claim payouts from 1978 to 2010 were $87,187,779. If true, the RLPs represent over 57% of paid claims during this period.)
[64] *Id*.
[65] *Id.* at 13-14. Many property owners who are actually at risk do not carry flood insurance for various reasons including the cost of premiums, lack of knowledge, or optimism about their exposure to risk and/or the moral hazard created by the NFIP. A moral hazard exists to the extent that federal assistance lowers the incentive to avoid risk. *Id.* at 14-16.
[66] JAMES TITUS, COASTAL SENSITIVITY TO SEA-LEVEL RISE: A FOCUS ON THE MID-ATLANTIC REGION 163-176 (James Titus, ed. 2009). *See also*, SmarterSafer Coalition, http://www.smartersafer.org/ (last visited July 10, 2012).
[67] *See* Craig E. Landry & Mohammad R. Jahan-Parvar, *Flood Insurance Coverage in the Coastal Zone*, 78 J. RISK & INS. 361, 364 (2011). A *charity hazard* exists to the extent that un- and under-insured property owners in high hazard areas rely on federal and state governments to rescue them in the event of a disaster.
[68] GORNITZ ET AL., *supra* note 30, at 28.
[69] *Id*.

- Increasingly serious social, economic and ecological consequences resulting from cost of repair/replacement of critical coastal infrastructure including drinking water, wastewater and transportation systems.

Federal, state, and local governments have ample legal authority to address these climate-related impacts on the coast, especially to the extent that they threaten human security interests. The federal government has several independent bases of Constitutional authority to respond to or act in a precautionary and preemptive manner to protect U.S. citizens and territory from potentially catastrophic results of climate change on the nation's coasts. For instance, the Preamble to the U.S. Constitution establishes the current form of federal government in order to "insure domestic Tranquility, provide for the common defense, promote the general Welfare, and secure the Blessings of Liberty to ourselves and our Posterity."[70]

The Constitution elaborates on this authority in Article I, sec. 8, which assigns Congress broad, though not unlimited and frequently contested, authority "to regulate commerce … among the several States" and "[t]o make all Laws which shall be necessary and proper" to execute its enumerated powers.[71] The Commerce Clause is considered to be the source of the navigational servitude, which assigns to the federal government the exclusive authority to regulate the navigable waters of the United States in the interest of regulating the "channels" of commerce.[72] The federal government's authority over navigability under the Rivers and Harbors Act is understood to include "flood protection, watershed development, recovery of the cost of improvements through utilization of power … [Its] authority is as broad as the needs of commerce."[73] In addition, the Commerce Clause, in combination with the "necessary and proper" clause, is the source of Congress' authority to enact most of the nation's public health-related, environmental laws, such as the federal Clean Water, Safe Drinking Water, Clean Air, and Endangered Species Acts, as well as the Federal Emergency Management Act and the National Flood Insurance Program, which already do and will continue to affect development in coastal and riparian floodplains.

The federal government is actively pursuing a wide range of GHG mitigation and climate change adaptation measures even in the absence of effective federal climate legislation – both because and in spite of recent climate change-related litigation.[74] Some of these measures are likely to affect Connecticut's efforts to address the projected effects of climate change on the State's coastal and

[70] U.S. CONST. pmbl.

[71] U.S. CONST. art. I §8.

[72] Gibbons v. Ogden, 22 U.S. 1 (1824). *See* PPL Montana, LLC v. Montana, 132 S. Ct. 1215 (2012) for clarification of the sources and extent of federal and state claims to navigable waters and submerged lands. The Court takes care to revisit the definition of *navigability*, which "… must be assessed as of the time of statehood, and … concerns the river's usefulness for 'trade and travel,' rather than for other purposes." *Id. at 1233.*

[73] United States v. Appalachian Elec. Power Co., 311 U.S. 377, 426 (1940). Also see PPL Montana, 132 S.Ct. at 1228, 1229, 1233 where the Court cites U.S. v. Appalachian Elec. Power Co. with approval in several instances regarding federal jurisdiction.

[74] *See* Massachusetts v. EPA, 549 U.S. 497 (2007). EPA subsequently issued a finding of "endangerment" under § 202(a) of the Clean Air Act; finalized GHG vehicle emissions standards in collaboration with the National Highway Traffic Safety Administration; and promulgated the *Mandatory Reporting of Greenhouse Gases Rule. See* http://www.epa.gov/climatechange/ (last visited July 10, 2012). *See also* American Electric Power, Co. v. Conn., 131 S.Ct. 2527 (2011); Center for Biological Diversity v. Kempthorne, 607 F.Supp.2d 1078 (D. Ariz. 2009); Comer v. Murphy Oil USA, Inc., 839 F.Supp.2d 849 (S.D. Miss. 2012); Coalition for Responsible Regulation, Inc. v. EPA, 2012 WL 2381955 (D.C. Cir. June 26, 2012), and Native Village of Kivalina v. ExxonMobil Corp., No. 09-17490 (9th Cir. argued 11/28/2011, decision pending) (video of oral argument available at http://www.ca9.uscourts.gov/media/view_video_subpage.php?pk_vid=0000006167).

riparian floodplain. For instance, the White House Council on Environmental Quality currently co-chairs the federal Interagency Climate Change Adaptation Task Force to develop a national strategy on adaptation to climate change and recommend ways in which federal agencies can contribute to adaptation.[75] The Department of Defense is actively engaged in planning related to climate change because of its strategic concerns with respect to national security, its obligations to reduce GHG emissions under various presidential Executive Orders,[76] and its obligations to operate and maintain military installations such as the U.S. Navy, U.S. Army, and Coast Guard facilities in New London, Groton, New Haven, and Milford, Connecticut.[77] In addition, the Department of Homeland Security, which was established by the Homeland Security Act of 2002, now has central responsibility for coordinating the federal response to natural disasters and disaster preparedness,[78] including reducing the nation's vulnerability to climate change-related risk.[79] Similarly, President Obama's Executive Order 13,603 National Defense Resources Preparedness[80] directs federal agencies to identify and be able to mobilize key natural resources, including energy, food, potable water, and water resources, in the interest of national security, and has been construed to assign the federal government broad emergency powers to manage natural resources to protect national security.[81] The federal government has also invested in state and local efforts such as the EPA's Climate-Ready Estuaries and Water Utilities Initiatives[82] to begin to address regional effects of climate change.

The State of Connecticut also has extensive legal authority to protect the public health, safety, welfare, and morals of its citizens using its Tenth Amendment police power jurisdiction, subject to constitutional restraints on state power such as the due process and property clauses of the Fifth

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[75] See Council on Environmental Quality, *Climate Change Adaptation Task Force*, http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation (last visited June 27, 2012).

[76] *See* Exec. Order No. 13,514, 74 Fed. Reg. 52,117 (Oct. 8, 2009); *See* Exec. Order No.13,604, 77 Fed. Reg. 18,885 (Mar. 22, 2012).

[77] *See* TASK FORCE CLIMATE CHANGE / OCEANOGRAPHER OF THE NAVY, U.S. NAVY, CLIMATE CHANGE ROADMAP (2010). (One of the U.S. Navy's mid-term goals is to: "address sea level rise impacts on infrastructure and real estate through strategic investments, develop and implement installation adaptation strategies to address water resource challenges, consider impact of climate change on future missions and force structure…" *Id.* at 8.). *See also* WADE SMITH ET AL., NOBLIS, CLIMATE CHANGE PLANNING FOR MILITARY INSTALLATIONS: FINDINGS AND IMPLICATIONS (2010). Smith et al. present observations about the DoD's "potential" vulnerability to extreme tidal and weather events associated with climate change at various bases with respect to military operations, personnel safety, installations and compliance with federal environmental laws on military bases. *Id.* at 35.

[78] Dep't of Homeland Sec., Preparedness, Response & Recovery, http://www.dhs.gov/files/prepresprecovery.shtm (last visited June 27, 2012).

[79] *Id*. *See also* DEP'T OF HOMELAND SEC., DEPARTMENT OF HOMELAND SECURITY STRATEGIC SUSTAINABILITY PERFORMANCE PLAN 19 (2010) which says in relevant part:

> DHS will take a proactive approach in evaluating climate change risks in the planning, design, construction, and renovation of its facilities. DHS will consider the following strategies for addressing and prioritizing considerations involving climate change risks and vulnerabilities: As part of other facility security, vulnerability, and/or condition assessments, include evaluations related to climate change vulnerabilities; Develop a climate change adaptation plan at the Department and Component level; and Address sea level rise in new and existing facility design and renovations. Possible strategies include elevating existing facilities or building with larger setbacks to accommodate the rise.

[80] Exec. Order No. 13,603, 77 Fed. Reg. 16,651 (Mar. 22, 2012).

[81] *See generally* Jim Garrison, *Martial Law by Executive Order*, HUFFINGTON POST, Mar. 21, 2012.

[82] *See* EPA, Climate Ready Estuaries, http://water.epa.gov/type/oceb/cre/index.cfm (last visited June 28, 2012); and EPA, Climate Ready Water Utilities, http://water.epa.gov/infrastructure/watersecurity/climate/ (last visited June 28, 2012).

Amendment.[83] The Connecticut Coastal Management Act (CMA),[84] in combination with other statutory environmental authority, articulate public and private interests in coastal resources and provide a comprehensive approach for planning, managing, and regulating development in the coastal zone. In addition, the State has broad common law authority to protect its citizens' public trust interests in access to water, lands, and natural resources below mean high water, subject to federal regulatory power over navigation.[85] The public trust doctrine may also protect Connecticut's efforts to use beach nourishment to rebuild the lost shoreline without fear of takings claims by littoral owners.[86]

However, Connecticut's cities and towns retain primary responsibility over land use, pursuant to the Home Rule[87] and Zoning Acts,[88] although local jurisdiction is subject to statutory preemption by the State.[89] While responsibility for land use decisions in coastal and riparian floodplains appears to be clearly distributed, it is increasingly well understood that governance of climate change related impacts on the coastal zone will rely less on hierarchical government regulation than on coordinated and cooperative public-private actions at shoreline, floodplain, and watershed scales.[90] Connecticut's acceptance of delegation to conjointly administer a variety of federal environmental laws[91] and its participation in the Long Island Sound National Estuary Program[92] represent two of many examples of

[83] BLACK'S LAW DICTIONARY 1156 (6th ed. 1990).

[84] CONN. GEN. STAT. §§ 22a-90 – 22a-111.

[85] *See* Conn. Dep't of Energy & Envtl. Prot., The Public Trust Doctrine, http://www.ct.gov/dep/cwp/view.asp?A=2705&Q=323792 (last visited July 1, 2012) ("Connecticut's shore belongs to the people ... The general public may freely use these lands and waters, whether they are beach, rocky shore, or open water, for traditional public trust uses such as fishing, shellfishing, boating, sunbathing, or simply walking along the beach. In Connecticut, a line of state Supreme Court cases dating back to the earliest days of the republic confirm that private ownership ends at mean high water line, and that the state holds title to the lands waterward of mean high water, subject to the private rights of littoral or riparian access.") *See also* PPL Montana, 132 S.Ct. at 1235 where the Court distinguishes federal and State jurisdiction as follows:

> Unlike the equal-footing doctrine, however, which is the constitutional foundation for the navigability rule of riverbed title, the public trust doctrine remains a matter of state law, subject as well to the federal power to regulate vessels and navigation under the Commerce Clause and admiralty power... Under accepted principles of federalism, the States retain residual power to determine the scope of the public trust over waters within their borders, while federal law determines riverbed title under the equal-footing doctrine. (internal citations omitted).

[86] Stop the Beach Renourishment, Inc. v. Fla. Dep't. of Envtl. Prot.,130 S. Ct. 2592 (2010). The unanimous Court distinquished between "avulsion" (sudden and perceptible loss or addition of soil) and "accretion" (gradual and imperceptible) and held that the beach nourishment project undertaken by Florida constituted an *avulsive* event that rebuilt the lost shoreline to the former mean high water mark and therefore did not invade any property rights of littoral property owners.

[87] CONN. GEN. STAT. §§ 7-187 - §7-201.

[88] CONN. GEN. STAT. §§ 8-1 - §8-13a.

[89] *See* State of Connecticut, Office of the Attorney General, Opinion No. 2001-022 (Oct. 15 2001) (In the case of conflict, local ordinances are preempted by State statutes that address the same subject matter and where the State has occupied the field).

[90] Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems,* 100 AM. ECON. REV. 3, 1 (2010); Arun Agrawal & Maria Carmen Lemos, *A Greener Revolution in the Making? Environmental Governance in the 21st Century,* 49 ENV 5, 36 (2007).

[91] *See* TRANSTECH MANAGEMENT, INC., DELEGATION OF FEDERAL ENVIRONMENTAL RESPONSIBILITY FOR HIGHWAY PROJECTS (2002) (as an example of the fact that Connecticut has accepted primacy for implementation and enforcement of the environmental provisions of a variety of federal laws, including but not limited to, the Clean Water Act, Clean Air Act, Coastal Zone Management Act, and the Federal Highway Transportation Act).

[92] *See* CONN. GEN. STAT. §22a-90-91(6) ("*The key to improved public management of Connecticut's coastal area is coordination at all levels of government* and consideration by municipalities of the impact of development on both

Connecticut's recognition of the importance of cooperative efforts to promote responsible, precautionary development and use of the coastal zone. In addition, Connecticut has assigned some key coordinating functions to 15 Regional Planning Organizations (RPOs) that could become increasingly important to State efforts to respond to the effects of climate change on coastal communities.[93] These functions include coordinating federally funded transportation and energy projects that affect multiple cities and towns; acting as an information hub with respect to economic, environmental, and social data; and supporting land use planning.[94]

However, in the absence of a consistent national policy regarding adaption to sea level rise and other climate change related risks, the State of Connecticut has three general choices:

(1) Do nothing, i.e., allow interactions between governments, property owners, insurance carriers, and real estate markets to evolve in the face of environmental change.
(2) Protect existing development in high-risk areas via armoring and/or shoreline engineering where retreat appears practicably infeasible or undesirable for strategic, economic, and/or political reasons.
(3) Provide incentives to encourage retreat and/or prohibit (re-)development in areas at high-risk of storm surge or inundation flooding where retreat is expected to better protect public health, safety, and welfare, and to be more cost effective than armoring and shoreline engineering.

The "no action" or "business as usual" approach should always be considered as the baseline case that protects the status quo. Unsurprisingly, governments are often inclined to pursue "laissez-faire" and "technological response" options in order to protect existing property rights, property markets, and large capital investments in coastal and water dependent uses. At the other extreme, coercive regulatory efforts are seldom popular unless there is compelling expert consensus about and public awareness of the exigency of the risk, and agreement about trade-offs between cost-effectiveness (efficiency) and the distributional (equity) effects of proposed solutions which are sufficient to trigger and support political action.[95] The *Report to the Governor on the Two Storms* and Connecticut's Natural Disaster and Hazard Mitigation Plans suggest that the "business as usual" approach is likely to be an increasingly expensive and non-viable alternative and that the destructive floods of 2010, Tropical Storm Irene, and the winter storms of 2011 may have created a political window to support direct policy and regulatory action.

A. The "No Action" or "Business as Usual" Approach

The New York Sea Level Rise Task Force concluded that many federal- and state-funded actions and programs that allow "property owners to rebuild or replace structures in high-risk environments [act to] protect or subsidize high-risk coastal development by shifting the cost of flood protection and

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coastal resources and future water-dependent development opportunities when preparing plans and regulations and reviewing municipal and private development proposals." (emphasis added)) and Long Island Sound Study, About Us, http://longislandsoundstudy.net/about/about-the-study/ (last visited July 10, 2012).

[93] CONN. GEN. STAT. §16a-4a.

[94] Conn. Assoc. of Reg'l Planning Orgs, The Geographic Scope Of Connecticut's Regional Planning, www.hvceo.org/carpo.php (Adopted May 13, 2010).

[95] *See* Nathaniel O. Keohane, et al., *The Choice of Regulatory Instruments in Environmental Policy*, 22 HARV. ENVTL. L. REV. 313 (1998); Lawrence H. Goulder & Ian W. H. Parry, *Instrument Choice in Environmental Policy*, 2 REV. ENVTL. ECON. & POL'Y 152 (2008).

storm recovery from property owners and local governments to state and federal taxpayers."[96] Such programs and actions include the NFIP, state-permitted shoreline armoring projects, and federal and state post-disaster recovery assistance. Moreover, the Task Force found, "These programs distort market forces and favor coastal development. One unintended effect of programs that support development in coastal floodplains will be increased risk of negative impacts from storm surge and inundation due to sea level rise."[97]

Connecticut, like other coastal states, is dependent on the NFIP and, increasingly since March of 2010, federal disaster assistance to help respond to the economic consequences of destructive natural disasters. The NFIP allows coastal communities to participate in the federally subsidized flood insurance program if they adopt the NFIP Flood Insurance Rate Maps (FIRMs) and agree to adopt and enforce floodplain management ordinances, particularly with respect to new construction.[98] The NFIP then requires federally regulated or insured lenders to require property owners who live in SFHAs in participating communities to purchase federal flood insurance.[99] This requirement appears to be poorly enforced.[100] In addition, low premiums which are intended to encourage participation in the NFIP; direct exemptions for properties built before 1974; failure to include other at-risk properties in the insurance pool; and claims on behalf of repetitive loss properties (RPLs) and properties outside the SFHAs, in combination with claims related to Hurricanes Katrina, Rita and Wilma in 2005 are largely responsible for the NFIP's current $17.8 billion debt.[101] Although supplementary private flood insurance is available,[102] few private insurance companies currently consider climate-related catastrophic risks in issuing policies,[103] and the private insurance and re-insurance industries (which insure the property casualty insurance providers) have been raising premiums, declining to renew policies, and denying coverage for coastal residents across the country.[104]

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[96] THE NEW YORK STATE SEA LEVEL RISE TASK FORCE, REPORT TO THE LEGISLATURE 43 (2010).

[97] *Id*.

[98] FEMA, *The National Flood Insurance Program,* http://www.fema.gov/plan/prevent/floodplain/index.shtm (last visited June 29, 2012).

[99] Tropical Storm Irene Preliminary Damage Assessment, *supra* note 44; Erwann Michel-Kerjan & Howard Kunreuther, *Redesigning Flood Insurance*, 333 SCI. 408 (2011).

[100] Landry & Jahan-Parvar, *supra* note 67, at 373. Lenders may be failing their legal obligation under the NFIP to tell mortgagees that federal flood insurance is required. Only 34% of over 6,000 respondents living in SFHAs in this study held a mortgage, and only 12% of these property owners claim they were told that the were required to carry flood insurance.

[101] *See* King, *supra* note 61, and PROPERTY CASUALTY INSURERS ASSOCIATION OF AMERICA (PCIAA), TRUE-MARKET RISK RATES FOR FLOOD INSURANCE 5 (2011) (The PCIAA notes that "NFIP's rate-setting method is very different from that of private insurers. The NFIP bases its rates on its average annual administrative and cash-flow losses for very broadly defined types of flood zones… The NFIP cannot deny insurance to "repetitive loss properties"… It does not purchase reinsurance, impose a catastrophe load, or build up or maintain a surplus to cover unexpectedly large events. The NFIP also does not seek a rate of return for the capital employed in the program nor does it include a tax provision in its rates. Furthermore, NFIP rates cannot be raised beyond an annual maximum of 10%…We conclude that the federal government is providing overall flood insurance at one-half the true-risk cost; specifically, in higher-risk areas, it is providing flood insurance at one-third the true-risk cost").

[102] *See*, e.g., the Russell Agency, which offers quotes for NFIP flood insurance ($250,000 cap on coverage for the dwelling and $100,000 for the contents), as well as quotes for private coverage (up to $5 million for properties that could be rebuilt for ≤$600,000) and excess flood insurance coverage (unlimited cap) (quote on file with author).

[103] SHARLENE LEURIG, CERES, CLIMATE RISK DISCLOSURE BY INSURERS: EVALUATING INSURER RESPONSES TO THE NAIC CLIMATE DISCLOSURE SURVEY 30 (2011).

[104] Sandra S. Nichols & Carl Bruch, *New Frameworks for Managing Dynamic Coasts: Legal and Policy Tools for Adapting U.S. Coastal Zone Management to Climate Change*, 1 SEA GRANT L. & POL'Y J. 19, 21 (2008).; *See* Leurig, *supra* note 103, at 6 (The author found that only 11 of 88 insurance companies surveyed reported having formal

The NFIP is currently up for re-authorization and has been extended through July 31, 2012[105] as the Senate considers the Flood Insurance Reform and Modernization Act of 2011 (S. 1940). If the bill passes, many problems associated with the NFIP will be corrected in terms of mapping high hazard flood risk areas, requiring more complete participation in the insurance pool, obligating lenders to inform borrowers about mandatory flood insurance coverage, limiting insurance liability for repetitive loss properties, and requiring conformance with elevation and building requirements to enable property owners to stay in place.[106] However, the proposal to significantly reduce the amount of funding available to re-build or condemn repetitive loss properties may actually increase the moral hazard problem to the extent that flood insurance is unavailable or unaffordable, or easily affordable but still perceived to be unnecessary. However, this may also provide an incentive for the State to reconsider flood and storm-related insurance policies in Connecticut, especially since the NFIP was recently found to be offering federal flood insurance at premiums that are one-half to one-third of the "true risk" cost.[107]

B. Protect Existing Development Via Armoring and/or Shoreline Engineering

Connecticut, like all coastal states, has invested in a variety of hard and soft shoreline engineering projects to promote and protect coastal development. The State works closely with the U.S. Army Corps of Engineers (USACE) to maintain port access and navigability as well as to engineer and modify the shoreline to protect and promote water-dependent uses; stabilize riverbanks and the shoreline; and prevent beach erosion.[108] The State also authorizes private property owners to undertake structural solutions to stabilize the shoreline, subject to permit requirements.[109] As a consequence of this approach to developing the coast, Titus et al. found that 80% of the dry land within one meter above mean high water has been developed in Connecticut and is either already protected or likely to be protected using a variety of defensive infrastructure projects.[110] Unsurprisingly, federal, state, and local governments as well as utilities are under pressure to rebuild infrastructure and restore services as swiftly as possible following a natural disaster[111] although these public investments signal to property owners that federal and state taxpayers will continue to insulate coastal development from climate change-related risks in high-risk areas.

However, it is becoming more widely understood and accepted that the "stay in place" option using shoreline armoring and flood-proofed construction that can withstand velocity waves and hurricane wave wash[112] can exacerbate coastal erosion; eliminate public trust access to the shoreline, the beach, and sub-tidal lands; and interfere with natural landward migration of barrier beaches, tidal marshes, and associated vegetation as sea level rises.[113] Connecticut's current policy is "to promote nonstructural

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policies with respect to climate change).

[105] *See* National Flood Insurance Program Extension Act, Pub. L. No. 112-123 (2012).

[106] S. 1940, 112th Congress (2012).

[107] PCIAA, *supra* note 101, at 6. *See also*, King, *supra* note 61.

[108] U.S. ARMY CORPS OF ENGINEERS, UPDATE REPORT FOR CONNECTICUT 1 (2012).

[109] CONN. GEN. STAT. §22a-92(b)(2)(F) and (J).

[110] J.Titus, et. al, *State and Local Governments Plan for Development of Most Land Vulnerable to Rising Sea Level along the U.S. Atlantic Coast*. 4 ENVTL. RES. LETT. 5 (2009).

[111] REPORT OF THE TWO STORM PANEL, *supra* note 47, at 14-16 (The Panel recommends studying "infrastructure hardening" including "undergrounding utilities," strengthening poles, and removal of hazardous trees.)

[112] *See* CONN. AGENCIES REGS. § 25-68h-1(a) (Definitions) and § 25-68h-2 (Floodplain management standards).

[113] James Titus & Michael Craghan, *Shore Protection and Retreat*, *in* COASTAL SENSITIVITY TO SEA-LEVEL RISE: A FOCUS ON THE MID-ATLANTIC REGION 87 (James Titus ed., 2009); JON BOOTHROYD, CONGRESSIONAL CAUCUS BRIEFING: UNDERSTANDING COASTAL GEOLOGIC HAZARDS, SEA LEVEL RISE AND CLIMATE CHANGE IN THE NORTHEASTERN U.S. (2009);

solutions to flood and erosion problems except … where structural alternatives prove unavoidable and necessary to protect existing inhabited structures, infrastructural facilities, or water dependent uses … and where there is no feasible, less environmentally damaging alternative."[114] Along these lines, Connecticut and the USACE have undertaken a variety of projects in recent years to restore ecosystem function by removing dams, jetties, and seawalls.[115] In addition, the President's Council on Environmental Quality (CEQ) issued draft guidance pursuant to the Water Resources Development Act of 2007 that directs all federal agencies that oversee water resources. For example, the USACE is to "maximize net national economic, environmental, and social benefits of water resources management; consider monetary and non-monetary benefits; avoid the unwise use of floodplains; and protect and restore natural ecosystems."[116] Therefore it may make sense for planners to observe the evolution of climate adaptation plans at U.S. Navy and Coast Guard installations in Connecticut to the extent they serve as sentinels of the changing federal and state philosophy regarding floodplain management.

In sum, the "business as usual" and "technological response" options clearly tend to support the status quo. Both distribute the cost of increased exposure to catastrophic losses associated with development of the coastal zone to federal, state and local taxpayers for the benefit of private property owners who receive the benefits at a disproportionately small share of the cost associated with the risks of life near the shore — an archetypal tragedy of the commons[117] that could and should be avoided based on the scientific consensus about climate change, the costs of failing to act, and widely accepted notions of fairness.

C. Compel or Provide Incentives to Encourage Retreat

Coastal development is not in itself a nuisance, especially low-density development that strives to minimize negative externalities and protect natural coastal features such as dunes and tidal wetlands and the broad array of non-market ecosystem services associated with them. However, the earliest pattern of development along the Atlantic coast was to occupy land along rivers and close to the shore in the interests of maintaining access to potable water, fisheries and trans-Atlantic commerce.[118] This development trend has resulted in high population density in Connecticut's coastal and riparian floodplains.[119] Unsurprisingly, few people will willingly abandon desirable and valuable properties in the coastal zone, including the floodplains, as long as it remains affordable to stay and there are no compelling reasons to leave. Ultimately however, the State of Connecticut, its municipal governments, taxpayers, and the business community could reasonably conclude that the ongoing incremental and capital costs associated with pursuing "remain in place" policies for properties located in high flood and erosion hazard areas exceed the value of insured coastal property, which was estimated to represent 62% of the State's insured property or $479 billion in 2007 dollars.[120]

Megan Higgins, *Legal and Policy Impacts of Sea Level Rise to Beaches and Coastal Property*, 1 SEA GRANT L. & POL'Y J. 1, 44 (2008).

[114] CONN. GEN. STAT. §22a-92(b)(2)(F) and (J) (2012).

[115] U.S. ARMY CORPS OF ENGINEERS, SECTION 206 PROGRAM - AQUATIC ECOSYSTEM RESTORATION: MILL RIVER AND MILL POND HABITAT RESTORATION PROJECT, STAMFORD, CONNECTICUT 6 (2004).

[116] Council on Environmental Quality, *Principles & Guidelines* in *Updated Principles and Guidelines for Water and Land Related Resources Implementation Studies,* http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation (last visited June 29, 2012)

[117] Garret Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

[118] *See* WILLIAM CRONON, CHANGES IN THE LAND: INDIANS, COLONISTS, AND THE ECOLOGY OF NEW ENGLAND (1983).

[119] Strauss, et al., *supra* note 48, at 11.

[120] George Bradner, Presentation to Urban Land Institute Boston Conference: Real Estate & Economic Impacts of Sea Level Rise in Connecticut (Jan. 25, 2012) (*See* slides 88-89 of 139, citing AIR Worldwide.)

The State of Connecticut, its municipal and regional governments, quasi-governmental agencies, and private sector partners have many legal legs to stand on to react to the social, economic and environmental consequences of existing patterns of development in the face of sea level rise. For instance, coastal properties which are damaged by sea level rise and associated inundation and wave–related flooding or extreme climate and weather events may well result in or contribute to failed and exposed septic systems, construction debris, biological and chemical contamination, and physical damage to other public and private properties and infrastructure. These types of externalities may violate federal, state or local laws and cause sufficient harm to public health, safety, and the environment to trigger a regulatory response.

Flood and erosion damage to the built environment can also result in common law public nuisance claims to the extent it results in "unreasonable interference with a right common to the general public"[121] or "violates public rights and produces a common injury."[122] In addition, development in coastal and riparian floodplains that physically interferes with the State's proprietary interests in public uses of the shore below mean high water,[123] or which harms the citizens' "public trust in the air, water and other natural resources of the state of Connecticut" [124] exposes the developer/property owner to whatever legal remedies the Commissioner of the Connecticut Department of Energy and Environmental Protection (CT DEEP) and the Attorney General have at their disposal to protect the State's proprietary and public trust interests in the environment, natural resources, and functioning ecosystems.[125]

The State and its subsidiary governments, however, can also act preemptively and in a precautionary manner to try to anticipate and reduce some of the social, economic, and environmental consequences associated with global warming and climate change while they are still on the horizon. At one extreme, governments and many quasi-public agencies have some constrained authority to purchase or condemn private property in order to accomplish legitimate public purposes [126] (e.g., to build sidewalks or retire Repetitive Loss Properties (RLPs)). At the other extreme, governments can and often do rely on low cost information-based strategies such as public education, public opinion surveys and imploring the public to "do the right thing" (e.g., "Please protect dune vegetation"). Other relevant examples of information-based strategies include requiring property owners to disclose known flooding and erosion risks at the point of sale, and recording flood and flood insurance information in the Land Evidence Records. Governments can also exercise their statutory authority to regulate private use of private property and/or use market-based techniques to signal the state's preferences regarding private behaviors that affect public interests in coastal and riparian floodplains.

Table 1 (below) presents a range of strategies available to Connecticut based on its authority and duty to protect public health, safety, and welfare, including the environment. The strategies shown in Table 1 are organized along a spectrum that suggests when a command and control, market-based, or

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[121] Restatement (Second) Of Torts § 821B(1) (1979).

[122] *See* Richard Faulk, *Public Nuisance: Defining the Tort*, NUISANCELAW.COM, June 29, 2012, citing Ganim v. Smith and Wesson Corp., 780 A.2d 98 (Conn. 2001) ("Thus, water pollution that affects only a few (e.g., fifty or a hundred lower riparian owners) people of their ability to use the water [does] not necessarily become a public nuisance. If the pollution, however, prevents the use of a public beach or causes a large fish kill such that an entire community is affected, it becomes a public nuisance.").

[123] *See* Joseph L. Sax, *Some Unorthodox Thoughts About Rising Sea Levels, Beach Erosion, And Property Rights*, 11 VT. J. ENVTL. L. 641, 643 (2010).

[124] CONN. GEN. STAT. §22a-15 (Declaration of policy).

[125] *Id*. at §§ 22a-6a; 22a-6e; 22a-6b; 22a-16; 22a-18; 22a-19 (Remedies); and 22a-17 (Defenses).

[126] Kelo v. City of New London, 545 U.S. 469, 481 (2005). (The State's authority to *condemn* or "take private property for public use with just compensation" derives from Article I, §11 of the Connecticut Constitution and the 5th Amendment of the U.S. Constitution as applied to the states by the 14th Amendment.)

information-based strategy might be chosen based on perception of risk and competing concerns about exigency, equity, and efficiency. Market-based strategies that allow participants to make individual decisions and trade on their competitive advantages are generally considered to be more efficient than regulatory strategies such as mandatory setbacks and mandatory insurance,[127] which treat all similarly situated regulated property owners the same way (equity). In principle, however, governments will tend to prefer command and control strategies when there is scientific certainty and political consensus about the cause, consequences and urgency of the problem and/or there is an accepted solution that can apply to everyone in the same situation at an acceptable level of administrative effort and cost.[128] Conversely, governments will tend to prefer low cost, information-and market-based strategies that allow individuals to make (informed) choices if the risk is not considered to be urgent, or there is scientific uncertainty and/or lack of political will, or the solutions are unknown and require flexibility and innovation.[129]

Table 1: Examples of (Non) Governmental Options to Motivate Retreat from the Shore.

Equity **Efficiency**

Exigency and Perception of risk

More ←----------→ **Less**

	COMMAND + CONTROL	MARKET: BUY +MAKE	MARKET: TAXES + SUBSIDIES	INFORMATION	
ACQUIRE RLPs and AT-RISK PROPERTY VIA EMINENT DOMAIN	LIMIT ABILITY TO REBUILD AFTER >50% LOSS and LIMIT EXPANSION OF EXISTING AND NEW DEVPT (DOWNZONE, LOT MERGER)	ACQUIRE AND PROTECT BUFFERS VIA PDRs AND EASEMENTS and INCENTIVIZE RELOCATION VIA TDRS	MANDATE MULTI-YEAR RISK- and MARKET-BASED INSURANCE PREMIUMS or PROHIBIT ACCESS TO STATE – SUPPORTED INSURANCE POOL	REQUIRE DISCLOSURE OF FLOOD, INUNDATION AND STORM DAMAGE HISTORY BY SELLERS, REALTORS, BANKS	CLIMATE EDUCATION; LABEL EVACUATION ROUTES
	REQUIRE AND ENFORCE SETBACKS AND BUFFERS *(EROSION CONTROL* AND *ROLLING EASEMENTS)*	LIMIT STATE RESPONSIBILITY FOR REBUILDING PUBLIC INFRA-STRUCTURE AFTER REPETITIVE LOSS	ADOPT RISK-BASED SPECIAL TAX ASSESSMENTS THAT RUN WITH THE LAND and/or OFFER TAX REBATES TO REWARD EROSION CONTROL EASEMENTS	REQUIRE *FIRM* DESIGNATION TO BE RECORDED IN LAND EVIDENCE RECORDS	
	DESIGNATE AND ENFORCE *UNBUILDABLE AREAS*	'HARD' AND 'SOFT' ARMORING; ENGINEER THE SHORELINE	CHARGE FOR "GIVINGS" THAT ALLOW CONTINUED OCCUPATION OF HIGH HAZARD AREAS		

[127] ROBERT N. STAVINS, RESOURCES FOR THE FUTURE, MARKET-BASED ENVIRONMENTAL POLICIES: WHAT CAN WE LEARN FROM U.S. EXPERIENCE (AND RELATED RESEARCH)? 4 (2003); NATIONAL CENTER FOR ENVIRONMENTAL ECONOMICS, U.S. ENVIRONMENTAL PROTECTION AGENCY, THE UNITED STATES' EXPERIENCE WITH ECONOMIC INCENTIVES FOR PROTECTING THE ENVIRONMENT 69 (2001).

[128] *Id.* at 2.

[129] *Id.* at 2-3.

IV. The Legal Implications of Managed Retreat

Coastal states and local governments are likely to be increasingly inclined to encourage retreat from coastal and riparian floodplains—especially in undefended cities and towns, if the projected consequences of global warming and climate change continue to materialize over the next ten to forty years (2020-2050). Therefore the goal of this section is to consider the extent to which the State and local governments are likely to be vulnerable to successful legal claims brought by private property owners pursuant to the Fifth Amendment of the U.S. Constitution and Article I, sec. 11 of the Connecticut Constitution if they choose to pursue increasingly extreme measures to relocate people and public infrastructure out of high flood and erosion hazard areas.

This section presents a user-friendly Fifth Amendment "takings" test based on current Supreme Court jurisprudence (Figure 2) in order to gauge the government's exposure to legal liability for (A) Acquiring or "taking" private property via eminent domain to retire the riskiest properties and establish buffers and easements to protect existing uses of the coastal zone; (B) Regulating development or prohibiting re-development in high flood and erosion hazard areas even if it results in "diminution of value," "loss of investment-backed expectations," or even "loss of all economically beneficial use;" and/or (C) Motivating responsible development and retreat using information- and market-based strategies.

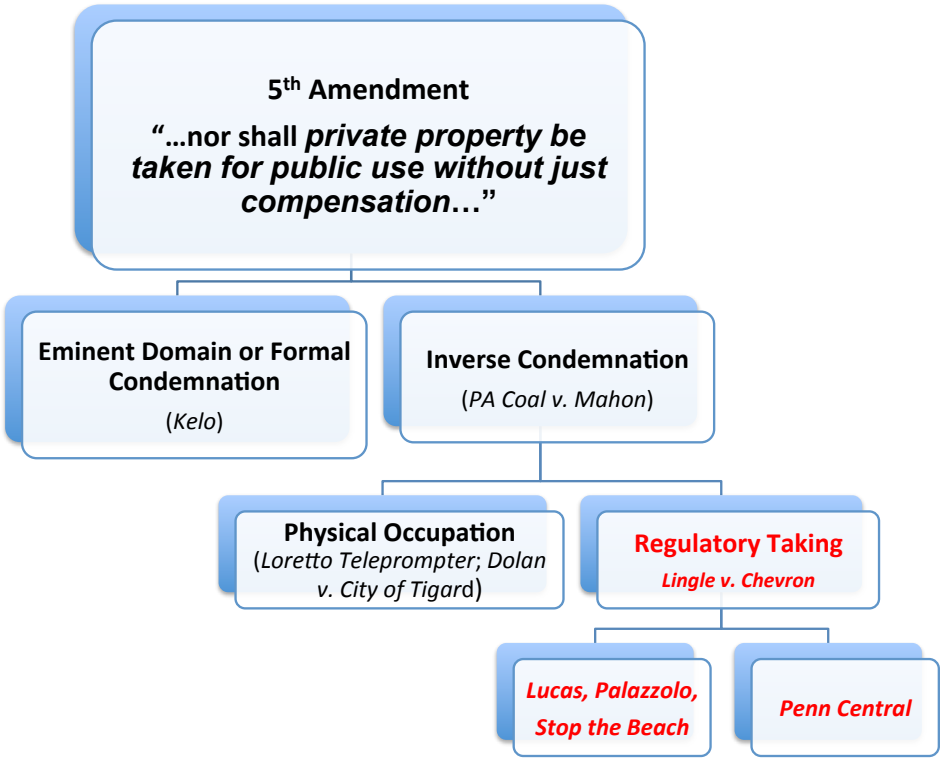

Fig. 2: Diagram of Fifth Amendment Takings Analysis.

A. *"Taking" Private Property by Eminent Domain*

The first question, *Can State and local governments "take" or condemn at-risk private property in*

areas that are currently at high risk of storm surge, inundation, or storm-related damage or that are expected to be at increased risk of climate change-related impacts in the future?, is relatively non-controversial and easy to answer following the U.S. Supreme Court decision in *Kelo v. City of New London*.[130] The Fifth Amendment of the U.S. Constitution, which states "... nor shall private property be taken for public use without just compensation," and Article I, sec. 11 of Connecticut's Constitution[131] plainly authorizes the State to condemn or take private property for a "legitimate public purpose," as long as just compensation is paid. In addition, the Court will ordinarily defer to the government's assessment of whether there is a legitimate public purpose, even if it does not like the transaction—as in *Kelo*, where the New London Development Corporation seized Suzette Kelo's property by eminent domain as part of a very public planning process intended to revitalize the City's waterfront.[132]

It is also important to note that FEMA's Flood Mitigation Assistance program explicitly recognizes condemnation as a legitimate measure to "reduce or eliminate the long-term risk of flood damage to ... structures insured under the National Flood Insurance Program."[133] Thus, these condemnation proceedings are extremely unlikely to trigger successful Fifth Amendment due process or takings challenges by property owners such as Suzette Kelo who do not wish to sell, especially where the State or local government is able to document a history of repetitive loss, or that the property poses an elevated level of risk to life, property, or protected resources because of its location in high flood and erosion hazard areas.[134]

However, condemnation of private property is an extremely expensive and inefficient mechanism to use to protect the State's coastal population, infrastructure, and ecosystems. An estimated 12,000 housing units currently lie less than one meter above local sea level, and at least 32,000 properties are located in the State's 100-year floodplain.[135] Therefore, public funds should be used strategically and opportunistically to work with willing buyers to acquire undeveloped land, distressed properties that are subject to foreclosure, and/or partial estates in land such as development rights and conservation easements. These acquisitions can serve as buffers to protect inland properties and allow natural coastal features, such as barrier beaches, dunes, and tidal wetlands, room to migrate landward.[136]

Since the State can almost certainly condemn and take title to private property to protect public health and safety, a related question is whether the State can compel property owners to sell their

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[130] 545 U.S. 469, 481 (2005).

[131] Conn. Const. Art. I §11.

[132] *See Kelo*, 545 U.S. at 481 (citing Justice Douglas in Berman v. Parker, 348 U.S. 26 (1954) with approval regarding deference to legislative assertions of public purpose:

> We do not sit to determine whether a particular housing project is or is not desirable. The concept of the public welfare is broad and inclusive... The values it represents are spiritual as well as physical, aesthetic as well as monetary. It is within the power of the legislature to determine that the community should be beautiful as well as healthy, spacious as well as clean, well-balanced as well as carefully patrolled. In the present case, the Congress and its authorized agencies have made determinations that take into account a wide variety of values. It is not for us to reappraise them. If those who govern the District of Columbia decide that the Nation's Capital should be beautiful as well as sanitary, there is nothing in the Fifth Amendment that stands in the way.

[133] FEMA, Flood Mitigation Assistance Program, http://www.fema.gov/government/grant/fma/index.shtm (last visited May 2, 2012).

[134] *See, e.g.,* Conn. Dept. of Energy & Envtl. Prot., Coastal Hazards Mapping Tool, http://www.ct.gov/dep/cwp/view.asp?a=2705&q=480782&depNav_GID=2022 (last visited May 2, 2012).

[135] Strauss, et al., *supra* note 21 at 1.

[136] *See* James Titus, *Greenhouse Effect and Coastal Wetland Policy: How Americans Could Abandon an Area the Size of Massachusetts at Minimum Cost,* 15 ENVTL. MGMT. 1, 12 (1991) for strategic approaches to acquiring title in coastal land.

property to the State with the option of leasing it back until the property is declared uninhabitable due to catastrophic damage or changes in the shoreline.[137] This transaction, which has been used in Maine, can help offset the cost of condemnation and seems very likely to be invulnerable to Fifth Amendment claims to the extent the government takes the property for "a legitimate public purpose" and pays "just compensation."[138] In addition, the State and local governments can accept or purchase development rights (PDRs) and conservation, rolling, and/or erosion easements[139] from willing sellers in order to buffer and protect critical coastal habitats and water-dependent uses of the shore. Local governments can promote the use of easements via "land use taxes" or tax exemptions that offer property owners a discounted property tax rate to maintain large tracts of open space and undeveloped land as buffers in high hazard areas, or to allow public access rights to "roll" landward as long as the land is kept in the designated use and serves an identified public purpose.[140]

B. Regulating Development in High Flood and Erosion Hazard Areas in the Coastal Zone

The second question, *Can state governments (or subordinate governments with delegated authority) regulate or prohibit development of property in high flood and erosion hazard areas even if the regulation results in (1) diminution of value, (2) loss of investment-backed expectations, or (3) even loss of all economically beneficial use?,* is more difficult to explain. Briefly, the answer is "yes" to all three questions for reasons articulated below.

Realistically, very few property owners will abandon desirable and valuable properties, even if they are located in high flood and erosion hazard areas, unless or until motivated or obligated to do so. However, the financial consequences of natural disasters for Connecticut are quite serious: the State's estimated insured losses between 2000 and 2009 exceeded $422 million,[141] whereas the State's insured losses for four storms in 2011 was over $594.5 million according to the State's Insurance Commissioner.[142] The Commissioner also cited a report estimating that the State's *insured losses* might be in the vicinity of $4 billion in the event of a Category 3/4 storm hitting New Jersey-New York, southern Connecticut, and Long Island, and that uninsured economic losses in the region might be over $90 billion.[143] As a result, state and local officials might well feel obliged to consider more strictly regulating existing development and/or preventing future development that might be susceptible to repetitive losses in the aftermath of destructive floods. However, government efforts to regulate private use of private property to protect the environment and public interests in natural resources have

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[137] Lisa St. Amand, *Sea Level Rise and Coastal Wetlands: Opportunities for a Peaceful Migration*, 19 BOS. COLL. ENVTL. AFFAIRS L. REV. 1, 3 (1991).

[138] BARBARA VESTAL ET AL., U.S. ENVTL. PROT. AGENCY, ANTICIPATORY PLANNING FOR SEA-LEVEL RISE ALONG THE COAST OF MAINE 5-3 (1995).

[139] *See* Conn. Dep't of Agric., *Farmland Preservation Program*, www.ct.gov/doag/ (last visited June 29, 2012) for a description of PDRs and (agricultural) conservation easements.

[140] *See* Conn. Office of Pol'y and Mgmt. (OPM), *Statutes Governing Property Assessment and Taxation*, http://www.ct.gov/opm/cwp/view.asp?a=2985&q=383128 (last visited June 29, 2012). (OPM issues guidelines for property tax exemptions and prescribes the process for obtaining maritime heritage land classification.

[141] ISO Property Claim Services, *The Financial Effects of Natural Disasters*, http://www.iso.com/insurance/natural-disasters/ (last visited June 29, 2012).

[142] *See* Bradner, *supra* note 120. (Slide 87/139 citing ISO-PCS). The Commissioner indicated that the $594.5 million figure did not include $8.6 million paid by the NFIP for Tropical Storm Irene-related losses. *Id.*

[143] *Id*. (Slide 90/139 citing AIR Worldwide.)

been increasingly subject to Fifth Amendment "regulatory takings" challenges[144] since the 1970s. These challenges, which are "fundamentally conflicts over legal transitions,"[145] have often had a "chilling effect" on government efforts intended to guide the location, type, and intensity of land use and development.

Therefore the basic underlying question is, to what extent can governments regulate private uses of private property that cause harm to public health, safety or welfare? Several U.S. Supreme Court cases frame the drift of the Court's thoughts about Fifth Amendment "regulatory takings" claims with respect to land use regulation. First and foremost, a long line of cases beginning with *Mugler v. Kansas* in 1887 has held that "all property in this country is held under the implied obligation that the owner's use of it shall not be injurious to the community."[146] The public nuisance limit on private use of private property is absolute – governments may continue to enact and enforce laws that prohibit injurious uses of private property, even if those laws reduce the value of the property.[147] Similarly, the Court has upheld municipal zoning as a legitimate exercise of police power since *Euclid v. Ambler,* even if it reduces the value of private property.[148] Justice Holmes, writing for the majority in *Pennsylvania Coal v. Mahon* (1922), agreed that, "[g]overnment hardly could go on if to some extent values incident to property could not be diminished without paying for every such change in the general law. As long recognized, some values are enjoyed under an implied limitation and must yield to the police power."[149] However, Justice Holmes went on to say,

> But obviously the implied limitation must have its limits or the contract and due process clauses are gone. One fact for consideration in determining such limits is the extent of the diminution… The general rule … is that *while property may be regulated to a certain extent, if regulation goes too far it will be recognized as a taking*.[150]

The Supreme Court has returned to the question of what constitutes a *regulatory taking* of private property many times since Congress passed the first wave of environmental laws in the early 1970s. Therefore, a step-wise articulation of the current Fifth Amendment regulatory takings test based on U.S. Supreme Court decisions as of spring 2012 is presented below and applied to the command and control, market-based, and information-based strategies described in Part III and Table 1.

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[144] The "regulatory takings" concept refers to a claim by a property owner that a government regulation denies her "all economically beneficial use" of her property thereby effectively taking her property for public use and entitling her to "just compensation" pursuant to the 5th Amendment of the U.S. Constitution.

[145] Holly Doremus, *Takings and Transitions*, 19 J. LAND USE 1, 3 (2003). ("Regulatory takings claims are fundamentally conflicts over legal transitions. They arise when the rules change, those changes are costly (in economic or other terms), and the people bearing the costs believe that they are being unfairly singled out. The problem is not the content of the new rules in the abstract, but simply that the rules are different than they once were.")

[146] Mugler v. Kansas, 123 U.S. 623 (1887). *See also Lucas,* 505 U.S. at 1027-29.

[147] *Lucas,* 505 U.S. at 1029-30. Justice Scalia, writing for the majority, explicitly overruled the "benefit-harm" test and held that "prevention of a harmful and noxious use" cannot insulate the government from compensating a property owner who has lost "all economically beneficial use" of her property UNLESS the state can show that "there are limitations inherent in [the property owner's] title" or that "background principles of the State's law of property and nuisance already place [restrictions] upon land ownership."

[148] Village of Euclid, Ohio v. Ambler Realty Co., 272 U.S. 365 (1926). (Note that Lingle v. Chevron USA, Inc., 125 S. Ct. 2074 (2005) explicitly repeals the *Nectow v. City of Cambridge* and *Agins v. City of Tiburon* decisions to the extent that they require the Court to consider whether a zoning ordinance "*substantially advances legitimate state interests*" as part of the 5th Amendment takings test.)

[149] Pennsylvania Coal v. Mahon, 260 U.S. 393, 413-15 (1922).

[150] *Id*. (emphasis added)

Regulatory Takings* Test Post-*Palazzolo

I. Did a regulatory action result in physical invasion, seizure, or limitation on "right of exclusive possession"? If so, the government action is COMPENSABLE.

II. Did a regulatory action deprive the property owner of "all economically beneficial use" of her property "as a whole"? If so, the government action results in a COMPENSABLE *per se* or *categorical* taking unless:

a. The government successfully argues that the regulated activity would have been considered a public nuisance under accepted principles of property and nuisance law, or

b. The property owner had no expectation of Fifth Amendment protection because of limitations inherent in the title at the time title was acquired EXCEPT "future generations, too, have a right to challenge unreasonable limitations on the use and value of land."

III. Even if the property owner did not lose all the economic value of her property, did the government action interfere with "a reasonable investment-back expectation" to develop the property? The government's action might result in a COMPENSABLE taking depending on an "ad hoc factual inquiry."

The first branch of the regulatory takings test is "Did a governmental action result in physical occupation, seizure, or limitation on the property owner's right of exclusive possession?"[151] The clear answer is that any government action that results in seizure; physical occupation, no matter how small; or limitation on the property owner's "right of exclusive possession" is compensable under both federal and state Constitutions.[152] For instance, state or local government conditions on a property owner's right to develop, such as requiring the property owner to maintain the public's visual access along the shore between the owner's sea wall and the mean high water line[153] or providing a public greenway and bike path across private property,[154] are compensable if they result in allowing unprivileged public access to private property.

However, conflicts are increasingly likely to occur between owners of littoral estates and members

[151] *See Lucas*, 505 U.S. 1003 and Lingle v. Chevron, 125 S. Ct. 2074 (2005) for clear presentations of the *regulatory takings* test. *Lucas* and *Lingle* take great pains to clarify the difference between the substantive due process arguments regarding the legitimacy of the government's police power authority that influenced *Mugler*, 123 U.S. 623 (1887) through *Euclid* and *Agins v. the City of Tiburon*, and the post-*Lucas* emphasis on "loss of all economically beneficial use", in combination with *Penn Central's* ad hoc analysis. *See* Robert Dreher, *Lingle's Legacy: Untangling Substantive Due Process from Takings Doctrine,* 30 HARV. L. REV. 371 (2007) for a more thorough discussion of the significance of *Lingle*.

[152] *See Kelo*, 545 U.S. 469 (2005); Loretto v. Teleprompter Manhattan CATV Corp., 458 U.S. 419 (1982); Nollan v. California Coastal Commission, 483 U.S. 825 (1987); Dolan v. City of Tigard, 512 U.S. 374 (1994).

[153] *Nollan*, 483 U.S. 825 (1987).

[154] Dolan v. City of Tigard, 512 U.S. 374 (1994). (Note that the Court acknowledged that the City of Tigard could have required Dolan to establish and maintain a greenway within the 100-year floodplain of the creek in order to reduce runoff that would contribute to flooding, but did not understand the City's argument for the dimensions of the greenway or why the greenway should be public as opposed to private.)

of the public who assert their protected public trust interests in commercial or recreational use of the shore as sea level rises and beaches erode. Therefore it is extremely important to understand the boundary between public and private lands in the coastal zone.[155] At common law, littoral property owners whose property abuts the sea "have the right to access and use the water, the right to an unobstructed view of the water, and the right to receive incremental accretions to the littoral property."[156] However, these littoral (and riparian) property rights are bounded by the state's permanent "ownership" of the submerged lands and the shore below mean high (or low water) in trust for the public.[157] Therefore, the property owner's common law claim to accreted land above mean high water and objections to public passage along newly created wet beach are extinguished if the submerged lands are exposed by sudden, avulsive events such as storm-related erosion[158] or filled by beach nourishment projects.[159] In dicta, the *Stop the Beach Renourishment* Court reaffirmed earlier decisions holding that States effect a taking if they "use their property in such a way that it destroys private property, or re-characterize as public property what was previously private property" but it did not find that Florida's beach nourishment program offended either principle.[160]

The Texas Supreme Court recently addressed a related question: "Can the State enforce removal of a house left stranded on the beach after an avulsive event such as Hurricane Rita if the house interferes with public use of the 'wet beach' between mean low and high water, or the 'new' dry sand beach?"[161] The Court held that "the State's [public trust] right to submerged land, including the wet beach, is firmly established, regardless of the water's incursion onto previously dry land"[162] and that,

> "a person purchasing beachfront property in Texas does so with the risk that her property may eventually, or suddenly, recede into the ocean. When beachfront property recedes seaward and becomes part of the wet beach or submerged under the ocean, the property owner loses that property to the public trust… Regardless of these changes, the boundary

[155] *See* Sax, *supra* note 123, at 643.

[156] *Stop the Beach Renourishment*, 130 S. Ct. at 2598 citing 1 H. Farnham, Law of Waters and Water Rights §62, pp. 278– 280 (1904). (Note that "the precise property rights [of littoral and riparian property owners relative to the public's interests in the public trust lands] vary among jurisdictions" since state law defines property interests in navigable waters and submerged lands. *Id*.). As stated by the DEEP, "[t]he adjacent landowner has the exclusive riparian or littoral right of access to navigable water. This does not mean that the owner can exclude others from the adjacent waters, but that only the owner may get to the water from his or her upland, as by constructing a dock or other structures where appropriate and appropriately authorized. In terms of access, navigable waters are equivalent to a public road, and a dock serves the same purpose as a private driveway. A littoral landowner may not exclude the public from lawful uses of the public trust area, just as an upland owner cannot exclude the public from driving or walking on the street in front of his or her house." Conn. Dep't of Energy & Envtl. Prot., *The Public Trust*, http://www.ct.gov/dep/cwp/view.asp?a=2705&q=323792&depNav_GID=1635 (last visited July 1, 2012).

[157] *See* DEEP, *supra* note 156. ("The public trust area comprises submerged lands and waters waterward of the mean high water line in tidal coastal, or navigable waters of the state of Connecticut… In general, if an area is regularly wet by the tides, [it is] probably safe to assume that it is in the public trust. The public trust area … is defined as "public beach" by the Connecticut Coastal Management Act, C.G.S. 22a-93(6).")

[158] *Stop the Beach Renourishment,* 130 S. Ct. at 2611.

[159] *Id. See also* City of Long Branch v. Jui Yung Liu, 4 A.3d 542 (2010) where the New Jersey Supreme Court held that a government-funded beach nourishment program that expanded the beach by adding sand below mean high water did not create a compensable claim for the littoral owner.

[160] *Stop the Beach Renourishment,* 130 S. Ct. 2592 (The Court held that the beach renourishment project was conducted in conformance with the state's Beach and Shore Preservation Act and established a permanent "erosion control line" which thereby eliminated the littoral property owners' future claims to accretion.).

[161] Severance v. Patterson, 2012 WL 1059341 (Tex. Mar. 30, 2012).

[162] *Id*. at *2.

remains fixed (relatively) at the mean high tide line.[163]

This plain statement of the public trust doctrine almost certainly applies in Connecticut as well based on the DEEP's articulation of the public trust doctrine.[164] As a result, the *Stop the Beach Renourishment*, *PPL Montana, City of Long Branch,* and *Severance* decisions tend to substantiate Connecticut's authority to undertake beach nourishment below the mean high water mark and to prevent rebuilding or flood-proofing private structures on the "wet beach." Arguably, the public trust doctrine could also be used to prevent proposed development in high flood or erosion hazard areas exposed to avulsive events (e.g., FIRM V-zones) that impinge on public trust interests in the "wet beach" and submerged lands.

It is important to note, however, that the Texas Supreme Court also held that the State's public trust interest in access along the shore cannot "roll" landward to follow the new vegetation line onto a newly formed dry sand beach in the absence of an express easement or history of public use "over time immemorial" that allows passage across the privately owned littoral estate above mean high water.[165] This interpretation of the public trust doctrine in Texas accords with Connecticut's description of the boundary between littoral and public trust rights on the shore. If so, Connecticut cannot use the public trust doctrine to allow public passage along private property landward of the mean high water line, and may not be able to rely on it to prohibit re-building or flood-proofing if the house is located on the dry beach although the State has other common law and statutory bases of authority to prohibit re-building in this instance.

If the answer to the first question is "no", the government's regulatory action has not resulted in occupation or seizure of private property, the next question is whether the regulatory action deprived the property owner of "all economically beneficial use" of her property. Government actions that deprive the property owner of "all or 99.9% of the economically beneficial use of the property"[166] constitute compensable *categorical* or *per se* takings unless the government successfully proves that:

- The property owner retains some "economically beneficial use;"[167]
- The regulated activity would have been considered a public nuisance under accepted

[163] *Id*. at *8.
[164] *See* DEEP, *supra* note 156. *See also* Titus & Craghan, *supra* note 113, at 6.
[165] *Severance*, 2012 WL 1059341 at *14 (The Court said, "a public beachfront easement in West Beach, although dynamic, does not roll under Texas law. The public loses that interest in privately owned dry beach when the land to which it is attached becomes submerged underwater.")
[166] *See* Lucas, 505 U.S. at 1019 (n 8) and 1028.
[167] *Id*. *See also* Palazzolo v. Rhode Island, 533 U.S. 606 (2001) (property owner retained upland portion of property worth $200,000); Hall v. Board of Environmental Protection, 528 A.2d 453, 455 (Me. 1987) (Maine Supreme Court held that just compensation was not required when the Maine Board of Environmental Protection denied a property owner a residential construction permit because the property owner had maintained a camper connected to utilities during the summer and could still sell or lease his land).

background principles of common law;[168] or

- The property owner had no expectation of Fifth Amendment protection because of legitimate limits in her title at the time title was acquired,[169] although "[f]uture generations, too, have a right to challenge unreasonable limitations on the use and value of land."[170]

Before applying this branch of the regulatory takings test to a variety of strategies that State and local planners might consider to motivate property owners to retreat from the shore, it is important to note that *per se*, categorical takings or total economic *wipe-outs* related to regulation are rare. Therefore, if the answer to the second question is that the property owner has not lost "all economically beneficial use" of her property, the *Penn Central* test applies. In *Penn Central*, the U.S. Supreme Court described a three-pronged *ad hoc* factual inquiry to determine whether the governmental action is compensable, which requires examining: (1) the reasonableness of the buyer's/developer's investment-backed expectation; (2) the nature or character of the governmental action; and (3) the economic impact of the regulation.[171]

The *Penn Central* test is difficult for a plaintiff/claimant to satisfy. For instance, Penn Central Transportation Corp. was unable to persuade the Supreme Court that it had a "reasonable investment-backed expectation" in being able to gut and re-develop Grand Central Station since the historic shell provided Penn Central with the functional elements of a rail station.[172] In *Palazzolo*, Justice Kennedy noted that the plaintiff's "claim is not barred by the mere fact that title was acquired after the effective date of the state-imposed restriction."[173] However, Justice O'Connor, joined by the four dissenters, noted that the claimant's knowledge of the regulatory regime in place at the time that he acquired title and "the nature and extent of permitted development ... may also shape the reasonableness of the claimant's investment-backed expectations ... [for] if existing regulations do nothing to inform the analysis, then some property owners may reap windfalls and an important indicium of fairness is lost."[174] The case was remanded to the Rhode Island Superior Court[175] where the State repeated its arguments that Rhode Island's public trust doctrine and wetlands laws were well established by the time that Anthony Palazzolo acquired title to the property in 1978, and that he retained significant

[168] *See Pennsylvania Coal*, 260 U.S. at 417 (from the dissent by Justice Brandeis: "The right of the owner to use his land is not absolute. He may not so use it as to create a public nuisance...Every restriction upon the use of property imposed in the exercise of the police power deprives the owner of some right theretofore enjoyed, and is, in that sense, an abridgment by the state of rights in property without making compensation. But restriction imposed to protect the public health, safety, or morals from dangers threatened is not a taking. The restriction here in question is merely the prohibition of a noxious use. The property so restricted remains in the possession of its owner. The state does not appropriate it or make any use of it. The state merely prevents the owner from making a use which interferes with paramount rights of the public."). *See* Milardo v. Coastal Resources Management Council, 434 A.2d 266, 269 (R.I. 1981) (state denial of ISDS permit was held not to be a taking); and Palazzolo v. State ex rel. Tavares, 785 A.2d 561 (R.I. 2001) (recognizing that [under Rhode Island Gen. Laws Ch. 118, §10 (1896)] "any ... unauthorized encroachment upon the public tide waters was "deemed to be a public nuisance")

[169] *See Lucas*, 505 U.S. at 1028 where Justice Scalia cites *Pennsylvania Coal,* 260 U.S. at 413 with approval for the proposition that "the property owner necessarily expects the uses of his property to be restricted, from time to time, by various measures newly enacted by the State in legitimate exercise of its police powers; "[a]s long recognized, some values are enjoyed under an implied limitation, and must yield to the police power."

[170] *See Palazzolo,* 533 U.S. 606.

[171] *Id*.

[172] *Id*.

[173] *Id*.

[174] *Id*. at 635 (O'Connor, J., concurring).

[175] *Palazzolo*, 785 A.2d at 561.

options to develop the upland portion of the property that he had not acted upon.[176] As one influential law professor said, "after the *Palazzolo* and *Lake Tahoe* decisions, we are left with the clear statement that in the most extreme cases (permanent physical occupation and newly-declared rules denying all economic use) compensation is automatically required, but the vast majority of the cases must be evaluated individually to see if the burdens of regulation are fairly distributed."[177] In sum, the *ad hoc Penn Central* inquiry is important though it has not been very useful to plaintiffs in recent regulatory takings cases since they have not often been able to prove that they suffered an "unfair" economic injury related to their investment.[178]

Returning to second question, *Did the regulatory action deprive the property owner of "all economically beneficial use" of her property?*, the most extreme and contentious regulatory options that federal, state, or local governments could pursue to compel retreat from the shore would arguably be to prohibit rebuilding seriously damaged coastal properties on the same footprint, or to prohibit new development in flood- or erosion-prone areas. These issues are discussed separately. However, both strategies can be shown to be insulated from Fifth Amendment regulatory takings challenges based on the exceptions presented above.

As a preliminary matter, regulatory actions seldom result in "loss of all of economically beneficial use" – defined by Justice Scalia in *Lucas v. South Carolina Coastal Council* as 99.9% of the value of the property.[179] This is true even when a statute is properly applied to prohibit development of coastal property to protect public trust interests in critical natural resources such as tidal wetlands and dunes;[180] in part, because the Supreme Court has held that property cannot be segmented for the purpose of a takings analysis.[181] Furthermore, the Courts may determine that remaining uses of the property, such as the ability to use the land for fishing and swimming, constitute economically beneficial uses that still inhere in the property.[182] For example, in *Hall v. Board of Environmental Protection*, the fact that a property could sustain a camper connected to public utilities was enough for the Maine Supreme Court to determine that the owners had not been deprived of all economically beneficial use.[183]

In addition, FEMA's "50% rule"[184] obligates FEMA-compliant states and municipalities to require owners of "substantially damaged" property[185] to rebuild to meet flood protection requirements. It is

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[176] *Id*.

[177] Doremus, *supra* note 145, at 11.

[178] *See* Lingle v. Chevron, 125 S. Ct. 2074 (2005). The Court states that the *takings* tests should focus on the effect of the regulation on the property owner, not the effectiveness of the regulation.

[179] *See Lucas*, 505 U.S. 1003.

[180] *See Palazzolo*, 533 U.S. 606. (Palazzolo was found to have retained over $200,000 of potentially developable upland).

[181] *Id. See also* Tahoe-Sierra Preservation Council, Inc. v. Tahoe Regional Planning Agency, 535 U.S. 302 (2002).

[182] Harold Skelton, *Houses on the Sand: Takings Issues Surrounding Statutory Restrictions on the Use of Oceanfront Property*, 18 BOS. COLL. ENVTL. AFFAIRS L. REV.1, 131 (1990).

[183] Hall v. Board of Environmental Protection, 528 A.2d 453, 455 (Me. 1987).

[184] *See* FEMA, GUIDANCE NO. 4511.61 E, THE 50% RULE:THE ELIGIBILITY OF FACILITIES FOR REPLACEMENT UNDER 44 CFR 206.226(D)(1), *available at* http://www.fema.gov/government/grant/pa/9524_4b.shtm ("A facility is considered repairable when disaster damages do not exceed 50% of the cost of replacing a facility to its predisaster condition, and it is feasible to repair the facility so that it can perform the function for which it was being used as well as it did immediately prior to the disaster."). *See also* Conn. Dep't of Permitting and Land Use, *Important Information for Owners of Buildings in Flood Zones*, *available at* http://www.ci.milford.ct.us/public_documents/MilfordCT_Permitting/flood%20docs/017AA618-000F8513.

[185] FEMA, *Substantial Damage*, http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/sd.shtm (last visited July 10, 2012) (FEMA defines "substantial damage" as the loss of property value due to destruction or the cost of improvements worth ≥50% of the market value, which is cumulative over a ten-year period).

important to note that the NFIP does not prohibit rebuilding unless "development would increase flood heights"[186] — although owners who cannot comply with flood-proofing standards are effectively denied the ability to rebuild although they may or may not be insured for their loss.[187] Connecticut relies on the municipalities to determine if a damaged structure is in a NFIP flood hazard area (FIRM A or V zones). Moreover, municipalities are tasked with enforcing the state building code with respect to the determination of "substantial damage" and "substantial improvement."[188] FEMA NFIP-compliant states and their municipalities can enforce the "50% rule" to compel property owners to move landward or to meet more stringent "flood-proofing" building codes.[189]

A number of states, including Massachusetts, Maine, South Carolina, and North Carolina, categorically prohibit all new development in areas that currently experience or are predicted to experience flooding or erosion hazards.[190] Prohibiting new construction or rebuilding may trigger takings challenges, especially if the prohibition is total. Property owners are most likely to argue that their "right" to rebuild after a substantial loss represents a "traditional incident of ownership" and/or that they have a "reasonable investment-backed expectation" to be allowed to rebuild.[191] However, it is important to note that neither David Lucas (the developer) nor Justice Scalia questioned the merits of South Carolina's 1988 Beachfront Management Act which prohibited new development on barrier beaches for a suite of social, economic, ecological, and environmental reasons, as long as the law applied prospectively to property owners who knew or should have known that the law applied to them when they acquired the property (the "limitation inherent in title" rule).[192] In 2005, the Massachusetts Supreme Court upheld the Town of Chatham's Zoning Board of Appeals, which had denied a permit to develop an undeveloped "marginal parcel of land" in a flood hazard zone that was also in a groundwater overlay district.[193] South Carolina's current coastal management laws prohibit new construction in

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[186] FEMA, FLOODPLAIN MANAGEMENT REQUIREMENTS: A STUDY GUIDE AND DESK REFERENCE FOR LOCAL OFFICIALS 6-8 (2010), *available at* http://www.fema.gov/plan/prevent/floodplain/. (FEMA goes on to say that, "[t]hese performance-oriented standards of the NFIP have never been ruled as a taking. This is highly significant, given that more than 19,000 communities administer floodplain management ordinances." *Id*.)

[187] *Id*. (A FEMA study found that only 2% of the property owners in Connecticut's flood hazard zones had purchased federal flood insurance in 2004.).

[188] CONN. DEPT. ENVTL. PROTECTION, NFIP REQUIREMENT: THE LOWEST FLOOR 1 (2009); NEW YORK DEP'T OF ENVTL. CONSERVATION, FLOODPLAIN MANAGEMENT REQUIREMENTS AFTER A FLOOD, *available at* http://www.dec.ny.gov/lands/24267.html.

[189] Also note that the NFIP "encourages states and communities to implement flood-plain management programs that go beyond NFIP minimum requirements since local flood hazards vary and what makes sense in one state or community may not make sense in another". *See* FLOODPLAIN MANAGEMENT REQUIREMENTS, *supra* note 195, at 6-1. Maine's *Coastal Sand Dunes Rules* reportedly prohibit rebuilding structures that are more than 50% damaged by storms unless the property owner can prove that the structure can remain stable even with an additional two-foot rise in sea level. *See* Charles Colgan & Samuel Merrill, *The Effects of Climate Change on Economic Activity in Maine: Coastal York County Case Study*, 17 POL'Y REV. 2 (2008).

[190] Mary Cooper Ellis, *Managed Retreat: Coastal Development in an Era of Climate Change*, LANDSCAPE ARCHITECTURE (2008), *available at* http://www.asla.org/lamag/lam08/march/ecology.html.

[191] *See Palazzolo*, 533 U.S. 606. (Although note that Justice Scalia skewered Palazzolo for wasting the court's time with speculative claims about his "reasonable investment-backed expectations.").

[192] *See Lucas*, 505 U.S. at 1027-32.

[193] Gove v. Zoning Board of Appeals of Chatham, 831 N.E.2d 865 (Mass. 2005) (The Court held that a regulatory taking occurs where a regulation deprives an owner of "all economically beneficial use" of private property, except to the extent that "background principles of nuisance and property law" independently limit the owner's use of the property. The Court also noted that the developers purchased the parcel of land knowing that local ordinances limited development.)

state-designated "erosion zones" and rebuilding of any property within the erosion zone that is two-thirds destroyed.[194]

Connecticut's Coastal Management Act (CMA) is more circumspect, but also clearly authorizes municipal boards in charge of reviewing coastal site plans to "approve … condition, or deny permission to build" based on the impact of the proposed activity on "coastal resources and future water-dependent development activities."[195] Connecticut's statute also references preventing harm to other littoral property owners, public uses of the shore, established resource users, and critical ecosystems as issues to be considered in approving or denying a permit.[196]

This is important for two reasons. The U.S. Supreme Court noted in *Lucas* that the government is not required to compensate landowners for regulatory actions that result in "loss of all economically viable use" if the regulated activity would have been considered a public nuisance under accepted principles of property and nuisance at common law. State and/or municipal governments are likely to have many public health and safety grounds on which to base decisions to deny permits to rebuild following extreme erosion and flood events. These include the safety of adjacent properties, capacity of coastal soils to assimilate (sanitary or industrial) wastes, and the contamination of wetlands and other areas critical in terms of their ecosystem services. Furthermore, the CMA explicitly refers to the State's trust responsibility to protect key public trust resources such as the fisheries and public trust rights, including access to the shore.[197]

In sum, state and municipal governments are likely to have compelling statutory, public nuisance and public trust arguments to justify denying permits to rebuild or develop in flood and erosion hazard areas. These arguments should be sufficient to insulate them from liability even if the court finds that the owner has lost all economically beneficial use of her property. Since this is true, it is easier to determine whether specific strategies such as (1) requiring setbacks and buffers, (2) prohibiting shoreline armoring, (3) downzoning, (4) limiting public expenditures in repair/replacement of public infrastructure after repetitive losses, or (5) mandating (or denying access to) insurance coverage are likely to constitute compensable takings. These strategies are considered in sequence.

1. Mandatory Setbacks and Buffers

Mandatory building setbacks and buffers are unlikely to generate successful regulatory takings claims since these requirements allow owners of coastal properties to continue to occupy and use their property but deny them the ability to develop seaward of a designated line in order to protect the shoreline and adjacent properties and ecosystems. Today, many states require new development to be set back from the shore by various setback lines which are determined by elevation above mean high water, erosion rates, distance from wetlands and receiving waters, or how the shore may change.[198] Vegetated buffers and setbacks protect public users and aquatic life from runoff and leaching of biological and chemical wastes generated on the private property and, ideally, provide sufficient land area to enable the property owner to retreat and/or relocate essential structures post-disaster such as

[194] Skelton, *supra* note 182, at 131.

[195] CONN. GEN. STAT. § 22a-105(e). On April 12, 2012, the Connecticut House Committee on the Environment recommended the passage of Substitute Bill 5128: An Act Concerning Certain Revisions to The Coastal Zone Management Statutes. This bill would amend §22-105(e) of the Coastal Management Act by endorsing the authority of boards to deny permission to build "provided any such denial shall constitute a taking for which the owner shall be compensated."

[196] *Id.* §22-105(a)–(e).

[197] *See id.* § 22a-92

[198] James Titus, *Rising Seas, Coastal Erosion, and the Takings Clause: How to Save Wetlands and Beaches Without Hurting Property Owners*, 57 MD. LAW REV. 1279, 1311 (1998).

the house, basement, on-site septic systems and parking. Setbacks also act to encourage coastal retreat by discouraging property owners from investing in their property to the point where their land is worth protecting from the sea.[199] However, establishing setbacks may be considered economically inefficient, as the designation of setback lines requires policy makers to draw a literal, although imaginary, line in the sand. By the time sea levels rise to where communities recognize that they are protected by the setback, new setbacks are often necessary. Moreover, lease revenue that could have been generated on the property seaward of the setback line has been forgone.[200] The same, of course, could be said about policies prohibiting development altogether.

Setbacks are unlikely to face successful regulatory takings challenges *unless* the state or local government presses the property owner to dedicate the undeveloped land for public access[201] because (1) the courts will examine the property as a whole when determining takings,[202] and (2) if lots are larger and deeper than the established setback line, the property's value may be reduced, but not by 99.9%. Thus, it is important to establish the definitions of and legal justifications for setbacks and buffers in order to avoid *ad hoc* decision-making.

2. Coastal Armoring and Defended Shorelines

Connecticut's Coastal Management Act has very clear language discouraging the use of coastal armoring and structural shoreline engineering techniques "except in those instances where structural alternatives prove unavoidable and necessary to protect existing inhabited structures, infrastructural facilities, water dependent uses."[203] Connecticut's policy of preventing coastal property owners from building erosion control structures such as bulkheads, levees, jetties, and other sea wall revetments could encourage retreat to the extent property owners clearly understand and accept the State's countervailing interests in safeguarding life, protecting property, and minimizing adverse environmental impacts. Massachusetts' Public Waterfront Act[204] is a model statute that codifies the State's public trust doctrine with respect to public rights in the shore, tidelands and navigable waters. As a result, its Coastal Beach regulations presume the importance of beaches for "storm damage prevention, flood control and the protection of wildlife habitat" and state that coastal projects "shall not" increase erosion or interfere with littoral drift, although beach nourishment is permitted.[205] Rhode Island's Coastal Resources Management Program prefers nonstructural erosion control and flood prevention methods such as vegetative buffers and beach nourishment to hardened structures and sandbags,[206] though enforcement and political pressure from property owners is a chronic problem.[207]

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[199] *Id.*
[200] *See* VESTAL ET AL., *supra* note 138.
[201] See discussion of *Nolan* and *Dolan*, *supra* notes 152-154.
[202] *See Palazzolo*, 533 U.S. 606.
[203] Conn. Gen. Stat. §22a-92(b)(2)(F).
[204] MASS. GEN. LAWS ch. 91, §§1-63, The Massachusetts Public Waterfront Act assigns the Massachusetts Department of Environmental Protection the responsibility to, among other things, (1) Preserve pedestrian access along the water's edge for fishing, fowling and navigation, (2) Protect and promote tidelands as a workplace, (3) protect areas of critical environmental concern from unnecessary encroachment by fill and structures, (4) protect the rights of waterfront property owners to access the water, and assure removal or repair of unsafe or hazardous structures.
[205] 310 MASS. CODE REG. § 10.27.
[206] R.I. CODE REG. § 16-2-300.7.

Littoral property owners in Rhode Island must consider all reasonable and practical alternatives (e.g., relocating the structure and nonstructural methods) when proposing structural shoreline protection methods[208] It is important to note that regulation of shoreline construction is addressed in these states without reference to the federal Clean Water Act and Coastal Zone Management Act incentives for state nonpoint source programs,[209] which encourage states to control runoff associated with impervious surfaces, shoreline and stream channel modification, and loss of coastal and riparian wetlands.

Under the public trust doctrine, as mentioned above, states have a duty to administer public trust resources, such as coastal lands, navigable waters, and natural resources, which are held in trust by the state for the benefit of all citizens. Therefore, Connecticut should be able to rely on the public trust doctrine, as well as its statutory authority, to deny proposals to armor the shoreline and to limit or remove impervious surface that interfere with public trust interests. Property owners may argue that prohibiting coastal armoring amounts to a compensable taking since littoral owners have the right to wall out the sea under the common law.[210] However, the State should be invulnerable to *takings* claims to the extent it can show that the *cumulative impact* of coastal armoring and runoff from impervious surfaces associated with the proposed construction project will contribute to erosion and/or contamination of the "wet beach" or tidelands or impede access to the public beach.

3. Cluster Zoning, Downzoning, and Upzoning

Cluster or open space zoning provides developers with a density bonus for "clustering" buildings on the site in order to maximize open space.[211] Downzoning refers to the process of re-zoning the permitted land uses in a designated area by changing the pattern or reducing the density of development from the previous zoning classification. For example, Stonington, Connecticut has adopted Flood Hazard and Aquifer Overlay Districts and changed zoning from RM20 (high-density single-family) to RC-120 (rural residential) in FIRM V-zones that are also in Aquifer Overlay Districts with the goal of preventing saltwater intrusion into the drinking water supply aquifer.[212] This zoning change limits the ability to subdivide the land and therefore may reduce the profits available to landowners and developers. *Upzoning* does the reverse. Both techniques have been used to protect agricultural lands and open space, prevent sprawl, and promote urban renewal. Currently, the State's zoning laws allow municipalities to determine local land uses for periods of up to five years[213] but these techniques could also be used to provide the basis for a regional Transferable Development Rights (TDR) system or land bank that provides density bonuses or tax incentives to relocate away from A- and V- zones to town centers at higher elevation with public infrastructure.

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[207] See Tracey C. O'Neill, *CRMC Votes for South Kingston Sea Wall*, RIFUTURE.ORG, May 9, 2012, http://www.rifuture.org/crmc-votes-for-public-safety-against-ocean-mist.html; *Dave Fisher and Tim Faulkner, Barriers Fall for Matunuck Beach Armoring*, ECORINEWS, May 14, 2012, http://www.ecori.org/front-page-journal/2012/5/10/barriers-fall-for-matunuck-beach-armoring.html.

[208] R.I. CODE REG. § 16-2-300.7.

[209] *See* Clean Water Act §319, 33 U.S.C. § 1329 (Nonpoint source management programs) and § 6217 of the Coastal Zone Act Reauthorization Amendments of 1990, 16 U.S.C. § 1455b. (Coastal Nonpoint Pollution Control Program).

[210] *See generally*, J. Peter Byrne, *Rising Seas and Common Law Baselines: A Comment on Regulatory Takings Discourse Concerning Climate Change*, 11 VT. J. OF ENVTL. L. 640 (2010).

[211] *See* Randall Arendt, *"Open Space" Zoning: What It Is & Why It Works*, PLAN. COMM'RS J. (1992), *available at* http://www.plannersweb.com/articles/are015.html.

[212] TOWN OF STONINGTON, CONNECTICUT, ZONING MAP ATLAS, PARCELS, ROADWAYS AND ZONING DISTRICTS (July 2010), *available at* http://www.stonington-ct.gov/Pages/StoningtonCT_Planning/zoning_map_atlas/index.

[213] CONN. GEN. STAT. § 8-17a.

Property owners affected by downzoning may well argue that the resulting decrease in their property value from the loss of potential development amounts to a regulatory taking.[214] However, downzoning is not likely to result in a compensable taking since the Courts have traditionally recognized zoning as a legitimate exercise of the states' police power to protect public health, safety, and welfare.[215] Furthermore, property owners are rarely, if ever, "denied all economically beneficial use" of their property by a zoning change, especially since the court will view the effect of the regulation on the property as a whole.

4. Limiting Public Expenditures in Repair/Replacement of Public Infrastructure

Connecticut could encourage property owners to retreat from high hazard areas by expanding upon insurance and building limits established by the federal Coastal Barrier Resources Act of 1982 (COBRA) and the Coastal Barrier Improvement Act of 1990 (CBIA).[216] COBRA specifically prohibits access to the NFIP for structures built or substantially improved after 1983, and also prohibits federal disaster relief and cost-sharing for repair/replacement of capital infrastructure in designated coastal barrier beach areas (CBRs) and Otherwise Protected Areas (OPAs).[217] Connecticut already cooperates with FEMA to enforce COBRA's insurance prohibitions and NFIP-consistent building permits in identified CBRS and OPA areas.[218] However, the State could do more to compel property owners in CBRS and OPA areas to obtain private flood insurance. The State could also limit its own expenditures on repair and replacement of public infrastructure subject to repetitive loss in high hazard areas.

Private property owners affected by abandoned or un-maintained infrastructure such as roads, bridges and buried utilities subject to washout will certainly be tempted to file takings claims, arguing that such policies reduce access to and therefore the value of their property. However, unless such policies deprive owners of "all economically beneficial use" of their land, takings challenges are likely to fail. It is also interesting to note that public "givings" or "windfalls," such as risk-spreading in terms of flood insurance and public investments in infrastructure that enable property owners to inhabit risky environments, are rarely if ever subtracted from "takings" or "wipeout" claims.[219] The State could approach this issue by shifting ownership and/or the maintenance and repair/replacement cost of "stranded" infrastructure to owners of repetitive loss properties and "hold-outs" in high flood- and erosion- hazard zones.

Connecticut has formal procedures for "abandonment" and "discontinuance" of roads that date back to 1799.[220] However it is unclear whether private property owners can legitimately claim entitlement to government benefits such as continued investments in and maintenance of public

[214] *See* Jesse Richardson, *Downzoning, Fairness, and Farmland Protection*, 19 J. OF LAND USE L. 59 (2003).
[215] *See generally,* Village of Euclid, Ohio v. Ambler Realty Co., 272 U.S. 365 (1926); Hadacheck v. Sebastian, 239 U.S. 394 (1915).
[216] *See* Federal Emergency Management Agency, Coastal Barrier Resource System, http://www.fema.gov/plan/prevent/floodplain/nfipkeywords/cbrs.shtm (last visited June 30, 2012).
[217] *Id.*
[218] *See* CONN. DEPT. OF ENVTL. PROTECTION, COBRA ZONES (2009).
[219] *See generally*, Abraham Bell and Gideon Parchomovsky, *Givings*, 111 THE YALE L. J. 547, 590-93 (2001) and DONALD HAGMAN & DEAN MISCZYNSKI, WINDFALLS FOR WIPEOUTS: LAND VALUE CAPTURE AND COMPENSATION (1978).
[220] *See* Richard Roberts, *Discontinuation and Abandonment:The End of the Road?,* CONN. LAW. 14:3 (Nov 2003), *available at* http://www.halloran-sage.com/Knowledge/articleDetail.aspx?storyid=1999.

infrastructure.[221] In some cases, where local transportation policies left property owners unable to access networks of public roadways or even their own property, courts have found the policies to constitute a compensable taking.[222] In addition, state and local governments may encounter tort liability when "active" roads are left unmaintained.[223] Historically, however, courts have held that local governments are not obligated to provide certain services.[224] Additionally, when local governments are faced with scarce resources and fewer available funds, it may be more difficult to determine whether funding decisions by municipalities amount to takings—especially if the decision in question is one that will ultimately save the municipality resources.[225]

5. Mandating Flood Insurance

As indicated earlier, the NFIP is over $17 billion in debt due in part to low premiums and high percent of uninsured property owners; exemptions of various at-risk properties from the insurance pool; repetitive loss properties (RPLs) and disaster relief associated with Hurricanes Katrina, Rita Wilma in 2005.[226] Requiring all property owners to pay a flood insurance premium through their homeowner's policy could generate legal challenges to the extent that not all property owners face flood risks. But limiting the flood insurance requirement to property owners in NFIP-designated A and V Zones significantly decreases the likelihood of a successful takings challenge.[227] Mandatory flood insurance does not deprive property owners of "all economically beneficial uses" of land and, in fact, adds value. Moreover, the NFIP has successfully survived takings challenges in the past. In 1979, the D.C. Circuit Court of Appeals held that a community's participation in the NFIP and its subsequent adoption of floodplain management ordinances did not constitute a compensable taking.[228] In 1989, the Oklahoma Supreme Court held that floodplain management regulations adopted in compliance with the NFIP did not deprive property owners of all economically beneficial uses of their land.[229]

In sum, state and municipal governments have many strategies at their disposal to motivate responsible development of FEMA-designated SFHAs and high flood and erosion hazard areas. Most of these strategies do not require additional statutory authority. The major exceptions appear to be with respect to the State's current ability to enforce compliance with mandatory risk-based flood insurance coverage and to expand (or deny) flood insurance coverage requirements to properties that are located at or below two meters above present sea level.

In addition, Connecticut and its subordinate governments acting with expressly delegated authority,

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[221] Craig Anthony Arnold, *Legal Castles in the Sand: The Evolution of Property Law, Culture, and Ecology in Coastal Lands*, 61 SYRACUSE L. REV. 213 (2011). *See also,* Estate of Hage v. U.S., 93 Fed. Cl. 709 (2010), protracted and unresolved takings litigation by a rancher claiming "ownership" of or continued access to water rights on public lands.

[222] J. Peter Byrne and Jessica Grannis, *Coastal Retreat Measures*, in THE LAW OF ADAPTATION TO CLIMATE CHANGE (Michael B. Gerrard & Katrina F. Kuh, eds.) (forthcoming 2012)

[223] *Id. See also* Chandler, Jr. & Others vs. County Commissioners of Nantucket County, 772 N.E.2d 578 (Mass. 2002) (Plaintiff beachfront property owners on Nantucket successfully defeated a plan by the County Commissioners to condemn private property parallel to the beach above mean high water to "preserve historic public rights of way to the sea.").

[224] Byrne & Grannis, *supra* note 225.

[225] *Id.*

[226] King, *supra* note 62.

[227] Charles Griffith, *The National Flood Insurance Program: Unattained Purposes, Liability in Contract, and Takings*, 35 WILLIAM AND MARY L. REV. 727, 748-63 (1994).

[228] *See* Texas Landowners Rights Ass'n v. Harris, 453 F.Supp. 1025, 1027 (D.D.C. 1978).

[229] *See* April v. City of Broken Arrow, 775 P.2d 1347 (Okla. 1989).

are very likely to be invulnerable to Fifth Amendment takings claims even if these regulations result in "diminution of value," "loss of investment-backed expectations," or "loss of all economically beneficial uses of the property." This is the likely outcome because the government will almost invariably be able to justify regulations that limit private use of private property based on (1) its police power obligation to protect public health, safety, and welfare; (2) its common law authority to protect its citizens from public nuisances created by flooding and erosion of the coastal zone that results in biological or chemical contamination of coastal waters, debris fields on the shore, and/or loss of critical aquatic habitat and associated ecosystem services; and (3) its common law duty to administer the public trust for the benefit of its citizens.

C. Motivating Responsible Development and Retreat

As Garrett Hardin famously observed, governments should always consider the "no action" or "business as usual" option as well as "appeal to conscience" before resorting to "legislated temperance," "mutual coercion," and markets.[230] This spectrum of options is illustrated in Table 1. As noted earlier, information- and market-based strategies are often relied on in the absence of consensus about risk and the desire to maximize individual flexibility and innovation.[231] Examples of these strategies include public education (about global warming and climate change-related risks); public opinion surveys intended to educate and/or elicit information about public attitudes (regarding climate science or adaptation and mitigation strategies); and appeals for volunteerism. Other potentially important information-based techniques include using real estate disclosure forms and land recording requirements to better communicate the risks associated with occupying high flood and erosion hazard areas. This strategy might be unpopular and politically infeasible because it might tend to reveal the "true", risk-adjusted value of real property. However, information-based strategies fundamentally cannot trigger successful regulatory takings claims even if they reduce the market value of the property since they operate by requiring property owners to internalize the consequences of their decisions. Note that this strategy could also motivate property owners to acquire additional flood insurance, especially if the State considered requiring property owners to carry multi-year policies and record the information in the Land Evidence Records.

V. When Retreat is the Better Part of Valor: Key Findings and Recommendations

> *If the waves crash up against the beach, eroding dunes and destroying homes, it is not the awesome power of Mother Nature. It is the awesome power of Mother Nature as altered by the awesome power of man, who has overpowered in a century the processes that have been slowly evolving and changing of their own accord since the earth was born*.[232]

Coastal states like Connecticut should continue to actively and proactively plan for adaptation to the projected impacts of global warming and climate change. These plans should almost certainly include preparing for measured retreat from low-lying coastal and riparian floodplains over the next few decades—especially in light of the "highly likely" economic and environmental consequences of pursuing a "business as usual" approach to coastal development in densely populated coastal watersheds. This section summarizes the key findings associated with this paper and offers

[230] Hardin, *Tragedy of the commons*, *supra* note 119. *See also*, LESTER B. LAVE, THE STRATEGY OF SOCIAL REGULATION: DECISION FRAMEWORKS FOR POLICY (1982).
[231] *See* Goulder & Parry, *supra* note 97.
[232] BILL MCKIBBEN, THE END OF NATURE 51 (1989).

recommendations on regulatory, information, and market-based strategies to motivate retreat from the shore.

A. Key Findings

Scientists from many different disciplines as well as the professional environmental planning community overwhelmingly agree that global warming and climate change are occurring and that the rate of change is accelerating. The U.S. National Academy of Sciences and Governor Malloy's Steering Committee on Climate Change recently estimated that sea level could rise along Connecticut's coast by 1.04 to 1.4 meters (3.4 to over 4.6 feet) by 2100 under the "rapid ice melt" scenario.[233] Recent technical papers by the Environmental Defense Fund and the Union of Concerned Scientists indicate that in the shorter term, the current 100-year coastal flood will occur in Connecticut every 32 years as a result of global warming-induced changes in the hydrological cycle, and that flood heights related to inundation and storm surge could range from 10 to 15 feet above the observed Mean High Water (MHW) line in Connecticut by 2020 depending on the location and category of storm.[234] Moreover, some of the risks associated with extreme climate and weather events are perhaps already observable based on the damage experienced in New England during the 2010-11 sequence of storms.

Trend is not destiny.[235] However, in the absence of planning, natural disaster-related damage to public infrastructure, private property, and the environment will challenge State and local taxpayers and tax the resilience of built and natural environments. Economically, the cost of doing nothing is very high. Tropical Storm Irene and the 2011 ice storm each cost the State of Connecticut nearly $1 billion, and FEMA estimates that a single 100-year storm could cost the State a little over $18 billion in property losses and business interruptions related solely to the 32,000 properties located in SFHAs.[236]

Connecticut clearly takes the recent pattern of destructive storm and weather events seriously. Various Governor-appointed commissions and task forces have published at least five major studies since 2010 focused on the State's vulnerability to climate change-induced risks, and its resilience or ability to respond and recover from climate and weather-related hazards. These studies suggest that it is prudent to continue to mitigate GHG emissions by participating in the Regional Greenhouse Gas Initiative (RGGI), with proceeds from the RGGI auctions going toward investments in energy efficiency, renewable energy, and demand management (measured as change in per capita energy use and emissions) in order to meet the State's commitment "to reduce greenhouse gases by 10% by 2020 and 80% by 2050" pursuant to the Connecticut Global Warming Solutions Act.[237]

However the current collective level of effort to mitigate emissions will not significantly "bend the curve" of "business as usual" GHG emissions. Therefore, the federal, state and local governments and the private sector share responsibility to act strategically to protect public health, safety and welfare as the effects of climate change continue to be expressed. These institutions have access to a wide variety of regulatory, market, and information-based strategies to help motivate retreat from the shore (See Parts III and IV). The following section presents key recommendations based on the summary of climate change-related risks and a review of public and private sector authority to respond in a precautionary manner to those risks.

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[233] *See* ADVANCING THE SCIENCE OF CLIMATE CHANGE, *supra* note 16, at 7-10; and ADAPTATION SUBCOMMITTEE REPORT, *supra* note 27.

[234] *See* GORNITZ ET AL., *supra* note 30; and FRUMHOFF ET AL., *supra* note 3, at 19.

[235] Rene' Dubos, *Trend is Not Destiny,* 34 ENGINEERING AND SCI. 5 (1971)

[236] REPORT OF THE TWO STORM PANEL, *supra* note 47.

[237] *See* An Act Concerning Connecticut Global Warming Solutions, 2008 Conn. Legis. Serv. P.A. 08-98 (H.B. 5600) (June 2, 2008).

B. Some Key Recommendations

Connecticut is most vulnerable to extreme climate and weather events along the shore and in low-lying coastal floodplains where 23% of the State's population lives. Much attention is focused on rapidly eroding, flood-prone beaches where the rate of change is most dramatic and easily visible. However, several densely populated, older industrial cities with large, poor ethnic populations are also located in this zone. These cities represent a significant portion of the State's social, economic and strategic assets. Although it may be tempting to commit public funds to defend the shore from inevitable sea level rise, climate change represents an opportunity to re-imagine the future of coastal cities such as New London, New Haven, and Bridgeport in terms of their infrastructure, architecture and relationship to water. The federal government's efforts to stabilize its Department of Defense and Coast Guard investments in the coastal zone may provide a useful signal about how and how rapidly to adapt to sea level rise and associated flooding and erosion risks.

Since the various threats associated with global warming and climate change will play out over a period of decades, the risks are not yet sufficiently urgent to warrant evacuation of the coastal zone. However, inexorable sea level rise and associated inundation and wave-related flooding and erosion justify considering how to pursue the following goals:

1. Buffer the shore in order to protect inland properties, water-dependent and customary public uses of the shore and tidal waters, coastal ecosystems (dunes, wetlands), and ecosystem services; and
2. Encourage property owners, residents, and businesses to retreat from the shore and coastal floodplains.

These goals are related to the extent that both assume that it will eventually be necessary to retreat from the shore because of the expense, uncertainty and negative externalities associated with armoring the coast, protecting and maintaining public infrastructure, and flood-proofing public and private property. (See Table 1 for the heuristic model used to describe the spectrum of regulatory, information and market-based strategies that could be used to accomplish these goals, depending on one's perception of the magnitude of the risk and preferences regarding equity and efficiency.)

Strategies that could be used to address Goal 1: *Buffer the shore in order to protect inland properties, customary public uses of the shore, coastal ecosystems (dunes, wetlands) and ecosystem services* include the following:

- **The federal, state and local governments should continue to partner with conservation groups to purchase coastal property, development rights and conservation, erosion and rolling easements. Strategic acquisitions could eventually secure a coastal buffer or "living shoreline" that would allow coastal features (i.e., barrier beaches, dunes, and wetlands) to migrate shoreward and protect coastal habitats, customary uses of the shore, and inland portions of coastal cities.** Purchasing fee interests and development rights in waterfront property is expensive and ineffectual, but there are no legal barriers to government acquisition of private property from willing sellers for defensible public purposes. Maine's approach of purchasing fee simple interests in waterfront properties and leasing them back to the owner as a way to recover costs and balance public and private interests in the shore seems worth exploring. The CT DEEP should continue to discourage

coastal armoring in conformance with the Coastal Management Act. In addition the State should evaluate the public costs associated with allowing the almost 1,500 Repetitive Loss Properties (RLPs) to rebuild in place and decide which of them to condemn, if any, and whether to convert those properties to wetlands or vegetated open space that could provide some level of flood storage.

- **The State, as the administrator of trust resources, should clarify and reaffirm the boundary between the public trust and private littoral lands and enforce the use of setbacks in a way that protects guaranteed public access to and use of the shore below the *observed* mean high water line.** Connecticut's Coastal Management Act clearly articulates the State's duty to protect the public's public trust interests in water, air and the environment. Therefore the State and/or local governments will likely be required to deny continued use of private property that becomes stranded on the "wet beach" and interferes with the State's proprietary interest in the tidelands and with public trust uses of the shore. The public trust doctrine represents a "background principle of property law" that should be consistently argued as a viable defense against takings claims. Erosion and rolling easements represent clever though administratively expensive market-based strategies to balance public trust interests and littoral rights to the shore. The DEEP and local governments should first routinely enforce setbacks in coastal and riparian flood and erosion hazard areas and secondly institute land use tax incentives to encourage property owners to voluntarily negotiate erosion and rolling easements. (Note that State and local governments should be careful not to impose exactions that result in public rights of way across private property *unless* the government is willing to pay just compensation, even if the property owner agrees, since the *Palazzolo* Court held that constitutionally protected rights are never forfeited.[238])

- **The State should define a *Coastal Growth Boundary*, identify a *TDR Receiving Area*, and identify and enforce development restrictions on *unbuildable land.*** The State and local governments should identify features that make properties "unbuildable." Some attributes of unbuildable land include close proximity to important natural features such as wetlands, dunes and drinking water supply aquifers; location in extreme flood and erosion hazard zones based on actual and projected (not historic) flood data; presence of critical or essential habitat for Federal or State-listed threatened and endangered species; or interference with recognized water-dependent uses. Municipal governments should be enabled and encouraged to establish *Flood and Erosion Hazard Overlay Districts* and to adopt and enforce ordinances to reduce development in these areas. Properties located within *Flood and Erosion Hazard Overlay Districts,* which are likely to include more properties than FIRM A and V zones since the FIRMs tend to be based on historic data rather than projections of climate-related sea level rise, should be required to carry multi-year flood insurance and pay an "erosion surcharge" as necessary.

[238] *See* Palazzolo, 533 U.S. at 624 ("Just as a prospective enactment, such as a new zoning ordinance, can limit the value of land without effecting a taking because it can be understood as reasonable by all concerned, other enactments are unreasonable and do not become less so through passage of time or title… A State would be allowed, in effect, to put an expiration date on the Takings Clause. This ought not to be the rule. Future generations, too, have a right to challenge unreasonable limitations on the use and value of land.")

- **The State should seriously consider establishing a Transferable Development Rights (TDR) program as a way to relocate proposed development away from coastal floodplains, and toward higher elevations.** The State and towns could identify "sending" areas but the 15 Regional Planning Organizations appear to be institutionally well-positioned to establish "receiving" areas and manage a land bank to the extent they already coordinate federally funded transportation and energy projects that affect multiple cities and towns; act as an information hub with respect to economic, environmental and social data; and support land use planning. TDRs could be used to help divert sprawling suburban development proposed to occur within *Coastal Growth Boundaries* to help re-build core cities in the coastal zone. Cluster and mixed use zoning, in combination with LEED-Neighborhood Development standards, can also be used to direct new development toward town centers to take advantage of existing public infrastructure.

- **The State should examine and clarify its authority to limit its financial responsibility for repair/replacement of public infrastructure subject to repetitive loss in the coastal zone following the federal COBRA model**. The State clearly has the authority to "abandon" and "discontinue" State roads and this should theoretically extend to other State resources and utilities, e.g., public water, wastewater treatment, to the extent that the State regulates withdrawals, diversions and discharges.[239]

Most climate change scenarios are projected to increase in intensity over the course of the next 10 to 90 years. Therefore, market and information-based techniques may be very effective in the near term at accomplishing Goal 2. *Encouraging property owners, residents and businesses to retreat from the shore and coastal floodplains* by getting property owners to internalize the risks of living in areas at high risk of storm surge, flooding, and wind and rain damage.

- **The federal government has many key roles to play in altering incentives to develop in areas that are or will be at high risk of erosion and inundation and storm surge flooding.** The NOAA-sponsored Sea Grant and Coastal Management Programs have been very influential at the state-level in terms of gathering physiographic, natural resource and demographic data, communicating information about climate change-related risk, and administering development and resource management programs in the coastal zone. The State should coordinate and model its adaptation strategies on the Climate-Ready Estuaries Program and other federal adaptation initiatives.

- **The federal and state flood and erosion insurance programs should be reformed in order to enable the State to reduce its exposure to uninsured losses related to extreme climate and weather events**. The National Flood Insurance Program (NFIP) continues to contribute to risky patterns of development in the coastal zone by subsidizing insurance premiums as a way to increase insurance coverage; exempting homes purchased before 1994 from many NFIP regulations;[240] indemnifying owners of the riskiest properties by allowing rebuilding after catastrophic and repetitive losses; and misrepresenting flooding

[239] See CONN. GEN. STAT. §22a-377(b)-1. (Connecticut regulates withdrawals and diversions from waters of the state and recognized that it needed broader authority to be able to reallocate water to the extent that some diversions were "grandfathered".)

[240] See R.D. Blanchard-Boehm, K.A. Berry, and P.S. Showalter, *Should Flood Insurance Be Mandatory? Insights in the Wake of the 1997 New Year's Day Flood in Reno-Sparks, Nevada*, 21 APPLIED GEOGRAPHY 199, 217 (2001).

risks by failing to account for widely accepted projections of sea level rise and related flooding risks in the NFIP Flood Insurance Rate Maps.

Some of these problems could be corrected by allowing the NFIP's private insurance partners to assess risk-based premiums that match market rates; requiring property owners to carry multi-year policies that run with the land; enforcing NFIP provisions that require lenders to police flood insurance for property owners who hold a federally insured mortgage; and enforcing COBRA and FEMA prohibitions on rebuilding infrastructure and private property that experience catastrophic damage or repetitive losses. The NFIP only requires homeowners in Special Flood Hazard Areas (SFHAs) to purchase flood insurance, but there is evidence that only 20% of eligible property owners carry mandatory insurance,[241] which means that these policies cover only 35-40% of the full risk.[242]

The State could address this situation, in part, by requiring all property owners whose properties lie less than two meters (6 feet) above sea level to purchase multi-year federal and/or private flood insurance as a way to increase the pool of insured properties. This would ensure that property owners in present and future high flood and erosion hazard areas recognize and internalize more of the cost of responding to catastrophic coastal events. Moreover, when coastal communities and a broader range of property owners participate in the NFIP pool, the State is in a better position to support community efforts to adopt more stringent regulatory ordinances to reduce the State's exposure to climate change-related risks.[243]

Alternatively, Connecticut could impose a moratorium to bar new development from participating in the NFIP until (1) NFIP flood insurance premiums reflect the "true risk" cost of living in FIRM A and V zones and/or (2) flood insurance is required for a broader range of at-risk properties. The State should also consider adopting the federal COBRA model and prohibit access to federal flood insurance for properties located in local *Flood and Erosion Hazard Overlay Districts* as a way to compel property owners to seek flood insurance from private insurance carriers that charge risk-based premiums. However these strategies potentially expose the State to greater economic risk in the event of a flood-related disaster to the extent that a larger population of property owners elects not to seek flood insurance and require emergency disaster assistance.

- **The State should amend the real estate disclosure form and Land Evidence recording requirements to more completely disclose flood, erosion and climate change-related risks associated with real property.**[244] These relatively simple and related information-based techniques could potentially achieve some of the same goals as flood insurance and regulation by giving prospective buyers and lenders adequate information on which to base the purchase of real estate, thereby signaling the "risk-adjusted" value of real property. (See discussion of the spectrum of strategies presented in Table 1.) Property owners should

[241] Martin Halek & Mark J. Browne, *Managing Flood Risk: A Discussion of the National Flood Insurance Program and Alternatives*, *in* PUBLIC INSURANCE AND PRIVATE MARKETS (Jeffrey R. Brown, ed. 2010).
[242] *Id.*
[243] It is important to note that policies mandating insurance coverage or performance bonds may be prohibitively costly for many low-income property owners who are also likely to be the least able to afford relocation if rebuilding prohibitions were set in place. Transferable development rights (TDRS), combined with a land bank, could be used to "insure" land for relocation of property owners who must be relocated.
[244] *See, i.e.*, Florida Association of Realtors, Seller's Real Property Disclosure Statement (2005) (Florida Real Estate Disclosure Form requires sellers to disclose whether the property is located in a special flood hazard area, requires flood insurance, and present or past flood or drainage problems).

> be required to record the most current FIRM designation associated with their property, as well as information regarding the history of flood damage in the Land Evidence Records. Ideally, this "risk-based" information should be collected by local tax assessors, updated as part of the routine tax re-assessment process, and used to form the basis for local risk-based special assessments and/or performance bonds levied and administered by the CT DEEP[245] to (1) protect public trust interests in water, access to the shore and subtidal lands, and the environment, and (2) help the State address public nuisances created by damage to properties located in high flood and erosion hazard areas.

In sum, it is important for coastal states like Connecticut to recognize that they have many well-established constitutional, common law, and statutory bases on which to justify precautionary action. Connecticut can also draw on the experiences of other jurisdictions in designing market-based, information and regulatory strategies to motivate responsible development in high-risk coastal zones. Of course, Connecticut's decisions regarding which strategies it ultimately chooses to pursue will depend on the way it balances its perception of the political and economic risks associated with trying to address climate change-related risks in a precautionary manner against the risks of failing to do so.

[245] CONN. GEN. STAT. §22a-107 (requiring performance bond as a condition to coastal site plan approval.)