

## APPENDIX





Good morning. My name is Anthony Broccoli and I am a Professor of Atmospheric Science at Rutgers University, Chair of the Department of Environmental Sciences, and Co-Director of the Rutgers Climate Institute. Thank you for the opportunity to come here today to talk about the science of climate change and, more specifically, how the effects of climate change are being felt in New Jersey.

Global average temperature has risen by approximately 2°F since the late 19th century. In each of the last four decades—the 1970s, 1980s, 1990s, and 2000s—temperatures at the earth's surface have been warmer than the previous decade, and warmer than any decade since modern thermometer records began. And the 2010s are on track to continue this trend.

During the past twenty years, the great ice sheets that cover most of Greenland and Antarctica have been shrinking, as have almost all mountain glaciers throughout the world. Based on trends going back to 1880, global sea level has been rising at an average of just under 7 inches per century. But sea level rise is accelerating. If we look at just the past 25 years, the global rate of sea level rise has almost doubled to about 13 inches per century.

The causes of these dramatic changes in global climate are well-understood. Heat-trapping gases in the atmosphere have increased as a result of human activities. The most important of these gases is carbon dioxide, which is released into the atmosphere by the

combustion of fossil fuels. The atmospheric concentration of carbon dioxide has reached levels that are unprecedented in at least the past 800,000 years, and its current concentration is approximately 45% higher than it was prior to the Industrial Revolution. Carbon dioxide is being emitted into the atmosphere at a rate of nearly 40 billion tons per year.

The basic physics of how carbon dioxide and other heat-trapping gases affect climate have been understood for well over a century. To maintain a consistent global temperature, the earth must send energy back into space in an amount that balances the energy it receives from the sun. Heat-trapping gases act as a blanket that makes it more difficult for the earth to send energy back into space, thereby making the earth warmer than it would be otherwise. The continued increase of these gases will lead to a continuation of the global warming trend that has been observed. Without a stabilization of the amount of heat-trapping gases in the atmosphere, the changes in climate that the world has experienced are expected to continue and intensify.

As might be expected in a warming world, future climate will feature more frequent and longer heat waves and fewer cold temperature extremes. But other aspects of climate are also associated with rising temperatures. Heavy rain events over middle latitude continents such as North America are expected to become more intense and more frequent as the climate warms. Global wind patterns may change in ways that have the potential to affect air travel. And, perhaps most

important, the rate of global sea level rise will continue to increase during the 21st century.

What about climate change in New Jersey? Looking back, New Jersey's average temperature has risen at a rate of just under 3°F per century, or somewhat faster than the global average. The six warmest calendar years on record have occurred since 1998, with 2012 being the warmest year. Summers have been unusually warm, with the seven warmest summers on record taking place since 1998.

Looking at extremes on a monthly basis, we can define an unusually warm month as one that is among the five warmest for that calendar month, and an unusually cold month as one that is among the five coldest. In recent years, unusually warm months have been far more prevalent than unusually cold months, outnumbering them by 35 to 0 since 2000. The trend toward higher temperatures is expected to continue in the decades to come as the concentrations of heat-trapping gases continue to increase.

Annual precipitation in New Jersey has undergone an upward trend of just over 2 inches per century since statewide records began in 1895. This trend is small compared with the year-to-year variability of precipitation. But increases in the amount of precipitation falling in heavy rain events have been noted throughout the northeastern United States, including New Jersey. By one measure, the frequency of these events has doubled over the past two decades. There is reason to

expect this trend will continue, as heavy precipitation events are anticipated to become more intense and more frequent as temperature increases, with implications for the frequency of inland flooding along New Jersey's rivers and streams.

Sea level rise along the New Jersey coast has been more rapid than the global average because the land is sinking at the same time that water levels are rising. At Atlantic City, where records extend back to 1912, sea level has risen by an average rate of 1.5 inches per decade. As the ocean continues to warm and glaciers and ice sheets continue to melt, sea level rise is expected to accelerate. According to a recent report produced by a team of scientists under the auspices of the New Jersey Climate Adaptation Alliance, central (or “middle-of-the-road”) estimates of sea level rise on the New Jersey coast relative to the year 2000 are 10 inches by 2030, 17 inches by 2050, and 28 to 41 inches by end of this century, with the values in 2100 dependent on the magnitudes of future carbon dioxide emissions.

The evidence for changes in storm activity, including tropical storms and hurricanes, is mixed and remains an area of active research. Recent studies suggest that the global frequency of tropical cyclones will either decrease or change little in response to global warming. But their average intensity is likely to increase, in terms of both maximum wind speed and rainfall, and the frequency of the most intense hurricanes is expected to increase.

What we would really like to know is how the risks to New Jersey from hurricanes and other storms will change in the future. Unfortunately, we do not yet have great confidence in regional projections of future storm activity. But there is high confidence that the impacts of future storms in the form of coastal flooding are likely to be more frequent and more severe, as rising sea levels raise the baseline for coastal flooding events. For example, some of my colleagues at Rutgers have estimated that Hurricane Sandy flooded an area 27 square miles greater than it would have if it had occurred in 1880, increasing the number of people living in areas inundated by the storm tide by ~38,000 in New Jersey alone. The future rise in sea level will likewise increase the areas at risk of coastal flooding.

Many of our traditional strategies for planning for future weather and climate events assume that they will look a lot like the events that we have experienced in the past. Climate change invalidates this assumption, creating a need to prepare for and adapt to conditions that will likely be quite different from what we have seen in the past.

Because the primary driver of future climate change is the emission of carbon dioxide into the atmosphere, there is the potential to mitigate the impacts of future climate change through the development of alternative sources of energy and policies to discourage carbon dioxide emissions. But regardless of what policy direction we ultimately follow, we are already experiencing changes in climate, and there is no realistic scenario in which future changes can be completely avoided. Thus it will be necessary to adapt to the changes in climate that are already

"wired in," even if mitigation policies are implemented to reduce carbon emissions. A combination of mitigation and adaptation will be required; it is not an "either-or" proposition.

Finally, it is important that the decisions that we make, here in New Jersey and elsewhere, should be informed by the best available science. At Rutgers, faculty and students from many departments, schools, and campuses are engaged in research that will lead to a better understanding of climate change and the development of solutions for mitigating climate change and adapting to its unwanted effects.

The Rutgers Climate Institute was formed to facilitate collaboration among climate change scholars across a broad range of disciplines in the natural, social and policy sciences. Rutgers scientists study the changes in climate and sea level that have occurred in the past in an effort to better understand the mechanisms that drive them. They use computer models to study the processes that drive changes in the atmosphere and ocean. They monitor conditions on land and in the coastal waters, using automated weather stations, ocean gliders, radar, and satellites. They study the effects of climate change on fisheries and on the forests of the Pinelands. Other research topics include the vulnerability of our residents to climate change and the impacts of climate change on agriculture here in the Garden State.

The Rutgers Energy Institute promotes research on the production, storage, and use of energy, including the development of alternative

energy sources such as bioenergy, solar, wind, and water. Rutgers is engaged in research on battery technology, green buildings, and energy-efficient transportation and supply chain management, to name but a few examples. All of these efforts are motivated by a desire to address what is arguably the most important environmental issue of the 21<sup>st</sup> century.

You will hear from other expert witnesses today who will discuss in greater detail some of the topics I've mentioned. To the committee chairs and to the committee members, I thank you again for the opportunity to talk with you today and provide an overview of this important issue.







**Testimony of Edward Lloyd, Evan M. Frankel Professor, Environmental Law at Columbia University Law School and Trustee, The Fund for New Jersey**

**Before the New Jersey Senate Environment and Energy Committee and Assembly Environment and Solid Waste Committee Joint Committee Meeting**

**August 10, 2017**

Good morning. Thank you for inviting The Fund for New Jersey to testify at today's hearing. My name is Edward Lloyd. I am a Trustee of The Fund for New Jersey. The Fund is a philanthropic foundation that has been active in New Jersey public affairs for nearly 50 years. Today, I will discuss the third report in The Fund for New Jersey's *Crossroads NJ* series. The title of the report is "Climate Change Adds Urgency to Environmental Protection." As the name of the Crossroad series suggests, our state is, indeed, at a crossroads. For years, the state has delayed making responsible decisions that would allow us to meet our fiscal obligations and to invest to help NJ's communities thrive. The *Crossroads NJ* reports offer options for how to confront problems head on.

The first report detailed the severity and urgency of the state's fiscal crisis, and recommended steps for New Jersey to take to get our fiscal house in order and get back to making the public investment so crucial to our well-being – like sage and reliable transportation, clean air and water, good education, and houses we can afford. The second report focused on jobs and the economy, and recommended policies that extend to everyone the opportunities that many enjoy—in a state where the cost of living is significantly higher than the national average. We emphasized expanding access to good jobs, more investment in small business, and job training plans that benefit both workers and New Jersey's employers.

The report I will discuss today is titled "Climate Change Adds Urgency to Environmental Protection." The report on both climate and environment emphasizes strong policies that are necessary to protect the natural resources of the garden state as well as the health and well-being of our residents. These policies have always been important. Now, because of the threats of climate change, they are urgent. For almost 50 years, the Fund for New Jersey has focused its philanthropy on improving the quality of life in our state. We support good policy decision-making, by making grants to nonprofit organizations in New Jersey.

This year, when New Jersey chooses a new Governor and Legislature, the Fund's Board decided that we needed to do more. *Crossroads NJ* reports present balanced and constructive recommendations on key issues. Our aim is to encourage informed and serious debate. We do not presume our recommendations are the only options. The Trustees do think, based on the evidence and input from experts, that the options presented are sound and workable. In addition to the three reports you have heard about, other issues covered include Criminal Justice, Transportation, education, and housing and land use.

I want to underscore that, as a philanthropic foundation, The Fund cannot—and does not—support candidates or take sides in partisan debates. As a courtesy, our reports are being sent to the candidates for governor. The recommendations in these reports are not based on any positions the candidates may have taken.

The Fund's climate change report demonstrates that climate change does indeed add urgency to environmental protection. A little history is instructive. 50 years ago, New Jersey saw serious threats to its physical and economic well-being. We became one of the first states to create a cabinet-level department to safeguard the environment and natural resources. That was a new idea in 1970.

New Jersey became a national leader in preserving open space; and protecting air and water quality; promoting recycling; cleaning up hazardous waste sites; and keeping people safe from toxic substances. We protected the pinelands, the highlands, and the meadowlands.

Today, we need that commitment again—for two reasons. First, climate change makes environmental protection more important than ever. Temperatures are rising and human activity is the main reason why—especially burning fossil fuels (that is, coal, oil, and natural gas). As the report states, summers in New Jersey are going to be as warm as Alabama is today.

Second, we have been backsliding in recent years. We have rolled-back rules on water quality management, on septic in the highlands, on a pipelines in the pines. And now the sea level is rising. That is a fact. The question is, "What are we going to do about it?"

The Fund's Climate and Environment report lays out common-sense ideas for how we can make sure New Jersey offers the best possible quality of life for the generations that come next.

It will not happen by itself. Starting with the next governor and legislature, it is up to the people and leaders of New Jersey to grasp the scientific realities that face us and take the actions that are needed.

The Fund report is an action plan for restoring environmental protection in New Jersey. It covers a lot of ground (and air, and water) because the challenges we face are so vast.

I won't mention every recommendation, though I urge you to look at all of them and to understand that all these issues are connected to each other—and that we need to take a comprehensive approach to make sure we address every aspect of how climate change threatens New Jersey's well-being.

The report covers four main areas: Advancing Clean, Homegrown Energy; Preserving and Protecting Water Supply and Quality; Invigorating State and Regional Planning; and Ensuring Environmental Justice.

Advancing clean, homegrown energy is the best way to reduce dangerous carbon emissions. NJ Should rejoin the Regional Greenhouse Gas Initiative. We should step up efforts on renewable energy sources, mandating that 80% of electricity comes from those sources by 2050; doing

more to move ahead with offshore wind; and adopting meaningful standards for saving energy. We should stop the diversions from The Clean Energy Fund and go back to using the money as it was intended: for clean energy projects and technologies. We should place a moratorium on all pending pipeline projects and undertake a review to determine whether they are necessary, safe, and consistent with reducing the impact of climate change.

Preserving and protecting water supply, and water quality, is especially important as erratic precipitation patterns due to climate change affect the amount of water in reservoirs and aquifers. Without safe and abundant water resources, New Jersey cannot overcome the impacts of climate change. We should restore and strengthen Clean Water Act protections. We should update the state Water Supply Master Plan. We should assess all state water programs and make all necessary repairs and improvements.

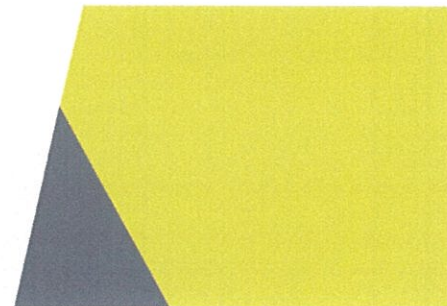
State and regional planning used to be the backbone of environmental protection in New Jersey; we were a national leader and we need to be again. We should develop a climate-action plan to address threats to the coast from rising sea levels. The shore protection master plan is 35 years old, predating decades of development, Superstorm Sandy, the latest climate change revelations, and sea-level rise. We should update the State Development and Redevelopment Plan, Pinelands Comprehensive Management Plan, and Highlands Regional Master Plan to address today's threats and tomorrow's.

The fourth key area is to bring Environmental Justice to New Jerseyans who suffer disproportionate dangers because of where they live—often in urban, economically distressed areas. No state regulatory approval or funding should be given for any development before it is screened to make sure that it does not add to pollution burdens in such communities. We should significantly step up efforts to test for lead and reduce exposure. We should reduce diesel emissions. And we should develop emergency plans to address the impacts of climate change—involving community residents, local groups, and environmental justice organizations.

As the report makes clear, time is not on New Jersey's side. Challenges that previously were little known now turn out to be substantial threats to residents' well-being. And in many instances, the situation is worsened because of action deferred and protections weakened. From rejoining the Regional Greenhouse Gas Initiative to developing a Shore Master Plan to protecting economically struggling communities, restoring New Jersey to national environmental leadership is about far more than bragging rights. The state's quality of life is on the line.

Thank you. I am happy to answer any questions.





## Prologue: At the Crossroads

### **These are not the best of times for New Jersey.**

Despite New Jersey's strengths—our location so close to major markets, our diverse and talented population, our history of prioritizing education and environmental protection—the future prosperity of our state is at risk. We have, for years, refused to make the public investments needed for New Jersey's communities to thrive and, by those decisions, have squandered our potential. We must, now, face the consequences of our choices, both the pressing needs we have ignored and the continuing impacts of the 2008 recession and Superstorm Sandy.

Yet, the “crossroads” we have reached is also a time of opportunity. The election of a new governor and a new Legislature in 2017, coupled with the urgency of the issues we must confront, create a unique moment in which it will be possible to set a new, sustainable course. This is the time for us to confront New Jersey's problems head on and to seek consensus on the policies that divide us. Inaction is a “road” no longer open.

The Fund for New Jersey's Board of Trustees has directed and participated in the preparation of a series of reports aimed at informing debate in this pivotal year. As the name of the project suggests, *Crossroads NJ* builds on our state's history and values, where we have come from, and outlines the “policy choices that define our future.”

### **The Board chose seven topics for exploration:**

- **State Fiscal Policy:** New Jersey's state finances are in terrible shape and getting worse; today, we are unable to meet our fixed obligations or to make the discretionary investments required to promote widespread prosperity.
- **Climate and Environment:** Climate change threatens all of us; New Jersey's coastline, drinking water supply, air, and other precious resources must be protected or the health of our residents and our communities will suffer.
- **Criminal Justice:** Racial and economic inequity permeate our system, which delivers punishments that are more punitive than needed to keep the public safe; New Jersey must find ways to eliminate mass incarceration.

The election of a new governor and a new Legislature in 2017, coupled with the urgency of the issues we must confront, create a unique moment in which it will be possible to set a new, sustainable course.



The Fund's aim is to present a set of balanced and constructive recommendations that build a foundation for discussion.

- **Education:** Some New Jersey children go to the best public schools in the United States while others struggle to learn in highly segregated urban schools; we have an obligation, embedded in our state constitution, to remedy educational disparities.
- **Housing and Land Use:** The cost of housing in New Jersey is among the highest in the nation; updated land use planning and strategic investments in cities and towns will make housing more affordable.
- **Jobs and the Economy:** New Jersey's economy is lagging behind that of its neighbors; we must expand support for business owners and workers by encouraging innovation and growth.
- **Transportation:** Years of neglect have taken their toll on a road and rail network crucial for moving people and goods through the nation's most densely populated state; our safety and prosperity depend on revitalizing New Jersey's infrastructure.

Each of these issues, separately, affects us in different and important ways; together, they are interrelated. That is, a strong economy depends on a well-educated workforce; modernizing the state's transportation infrastructure cannot happen without getting the state's finances in order; and, good land use policy leads to a healthy environment and thriving neighborhoods that families can afford.

Since 1970, [The Fund for New Jersey](#) has focused its philanthropy on improving the quality of life in the Garden State by supporting good policy decision-making. Most of its resources are used to make direct grants to diverse nonprofit organizations across the state. The Trustees—Republicans and Democrats alike—seek clear-eyed, evidence-based, nonpartisan solutions that expand opportunities for all New Jerseyans. *Crossroads NJ* does not back a candidate, party, or ideology but, rather, presents ideas, thought through by experts, that the Trustees feel are sound and workable.

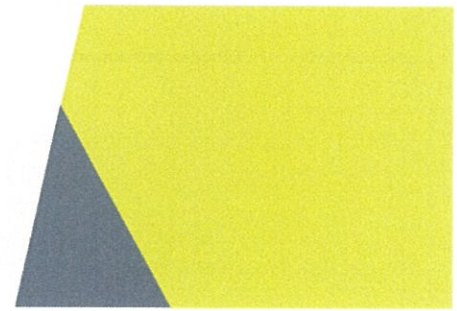
The *Crossroads NJ* reports do not offer easy answers. They are meant to convey urgency, not to discourage, to promote aspiration and action, not blame. The Fund's aim is to present a set of balanced and constructive recommendations that build a foundation for discussion. The Trustees do not presume that their recommendations are the only available options; our hope is to encourage serious debate consistent with The Fund's long-term mission.

Not every challenge facing New Jersey is under state policymakers' control. Federal policy is very much in flux and decisions made in Washington, D.C., will affect all of the states. For New Jersey, proposals to increase enforcement of immigration laws would be devastating for many of our 500,000 undocumented immigrant residents and their families and would have significant economic consequences throughout the state. Similarly, health care for more than 500,000 other New Jersey residents remains precarious while federal policies related to Medicaid and the Affordable Care Act are debated. In addition, there are threats to cut federal support for major transportation projects and clean energy programs.

This uncertainty at the federal level heightens the need for responsible and strong state policies.

New Jersey has the ability to put its fiscal house in order and to achieve constructive change. The Fund offers *Crossroads NJ* as a guide to action.

Approved by the Trustees of The Fund for New Jersey. Tom Byrne did not participate in the *Crossroads NJ* project because he was actively considering becoming a candidate for governor.



## SUMMING UP:

# Climate Change Adds Urgency to Restoring Environmental Protection

Facing serious impending dangers from climate change, New Jersey needs, more than ever, to restore protecting its environment to the prominent role necessary for a healthy, secure future.

New Jersey is vulnerable to the hotter, wetter weather and rising seas produced by climate change. Our geography and dense development—more than half the state's people live in a coastal county—contribute to substantial threats to residents' well-being. And, in many instances, the situation is worsened because of action deferred and protections weakened. Restoring New Jersey to national environmental leadership is about far more than bragging rights. The state's quality of life is on the line.

Our economic and physical health depend on devoting attention, leadership, and financial resources to execute common-sense policies in four key areas that address the scientific realities of climate change.

- Energy Policy
- Water Supply and Quality
- State and Regional Planning
- Environmental Justice

Each of these areas is important on its own. Together, they must be part of a sustained, well-coordinated effort to prevent climate change from being disastrous for New Jersey.

## Key Recommendations

**New Jersey needs to advance the use of renewable energy, substantially reduce carbon emissions, and use energy more efficiently.**

- Rejoin the Regional Greenhouse Gas Initiative, a multi-state collaborative proven to reduce carbon dioxide levels and promote energy efficiency while at the same time generating revenue to fund clean energy programs.
- Require a 25% reduction in emissions for power plants located in economically disadvantaged communities.
- Mandate that 80% of all electricity sold in the state comes from renewable sources by 2050.



- Increase efficiency standards for energy use, utilities, appliances, and construction.
- Create a statewide hub for “green jobs” training, modeled on successful programs in Trenton and Newark.
- Take the necessary steps to move ahead with offshore wind projects, including creation of Offshore Wind Renewable Energy Credits as the financing mechanism necessary for investment in wind projects.
- Place a moratorium on all pending pipeline projects and conduct a review to determine whether they are necessary, safe, and consistent with the state’s goals to reduce the adverse impacts of climate change.

**The state needs to maintain safe and abundant water resources, recognizing that the health and well-being of New Jerseyans depend on water supply and quality.**

- Restore and strengthen Clean Water Act protections after years of rollbacks.
- Update the state Water Supply Master Plan.
- Adopt strict standards limiting contaminants in drinking water.
- Require the Pinelands Commission and Highlands Council to update their plans to address the impacts of climate change.

**New Jersey needs to preserve and protect its shoreline and open space, to prevent harm to residents and natural resources threatened by climate change.**

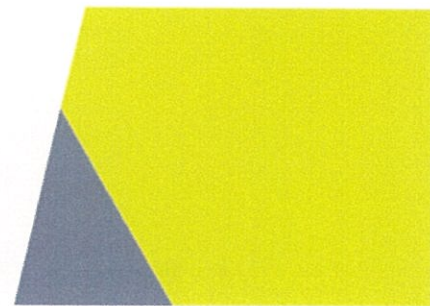
- Develop a climate-change action plan to address threats from rising sea level to large swaths of the coast, with effective growth management strategies, sustainable-development practices, and protective shoreline-management plans.
- Update the State Development and Redevelopment Plan, Pinelands Comprehensive Management Plan, and Highlands Regional Master Plan to address threats New Jersey faces.
- Strengthen state and regional planning agencies.

**A well-designed response to climate change would improve conditions for many people in New Jersey who suffer disproportionately from health problems because of pollution where they live.**

- Impose a moratorium on state regulatory approval or funding for any development that has not been screened to ensure it does not add to pollution burdens already imposed on economically struggling communities or communities of color.
- Increase significantly efforts to test for—and lessen exposure to—lead, and identify new sources of funds to assist with reducing health risks.
- Improve air quality by significantly reducing pollution.
- Develop adaptation and emergency plans to address the impacts of climate change, with the involvement of community residents, local groups, and environmental justice organizations.

*Climate Change Adds Urgency to Environmental Protection* is one of seven reports in the *Crossroads NJ* series produced by The Fund for New Jersey to inform debate in this pivotal election year. The full text of the reports and other information about *Crossroads NJ* are available at [www.fundfornj.org/crossroadsnj](http://www.fundfornj.org/crossroadsnj). If you have questions about *Crossroads NJ*, email [crossroadsnj@taftcommunications.com](mailto:crossroadsnj@taftcommunications.com).





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For immediate release

Contact:  
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## ***Crossroads NJ* Report Calls for Pipeline Moratorium, Other Steps to Combat Climate Change**

### ***Renewable Energy, Better Planning Among Key Needs***

TRENTON (July 19, 2017) — “Facing serious impending dangers from climate change, New Jersey needs, more than ever, to restore protecting its environment to the prominent role necessary for a healthy, secure future,” a new report from The Fund for New Jersey says.

The report, “Climate Change Adds Urgency to Restoring Environmental Protection,” is the third in the seven-part *Crossroads NJ* series aimed at informing public debate in this pivotal election year. It was produced by [The Fund for New Jersey](http://www.fundfornewjersey.org), which since 1970 has focused its philanthropy on improving the quality of life in the Garden State by supporting good policy decision-making. The other *Crossroads NJ* reports cover the state’s fiscal crisis, jobs and the economy, criminal justice, education, housing and land use, and transportation.

The full text of the reports, as they are released, and other information about *Crossroads NJ* is available at [www.fundfornewjersey.org/crossroadsnj](http://www.fundfornewjersey.org/crossroadsnj).

Calling for “a sustained, well-coordinated effort to prevent climate change from being disastrous for New Jersey,” the report notes, “Our economic and physical health depend on devoting the leadership, financial resources, and attention to scientific realities needed to execute common-sense policies.” It calls for action in four areas:

- Energy policy, including more reliance on wind, solar, and other renewable sources
- Water supply and quality, necessary for our health and well-being
- State and regional planning, to safeguard natural resources and communities threatened by climate change
- Environmental justice, so people do not suffer disproportionately from pollution and environmental problems because of where they live

Key recommendations include:

#### **ENERGY SOURCES & EFFICIENCY**

- Rejoin the Regional Greenhouse Gas Initiative, a multi-state collaborative proven to reduce carbon dioxide levels and promote energy efficiency while at the same time generating revenue to fund clean energy programs.

- Mandate a 25% reduction in emissions for power plants located in economically disadvantaged communities.
- Require 80% of all electricity sold in the state to be from renewable sources by 2050.
- Create a statewide hub for “green jobs” training.
- Move ahead with offshore wind projects, including creation of Offshore Wind Renewable Energy Credits as the financing mechanism necessary for investment in wind projects.
- Place a moratorium on pending pipeline projects and determine whether they are necessary, safe, and consistent with reducing adverse impacts of climate change.

#### **MAINTAINING WATER SUPPLY & QUALITY**

- Restore and strengthen Clean Water Act protections after years of rollbacks.
- Update the state Water Supply Master Plan.
- Adopt stronger standards on contaminants in drinking water.
- Require the Pinelands Commission and the Highlands Council to update their plans to address impacts of climate change.

#### **BETTER PLANNING TO PRESERVE AND PROTECT THE SHORE AND OPEN SPACE**

- Develop a climate-change action plan for the shore to address consequences of rising sea level that threatens large areas of the coast.
- Update the State Development and Redevelopment Plan, Pinelands Comprehensive Management Plan, and Highlands Regional Master Plan.

#### **PROMOTING ENVIRONMENTAL JUSTICE**

- Withhold state regulatory approval or funding for any development not screened to ensure it does not add to pollution burdens for economically struggling communities or communities of color.
- Increase significantly efforts to test for — and lessen exposure to — lead, and identify new sources of funds to assist with reducing health risk.
- Develop emergency plans to address the impacts of climate change, with involvement of community residents, local community groups, and environmental justice organizations.

“The aim of *Crossroads NJ* is to present evidence-based policy recommendations, generated and vetted by experts, that The Fund for New Jersey Trustees feel are sound and workable,” said Board Chair, retired Chief Justice Deborah T. Poritz.

Consistent with The Fund’s status as a philanthropic foundation, The Fund for New Jersey does not support candidates or political parties.

###



CLIMATE AND ENVIRONMENT

## CLIMATE CHANGE ADDS URGENCY TO RESTORING ENVIRONMENTAL PROTECTION

# Climate Change Adds Urgency to Restoring Environmental Protection

If a single public policy issue embodies the phrase “Think globally, act locally,” it is climate change.

**Facing serious dangers from climate change, New Jersey needs more than ever to restore protecting its environment to the prominent role necessary for a healthy, secure future.**

Nearly 50 years ago, New Jersey recognized substantial threats to the health of its residents and to the state's economic well-being and became one of the first states to create a cabinet-level department charged with safeguarding the environment and natural resources. The state became a national leader in such areas as regulating land use to preserve open space and guide development, protecting air and water quality, promoting recycling, identifying and remediating hazardous waste sites, and keeping the public safe from toxic substances.

Now, our economic and physical health depend on devoting attention, leadership, and financial resources to adopt and execute common-sense policies in four key areas that address the scientific realities of climate change.

- Energy Policy
- Water Supply and Quality
- State and Regional Planning
- Environmental Justice<sup>1</sup>

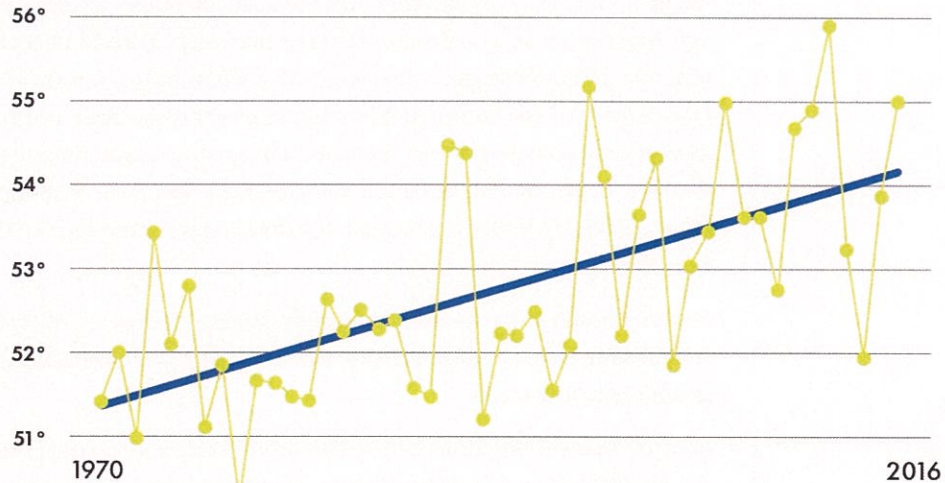
Each of these areas is important on its own. Together they should be part of a sustained, well-coordinated effort to prevent climate change from being disastrous for New Jersey.

If a single public policy issue embodies the phrase “Think globally, act locally,” it is climate change. Globally, climate change threatens humanity's existence.

The overwhelming scientific consensus is that an alarming rise in average temperature over the past century is due to human activity—especially burning fossil fuels (oil, coal, natural gas), which increases carbon dioxide and other greenhouse gases in the atmosphere. New Jersey experiences climate change in the form of increased rainfall, higher temperatures, rising sea level, and an increase in the frequency and severity of extreme weather events. Average annual temperatures, after creeping upward for most of the 20th century, jumped by 1.2 degrees Fahrenheit in the first decade of the 21st century,



### New Jersey Warming Since the First Earth Day

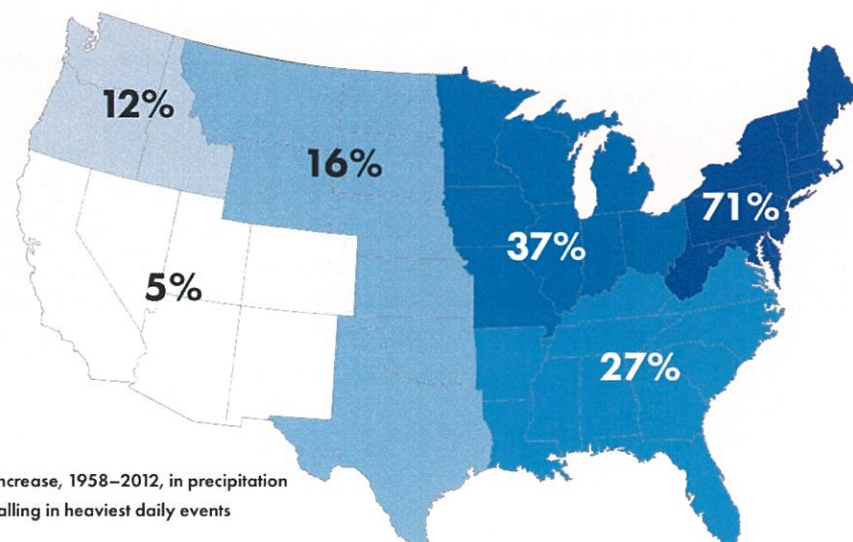


Source: Climate Central (Average Annual Temperature per NOAA/NCEI)<sup>2</sup>

to an average of 53.9°F in the period 2000-2010,<sup>3</sup> from 52.7°F in 1971-2000. The number of days over 90°F rose by 36% since 1949.<sup>4</sup> January through June 2016 was the warmest six-month period ever recorded, with average temperatures 1.3°F warmer than in the late 1800s.<sup>5</sup>

Researchers predict hotter, wetter weather. New Jersey's mean annual temperature is expected to increase by 3 to 5 degrees Fahrenheit by the 2050s, and by 4 to 7.5 degrees Fahrenheit by the 2080s. Summers in the Garden State will be as warm as they are in Alabama today. Precipitation is expected to increase by 10% to 20%.<sup>6</sup> Such changes in temperature and rainfall, which might not seem dramatic, would significantly affect agriculture and plant and animal life, and exacerbate both flooding and droughts.

### Heavy Downpours Increasing



Increase, 1958–2012, in precipitation  
falling in heaviest daily events

Source: Climate Central<sup>7</sup>



The nature of New Jersey's energy supply and demand poses serious challenges to the effort to reduce harmful emissions.

Dense development, rising seas, and other factors make New Jersey's coast highly vulnerable to climate change. The sea level along the New Jersey coastline has risen by about 1.5 inches every 10 years over the past 100 years—nearly twice the global average. And the sea level is projected to rise between 1.0 and 1.8 feet by 2050 regardless of future greenhouse gas emissions, with a worst-case scenario of 2.8 feet.<sup>8</sup> The state Department of Environmental Protection predicts the large storms that occur every 20 years will come every five years by 2050, greatly increasing the potential for coastal damage. By the end of the century, 1% to 3% of New Jersey's shoreline is likely to be lost to rising sea levels, and occasional flooding will inundate 6.5% to 9% of the state's coastal area.<sup>9</sup>

Altered rainfall patterns associated with climate change are likely to increase the intrusion of saltwater into the Delaware River and Bay and coastal aquifers, threatening New Jersey's drinking water.

Because many predictions of the dangers from climate change extend over decades, it can be difficult to get policymakers to take immediate and decisive action. For elected officials whose terms will expire long before the most severe predicted consequences, the easiest decision often is to do nothing. Today, that is not good enough. Much more needs to be done in New Jersey to confront climate change.

Specifics are described in the sections below. In many cases, these measures have cross-cutting relevance beyond the section in which they are listed. The magnitude of the threats that climate change poses to New Jersey creates overlapping areas of concern requiring aggressive steps.

### **Advancing Clean, Homegrown Energy**

The nature of New Jersey's energy supply and demand poses serious challenges to the effort to reduce harmful emissions.

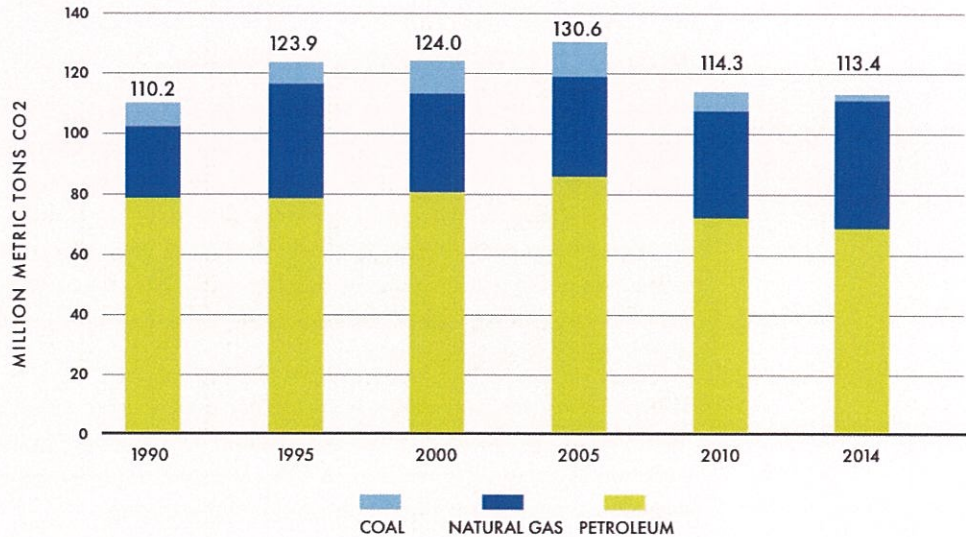
New Jersey's electricity portfolio, when last reported in 2015, included 49.5% that was generated through the use of natural gas.

Nuclear plants provided 44.5%, and only 2% came from coal. Coal usage, which has been declining sharply since 2006, now is close to zero: in June 2017, Public Service Electric & Gas closed the state's two largest and oldest remaining coal-fired power plants, leaving two smaller plants.

Despite that, overall emissions from energy generation declined by only 8% from 2006 to 2015.<sup>10</sup> Heavy reliance on the burning of natural gas was the reason the drop was not greater. Gas-fired generation in New Jersey increased dramatically—by 51% from 2013 to 2016 (surpassing nuclear power)—and that brought a significant increase in carbon dioxide (CO<sub>2</sub>) from combustion.<sup>11</sup> When methane emissions from natural gas are taken into account, the situation became even more serious, given that methane is a more potent greenhouse gas than CO<sub>2</sub> in the short run.



**New Jersey  
Emissions Decline  
Stalled by  
Natural Gas**



Data show emissions from all sectors: industrial, commercial, residential, electrical, and transportation.

Source: U.S. Energy Information Association<sup>12</sup>

The trend away from nuclear power is likely to accelerate when the Oyster Creek nuclear plant, responsible for about 4% of in-state generation, closes in 2019.

PSEG has raised concerns about the financial viability of its nuclear plants in New Jersey. For New Jersey, then, emissions reductions from electricity production is a matter of reducing natural-gas generation while substantially improving efficiency and increasing renewable energy production.

On the demand side, New Jerseyans' energy consumption is lower than the national average. The state ranks 37th in per-capita energy consumption.<sup>13</sup>

#### **LIMITING CARBON EMISSIONS**

New Jersey was once among the leading states in a cooperative effort to reduce carbon dioxide emissions, which included the "California Car" program, the 2007 state Global Warming Response Act, the 2008 state Energy Master Plan, and a regional cap-and-trade<sup>14</sup> agreement. The state was among seven that in 2005 established the Regional Greenhouse Gas Initiative,<sup>15</sup> the nation's first mandatory cap and trade program. States participating in RGGI commit to capping their carbon emissions and requiring power plants to purchase allowances in order to emit specific amounts of carbon. Three more states joined in 2007. Then New Jersey dropped out in 2011.

## RECOMMENDATION

### Rejoin the Regional Greenhouse Gas Initiative.

RGGI has proven to be a useful way to reduce carbon dioxide levels and promote energy efficiency. RGGI participants allocate CO<sub>2</sub> allowances largely through regional auctions that generate money for the states to reinvest in energy-saving programs. Through 2014, states used nearly \$1.4 billion in this way, with each state deciding how to spend its share. New York, for example, in 2016 launched a \$16 million initiative that helps municipalities reduce energy consumption and promote clean energy use. Since RGGI began, power sector pollution is down 45% in the participating states.

If New Jersey rejoined RGGI, it should dedicate a stated share of funds from CO<sub>2</sub> auctions for use in urban areas and communities of color where harm caused by pollution is greatest. In addition, a 25% reduction in emissions should be mandated for power plants located in such neighborhoods.

## PROMOTING CLEAN ENERGY

The safest, most efficient energy future for New Jersey is clean, renewable energy such as wind and solar, combined with reduced energy waste. The state Senate has twice voted overwhelmingly to enact the Renewable Energy Transition Act. RETA would require that 80% of all electricity sold in the state “shall be from Class I renewable energy sources” by 2050. Class I sources include solar photovoltaic, wind, and methane gas from landfills.

RETA sets up a schedule of increases, starting with 20% renewables by 2020 and increasing the target by 10% every five years, reaching the full 80% level by 2050. The amount of electricity sold in the state from renewable sources—nearly zero just 10 years ago—is currently less than 10%.

Enactment of RETA would make New Jersey one of the leading states in the use of renewables. The California Senate has adopted legislation to speed its transition to 50% renewable energy by 2026 and to move to 100% renewable energy by 2045. Hawaii enacted a 100% renewable energy mandate by 2045. New York is committed to achieve 50% renewable energy by 2030.

## RECOMMENDATION

**Mandate that 80% of all electricity sold in the state comes from renewable sources by 2050. Pass the Renewable Energy Transition Act to move immediately toward this mandate.**





The state is not on track, nor does it have a plan, to meet the 2050 emissions reduction goals.

### LONG-TERM ENERGY PLANNING TO MEET EMISSION TARGETS

Chief among existing New Jersey state laws addressing climate change is the Global Warming Response Act (GWRA), passed in 2007. It calls for reducing greenhouse gas emissions to 1990 levels by 2020, and sets a target of further reducing emissions to 80% below 2006 levels by 2050. The state is not on track, nor does it have a plan, to meet the 2050 goals. In fact, as already noted, emissions reductions in the electricity generation sector have slowed due to the significant increase in gas-fired electric generation.

The law would be even more effective if it set specific targets for increased renewables such as wind and solar and for reduced energy use.

#### RECOMMENDATION

**Require a Clean Energy Master Plan, to be updated every five years, that establishes a pathway to achieve the statewide target for 2050. It should include analysis and interim emissions targets by sector for 15 years.**

**Adopt a measurable, accountable energy-saving goal of 30% below 2015 levels for electric and natural gas usage in New Jersey by 2030.**

This goal is to be reached by reducing residential, commercial, and industrial energy consumption; reducing vehicle miles and increasing the proportion of low- and zero-emission vehicles on the road; shifting from fossil fuels to renewable sources (solar, wind, geothermal); and fostering land-use patterns that preserve and protect open space, tidal marshes, and forests.

### MAKE ENERGY EFFICIENCY A WAY OF LIFE

Climate change and other 21<sup>st</sup>-century considerations require giving more attention to how the places where New Jerseyans live and work are built and operated.

#### RECOMMENDATION

**Establish an Energy Efficiency Portfolio Standard that requires utilities to meet a minimum level of energy efficiency each year and includes incentives to achieve higher energy efficiency gains.<sup>16</sup>**

As of January 2017, 26 states had fully funded policies in place, with specific energy savings targets that utilities or non-utility program administrators must meet through customer energy efficiency programs.



## RECOMMENDATION

**Increase minimum energy efficiency standards for household and commercial appliances, codified in law and regulation; and update state construction code standards for new commercial and residential buildings.**

**Set a goal to accelerate wider-scale development of “net zero” homes and buildings — those where the amount of energy consumed yearly is about the same as the amount of renewable energy created there.**

An aggressive policy would require all new homes built in the state to be net zero by 2020, and all new commercial buildings by 2030.

## MAKE STATE GOVERNMENT A STRONGER PARTNER

Energy efficiency is important enough to be promoted more actively at the state level.

## RECOMMENDATION

**Establish a state agency or authority to drive energy efficiency measures, monitor and evaluate the success of current and future measures, and develop innovative ways to reduce energy use.**

Such an agency should prioritize low-income communities.

State officials also could play a larger role in helping residents learn about and prepare for job opportunities that can come from energy efficiency.

**Create a statewide hub for “green jobs” training, modeled on successful programs in Trenton and Newark.**

Examples of green jobs include stormwater management, cleaning up “brown-fields” for reuse, urban forestry, and assessing buildings to see whether they meet energy efficiency standards. This effort could leverage federal and state job-training funds and involve renewing the state tax credit for employers that hire graduates of the program.

## DEALING WITH VEHICLE POLLUTION

Greenhouse gases also originate from mobile sources, primarily motor vehicles. At least until the new administration took over, the U.S. Department of Transportation had steadily toughened Corporate Average Fuel Economy (CAFE) standards to meet more stringent greenhouse gas emissions standards set by the U.S. Environmental Protection Agency. New Jersey, in turn, adopted the California Car program,<sup>17</sup> requiring passenger vehicles and light-duty trucks sold after Jan. 1, 2009, to meet the EPA’s strictest vehicle emissions standards, and creating incentives for Zero Emission Vehicles.

Regardless of where federal policy goes next, the improved fuel efficiency of cars and the increasing number of low- and zero-emission vehicles on New Jersey's roads show the effectiveness of the CAFE standards and the California Car program. Their salutary effect, however, is at least partially offset by steady growth in miles traveled by New Jersey motorists: 75.4 million miles in 2015, compared with 72.8 million in 2009.<sup>18</sup>

#### RECOMMENDATION

**Expand electric car infrastructure by participating in the regional Transportation and Climate Initiative on electric vehicles, and support proposed expansion of CAFE standards for cars and light trucks during the National Highway Traffic Safety Administration program review.<sup>19</sup>**

The Transportation and Climate Initiative is a collaboration of 12 Northeast and Mid-Atlantic jurisdictions that seek to develop the clean energy economy and reduce greenhouse gas emissions in the transportation sector. CAFE standards are adopted pursuant to the law that Congress passed in 1975 to improve average fuel economy of cars and light trucks manufactured for sale in the U.S.

**Accelerate expansion of fast charging stations for electric vehicles on the state's roadways, modeled on the U.S. Department of Transportation's "alternative fuel corridors" initiative.**

New technology requires commitment of state resources. Gas stations along highways are of no use to owners of electric cars, and electric car infrastructure is a must if such vehicles are to help address New Jersey's pollution problems.

#### HARNESSING WIND FOR POWER

The Offshore Wind Economic Development Act, adopted in 2010, authorized the state Economic Development Authority to provide tax credits for qualified facilities in wind energy zones. There has been no effort to implement this law, however—costing New Jersey jobs, renewable energy, and investments that offshore wind projects generate in other states. New Jersey has significant potential generation capacity, and with greater support from policymakers the state is positioned to be a national leader on offshore wind projects.<sup>20</sup>





New Jersey should promote additional growth in solar by considering policies that other states have recently implemented to foster the solar market.

## RECOMMENDATION

**Take the necessary steps to move ahead with offshore wind projects, including creation of Offshore Wind Renewable Energy Credits as the financing mechanism necessary for investment in wind projects.**

Other states already have begun awarding ORECs. New Jersey needs to catch up, starting with a definitive evaluation of the potential for offshore wind, including capacity, preliminary siting scenarios, and an economic analysis to determine the cost to utility consumers. The Offshore Wind Economic Development Act mandates that the Board of Public Utilities take into account the cost of a project and conduct a cost-benefit analysis. The bid process and the cost of ORECs will provide a clear snapshot of the expected cost of the project for utility customers. BPU's analysis should examine the outright cost of the energy as well as the social cost of carbon (including projected sea-level rise). This calculation would offset the higher initial cost currently of renewable energy with the future cost of fossil fuel energy, and would factor in cost-reductions in the clean energy technology.

With the goal of reaching 3,000 megawatts of offshore wind by 2025 and 5,000 megawatts by 2030, an ongoing comprehensive ocean planning process will inform decisions on siting and size.

## PROMOTE CONTINUED DEVELOPMENT OF SOLAR POWER

New Jersey has been a nationally recognized leader in solar power development, ranking first on the East Coast and among the top three states nationwide in installed solar capacity. In 2015, solar power became the state's largest source of renewable electricity.

New Jersey should promote additional growth in solar by considering policies that other states have recently implemented to foster the solar market. For example, New York implemented a public/private partnership, called NY-Sun, that coordinates and expands existing solar programs, including that of PSEG Long Island, to support solar expansion. The cost of utility grid solar has significantly decreased in New York. Delaware and Connecticut now use a bidding system for inclusion in long-term contracts, with some solar companies bidding zero charges for the first three or four years to gain the security of the longer term.

## RECOMMENDATION

**Expand solar to about 15% of New Jersey's energy mix by 2030, and help reach that goal by adopting a program to reduce costs to residences and businesses.**

**Direct New Jersey's Board of Public Utilities to undertake a comprehensive review of best practices nationally and make recommendations for further strengthening and expanding New Jersey's solar capacity through a public process.**



## USE CLEAN ENERGY FUND AS INTENDED

New Jersey slowed its move to clean energy by diverting more than \$1.3 billion that utility customers had paid into programs designed to reduce energy use and promote development of renewable energy sources. These diversions for other purposes continued under the state budget adopted for the fiscal year starting July 1, 2017.

### RECOMMENDATION

**Use money from the Clean Energy Fund exclusively for energy efficiency, clean energy projects, and innovative clean energy technologies.**

Raiding this fund and others is a counterproductive practice that delays a meaningful solution to the state's fiscal problems and sets back efforts to improve residents' well-being in important areas. This needs to stop. If legislators and the governor summoned the will, they could generate the resources needed for top state priorities.

At least 40% of yearly allocations from the Clean Energy Fund should go to energy efficiency and renewable energy projects in New Jersey's urban areas and communities of color.

## PIPELINE PROLIFERATION

New Jersey's increased reliance on natural gas for electricity has serious drawbacks. Though natural gas burns more cleanly than oil or coal, it is a non-renewable fossil fuel, with high levels of carbon dioxide, and it brings a dramatic increase in emissions of methane—a powerful greenhouse gas that absorbs 25 times as much heat as CO<sub>2</sub> does. In addition to the climate impact, there are direct local effects: some power plants fueled by natural gas, including the Newark Energy Center, are in economically distressed neighborhoods and communities of color, where they contribute to air pollution that already is at disproportionately high levels.

A growing share of the natural gas reaching New Jersey comes from hydraulic fracturing ("fracking") in Pennsylvania. To carry this product from source to end users elsewhere in the U.S. and overseas, new pipelines have been proposed for New Jersey. Already, 1,520 miles of pipelines crisscross the state. Serious questions have been raised about the dangers these pipelines pose to public health and ecologically sensitive lands and habitat—explosions, as well as accidents, leaks, and spills—as well as about whether more pipelines are being proposed than needed to meet demand.

## RECOMMENDATION

**Place a moratorium on all pending pipeline projects and conduct a review to determine whether they are necessary, safe, and consistent with the state's goals to reduce the adverse impacts of climate change.**

Such an assessment would include determining pipelines' impact on New Jersey's ability to meet targets under the Global Warming Response Act.

**Ensure that pipelines do not damage critical natural resources, by using the state's full authority under the Clean Water Act and state regulations.**

This would help prevent the approval of projects that are inconsistent with the regional plans protecting the Pinelands and the Highlands.

## Preserving and Protecting Water Supply and Quality

Many factors affect the quality and quantity of drinking water available to New Jerseyans. Erratic precipitation patterns change the amount of water in reservoirs and aquifer-recharge areas. Residential development increases the demand for water while reducing the open space that absorbs rainwater and recharges the supply of ground water. Pollution taints the water drawn from reservoirs and wells.

For maximum effectiveness of state and federal laws enacted to protect water, sound water- and land-use planning is essential. That means knowing where water will come from, how much is needed in the future, and what steps must be taken to ensure water quality.

Failure to update New Jersey's Water Supply Master Plan since 1996 means important information is lacking. Many county water-quality management plans are out of date as well.

## RECOMMENDATION

**Restore and strengthen Clean Water Act protections.**

In recent years, rollbacks of Water Quality Management Planning, septic rules in the Highlands, the Coastal Area Facility Review Act, and other rules and regulations have jeopardized water resources and put New Jersey in a worse position to meet the state's clean water needs. Without safe and abundant water resources, New Jersey cannot overcome the impacts of climate change.

**Update the state Water Supply Master Plan.**

The last Water Supply Master Plan was adopted by the NJDEP in 1996. New Jersey law requires that the plan be updated at least once every five years, but release of the update was delayed for over 15 years, costing New Jersey valuable time and depriving residents of the opportunity to evaluate strategies for maintaining an adequate supply of clean water. The DEP finally released a draft Water Supply Master Plan in spring 2017, but it is primarily a recapitulation of existing data. It fails to go into sufficient detail about vulnerable sub-watersheds and falls significantly short in proactively planning for New Jersey's water supply needs.





An extensive inventory of New Jersey's drinking water infrastructure is long overdue.

## WATER QUALITY

The state Drinking Water Quality Institute, an expert panel responsible for developing standards for hazardous contaminants in drinking water, rarely meets. There has been very little implementation of new or more-stringent standards the DWQI has recommended for at least 12 years for about 16 contaminants.

### RECOMMENDATION

**Adopt the standards on contaminants in drinking water proposed by the Drinking Water Quality Institute.**

The standards include a recommendation for the strictest health standard in the nation for perfluorooctanoic acid (PFOA), a contaminant found in Teflon, carpet cleaning products, and weather-proof fabrics.

## CAPACITY

An extensive inventory of New Jersey's drinking water infrastructure is long overdue. Only with a clearer idea of the condition of every aspect of the system can policymakers know what is needed to rebuild water and sewer capacity and make other investments to assure residents of a safe, plentiful supply.

### RECOMMENDATION

**Conduct a comprehensive assessment of all state water programs, including an analysis of needed repairs and improvements.**

The emphasis and priority should be on developing stormwater utilities, permeable pavements, and other "green infrastructure."

## THE PINELANDS AND HIGHLANDS

To protect water sources that are acutely vulnerable to climate change, the state carved out two regions for special attention—the Pinelands and the Highlands. In the Pinelands, warmer temperatures, stronger storm systems, and changing rainfall patterns increase the risk of wells drying up and salt water intruding into the Kirkwood-Cohansey Aquifer. In the Highlands, development and climate change increase the likelihood of severe flooding and stormwater runoff, exposing water supplies to contamination.

To date, the Pinelands Commission and the Highlands Council have not directly addressed the threats posed by climate change. Neither the Pinelands Commission's most recent five-year review of the Comprehensive Management Plan nor the Highlands Council's Regional Master Plan, adopted in 2008, addresses climate change.

## RECOMMENDATION

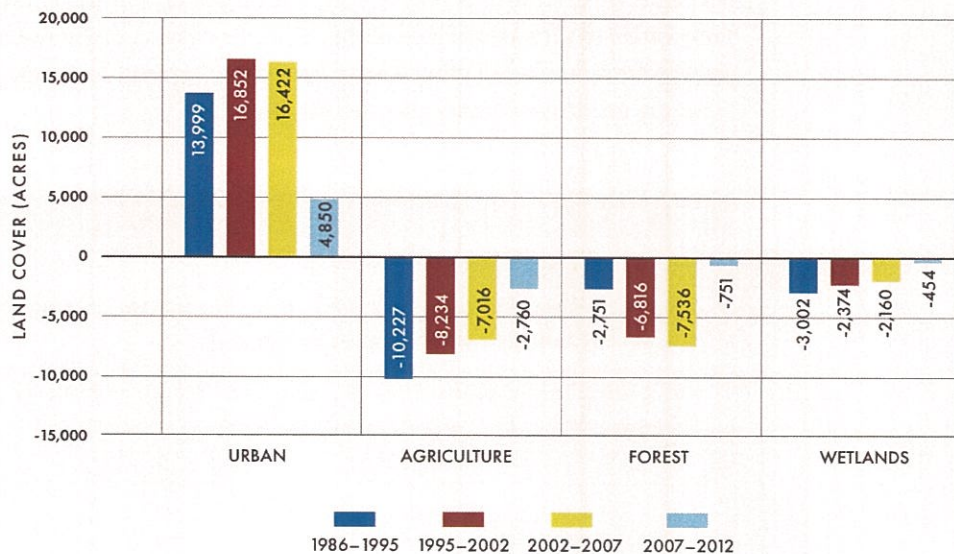
**Require the Pinelands Commission and the Highlands Council to update their plans to address the impacts of climate change.**

## Invigorating State and Regional Planning

“Buy land,” Will Rogers famously counseled nearly a century ago. “They ain’t making any more of the stuff.” If the vaudevillian-turned-social commentator were alive today, he might advise New Jerseyans: “Preserve land. There ain’t much more of the stuff left.”

New Jersey is the most densely populated state and the most built-out. More than 2 million of the state’s 5 million acres are fully developed, and an estimated 1.4 million acres are protected by various levels of government. With much of the remaining land unsuitable for development, researchers expect New Jersey to approach near-total build-out by midcentury.<sup>21</sup>

### New Jersey’s Disappearing Open Space



Source: “Changing Landscapes in the Garden State”<sup>22</sup>

Preserving and protecting New Jersey’s shoreline, its diminishing open fields, forests, wetlands, highlands, farmland, and parkland are more than a matter of aesthetics. Undeveloped land absorbs rainfall, replenishing aquifers that are major sources of drinking water. The impervious surfaces in fully developed areas prevent rainwater from being absorbed by the ground, causing urban flooding, stormwater runoff, and sewer overflows.



### SHORE PLAN LONG OVERDUE

Some municipalities along the Atlantic coast, Delaware Bay, and other low-lying areas are taking steps on their own. These include planning to buy out residents whose homes are severely damaged or destroyed in future storms; amending master plans to return storm-devastated residential areas to open space; requiring foundations of rebuilt homes to be raised several feet above previous levels; and upgrading sewer systems to protect against water contamination from severe flooding. But this is too big a problem to leave to local action.

### RECOMMENDATION

**Develop a climate-change action plan to address the coastal threats from rising sea levels. The plan should include effective growth-management strategies, sustainable-development practices, and protective shoreline-management plans.**

This plan should include an immediate update of the Shore Protection Master Plan. The 35-year-old plan predates decades of development, Superstorm Sandy, the latest revelations about climate change, and the sea-level rise.

### STRENGTHENING STATE PLANNING

New Jersey's development patterns through the last three decades of the 20<sup>th</sup> century and into the second decade of the 21<sup>st</sup> have led to suburban sprawl, turning farmland into shopping malls, office parks, and residential developments. This, in turn, has brought more parking lots, streets and sidewalks, and bigger, wider highways that enable commuters to travel greater distances between home and work, increasing motor-vehicle use, gasoline consumption, toxic air pollution, and greenhouse gas emissions.

New Jersey's first major attempt at curbing sprawl statewide came in 1985, with passage of the State Planning Act. The Act established the State Planning Commission (SPC) and the Office of State Planning (OSP). The SPC was assigned the duty of creating a "coordinated, integrated and comprehensive plan for the growth, development, and conservation of the State and its regions...which...identif[ies] areas for growth, agriculture, open space conservation and other appropriate designations."<sup>23</sup>

The commission adopted New Jersey's first State Development and Redevelopment Plan in 1992, made changes and readopted in 2001, and offered a revision in 2010 that was not adopted. While many municipalities and counties actively participated in a "cross-acceptance" process aimed at linking the goals and objectives of the SDRP with local planning efforts, the effort was doomed by a flaw: the state plan was not binding. It became a haphazardly applied blueprint.

State and regional efforts, critical to climate change adaptation, demand greater urgency.



The State Planning Commission, for all practical purposes, is moribund.

## RECOMMENDATION

**Update the State Development and Redevelopment Plan, Pinelands Comprehensive Management Plan, and Highlands Regional Master Plan to address the threats New Jersey faces.**

The 2010 version of the SDRP offered a prescient observation (originally attributed to Benjamin Franklin). “Failing to plan,” it declared, “is tantamount to planning to fail.”

Events of recent years bear out this sentiment. The OSP was reconstituted as the Office for Planning Advocacy in the Department of State. The SDRP became the State Strategic Plan, refocused primarily on where state investment should be guided, but was never adopted. The SPC, for all practical purposes, is moribund. According to the last two meetings for which minutes are available, the commission met for three minutes in July 2015 and for seven minutes in January 2016. Seven of its last 11 scheduled meetings have been canceled.

## RECOMMENDATION

**Remove the Office of State Planning from the Department of State and establish it as an independent agency located in the Department of Treasury.**

The State Planning Act provided for the Office of State Planning and the State Planning Commission to be “established in the Department of the Treasury” as an independent body with a director appointed by and serving at the pleasure of the governor. The director was to act as the principal executive officer of the SPC. Over time, the independent authority of the SPC and its staff has been eroded. A return to the organizational infrastructure set forth by the State Planning Act, combined with a commitment to the mission and core principles of the State Planning Act, are necessary to restore the critical role of the SPC and its staff in undertaking sound and integrated statewide planning to protect the environment, revitalize cities and towns, and foster economic growth.<sup>24</sup>

## STRENGTHENING REGIONAL PLANNING BODIES

New Jersey’s efforts at regional planning have been more successful. In 1969, the Legislature established the Hackensack Meadowlands Development Commission (“Development” was later dropped from its name). The HMDC statute set up a district comprising 14 municipalities in Bergen and Hudson counties, with the commission largely responsible for converting the Meadowlands from landfill-infested marshland in the basin of the polluted Hackensack River into a transportation and recreation hub boasting 8,400 acres of preserved wetlands and open space.

The commission accomplished this through an innovative tax-sharing plan, under which the municipalities pooled revenue and enjoyed the economic benefits of sharing services and consolidating their planning, zoning, and regulatory functions into a single entity. Despite recent legislation and administrative action that weakened this regional collaboration, the transformation of the Meadowlands has been impressive.

The Pinelands offers another regional planning success. In 1978, Congress created the Pinelands National Reserve, covering 1.1 million acres—or 22% of the state's total land mass, the largest area of open space between Richmond and Boston. One year later, the New Jersey Legislature passed the Pinelands Protection Act, “to preserve, protect, and enhance the natural and cultural resources of the Pinelands National Reserve, and to encourage compatible economic and other human activities consistent with that purpose.”

The responsibility for carrying out this ambitious goal was placed in a 15-member appointed Pinelands Commission with an unusual level of land-use authority over an area encompassing 53 municipalities in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, and Ocean counties. Among other powers, the commission can override local land-use and development regulations. Municipalities are required to conform their local master plans and zoning ordinances to the regional plan.

Pursuant to the statute, the commission in 1980 delineated areas where development would be permitted, limited, or prohibited. By law, this Comprehensive Management Plan is updated every five years.

Despite occasional disputes between the Pinelands Commission and its constituent municipalities and counties (as well as the Legislature and the governor), the vision set forward more than three decades ago largely prevails. Nearly half of the Pinelands (460,000 acres) is permanently protected through cooperative state, county, municipal, and private efforts. The New Jersey Pinelands Commission's annual Long-Term Economic Monitoring Program finds that managed development has overall shown economic benefits for Pinelands municipalities using indicators such as population growth, real estate values, income and employment trends, and municipal finances.<sup>25</sup>

The New Jersey Highlands Council, established in 2004, lacks the Pinelands Commission's level of authority. Its jurisdiction covers 859,000 acres spread across 88 municipalities in Bergen, Hunterdon, Morris, Passaic, Somerset, Sussex, and Warren counties.

Like the Pinelands Act, the Highlands Act aims to protect important water supplies—in this case, the sources for 5.4 million New Jersey residents, or 60% of the state's population. Unlike the Pinelands Comprehensive Management Plan, however, the Highlands Regional Plan is more an advisory document than an enforceable plan of action. It more closely resembles the State Planning Act in this regard, carrying sufficient weight to persuade some municipalities and counties to participate in joint planning efforts but lacking enforcement clout except in a Preservation Area regulated by the DEP. And, like the State Planning Commission, the Highlands Council's influence depends largely on the attention—or inattention—it receives from the administration in Trenton.



In recent years, some decisions have been made that run counter to the mission of preserving valuable resources and promoting regional solutions. Examples include eliminating regional tax sharing in the Meadowlands and approving a gas pipeline through the Pinelands' fragile ecosystem. In addition, the DEP has made more land in the Highlands available for development by increasing the number of septic systems allowed there. Corrections are needed to get back on course.

#### RECOMMENDATION

**Appoint members to the State Planning Commission, Pinelands Commission, and Highlands Council who are committed to carrying out these agencies' missions.**

All of these efforts are important to controlling sprawl, reversing unsustainable land-use patterns, slowing the inexorable drive toward build-out, and crafting regional solutions. But more is needed. Along the Atlantic coast and in other tidally influenced areas such as the Delaware Bayshore, Delaware River, and Hudson-Raritan estuary, the threats posed by climate change—beach erosion, tidal flooding and, ultimately, the permanent loss of habitable land to the rising sea—require regional, rather than local, strategies.

#### BEACH REPLENISHMENT

The Army Corps of Engineers, which has spent an estimated \$1.5 billion on New Jersey beach projects over the past 25 years, proposes to spend an additional \$1.92 billion for sand dredging and pumping through 2060, to replenish beaches and reconstruct dunes, which will be in ever-greater danger of washing away in extreme weather.<sup>26</sup> This is a losing proposition.

Even the best efforts of coastal municipalities to adapt their master plans, zoning ordinances, and building codes to changing climate conditions are no substitute for a larger scope of regional planning and management strategies.

#### RECOMMENDATION

**Conduct a comprehensive cost-benefit analysis of all beach replenishment projects involving climate change considerations. The analysis should include alternatives to replenishment as a way to respond appropriately to the risks associated with climate change.**



The harm from unhealthy air, unsafe water, haphazard development, and projects such as incinerators and power plants is often worst in neighborhoods that are beset by social and economic stress...

## Ensuring Environmental Justice

A well-designed response to climate change would have the additional benefit of improving conditions for many in New Jersey who suffer disproportionately from environmental problems because of where they live.

The harm from unhealthy air, unsafe water, haphazard development, and projects such as incinerators and power plants is often worst in neighborhoods that are beset by social and economic stress and that do not have the clout of other communities to reject such projects. Air quality deteriorates in urban areas where ozone is trapped and concentrations of particulate matter are elevated; when temperatures rise, the air quality worsens further. Tap water for residents of many economically hard-pressed neighborhoods and communities of color comes from pipes more than 100 years old, which increases the potential for contamination. In many older homes and school buildings, children are exposed to unhealthy levels of lead, mold, and other indoor toxins—found in paint, in water drawn through lead pipes or copper plumbing soldered with lead, in furniture, even in older toys. The toxins can cause lasting brain injury, impairing children's ability to learn and grow.

New Jersey's urban areas also contain high concentrations of contaminated industrial sites, where cleanup efforts can be delayed for years—even decades—by litigation, the inability to identify a responsible party, lack of funding, or low priority on the remediation list. Some sites are simply paved over. Many urban parking lots, athletic facilities, and schools sit atop sequestered accumulations of toxic substances. One investigation found that 74% of New Jersey residents with incomes below the federal poverty line live within a mile of a contaminated site for which no cleanup plan exists.<sup>27</sup>

The responses to these communities' environmental problems generally are site-specific or substance-specific. Poor air quality is treated as an air issue; poor water quality as a water issue; where to build a power plant is a siting issue. There is growing realization, however, that these multiple environmental problems need to be addressed together and to be framed in terms of the public health harms the pollutants cause.

Further, economically distressed neighborhoods and communities of color are too frequently located in places vulnerable to the effects of climate change: urban areas that experience unhealthy air quality when temperatures rise, severe flooding and contaminated water when rainfalls increase, plus inconvenience and worse when extreme weather disrupts the energy supply. More needs to be done to protect people in these communities.



## RECOMMENDATION

**Impose a moratorium on state regulatory approval or funding for any development that has not been screened to ensure that it is not adding to pollution burdens already imposed on economically struggling communities.**

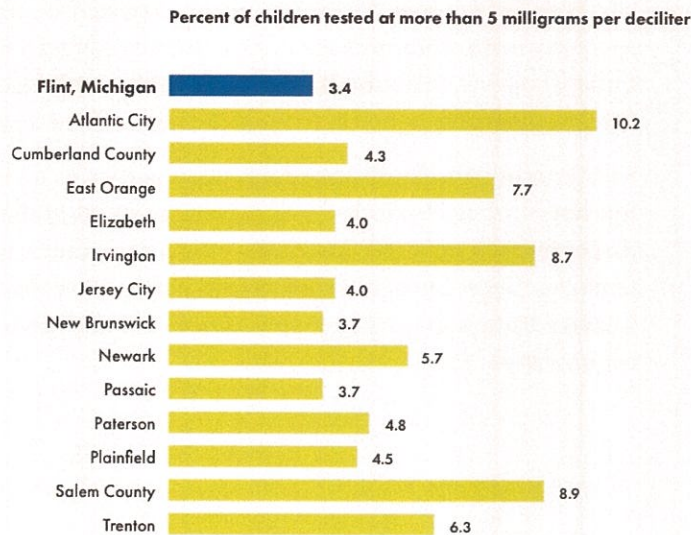
The requirement that state agencies take environmental justice into account would be strengthened by establishment of an Environmental Justice Advisory Council, whose responsibilities would include monitoring the cumulative impacts of development in communities over time.

In the current system, developers need show only that the harm from any one form of pollution does not exceed danger levels. With analysis of cumulative impacts, the multiple forms of pollution would be measured comprehensively, which will more clearly show the additive effects of environmental hazards on the health of residents.

## DEALING WITH DANGERS FROM LEAD

Science shows there is no safe level of exposure to lead, and children are most vulnerable to lead poisoning and the permanent damage it can cause. Eleven New Jersey communities have a higher proportion of young children with dangerous lead levels than does Flint, Mich.

**More Children  
Experience Dangerous  
Lead Levels in  
New Jersey Than in  
Flint, Michigan**



Source: nj.com<sup>28</sup>

36x

Atlantic City, Irvington, and East Orange had the state's highest levels. One effort to address the issue of cumulative impacts is under way in Newark, where the city has adopted a municipal ordinance requiring the creation and maintenance of a resource inventory that includes demographic, health, and environmental data.<sup>29</sup> The ordinance also mandates that newly proposed commercial and industrial activities reveal the type and amount of pollution they will produce.

A broader state-coordinated approach is needed.

#### RECOMMENDATION

**Significantly step up efforts to test for—and lessen exposure to—lead, and identify new sources of funds to assist with reducing health risks.**

Necessary measures include:

- annual testing for lead in drinking water at schools, day-care centers, and pre-schools;
- requiring municipalities to conduct lead paint inspections in one- and two-family rental units;
- mandating soil testing to determine lead content prior to sales of homes that have a higher risk of contamination;
- compiling and granting public access to tests of soil lead levels; and
- adopting a statewide plan to reduce exposure from lead-contaminated buildings, soil, and drinking water.

#### DIESEL EMISSIONS

Living in urban areas also exposes residents to higher levels of vehicle exhaust than suburban and rural New Jerseyans face. State policy should take this into consideration.

#### RECOMMENDATION

**Mandate significantly reduced diesel particulate-matter emissions, beginning with support for reviving a ban on pre-2007 trucks from ports operated by the Port Authority of New York and New Jersey.**

Improving air quality will have a salutary effect on the health of residents in Newark, Elizabeth, and the surrounding area.



## DISASTER READINESS

Though the consequences of climate change are more threatening and immediate in economically distressed neighborhoods and communities of color, many of those communities are unprepared.

### RECOMMENDATION

**Develop adaptation and emergency plans to address the impacts of climate change, with the involvement of community residents, local community groups, and environmental justice organizations.**

Such plans should include steps to be taken for evacuation; police, fire, and public works deployment; and feeding and housing people when a climate-related crisis occurs.

## Conclusion

Time is not on New Jersey's side. Challenges that previously were little known now turn out to be substantial threats to residents' well-being. And, in many instances, the situation is worsened because of action deferred and protections weakened. From rejoining the Regional Greenhouse Gas Initiative to developing a shore master plan to protecting economically struggling communities, restoring New Jersey to national environmental leadership is about far more than bragging rights. The state's quality of life is on the line.



## Endnotes

- <sup>1</sup> "Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." [U.S. Environmental Protection Agency](#).
- <sup>2</sup> ["New Jersey Warming since the first Earth Day," Climate Central.](#)
- <sup>3</sup> [Union of Concerned Scientists, Northeast Climate Impacts Assessment Synthesis Team. "Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions," July 2007.](#)
- <sup>4</sup> [Sustainable Jersey Climate Change Adaptation Task Force, "New Jersey Climate Change Trends and Projections Summary," September 26, 2011.](#)
- <sup>5</sup> [National Aeronautics and Space Administration, "2016 Climate Trends Continue to Break Records," July 19, 2016.](#)
- <sup>6</sup> [National Conference of State Legislatures, "Climate Change and the Economy/New Jersey: Assessing the Costs of Climate Change," 2008.](#)
- <sup>7</sup> ["Extreme Precipitation Events are on the Rise," Climate Central, May 6, 2014.](#)
- <sup>8</sup> [NJ Climate Adaptation Alliance, "Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: Report of the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel," October 2016.](#)
- <sup>9</sup> [National Conference of State Legislatures, "Climate Change and the Economy/New Jersey: Assessing the Costs of Climate Change," 2008.](#)
- <sup>10</sup> [US Energy Information Administration, "State Carbon Dioxide Emissions," November 3, 2016.](#)
- <sup>11</sup> [U.S. Environmental Protection Agency, "2015 Greenhouse Gas Emissions from Large Facilities," reported to EPA by facilities as of August 13, 2016.](#)
- <sup>12</sup> [US Energy Information Administration, "State Carbon Dioxide Emissions," November 3, 2016.](#)
- <sup>13</sup> Ibid.
- <sup>14</sup> The cap on greenhouse gas emissions is a limit backed by science. Companies pay penalties if they exceed the cap, which gets stricter over time. The trade part is a market for companies to buy and sell allowances that permit them to emit only a certain amount. Trading gives companies a strong incentive to save money by cutting emissions. [Environmental Defense Fund, "How Cap and Trade Works."](#)

- <sup>15</sup> [Regional Greenhouse Gas Initiative, "Regional Greenhouse Gas Initiative: An Initiative of the Northeast and Mid-Atlantic States of the U.S."](#)
- <sup>16</sup> [American Council for an Energy-Efficient Economy, "Energy Efficiency Resource Standard."](#)
- <sup>17</sup> The California Car program is based upon the 1970 Clean Air Act provisions that permit California to adopt more stringent auto-emissions standards than the federal government sets. Other states also may adopt the California emissions standards. New Jersey is considered a California Clean Cars state, and specifically one of 10 Section 177 states that are part of the Zero Emission Vehicle (ZEV) program. Based on the travel provision, auto manufacturers have been able to bank credits in Section 177 states for ZEVs based on ZEV sales in California. This credit program will expire in 2018, which makes it even more critical for New Jersey to ramp up its electric vehicle program. ["U.S.: Section 177 States." TransportPolicy.net, September 6, 2013.](#)
- <sup>18</sup> [New Jersey Department of Transportation, "New Jersey Annual Certified Public Road Mileage and VMT Estimates," 2015.](#)
- <sup>19</sup> The U.S. Department of Transportation's National Highway Traffic Safety Administration is responsible for establishing Corporate Average Fuel Economy (CAFE) standards under the Energy Policy and Conservation Act, as amended by the Energy Independence and Security Act (EISA). Its first National Program addressed 2012-2016 vehicles and the second phase of the national program covers 2017-2025 light duty vehicles. [U.S. Environmental Protection Agency: Regulations from Emissions from Vehicles and Engines.](#)
- <sup>20</sup> [Environment New Jersey Research and Policy Center, "Turning to the Wind: American Wind Power is Cutting Carbon Pollution Today and Paving the Way for a Clean Energy Future," Winter 2015.](#)
- <sup>21</sup> [John Hasse, "Final Harvest in the Garden State: New Jersey's Struggle with Suburban Sprawl," in \*Earthcare: An Anthology in Environmental Ethics\*, eds. David Clowney and Patricia Mosto \(Lanham: Rowman & Littlefield Publishers, 2009\).](#)
- <sup>22</sup> [Richard G. Lathrop and John A. Bognar, Center for Remote Sensing and Spatial Analysis, Rutgers University, John E. Hasse, Geospatial Research Lab, Rowan University, "Changing Landscapes in the Garden State," December 2016.](#)
- <sup>23</sup> [State Planning Act, N.J.S.A. 52:18A-196 \(2006\).](#)
- <sup>24</sup> Ibid.
- <sup>25</sup> [New Jersey Pinelands Commission, "New Jersey Pinelands Long-Term Economic Monitoring Program: 2015 Annual Report," June 2016.](#)
- <sup>26</sup> [Kirk Moore, "Money and Sand: Will There Be Enough for New Jersey's Beaches?" NJ Spotlight, September 29, 2016.](#)
- <sup>27</sup> ["Dirty Little Secrets: New Jersey's Poorest Live Surrounded by Contamination," WNYC, December 9, 2015.](#)
- <sup>28</sup> [Ben Horowitz, "Why 11 N.J. cities have more lead-affected kids than Flint, Michigan," nj.com, February 3, 2016.](#)
- <sup>29</sup> [City of Newark, Environmental Justice and Cumulative Impact Ordinance, July 7, 2016.](#)



## Integrating Climate Science into Coastal Resilience Planning and Decision Making in New Jersey

*A summary of two reports prepared for the New Jersey Climate Adaptation Alliance*

October 2016

### **Introduction**

State, local and Federal decision makers throughout New Jersey are working to enhance the resilience of coastal communities and resources to hazards – including flooding driven by sea-level rise and coastal storms – that are increasing as a result of climate change. The New Jersey Climate Adaptation Alliance, a network of policymakers, public and private sector practitioners, academics, nongovernmental organizations, and business leaders, has joined together to enhance New Jersey's climate change preparedness. During an extensive stakeholder engagement process hosted by the Alliance, decision makers communicated a need for more science-informed guidance to support resilience planning and implementation. The Alliance's Advisory Committee requested that Rutgers University convene a Science and Technical Advisory Panel (STAP) to synthesize for practitioners the most recent climate science needed to inform efforts to increase the resilience of New Jersey's people, places, and assets (including infrastructure, communities and natural resources) to regional sea-level rise (SLR), changing coastal storms and the resulting flood risk.

The outputs of the STAP effort are two reports, issued in October 2016, for which this document provides a combined, high-level overview. The first report, ***Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: Report of the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel***, summarizes the deliberations of the scientists who participated in the STAP. The second report, ***Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: A Companion Report to the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel Report***, describes how coastal hazard data and coastal climate change impacts are currently being addressed in New Jersey.

### **Approach and Purpose**

The STAP efforts provide science-informed guidance and planning options for practitioners and decision makers. With guidance from the Alliance's Advisory Committee, Rutgers staff undertook three efforts:

- **STAP Convening** –To inform planning and decision making, Rutgers staff consulted with scientists to assess the state of knowledge regarding sea-level rise, coastal storms and flood hazards in New Jersey. Rutgers staff and faculty convened experts in climate change, sea-level rise, coastal hazards, and coastal resilience to deliberate on a set of charge questions and summarize current science with regard to sea-level rise, coastal storms, and flood hazards.
- **Engagement of coastal decision makers** – Rutgers staff analyzed the information needs of coastal planners and decision makers to support their resilience efforts. Rutgers staff elicited feedback from practitioners on the initial STAP insights and Rutgers staff also reached out to coastal community planners, decision makers and practitioners about their needs with regard to science and data that can support coastal resilience efforts.
- **Review of basis for current planning and decision making** – Rutgers staff summarized how science and data about coastal hazards and climate change are currently being used to inform planning and

decision making that affects coastal communities and assets. They consulted with practitioners to understand the science and data that are currently being used to inform local coastal resilience decision making. Rutgers staff also reviewed current Federal, State, and local authoritative documents and conducted interviews with State decision makers to assess the state of current use of science and data as the basis for planning and decision making in New Jersey.

## Outcomes

The two full reports provide a more comprehensive and detailed descriptions of important issues summarized below.

**Sea-Level Rise Magnitude** - The STAP report identifies a range of projected sea-level rise estimates for New Jersey, along with the likelihood of those estimates occurring. The table below summarizes the STAP's outcomes regarding projected sea level rise estimates for New Jersey, measured in feet. All values are based on a baseline of the midpoint between 1991-2009. Each column represents a different probability for a sea level rise projection. For example, the "Likely Range" column represents a range between the 17<sup>th</sup> and 83<sup>rd</sup> percentile with 67% being used to show probability. Each row represents a year; two rows are provided for the year 2100 so as to include a low emissions scenario and a high emissions scenario.

|                        | Central Estimate                        | Likely Range                      | 1-in-20 Chance                         | 1-in-200 Chance                          | 1-in-1000 Chance                         |
|------------------------|---|-----------------------------------|--|--|--|
| Year                   | 50% probability SLR meets or exceeds... | 67% probability SLR is between... | 5% probability SLR meets or exceeds... | 0.5% probability SLR meets or exceeds... | 0.1% probability SLR meets or exceeds... |
| 2030                   | 0.8 ft                                  | 0.6 – 1.0 ft                      | 1.1 ft                                 | 1.3 ft                                   | 1.5 ft                                   |
| 2050                   | 1.4 ft                                  | 1.0 – 1.8 ft                      | 2.0 ft                                 | 2.4 ft                                   | 2.8 ft                                   |
| 2100<br>Low emissions  | 2.3 ft                                  | 1.7 – 3.1 ft                      | 3.8 ft                                 | 5.9 ft                                   | 8.3 ft                                   |
| 2100<br>High emissions | 3.4 ft                                  | 2.4 – 4.5 ft                      | 5.3 ft                                 | 7.2 ft                                   | 10 ft                                    |

The STAP "likely range" of sea-level rise estimates is consistent with recent guidance proposed by New York State and the Federal government's sea-level rise estimates for New Jersey developed by an interagency working group, as well as with the assessment of the Intergovernmental Panel on Climate Change's Fifth Assessment Report.

The STAP encourages practitioners to consider the nature of the decision at hand when determining which sea-level rise estimate(s) to incorporate. Practitioners are encouraged to use several sea-level rise estimates in order to capture a variety of possible future outcomes. A focus on the "likely" range may be appropriate when considering decisions where flooding exposures or anticipated damages are limited, such as installation of recreational amenities. For decisions where potential exposures and damages may be significant (such as those related to energy, water or transportation infrastructure projects), or where a population is already vulnerable to stressors that will be further exacerbated by climate change (such as residential neighborhoods juxtaposed with facilities that store hazardous materials or have contaminated soil, either of which could become further mobilized with heavy flooding), the STAP encourages practitioners to consider at least two different likelihood levels - one



within the likely range, and one reflecting a lower-probability but higher consequence. Additionally, for decisions with impacts lasting beyond 2050, the STAP advises practitioners to consider both low and high greenhouse gas emissions futures.

*Sea-Level Rise Rates* – For some decisions, the rate of sea-level rise is as critical a consideration as the magnitude of sea-level rise. For example, rates of sea-level rise have an important impact on the extent to which natural systems, such as marshes, can adapt to changing sea levels. The STAP found that the rate by which sea level rises in coastal New Jersey over the period of 2010-2030 is likely to be 2–4 inches per decade. The STAP also concluded that, after 2030, changes in the rate of sea level rise depend on future greenhouse gas emissions. The full STAP report provides full probability distributions of post-2030 rates of sea-level rise under two greenhouse gas emissions scenarios.

*Coastal Storms* – By increasing the baseline for flooding, higher sea levels will increase the impact of coastal storms on New Jersey. Changes in the frequency, intensity and tracks of coastal storms may also affect the impact of coastal storms in New Jersey. This is an area of active research. The STAP concluded that, for now, planning and decision making in New Jersey should be guided by the Intergovernmental Panel on Climate Change (IPCC)'s conclusions regarding changes in future storms, including:

- The global frequency of tropical cyclones (i.e., hurricanes) is not likely to increase, while maximum wind speeds are likely to increase;
- Precipitation intensity during tropical cyclones is likely to increase; and
- The global frequency of extratropical cyclones (i.e., nor'easters) is not likely to change substantially; however precipitation associated with winter storms is likely to increase.

*Exposure Assessments* – As mentioned earlier, Rutgers staff convened a set of coastal resilience practitioners to evaluate the practicality of applying the STAP outcomes. Among their many insights, they indicated that, in addition to considering extreme coastal flooding and permanent inundation, exposure assessments should take into account projections that point to areas that are affected by tidal (sometimes referred to as “nuisance” flooding). Based on input from the practitioners, as well as input on the needs of coastal planners and decision makers received by Rutgers staff, the STAP report outlines example methods that practitioners may use to integrate the STAP science outcomes into different planning horizons and risk preferences.

*Current Use of Climate Data and Science* –In addition to engagement of municipal officials and practitioners, Rutgers staff interviewed State agency officials and conducted a literature review to ascertain how sea-level rise and anticipated changes in coastal storms are addressed in practice in coastal regions of New Jersey. Rutgers staff found that there is no uniform approach in New Jersey for addressing coastal climate change impacts at the current time. Local governments can exceed New Jersey building code elevation requirements or the requirements under the National Flood Insurance Program for structures in floodplains; it is estimated by the State of New Jersey that 20 municipalities do have more stringent building elevation ordinances than Federal or State requirements. The Rutgers research found that these more restrictive requirements are motivated by the desire for increased flood protection from current conditions; discounts on insurance rates through the Federal Community Rating System (CRS) program; and in one case, Rutgers staff identified a municipality that did cite sea-level rise as a concern in establishing its local ordinance. At the State level, New Jersey programs generally follow Federal requirements or incorporate national guidance developed by professional societies that establish design standards for structures in floodplains but to date, New Jersey regulatory programs

have not been developed to address sea-level rise. The State of New Jersey is addressing impacts from sea-level rise and changes in coastal storms when the Federal government has required these considerations as a condition of Federally-funded projects and programs (e.g., under Federal Hurricane Sandy appropriations or grants tied to Federally-approved State Hazard Mitigation Planning). Federal agencies are currently developing plans to implement the Federal Flood Risk Management Standard (FFRMS) which expressly considers increases in flood risk expected to result from climate change for Federally-funded projects. As Federal agencies implement the standard for Federally-funded projects in New Jersey, the STAP approach could be helpful. The STAP approach can also be helpful for New Jersey entities wishing to plan for coastal climate change impacts. Finally, it is important to note that the current suite of regulatory approaches focus on new construction or substantial improvement to existing structures; existing structures in coastal areas that have not been elevated to account for coastal climate change impacts or are located in communities that have not implemented other flood damage reduction actions to account for coastal climate change impacts (such as those incentivized through the CRS) may continue to be vulnerable to such impacts.

*Needs of Coastal Communities* - Rutgers staff engaged coastal professionals and decision makers to better understand their needs with regard to climate data and science to inform decision making. In general, Rutgers staff heard a need for clear and consistent and science-based standards and/or guidance to inform local coastal resilience planning. The outcomes of the STAP effort can be informative in addressing some of those needs, including:

- Coastal decision makers and practitioners agreed that, since Superstorm Sandy, there has been widespread increased awareness of flooding and coastal hazards and a greater recognition of the contribution of sea-level rise to those hazards. Among coastal municipalities, there is greater support for regulatory measures to inform and support coastal community planning and recognition of a need for a more holistic approach to resilience guided by a statewide vision for planning and implementation in New Jersey.
- Coastal municipalities pointed to inconsistent and sometimes conflicting guidance from multiple State and Federal agencies on standards and regulatory practices that are meant to be implemented at the local level. More specifically, the municipal practitioners indicated a need for clear and consistent guidance on sea-level rise projections between and within State agencies. In addition to having climate data that are consistent, local officials indicated a need to integrate sea-level rise projections with local knowledge about historic floods to better inform decision making.
- Coastal municipalities need technical assistance to, among other things, apply climate data and science to efforts to plan for resilience. They also indicate a need for additional training on disaster response and preparedness.
- Coastal practitioners also expressed concern that, with a post-Sandy emphasis on home elevations, residents who have elevated their homes will avoid evacuation feeling secure in their homes not realizing that roadways, infrastructure and critical facilities remain exposed and non-resilient.

Rutgers staff will continue to work with communities, coastal planners, and decision makers, and intend to further develop and deploy guidance for using the methods outlined in the two reports.

### **For more information**

Both full reports can be found at <http://njadapt.rutgers.edu/>. Questions regarding the reports can be directed to Dr. Marjorie Kaplan at [kaplan@envsci.rutgers.edu](mailto:kaplan@envsci.rutgers.edu) or Jeanne Herb at [jherb@ejb.rutgers.edu](mailto:jherb@ejb.rutgers.edu).



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## **2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory**

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March 2015

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## 2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory

### Background

This report updates New Jersey's estimated total greenhouse gas (GHG) emissions as reported in New Jersey's *Statewide Greenhouse Gas Emission Inventory*, last issued November 2012 for year 2009<sup>1</sup>, with emissions estimates for 2010, 2011, and 2012. This report, which will hereafter be referred to as the 2012 inventory, also discusses aspects regarding progress towards achieving the 2020 and 2050 greenhouse gas limits established by New Jersey's Global Warming Response Act (GWRA) (see N.J.S.A. 26:2C-43).

As stated in the GWRA, the 2020 limit is a quantity equal to the 1990 emissions total (baseline), which has been estimated to be 125.6 million metric tons of carbon dioxide equivalent (MMTCO<sub>2</sub>e)<sup>2</sup> and the 2050 limit is a quantity 80 percent less than the 2006 emissions. The 2006 emission has been estimated to be 127.0 MMTCO<sub>2</sub>e, so the 2050 limit is 25.4 MMTCO<sub>2</sub>e.

New Jersey's first GHG inventory pursuant to the GWRA was finalized in November 2008 and included 1990 estimated emissions, estimated emissions for 2004 and projections out to 2020.<sup>3</sup> The first biennial report was completed in November 2009 and included estimated greenhouse gas emissions for 2005 through 2007.<sup>4</sup> The second biennial report was completed in May 2011 and included estimated greenhouse gas emissions for 2008.<sup>5</sup>

It is extremely important to note the context for this report. This report follows methods that were employed for previous statewide GHG emissions inventories conducted in previous years in the State of New Jersey. The same methods were used in this report to ensure consistency in the inventory from year-to-year. While the benefit of having a

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<sup>1</sup> Statewide Greenhouse Gas Emission Inventory for 2009.

<http://www.nj.gov/dep/sage/docs/ghg-inventory2009.pdf>

<sup>2</sup> "Carbon dioxide equivalent" represents the conversion of all emitted compounds, which includes methane and other gases, to the equivalent quantity of carbon dioxide. The global warming potential (GWP) values provided by the AR4 of Intergovernmental Panel on Climate Change (IPCC) were used. See IPCC AR4, 2007, Climate Change 2007: Working Group I: The Physical Science Basis, Technical Summary, Chapter TS 2.5, available at [http://www.ipcc.ch/publications\\_and\\_data/ar4/wg1/en/ts.html](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ts.html) (accessed 5/9/12). The AR4 global warming potentials were used to make these 2010, 2011, and 2012 inventories more directly comparable to earlier inventories, including the 1990 baseline inventory, for which these potentials were also used without having to re-do all the earlier inventories. Were the new values used, the carbon dioxide equivalent of some gases would change slightly, because the value provided in AR5 is somewhat different.

<sup>3</sup> The report "New Jersey Greenhouse Gas Inventory and Reference Case Projections" is available at [http://njedl.rutgers.edu/search\\_results?query=GHG+inventory](http://njedl.rutgers.edu/search_results?query=GHG+inventory) accessed 3/17/15

<sup>4</sup> New Jersey Statewide Greenhouse Gas Emissions Inventory Update: 2005, 2006, and 2007 Estimates. <http://www.nj.gov/dep/sage/docs/inventory-05-06-07.pdf>

<sup>5</sup> Statewide Greenhouse Gas Emission Inventory for 2008. <http://www.nj.gov/dep/sage/docs/ghg-inventory2008.pdf>



temporally consistent method for the statewide emissions inventory is critically important, we do recognize that use of these methods does present some limitations. These limitations could be addressed in a more comprehensive analysis of sources of GHG emissions in New Jersey. This analysis could include:

- Addressing long-standing challenges to inventorying emissions at a state level including accounting for life cycle contributions of GHG emissions (for example, emissions created from out-of-state extraction of energy sources) as well as out-of-state emissions associated with in-state activities (e.g. air travel); and
- Considering improved analytical methods for a statewide inventory by comparing methods used for this statewide inventory with GHG emissions analyses that have been conducted by the three Metropolitan Planning Organizations in New Jersey as well as with methodologies in place for conducting community and municipal level GHG emissions inventories in New Jersey.

### **Methods**

As with previous statewide inventories, the 2012 inventory is largely based on fuel use data obtained from the Energy Information Administration (EIA).<sup>6,7</sup> These data are typically not available or made public for any year until approximately one and one-half years after the end of a given year. Details on methods used to estimate releases from these data are discussed in the report “New Jersey Greenhouse Gas Inventory and Reference Case Projections 1990-2020” (Inventory and Projections) dated November 2008.<sup>8</sup> Certain improvements were subsequently made to these methods and are discussed in the first and second biennial reports referenced above. Minor additional improvements to the methods made for the 2012 inventory are noted in Appendix A.

### **Statewide Greenhouse Gas Emissions for 2010, 2011, and 2012**

In 2010, total statewide estimated greenhouse gas emissions were estimated to be 112.7 million metric tons of carbon dioxide equivalent (MMTCO<sub>2</sub>e). The estimated emissions for 2011 and 2012 were 111.7 and 104.6 MMTCO<sub>2</sub>e, respectively. Figure 1 (below) presents the greenhouse gas emissions for each sector for 2012.

As in earlier years, the top three sectors for greenhouse gas emissions in New Jersey are transportation, electricity generation and combined fossil fuel use for residential, commercial and industrial facilities. Transportation continues to be New Jersey’s largest source of greenhouse gas emissions, accounting for approximately 46.3 MMTCO<sub>2</sub>e, which is 41 percent of gross statewide greenhouse gas emissions. Electricity generation is New Jersey’s second largest sector of greenhouse gas emissions, releasing approximately 20.9 MMTCO<sub>2</sub>e (~19 percent) of statewide emissions. Fossil fuel used in residential, industrial and commercial sectors, mainly for heating, had combined releases of 32.4 MMTCO<sub>2</sub>e, contributing 29 percent of gross statewide emissions. Gross statewide emissions do not include the 7.9 MMTCO<sub>2</sub>e that were estimated to be sequestered by

<sup>6</sup> <http://www.eia.gov/state/seds/>, downloaded July 10, 2014

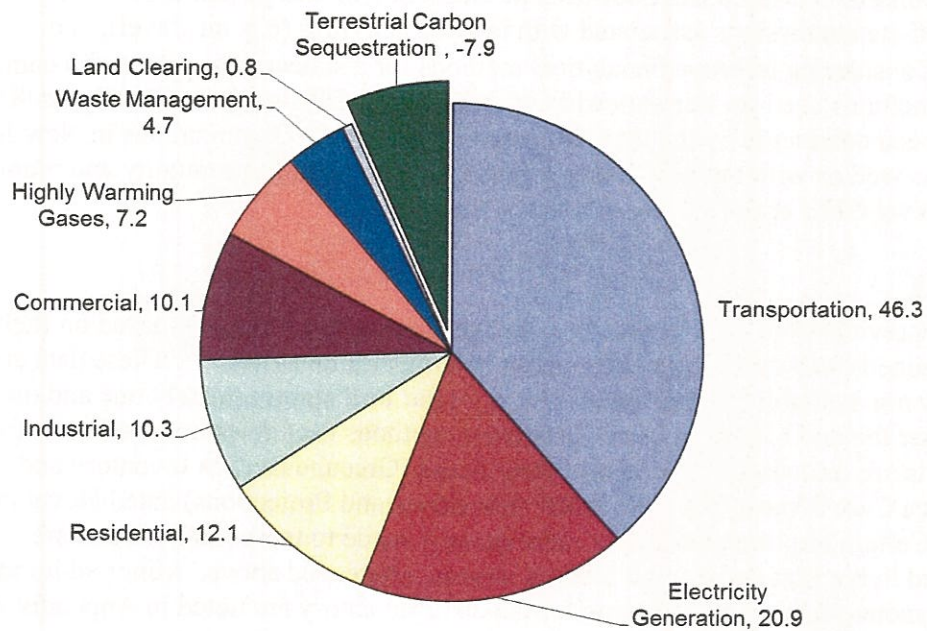
<sup>7</sup> <http://www.eia.doe.gov/oiaf/1605/coefficients.html>, accessed June 30, 2010

<sup>8</sup> <http://www.nj.gov/globalwarming/home/documents/pdf/20081031inventory-report.pdf>

growth of the state's forests and other vegetation, including the accumulation of carbon in the associated undisturbed soils.

Figure 1

**Estimated NJ Statewide Greenhouse Gas Emissions, 2012**  
**Total emission 104.6 MMTCO<sub>2</sub>e**



**Table 1: Estimated New Jersey Statewide Greenhouse Gas Emission  
Million Metric Tons Carbon Dioxide Equivalents**

**Table 1: Estimated NJ Statewide greenhouse gas emissions**

| Sector   | 1990  | 2005  | 2006  | 2007  | 2008  | 2009  | 2010  | 2011  | 2012  | Notes |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Commercial   | 10.7  | 10.8  | 9.2   | 10.6  | 10.2  | 10.8  | 10.6  | 11.3  | 10.1  |       |
| Industrial   | 19.8  | 17.3  | 16.3  | 15.9  | 13.9  | 10.6  | 9.1   | 10.3  | 10.3  |       |
| Residential  | 15.2  | 16.3  | 13.7  | 15.6  | 14.9  | 15.2  | 14.2  | 13.6  | 12.1  |       |
| Transportation   |       |       |       |       |       |       |       |       |       |       |
| on-road gasoline   | 28.9  | 38.0  | 38.1  | 39.0  | 38.2  | 37.3  | 36.8  | 36.1  | 35.3  |       |
| distillate (primarily on-road diesel)  | 5.6   | 10.8  | 10.8  | 11.4  | 9.9   | 7.9   | 8.9   | 10.2  | 8.7   |       |
| jet fuel   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | 1.0   | *1    |
| residual (primarily marine)  | 1.0   | 0.9   | 0.8   | 0.8   | 0.8   | 0.8   | 0.8   | 0.8   | 0.8   | *2    |
| other  | 0.4   | 0.3   | 0.3   | 0.3   | 0.3   | 0.3   | 0.5   | 0.5   | 0.4   |       |
| Electricity  |       |       |       |       |       |       |       |       |       |       |
| in-state electric  | 12.4  | 19.8  | 18.5  | 22.7  | 19.1  | 15.0  | 17.7  | 15.7  | 15.1  | *3    |
| imported electric  | 14.1  | 13.1  | 11.7  | 11.9  | 10.0  | 7.7   | 7.7   | 6.8   | 5.2   |       |
| MSW incineration   | na    | 0.8   | 0.8   | 1.0   | 0.8   | 0.8   | 0.7   | 0.7   | 0.6   |       |
| Halogenated gases (ex. SF6)  | 0.0   | 3.0   | 3.2   | 3.2   | 3.3   | 3.4   | 3.9   | 4.0   | 4.1   | *4a   |
| SF6  | 1.0   | 0.4   | 0.3   | 0.3   | 0.3   | 0.3   | 0.2   | 0.2   | 0.1   | *4a   |
| Industrial non-fuel related  | 0.3   | 0.1   | 0.1   | 0.1   | 0.1   | 0.1   | 0.1   | 0.1   | 0.1   | *4    |
| Agriculture  | 0.6   | 0.5   | 0.5   | 0.5   | 0.5   | 0.5   | 0.4   | 0.4   | 0.4   | *4    |
| Natural gas T&D  | 2.5   | 2.4   | 2.6   | 2.6   | 2.6   | 2.5   | 2.5   | 2.5   | 2.5   | *4b   |
| Landfills, in-state  | 11.7  | 3.6   | 3.5   | 3.5   | 3.4   | 3.3   | 3.3   | 3.2   | 3.2   |       |
| out-of-state   | 2.6   | 1.0   | 1.0   | 1.1   | 1.1   | 1.1   | 1.1   | 1.1   | 1.1   | *7    |
| industrial   | 1.1   | 0.3   | 0.2   | 0.2   | 0.2   | 0.2   | 0.2   | 0.2   | 0.2   |       |
| POTWs  | 0.2   | 0.2   | 0.2   | 0.2   | 0.2   | 0.2   | 0.2   | 0.2   | 0.2   | *5    |
| Released thru land clearing  | 0.6   | 1.7   | 1.7   | 0.8   | 0.8   | 0.8   | 0.8   | 0.8   | 0.8   | *8    |
| Total gross emissions, MMT   | 129.6 | 142.2 | 134.6 | 142.6 | 131.6 | 119.8 | 120.6 | 119.7 | 112.5 |       |
| Sequestered by forests   | -4.0  | -7.6  | -7.6  | -7.9  | -7.9  | -7.9  | -7.9  | -7.9  | -7.9  | *6    |
| Total net emissions MMT CO2eq  | 125.6 | 134.6 | 127.0 | 134.7 | 123.7 | 111.9 | 112.7 | 111.7 | 104.6 |       |
| All numbers are estimates; uncertainty of totals is likely in range of plus or minus 5 percent |       |       |       |       |       |       |       |       |       |       |

\*1 set equal to 1 MMT in effort to account for in-state only

\*2 estimated to represent in-state only per methods of NJ GHG Inventory & Reference Case Projections 1990-2020, NJDEP, Nov. 2008, assumed same 2006 thru 2012

\*3 1990 value from NJ GHG Inventory & Reference Case Projections 1990-2020, NJDEP, Nov. 2008, includes MSW incineration.

\*4 2005 value from NJ GHG Inventory & Reference Case Projections 1990-2020, NJDEP, Nov. 2008; 2006 thru 2009 assumed equal to 2005. 2010, 2011, and 2012 Agr. from NJDEP

\*4a based on U.S. data from EPA, apportioned to NJ based on population for HFCs, based on elec. use for SF6

\*4b Through 2009, based on pipeline data from US DOT. 2010 through 2012 assumed the same as 2009.

\*5 earlier values have been adjusted; assumed equal to newly-calculated value for 2008 & 2009; 2010 thru 2012 from NJDEP

\*6 all values updated per latest NJDEP calculations

\*7 values from 2009 on are assumed equal to 2008 and 2007.

\*8 values for 2008 thru 2012 based on carbon release rate with development as calc'd for 2007, but apportioned to number of building permits issued for a given year

Note issues with the transportation methodology described in notes in "CO2\_EIA\_based" worksheet

Notes to table 1: "MSW" stands for municipal solid waste, "SF6" stands for sulfur hexafluoride, "T&D" stands for transmission and distribution, "MMT" stands for million metric tons, "POTW" stands for Publicly Owned Treatment works, and "CO2eq" stands for carbon dioxide equivalents (see earlier note on carbon dioxide equivalents).



## **Trends and Progress Toward 2020 and 2050 Limits**

This section briefly discusses recent trends in greenhouse gas emissions and progress toward achieving the 2020 and 2050 statewide greenhouse gas limits. Trends for specific sectors are discussed, including key related data for specific sectors, where appropriate.

- *Statewide Progress in meeting 2020 and 2050 limits*

Table 1 above presents estimated statewide greenhouse gas emissions for 1990 (the 2020 limit) and 2005 through 2012. The statewide greenhouse gas limit for 2020 is to stabilize emissions to the level of 1990, which, as noted above, is 125.6 MMTCO<sub>2</sub>eq. Since 2008, statewide greenhouse gas emissions have been consistently below the 2020 limit.

The statewide greenhouse gas limit for 2050 is 80 percent less than the 2006 level (127 MMTCO<sub>2</sub>e ) of statewide greenhouse gas emissions, or 25.4 MMTCO<sub>2</sub>e. To achieve this limit, current greenhouse gas emissions must be reduced by approximately 75%; the 2012 emissions, at 104.6 MMTCO<sub>2</sub>e, are 79.2 MMTCO<sub>2</sub>e above the 2050 limit.

The state's greenhouse gas emissions in 2012 were nearly seven percent lower than the average emissions of the three previous years, 2009, 2010, and 2011. A decrease of this degree in just one year might suggest that the state is well on the road to achieving the 2050 limit. However, data from the NJ State Climatologist indicate that 2012 had an unusually warm winter and an unusually cool summer,<sup>9</sup> which meant that less fuel was combusted and less electricity used for both heating and cooling by the residential, commercial, and industrial sectors. Figures 2 and 3, which show heating and cooling degree days,<sup>10</sup> illustrate the unusual mildness of 2012 regarding both parameters.

### **Potential reasons for the 2012 decline in statewide Greenhouse Gas Emissions**

- 1) Natural gas, which emits less GHG per unit of energy, replaced coal in some electricity generating plants. Natural gas also replaced some uses of heating oil in residential and commercial facilities, which also lowered GHG emissions.
- 2) 2012 had a relatively warm winter, which lessened the combustion of fuels for heating. The year also had a relatively cool summer, which lessened the need for electricity for cooling. Both of these reductions led to lower GHG emissions.
- 3) Energy efficiency measures, both those encouraged by State policies and those resulting from a long-standing trend apparent at the national level, lowered energy use and GHG emissions.
- 4) Although relatively small in effect, a trend of more electricity production from photovoltaic sources continued, resulting in less generation from fossil fuel sources, lowering GHG emissions.

<sup>9</sup> New Jersey State Climatologist, 2014, Monthly Mean Temperatures in New Jersey From 1895-2014, [http://climate.rutgers.edu/stateclim\\_v1/data/njhisttemp.html](http://climate.rutgers.edu/stateclim_v1/data/njhisttemp.html),

<sup>10</sup> Heating degree days (HDD) and cooling degree days (CDD) are measurements that reflect the demand for energy needed to heat or cool a building. Heating degree days are typically calculated as the difference between a day's average temperature and 65° F, if that day's average was below 65° F. Cooling degrees are the difference between a day's average temperature and 65° F if the average temperature was above 65° F. For this analysis, monthly mean temperatures, as provided by the NJ State Climatologist (see footnote above) were used.

Figure 2.

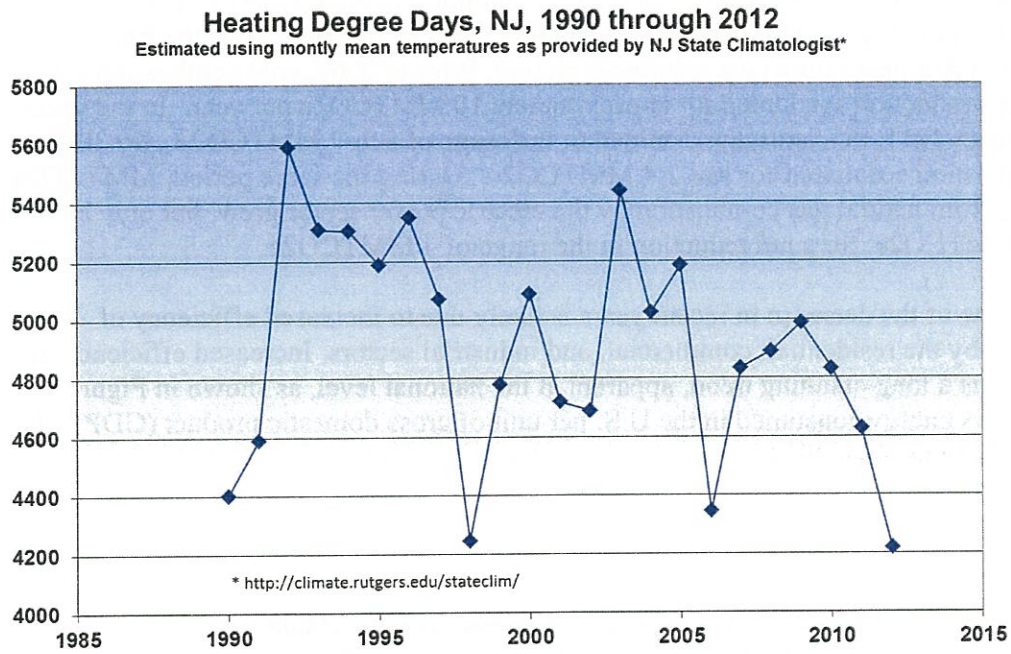
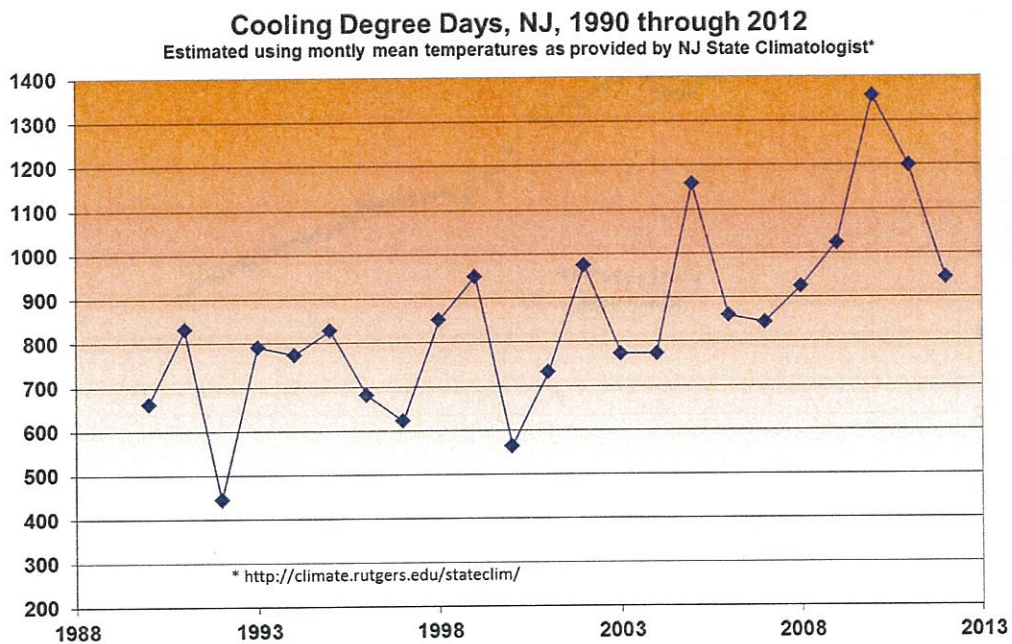


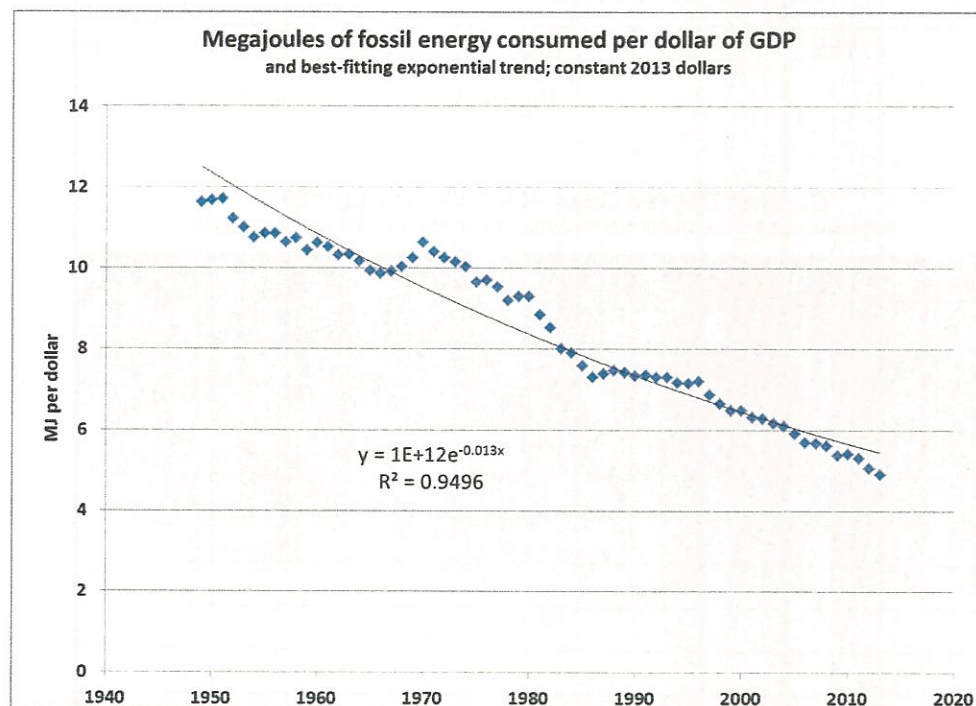
Figure 3



Another reason for the decrease in emissions in 2012, and for the lowered emissions of 2009 through 2011 as compared to earlier years, is that the use of coal for electricity generation has been sharply reduced as coal consumption in New Jersey has been replaced by natural gas. This is shown by the fuel use data obtained from the Energy Information Administration (see references above). Prior to 2009, coal combustion for electricity production accounted for approximately 10 MMTCO<sub>2</sub>e per year. In the years 2009 through 2011, this emission declined to the range of 5 to 7 MMTCO<sub>2</sub>e. By 2012, coal combustion accounted for just 2.4 MMTCO<sub>2</sub>e. During the same period, MMTCO<sub>2</sub>e emissions from natural gas combustion by the electric power sector grew, but only by about 4 MMTCO<sub>2</sub>e, for a net reduction in the range of 4 MMTCO<sub>2</sub>e.

Finally some of the decrease in recent years is likely due to increased efficiency of energy use by the residential, commercial, and industrial sectors. Increased efficiency in energy use is a long-standing trend, apparent at the national level, as shown in Figure 4, which shows energy consumed in the U.S. per unit of gross domestic product (GDP)<sup>11</sup> for the years 1950 through 2013.

*Figure 4*



<sup>11</sup> Gross domestic product (GDP) is the market value of all officially recognized final goods and services produced within a country in a year, or over a given period of time. GDP data, from <http://www.bea.gov/national/xls/gdplev.xls>, adjusted to constant 2013 dollars using cost price indicator data from <http://stats.bls.gov/cpi/cpifiles/cpia1.txt>. Energy use data from U.S. DOE/EIA, <http://www.eia.gov/>



Clearly, continued moderation of the weather, even if it should occur, cannot reduce the energy use of the residential, commercial and industrial sectors by the approximately 75 percent below 2012 emissions needed to reach the 2050 limit. A continuation of the switching from coal and heating oil to natural gas would lead to additional reductions. However, this switching alone cannot achieve nearly the degree of emissions reduction necessary to achieve the 2050 limit, because the total GHG emission from combustion of coal and heating oil in the state in 2012 totaled only approximately 5 MMTCO<sub>2</sub>eq of the approximately 80 MMT CO<sub>2</sub>eq reduction needed from current levels. Continued progress in energy efficiency also holds promise. However a closer examination of the data indicates that this source of reductions, too, is likely to be far less than will be needed to reach the 2050 limit. The current rate of improvement in energy efficiency in the U.S., in terms of energy used per unit of GDP, is about 1.3 percent per year (see Figure 4). This is approximately equivalent to the yearly increase in GDP in recent years. Overall, energy use has not decreased significantly due to increased efficiency. Assuming that similar rates of improvement in efficiency and growth in GDP exist in New Jersey, a significant reduction in GHG emissions through increased efficiency cannot be expected unless either the rate of efficiency improvement accelerates dramatically, GDP growth ceases, or both.

More progress in a number of the major sectors is needed to achieve the 2050 limit. These sectors are discussed below, starting with the largest sector, transportation.

- *Transportation*

Greenhouse gas releases from transportation remained the largest contributor to statewide greenhouse gas emissions, with a total of 46.3 MMTCO<sub>2</sub>e in 2012. A modest reduction trend appears to be evident, with total emissions from on-road gasoline and on-road diesel taking place from 2011 to 2012, even though vehicle miles traveled,<sup>12</sup> which had showed an earlier decline likely due to the recession, rebounded somewhat. See Figure 5. New federal motor vehicle miles per gallon standards<sup>13</sup> that require increased fuel economy to the equivalent of 54.5 mpg for new cars and light-duty trucks by Model Year 2025 are expected to result in a further decline in emissions from this sector. However, it is virtually certain that additional steps will be necessary. Even if the entire car and light truck fleet averaged 54.5 mpg by 2050, and VMT did not increase, an overall reduction from this source of no more than approximately 60 percent could be expected, since the fleet average mpg today is in the range of 20 mpg<sup>14</sup>. Additional steps necessary to reach the 2050 limit will likely include extensive electrification of the fleet, provided that the electricity is generated from low- and zero-carbon sources.

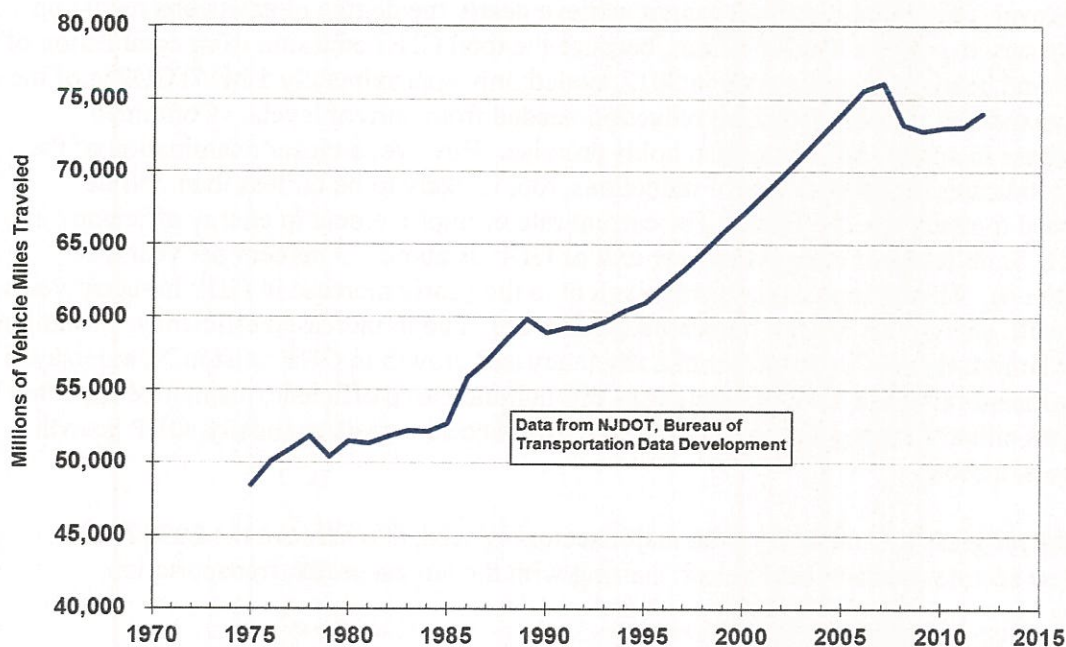
<sup>12</sup> [http://www.state.nj.us/transportation/refdata/roadway/pdf/hpms2008/prmvmt\\_08.pdf](http://www.state.nj.us/transportation/refdata/roadway/pdf/hpms2008/prmvmt_08.pdf)

<sup>13</sup> National Highway Traffic Safety Administration, 2012, Obama Administration Finalizes Historic 54.5 mpg Fuel Efficiency Standards, <http://www.nhtsa.gov/About+NHTSA/Press+Releases/2012/Obama+Administration+Finalizes+Historic+54.5+mpg+Fuel+Efficiency+Standards>, accessed 11/10/14

<sup>14</sup> U.S. Department of Transportation, Bureau of Transportation Statistics, 2014, Table 4-23: Average Fuel Efficiency of U.S. Light Duty Vehicle, [http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national\\_transportation\\_statistics/html/table\\_04\\_23.html](http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national_transportation_statistics/html/table_04_23.html), accessed 11/10/14

Figure 5

Vehicle Miles Traveled, NJ; 1975 through 2012



- *Electricity Generation*

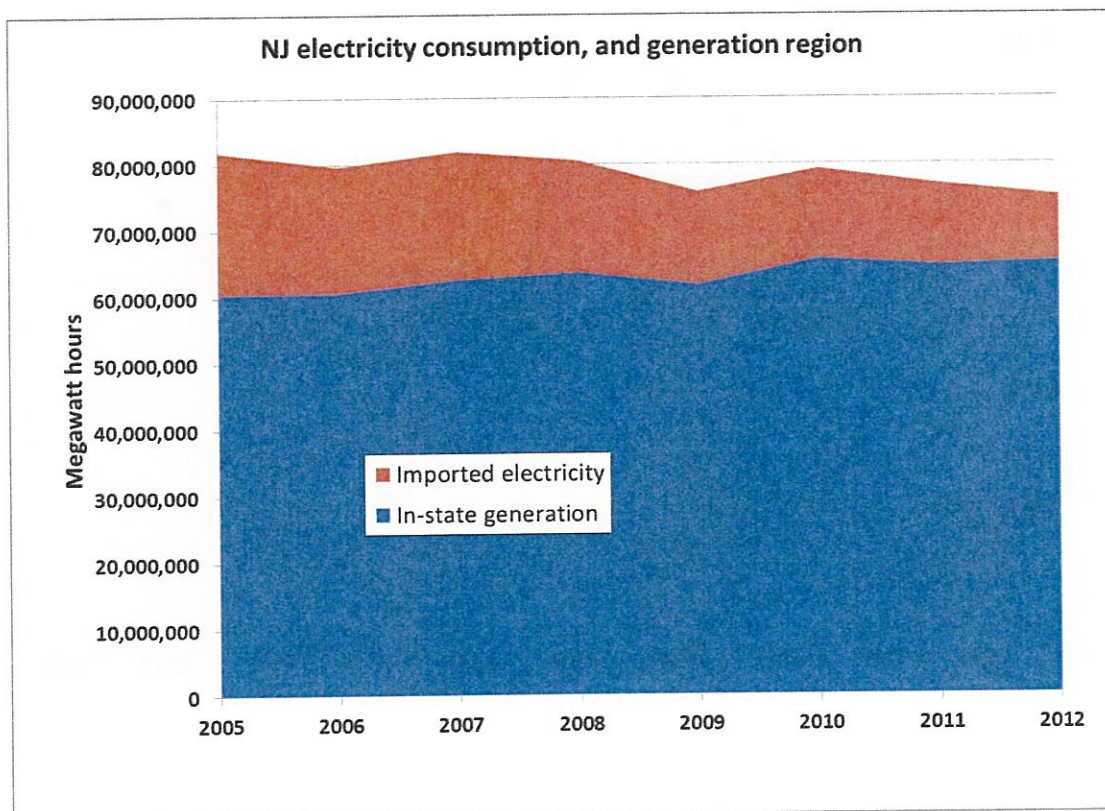
Electricity generation accounted for a smaller percentage of total gross emissions in 2012 than in earlier years. Much of this decrease, as discussed above, is a result of switching from coal to natural gas. Also, both the quantity of electricity consumed in the state and the portion of that electricity imported has declined in recent years. The decline in amount of electricity imported has been especially important in the overall emissions reduction, because production of imported electricity is more carbon-intensive than electricity production in-state. Emissions from the generation of imported electricity are estimated using the most recent emission factor available from the PJM grid.<sup>15</sup> For 2012, this emission factor was approximately 0.53 metric tons CO<sub>2</sub>e/MWh (about 1100 lbs/MWh). In-state generation, because of the high percentage of virtually zero-carbon nuclear power in the mix, had an emission factor in 2012 of only about 0.23 metric tons CO<sub>2</sub>e/MWh (about 510 lbs/MWh), based on emissions data provided by NJDEP's

<sup>15</sup> PJM is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of 13 states and the District of Columbia, including NJ. Yearly emission factors were provided by NJDEP (Steve Jenks, NJDEP, personal communication, August, 2014) based on data made available by PJM.



Emissions Statement program,<sup>16</sup> electricity consumption data from US DOE, and Energy Information Administration's State Electricity Profiles.<sup>17</sup> See Figure 6.

*Figure 6*



Trends would indicate that the decline in electricity use evident from 2008 to 2009 is very likely due to the recession. However, the decline since 2010 is not associated with a decrease in economic activity, since New Jersey's gross domestic product (GDP) increased during this period.<sup>18</sup> See Figure 7. An increase in energy efficiency, as well as milder than usual demands for both heating and cooling in 2012, as noted above, are likely reasons for the decline of electricity consumption since 2010.

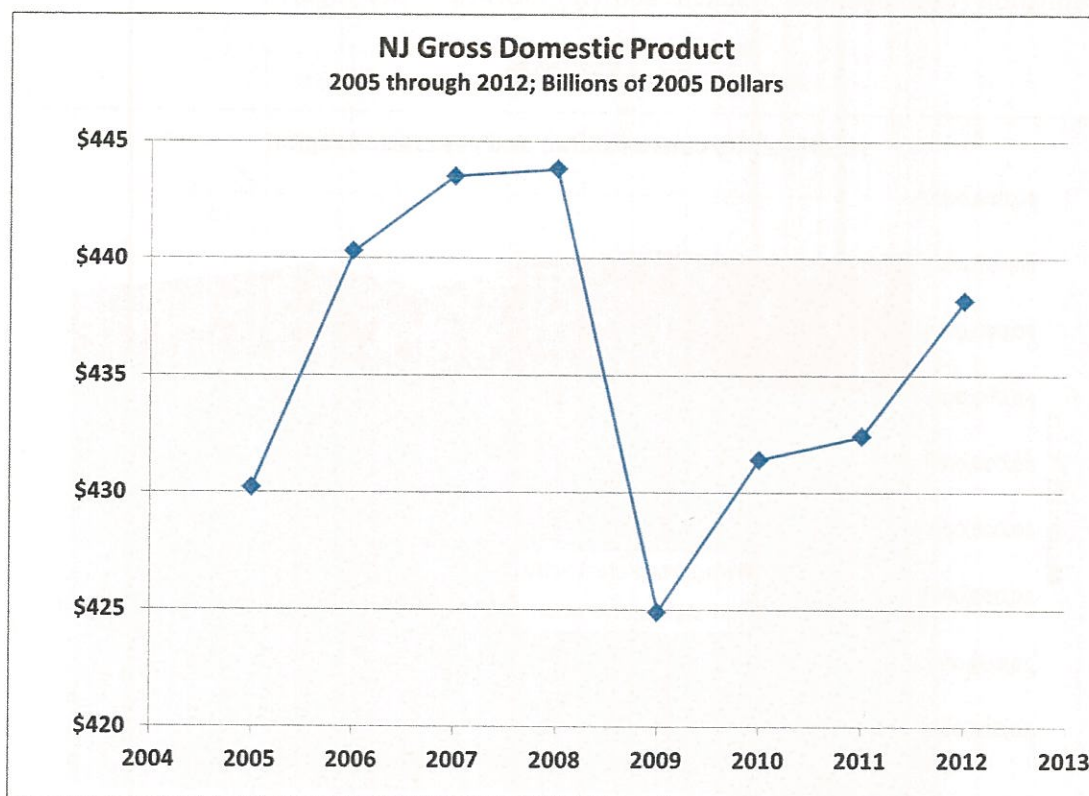
<sup>16</sup> NJDEP, 2014, Emissions Statement Program, <http://www.nj.gov/dep/aqm/es/emstatpg.html> , data provided by Steve Jenks, NJDEP (personal communication, August, 2014)

<sup>17</sup> USDOE/EIA, 2014, EIA State Electricity Profiles, [http://www.eia.gov/cneaf/electricity/st\\_profiles/new\\_jersey.html](http://www.eia.gov/cneaf/electricity/st_profiles/new_jersey.html), accessed August, 2014

<sup>18</sup> [http://www.eia.gov/state/seds/sep\\_use/notes/use\\_gdp.pdf](http://www.eia.gov/state/seds/sep_use/notes/use_gdp.pdf) accessed 8/13/14



Figure 7



Another reason for emissions reductions is the increase in electricity produced by solar photovoltaic (PV) systems, although the effect is relatively small. New Jersey is among the leading states in the nation in installation of solar PV capacity. By the end of 2012, the state had 956 MW of installed solar capacity. Assuming a capacity factor of 14.5 percent, this produced about 1.2 million MWh of electricity in 2012, which is about 1.6% of the state's total electricity consumption. Based on the emissions associated with electricity generation, as discussed above, if this amount of electricity had instead been produced by existing sources in-state, or imported from out-of-state sources, it would have added 0.3 to 0.6 MMTCO<sub>2</sub>e to the state's GHG emission total.

- *Residential and Commercial*

Greenhouse gas emissions from fuel use in the residential sector decreased about 16 percent from 2011 to 2012, and the commercial sector's emissions decreased by approximately 7 percent. As noted above, one reason for this decline is very likely the mild heating and cooling demands presented by the weather of 2012. However, increased energy efficiency is also likely a factor.

- *Industrial*

Greenhouse gas releases from the industrial sector have stayed relatively consistent through the 2009 to 2012 period.

- *Halogenated Gases and Sulfur Hexafluoride (SF<sub>6</sub>)*

Halogenated gases are a category of emissions that includes compounds of carbon and fluorine (PFCs) such as carbon tetrafluoride (CF<sub>4</sub>), and compounds of carbon, fluorine, and hydrogen (HFCs), such as HFC-134a. As noted in Table 1, above, data on emissions of these compounds are from the USEPA,<sup>19</sup> apportioned to New Jersey based on population. This class of chemicals is used in a variety of industrial and consumer applications. In New Jersey, most of the emissions of halogenated gases are associated with their uses in, and releases from, air conditioning and refrigeration systems. Sulfur hexafluoride (SF<sub>6</sub>) is also a halogenated gas but has been treated separately in New Jersey GHG emission inventories due to its specialized uses as an insulating fluid in high voltage electrical equipment. Data on this compound are from the same USEPA source as for the other halogenated gases referenced above, but are apportioned to New Jersey based on electricity use.

Many of this class of chemicals, especially certain HFCs such as HFC-134a, are replacements for chlorofluorocarbons (CFCs). Many of the CFCs have very high global warming potential (GWP), and their continued, albeit slowly declining, presence in the atmosphere contributes significantly to global warming. In addition to exerting a warming effect, CFCs also deplete stratospheric ozone, which protects the earth from dangerous ultraviolet radiation. They have traditionally not been included in GHG inventories because their production has been banned or severely restricted through international agreements.

Like CFCs, all of the halogenated gases included in the GHG inventories have high global warming potential (GWP), which means that relatively small quantities of emissions nevertheless can translate to significant emissions when weighted as carbon dioxide equivalents, as they have been in the NJ GHG emission inventories. Emissions of some of these compounds, such as HFC-134a, are steadily increasing. Should this increasing trend continue, halogenated gases have the potential to offset reductions in emissions from other sectors. Because these gases are industrial and commercial products of some value, curtailing their emissions from leaks, in addition to reducing the state's GHG emissions, could be cost-effective.

It should be noted that a relatively large percentage, in the range of 50%, of emissions of HFC-134a are associated with the motor vehicle sector. Since the mid-1990s, this

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<sup>19</sup> USEPA, 2015, National Greenhouse Gas Emissions Data, <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>, accessed 1/6/15 and on earlier dates.



compound has been the refrigerant fluid used in motor vehicle air conditioning systems.<sup>20</sup> Leaks of refrigerant fluid from motor vehicles are more difficult to control than are leaks from other air conditioning systems due to vibration and other stresses, including accidents. Substitute compounds have been developed but have not achieved wide usage to date. More comprehensive leak detection and repair could reduce emissions. It is likely that curtailing the sale of HFC-134a in small cans to consumers for do-it-yourself auto repairs would reduce emissions.<sup>21</sup>

### ***Acknowledgements***

Thanks to Jorge Reyes, Steve Jenks, and Joe Carpenter of NJDEP, Office of Sustainability and Green Energy, for review of data and text and provision of updated estimates and data. Thanks also to the Michael J. and Susan Angelides Public Policy Research Fund of the Rutgers University Edward J. Bloustein School of Planning and Public Policy for support for development of this report.

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<sup>20</sup> Data available from USEPA used for this report are not sufficiently detailed to permit a more precise breakdown of the portion of HFC-134a emissions associated with the motor vehicle sector vs. other sectors, such as residential and commercial refrigeration. It can be argued that HFC-134a emissions should be included in the transportation sector. However, to do this would skew the data, making the emissions from the years since the 1990 baseline year relatively higher, because HFC-134a was not in use in 1990. At that time, CFC-12 was used in motor vehicle air conditioning systems. CFC-12, like all the CFCs, has not been included in this inventory to be consistent with other GHG emission inventories.

<sup>21</sup> <http://www.sae.org/events/aars/presentations/2008/albertoayala.pdf>, accessed 1-6-15



## Appendix A: Changes in Greenhouse Gas Inventory Data and Methods, and Discussion of Some Limitations

There have been some improvements to the estimation methodologies in this latest iteration of the New Jersey GHG emissions inventory. These are noted below. Changes made in previous years are discussed in the inventory reports for those years. Most of these changes have been improvements to some of the smaller emission sectors. The bulk of the emissions continue to be estimated based on fuel use data from EIA and from NJDEP Emissions Statement data; there have been no significant changes to these methods.

Also, several significant limitations of the methodology exist. These limitations apply to earlier inventories as well, so their presence in these updated inventories does not hinder, and in a sense enhances, the ability of these latest inventories to depict trends in emissions over time. Nevertheless, further work to overcome these limitations appears warranted. The limitations apply to jet fuel and residual fuel used in ocean-going ships. Imprecision in data characterizing leaks of natural gas is also a significant limitation. These limitations are discussed below.

- *POTWs*

Revised calculations completed by NJDEP,<sup>22</sup> based partly on the EPA's State Greenhouse Gas Inventory Tool,<sup>23</sup> were used for the 2010 through 2012 estimates.

- *Sequestered by Forests and Other Land-Uses and Released Through Land Clearing*

Since the 2009 inventory, new estimates of carbon sequestration by forests and other land-uses have been calculated based on updated NJDEP Land Use/Land Cover data (latest available 2012 update). The amount of land converted from undeveloped to developed, and the resulting change in carbon released from land clearing has been recalculated based on the updated land use data.<sup>24</sup>

- *Limitations; Jet Fuel and Residual Fuel Used on Ocean-going ships*

As noted above, estimates of fuels consumed in New Jersey are used to estimate the consumption of these fuels as reported by the USDOE EIA. These consumption data are in turn used to estimate GHG emissions from combustion of these fuels. For fuels such as coal and natural gas used to generate electricity, or used to heat residential and commercial facilities, the translation from quantities consumed to GHG emissions is direct and straightforward. Jet fuel and residual fuel used in ocean-going ships are problematic, however, because the estimated quantities of these fuels sold in New Jersey

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<sup>22</sup> Reyes, Jorge, 2014, personal communication from Jorge Reyes, NJDEP, August, 2014

<sup>23</sup> <http://epa.gov/statelocalclimate/resources/tool.html>

<sup>24</sup> Reyes, Jorge, 2014, personal communication from Jorge Reyes, NJDEP, August, 2014

does not reflect the quantity of that fuel actually combusted in the state. Much of the fuel used by jets, and ocean-going ships, is burned in air space or ocean waters well beyond New Jersey's boundaries. Importantly, New Jersey has essentially no control over these emissions. In earlier inventories, a decision was made to include only those emissions of these fuels over which New Jersey could conceivably exert some control with possible future actions, such as electrifying terminals where ships are moored or limiting runway taxiing at airports. There is a high degree of uncertainty over what portion of the emissions of these fuels is in fact potentially amenable to such state control. For this reason, the reported emissions of these fuels, although based on calculations or engineering judgment with some rationale<sup>25</sup> should be considered to be little more than placeholders. Clearly, improvements in the methods will be necessary to better characterize these emission sources. Nevertheless, the consistent use of essentially the same placeholder values over time for these sectors permits a view of trends of the remaining GHG emissions, which the state has a greater potential to reduce.

- *Limitations; Natural Gas Leaks*

Natural gas has a relatively high GWP, in the range of 25 to 30 times that of CO<sub>2</sub> when looked at over a 100-year time frame (see discussion and references above). Because natural gas contains less carbon per unit of energy content than coal and petroleum-derived fuels such as gasoline, diesel fuel, and heating oil, switching from these fuels to natural gas is widely perceived as a strategy to reduce CO<sub>2</sub> equivalent emissions. This strategy becomes less effective and perhaps even harmful from a GHG emissions perspective, however, if a sufficient quantity of natural gas leaks before, or during, combustion. In one study, for example, it was estimated that new natural gas power plants produce net climate benefits relative to efficient, new coal plants only as long as leakage in the natural gas system is less than 3.2% from well through delivery at a power plant.<sup>26</sup> The overall picture of the rate of natural gas leakage from not only the production process, e.g. well drilling and/or hydrofracturing, but also natural gas compression and processing stations and transmission and distribution systems is still not clear, with widely varying emission rate estimates available in the literature.

Leaks from natural gas transmission lines passing through New Jersey have been estimated, based primarily on the type of piping material, and have been included (Natural gas T&D) in the GHG inventories and these updates. However, possible additional emissions from distribution to consumers or elsewhere in the entire system are not included. There is enough uncertainty associated with the natural gas leak rate that emission estimates for this source, like those from jet and residual fuel discussed above, should be considered more as placeholders than firm estimates.

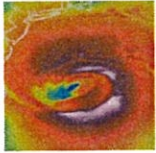
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<sup>25</sup> See the sections "Commercial Marine Vessels" and "Aviation" in New Jersey Greenhouse Gas Inventory and Reference Case Projections.

<http://www.nj.gov/globalwarming/home/documents/pdf/20081031inventory-report.pdf>

<sup>26</sup> Alvarez, R., S. Pacala, J. Winebrake, W. Chameides, and S. Hamburg, 2012, Greater focus needed on methane leakage from natural gas infrastructure, *PNAS*, 109, 6435-40

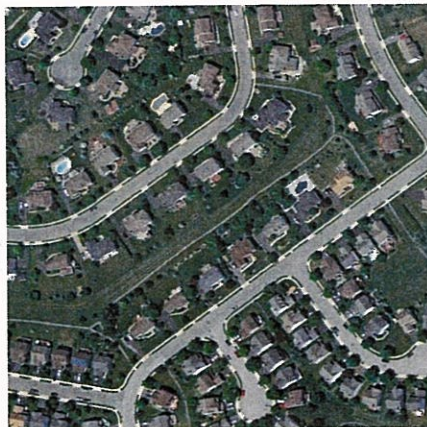
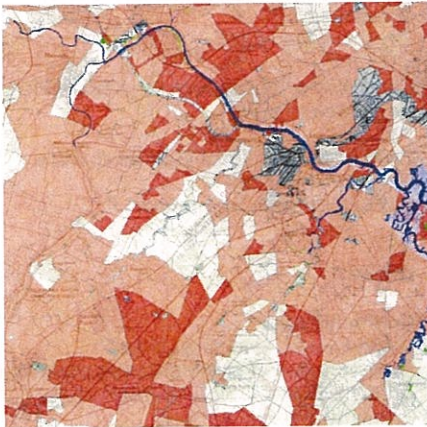




# Resilience

## Preparing New Jersey for Climate Change

Policy Considerations from the New Jersey Climate Adaptation Alliance



June 2014



# New Jersey Climate Adaptation Alliance

The New Jersey Climate Adaptation Alliance ("the Alliance") is a network of policymakers, public and private sector practitioners, academics, and nongovernmental and business leaders organized to build climate change preparedness capacity in New Jersey. The mission of the Alliance is to identify, demonstrate, recommend, and communicate policies and cost-effective activities that can prepare New Jersey's vulnerable sectors to better meet the anticipated impacts of climate change. The Alliance is guided by an advisory committee and is facilitated by Rutgers University.

Members of the New Jersey Climate Advisory Alliance Committee who participated in the process leading to these recommendations include the following:

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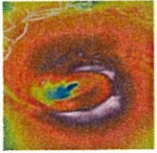
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# Resilience

## Preparing New Jersey for Climate Change

Policy Considerations from the New Jersey Climate Adaptation Alliance

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## Executive Summary

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*Resilience: Preparing New Jersey for Climate Change: Policy Considerations from the New Jersey Climate Adaptation Alliance* is the culmination of a deliberative research and stakeholder engagement process undertaken by the New Jersey Climate Adaptation Alliance ("the Alliance"), a network of policymakers, public and private sector practitioners, academics, nongovernmental organizations, and business leaders designed to build climate change preparedness capacity in New Jersey. The mission of the Alliance is to identify, demonstrate, recommend and communicate policies and activities that can prepare New Jersey's vulnerable sectors to better meet the anticipated impacts of climate change. The individuals and organizations that comprise the Alliance Advisory Committee agree that the recommendations in this report present the compelling issues to be addressed as part of a statewide climate change adaptation discussion. Rutgers University serves as the facilitator of the Alliance. In this defined role, staff at Rutgers, at the direction of the Committee, undertook the research and stakeholder engagement process that resulted

in these recommendations and, as such, these recommendations do not represent the position of the University. While individual members of the Alliance Advisory Committee do not necessarily endorse each and every specific recommendation, the Committee has reached consensus that these recommendations accurately reflect and present the issues that emerged from the research and stakeholder engagement process, and require further consideration and discussion in New Jersey.

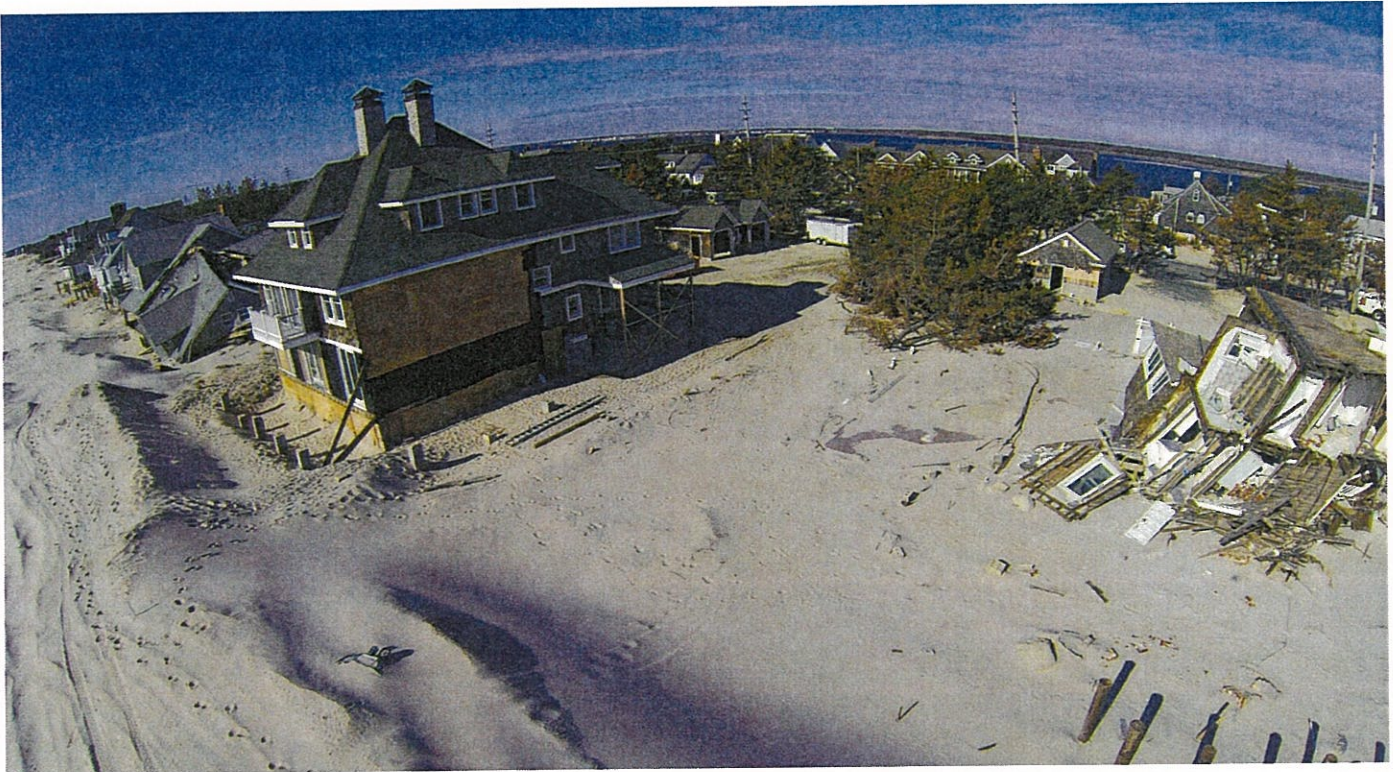
The Alliance recognizes that important climate change adaptation and preparedness efforts are already underway in New Jersey. The intent of these recommendations is to support and advance ongoing activities as well as to foster a statewide dialogue regarding consistent and long-term public policy action to enhance preparedness for a changing climate in New Jersey. Examples of some ongoing and important climate change adaptation and preparedness efforts already undertaken in New Jersey are noted in the Introduction of this report.

The approach followed to develop these recommendations was guided by the Alliance Advisory Committee and involved several tasks, including research on climate change impacts in New Jersey, analysis of leading policy practices and extensive stakeholder engagement. The Alliance focused on key sectors and cross-cutting issues: agriculture; built infrastructure (transportation, energy, and telecommunications); coastal communities; emergency management; environmental justice; natural resources; public health; social services; and water resources. Stakeholder engagement partners were commissioned to gather the views of sectoral experts through various methods (surveys, workshops, listening sessions, one-on-one interviews). In addition, information was synthesized from a statewide survey on public perception of climate change, a May 2013 Alliance sponsored conference on climate adaptation leading practices, and specific research reports on climate adaptation from the perspective of the media, the state's environmental community, policies related to building resilient structures, vulnerable

Floods in Sparta after days of heavy rains in August 2000 buckled roads and damaged bridges (Chris Hondros, iStock).







Above: Damaged homes in Mantoloking five months after Hurricane Sandy (Wendell A. Davis, Jr., FEMA).



Left: A Lambertville homeowner surveys her backyard after rains in June 2006 caused flooding along the Delaware River (Colin Archer, iStock).

populations, and climate change adaptation funding and financing mechanisms. The outcomes of these efforts serve as basis and background to these recommendations and are available in a set of reports (also identified in the Introduction) that can be found on the Alliance's website. A companion document to these recommendations which provides an overview of actions that New Jerseyans can take now, at the individual, family, neighborhood and community level, to prepare themselves and their communities for a changing climate, can be found here: [https://www.sas.rutgers.edu/cms/njadapt/component/docman/doc\\_download/117-what-you-can-do?Itemid=](https://www.sas.rutgers.edu/cms/njadapt/component/docman/doc_download/117-what-you-can-do?Itemid=).

In December 2013, the Alliance issued the report, *Resilience: Preparing New Jersey for Climate Change: A Gap Analysis from the New Jersey Climate Adaptation Alliance*,

which outlined gaps in public policy that had been identified via extensive stakeholder engagement as well as informed by the research that had been completed to date. The December 2013 report identified six general areas of policy gaps:

- Research, needs assessment and data development;
- Enhanced implementation of existing data, tools, and methods;
- Regulation, policy and governance support;
- Coordination of adaptation planning and preparedness actions;
- Ensure suitable funding;
- Education and outreach efforts.

This report builds upon the December 2013 report by identifying recommendations that correspond to the six major categories in the gap analysis. These recommendations incorporate iterative consideration by the Alliance Advisory Committee in consultation with stakeholder engagement partners and technical experts. The table below provides a brief summary of the recommendations organized by the six gap categories. For each recommendation, the sectors affected by the recommendation are identified and those recommendations that can be considered initial steps are also identified.

Below: Extended periods of high temperatures pose a wide range of risks, including heat-related health issues, road and rail damage, spikes in energy and water use, and stressed crops and livestock (iStock).

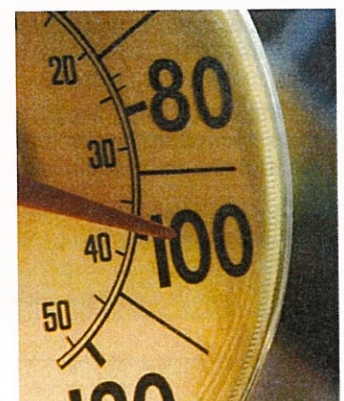



















































Table 1: Climate change policy recommendations

**1.0 - Strengthen climate change preparedness and adaptation in New Jersey through the establishment of a statewide climate adaptation policy that is designed to significantly reduce New Jersey's vulnerabilities to a changing climate through actions that direct integration of science-based standards into state policies, programs and regulations and that direct actions consistent with the statewide policy be taken by State agencies, regional and local planning authorities and commissions, municipal and county government.**








|     | RECOMMENDATIONS   | SECTORS  | INITIAL STEPS |
|-----|---|--|---------------|
| 1.1 | Establish a statewide Climate Change Working Group through legislative or executive action to foster statewide preparedness planning, coordinate scientific and technical assessment of potential climate change impacts to the citizens and environs of New Jersey and to frame adaptation policy. |                   | ✓             |
| 1.2 | Form a Science and Technical Advisory Panel (STAP) within the Climate Change Working Group to rapidly develop a climate impact assessment.  |                   | ✓             |
| 1.3 | Use the climate impact assessment to inform consistent development and adoption of statewide climate adaption policy.   |                   |               |
| 1.4 | Incorporate consideration of a changing climate into long-term planning that governs regulations, program operations, and funding allocation decisions with discrete outcomes, necessary resources, staff development and schedules for implementation.   |                   |               |
| 1.5 | Incorporate climate change policy into capital planning and decision making of state agencies, regional and local planning authorities and commissions, municipal and county governments.   |       |               |
| 1.6 | Conduct a comprehensive evaluation of policies and regulations governing New Jersey's coastal zone in light of identified risks to a changing climate.  |       |               |
| 1.7 | Convene a working group of experts to consider the outcomes of the statewide climate impact assessment on certain geographic areas of the state, including urban communities and the Delaware Bayshore, as well as on certain populations that are particularly vulnerable to a changing climate.   |    | ✓             |
| 1.8 | Revise the Municipal Land Use Law to require a master plan element that addresses natural hazards such as climate change.   |       |               |

**2.0 - Implement standards, regulations and policies that apply a risk management approach to identify people, places and assets (including natural capital) most at risk to climate stressors and direct investment to risk reduction efforts as well as uses that are compatible with a changing climate.**



















|     |  |   |  |
|-----|--|---|--|
| 2.1 | Develop and enhance tools to restrict or discourage future development and redevelopment in areas at high risk to the impacts of current and future storms, flooding and sea level rise. |    |  |
|-----|--|---|--|



































|     | RECOMMENDATIONS  | SECTORS   |   |   | INITIAL STEPS |
|-----|--|---|---|---|---------------|
| 2.2 | Assess the vulnerability of New Jersey's agricultural lands to a changing climate, including activities on land as well as aquaculture in coastal waters.  |   |  |  | ✓             |
| 2.3 | Assess the vulnerability of natural areas (i.e. tidal wetlands, forests, and other natural areas) and the value of these areas for reducing and/or adapting to climate change.   |   |  |  | ✓             |
| 2.4 | Require that all public water supply and public wastewater utilities develop, implement and periodically update plans for the identification and mitigation of natural and other risks to facility operations in light of the statewide climate change impact assessment and as part of current compliance requirements. |   |   |  | ✓             |
| 2.5 | Assess the vulnerability of transportation infrastructure using the climate change impact assessment.  |  |   |   |               |













**3.0 - Rely on existing governance structures and programs, to the greatest extent possible, and build partnerships with community-based organizations, as a means to integrate climate change adaptation and preparedness rather than create new programs.**

|     |   |   |   |   |   |   |
|-----|---|---|---|---|---|---|
| 3.1 | Assess the existing health and environmental burdens experienced by certain communities that may be exacerbated by a changing climate and enhance programmatic attention including climate change adaptation policy in these communities.                                   |   |   |   |   | ✓ |
| 3.2 | Develop and sustain meaningful incentives at a statewide scale to encourage counties and municipalities to advance targeted and comprehensive buy-out programs for flood and storm prone areas.   |  |  |   |   |   |
| 3.3 | Encourage greater participation by a broader set of state and local agencies in state and local emergency management and hazard mitigation planning.  |  |  |  |  | ✓ |
| 3.4 | Analyze and determine how to effectively plan for debris management during disasters and storms events.   |   |   |  |  |   |
| 3.5 | Enhance compliance inspections and pollution prevention assistance to facilities using petroleum or hazardous materials that exist in flood prone areas.  |  |   |  |  |   |
| 3.6 | Assess farmland preservation strategies and coordinated agricultural, floodplain and wetland easement purchases for agricultural locations that may be vulnerable to sea level rise or flooding from climate change to facilitate climate change adaptation preparedness.   |   |   |   |   | ✓ |
| 3.7 | Examine regulation of agricultural conservation practices under federal and state authorities to best minimize barriers for farmers to apply conservation strategies that are beneficial for climate adaptation and consider health and sustainability of other ecosystems. |   |   |   |  | ✓ |





















|      | RECOMMENDATIONS   | SECTORS  | INITIAL STEPS |
|------|---|--|---------------|
| 3.8  | Develop long-term resiliency plans for the electric distribution system and investigate the feasibility of alternative configurations including micro-grids or implementation of smart-grid technology to mitigate risk related to power outages. |                   |               |
| 3.9  | Develop and adopt a comprehensive climate adaptation public health strategy as guided by the federal Centers for Disease Control Building Resilience Against Climate Effects (BRACE) framework.   |   |               |
| 3.10 | Set a goal of 80% municipal participation in the FEMA Community Rating System program.  |                   | ✓             |
| 3.11 | Convene a team of experts to recommend climate resilient design and construction guidelines along with commensurate amendments to regulations, codes and standards to meet the new guidelines.  |   | ✓             |
| 3.12 | Modify regulatory standards regarding stormwater runoff, stream flow and water quality based effluent limits in NJPDES permits and water allocations to incorporate implications of climate change.   |     | ✓             |
| 3.13 | Require proposed shore erosion control projects to consist of nonstructural shoreline stabilization measures, such as living shorelines, as a default design standard.  |    | ✓             |
| 3.14 | Consider the need for mold standards to protect worker health and safety.   |    | ✓             |
| 3.15 | Enhance environmental surveillance during and after storms in communities that already experience other environmental burdens such as contaminated sites or industrial facilities with hazardous materials.                                       |     | ✓             |
| 3.16 | Encourage efforts to foster collaborative partnerships between local neighborhood organizations and various governmental levels of emergency management.  |       |               |




















#### 4.0 - Explore and implement creative strategies to generate stable funding for climate change adaptation and preparedness activities, favoring strategies that also result in reductions of emissions that cause climate change.

|     |  |  |
|-----|--|--|
| 4.1 | Convene a Blue Ribbon Panel to examine approaches to establish dedicated funds to support climate change preparedness in New Jersey and prepare a report to the Legislature with recommendations.  |       |
| 4.2 | Reflect the integration of the statewide climate change adaptation policy in the annual budget process of state agencies and authorities by including capital programming and operating and maintenance funds for enhancing resiliency and climate adaptation. |       |






























|     | RECOMMENDATIONS   | SECTORS  | INITIAL STEPS |
|-----|---|--|---------------|
| 4.3 | The State should pursue opportunities to participate in regional multi-state regulatory and non-regulatory initiatives that not only result in significant reductions in emissions through creation of markets for low-carbon energy, transportation and other sources of greenhouse gas emissions, but that also generate revenue which can be invested in strategies to address the impacts that result from these emissions by enhancing climate change preparedness and adaptation in New Jersey. |       | ✓             |
| 4.4 | Maximize efforts to secure federal funds for climate adaptation and preparedness efforts.   |       |               |
| 4.5 | Encourage the NJ Congressional Delegation to champion increased funding for existing flood mitigation programs managed by the Federal Emergency Management Agency.  |       | ✓             |

**5.0 - Promote education, training, outreach and innovative partnerships to better inform the public, decision makers and practitioners about climate change impacts and adaptation strategies to foster adaptation and preparedness capacity.**

|     |  |  |   |
|-----|--|--|---|
| 5.1 | Engage the New Jersey Climate Adaptation Alliance to lead a public education effort that effectively communicates climate change impacts and risks to New Jersey.  |             | ✓ |
| 5.2 | Authorize enhanced state training and resources for local officials regarding climate adaptation and resiliency planning.  |       | ✓ |
| 5.3 | Develop innovative approaches to implementing agricultural-sector climate change adaptation through public-private partnerships.   |    |   |
| 5.4 | Develop a long-term, sustained education and outreach curriculum for the agricultural community, farmers, commercial fishermen and shellfishermen on climate change impacts and recommended management practices.                |     |   |
| 5.5 | Develop a systematic and sustained training curriculum to teach transportation facility managers, infrastructure engineers and operators the basics of risk analysis and climate science.  |   |   |
| 5.6 | Educate health care providers and practitioners on climate change impacts; start an organized campaign to educate vulnerable populations about self-reliance in the case of extreme weather events, including high temperatures. |    |   |
| 5.7 | Improve statewide and local emergency response communication protocols to ensure timely community communication about potential hazardous risks during extreme weather events.   |   | ✓ |



## 6.0 - Undertake analyses and research to inform climate adaptation and preparedness practices in New Jersey.

|     | RECOMMENDATIONS  | SECTORS  | INITIAL STEPS |
|-----|--|--|---------------|
| 6.1 | Foster collaboration between state agencies, academic, federal and local governments as well as the NGO community with the goal of undertaking research and analyses on key issues to support climate change preparedness in New Jersey.   |                   |               |
| 6.2 | Analyze New Jersey's current utility regulatory structure to determine the degree to which it provides disincentives for proactive climate adaptation implementation   |                   | ✓             |
| 6.3 | Analyze the extent to which all-hazards planning within healthcare organizations is incorporating consideration of climate change impacts.   |   |               |
| 6.4 | Foster collaboration between public, private and non-profit sectors to develop and propagate strategies that improve personal resiliency among New Jersey residents.   |                   |               |
| 6.5 | Evaluate needs for creating a statewide system that could allow private health care practitioners and other health care providers to establish links in the event of emergency events to share and maintain refrigeration for critical medical needs.  |    |               |
| 6.6 | Enhance existing agricultural extension programs to better address climate change impacts to New Jersey agriculture.   |    |               |
| 6.7 | Analyze NJ's regulatory structure and policies for public investment to identify approaches to remove barriers to and provide incentives for use of green infrastructure, innovative design, and compatible uses that cost effectively promote climate adaptation while delivering additional ecosystem service or other benefits. |       |               |



**Figure 1. Projected High Tide in 2050 with 1.4 ft sea-level rise**



Project: Lavallette, NJ

Map By: EAC/Rutgers University

August 2017

Data Source: NJDEP/DOIT/BGIS; Edition 20170227; Esri World Imagery Basemap

0 1,000 2,000 Feet





**Figure 2. Projected Flood Depth in 2050 with 1.4 ft sea-level rise and 6 ft Sandy-level surge**



Project: Lavallette, NJ

Map By: EAC/Rutgers University

August 2017

Data Source: NJDEP/DOIT/BGIS; Edition 20170227; Esri World Imagery Basemap

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# Two Rivers, One Future

New Jersey Fostering Regional Adaptation through Municipal Economic Scenarios (FRAMES)

## #MapWhatMatters to you in the Two Rivers region

Help us to map out the most important places in your community and help protect them from floodwaters.

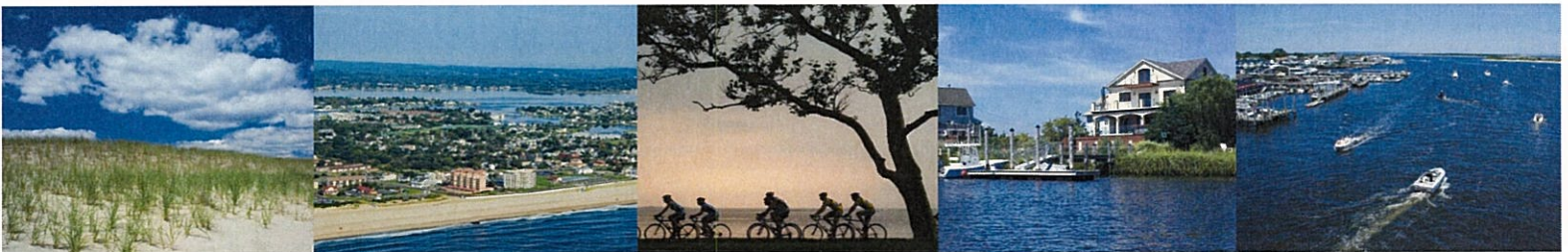
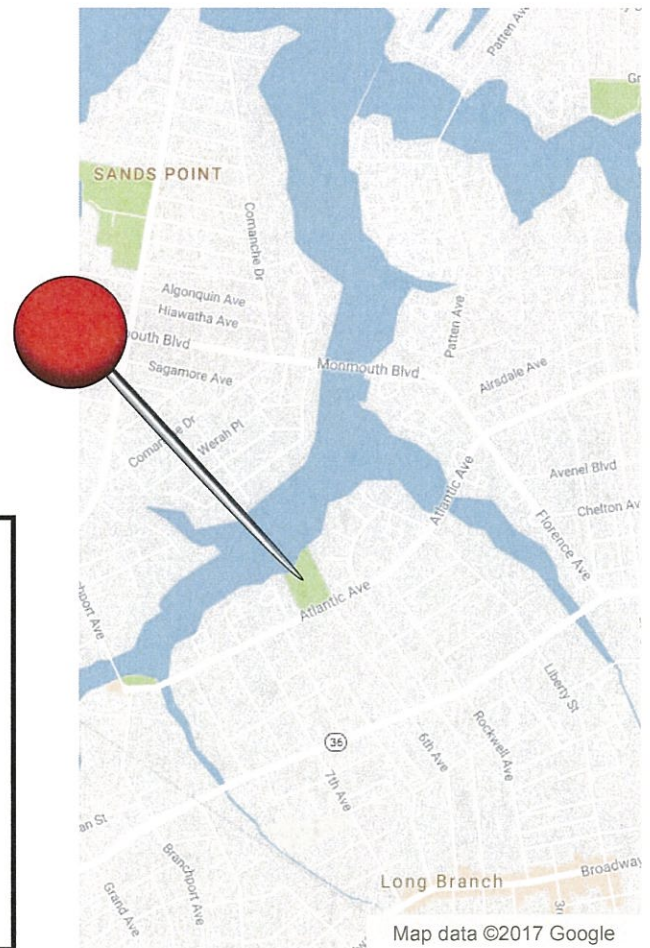
What places are most important to you? Do you value your town's library, outdoor concert venue, or a nearby hospital? Let us know!

The information you provide will help us make the Two Rivers region more resilient against flooding!

### Here's how you can participate:

Visit [TwoRiversOneFuture.nj.gov](http://TwoRiversOneFuture.nj.gov) to learn more and start mapping.

Or, use **#MapWhatMatters** and **#TwoRiversOneFuture** with images and info to tweet about your favorite places.



Louis Berger







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## TESTIMONY

### Testimony for New Jersey Joint Environment Committee

Lavallette, NJ

August 10, 2017

**Contact:** David Kutner, 609-393-0008 ext. 105  
dkutner@njfuture.org

Good morning, Senator Smith and Senator Greenstein, members of the Senate Environment and Energy Committee, and Assemblyman Eustace and Assemblyman McKeon, and all members of the Assembly Environment and Solid Waste Committee. I thank you for inviting me to talk today.

My name is David Kutner, and I'm the Planning Manager at New Jersey Future, responsible for the organization's municipal outreach and assistance, with a focus on coastal communities vulnerable to sea level rise. I'm a licensed professional planner with more than 30 years of land use and environmental planning experience.

Founded in 1987, [New Jersey Future](http://njfuture.org) is a nonprofit, nonpartisan organization that promotes responsible growth, redevelopment, and infrastructure investments to foster vibrant cities and towns, protect natural lands and waterways, enhance transportation choices, and provide access to safe, affordable, and aging-friendly neighborhoods to fuel a strong economy.

Today I will address the work that we have done with New Jersey communities in the aftermath of Hurricane Sandy, and then talk about immediate and long-term actions the state can take to prepare our communities for the consequences of climate change and sea level rise.

Since early 2013, I've overseen New Jersey Future's Local Recovery Planning Manager program, which provides ongoing and direct assistance to municipalities seeking to rebuild from the devastating damage of Hurricane Sandy.

The Local Recovery Manager Program is unique compared to the various assistance efforts launched after Hurricane Sandy because we embedded professional planners in communities that were hit hard by the hurricane. Six communities participated in our program: Sea Bright and Highlands in Monmouth County; Little Egg Harbor and Tuckerton in Ocean County; and Commercial and Maurice River in Cumberland County.

Our recovery planning managers set up desks right in the town halls so they could work closely with elected officials and staff on many issues they faced in the aftermath of the storm. We continued to work with these towns for at least three years, and we're still working with some of them today, almost five years after the storm. This long term, hands-on relationship was essential to gaining trust of local officials and community residents.

*Working for Smarter Growth...More Livable Places and Open Spaces*



All the towns that sustained storm damage were seeking a return to normalcy, getting residents back in homes, businesses back in operation, and mountains of debris cleared from their streets. During our first program year, we worked with our participating towns to address these objectives. We were able to help them obtain over \$8 million in grants for projects ranging from purchase of emergency communication equipment, to installing green infrastructure, from restoring a community park, to obtaining a police car.

However, we knew that eventually the towns would need to move forward from emergency response to long term recovery, and that meant confronting vulnerability to future coastal storms and risks associated with sea level rise. Increasingly, residents in the communities we're working with acknowledge that circumstances are changing. A resident in one coastal community told me she used to enjoy the thrill of storm events, now she views them with alarm and dread, emotions clearly on display when I watched residents frantically moving cars, boats, families and neighbors, as Hurricane Joaquin was bearing down on the coast in 2015.

When we started our work, we found that no municipality was prepared to respond to the damage they experienced from Sandy. In Sea Bright Borough, for example, 50 percent of the businesses were wiped out and 50 percent of the Borough's residents were forced from their homes. It was months before they were able to contact many of the displaced families - and in some of these municipalities, residents are still not back in their houses.

But our coastal towns SHOULD have been prepared for Sandy...

On average, almost every year for the past two decades, New Jersey has experienced a presidential-declared disaster on some part of its coast. We keep repeating these experiences and we keep responding by insisting on rebuilding and returning everything to pre-storm condition as quickly as possible without considering the inevitability of the next event. The storms are trying to tell us something but we haven't been listening.

We're now experiencing coastal risks that the state can no longer afford to ignore. Sandy was our most dramatic storm in recent memory, but it's been followed by two presidential declared flood-related disasters and several severe storms and nor'easters. Today, towns are experiencing recurring flooding during regular high tides. We used to shrug these occurrences off as nuisance flooding but they're not merely a nuisance when they regularly inundate ever larger areas of the coast, block emergency evacuation routes, and cause considerable property damage. Projections indicate that these conditions will grow more severe over time.

The relationships we cultivated with the towns and their residents enabled us to discuss what climate change and sea level rise would mean to their futures. In Little Egg, we worked with a steering committee for well over a year to prepare a detailed risk analysis. When that analysis was completed we asked the council to schedule public hearings to discuss our findings with residents of their town. It took us four months to get them to just talk about the meetings. Council members said they were very nervous about us discussing these topics with their residents, because, in one council person's words, "it

will scare the hell out of them.” In the end, however, the meetings were scheduled and very productive public discussions were conducted.

These are very difficult conversations for local officials to initiate because they fear that people will no longer invest in their town, or they will move out. And local officials have no buffer. The administrator in Little Egg told us, “We can’t do this by ourselves. Invite state and federal agencies and other towns to join the conversation but on our own, we can’t talk to our residents about these issues.”

We need to find a way to facilitate these conversations because we can’t keep rebuilding in the 1 percent flood zone if we want resilient, thriving municipalities with sustainable tax bases. In Toms River, the valuation of land and buildings in the 1% flood zone is worth a staggering \$4.7 billion encompassing almost 1/3 of their land area. What happens to their tax base when those properties are under water?

We can’t ignore what climate science is telling us, and we can’t ignore that our communities are unprepared for the consequences of climate change and sea level rise.

To demonstrate what communities will face, in terms that local officials could relate to, we developed an analysis that translated risk into financial impact. We recognized that maps alone are not sufficient; maps are abstract representations to most people. So we developed a parcel-based risk analysis that predicts depth of inundation throughout a community and models structural damage to calculate financial exposure and tax revenue loss. This analysis enabled us to determine, for example, that by 2050, sea level rise plus a Sandy-magnitude storm would inundate 55 percent of the area of Little Egg Harbor, and the Township could lose as much as 35 percent of its assessed value. That would be an economically unsustainable hit. It was at that point, with these calculations in hand that municipal representatives finally acknowledged that we have to seriously consider how we respond to sea level rise.

To effectively respond to risk, New Jersey’s municipalities urgently need state-level direction and assistance. There are several steps the state can take to move coastal communities forward toward resiliency. These actions need to be taken now while we have time to plan ahead, instead of waiting and reacting to conditions that will leave us with no alternatives. The state should:

1. **Assume a leadership role** in assisting coastal municipalities to implement adaptation and mitigation options ;
2. **Establish uniform, forward-looking sea level rise standards and guidelines for mitigation planning.**  
We suggest using sea level rise projections from a report by the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel entitled [Assessing New Jersey’s Exposure to Sea level Rise and Coastal Storms](#). Just about every organization working in the field of resiliency in New Jersey is presently relying on these projections.
3. **Adopt principles set forth in [President Obama’s Executive Order 13960](#)**, which encourages state, county, and local agencies to use the best available science to ensure that no critical facility is located in an area subject to current and future flood risk.



**4. Require and provide assistance to enable every coastal municipality to assess its risk and vulnerability to sea level rise.** These assessments need to be performed immediately because: even though sea levels are rising and damage from coastal storms is becoming more severe, we still have time to plan and enact rational adaptation and mitigation strategies; and because Land use changes that ensure that people and property are not in harm's way will require a long period of adjustment before they achieve successful outcomes

We also need to recognize that climate change and sea level rise will overwhelm the resources and abilities of individual municipalities to plan for them. Sea level rise and storm events don't respect municipal boundaries; they have regional impacts that demand regional response. Steps the state could take to better support our communities through a regional approach could be to:

1. **Enter into broad-scale dialogue with at-risk communities.** We need to reimagine the future of the shore, how it will be used, and how current development can be shifted gradually out of harm's way. Reimagining the future of New Jersey's coast necessarily involves extensive engagement and communication with local residents, business owners, and officials to garner public support to implement necessary adaptation strategies.
2. **Adopt a regional perspective to all local planning and programs.** As I've already mentioned, adaptation cannot be implemented on a community by community basis. Uncoordinated, individual responses (such as sea walls and bulkheads) can and do result in unintended adverse impacts on neighboring communities. Effective risk response must encompass entire coastal areas unconstrained by municipal boundaries.
3. **Consider creation of a regional resilience commission and explore development of regional revenue-sharing policies.** Regional tax-sharing was a founding principal when the Meadowlands Commission was established to protect fragile wetlands. That approach could serve as a model policy framework to balance windfalls and wipeouts to help municipalities make the right development choices in vulnerable coastal areas.
4. **Revise the Municipal Land Use Law to require incorporation of risk and vulnerability analyses into municipal master plans.** The MLUL must be revised to address the risks of sea level rise and climate change. Towns will also need technical and financial assistance to align local land use plans and policies, zoning regulations and capital investment plans with natural hazard information mitigation and adaptation strategies.
5. **Align state programs and incentives to discourage development in areas at risk of flooding or inundation.** This could be accomplished through a rekindled state plan process.

When I first I met Mayor Dina Long of Sea Bright Borough, she was wearing her hip-high waders. She told me this was normal, the town experiences flooding on a monthly basis, waders are standard-issue borough attire. The problem stems from the fact that the Borough's stormwater outfall pipes are lower than the level of the Shrewsbury River during high tides, so as the river rises, waters back up through the collection system and regularly flood the streets. The thing is, the flooding is occurring more often and becoming more persistent. It's happening with alarming regularity in Miami, where fish are swimming in the streets during high tides, and in many coastal towns and cities along the East Coast.

The state can and should take the lead as a valuable partner to mayors like Dina who are striving to do the right thing but need support, guidance, and funding to plan an orderly transformation of their towns into communities that can be sustainable in the face of sea level rise and a changing climate. To that end, New Jersey can follow the path set by other states including Massachusetts, New York, Maryland, Delaware, Virginia and North Carolina, to name a few. We urge the members of the Joint Environment Committee to advocate for policy changes and enact legislation to protect and preserve the vital economic and environmental resources that are New Jersey's coast.

If you want to know more about the work we did in coastal communities, I have copies of our report, In Deep, which is also on the New Jersey Future website. I am happy to answer questions. Thank you very much.









# IN DEEP

**Helping Sandy-Affected Communities  
Address Vulnerability and Confront Risk**



October 2015





# IN DEEP

Helping Sandy-Affected Communities  
Address Vulnerability and Confront Risk



October 2015





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## FOREWORD

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In 2011, the Federal Emergency Management Agency published its National Disaster Recovery Framework (NDRF),<sup>1</sup> which was based on the agency's experiences with disasters throughout the country. The NDRF acknowledges that local governments have primary responsibility to plan and manage all aspects of a community's recovery, but that local officials often become overwhelmed with the demands of disaster response and need additional leadership, staff support, and expertise to manage recovery efforts effectively. This capacity deficit is the principal reason the NDRF "... strongly recommends that State Governors as well as local government ... prepare as part of their disaster recovery plans to appoint Local Disaster Recovery Managers to lead disaster recovery for the jurisdiction."<sup>2</sup>

On December 7, 2012, a little more than one month after Hurricane Sandy, New Jersey Future and Monmouth University's Kislak Real Estate and Urban Coast institutes sponsored "Rebuilding a Resilient New Jersey Shore," a half-day conference exploring the impacts of the storm.<sup>3</sup> Representatives from local, state and federal agencies, including FEMA, were among the attendees. FEMA was already building its recovery support teams and Denise Gilliam, a program specialist at the Department of Homeland Security and FEMA's representative for federal disaster recovery coordination, was meeting with key stakeholders around the state. Recognizing that private philanthropy could provide funds much more quickly than federal sources and that a local nonprofit partner might be more agile and knowledgeable about the needs of local governments, Ms. Gilliam connected New Jersey Future with the Merck Foundation. In mid-December 2012, with FEMA's encouragement, the Merck Foundation committed the funding to support New Jersey Future's local recovery planning manager (LRPM) program.

The Merck Foundation was not the only philanthropic institution gearing up for long-term recovery work. About two months after the storm, a group of 26 charitable groups, corporations and philanthropic organizations pooled their resources to create the New Jersey Recovery Fund,<sup>4</sup> led by the Geraldine R. Dodge Foundation and the Community Foundation of New Jersey. New Jersey Future proposed the LRPM program to the fund, and at the end of May 2013 the fund awarded one of its largest grants to New Jersey Future's effort. This enabled the organization to create four LRPM positions, one of which would be responsible for overall program coordination and management as well as local project-specific support, and three that would be embedded with towns for at least 18 months.

This report chronicles New Jersey Future's LRPM program, including initial goals, successes and challenges, and lessons learned that can inform future disaster recovery initiatives both in New Jersey and across the country.



# INTRODUCTION

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**H**urricane Sandy revealed uncomfortable truths about the way New Jersey's municipalities, and in particular its coastal towns, are built and governed. Patterns of concentrated development along the state's coastal edge have left too many people and structures dangerously vulnerable to storm damage and floods. In addition, resistance to regional solutions that has grown out of New Jersey's home rule form of governing have left many small coastal communities – often the ones that suffered the worst damage from Sandy – without sufficient capacity to recover or rebuild in a manner that would make them less vulnerable. To be sure, many of the challenges communities faced existed prior to Sandy, and to varying degrees towns throughout New Jersey have long struggled to address them. The storm merely cast these issues in sharper relief.

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New Jersey Future, whose mission is specifically focused on “smart” development and redevelopment, was in a position to provide the extra assistance through local recovery planning managers (LRPMs), helping the towns to move people and assets out of harm's way and leaving them with more resources to prepare for the next storm.

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And yet these uncomfortable truths also presented a unique opportunity, if there were a way to take advantage of it. Damage in many towns was so extensive that it had the potential to provoke a more realistic acknowledgement of the vulnerability inherent in dense, intense coastal development. This realization might in turn encourage these towns to question whether they were best served by merely restoring themselves to their pre-storm state or, in light of New Jersey's history of coastal flooding and



SEA BRIGHT BOROUGH, OCT. 29, 2012  
(COURTESY KRISTI JACOBS)

projections of rising sea levels, whether it might be more prudent to rebuild differently.

The reality was that Sandy-damaged towns were so consumed with managing their immediate recovery that they had neither the time nor the resources to consider the systemic changes that would be needed to help protect against future storms. The towns and their existing consultants could have guided their efforts if merely putting things back the way they were before the storm had been the goal. However, if the goal was to re-think completely how towns were planning to rebuild given their history of repetitive flood damages, they needed more help. An organization like New Jersey Future, whose mission is specifically focused on “smart” development and redevelopment, was in a position to provide the extra assistance through local recovery planning managers (LRPMs), helping the towns to move people and assets out of harm's way and leaving them with more resources to prepare for the next storm.



## WHICH TOWNS?

As generous as the grants were to New Jersey Future, the funding to develop and implement the LRPM program would clearly not be sufficient to meet all, or even a significant portion, of the needs of the 130-plus coastal towns that experienced damage from the storm, or even the 30 communities that were hardest hit.<sup>5</sup> A method was needed to prioritize and focus resources to ensure the funding that was provided would have the greatest possible impact and provide useful and transferable lessons.

The initial plan was to assign the three recovery managers to one town each, enabling each recovery manager to cultivate the relationships and trust needed to perform the LRPM role effectively. However, in an effort to make the most out of the available funding, New Jersey Future concluded that if selected municipalities were geographically proximate and had somewhat similar needs, it would be possible for the recovery manager to serve two towns simultaneously. By having each of its LRPMS work in two neighboring towns, New Jersey Future might also be able to encourage the municipalities to work together during the recovery process. It also seemed possible that, through cooperation and linked projects, municipalities might begin to think regionally, a perspective necessary to address vulnerability to natural disasters that are unconstrained by political jurisdictional boundaries.

To help determine where it would focus its resources, New Jersey Future collected a variety of municipal data, including FEMA's community storm damage assessments, housing tenure and value data and State Planning Area designations. In addition, the organization reviewed a FEMA Community Data-Based Analysis, which detailed government type and unemployment rate, and evaluated damage costs, availability of emergency services (police, fire, etc.), and hazard mitigation plan status. Ultimately three criteria were used to determine where the LRPM program would focus its efforts:

1. Whether the community experienced widespread storm damage based on FEMA assessments;
2. Whether the majority of the community's resident population was year-round, based on housing tenure;



THREE MONTHS POST-SANDY, LITTLE EGG HARBOR TOWNSHIP  
(COURTESY MICHAEL FROMOSKY)



SANDY STORM DAMAGE, TUCKERTON BOROUGH  
(COURTESY JENNY GLEGHORN, BOROUGH MANAGER)



SANDY STORM DEBRIS REMOVAL, SEA BRIGHT  
(COURTESY KRISTI JACOBS)



3. Whether the municipality had limited in-house capacity due to an absence of either planning staff or outside consultants.

Using these criteria, 13 communities were identified as potential candidates for direct assistance.

The next step was to conduct community interviews to determine whether services that New Jersey Future was equipped to offer would be welcomed by any of the identified municipalities.

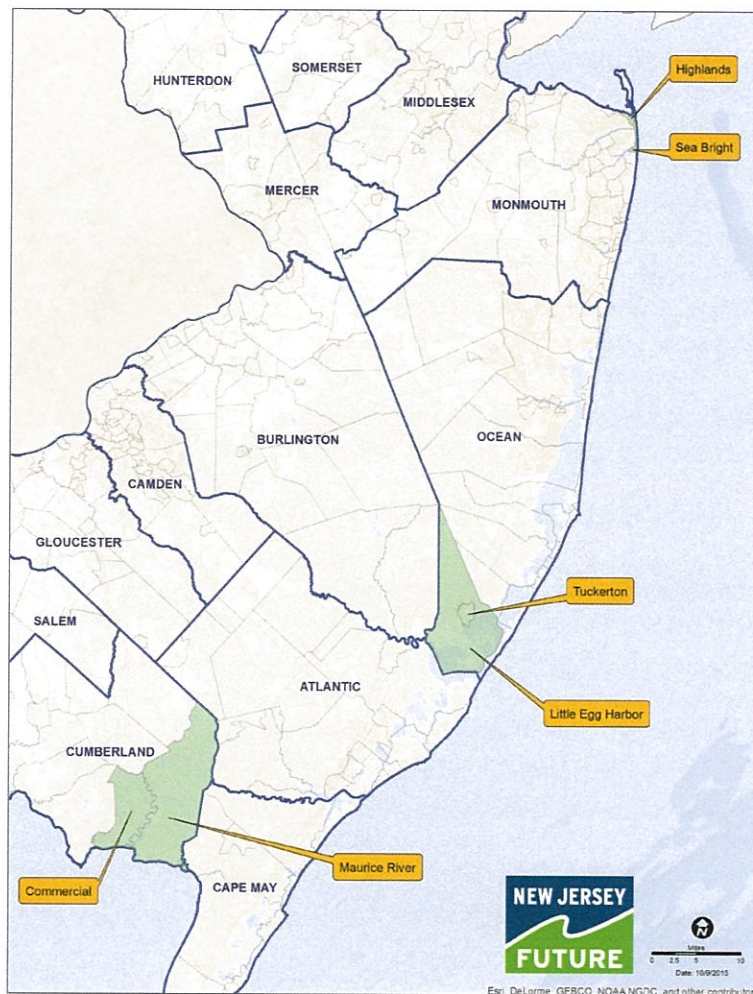
These interviews took place during the spring and summer of 2013, a particularly chaotic period for community officials. Many organizations, agencies and institutions were offering a varied but uncoordinated mix of assistance. The communities were desperately focused on recovery: getting residents back in their homes, getting businesses back in operation, and disposing of the enormous quantities of debris that had smothered residential areas, downtown business districts, beaches and roadways since the storm. Officials in these communities were overwhelmed by the magnitude of the demands they faced and some were unable to sort out whether the assistance New Jersey Future was offering would benefit them; some towns never responded to the outreach.

Each town that was interested in hosting a LRPM was asked to adopt a resolution of engagement, formally requesting the services. The objective of the resolution was to ensure that the municipality's governing body was truly supportive of the program. The resolution also committed

the municipality to 11 aspirational actions, including considering the impacts of sea-level rise; collaborating with neighboring municipalities to address region-wide issues; assuring that hazard mitigation plans would be integrated with local plans and regulations; and involving the community in the decision-making process (see *Appendix A, Resolution of Engagement*).

Once the resolution of engagement was adopted, a memorandum of agreement (MOA) between the municipality and New Jersey Future was executed.

The MOA established a chief point of contact in the municipality and assured the local recovery planning manager access to municipal staff, local officials and residents of the town. It also obligated the municipality to provide the LRPM with a work space. The agreement provided assurance that the costs of the LRPM would be the responsibility of New Jersey Future; it set forth the term of engagement and provisions for termination of the agreement; and it stipulated that following a thorough assessment of needs the LRPM would draft a detailed



PARTICIPATING MUNICIPALITIES

scope of work that would be made part of the MOA. New Jersey Future deemed these three documents to be necessary in order to manage a participating municipality's expectations.

Eventually, New Jersey Future came to an agreement with six towns: Sea Bright and Highlands in Monmouth County; Little Egg Harbor and Tuckerton in Ocean County; and Commercial and Maurice River in Cumberland County (see *Participating Municipalities map*).



## MILESTONES

|                              |  |
|------------------------------|--|
| <b>October 29, 2012</b>      | Hurricane Sandy strikes the Northeast United States, causing significant damage along all of New Jersey's coastline.   |
| <b>Winter 2012-2013</b>      | Private philanthropy jump-starts a pilot local recovery planning manager program through the nonprofit New Jersey Future.  |
| <b>Spring 2013</b>           | Lead local recovery planning manager hired by New Jersey Future. Participating coastal towns screened and selected.  |
| <b>Summer 2013</b>           | Engagement agreements negotiated with participating towns. Embedded local recovery planning managers hired.  |
| <b>Fall/Winter 2013-2014</b> | Local recovery managers begin active engagement in participating towns, including local outreach, meetings, assessments and identification of new resources.<br>New parcel-based risk assessment tool is developed.<br>First of the local steering committees holds kickoff meeting.   |
| <b>Spring 2014</b>           | First towns move through the "Getting to Resilience" self-assessment process.<br>First new grants garnered for towns by local recovery planning managers, including multi-million dollar shoreline restoration/stabilization grant.<br>First local risk assessment completed.  |
| <b>Summer 2014</b>           | Risk assessment information shared with local officials and steering committee members.<br>Community engagement process developed and established with steering committee and town leaders.<br>First town adopts risk assessment as a baseline for future decision-making.   |
| <b>Fall 2014</b>             | Additional grants are secured for towns, including a major Sandy disaster-relief grant for historic properties and shoreline stabilization.<br>Shored Up documentary screening takes place and kicks off first public meetings.  |
| <b>Winter 2014-2015</b>      | New Jersey Future facilitates regional meeting of municipal managers.<br>Community Risk Perception study conducted with Carnegie Mellon University completed.<br>One town begins Hazard Mitigation Plan update.<br>One town initiates a Health Impact Assessment for property buyouts.   |
| <b>Spring 2015</b>           | Local recovery planning manager work inspires the George Street Playhouse creation and presentation of <i>Gabi Goes Green!</i> , a children's play about climate change.<br>At least 12 significant local projects under management by local recovery planning managers.   |
| <b>Summer 2015</b>           | Public meetings take place, focused on topics ranging from adaptation strategies to planning for the future.<br>New Jersey Future extends local recovery manager planning services to several participating towns as funding support dwindles but important projects are proceeding.   |
| <b>Fall 2015</b>             | Local recovery planning managers begin reducing their time commitments as funding cycle comes to an end.   |
| <b>Winter 2015-2016</b>      | Without additional funding, local recovery planning managers will need to end their assignments. Unfinished projects include: <ul style="list-style-type: none"> <li>• Community Rating System certification to reduce insurance costs</li> <li>• Implementation/management of upcoming and ongoing resiliency projects</li> <li>• Integration of risk assessments into municipal land-use process</li> <li>• Integrating risk into development plans and policies</li> <li>• Advancing the public discussion and acceptance of new risk levels</li> </ul> |

Note: This is a general timeline of milestones for all six towns. Some towns reached specific milestones earlier or later than others.



# BUILDING TRUST

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**G**aining the trust of elected officials and community members was essential if the LRPM program were going to achieve lasting success. New Jersey Future had few pre-existing relationships with the community leaders of the selected municipalities, and many of their long-serving engineering consultants viewed the program with suspicion. It would take a good deal of time – at least a year – for communities to develop confidence in New Jersey Future, one of the program’s earliest lessons learned. Some activities that proved instrumental in helping to develop those relationships:

- **Initial Focus on Short Term Accomplishments:** The LRPMS began by working on short-term successes – smaller-scale projects they could accomplish that would address the towns’ most urgent rebuilding needs. Making progress with these projects demonstrated that New Jersey Future had the towns’ best interest at heart.
- **Mutually Agreed-Upon Scope of Assistance:** Setting the bounds of involvement through the resolution of engagement, the memorandum of agreement and a carefully delineated scope of services was important to manage the expectations and define the responsibilities of all parties.
- **Regular Visibility:** The LRPMS were regularly available and readily accessible to municipal officials and staff and often spent time working within the municipal offices. Constancy, reliability and visibility were essential ingredients to building lines of communication. In many cases municipal representatives increasingly came to rely on the LRPMS to wade through the regulatory maze and communicate directly on the community’s behalf with the wide array of organizations and state and federal agencies that were offering recovery funding. Community officials have increasingly accorded the LRPMS considerable latitude to manage and act as chief municipal contact for implementation of several significant projects. This depth of relationship is only possible through long-term and regular community involvement.
- **Steering Committees:** The LRPMS encouraged their towns to establish steering committees that would include not just elected leaders but stakeholders from

across the community, to help guide the long-term recovery process. The objective was to emphasize and ensure that the community, not the LRPM, was in charge of how the municipality would recover and that the LRPM would provide continuous support and technical guidance. Where committees were created, input from members provided increased understanding of community needs and issues and valuable assistance with community outreach. However, not every

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Across the six towns the LRPMS secured approximately \$8 million in grants from a variety of sources to fund such diverse projects as living shoreline restoration, streetscape upgrades, lagoon dredging, repair of wastewater facilities, flood protection of a historic lighthouse and acquisition of emergency radio communication equipment.

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community was accustomed to working through or with committees of unelected representatives, which considerably narrowed efforts to generate effective resident engagement.

- **Funding Local Projects:** When New Jersey Future’s LRPM program first began it was clear that the communities’ highest priority was immediate recovery rather than future resiliency. To help address that priority, the LRPMS focused on a wide range of projects that were intended to respond to particular municipal needs. The LRPMS led the development of each town’s Strategic Recovery Planning Report, which was required in order to gain access to other state planning funds (see p. 11). Across the six towns the LRPMS secured approximately \$8 million in grants from a variety of sources to fund such diverse projects as living shoreline restoration, streetscape upgrades, lagoon dredging, repair of wastewater facilities, flood protection of a historic lighthouse and acquisition of emergency radio communication equipment. Securing the funds for, and managing the implementation of, these projects were essential to building relationships of trust with local officials and key community leaders.



# PIVOTING TOWARD RESILIENCE: REACHING A COMMON UNDERSTANDING ABOUT RISK

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**A**s New Jersey Future began its municipal engagements, it was clear that the municipal attention would be understandably fixed on returning community life to as “normal” a state as possible. Mindful of this, the LRPMS began by focusing on securing funding to undertake a wide range of projects tailored to serve the municipalities’ short-term needs. But New Jersey Future also recognized that communities would eventually need to grapple with how they could move forward from immediate relief to long-term recovery. In doing so, it would be critical to identify the current vulnerabilities and future risks these communities would likely be facing, in order to ensure that investments of scarce resources for recovery did not merely put people and property back in harm’s way.

first round of federal Sandy recovery funds included such a meager allocation for planning that recipient towns couldn’t afford to expend adequate resources on exploring this critical question.

Yet the fact remains that in a home-rule state such as New Jersey, virtually all land-use decisions are made at the local level, and without a local understanding of future risk there could be no realistic long-term resiliency planning. In the absence of a long-term planning context it was also unlikely that a municipality could develop a strategic rationale for prioritizing critical infrastructure investments that wouldn’t leave the community just as exposed as it was before Sandy.

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Not surprisingly, both local and state elected officials were very reluctant to engage in discussions about vulnerability to severe weather, flooding and the threat of projected sea-level rise. In part this was because acknowledging these vulnerabilities might make real estate in affected communities less attractive, with resulting negative effects on property values and, consequently, the towns’ tax bases.

Part of the blame for this reluctance at the local level can also be attributed to an absence of substantive direction from state government about how and whether to address future risk. For the most part the state has focused on rebuilding damaged areas to pre-storm conditions, and state policies have yet to consider scientific projections of rising sea levels and climate change. In the absence of state guidance, local officials are largely unequipped to address these issues on their own, primarily because they affect areas much larger than any single municipal jurisdiction. Furthermore, under the state’s direction the

## Forward-Looking Risk Assessment

Given the importance of understanding future risk and the general reluctance to facing it, New Jersey Future needed to devise an evaluation method that would speak directly to the concerns of local officials and residents. The expectation was that if the analysis were presented in a sufficiently compelling manner, local officials would be emboldened to open difficult but essential public-policy discussions with their residents about vulnerability.

Working with the environmental engineering firm Princeton Hydro, New Jersey Future developed a vulnerability and risk analysis (see sidebar, Understanding Risk) explicitly intended to relate convincingly the impacts of sea-level rise. This parcel-based mapping analysis predicts depths of inundation throughout a community under various future scenarios, then models resulting structural damage and calculates both the property owners’ financial exposure and the towns’ related potential tax revenue losses. This level of detail is essential in helping the community to appreciate the economic risks of future flooding and sea-level rise, and to reach a realistic determination of how and where to allocate scarce personnel and financial resources. Describing the economic implications of sea-level rise also captures and focuses the attention of local officials very effectively.

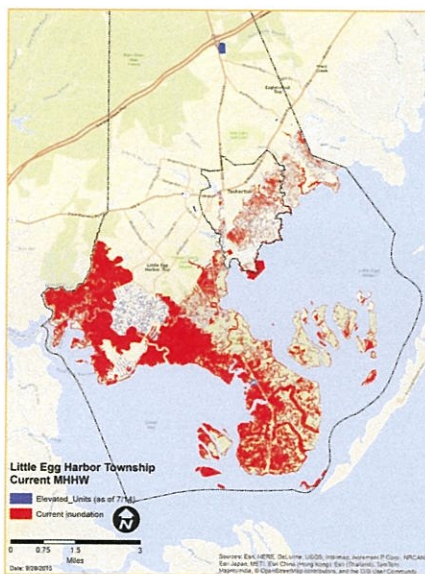




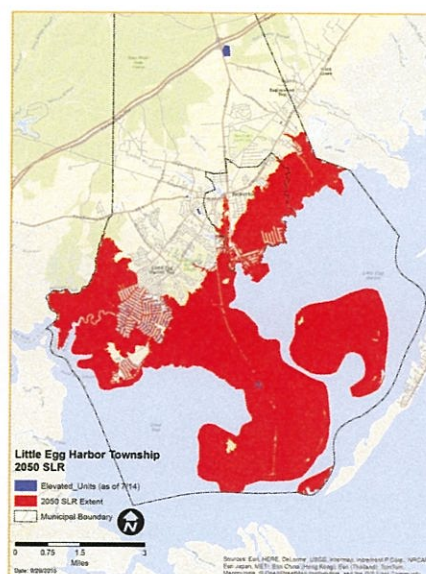
## UNDERSTANDING RISK

New Jersey Future's vulnerability and risk analysis examines current and future flooding conditions given projected sea-level rise, and evaluates the impact of those conditions on the assessed value of the community. Future sea-level-rise scenarios were based on projections developed by the Department of Earth and Planetary Sciences at Rutgers University and modeled using precise digital elevation data. A 2050 planning horizon was selected, roughly reflecting the period of a conventional home mortgage if taken out today, in an effort to make the analysis more relevant to local property owners. Impacts are evaluated under three scenarios: current conditions, 2050 sea-level rise and 2050 sea-level rise with a 1-percent storm (equivalent to Hurricane Sandy).

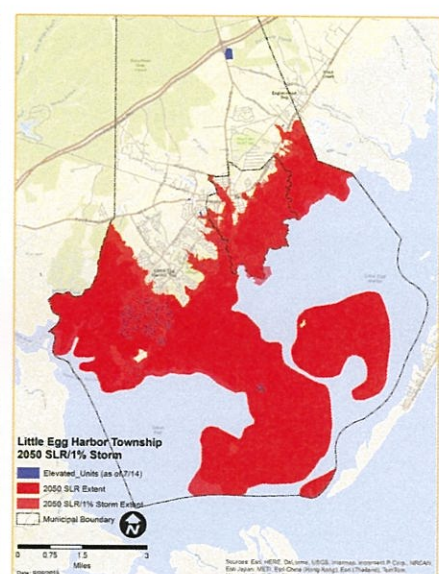
For example, in Little Egg Harbor, the exposure analysis indicates that by 2050, sea-level rise will inundate 31 percent of the area of the municipality, encompassing 9 percent of its assessed value. In comparison, by 2050, sea level rise coupled with a 1-percent storm will inundate 34 percent of the area of the township, and encompass as much as 31 percent of its assessed value. The maps below illustrate these impacts.



CURRENT CONDITIONS



2050 SEA-LEVEL RISE



2050 SEA-LEVEL RISE + 1% STORM

The state's Post-Sandy Planning Assistance Grant (PAG) program,<sup>6</sup> administered by the New Jersey Department of Community Affairs, was intended to provide municipalities the necessary funding to hire experts to help formulate a long-term rebuilding strategy and codify it into a document the state called a Strategic Recovery Planning Report. A completed report opened the door to additional funds to update community master plans, hazard mitigation plans, capital investment strategies and development regulations. At its minimum, the report needed to include a baseline evaluation of community impacts from Hurricane Sandy that highlighted

existing and potential vulnerabilities, and an outline of initiatives the community could undertake to improve public safety and stimulate recovery. However, the PAG guidelines provided no specifics about evaluating existing vulnerability or required any analysis of future risk. New Jersey Future deemed such analysis essential to a realistic understanding of future storm and flood-related risks and insisted that this analysis be included in reports it prepared for the communities participating in the LRPM program. The reports were an indispensable starting point for beginning the discussions about community risk.



## Beginning the Public Conversation

New Jersey Future's risk analyses, which highlight the potential for significant property damage, loss of property value and declining municipal tax revenues, offer a strong argument that rebuilding in place will not serve to make coastal communities safer. The results suggest that it will be necessary to consider reshaping coastal development patterns considerably and rethinking much of how the shore will contribute to the state's tourism economy in the future. Making this argument as straightforward as possible has been instrumental to New Jersey Future's efforts to help communities begin both the internal and public conversations about steps they will need to take in order to make themselves more resilient to growing climate-related threats.

Prior to preparing the risk analysis, each participating community engaged in the "Getting To Resilience" (GTR) process,<sup>7</sup> which was facilitated by the LRPM and led by staff from the Jacques Cousteau National Estuarine



BOROUGH OF SEA BRIGHT PUBLIC MEETING OCT. 9, 2014, MAYOR DINA LONG DISPLAYING WADERS SHE WEARS DURING REGULAR FLOOD EVENTS

Research Reserve. This exercise introduces community officials to flood risks and guides them through a series of questions about the municipality's plans and regulations to determine where changes may be warranted to help reduce vulnerability. GTR was a helpful way to start

## CONSIDERING BUYOUT AS A RECOVERY STRATEGY

In the disaster-recovery world, buyouts refer to government programs that purchase at-risk properties in order to help move people out of harm's way. New Jersey's Blue Acres program, administered through the New Jersey Department of Environmental Protection, targets flood-prone properties and, following Hurricane Sandy, received an allocation of federal disaster recovery funds specifically to give homeowners the option to sell houses that were flooded during the storm. Homes are purchased at pre-storm value and then demolished and the land is permanently preserved as open space, accessible to the public for recreation or conservation. Preserved lands can serve as natural buffers against future storms and floods. Many local officials have considerable reservations about buyouts, fearing the loss of taxable property and the effect this loss could have on the local economy.

With support from the Health Impact Project, a collaborative between the Pew Charitable Trusts and the Robert Wood Johnson Foundation, New Jersey Future and Rutgers University are conducting a health impact assessment (HIA) to evaluate the effects of a coordinated buyout strategy in the Mystic Island section Little Egg Harbor Township. Preliminary findings show that there are persistent and widespread fiscal, physical and mental health issues at play, and that buyouts could help address these issues by purchasing the most vulnerable houses and replacing them with shoreline protections specifically designed to make the area less flood-prone and more secure. In addition to the work in Ocean County, New Jersey Future is completing a fiscal impact analysis on behalf of the Borough of Sea Bright in Monmouth County, that evaluates the effect of purchasing approximately 200 of the community's most flood-prone homes (representing 16 percent of the municipality's total housing stock). Findings show that purchasing properties that experience severe repetitive losses from flood damage would result in significant financial benefits for this highly vulnerable, low-lying barrier-island community.



conversations with municipal representatives about risk and vulnerability and contributed to preparing them for broader community outreach.

The public discussion of the impacts of future sea-level rise needed to be crafted carefully, to overcome skepticism and encourage a reasoned evaluation of risks, responses and adaptation strategies. To help make these conversations as productive as possible, New Jersey Future teamed with a psychologist<sup>8</sup> from the Department of Engineering and Public Policy at Carnegie Mellon University whose specialty is communicating risk. She worked with New Jersey Future for more than a year, helping to frame the community discussions about sea-level rise and climate change. She distributed a survey to residents in all the LRPM program participating municipalities, the responses to which helped her and New Jersey Future understand how residents perceive flooding and flood risk. Among the key insights: Survey respondents acknowledged that flood risk is increasing but that long-time residents have high tolerance for flooding and would have to experience a far greater probability of risk before they would consider relocating from vulnerable coastal areas. Respondents also indicated that long-term preparation is important but some believed that such activity might create a stigma that would discourage investment in their communities. This information was instrumental in shaping the content of the public presentations and the manner of communication and outreach. A full report on the results of her work is expected by November 2015.



ADVERTISEMENT FOR SCREENING OF *SHORED UP* IN SEA BRIGHT

In September 2014, Sea Bright Mayor Dina Long kicked off the public meetings on vulnerability with a screening of the film *Shored Up*, an award-winning documentary about coastal development and risk in New Jersey and North Carolina. After the screening a panel discussion and a question-and-answer session was conducted featuring the film's director and three local coastal and environmental experts. Subsequent to the film-screening event, the mayor led a special town-hall meeting at which New Jersey Future presented the borough's full vulnerability and risk analysis. Although the information was difficult for residents to hear because so much of the municipality is at risk of future inundation, attendees expressed their appreciation



PUBLIC MEETING, JUNE 20, 2015  
LITTLE EGG HARBOR COMMUNITY CENTER





for the opportunity for a fact-based discussion. Sea Bright plans to schedule subsequent public meetings about risk and mitigation as it completes its hazard mitigation plan, which is currently in development.

The first of a series of three public meetings for residents of Little Egg Harbor Township and Tuckerton Borough, entitled “Planning for Our Coastal Future,” was conducted in April 2015. Almost 70 residents from the two municipalities turned out to hear the results of the vulnerability and risk analyses that New Jersey Future prepared for both towns. A follow-up meeting in May focused on reviewing short-term adaptation strategies and recovery projects the municipalities have already started. The final meeting in the series took place on a Saturday in June in order to obtain input from seasonal as well as year-round homeowners in the area. Unlike the prior meetings, participants in the final meeting were

divided into facilitated breakout groups that enabled extensive discussion about their experiences during and after the storm and the types of initiatives in which they thought their elected officials should be engaging to reduce future risks. This proved to be a particularly productive meeting format. At the conclusion of the meeting residents unanimously and enthusiastically agreed that community discussions regarding coastal risks, community vulnerability and mitigation and adaptation strategies should continue.

In August 2015 New Jersey Future conducted a public presentation of the risk and vulnerability analyses for the Commercial Township Committee. Having reviewed their SRPR, officials from Maurice River Township invited New Jersey Future to present the findings of the risk and vulnerability analysis in September 2015 with an expectation of formal adoption before the end of the year.

## GABI GOES GREEN!



New Jersey Future collaborated with the issue-oriented Educational Touring Theatre of the George Street Playhouse, an organization that commissions and produces touring theatre with themes relevant for young audiences. The plays are also used as a foundation for workshops and for engaging classroom discussions that fulfill the New Jersey Core Curriculum Content Standards for the performing arts. Each year these workshops attract more than 200 teachers. This year, the playhouse built a performance, inspired in part by New Jersey Future's community recovery assistance work, entitled *Gabi Goes Green!*, which focused on climate change. Following the performance, New Jersey Future presented the risk analysis findings during panel discussions with educators to help them shape their environmental-education classes for elementary- to high school-level students.



# CONCLUSION

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**A**fter more than two years working hand-in-hand with Sandy-affected communities, New Jersey Future has seen that the local recovery planning manager program is a very effective approach to helping towns respond to the immediate impacts of a disaster while at the same time building a platform for smarter, longer-term decisions in light of future risk. This strongly reinforces FEMA's contention that building local capacity is a critical ingredient of recovery and resiliency longer term. The LRPM program model that New Jersey Future has developed is highly transferable and the hope is that state and federal policy makers will take the lessons learned in New Jersey and establish a mechanism for replicating, expanding and supporting the program elsewhere.

## Lessons Learned

In thinking about the challenges and success of the LRPM program, New Jersey Future has identified valuable lessons about how the program can best be administered going forward, the key elements of which include:

- **It takes time.** It takes at least several months, and maybe as much as a year, to earn a community's trust and to develop relationships with key community representatives, including its retained planning and engineering professionals, who were initially unsure of the LRPM's role and how it affected their own standing within the communities.
- **Start with the short-term needs to get to longer-term changes.** Addressing short-term needs can help build the trust necessary to deal with larger, longer-term issues.
- **Check in regularly.** It is very difficult to capture the undivided attention of local administrators and elected officials, particularly during a crisis. At the start of the engagement, either through the MOA or some other formal arrangement, regularly occurring meetings between the LRPM and key decision-makers should be required and scheduled to provide opportunities to discuss issues, obstacles and progress. This is particularly important since the LRPM program was provided at no cost to the municipality,

"I can't afford not to have New Jersey Future."

— Jenny Gleghorn, Administrator  
Tuckerton Borough

"We need a co-pilot."

— Hon. Judson Moore, Mayor  
Maurice River Township

which makes it easier for officials to distance themselves from discussions of risk.

- **Manage expectations.** It is critical to manage a community's expectations through detailed scopes of services that define tasks and deliverables clearly.
- **Become the central point of contact for recovery matters.** The LRPM must assume the role of principal intermediary on behalf of the town for recovery and rebuilding matters, to help make the best use of the torrent of offers of assistance from outside organizations and institutions.
- **Build stakeholder support for the work.** Establishment of a steering committee representing a broad cross-section of community interests is a very helpful way to learn quickly about community needs and to build support for and engagement in the recovery and planning process. However, steering committee functions and community outreach must be undertaken in coordination with, and optimally involvement of, local elected officials.
- **Have a transition plan.** LRPM assistance should be designed to help build local capacity where possible and, as program funding begins to reach its limits, a detailed transition plan should be developed to enable the participating towns to take over administration of ongoing programs.

## More Work to be Done

There is still a considerable amount of work to be done to help towns recover from the storm. Experience with Hurricane Katrina in New Orleans suggests that it takes



as much as a decade before it's possible to approach full recovery from a major natural disaster.

For the towns participating in the LRPM program, there are several important initiatives under way on which New Jersey Future would like to continue working to help achieve successful outcomes. However, because the available funds to support LRPM activity are almost depleted, the level of involvement will have to be scaled back considerably. Significant projects already under way that should be carried through include:

- **Community Rating System (CRS) certification.** Each of the participating communities has taken the preliminary step of enrolling in the National Flood Insurance Program's (NFIP) CRS program,<sup>9</sup> which offers reduced flood insurance premiums for the town and its residents in exchange for the adoption of municipal strategies that address vulnerability to flooding. There are different levels of certification and none of them is easy to achieve, requiring extensive paperwork and a lasting commitment to addressing flood risk. New Jersey Future views this program as a tremendous incentive to encourage municipalities to move forward with innovative resilience and adaptation approaches.
- **Integrating vulnerability and risk analysis into local plans and policies.** Now that the risk assessments for all six towns are completed, a critical next step is to embed the findings in the complete range of plans and regulations on which each municipality relies to guide its land use and development decisions. Specifically, the assessments must be integrated with municipal master plans; land use, zoning and subdivision regulations; building codes; design guidelines; and capital investment plans. With additional funding, New Jersey Future would have the necessary time and resources to develop a plan for each municipality that identifies how the risk assessments and local land use controls and plans, including the county hazard mitigation plan, can be integrated.
- **Advancing the public discussion of risk.** Perhaps the most difficult task ahead is continuing to engage residents in the discussion about what the future of the community should be. This is essential to building broad support for coastal community recovery and resilience. One of the most important roles that New Jersey Future has played, and can continue to play,



THREE YEARS AFTER SANDY, MANY HOMES REMAIN VACANT OR HAVE YET TO BE REPAIRED.  
MYSTIC ISLAND, LITTLE EGG HARBOR TOWNSHIP

is instigator and facilitator of discussions about the risks and implications of sea-level rise. A sustained effort is needed to help move those affected away from emotional and sometimes skeptical reaction toward rational discussions, and to help set a course for necessary and fundamental changes that enable the inhabitants of these towns to develop and live safely in shoreline areas.

## More Towns Need Assistance

To respond effectively to the impending risks of sea-level rise, patterns of regular flooding and severe storms, it will be necessary to move beyond New Jersey Future's six participating LRPM towns and into more communities. New Jersey's history of repetitive storm damage and loss over the past two decades is an unambiguous indicator that such conditions will continue to plague the state's coastline. Only a few communities have the staffing depth or expertise to grapple with this problem and begin to devise effective long-range plans and implementation strategies that will address predicted impacts of a changing climate. A forward-looking analysis of vulnerability and risk for every community in the state that borders tidally influenced waters is needed to support and promote preparedness, mitigation, and planned adaptation rather than far costlier emergency response and disaster relief. However, absent another major storm event and/or major shifts in current state and federal policies (see Afterword), it will be difficult to muster the resources necessary to provide this critical information and guidance.



# AFTERWORD

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As effective as the LRPM program has been in the six towns that have participated in it, the program could have been leveraged to an even greater degree had state and federal policies been better aligned to support these local efforts. Below are some suggestions for bringing state and federal disaster-recovery policies and programs into alignment with the goals of both the LRPM program and with FEMA's National Disaster Recovery Framework.

## State Policies

Confronting the reality of future flooding risks along New Jersey's coast is difficult, because the stakes are high and the prognosis is not good. New Jersey Future's analyses in the communities engaged in the LRPM program show that as sea levels rise, large areas will be under water or damaged by regular flooding. Many of these areas will no longer be viable and over time property values will decline and property tax revenues will shrink dramatically. These are particularly difficult discussions for local officials in New Jersey because (unlike in neighboring states) few of our state policies have acknowledged this issue and there is a dearth of voices at the state level insisting on addressing it.

The official priority to date has been to rebuild as quickly as possible, irrespective of future consequences. But as New Jersey Future's local vulnerability and risk analyses have shown, all coastal communities need to map areas at risk, set appropriate policy – whether to fortify, accommodate or retreat – and then act accordingly. Requiring the inclusion of projected sea-level rise in all post-Sandy project planning, or in forward-looking county hazard mitigation plans that include detailed assessments of risk for each municipality, would have put New Jersey's coastline much further down the path of increased resilience than it is now. The state should consider the following actions that would make it easier for vulnerable communities to make difficult but necessary decisions about rebuilding:

- **Adopt official sea-level rise projections.** The state and each county and municipality should map areas likely to be flooded today and in 2050 and adopt these maps as part of their land-use plans (via either the

State Development and Redevelopment Plan or county and municipal master plans) and hazard mitigation plans, in order to guide public and private investments.

- **Fund forward-looking municipal planning.** As a prerequisite to the use of any recovery planning funds that may be made available, either through current or future sources, the state should require risk mapping for coastal communities. Furthermore, risk assessments are likely to be increasingly important as the effects of sea-level rise become more pronounced. Consequently, the state should establish a source of adequate funding to allow all coastal communities to perform risk-based mapping. In addition, to build community capacity to plan for and respond to natural disasters, the state should allocate more grant funds to enable broader implementation of such initiatives as the LRPM program.

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The state and each county and municipality should map areas likely to be flooded today and in 2050 and adopt these maps as part of their land-use plans.

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- **Revise and coordinate hazard mitigation planning.** The state should revise its Hazard Mitigation Plan (HMP) to explain how it will upgrade state-owned infrastructure – tunnels, roads, parks, rail storage and other assets – by using vulnerability as one of the key factors in prioritizing its capital investments, and it should require local governments to do the same. Furthermore, the state HMP should require that counties consider sub-regional affiliations based on boundaries defined by common exposure to risk, and encourage the formation of municipal cooperatives to address these common issues. The state should also require that municipalities be far more active partners in developing county hazard mitigation plans by ensuring representation from municipal planners, who would then work with their local planning boards to ensure hazard mitigation/master plan coordination. Finally, the state HMP should require



that state agencies and county and local governments develop effective mitigation strategies. Such strategies should reduce vulnerability to the impacts of natural hazards, minimize future damages – particularly in repetitive-loss areas – and confront directly the threats that sea-level rise poses in all tidally-influenced areas throughout New Jersey.<sup>10</sup>

- **Increase freeboard standards.** The state's Flood Hazard Area Control Act currently mandates for all structures one foot of “freeboard,” or additional clearance, above the 100-year flood level. But projections show

that won't be enough in 2050 when sea levels could be significantly higher than today. The state should increase these freeboard standards for coastal areas by a minimum of two feet to a total of three feet, with a finer-grained analysis required for large public infrastructure assets and areas subject to wave action. The state should engage Rutgers University to refine the infrastructure standards and then embed them into grant programs like the new Energy Resilience Bank and into state regulations such as for water and wastewater treatment plants.

## ADVOCATING FOR THE EFFECTIVE USE OF FEDERAL RECOVERY FUNDS

Work under the LRPM program provided extensive knowledge of the issues local governments were facing and offered unusual insight into how state and federal assistance could be applied most effectively. That insight helped to inform New Jersey Future's advocacy efforts in several areas, including:

- **CDBG-DR Spending:** The majority of federal funds available to New Jersey were funneled through HUD's Community Development Block Grant Program – Disaster Recovery (CDBG-DR). Because the state had considerable latitude to determine how these dollars were allocated, New Jersey Future pressed decision-makers at HUD and the state, including those at the NJDCA, NJDEP and the Governor's Office on Recovery and Rebuilding, to innovate and make the most out of the available funding. In response to several letters and outreach from New Jersey Future, sometimes in concert with planning and fair-housing partners, HUD strengthened its requirements for the second round of CDBG-DR funding, and the subsequent New Jersey Action Plan Amendment that detailed how the funding would be deployed included language about the need to consider future risks, including sea-level rise, in infrastructure decision-making. The plan applied the new federal requirement for risk assessment to two categories of infrastructure projects – the Flood Hazard Risk Reduction and Resiliency Measures Program and the Energy Resilience Bank – and required infrastructure projects to perform a “risk analysis” as part of evaluating projects.
- **State Hazard Mitigation Plan:** To provide input into New Jersey's 2014 State Hazard Mitigation Plan, New Jersey Future met and communicated regularly with state officials over several months. Once a draft plan was released, New Jersey Future coordinated a joint comment letter from state and national planning and environmental organizations. The resulting plan placed a greater emphasis on risks associated with climate change and rising sea levels than its predecessor, but did not incorporate this information into decision-making. The plan was also drafted prior to public input and many of the comments received were noted in the “Next Steps” chapter rather than implemented in the plan itself.
- **NJDCA Planning Assistance Grant Program:** New Jersey Future advocated for expansion of the scope of the Strategic Recovery Planning Report, required under the NJDCA Post-Sandy Planning Assistance Grant program, to include comprehensive, forward-looking risk assessments; assistance to encourage participation in NFIP Community Rating System and Getting to Resilience programs; use of green infrastructure; strategies to address combined-sewer overflow issues in order to reduce chronic flooding; and a comprehensive update of the state's Shore Protection Master Plan. New Jersey Future also provided a detailed scope for a risk and vulnerability analysis which the state has provided to eligible municipalities as a model for conducting such assessments.



- **Revise the Municipal Land Use Law (MLUL)** to require that hazard mitigation planning be incorporated into master plan elements. Municipalities should also be provided with technical guidance to align the community's policies, codes and programs and natural hazard information and mitigation strategies, and through such integration encourage collaborative planning and inter-agency coordination.
- **Promote strategies that shift development from areas at risk.** The state needs to consider developing revenue-sharing strategies that can offset ratable losses related to buyouts, and should consider developing regional transfer-of-development rights and life-rights programs<sup>11</sup> to encourage alternatives to rebuilding in vulnerable coastal areas. In addition, the state's Blue Acres buyout program, which is New Jersey's chief mechanism for acquiring properties that have been damaged by or may be prone to damage from repetitive storm-related flooding, should set acquisition priorities based on risk-based criteria and should focus buyout activity in the most vulnerable areas.

## Federal Policies

Federal policy, like state, considerably influences disaster response and preparedness. The following recommendations are intended to strengthen the federal role and the impact it could have in preparing coastal areas more effectively for future flooding and storms:

- **Align federal disaster-recovery guidelines to account for sea-level rise projections.** The January 2015 White House executive order requiring all federal projects,<sup>12</sup> and all projects to which federal funds flow, to incorporate sea-level-rise projections into their planning was a welcome strong signal that communities in vulnerable locations cannot expect to be bailed out on a repetitive basis for disaster-related damage that they can take reasonable steps to avoid. Still, other federal guidelines on post-disaster rebuilding<sup>13</sup> require only that infrastructure be returned to its pre-disaster condition, which works in direct opposition to efforts to make regions less vulnerable. These guidelines need to be revised to reflect the directives of the executive order.
- **Inform communities of long-term risks.** Shortly after the storm, FEMA's Recovery Support Function teams

engaged several New Jersey municipalities in a process to determine what recovery projects the towns *wanted* to undertake, with no consideration for what effect such projects would have on risk exposure. Doing this without a discussion of future risk from projected sea-level rise and severe storms left communities without a clear context for their decision-making and priority-setting, and in the cases where New Jersey Future later got involved, required the entire community conversation to be restarted once the analyses were complete. (FEMA undertakes post-disaster recovery efforts at the invitation of the state in which the disaster event has occurred and the direction and scope of its work is guided by the host state. New Jersey's recovery focus after Sandy

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The state needs to consider developing revenue-sharing strategies that can offset ratable losses related to buyouts, and should consider developing regional transfer-of-development rights and life-rights programs to encourage alternatives to rebuilding in vulnerable coastal areas.

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was fixed on returning coastal communities to their pre-storm state without consideration of sea-level rise projections or the impacts of climate change. This explains in part why acknowledgement of these factors was not factored into FEMA's community recovery plans.)

- **Encourage regional cooperation.** FEMA guidelines, which do not currently promote regional collaborations, should be modified to give greater ranking weight when such coordination/ collaboration is appropriate and can be achieved. This is particularly important because natural disasters are not constrained by municipal boundaries and encouraging collaboration will help to ensure that individual municipal investments coalesce to achieve sufficiently comprehensive protections.
- **Revise the National Flood Insurance Program (NFIP) to reflect the true risk faced by coastal areas.** It is increasingly apparent that, based on projections of rising sea levels, the development that has characterized much





FORTESCUE, CUMBERLAND COUNTY

of New Jersey's coastal communities will not be sustainable into the future. In 2012 a major reform of the NFIP program was signed into law that was intended to shift flood insurance rates to actuarial prices. However, in view of the considerable financial impacts, short phase-in period, and concerns raised by policyholders and real estate interests, in 2014 some of these reform provisions were modified to roll back certain rate increases for primary residences. Although a risk-

based insurance rate system does cause considerable financial burdens to existing primary homeowners, continuing to subsidize flood insurance in inherently vulnerable areas merely continues to keep people and property at risk. Financial incentives and disincentives are likely to be the most powerful approach to discouraging development in flood-prone areas; therefore, FEMA needs to continue to explore ways to implement these changes to the NFIP.

## Endnotes

- 1 <https://www.fema.gov/national-disaster-recovery-framework>
- 2 National Disaster Recovery Framework. FEMA. September, 2011. Pg. 25.
- 3 <http://www.njfuture.org/events/special-events/rebuilding-the-shore/>
- 4 <http://www.cfnj.org/new-jersey-recovery/>
- 5 Municipal impact is measured by the amount of FEMA public assistance per capita. Source: <http://njdatabank.newark.rutgers.edu/sites/default/files/files/RutgersSandyImpact-FINAL-25Oct13.pdf>
- 6 <http://www.nj.gov/dca/services/lps/pspag.html>
- 7 <http://www.prepareyourcommunity.org/>
- 8 Gabrielle Wong-Parodi, Research Scientist, Ph.D. UC Berkeley, Energy and Resources Group. Expertise: Risk theory, Risk perceptions, Risk communications; <https://www.cmu.edu/epp/people/faculty/gabrielle-wong-parodi.html>.
- 9 <http://www.fema.gov/national-flood-insurance-program-community-rating-system>
- 10 In response to a March 2014 notice posted by the New Jersey Office of Emergency Management, New Jersey Future joined with several other organizations and interested parties in April 2014 to provide recommendations for modifications to the state's Hazard Mitigation Plan. Unfortunately, the plan had already been submitted to FEMA for approval, even before the March 2014 public notice was posted. New Jersey Future requested that FEMA delay, but they indicated it would have resulted in a gap in coverage of an approved plan, potentially jeopardizing the availability of emergency assistance in the event of a disaster. All of the April 2014 recommendations remain applicable and are still worthy of consideration.
- 11 Life rights or life tenancy programs grant a current property owner the right to remain living in a home for the duration of the owner's life but once that owner no longer inhabits the property it cannot be resold or reused. In exchange, the owner is paid a fair market value for the property at the time he or she signs the life-rights agreement.
- 12 <https://www.whitehouse.gov/the-press-office/2015/01/30/executive-order-establishing-federal-flood-risk-management-standard-and->
- 13 This includes the Water Resources Development Act – the authorizing legislation for the Army Corp of Engineers; the National Flood Insurance Program; Community Development Block Grant – Disaster Recovery funding; transportation funding; and wastewater and drinking water infrastructure funding

# APPENDIX A: RESOLUTION OF ENGAGEMENT

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\_\_\_\_\_ Township/Borough

Resolution Number \_\_\_\_\_

## **Resolution Requesting Assignment of a Local Recovery Planning Manager**

**Whereas**, the Township/Borough of \_\_\_\_\_, New Jersey, and its neighboring communities, experienced major devastation as a result of Superstorm Sandy that struck the area on October 29, 2012; and

**Whereas**, the federal and state governments will be providing billions of dollars of aid and thousands of hours of technical support to towns in New Jersey that were affected by the storm; and

Whereas, the Township/Borough of \_\_\_\_\_ has a limited municipal staff and in-house resources to:

1. Access federal and state support and manage the recovery and rebuilding process following the storm
2. Perform the planning and community engagement necessary to address future storm events; and

**Whereas**, the Township/Borough of \_\_\_\_\_ is committed to rebuilding in a manner that anticipates and responds to future storm events and sea level rise and helps the community to be more resistant to damage from such events and is more sustainable for future generations;

**Therefore, be it resolved** that the Township/Borough of \_\_\_\_\_:

1. Requests that New Jersey Future assign a Local Recovery Planning Manager to work with the municipality to provide direct, ongoing assistance to help municipal staff develop and implement its long-term recovery and rebuilding process as quickly as possible;
2. Authorizes the **Township/Borough Administrator** to enter into the appropriate agreements with New Jersey Future to have a Local Recovery Planning Manager work with the town on a regular basis for at least one year at no contract cost to the town;
3. Agrees to the **Planning Principles** set forth herein below to guide planning and rebuilding activities;
4. Supports active outreach and community engagement throughout the planning process to inform recovery response and mitigation planning and decision-making;

**Further be it resolved** that, the Township/Borough Council of the Township/Borough of \_\_\_\_\_ encourages all citizens and staff to participate in the recovery and rebuilding activities coordinated through the Recovery Planning Manager, the County of \_\_\_\_\_, the State of New Jersey, FEMA's Long-Term Community Recovery group and other recovery partners.



### Planning Principles

The following principles are intended to guide development and implementation of strategies associated with recovery from damage that resulted from Superstorm Sandy. The objective of these principles is to: encourage recovery planning and implementation in a manner that anticipates and responds to sea level rise and future storm events; balance the need for development and redevelopment with the necessity to protect critical natural resources; and avoid, minimize or mitigate risk and break cycles of repetitive loss.

1. Consider the system-wide implications of sea level rise and future weather-related events on the built and natural environment.
2. Where the potential of system wide impacts extend beyond jurisdictional boundaries, consider collaborating and coordinating efforts on a multi-jurisdictional basis.
3. Assure that mitigation plans, programs and strategies are integrated with the local plans and regulations.
4. Promote mixed-use development that is compact and conserves land. Build with suitable designs and densities that support walking, biking and public transportation.
5. Assign priority to redevelopment and reuse of existing sites and structures. Encourage development that incorporates green design and construction principles and opportunities for clean and renewable energy and efficiency measures.
6. Enhance community character and design, especially in historic areas, by reusing significant buildings, reinforcing architectural styles, incorporating art, and providing pedestrian-friendly streetscapes.
7. Maintain and enhance transportation options that improve access, safety, affordability and air quality for all users: pedestrians, bicyclists, transit-users, ride-shares and drivers.
8. Support construction and rehabilitation of homes that meet the needs of households of all sizes and income levels.
9. Protect and restore the environment, sensitive lands, ecosystems and natural resources.
10. Protect agricultural lands, and historic sites and landscapes. Provide accessible neighborhood parks and recreational systems.
11. Engage and involve the community throughout the planning and land use decision-making process. Gather and consider public input during program implementation.

### Certification

I, \_\_\_\_\_, Municipal Clerk of \_\_\_\_\_ Township/Borough, a Municipal Corporation of the State of New Jersey, located in the County of \_\_\_\_\_, do hereby certify that the foregoing is a true and accurate copy of a Resolution adopted by the Township/Borough Council of \_\_\_\_\_ Township/Borough at a regular meeting held in \_\_\_\_\_, \_\_\_\_\_, NJ \_\_\_\_\_ on \_\_\_\_\_, \_\_\_\_\_ at 7:30 p.m.

Signed \_\_\_\_\_  
\_\_\_\_\_, Township/Borough Clerk

## APPENDIX B: OVERVIEW OF ACCOMPLISHMENTS

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Following is an overview of the activities in which New Jersey Future's local recovery planning managers (LRPMs) have been engaged on behalf of the six participating communities since the program's inception in March 2013.

### **Community outreach and communication**

- Presented risk analyses, at a public meeting in Sea Bright and to the Commercial and Maurice River township committees
- Conducted "Planning for Our Coastal Future" public meeting series – implications of long-term risk, sea level rise – in Little Egg Harbor and Tuckerton
- Facilitated Mayor's Town Hall, screened *Shored Up* documentary in Sea Bright
- Continuing to work with all communities to expand outreach and communication through social media
- Completed government operations/organization evaluation (\$15,000), Sea Bright

### **Community mitigation/adaptation, resilience planning**

- Prepared Strategic Recovery Planning Report and detailed vulnerability assessment for each participating community
- Secured NJDCA Planning Assistance Grant for detailed risk assessment and to identify adaptation and mitigation strategies (\$20,000), Tuckerton Borough
- In conjunction with the Jacques Cousteau National Estuarine Research Reserve, helped facilitate "Getting to Resilience" process in all participating municipalities
- Completed property buyout Health Impact Assessment, Little Egg Harbor
- Obtained NJDEP Sustainable and Resilient Coastal Communities grant to evaluate risk-based criteria for Coastal Area Facilities Review Act center designations (\$287,000), Little Egg Harbor, Tuckerton, Toms River

### **Shoreline stabilization and enhancement (green and gray infrastructure)**

- Secured and managing National Fish and Wildlife Foundation Hurricane Sandy Coastal Resiliency Grant (Marsh Restoration and Replenishment). Work includes application development, overall management of engineering services, permit preparation and coordination with federal and state agencies, (\$2,130,000), Little Egg Harbor and Tuckerton
- Coordinated thin layer deposition project monitoring (\$46,752), Little Egg Harbor and Tuckerton
- Secured NJDEP Municipal Public Access Grant to provide access to tidal waterways (\$15,000), Tuckerton
- Secured NJDEP Municipal Public Access Grant (\$15,000), Little Egg Harbor

### **Community economic development**

- Facilitated branding and marketing project in Sea Bright
- Participated in Tourism and Economic Development and Infrastructure and Shoreline Protection sub-committees, Maurice River and Commercial
- Facilitated tourism development workshops, Sea Bright and Highlands



### **Community redevelopment**

- Prepared redevelopment plan, Maurice River
- Currently developing commercial and residential area design standards in Maurice River
- Currently managing bikeway plan, Sea Bright
- Secured NJEDA Streetscape grant (\$1,500,000), Highlands
- Secured NJEDA Streetscape grant, Ocean Avenue (\$1,300,000), Sea Bright
- Secured Transportation Alternative Program grant for North Beach Multi-Use Path (\$800,000), Sea Bright

### **Infrastructure improvements**

- Secured CDBG-DR grant for South Green Street Park restoration (\$1,481,900), Tuckerton
- Currently managing USDA Special Evaluation Assistance for Rural Communities and Households (SEARCH) Grant – Leesburg and Dorchester wastewater disposal solutions (\$30,000), Maurice River
- Currently managing USDA SEARCH Grant – Port Elizabeth wastewater disposal solutions (\$30,000), Maurice River
- Currently managing USDA SEARCH Grant – wastewater disposal solutions (\$30,000), Commercial
- Secured funding for police personnel (enforcement of crosswalk lanes), (\$10,000) Sea Bright

### **Community disaster preparedness**

- Currently assisting each community to participate in and become certified under the NFIP Community Rating System program
- Secured emergency radio communications grant (\$50,000), Little Egg Harbor and Tuckerton
- Developed debris management plan (\$25,000), Sea Bright
- Secured USDA emergency vehicle acquisition grant (\$35,000), Maurice River
- Secured USDA grant for police vehicle purchase (\$50,000), Tuckerton
- Developed geographic information system for asset management (\$25,000), Sea Bright

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## ABOUT NEW JERSEY FUTURE

New Jersey Future is a nonprofit, nonpartisan organization that brings together concerned citizens and leaders to promote responsible land use policies. The organization employs original research, analysis and advocacy to build coalitions and drive land-use policies that help revitalize cities and towns, protect natural lands and farms, provide more transportation choices beyond cars, expand access to safe and affordable neighborhoods and fuel a prosperous economy.



## ABOUT THE AUTHOR

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David manages New Jersey Future's Local Recovery Planning Manager program, which provides direct, long-term assistance to municipalities seeking to rebuild from the devastating damage of Hurricane Sandy. David is a licensed professional planner with more than 30 years of land use and environmental planning experience working in the private sector as a planning consultant and the public sector for local, county and state planning agencies in New Jersey, Massachusetts, New York, Pennsylvania, and Florida.





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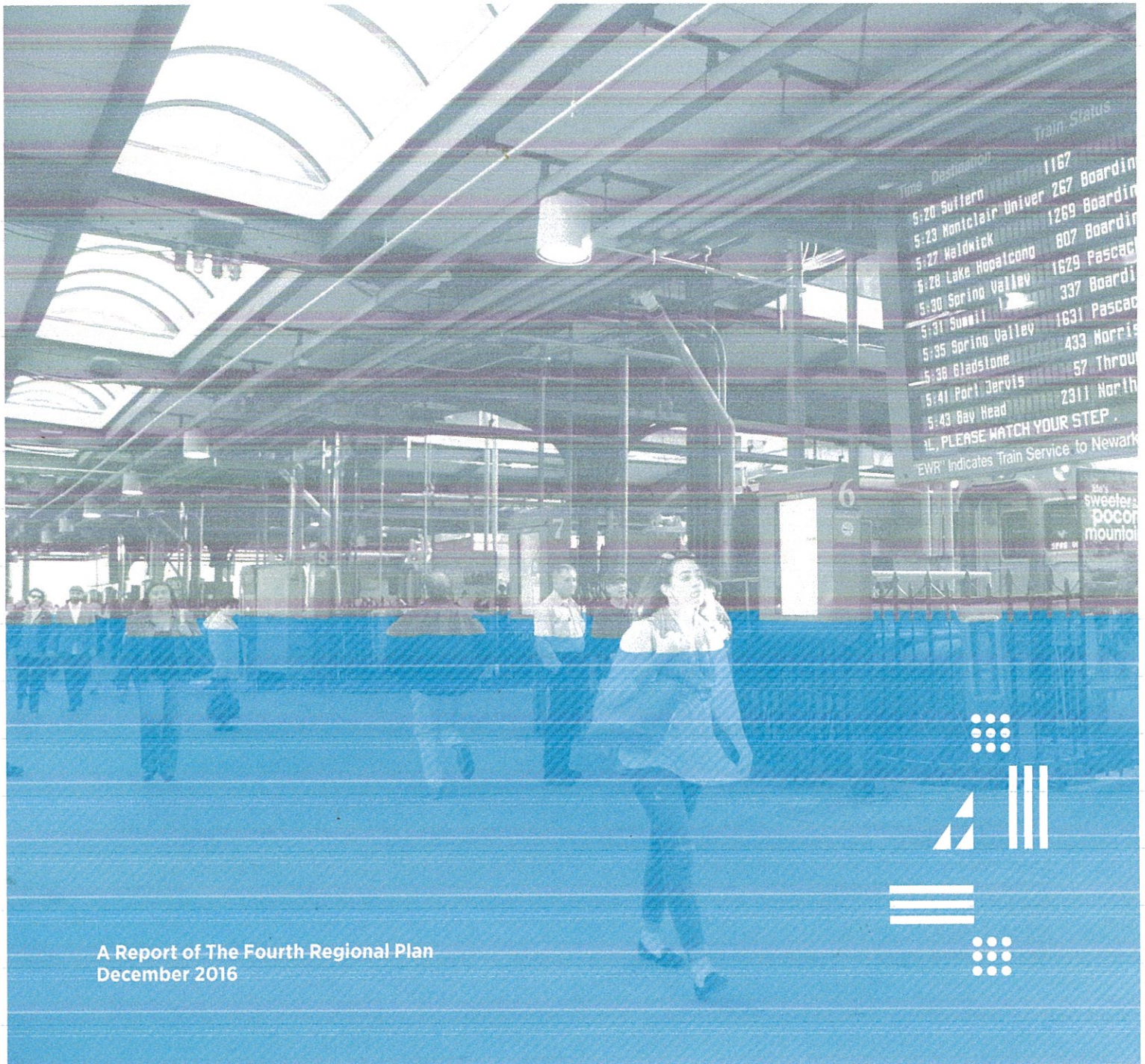
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# Under Water

How Sea Level Rise Threatens the Tri-State Region



A Report of The Fourth Regional Plan  
December 2016



# Acknowledgments

This paper belongs to a series of reports that lay the groundwork for the policy recommendations of the fourth regional plan, *A Region Transformed*. Subsequent papers due in early 2017 will address housing and transportation issues. The full plan will appear next fall.



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# Summary

Coastal regions around the world are struggling to adjust to the gradual but relentless encroachment of ocean waters caused by climate change. The New York metropolitan area, with 23 million residents and some 3,700 miles of tidal coastline, faces a severe threat from sea level rise, yet relatively little has been done to address the inevitable permanent inundation of buildings, infrastructure and communities.

Permanent flooding from sea level rise is different than the intermittent flooding from storm surge or precipitation. Intermittent flooding recedes once a storm passes while sea level rise flooding is permanent and can be expected to encroach further inland over time. Sea level rise not only permanently alters the coast line. It also widens the area vulnerable to storm surge.

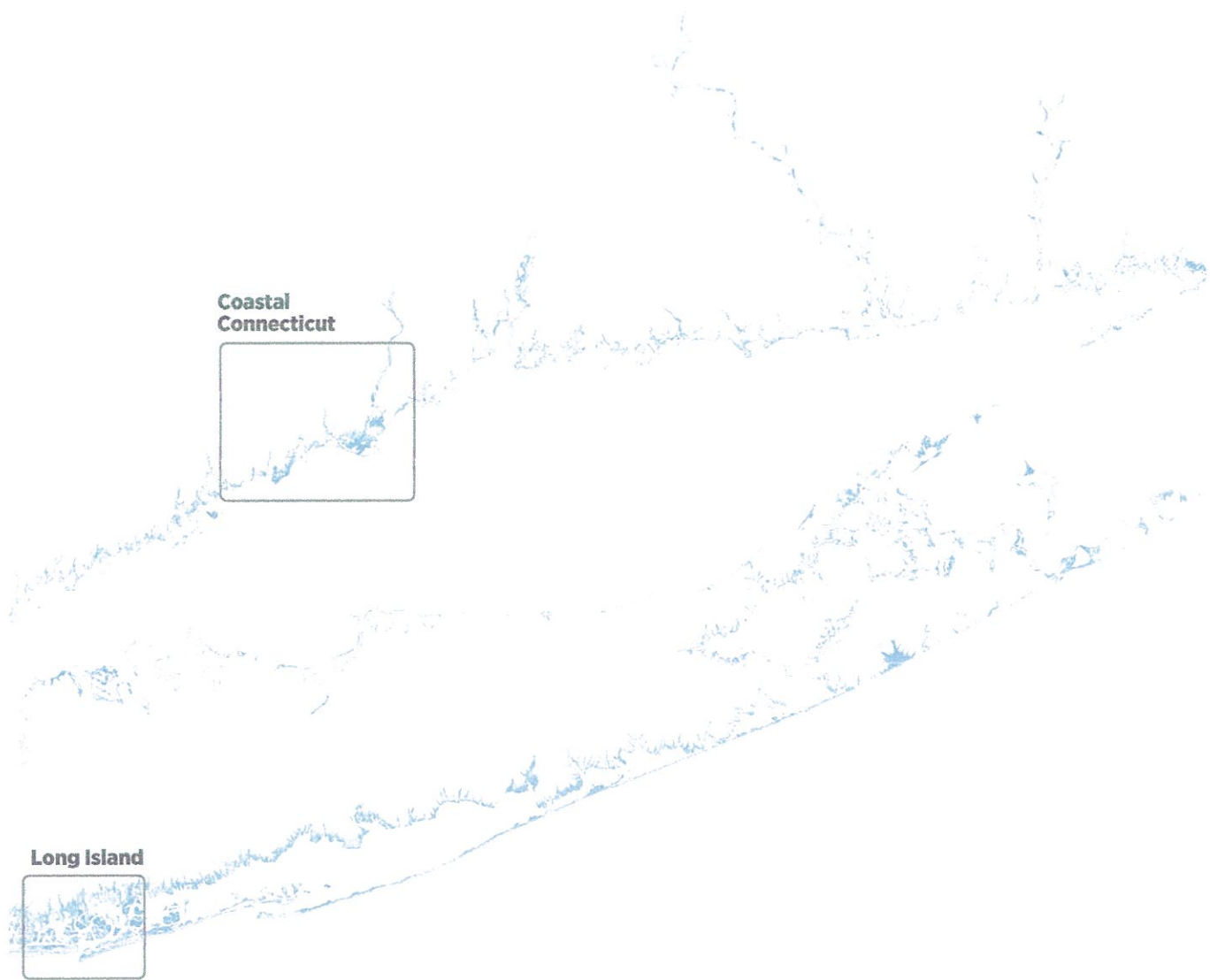
This report identifies the places in the New York, New Jersey and Connecticut metropolitan area that are most at risk of being permanently flooded, and describes the effects of 1, 3 and 6 feet of sea-level rise on neighborhoods, employment centers and infrastructure.<sup>1</sup> Taking into account the latest scientific findings on sea level rise and climate change, the study finds that many of the major resilience policies, plans and projects under development today fall short of adequately addressing the long term, existential threat of permanent flooding from sea level rise.

<sup>1</sup> One, three and six feet of sea level rise in this report refer to measurements of sea levels above a 1991-2009 baseline and the probable timing is based on RPA's interpretations of research carried out by the New York Panel on Climate Change (NPCC), New York State and the New Jersey Climate Adaptation Alliance, which are based on Kopp et. al (2014).

Hudson Valley /  
Long Island Sound

Northern  
and Central  
New Jersey

New York City



The region could see at least  
**one foot** of sea level rise by 2050,  
possibly as soon as the 2030s.  
**Three feet** could be realized  
by the end of the century,  
possibly as soon as the 2080s.  
**Six feet** of sea level rise is possible  
early in the next century.



## Key Findings

- ▶ Sea level rise has begun to permanently affect communities and critical infrastructure in the New York-New Jersey-Connecticut region, requiring tough choices for what we can and must protect, and where we will need to begin the process of returning the land to nature.
- ▶ The pace at which seas are rising is accelerating. Sea levels could rise around one foot as soon as the 2030s. Three feet could occur as early as the 2080s. Six feet of sea level rise could come early in the next century.
- ▶ The communities and infrastructure with the most at risk are those located in the region's bay areas (including the Great South Bay and South Oyster Bay on Long Island, Flushing Bay and Jamaica Bay in New York City, and Raritan Bay and Barnegat Bay in New Jersey), and the region's tidal estuaries (including the Hackensack Meadowlands and the Navesink and Shrewsbury Rivers).
- ▶ Large portions of the New Jersey Meadowlands - home to over 30,000 at-risk residents, Teterboro Airport, the Secaucus rail station, Giants Stadium, the American Dream entertainment project, thousands of industrial jobs and several critical roads and rail lines - could be significantly affected at three feet and largely inundated at six feet. Because of its size and complex ecology, comprehensive planning for the entire Meadowlands will be needed to determine where the water can be kept out and how to adapt to permanent flooding where it cannot.
- ▶ The communities of the Rockaways, Jamaica Bay, Coney Island and the East Shore of Staten Island are amongst the most threatened in New York City. With 3 feet of sea level rise, the communities of Broad Channel, Arverne, Edgemere and Howard Beach are particularly affected by flooding. With 6-feet of sea level rise, much of the Rockaway peninsula is under water, Jamaica Bay will have extended its reach deeper into its waterfront communities and more than half of Coney Island's current population could be at risk of permanent inundation. While any transition will take place over several decades, planning needs to give priority to the large number of low and moderate-income renters and homeowners in these communities.
- ▶ The barrier beach and back bay communities of the Jersey Shore and Long Island's south shore are among the most difficult to protect. Many of these could begin to be affected by one foot of sea level rise, and nearly all will be impacted by 6 feet. Most will need some combination of elevated structures, moving to higher ground or transitioning to seasonal communities.
- ▶ The region's airports are in areas that are most threatened. Most of Teterboro Airport could be permanently flooded with as little as one foot of sea level rise, potentially grounding its more than 165,000 annual General Aviation flights. Parts of LaGuardia could be affected at one foot as well and with three feet, more than half of the airport could be permanently flooded, threatening to disrupt service for over 28 million annual passengers. Newark Liberty and its 35 million annual passengers could be minimally affected by three feet and is more vulnerable at six feet. JFK and its nearly 57 million annual passengers are likely to be able to withstand both three and six feet, but will need to be hardened for the more severe future storm surges.
- ▶ Without additional protection measures, one foot of sea level rise will inundate nearly 60 square miles, where more than 19,000 residents in 10,000 homes live today, and where approximately 10,000 people work.
- ▶ Three feet of sea level rise could inundate close to 133 square miles where nearly 114,000 residents in 68,000 homes live today. Some 62,000 jobs are currently located in these areas.
- ▶ Six feet of sea level rise could inundate 280 square miles with 619,000 residents, 308,000 homes and more than 362,000 of today's jobs.
- ▶ Six feet of sea level rise will also threaten 20% of the region's power generating capacity and around 12,000 units of public housing.
- ▶ Cities and towns with the greatest number of residents living in areas at risk from six feet of sea level rise include New York City (203,000); Town of Hempstead, NY (80,000); Hoboken, NJ (28,000); City of Long Beach, NY (18,000); Town of Babylon, NY (17,000); Town Of Oyster Bay, NY (14,000); Jersey City, NJ (13,000); Town of Brookhaven, NY (13,000); and Town of Islip, NY (12,500)
- ▶ While New York City's 2013 Special Initiative for Rebuilding and Resiliency Report and New York State's Community Risk and Resiliency Act make efforts to address sea level rise, current resilience approaches mainly focus on storm surge and do not adequately tackle the challenge of long term permanent flooding. None of the projects currently pursue a regional approach.

We are past the point where sea level rise can be ignored in the hope that future technology will provide an easy solution.

With the first damaging consequences of sea level rise already affecting some of the region's neighborhoods, our current generation of elected officials, policy makers, planners, advocates, scientists, developers and residents are the only ones that can choose a different course from the one we're on. We are the only ones who can choose not to purchase, approve or develop in places that will be flooded in a matter of decades. There is no future generation left to figure this out.

Broadly speaking, there are three ways to protect ourselves from rising seas in the places most at risk:

1. We can develop engineering solutions, continually pumping more sand onto beaches or building higher berms and sea walls around communities and infrastructure, installing pumps to keep the water out;
2. We can learn to live with the water, elevating more structures and infrastructure and adjusting to a new life on less dry ground; or
3. We can phase out new development and retreat from at risk places over the coming decades, returning the land to nature.

All of these options present significant obstacles, raise tough questions and would require substantial investment and political leadership. We will need to figure out what combination of these approaches is best for each community at risk — and what policy and fiscal tools will be needed.

We can neither wall off the region's entire 3,700 mile coast from the sea, nor can we retreat from every future flood zone. The many resilience projects being implemented today will help us weather the storms, but most will not eliminate the threat of sea level rise. Difficult choices will need to be made in every community with a developed waterfront.

Significant adaptation investments, changes in future development policies and comprehensive buyout programs across the region will be required to ensure we are adequately planning for and confronting sea level rise.

RPA's fourth regional plan, *A Region Transformed*, will propose specific policies and investments to allow the region to mitigate climate change and confront its effects. But some immediate actions are clear:

- ▶ The 2015 international Paris agreement to limit future greenhouse gas emissions must be implemented if we are to have any hope of avoiding catastrophic effects from sea level rise and other outcomes of global warming. While the primary responsibility is at the federal level, state and local governments can have a substantial impact through land use, energy and transportation policies.
- ▶ Federal, state and local efforts to make us more resilient to future storms should also include funding and planning to address the effects of sea level rise.
- ▶ Vulnerable communities should begin having conversations about how best to adapt to sea level rise. There is time to prepare if we start now, but the conversations can be difficult and will take time to address multiple concerns and complicated options including social vulnerability.



# Sea Level Rise Is Accelerating

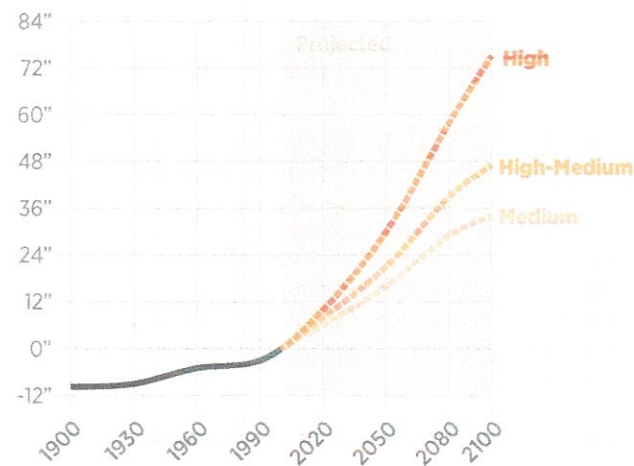
Sea levels across the planet are on the rise. In the New York metropolitan region, sea levels already have risen by about a foot since 1900. That rate, which is ahead of the global average, is expected to accelerate over the course of this century.<sup>2</sup> The rising waters pose an enormous threat to the safety, prosperity and quality of life of the tri-state area. By the first half of the next century, over 600,000 of today's residents and critical regional infrastructure such as power plants, wastewater treatment plants, LaGuardia airport and low lying rail lines could be permanently inundated by flood waters.

Predicting how much sea level rise will occur by certain dates in certain places is complicated. Because there are so many factors at play — the number of emissions generated and rate of warming, the amount of ice melt, the topography of the land and integrity of coastal infrastructure, subsidence and compaction of land over time and changes in natural climate patterns — it is impossible to predict sea level rise for a particular time period with precision. As a result, scientists have developed models that provide ranges of sea level rise at varying levels of probabilities. A common methodology for projections first adopted by the New York City Panel on Climate Change and since adopted by New York State is providing the clearest picture for how much sea level rise will happen by when. The New Jersey Climate Adaptation Alliance of Rutgers University also has adopted the methodology to develop projections for New Jersey. RPA has reviewed the projections of each and assumes the following as the most probable of sea level rise projections for our region:

The region could see at least one foot of sea level rise by 2050, possibly as soon as the 2030s. Three feet could be realized by the end of the century, possibly as soon as the 2080s. Six feet of sea level rise is possible early in the next century.

The primary cause of sea level rise is global warming caused by the release of greenhouse gases like carbon dioxide into the atmosphere from burning fossil fuels for electricity, heat and transportation.<sup>3</sup> Average global

**Historic sea level rise observations and future projections for New York City / Lower-Hudson Region.**



Source: Adapted from NPCC and New York State projections.  
Note: The Low scenario developed by the NPCC is not included in this chart. That scenario is dependent on a radical and immediate reduction in carbon emissions reduction that is considered by many experts to be unrealistic, and most consider the Medium scenario to be the lower range of what may occur.

temperatures rose 0.87°C between 1880 and 2015. The last three decades were the warmest 30 years of the last 1,400 years.<sup>4,5</sup>

As ocean waters are heated by rising temperatures, they physically expand, extending their reach inland. At the same time, glaciers and ice sheets are melting, adding to the volume of the ocean. The New York region is also prone to the slow sinking of our land, known as subsidence, as well as compaction from the removal of groundwater, both of which further the inland reach of the sea.

The Paris Agreement of 2015 to limit future greenhouse gas emissions to a measure that would level off warming at 2°C is a critical step toward avoiding catastrophic warming. But warming of our planet by 2°C still locks in around 3 feet of sea level rise by the end of this century, and at least 20 feet in the long term.<sup>6</sup> If emission trends continue unabated, we are on track for 4.5°C of warming, with devastating con-

<sup>2</sup> New York City Panel on Climate Change (NPCC). 2015  
<sup>3</sup> U.S. Environmental Protection Agency. 2014

<sup>4</sup> NASA's Goddard Institute for Space Studies (GISS). 2015  
<sup>5</sup> IPCC Synthesis Report Summary for Policymakers. 2014  
<sup>6</sup> Svetlana Jevrejeva et al. 2016. Coastal sea level rise with warming above 2 °C.



sequences. So while this report serves as a call-to-action to begin planning for the sea level rise that we know is coming, the greatest urgency remains to find ways locally, regionally, nationally and globally to reduce our carbon emissions.

## Permanent vs. Intermittent Flooding

The developed coastal areas of the tri-state metropolitan region are at significant risk of flooding from sea level rise, storm surge and their cumulative effect over time. There has been substantial progress in planning for recovery and resilience against future storms in the aftermath of Hurricanes Irene and Sandy. But it is important to distinguish between the flooding caused by catastrophic storms and sea level rise.

Large and catastrophic storms like Sandy happen occasionally and unpredictably, producing large increases in tidal height, or storm surge, coupled with destructive wave action and — in some storms — heavy precipitation, all of which leave behind a wake of disaster and initiate a long period of recovery across large portions of the coastal region. The process is traumatic and painful, but it is ultimately temporary. Residents and businesses can evacuate and then come back to rebuild, even if it takes years. Technology and engineering may even allow for flood proofing that prevents major disruptions.

Sea level rise, on the other hand, is happening slowly and steadily over time with serious and permanent consequences for a growing number of places. The flood waters of sea level rise won't recede once a storm passes. They will be permanent and over time will inundate our streets and homes, intrude into our drinking water aquifers, fill our tunnels, basements and storm drains, saturate our brown-fields and other contaminated sites and eventually overwhelm low-lying rail lines and wastewater treatment and power plants. They will permanently change our coastline.

What's more, sea level rise exacerbates the impact of storm surge, extending its reach inland. A catastrophic storm today could produce a surge that affects up to one million residents in the region. With a two to three foot rise in sea levels, a catastrophic storm could produce a surge that doubles the vulnerable population to more than two million.

## RPA Sea Level Rise Mapping Methodology

RPA's sea level rise maps are based on the "bathtub model" and methodology developed by NOAA. The sea level is represented by the Mean Higher High Water (MHHW) which is measured relative to the NAVD88 vertical datum. Elevation data comes from the USGS National Elevation Dataset (NED) at a resolution of 1/3 arc-second. The difference in sea level is added to the MHHW, which is subtracted from the NED to obtain the depth and extent of sea level rise inundation. Areas below the new sea level that are non-contiguous with the sea are classified as "Low-lying Areas" and not assumed to be inundated for the purposes of the analysis.

### Methodology

RPA's sea level rise inundation estimates are based on the methodology developed by NOAA for estimating the extent of sea level rise inundation (NOAA 2012). This so-called "bathtub model" approach, in which sea level behaves like the water level rising in a bathtub, is also the basis for the sea level rise mapping methods used by Climate Central (Strauss et al. 2012), TNC (Gilmer 2011), and Scenic Hudson (Scenic Hudson 2015).

Two datasets were used for the sea level rise analysis. For land elevation, the National Elevation Dataset (NED) from USGS, a digital elevation model (DEM) with a resolution of 1/3 arc-second. Tidal elevation comes from NOAA's VDatum tool, which converts tidal elevation data to the NAVD88 for compatibility with the NED. The extent of the sea is based on Mean Higher High Water (MHHW), which is the average elevation of the higher of the two daily high tides. MHHW represents the average extent of the tide in any given day. Similar sea level rise inundation analyses either used MHHW (NOAA 2012; Scenic Hudson 2015) or Mean High Water (MHW) (Strauss et al. 2012; Gilmer 2011).

The level of sea level rise (e.g. +1ft, +3ft, and +6ft) was added the MHHW level to project a future sea level. The DEM land elevation was then subtracted from the projected sea level layer to produce a depth grid. Values equal or less than zero, which represent dry land, were excluded from the layer. The remaining areas contiguous to the sea were considered inundated, while remaining non-contiguous areas were classified as "Low Lying Areas", which are below the projected sea level and may or may not be subject to flooding, depending on geophysical and hydrostatic factors beyond the scope of the analysis.

The population and jobs analysis applies to "SLR Inundation Areas" only and does not include "Low Lying Areas" non-contiguous with the sea. The population and jobs analysis is based off current (2010-2011) figures and does not necessarily represent the number of people who will still be living in inundated areas in 50-100 years. Block-level population and housing data originated from the 2010 decennial US Census. Block-level jobs numbers came from the 2011 US Census Longitudinal Employment-Housing Dynamics Survey. Data related to infrastructure came from the Metropolitan Transportation Authority, Port Authority of New York and New Jersey, Amtrak, the US Department of Transportation, Environmental Protection Agency, US Department of Housing and Urban Development, and the US Energy Information Administration.

### References

- Gilmer, Ben. 2011. "TNC's SLR and Storm Surge Mapping Methods"
- NOAA Coastal Services Center. 2012. "Detailed Methodology for Mapping Sea Level Rise Inundation."
- Scenic Hudson. 2015. "Scenic Hudson GIS Methodology for Mapping Sea Level Rise."
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# The New York Region at One, Three and Six Feet of Sea Level Rise

The following narratives provide hypothetical scenarios of what our region might face as sea levels rise. They are followed by a summary of geospatial analysis that estimates the current population, number of housing units, total area, jobs and critical infrastructure in areas projected to be affected by sea level rise.

## Approaching a foot of sea level rise - Canaries in the Coal Mine

*The shift to one foot of sea level rise was neither immediate nor dramatic. Still contained by bulkheads, seawalls and other coastal infrastructure for much of this time, the sea inched higher and higher, occasionally overflowing into yards or onto streets at the highest tides, causing nuisance flooding. Streets would be closed for a day or two, storm water infrastructure would become temporarily overwhelmed and sometimes the levels would get high enough to damage personal property such as cars, basements or ground floors of homes and businesses. Then the tide would go back out, the water would recede and life would return to normal.*

*But at some point along the way in particularly vulnerable areas, the water began to stay around even longer, until it stopped receding altogether. A few inches remained at all times, rising with*

*high tide and retreating to a few inches at low tide. Some roads became unusable and a number of homes and businesses experienced standing water in their basements. Street and yard trees began to die, unable to process the salt water now surrounding their roots. Suburban septic systems began to fail. In the hardest hit places, sections of neighborhoods along the waterfront became uninhabitable, and some people chose to leave. Where it could be afforded, states and municipalities invested in higher bulkheads, elevated streets and hard-working pumps to send the water back out to the sea. But it was becoming clear that sea level rise was real and having an impact in a growing number of places.*

Area Flooded: **60 square miles**  
(about 0.5% of the entire region's land)

### **People affected\***

Residents: **nearly 19,000**

Housing Units: **more than 10,000**

Jobs: **10,000** (more than half of which are in New Jersey)

### **Places most affected**

Communities directly adjacent to the waterfront along the region's bays and tidal rivers, in many cases where wetlands and marshes were filled for development decades ago.

\* Based on 2010 Census data for population, housing units and 2011 Census data for jobs.



## From 1 to 3 feet - Reality Sets In

*By the time sea levels had risen to three feet, it became clear that sea level rise was having enormous consequences in the region. At one foot of sea level rise, the relatively few sections of places with permanent flooding had become curiosities for others to see. At two feet, nuisance flooding became a more regular occurrence for more communities whose residents now knew that this was the sign they would be next. The coast was becoming an unpleasant and unnerving place to live. Three feet of sea level rise began to wreak havoc across the region, flooding runways of major airports, lapping up against extensive rail networks and storage yards, expanding floodwaters deeper into the suburbs and beginning to turn some urban streets into canals. More waterfront parks were becoming submerged, and waterfront infrastructure - including treatment plants, storm drains and combined sewer overflows backed up during storms. Even in the dry parts of the region, quality of life was suffering as encroaching waters made travel difficult, curtailed recreation and affected more families and co-workers.*

Area Flooded: **133 square miles**  
(about 1% of the entire region's land)

### **People affected\***

Residents: **nearly 114,000**  
Housing Units: **more than 67,000**  
Jobs: **62,000** (more than half of which are in New Jersey)

### **Places most affected**

Communities directly adjacent to the waterfront along the region's bays and tidal rivers, with further reach in the suburbs and the beginning of more significant impacts in some urban places.

## The region at Six Feet - A New Coastline

*With six feet of sea level rise, the region's coast became unrecognizable. So many developed places were reclaimed by the sea, taking with it entire communities, vital infrastructure and natural systems that had served as protection. As sea level rise approached six feet, what had been primarily a suburban disaster became a force of destruction in our urban centers where many more people were affected. Entire sections of the region, including coastal beaches, tidal rivers and estuaries, were lost. Nearly every mile of the region's coastline was now penetrated by a deeper and more unpredictable sea.*

Area Flooded: **280 square miles**  
(about 2% of the entire region's land)

### **People affected\***

Residents: **nearly 620,000**  
Housing Units: **more than 308,000**  
Jobs: **363,000** (more than half of which are in New York City)

### **Places most affected**

Now include urban centers such as Hoboken and Jersey City, the communities around Jamaica Bay and the Rockaways in New York City and the iconic beach towns of the Jersey Shore.



# New York City

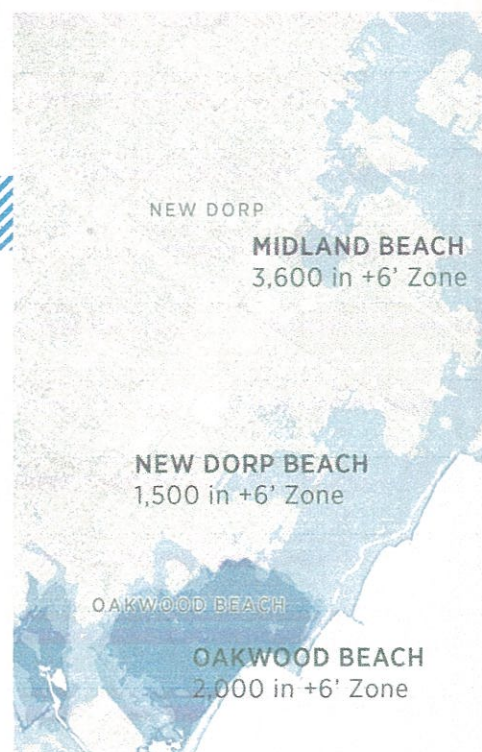
Residents Inundated +1': 1,278 +3': 12,275 +6': 202,784

**+1'** Because so much of the city's shoreline is hardened against flooding, the vast majority of neighborhoods in New York City are expected to experience few consequences from one foot of sea level rise, save a handful of places in and around Jamaica Bay, Flushing Bay and the particularly vulnerable eastern shore of Staten Island. The community of Broad Channel in Queens is significantly threatened with one foot of sea level rise. LaGuardia Airport will likely begin to experience periods of nuisance flooding at particularly high tides that could disrupt operations from time to time. At one foot of sea level rise, a number of waterfront parks around the city begin to face partial inundation.

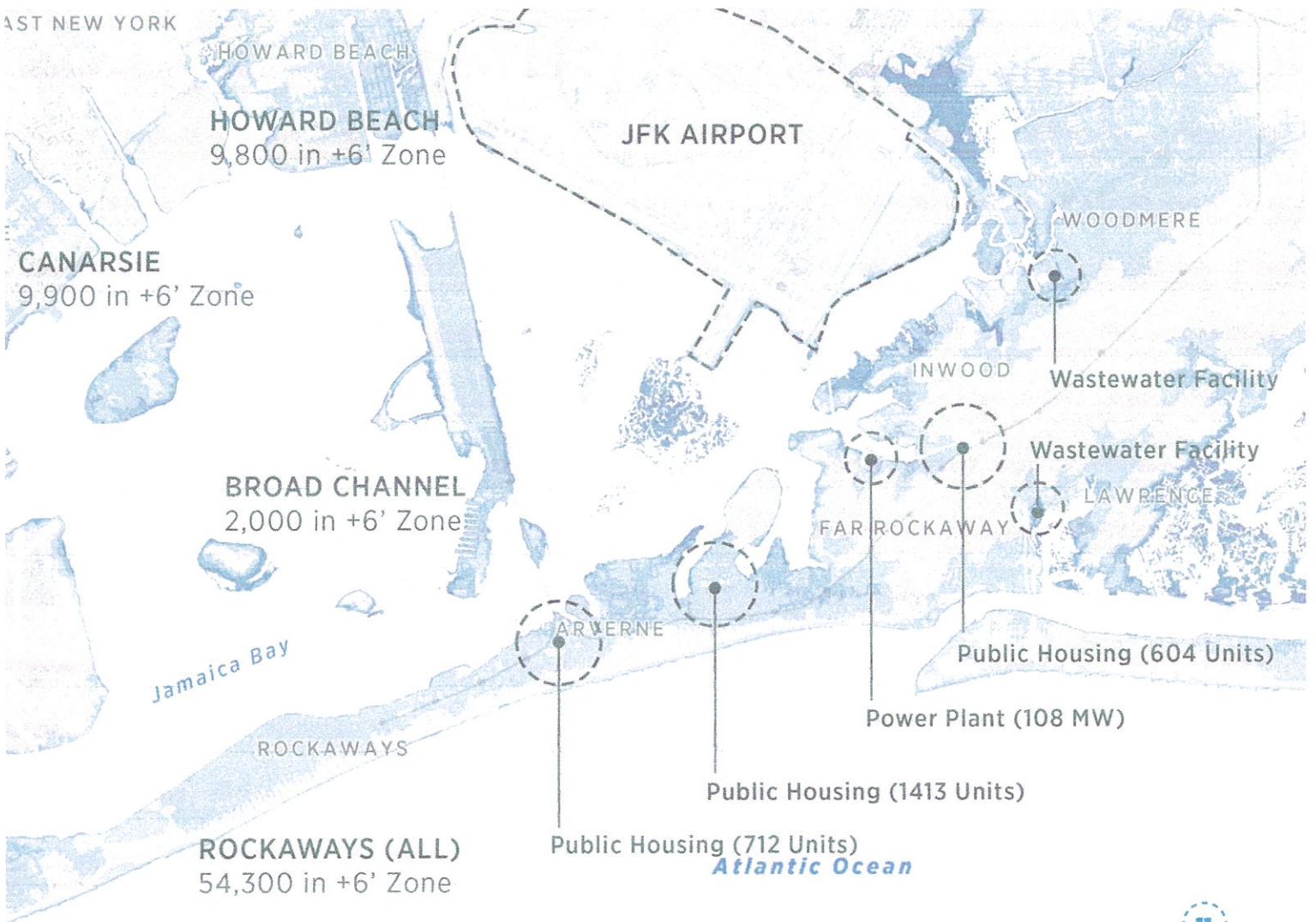
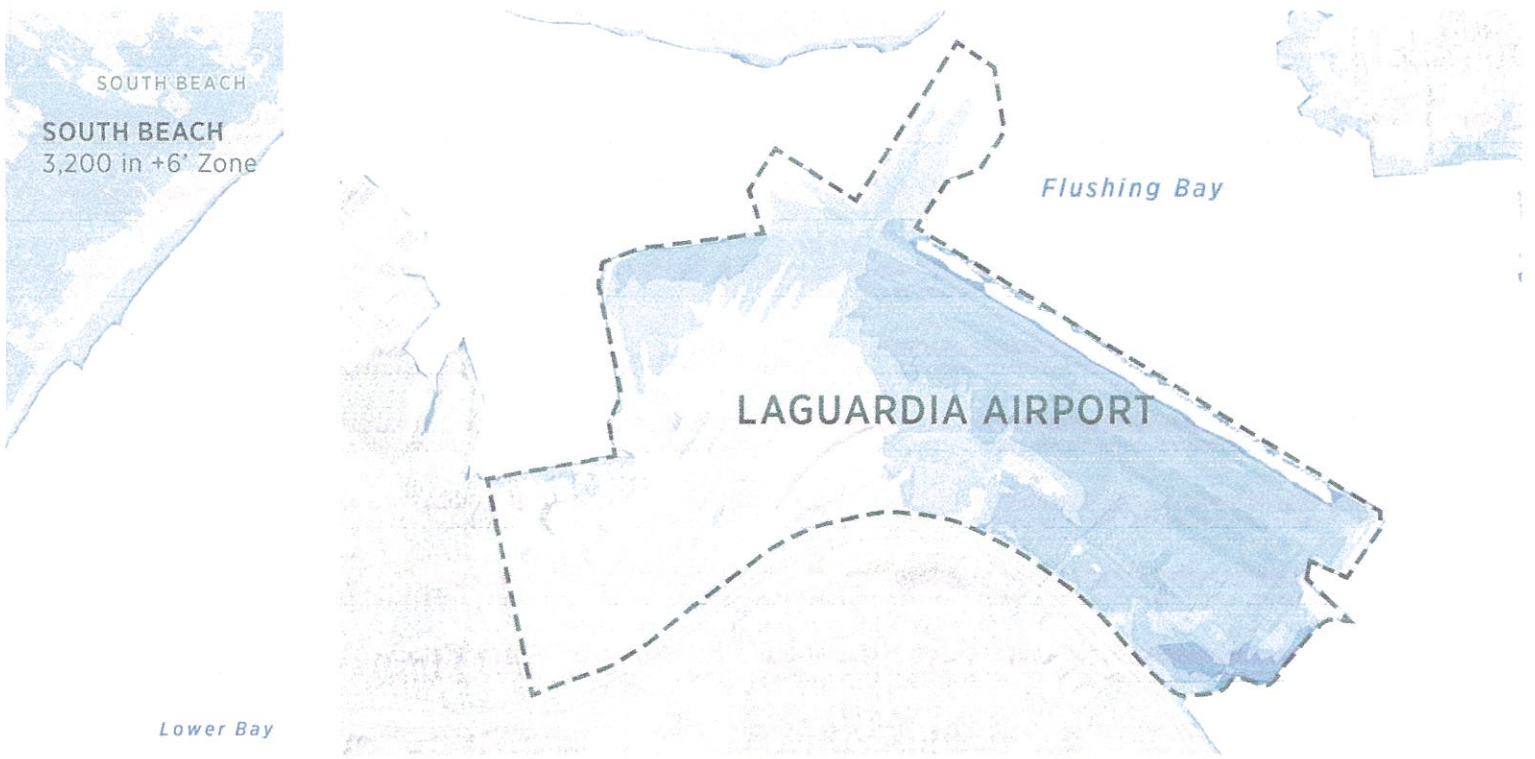
**+3'** With three feet of sea level rise, places that were experiencing smaller incidents of flooding at one foot will likely face greater or more permanent inundation. More than 12,000 of today's New York City residents live in places that could be permanently flooded by a rise of three feet, the vast majority along the shores of Jamaica Bay, Flushing Bay and eastern Staten Island. The flooding in Broad Channel is likely to become even more significant, also affecting the subway connection between the Rockaways and Howard Beach. LaGuardia Airport's 13/31 runway and portions of its terminal areas begin to become permanently inundated around two feet of sea level rise, with more coverage at three feet. Waterfront parks, coastal protection infrastructure and topography continue to buffer much of the rest of New York City's neighborhoods from permanent flooding, though stormwater and drainage infrastructure could become prone to backups at high tides and low-lying neighborhoods may experience increased incidents of nuisance flooding.

**+6'** At six feet of sea level rise, portions of New York City begin to look very different than they do today. The coastal protection infrastructure and waterfront parkland that had buffered much of the city through three feet of sea level rise is no longer enough to hold back water from places where more than 200,000 residents live today. Over 150,000 of those residents are located in the boroughs of Brooklyn and Queens, the majority residing in communities around Jamaica Bay and the Rockaways, Coney Island, Brighton Beach and Sheepshead Bay. Broad Channel is completely inundated at six feet. Flushing Bay communities as well as Red Hook and Sunset Park also could see permanent flooding of portions of their waterfronts. The industrial areas of Sunset Park and the Brooklyn Navy Yard are two major employment centers that face near total inundation. At six feet of sea level rise, both runways and the terminals of LaGuardia airport could become fully inundated. JFK airport is likely not to be affected by six feet of sea level rise but will be more susceptible to storm surge.

In Manhattan, close to 30,000 residents today live in places that could be permanently flooded in particularly vulnerable neighborhoods such as Harlem, Battery Park City, Hudson Yards and Chelsea, and the Lower East Side and East Village. The Bronx could see flooding in places where over 5,000 of today's residents live, primarily in Schuylerville, Throgs Neck, Edgewater Park and University and Morris Heights. The east shore communities of Oakwood Beach, Midland Beach, and South Beach account for about 80% of the close to 15,000 Staten Island residents who live in places today that could be permanently flooded.









# Long Island

Residents Inundated +1': 7,122 +3': 41,023 +6': 164,592

**+1'** The south shore of Long Island is one of the region's most susceptible areas to one foot of sea level rise, and unlike other similarly threatened places, it is more developed and more populous. Nassau County and Suffolk County combined account for more than 7,000 of the 9,000 New York State residents in the region expected to be permanently flooded by one foot of sea level rise. Most are located along the Great South Bay and South Oyster Bay in the Towns of Brookhaven, Islip, Babylon and Hempstead.

**+3'** At three feet of sea level rise, the south shore remains New York's most affected area. Water that had penetrated communities along the Great South Bay and South Oyster Bay expands its reach inward and gets deeper in places it had already flooded. Close to 40,000 of today's residents on Long Island live in places that could be permanently inundated with a rise of three feet of sea levels, nearly six times the population affected at one foot.

**+6'** At six feet of sea level rise, nearly 165,000 Long Island residents today live in places that could be permanently flooded. No community along the south shore is left untouched and the long stretches of sandy barrier beaches that today are one of the region's most popular destinations likely will be reduced to thin slivers of sand interspersed with frequent inlets.

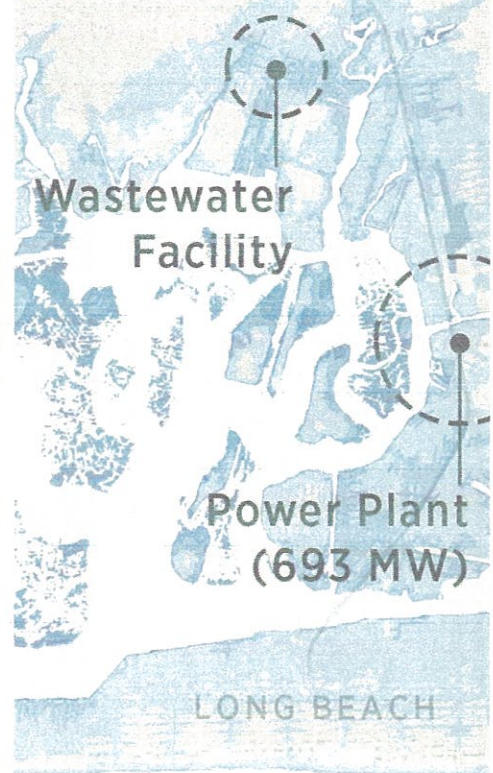
The additional flooding brought on from three to six feet affects Nassau County communities more significantly than those in Suffolk. Over 113,000 Nassau County residents today could be affected, nearly 80,000 alone in the Town of Hempstead. Particularly vulnerable communities include Baldwin Harbor, Freeport, Long Beach, Merrick, Oceanside, Seaford, Valley Stream and Woodmere. Places that face community-wide inundation could include Barnum Island, Bay Park, Island Park and Lido Beach. The neighboring Town of Oyster Bay could see flooding that affects places where over 14,000 residents live today.

In Suffolk County, much of the additional flooding occurs in places where 51,000 residents live today and that were already flooded at three feet of sea level rise, primarily in the towns of Babylon, Islip and Brookhaven along the Great South Bay. Communities on Fire Island are nearly all lost to the sea. It is also notable that at six feet of sea level rise, communities on Long Island's north shore are likely to see higher levels of inundation in places like Bayville, where about a third of today's population could see permanent flooding.

Land inundated when sea level rise reaches

+1ft  
+3ft  
+6ft

Low-lying Areas



**LONG BEACH**  
18,100 in +6' Zone







# Hudson Valley / Long Island Sound

Residents Inundated +1': 659 +3': 2,454 +6': 6,652

**+1'** Because of topography and historical development patterns, Hudson River communities, many of which are developed on higher ground, are less at risk from sea level rise than other communities in the region. Still, places like Yonkers, Piermont and Stony Point, whose waterfront edges are more developed or are developed on fill, begin to see permanent flooding. Sections of Long Island Sound towns to the east including New Rochelle, Rye and Mamaroneck town are also likely to see permanent flooding.

**+3'** Those New York communities along the Hudson River and Long Island Sound that saw flooding affecting sections of town at one foot sea level rise are likely to see the area and depth of flooding increase at three feet. Portions of the Metro-North Hudson rail line could become threatened at three feet of sea level rise. More than 2,000 of today's Westchester and Rockland County residents live in places along the Hudson and the Sound that could be permanently flooded at three feet of sea level rise, with the greatest numbers in Yonkers, Rye, New Rochelle and Mamaroneck town. Nearly 9% of Piermont's population today faces inundation at three feet.

**+6'** At six feet of sea level rise, the Hudson River is likely to have reclaimed many of the areas that had been filled in over time, affecting over 2,500 residents as well as critical infrastructure including waterfront parks, wastewater treatment plants and power generating facilities. The Metro-North Hudson rail line and its 12 stations between New York City and Poughkeepsie along with Amtrak's Empire Corridor line is at risk of inundation in a number of low lying sections along the Hudson's eastern shore. On the western shore, the River Subdivision — a freight line owned by CSX — runs north along the shoreline to Selkirk, just south of Albany and has low lying sections at risk in places as well.

About one third of the Town of Mamaroneck's population today could be inundated at six feet of sea level rise, making it one of the hardest hit Long Island Sound towns. Rye and New Rochelle continue to lose land to the Sound at six feet.

Land inundated when sea level rise reaches

+1ft

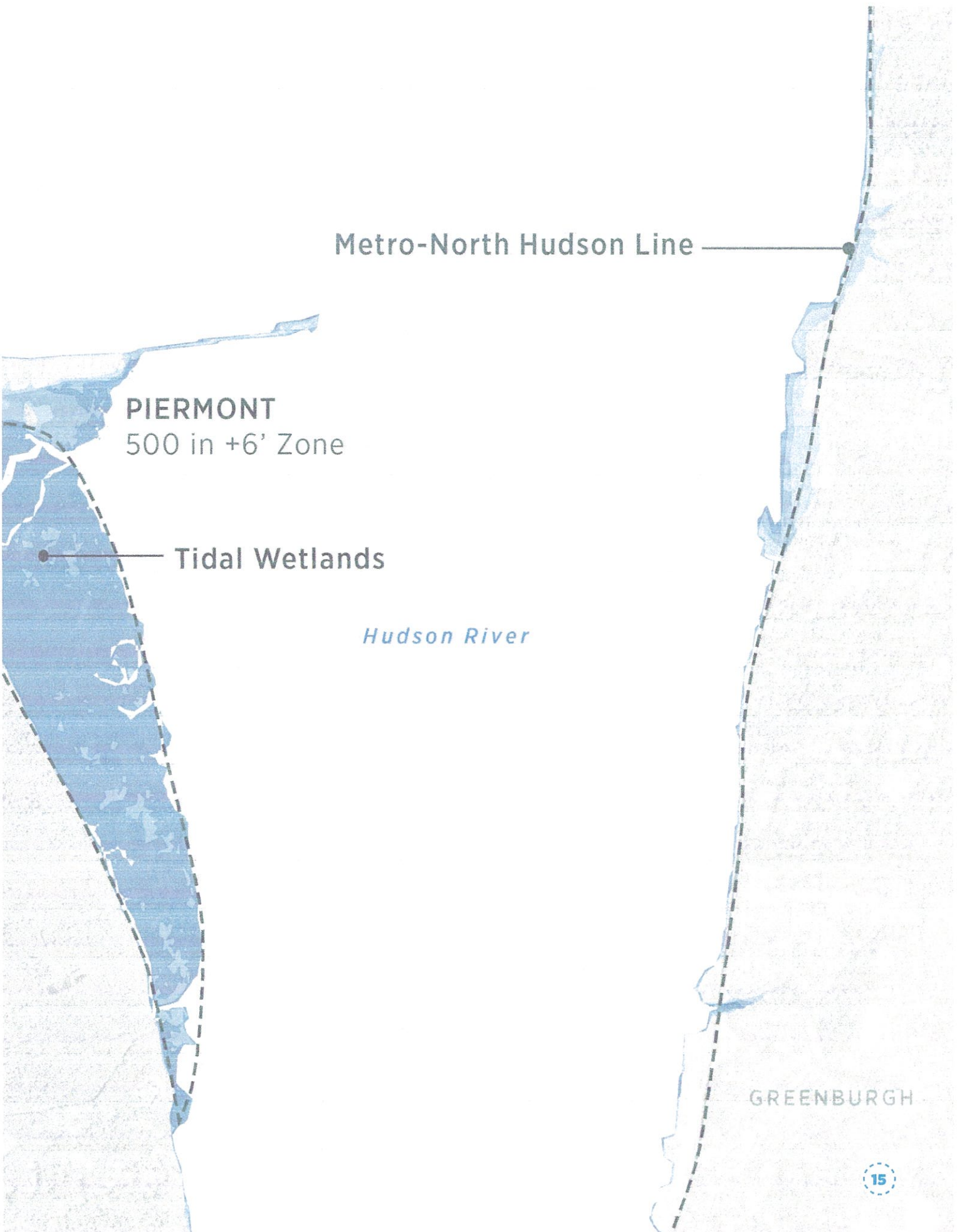
+3ft

+6ft

Low-lying Areas

PIERMONT

ORANGETOWN



Metro-North Hudson Line

PIERMONT  
500 in +6' Zone

Tidal Wetlands

*Hudson River*

GREENBURGH

15



# Northern and Central New Jersey

Residents Inundated +1': 7,833 +3': 47,208 +6': 197,681

## The Harbor and Its Tributaries

**+1'** New Jersey communities along the shores of the Hudson River, Arthur Kill, Hackensack, Passaic and Raritan rivers and Newark and Raritan Bay, in general are more urbanized than in other parts of New Jersey and thus have more protective infrastructure in place to minimize the flooding of one foot of sea level rise. In the Hackensack Meadowlands however, a few communities such as Moonachie and parts of Secaucus as well as Teterboro Airport begin to see inundation at one foot. Communities along the Raritan Bay and the Raritan River are more affected with more than 1,000 of today's population facing inundation in towns like Middletown, Sayreville and Union Beach.

**+3'** The permanent flooding that had begun at one foot of sea level amplifies broadly to affect a growing number of residents at three feet. The more Urban areas - Jersey City, Hoboken, Perth Amboy - still remain minimally affected, though notably Hoboken rail terminal is likely to become partially flooded. The towns within the Meadowlands and around Raritan River and Bay that saw flooding at one foot now could see thousands more of today's residents permanently flooded. The Meadowlands town of Moonachie could experience flooding that affects nearly 70% of its total population today.

Critical infrastructure, including the numerous passenger and freight rail lines and warehouse and distribution facilities in the Meadowlands become threatened at three feet, and Teterboro is likely to be completely inundated, rendering it unusable.

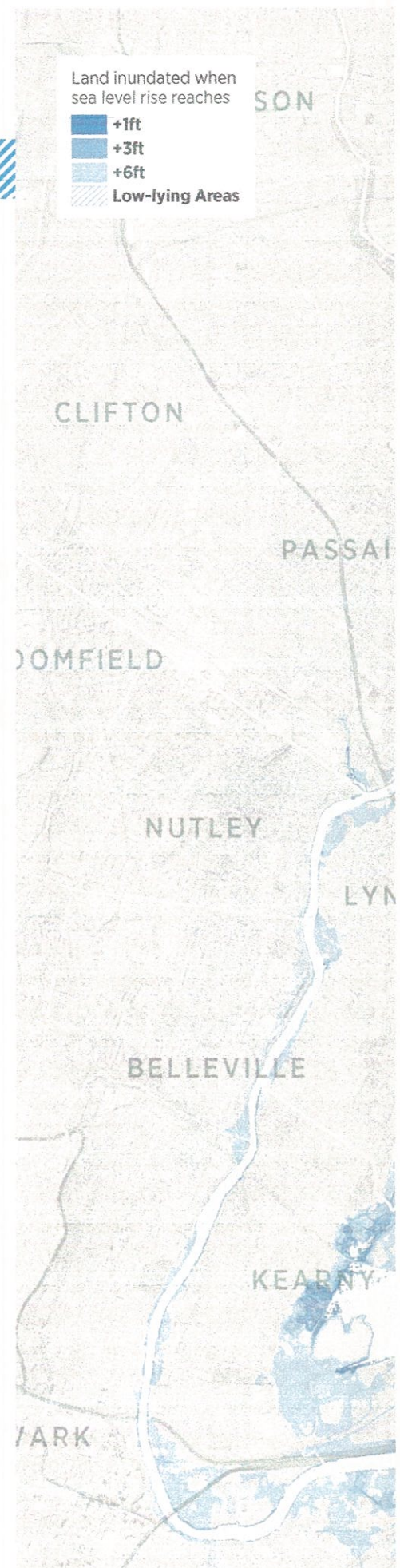
**+6'** Like New York City, New Jersey's more urban communities are more significantly affected by six feet of sea level rise. The most significantly impacted city in the region is Hoboken, where more than half of today's 50,000 residents live in places that will be permanently flooded. Historically, Hoboken was an island separated from mainland New Jersey, but over time was filled in with dense uses. As floodwaters crest the protective infrastructure along the city's waterfront, the low-lying fill areas are likely to fill back in with water, affecting more than 28,000 of today's residents. The Hoboken rail terminal and yards are also likely completely inundated at six feet, affecting NJ Transit, PATH and Hudson Bergen Light Rail lines.

Neighboring Jersey City's waterfront is also likely to see significant inundation, affecting areas where more than 13,000 residents live today. More than 6,000 residents of Newark currently live in places that could become permanently inundated and both the Port of New York and New Jersey and Newark Liberty International Airport face significant risk of permanent flooding across vast sections..

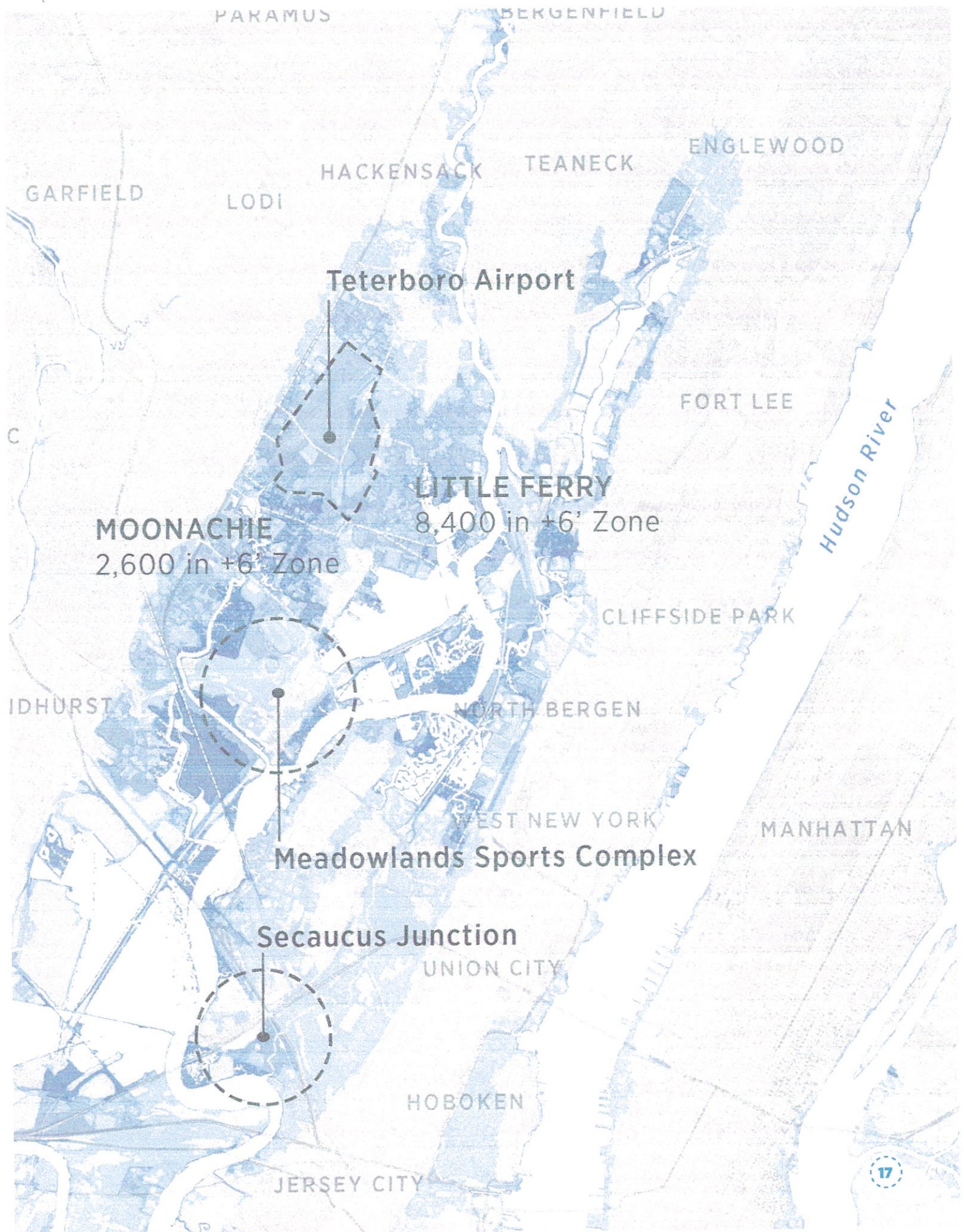
The rising sea levels continue to drastically affect communities in the Meadowlands and along the Hackensack River. Six feet of sea level rise threatens the viability of this transportation, energy and warehousing hub. Nearly all of Little Ferry's and Moonachie's residents today live in places that would become permanently flooded as does more than half of Kearny's population. The areas around Raritan Bay and its tributaries have around 20,000 residents living in places today that could become permanently inundated in the towns of Hazlet, Keansburg, Middletown, Sayreville, South River and Woodbridge alone. Highlands borough could see nearly half of its current population inundated.

Land inundated when sea level rise reaches

- +1ft
- +3ft
- +6ft
- Low-lying Areas







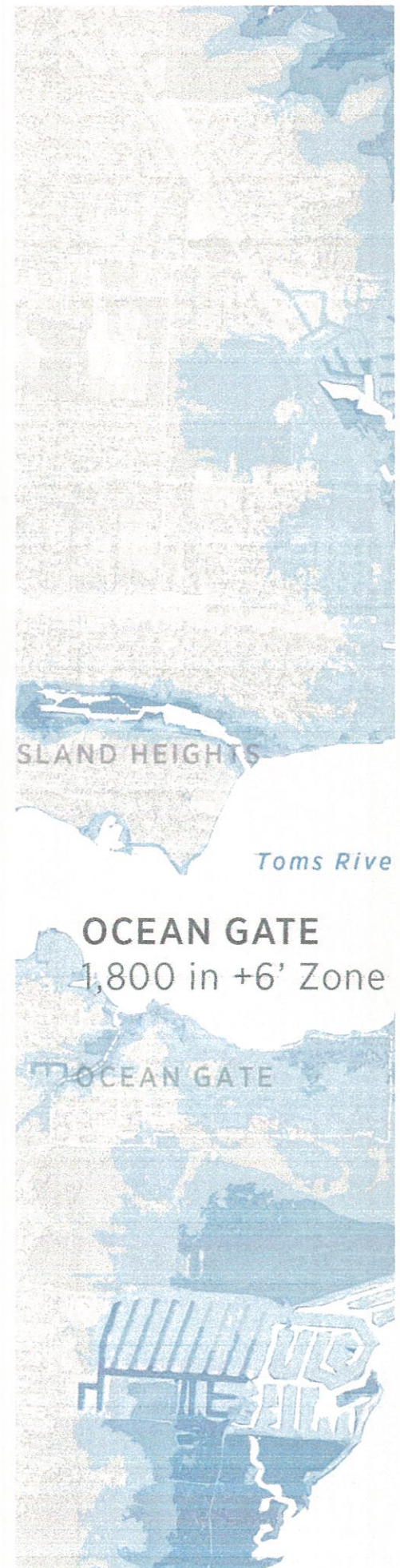


## The Jersey Shore

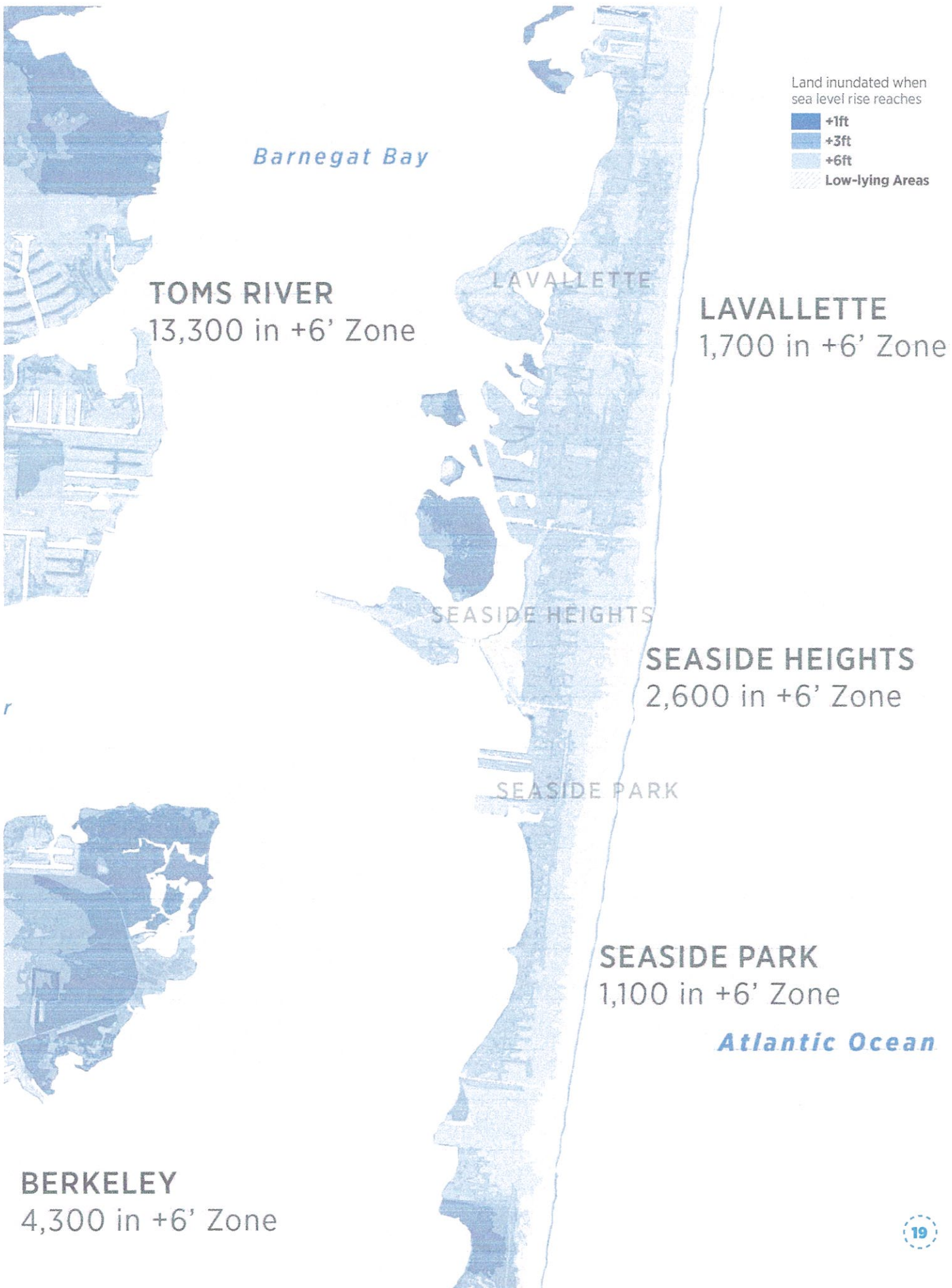
**+1'** At one foot of sea level rise, the Jersey Shore is particularly vulnerable to permanent flooding, with much of the initial inundation in communities that line its back bays, tidal rivers and estuaries. Particularly affected are the Ocean County communities around Barnegat Bay and Toms River, where over 3,000 of today's residents live in places that could be inundated.

**+3'** As sea levels rise to three feet, the bay and tidal river portions of the shore will continue to be the hardest hit in the state. Permanent flooding is likely to inundate many more towns than were affected at one foot and those places already flooded will likely experience worse and more far reaching inundation. The areas around the Navesink and Shrewsbury rivers could see flooding that affects thousands in Highlands, Oceanport, Rumson and other towns. Sea Bright could see almost half of today's population permanently flooded. Further down the shore, the beach and coastal river towns of Monmouth County including Long Branch, Manasquan, Monmouth Beach, Ocean and Point Pleasant Beach will likely see flooding affect over 10,000 of today's residents. While in Ocean County, the communities along Barnegat Bay and Toms River are likely to continue to experience the greatest amount of flooding in New Jersey with nearly 23,000 residents living in places today that could be permanently flooded in towns such as Berkeley Township and Seaside heights where more than half of the current population will be affected.

**+6'** At six feet of sea level rise, the flooding of bay, river and estuary communities continues to expand, but the biggest shift between three and six feet is the devastating impact to New Jersey's beach towns. The coastal waterfronts of Monmouth and Ocean counties have a combined current population of over 80,000 residents that could become permanently flooded. Thousands in Long Branch, Manasquan, Monmouth Beach, Oceanport and Rumson are at risk, while in Sea Bright more than 80% of today's population could be permanently flooded. The area around Barnegat Bay and Toms River accounts for the majority of the 80,000 residents at risk. There, the string of towns that form the popular summer destination of Long Beach Island faces near complete inundation as do many of the places that form the iconic postcard images of the Jersey Shore, like Point Pleasant Beach, Seaside Heights and Seaside Park. Toms River's barrier beach communities also face near complete inundation. At six feet of sea level rise, the story of the Jersey Shore is the loss of the arcades, boardwalks, amusement parks and sands that fuel New Jersey's tourism economy.







12.5x



# Coastal Connecticut

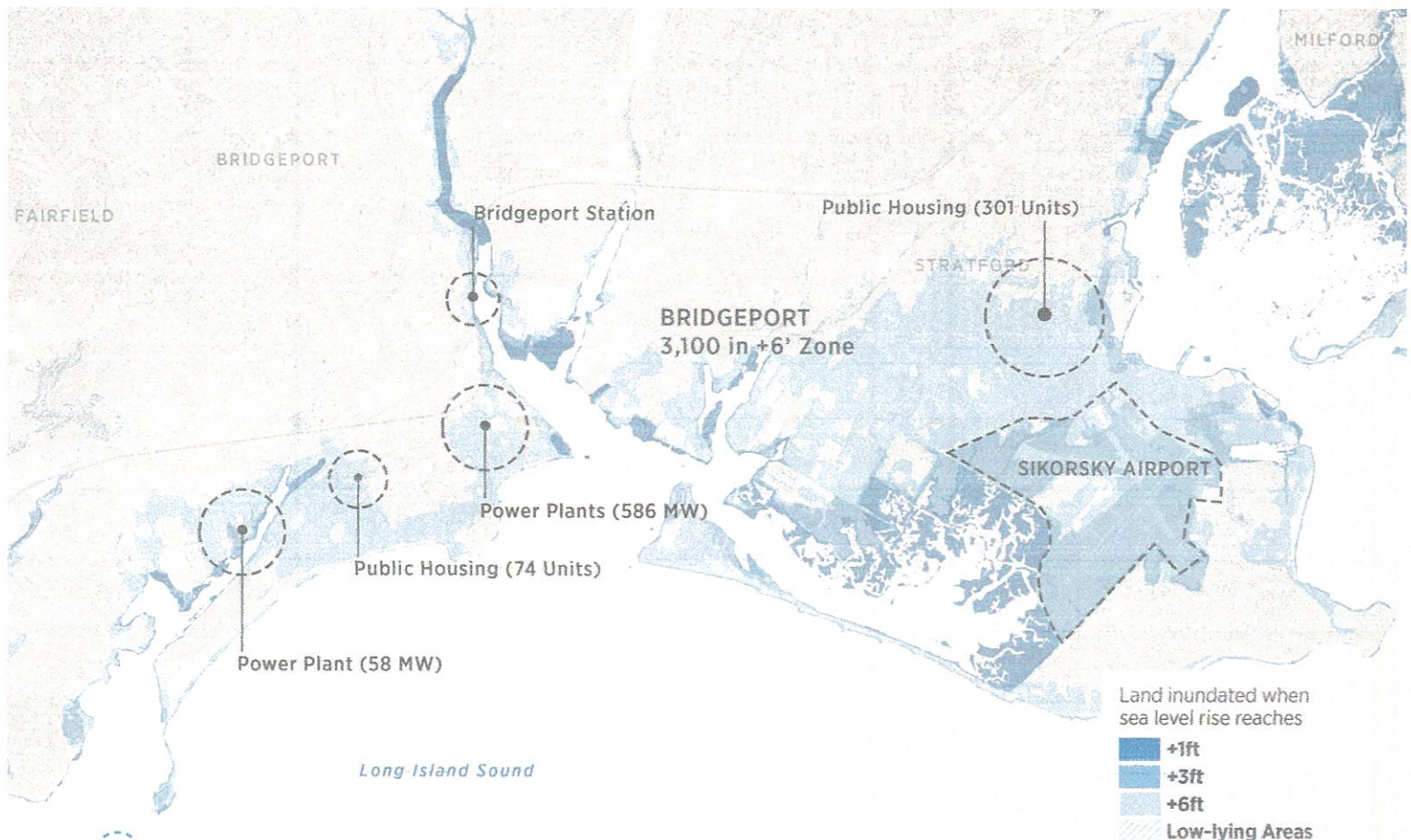
Residents Inundated +1': 2,295 +3': 10,901 +6': 47,182

## Long Island Sound Cities

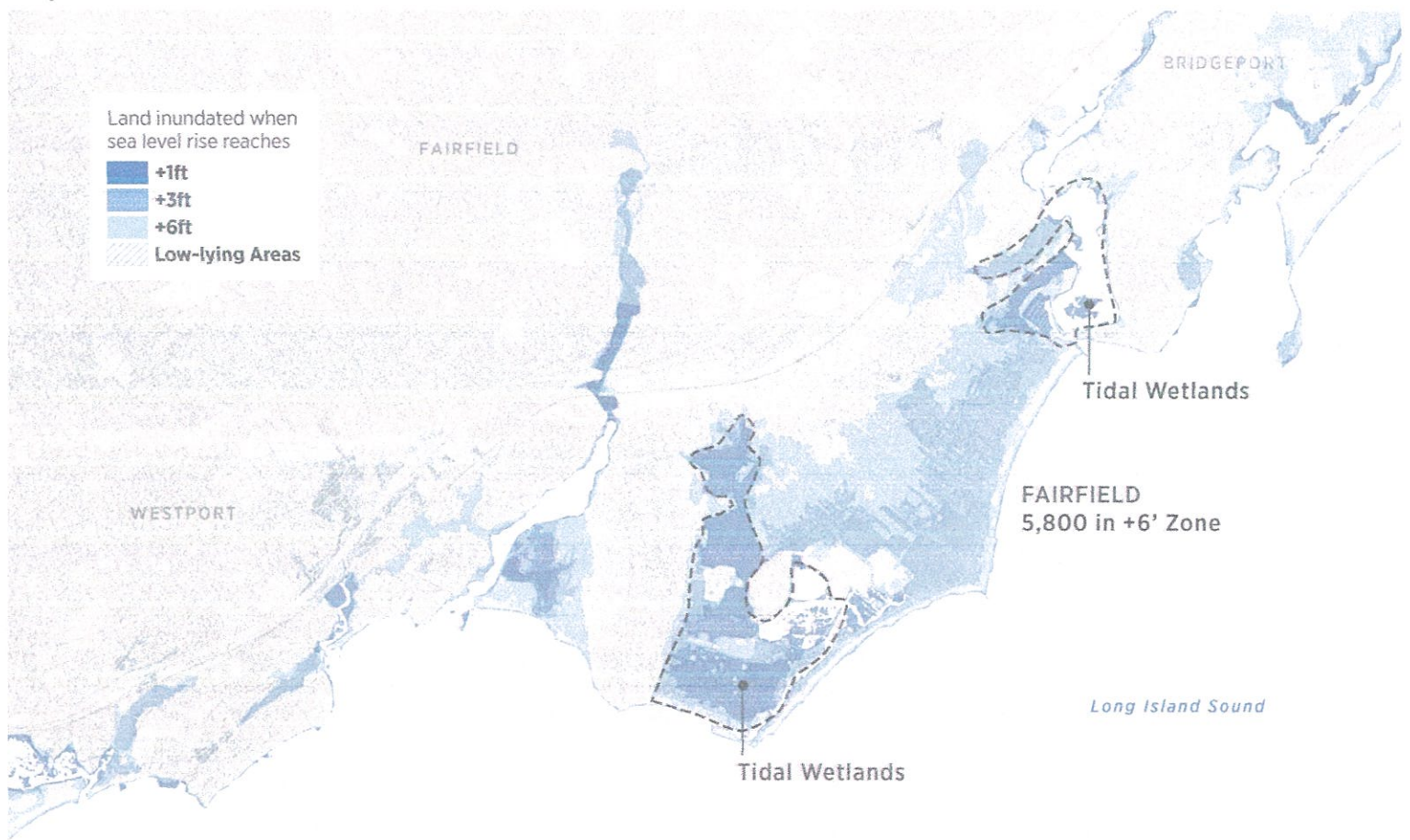
**+1'** Connecticut's coastal cities — Stamford, Bridgeport and New Haven — are only minimally affected by one foot of sea level rise with small sections inundated and just over one hundred of today's residents in places at risk.

**+3'** The cities remain largely protected from a three foot rise in sea levels, with some areas more threatened than others. Hundreds of residents live in places today that could be affected by permanent flooding in Bridgeport and New Haven, while close to 2,000 of Stamford's waterfront residents could experience inundation at three feet, a significant jump from the flooding at one foot.

**+6'** With six feet of sea level rise, Connecticut's coastal cities start to see more dramatic effects from permanent flooding. In total, over 12,000 Bridgeport, New Haven and Stamford residents currently live in places that could become permanently flooded, nearly half of them located along the Stamford waterfront.







## Long Island Sound Suburbs

**+1'** With one foot of sea level rise, suburban development along Connecticut's coast faces greater threats from permanent flooding than do the urban centers. In particular, portions of Fairfield, Milford and Branford account for more than half of the state's total population at risk with 1,200 of today's population living in places that could become permanently flooded.

**+3'** The majority of Connecticut residents affected by three feet of sea level rise continues to be in the waterfront suburban towns of Fairfield and Milford where close to 4,000 residents today live in places that could be permanently flooded. Meanwhile, communities including Branford, East Haven, Greenwich, Norwalk, Stratford and Westport are likely to see an increasing number of residents permanently flooded.

**+6'** Despite the additional areas of Connecticut's cities affected by six feet of sea level rise, the vast majority of residents facing increased permanent flooding at six feet remain in the waterfront suburbs. Fairfield remains the most affected of Connecticut towns with nearly 6,000 residents at risk, followed closely by Stratford and Milford with each over 5,000. Norwalk, Westport, Branford, East Haven and Milford together have close to 12,000 people living in places that could be permanently flooded.



# What's Being Done

## New York State Community Risk and Resilience Act (CRRA)

CRRA was signed into law on September 22, 2014 with the aim to ensure that certain state funding, facility-siting regulations and permits consider the effects of climate change and extreme weather events. Five major provisions of the law include:

1. The state adopting its own official sea level rise projections, adjusted for sub-regions of the state and based on New York City's methodology carried out by the New York City Panel on Climate Change.
2. Requiring applicants for permits or funding in specified programs to demonstrate that they have considered the risks of sea level rise, storm surge and flooding and that they are factored into facility-siting regulations.
3. Ensuring that mitigation of sea level rise, storm surge and flooding risks are added to the list of smart-growth criteria for public infrastructure.
4. Requiring the NYC Department of State (DOS) and the Department of Environmental Conservation (DEC) to develop model local laws that consider risk from sea level rise, storm surge and flooding.
5. Requiring DEC and DOS to develop guidance for how to use natural resources and processes to enhance resilience.

While many of the final details for implementation are currently being worked out at many levels, this law represents a proactive and forward-looking approach to tackle climate change risks, including sea level rise. The details of implementation will determine how effective and replicable the law could be for the rest of the region.

## New York City's Special Initiative for Rebuilding and Resiliency

Following Superstorm Sandy, New York City under Mayor Michael Bloomberg responded to the disaster by building off of the already strong approaches it had been crafting around recovery and resilience, with a focus on preparing for the long term. The City released a final report in June 2013 that summarized the threats from climate change to neighborhoods and vital infrastructure and laid out an ambitious set of recommendations to meet the challenges posed by those threats. Projects in the plan include an estimated \$20 billion worth of projects ranging from hard infrastructure such as sea walls to living shorelines and everything in between.

Under Mayor DeBlasio, a number of the plan's projects have made good progress in places like Red Hook, Hunts Point, Sea Gate, Staten Island's East Shore, the Rockaways and Jamaica Bay and along Manhattan's Lower East Side where coastal defences are being planned and implemented. Funds are being secured for coastal protection projects and new policies have been adopted to support coastal protection. The SIRR report looked ahead to 2050 to consider the risk of sea level rise on City neighborhoods and infrastructure. The ambitious actions the City is taking to become more resilient are similarly focused more on threats for the next few decades, than those beyond, meaning higher levels of sea level rise will need to be addressed in future planning.

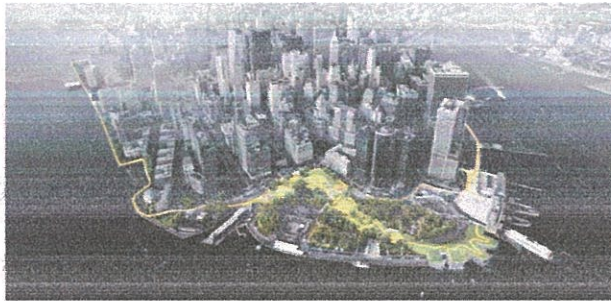
## Rebuild by Design

The innovative and imaginative Rebuild by Design competition process grew out of a unique partnership of the Rockefeller Foundation and the U.S. Department of Housing and Urban Development. Together, along with key partnerships with Regional Plan Association, the Municipal Art Society, the Institute for Public Knowledge and the Van Alen Institute, the competition brought together designers, planners,



architects and scientists to dream a new vision of resilience for our region. The resulting set of projects are at various points of implementation and represent the vanguard for resilience planning. RPA looked specifically at four to evaluate the degree to which they will protect against sea level rise, separate from extreme storms.

### Big U/East Side Coastal Resiliency



Source: BIG (Bjarke Ingels Group)

Originally conceived as “the Big U,” the East Side Coastal Resiliency project is the first segment of an integrated flood protection system around the southern tip of Manhattan, and is a signature project of New York City’s SIRR report. It aims to fuse structural protection with public amenities such as open space to provide protection for neighborhoods that include over 9,000 NYCHA housing units, critical networks of the City subway system, Con Edison substations, the Manhattan pump station and the FDR Drive. Ultimately, the primary purpose of the project is to protect these places from the storm surge that comes with extreme storms. It is being designed for the “100-year flood plus sea level rise.” Because it cannot seamlessly seal off every section from the Harbor, flood waters could eventually find inlets into some neighborhoods and depending on the final height of the structure could top the structure in the long run.

### Resilient Bridgeport



Source: WB Unabridged

Focusing on Connecticut’s most dense, diverse and socially vulnerable city, Resilient Bridgeport aims to tackle the flooding from rainfall and storm surge that will be made worse by sea level rise. The project also aims to boost habitat restoration, economic development and community revitalization in the South End neighborhood of the city by elevating a critical road, building a waterfront berm and

establishing offshore breakers to mitigate surge. While the project focuses largely on surge and rainfall flooding, final designs include adaptable space to adjust for sea level rise.

### New Meadowlands/Rebuild by Design-Meadowlands



Source: MIT CAU + ZUS + URBANISTEN

As a pilot of a larger vision, this project intends to protect the five municipalities in the New Jersey Meadowlands region of New Jersey. Originally conceived as a network of protective berms to keep out floodwaters, provide developable space and create room for wetland restoration, the project has been scaled back and as part of an environmental impact statement process underway is considering three alternatives, 1) structural flood protection; 2) stormwater drainage and management to minimize flooding from extreme precipitation; and 3) a hybrid approach. The project as it is being studied, looks to the year 2075 to develop and evaluate anticipated flooding conditions, which should account for more than a foot of sea level rise. It is unclear how future increases in sea level rise will be factored into the final project.

### Resist, Delay, Store and Discharge/Rebuild by Design-Hudson River



Source: OMA

The proposed project for Hoboken is squarely focused on taking a comprehensive water management approach to address flooding from periodic major storms and high tides and from periodic extreme rainfall events. It combines hard infrastructure to protect against storm surge and high tides, including berms and levees, with new green infrastructure and improvements to existing stormwater infrastructure. The coastal protection components of the proposal are being designed for a 500-year flood event, but does not specifically discuss the permanent implications of flooding from sea level rise.



# Taking Action

With the first damaging consequences of sea level rise projected to affect our neighborhoods as soon as the next 15-20 years, we can no longer put off preparing. The purpose of this report is to put sea level rise at the forefront of policy discussions that will determine how well we adapt to a new environment and coastline. Using the best data available, it paints a picture of the future we could see if we fail to reduce our carbon emissions and change the way we plan, develop and adapt along our waterfronts.

The following offers some overarching tenets, many of which will be explored in greater detail in RPA's fourth regional plan due out next year, that should inform what we can do to do address sea level rise today.

## 1. Follow through on commitments to reduce carbon emissions

As we accept and brace for a future with dramatically rising seas, we must remain steadfast in doing everything we can to reduce our carbon emissions, locally, regionally and nationally. Our nation has committed to reduction goals and our region can lead the way in meeting and exceeding those levels. Reducing our carbon emissions is the only way for us to slow the rate and minimize the amount of sea level rise around us.

## 2. Plan now for sea level rise at the state, municipal and community level.

It might seem obvious, but the first step in confronting sea level rise is to acknowledge that it is happening and take the necessary steps to plan for it. All too many communities in our region aren't fully aware of the threat and aren't planning for its consequences. While 85, or 50 or even 15 years seems like a long way off, the planning and development decisions we make today have long-term effects. A new apartment building approved for development today and built in an area that will eventually be submerged by the sea will be fine in the short term, but as difficulties arrive, from initial nuisance flooding at high tides to the eventual inundation of the property, the challenges for how to ensure the safety and well-being of people living in these places there will multiply.

There will be places where we will need to cease development because of sea level rise, others that we will need to reclaim as open space and habitat and some places where it

will make sense to reinforce and redevelop. Those decisions will happen today in master plans, zoning updates, hazard mitigation plans, open space protection plans and other policies that set the table for growth in our region. New York State has taken a bold step with the Community Risk and Resiliency Act that ensures that state funding, facility-siting regulations and permits account for climate risks and extreme weather events. New Jersey and Connecticut should enact similar legislation. And local municipalities will need support, both funding and knowledge, to begin planning for sea level rise.

## 3. Know what's at risk.

The numerous web-based tools available from federal, state and local government, universities and non-profit organizations allow all of us to use the latest science, projections and models to pinpoint areas at greatest risk from sea level rise. What's essential in planning for sea level rise is knowing where those areas are and what is in them. This report has taken a first look at our region and has identified the people, jobs and some of the major infrastructure at greatest risk, but it is incumbent upon each community to do a more exhaustive analysis. New York City has taken stock of who and what is at risk from catastrophic storms as well as from sea level rise through 2050. Properly scaled versions of their approach looking to the longer term should be emulated in municipalities across the region to so that action can be taken to confront this growing risk.

## 4. Fund sea level rise adaptation.

Adapting to sea level rise will require varied investments depending on the context. Some areas will need investments in hard infrastructure and pumps to keep water out; others will need to elevate homes, infrastructure, perhaps entire facilities; still others may require a more natural approach with restored wetlands and other living shorelines; some areas eventually might need to move away from the water's edge and return the land to nature. All of these measures will require levels of funding that are currently insufficient. There will be no adaptation steps taken to confront sea level rise unless there is funding to do so, and requirements to ensure it is done. New funding sources will be needed, and all existing sources of adaptation funding, from federal to state to local and philanthropic, need to address sea level rise in addition to intermittent, storm related flooding.

## **5. Implement resilience projects for the short and long term.**

In the wake of Hurricanes Irene and Sandy in our region, funding has been dedicated to plan, design and implement multiple resilience projects. These projects, as they are completed, will provide necessary protection and improved practices in the face of catastrophic storms. These projects should continue to be implemented with no interruption.

At the same time, there should be an acknowledgment that many of these projects will offer limited or - at best — short-term protection from sea level rise, and additional projects will be needed in the long term. Many of these existing projects can be leveraged to maximize their usefulness in the long term to best protect against sea level rise.

## **6. Pay special attention to the most socially and economically vulnerable.**

The consequences of sea level rise will affect many of our region's residents, but the poor, elderly, renters and others who are vulnerable for economic or social reasons will be hit harder. About one-third of residents at risk of flooding from sea level rise could be considered socially vulnerable. With lower incomes, fewer job choices, less ability to be mobile and a limited supply of affordable housing, the challenges faced by socially vulnerable populations will be exacerbated by sea level rise. Even the adaptation tools available to confront sea level rise will need to be tailored to different populations. For example, buyout programs work best for homeowners of single family homes and are not adequately structured to fairly acquire multi-family buildings with renters. Municipal leaders, policy makers and adaptation funders will need to develop adaptation programs for and effectively communicate with those who are socially vulnerable.





## Regional Plan Association

Regional Plan Association is America's most distinguished independent urban research and advocacy organization. RPA improves the New York metropolitan region's economic health, environmental sustainability and quality of life through research, planning and advocacy. Since the 1920s, RPA has produced three landmark plans for the region and is working on a fourth plan that will tackle challenges related to sustained economic growth and opportunity, climate change, infrastructure and the fiscal health of our state and local governments. For more information please visit, [www.rpa.org](http://www.rpa.org).

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