Two Rivers, One Future

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

Regional Resilience Adaptation Action Plan

December 16, 2019

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The No Action Risk Assessment Report and its attachments are the product of a collaborative effort between members of the NJ FRAMES project team, including NOAA, NJ DEP, Jacques Cousteau National Estuarine Research Reserve, Louis Berger, Binera Inc., the Rutgers Climate Institute and a representative on behalf of the Borough of Oceanport who provided guidance in the development of the report.

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List of Acronyms and Abbreviations

DEP	New Jersey Department of Environmental Protection
MHHW	Mean Higher High Water
NJ FRAMES	New Jersey Fostering Regional Adaptation through Municipal Economic Scenarios
NOAA	National Oceanic and Atmospheric Administration

EXECUTIVE SUMMARY

The Two Rivers Regional Resilience Adaptation Action Plan (Regional Action Plan) is the result of a 3-year risk assessment, outreach, and scenario planning process for New Jersey Fostering Regional Adaptation through Municipal Economic Scenarios (NJ FRAMES). The project is based in the Two Rivers region of Monmouth County, New Jersey, and is composed of 15 communities along the Shrewsbury and Navesink Rivers, as well as communities on the Bayshore and Atlantic Ocean coastline. The project is funded by the National Oceanic and Atmospheric Administration (NOAA) Regional Resilience Grant Program, and its approach and key principles are based on the framework laid out in NOAA's "What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure."

As one of the final products of the project, this Regional Plan presents six strategies for achieving regional resilience, as well as a potential path for implementation of the strategies, called the Conceptual Scenario. The Conceptual Scenario can serve as a guiding document in the planning and development of the communities located within the Two Rivers Region or can potentially spur projects of their own through implementation of the strategies.

The regional planning strategies listed below have been developed as a response to a comprehensive risk analysis done for the region that considered coastal storm and sea-level-rise impacts to a variety of environmental, social, and economic impacts. They also respond to the regional resilience goals set forth in the project and have been iteratively updated based on extensive outreach with the public, stakeholders, steering committee members, and technical and constituent advisors who served on separate committees.

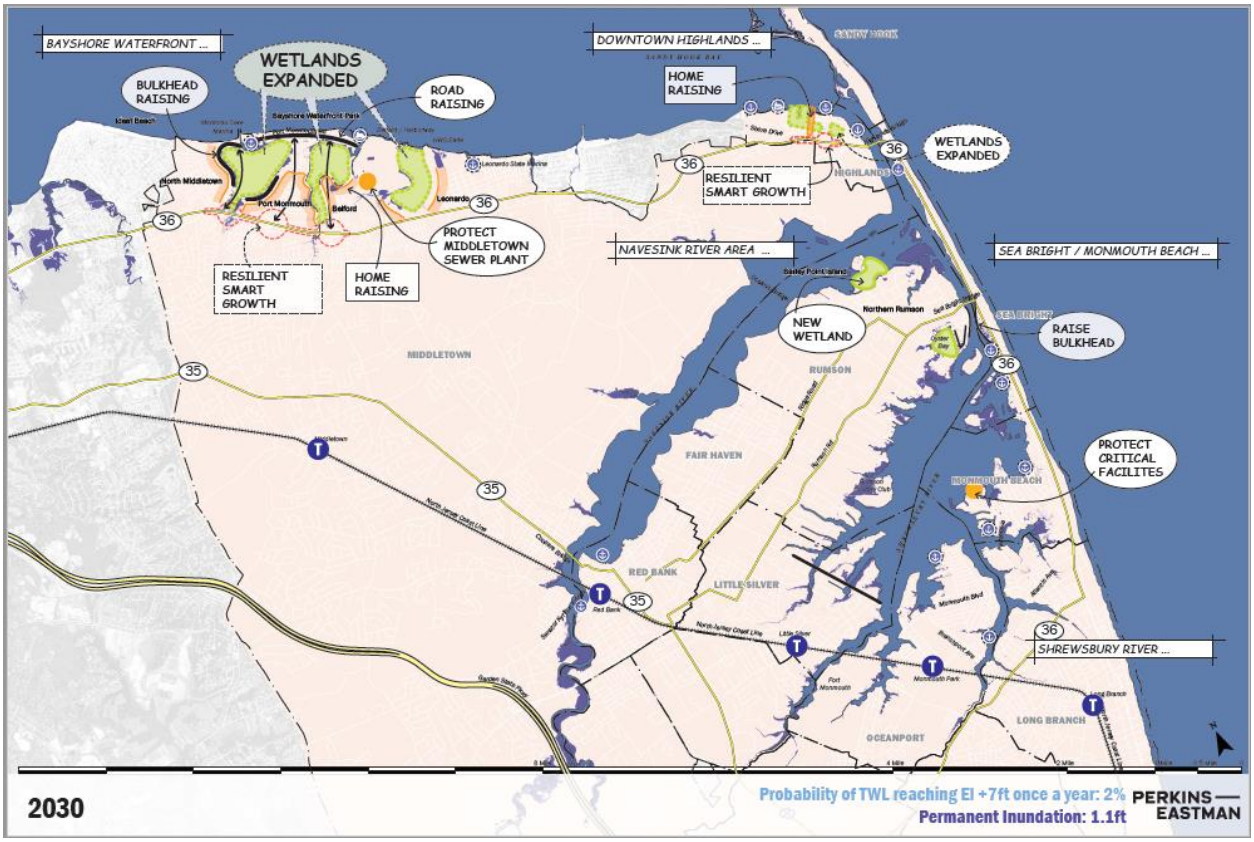
1. New Coastal Protection Infrastructure
2. Protect Critical Facilities
3. Harden and Plan for Future of Water-Dependent Assets
4. Neighborhood-level Adaptation Measures
5. Long-term Vision and Master Planning for Permanent Inundation
6. The Monmouth County Coastal Resilience Committee

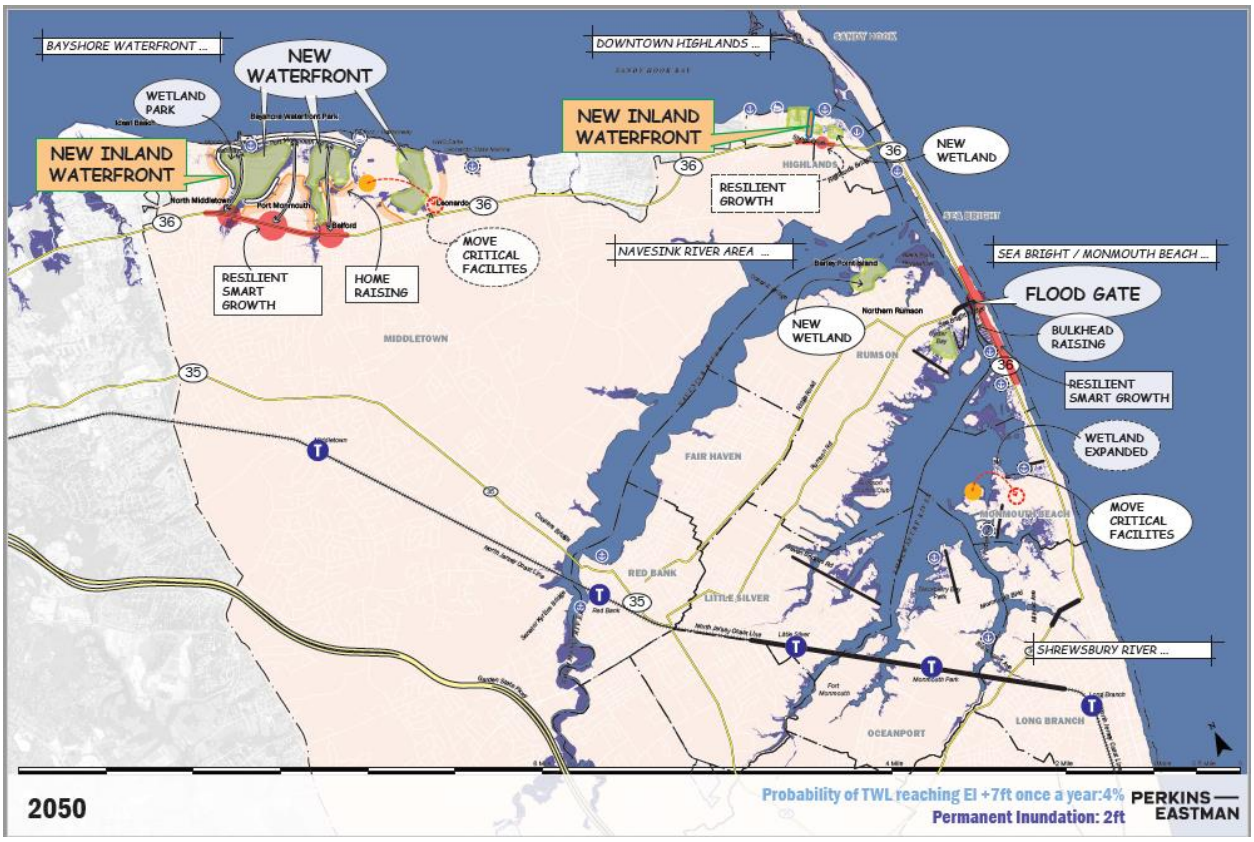
Each of these strategies responds to regional risk of total water levels (accumulation of floodwater above mean higher high water (MHHW)) and permanent inundation due to sea level rise. While many of these strategies can be championed and integrated individually into the planning and development of the region, together these strategies provide a viable, community-reviewed approach to mitigate risk of loss from storm surge and permanent inundation.

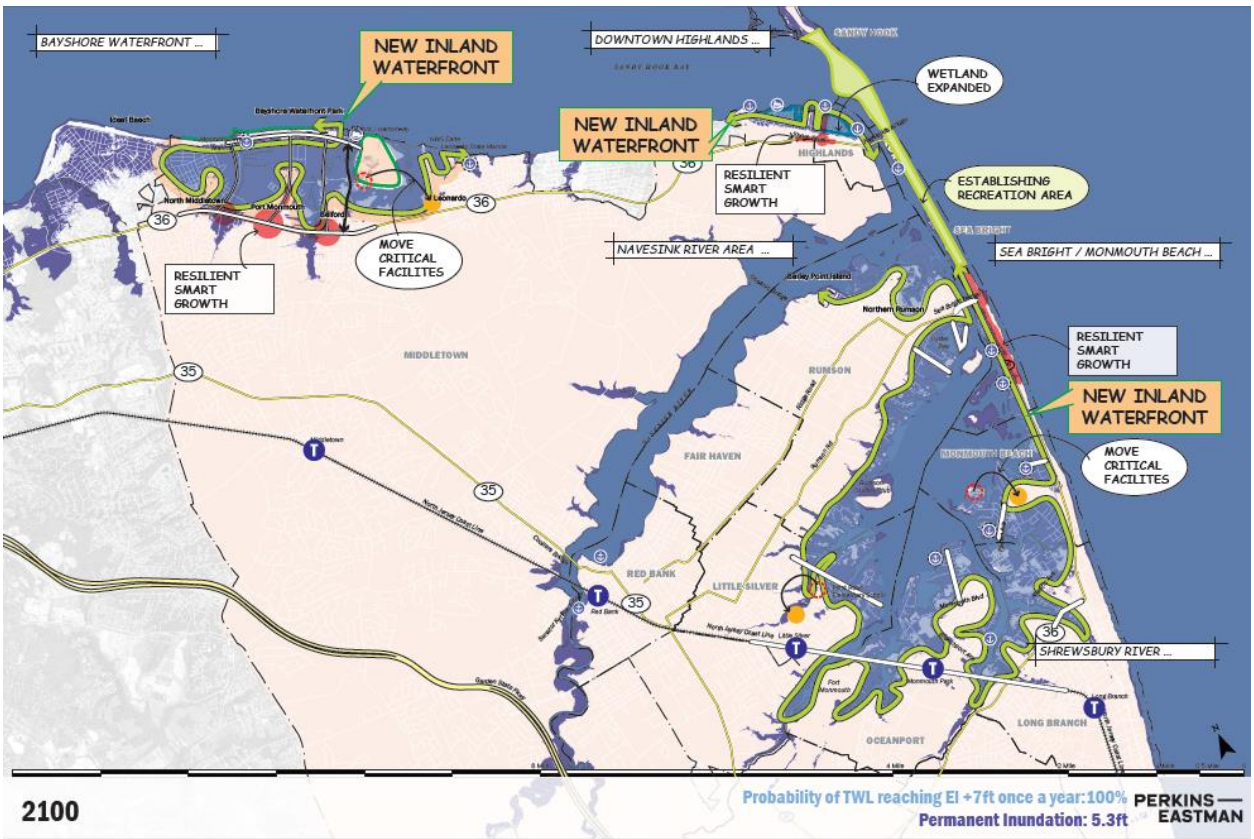
The first strategy, New Coastal Protection Infrastructure, suggests a wide range of green and grey solutions that can be applied across the region to protect from the greatest impacts of storms, particularly damage from total water levels. The second strategy focuses on critical facilities, promoting approaches to protect, adapt, and relocated important assets that are at risk. The third strategy creates a plan for the future of water-dependent assets, which are economically and culturally important for the region. The fourth strategy proposes measures that adapt current infrastructure and building stock to provide near-and-long term protection. The fifth strategy provides a long-term vision and master planning approach to promote a sustainable region and develop and use opportunities in light of permanent inundation, which has significant impacts in the long-term. Finally, the sixth strategy proposes the commencement of a planning forum, named the Monmouth County Coastal Resilience

Committee that focuses on regional approaches to resilience, including the promotion of strategies presented in this regional plan.

The regional plan is designed to guide current and future planning and development and not provide a singular approach to resilience planning. To help visualize how these strategies might direct future projects and policies, the planning team created a conceptual scenario that applies potential projects and developments to future planning years. The conceptual scenario has been developed based on stakeholder feedback but is just one future pathway of many that the strategies can help guide.




BAYSHORE WATERFRONT ...
NEW WATERFRONT
WETLAND PARK
NEW INLAND WATERFRONT
DOWNTOWN HIGHLANDS ...
NEW INLAND WATERFRONT
NEW WETLAND
RESILIENT GROWTH
MOVE CRITICAL FACILITES
NAVESINK RIVER AREA ...
SEA BRIGHT / MONMOUTH BEACH ...
FLOOD GATE
RESILIENT SMART GROWTH
HOME RAISING
NEW WETLAND
BULKHEAD RAISING
RESILIENT SMART GROWTH
WETLAND EXPANDED
MOVE CRITICAL FACILITES
SHREWSBURY RIVER ...
MIDDLETOWN
FAIR HAVEN
RED BANK
LITTLE SILVER
OCEANPORT
LONG BRANCH
2050
Probability of TWL reaching El +7ft once a year:4%
Permanent Inundation: 2ft
PERKINS EASTMAN


BAYSHORE WATERFRONT ...
NEW INLAND WATERFRONT
DOWNTOWN HIGHLANDS ...
WETLAND EXPANDED
NEW INLAND WATERFRONT
RESILIENT SMART GROWTH
ESTABLISHING RECREATION AREA
MOVE CRITICAL FACILITES
NAVESINK RIVER AREA ...
SEA BRIGHT / MONMOUTH BEACH ...
RESILIENT SMART GROWTH
RESILIENT SMART GROWTH
NEW INLAND WATERFRONT
MOVE CRITICAL FACILITES
SHREWSBURY RIVER ...
MIDDLETOWN
FAIR HAVEN
RED BANK
LITTLE SILVER
OCEANPORT
LONG BRANCH
2100
Probability of TWL reaching El +7ft once a year:100%
Permanent Inundation: 5.3ft
PERKINS EASTMAN

The rest of this Regional Action Plan outlines the planning approach and strategies for regional resilience. Chapter 1 provides an introduction, with background information including an overview of the region and a description of what is at risk. Chapter 2 details the six strategies and highlights the many pathways in which they can provide regional approaches to resilience in the Two Rivers Region. Chapter 3 concludes the Regional Action Plan with a detailed matrix of next steps for the region and its leaders, including the formation of a steering committee to guide the development of a new regional committee dedicated to coastal resilience, named the Monmouth County Coastal Resilience Commission.

1.0 INTRODUCTION

As part of the New Jersey Fostering Regional Adaptation through Municipal Economic Scenarios (NJ FRAMES) project, this Two Rivers Regional Resilience Adaptation Action Plan (Regional Action Plan) serves as the Region's action plan for a coordinated approach to the future risk of coastal and tidal flooding and permanent inundation. The Two Rivers Regional Action Plan presents six strategies for regional resilience, coordinated as a regional plan that applies to 15 municipalities in the study area. The Two Rivers Regional Action Plan is the culmination of close to 4 years of dedicated focus, including a comprehensive review of assets, development of community goals, a baseline and future risk assessment, and a scenario-based planning study.

1.1 Background of Team

NJ FRAMES is funded through the National Oceanic and Atmospheric Administration (NOAA) Regional Coastal Resilience Grant issued to the New Jersey Department of Environmental Protection (NJ DEP) Coastal Management Program (CMP). The Regional Action Plan and its attachments and appendices are the product of a collaboration among members of the NJ FRAMES project team, including the CMP, WSP Inc. (formerly Louis Berger), Perkins Eastman, Binera Inc., Rutgers University, the Jacques Cousteau National Estuarine Research Reserve (JC NERR), and a representative of the Borough of Oceanport which provided guidance in the development of the report.

1.2 Background of Region

The NJ FRAMES study area includes the Two Rivers region, which consists of 15 municipalities across the Sandy Hook Bayshore (Bayshore), Navesink River, and Shrewsbury River in coastal Monmouth County, New Jersey. The area consists of 109 square miles of land, with a population of over 215,000 as of the last census. The region consists of many waterfront communities that are susceptible to coastal and riverine flood events. Hurricane Sandy caused major damage in most municipalities within the study area, and perennial small flood events affect several vulnerable neighborhoods.

The region is culturally and economically connected to the water through its beaches, marinas, waterfront shops, and open spaces. Connection to the water is essential to the character of the Two Rivers region. The region contains several entities and assets that provide connection between the 15 municipalities of the region and to areas outside the region, including:

- Multiple beach and recreation areas, including Sandy Hook
- Two major hospitals
- Two major ferry terminals
- Five train stations
- Economically-important state highways
- Regional water treatment and outfall facilities

Figure 1-1. Two Rivers Region

1.3 Getting to Regional Strategies

The Two Rivers Regional Action Plan and its regional strategies are the product of multiple years of engagement and risk assessment. The result is the strategies and recommendations listed in this Action Plan. The following sections will provide a brief overview of the steps taken to get to this point. To produce this Action Plan, the NJ FRAMES project team completed a series of tasks that identified regional goals and assets, analyzed current and future risk, and developed a scenario-based planning approach to gain feedback on potential strategies.

Throughout the project and each step outlined below, opportunities were provided to gather feedback from the residents, visitors, and all the members of the committees described below.

1.3.1 What's at Risk?

To ensure that the NJ FRAMES project represents the regions interests, an advisory committee was established consisting of several technical experts and a group of stakeholders representing varied interests in the region. A separate steering committee serves as a decision-making body and largely consists of municipality officials and select representatives from the constituent advisory group.

To understand what is at risk in the region a comprehensive asset inventory campaign, marketed as #MapWhatMatters, worked with committee members and the public to gather information. This asset inventory reviewed assets that traditionally are thought of as critical (evacuation routes, hospitals, police stations, etc.), but also highlighted assets that community members have identified as important to a region. The project team collected the data and digitized it into a web map for further spatial analysis. In addition, the project team conducted interviews with local social service organizations to understand the needs of socially vulnerable populations that reside within the study area.

To guide the project and the outcomes outlined in this plan, the vision, needs and desires of the region were considered. Regional goals were developed and agreed upon by the steering committee (Appendix A) and represent environmental, social, and economic principles.

This was then used to develop the baseline risk assessment, which assessed the risk of total water levels at +3 feet above MHHW, +7 feet above MHHW, and +12 feet above MHHW. Appendix B contains the full methodology for the background on total water levels, and Appendix C provides the methodology for the baseline risk assessment.

An important assumption for our risk analysis is the future changes that would occur with no action taken. This action plan and the analyses used to develop it assumes the presence of permanent inundation, which assumes a higher base MHHW level of +1.1' by 2030, +2.0' above MMHW in 2050 and +5.3' by 2100, with 2000 as the base year. For the purposes of visualizing risk, the regional action plan notes that permanent inundation implies that during a high tide event, any land at these previously stated levels would be wet and therefore not viable for most daily functions. The permanent inundation projections not only accrue permanent loss, but increase the frequency of reaching the three water levels of +3', +7', and +12' above MHHW. This in turn increases the annualized risk of impact.

For this exposure analysis, the project team references water levels to the MHHW vertical datum. The project team uses this datum to remain consistent with local and national exposure assessment tools (e.g., NOAA Sea Level Rise Viewer) for coastal flood hazard assessments. Different agencies and

professionals may use different vertical datums when discussing the height of a given flood event. For example, the National Weather Service (NWS) typically reports flood events as heights above Mean Lower Low Water in their forecasts and advisories. Construction code officials and engineering professionals often reference the North American Vertical Datum of 1988 (NAVD88) when designing to meet local base flood elevation and freeboard requirements. A comparison of vertical datums for the Sandy Hook tide gauge is available here.

In general, the region is subject to a high amount of risk and permanent loss throughout the century. As the frequency in which the region experiences higher water levels increases, the cost of that risk quickly grows in the region. A quantified breakdown of the risk to the region if no action is taken is shown below. In later years, increased frequency of storms leads to a higher annual likelihood of reaching the total water level marks. In 2030 and 2050, the high frequency of the 3 foot above MHHW brings about the most annualized risk for the region. By 2100, risk from a 7-foot event is highest.

Flood Event	Average Annual Frequency	Total Impacts (2017 USD)	Annualized Losses (2017 USD)	Permanent Loss (Absolute Loss)
2020				
MHHW + 3'	72%	$256,350,519	$184,572,374	N/A
MHHW + 7'	1.5%	$1,650,305,499	$24,754,582	N/A
MHHW + 12'	.10%	$4,984,228,820	$4,984,229	N/A
2030				
MHHW + 3'	90%	$144,036,395	$129,632,755	$232,121,024
MHHW + 7'	2%	$1,548,155,923	$30,963,118	$232,121,024
MHHW + 12'	.10%	$4,875,848,873	$4,875,848	$232,121,024
2050				
MHHW + 3'	100%	$80,240,583	$80,240,583	$458,048,822
MHHW + 7'	4%	$1,516,538,989	$60,661,560	$458,048,822
MHHW + 12'	.20%	$4,812,846,944	$9,625,694	$458,048,822
2100				
MHHW + 3' [1]	100%	$0	$0	$886,114,195
MHHW + 7'	100%	$683,415,441	$683,415,441	$2,597,858,119
MHHW + 12'	1%	$4,133,838,642	$41,338,386	$2,597,858,119

The risk assessment also reviewed non-monetized impacts to roads, parks, beaches, publicly-identified assets, and other facilities to comprehensively gauge the extent of coastal risk, guided by the resilience goals. The full results can be found in Appendix D.

[1] The MHHW + 3' is calculated from the summation of damage to 3' permanently inundated assets

1.3.2 Planning Scenarios

In response to the risk assessment, the planning team moved on to a scenario-based planning exercise to mitigate, avoid, or adapt the impacts that permanent inundation and increased flooding will have. Each scenario listed a theme of strategies that were used to carry out mitigation and adaptation. These strategies can include actions to address risk by helping the region adapt to future conditions. Strategies can be planning actions, specific projects, or larger regional initiatives that either allow the region and its communities to live with water, will protect them from the water, or will help them transition to a new use and vision for the land and waterways as areas are permanently inundated. The strategies can provide benefits on their own or can work together and be combined for additional benefits.

The three scenarios developed are the following:

- Living with the Water
- Protecting Our Communities from the Water
- Moving Away from the Water

The three planning scenarios helped map out potential routes for mitigating action, responses to each potential approach were diverse and concerns were expressed for each scenario. Through active, multi-stage engagement with the Steering Committee, advisory committees, and the public, the team heard support and criticism for all three scenarios. In general, overall, the project team recognizes the need for an open, collaborative approach to developing strategies. The regional action plan, presented in Chapter 2, was developed with these three planning scenarios and associated comments in mind.

2.0 SIX STRATEGIES FOR REGIONAL RESILIENCE IN THE TWO RIVERS REGION

2.1 Introduction

This section presents six strategies for inclusion in planning and future development of the Two Rivers region. The three planning scenarios, as described in Section 1.3.2, are the basis for the actions within each of the six strategies. Developed through a series of community meetings, feedback and commentary periods, and direct engagement with members of the steering and advisory committees, the six strategies provide guidance for regional action for the 15 participating communities.

The strategies are the product of comprehensive and iterative engagement with steering committee members. The resilience goals were a launching point for the plan, as they provided backing to map important regional assets and provide a vision for what needed to be prioritized. These goals helped frame specific features of the plan, such as the importance of water access and the need for connected communities.

Throughout the first half of 2019, the project team continued to develop the initial planning scenarios based on specific areas of risk and feedback from the advisory and steering committees. The initial planning scenarios were completed by July 2019 and presented in full to the community in a public open house, and to the advisory committees and steering committee in a webinar in September 2019. These feedback sessions were critical for the development of the six strategies, providing key principles to guide refinement of the proposed scenarios into the six strategies, including:

- Strategies should be framed as recommended approaches that the region should consider, and not as a singular way to address coastal risk.
- Strategies should to be tied directly to other planning processes, especially in the near term and middle term (through 2050) when long-range regional planning is currently occurring.
- Strategies should have multi-jurisdictional applications and region-wide benefits.
- Strategies should consider the specific unintended consequences that their implementation might cause
- Strategies should not prescribe specific approaches to implementation and should be developed in a way that allows for variation, especially in the implementation of long-term approaches.

These guiding principles came from direct feedback received when presenting the initial three scenarios. Specifically, the team received strong support for nature-based approaches but also concern that this might not work everywhere and should be combined with other structural approaches where necessary. The team also heard that large, structural projects and implementations need to be well studied and not restrict the current access to water. Additionally, the team heard significant feedback that the approaches included in the Moving Away from the Water scenario should be generalized for communities to have a leading voice.

The remaining sub-sections will present the six strategies. The Monmouth County Coastal Resilience Committee, discussed in Section 2.7, is envisioned to be a leader in integrating the following strategies into current and future planning and development. The strategy narratives will explain the potential

approach to planning and development that the strategies advocate for, and the supporting visualizations will provide a conceptual view at what this implementation might look like.

The first strategy, New Coastal Protection Infrastructure, suggests a wide range of green and grey solutions that can be applied across the region to protect from the greatest impacts of storms, particularly damage from storm surge. The second strategy focuses on critical facilities, promoting approaches to protect, adapt, and relocated important assets that are at risk. The third strategy creates a plan for the future of water-dependent assets, which are economically and culturally important for the region.

The fourth strategy proposes measures that adapt current infrastructure and building stock to provide near-and-long term protection. The fifth strategy provides a long-term vision and master planning approach to promote a sustainable region and develop and use opportunities in light of permanent inundation, which has significant impacts in the long-term. Finally, the sixth strategy proposes the commencement of a planning forum, named the Monmouth County Coastal Resilience Committee, that focuses on regional approaches to resilience, including the promotion of strategies presented in this regional plan. This Committee, discussed in detail in Section 2.7,

2.2 New Coastal Protection Infrastructure Strategy

The New Coastal Protection Infrastructure Strategy focuses on protecting areas of the Shrewsbury and Navesink Rivers and the Bayshore, through infrastructure creation such as a storm surge barrier, living shorelines, wetlands, and bulkheads.

In the Bayshore and within estuaries of Navesink and Shrewsbury Rivers, this strategy aims to prevent lower level flooding events below 7 feet of water and the need for ecological preservation and restoration by focusing on developing and maintaining wetlands, living shorelines, and other nature-based approaches. The focus is on areas presently at-risk areas within the estuaries and the Bayshore. Use of green infrastructure and other nature-based approaches could create new economic opportunities in the future.

The annual risk of properties and assets around the Shrewsbury River is some of the highest concentrated risk in the region, with over $7 billion in net risk for all assets south of the Shrewsbury-Rumson Bridge. Due to this risk, the planning team recommends the development of a large public works project that can minimize the impacts of at least storm surge. At a site near the confluence of the Shrewsbury and Navesink Rivers between Rumson and Sea Bright, this strategy proposes the construction of a storm surge barrier to mitigate sudden and temporary storm surge up to a 12-foot water level in the Shrewsbury River region.

To minimize ecological impacts, and allow for the continuation of recreational boat traffic, the storm surge barrier will act as a floodgate, with a default open position to minimize ecological impacts and allow full access for boats. This strategy potentially provides a cost-effective protection measure for all storm surge events up to 2100 but would not protect the area from permanent inundation or lower-level flooding events. The storm surge barrier could also minimize the need for other storm surge mitigation strategies in the areas such as home raisings and retrofitting waterfront assets. The storm surge barrier, along with the existing sea wall on the ocean side of Sea Bright and Monmouth Beach, is envisioned to allow comprehensive protection against storm surge in the entire Shrewsbury River Area.

In areas adjacent to the Sandy Hook Bay or the Navesink and Shrewsbury Rivers that will regularly experience water levels up to 7 feet, this strategy aims to protect assets through a comprehensive analysis into the best options for preventing the effects of storm surge backup into sewage systems and streets. It will also call for a comprehensive overhaul of municipal codes to coordinate private properties to protect vulnerable areas from storm surge through the construction of floodwalls and associated green infrastructure that can adequately protect up to a 7-foot water level. Measures proposed in this strategy would be implemented by 2030, with a lifespan of 50 years. Much of this bulkhead development, like home raisings proposed later in the Neighborhood-level Adaptation Measures Strategy, are intended to provide early-year protection from the increasing risk of storm surge.

Implementation Strategy: 2030, 2050, and 2100

Following is a description of how the New Coastal Protection Infrastructure Strategy would be implemented across the region. Work would progress simultaneously in all the areas marked out in this strategy.

Immediate Action

Beginning in 2020, this strategy recommends a region-wide study into the feasibility of nature-based approaches for inland waterways and the Bayshore. The feasibility study would outline the most effective nature-based approaches for storm surge, practical locations for development, and identification of funding sources for public and private implementation. The outcome would be in the form of a masterplan with guidelines on how projects and ecosystems can respond to and/or survive sea-level rise and suggest specific projects that could be effective even after an area is permanently inundated.

Starting now, the Bayshore and Two Rivers region should work with engineers to understand the best options for adapting utilities to frequent flooding and larger storm surge events up to a 7-foot water level. As these impacts generally manifest through public utility infrastructure (rather than through municipal infrastructure), municipalities will study the ways they can collaborate with such utilities and fund mitigation of storm water system backups to be implemented by 2030.

2030

In 2030, living shorelines could be constructed along public shorelines and participating private shorelines along the bay and estuaries of the region. Existing uplands could be converted back to wetlands. For areas where living shorelines and green infrastructure are most feasible, municipal codes and design guidelines that require the development of green infrastructure by 2030 would be implemented. In the Bayshore, the strategy entails maintaining and developing more than 650 acres of wetlands, and using natural resource-based materials (levees, earthen berms) to protect Middletown communities that surround these wetlands. Municipalities would work with private homeowners to assess the potential for connected nature-based approaches. Where possible, wetlands would be expanded in creeks and tributaries around the Shrewsbury River.

The potential storm surge barrier is scoped to be located between Rumson and Sea Bright in a location that would maximize the most benefit while lowering the size and cost. By 2030, preliminary environmental and engineering analysis should be done to properly identify and comprehensively evaluate the risks, opportunities, and unintended consequences of a storm surge barrier. Preliminary

feasibility and environmental assessments should be completed by this time as well, along with proper stakeholders who should lead development (such as the USACE). The assessment will also review the specific design requirements to ensure adequate protection of up to a 12' water level, including added floodwalls that would need to follow Rumson Road in Rumson Borough and connection to the sea wall in Sea Bright.

Municipalities should collaborate through the Monmouth County Coastal Resilience Committee to understand current approaches to ease storm water backup and explore the best practices to mitigate or avoid impacts. The Committee should also study how permanent inundation will contribute to storm water issues in areas that will be impacted through 2100. Highlands, Sea Bright, northern and eastern parts of Rumson, and Monmouth Beach will be the focus of this study and potential implementation.

2050

By 2050, efforts would be directed towards continuing maintenance of wetlands and living shoreline in the Bayshore region to ensure the infrastructure's effectiveness in mitigating the risk of storm surge. In the area of Rumson and Sea Bright, design and engineering plans for the storm surge barrier would have progressed and funding streams identified so that construction could begin in the near future in accordance with the environmental and financial findings. The storm surge barrier would be deployed every time there is a projected storm surge of 3 feet or greater, which will be at least an annual event in 2050. In the Bayshore and Two Rivers region, flood protection measures would continue to operate to protect against storm surge up to a 7-foot water level. Bulkheads and shoreline protection measures would be maintained and integrated with green infrastructure and nature-based approaches. Based on studies and best practices, storm water backup protection devices would be deployed where necessary to protect properties and infrastructure. They would also be designed to consider the impacts of permanent inundation, especially where tides can dramatically affect municipal sewage and wastewater systems.

2100

By 2100, due to major storm surge and 5.3 feet of permanent inundation, the wetlands and green infrastructure approaches would be significantly altered. Guided by the nature-based approaches master plan created in 2030, new areas where wetlands conversion could occur would be identified to mitigate the increased risk profile of higher water levels. By 2100, the shoreline developed as envisioned by the master plan would include nature-based approaches along most of the shoreline of the Bayshore and estuary of the Navesink and Shrewsbury Rivers. The storm surge barrier would still be used to protect from storm surge up to a 12-foot water level. Note that the storm surge barrier would not be designed to mitigate permanent inundation, and therefore would not reduce damage caused by permanent inundation in 2100 (5.3 feet). Subsequent studies would be conducted to understand the storm surge barrier's usefulness and operational capacity past 2100. Sea levels would have risen to 5.3 feet above 2000 MHHW levels. At this height, most technical solutions for flood protection would be infeasible and bulkheads would be unnecessary by 2100 if other strategies were implemented to either adapt shorelines with floodable open space or relocate the most impacted assets away from water.

Connections to Other Strategies

The vision of a vibrant coast, combined with the possibility of exposures to incremental flooding and permanent inundation, the inclusion of green infrastructure and other nature-based approaches are

vital. Such an approach along with bulkheads developed at critical points, road raisings and other permanent inundation mitigation measures allow for a comprehensive mitigation strategy to storm surge for all regions. It should be noted, however, that this strategy alone would not provide a potent solution to permanent inundation.

Table 2-1. New Coastal Protection Infrastructure Strategy: Planning and Development Initiatives

Strategy Component	Applicable Planning and Development Initiatives
Wetlands Maintenance and Development	The Wetlands Reserve Program by USDA
	NJDEP's New Jersey Wetland Program Plan 2019-2022
Green Infrastructure and other nature-based approaches	EPA Office of Sustainable Communities Greening America's Communities Program
	NERACOOS's High Resolution Coastal Inundation Modeling and Advancement of Green Infrastructure and Living Shoreline Approaches in the Northeast
	The Nature Conservancy's "Increasing Resilience through Application of Nature-Based Infrastructure"
	Monmouth County-NWS Earle Joint Land Use Study
	NOAA/The Nature Conservancy post-Sandy Grant
	Getting to Green: Paying for Green Infrastructure, Finance Options and Resources for Local Decision-Makers (Report)
Storm Surge Barrier	Army Corps Back Bay Study/ USACE Shrewsbury River Basin, Sea Bright, New Jersey Coastal Storm Risk Management Feasibility Study
Bulk heads and flood walls	FEMA Flood Mitigation Assistance Grant Program

Table 2-2. New Coastal Protection Infrastructure Strategy: Potential Funding Sources

Strategy Name	Potential Funding Sources
"Wetlands Maintenance and Development"	EPA Federal Funding for Wetlands (many programs, examples include EPA Office of Wetlands, Oceans, and Watersheds (OWOW) Funding; Wetland Program Development Grants (WPDG)
	NFWF Five Star and Urban Waters Restoration Grant Programs
"Green Infrastructure and other nature-based approaches"	Nature Conservancy's Living Shorelines Program
	EPA Federal Funding for Green Infrastructure
"Flood Gate"	Federal funding through Monmouth County
	FEMA Flood Mitigation Assistance Grant Program
"Bulk heads and flood walls"	FEMA Flood Mitigation Assistance Grant Program

Strategy Name	Potential Funding Sources
	ANJEC Smart Growth Planning Grant

Examples of Protected or Adapted Community-Identified Assets

- Bayshore Waterfront Park
- Red Bank Primary School
- Sandy Hook Bay Catamaran Club
- Barley Point Island
- Bahr's Point restaurant
- Raccoon Island Fields
- Rumson Country Club
- Monmouth Park
- Monmouth Beach Cultural Center
- Sea Bright municipal facilities
- Monmouth Beach municipal facilities
- Oceanport municipal facilities
- Long Branch emergency services
- Fort Monmouth Economic Development Project
- Shrewsbury River and southern Sea Bright-based marinas and boat launches
- Two Rivers Water Reclamation Authority
- West Park Neighborhood and Community Assets
- Channel Club Tower

2.3 Protect Critical Facilities Strategy

This strategy aims to protect critical facilities located in the areas at risk to storm surge and permanent inundation using physical barriers, pumping systems, buildings and road raisings. The idea is to allow other strategies to wholly focus on non-critical but inhabited areas in the region. In the short-term, critical facilities impacted by 2.0 feet of permanent inundation by 2050 would be identified for in-place protection using physical barriers and pumping systems. Two of the most important critical facilities in the region are the Middletown Wastewater Treatment Plant and Two Rivers Water Reclamation Facility, which are very close to the shoreline in the Bayshore and Shrewsbury River, respectively. Although, monetary benefits for this specific strategy is lower than others, the social importance of reliable emergency operations, waste and energy infrastructure systems, and other lifeline infrastructure is highly important and aligns with the regional goals set forth in the project. These strategies have the biggest benefits for non-Hazus monetized assets because they effectively reduce risk across the whole study area for all water levels.

Implementation Strategy: 2030, 2050, and 2100

This strategy focuses on ensuring that critical facilities are not hampered by storm surge and/or permanent inundation. Thus, a cohesive "inventory" of critical facilities would be mapped out, and a plan for protection and/or relocation of each facility would begin. The most vulnerable of these facilities would be targeted for immediate protection from both storm surge and permanent inundation, the latter being accomplished with pumping systems to keep the facilities continuously dry up to 2 feet of sea level rise. This would require continuous pumping, which is needed for the most critical, hard-to-move facilities. To ensure continued operations within the region, substations, emergency operations assets, and major facilities would need to be protected up to 7 feet of water.

2030

By 2030, a feasibility study would commence that lists options for protecting and/or moving wastewater and water treatment plants in the region. Two of these plants, the Middletown Wastewater Treatment Plant and the Two Rivers Water Reclamation Facility, are directly on the water and would need to be protected up to 2 feet of permanent inundation by 2050 as well as storm surge impacts.

2050

By 2050, those critical facilities that can no longer be protected in place, planning would begin for potential relocation to areas outside of the 7-foot exposure area. If it were determined that a new location for the treatment plants is feasible, the moving process would commence in 2050 to a place outside of potential future permanent or frequent inundation. If it is determined that a new location is not feasible, then a plan for protection for risks beyond 2050, namely a 12-foot total water level and 5.3 feet of permanent inundation by 2100, would be implemented starting in 2050. Emergency operations and public work assets that may be in vulnerable positions would start to be constructed in locations that are above the 12-foot water level and developed to serve population growth through 2050 (considering movement due to permanent inundation of residential areas).

2100

By 2100, all critical facilities identified in the risk assessment, as well as other important facilities like energy, waste, and waste infrastructure, would be relocated to other areas above the 12-foot water

level. Further analysis would be conducted to ensure the protection to these assets and systems past 2100.

Connections to Other Strategies

Protection of critical assets has numerous social and economic benefits for the region. This strategy has little direct connection with other proposed strategies; however, it addresses both permanent inundation and storm surge effects on the most important assets in the region, allowing other strategies to focus on other assets. While this strategy calls for the movement of critical facilities above a 12' water level, critical facilities that would be protected from storm surge may not need to move since all storm-surge related risk would be mitigated for these assets.

Table 2-3. Protect Critical Facilities Strategy: Planning and Development Initiatives

Strategy Name	Applicable Planning and Development Initiatives
Protection of Critical Facilities through structural raises, installation pumping systems, and physical barriers	USACE Shrewsbury River Basin, Sea Bright, New Jersey Coastal Storm Risk Management Feasibility Study
	Rutgers Community based Green Infrastructure Initiative in New Jersey (for sewer facilities)

Table 2-4. Protect Critical Facilities Strategy: Potential Funding Sources

Strategy Name	Potential Funding Sources
Protection of Critical Facilities through structural raises, installation pumping systems and physical barriers	U.S. Army Corps of Engineers Federal Grants
	EPA Water Infrastructure and Resiliency Finance Center (WIRFC)

Examples of Protected or Adapted Community-Identified Assets

- Middletown Township Sewerage Authority
- Two Rivers Water Reclamation Authority
- Long Branch Sewerage Authority
- Highlands Police and Fire Departments
- Sea Bright Police and Fire Departments
- Rumson Police, Fire, and Department of Public Works facilities
- Oceanport emergency services
- Long Branch emergency services
- Port Monmouth Fire Company
- Riverview Medical Center
- Monmouth Medical Center
- All at-risk schools and low-lying shelters

2.4 Harden and Plan for Future of Water-Dependent Assets Strategy

The coastline and shorelines of the Two Rivers region are some of the most active waterfront areas in the state. From fishing co-ops and ferry terminals to private and public marinas, the region's coastal assets provide major economic and social benefits to the entire region. This strategy recommends adapting these coastal assets against permanent inundation and surge events to ensure their long-term operation and that these assets be specifically considered in resilience planning and projects. The strategy includes building bulkheads and green infrastructure to protect marinas to a 3-foot water level, and ferry terminals and larger water-dependent economic assets like the Belford Fishing Co-Op up to a 7-foot water level in 2050. After 2050, these waterfront assets must be part of a larger movement to redefine the shoreline of the Bayshore and two rivers region, which would be considered in the design of coastal facilities that are planned for 5.3 feet of sea level rise by 2100.

Identifying Water-Dependent Assets

The plan considers several different economic assets that are water-dependent and at risk of storm surge and permanent impacts in the future. Among these assets are 20 marinas at risk, comprising more than 1,400 slips. Many of these marinas experienced damage during Hurricane Sandy, and some have implemented some resilience measures to better handle the impacts of storms. Marinas are a major cultural attraction, providing direct access to the water for the region.

Some of the most important water-dependent assets that were considered include the ferry terminals in Middletown and Highlands. The ferry terminal in Middletown is part of a larger waterfront area owned by Monmouth County that includes the Belford Seafood Cooperative and is adjacent to the new Port Belford development that is currently planned. Naval Weapons Station (NWS) Earle, located in the Middletown Bayshore, is also a large importance to the regional economy and of great importance to national security interests.

After talking with residents and regional leaders, the project team recognizes that these assets are major economic drivers and transportation assets that would have serious impacts if not operational. Accordingly, this strategy recommends that these assets be considered for higher levels of protection in the implementation of this strategy.

Implementation Strategy: 2030, 2050, and 2100

This strategy focuses on specific assets throughout the region and recommends that they be directly included in any resilience planning and design process.

2020

To implement this strategy, regional officials must begin to hold conversations with individual marina operators and the Marine Trades Association as early as 2020 to discuss the risk of current and future storm surge and permanent inundation. The level of protection envisioned in this strategy is up to MHHW +3 feet for private marinas, which protects against nuisance flooding, a common source of financial risk through 2050. In 2030, this equates to almost $118,000 in annual risk to marinas, and by 2050 this equates to just over $200,000 in annual risk. Individual risk assessments will be conducted for marinas to determine the level of effort needed to protect each facility and identify the level of effort needed to protect marinas from small-scale storm surge events.

More importantly, municipalities should work with private owners of marinas to implement projects that will maintain public access to water. Maintaining public access is a key goal from the region and working with both public and private marina operators to maintain this access will preserve critical cultural values for the region. These sorts of projects include hardening at marinas (bulk heading,

impervious surface retrofitting, and other adaptation approaches) along with projects that will maintain access in dry conditions and during low-level storms, maintain recovery plans, and plan for marina and other small water-dependent assets in long-term land use plans that account for permanent inundation where marinas may already exist.

Similar conversations must be held with ferry terminal operators and water-dependent economic facilities in the Bayshore region. Because of the important economic transportation functions these facilities serve, there will be a higher standard of protection to MHHW +7-foot water level. The type of protection envisioned at the terminals and for land around NWS Earle includes higher bulkheads, as well as the raising of any supporting piers, docks, and other facilities to avoid impact from permanent inundation.

Access to the terminals and major water-dependent assets is a major transportation and economy need for the region, and stakeholders around access roadways should be the focus of adaptation. Nature-based approaches, such as living shorelines and dune expansion, should be used around waterfront assets to the extent possible, providing a more environmentally friendly approach to mitigating storm surge. However, the facilities themselves will largely rely on gray infrastructure, like increased bulkhead elevations, to adapt to the increasing risk.

2030

By 2030, all economic assets should be protected up to recommended levels.

2050

In 2050, actions implemented in 2030 must be maintained. Throughout this process, municipalities and county officials should continue to work with marina and ferry operators to understand future impacts. As part of the long-term vision and master planning strategy, regional leaders should continue to study how waterfront economic assets need to adapt to rising seas, and the best ways to retrofit access to these facilities given permanent inundation. By 2050, any long-term visioning should call out specific adaptation and planning recommendations for these assets.

2100

By 2100, permanent inundation will dramatically change the coast and shorelines of the region. With this, waterfront assets must adapt to this changing coastline, and regional entities that provide transportation and utility connections must improve assets. This strategy recognizes that future growth of waterfront assets must happen in areas that will be on the waterfront in 2100. As different areas within the region transition towards land uses that are developed for frequent inundation, uses, raised waterfront assets should be considered for development to maintain the cultural and economic connection to the water that currently exists. This includes the relocation of marinas, new public access points that will be built in areas that are currently developed and transportation and utility connections to support this growth.

Connections to Other Strategies

This strategy focuses on the short-term impacts of waterfront economic assets and their adaptation. When cost analyses are performed for more regional resilience projects, the benefits of protecting marinas, ferry terminals, and other water-dependent assets should be assessed. If these larger regional projects are designed to protect all assets from the impacts of total water levels, the need to protect individual assets will focus on other risks, like low-level nuisance flooding or permanent inundation. For example, if a major public works protection project like a levee system or a storm surge barrier protects

an area like the Shrewsbury River or Middletown's Bayshore, the benefits to these assets should be considered, as should the cost avoidance of protecting these assets on an individual project basis.

The long-term recommendations in this strategy—namely the need for ferry terminals and private marinas —will be incorporated into the vision for an inland shore and use of the land considering permanent inundation visioning needs. This strategy stresses that any long-term visioning must recognize the cultural and economic importance of waterfront access and plan for this access in consideration of sea level rise and frequent coastal flooding.

Connections to Current Planning Initiatives and Potential Funding Sources

There is a variety of ways that economic waterfront assets are incorporated into current planning and development processes. NWS Earle has worked extensively with the County to address resilience concerns in their Joint Use Land Study and follow-on resilience planning. Major outcomes include 11 planned resilience projects for the Bayshore region to implement flood mitigation, coastal restoration, and storm water improvement. The planning has also led to regional partnerships for shared services, microgrids, and land use review.

For marinas, many facilities such as the Leonardo State Marina or the Belford/Harbor Way ferry terminal are on public property, and should be considered in capital planning processes, County master planning, and as part of larger resilience initiatives such as Army Corps plans. Many other assets, particularly marinas, are private entities with their own planning dilemmas. Many of these are represented through the Marine Trades Association who can voice the needs and concerns of these facilities. As part of this strategy, planners and developers should be in contact with individual operators and the Marine Trades Association to discuss access issues and options private marinas must retrofit their properties and maintain access.

Table 2-3. Water-dependent Asset Strategy: Applicable Planning and Development Initiatives

Strategy Component	Applicable Planning and Development Initiatives
Marina Retrofitting and Protection	Coordination with individual Marinas Marine Trades Association
	Incorporation of resilience protection for public marinas in capital planning processes
	Land use planning updates for public properties that lease marina space
	Municipal resilience planning and engineering
	Incorporation of resilience needs and studies as part of the New Jersey Clean Marinas Program.
	Incorporation of benefits and avoided costs to marinas in analysis for regional projects, such as an Army Corps plan
	Incorporation of benefits and avoided costs to marinas in analysis for regional projects, such as an Army Corps plan
Ferry terminal retrofitting and protection	Land use planning updates for public properties (such as the Belford / HarborWay ferry terminal) that lease terminal or other space
	Impacts to terminals in the conduction of regional transportation planning, like NJTPA's Long Range Transportation Plan
	Detailed study of the value of the ferry terminals for the regional economy, similar in scope to economic impact studies conducted by industry groups like the Marine Trades Association. Detailed transportation and economic study

Strategy Component	Applicable Planning and Development Initiatives
	should be conducted in conjunction with County planning processes or State Economic Development Planning
	Municipal planning board statute for Middletown and Highlands that requires storm surge protection be implemented when ferry terminal retrofits are made
Long term Planning for Economic Waterfront Assets	Consideration of waterfront assets in future regional risk analyses
	Statute requiring public waterfront access in future developments. A model approach for the consideration of permanent inundation has been taken at other ferry terminals, including in the preferred alternative for the Washington State DOT Mulkiteo Multimodal Ferry Terminal. This consideration was made in light of the state integrated climate response strategy[2]
	Incorporation of site plans and adaptation of current facilities in a Permanent Inundation Master Plan

Table 2-4. Water-dependent Asset Strategy: Potential Funding Sources

Strategy Component	Potential Funding Sources
Marina Retrofitting and Protection	WSFR Boating Infrastructure Grant Program
	WSFR Boating Access Grant Program
Ferry terminal retrofitting and protection	HUD Community Develop Block Grants
	USDOT Better Utilizing Investments to Leverage Development (BUILD)
Long Term Waterfront Asset Visioning	Private Investment (Public-Private Partnership) Opportunities for new Waterfront Facilities

Examples of Protected or Adapted Community-Identified Assets

The following assets would be adapted, protected, or generally considered in the implementation of the Water-dependent Assets Strategy (this is not a comprehensive list):

- Belford/Harbor Way Terminal
- Naval Weapons Station Earle
- Highlands Ferry Terminal
- Bayshore-based private marinas and boat launches
- Lower Navesink-based private marinas and boat launches
- Shrewsbury-based private marinas and boat
- Wharfside Marina
- Monmouth Sailing Center
- Belford Seafood Cooperative Assoc.

[2] https://fortress.wa.gov/ecy/publications/publications/1201004.pdf

- Navesink Yacht Sales & Marina
- Irwins Yacht Works Inc
- Surfside Marina
- Covesail Marina
- Monmouth Cove Marina
- Shrewsbury River Sailing Center
- Leonardo State Marina

2.5 Neighborhood-level Adaptation Measures Strategy

This strategy deals with adaptation to address near-term risk of storm surge by means of home raisings and targeted road raisings. Home raising is a strategy commonly seen throughout New Jersey's coastal communities. It provides protection against storm surge not permanent inundation and will be used where appropriate and where property owners find it practical in the near term. In the long-term, homes that may not be at risk today (i.e., homes not in a 7-foot water level but within a 12-foot water level and therefore have not been raised yet) will be at risk. This strategy suggests a region-wide policy for planning for home raisings to mitigate damage risk from storm surge. Areas that may have homes eligible for home raisings in the future (after 2050) but that are not currently slated for raisings include Red Bank, Rumson, Little Silver, Oceanport, and parts of Long Branch near the Shrewsbury River.

Road raisings provide a short-term solution for permanent inundation up to 2050, for areas identified as the most vulnerable coastal areas in the study area. These areas include downtown Highlands, Sea Bright, Monmouth Beach, sections of the Middletown Bayshore, and neighborhoods in eastern Rumson. On a local level and for smaller areas affected by permanent inundation, there are technical solutions that may be more applicable than road raisings, including raising of infrastructure to be above permanent inundation. In 2030, this is assumed to be 1.1 feet, and in 2050, this new water line is assumed to be 2.0 feet. Targeted road raising will identify areas that will be significantly impacted by permanent inundation to the 2-foot water level in 2050 and plan, design and implement a solution by 2030. The tentative areas where road raising will be most effective must be studied for feasibility, as this is a noted concern for communities that have previously studied it. One of the largest issues is public right of way, which would make road raisings more feasible for communities with larger right of ways.

Implementation Strategy: 2030, 2050, and 2100

2030

Homes that are at a risk of 7-foot storm surge and have not been raised yet because they are currently outside flood map zones will be a new area for adaptation. The region should consider an aggressive standard for raisings, and the feasibility of elevating roadways to avoid permanent inundation in 2050 will be studied to select roadways for preliminary elevation design. Electrical, communications, and water and sewage systems will be considered while elevating roadways. The planning team notes that in many potential examples there is a concern about the feasibility of raised roadways, particularly on narrow streets, or where road raisings may cause flooding elsewhere (as water gravitates away from raised roads). However, it's applicability should be noted for other areas.

2050

Road raisings should continue to have protection measures in the region, but these raisings will act only as a temporary measure for the most vulnerable areas. All homes that do not have other storm surge protection should be raised if damaged or undergoing renovation that would require a building permit from the municipality. As the frequency of higher storm surge increases, municipalities will develop and enforce their own stands for elevation based on state and national data. This is particularly important for communities that have previously not had to consider storm surge risk but will face risk from a 12-foot water level, which has the same frequency of occurring in 2100 as a 1% storm event. These communities include West Long Branch, Eatontown, Tinton Falls, and Ocean Township.

2100

Road raisings will no longer be a feasible adaptation strategy in those areas experiencing permanent inundation, but home raisings will continue to be part of the larger a regional adaptation strategy for

areas where it is viable to stay in place and live with new water conditions. By 2100, most homes within the 12-foot water level that have not already been raised above that level will be raised to a level of BFE + 4 feet (for example) to protect against storms and other flooding not associated with permanent inundation. New construction would require homes to be raised at a high level compared to the latest

Connections to Other Strategies

This strategy provides a major benefit to curbing residential building loss from storm surge but does not address permanent inundation. Because this strategy does not account for supporting infrastructure and utilities, it must be combined with other strategies that address other assets, such as commercial facilities, ecosystem services, utilities and infrastructure, or social vulnerability, to contribute to a more resilient, connected region. Road raising also covers smaller geographies but provide the ability to plan long term in those areas and could provide temporary solutions in the interim before long-term plans by combining with strategies that support residents and municipalities that decide to move away from areas that are permanently inundated. This strategy allows for ingress and egress when viable, thus providing sustainable solutions.

Table 2-7. Neighborhood-level Adaptation Measures Strategy: Planning and Development Initiatives

Strategy Component	Applicable Planning and Development Initiatives
Home Raisings	FEMA Hazard Mitigation Grant Program
	Blue Acres Program
Road Raisings	USDOT & The Recovery Act

Table 2-8. Neighborhood-level Adaptation Measures Strategy: Potential Funding Sources

Strategy Component	Potential Funding Sources
Home Raisings	FEMA Flood Mitigation Assistance Grant
	Federal funding through EPA
	National Flood Insurance Program (NFIP)
Road Raisings	FEMA Flood Mitigation Assistance Grant
	Federal funding through USDOT
	American Recovery and Reinvestment Act

2.6 Long-term Vision and Master Planning for Permanent Inundation Strategy

This strategy aims to create a long-term master plan geared towards a regional vision and recommendation of specific policies and plans that mitigate the losses of 5.3 feet of permanent inundation. The Master Plan should focus on socioeconomic planning, land use, and sustainable development along with resilient smart growth. These plans should incorporate existing county-level mitigation plans and draw from relevant studies performed for the region. The amount of impacted coastal land in the region by 5.3 feet of sea-level rise is significant, and it represents more than $2.7 billion (in real terms, 2018 USD) in total loss in 2100. A core component of this strategy is to develop a plan to move away permanent use of areas that will be completely inundated by 2100. This strategy calls for a master plan that creates a framework dealing with permanent inundation across the 70-year study period and specifically deals with the social impacts that permanent inundation will engender, setting forth community-supported actions that help residents, businesses, and other stakeholders adapt to rising waters.

A second component of the strategy deals with land use and envisions much of the public land to be devoted to ecological and recreational use designed for frequent flooding of up to 7 feet. Sea-level rise is expected to be 5.3 feet and will alter the physical characteristics of the ocean coastline and shoreline of the bay and estuaries. This component therefore aims at creating new inland shores that are vibrant and sustainable. The creation of new inland shores in the two rivers region must consider actions private property owners should take to maintain viable waterfront parcels, including municipal codes that call for ecological land use directly along the water. The permanent inundation master plan should determine specific code measures for the many private and public landowners on the water, including guidance the potential for zoning guidance that restricts land uses in areas that will be permanently inundated in the near future. Despite permanent inundation in most areas along the shorelines, some of the barrier islands would still be part of the new coastline. To account for this change, development of recreational areas is proposed in areas south of Sandy Hook to promote recreation on the portions of the barrier islands and new coastline with improved access in 2100.

Along with socioeconomic and land use planning, this strategy also considers sustainable development. As further development is curbed in areas that will be permanently inundated, it is vital to keep the area economically vibrant through sustainable development projects. The approach should focus on creating density, housing, and appropriate amenities in upland areas that will not be impacted from coastal storm surge or inundation. A partnership between municipalities and region-wide housing and economic development goals is recommended. Although, certain development mechanisms such as allowing increased density or the subdivision of underutilized lots, should be local decisions, these actions need to be coordinated on a regional level, possibly through a regional planning body (as proposed in the Forum for Advancing Regional Resiliency Challenges Strategy).

Implementation Strategy: 2030, 2050, and 2100

With the intent of introducing the concept of moving away at-risk permanent uses of land that will be inundated, the process to develop a master plan to address permanent inundation should begin in 2020. This master plan would target near term impacts and develop a framework to address the long-term impacts of permanent inundation. Simultaneously, in-depth studies to further understand the impacts of flooding and identify future at-risk areas in 2030 would commence.

2030

By 2030, areas that are most at-risk from permanent inundation (up to 2.0 feet of impact from sea level rise by 2050) should be identified in the master plan and mitigation projects would be developed. To

ensure successful implementation of the plan, governing bodies in the region need to work together to discuss shared approaches to both permanent inundation and storm surge, and to share lessons learned, residential, commercial, and environmental concerns, and future plans. This can be conducted through an extension of the Two Rivers Council of Mayors or some other coordinating body. By 2030, early vision planning should commence to explore how residents envision the future of the area in terms of land use, and upland communities should review their comprehensive master plan to better understand the potential for further density to accommodate consolidated growth in the future.

2050

By 2050, the visioning process to adopt increased density should commence, both in regions like Red Bank and Long Branch, which boast high levels of density already, and in uplands that have the potential to adopt density increments. 2050 becomes an inflection year for the area; at this point, risk of larger floods and permanent inundation becomes a frequent concern. The majority of the $458 million in permanent inundation losses occurs in on the back side of Sea Bright and Monmouth Beach, as well as the lowest-lying areas of Rumson, particularly the West Park neighborhood. Downtown Highlands and small portions of Middletown's Bayshore also see impacts.

The permanent inundation masterplan should provide context for new inland shore development and municipalities should decide the type of recreation and economic opportunities to adopt along with the type of ecological benefits that the new inland shore will foster. The permanent inundation master plan should also provide projections on areas that will be severely impacted by permanent inundation in later years so much so that built measures, including green infrastructure and infrastructure and structure elevations, may not be feasible to maintain. For those areas, a long-range plan for moving away to higher grounds is, therefore, imperative. By identifying these areas early, it is possible to allow affected residents, municipalities, and the region to remain vibrant, to provide support to residents and municipalities when making decisions about what is sustainable and would mitigate the social and cultural impacts that permanent inundation can have.

2100

By 2100, areas around the Shrewsbury River, in Highlands, and in communities along the Bayshore will face very frequent flooding or be inundated by normal tides. These areas accounts for about 83% of the combined $2.7 billion in projected permanent inundation loss in the area as well as 82% of $683 million in annual risk of 7 foot floods. At this time, the shoreline will naturally be adapted further inland, economic assets like ferry terminals, private and public marinas, storefronts, restaurants, and tourist accommodations will need to be redeveloped within the context of new conditions. The permanent inundation master plan should guide the movement of communities further inland where moving remains the most feasible option. This transition should occur over a long period of time - 50-years in the context of this project - thus providing enough time to property owners and municipalities to assess and determine for themselves when it is no longer feasible to stay in place. The permanent inundation master plan should provide recommendations on costs, funding sources, and explain how moving away should be completed in conjunction with other resilience measures such as natural and man-made projects to protect from storm surges of greater than 5.3 feet. The BCA determined that moving away from all properties affected by 5.3 feet of permanent inundation in the study area in 2100 (with cost assumptions reflecting typical buy-out programs) will be cost effective, with an indicative planning Benefit to cost Ratio of 2.1, implying that the benefits of moving away outweigh its cost by at least twice the total cost. Sustainable development should continue past 2100 and will be an integral part of municipal and regional planning prior to this year.

Connection to other strategies

This strategy acts as an anchor for other planning and policy strategies that together can create a sustainable path for dealing with permanent inundation in 2100. Implementation of the permanent inundation masterplan in conjunction with the planning body is mentioned in Section 2.7.

Connections to Current Planning Initiatives and Potential Funding Sources

Table 2-9. Long-term Vision and Master Planning for Permanent Inundation Strategy: Planning and Development Initiatives

Strategy Component	Applicable Planning and Development Initiatives
Socioeconomic Planning	NJDEP Coastal Resilience Plan
	NJTPA Long Range Plan
Land Use Planning	NJDEP Coastal Resilience Plan
	Private Site Development Planning
Smart Resilient Growth	HUD Resilient Coastal Communities initiative
	Municipal zoning for storm water (like the City of Norfolk, Va.'s establishment of a Coastal Resilience Overlay zone
	NJ Transit Capital Planning on the Coast Line

Table 2-10. Long-term Vision and Master Planning for Permanent Inundation Strategy: Planning and Development Initiatives

Strategy Component	Potential Funding Sources
Socioeconomic Planning	Sustainable Jersey Small Grants Program Nature Conservancy Living Shorelines Program
Land Use Planning	ANJEC Smart Growth Planning Grant NOAA Coastal Resilience Grants Program New Jersey Transfer of Development Rights Bank U.S. Fish & Wildlife Service's National Coastal Wetlands Conservation Grant Program
Smart Resilient Growth	ANJEC Smart Growth Planning Grant FEMA Flood Mitigation Assistance Grant Program

Examples of Protected or Adapted Community-Identified Assets

- Downtown highlands residential and commercial assets
- Dunes at Shoal Harbor Condos

- Belford Seafood Cooperative Association
- Belford/Harbor Way Terminal
- Highlands Ferry Terminal
- Bayshore-based private marinas and boat launches
- Lower Navesink-based private marinas and boat launches
- Shrewsbury River-based private marinas and boat launches
- Middletown Township Sewerage Authority
- Two Rivers Water Reclamation Authority
- Red Bank Primary School
- Locust Point apartments
- Sand Point south Condos
- Manhasset Park
- Channel Club Tower

2.7 Strategy for the Development of the Monmouth County Coastal Resilience Committee

Inspired by the regional approach to shared services and the collaborative nature of the Two Rivers Council of Mayors, NJ FRAMES created a steering committee to coalesce the diverse views of the 15 participating communities and other regional constituent representatives like the Monmouth County Division of Planning, Office of Emergency Management, Monmouth University, the Sea Grant Consortium, and the American Littoral Society. As advisors and decision makers, this group helped the project team craft strategies that align with the community goals (see Appendix A) and risk to the region. As this plan has been developed, there has been agreement from all steering committee members who were actively engaged throughout the project that continuing the conversation is critical to the implementation of a regional resilience plan. This final strategy advocates for the creation of a committee that can further champion these strategies and ensure regional resilience throughout the regions' planning and development. This planning committee is henceforth referred to as the Monmouth County Coastal Resilience Committee

There are several potential approaches to developing a regional planning body that advocates for regional resilience. The following presents three brief case studies on the roles, responsibilities, and authorities of other regional environmental bodies:

North Carolina Coastal Federation

501(c)(3) organization with advocacy and small-scale project arms

A non-profit that represents the coastal community and environmental interests across the state, the federation's approach works to advocate for sustainable land and water uses through lobbying and on-the-ground project development. The federation's Coastal Resilience Initiative is a collaborative approach to implement nature-based approaches for coastal protection and help develop watershed restoration plans. As part of the North Carolina Climate Risk

Assessment and Resiliency Plan, the federation acts an outreach and stakeholder engagement to elicit feedback on the plan.[3]

The North Carolina Coastal Federation's approach to resilience is one of advocacy and project development. While its geographic scope is much larger than the Two Rivers region, it provides a potential route for the region to coordinate and implement small projects and advocate for resilient solutions.

Chesapeake Bay Commission

Multi-state agency with clear and influential advisory powers on state legislation around the Bay

The Chesapeake Bay Commission is a three state-appointed commission that leads regional policy development for the Bay. Developed from EPA's landmark study on the decline of the Bay, the primary focus of the Commission is on clean water. While members of the 21-person commission represent elected officials and cabinet-level leaders in the surrounding states of Virginia, Maryland, and Pennsylvania, the Commission itself does not legislate or enact policy for the Bay; however, it acts as one of the major advisors for policy development and has a direct connection to the Chesapeake Executive Council and state legislatures that enact and enforce clean water policy.[4]

While the Commission's scope is focused on water quality and less on climate resilience, its success in multi-lateral policy development through official representation and consultation serves as a model for jurisdictions to protect and enhance a shared waterfront.

New Jersey Highlands Council

State agency with direct authority from state legislation with land use and regulatory powers

The Highlands Council is a 15-member body created by the Highlands Water Protection and Planning Act of 2004. The Highlands Council has broad administrative and regulatory powers that are informed and advised by an Executive Director and staff. Council members are appointed by the governor on the advice of the State Senate, and the council oversees the Highlands Regional Master Plan, whose goal is to protect and enhance the significant values of resources [of the region]."[5]

The Highlands Council presents a model for a planning body that incorporates direct land regulatory powers specific to the region, as well as representation and dedicated staff that assist in the implementation of regulation and planning. Its existence within the state shows that there is precedence for regional planning, but its approach as a regulatory agency is not entirely in line with comments heard during outreach with the Two Rivers region.

Although the models for a regional planning body are vast, the project team has noted broad support for some form of an official forum that continues the planning and visioning for a resilient Two Rivers region. The project team has heard support for the idea that leadership and representation in this forum should exist within the group, and not from the state. The project team also recognizes the current initiatives and bodies that already exist to coordinate regional planning, particularly on the county-level.

[3] North Carolina Coastal Federation, *Coastal Resilience Initiative*, 2019
[4] Chesapeake Bay Commission, *Mission Statement*
[5] New Jersey Highlands Council, Regional Master Plan, 2008

These have been mentioned in specific strategy narratives and includes County Master Planning, Hazard Mitigation planning, capital planning for public authorities in the region, and more.

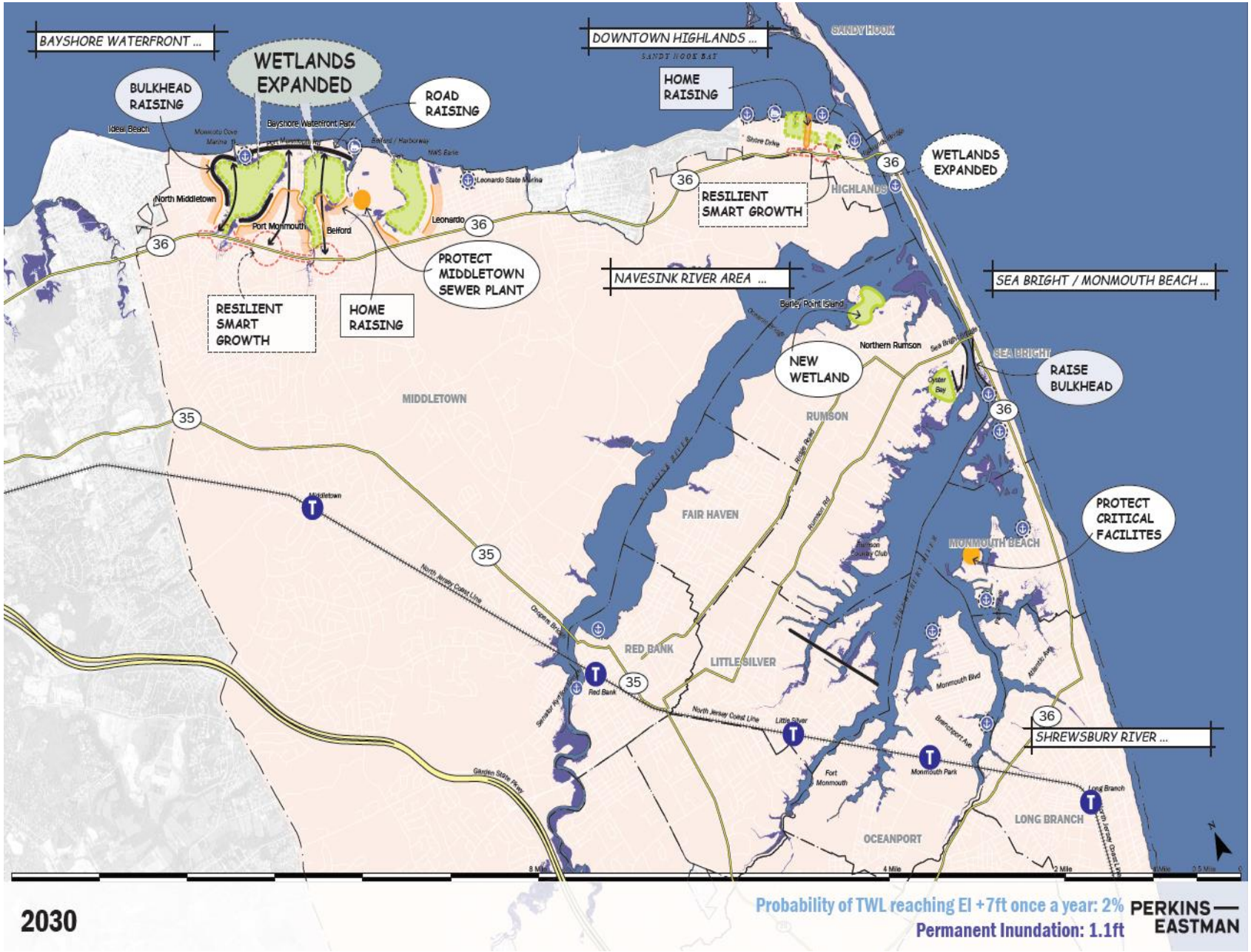
To that end, this strategy calls for the creation of a steering committee that will study and advocate for the most appropriate functions of the Monmouth County Coastal Resilience Commission. This steering committee should work closely with stakeholders such as the state, county, NJ Coastal Coalition, and others who can help detail what mechanisms exist for a group to form. These recommendations should be developed in a report that outlines the vision, goals, proposed roles and responsibilities, and next steps. This strategy recommends that the Committee should use the Regional Action Plan to guide the focus of the body's advocacy, coordination efforts, and other potential roles.

Strategy Component	Applicable Planning and Development Initiatives
Steering Committee for a Regional Planning Body	Agreement of the Two Rivers Council of Mayors
	Planning Initiative of the County
	Initiative of local climate-focused non-governmental organization
Regional Planning Forum proceedings and roles	Coordination of regional planning processes through County master planning, private development, and individual municipality measures

2.8 The Conceptual Scenario

2.8.1 Region-Wide Cartoon Strip Visualizations

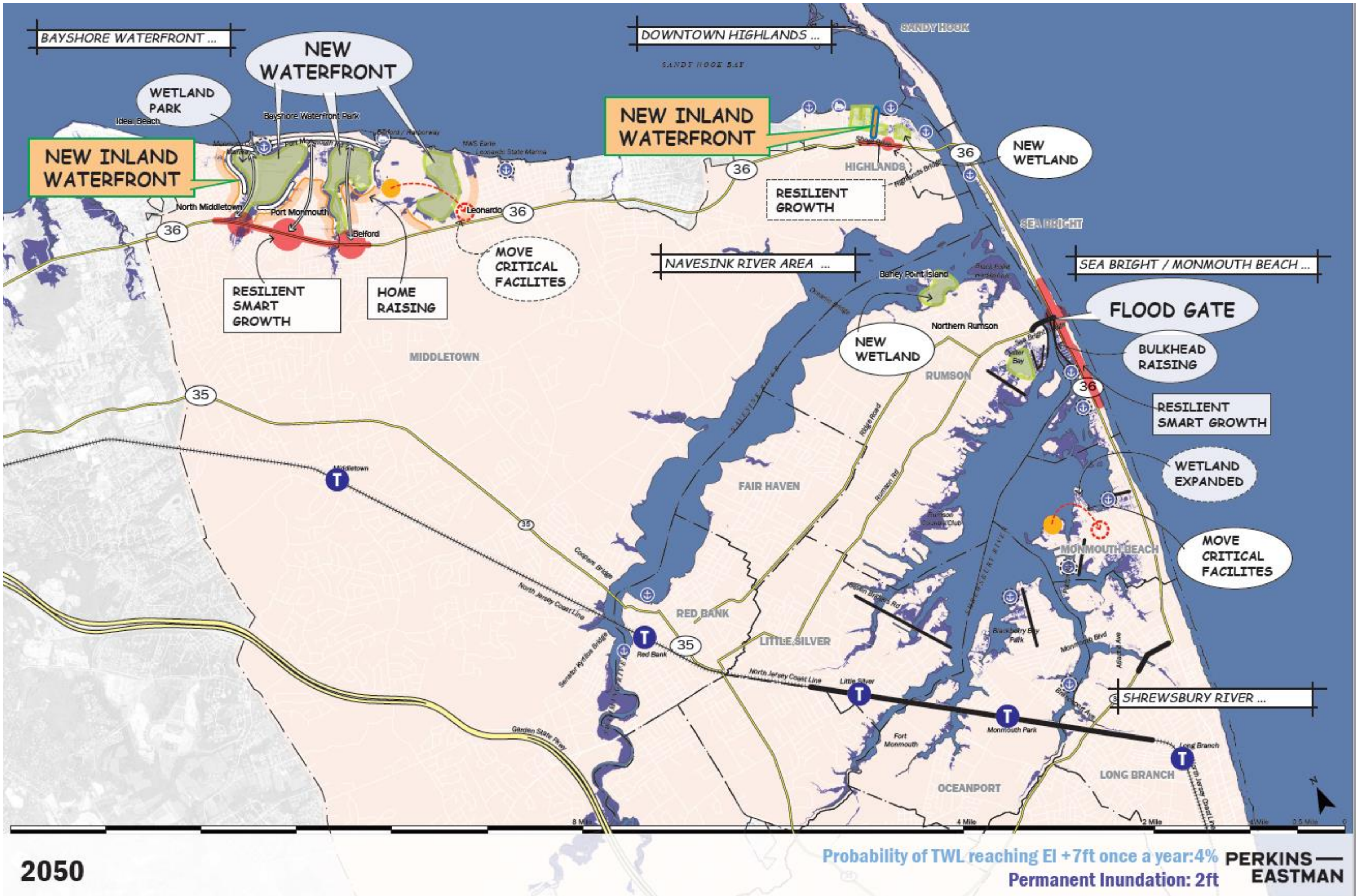
The Conceptual Scenario describes the potential implementation of the six strategies in the near, medium, and long term. Projects, plans, and policies that are potential outcomes of strategy implementation are shown for the years 2030, 2050, and 2100, which align with the planning years of the risk outlined in Section 1. The following descriptions provide a snapshot of the potential implementation of each of the six strategies to show how they can work together and how the region could look if they were implemented in this manner. Appendix E provides detailed renderings throughout the region of potential projects and development that would be in line with how the six strategies could be implemented to address the increased risk throughout the end of the century. This is just one way the six strategies within the plan can be combined and implemented throughout the region for the next 80 years.


BAYSHORE WATERFRONT ...
WETLANDS EXPANDED
BULKHEAD RAISING
ROAD RAISING
Bayshore Waterfront Park
Ideal Beach
North Middletown
Port Monmouth
Belford
Leonardo
Leonardo State Marina
PROTECT MIDDLETOWN SEWER PLANT
RESILIENT SMART GROWTH
HOME RAISING
DOWNTOWN HIGHLANDS ...
SANDY HOOK
SANDY HOOK BAY
HOME RAISING
WETLANDS EXPANDED
RESILIENT SMART GROWTH
HIGHLANDS
NAVESINK RIVER AREA ...
SEA BRIGHT / MONMOUTH BEACH ...
Bayley Point Island
Northern Rumson
NEW WETLAND
SEA BRIGHT
RAISE BULKHEAD
MIDDLETOWN
RUMSON
FAIR HAVEN
PROTECT CRITICAL FACILITES
MONMOUTH BEACH
RED BANK
LITTLE SILVER
SHREWSBURY RIVER ...
OCEANPORT
LONG BRANCH
Middletown
Red Bank
Little Silver
Monmouth Park
Fort Monmouth
Long Branch
North Jersey Coast Line
Garden State Pkwy
35
36
2030
Probability of TWL reaching El +7ft once a year: 2%
Permanent Inundation: 1.1ft
PERKINS — EASTMAN

implemented to address inundation caused from sea-level rise and changing coastal storms that result in +3-foot water levels. Many planning and policy developments could also be put in place that are designed to start the initial planning for larger projects and initiatives to address the impacts due to permanent inundation and frequent, high-impact storm surge. In order to properly this risk, the region needs to make decisions soon to mitigate these near-term impacts.

By 2030, protection measures should be introduced for some of the most vulnerable areas in the region. These protection measures would generally be shoreline-based and provide protection or coastal storm mitigation to assets and properties directly on the water. Wetlands and bulkheads could be developed in areas where frequent flooding and risk of storm surge is common, and home raisings would continue to be completed in areas not already addressed. Critical Facilities, particularly the water treatment plants in the early years, will need to be the focus of study and action to protect against near-term impacts. Major economic waterfront facilities like the ferry terminals will also have protection, including bulkheading to protect the assets as well as green infrastructure and nature-based solutions to provide protection for access roadways.

2030 is also a kick-off year for long-term planning when the region will use the formed Monmouth County Coastal Resilience Committee to help coordinate and potentially lead efforts that are based on strategies of the regional action plan. The committee will be responsible for taking steps to set the vision for regional resilience that will now be the basis for the long-term planning that is needed. This long-term planning effort will not only have begun to consider the resilience needs of the region, but also will provide a list of specific projects that have been informed by the strategies in the Regional Plan. A vision for how critical facilities will be sustained will be established, and a detailed benefit-cost analysis will help the region determine whether pump stations and other low-lying critical infrastructure like schools, regional transportation infrastructure, and communications infrastructure should be protected in place or be relocated to low-risk areas. Further long-term resilience planning will continue to be informed by the latest science, and officials working on planning will continue to use the latest sea-level rise guidance for the state.


BAYSHORE WATERFRONT ...
NEW WATERFRONT
WETLAND PARK
NEW INLAND WATERFRONT
RESILIENT SMART GROWTH
HOME RAISING
MOVE CRITICAL FACILITES
DOWNTOWN HIGHLANDS ...
NEW INLAND WATERFRONT
RESILIENT GROWTH
NEW WETLAND
NAVESINK RIVER AREA ...
SEA BRIGHT / MONMOUTH BEACH ...
FLOOD GATE
BULKHEAD RAISING
RESILIENT SMART GROWTH
NEW WETLAND
WETLAND EXPANDED
MOVE CRITICAL FACILITES
SHREWSBURY RIVER ...
SANDY HOOK
SANDY HOOK BAY
HIGHLANDS
SEA BRIGHT
MIDDLETOWN
RUMSON
FAIR HAVEN
RED BANK
LITTLE SILVER
MONMOUTH BEACH
OCEANPORT
LONG BRANCH
North Middletown
Port Monmouth
Belford
Leonardo
Ideal Beach
Bayshore Waterfront Park
Northern Rumson
Middletown
Red Bank
Little Silver
Monmouth Park
Long Branch
North Jersey Coast Line
Garden State Pkwy
36
35
2050
Probability of TWL reaching El +7ft once a year:4%
Permanent Inundation: 2ft
PERKINS EASTMAN

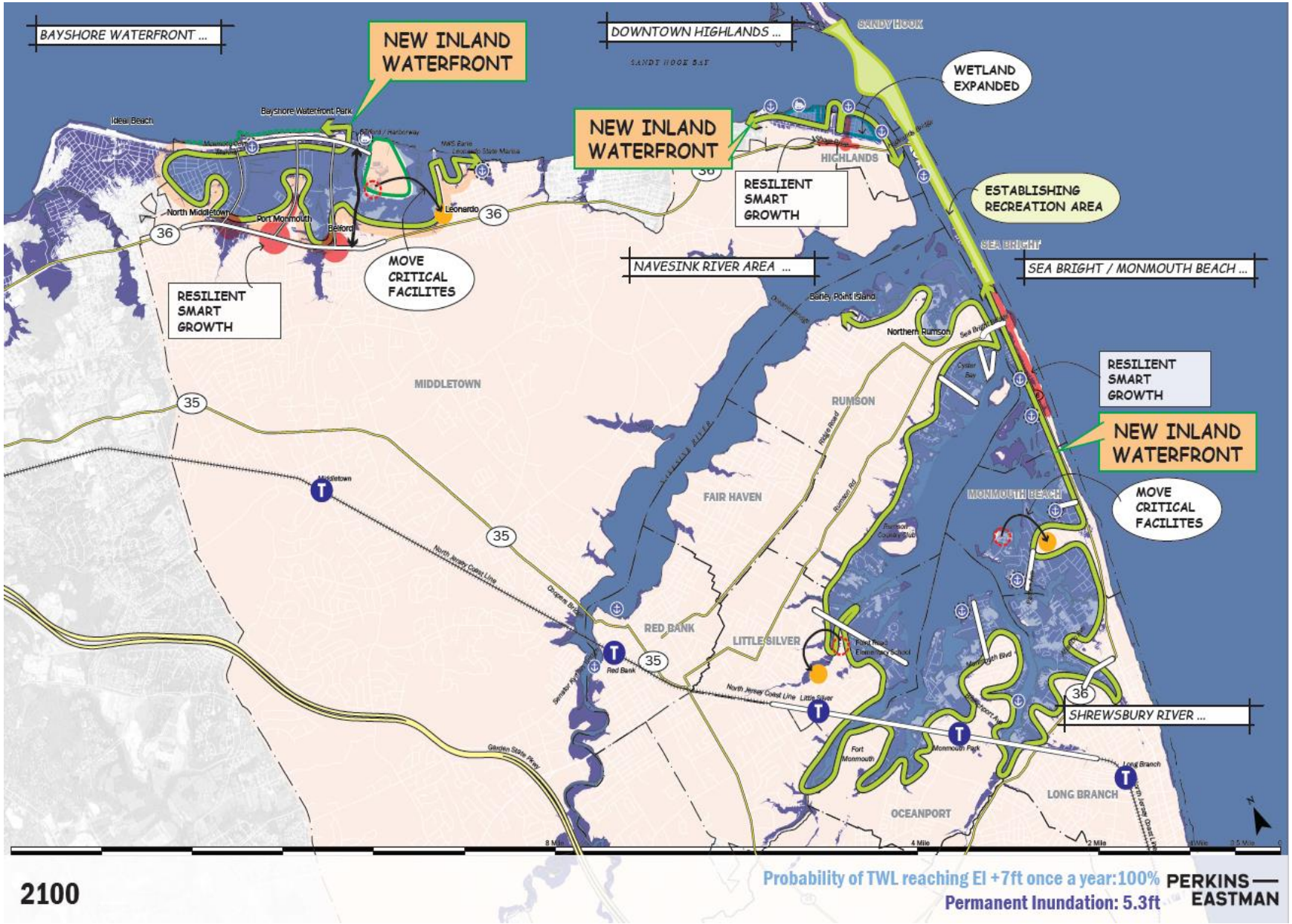
2050 is a pivot year for the region because by this time mitigation and adaptation measures need to be integrated into plans and project development for the region to successfully reduce its risk from sea-level rise and increase storm events.

By this time, sea levels are expected to be +2' above 2000 levels, which means there is likely to be a 100% chance that the region will experience +3' total water level at least once a year, a 4% chance of experiencing a +7' water level, and a 0.2% chance of a 12' water level. At this time, permanent inundation has impacts in small but populated areas of the region, such as in downtown Highlands, parts of the West Park neighborhood in Rumson, and some low streets in Monmouth County. As the end-point of a 30-year mortgage and the end point of our current long-range planning initiatives, 2050 acts as a transition from near-term planning and near-certain risk to a period of long-term planning that carries more uncertainty.

To target long-term risk, this strategy calls for the expansion of nature-based infrastructure to be a common, encompassing feature of the region's non-ocean-facing shoreline. To account for the large degree of risk located in the Shrewsbury River, the project team proposes a storm surge barrier to be built between Rumson and Sea Bright in order to nullify the impacts of large storm surge events, which is a +7' and +12' total water levels. By 2050, the identified critical facilities at risk will be either fully protected from the impacts of storm surge and permanent inundation or planned to be transitioned away from areas at risk.

2050 will also be the kick-off year for planning for large, widely impactful levels of permanent inundation, as called for in the Permanent Inundation Master Plan. Communities will begin to develop specific adaptation plans with significant permanent inundation in mind and continue large socioeconomic planning approaches to design specific adaptation, protection, and other policies in consideration of the assets, people, and institutions at risk. The region will also begin to implement development plans for residents, businesses, and others who may need to move, and work together to form a vision for a new shoreline that considers the daily impacts of inundation.

2050 is an important year for community officials, property owners, and asset managers to determine what is the best approach for their individual assets. At this point, community plans and owners must make a concerted decision for areas that will be impacted by permanent inundation to either protect in place or move away from the water for all development. While early year planning and protection can leave this option open in the early years, 2050 will become a major decision year in order to adequately account for the mitigation of permanent loss, especially for regional assets.


BAYSHORE WATERFRONT ...
NEW INLAND WATERFRONT
DOWNTOWN HIGHLANDS ...
SANDY HOOK
WETLAND EXPANDED
NEW INLAND WATERFRONT
RESILIENT SMART GROWTH
ESTABLISHING RECREATION AREA
MOVE CRITICAL FACILITES
NAVESINK RIVER AREA ...
SEA BRIGHT / MONTMOUTH BEACH ...
RESILIENT SMART GROWTH
RESILIENT SMART GROWTH
NEW INLAND WATERFRONT
MOVE CRITICAL FACILITES
SHREWSBURY RIVER ...
MIDDLETOWN
RUMSON
FAIR HAVEN
MONMOUTH BEACH
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OCEANPORT
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Bayshore Waterfront Park
North Middletown
Port Monmouth
Belford
Leonardo
Highlands
Sea Bright
Barley Point Island
Northern Rumson
Middletown
Red Bank
Little Silver
Fort Monmouth
Monmouth Park
Long Branch
36
35
2100
Probability of TWL reaching El +7ft once a year:100%
Permanent Inundation: 5.3ft
PERKINS EASTMAN

While the state of risk in 2100 more uncertain than near-term risk, the FRAMES risk assessment attempted to analyze the conservative and plausible scenario in 2100. The regional plan as proposed for this long-term planning year addresses this risk, which assumes permanent inundation due to +5.3' of sea-level rise, there is a 100% chance that the region will experience +7' total water level on an annual basis, and and a 1% chance it will experience +12' above MHHW. To adequately account for this high level of risk, the regional plan assumes the ongoing operations and maintenance of large projects that were developed in 2050, including storm surge protections on shorelines, the flood barrier between Rumson and Sea Bright, and the maintenance of levees and storm surge protections in Middletown's Bayshore. By 2100, permanent inundation will have major impacts on the built environment, including in the Shrewsbury River, the bayside of Sea Bright and Monmouth Beach, Downtown Highlands and the rest of the Bayshore. The implementation of a long-range vision will adequately account for this inundation through the creation of floodable development, waterfront development in line with the new shoreline, and the further development of open space along the coast.

3.0 CONCLUSION

The Regional Action Plan provides a framework for incorporating regional resilience in Monmouth County and the Two Rivers Region's current processes as well as in long term planning. The six strategies presented provide a potential scenario for resilience that provides adaptation, protection, and transition-based approaches. However, the strategies are intended to be modified or combined with the future realities of the region depending on realized risk or changes in governance.

3.1 Immediate Next Steps

While the regional action plan provides a framework for the next 80 years, it is important to launch immediate next steps that begin to implement the six strategies and regional resilience overall. The project team recommends the following steps that can begin in 2020 for implementation of the regional plan.

	Recommendation	Start Date	Potential Implementers	Time to Completion	Other stakeholders
1	A team of county leaders and select municipal and non-profit and academic leaders will determine the roles and responsibilities of the Monmouth County Coastal Resilience Committee	January 2020	Monmouth County Planning, Two River Council of Mayors	1 year	Current Stakeholder members
2	Coordination with waste water and sewage treatment plants to understand risk and development plans	Spring 2020	Municipal officials, Two Rivers Council of Mayors	Ongoing	Sewer/wastewater customers beyond the Two Rivers region
3	Presentation of regional strategies for consideration in Army Corps project planning and feasibility studies	2020	County, DEP Coastal Engineering	Ongoing	USACE, Baykeeper, American Littoral Society, waterfront residents and building owners
4	Consideration of regional strategies for residential,	2020	County, Municipal Leaders	Ongoing	Waterfront property and asset owners

	commercial, and open space development (enforceable by planning boards and municipality/county plans)				
5	Adaptation of progressive home raising measures for each municipality	2020	Municipal Leaders and Zoning Boards	Ongoing	Individual residential property owners
6	Coordination with regional transportation entities to understand long term risk	2020	Monmouth County Office of Emergency Management, Monmouth County Planning	Ongoing	NJ DOT, Monmouth County Engineering, NJ Transit, municipal leaders