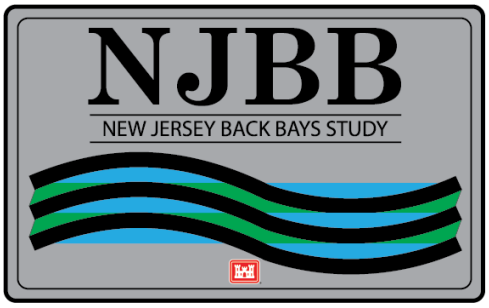
PLAN FORUMLATION APPENDIX

NEW JERSEY BACK BAYS
COASTAL STORM RISK MANAGEMENT
FEASIBILITY STUDY

PHILADELPHIA, PENNSYLVANIA

APPENDIX A

August 2021



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A-1) EXISTING CSRM STUDIES, REPORTS, PROJECTS, ACTIONS AND PROGRAMS

Coastal storm risk is managed along the Atlantic Ocean coast of New Jersey by a number of Federal CSRM projects. However, the NJBB study area is presently exposed to significant coastal/tidal flood risk, due to the scattered number of constructed Federal (**Figure 1** and **2**, **Table 1, 2** and **3**) and State (**Figure 3**; **Table 4** and **5**) coastal storm risk management projects thus resulting in non-comprehensive coastal flooding risk management.

Federal Efforts

The U.S. Department of the Interior received $360 million in appropriations for mitigation actions to restore and rebuild national parks, national wildlife refuges, and other Federal public assets through resilient coastal habitat and infrastructure. The full list of funded projects can be found at http://www.nfwf.org/hurricanesandy/Documents/doi-projects.pdf.

In August 2013, the Department of the Interior (DOI) announced that USFWS and the National Fish and Wildlife Foundation (NFWF) would assist in administering the Hurricane Sandy Coastal Resiliency Competitive Grants Program, which will support projects that reduce communities' vulnerability to the growing risks from coastal storms, SLC, flooding, erosion, and associated threats through strengthening natural ecosystems that also benefit fish and wildlife (NFWF 2013). The Hurricane Sandy.

Coastal Resiliency Competitive Grants Program will provide approximately $100 million in grants for over 50 proposals to those states that were affected by Hurricane Sandy. States affected is defined as those states with disaster declarations as a result of the storm event. The grants range from $100,000 to over $5 million and were announced on June 16, 2014. More information on the program can be found at www.nfwf.org/HurricaneSandy.

In 2018, the National Fish and Wildlife Foundation and National Oceanic and Atmospheric Administration (NOAA) commenced a partnership that will restore, increase, and strengthen natural infrastructure to protect coastal communities, while also enhancing habitats for fish and wildlife. This National Coastal Resilience Fund will invest up to $30 million in the restoration or expansion of natural features such as coastal marshes and wetlands, dune and beach systems, oyster and coral reefs, mangroves, forests, coastal rivers, and barrier islands that help minimize the impacts of storms, rising sea levels and other extreme events on nearby communities and infrastructure.

More information is available at https://www.nfwf.org/coastalresilience/Pages/home.aspx.

HUD has allocated approximately $13 billion for recovery actions, including Rebuild by Design, to rebuild areas affected by Hurricane Sandy through the Community Development Block Grant Program (CDBG), with an additional $2.5 billion identified for future allocation upon approval of the amendments to the State and City Disaster Recovery Plans. In the State of New Jersey, $3.79 billion of CDBG funds were made available for areas affected by Hurricane Sandy, with an additional $881 million identified for future allocation upon approval of the amendment to the State and City Disaster Recovery Plans. More information is available at www.hud.gov/sandy.

State Efforts

The New Jersey Department of Environmental Protection Division of Coastal Engineering (the non-Federal Sponsor) administers the NJ Shore Protection Program. New Jersey's Shore Protection Program was created through state legislation, to provide for the protection of life and property along the coast, preserve the vital coastal resources of New Jersey, and maintain safe and navigable waterways throughout the state. The Division of Coastal Engineering is responsible for administering this program throughout the state using the $25,000,000 annual appropriation from the Shore Protection Fund. Approximately $20 million of the $25 million per year is dedicated to cost-share matches for federal USACE projects and state/Local shore protection projects.

The NJ Office of Emergency Management has produced the State of New Jersey Hazard Mitigation Plan (State of New Jersey 2012) that details the risk to population and infrastructure from flooding, coastal storm damage, sea level change, and other factors. The localities have also produced similar plans, which are regularly updated. The New Jersey Department of Environmental Protection is the state's primary point of contact for CSRM and flood risk management laws and programs for the State of New Jersey.

The New Jersey Department of Community Affairs (NJDCA) Action Plan/NJ Community Development Block Grant (CDBG) Disaster Recovery Plan (NJDCA, 2014) is part of the process to allocate HUD CDBG Disaster Recovery funds to rebuild areas affected by Hurricane Sandy. This plan quantifies the level of damage known thus far based on current data and describes New Jersey's plan for spending the $3,290,000,000 Community Disaster Block Grant Disaster Recovery (CDBG-DR) funds, which HUD allocated to New Jersey as part of its initial $5,400,000,000 fund allocation. To address New Jersey's housing needs, the state will undertake a number of initiatives including: (1) Providing funding assistance for reconstruction and rehabilitation programs that focus primarily, but not exclusively, on low and moderate income households; (2) developing adequate, storm-resistant housing that will meet building standards and incorporate mitigation measures, including green technologies, where feasible and/or housing elevations, which may require construction to FEMA's Advisory Base Flood Elevation maps; (3) providing resettlement and re-occupancy incentives to homeowners contemplating selling or abandoning their homes post-storm; (4) developing affordable rental housing across household income levels, with a focus on serving low and moderate income households and priority given to the nine counties identified by HUD as most impacted by the storm.

Several State of New Jersey universities were tasked with analyzing vulnerable storm affected regions in order to identify structural, non-structural, and natural flood mitigation solutions and strategies. Broad applicability to other regions of the state with similar risk profiles is also being considered in these evaluations. Final reports of these studies are still under development. Draft reports made available in May 2014 are summarized below.

The beneficial use of dredged material to identify and restore wetlands for coastal flood mitigation in Barnegat Bay was analyzed by Richard Stockton College (Stockton College, 2014). This report discusses that there is a need to beneficially reuse dredged material since existing capacity at placement sites is limited and many state channels are shoaled as a result of Hurricane Sandy. As a result, there is a sufficient amount of dredged material for marsh edge restoration projects within Barnegat Bay that has the potential to reduce coastal storm surge and wave damage to communities along the Barnegat Bay shoreline.

Rutgers also identified flood risk reduction strategies for Barnegat Bay (Rutgers, 2014). Existing strategic solutions are reviewed, and new strategic solutions are presented which can be further applied to areas with similar field conditions. These solutions include new and enhanced bulkheads and concrete flood walls with movable panels/parts to increase structure height, levees with culvert/pipe with check valve, elevation of residences and roadways as well as consideration of sluice gates, flood gates and pump stations. A Framework for Coastal Flood Risk Reduction is also provided which addresses both short-term as well as more regional long-term solutions. These efforts are considered for five municipalities including Point Pleasant Borough, Brick Township, Toms River Township, Stafford Township and Little Egg Harbor Township.

The Rutgers Climate Change Adaptation Alliance developed a report titled “Resilience: Preparing New Jersey for Climate Change,” which identifies steps to be taken towards the goal of developing policy recommendations to enhance climate change preparedness.

The New Jersey Living Shorelines Program has been developed to encourage and effectively implement New Jersey-appropriate living shorelines and related natural and nature-based infrastructure methodologies and policies tailored to New Jersey’s coastal environment. The program addresses (1) excessive shoreline erosion and SLC causing the loss of beneficial natural areas and related habitat and (2) the adverse impacts of traditional “hard” structural-only stabilization in order to protect/enhance natural systems that will provide resilient ecological and economic protection/mitigation for the expected changes due to future coastal shoreline impacts.

Non-Governmental Organization Efforts

The Barnegat Bay Partnership (BBP) continues to advance the principles of the Delaware Estuary Living Shoreline Initiative by inventorying living shoreline opportunities towards building coastal wetland resilience for Barnegat Bay (PDE, 2013). The BBP also discusses restoration and recovery principles for coastal resilience in Barnegat Bay in a document titled ‘Building a Resilient Barnegat Bay’ (http://bbp.ocean.edu/).

Structures of Coastal Resilience (SCR) is a Rockefeller Foundation supported project dedicated to studying and proposing resilient designs for urban coastal environments in the North Atlantic region. The Princeton team favors an approach to resilience that considers non-structural strategies, including elevating houses and infrastructure, which anticipates rising sea levels and calibrates wetland migration to create a livable future in the back bay of Atlantic City.

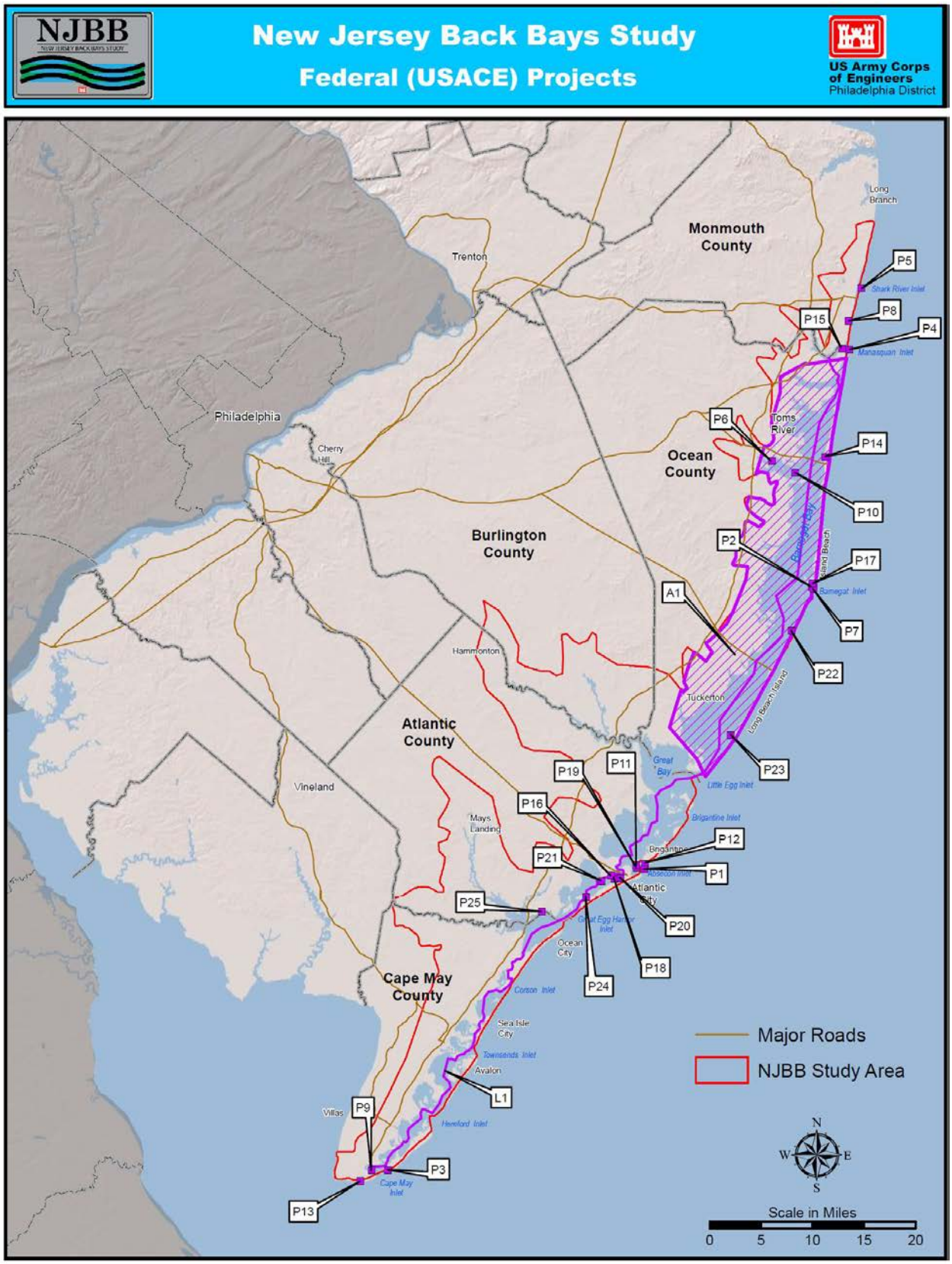


Figure 1. NJBB Study Area, USACE Projects

Table 1: NJBB Study Area, USACE Projects

USACE Projects and Studies in NJBB Study Area			
Project Type	**Map ID**	**Project Name**	**Phase**
Existing USACE Projects			
NV	P1	Absecon Inlet	N
NV	P2	Barnegat Inlet	N
NV	P3	Cold Spring (Cape May) Inlet	N
NV	P4	Manasquan Inlet	N
NV	L1	New Jersey Intracoastal Waterway	N
NV	P5	Shark River Inlet	N
NV	P6	Toms River	N
General Investigations Studies			
NV/CSRM/RSM	P7	Barnegat Inlet Regional Sediment Management	S
ER	A1	Barnegat Bay Watershed Study	S
ER/RSM	L1	New Jersey Intracoastal Waterway Feasibility Study	S
ER/CSRM	P8	Wreck Pond Watershed, Monmouth County, NJ	S
Continuing Authorities Program Projects and Studies			
CSRM	P9	Cape May City , NJ, Del Ave (Sec14)	S
CSRM	P10	Ocean Gate, NJ (Sec 14)	C
CSRM	P11	Snug Harbor, Atlantic City, NJ (Sec 14)	S
CSRM	P12	Brigantine Island, Southern End, NJ (Sec 103)	S
CSRM	P13	Cape May City , NJ, Seawall (Sec103)	S
CSRM	P14	Seaside Park, NJ (Sec 103)	S
NV	P15	Wills Hole Thorofare, Ocean County, NJ (Sec 107)	
ER/RSM	P16	New Jersey Intracoastal Waterway Dredged Hole 34 Restoration (Sec 204)	S
CSRM/RSM	P17	Sedge Island Protection, Ocean County, NJ (Sec 204)	C
CSRM	P18	Chelsea Heights, Atlantic City, NJ, (Sec 205)	S
CSRM	P19	Massachusetts Avenue, Flood Risk Mgmt. , Atlantic City, NJ (Sec 205)	S
CSRM	P20	Sunset Avenue, Atlantic City, NJ, (Sec 205)	S
CSRM	P21	Ventnor, NJ, Back Bay Bulkheads, (Sec 205)	S
ER/RSM	P22	Environmental Restoration of Dredged Hole #6 (Sec 1135)	C
ER/RSM	P23	Mordecai Island (Sec 1135)	S
CSRM	P24	Margate City, NJ	S
CSRM	P25	Somers Point City, NJ	S
Initiatives			
ER/CSRM		Systems Approach to Geomorphic Engineering (SAGE): Barnegat Bay	S

Project Type	**Phase**
CSRM = Coastal Storm Risk Management **ER** = Ecosystem Restoration **NV** = Navigation **RSM** = Regional Sediment Management	**C** = Initial Construction Completed **N** = Navigation Maintenance **S** = Study

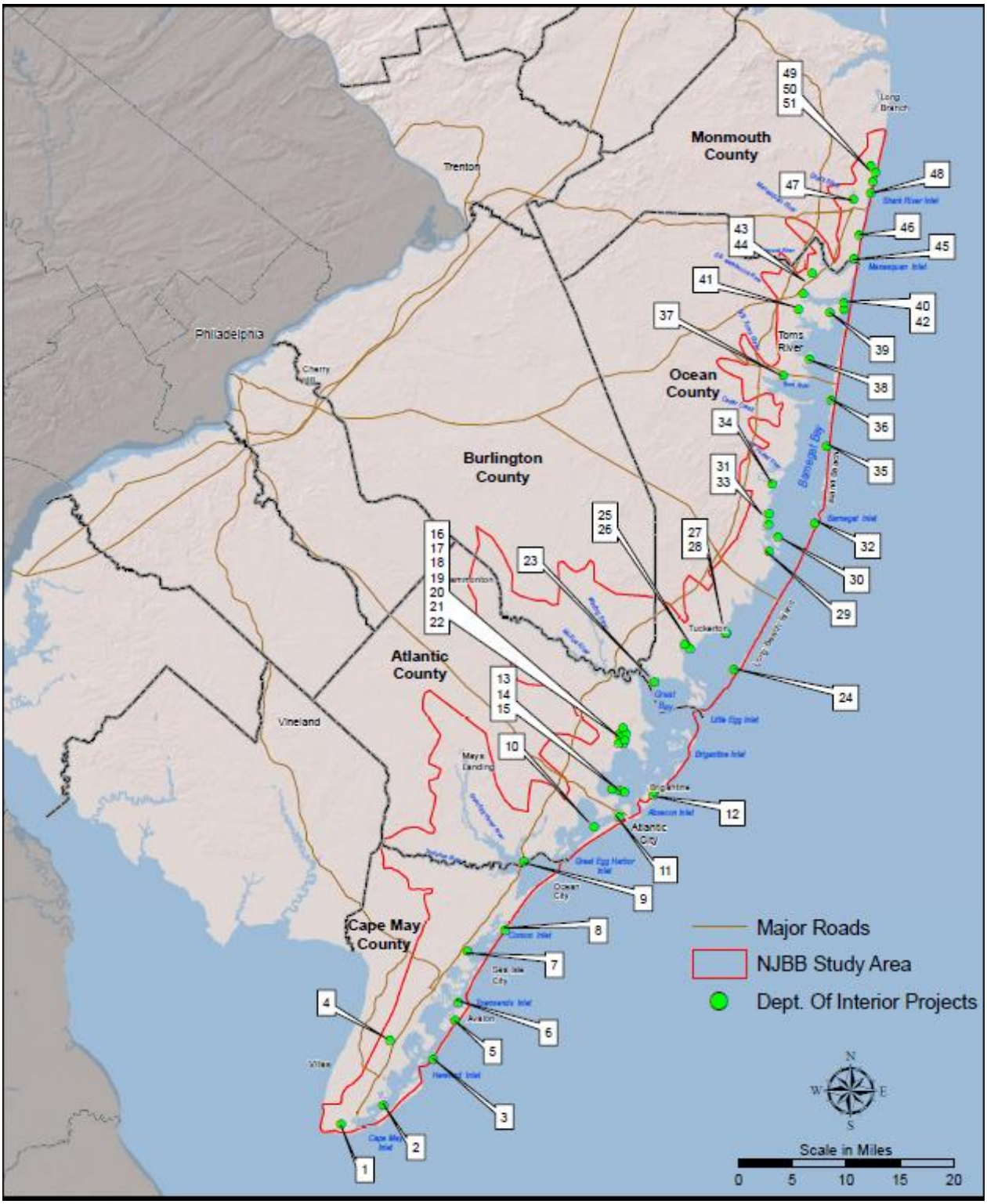


Figure 2: NJBB Study Area, non-USACE Projects

Table 2: NJBB Study Area, non-USACE Projects to Accompany Figure 2

MAP-ID	AGENCY	PROJECT
1	NJDEP - Office of Nat. Resc. Restoration	Higbee Beach Wildlife Management Area Restoration Project
2	Environmental Law Institute	Local Government Implementation of Coastal Resilience Tools
3	New Jersey Audubon Society	Beach Restoration at Southern Seven Mile Island, New Jersey
4	Conserve Wildlife Foundation of NJ, Inc.	Enhancing and Protecting Vernal Pools in New Jersey
5	NJDEP - Office of Nat. Resc. Restoration	Beneficial Reuse of Dredge Material to Restore Salt Marshes
6	The Nature Conservancy	Regional assessment of natural infrastructure projects
7	University of Massachusetts	Initiative for Climate Extremes
8	Rutgers University	Regional Vulnerability Assessment
9	City of Ocean City, NJ 08226	Restore Damaged Wetlands on Islands in Great Egg Harbor Bay
10	Princeton University	Ventnor NJ Wetland & Comm. Coastal Resiliency Assessment
11	The Nature Conservancy, New York	Northeastern Marsh Elevation Monitoring Cooperative
12	City of Brigantine, New Jersey	Brigantine Island Sand Back-Passing
13	Princeton	Atlantic City NJ Strategies and Design
14	Princeton	Atlantic City NJ Hurricane Storm Surge Hazards Assessment
15	Princeton	Atlantic City NJ Local Sea Level Rise Projections
16	The Richard Stockton College of NJ	Beach Replenishment Effects on Downdrift Habitats
17	Polistes Foundation, Inc.	Chemical Contaminants in Piping Plover Eggs and Prey (NJ)
18	University of Louisiana at Lafayette	Prioritizing Reforestation Efforts in Maritime Forests
19	Rutgers, The State University of NJ	A reference site to assess resilience of salt marsh restoration
20	NJDEP	NJ Tidal Wetlands: Resilient and Sustainable into the Future
21	Rutgers, The State University of NJ	Develop a Protocol, Monitor & Assess Bay Shoreline Changes
22	University of Delaware	Assessing coastal restoration for black duck resiliency
23	NJ Dept. of Environmental Protection	Mullica River/Great Bay Oyster Enhancement and Restoration
24	Mordecai Land Trust	The Mordecai Island Coastal Wetlands Restoration Project
25	NJDEP	Improve Estuarine Water-Quality and Ecological Resiliency
26	Little Egg Harbor Township	Marsh Restoration and Replenishment, Little Egg Harbor NJ
27	NJ Dept. of Environmental Protection	Barnegat Bay Shellfish Resource Restoration Education.
28	NERACOOS	Improving Access and Usability of Storm-Related Data
29	Barnegat Bay Partnership	Resiliency assessment of sea nettle blooms in Barnegat Bay.
30	Drexel University	Lessons from Hurricane Sandy:
31	The Leatherback Trust	Impact of Hurricane Sandy on Barnegat Bay, New Jersey
32	NJDEP	Building Ecological Solutions to Coastal Community Hazards
33	Partnership for the Delaware Estuary, Inc.	Living Shorelines & Marsh Futures for Coastal Resilience
34	Clean Ocean Action	Regional Dredged Material Mgmt. Plan for Barnegat Bay
35	University of Massachusetts, Amherst	Enhancing Resiliency of Streams and Transportation Systems
36	The Nature Conservancy	Building a More Resilient Northeast Coast to Reduce Risk
37	Barnegat Bay Partnership	Long Swamp Creek (NJ) â€“ Flood Mitigation Assessment

38	New Jersey Institute of Technology	Living With Water: Resiliency Assessments/Designs/Projects
39	Township of Middletown	Monmouth-Ocean Storm Resiliency(New Jersey)
40	The Trust for Public Land	Converting a Marina to Natural Buffer at Mantoloking Bridge
41	Township of Brick	Township of Brick Cherry Quay Pond Restoration Project
42	Montclair State University	Developing Resilience in SAV Habitats through Restoration
43	Brick Township Municipal Utilities Authority	Building the Resiliency of a Coastal New Jersey Water Supply
44	Township of Brick	Township of Brick Coastal Resiliency Assessment & Plan
45	Borough of Manasquan	Deep Creek Salt Marsh Restoration Project
46	NJDEP	Wreck Pond Berm and Living Shoreline to Enhance Resiliency
47	Neptune Township	Shark River Living Shoreline
48	Borough of Bradley Beach	Fletcher and Sylvan Lakes Habitat Resiliency Restoration
49	Ocean Grove Camp Meeting Association	Ocean Grove Dune Restoration Project
50	HUD	Coastal Commercial Resiliency Financing - Asbury Park
51	Deal Lake Commission	Deal Lake Tributary Stream Restoration and Resiliency Plan

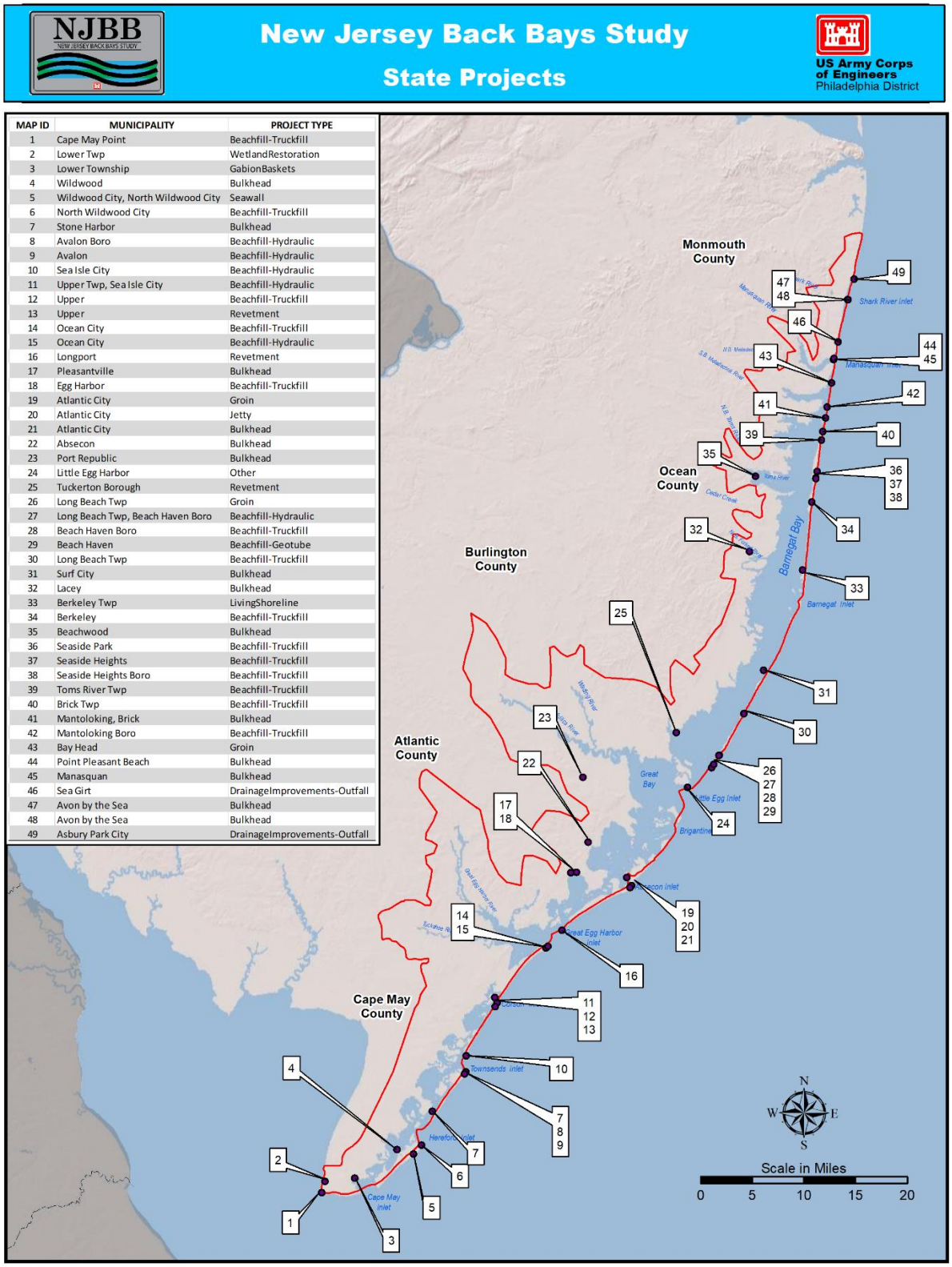
Table 3: NJBB Study Area, Department of Interior Projects

Other (non-USACE) Federal Projects and Studies in NJBB Study Area			
Project Type	**Project Name**	**Partner Agency/Organization**	**Phase**
Department of Interior – Hurricane Sandy Coastal Resiliency Grant Projects			
CSRM/ER	Atlantic City Living Shoreline Project	NJDEP –Office of Coastal Land Use and Planning	S
CSRM/ER	Brigantine City Living Shoreline Project	NJDEP –Office of Coastal Land Use and Planning	S
CSRM/ER	Upper Township Living Shoreline Project	NJDEP –Office of Coastal Land Use and Planning	S
CSRM/ER	Avalon-Stone Harbor Living Shoreline Project	NJDEP –Office of Coastal Land Use and Planning	C
CSRM/ER	Somers Point City Living Shoreline Project	NJDEP –Office of Coastal Land Use and Planning	S
CSRM/ER	Margate City Living Shoreline Project	NJDEP –Office of Coastal Land Use and Planning	S
CSRM/ER	Beneficial Reuse of Dredge Material to Restore Salt Marshes	NJDEP - Office of Natural Resource Restoration	U
CSRM/ER	Restoring Over One Hundred Wetland Acres in Great Egg Harbor Bay (NJ)	City of Ocean City, NJ 08226	S
CSRM/ER	Replenishing Little Egg Harbor's Marshes and Wetlands (NJ)	Little Egg Harbor Township	S
CSRM	Improving Access and Usability of Storm-Related Data	Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS)	S
Other Department of Interior Projects			
CSRM/ER	Regional assessment of natural infrastructure projects	The Nature Conservancy	Un
CSRM	Initiative for Climate Extremes	University of Massachusetts	Un
CSRM	Regional Vulnerability Assessment	Rutgers University	Un

Other (non-USACE) Federal Projects and Studies in NJBB Study Area			
Project Type	**Project Name**	**Partner Agency/Organization**	**Phase**
CSRM	Ventnor NJ Wetland & Community Coastal Resiliency Assessment	Princeton University	Un
CSRM	Northeastern Marsh Elevation Monitoring Cooperative	The Nature Conservancy, New York	Un
CSRM	Brigantine Island Sand Back-Passing	City of Brigantine, New Jersey	Un
CSRM	Atlantic City NJ Strategies and Design	Princeton	Un
CSRM	Atlantic City NJ Hurricane Storm Surge Hazards Assessment	Princeton	Un
CSRM	Atlantic City NJ Local Sea Level Rise Projections	Princeton	Un
CSRM/ER	Beach Replenishment Effects on Downdrift Habitats	The Richard Stockton College of New Jersey	Un
ER	Chemical Contaminants in Piping Plover Eggs and Prey (NJ)	Polistes Foundation, Inc.	Un
ER	Prioritizing Reforestation Efforts in Maritime Forests	University of Louisiana at Lafayette	Un
ER	A reference site to assess resilience of salt marsh restoration	Rutgers, The State University of New Jersey	Un
ER	NJ Tidal Wetlands: Resilient and Sustainable into the Future	NJDEP	Un
CSRM	Develop a Protocol, Monitor & Assess Bay Shoreline Changes	Rutgers, The State University of New Jersey	Un
ER	Assessing coastal restoration for black duck resiliency	University of Delaware	Un
ER	Mullica River/Great Bay Oyster Enhancement and Restoration	NJ Department of Environmental Protection	Un
ER	The Mordecai Island Coastal Wetlands Restoration Project	Mordecai Land Trust	Un
ER	Improve Estuarine Water-Quality and Ecological Resiliency	NJDEP	Un
CSRM/ER	Marsh Restoration and Replenishment, Little Egg Harbor NJ	Little Egg Harbor Township	Un
ER	Barnegat Bay Shellfish Resource Restoration Education.	NJ Department of Environmental Protection	Un
ER	Resiliency assessment of sea nettle blooms in Barnegat Bay.	Barnegat Bay Partnership	Un
CSRM	Lessons from Hurricane Sandy:	Drexel University	Un
ER	Impact of Hurricane Sandy on Barnegat Bay, New Jersey	The Leatherback Trust	Un
CSRM/ER	Living Shorelines & Marsh Futures for Coastal Resilience	Partnership for the Delaware Estuary, Inc.	Un
CSRM/ER	Regional Dredged Material Management Plan for Barnegat Bay	Clean Ocean Action	Un
CSRM	Enhancing Resiliency of Streams and Transportation Systems	University of Massachusetts, Amherst	Un
CSRM	Building a More Resilient Northeast Coast to Reduce Risk	The Nature Conservancy	Un
CSRM	Long Swamp Creek (NJ) Flood Mitigation Assessment	Barnegat Bay Partnership	Un
CSRM	Living With Water: Resiliency Assessments/Designs/Projects	New Jersey Institute of Technology	Un

Other (non-USACE) Federal Projects and Studies in NJBB Study Area			
Project Type	**Project Name**	**Partner Agency/Organization**	**Phase**
CSRM	Monmouth-Ocean Storm Resiliency(New Jersey)	Township of Middletown	Un
CSRM/ER	Converting a Marina to Natural Buffer at Mantoloking Bridge	The Trust for Public Land	Un
CSRM/ER	Township of Brick Cherry Quay Pond Restoration Project	Township of Brick	Un
CSRM/ER	Developing Resilience in SAV Habitats through Restoration	Montclair State University	Un
CSRM	Building the Resiliency of a Coastal New Jersey Water Supply	Brick Township Municipal Utilities Authority	Un
CSRM	Township of Brick Coastal Resiliency Assessment & Plan	Township of Brick	Un
CSRM/ER	Deep Creek Salt Marsh Restoration Project	Borough of Manasquan	Un
CSRM/ER	Wreck Pond Berm and Living Shoreline to Enhance Resiliency	NJDEP	Un
CSRM/ER	Shark River Living Shoreline	Neptune Township	Un
ER	Fletcher and Sylvan Lakes Habitat Resiliency Restoration	Borough of Bradley Beach	Un
CSRM	Coastal Commercial Resiliency Financing - Asbury Park	HUD	Un
CSRM/ER	Deal Lake Tributary Stream Restoration and Resiliency Plan	Deal Lake Commission	Un
National Oceanic and Atmospheric Administration			
	Activity 1: Maintain water level stations and collect water level and ellipsoidal data in NY, NJ, CT, and RI to refine datum models to support hydro and shoreline surveys from Rhode Island to New Jersey (CO-OPS). Activity 2: Establish global positioning system observations for determining geodetic to ellipsoid relationships at historic tidal gauge sites (NGS).	N/A	C
	Contract topometric-bathymetric LiDAR data collection of the shoreline in the highest impact areas (primarily NY/NJ).	N/A	Un
	Hurricane Sandy caused extensive damage to the seawater system (part of the lab building) and building 74. Site is part of the National Park Service (NPS) Gateway National Recreation Area. The state of NJ has leases with the NPS and leases the NPS Building 74 and NJ-owned lab. Annex site is proposed on former lab site (burned down in 1985 from arson).	N/A	Un

Project Type	**Phase**
CSRM = Coastal Storm Risk Management **ER** = Ecosystem Restoration **NV** = Navigation **RSM** = Regional Sediment Management	**C** = Initial Construction Completed **U** = Under Construction **N** = Navigation Maintenance **S** = Study **Un** = Unknown



MAP ID	MUNICIPALITY	PROJECT TYPE
1	Cape May Point	Beachfill-Truckfill
2	Lower Twp	WetlandRestoration
3	Lower Township	GabionBaskets
4	Wildwood	Bulkhead
5	Wildwood City, North Wildwood City	Seawall
6	North Wildwood City	Beachfill-Truckfill
7	Stone Harbor	Bulkhead
8	Avalon Boro	Beachfill-Hydraulic
9	Avalon	Beachfill-Hydraulic
10	Sea Isle City	Beachfill-Hydraulic
11	Upper Twp, Sea Isle City	Beachfill-Hydraulic
12	Upper	Beachfill-Truckfill
13	Upper	Revetment
14	Ocean City	Beachfill-Truckfill
15	Ocean City	Beachfill-Hydraulic
16	Longport	Revetment
17	Pleasantville	Bulkhead
18	Egg Harbor	Beachfill-Truckfill
19	Atlantic City	Groin
20	Atlantic City	Jetty
21	Atlantic City	Bulkhead
22	Absecon	Bulkhead
23	Port Republic	Bulkhead
24	Little Egg Harbor	Other
25	Tuckerton Borough	Revetment
26	Long Beach Twp	Groin
27	Long Beach Twp, Beach Haven Boro	Beachfill-Hydraulic
28	Beach Haven Boro	Beachfill-Truckfill
29	Beach Haven	Beachfill-Geotube
30	Long Beach Twp	Beachfill-Truckfill
31	Surf City	Bulkhead
32	Lacey	Bulkhead
33	Berkeley Twp	LivingShoreline
34	Berkeley	Beachfill-Truckfill
35	Beachwood	Bulkhead
36	Seaside Park	Beachfill-Truckfill
37	Seaside Heights	Beachfill-Truckfill
38	Seaside Heights Boro	Beachfill-Truckfill
39	Toms River Twp	Beachfill-Truckfill
40	Brick Twp	Beachfill-Truckfill
41	Mantoloking, Brick	Bulkhead
42	Mantoloking Boro	Beachfill-Truckfill
43	Bay Head	Groin
44	Point Pleasant Beach	Bulkhead
45	Manasquan	Bulkhead
46	Sea Girt	DrainageImprovements-Outfall
47	Avon by the Sea	Bulkhead
48	Avon by the Sea	Bulkhead
49	Asbury Park City	DrainageImprovements-Outfall

Figure 3: NJBB Study Area, State Projects

Table 4: NJBB Study Area, State of New Jersey Projects

Project Type	MAP ID	Municipality	Description	Status
Beachfill-Truckfill	1	Cape May Point	Emergency delivery of sand for the construction of a dune prior to the predicted coastal storm on March 8, 2013.	Complete
Wetland Restoration	2	Lower Twp.	Reestablish self-sustaining tidal inundation to a portion of Pond Creek marsh and/or the Higbee Beach State Wildlife Management Area for the restoration (rehabilitation) and enhancement of the existing marsh habitat, and the upland habitat on the former Harbison Walker Magnesite Plant.	Design
Gabion Baskets	3	Lower Township	Gabion basket shoreline stabilization at Cape May Canal/Spicers Creek junction.	Bid/Award
Bulkhead	4	Wildwood	Shoreline improvement project that includes the bulkhead replacements of damaged areas.	Complete
Seawall	5	Wildwood City, North Wildwood City	Construct a steel bulkhead between 5th and 7th Avenues; construct a vinyl bulkhead between 4th and 5th Avenues; construct a new seawall between 3rd and 7th Avenues; reinforce the existing USACE seawall between 2nd and 3rd avenues; construct a beach vehicle access drive at the end of 8th Avenue.	Design
Beachfill-Truckfill	6	North Wildwood City	Emergency beach repair and stabilization measures prior to the predicted coastal storm on January 22 through 24, 2016.	Complete
Bulkhead	7	Stone Harbor	Shoreline improvement project that includes the construction of bulkheads along the bayfront in the Borough of Stone Harbor.	Complete
Beachfill-Hydraulic	8	Avalon Boro	Shoreline improvement project including the placement of sand along the Atlantic Ocean from 9th Street to 26th Street.	Complete
Beachfill-Hydraulic	9	Avalon	Beach renourishment project from approximately 8th Street to 19th Street.	Complete
Beachfill-Hydraulic	10	Sea Isle City	Shoreline improvement project including the placement of sand along the Atlantic Ocean from 73rd Street to 94th Street.	Complete
Beachfill-Hydraulic	11	Upper Twp., Sea Isle City	Sea Isle and Strathmere renourishment using FEMA funds	Complete
Beachfill-Truckfill	12	Upper	Emergency beach renourishment project from Seaview Ave to Sea Cliff Ave on State and municipal property.	Complete

Revetment	13	Upper	Shoreline improvement project that includes the construction of a revetment along the eastern side of Ocean Drive between Rush Chattin Bridge and Corson's Inlet Bridge.	Complete
Beachfill-Truckfill	14	Ocean City	Purchase and delivery of sand for the construction of a dune in relation to the predicted coastal storm on March 8, 2013	Complete
Beachfill-Hydraulic	15	Ocean City	Beach renourishment project from the terminal groin at the intersection of Waverly Boulevard and Seaspray Road South to approximately 12th Street.	Complete
Revetment	16	Longport	Repair and rehabilitate three shore protection structures, all damaged in Superstorm Sandy including: Atlantic Avenue Point Jetty, Point Drive Revetment, and 11th Avenue Terminal Groin.	Complete
Bulkhead	17	Pleasantville	Construction of a bulkhead between the existing city marina and the upland behind the marina along the Lakes Bay shorefront.	Complete
Beachfill-Truckfill	18	Egg Harbor	Removal of 17 existing stormwater outfall structures, installation of 5 new stormwater outfall structures utilizing non-polluting materials, and the construction of approximately 5000 linear feet of sand dune along the shoreline of Lakes Bay.	Complete
Groin	19	Atlantic City	Groin restoration and expansion, and construct a low profile timber groin and rock sill.	Complete
Jetty	20	Atlantic City	Repair and reconstruct approximately 1,200 linear feet of the south Absecon Inlet Jetty located in Atlantic City.	Construction
Bulkhead	21	Atlantic City	Construction of approximately 1577 linear feet of shore protection structure along the city owned portion of Caspian Point.	Construction
Bulkhead	22	Absecon	Shoreline improvement project that includes the construction of a bulkhead along the Absecon Creek in the City of Absecon.	Complete
Bulkhead	23	Port Republic	Shoreline improvement project including an emergency bulkhead repair and scour protection.	Complete
Other	24	Little Egg Harbor	Emergency removal and disposal of the United States Geological Survey tidal monitoring station in Little Egg Inlet near Beach Haven Heights, NJ.	Complete

Revetment	25	Tuckerton Borough	Construction of a stone revetment along the Tuckerton Bay.	Complete
Groin	26	Long Beach Twp.	Install steel sheeting next to existing dilapidated timber/stone terminal groin.	Complete
Beachfill-Hydraulic	27	Long Beach Twp., Beach Haven Boro	Beach nourishment project, with a maximum of 1,500,00 cubic yards of sand to be pumped hydraulically via a cutter-head pipeline dredge to the beach from the offshore borrow site (Little Egg Inlet).	Complete
Beachfill-Truckfill	28	Beach Haven Boro	Purchase and delivery of sand for the construction of a dune in relation to the predicted coastal storm on January 22-24, 2016	Complete
Beachfill-Geotube	29	Beach Haven		Complete
Beachfill-Truckfill	30	Long Beach Twp.	Additional assistance for emergency beach repair and stabilization prior to predicted storm on January 22 to 24, 2016	Complete
Bulkhead	31	Surf City	Repairs of various wooden bulkheads within the municipality	Complete
Bulkhead	32	Lacey	Replacement of bulkhead at Forked River Marina.	Complete
Living Shoreline, Groin	33	Berkeley Twp.	This project consists of construction of T-groins, as well as living shoreline to reduce erosion to the kayak launch and surrounding area at IBSP.	
Beachfill-Truckfill	34	Berkeley	Truckfill for dune construction.	Complete
Bulkhead	35	Beachwood	Shoreline improvement project that includes the construction of a bulkhead along Toms River in the Borough of Beachwood.	Complete
Beachfill-Truckfill	36	Seaside Park	Purchase and delivery of sand for the construction of a temporary dune prior to the predicted coastal storm during the week of Thanksgiving 2013.	Complete
Beachfill-Truckfill	37	Seaside Heights	Purchase and delivery of sand for the construction of a temporary dune prior to the predicted coastal storm during the week of Thanksgiving 2013.	Complete
Beachfill-Truckfill	38	Seaside Heights Boro	Emergency purchase and delivery of sand for the construction of a dune for the January 22nd through 24th 2016 event.	Complete
Beachfill-Truckfill	39	Toms River Twp.	Additional assistance for emergency beach repair and stabilization prior to predicted storm on January 22 to 24, 2016	Complete

Beachfill-Truckfill	40	Brick Twp.	Purchase and delivery of sand for covering the revetment that was exposed during storms in 2015 and 2016.	Complete
Bulkhead	41	Mantoloking, Brick	Construction of an approximately 18,700 foot long continuous steel sheet pile bulkhead located on the oceanfront beach/dune area extending from the Township of Brick to the Borough of Mantoloking.	Complete
Beachfill-Truckfill	42	Mantoloking Boro	Purchase and delivery of sand for the construction of a temporary dune prior to the predicted coastal storm on February 12, 2014.	Complete
Groin	43	Bay Head	Repair and modification to existing stone and timber groins.	Complete
Bulkhead	44	Point Pleasant Beach	Replace approximately 202 linear feet of deteriorated aluminum bulkhead on the Point Pleasant Beach side of the Manasquan Inlet with a new steel sheet bulkhead within 18"" of the existing bulkhead.	Complete
Bulkhead	45	Manasquan	Construct approximately 375 linear feet of steel bulkhead, with stone toe protection, construct approximately 220 linear feet of stone revetment in the northern section of Fisherman's cove, and extend the existing stormwater outfall pipe through the new bulkhead.	Complete
Drainage Improvements - Outfall	46	Sea Girt	Baltimore Boulevard and Neptune Place outfall extensions and infrastructure improvements.	Complete
Bulkhead	47	Avon by the Sea	Removal of 641 linear feet of an existing, failed aluminum bulkhead and replace it in place with a steel sheet piling bulkhead.	Complete
Bulkhead	48	Avon by the Sea	Emergency removal of damaged bulkhead.	Complete
Drainage Improvements-Outfall	49	Asbury Park City	Repair of gap between the outshore manhole and oceanside outfall pipe at Wesley Lake that causes beach sand to accumulate within the outfall.	Complete

Table 5: NJBB Study Area, Local, NGO, and Academic Projects

Local, NGO, and Academic Projects and Studies in the NJBB Study Area		
Project Type	**Project Name**	**Phase**
Municipalities		
CSRM	Road Elevations at Seaview Meadows, Snake Road, and South Drive, Brick Township	S
CSRM	Flood Risk Study, Manasquan	S
CSRM	Flood Valves in Silver Lake, Belmar	S
CSRM	Ocean Outfalls with Tide Valve Controls in Lake Como, Belmar	S
CSRM	Tide Surge Gate on Shark River, Belmar	S
CSRM	Bayside Wave Dissipating Wall, Reduction of Outfalls, Installing Tide Flux Valves at Outfalls, Seaside Park	S
CSRM	Installation of Tideflex Valves on Outfalls, Neptune Township	C
CSRM	Replacement of Cape Island Creek Tidegate (Cape May)	C
CSRM	Elevation of Sea Isle Blvd, Middle Township	U
CSRM	Additional bulk heading along S. Riverside Drive and upgrading outfalls, installing new bulkheads, installing tideflex valves, and elevating portions of S. Concourse, Neptune Township	S
Non-Governmental Organizations and Academic Institutions		
CSRM	Structures of Coastal Resilience Study, Chelsea Heights, Atlantic City, NJ (Rockefeller Foundation)	S
CSRM	Economic Vulnerability and Adaptation to Climate Hazards and Climate Change: Building Resilience in the Barnegat Bay Region (Barnegat Bay Partnership and Rutgers University)	S
CSRM/ER	Tuckerton Living Shorelines Project (American Littoral Society (ALS))	S
CSRM/ER	Tuckerton Living Shorelines Project (The Nature Conservancy)	S
CSRM/ER	Cattus Island Living Shoreline Project (Barnegat Bay Partnership (BBP))	S
CSRM/ER	Good Luck Point Living Shoreline Project (American Littoral Society)	S
ER	Barnegat Bay Shellfish Restoration Project – Good Luck Point Reef (ALS, BBP, Rutgers Institute of Marine and Coastal Sciences, ReClam the Bay, NJDEP, Restore America's Estuaries, Rutgers Cooperative Research and Extension of Ocean County)	C
ER	Little Egg Harbor Eelgrass Restoration (USFWS, BBP, Jacques Cousteau National Estuarine Research Reserve, Forsythe National Wildlife Refuge, Rutgers University Marine Field Station)	C
ER/CSRM/RSM	Beneficial Use of Dredged Material to Restore Wetlands for Coastal Flood Mitigation, Barnegat Bay, New Jersey. (Stockton University)	S
CSRM	Storm Surge Reduction Alternatives for Barnegat Bay (Stevens Institute of Technology)	S
CSRM	Strategies for Flood Risk Reduction for Vulnerable Coastal Populations around Barnegat Bay. (Rutgers University)	S

Project Type	**Phase**
CSRM = Coastal Storm Risk Management **ER** = Ecosystem Restoration **NV** = Navigation **RSM** = Regional Sediment Management	**C** = Initial Construction Completed **U** = Under Construction **N** = Navigation Maintenance **S** = Study **Un** = Unknown

A-2) NONSTRUCTURAL CSRM MEASURE INVENTORY

1. Managed Coastal Retreat

This effort involves a series of different tools to reduce the level of development along a shoreline, reduce the number of repetitive losses, and limit the encroachment of private properties onto vulnerable shorelines through a series of nonstructural efforts to be carried out at the municipal, state, and federal level. Specific tools from the Columbia School of Law report on managed coastal retreat are listed below. Some of these measures are more valuable along undeveloped shorelines where property and infrastructure are not as dense as it is along the New Jersey shoreline.

a. Setbacks-Setbacks require property owners to locate structures at some distance from the shoreline. Setbacks are successful in communities that are not 100% built out and fully developed, or in the planning of new communities since they reduce the contact of damaging flood waters, erosion, and waves. After the Ash Wednesday storm of 1962, the state of New Jersey established a building line or bulkhead line in coastal communities facing the Atlantic Ocean beyond which no structures could be built. New setback guidelines could be established for new construction, or re-construction that could reduce infrastructures exposure to storm events on the New Jersey Back Bay.

   There are two main methods of establishing a setback distance, set distance and projected erosion rates. Set distances establish a fixed distance from the shoreward edge of a property to some fixed tidal landmark. Projected erosion rates can be established from historic erosion rates multiplied by a factor based on the level of risk for that structure. North Carolina and Florida have erosion setback based on erosion rates. North Carolinas Administrative Code for Coastal Hazard establishes a setback distance from the first line of vegetation (beach vegetation) depending on the size of the structure. For structures less than 5,000 square ft. the setback distance is 30 times the rate of annual erosion, for structures over 10,000 square ft. the setback distance is established at 90 times the rate of erosion.

b. Rolling easements- A rolling easement can be a set distance from the established shoreline. They can be established to “roll” a set distance from the shoreline to allow communities to establish private property rights and public access to migrate landward with increased erosion and sea level rise. Rolling easement is a term used to refer to any public policy that protects lands in the public trust as the sea level “rolls” inland. A rolling easement grants the public access to a portion of the dry beach on a private property owner’s land and that rolls inland with the rising sea. This type of easement may also be important in areas of tidal encroachment that intersects with private property over time in order to protect public access to the shoreline as Defined in the Public Trust Doctrine. This public access enforcement principle was recently shot down in Severance vs. Patterson in the Texas Supreme Court in 2011 when the court ruled that unless a public easement was expressly included in the initial land grant, the state cannot rely on custom alone to secure public access.

Setback and rolling easements not only allow for protection of coastal properties by reducing their exposure to coastal floods, but they also allow for long term managed coastal retreat and for the reduction in repetitive loss properties. It is important to note that a setback conveys no right to the public as it is a building site restriction. But an easement grants the public as certain access rights under the Public Trust Doctrine.

c. Exactions- An exaction is a condition tied to the granting of a development permit. The exaction requires the landowner to take some action or refrain from some action in order to mitigate the potential negative effects of the development. The California Coastal Commission uses exactions to limit future armoring of the shoreline that may be harmful to the broader area or region.

d. Mitigation fees - Mitigation fees are fees that are assessed to landowners who development actions burden or cause harm to other landowners and the public and can be used to fund further managed retreat strategies discussed in this section including buyouts, relocations, transfer development rights or green banks to fund local flood risk management project.

e. Building restrictions – Building restrictions fall into two categories, limited resilient building and conditional rebuilding. Limited resilient building requires that damaged structures be replaced by structures that are more resilient to wave, erosion and inundation damages or be moved further from the coast, Conditional rebuilding requires property owners agree to certain conditions before they are allowed to rebuild. Owners might be asked to purchase additional insurance, to remove structures that may be threatened by erosion, or inundation, or be limited in the number of times they can rebuild. This is a tool to reduce the number of repetitive loses and is currently being promoted and implemented by FEMA in certain regions of the New Jersey Shore in a new post Sandy context.

f. Zoning changes/overlay zoning/downzoning/un-inhabitability - Overlay zoning works in concert with existing zoning laws to apply an additional measure of approval for construction in high hazard coastal areas. Overlays can set development densities, building regulations, or setback requirements based on the location of the site in relation to flood sources. Downzoning reduces the use intensity of an existing zone by reducing densities or permitted use in the area. Specific downzoning techniques could change the classification of a zone from residential to conservation to reduce the development density. Un-inhabitability refers to the safety and livability of a coastal area in the face of coastal storms, sea level rise and erosion. Decisions have to be made in communities that have high rates of erosion and exposure to coastal storms on whether the community is inhabitable in the long run in the face of these extreme events.

g. Conservation easements – A conservation easement is a voluntary legal agreement between a landowner and an organization that limits specific activities in order to protect conservation values such as wildlife habitat, biodiversity, or open space. Although the typical use for a conservation easement is to improve wildlife habitat, they could have the additional benefit of reducing damage to property from coastal storms if they reduce development densities and preserve land that is undeveloped, but slated for future development.

h. Transfer Development Rights (TDRs) - TDRs are a market based mechanism intended to guide development toward preferred areas while limiting development in undesirable areas. The legal premise of the TDR ownership of the land is severable from the development rights. Developers in areas where development is desirable and encouraged can purchase the development rights from homeowners who are restricted in their development, in order to build in more desirable locations. So, homeowners who are restricted from development through setback limits, or building restrictions, zoning changes, zoning overlays, can sell this development right to a developer in a separate onshore community in a high density setting. TDR programs have not yet been employed to mitigate hazards caused by sea level rise, but they have been used to achieve a wide range of land use goals including the protection of agricultural lands, preservation of wildlife habitats and coastal resources and control of development densities. According to one estimate from 2012, there are 239 TDR programs in 35 states under development.

i. Buyout programs (e.g., New Jersey Blue Acres) - Buyout programs are a specific type of acquisition program in which the government uses public funds to purchase title of privately held lands, demolishes existing structures on the land, and maintains the land in an undeveloped state for public use in perpetuity. Buyout programs can be conducted without the consent of the landowners by using eminent domain to acquire the lands, but most often buyout programs are conducted with voluntary sales from landowners who have recently experienced one of the disasters to which they are vulnerable. Buyout programs can be structured to provide financial incentives for owners who are uncertain about selling their property. Buyout programs can, reduce the exposure of people to dangerous conditions, reduce future disaster response costs by removing buildings and structures from the path of flooding, reduce future flood insurance payments, and assist homeowners by providing them with financial means to move from the floodplains and provide open space.

j. Relocations/utility/residential managed retreat often emphasizes movement away from the vulnerable coasts without identifying areas that are available for development. This is true of most of the tools in this category but is particularly true of buyout programs where landowners are selling their homes and divesting their entire interest in the land. Having a relocation plan is crucial for maintaining communities, for gaining public support, and for long-term economic development.

k. Eminent domain - Buyout programs are all voluntary programs, in which the homeowner has agreed to sell coastal property. However, the government can acquire shoreline properties using eminent domain, even without the consent of the owner, if the government pays the owner compensation and is pursuing a legitimate public purpose.

2. Building Retrofit

Building retrofit measures provide flood risk management to individual buildings. Retrofit measures include the following:

a. Elevation - raising the existing structure on fill or foundation elements such as solid perimeter walls, piers, posts, columns, or pilings.

b. Dry flood proofing - strengthening of existing foundations, floors, and walls to withstand flood forces while making the structure watertight.

c. Wet flood proofing - making utilities, structural components, and contents flood- and water resistant during periods of flooding within the structure.

d. Ringwall - construction of a floodwall around an individual structure.

e. Replace building - demolition of the structure and subsequent building of an equivalent structure within the same property boundary to the design elevation.

FEMA's NFIP regulations require that the lowest floor of new and substantially improved residential structures be elevated to or above the base flood elevation. However, non-residential structures may be flood proofed below that elevation, provided that the structure is watertight, with walls that are impermeable to floodwaters. Elevation of an existing structure is usually limited to smaller buildings and depends on a number of factors, including the foundation type, wall type, size of structure, condition, etc. Other measures such as elevation of critical systems and abandoning lowest occupied floor and wet proofing the abandoned floor may be used to reduce flood risk and increase resilience.

In addition, short-term adaption measures may be used to increase resilience such as installing backflow valves to prevent water from flowing back into a home through sanitary/storm sewer systems, elevation or anchoring of heavy equipment like washing machines, bringing outside furniture inside the home.

3. Coastal Storm Plans and Preparedness

a. Hazard Mitigation Plans

Hazard mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. It is most effective when implemented under a comprehensive, long-term mitigation plan. State, tribal, and local governments engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural disasters and develop long-term strategies for protecting people and property from future hazard events. The State of New Jersey and all five counties in the study area have FEMA-approved hazard mitigation plans.

b. Emergency and Evacuation Plans

Emergency and evacuation planning is imperative for areas with limited access, such as barrier islands, high density housing areas, elderly population centers, cultural resources, and areas with limited transportation options. When a coastal storm threatens many of the communities in the study area, the limited number of bridges and causeways that connect the islands with the mainland become overcrowded, making evacuations from the barrier islands to the mainland difficult. Timely evacuation depends on well-defined emergency evacuation plans used in conjunction with accurate flood forecasting.

The State of New Jersey Office of Emergency Management completed a hurricane evacuation study in 2007 with the support of the USACE and FEMA that provides the State of New Jersey with updated local and regional hurricane evacuation clearance times. The State also developed a hurricane survival guide and coastal evacuation maps. Prior to an emergency local, county or State emergency management officials notify neighborhoods of the need to evacuate or take other protective actions prior to the arrival of a storm event. This done via Emergency Alert System messages on local radio and TV. They may also alert entire areas via community notification systems such as “Reverse 911,” which sends messages to home telephones.

c. Early Flood Warning Systems

A critical component of successful emergency and evacuation plans are early flood warning systems. Despite improved tracking and forecasting techniques, the uncertainty associated with the size of a storm, the path, or its duration necessitate that warnings be issued as early as possible.

The National Hurricane Center and National Weather Service are responsible for preparing hurricane and nor’easter forecasts and warnings respectively. Both agencies are able to predict storm surge in real-time and asses potential storm surge flooding while the track of the storm is still changing. A limiting factor in the accuracy of early forecasts are predictions of storm track and intensity.

In addition to NHC and NWS storm surge forecasts, the New Jersey Tide Telemetry System (NJTTS) is able to report observed tidal elevations and weather data at 20 tide gauges, 5 tide/weather stations, and 31 tidal crest-stage gauges in 13 New Jersey counties. The tide level at each of the tide gauges is automatically transmitted by NOAA and to specific critical decision-making centers. Additional work needs to be accomplished with Early Flood Warning Systems so local flood risk managers understand the severity of each event as it relates to their location based on the surge forecast and the regional topography. Descriptions such as “high”, “medium” and “low” risks for flooding, without definitions of what that means for local residents are not meaningful. Without two critical pieces of information, surge level compared to topography, a flood warning system may not communicate the specific level of risk to that community. More standardized systems, based on surge prediction networks, and local topography, and standardized elevation data can help local municipalities understand the risk for each surge event.

d. Public Education and Risk Communication

Hazard mitigation plans, emergency and evacuation plans, and early flood warning systems are of little value without communicating risk to local officials, community leaders, and decision-makers who are responsible for land use, evacuation planning, and implementation of mitigation measures. Public acceptability of coastal storm risk management measures, the difficulty individuals and communities have in understanding their own risk, and a lack of community engagement about coastal storm risk management options have all been cited as barriers to implementing good coastal management strategies.

Communities and residents often struggle navigating the complicated network of Federal, State, and local coastal programs. Hurricane Sandy generated huge public

interest and awareness in flood risk management; however, it also led to several new initiatives and programs that may make communities feel overwhelmed and calloused to flood risk management opportunities.

4. National Flood Insurance Program Refinement

a. Increase homeowner participation

Residents that are uncertain about reducing risk to their belongings may be prone to attempt to remain in vulnerable areas during storm events, creating further risk. Knowing that personal property is insured, residents may be more comfortable with evacuating vulnerable areas at the approach of a storm. Flood insurance rates and regulations directly and indirectly impact property owners' decisions to reduce risk to their property through favorable construction practices.

b. Increase municipal participation in Community Rating System (CRS)

Community participation in the NFIP is conditional on meeting program guidelines. Participating communities must manage development within their floodplains in accordance with FEMA standards or risk removal from the program, which risks cancellation of all flood insurance policies within the community. Under the CRS, flood insurance premium rates are discounted to reward community actions that meet the three goals of the CRS, which are: (1) reduce flood damage to insurable property; (2) strengthen and support the insurance aspects of the NFIP; and (3) encourage a comprehensive approach to floodplain management. Participation in the CRS helps strengthen and enforce floodplain management policies.

c. Voucher system to assist lower income groups

One way to increase participation in the NFIP is a voucher system to provide assistance to lower income groups. Rising insurance rates and expanded flood plains have a greater burden on low income groups who may not be able to afford the increasing premiums associated with the Biggert-Waters Flood Insurance Reform Act.

5. Zoning Changes

Effective local floodplain management could potentially reduce the risk of flood peril even before the next storm event occurs. Communities at risk of flood peril have the regulatory authority to address local land use, zoning, and building codes to avoid siting development in floodplains. Communities participating in the NFIP must incorporate flood resistant construction standards into building codes. Local ordinances have been established in in some municipalities to reduce impervious surfaces such as driveways and parking areas, promote uniform bulkhead elevations, and require buildings to have an additional 2-3 ft. of freeboard above the FEMA Base Flood Elevation (BFE). An interagency task force could help municipalities incorporate climate change and sea level change in their planning, zoning, and adaptation plans.

6. Emergency and Evacuation Planning

Emergency and evacuation planning is imperative for areas with limited access, such as barrier islands, high density housing areas, elderly population centers, cultural resources, and areas with limited transportation options. When a coastal storm threatens many of the communities in the study area, the limited number of bridges and causeways that connect the islands with the mainland become overcrowded, making evacuations from the barrier islands to the mainland difficult. Timely evacuation depends on well-defined emergency evacuation plans used in conjunction with accurate flood forecasting.

The State of New Jersey Office of Emergency Management completed a hurricane evacuation study in 2007 with the support of the USACE and FEMA that provides the State of New Jersey with updated local and regional hurricane evacuation clearance times. Hurricane evacuation clearance times are developed in a multi-step process. First the National Oceanic and Atmospheric Administration (NOAA) creates what they call a Sea, Lake and Overland Surges from Hurricanes (SLOSH) model that predicts where and how deep water will be based on the hurricane's intensity. Once the SLOSH model is analyzed to determine the different levels of inundation that would occur with various storms, evacuation zones are created that coincide with predicted ranges of hurricane impacts. These zones are then imported into a transportation model that overlays with census data and the evacuation network to predict how long it would take to clear that evacuation zone of all occupants, also known as a clearance time. These clearance times are then uploaded to the HURREVAC program for local emergency managers to use to track the storm and keep an eye on their predicted clearance times so that they can start the evacuation at the proper time.

The State has also developed a hurricane survival guide for their residents that highlight the importance of being prepared, having an evacuation plan, and knowing where to find pertinent evacuation information. Prior to an emergency, local or State emergency management officials notify neighborhoods of the need to evacuate or take other protective actions prior to the arrival of a storm event. This done via Emergency Alert System messages on local radio and TV. They may also alert entire areas via community notification systems such as "Reverse 911," which sends messages to home telephones.

An updated hurricane evacuation study is in progress and updated clearance times are predicted to be released by the 2020 hurricane season. The updated study will include greater detail in the forecasting of storm surge inundation based on not only the hurricane's intensity, but also its forward speed and direction. This increased level of forecasting will reduce over evacuating the populace while ensuring the most accurate storm surge inundation results.

A-3) MANAGEMENT MEASURE SCREENING PROCESS

Screening is the process of eliminating management measures from the initial formulation list that do not resolve the problem/opportunities or the Planning Criteria. The list was derived from the specific planning study based on the planning problems, opportunities, and constraints of the study/project area. Plans are also screened against the four Planning Criteria for Efficiency, Acceptability, Effectiveness and Completeness as defined in the ER 1105-2-100.

The initial screening (Cycle 1) of the management measures against the problems and opportunities was facilitated by the use of a problem/opportunity/management measure matrix. The measures were listed on the left hand side of the matrix while the weighted problems and opportunities were listed at the top of the matrix. The value assignment of problem/opportunity weights was made to characterize the relative importance and was based upon the purpose of the study. Weighting was discussed among USACE staff and was based upon input from other flood risk management professionals from Federal and State agencies. Subsequently, measures were ranked with a score of 1, 0.5, or 0 based on that measures ability to take advantage of that opportunity. Scores were tallied and ranked for each measure (Error! Reference source not found.). Results are shown in Error! Reference source not found.**6**.

The measure was further screened against the Four Planning Criteria (Cycle 2). The score from the initial screening was carried over to a second matrix, again with the measure listed on the left but this time with the Four Planning Criteria listed across the top. The measure received a score of 1, 0.5 or 0 if it was deemed to satisfy the Planning Criteria. Each Measure then received a score that reflected the percentage of the planning criteria it satisfied based on the score for the measure against a possible total of 4. A weighted score was calculated from the total Cycle 2 score divided by 4. The Cycle 2 screening results were then combined with the Cycle 1 results by multiplying the Cycle 2 weighted score by the Cycle 1 score for a combined score for each planning measure (**Figure 5**: Management Measure Rank and Score Against the Problems and Opportunities and the 4 Planning Criteria). These results can be seen in Error! Reference source not found.**7**.

The results of the combined screening were grouped into the three Themed Measure Categories:

1. **Preserve** (also referred to as “Protect”)

   An adaptation strategy, sometimes termed “protect,” that focuses on preserving the function or reliability of the given economic, social, and/or environmental system that is adversely affected by climate change (e.g., navigation channels continue to function reliably, coastal storm risk management measures continue to manage and reduce risk), and may include structural, nonstructural, NNBF measures.

2. **Accommodate**

   An adaptation strategy that allows individuals and communities to adapt to sea level changes and other impacts as they occur over time. This strategy could include traditional nonstructural measures, such as elevation, flood proofing, and ring walls, along with improved implementation of NNBF measures.

3. **Avoid**

An adaptation strategy, sometimes termed “retreat,” that seeks to avoid increasing impacts through traditional nonstructural activities, such as acquisition, to convert land to open space, providing natural infrastructure risk reduction benefits, but also could include other strategies, such as NNBF measures.

The results of the initial screening indicate that there are measures within the themed categories of Preserve, Accommodate, and Avoid that score highly, and measures that score low, and certain alternatives (Preserve) that had overall high score. This indicates that many within that group meet the identified problems and opportunities and also screened well against the Four Planning Criteria and will be evaluated further. Low scoring measures within the Avoid Strategy, like hazard mitigation plans, emergency evacuation plans, and early flood warning systems would add value to a comprehensive storm damage risk reduction plan, but may not meet federal criteria for further consideration. Most of the measures in the Preserve Category scored high, with all but three coming in the top 10 overall, indicating the Preserve Category as a strong theme for the NJBB across most localities. The lowest ranking Strategy was Accommodate, with most of the measures in this category ranked between 16 to 25 out of a potential 25 measures.

Table 6: Management Measure Cycle 1 Screening Results

Management Measures - Cycle 1 Screening		Problem & Oppurtunity Statements											
	Problem	No Comprehensive CSRM system to protect against erosion, inundation, wave attack			Sea Level Change/Climate Change	Inadequate Municipal Storm Water Infrastructure	No Multi-Agency efforts	Degraded Ecosystems	Economic Disruption	Inconsistent Flood Forecasting	Lack of Local Flood Risk Management Capabilities	Score	Rank
	Oppurtunity	Reduce Inundation Damage	Reduce Wave Damage	Reduce Erosion Damage	Mitigate Sea Level Change/Climate Change	Reduce Flooding Associated with Inadequate Municipal Storm Water Infrastructure	Create Multi-Agency efforts	Restore Degraded Ecosystems	Promote Community Resilience (Economic)	Improve Flood Forecasting/Evacuation Procedures	Support Local Efforts/Resources		
	Problem Weight	51	7	7	10	5	2	5	5	6	2	100	
Non-Structural Measures													
1 Managed Coastal Retreat	N1M	1	1	1	1	0	1	1	0	0	0	82	2
2 Building Retrofit	N2B	1	1	0.5	0.5	0	1	0	1	0	0	74	10
3 Hazard Mitigation Plans (County)	N3H	0	0	0	0	0	1	0	0.5	1	1	13	22
4 Emergency Evacuation Plans	N4E	0	0	0	0	0	1	0	0.5	1	1	13	22
5 Early Warning Systems (State/County)	N5EW	0	0	0	0	0	1	0	0.5	1	1	13	22
6 Public Education/Risk Communication	N6P	0	0	0	0	0	1	0	0.5	1	1	13	22
7 National Flood Insurance Program Improvements	P1NF	1	1	0.5	1	0	1	0	1	0	1	81	3
8 Zoning Changes (Code/Ordinance)	P4Z	0.5	0.5	0.5	1	0.5	1	0	1	0	0.5	53	14
Structural Measures													
1 Inlet Storm Surge Barriers	S1S	1	0.5	0.5	0.5	0	0	0	1	0	0	68	12
2 Interior Bay Closures (Tide Gates)	S2T	1	0.5	0.5	0.5	0	0	0	1	0	0	68	12
3 Road/Rail Elevation	S3R	1	1	0.5	1	0	0	0	1	0	0	77	6
4 Levees	S4L	1	1	0.5	1	0	0	0	1	0	0	77	6
5 Permanent Floodwalls	S5F	1	1	0.5	1	0	0	0	1	0	0	77	6
6 Deployable Floodwalls	S6D	1	1	0.5	1	0	0	0	1	0	0	77	6
7 Crown Walls	S7C	1	1	0	1	0	0	0	1	0	0	73	11
8 Beach Restoration/Groins/Breakwaters	S8B	1	1	1	1	0	0	1	1	0	0	85	1
9 Bulkheads	S9B	1	1	1	1	0	0	0	1	0	0	80	4
10 Seawalls (New)	S10S	1	1	1	1	0	0	0	1	0	0	80	4
11 Revetments (Slope Improvement)	S11R	0	1	1	1	0	0	0	1	0	0	24	18
12 Storm System Drainage Improvements	S12SD	0.5	0	0	1	1	1	0	1	0	0.5	49	15
Natural and Nature-Based Features													
1 Living Shorelines	NB1L	0	1	1	0	0	1	1	0.5	0	0	24	19
2 Reefs	NB2R	0	1	0.5	0	0	1	1	0	0	0	18	20
3 Wetland Restoration	NB3WR	0	1	1	1	0	1	1	0.5	0	0	34	17
4 Submerged Aquatic Vegetation	NB4BIR	0	0.5	0.5	0	0	1	1	0	0	0	14	21
5 Green Stormwater Management	NB5G	0.5	0	0	0.5	1	1	1	0.5	0	0	45	16
Total													

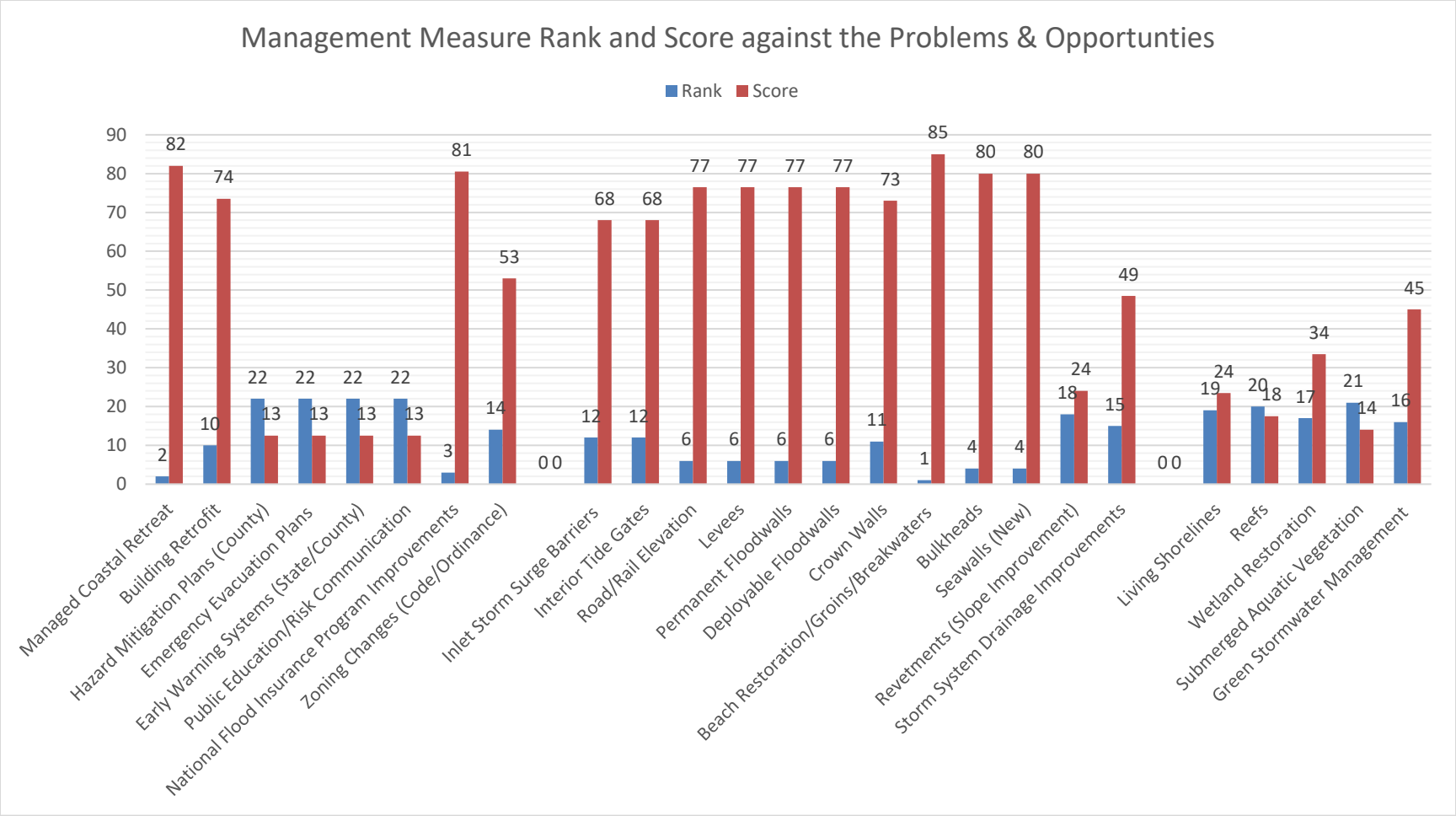


Figure 4: Management Measure Rank and Score Against the Problems and Opportunities.

Table 7: Management Measure Cycle 2 Screening Results

Management Measures - Cycle 2 Screening		Problem & Objective Statements								
		4 Planning Criteria					Score	Weighted score	Combined score	Rank
		Code	Effectiveness	Efficiency	Acceptability	Completeness				
Non-Structural Measures										
1	Managed Coastal Retreat	P1NF	1	0.5	0	0.5	2	0.5	41	13
2	Building Retrofit	N2B	1	1	1	0	3	0.75	55	10
3	Hazard Mitigation Plans (County)	N1M	0.5	1	1	0	2.5	0.625	8	20
4	Emergency Evacuation Plans	P4Z	0.5	1	1	0	2.5	0.625	8	20
5	Early Warning Systems (State/County)		0.5	1	1	0	2.5	0.625	8	20
6	Public Education/Risk Communication	N4E	0.5	1	1	0	2.5	0.625	8	20
7	National Flood Insurance Program Improvements	N5EW	1	1	1	0.5	3.5	0.875	70	2
8	Zoning Changes (Code/Ordinance)	N6P	0.5	1	0.5	0.5	2.5	0.625	33	14
Structural Measures										
1	Inlet Storm Surge Barriers	S4L	1	1	0.5	1	3.5	0.875	60	6
2	Interior Bay Closures (Tide Gates)	S9B	1	1	0.5	1	3.5	0.875	60	6
3	Road/Rail Elevation	S5F	1	0.5	1	0.5	3	0.75	57	8
4	Levees	S8B	1	1	1	1	4	1	77	1
5	Permanent Floodwalls	S1S	1	1	0.5	1	3.5	0.875	67	3
6	Deployable Floodwalls	S2T	0.5	1	1	0.5	3	0.75	57	8
7	Crown Walls	S3R	0.5	1	1	0.5	3	0.75	55	11
8	Beach Restoration/Groins/Breakwaters	S6D	0.5	1	1	0.5	3	0.75	64	4
9	Bulkheads	S7C	0.5	1	1	0.5	3	0.75	60	5
10	Seawalls (New)	S10S	1	0.5	0.5	0.5	2.5	0.625	50	12
11	Revetments (Slope Improvement)	S12SD	0.5	0.5	0.5	0	1.5	0.375	9	19
12	Storm System Drainage Improvements	S11R	0.5	0.5	1	0	2	0.5	24	15
Natural and Nature-Based Features										
1	Living Shorelines	NB5G	0.5	0.5	1	0	2	0.5	12	18
2	Reefs	NB3WR	0	0.5	0.5	0	1	0.25	4	24
3	Wetland Restoration	NB1L	0.5	0.5	1	0	2	0.5	17	17
4	Submerged Aquatic Vegetation	NB2R	0	0	1	0	1	0.25	4	25
5	Green Stormwater Management	NB4BIR	0.5	0	1	0	1.5	0.375	17	16
	Total									

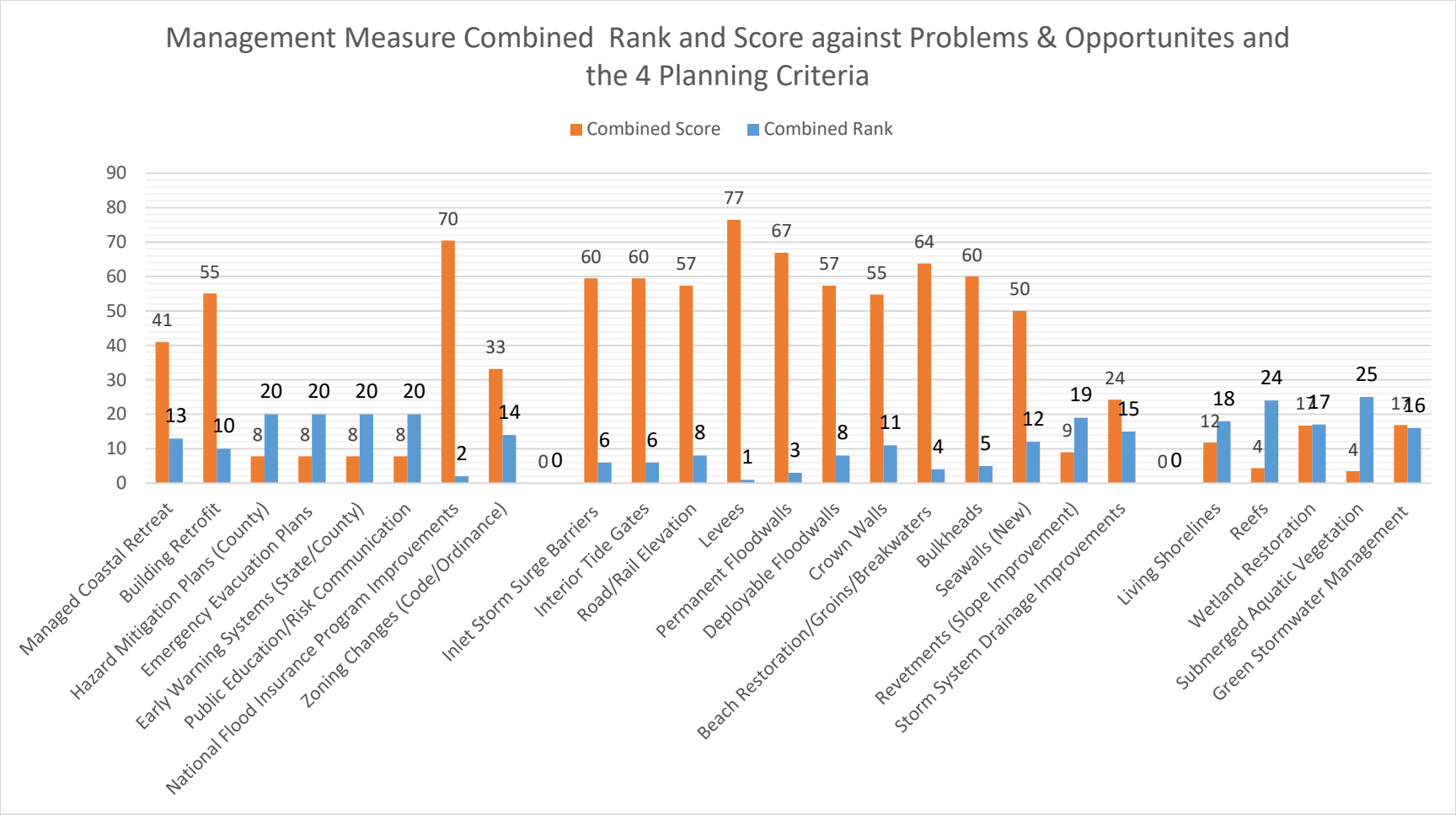


Figure 5: Management Measure Rank and Score Against the Problems and Opportunities and the 4 Planning Criteria

Table 8: Adaption Categories with Screened and Ranked Measures

Adaptation Categories with Screened and Ranked Measures			
	1. Preserve Focused Category– An adaptation category, sometimes termed "protect," that focuses on preserving the function or reliability of the given economic, social, and/or environmental system that is adversely affected by climate change (e.g., navigation channels continue to function reliably, coastal storm risk management measures continue to manage and reduce risk), and may include structural, nonstructural, NNBF, and combinations of each as appropriate.	**2. Accommodate Focused Category**– An adaptation category that allows individuals and communities to adapt to sea level changes and other impacts as they occur over time. This strategy could include traditional nonstructural measures, such as elevation, flood proofing, and ring walls, along with improved implementation of NNBF measures.	**3. Avoid Focused Category**– An adaptation category, sometimes termed "retreat," that seeks to avoid increasing impacts through traditional nonstructural activities, such as acquisition, to convert land to open space, providing natural infrastructure risk reduction benefits, but also could include other strategies, such as NNBF measures.
„	**"Protect"**	**"Adapt"**	**"Managed Coastal Retreat"**
	Includes traditional structural as well as NNBF and nonstructural measures	Includes nonstructural (i.e., elevation, flood proofing, building retrofit including ringwalls), structural (levees) and NNBF measures, as well as community-level efforts	Includes nonstructural and NNBF measures/natural infrastructure risk reduction benefits, with specific emphasis on managed coastal retreat (i.e., setbacks, rolling easements, exactions, mitigation fees, building restrictions, conservation easements, transfer development rights, buyout/acquisition programs, relocations, and eminent domain).
HIGH	Levees	NFIP Refinement	Managed Coastal Retreat
Ranked Management Measures	Floodwalls	Building Retrofit	Zoning Changes (Code/Ordinance)
	Beach Restoration	Managed Coastal Retreat	Wetland Restoration
	Bulkheads	Green Storm water Management	Living Shorelines
	Inlet Storm Surge Barriers	Wetland Restoration	Public Education/Risk Communication
	Interior Bay Closures	Living Shorelines	Reefs
	Road/Rail Elevation	Hazard Mitigation Plans	Submerged Aquatic Vegetation
	Deployable Floodwalls	Emergency Evacuation Plans	
	Building Retrofit	Early Flood Warning Systems	
	Crown Walls	Public Education/Risk Communication	
	Seawalls	Reefs	
	Managed Coastal Retreat	Submerged Aquatic Vegetation	
	Zoning Changes		
	Storm Drainage Improvements		
	Green Storm water Management		
	Wetland Restoration		
	Living Shorelines		
LOW	Submerged Aquatic Vegetation		
KEY	Structural		
	Nonstructural		
	Natural and Nature-Based Features		
	Community-Level Efforts		
	Policy/Programmatic Considerations:		
	Public/Private & Public/Public Partnerships		
	Zoning Changes		
	Regional Sediment Management		
	Engineering With Nature		
	Green Banks		
	Tax Incentive		

The Preserve, Accommodate, Avoid Categories work within themes established by the North Atlantic Comprehensive Study to organize and provide clarity on the overall strategy of the formulation process (Error! Reference source not found.**8**).

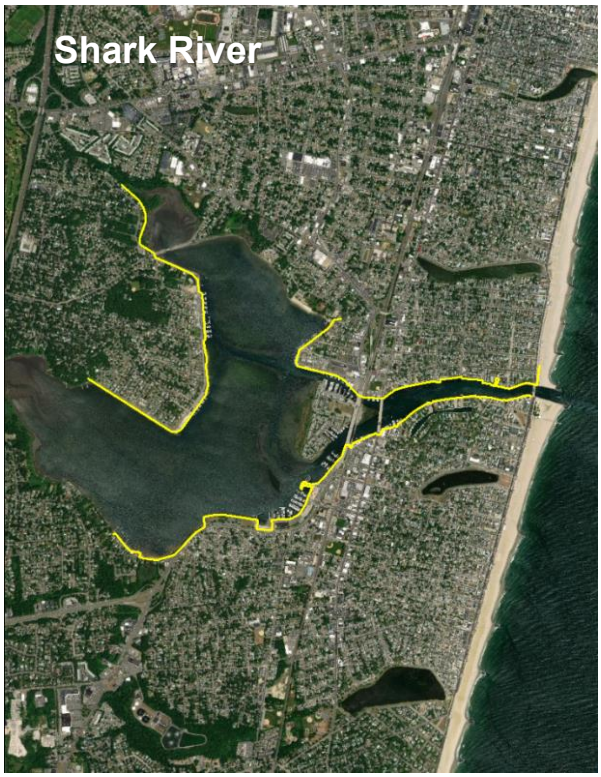
A-4) PERIMETER MEASURE SCREENING PROCESS (CYCLE 0-2)

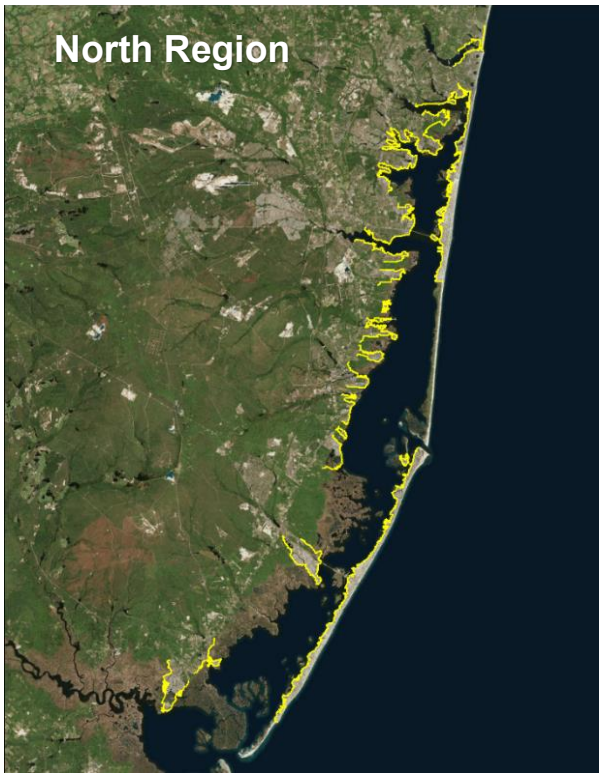
Perimeter Measure Screening – Cycle 0

The initial analysis effort was a comprehensive qualitative screening of potential perimeter measure locations across the entire study area. The analysis completed in Cycle 0 did not assign refined costs nor benefits to identified perimeter locations. The analysis focused on identifying vulnerable areas where a perimeter solution was implementable.

Cycle 0 identified 49 possible perimeter locations across the study area. These locations represent the base for future analysis. All successive cycles of analysis refined cost and benefit inputs to screen these identified locations to only the economically justified alternatives. Economic justification is defined by the implementation of a plan having positive Average Annual Net Benefits (AANB).

Figure 6: Perimeter Measure–Analysis - Cycle 0 shows all 49 identified perimeter locations. Measures include floodwalls and/or levees depending on ground conditions. In total, Cycle 0 presents 1.8 million ft. of perimeter length.





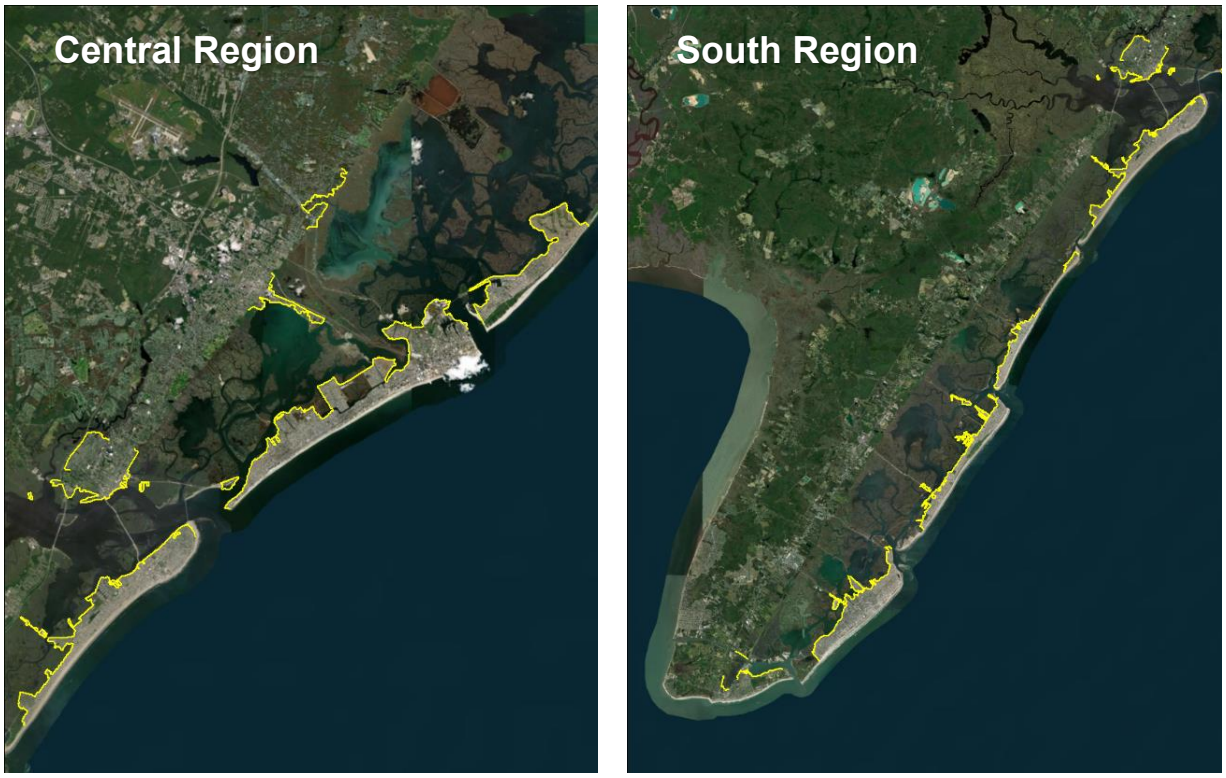


Figure 6: Perimeter Measure–Analysis - Cycle 0

Perimeter Measure Screening – Cycle 1

Cycle 1 incorporated all the areas identified in Cycle 0 and introduced cost inputs and benefit estimates. The inclusion of cost and benefit estimates allowed the PDT to assign preliminary Average Annual Net Benefits (AANBs) and Benefit-Cost Ratios (BCRs)[1] to each of the 49 locations identified in Cycle 0. The AANB results from Cycle 1 were used to screen locations for implementation of the perimeter measure; locations with positive AANB estimates would progress to Cycle 2 analysis and locations with negative AANB estimates would not be considered further for implementation of the perimeter measure.

Perimeter costs were adapted from the North Atlantic Coast Comprehensive Study (NACCS) and benefits were calculated using an excel-based model with preliminary structure inventory data and a simplified depth-percent damage curve. Cost estimates included $8,000 per linear foot of

[1] Benefit-cost analysis is a technique to evaluate in monetary terms what is achieved (benefits) in comparison to what is invested (costs). It is used to ensure that the value of the benefits exceeds the value of the costs, or, in other words, resources are allocated in the most efficient manner possible. When both benefits and costs can be measured in monetary terms, then benefit-cost analysis can help decision makers select the best solution. Benefit-cost analysis involves two mathematical comparisons:

- **Net benefits** are calculated by subtracting total economic costs from total economic benefits. Net benefits represent the amount of total benefits less the total costs. This analysis is used to select and scale a recommended course of action from an array of alternatives
- **A benefit-cost ratio** is calculated by dividing total economic benefits by total economic costs. A benefit-cost ratio tells us which alternative produces the most benefits for every dollar of cost (total benefits/total costs). The benefit-cost ratio is useful for comparing or ranking different projects.

floodwall with additional costs added for miter gates, sluice gates, or road closures where applicable. Analysis was completed using the FY2018 Federal Discount Rate of 2.75% with a 50 year period of analysis. The PDT anticipated that the NACCS costs were likely an underestimate of the actual cost of implementation, and the use of a preliminary structural inventory with a simplified depth damage curve was likely to overestimate benefits. However, at this early stage of the analysis, the decision was made to use lower than anticipated cost estimates and higher than expected benefit assessments to capture the largest number of theoretically justified perimeter locations. Error! Reference source not found. **9** shows the 13 perimeter locations that displayed Benefit-Cost Ratios above 1.0.

In Error! Reference source not found. **9** below, Average Annual Cost includes annual Operations & Maintenance (O&M), and Average Annual Damages includes estimates for vehicle damages, infrastructure damages, and emergency costs.

All 13 of the locations identified in Error! Reference source not found. **9** were carried forward into Cycle 2 to be evaluated further using HEC-FDA. This includes Strathmere with a 0.76 Benefit-Cost Ratio as this was the only community on the barrier islands without an initial BCR above 1.0.

Several main-land communities such as Somers Point and West Atlantic City had BCRs above 0.9 based on current parametric cost estimates. However, these areas have been ultimately excluded from further perimeter measure analysis as anticipated costs associated with more detailed analyses in the future are expected to rise substantially while benefits were not expected to greatly fluctuate. In other words, though Cycle 1 analysis operated with a high degree of uncertainty, none of the 36 screened locations could reasonably be expected to attain future economic justification with perimeter measures and their exclusion presents no risk to final study results.

Table 9: Perimeter Measure–Analysis - Cycle 1 Results

ID	Location	Length	Initial Const.	AAC	AAD	AANB	BCR
1	Cape May City	15,757	$133,361,310	$6,273,439	$16,961,371	$10,687,932	2.7
2	Wildwood Island	54,070	$491,161,680	$23,104,697	$93,958,647	$70,853,950	4.1
4	West Wildwood	11,727	$100,154,110	$4,711,341	$11,938,657	$7,227,316	2.5
5	Stone Harbor / Avalon	96,936	$858,289,730	$40,374,738	$63,320,119	$22,945,381	1.6
10	Sea Isle City	34,954	$329,939,900	$15,520,676	$38,710,939	$23,190,263	2.5
11	Strathmere	8,165	$77,850,490	$3,662,159	$2,777,660	-$884,499	0.8

12	Ocean City	78,573	$703,272,670	$33,082,593	$186,282,803	$153,200,210	5.6
18	Absecon Island	97,409	$977,008,560	$45,959,381	$400,981,475	$355,022,094	8.7
23	Brigantine	48,590	$431,911,960	$20,317,536	$52,970,720	$32,653,184	2.6
26	Long Beach Island	206,561	$1,883,468,300	$88,600,081	$145,286,947	$56,686,867	1.6
42	Island Beach	186,140	$1,784,578,000	$83,948,190	$160,691,242	$76,743,052	1.9
45	Manasquan Inlet (North)	22,642	$235,353,970	$11,071,267	$32,182,394	$21,111,127	2.9
52	West Cape May	4,481	$57,882,910	$2,722,865	$15,923,307	$13,200,441	5.8
TOTAL ESTIMATED		**866,005**	**$8,064,233,590**	**$379,348,963**	**$1,221,986,280**	**$842,637,317**	**3.2**
ROUNDED		**866,000**	**$8,064,234,000**	**$379,349,000**	**$1,221,986,000**	**$842,637,000**	**3.2**

Error! Reference source not found.**,** Error! Reference source not found.**8** and Error! Reference source not found.**9** show the 13 remaining perimeter measure locations. In total, Cycle 1 presents 840,000 ft. of perimeter length.

Figure 7: Perimeter Measure North Region Analysis - Cycle 1

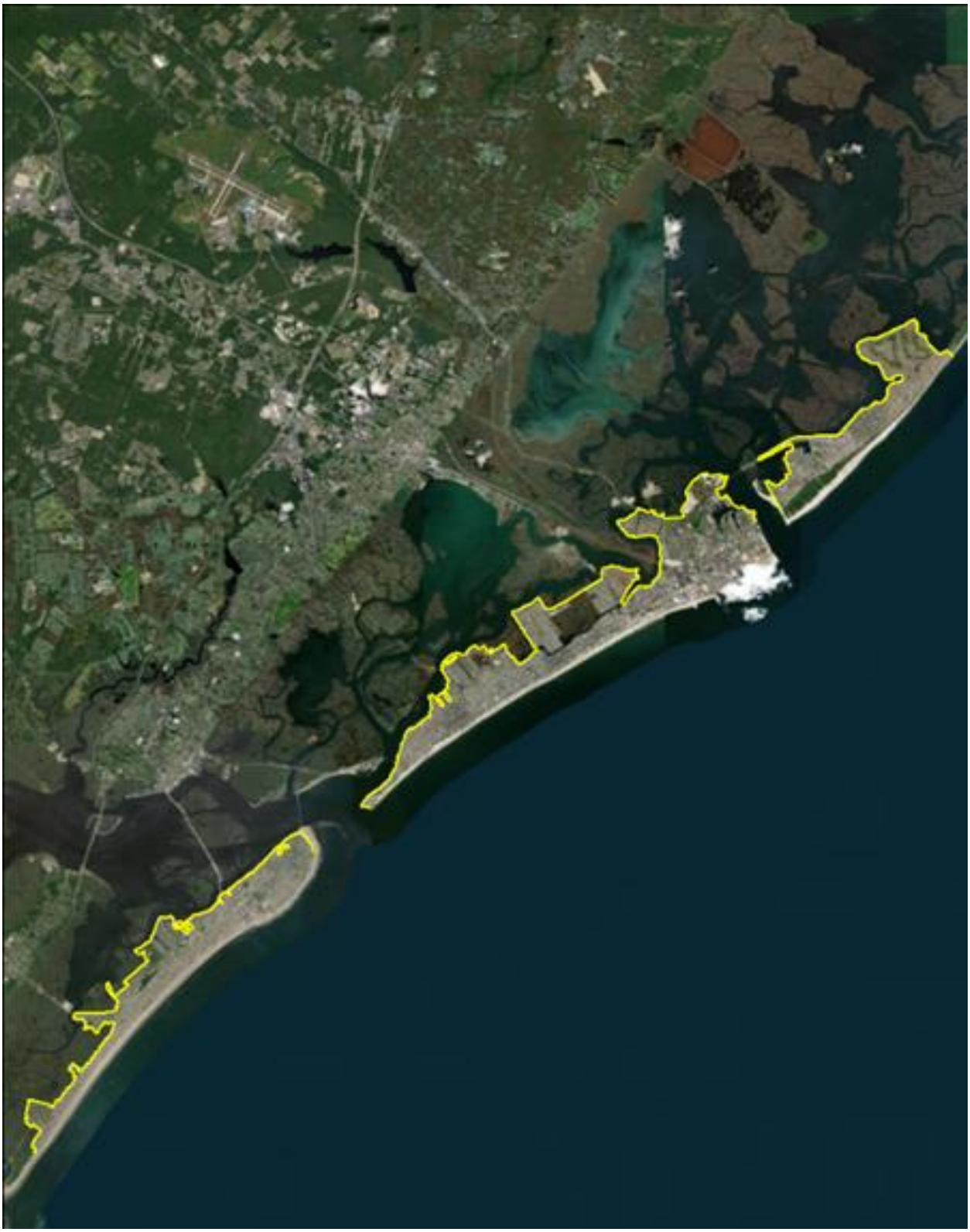


Figure 8: Perimeter Measure Central Region Analysis - Cycle 1

Figure 9: Perimeter Measure South Region Analysis - Cycle 1

Perimeter Measure Screening – Cycle 2

The final analysis cycle for implementation of perimeter strategies transferred the Cycle 1 modeling using preliminary excel-based tools to USACE certified HEC-FDA modeling. Evaluation with HEC-FDA allows for significantly greater complexity and accuracy than possible with excel-based methods.

Cost estimates were also updated with modifications to perimeter measure placement and lengths as well as efforts to improve accuracy with changes to cost per linear foot and applied contingencies.

Cycle 2 Design Considerations and Assumptions

The Cycle 2 perimeter measure utilized the following design considerations and assumptions.

A rough estimate of level of design was 5%.

Structural Measures

- Floodwall – Pile supported concrete “T-wall” – Two (2) types: a) Wet construction, and b) Dry construction
- Levee – Random fill interior with riprap exterior, includes steel sheetpile cutoff wall
- Miter gate (65 foot-wide)
- Sluice gate (60 foot-wide)
- Road closure (2 & 4 lanes)
- Pump stations

Alignment Assumptions

- Tie-in to high ground above the FEMA 500-year floodplain
- Tie-in to USACE dunes and seawalls on ocean-side
- Alignment selected for least impacts to existing structures

Interior Drainage

- Line of protection includes drainage pipes through the structure for local drainage
- Pump Stations added for Interior Drainage; see the Engineering Appendix B for detailed analyses

Typical Sections

- Error! Reference source not found., Error! Reference source not found.**11** and Error! Reference source not found.**12** show typical sections which have been used in the perimeter plan design to date.

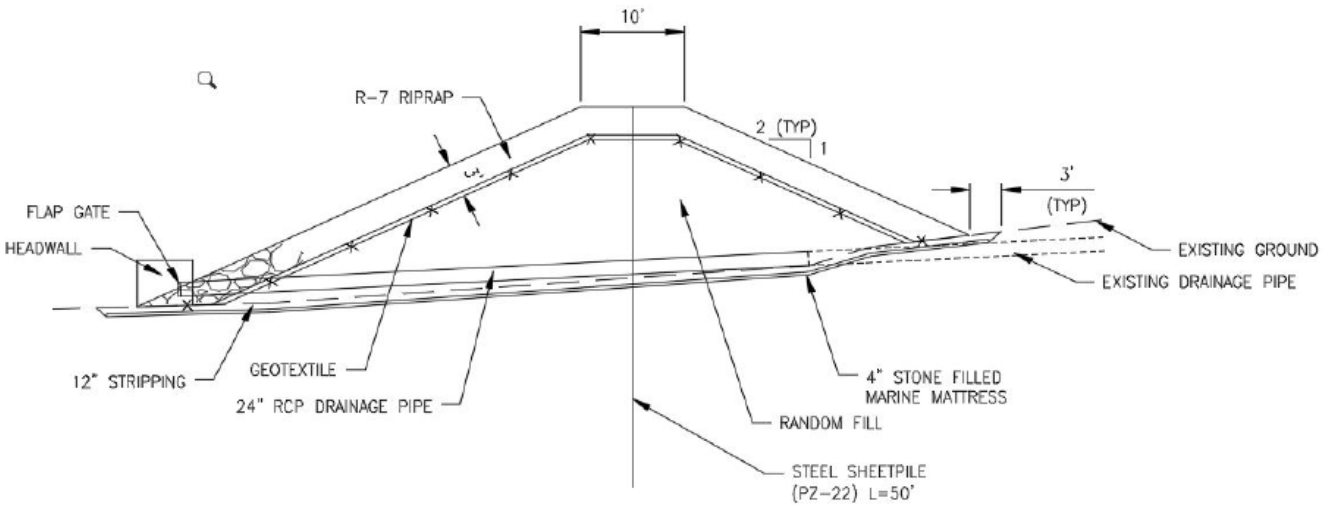


Figure 10: Typical Section – Levee – Type A

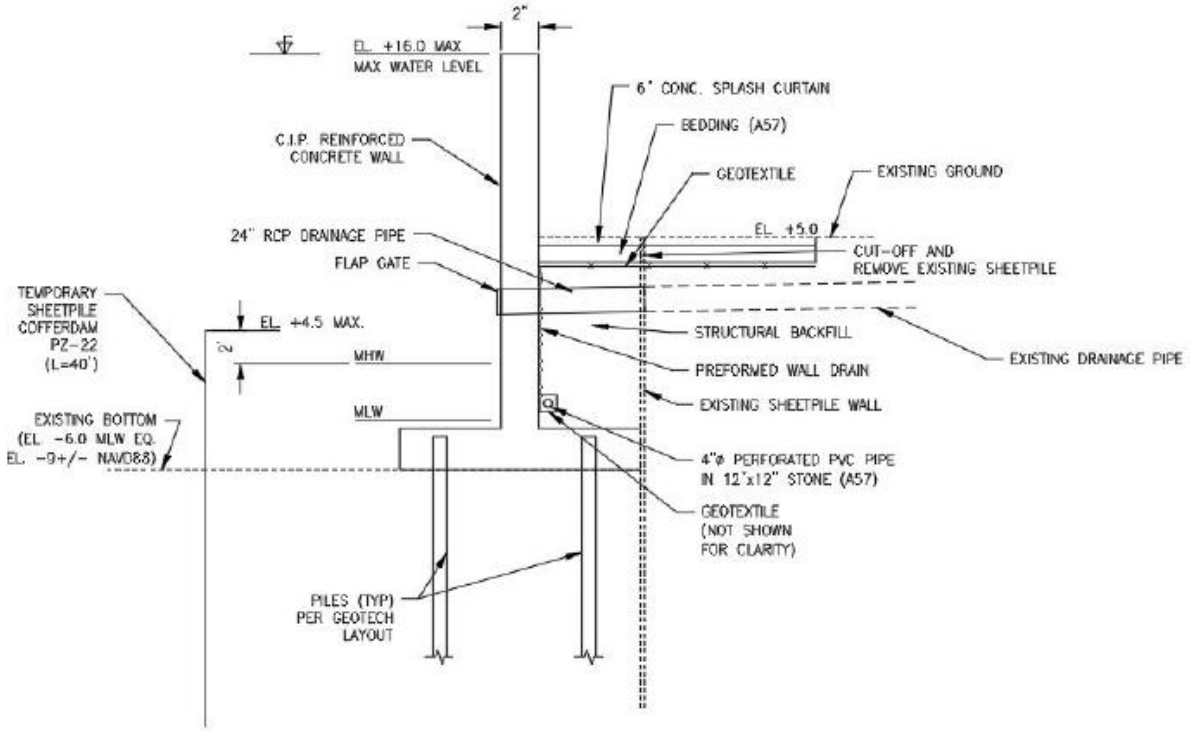


Figure 11: Typical Section – Concrete Cantilever Wall on Piles – Type B

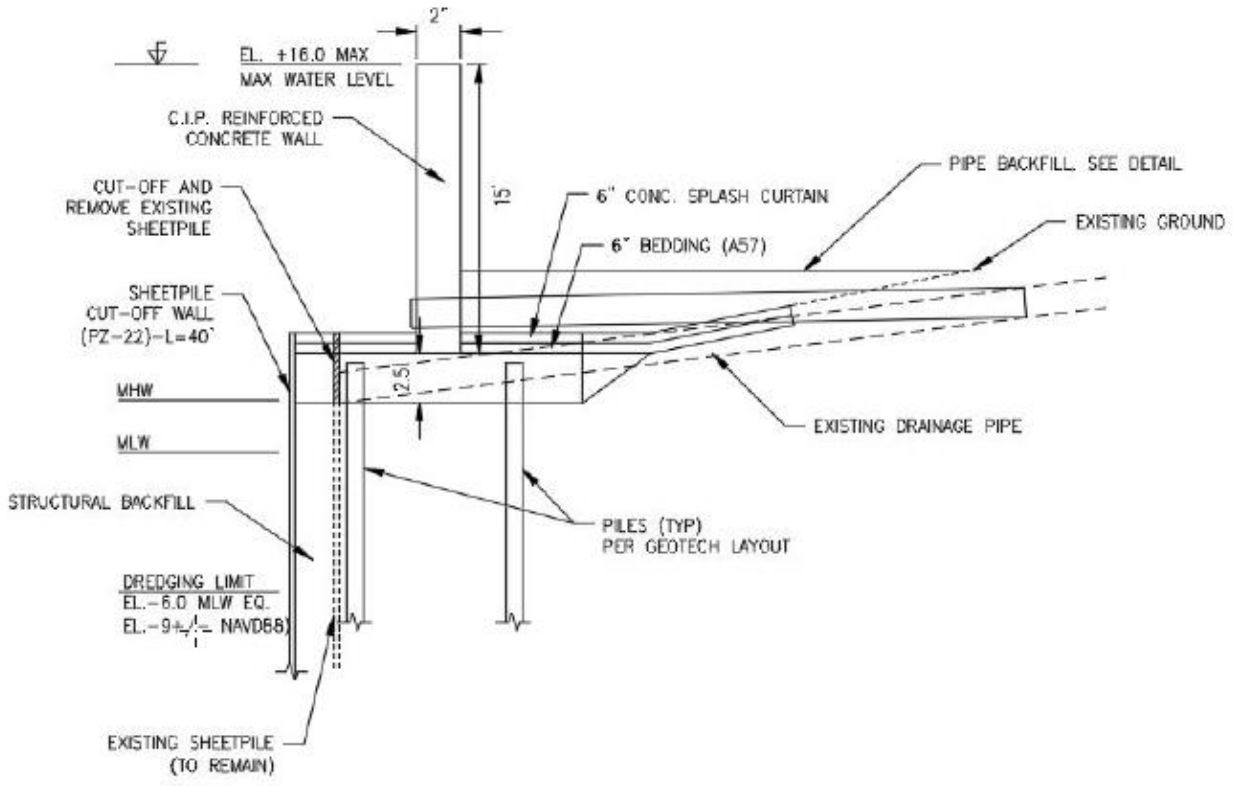


Figure 12: Typical Section – Concrete Cantilever Wall – Type C

Cycle 2 Cost and Contingency Considerations and Assumptions

The Cycle 2 perimeter measure utilized the following cost and contingency considerations and assumptions. Due to the level of detail of engineering analyses at this point of the study, the unit costs presented below were based on analyses performed for different USACE feasibility studies including the New York-New Jersey Harbor and Tributaries CSRM Feasibility Study and the Norfolk CSRM Feasibility Study.

Unit Costs

- Floodwall:
    - Range between $9,715/linear ft. (lf) and $11,558/lf. Cost range is based on floodwall types discussed in above section and is dependent upon construction access for the different floodwall types. Construction from the land side can be performed from if no access limitations exist. Construction from the water side resulting from existing infrastructure or environmental mitigation activities will require water-based equipment and resulting cost differences
- Levee: $10,385/lf
- Miter Gate: $13,507,000 ea.

- Sluice Gate: $9,800,000 ea.
- All costs adjusted based on an area factor and Oct17 price level
- Desktop estimate of interior pumping
- Real Estate: 10% of project costs
- Mitigation: 5% of project cost
- PED used 12% and S&A used 10% of construction costs
- Annual O&M is 1% of First Costs

Contingency

- Cycle 2 Contingency is 40% of construction costs for a “5% design level”
- Contingency includes
    - Utility relocations
    - 157 Crossovers and ADA accessibility
    - HTRW
    - Demolition/reconstruction of docks and ramps
    - Demolition/removal of bulkheads and revetments
    - Local borrow area and disposal sites
    - Accommodating navigation depths/vessel restrictions
    - Drainage outlets spaced every 400 ft.
- Final Contingency will be based on ‘Crystal Ball’ analysis and will likely be different.

Cycle 2 Screening Results

Of the 13 locations from the Cycle 1 analysis, 7 locations remain economically justified with positive Average Annual Net Benefits. Three sites (shaded yellow) could realistically attain justification with optimizations to measure placement or type and are therefore being carried forward for a total of 10 potential locations. However, three sites (shaded orange) have negative Average Annual Net Benefits as well as other factors which make justification highly unlikely. For instance, Strathmere does not have the inventory to remain economically feasible and the sheer length of floodwall necessary to protect Long Beach Island or Island Beach creates a cost hurdle.

Compared to Cycle 1, estimated Average Annual Costs increased 71% over their Cycle 1 values, and Average Annual Benefits decreased -19% in the HEC-FDA based Cycle 2 analysis (Error! Reference source not found.**10**). This results in a total -59% decrease in Average Annual Net Benefits. Error! Reference source not found.**13**, Error! Reference source not found.**14** and Error! Reference source not found.**15** show the locations of the 7 to 10 perimeter locations that passed the economic criteria for Cycle 2 and were carried through for inclusion in alternative formulation.

Table 10: Perimeter Measure Analysis – Cycle 2 Results

ID	Location	Length	Initial Const.	AAC	AAB	AANB	BCR
1	Cape May City	15,825	$249,540,895	$11,738,633	$9,887,438	-$1,851,196	0.8
2	Wildwood Island	54,171	$810,770,180	$38,139,375	$84,907,400	$46,768,025	2.2
4	West Wildwood	11,726	$170,039,200	$7,998,800	$15,864,050	$7,865,250	2.0
5	Stone Harbor / Avalon	97,225	$1,443,894,068	$67,922,105	$46,650,575	-$21,271,530	0.7
10	Sea Isle City	35,166	$544,084,466	$25,594,234	$31,810,925	$6,216,691	1.2
11	Strathmere	8,187	$117,797,150	$5,541,286	$2,472,163	-$3,069,124	0.4
12	Ocean City	78,732	$1,149,394,269	$54,068,563	$182,588,238	$128,519,674	3.4
18	Absecon Island	111,114	$1,755,389,808	$82,575,151	$320,230,675	$237,655,524	3.9
23	Brigantine	48,699	$714,920,468	$33,630,516	$30,157,550	-$3,472,966	0.9
26	Long Beach Island	209,124	$3,172,187,591	$149,222,621	$118,660,075	-$30,562,546	0.8
42	Island Beach	186,871	$3,092,467,435	$145,472,512	$107,272,863	-$38,199,649	0.7
45	Manasquan Inlet (North)	22,820	$461,553,732	$21,711,912	$30,560,638	$8,848,726	1.4
52	West Cape May	4,480	$88,265,089	$4,152,071	$8,890,325	$4,738,254	2.1
TOTAL ESTIMATED		**884,140**	**$13,770,304,352**	**$647,767,779**	**$989,952,913**	**$342,185,134**	**1.5**
ROUNDED		**884,000**	**$13,770,304,000**	**$647,768,000**	**$989,953,000**	**$342,185,000**	**1.5**

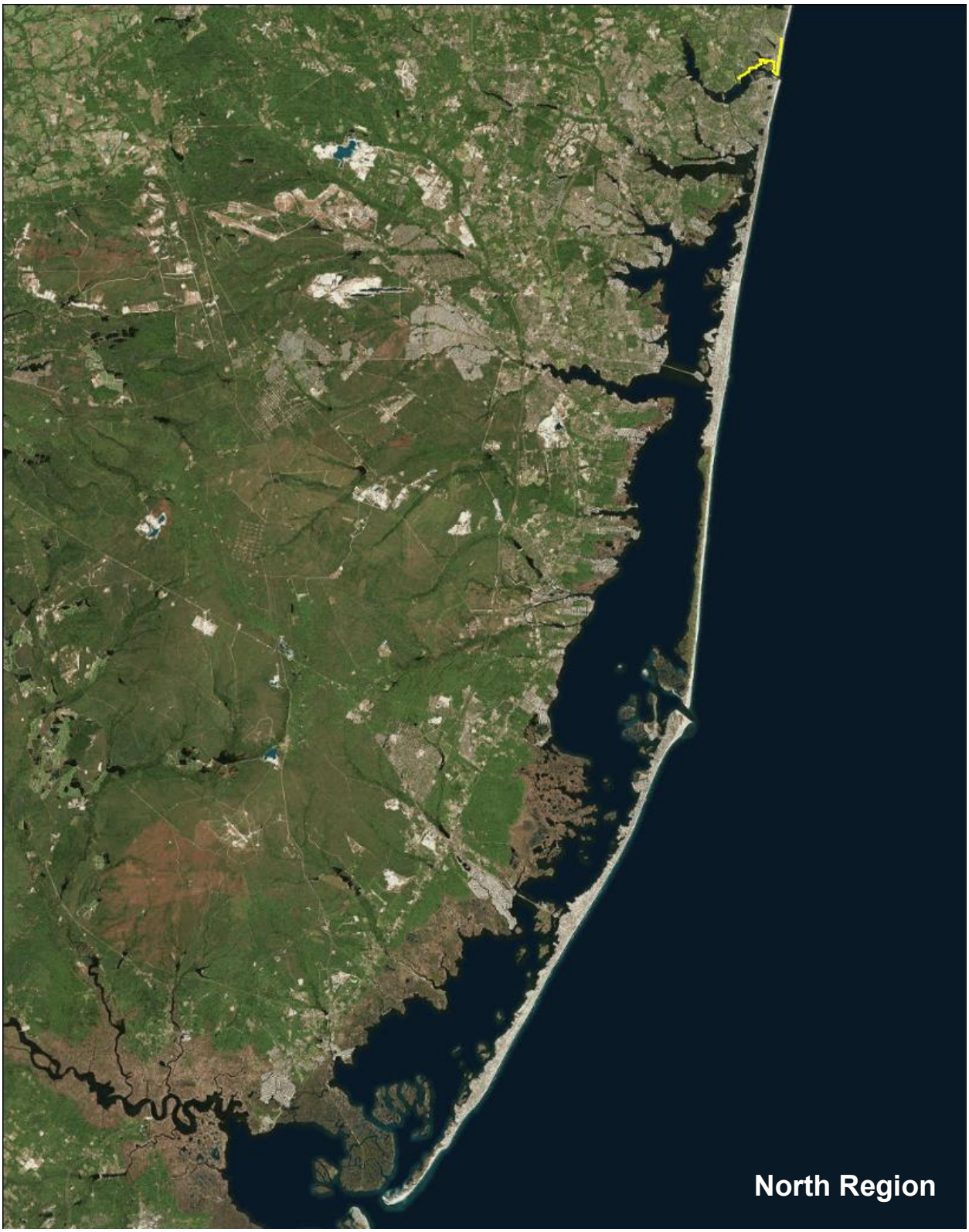


Figure 13: Perimeter Measure North Region Analysis - Cycle 2

Figure 14: Perimeter Measure Central Region Analysis - Cycle 2

Figure 15: Perimeter Measure South Region Analysis - Cycle 2

A-5) ALTERNATIVE PLAN SCREENING MATRIX

This section includes the screening matrix which shows the results of the alternative plan screening process discussed in Chapter 10. Plan Formulation Process of the Main Report (**Table 11**). An iterative screening of each of the 51 alternatives was performed for this draft report based on the NED, OSE and EQ systems of accounts as identified in ER 1105-2-100. Pass/Fail and Ranking for the NED and the EQ systems of accounts are provided, with summary values in the rightmost columns. Alternatives are screened for the Shark River, North, Central and South regions of the study area.

Table 11: Alternative Plan Screening Matrix

KEY

- Screened out for further consideration due to negative AANB or Enviornmental Issues
- Alternative with Highest AANB (NED Maximized)
- Alternative with Lowest Environmental Impact (EQ Maximized)
- Alternative with lowest Residual Risk

Alternative Screening Matrix		System of Accounts														Summary Ranks	
		National Economic Development (NED)						Envrionmental Quality				Other Social Effects (OSE)					
		Initial Construction	Average Annual Net Benefits	BCR	Residual Damages	NED Rank	NED Pass/Fail	EQ Index Score	EQ Rank	EQ Pass/Fail	Cultural Resources	Nuisance Flooding	Social Risk and Vulnerability	Infrastructure Exposure	Community Cohesion	Screened NED Rank	EQ Rank
All Regions																	
1B	**All Perimeter**	**$5,229,000,000**	**$457,000,000**	**2.6**	**53%**	**1**	**Pass**	**2.9**	**2**	**Pass**	**Unknown**	Floodwalls and Levees would reduce innundation during higher frequency events	No coastal storm risk management is provided to vulnerable communites on the mainland	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands	Potential for reduction in bayside views and access by floodwalls. Real estate easements required to construct walls.	**1**	**2**
1A	**All Non-Structural**	**$7,075,000,000**	**$190,000,000**	**1.7**	**71%**	**4**	**Pass**	**4.2**	**1**	**Pass**	**Unknown**	No reduction in innudation during higher frequency events	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**2**	**1**
0	**No Action**	**$0**	**$0**	**N/A**	**100%**	**N/A**	**N/A**	**4.3**	**N/A**	**N/A**	**N/A**	No reduction in innudation during higher frequency events	No coastal storm risk management is provided to vulnerable communities in the study area	No reduction of exposure of critical infrastructure and evacuation routes	Continued Sea Level Rise will increase the damages from coastal storms in the future putting people and property at risk.	**N/A**	**N/A**
1C	**All Closed**	**$21,485,000,000**	**$146,000,000**	**1.1**	**6%**	**5**	**Pass**	**1.3**	**4**	**Fail**	**Unknown**	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events.	Exposure of critical infrastructure and evacuation routes is lessened during low frequency events.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed.	**N/A**	**4**
1D	**All Closed Less One**	**$15,457,000,000**	**$276,000,000**	**1.3**	**22%**	**3**	**Pass**	**1.8**	**3**	**Fail**	**Unknown**	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events.	Exposure of critical infrastructure and evacuation routes is lessened during low frequency events.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed.	**N/A**	**3**
Shark River																	
2A	**All Non-Structural**	**$23,000,000**	**$286,000**	**1.3**	**88%**	**1**	**Pass**	**4.2**	**1**	**Pass**	**Unknown**	No reduction in innudation during higher frequency events	There is risk that elevating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**1**	**1**
2B	**All Perimeter**	**$512,000,000**	**-$22,000,000**	**0.1**	**62%**	**2**	**Fail**	**3.8**	**2**	**Pass**	**Unknown**	Floodwalls and Levees would reduce innundation during higher frequency events	No coastal storm risk management is provided to vulnerable communites on the mainland	Exposure of critical infrastructure and evacuation routes is lessened	Potential for reduction in bayside views and access by floodwalls. Real estate easements required to construct walls.	**N/A**	**2**
2C	**All Closed**	**$591,000,000**	**-$27,000,000**	**0.2**	**37%**	**3**	**Fail**	**2.3**	**3**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events.	Exposure of critical infrastructure and evacuation routes is lessened during low frequency events.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed.	**N/A**	**3**

North Region (Manasquan to Little Egg Inlet)																
3E.2	**All Cosed Less Little Egg + Non-Structural**	**$3,838,000,000**	**$160,000,000**	**1.8**	**34%**	**1**	**Pass**	**1.8**	**5**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Manasquan and Barnegat inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures might create a false sense of security during a storm event reducing compliance with evacuation orders around Tuckerton. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable in the southern vincinity of Tuckerton where non-structural measures will be implemented.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**1**	**5**
3E.1	**All Closed Less Little Egg**	**$2,549,000,000**	**$154,000,000**	**2.0**	**44%**	**2**	**Pass**	**1.8**	**5**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Manasquan and Barnegat inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. No coastal storm risk management is implemented in the vicinity of Tuckerton.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable in the southern vincinity of Tuckerton	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. The ommision of coastal storm risk management in the vicinity of Tuckerton could have a negative impact on this community in the future	**2**	**5**
3E.3	**All Closed Less Little Egg + Non-Structural + LBI Perimeter**	**$4,776,000,000**	**$136,000,000**	**1.5**	**27%**	**3**	**Pass**	**1.8**	***6***	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Manasquan and Barnegat inlets, but will not address the risk to communities from higher frequency events. Southern LBI will experience less nusiance flooding due to the construction of a floodwall.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events, except in southern LBI where a floodwall will be constructed. There is risk that elevating structures might create a false sense of security during a storm event reducing compliance with evacuation orders around Tuckerton. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed and in LBI due to the presense of a floodwall. However, infrastructure is vulnerable in the southern vincinity of Tuckerton where non-structural measures will be implemented.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. In southern LBI, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.	**3**	**6**
3A	**All Non-Structural**	**$3,629,000,000**	**$69,000,000**	**1.5**	**63%**	**5**	**Pass**	**4.2**	**1**	**Pass**	**Unknown**	No reduction in innudation during higher frequency events	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**4**	**1**
3D	**All Perimeter Less Island Beach + Non - Structural**	**$3,899,000,000**	**$65,000,000**	**1.4**	**61%**	**7**	**Pass**	**2.9**	**2**	**Pass**	**Unknown**	No reduction in innudation during higher frequency events, except along the Manasquan North floodwall.	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	No reduction of exposure of critical infrastructure and evacuation routes, except along the Manasquan North Floodwall.	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. Along the Manasquan North floodwall, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.	**5**	**2**
3C	**All Perimeter Less LBI/ Island Beach**	**$462,000,000**	**$3,500,000**	**1.2**	**95%**	**8**	**Pass**	**2.9**	**2**	**Pass**	**Unknown**	No reduction in innudation during higher frequency events, except along the Manasquan North floodwall.	No coastal storm risk management is provided to vulnerable communites south of the Manasquan North Floodwall	No reduction of exposure of critical infrastructure and evacuation routes, except along the Manasquan North Floodwall.	Potential for reduction in bayside views and access by floodwalls. Real estate easements required to construct walls.	**6**	**2**
3B	**All Perimeter**	**$6,726,000,000**	**-$161,000,000**	**0.6**	**50%**	**10**	**Fail**	**3.2**	**3**	**Pass**	**Unknown**	Floodwalls and Levees would reduce innundation during higher frequency events	No coastal storm risk management is provided to vulnerable communites on the mainland	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands	Along the Manasquan North floodwall, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct	**N/A**	**3**
3F.1	**All Closed Less Little Egg + Holgate Closure**	**$5,925,000,000**	**$67,000,000**	**1.2**	**21%**	**6**	**Pass**	**1.2**	**7**	**Fail**	**Unknown**	Storm surge barriers will manage risk from low frequency storms, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. No coastal storm risk management is implemented south of the Holgate Bay Closure. . However, there is minimal social vulnerability and expsoure in this area.	Exposure of critical infrastructure and evacuation routes is lessened during low frequency events when the storm surge barrier is closed.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed.	**N/A**	**7**
3F.2	**3F+ (1) No Action or (2) Non-Structural**	**$6,355,000,000**	**$73,000,000**	**1.2**	**17%**	**4**	**Pass**	**1.2**	**7**	**Fail**	**Unknown**	Storm surge barriers will manage risk from low frequency storms, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that evelating structures south of the Holgate Bay Closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened during low frequency events when the storm surge barriers are closed.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities directly south of the Holgate Bay closure. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements	**N/A**	**7**

Central Region (Brigantine to Corsons Inlet)																
4D	**All Perimeter Less Brigantine non-Structural**	**$3,337,000,000**	**$378,000,000**	**3.1**	**21%**	**1**	**Pass**	**2.9**	**2**	**Pass**	**Unknown**	Floodwalls and Levees would reduce inundation in barrier island (except Brigantine Island) communities during higher frequency events.	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in Brigantine, Somers Point, Linwood, Northfield, Pleasantville, and Absecon. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands, except for Brigantine. Infrastructure and evacuation routes remain vunerable on the mainland and Brigantine.	Potential for reduction in bayside views and access by floodwalls in Ocean City and Absecon Island. Real estate easements required to construct walls could be difficult to obtain. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities in Brigantine, Somers Point, Linwood, Northfield, Pleasantville, and Absecon. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**1**	**2**
4D2	**All Perimeter + Non-Structural**	**$3,822,000,000**	**$368,000,000**	**2.8**	**18%**	**2**	**Pass**	**2.9**	**2**	**Pass**	**Unknown**	Floodwalls and Levees would reduce inundation in barrier island communities during higher frequency events.	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in Somers Point, Linwood, Northfield, Pleasantville, and Absecon. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands. Infrastructure and evacuation routes remain vunerable on the mainland.	Potential for reduction in bayside views and access by floodwalls in Ocean City, Absecon Island, and Brigantine. Real estate easements required to construct walls could be difficult to obtain. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities in Somers Point, Linwood, Northfield, Pleasantville, and Absecon. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**2**	**2**
4C	**All Perimeter Less Brigantine**	**$2,905,000,000**	**$367,000,000**	**3.2**	**24%**	**3**	**Pass**	**2.9**	**2**	**Pass**	**Unknown**	Floodwalls and Levees would reduce inundation in barrier island communities during higher frequency events.	No coastal storm risk management is provided to vulnerable communites on Brigantine Island and the mainland such as Somers Point, Linwood, Northfield, Pleasantville, and Absecon.	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands, except for Brigantine. Infrastructure and evacuation routes remain vunerable on the mainland and Brigantine.	Potential for reduction in bayside views and access by floodwalls in Ocean City and Absecon Island. Real estate easements required to construct walls could be difficult to obtain. No coastal storm risk management in Brigantine, Somers Point, Linwood, Northfield, Pleasantville, and Absecon could negatively impact those communities.	**3**	**2**
4B	**All Perimeter**	**$3,620,000,000**	**$361,000,000**	**2.8**	**20%**	**4**	**Pass**	**2.9**	**2**	**Pass**	**Unknown**	Floodwalls and Levees would reduce inundation in barrier island communities during higher frequency events.	No coastal storm risk management is provided to vulnerable communites on the mainland such as Somers Point, Linwood, Northfield, Pleasantville, and Absecon.	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands. Infrastructure and evacuation routes remain vunerable on the mainland.	Potential for reduction in bayside views and access by floodwalls in Ocean City, Absecon Island, and Brigantine Island. Real estate easements required to construct walls could be difficult to obtain. No coastal storm risk management in Somers Point, Linwood, Northfield, Pleasantville, and Absecon could negatively impact those communities.	**4**	**2**
4G.8	**G5 + South Ocean City Bay Closu**	**$5,554,000,000**	**$303,000,000**	**1.9**	**9%**	**5**	**Pass**	**1.8**	**5**	**Pass**	**Unknown**	Storm surge barriers and bay closureswill manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures north of the Absecon Bay Blvd closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier and bay closures are closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the Absecond Blvd bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. North of the bay closure, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities north of the Absecond Blvd bay closure.	5	5
4G.7	**4G5 + Non-structural and Perimeter in Southern Ocean City**	**$5,574,000,000**	**$303,000,000**	**1.9**	**10%**	**6**	**Pass**	**1.8**	**4**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd and around Corsons Inlet will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall in Southern Ocean City will reduce inundation from higher frequency events.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures north of the Absecon Bay Blvd closure and around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area. North of the bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities north of the Absecond Blvd bay closure and around Corsons Inlet. There is potential for reduction in bayside views and access by floodwalls in Southern Ocean City. Real estate easements required to construct walls could be difficult to obtain.	**6**	**4**
4G.6	**4G5 + Non-structural in Southern Ocean City**	**$5,521,000,000**	**$302,000,000**	**1.9**	**11%**	**7**	**Pass**	**1.8**	**4**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd and around Corsons Inlet will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures north of the Absecon Bay Blvd closure and around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. North of the bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities north of the Absecond Blvd bay closure and around Corsons Inlet.	**7**	**4**

4G.5	**All Closed Less Corson/Little Egg/Absecon + Absecon Blvd + Non-structural in Brigantine and Absecon**	**$5,132,000,000**	**$301,000,000**	**2.0**	**13%**	**8**	**Pass**	**1.8**	**4**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. No coastal storm risk management is provided to communities around Corsons Inlet.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities around Corsons Inlet remain vulnerable as this inlet will not be closed. There is risk that elevating structures north of the Absecon Bay Blvd closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. North of the bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities north of the Absecond Blvd bay closure. No coastal storm risk management on around Corsons Inlet can have negative impacts on these communities.	**8**	**4**
4G.12	**4G9 + South Ocean City Bay Closu**	**$6,035,000,000**	**$299,000,000**	**1.8**	**6%**	**9**	**pass**	1.8	5	Pass	Unknown	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall around Brigantine will reduce innundation from higher frequency events.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. . There is risk that elevating structures on the mainland north of the Absecon Bay Blvd closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the Absecon Blvd bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall around Brigantine could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland north of the Absecond Blvd bay closure. There is potential for reduction in bayside views and access by floodwalls in Brigantine. Real estate easements required to construct walls could be difficult to obtain.	9	5
4G.11	**4G9 + Non-structural and Perimeter in Southern Ocean City**	**$6,059,000,000**	**$299,000,000**	**1.8**	**6%**	**10**	**Pass**	**2.0**	**4**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland and around Corsons Inlet to the south will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwalls around Brigantine and southern Ocean City will reduce innundation from higher frequency events.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures on the mainland north of the Absecon Bay Blvd closure and to the south around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwalls around Brigantine and southern Ocean City could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland north of the Absecond Blvd bay closure and to the south around Corsons Inlet. There is potential for reduction in bayside views and access by floodwalls in Brigantine and southern Ocean City. Real estate easements required to construct walls could be difficult to obtain.	**10**	**4**
4G.10	**4G9 + Non-structural in Southern Ocean City**	**$6,006,000,000**	**$297,000,000**	**1.8**	**7%**	**11**	**Pass**	**1.8**	**4**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland and around Corsons Inlet to the south will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall around Brigantine will reduce innundation from higher frequency events.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures on the mainland north of the Absecon Bay Blvd closure and to the south around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall around Brigantine could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland north of the Absecond Blvd bay closure and to the south around Corsons Inlet. There is potential for reduction in bayside views and access by floodwalls in Brigantine. Real estate easements required to construct walls could be difficult to obtain.	**11**	**4**
4G.9	**All Closed Less Corson/Little Egg/Absecon + Absecon Blvd + Brigantine Perimeter+ Non-structural in Absecon**	**$5,617,000,000**	**$296,000,000**	**1.9**	**10%**	**12**	**Pass**	**1.8**	**4**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall around Brigantine will reduce innundation from higher frequency events. No coastal storm risk management is provided to communities around Corsons Inlet.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities around Corsons Inlet remain vulnerable as this inlet will not be closed. There is risk that elevating structures on the mainland north of the Absecon Bay Blvd closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall around Brigantine could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland north of the Absecond Blvd bay closure. There is potential for reduction in bayside views and access by floodwalls in Brigantine. Real estate easements required to construct walls could be difficult to obtain.No coastal storm risk management on around Corsons Inlet can have negative impacts on these communities.	**12**	**4**

4G.3	**4G1 + Perimeter and non-structural in Southern Ocean City**	**$5,326,000,000**	**$296,000,000**	**1.9**	**12%**	**13**	**Pass**	**1.8**	**4**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. The floodwall in Southern Ocean City will reduce innundation from higher frequency events. Non-structural measures on the mainland around Corsons Inlet will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. No coastal storm risk management is provided to communities north of the Absecon Blvd bay closure.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland around Corsons Inlet remain vulnerable as this inlet will not be closed. Communities north of the Absecon Blvd Bay closure will be vulnerable to coastal storm damages from Little Egg Inlet to the north. There is risk that evelating structures on the mainland around Corsons inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area. North of the bay closure and on the mainland around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. No coastal storm risk management on north of the Absecon Bay Blvd closure can have negative impacts on these communities. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland around Corsons Inlet. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. There is potential for reduction in bayside views and access by floodwalls in Southern Ocean City. Real estate easements required to construct walls could be difficult to obtain.	**13**	**4**
4G.2	**4G1 + Non-structural in Southern Ocean City**	**$5,273,000,000**	**$294,000,000**	**1.9**	**13%**	**14**	**Pass**	**1.8**	**4**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures around Corsons Inlet will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. No coastal storm risk management is provided to communities north of the Absecon Blvd bay closure.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities around Corsons Inlet remain vulnerable as this inlet will not be closed. Communities north of the Absecon Blvd Bay closure will be vulnerable to coastal storm damages from Little Egg Inlet to the north. There is risk that evelating structures around Corsons inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. North of the bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. No coastal storm risk management on north of the Absecon Bay Blvd closure can have negative impacts on these communities. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities around Corsons Inlet. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**14**	**4**
4G.1	**All Closed Less Corson/Little Egg/Absecon + Absecon Blvd**	**$4,884,000,000**	**$293,000,000**	**2.0**	**15%**	**15**	**Pass**	**1.8**	**4**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. No coastal storm risk management is provided to communities north of Absecon Inlet or around Corsons Inlet.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities around Corsons Inlet remain vulnerable as this inlet will not be closed. Communities north of the Absecon Blvd Bay closure will be vulnerable to coastal storm damages from Little Egg Inlet to the north.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. North of the bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. No coastal storm risk management on the mainland adjacent to Corsons Inlet and north of the Absecon Bay Blvd closure can have negative impacts on these communities.	**15**	**4**
4G.4	**4G1+ South Ocean City Bay Closure**	**$4,884,000,000**	**$293,000,000**	**2.0**	**15%**	**16**	**Pass**	**1.8**	**5**	**Pass**	**Unknown**	Storm surge barriers and the bay closures will manage risk from low frequency storms in the area of influence around Great Egg Harbor when closed, but will not address the risk to communities from higher frequency events. No coastal storm risk management is provided to communities north of Absecon Inlet.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Communities north of the Absecon Blvd Bay closure will be vulnerable to coastal storm damages from Little Egg Inlet to the north.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. North of the Absecon Blvd bay closure, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. No coastal storm risk management north of the Absecon Bay Blvd closure can have negative impacts on these communities.	**16**	**5**
4E.2	**4E1+ Non-Structural**	**$7,141,000,000**	**$160,000,000**	**1.4**	**17%**	**17**	**Pass**	**1.8**	**3**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland Little Egg Inlet remain vulnerable as these inlets will not be closed. There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in mainland communities adjacent to Little Egg Inlet.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Harbor and Absecon Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities in Southern Ocean City and Absecon. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**17**	**3**

4E.4	**4E1 + Southern Ocean City Bay Closure + Non-structural**	**$7,174,000,000**	**$146,000,000**	**1.3**	**15%**	**18**	**Pass**	**1.8**	**4**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events. The floodwall in Southern Ocean City will reduce innundation from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland around Corsons Inlet and Little Egg Inlet remain vulnerable as these inlets will not be closed. There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in mainland communities adjacent to Little Egg Inlet and Corsons Inlet. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg and Absecon Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland adjacent to Little Egg Inlet. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**18**	**4**
4E.3	**4E2 + Southern Ocean City Perimeter**	**$7,194,000,000**	**$146,000,000**	**1.3**	**16%**	**19**	**Pass**	**1.8**	**3**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events. The floodwall in Southern Ocean City will reduce innundation from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland around Corsons Inlet and Little Egg Inlet remain vulnerable as these inlets will not be closed. There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in mainland communities adjacent to Little Egg Inlet and Corsons Inlet. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland adjacent to Corsons and Little Egg Inlet. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. Potential for reduction in bayside views and access by floodwalls in Southern Ocean City. Real estate easements required to construct walls could be difficult to obtain.	**19**	**3**
4E.1	**All Closed Less Corson/Little Egg**	**$6,734,000,000**	**$145,000,000**	**1.3**	**19%**	**20**	**Pass**	**1.8**	**3**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, southern Ocean City and communities on the mainland around Corsons Inlet and Little Egg Inlet remain vulnerable as these inlets will not be closed.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area.	**20**	**3**
4A	**All Non-Structural**	**$1,955,000,000**	**$77,000,000**	**2.1**	**79%**	**21**	**Pass**	**4.2**	**1**	**Pass**	**Unknown**	No reduction in innudation during higher frequency events	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**21**	**1**
4F.3	**4F2+ Perimeter in Southern Ocean City**	**$10,274,000,000**	**$34,000,000**	**1.1**	**4%**	**22**	**Pass**	**1.8**	**4**	**Fail**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events. The floodwall in Southern Ocean City will reduce innundation from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland around Corsons Inlet remain vulnerable as these inlets will not be closed. There is a risk that elevating structures adjacent to Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg and Absecon Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. No coastal storm risk management on the mainland adjacent to Corsons Inlet can have negative impacts on these communities. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities adjacent to Corsons Inlet. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. Potential for reduction in bayside views and access by floodwalls in Southern Ocean City. Real estate easements required to construct walls could be difficult to obtain.	**N/A**	**4**
4F.2	**4F1+ Non-structural in Southern Ocean City**	**$10,220,000,000**	**$32,000,000**	**1.1**	**5%**	**23**	**Pass**	**2.0**	**4**	**Fail**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland around Corsons Inlet remain vulnerable as these inlets will not be closed. There is a risk that elevating structures adjacent to Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg and Absecon Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. No coastal storm risk management on the mainland adjacent to Corsons Inlet can have negative impacts on these communities. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities adjacent to Corsons Inlet. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**N/A**	**4**

4F.4	**4F1+ South Ocean City Bay Closure**	**$9,831,000,000**	**$30,000,000**	**1.0**	**7%**	**24**	**Pass**	**1.7**	**5**	**Fail**	**Unknown**	Storm surge barriers and bay closures will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg and Absecon Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed.	**N/A**	**5**
4F.1	**All Closed Less Corson/Little Egg + North Point Bay Closure**	**$9,831,000,000**	**$30,000,000**	**1.0**	**7%**	**25**	**Pass**	**1.8**	**4**	**Fail**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland around Corsons Inlet remain vulnerable as these inlets will not be closed.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg and Absecon Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. No coastal storm risk management on the mainland adjacent to Corsons Inlet can have negative impacts on these communities.	**N/A**	**4**
South Region (Strathmere to Cape May)																	
5D	**All Perimeter Less Seven Miles/Strathmere non-structural**	**$2,287,000,000**	**$96,000,000**	**1.9**	**34%**	**1**	**Pass**	**3.3**	**2**	**Pass**	**Unknown**	No reduction in innudation during higher frequency events in Strathmere and 7 Mile Island. Floodwalls and Levees would reduce innundation during higher frequency events in Cape May, the Wildwoods, and Sea Isle City.	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened in the Wildwoods, Cape May, and Sea Isle City. Exposure to critical infrastructure is not lessened in Strathmere and 7 Mile Island. Infrastructure and evacuation routes remain vunerable on the mainland.	Residual risk to infrastructure and properties that don't qualify for elevation in Strathmere and 7 Mile Island could reduce the robustness of those coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. Along the floodwalls in Sea Isle City, the Wildwoods, and Cape May, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.	**1**	**2**
5C	**All Perimeter Less Seven Mile**	**$1,863,000,000**	**$87,000,000**	**1.9**	**42%**	**2**	**Pass**	**3.3**	**2**	**Pass**	**Unknown**	No reduction in innudation during higher frequency events in Strathmere and 7 Mile Island. Floodwalls and Levees would reduce innundation during higher frequency events in Cape May, the Wildwoods, and Sea Isle City.	No coastal storm risk management is provided to vulnerable communites in Strathmere and 7 Mile Island.	Exposure of critical infrastructure and evacuation routes is lessened in the Wildwoods, Cape May, and Sea Isle City. Exposure to critical infrastructure is not lessened in Strathmere and 7 Mile Island. Infrastructure and evacuation routes remain vunerable on the mainland.	Along the floodwalls in Sea Isle City, the Wildwoods, and Cape May, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls. Communities in Strathmere and 7 Mile Island may be more significantly impacted during future coastal storm events due to no project in these areas.	**2**	**2**
5D2	**All Perimeter Less Seven Mile + Non-structural**	**$3,429,000,000**	**$57,000,000**	**1.3**	**24%**	**3**	**Pass**	**3.3**	**2**	**Pass**	**Unknown**	No reduction in innudation during higher frequency events in Strathmere. Floodwalls and Levees would reduce innundation during higher frequency events in Cape May, the Wildwoods, 7 Mile Island and Sea Isle City.	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in Strathmere.People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened in the Wildwoods, Cape May, 7 Mile Island and Sea Isle City. Exposure to critical infrastructure is not lessened in Strathmere. Infrastructure and evacuation routes remain vunerable on the mainland.	Residual risk to infrastructure and properties that don't qualify for elevation in Strathmere could reduce the robustness of those coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. Along the floodwalls in Sea Isle City, the Wildwoods, 7 Mile Island, and Cape May, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.	**3**	**2**
5B	**All Perimeter**	**$3,424,000,000**	**$51,000,000**	**1.3**	**25%**	**4**	**Pass**	**3.3**	**2**	**Pass**	**Unknown**	Floodwalls and Levees would reduce innundation during higher frequency events	No coastal storm risk management is provided to vulnerable communites on the mainland	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands. Infrastructure and evacuation routes remain vunerable on the mainland.	Potential for reduction in bayside views and access by floodwalls. Real estate easements required to construct walls.	**4**	**2**
5A	**All Non-Structural**	**$1,467,000,000**	**$44,000,000**	**1.8**	**68%**	**5**	**Pass**	**4.2**	**1**	**Pass**	**Unknown**	No reduction in innudation during higher frequency events	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**5**	**1**

5E.2	**5E+ (1) No Action, OR (2) Non-Structural**	**$4,681,000,000**	**$17,000,000**	**1.1**	**6%**	**6**	**Pass**	**2.0**	**3**	**Fail**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence aroundCape May Canal, Hereford and Townsends inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures might create a false sense of security during a storm event reducing compliance with evacuation orders around Strathmere. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Cape May Canal, Hereford and Townsends inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable in Strathmere where non-structural measures will be implemented.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities in Strathmere. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**N/A**	**3**
5E.1	**All Closed less Corson**	**$4,639,000,000**	**$16,000,000**	**1.1**	**6%**	**7**	**Pass**	**2.0**	**3**	**Fail**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Cape May Canal, Hereford and Townsends inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. No coastal storm risk management is implemented in the vicinity of Strathmere near Corson's Inlet.	Exposure of critical infrastructure and evacuation routes is lessened around Cape May Canal, Hereford and Townsends inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable in Strathmere near Corson's Inlet	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. The ommision of coastal storm risk management in Strathmere near Corson's Inlet could have a negative impact on this community in the future	**N/A**	**3**
5F	**All Closed Less Corson Sea isle Closure**	**$5,266,000,000**	**-$11,000,000**	**1.0**	**4%**	**8**	**Fail**	**2.0**	**3**	**Fail**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Cape May Canal, Hereford and Townsends inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures might create a false sense of security during a storm event reducing compliance with evacuation orders around Strathmere. People sheltering in place could increase both their personal risk and the risk to emergency responders. Additionally, more modeling would need to occur to verify that the bay closure will not induce flooding in Strathmere	Exposure of critical infrastructure and evacuation routes is lessened around Cape May Canal, Hereford and Townsends inlets during low frequency events when the storm surge barrier is closed. The Bay closure at Sea Isle City Blvd will reduce risk to that evacuation route. However, infrastructure is vulnerable in Strathmere where non-structural measures will be implemented.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closure are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities in Strathmere. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**N/A**	**3**
5G	**All Closed Less Corson+Sea Isle+Wildwood+Stone Harbor**	**$5,924,000,000**	**-$50,000,000**	**0.9**	**5%**	**9**	**Fail**	**2.0**	**3**	**Pass**	**Unknown**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Cape May Canal and Townsends inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures might create a false sense of security during a storm event reducing compliance with evacuation orders around Strathmere. People sheltering in place could increase both their personal risk and the risk to emergency responders. Additionally, more modeling would need to occur to verify that the bay closures will not induce flooding in Strathmere	Exposure of critical infrastructure and evacuation routes is lessened around Cape May Canal, Hereford and Townsends inlets during low frequency events when the storm surge barrier is closed. The Bay closures at Sea Isle City Blvd, Stone Harbor Blvd, and Wildwood Blvd will reduce risk to that evacuation route. However, infrastructure is vulnerable in Strathmere where non-structural measures will be implemented.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closure are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities in Strathmere. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.	**N/A**	**3**

A-6) FOCUSED ARRAY COMPARISON MATRIX

This section includes a comparison of the 16 alternative plans plus six permutations included in the focused array (**Table 12**). This table shows the detailed results associated with the screening of the 51 alternative plans discussed in Chapter 10. Plan Formulation Process of the Main Report. Results included in this table include the NED, OSE and EQ systems of accounts as well as the Planning Criteria identified in ER 1105-2-100. The focused array of alternatives is presented in this table by the Shark River, North, Central and South regions of the study area.

Table 12: Focused Array Comparison Matrix

NJBB TSP IPR Focused Array Comparison		Planning Criteria				System of Accounts										
						National Economic Development (NED)					Environmental Quality			Other Social Effects (OSE)			
		Effectiveness	Efficiency	Acceptability	Completeness	Initial Construction	Average Annual Net Benefits	BCR	Residual Damages	NED Rank	EQ Index Score	EQ Rank	Direct Impact Acres (all habitats)	Nuisance Flooding	Social Risk and Vulnerability	Infrastructure Exposure	Community Cohesion
Shark River																	
2A	**All Non-Structural**	**Pass - elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure**	**Pass (BCR>1)**	**Pass: There is risk due to uncertainty of implementatbility due to remaining questions about compliance with state and local laws.**	**Pass - Very high residual risk (71%)**	**$23,000,000**	**$286,000**	**1.3**	**88%**	**1**	**4.2**	**1**	**negligible**	No reduction in innudation during higher frequency events	There is risk that elevating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.
North Region (Manasquan to Little Egg Inlet)																	
3E.2	**All Cosed Less Little Egg + Non-Structural**	**Pass - Storm surge barriers will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure**	**Pass (BCR>1)**	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers. There is risk due to uncertainty of implementatbility due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities, but only during low frequency events. Structure elevation will provide some CSRM to more vulnerable structures.**	**$3,838,000,000**	**$160,000,000**	**1.8**	**34%**	**1**	**1.8**	**3**	**31.6**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Manasquan and Barnegat inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures might create a false sense of security during a storm event reducing compliance with evacuation orders around Tuckerton. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable in the southern vincinity of Tuckerton where non-structural measures will be implemented.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.
3E.1	**All Closed Less Little Egg**	**Pass - Storm surge barriers will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events.**	**Pass (BCR>2)**	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities, but only during low frequency events.**	**$2,549,000,000**	**$154,000,000**	**2.0**	**44%**	**2**	**1.8**	**3**	**31.6**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Manasquan and Barnegat inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. No coastal storm risk management is implemented in the vicinity of Tuckerton.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable in the southern vincinity of Tuckerton	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. The ommision of coastal storm risk management in the vicinity of Tuckerton could have a negative impact on this community in the future
3E.3	**All Closed Less Little Egg + Non-Structural + LBI Perimeter**	**High - Storm surge barriers will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure on the mainland. In southern LBI, the floodwall will manage risk for both high and low frequency events**	**Pass (BCR>1)**	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and high uncertainty whether the high direct impacts of a floodwall would be acceptabile to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Lowest residual risk plan in this region. Provides CSRM to both mainland and barrier islands.**	**$4,776,000,000**	**$136,000,000**	**1.5**	**27%**	**3**	**1.8**	**4**	**165.3**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Manasquan and Barnegat inlets, but will not address the risk to communities from higher frequency events. Southern LBI will experience less nuisance flooding due to the construction of a floodwall.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events, except in southern LBI where a floodwall will be constructed. There is risk that elevating structures might create a false sense of security during a storm event reducing compliance with evacuation orders around Tuckerton. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed and in LBI due to the presense of a floodwall. However, infrastructure is vulnerable in the southern vincinity of Tuckerton where non-structural measures will be implemented.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. In southern LBI, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.
3A	**All Non-Structural**	**Pass - elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure**	**Pass (BCR>1)**	**Pass: There is risk due to uncertainty of implementatbility of non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass - High residual risk (71%). Provides CRSM to both mainland and barrier islands**	**$3,629,000,000**	**$69,000,000**	**1.5**	**63%**	**4**	**4.2**	**1**	**negligible**	No reduction in innudation during higher frequency events	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.
3D	**All Perimiter Less Island Beach + Non - Structural**	**Pass - Elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure on the mainland. Behind the Manasquan North floodwall, the floodwall will manage risk for both high and low frequency events**	**Pass (BCR>1)**	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty whether the high direct impacts of a floodwall would be acceptabile to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass - High residual risk (61%). Provides CRSM to both mainland and barrier islands**	**$3,899,000,000**	**$65,000,000**	**1.4**	**61%**	**5**	**2.9**	**2**	**37.2**	No reduction in innudation during higher frequency events, except along the Manasquan North floodwall.	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	No reduction of exposure of critical infrastructure and evacuation routes, except along the Manasquan North Floodwall.	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. Along the Manasquan North floodwall, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.
Central Region (Brigantine to Corsons Inlet)																	
4D	**All Perimiter Less Brigantine non-Structural**	**Pass - Elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure on the mainland. In Ocean City and Absecon Island, the floodwalls will manage risk for both high and low frequency events.**	**Pass (BCR>2)**	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty whether the high direct impacts of a floodwall would be acceptabile to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands (Except Brigantine) and mainland communities. Elevating structures does not reduce risk to other critical infrastructure. Plan has low residual risk.**	**$3,337,000,000**	**$378,000,000**	**3.1**	**21%**	**1**	**2.9**	**2**	**237.6**	Floodwalls and Levees would reduce innundation in barrier island (except Brigantine Island) communities during higher frequency events.	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in Brigantine, Somers Point, Linwood, Northfield, Pleasantville, and Absecon. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands, except for Brigantine. Infrastructure and evacuation routes remain vunerable on the mainland and Brigantine.	Potential for reduction in bayside views and access by floodwalls in Ocean City and Absecon Island. Real estate easements required to construct walls could be difficult to obtain. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities in Brigantine, Somers Point, Linwood, Northfield, Pleasantville, and Absecon. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.
4D2	**All Perimeter + Non-Structural**	**Pass - Elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure on the mainland. In Ocean City, Absecon Island, and Brigantine, the floodwalls will manage risk for both high and low frequency events.**	**Pass (BCR>2)**	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty whether the high direct impacts of a floodwall would be acceptabile to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure. Plan has low residual risk.**	**$3,822,000,000**	**$368,000,000**	**2.8**	**18%**	**2**	**2.9**	**2**	**287.7**	Floodwalls and Levees would reduce innundation in barrier island communities during higher frequency events.	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in Somers Point, Linwood, Northfield, Pleasantville, and Absecon. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands. Infrastructure and evacuation routes remain vunerable on the mainland.	Potential for reduction in bayside views and access by floodwalls in Ocean City, Absecon Island, and Brigantine. Real estate easements required to construct walls could be difficult to obtain. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities in Somers Point, Linwood, Northfield, Pleasantville, and Absecon. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.

4G.8	**4G5 + South Ocean City Bay Closur**	**Pass - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Non-structural measures such as building elevation north of the Absecon Blvd Bay closure will manage risk to structures, but not other critical infrastructure.**	Pass (BCR>2)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure. Very low residual risk.**	**$5,554,000,000**	**$303,000,000**	**1.9**	**9%**	**3**	**1.8**	**5**	**131.9**	Storm surge barriers and bay closureswill manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures north of the Absecon Bay Blvd closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier and bay closures are closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the Absecon Blvd bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. North of the bay closure, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities north of the Absecond Blvd bay closure.
4G.7	**4G5 + Non-structural and Perimeter in Southern Ocean City**	**Pass - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Non-structural measures such as building elevation north of the Absecon Blvd Bay closure will manage risk to structures, but not other critical infrastructure. The floodwall along southern Ocean City will manage risk from both high and low frequency events.**	Pass (BCR>1)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure. Very low residual risk.**	**$5,574,000,000**	**$303,000,000**	**1.9**	**10%**	**4**	**1.8**	**4**	**157**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd and around Corsons Inlet will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall in Southern Ocean City will reduce innundation from higher frequency events.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures north of the Absecon Bay Blvd closure and around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area. North of the bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities north of the Absecond Blvd bay closure and around Corsons Inlet. There is potential for reduction in bayside views and access by floodwalls in Southern Ocean City. Real estate easements required to construct walls could be difficult to obtain.
4G.6	**4G5 + Non-structural in Southern Ocean City**	**Pass - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Non-structural measures such as building elevation north of the Absecon Blvd Bay closure will manage risk to structures, but not other critical infrastructure.**	Pass (BCR>1)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure. Very low residual risk.**	**$5,521,000,000**	**$302,000,000**	**1.9**	**11%**	**5**	**1.8**	**4**	**107.1**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd and around Corsons Inlet will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures north of the Absecon Bay Blvd closure and around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk North of the bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities north of the Absecond Blvd bay closure and around Corsons Inlet.
4G.5	**All Closed Less Corson/Little Egg/Absecon + Absecon Blvd + Non-structural in Brigantine and Absecon**	**Pass - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Non-structural measures such as building elevation north of the Absecon Blvd Bay closure will manage risk to structures, but not other critical infrastructure.**	Pass (BCR>2)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure. Very low residual risk.**	**$5,132,000,000**	**$301,000,000**	**2.0**	**13%**	**6**	**1.8**	**4**	**107.1**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. No coastal storm risk management is provided to communities around Corsons Inlet.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities around Corsons Inlet remain vulnerable as this inlet will not be closed. There is risk that elevating structures north of the Absecon Bay Blvd closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk North of the bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities north of the Absecond Blvd bay closure. No coastal storm risk management on around Corsons Inlet can have negative impacts on these communities.
4G.12	**4G9 + South Ocean City Bay Closur**	**Pass - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Non-structural measures such as building elevation north of the Absecon Blvd Bay and north of Corsons Inlet closure will manage risk to structures, but not other critical infrastructure. The floodwall along Brigantine will manage risk from both high and low frequency events.**	Pass (BCR>1)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure. Lowest residual risk plan in this region.**	**$6,035,000,000**	**$299,000,000**	**1.8**	**6%**	7	1.8	5	181.9	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall around Brigantine will reduce innundation from higher frequency events.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. . There is risk that elevating structures on the mainland north of the Absecon Bay Blvd closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the Absecon Blvd bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall around Brigantine could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland north of the Absecond Blvd bay closure. There is potential for reduction in bayside views and access by floodwalls in Brigantine. Real estate easements required to construct walls could be difficult to obtain.
4G.11	**4G9 + Non-structural and Perimeter in Southern Ocean City**	**Pass - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Non-structural measures such as building elevation north of the Absecon Blvd Bay and north of Corsons Inlet closure will manage risk to structures, but not other critical infrastructure. The floodwall along Brigantine and around southern Ocean City will manage risk from both high and low frequency events.**	Pass (BCR>1)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure. Lowest residual risk plan in this region.**	**$6,059,000,000**	**$299,000,000**	**1.8**	**6%**	**8**	**2.0**	**4**	**207.1**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland and around Corsons Inlet to the south will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwalls around Brigantine and southern Ocean City will reduce innundation from higher frequency events.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures on the mainland north of the Absecon Bay Blvd closure and to the south around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk The floodwalls around Brigantine and southern Ocean City could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland north of the Absecond Blvd bay closure and to the south around Corsons Inlet. There is potential for reduction in bayside views and access by floodwalls in Brigantine and southern Ocean City. Real estate easements required to construct walls could be difficult to obtain.

4G.10	**4G9 + Non-structural in Southern Ocean City**	**Pass - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Non-structural measures such as building elevation north of the Absecon Blvd Bay and north of Corsons Inlet closure will manage risk to structures, but not other critical infrastructure. The floodwall along Brigantine will manage risk from both high and low frequency events.**	Pass (BCR>1)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure. Very low residual risk.**	**$6,006,000,000**	**$297,000,000**	**1.8**	**7%**	**9**	**1.8**	**4**	**157.1**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland and around Corsons Inlet to the south will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall around Brigantine will reduce innundation from higher frequency events.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that elevating structures on the mainland north of the Absecon Bay Blvd closure and to the south around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall around Brigantine could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland north of the Absecond Blvd bay closure and to the south around Corsons Inlet. There is potential for reduction in bayside views and access by floodwalls in Brigantine. Real estate easements required to construct walls could be difficult to obtain.
4G.9	**All Closed Less Corson/Little Egg/Absecon + Absecon Blvd + Brigantine Perimeter+ Non-structural in Absecon**	**Pass - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Non-structural measures such as building elevation north of the Absecon Blvd Bay closure will manage risk to structures, but not other critical infrastructure. The floodwall along Brigantine will manage risk from both high and low frequency events.**	Pass (BCR>1)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure. Very low residual risk.**	**$5,617,000,000**	**$296,000,000**	**1.9**	**10%**	**10**	**1.8**	**4**	**157.1**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall around Brigantine will reduce innundation from higher frequency events. No coastal storm risk management is provided to communities around Corsons Inlet.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities around Corsons Inlet remain vulnerable as this inlet will not be closed. There is risk that elevating structures on the mainland north of the Absecon Bay Blvd closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall around Brigantine could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland north of the Absecond Blvd bay closure. There is potential for reduction in bayside views and access by floodwalls in Brigantine. Real estate easements required to construct walls could be difficult to obtain.No coastal storm risk management on around Corsons Inlet can have negative impacts on these communities.
4E.2	**4E1+ Non-Structural**	**Pass - Storm surge barriers will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Elevating structures north of Corsons Inlet and in the vincinity of Absecon, will reduce damages to buildings, but do not reduce risk to other infrastructure**	Pass (BCR>1)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities, but only during low frequency events.**	**$7,141,000,000**	**$160,000,000**	**1.4**	**17%**	**11**	**1.8**	**3**	**33**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland Little Egg Inlet remain vulnerable as these inlets will not be closed. There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in mainland communities adjacent to Little Egg Inlet.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Harbor and Absecon Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities in Southern Ocean City and Absecon. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.
4E.4	**4E1 + Southern Ocean City Bay Closure + Non-structural**	**Pass - Storm surge barriers will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Elevating structures north of Corsons Inlet and in the vincinity of Absecon, will reduce damages to buildings, but do not reduce risk to other infrastructure**	Pass (BCR>1)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities, but only during low frequency events.**	**$7,174,000,000**	**$146,000,000**	**1.3**	**15%**	**12**	**1.8**	**4**	**57.8**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events. The floodwall in Southern Ocean City will reduce innundation from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland around Corsons Inlet and Little Egg Inlet remain vulnerable as these inlets will not be closed. There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in mainland communities adjacent to Little Egg Inlet and Corsons Inlet. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg and Absecon Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland adjacent to Little Egg Inlet. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.
4E.3	**4E2 + Southern Ocean City Perimeter**	**Pass - Storm surge barriers will reduce coastal storm risk during low frequency events, but will not reduce risk from more frequent storm events. Elevating structures north of Corsons Inlet and in the vincinity of Absecon, will reduce damages to buildings, but do not reduce risk to other infrastructure. The floodwall in southern Ocean City will manage risk from high and low frequency events.**	Pass (BCR>1)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities, but only during low frequency events. The floodwall in Ocean City will provide CRSM during high frequency events. Non-structural measures will manage risk to structures, but not other infrastructure.**	**$7,194,000,000**	**$146,000,000**	**1.3**	**16%**	**13**	**1.8**	**3**	**83**	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events. The floodwall in Southern Ocean City will reduce innundation from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland around Corsons Inlet and Little Egg Inlet remain vulnerable as these inlets will not be closed. There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in mainland communities adjacent to Little Egg Inlet and Corsons Inlet. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is dosed. However, infrastructure is vulnerable when the storm surge barriers are open. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland adjacent to Corsons and Little Egg Inlet. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. Potential for reduction in bayside views and access by floodwalls in Southern Ocean City. Real estate easements required to construct walls could be difficult to obtain.
4A	**All Non-Structural**	**Pass - elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure**	Pass (BCR>2)	**Pass: There is risk due to uncertainty of implementability of non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass - High residual risk (79%). Provides CRSM to both mainland and barrier islands**	**$1,955,000,000**	**$77,000,000**	**2.1**	**79%**	**14**	**4.2**	**1**	**negligible**	No reduction in innudation during higher frequency events	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.
South Region (Strathmere to Cape May)																	
5D	**All Perimiter Less Seven Miles/Strathmere non-structural**	**Pass - Elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure on the mainland. In Cape May City, Wildwood Island and Sea Isle City, the floodwalls will manage risk for both high and low frequency events.**	Pass (BCR>1)	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure.**	**$2,287,000,000**	**$96,000,000**	**1.9**	**34%**	**1**	**3.3**	**2**	**182.4**	No reduction in innudation during higher frequency events in Strathmere and 7 Mile Island. Floodwalls and Levees would reduce innundation during higher frequency events in Cape May, the Wildwoods, and Sea Isle City.	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened in the Wildwoods, Cape May, and Sea Isle City. Exposure to critical infrastructure is not lessened in Strathmere and 7 Mile Island. Infrastructure and evacuation routes remain vunerable on the mainland.	Residual risk to infrastructure and properties that don't qualify for elevation in Strathmere and 7 Mile Island could reduce the robustness of those coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. Along the floodwalls in Sea Isle City, the Wildwoods, and Cape May, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.

5D2	**All Perimiter Less Seven Mile + Non-structural**	**Pass - Elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure on the mainland. In Cape May City, Wildwood Island, Seven Mile Island, and Sea Isle City, the floodwalls will manage risk for both high and low frequency events.**	**Pass (BCR>1)**	**Pass: There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass: Provides CSRM benefits to both barrier islands and mainland communities. Elevating structures does not reduce risk to other critical infrastructure on the mainland. This plan has the lowest residual risk (25%) in the region.**	**$3,429,000,000**	**$57,000,000**	**1.3**	**24%**	**2**	**3.3**	**2**	**307.8**	No reduction in inundation during higher frequency events in Strathmere. Floodwalls and Levees would reduce inundation during higher frequency events in Cape May, the Wildwoods, 7 Mile Island and Sea Isle City.	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders in Strathmere. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened in the Wildwoods, Cape May, 7 Mile Island and Sea Isle City. Exposure to critical infrastructure is not lessened in Strathmere. Infrastructure and evacuation routes remain vunerable on the mainland.	Residual risk to infrastructure and properties that don't qualify for elevation in Strathmere could reduce the robustness of those coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. Along the floodwalls in Sea Isle City, the Wildwoods, 7 Mile Island, and Cape May, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.
5A	**All Non-Structural**	**Pass - elevating structures will reduce damages to buildings, but do not reduce risk to other infrastructure**	**Pass (BCR>2)**	**Pass: There is risk due to uncertainty of implementability of non-structural measures due to remaining questions about compliance with state and local laws.**	**Pass - High residual risk (71%). Provides CRSM to both mainland and barrier islands**	**$1,467,000,000**	**$44,000,000**	**1.8**	**68%**	**3**	**4.2**	**1**	**negligible**	No reduction in inundation during higher frequency events	There is risk that evelating structures might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.

A-7) PRELIMINARY FOCUSED ARRAY OF ALTERNATIVES

Introduction and Overview

The preliminary focused array of alternative plans has been formulated based on management measures screening and the evaluation and comparison of alternative plans as discussed in preceding sections. From the 51 presented regional alternative plans, 20 preliminary regional alternative plans within 10 themes are included in the focused array and are discussed in this chapter. Nonstructural measures are being considered in all regions. Storm surge barriers are considered only in the North and Central regions, while interior bay closures are considered in only the Central region. Perimeter measures including floodwalls and levees are considered in all regions. Error! Reference source not found. **13** provides an overview of the strategies that remain under consideration within each region.

Table 13: Preliminary Focused Array of Alternative Plans

Region	Themes	Alternative	NONSTRUC	PERIMETER	SSB	BC
SHARK RIVER	2A	2A	X			
NORTH	3A	3A	X			
	3D	3D	X	X		
	3E	3E(2)	X		X	
		3E(3)	X	X	X	
CENTRAL	4A	4A	X			
	4D	4D(1)	X	X		
		4D(2)	X	X		
	4E	4E(2)	X		X	
		4E(3)	X	X	X	
		4E(4)	X		X	X
	4G	4G(6)	X		X	X
		4G(7)	X	X	X	X
		4G(8)	X		X	X
		4G(10)	X	X	X	X
		4G(11)	X	X	X	X
		4G(12)	X	X	X	X
SOUTH	5A	5A	X			
	5D	5D(1)	X	X		
		5D(2)	X	X		

Region	Overview	Alternative	INIT. CONST.	AANB	BCR	RESIDUAL
SHARK RIVER	2A	2A	$24,468,000	$227,000	1.25	88.47%

NORTH	3A	3A	$3,629,095,000	$68,586,000	1.51	62.97%
	3D	3D	$3,898,614,000	$64,831,000	1.43	60.81%
	3E	3E(2)	$3,837,663,000	$160,160,000	1.79	33.84%
		3E(3)	$4,838,353,000	$131,861,000	1.49	27.06%
CENTRAL	4A	4A	$1,954,627,000	$76,562,000	2.06	78.81%
	4D	4D(1)	$3,336,914,000	$377,671,000	3.10	20.65%
		4D(2)	$3,822,130,000	$367,689,000	2.76	18.02%
	4E	4E(2)	$7,140,707,000	$160,299,000	1.38	16.64%
		4E(3)	$7,169,796,000	$146,094,000	1.33	15.64%
		4E(4)	$7,173,761,000	$145,853,000	1.32	15.24%
	4G	4G(6)	$5,520,576,000	$302,114,000	1.93	10.80%
		4G(7)	$5,549,665,000	$303,630,000	1.92	9.71%
		4G(8)	$5,553,629,000	$303,405,000	1.91	9.30%
		4G(10)	$6,005,792,000	$297,380,000	1.84	7.42%
		4G(11)	$6,034,880,000	$298,897,000	1.83	6.33%
		4G(12)	$6,038,845,000	$298,671,000	1.82	5.93%
SOUTH	5A	5A	$1,467,103,000	$44,216,000	1.81	68.27%
	5D	5D(1)	$2,286,822,000	$96,408,000	1.88	33.53%
		5D(2)	$3,428,552,000	$57,310,000	1.32	23.52%

The focused array of alternative plans is presented by region as even just the remaining 20 alternatives have a total of 144 unique, non-repetitive combinations if they were aggregated to a study-wide level. In addition, each region (with the exception of Shark River) has multiple alternative types still under consideration with further analysis necessary to determine the NED Plan.

However, as each region is functionally independent, it is possible to calculate the AANB and BCR for any and all of the 144 combinations. For example, the current NED maximizing study wide plan is the combination of 2A + 3E(2) + 4D(1) + 5D(1) for a total of $634,466,000 in AANB with a 2.29 BCR with 28.22% residual damages. The current damage minimization plan is 2A + 3E(3) + 4G(12) + 5D(2) with $488,069,000 in AANB with a 1.6 BCR and 17.29% in residual damages.

Combinations that minimize environmental impact or maximize social benefits or any other objective can be calculated by aggregating one alternative from each Region.

Preliminary Focused Array Description by Region

No Action

The No Action alternative is a plan that proposes the USACE will not implement any of the proposed actions identified in this study. The No Action Alternative also assumes current floodplain management conditions continue into the future. Estimated future changes such as changes in sea level, local environment, land use, and population as well as policy, laws and regulations are incorporated into the No Action Alternative.

This plan is considered the projected baseline, or without project, condition which is used to compare all other proposed alternatives. Future economic, environmental, and social impacts of all proposed alternatives are assessed against the No Action Alternative.

The project baseline is estimated to be 2030 when construction of the actual project will begin. All Federal, NJDEP and NGOs (i.e., NFWF) constructed or ongoing navigation projects as identified in Plan Formulation Appendix A in the 'Existing CSRM Studies, Reports Projects, Actions and Programs' Section are considered included in the No Action alternative.

Shark River & Coastal Lakes Region

Alternative 2A

This alternative includes only nonstructural solutions for 106 residential structures. Only structure elevation is being considered as a nonstructural measure at this point in the study. No storm surge barriers or interior bay closures, or floodwalls/levees are included in this alternative plan. Of particular note is that the storm surge barrier alternative was not justified economically due to relative higher costs than the nonstructural solution and was eliminated as an alternative in the preliminary focused array. NNBF will be considered for this and future focused array alternative plans as they are developed during subsequent phases of the feasibility study. The management measure features of this alternative plan are provided in Error! Reference source not found.**16**.

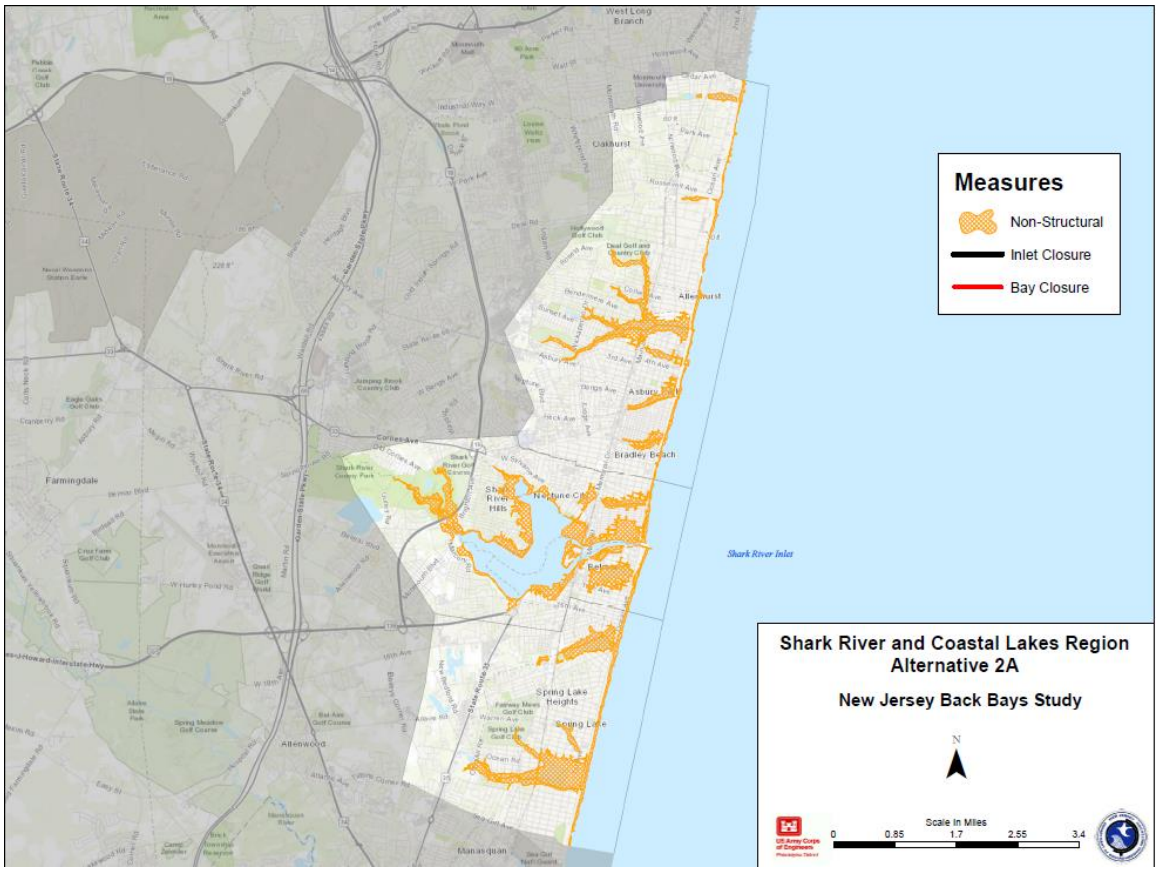


Figure 16: Shark River & Coastal Lakes Region Alternative 2A Management Measure Features (Note: Approximate, preliminary locations)

North Region

Analyses for the North Region have indicated a combination of storm surge barriers, floodwalls/levees, and nonstructural solutions (including structure elevation for residential structures only at this point in the study) to address coastal storm risk (including residual coastal flooding impacts due to increasing sea level over the extended project period) for the larger Barnegat Bay and Great Bay system. Detailed quantities for storm surge barriers and floodwall/levee solutions can be found in the Engineering Sub-Appendix of the Engineering Appendix B. Detailed hydrodynamic modeling results for storm surge barriers can be found in the Hydrology, Hydraulics and Coastal Engineering Sub-Appendix.

The North Region of the NJBB Study Area includes three themes in the preliminary focused array of alternative plans including 3A, 3D and 3E. Alternative 3A considers nonstructural solutions only. Alternative 3D includes nonstructural and floodwall/levee solutions. Theme 3E, which has two alternative plans including 3E(2) and 3E(3), includes variations of storm surge barrier, nonstructural and floodwall/levee solutions. A more detailed description of the alternative plans is provided below.

Alternative 3A

This preliminary alternative plan includes only nonstructural solutions for 16,421 residential structures. No storm surge barriers or interior bay closures, or floodwalls/levees are included in this alternative plan. The management measure features of Alternative 3A are provided in Error! Reference source not found.**17**.

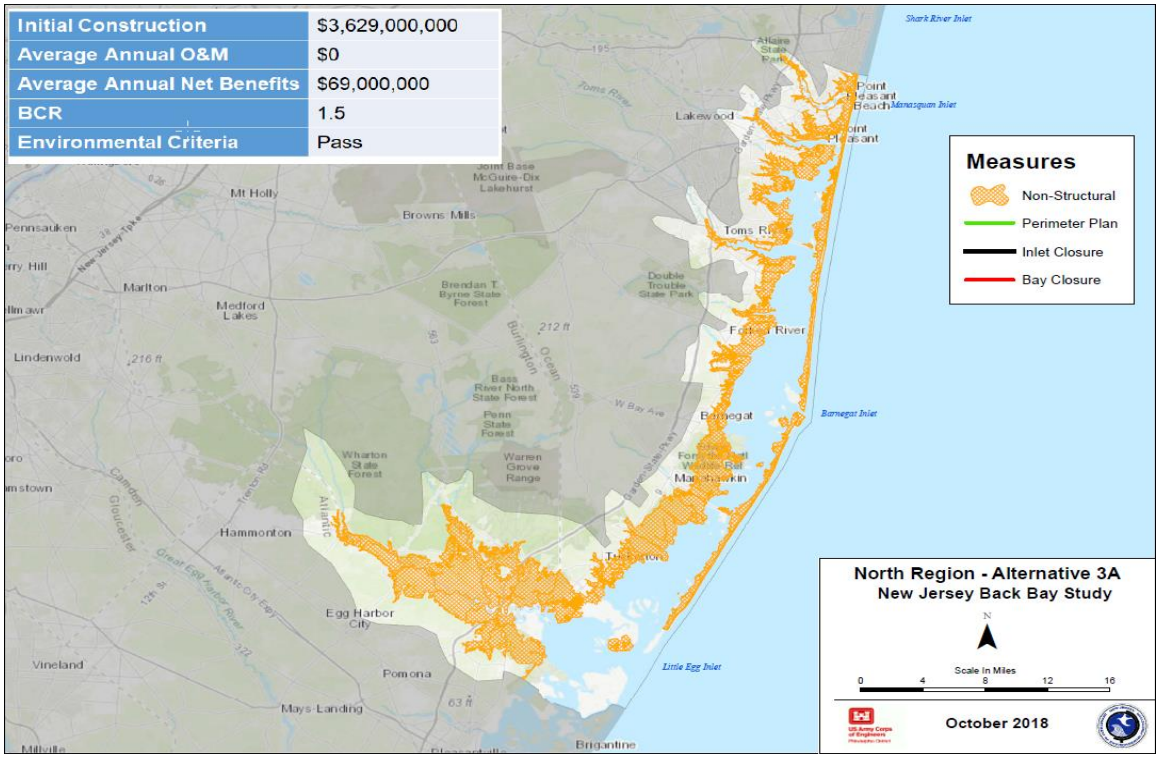


Figure 17: North Region Alternative 3A Management Measure Features (Note: Approximate, preliminary locations)

Alternative 3D

The preliminary strategy developed for Alternative 3D includes nonstructural solutions for 15,565 residential structures for the municipalities on the mainland adjacent to Great Bay and Mullica River Embayment, Little Egg Harbor and portions of Manahawkin Bay, and associated tributaries and canals. This alternative plan also includes over six miles of floodwalls inclusive of three miter gates and two road closures as well as approximately two miles of levees in the vicinity of Manasquan Inlet in Manasquan, Brielle, and Point Pleasant Beach. The management measure features of this alternative plan are provided in Error! Reference source not found.**18**.

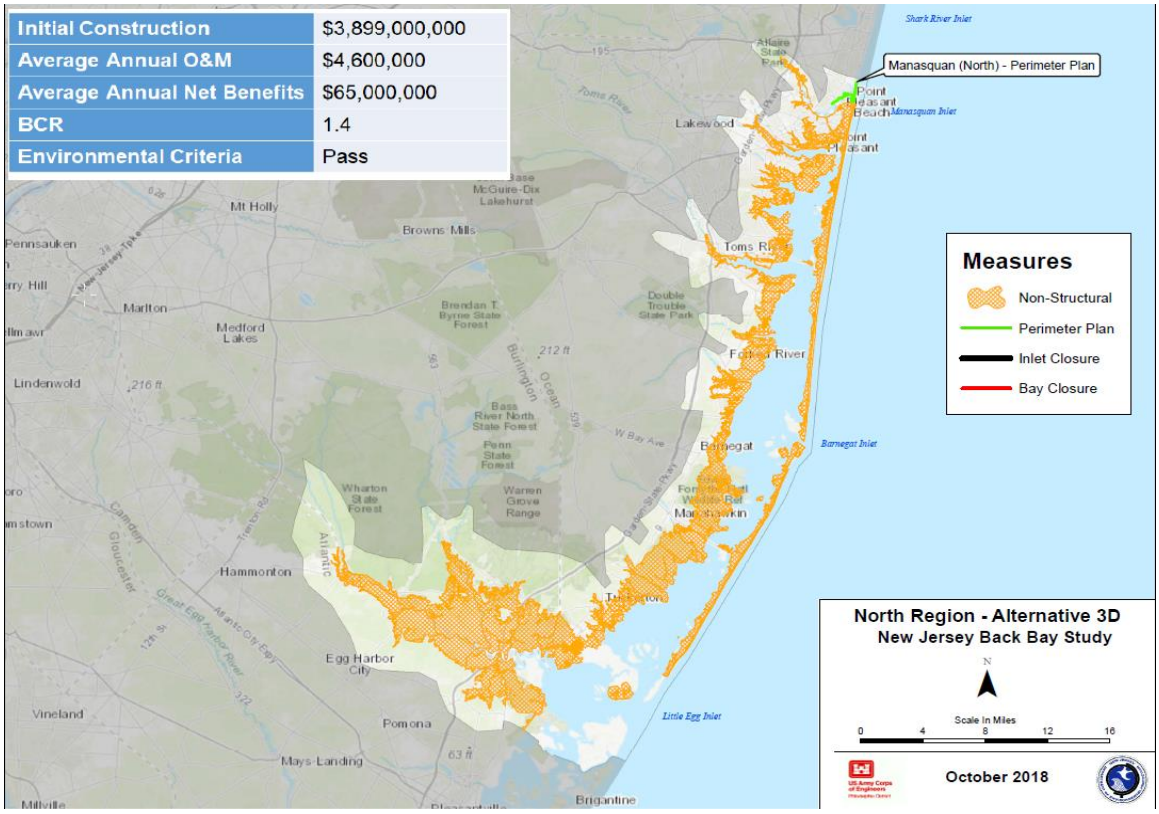


Figure 18: North Region Alternative 3D Management Measure Features (Note: Approximate, preliminary locations)

Alternative 3E(2) and 3E(3)

A preliminary strategy was developed for Alternatives 3E(2) and 3E(3) to focus on managing the risk of coastal flooding and sea level rise in the North Region of the NJBB study area. These alternative plans include storm surge barriers located at both Manasquan Inlet and Barnegat Inlet. Detailed quantities for each of these storm surge barriers can be found in the Civil Engineering Sub-Appendix. Detailed hydrodynamic modeling results for storm surge barriers can be found in the Hydrology, Hydraulics and Coastal Engineering Sub-Appendix. Each of these alternative plans include nonstructural solutions for the municipalities on the mainland adjacent to Great Bay and Mullica River Embayment, Little Egg Harbor and portions of Manahawkin Bay, and associated tributaries and canals.

Alternative 3E(2) includes nonstructural solutions for 5,843 residential structures developed portions of Long Beach Island fronting Little Egg Harbor and portions of Manahawkin Bay. Alternative 3E(3) includes 75 miles of floodwalls inclusive of 10 miter gates and 10 road closures, and approximately three miles of levees along Long Beach Island fronting Little Egg Harbor and portions of Manahawkin Bay rather than the nonstructural solutions for the Long Beach Island shoreline offered in alternative 3E(2). This alternative plan includes nonstructural solutions for 3,780 residential structures. The management measure features of these alternative plans are provided in Error! Reference source not found.**19** and Error! Reference source not found.**20**.

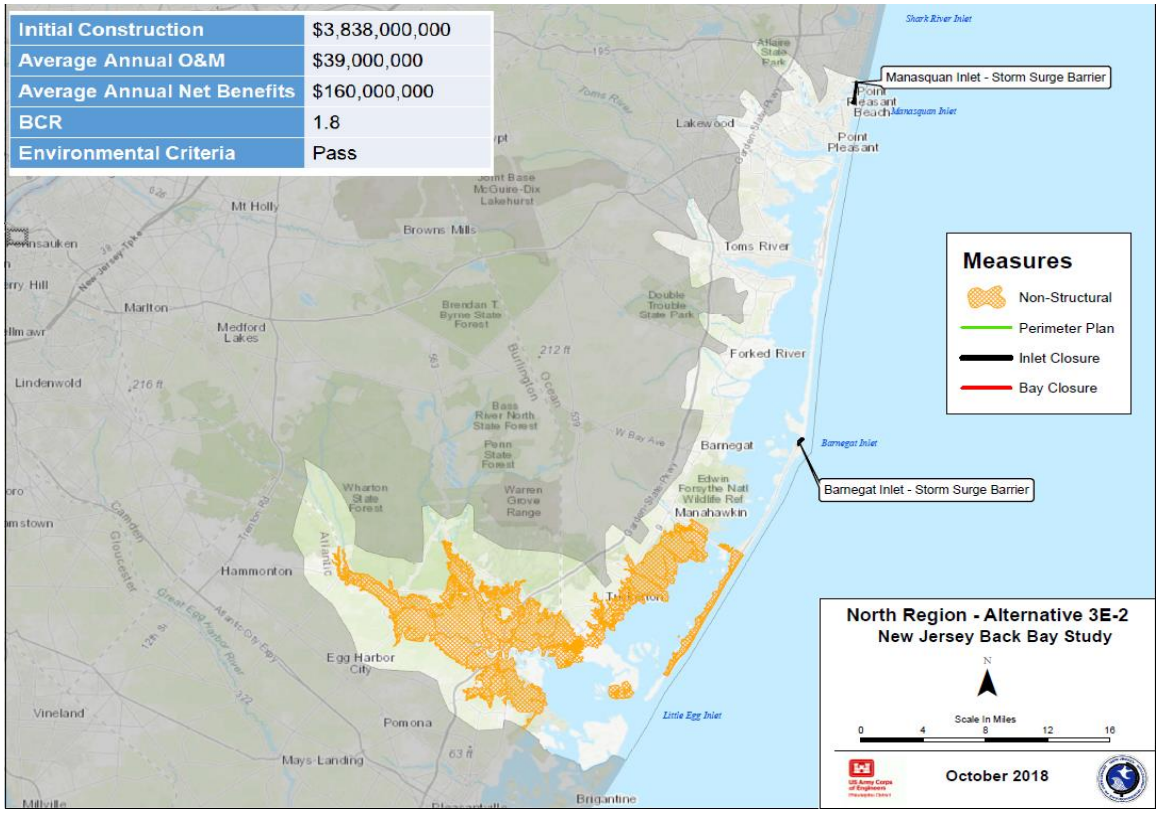


Figure 19: North Region Alternative 3E(2) Management Measure Features (Note: Approximate, preliminary locations)

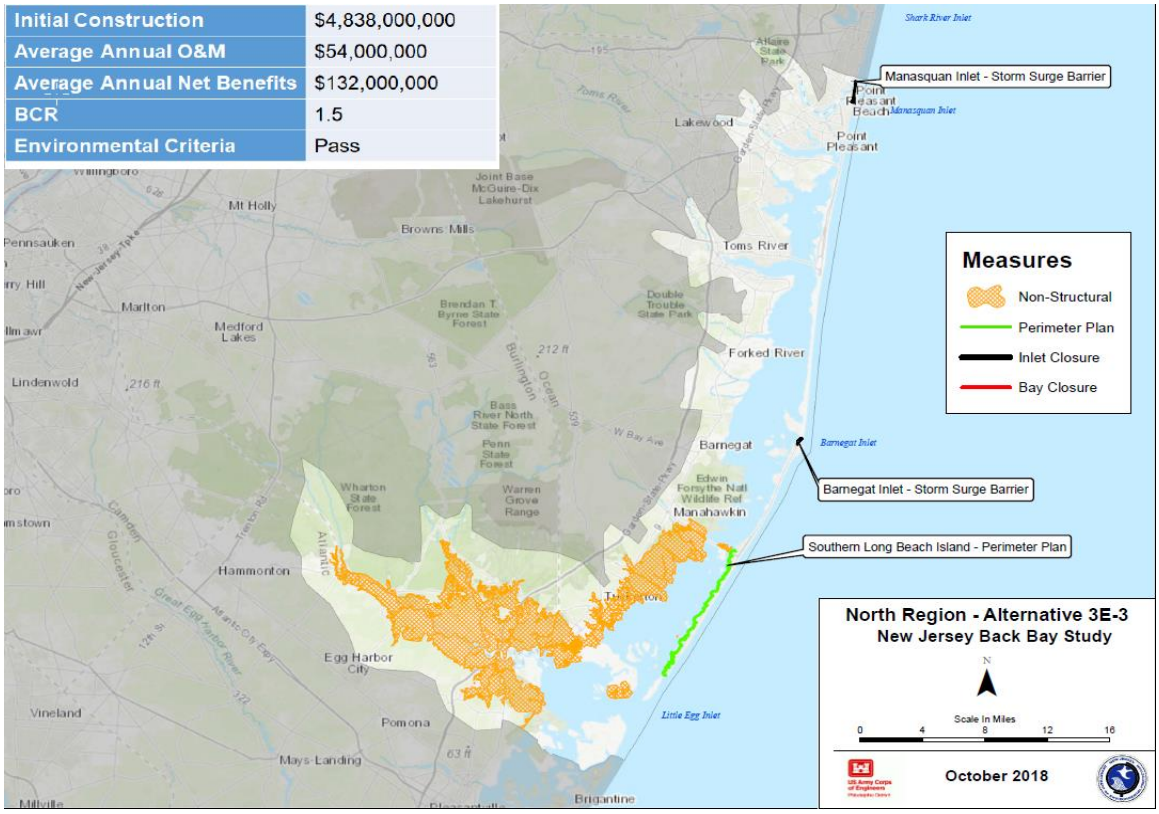


Figure 20: North Region Alternative 3E(3) Management Measure Features (Note: Approximate, preliminary locations)

Central Region

Analyses for the Central Region have indicated a preliminary combination of storm surge barriers, interior bay closures, nonstructural (including structure elevation only at this point in the study) and floodwalls/levees solutions to address coastal storm risk for the Reed Bay and Absecon Bay area's backing Brigantine, Lakes Bay and Scull Bay backing Absecon Island, and the Great Egg Harbor Bay System backing Peck Island (Ocean City).

The Central Region of the NJBB Study Area is probably the most complicated and includes thirteen alternative plans in the preliminary focused array within four themes. Theme 1 constitutes Alternative 4A which considers only nonstructural solutions. Theme 2 includes Alternatives 4D(1) and 4D(2) which considers floodwalls/levees and nonstructural solutions. Theme 3 includes Alternatives 4E(2) 4E(3), and 4E(4) which includes both storm surge barriers at inlets, interior bay closures, nonstructural solutions, and floodwalls/levees. Theme 4 includes Alternatives 4G(6) through 4G(12) which includes both storm surge barriers at inlets, interior bay closures, nonstructural solutions, and floodwalls/levees, as well as the no action alternative for some areas. A more detailed description of these alternative plans is provided below.

Alternative 4A

This preliminary alternative plan includes only nonstructural solutions for 8,744 residential structures. No storm surge barriers, interior bay closures or floodwalls/levees are included in this alternative. The management measure features of this alternative plan are provided in Error! Reference source not found.**21**.

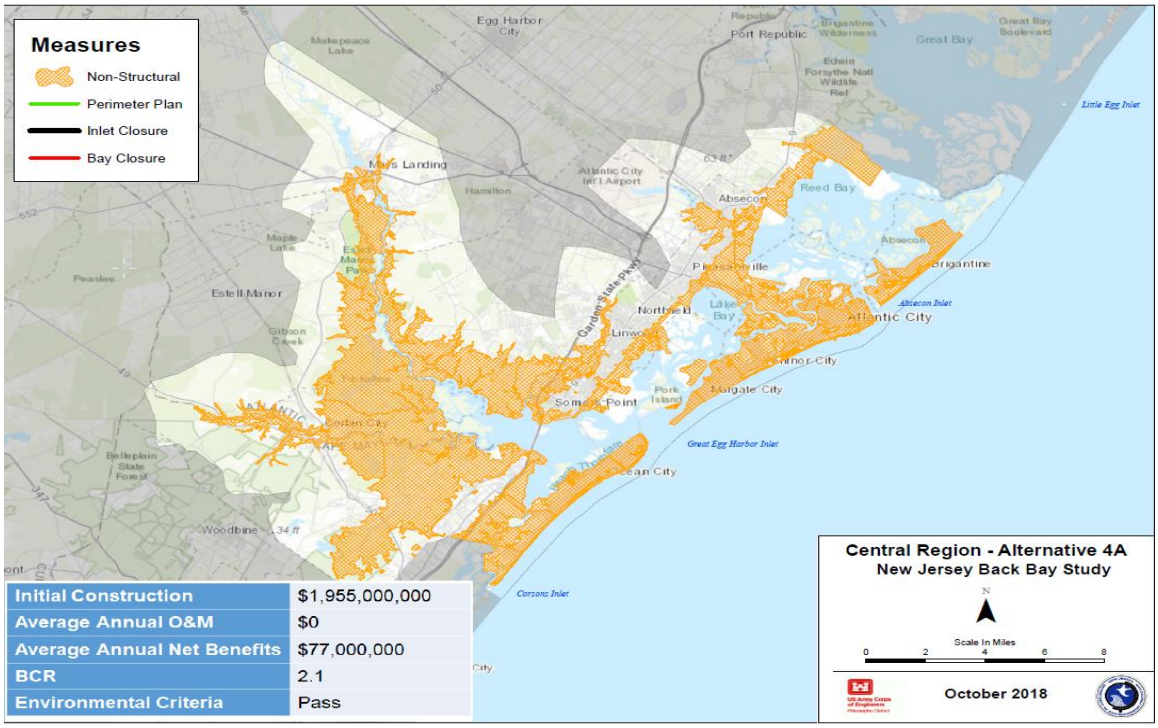


Figure 21: Central Region Alternative 4A Management Measure Features (Note: Approximate, preliminary locations)

Alternatives 4D(1) and 4D(2)

A preliminary strategy was developed for Alternatives 4D(1) and 4D(2) to focus on managing the risk of coastal flooding and sea level rise in the Central Region of the NJBB study area. These alternative plans include nonstructural and floodwall/levee solutions. These alternative plans do not include storm surge barriers or interior bay closures due to reduced economic justification due to greater initial construction costs and lower AANB compared to nonstructural and floodwall/levee solutions. Alternative 4D(1) includes nonstructural solutions for 1,928 residential structures for: a) the municipalities on the mainland adjacent to Reed Bay, Lake Bay and Great Egg Harbor Bay and associated tributaries including the Mullica River; and b) Brigantine Island. Alternative 4D(1) also includes greater than 65 miles of floodwalls inclusive of 11 miter gates and 15 road closures and approximately 6 miles of levees along the backside of Absecon Island and Ocean City.

Alternative 4D(2) differs from Alternative 4D(1) in that coastal flood risk is managed at Brigantine through floodwall and levee solutions rather than nonstructural solutions. Floodwall and levee solutions on Brigantine includes approximately 18 miles of floodwalls with 1 miter gate and 5 road closures and approximately a minimal length of levees. This alternative plan includes nonstructural solutions for 901 residential structures. The management measure features of this alternative plan are provided in Error! Reference source not found.**22** and Error! Reference source not found.**23**.

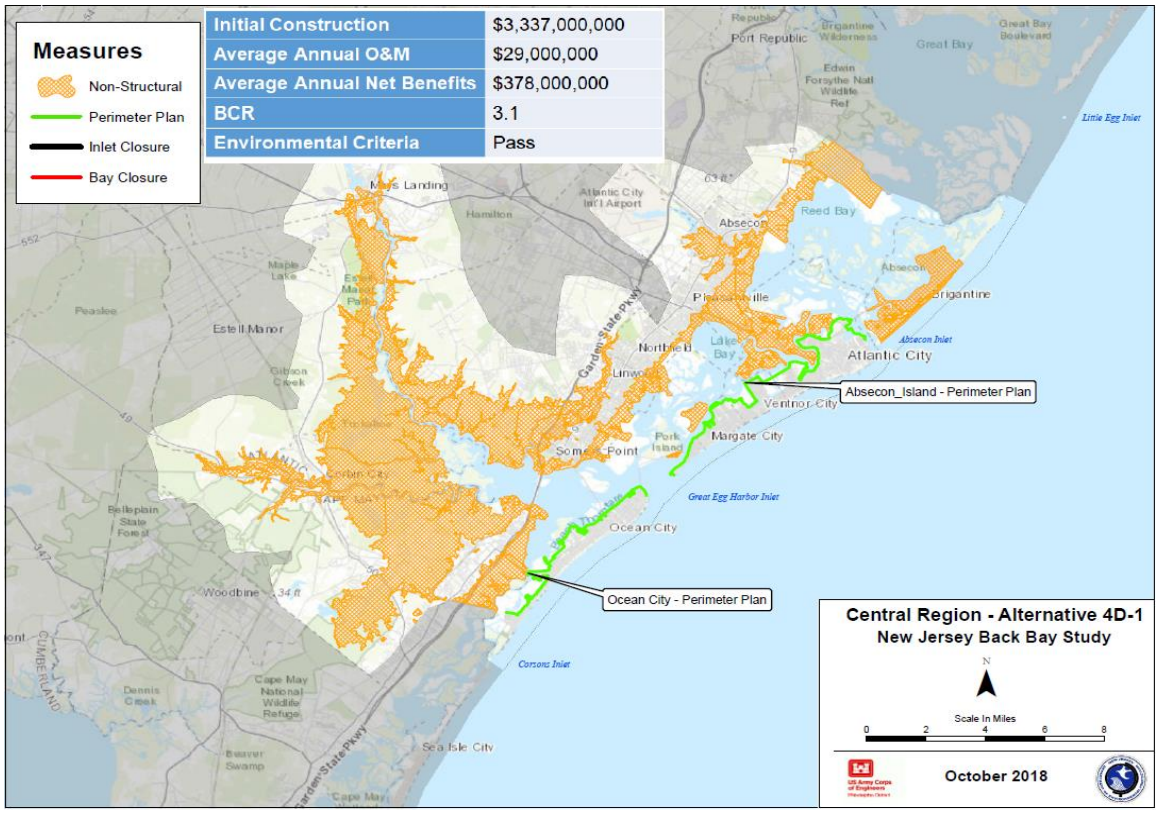


Figure 22: Central Region Alternative 4D(1) Management Measure Features (Note: Approximate, preliminary locations)

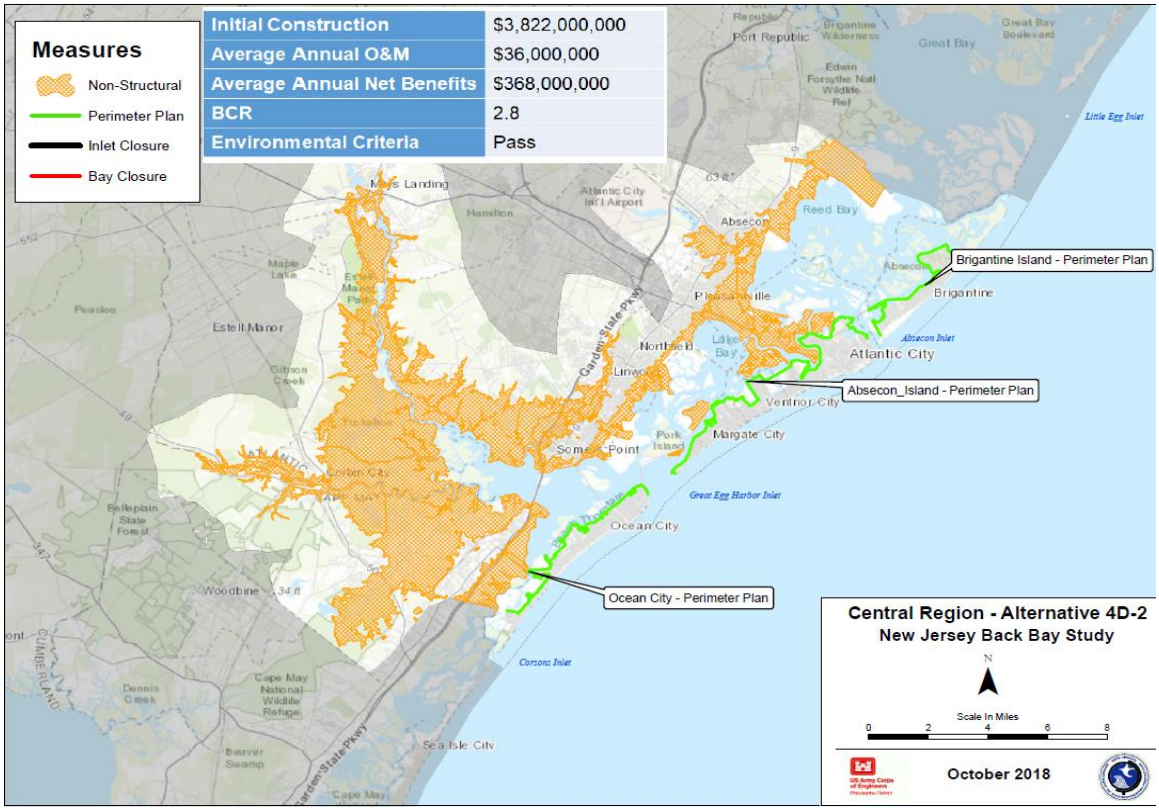


Figure 23: Central Region Alternative 4D(2) Management Measure Features (Note: Approximate, preliminary locations)

Alternatives 4E(2), 4E(3), and 4E(4)

A preliminary strategy was developed for Alternatives 4E(2), 4E(3) and 4E(4) to focus on managing the risk of coastal flooding and sea level rise in the Central Region of the NJBB study area. These alternative plans include storm surge barriers located at both Absecon Inlet and Great Egg Harbor Inlet. Detailed quantities for each of these storm surge barriers can be found in the Civil Engineering Sub-Appendix. Detailed hydrodynamic modeling results for storm surge barriers can be found in the Hydrology, Hydraulics and Coastal Engineering Sub-Appendix. Each of these alternative plans include nonstructural solutions for the mainland shorelines of the Municipality of Absecon fronting Reeds Bay. The remaining difference between these three alternative plans is the strategy identified for southern Ocean City and adjacent portions of Upper Township on the mainland side of the NJ Intracoastal Waterway between Peck Bay and Corson Sound.

Alternative 4E(2) includes nonstructural solutions for this area while Alternative 4E(3) includes nonstructural solutions for the Upper Township portion and a floodwall/levee solution for the Ocean City portion. Alternative 4E(4) includes an interior bay closure for this area rather than nonstructural or floodwall/levee solutions. The management measure features of this alternative plan are provided in Error! Reference source not found.**24**, Error! Reference source not found.**25**, and Error! Reference source not found.**26**.

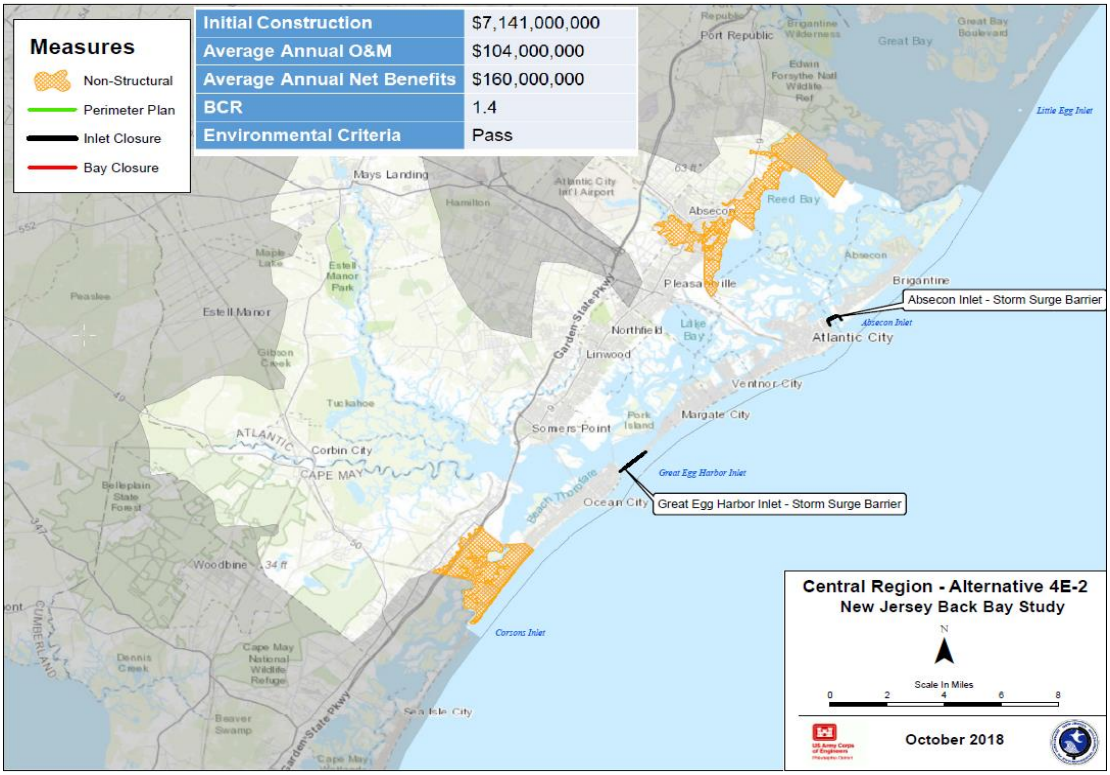


Figure 24: Central Region Alternative 4E(2) Management Measure Features (Note: Approximate, preliminary locations)

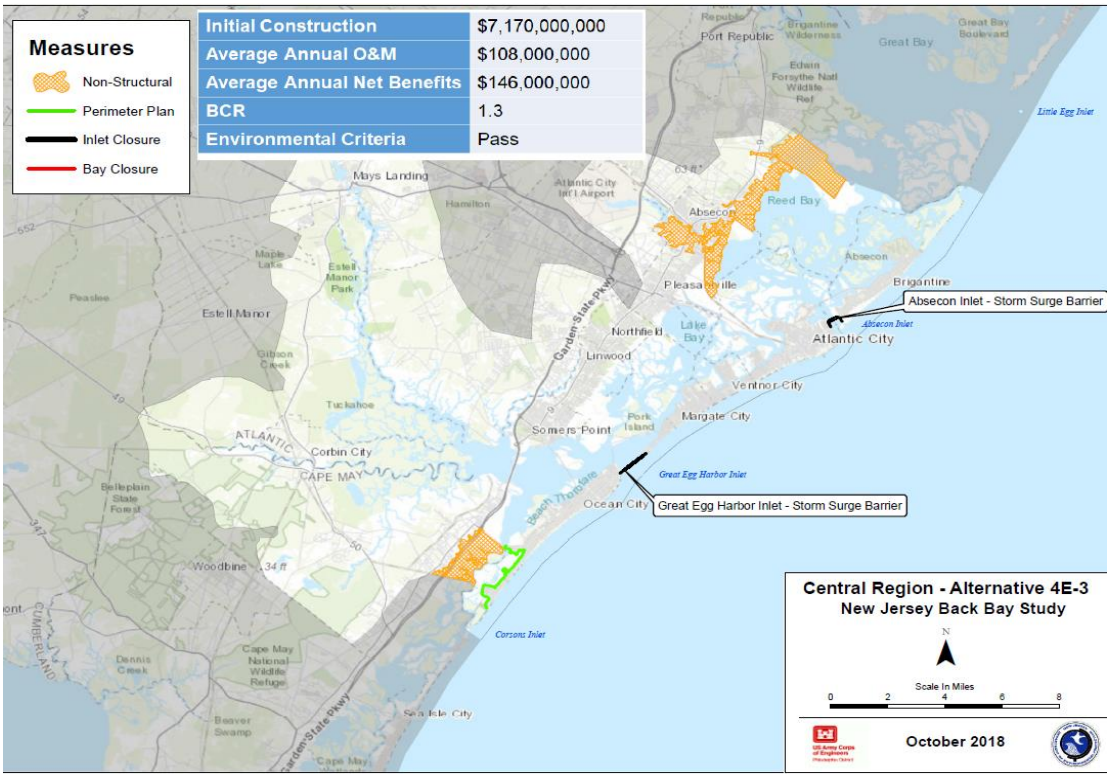


Figure 25: Central Region Alternative 4E(3) Management Measure Features (Note: Approximate, preliminary locations)

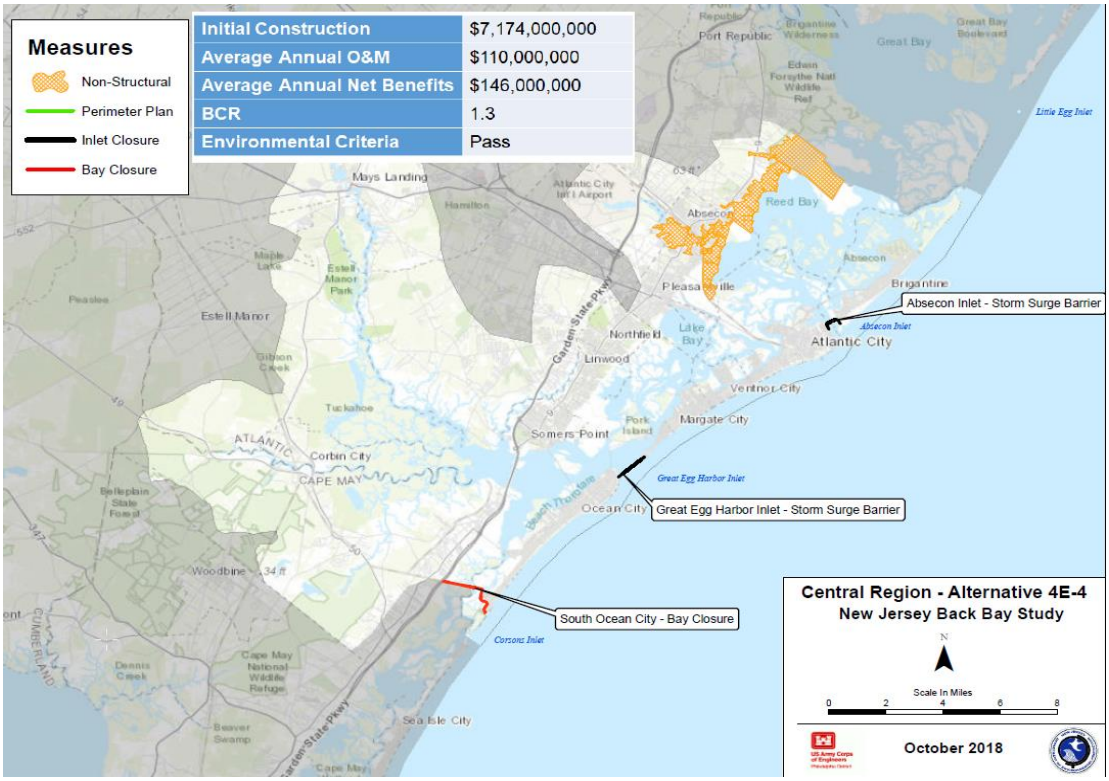


Figure 26: Central Region Alternative 4E(4) Management Measure Features (Note: Approximate, preliminary locations)

Alternatives 4G(6) through 4G(12)

A preliminary strategy was developed for Alternatives 4G(6) through 4G(12) to focus on managing the risk of coastal flooding and sea level rise in the Central Region of the NJBB study area. These alternative plans include storm surge barriers located only at Great Egg Harbor Inlet. Each of these alternative plans include an interior bay closure at Absecon Blvd between Atlantic City and Pleasantville and nonstructural solutions for the mainland shorelines of the Municipality of Absecon fronting Reeds Bay. The remaining differences between these alternative plans include a) nonstructural solutions or floodwall/levee solutions at Brigantine; and b) a combination of interior bay closure, nonstructural or floodwall/levee solutions at southern Ocean City and southern Upper Township on the mainland side of the NJ Intracoastal Waterway between Peck bay and Corson Sound. The management measure features of this alternative plan are provided in Error! Reference source not found.**27** and Error! Reference source not found.**28**.

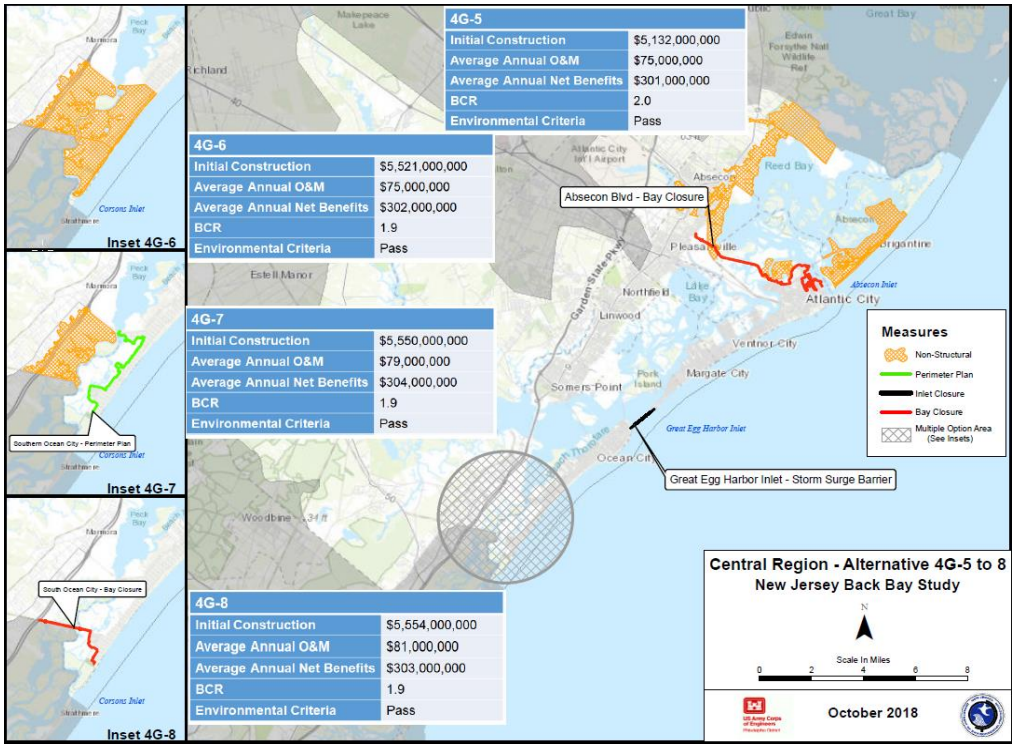


Figure 27: Central Region Alternatives 4G(6) through 4G(8) Management Measure Features (Note: Approximate, preliminary locations)

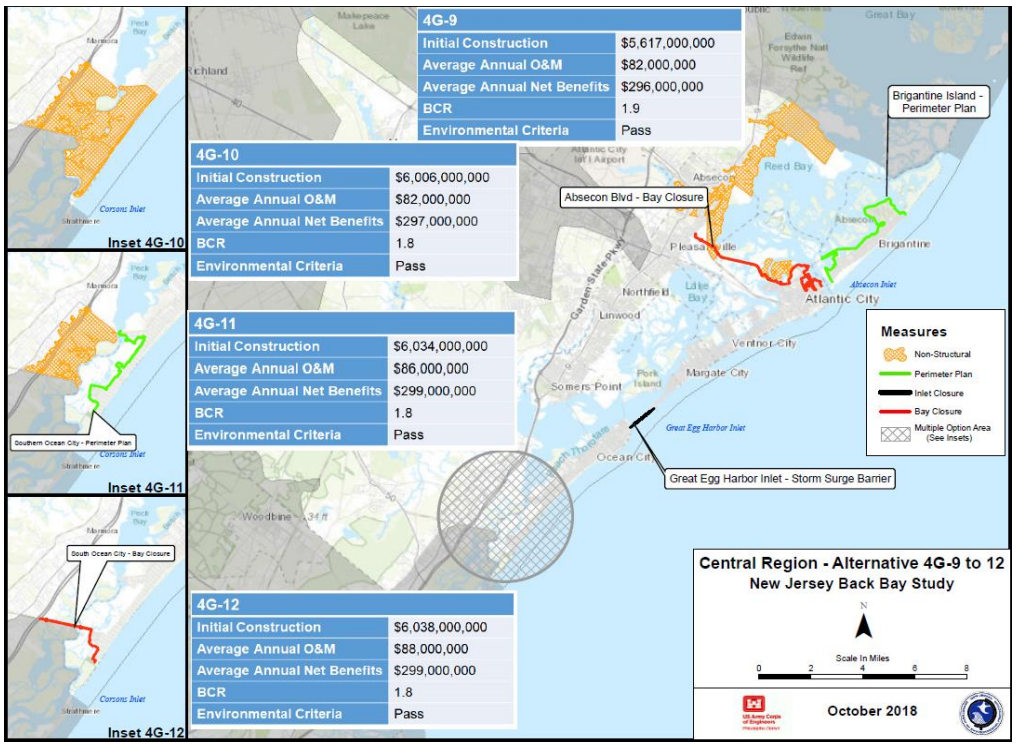


Figure 28: Central Region Alternatives 4G(9) through 4G(12) Management Measure Features (Note: Approximate, preliminary locations)

South Region

Analyses for the South Region have indicated a preliminary combination of nonstructural and floodwalls/levees solutions to address coastal storm risk for the Ludlam Bay and Townsend Sound backing Ludlam Island (Sea Isle City), Great Sounds and Jenkins Sound backing Seven Mile Island (Avalon and Stone Harbor), Grassy Sound, Richardson Sound and Jarvis Sound backing Wildwood Island, and Cape May Harbor backing the Cape May Peninsula. Detailed quantities for floodwall/levee solutions can be found in the Civil Engineering Sub-Appendix.

The South Region of the NJBB Study Area includes three preliminary alternatives in the preliminary focused array of alternative plans within two themes. Theme 1 constitutes Alternative 5A which considers only nonstructural solutions. Theme 2 includes Alternatives 5D(1) and 5D(2) which considers floodwalls/levees and nonstructural solutions. A more detailed description of these alternative plans is provided below.

Alternative 5A

The preliminary strategy developed for Alternative 5A includes nonstructural solutions for 6,389 residential structures for the municipalities on the mainland adjacent to the back bays stretching from Corson's Inlet to Cape May and associated tributaries and canals inclusive of the Cape May Canal. No storm surge barriers or interior bay closures, or floodwalls/levees are included in this alternative plan. The management measure features of this alternative plan are provided in Error! Reference source not found.**29**.

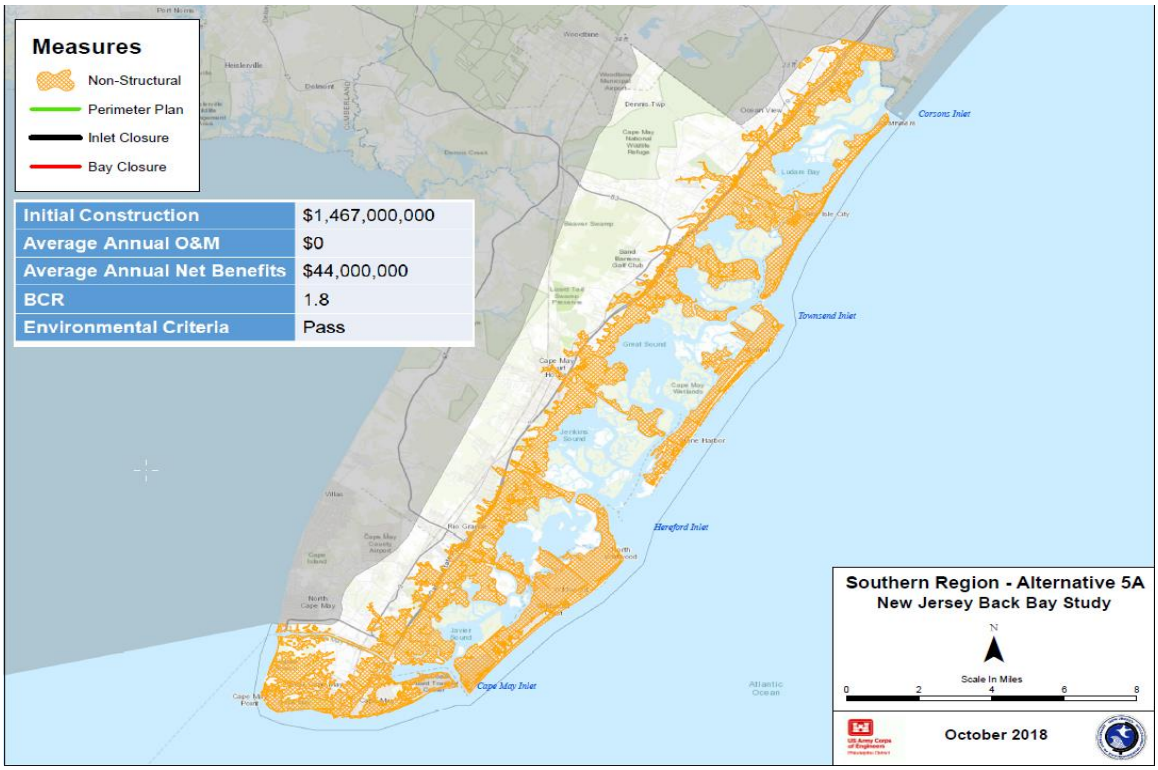


Figure 29: South Region Alternative 5A Management Measure Features (Note: Approximate, preliminary locations)

Alternatives 5D(1) and 5D(2)

A preliminary strategy was developed for Alternatives 5D(1) and 5D(2) to focus on managing the risk of coastal flooding and sea level rise in the South Region of the NJBB study area. These alternative plans include nonstructural and floodwall/levee solutions. These alternative plans do not include storm surge barriers owing in part to the close spacing of inlets in the South Region allowing many possibilities for storm surge entry into the back bays.

Alternative 5D(1) includes nonstructural solutions for 1848 residential structures for: a) the municipalities on the mainland adjacent to the back bays stretching from Corson's Inlet to Cape May inclusive of the Cape May Canal; and b) barrier island municipalities including Strathmere, Seven Mile Island, and Lower Township. Alternative 5D(1) also includes greater than 36 miles of floodwalls inclusive of 4 miter gates and 17 road closures and approximately 10 miles of levees along the backside of Sea Isle city, Wildwood Island (including West Wildwood) and Cape May City.

Alternative 5D(2) differs from Alternative 5D(1) in that coastal flood risk is managed at Seven Mile Island through floodwall and levees solutions rather than nonstructural solutions. This includes approximately 35 miles of floodwalls with 2 miter gates and 9 road closures and approximately 1 mile of levees. This alternative plan includes nonstructural solutions for 544 residential structures. The management measure features of this alternative plan are provided in Error! Reference source not found.**30** and Error! Reference source not found.**31**.

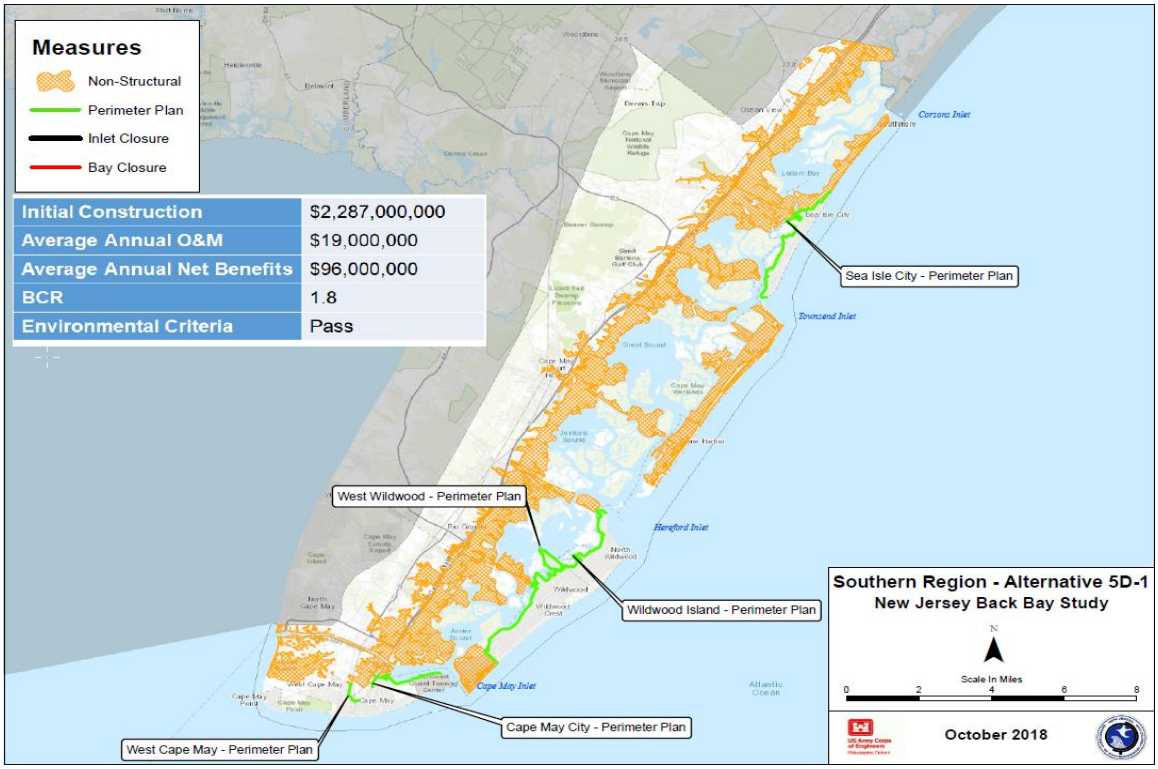


Figure 30: South Region Alternative 5D(1) Management Measure Features (Note: Approximate, preliminary locations)

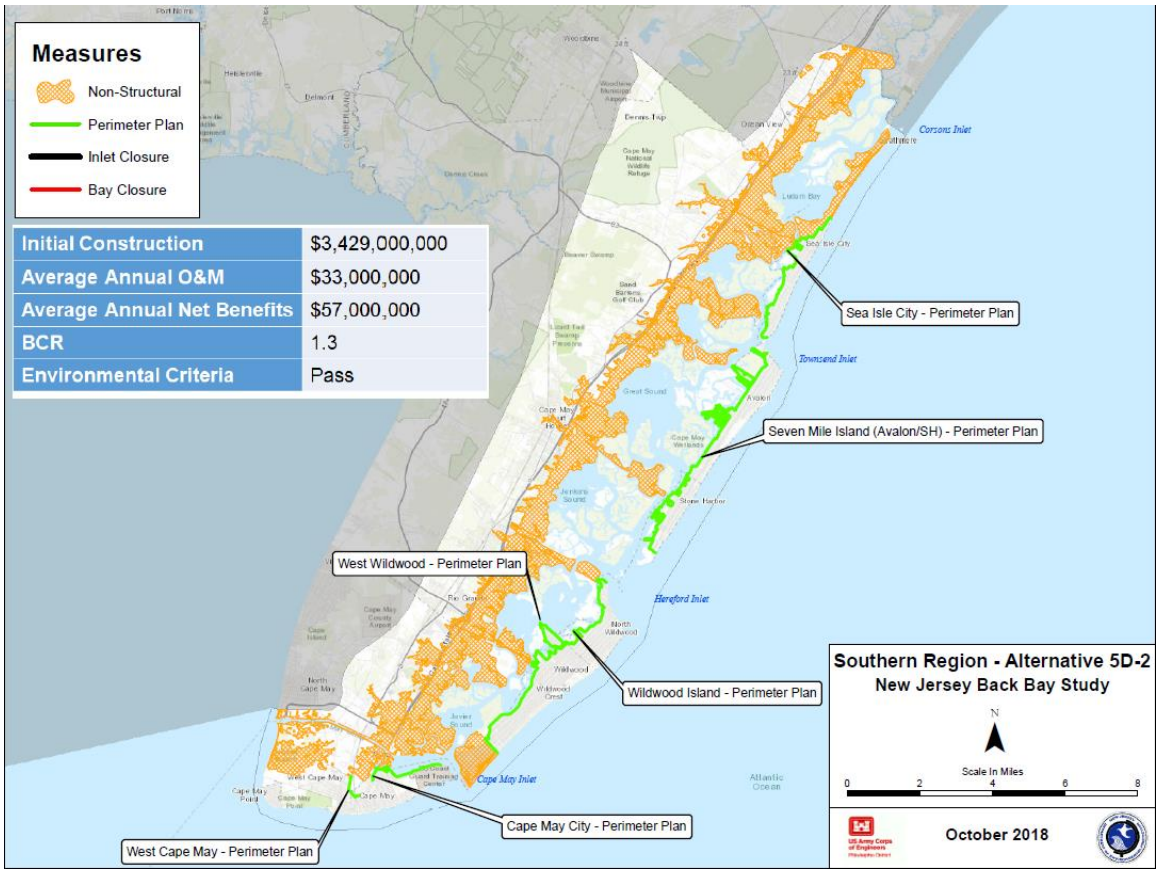


Figure 31: South Region Alternative 5D(2) Management Measure Features (Note: Approximate, preliminary locations)

Preliminary Focused Array Assumptions

This study is guided by the principle of iterative planning, which encourages risk-informed decision making and the appropriate levels of detail for each round of alternative plan formulation. The preliminary focused array of alternatives for the NJBB Region provided in this Draft Integrated Report have focused on identifying feasible system-wide CSRM solutions. These focused array solutions are preliminary and are based on a lower level of detailed analyses at this phase of the study. As a result, a number of assumptions were made during the planning process, including:

- **Economics**
  - HEC-FDA to model economic benefits
  - Reduced sample size of structures given the large study area resulting in the development of assumptions with respect to structure type and first floor elevation height
  - Depreciated replacement value adjustment

- **Engineering**
    - Existing information utilized for engineering analyses rather than field-collected data at specific locations
    - Less level of detail of engineering analyses given the use of existing information
    - Parametric cost estimates application
- **Environmental**
    - Indirect impacts have not been identified resulting in preliminary understanding of comprehensive environmental impacts of measure features
    - NEPA compliance and cultural resource investigations are in progress and preliminary
- **Plan Formulation**
    - Formulation of alternative plans including the preliminary focused array of alternative plans is preliminary based on the level of analyses discussed above.
- **Real Estate**
    - Widespread stakeholder/landowner approval of the project
    - Use of basic real estate assumptions including cost estimated for the level of project detail available
    - Real estate interests required for all project areas will be acquired for minimal appraised values once off-setting project benefits are applied

Environmental Considerations of the Preliminary Focused Array

At this stage of the feasibility study and NEPA analysis, accurate quantitative impact analyses are generally unavailable for a number of these alternatives due to the current preliminary low-level of design, and that detailed numerical modeling has not been applied at this point. Therefore, impact assessment is introduced in this section, and the general impacts and/or range of impacts are presented, as known, at this time. Early estimates of direct habitat impact with respect to the preliminary focused array of alternative plans is provided in Error! Reference source not found. **14**. However, impact “avoidance” and “minimization” have not been applied at this stage, which could affect these preliminary estimates. The Environmental and Cultural Resources Appendix F provides a more detailed discussion on environmental considerations on the preliminary focused array. Additionally, a preliminary conceptual model intended to articulate the mechanisms of environmental impact of proposed flood risk management alternatives, inform the NEPA process and transparently link actions to specific pieces of environmental policy and legislation, and to identify any gaps in quantitative tools needed for future impact assessment is being developed (Error! Reference source not found.. This conceptual model is at an early stage, but will be further developed with research from relevant peer-reviewed literature, engagement with resource agency staff technical experts, and iterative development with USACE staff, which will help guide the impact analyses and development of numerical modeling leading up to the TSP and Draft EIS.

The No Action alternative (Future without Project Condition) would involve no additional action from current USACE actions to mitigate against coastal storm risk. Some generalized assumptions for the array of alternatives are that no action will continue existing environmental trends unless significant changes are implemented such as regulatory changes, development policies related to land use, and natural events with awareness of current knowledge of climate change and sea level rise as a major driving force.

For structural measures in the array, the perimeter plans are expected to have significant direct impacts particularly on wetlands and shallow aquatic habitats within the footprint of floodwalls and levees over long linear distances, which would have regional effects. Additionally, perimeters are expected to have significant impacts on visual resources. The inlet storm surge barriers and interior bay closures would have moderate to significant direct impacts on aquatic habitats, but comparatively less than the perimeter plans. However, there may be more potential indirect impacts that storm surge barriers and interior bay closures may pose on hydrodynamics, water quality, and shifts in flora and fauna abundance, distributions, and migrations. These potential effects have a high level of uncertainty particularly with the unknown frequency of gate closures coupled with changes in tidal flooding events related to sea level rise. This would require further modeling efforts to inform the impact assessment of storm surge barriers and interior bay closures. As part of the TSP phase, the preliminary focused array of alternative plans will undergo a rigorous evaluation of avoidance and minimization of these direct and indirect impacts; however, based on the scale of these alternatives, it is likely that substantial compensatory mitigation would be required.

Nonstructural measures are a component for all of the preliminary focused array of alternative plans either as a standalone alternative or in various combinations with other structural components. At this point, the preliminary focused array has only evaluated building elevation and floodproofing, which may have some temporary adverse direct and indirect effects related to earth disturbance, but are not significant. However, impacts on cultural resources (particularly if building modifications are on historic structures or in a historic district) and community or other social effects are potentially significant. Other nonstructural measures such as building acquisition and relocation have not been evaluated at this point, but will be considered in the next phase prior to the identification of the TSP. A measure like building acquisition and relocation could provide significant environmental benefit by increasing open space by converting existing privately owned and buildable properties into natural habitat. However, as is the case with building elevation (retrofit), there is a potential for significant adverse impacts to cultural resources and other social effects

NNBFs would need to have a direct CSRM function for flooding and/or function as a scour protection feature of a traditional structural CSRM feature while providing ecological uplift. NNBFs would help in slowing storm surges and dissipating wave energies. These features would promote resilience and be adaptable to climate change and sea level rise. Some considerations for NNBF features include island creation, saltmarsh creation, SAV restoration or reefs, and possibly combinations, thereof. The selection of locations for NNBFs require the consideration of the existing habitat values for fish and wildlife resources. NNBFs are expected to have temporary and minor impacts on aquatic resources and water quality during their construction, but would have a long-term beneficial effect on aquatic and some terrestrial habitats and the flora and fauna that inhabit these areas. However, NNBFs have not been evaluated at this point, but will be considered in the next phase of the study.

Table 14: Preliminary Environmental Considerations of the Preliminary Focused Array of Alternatives

REGION	ALT	NONSTRUCTURAL Building Elevation for structures with first floor w/in 20-yr floodplain	PERIMETER Floodwalls, Levees and Miter Gates	STORM SURGE BARRIER Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	BAY CLOSURE Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees
SHARK RIVER	2A	**Location:** Portions of Belmar, Bradley Beach, Neptune City & Shark River Hills **Env. Considerations:** Potential impacts to community, cultural resources, noise. **Mitigation:** None likely.	NA	NA	NA
NORTH (Manasquan Inlet to Little Egg Inlet)	3A	**Location:** Point Pleasant, Manasquan, all communities on LBI, western shore of Barnegat Bay, Mystic Island, and along lower Mullica River Basin **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	NA	NA	NA
	3D	**Location:** All communities on LBI, western shore of Barnegat Bay, Mystic Island, and along lower Mullica River Basin **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Manasquan Inlet/ Point Pleasant Area **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Moderate permanent losses of soft bottom subtidal (9 ac.), tidal marsh (3 ac.). Moderate impacts to fish and wildlife. ESA consultation likely due to levee structure on Manasquan Beach. Obstruction of viewsheds. **Mitigation:** Moderate	NA	NA
	3E(2)	**Location:** All communities on southern LBI (Cedar Bonnet Island and south), western shore of Barnegat Bay at Beach Haven West and south, Mystic Island, and along lower Mullica River Basin **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	NA	**Location:** Manasquan Inlet and Barnegat Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (8 ac.). ESA consultation likely due to levee structure on Manasquan Beach and dune tie-ins in Barnegat Inlet. Potential indirect significant impacts to hydrodynamics, water quality and	NA

REGION	ALT	NONSTRUCTURAL Building Elevation for structures with first floor w/in 20-yr floodplain	PERIMETER Floodwalls, Levees and Miter Gates	STORM SURGE BARRIER Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	BAY CLOSURE Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees
				fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	
	3E(3)	**Location:** Cedar Bonnet Island, western shore of Barnegat Bay at Beach Haven West and south, Mystic Island, and along lower Mullica River Basin **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Along western side of S. LBI from Ship Bottom to Holgate **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Significant permanent losses of soft bottom subtidal (76 acres), SAV beds (11 ac.), intertidal flats (24 ac.), tidal marsh (21 ac.), scrub-shrub (5 ac ac). Significant impacts to fish/shellfish and wildlife. Obstruction of viewsheds. **Mitigation:** Very High	**Location:** Manasquan Inlet and Barnegat Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (8 ac.). ESA consultation likely due to levee structure on Manasquan Beach and dune tie-ins in Barnegat Inlet. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	NA
CENTRAL **(Little Egg Inlet to Corson's Inlet)**	4A	**Location:** Brigantine, Absecon, Pleasantville, West A.C., A.C., Ventnor, Margate, Longport, Northfield, Linwood, Estelle Manor, Mays Landing, Somers Point, Marmora, Ocean City, Palermo **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	NA	NA	NA
	4D(1)	**Location:** Brigantine, Absecon, Pleasantville, West A.C., Northfield, Linwood, Estelle Manor, Mays Landing, Somers Point, Marmora, Palermo **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Along Absecon Inlet and western side of A.C., Ventnor, Margate, Longport, & Ocean City **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Significant permanent losses of soft bottom subtidal (96 ac.), intertidal flats (27 ac.), tidal marsh (63 ac.), scrub-shrub (10 ac.). Significant impacts to fish/shellfish and wildlife. Obstruction of viewsheds. **Mitigation:** Very High	NA	NA

REGION	ALT	NONSTRUCTURAL Building Elevation for structures with first floor w/in 20-yr floodplain	PERIMETER Floodwalls, Levees and Miter Gates	STORM SURGE BARRIER Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	BAY CLOSURE Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees
	4D(2)	**Location:** Absecon, Pleasantville, West A.C., Northfield, Linwood, Estelle Manor, Mays Landing, Somers Point, Marmora, Palermo **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Along Absecon Inlet and western side of Brigantine, A.C., Ventnor, Margate, Longport, & Ocean City **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Significant permanent losses of soft bottom subtidal (112 ac.), intertidal flats (38 ac.), tidal marsh (83 ac.), scrub-shrub (11 ac.). Significant impacts to fish/shellfish and wildlife. Obstruction of viewsheds. **Mitigation:** Very High	NA	NA
	4E(2)	**Location:** Absecon, Pleasantville, S. Ocean City, Marmora, & Palermo **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	NA	**Location:** Absecon Inlet & Great Egg Harbor Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (24 ac.) and intertidal flats (5 ac.). ESA consultation likely due to dune tie-ins in both inlets. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	NA
	4E(3)	**Location:** Absecon, Pleasantville, Marmora, & Palermo **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Western side of S. Ocean City **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Significant permanent losses of soft bottom subtidal (26 ac.), intertidal flats (5 ac.), tidal marsh (33 ac.), scrub-shrub (4 ac.). Significant impacts to fish/shellfish and wildlife. Obstruction of viewsheds. **Mitigation:** High	**Location:** Absecon Inlet & Great Egg Harbor Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (24 ac.) and intertidal flats (5 ac.). ESA consultation likely due to dune tie-ins in both inlets Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	NA

REGION	ALT	NONSTRUCTURAL Building Elevation for structures with first floor w/in 20-yr floodplain	PERIMETER Floodwalls, Levees and Miter Gates	STORM SURGE BARRIER Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	BAY CLOSURE Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees
	4E(4)	**Location:** Absecon & Pleasantville **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	NA	**Location:** Absecon Inlet & Great Egg Harbor Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (24 ac.) and intertidal flats (5 ac.). ESA consultation likely due to dune tie-ins in both inlets. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	**Location:** Cross-bay barrier in S. Ocean City from 52nd St. **Env. Considerations:** Temporary turbidity, air quality, noise. Significant permanent losses of soft bottom subtidal (26 ac.), intertidal flats (5 ac.), tidal marsh (22 ac.), scrub-shrub (1 ac.). Significant impacts to fish/shellfish and wildlife. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts
	4G(6)	**Location:** Brigantine, Absecon, Pleasantville, West A.C., Marmora, S. Ocean City, Palermo, **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	NA	**Location:** Great Egg Harbor Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (18 acres). ESA consultation likely due to dune tie-ins in inlet. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	**Location:** Cross-bay barrier along S. Absecon Inlet and Absecon Blvd. **Env. Considerations:** Temporary turbidity, air quality, noise. Significant permanent losses of soft bottom subtidal (39 ac.), intertidal flats (6 ac.), tidal marsh (52 ac.), scrub-shrub (2 ac.). Significant impacts to fish/shellfish and wildlife. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** High for Direct Impacts and Potentially High for Indirect Impacts
	4G(7)	**Location:** Brigantine, Absecon, Pleasantville, West A.C., Marmora **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Western side of S. Ocean City **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Significant permanent losses of soft bottom subtidal (26 ac.), intertidal flats (5 ac.), tidal marsh (33 ac.), scrub-shrub (4 ac.). Significant impacts to fish/shellfish and wildlife. Obstruction of viewsheds. **Mitigation:** High	**Location:** Great Egg Harbor Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (18 acres). ESA consultation likely due to dune tie-ins in inlet. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	**Location:** Cross-bay barrier along S. Absecon Inlet and Absecon Blvd **Env. Considerations:** Temporary turbidity, air quality, noise. Significant permanent losses of soft bottom subtidal (39 ac.), intertidal flats (6 ac.), tidal marsh (52 ac.), scrub-shrub (2 ac.). Significant impacts to fish/shellfish and wildlife. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets.

REGION	ALT	NONSTRUCTURAL Building Elevation for structures with first floor w/in 20-yr floodplain	PERIMETER Floodwalls, Levees and Miter Gates	STORM SURGE BARRIER Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	BAY CLOSURE Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees
					Mitigation: High for Direct Impacts and Potentially High for Indirect Impacts
	4G(8)	**Location:** Brigantine, Absecon, Pleasantville, West A.C., **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	NA	**Location:** Great Egg Harbor Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (18 acres). ESA consultation likely due to dune tie-ins in inlet. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	**Location:** Cross-bay barrier along S. Absecon Inlet and Absecon Blvd **Env. Considerations:** Temporary turbidity, air quality, noise. Significant permanent losses of soft bottom subtidal (39 ac.), intertidal flats (6 ac.), tidal marsh (52 ac.), scrub-shrub (2 ac.). Significant impacts to fish/shellfish and wildlife. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** High for Direct Impacts and Potentially High for Indirect Impacts
	4G(10)	**Location:** Absecon, Pleasantville, West A.C., Marmora, S. Ocean City, Palermo **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Western side of Brigantine **Env. Considerations: Location:** Western side of S. Ocean City **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Significant permanent losses of soft bottom subtidal (15 ac.), intertidal flats (12 ac.), tidal marsh (20 ac.), scrub-shrub (0.1 ac.). Significant impacts to fish/shellfish and wildlife. Obstruction of viewsheds. **Mitigation:** High	**Location:** Great Egg Harbor Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (18 acres). ESA consultation likely due to dune tie-ins in inlet. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	**Location:** Cross-bay barrier along S. Absecon Inlet and Absecon Blvd **Env. Considerations:** Temporary turbidity, air quality, noise. Significant permanent losses of soft bottom subtidal (39 ac.), intertidal flats (6 ac.), tidal marsh (52 ac.), scrub-shrub (2 ac.). Significant impacts to fish/shellfish and wildlife. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** High for Direct Impacts and Potentially High for Indirect Impacts

REGION	ALT	NONSTRUCTURAL Building Elevation for structures with first floor w/in 20-yr floodplain	PERIMETER Floodwalls, Levees and Miter Gates	STORM SURGE BARRIER Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	BAY CLOSURE Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees
	4G(11)	**Location:** Absecon, Pleasantville, West A.C., Marmora, Palermo **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Western side of Brigantine and S. Ocean City **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Significant permanent losses of soft bottom subtidal (16 ac.), intertidal flats (12 ac.), tidal marsh (53 ac.), scrub-shrub (4 ac.). Significant impacts to fish/shellfish and wildlife. Obstruction of viewsheds. **Mitigation:** High	**Location:** Great Egg Harbor Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (18 acres). ESA consultation likely due to dune tie-ins in inlet. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	**Location:** Cross-bay barrier along S. Absecon Inlet and Absecon Blvd **Env. Considerations:** Temporary turbidity, air quality, noise. Significant permanent losses of soft bottom subtidal (39 ac.), intertidal flats (6 ac.), tidal marsh (52 ac.), scrub-shrub (2 ac.). Significant impacts to fish/shellfish and wildlife. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** High for Direct Impacts and Potentially High for Indirect Impacts
	4G(12)	**Location:** Brigantine, Absecon, Pleasantville, West A.C., **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Western side of Brigantine **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Significant permanent losses of soft bottom subtidal (15 ac.), intertidal flats (12 ac.), tidal marsh (20 ac.), scrub-shrub (0.1 ac.). Significant impacts to fish/shellfish and wildlife. Obstruction of viewsheds. **Mitigation:** High	**Location:** Great Egg Harbor Inlet **Env. Considerations:** Temporary turbidity, air quality, noise. Moderate permanent losses of soft bottom subtidal (18 acres). ESA consultation likely due to dune tie-ins in inlet. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** Moderate for Direct Impacts and Potentially High for Indirect Impacts	**Location:** Cross-bay barrier along S. Absecon Inlet and Absecon Blvd. and cross-bay barrier in S. Ocean City from 52nd St. **Env. Considerations:** Temporary turbidity, air quality, noise. Significant permanent losses of soft bottom subtidal (39 ac.), intertidal flats (6 ac.), tidal marsh (52 ac.), scrub-shrub (2 ac.). Significant impacts to fish/shellfish and wildlife. Potential indirect significant impacts to hydrodynamics, water quality and fish/shellfish and wildlife. Obstruction of viewsheds in inlets. **Mitigation:** High for Direct Impacts and Potentially High for Indirect Impacts
SOUTH (Corson's Inlet to Cape May Inlet)	5A	**Location:** All Atlantic Coast and bayside communities from Ludlam Island (Upper Twp.) south to Cape May and W. Cape May **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	NA	NA	NA

REGION	ALT	NONSTRUCTURAL Building Elevation for structures with first floor w/in 20-yr floodplain	PERIMETER Floodwalls, Levees and Miter Gates	STORM SURGE BARRIER Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	BAY CLOSURE Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees
	5D(1)	**Location:** All Atlantic Coast and bayside communities from Ludlam Island (Upper Twp.) south to Cape May and W. Cape May except for SIC, all WW, and Cape May **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Western side of Sea Isle City, all Wildwoods, and southern shore along Cape May Harbor in Cape May **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Significant permanent losses of soft bottom subtidal (40 ac.), intertidal flats (32 ac.), tidal marsh (72 ac.), scrub-shrub (16 ac.), and forested wetland (5 ac). Significant impacts to fish/shellfish and wildlife. Obstruction of viewsheds. **Mitigation:** Very High	NA	NA
	5D(2)	**Location:** All bayside communities from Ludlam Island (Upper Twp.) south to Cape May and W. Cape May; Strathmere and N. Cape May Inlet along Atlantic Coast. **Env. Considerations:** Potential impacts to community, cultural resources, noise **Mitigation:** None likely.	**Location:** Western side of Sea Isle City, Seven Mile Island, all Wildwoods, and southern shore along Cape May Harbor in Cape May **Env. Considerations:** Temporary turbidity, air quality, noise, community disruption. Significant permanent losses of soft bottom subtidal (109 ac.), intertidal flats (44 ac.), tidal marsh (103 ac.), scrub-shrub (21 ac.), and forested wetland (5 ac). Significant impacts to fish/shellfish and wildlife. Obstruction of viewsheds. **Mitigation:** Very High	NA	NA

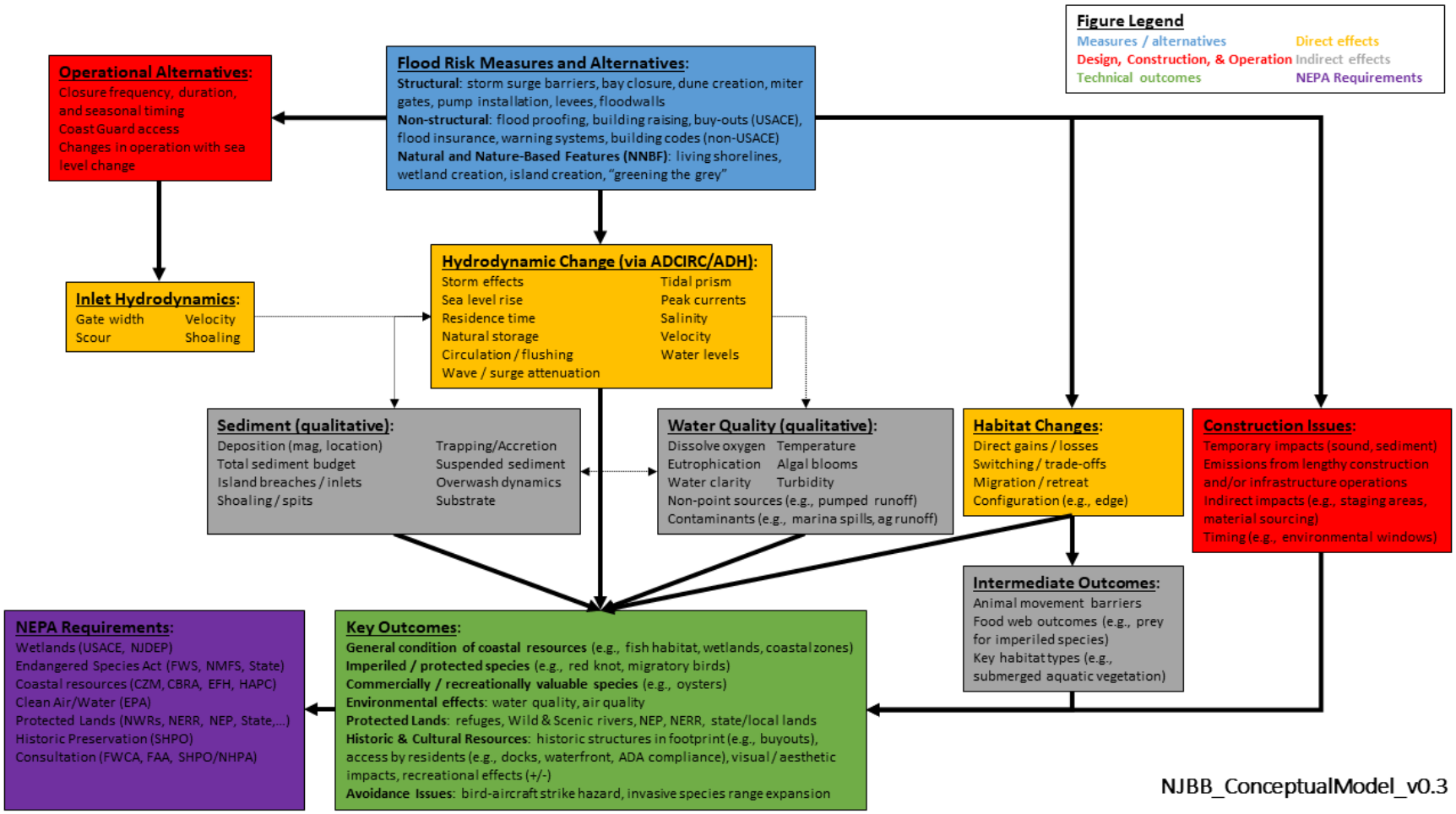


Figure 32: Preliminary Conceptual Model of NJBB Structural, Nonstructural and NNBF Measures

Environmental Mitigation

A preliminary evaluation of the structural components of the preliminary focused array of alternative plans has identified that the impacts to wetlands and other aquatic habitats are moderate to significant. This is inherent in the proposed use of floodwalls, levees, and miter gates for the perimeter plans, the proposed use of floodwalls, levees, sector gates and lift gates for the storm surge barriers and the proposed use of interior bay closures, which are all water dependent features required for flood and erosion control.

When potential significant impacts are identified, CEQ regulations direct Federal agencies to “use the NEPA process to identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions…” 40 CFR § 1500.2(e); see 40 CFR § 1500.2(f). The practice of avoidance and minimization is also inherent in the Clean Water Act Section 404(b)(1) guidelines when evaluating the effects of the discharge of dredged or fill material into waters of the United States including wetlands. USACE has adopted a mitigation hierarchical sequencing for civil works projects as defined in ER 1105-2-100. This mitigation sequencing includes:

a. Avoiding the impact altogether by not taking a certain action or part of an action;

b. Minimizing impacts by limiting the degree or magnitude of the action and its implementation;

c. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

d. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;

e. Compensating for the impact by replacing or providing substitute resources or environments. “Replacing" means the replacement of fish and wildlife resources in-kind.

"Substitute" means the replacement of fish and wildlife resources out-of-kind. Substitute resources, on balance, shall be at least equal in value and significance as the resources lost.

The current preliminary focused array of alternative plans is a result of screening that considered the Environmental Quality (EQ) account. Several preliminary alternatives were screened out based on EQ criteria that eliminated them based on their unacceptable level of adverse impacts. These alternatives including storm surge barriers located at Little Egg Harbor Inlet, Hereford Inlet, and BCs at North Point (Edwin B. Forsythe NWR), which would have induced significant impacts on critical fish and wildlife resources. By eliminating these alternatives, the practice of “avoidance” has been accomplished at an early stage. However, additional avoidance measures with the current preliminary focused array will be considered, where practicable for development of the final array and TSP. Avoidance could be accomplished through design modifications in either the structures themselves or by moving the structure to another location, wherever practicable. An example would be to seek locations where a floodwall or levee could be set-back further from a sensitive habitat. “Minimization” of the impact will also be considered, and some of the same means for avoidance could be applied. An example of minimization could be to maximize the location of a structure feature outside of a sensitive habitat such as a wetland or aquatic area even though avoidance is not practicable. Additionally, minimization can also be practiced if NNBF alternatives are employed that can effectively offset some of the impacts of a structural alternatives’ impacts by providing an ecological uplift through an NNBF feature implementation.

After the practice of minimization is considered, compensation is the most likely form of mitigation in this situation. Compensatory mitigation would require intensive coordination with resource agencies on site selection and mitigation methods. In accordance with USACE policy, a habitat model is required to assess the baseline habitat values, and to determine the severity of the impact to derive an appropriate compensation for the impact. The selection of compensatory mitigation requires the utilization of "cost effectiveness and incremental cost analysis" to determine the optimal level of ecosystem outputs compared with cost considerations.

In the case of the NJBB study, USACE is considering the use of the New England Salt Marsh Model for assessing wetland impacts and mitigation needs. The New England Salt Marsh Model is a community model that quantifies the heath and function of salt marsh based on marsh characteristics and the presence of habitat types that contribute to use by terrestrial species. The model consists of eight wetland and landscape components that are used to assess and evaluate salt marsh wildlife habitat values. Several of the components are directly based on the different habitat types found in and around marshes or ecosystems that are linked to salt marshes. Other components reflect the anthropogenic alteration of these habitats. The remaining components consider the size, morphology, and landscape positions of the marsh, which may be important to territorial species and those that require adjacent upland habitats. The eight components are (1) marsh habitat types, (2) marsh morphology, (3) marsh size, (4) degree of anthropogenic modification, (5) vegetative heterogeneity, (6) surrounding land use, (7) connectivity, and (8) vegetation types. Model output is a numerical score with a maximum possible score of 784. For estuarine aquatic habitat impacts, the Benthic Index of Biotic Integrity (BIBI) is being considered. The combination of the New England Saltmarsh Model and BIBI provides a means to comprehensively evaluate the loss of ecological functions and services across a wide range of habitats.

A future analysis will consider if NNBFs either as standalone or in conjunction with structural alternatives can be considered as compensatory mitigation toward structural features. A representative example includes consideration of NNBF such as a horizonal levee constructed outshore and adjacent to a floodwall as compensatory mitigation for the floodwall.

Historic and Cultural Resources

The New Jersey Back Bays Study will be especially challenging regarding potential impacts to historic properties eligible for or listed on the National Register of Historic Places (NRHP). This project involves the entire southern coast of New Jersey from Monmouth to Cape May. Background research within the general study area show many previously recorded archaeological sites, historic structures, historic districts, shipwrecks, and other cultural resources. The following is the current count of recorded historic properties eligible for or listed on the NRHP for each county in the study area: Monmouth County – 377; Ocean County - 179; Burlington County – 331, one of which is a Paleo-Indian archaeological site; Atlantic County – 153; and Cape May County – 189. Continued consultation with the New Jersey State Historic Preservation Office, the Tribes, and other Consulting Parties will be required pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA) as the project develops. Once our study isolates viable alternatives, we will define the Area of Potential Effects (APE) and conduct the necessary investigations and consultation in order to avoid, minimize, or to mitigate Adverse Effects to historic properties.

A-8) TENTATIVELY SELECTED PLAN COMPARISON MATRIX

This section includes a refined comparison of the 20 plans included in the focused array (**Table 15**). This table shows the detailed results associated with the screening of the 20 alternative plans discussed in Chapter 10, Plan Formulation Process of the Main Report. Results included in this table include Planning Criteria identified in ER 1105-2-100, as well as the NED, OSE and EQ systems of accounts. The focused array of alternatives is presented in this table by the Shark River & Coastal Lakes, North, Central and South regions of the study area. The TSP plans are highlighted in green with options being carried forward for additional analyses highlighted in yellow.

Table 15: Focused Array Comparison Matrix

NJBB TSP IPR Focused Array Comparison		Planning Criteria				System of Accounts				
						National Economic Development (NED)				
		Effectiveness	Efficiency	Acceptability	Completeness	Initial Construction	Average Annual Net Benefits	BCR	Residual Damages	NED Rank
Shark River										
2A	**All Non-Structural**	**Medium - will reduce damages to buildings (i.e. structure and content), but does not reduce risk to infrastructure (e.g., roads, utilities, etc.)**	**High (BCR>1) - environmental impacts likely lowest compared to other measures because of construction within the footprint; therefore, net benefits may be highest relative to other measures as mitigation costs are refined**	**Medium - There is risk due to uncertainty of implementatbility of non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Very high residual risk (69%); as we refine the analysis and community participation rates, residual risk may increase for non-structural. Non-structural measures do not reduce risk to infrastructure.**	**$41,531,000**	**$1,618,000**	**2.1**	**69%**	**1**
North Region (Manasquan to Little Egg Inlet)										
3A	**All Non-Structural**	**Medium - will reduce damages to buildings (i.e. structure and content), but does not reduce risk to infrastructure (e.g., roads, utilities, etc.)**	**High (BCR = 2) - environmental impacts likely lowest compared to other measures because construction is within the footprint; therefore, net benefits may be highest relative to other measures as mitigation costs are refined**	**Medium - There is risk due to uncertainty of implementatbility of non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CRSM to both mainland and barrier islands. Non-structural measures do not reduce risk to infrastructure. As we refine the analysis and community participation rates, residual risk may increase for non-structural.**	**$6,593,000,000**	**$252,392,000**	**2.0**	**33%**	**2**
3D	**Limited Perimeter (Manasquan Inlet) + Non - Structural**	**Low - Non-structural measures such as building elevation will reduce damages to structures (i.e. structure and content), but do not reduce risk to infrastructure on the mainland. Behind the Manasquan North floodwall, the floodwall will manage risk for both high and low frequency events; however, perimeter measures would result in increased "with project" incremental life loss in the case of failure of the structure. This potential structure failure coupled with the potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall) could contribute to increased with project incremental life loss consequences. In addition, the perimeter plan is not adaptable to sea level rise, which could further excaberate life loss potential.**	**Medium (BCR>1) - has the potential for elevated mitigation or real estate costs as design is refined for the perimeter plan. Net benefits for the non-structural component may highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CRSM to both mainland and barrier islands. Perimeter measures not adaptable to sea level rise and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Non-structural measures do not reduce risk to infrastructure. As we refine the analysis andcommunity participation rates, residual risk may increase for non-structural.**	**$7,137,000,000**	**$229,634,000**	**1.8**	**33%**	**3**
3E.2	**Barnegat Inlet and Mansquan Inlet SSB + Non-Structural**	**High - Storm surge barriers will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an adaptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss (as compared to a perimerter measure) if overtopped. Non-structural measures such as building elevation will reduce damages to buildings (i.e. structure and content), but do not reduce risk to other infrastructure**	**Medium (BCR>1) - high uncertainty for elevated mitigation for indirect effects of storm surge barriers. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers. There is risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CSRM benefits to both barrier islands and mainland communities, but likely only during low frequency events. Implementation and maintenance of storm surge barriers may be cost prohibitive. Non-structural measures do not reduce risk to infrastructure. As we refine the analysis and community participation rates, residual risk may increase for non-structural.**	**$6,007,000,000**	**$268,881,000**	**1.9**	**22%**	**1**
3E.3	**Barnegat Inlet and Mansquan Inlet SSB + Non-Structural + Southern LBI Perimeter**	**Low - Storm surge barriers will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an adaptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss if overtopped (as compared to the perimerter measure). Non-structural measures such as building elevation will reduce damages to buildings (i.e. structure and content), but do not reduce risk to other infrastructure on the mainland. In southern LBI, the floodwall will manage risk for both high and low frequency event; however, perimeter measures would result in increased with project incremental life loss in the case of failure of the structure. This potential structure failure coupled with the potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall) could contribute to increased with project incremental life loss consequences. In addition, the perimeter plan is not adaptable to sea level rise, which could further excaberate life loss potential.**	**Low (BCR>1) - high uncertainty for elevated mitigation for indirect effects of storm surge barriers. Perimeter plan component has the potential for elevated mitigation or real estate costs as design is refined. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Lowest residual risk plan in this region (18%). Provides CSRM to both mainland and barrier islands. Perimeter measures not adapatable to sea level rise and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Implementation and maintenance of SSBs may be cost prohibitive. Non-structural measures do not reduce risk to infrastructure. As we refine the analysis and community participation rates, residual risk may increase for non-structural.**	**$7,861,000,000**	**$169,123,000**	**1.4**	**18%**	**4**

NJBB TSP IPR Focused Array Comparison		Planning Criteria				System of Accounts				
						National Economic Development (NED)				
		Effectiveness	Efficiency	Acceptability	Completeness	Initial Construction	Average Annual Net Benefits	BCR	Residual Damages	NED Rank
Central Region (Brigantine to Corsons Inlet)										
4A	**All Non-Structural**	**Medium - will reduce damages to buildings (i.e. structure and content), but does not reduce risk to infrastructure (e.g., roads, utilities, etc.)**	**High (BCR>2) - environmental impacts likely lowest compared to other measures because construction is within the footprint; net benefits may be highest relative to other plans as mitigation costs are refined**	**Medium - There is risk due to uncertainty of implementatbility of non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - High residual risk (47%). Provides CRSM to both mainland and barrier islands. Non-structural measures do not reduce risk to infrastructure. As we refine the analysis and community participation rates, residual risk may increase for non-structural.**	**$3,600,000,000**	**$220,044,000**	**2.7**	**47%**	**2**
4D	**All Perimeter Less Brigantine + non-Structural**	**Low - Non-structural measures such as building elevation will reduce damages to buildings (i.e. structure and content), but do not reduce risk to other infrastructure on the mainland. In Ocean City and Absecon Island, the floodwalls will manage risk for both high and low frequency events; however, perimeter measures would result in increased "with project" incremental life loss in the case of failure of the structure. This potential structure failure coupled with the potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall) could contribute to increased with project incremental life loss consequences. In addition, the perimeter plan is not adaptable to sea level rise, which could further excaberate life loss potential.**	**Low (BCR>1) - perimeter plan has the potential for elevated mitigation or real estate costs as the design is refined. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CSRM benefits to both barrier islands (Except Brigantine) and mainland communities. Perimeter measures not adapatable to sea level rise and and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Non-structural measures do not reduce risk to infrastructure. Plan has low residual risk. As we refine the analysis and community participation rates, residual risk may increase for non-structural.**	**$6,652,000,000**	**$230,502,000**	**1.7**	**15%**	**1**
4D2	**All Perimeter + Non-Structural**	**Low - Non-structural measures such as building elevation will reduce damages to buildings, but do not reduce risk to other infrastructure on the mainland. In Ocean City, Absecon Island, and Brigantine, the floodwalls will manage risk for both high and low frequency events. Perimeter measures would result in high potential for incremental life loss associated with based on complacency (i.e., if people don't evacuate) and because water levels would increase in case of a failure. Perimeter plan is not adaptable with sea level rise and excaberates life loss potential.**	**Low (BCR>1) - perimeter plan has the potential for elevated mitigation or real estate costs as the design is refined. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Medium - Provides CSRM benefits to both barrier islands and mainland communities. Perimeter measures not adapatable to sea level rise and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Non-structural measures do not reduce risk to infrastructure. Plan has low residual risk. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural.**	**$7,808,000,000**	**$182,728,000**	**1.5**	**13%**	**7**
4E.2	**Absecon Inlet and Great Egg SSB + Non-Structural**	**High - Storm surge barriers will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an adaptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss if overtopped (relative to perimeter measures). Non-structural measures such as building elevation north of Corsons Inlet and in the vicinity of Absecon, will reduce damages to buildings, but do not reduce risk to infrastructure**	**Low (BCR>1) - high uncertainty for elevated mitigation for indirect effects of storm surge barriers. Net benefits for the non-structural component be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CSRM benefits to both barrier islands and mainland communities, but likely only during low frequency events. Implementation and maintenance of storm surge barriers may be cost prohibitive. Non-structural measures do not reduce risk to infrastructure. Plan has low residual risk. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural.**	**$6,164,000,000**	**$184,495,000**	**1.5**	**16%**	**6**
4E.3	**Absecon Inlet and Great Egg SSB + Southern Ocean City Perimeter +Non-Structural**	**Low- Storm surge barriers will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an adaptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss if overtopped (relative to perimeter measures). Non-structural measures such as building elevation north of Corsons Inlet and in the vicinity of Absecon, will reduce damages to buildings, but do not reduce risk to infrastructure. The floodwall in southern Ocean City will manage risk from high and low frequency events; however, perimeter measures would result in increased "with project" incremental life loss in the case of failure of the structure. This potential structure failure coupled with the potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall) could contribute to increased with project incremental life loss consequences. In addition, the perimeter plan is not adaptable to sea level rise, which could further excaberate life loss potential.**	**Low (BCR>1) - high uncertainty for elevated mitigation for the storm surge barriers for indirect effects. Perimeter plan has the potential for elevated mitigation or real estate costs as the design is refined. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CSRM benefits to both barrier islands and mainland communities, but only during low frequency events. The floodwall in Ocean City will provide CRSM during high frequency events. Perimeter measures not adapatable to sea level rise and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Non-structural measures will manage risk to structures, but not infrastructure. Plan has low residual risk. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural.**	**$6,473,000,000**	**$177,626,000**	**1.4**	**14%**	**9**

NJBB TSP IPR Focused Array Comparison		Planning Criteria				System of Accounts				
		Effectiveness	Efficiency	Acceptability	Completeness	National Economic Development (NED)				
						Initial Construction	Average Annual Net Benefits	BCR	Residual Damages	NED Rank
Central Region (Brigantine to Corsons Inlet)										
4E.4	**Absecon Inlet and Great Egg SSB + Southern Ocean City Bay Closure + Non-structural in Absecon**	**High - Storm surge barriers will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an adaptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss if overtopped (relative to perimeter measures). Non-structural measures such as building elevation north of Corsons Inlet and in the vincinity of Absecon, will reduce damages to buildings, but do not reduce risk to infrastructure.**	**Low (BCR>1) - high uncertainty for elevated mitigation for the storm surge barriers and bay closure from indirect effects. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CSRM benefits to both barrier islands and mainland communities, but likely only during low frequency events. Implementation and maintenance of SSBs may be cost prohibitive. Non-structural measures will manage risk to structures, but not infrastructure. Plan has low residual risk. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural.**	**$6,206,000,000**	**$180,579,000**	**1.5**	**15%**	**8**
4G.6	**Absecon Blvd Bay Closure + Great Egg Harbor Inlet SSB + Non-structural in Brigantine and Absecon + Non-structural in Southern Ocean City**	**High - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an daptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss if overtopped (relative to perimeter measures). Non-structural measures such as building elevation north of the Absecon Blvd Bay closure will manage risk to structures, but not other critical infrastructure.**	**Low (BCR>1) - high uncertainty for elevated mitigation for the storm surge barrier and bay closure from indirect effects. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CSRM benefits to both barrier islands and mainland communities. Non structural measures do not reduce risk to infrastructure. Very low residual risk. Non-structural measures do not reduce risk to other critical infrastructure. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural. Implementation and maintenance of SSBs and bay closure may be cost prohibitive.**	**$6,203,000,000**	**$216,837,000**	**1.6**	**13%**	**3**
4G.7	**Absecon Blvd Bay Closure + Great Egg Harbor Inlet SSB + Non-structural in Brigantine and Absecon + Non-structural and Perimeter in Southern Ocean City**	**Low - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an adaptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss if overtopped (relative to perimeter measures). Non-structural measures such as building elevation north of the Absecon Blvd Bay closure will manage risk to structures, but not other critical infrastructure. The floodwall along southern Ocean City will manage risk from both high and low frequency events; however, perimeter measures would result in increased with project incremental life loss in the case of failure of the structure. This potential structure failure coupled with the potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall) could contribute to increased "with project" incremental life loss consequences. In addition, the perimeter plan is not adaptable to sea level rise, which could further excaberate life loss potential.**	**Low (BCR>1) - high uncertainty for elevated mitigation for the storm surge barriers for indirect effects. Perimeter plan has the potential for elevated mitigation or real estate costs as the design is refined. Net benefits for the non-structural may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CSRM benefits to both barrier islands and mainland communities. Perimeter measures not adapatable to sea level rise and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Non-structural measures do not reduce risk to infrastructure. Very low residual risk. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural. Implementation and maintenance of SSBs and bay closure may be cost prohibitive.**	**$6,512,000,000**	**$209,968,000**	**1.5**	**10%**	**5**
4G.8	**Absecon Blvd Bay Closure + Great Egg Harbor Inlet SSB + Non-structural in Brigantine and Absecon + South Ocean City Bay Closure**	**High - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an adaptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss if overtopped (relative to perimeter measures). Non-structural measures such as building elevation north of the Absecon Blvd Bay closure will manage risk to structures, but not infrastructure.**	**Low (BCR>1) - high uncertainty for elevated mitigation for the storm surge barriers and bay closure. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CSRM benefits to both barrier islands and mainland communities. Non-structural measures do not reduce risk to other critical infrastructure. Very low residual risk. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural. Implementation and maintenance of SSBs and bay closure may be cost prohibitive.**	**$6,245,000,000**	**$212,921,000**	**1.6**	**11%**	**4**

NJBB TSP IPR Focused Array Comparison		Planning Criteria				System of Accounts				
						National Economic Development (NED)				
		Effectiveness	Efficiency	Acceptability	Completeness	Initial Construction	Average Annual Net Benefits	BCR	Residual Damages	NED Rank
Central Region (Brigantine to Corsons Inlet)										
4G.10	**Absecon Blvd Bay Closure + Great Egg Harbor SSB + Brigantine Perimeter + Non-structural in Absecon + Non-structural in Southern Ocean City**	Low - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an adaptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss if overtopped (relative to perimeter measures). Non-structural measures such as building elevation north of the Absecon Blvd Bay and north of Corsons Inlet closure will manage risk to structures, but not other critical infrastructure. The floodwall along Brigantine will manage risk from both high and low frequency events; however, perimeter measures would result in increased with project incremental life loss in the case of failure of the structure. This potential structure failure coupled with the potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall) could contribute to increased with project incremental life loss consequences. In addition, the perimeter plan is not adaptable to sea level rise, which could further excaberate life loss potential.	Low (BCR>1) - high uncertainty for elevated mitigation for the storm surge barriers for indirect effects. Perimeter plan has the potential for elevated mitigation or real estate costs as the design is refined. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint	Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.	Low - Provides CSRM benefits to both barrier islands and mainland communities. Perimeter measures not adapatable to sea level rise and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Non-structural measures do not reduce risk to infrastructure. Very low residual risk. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural. Implementation and maintenance of SSBs and bay closure may be cost prohibitive.	$7,359,000,000	$169,063,000	1.4	10%	10
4G.11	**Absecon Blvd Bay Closure + Great Egg Harbor SSB + Brigantine Perimeter + Non-structural in Absecon + Non-structural and Perimeter in Southern Ocean City**	Low - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an adaptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss if overtopped (relative to perimeter measures). Non-structural measures such as building elevation north of the Absecon Blvd Bay and north of Corsons Inlet closure will manage risk to structures, but not other critical infrastructure. The floodwall along Brigantine and around southern Ocean City will manage risk from both high and low frequency events; however, perimeter measures would result in increased with project incremental life loss in the case of failure of the structure. This potential structure failure coupled with the potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall) could contribute to increased "with project" incremental life loss consequences. In addition, the perimeter plan is not adaptable to sea level rise, which could further excaberate life loss potential.	Low (BCR>1) - high uncertainty for elevated mitigation for the storm surge barriers for indirect effects. Perimeter plan has the potential for elevated mitigation or real estate costs as the design is refined. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint	Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.	Low - Provides CSRM benefits to both barrier islands and mainland communities. Perimeter measures not adapatable to sea level rise and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Non-structural measures do not reduce risk to other critical infrastructure. Lowest residual risk plan in this region (8%). As we refine the analysis and refine community participation rates, residual risk may increase for non-structural. Implementation and maintenance of SSBs and bay closure may be cost prohibitive.	$7,668,000,000	$162,195,000	1.4	8%	12
4G.12	**Absecon Blvd Bay Closure + Great Egg Harbor SSB + Brigantine Perimeter + Non-structural in Absecon + South Ocean City Bay Closure**	Low - Storm surge barriers and bay closures will reduce coastal storm risk during low frequency events, but will likely not reduce risk from more frequent storm events. Storm surge barriers provide an adaptable approach to flood risk management; flexibility with operation and maintenance (i.e., timing and frequency of gate opening/closing). Less potential for elevated incremental life loss if overtopped (relative to perimeter measures). Non-structural measures such as building elevation north of the Absecon Blvd Bay and north of Corsons Inlet closure will manage risk to structures, but not other critical infrastructure. The floodwall along Brigantine will manage risk from both high and low frequency events; however, perimeter measures would result in increased with project incremental life loss in the case of failure of the structure. This potential structure failure coupled with the potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall) could contribute to increased with project incremental life loss consequences. In addition, the perimeter plan is not adaptable to sea level rise, which could further excaberate life loss potential.	Low (BCR>1) - high uncertainty for elevated mitigation for the storm surge barriers for indirect effects. Perimeter plan has the potential for elevated mitigation or real estate costs as the design is refined. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint	Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty of indirect impacts to water quality and circulation from Storm Surge Barriers and Bay Closures and very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.	Low - Provides CSRM benefits to both barrier islands and mainland communities. Perimeter measures not adapatable to sea level rise and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Non-structural measures do not reduce risk to infrastructure. Lowest residual risk plan in this region. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural. Implementation and maintenance of SSBs and bay closure may be cost prohibitive.	$7,400,000,000	$165,147,000	1.4	9%	11
South Region (Strathmere to Cape May)										
5A	**All Non-Structural**	Medium - will reduce damages to buildings (i.e. structure and content), but does not reduce risk to infrastructure (e.g., roads, utilities, etc.)	High (BCR > 2) - environmental impacts likely lowest compared to other measures because construction is within the footprint; therefore, net benefits may be highest relative to other measures as mitigation costs are refined	Medium - There is risk due to uncertainty of implementatbility of non-structural measures due to remaining questions about compliance with state and local laws.	Low - High residual risk (40%). Provides CRSM to both mainland and barrier islands. Non-structural measures do not reduce risk to infrastructure. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural.	$3,125,000,000	$97,758,000	1.8	40%	1

NJBB TSP IPR Focused Array Comparison		Planning Criteria				System of Accounts				
						National Economic Development (NED)				
		Effectiveness	Efficiency	Acceptability	Completeness	Initial Construction	Average Annual Net Benefits	BCR	Residual Damages	NED Rank
South Region (Strathmere to Cape May)										
5D	**All Perimeter Less Seven Miles/Strathmere non-structural**	**Low - will reduce damages to buildings (i.e. structure and content), but do not reduce risk to other infrastructure on the mainland. In Cape May City, Wildwood Island and Sea Isle City, the floodwalls will manage risk for both high and low frequency events; however, perimeter measures would result in increased with project incremental life loss in the case of failure of the structure. This potential structure failure coupled with the potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall) could contribute to increased "with project" incremental life loss consequences. In addition, the perimeter plan is not adaptable to sea level rise, which could further excaberate life loss potential.**	**Low (BCR>1) perimeter plan has the potential for elevated mitigation or real estate costs as the design is refined. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CSRM benefits to both barrier islands and mainland communities. Perimeter measures not adapatable to sea level rise and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Non-structural measures do not reduce risk to infrastructure. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural.**	**$4,656,000,000**	**$63,401,000**	**1.3**	**21%**	**2**
5D2	**All Perimeter Less Seven Mile + Non-structural**	**Low - will reduce damages to buildings (i.e. structure and content), but do not reduce risk to other infrastructure on the mainland. In Cape May City, Wildwood Island, Seven Mile Island, and Sea Isle City, the floodwalls will manage risk for both high and low frequency events; however, perimeter measures would result in increased with project incremental life loss in the case of failure of the structure. This potential structure failure coupled with the potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall) could contribute to increased "with project" incremental life loss consequences. In addition, the perimeter plan is not adaptable to sea level rise, which could further excaberate life loss potential.**	**Low (BCR>1) - perimeter plan has the potential for elevated mitigation or real estate costs as the design is refined. Net benefits for the non-structural component may be highest relative to other measures as mitigation costs are refined; environmental impacts are likely lowest compared to other measures because construction is within the footprint**	**Low - There is risk that the project may not be implementable due to environmental laws. This risk is based in the very high uncertainty whether the high direct impacts of a floodwall would be acceptable to resource agencies. There is also risk due to uncertainty of implementing non-structural measures due to remaining questions about compliance with state and local laws.**	**Low - Provides CSRM benefits to both barrier islands and mainland communities. Perimeter measures not adapatable to sea level rise and may cause a potential for increased community complacency (i.e., if people don't evacuate based on the presence of the perimeter wall); thereby, potentially increasing with project incremental life loss consequences in the case of structure failure. Non-structural measures do not reduce risk to infrastructure on the mainland. This plan has the lowest residual risk (14%) in the region. As we refine the analysis and refine community participation rates, residual risk may increase for non-structural.**	**$7,286,000,000**	**-$57,365,000**	**0.8**	**14%**	**3**

NJBB TSP IPR Focused Array Comparison		System of Accounts (continued)																
		Environmental Quality (EQ)										Envrionmental Quality			Other Social Effects (OSE)			
		Regulatory Constraint	Circulation	Sedimentation/Scour	Water Quality	Air Quality	Endangered Species	Fisheries	Aquatic Life	Wetlands /Aquatic Habitat	Terrestrial Habitat	EQ Index Score	EQ Rank	Direct Impact Acres (all habitats)	Cultural Resources	Nuisance Flooding	Social Risk and Vulnerability	Infrastructure Exposure	Community Cohesion
Shark River																			
2A	**All Non-Structural**	4	5	5	4	4	4	4	4	4	4	4.2	1	negligible	Unknown	No reduction in innudation during higher frequency events	There is risk that non-structural measures such as building elevation might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements.
North Region (Manasquan to Little Egg Inlet)																			
3A	**All Non-Structural**	4	5	5	4	4	4	4	4	4	4	4.2	1	negligible	Unknown	No reduction in innudation during higher frequency events	There is risk that non-structural measures such as building elevation might create a false sense of security d+AA10uring a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements.AC10
3D	**Limited Perimeter (Manasquan Inlet) + Non - Structural**	2	5	4	3	4	3	1	1	1	4	2.9	2	37.2	Unknown	No reduction in innudation during higher frequency events, except along the Manasquan North floodwall.	There is risk that non-structural measures such as building elevation might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	No reduction of exposure of critical infrastructure and evacuation routes, except along the Manasquan North Floodwall.	Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements. Along the Manasquan North floodwall, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.
3E.2	**Barnegat Inlet and Mansquan Inlet SSB + Non-Structural**	2	2	2	2	3	1	1	1	1	3	1.8	3	31.6	Unknown	Storm surge barriers will manage risk from low frequency storms in the area of influence around Manasquan and Barnegat inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that non-structural measures such as building elevation would create a false sense of security during a storm event reducing compliance with evacuation orders around Tuckerton. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable in the southern vincinity of Tuckerton where non-structural measures will be implemented.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements.
3E.3	**Barnegat Inlet and Mansquan Inlet SSB + Non-Structural + Southern LBI Perimeter**	2	2	2	2	3	1	1	1	1	3	1.8	4	165.3	Unknown	Storm surge barriers will manage risk from low frequency storms in the area of influence around Manasquan and Barnegat inlets, but will not address the risk to communities from higher frequency events. Southern LBI will experience less nusiance flooding due to the construction of a floodwall.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events, except in southern LBI where a floodwall will be constructed. There is risk that non-structural measures such as building elevation would create a false sense of security during a storm event reducing compliance with evacuation orders around Tuckerton. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed and in LBI due to the presense of a floodwall. However, infrastructure is vulnerable in the southern vincinity of Tuckerton where non-structural measures will be implemented.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements. In southern LBI, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.

NJBB TSP IPR Focused Array Comparison		System of Accounts (continued)																
		Environmental Quality (EQ)										Envrionmental Quality				Other Social Effects (OSE)			
		Regulatory Constraint	Circulation	Sedimentation/Scour	Water Quality	Air Quality	Endangered Species	Fisheries	Aquatic Life	Wetlands /Aquatic Habitat	Terrestrial Habitat	EQ Index Score	EQ Rank	Direct Impact Acres (all habitats)	Cultural Resources	Nuisance Flooding	Social Risk and Vulnerability	Infrastructure Exposure	Community Cohesion
Central Region (Brigantine to Corsons Inlet)																			
4A	**All Non-Structural**	4	5	5	4	4	4	4	4	4	4	4.2	1	negligible	Unknown	No reduction in innudation during higher frequency events	There is risk that non-structural measures such as building elevation would create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	No reduction of exposure of critical infrastructure and evacuation routes	Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements.
4D	**All Perimeter Less Brigantine + non-Structural**	2	5	4	3	4	3	1	1	1	4	2.9	2	237.6	Unknown	Floodwalls and Levees would reduce innundation in barrier island (except Brigantine Island) communities during higher frequency events.	There is risk that non-structural measures such as building elevation might create a false sense of security during a storm event reducing compliance with evacuation orders in Brigantine, Somers Point, Linwood, Northfield, Pleasantville, and Absecon. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands, except for Brigantine. Infrastructure and evacuation routes remain vunerable on the mainland and Brigantine.	Potential for reduction in bayside views and access by floodwalls in Ocean City and Absecon Island. Real estate easements required to construct walls could be difficult to obtain. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities in Brigantine, Somers Point, Linwood, Northfield, Pleasantville, and Absecon. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements.
4D2	**All Perimeter + Non-Structural**	2	5	4	3	4	3	1	1	1	4	2.9	2	287.7	Unknown	Floodwalls and Levees would reduce innundation in barrier island communities during higher frequency events.	There is risk that non-structural measures such as building elevation might create a false sense of security during a storm event reducing compliance with evacuation orders in Somers Point, Linwood, Northfield, Pleasantville, and Absecon. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened on the barrier islands. Infrastructure and evacuation routes remain vunerable on the mainland.	Potential for reduction in bayside views and access by floodwalls in Ocean City, Absecon Island, and Brigantine. Real estate easements required to construct walls could be difficult to obtain. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities in Somers Point, Linwood, Northfield, Pleasantville, and Absecon. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements.
4E.2	**Absecon Inlet and Great Egg SSB + Non-Structural**	2	2	2	2	3	1	1	1	1	3	1.8	3	33	Unknown	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland Little Egg Inlet remain vulnerable as these inlets will not be closed. There is risk that non-structural measures such as building elevation might create a false sense of security during a storm event reducing compliance with evacuation orders in mainland communities adjacent to Little Egg Inlet.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Harbor and Absecon Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities in Southern Ocean City and Absecon. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements.
4E.3	**Absecon Inlet and Great Egg SSB + Southern Ocean City Perimeter +Non-Structural**	2	2	2	2	3	1	1	1	1	3	1.8	3	83	Unknown	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events. The floodwall in Southern Ocean City will reduce innundation from higher frequency events.	Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland around Corsons Inlet and Little Egg Inlet remain vulnerable as these inlets will not be closed. There is risk that non-structural measures such as building elevation might create a false sense of security during a storm event reducing compliance with evacuation orders in mainland communities adjacent to Little Egg Inlet and Corsons Inlet. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Manasquan and Barnegat Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area.	As of now, the full extent of the indirect impacts of a storm surge barrier are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for elevation could reduce the robustness of coastal communities on the mainland adjacent to Corsons and Little Egg Inlet. Additionally, there might be community opposition to selective elevating of structures and the needed real estate easements. Potential for reduction in bayside views and access by floodwalls in Southern Ocean City. Real estate easements required to construct walls could be difficult to obtain.

NJBB TSP IPR Focused Array Comparison		System of Accounts (continued)																	
		Environmental Quality (EQ)										Envrionmental Quality				Other Social Effects (OSE)			
		Regulatory Constraint	Circulation	Sedimentation/Scour	Water Quality	Air Quality	Endangered Species	Fisheries	Aquatic Life	Wetlands /Aquatic Habitat	Terrestrial Habitat	EQ Index Score	EQ Rank	Direct Impact Acres (all habitats)	Cultural Resources	Nuisance Flooding	Social Risk and Vulnerability	Infrastructure Exposure	Community Cohesion
Central Region (Brigantine to Corsons Inlet)																			
4E.4	**Absecon Inlet and Great Egg SSB + Southern Ocean City Bay Closure + Non-structural in Absecon**	**1**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**3**	**1.8**	**4**	**57.8**	**Unknown**	**Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor and Absecon Inlets, but will not address the risk to communities from higher frequency events. The floodwall in Southern Ocean City will reduce innundation from higher frequency events.**	**Storm surge barriers will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. Additionally, communities on the mainland around Corsons Inlet and Little Egg Inlet remain vulnerable as these inlets will not be closed. There is risk that non-structural measures such as building elevation might create a false sense of security during a storm event reducing compliance with evacuation orders in mainland communities adjacent to Little Egg Inlet and Corsons Inlet. People sheltering in place could increase both their personal risk and the risk to emergency responders.**	**Exposure of critical infrastructure and evacuation routes is lessened around Great Egg and Absecon Inlets during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area.**	**As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities on the mainland adjacent to Little Egg Inlet. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements.**
4G.6	**Absecon Blvd Bay Closure + Great Egg Harbor Inlet SSB + Non-structural in Brigantine and Absecon + Non-structural in Southern Ocean City**	**1**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**3**	**1.8**	**4**	**107.1**	**Unknown**	**Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd and around Corsons Inlet will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads.**	**Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that non-structural measures such as building elevation north of the Absecon Bay Blvd closure and around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.**	**Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. North of the bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.**	**As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities north of the Absecond Blvd bay closure and around Corsons Inlet.**
4G.7	**Absecon Blvd Bay Closure + Great Egg Harbor Inlet SSB + Non-structural in Brigantine and Absecon + Non-structural and Perimeter in Southern Ocean City**	**1**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**3**	**1.8**	**4**	**157**	**Unknown**	**Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd and around Corsons Inlet will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall in Southern Ocean City will reduce innundation from higher frequency events.**	**Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that non-structural measures such as building elevation north of the Absecon Bay Blvd closure and around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.**	**Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall in Southern Ocean City could improve risk management for critical infrastructure in this area. North of the bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.**	**As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities north of the Absecond Blvd bay closure and around Corsons Inlet. There is potential for reduction in bayside views and access by floodwalls in Southern Ocean City. Real estate easements required to construct walls could be difficult to obtain.**
4G.8	**Absecon Blvd Bay Closure + Great Egg Harbor Inlet SSB + Non-structural in Brigantine and Absecon + South Ocean City Bay Closure**	**1**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**1**	**3**	**1.8**	**5**	**131.9**	**Unknown**	**Storm surge barriers and bay closureswill manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads.**	**Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that non-structural measures such as building elevation north of the Absecon Bay Blvd closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.**	**Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier and bay closures are closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the Absecond Blvd bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. North of the bay closure, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.**	**As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities north of the Absecond Blvd bay closure.**

NJBB TSP IPR Focused Array Comparison		System of Accounts (continued)																
		Environmental Quality (EQ)										Envrionmental Quality			Other Social Effects (OSE)			
		Regulatory Constraint	Circulation	Sedimentation/Scour	Water Quality	Air Quality	Endangered Species	Fisheries	Aquatic Life	Wetlands /Aquatic Habitat	Terrestrial Habitat	EQ Index Score	EQ Rank	Direct Impact Acres (all habitats)	Cultural Resources	Nuisance Flooding	Social Risk and Vulnerability	Infrastructure Exposure	Community Cohesion
Central Region (Brigantine to Corsons Inlet)																			
4G.10	**Absecon Blvd Bay Closure + Great Egg Harbor SSB + Brigantine Perimeter + Non-structural in Absecon + Non-structural in Southern Ocean City**	1	2	2	2	3	1	1	1	1	3	1.8	4	157.1	Unknown	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland and around Corsons Inlet to the south will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall around Brigantine will reduce innundation from higher frequency events.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that non-structural measures such as building elevation on the mainland north of the Absecon Bay Blvd closure and to the south around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall around Brigantine could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities on the mainland north of the Absecon Blvd bay closure and to the south around Corsons Inlet. There is potential for reduction in bayside views and access by floodwalls in Brigantine. Real estate easements required to construct walls could be difficult to obtain.
4G.11	**Absecon Blvd Bay Closure + Great Egg Harbor SSB + Brigantine Perimeter + Non-structural in Absecon + Non-structural and Perimeter in Southern Ocean City**	1	2	2	2	3	1	2	2	1	3	2.0	4	207.1	Unknown	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland and around Corsons Inlet to the south will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwalls around Brigantine and southern Ocean City will reduce innundation from higher frequency	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that non-structural measures such as building elevation on the mainland north of the Absecon Bay Blvd closure and to the south around Corsons Inlet might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwalls around Brigantine and southern Ocean City could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure and around Corsons Inlet, there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities on the mainland north of the Absecon Blvd bay closure and to the south around Corsons Inlet. There is potential for reduction in bayside views and access by floodwalls in Brigantine and southern Ocean City. Real estate easements required to construct walls could be
4G.12	**Absecon Blvd Bay Closure + Great Egg Harbor SSB + Brigantine Perimeter + Non-structural in Absecon + South Ocean City Bay Closure**	1	2	2	2	3	1	1	1	1	3	1.8	5	181.9	Unknown	Storm surge barriers will manage risk from low frequency storms in the area of influence around Great Egg Harbor, but will not address the risk to communities from higher frequency events. Non-structural measures to the north of the Absecon Bay Blvd on the mainland will reduce risk to structures from nuisance flooding, but will not impact other critical infrastructure such as roads. The floodwall around Brigantine will reduce innundation from higher frequency events.	Storm surge barriers and bay closures will manage risk from low frequency coastal storms, but will not address the risk to communities from higher frequency events. There is risk that non-structural measures such as building elevation on the mainland north of the Absecon Bay Blvd closure might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened around Great Egg Inlet and south of the Absecon Blvd bay closure during low frequency events when the storm surge barrier is closed. However, infrastructure is vulnerable when the storm surge barriers are open. The construction of the Absecon Blvd bay closure will elevate Absecon Blvd, which will reduce exposure of the evacuation route to coastal storm risk. The floodwall around Brigantine could improve risk management for critical infrastructure in this area. On the mainland north of the Absecon Blvd bay closure there is no risk reduction to critical infrastructure or evacuation routes. Modeling would need to be completed to confirm that the bay closure doesn't induce flooding north of the structure from Little Egg Inlet.	As of now, the full extent of the indirect impacts of a storm surge barrier and bay closures are not understood. There is risk that these structures could result in environmental degradation, which can have negative impacts on the recreational and aquaculture industries in the study area. However, storm surge barriers will reduce coastal storm risk in mainland communities such as Somers Point, Linwood, and Northfield during low frequency events when the barrier is closed. Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities on the mainland north of the Absecond Blvd bay closure. There is potential for reduction in bayside views and access by floodwalls in Brigantine. Real estate easements required to construct walls could be difficult to obtain.
South Region (Strathmere to Cape May)																			
5A	**All Non-Structural**	**4**	**5**	**5**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4.2**	**1**	**negligible**	**Unknown**	**No reduction in innudation during higher frequency events**	**There is risk that non-structural measures such as building elevation might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.**	**No reduction of exposure of critical infrastructure and evacuation routes**	**Residual risk to infrastructure and properties that don't qualify for non-structural measures could reduce the robustness of coastal communities. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements.**

NJBB TSP IPR Focused Array Comparison		System of Accounts (continued)																
		Environmental Quality (EQ)										Envrionmental Quality			Other Social Effects (OSE)			
		Regulatory Constraint	Circulation	Sedimentation/Scour	Water Quality	Air Quality	Endangered Species	Fisheries	Aquatic Life	Wetlands /Aquatic Habitat	Terrestrial Habitat	EQ Index Score	EQ Rank	Direct Impact Acres (all habitats)	Cultural Resources	Nuisance Flooding	Social Risk and Vulnerability	Infrastructure Exposure	Community Cohesion
South Region (Strathmere to Cape May)																			
5D	All Perimeter Less Seven Miles/Strathmere non-structural	2	5	4	3	4	3	2.5	2	2	4	3.3	2	182.4	Unknown	No reduction in innudation during higher frequency events in Strathmere and 7 Mile Island. Floodwalls and Levees would reduce innundation during higher frequency events in Cape May, the Wildwoods, and Sea Isle City.	There is risk that non-structural measures such as building elevation might create a false sense of security during a storm event reducing compliance with evacuation orders. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened in the Wildwoods, Cape May, and Sea Isle City. Exposure to critical infrastructure is not lessened in Strathmere and 7 Mile Island. Infrastructure and evacuation routes remain vunerable on the mainland.	Residual risk to infrastructure and properties that don't qualify for non-structural measures in Strathmere and 7 Mile Island could reduce the robustness of those coastal communities. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements. Along the floodwalls in Sea Isle City, the Wildwoods, and Cape May, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.
5D2	All Perimeter Less Seven Mile + Non-structural	2	5	4	3	4	3	2.5	2	2	4	3.3	2	307.8	Unknown	No reduction in innudation during higher frequency events in Strathmere. Floodwalls and Levees would reduce innundation during higher frequency events in Cape May, the Wildwoods, 7 Mile Island and Sea Isle City.	There is risk that non-structural measures such as building elevation might create a false sense of security during a storm event reducing compliance with evacuation orders in Strathmere. People sheltering in place could increase both their personal risk and the risk to emergency responders.	Exposure of critical infrastructure and evacuation routes is lessened in the Wildwoods, Cape May, 7 Mile Island and Sea Isle City. Exposure to critical infrastructure is not lessened in Strathmere. Infrastructure and evacuation routes remain vunerable on the mainland.	Residual risk to infrastructure and properties that don't qualify for non-structural measures in Strathmere could reduce the robustness of those coastal communities. Additionally, there might be community opposition to selective elevating of structures or other measures and the needed real estate easements. Along the floodwalls in Sea Isle City, the Wildwoods, 7 Mile Island, and Cape May, there is potential for reduction in bayside views and access by floodwalls. There will also likely be difficulties in obtaining real estate easements required to construct walls.

Within the Coastal Lakes Region which consists of sixteen bodies of water commonly referred to as “coastal lakes” (Figure 33), eight of these lakes are included in the TSP, including:

- Sylvan Lake (Bradley Beach/Avon-by-the-Sea)
- Silver Lake (Belmar)
- Stockton Lake (Sea Girt/Manasquan)
- Glimmer Glass (Manasquan)
- Lake Louise (Pt Pleasant Beach)
- Little Silver Lake (Pt Pleasant Beach)
- Lake of the Lilies (Pt Pleasant Beach)
- Twilight Lake (Bay Head)

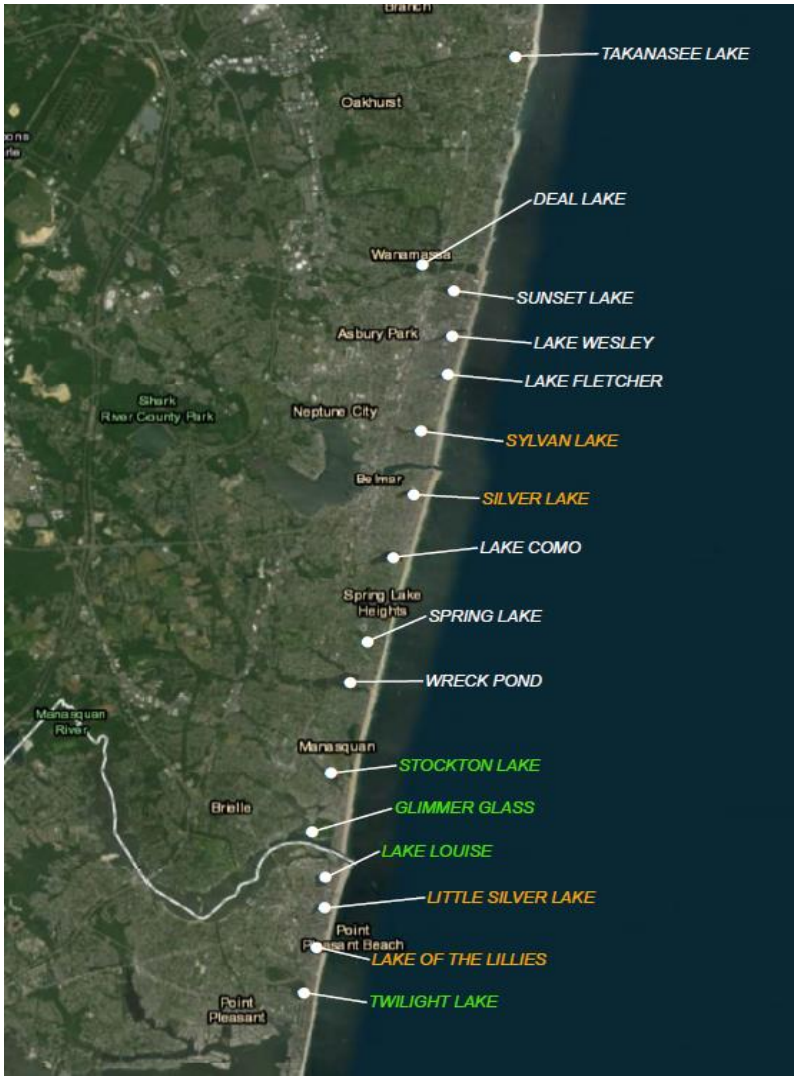


Figure 33: Coastal Lakes within the NJBB Study Area

Four of the lakes are ordinary tidewater bodies with direct, open channel tidal connections to the ocean through Manasquan Inlet or upper Barnegat Bay. These four lakes and adjacent land and structures are included in the TSP and will be evaluated for coastal flood risk using HEC-FDA similar to the other portions of the study area. This includes the consideration of the application of NACCS stage-frequency data at appropriate data save points to inventories of structures surrounding each water body. The Manasquan Inlet storm surge barrier and nonstructural measures, but not perimeter measures at this time, offer CSRM capabilities as part of the TSP. This group of four "lakes" and their tidewater connection are highlighted in green text in Figure 33 and consist of:

- Stockton Lake (Manasquan Inlet)
- Glimmer Glass (Manasquan Inlet)
- Lake Louise (Manasquan Inlet)
- Twilight Lake (upper Barnegat Bay)

There are also four "lakes" that do not have direct open channel connections to the ocean. However, because of a combination of topography and/or underground hydraulic connections (i.e., "plumbing"), they will be evaluated using the same general methodology described above and are included in the TSP. Coastal storm risk will be managed as part of the TSP at Sylvan Lake and Silver Lake primarily though nonstructural measures, and at Little Silver Lake and Lake of the Lillies primarily through the Manasquan Inlet storm surge barrier. These four lakes are highlighted in orange text in Figure 33.

Future analyses may be warranted for the Coastal Lakes Region. The remaining eight "coastal lakes" are highlighted in white, which will not be included in the TSP, include:

- Lake Takanassee
- Deal Lake
- Sunset Lake
- Wesley Lake
- Fletcher Lake
- Lake Como
- Spring Lake
- Wreck Pond

These lakes are not directly connected to tidal inlets; hence they are subject to a different type of flood risk than the eight lakes previously discussed and will consequently require an alternate method of analysis. Potential flood pathways for these lakes include fluvial flooding due to precipitation over each lake's watershed, ocean wave and storm surge overtopping of the barrier beach, and ocean storm surge flooding that "backs up" from the ocean into the lake through the underground drainage pipes.

For these eight coastal lakes that are functionally independent from back bay flooding and are only impacted by coastal flooding, the inventory is still analyzed for nonstructural measures, but

there are no proposed structural measures for the coastal lakes themselves. In other words, the structures around the coastal lakes are included in the study, but not the lakes themselves.

Since these eight coastal lakes are not part of the TSP, a possible alternative study approach is the USACE Continuing Authorities Program or a General Reevaluation Study for the Sea Bright to Manasquan Inlet CSRM project. Any of these potential future study paths would require approval from USACE higher authority, and endorsement by the non-federal sponsor, NJDEP.

A-9) BEACH AND DUNE CONSIDERATIONS

A map of existing USACE CSRM projects in New Jersey, Figure 34 shows that nearly the entire Atlantic Ocean facing shoreline, from Cape May to Sandy Hook, is part of an existing USACE CSRM project. The only exception is Island Beach State Park and few sand spits or shorelines adjacent to inlets where there is little infrastructure at risk. Several of the USACE CSRM projects were authorized but unconstructed until Hurricane Sandy in October of 2012. Following Hurricane Sandy, nearly all of the projects have been constructed or are currently under construction.

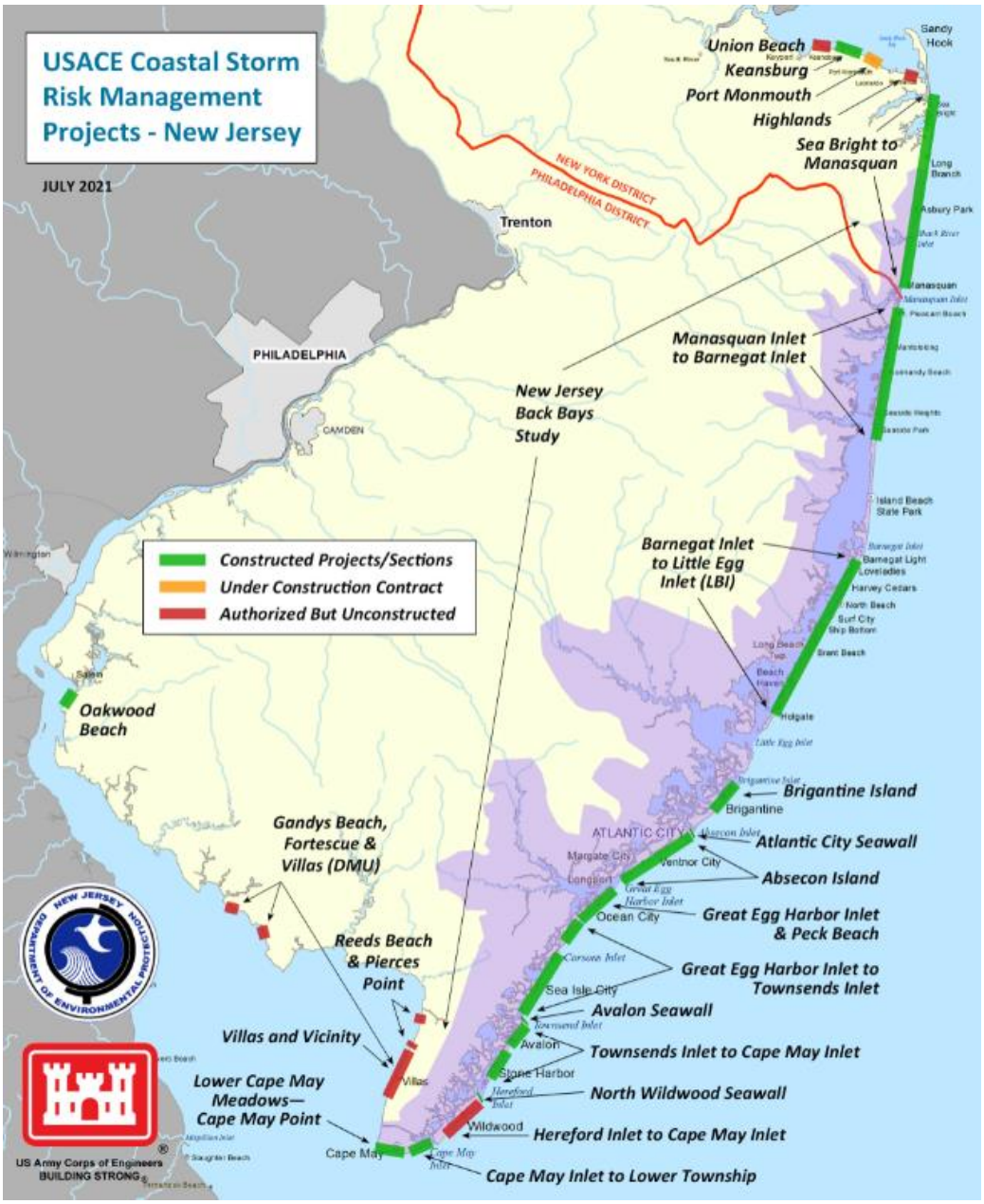


Figure 34: USACE CSRM Projects along Ocean Shorelines

Feasibility studies for each of the USACE CSRM projects were completed independently of each other and determined design dune and berm conditions by optimizing NED benefits within each respective study area. Due to unique nature of each study area the optimization resulted in variability in the design dune dimensions up and down the coast. There is even variability in the design dune heights in some of the projects and two projects don't have an authorized dune as part of the project. A summary of the existing USACE-CSRM projects authorized design dune/seawall heights is provided in **Table 16**. These studies optimized the dune and berm dimensions with the understanding that back-bay flooding could still occur during storm events, thus limiting the potential flood inundation benefits provided by dunes along the ocean. Therefore, it is possible that the risk of back-bay flooding constrained the optimized dune heights in some studies.

Table 16: Existing USACE CSRM Projects in Study Area

Project	Location	Authorized Crest Elevation (ft, NAVD88)
Manasquan Inlet to Barnegat Inlet	Northern Point Pleasant Beach and Seaside Heights	18
Manasquan Inlet to Barnegat Inlet	Rest of Project Area	22
Barnegat Inlet to Little Egg Inlet	Long Beach Island	22
Brigantine Island	Brigantine Island	10
Absecon Island	Absecon Seawall	16
Absecon Island	Atlantic City	14.75
Absecon Island	Ventnor, Margate, Longport	12.75
Great Egg Harbor Inlet & Peck Beach	Ocean City - North	n/a
Great Egg Harbor Inlet to Townsends Inlet	Ocean City - South	12.8
Great Egg Harbor Inlet to Townsends Inlet	Strathmere and Sea Isle City	14.8
Townsends Inlet to Cape May Inlet	Townsends Seawall	11.7
Townsends Inlet to Cape May Inlet	Avalon	14.75
Townsends Inlet to Cape May Inlet	Stone Harbor	14.75
Townsends Inlet to Cape May Inlet	Hereford Seawall	11.7
Hereford Inlet to Cape May Inlet	Wildwood	16
Cape May Inlet to Lower Township	Cape May	n/a
Lower Cape May Meadows	Cape May Meadows	16.75

Notes: Grey-shaded rows are Seawalls, not dunes

Consideration has been given regarding how these existing projects would mesh with the NJBB CSRM alternatives. Since the beginning of the NJBB study there have been questions about whether the existing USACE CSRM projects dunes are robust and reliable enough to be part of NJBB storm surge barrier alternative or bay shoreline floodwall alternative (i.e., perimeter plan). There are many complexities to answering this question and identifying a path forward for evaluating the interaction between the ocean dunes and NJBB alternatives.

It is unlikely that a storm surge barrier alternative would need to maintain an uninterrupted line of impregnable dunes along the shoreline. Dune erosion and overtopping would allow more water into the bay and increase bay water levels; however, it is not an “all or nothing situation” where any dune failure would completely negate the benefits of the storm surge barriers. It is also important to note that the ocean shoreline is exposed to significantly larger waves than the bay and therefore design crest elevations for CSRM measures along the bay are likely to be lower than ocean for the same design level.

Another pertinent topic considers if the existing CSRM projects along the ocean may provide a practical upper limit to the design level on NJBB bay alternatives. If a NJBB alternative did require modifications to the existing CSRM projects, such as higher dunes, the cost associated with these modifications would extend well beyond the additional sand required to construct the dune. Increasing the dune height would increase the footprint of the dune and push the design profile further seaward, increasing fill quantities and periodic nourishment quantities/frequency. In some erosion hot spots, it may be difficult to maintain the expanded design profile between periodic nourishment operations. Modifying the dune height may also require obtaining new easements, since the existing easements are based on specific dune crest elevation. Despite these complexities, an evaluation would need to be completed to determine if costly dune modifications would be offset by a reduction in damages and still be part of an optimized NED plan.

A potential path forward includes obtaining a better understanding of the sensitivity of back-bay water levels to the dune conditions and the performance of the NJBB alternatives without any modifications to the existing USACE CSRM projects. To complete these analyses ADCIRC simulations will be completed for three dune conditions: (1) Existing/authorized dune heights, (2) Partially eroded, 50% of dune height removed, and (3) No dune. The ADCIRC simulations will be performed for a small subset of representative storms.

The second step is to improve our collective understanding of how likely the existing USACE CSRM projects are to become eroded during storm events. This will be accomplished by running SBEACH simulations for the existing/authorized dune heights for a small subset of representative storms.

The third step, if necessary, is to develop designs and cost estimates for modifications to the existing USACE CSRM projects.

A-10) EXPOSURE AND VULNERABILITY ASSESSMENT (INCLUDING CRITICAL INFRASTRUCTURE)

A NJBB exposure and vulnerability assessment was performed for four different inundation scenarios to best assess vulnerability to critical assets in the study area.

The four inundation scenarios included in this analysis are:

a. Category 4 MOM inundation limits serve as a worst-case inundation scenario for hurricane evacuation planning from a Category 4 hurricane, irrespective of landfall point, forward speed, track direction, or radius of maximum winds. Category 4 MOM inundation values have no exceedance probability associated with them.

b. FEMA “1 percent probability” inundation limits (also referred to as the “100 year flood plain”). The FEMA 1 percent flood plain is regulated by FEMA and the National Flood Insurance Program manages flood insurance using this recurrence probability.

c. FEMA “1 percent probability” inundation limits plus sea level rise using the USACE intermediate curve to 2080 which coincides with the 50-year economic future damages, engineering and environmental performance period given a construction baseline of 2030.

d. High frequency flooding (aka nuisance flooding) map based on the moderate flooding threshold from NWS as presented in NOAA CO-OPS 086 Report. The moderate threshold is differentiated from the additional minor and major flooding thresholds presented in the Report.

The Category 4 MOM (dark blue) and the FEMA 1 percent probability (turquoise) inundation limits are shown on Error! Reference source not found.**35** within the NJBB study area.

The “1 percent probability” inundation limits plus sea level rise using the USACE intermediate curve to 2080 inundation limits are shown on Error! Reference source not found.**36**. The Hurricane Sandy flooding limits are superimposed in Error! Reference source not found.**36** for relative purposes. Note the greater floodplain extent of the projected SLR floodplain that the Hurricane Sandy limits.

The high frequency flooding inundation limits without sea level change for the study regions within the study area shown in Error! Reference source not found.**37**, Error! Reference source not found.**38**, Error! Reference source not found.**39**, and Error! Reference source not found.**40**.

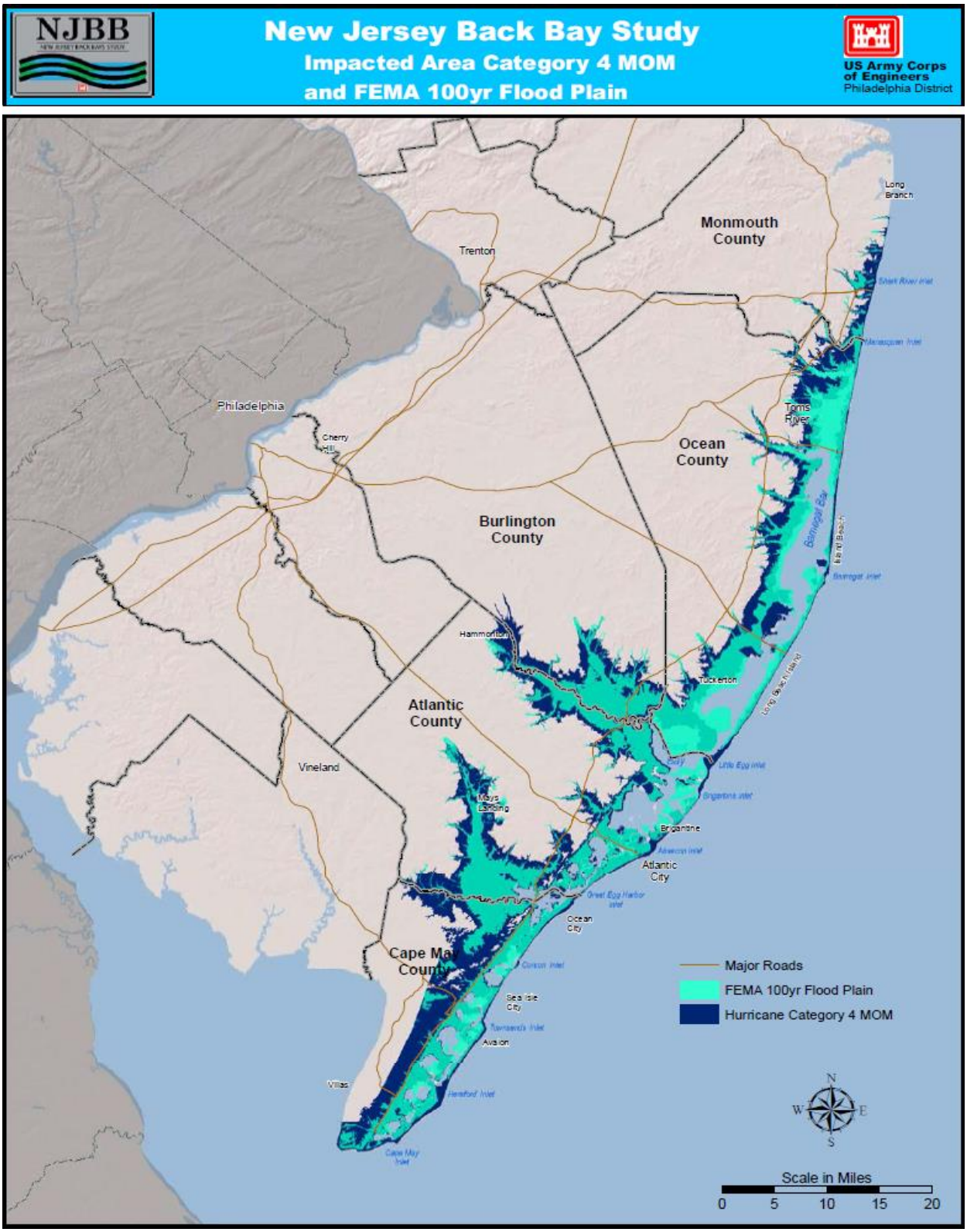


Figure 35: NJBB Study Area, Category 4 MOM and FEMA 100yr Flood Plain

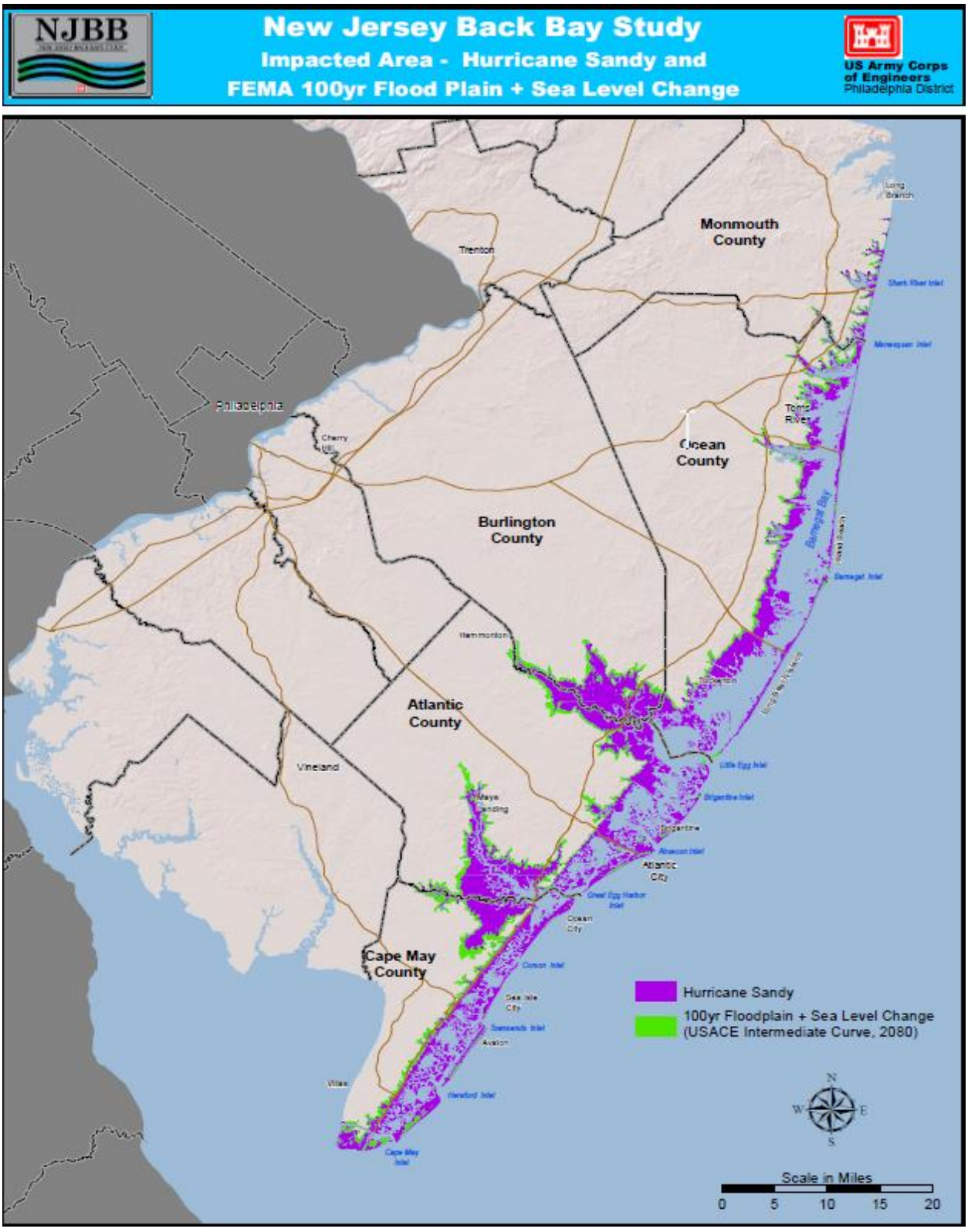


Figure 36: NJBB Study Area, Hurricane Sandy impacted area, and FEMA 100yr Flood Plain plus Sea Level Change with USACE Intermediate Curve to 2080

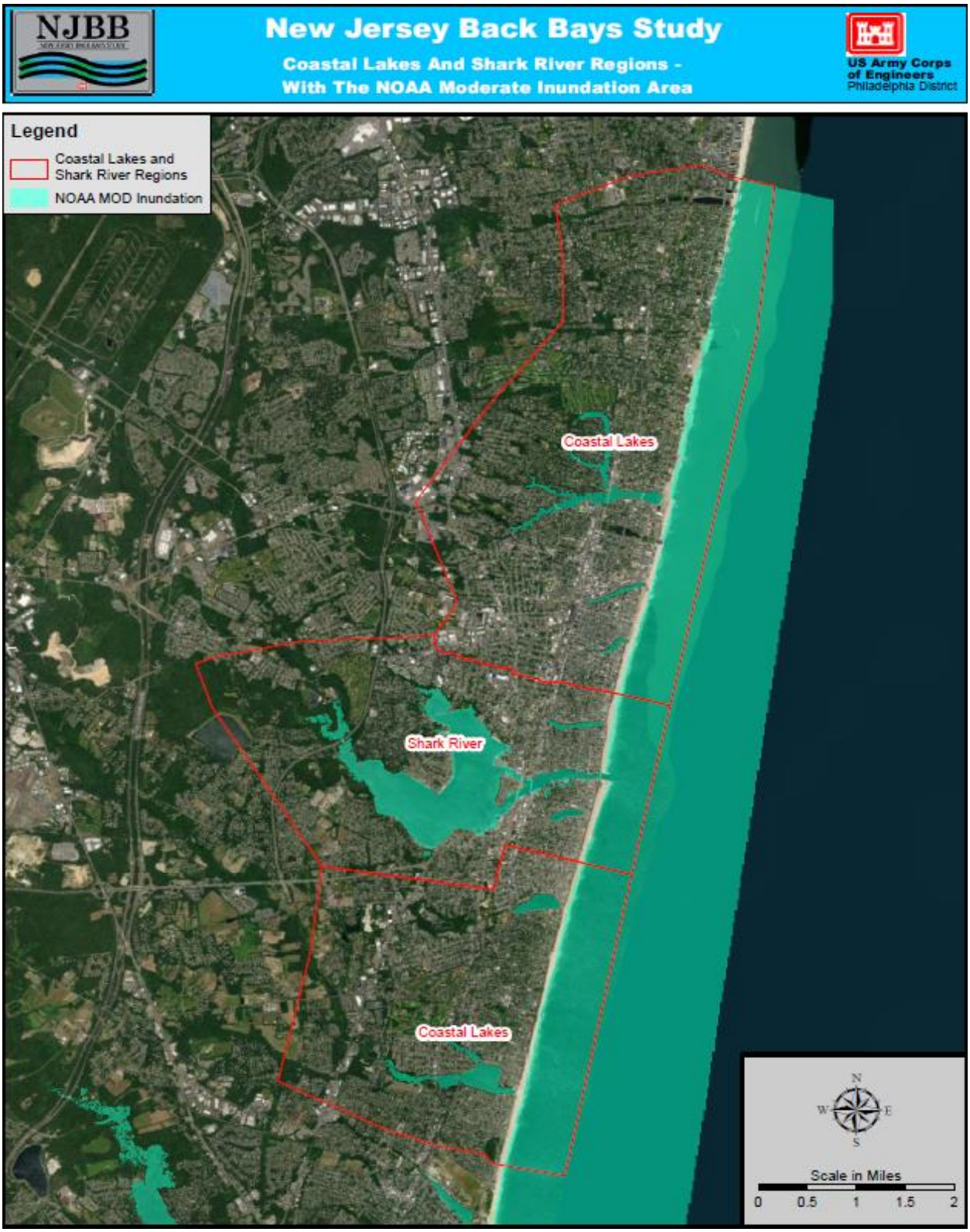


Figure 37: NOAA Moderate (MOD) Inundation Area for the Coastal Lakes and Shark River Study Region

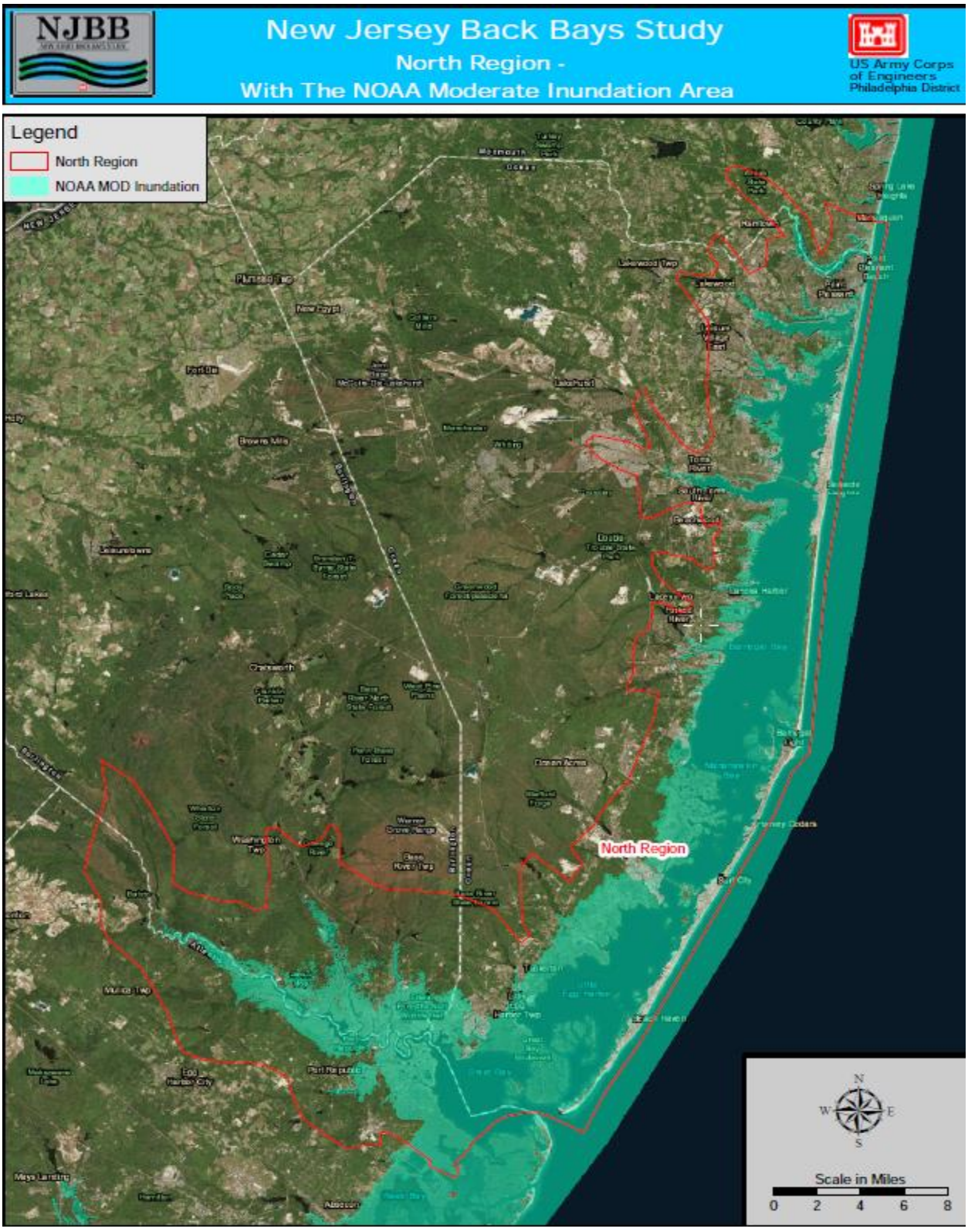


Figure 38: NOAA Moderate Inundation Area for the North Study Area

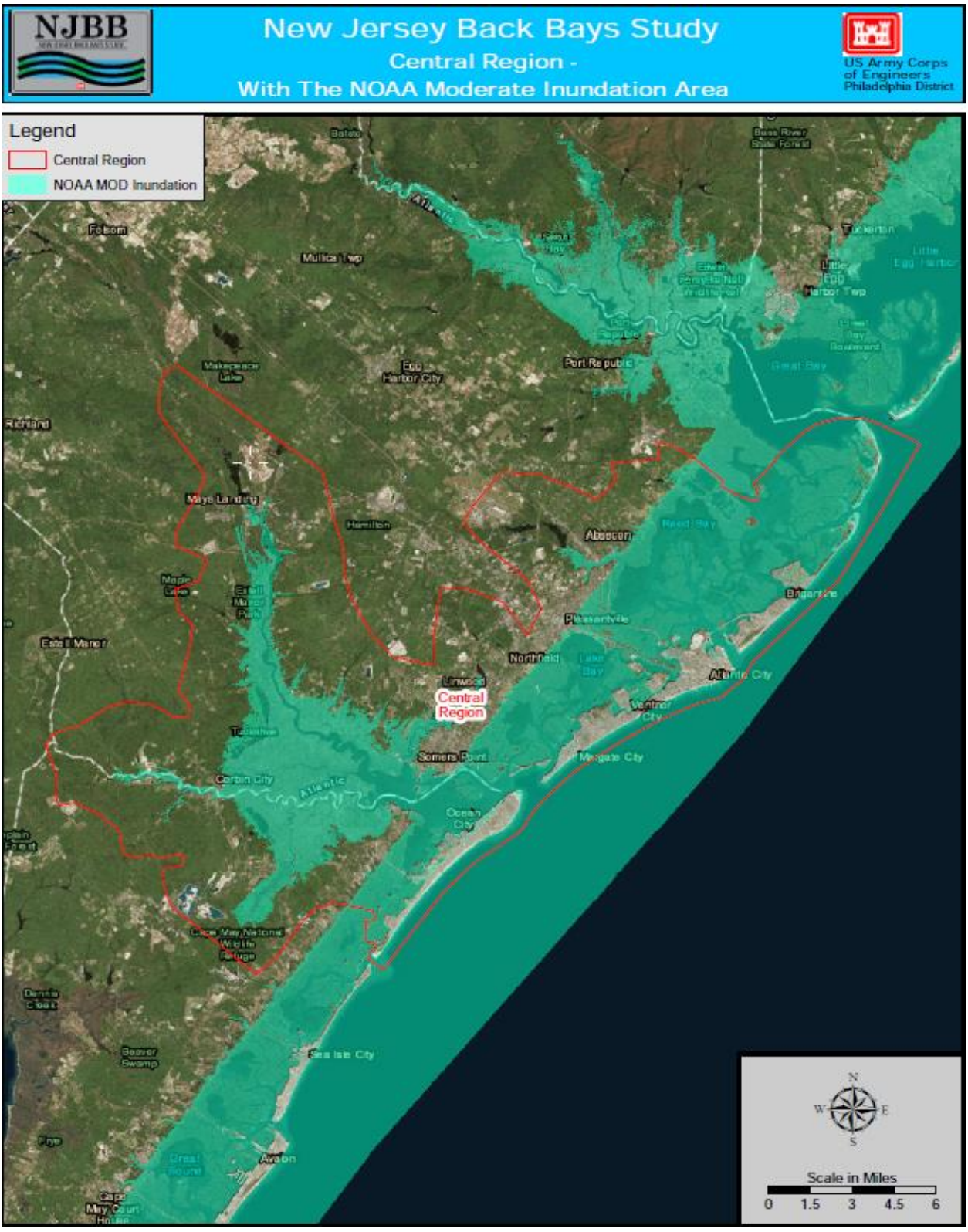


Figure 39: NOAA Moderate Inundation Area for the Central Study Region

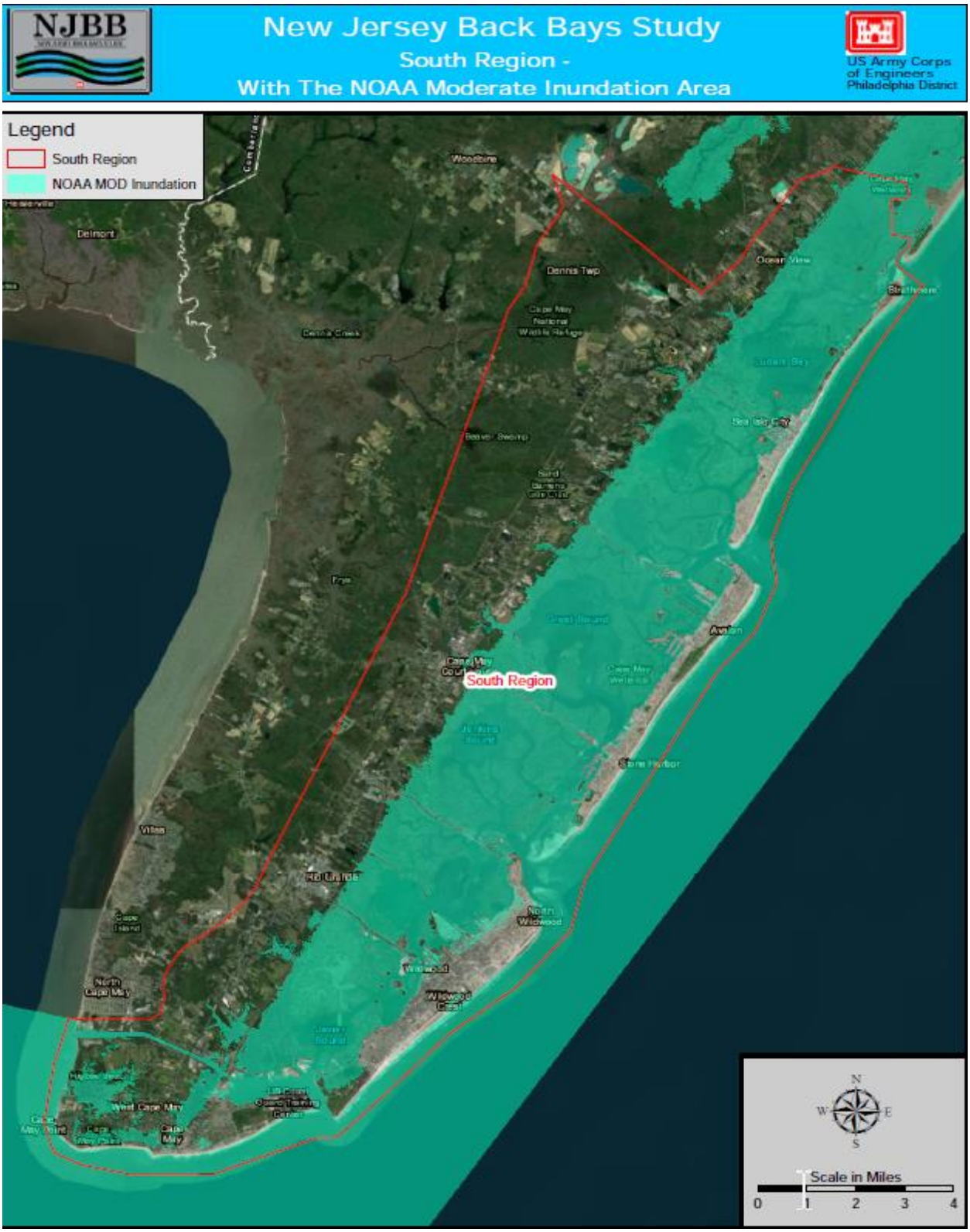


Figure 40: NOAA Moderate Inundation Area for the South Study Region

The NJBB Study has developed an exposure assessment for the entire study area to best characterize exposure.

Although a many factors or criteria can be used to identify exposure, the NJBB study focused on the following categories and criteria:

a. Population Density and Infrastructure: Population density identifies the number of persons per unit area of the study area; infrastructure includes critical infrastructure that supports the population and communities. These factors were combined to reflect overall exposure of the built environment.

b. Social Vulnerability: Social vulnerability includes certain segments of the population that may have more difficulty preparing for and responding to coastal flood events.

c. Environmental and Cultural Resources: The environmental and cultural resources exposure captures important habitat and cultural resources that would be affected by storm surge, winds, and erosion.

Using data developed during the NACCS, a composite exposure index was created that integrates population and infrastructure, social vulnerability, and environmental indices (USACE 2015) (Error! Reference source not found.**41**). This index identifies areas of high exposure as indicated by the red colors. In summary, much of the NJBB study area is indicated as having high composite exposure.

Error! Reference source not found. **17** shows overview statistics for population (U.S. Census Bureau, 2010), number of residential units, and infrastructure units within the footprint of the Category 4 MOM inundation limits, the FEMA 1% probability inundation limits, and the NWS moderate flooding threshold as a representation for high frequency flooding for the study regions.

A closer investigation of impacted critical infrastructure within the Category 4 MOM and the FEMA “1 percent probability” inundation limits are presented for each of the study regions within the study area shown in Error! Reference source not found.**42**, Error! Reference source not found.**43**, Error! Reference source not found.**44**, and Error! Reference source not found.**45**.

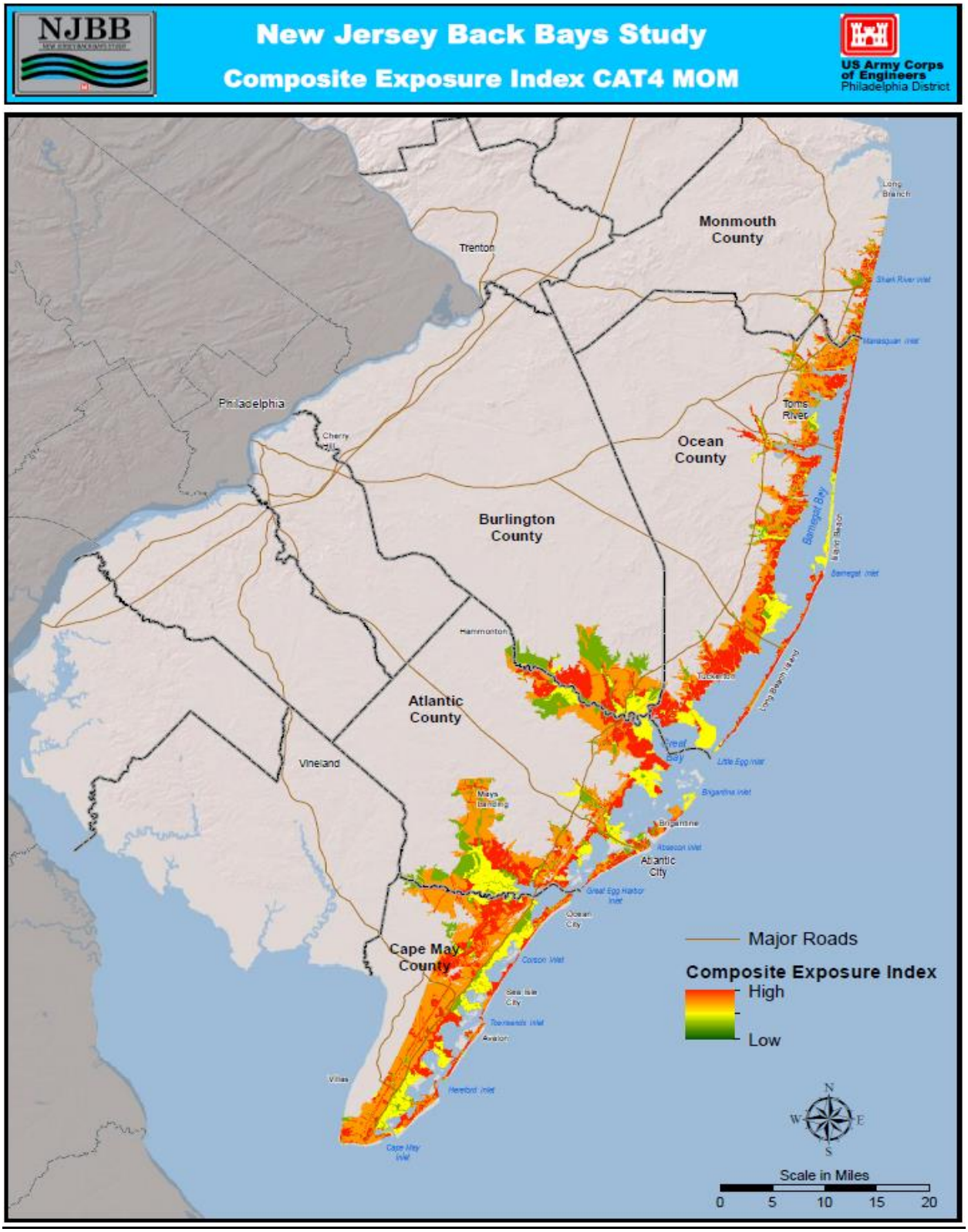


Figure 41: NJBB Study Area, Composite Exposure Index CAT 4 MOM

Table 17: Population, Housing Units, and Infrastructure included within CAT 4 MOM

REGION	INUNDATION AREA	REGION AREA SQ MILES	POPULATION (Based on 2010 Census)	RESIDENTIAL UNITS	CRITICAL INFRASTRUCTURE UNITS
Shark River and Coastal Lakes	Region	31	86,576	7,386	124
	CAT 4 MOM		44,839	7,386	54
	100 year floodplain		5,502	2,777	8
	NOAA Moderate flooding threshold		528	18	0
Northern	Region	536	325,123	82,070	309
	CAT 4 MOM		196,759	81,749	176
	100 year floodplain		100,789	69,357	57
	NOAA Moderate flooding threshold		15,122	3,676	2
Central	Region	312	185,606	47,452	225
	CAT 4 MOM		135,439	47,448	146
	100 year floodplain		97,211	45,145	90
	NOAA Moderate flooding threshold		9,955	1,440	2
South	Region	146	48,268	36,937	97
	CAT 4 MOM		46,745	36,937	95
	100 year floodplain		26,600	33,798	45
	NOAA Moderate flooding threshold		4,097	2,286	1

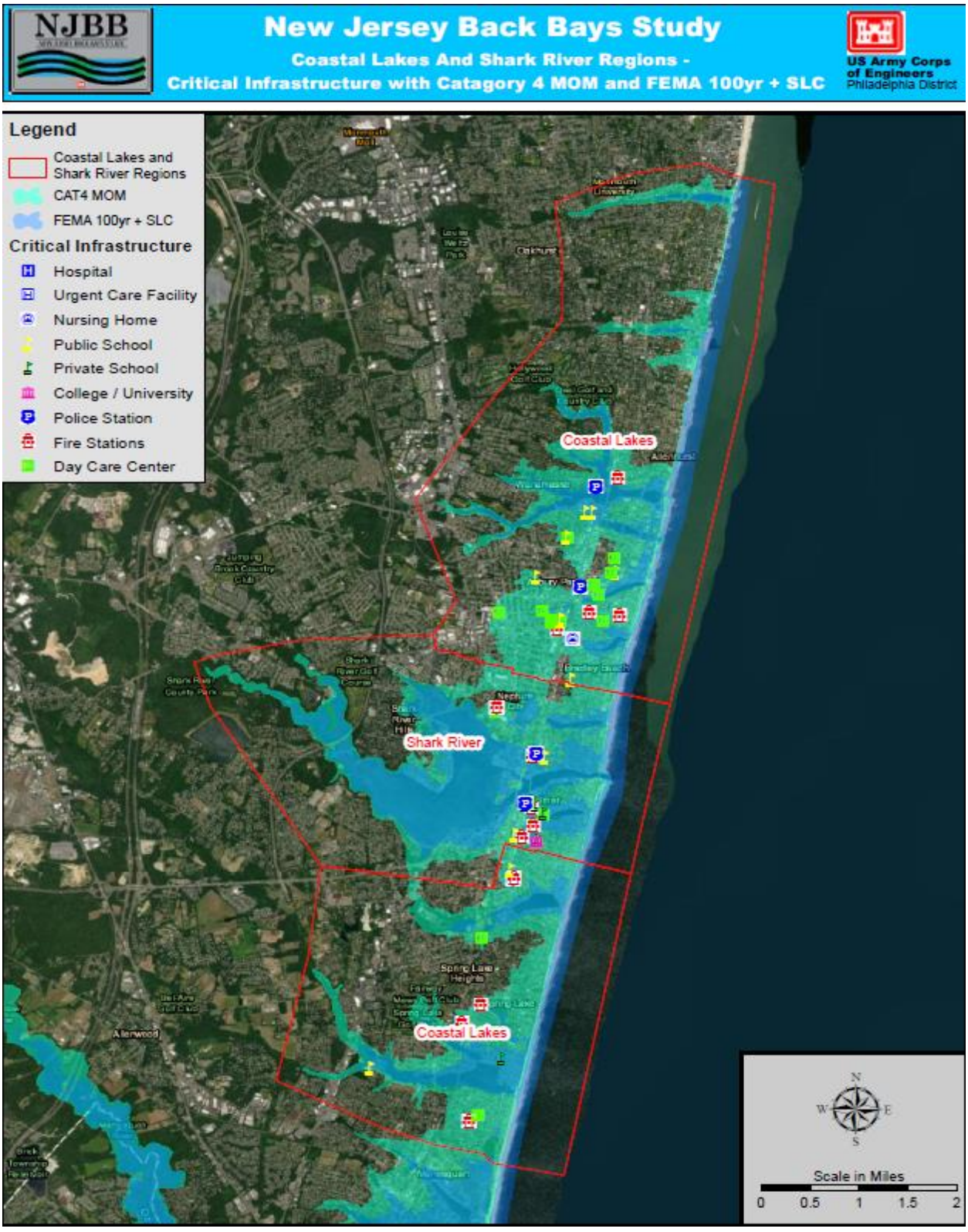


Figure 42: Impacted Critical Infrastructure in the Coastal Lakes and Shark River Study Regions within the CAT 4 MOM and FEMA 1% Probability Inundation Limits

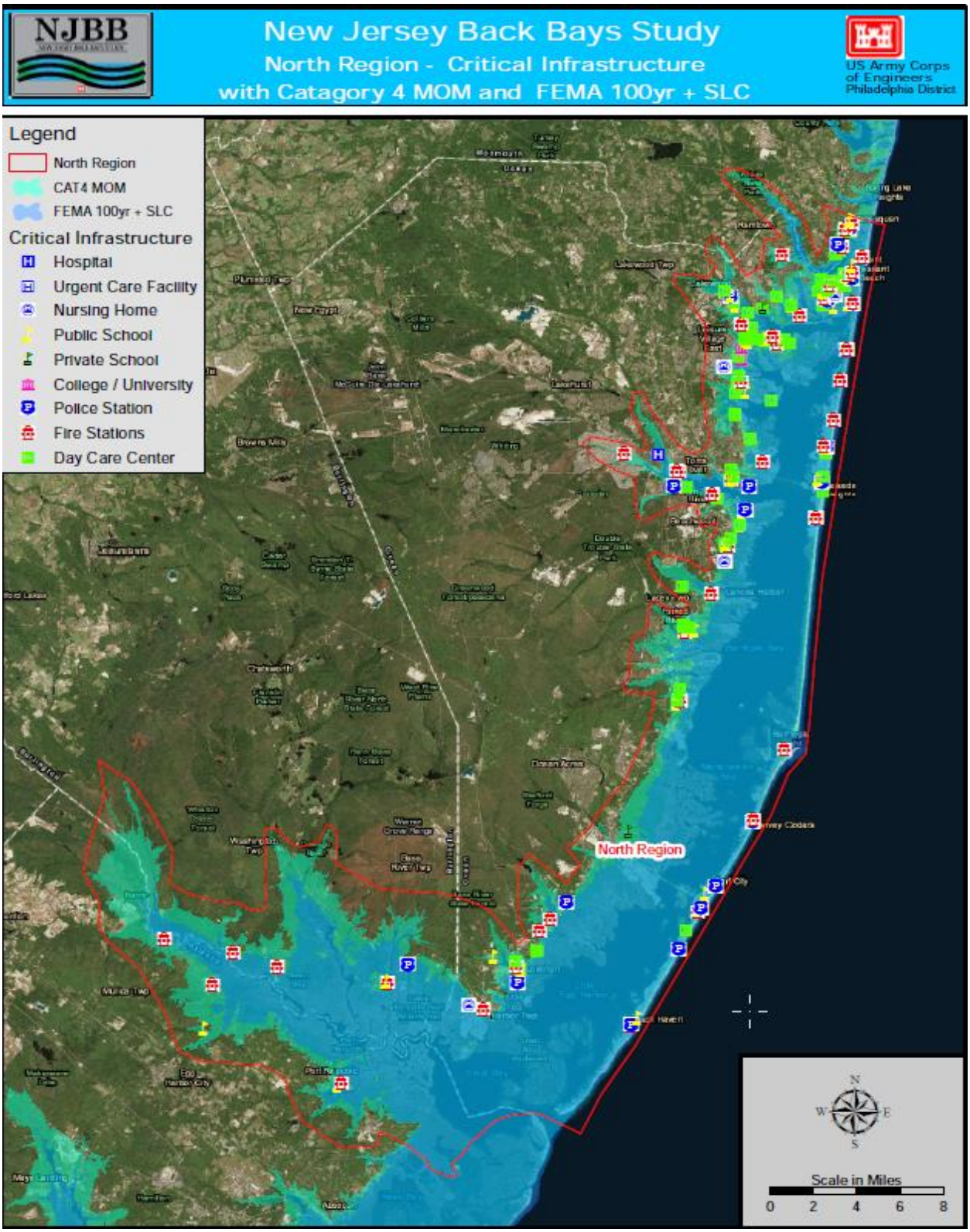


Figure 43: Impacted Critical Infrastructure in the North Study Region within the CAT 4 MOM and FEMA 1% Probability Inundation Limits

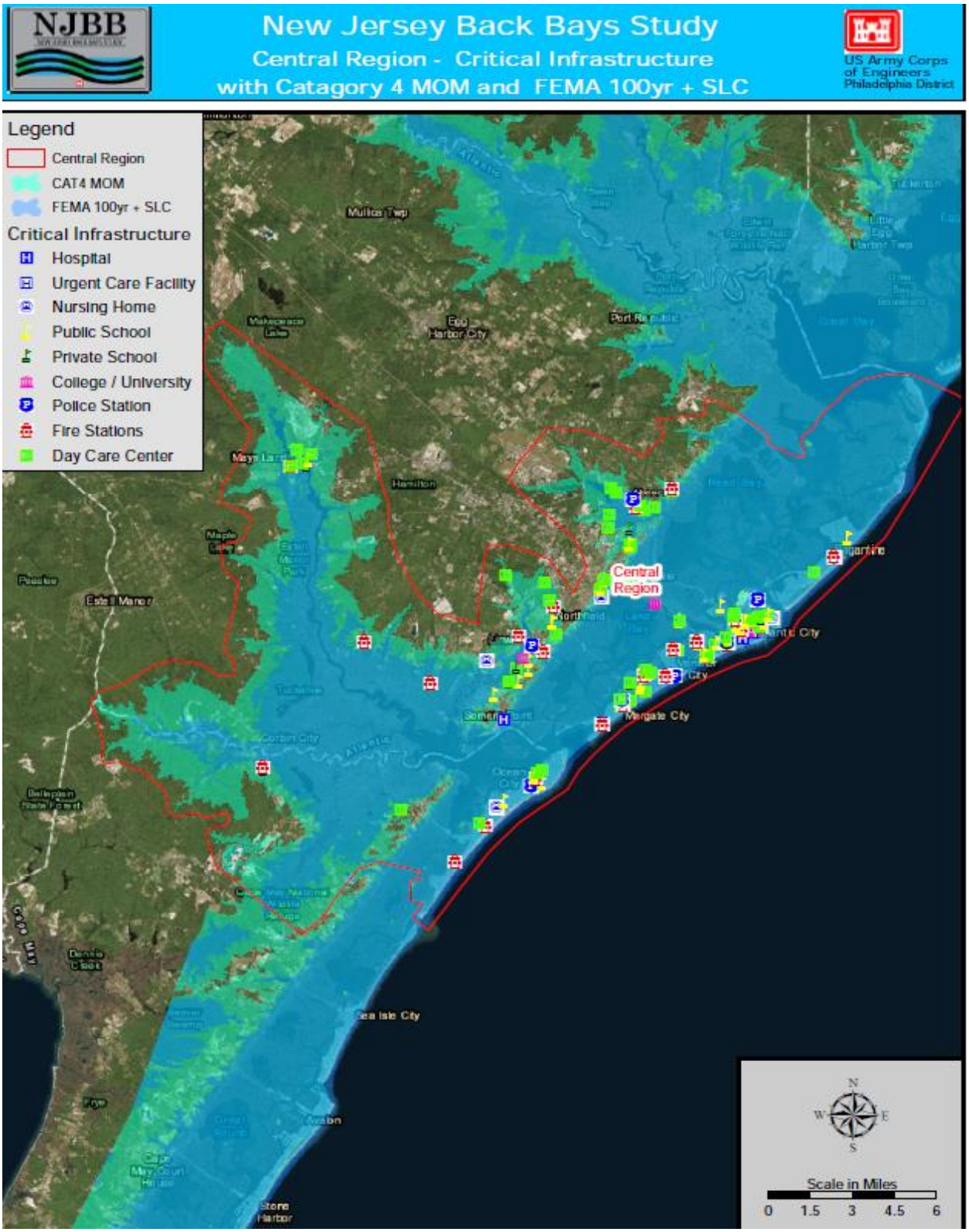


Figure 44: Impacted Critical Infrastructure in the Central Study Region within the CAT 4 MOM and FEMA 1% Probability Inundation Limits

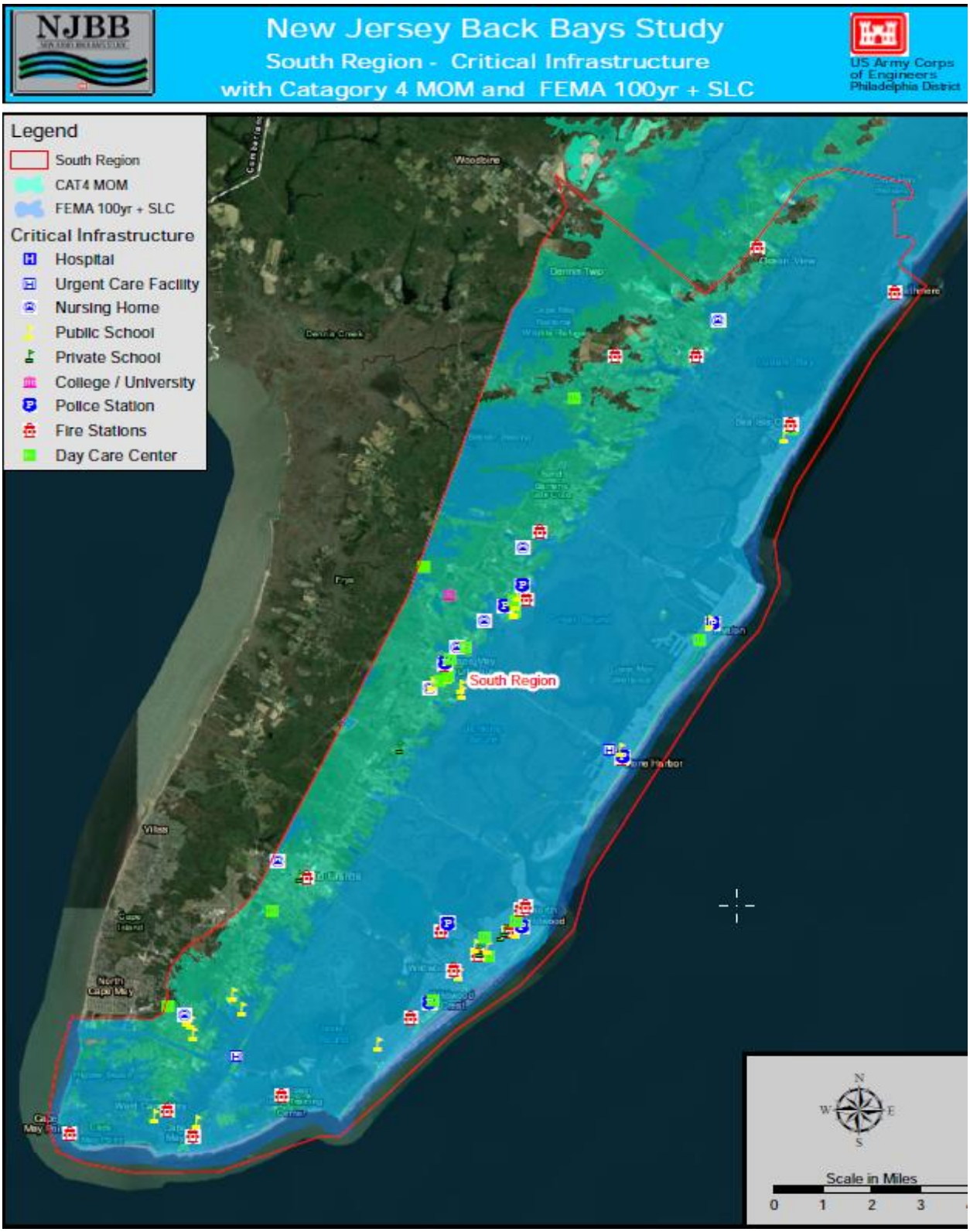


Figure 45: Impacted Critical Infrastructure in the South Study Region within the CAT 4 MOM and FEMA 1% Probability Inundation Limits

A-11) NJBB STUDY AREA MUNICIPALITY INFORMATION

A map with municipalities in the State of New Jersey can be found in **Figure 46**. **Table 18** lists municipalities by study region.

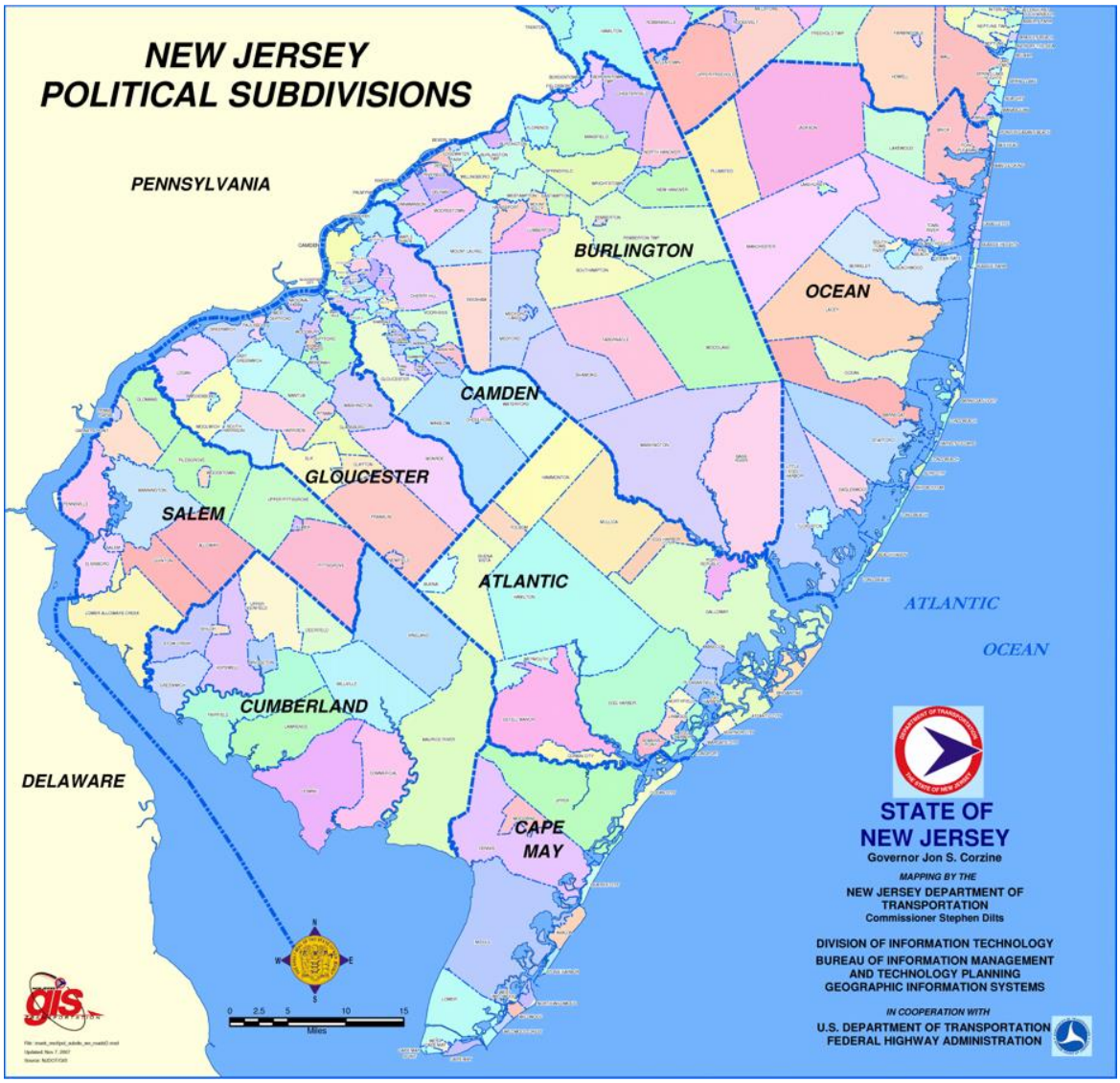


Figure 46: Municipalities in the State of New Jersey

Table 18: NJBB CSRM Feasibility Study Municipalities by Region

Region	NAME	MUN_TYPE	COUNTY
Coastal Lakes	Allenhurst Borough	Borough	MONMOUTH
	Asbury Park	City	MONMOUTH
	Belmar Borough	Borough	MONMOUTH
	Bradley Beach Borough	Borough	MONMOUTH
	Deal Borough	Borough	MONMOUTH
	Interlaken Borough	Borough	MONMOUTH
	Lake Como Borough	Borough	MONMOUTH
	Loch Arbour Village	Village	MONMOUTH
	Long Branch	City	MONMOUTH
	Manasquan Borough	Borough	MONMOUTH
	Neptune City Borough	Borough	MONMOUTH
	Neptune Township	Township	MONMOUTH
	Ocean Township	Township	MONMOUTH
	Sea Girt Borough	Borough	MONMOUTH
	Spring Lake Borough	Borough	MONMOUTH
	Spring Lake Heights Borough	Borough	MONMOUTH
	Wall Township	Township	MONMOUTH
	West Long Branch Borough	Borough	MONMOUTH
Shark River	Avon-by-the-Sea Borough	Borough	MONMOUTH
	Belmar Borough	Borough	MONMOUTH
	Bradley Beach Borough	Borough	MONMOUTH
	Lake Como Borough	Borough	MONMOUTH
	Neptune City Borough	Borough	MONMOUTH
	Neptune Township	Township	MONMOUTH
	Wall Township	Township	MONMOUTH
North	Barnegat Light Borough	Borough	OCEAN
	Barnegat Township	Township	OCEAN
	Bass River Township	Township	BURLINGTON
	Bay Head Borough	Borough	OCEAN
	Beach Haven Borough	Borough	OCEAN
	Beachwood Borough	Borough	OCEAN
	Berkeley Township	Township	OCEAN
	Brick Township	Township	OCEAN
	Brick Township	Township	OCEAN
	Brielle Borough	Borough	MONMOUTH
	Eagleswood Township	Township	OCEAN
	Egg Harbor City	City	ATLANTIC
	Galloway Township	Township	ATLANTIC
	Hammonton	Town	ATLANTIC
	Harvey Cedars Borough	Borough	OCEAN

	Howell Township	Township	MONMOUTH
	Island Heights Borough	Borough	OCEAN
	Lacey Township	Township	OCEAN
	Lakewood Township	Township	OCEAN
	Lavallette Borough	Borough	OCEAN
	Little Egg Harbor Township	Township	OCEAN
	Long Beach Township	Township	OCEAN
	Manasquan Borough	Borough	MONMOUTH
	Manchester Township	Township	OCEAN
	Mantoloking Borough	Borough	OCEAN
	Mullica Township	Township	ATLANTIC
	Ocean Gate Borough	Borough	OCEAN
	Ocean Township	Township	OCEAN
	Pine Beach Borough	Borough	OCEAN
	Point Pleasant Beach Borough	Borough	OCEAN
	Point Pleasant Borough	Borough	OCEAN
	Point Pleasant Borough	Borough	OCEAN
	Port Republic	City	ATLANTIC
	Sea Girt Borough	Borough	MONMOUTH
	Seaside Heights Borough	Borough	OCEAN
	Seaside Park Borough	Borough	OCEAN
	Shamong Township	Township	BURLINGTON
	Ship Bottom Borough	Borough	OCEAN
	South Toms River Borough	Borough	OCEAN
	Stafford Township	Township	OCEAN
	Surf City Borough	Borough	OCEAN
	Toms River Township	Township	OCEAN
	Tuckerton Borough	Borough	OCEAN
	Wall Township	Township	MONMOUTH
	Washington Township	Township	BURLINGTON
Central	Absecon	City	ATLANTIC
	Atlantic City	City	ATLANTIC
	Brigantine	City	ATLANTIC
	Corbin City	City	ATLANTIC
	Dennis Township	Township	CAPE MAY
	Egg Harbor Township	Township	ATLANTIC
	Estell Manor	City	ATLANTIC
	Galloway Township	Township	ATLANTIC
	Hamilton Township	Township	ATLANTIC
	Linwood	City	ATLANTIC
	Longport Borough	Borough	ATLANTIC
	Margate City	City	ATLANTIC
	Maurice River Township	Township	CUMBERLAND

	Northfield	City	ATLANTIC
	Ocean City	City	CAPE MAY
	Pleasantville	City	ATLANTIC
	Somers Point	City	ATLANTIC
	Upper Township	Township	CAPE MAY
	Ventnor City	City	ATLANTIC
	Weymouth Township	Township	ATLANTIC
	Woodbine Borough	Borough	CAPE MAY
South	Avalon Borough	Borough	CAPE MAY
	Cape May	City	CAPE MAY
	Cape May Point Borough	Borough	CAPE MAY
	Dennis Township	Township	CAPE MAY
	Lower Township	Township	CAPE MAY
	Middle Township	Township	CAPE MAY
	North Wildwood	City	CAPE MAY
	Sea Isle City	City	CAPE MAY
	Stone Harbor Borough	Borough	CAPE MAY
	Upper Township	Township	CAPE MAY
	West Cape May Borough	Borough	CAPE MAY
	West Wildwood Borough	Borough	CAPE MAY
	Wildwood	City	CAPE MAY
	Wildwood Crest Borough	Borough	CAPE MAY
	Woodbine Borough	Borough	CAPE MAY

A-12) REFERENCES

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