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Resiliency Institute for Storms and Emergencies

Research Work Unit 2.3
Flooding Impacts on Wastewater Infrastructure

NYU POLYTECHNIC SCHOOL OF ENGINEERING

Cornell University

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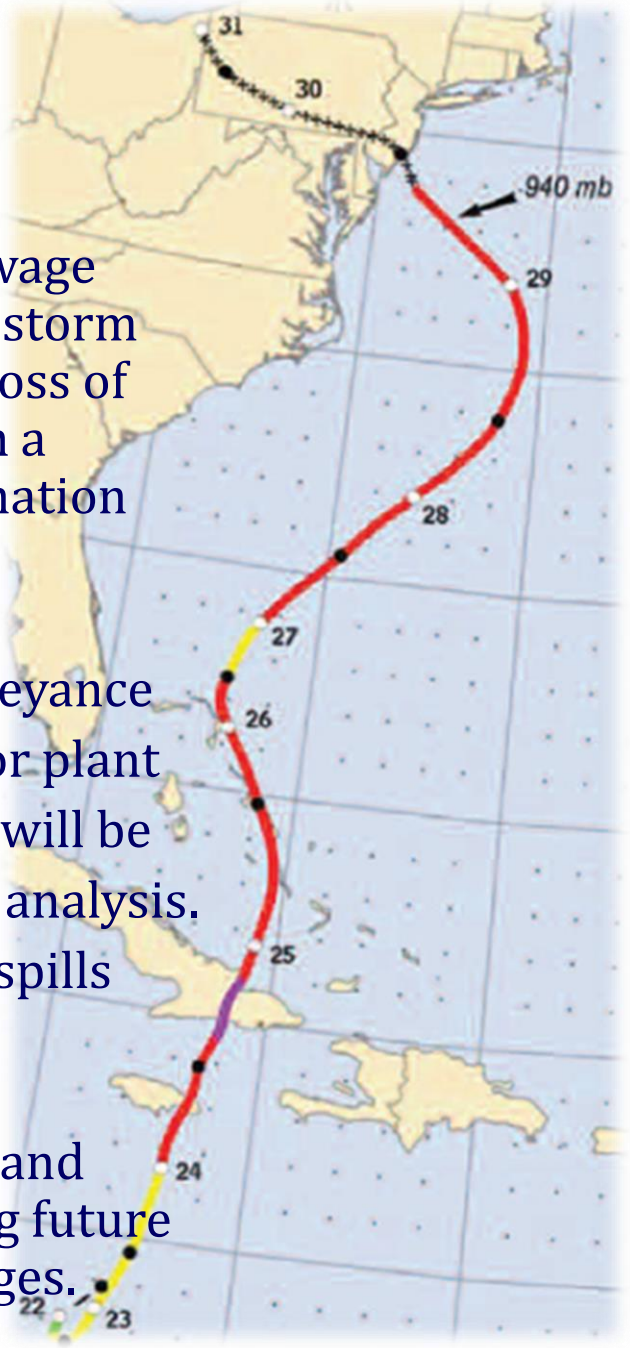
Scope of Work

Inventory, mapping, and performance reviews of sewage treatment plants and pumping stations relative to storm surge levels, characteristics of plant damage, and loss of service at pump stations will be evaluated through a review of publicly available documents and information from government agencies and experts.

The most vulnerable treatment equipment and conveyance system components will be identified. Measures for plant protection and conveyance system improvements will be evaluated, and ranked on the basis of cost/benefit analysis. Temporal and spatial distributions of wastewater spills and dispersions in past storms.

Working with US-EPA, NYS-EFC, NYS-DOS, NYS-DEC and NYC-DEP to make recommendations on preventing future plant failures and mitigating environmental damages.



WWTPs in NYC

Area No.	Location (North, South, East)	Capacity Mgd
	North	
1	Bowery Bay	150
2	Hunts Point	200
3	Tallman Island	80
4	Wards Island	275
	South	
5	Newtown Creek	310
6	North River	170
7	Oakwood Beach	40
8	Port Richmond	60
9	Red Hook	60
	East	
10	26th Ward	85
11	Coney Island	110
12	Jamaica	100
13	Owls Head	120
14	Rockaway	45
	Total	1805

Coney Island WWTP, Brooklyn NYC

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Flooding risks on Wastewater Infrastructure

Facility: **Coney Island Wastewater Treatment Plant**	☑ WWTP/WPCP
Leading agency: **NYCDEP**	Coordinates
Address: **Knapp St**	40.5902235 N
City State Zip code: **Brooklyn, NY 11235**	73.933635 W

Wastewater Treatment or Water Pollution Control Plant (WWTP/WPCP)

Description and physical characteristics

WWTP/WPCP type:	☑ Activated sludge		
	☐		
	☐		
Dewatering facilities:	☐ Yes ☑ No		
Local grade (Range as per Google Earth):	1 ~ 11	feet	
Elevation of the lowest electrical control:	8.5	feet	
Elevation of the lowest mechanical device:	8.5	feet	

Hydraulic characteristics

Design dry weather flow:	110	MGD	**Notes: (i)** The plant has a relatively flat terrain, most plant buildings would be flooded by three or more feet of water during the critical flood event.
Maximum wet weather flow:	220	MGD	
Discharge waterbody:	Jamaica Bay		**(ii)**There is a total of 1,204 target pieces of equipment lo- cated in these at-risk facilities that are below the critical flood elevation and are at risk of flooding.
Critical flood elevation:	15.5	ft (NAVD 88)	**(iii)** Given that Coney Island is susceptible to flood damage from an interconnected tunnel system (Tunnel A).
Hurricane Sandy:	10.1	ft (NAVD 88)	**(iv)** During the peak of the sandy, water from the adjacent Rockaway Inlet/Shell Bank Creek overtopped the banks behind the Sludge and Digester building complex, flooded Knapp Street and flowed through the main wastewater treatment plant parking lot and into low-lying buildings.
Contributing area:		acres	

Historical information

Hurricane Sandy flood damage:	☐ Catastrophic ☑ Major ☐ Significant/Noticeable ☐ Minor/Limited ☐ None	
Historic flooding:	☐ Yes ☐ No	if yes, describe: **NA**
Historic loss of power:	☐ Yes ☐ No	if yes, describe: **NA**
Affected by Hurricane Sandy:	☑ Yes ☐ No	if yes, describe: **see note iv.**
Beach affected:	☑ Yes ☐ No	if yes, describe: **NA**

Risk assessment and analysis

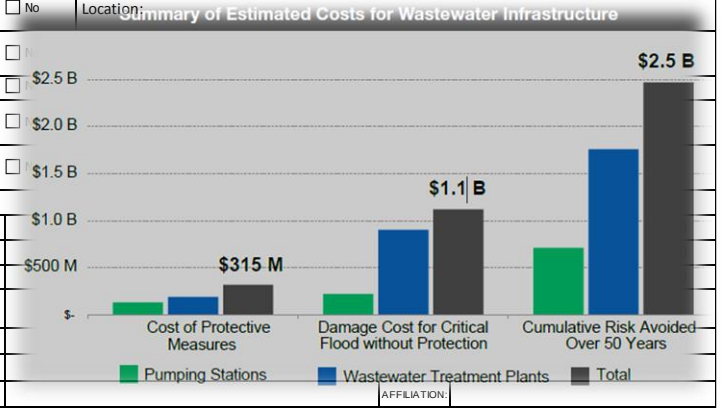
Number of residents served (population in affected areas):	596,326
Number of critical facilities in affected area:	____ Hospitals - ____ Schools - ____ Public safety
Critical 100-year flood elevation [+30 inches of sea level rise]:	15.5 feet NAVD88 - 14.02 feet Brooklyn Sewer Datum
High likelihood to impact beaches:	☑ Yes ☐ No

Potential flood pathways

Rollup doors:	☐ Yes	☐ No	Location and description:
Doorways:	☐ Yes	☐ No	Location and description:
Windows:	☐ Yes	☐ No	Location and description:
Areaways:	☐ Yes	☐ No	Location and description:
Tunnels:	☐ Yes	☐ No	Location and description:
Grates:	☐ Yes	☐ No	Location and description:
Electrical conduits:	☐ Yes	☐ No	Location and description:
Manholes:	☐ Yes	☐ No	Location and description:
Mechanical:	☐ Yes	☐ No	Location and description:

Resiliency strategy

Elevate equipment:	☐ Yes	☐ No	Location:
Install flood-proof equipment:	☐ Yes	☐ No	Location:
Install static barrier:	☐ Yes	☐ N	
Seal building:	☐ Yes	☐	
Install temporary sandbags:	☐ Yes	☐	
Install backup power:	☐ Yes	☐	
Survey was conducted by:	NAME:		
	NAME:		
	NAME:		
Contact person(s) and affiliation(s):	NAME:		
	NAME:		
	NAME:		
	NAME:	AFFILIATION:	



Cost of Protective Measures: $15.48M
Damage Cost for Critical Flood without Protection: $84.95M
Cumulative Risk Avoided over 50 years: $349.81M

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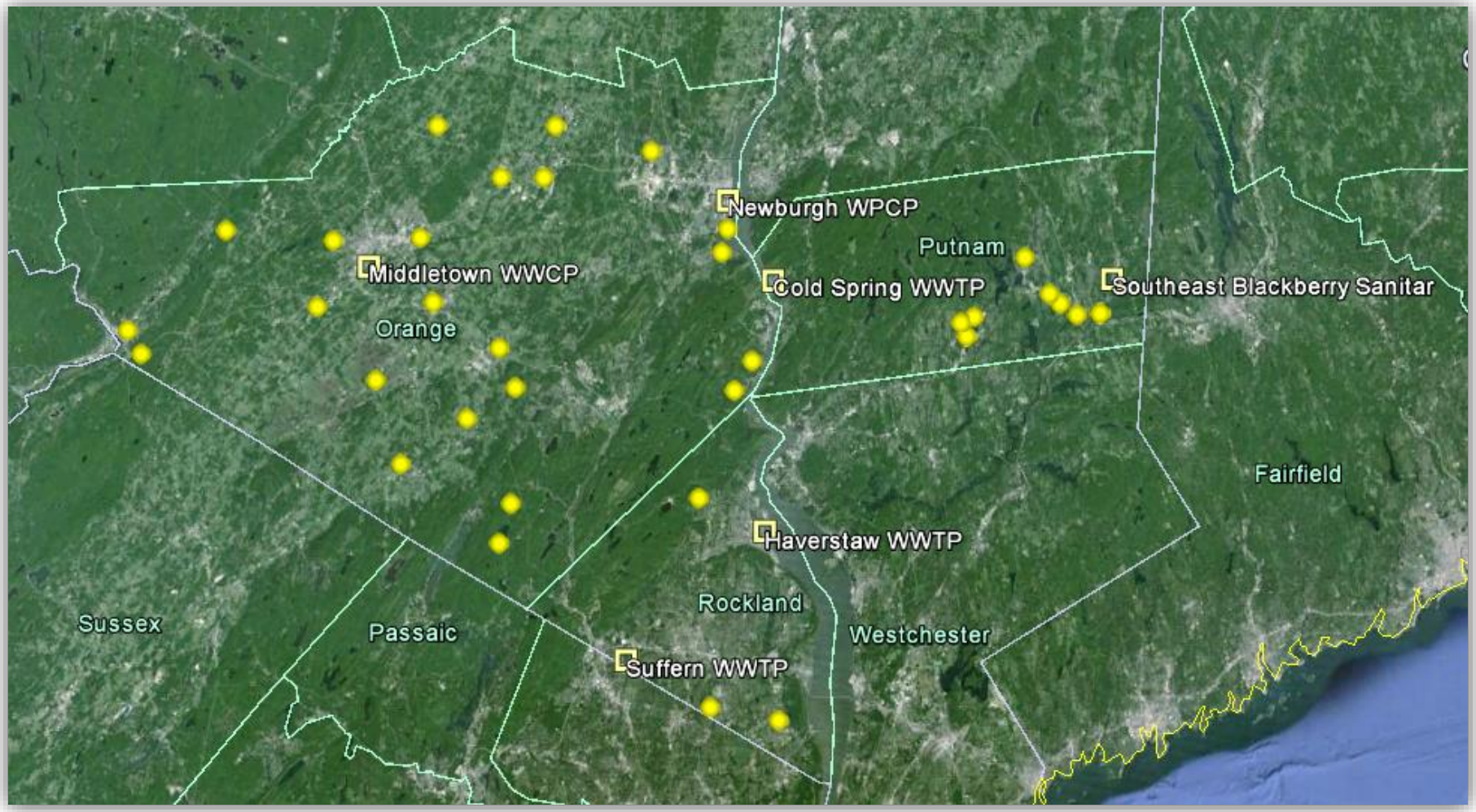
WWTPs in Rockland, Orange and Putnam Counties of NY



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Pumping Stations in NYC

Paerdegat PS, Brooklyn NYC

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Work Unit 2.3

Flooding risks on Wastewater Infrastructure

Facility: **Paerdegat Pumping station**	☑ PS ☐
Leading agency: **NYCDEP**	Coordinates
Address: **6016 Flatlands Avenue**	40.633062 N
City State Zip code: **Brooklyn NY 11234**	73.9170446 W

Pumping Station (PS)

Description and physical characteristics

Pump Station type:	☑ Combined ☐ Storm Water ☐ Sanitary		**Note: (i)** The recommended strategy at Paer- degat is to construct a barrier around the station.
Pump type:	☐ Submersible ☑ Non-Submersible		
Local grade:	12	ft (NAVD88)	
Elevation of the lowest electrical control:	14.1	feet	
Elevation of the lowest mechanical device:	-11.6	feet	

Hydraulic characteristics

Operating capacity:	57.00	MGD
Maximum allowable capacity:		MGD
Connected to other stations:	☑ Yes	☐ No
Critical flood elevation:	14.5	ft (NAVD88)
Hurricane Sandy:	NA	ft (NAVD88)
Affected area:	2226	acres

Historical information

Hurricane Sandy flood damage:	☐ Catastrophic ☐ Major ☐ Significant/Noticeable ☐ Minor/Limited ☑ None	
Historic flooding:	☐ Yes ☑ No	if yes, describe:
Historic loss of power:	☐ Yes ☑ No	if yes, describe:
Affected by Hurricane Sandy:	☐ Yes ☑ No	if yes, describe:
Beach affected:	☑ Yes ☐ No	if yes, describe:

Risk assessment and analysis

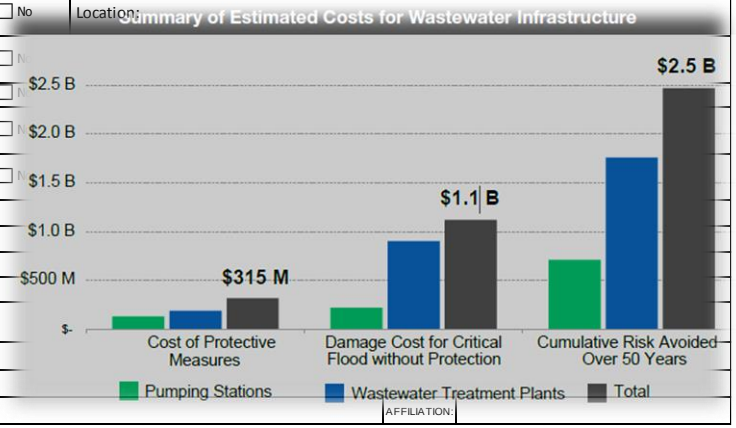
Number of residents served (population in affected areas):	128,903
Number of critical facilities in affected area:	83
Critical 100-year flood elevation [+30 inches of sea level rise]:	14.5 feet NAVD88
High likelihood to impact beaches:	☑ Yes ☐ No

Potential flood pathways

Rollup doors:	☐ Yes	☐ No	Location and description:
Doorways:	☐ Yes	☐ No	Location and description:
Windows:	☐ Yes	☐ No	Location and description:
Areaways:	☐ Yes	☐ No	Location and description:
Tunnels:	☐ Yes	☐ No	Location and description:
Grates:	☐ Yes	☐ No	Location and description:
Electrical conduits:	☐ Yes	☐ No	Location and description:
Manholes:	☐ Yes	☐ No	Location and description:
Mechanical:	☐ Yes	☐ No	Location and description:

Resiliency strategy

Elevate equipment:	☐ Yes	☐ No	Location:
Install flood-proof equipment:	☐ Yes	☐ No	Location:
Install static barrier:	☐ Yes	☐ N	
Seal building:	☐ Yes	☐ N	
Install temporary sandbags:	☐ Yes	☐ N	
Install backup power:	☐ Yes	☐ N	
Survey was conducted by:	NAME:		
	NAME:		
	NAME:		
Contact person(s) and affiliation(s):	NAME:		
	NAME:		
	NAME:		
	NAME:		AFFILIATION:



Cost of Protective Measures: $16.96M
Damage Cost for Critical Flood without Protection: $15.41M
Cumulative Risk Avoided over 50 years: $19.21M

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Work Status

WU 2.3 Assessment of Base Plans		2013			2014							
Tasks	**Budget**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
Work unit technical management	$4,141.27	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	
Literature review	$4,141.27	10%	10%	20%	40%	20%						
Inventory, mapping, and performance review of WWTPs	$16,565.07			10%	20%	30%	40%					
Working with NYS EFC, DOS, DEC and NYC DEP	$12,423.80					20%	50%	30%				
Select sample Counties	$4,141.27					50%	50%					
WWTP performance and vulnerability evaluation	$20,706.33					20%	20%	20%	20%	20%		
Draft report preparation & submission	$12,423.80					30%		70%				
Recommendations and ranking on the basis of cost/benefit analysis	$4,141.27							50%	50%			
Final report	$4,141.27								20%	30%	50%	
TOTAL	**$82,825.34**											
Projected	**Earned Value**	$828.25	$828.25	$2,898.89	$5,383.65	$18,635.70	$19,463.95	$19,049.83	$7,454.28	$5,797.77	$2,484.76	
	%	1%	1%	4%	7%	23%	24%	23%	9%	7%	3%	
	BCWS	1%	2%	6%	12%	35%	58%	81%	90%	97%	100%	
	BCWP	1%	2%	4%	9%	20%	45%					
	%	1%	1%	2%	5%	12%	25%	0%	0%	0%	0%	0%
Actual	**Earned Value**	$828.25	$828.25	$1,242.38	$4,141.27	$9,524.91	$20,706.33	$0.00	$0.00	$0.00	$0.00	

Tasks	**Budget**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**
Work unit technical management	$4,141.27	10%	10%	10%	10%	10%	10%					
Literature review	$4,141.27	10%	10%	20%	40%	10%	10%					
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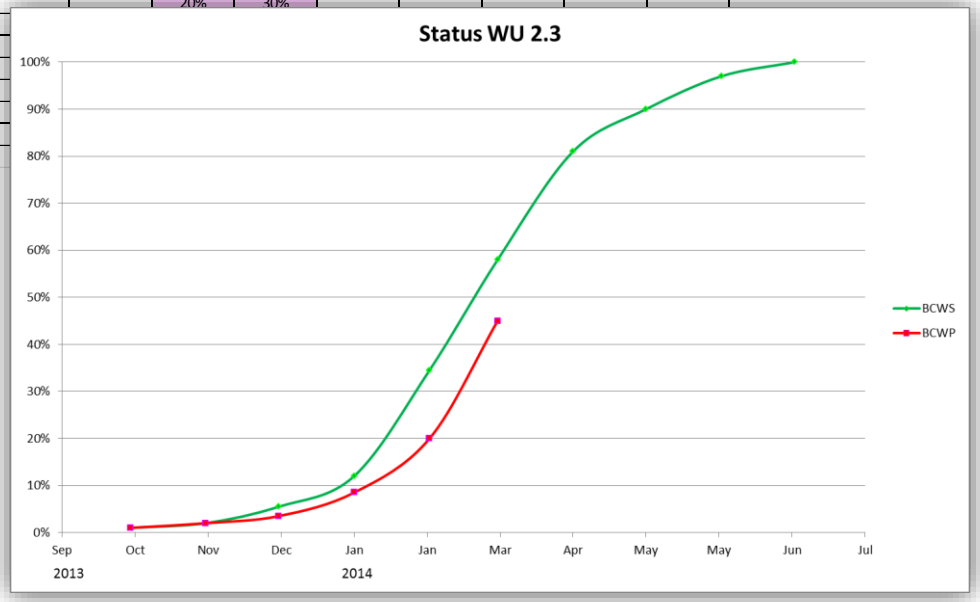

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Research Results To Date

- Literature review has been completed
- Approximately 50% of inventory, mapping and performance review of WWTPs and Pumping Stations has been completed
- Gathering of technical information and data from all associated NYS and NYC agencies has been initiated
- Wastewater performance and vulnerability evaluation has been initiated
- Over 30% of wastewater treatment plants review has been completed
- Approximately 20% of review of wastewater treatment plants has been completed.

Deliverables

- A final report will be produced that summarizes the most important causes of damage and component vulnerability during a storm in the wastewater treatment systems in the study region. Analysis of the design, operation and capacity characteristics of the existing wastewater infrastructure system will be performed based on historical data, drawings and characteristics of the wastewater infrastructure. The limitations, deficiencies, potentials and dynamics of each component of the system will be determined and analyzed.

- Recommendations for protection of each system component and improved service (in terms of improvement of the efficiency and capacity of each component) will be developed and ranked on the basis of cost/benefit assessment. Studies of wastewater treatment infrastructure systems in NYC, Long Island (both Nassau and Suffolk Counties), Westchester County, Orange County, Rockland County, and Putnam County will be conducted, the lessons from which can be implemented in the flood prone locations of other counties of New York State, as needed.

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Q&A

"NYS-RISE will bring together several of our state's top universities to serve as a world-class think tank of research and education on extreme weather and emergency preparedness. We are gathering top academic leaders, policy makers, emergency experts and first responders from across the nation to develop strategies to meet one simple goal – and that is to better protect New York's communities in natural disasters."

Governor Andrew M. Cuomo
11/1/2013

"In our vision of a stronger, more resilient city, many vulnerable neighborhoods will sit behind an array of coastal defenses. … Water that makes its way inland … will be absorbed by expanded green infrastructure, or diverted into new high-level sewers. Meanwhile, … water and wastewater … networks will operate largely without interruptions, or will return to service quickly when preventive shutdowns or localized interruptions occur. … We are a coastal city … and we cannot, and will not, abandon our waterfront. Instead we must build a stronger, more resilient city…"

Mayor Michael R. Bloomberg
6/11/2013