Overview of Resiliency Strategies

INSTALL MORE SUSTAINABLE AND RESILIENT INFRASTRUCTURE			
Strategy	**How It Was Used**	**Benefits**	**Challenges**
New, more efficient boilers	Where boilers were severely damaged after Hurricane Sandy, the Recovery and Resilience program installed new heat and hot water systems and protected them from future flooding	· New boilers are more efficient and emit less pollution than the boilers they replaced, improving environmental performance as well as resiliency	· When boilers are replaced without a full system replacement, the full benefit can be difficult to realize
Provide resilient back-up power	NYCHA installed full back-up power generators at over 200 buildings that experienced power outages and flooding during Hurricane Sandy	· Back-up power allows buildings to be re-occupied quickly after a coastal storm and minimizes interruptions to daily life for residents · Generators can provide protection from outages that are unrelated to coastal storms as well, a co-benefit of full-building, permanent back-up generation · Back-up power ensures that sump pumps remain operational during a flooding event	· Generators require extensive new gas and electrical connections · Generators were an entirely new class of asset at NYCHA, that required new maintenance protocols · Extensive coordination with utilities is required for installation · No funding for controls to allow for revenue generation
PROTECT MECHANICAL , ELECTRICAL, AND PLUMBING INFRASTRUCTURE			
Build raised annexes to protect mechanical, electrical, and plumbing equipment	MEP annexes were built at 23 sites—this was often the most cost-effective way to provide ongoing, passive protection to MEP systems. Centralized generator enclosures were also installed at 15 sites.	· Critical equipment can more easily be protected in excess of the Design Flood Elevation and is protected without the need for flood walls or deployable barriers · Construction of new buildings can provide co-benefits by bringing new spaces to developments · Provides easier access to equipment on a day-to-day basis for service	· Increased cost · Requires installation of new site-wide distribution · Not all sites could accommodate new buildings given site constraints and zoning limitations
Protect mechanical, electrical, and plumbing equipment inside buildings	Sometimes, it was most cost-effective to create protected zones within buildings by constructing flood doors and barriers around mechanical rooms or elevating equipment above the design flood elevation indoors.	· Often less expensive than constructing a new structure · Reduces impacts to open spaces and air and light in apartments	· Does not provide co-benefits like easier access for service & creation of new spaces · Space constraints can make the installation of flood doors inside buildings challenging, especially in narrow hallways · Elevating equipment inside buildings creates a considerable challenge servicing equipment for staff because it is so high off the ground

PROTECT MECHANICAL , ELECTRICAL, AND PLUMBING INFRASTRUCTURE (CONTINUED)			
Strategy	**How It Was Used**	**Benefits**	**Challenges**
Locate mechanical equipment on the roofs of buildings	Generators were located on roofs at 21 developments, while boilers were relocated to building roofs at just one development, Bayside.	· When generators are installed on roofs, each building has an independent resilient power supply that is not at risk of flooding · When boilers are located on individual buildings' roofs, they can be more efficient because they minimize distribution losses	· Not all roofs were able to structurally support generators · Maintaining many individual buildings' generators is more costly and time-consuming than maintaining at a central location · Moving from a centralized to a distributed boiler system requires extensive in-building work, which is challenging outside of a comprehensive building renovation
PROTECT STRUCTURES			
Floodproof buildings, using deployable flood barriers for entrances and windows	Used at 22 developments, this strategy allowed NYCHA to create a continuous barrier to floodwaters around a building by reinforcing the buildings' walls and adding floodproof perimeter walls in some locations. Entrances and windows below the Design Flood Elevation are sealed with deployable elements when necessary.	· Protects entire building from flooding · Barriers can be deployed as needed prior to a storm · Costs are lower than passive barrier systems	· Storage and long-term maintenance of deployable elements is challenging · Ensuring that trained operators of deployable systems are available in the event of a storm is a challenge · Structural reinforcement of existing building walls is challenging and costly · Long-term maintenance and operations funding for deploying barriers prior to storm
Floodproof buildings, using passive barriers for entrances	This strategy, used at eleven (11) developments, creates a continuous barrier around the building. Elements at building entrances deploy automatically when water begins to rise around a building.	· No need to store or deploy flood barrier elements	· Not feasible if there is not enough underground space for the installation of barriers · System must be maintained to ensure it functions during a storm event · Structural reinforcement of existing building walls is challenging and costly · More costly than deployable barriers
Install backwater prevention valves	Backwater prevention valves are required by code wherever plumbing is modified, but they are also an essential element in preventing sewage and stormwater from inundating buildings during a storm	· Necessary element of flood protection to prevent water from entering the building through sewer and stormwater systems	· New maintenance protocols are required for buildings with backwater prevention valves

PROTECT STRUCTURES (CONTINUED)			
Strategy	**How It Was Used**	**Benefits**	**Challenges**
Use "wet" floodproofing to protect buildings from floods without sealing water out	Used in six developments, wet floodproofing allows floodwaters to pass through a building without endangering a building's structural stability or critical systems. Critical infrastructure is relocated above the design flood elevation, and vents are installed to allow water to enter and exit the building. In some cases, certain rooms are dry floodproofed to protect critical spaces.	· Structural reinforcement of walls is not required · Cost is much lower than dry floodproofing strategies	· Requires acceptance that some degree of damage will result from a storm
Use floodwalls and changes in landscape grade to protect the site	At two developments—Baruch and Bayside—landscape-based flood walls were used to provide passive, consistent flood protection for large areas of the site. In Red Hook, an innovative "Lily Pad" design will raise the elevation of large areas between buildings and provide sitewide passive protection.	· Landscape-scale strategies provide protection beyond the buildings, keeping areas of the grounds protected during a flood event · These strategies can provide major co-benefits, such as the seating created by the flood wall at Baruch and the re-imagined community spaces that will be created at Red Hook	· This type of solution is only possible at large developments and where the site's configuration allows · Construction of landscape-scale solutions can be extremely disruptive and often requires the removal of large numbers of trees · Unexpected locations of utilities and abandoned older infrastructure can create significant unanticipated costs