



STORM SURGES FLOODING NEW YORK CITY STREET

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DID YOU KNOW?

WHEN A STORM, SUCH AS HURRICANE SANDY, SETS WATERS IN NEW YORK HARBOR RISING, THOSE SLOSHING SEAS ARE NOW 20 TIMES MORE LIKELY TO OVERTOP THE MANHATTAN SEAWALL THAN 170 YEARS AGO.



THE WHY

WHY WATER LEVELS ARE RISING.

While the **rise in sea level** is attributable to the expansion of warming ocean waters and ice melt, the cause of the rise in storm tide is not yet clear, nor is the possibility that the rise will continue into the future.



THERMAL EXPANSION

As air temperatures rise (due to climate change) the water in the oceans is warmed and expands. This process is called thermal expansion.



MELTING ICE

As ice sheets and glaciers melt, they increase the amount of water in the oceans. Scientists have shown that in the past there have been periods of significant sea level change due to natural factors.



UNKNOWN FACTORS

The researchers suggest that the trend in rising storm tide could be partly due to decades-long changes in a climate pattern called the North Atlantic Oscillation, as well as longer-term trends driven by climate change. More local effects, like the dredging of ship channels, could also play a role.

THE WHY

WHY NEW YORK IS MORE LIKELY TO FLOOD.

Historically, some communities throughout New York City have been prone to flooding. Sections of Queens, Staten Island, the Bronx and Brooklyn, for instance, have periodically faced this problem. In recent years, however, flooding has occurred more frequently than in the past, affecting a broader range of communities than ever.

EXTREME WEATHER AND INCREASED PRECIPITATION

In addition to increased average temperatures, rising sea levels, increased frequency of coastal floods, New York also experiences increased precipitation. This is a significant factor as annual precipitation ranges from **43 - 50 inches**. Precipitation has increased at a rate of approximately 0.8 inches per decade from 1900 to 2013 in Central Park.

IMPERVIOUS SURFACES

Rather than being absorbed into the ground, much of the stormwater in New York City flows over impervious surfaces into roof drains or catch basins in the streets, and from there into the sewers. These impervious surfaces cover approximately 72% of New York City's 305 square miles in land area and generate a significant amount of stormwater.

BLOCKED CATCH BASIN GRATES

Another serious cause of flooding is the blocking of catch basin grates in our streets. During very intense storms—water pushes debris like leaves, wrappers and flyers on to the catch basin where it forms a block so completely that water cannot enter the storm sewers. Instead, it pools around the basin, causing flooding even before the sewer is full.

HURRICANE SANDY STATISTICS



\$19B

DAMAGE TO NEW YORK



305K

DAMAGE TO HOUSING



49.9%

REPAIRS FOR AFTERMATH



67K

BUILDING FLOOD PRONE



PREVENTION

WAYS TO PREVENT THIS FLOODING.

There's no shortage of ideas out there for how the city could adapt to rising sea levels. A lot of them haven't been deployed or more seriously studied because they seem too expensive or daunting. But an event like Sandy quickly changes that calculus. Suddenly, some of these solutions don't look quite as expensive as cleaning up after a hurricane:



SEAL OFF NEW YORK HARBOR COMPLETELY



SEPARATE THE NEW YORK SEWER SYSTEM



CREATE MORE ELEVATED INFRASTRUCTURES



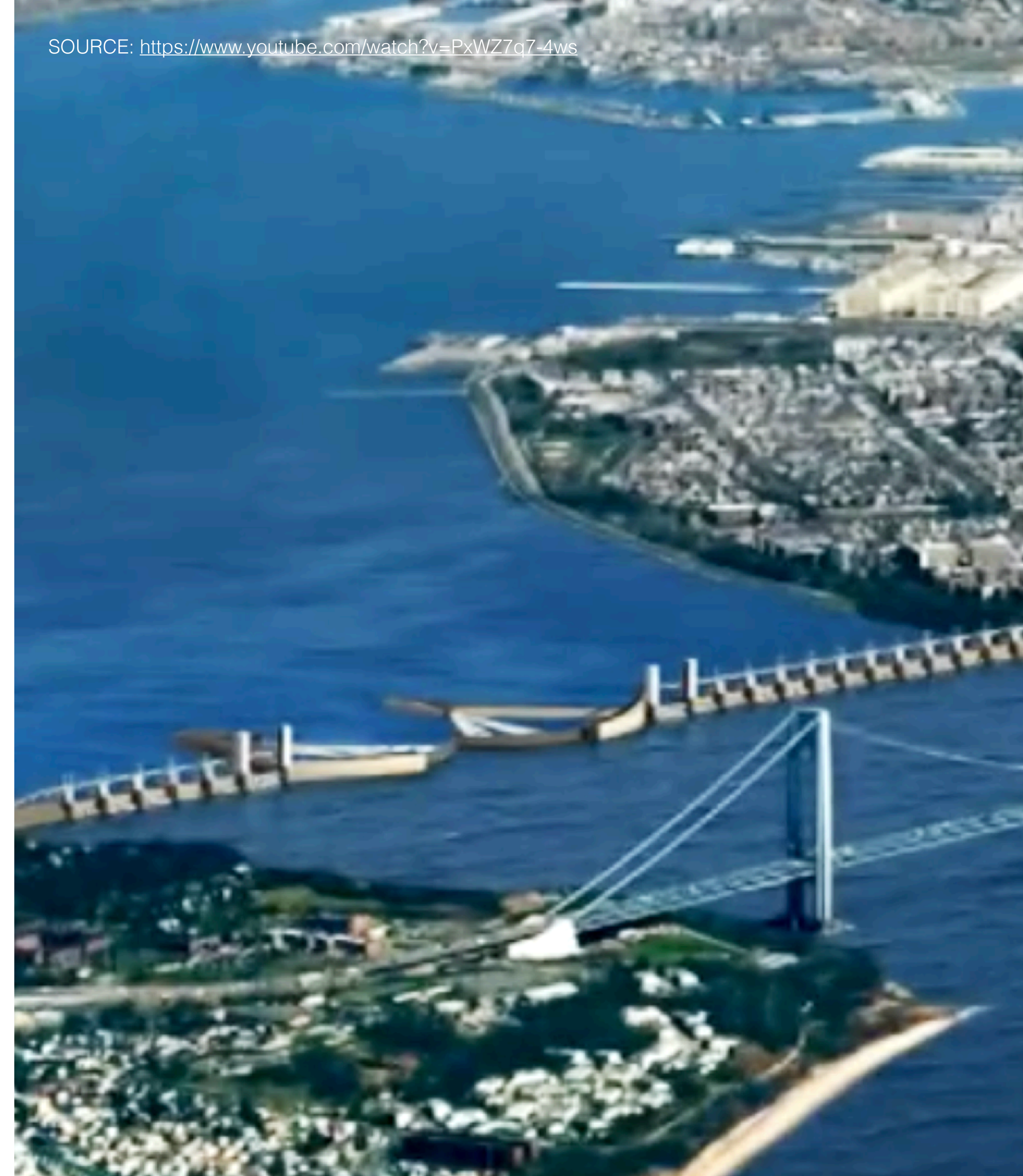
PROTECT LOWER MANHATTAN WITH 'THE BIG U'

PREVENTION

SEAL OFF NEW YORK HARBOR COMPLETELY.

Other countries have taken this route, most notably the Netherlands. The Dutch began construction of their huge system of protective dams and moveable storm-surge barriers, called Delta Works, in the 1950s, and it took more than 50 years to complete. The cost of such a large infrastructure project would be enormous, with estimates ranging from **\$9 billion to \$29 billion**, if the cost of fortifying areas around the barriers are included.

Despite protecting a large part of the city, barriers would also leave many areas unprotected, like the Rockaways, which were devastated during Sandy. There are ecological issues that must be closely examined, since the **barrier could reduce water circulation in the harbor and affect marine life.**

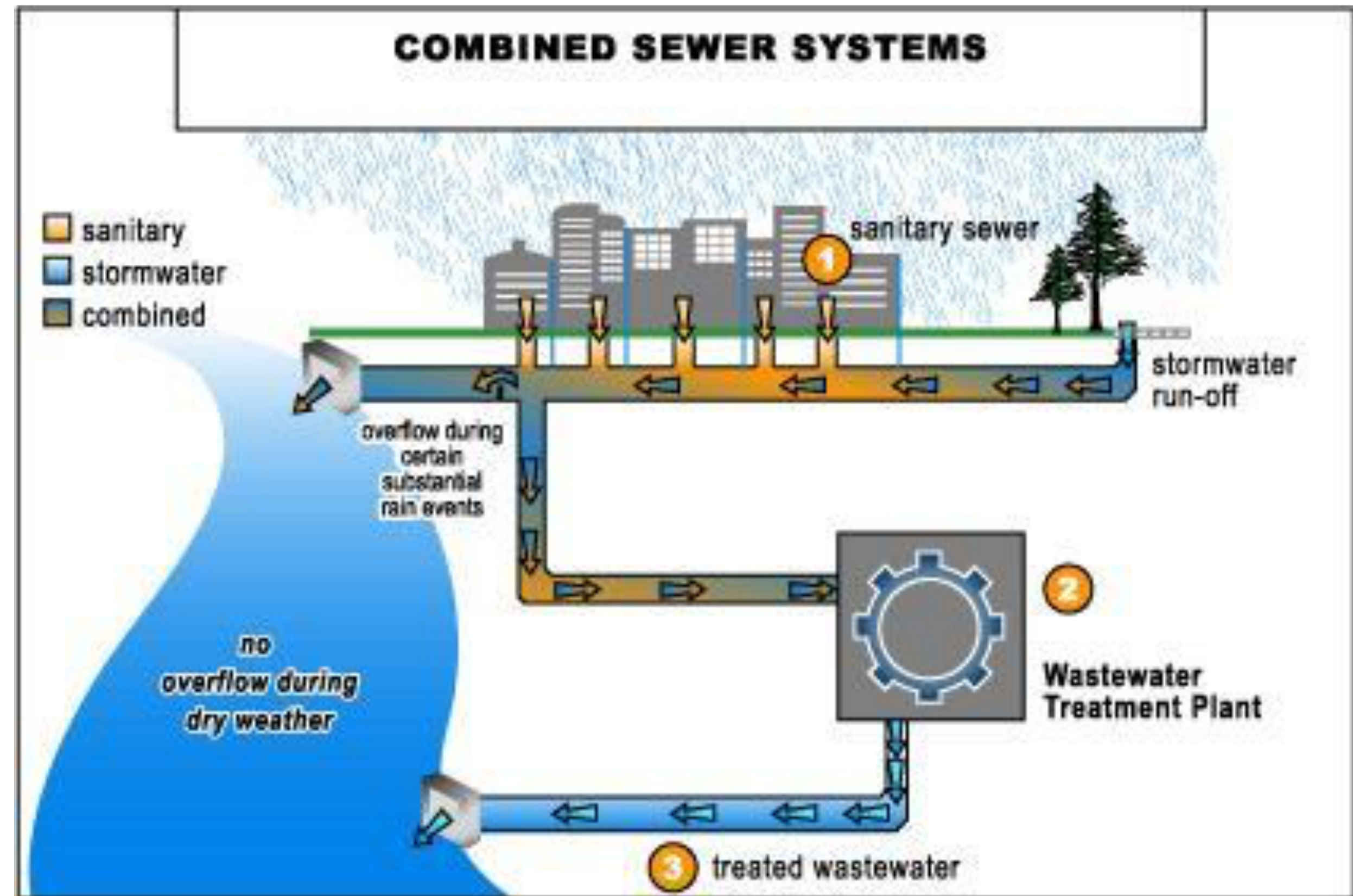


PREVENTION

SEPARATE THE NEW YORK SEWER SYSTEM.

Now the sewer system and the flood system are combined which cause the entire system to overflow and cause issues with water quality. DEP (Department of Environmental Protection) is trying to implement city wide sustainable green infrastructure efforts to better manage stormwater.

They're trying to use techniques such as detaining or retaining stormwater runoff through capture and controlled release (infiltration into the ground, vegetative uptake and evapotranspiration thereby reducing the need for end-of-pipe stormwater storage and treatment systems)



PREVENTION

CREATE MORE ELEVATED INFRASTRUCTURES.

There are very few buildings in the entire state of New York built at grade at elevations below sea level. But New York City has constructed one massive piece of infrastructure below that threshold: **the subway system**. As we saw this week, flooding can devastate an underground network of tunnels, train platforms and corridors. For a solution, elevating subway entrances would help. Bangkok, another low-lying city susceptible to rising tides, has built precisely these kinds of subway entrances. They're raised a meter off the ground and include built-in floodgates. To enter an underground subway, once must first go up, then down.



PREVENTION

PROTECT LOWER MANHATTAN WITH 'THE BIG U'.

The "BIG U" started as a proposal in the Rebuild By Design competition, which asked scientists and urban designers to come up with ideas for rebuilding Sandy-affected areas. This proposal, from the Bjarke Ingels Group of Denmark, would surround all of lower Manhattan with a series of berms, folding panels and green space. **Though the overall price tag is lower than some other projects, it would still only protect Manhattan, not other boroughs or surrounding areas.**



BIBLIOGRAPHY

1. <http://www.citylab.com/tech/2012/10/5-ideas-could-have-prevented-flooding-new-york/3754/>
2. http://www.nyc.gov/html/dep/html/stormwater/combined_sewer_overflow.shtml
3. <https://www.alexandriava.gov/uploadedImages/tes/oeq/info/CssCombinedSewerSystem.jpg>
4. http://www.huffingtonpost.com/2013/10/29/hurricane-sandy-impact-infographic_n_4171243.html
5. <https://project.wnyc.org/flooding-sandy-new/#12.00/40.7378/-74.0702>
6. <http://www.climatecentral.org/news/storm-surge-could-flood-nyc-1-in-every-4-years-17344>
7. <http://www.nyc.gov/html/dep/html/stormwater/index.shtml>
8. http://www.nyc.gov/html/dep/html/stormwater/flooding_index.shtml
9. http://www.nyc.gov/html/dep/html/stormwater/using_green_infra_to_manage_stormwater.shtmlhttp://www.nyc.gov/html/dep/html/stormwater/combined_sewer_overflow.shtml
10. <http://www.nydailynews.com/new-york/100m-project-protect-manhattan-major-storms-article-1.2338430>
11. <http://www.popsci.com/subway-flood-proofing-and-repairs#page-2>
12. <http://www.npr.org/2015/10/08/446600221/to-flood-proof-subways-n-y-looks-at-everything-from-plugs-to-sheets>
13. <http://www.rollingstone.com/politics/news/can-new-york-be-saved-in-the-era-of-global-warming-20160705>
14. http://www.huffingtonpost.com/2014/10/29/sandy-anniversary-nyc_n_6062766.html