



# Santa Ana River Watershed 2014



## *Keeping Our Cool*



## Achieving Long-term Sustainability of the Santa Ana Watershed

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**“It’s better to know nothing  
than to know what ain’t so.”**



## **Point #1:**

**Our New Reality is  
Extreme Complexity  
and Extreme  
Uncertainty**



## What We Do Know

- Temperatures will continue to go up
- Evaporative demands for water will increase
- The ratio of mountain rain to snow will rise
- Snowpack will diminish
- The timing of runoff will change
- Sea-level will rise, affecting estuaries & aquifers
- Severe earthquakes will periodically interrupt supply delivery and impact water quality



# Stationarity is Dead

“In view of the magnitude and ubiquity of the hydroclimatic change apparently now under way . . . we assert that **stationarity is dead and should no longer serve as a central, default assumption in water-resource risk assessment and planning.**”

Source: P.C.D. Milly et al. “Stationarity is Dead: Wither Water Management.” *Science*, 319, February 2008.



## Definition of extreme uncertainty

“There are no stationary trends, no data points close to the relevant values of a variable and no theory to guide the forecast. . . an environment approximating **an information vacuum.**”

Source: Michael Schwarz, 1999



**Point #2:**  
**Risk is Different  
from Uncertainty  
when Making  
Decisions**



## IPCC Definitions

**‘Risk’** . . . To the extent that there is a detailed understanding of the characteristics of a specific event, experts will normally be in agreement regarding estimates of the likelihood of its occurrence and its resulting consequences.

**‘Uncertainty’** denotes a cognitive state of incomplete knowledge that results from a lack of information and/or from disagreement about what is known or even knowable.

Source: IPCC 5th Assessment Report "Climate Change 2014: Mitigation of Climate Change"





## Are we taking this advice?

“The place to start our investigation . . . is with the question: **can ignorance be modeled probabilistically? The answer is ‘no’.** The ignorance which is important to the decision maker is a disparity between what is known and what needs to be known in order to make a responsible decision.”

Source: Yakov Ben-Haim, *Info-Gap Decision Theory: Decisions Under Severe Uncertainty*.



## Are we taking this advice?

"The world today faces the enormous, dual challenges of renewing its decaying water infrastructure and building new water infrastructure. **Now is an opportune moment to update the analytic strategies** used for planning such grand investments under an uncertain and changing climate."

Source: P.C.D. Milly et al. "Stationarity is Dead: Wither Water Management." *Science*, 319, February 2008.



**Point #3:**  
**Let's Transition to  
Post-Recovery  
Solutions before  
the Plausible  
Crisis Hits**





## Protecting the City, Before Next Time



Architecture Research Office and dlandstudio

**URBAN WETLANDS** A rendering of Lower Manhattan that shows tidal marshes to absorb waves.

By ALAN FEUER

Published: November 3, 2012





# Rebuild by Design Winner: BIG U



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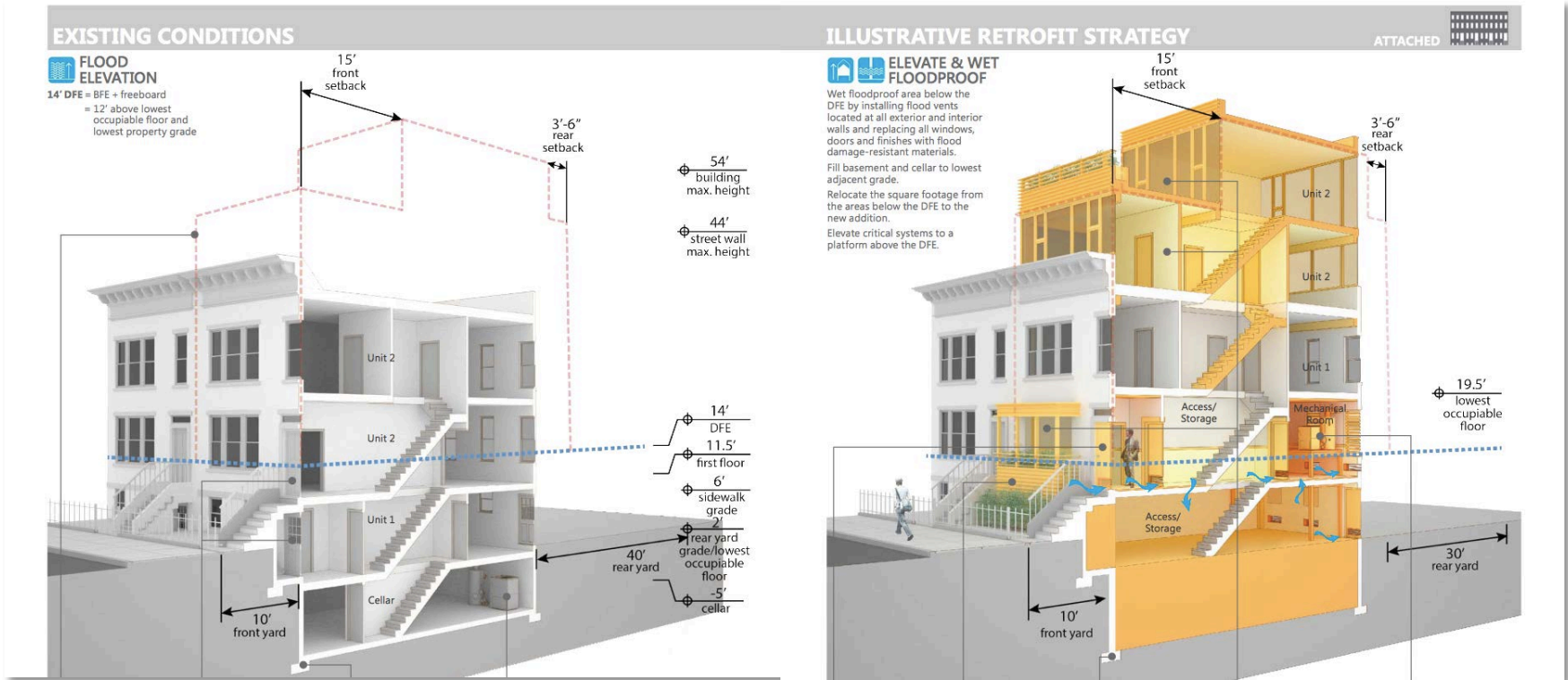
57

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## NYC Coastal Climate Resiliency



Source: NYC Dept. of City Planning, Retrofitting Buildings for Flood Risk





# Breaking the cycle of catastrophe-driven change





# Breaking the cycle of catastrophe-driven change





# Strategies for Uncertainty

- Diversified
- Multi-purpose
- Smaller-scale
- Incremental
- Context Sensitive
- Flexible
- Resilient
- Low Regret
- Locally Managed
- Distributed

**Keep mistakes small and learning constant**



## Original 1828 Royal Charter of the Institution of Civil Engineers

**"...the art of directing the great  
sources of power in nature for the  
use and convenience of man."**



“The Best way to predict the future is to invent it” – Alan Kay 1989

**“In some sense our ability to open the future will depend not on how well we learn anymore – but how well we are able to unlearn.”**



Thank You!



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