

Impacts of Changing Climate on Water Resources

Texas Association of Clean Water Agencies

July 23, 2021



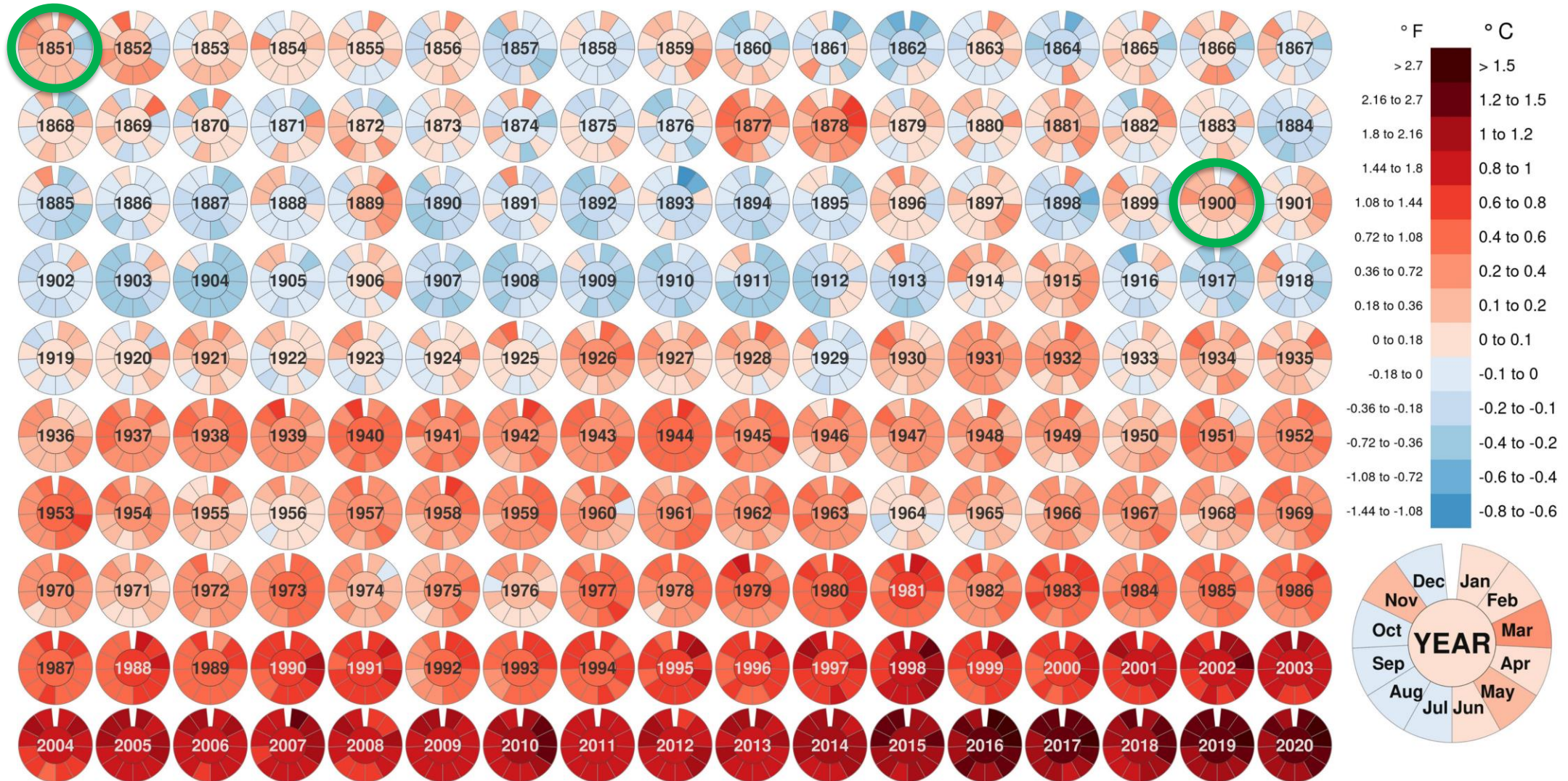
**CDM
Smith**

WATER + ENVIRONMENT + TRANSPORTATION + ENERGY + FACILITIES

Dan Rodrigo
One Water
Practice Leader

Climate is Changing (Source: Visual Capitalist)

Monthly global mean temperatures compared to reference period (1851-1900 average)



Overview of Climate Change Impacts on Water Resources



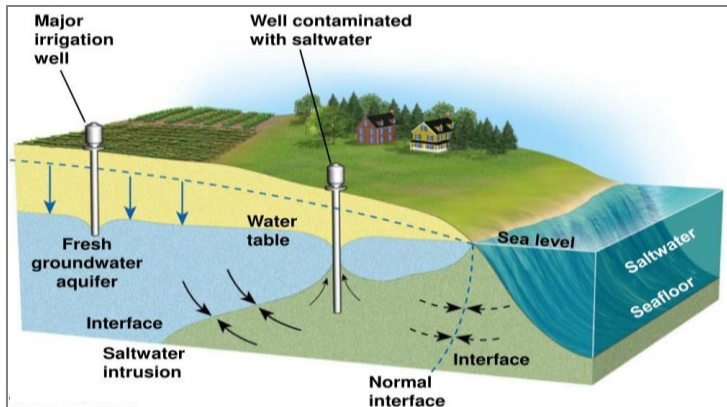
More Frequent & Severe Droughts



Reduced Mountain Snowpack



More Frequent & Severe Flooding



Saline Groundwater Intrusion



Increasing Wildfires



Degraded Source Water Quality

Rising Temperatures and Changing Rainfall Patterns Causing More Intense Droughts in Southern U.S.

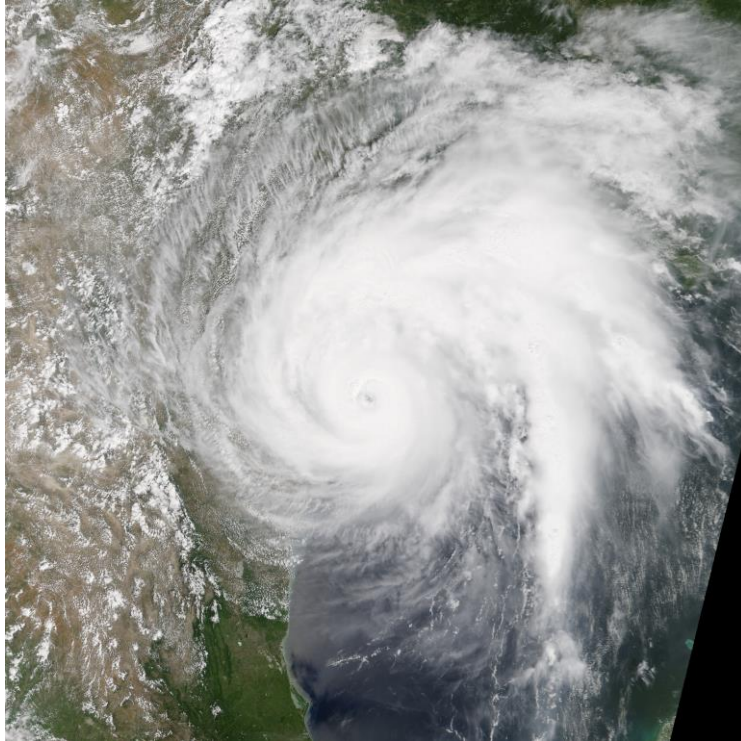


Lake Travis outside of Austin during 2008-2016 drought (Source: Austin Water IWRP)



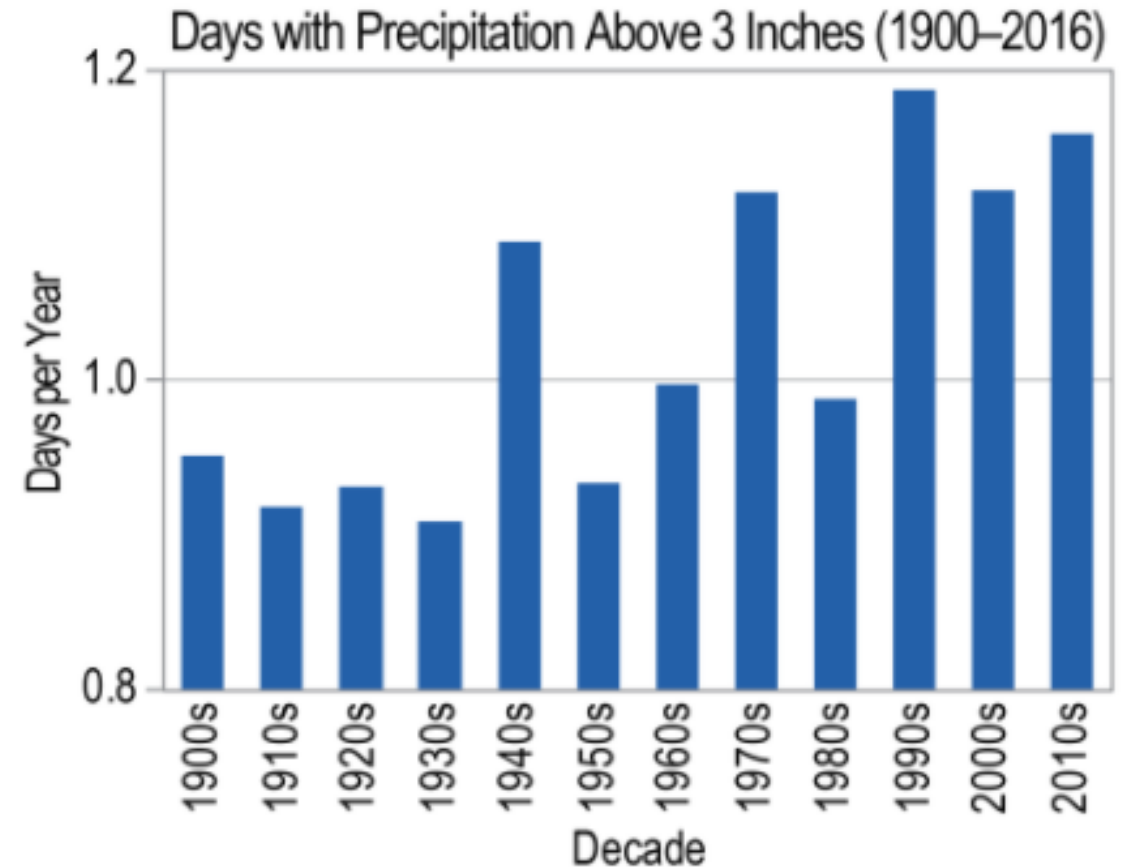
Extreme drought in 2007 for Lake Lanier, Georgia (Source: Flickr.com)

Increasing Storm Events in Southern United States



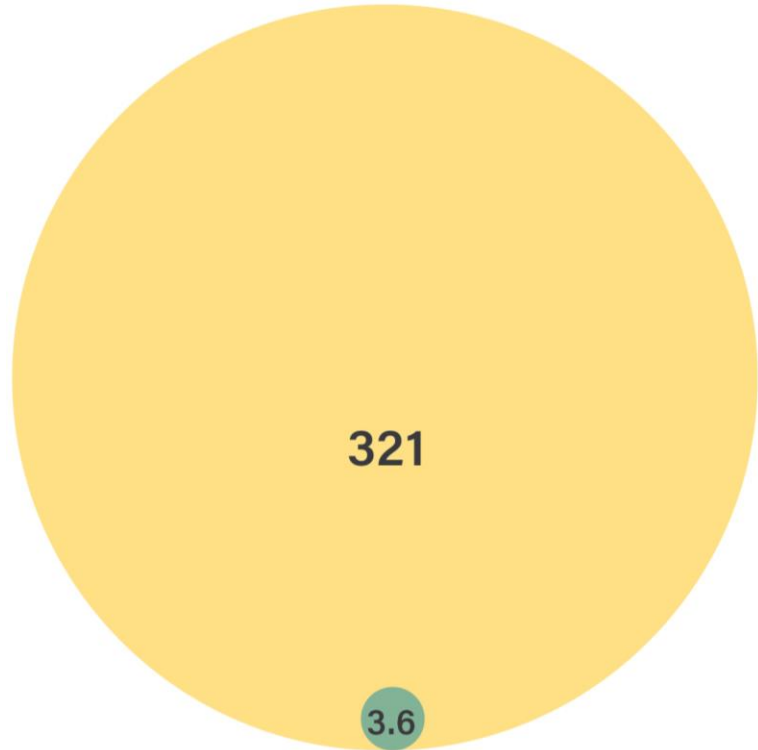
Rainfall amounts from intense storms such as Hurricane Harvey are about **5%–7%** greater now than a century ago.

Source: Precipitation Change in the United States. Climate Science Special Report: Fourth National Climate Assessment, 2017.



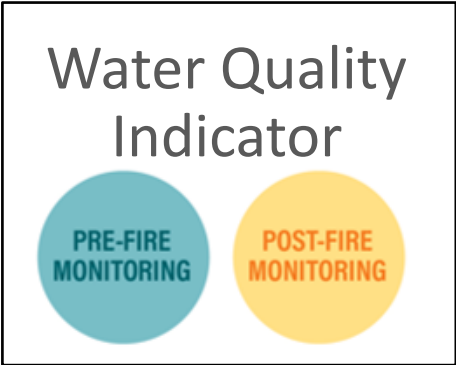
Sources: NOAA NCEI and CICS-NC.

Wildfires in U.S. Happening at Unprecedented Levels Impacting Watersheds and Source Water Quality



Turbidity (NTU)

90-fold increase



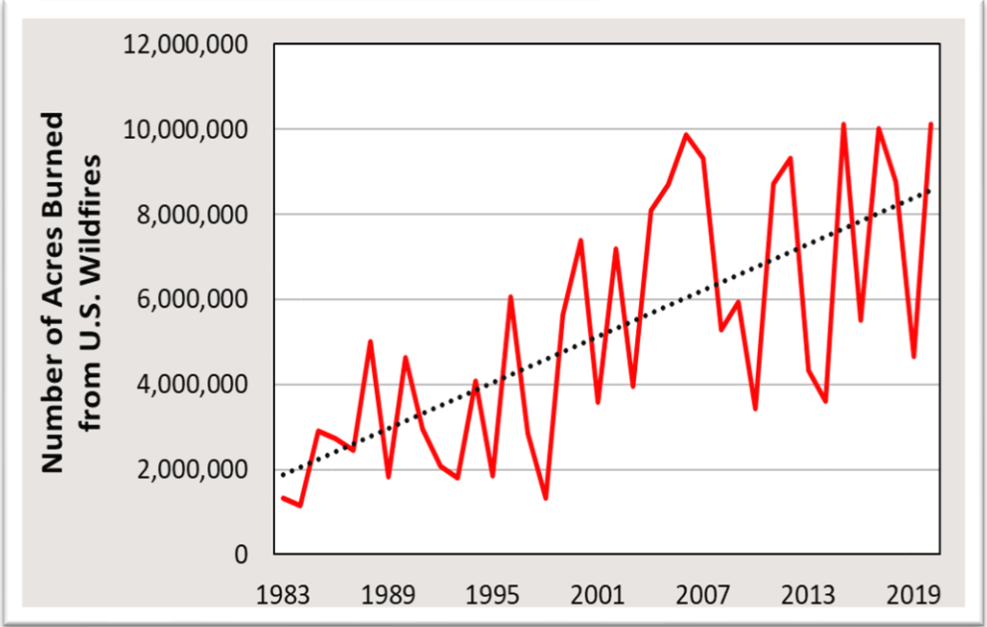
Total Phosphorus (mgP/L)

20-fold increase



Total Nitrogen (mgN/L)

5-fold increase



Higher Temperatures Exacerbating Water Quality Episodes Such as Algae Blooms



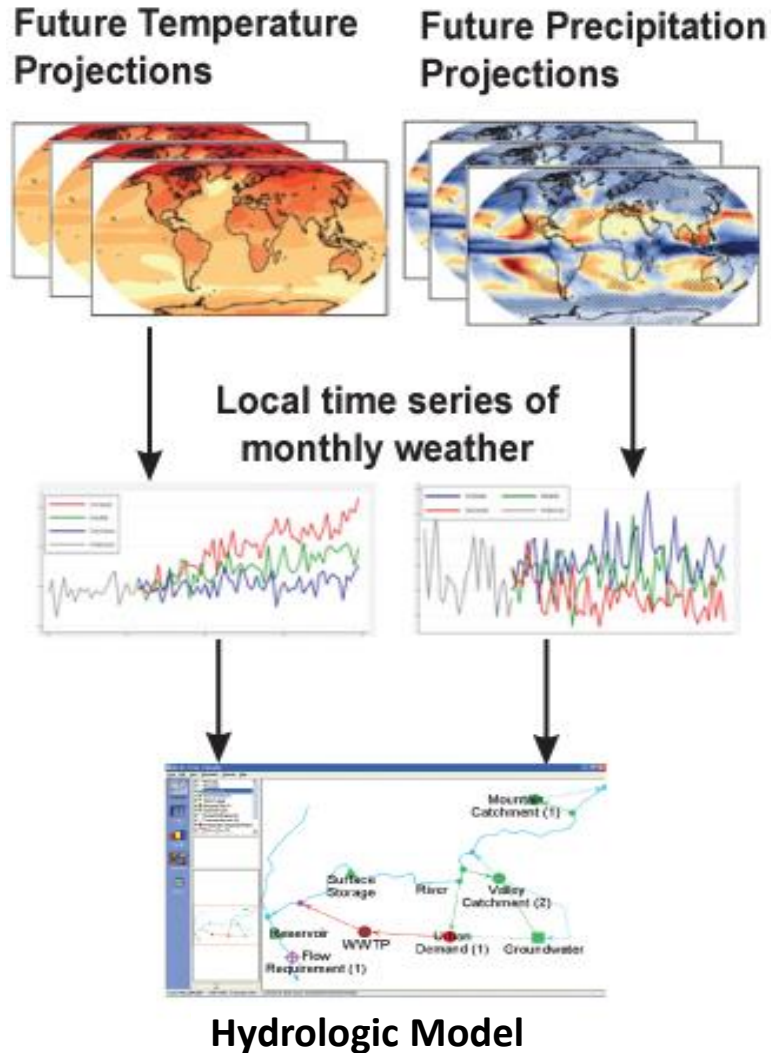
Algae bloom episode in Lake Okeechobee, FL, July 2018 (Source: Lynne Sladky, AP News)



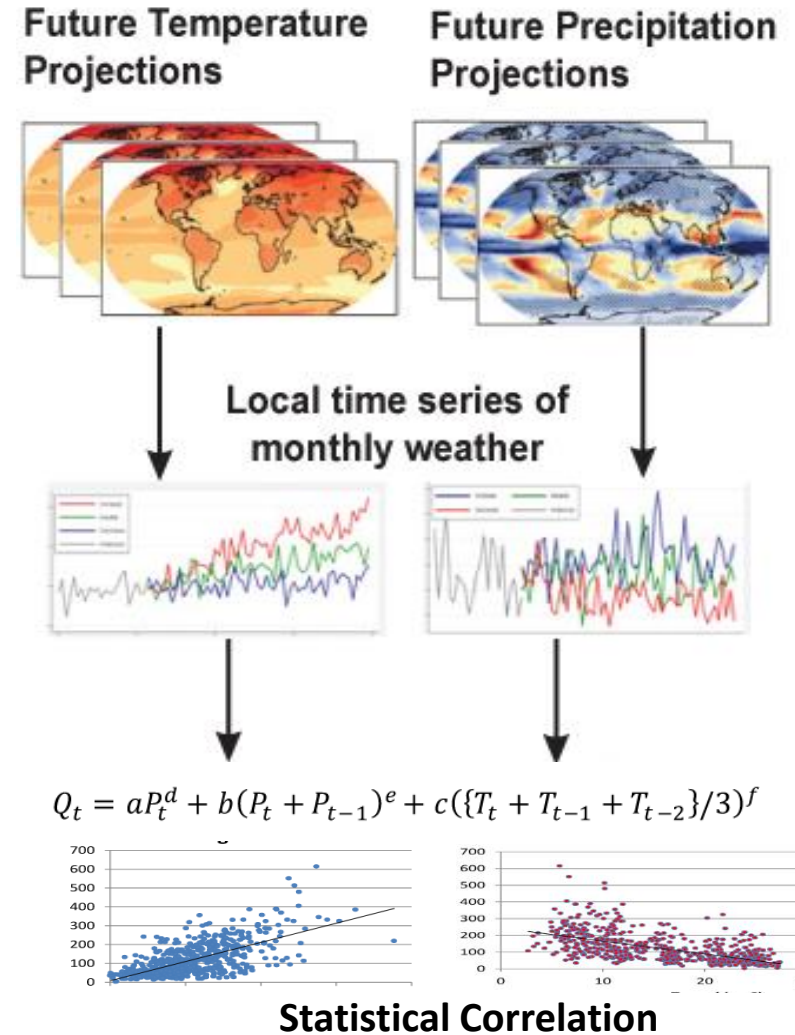
Algae bloom episode in Lake Erie, Great Lakes, 2011 (Source: Amusing Planet)

Methods to Capture Climate Change Impacts

Numerical Modeling



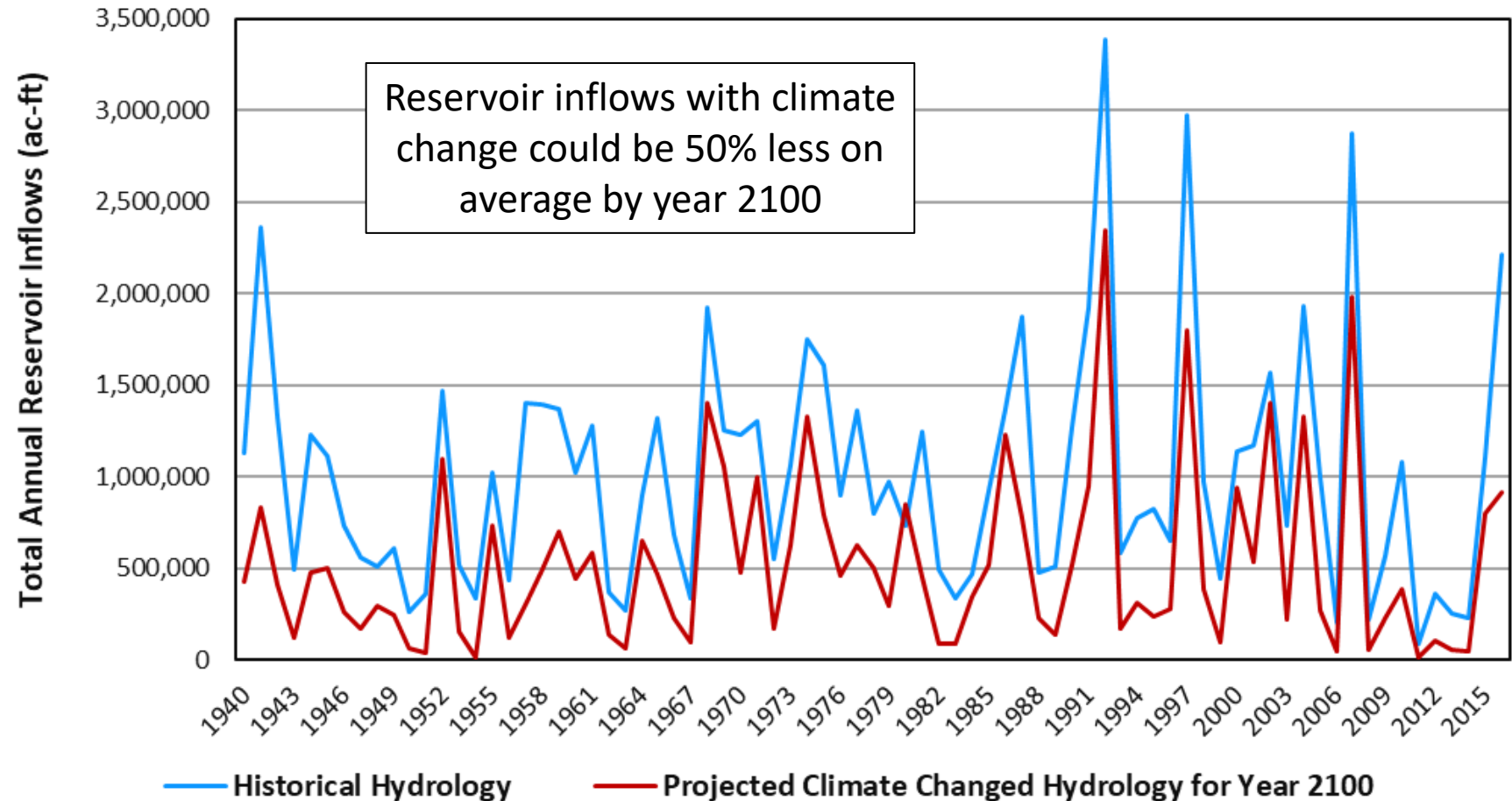
Empirical Regression



*https://gdo-dcp.ucllnl.org/downscaled_cmip_projections

Case Example: Projecting Impacts to Water Supply in Austin, Texas (Numerical Modeling)

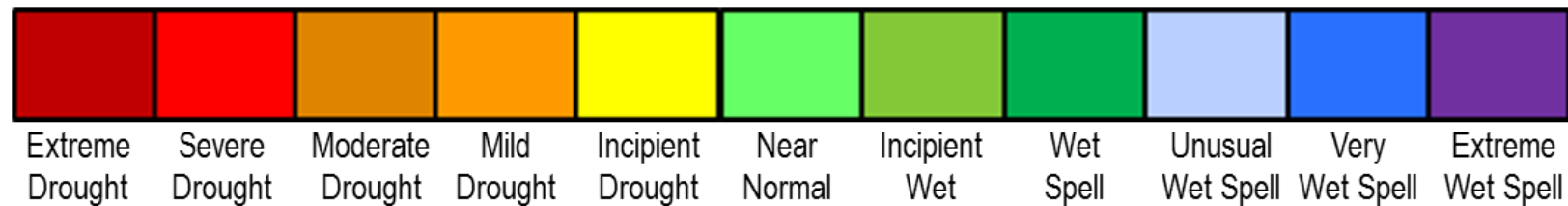
As part of the Integrated Water Resources Plan that CDM Smith prepared for Austin, climate change impacts on water supply were analyzed to help develop resilient “One Water” strategies



Case Example: Projecting Changes in Drought Palmer Index for Atlanta, Georgia (*Empirical Regression*)

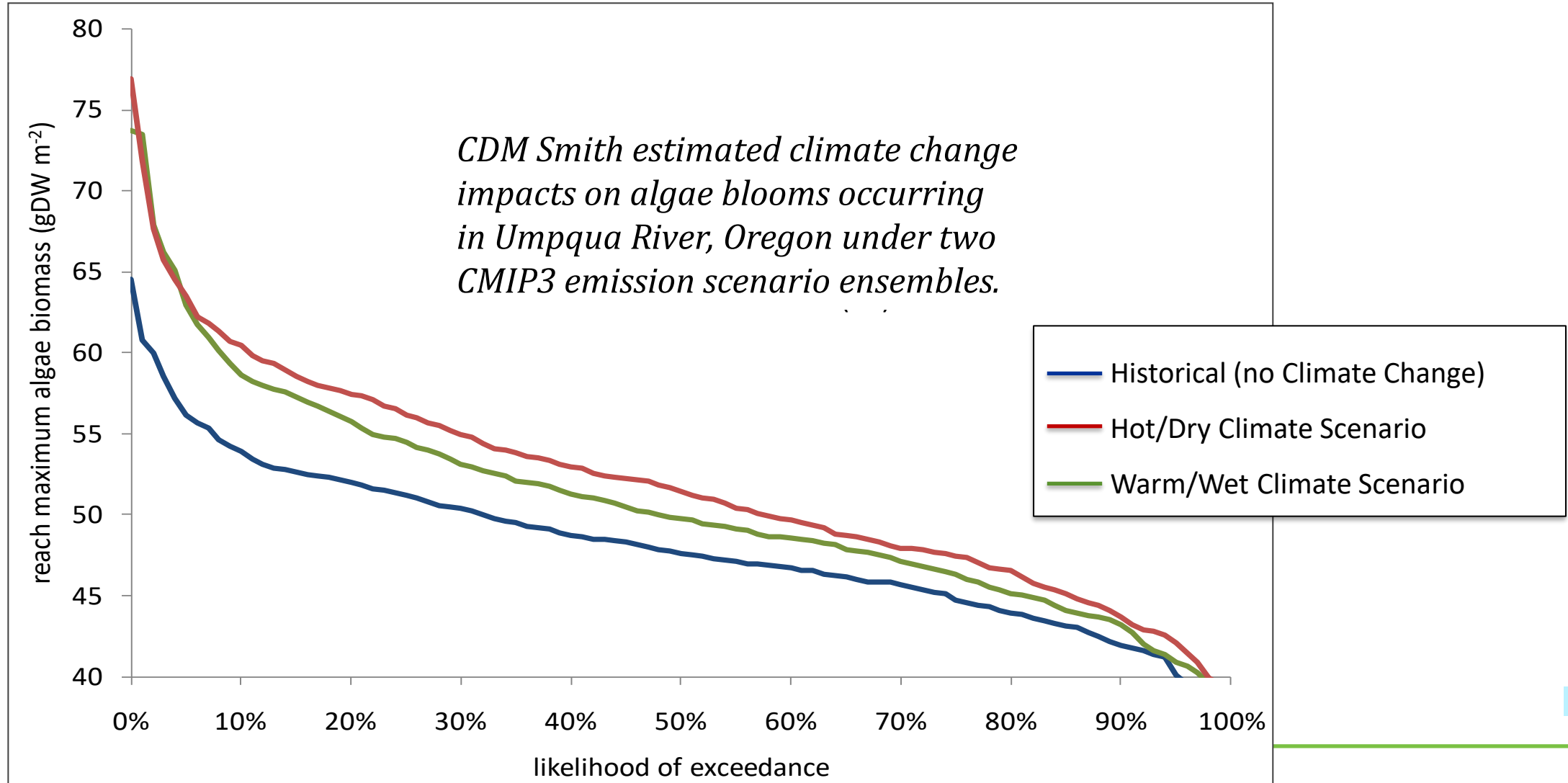
For Metro North Georgia region, CDM Smith estimated projected changes in Palmer Drought Index as a result of climate change scenarios.

Summary of Mann-Kendall Drought Analysis: Atlanta, 2000 - 2100				
Projection	Avg PDSI	Avg Drought Condition	Avg PDSI	Avg Drought Condition
<i>Historical Observed (1900 - 2014)</i>	-0.20	Near normal		
Future Climate Scenarios	2000 - 2049		2050 - 2100	
<i>Central Tendency</i>	-0.73	Incipient dry	-1.72	Mild drought
<i>Hot/Dry</i>	-1.81	Mild drought	-4.49	Extrm. drought
<i>Warm/Dry</i>	-0.81	Incipient dry	-1.34	Mild drought
<i>Hot/Wet</i>	-0.10	Near normal	-0.99	Incipient dry
<i>Warm/Wet</i>	0.24	Near normal	0.21	Near normal

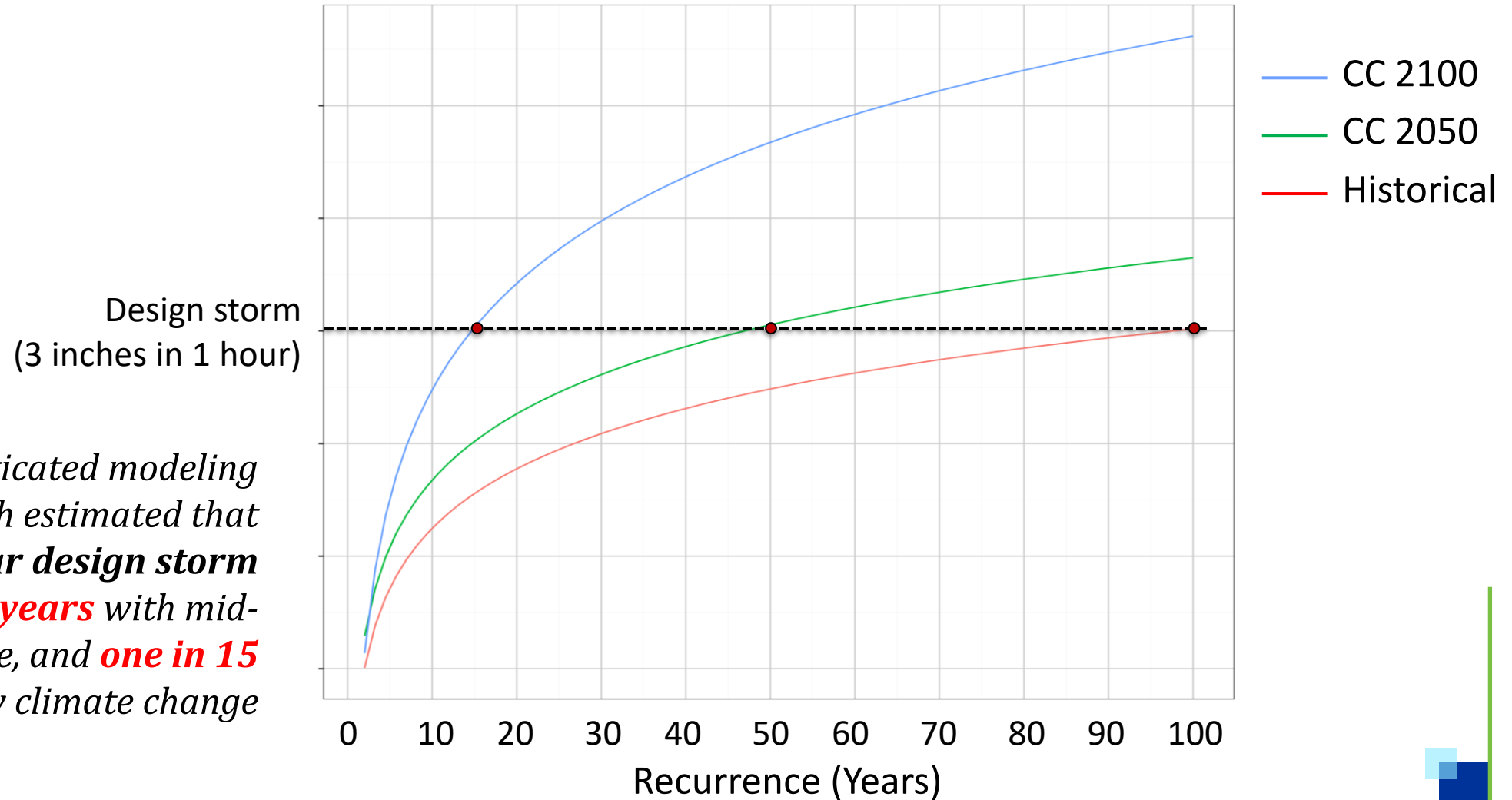


Palmer Index

Case Example: Measuring Impacts on Water Quality, South Umpqua River, Oregon (Empirical Regression)

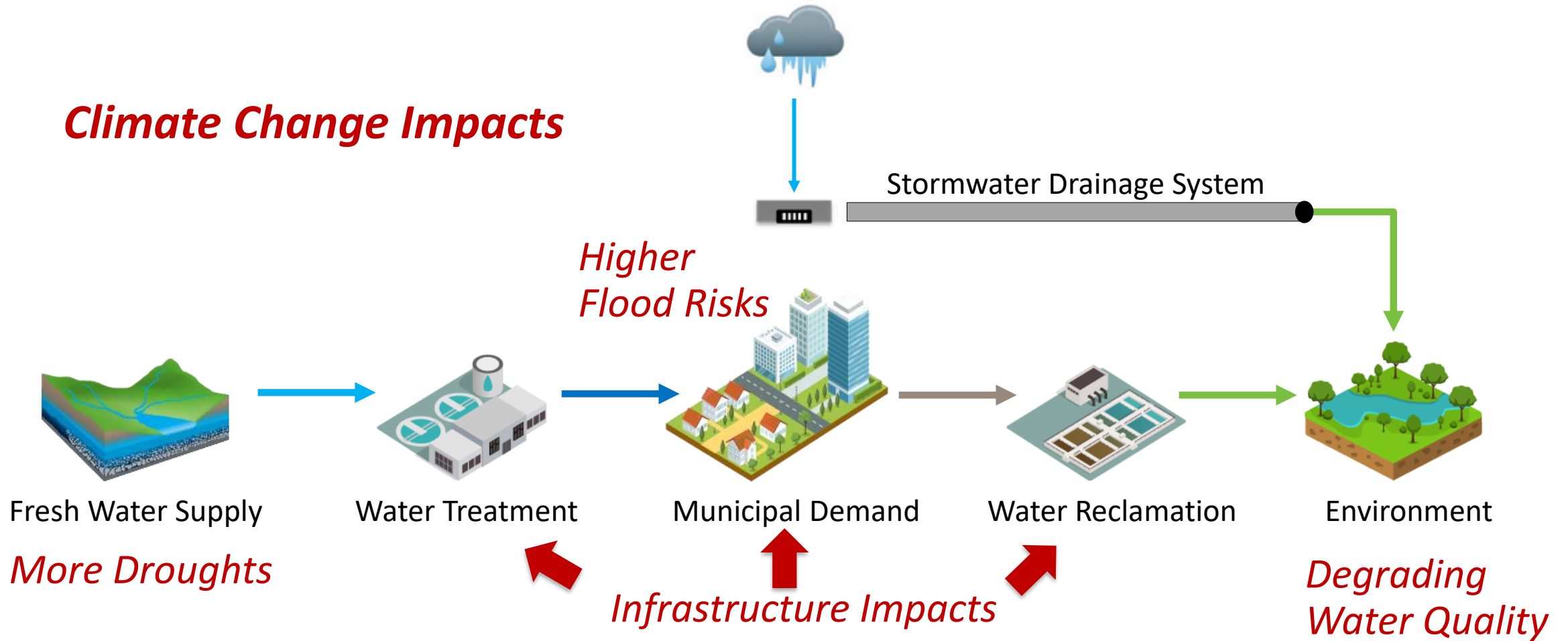


Case Example: Measuring Change in Flood Risk for Philadelphia (Empirical & Numerical Modeling)

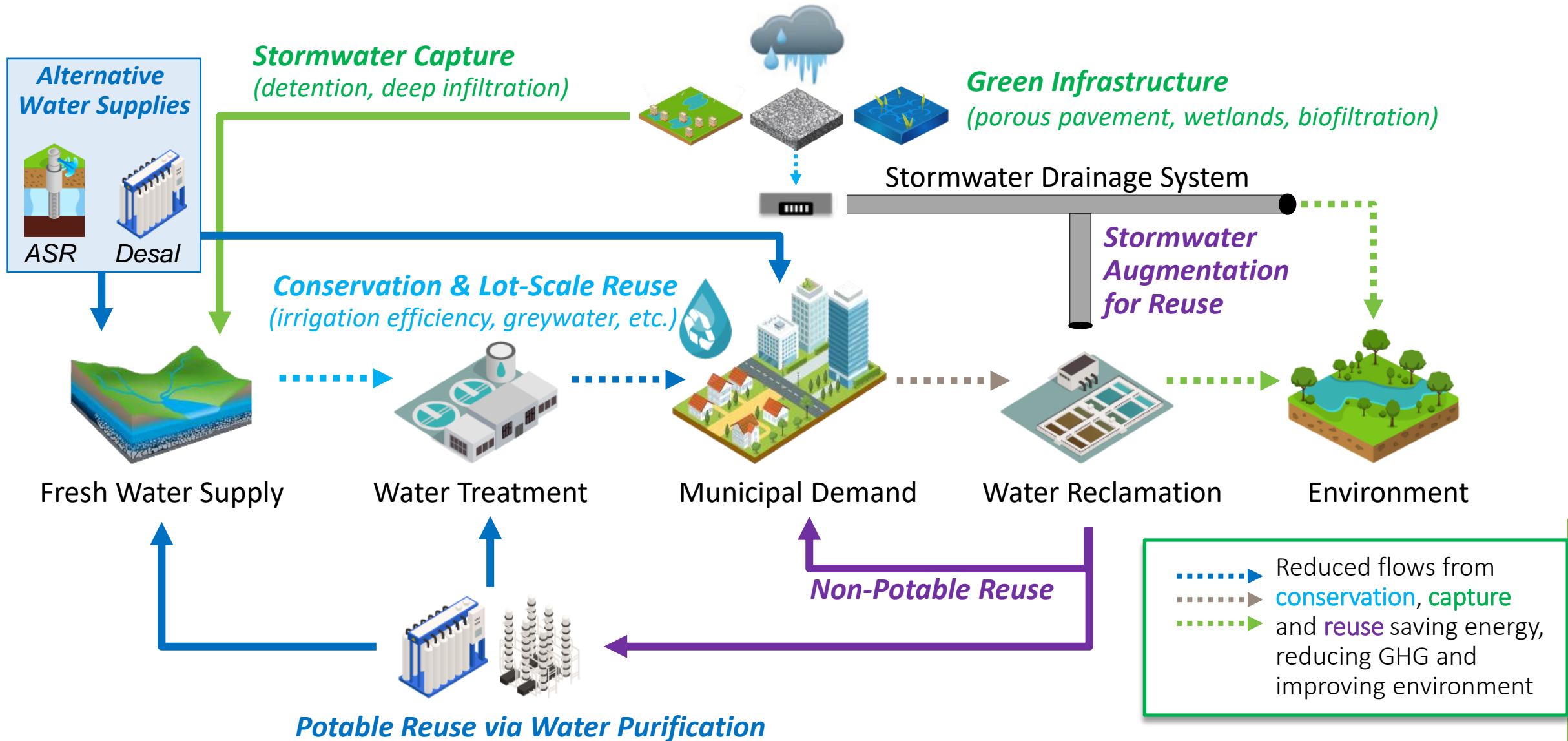


*Using a sophisticated modeling approach, CDM Smith estimated that the historical **100-year design storm** would occur **one in 50 years** with mid-century climate change, and **one in 15 years** with full century climate change*

Non-Integrated Urban Water System



One Water Provides Greater Climate Resiliency and Sustainability for the Future



One Water Plans Addressing Resiliency Prepared by CDM Smith



San Diego, 2013

Outcomes:

- Landscape conversions
- Brackish GW desalination
- Pure Water Program (potable reuse)



Los Angeles, 2007/2018

Outcomes:

- Water conservation
- \$500 M voter approved bond for green infrastructure
- Bold strategy for potable reuse



Austin, 2019

Outcomes/Strategies:

- Water conservation
- Lot-scale reuse and stormwater capture
- ASR
- Indirect potable reuse



JEA (Jacksonville, FL), 2021

Outcomes/Strategies:

- First ever DSM program
- Pilot project for potable reuse
- Brackish GW desal
- Zero WW discharge



Thank You!

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