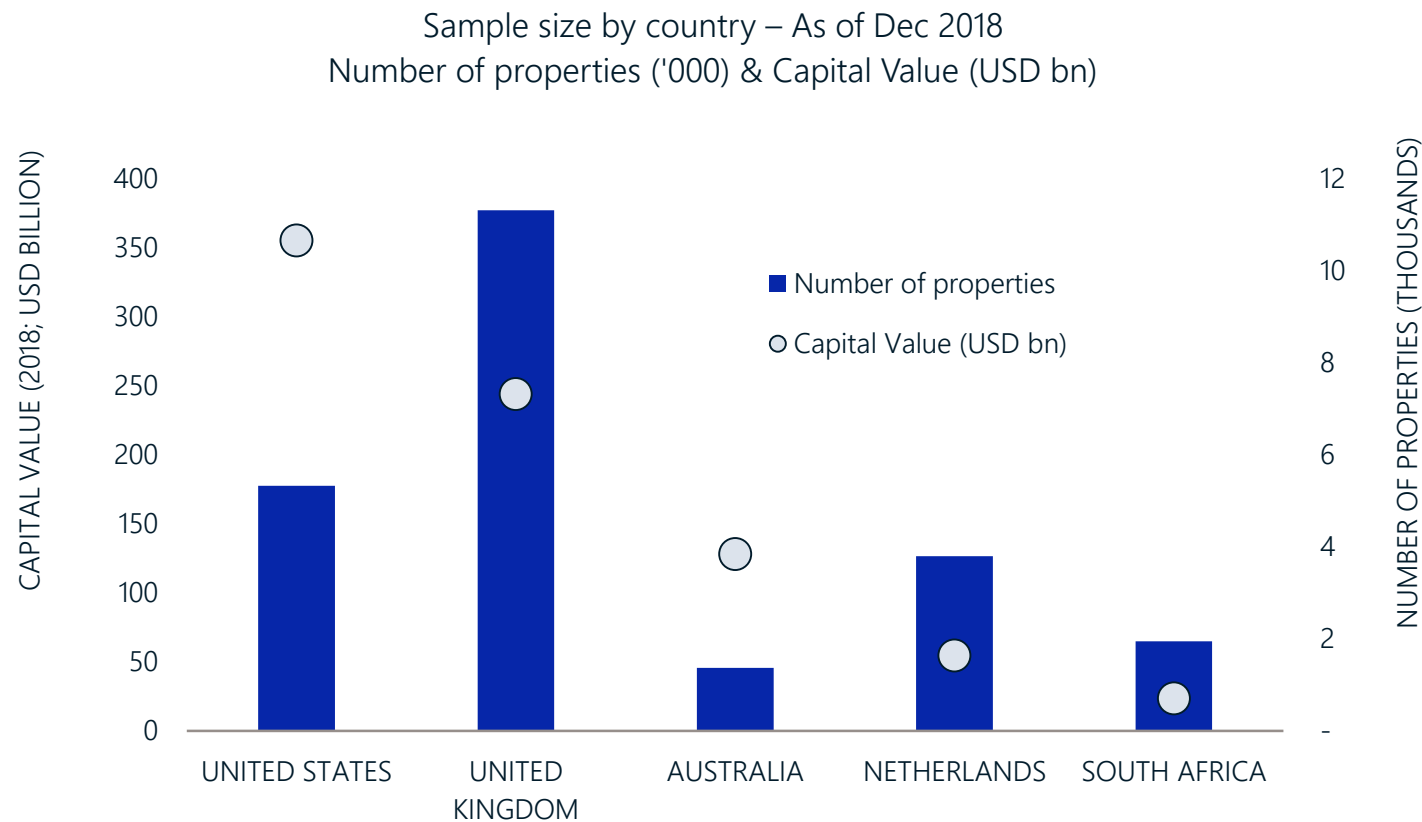


Climate risk in private real estate portfolios:

What is the exposure?

Approach

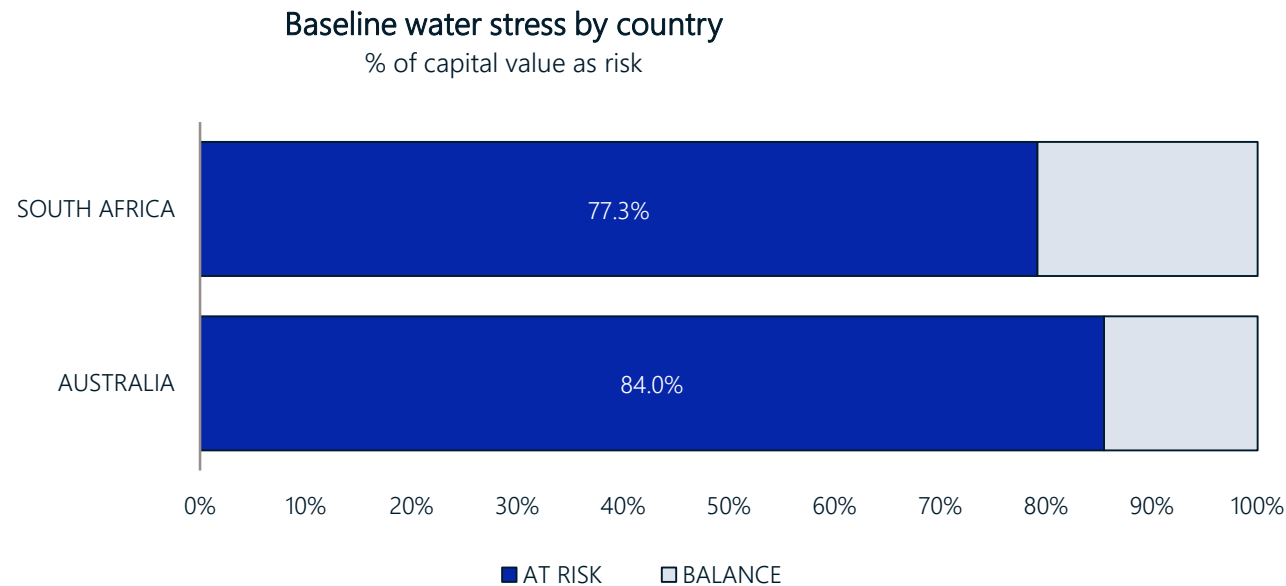
- Analysis of 5 real estate markets on most relevant physical risk from climate change
- Asset by asset analysis to better understand exposure



Data

Dataset	Hazard	Source	Coverage
Geolocation of each asset		MSCI Real Estate	United States, Netherlands, United Kingdom, South Africa, Australia
Aqueduct 3	Water stress	World Resources Institute	Australia, South Africa
Hurricane Zones	Hurricanes	Munich Re Group	United States, Australia
Storm Surge	Hurricane-related flooding	NOAA's National Hurricane Center	United States
Risk of flooding from rivers and sea	Flooding	Environment Agency (UK)	England
Risicokaart	Flooding	BIJ12 and Dutch Provincial Government	Netherlands

Measuring water stress



South Africa

1,951 properties located within 629 hydrological sub-basins in the 9 provinces

Australia

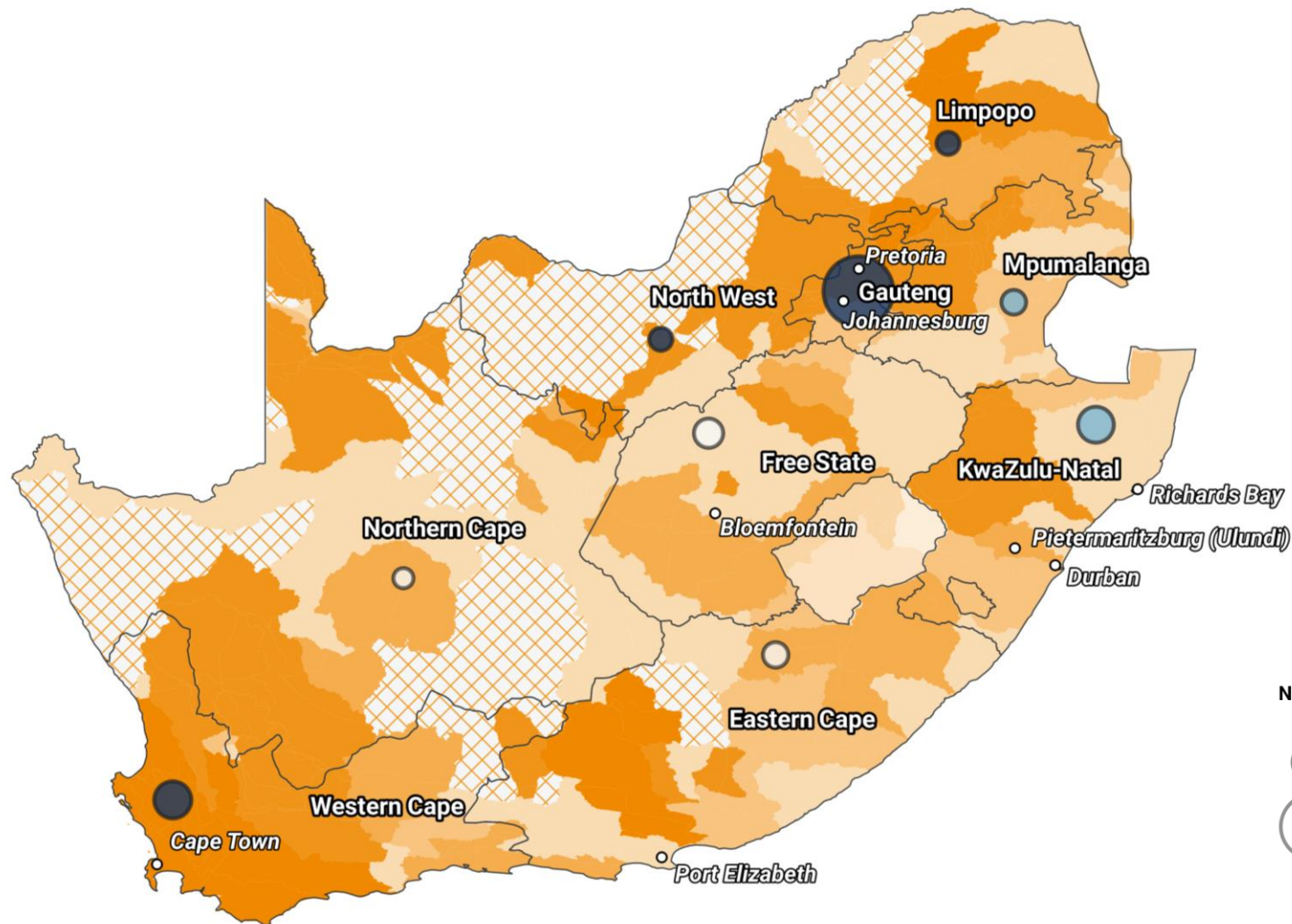
1,371 properties located within the 1,990 hydrological sub-basins in the 6 states and 3 internal territories

Baseline Water Stress (BWS)

BWS is a measurement of chronic stress on groundwater resources that can produce long-term challenges to a region.

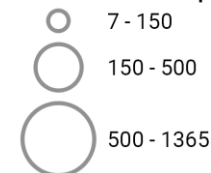
Data as of Dec. 31, 2018

Baseline water stress in South Africa

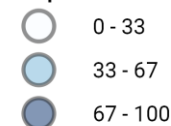


Key Finding: High risk in Gauteng Province where Johannesburg, the economic hub of South Africa, is located and is home to more than 60% of the country's commercial property by value

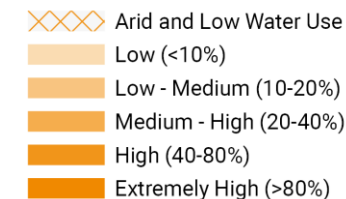
Number of assets per province



% Capital value at risk

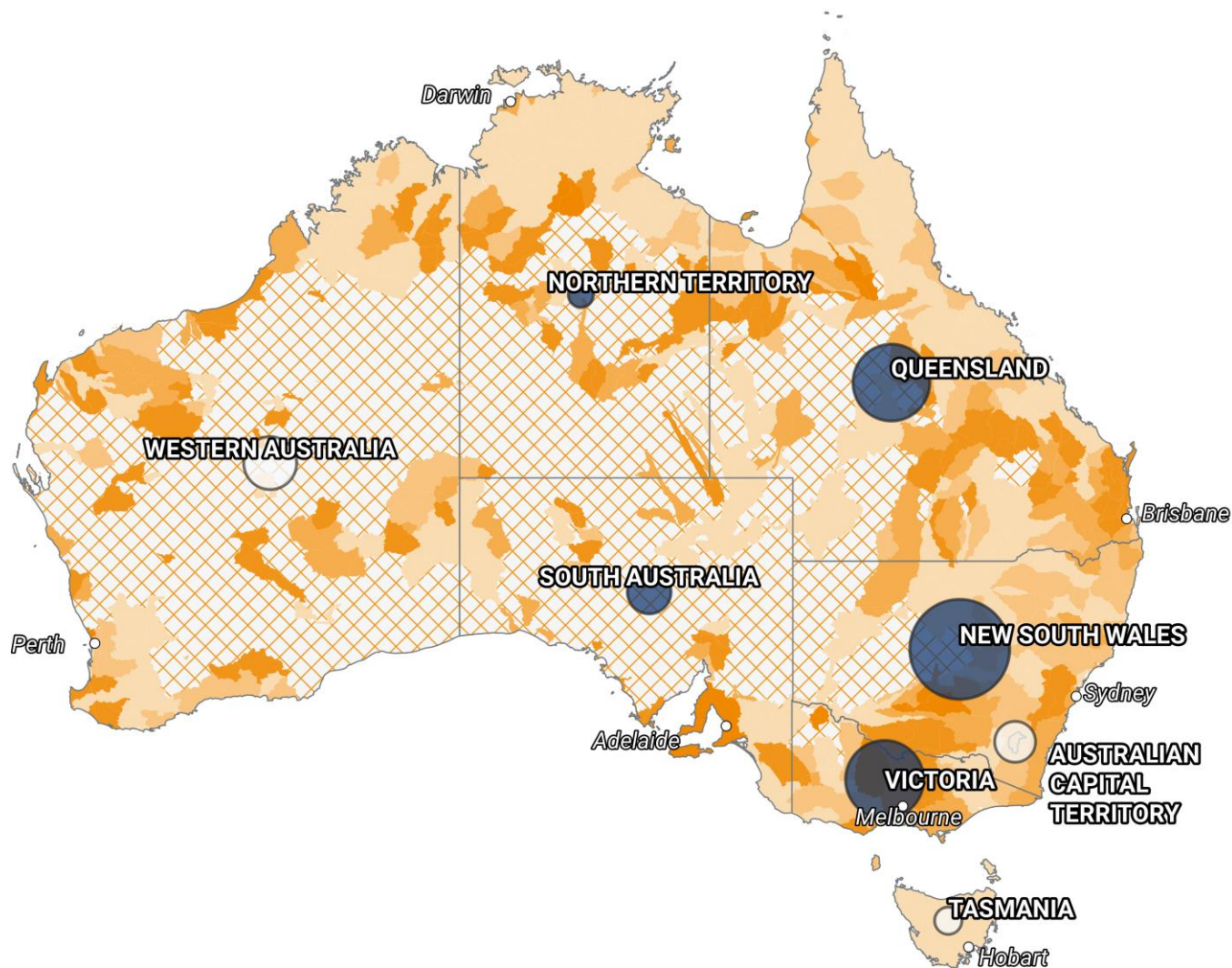


Baseline Water Stress



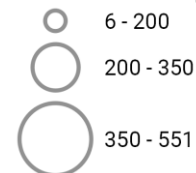
Data as of Dec. 31, 2018

Baseline water stress in Australia

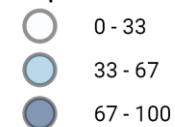


Key Finding: 84% of the capital value (USD 107 billion) was at risk. The provinces with the greatest number of assets at risk were Queensland, New South Wales, and Victoria

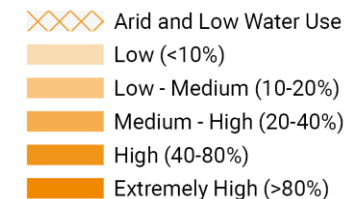
Number of assets per province



% Capital value at risk

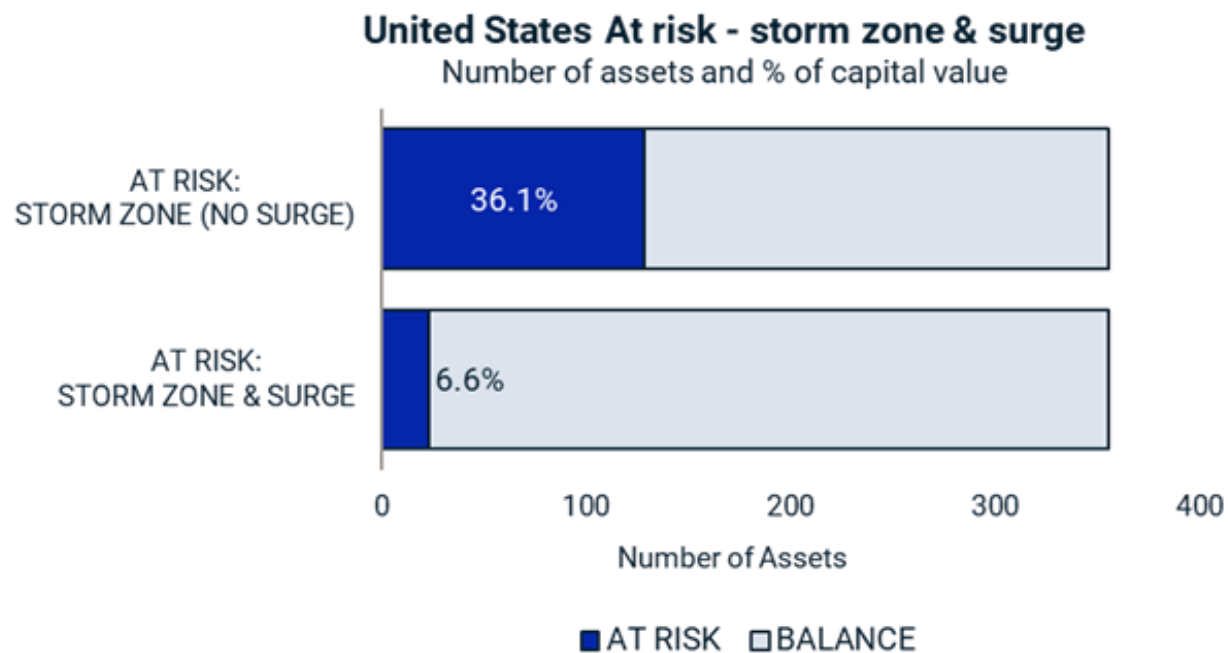


Baseline Water Stress



Data as of Dec. 31, 2018

Measuring hurricane risk



Additional Factor: **Storm Surge**

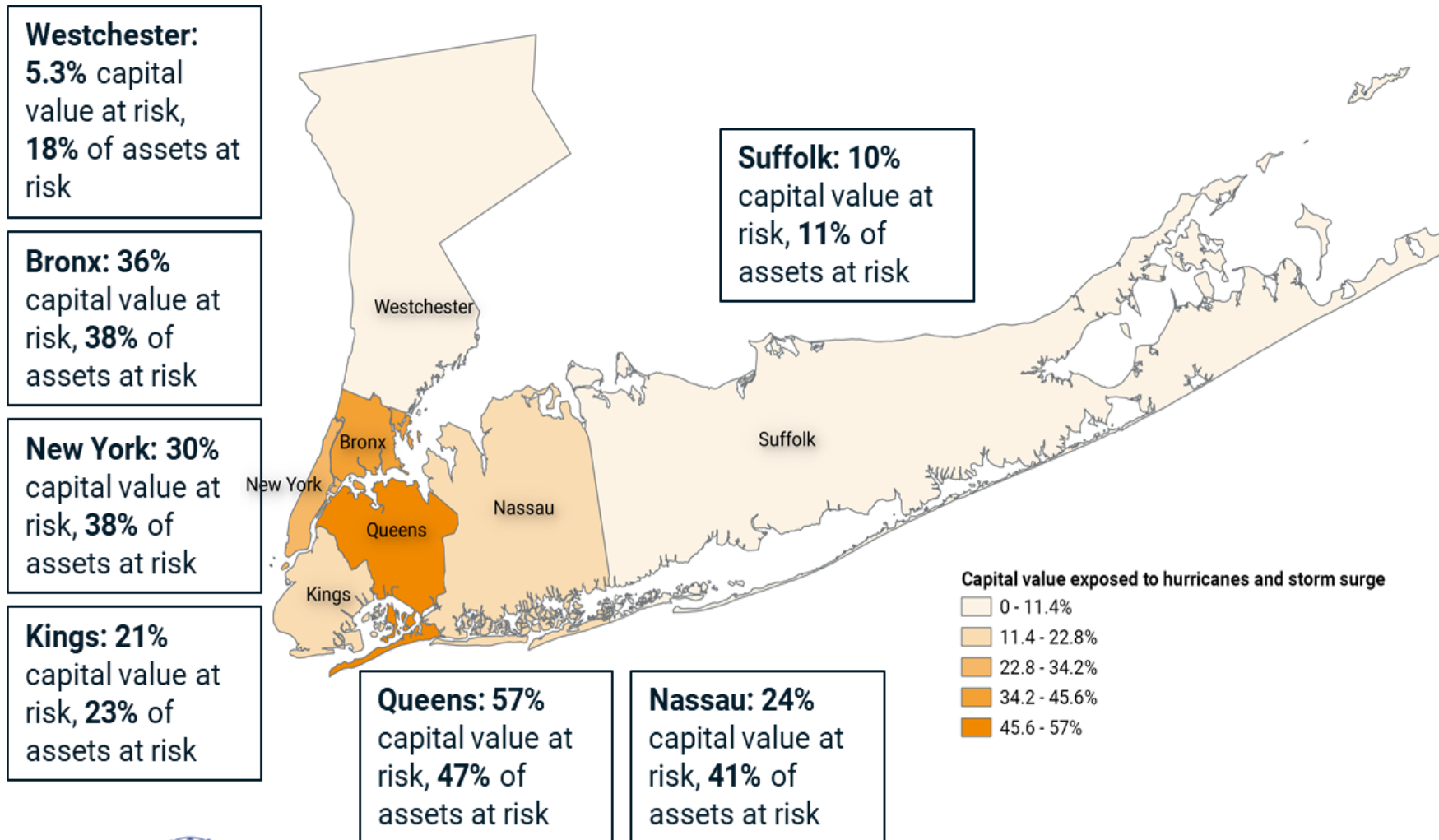
United States

- 1,558 properties located in 13 states were at risk to hurricanes
- Storm surge - when water from the ocean is pushed toward the shore by the force of wind – increases risk
- When combined with normal tides, storm surge can increase the water level by up to 30 feet

Data as of Dec. 31, 2018

Hurricane risk in the United States

CV and assets at risk by county in New York



Key Finding:

New York had the largest absolute capital value exposure, with half the assets at risk located in New York City

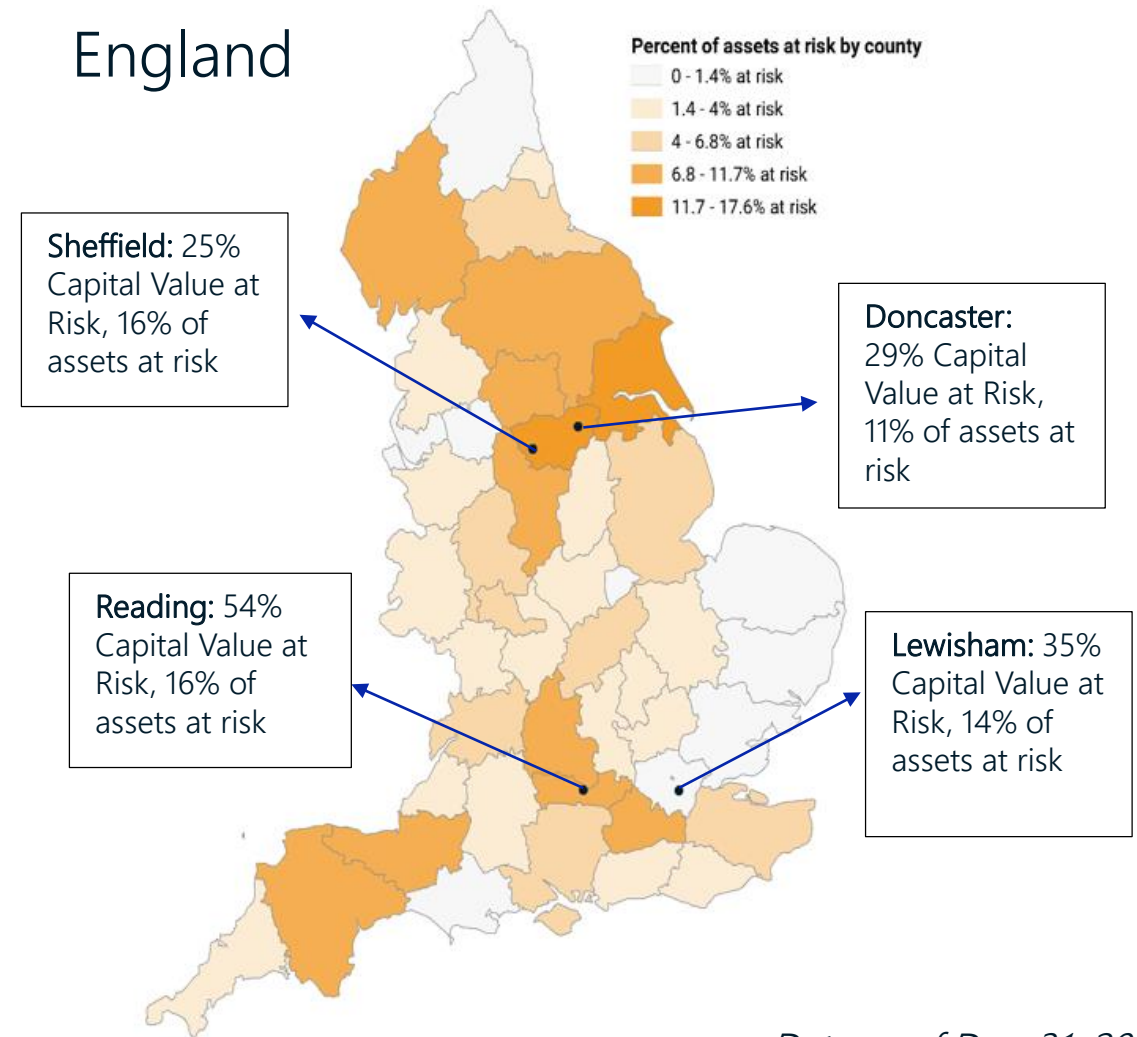
Data as of Dec. 31, 2018

Flooding risk in England and the Netherlands

Key Finding:

- Exposure varied by location and sector
- 54% of the capital value of properties in Reading were at risk to flooding
- Greater London was less exposed because of the Thames Barrier, the second largest moveable flood defense system in the world
- Capital value at risk in Netherlands was ~USD 90 million, representing only 1% of the measured assets
- Without flood defenses, an additional 6% of measured assets in Netherlands, valued at USD 2.4 billion, would be at risk

England



Data as of Dec. 31, 2018

Modeling cost of extreme weather: input data

- **Vulnerability**

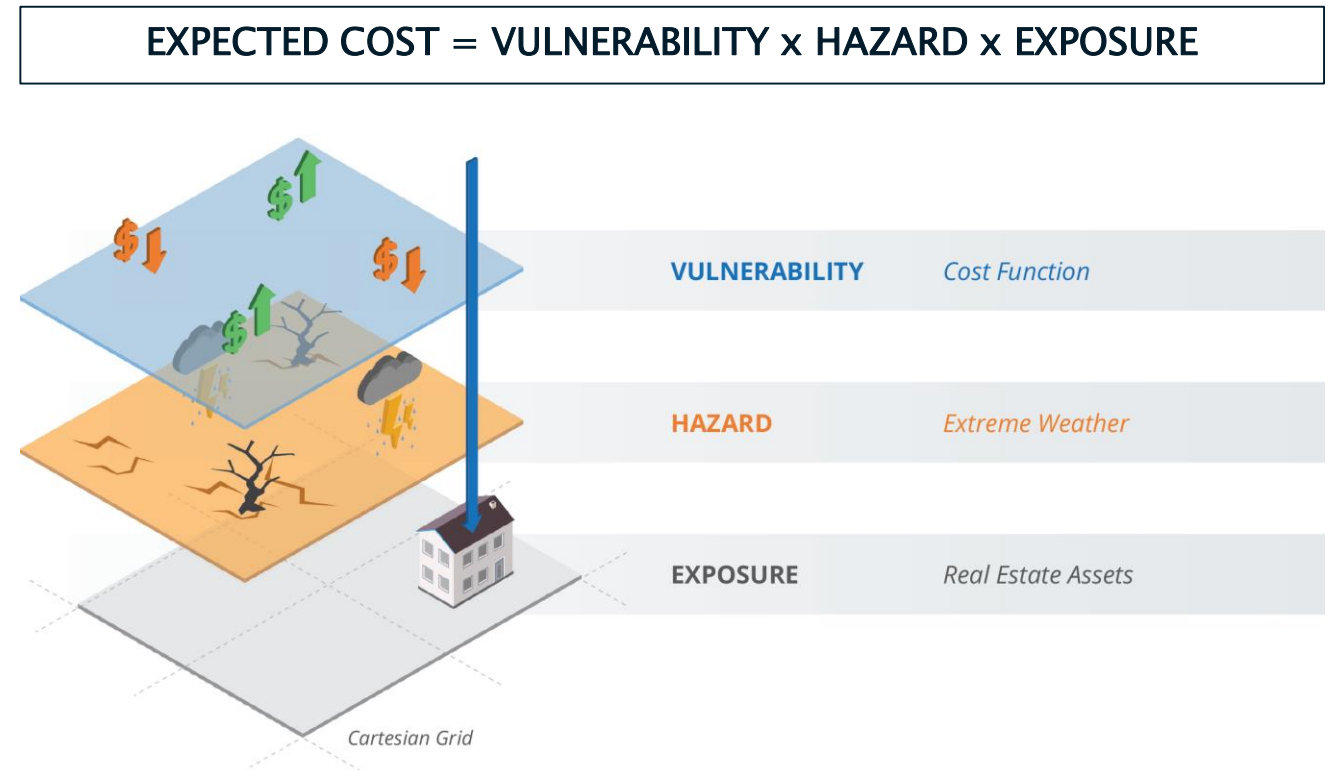
- Building damage → Costs
- Increased heating and cooling demand → Costs

- **Hazards: Weather Maps**

- Temperature
- Hurricanes
- Flooding

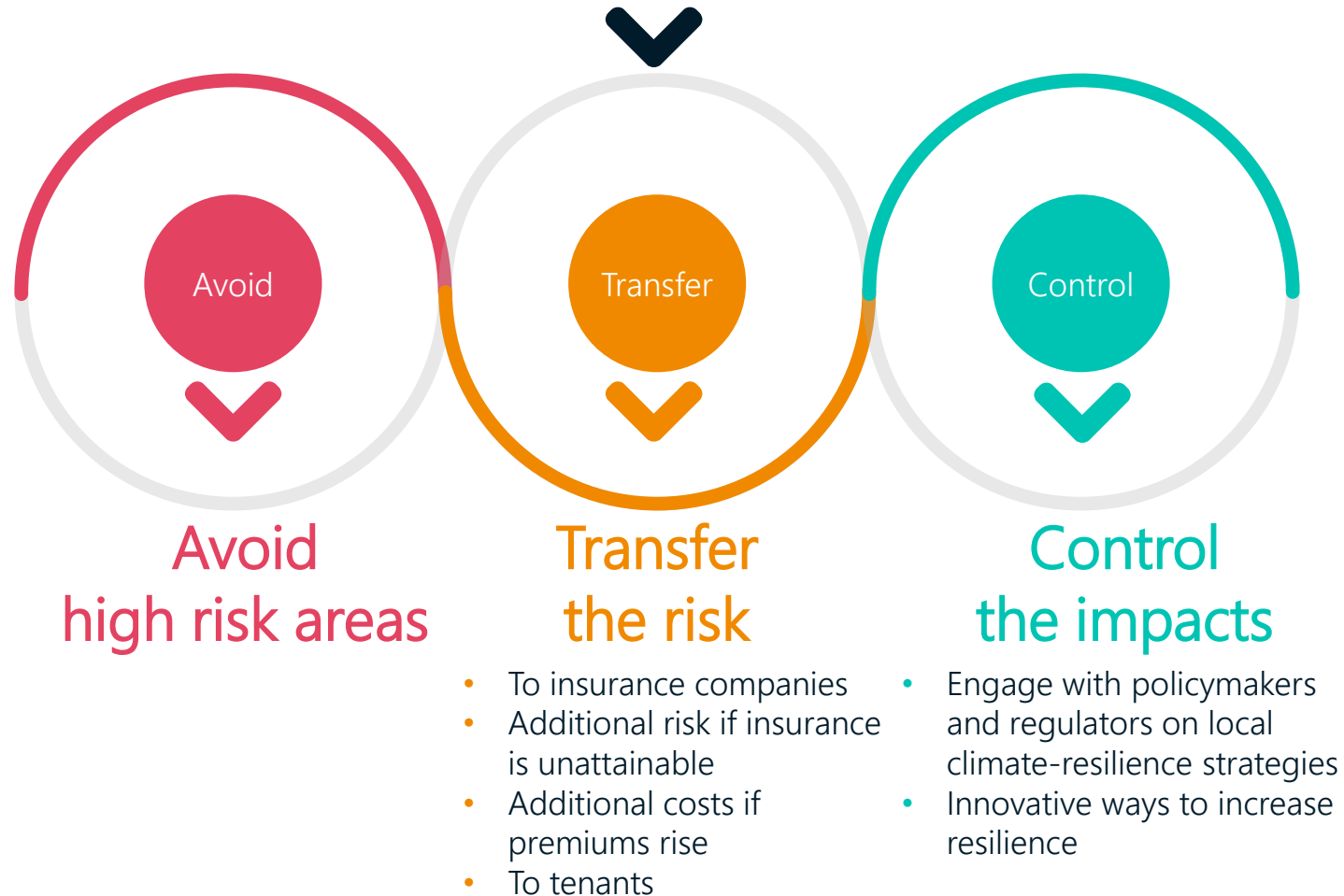
- **Asset-specific data**

- Location, Type, Size



Options to manage risk – investor approaches

REAL ESTATE INVESTOR AND PHYSICAL RISK



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