February 14 - 17, 2017

Preparing for Climate Change Uncertainty in Honolulu

Lynn Stephens, Co-Principal Investigator

Pacific Water Conference

Acknowledgements

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- Project Advisory Committee
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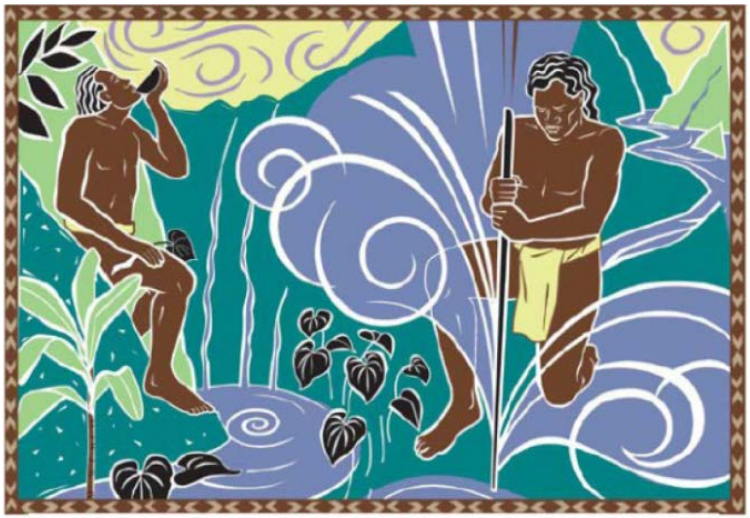
Presentation Roadmap

- Project Overview
  - Drivers for Initiation
  - Project Objectives
  - Desired Outcomes
  - Technical Approach
- Climate Projections
- Next Steps



"Water for Life – Ka Wai Ola."

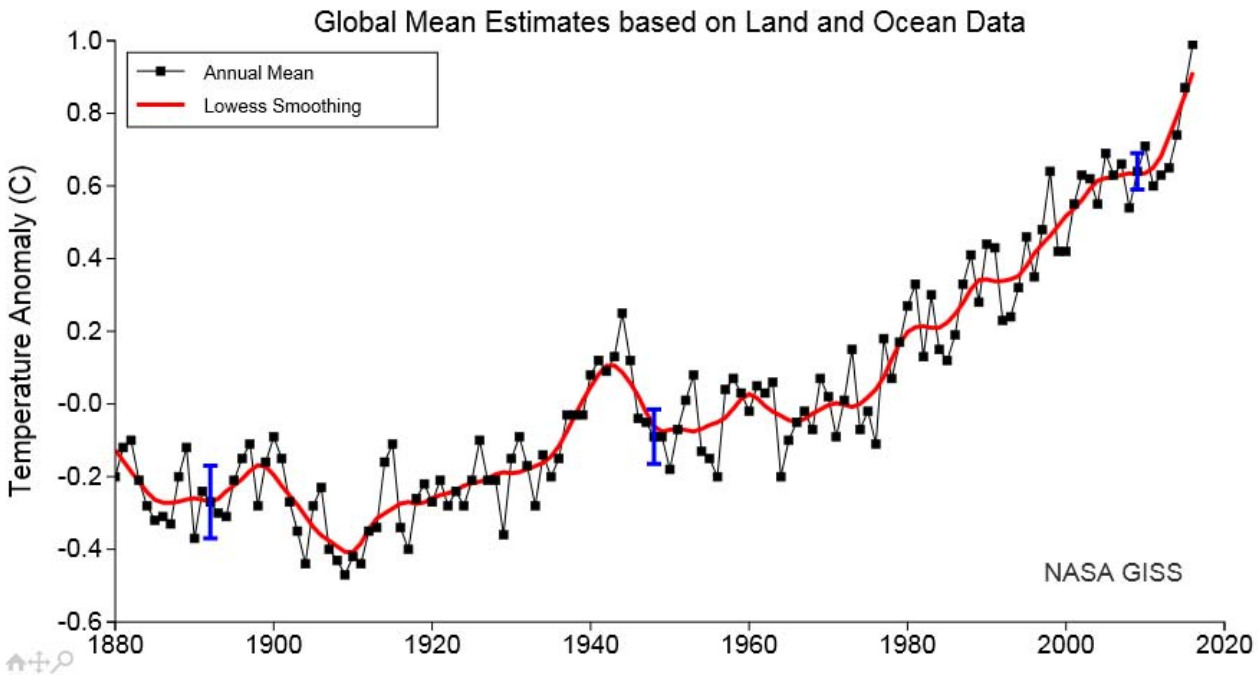
Project Overview

Driving Forces - Steadily Rising Temperatures

The Washington Post

U.S. scientists officially declare 2016 the hottest year on record. That makes three in a row.

By **Chris Mooney** January 18 at 1:30 PM



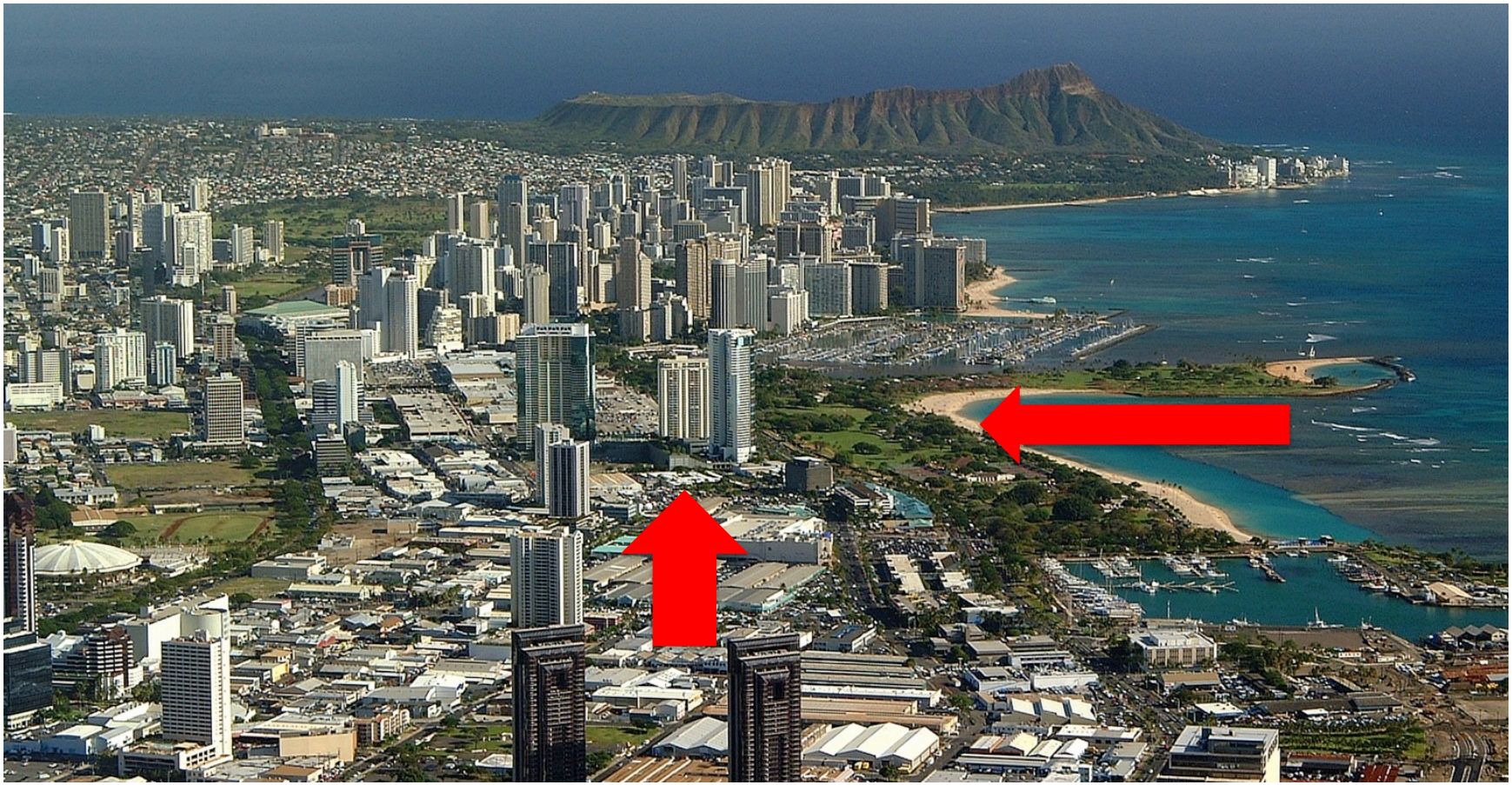
Source: Hansen et al. 2010. Global surface temperature change. Rev. Geophys., 48. RG4004, doi:10.1029/2010RG000345

Extreme Precipitation Events and Longer Droughts Expected

Coastal Erosion

Source: Chip Fletcher, University of Hawaii, Workshop 1

Groundwater Inundation



Objectives and Outcomes

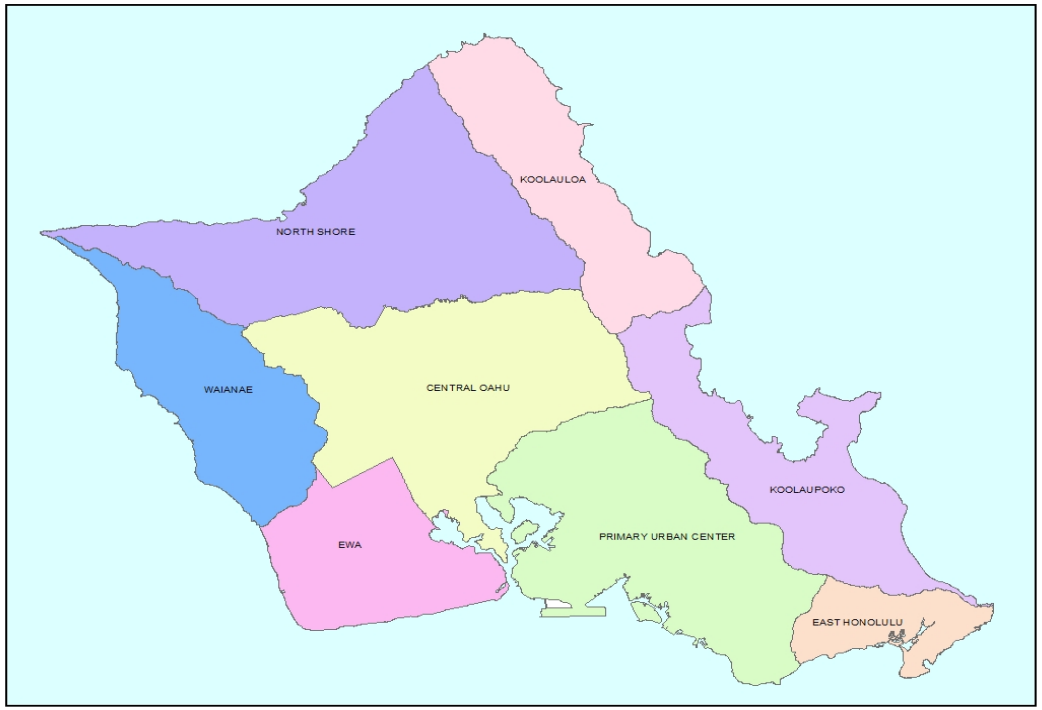
- Objectives:
  - Evaluate climate change impacts on Honolulu Board of Water Supply (BWS) infrastructure and water supply
  - Develop a suite of strategies to address the anticipated changes
  - Serve as an example for other utilities

- Desired Outcomes:
  - Identification of adaptive measures and/or action items and incorporate into future CIP planning and policies
    - Immediately implemented or programmed for near-term
    - Future implementation

Technical Approach

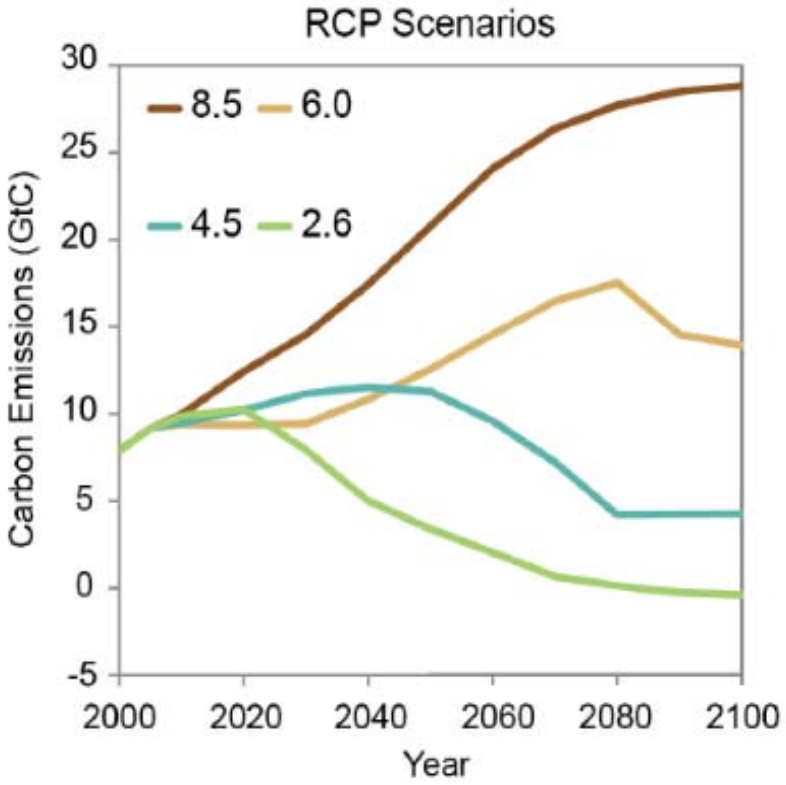
Technical Approach

- 3 timeframes for assessment and strategies
  - Short-term: 2020-2030
  - Mid-term: 2030-2050
  - Long-term: 2050-2100
- 8 geographic areas for assessment

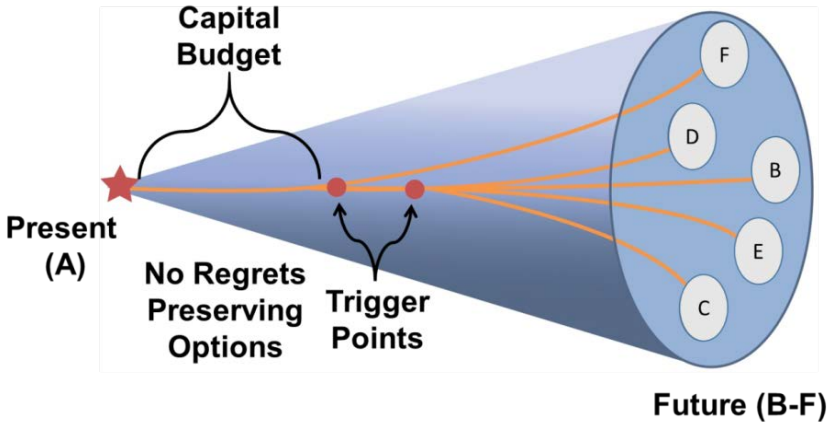


Planning around Climate Change Uncertainty

Representative Concentration Pathways - RCP



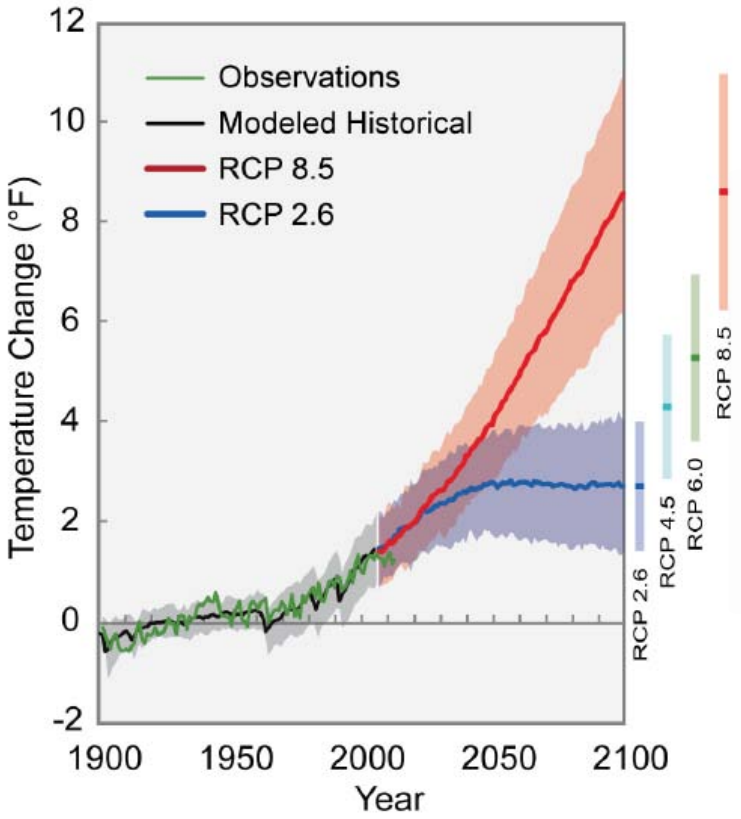
Source: Melillo et al. 2014, Appendix A3



Source: Courtesy of Denver Water

Climate Projections

Temperature Predictions



Source: Stocker et al. 2013

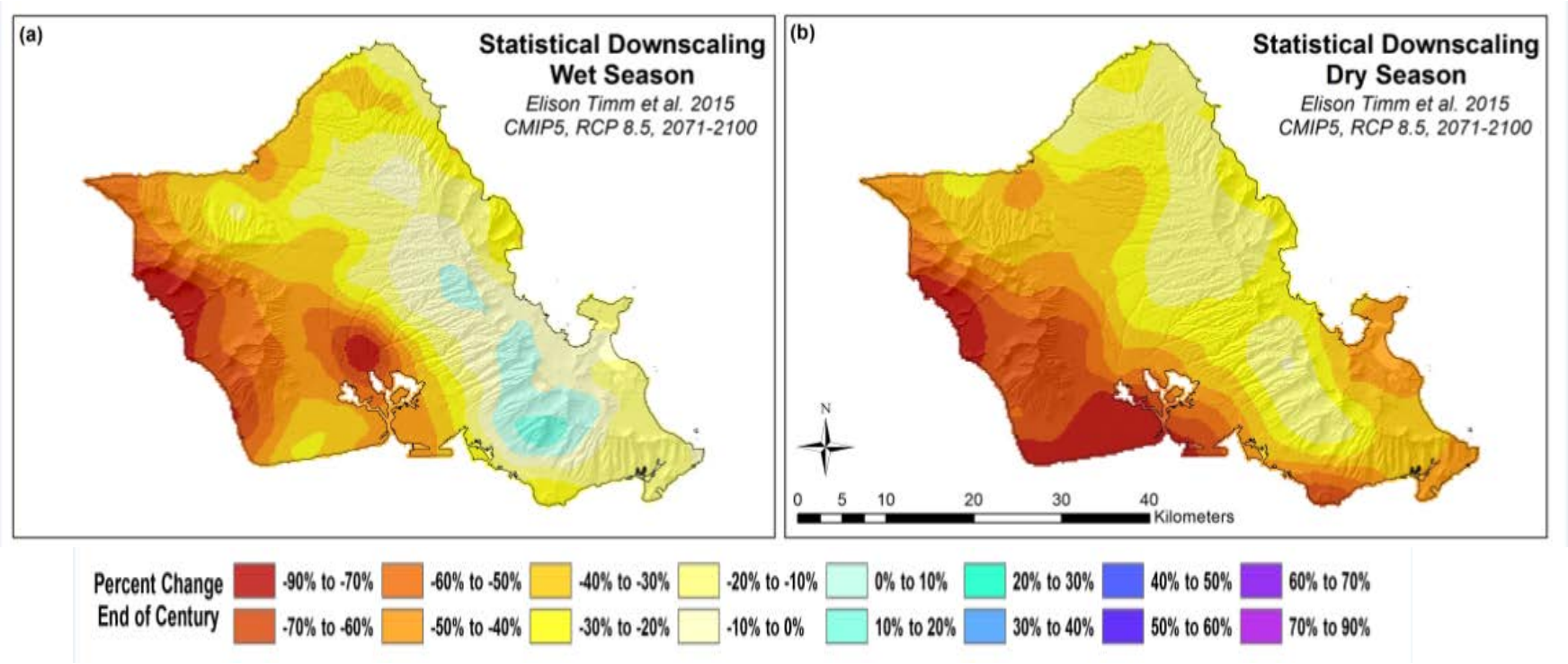
Global Mean Surface Temperature Change (°F)				
Scenario	2046–2065		2081–2100	
	Mean	Likely Range (5%–95% model ranges)	Mean	Likely Range (5%–95% model ranges)
RCP 2.6	1.8	0.72–2.9	1.8	0.5–3.1
RCP 4.5	**2.5**	**1.6–3.6**	**3.2**	**2.0–4.7**
RCP 6.0	2.3	1.4–3.2	4.0	2.5–5.6
RCP 8.5	**3.6**	**2.5–4.7**	**6.7**	**4.7–8.6**

Consistent Warming is Predicted Island Wide

Historical and Predicted Mean Annual Air Temperature (°F)							
District	Historical (1957–1981)	Mid-Century (2040–2069)		Change in Temperature	End-of-Century (2070–2099)		Change in Temperature
		RCP 4.5	RCP 8.5		RCP 4.5	RCP 8.5	
Waianae	71.9	74.2	75.2	2.3 – 3.3	74.8	77.5	2.9 – 5.6
Koolaupoko	72.7	74.9	75.9	2.2 – 3.2	75.6	78.2	2.9 – 5.5
Ewa	73.6	75.9	76.9	2.3 – 3.3	76.5	79.2	2.9 – 5.6
East Honolulu	72.5	74.7	75.8	2.2 – 3.3	75.4	78.1	2.9 – 5.6

Source: Giambelluca et al. 2014; Timm et al. 2016.

Precipitation Predictions Vary Across Oahu



Source: Figure developed by Abby Frazier, UH. Modified from data presented in Helweg et al. 2016

Precipitation Predictions – Wet Season

Historical and Projected Wet Season Precipitation (in) Based on Statistical Downscaling							
District	Historical Wet Averages (1978–2007)	Mid-Century Wet Precipitation (2040–2069)			End-of-Century Wet Precipitation (2070–2099)		
		RCP 4.5	RCP 8.5	Percent Change [a]	RCP 4.5	RCP 8.5	Percent Change [a]
Waianae	25.5	16.5	14.3	-35% to -44%	14.7	10.0	-42% to -61%
Koolaupoko	41.2	38.5	39.0	-7% to -5%	38.2	38.1	-7% to -8%
Ewa	17.1	12.3	11.6	-28% to -32%	11.5	9.4	-33% to -45%
East Honolulu	30.0	26.7	26.7	-11%	26.1	26.0	-13% to -14%

Source: Giambelluca et al. 2013; Timm, Giambelluca, and Diaz 2015.

a. *Percent change range corresponds to predictions for RCPs 4.5 and 8.5, respectively.*

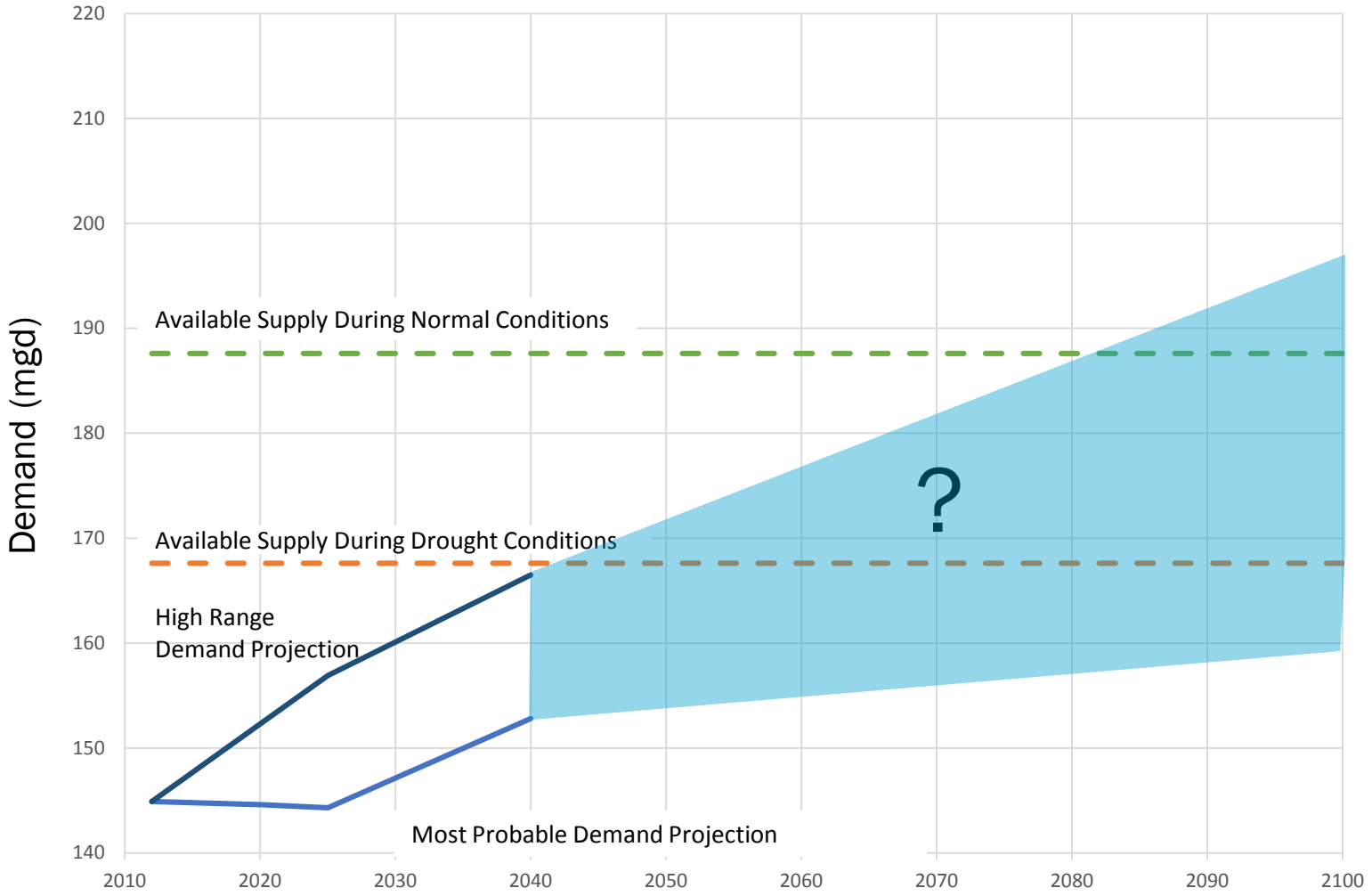
Precipitation Predictions – Dry Season

Historical and Projected Dry Season Precipitation (in) Based on Statistical Downscaling							
District	Historical Dry Averages (1978–2007)	Mid-Century Dry Precipitation (2040–2069)			End-of-Century Dry Precipitation (2070–2099)		
		RCP 4.5	RCP 8.5	Percent Change [a]	RCP 4.5	RCP 8.5	Percent Change [a]
Waianae	12.8	9.0	7.6	-30% to -41%	8.9	5.2	-30% to -60%
Koolaupoko	26.5	22.2	20.5	-16% to -23%	21.5	18.1	-19% to -32%
Ewa	8.2	5.1	4.1	-37% to -50%	4.9	2.5	-39% to -70%
East Honolulu	15.1	12.0	10.9	-21% to -28%	11.8	9.2	-22% to -39%

Source: Giambelluca et al. 2013; Timm, Giambelluca, and Diaz 2015.

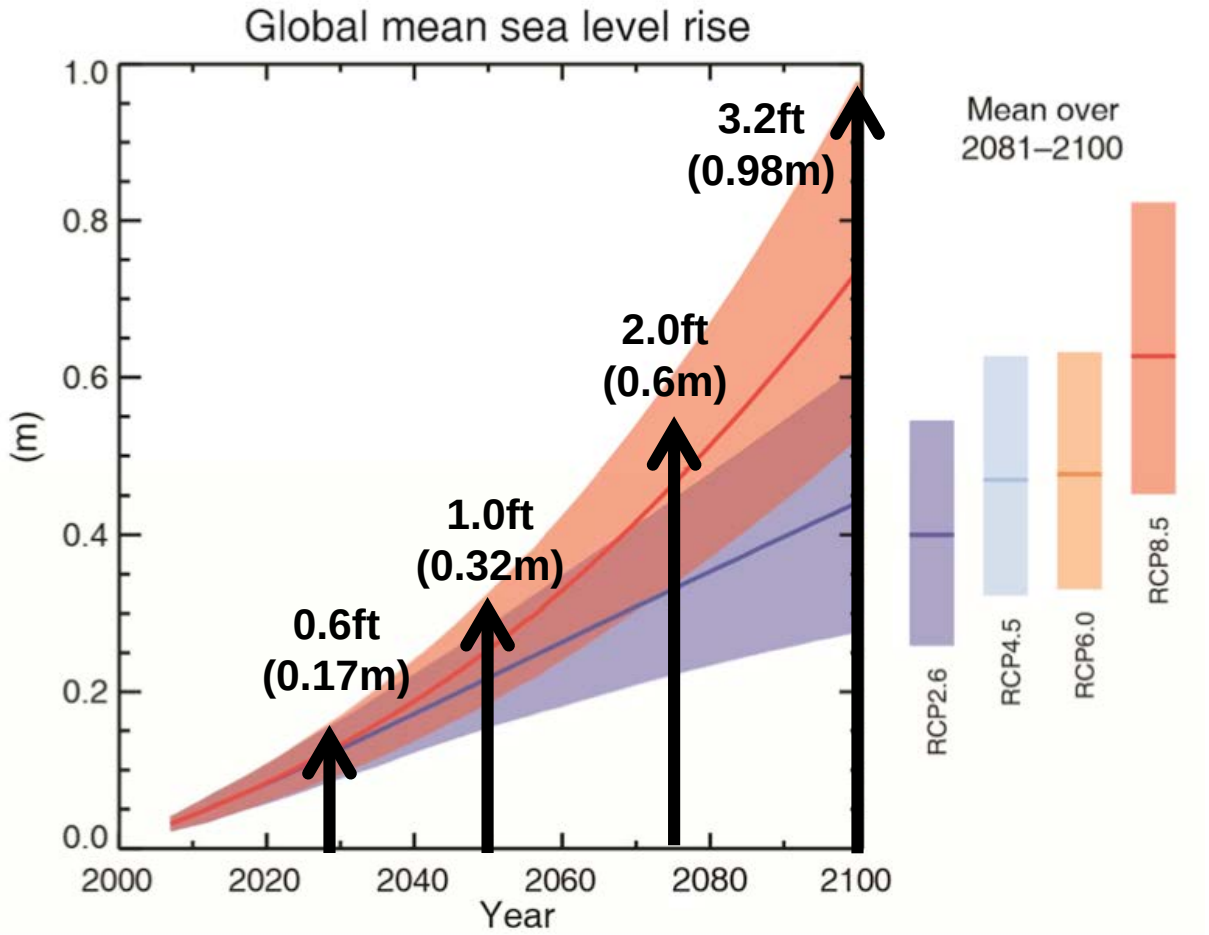
a. *Percent change range corresponds to predictions for RCPs 4.5 and 8.5, respectively.*

Assessment of Supply Risks



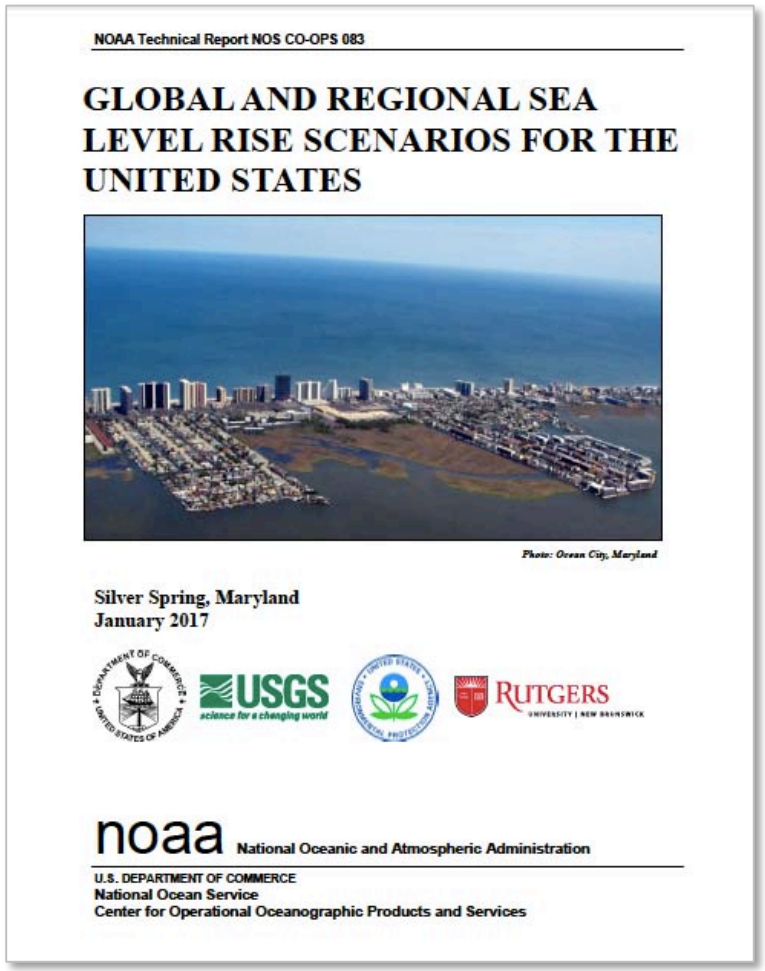
Source: Modified from BWS Master Plan

Sea Level Rise



Source: Stocker et al. 2013

Sea Level Rise


NOAA Technical Report NOS CO-OPS 083

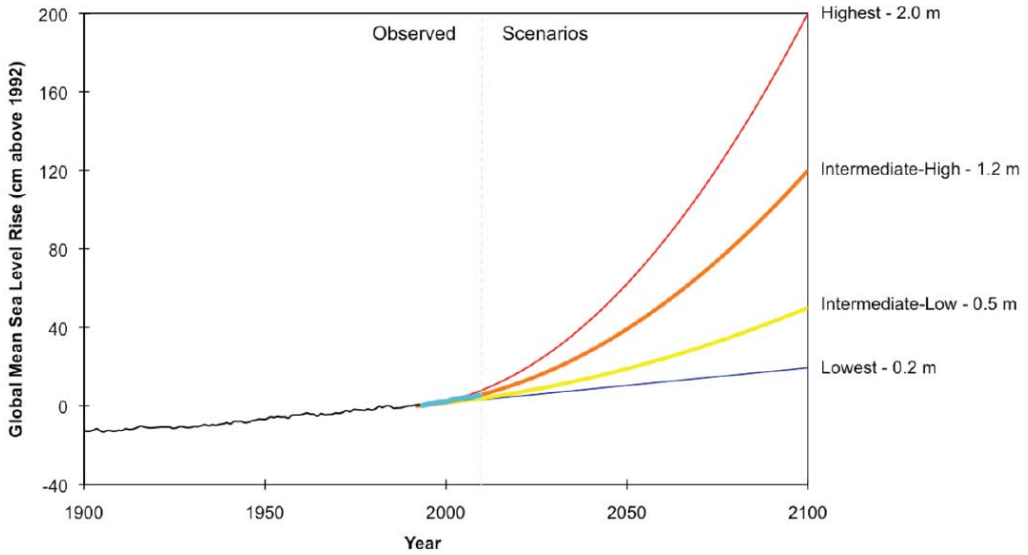
GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES

Photo: Ocean City, Maryland

Silver Spring, Maryland
January 2017

noaa National Oceanic and Atmospheric Administration

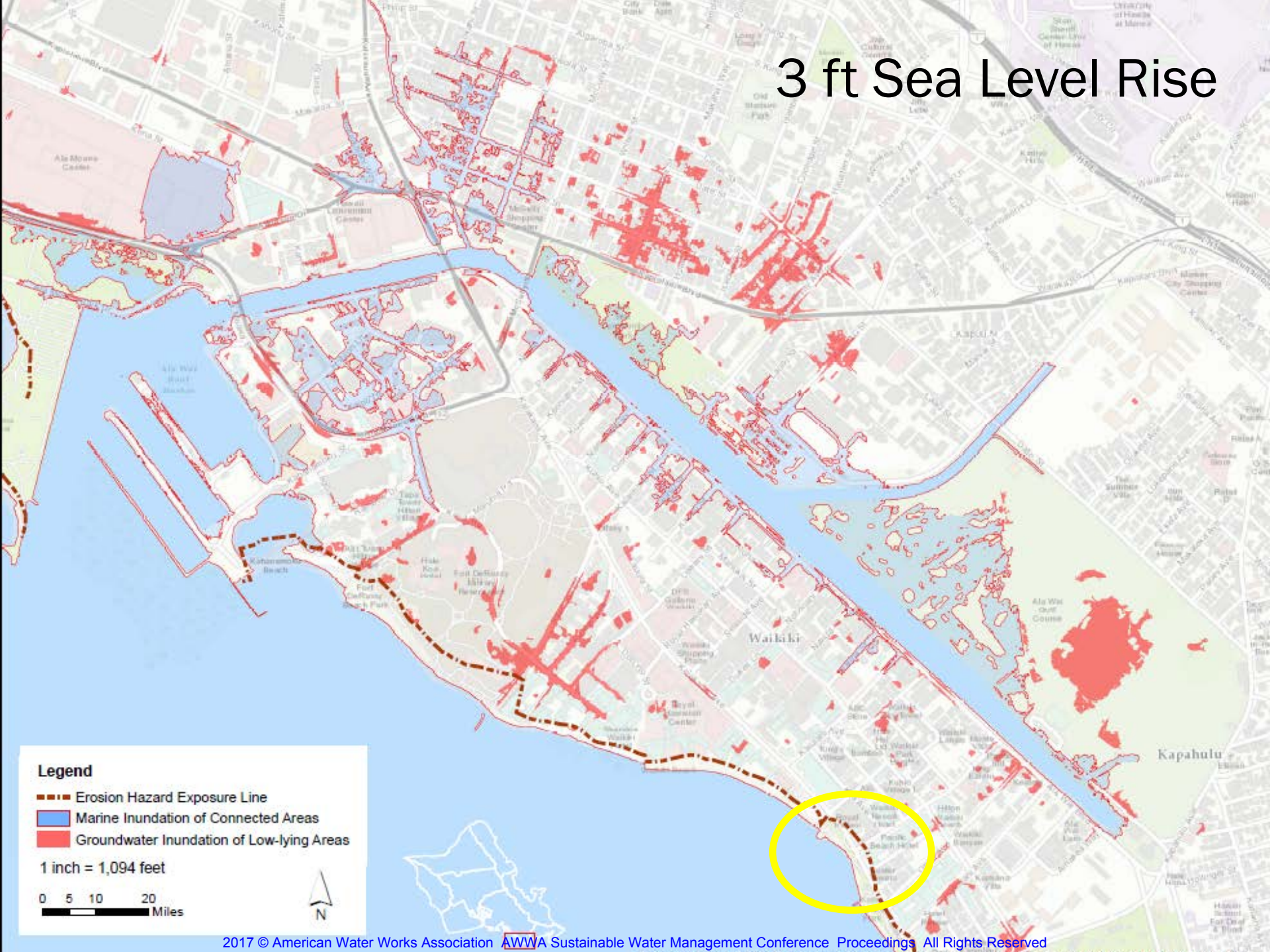
U.S. DEPARTMENT OF COMMERCE
National Ocean Service
Center for Operational Oceanographic Products and Services

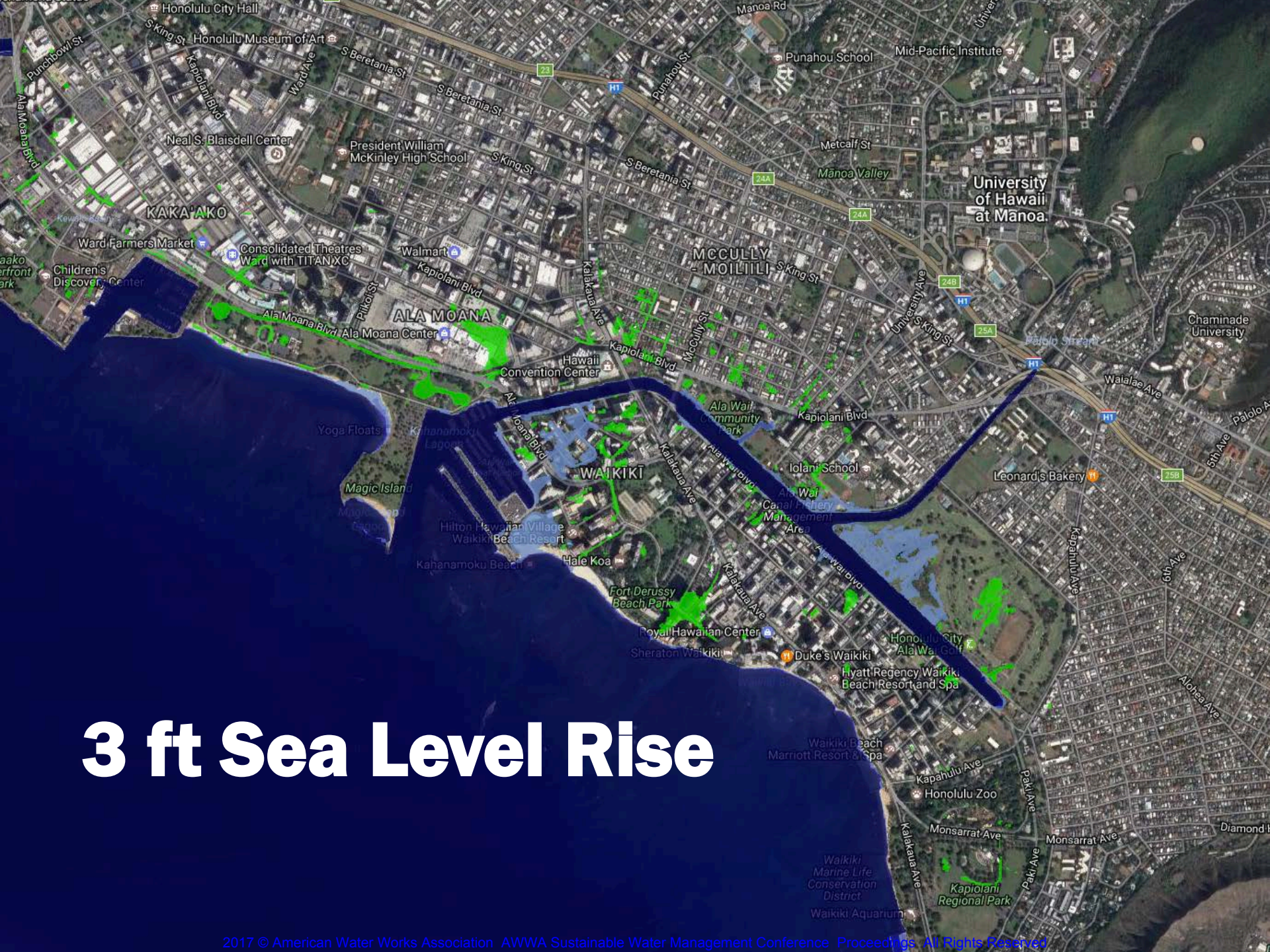


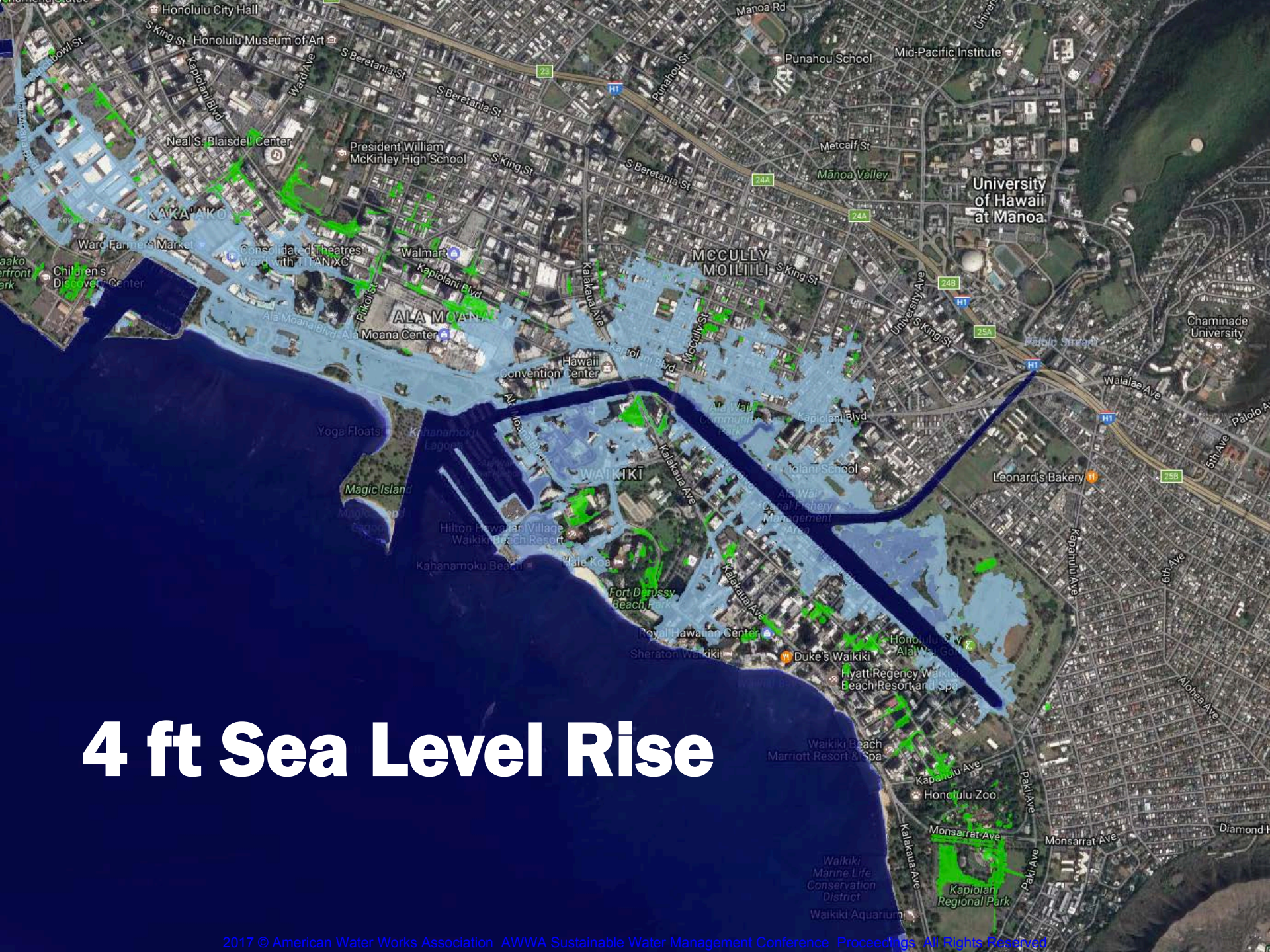
Source: Sweet et al. 2017 (NOAA)

1 ft Sea Level Rise

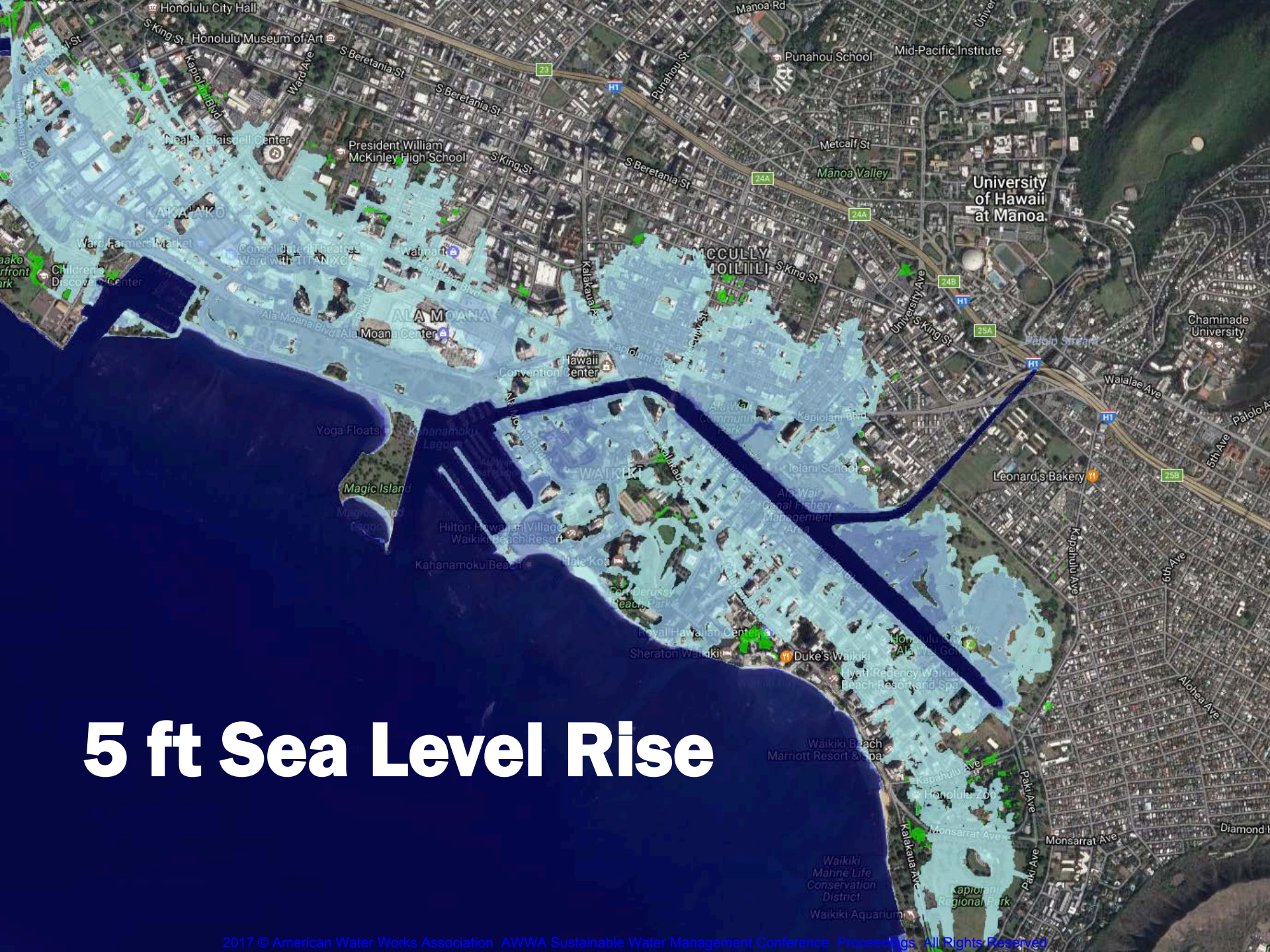
3 ft Sea Level Rise

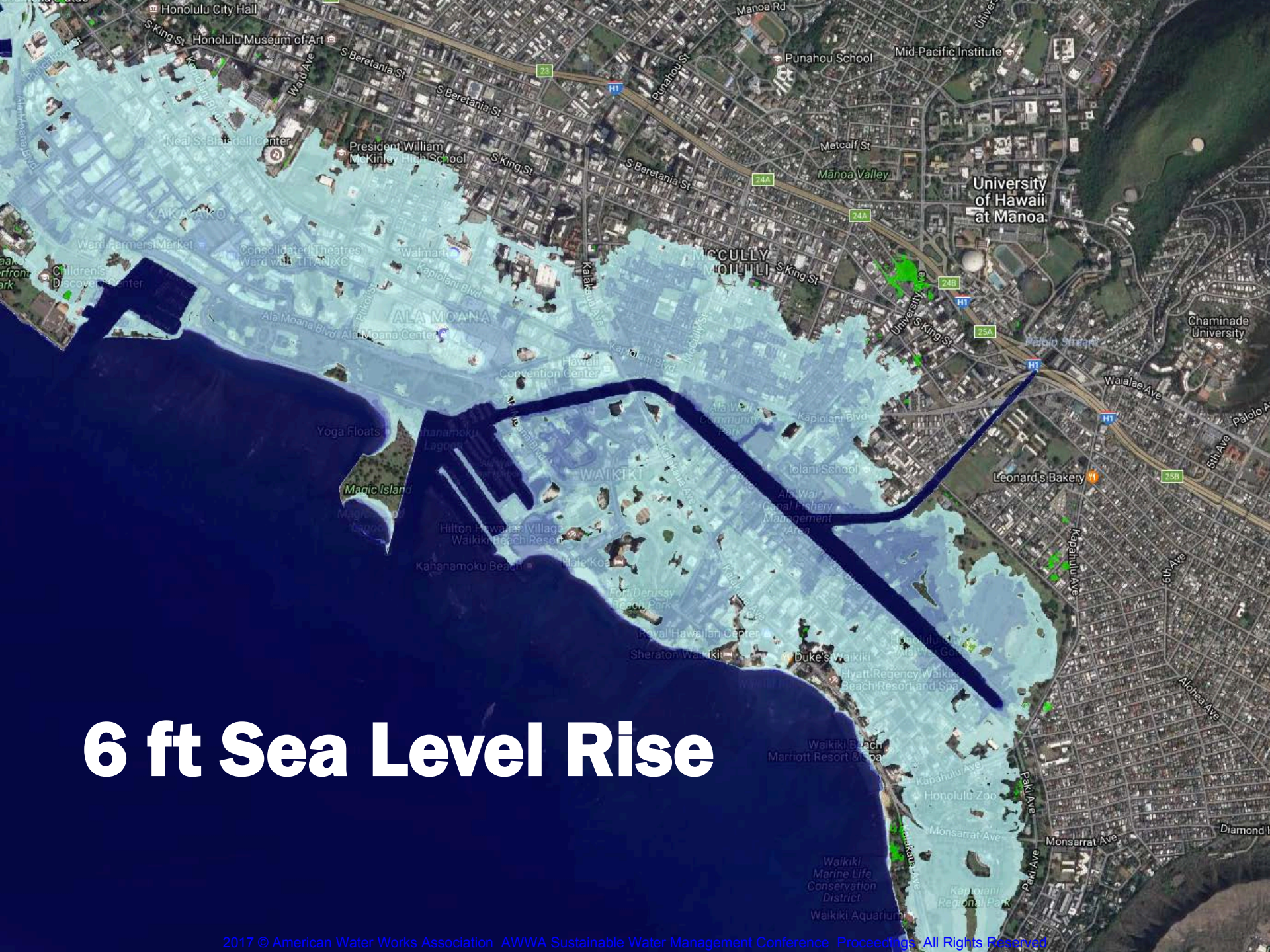






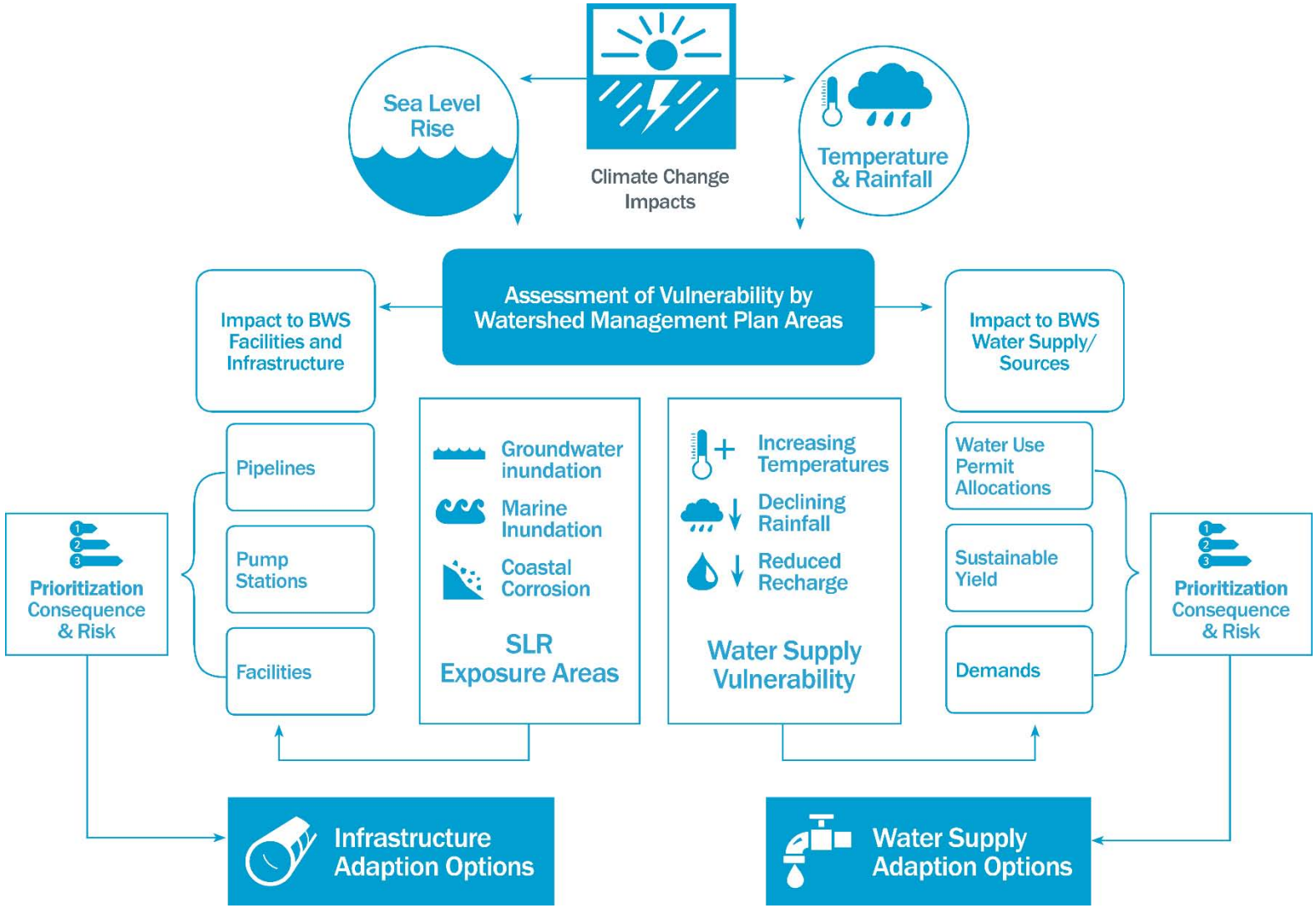
4 ft Sea Level Rise





Next Steps

Vulnerability Assessment



Conclusions

- Goal is to better understand potential water supply and infrastructure impacts from climate change
- Vulnerabilities and strategies are being evaluated for 3 timeframes
- Adaptation calls for making changes that enhance resiliency and reduces vulnerability given future uncertainty
- Draft recommendations are expected in February, 2018
- Publication is expected in late 2018/early 2019

Thank you

Questions?

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Brown AND Caldwell