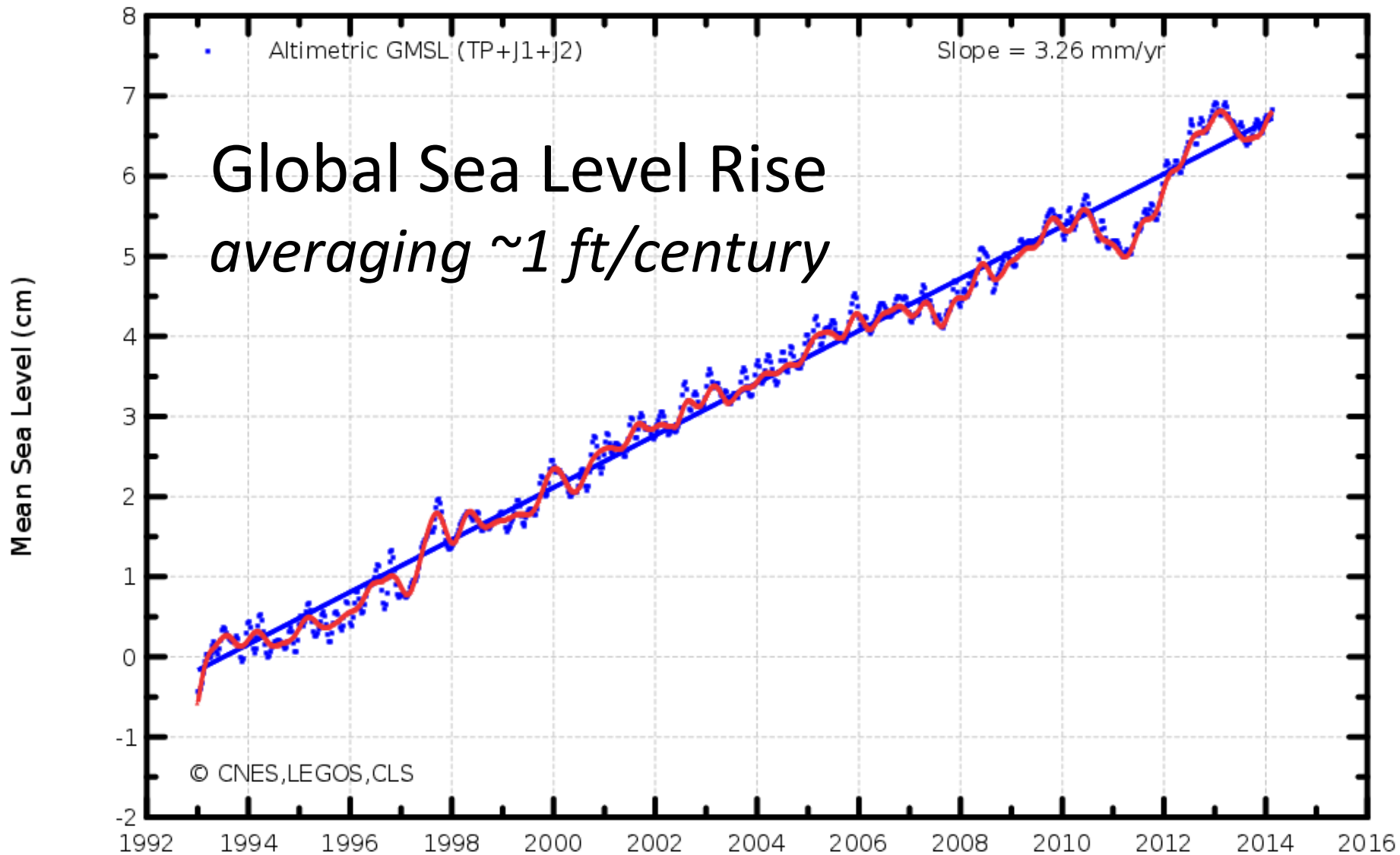


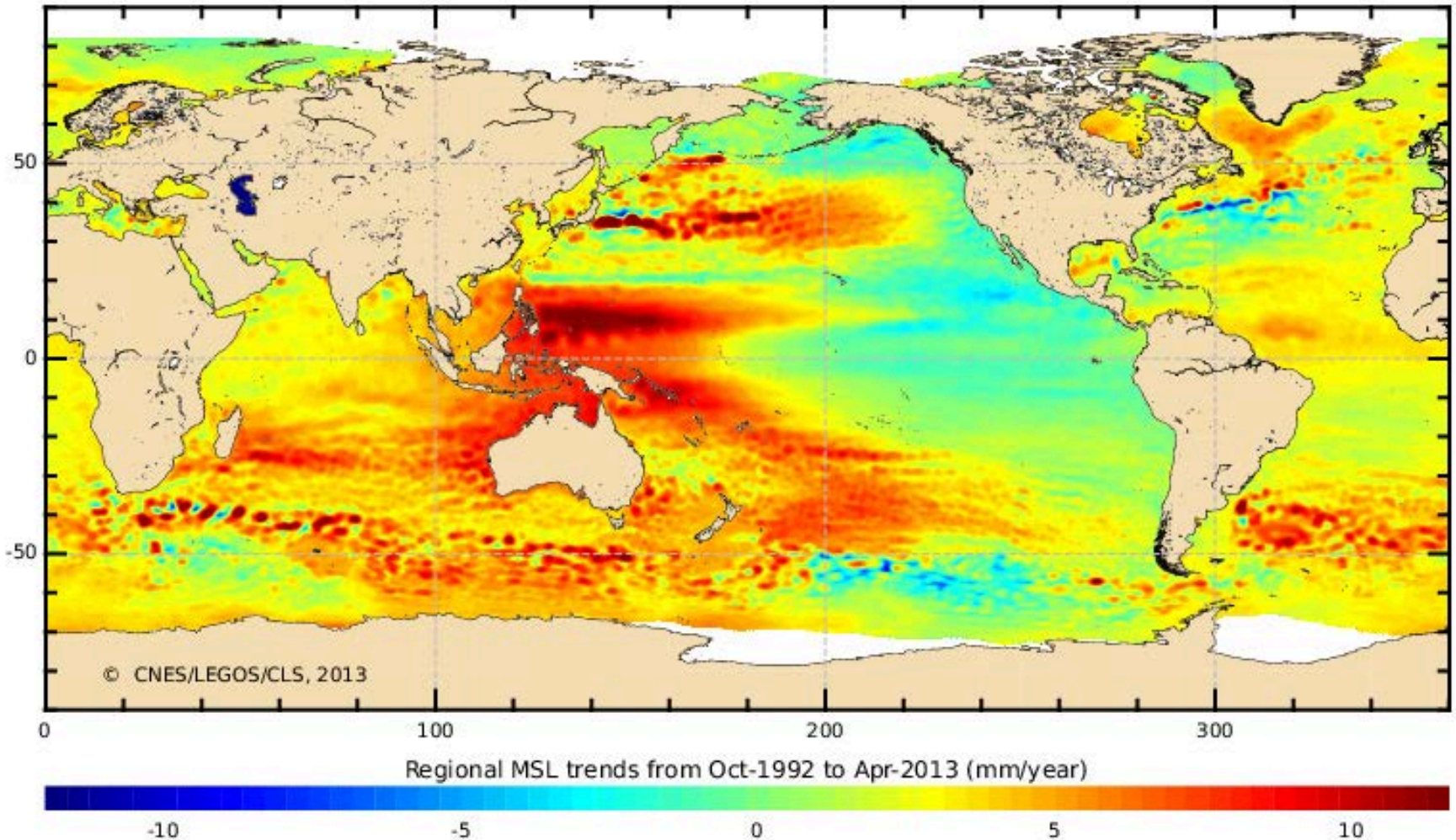
The worlds oceans are rising



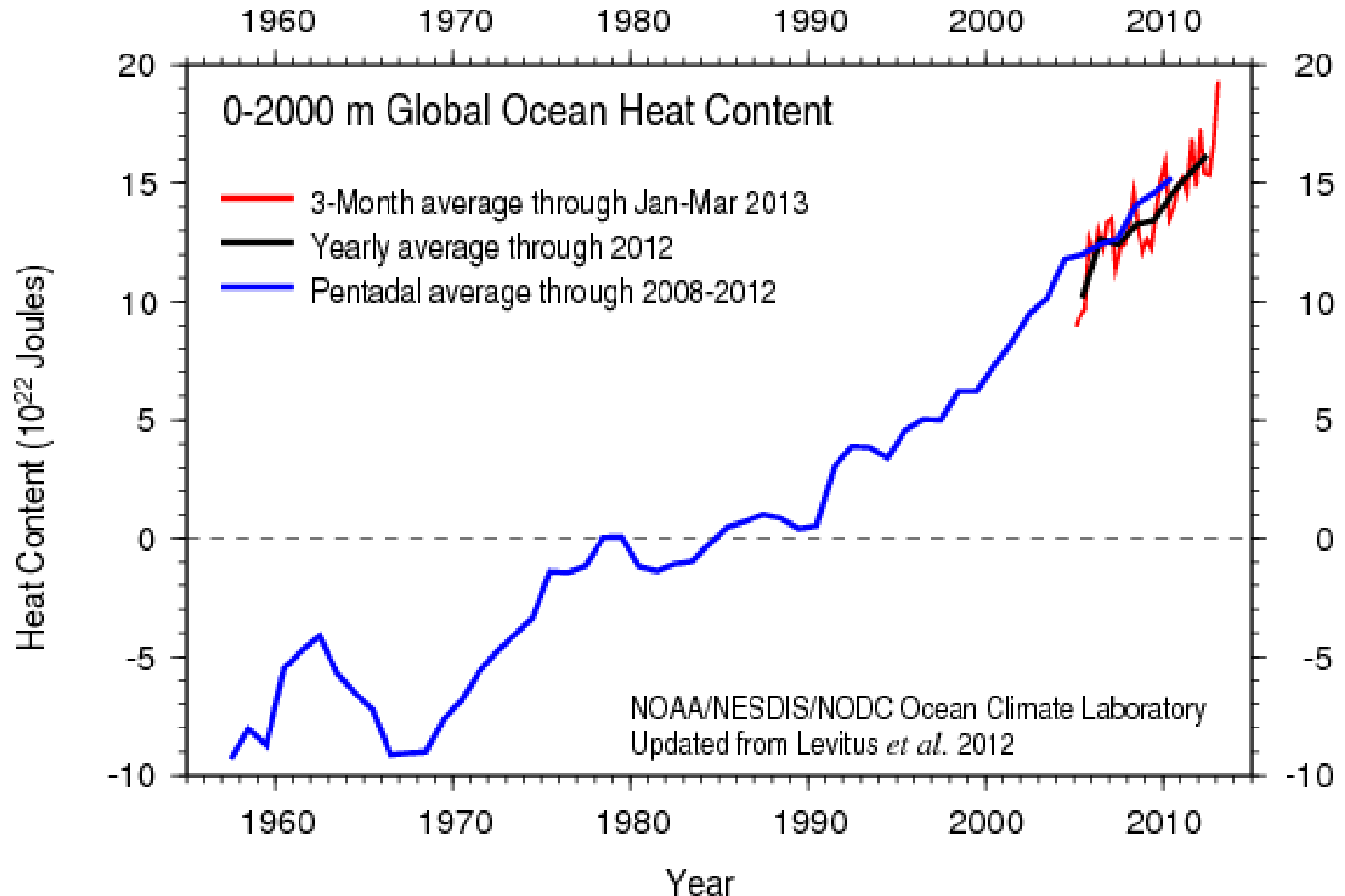


Global Sea Level Trends

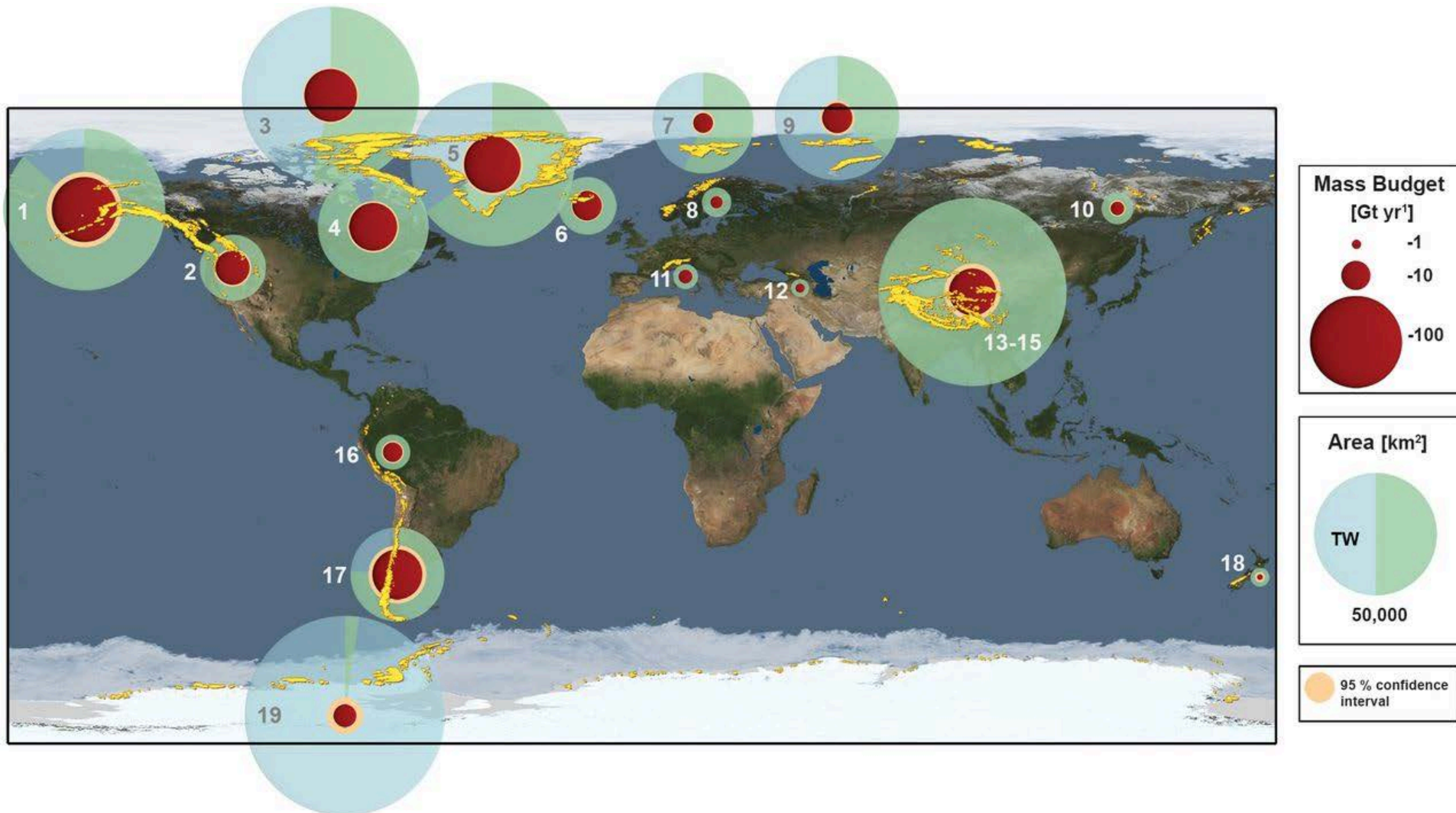
highly variable, future variability unknown



Ocean is Accumulating Heat ($\sim 1/3$ SLR)



Mountain glaciers – all regions losing mass (~1/3 SLR)



Greenland is losing Ice



Antarctica is losing Ice



National Research Council, 2012

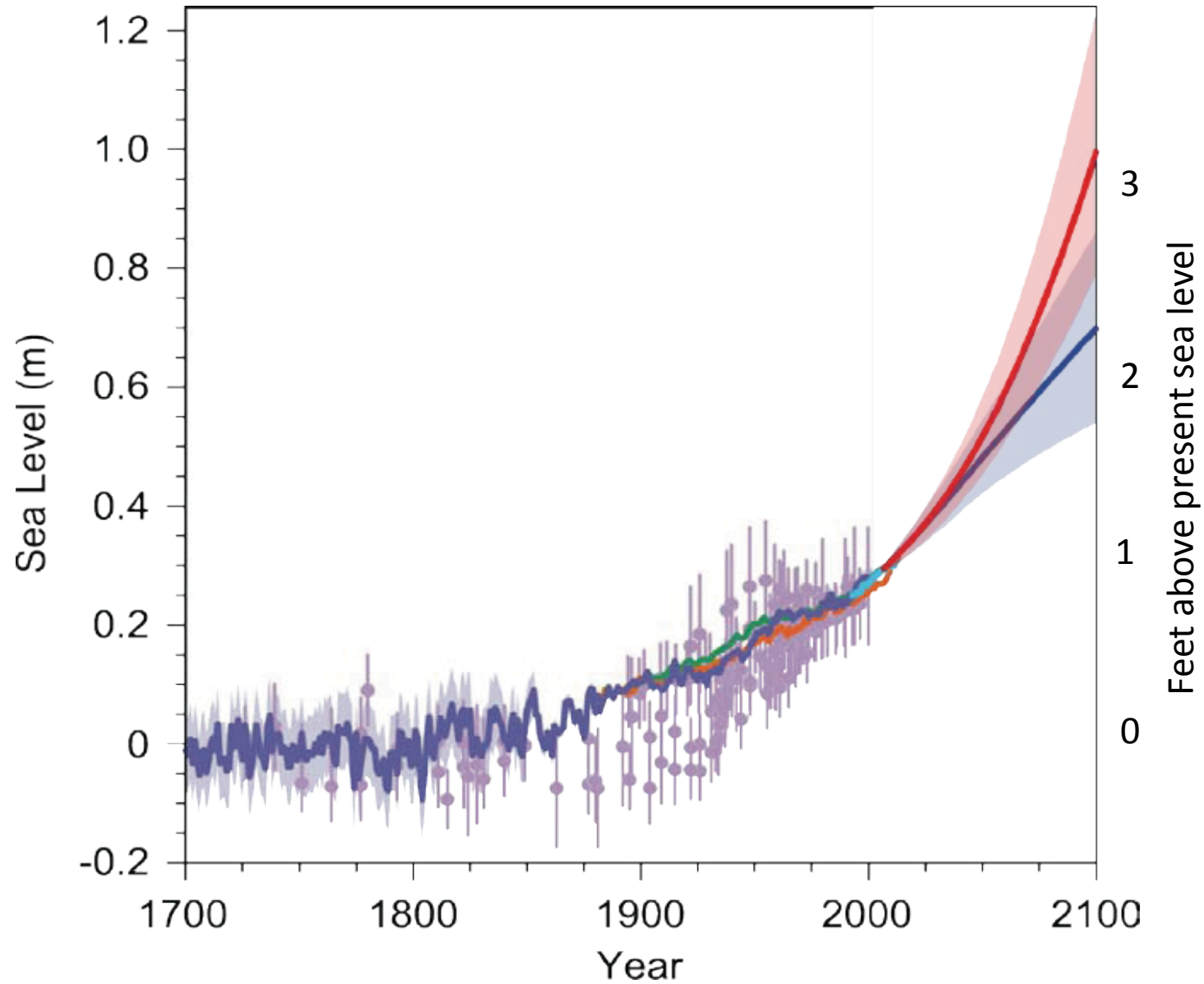
National Academy of Science

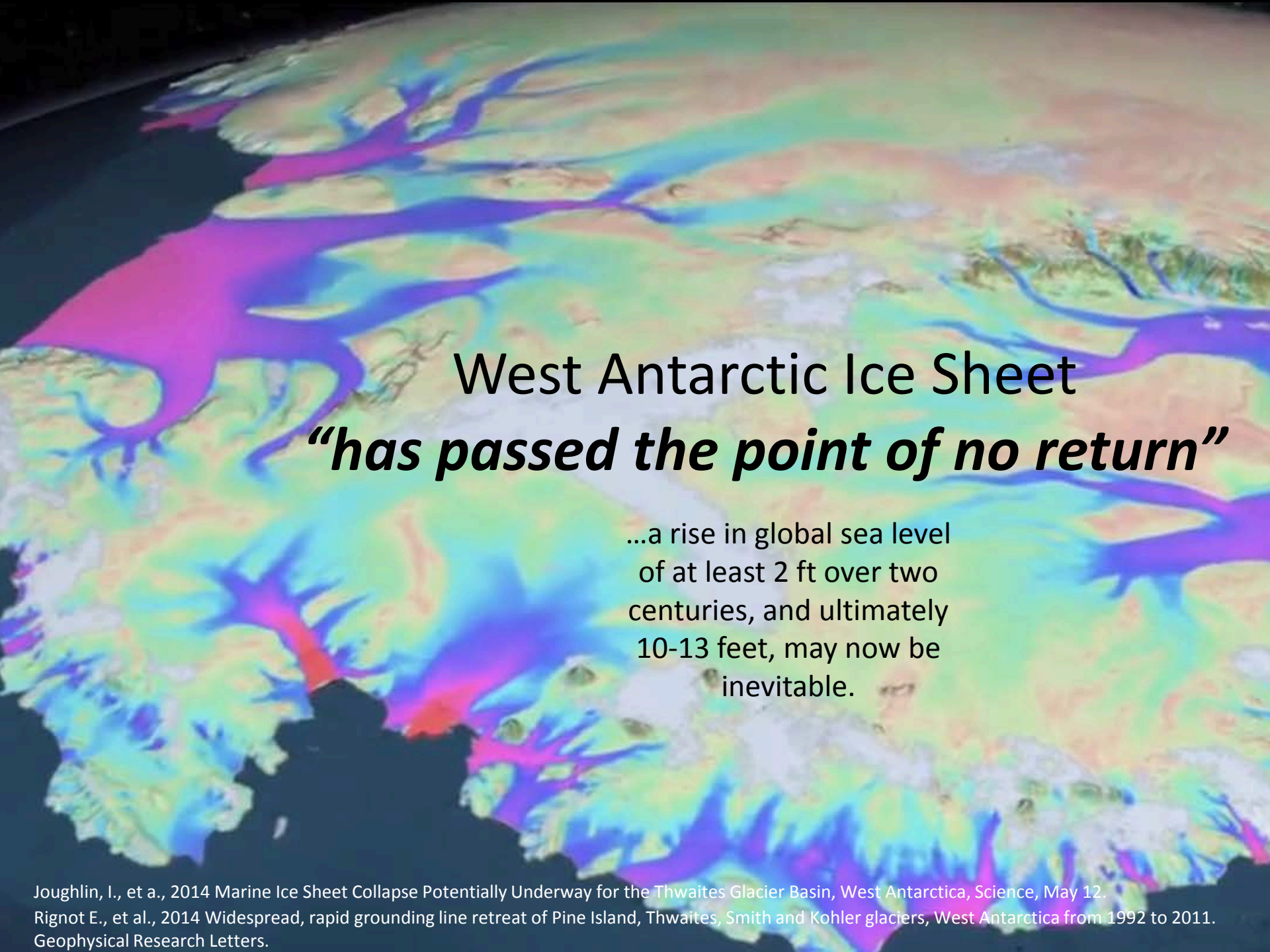
- 3-9 in by 2030
- 0.6-1.6 ft by 2050
- 1.6-4.6 ft by 2100



http://www.nap.edu/catalog.php?record_id=13389

IPCC AR5 - 2013



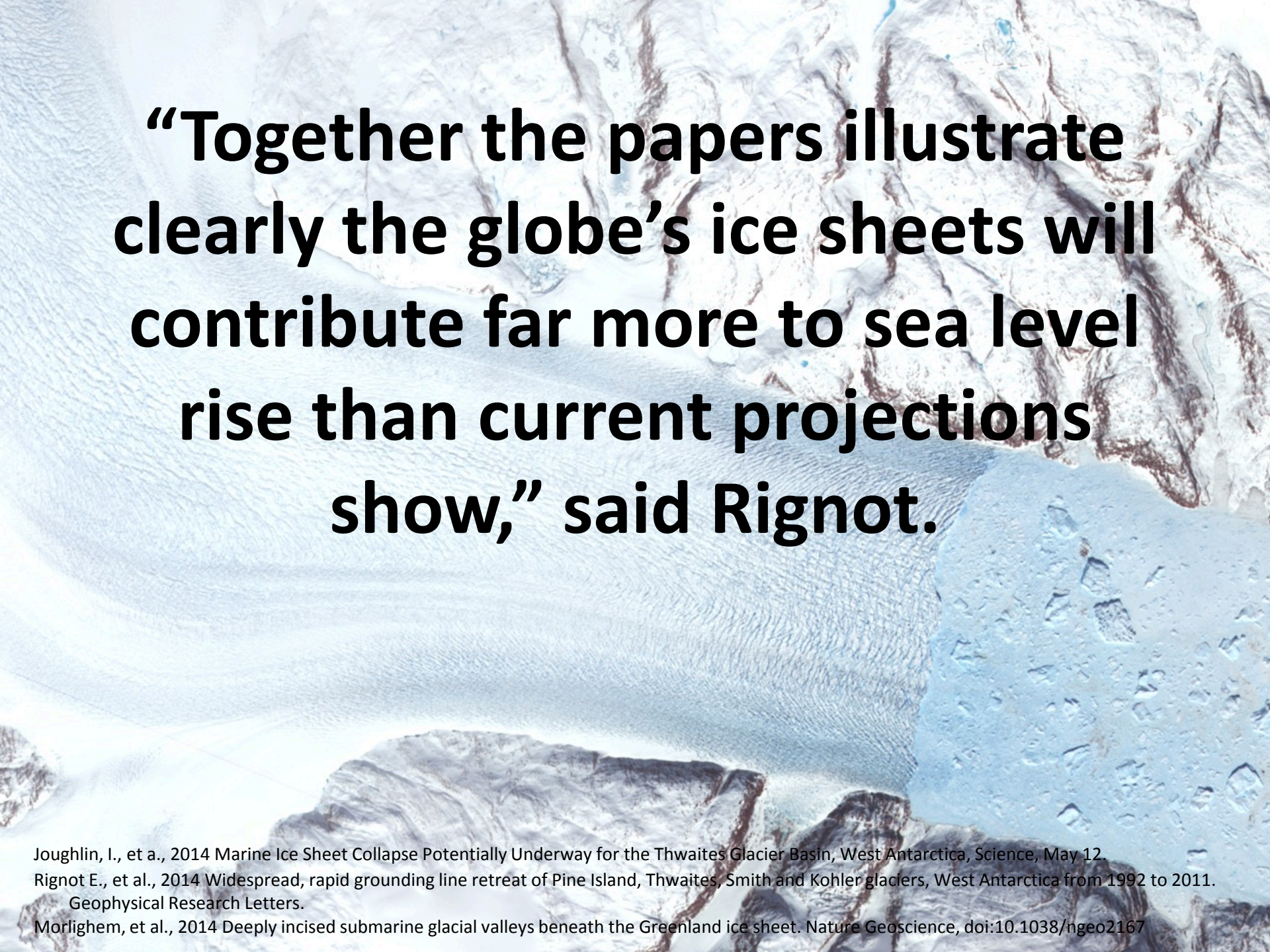


West Antarctic Ice Sheet *“has passed the point of no return”*

...a rise in global sea level
of at least 2 ft over two
centuries, and ultimately
10-13 feet, may now be
inevitable.

Joughlin, I., et al., 2014 Marine Ice Sheet Collapse Potentially Underway for the Thwaites Glacier Basin, West Antarctica, Science, May 12.

Rignot E., et al., 2014 Widespread, rapid grounding line retreat of Pine Island, Thwaites, Smith and Kohler glaciers, West Antarctica from 1992 to 2011. Geophysical Research Letters.

An aerial photograph of a vast glacier system. A large, flat ice shelf extends from the top left towards the center. To the right, a large icebergs is visible, partially submerged in the water. The surrounding water is a deep blue, and the glacier's surface shows various textures and colors, including white, light blue, and brownish streaks, indicating different ice types and meltwater channels.

“Together the papers illustrate clearly the globe’s ice sheets will contribute far more to sea level rise than current projections show,” said Rignot.

Joughlin, I., et al., 2014 Marine Ice Sheet Collapse Potentially Underway for the Thwaites Glacier Basin, West Antarctica, *Science*, May 12.

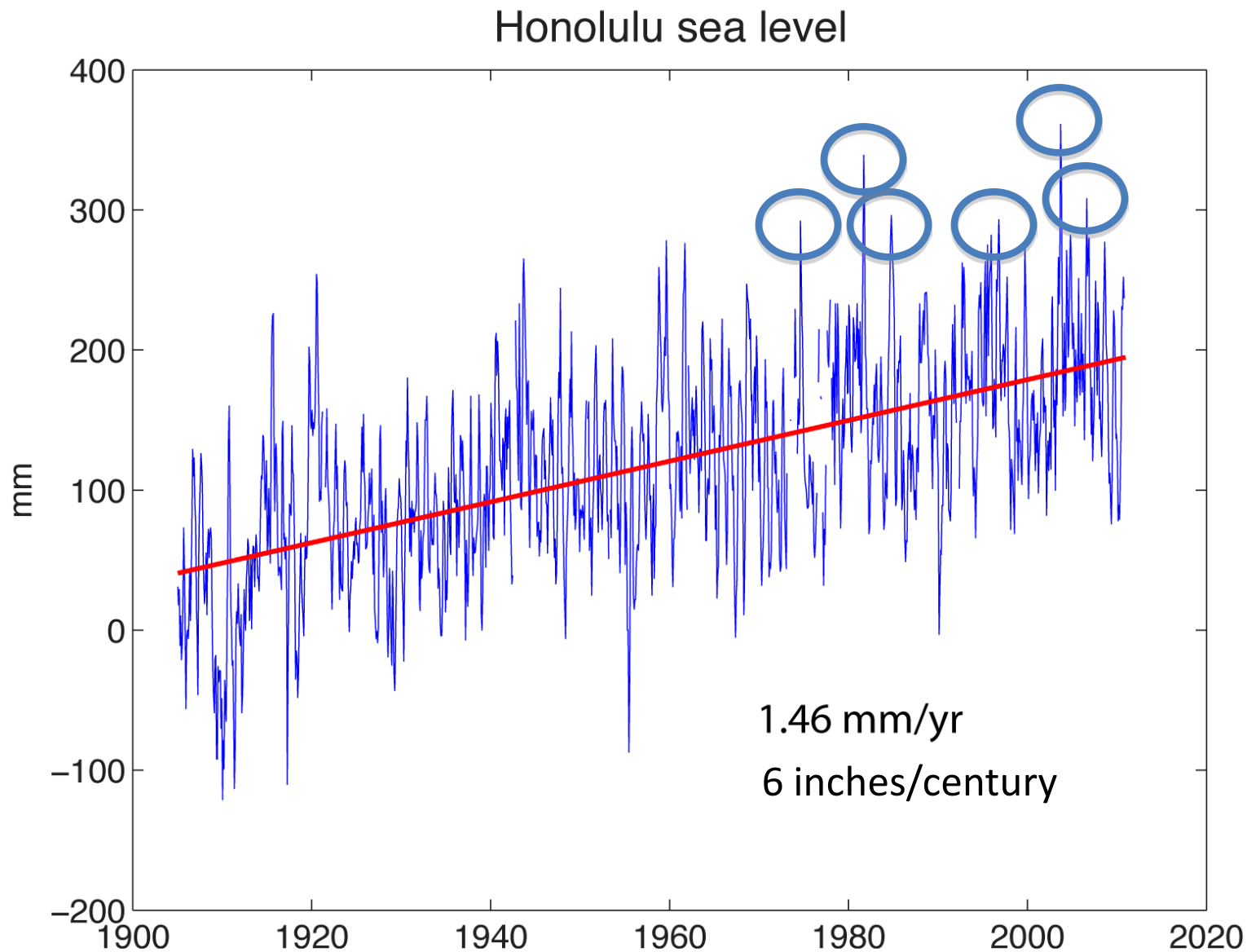
Rignot E., et al., 2014 Widespread, rapid grounding line retreat of Pine Island, Thwaites, Smith and Kohler glaciers, West Antarctica from 1992 to 2011. *Geophysical Research Letters*.

Morlighem, et al., 2014 Deeply incised submarine glacial valleys beneath the Greenland ice sheet. *Nature Geoscience*, doi:10.1038/ngeo2167

"During that time, the sea level on a global basis rose (8 different times) about 50 feet in just 350 years – or about 20 times faster than sea level rise over the last century,"
Peter Clark, Oregon State University



Honolulu Sea Level *extreme tides*



Coastal Erosion



**70% of all
Hawaiian
beaches
eroding**

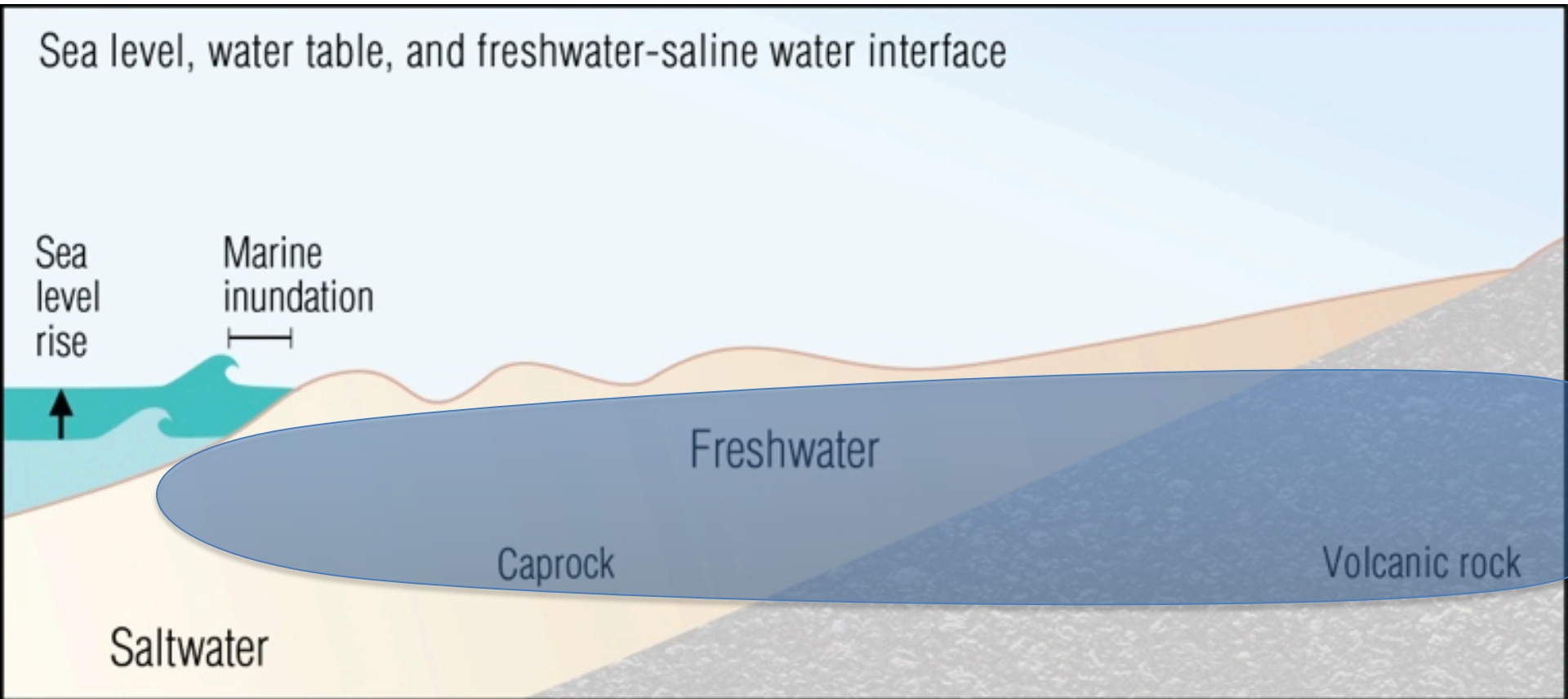




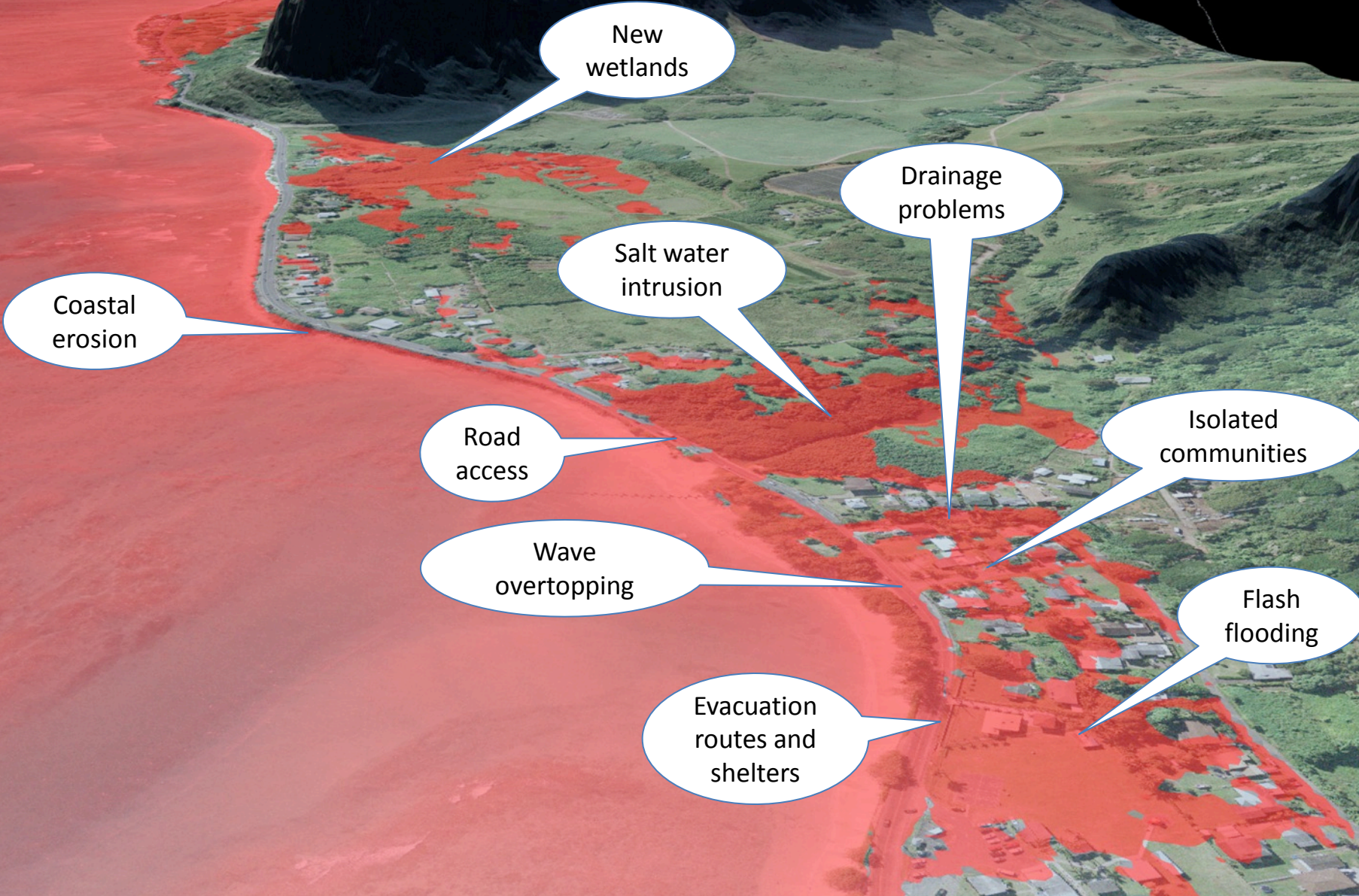
Sea level
rise will
cause
drainage
problems

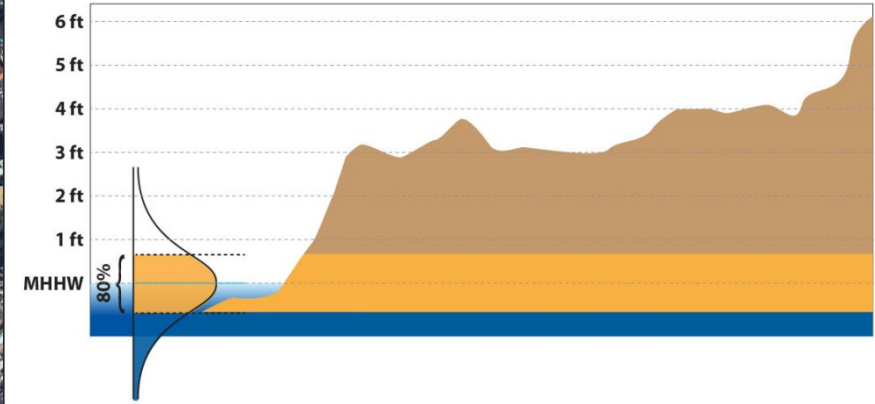
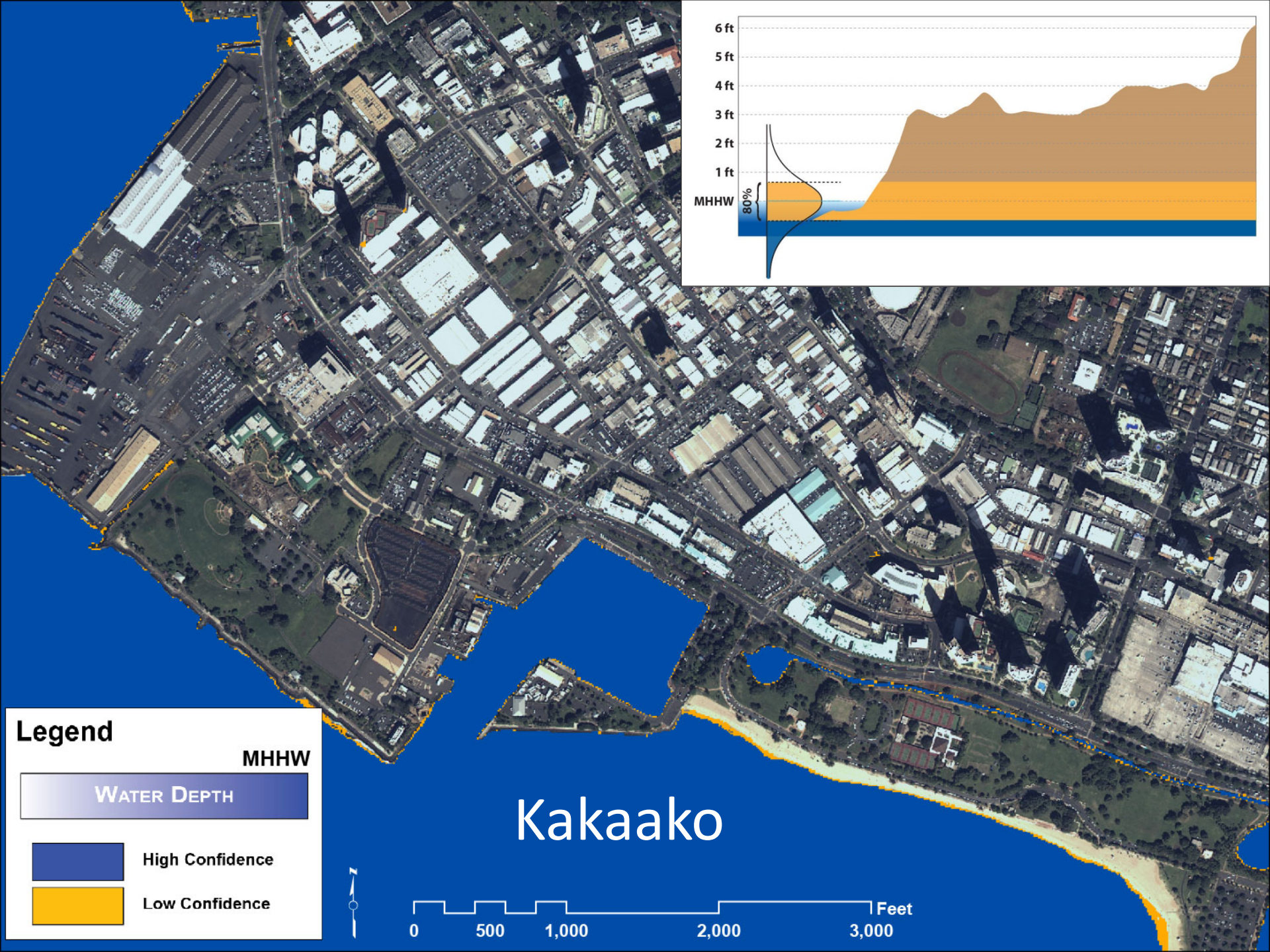
Waikiki, Outrigger Reef Hotel

Groundwater Inundation



Sea level +3 ft





Legend

MHHW

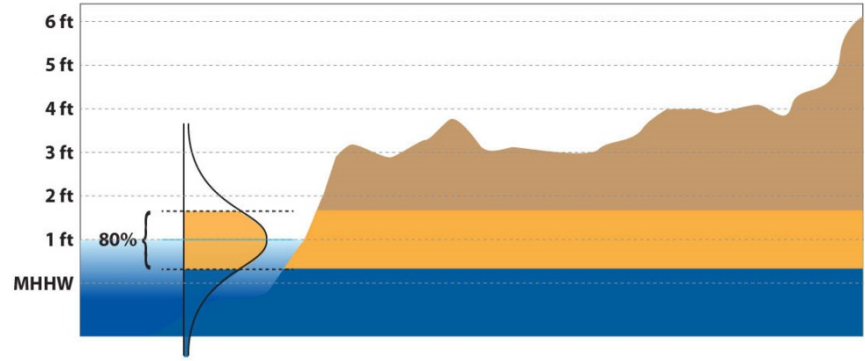
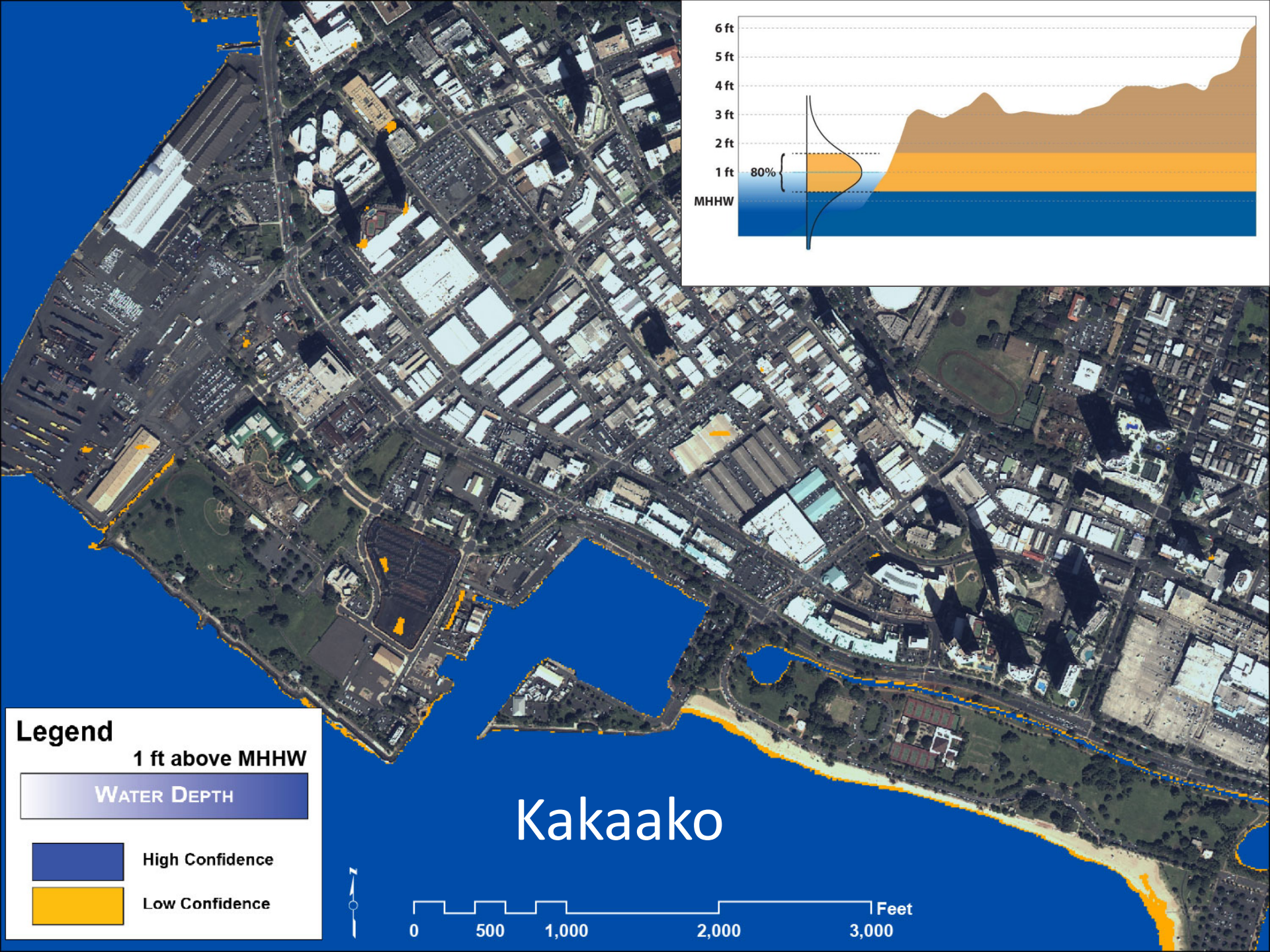
WATER DEPTH

High Confidence

Low Confidence

Kakaako





Legend
1 ft above MHHW

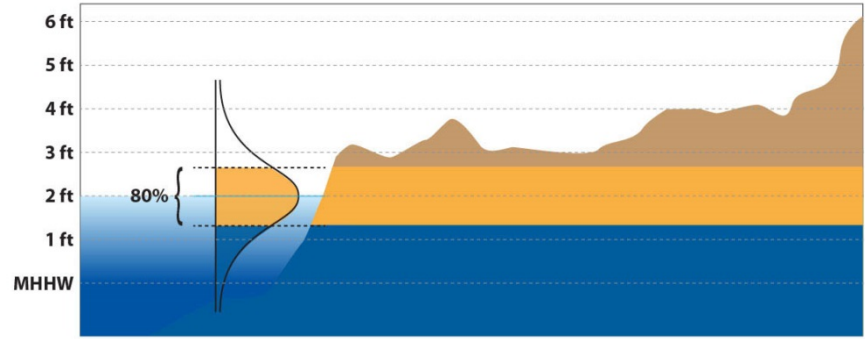
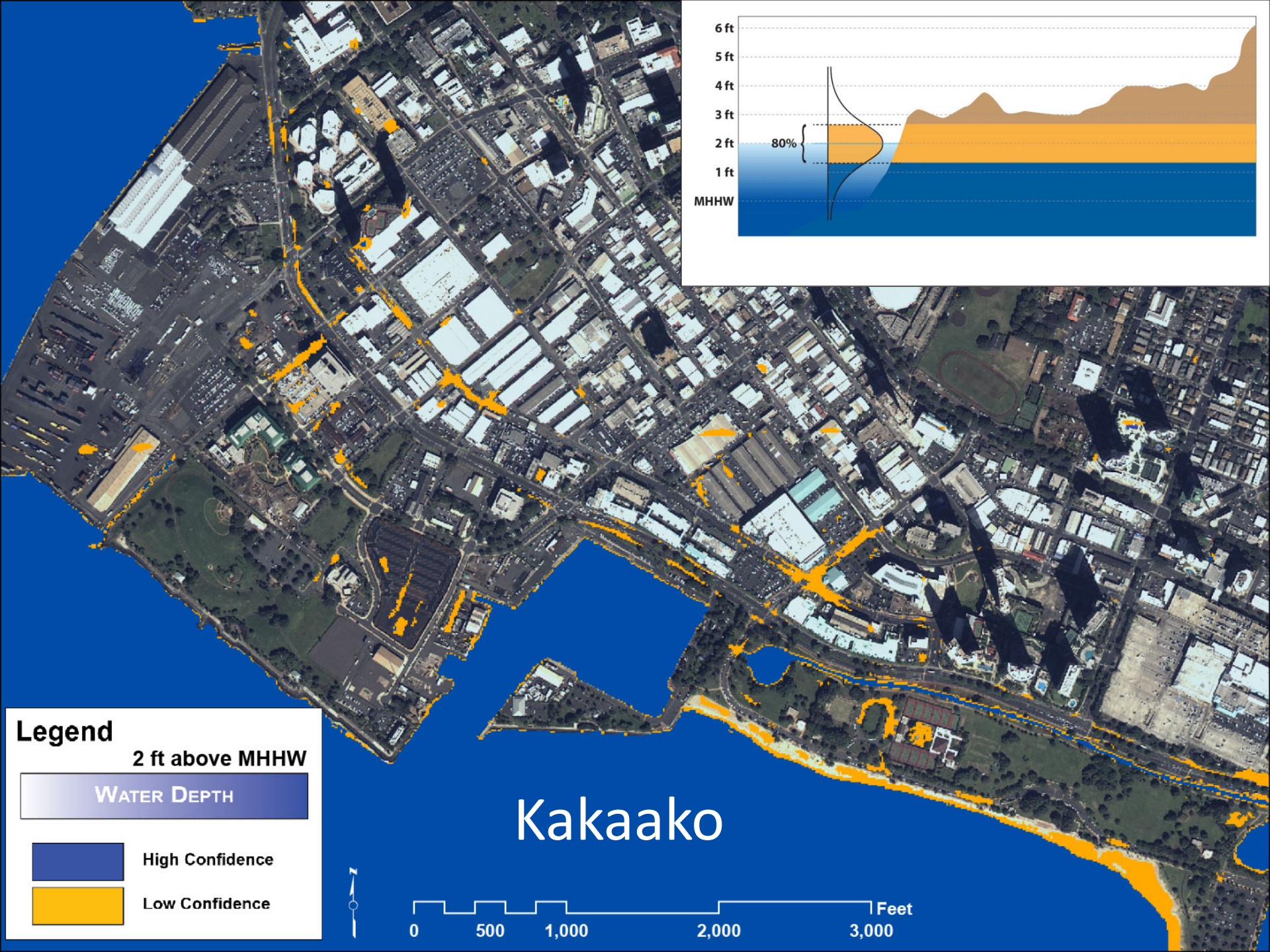
WATER DEPTH

High Confidence

Low Confidence

Kakaako







Legend

2 ft above MHHW

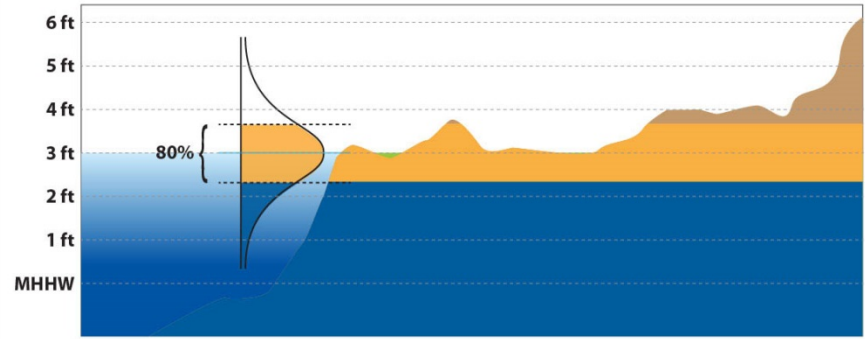
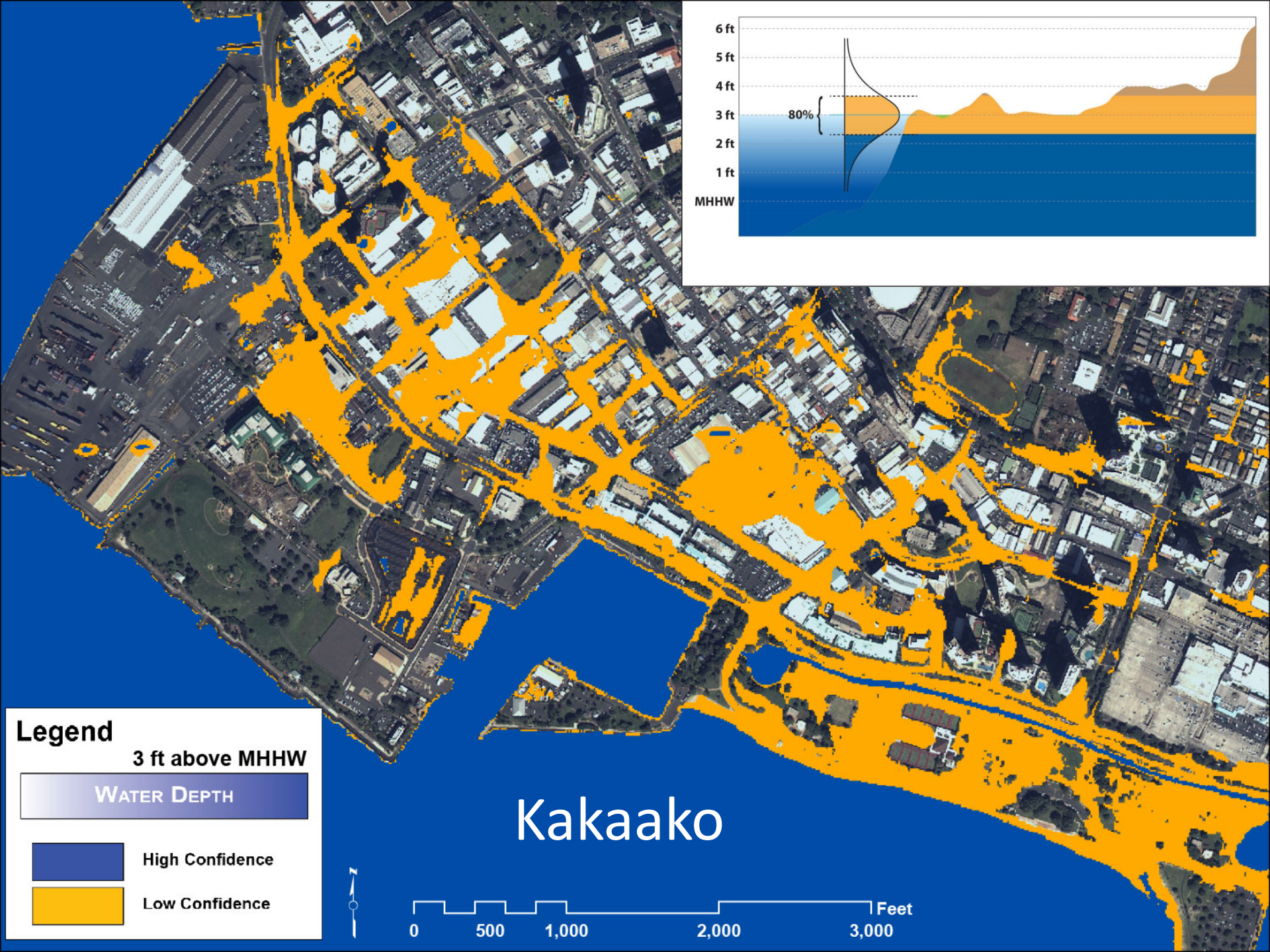
WATER DEPTH

 High Confidence

 Low Confidence

Kakaako





Legend

3 ft above MHHW

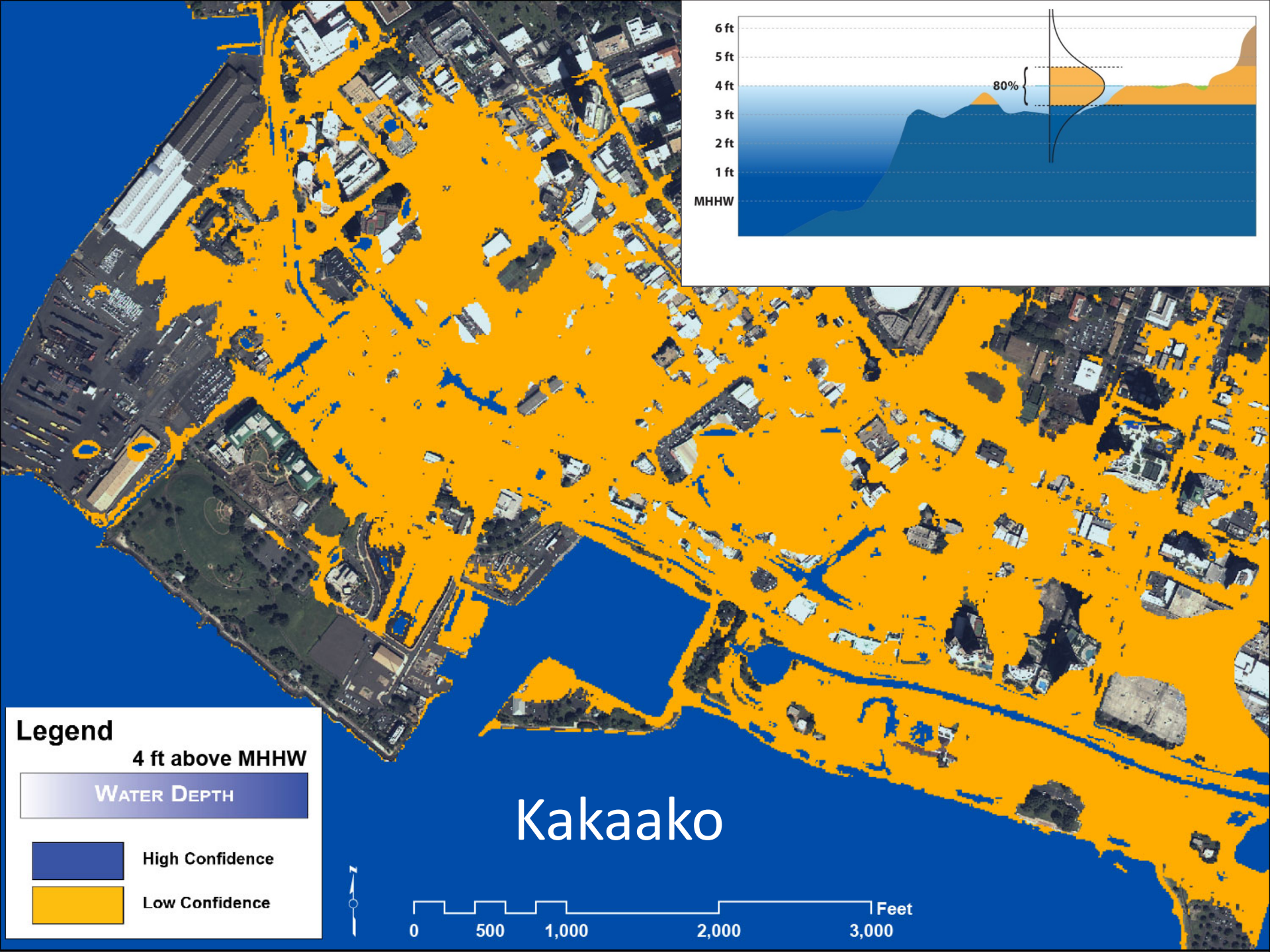
WATER DEPTH

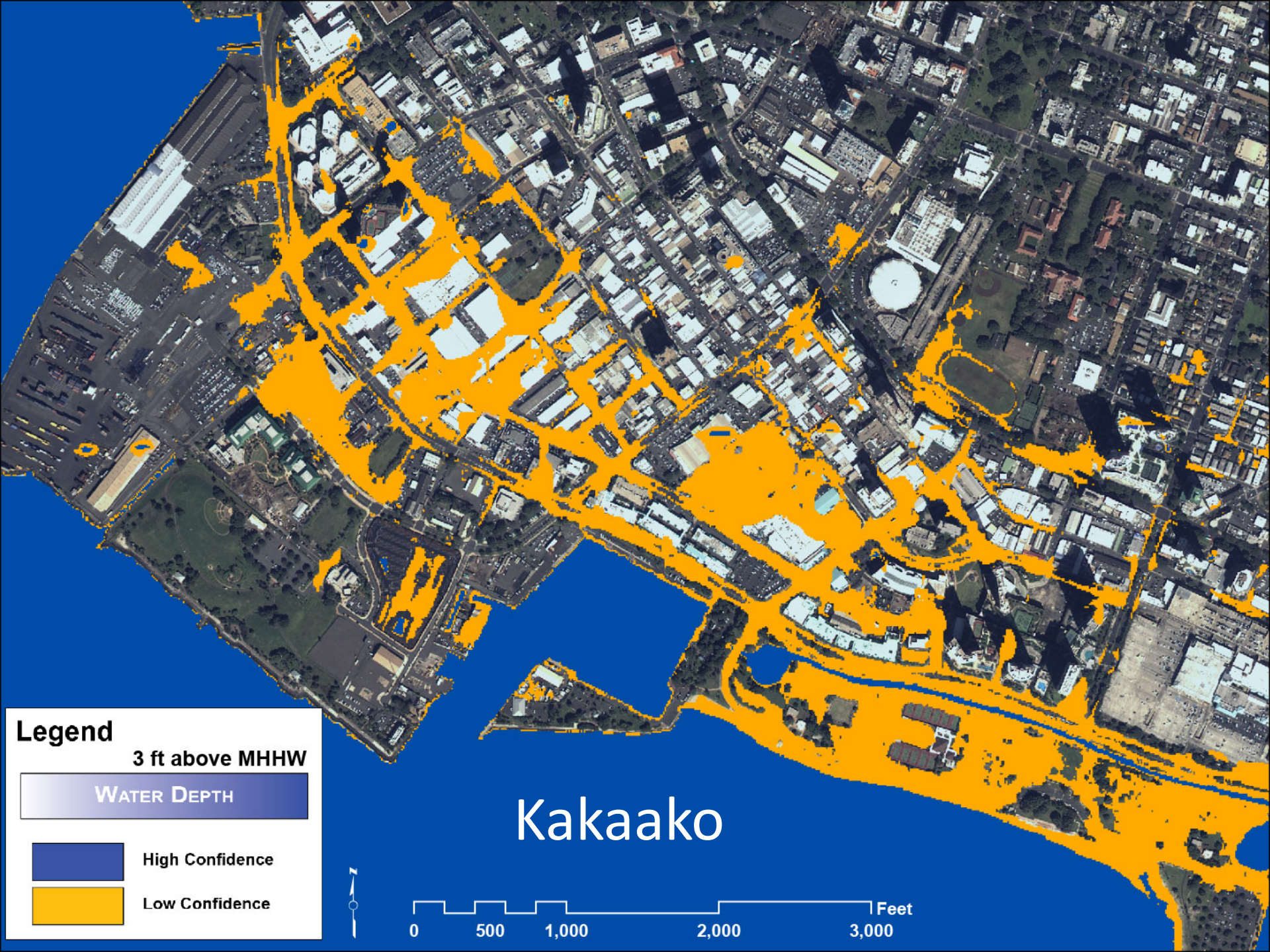
High Confidence

Low Confidence

Kakaako







Legend
3 ft above MHHW

WATER DEPTH

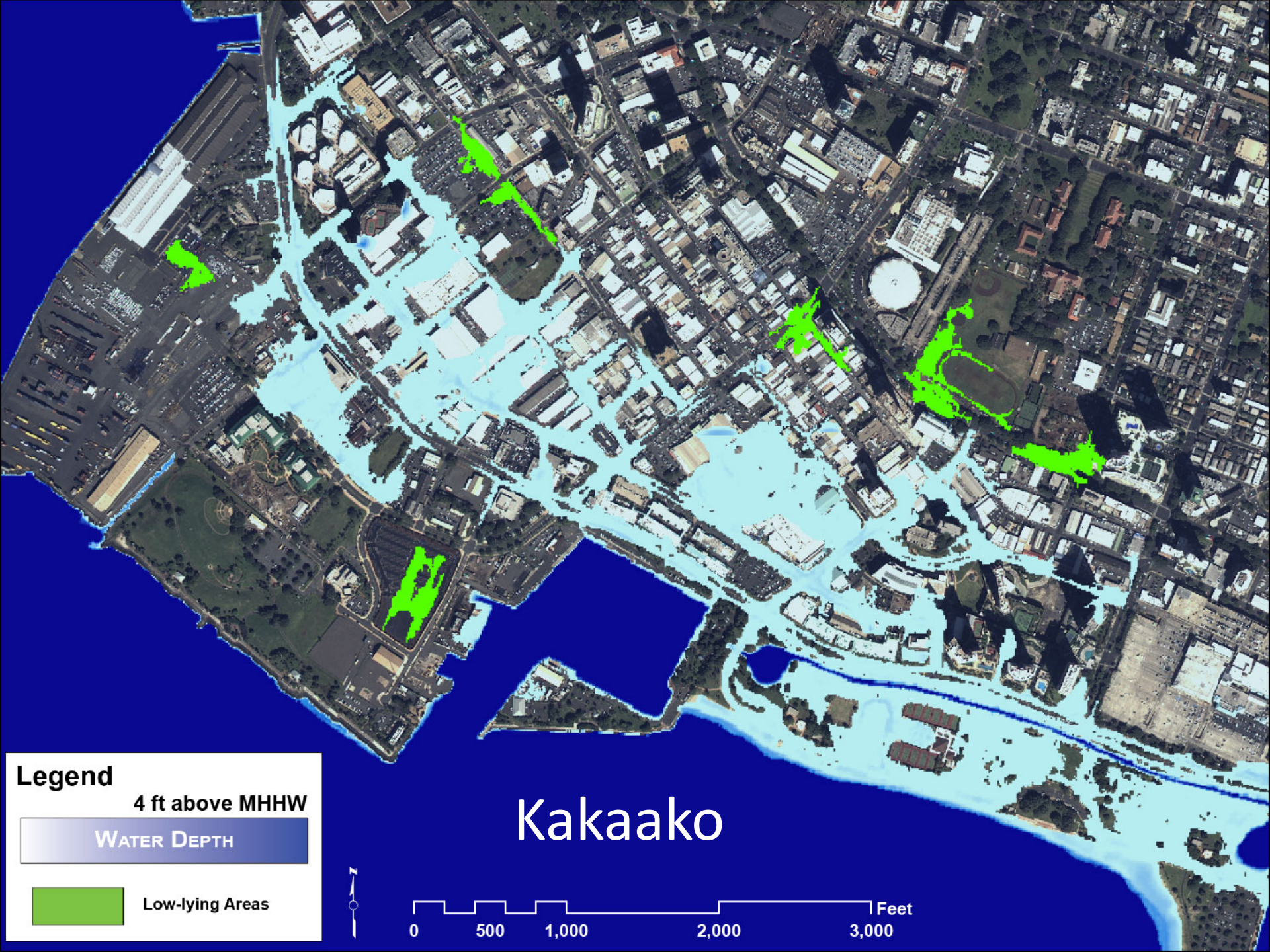
High Confidence

Low Confidence

Kakaako



0 500 1,000 2,000 3,000 Feet



Legend

4 ft above MHHW



WATER DEPTH

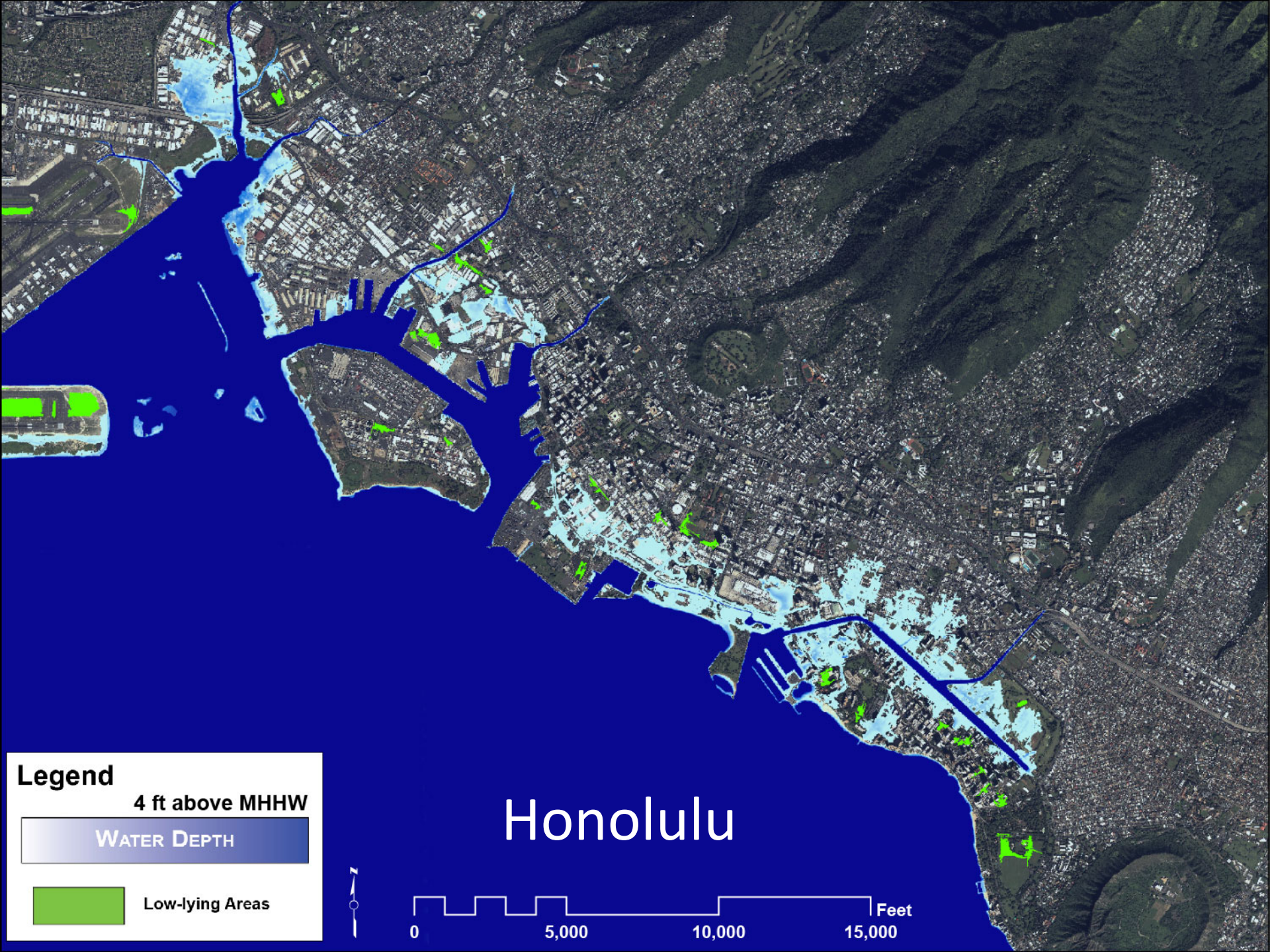


Low-lying Areas

Kakaako



Feet



Legend

4 ft above MHHW



WATER DEPTH



Low-lying Areas

Honolulu



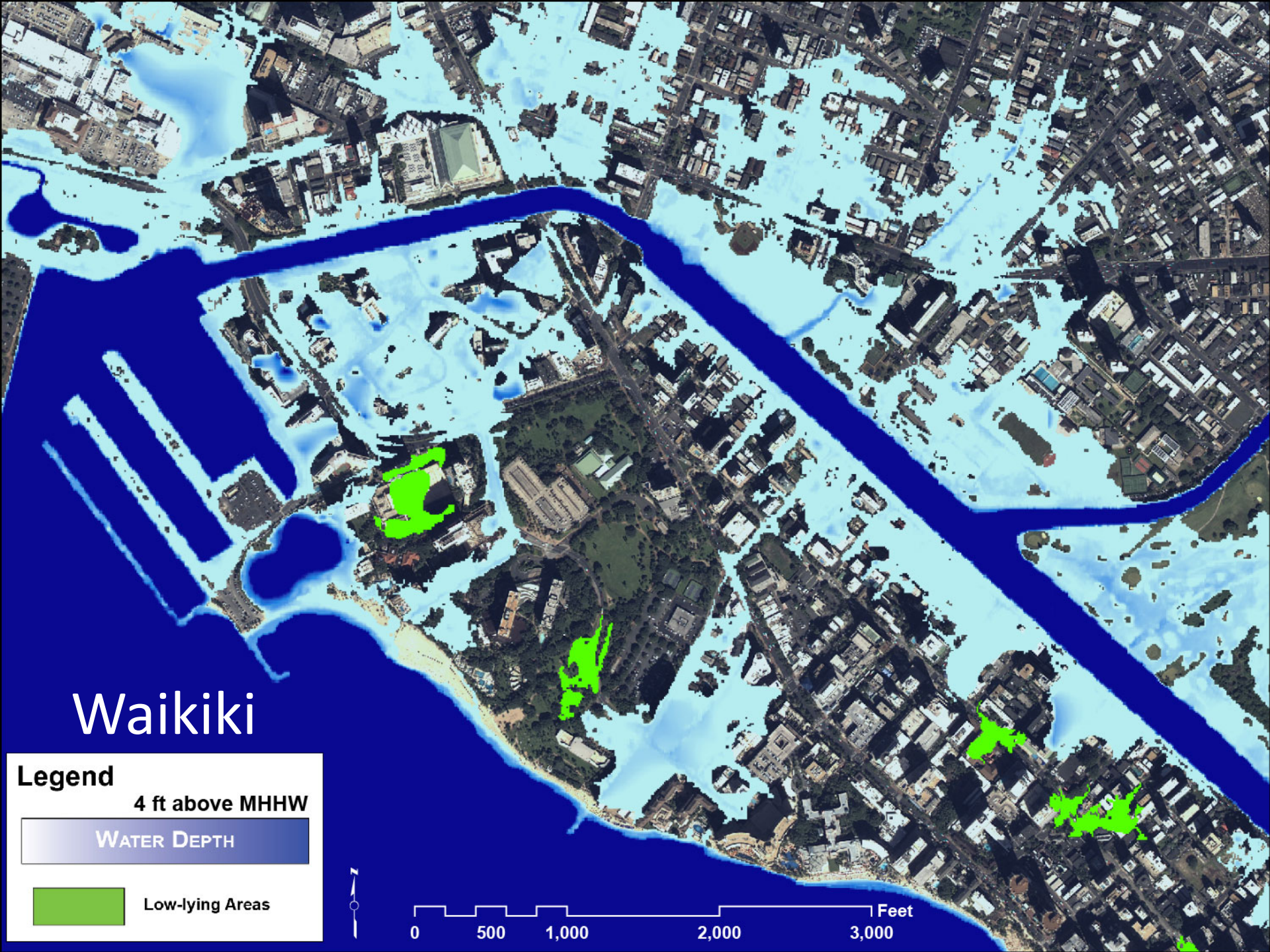
0

5,000

10,000

15,000

Feet



Waikiki

Legend

4 ft above MHHW

WATER DEPTH

Low-lying Areas



Nanakuli

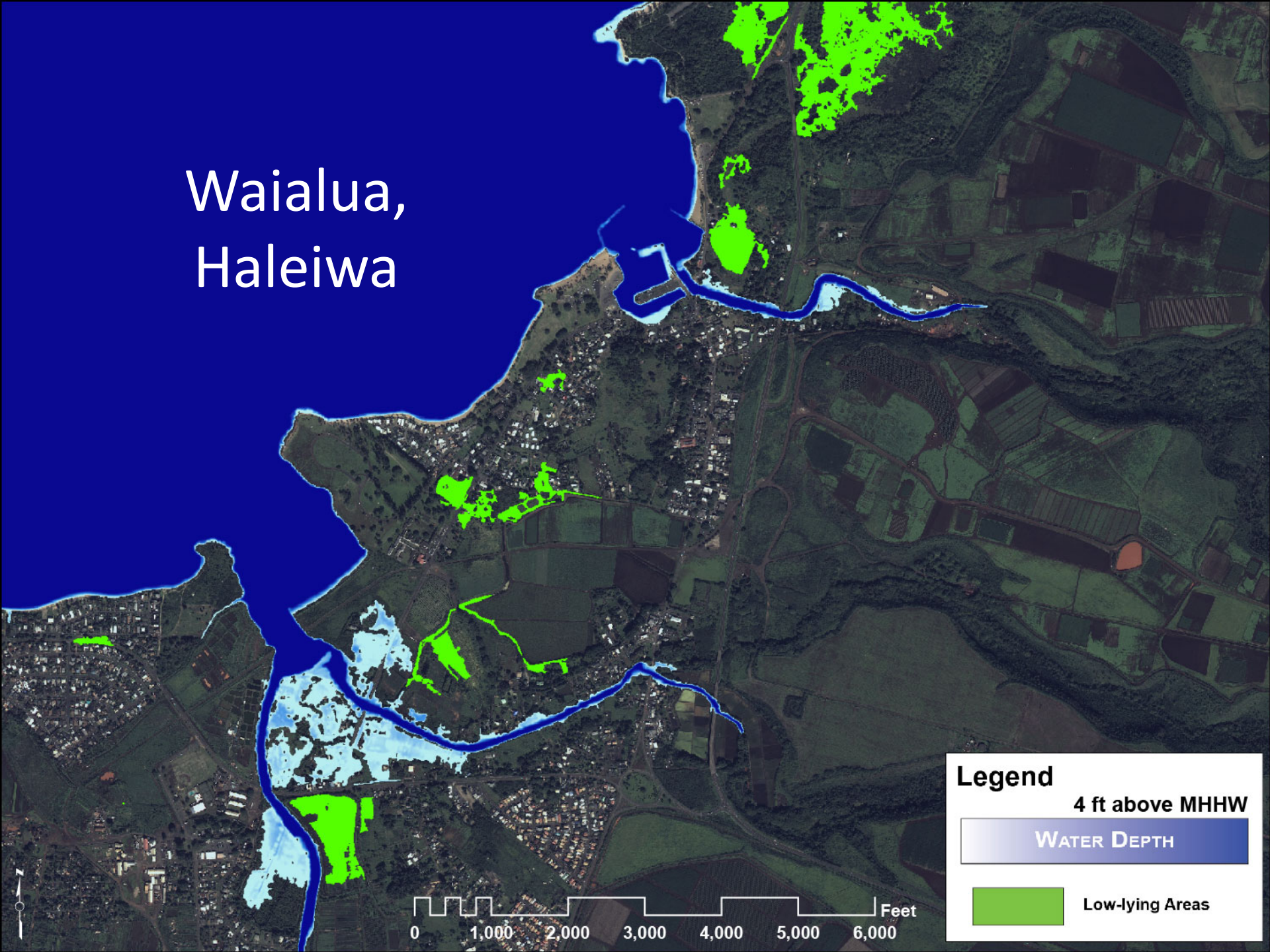


Legend

- 4 ft above MHHW
- WATER DEPTH
- Low-lying Areas

0 1,000 2,000 3,000 Feet

Waialua, Haleiwa



Legend

4 ft above MHHW

WATER DEPTH

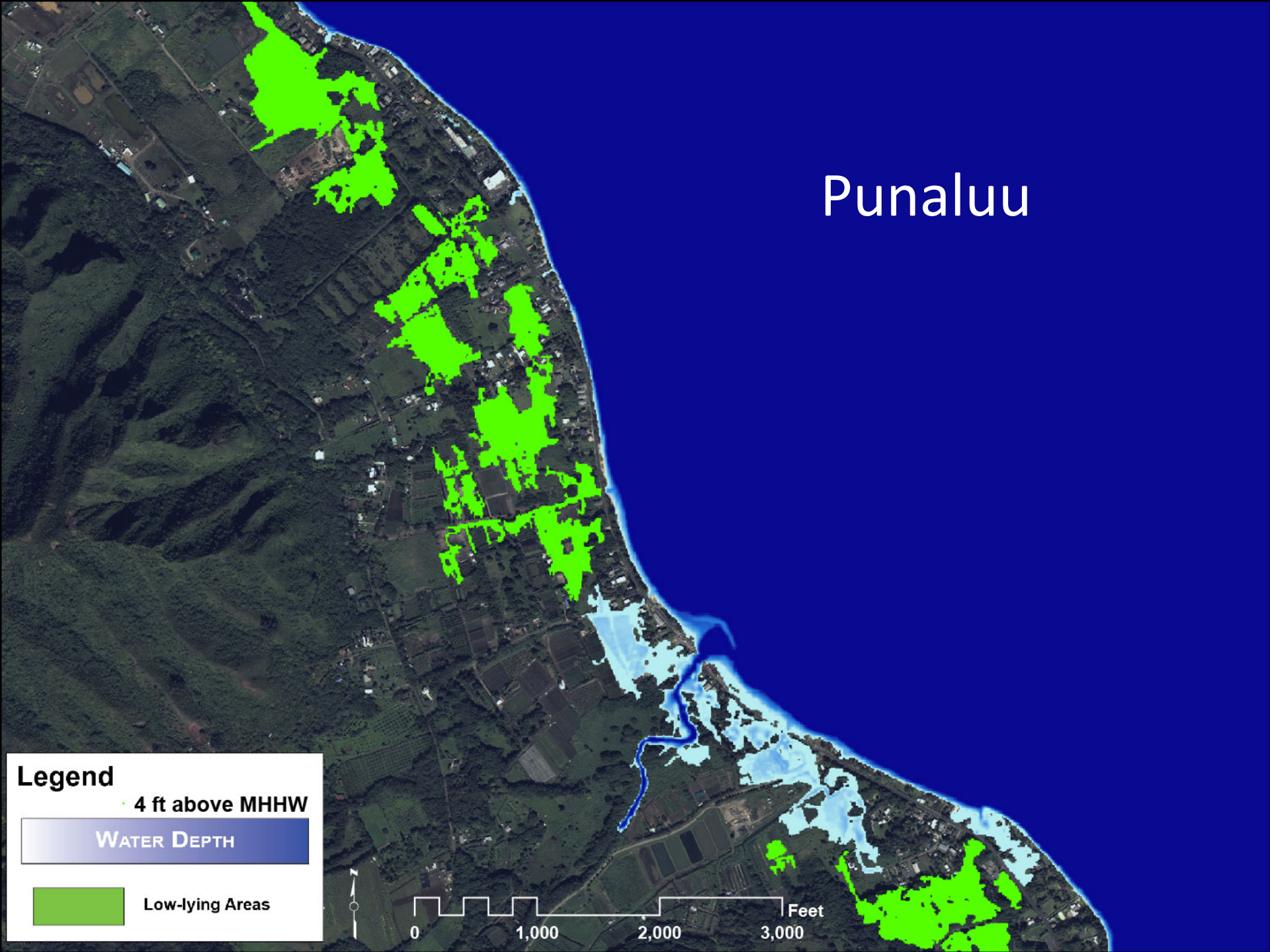
Low-lying Areas



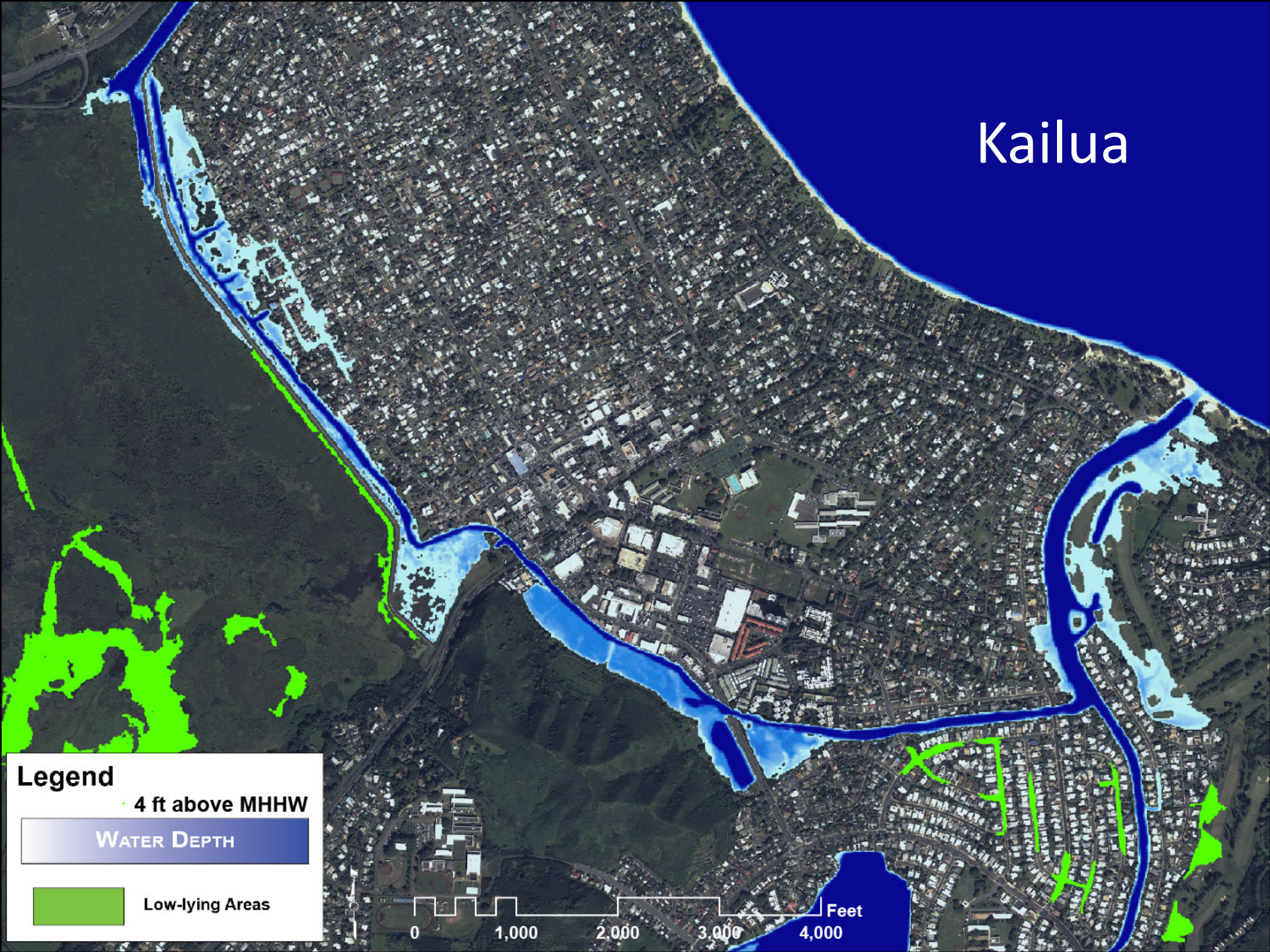
Punaluu

Legend

- 4 ft above MHHW
- WATER DEPTH
- Low-lying Areas



Kailua



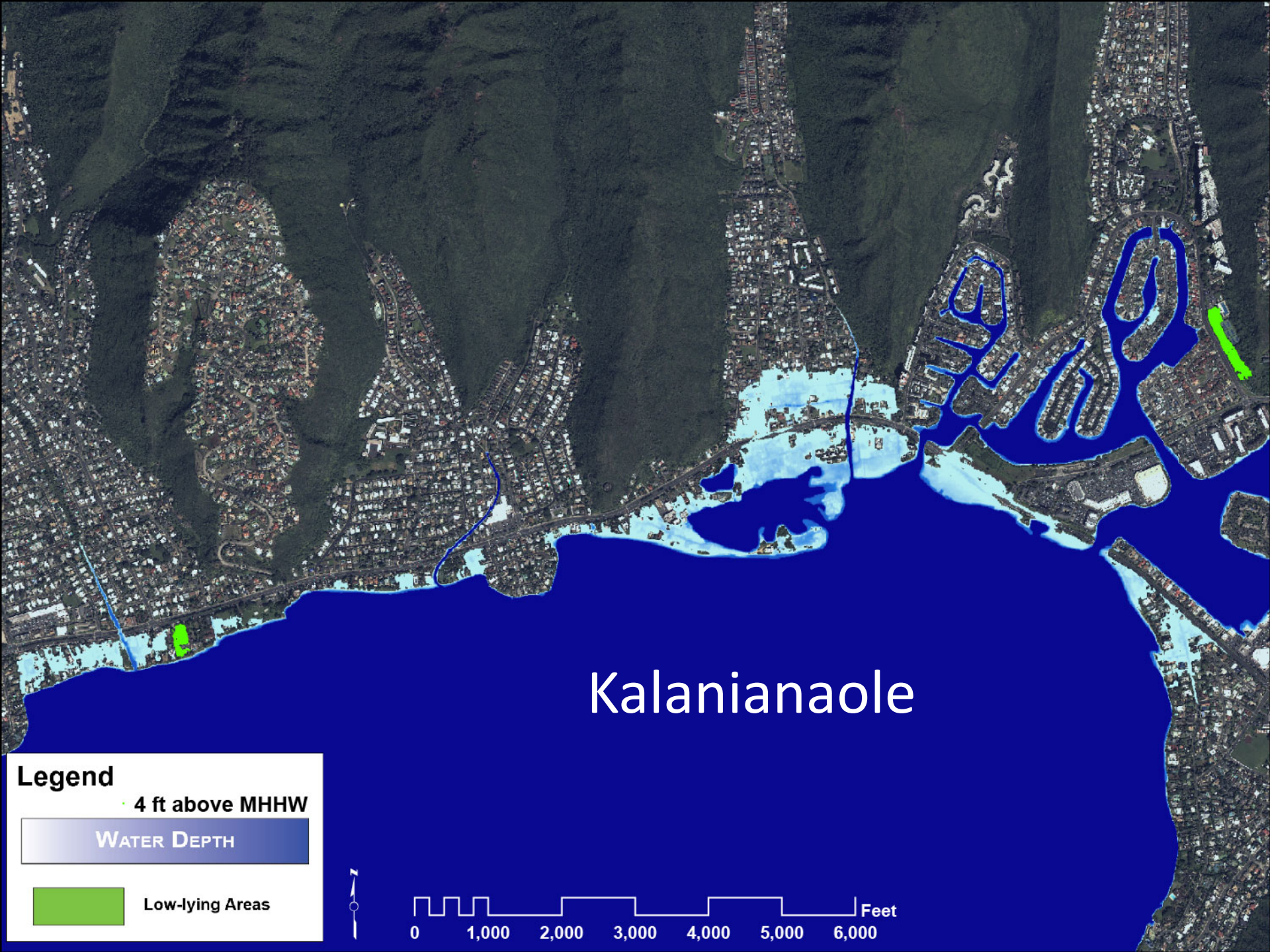
Legend

4 ft above MHHW

WATER DEPTH

Low-lying Areas

0 1,000 2,000 3,000 4,000 Feet



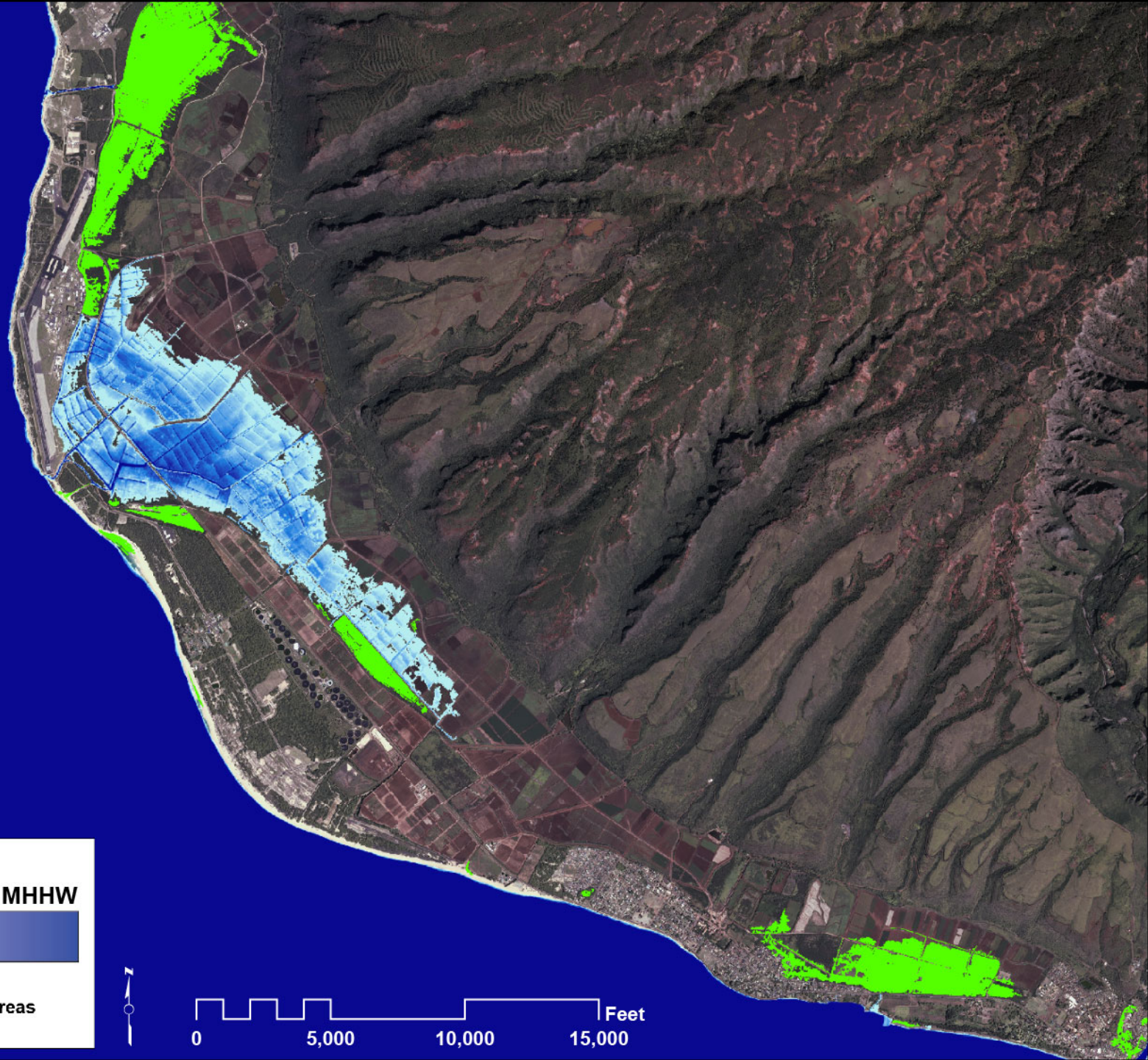
Kalanianaʻole

Legend

- 4 ft above MHHW
- WATER DEPTH
- Low-lying Areas



Mana



Legend

4 ft above MHHW



WATER DEPTH

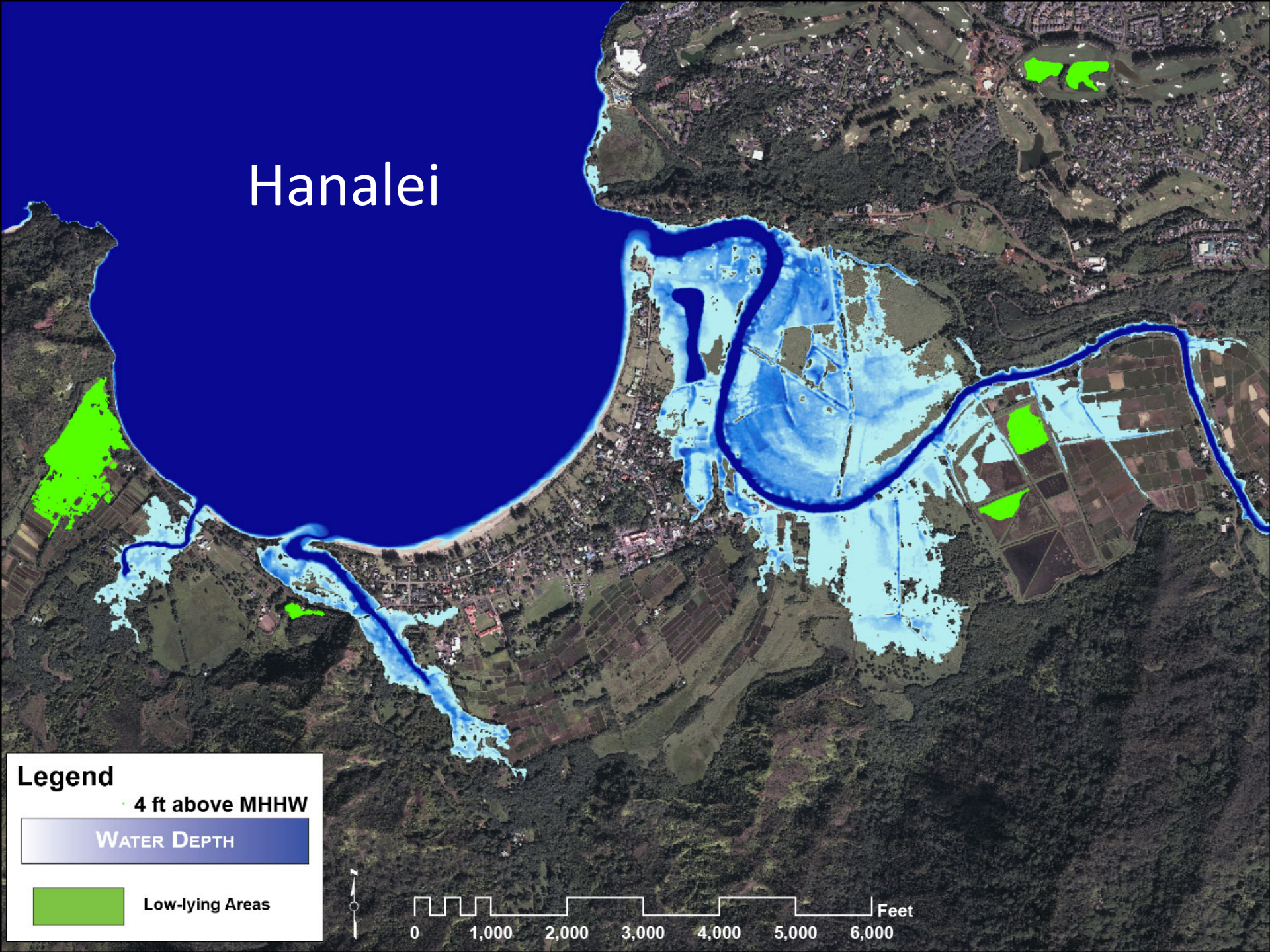


Low-lying Areas



0 5,000 10,000 15,000 Feet

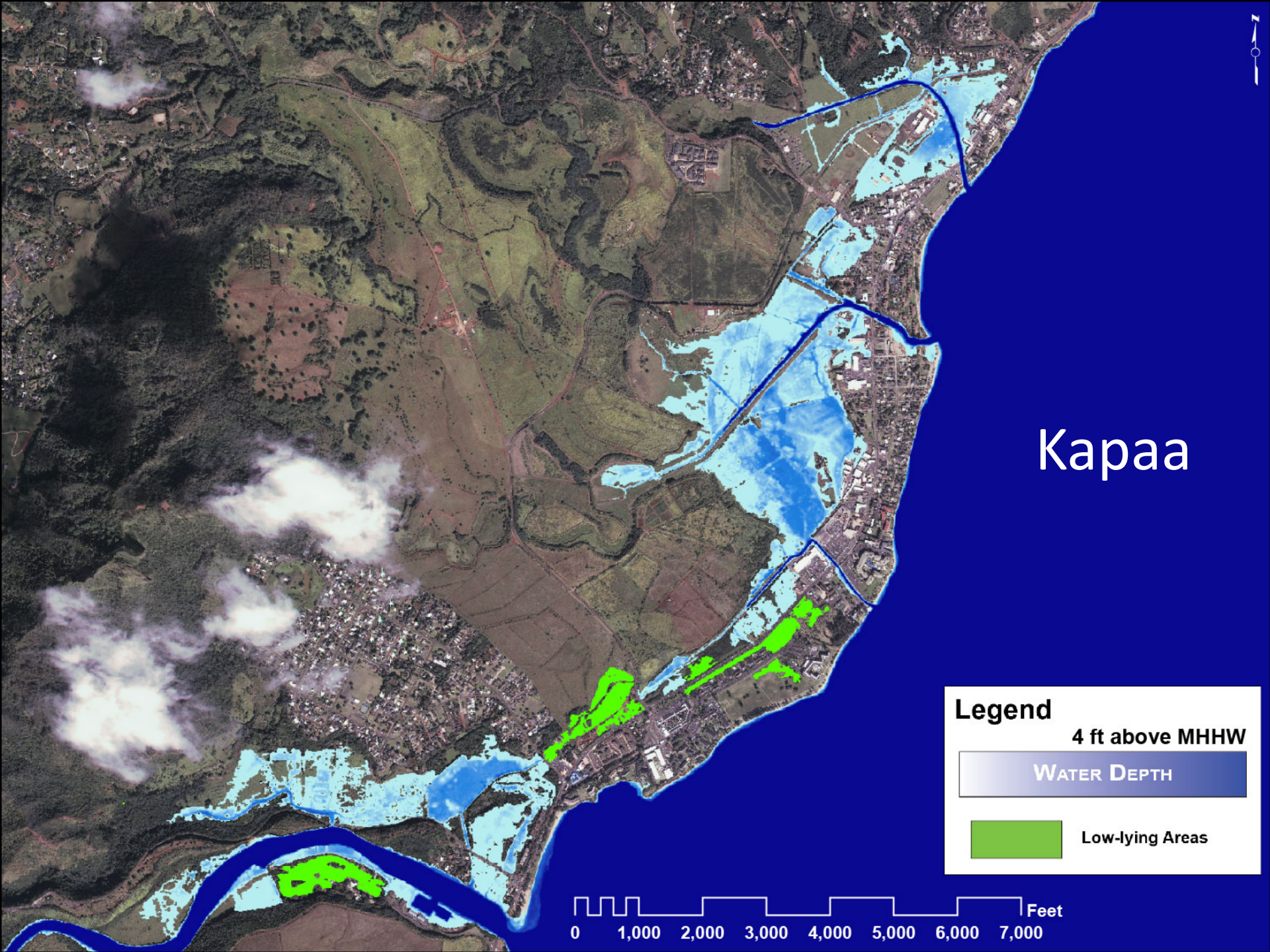
Hanalei



Legend

- 4 ft above MHHW
- WATER DEPTH
- Low-lying Areas





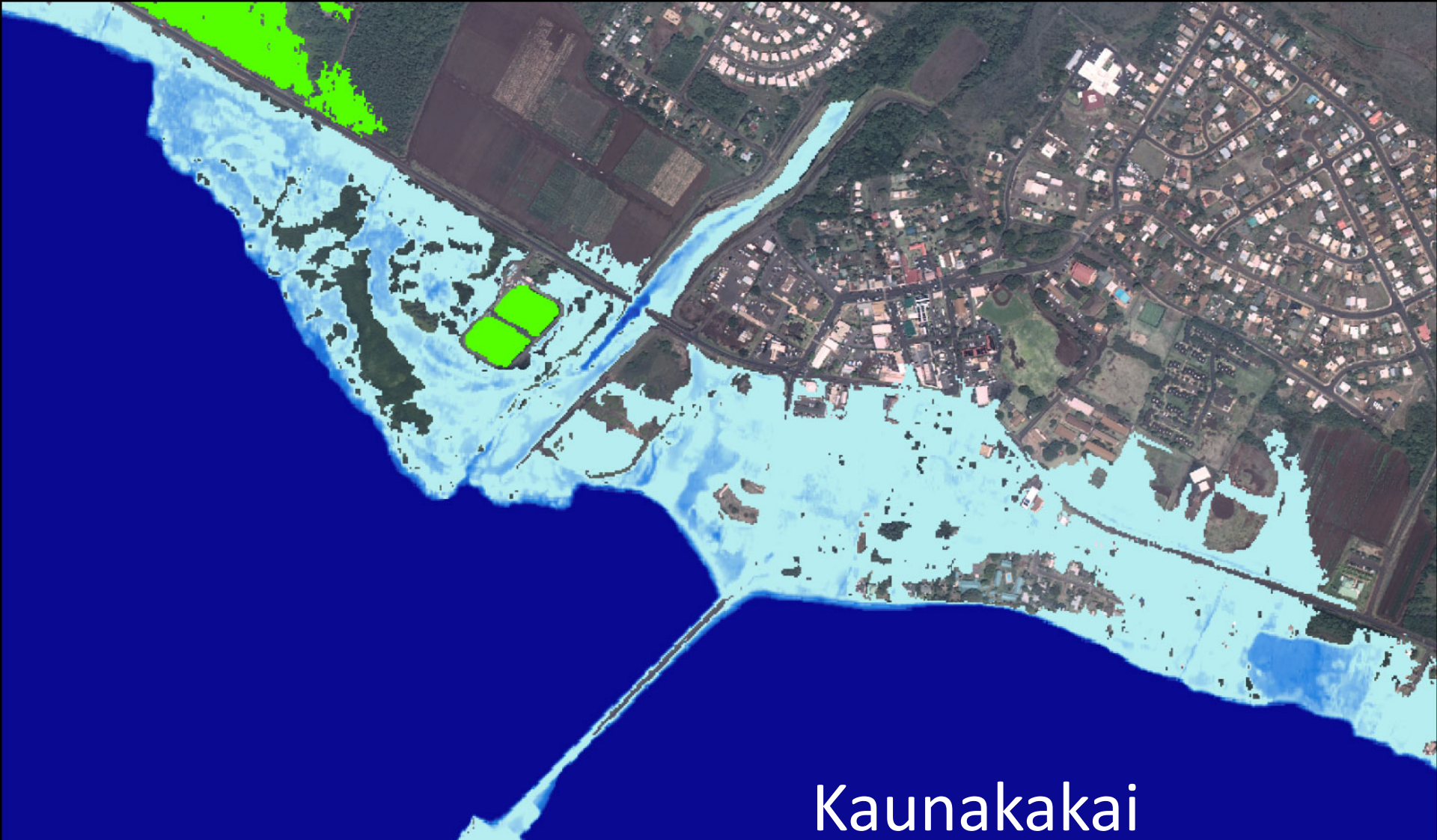
Kapaa

Legend
4 ft above MHHW

WATER DEPTH

Low-lying Areas





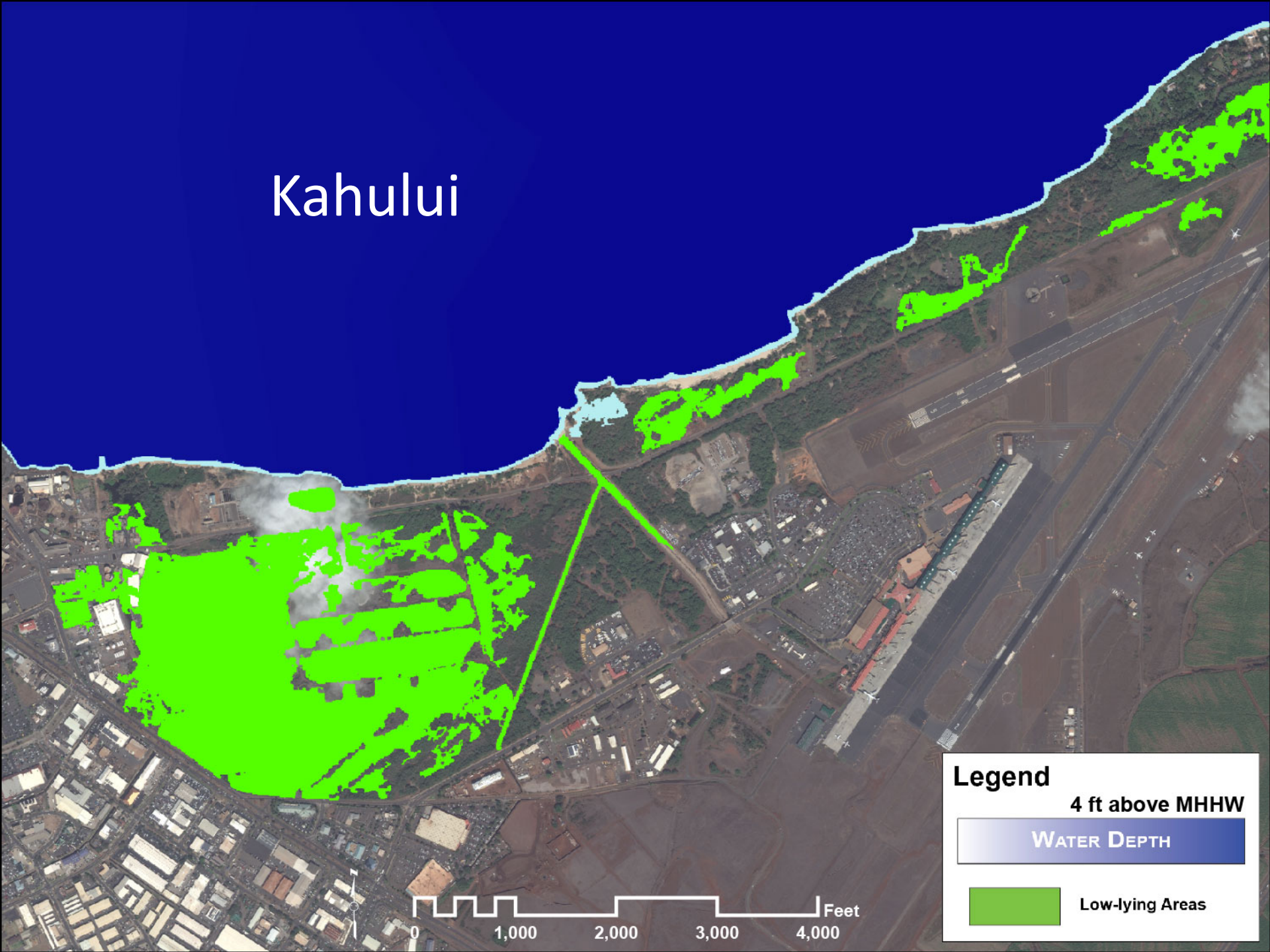
Kaunakakai

Legend

- 4 ft above MHHW
- WATER DEPTH
- Low-lying Areas



Kahului



Legend

4 ft above MHHW

WATER DEPTH



Low-lying Areas



Kihei

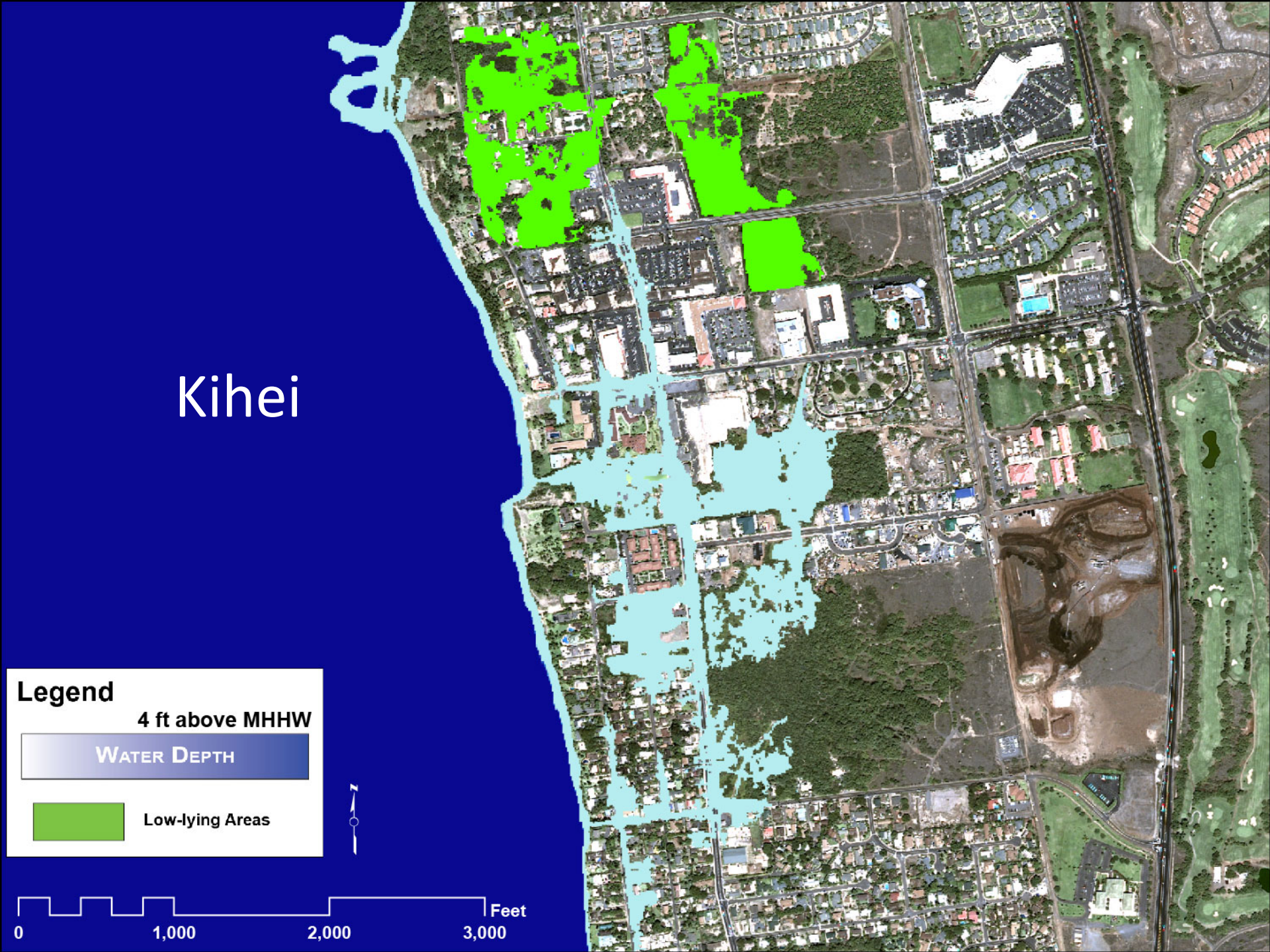
Legend

4 ft above MHHW

WATER DEPTH



Low-lying Areas





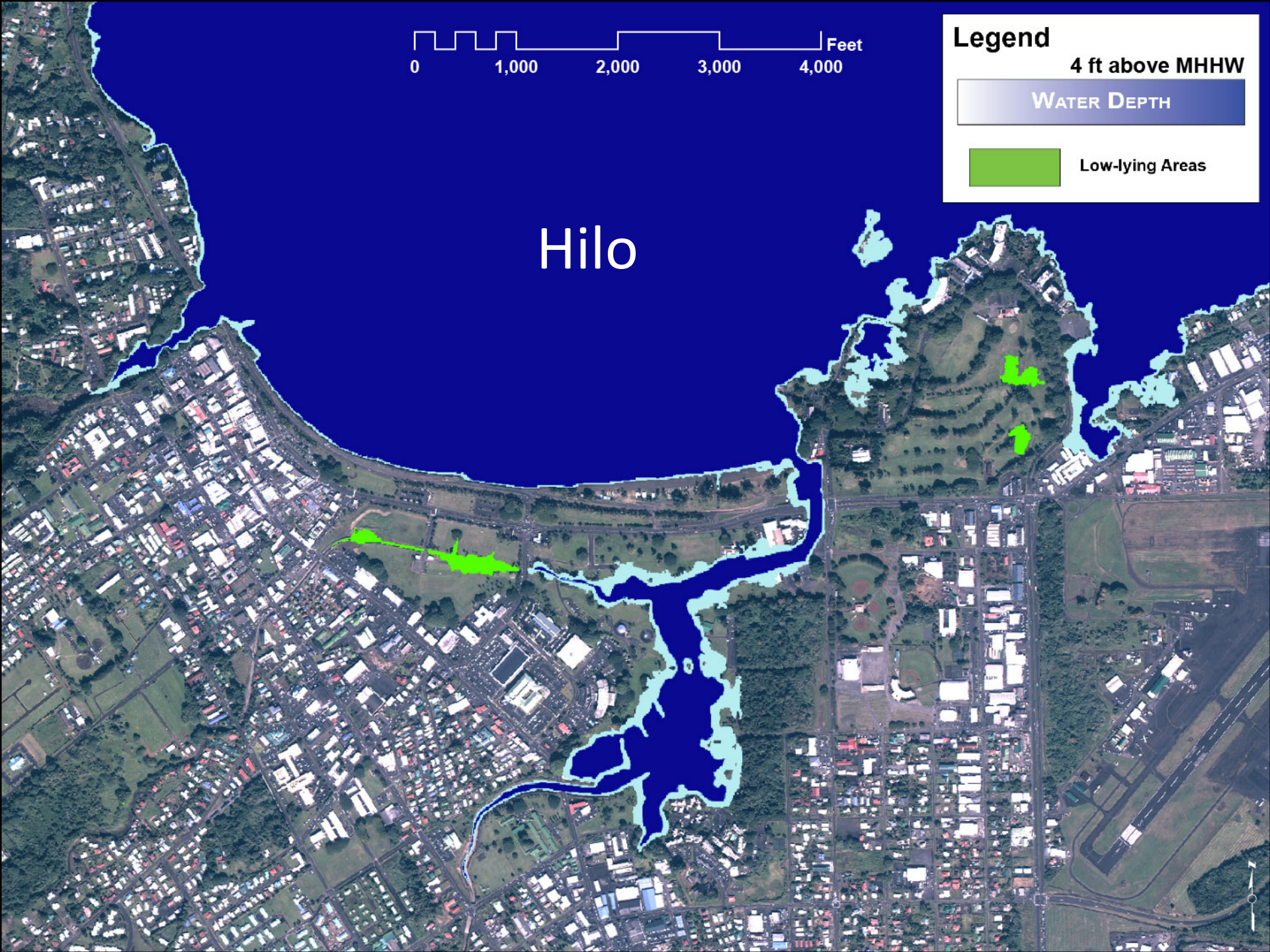
Legend

4 ft above MHHW

WATER DEPTH

Low-lying Areas

Hilo



U.S Army Corps of Engineers



*New photos and new
DEM's*

Mahalo for your time