2018 Association of State Floodplain Managers Conference

Harvey, Irma, Debbie, Maria, and Ophelia: The New Normal?

Forecasting mantra:

The goal of forecasting is not to predict the future, but to tell you what you need to know to take ***meaningful action*** in the present.

Dr. Paul Saffo

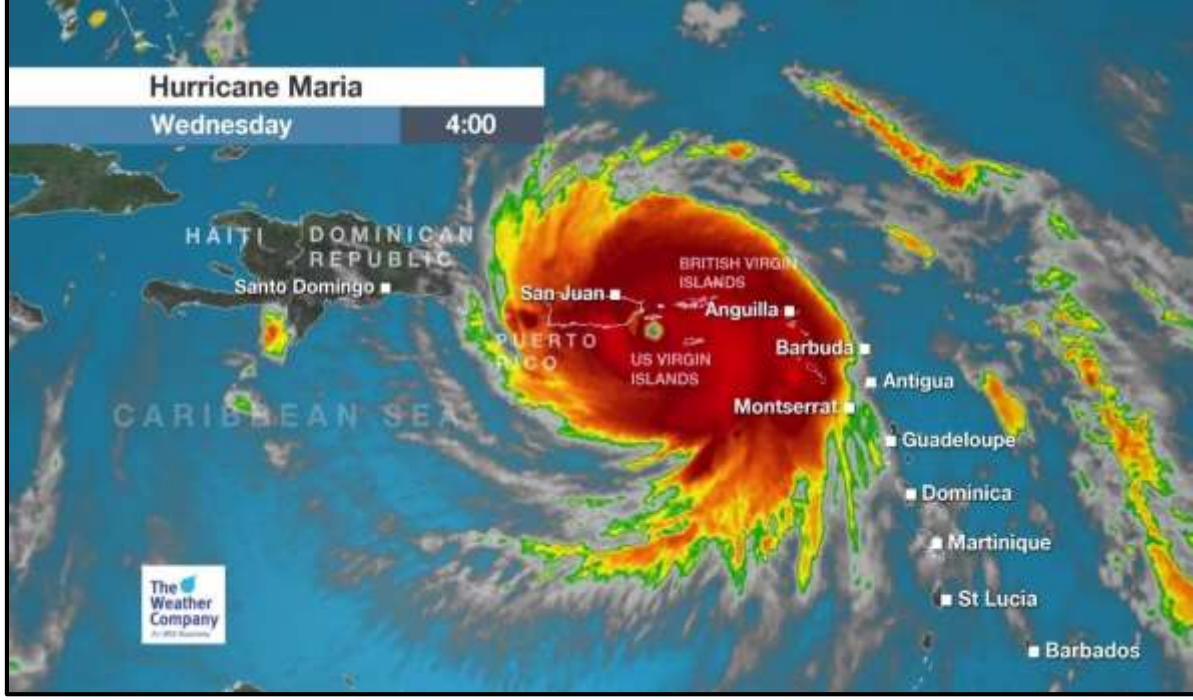
Hurricane Harvey (2017)

- Saffir-Simpson Category 4
- Max sustained winds to 135 mph
- ~$125 Billion in damage
- 5-day rainfall in Beaumont, TX of 60.58 inches
- 10,000 sq. mi depth-area rainfall of 34.72 inches in 5 days
- Death toll 107
- Storm center pushed 140 mi inland before returning to sea

Hurricane Irma (2017)

- Saffir-Simpson Category 5
- SSTs of 86°F provided the fuel
- Max sustained winds of 185 mph for 37 hours
- Death toll 102 (75 in Florida)
- 6.5 million people evacuated
- $50 billion in damage
- http://www.pbs.org/wgbh/nova/next/wp-content/uploads/2017/11/hurricane-irma-eye.mp4

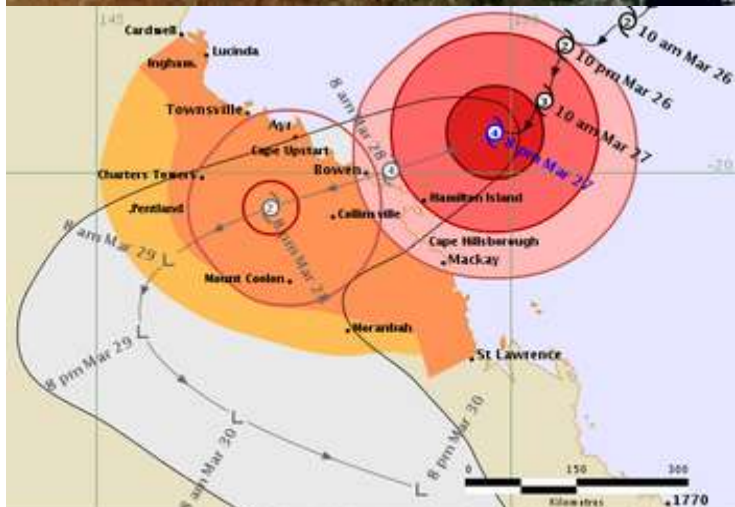
Hurricane Maria (2017)



- Saffir-Simpson Category 5
- Max sustained winds of 155 mph
- Central pressure of 908mb
- Death toll officially 112, more than likely ~1000
- 6.5 million people evacuated
- $91.61 billion

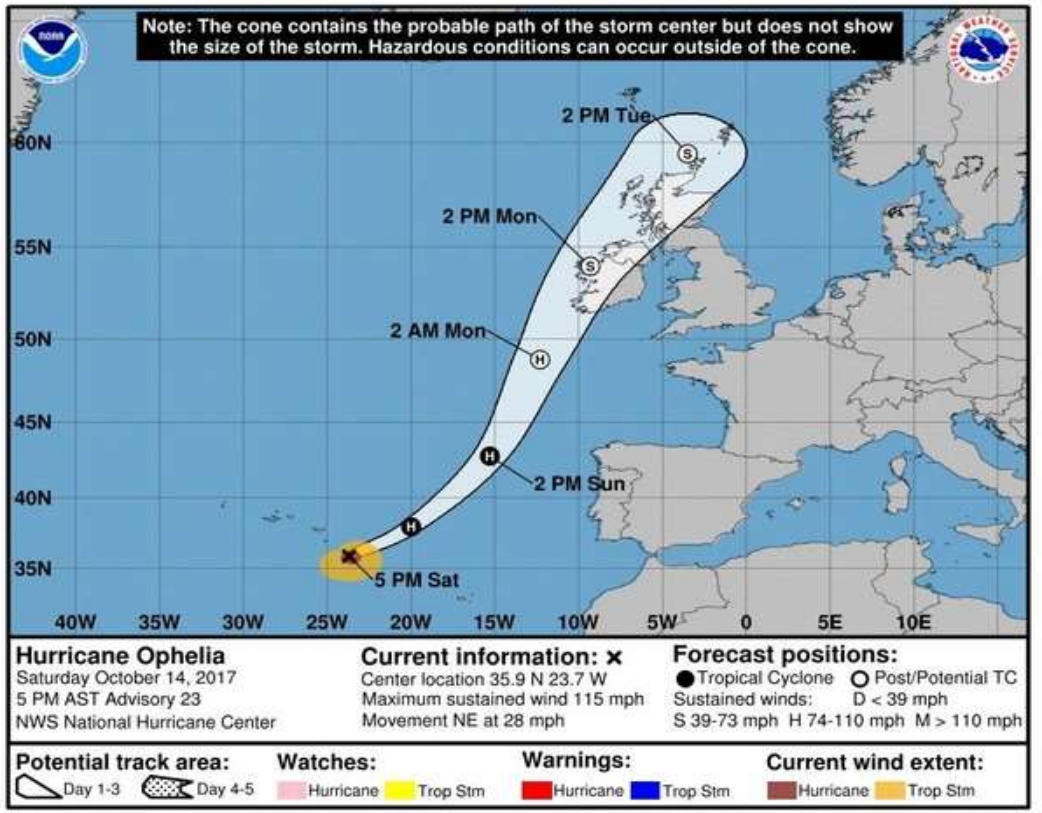
Severe Tropical Cyclone Debbie (Australia, 2017)

- Landfall as a CAT 4 (AUS)
- Max sustained winds of 195 kmh (120 mph) with gusts to 250 kmh (155 mph)
- “Phenomenal” rains of 1000mm (39.37”) in 48 hours
- Maximum storm tide 7.21m (23.7 feet) at Laguna Quays
- Death toll officially 14
- ~$2.67 billion (USD) in damages



Hurricane Ophelia (2017)

- Saffir-Simpson Category 3
- Max sustained winds of 115 mph
- Worst storm in Ireland in 50 years
- Death toll 5
- Still a tropical circulation north of 55N
- ~$13.6 million in damages



Is this the new (ab)normal?

There are many factors at play…

Thermal energy and heat drive Tropical Cyclones

Salinity drives the ocean's currents

Currents are warming and slowing as salinity declines (March 2018, Columbia Univ. and Johns Hopkins Univ.)

As the atmosphere and oceans warm, the conclusion has been drawn that there will be a commensurate increase in the intensity of cyclones.

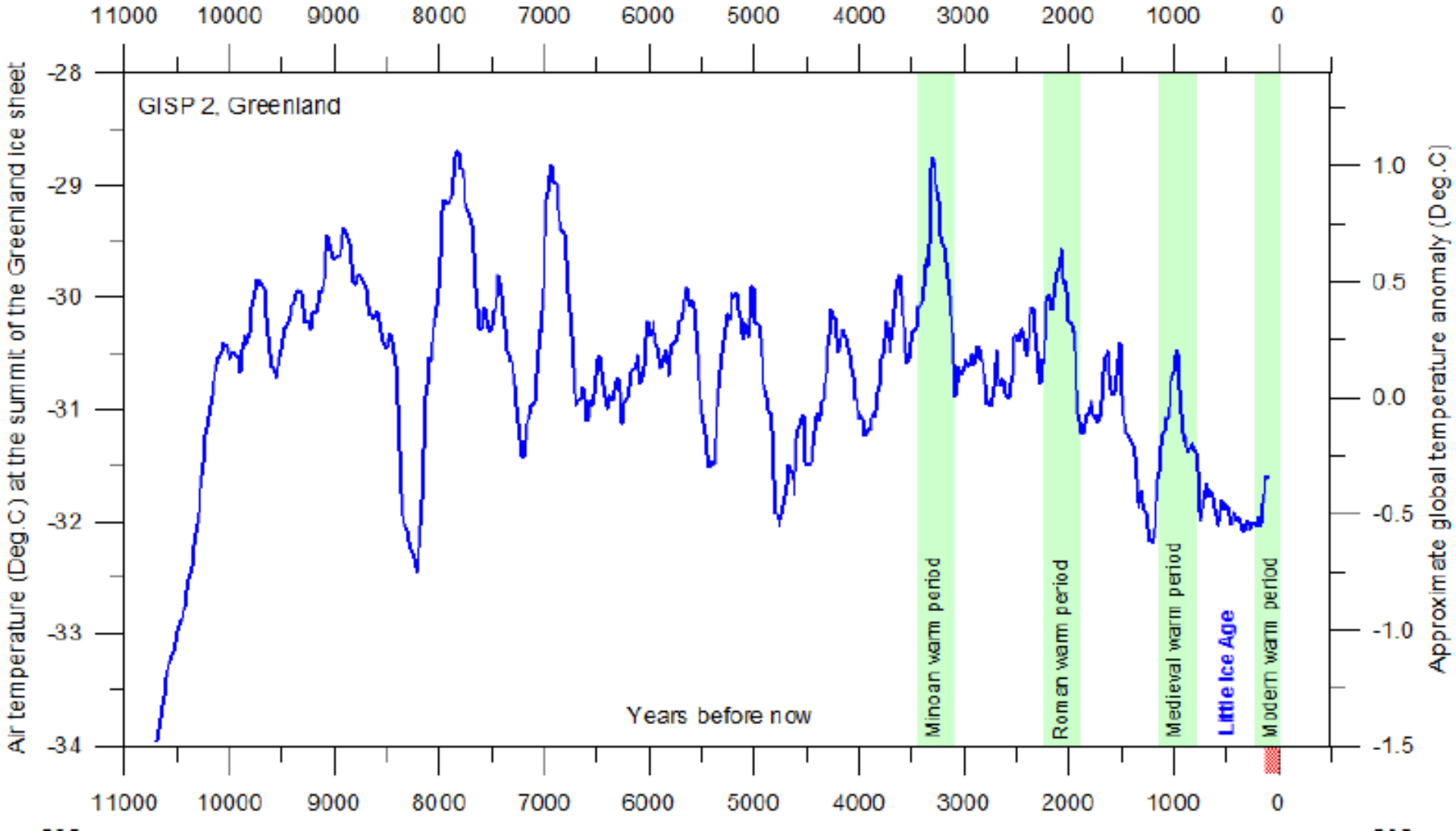
As air temperatures increase, so does the ability for the atmosphere to hold more water (Classius Clapyeron equation)

Is this the new normal? Not necessarily…

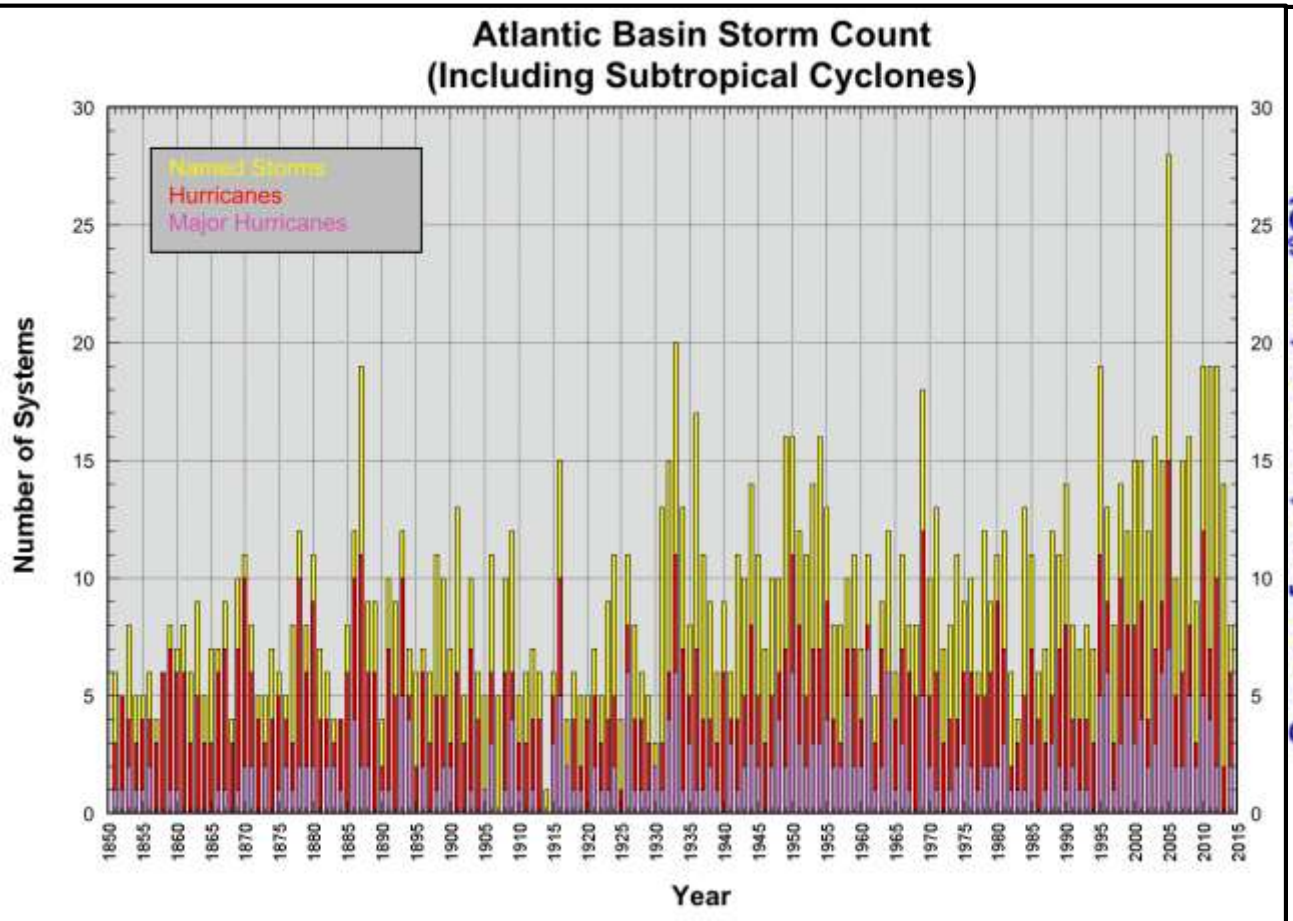
Tropical cyclones formation and dynamics are driven by many other physical parameters

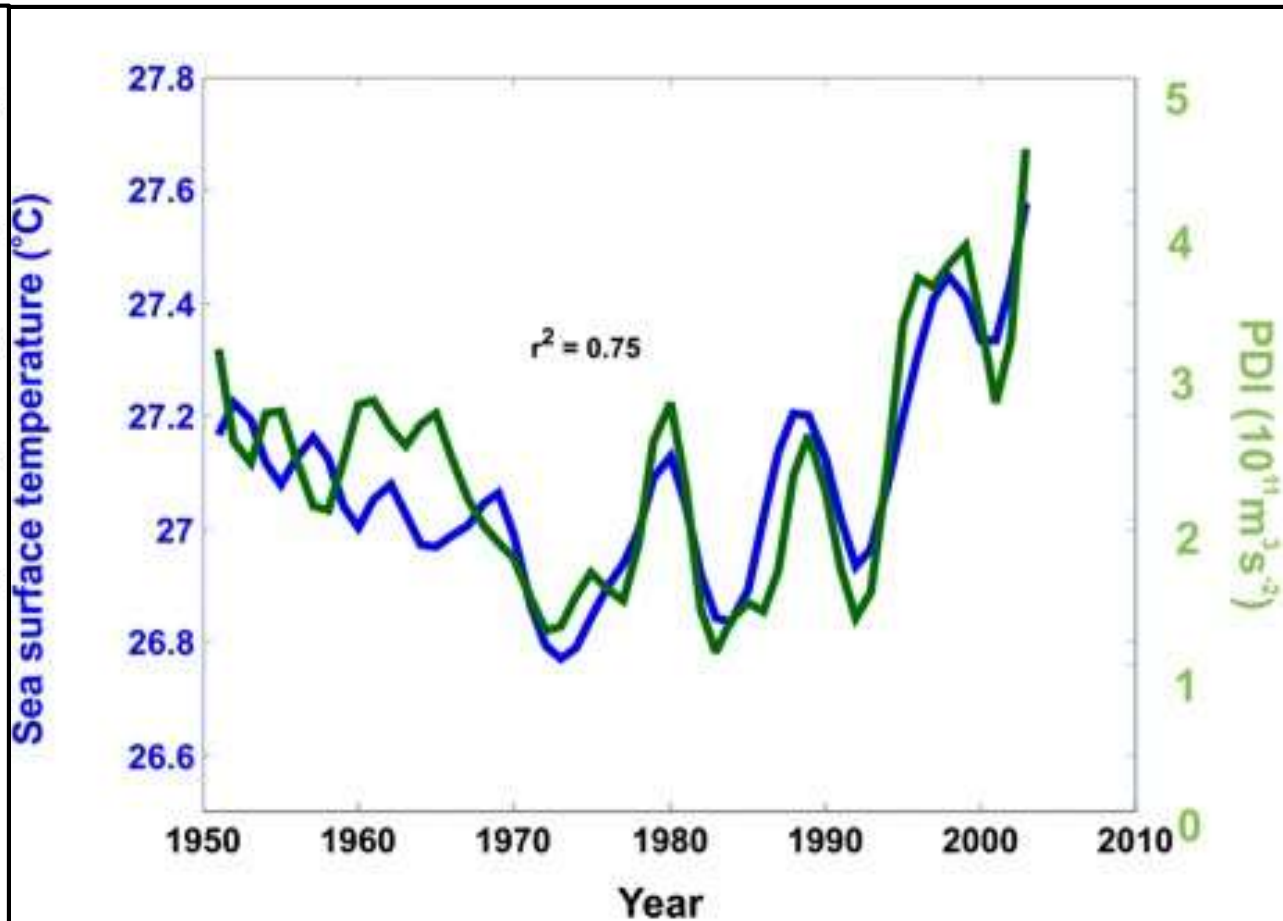
- La Niña/El Niño cycle
- A warming atmosphere doesn’t insure greater storm intensity because it is warming the entire column of air
- The presence of a disturbance to start cyclonic motion still has to be there to create the storm
- Significant changes in currents and salinity may or may not be a consequence of a changing climate, and may or may not contribute to storm of greater intensity.

Is there a “Normal” Depends on Period of Record

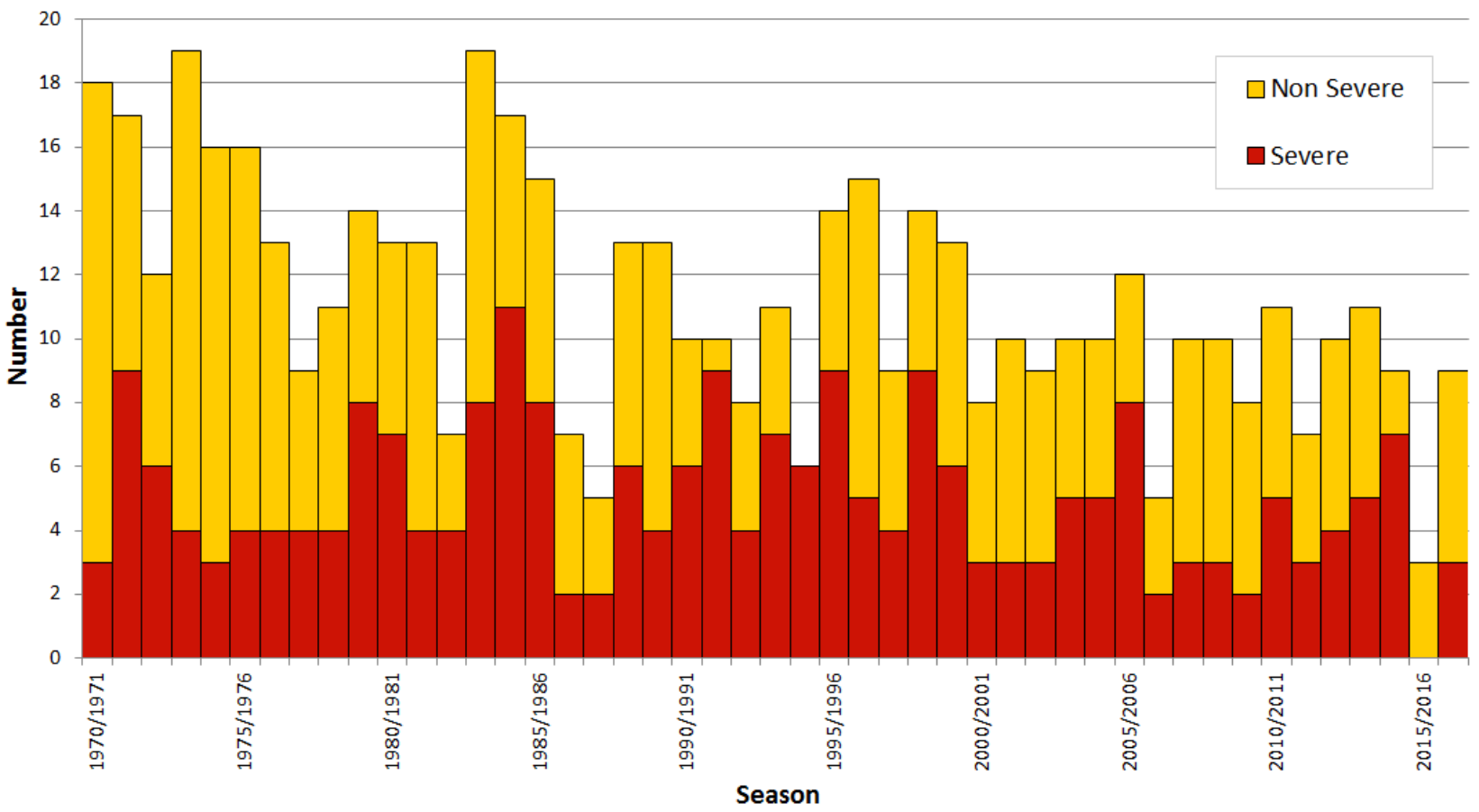


In the Atlantic we are seeing…





On the other hand, in Australia we are seeing…



CSIRO and BOM, 2015

Storm Consequences

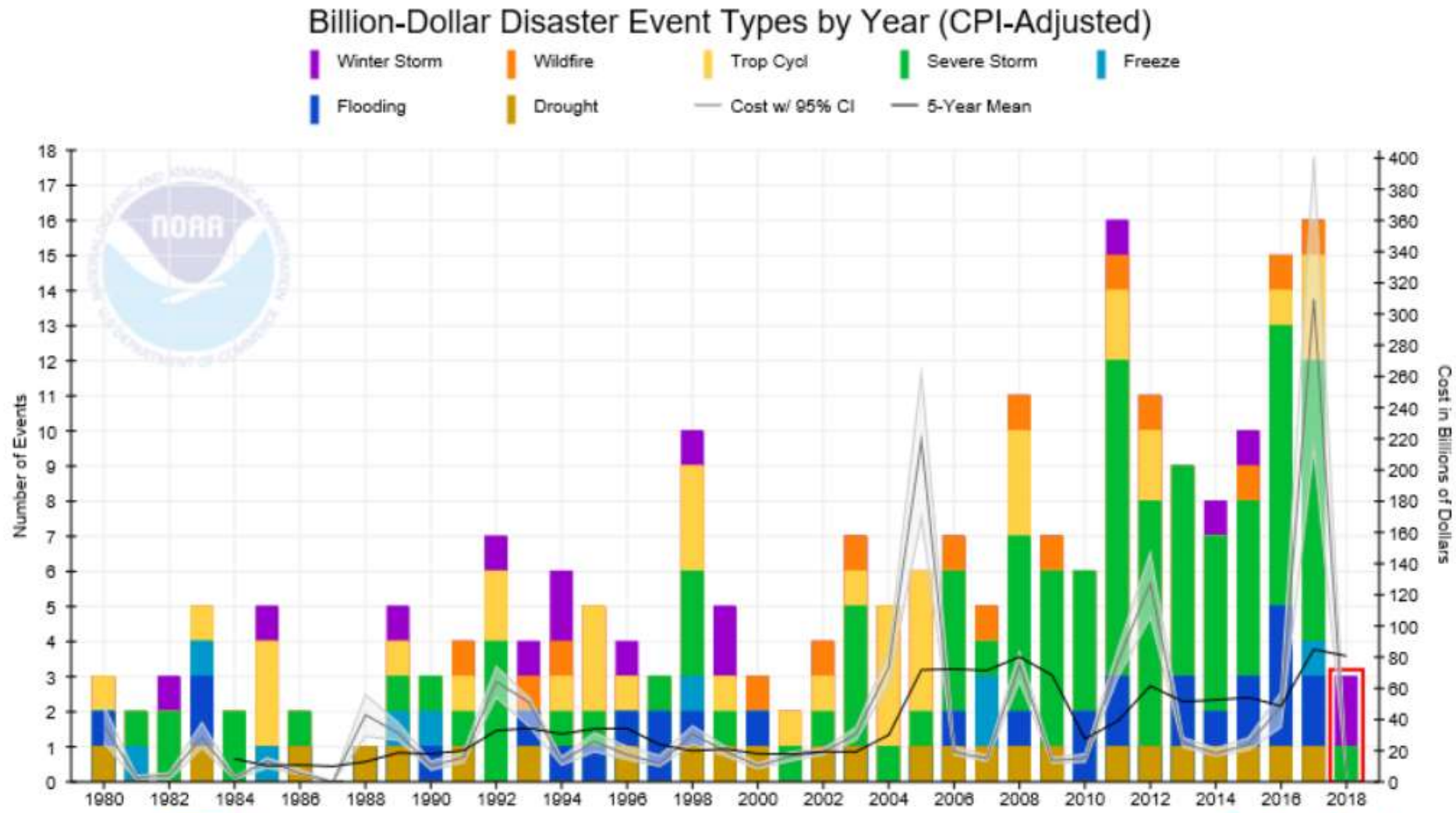
While data shows that tropical cyclones are increasing in frequency and intensity in the North Atlantic, there are other factors as well.

- More people are living in exposed coastal regions than ever before
- The cost of extreme storm hazard mitigation is increasing
- The U.S. is still in a reactive rather than proactive response mode

Drought | Freeze | Tropical Cyclone | Winter Storm | Cost with 95% CI

Flooding | Severe Storm | Wildfire | All Disasters | 5-Year Cost Mean

Update



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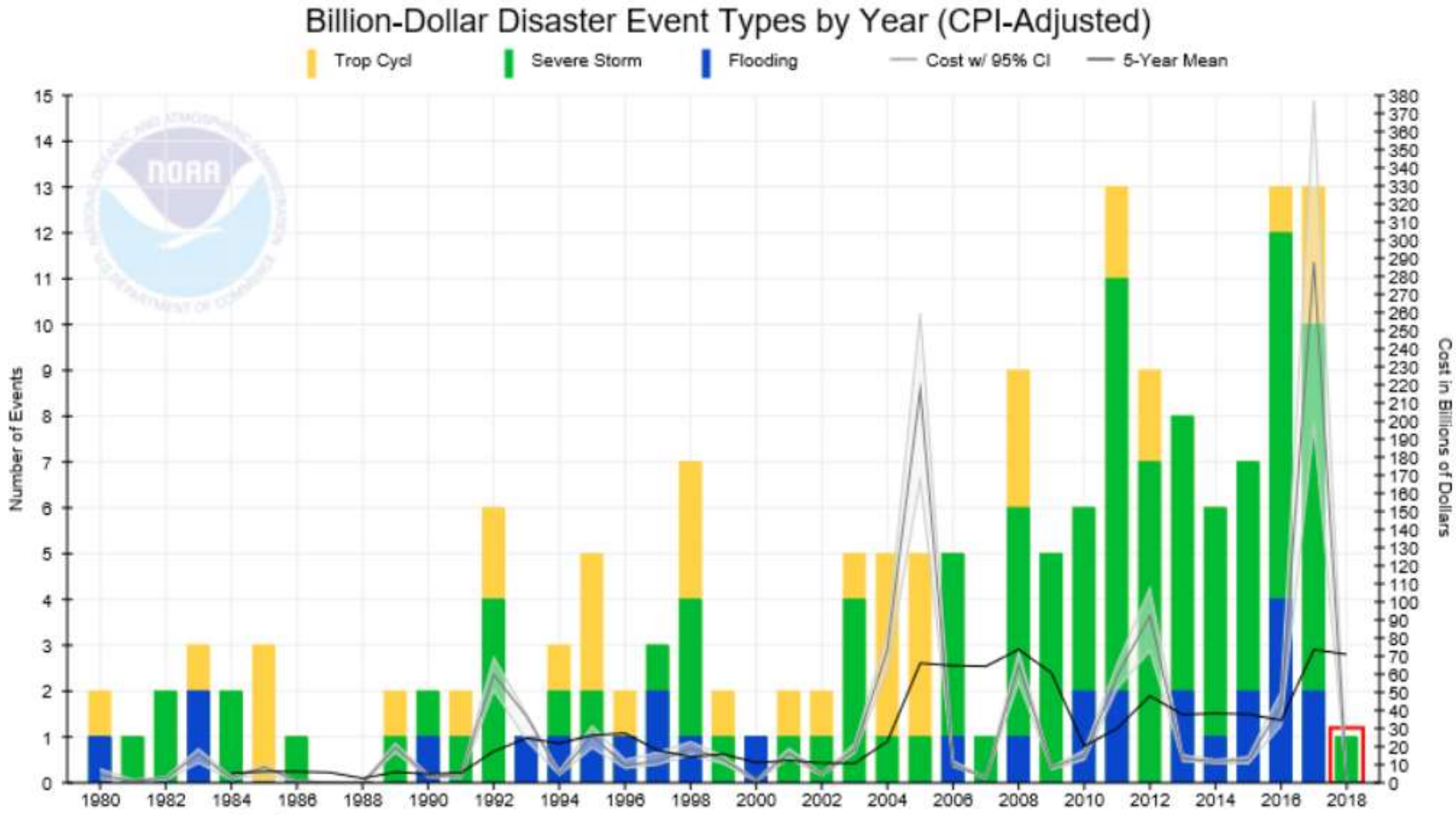
Number of events as of April 6, 2018

☐ Drought ☐ Freeze ☑ Tropical Cyclone ☐ Winter Storm ☑ Cost with 95% CI

☑ Flooding ☑ Severe Storm ☐ Wildfire ☐ **All Disasters** ☑ 5-Year Cost Mean

Update



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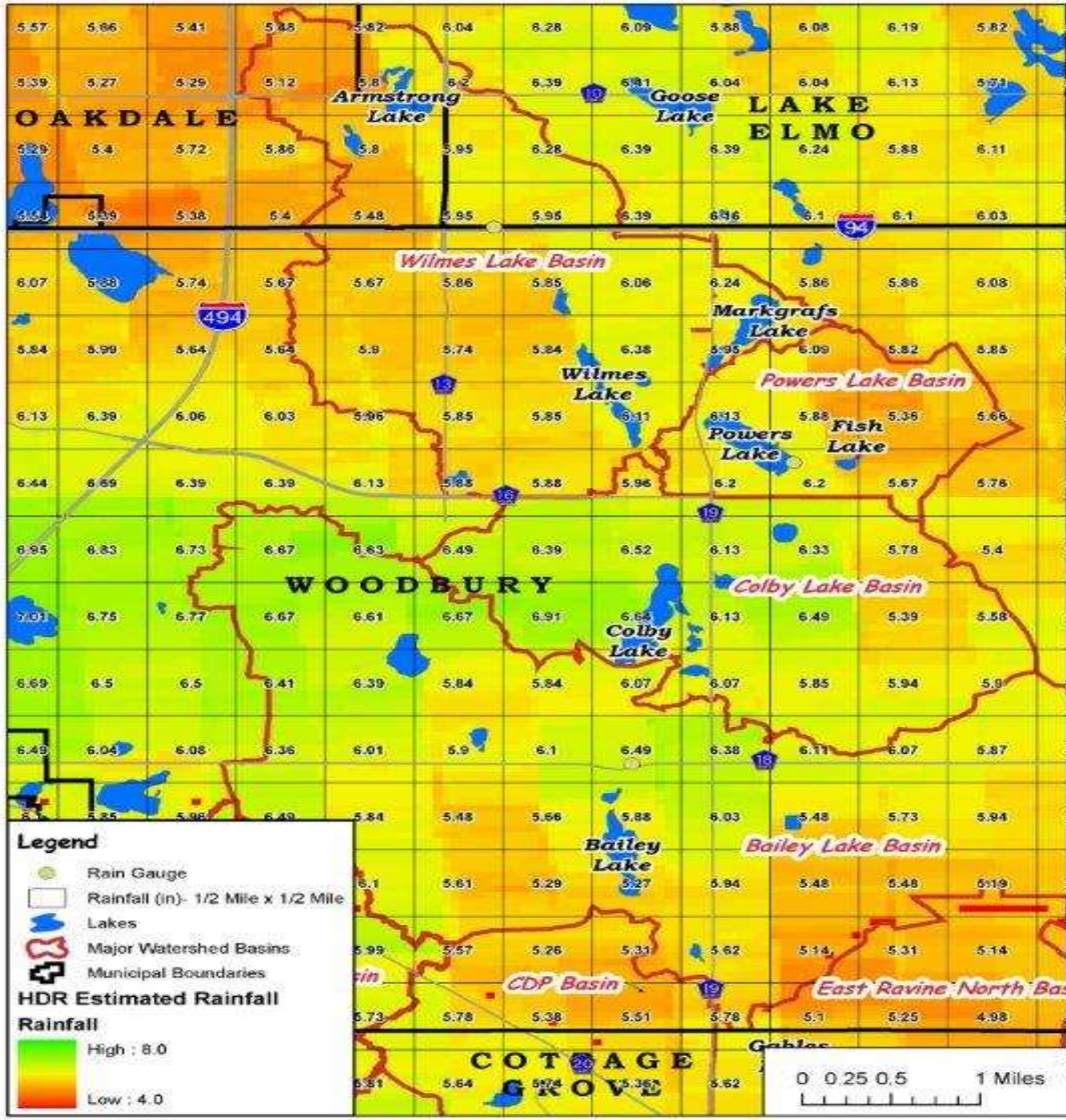
Number of events as of April 6, 2018

32 Years of Super Storms and Floods of Record

- 1987 Minneapolis, MN Super Storm
- 1993 Mississippi River Floods
- 1997 Grand Forks/East Grand Forks Red River of North Floods
- 2004 South Washington Super Storm
- 2005 Hurricane Katrina
- 2008 Cedar Rapids, IA Floods
- 2009 Hurricane Sandy
- 2011 Souris River Floods (Minot, ND)
- 2011 MO River Floods Council Bluffs, IA Flood Fight
- 2013 Colorado Flash Floods
- 2015 South Carolina Floods
- 2017 Hurricane Harvey
- 2018* Mo River Flood Repeat?

South Washington Watershed District Central Draw

- Development criteria was to maintain existing flow rates for a TP-40 - 5.9 inch 100-yr 24-hour event
- Low floor elevations 3 feet above 100-year elevations around rate control basins.
- A “training” event of convective thunderstorms produced rainfall totals that met or exceeded the design event in terms of volume and intensity
- Many basins exceeded their freeboard, causing walk-out flooding around basins.
- Volume control became an issue as ponds in series did not factor upstream releases from basins.



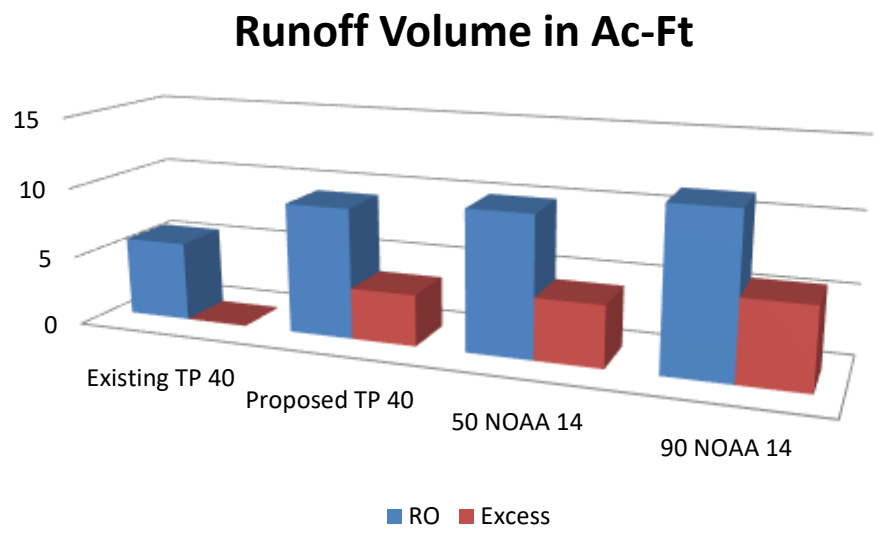
The Problem With Criteria

- Community Drainage Standard – No Increase in peak discharge from 100-year, 24-hour storm.
- Type II Rainfall Distribution – Created high peak, low volume dry basin to temporarily detain excess runoff over existing conditions.
- In general, average soil moisture conditions were applied to design basins.
- Three feet of freeboard above predicted 100-year of basin was used (borrowed from FEMA regulations) to establish low floor elevations.
- No provisions for overflow provided

Existing Land Use = Rural-Open
Soil Group B with Moderate Slope
Runoff Coefficient 0.23

Proposed Land Use – Mixed Residential
Runoff Coefficient 0.38

100-year TP 40 Rainfall 5.9 inches
100-year NOAA 14 Rainfall 6.3 inches 50 Percentile
100-Year NOAA 14 Rainfall 7.2 inches 90 Percentile



Hydraulic Drainage Criteria Creates Interior Flooding Situations

- **SECTION 3 - STREET FLOW**
- **3.1.0 - GENERAL**
- The location of inlets and permissible flow of water in streets should be related to the extent and frequency of interference to traffic and the likelihood of flood damage to surrounding property for the 25 and 100 year frequency storms. Interference to traffic is regulated by design limits of the spread of water into traffic lanes, especially in regard to arterials. Flooding of surrounding property from streets is controlled by limiting curb buildup to the top of curb for a 25 year storm which is designated as the design storm. **Conveyance provisions for the 100 year storm must also be made within defined right of way and easements.**

Broad Application of Community Development Permitting and Drainage Criteria Has Secured Drainage Problems For Decades to Come

- South Washington Watershed District, Mn – Central Draw Project
- Louisville Kentucky, Interior Drainage System
- Federal, State, Local Roadway Systems
- Major Rail Systems

Understanding the Needs of the Community

- Climate Is Variable and Non-Stationary
- Chronic stresses weaken community
- Climate and natural shocks will increase scale of plausible disasters
- Resiliency is in the planning, response and action

City Resilience…

…is the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience. (source: Rockefeller Foundation)

Never Again!
Cedar Rapids

- Designed to convey the same water volume as the flood of 2008
- Approximately 7 miles long
- Protects both sides of the river
- Combination of permanent floodwalls, removable walls, levees and gates (approximately 20 percent removable walls)
- Incorporates aesthetic elements that reflect culture and history of the community
- Includes pump stations and detention basins to protect against rain water flooding as pipes close to protect against river.

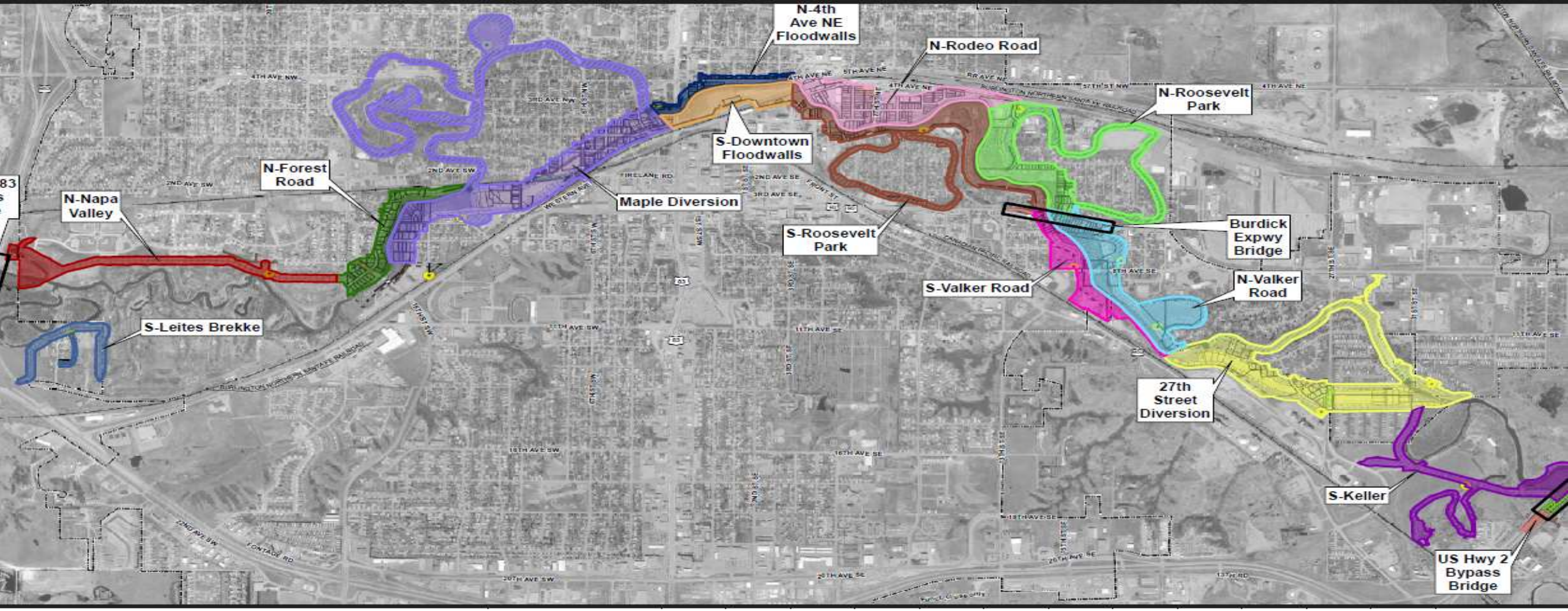

Cedar Rapids


Minot

Cedar Rapids Flood Damage Reduction Elements

Cedar Rapids Elements Completed To Date

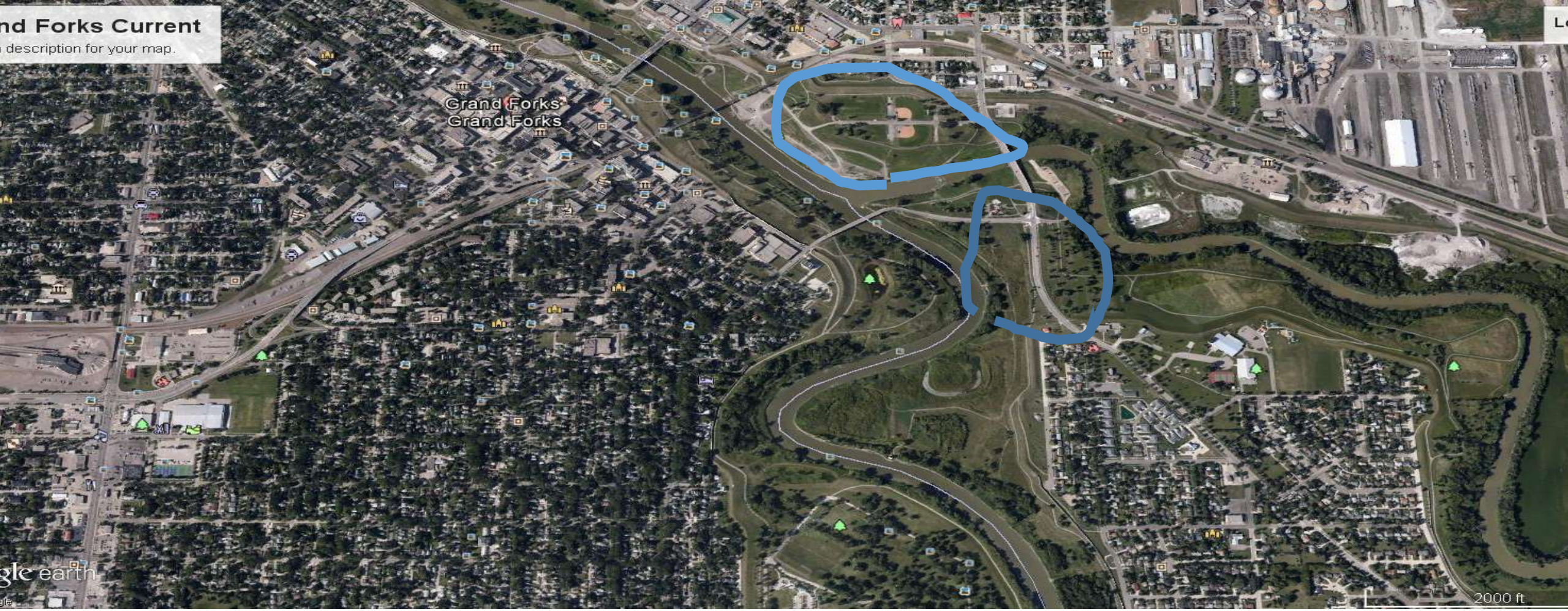
Minot 2011 – Never Again!



Minot Multi-Year Plan With Final Construction in 2026

1979 Grand Forks Flood

Grand Forks Flood of 1997



Grand Forks – Flood of Record (212 Year plus 2.7 feet of Freeboard) Flood Control

The New Normal Is? - There Never Was Normal