



# Disasters Near Work Zones: Rapid Response Techniques



*Traffic Management and Safety during Winter Construction and Severe Weather*  
Funded by FHWA 2016 Work Zone and Guardrail Safety Grant Program

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**Federal Highway Administration**

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# Learning Objectives

Today's focus: Rapid response to the combined effects of a work zone and a disaster such as severe weather

By the end of this webinar, you should able to:

- Explain why some parts of the US are getting less precipitation and others more
- Explain how this affects work zones
- Discuss options for building **expedient** roads
- Discuss options for **expedient** waterway crossings
- Discuss **temporary** roundabouts



Source: NASA



# What is “Expedient”

Expedient facilities:

- Rapidly constructible
- Based on readily-available personnel, equipment, and materials
- Intended to serve only essential traffic
- Expected service life about a year (or less)
- Built under emergency authority
- Easy to remove and restore to prior condition



Source: Photographer unknown/University of Washington collection

*Example:*

- *Due to flooding, a community has been cut off from the highway network*
- *Existing culverts washed out*
- *No culvert pipe available locally*
- *Solution: Build box culverts using local materials (timbers, logs, stone, etc.)*



# Work Zones Can Make Existing Vulnerabilities Worse

**Adverse event vulnerabilities vary by region and site**

- Storms (hurricanes, etc.)
- Flooding
- Snow in unusual times/places
- Wildfires
- Earthquakes
- Rockslides
- Dam failures
- Train derailments



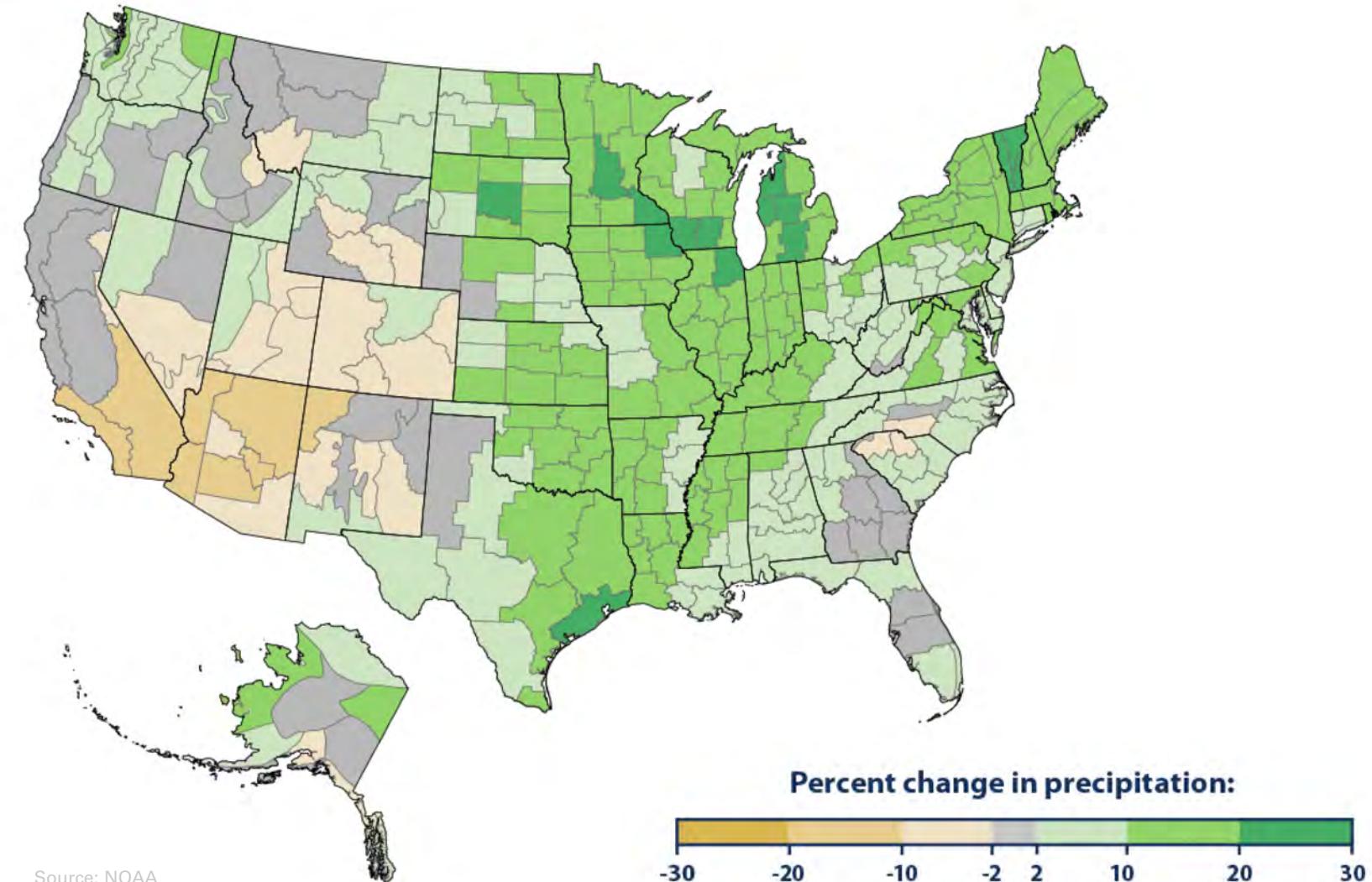
Source: Jocelyn Augustino/FEMA



Source: Jblackst/Wikimedia Commons [CC 3.0]



# Change in Precipitation in the United States, 1901–2020





# Why are some parts of the US getting drier and others wetter?



## California 2021

Source: Ventura County Fire Dept



## Missouri 2019

Source: Alk123/Wikimedia Commons

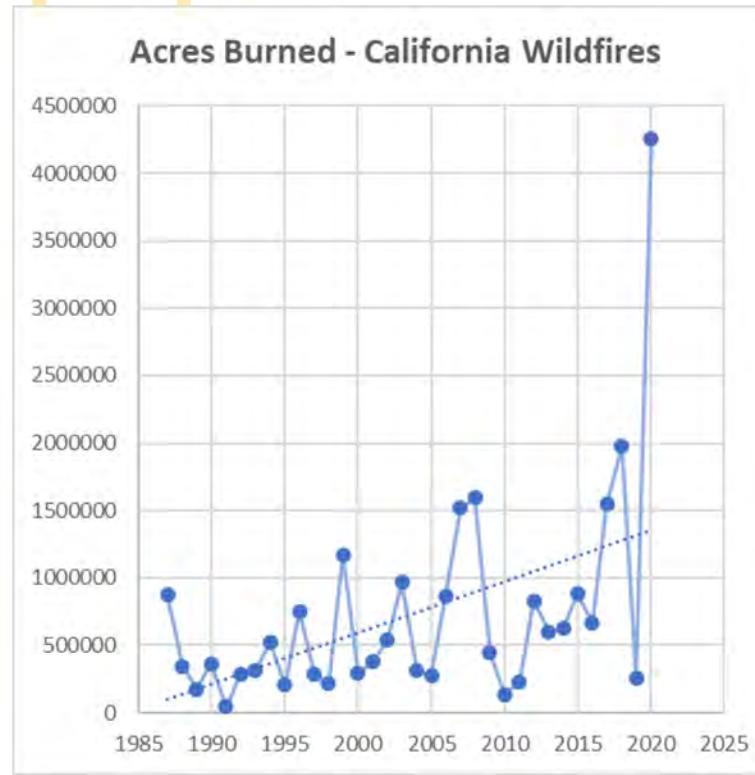


## Louisiana 2020

Source: Josiah Pugh/US National Guard



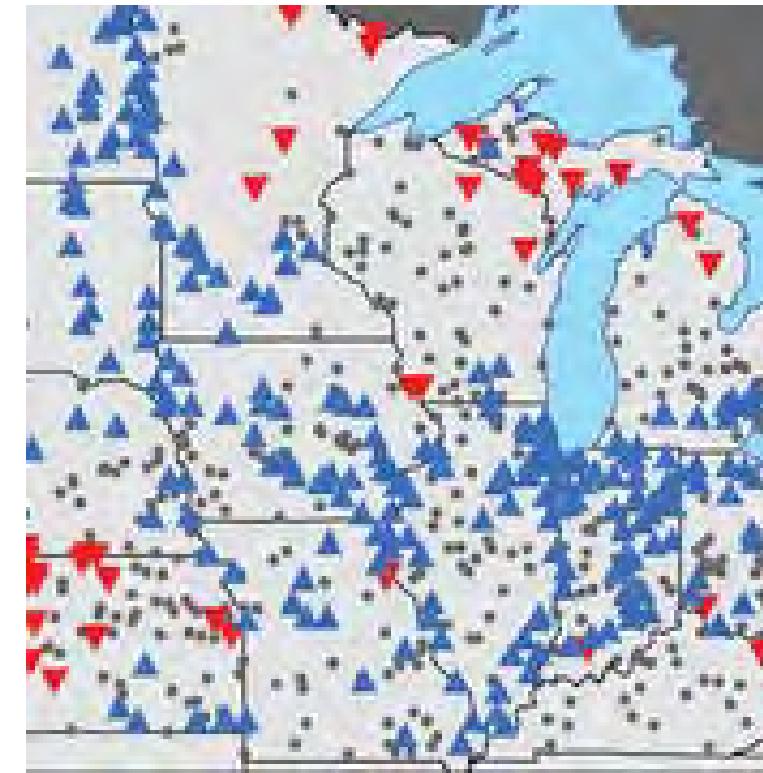
# Long-term trends



## California Wildfires

Acres burned per year

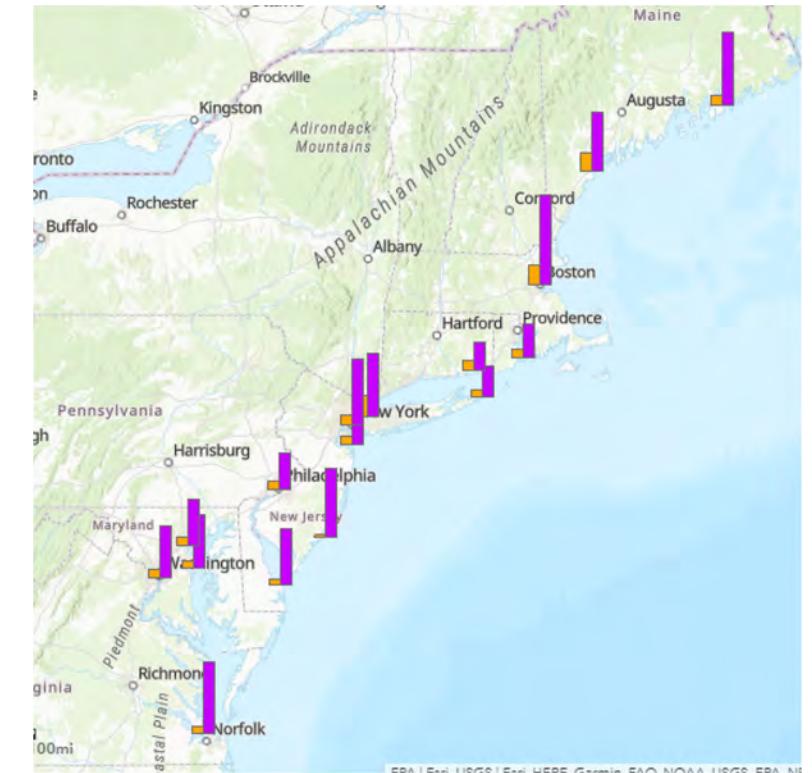
Source: CalFire (State of California)



## Inland Flooding

Blue triangles: Increasing  
Red triangles: Decreasing

Source: Millakpour & Villarini 2015



## Coastal Flooding

Orange bars: 1950s  
Purple bars: 2010s

Source: NOAA/EPA



# Nautical Logs: A Window Into Past Weather

**LOG of the UNITED STATES Arctic Steamer "Jeannette"**, Rate G  
Making passage from Kolukchui Bay in search of Wrangel Land.

Hour.	Knots.	Fathoms.	Courses steered.	WINDS.		Leway,	BAROMETER.		TEMPERATURE.			State of the weather by symbols.	Forms of Clouds by symbols.	Perc. of clear Sky, in 10ths.	State of the Sea.	Record of the sail the vessel is at end of watch.
				Direction.	Force.		Height in inches.	Ther. att'd.	Air Dry Bulb.	Air Wet Bulb.	Water at surface.					
A. M.																
1	Turning in a circle	"	N.	1			30.09	32	31	3	34	8.c.	Strat.	9	5.	
2	"	"	N.	1			30.09	32	32	3	34					
3	1 0	N.N.W.	N.	1			30.09	32	32	3	34					
4	1 0	"	N.	1			30.04	32	30	8	32					
5	5 0	North W.	"	3			30.05	82	28	28	32					
6	5 0	"	"	4			30.05	81	29	20	32					
7	4 0	N.N.W.	"	4			30.05	81	27	21	31					

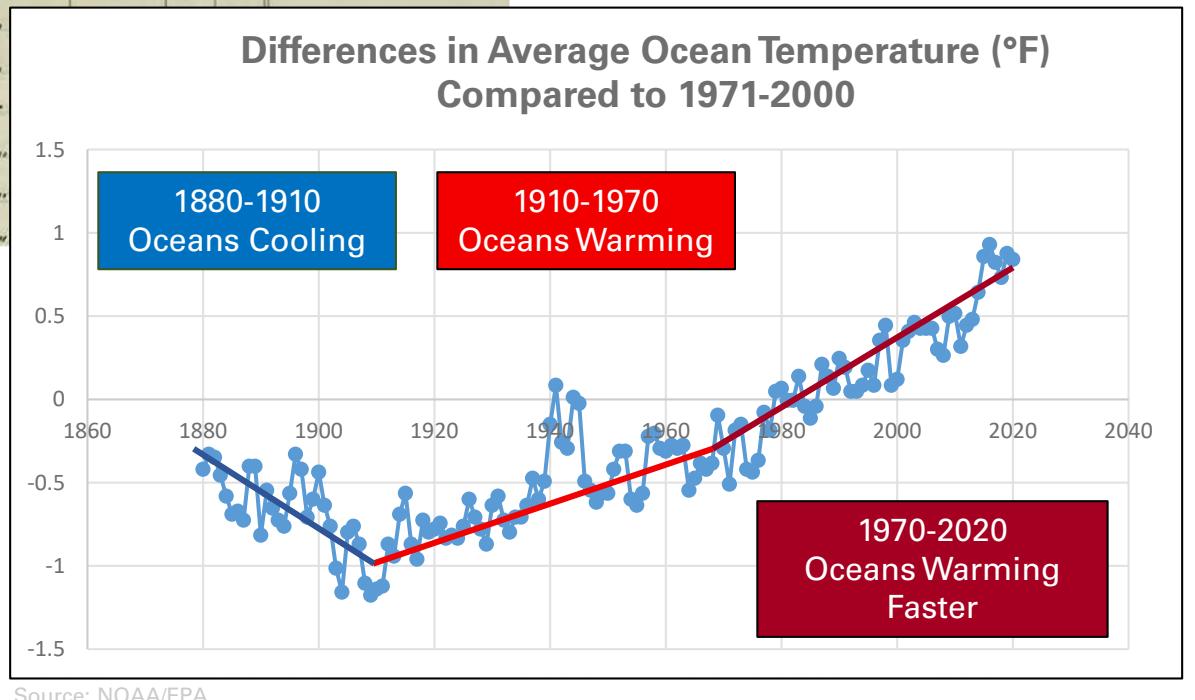
Source: US Navy

Millions of observations from 100,000s of voyages:

- Wind speed & direction
- Barometric pressure
- Air temperature
- Water temperature

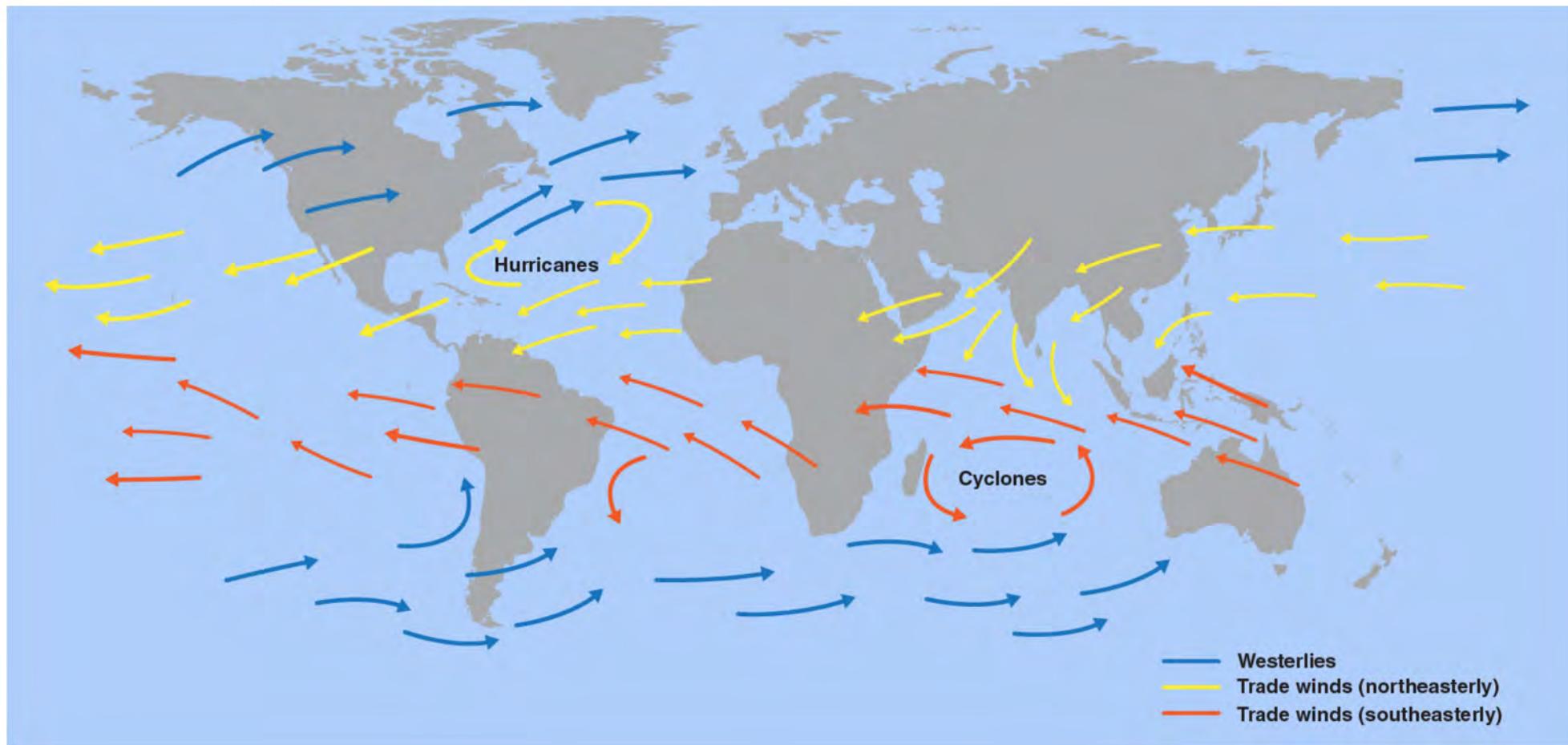


Source: James Gale Tyler (oil on canvas 1883)





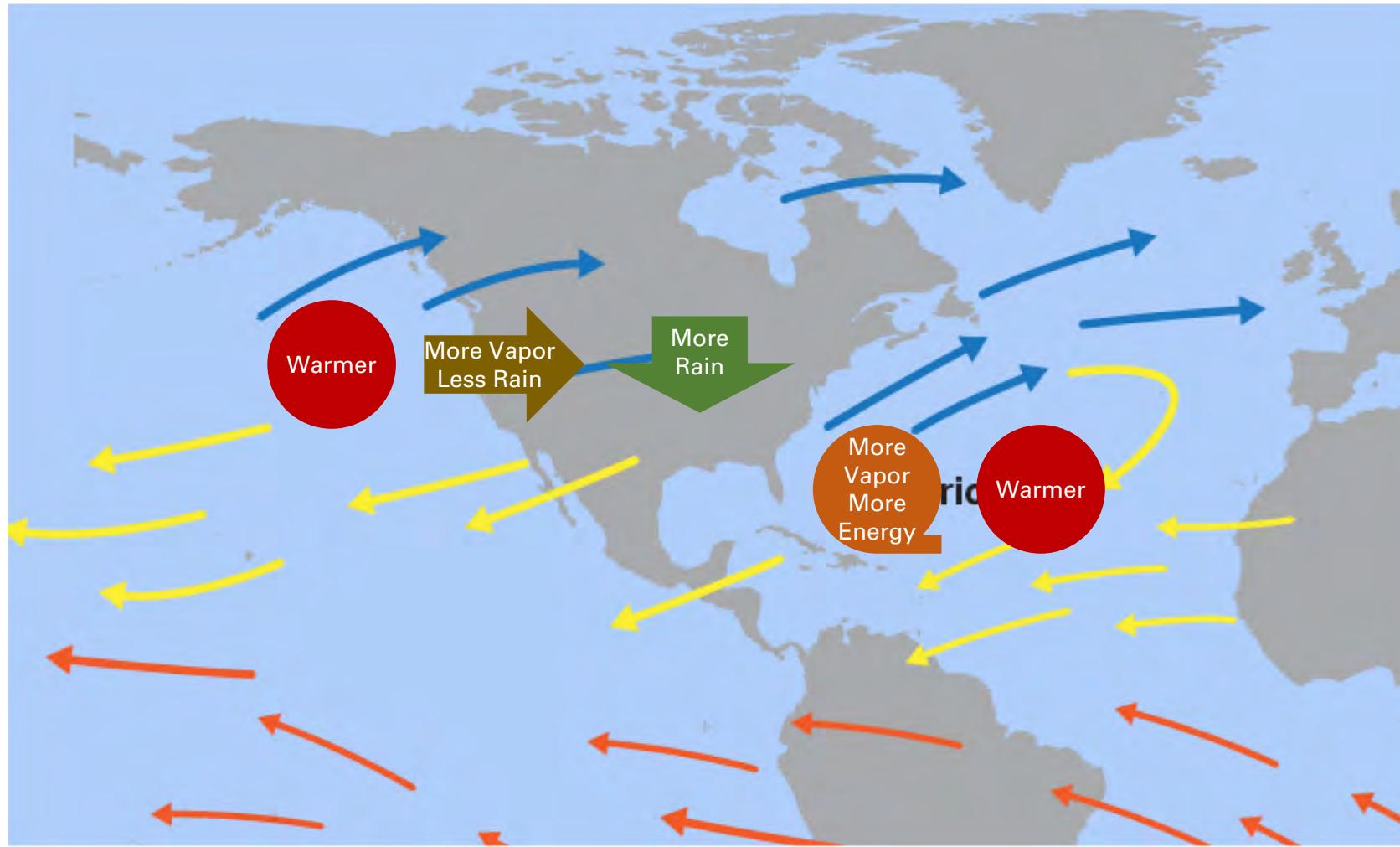
# Prevailing Surface Winds



Source: NASA/JPL-Caltech



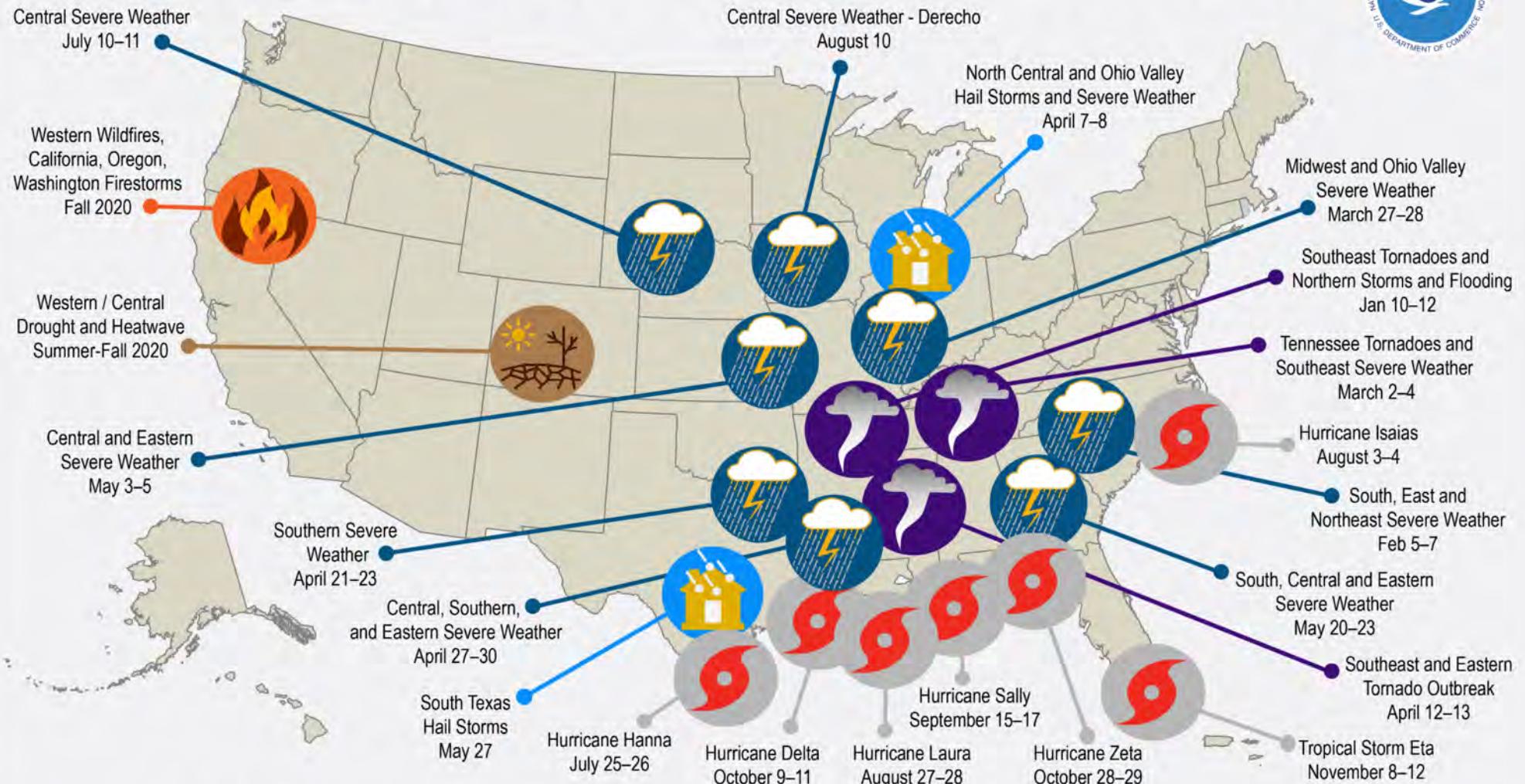
# Effect on North America



Base Map Source: NASA/JPL-Caltech



# 2020 Weather & Climate Disasters with Damage >\$1 Billion

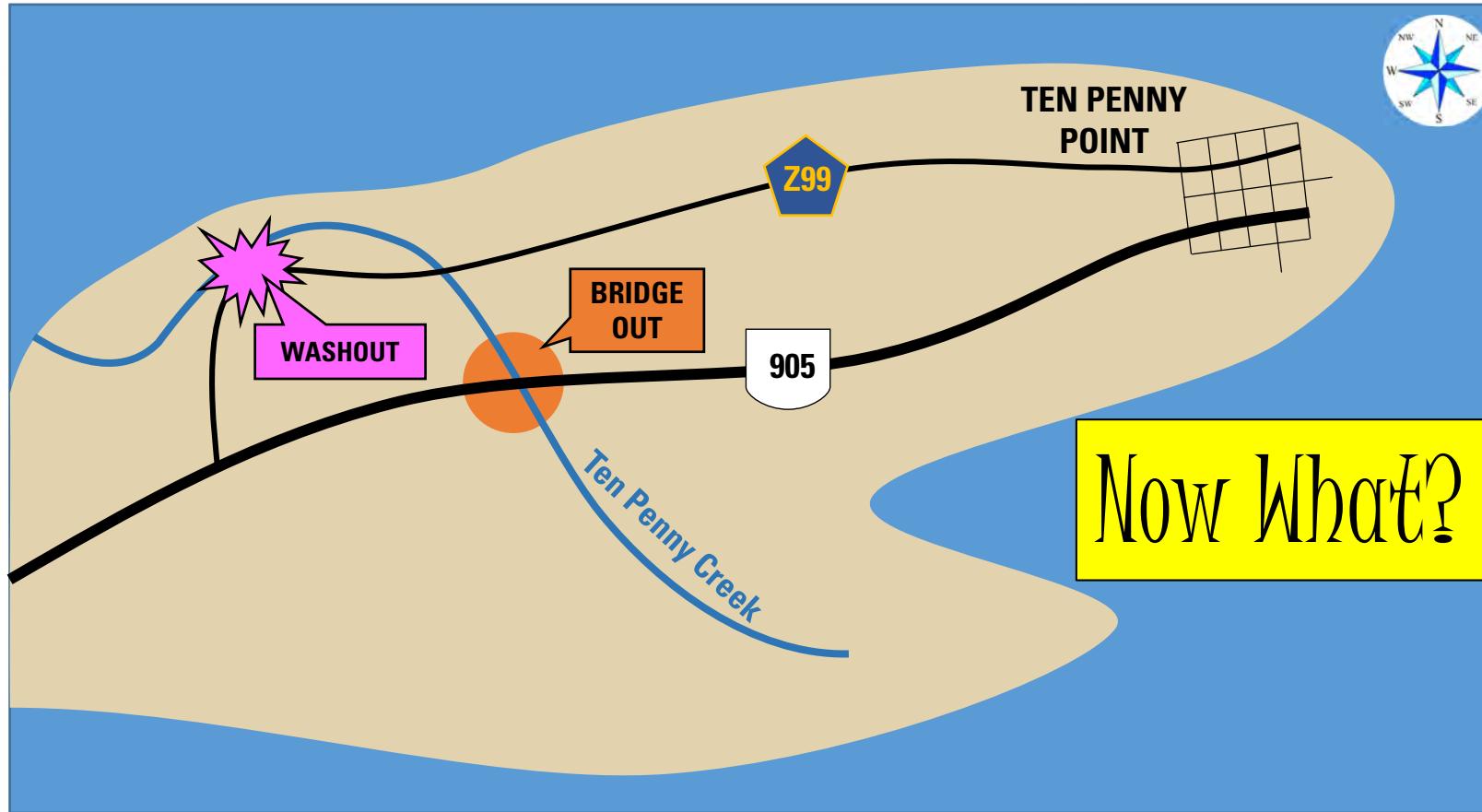


Source: NOAA

This map denotes the approximate location for each of the 22 separate billion-dollar weather and climate disasters that impacted the United States during 2020.



## Current Situation

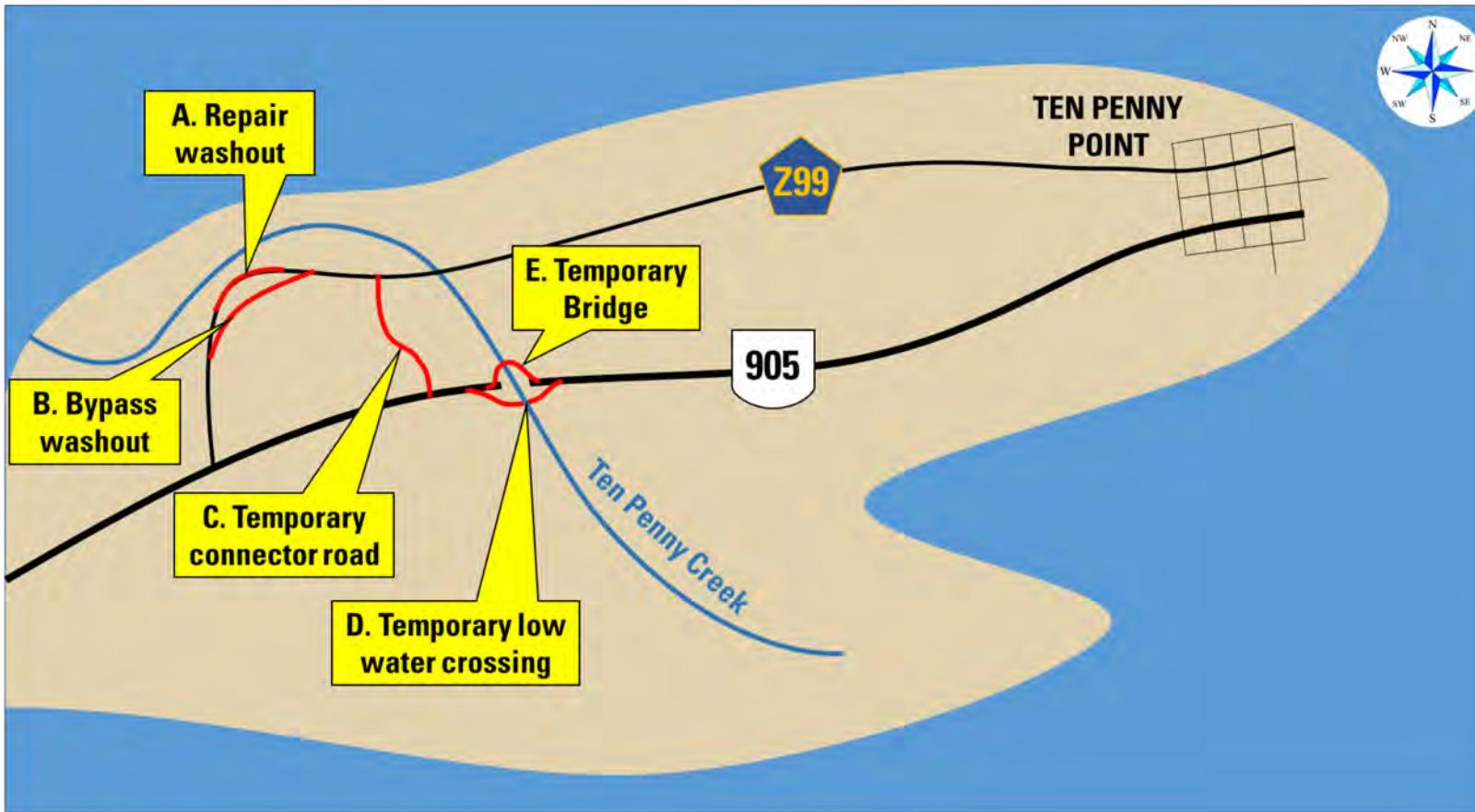


Source: FHWA

As the number of adverse events continues to increase, so does the likelihood of interactions between events and work zones.



# General Strategies



Source: FHWA

- Reinstating facility that was under construction
  - Repairing damage
  - Bypassing damage with expedient road or trail
  - Temporary connectors
  - Temporary low water crossings
  - Temporary bridges and culverts



# Expedient Facilities

In most cases, an expedient facility will **not** be able to handle all types of traffic in all types of weather.

## **What is the objective at this site?**

- Access for first responders (fire, police, EMS, etc.)
- Access for residents
- Evacuation of residents
- Support emergency response
- Support post-incident recovery
- Bypass the affected area

## **What traffic is to be served?**

- Pedestrians
- All-terrain vehicles
- Sedans
- Light trucks and SUVs
- Fire trucks with all-wheel drive
- Fire trucks with two-wheel drive
- Heavy trucks



# Case Example: Wildfires in Eurobodalla Shire, Australia (2019)

Before Fire



Fire Damage – December 2019



- Wildfires destroyed 18 timber bridges
- Access to rural communities cut off

Source: Eurobodalla Shire Council (both images)



# Case Example: Wildfires in Eurobodalla Shire, Australia (2019)

**"Our initial priority was to restore access and it was all hands on deck to undertake temporary repairs and build side tracks where we could."**

--Lew Oldfield, Council Engineer

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# Case Example: Wildfires in Eurobodalla Shire, Australia (2019)

Temporary Side Path – January 2020



Temporary Bridge on Old Alignment – March 2020



Permanent Bridge Construction – July 2021



"We are now focusing on permanent solutions. It's a massive undertaking but we're making solid headway."

--Lew Oldfield, Council Engineer.

Source: Eurobodalla Shire Council (all images)



# Temporary Road Surfacing



Source: Lionel Allorge/Wikimedia Commons [CC]



Source: Millsy/Wikimedia Commons [CC]



Source: Qyd/Wikimedia Commons [CC]



Source: John Suscovich/YouTube

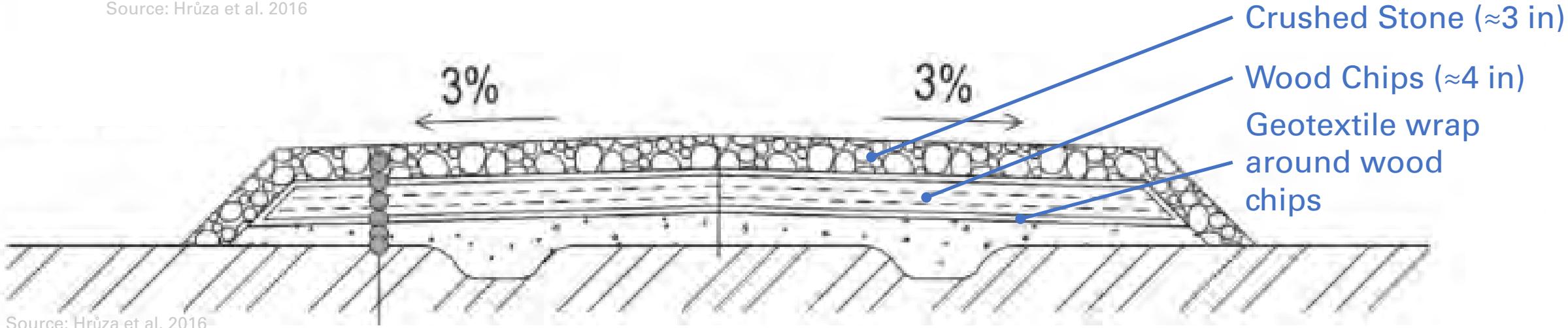


# Stabilization – Wood Chips in Geotextile Envelope



Source: Hrůza et al. 2016

- Deep wood chip fills widely used for forestry roads
- Decays naturally
- Wood chips wrapped in geotextile for stabilization of soft subgrades





# Bagged Aggregate Technique

1. Placing and tamping first layer of gravel-filled bags



2. Spreading gravel interlayer



3. Placing and tamping second layer



4. Nearly completed road

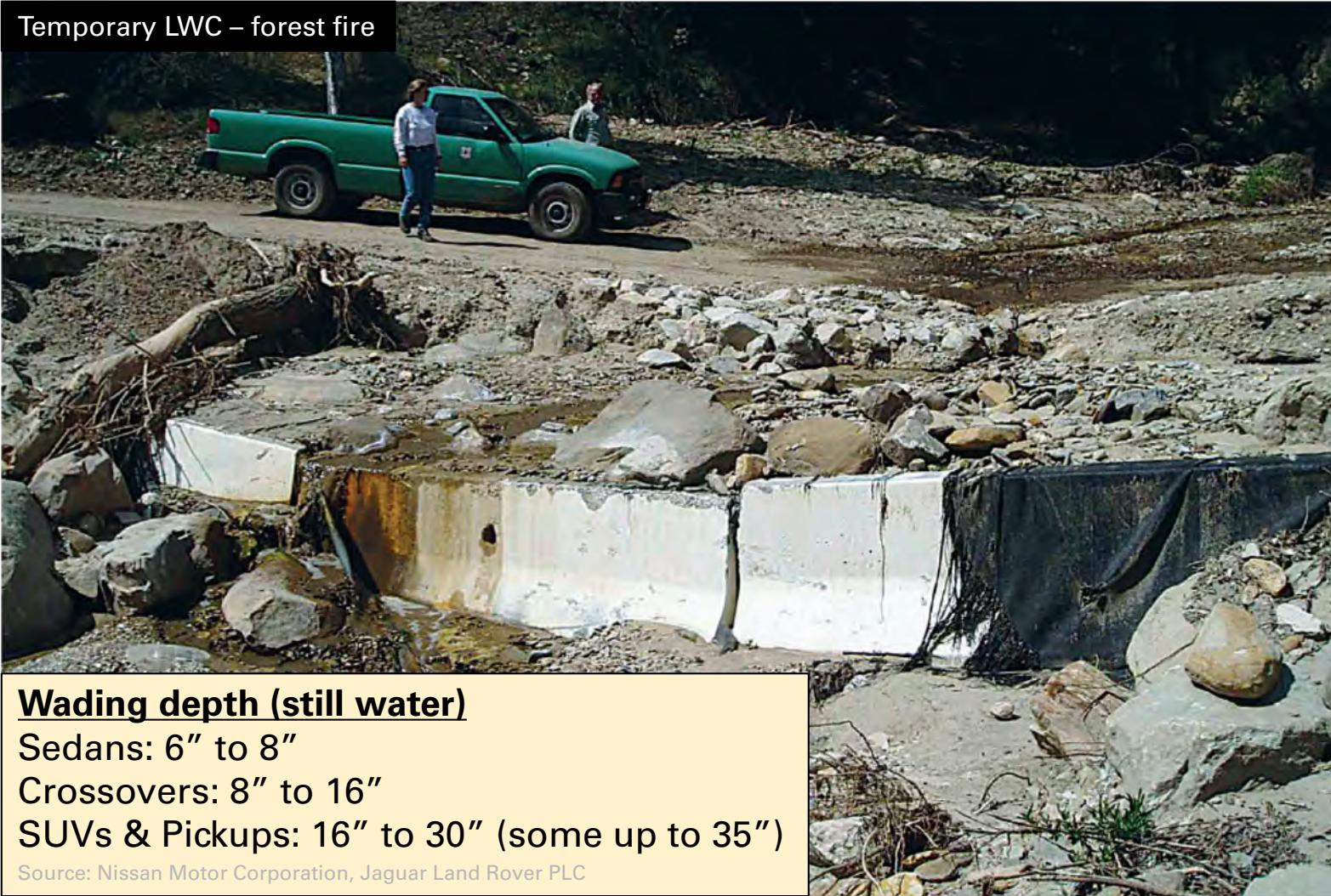


Source: Community Road Empowerment (all images)



# Temporary Low Water Crossings

Temporary LWC – forest fire



Source: Upper right – Massachusetts Dept of Environmental Protection. All others -- U.S. Department of Agriculture – Forest Service



# Temporary Pipe Culverts





# Temporary Box Culverts – Bagged Gravel & Logs

3. Placing log deck



1. Tamping bags



2. Checking height



4. Gravel running surface



Source (all images): Japan International Cooperation Agency/YouTube



# Temporary Bridges 1: Skidder

Timber



Steel



Stackable



Flat Rack



Source: Main image - Vermont Agency of Natural Resources; top right and center right- North Carolina Division of Forest Resources; lower right - Gazouya-japanWikimedia Commons



# Temporary Bridges 2: Floating/Pontoon

Pedestrian



Barge



Military M4T6



High Capacity





# Temporary Bridges 3: Bailey Bridge



Source: Хрюша/Wikimedia Commons [CC 3.0]

- Modular panel truss
- 10 foot sections
- Each component less than 600 lb
- Hand launch with groups of ~6 people
- Can launch from one side of river or gorge
- Can double or triple panels horizontally or vertically for more load capacity
- Non-proprietary
- Invented 1940-41, still in production



# Temporary Bridges 3: Bailey Bridge Examples



Source: Rob Kemme/Wikimedia Commons [CC 3.0]



Source: Jaggery/Wikimedia Commons [CC 3.0]



Source: Robby/Wikimedia Commons



Source: Jollyswagman/Wikimedia Commons [CC 3.0]



# Temporary Bridges 4: Additional Designs

Mabey-Johnson



Source: U.S. Army/Flickr

Callender-Hamilton



Source: Llewelyn Pritchard/Wikimedia Commons [CC 3.0]

Prefabricated Girder



Source: Vermont Agency of Natural Resources

Experimental



Source: Hiroshima University/YouTube



# Temporary Roundabouts



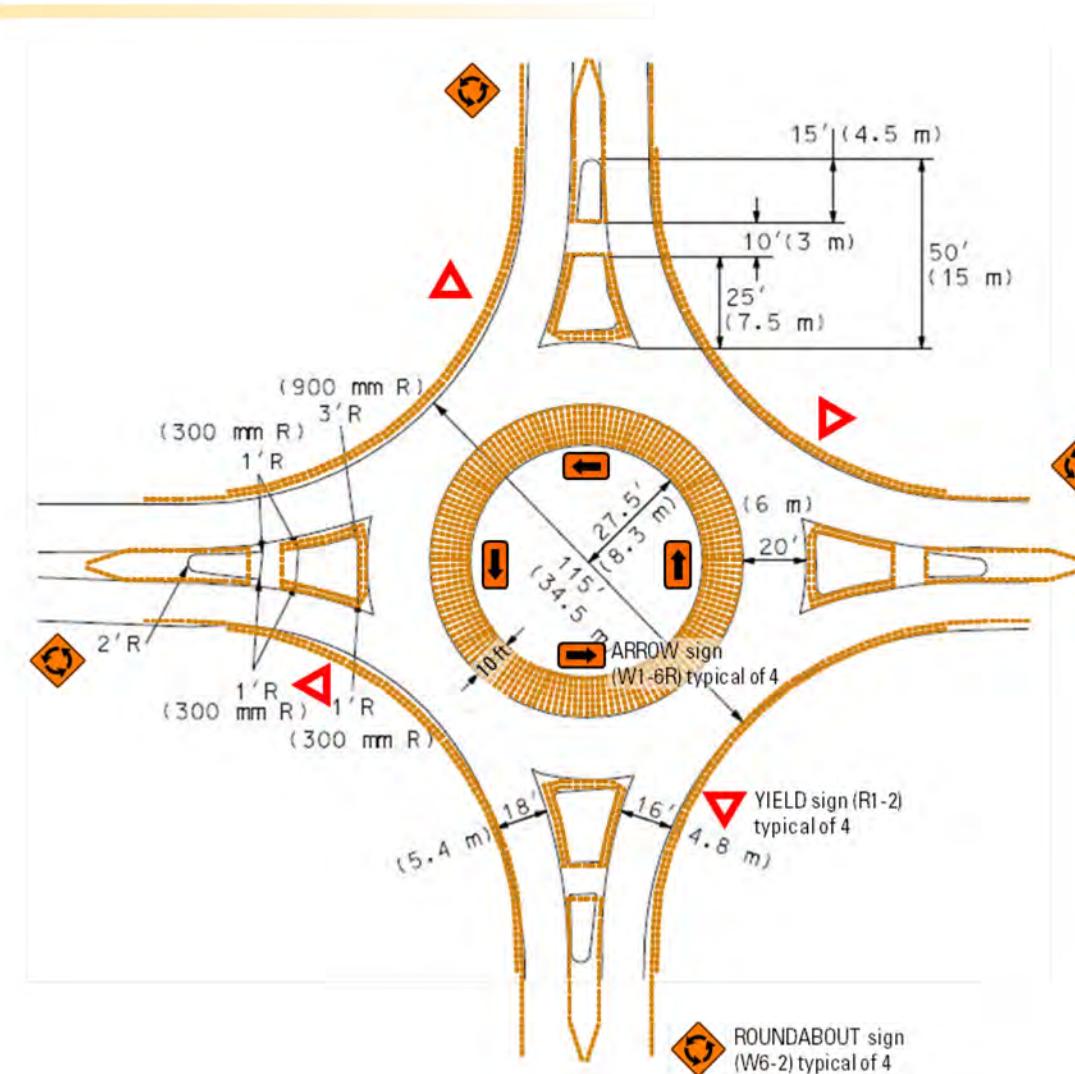
Source: Wrightsville Beach Fire & Rescue

## Hurricane Florence (2018)

- Electrical outages in Wilmington, NC
- Crashes and backups at major intersections
- Roundabouts placed within existing signalized intersections
- Functioned well
- High maintenance due to cone knock-downs



# Temporary Roundabouts

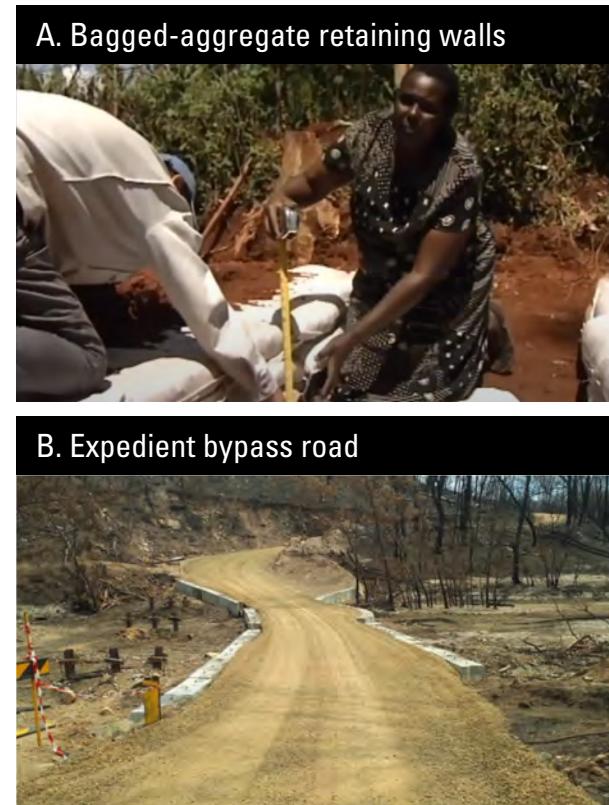
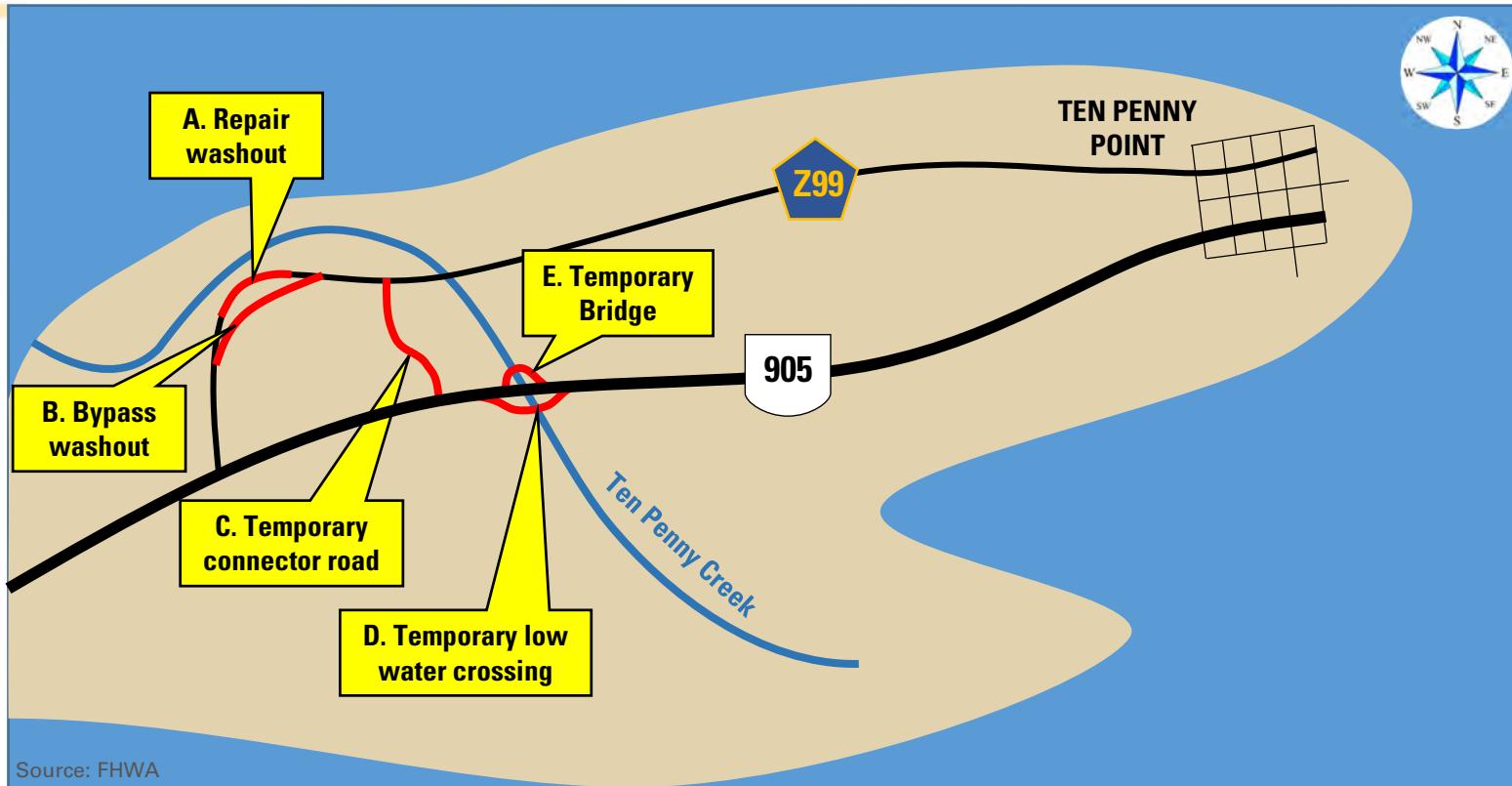


## Conceptual Solution

- Instead of cones, use sandbags as temporary curbs
- Has not yet been tried in the field



# Every site is different – Every situation is different



Sources: A: Japan International Cooperation Agency; B: Eurobodalla Shire Council; C: John Suscovich//YouTube; D: Massachusetts Dept of Environmental Protection; E: Rob Kemme/Wikimedia Commons



# Next Week: Planning for Rapid Response

*Incorporating resilience to adverse events in the Transportation Management Plan (TMP) development process*

**Open for registration at:**

**<https://pretix.eu/intrans/wzplan/>**



## Q&A and Discussion

# What are YOUR experiences?

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