2020 Tropical High Water Mark Review/Lessons learned
A 'model' for future surveys

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Goal

Find, measure, survey, collect, and store accurate high water marks from storm surge flooding

- **Determine height & inland extent**
- **Refence Above Ground Level (AGL) & above a datum (i.e. NAVD88)**
- **Provide to the National Hurricane Center for verification/post event review (3’ or greater AGL).**

Image- Jeffry Evans, NWS

Reasons for Collecting High Water Marks

- Determine water surface elevations between gage locations
- Determine water surface elevation return frequency (10, 50, 100-yr)
- Help in calibrating hydrologic models
- Help in determining the area extent of flooding
- Develops a historical record of flood events and comparisons
- Improve future forecasts and services!

Image- Jeffry Evans, NWS

Collecting High Water Marks

- Stillwater, wave, wave run-up
- Above datum vs. Above Ground Level (AGL)
- Debris line is not always the HWM
- Examine entire area
- Finding HWM's can be difficult, frustrating, and time consuming


Image- Jeffry Evans, NWS

Collecting High Water Marks

What to look for:

- Vegetative debris lines (good, caution)
- Laid down grass (caution)
- Seed lines (excellent, inside structures)
- Mud lines (caution)
- Debris on chain link fences (good)

Where to look:

- Hills and slopes
- Bridge decks, slope paving, bridge cords
- Power poles, fences, buildings, tree trunk (careful of tree limbs)
- Be careful and anything that can be moved or float

Examples:

Image: Jeffry Evans, NWS

What is 'AGL'

- Determining 'AGL' of debris line is tricky along beach.
  - Technically MHHW at debris line is 'zero'.
  - Measure MHHW and take the difference
  - Without GPS readings in the field, this would be nearly impossible to determine.

What is 'AGL'

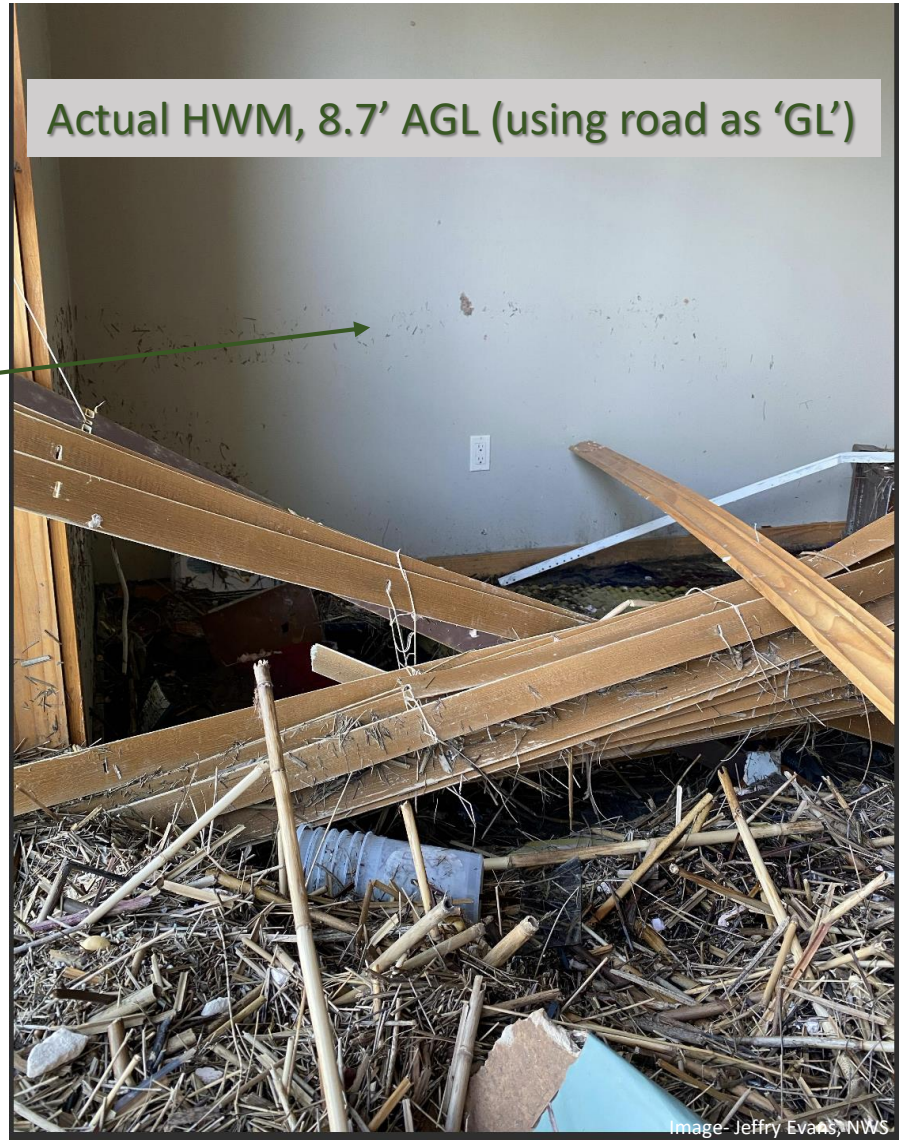
Determining 'AGL' of HWM can be even trickier when well inland.

- **There is no MHHW.**
- **Structures may be elevated either on mounds or stilts**
- **Measure 'GL' using surrounding mean level ground.**
- **Document what was used as GL.**
- **Without GPS readings in the field, this would be nearly impossible to determine.**

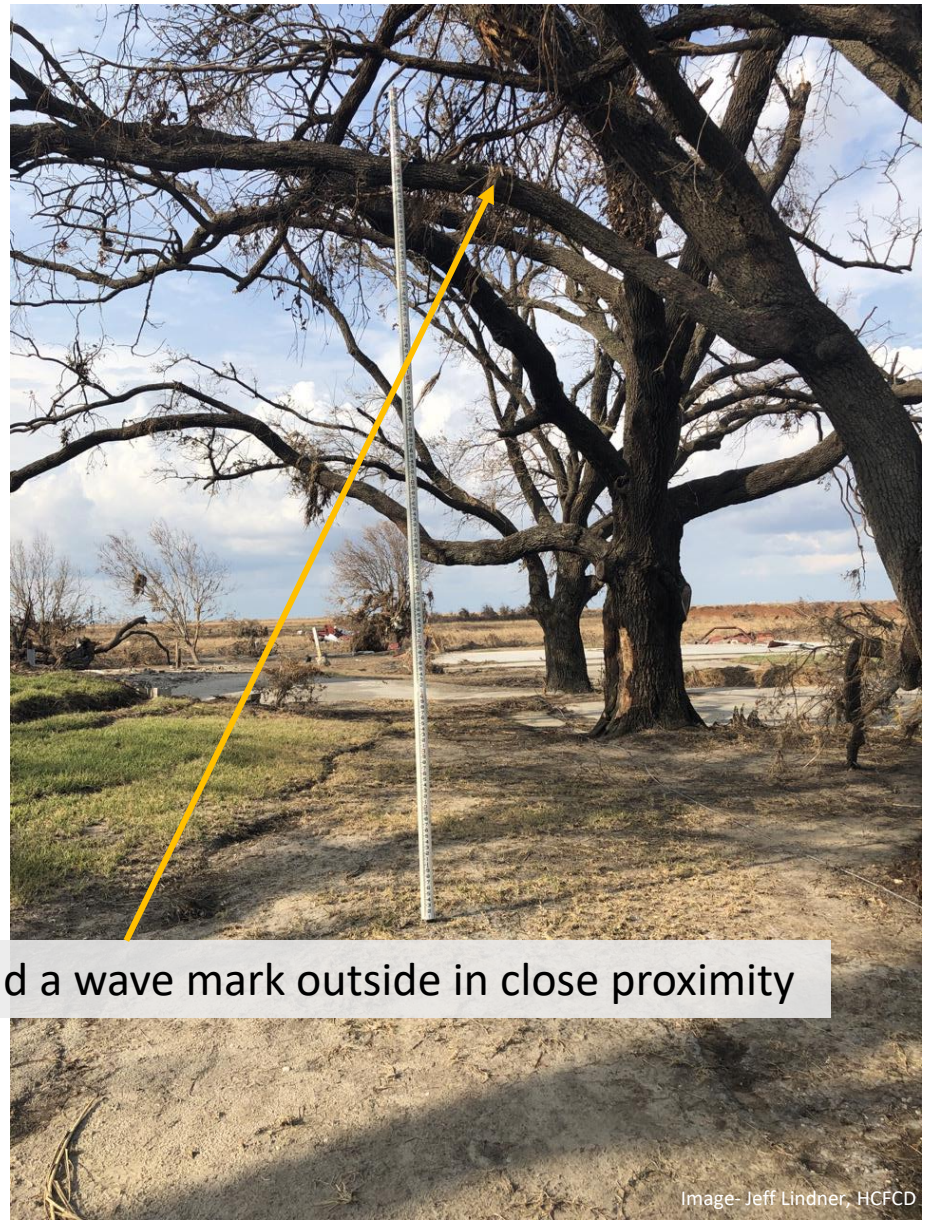
Laura 2020 *(near Grand Chenier, LA)*

Debris Line may not be HWM

This was spray painted as the HWM



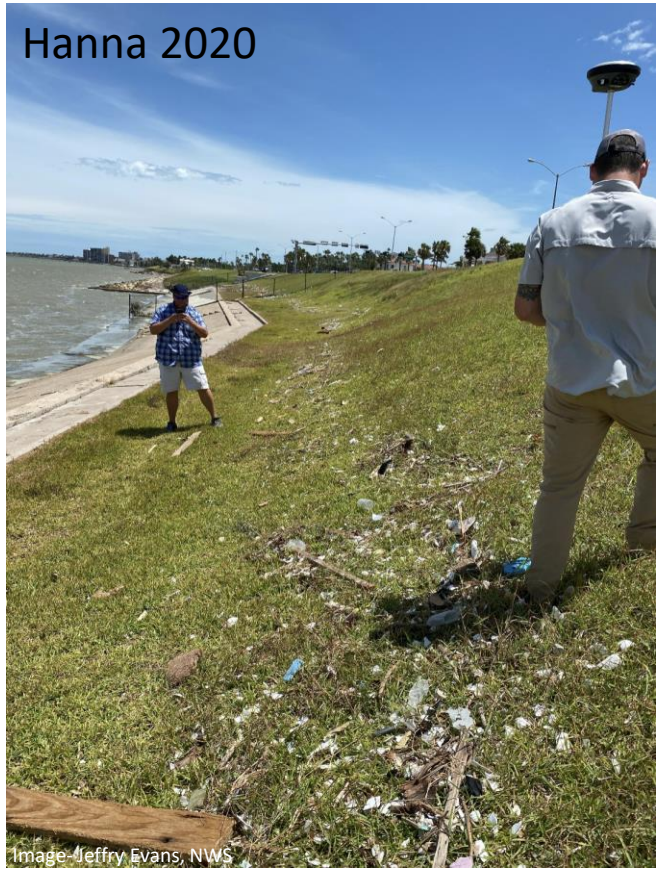
Be wary of waves



5 feet of difference between an ‘excellent’ still water mark and a wave mark outside in close proximity

Understand the exposure

- Need to know the wind/surge ‘direction’ and exposure at the location.
- Determining ‘AGL’ of debris line is tricky.
  - Look for MHHW and take the difference



Challenge: Travel

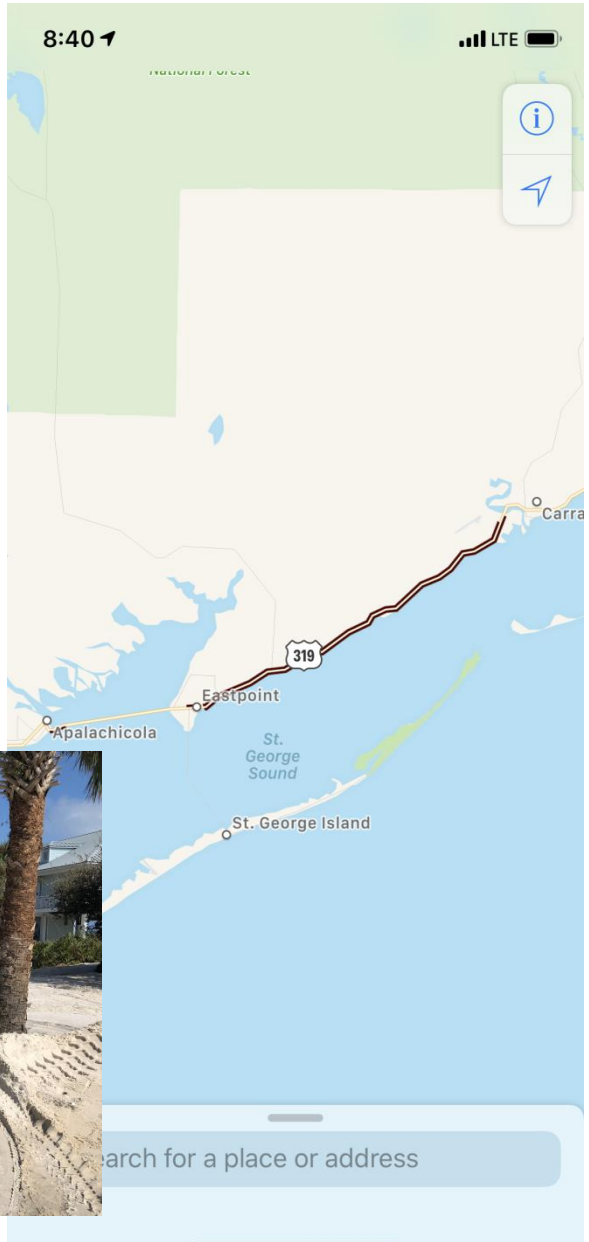
Image- Jeff Lindner, HCFCD

- Roadway Damage
- Road Closures
- Clean-up/Repair
- Traffic

Hurricane Michael survey- 2018


Image- Jeff Lindner, HCFCD


Image- Jeff Lindner, HCFCD



Not for the faint hearted


Image- Jeffry Evans, NWS


Image- Jeff Lindner, HCFCD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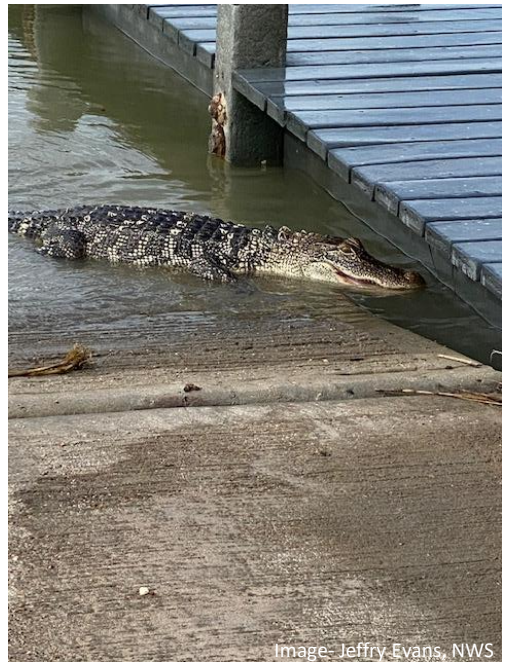
Image- Jeffry Evans, NWS

Highest measured from Laura

17.1 feet AGL

2.5 feet deep on SECOND floor!

18 feet AGL is the estimated peak surge for Laura using hindcast simulations

Lessons

- Arrive in impact area 1-2 weeks post event (depends on intensity)
  - SAR complete
  - Most residents not returned
- Needs to be a partnership!
  - Someone with technical skills/equipment (GPS)
  - NWS personal with local relationships/knowledge, navigation, understanding of meteorology/hydrology that caused the flooding
- Logistical challenges
  - Lodging/hotels (1-2 hours to reach impact zone)
  - Cell phone service spotty (maps, data collection devices)
  - No food, restrooms, gas
- Roads may be compromised, ferries and bridges out
- Residents may need supplies, ask for help (FEMA, ect)
- Prepare for 14-16 hour days
- Watch for nails, broken glass, hazardous wildlife
- Marking multiple events (Laura and Delta) and tide cycles


Image- Jeffry Evans, NWS

Future for tropical HWM surveys?

- Coastal Act (beginning 2023)
  - More uniform federal effort to accurately capture surge HWM
  - NHC surge unit will likely have a large role
  - Capture AGL and a set datum, in a consistent manner, across the U.S. coastline
- 2020 ‘concept’ may become the expectation
- Partnering of agencies with expertise in equipment, surge and meteorology
- NWS, USGS, and other agencies (HCFCD) could all play a role in capturing HWM

Image- Jeff Lindner, HCFCD

Questions

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