Hazardous Weather and Flooding Preparedness
A Cooperative Effort
Administrative Information

- Emergency exits and procedures
- Location of restrooms
- Mobile devices
- Procedure for questions
- Course materials
- Evaluation forms
Unit 1: Introduction and Course Overview
Importance of Hazardous Weather Training

• Allows you to perform more effectively
• Enables you to make better emergency management decisions

✓ Preparedness ✓ Mitigation
✓ Protection ✓ Response
✓ Prevention ✓ Recovery
Hazardous weather and flooding preparedness requires a team approach
Course Goals

To enable you to:

• Recognize potentially hazardous weather and flooding situations
• Plan appropriately
• Coordinate warnings and responses
# Units of Instruction

<table>
<thead>
<tr>
<th>Unit 1</th>
<th>Introduction and Course Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 2</td>
<td>Weather Overview</td>
</tr>
<tr>
<td>Unit 3</td>
<td>Introduction to Hazardous Weather</td>
</tr>
<tr>
<td>Unit 4</td>
<td>Role of the Emergency Manager</td>
</tr>
<tr>
<td>Unit 5</td>
<td>NWS Hazardous Weather Products</td>
</tr>
<tr>
<td>Unit 6</td>
<td>Projecting the Impacts of Hazardous Weather and Flooding</td>
</tr>
<tr>
<td>Unit 7</td>
<td>Activity</td>
</tr>
<tr>
<td>Unit 8</td>
<td>Course Summary</td>
</tr>
</tbody>
</table>
Course Objectives (1 of 2)

• Analyze how the components of weather interact to create hazardous weather

• Anticipate the impact of hazardous weather events to enhance preparedness

• Evaluate actions taken by Emergency Managers to prepare for and respond to, actual hazardous weather events
Course Objectives (2 of 2)

• Interpret information contained in National Weather Service forecast and warning products, as well as in other weather resources

• Assess your community’s state of readiness for hazardous weather and flooding events

• Evaluate the effectiveness of emergency response actions for a given scenario
Course Schedule

• Day 1: Units 1–3
• Day 2: Units 4–6
• Day 3: Units 7–8 (1/2 day)
Participant Introductions

- Name
- Location
- Job description
  - Primary responsibilities
  - Hazardous weather and flooding preparedness expertise/experience
- Training goals/expectations
Hazardous Weather in the U.S.

Annual averages:
- 100,000 thunderstorms
- 5,000 floods
- 1,300 tornadoes
- 6 Atlantic hurricanes
- 600 fatalities
- $14B in losses
Tornadoes

• 10 times more tornadoes in the U.S.
• 70-75 deaths per year on average
• People at greatest risk in mobile homes or outdoors
• Safest place is underground or in properly built safe room
Flash Floods

• Over 90 deaths each year
• Nearly half due to driving through flood waters
• Many flash floods occur at night
Severe Thunderstorms

- Damaging hail
- Destructive winds
- Potential tornadoes
- Frequent lightning
Extreme Temperatures

• Cause approximately 1,100 deaths in the U.S. each year

• Most at risk:
  – Elderly
  – Children
  – People with chronic medical conditions
  – People outdoors
Winter Storms

- Transportation interruptions impact:
  - Goods and services
  - Emergency vehicles
  - Local transportation

- Extended power outages can lead to:
  - Hypothermia
  - Carbon monoxide poisoning
Tropical Cyclones

• Nearly 50 deaths per year
• Over $5 billion in damages per year
• Include:
  – Hurricanes
  – Typhoons
  – Tropical storms
  – Tropical depressions
Tsunamis

• Series of ocean waves

• Caused by:
  – volcanic eruptions
  – undersea earthquakes
  – landslides

• High hazard in the Pacific and Caribbean

• Low hazard but high impact for Atlantic and Gulf of Mexico
Space Weather

- Solar storms that impact the Earth and our technological systems
- NWS’ Space Weather Prediction Center warns for space weather hazards
- Impacts can include:
  - Radio communications outages
  - Power disruptions
  - Significant GPS errors
Case Study:

September 2013 Floods
Unit Summary

• What to expect from the course
• The importance of planning for hazardous weather events
Unit 2: Weather Overview
(Northern Hemisphere and the U.S.)
Objectives

• Define basic components of weather
• Distinguish between high and low pressure areas on a map
• Calculate the dew point using a conversion chart, when given the relative humidity and temperature
• Describe weather patterns
Basic Components of Weather

- Temperature
- Moisture
- Air Pressure
- Wind
Temperature

• Degree of heat in the atmosphere
• Measures heat energy and expresses molecular activity
• Hot air is less dense and rises
• Cold air is more dense and sinks
• Molecules move to equalize temperature variations
• Temperature variations influence atmospheric circulation
Moisture

• Enters atmosphere as water vapor
• Condensation creates:
  – Clouds
  – Rain
  – Dew
  – Frost
  – Fog
Air Pressure

- Amount of force exerted on the Earth by the air mass above a given location
- Measured by one-square-inch columns of air extending through atmosphere
- Molecules in atmosphere move to equalize pressure
Hazardous Weather and Flooding Preparedness

Wheeler Peak
13,161 ft.

Mt Everest, 29,035 ft.

Perspective

The depth of the atmosphere is about 300 miles (500 km), though there isn’t a well-defined outer limit.

99% of the atmosphere lies within 30 km, or 19 miles of the earth’s surface.
Isobars

Lines that connect points of equal air pressure on the Earth’s surface

Image Credit: National Oceanic and Atmospheric Administration
Cold air mass pushes southward setting up classic low level east to west flow or “upslope” pattern.
November 7, 2015

Posted by Sandia Crest House
29,723 Views

FEMA
Hazardous Weather and Flooding Preparedness
Wind

- Movement of air due to pressure differences
- Flow determined by:
  - Pressure gradient force
  - Coriolis Effect
  - Friction

Image Credit: National Oceanic and Atmospheric Administration
Coriolis Effect
Pressure Patterns

- Low
- High
- Trough
- Ridge

Image credit: National Oceanic and Atmospheric Administration
Walkthrough:
Reading a Surface Pressure Map

Activity/Image Source: National Weather Service
JetStream Online School for Weather
Reading a Surface Pressure Map
Isobars
Areas of High and Low Pressure
Areas of Expected Precipitation
Wind Direction
# Moisture: Fuel for Severe Weather

<table>
<thead>
<tr>
<th>Dew Point</th>
<th>Relative Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature to which air must be cooled to be saturated</td>
<td>Percentage of water vapor in air compared to what the air is capable of holding</td>
</tr>
</tbody>
</table>
Temperature & RH Relationship

<table>
<thead>
<tr>
<th>Temperature</th>
<th>RH</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>50°F</td>
<td>100%</td>
<td>(saturated) 3 grams</td>
</tr>
<tr>
<td>50°F</td>
<td>50%</td>
<td>(unsaturated) 3 grams</td>
</tr>
<tr>
<td>90°F</td>
<td>25%</td>
<td>(unsaturated) 3 grams</td>
</tr>
</tbody>
</table>
Converting Relative Humidity to Dew Point

Example:

• Relative humidity = 50%
• Temperature = 50°F
• Dew point = ?
Converting Relative Humidity to Dew Point

Practice #1:

• Relative humidity = 85%
• Temperature = 80ºF
• Dew point = ?
Converting Relative Humidity to Dew Point

Practice #2:

- Relative humidity = 60%
- Temperature = 80°F
- Dew point = ?
Precipitation

Occurs when the atmosphere can no longer hold moisture

<table>
<thead>
<tr>
<th>Frozen Precipitation</th>
<th>Unfrozen Precipitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snow</td>
<td>Drizzle Rain</td>
</tr>
<tr>
<td>Sleet</td>
<td></td>
</tr>
<tr>
<td>Hail</td>
<td></td>
</tr>
</tbody>
</table>
Winter Precipitation: Snow

- Surface temperature increases with height then decreases
- Temperature remains below freezing and precipitation falls as snow

Image credit: National Oceanic and Atmospheric Administration
Winter Precipitation: Sleet

- Temperature increases to above freezing before decreasing
- Snowflakes partially melt and then refreeze into ice pellets

Image credit: National Oceanic and Atmospheric Administration
Winter Precipitation: Freezing Rain

• Precipitation becomes rain in warm layer

• Falls back into below freezing air temperature

• No time to refreeze into sleet but freezes on contact

Image credit: National Oceanic and Atmospheric Administration
How do the Great Lakes affect weather in warm conditions?
Air Masses

1. Polar latitudes
2. Continental
3. Maritime
4. Tropical latitudes

Image credit: National Oceanic and Atmospheric Administration
Fronts

- Cold fronts
- Warm fronts
- Stationary fronts
Cold Front

• Leading edge of an advancing cold air mass
• Creates thunderstorms and severe weather conditions
• Shown on weather maps as a straight line with triangles hanging below it

Image credit: National Oceanic and Atmospheric Administration
Warm Front

- Edge of an advancing warm air mass
- Usually moves slowly
- Brings precipitation
- Shown on weather maps as a straight line with half circles on top of it

Image credit: National Oceanic and Atmospheric Administration
Stationary Fronts

- Creates the potential for long-term precipitation
- Shown on weather maps as a straight line with blue triangles below and red semicircles on top
Fronts on a Weather Map
What are the four basic components of weather that contrast sharply in the area of a front?
Low Pressure Development

This map shows the development of low pressure systems with areas of cold air on the left and warm air on the right. The map highlights regions where hazardous weather and flooding may occur due to low pressure development.
Low Pressure Development
Low Pressure Development

COLD

FRONTAL

WAVE

WARM
Low Pressure Development
Low Pressure Development
Low Pressure Development
Global Circulations

The global circulation would be simple (and the weather boring) if... Earth did **not** rotate, the rotation was **not** tilted relative to the sun, and had no water.
Prevailing Westerlies
Jet Streams
Why La Niña/ El Niño Matters!

Polar Jet Stream is located above the greatest horizontal temperature gradient!
Changes Associated with ENSO

The focus is on SST anomalies, but there are many variables that fluctuation during the ENSO cycle:

- Strength of Low Level Trade Wind || Sea-level pressure
- Distribution of Tropical Convection || Height of sea surface
New Mexico Affected by Jet Stream
Shift in Jet Stream
Unit Summary

• Define basic components of weather
• Distinguish between high and low pressure areas on a map
• Calculate the dew point using a conversion chart, when given the relative humidity and temperature
• Describe weather patterns
Unit 3: Introduction to Hazardous Weather
Unit Objectives

• Describe various types of hazardous weather
• Summarize potential dangers caused by hazardous weather
• Explain how community and environmental factors can worsen the impact of hazardous weather
Hazardous Weather and Flooding Preparedness

Hazardous Weather Events
Choose a Natural Hazard

- Thunderstorms
- Tornadoes
- Flash Floods
- River Floods
- Coastal or Lakeshore Floods
- Extratropical Cyclones
- Tropical Cyclones
- Tsunamis
- Winter Storms
- Excessive Cold
- Fog
- Excessive Heat
- Dust Storms
- Wind Storms
- Fire Weather
- Space Weather
- Volcanic Ash
- Go to Activity
Thunderstorms

• Local storm produced by a cumulonimbus cloud
• Accompanied by lightning, thunder, gusty winds, heavy rain, and hail
• May be violent
Thunderstorm Hazards

- Lightning
- Hail
- Damaging winds
- Flash flooding
- Tornadoes
- Wildfires
## Thunderstorm Classifications

<table>
<thead>
<tr>
<th>Category</th>
<th>Wind Speed</th>
<th>Precipitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary</td>
<td>&lt; 35 knots (40 mph)</td>
<td>Variable</td>
</tr>
<tr>
<td>Approaching</td>
<td>≥ 35 knots (40 mph)</td>
<td>Hail &gt; ¾ inch</td>
</tr>
<tr>
<td>Severe</td>
<td>≥ 50 knots (58 mph)</td>
<td>Hail ≥ 1 inch</td>
</tr>
</tbody>
</table>
Thunderstorm 101
Basic Ingredients

• **Moisture** – most notably in the lower levels of the atmosphere.
  – Gulf of Mexico, Pacific Ocean, Gulf of California.

• **Instability** – ability of air to accelerate up (or down) when given a push.
  – Warm moist conditions near surface.
  – Dry, cold conditions aloft.

• **Lifting Mechanism** – The “push” that gets the whole thing started.
Stages of Thunderstorms
Types of Thunderstorms

SINGLE CELL

MULTICELL

SUPERCELL

© 2013 Jennifer Palucki

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© Todd Shoemake June 7, 2014

© 2014 Kerry Jones
Severity of Thunderstorms

Lifted Index (LI)

Convective Available Potential Energy (CAPE)

Prob. LI<0
Surface Weather Map

LI = -12

CAPE = >4500 J/kg
Supercell Formation

- Supercells form in highly sheared, unstable environments.
- Horizontal rolls develop.
Supercell Formation

- The horizontal rolls are tilted and stretched into the storms updraft and the mesocyclone (and supercell) develops.
Thunderstorms: Damaging Winds

- Straight-line winds
- Downbursts
- Micro bursts
- Gust fronts
Thunderstorms: Hail

- Updrafts carry water droplets to a freezing altitude
- Ice chunks become too large to be sustained by updrafts
- Ice falls to earth as hail
- Can reach speeds of 100+ mph
- Largest hailstone in U.S. measured was 8 inches wide!
- Largest hailstone in New Mexico?
The Science of Hail

- Hailstones grow by collision with supercooled water drops.
- Two methods by which a hailstone grows, wet growth and dry growth.
- In wet growth, the hailstone nucleus (a tiny piece of ice) is in a region where the air temperature is below freezing, but not super cold. Upon colliding with a supercooled drop the water does not immediately freeze around the nucleus.
- Instead liquid water spreads across tumbling hailstones and slowly freezes. Since the process is slow, air bubbles can escape resulting in a layer of clear ice.
- With dry growth, the air temperature is well below freezing and the water droplet immediately freezes as it collides with the nucleus. The air bubbles are "frozen" in place, leaving cloudy ice.

<table>
<thead>
<tr>
<th>Hailstone</th>
<th>Diameter</th>
<th>Updraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dime</td>
<td>½”</td>
<td>35 mph</td>
</tr>
<tr>
<td>Quarter</td>
<td>1”</td>
<td>49 mph</td>
</tr>
<tr>
<td>Golfball</td>
<td>1.75”</td>
<td>64 mph</td>
</tr>
<tr>
<td>Softball</td>
<td>4.5”</td>
<td>103 mph</td>
</tr>
</tbody>
</table>
Large Hail Hazards
(or a lot of small hail)

- Large hail can break windows and cause bodily harm.
- ½ inch hail falls near 20 mph!
- 3 inch hail falls near 100 mph!
Reported NM Hail Events by Month
1955-2015

Near Stanley, NM
Courtesy of Sharon Higgins

Data includes 0.75" hail and larger.

FEMA
Hazardous Weather and Flooding Preparedness
Thunderstorms: Lightning

- Powerful discharge between cloud and ground
- No safe place outdoors!
The Science of Lightning

- Ice formation in cloud leads to charge separation
- Charges pool in cloud & on ground
- Types: Cloud to Ground, Intra Cloud, Cloud to Cloud, and Cloud to Air

No Severe Criteria but storm severity often related to lightning intensity and frequency
Lightning in Very Slow-Mo!
Lightning is most common between 2pm-7pm.

Plan accordingly!
Tornadoes

- Most violent storms on earth
- Typically develop along a dryline
- Often occur in early spring
Tornado Plots
Tornado Characteristics

- Destructive wind
- Movement
- Rain/hail
Funnel Clouds and Waterspouts

© 8/19/2012 C.S. Carroll

© 8/19/2012 Michelle Crowder
## The Enhanced Fujita Scale

<table>
<thead>
<tr>
<th>F Number</th>
<th>Fastest 1/4-mile (mph)</th>
<th>3 Second Gust (mph)</th>
<th>EF Number</th>
<th>3 Second Gust (mph)</th>
<th>EF Number</th>
<th>3 Second Gust (mph)</th>
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<tbody>
<tr>
<td>0</td>
<td>40-72</td>
<td>45-78</td>
<td>0</td>
<td>65-85</td>
<td>0</td>
<td>65-85</td>
</tr>
<tr>
<td>1</td>
<td>73-112</td>
<td>79-117</td>
<td>1</td>
<td>86-109</td>
<td>1</td>
<td>86-110</td>
</tr>
<tr>
<td>2</td>
<td>113-157</td>
<td>118-161</td>
<td>2</td>
<td>110-137</td>
<td>2</td>
<td>111-135</td>
</tr>
<tr>
<td>3</td>
<td>158-207</td>
<td>162-209</td>
<td>3</td>
<td>138-167</td>
<td>3</td>
<td>136-165</td>
</tr>
<tr>
<td>4</td>
<td>208-260</td>
<td>210-261</td>
<td>4</td>
<td>168-199</td>
<td>4</td>
<td>166-200</td>
</tr>
<tr>
<td>5</td>
<td>261-318</td>
<td>262-317</td>
<td>5</td>
<td>200-234</td>
<td>5</td>
<td>Over 200</td>
</tr>
</tbody>
</table>
Enhanced Fujita Scale

Statistics are for NM Tornadoes only. 1950-2014

Weak Tornadoes (EF0, EF1)
Winds 65-110 mph
~93% of tornadoes are weak.
Account for <1% of tornado deaths.
Usually brief, path lengths less than a few miles long.

Strong Tornadoes (EF2, EF3)
Winds 111-165 mph
Account for ~7% of all tornadoes.
Account for up to 99% of tornado deaths.
Paths could be 10 to 15 miles or longer.

Violent Tornadoes (EF4, EF5)
Winds 166-200+ mph
Account for <1% of all tornadoes.
Account for up to ??% of tornado deaths.
Very long paths, widths greater than 1 mile possible.
<table>
<thead>
<tr>
<th>#</th>
<th>Damage Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Small barns, farm outbuilding</td>
</tr>
<tr>
<td>2</td>
<td>One- or two-family residence</td>
</tr>
<tr>
<td>3</td>
<td>Single-wide mobile home</td>
</tr>
<tr>
<td>4</td>
<td>Double-wide mobile home</td>
</tr>
<tr>
<td>5</td>
<td>Apt, condo, townhouse</td>
</tr>
<tr>
<td>6</td>
<td>Motel</td>
</tr>
<tr>
<td>7</td>
<td>Masonry apt. or motel</td>
</tr>
<tr>
<td>8</td>
<td>Small retail bldg</td>
</tr>
<tr>
<td>9</td>
<td>Small professional bldg</td>
</tr>
<tr>
<td>10</td>
<td>Strip mall</td>
</tr>
<tr>
<td>11</td>
<td>Large shopping mall</td>
</tr>
<tr>
<td>12</td>
<td>Large, isolated retail bldg</td>
</tr>
<tr>
<td>13</td>
<td>Automobile showroom</td>
</tr>
<tr>
<td>14</td>
<td>Automotive service bldg</td>
</tr>
<tr>
<td>15</td>
<td>School, elementary</td>
</tr>
<tr>
<td>16</td>
<td>School, junior or senior high</td>
</tr>
<tr>
<td>17</td>
<td>Low-rise bldg</td>
</tr>
<tr>
<td>18</td>
<td>Mid-rise bldg</td>
</tr>
<tr>
<td>19</td>
<td>High-rise bldg</td>
</tr>
<tr>
<td>20</td>
<td>Institutional bldg</td>
</tr>
<tr>
<td>21</td>
<td>Metal bldg system</td>
</tr>
<tr>
<td>22</td>
<td>Service station canopy</td>
</tr>
<tr>
<td>23</td>
<td>Warehouse</td>
</tr>
<tr>
<td>24</td>
<td>Transmission line tower</td>
</tr>
<tr>
<td>25</td>
<td>Free-standing tower</td>
</tr>
<tr>
<td>26</td>
<td>Free-standing pole</td>
</tr>
<tr>
<td>27</td>
<td>Tree – hardwood</td>
</tr>
<tr>
<td>28</td>
<td>Tree - softwood</td>
</tr>
</tbody>
</table>
Example
## Degree of Damage (DI = 2)

<table>
<thead>
<tr>
<th>DOD</th>
<th>Damage Description</th>
<th>EXP</th>
<th>LB</th>
<th>UB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Threshold of visible damage</td>
<td>65</td>
<td>53</td>
<td>80</td>
</tr>
<tr>
<td>2</td>
<td>Some loss of roof covering material, gutters, awning, or siding</td>
<td>79</td>
<td>63</td>
<td>97</td>
</tr>
<tr>
<td>3</td>
<td>Broken glass in doors and windows</td>
<td>96</td>
<td>79</td>
<td>114</td>
</tr>
<tr>
<td>4</td>
<td>Uplift of roof deck, significant loss of material</td>
<td>97</td>
<td>81</td>
<td>116</td>
</tr>
<tr>
<td>5</td>
<td>Entire house shifts off foundation</td>
<td>121</td>
<td>103</td>
<td>141</td>
</tr>
<tr>
<td>6</td>
<td>Large sections of roof removed</td>
<td>122</td>
<td>104</td>
<td>142</td>
</tr>
<tr>
<td>7</td>
<td>Exterior walls collapsed</td>
<td>132</td>
<td>113</td>
<td>153</td>
</tr>
<tr>
<td>8</td>
<td>Most walls collapsed</td>
<td>152</td>
<td>127</td>
<td>178</td>
</tr>
<tr>
<td>9</td>
<td>All walls</td>
<td>170</td>
<td>142</td>
<td>198</td>
</tr>
<tr>
<td>10</td>
<td>Slab swept clean</td>
<td>200</td>
<td>165</td>
<td>220</td>
</tr>
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</tbody>
</table>
May 23, 2010 Union County NM

Images courtesy
KVII Amarillo
May 3, 1999 Tornado Event, OK- KS
Flash Floods

- Heavy rains
- Dam or levee failure
- Water from breakup of ice
- Intense rainfall on impervious areas
Flash Flood Factors

• Rainfall intensity and duration
• Topography
• Soil composition
• Ground cover
Flash Flood Hazards

- Force of water
- Debris flows
- Mud slides
Recent Examples

2012 Dixon Apple Orchard

2014 Albuquerque

2015 Philmont Scout Ranch

2013 Mogollon

Back to Menu
River Floods

• Long-term event
• Along rivers and streams
• Natural and inevitable
River Flood Factors

- Heavy rainfall from large-scale storms
- Stationary or slow-moving thunderstorms
- Land-falling tropical storms / hurricanes
- Saturated soil from previous rainfall
- High existing river flows
- River ice jams
- Rapid snowmelt
- Aggradation
- Large watersheds
- Watershed development
River Flood Hazards

- Damaged buildings and vehicles
- Uprooted trees
- Drowning
- Drinking water contamination
- Hazardous material release
- Sewer overflows
- Debris with sharp objects
- Communications and/or transportation interruptions
- Fires
Great Flood of 1993
Coastal and Lakeshore Flooding Terms

- Surf
- MSL
- Tidal Cycle
- Datum Plane
- Seiche
- Storm Surge
- Swell
Storm Surge Characteristics

• Caused by storm winds across water
• Worsened by above normal tide levels
• Development factors include:
  – Low barometric pressure
  – Wind
Coastal Floods

- Inundation of land along the oceanic coast by sea waters
- Originates from ocean front, back bays, and sounds
- Affects public and maritime interests
Coastal Flood Ingredients

Results from:

- Storm surge and/or seiche reaching land
- Heavy surf
- Tidal piling
Coastal Flood Factors

• Tidal cycles
• Persistence and behavior of the storm
• Topography, shoreline orientation, and bathymetry of the area
• River stage or stream run-off
• Presence or absence of offshore reefs
Coastal Flooding Hazards

- High winds
- Quickly rising water levels
- Fierce wave action
- Shore erosion, seawall destruction
- Debris from destroyed property
- Destruction of protective dunes and barrier islands
November 22, 2006
North Carolina Coastal Flooding

Total Precipitation during the 2006 Thanksgiving Week Nor'easter
Precipitation totals from November 21-23, 2006
Yellow: Total Precipitation less than an inch
Light Green: Total Precipitation of 1 to 2 inches
Medium Green: Total Precipitation of 2 to 4 inches
Dark Green: Total Precipitation of 4 to 8 inches
Purple: Total Precipitation of 6 inches or more
Precipitation amounts reported in inches.

Data analysis - Phillip Badgett
Graphic - Jonathan Blaes
NWS Raleigh, NC
www.erh.noaa.gov/rah

Back to Menu
Review Lakeshore Floods
Lakeshore Flooding

• Affects general public and marine interests
• Causes are variable
• Extent of the flooding is dependent on the shore terrain
Lakeshore Flooding Hazards

- High winds
- Quickly rising water levels
- Fierce wave action
- Shore erosion
- Debris carried by water
Lakeshore Flooding Examples

- Ottawa, Erie, Lucas, and Sandusky Counties, Ohio: November 11, 1998
- New York Shore of Lake Erie: November 6, 2005
Extratropical Cyclones

- Low-pressure storms
- Form off the Pacific coast, in Gulf of Mexico, over the Atlantic, or in Great Lakes
Extratropical Cyclone Characteristics

- Form outside the tropics
- Cover area 700-1000 miles across
- Center is colder than surrounding air
- Winds are strongest in upper atmosphere
Extratropical Cyclone Hazards

- Swells, storm surges, and huge waves
- High winds
- Heavy rains, flooding, and flash flooding

- Heavy snow
- Mud slides
- Downbursts
- Tornadoes
- Ice Storms
1993 Superstorm
Tropical Cyclones

- Coastal storms that form within the tropics
- Storm center is warmer than the surrounding air
- Winds are strongest at 10,000 feet
### Tropical Cyclone Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Wind Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical Depression</td>
<td>Maximum sustained winds near the surface less than 39 mph</td>
</tr>
<tr>
<td>Tropical Storm</td>
<td>Winds of 39–73 mph</td>
</tr>
<tr>
<td>Hurricanes or Typhoons</td>
<td>Winds of 74 mph or more</td>
</tr>
</tbody>
</table>
Hurricane Ingredients

- Water over 80°F and 200 feet deep
- Winds converging near water surface
- Unstable air and humidity
- Winds moving in one direction
- Upper atmosphere high pressure
## Hurricane Classifications

<table>
<thead>
<tr>
<th>Category</th>
<th>Central Pressure (Millibars)</th>
<th>Central Pressure (Inches)</th>
<th>Winds (MPH)</th>
<th>Wind (KTS)</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$\geq 980$</td>
<td>28.94</td>
<td>74 – 95</td>
<td>64 – 82</td>
<td>Minimal</td>
</tr>
<tr>
<td>2</td>
<td>965 – 979</td>
<td>28.50 – 28.93</td>
<td>96 – 110</td>
<td>83 – 95</td>
<td>Moderate</td>
</tr>
<tr>
<td>3</td>
<td>945 – 964</td>
<td>27.91 – 28.49</td>
<td>111 – 129</td>
<td>96 – 112</td>
<td>Extensive</td>
</tr>
<tr>
<td>4</td>
<td>920 – 944</td>
<td>27.17 – 27.90</td>
<td>130 – 156</td>
<td>113 – 136</td>
<td>Extreme</td>
</tr>
<tr>
<td>5</td>
<td>&lt; 920</td>
<td>&lt; 27.17</td>
<td>&gt; 156</td>
<td>&gt; 136</td>
<td>Catastrophic</td>
</tr>
</tbody>
</table>
Hurricane Hazards

- Coastal flooding
- Wind storms
- Riverine/flash flooding
- Tornadoes
Tsunamis

• Series of ocean waves of extremely long length

• Generated by:
  – Earthquakes (primarily)
  – Volcanic eruptions
  – Landslides
  – Asteroid impacts
Tsunami Characteristics

- Can be 100 miles or more from crest to crest
- 2-3 inches high in deep ocean
- 30-100 feet high near land
- Wave speed of up to 500 mph
Tsunami Types

Local/Regional
- Source generally within 1,000 km
- Response time = minutes
- Automatic public evacuation required

Distant (Teletsunami)
- Source generally more than 1,000 km away
- Response time = a few hours
- Organized evacuation possible
Tsunami Hazards

• Coastal tsunami inundation
• Damage from debris
Tsunami Information

NWS tsunami warning centers:

• **Alaska Tsunami Warning Center (ATWC)**
• **Pacific Tsunami Warning Center (PTWC)***
2009 Tsunami in American Samoa
Winter Storms

Extratropical storms that bring:

• Cold temperatures
• Precipitation
• High winds
Winter Storm Ingredients

• Cold air
• Moisture
• Lift
The Science of Snow

- All snowflakes are “hexagonal,” or six-sided, because water molecules bond only at 120°.
- The type of snow crystal that forms depends on the temperature and relative humidity of the air.
- Dendrites are common at temperatures between -12°C and -16°C, while plates form at both colder and warmer temperatures.
- Shapes are more simple at lower humidities and more complex, often larger at higher humidities.
- Wind, both horizontal and in the vertical, can fracture snow crystals or cause them to “clump” together.

“Stellar Dendrite”
Courtesy of Becky Ramotowski, Tijeras, NM
Perspective

The depth of the atmosphere is about 300 miles (500 km), though there isn’t a well-defined outer limit.

99% of the atmosphere lies within 30 km, or 19 miles of the earth’s surface.

Preferred growth zone for snowflakes between -12°C and -18°C (14-18K ft).
Temperature has a much more complicated structure than pressure or density.

The change in temperature with height is called the **lapse rate**

When temperature increases with height, an inversion is produced.
Cold air mass pushes southward setting up classic low level east to west flow or “upslope” pattern.

East or southeast winds Rio Grande Valley
Winter Storm Hazards

- Strong winds
- Extreme cold
- Precipitation
- Blizzard conditions
1993 Superstorm
Excessive Cold

- Varies according to the normal climate of a region
- May accompany or follow winter storms
- Can occur without storm activity
## Excessive Cold: Wind Chill

<table>
<thead>
<tr>
<th>Wind</th>
<th>30°</th>
<th>25°</th>
<th>20°</th>
<th>15°</th>
<th>10°</th>
<th>5°</th>
<th>0°</th>
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</thead>
<tbody>
<tr>
<td>15 mph</td>
<td>19°</td>
<td>13°</td>
<td>6°</td>
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<td>-7°</td>
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<td>20 mph</td>
<td>17°</td>
<td>11°</td>
<td>4°</td>
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<td>25 mph</td>
<td>16°</td>
<td>9°</td>
<td>3°</td>
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<td>-11°</td>
<td>-17°</td>
<td>-24°</td>
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<tr>
<td>30 mph</td>
<td>15°</td>
<td>8°</td>
<td>1°</td>
<td>-5°</td>
<td>-12°</td>
<td>-19°</td>
<td>-26°</td>
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</tbody>
</table>
Extreme Cold Hazards

- Frostbite
- Hypothermia
- Death
Albuquerque normally around 11-12 psi during the winter months. During the December Blizzard, one would have only needed to climb to ~17,800 feet MSL to experience 40% LESS atmospheric pressure 7.25psi (500mb)
Conversely, one would have only needed to climb another 500 feet to ~18,300 feet MSL to experience 40% LESS atmospheric pressure. BUT, all about LOCATION, LOCATION, LOCATION!
December 1992 Blizzard
Fog

• Water droplets suspended in the air
• Hazardous when visibility is reduced to 1/4 mile or less
Fog Characteristics and Hazards

- Intensity and duration varies with location and type
- Reduces visibility for motorists and air traffic
2007 California Multi-vehicle Accident
Excessive Heat

Occurs from a combination of high temperatures and high humidity
Excessive Heat Characteristics

• Definition varies according to normal climate
• Death rates affected by:
  – Sudden rise in temperature
  – Prolonged heat waves
Heat Index

NOAA's National Weather Service

Heat Index
Temperature (°F)

Relative Humidity (%)  

<table>
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<th>80</th>
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</tbody>
</table>

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity
- Caution
- Extreme Caution
- Danger
- Extreme Danger
Extreme Heat Hazards

- Mechanical and electrical failures
- Heat cramps
- Fainting
- Heat exhaustion
- Heatstroke
July 1995 Heat Wave
Dust Storms

Particles of dust or sand lifted into the air by strong winds
Dust Storm Hazards

- Injury, especially respiratory issues
- Reduced visibility
- Damage to crops, buildings, and vehicles
- Abrasive effect on machinery
- Power outages
Types of Dust Storms

• Non-convective
  – Caused by sustained high wind at the surface
  – May last several hours or days

• Convective
  – Caused by thunderstorm or microburst
  – Usually sudden and short-lived
## Dust Storm Characteristics

<table>
<thead>
<tr>
<th>Factor</th>
<th>Nonconvective Events</th>
<th>Convective Events</th>
</tr>
</thead>
</table>
| Speed of onset  | • Recognizable weather patterns
• Easily identified 24 to 36 hours in advance                                          | • Predictable over an area of jurisdiction within 0-3 hours
• Locations identifiable minutes in advance                                              |
| Duration        | Ranges 3-4 hours to 2-3 days                                                          | • Microbursts – a few seconds
• Macrobursts – a few minutes
• Wake depression – up to two hours                                                   |
| Timing          | • Occur mainly during the late winter and early spring
• Conditions worsen during late morning
• Most intense during late afternoon                                                   | • Usually occur during the spring and summer
• Occur in association with late afternoon or evening thunderstorms                   |
April 1995 Arizona Dust Storm
Wind Storms

Require a warning when:

- Sustained winds of 40+ mph last 1 hour or longer
- Winds of 58+ mph occur
Types of Nonconvective Wind

- Gradient High Winds
- Mesoscale High Winds
- Channeled High Winds
- Tropical Cyclone Associated High Winds
- Chinook or Foehn Winds
Wind Storm Ingredients

Extreme pressure gradient caused by:

- Terrain effect
- Temperature differences, as with downslope winds
- Mesoscale systems or convective complexes
Wind Storm Hazards

- Impaired visibility
- Crop damage
- Destruction to buildings and vehicles
- Power outages and other infrastructure damage
- Broken trees
November 1991
California Wind Storm
Fire Weather

Meteorological conditions that promote the spread of wildfire

Las Conchas, 2011

Martin Fire, Lea County, 2011
Fire Weather Terms

- Fire Danger
- Prescribed Burn
- Red Flag Warning
- Wildfire
- Wildlands
Fire Weather Hazards

- Destruction of property
- Injury
- Death
- Secondary effects:
  - Erosion
  - Landslides
  - Water quality problems
Fire Weather Ingredients

- Low humidity
- High winds
- Dry thunderstorms
- Unstable air
Other Factors

- Dry conditions
- Urban-wildland interface
- Available fuel
- Hilly terrain
# Single Index for Dryness & Stability

<table>
<thead>
<tr>
<th>Haines Index</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 or 3</td>
<td>Very Low</td>
</tr>
<tr>
<td>4</td>
<td>Low</td>
</tr>
<tr>
<td>5</td>
<td>Moderate</td>
</tr>
<tr>
<td>6</td>
<td>High</td>
</tr>
</tbody>
</table>
2011 Record Wildfire Season in NM

Pacheco Fire, June 25

Las Conchas Fire, June 26
October 1991 California Brush Fire
Space Weather

- Solar storms impacting Earth and technological systems
- Solar cycle maximum forecast to occur in 2013 and again in 2022 = more active space weather
- NWS’ Space Weather Prediction Center warns for space weather hazards
Space Weather Impacts

- Radio communications outages
- Power disruptions
- Significant GPS errors

Image credit: NOAA/SWPC
Source of Space Weather: The Sun

- Sunspots
- Coronal Mass Ejection (CME)
- Solar Flares
Solar Wind

- Outward flow of solar particles and magnetic fields from the Sun
- Solar flares and CMEs increase the density and velocity of the solar wind
- When directed at the earth’s magnetic field it can be compressed to the altitude of our satellites
- The increased energy from the solar wind result in geomagnetic storms
Space Weather Storm Types

- Radio Blackouts
- Solar Radiation Storms
- Geomagnetic Storms
Geomagnetically induced currents (GIC) can flow into power lines and transformers, leading to:

- Transformer saturation
- Overheating
- Voltage drops
- Transformer damage
- Potential grid collapse
Volcanic Ash

• Small jagged pieces the size of sand and silt (less than 1/12 inch in diameter) of:
  – rocks
  – minerals
  – volcanic glass
Volcanic Ash Impacts

• Four inches leads to collapse of weaker roofs
• Twelve inches leads to death of most:
  – vegetation
  – livestock
  – aquatic life
• Can scratch the skin and eyes
• Can lead to respiratory failure
Volcanic Ash Services

• NOAA operates 2 Volcanic Ash Advisory Centers
• NWS Forecast Offices use this information to issue local Ashfall Advisories
• Advisories mean that airborne ash plume is resulting in deposition at the surface – it is snowing ash
April 2009 Mount Redoubt, AK
May 1980 Mount Saint Helens, WA
Activity: Identifying Potentially Hazardous Situations
Unit Summary

• Describe various types of hazardous weather
• Summarize potential dangers that can be caused by hazardous weather events
• Explain how community and environmental factors can worsen the impact of hazardous weather
Unit 4: Role of the Emergency Manager
Objectives

• Describe the role of the Emergency Manager in planning and responding to hazardous weather events
• Identify actions Emergency Managers should take to prepare for, and respond to, hazardous weather events
• Develop strategies for improving coordination among State and local communities in the days or hours leading to a hazardous event
What is your role in planning for and responding to hazardous weather?
The Role of the Emergency Manager

• Identifies and coordinates resources
• Facilitates emergency management activities
• Ensures participation and cooperation among all key players
Key Functions of the Emergency Manager

- Mitigate
- Detect
- Warn
- Respond
- Recover
What mitigation actions has your community taken for hazardous weather events?
What action does your Emergency Operations Plan (EOP) require the emergency manager to take when a NWS warning is issued?
Do you wait for the NWS to issue it or might you issue a warning prior to the NWS?
Large Scale Events

Lead time usually allows time to:

• Track the event’s evolution and progress
• Provide detailed warning
• Prepare an adequate response
2016 Post Christmas Blizzard

- 2 fatalities
- $1 billion damage
What steps should the Emergency Managers have taken?
If a similar event happened in your area, what warning and coordination procedures would be used, according to your EOP?
2013 Historic Flooding

- 3 fatalities
- Evacuations displaced several hundred
- Losses of $18 billion
- 2 Presidential Disaster Declarations
Small Scale Events

- Localized
- May develop without, or with minimal, advance notice
Radar Mosaic – 315am MDT to 415am MDT

These images at 15 minute intervals show the first wave of heavy storms (315am to 330am) that prompted the SPS issued at 338am.

Additional rain fell over and upstream of the camps prior to 400 am.

Reports of 3 in and 7 in (near Baldy) of rain were reported to me but have not been verified.
The Philmont Scout Ranch Flash Flood – June 2015

- Flash flood killed 1 person, injured 4
- $240K in damage
What advanced planning activities should the Emergency Manager have completed to help prepare for the event?
During and immediately following the event, how should the Emergency Manager have responded?
Does anyone have any questions about the Emergency Manager’s role during small-scale events?
Small Group Activity: The Dallas Hailstorm
6:44 p.m.
7:25 p.m.
Unit Summary

• Describe the role of the Emergency Manager in planning and responding to hazardous weather events

• Identify actions Emergency Managers should take to prepare for and respond to hazardous weather events

• Develop strategies for improving coordination among State and local communities in the days or hours leading to a potentially hazardous event
Unit 5: NWS Hazardous Weather Products
Objectives

- Describe the mission of the NWS
- Describe the basic organizational structure of the NWS
- Explain the purpose of various NWS products
- Explain how Probability of Precipitation is determined
- Select the NWS forecast products and other local resources that are most appropriate for the hazards affecting your community
NWS Overview

- Gathers and disseminates weather and flooding information
- Provides weather, hydrologic and climate forecasts and warnings
- Focused on protection of life and property
NWS Facilities

Western Region
- Space Weather Prediction Center
- Aviation Weather Center
- Storm Prediction Center

Central Region
- NWS Headquarters
- Regional Headquarters (6)
- NCEP Center (9)
- River Forecast Center (13)
- Weather Forecast Office (122)
- Center Weather Service Unit (21)
- Weather Service Office (21)
- Tsunami Warning Center (2)
- Data Collection Office (2)
- Other National Centers (8)

Eastern Region
- NCEP Central Operations
- Climate Prediction Center
- Hydrometeorological Prediction Center
- Environmental Modeling Center

Southern Region
- Ocean Prediction Center

Tropical Prediction Center

Alaska Region
- Guam

Pacific Region
- Hawaii

FEMA
Hazardous Weather and Flooding Preparedness
Group Activity: NWS Offices Knowledge Bowl

• Review the activity sheet (5 minutes)
• First team captain to raise a hand answers
• Provide answer within 15 seconds
• Turn ends when:
  – An incorrect answer is given,
  – Time runs out, OR
  – The team answers 3 questions correctly
Which NWS office type is responsible for working with water resource managers?
Which office is responsible for training observers and storm spotters?
Which two office types have 21 locations?
Which office type has 122 locations?
Which office type works exclusively with the FAA?
Which office type develops and improves numerical weather, climate, hydrological, and oceanic predictions?
Which office is made up of nine centers?
Which office executes the operational suite of the numerical analysis and forecast models?
Which office provides tornado and severe thunderstorm weather watches?
Which office provides space weather alerts and warnings?
Which office monitors and forecasts short-term climate fluctuations including issuing seasonal outlooks for hurricane season?
Which office issues weather predictions for the Atlantic and Pacific Oceans?
Which office provides real-time weather model diagnostics and national precipitation predictions?
Which office provides national aviation warnings and forecasts?
Which offices oversee policy, service, and operational issues for the NWS offices in their Regional areas of responsibility?
Which offices work with FEMA, NEMA, and IAEM on national policy, service, and operational issues?
Which offices provide tsunami warnings?
Which office provides forecasts of tropical weather systems in both the Atlantic and Eastern Pacific?
Which office type would most likely provide routine operational decision support to your EOC?
NWS Information Dissemination

- NOAA Weather Wire Service (NWWS)
- NOAA Weather Radio All Hazards (NWR)
- National Warning System (NAWAS)
- Emergency Managers Weather Information Network (EMWIN)

- Family of Service (FOS)
- NOAAPort
- Interactive NWS (iNWS)
- NWSChat
- Social Media
- Integrated Public Alert and Warning System (IPAWS)
NWWS

• Most reliable and timely warning delivery system
• NWS forecasts, warnings, and other products
NWR

- Provides voice broadcasts of weather information
- Is available to most of U.S. population
- Can activate alarms to alert users to imminent threats
- Used by NWS as primary means to activate EAS
NAWAS

- Network connecting Federal, State, area, county, and city warning points
- Warns public of potential loss of life and/or property
- Provides free exchange between law enforcement, EM agencies, and NWS
EMWIN

• Supplement to other services
• Live stream of critical emergency information at no recurring cost
• Uses radio, internet, and satellite methods to disseminate the basic datastream
FOS

Subscription services available to media, EM agencies, and private companies

• Server Access Service (SAS)
• Radar Product Services (RPS)
NOAAPort

Data is...

• Collected by GOES satellite environmental sensors and NWS observing systems
• Processed to create NWS operational data stream
• Routed to the appropriate NOAAAPort channel for uplink and broadcast
• Provided in near-real-time to NOAA and external users
iNWS

• Mobile alert service
  – Text messages
  – Email alerts
  – Doppler radar data

• For NWS core partners only
  – Emergency managers
  – Public safety officials
  – SKYWARN amateur radio operators
  – Government partners
NWS Chat

• Situational awareness tool tailored for:
  – Emergency managers
  – Other public safety officials
  – News media
  – Skywarn Net Control Operators

• Provides a direct, operational communication link for information exchange during hazardous weather events
Social Media

U.S. National Weather Service

Write something...

Attach...

Shared

Connect With More Friends

Share the Facebook applications with some of your friends; your user name shows here to start connecting.

Max Ads

U.S. National Weather Service Kids are off form school but the learning doesn’t have to stop. Want to do some experiments with weather? Here are a few...

- Weather Experiments
  - Weather Experiments
  - Weather Experiments

- How About You:
  - Ground rock in a field before a store comes!
  - 1 hour ago: Like + 0 person: Flug

- 96 hours ago Comment like Share

30 people like this.
View all 4 comments

U.S. National Weather Service Do your children ever ask you, what makes a Rainbow? Do you wonder yourself? NWS Western Region explains how rainbows form...


Twitter: @NWS
Tweet Date: 2010-02-20 10:22:22
in reply to @user

Twitter: @weatherreporter
Tweet Date: 2010-02-20 05:26:49
in reply to @user

Twitter: @NWS Amateur
Tweet Date: 2010-02-20 05:26:49
Not described

Twitter: @user2
Tweet Date: 2010-02-18 23:16:32
http://example.com/article

Twitter: @user1
Tweet Date: 2010-02-18 23:16:32
http://example.com/article
IPAWS

• Next-generation infrastructure of alert and warning networks
  – Commercial Mobile Alert System (CMAS)
  – Wireless Emergency Alerts (WEA)

• Automatic alerts with unique ring tone and vibration
Hazardous Weather and Flooding Preparedness

IPAWS, continued

Part 1 of 3-part graphic, titled Alerting Authorities. The validated Alerting Authorities can be Federal, State, territorial, tribal, or local officials designated within their level of government as an authority responsible for communicating emergency alerts and information to the public. After completing FEMA sponsored training, IPAWS recognized Alerting Authorities will be given a Collaborative Operations Group and access to the IPAWS capabilities. IPAWS CAP alert messages will be generated and sent to an IPAWS CAP Alert Origination Tool, such as Framework or other compatible emergency and incident management tools.

Part 2 of 3-part graphic, titled Alerting Disseminators. The Alert Disseminators include: the Emergency Alert System (EAS), Commercial Mobile Alert System (CMAS), Internet Services, National Oceanic and Atmospheric Administration (NOAA), and various state/local unique alerting systems.

Part 3 of 3-part graphic, titled American People. EAS provides alerts via the traditional broadcast means of radio (AM, FM, and Satellite) and television (digital and analog over the air, cable, and satellite). CMAS provides alerts via participating cellular phones, pagers, and other commercial mobile network devices. Likewise, Internet Services allow the American public to retrieve alert messages via independent web services and sites or applications that may be offered. Internet services also allow for growth and integration with future consumer technologies accessible via internet connected devices. NOAA provides alert information via the All Hazards Weather Radio system and other National Weather System alert and information services. Individual state and local governments may also choose to integrate local alerting systems such as emergency telephone networks, sirens, and digital signs on roadways with IPAWS to receive and be activated by CAP alerts.

IPAWS Architecture

Standards based alert message protocols, authenticated alert message senders, shared, trusted access & distribution networks, alerts delivered to more public interface devices.
What other location dissemination systems are in use?
Other Dissemination Systems

- Law Enforcement Telecommunications Systems (LETS)
- State Warning Point (SWP)
- Area Warning Points (AWPs)
- County Warning Points (CWPs)
- NWS WFO and National Center web sites
- Emergency Alert System
- Outdoor Warning Siren Systems

(38)
Interpreting Probability

Probability of Precipitation (PoP):

The chance or likelihood of an event occurring at some point in the forecast area, over a certain period of time.
PoP

- \( \text{PoP} = P_a \times a_c \)
- \( P_a \) = probability that precipitation will occur somewhere in the forecast area during the forecast period
- \( a_c \) = percent of the area that will receive measurable precipitation
## PoP Examples

<table>
<thead>
<tr>
<th>No precipitation, but scattered storms</th>
<th>Precipitation occurring, scattered storms to continue</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_a = 80%$</td>
<td>$P_a = 100%$</td>
</tr>
<tr>
<td>$a_c = 30%$</td>
<td>$a_c = 30%$</td>
</tr>
<tr>
<td>PoP = $0.80 \times 0.30 = 24% = 20%$</td>
<td>PoP = $1.0 \times 0.30 = 30%$</td>
</tr>
</tbody>
</table>
PoP Example

• A line of thunderstorms is forecast to cover the northern 80% of the forecast area

• The forecaster is confident of the likelihood of the occurrence (100% probability)

• PoP for the forecast area would be 80%

• $100\% \times 80\% = 80\%$
What is the PoP for a city in the southernmost part in the forecast area if the thunderstorms are NOT expected to move through the city?
Pre-Impact Information

• Typical life-cycle for the event
• Upstream conditions
• Impact in other areas
• Current conditions
What factors tend to increase the reliability of forecasts?
NWS Forecast Products

Goals:

• Increase public awareness of potential impact
• Promote appropriate public response
Activity: NWS Products

• Work with your table group
• Review information for your assigned NWS product
• Prepare a 5-minute presentation
• Address the questions on the activity instructions
## Non-routine NWS Products

<table>
<thead>
<tr>
<th>Outlooks or Statements</th>
<th>Advisories</th>
<th>Watches</th>
<th>Warnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>• HW event may develop</td>
<td>• HW event is imminent or occurring</td>
<td>• Risk of HW event has increased but still uncertain</td>
<td>• HW event is imminent or occurring</td>
</tr>
<tr>
<td>• Forecaster confidence &gt; 30%</td>
<td>• Forecaster confidence &gt; 80%</td>
<td>• Forecaster confidence &gt; 50%</td>
<td>• Forecaster confidence &gt; 80%</td>
</tr>
<tr>
<td>• Provides considerable lead time</td>
<td>• Used for less serious conditions</td>
<td></td>
<td>• Used for conditions that threaten life and property</td>
</tr>
</tbody>
</table>
How is the information provided by NWS different from the information given by TV news stations?
Emergency Manager’s Decision Support Page

• Local website maintained by many Local NWS Offices

• Provides Emergency Managers with information on:
  • Weather hazards facing the area
  • Preparedness
  • Upcoming workshops
Forecasts

Outlooks, Advisories, and Warnings

- Short-term
- Zone
- Extended
- Long range
Statements and Discussions

Statements

• Issued during weather events to advise of changing conditions
• Can amplify or cancel previously issued advisories and warnings

Discussions provide rationale for the forecasts
Other Sources

• Automated Local Evaluation in Real Time (ALERT)
• Local spotter groups/SKYWARN
• Amateur Radio Relay League (ARRL) and Amateur Radio Emergency Services (ARES)
• America’s Weather and Climate Industry
• Online resources
ALERT

- Computerized local flood-warning system
- Integrates self-reporting, field sensors, base station microcomputer, and specialized software
- Includes real-time streamflow simulation model
Spotters/SKYWARN

National network of trained volunteers who provide:

• Weather observations
• Valuable local data
ARRL and ARES

Amateur radio operators can provide:

• Emergency communications
• Their own equipment
• Service as weather spotters
America’s Weather and Climate Industry

- Various private vendors for weather and climate information
- Services available by subscription
- Cost and quality varies among vendors
Online Resources

Forecasting and historical weather data from:

• NWS
• Many universities
• Other online resources
Individual Activity: Selecting a Forecast Product

• Work individually
• List appropriate products and resources for your community
• Refer to information from the earlier Group Activity
• Be prepared to share your responses
Unit Summary

- Describe the mission of the NWS
- Describe the basic organizational structure of the NWS
- Explain the purpose of various NWS forecast products
- Explain how Probability of Precipitation is determined
- Select the NWS forecast products and other local resources that are most appropriate for the hazards affecting your community
Unit 6: Projecting the Impacts of Hazardous Weather and Flooding
Objectives

- List sources of information needed to determine a community’s vulnerability to hazardous weather events
- Identify climatological and community factors that contribute to your community’s vulnerability to hazardous weather and flooding
- Complete a hazard analysis for a hydrometeorological event to which your jurisdiction is vulnerable
- Propose mitigation measures for a hazardous weather or flooding event
What is your community’s state of readiness for responding to hazardous weather and flooding events?
In light of what you now know, what are your concerns about your community’s response capabilities?
Local Vulnerability

Based on climatological and community factors
Climatological Factors

• How bad can it get?
• How often has it occurred?
• How likely is it to happen?
• When are we most vulnerable?
What are the sources of information you would use to relate each of these factors to your community’s vulnerability?
Community Factors

- People at risk
- Property at risk
- Local building codes
- Locations of critical facilities
- Locations of key resources
- Condition of infrastructure
- Local geography and topography
Activity: Analyzing Threats
Debrief: Mitigation Measures

What mitigation measures can your community implement to reduce the impacts of the event you just analyzed?
Mitigation Funding Resources

- Local
- State
- Federal
Potential Local Mitigation Funding Resources

- Nonprofit organizations
- Taxes
- Private sector funding
Potential State Mitigation Funding Resources

- Emergency funds
- Conservation and historical preservation initiatives
- Earmarked funds from lottery, taxes, and other sources
Federal Mitigation Funding Resources

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM) Program
- Public Assistance (PA) Grant Program
- Flood Mitigation Assistance (FMA) Program
- Repetitive Flood Claims (RFC) Program
- Severe Repetitive Loss (SRL) Program
- HUD’s Community Development Block Grants (CSBG)
- National Tsunami Hazard Mitigation Program (NTHMP)
Unit Summary

• List sources of information needed to determine a community’s vulnerability to hazardous weather events

• Identify climatological and community factors that contribute to your community’s vulnerability to hazardous weather and flooding

• Complete a threat analysis for a hydrometeorological event to which your jurisdiction is vulnerable

• Propose mitigation measures for a hazardous weather or flooding event
Unit 7: Activity
Unit Objectives

- Describe factors that influence the selection of emergency response options
- Determine response priorities
- Propose appropriate emergency responses
Activity:
Severe Weather
Activity Notes

• Work in your table group
• Role-play as the affected emergency management agency
• Consider your own EOP
• Use NWS forecasts and graphics
Activity Scenario

- Role: Emergency management
- City: Clayton, New Mexico
- Population: 4,370
- 3830 sq. mi
Transportation

• Three US highways
• State Roads
• Municipal airport
• Multiple rail crossings
Community Info

- Community Anchor Institutions
  - Education
    - Public Schools K12
  - Higher Education
- Medical/Healthcare
  - Hospitals
  - Health Centers
- Libraries
- Public Safety
  - Emergency Operations Centers
  - Fire Stations
  - Law Enforcement
- Government Agencies
  - State Govt Agency
  - Other Govt / Community Support
Medical and Educational Facilities

- Hospital
- 1 Nursing Home
- High School
- Middle School
- 2 Elementary Schools
- Detention Facility
Group Activity
Sunday 3:50 AM
Hazardous Weather Outlook

What’s the main concern today and tonight?

- Wind advisory in effect from 2 PM this afternoon to 8 PM MDT this evening...
- Today: Partly cloudy. Windy. Isolated showers and thunderstorms in the afternoon. Highs in the mid 80s to lower 90s. South winds 10 to 20 mph increasing to 25 to 35 mph in the afternoon. Gusts up to 50 mph.
- Tonight: Windy. Partly cloudy with scattered showers and thunderstorms. Lows in the lower to mid 50s. South winds 25 to 35 mph decreasing to 15 to 25 mph after midnight. Gusts up to 50 mph.
- Monday: Very windy. Partly cloudy with isolated showers and thunderstorms. Highs in the mid 70s to lower 80s. South winds 25 to 35 mph increasing to the southwest 20 to 40 mph in the afternoon. Gusts up to 50 mph.

- Wind speeds over the northeast plains will remain gusty before tapering off late Monday afternoon. Gust speeds combined with continued low humidities will produce dangerous fire weather over the northeast highlands and central mountain chain on Monday afternoon.

- For Tuesday through Friday, the probability for widespread hazardous weather is low. However, thunderstorms developing each afternoon over the eastern plains may produce hail...downpour...wind gusts...and local downbursts.

- Weather can change very rapidly. Always use the latest forecasts...watches and warnings for planning purposes.

- Spotters are encouraged to report measured wind speeds...wind impacts...and wildfire starts through the National Weather Service Albuquerque NEXRAD site at weather.gov/abq or by calling 1.888.386.7657.
## Risk Categories for Convective Outlooks

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLGT</td>
<td>Well-organized severe thunderstorms in relatively small numbers/coverage</td>
</tr>
<tr>
<td>MDT</td>
<td>Substantial severe storm coverage or significant outbreak</td>
</tr>
<tr>
<td>HIGH</td>
<td>Major or extreme severe weather outbreak with large coverage</td>
</tr>
</tbody>
</table>
# Day 1 Probability to Categorical Outlook Conversion

<table>
<thead>
<tr>
<th>Outlook Probability</th>
<th>TORNADO</th>
<th>WIND</th>
<th>HAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>SEE TEXT</td>
<td>NOT USED</td>
<td>NOT USED</td>
</tr>
<tr>
<td>5%</td>
<td>SLGT</td>
<td>SEE TEXT</td>
<td>SEE TEXT</td>
</tr>
<tr>
<td>10%</td>
<td>SLGT</td>
<td>NOT USED</td>
<td>NOT USED</td>
</tr>
<tr>
<td>15%</td>
<td>MDT</td>
<td>SLGT</td>
<td>SLGT</td>
</tr>
<tr>
<td>30%</td>
<td>HIGH</td>
<td>SLGT</td>
<td>SLGT</td>
</tr>
<tr>
<td>45%</td>
<td>HIGH</td>
<td>MDT</td>
<td>MDT*</td>
</tr>
<tr>
<td>60%</td>
<td>HIGH</td>
<td>HIGH*</td>
<td>MDT</td>
</tr>
</tbody>
</table>

*SIGNIFICANT SEVERE area needed where denoted by hatching – otherwise default to next lower category
Instructions

• Work in your table group
• Consider:
  – Community information
  – Maps
  – NWS products provided
• Discuss questions and record responses
• Be prepared to share
Scenario Update #1
Sunday 11:30 AM
DAY 1 CONVECTIVE OUTLOOK
NWS STORM PREDICTION CENTER NORMAN OK
1130 AM CDT SUN MAY 23 2010

VALID 231600Z - 241200Z

...THERE IS A SLGT RISK OF SVR TSTMS FROM THE UPPER MS VALLEY THROUGH THE CNTRL PLAINS INTO THE SRN HIGH PLAINS...

...SYNOPSIS...

THE PRIMARY FEATURE OF INTEREST THIS PERIOD IS A STRONG MID AND UPPER-LEVEL LOW CURRENTLY DIGGING SWD OVER CA/NV. THIS SYSTEM WILL BEGIN TO TURN EW AND LATER TODAY PRIOR TO ACCELERATING NW/WD INTO THE FOUR CORNERS REGION TONIGHT AS MID/HIGH-LEVEL JET STREAMS ROUND THE TROUGH BASE AND DEVELOP DOWNSTREAM OVER THE ROCKIES. THIS EVOLUTION WILL RESULT IN A CORRIDOR OF SIGNIFICANT HEIGHT FALLS/DYNAMIC FORCING FOR ASCENT SPREADING EW/WD FROM THE LOWER CO VALLEY INTO THE CNTRL/SRN ROCKIES.

AT THE SURFACE...CURRENT MESOANALYSIS SHOWS PRIMARY SYNOPTIC FRONT EXTENDING FROM CNTRL MN SWD THROUGH THE MID MO VALLEY INTO THE SRN HIGH PLAINS AND SRN ROCKIES. THE SWD PORTION OF THIS BOUNDARY WILL SHIFT SLOWLY EW TODAY GRADUALLY WEAKENING WITH TIME BENEATH BUILDING MIDLEVEL HEIGHTS. MEANWHILE...THE SWD EXTENSION OF THIS FRONT WILL RETREAT NWD THROUGH THE CNTRL PLAINS IN RESPONSE TO LEE CYCLGENESIS OVER ERN CO LATER TODAY INTO TONIGHT. AS THIS OCCURS...A LEE TROUGH/DRY LINE WILL BE ENHANCED OVER THE HIGH PLAINS...ALLOWING FOR THE NWD MWN WIND ADECTION OF A MOIST BOUNDARY OVER THE HIGH PLAINS.

...CENTRAL/SRN HIGH PLAINS THIS AFTERNOON AND TONIGHT...

5 PERCENT TORNADO PROBABILITY HAS BEEN EXTENDED SWD INTO THE TX PANHANDLE WHERE INCREASING SSEL LOW LEVEL WINDS WILL ENHANCE LOW LEVEL SHEAR INTO THIS REGION. OTHERWISE...THE FORECAST FOR THIS PART OF THE SLIGHT RISK AREA REMAINS ON TRACK. SPC MESOSCALE DISCUSSION 674 WILL PROVIDE SHORT TERM MESOSCALE AND SEVERE WEATHER THREAT DETAILS ACROSS PARTS OF WRN KS TO THE TX PANHANDLE.
Scenario Update #3
Sunday 5:19 PM – 5:27 PM
NWS Briefing

SEVERE WEATHER OUTBREAK POSSIBLE TODAY
LARGE, STRONG, LONG-TRACK TORNADOES POSSIBLE

REVIEW SEVERE WEATHER SAFETY RULES NOW

AT HOME OR AT WORK, HAVE A PLAN FOR TAKING SHELTER

KEEP INFORMED OF LATEST FORECAST INFO; LISTEN FOR WATCHES, WARNINGS, UPDATES

Graphicast Tue May 24 2:26AM CDT
Norman Forecast Office
The National Weather Service in Albuquerque has issued a

* Severe Thunderstorm Warning for...
  Extreme Northeastern Quay County in East Central New Mexico
  East Central Harding County in Northeast New Mexico
  Southeastern Union County in Northeast New Mexico

* Until 5:45 PM MDT

* At 5:15 PM MDT...National Weather Service Doppler Radar indicated a
  Severe Thunderstorm capable of producing quarter size hail...and
  Damaging winds in excess of 60 MPH. This storm was located near
  Amistad...and moving northeast at 45 MPH.

* Locations impacted include...
  Sedan...

Precautionary/Preparedness Actions...

Severe storms produce damaging winds and large hail. Move indoors and
avoid windows.

---

LAT...LOC 3565 10303 3575 10343 3634 10328 3633 10302
3632 10300
TIME...NOT...LOC 2319Z 209DBG 55KT 3604 10310

---

KJ
From The ABQ ARCHIVES
Generated For Print on February 8 2016 at 12:19:46 pm
NOTE: NOT A CERTIFIED WEATHER DOCUMENT! NOT ADMISSABLE IN COURT!

ABQSVRAQ
WUUS55 KABQ 232327
SVRABQ
NMC059-240015-
/O.NEW.KABQ.SV.W.006Z.100523212327Z-100524100152/

BULLETIN - EAS ACTIVATION REQUESTED
SEVERE THUNDERSTORM WARNING
NATIONAL WEATHER SERVICE ALBUQUERQUE NM
527 PM MDT SUN MAY 23 2010

THE NATIONAL WEATHER SERVICE IN ALBUQUERQUE HAS ISSUED A

* SEVERE THUNDERSTORM WARNING FOR...
  NORTHEASTERN UNION COUNTY IN NORTHEAST NEW MEXICO

* UNTIL 615 PM MDT

* AT 524 PM MDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A
  SEVERE THUNDERSTORM CAPABLE OF PRODUCING QUARTER SIZE HAIL...AND
  DAMAGING WINDS IN EXCESS OF 60 MPH. THIS STORM WAS LOCATED 8 MILES
  EAST OF MOUNT IZORA...OR ABOUT 10 MILES WEST OF CLAYTON...AND MOVING
  NORTH AT 35 MPH.

* LOCATIONS IMPACTED INCLUDE...
  SENECA...

PRECAUTIONARY/PREPAREDNESS ACTIONS...

SEVERE STORMS PRODUCE DAMAGING WINDS AND LARGE HAIL. MOVE INDOORS AND
AVOID WINDOWS.

$&

LAT...LON 3700 10300 3640 10310 3630 10350 3700 10361
  3701 10301
TIME...DST...LOC 2327Z 187DEG 31KT 3650 10335

$$
Scenario Update #4
Sunday 5:42 PM – 5:58 PM
Hazardous Weather and Flooding Preparedness

From The ABQ ARCHIVES
Generated For Print on February 8 2016 at 12:20:05 pm
NOTE: NOT A CERTIFIED WEATHER DOCUMENT! NOT ADMISSABLE IN COURT!

ABQSVRABQ
WUUS55 KABQ 232342
SVRABQ
WXC037-059-240015-
/O.NEW.KABQ.SV.W.0063.100523T2342Z-100524T0015Z/

BULLETIN - EAS ACTIVATION REQUESTED
SEVERE THUNDERSTORM WARNING
NATIONAL WEATHER SERVICE ALBUQUERQUE NM
542 PM MDT SUN MAY 23 2010

THE NATIONAL WEATHER SERVICE IN ALBUQUERQUE HAS ISSUED A

* SEVERE THUNDERSTORM WARNING FOR...
  NORTHEASTERN QUAY COUNTY IN EAST CENTRAL NEW MEXICO
  SOUTHEASTERN UNION COUNTY IN NORTHEAST NEW MEXICO

* UNTIL 615 PM MDT

* AT 540 PM MDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A
  SEVERE THUNDERSTORM CAPABLE OF PRODUCING QUARTER SIZE HAIL...AND
  DAMAGING WINDS IN EXCESS OF 60 MPH. THIS STORM WAS LOCATED NEAR
  SEDAN...OR ABOUT 14 MILES NORTH OF AMISTAD...AND MOVING
  NORTHEAST AT 35 MPH. ANOTHER SEVERE THUNDERSTORM WAS LOCATED 20 MILES
  WEST OF NARA VISA ALSO MOVING NORTHEAST AT 35 MPH.

* LOCATIONS IMPACTED INCLUDE...
  RURAL EXTREME EAST CENTRAL UNION COUNTY...

PRECAUTIONARY/PREPAREDNESS ACTIONS...

SEVERE STORMS PRODUCE DAMAGING WINDS AND LARGE HAIL. MOVE INDOORS AND
AVOID WINDOWS.

&&
LAT...LON 3557 10335 3591 10334 3631 10322 3638 10303
3560 10303
TIME...MDT...LOC 2341Z 207DEG 31KT 3612 10306
$$
KJ
BULLETIN - EAS ACTIVATION REQUESTED
TORNADO WARNING
NATIONAL WEATHER SERVICE ALBUQUERQUE NM
558 PM MDT SUN MAY 23 2010

THE NATIONAL WEATHER SERVICE IN ALBUQUERQUE HAS ISSUED A

* TORNADO WARNING FOR...
  EAST CENTRAL QUAY COUNTY IN EAST CENTRAL NEW MEXICO

* UNTIL 630 PM MDT

* AT 557 PM MDT...SKYWARN SPOTTERS REPORTED A FUNNEL CLOUD OVER EAST CENTRAL QUAY COUNTY...OR ABOUT 25 MILES SOUTH OF NARA VISA...MOVING NORTH AT 35 MPH...

* LOCATIONS IMPACTED INCLUDE...
  RURAL NORTHEASTERN QUAY COUNTY...

PRECAUTIONARY/PREPAREDNESS ACTIONS...

IF YOU ARE IN OR NEAR THE PATH OF THIS STORM...TAKE COVER NOW.

& &

LAT...LON 3553 10335 3552 10303 3519 10319 3520 10334
TIME...MOT...LOC 2358Z 188DEG 29KT 3528 10325

$$
Scenario Update #5
Sunday 6:07 PM
From The ABQ ARCHIVES
Generated For Print on February 8 2016 at 12:20:57 pm
NOTE: NOT A CERTIFIED WEATHER DOCUMENT! NOT ADMISSABLE IN COURT!

ABQTRABO
WFUS55 KABQ 240007
TORABO
NMC059-240030-
/O.NEW.KABQ.TO.W.0004.100524T0007Z-100524T0030Z/

BULLETIN - EAS ACTIVATION REQUESTED
TORNADO WARNING
NATIONAL WEATHER SERVICE ALBUQUERQUE NM
607 PM MDT SUN MAY 23 2010

THE NATIONAL WEATHER SERVICE IN ALBUQUERQUE HAS ISSUED A

* TORNADO WARNING FOR
  EAST CENTRAL UNION COUNTY IN NORTHEAST NEW MEXICO

* UNTIL 630 PM MDT

* AT 606 PM MDT...SKYWARN SPOTTERS REPORTED FUNNEL CLOUDS AND
  TENNIS BALL SIZED HAIL 14 MILES SOUTHEAST OF CLAYTON.
  THE LARGE SEVERE THUNDERSTORM WAS MOVING NORTH AT 40 MPH.

* LOCATIONS IMPACTED INCLUDE...
  RURAL EXTREME EAST CENTRAL UNION COUNTY...

PRECAUTIONARY/PREPAREDNESS ACTIONS...

THIS IS A DANGEROUS STORM. LEAVE AUTOMOBILES AND MOBILE HOMES. MOVE
INTO AN INTERIOR ROOM OR HALLWAY ON THE LOWEST FLOOR. STAY AWAY FROM
WINDOWS AND OUTSIDE WALLS.

&&

LAT...LON 3615 10302 3620 10322 3639 10325 3661 10324
3662 10301 3650 10301 3641 10303
TIME...MOT...LOC 00065 201DEG 36KT 3632 10304

$$
KJ
Scenario Update #6
Sunday 8:01 PM
From The ABQ ARCHIVES
Generated For Print on February 8 2016 at 12:21:29 pm
NOTE: NOT A CERTIFIED WEATHER DOCUMENT! NOT ADMISSIBLE IN COURT!

ABQ|TOR|ABQ
WFUS55 KABQ 240201
TORABQ
NMC059-240230-
/O.NEW.KABQ.TO.W.0005.100524T0201Z-100524T0230Z/

BULLETIN - EAS ACTIVATION REQUESTED
TORNADO WARNING
NATIONAL WEATHER SERVICE ALBUQUERQUE NM
801 PM MDT SUN MAY 23 2010

THE NATIONAL WEATHER SERVICE IN ALBUQUERQUE HAS ISSUED A

* TORNADO WARNING FOR...
  EAST CENTRAL UNION COUNTY IN NORTHEAST NEW MEXICO

* UNTIL 830 PM MDT

* AT 758 PM MDT..SKYWARN SPOTTERS REPORTED A TORNADO 9 MILES SOUTH
  OF CLAYTON..MOVING NORTHEAST AT 25 MPH.

* LOCATIONS IMPACTED INCLUDE...
  RURAL EAST CENTRAL UNION COUNTY...

PRECAUTIONARY/PREPAREDNESS ACTIONS...

THIS IS A DANGEROUS STORM. LEAVE AUTOMOBILES AND MOBILE HOMES. MOVE
INTO AN INTERIOR ROOM OR HALLWAY ON THE LOWEST FLOOR. STAY AWAY FROM
WINDOWS AND OUTSIDE WALLS.

&

LAT...LON 3648 10301 3642 10301 3629 10303 3632 10324
  3660 10321 3657 10299 3648 10300
TIME...MDT...LOC 02012 208DEG 22KT 3634 10316

$$
Activity Debrief
Group Reporting

• What actions did you take?
• What worked well?
• What didn’t work well?
• How did you address communication and coordination with NWS and others?
Images from the Event

Image provided courtesy of Tom Pastrano

Tom Pastrano
Chickasha
6/24/2011

Image provided courtesy of Marco Kaschuba
Destruction
Track
Radar Imagery
Radar Imagery
Satellite and Radar Imagery
Storm Reports

SPC Storm Reports for 05/23/10
Map updated at 1206Z on 06/02/10

- TORNADO REPORTS... (16)
- WIND REPORTS/HI...... (52/1)
- HAIL REPORTS/LG...... (88/10)
- TOTAL REPORTS....... (156)

- High Wind Report (65KT +)
- Large Hail Report (2” dia. +)

Preliminary Data Only

FEMA
Hazardous Weather and Flooding Preparedness
## Union County Tornadoes 1890-2015

http://www.srh.noaa.gov/abq/?n=cli_torns

<table>
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<tr>
<th>Date</th>
<th>Time</th>
<th>Length (mi)</th>
<th>Width (yds)</th>
<th>F-scale</th>
<th>Killed</th>
<th>Injured</th>
<th>Location</th>
<th>County</th>
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Unit Summary

• How has this activity made you think differently about your emergency management responsibilities during hazardous weather events?

• How can you improve coordination with NWS and others during hazardous weather events?
You should now be able to...

• Describe factors that influence the selection of emergency response options during a hazardous weather event
• Determine response priorities for a hazardous weather event
• Propose appropriate emergency responses for a hazardous weather event in a given scenario
Unit 8: Course Summary
Unit Objectives Review

For each unit objective, consider:

• Did we cover it?
• Can you do it?
• Do you have any questions?
Unit 1: Introduction and Course Overview

This unit focused on preparing you to:

Recognize the importance of planning for hazardous weather and flooding events
Unit 2: Weather Overview

This unit focused on preparing you to:

Analyze how the components of weather interact to create hazardous weather
Unit 2 Review Question #1

What is the significance of a dew point greater than 60°F?
Unit 2 Review Question #2

With what type of pressure system are cloudy skies associated?
Unit 3: Introduction to Hazardous Weather

This unit focused on preparing you to:

Anticipate the impact of hazardous weather events to enhance preparedness
Unit 3 Review Question #1

What are some hazards associated with a winter storm? What effects might they have on the community?
Unit 3 Review Question #2

What are three basic factors that contribute to thunderstorm development?
What are some community factors that contribute to the risk level of hazardous weather events?
Unit 4: Role of the Emergency Manager

This unit focused on preparing you to:

Evaluate actions taken by Emergency Managers to prepare for, and respond to, actual hazardous weather events
Unit 4 Review Question #1

What are the five primary responsibilities of the emergency manager related to hazardous weather events?
Unit 4 Review Question #2

What are some ways that emergency managers can prepare for hazardous weather in advance?
Unit 5: NWS Hazardous Weather Products

This unit focused on preparing you to:

Interpret information contained in National Weather Service forecast and warning products, as well as in other weather resources
Unit 5 Review Question #1

What is the difference between a Watch and a Warning?
Unit 5 Review Question #2

What two values are multiplied to figure the Probability of Precipitation?
Unit 5 Review Question #3

Which type of NWS office directly supports local/state emergency management response to hazardous weather?
Unit 6: Project the Impacts of Hazardous Weather and Flooding

This unit focused on preparing you to:

Assess your community’s state of readiness for hazardous weather and flooding events
Unit 6 Review Question #1

How can you help your community be ready for hazardous weather events?
Unit 6 Review Question #2

What potential resources may be used to help fund mitigation measures?
Unit 7: Activity

This unit focused on preparing you to:

Evaluate the effectiveness of emergency response actions for a given scenario
Unit 7 Review Question #1

In the Unit 7 activity, what did you learn about your community’s ability to respond to real events?
Thank you for attending!

• Course Evaluation
• Final Exam
• Closing Remarks
• Certificates