Department of Commerce • National Oceanic & Atmospheric Administration • National Weather Service

NATIONAL WEATHER SERVICE INSTRUCTION 10-1605

AUGUST 17, 2007

Operations and Services
Performance, NWSPD 10-16

STORM DATA PREPARATION

NOTICE: This publication is available at: http://www.nws.noaa.gov/directives/.

OPR: W/OS52 (B. MacAloney) **Certified by:** W/OS5 (R. McLeod)
Type of Issuance: Routine

SUMMARY OF REVISIONS: This Directive supersedes National Weather Service Instruction (NWSI) 10-1605, dated November 17, 2005.

The following changes were made:

- Documentation on the new Enhanced Fujita (EF) Scale replaced the old Fujita Scale documentation. The F-scale was replaced by the EF-Scale on February 1, 2007.
- The event name of Landslide was renamed to Debris Flow. .
- Descriptions of event times and locations were clarified. Three times (beginning, met/exceeded advisory/warning criteria value, and ending) are now required for Blizzard, Heavy Snow, Ice Storm, Lake-effect Snow, Sleet, and Winter Storm.
- Old "StormDat' references were replaced with a generic "*Storm Data* software" phrase.
- Differences between direct and indirect fatalities and injuries were clarified.
- A table of monetary estimates for storm damage was added as a new Appendix B.
- Heat index tables were updated.
- Flood/Flash Flood events were modified to reflect the new requirement that the cause of a flood event be indicated in the event narrative.
- Differences between Storm Surge/Tide events and Coastal Flood events were clarified.
- Minor descriptive enhancements were done in several events.
- Event narratives were made a requirement for Thunderstorm Wind events with estimated wind gust values.
- The Outstanding Storms of the Month section was edited to show more concise information on submission and narratives, etc.

/signed/ August 3, 2007
James Hoke Date
Acting Director, Office of Climate, Water, and Weather Services

Storm Data Preparation

Table of Contents: Page

1. *Storm Data* Disclaimer. *Storm Data* is an official publication of the National Oceanic and Atmospheric Administration (NOAA) which documents:

a. The occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce;

b. Rare, unusual, weather phenomena that generate media attention, such as snow flurries in South Florida or the San Diego coastal area; and

c. Other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occur in connection with another event.

Some information appearing in *Storm Data* may be provided by or gathered from sources outside the National Weather Service (NWS), such as the media, law enforcement and/or other government agencies, private companies, individuals, etc. An effort is made to use the best available information, but because of time and resource constraints, information from these sources may be unverified by the NWS. Accordingly, the NWS does not guarantee the accuracy or validity of the information. Further, when information appearing in *Storm Data* originated from a source outside the NWS (frequently credit is provided), *Storm Data* users requiring additional information should contact that source directly. In most cases, NWS employees will not have the knowledge to respond to such requests. In cases of legal proceedings, Federal regulations generally prohibit NWS employees from appearing as witnesses in litigation not involving the United States. The determination of direct versus indirect causes of weather-related fatalities or injuries is not a legal determination and should not be considered as such. The determination is intended for internal NWS statistical review to assist NWS in issuing forecasts and warnings.

1.1 Local Data Retention Requirements. All documentation used for the production of *Storm Data* will be retained locally for two years. Note: The National Climatic Data Center (NCDC) is the official custodian of NWS weather records and responds to requests for certified records for litigation purposes.

2. *Storm Data* Preparation. The *Storm Data* preparer should allocate a sufficient amount of preparation time to ensure that documentation and verification of significant weather phenomena are as accurate and complete as possible. The preparer will carefully coordinate the time and location of events that cross county warning areas (CWAs) to prevent inconsistencies in the *Storm Data* database. These quality control procedures are important, especially for events used in the NWS national verification program.

Preparation will be done using the currently authorized on-line *Storm Data* software program. Software methodology and hardware requirements are provided on the Office of Climate, Water, and Weather Services (OCWWS) Performance Branch's Performance Management web site. Certification of the monthly data will be accomplished electronically on-line. Inclusion of pictures in the monthly reports should be limited to unusual or highly significant events in order to keep the *Storm Data* publication at a reasonable size. If pictures are not the property of NOAA, proper attribution should be provided.

2.1 Permitted Storm Data Events. The only events permitted in *Storm Data* are listed in Table 1 of Section 2.1.1. The chosen event name should be the one that most accurately describes the meteorological event leading to fatalities, injuries, damage, etc. However, significant events, such as tornadoes, having no impact or causing no damage, should also be included in *Storm Data*. See Section 7 for detailed examples.

All events meeting the criteria for inclusion in *Storm Data* should be entered, regardless of the rules used for verification, such as the 10 mile/15 minute rule (see NWSI 10-1601, Verification Procedures, Section 2.1.1). However, in some cases, it is permissible to document only one event when the phenomenon was continuous, or nearly continuous, from Point A to Point B, rather than enter into the *Storm Data* software each and every single event/report that occurred between Point A and Point B (e.g., a long-lived thunderstorm wind event, or many similarly-sized hail reports in a metropolitan area).

Additional details about record values of temperature, precipitation, etc., may be included in the narrative of an appropriate *Storm Data* event. However, only the more significant values should be summarized, such as monthly, seasonal, or yearly records. For example, a new monthly single-storm, snowfall record can be included in the event narrative of a Heavy Snow event, or a new, all-time, 4-hour rainfall record value can appear in the event narrative of a Flash Flood event.

In some cases, such as with Hurricane Katrina, it may be nearly impossible to determine what event (i.e., Storm Surge/Tide, Hurricane, Flash Flood, or High Surf) resulted in a directly-related death. For these situations, in order to simplify the *Storm Data* preparation process, it is appropriate to assign the death to the Hurricane (Typhoon) event. However, state this fact in the event narrative.

2.1.1 Storm Data Event Table

Event Name	**Designator**	**Event Name**	**Designator**
Astronomical Low Tide	Z	Hurricane (Typhoon)	Z
Avalanche	Z	Ice Storm	Z
Blizzard	Z	Lake-Effect Snow	Z
Coastal Flood	Z	Lakeshore Flood	Z
Cold/Wind Chill	Z	Lightning	C
Debris Flow	C	Marine Hail	M
Dense Fog	Z	Marine High Wind	M
Dense Smoke	Z	Marine Strong Wind	M
Drought	Z	Marine Thunderstorm Wind	M
Dust Devil	C	Rip Current	Z
Dust Storm	Z	Seiche	Z
Excessive Heat	Z	Sleet	Z
Extreme Cold/Wind Chill	Z	Storm Surge/Tide	Z
Flash Flood	C	Strong Wind	Z
Flood	C	Thunderstorm Wind	C
Frost/Freeze	Z	Tornado	C
Funnel Cloud	C	Tropical Depression	Z
Freezing Fog	Z	Tropical Storm	Z
Hail	C	Tsunami	Z
Heat	Z	Volcanic Ash	Z
Heavy Rain	C	Waterspout	M
Heavy Snow	Z	Wildfire	Z
High Surf	Z	Winter Storm	Z
High Wind	Z	Winter Weather	Z

Legend: There are three designators: C - County/Parish; Z - Zone; and M - Marine. (Refer to Section 2.4 to find instructions on how to designate Alaska Region events.)

Table 1. *Storm Data* Event Table.

2.2 Aircraft/Marine Incidents. It is the responsibility of the National Transportation Safety Board (NTSB) to investigate and file reports on the probable causes of aviation and marine-related incidents. A *Storm Data* preparer, however, can include events that may have resulted in an incident in *Storm Data* as long as associated NWS operational performance is not discussed. See Funnel Cloud, Marine Thunderstorm Wind, and Seiche examples in Section 7.

2.3 Time. The beginning and ending time for each event will be entered as accurately as possible. Use local standard time in 24-hour clock throughout the year, such as 0600 Eastern Standard Time (EST), 0925 Central Standard Time (CST), 1800 Mountain Standard Time (MST), etc. Forecast offices having a CWA responsibility in multiple-time zones should enter data in the appropriate time zone for the event's location.

Establishing the time of an event to the nearest minute will be difficult in certain situations. To minimize this problem, the *Storm Data* preparer should carefully compare all storm reports to available radar data, using unique radar signatures to make adjustments in the event time.

The *Storm Data* preparer must ensure that event times in the event header-strip are consistent with event times mentioned in the event narrative. Extra quality control is needed in order to minimize user confusion and ensure that the national severe weather database is as accurate as possible.

In general, the time of an event, as it appears in the header-strip, is the time when the event reached locally, regionally, or nationally established advisory or warning criteria (exceptions defined in Section 2.3.1). The event time could be the single time that a peak wind gust of 65 knots (75 mph) occurred, or it could be beginning and ending times of a 10-minute shower of large, damaging hailstones. If the time of the event in the header-strip is a broad guesstimate, then it should be indicated as such in the event narrative.

2.3.1 Winter Weather Event Times. For the winter-related events of Blizzard, Heavy Snow, Ice Storm, Lake-Effect Snow, Sleet, and Winter Storm, there will be three times that are populated in different fields in the *Storm Data* software:

a. Beginning Time – In most cases, the beginning time will be when accumulations began, since this is usually the approximate time that the event started to have an impact or became a nuisance. For Blizzard events, the beginning time will be when blizzard conditions were first experienced (meeting visibility and wind criteria). The *Storm Data* preparer must use good judgment, but must also be consistent from one event to the next;

b. Criteria Time – this is the time when the event reached locally, regionally, or nationally-established warning criteria. The criteria time will not appear in the event's header-strip in the *Storm Data* publication; only the beginning and ending times of the event will appear. The criteria time must fall between the date/time the event began and the date/time the event ended;

c. Ending Time – this is the ending time of an event. In most cases the ending time will be when precipitation ended. In Blizzard events, it will be when visibilities or winds no longer met blizzard criteria.

2.3.2 Events That Span More Than One Month. Events that span more than one month will be entered for each month they occur. Directly-related fatalities, injuries, and damages will be given in the appropriate column for the month currently being prepared. Additional summary information on cumulative fatalities, injuries, or damages from previous months can be explained in the event narrative of the *Storm Data* entry for the final month of the event. If the event continued into the month that follows the month currently being prepared, then mention that fact in the event narrative.

2.4 Location. A hydro-meteorological event will be referenced, minimally, to the nearest tenth of a mile, to the geographical center (not from the village/city boundaries or limits) of a particular village/city, airport, or inland lake, providing that the reference point is documented in the S*torm Data* software location database. The *Storm Data* preparer can reference an event to the nearest hundredth of a mile for greater accuracy (desirable for tornado events). As an alternative, the *Storm Data* preparer can enter the latitude/longitude coordinates of the severe weather event for greatest accuracy.

In some cases, the reference point of a large, irregularly-shaped city may have been redefined to co-exist with the cultural/economic/political center of that city, commonly referred to as the "downtown" location (for example, the geographical centers of New York City, Chicago, Milwaukee, Houston, and Los Angeles, as indicated in AWIPS, generally don't correspond to their cultural/economic/political centers). If this is the case, then state this difference in the event narrative.

The referenced location used in the *Storm Data* software must be in the same county in which the event took place. Additional, detailed information on the exact location of an event can be included in the event narrative. This additional, detailed information, such as highway names or numbers, intersections of major roads, city parks, and small lakes or other landmarks, would be useful when the event occurs within the boundaries of a large city. In some cases, if the event is relatively widespread, the *Storm Data* preparer may reference two locations on either side of the impacted area and describe the impacted area in the event narrative.

For marine zones, a hydro-meteorological event will be referenced (azimuth and range) to the reference points documented in the *Storm Data* software location database. In general, these would be coastal harbors or other prominent coastal shoreline features.

The *Storm Data* preparer can enter the azimuth/range of an event with respect to a reference city within the *Storm Data* software, or he/she can enter the latitude/longitude coordinates of the severe weather event. Given one set of numbers, the software is able to calculate the same data in the other format.

In the NWS's Alaska Region, all land-based events are reported by zone (Z), since Alaska is not completely covered by counties.

2.5 Event Source. The source of each *Storm Data* event will be entered in the software program. Possible sources of reports include "trained spotter," "law enforcement," and "emergency management." In those cases where the source of the event report is not obvious, the preparer should use professional judgment as to what source is appropriate. Even though the event source does not appear in the final *Storm Data* publication, this information is used in related NWS statistical studies.

2.6 Fatalities/Injuries. The determination of direct versus indirect causes of weather-related fatalities or injuries is one of the most difficult aspects of *Storm Data* preparation. Determining whether a fatality or injury was direct or indirect has to be examined on a case-by-case basis. It is impossible to include all possible cases in this Directive. The preparer should include the word "indirect" in all references to indirect fatalities or injuries in the event narrative. This will minimize any potential confusion as to what fatalities and injuries referenced in the event narrative were direct or indirect. An event narrative example follows.

> "Powerful thunderstorm winds leveled trees and power lines in and around Morristown, TN. One of the toppled trees struck and killed two men running for shelter. During the clean-up operations after the storm, a person on an ATV was injured (indirect) when the vehicle struck a tree that blocked a road."

Special care must be exercised when dealing with situations in which vehicles leave a road surface (due to a non-weather reason) not covered with flood waters and go into non-flooded rivers or canals. Any fatalities, injuries, or damage in these cases will not be entered using the *Storm Data* software, since they are not weather-related. However, if a vehicle drives into waters crossing a roadway and the driver is killed, such a fatality would be entered using the *Storm Data* software.

2.6.1 Direct Fatalities/Injuries. A direct fatality or injury is defined as a fatality or injury directly attributable to the hydro-meteorological event itself, or impact by airborne/falling/moving debris, i.e., missiles generated by wind, water, ice, lightning, tornado, etc. In these cases, the weather event was an "active" agent or generated debris which became an active agent. Generalized examples of direct fatalities/injuries would include:

a. Thunderstorm wind gust causes a moving vehicle to roll over;

b. Blizzard winds topple a tree onto a person; and

c. Vehicle is parked on a road, adjacent to a dry arroyo. A flash flood comes down the arroyo and flips over the car. The driver drowns.

Fatalities and injuries directly caused by the weather event will be entered in the *Storm Data* software "fatality" and "injury" entry fields, respectively. For direct fatalities, enter the specific data as queried by the software, i.e., number of individuals, age, gender, location, etc. Obtain information from reliable sources. The alphanumeric fatality code trailing the narrative is automatically inserted by the software. See Section 7 for detailed examples.

A directly-related weather injury is one that requires treatment by a first-responder or subsequent treatment at a medical facility. Injured persons who deny medical treatment also may be included. Persons who are not considered injured but who are affected by the phenomenon may be discussed in the event narrative.

In very rare cases, a pregnant woman may die from the direct effects of an event. In these situations, only one death (the pregnant woman) will be documented in *Storm Data.*

If a child less than 1 year of age (for example, 2-months old) dies directly in a weather event, the child's age is to be rounded up to 1 year of age.

In some cases, such as with Hurricane Katrina, a person in New Orleans, LA, may have been directly injured by the event, but was subsequently evacuated to another city, such as Houston, TX. If this person eventually died from his/her initial injuries while in Houston, TX, and if this information was made available in a timely fashion to the *Storm Data* preparer at the New Orleans/Slidell office, this death should be documented as if it occurred in New Orleans. If this person died from other causes (vehicle accident, homicide, etc.) while in Houston, then his/her death was not related to Hurricane Katrina, and no *Storm Data* entry would be made.

2.6.1.1 Specifying Direct Fatality Locations. When specifying the location of the direct Fatality, only the choices found in Table 2 of Section 2.6.1.2 are to be used. In some cases, it will be easy to establish the fatality location, and in others it will be difficult, especially with water situations. For example, a person drives a vehicle into a flash flood; the vehicle is overturned, and the person drowns. In this situation, you should choose the "Vehicle and/or Towed Trailer" location (VE), since the person died as a result of being in the vehicle in floodwaters. The flash flood was still the cause of the death, but the VE designation indicates the "where they were found" portion of the death situation. Another example involving water would include cases where people were sent overboard and drown in weather-related boating accidents. In these situations, the fatality should be coded as BO instead of IW.

With respect to the example described in the last paragraph of Section 2.6.1, the preparer should use the "Other/Unknown" location (OT) for situations where a person was evacuated to another site and died from direct injuries suffered at an unknown initial location. However, if available information is sufficient to determine the location where the direct injuries were initially sustained, then the *Storm Data* preparer should choose the appropriate fatality location.

2.6.1.2 Direct Fatality Location Table.

BF	Ball Field	MH	Mobile/Trailer Home
BO	Boating	OT	Other/Unknown
BU	Business	OU	Outside/Open Areas
CA	Camping	PH	Permanent Home
CH	Church	PS	Permanent Structure
EQ	Heavy Equip/Construction	SC	School
GF	Golfing	TE	Telephone
IW	In Water	UT	Under Tree
LS	Long Span Roof	VE	Vehicle and/or Towed Trailer

Table 2. Direct Fatality Location Table.

2.6.2 Indirect Fatalities/Injuries. Fatalities and injuries, occurring in the vicinity of a hydro-meteorological event, or after it has ended, but not directly caused by impact or debris from the event (weather event was a passive entity), are classified as indirect. The *Storm Data* preparer can enter the number of indirect fatalities into a field in the *Storm Data* software, along with the age, gender, and location of the fatality. Consequently, this data lends itself to internal NWS statistical review. However, indirect fatality information will not appear in the header-strip of the *Storm Data* publication.

Any available indirect fatalities and injuries should be discussed in the event narrative. Indirect injuries may be entered into a field within the *Storm Data* software, but they will not be tallied in official *Storm Data* statistics.

Fatalities and injuries due to motor vehicle accidents on slippery, rain, or ice-covered roads are indirect. Ice, snow, and water on road surfaces are "passive" agents that do not directly impact a person or property, even though they induce conditions that trigger another event causing a fatality or injury.

If the hydro-meteorological event induced conditions that triggered another event resulting in the fatality/injury, then it is indirect. For example, heart attacks, resulting from overexertion during or following winter storms, electrocution caused by contact with a downed power line after a storm has ended, a death occurring during post-storm cleanup operations, or a death in a fire triggered by lightning are indirect.

Fatalities and injuries resulting from driving in dense fog, a blinding blizzard, a winter storm, a winter weather event, or a dust/sandstorm are indirect. Generalized examples of indirect fatalities/injuries (see Section 7 for detailed examples) include:

a. Dense fog reduces visibilities from zero to 1/8 mile. A 20-vehicle pile-up occurs;

b. Thunderstorm winds topple trees onto a road. A motorist runs into a tree 30 minutes after the storm occurred;

c. Heavy snow is in progress and roads become icy/snow-covered. A vehicle slides across the road into another vehicle;

d. Lightning starts a fire which destroys a home, killing its occupants; and

e. People suffer carbon monoxide poisoning due to improper or inadequate venting of heating systems, portable heaters, generators, etc.

2.6.3 Delayed Fatalities. On occasion, a fatality will occur a few days after the end of a meteorological event, due to weather-related injuries or the effects of the event. This is most common with long-duration, excessive heat episodes in which individuals never recover from the initial effects of the heat wave. The *Storm Data* preparer must enter the post-event fatality information as part of the meteorological event that just ended, but enter the actual date of delayed fatality in the fatality entry field. An explanation can be given in the narrative.

2.7 Damage. Property damage estimates should be entered as actual dollar amounts, if a reasonably accurate estimate from an insurance company or other qualified individual is available. If this estimate is not available, then the preparer has two choices: either check the "no information available" box, or make an estimate. The exception is for flood events. The *Storm Data* preparer must enter monetary damage amounts for flood events, even if it is a "guesstimate." The U.S. Army Corps of Engineers requires the NWS to provide monetary damage amounts (property and/or crop) resulting from any flood event.

The *Storm Data* preparer is encouraged to make a good faith attempt to obtain or estimate the damage. Property damage estimates are very important for many users and should be obtained if at all possible.

Estimates can be obtained from emergency managers, U.S. Geological Survey, U.S. Army Corps of Engineers, power utility companies, and newspaper articles. If the values provided are rough estimates, then this should be stated as such in the narrative. Estimates should be rounded to three significant digits, followed by an alphabetical character signifying the magnitude of the number, i.e., 1.55B for $1,550,000,000. Alphabetical characters used to signify magnitude include "K" for thousands, "M" for millions, and "B" for billions. If additional precision is available, it may be provided in the narrative part of the entry. When damage is due to more than one element of the storm, indicate, when possible, the amount of damage caused by each element. If the dollar amount of damage is unknown, or not available, check the "no information available" box.

The *Storm Data* preparer should use the table in Appendix B entitled Property Damage Estimates in determining monetary losses. This table would allow the preparer to estimate monetary amounts for damaged objects when timely communication is not possible with emergency managers or insurance adjusters just prior to *Storm Data* submission. It is suggested that the *Storm Data* preparer, in conjunction with local emergency managers, insurance adjusters, utility company representatives, and the U.S. Army Corps of Engineers, enhance the table to more accurately reflect values typically found in the local CWA.

Typically, damage refers to damage inflicted to private property (structures, objects, vegetation) as well as public infrastructure and facilities. Specific breakdowns should be stated in the event narrative (refer to Section 2.9), if possible. The number of structures with minor or moderate damage should be indicated, as well as the number of buildings destroyed.

In order to determine if the damage is directly related or indirectly related to the hydro-meteorological event, the *Storm Data* preparer will use the same guidelines for fatalities and injuries provided in Section 2.6.

2.7.1 Flood-Related Damage. Each WFO will report flood damage in their CWA. The Service Hydrologist should assist in the collection and assessment of flood/flash flood information that pertains to *Storm Data*.

2.7.2 Crop Damage Data. Crop damage information may be obtained from reliable sources, such as the U.S. Department of Agriculture (USDA), the county/parish agricultural extension agent, the state department of agriculture, crop insurance agencies, or any other reliable authority. Crop damage amounts may be obtained from the USDA or other similar agencies.

The *Storm Data* preparer should be very careful when using crop damage to infer that a Thunderstorm Wind event occurred with wind gusts equal to or greater than 50 knots (58 mph), or to infer that a Hail event occurred with hail stones 3/4 inch or larger. Lesser wind speeds and smaller hail stones can result in crop damage. Additional investigation will be needed in these situations, such as contacting a person who lives in the affected area, and/or comparing what happened to other severe weather reports in the vicinity.

2.7.3 Other Related Costs. The cost of such items as snow removal, debris clearing/moving, fire fighting, personnel overtime charges, public housing assistance, etc., will not be tallied as directly-related parts of the storm/crop damage. If "other related" cost estimates are available, they may be included in the narrative as a separate item ("for information only"), and stated as such.

2.7.4 Delayed Damage. On occasion, vegetative or structural damage will occur within a few days, or even a couple of weeks, after a meteorological event. This is most common after a very heavy snowfall, or very heavy rain due to weight loading on roofs or buildings, tree branches, or power lines. Windy conditions after a heavy snow or heavy rain event may amplify the damage. In these cases, the *Storm Data* preparer must enter the post-event damage information as part of the hydro-meteorological event that just ended and explain the situation in the event narrative.

2.8 Character of Storm. Select the type of storm or phenomenon from the available options provided in the software. If known, maximum gusts will be encoded as "measured;" otherwise, they will be an estimate (gusts are given in knots). Hail size will be given in hundredths of an inch (0.50, 0.75, 0.88, 1.00, 1.50, etc., are the most common). Data regarding multiple severe phenomena (events) within a single episode will be provided as separate entries.

2.9 Textual Description of Storm. There are two kinds of textual descriptions: episode narrative and event narrative. Minimally, a brief episode narrative is needed for any weather event entry within the *Storm Data* software. The event narrative may or may not be needed. If the event does not cause injury, fatality or property/crop damage, the event does not require an event narrative, unless otherwise significant. For example, Hail events, as a single phenomenon, should not necessitate narratives unless they are part of a more complex weather event or cause a fatality/injury or property/crop damage.

2.9.1 Episode Narrative. An episode narrative must be generated, otherwise individual events can not be entered into the *Storm Data* software. An episode narrative describes the entire episode in a general fashion, and briefly describes the synoptic meteorology associated with the episode. This narrative doesn't need to be long or elaborate, rather make it brief and informative. An example would be "A strong cold front passed through the Washington, D.C. area, triggering several instances of damaging thunderstorm winds and large, baseball-size hail." Information in the episode narrative can be very useful for researchers and other users of *Storm Data*. This narrative will appear in the *Storm Data* publication after all events contained within the episode. The episode narrative does not appear in the examples shown in Section 7, which is reserved for only event narratives.

2.9.2 Event Narrative. Detailed information pertaining specifically to the event and not the overall episode, will appear in an event narrative. The event narrative describes the significance or impact of an event within an episode. An event narrative is required for all tornado events, and all thunderstorm wind events for which winds gusts are estimated. This narrative will appear immediately below the header-strip in the publication and should contain descriptive information about the times, locations, and severity of destruction of property, trees, crops, power lines, roads, bridges, etc. Additionally, a brief summary of fatalities and injuries should be part of the event narrative. For Thunderstorm Wind events with estimated gusts, use sentences such as "Several trees were toppled by wind gusts estimated at 70 mph."

The event narrative should be concise and not repeat information provided in the quantitative data found in the header-strip. When used properly, the event narrative integrates the numerical data into a cohesive meteorological event.

The event narrative must always appear as a complete description of the event. The event narrative will never consist of a single, stand-alone phrase such as "See the 07/18/06 Thunderstorm Wind event at 1800CST for details." However, it is permissible to include a similar reference phrase at the end of an event narrative when that event spans two CWAs or different months.

Should a reference time be used in the event narrative, it is recommended that a blank space not be inserted between the numerical time and the time zone (e.g, 1200EST is the preferred method). This practice may end up saving a few lines in the *Storm Data* publication.

When writing the event narrative, always indicate when and where tornadoes and thunderstorm wind events cross county, parish, and state lines, and boundaries of WFO CWAs. S*torm Data* preparers will coordinate with other affected offices to determine time and location of border-crossing tornadoes or other events. Storm characteristics, such as the intermittence of tornado paths, may be included.

For lightning injuries, it is highly desirable to include in the event narrative, the age, gender, location, and weather conditions at the time of occurrence, if known or determinable. The age, gender, and location information is used in compiling lightning statistics used in the national report entitled *Summary of Natural Hazard Statistics in the United States*.

Additional event narrative remarks (or an electronically inserted picture or graphic) may serve to locate storms more precisely and may give the areal extent and the directional movement or speed. Such additional detail should be prepared as support documentation to Outstanding Storms of the Month (see Section 4, Outstanding/Unusual Storms of the Month [OSM]).

In an effort to maintain a consistent look and feel to the *Storm Data* publication, use the following guidelines for writing narratives:

a. Type all narratives in sentence format. All sentences begin with a capital letter. All sentences end with a period;

b. Do not begin a sentence with a number; instead, spell out the number: "17 inches of snow fell overnight" *should* read "Seventeen inches of snow fell overnight;"

c. Do not title the narrative with "Event Summary for Month, Day:" The event narrative IS the event summary so there is no need to identify it as such;

d. If an event spans two or more consecutive months, then state this fact in the event narrative;

e. The *Storm Data* preparer should title episode narratives for tropical cyclones with the name of the cyclone. Example: "Hurricane Katrina;"

f. Do not use simple phrases such as "trees down." Instead, use complete sentences such as "Several trees were downed by wind gusts estimated at 70 mph;"

g. Put the gender, age, location of fatality or injury in the event narrative, not the episode narrative (M62PH and "A 62-year old man was killed while inside a permanent home in city, state");

h. Do not use the hard return key before or after the narrative. This adds an extra blank line that takes up valuable space in the publication; and

i. When beginning a new paragraph, use a hard return instead of an indent (tab key). In other words, each paragraph is left-justified.

2.9.3 Cause of Event. The cause or trigger for Flood and Flash Flood events will be entered into the *Storm Data* software, in order for the NWS to generate internal verification and other statistical calculations. Possible causes to choose from are displayed within the *Storm Data* software (e.g. heavy rain).

2.10 Pictures. Inclusion of electronic images (.jpg, gif, or png format) into the monthly reports should be limited to unusual or highly significant events in order to minimize the size of the *Storm Data* publication. Minimally, images should have a 640x480 resolution at 100 dpi.

3. Disposition of *Storm Data*. *Storm Data* must be certified by the Warning Coordination Meteorologist (WCM) or Meteorologist-in-Charge (MIC), no later than 60 days after the end of the month for which the data is valid. Certification must take place for all months even if no events occurred in the given month. The WCM and MIC are the only people who are allowed to certify data. If the data is not certified, it will not appear in the *Storm Data* publication; nor will it be used in the verification process.

In the event of corrections and/or additions in the data to a previously certified month, the WCM or MIC must recertify the month in which the modification was made. This can only be accomplished going back 18 months from the current month being certified.

4. Outstanding/Unusual Storms of the Month (OSM). A very important feature of the publication *Storm Data* is the OSM section. The OSM may be any type of event (tornadoes, hurricanes, snow, ice, hail, meso-systems, etc.). Events may be selected for this section for their meteorological significance or uniqueness, even if damage or casualties are minimal. Tornadoes of EF4 intensity or greater should be submitted for the OSM. Otherwise, providing information for the OSM is optional but highly desirable. Good OSM material makes *Storm Data* more interesting and ultimately a more desirable product for users, thus assuring wider distribution of the monthly *Storm Data* input received from WFOs.

Although the WCM or a *Storm Data* focal-point prepares the OSM, the MIC is ultimately responsible for OSM contributions from the field office. This includes all forensic discovery (data gathering, fact finding, development of statistics, etc.), drafting graphics and tables, supplying photographs, and preparing the narrative.

4.1 Requirements for Outstanding/Unusual Storms of the Month. The OSM material is used to enhance the cover appearance of the *Storm Data* publication, as well as provide additional detail not found in a documented event.

4.1.1 Text Format. The OSM should be prepared using any American Standard Code for Information Interchange (ASCII)-based software (Microsoft Word, Wordpad or Notepad preferred).

4.1.2 Disposition Dates. The NCDC should be contacted within 30 days following the end of the month in which the event occurred, if a WFO wishes to have material considered for the OSM. All OSM material will be submitted to NCDC within 60 days following the end of the month in which the event occurred. OSM material submitted beyond 60 days might not be considered.

4.1.3 Copyrights. Permission or credit for the use of each item must be obtained from the original source before sending to NCDC. Make sure that the submitted photographs are accompanied by a caption and the name of photographer.

4.1.4 Final Editing. The NCDC will be responsible for final editing of the narrative and any necessary assembly of multiple OSM products. In addition, NCDC may produce additional OSM features.

4.1.5 Write-up/Discussion. The OSM will include a one or two-page write-up which incorporates the following: synoptic discussion of events leading up to the event, any warnings and watches in effect at the time of the event, any other notable information about the storm, storm statistics: (EF-scale, hail size, wind gusts, snow amounts, etc.) and aftermath (fatalities, injuries, damage).

4.1.6 Pictures. Photographs, charts, or maps of the storm or the damage/aftermath should conform to the following guidelines:

a. Digital Images: Digital camera images may be used if they are taken on a good quality digital camera. Images submitted should have a 1600x1200 or greater resolution, or 300 or greater dpi. Cover picture photographs should be of the highest quality. Please send the original (raw) photograph and not a post-production photograph, as the quality may be degraded.

b. Pictures (35 mm photographs or slides), images, maps, or charts may be scanned and sent to NCDC:

1. Scan at original size;
2. Scan at 300 dpi or greater (dots per inch); and
3. Save as raw, tif , or jpg format;

c. Or you may send material (35 mm photographs, slides, images, maps, or charts) to NCDC via regular mail, where they will be scanned and returned to sender.

d. Hand drawn or computer-generated maps, charts or drawings may be submitted to depict damage amounts and/or location.

4.1.7 Data Submission. All OSM material should be submitted to NCDC no later than 60 days after the end of the month in which the event occurred. The above information may be submitted using one of two methods:

a. via regular mail to:

Editor - Storm Data
National Climatic Data Center
151 Patton Avenue
Asheville, NC 28732;

b) via E-mail to: Storm.Data@noaa.gov ;

5. Tornado and Severe Thunderstorm Confirmation Reports. Four alphanumeric text products are produced by the Storm Prediction Center (SPC). These text products, referenced below in Table 3, summarize unofficial (preliminary) tornado and severe thunderstorm reports that were processed at SPC and originated from each WFO. Each WFO should compare the appropriate message with its local records. Any change in event information should be noted, but corrections will be made via *Storm Data*. Additional severe weather statistics and graphics can be found on the SPC Web page: http://www.spc.noaa.gov.

There will be differences between the STAHRY/STADTS messages and the WFO's LSRs. The SPC lists delete similar events according to the 10 mile/15 minute rule (see NWSI 10-1601, Verification Procedures, Section 2.1.1).

5.1 Table of SPC Statistical Messages .

AWIPS ID	WMO Comms Header	Product Description
STADTS	NWUS20 KWNS	Listing of tornado and severe thunderstorm from 6 AM CST the previous day to 6 AM CST on the current day
STAHRY	NWUS22 KWNS	Listing of tornado and severe thunderstorm reports from 6 AM CST on the current day, and updated on an hourly accumulative basis
STAMTS	NWUS21 KWNS	Statistics for tornado totals, tornado-related fatalities, and number of killer tornadoes on a monthly and yearly basis (current year and previous 3 years)
SPCSTATIJ	NWUS23 KWNS	Listing of killer tornadoes for current year

Table 3. SPC Tornado and Severe Thunderstorm Statistical Report Table.

6. Weekly Warning Reports. A weekly listing of all severe weather warnings, categorized by WFO, is posted on the Performance Management web site. A *Storm Data* preparer should note any discrepancies in this report, and E-mail or fax copies of warning/text changes to W/OS52 as soon as possible. Photocopies will suffice.

7. Event Types. This section provides guidelines for entering event types in the *Storm Data* software.

Note: only event narratives appear in the event examples in Section 7. The episode narrative does not appear.

7.1 **Astronomical Low Tide (Z).** Abnormal, or extremely low tide levels, that result in deaths or injuries, watercraft damage, or significant economic impact due to low water levels. Astronomical low tides are made more extreme when strong winds produce a considerable seaward transport of water, resulting in previously submerged, non-hazardous objects become hazardous or exposed.

Beginning Time - When the low tide began to cause damage.

Ending Time - When tides returned to normal.

Direct Fatalities/Injuries

- ❑ A boat traversing an ocean inlet foundered on the rocks in the unusually low waters and the boaters were injured when equipment on the boat was suddenly thrown about.

Indirect Fatalities/Injuries

- ❏ A sightseer was killed when he drove off the road while looking at the absence of water.

Example:

AKZ203-204 Eastern Beaufort Sea Coast - Central Beaufort Sea Coast
24 0100AST 0 0 Astronomical Low Tide
25 2300AST
Over the Arctic coast from the evening of the 23rd through the 25th, east winds ranging from 25 to 45 kts (28 to 52 mph) persisted. The sea ice edge was 20 miles offshore and the wind produced a considerable seaward transport of water, causing the water level in Prudhoe Bay to run several feet below normal. Normal tidal variations are only one foot or less along the Beaufort Sea coastline. Extensive marine operations were halted at Prudhoe Bay during this time, including the unloading of barges.

7.2 **Avalanche (Z).** A mass of snow, sometimes containing rocks, ice, trees, or other debris, that moves rapidly down a steep slope, resulting in a fatality, injury, or significant damage. If a search team inadvertently starts another avalanche, it will be entered as a new Avalanche event.

Beginning Time - When the snow mass started to descend.

Ending Time - When the snow mass ceased motion.

Direct Fatalities/Injuries

- ❏ People struck by the snow mass or any debris contained within.
- ❏ People struck by debris tossed clear of the avalanche.
- ❏ People buried by the avalanche.

Indirect Fatalities/Injuries

- ❏ People who ran into (in a motor vehicle, on skis, etc.) the snow mass or debris *after* it stopped moving.

Example:

COZ012 West Elk and Sawatch Mountains/Taylor Park
06 1900MST 5 1 Avalanche
1915MST
Four college students were caught in an avalanche, triggered when one of the students crossed a slope just below the summit on Cumberland Pass, which is about 25 miles east-northeast of Gunnison in the Sawatch Mountain Range. The entire slope at the 12,000-foot elevation fractured 6-feet deep and 1500 feet across and ran 400 vertical feet, with the resulting avalanche scouring the slope all the way to the 9,000-foot level. The skier who triggered the avalanche was buried next to a tree which provided an air space that was crucial to his survival. The other three

students, including a snow-mobiler, a snow-boarder, and another skier, perished in the snow. The avalanche also destroyed a cabin, killing the occupant. Boulders dislodged by the avalanche, struck a car, killing the driver. M19OU, M20OU, M22OU, M43PH, F37VE

7.3 **Blizzard (Z).** A winter storm which produces the following conditions for 3 hours or longer: (1) sustained winds or frequent gusts 30 knots (35 mph) or greater, and (2) falling and/or blowing snow reducing visibility frequently to less than 1/4 mile, on a widespread or localized basis.

Some Winter Storm and Blizzard events may have had sustained or maximum wind gusts that met or exceeded High Wind criteria. Rather than document an additional High Wind event, the *Storm Data* preparer should just mention the time, location, and wind value in the Winter Storm or Blizzard event narrative

Beginning Time - when public impact from the blizzard began or was inferred to begin from surrounding reports. Normally, this will be the time of the first observation when blizzard wind/visibility conditions were first observed. The time that snow started to accumulate and/or blowing snow was first observed can be mentioned in the event narrative.

Criteria Time – when the 3rd hour of blizzard conditions was observed to occur or inferred to occur from surrounding reports.

Ending Time - when blizzard wind and visibility conditions are no longer observed or have been inferred to end from surrounding reports.

In *Storm Data*, no blizzard should cover a time period of less than 3 hours. If blizzard-like conditions occur for less than 3 hours, the event should be entered as Winter Storm, Heavy Snow, or Winter Weather, perhaps noting in the narrative that near-blizzard or blizzard-like conditions were observed at the height of the storm.

Direct Fatalities/Injuries

- ❏ People who became trapped or disoriented in a blizzard and suffered/died from hypothermia.
- ❏ People who were struck by objects borne or toppled in blizzard wind.
- ❏ People suffered/died from a roof collapse due to the weight of heavy snow.
- ❏ A vehicle stalled in a blizzard. The occupant suffered from/died of hypothermia.

Indirect Fatalities/Injuries

- ❏ Vehicle accidents caused by poor visibility and/or slippery roads.

Example:

MIZ049-055 Huron - Sanilac
02 2200EST 2 0 Blizzard
03 0300EST
An unusually active lake-effect snow event occurred in the Thumb area. Aided by sustained north winds of 35 to 43 knots (40 to 50 mph), with gusts to 56 knots (65 mph), the snow and blowing snow reduced visibilities to near zero across much of Huron and Sanilac Counties. Snow accumulations were very difficult to measure due to the high winds, but were commonly cited in the 12- to 17-inch range. Up to 10-foot snow drifts were observed. This blizzard essentially shut down most of the area for the next 3 days. Two people in Huron County froze to death after they left their snow-covered vehicle and attempted to walk to a nearby farm home. M55OU, F60OU

7.4 **Coastal Flood (Z).** Flooding of coastal areas due to the vertical rise above normal water level caused by strong, persistent onshore wind, high astronomical tide, and/or low atmospheric pressure, resulting in damage, erosion, flooding, fatalities, or injuries. Coastal areas are defined as those portions of coastal land zones (coastal county/parish) adjacent to the waters and bays of the oceans. Farther inland, the *Storm Data* preparer must determine when and where to encode a flood event as Flash Flood or Flood. Terrain (elevation) features will determine how far inland the coastal flooding extends.

Note: Flooding of lakeshore areas (e.g., Great Lakes, Lake Okeechobee, and Lake Pontchartrain and Lake Maurepas) should be entered under the Lakeshore Flood event category.

If the astronomical tide height for the flooded area is known, it should be subtracted from the total water level/storm tide (runup/debris line), and the result specifically labeled in the narrative as "storm surge." The method of measuring surge height should be mentioned in the narrative, e.g., "NWS survey team calculated a surge height of 4 feet by subtracting the astronomical tide height from the runup/debris line height." **For *Storm Data*, coastal flood events that are associated with a storm of tropical origin (e.g., hurricane, typhoon, or tropical storm) should be reported under the Storm Surge/Tide event category, even if the tropical system is hundreds of miles away. All other coastal flooding events should be reported as a Coastal Flood.**

Beginning Time - When the water level began to cause damage or flooding.

Ending Time - When the water level dropped to a point where damage or flooding ended.

Direct Fatalities/Injuries
- ❏ A coastal dwelling was washed away injuring/killing the occupants.
- ❏ A person drowned when a vehicle was swept away by the storm surge/tide.

Indirect Fatalities/Injuries
- ❏ A person suffered a heart attack while evacuating from a storm tide.

- ❑ A person died in a vehicle accident caused by the storm tide washing away a traffic signal.
- ❑ A person died in a vehicle accident after losing control in standing water on a road.

Example:

ORZ022 Curry County Coast
07 0600PST 0 0 100K Coastal Flood
1000PST
A 4-foot storm tide, as reported by local police, affected a portion of the Oregon coast. The storm tide washed away part of Port Orford's sewage treatment plant.

7.5 **Cold/Wind Chill (Z).** Period of low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined advisory (typical value is -18^{0}F or colder) conditions, on a widespread or localized basis. There can be situations where advisory criteria are not met, but the combination of seasonably cold temperatures and low wind chill values (roughly 15^{0}F below normal) must result in a fatality. In these situations, a cold/wind chill event may be documented if the weather conditions were the primary cause of death as determined by a medical examiner or coroner. Normally, cold/wind chill conditions should cause human and/or economic impact.

Use this event only if a fatality/injury does not occur during a winter precipitation event.

Beginning Time - When cold temperatures or wind chill equivalent temperatures began.

Ending Time - When cold temperatures or wind chill equivalent temperatures ended.

Direct Fatalities/Injuries
- ❑ A fatality where hypothermia was ruled as the primary, or major contributing factor as determined by a medical examiner or coroner. If other weather factors, such as freezing/frozen precipitation, disorient the person, trap the person, or cause the person to collapse, but cause of fatality was exposure or hypothermia, the fatality may be entered under the event type Winter Storm, Winter Weather, etc. The *Storm Data* preparer must use sound judgment and work with the local medical examiner or coroner.
- ❑ Elderly person wandered away from a nursing home, became disoriented, and died outdoors. Medical examiner ruled that the major cause of death was hypothermia.
- ❑ Cases in which people receive medical treatment for frostbite or cold-hypothermia can be considered a direct injury.
- ❑ A man dies from hypothermia after falling down a flight of stairs in his dark (became unconscious), unheated home.

Indirect Fatalities/Injuries
- ❑ Cases where people suffer carbon monoxide poisoning from using an improperly ventilated fuel burning portable heater due to the cold.

- ❑ Cases where people are injured or killed in a house fire due to improper use of portable heaters due to the cold.

Example:

WIZ001>004 Ashland – Bayfield – Douglas - Iron
05 0600CST 2 0 0 0 Cold/Wind Chill
07 1200CST
Wind chill values dropped to -18 to -30 as northwest winds blew at 20 to 30 mph. Two cross-country skiers died from exposure on a trail west of Hurley in Iron County. The medical examiner classified the fatalities as being due to cold-hypothermia. M32OU, F33OU

INZ001 Lake
11 2000CST 1 0 Cold/Wind Chill
12 1400CST
A homeless man was found dead in Gary, Indiana. The cause of death was hypothermia. It was raining on this cold October day with winds of 17 to 26 knots (20 to 30 mph) and temperatures in the 30s. M42OU

7.6 **Debris Flow (C)**. A combination of either water, soil, rock and other material that forms on the sides of hill slopes and moves rapidly downhill. Debris flows are fast moving and highly destructive due to the amount of material being carried with the flow. Large boulders, trees and massive amounts of sediment can be carried in a debris flow. In most cases, lahars or mudflows from volcanic activity are considered a debris flow.

Beginning Time - When the debris flow started to descend.

Ending Time - When the debris flow ceased motion.

Direct Fatalities/Injuries
- ❑ People were struck by the debris flow.
- ❑ People killed or injured when a vehicle was struck by moving debris flow.

Indirect Fatalities/Injuries
- ❑ Motorists who ran into the mass of debris flow in the road after the mass stopped moving.

Example:

Flathead County
6 SE West 15 0700MST 1 1 Debris Flow
Glacier 0710MST
A thunderstorm produced very heavy rain early in the morning along Highway 2 in the West Glacier Region. A debris flow slide of large rocks and earth

cascaded onto Highway 2 between West Glacier and Essex. A large rock hit a moving vehicle and killed one of the occupants instantly. The driver was seriously injured. M36VE

7.7 **Dense Fog (Z).** Water droplets suspended in the air at the Earth's surface, over a widespread or localized area, reducing visibility to values equal to or below locally/regionally established values for dense fog (usually 1/4 mile or less) and impacting transportation or commerce. Accidents, which resulted in injuries or fatalities, during a dense fog event are reported using this event category.

Beginning Time – When dense fog criteria were first met.

Ending Time – When dense fog criteria were no longer met.

Direct Fatalities/Injuries – None.

Indirect Fatalities/Injuries

- ❑ Fatalities and injuries resulting from vehicular accidents caused by dense fog.
- ❑ During extremely dense fog, a construction worker lifted a metal pipe which touched a power line, resulting in electrocution.

Example:

NCZ053-065 Buncombe - Henderson
30 0400EST 0 0 Dense Fog
1000EST

Dense fog developed in the early morning hours in the French Broad River valley. The fog played havoc with the morning commute, and contributed to several accidents in and south of Asheville. At 0900EST, the fog contributed to a 25-car pile-up on Interstate 40 on the south side of Asheville. The accident claimed 4 lives (indirect fatalities) and injured 17 (indirect). Asheville Regional Airport was closed for most of the morning. The North Carolina State Police shut down Interstate 26 between the airport and the city as a precautionary measure.

7.8 **Dense Smoke (Z).** Widespread or localized dense smoke, reducing visibilities to values equal to or below locally/regionally established values (usually ¼ mile or less), that adversely affects people and/or impacts transportation or commerce. Dense smoke in various concentrations suspended in the air at the Earth's surface can cause problems for people with heart or respiratory ailments.

Beginning Time - When dense smoke criteria were first met.

Ending Time - When dense smoke criteria were no longer met.

Direct Fatalities/Injuries

- ❏ People who suffered/died from inhalation of dense smoke.

Indirect Fatalities/Injuries

- ❏ Fatalities and injuries resulting from vehicular accidents caused by dense smoke.

Example:

MTZ0005 Missoula/Bitterroot Valleys

31 0400MST 2 0 Dense Smoke

1000MST

Dense smoke developed in the early morning hours in the Missoula and Bitterroot Valleys from a combination of surrounding forest fires in the Bitterroot Mountains. The dense smoke played havoc with the morning commute, and contributed to several long delays from minor accidents on Highway 93 near Lolo. Two elderly people died after being hospitalized for smoke inhalation near Florence. Dense smoke also delayed morning flights for several hours at Missoula International Airport. M88OU, F92OU

7.9 **Drought (Z).** Drought is a deficiency of moisture that results in adverse impacts on people, animals, or vegetation over a sizeable area. Conceptually, drought is a protracted period of deficient precipitation resulting in extensive damage to crops, resulting in loss of yield. There are different kinds of drought: meteorological, agricultural, hydrological, and social-economic. Each kind of drought starts and ends at different times. Additional information can be obtained at this web address: http://drought.unl.edu/whatis/concept.htm.

A drought event should be included in *Storm Data* when the intensity of the moisture deficiency and other factors result in a D2 classification, or higher, as indicated in the Drought Monitor, a multi-agency effort. Details can be found at this web address: http://drought.unl.edu/dm/monitor.html.

Droughts are rated as D0, D1, D2, D3, or D4. This information should be included in the narrative.

Beginning Time - When an area first reaches D2 classification (severe drought).

Ending Time - When an area is no longer in at least a D2 classification.

Direct Fatalities/Injuries

- ❏ Extremely rare.

Indirect Fatalities/Injuries

- ❏ None.

Example:

MTZ003	**Flathead/Mission Valleys**				
	01 0000MST	**0**	**0**	**55K**	**Drought**
	22 1800MST				

A drought, which began in early July ended for much of the Flathead and Mission Valleys on September 22, when 3 to 5 inches of precipitation fell. For many locations this was the first significant rain exceeding a quarter of an inch since July 4. The drought's effect was especially felt during the first 3 weeks of September (D3) after numerous grass fires prompted many communities to ban any type of outdoor burning. Among the largest fires reported were: 180-200 acres of grassland and timber from Pablo to St. Ignatius. The most costly reported fire was when smoldering leaves ignited dry grass near Ronan, eventually spreading into two homes and causing $55,000 worth of damage. Damage amounts do not include costs to individual fire departments for fire containment.

Note: This example above should have entries in July and August *Storm Data* as well. Damage amounts in the header are for the current month only. Grand totals for the entire drought episode should be mentioned in the narrative. In some cases the effects and cost of a drought may not be known for some time.

7.10 **Dust Devil (C).** A ground-based, rotating column of air, not in contact with a cloud base, usually of short duration, rendered visible by dust, sand, or other debris picked up from the ground, resulting in a fatality, injury, or damage. Dust devils usually result from intense, localized heating interacting with the micro-scale wind field. Dust devils that do not produce a fatality, injury, or significant damage may be entered as an event if they are unusually large, noteworthy, or create strong public interest.

Beginning Time - When the rotating column of air first became visible.

Ending Time - When the rotating column of air was no longer visible.

Direct Fatalities/Injuries

- ❏ People who were asphyxiated due to high dust/sand content in the air. (Rare)
- ❏ People who were hit by flying debris.
- ❏ Vehicle was tipped over or blown off a road.

Indirect Fatalities/Injuries

- ❏ Vehicular accidents caused by reduced visibility during a dust devil, or vehicular accidents caused by debris left on a road after a dust devil passed by.

Example:

Maricopa County
4 W Gila Bend 12 1400MST 0 2 Dust Devil
1420MST

A fairly strong dust devil developed and moved directly along Interstate 8, according to amateur radio reports. Visibility was severely reduced in the dust devil. One motorist drove into the dust devil, which pushed and flipped the vehicle off the road. The driver and one passenger were injured. Winds were estimated at 56 knots (65 mph).

7.11 **Dust Storm (Z).** Strong winds over dry ground, with little or no vegetation, that lift particles of dust or sand, reducing visibility over a localized or widespread area below locally/ regionally established values (usually 1/4 mile or less), and results in a fatality, injury, damage, or major disruption of transportation.

Some dust storms may be due to winds meeting or exceeding locally/regionally defined high wind warning criteria. The preparer should enter these events as Dust Storm events, as well as enter High Wind events for those events which met or exceeded locally/regionally defined warning criteria. All fatalities, injuries, and/or damage should be entered in association with the Dust Storm.

Beginning Time - When an area of blowing dust or sand first reduced visibility to locally/ regionally established values or began to cause a major impact.

Ending Time - When an area of blowing dust or sand diminished so that visibility was above locally/ regionally established values or no longer had a major impact.

Direct Fatalities/Injuries

- People who were asphyxiated due to high dust/sand content in the air. (Rare)
- People who were hit by flying debris.
- Vehicle tipped/pushed over or blown off a road by the strong winds, resulting in an accident and associated fatalities/injuries.

Indirect Fatalities/Injuries

- Vehicular accidents caused by reduced visibility during a dust storm or by debris left on a road after a dust storm passed.

Example:

KSZ061 Hamilton
24 1600MST 0 2 20K Dust Storm
1645MST

A strong cold front caused wind gusts to around 43 knots (50 mph) across far western Kansas. An area of dust and dirt was lifted hundreds of feet into the air, reducing the visibility to near zero across U.S. Highway 50, west of Syracuse.

A wind gust overturned and damaged an empty semi-trailer, injuring the two occupants.

7.12 **Excessive Heat (Z).** Excessive Heat results from a combination of high temperatures (well above normal) and high humidity. An Excessive Heat event occurs and is reported in *Storm Data* whenever heat index values meet or exceed locally/regionally established excessive heat warning thresholds, on a widespread or localized basis. Fatalities (directly-related) or major impacts to human health occurring during excessive heat warning conditions are reported using this event category.

Fatalities or impacts to human health occurring when conditions meet locally/regionally defined heat advisory criteria are reported within the Heat event category (Refer to section 7.20 – Heat, for more details). If deaths are determined to be a result of the heat, but locally/ regionally defined heat warning or heat advisory criteria are not met, then the fatalities can only be mentioned in the narrative of another *Storm Data* event that occurred near the time of death.

In some heat waves, fatalities occur up to three days following the meteorological end of the event. The preparer should include these fatalities in the event, but encode the actual date of the directly-related fatalities in the fatality entry table.

Depending on the part of the country experiencing high temperatures, the heat effects are modulated by relative humidity, cloud cover, wind speeds, the duration of a hot spell, the time of the year, and other factors, including mortality rates and types of housing.

Beginning Time - When local/regional thresholds for excessive heat were first met or when abnormally hot conditions began.

Ending Time - When local/regional thresholds for excessive heat were no longer met or abnormally hot conditions ended.

Direct Fatalities/Injuries

- ❏ Fatality where heat-related illness or heat stress was the primary, or major contributing factor as determined by a medical examiner or coroner.
- ❏ An elderly person suffered heat stroke and died inside a stuffy apartment during a heat wave.
- ❏ A toddler was left inside a car while a parent went inside a grocery store on a hot day where ambient conditions met the local/regional definition of excessive heat. The windows were left rolled up, and the toddler died. Likewise, any person or group of persons who die as a result of being trapped inside a vehicle or other enclosure during excessive heat conditions, would be labeled as direct fatalities.
- ❏ Cases in which people receive medical treatment for heat-hyperthermia (severe dehydration, sunstroke, heatstroke, etc.) and survive are considered injuries, not illnesses, for *Storm Data* purposes.

Indirect Fatalities/Injuries

- ❑ Fatality where excessive heat was the secondary, or contributing factor.
- ❑ Excessive heat triggered widespread power outages, which in turn caused a person's respirator to turn off, and that person died.

Examples:

MIZ068>070-075-076-082-083 **Monroe - Livingston - Oakland - Macomb - Washtenaw - Wayne - Lenawee -**

02 1300EST 4 24 Excessive Heat
05 2000EST

Very hot and humid weather occurred over southeast Michigan over the Fourth of July weekend. High temperatures were in the mid to upper 90s across metro Detroit all 4 days, with Detroit City Airport reaching 100 degrees on July 4. The high of 97 degrees at Detroit Metropolitan Airport on July 5 set a new record for that date. Heat indices were in the 105 to 115-degree range all four afternoons. Dozens of people were treated at area hospitals for heat-related illnesses over the weekend, and four elderly people died from heat stroke based on medical reports. Two of the fatalities occurred on July 4, one on July 5, and one person died on July 7 after being hospitalized for heat stroke for 2 days. The heat wave finally broke when a cold front moved through Lower Michigan late in the day on July 5. M89PH, F77PH, M95PH, F72PH

MOZ037 **Jackson**

10 1800CST 1 0 Excessive Heat
11 2000CST

The high temperature reached 105 degrees with a heat index of 115 on the afternoon of June 11. During the overnight hour of June 10th, the heat indices stayed above 85. The medical examiner reported an elderly woman died from heat stress. She was found dead in her apartment. F84PH

ILZ027>031-036>038-040>057-061>063-066>068-071>073 **Knox – Stark – Peoria – Marshall – Woodford – Fulton – Tazewell - Mclean – Schuyler – Mason – Logan – DeWitt – Piatt – Champaign - Vermilion – Cass – Menard – Scott – Morgan – Sangamon – Christian - Macon – Moultrie – Douglas – Coles – Edgar – Shelby – Cumberland - Clark – Effingham – Jasper – Crawford – Clay – Richland - Lawrence**

30 1100CST 0 0 Excessive Heat
31 2359CST

An extended period of excessive heat and humidity occurred across central and southeast Illinois from July 30th to August 2nd. Afternoon high temperatures ranged from 99 to 106 degrees most afternoons, with afternoon heat index values ranging from 110 to 120. Overnight lows only fell into the upper 70s. A 39 year old male from Mapleton (Peoria County) suffered a heart attack and died in his mobile home. The excessive heat was a contributing factor, since the victim was taking a medication that prevented him from sweating (indirect fatality).

7.12.1 Heat Index Table.

HEAT INDEX VALUES DEWPOINTS (F)											
T(F)	35	40	45	50	55	60	65	70	75	80	85
75	76	77	77	78	78	79	78	77	75		
80	79	79	79	80	80	81	82	83	85	87	
85	82	82	82	83	84	85	87	90	93	99	107
90	86	86	86	87	88	90	92	96	100	107	117
95	90	91	91	92	93	95	97	101	107	115	126
100	95	95	96	97	98	101	104	108	114	121	132
105	99	100	101	102	104	106	109	114	120	129	140
110	104	104	105	107	109	112	115	120	126	134	145
115	107	108	110	112	114	117	121	126	133	141	152
120	111	112	113	116	118	122	125	132	138	146	156
125	114	115	117	120	123	127	130	136	142	151	163
130	116	117	119	123	125	130	134	141	149	156	168

HEAT INDEX VALUES RELATIVE HUMIDITY (%)											
T(F)	20	30	35	40	45	50	55	60	70	80	90
75	71	72	73	73	74	74	75	75	76	77	78
80	79	79	80	80	80	81	81	82	83	84	86
85	82	83	84	84	85	87	88	89	93	97	102
90	86	88	89	91	93	95	97	100	106	113	122
95	92	94	97	99	102	105	109	113	123	134	147
100	98	102	106	109	114	118	124	130	143	158	
105	104	112	116	122	127	134	141	149	166		
110	112	122	129	136	143	152	161	171			
115	121	135	143	152	162	173	184				
120	130	148	159	170	182	196					
125	140	163	176	190	205						
130	151	179	195	212							

Table 4. Heat Index Values Based on Relative Humidity or Dew Point.

7.13 **Extreme Cold/Wind Chill (Z).** A period of extremely low temperatures or wind chill temperatures reaching or exceeding locally/regionally defined warning criteria (typical value around -35^{0}F or colder), on a widespread or localized basis. Normally these conditions should cause significant human and/or economic impact. However, if fatalities occur with cold temperatures/wind chills but extreme cold/wind chill criteria are not met, the event should also be included in *Storm Data* as a Cold/Wind Chill event and the fatalities are direct.

Use this event only if a fatality/injury does not occur during a winter precipitation event.

Beginning Time - When extreme or abnormally cold temperatures or wind chill equivalent temperatures began.

Ending Time - When extreme or abnormally cold temperatures or wind chill equivalent temperatures ended.

Direct Fatalities/Injuries

- A fatality where hypothermia was ruled as the primary, or major contributing factor, as determined by a medical examiner or coroner. If other weather factors, such as freezing/frozen precipitation, disorient the person, trap the person, or cause the person to collapse, but cause of fatality was exposure or hypothermia, the fatality may be entered under the event type Winter Storm, Winter Weather, etc. The *Storm Data* preparer must use sound judgment and work with the local medical examiner or coroner.
- Elderly person wandered away from a nursing home, became disoriented, and died outdoors. Medical examiner ruled that the major cause of death was hypothermia.

- ❑ Cases in which people receive medical treatment for frostbite or cold-hypothermia can be considered an injury.
- ❑ A man dies from hypothermia after falling down a flight of stairs in his dark (became unconscious), unheated home.

Indirect Fatalities/Injuries

- ❑ After shoveling snow, a man collapsed in the driveway. The medical examiner determined the primary cause of fatality was heart attack.

Examples:

WYZ054>058 North Campbell - South Campbell – Western Crook - Wyoming Black Hills - Weston

01 1200MST	**4**	**0**	**500K**	**50K**	**Extreme Cold/Wind Chill**
03 1000MST					

Temperatures fell to 35 below to 45 below zero (-45 in Gillette) on the 2nd. Four fishermen were found frozen at their campsite near Pine Haven at Keyhole State Park in Crook County. The medical examiner classified the fatalities as being due to cold-hypothermia. The extreme cold caused water mains and pipes to freeze and burst in Gillette and Newcastle, resulting in water damage to homes and businesses. In addition, a couple of ranchers reported losses of livestock. M44OU, F42OU, F57OU, M59OU

NDZ050 McIntosh

15 1000CST	**1**	**0**			**Extreme Cold/Wind Chill**
15 2200CST					

An 84-year-old Lehr man died of hypothermia when he went to visit the grave of his wife. The man was found 1 mile from his house. Temperatures that day were around 20 below and wind speeds of 17 to 22 knots (20-25 mph). Wind chills were estimated to be around 50 below. The man was not wearing a coat or gloves when he was found. M84OU

7.13.1 <u>Wind Chill Table</u>.

Wind Chill Chart

Wind (mph)

Temperature (°F)

Calm	5	10	15	20	25	30	35	40	45	50	55	60
40	36	34	32	30	29	28	28	27	26	26	25	25
35	31	27	25	24	23	22	21	20	19	19	18	17
30	25	21	19	17	16	15	14	13	12	12	11	10
25	19	15	13	11	9	8	7	6	5	4	4	3
20	13	9	6	4	3	1	0	-1	-2	-3	-3	-4
15	7	3	0	-2	-4	-5	-7	-8	-9	-10	-11	-11
10	1	-4	-7	-9	-11	-12	-14	-15	-16	-17	-18	-19
5	-5	-10	-13	-15	-17	-19	-21	-22	-23	-24	-25	-26
0	-11	-16	-19	-22	-24	-26	-27	-29	-30	-31	-32	-33
-5	-16	-22	-26	-29	-31	-33	-34	-36	-37	-38	-39	-40
-10	-22	-28	-32	-35	-37	-39	-41	-43	-44	-45	-46	-48
-15	-28	-35	-39	-42	-44	-46	-48	-50	-51	-52	-54	-55
-20	-34	-41	-45	-48	-51	-53	-55	-57	-58	-60	-61	-62
-25	-40	-47	-51	-55	-58	-60	-62	-64	-65	-67	-68	-69
-30	-46	-53	-58	-61	-64	-67	-69	-71	-72	-74	-75	-76
-35	-52	-59	-64	-68	-71	-73	-76	-78	-79	-81	-82	-84
-40	-57	-66	-71	-74	-78	-80	-82	-84	-86	-88	-89	-91
-45	-63	-72	-77	-81	-84	-87	-89	-91	-93	-95	-97	-98

<u>Frostbite Times</u>

30 Minutes   10 Minutes   5 Minutes

Table 5. Wind Chill Values Based on Temperature and Wind Speed.

7.14 **<u>Flash Flood (C)</u>.** A rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam-related), on a widespread or localized basis. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising flood waters. The *Storm Data* preparer must use good, professional judgment in determining when the event is no longer characteristic of a Flash Flood and becomes a Flood. Flash floods do not exist for two or three consecutive days.

River flooding which develops as a result of flash flooding may be included in the narrative. However, such entries should be confined only to the effects of the flooding, such as roads and bridges washed out, homes and businesses damaged, and the dollar estimates of such damage.

7.14.1 <u>General Guidelines for the Determination of a Flash Flood</u>. The guidelines listed below can be used by the Storm Data preparer to aid in the determination as to whether or not a flash flood has occurred. If one or more of the conditions listed below begins within 6 hours or less, the *Storm Data* preparer should consider an entry in the Flash Flood section of the *Storm Data* software.

It can be difficult to ascertain whether or not a flash flood has occurred without accurate reports. Questions for observers are provided below that may help with this effort. Basically, if water rose rapidly in places that are normally dry or normally at a much lower level and pose a threat to life or property, the situation may be considered a Flash Flood. For example, water moving over a road causing a car to get swept into a swollen creek (above or within banks) may be considered a Flash Flood. As a guide, a depth of approximately six inches of fast-moving water should be considered as it will knock a person off his/her feet and begin to cause some cars to move out of control. There may also be cases where a lesser amount of swiftly moving water results in impact criteria described below, and could also be considered a Flash Flood.

These Flash Flood guidelines are not meant to be all-inclusive and may vary locally or regionally. The guidelines are meant to aid the *Storm Data* preparer by giving him/her a starting point.

Note: When events such as mudslides or lahars are caused primarily by volcanic activity, or when rainfall is not the primary cause, then document them as a Debris Flow. Refer to Section 7.6 of this directive for details.

7.14.2 Suggested Specific Guidelines. A Flash Flood begins within 6 hours of a causative event such as moderate to heavy rain, dam break, or ice jam release:

- ❑ River or stream flows out of its banks and is a threat to life or property.
- ❑ Person or vehicle is swept away by flowing water from runoff that inundates adjacent grounds.
- ❑ A maintained county or state road is closed by high water.
- ❑ Approximately six inches or more of water flows over a road or bridge. This includes low water crossings in a heavy rain event that is more than localized (i.e., radar and observer reports indicate flooding in nearby locations) and poses a threat to life or property.
- ❑ Dam break or ice jam release causes dangerous out of bank stream flows or inundates normally dry areas, creating a hazard to life or property.
- ❑ Any amount of water in contact, flowing into or causing damage of an above ground residence or public building and is runoff from adjacent grounds.
- ❑ Three feet or more of ponded water that poses a threat to life or property (A 1988 United States Bureau of Reclamation (USBR) study indicated 3 feet or more as a danger to people and vehicles).
- ❑ Flood waters containing a minimal amount of debris (mud, rock, vegetation) caused by rainfall. This could possibly occur in a burned area with only light to moderate rainfall.

The following can be used as signals to search further for evidence of a Flash Flood, but do not by themselves indicate a Flash Flood has occurred. More supporting information should be gathered - i.e., actual reports of flooding in the area which meet local Flash Flood criteria.

- ❑ Damage to any maintained road.
- ❑ Basement flooding. (This could be due to something other than Flash Flooding.)
- ❑ Some kind of a debris flow.

7.14.3 Questions to ask observers, Emergency Managers, etc. Questions should be posed in such a way as to determine whether or not a flooding episode was truly a Flash Flood. Example questions are given below. These could also be used in real time as the heavy rain event becomes a flood.

The following are worded for follow-up verification, but could be re-worded to aid in the determination of a Flash Flood event:

- ❏ Was the river/stream flowing out of banks and a danger to life or property? Was there around 6 inches or more of water flowing over the ground/bridge/road? Do you know about what time this began?
- ❏ Were any roads or bridges closed? Do you know about what time they were first closed?
- ❏ Was water rapidly flowing over the road or land surface (yard, field, etc)?
- ❏ Can you estimate the maximum depth of the moving water? (May ask to compare to car tires. Six inches may verify a warning.)
- ❏ Can you estimate the depth of ponded or standing water? (Three feet of ponded water may verify a warning.)
- ❏ Did water inundate any houses or buildings? If so, was flooding the result of sewer backup or sump pump failure? (If yes to the second question, this does <u>*not*</u> verify a warning.)
- ❏ Were there any evacuations due to flood waters?
- ❏ Can you estimate the beginning and ending time of the flood that created impacts?
- ❏ If you were not present at the time of flooding, can you determine high-water marks on trees, buildings, or other objects?

7.14.4 <u>Low-impact Flooding vs. Threat to Life or Property</u>. In an effort to maintain the most reliable data set it is important to separate low-impact flooding from Flash Flooding. Low-impact flooding should not be considered a Flash Flood. Low-impact flooding does not pose a significant threat to life or property:

- ❏ Minor flooding in urban areas and bottom lands of small streams/creeks (conditions that do not pose a threat to life or property).
- ❏ Minor ponding of water during or after a heavy rain event or flood (deep ponding of water may pose a threat to life and property).
- ❏ High stream levels due to steady or slowly rising/receding creeks/streams that do not pose a threat to life or property.

There may be times when fatalities or damage occur due to a heavy rain event that does not meet the Flash Flood criteria above, or the event may be so isolated that it was determined not to be a danger to life or property. These are entered in *Storm Data* in the Heavy Rain event (refer to Section 7.21 for more details), or another suitable event that took place at the same time. An example would be the weight of heavy rain collapsing a roof on a single building.

There may be times when fatalities occur well after the flood is over. An example would be someone who drives into a receding stream at high levels but within banks, or drives into a flooded underpass that has been barricaded due to high water for an extended period of time after the flood. These would be recorded as indirect Flood or Flash Flood fatalities.

Note: Direct fatalities which are vehicle-related will be coded as VE. In addition, if a person drives into a flooded area, exits his/her vehicle and drowns, the fatality will be coded as VE (Vehicle and/or Towed Trailer), not IW (In Water).

Beginning Time - When flood waters began to threaten life or property. In some cases, a flash flood may begin when water left the banks of a river; in others it may be when the water level was 2 to 3 feet above bank-full. It may also be when raging currents of water only 1-foot deep on urban streets swept people off their feet, resulting in a fatality/injury. An important distinction between Flash Flood and Flood events is that a Flash Flood exhibits a rapid rise in water levels, begins within 6 hours of the causative event, and is usually characterized by rapidly flowing water.

It is possible for a flash flood event to occur during a flood event due to intense rainfall in a short period of time. The beginning time of the flash flood event should correspond to the rapid rise in water levels following the causative event (6 hours or less).

- ❏ A maintained county or state road is first closed by high water.
- ❏ Approximate time when six inches or more of flowing water is observed over a road or bridge.
- ❏ The point at which any amount of water comes in contact, flowing into, or causes damage to an above ground residence or public building and is the runoff from adjacent grounds.
- ❏ The time when three feet or more of water has ponded and poses a threat to life and property. Professional judgment is needed by the *Storm Data* preparer to assess whether this is a climatologically normal event or if it is unusual. For example, an event would not be considered a Flash Flood if ponding three to four feet deep typically occurs with only minimal rainfall.

Ending Time - When flood waters receded to a point where there was no longer any threat to life or property. Alternatively, the ending time of a Flash Flood event can be defined as the time water levels began to recede. The event may then be continued as a Flood event. Keep in mind that flash flooding may continue to threaten life or property many hours after the causative event ends.

Cause of Flash Flood Event – *Storm Data* software requires that an entry be made for the cause of the Flash Flood event (e.g., heavy rain). This cause will not appear in *the Storm Data* publication.

Direct Fatalities/Injuries

- ❏ A person drowned in a flash flood or was struck by an object in flash flood waters.
- ❏ A motorist drowned in an overturned car after driving down a hill onto a flooded stretch of highway that had flood waters 4 feet deep. (It doesn't matter how irresponsible the driver was.)
- ❏ A group of people having a party in an apartment located in a floodplain drowned when flood waters trapped them.
- ❏ Several campers drowned when a thunderstorm 10 miles away in an adjacent county/parish sent a flash flood wave down an arroyo where they camped.
- ❏ Debris or missiles caught in flood waters struck and injured a person walking along a flooding river.

- ❑ A child playing near a stream or storm sewer was swept away by flood waters and drowned.
- ❑ Drowning due to the collapse of a levee or retaining wall caused by flood waters.
- ❑ Drowning or injuries due to flooding caused by a dam break.

Indirect Fatalities/Indirect Injuries

- ❑ Vehicular accidents and incidents that the flash flood contributed to but did not directly cause.
- ❑ Children playing in debris or workers cleaning up debris left by a flood. Debris shifted and child or worker was struck, pinned, or crushed by debris.
- ❑ A flash flood loosened rocks on a mountainside. After the water receded, a rock climber fell to his death after grabbing onto one of the loosened rocks for a handhold.
- ❑ A remote mountain pass road was undermined in a flash flood by a nearby creek. After the water receded, a vehicle drove into the hole in the road, killing the passenger and injuring the driver.

Examples:

Milwaukee County

Wauwatosa to	**06 1000CST**	**2**	**0**	**2.5M**	**Flash Flood**
Milwaukee	**07 0000CST**				

Thunderstorms dumped rainfall amounts of 8 to 12 inches between 0700CST and 1900CST on July 6 in a 7-mile-wide band from the city of Waukesha (Waukesha Co.) east to downtown Milwaukee (Milwaukee Co.). Flash flooding killed two people who drowned when their car was swept away by flood waters at the intersection of I-94 and I-43. Widespread flood damage occurred to 2000 homes and 500 businesses. The maximum rainfall total in Milwaukee County was 11.25 inches, which was measured at the downtown Public Safety Building. M25VE, F24VE

Waukesha County

Waukesha to	**06 1000CST**	**4**	**10**	**2.0M**	**Flash Flood**
Elm Grove	**07 0000CST**				

Thunderstorms dumped rainfall amounts of 8 to 12 inches between 0700CST and 1900CST on July 6 in a 7-mile-wide band from the city of Waukesha (Waukesha Co.) east to downtown Milwaukee (Milwaukee Co.). Widespread flood damage occurred to 500 homes and 150 businesses from the city of Waukesha east through Brookfield and Elm Grove. Four people in a vehicle drowned when flash flood waters up to 5 feet deep flipped their car over at the intersection of I-94 and Moorland Road. Ten people were injured in the city of Waukesha by floating tree debris in Fox River. A cooperative observer in the southern part of Brookfield (Waukesha Co.) measured 11.98 inches of rain between 0700CST and 1900CST on the 6th. M48VE, F46VE, M14VE, F15VE

Herkimer County

Dolgeville	**28**	**0930EST 1500EST**	**0**	**0**	**4K**	**Flash Flood**

An ice jam developed during the morning of February 28 along East Canada Creek at the State Highway 29 bridge in the village of Dolgeville. The water rapidly backed up, flooding the cellars of nearby buildings. The ice jam broke up in the late afternoon without any further flooding downstream.

Cannon County

Woodbury	**07**	**0830CST 1300CST**	**0**	**0**	**100K**	**Flash Flood**

A dam broke and the resultant flash flood damaged a dozen homes downstream. (This example would apply to levees, retaining walls, and other structures.)

7.14.5 Examples of a Flash Flood that Evolved into a Flood.

Kern County

Frazier Park	**10 11**	**1900PST 0100PST**	**0**	**0**	**1.0M**	**Flash Flood**

A powerful storm dropped 3 to 4 inches of rain over portions of Kern County during the afternoon of the 10th. The heavy rains caused flash flooding on several creeks. Frazier Mountain Road between I-5 and Shallock Road and Highway 66 near Maricopa were all washed out by overflowing creeks.

Kern County

Frazier Park	**11 11**	**0100PST 1000PST**	**0**	**0**		**Flood**

A powerful storm dropped 3 to 4 inches of rain over portions of Kern County during the afternoon of the 10th. The heavy rains caused flash flooding on several creeks. Frazier Mountain Road between I-5 and Shallock Road and Highway 66 near Maricopa were all washed out by overflowing creeks. Additional 1 to 2 inches of rain caused creeks to stay in flood and roads to remain closed through the night. Flood waters subsided by late morning on the 11th.

7.15 **Flood (C).** Any high flow, overflow, or inundation by water which causes or threatens damage. In general, this would mean the inundation of a normally dry area caused by an increased water level in an established watercourse, or ponding of water, generally occurring more than 6 hours after the causative event, and posing a threat to life or property. This can be on a widespread or localized basis. Refer to the Flash Flood event (Section 7.14) for guidelines for differentiating between Floods and Flash Floods.

River flooding may be included in the Flood category. However, such entries should be confined only to the effects of the river flooding, such as roads and bridges washed out, homes and businesses damaged, and the dollar estimates of such damage. OCWWS at National Weather Service Headquarters will maintain the official records of river stages, flood stages, and crests. Therefore, river stages need not be included in *Storm Data*.

Note: Direct fatalities which are vehicle-related will be coded as VE. In addition, if a person drives into a flooded area, exits his/her vehicle and drowns, the fatality will be coded as VE (Vehicle and/or Towed Trailer), not IW (In Water).

Beginning Time - When flood waters began to threaten life or property. In some cases, a flood may have been when water left the banks of a river, in others it may not have been until the water level was 2 to 3 feet above bank-full. Professional judgment should be used by the *Storm Data* preparer.

Ending Time - When flood waters receded to a point where there was no longer any threat to life or property. Keep in mind that flooding may continue to threaten life or property many days after the rain ends.

Cause of Flood Event – *Storm Data* software requires that an entry be made for the cause of the Flood event (e.g., heavy rain). This cause will not appear in *the Storm Data* publication.

Direct Fatalities/Injuries

- ❏ A fatality occurred as a result of the person drowning in a flood or being struck by an object in flood waters.
- ❏ A person walked around a barricade into 3-foot deep flood waters near a river. The current swept him off his feet and he drowned.
- ❏ Two people were rafting down a flooded street hanging onto inner tubes. Water turbulence flipped them over, causing them to hit their heads on a curb, and both drowned.
- ❏ Debris or missiles caught in flood waters struck and injured a person walking along a flooded river.

Indirect Fatalities/Injuries

- ❏ Vehicular accidents the flood contributed to but did not directly cause.
- ❏ A person suffered a heart attack while taking part in sandbagging operations.

Example:

Providence County
South Foster **17 0200EST** **0** **2** **3.5M** **5.7M** **Flood**
18 1500EST

Widespread low-land flooding occurred in northwest Providence County, resulting in considerable flood damage to 1500 homes, 400 businesses, and 200 agricultural farms. Two men near South Foster were injured by floating debris in the Ponaganset River when they rescued a dog. The flood was initiated by rainfall amounts of 4 to 5 inches (on top of wet ground) that fell between 1800EST on the 16th and 1800EST on the 17th.

7.16 **Freezing Fog (Z).** Fog which freezes on contact with exposed objects and forms a coating of rime and/or glaze, on a widespread or localized basis, resulting in an impact on transportation, commerce, or individuals. Freezing fog can occur with any visibility of 6 miles or less. Even small accumulations of ice can have an impact.

Beginning Time – When freezing fog began.

Ending Time – When freezing fog ended.

Direct Fatalities/Injuries – None.

Indirect Fatalities/Injuries
- ❑ Fatalities and injuries resulting from vehicle accidents caused by freezing fog.

Example:

ARZ044 Pulaski
14 0400CST 0 0 Freezing Fog
1100CST
Freezing fog occurred in areas near the Arkansas River, reducing visibility to below ½ mile. The fog resulted in a number of multiple-vehicle accidents during the morning rush-hour. The majority of these accidents occurred on elevated sections of Interstate 440, on the river bridges of Interstates 30 and 430, and on the Levy Bridge on Interstate 40. Altogether, the accidents caused five injuries (indirect injuries).

7.17 **Frost/Freeze (Z).** A surface air temperature of 32 degrees Fahrenheit (F) or lower, or the formation of ice crystals on the ground or other surfaces, over a widespread or localized area for a period of time long enough to cause human or economic impact, during the locally defined growing season.

Beginning Time - When the temperature first fell below freezing or frost began to form.

Ending Time - When the temperature rose above freezing or frost melted.

Direct Fatalities/Injuries
- ❑ None. This *Storm Data* event type applies to agricultural losses. Any fatality in which the medical examiner or coroner determined that the primary cause was hypothermia should be entered under the event type Extreme Cold/Wind Chill, or the Cold/Wind Chill event.

Indirect Fatalities/Injuries

- Any traffic fatalities/injuries due to ice formation on roads or bridges, and any pedestrian casualties due to icy walkways.

Examples:

FLZ039-042 -048 **Levy - Citrus – Hernando**
18 0500EST 0 0 50K Frost/Freeze
18 0800EST
Freezing temperatures between 30 and 32 degrees occurred. The average duration was around 1 hour, with up to 3 hours in isolated locations. Some crop damage was noted in Levy County.

GAZ028-029 **Hart – Elbert**
06 0500EST 0 0 Frost/Freeze
06 0800EST
Near-record low temperatures in the lower to mid 30s with clear skies and light winds resulted in widespread frost. No crop damage was reported, but frost formation on roads and bridges resulted in several traffic accidents, including one fatality (indirect fatality) on Highway 72, at the Broad River Bridge.

7.18 **Funnel Cloud (C).** A rotating, visible, extension of a cloud pendant from a convective cloud with circulation not reaching the ground. This would include cold-air funnels which typically form in a shallow, cool air mass behind a cold front. The funnel cloud should be large, noteworthy, or create strong public interest to be entered.

Beginning Time - When the funnel cloud was first observed.

Ending Time - When the funnel cloud was no longer visible.

Direct Fatalities/Injuries

- A fatality or injury directly caused by the circulating winds of a funnel cloud. Note that by definition, a funnel cloud fatality can not occur on the ground, so fatalities or injuries can only be associated with aviation mishaps. (Rare)

Indirect Fatalities/Injuries

- All fatalities/injuries that resulted from distress brought on by the sight of the funnel cloud or by any telecommunication to those individuals of the possibility of funnel clouds.

Examples:

Tolland County							
Gilead	**10**	**1800EST** **1805EST**	**0**	**0**			**Funnel Cloud**

A funnel cloud was observed by local law enforcement officials, and Amateur Radio operators. It extended about halfway from the cloud base to the ground as it passed over town.

Power County							
13 E American Falls	**30**	**1300MST** **1302MST**	**0**	**1**	**150K**		**Funnel Cloud**

A small airplane flew into a funnel cloud west of Pocatello; and based on reports from highway motorists, the pilot lost control. The pilot crash-landed at the Pocatello Municipal Airport, and was injured. The plane was a total loss, based on the insurance claim.

Deuel County							
3 S Chappell	**21**	**1612MST** **1620MST**	**0**	**0**			**Funnel Cloud**

A cold air funnel was observed 3 miles south of Chappell, and persisted for 8 minutes. The funnel was observed by numerous citizens in Chappell and motorists, who stopped along Interstate 80.

7.19 **Hail (C).** Frozen precipitation in the form of balls or irregular lumps of ice. Hail 3/4 of an inch or larger in diameter will be entered. Hail accumulations of smaller size which cause property and/or crop damage, or casualties, should be entered. Maximum hail size will be encoded for all hail reports entered.

Storm Data software permits only one event name for encoding severe and non-severe hail events, and allows the preparer to enter any hail size in hundredths of an inch. Therefore, the preparer is not restricted to only those sizes that appear in Table 6 of Section 7.19.1. If hail diameters are equal to, or greater than, 3/4 of an inch, a hail event always will be encoded. If hailstones with diameters less than 3/4 of an inch result in fatalities, injuries, or significant damage, encoding a hail event is recommended. Encoded values of estimated or measured hail diameters below 3/4 of an inch (non-severe), regardless of extent and/or severity of fatalities, injuries, and damage, will not initiate the verification process.

Beginning Time - When hail first occurred.

Ending Time - When hail ended.

Direct Fatalities/Injuries

- Baseball-size hail struck a person in the head, causing a fatality/injury.

- ❑ A fatality/injury directly caused by wind-driven hail, where both the hail size and winds were below severe criteria. This would be an extremely rare event.

Indirect Fatalities/Injuries

- ❑ Hail covered the road. A vehicle lost control on the slippery road and crashed into a tree, killing or injuring the driver.
- ❑ Hail falls with sufficient intensity to restrict visibility causing a driver to lose control of a vehicle. The vehicle rolls over or hits an object, resulting in a fatality/injury.

Examples:

Medina County							
Brunswick	**20**	**1730EST** **1735EST**	**1**	**3**	**1.3M**	**50K**	**Hail (4.00)**

A prolific hailstorm sat over Brunswick, Ohio, for 5 minutes, resulting in a fatality, injuries, and considerable property damage. A 10-year old boy died on a ball field due to head injuries sustained in a barrage of 4-inch diameter hail. Three other boys suffered head injuries. The large hail damaged at least 500 vehicles, and 700 homes reported broken windows or awnings. The ground was covered white, and the hail didn't melt until the following afternoon. M10BF

King County							
Guthrie	**02**	**2240CST** **2245CST**	**0**	**0**		**500K**	**Hail (0.50)**

Hail up to ½ inch in diameter accumulated to several inches. The hail completely flattened and shredded young corn crops at several farms near Guthrie. Insurance company officials declared the corn crop a total loss.

7.19.1 Hail Conversion Table. To assist in the task of converting spotter hail reports to actual hail diameter, a recommended guideline follows in Table 6. The comparisons may not be accurate, but may used for estimates. Care must be exercised since apples, softballs, and grapefruit come in different sizes. For example, softballs range in size from 3.50 inches to 5.09 inches. Additionally, dime-size hail was the coin type associated with 0.75-inch diameter hailstones for many years. However, the diameter of a dime is 11/16 inch, slightly smaller than a penny, which is 12/16 inch (0.75 inch). Also, for many years, marble-size hail was associated with hailstones ½ inch in diameter. However, marbles come in different sizes. Therefore, use of the term "marble-size" or "dime-size" hail is not recommended.

Pea	0.25 - .375 inch	Lime	2.00 inches
Small marble	0.50 inch	Tennis Ball	2.50 inches
Penny	0.75 inch	Baseball	2.75 inches
Nickel	0.88 inch	Large Apple	3.00 inches
Quarter	1.00 inch (15/16")	Softball	4.00 inches
Half dollar	1.25 inch	Grapefruit	4.50 inches
Walnut/Ping Pong	1.50 inch	Computer CD/DVD	4.75 - 5.00 inches
Golf ball	1.75 inch		

Table 6. Hail Conversion Table.

7.20 **Heat (Z).** A period of heat resulting from the combination of high temperatures (above normal) and relative humidity. A Heat event occurs and is reported in *Storm Data* whenever heat index values meet or exceed locally/regionally established advisory thresholds. Fatalities or major impacts on human health occurring when ambient weather conditions meet heat advisory criteria are reported using the Heat category. If the ambient weather conditions are below heat advisory criteria, a Heat event entry is permissible only if a directly-related fatality occurred due to unseasonably warm weather, and not man-made environments.

Depending on the part of the country experiencing high temperatures, the heat effects are modulated by relative humidity, cloud cover, wind speeds, the duration of a hot spell, the time of the year, and other factors, including mortality rates and types of housing.

In some heat waves, fatalities occur in the few days following the meteorological end of the event. The preparer should include these fatalities in the Heat event, but encode the actual date of the directly-related fatalities in the fatality entry table.

Beginning Time - When local/regional thresholds for heat were first met or when unseasonably or abnormally hot conditions began.

Ending Time - When local/regional thresholds for heat were no longer met or unseasonably or abnormally hot conditions ended.

Direct Fatalities/Injuries

- ❑ Fatality where heat-related illness or heat stress was the primary or major contributing factor as determined by a medical examiner or coroner.
- ❑ An elderly person suffered heat stroke and died inside a stuffy apartment during a heat wave.

- ❑ Cases in which people receive medical treatment for heat-hyperthermia (severe dehydration, sunstroke, heatstroke, etc.) are considered injuries, not illnesses, for *Storm Data* purposes.
- ❑ Situations in which a person dies (primary cause was heat) in an unseasonably warm period in April in the Great Lakes region with maximum temperatures around 90 and surface dew-points in the upper 60s.

Indirect Fatalities/Injuries

- ❑ Fatality where heat stress was the secondary, or contributing factor, but the heat was man-made and ambient conditions were not abnormally hot or extreme. The heat fatality was not weather-related.
- ❑ A toddler was left inside a car while a parent went inside a grocery store on a sunny day, where ambient conditions did not meet the local/regional criteria for a heat advisory (heat index only in the 80s.) The windows were left rolled up, and the toddler died. In this case the toddler likely would have survived in the ambient conditions if the windows were down.
- ❑ A medical examiner reported a man working inside a steel mill died primarily of heat stress. The outside temperature was only 72 degrees on May 1st in Chicago (weather conditions didn't meet ambient heat advisory criteria).

Example:

MOZ064	**St. Louis**			
	02 1300CST	**1**	**0**	**Heat**
	05 2000CST			

Unseasonably hot and humid weather settled over Missouri during the first five days of March. On March 4th, record-setting maximum air temperatures of 90 degrees combined with dew points of 70-75 resulted in heat index values of 95 to 100. As a result, 1 person in St. Louis died from the effects of this heat. F90PH.

7.21 **Heavy Rain (C).** Unusually large amount of rain which does not cause a flash flood or flood, but causes damage, e.g., roof collapse or other human/economic impact. Heavy rain situations, resulting in urban and/or small stream flooding, should be classified as a Heavy Rain event, or another suitable event that occurred at the same time.

Beginning Time - When heavy rain that led to damage began.

Ending Time - When heavy rain diminished to the degree that it no longer posed a threat to life or property.

Direct Fatalities/Injuries

- ❑ A fatality or injury caused by debris from a structural collapse resulting from water loading.

Indirect Fatalities/Injuries

- ❑ All fatalities/injuries that resulted from vehicle accidents due to hydroplaning, or from sliding on slippery road surfaces, or from poor visibility.

Example:

Minnehaha County

Sioux Falls	**03**	**1100CST 1200CST**	**2**	**7**	**300K**	**Heavy Rain**

A short-lived but intense thunderstorm dumped 2 inches of rain between 0930CST and 1130CST, resulting in the collapse of a roof of an old school building at noon. Two students were crushed by roof debris, and 7 others were injured. Apparently, the rain came down so hard that water loading on the roof led to the roof collapse. Minor street flooding occurred elsewhere in Sioux Falls, but in general the city's drainage system was up to the task. M8SC, M9SC

7.22 **Heavy Snow (Z).** Snow accumulation meeting or exceeding locally/regionally defined 12 and/or 24 hour warning criteria, on a widespread or localized basis. This could mean such values as 4, 6, or 8 inches or more in 12 hours or less; or 6, 8, or 10 inches in 24 hours or less. In some heavy snow events, structural damage, due to the excessive weight of snow accumulations, may occur in the few days following the meteorological end of the event. The preparer should include this damage as part of the original event and give details in the narrative.

The *Storm Data* preparer should include in the narrative the times that heavy snow began to accumulate, met criteria, and accumulation ended.

Beginning Time – When snow was first observed to accumulate or inferred to accumulate from surrounding reports.

Criteria Time - When snow accumulations reach locally/regionally established warning threshold values, or as inferred by damage reports.

Ending Time - When snow was observed to stop accumulating or inferred to stop accumulating from surrounding reports.

Direct Fatalities/Injuries

- ❑ A fatality/injury from a mass of snow sliding off a roof or falling through a structure.
- ❑ A tree toppled from heavy snow and landed on someone, killing him/her.
- ❑ A person walking through deep snow, fell down, and died of exposure.

Indirect Fatalities/Injuries

- ❑ Any fatality from a vehicle accident related to deep snow on the roads or slippery roads.
- ❑ Any fatality related to shoveling or moving snow.

Examples:

IA013-014 Fayette – Clayton

25 0800CST	**0**	**0**			**Heavy Snow**
25 1800CST					

Snow began to accumulate at 0800CST, and tapered off to flurries by 1800CST. A total of 6 to 8 inches of snow fell from Oelwein to Strawberry Point.

VTZ013-014 Bennington - Windham

11 1500EST	**1**	**0**		**500K**	**Heavy Snow**
12 1800EST					

Record-breaking heavy snow pounded the southern part of Vermont. Accumulations of 30 to 40 inches paralyzed the region. Travel and commerce came to a halt, and there were numerous reports of downed power lines and structural damage due to the weight of snow on roofs. Some roofs of businesses collapsed during the two days following the end of the heavy snow, since clean-up crews were unable to reach those buildings. One person died from exposure after he left his snow-covered vehicle and attempted to walk to a nearby residence during the height of the storm. Accumulating snow and lower visibilities began at 1500EST on the 11th and accumulation rates increased to 2 to 3 inches per hour through the overnight and morning hours. M70OU

7.23 **High Surf (Z)**. Large waves breaking on or near shore, resulting from swell spawned by a distant storm or from strong onshore winds, causing a fatality, injury or damage. In addition, if accompanied by anomalous astronomical high tides, high surf may produce beach erosion and possible damage to beachfront structures. High surf conditions are usually accompanied by rip currents and near-shore breaks.

Beginning Time - When near-shore wave heights met locally developed criteria (usually 7 to 10 feet).

Ending Time - When near-shore waves subsided below locally developed criteria.

Direct Fatalities/Injuries

- ❑ A surfer ventured out into severe wave conditions and was injured or drowned.
- ❑ A man fishing off a pier was swept into the sea.
- ❑ A boat traversing an ocean inlet foundered on the rocks and the boaters drowned.

Indirect Fatalities/Injuries

- ❑ A swimmer, struggling to get out of the high surf, suffered a heart attack.

<u>Examples</u>:

CAZ042-043 Orange County Coast - San Diego County Coast

09 2000PST	**0**	**2**	**2M**		**High Surf**
10 0600PST					

A high surf and swells battered beachfront buildings. Waves which occasionally reached 15 to 20 feet damaged 32 homes in San Clemente. A Solana Beach lifeguard was injured while rescuing a drowning teen who also suffered minor injuries.

VAZ098>100 Virginia Beach - Northampton - Accomack

15 1500EST	**0**	**0**	**10M**		**High Surf**
16 1200EST					

A strong northeast wind caused significant beach and property damage along the Atlantic coast from Virginia Beach, VA, to Ocean City, MD. At least 100 vacation homes reported damage.

7.24 **<u>High Wind (Z)</u>.** Sustained non-convective winds of 35 knots (40 mph) or greater lasting for 1 hour or longer or winds (sustained or gusts) of 50 knots (58 mph) for any duration (or otherwise locally/regionally defined), on a widespread or localized basis. In some mountainous areas, the above numerical values are 43 knots (50 mph) and 65 knots (75 mph), respectively.

The High Wind event name will not be used for severe local storms, tropical cyclones, or winter storm events. Inland offices which experience high winds/damage associated with tropical cyclones will document such winds under the Tropical Storm or Hurricane/ Typhoon category, as appropriate, not under the High Wind category.

When high wind conditions are satisfied, a *Storm Data* event entry is required, and the preparer will indicate in the entry field whether the wind value represents a maximum sustained wind, or maximum wind gust. Depending on the choice, the software will place an S or G in front of the wind value that appears in the *Storm Data* publication. Additionally, the on-line *Storm Data* software program requires the preparer to indicate whether the wind gust value, or sustained wind value, is measured or estimated. Refer to Table 9 in Section 7.39.4 for wind speed and damage factors.

Events with winds less than the High Wind event threshold numbers, resulting in fatalities, injuries, or significant property damage, will be encoded as a Strong Wind event.

Events over large inland lakes (with no specific, assigned Marine Forecast Zone number) that meet High Wind criteria will be entered as a High Wind event, rather than a Marine High Wind event.

<u>Beginning Time</u> - When sustained winds or wind gusts first equaled or exceeded locally/regionally established criteria for high wind. Wind speed values can be inferred from damage reports.

Ending Time - When sustained wind or wind gusts dropped below high wind criteria.

Direct Fatalities/Injuries
- ❏ Fatalities or injuries caused by being struck by falling debris associated with structural failure (including falling trees, utility poles, and power lines).
- ❏ Fatalities or injuries associated with vehicles that were blown over, or vehicles that were blown into a structure or other vehicle.
- ❏ Fatalities or injuries caused by people or vehicles that were struck by airborne objects.
- ❏ Drowning due to boat capsized by wind.

Indirect Fatalities/Injuries
- ❏ Fatalities or injuries when vehicles collided with stationary obstructions/debris placed in roadways by high wind.
- ❏ Any fatalities or injuries incurred during the clean-up process.
- ❏ Fatalities or injuries associated with contact with power lines after they fell.
- ❏ Any fatalities or injuries that loss of electrical power contributed to, including lack of heat, cooling, or light, or failure of medical equipment.

Examples:

MNZ088-095 Fillmore - Winona
30 0100CST 0 0 2.5K High Wind (EG56)
0900CST
Southwest winds gusting to an estimated 56 knots (65 mph) for about 8 hours blew down numerous trees and toppled dozens of signs in Spring Valley and Lewiston. A young girl in Spring Valley was killed when she touched a downed power-line (indirect fatality).

SDZ001-002- Butte - Harding – Nrn Meade Co Plains - Perkins
012-013 06 0900MST 0 0 High Wind (ES39)
1300MST
Sustained west winds reached 39 knots (40 to 45 mph) for several hours across northwest South Dakota behind a fast-moving cold front. No gusts of 50 knots (58 mph) or higher were reported.

7.25 **Hurricane/Typhoon (Z).** A tropical cyclone in which the maximum 1-minute sustained surface wind is 64 knots (74 mph) or greater. In the Atlantic Ocean or the North Pacific Ocean east of the International Date Line this event would be labeled a Hurricane, and in the North Pacific Ocean west of the International Dateline this event would be classified as a Typhoon.

The hurricane/typhoon will usually include many individual hazards, such as storm tide, freshwater flooding, tornadoes, rip currents, etc. The Hurricane/Typhoon data header-strip will only include fatalities, injuries, and damage amounts associated with wind damage (the other hazards will already be reported in their respective *Storm Data* entries). Include the other hazard information in the Hurricane/Typhoon narrative to ensure a complete synopsis for the event.

Note: Tropical cyclone entries in *Storm Data* are based upon the wind speeds observed in the WFO's coastal, inland, and marine zones. If a hurricane produces only tropical storm force winds in a particular CWA, the entry should be made under Tropical Storm. However, such entries must include a reference to the hurricane in the narrative section, e.g., "Hurricane Dennis produced tropical storm force winds in ...."

Inland offices which experience high winds/damage associated with tropical cyclones will document such winds under the Tropical Storm or Hurricane/ Typhoon category, as appropriate, not under the High Wind category

7.25.1 <u>Separating the Various Hurricane/Typhoon Hazards</u>. After a tropical cyclone event, offices will: (a) have an entry for the tropical cyclone, summarizing the total impact, and (b) separately list the impacts attributed to individual hazards events (storm surge/tide, freshwater flooding, tornadoes, debris flow, rip currents, etc.). These separate event entries (i.e., their associated fatalities, injuries, and damage amounts) are not included/encoded as part of the hurricane/typhoon header-strip. Flooding along the coast, even if it is from distant swells, will be entered as Storm Surge/Tide, not Coastal Flood. Rip Currents and High Surf can be entered in addition to Storm Surge/Tide, if applicable. The name of the tropical cyclone will be included in the narrative of all associated individual hazards/events.

Wind damage is the only individual hazard to be encoded in Hurricane/Typhoon, Tropical Storm, and Tropical Depression. This restriction prevents a "double-count" from occurring in the national report entitled "*A Summary of Natural Hazard Statistics for [Year] in the United States*," which is based upon the header strips of *Storm Data* events. In other words, the fatalities, injuries, and damage amounts appearing in the header-strip of a tropical cyclone are attributed only to wind damage experienced in the counties/parishes listed in the header-strip. The effects from the other individual hazards associated with a tropical cyclone can be found in other cyclone-related events.

In order to provide complete documentation of the tropical cyclone effects, the *Storm Data* preparer will do two additional things:

a. Insert into the tropical cyclone narrative the total fatalities, injuries, and damage amounts attributed to *all* tropical cyclone hazards, for affected coastal and inland counties/parishes within a CWA (e.g., "The collective effects of Hurricane Alpha during the period of August 1-3, resulted in 10 fatalities, 50 injuries, $800M in property damage, and $200M in crop damage in the counties of S, T, U, V, W, X, Y, and Z"). This will ensure that all tropical cyclone effects are summarized in one sentence; and

b. Provide in the tropical cyclone narrative, a general breakdown of fatalities, injuries, and damage amounts attributed to individual hazards/events, for both coastal and inland counties/parishes (e.g., "During the passage of Hurricane Alpha in the counties of S, T, U, V, W, X, Y, and Z, five tornadoes killed 3 people and resulted in $1.0M in property damage, flash floods injured 20 people and resulted in $175M in crop damage, rip currents resulted in 5 fatalities," etc.).

In addition, the following information will be included in the narrative for tropical cyclones at coastal locations:

- Tropical cyclone name;
- The point of landfall, even if not in the WFO's CWA;
- Storm surge/tide;
- Minimum surface pressure; and
- Saffir-Simpson Hurricane Scale or Saffir-Simpson Tropical Cyclone Scale, upon landfall, as appropriate.

The following information will be included for both coastal and inland locations:

- Maximum sustained wind speed/peak gusts;
- Rainfall totals; and
- Record-breaking data.

In some situations (e.g. delayed fatalities and delayed damage), there may be tropical cyclone-related hazards, as mentioned above, occurring prior to or after the beginning/ending time of the tropical cyclone event. Professional judgment must be exercised in determining if these related hazards are part of the cyclone. Refer to Sections 2.6.3 and 2.7.4 for the decision process.

Damage listed in the header-strip of the individual hazards, or the tropical cyclone, should not include such things as business losses from reduced tourism, etc.

Tables 7 and 8 in Section 7.25.2 depict the Saffir-Simpson Hurricane Scale and Saffir-Simpson Tropical Cyclone Scale.

<u>Beginning Time</u> - When the direct effects of the hurricane/typhoon were first experienced.

<u>Ending Time</u> - When the direct effects of the hurricane/typhoon were no longer experienced.

<u>Direct Fatalities/Injuries</u>

- ❑ Casualties caused by storm tide, high surf, freshwater flooding, debris flow, wind-driven debris, or structural collapse.
- ❑ The wind caused a house to collapse or blew a tree onto someone.
- ❑ A person drowned while surfing in rough waters.
- ❑ The storm tide drowned people in a beach house.
- ❑ Someone drowned when flood-waters swept a vehicle into a river.

<u>Indirect Fatalities/Injuries</u>

- ❑ Someone suffered a heart attack while removing debris.

- ❑ Someone was electrocuted by touching downed power lines.
- ❑ Someone drowned when a vehicle was driven into a canal.
- ❑ Someone was killed in a vehicle accident caused by a hurricane-related missing traffic signal.

Examples:

FLZ018-021 Broward - Collier - Dade - Monroe
>023 24 0325EST 4 50 13B 750M Hurricane/Typhoon
0900EST

The eye of Hurricane Andrew moved ashore in south Dade County near Homestead with a minimum central pressure of 922 mb and maximum storm surge of 16.9 feet. Maximum sustained winds were estimated at 145 knots (165 mph) with gusts to at least 152 knots (175 mph). Andrew was a Category 5 storm on landfall and was the third strongest in U.S. history. In southeast Florida, the maximum rainfall was 7.79 inches in Broward County. The height of the storm tide (the sum of the storm surge and astronomical tide, referenced to mean sea level) ranged from 4 to 6 ft in northern Biscayne Bay increasing to a maximum value of 16.9 ft at the Burger King International Headquarters, located on the western shoreline in the center of the bay, and decreasing to 4 to 5 ft in southern Biscayne Bay. The observed storm tide values on the Florida southwest coast ranged from 4 to 5 ft near Flamingo to 6 to 7 ft near Goodland. In Broward, Collier, Dade, and Monroe Counties, the winds killed 4 people (trees falling on moving vehicles). All of the associated effects of Andrew in southeast Florida resulted in 15 fatalities, 250 injuries, $25.0B in property damage, and around $1.0B in crop damage. Specifically in southeast Florida, Andrew's inland flood waters resulted in 5 fatalities, 100 injuries, $5B in property damage, and $250M in crop damage. The eight associated tornadoes resulted in 2 fatalities, 25 injuries, and $1B in property damage. The powerful winds resulted in 4 fatalities, 50 injuries, $13B in property damage, and $750M in crop damage. The storm tide along the coast resulted in 4 fatalities, 75 injuries, and $6M in property damage. Besides the 15 direct fatalities, at least 26 indirect fatalities occurred, during clean-up activities. M67VE, F12VE, M45VE, F46VE

GUZ001 Guam
15 1700ChST 0 1 254M Hurricane/Typhoon
16 1200ChST

Typhoon Paka entered the Marshall Islands as a tropical storm on December 10 became a typhoon on December 11 and crossed through the Marshall Islands until December 14, damaging structures and crops. Paka became a super typhoon on December 15 and passed 5 miles north of Guam. The lowest pressure observed on Guam was 948 mb and the highest sustained wind was measured at 100 knots (115 mph) with a gust to 152 knots (175 mph). On the Saffir-Simpson Tropical Cyclone Scale, this corresponds to a Category 3 typhoon based on the sustained-wind value but more accurately to a Category 4 typhoon based on the gust value.

Maximum storm tide on Guam was about 30 feet (run-up/debris line) at Arunao Beach on the northwest coast, 16 feet (run-up/debris line) at the Commercial Port, 13 feet (run-up/debris line) on the north side of Tumon Bay (standing water measurement), and 8 feet (run-up/debris line) on Agana Bay. Maximum rainfall at WFO Guam was 20.75 inches from 16 December at 1600ChST to 17 December at 1600ChST. While Paka was on Guam, the typhoon winds resulted in 1 injury (debris hit a person on the head), and damaged numerous businesses and homes. Collectively, all of the effects of Typhoon Paka resulted in no fatalities, 2 people injured, and over $504M in property damage. Specifically, Paka's flood waters resulted in 1 injury, and $200M in property damage; associated winds resulted in 1 injury and over $254M in property damage. The storm tide resulted in $50M in property damage.

7.25.2 Tables for Determining Saffir-Simpson Hurricane Scale and Saffir-Simpson Tropical Cyclone Scale**.**

CATEGORY (SCALE NUMBER)	**WIND SPEED**	**STORM TIDE (FT)**	**DAMAGE**
1	64-82 kts (74-95 mph)	4-5	Minor
2	83-95 kts (96-110 mph)	6-8	Moderate
3	96-113 kts (111-130 mph)	9-12	Major
4	114-135 kts (131-155 mph)	13-18	Severe
5	Greater than 135 kts (Greater than 155 mph)	Greater than 18	Catastrophic

Table 7. Saffir-Simpson Hurricane Scale.

Note: A scale ranging from 1 to 5 based on a hurricane's intensity. This can be used to give an estimate of the potential property damage and flooding expected. In practice, wind speed is the parameter that determines the category since storm tide is highly dependent on the slope of the continental shelf. Storm tide (run-up/debris line) equals sum of storm surge and astronomical tide.

Tropical Storm Categories	**Sustained Winds**	**Wind Gusts**	**Tide WR**	**Tide NR**	**Damage Level**	**Description of Damages and Storm Tide/Inundation**
A Weak	26-43 kts (30-49 mph)	33-56 kts (40-64 mph)	<1 ft	1 ft	Tiny	Damage only to the flimsiest lean-to type structures and tents. Minor damage to huts made of thatch or loosely attached corrugated sheet metal or plywood. Salt spray causes majority of damage to vegetation. Rough surf at reef front with moderately strong rip currents inside reef.
B Severe	44-63 kts (50-73 mph)	57-81 kts (65-94 mph)	<1 ft	1-2 ft	Small	Major damage to huts made of thatch or loosely attached corrugated sheet metal or plywood; sheet metal and plywood may become airborne. Minor damage to buildings of light materials. Moderate damage to banana and papaya trees, and most fleshy crops. Very rough surf at reef front with strong rip currents inside reefs.
Typhoon Categories	**Sustained Winds**	**Wind Gusts**	**Surge WR**	**Surge NR**	**Damage Level**	**Description of Damages and Storm Tide/Inundation**
1 Minimal	64-82 kts (74-95 mph)	82-105 kts (95-120 mph)	1-2 ft	2-4 ft	Minimal	Corrugated sheet metal and plywood stripped from poorly constructed or termite-infested structures and may become airborne. A few wooden, non-reinforced power poles tilted and some rotten power poles broken. Some secondary power lines downed. Major damage to exposed banana and papaya trees, and fleshy crops. Some palm fronds crimped and bent back through the crown of coconut palms. Less than 10% defoliation of trees and shrubs. Minor pier damage. Some small boats in exposed anchorages break moorings.

Typhoon Categories	Sustained Winds	Wind Gusts	Surge WR	Surge NR	Damage Level	Description of Damages and Storm Tide/Inundation
2 Moderate	83-95 kts (96-110 mph)	106-121 kts (121-139 mph)	2-4 ft	4-6 ft	Moderate	Damage to wooden and tin roofs and door and windows of termite-infested or rotted structures, but no major damage to well-constructed wooden, sheet metal, or concrete structures. Considerable damage to structures made of light materials. Several rotten power poles snapped and many non-reinforced poles tilted. Many secondary power lines down. Exposed banana and papaya trees totally destroyed; 10-20% defoliation of trees and shrubs. Some erosion of beaches, some moderate pier damage and some exposed large boats torn from moorings.
3 Strong	96-113 kts (111-130 mph)	121-144 kts (140-165 mph)	5-8 ft	6-10 ft	Extensive	Some roof, window and door damage to well-built wooden and metal residences and industrial buildings. Extensive damage to structures weakened by termites, wood rot and corroded roof/hurricane straps. Non-reinforced cinderblock walls blown down. Many mobile homes and buildings of light materials destroyed. Some glass failure due to flying debris but minimal glass failure due to pressure forces associated with extreme gusts. A few non-reinforced hollow-spun concrete power poles broken or tilted and many non-reinforced wooden poles broken or blown down. Chain-link fences begin to blow down. Some light and high-paneled vehicles overturned. Some unsecured construction cranes blown down. Air is full of light projectiles and debris. Coconut palms begin to lose crowns. Considerable beach erosion. Many large boats and some large ships torn from moorings.

Typhoon Categories	**Sustained Winds**	**Wind Gusts**	**Surge WR**	**Surge NR**	**Damage Level**	**Description of Damages and Storm Tide/Inundation**
4 Very Strong	114-135 kts (131-155 mph)	145-171 kts (166-197 mph)	8-12 ft	10-15 ft	Extreme	Complete failure of many non-concrete roof structures and unprotected window frames and doors; many well-built wood and sheet metal structures severely damaged or destroyed. Considerable glass failure due to flying debris and explosive pressure forces from extreme wind gusts. Weakly reinforced cinderblock walls blown down. Some reinforced hollow-spun concrete power poles and numerous reinforced wooden power poles blown down; numerous secondary and a few primary power lines downed. Support poles of chain-link fences bent 90 degrees. Some secured construction cranes blown down. Some fuel storage tanks damaged. Considerable damage to airport jet-ways. Air is full of large projectiles and debris. Shrubs and trees 50-90% defoliated. Severe beach erosion. Severe damage to port facilities including some loading derricks and gantry cranes. Most ships torn from moorings.
5 Devastating	136-170 kts (156-194 mph)	171-216 kts (198-246 mph)	12-20 ft	15-28+ ft	Catastro-phic	Total failure of non-concrete reinforced roofs; extensive damage to total destruction of non-concrete residences and industrial buildings. Some structural damage to concrete structures from large debris such as cars and large appliances. Extensive glass failure due to impact of flying debris and explosive pressure forces during extreme wind gusts; many well-constructed typhoon shutters ripped from structures. Some fuel storage tanks ruptured. Most cranes blown down. Air is full of very large and heavy projectiles and debris. Shrubs and trees up to 100% defoliated. Numerous crowns and virtually all green coconuts blown from palm trees. Most bark stripped from trees and wood is severely sandblasted. Most standing trees are devoid of all but largest branches, which are stubby in appearance. Numerous very large boulders carried inland with waves. Extensive to complete beach erosion. Extensive damage to total destruction of port facilities including derricks and cranes. Virtually all ships, regardless of size, torn from moorings.

Table 8. Saffir-Simpson Tropical Cyclone Scale Table (Guard and Lander 1999) for the Pacific Ocean. Sustained winds and wind gusts are in miles per hour (mph). “Tide” refers to the

vertical height of run-up (storm tide) or inundation. Storm tide (run-up/debris line) equals sum of storm surge and astronomical tide. Tide heights are in feet. "WR" refers to "wide" coral reefs with the reef front greater than 250 feet from shore; "NR" refers to "narrow" reefs with the reef front less than or equal to 250 feet from shore. "TS" refers to tropical storm.

7.26 **Ice Storm (Z).** Ice accretion meeting or exceeding locally/regionally defined warning criteria (typical value is 1/4 or 1/2 inch or more), on a widespread or localized basis. The *Storm Data* preparer should include the times that ice accretion began, met criteria, and accretion ended.

Use this event for a fatality/injury that results from hypothermia in a power loss situation due to an ice storm. Do not use the Cold/Wind Chill or Extreme Cold/Wind Chill events. Refer to Section 2 for related details.

Beginning Time - When ice accretion first began or was inferred to begin, from surrounding reports.

Criteria Time – When ice accretion equals locally/regionally established warning threshold values, or as inferred by damage reports.

Ending Time - When accretion ends or was inferred to have ended from surrounding reports.

Direct Fatalities/Injuries
- ❏ A large chunk of ice falls off a structure and strikes and kills someone.
- ❏ Large tree or other structure falls or collapses (due to ice load) and kills someone.
- ❏ Power is lost and people die from extreme cold.

Indirect Fatalities/Injuries
- ❏ All vehicle-related fatalities due to ice-covered roads and hazardous driving conditions.
- ❏ Someone suffers a heart attack or dies while removing or cleaning up downed trees or other structural debris.
- ❏ Any fatality/injury suffered by workers involved in post-storm recovery.

Example:

MEZ007>009-012 Northern Oxford - Northern Franklin - Central Somerset - Southern Oxford

06 0300EST 1 0 304M Ice Storm
08 1100EST

A severe ice storm hit sections of central and southern Maine where 1 to 3 inches of ice accreted on trees, power lines, and other exposed surfaces. Nearly everyone in the region experienced power loss. Due to the added weight of ice, an ice-covered tree limb broke and fell on a man who was walking underneath a tree. The man died from head injuries. M36OU

7.27 **<u>Lakeshore Flood (Z)</u>.** Flooding of lakeshore areas due to the vertical rise of water above normal level caused by strong, persistent onshore wind and/or low atmospheric pressure, resulting in damage, erosion, flooding, fatalities, or injuries. Lakeshore areas are defined as those portions of land zones (coastal county/parish) adjacent to the waters of the Great Lakes, Lake Okeechobee, Lake Pontchartrain and Lake Maurepas. Farther inland, the *Storm Data* preparer must determine when and where to encode a flood event as Flash Flood or Flood. Terrain (elevation) features will determine how far inland the lakeshore flooding extends.

For *Storm Data*, coastal flood events that are associated with a storm of tropical origin (e.g., hurricane, typhoon, or tropical storm) should be reported under the Storm Surge/Tide event category; all other lakeshore flooding events should be documented as a Lakeshore Flood.

Note: Direct fatalities which are vehicle-related will be coded as VE. Thus, if a person drives into a flooded area, exits his/her vehicle and drowns, the fatality will be coded as VE (Vehicle and/or Towed Trailer), not IW (In Water).

<u>Beginning Time</u> - When the water level began to cause damage or flooding.

<u>Ending Time</u> - When the water level dropped to a point where damage or flooding ended.

<u>Direct Fatalities/Injuries</u>

- ❑ A lakeshore dwelling was washed away injuring/killing the occupants.
- ❑ A person drowned when a vehicle was swept away by the storm surge.

<u>Indirect Fatalities/Injuries</u>

- ❑ A person suffered a heart attack while evacuating from a storm surge.
- ❑ A person died in a vehicle accident caused by the storm surge washing away a traffic signal.
- ❑ A person died in a vehicle accident after losing control in standing water on a road.

<u>Example</u>:

ILZ014 **Cook**

27 0600CST 0 0 250K Lakeshore Flood
1200CST

North to northeast winds of 26 to 39 knots (30 to 45 mph) affected southern Lake Michigan. The Department of Transportation estimated a storm tide of 2 feet and 10- to 15-foot waves along the Chicago lakefront. Lake Shore Drive was closed due to water and sand on the pavement. Damage occurred to a dozen piers.

7.28 **<u>Lake-Effect Snow (Z)</u>.** Localized, convective snow bands that occur in the lee of large bodies of water, e.g. the Great Lakes or the Great Salt Lake, when relatively cold air flows over warm water. In extreme cases, snowfall rates of several inches per hour and thunder and lightning may occur. Lake-effect snow accumulations must meet or exceed locally defined 12 and/or 24 hour warning criteria (typical values of 6 to 8 inches within 12 hours or 8 to 10 inches within 24 hours). In some lake-effect snow events, structural damage, due to the excessive weight of snow accumulations, may occur in the few days following the meteorological end of the event. The preparer should include this damage as part of the original event and give details in the narrative.

The *Storm Data* preparer should include in the narrative the times that snow began to accumulate, met criteria, and stopped accumulating.

Beginning Time – When snow was first observed to begin to accumulate or inferred to begin to accumulate from surrounding reports.

Criteria Time - When lake-effect snow accumulation reached locally/regionally established warning threshold values, or as inferred by damage reports.

Ending Time - When snow accumulations ended.

Direct Fatalities/Injuries

- ❏ A fatality/injury from a mass of snow sliding off a roof or falling through a structure.
- ❏ A tree toppled from heavy snow and landed on someone, killing him.
- ❏ A person walking through deep snow, fell down, and died of exposure.

Indirect Fatalities/Injuries

- ❏ Any fatality from a vehicle accident related to deep snow on the roads or slippery roads.
- ❏ Any fatality related to shoveling or moving snow.

Examples:

OHZ003-013-014 **Cuyahoga – Geauga - Ashtabula**
16 0600EST **0** **0** **Lake-Effect Snow**
17 1500EST
Lake-effect snow showers affected Northeast Ohio. This activity began during the predawn hours of the 16th with accumulations starting around 0600EST, and continued through midday on the 17th. The heaviest snow fell during the late afternoon and evening hours of the 16th when visibilities at times were near zero. Accumulations ranged from 6 to 8 inches in Geauga, southern Ashtabula and eastern Cuyahoga Counties. Dozens of accidents were reported.

PAZ002-003 **Southern Erie - Crawford**
19 0100EST **0** **0** **Lake-Effect Snow**
20 2000EST
Lake-effect snow showers developed early on the 19th. This activity persisted into the evening hours and then dissipated. Accumulations through late evening on

the 19th ranged from 6 to 10 inches. Just after midnight on the 20th, an intense band of snow redeveloped over southern Erie and northern Crawford Counties. Thunder and lightning were observed with this band and snowfall rates exceeded three inches per hour at times. The band moved slowly west during the predawn hours. Accumulations from shortly after midnight to daybreak on the 20th ranged from 8 to 14 inches over much of southern Erie and northern Crawford Counties. The snow finally tapered off during the afternoon hours after several more inches of accumulation. Some locations saw over two feet of snow during this two day event. Travel was severely hampered by this storm and hundreds of accidents were reported.

7.29 **Lightning (C).** A sudden electrical discharge from a thunderstorm, resulting in a fatality, injury, and/or damage.

Fatalities and injuries directly related to lightning strikes will be included in *Storm Data*. Report the specific location (see Table 2 in Section 2.6.1.2), gender and age of fatalities. If reliable estimates of lightning-related damages (such as costs associated with structural fires, equipment loss, and electrical power and/or communications outages) are available or can be made, they should be entered. Because of the difficulty in obtaining lightning-related information, extra effort, such as fostering contacts with the media, fire departments or other first responders, hospitals and medical examiner offices, is recommended to help obtain such information.

The extent of lightning-related injuries is often difficult to determine. In many cases the extent of an injury may not be known until days or weeks after the incident. As a general guideline, as with other injuries for *Storm Data*, anyone seeking or receiving medical attention following a lightning incident should be counted as a lightning injury. Also, anyone reporting numbness, a tingling sensation, a headache, or other pain following a lightning incident, whether or not they receive treatment, should be counted as an injury.

For lightning injuries, it is highly desirable to include in the event narrative, the age, gender, location, and weather conditions at the time of occurrence, if known or determinable. The age, gender, and location information is used in compiling lightning statistics used in the national report entitled *Summary of Natural Hazard Statistics for [Year] in the United States*.

Over the western states, lightning may start hundreds of wildfires in a single CWA. In these cases, the preparer may have to limit the number of incidents appearing in *Storm Data* by setting a threshold value based on minimum burned acreage, or some other parameter. In other situations, lightning may cause a fire that ultimately leads to fatalities and/or injuries. In these cases, the fatalities and/or injuries will be classified as indirectly-related. Refer to Section 2.6 for additional information.

Beginning Time - Exact time of lightning strike(s).

Ending Time - Same as beginning time.

Direct Fatalities/Injuries

- ❑ A person was killed/injured by the electrical current that was generated when lightning struck the person directly.
- ❑ A person was killed/injured by an electrical current that was generated when lightning struck nearby.
- ❑ A person was killed/injured when lightning struck a tree and knocked it over onto a person.

Indirect Fatalities/Injuries

- ❑ A person was killed/injured in a traffic accident when lightning caused traffic signals to malfunction
- ❑ A person was killed/injured while removing or cleaning up debris caused by a lightning strike.
- ❑ A person was killed/injured in a fire that was initiated by lightning.

Example:

Tioga County
3 SW Tioga 06 1900EST 1 5 Lightning
A 26 year old male died when he was struck by lightning while boating on the Hammond Reservoir during a fishing contest. In addition, 5 other people received medical treatment for lightning-related injuries. M26BO

7.30 **Marine Hail (M).** Hail 3/4 of an inch in diameter or larger, occurring over the waters and bays of the ocean, Great Lakes, Lake Okeechobee, Lake Pontchartrain and Lake Maurepas (those assigned specific Marine Forecast Zones), will be entered. Hail 3/4 of an inch in diameter or larger, occurring immediately along the shorelines (to a maximum distance of 1 mile inland) of the waters and bays of the ocean, Great Lakes, Lake Okeechobee, or Lake Pontchartrain and Lake Maurepas (those assigned specific Marine Forecast Zones), should be entered as a Marine Hail event, especially if the storm moved out over the near-shore waters (reasonable to assume it maintained its strength). Hail of smaller size, causing damage to watercraft or fixed platforms, should be entered. A maximum hail size will be entered.

The use of WSR-88D Doppler radar intensities (dBZ values) cannot be used to infer that a thunderstorm was sufficiently strong enough to produce hailstones meeting or exceeding the criteria listed in the previous paragraph.

Storm Data software permits only one event name for encoding severe and non-severe Marine Hail events. If hail diameters over water surfaces with an assigned marine zone number are equal to, or greater than, 3/4 of an inch, a Marine Hail event always will be encoded. It is recognized that a number of Marine Hail events will never be documented. Hail sizes equal to or greater than 3/4 of an inch will initiate the verification process for Marine Hail events.

If hailstones with diameters less than 3/4 of an inch result in fatalities, injuries, or damage, encoding a Marine Hail event is recommended. Encoded values of estimated or measured marine hail diameters below 3/4 of an inch (non-severe), regardless of extent and/or severity of fatalities, injuries, and property damage, will not initiate the verification process.

Refer to Table 6 in Section 7.19.1 in order to convert estimated hail sizes to measured values.

Beginning Time - When hail began.

Ending Time - When hail ended.

Direct Fatalities/Injuries
- ❏ Hail injured a boater.
- ❏ Wind-driven hail shredded the sail of a sailboat, causing the boat to overturn, drowning the boater.

Indirect Fatalities/Injuries
- ❏ A boater panicked in a hailstorm and ran into a breakwater.

Examples:

ANZ230 Boston Harbor MA
10 1530EST 0 0 Marine Hail (1.00)
1532EST
A boater reported quarter-size hail.

LEZ149 Conneaut OH to Ripley NY
18 1604EST 0 0 5K Marine Hail (0.50)
1608EST
One-half-inch diameter hail driven by 30 knot (35 mph) winds damaged two sailboats near Erie, PA.

7.31 **Marine High Wind (M).** Non-convective, sustained winds or frequent gusts of 48 knots (55 mph) or more, resulting in a fatality, injury, or damage, over the waters and bays of the ocean, Great Lakes, Lake Okeechobee, Lake Pontchartrain and Lake Maurepas (those assigned specific Marine Forecast Zones). These conditions would correspond to a “storm” situation (48 to 63 knots/55 to 73 mph), or a “hurricane-force” wind situation (64 knots or higher/74 mph or higher). A peak wind gust (estimated or measured) or maximum sustained wind value will be entered.

When these wind conditions are satisfied, a *Storm Data* event entry is required, and the preparer will indicate in the entry field whether the wind value represents a maximum sustained wind, or maximum wind gust, entered in knots. Depending on the choice, the software will place an S or G in front of the wind value that appears in the *Storm Data* publication. Additionally, the *Storm Data* software program requires the preparer to indicate whether the wind gust value, or sustained wind value, is measured or estimated. Refer to Sections 7.24 and 7.39 for related information.

Events with winds less than the above threshold numbers, resulting in fatalities, injuries, or property damage, will be encoded as a "Marine Strong Wind" event. Refer to Section 7.32, Marine Strong Wind, for more details.

The preparer can use high wind events occurring immediately along the shorelines (to a maximum distance of 1 mile inland) of the waters and bays of the ocean, Great Lakes, Lake Okeechobee, Lake Pontchartrain and Lake Maurepas (those assigned specific Marine Forecast Zones), to infer that a Marine High Wind event occurred over the near-shore waters (reasonable to assume its strength was maintained over water).

Note: Direct fatalities which are related to a marine vessel will be coded as BO (Boating), not IW (In Water).

Beginning Time - When Marine High Wind conditions were first met, which resulted in a fatality, injury, or damage.

Ending Time - When Marine High Wind conditions were no longer met, which had resulted in a fatality, injury, or damage.

Direct Fatalities/Injuries

- ❏ Fatalities or injuries caused by falling or airborne debris associated with structural failure of a marine vessel due to wind.
- ❏ Fatalities resulting from drowning due to an overturned, damaged, or destroyed marine vessel.
- ❏ Any fatalities or injuries from loss of electrical power, including lack of heat or cooling.

Indirect Fatalities/Injuries

- ❏ Fatalities or injuries when a marine vessel collided with debris on the water surface left over from a previous wind or storm event.
- ❏ Any fatalities or injuries incurred during the clean-up process.
- ❏ Fatalities or injuries associated with making contact with power lines after they fell.

Example:

LMZ643 Sheboygan to Pt Washington

9 E Oostburg	**04**	**1200CST** **2100CST**	**4**	**0**	**300K**	**Marine High Wind (MG61)**

Powerful southwest winds persisted for about 9 hours over central Lake Michigan. The winds capsized a luxury cruise boat east of Oostburg in the open waters. Four people drowned inside the boat as it flipped over due to estimated waves of 8 to 12 feet. The boat sustained major structural damage.
M57BO F50BO M65BO F66BO

7.32 **Marine Strong Wind (M).** Non-convective, sustained winds or frequent gusts up to 47 knots (54 mph), resulting in a fatality, injury, or damage. Wind speed values of 34 to 47 knots (39 to 54 mph) would correspond to a "gale" situation. A peak wind gust (estimated or measured) or maximum sustained wind value will be entered, in knots. Refer to Sections 7.38 and 7.39 for related information.

The preparer can use strong wind events occurring immediately along the shorelines (to a maximum distance of 1 mile inland) of the waters and bays of the ocean, Great Lakes, Lake Okeechobee, Lake Pontchartrain and Lake Maurepas (those assigned specific Marine Forecast Zones), to infer that a Marine Strong Wind event occurred over the near-shore waters (reasonable to assume its strength was maintained over water).

Note: Direct fatalities which are related to a marine vessel will be coded as BO (Boating), not IW (In Water).

Beginning Time - When Marine Strong Wind conditions were first met, which resulted in a fatality, injury, or damage.

Ending Time - When Marine Strong Wind conditions were no longer met, which had resulted in a fatality, injury, or damage.

Direct Fatalities/Injuries

- ❏ Fatalities or injuries caused by falling or airborne debris associated with structural failure of a marine vessel due to wind.
- ❏ Fatalities resulting from drowning due to an overturned, damaged, or destroyed marine vessel.
- ❏ Any fatalities or injuries from loss of electrical power, including lack of heat or cooling.

Indirect Fatalities/Injuries

- ❏ Fatalities or injuries when a marine vessel collided with debris on the water surface left over from a previous wind or storm event.
- ❏ Any fatalities or injuries incurred during the clean-up process.
- ❏ Fatalities or injuries associated with making contact with power lines after they fell.

Example:

LMZ665 Sheboygan to Pt Washington
3 E Oostburg 31 0600CST 1 1 10K Marine Strong Wind (EG40)
1800CST

Strong, gusty southwest winds persisted for about 12 hours over central Lake Michigan. The winds capsized a small boat east of Oostburg in the near-shore waters. One person drowned after he was thrown into the water, and one person was injured as the boat flipped over due to estimated waves of 5 to 8 feet. The boat sustained minor structural damage. M27BO

7.33 **<u>Marine Thunderstorm Wind (M)</u>.** Winds, associated with thunderstorms, occurring over the waters and bays of the ocean, Great Lakes, Lake Okeechobee, Lake Pontchartrain and Lake Maurepas (those assigned specific Marine Forecast Zones), with speeds of at least 34 knots (39 mph) for 2 hours or less, or winds of any speed that result in a fatality, injury, or damage to watercraft or fixed platforms. Similar thunderstorm winds occurring immediately along the shorelines (to a maximum distance of 1 mile inland) of the waters and bays of the ocean, Great Lakes, Lake Okeechobee, Lake Pontchartrain and Lake Maurepas (those assigned specific Marine Forecast Zones), should be entered as a Marine Thunderstorm Wind, especially if the storm then moved out over the near-shore waters (reasonable to assume it maintained its strength). Marine thunderstorm winds must occur within 45 minutes before or after lightning is observed or detected.

The use of WSR-88D Doppler radar intensities (dBZ values) cannot be used to infer that a thunderstorm was sufficiently strong enough to produce wind gusts meeting, or exceeding, the criteria listed in the previous paragraph.

Storm Data software permits only one event name for encoding severe and non-severe “Marine Thunderstorm Winds.” Maximum wind gusts (measured or estimated) equal to or greater than 34 knots (39 mph) always will be entered. Values less than 34 knots (39 mph) should be entered only if they result in fatalities, injuries, or property damage.

Note that damage alone does not automatically imply wind speeds of 34 knots (39 mph) or greater. When estimating a wind speed value, the preparer should take into account the amount and degree of severity, and condition of the damaged property. The resultant damage <u>must</u> support such a value. Refer to Table 9 in Section 7.39.4 for guidelines on estimating wind speeds. Estimated or measured wind gusts below 34 knots (39 mph), regardless of extent and/or severity of fatalities, injuries, and property damage, will not initiate the verification process. Wind values of 34 knots (39 mph) or more will initiate the verification process for Marine Thunderstorm Wind events.

Note: Direct fatalities which are related to a marine vessel will be coded as BO (Boating), not IW (In Water).

<u>Beginning Time</u> - When winds of 34 knots or greater first occurred or when a fatality, injury, or damage began.

<u>Ending Time</u> - When winds diminished to less than 34 knots or when reports of fatalities, injuries, or damage were no longer received.

<u>Direct Fatalities/Injuries</u>

- ❑ A wind gust, associated with a thunderstorm, overturned a canoe and the canoeist drowned.
- ❑ A jet-skier, jumping large waves created by thunderstorm winds, was killed when the craft flipped over.

- ❑ A thunderstorm-generated wave hit a boat broadside, and a boater lost his balance, fell overboard and drowned.

Indirect Fatalities/Injuries

- ❑ Thunderstorm winds uprooted a tree that fell in the water. An hour later, a water skier ran into the tree and was killed.

Examples:

ANZ531 Chesapeake Bay from Pooles Island to Sandy Point MD
10 1530EST 1 0 Marine Tstm Wind (EG25)
1532EST
A one-person catamaran sailing in Chesapeake Bay just offshore Sandy Point State Park capsized when an estimated wind gust of 25 knots (30 mph), generated by a thunderstorm, caught it broadside. The sailor drowned after hitting his head on the mast and being thrown into the water. M20BO

LMZ741 Wilmette Harbor to Meigs Field IL
18 1604CST 0 0 Marine Tstm Wind (MG42)
1606CST
A squall line moved through the Chicago area and off the lakefront. A peak gust to 42 knots (48 mph) was recorded at the Harrison Street Crib.

7.34 **Rip Current (Z).** A narrow channel of water that flows away from the beach, through the surf zone and dissipates beyond the breaking waves. Rip currents can develop along the waters and bays of the ocean, Great Lakes, Lake Okeechobee, Lake Pontchartrain and Lake Maurepas (those assigned specific Marine Forecast Zones), or any location that experiences breaking waves. They often form when the gradient wind is strong and directly onshore or when swells from a distant extra-tropical or tropical cyclone impinge on the coast. Rip currents will be listed in *Storm Data* only when they cause a drowning(s), near-drowning(s), result in numerous rescues (i.e., 5 or more at one beach community), or damage watercraft. Events associated with other surf-related currents, such as long-shore or tidal currents, will not be included in *Storm Data* as Rip Current events.

Also remember that rip currents are mistakenly blamed for other surf-related drownings. Follow-up information often proves that many of these drownings can be attributed to situations such as heart attacks, rough surf, lack of swimming ability, etc. As a result, every attempt should be made to confirm the cause of the drowning, or near-drowning. The best way to confirm what caused the event is to contact the local lifeguards, beach services or the law enforcement agency responsible for interviewing witnesses and filing the report.

Beginning Time - The time when a rip current drowning, near-drowning, or rescue incident began, or damage began.

Ending Time - The time that the rip current drowning, near-drowning, or rescue incident ended, or damage ended.

Direct Fatalities/Injuries

- ❑ A fatality due to a drowning from a rip current that was caused by wind or wave activity.
- ❑ A near-drowning due to a rip current that required medical treatment (either on-site or at a hospital) is considered an injury.

Indirect Fatalities/Injuries

- ❑ None

Examples:

FLZ072 **Coastal Waters from Deerfield Beach to Ocean Reef FL**
25 1400EST 1 1 Rip Current
1630EST
A 78-year old tourist swimming in the Atlantic behind his hotel near Fort Lauderdale drowned in a rip current. The beach patrol rescued four others, one of whom was transported to the hospital for medical treatment. M78IW

CAZ042 **Inner Waters from Pt. Mugu to San Mateo Pt CA**
05 0900PST 2 2 Rip Current
1600PST
A 25-year-old male and a 24-year-old female drowned in a rip current near a pier at Huntington Beach. Lifeguards made over two dozen rescues with two near-drowning as 10-foot swells from Hurricane Angelo swept north. M25IW, F24IW

7.35**.** **Seiche (Z).** A standing-wave oscillation in any enclosed lake which continues after a forcing mechanism has ceased and results in shoreline flooding and/or damage. In the Great Lakes and large inland lakes, large pressure differences, high winds, or fast-moving squall lines may act as the forcing mechanism. In addition, earthquakes or debris flows can initiate a seiche. When the forcing mechanism ends, the water sloshes back and forth from one end of the lake to the other, causing water level fluctuations of up to several feet before damping out.

Beginning Time - When water levels rose to initiate shoreline flooding, resulting in a fatality, injury or damage.

Ending Time - When water returned to pre-seiche levels.

Direct Fatalities/Injuries

- ❑ Persons near shore were swept away by the large wave and drowned.
- ❑ A boat was overturned by the large wave, drowning or injuring those on board.
- ❑ A structure was damaged or flooded by the wave, killing or injuring those inside.

Indirect Fatalities/Injuries

- ❑ Person died when cleaning up seiche-generated debris after the seiche ended.

- ❑ Person died from a building that collapsed from beach erosion after a seiche ended.

Example:

MIZ071 Van Buren
28 0300EST 0 0 500K Seiche
0315EST
An early-morning seiche of 3 feet, caused by a thunderstorm squall line that crossed Lake Michigan, caused damage in western Lower Michigan. The rising water damaged boats and docks at South Haven. At least $500,000 in damage occurred to piers and boats along the shoreline.

7.36 **Sleet (Z).** Sleet accumulations meeting or exceeding locally/regionally defined warning criteria (typical value is ½ inch or more). The *Storm Data* preparer should include in the narrative the times that sleet accumulation began, met criteria, and ended.

Beginning Time – When sleet was first observed to accumulate, or inferred to start accumulating from surrounding reports.

Criteria Time - When sleet accumulations equaled locally/regionally established warning threshold values, or as inferred by damage reports.

Ending Time - When sleet accumulation was observed to end, or inferred to end from surrounding reports.

Direct Fatalities/Injuries
- ❑ The weight of sleet on a roof or other structure causes it to collapse, killing someone. (Rare)

Indirect Fatalities/Injuries
- ❑ Any automobile-related accident due to sleet accumulation or poor driving conditions.
- ❑ Any fatality or injury related to someone falling or slipping on sleet.

Example:

WYZ015-062 Natrona - North Carbon
03 1200MST 0 0 65K Sleet
04 0200MST
Sleet began to accumulate around 1200MST on the 3rd . Accumulations eventually reached as much as 8 inches in the central foothills of Wyoming, causing extensive ice conditions and drifts of sleet, before ending around 0200MST on the 4th. Driving was hazardous at best with numerous accidents along Highway 54. The slippery road surface resulted in one accident involving

two trucks in which four people were injured (indirectly). The roof a Natrona business collapsed due to the weight of the sleet.

7.37 **Storm Surge/Tide (Z).** For coastal and lakeshore areas, the vertical rise above normal water level associated with a storm of tropical origin (e.g., hurricane, typhoon, or tropical storm) caused by any combination of strong, persistent onshore wind, high astronomical tide and low atmospheric pressure, resulting in damage, erosion, flooding, fatalities, or injuries. Coastal flooding not associated with a typhoon, hurricane, or tropical storm should be reported under the Coastal Flood category.

For coastal areas, normal water level is defined as mean sea level. Basically, storm tide is the sum of storm surge and astronomical tide. If the astronomical tide height for the flooded area is known, it should be subtracted from the total water level/storm tide (run-up/debris line), and the result specifically labeled in the event narrative as "storm surge." The method of measuring surge height should be mentioned in the narrative, e.g., "NWS survey team calculated a surge height of 4 feet by subtracting the astronomical tide height from the run-up/debris line height."

Coastal and lakeshore areas are defined as those portions of coastal land zones (coastal county/parish) adjacent to the waters and bays of the oceans, Great Lakes, Lake Okeechobee, and Lake Pontchartrain and Lake Maurepas. Farther inland, the *Storm Data* preparer must determine when and where to encode a flood event as Flash Flood or Flood. Terrain (elevation) features will determine how far inland the coastal/lakeshore flooding extends.

Beginning Time - When the water level began to cause damage or flooding.

Ending Time - When the water level dropped to a point where damage or flooding ended.

Direct Fatalities/Injuries

- ❑ A coastal dwelling was washed away injuring/killing the occupants.
- ❑ A person drowned when a vehicle was swept away by the storm tide.

Indirect Fatalities/Injuries

- ❑ A person suffered a heart attack while evacuating from a storm tide.
- ❑ A person died in a vehicle accident caused by the storm tide washing away a traffic signal.
- ❑ A person died in a vehicle accident after losing control in standing water on a road.

Example:

FLZ041-047- Volusia - Brevard - Indian River - St. Lucie - Martin
054-059-064 25 2200EST 0 0 8M Storm Surge/Tide
26 1600EST
The greatest storm tides occurred between Brevard and St. Lucie Counties, to the right of the land-falling eye-wall of Hurricane Jeanne. Initial estimates of storm tide ranged from 7 feet in Volusia County to around 11 feet in St Lucie County.

Storm surge heights for those areas ranged respectively from 6 to 10 feet, as determined by NWS survey teams that subtracted a 1 foot astronomical tide height from debris line heights. Damage would have been greater except that Jeanne came ashore during low tide. Hardest hit was the town of New Smyrna Beach where much of the sand east of the town's seawall was removed. About 100 ocean-front homes were damaged, as well as about 75 piers.

7.38 **Strong Wind (Z).** Non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph), resulting in a fatality, injury, or damage. Consistent with regional guidelines, mountain states may have higher criteria. A peak wind gust (estimated or measured) or maximum sustained wind will be entered.

Inland counties/parishes which experience strong winds/damage associated with tropical cyclones will be documented under the Tropical Depression or Tropical Storm category, as appropriate, not as a Strong Wind event.

Events over large inland lakes (with no specific, assigned Marine Forecast Zone number) that meet Strong Wind criteria will be entered as a Strong Wind event, rather than a Marine Strong Wind event.

Beginning Time - When the wind started to cause a fatality, injury, or significant damage.

Ending Time - When the wind no longer caused a fatality, injury, or significant damage.

Direct Fatalities/Injuries

- ❏ Fatalities or injuries caused by falling debris associated with structural failure (includes falling trees, utility poles, and power lines).
- ❏ Fatalities or injuries associated with vehicles that were blown over, or with vehicles that were blown into a structure or other vehicles.
- ❏ Fatalities or injuries caused by airborne objects striking people or vehicles.
- ❏ Drowning due to boats capsizing from wind on inland lakes without an assigned Marine Forecast Zone.
- ❏ Any fatalities or injuries from loss of electrical power, including lack of heat or cooling.

Indirect Fatalities/Injuries

- ❏ Fatalities or injuries when a vehicle collided with debris scattered on a roadway.
- ❏ Any fatalities or injuries incurred during the clean-up process.
- ❏ Fatalities or injuries associated with making contact with power lines after they fell.

Example:

TXZ252-253-255	**Starr - Hidalgo - Cameron**					
	22 1000CST 2100CST	**1**	**0**	**25K**	**Strong Wind (MG45)**	

Gusty winds to 45 knots (52 mph) occurred in the Rio Grande Valley of Deep South Texas. Power lines and store signs were downed in Rio Grande City, Mercedes, and Brownsville. The wind pushed a large store sign onto a passing car on US 281 in Brownsville, killing the driver. M27VE

7.39 **Thunderstorm Wind (C).** Winds, arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage. Maximum sustained winds or wind gusts (measured or estimated) equal to or greater than 50 knots (58 mph) will always be entered. Events with maximum sustained winds or wind gusts less than 50 knots (58 mph) should be entered as a *Storm Data* event only if they result in fatalities, injuries, or serious property damage. *Storm Data* software permits only one event name for encoding severe and non-severe thunderstorm winds. The *Storm Data* software program requires the preparer to indicate whether the sustained wind or wind gust value was measured or estimated.

Note: "Extreme" damage, produced by thunderstorm winds greater than 64 knots (74 mph), is equivalent to estimated winds in the EF0 category of the Enhanced Fujita damage scale. Therefore, partial roofs removed, windows broken, light trailer homes pushed over/overturned, automobiles pushed off the road would be considered extreme wind damage. Refer to Table 9 in Section 7.39.4 for guidance and to the EF-Scale information available at **http://www.spc.noaa.gov/efscale/**.

7.39.1 Downbursts. Downbursts, including dry, or wet, microbursts or macrobursts, will be classified as Thunderstorm Wind events. In some cases, the downburst may travel several miles away from the parent thunderstorm, or the parent thunderstorm may have dissipated. However, since the initiation of the downburst event was related to a thunderstorm, Thunderstorm Wind is the appropriate event to use.

7.39.2 Gustnadoes. A gustnado is a small, and usually weak whirlwind which forms as an eddy in thunderstorm outflows. They do not connect with any cloud-base rotation and are not tornadoes. Since their origin is associated with cumuliform clouds, gustnadoes will be classified as Thunderstorm Wind events.

7.39.3 Thunderstorm Wind Damage. Note that damage alone does not automatically imply wind speeds of 50 knots (58 mph) or greater. When estimating a wind speed value, the preparer should take into account the amount and degree of severity, and condition of the damaged property (age, type of construction technique used, exposure, topography, soil moisture/ composition, and local wind funneling effects due to orientation/closeness of other objects). The resultant damage must support such a value. Refer to Table 9 in Section 7.39.4 for guidelines on estimating wind speeds as well as the EF-Scale information available at

http://www.spc.noaa.gov/efscale/. Estimated or measured winds (sustained or gusts) below 50 knots (58 mph), regardless of extent and/or severity of fatalities, injuries, and property damage, will not initiate the verification process. Encoded wind values of 50 knots (58 mph) or more will initiate the verification process for Thunderstorm Wind events.

The *Storm Data* preparer must use professional judgment to determine the estimated maximum wind value based on observed structural or tree damage. For example, a rotted tree that is toppled by thunderstorm winds would not support an estimated wind gust of 50 knots (58 mph). On the other hand, numerous large trees, power lines, and road signs toppled by high winds would support an estimated gust value over 50 knots (58 mph).

The preparer should note in the *Storm Data* software program whether the thunderstorm wind (gust) was measured (MG), estimated (EG), measured sustained (MS), estimated sustained (ES), or unknown.

Beginning Time - When damage first occurred or winds 50 knots (58 mph) or greater were first reported.

Ending Time - When damage ended or winds of 50 knots (58 mph) were last reported.

Direct Fatalities/Injuries

- A thunderstorm wind gust snapped a large tree limb. The limb fell on a passing car, killing or injuring the driver.

Indirect Fatalities/Injuries

- A wind gust snapped a large tree limb which fell on the road. A few minutes later, a car drove into the tree limb and the driver was killed or injured.
- A wind gust downed numerous trees and limbs. The next morning, a person cleaning up the debris in his yard died or was injured from a chainsaw accident.
- A thunderstorm gust toppled a tree on a home's gas meter, causing an explosion. The resultant fire subsequently killed two people who were in the home.

Examples:

El Paso County
Colorado Spgs 23 1730MST 0 0 Thunderstorm Wind (MG70)
A small, dry-microburst struck the 5100 block of North Nevada Avenue in Colorado Springs. The downburst winds tore down power lines (but left the poles standing), ripped 40 square feet of roofing off a building, blew a pontoon boat 30 feet off its trailer, damaged billboards, and brought down tree limbs 6 to 8 inches in diameter.

DeKalb County
Malta 12 1505CST 0 0 15K 10K Thunderstorm Wind (EG65)
Thunderstorm winds estimated at 65 knots (75 mph) downed numerous large trees, ripped off several barn roofs, and blew over a fuel storage tank. Two

people were injured (indirectly related) when their vehicle struck a large tree on a road about 1 hour after the storm ended.

Langlade County
Antigo 10 1309CST 0 0 3K Thunderstorm Wind (MG45)
A wind gust from a thunderstorm blew a home-built aircraft onto its side, resulting in damage to the airplane.

Waukesha County
Genesee 15 1915CST 0 0 50K Thunderstorm Wind (EG50)
A gustnado along the leading edge of a downburst produced wind gusts estimated at nearly 60 mph, damaging a barn and farm house along Highway 59 near Genesee. Interaction between the downburst and outflow from another thunderstorm just south of the city of Waukesha generated the gustnado.

7.39.4 Table for Estimating Wind Speed from Damage.

Wind Speed	Observations
26-38 kts (30-44 mph)	Trees in motion. Light-weight loose objects (e.g., lawn furniture) tossed or toppled.
39-49 kts (45-57 mph)	Large trees bend; twigs, small limbs break, and a few larger dead or weak branches may break. Old/weak structures (e.g., sheds, barns) may sustain minor damage (roof, doors). Building partially under construction may be damaged. A few loose shingles removed from houses. Carports may be uplifted; minor cosmetic damage to mobile homes and pool lanai cages.
50-64 kts (58-74 mph)	Large limbs break; shallow rooted trees pushed over. Semi-trucks overturned. More significant damage to old/weak structures. Shingles, awnings removed from houses; damage to chimneys and antennas; mobile homes, carports incur minor structural damage; large billboard signs may be toppled.
65-77 kts (75-89 mph)	Widespread damage to trees with trees broken/uprooted. Mobile homes may incur more significant structural damage; be pushed off foundations or overturned. Roof may be partially peeled off industrial/commercial/ warehouse buildings. Some minor roof damage to homes. Weak structures (e.g., farm buildings, airplane hangars) may be severely damaged.
78+ kts (90+ mph)	Many large trees broken and uprooted. Mobile homes severely damaged; moderate roof damage to homes. Roofs partially peeled off homes and buildings. Moving automobiles pushed off dry roads. Barns, sheds demolished.

Table 9. Estimating Wind Speed from Damage.

Note: All references to trees are for trees with foliage. Appreciably higher winds may be required to cause similar damage to trees without foliage. In addition, very wet soil conditions may allow weaker winds of 26 to 49 knots (30 to 57 mph) to uproot trees. For additional information, please refer to Damage Indicators 27 and 28 in the EF-Scale information located at **http://www.spc.noaa.gov/efscale/**.

7.39.5 Knots-Mile Per Hour Conversion Tables. Tables 10 and 11 will assist in conversion of wind speed values between knots and miles per hour.

KTS	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	5	6	7	8	9	10
10	12	13	14	15	16	17	18	20	21	22
20	23	24	25	26	28	29	30	31	32	33
30	35	36	37	38	39	40	41	43	44	45
40	46	47	48	50	51	52	53	54	55	56
50	58	59	60	61	62	63	64	66	67	68
60	69	70	71	73	74	75	76	77	78	79
70	81	82	83	84	85	86	88	89	90	91
80	92	93	94	96	97	98	99	100	101	102
90	104	105	106	107	108	109	111	112	113	114

Table 10. Knots to miles per hour. (Example: 45 knots equals 52 mph)

MPH	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	3	4	5	6	7	8
10	9	10	10	11	12	13	14	15	16	16
20	17	18	19	20	21	22	23	23	24	25
30	26	27	28	29	30	30	31	32	33	34
40	35	36	36	37	38	39	40	41	42	43
50	43	44	45	46	47	48	49	49	50	51
60	52	53	54	55	56	56	57	58	59	60
70	61	62	63	63	64	65	66	67	68	69
80	70	70	71	72	73	74	75	76	76	77
90	78	79	80	81	82	82	83	84	85	86

Table 11. Miles per hour to knots. (Example...45 mph equals 39 knots)

7.39.6 Speed-Distance Conversion Table. On occasion, the *Storm Data* preparer may need to calculate beginning and ending times, time of arrival, or validity of storm report times, based on a known thunderstorm speed from radar. To assist in this task, use Table 12.

KTS/MPH	1 Mile in X Minutes	KTS/MPH	1 Mile in X Minutes
52/60	1 mile in 1.0 min	**26/30**	1 mile in 2.0 min
48/55	1 mile in 1.1 min	**22/25**	1 mile in 2.4 min
43/50	1 mile in 1.2 min	**17/20**	1 mile in 3.0 min
39/45	1 mile in 1.3 min	**13/15**	1 mile in 4.0 min
35/40	1 mile in 1.5 min	**9/10**	1 mile in 6.0 min
30/35	1 mile in 1.7 min	**4/5**	1 mile in 12.0 min

Table 12. Speed to Distance Conversion.

7.40 **Tornado (C).** A violently rotating column of air, extending to or from a cumuliform cloud or underneath a cumuliform cloud, to the ground, and often (but not always) visible as a condensation funnel. Literally, in order for a vortex to be classified as a tornado, it must be in contact with the ground and extend to/from the cloud base, and there should be some semblance of ground-based visual effects such as dust/dirt rotational markings/swirls, or structural or vegetative damage or disturbance.

The tornado path length will be entered in miles and tenths of a mile. The maximum tornado path width will be entered in yards. See Section 7.40.7 for details in determining path length (including beginning and ending points) and path width. Professional judgment must be exercised in determining the existence of separate tornadoes. Each and every case is a different situation.

An Enhanced Fujita Damage Scale value will be entered. Although it is not required, it is desirable to include the Damage Indicator (DI) and Degree of Damage (DOD) information in the event narrative that led to the EF Damage Scale value assigned to the tornado.

If possible to determine, it is very desirable to include in the event narrative the type of thunderstorm that was associated with the tornado, such as high-precipitation supercell, low precipitation supercell, non-supercell thunderstorm, line thunderstorm, bookend vortex, etc.

When discernable, wind damage from the rear-flank downdraft should not be considered part of the tornado path but should be entered as a Thunderstorm Wind event.

Gustnadoes will be reported as Thunderstorm Wind events. Refer to Section 7.39.2 for details.

Landspouts and cold-air funnels, ultimately meeting the objective tornado criteria listed in Section 7.40.6, will be classified as Tornado events.

7.40.1 Tornado, Funnel Cloud, and Waterspout Events. The terms Tornado, Funnel Cloud, and Waterspout are defined below:

a. Tornado. A violently rotating column of air extending from a cumuliform cloud or underneath a cumuliform cloud, to the ground, and often (but not always) visible as a condensation funnel. Literally, in order for a vortex to be classified as a tornado, it must be in contact with the ground and extend to/from the cloud base. On a local scale, it is the most destructive of all atmospheric phenomena;

b. Waterspout. A violently rotating column of air usually pendant to a cumulus/ cumulonimbus, over a body of water, with its circulation reaching the water; and

c. Funnel Cloud. A rotating visible extension of cloud pendant to a cumulus/ cumulonimbus with circulation not reaching the ground or water.

In some situations, many public and spotter reports of funnel clouds are passed on to a WFO. In these cases, the preparer should document only the most significant funnel clouds, especially those that generate public or media attention.

WFOs are responsible for identifying, investigating, and confirming storms occurring in their warning areas. To accomplish this, the *Storm Data* preparer should use all available severe weather reports, including information from newspapers, letters and photographs, airborne surveys and pilot reports, state/local emergency management, and personal inspections.

When available information includes a reliable report that a tornado vortex was distinctly visible (condensation funnel pendant from a cloud - usually a cumulonimbus), and in contact with the ground, or a rotating dust/dirt/debris column at the ground is overlaid with a condensation funnel pendant above, identification of a tornado is a simple matter. This is particularly true when reports have been investigated by the responsible NWS official and found to be reliable. However, tornadoes, funnel clouds, and waterspouts can be hidden by precipitation, low clouds, or dust. Darkness or lack of observers also may result in a tornado or waterspout not being observed. The WFO must exercise professional judgment to identify a tornado or waterspout from its effects.

7.40.2 Criteria for a Waterspout. A vortex in contact with the water surface that develops on, or moves over, the waters and bays of the oceans, Great Lakes, Lake Okeechobee, Lake Pontchartrain and Lake Maurepas (assigned Marine Forecast Zones) will be characterized as a Waterspout for that portion of its path over those water surfaces. The vortex will be classified as a Tornado for that portion of its path over land or inland bodies of water that are not assigned Marine Forecast Zones. Refer to Section 7.45 for additional waterspout details.

7.40.3 Tornadoes Crossing CWA Boundaries. Tornadoes crossing state lines or boundaries of WFO CWA responsibility will be coordinated between WFOs. The preparer will ensure that the exact location, where a tornado crosses a county, parish, or state line, is incorporated into the event narrative. Sharp-turning tornadoes may need to be segmented into individual pieces in order to adequately describe the path of that event. However, segmenting a tornado within the same county/parish is not allowed since this practice may lead to confusion and over-counting of tornadoes by the Storm Prediction Center, NCDC and *Storm Data* users. It is recommended that the preparer encode only one beginning and ending point for the tornado path within each county/parish affected, and provide detailed information in the event narrative about the intermediate locations where the tornado turned sharply. Additional instructional information regarding these “border-crossing” tornadoes can be found in the Tornado event examples in this Section.

7.40.4 Landspouts and Dust Devils. A landspout (slang-term for non-supercell tornado) will be classified as a Tornado, assuming the preparer has reliable reports meeting the criteria outlined in Section 7.40.6. Similarly, cold-air funnels, meeting the criteria outlined in Section 7.40.6, will be classified as a Tornado event.

On the other hand, dust devils will not be classified as tornadoes since they are ground-based whirlwinds that do not meet the tornado criteria outlined in Section 7.40.6. A Dust Devil is an allowable *Storm Data* event name as indicated in Section 7.10.

7.40.5 On-site Inspections (Surveys). WFO tornado/waterspout and extreme downburst damage surveys are desirable in those cases when the MIC or WCM believes additional information is needed for *Storm Data* preparation. A survey should be done as soon as possible before clean-up operations remove too much damage evidence.

If an event occurs where the damage is estimated to be **greater** than EF3, it is recommended through Directive 10-1606, section 3.1 that a Post-Data Acquisition (PSDA) Quick Response Team (QRT) be formed in addition to surveys and service assessment activities. Please refer to **http://www.nws.noaa.gov/directives/sym/pd01016006curr.pdf** for further details.

7.40.6 Objective Criteria for Tornadoes. An event will be characterized as a tornado if the type or intensity of the structural and vegetative damage and/or scarring of the ground could only have been tornadic, or if any two of the following guidelines are satisfied:

a. Fairly well-defined lateral boundaries of the damage path;

b. Evidence of cross-path wind component, e.g., trees lying 30 degrees or more to the left/right of the path axis (suggesting the presence of a circulation);

c. Evidence of suction vortices, ground striations, and extreme missiles; or

d. Evidence of surface wind convergence as suggested by debris-fall pattern and distribution. In fast-moving storms, the convergence pattern may not be present and debris pattern may appear to fall in the same direction.

Additionally, an event will be characterized as a tornado if:

a. Eyewitness reports from credible sources, even with little or no structural or vegetative damage, and/or little or no scarring of the ground, indicate that a violent circulation extended from the convective cloud base to the ground; or

b. Videotapes or photographs from credible sources, even with little or no structural or vegetative damage, and/or little or no scarring of the ground, indicate that a violent circulation extended from the convective cloud base to the ground.

There may be situations, especially in the central or western parts of the United States, where verification of tornadoes will be difficult. However, if available evidence establishes that it was highly likely a Tornado event occurred, the preparer will enter the event in *Storm Data*.

7.40.7 Determining Path Length and Width. Path length (in miles and tenths of miles) and maximum path width (in yards) will be indicated for all tornadoes, including each member of families of tornadoes, or for all segments of multi-segmented tornadoes. The length in the header-strip is the length of that particular segment in that particular county/parish. The Storm Prediction Center, NCDC or a *Storm Data* user can determine the entire length of a multi-segmented tornado by adding the lengths from each segment as well as using the latitude and longitude of that segment. Note that latitude and longitude are not available in the *Storm Data* publication, but are available on the internet in National Climatic Data Center and the Storm Prediction Center databases.

The tornado path length generally excludes sections without surface damage/disturbance, unless other evidence of the touchdown (e.g., a trained spotter report, videotape of the tornado over a plowed field, etc.) is available. The excluded section will generally not exceed 2 continuous miles or 4 consecutive minutes of travel time; otherwise, the path will be categorized as separate Tornado events. The beginning and ending locations of the excluded sections should be described as accurately as possible in the event narrative. In some cases, careful analysis and eyewitness descriptions will determine if separate tornadoes actually occurred within 2 miles or 4 minutes. Refer to Section 7.40.9 for related information. Use the event narrative to describe whether a tornado "skipped" or was continuous in these types of cases.

The width in the header-strip is the maximum observed through the entire length of a tornado, or of each segment in a multi-segment tornado. Generally, in the absence of structural damage, broken small tree branches of at least 3 inches in diameter can be considered as a marker for tornado width (assuming this damage isn't related to the rear flank downdraft). In arid regions where there is a lack of trees, other vegetation or landscape material will have to be used as a marker. To determine the tornado's maximum width, the Storm Prediction Center or *Storm Data* user must check each segment which is entered as a separate event.

The preparer is encouraged to include in the event narrative the average path width (in yards) of all tornadoes, especially for strong or violent tornadoes (EF2 damage or worse). Availability of average path width information in *Storm Data* benefits the scientific research community and other users.

7.40.8 Using the Enhanced Fujita (EF) Scale. Use of the EF-Scale is listed at **http://www.spc.noaa.gov/efscale/** and **http://www.wdtb.noaa.gov/courses/EF-scale/index.html**. EF-Scale values will be assigned to every documented tornado. The *Storm Data* preparer may refer to either internet documents and exercise professional judgment to determine the EF-Scale rating. These documents provide more examples and descriptions through the use of Damage Indicators and Degrees of Damage to evaluate tornado damage.

Eyewitness verbal accounts, newspaper or personal photographs, and videotapes of the tornado(s) may be relied upon when an inspection/survey is not possible. In cases where there is damage to numerous structures, damage to a single structure should not be used as the deciding factor for the appropriate EF-Scale rating. The surveyor should take into account the overall damage, evaluating tornado damage versus debris-caused damage and other extenuating circumstances. Experience has shown that the F-Scale of a tornado cannot be determined, consistently and reliably, solely on appearance, and this is assumed with the EF-Scale as well. Although there exist more documented examples of tornado damage, the assigned value may vary by +/- 1 in EF-Scale value.

When composing the event narrative of a tornado event, the description should be written remembering that it is a damage scale and the winds listed are estimated. Thus, a tornado does not necessarily "strengthen" as it moves into a city, housing development, subdivision or industrial area. If the tornado increases in speed or widens, then it may be assumed that the tornado physically is strengthening. Because the tornado moves into an area encountering more structures, creating more debris, does not necessarily indicate a strengthening of the tornado.

To assist the WFO, please refer to **http://www.spc.noaa.gov/efscale/** and **http://www.wdtb.noaa.gov/courses/EF-scale/index.html.** These tables and damage pictures correlate observed structural damage with types of construction and the resultant EF-Scale value.

7.40.9 Simultaneously Occurring Tornadoes. On occasions, especially over the Plains States, a single cumulonimbus may have several, separate, tornadoes occurring simultaneously. They may be separated by a distance as little as ½ to 1 mile; and each may have a distinct, separate trajectory. In these cases, the *Storm Data* preparer should classify the tornadoes as separate events, each with a unique start/end location/time combination. The preparer will have to rely on credible evidence such as eyewitness reports, videotapes, and damage along the path in order to determine how many tornadoes actually existed. Existing *Storm Data* indicates that "landspout" tornadic situations have resulted in several simultaneously occurring tornadoes.

If evidence suggests that a multiple-vortex tornado occurred, the *Storm Data* preparer will document this situation as a single tornado event, even though each vortex created a distinct damage path. The multiple vortices rotate around a common center—the tornado center. Conversely, separate tornadoes, even if they are closely spaced, will not rotate around a common center.

A brief, detailed explanation of simultaneously occurring tornadoes can be included in the narrative associated with each tornado event.

Beginning Time - When the sub-cloud vortex first contacted the ground.

Ending Time - When the sub-cloud vortex lost contact with the ground.

Direct Fatalities/Injuries

- ❏ Structures or trees were blown over and landed on someone, resulting in a fatality/injury.
- ❏ People became airborne and struck the ground or objects, resulting in a fatality/injury.
- ❏ High voltage power lines were blown onto a car, killing or injuring those inside.
- ❏ A high-profile vehicle was blown over, resulting in a fatality/injury.
- ❏ A vehicle was blown into a structure or oncoming traffic, resulting in a fatality/injury.
- ❏ Objects became airborne (debris, missiles), resulting in a fatality/injury.
- ❏ A boat on an inland lake or river was blown over or capsized, resulting in a drowning.

Indirect Fatalities/Injuries

- ❏ A person was killed or injured after running into a tree downed by the tornado.
- ❏ Someone was electrocuted by touching downed power lines.
- ❏ Someone suffered a heart attack and died as a result of removing debris.

7.40.10 Single-Segment (Non Border-crossing) Tornado Entries.

7.40.10.1 Example of a Tornado Within One County/Parish.

Page County									
Bingham to 2 NE Norwich	**22**	**1905CST 1917CST**	**6**	**75**	**0**	**0**	**5K**	**5K**	**Tornado (EF0)**

At 1905CST, a tornado spun up near Bingham, and moved east to Norwich before lifting off the ground 2 miles northeast of Norwich. Two homes in Bingham and one in Norwich sustained minor damage (DI 2, DOD 2). The tornado track was not continuous; there were two areas (both about one-half-mile long) east of Bingham where damage was not discernable. Average path width was 30 yards.

7.40.10.2 Example of a Tornado that Changed Direction Within One County/Parish. A tornado that affects only one county/parish should be entered as only one segment, even if the tornado changed direction within a county/parish. The end points should be entered in the header-strip and the complete description of the tornado's path, including any variation from a straight line, should be described in the event narrative.

Jackson County									
5 W Vernon to 5 NNE Vernon	**14**	**2308CST 2326CST**	**10**	**150**	**0**	**0**		**150K**	**Tornado (EF1)**

A tornado spun up 5 miles west of Vernon. The tornado moved east through the city of Vernon, and then veered left at the center of the city. It finally dissipated about 5 miles north-northeast of town. Trees and power lines were blown down and several barns were damaged. A business (DI 12, DOD 3) and a home were partially unroofed in Vernon. Based on damage, the tornado winds were around 83 knots (95 mph). Average path width was 75 yards.

7.40.10.3 Example of a Tornado over an Inland Body of Water (Without an Assigned Marine Forecast Zone).

Davis County									
7SW Layton	**01**	**1738MST 1741MST**	**1**	**30**	**0**	**0**			**Tornado (EF0)**

State Police spotted a tornado over Great Salt Lake. It dissipated before reaching shore.

7.40.10.4 Examples of a Tornado that Became a Waterspout (Body of Water with Assigned Marine Forecast Zone).

St. Louis County									
2E Arnold to French River	**28**	**1651CST 1655CST**	**4.4**	**60**	**0**	**0**			**Tornado (EF1)**

A tornado spun up 2 miles east of Arnold. A barn and an outbuilding were destroyed (DI 1, DOD 8) and trees were damaged. The tornado traveled until it reached the shore of Lake Superior at French River where it continued as a waterspout.

LSZ144

Two Harbors to Duluth MN	**28**	**1655CST 1657CST**	**0**	**0**		**Waterspout**

The St. Louis County tornado event reached the shores of Lake Superior. This waterspout lasted another 2 minutes before dissipating.

7.40.10.5 Examples of a Waterspout (Body of Water with Assigned Marine Forecast Zone) That Became a Tornado.

LMZ645

5NE Wind Pt to Wind Pt WI	**15**	**1700CST 1705CST**	**0**	**1**	**100K**	**Waterspout**

A waterspout developed northeast of Wind Point and moved slowly southwest. Three sailboats about 2 miles offshore were destroyed and one person was injured. The waterspout moved onshore at Wind Point and continued as a tornado in Racine County.

Racine County

Wind Pt to 3SW Wind Pt	**15**	**1705CST 1707CST**	**1**	**25**	**0**	**0**	**1M**	**Tornado (EF1)**

The waterspout that spun up 5 miles northeast of Wind Point moved onshore as a tornado at Wind Point, and dissipated about 3 miles inland. The tornado weakened but still managed to cause significant damage to two piers, a yacht club building, two small boats, and a dozen homes (DI 2, DOD 4). Estimated wind speeds of the tornado were about 87 knots (100 mph).

7.40.11 Segmented and Border-crossing Tornado Entries.

7.40.11.1 Examples of a County/Parish Line-crossing Tornado Within a CWA. Tornadoes that cross county/parish lines must be entered as segments with one segment per county/parish. *Storm Data* preparers must coordinate entries for tornadoes that cross state lines or CWAs. Consistency between *Storm Data* entries of border crossing tornadoes is needed to assure an accurate tornado path. Otherwise a single tornado may be misinterpreted as being two separate tornadoes. This can easily occur when external users, not familiar with *Storm Data* practices, use the National Climatic Data Center's (NCDC) Web site query feature. It is critical that all counties/parishes affected by a single tornado, and the exact location that a tornado exits or enters a county/parish, be mentioned in the event narrative that discusses that tornado. Do not segment a tornado within a county/parish (an entry for each portion of a tornado that appreciably changes directions). In the example below, the first line of the event narrative makes it clear that the tornado moved across a county/parish line, and indicates exactly where the tornado exited the first county/parish.

Coal County
4 SE Coalgate 11 0425CST 8 200 1 1 75K Tornado (EF2)
2.5 ENE Cairo 0434CST

This tornado formed 4 miles southeast of Coalgate and tracked northeastward for 8 miles before exiting Coal County about 2.5 miles east-northeast of Cairo at 0434CST. The tornado continued in Atoka County for another 5 miles, before dissipating at 0440CST. In Coal County, 1 fatality and injuries to another person occurred when a mobile home was thrown approximately 200 yards and disintegrated 4 miles east of Coalgate. In addition, a well-constructed frame home suffered severe roof damage and exterior wall damage in extreme eastern Coal County (DI 2, DOD 6). While in Coal County it was rated as EF2, but in Atoka County it was rated as EF0. Average path width in Coal County was 100 yards, while the maximum width was 200 yards. F62MH

Atoka County
1.5 NW Wardville 11 0434CST 5 100 0 0 6K Tornado (EF0)
to 5.5 SE Wardville 0440CST

This tornado formed 4 miles southeast of Coalgate in Coal County and entered Atoka County about 1.5 miles northwest of Wardville at 0434CST. The tornado then continued for another 5 miles before dissipating 5.5 miles southeast of Wardville at 0440CST. In Atoka County, minor roof damage was inflicted on a mobile home (DI 3, DOD 2), and numerous trees were damaged. While in Coal County, it was rated as EF2, but in Atoka County it was rated as EF0. Average path width in Coal County was 50 yards.

7.40.11.2 Example of a Triple-segmented, Two-County Tornado. In some cases, a tornado may spin up in County A, cut across the corner of County B, and re-enter and dissipate in County A. In these situations, three tornado events will be entered into the *Storm Data* software: the first event covers the first County A segment, the second event covers the County B segment, and the third event covers the second County A segment.

Columbia County
3 E Wis Dells to 06 1754CST 6.1 200 0 0 400K Tornado (EF1)
2 SE Lewiston 1813CST

The first segment of a multi-segmented tornado spun up near the intersection of Broadway Rd. and CTH Q east of Wisconsin Dells. It damaged 9 homes (DI 2, DOD 4) before it exited Columbia County on the Wisconsin River at 1813CST. This tornado then clipped the northeast corner of Sauk County (southeast of Lake Delton) and re-entered Columbia County at 1817CST. Average path width was 75 yards.

Sauk County
9 SE Lk Delton to 06 1813CST 1.6 100 0 0 1K Tornado (EF0)
10 SE Lk Delton 1817CST

This tornado segment is a continuation of a tornado that initially started 3 E of Wisconsin Dells at 1754CST on June 6th. It lightly damaged a home's siding (DI 2, DOD 2), and ripped up some trees. It entered Sauk County at the intersection of N Hein Rd and Levee Rd., and exited Sauk County into Columbia County where Levee Rd. enters Columbia County. Average path width was 50 yards.

Columbia County
7 W Portage to 06 1817CST 9.2 200 0 0 600K Tornado (EF1)
1 SW Dekorra 1840CST

This is the 3rd segment of a single tornado that initially started east of Wisconsin Dells at 1754CST, crossed into Sauk County at 1813CST, and re-entered Columbia County at 1817CST where Levee Rd. enters Columbia County from the west. Ten homes (DI 2, DOD 4) and a campground sustained damage. Five vehicles were lightly damaged by tree debris. This tornado segment ended southwest of Dekorra, just after crossing the Wisconsin River for the second time. Average path width was 100 yards.

7.40.11.3 Example of CWA Boundary-crossing Tornado. WFOs must coordinate the beginning and ending locations of tornadoes that move from one CWA into another. This will assure that all affected counties/parishes are mentioned. In the following example, both segments mention that the tornado crossed from one county into another one.

TEXAS, North
Cooke County
4 NW Gainesville 11 0255CST 2.6 150 0 0 30K Tornado (EF1)
to 6 N Gainesville 0258CST

A tornado touched down 4 miles northwest of Gainesville. It then moved into Love County, Oklahoma, 6 miles north of Gainesville (see *Storm Data* for Oklahoma, Western, Central and Southeast). In Cooke County, a mobile home (DI 3, DOD 5) and a storage pole barn were heavily damaged northwest of Gainesville. Average path width for the Texas portion was 75 yards.

OKLAHOMA, Western, Central, and Southeast
Love County
5 S Thackerville to 11 0258CST 5 100 0 0 100K 100K Tornado (EF1)
3 ESE Thackerville 0304CST

This tornado developed in Cooke County, Texas, about 4 miles northwest of Gainesville, and tracked northeastward before crossing the Red River into Love County in Oklahoma (see *Storm Data* for Texas, North, for more information on the beginning portion of this tornado in Texas) at 0258CST at a point 5 miles south of Thackerville. In Oklahoma, the most significant damage, rated EF1, occurred 3 miles southeast of Thackerville where a barn was destroyed (DI 1, DOD 8), and some soy bean crop was uprooted.

Nearby, a mobile home was severely damaged. Average path width for the Oklahoma portion was 50 yards.

7.40.12 The Enhanced Fujita Tornado Intensity Scale.

7.40.12.1 EF-Scale and Fujita Scale Wind Speed Table.

EF Scale Wind Speed Ranges Derived from F-Scale Wind Speed Ranges

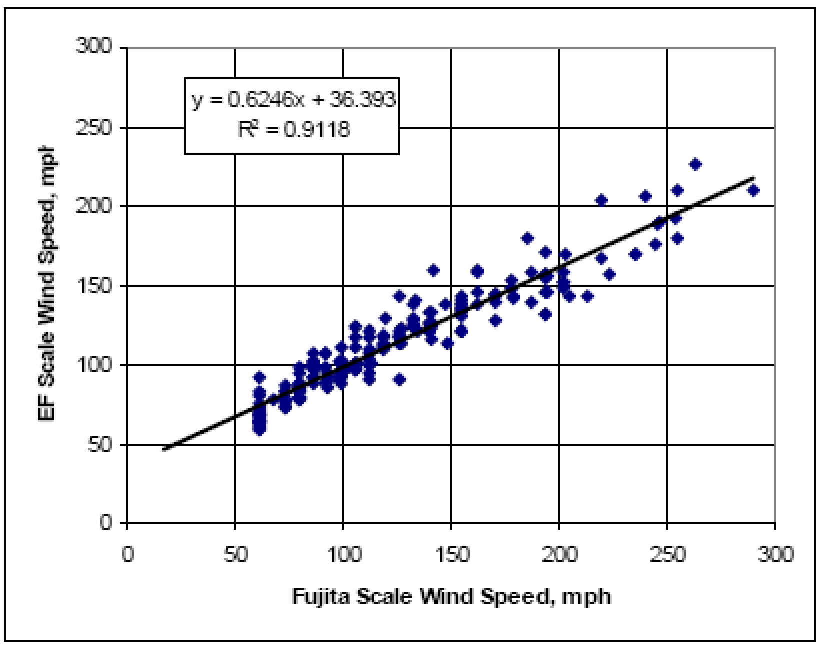
Fujita Scale			EF Scale	
Fujita Scale	Fastest 1/4/-mile Wind Speeds, mph	3-Second Gust Speed, mph	EF Scale	3-Second Gust Speed, mph
F0	40 - 72	45 - 78	EF0	65 - 85
F1	73 - 112	79 - 117	EF1	86 - 109
F2	113 - 157	118 -161	EF2	110 - 137
F3	158 - 207	162 - 209	EF3	138 - 167
F4	208 - 260	210 - 261	EF4	168 - 199
F5	261 - 318	262 - 317	EF5	200 - 234

Table 13. EF-Scale and Fujita Scale Wind Speed Table

The EF-Scale conversion from the F-Scale was derived using the following equation,

$$y = 0.6246x + 3.693$$

where y is the EF-Scale wind speed and x is the F-scale wind speed (in 3-sec gusts in mph). The correlation when plotted on a graph look like:



The above graph shows a close relationship between the EF-Scale (3-sec gust) and the F-Scale (1/4-mile gust).

7.40.12.2 Enhanced Fujita Tornado Intensity Scale Table.

Derived EF Scale		Recommended EF Scale
EF Classes	3-Second Gust Speed, mph	3-Second Gust Speed, mph
EF0	65 - 85	65 - 85
EF1	86 - 109	86 - 110
EF2	110 - 137	111 - 135
EF3	138 - 167	136 - 165
EF4	168 - 199	166 - 200
EF5	200 - 234	>200

Table 14. Enhanced Fujita Tornado Intensity Scale

7.41 **Tropical Depression (Z).** A tropical cyclone in which the 1-minute sustained wind speed is 33 knots (38 mph), or less. The tropical depression number will be included in the narrative section. The Tropical Depression should be included as an entry if its effects, such as gradient wind, freshwater flooding, and along the coast, storm tide, are experienced within the WFO's CWA, including its coastal waters. The center of the tropical depression may not actually move ashore. Terrain (elevation) features, in addition to the storm tide/run-up height, will determine how far inland the coastal flooding extends.

The tropical depression will usually include many individual hazards, such as storm surge, freshwater flooding, tornadoes, debris flows, rip currents, etc. Refer to Section 7.25 for additional information that may be applicable for tropical depressions, as well as their associated individual hazards. Wind damage that occurred inland as well as in coastal counties/parishes and islands affected by tropical depression winds will be entered as a Tropical Depression event.

Beginning Time - When the direct effects of the tropical depression were first experienced.

Ending Time - When the direct effects of the tropical depression were no longer experienced.

Direct Fatalities/Injuries
- ❑ Casualties caused by storm tide, high surf, freshwater flooding, or wind-driven debris.
- ❑ Wind caused a tree to blow onto someone.
- ❑ A person drowned while surfing in rough waters.
- ❑ Someone drowned when flood waters swept a vehicle into a river.

Indirect Fatalities/Injuries
- ❑ Someone suffered a heart attack while removing debris.

- ❑ Someone was electrocuted by touching downed power lines.
- ❑ Someone drowned when a vehicle was driven into a canal.

Example:

TXZ183 Val Verde
23 2200CST 0 0 Tropical Depression
1000CST
The remnants of Tropical Depression Two stalled over the Big Bend area and produced up to 18 inches of rain in Del Rio. Winds gusts of 35 knots (40 mph) and minimum sea-level pressure of 1015 mb were reported at Del Rio. The main effect of T.D. #2, flash flooding on San Felipe Creek, resulted in 9 fatalities (drowning), and 150 injuries. For a complete description of the flash flooding damage, refer to the Flash Flood event for September 23, 2006.

7.42 **Tropical Storm (Z).** A tropical cyclone in which the 1-minute sustained surface wind ranges from 34 to 63 knots (39 to 73 mph) inclusive. The tropical storm should be included as an entry when its effects, such as wind, storm tide, freshwater flooding, and tornadoes, are experienced in the WFO's CWA, including the coastal waters. Terrain (elevation) features, in addition to the storm tide/run-up height, will determine how far inland the coastal flooding extends.

The tropical storm will usually include many individual hazards, such as storm tide, freshwater flooding, tornadoes, debris flows, rip currents, etc. Refer to Section 7.25 for additional information that may be applicable for tropical storms, as well as their associated individual hazards. In the western North Pacific and American Samoa, the appropriate Tropical Storm Category (A or B) on the Saffir-Simpson Tropical Cyclone Scale will be annotated (refer to Section 7.25.2 for the Scale).

Note: Tropical Storm force winds can carry well inland and are not restricted to coastal counties and marine zones. Inland fatalities, injuries, and/or damage that were related to tropical storm winds will be entered into a Tropical Storm event, not in a Strong Wind or High Wind event.

If a hurricane produces only tropical storm force winds in a particular CWA, or in a portion of that CWA, the entry should be made under Tropical Storm. However, such entries must include a reference to the hurricane in the narrative section, e.g., "Hurricane Dennis produced tropical storm force winds in ...."

Beginning Time - When the direct effects of the tropical storm were first experienced.

Ending Time - When the direct effects of the tropical storm were no longer experienced.

Direct Fatalities/Injuries
- ❑ Casualties caused by storm surge, high surf, freshwater flooding, or wind-driven debris or structural collapse.
- ❑ Wind caused a tree to blow onto someone.

- ❑ Someone drowned while surfing in rough waters.
- ❑ Someone drowned when flood waters swept a vehicle into a river.

Indirect Fatalities/Injuries

- ❑ Someone suffered a heart attack while removing debris.
- ❑ Someone was electrocuted by touching downed power lines.
- ❑ Someone drowned when a vehicle was driven into a canal.
- ❑ Someone was killed in a vehicle accident caused by a tropical storm-related missing traffic signal.

Example:

FLZ007>019-026>028 Inland Walton - Coastal Walton - Holmes - Washington - Jackson - Bay - Calhoun - Gulf - Franklin - Gadsden - Leon - Jefferson - Madison - Liberty - Taylor - Wakulla

21 1800EST 0 0 1M 100K Tropical Storm
23 0000EST

Tropical Storm Helene made landfall near Fort Walton Beach during the late morning hours of September 22. Storm total rainfall ranged from a half inch at Perry to 9.56 inches at Apalachicola. The highest sustained wind of 39 knots (45 mph) with a peak gust of 56 knots (65 mph) was recorded at Cape San Blas. The lowest sea-level pressure was 1011 mb at Panama City. Coastal storm tides of 2 feet or less above astronomical tide levels were common, with only minor beach erosion reported. Near the coast, as well as inland, many properties, homes, and businesses sustained wind damage. No fatalities or injuries were attributed to the winds. All of the associated effects of Helene resulted in 4 fatalities, 13 injuries, $3.0M in property damage, and around $1.0M in crop damage. Specifically, Helene's flood waters in the Florida Panhandle resulted in 2 fatalities, 3 injuries, $1.0M in property damage, and $750K in crop damage. The nine associated tornadoes resulted in 2 fatalities, 10 injuries, $1M in property damage, and $150K in crop damage. The powerful winds caused $1M in property damage and $100K in crop damage. The storm surge along the coast resulted in $500K in property damage.

7.43 **Tsunami (Z).** A series of very long waves generated by any rapid, large-scale disturbance of the sea (e.g., an underwater earthquake, landslide, or volcanic eruption) resulting in a fatality, injury or damage. When the wave reaches the coast, a tsunami may appear as a rapidly rising or falling tide, a series of breaking waves, or even a bore. The event narrative should include the source of the tsunami (e.g., 8.5 magnitude earthquake near the western coast of Chile), the height and time of the maximum wave, and the inland distance of inundation. Any other characteristics, such as the observation of water draining from bays should be included.

Beginning Time - When the water level first began to change rapidly.

Ending Time - When the water level returned to near normal.

Direct Fatalities/Injuries

- ❏ A coastal dwelling was washed away injuring or killing the occupants.
- ❏ A person drowned when a vehicle was swept away.

Indirect Fatalities/Injuries

- ❏ A person suffered a heart attack while evacuating.
- ❏ After the tsunami, a person died when the house he returned to collapsed.

Example:

HIZ008 South Hawaii including Kauna Point
07 0600HST 0 0 5M Tsunami
1000HST

A tsunami wave affected coastal sections of the south and east shores of the Big Island of Hawaii from Hilo Harbor to Kauna Point. The tsunami resulted from an 8.3 earthquake that occurred off the coast of Chile. Tide gauges located on buoys 150 miles SE of the Big Island of Hawaii reported a 2-inch rise as the tsunami passed. A 20-foot wave at Punaluu Harbor was the highest of three waves that occurred over a 2-hour and 20-minute period. The wave went inland as far as ½ mile. The height of the waves ranged from 5 feet at Hilo Harbor on the east coast to 20 feet at Punaluu Harbor on the southeast coast to 3 feet near Kauna Point on the southwest coast. There were no deaths or injuries, but several marinas were heavily damaged and coastal roads were flooded. These damages amounted to $5.0 million.

7.44 **Volcanic Ash (Z).** Fine particles of mineral matter from a volcanic eruption which can be dispersed long distances by winds aloft, resulting in fatalities, injuries, damage, or a disruption of transportation and/or commerce.

Beginning Time - When volcanic ash began to cause disruption to transportation, commerce, fatality, injury, or damage.

Ending Time - When volcanic ash stopped falling.

Direct Fatalities/Injuries

- ❏ People who were asphyxiated due to high ash content in the air. (Rare)
- ❏ People who were involved in aircraft accidents due to ash being ingested into the engines.

Indirect Fatalities/Injuries

- ❏ Vehicular accidents caused by reduced visibility and slippery roads due to volcanic ash fall, or due to falls while walking through volcanic ash.

Example:

WAZ040 **Southern Cascade Foothills**
10 1800PST 0 0 Volcanic Ash
2100PST

A minor eruption of Mt. St. Helens caused ash to rise about 10,000 feet into the atmosphere. The ash drifted to the southwest and fell in the southern Cascade foothills. State Highway 503 became slippery when it was covered with ash, which caused a head-on collision of two vehicles. One person was killed (indirect fatality) and the other seriously injured (indirect injury).

7.45 **Waterspout (M).** A rotating column of air, pendant from a convective cloud, with its circulation extending from cloud base to the water surface of an area assigned as a Marine Forecast Zone, including bays, the Great Lakes, Lake Okeechobee, Lake Pontchartrain and Lake Maurepas. A condensation funnel may or may not be visible in the vortex.

A vortex that moves over both water and land will be characterized as a Waterspout for that portion of its path over the water surface of an assigned Marine Forecast Zone, and a Tornado for its path over the land. A vortex over any water surface not designated as an official marine zone will be entered as a Tornado.

Note: Direct fatalities which are related to a marine vessel will be coded as BO (Boating), not IW (In Water).

Beginning Time - When a waterspout was first reported to exist.

Ending Time - When a waterspout was last reported to exist.

Direct Fatalities/Injuries

- ❏ A waterspout capsized a small boat, drowning the occupant.
- ❏ A waterspout blew a vehicle off a bridge and the driver drowned.

Indirect Fatalities/Injuries

- ❏ A boater fleeing a waterspout crashed into a breakwater.
- ❏ A boater suffered a heart attack after sighting a waterspout.

Examples:

LMZ654
2 E Port Washington 18 1835CST 0 0 Waterspout

A brief waterspout was spotted over Lake Michigan a couple miles offshore of Port Washington. The distance was estimated.

GMZ053

Craig Key to West end of 7 Mile Bridge FL	**10**	**1200EST 1206EST**			**0**	**2**	**50K**		**Waterspout**

A large waterspout from the Florida Straits moved across a marina at Marathon damaging three sailboats and injuring two people.

7.45.1 <u>Example of a Tornado That Became a Waterspout (Body of Water with Assigned Marine Forecast Zone)</u>.

St. Louis County

2 E Arnold to 1 S French River	**28**	**1651CST 1655CST**	**4.4**	**60**	**0**	**0**	**100K**		**Tornado (EF1)**

A tornado touched down north of Duluth. A barn and an outbuilding were destroyed (DI 1, DOD 8) and trees were damaged. The tornado reached the shore of Lake Superior just south of French River, and then curved northeast as a waterspout moving toward Two Harbors.

LSZ144

1 S French River to Two Harbors	**28**	**1655CST 1705CST**			**0**	**0**			**Waterspout**

This waterspout initially began as a tornado in St. Louis County near Arnold. It crossed over the Lake Superior shoreline just south of the village of French River, and then curved northeast toward Two Harbors. No marine-related damage was noted.

7.45.2 <u>Example of a Waterspout (Body of Water with Assigned Marine Forecast Zone) That Became a Tornado</u>.

Lake County

.5 S Two Harbors to 2N Two Harbors	**28**	**1705CST 1707CST**	**2.5**	**25**	**0**	**0**	**250K**	**Tornado (EF1)**

A waterspout on Lake Superior moved onshore as a tornado just south of Two Harbors. The tornado continued on the ground for about 2.5 miles before dissipating. A small building was destroyed (DI 1, DOD 8) and a cottage damaged near where the tornado came onshore. The tornado damaged four more homes and downed around three dozen trees before finally dissipating. The damage path was no more than 25 yards in width.

7.46 **<u>Wildfire (Z)</u>.** Any significant forest fire, grassland fire, rangeland fire, or wildland-urban interface fire which consumes the natural fuels and spreads in response to its environment. Significant here is defined as a wildfire that causes one or more fatalities, one or more injuries, and/or property damage (including equipment damaged in fighting the fire). Professional judgment is used in deciding to include a Wildfire in *Storm Data*. In general, forest fires smaller than 100 acres, grassland or rangeland fires smaller than 300 acres, and wildland use fires not actively managed as wildfires should not be included. This is consistent with the definitions for significant and/or large fires utilized by most land use agencies.

Beginning Time - When a forest fire, grassland fire, rangeland fire, or wildland-urban interface fire became out of control.

Ending Time - When a wildfire became under control.

Direct Fatalities/Injuries

- ❑ A wildfire swept through a campground. Two campers died when their RV was consumed by fire.
- ❑ A man drove into an evacuated area to try to save belongings from a cabin that was threatened by a wildfire. The man died when fire burned the cabin to the ground.
- ❑ People who were asphyxiated due to smoke inhalation.

Indirect Fatalities/Injuries

- ❑ All vehicular accidents caused by reduced visibility due to smoke.

Example:

MTZ005-006 Missoula/Bitterroot Valleys-Bitterroot
06 1500MST 0 0 8M Wildfire
31 1500MST
Dry lightning and strong winds started fires which spread into urban areas of the southern part of the county. Structural damage from fires occurred from August 6-8, but fires raged to the end of the month with a total of 335,356 acres burned. Sixty-four residences and cabins were destroyed, and five were partially destroyed. A total of 164 outbuildings and 87 vehicles were destroyed.

7.47 **Winter Storm (Z).** A winter weather event which has more than one significant hazard (i.e., heavy snow and blowing snow; snow and ice; snow and sleet; sleet and ice; or snow, sleet and ice) and meets or exceeds locally/regionally defined 12 and/or 24 hour warning criteria for at least one of the precipitation elements, on a widespread or localized basis. Normally, a winter storm would pose a threat to life or property.

In cases of winter storms, the preparer should be careful to classify the event properly *in Storm Data*. In general, the event should be classified as a Winter Storm event (rather than an Ice Storm event or a Heavy Snow event) only if more than one winter precipitation type presented a significant hazard.

Some Winter Storm and Blizzard events may have had sustained or maximum wind gusts that met or exceeded High Wind criteria. Rather than document an additional High Wind event, the *Storm Data* preparer should just mention the time, location, and wind value in the Winter Storm or Blizzard event narrative. This is permissible even if only light snow and minor blowing snow (no serious reduction in visibility below 3 miles) occurred with the high winds, as long as the

High Wind report is deemed reliable, and was generated by the same synoptic storm system that resulted in the Winter Storm or Blizzard event. Normally, this scenario would be most likely in the mountains in the western United States.

Beginning Time – The time when accumulating precipitation (measurable) began.

Criteria Time - The time when the winter storm first met or exceeded locally or regionally defined warning criteria.

Ending Time - The time when precipitation stopped accumulating.

Direct Fatalities/Injuries

- ❑ The weight of snow and ice caused a machine shed roof to collapse, killing a farmer.

Indirect Fatalities/Injuries

- ❑ All vehicle-related fatalities or injuries due to poor visibility and/or slippery roads.

Example:

WVZ033>035-042>044	**McDowell - Mercer - Monroe - Raleigh - Summers – Wyoming**			**Winter Storm**
	01 1500MST	**0**	**0**	
	02 1800MST			
	The New Year started off with a major winter storm. A combination of snow, sleet, and freezing rain began around 1400MST, started to accumulate about 1500MST, and eventually left about 10 inches of frozen precipitation on the ground across the area. Transportation came to a stop for much of the holiday weekend.			

7.48 **Winter Weather (Z).** A winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation but does not meet locally/regionally defined warning criteria. A Winter Weather event could result from one or more winter precipitation types (snow, or blowing/drifting snow, or freezing rain/drizzle), on a widespread or localized basis

Note that, in *Storm Data*, Blizzard events should cover a time period of 3 hours or more. Therefore, if blizzard-like conditions occur for less than 3 hours, the event should be entered as a Winter Storm, Heavy Snow, or Winter Weather, noting in the event narrative that near-blizzard or blizzard-like conditions were observed at the height of the event.

The *Storm Data* preparer must use judgment in determining whether the impact of a winter weather event is significant enough to enter into *Storm Data*.

Beginning Time –Time when winter weather precipitation started to accumulate or phenomena, such as blowing snow, began.

Ending Time – Time when the winter weather precipitation stopped accumulating or phenomena ended.

Direct Fatalities/Injuries

- ❑ A vehicle accident where the driver suddenly encountered an intense snow squall, heavy freezing rain or sleet that was unavoidable. (Rare)

Indirect Fatalities/Injuries

- ❑ Almost all vehicle-related fatalities/injuries due to snow or ice covered roads, hazardous driving conditions, and visibility restrictions.
- ❑ Any vehicle accident involving a snow plow.

Examples:

MAZ001>004 Berkshire - Western Franklin - Eastern Franklin - Northern Worcester Winter Weather
06 0500EST 0 0
1900EST
A period of freezing drizzle and freezing rain led to a thin layer of ice or glaze over northwest Massachusetts. There were numerous car accidents with minor injuries (indirect) due to the icy conditions, especially along Highways 2 and 202.

SCZ047>049 Jasper - Beaufort - Southern Colleton Winter Weather
01 1800EST 0 0
2200EST
A mixture of freezing rain, sleet, and snow brought hazardous travel conditions to sections of southern South Carolina. Although the accumulation of ice was small, (less than 1/8 inch), the combination of elements led to accidents, especially along Interstate 95.

NDZ014-015 Benson – Ramsey Winter Weather
12 2200CST 0 0
13 0300CST
Strong winds and fresh snow caused blowing snow to lower visibilities to 1/4 to ½ mile at times overnight. Several cars were stranded along County Road 5 in Benson County.

KYZ004-005 Ballard - McCracken Winter Weather
16 1300CST 0 0
2200CST
Slippery driving conditions caused by an extended period of sleet led to numerous car accidents across extreme western Kentucky. The worst conditions were around Paducah where slick streets led to multi-car accidents and the closing of some highways around town.

PAZ001-002 Northern Erie - Southern Erie

25 1400EST 0 0 Winter Weather
2000EST

Slippery roads caused by 4 to 5 inches of snow led to numerous accidents and minor injuries (indirect) across Erie County in northwest Pennsylvania. Two school buses collided on a snow-covered hill just east of Fairfield, but no one was seriously injured.

APPENDIX A - Glossary of Terms

County Warning Area (CWA) - The geographical area of responsibility assigned to a WFO for providing warnings, forecasts, and other weather information.

Enhanced Fujita-Scale - A 0 to 5 rating based on a tornado's intensity, directly related to observed damage. Since structural design determines damage, probable wind speeds are associated with each EF-Scale number. There are 28 Damage Indicators (DI), each with varying numbers of Degree of Damage (DOD) that are utilized in determining each EF-rating.

Header-strip - Bold-faced lines of text and numbers at the beginning of each *Storm Data* entry, providing specific information on the time and character of the weather event. This includes location, beginning and ending times, deaths, injuries, property damage, and type of event. In some cases, it also includes the Universal Generic Code and the magnitude of the event, i.e., hail size and tornado EF-Scale.

Saffir/Simpson Hurricane Scale - A 1 to 5 rating based on a hurricane's intensity. This scale designates sustained wind speeds and estimates potential property damage. It sometimes provides estimated associated storm surge.

Saffir/Simpson Tropical Cyclone Scale - A rating scale based on the intensity of a tropical cyclone. This scale has two tropical storm categories and 5 typhoon/cyclone categories, and is used in the western Pacific and other tropical areas. The scale designates sustained wind speeds and corresponding wind gusts, estimated storm surge, and potential property damage.

Storm Data - NOAA's official publication which documents the occurrence of storms and other significant natural hazards having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce.

***Storm Data* software** - The on-line software program that documents specifics and narratives of significant or unusual weather events. Data is transferred from WFOs to the Performance Branch in OCWWS for use in the NWS verification program and to the NCDC for publication of *Storm Data*.

APPENDIX B – Property Damage Estimates

Trees	
Large tree limbs downed	0.20K – 0.80K
Tree destroyed	0.50K – 1.50K
Tree on house .. no house damage	1.50K – 3.50K
Tree on house .. house damage	3.00K - 7.50K
Power Lines/Poles	
Power lines downed	0.75K – 2.00K
Small transformer	1.00K – 3.00K
Regular size power pole cost	0.30K – 1.00K
Large power pole cost	0.75K – 1.50K
Labor cost for pole replacement	5-10 times cost of pole
Large transmission pole destroyed	40.0K – 80.0K
Roofs	
Minor roof damage repair	2.00K – 5.00K
Major roof damage (truss/roof replace)	15.0K – 30.0K
Damaged gutters/downspouts	0.10K – 0.30K
Replace brick chimney	0.20K per foot
Buildings	
Awning damaged	0.25K – 1.00K
Window broken	0.20K – 1.00K
Covered porch destroyed	5.00K – 15.0K
Replace siding, one side average house	2.00K – 5.00K
One-car garage destroyed	6.00K – 15.0K
Two-car garage destroyed	15.0K – 30.0K
House destroyed	Value of house, belongings
Mobile home destroyed	25.0K – 50.0K
Small shed destroyed	0.50K – 1.50K
Small pole barn destroyed	10.0K – 30.0K
Large pole barn destroyed	25.0K – 75.0K
House basement flooded (minor)	1.00K – 10.0K
House basement flooded (major)	10.0K – 25.0K
Electrical damage from lightning	2.50K – 7.50K

Vehicles	
Vehicle windshield replace	0.25K – 1.00K
Hail damage to vehicle	1.00K – 15.0K
Minor car damage, hail-debris	1.00K – 3.00K
Major car damage, hail-debris	2.50K – 15.0K
Car destroyed (flooding or otherwise)	Car value
Semi-trailer overturned	7.50K – 15.0K
Agriculture	
Crop damage	[Crop value/acre]x [#acres]
Small grain bin destroyed	7.50K – 30.0K
Large grain bin destroyed	20.0K – 50.0K
Cow killed	1.50K – 3.00K
Center pivot irrigation system destroyed	25.0K – 50.0K
Miscellaneous	
County road culvert washed out	2.50K – 50.0K
County bridge washed out	25.0K – 75.0K
State-federal bridge washed out	250K – 750K