25-SDP
(Released August 2024)

UNITED STATES DEPARTMENT OF AGRICULTURE
Federal Crop Insurance Corporation
SHELLFISH DATA PROVISIONS (SDP)
2025 AND SUCCEEDING CROP YEARS

1. Applicability – These Shellfish Data Provisions (SDP) establish the methodology for determining the county loss trigger under the Shellfish Commodity Provisions. The county loss trigger is activated when an insurable cause of loss listed in the Shellfish Commodity Provisions and SDP occurs in the county during the insurance period, as determined by each applicable methodology.
2. Counties – Counties referenced in this document are based on shapefile boundaries provided by the US Census Bureau at https://www.census.gov/cgi-bin/geo/shapefiles/index.php, or a successor website. The most recent shapefile available at the contract change date will be used to determine counties in which a county loss trigger occurs. Census county boundaries may be modified by the Special Provisions (SP).
3. Data Sources
   (a) United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)
      (i) National Hurricane Center (NHC)
      (ii) Center for Operational Oceanographic Products and Services (CO-OPS) at https://opendap.co-ops.nos.noaa.gov/axis/webservices/waterlevelverifiedhourly/index.jsp
      (iii) Climate Prediction Center (CPC)
      (iv) National Centers for Environmental Information (NCEI) at https://ftp.cpc.ncep.noaa.gov/precip/PEOPLE/wd52ws/global_temp/
   (b) Iowa State University, Aviation Weather Center METAR at: IEM: Download ASOS/AWOS/METAR Data (iastate.edu)
4. Causes of Loss
   (a) Named Storm – A named storm refers to a storm system that has been identified as a hurricane or nor'easter. Hurricanes are identified by NOAA NHC and named in accordance with the protocol provided by the World Meteorological Organization (WMO). Nor'easter storms are identified based on the associated weather metrics described in subsequent sections.
      (i) Hurricane – The data used for determining if a hurricane intersects a county is the International Best Track Archive for Climate Stewardship (IBTrACS) dataset from the National Climatic Data Center within the National Hurricane Center operated by NOAA (https://www.ncei.noaa.gov/products/international-best-track-archive). The table below shows the variables used to develop the wind extents and determine the trigger counties. The 64-knot wind speeds are associated with a hurricane event.

Variable	Column Name	Units
Season	SEASON	Year
Name	NAME	N/A
Time	ISO_TIME	UTC (YYYY-MM-DD HH:MM:SS)
Latitude	USA_LAT	Degrees North
Longitude	USA_LON	Degrees East
Maximum Sustained Winds	USA_WIND	Knots
Hurricane Category	USA_SSHS	Saffir-Simpson Wind Scale
Wind Extents Northeast	USA_R64_NE	Nautical Miles
Wind Extents Southeast	USA_R64_SE	Nautical Miles
Wind Extents Southwest	USA_R64_SW	Nautical Miles
Wind Extents Northwest	USA_R64_NW	Nautical Miles

IBTrACS generally records new values for these variables in three-hour intervals. RMA will use all available data from NOAA. If data is missing, RMA will coordinate with NOAA to fill in the missing data. If NOAA is unable to provide the missing data, the missing data will be interpolated, averaged, or projected using the best available data from NOAA as determined by RMA. Data is missing if none of the fields are available. For example, if one quadrant is missing from the wind extents, it is not considered to be missing if at least one other wind extent is available.

The county boundary shapefile (refer to 2. Counties above) is used to determine if the cyclone corridor intersects the county boundary. Adjacent counties are determined using the county adjacency file from the U.S. Census Bureau. Due to the timing of the contract change dates, the shapefile and county adjacency file used will have a two-year lag behind the reinsurance year. Census county boundaries and adjacent counties may be modified by Special Provisions of Insurance.

The wind corridor is used to determine which counties the storm intersects. The wind corridor is constructed from convex hulls of the wind buffer radii (USA_R64_NE, USA_R64_SE, USA_R64_SW, USA_R64_NW) which are centered around the storm center points.

IBTrACS uses World Geodetic System 1984 longitude and latitude coordinates which locate the center of the cyclone. When wind speeds reach or exceed 64 knots (USA_WIND >= 64), the storm center point is a hurricane center point. In addition, RMA will calculate a hurricane center point between the last tropical storm center point and the first hurricane center point (i.e., when a tropical storm strengthens to a hurricane) and another hurricane center point between the last hurricane center point and the first tropical storm center point (i.e., when a hurricane weakens to a tropical storm). A tropical storm center point by itself does not constitute a hurricane center point for determining a county trigger.

The maximum of the 64-knot wind radii extents is used to determine a buffer around the cyclone. The wind radii extents describe the maximum distance at which the given wind speed existed in the four quadrants (northeast, northwest, southwest, southeast). The maximum over the quadrants is used for the buffer.

Hurricane Buffer = Max(USA_R64_NE, USA_R64_SE, USA_R64_SW, USA_R64_NW)

Example:
Suppose the maximum distance of the hurricane wind extents from the storm center point is 35 nautical miles (nm) for the northeast quadrant, 25 nm for the southeast quadrant, 10 nm for the southwest quadrant, and 30 nm for the northwest quadrant. In this case, the maximum distance of the hurricane wind extents from the storm center is 35 nm (northwest quadrant). The hurricane buffer is then a 35 nm radius circle around the storm center point.

A hurricane ceases to exist at some point between where the last hurricane center point is measured and when the first tropical storm center point is measured. The maximum sustained winds (USA_WIND) value is used to calculate where the estimated hurricane center point and wind extents are measured. The term transitional cyclone centerpoint is used when transitioning between hurricanes, tropical storms and tropical depressions.

The estimated cyclone center point and buffer are calculated based on the last cyclone center point (USA_LAT and USA_LON) and maximum sustained wind speeds (USA_WIND_{hurr}) and the transitional cyclone center point (USA_LAT and USA_LON) and maximum sustain wind speeds (USA_WIND_{ts}). The following examples are when a hurricane transitions to a tropical storm.

$$\text{Distance} = Distance_{full} * \frac{USA\_WIND_{hurr} - 64}{USA\_WIND_{hurr} - USA\_WIND_{ts}}$$

The estimated buffer is calculated using the last hurricane buffer ($HurricaneBuffer_{last}$) and the following formula:

$$\text{Buffer} = Max\left(\frac{HurricaneBuffer_{last}}{2}, HurricaneBuffer_{last} * \left(1 - \frac{USA\_WIND_{hurr} - 64}{USA\_WIND_{hurr} - USA\_WIND_{ts}}\right)\right)$$

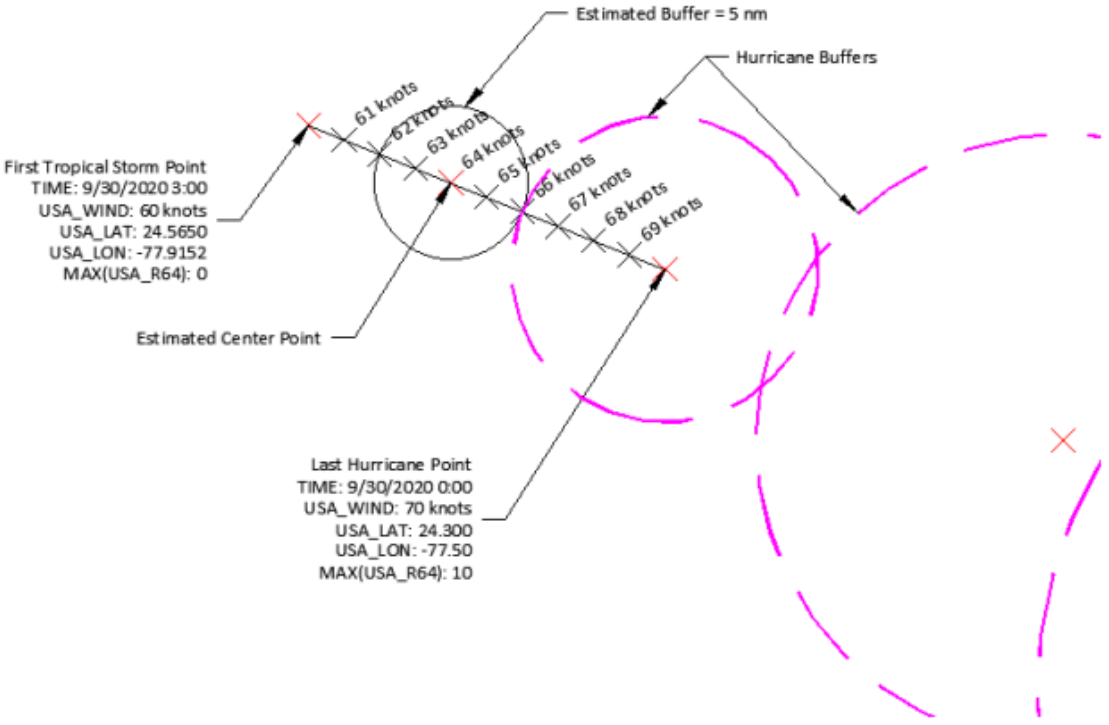
A similar calculation is used during the formation of a hurricane, using the last tropical storm center point and the first hurricane center point.

Example:

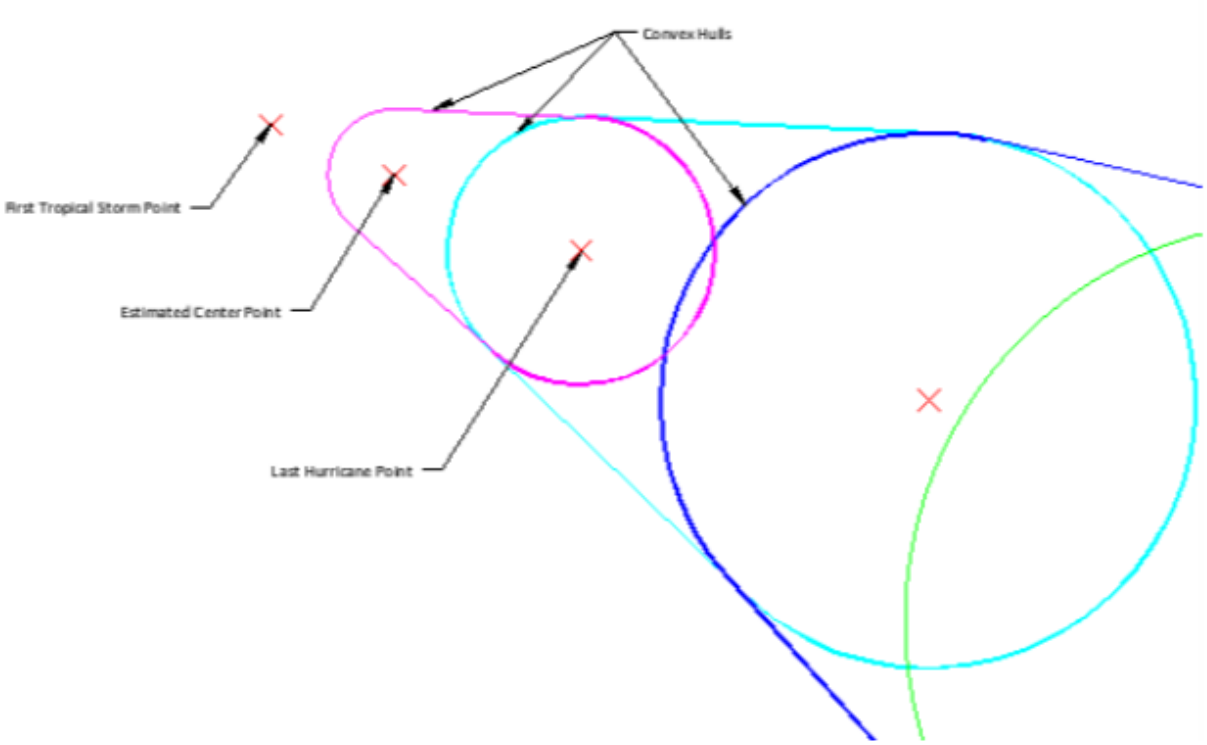
Given the table below:

SEASON	NAME	ISO_TIME	USA_LAT	USA_LON	USA_SSHS	USA_WIND	USA_R64_NE	USA_R64_SE	USA_R64_SW	USA_R64_NW
2020	HURRICANE	9/29/20 0:00	21.3000	-74.0000	0	60				
2020	HURRICANE	9/29/20 3:00	21.6999	-74.5877	1	65	15			
2020	HURRICANE	9/29/20 6:00	22.1000	-75.1000	1	70	25	15		20
2020	HURRICANE	9/29/20 9:00	22.5072	-75.5228	1	75	30	15	15	20
2020	HURRICANE	9/29/20 12:00	22.9000	-75.9000	1	80	35	25	10	30
2020	HURRICANE	9/29/20 15:00	23.2574	-76.3003	1	90	35	20	11	30
2020	HURRICANE	9/29/20 18:00	23.6000	-76.7000	1	80	30	20	11	25
2020	HURRICANE	9/29/20 21:00	23.9649	-77.1001	1	75	20	15		20
2020	HURRICANE	9/30/20 0:00	24.3000	-77.5000	1	70	10			
2020	HURRICANE	9/30/20 3:00	24.5650	-77.9152	0	60				

The last hurricane center point occurs on September 30th at 0:00 hours and the first tropical storm center point occurs on September 30th at 3:00 hours. The maximum sustained wind speeds are 70 knots and 60 knots, respectively. The figure below shows the estimated hurricane center point and buffer.



When the cyclone center points and corresponding cyclone buffers are plotted, the result is a series of (often overlapping) circles. A convex hull is calculated for each pair of adjacent buffers which results in a series of ovals. The figure below shows the convex hulls for the adjacent buffers. A corridor is then made of all the convex hulls of a cyclone and is used to determine the county intersections.



Once the convex hulls are calculated, county loss triggers are determined. The convex hulls and the county shapefile are mapped in the same coordinate reference system. Any county shape that intersects the convex hulls meets the county loss trigger. Any county that is adjacent (according to the U.S. Census Bureau County Adjacency File) to a county that is intersected by the convex hulls will also meet the county loss trigger.

The county loss trigger and date will be published in the actuarial documents. The date will be the date that the cyclone corridor intersects the county for direct triggers, or the first date that the county was indirectly triggered.

(ii) Nor'easter

(A) Data – Hourly barometric pressure data are obtained from the METAR data series (IEM, 2022). Weather stations were chosen for each insurable county based on proximity to production areas. The weather stations chosen for each county are presented in Appendix A. The applicable county weather station data aggregate to the county level by averaging across the available hourly data and rounding to the nearest whole number.

(B) Methodology – Nor'easters will be considered a county loss trigger when the weather stations report an average hourly barometric pressure at or below 990 millibars of pressure for at least 12 consecutive hours.

(C) Adjacent county triggers are not applicable.

(b) Excessive Heat and Freeze

(i) Data – NOAA CO-OPS reports historical and real time low tide data collected from ocean monitoring stations along the coast. The specific data period and metrics reported for each station vary, but all stations report water levels at hourly or finer aggregations. The chosen monitoring stations, displayed in Figure 1, are presented in Appendix B.

Figure 1. Selected NOAA CO-OPS Tides and Currents Weather Reporting Stations

Source: NOAA CO-OPS 2022

(A) The low tide metric is reported as a function of the Mean Lower Low Water (MLLW) which NOAA defines as (NOAA, 2016): Mean Lower Low Water (MLLW) is simply the lowest of the two low tides per day (or the one low tide) averaged over a 19-year period. This 19-year period is called the National Tidal Datum Epoch, which currently runs from 1983 through 2001.

(B) Low tide events are identified as any event where the tide is at or below the MLLW, reported as either 0 or a negative number.

(C) These hourly low tide events are evaluated along with the daily air temperatures obtained from NOAA CPC and NCEI. These data consist of daily minimum and maximum temperature observations from over 5,000 stations across the US, including Alaska and Hawaii, in near real time (within 12 hours). Based on the NOAA CPC website, the data include multiple sources: “First order” World Meteorological Organization (WMO) Global Telecommunications System (GTS) sites; NWS Cooperative Observer Network (COOP) via River Forecast Centers (RFC) and Weather Forecast Offices (WFO); and the Hydro Meteorological Automated Data System (HADS) dataset. NOAA NCEI provides access to comprehensive oceanic, atmospheric, and geophysical data. The compilation includes a dozen daily averages from global hourly station data. The NOAA CPC dataset includes the mean minimum and maximum temperatures from all weather stations as a representative temperature in a specified geographical grid. The daily temperature data from NOAA CPC is gridded using the Shepard Algorithm and the spatial coverage of the grids are reported to be 0.50-degree latitude by 0.50-degree longitude. Grids were selected based on their proximity to the CO-OPS oceanic weather stations. The selected grids are shown in Figure 2 and detailed further for each insurable county in Appendix C. The maximum and minimum temperatures are aggregated to the county-level for counties with multiple grids. These maximum and minimum temperatures are averaged across available daily grid data and rounded to the nearest tenth.

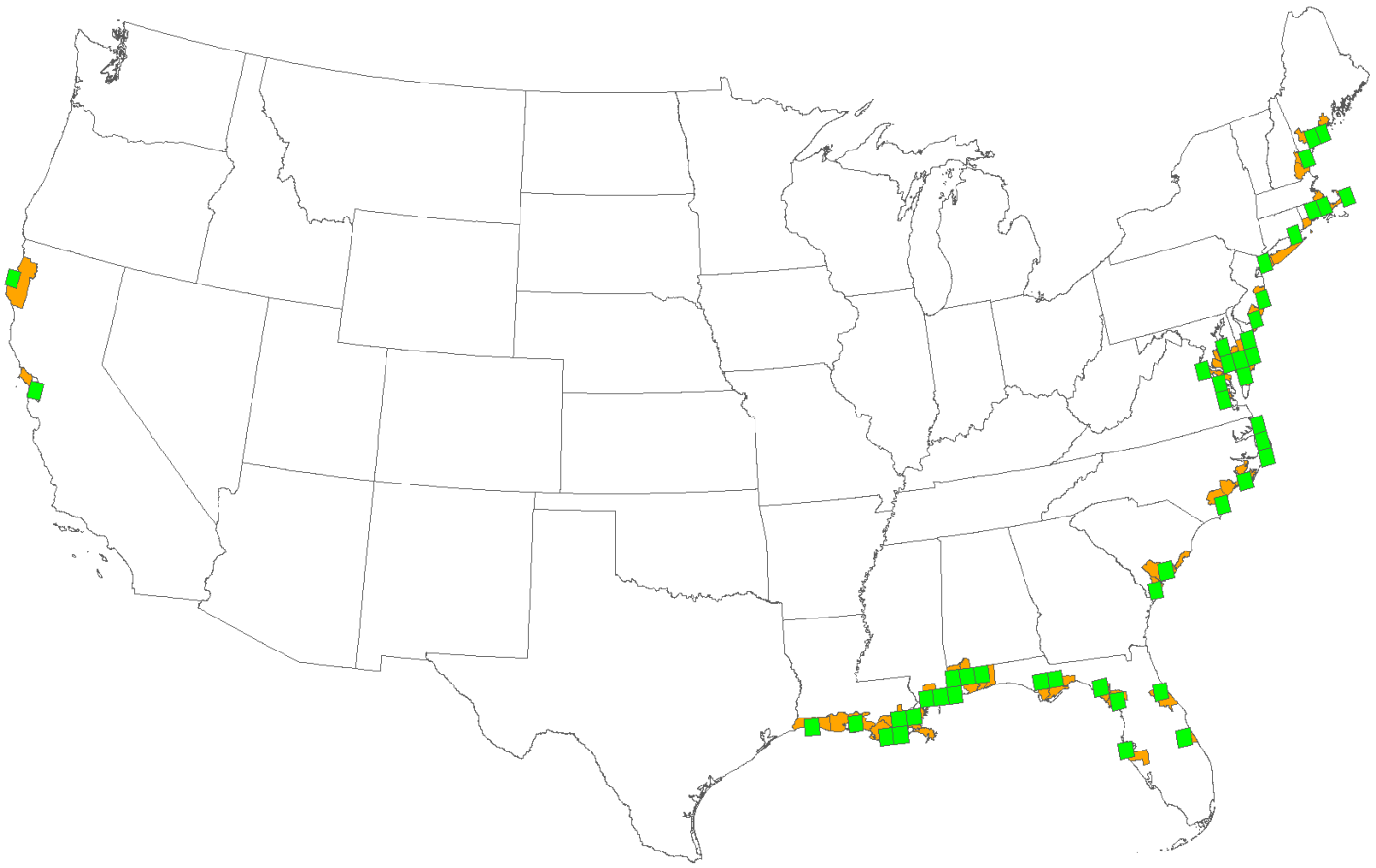


Figure 2. NOAA CPC Temperature Grids Intersecting Nearest NOAA CO-OPS Stations

Source: NOAA CO-OPS 2022 & CPC 2022

(ii) Methodology – NOAA CPC temperature county-level data observations that occurred in conjunction with a low tide event are evaluated to assess if there was a freeze or excessive heat county loss trigger.

(A) Freeze as a cause of loss will be considered a county loss trigger when the average minimum daily temperature, during a day in which a low tide event was experienced, was at or below the location-specific low temperature thresholds detailed in Table 1.

Table 1. Low Temperature Thresholds by Insurable County

State Name	State Code	County Name	County Code	Low Temp Threshold (Degrees Celsius)
Alabama	01	Baldwin	003	-20.6
Alabama	01	Mobile	097	-20.6
California	06	Humboldt	023	-20.6
California	06	Marin	041	-20.6
Delaware	10	Sussex	005	-20.6
Florida	12	Dixie	029	-20.6
Florida	12	Escambia	033	-20.6
Florida	12	Franklin	037	-20.6
Florida	12	Gulf	045	-20.6
Florida	12	Indian River	061	-20.6
Florida	12	Levy	075	-20.6
Florida	12	Manatee	081	-20.6
Florida	12	Santa Rosa	113	-20.6
Florida	12	Volusia	127	-20.6

State Name	State Code	County Name	County Code	Low Temp Threshold (Degrees Celsius)
Florida	12	Wakulla	129	-20.6
Louisiana	22	Cameron	023	-20.6
Louisiana	22	Iberia	045	-20.6
Louisiana	22	Jefferson	051	-20.6
Louisiana	22	Lafourche	057	-20.6
Louisiana	22	Plaquemines	075	-20.6
Louisiana	22	St Bernard	087	-20.6
Louisiana	22	St Mary	101	-20.6
Louisiana	22	Terrebonne	109	-20.6
Louisiana	22	Vermilion	113	-20.6
Maine	23	Cumberland	005	-28.1
Maine	23	Lincoln	015	-28.1
Maryland	24	Calvert	009	-20.6
Maryland	24	Dorchester	019	-20.6
Maryland	24	St Mary's	037	-20.6
Maryland	24	Wicomico	045	-20.6
Maryland	24	Worcester	047	-20.6
Massachusetts	25	Barnstable	001	-20.6
Massachusetts	25	Plymouth	023	-20.6
Mississippi	28	Harrison	047	-20.6
New Hampshire	33	Rockingham	015	-28.1
New Hampshire	33	Strafford	017	-28.1
New Jersey	34	Atlantic	001	-20.6
New Jersey	34	Cape May	009	-20.6
New Jersey	34	Ocean	029	-20.6
New York	36	Nassau	059	-20.6
New York	36	Suffolk	103	-20.6
North Carolina	37	Carteret	031	-20.6
North Carolina	37	Dare	055	-20.6
North Carolina	37	Onslow	133	-20.6
North Carolina	37	Pamlico	137	-20.6
North Carolina	37	Pender	141	-20.6
Rhode Island	44	Newport	005	-21.8
Rhode Island	44	Washington	009	-21.8
South Carolina	45	Beaufort	013	-20.6
South Carolina	45	Charleston	019	-20.6
South Carolina	45	Colleton	029	-20.6
Virginia	51	Accomack	001	-20.6
Virginia	51	Gloucester	073	-20.6
Virginia	51	Northumberland	133	-20.6
Virginia	51	Westmoreland	193	-20.6

(B) Excessive heat as a cause of loss will be considered a county loss trigger when the average maximum daily temperature, during a day in which a low tide event occurred, is at or above 38.0 degrees Celsius.

(c) Low Salinity Caused by Excessive Rainfall

(i) Data – Data utilized for determining if a county level trigger has occurred due to low salinity caused by excessive rainfall are obtained from NOAA CPC Gridded daily precipitation data aggregated across each county's applicable watershed area. NOAA CPC performs quality control and publishes these results as the "updated" product at: https://ftp.cpc.ncep.noaa.gov/precip/CPC_UNI_PRCP/GAUGE_CONUS/UPDATED/. This updated product will be used for trigger identification when available. When the updated product is not available, real-time ("RT") data will be used. RT data can be found at: https://ftp.cpc.ncep.noaa.gov/precip/CPC_UNI_PRCP/GAUGE_CONUS/RT/. NOAA CPC and NCEI gridded temperature data will also be utilized to assess the salinity trigger. These grids by county can be referenced in Appendix C.

(A) The Unified Continental United States (CONUS) Gauge Daily Precipitation Analysis, a part of the NOAA CPC Unified Precipitation Products Suite, is a gridded daily precipitation data source covering the continental United States. The daily gauge analysis is based on a 0.25° × 0.25° grid extending from 20°N to 55°N and 80°W to 160°W by interpolating gauge observations from the Global Tele-Connect (GTS) weather stations. The Optimal Interpolation (OI) algorithm (Xie, et al., 2007) was incorporated, with consideration of orographic effects in precipitation, to produce a continuous precipitation raster. Near-real time production of the data set began in January 2007, though historical data were used to calculate interpolated rasters starting from January 1, 1948.

(B) Information regarding the in-land watershed areas that impact the individual production areas was collected from the U.S. Department of the Interior U.S. Geological Survey (USGS) (USGS, 2022). The watersheds, and their overlapping NOAA CPC grids, utilized to estimate the historic rate of freshwater flow are depicted in Figure 3. A crosswalk of the applicable watershed for each of the insurable counties is provided in Appendix D. The locations of each of the NOAA CPC precipitation grids utilized for each of the watershed areas can be referenced in Appendix E. The precipitation reported in each of these grids should be aggregated across a rolling 30-day period and summed at the watershed level. The maximum precipitation that occurred during any 30-day period is utilized to assess if a low salinity event occurred.

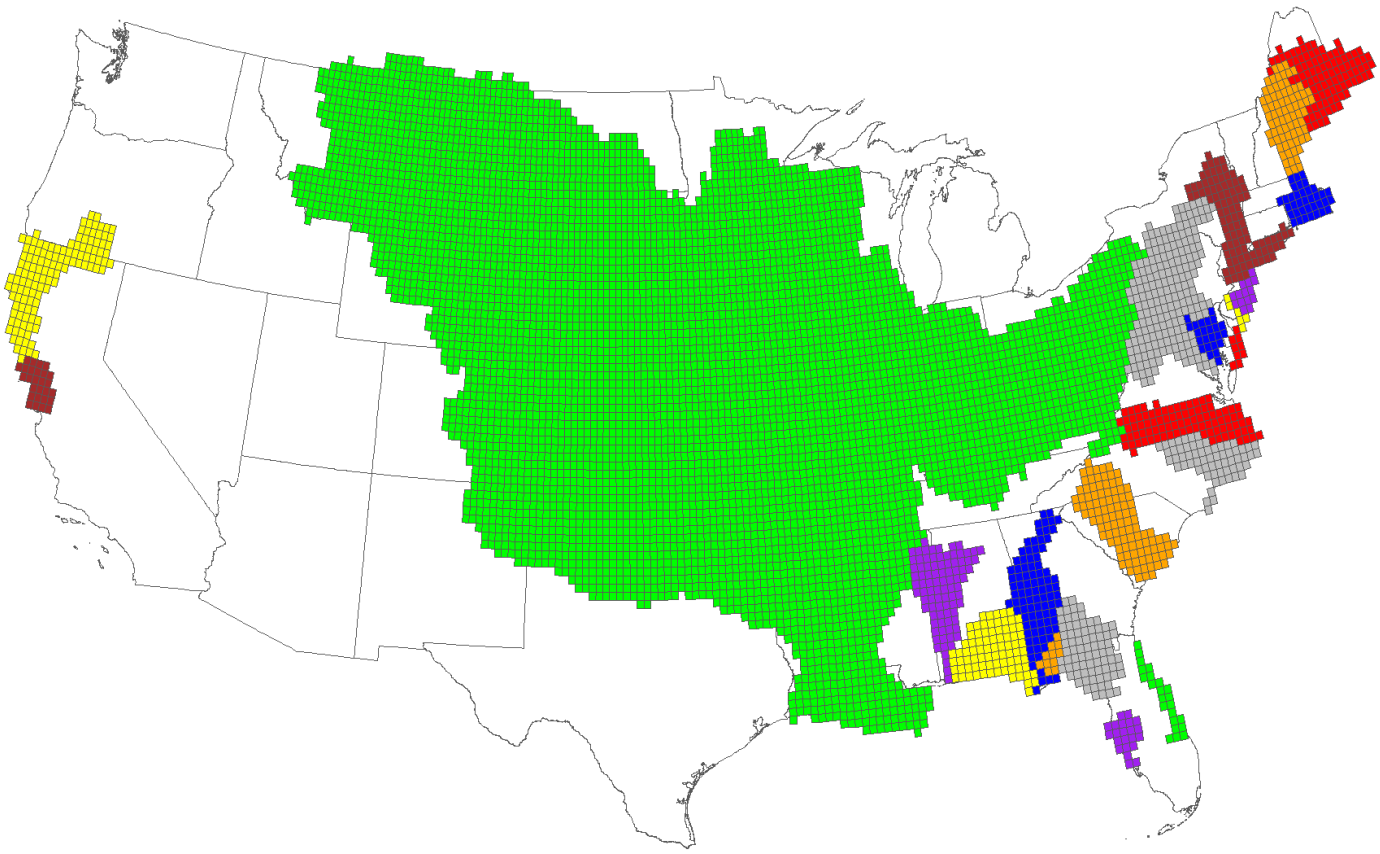


Figure 3. Watersheds Impacting Insurable Counties

Source: USGS 2022

(ii) Methodology – Low salinity caused by excessive rainfall will be considered a county loss trigger if:

(A) The precipitation in the applicable watershed area meets or exceeds the threshold specified in Table 2 during six consecutive 30-day windows within the insurance period; and

(B) The daily maximum temperature reported on the final day of all six 30-day windows meets or exceeds 20 degrees Celsius.

(C) For example, Baldwin, Alabama, has a 30-day precipitation of 2,000 cm for June 30 (total for June 1 to June 30). The maximum temperature on June 30 is 28 degrees Celsius. This is one day meeting the criteria for rainfall and temperature. The same criteria must be met for six consecutive days, in this case all days from June 30 to July 5.

Table 2. County-Level Excess Precipitation Salinity Thresholds

State Name	State Code	County Name	County Code	Watershed Total 30-Day Precipitation Threshold (cm)	Watershed Average 30-Day Precipitation Threshold (in)
Alabama	01	Baldwin	003	1,803	7.32
Alabama	01	Mobile	097	1,803	7.32
California	06	Humboldt	023	2,316	7.29
California	06	Marin	041	348	5.48
Delaware	10	Sussex	005	142	5.59
Florida	12	Dixie	029	1,430	7.13
Florida	12	Escambia	033	1,573	7.65
Florida	12	Franklin	037	1,937	6.57
Florida	12	Gulf	045	1,937	6.57
Florida	12	Indian River	061	431	7.38
Florida	12	Levy	075	1,430	7.13
Florida	12	Manatee	081	466	8.34
Florida	12	Santa Rosa	113	1,573	7.65
Florida	12	Volusia	127	431	7.38
Florida	12	Wakulla	129	330	7.64
Louisiana	22	Cameron	023	51,631	3.71
Louisiana	22	Iberia	045	51,631	3.71
Louisiana	22	Jefferson	051	51,631	3.71
Louisiana	22	Lafourche	057	51,631	3.71
Louisiana	22	Plaquemines	075	51,631	3.71
Louisiana	22	St Bernard	087	51,631	3.71
Louisiana	22	St Mary	101	51,631	3.71
Louisiana	22	Terrebonne	109	51,631	3.71
Louisiana	22	Vermilion	113	51,631	3.71
Maine	23	Cumberland	005	1,020	5.50
Maine	23	Lincoln	015	1,131	5.50
Maryland	24	Calvert	009	2,050	4.95
Maryland	24	Dorchester	019	2,050	4.95
Maryland	24	St Mary's	037	2,050	4.95
Maryland	24	Wicomico	045	2,050	4.95
Maryland	24	Worcester	047	142	5.59
Massachusetts	25	Barnstable	001	468	5.94
Massachusetts	25	Plymouth	023	468	5.94
Mississippi	28	Harrison	047	51,631	3.71
New Hampshire	33	Rockingham	015	1,020	5.50
New Hampshire	33	Strafford	017	1,020	5.50

State Name	State Code	County Name	County Code	Watershed Total 30-Day Precipitation Threshold (cm)	Watershed Average 30-Day Precipitation Threshold (in)
New Jersey	34	Atlantic	001	158	5.65
New Jersey	34	Cape May	009	158	5.65
New Jersey	34	Ocean	029	248	5.74
New York	36	Nassau	059	1,399	5.51
New York	36	Suffolk	103	1,399	5.51
North Carolina	37	Carteret	031	1,096	6.35
North Carolina	37	Dare	055	1,364	5.84
North Carolina	37	Onslow	133	1,096	6.35
North Carolina	37	Pamlico	137	1,096	6.35
North Carolina	37	Pender	141	1,096	6.35
Rhode Island	44	Newport	005	468	5.94
Rhode Island	44	Washington	009	468	5.94
South Carolina	45	Beaufort	013	1,597	5.99
South Carolina	45	Charleston	019	1,597	5.99
South Carolina	45	Colleton	029	1,597	5.99
Virginia	51	Accomack	001	1,695	4.91
Virginia	51	Gloucester	073	2,547	4.89
Virginia	51	Northumberland	133	2,547	4.89
Virginia	51	Westmoreland	193	2,547	4.89

Note: Total 30-day precipitation threshold is the sum of precipitation in the watershed for all grids in a 30-day period. Average 30-day precipitation is the average of the total precipitation per grid. For example, the watershed for Baldwin, Alabama, contains 97 grids. The 30-day average is 1,803 cm ÷ 97 grids ÷ 2.54 cm/in = 7.32 inches per grid.

5. References

(a) NOAA CPC & NCEI. (2022). Daily temperature data. https://ftp.cpc.ncep.noaa.gov/precip/PEOPLE/wd52ws/global_temp/

(b) Iowa Environmental Mesonet (IEM). (2022). ASOS-AWOS-METAR Data Download. Iowa State University. IEM :: Download ASOS/AWOS/METAR Data (iastate.edu)

(c) NOAA. (2016). MMLW: The alphabet soup of vertical datums: Why MHHW is Mmm Mmm Good. *National Oceanic and Atmospheric Administration: Inside the Eye*. https://noaanhc.wordpress.com/2016/01/29/the-alphabet-soup-of-vertical-datums-why-mhhw-is-mmm-mmm-good/

(d) NOAA CO-OPS. (2022) Water Level Hourly Height Data. Center for Operational Oceanographic Products and Services. https://opendap.co-ops.nos.noaa.gov/axis/webservices/waterlevelverifiedhourly/index.jsp

(e) USGS. (2022). Science in Your Watershed. https://water.usgs.gov/wsc/map_index.html

(f) Xie, P., A. Yatagai, M. Chen, T. Hayasaka, Y. Fukushima, C. Liu, and S. Yang. (2007). A Gauge-based Analysis of Daily Precipitation over East Asia. *Journal of Hydrometeorology*, 8, 607-626.

APPENDIX A: METAR STATION METADATA

State Name	State Code	County Name	County Code	Station ID	Latitude	Longitude
Alabama	01	Baldwin	003	MOB	30.69	-88.25
Alabama	01	Baldwin	003	BFM	30.63	-88.07
Alabama	01	Baldwin	003	4R4	30.46	-87.88
Alabama	01	Baldwin	003	JKA	30.29	-87.67
Alabama	01	Baldwin	003	NBJ	30.39	-87.64
Alabama	01	Baldwin	003	CQF	30.46	-87.88
Alabama	01	Baldwin	003	1R8	30.87	-87.82
Alabama	01	Mobile	097	MOB	30.69	-88.25
Alabama	01	Mobile	097	PQL	30.46	-88.53
Alabama	01	Mobile	097	BFM	30.63	-88.07
Alabama	01	Mobile	097	4R4	30.46	-87.88
Alabama	01	Mobile	097	CQF	30.46	-87.88
Alabama	01	Mobile	097	1R8	30.87	-87.82
Delaware	10	Sussex	005	GED	38.69	-75.36
Florida	12	Dixie	029	CTY	29.64	-83.10
Florida	12	Escambia	033	PNS	30.48	-87.19
Florida	12	Franklin	037	AAF	29.73	-85.03
Florida	12	Gulf	045	AAF	29.73	-85.03
Florida	12	Indian River	061	VRB	27.66	-80.42
Florida	12	Levy	075	X60	29.36	-82.47
Florida	12	Manatee	081	SRQ	27.40	-82.56
Florida	12	Santa Rosa	113	PNS	30.48	-87.19
Florida	12	Volusia	127	DAB	29.18	-81.06
Florida	12	Volusia	127	EVB	29.06	-80.95
Florida	12	Wakulla	129	TLH	30.39	-84.35
Florida	12	Wakulla	129	2J9	30.60	-84.56
Louisiana	22	Cameron	023	3L4	29.80	-92.80
Louisiana	22	Iberia	045	ARA	30.03	-91.88
Louisiana	22	Jefferson	051	GAO	29.44	-90.26
Louisiana	22	Lafourche	057	HUM	29.57	-90.66
Louisiana	22	Plaquemines	075	LNQ	29.36	-89.44
Louisiana	22	Plaquemines	075	NBG	29.83	-90.04
Louisiana	22	St Bernard	087	NBG	29.83	-90.04
Louisiana	22	St Mary	101	P92	29.56	-91.53
Louisiana	22	Terrebonne	109	PTN	29.71	-91.34
Louisiana	22	Terrebonne	109	HUM	29.57	-90.66
Louisiana	22	Vermilion	113	IYA	29.98	-92.08
Maine	23	Cumberland	005	PWM	43.64	-70.30
Maine	23	Cumberland	005	LEW	44.05	-70.28
Maine	23	Cumberland	005	NHZ	43.89	-69.94
Maine	23	Lincoln	015	RKD	44.06	-69.10

State Name	State Code	County Name	County Code	Station ID	Latitude	Longitude
Maine	23	Lincoln	015	AUG	44.32	-69.80
Maine	23	Lincoln	015	NHZ	43.89	-69.94
Maine	23	Lincoln	015	IWI	43.96	-69.71
Maryland	24	Calvert	009	NUI	38.15	-76.43
Maryland	24	Calvert	009	ESN	38.80	-76.07
Maryland	24	Calvert	009	2W6	38.32	-76.55
Maryland	24	Calvert	009	NHK	38.29	-76.41
Maryland	24	Calvert	009	CGE	38.54	-76.03
Maryland	24	Dorchester	019	NUI	38.15	-76.43
Maryland	24	Dorchester	019	ESN	38.80	-76.07
Maryland	24	Dorchester	019	2W6	38.32	-76.55
Maryland	24	Dorchester	019	NHK	38.29	-76.41
Maryland	24	Dorchester	019	CGE	38.54	-76.03
Maryland	24	St Mary's	037	NUI	38.15	-76.43
Maryland	24	St Mary's	037	2W6	38.32	-76.55
Maryland	24	St Mary's	037	NHK	38.29	-76.41
Maryland	24	Wicomico	045	NUI	38.15	-76.43
Maryland	24	Wicomico	045	ESN	38.80	-76.07
Maryland	24	Wicomico	045	2W6	38.32	-76.55
Maryland	24	Wicomico	045	NHK	38.29	-76.41
Maryland	24	Wicomico	045	CGE	38.54	-76.03
Maryland	24	Worcester	047	OXB	38.31	-75.12
Massachusetts	25	Barnstable	001	CQX	41.69	-69.99
Massachusetts	25	Barnstable	001	FMH	41.66	-70.52
Massachusetts	25	Barnstable	001	PVC	42.07	-70.22
Massachusetts	25	Barnstable	001	HYA	41.67	-70.28
Massachusetts	25	Plymouth	023	OWD	42.19	-71.17
Massachusetts	25	Plymouth	023	GHG	42.10	-70.67
Massachusetts	25	Plymouth	023	EWB	41.68	-70.96
Massachusetts	25	Plymouth	023	TAN	41.88	-71.02
Massachusetts	25	Plymouth	023	MQE	42.21	-71.11
Massachusetts	25	Plymouth	023	FMH	41.66	-70.52
Massachusetts	25	Plymouth	023	PYM	41.91	-70.73
Massachusetts	25	Plymouth	023	BOS	42.36	-71.01
Mississippi	28	Harrison	047	BIX	30.41	-88.92
Mississippi	28	Harrison	047	HSA	30.37	-89.45
Mississippi	28	Harrison	047	GPT	30.41	-89.07
New Hampshire	33	Rockingham	015	PSM	43.08	-70.82
New Hampshire	33	Strafford	017	PSM	43.08	-70.82
New Jersey	34	Atlantic	001	ACY	39.46	-74.58
New Jersey	34	Cape May	009	WWD	39.01	-74.91
New Jersey	34	Ocean	029	MJX	39.93	-74.29
New Jersey	34	Ocean	029	NEL	40.03	-74.35

State Name	State Code	County Name	County Code	Station ID	Latitude	Longitude
New Jersey	34	Ocean	029	BLM	40.18	-74.13
New York	36	Nassau	059	JFK	40.64	-73.76
New York	36	Nassau	059	FRG	40.73	-73.41
New York	36	Nassau	059	LGA	40.78	-73.88
New York	36	Nassau	059	NYC	40.78	-73.97
New York	36	Nassau	059	JRB	40.70	-74.01
New York	36	Nassau	059	HPN	41.07	-73.71
New York	36	Nassau	059	ISP	40.79	-73.10
New York	36	Suffolk	103	JPX	40.96	-72.25
New York	36	Suffolk	103	HTO	40.96	-72.25
New York	36	Suffolk	103	MTP	41.07	-71.92
New York	36	Suffolk	103	FOK	40.84	-72.63
New York	36	Suffolk	103	HWV	40.82	-72.87
New York	36	Suffolk	103	FRG	40.73	-73.41
New York	36	Suffolk	103	ISP	40.79	-73.10
North Carolina	37	Carteret	031	NBT	35.02	-76.46
North Carolina	37	Carteret	031	MRH	34.73	-76.66
North Carolina	37	Carteret	031	NJM	34.69	-77.03
North Carolina	37	Carteret	031	NKT	34.90	-76.88
North Carolina	37	Dare	055	2DP	35.67	-75.90
North Carolina	37	Dare	055	FFA	36.02	-75.67
North Carolina	37	Dare	055	7W6	35.56	-75.96
North Carolina	37	Dare	055	HSE	35.23	-75.62
North Carolina	37	Dare	055	MQI	35.92	-75.70
North Carolina	37	Onslow	133	NCA	34.71	-77.44
North Carolina	37	Onslow	133	OAJ	34.83	-77.61
North Carolina	37	Onslow	133	NJM	34.69	-77.03
North Carolina	37	Pamlico	137	NBT	35.02	-76.46
North Carolina	37	Pamlico	137	EWN	35.07	-77.05
North Carolina	37	Pamlico	137	MRH	34.73	-76.66
North Carolina	37	Pamlico	137	NKT	34.90	-76.88
North Carolina	37	Pender	141	NCA	34.71	-77.44
North Carolina	37	Pender	141	OAJ	34.83	-77.61
North Carolina	37	Pender	141	NJM	34.69	-77.03
Rhode Island	44	Newport	005	SFZ	41.92	-71.49
Rhode Island	44	Newport	005	OQU	41.60	-71.41
Rhode Island	44	Newport	005	EWB	41.68	-70.96
Rhode Island	44	Newport	005	BID	41.17	-71.58
Rhode Island	44	Newport	005	TAN	41.88	-71.02
Rhode Island	44	Newport	005	UUU	41.53	-71.28
Rhode Island	44	Newport	005	PVD	41.72	-71.43
Rhode Island	44	Washington	009	MTP	41.07	-71.92
Rhode Island	44	Washington	009	OQU	41.60	-71.41

State Name	State Code	County Name	County Code	Station ID	Latitude	Longitude
Rhode Island	44	Washington	009	BID	41.17	-71.58
Rhode Island	44	Washington	009	UUU	41.53	-71.28
Rhode Island	44	Washington	009	PVD	41.72	-71.43
Rhode Island	44	Washington	009	WST	41.35	-71.80
South Carolina	45	Beaufort	013	ARW	32.41	-80.63
South Carolina	45	Beaufort	013	NBC	32.48	-80.72
South Carolina	45	Beaufort	013	HXD	32.22	-80.70
South Carolina	45	Charleston	019	JZI	32.70	-80.00
South Carolina	45	Charleston	019	DYB	33.06	-80.28
South Carolina	45	Charleston	019	MKS	33.19	-80.04
South Carolina	45	Charleston	019	LRO	32.90	-79.78
South Carolina	45	Charleston	019	CHS	32.90	-80.04
South Carolina	45	Colleton	029	DYB	33.06	-80.28
South Carolina	45	Colleton	029	ARW	32.41	-80.63
South Carolina	45	Colleton	029	RBW	32.92	-80.64
South Carolina	45	Colleton	029	NBC	32.48	-80.72
Virginia	51	Accomack	001	MFV	37.65	-75.76
Virginia	51	Accomack	001	WAL	37.94	-75.46
Virginia	51	Accomack	001	TGI	37.83	-76.00
Virginia	51	Gloucester	073	PHF	37.13	-76.49
Virginia	51	Gloucester	073	FYJ	37.52	-76.76
Virginia	51	Gloucester	073	FAF	37.13	-76.61
Virginia	51	Gloucester	073	W75	37.60	-76.45
Virginia	51	Gloucester	073	JGG	37.24	-76.72
Virginia	51	Gloucester	073	LFI	37.08	-76.36
Virginia	51	Northumberland	133	W75	37.60	-76.45
Virginia	51	Northumberland	133	TGI	37.83	-76.00
Virginia	51	Northumberland	133	NUI	38.15	-76.43
Virginia	51	Northumberland	133	2W6	38.32	-76.55
Virginia	51	Northumberland	133	NHK	38.29	-76.41
Virginia	51	Westmoreland	193	XSA	37.86	-76.89
Virginia	51	Westmoreland	193	NUI	38.15	-76.43
Virginia	51	Westmoreland	193	2W6	38.32	-76.55
Virginia	51	Westmoreland	193	NHK	38.29	-76.41

APPENDIX B: CO-OPS WEATHER STATION METADATA

State Name	State Code	County Name	County Code	Station ID	Station Name
Alabama	01	Mobile	097	8735180	Dauphin Island
Alabama	01	Mobile	097	8735391	Dog River Bridge
Alabama	01	Mobile	097	8736897	Coast Guard Sector Mobile
Alabama	01	Mobile	097	8737048	Mobile State Docks
Alabama	01	Mobile	097	8737138	Chickasaw Creek
California	06	Humboldt	023	9418767	North Spit
California	06	Marin	041	9415020	Point Reyes
Delaware	10	Sussex	005	8557380	Lewes, DE
Florida	12	Escambia	033	8729840	Pensacola, FL
Florida	12	Franklin	037	8728690	Apalachicola
Florida	12	Indian River	061	8721604	Trident Pier, Port Canaveral, FL
Florida	12	Levy	075	8727520	Cedar Key, FL
Florida	12	Manatee	081	8726384	Port Manatee, FL
Florida	12	Santa Rosa	113	8729840	Pensacola, FL
Florida	12	Volusia	127	8721604	Trident Pier, Port Canaveral, FL
Louisiana	22	Cameron	023	8770822	Texas Point, Sabine Pass, TX
Louisiana	22	Iberia	045	8766072	Freshwater Canal Locks, LA
Louisiana	22	Jefferson	051	8761724	Grand Isle, LA
Louisiana	22	Lafourche	057	8761724	Grand Isle, LA
Louisiana	22	Plaquemines	075	8760922	Pilots Station East, S.W. Pass, LA
Louisiana	22	Plaquemines	075	8760721	Pilottown, LA
Louisiana	22	St Bernard	087	8761305	Shell Beach, LA
Louisiana	22	St Mary	101	8764044	Berwick, Atchafalaya River, LA
Louisiana	22	St Mary	101	8764227	LAWMA, Amerada Pass, LA
Louisiana	22	St Mary	101	8764314	Eugene Island, North of, Atchafalaya Bay
Louisiana	22	Terrebonne	109	8764227	LAWMA, Amerada Pass, LA
Louisiana	22	Terrebonne	109	8764314	Eugene Island, North of, Atchafalaya Bay
Louisiana	22	Vermilion	113	8766072	Freshwater Canal Locks, LA
Maine	23	Cumberland	005	8418150	Portland
Maryland	24	Calvert	009	8577330	Solomons Island
Maryland	24	Dorchester	019	8571421	Bishops Head
Maryland	24	Dorchester	019	8571892	Cambridge
Maryland	24	St Mary's	037	8577330	Solomons Island
Maryland	24	Wicomico	045	8571421	Bishops Head
Maryland	24	Wicomico	045	8571892	Cambridge
Maryland	24	Worcester	047	8570283	Ocean City Inlet, MD
Massachusetts	25	Barnstable	001	8447435	Chatham
Massachusetts	25	Barnstable	001	8447930	Woods Hole
Mississippi	28	Harrison	047	8741533	Pascagoula NOAA Lab
Mississippi	28	Harrison	047	8747437	Bay Waveland Yacht Club

State Name	State Code	County Name	County Code	Station ID	Station Name
New Hampshire	33	Rockingham	015	8419870	Seavey Island, ME
New Hampshire	33	Strafford	017	8419870	Seavey Island, ME
New Jersey	34	Atlantic	001	8534720	Atlantic City, NJ
New Jersey	34	Cape May	009	8536110	Cape May, NJ
New Jersey	34	Ocean	029	8534720	Atlantic City, NJ
New York	36	Nassau	059	8516945	Kings Point
New York	36	Suffolk	103	8510560	Montauk
North Carolina	37	Carteret	031	8656483	Beaufort
North Carolina	37	Dare	055	8651370	Duck
North Carolina	37	Dare	055	8652587	Oregon Inlet Marina
North Carolina	37	Onslow	133	8658163	Wrightsville Beach
North Carolina	37	Onslow	133	8658120	Wilmington
Rhode Island	44	Newport	005	8452660	Newport
Rhode Island	44	Newport	005	8452944	Conimicut Light
Rhode Island	44	Newport	005	8454000	Providence
Rhode Island	44	Washington	009	8454049	Quonset Point
South Carolina	45	Beaufort	013	8670870	Fort Pulaski
South Carolina	45	Charleston	019	8665530	Charleston
Virginia	51	Accomack	001	8631044	Wachapreague
Virginia	51	Gloucester	073	8637689	Yorktown USCG Training Center
Virginia	51	Northumberland	133	8635750	Lewisetta
Virginia	51	Northumberland	133	8636580	Windmill Point
Virginia	51	Westmoreland	193	8635027	Dahlgren

Note: Due to lack of available weather stations, proxy counties will be utilized for counties that do not have information available. Table 3 outlines the proxy counties used to determine the events for the remaining insurable counties.

Table 3. NOAA CO-OPS Station Tide Data Proxy Counties

State Name	State Code	County Name	County Code	Proxy State Name	Proxy State Code	Proxy County Name	Proxy County Code
Alabama	01	Baldwin	003	Alabama	01	Mobile	097
Florida	12	Dixie	029	Florida	12	Levy	075
Florida	12	Gulf	045	Florida	12	Franklin	037
Florida	12	Wakulla	129	Florida	12	Franklin	037
Maine	23	Lincoln	015	Maine	23	Cumberland	005
Massachusetts	25	Plymouth	023	Massachusetts	25	Barnstable	001
North Carolina	37	Pamlico	137	North Carolina	37	Carteret	031
North Carolina	37	Pender	141	North Carolina	37	Onslow	133
South Carolina	45	Colleton	029	South Carolina	45	Charleston	019

APPENDIX C: NOAA CPC TEMPERATURE GRIDS METADATA

State Name	State Code	County Name	County Code	Longitude Min	Longitude Max	Latitude Min	Latitude Max
Alabama	01	Mobile	097	-88.5	-88	30	30.5
Alabama	01	Mobile	097	-88.5	-88	30.5	31
California	06	Humboldt	023	-124.5	-124	40.5	41
California	06	Marin	041	-122.5	-122	37.5	38
Delaware	10	Sussex	005	-75.5	-75	38.5	39
Florida	12	Dixie	029	-83.5	-83	29.5	30
Florida	12	Escambia	033	-87.5	-87	30.5	31
Florida	12	Franklin	037	-85	-84.5	30	30.5
Florida	12	Gulf	045	-85.5	-85	30	30.5
Florida	12	Indian River	061	-81	-80.5	27.5	28
Florida	12	Levy	075	-83	-82.5	29	29.5
Florida	12	Manatee	081	-83	-82.5	27.5	28
Florida	12	Santa Rosa	113	-88	-87.5	30.5	31
Florida	12	Santa Rosa	113	-87.5	-87	30.5	31
Florida	12	Volusia	127	-81.5	-81	29	29.5
Louisiana	22	Cameron	023	-93.5	-93	29.5	30
Louisiana	22	Iberia	045	-92	-91.5	29.5	30
Louisiana	22	Jefferson	051	-90.5	-90	29.5	30
Louisiana	22	Lafourche	057	-90.5	-90	29	29.5
Louisiana	22	Plaquemines	075	-90	-89.5	29.5	30
Louisiana	22	St Bernard	087	-90	-89.5	29.5	30
Louisiana	22	St Mary	101	-91.5	-91	29.5	30
Louisiana	22	Terrebonne	109	-91	-90.5	29	29.5
Louisiana	22	Vermilion	113	-92.5	-92	29.5	30
Maine	23	Cumberland	005	-70.5	-70	43.5	44
Maine	23	Lincoln	015	-70	-69.5	43.5	44
Maryland	24	Calvert	009	-76.5	-76	38	38.5
Maryland	24	Dorchester	019	-76.5	-76	38	38.5
Maryland	24	Dorchester	019	-76.5	-76	38.5	39
Maryland	24	St Mary's	037	-76.5	-76	38	38.5
Maryland	24	Wicomico	045	-75.5	-76	38	38.5
Maryland	24	Worcester	047	-75.5	-75	38	38.5
Massachusetts	25	Barnstable	001	-70	-69.5	41.5	42
Massachusetts	25	Barnstable	001	-71	-70.5	41.5	42
Mississippi	28	Harrison	047	-89.5	-89	30	30.5
Mississippi	28	Harrison	047	-89	-88.5	30	30.5
New Hampshire	33	Rockingham	015	-71	-70.5	43	43.5
New Hampshire	33	Strafford	017	-71	-70.5	43	43.5
New Jersey	34	Atlantic	001	-75	-74.5	39	39.5
New Jersey	34	Cape May	009	-75	-74.5	39	39.5

State Name	State Code	County Name	County Code	Longitude Min	Longitude Max	Latitude Min	Latitude Max
New Jersey	34	Ocean	029	-74.5	-74	39.5	40
New York	36	Nassau	059	-74	-73.5	40.5	41
New York	36	Suffolk	103	-72.5	-72	41	41.5
North Carolina	37	Carteret	031	-77	-76.5	34.5	35
North Carolina	37	Dare	055	-76	-75.5	36	36.5
North Carolina	37	Dare	055	-76	-75.5	35.5	36
North Carolina	37	Dare	055	-76	-75.5	35	35.5
North Carolina	37	Onslow	133	-78	-77.5	34	34.5
North Carolina	37	Pender	141	-78	-77.5	34	34.5
Rhode Island	44	Newport	005	-71.5	-71	41.5	42
Rhode Island	44	Washington	009	-71.5	-71	41.5	42
South Carolina	45	Beaufort	013	-81	-80.5	32	32.5
South Carolina	45	Charleston	019	-80.5	-80	32.5	33
Virginia	51	Accomack	001	-76	-75.5	37.5	38
Virginia	51	Gloucester	073	-77	-76.5	37	37.5
Virginia	51	Northumberland	133	-77	-76.5	37.5	38
Virginia	51	Westmoreland	193	-77.5	-77	38	38.5

APPENDIX D: WATERSHED CROSSWALK

State Name	State Code	County Name	County Code	Assigned Watershed
Alabama	01	Baldwin	003	AL1
Alabama	01	Mobile	097	AL1
California	06	Humboldt	023	CA1
California	06	Marin	041	CA2
Delaware	10	Sussex	005	DE1
Florida	12	Dixie	029	FL4
Florida	12	Escambia	033	FL5
Florida	12	Franklin	037	FL1
Florida	12	Gulf	045	FL1
Florida	12	Indian River	061	FL3
Florida	12	Levy	075	FL4
Florida	12	Manatee	081	FL6
Florida	12	Santa Rosa	113	FL5
Florida	12	Volusia	127	FL3
Florida	12	Wakulla	129	FL2
Louisiana	22	Cameron	023	MS1
Louisiana	22	Iberia	045	MS1
Louisiana	22	Jefferson	051	MS1
Louisiana	22	Lafourche	057	MS1
Louisiana	22	Plaquemines	075	MS1
Louisiana	22	St Bernard	087	MS1
Louisiana	22	St Mary	101	MS1
Louisiana	22	Terrebonne	109	MS1
Louisiana	22	Vermilion	113	MS1
Maine	23	Cumberland	005	ME2
Maine	23	Lincoln	015	ME1
Maryland	24	Calvert	009	MD1
Maryland	24	Dorchester	019	MD1
Maryland	24	St Mary's	037	MD1
Maryland	24	Wicomico	045	MD1
Maryland	24	Worcester	047	DE1
Massachusetts	25	Barnstable	001	MA1
Massachusetts	25	Plymouth	023	MA1
Mississippi	28	Harrison	047	MS1
New Hampshire	33	Rockingham	015	ME2
New Hampshire	33	Strafford	017	ME2
New Jersey	34	Atlantic	001	NJ1
New Jersey	34	Cape May	009	NJ1
New Jersey	34	Ocean	029	NJ2
New York	36	Nassau	059	NY1
New York	36	Suffolk	103	NY1

State Name	State Code	County Name	County Code	Assigned Watershed
North Carolina	37	Carteret	031	NC1
North Carolina	37	Dare	055	NC2
North Carolina	37	Onslow	133	NC1
North Carolina	37	Pamlico	137	NC1
North Carolina	37	Pender	141	NC1
Rhode Island	44	Newport	005	RI1
Rhode Island	44	Washington	009	RI1
South Carolina	45	Beaufort	013	SC1
South Carolina	45	Charleston	019	SC1
South Carolina	45	Colleton	029	SC1
Virginia	51	Accomack	001	VA1
Virginia	51	Gloucester	073	VA2
Virginia	51	Northumberland	133	VA2
Virginia	51	Westmoreland	193	VA2

APPENDIX E: NOAA CPC PRECIPITATION GRIDS FOR EACH APPLICABLE WATERSHED