HYDROMETEOROLOGICAL DESIGN STUDIES CENTER
QUARTERLY PROGRESS REPORT

1 October to 31 December 2015

National Water Center
National Weather Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
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DISCLAIMER

The data and information presented in this report are provided only to demonstrate current progress on the various tasks associated with these projects. Values presented herein are NOT intended for any other use beyond the scope of this progress report. Anyone using any data or information presented in this report for any other purpose does so at their own risk.

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I. INTRODUCTION

The Hydrometeorological Design Studies Center (HDSC) within the National Water Center (formerly, Office of Hydrologic Development)[1] of the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) has been updating precipitation frequency estimates for various parts of the United States and affiliated territories. Updated precipitation frequency estimates for durations from 5 minutes to 60 days and average recurrence intervals between 1- and 1,000-years, accompanied by additional relevant information (e.g., 95% confidence limits, temporal distributions, seasonality) are published in NOAA Atlas 14. All NOAA Atlas 14 products and documents are available for download from the Precipitation Frequency Data Server (PFDS).

NOAA Atlas 14 is divided into volumes based on geographic sections of the country and affiliated territories. Figure 1 shows the states or territories associated with each of the Volumes of the Atlas. To date, precipitation frequency estimates have been updated for Arizona, Nevada, New Mexico and Utah (Volume 1, 2004), Delaware, District of Columbia, Illinois, Indiana, Kentucky, Maryland, New Jersey, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia and West Virginia (Volume 2, 2004), Puerto Rico and U.S. Virgin Islands (Volume 3, 2006), Hawaiian Islands (Volume 4, 2009), Selected Pacific Islands (Volume 5, 2009), California (Volume 6, 2011), Alaska (Volume 7, 2011), Colorado, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Wisconsin (Volume 8, 2013), and Alabama, Arkansas, Florida, Georgia, Louisiana and Mississippi (Volume 9, 2013). On September 30th, 2015, HDSC published updated estimates for the following seven northeastern states: Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont in Volume 10. Since May 2015, HDSC has been working on updating precipitation frequency estimates for the state of Texas. They are expected to be published in mid-2018 in NOAA Atlas 14, Volume 11.

We have been working with the Federal Highway Administration (FHWA) and several state agencies on securing funding to extend NOAA Atlas 14 coverage to the remaining five northwestern states: Idaho, Montana, Oregon, Washington, and Wyoming in Volume 12. An updated solicitation for this project will be listed on the FHWA's Transportation Pooled Fund Program's web page in the near future. This program allows interested federal, state, and local agencies and other organizations to combine resources to support transportation relevant research studies. For any inquiries regarding the status of this effort, please send an email to HDSC.questions@noaa.gov.

Due to lack of funding, in FY15 HDSC suspended activities on the following two projects: "Analysis of potential impacts of climate change on precipitation frequency estimates" and "Development of regional areal reduction factors to accompany NOAA Atlas 14 point precipitation frequency estimates." Consequently, we omit related sections in the most current progress reports.

[1]As of April 1, 2015, the Office of Hydrologic Development reorganized into the National Water Center (NWC) with locations in Chanhassen, MN; Silver Spring MD; and Tuscaloosa, AL.

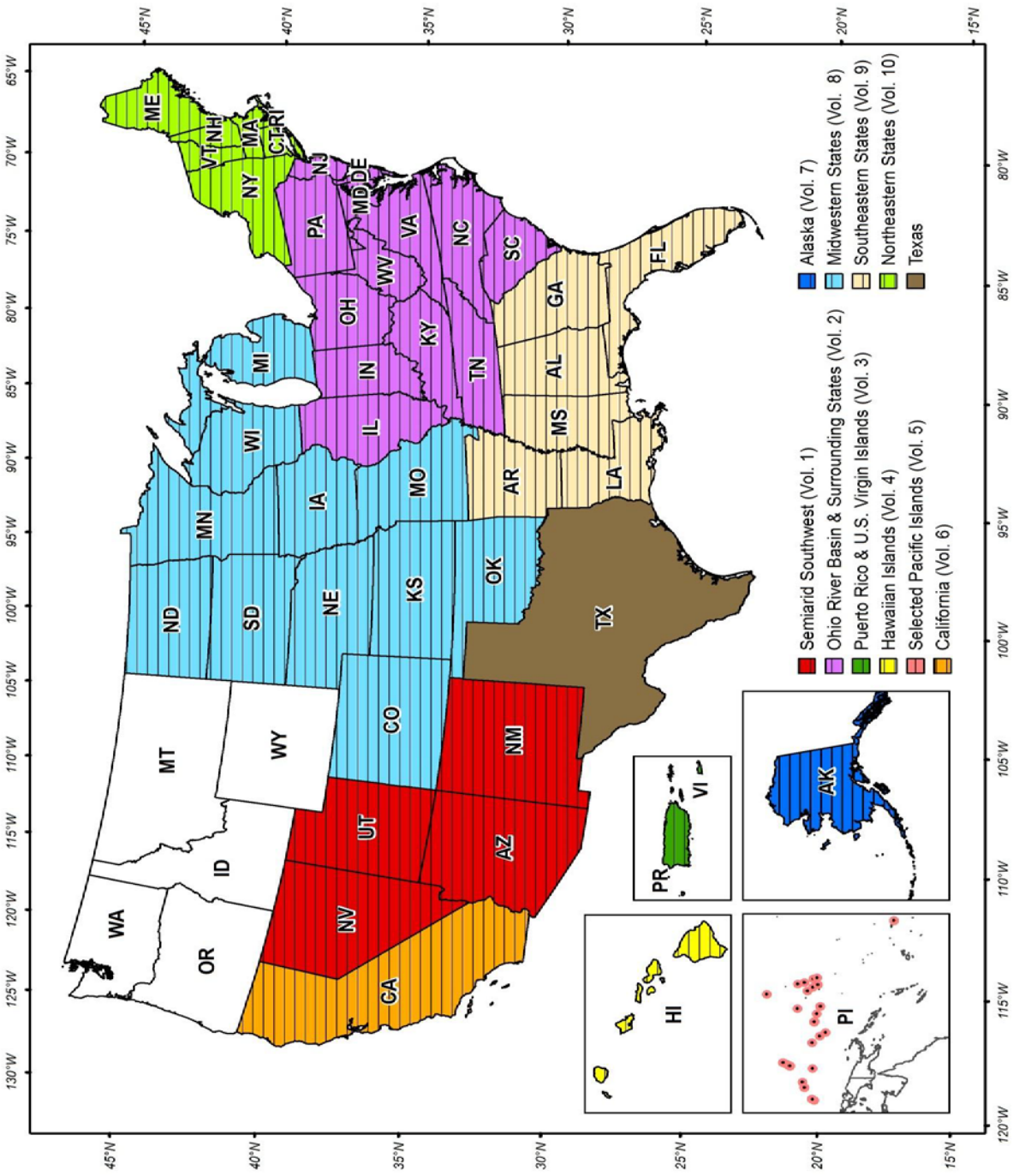

Figure 1. Current project area for Volume 11 (Texas) and project areas included in published Volumes 1 to 10.

II. CURRENT PROJECTS

1. PRECIPITATION FREQUENCY PROJECT FOR THE NORTHEASTERN STATES

1.1 PROGRESS IN THIS REPORTING PERIOD (Oct - Dec 2015)

The project area for the Northeastern precipitation frequency project includes the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont. Precipitation data from stations in approximately a 1-degree buffer around these states was also collected to assist in regional frequency analysis (Figure 2).

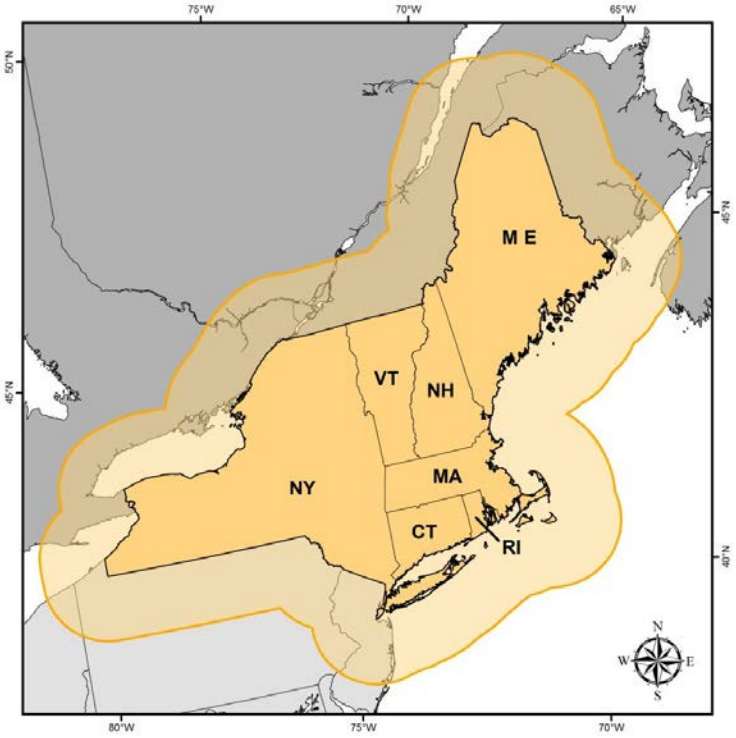

Figure 2. Extended project area for Volume 10 (shown in orange).

1.1.1 Publication announcement

Precipitation frequency estimates for the seven northeastern states listed above were published on September 30th 2015, as NOAA Atlas 14 Volume 10. They are available for any location in the project area in a variety of formats through the Precipitation Frequency Data Server (PFDS) at http://hdsc.nws.noaa.gov/hdsc/pfds (via a point-and-click interface). Additional results and information available there include:

- ASCII grids of partial duration series-based and annual maximum series-based precipitation frequency estimates and related confidence limits for a range of

durations and frequencies with associated Federal Geographic Data Committee-compliant metadata;
- cartographic maps of partial duration series-based precipitation frequency estimates for selected frequencies and durations;
- quality controlled annual maximum series for all observing locations in the project area;
- temporal distributions;
- seasonality analysis.

Cartographic maps were created to serve as visual aids and are not recommended for estimating precipitation frequency estimates. Users are advised to take advantage of the PFDS interface or the downloadable underlying ASCII grids for obtaining precipitation frequency estimates.

Work on documentation describing the station metadata, data, and project methodology has ceased until we resolve some funding issues. We expect to release the accompanying document in mid-2016.

1.2 PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jan – Mar 2016)

In the next reporting period, we expect we'll resolve funding issues and work on the documentation to accompany Volume 10 precipitation frequency estimates.

1.3 PROJECT SCHEDULE

Data collection, formatting, and initial quality control [Complete]

Extraction of annual maximum series (AMS); additional quality control and data reliability tests (e.g., outliers, independence, consistency across durations, duplicate stations, candidates for merging) [Complete]

Regionalization and frequency analysis [Complete]

Initial spatial interpolation of precipitation frequency (PF) estimates and consistency checks across durations [Complete]

Peer review [Complete]

Revision of PF estimates [Complete]

Remaining tasks (e.g., development of gridded precipitation frequency estimates, confidence intervals, development of PFDS web pages) [Complete]

Web publication of estimates [Complete]

Web publication of Volume 10 documentation [mid-2016]

2. PRECIPITATION FREQUENCY PROJECT FOR TEXAS

2.1 PROGRESS IN THIS REPORTING PERIOD (Oct - Dec 2015)

NOAA Atlas 14, Volume 11 precipitation frequency project includes the state of Texas and approximately a 1-degree buffer around this state (Figure 3). This project began in May 2015 and is expected to be completed in mid-2018.

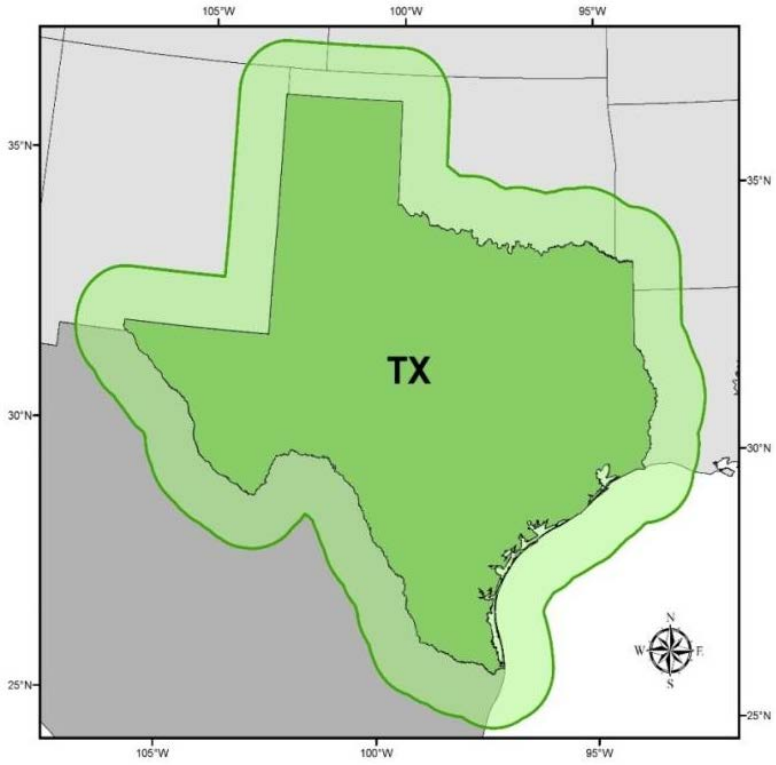

Figure 3. NOAA Atlas 14, Volume 11 extended project area (shown in green).

2.1.1. Data collection and data screening

The primary source of data for NOAA Atlas 14 Volumes is the NOAA's National Centers for Environmental Information (NCEI), but it is recognized that the NCEI's precipitation data may not be sufficient to accomplish the objectives of NOAA Atlas 14. Therefore, for each project area, we also collect digitized data measured at 1-day or shorter reporting intervals from other Federal, State and local agencies. For this project area, we are interested in collecting all available precipitation datasets (daily, hourly, 5-minute, etc.) for stations in Texas, as well as in adjacent portions of neighboring states (Arkansas, Louisiana, New Mexico, and Oklahoma) and also in Mexico.

We have downloaded and formatted 15-minute, hourly and daily data from the following NCEI's datasets: Automated Surface Observing System (ASOS); Automated Weather Observing System (AWOS), DSI 3260, DSI 23240, U.S. Climate Reference Network (USCRN), Global Historical Climatology Network (GHCN) Daily, Quality Controlled Local Climatological

Data (QCLCD) and Unedited Local Climatological Data (ULCD). We are still waiting to receive 1-minute data from NCEI since it is not available over the FTP server.

In addition to NCEI, we have received the following datasets: Climate Database Modernization Program - 19th Century Forts and Voluntary Observers Database Build Project (FORTS), National Atmospheric Deposition Program (NADP), Remote Automatic Weather Stations, Okloahoma Mesonet Observation Network, USDA NRCS Soil Climate Analysis Network (SCAN), and Meteorological Assimilation Data Ingest System (MADIS). Work has begun in order to format the data and metadata from these datasets into our common format.

In early 2015, we asked our partners for assistance with the data. During this reporting period, we continued reviewing the information they provided and contacting other agencies which were indicated as additional sources of potentially useful data. We have reached out to several potential dataset providers: Texas Commission on Environmental Quality (TCED) Air Quality Network, Tarrant Regional Water District (Greater Fort Worth area)/ Tarrant County Urban Flood Control Network, City of Austin ALERT Network, Texas Water Development Board, Bexar County Urban Flood Control Network, West Texas Mesonet, Edwards Aquifer Authority, Road Weather Information System (RWIS), and City of Dallas ALERT Network.

We would like to thank all of those who responded to our inquiry and/or provided the data. We welcome any information on the data for this project area. If you have any relevant information, please contact us at HDSC.Questions@noaa.gov.

2.1.2. Metadata quality control

We completed screening NCEI's stations' metadata (which make up the majority of the data for the project) for errors. Stations with potential errors were identified by reviewing published coordinates and elevations for large changes over the course of the station's lifetime. Stations with assigned elevations that were more than 100 feet different from elevations extracted from a 10-m digital elevation model (DEM) were investigated. Such stations may be re-located based on inspection of satellite images, maps and records of the station's history. Misplacements were typically the result of latitude and longitude data having inadequate precision. Original and revised coordinates for all stations used in the analysis will be provided in Appendix 1 of the accompanying NOAA Atlas 14 Volume 11 document. Stations with no elevation information were assigned DEM elevations.

2.2 PROJECTED ACTIVITIES FOR THE NEXT REPORTING PERIOD (Jan - Mar 2016)

The main focus for the next period will be on station cleanup. We will also continue with data collection, reformatting, and station metadata checks for non-NCEI stations. All collected data will be examined and formatted into a common format, where appropriate.

2.3 PROJECT SCHEDULE

Data collection, formatting, and initial quality control [February 2016]

Extraction of annual maximum series (AMS); additional quality control and data reliability tests (e.g., outliers, independence, consistency across durations, duplicate stations, candidates for merging) [January 2017]

Regionalization and frequency analysis [March 2017]

Initial spatial interpolation of precipitation frequency (PF) estimates and consistency checks across durations [June 2017]

Peer review [August 2017]

Revision of PF estimates [January 2018]

Remaining tasks (e.g., development of precipitation frequency estimates for partial duration series, seasonality, temporal distributions, documentation) [March 2018]

Web publication [April 2018]

III. OTHER

1. PERSONNEL

Beginning in January, Orlan Wilhite will be working part-time at HDSC. He will be assisting with digitizing data, metadata checking and data formatting for the Texas project.

2. UPDATE TO MISSOURI LONG DURATION GRIDS (VOLUME 8)

Missouri's design criteria for animal feeding operations include magnitudes of the 10-year average recurrence interval for 90-day, 180-day and 365-day durations. To accommodate the need for these values, in Volume 8 we did additional at-station frequency analysis for Missouri for these durations. In the process of trimming the Missouri long duration grids, the third and the fourth decimal values in latitude (yllcorner) and longitude (xllcorner) header ASCII grids information were rounded. The consequence of the round of error was that the Missouri long duration grids were not aligning exactly with the NOAA Atlas Volume 8 grids. In this reporting period, we have corrected the ASCII header information in the Missouri long duration grids. The correct xllcorner value is -95.896372 (as compared to -95.896400) and the correct yllcorner value is 35.937395 (as compared to 35.937400).

3. EXCEEDANCE PROBABILITY ANALYSIS FOR THE RECENT TEXAS STORM EVENTS

During this reporting period, HDSC analyzed annual exceedance probabilities (AEPs) for two rainfall events that occurred in Texas in late October 2015: (1) near Corsicana on 24 - 25 October and (2) near Austin on 30 October. The AEP is the probability of exceeding a given amount of rainfall at least once in any given year at a given location. It is an indicator of the rarity of rainfall amounts and is used as the basis of hydrologic design.

The underlying data for the AEP analyses were rainfall observations and point rainfall frequency estimates for a range of durations and frequencies. Hourly rainfall data at 4km grid resolution came from the National Centers for Environmental Prediction (NCEP), Environmental Modeling Center's (EMC) Stage IV analysis. Rainfall frequency estimates were obtained from digitized paper cartographic maps from the Weather Bureau's Technical Paper 40 (TP40), which is still the valid NWS precipitation frequency document for the state of Texas. Since the TP40 estimates are available only for AEPs up to the 1/100, we adopted simplified NOAA Atlas 14 methodology to extrapolate estimates to 1/200 and 1/500 AEP (for more details see Texas, October 2015 AEP analysis document)

For the Corsicana storm of 24 - 25 October, the critical duration was 24 hours. The Automated Surface Observing System (ASOS) C David Campbell Field Corsicana Municipal Airport gauge KCRS, 5 miles SE of Corsicana, for example, experienced rainfall magnitudes over 20 inches, with an AEP lower than 1/500 (0.2%) at the 24-hour duration. The map in Figure 4 shows areas that experienced 24-hour rainfall magnitudes with AEPs ranging from 1/10 (10%) to smaller than 1/500 (0.2%).

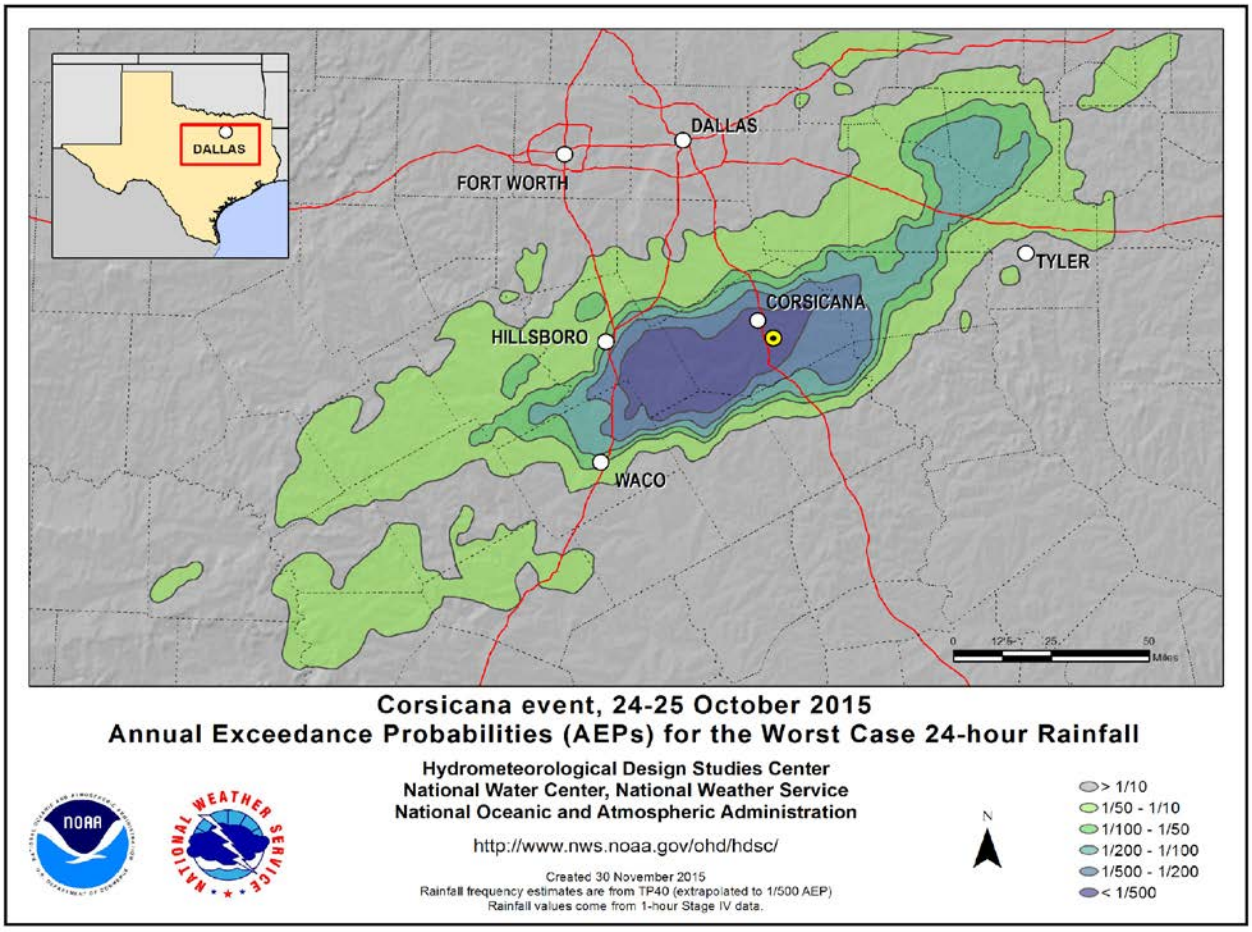

Figure 4. Annual exceedance probabilities for the worst case 24-hour rainfall from 24 to 25 October 2015 near Corsicana. The yellow marker is the location of the KCRS gauge.

For the Austin storm of 30 October, we created AEP maps for 3-hour and 6–hour durations (Figures 5 and 6). For this event, for example, the Lower Colorado River Authority LCRA) rain gauge at Highway 183 and Onion Creek recorded over 13 inches in 3 hours and over 14 inches in 6 hours with an AEP lower than 1/500 (0.2%) at these durations.

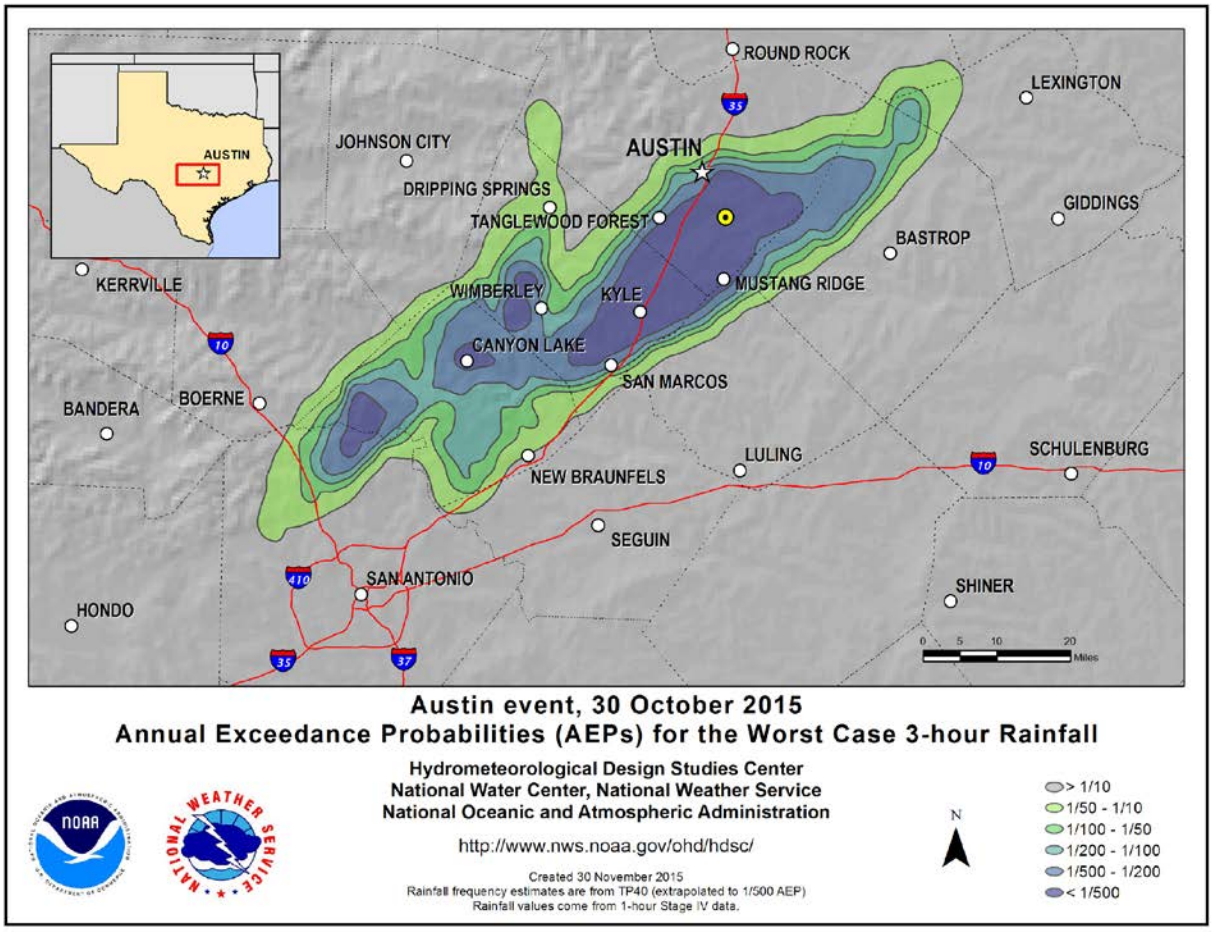

Figure 5. Annual exceedance probabilities for the worst case 3-hour rainfall from 30 October 2015 near Austin. The yellow marker is the location of the LCRA gauge.

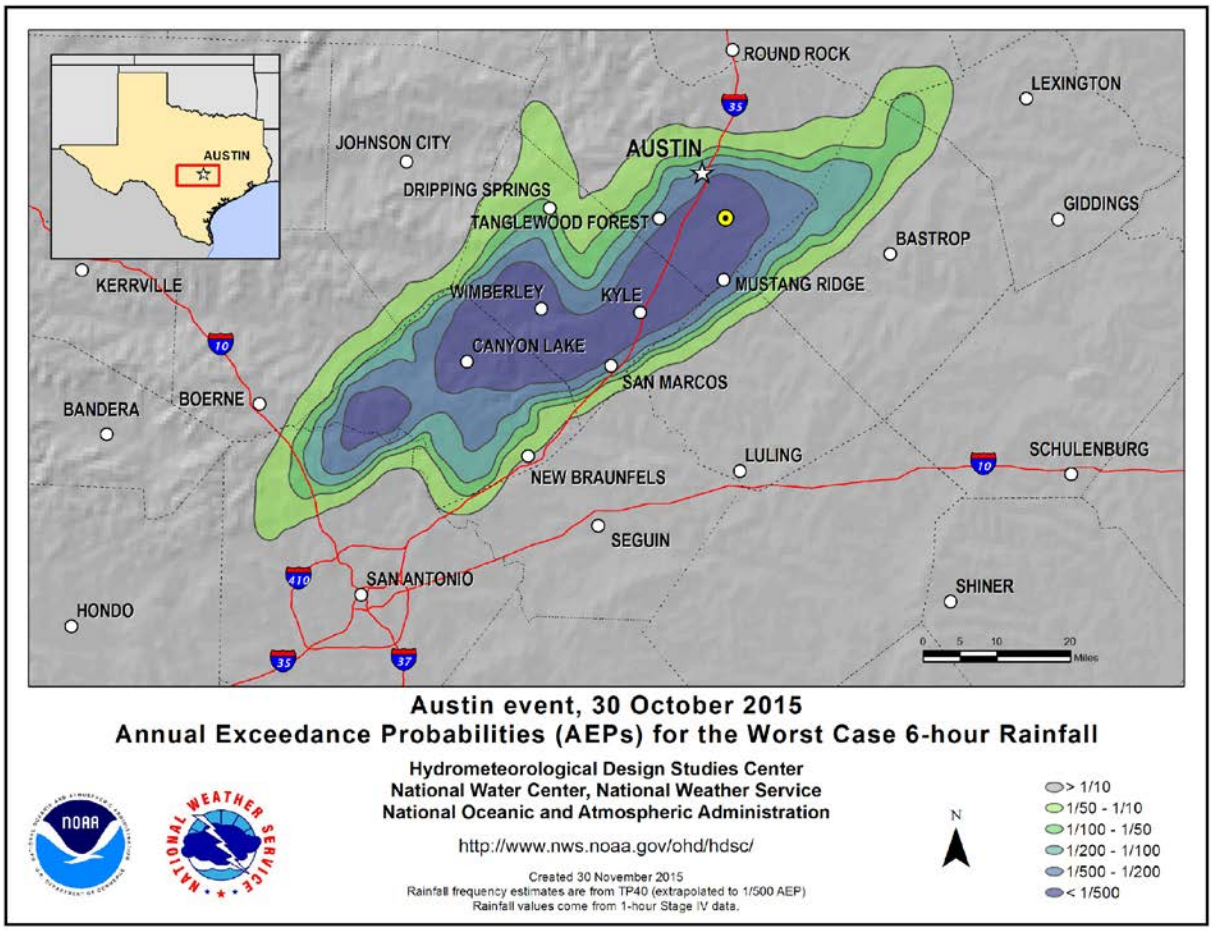

Figure 6. Annual exceedance probabilities for the worst case 6-hour rainfall from 30 October 2015 near Austin. The yellow marker is the location of the LCRA gauge.