

NWS FORM E-5 (11-88) (PRES. by NWS Instruction 10-924)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE	HYDROLOGIC SERVICE AREA (HSA)	
		Tulsa, Oklahoma (TSA)	
MONTHLY REPORT OF RIVER AND FLOOD CONDITIONS		REPORT FOR:	
		MONTH July	YEAR 2014
TO: Hydrometeorological Information Center, W/OH2 NOAA / National Weather Service 1325 East West Highway, Room 7230 Silver Spring, MD 20910-3283		SIGNATURE Steven F. Piltz (Meteorologist-in-Charge)	
		DATE August 5, 2014	

When no flooding occurs, include miscellaneous river conditions, such as significant rises, record low stages, ice conditions, snow cover, droughts, and hydrologic products issued (NWS Instruction 10-924)

An "X" in the box indicates no flood stages were reached in this Hydrologic Service Area (HSA) during the month above.

Several cold fronts brought well below average temperatures to eastern OK and northwest AR in July 2014, with Fayetteville, AR having its coldest July since records began in 1950. Far northeast OK and northwest AR received below normal rainfall this month, with much above normal precipitation across southeast OK. Normal rainfall for the month of July ranges from 2.6 inches in McIntosh County to 3.4 inches in Ottawa County. The Ozark region of northwest Arkansas averages 3.1 inches for the month.

Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 1a), rainfall totals for July 2014 ranged from 1" in northwest AR to around 11" in isolated locations of southeast OK. The majority of the HSA received 3"-5" of rain this month. Most of northwest AR, as well as far northeast OK, received only 25%-75% of the normal July rainfall this month, though portions of Crawford, Sebastian, and Franklin Counties ended the month above normal (Fig. 1b). The remainder of eastern OK saw near normal to around 200% of normal this month, and central Pittsburg County received over 300% of the normal July rainfall.

Tulsa, OK (TSA): July, 2014 Monthly Observed Precipitation
 Valid at 8/1/2014 1200 UTC- Created 8/3/14 23:56 UTC

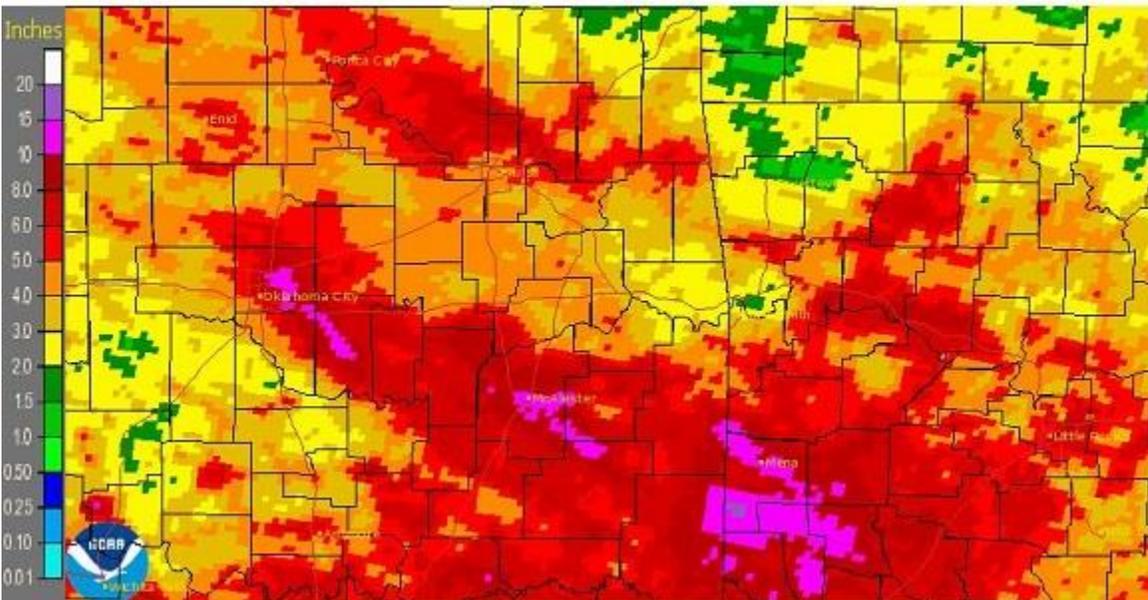


Fig. 1a. Estimated Observed Rainfall for July 2014

Tulsa, OK (TSA): July, 2014 Monthly Percent of Normal Precipitation
 Valid at 8/1/2014 1200 UTC- Created 8/3/14 23:57 UTC

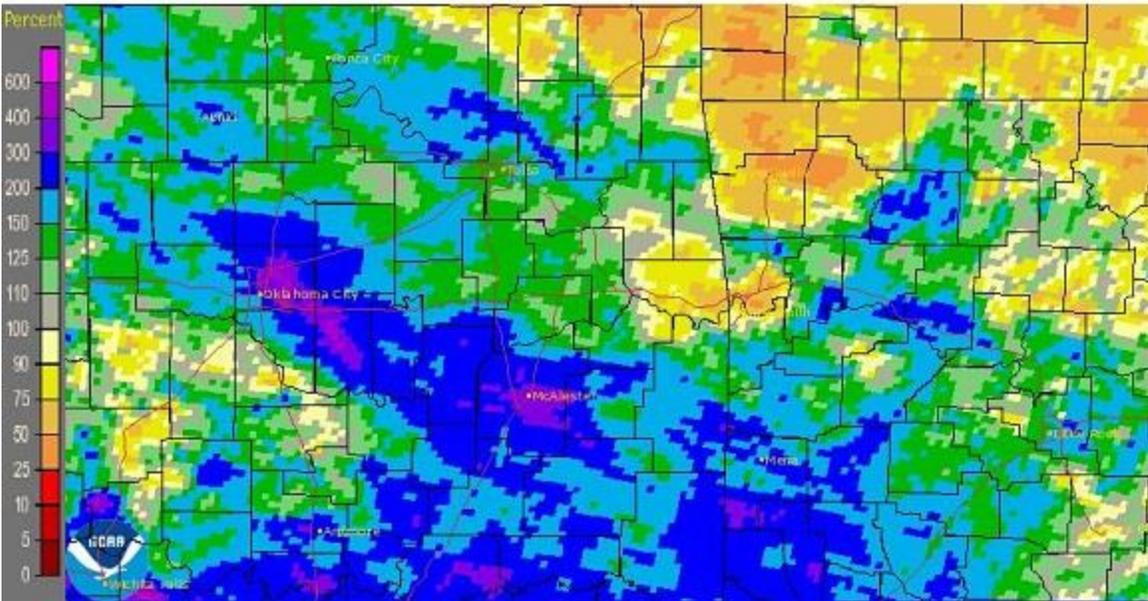


Fig. 1b. Estimated % of Normal Rainfall for July 2014

In Tulsa, OK, July 2014 ranked as the 5th coldest July (78.2°F; since records began in 1905) and the 34th wettest July (4.42"; since records began in 1888). Fort Smith, AR was the 8th coldest July (78.3°F; since records began in 1882) and the 58th wettest July (2.68", tied 1893; since records began in 1882). Fayetteville, AR was the **record coldest** (72.7°F; previous record 73.8°F in 1950) and the 33rd wettest and driest (2.43") July since records began in 1950.

Some of the larger precipitation reports (in inches) for July 2014 included:

Clayton, OK (meso)	11.30	McAlester, OK (meso)	11.02	McAlester, OK (ASOS)	9.95
Talihina, OK (meso)	8.26	Cloudy, OK (meso)	7.70	Skiatook, OK (meso)	7.64
Wister, OK (meso)	7.12	Ralston, OK (coop)	6.84	Bengal, OK (coop)	6.35

Some of the lowest precipitation reports (in inches) for July 2014 included:

NW AR Regional Airport (ASOS)	1.70	Vinita, OK (meso)	2.24	Hindsville 10NNE, AR (coop)	2.38
Nowata, OK (meso)	2.39	Fayetteville, AR (ASOS)	2.43	Berryville 5NW, AR (coop)	2.46
Miami, OK (meso)	2.48	Copan, OK (meso)	2.62	Fort Smith, AR (ASOS)	2.68

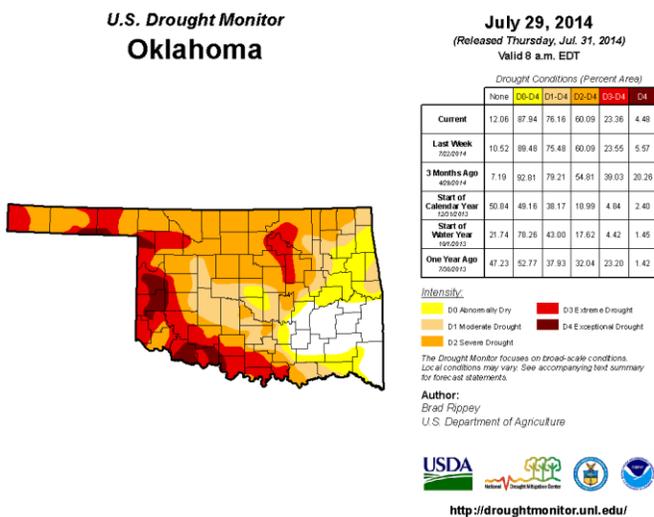


Fig. 2. Drought Monitor for Oklahoma

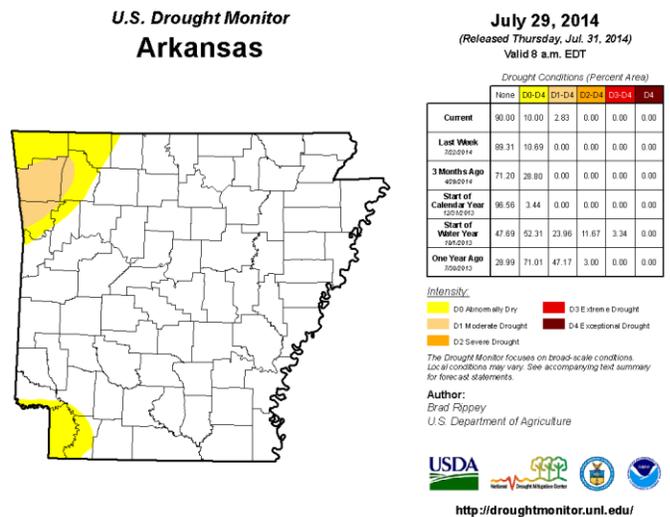


Fig. 3. Drought Monitor for Arkansas

According to the [U.S. Drought Monitor](http://droughtmonitor.unl.edu/) (USDM) from July 29, 2014 (Figs 2, 3), Extreme Drought (D3) conditions remained across Pawnee, southwest Osage, and western Creek Counties in northeast OK. Severe

Drought (D2) conditions were Osage, eastern Creek, western Okfuskee, western Okmulgee, western Tulsa, Washington, northern Rogers, Nowata, and Craig Counties in eastern OK. Moderate Drought (D1) conditions were present across Ottawa, southern Craig, southern Rogers, Tulsa, eastern Okfuskee, Okmulgee, northern Mayes, western Wagoner, Adair, eastern Sequoyah, and western Choctaw Counties in eastern OK, and Crawford and Washington Counties in northwest AR. Abnormally Dry (D0), but not experiencing drought, conditions were occurring across the remainder of eastern OK along and north of I-40, as well as southern Pushmataha and Choctaw Counties. In northwest AR, D0 conditions were affecting Benton, Carroll, southeastern Crawford, Madison, and far northwestern Franklin Counties.

According to the USACE, most of the major reservoirs in the HSA were operating within $\pm 3\%$ of the top of their conservation pools as of 7/31/2014. Several lakes remained below normal: Skiatook Lake 64%, Ft. Gibson Lake 85%, Heyburn Lake 89%, and Beaver Lake 91%. A few lakes had levels within their flood control pools: Sardis Lake 115%, Eufaula Lake 106% and Hudson Lake 104%.

According to statistics from the [Oklahoma Climatological Survey](#) (OCS):

Rank since 1921	Last 30 Days (Jul 2 – Jul 31)	Summer 2014 (Jun 1 – Jul 31)	Last 90 Days (May 3 – Jul 31)	Warm Growing Season (Mar 1 – Jul 31)	Year-to-Date (Jan 1 – Jun 30)	Water Year-to-Date (Oct 1 – Jun 30)	Last 365 Days (Aug 1, 2013 – Jul 31, 2014)
Northeast OK	29 th wettest	25 th wettest	34 th wettest	25 th driest	13th driest	14th driest	19 th driest
East Central OK	19 th wettest	22 nd wettest	37 th wettest	41 st driest	19 th driest	29 th driest	25 th driest
Southeast OK	7th wettest	15th wettest	14th wettest	24 th wettest	43 rd driest	42 nd wettest	41 st driest
Statewide	11th wettest	11th wettest	23 rd wettest	41 st driest	26 th driest	23 rd driest	23 rd driest

Outlooks

The [Climate Prediction Center](#) (CPC) outlook for August 2014 (issued July 31, 2014) indicates a slightly enhanced chance for above median precipitation and equal chances for above, near, and below normal temperatures across all of eastern OK and northwest AR. This outlook is based on short-range forecasts of expected weather conditions, primarily for the first half of August.

For the 3-month period August-September-October 2014, CPC is forecasting a slightly enhanced chance for above median precipitation and equal chances for above, near, and below normal temperatures across all of eastern OK and northwest AR (outlook issued July 17, 2014). According to CPC, current atmospheric and oceanic observations suggest a transition from ENSO neutral to El Niño conditions is underway. El Niño is still favored to be in place by early fall, though the uncertainty about the pace of onset and intensity have increased slightly. An El Niño of weak to moderate strength is most likely. Therefore, this outlook is based on both statistical and dynamical forecast tools and considering El Niño conditions.

Summary of Precipitation Events

July 1-15

An outflow boundary was in place across southeast OK and into west central AR, allowing showers and thunderstorms to develop during the evening hours of the 1st. Rainfall rates were as high as 2.5"/hour at times. Rain continued near the boundary overnight and into the morning hours of the 2nd as an upper-level wave moved across the region. Rainfall totals were 0.25" to around 3" across a large portion of southeast OK, south of I-40 (Fig. 4).

Tulsa, OK (TSA): 7/2/2014 1-Day Observed Precipitation
Valid at 7/2/2014 1200 UTC- Created 7/4/14 23:32 UTC



Fig. 4. 24-hr estimated observed rainfall ending at 7am 7/2/2014.

Tulsa, OK (TSA): 7/9/2014 1-Day Observed Precipitation
Valid at 7/9/2014 1200 UTC- Created 7/10/14 13:42 UTC

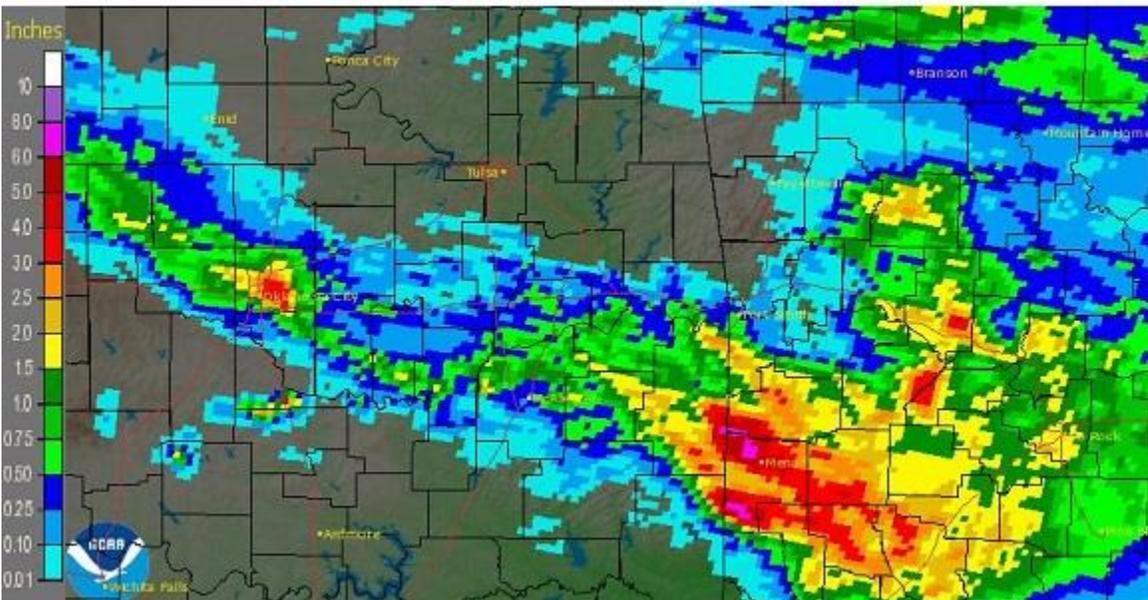


Fig. 5. 24-hr estimated observed rainfall ending at 7am 7/9/2014.

A cold front moved south into the HSA on the 8th, and stalled across southeast OK and west central AR. Thunderstorms developed along and near the front during the evening hours producing periods of heavy rain, primarily across Le Flore County. Scattered showers and thunderstorms continued near the stalled front overnight and into the morning of the 9th. By 7am on the 9th, rainfall totals across the affected area ranged from around 0.50" to around 1.5". Higher totals of 1.5"-6" fell in Le Flore County, with a rainfall measurement of 5.39" 5 miles north of Page, OK (Fig. 5). A small area just south of McAlester also saw higher totals of 1.5" to around 3" of rain.

During the morning hours of the 10th, an MCS over southern KS moved into north central and northeast OK. The MCS continued to move southeast across east central OK and northwest AR into the early afternoon. A secondary round of thunderstorms developed near the OK/KS state line late-morning and moved over the same areas as the first round of storms. This led to flash flooding in the Skiatook vicinity. The axis of heaviest rain, 1.5" – 4", occurred along a Pawhuska to Claremore to Mountainburg line (Figs. 6 and 7). Rainfall totals

elsewhere ranged from 0.25" – 1.5" for much of the HSA. The clouds and rain kept temperatures very cool – with an unusual-for-July temperature range of 32° across the state (from 68° in Cherokee and Adair Counties to 100° in Tillman County, Fig. 8).

Measured rainfall totals ending at 7am 7/11/2014:

Avant, OK (DCP)	5.14"	Skiatook 4NW, OK (meso)	3.75"
Claremore 7.5W, OK (CoCoRaHS)	3.72"	Owasso, OK (CoCoRaHS)	3.25"
Inola 3SSE, OK (meso)	3.18"		

Tulsa, OK (TSA): 7/11/2014 1-Day Observed Precipitation
Valid at 7/11/2014 1200 UTC- Created 7/13/14 23:33 UTC

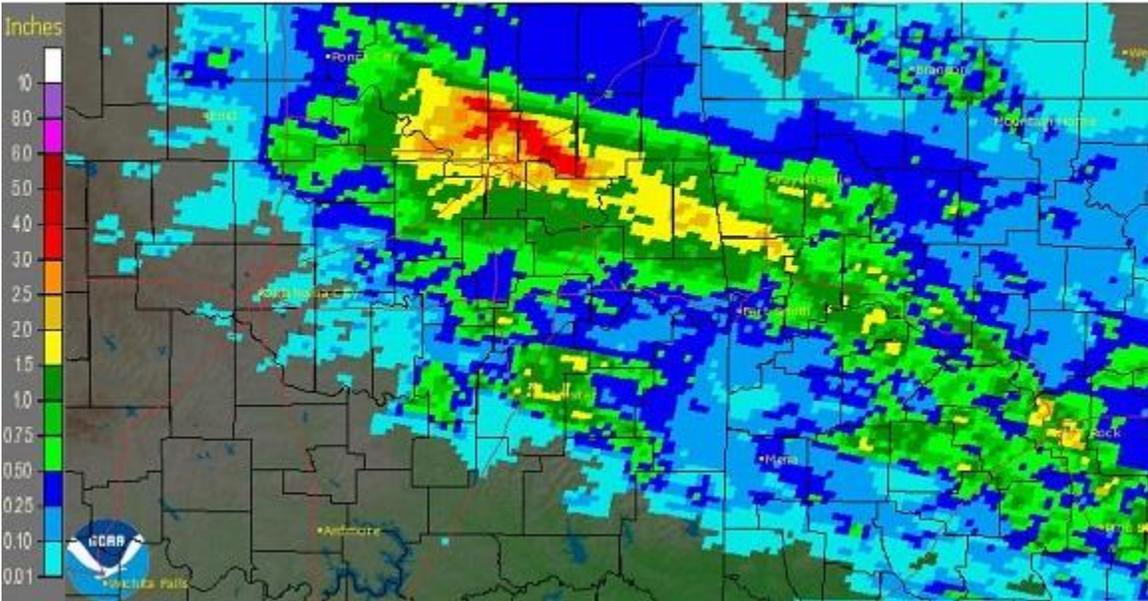
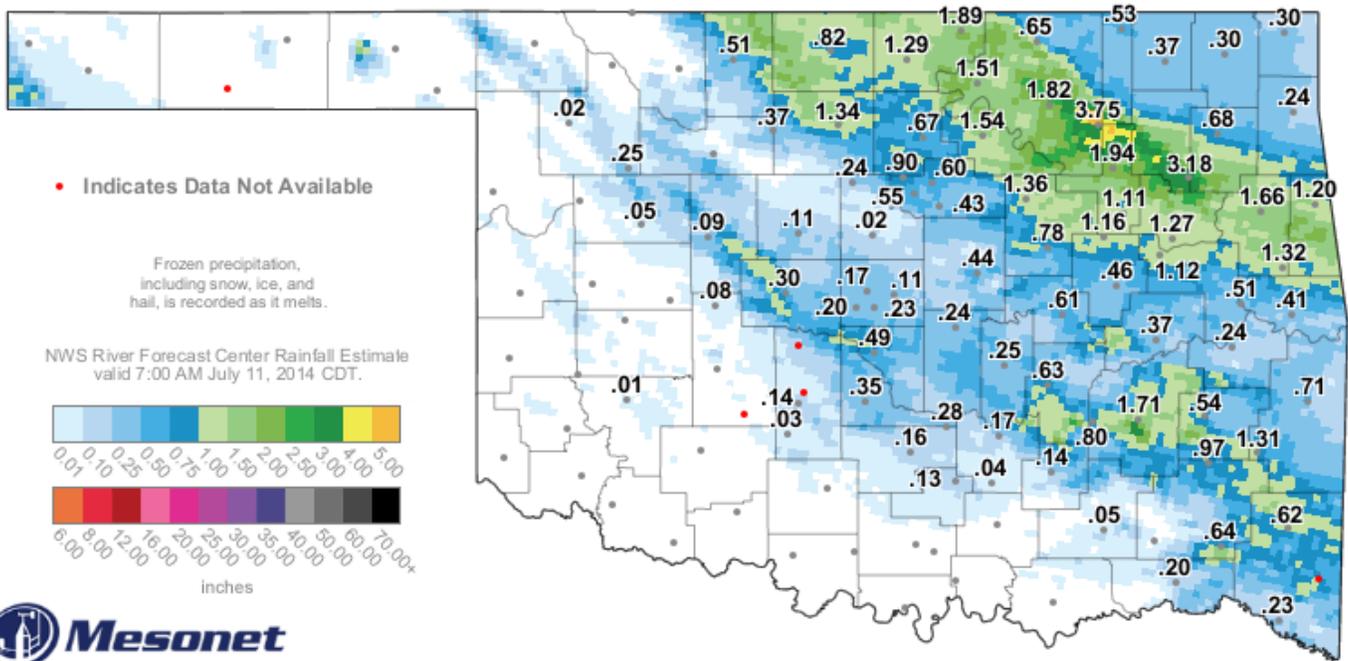


Fig. 6. 24-hr estimated observed rainfall ending at 7am 7/11/2014.



Mesonet
2-Day Rainfall (inches)

8:15 AM July 11, 2014 CDT
Created 8:20:17 AM July 11, 2014 CDT. © Copyright 2014

Fig. 7. 2-day estimated observed rainfall (image) and OK Mesonet measurements ending at 8:15am 7/11/2014.

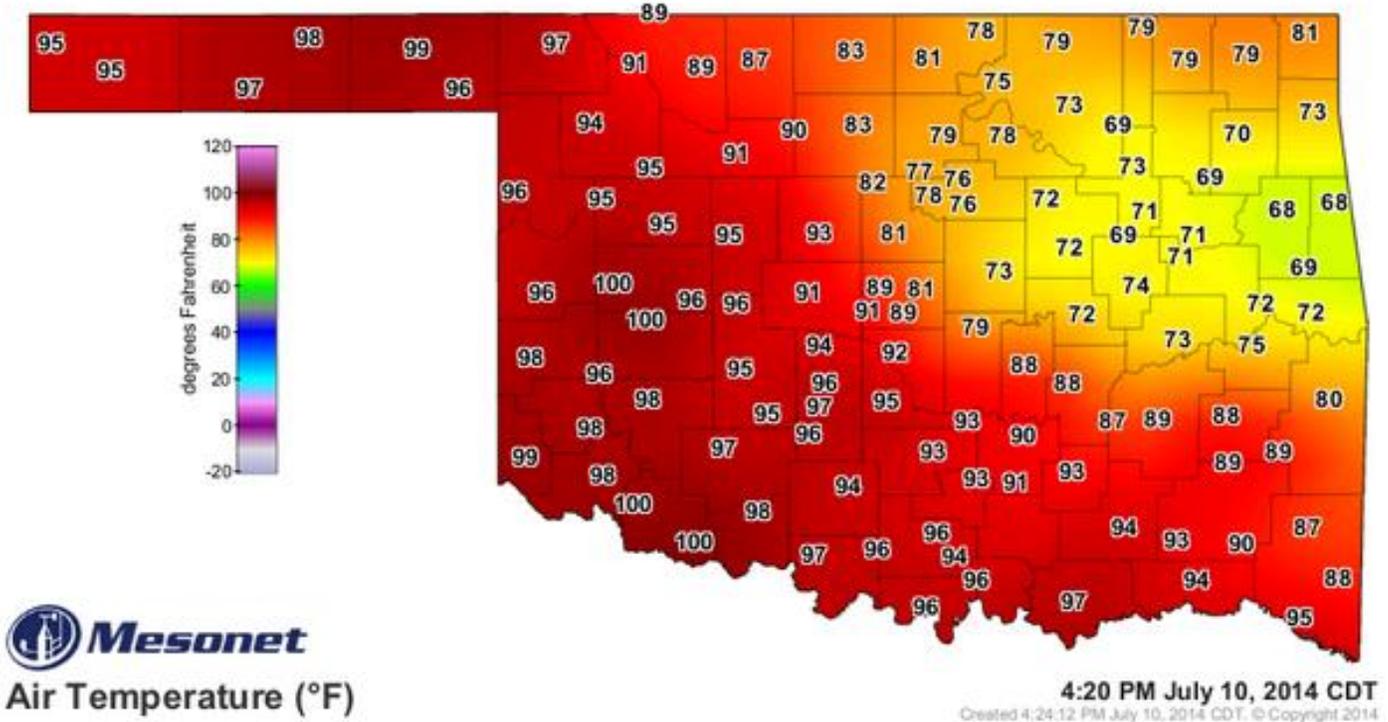


Fig. 8. OK Mesonet temperatures at 4:20pm 7/10/2014.

A weak cold front moved into northeast OK during the late afternoon and evening hours of the 13th, causing widely scattered showers and thunderstorms to develop from Pawnee to Collinsville to Miami. Affected locations received 0.25"-0.75", with isolated totals of 1"-1.5".

Showers and thunderstorms developed along the weak boundary during the morning of the 14th, primarily affecting southeast OK into northwest AR. A stronger cold front moved south into the region during the late afternoon and evening hours, with additional isolated convection across northeast OK, southeast OK, and northwest AR. Rainfall totals were generally around 0.50" or less, with higher totals of 1" to around 2" across eastern Crawford, Franklin and southern Madison Counties in west central AR. This front also brought unseasonably cold temperatures to the region.

July 16-31

It was unseasonable cool and wet for several days across the HSA mid-month. An area of showers and thunderstorms moved southeast along an 850mb front during the afternoon of the 16th through the early morning hours of the 17th. This activity primarily affected locations southwest of a Pawhuska to Fort Smith line, where 0.25"-1.5" of rain occurred. A narrow band of 2"-4" of rain fell across southern Pushmataha County (Figs. 9, 11). In addition, a warm front moved north and became quasi-stationary from north central TX to southwest LA on the 16th/early on the 17th. Strong isentropic lift over the front, combined with a potent mid-level shortwave and a very moist atmosphere, caused widespread showers and thunderstorms across eastern OK and northwest AR for much of the day on the 17th. Rainfall remained relatively light, with an additional 0.25"-1" across a large portion of the area (Fig. 10). All of the clouds and rain kept temperatures very cool on the 17th, with highs only in the mid- to upper-60s for most of the HSA (Fig. 12) – very unusual for mid-July! Tulsa recorded 4 days in a row, July 15-18, 2014, with temperatures colder than 80°F, the first time in recorded history (since 1905) this has occurred. Several reporting stations recorded new record daily cold maximum temperatures and new record minimum temperatures. According to the Oklahoma Climatological Survey, July 17, 2014 was the coolest July day on record for Oklahoma, with July 16, 2014 ranking as 3rd coolest on record (read more about this here: <http://ticker.mesonet.org/select.php?mo=07&da=18&yr=2014>).

Tulsa, OK (TSA): 7/17/2014 1-Day Observed Precipitation
Valid at 7/17/2014 1200 UTC- Created 7/18/14 17:42 UTC

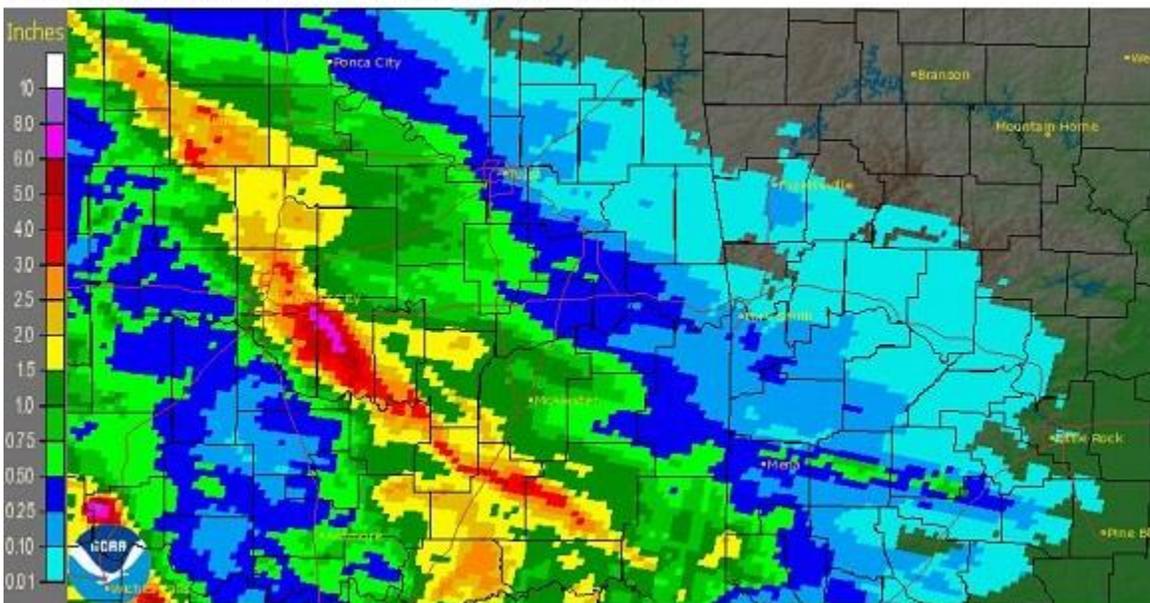


Fig. 9. 24-hr estimated observed rainfall ending at 7am 7/17/2014.

Tulsa, OK (TSA): Current 1-Day Observed Precipitation
Valid at 7/18/2014 1200 UTC- Created 7/18/14 17:54 UTC

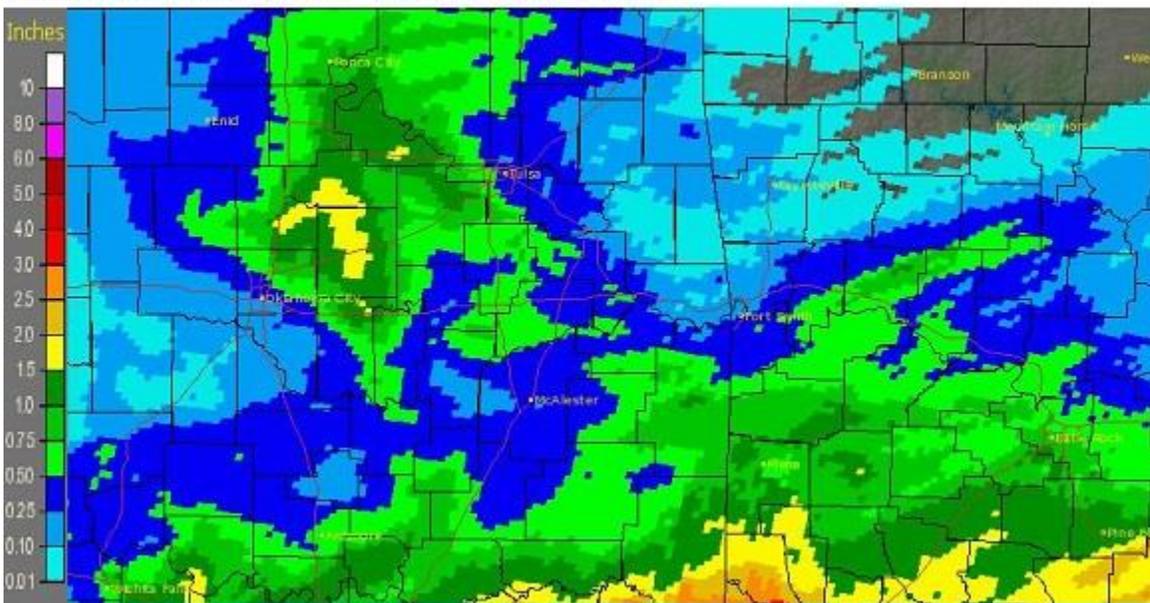
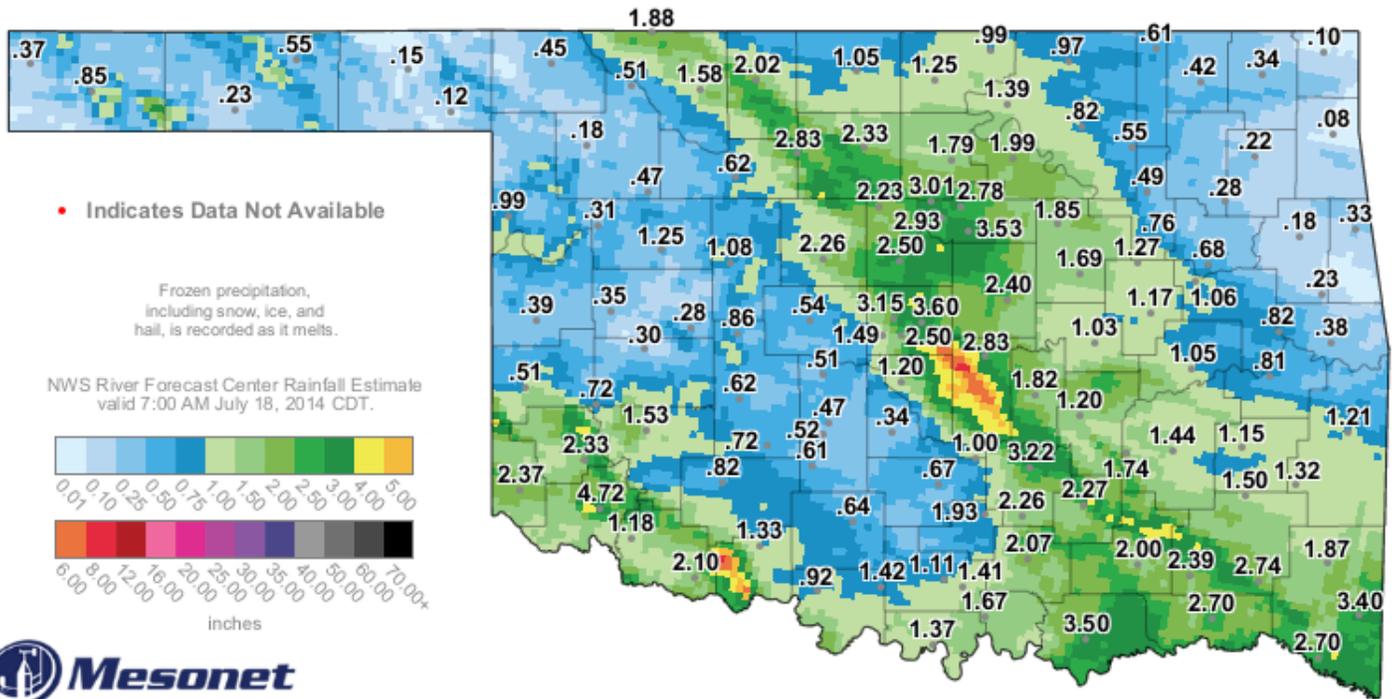


Fig. 10. 24-hr estimated observed rainfall ending at 7am 7/18/2014.

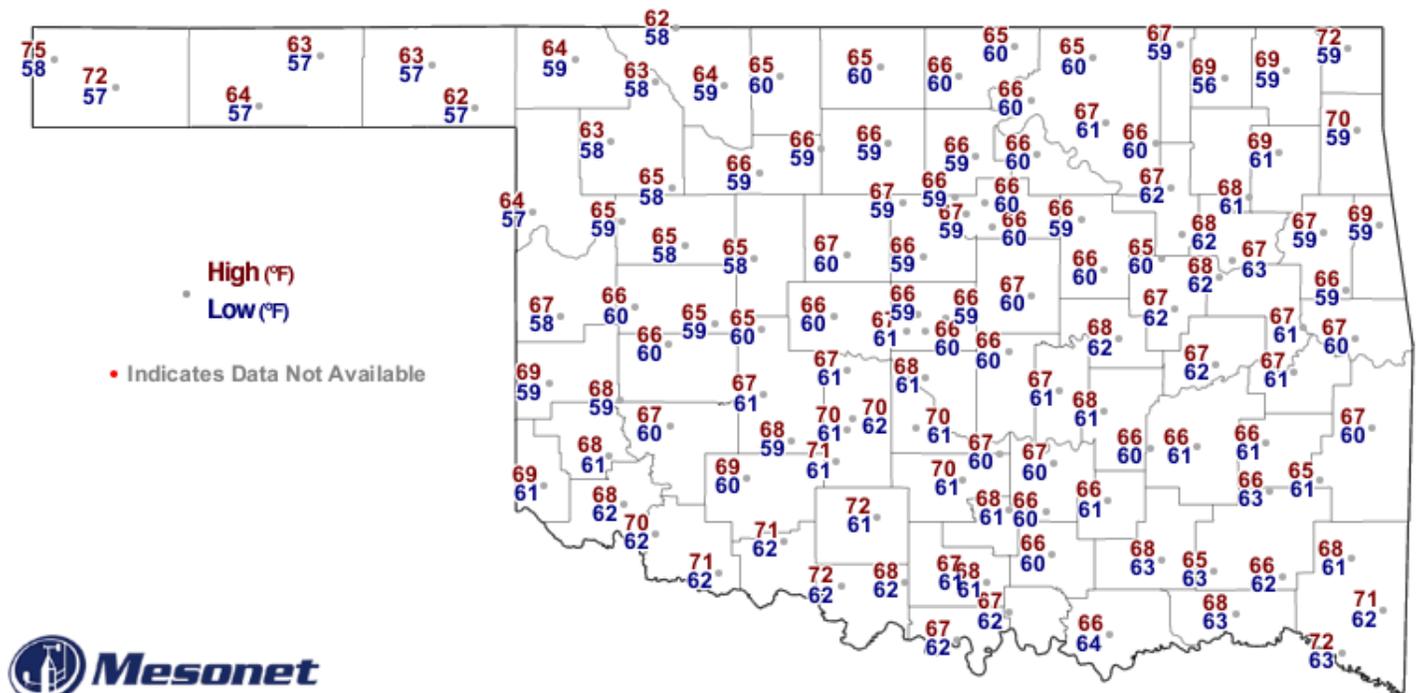


2-Day Rainfall (inches)

8:10 AM July 18, 2014 CDT

Created 8:14:35 AM July 18, 2014 CDT. © Copyright 2014

Fig. 11. 2-day estimated observed rainfall (image) and OK Mesonet measurements ending at 8:10am 7/18/2014.



Max and Min Temperatures (°F)

July 17, 2014

Created 7:30:12 AM July 18, 2014 CDT. © Copyright 2014

Fig. 12. OK Mesonet High and Low Temperatures for 7/17/2014.

An MCS moved out of KS and into eastern OK and western AR on the 24th. A combination of a hot and humid, and therefore unstable, airmass ahead of the line of storms and a strong cold pool behind them caused the line to bow out and produce widespread wind damage across far eastern OK and western AR. Rainfall totals were primarily 0.25"-1.5" east of Hwy 75, which mostly fell in a short amount of time (Fig. 16). Southern Franklin and southwest Sebastian Counties received 1.5"-4" of rain (Fig. 13). Local farmers just west of Altus in southern Franklin County stated they measured upwards of 5" in just a couple of hours during this event. Street

flooding was reported in Altus, with water briefly over county roads near and just west of Altus. Ratcliff, AR measured 2.96". The cold pool created a significant drop in temperatures as the storms passed, with a 15°-20° drop in just 1 hour (Figs. 14, 15)!

Tulsa, OK (TSA): 7/24/2014 1-Day Observed Precipitation
Valid at 7/24/2014 1200 UTC- Created 7/24/14 14:18 UTC

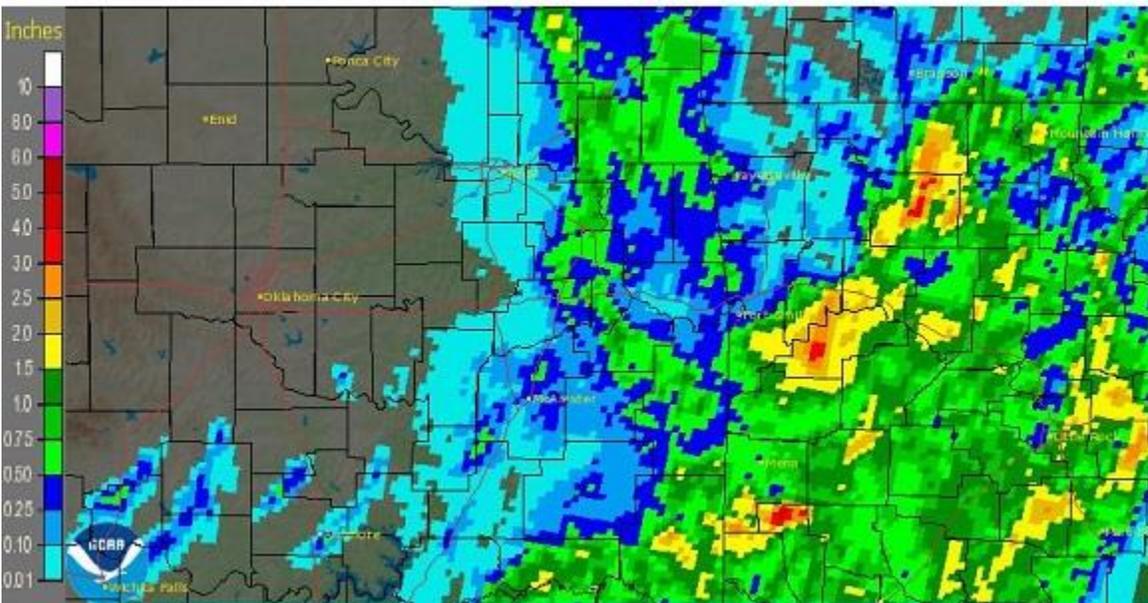
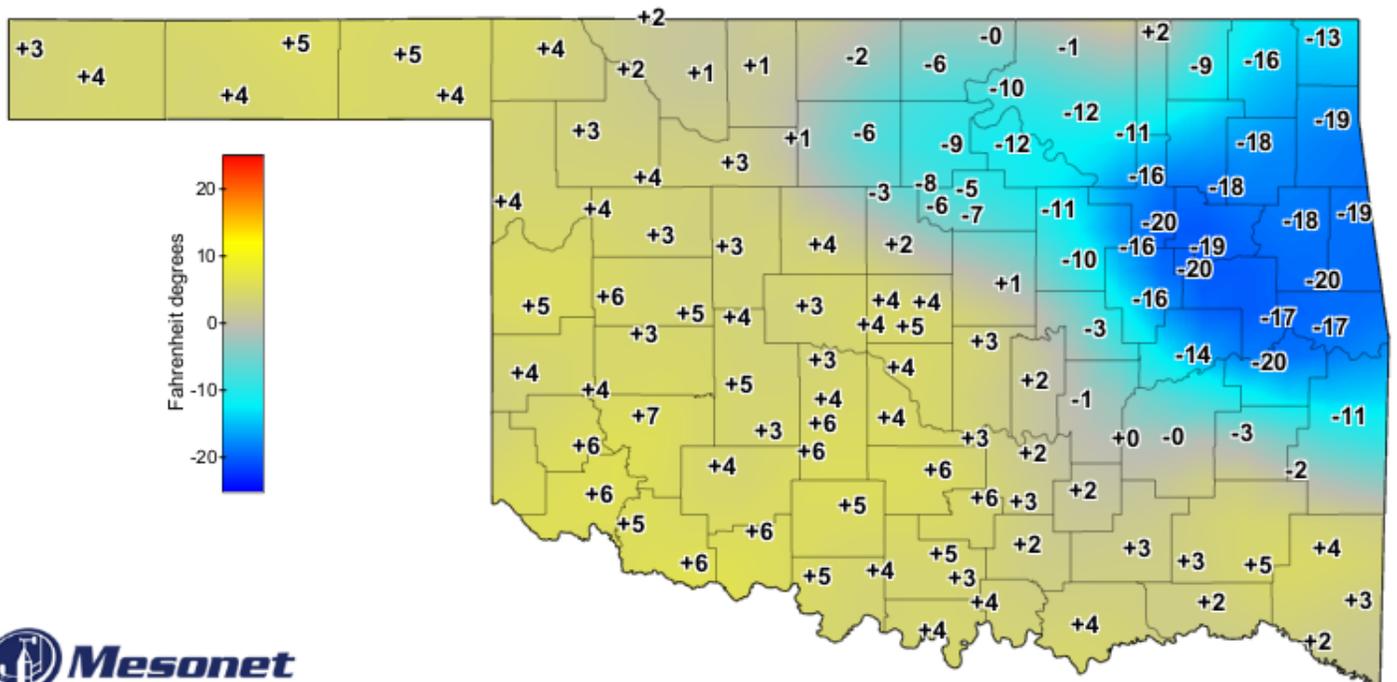


Fig. 13. 24-hr estimated observed rainfall ending at 7am 7/18/2014.



3-Hour Temperature Change (°F)

3:25 PM July 23, 2014 CDT

Created 3:29:03 PM July 23, 2014 CDT. © Copyright 2014

Fig. 14. OK Mesonet 3-hour Temperature Change ending at 3:25pm CDT 7/23/2014.

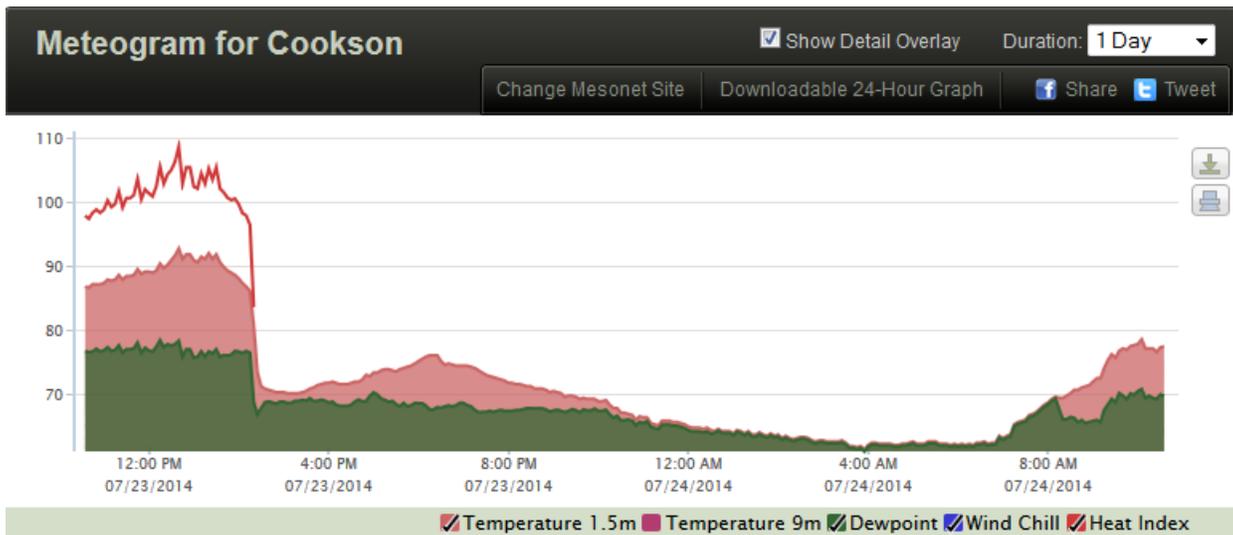


Fig. 15. OK Mesonet Meteogram for Cookson, OK showing fast temperature drop.

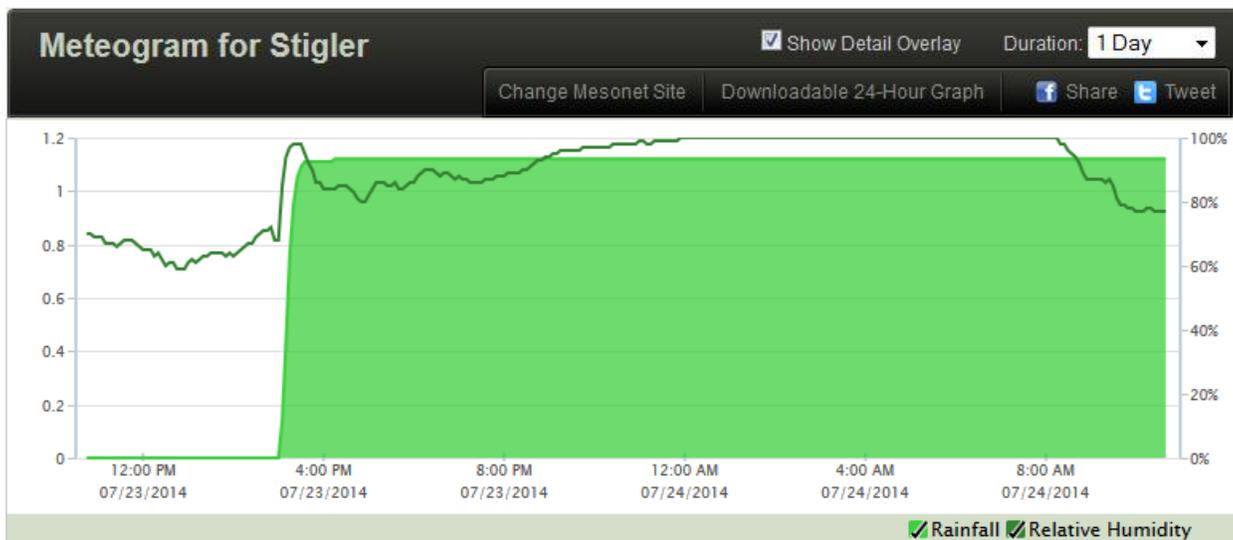
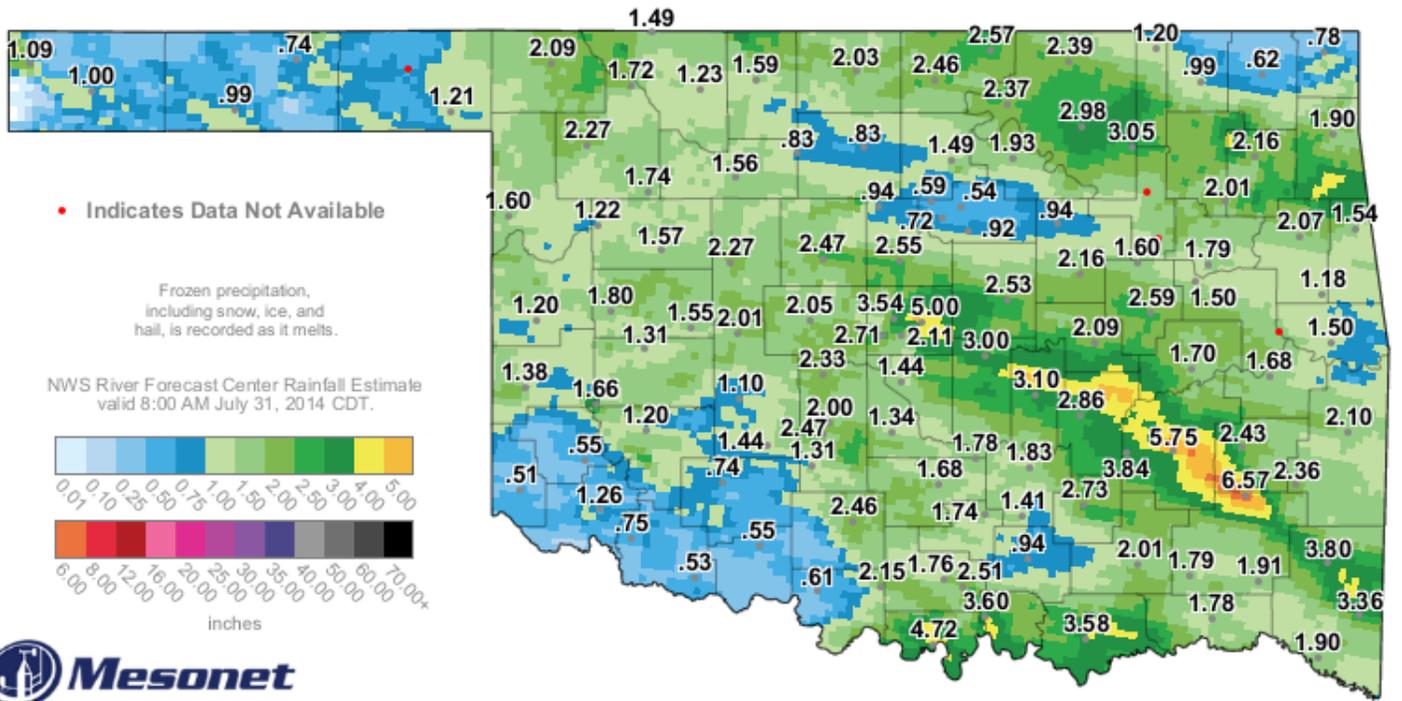


Fig. 16. OK Mesonet Meteogram for Cookson, OK showing fast rainfall accumulation.

Deep moisture, an elevated frontal zone, and a mid-level shortwave produced widespread rainfall across all of eastern OK and northwest AR on the 30th through the morning of the 31st. Most of the HSA received 1"-2" of rain from this event, with several locations reporting 2"-3". A narrow band of heavy rain fell from northwest Pittsburg County to northern Pushmataha County, bringing 4"-7" of rain (Figs. 17, 18, 19). The Oklahoma Mesonet site in Clayton (northern Pushmataha Co.) measured 6.57", the Mesonet site in McAlester measured 5.75", the USACE river gage station 4ESE Hartshorne (southwest Latimer Co.) measured 5.95", and the ASOS in McAlester (Pittsburg Co.) measured 5.18" by 9am CDT 7/31/2014. This heavy rain led to flash flooding. Street flooding was reported throughout McAlester. The Kiamichi River near Clayton rose 6 feet in 7 hours, though remained below an established flood stage. The rain gage at this location also measured 4.67" of rain. Weak showers persisted during the day on the 31st across much of the HSA, bringing an additional 0.10"-0.50" to southeast OK, and around 0.10" or less to the remainder of the area. The rain at the end of the month once again kept temperatures much cooler than average throughout the region.



2-Day Rainfall (inches)

9:00 AM July 31, 2014 CDT

Created 9:04:16 AM July 31, 2014 CDT. © Copyright 2014

Fig. 17. 2-day estimated observed rainfall (image) and OK Mesonet measurements ending at 9am 7/31/2014.

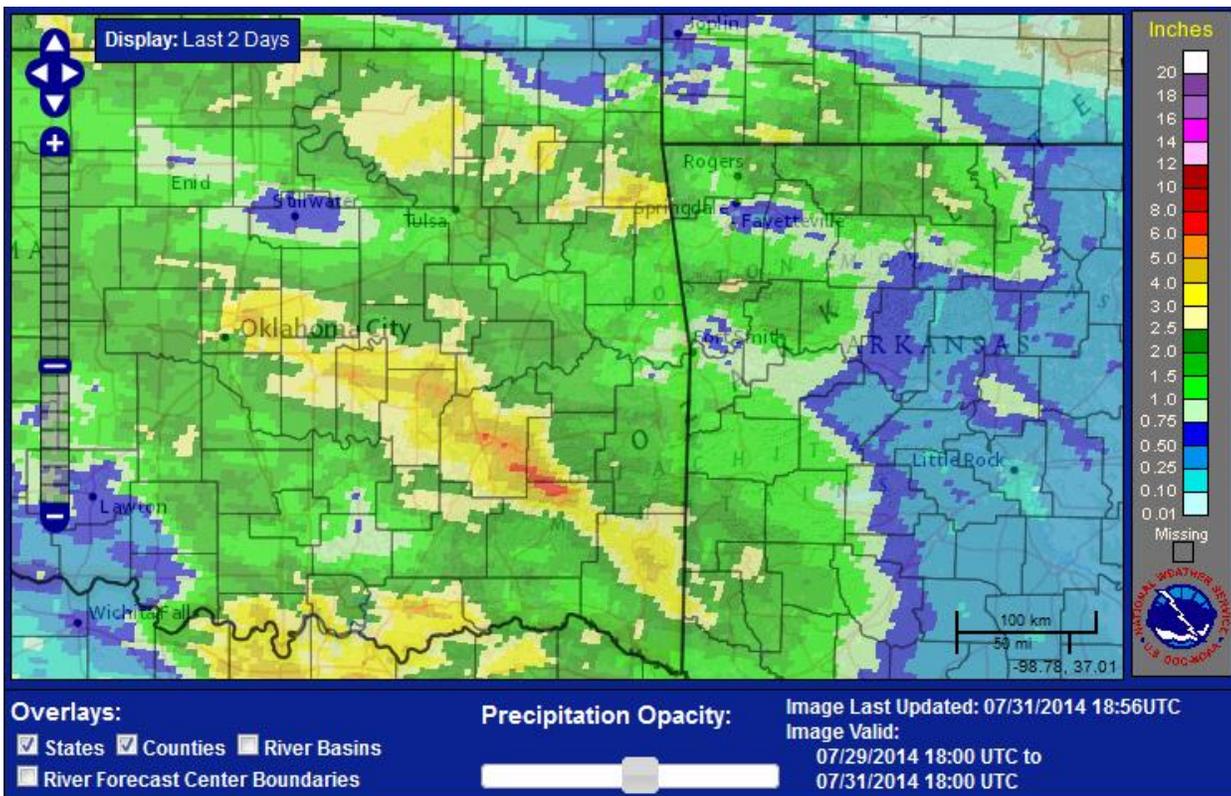


Fig. 18. 2-day estimated observed rainfall ending at 1pm 7/31/2014.

Tulsa, OK (TSA): 7/31/2014 1-Day Observed Precipitation
Valid at 7/31/2014 1200 UTC- Created 7/31/14 19:54 UTC

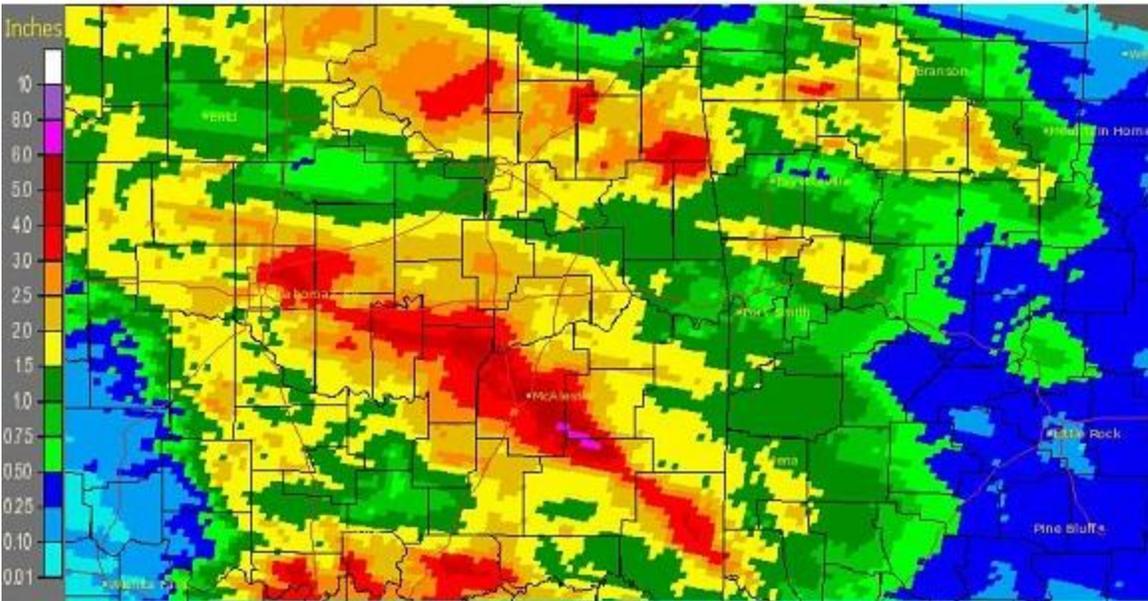


Fig. 19. 24-hr estimated observed rainfall ending at 7am 7/31/2014.

Written by:

Nicole McGavock
Service Hydrologist
WFO Tulsa

Products issued in July 2014:

*MLBA4 and OZGA4 transferred to NWS Tulsa HSA February 5, 2014

*Mixed case River Flood products began July 31, 2013

- 7 Flash Flood Warnings (FFW)
- 5 Flash Flood Statements (FFS)
- 3 Flash/Areal Flood Watches (FFA) (13 Watch FFA CON/EXT/EXA/CAN)
- 8 Urban and Small Stream Advisories (FLS)
- 6 Areal Flood Warnings (FLW)
- 0 Areal Flood Statements (FLS)
- 0 River Flood Warnings (FLW)
- 0 River Flood Statements (FLS)
- 1 River Flood Advisories (FLS) (2 Advisory FLS CON/EXT/CAN)
- 0 River Flood Watches (FFA) (0 Watch FFA CON/EXT/CAN)
- 0 River Statements (RVS)
- 0 Hydrologic Outlooks (ESF)
- 1 Drought Information Statements (DGT)

Preliminary Hydrographs:

None