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 **June** YEAR **2010**
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 **July 1, 2010**

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 HSA during the month above.**

The northwest portion of the NWS Tulsa Hydrologic Service Area (HSA) received well above normal rainfall during June 2010, while the southeast portion received well below normal rainfall. A mix of areas of above, near, and below normal rainfall occurred in between. Seven rivers exceeded flood stage this month, affecting the Verdigris, Grand-Neosho, Lower Arkansas, and Canadian River basins. Normal rainfall in the month of June ranges from 3.9 inches in McIntosh County to 5.9 inches in Wagoner County. The Ozark region of northwest Arkansas averages 5.1 inches for the month.

Summary of Rain Events

June 1 - 15:

Showers and thunderstorms developed across northeast OK and far northwest AR along an outflow boundary late on June 2 and into the early morning hours of June 3. Slow storm movement caused many locations to receive 2 to 3 inches of rainfall in a short period of time, including some areas that received 1 inch of rain in as little as 10 minutes. The Tulsa ASOS recorded 2.18" in 3 hours, with a total of 2.28" for the day, setting a new daily record. A large portion of the affected area received between 0.5" and 2" of rain, with isolated locations receiving in excess of 3 inches (see Figs. 1 and 2). Flash flooding was reported in Creek County from all of the rain. Isolated showers and thunderstorms redeveloped during the late afternoon of the 3rd across southeast OK, bringing localized 0.5" to 1.5" of rain.

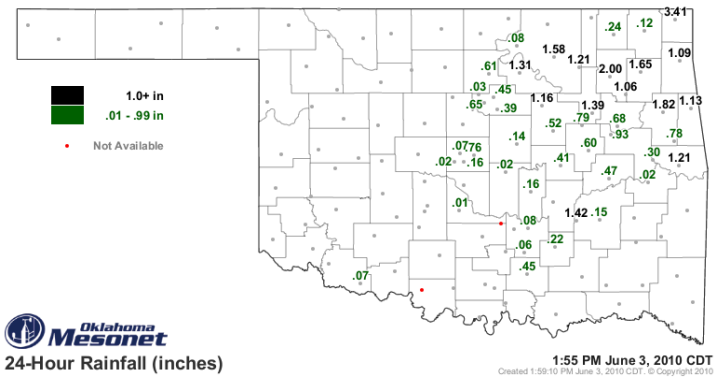


Fig. 1. 24-hour rainfall ending 1:55 pm CDT June 3

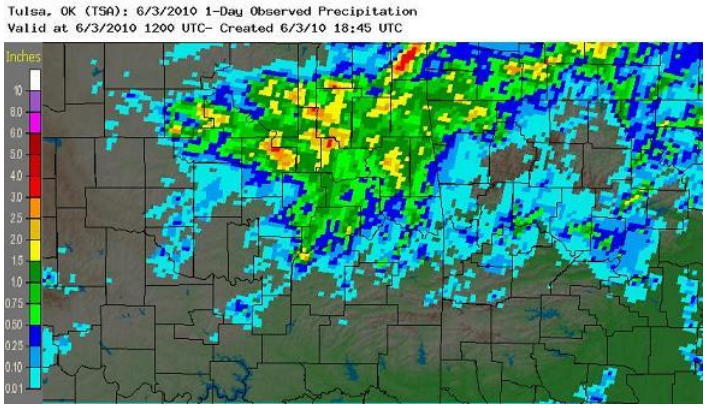


Fig. 2. Estimated 24-hour rainfall ending 7am CDT June 3

Isolated thunderstorms developed during the heat of the afternoon on June 6 along a diffuse cold front that stretched across far southeast OK, bringing upwards of 1" to 1.5" of rain to southern Pushmataha and northern Choctaw Counties. An MCS propagated out of Kansas and into the HSA during the morning of June 7. This storm complex initially brought winds of 40 to 60 mph to the far northwest portion of the HSA before weakening. The line of thunderstorms moved southeast across eastern OK and western AR through the morning hours and had exited the HSA by noon. Rainfall totals from this system ranged from around one third of an inch to over

one inch across all but far southeast OK.

Thunderstorms that developed along a cold front in Kansas merged into a storm complex that affected northeast OK, primarily along and north of I-44, through the morning hours of the 9th. These storms brought 1" to 2" across a large area of northeast OK (see Fig. 3), with much higher amounts (3"-5") further north in southeast Kansas. All of this rainfall led to minor flooding along the Neosho River near Commerce (see E3 report for details). Widely scattered showers redeveloped along the favored terrain areas of southeast OK and northwest AR later in the afternoon on the 9th, with localized rainfall of around one half inch or less.

An upper low brought very heavy rainfall to northeast TX and southwest AR, leading to deadly flash flooding in the Albert Pike Recreation Area (Montgomery County, AR) on the morning of June 11th. The majority of this precipitation remained south and east of the Tulsa HSA, though portions of Crawford, Franklin, Madison, and Washington Counties in northwest AR received between 0.5" and 2" of rainfall (isolated totals estimated to be 2.5"-3"), as seen in Fig. 4.

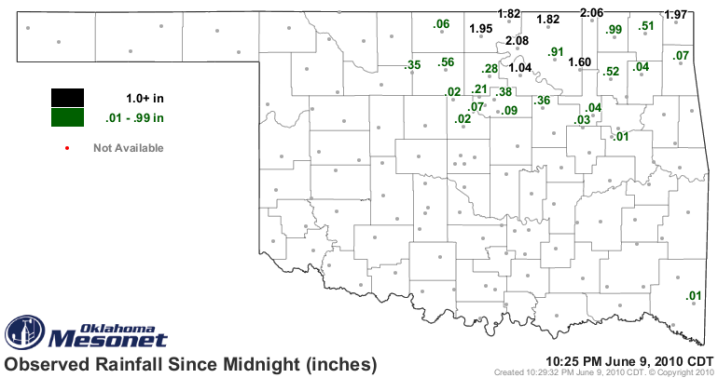


Fig. 3. Rainfall from Midnight – 10:25 pm CDT 6/9/2010.

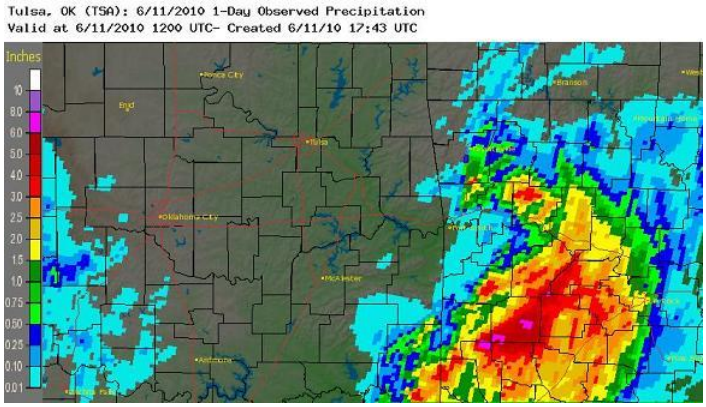


Fig. 4. Estimated 24-hour rainfall ending 7am CDT June 11

A very humid airmass settled over the HSA on June 12th, making it feel more like Florida than Oklahoma or Arkansas. Isolated to widely scattered showers and thunderstorms developed during the afternoon hours on the 12th and 13th along various outflow boundaries, bringing rainfall of around 0.5" or less.

Another significant flood and flash flood event occurred June 14-15. Several MCSs moved across Oklahoma, beginning during the early morning hours of June 14 and ending during the early morning hours of the 15th. These storms were efficient rain producers and widespread 1 to 3 inches fell across eastern OK and far northwest AR. The majority of northwest AR, however, received around 0.5" or less of rain. Isolated higher amounts of 4" to 6" occurred primarily across portions of Osage, Tulsa, Creek, Okfuskee, Pittsburg, and Pushmataha Counties (see Fig. 5). The Oklahoma Mesonet site in Bristow measured 5.53" of rainfall from this event (Fig. 6), with Tulsa International Airport setting a new 24-hour daily rainfall record for the 14th, with 3.03" of measured rainfall (previous record was 2.58" in 1961). Most of the City of Tulsa ALERT gages recorded between 1.5" and 2.5" of rain in the 24 hours ending at 7 am CDT June 15. Unfortunately, portions of the Oklahoma City metro area received in excess of 11 inches of rain from this system, including 9.27" falling in 6 hours (exceeds the 500-year/0.2% annual chance rainfall event) causing extreme flash flooding. Further east, the flash flooding was primarily confined to low lying areas, with reports of water over roads in Osage County and in the City of Tulsa. The widespread rainfall also created mainstem flooding (see E3 report for details). Moderate flooding occurred along Bird Creek near Sperry, with minor flooding near Owasso-Mingo and near Avant. Minor flooding also occurred along the Caney River from Ramona to Collinsville and along Polecat Creek near Sapulpa. Routed water from central OK led to moderate flooding several days later along the Deep Fork River near Beggs.

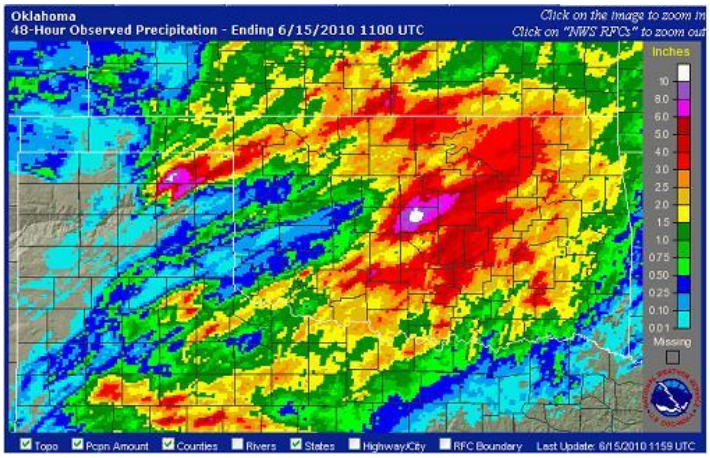


Fig. 5. 48-hour rainfall ending at 6am June 15.

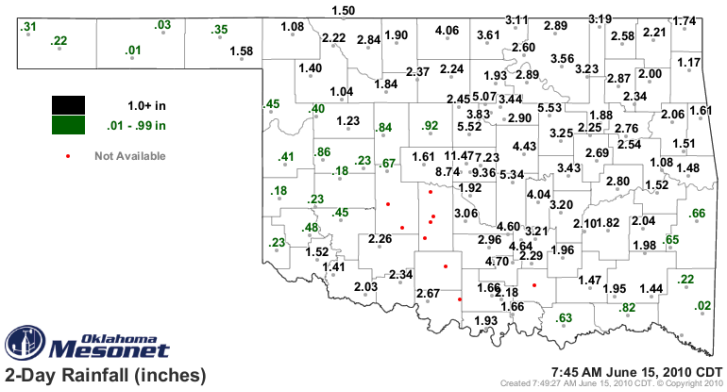


Fig. 6. 48-hour rainfall ending at 7:45 am June 15.

<u>June 16 - 30:</u>

Isolated diurnal convection developed during the afternoon of the 16th, while at the same time a thunderstorm complex moved out of north central OK and into northeast OK. The diurnal convection brought rain to higher terrain areas of northwest AR, while the thunderstorm complex brought rain to locations near the I-44 and SH 412 corridors. Rainfall amounts from all of this activity ranged from a few hundredths to around 1 inch.

Thunderstorms developed along outflow boundaries on June 19th, affecting northwest AR and Adair and Sequoyah Counties in east central OK. These storms were nearly stationary, generally bringing around 0.25" to 1" of rain. However, localized amounts of 2"-3" occurred across Carroll and Adair Counties.

Thunderstorms that developed along a slow moving cold front in Kansas produced an outflow boundary that sparked thunderstorms on the evening of June 23. These storms affected locations along a line from Bristow, to Barnsdall, to Bartlesville, to Copan (see Fig. 7), bringing damaging wind gusts and locally heavy rain. This activity generally produced from around 0.5" to around 1.5" of rainfall, though higher amounts of 2" to 4" fell across far northeast Osage and northern Washington Counties. The Oklahoma Mesonet site near Copan recorded 2.24" of rain, with nearly 2" falling within just one hour. This outflow boundary effectively became a cool front on the 24th. During the afternoon hours, showers and thunderstorms developed across the favored terrain areas of southeast OK and northwest AR and along the boundary, which had stalled near the I-40 corridor. Rainfall totals were generally less than an inch, though a few locations received around 2"-3". Widely scattered convection affected locations east of a McAlester to Jay line as a weak mid-level trough moved over the region on the 25th and 26th, with isolated rainfall totals near one inch.

Showers and thunderstorms developed across northeast OK along an outflow boundary and under the influence of a low-level jet on the morning of June 27. Redevelopment occurred along the outflow boundary further south and east during the heat of the afternoon, with additional convection developing along a cold front moving into the region during the overnight hours. These boundaries, combined with high precipitable water and slow cell movement, led to high rainfall totals of 2" to 5", especially just south of I-40 (see Fig. 8.)

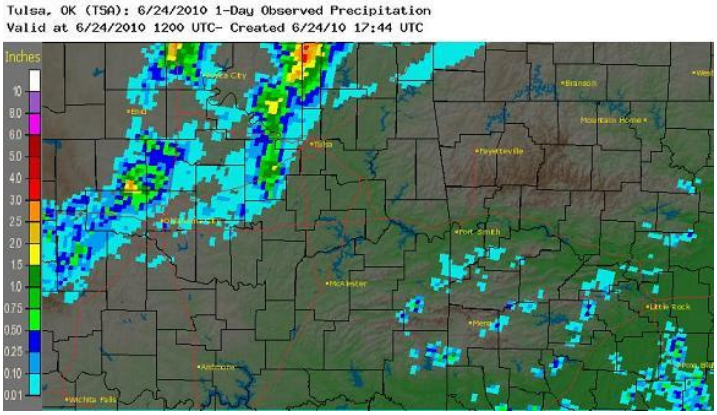


Fig. 7. 24-hour rainfall ending at 7 am June 24

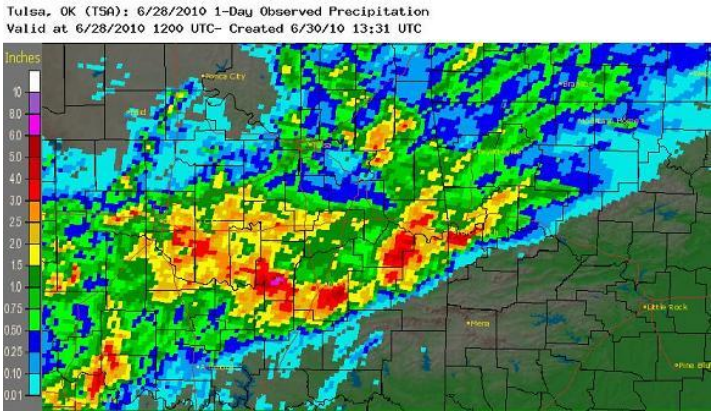


Fig. 8. 24-hour rainfall ending at 7 am June 28

Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 9a.), rainfall totals for June 2010 ranged from less than 2" to over 10" across the HSA. Most locations west of Hwy 75 and northwest of I-44 received over 150% of the normal June precipitation, while locations across far southeast OK and portions of Madison and Carroll Counties in northwest AR only received around 25% of the normal June rainfall (see Fig. 9b).

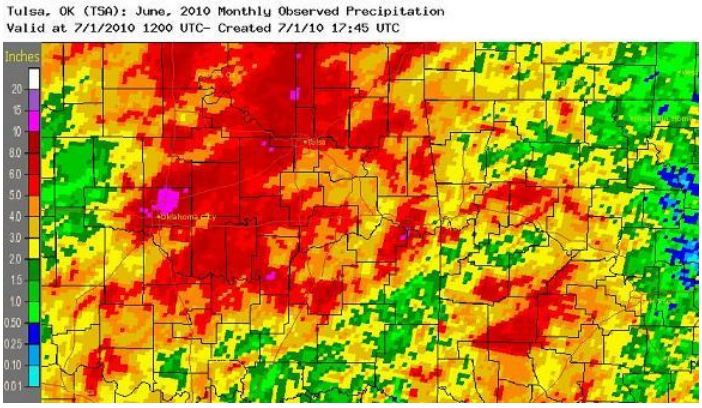
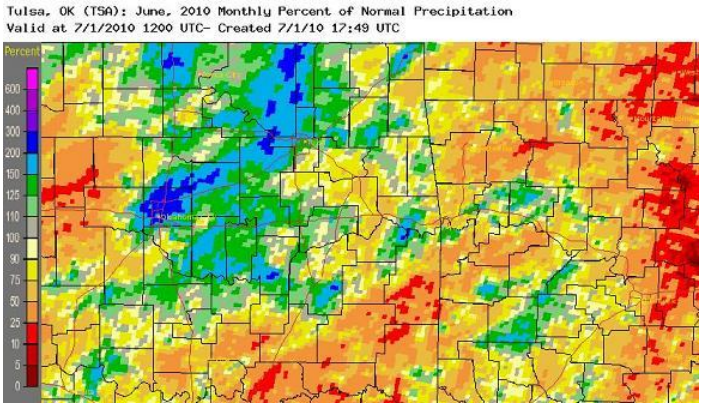


Fig. 9a. Estimated Observed Precip. for June 2010



9b. Estimated % of Normal Precip. for June 2010

In Tulsa, OK, June 2010 ranked as the 11th warmest June (81.9°F, since records began in 1905) and was the 20th wettest June (7.07", since records began in 1888). Fort Smith, AR was the 4th warmest June (83.6°F) and was the 32nd wettest June (5.36") since records began in 1883. The average June temperature in Fort Smith was 6.1°F above the 1971-2000 normal.

Some of the larger precipitation reports (in inches) for June 2010 included:

Bartlesville, OK (ASOS)	8.46	Miami, OK (meso)	8.14	Oilton, OK (meso)	8.10
Skiatook, OK (meso)	8.06	Copan, OK (meso)	8.02	Sallisaw, OK (meso)	7.56
Okemah, OK (meso)	7.48	Wynona, OK (meso)	7.42	Claremore 2ENE, OK (coop)	7.39

According to the U.S. Drought Monitor (USDM) from June 29, 2010, abnormally dry conditions existed across Choctaw, Pushmataha, and southern Le Flore Counties in southeast OK. Elsewhere in the HSA, drought conditions did not exist. According to the Oklahoma Climatological Survey, southeast OK has ranked as the 10th driest warm growing season since records began in 1921 (see table below).

The major reservoirs in the Tulsa HSA reported full conservation pools with flood control storage within 4% as of June 30, 2010. However, several reservoirs were well into the flood control storage with a couple experiencing deficits within the conservation pool. Both Ft. Gibson Lake (61% from 84%) and Hugo Lake (81% from 94%) experienced decreases in their conservation pools from last month. However, flood control pools increased for many of the area reservoirs. Flood control storage: Eufaula Lake 24%, Oologah Lake 20%, Skiatook Lake 14%, Hudson Lake 11%, and Keystone Lake 8%.

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

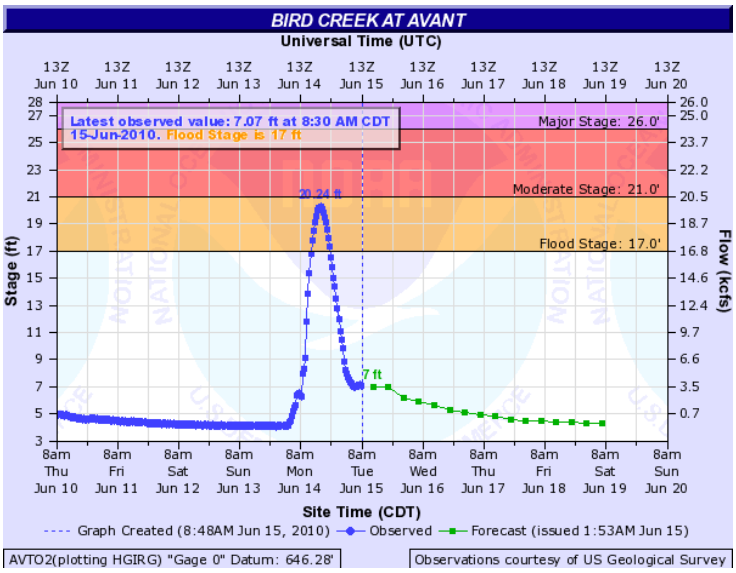
Rank since 1921 ("Last XX days" ending June 30, 2010)	June 2010	Year-to-Date 2010	Last 60 days (May. 2 – Jun. 30)	Water Year (Oct.1, 2009 – Jun. 30, 2010)	Warm Growing Season (Mar. 1 – Jun. 30)	Last 365 days (Ju1. 1, 2009 – Jun. 30, 2010)
Northeast OK	30th wettest	43rd wettest	32nd wettest	36th wettest	44th driest	22nd wettest
East Central OK	34th wettest	36th driest	40th wettest	38th wettest	31st driest	30th wettest
Southeast OK	23rd driest	21st driest	20th driest	40th wettest	**10th driest**	17th wettest

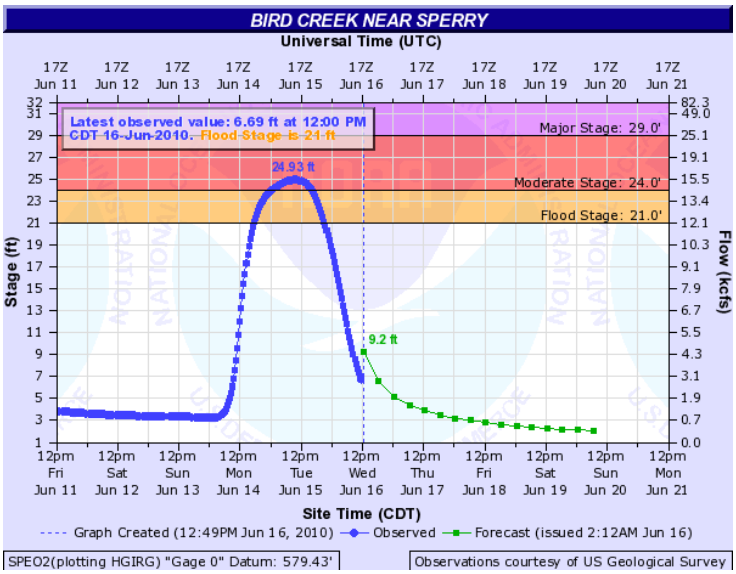
The Climate Prediction Center (CPC) outlook for July 2010 (issued June 30, 2010) indicates equal chances for above, near, and below normal temperature and precipitation. According to CPC, this outlook is based primarily on dynamical model output and composites from previous years in which an El Niño winter transitioned to ENSO-neutral or to La Niña conditions. For the 3-month period Jul-Aug-Sep 2010, CPC is forecasting equal chances for above, near, and below average temperatures and precipitation (outlook issued June 17, 2010). Sea-surface temperatures in the equatorial Pacific have decreased and are now indicating ENSO-neutral conditions are present. According to CPC, La Niña conditions could develop by late summer. Therefore, a La Niña Watch is in effect, meaning that conditions are favorable for a transition to La Niña conditions during June-August 2010.

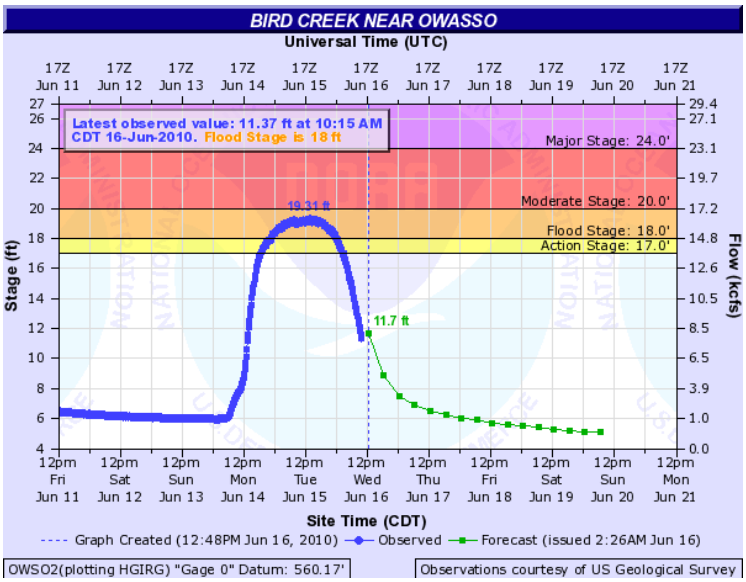
Written by:
Nicole M^{c}Gavock,
Service Hydrologist
WFO Tulsa

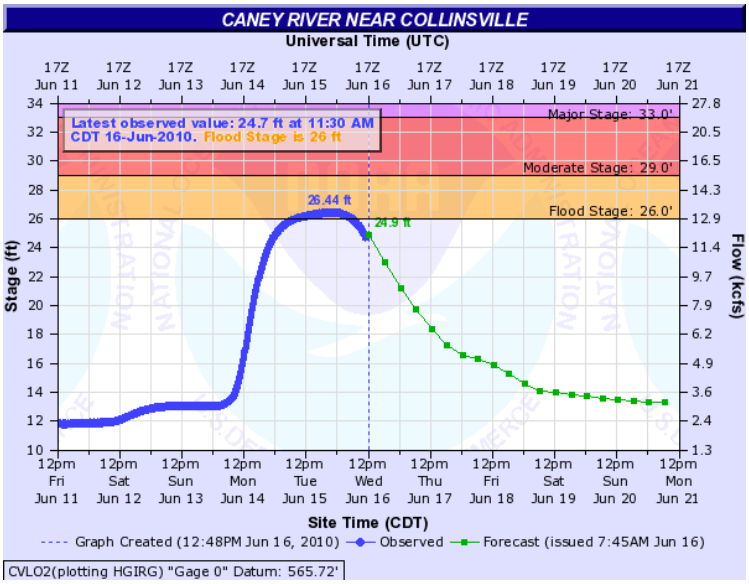
Products issued:

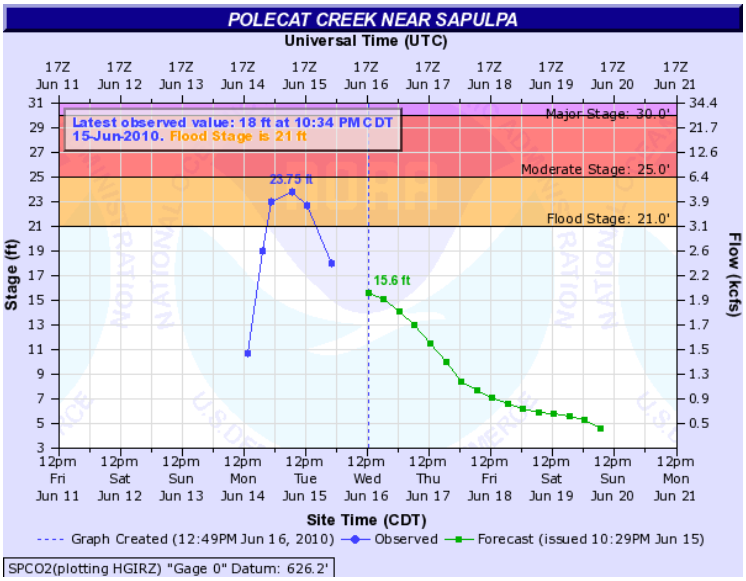
12 River Flood Warnings (FLW)
75 River Flood Statements (FLS)
2 River Flood Advisories (FLS) (16 Advisory FLS CON/EXT/CAN)
0 River Flood Watches (FFA) (0 Watch FFA CON/EXT/CAN)
0 River Statements (RVS)
1 Hydrologic Outlooks (ESF)
0 Drought Information Statements (DGT)

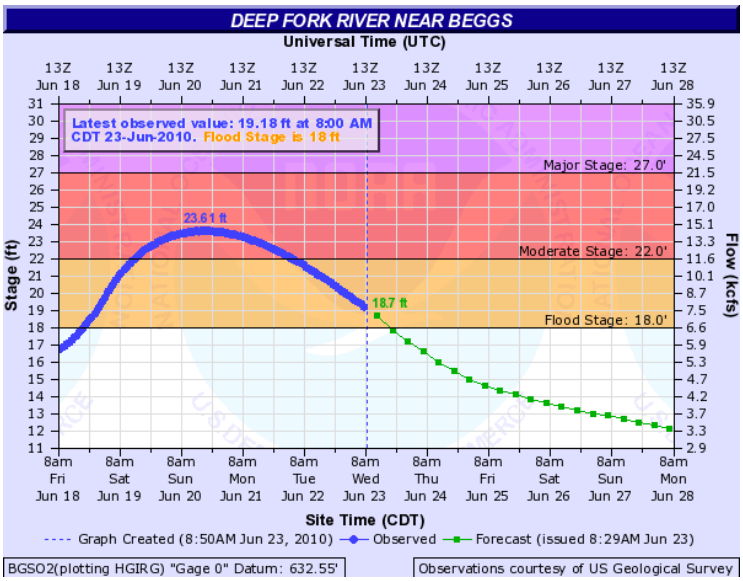





BIRD CREEK NEAR OWASSO
Universal Time (UTC)
Latest observed value: 11.37 ft at 10:15 AM CDT 16-Jun-2010. Flood Stage is 18 ft
Major Stage: 24.0'
Moderate Stage: 20.0'
Flood Stage: 18.0'
Action Stage: 17.0'
19.31 ft
11.7 ft
Stage (ft)
Flow (kcfs)
Site Time (CDT)
Graph Created (12:48PM Jun 16, 2010)
Observed
Forecast (issued 2:26AM Jun 16)
OWSO2(plotting HGIRG) "Gage 0" Datum: 560.17'
Observations courtesy of US Geological Survey


CANEY RIVER NEAR COLLINSVILLE
Universal Time (UTC)
Latest observed value: 24.7 ft at 11:30 AM CDT 16-Jun-2010. Flood Stage is 26 ft
Major Stage: 33.0'
Moderate Stage: 29.0'
Flood Stage: 26.0'
26.44 ft
24.9 ft
Stage (ft)
Flow (kcfs)
Site Time (CDT)
Graph Created (12:48PM Jun 16, 2010)
Observed
Forecast (issued 7:45AM Jun 16)
CVLO2(plotting HGIRG) "Gage 0" Datum: 565.72'


POLECAT CREEK NEAR SAPULPA
Universal Time (UTC)
Latest observed value: 18 ft at 10:34 PM CDT 15-Jun-2010. Flood Stage is 21 ft
Major Stage: 30.0'
Moderate Stage: 25.0'
Flood Stage: 21.0'
23.75 ft
15.6 ft
Stage (ft)
Flow (kcfs)
Site Time (CDT)
Graph Created (12:49PM Jun 16, 2010)
Observed
Forecast (issued 10:29PM Jun 15)
SPCO2(plotting HGIRZ) "Gage 0" Datum: 626.2'


DEEP FORK RIVER NEAR BEGGS
Universal Time (UTC)
13Z Jun 18
13Z Jun 19
13Z Jun 20
13Z Jun 21
13Z Jun 22
13Z Jun 23
13Z Jun 24
13Z Jun 25
13Z Jun 26
13Z Jun 27
13Z Jun 28
Latest observed value: 19.18 ft at 8:00 AM CDT 23-Jun-2010. Flood Stage is 18 ft
Major Stage: 27.0'
Moderate Stage: 22.0'
Flood Stage: 18.0'
23.61 ft
18.7 ft
Stage (ft)
Flow (kcfs)
8am Fri Jun 18
8am Sat Jun 19
8am Sun Jun 20
8am Mon Jun 21
8am Tue Jun 22
8am Wed Jun 23
8am Thu Jun 24
8am Fri Jun 25
8am Sat Jun 26
8am Sun Jun 27
8am Mon Jun 28
Site Time (CDT)
Graph Created (8:50AM Jun 23, 2010)
Observed
Forecast (issued 8:29AM Jun 23)
BGSO2(plotting HGIRG) "Gage 0" Datum: 632.55'
Observations courtesy of US Geological Survey