

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	
TO: Hydrometeorological Information Center, W/OH2 NOAA / National Weather Service 1325 East West Highway, Room 7230 Silver Spring, MD 20910-3283		REPORT FOR: MONTH September YEAR 2010
		SIGNATURE Steven F. Piltz (Meteorologist-in-Charge)
		DATE October 5, 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 Hydrologic Service Area (HSA) during the month above.

After an extremely dry August, September 2010 saw a return of precipitation. The biggest weather maker was the remnants of Tropical Storm Hermine, which brought widespread heavy rain and flash flooding during the first part of the month. Normal rainfall for September ranges from 4.2 inches in Okmulgee County to 5.4 inches in Delaware County. In the Ozark region of northwest Arkansas, rainfall averages 4.5 inches for the month.

Monthly Summary

Using the radar-derived estimated observed precipitation from the RFCs (Fig. 1a.), rainfall totals for September 2010 ranged from 2" to around 15" across the HSA. The highest rainfall totals, widespread 10+ inches, occurred across east central OK and west central AR due primarily to the copious rainfall from the remnants of Tropical Storm Hermine (see below for details). This yielded from around 150% to around 300% of the normal September rainfall for this region, as well as much of northwest AR (Fig. 1b). Areas northwest of Interstate 44 and portions of southeast OK, however, only received between 33% and 75% of the normal September rainfall. Pittsburg County experienced the greatest extremes, with the northern portion of the county receiving 200-300% of the normal rainfall, while the southern half of the county only received 50-75% of normal. Interestingly, the rainfall pattern for September 2010 was almost completely opposite of that from August 2010. According to the Oklahoma Climatological Survey (OCS), east central Oklahoma went from being the 5th driest August on record to the 8th wettest September on record (see table below).

In Tulsa, OK, September 2010 ranked as the 37th warmest September (75.1°F, since records began in 1905) and was the 53rd driest September (2.85", since records began in 1888). Fort Smith, AR was the 34th warmest September (76.0°F) and was the 21st wettest September (5.79") since records began in 1882.

The end of September 2010 also marks the end of Water Year 2010 (October 1, 2009 – September 30, 2010). From [CoCoRaHS](#), "Hydrologists and climatologists often use the "Water Year" calendar for tracking water resources. In the cool months, evaporation rates are very low, snow accumulates in cold regions, storms tend to be widespread, and most areas see accumulation of moisture in the soil. Then comes spring with its accompanying snow melt and high runoff from mountainous regions and higher latitudes. The summer months bring high evaporation rates. Precipitation (much from thunderstorms) becomes much more localized. Soil moisture may be gradually depleted during summer as vegetation uses large volumes of water. Streams run slower and clearer."

According to OCS, northeast OK ranked as the 24th wettest (104% of normal), east central OK ranked as the 32nd wettest (101% of normal), and southeast OK ranked as the 43rd driest (95% of normal) Water Year since records began in 1921. Precipitation for Water Year 2010 ranged from 35" to 60" across the HSA. This corresponded to ±25% of the normal Water Year rainfall for the entire area (see figs. 2a and 2b). The only exception was across portions of northern Osage and northern Washington Counties in northeast OK, which received between 125% and 150% of the normal rainfall during this time frame.

Tulsa, OK (TSA): September, 2010 Monthly Observed Precipitation
Valid at 10/1/2010 1200 UTC- Created 10/3/10 21:40 UTC

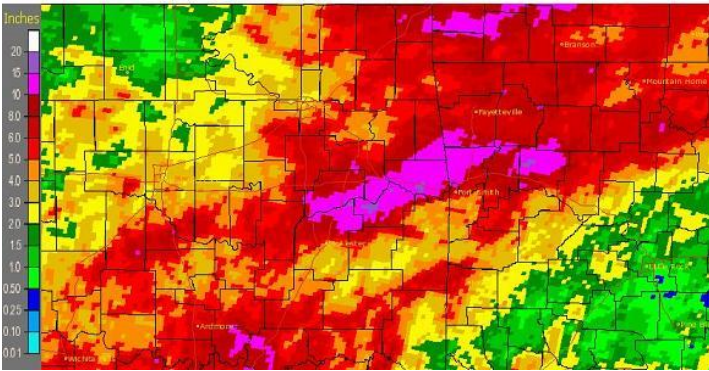
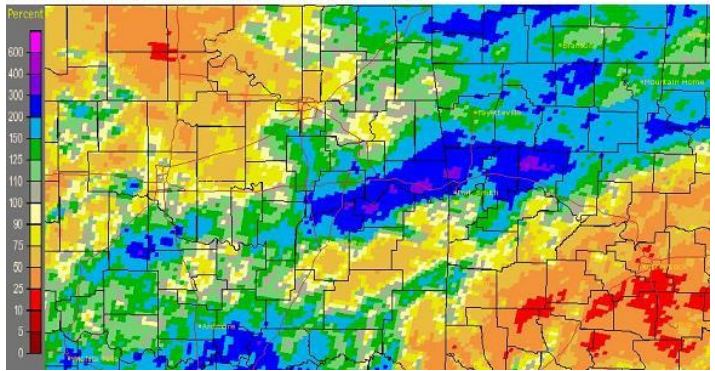


Fig. 1a. Estimated Observed Rainfall for September 2010

Tulsa, OK (TSA): September, 2010 Monthly Percent of Normal Precipitation
Valid at 10/1/2010 1200 UTC- Created 10/3/10 21:44 UTC



1b. Estimated % of Normal Rainfall for September 2010

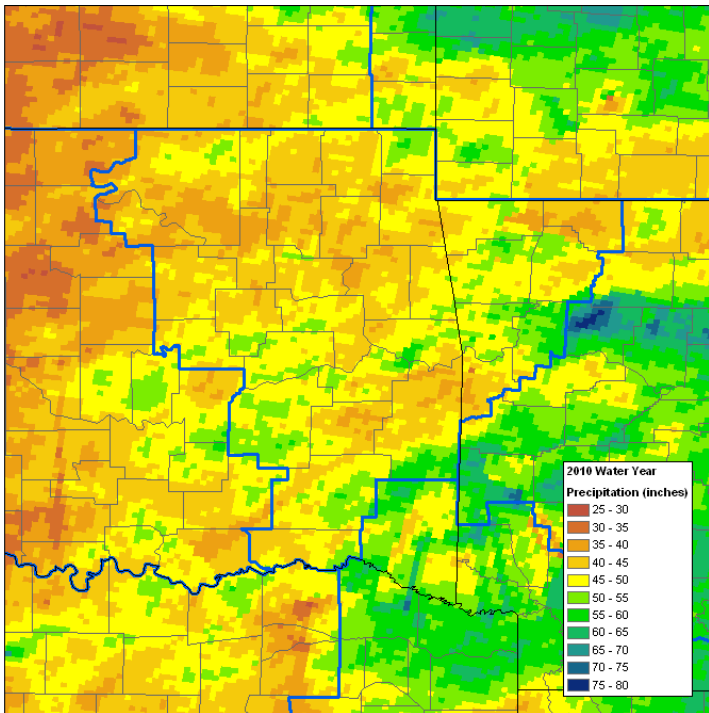
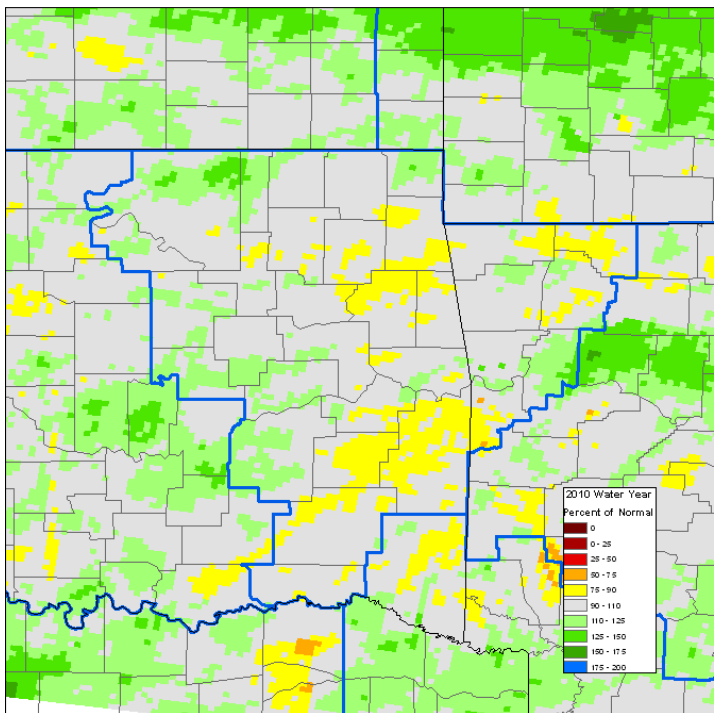


Fig. 2a. Estimated Observed Rainfall for Water Year 2010



2b. Estimated % of Normal Rainfall for Water Year 2010

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

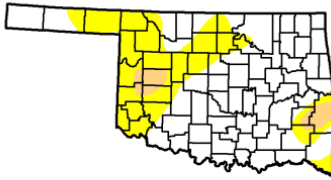
Sallisaw, OK (meso)	14.97	Natural Dam, AR (coop)	14.50	Whitefield, OK (DCP)	14.01
Stigler, OK (meso)	13.42	Mountainburg, AR 2NE (coop)	12.91	Eufaula, OK (meso)	11.85
Odell, AR 2N (coop)	11.15	Webbers Falls, OK (meso)	10.62	Cookson, OK (meso)	9.88

According to the [U.S. Drought Monitor](#) (USDM) from September 28, 2010, abnormally dry conditions (D0) and moderate drought (D1) (both agricultural and hydrological) existed across portions of Pushmataha, Latimer, Le Flore, and Sebastian Counties (see Figs. 3 and 4). Abnormally dry conditions (D0) were also indicated across western Pawnee County. Elsewhere, rainfall from this September (especially the heavy rain from the remnants of Hermine) alleviated much of the drought conditions that were in place at the end of August.

U.S. Drought Monitor Oklahoma

September 28, 2010
Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	66.3	33.7	4.2	0.0	0.0	0.0
Last Week (09/21/2010 map)	58.8	41.2	4.2	0.0	0.0	0.0
3 Months Ago (07/06/2010 map)	92.8	7.2	4.7	0.0	0.0	0.0
Start of Calendar Year (01/01/2010 map)	100.0	0.0	0.0	0.0	0.0	0.0
Start of Water Year (10/01/2009 map)	98.0	2.0	0.0	0.0	0.0	0.0
One Year Ago (09/29/2009 map)	98.0	2.0	0.0	0.0	0.0	0.0



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

<http://drought.unl.edu/dm>



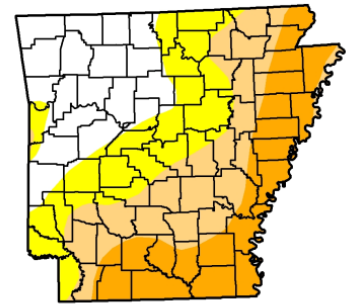
Released Thursday, September 30, 2010
Author: R. Heim/L. Lov-Brotak, NCDC/NOAA

Fig. 3. Drought Monitor for Oklahoma

U.S. Drought Monitor Arkansas

September 28, 2010
Valid 7 a.m. EST

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	25.2	74.8	50.7	25.2	0.0	0.0
Last Week (09/21/2010 map)	33.3	66.7	43.7	12.5	0.0	0.0
3 Months Ago (07/06/2010 map)	44.3	55.7	6.1	0.3	0.0	0.0
Start of Calendar Year (01/01/2010 map)	100.0	0.0	0.0	0.0	0.0	0.0
Start of Water Year (10/01/2009 map)	100.0	0.0	0.0	0.0	0.0	0.0
One Year Ago (09/29/2009 map)	100.0	0.0	0.0	0.0	0.0	0.0



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

<http://drought.unl.edu/dm>



Released Thursday, September 30, 2010
Author: R. Heim/L. Lov-Brotak, NCDC/NOAA

Fig. 4. Drought Monitor for Arkansas

Many of the major reservoirs in the Tulsa HSA were reporting 95-100% of their full conservation pools as of September 30, 2010. Corresponding to the rainfall deficits from August, several reservoirs were still experiencing deficits within the conservation pool despite this month's rainfall, especially in the Lower Arkansas and Lower Red River basins. Conservation pool deficits: Hugo Lake 71% (up from 41% at the end of August), Ft. Gibson Lake 75%, Wister Lake 88%, Skiatook Lake 93%, and Sardis Lake 94%.

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

Rank since 1921 ("Last XX days" ending September 30, 2010)	September 2010	Last 60 days (Aug. 2 – Sep. 30)	Last 120 Days (Jun 3 – Sep 30)	Last 180 Days (Apr 4 – Sep 30)	Year-to-Date 2010	Water Year (Oct 1, 2009 – Sep 30, 2010)
Northeast OK	27 th wettest	31 st wettest	23 rd wettest	33 rd wettest	35 th wettest	24 th wettest
East Central OK	8 th wettest	26 th wettest	20 th wettest	42 nd wettest	41 st wettest	32 nd wettest
Southeast OK	22 nd wettest	24 th driest	25 th driest	10 th driest	40 th wettest	43 rd driest

The [Climate Prediction Center](#) (CPC) outlook for October 2010 (issued September 30, 2010) indicates an enhanced chance for above average temperatures and an enhanced chance for below median precipitation. For the 3-month period Oct-Nov-Dec 2010, CPC is forecasting an enhanced chance for above average temperatures and an enhanced chance for below median precipitation (outlook issued September 16, 2010). The enhanced chance for above average temperatures and below median precipitation for the 1- and 3-month outlooks are consistent with La Niña impacts across the southern Plains. According to CPC, La Niña conditions strengthened during August and early September. These conditions are expected to strengthen and at least last through winter 2010-11, though are very likely to continue into the spring. A La Niña Advisory continues, meaning La Niña conditions have been observed and are expected to continue.

Summary of Rain Events

September 1 - 6:

After a dry August, the first day of September brought widespread rainfall to those areas experiencing moderate drought conditions. An outflow boundary that moved south out of KS/MO brought heavy rain to far northeast Oklahoma as it interacted with a moist atmosphere. Widespread 3" to 6" fell across Ottawa Co. from this activity (see Fig. 5). A second area of showers and thunderstorms brought 0.5" to 2.5" of rain to southeast OK. More scattered activity occurred elsewhere, with rainfall totals from around 0.25" to around 3". A strong cold front traversed the HSA on September 2, bringing pleasantly cooler temperatures and much needed rain to all but far southeast OK. Rainfall totals ranged from 0.5" to around 3", and the Gravette, AR coop observer

reported a 24-hr rainfall total of 2.98". The highest totals were across Mayes, Adair, Washington AR, and Benton Counties (see Fig. 6). Dry and pleasant conditions then occurred for the Labor Day weekend, Sept. 3-6.

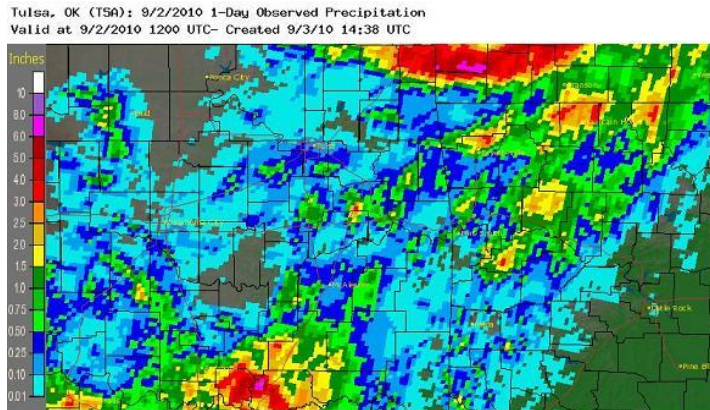


Fig. 5. 24-hour rainfall ending 7am CDT Sep. 2, 2010

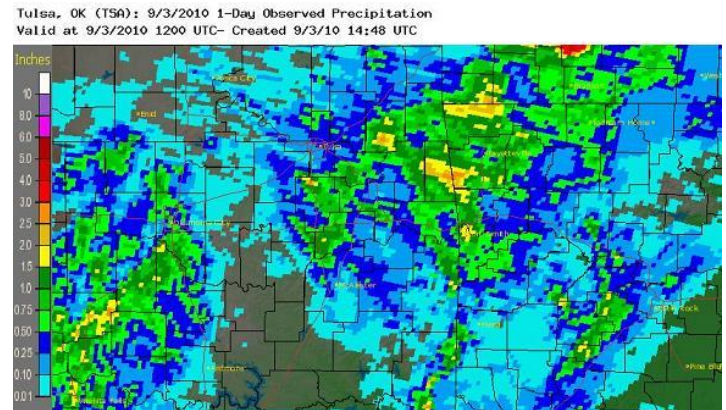


Fig. 6. 24-hour rainfall ending 7am CDT Sep. 3, 2010

September 7 – 9 Tropical Storm Hermine:

The remnants of Tropical Storm Hermine began to affect southeast OK and northwest AR on the 7th before spreading further north on the 8th and 9th. The low center moved from southwest OK into northeast OK (see Fig. 7a-h), with the heaviest rainfall totals occurring east of the storm track. Convective development occurred along the northern periphery of Hermine on the 7th, while the center of the storm was over central TX. This first wave of rainfall brought 0.5" to near 2", with localized higher amounts of 3" to 5", to locations southeast of a Checotah, OK to Berryville, AR line (see Fig. 8). The NWS cooperative observer Kingston 5NW reported a 24-hour rainfall total of 3.99" ending at 7am CDT September 8.

Light rain fell across much of the area during the day on the 8th, before the rainfall intensity increased later that night and through the morning of the 9th. Rainfall rates of over 2" per hour and rainfall totals of 8" to 14" across east central OK and northwest AR led to widespread flash flooding (see Table 1 and figs. 10-13). Many small creeks and streams rose very quickly from this rainfall. Frog Bayou in Crawford Co. crested at 16.99' at the Rudy gage site by the afternoon of the 9th, overtopping the Hwy 282 bridge. The water rose ~16' in only 6 hours (from ~7am - ~1pm) at this site. Businesses and residences in Sallisaw, OK were inundated by high water, forcing schools to close. Emergency officials performed numerous swift water rescues and many roads were closed due to the high water throughout the area. Unfortunately, a 19-yr old male drowned on the morning of the 9th as he tried to drive through high water over a low water crossing 7 miles south of Stilwell in Adair County. Numerous small bridges and low water crossings were washed out, especially in Muskogee, Sequoyah, and Crawford Counties.

Mainstem river flooding was minimized since much of the rainfall and runoff was contained by Eufaula Lake and R.S. Kerr Reservoir. However, high lake levels at Kerr Reservoir resulted in high outflow downstream of Kerr, which then led to brief minor flooding along the Arkansas River at Van Buren (see E3 report for details). An additional summary of this event is available at: http://www.srh.noaa.gov/tsa/?n=tsa_hermine

Table 1. Top 20 Measured Rainfall Totals* from Hermine (3-Day Storm Total Amounts in Inches)

LOCATION	AMOUNT	SOURCE	LOCATION	AMOUNT	SOURCE
Whitefield	13.42	DCP	Bunch (0.8N)	6.95	CoCoRaHS
Stigler	11.25	OK Mesonet	St. Paul (1E)	6.92	NWS Coop
Sallisaw	10.41	OK Mesonet	Cookson	6.20	OK Mesonet
Eufaula (4.6ENE)	10.35	CoCoRaHS	Webbers Falls L&D	6.13	DCP
Mountainburg (2NE)	9.81	NWS Coop	Tenkiller Lake	6.11	DCP
R.S. Kerr Reservoir	9.60	DCP	Big Cedar	5.90	DCP
Natural Dam	9.00	NWS Coop	Gore	5.63	DCP
Short (1W)	8.40	DCP	Stigler	5.63	DCP
Scipio (1S)	7.69	NWS Coop	Van Buren	5.36	DCP
Webbers Falls	7.40	OK Mesonet	Eufaula Lake	5.28	DCP

*Additional rainfall totals and Hermine information can be found at: http://www.srh.noaa.gov/tsa/?n=tsa_hermine

- [OK Mesonet - Courtesy of the Oklahoma Climatological Survey](#)
- [CoCoRaHS - Volunteer Observers](#) (ending 8 am CDT 9/10/2010)
- [Coop - NWS Observers](#) (ending 7am CDT 9/10/2010)
- [Automated Gage](#) (ending 1030am CDT 9/10/2010)

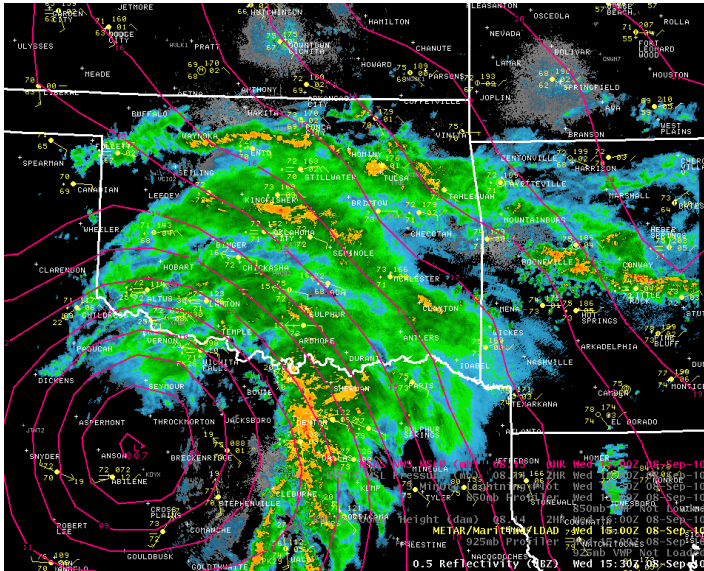


Fig. 7a. Radar, MSLP (pink contours) at 10:30am CDT 9/8/2010

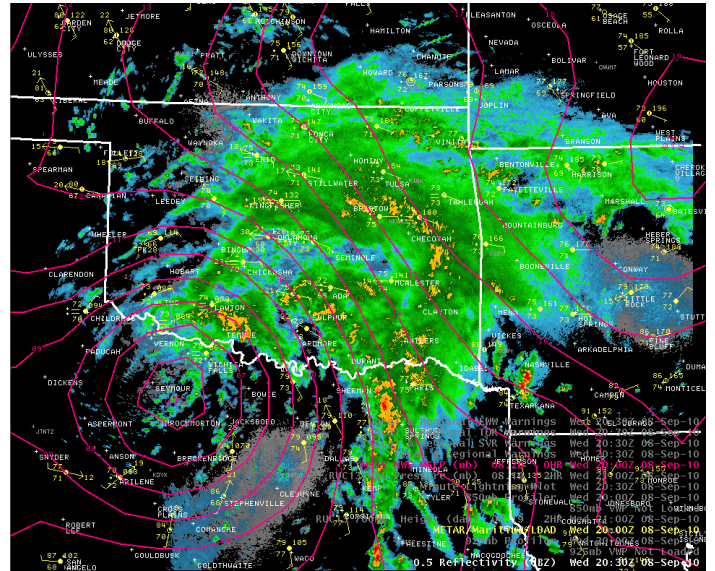


Fig. 7b. Radar, MSLP (pink contours) at 3:30pm CDT 9/8/2010

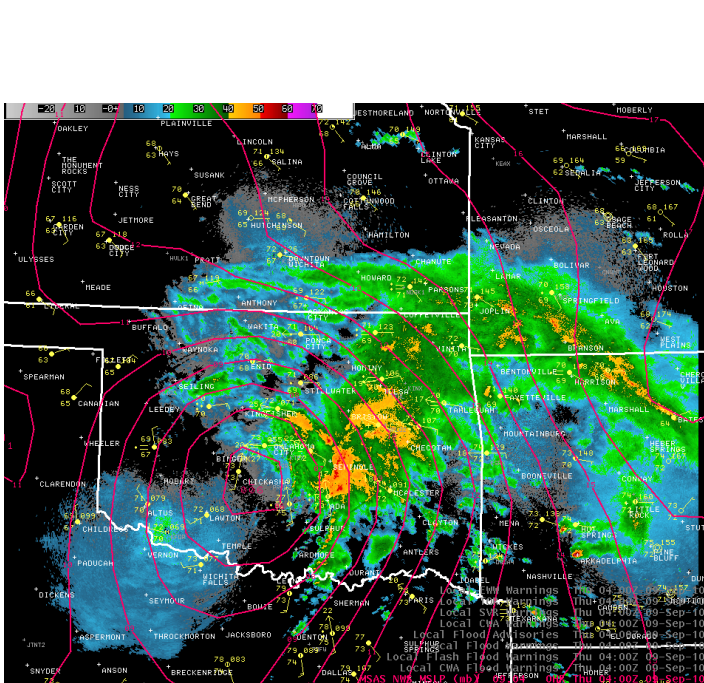


Fig. 7c. Radar, MSLP (pink contours) at 11:00pm CDT 9/8/2010

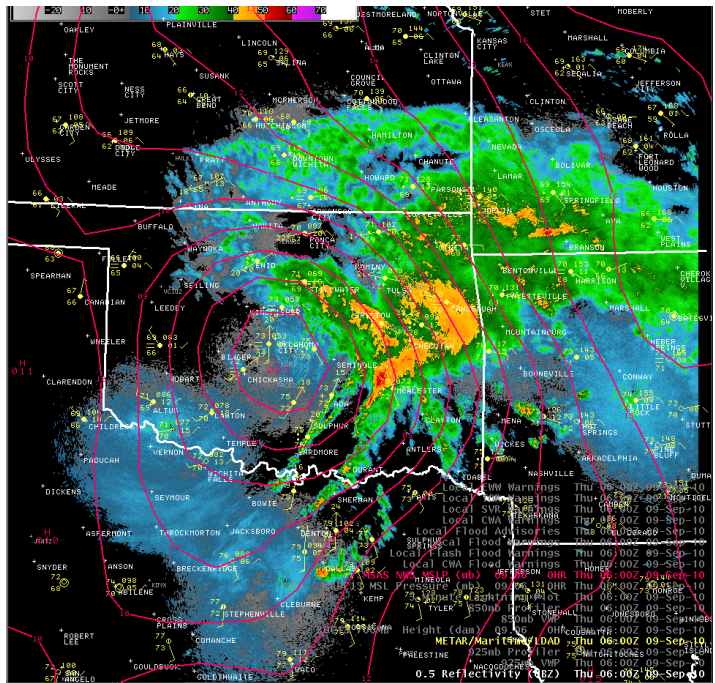


Fig. 7d. Radar, MSLP (pink contours) at 1:00am CDT 9/9/2010

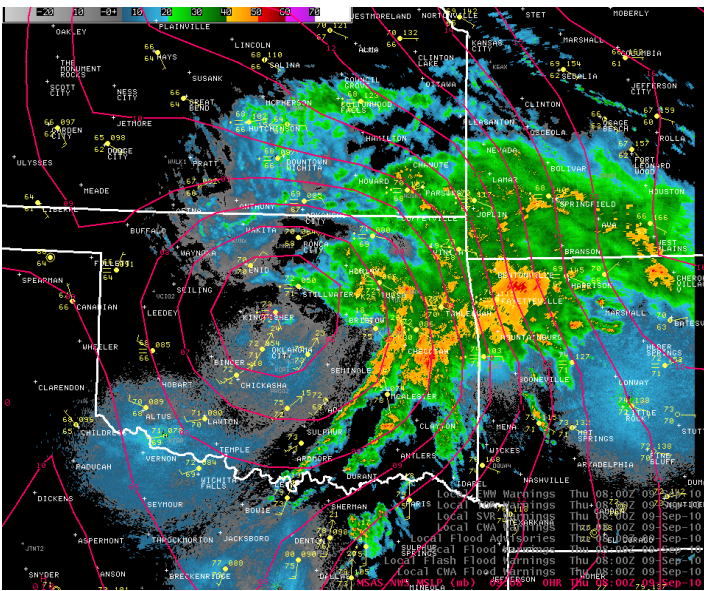


Fig. 7e. Radar, MSLP (pink contours) at 3:00am CDT 9/9/2010

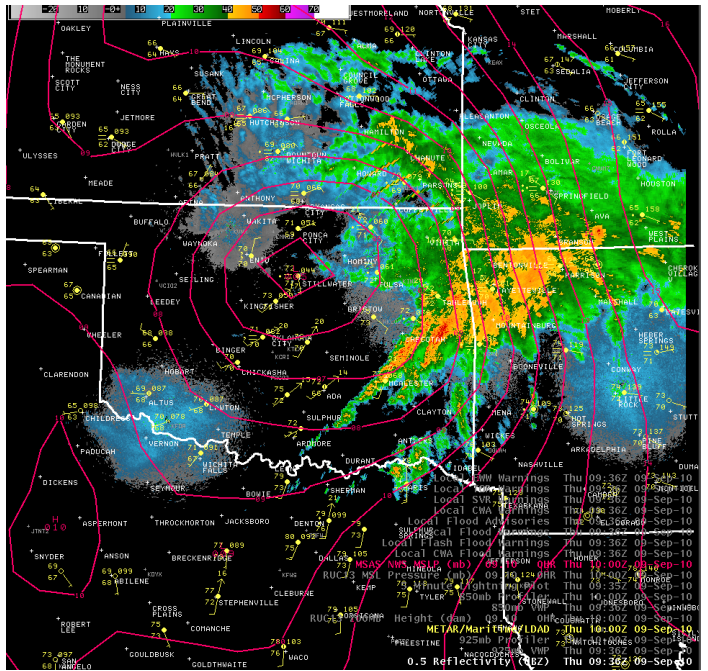


Fig. 7f. Radar, MSLP (pink contours) at 4:30am CDT 9/9/2010

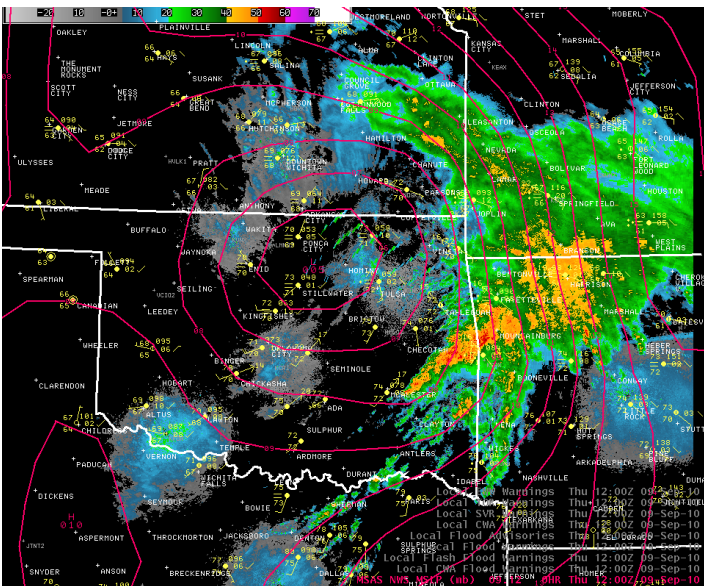


Fig. 7g. Radar, MSLP (pink contours) at 7:00am CDT 9/9/2010

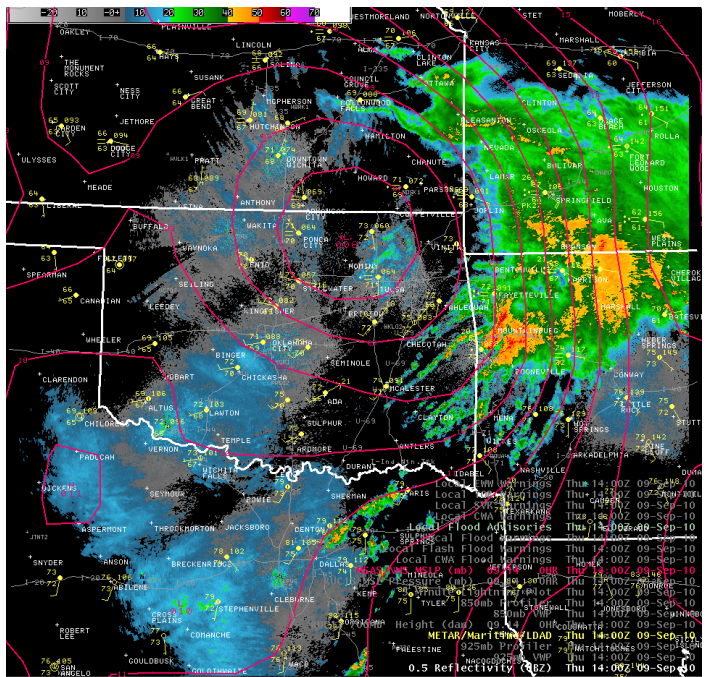


Fig. 7h. Radar, MSLP (pink contours) at 9:00am CDT 9/9/2010

Tulsa, OK (TSA): 9/8/2010 1-Day Observed Precipitation
Valid at 9/8/2010 1200 UTC - Created 9/8/10 15:43 UTC

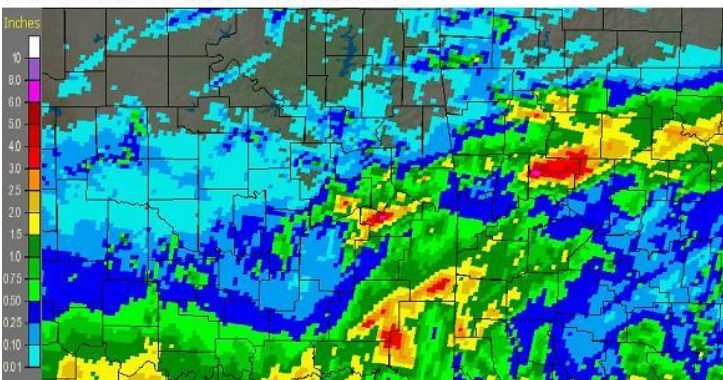
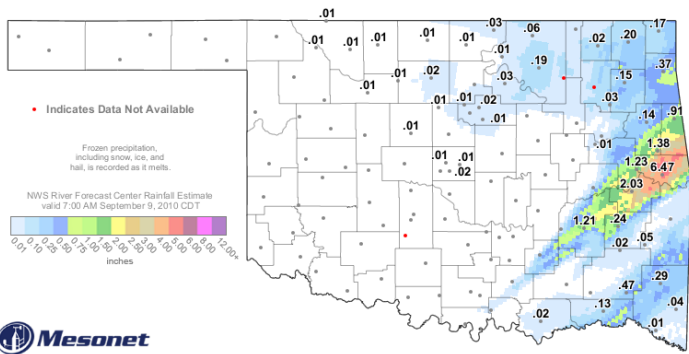


Fig. 8. 24-hour rainfall ending 7am CDT 9/8/2010

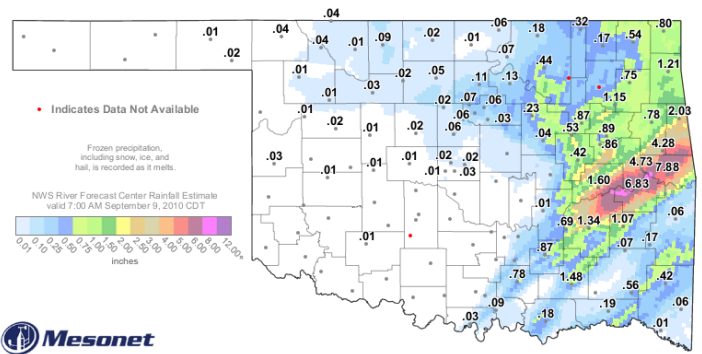
...SIGNIFICANT FLOODING POSSIBLE LATER TODAY INTO THURSDAY...

Hazard	Wed	Thu	Fri	Sat	Sun	Mon	Tue
H AZARD							
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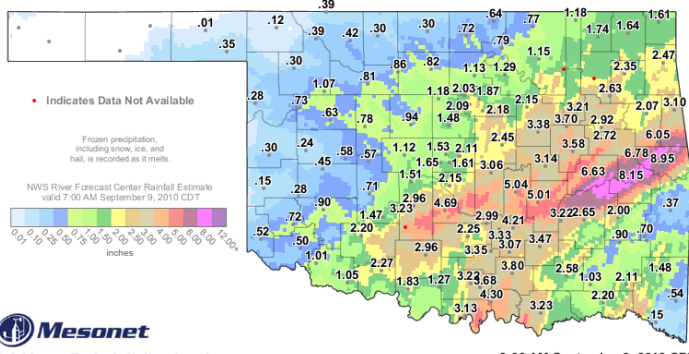
Fig. 9. Heavy rain, flash flooding, and river flooding were among the hazards expected on Wed., 9/8/2010 – Thurs., 9/9/2010.



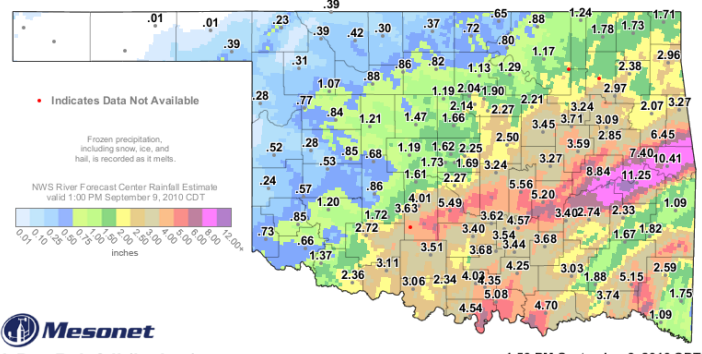
Mesonet
3-Hour Rainfall (inches)
Fig. 10a. Radar + Mesonet 3-hr rainfall at 7:55am CDT 9/9/2010



Mesonet
6-Hour Rainfall (inches)
Fig. 10b. Radar + Mesonet 6-hr rainfall at 8:00am CDT 9/9/2010



Mesonet
24-Hour Rainfall (inches)
Fig. 10c. Radar + Mesonet 24-hr rainfall at 8:00am CDT 9/9/2010



Mesonet
3-Day Rainfall (inches)
Fig. 10d. Radar + Mesonet 3-day rainfall at 1:50pm CDT 9/9/2010

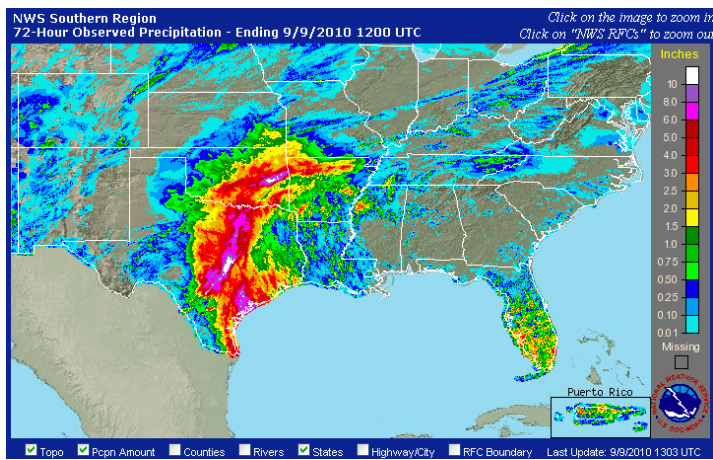


Fig. 11. 72-hr rainfall ending at 7:00am CDT 9/9/2010

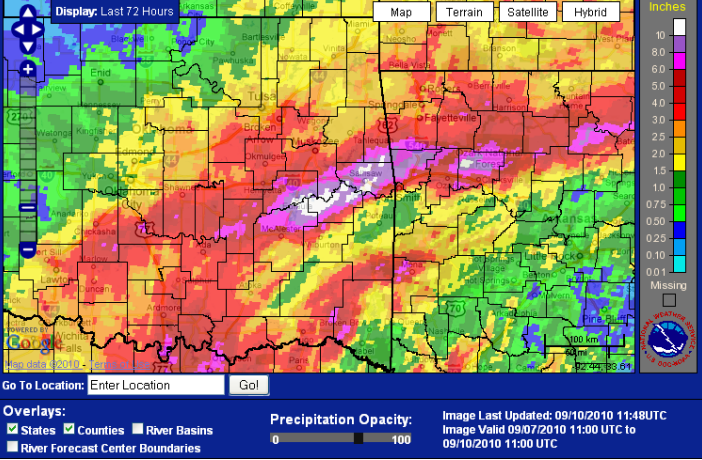


Fig. 12. 72-hour rainfall ending at 6:00am CDT 9/10/2010

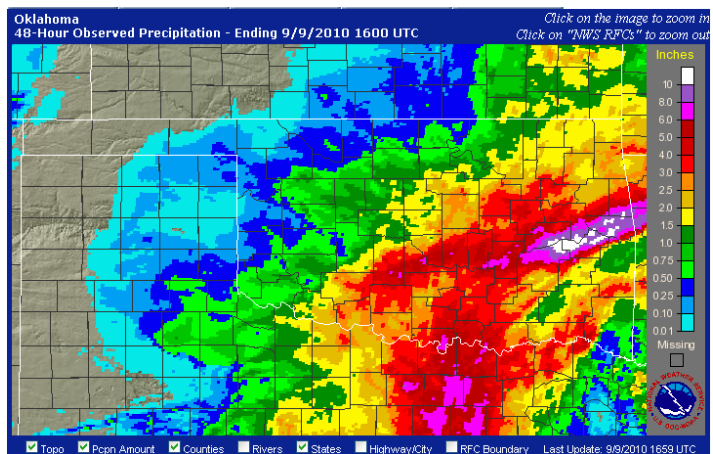


Fig. 13a. 48-hr rainfall ending at 11:00am CDT 9/9/2010

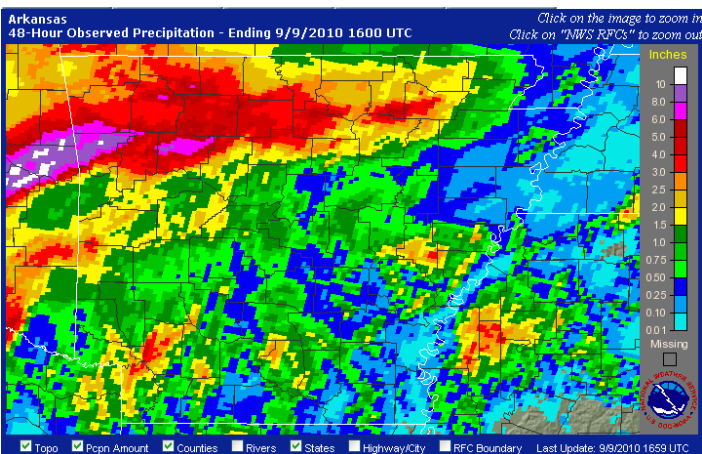


Fig. 13b. 48-hour rainfall ending at 11:00am CDT 9/9/2010

September 10 - 30:

Light showers developed across northeast OK on the 10th ahead of an approaching cold front. By later that night, showers and thunderstorms along the front in southeast KS began to build further south into northeast OK. This activity continued to move southeast into western AR before diminishing early on the 11th, with most locations receiving around 0.5" or less of rain. Isolated convection then redeveloped across Choctaw, Pushmataha, Le Flore, Sebastian, and Franklin Counties on the afternoon of the 11th, bringing upwards of 2" to localized areas.

Scattered showers and thunderstorms developed during the early morning hours of the 13th across northeast OK and then spread east into northwest AR during the day. Rainfall totals from this activity were around 1" or less, though a few isolated locations received around 2".

A complex of showers and thunderstorms moved out of eastern KS and into northeast OK on the morning of the 14th. This activity continued to propagate south southeast, bringing rain to the entire HSA. While widespread rainfall amounts of around 0.5" to 1.5" were common, the highest totals of 3"-5" were estimated across southern Haskell, far northeast Latimer, and west central Le Flore Counties (see Fig. 14). During the evening of the 15th, supercells moving south out of Kansas developed into a thunderstorm complex over northeast OK. In addition to hail and strong winds, these storms brought 0.5" to around 1.5" of rain to northeast OK. The storms weakened as they moved to the southeast, with lighter rainfall amounts of less than 0.5" affecting locations along and north of a McAlester to Fort Smith line.

Tulsa, OK (TSA): Current 1-Day Observed Precipitation
Valid at 9/15/2010 1200 UTC - Created 9/15/10 17:43 UTC

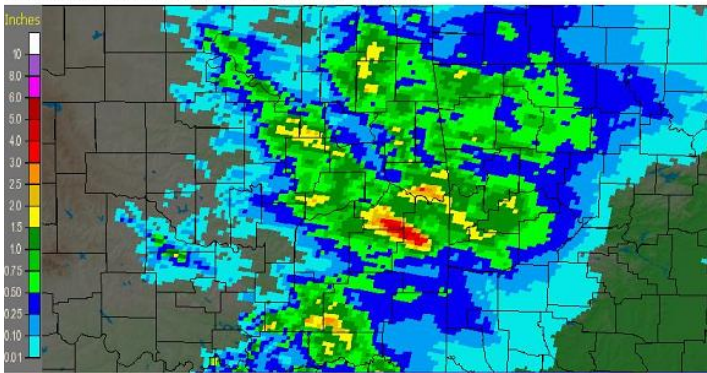


Fig. 14. 24-hour rainfall ending 7am CDT Sep. 2, 2010

A few isolated showers and thunderstorms brought very localized rainfall of 1" to 2" to portions of southeast OK and northwest AR on the 18th and 19th. A cold front moved into northeast OK and northwest AR during the late evening hours of the 23rd and continued to push south during the day of the 24th. Showers with isolated thunderstorms developed along the front, bringing rainfall to the entire HSA. Rainfall totals ranged from around 0.33" to around 1.5" across the region. The highest totals of around 2" occurred across Sequoyah County. The last week of the month brought drier and cooler weather to the region.

Written by:
Nicole M^cGavock,
Service Hydrologist
WFO Tulsa

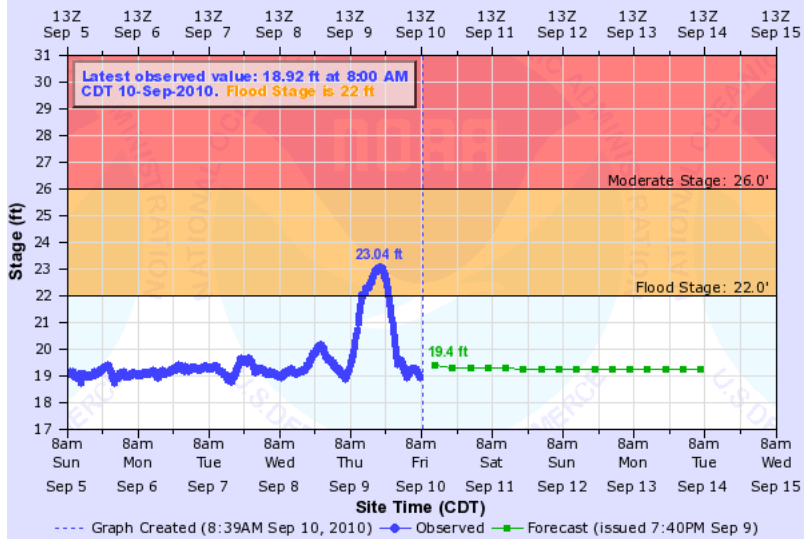
Products issued:

- 1 River Flood Warnings (FLW)
- 4 River Flood Statements (FLS)
- 2 River Flood Advisories (FLS) (5 Advisory FLS CON/EXT/CAN)
- 6 River Flood Watches (FFA) (12 Watch FFA CON/EXT/CAN)
- 0 River Statements (RVS)
- 4 Hydrologic Outlooks (ESF)
- 0 Drought Information Statements (DGT)

***Hydrographs below are from the NWS AHPS website and do not reflect official crests/flows as set by the USGS.*

ARKANSAS RIVER AT VAN BUREN

Universal Time (UTC)



VBUA4(plotting HGIRG) "Gage 0" Datum: 372.36'