

September 10, 2009 Sedona Flooding

Summary: A cluster of strong thunderstorms with intense rainfall moved across the Sedona area between 1:45 – 3:00 PM MST. Most of Sedona received between 0.5 to 3 inches of rain in less than one hour (figure 1). The runoff from the intense rain resulted in flash flooding at several locations, with the worst reported flooding at Tlaquepaque and West Sedona.

The combination of abundant moisture, an unstable air mass, and a compact upper level low moving south across the region set the stage for scattered showers and thunderstorms over northern Arizona during the afternoon of September 10, 2009. A few of these thunderstorms produced intense rain and small hail. The strongest thunderstorm of the day formed northwest of Sedona around 1:30 PM MST and tracked southeast across much of Sedona during the next one and a half hours.

The rain began to fall across north and west portions of Sedona around 2:00 PM MST. A period of intense rain fell across West Sedona from 2:05 PM to 2:45 PM MST. Figure 1 depicts radar estimated rainfall during this event, and shows the band of heavy which fell north of Highway 89A across west Sedona, generally near Soldier Pass Road.

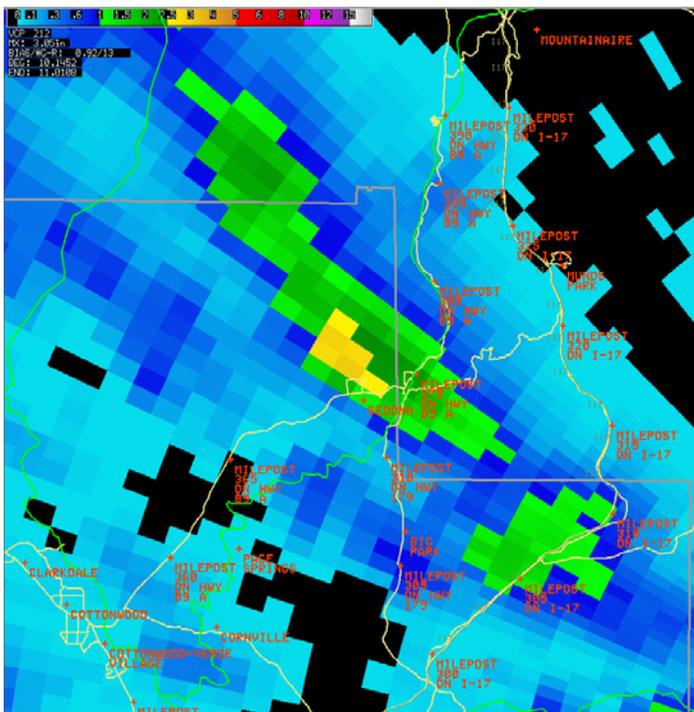


Figure 1. Radar estimated rainfall

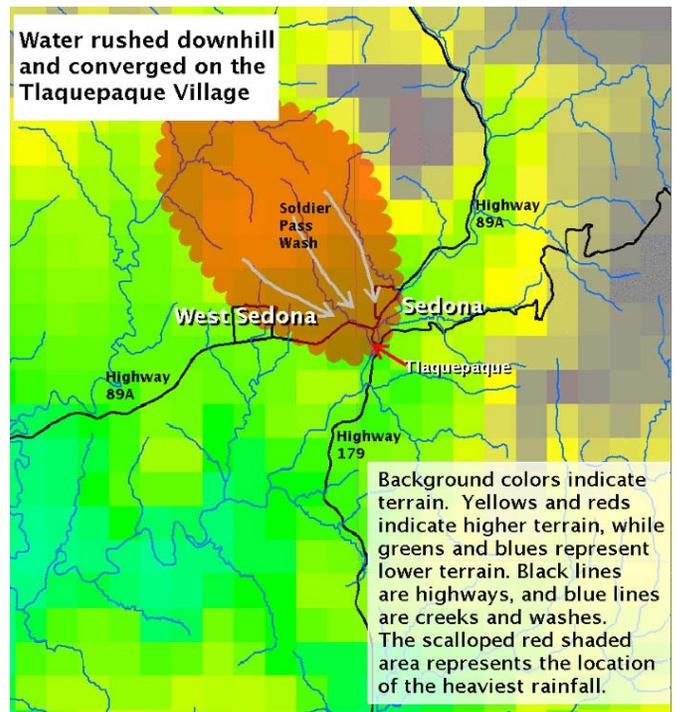


Figure 2. Terrain Map

Given the terrain in this area, the resulting rainfall flowed downhill toward the intersection of Highway 89A and Highway 179. Much of the water funneled into Soldier Pass Wash, which subsequently flows downstream into Oak Creek, passing the Tlaquepaque Arts and Crafts Village along the way (figure 2). The initial flooding occurred in west Sedona as a result of the sheet flow water runoff. There were

numerous reports of widespread street flooding, streambeds overflowing banks, and flooding of homes in the west Sedona area. A short time later, Soldier Pass Wash began overflowing its banks at the Tlaquepaque Village, inundating the village with 2 feet of water and floating and overturning numerous cars which were parked in the village's parking lot. Several cars were swept into Soldier Pass Wash and carried 100 to 200 yards downstream. As the flood waters receded, a thick layer of mud and flood-damaged cars remained over much of the village area (figures 3, 4 and 5).



Figure 3: Mud, debris and cars by Oak Creek Brewers (building on left).



Figure 4. Mud in parking lot at Los Abrigados.



Figure 5: Car removed from Soldier Pass Wash near Los Abrigados.

The forecast staff of the National Weather Service in Flagstaff quickly recognized the developing flood situation well before flooding began, and issued a flash flood warning (figure 6) for the Sedona area at 2:08 PM MST, only minutes after the rain began falling in that area. According to witnesses in the affected locations, flooding began around 2:20 PM MST in west Sedona and around 2:30 PM MST at Tlaquepaque Village. The flood warning gave citizens in the area between 12 and 22 minutes advance warning of the impending flood waters.

The following is a timeline of events associated with the Sedona flooding (all times MST):

- 10:08 PM – Hazardous Weather Outlook issued – highlighted flooding potential. (Figure 6)
- 1:45 PM – Short Term Forecast issued to highlight heavy rains approaching Sedona (Figure 7)
- 2:05 PM – Rain began falling in the Sedona area
- 2:08 PM – Flash Flood warning issued for south central Coconino Count and east central Yavapai County in west central Arizona, including the city of Sedona (Figure 8).
- 2:20 PM – First report of flooding in west Sedona.
- 2:30 PM – First report of flooding at Tlaquepaque Village in Sedona.
- 2:32 PM – Flash Flood Statement issued to update the 2:08 PM Flash Flood Warning
- 2:38 PM - Flash Flood Statement issued to update the 2:08 PM Flash Flood Warning
- 3:16 PM – Preliminary Local Storm Report issued regarding the Sedona flooding (Figure 9)
- 3:27 PM - Flash Flood Statement issued to update the 2:08 PM Flash Flood Warning
- 4:17 PM – Flash Flood Statement issued to expire the 2:08 PM Flash Flood Warning

HAZARDOUS WEATHER OUTLOOK
NATIONAL WEATHER SERVICE FLAGSTAFF AZ
1008 AM MST THU SEP 10 2009

AZZ004>018-037>040-110830-
KAIBAB PLATEAU-MARBLE AND GLEN CANYONS-GRAND CANYON COUNTRY-
COCONINO PLATEAU-YAVAPAI COUNTY MOUNTAINS-
NORTHEAST PLATEAUS AND MESAS HWY 264 NORTHWARD-CHINLE VALLEY-
CHUSKA MOUNTAINS AND DEFIANCE PLATEAU-
LITTLE COLORADO RIVER VALLEY IN COCONINO COUNTY-
LITTLE COLORADO RIVER VALLEY IN NAVAJO COUNTY-
LITTLE COLORADO RIVER VALLEY IN APACHE COUNTY-
WESTERN MOGOLLON RIM-EASTERN MOGOLLON RIM-WHITE MOUNTAINS-
NORTHERN GILA COUNTY-YAVAPAI COUNTY VALLEYS AND BASINS-
OAK CREEK AND SYCAMORE CANYONS-BLACK MESA AREA-
NORTHEAST PLATEAUS AND MESAS SOUTH OF HWY 264-
1008 AM MST THU SEP 10 2009

THIS HAZARDOUS WEATHER OUTLOOK IS FOR PORTIONS OF EAST CENTRAL
ARIZONA...NORTH CENTRAL ARIZONA...NORTHEAST ARIZONA AND WEST
CENTRAL ARIZONA.

.DAY ONE...TODAY AND TONIGHT

LINGERING MONSOON MOISTURE WILL RESULT IN SCATTERED SHOWERS AND
THUNDERSTORMS ACROSS MOST OF NORTHERN ARIZONA TODAY. LOCALIZED
FLOODING AND HAIL WILL BE THE MAIN THREAT FROM THE STRONGEST
STORMS TODAY.

.DAYS TWO THROUGH SEVEN...FRIDAY THROUGH WEDNESDAY

MOISTURE WILL LINGER OVER THE AREA FOR THE NEXT SEVERAL DAYS.
ISOLATED TO SCATTERED THUNDERSTORMS WILL DEVELOP EACH
DAY...PRIMARILY DURING THE AFTERNOON AND EVENING...WITH SUBTLE
DAY TO DAY CHANGES IN WEATHER IMPACTS. LOCALIZED AREAS OF HEAVY
RAINFALL AND FLASH FLOODING ARE POSSIBLE EACH DAY.

.SPOTTER INFORMATION STATEMENT...

WEATHER SPOTTERS ARE ENCOURAGED TO REPORT SIGNIFICANT WEATHER
CONDITIONS ACCORDING TO STANDARD OPERATING PROCEDURES.

Figure 6: Hazardous Weather Outlook issued at 10:08 AM MST on September 10th, 2009

NORTHERN ARIZONA SHORT TERM FORECAST
NATIONAL WEATHER SERVICE FLAGSTAFF AZ
145 PM MST THU SEP 10 2009

AZZ008-015-037-038-102145-
OAK CREEK AND SYCAMORE CANYONS AZ-
YAVAPAI COUNTY VALLEYS AND BASINS AZ-YAVAPAI COUNTY MOUNTAINS AZ-
WESTERN MOGOLLON RIM AZ-
145 PM MST THU SEP 10 2009

.NOW...

AN AREA OF THUNDERSTORMS...MOVING SOUTHEAST AT 10 MPH...WILL AFFECT
SEDONA...UNTIL 245 PM MST. GUSTY WINDS OF 30 TO 40 MPH WILL OCCUR.
THIS STORM WILL PRODUCE HAIL UP TO THE SIZE OF PENNIES. RADAR IS
ESTIMATING RAINFALL RATES GREATER THAN ONE INCH PER HOUR WITH THIS
STORM. TORRENTIAL RAINS WILL CAUSE PONDING OF WATER ON ROADS...AND
MINOR FLOODING OF POOR DRAINAGE AREAS. THE HEAVY RAINFALL WILL ALSO
CAUSE NORMALLY DRY WASHES...CREEKS AND STREAMS TO BECOME INUNDATED
WITH THE RAPID RUNOFF. MOTORISTS WHO MAY USE THESE DRY CREEKS AND
STREAM BEDS AS ROADS SHOULD BE AWARE OF RAPIDLY RISING WATERS AND
USE CAUTION.

Figure 7: Short Term Forecast (NOWCAST) issued at 1:45 PM MST on September 10th, 2009

BULLETIN - EAS ACTIVATION REQUESTED
FLASH FLOOD WARNING
NATIONAL WEATHER SERVICE FLAGSTAFF AZ
208 PM MST THU SEP 10 2009

THE NATIONAL WEATHER SERVICE IN FLAGSTAFF HAS ISSUED A

* FLASH FLOOD WARNING FOR...
SOUTH CENTRAL COCONINO COUNTY IN NORTH CENTRAL ARIZONA...
EAST CENTRAL YAVAPAI COUNTY IN WEST CENTRAL ARIZONA...
THIS INCLUDES THE CITY OF SEDONA...

* UNTIL 415 PM MST

* AT 204 PM MST...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED
FLASH FLOODING FROM A THUNDERSTORM OVER THE WARNED AREA.

* THE STORM PRODUCING FLASH FLOODING WILL OTHERWISE REMAIN OVER
MAINLY RURAL AREAS OF THE INDICATED COUNTIES.

PRECAUTIONARY/PREPAREDNESS ACTIONS...

THIS INCLUDES THE FOLLOWING STREAMS AND DRAINAGES...
WEST FORK OAK CREEK...TULE TANK WASH...SYCAMORE CREEK...OAK CREEK...
DRY CREEK...SPRING CREEK...DRY BEAVER CREEK...JACKS CANYON...TURKEY
CREEK AND COFFEE CREEK.

DO NOT DRIVE YOUR VEHICLE INTO AREAS WHERE THE WATER COVERS THE
ROADWAY. THE WATER DEPTH MAY BE TOO GREAT TO ALLOW YOUR CAR TO CROSS
SAFELY. MOVE TO HIGHER GROUND.

FLOODING IS OCCURRING OR IS IMMINENT. MOST FLOOD RELATED DEATHS OCCUR
IN AUTOMOBILES. DO NOT ATTEMPT TO CROSS WATER COVERED BRIDGES...
DIPS...OR LOW WATER CROSSINGS. NEVER TRY TO CROSS A FLOWING STREAM...
EVEN A SMALL ONE...ON FOOT. TO ESCAPE RISING WATER MOVE UP TO HIGHER
GROUND.

A FLASH FLOOD WARNING MEANS THAT FLOODING IS IMMINENT OR OCCURRING.
IF YOU ARE IN THE WARNING AREA MOVE TO HIGHER GROUND IMMEDIATELY.
RESIDENTS LIVING ALONG STREAMS AND CREEKS SHOULD TAKE IMMEDIATE
PRECAUTIONS TO PROTECT LIFE AND PROPERTY. DO NOT ATTEMPT TO CROSS
SWIFTLY FLOWING WATERS OR WATERS OF UNKNOWN DEPTH BY FOOT OR BY
AUTOMOBILE.

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LAT...LON 3485 11161 3475 11179 3484 11196 3502 11205
3506 11176

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CLARK

Figure 8: Flash Flood Warning issued at 2:08 PM MST on September 10th, 2009

PRELIMINARY LOCAL STORM REPORT
 NATIONAL WEATHER SERVICE FLAGSTAFF AZ
 316 PM MST THU SEP 10 2009

..TIME...	...EVENT...	...CITY LOCATION...	...LAT.LON...
..DATE...	...MAG....	..COUNTY LOCATION..ST..	...SOURCE....
	..REMARKS..		
0230 PM 09/10/2009	FLASH FLOOD	SEDONA YAVAPAI	34.86N 111.79W AZ FIRE DEPT/RESCUE
	NUMEROUS HOMES FLOODED		
0230 PM 09/10/2009	FLASH FLOOD	SEDONA YAVAPAI	34.86N 111.79W AZ TRAINED SPOTTER
	WIDESPREAD STREET FLOODING...STREAMBEDS OVERFLOWING BANKS		

PRELIMINARY LOCAL STORM REPORT...CORRECTED
 NATIONAL WEATHER SERVICE FLAGSTAFF AZ
 417 PM MST THU SEP 10 2009

..TIME...	...EVENT...	...CITY LOCATION...	...LAT.LON...
..DATE...	...MAG....	..COUNTY LOCATION..ST..	...SOURCE....
	..REMARKS..		
0230 PM 09/10/2009	FLASH FLOOD	SEDONA YAVAPAI	34.86N 111.79W AZ FIRE DEPT/RESCUE
	NUMEROUS HOMES FLOODED		
0230 PM 09/10/2009	FLASH FLOOD	SEDONA YAVAPAI	34.86N 111.79W AZ TRAINED SPOTTER
	WIDESPREAD STREET FLOODING...STREAMBEDS OVERFLOWING BANKS...LARGE BOULDERS WASHED INTO STREETS...PAVED ROADWAYS ERODED		
0230 PM 09/10/2009	FLASH FLOOD	SEDONA YAVAPAI	34.86N 111.79W AZ TRAINED SPOTTER
	TLAQUEPAQUE SHOPPING CENTER PARKING LOT AND BUSINESSES FLOODED. CARS MOVED BY WATER.		

Figure 9: Local Storm Reports issued at 3:16 and 4:17 PM MST on September 10th, 2009