



2015

Big Chino Sub-Basin Water Monitoring Project Monsoon Season Report: July 1 – September 30



Pine Creek – 9/22/2015



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Introduction

The purpose of the Big Chino Sub-Basin Ephemeral Stream Flow Monitoring Project is to collect additional surface water hydrologic data for use in the development of a numerical groundwater flow model. The stream flow data are part of a larger long-term data collection program. This monsoon season report is the second report developed for the CA1 Monitoring Committee as part of the Big Chino Sub-Basin Water Monitoring Project in collaboration with the City of Prescott, Town of Prescott Valley, and Salt River Project (SRP). Under an independent contractor's agreement approved in 2013, SRP Water Measurement was selected to provide the installation, maintenance, and data collection at nine stream-flow sites within the Big Chino Sub-Basin. A summary of flow events recorded during the 2015 monsoon season (July 1 to September 30, 2015) at each location are documented within this report.

Background and Rating Development

As part of this monitoring effort, SRP Flowtopography™ equipped stream-flow monitoring locations were installed between December 2013 and June 2014. SRP Flowtopography™ is a system of hardware combined with back-office processes that utilizes time-lapse high resolution photography coupled with a fixed event gage within the frame of the image collected (see Figure 1). The standard configuration at most monitoring locations includes upstream and downstream event gages equipped with pressure transducers (that record stage values) and a flowtopography camera assembly on the stream bank that records images of the upstream event gage. Surveys conducted at each site allow us to determine the channel cross sections for both the upstream and downstream event gages (see Figure 2). Using the Slope-Area Method and preliminary survey data collected in the field, an estimate of flow was calculated for channel stage values. The collected survey information was also entered into HEC-RAS to generate a rating equation and table for the upstream and downstream cross sections. Sites were resurveyed in January 2015 to make sure that the model reflected any changes in the channel cross sections.

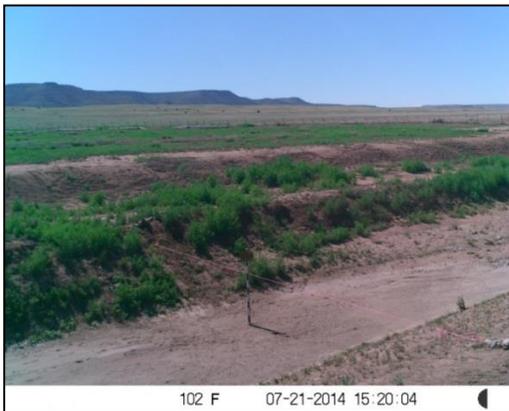


Figure 1. Upper Big Chino Wash tagline reference.

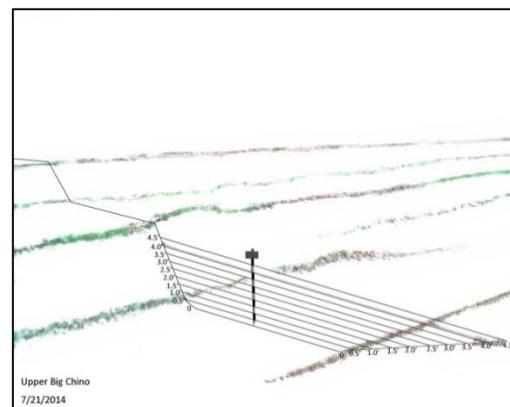


Figure 2. Upper Big Chino Wash stage level overlay.

Site Maintenance and Data Processing

A number of site visits were required to perform routine maintenance and non-routine servicing. Routine maintenance included collection of upstream and downstream transducer data, collection of flowtophography images from cameras, general cleaning of each site, and verification of general site operation. Several non-routine servicing (break-fix events) were also required and included replacing transducers and event gages damaged by flash flood events, troubleshooting camera issues and wireless modem operation, debris removal, and additional survey and site investigation required for data processing. Specifics on site visits for each location are discussed in the Location Summaries section.

Data processing of stage values and rating curves was completed using Aquarius (version 3.5) time series software. Stage values (in feet) collected from the upstream transducer serve as the primary data source (downstream transducer data serves as the secondary data source). Data from the transducers are compared to the photographic data to develop a 15-minute stage time series for each location.

The channel ratings are used to generate discharge values in cubic-feet per second (CFS) for each stage value. The flows are summed over each day to calculate the total volume of water in acre-feet (AF) for each flow event. Data and images are stored and maintained by SRP and are available to the CA1 monitoring committee via a secure SRP hosted web portal (www.azwatergage.com).

Monsoon Precipitation Summary

Figure 3 is a map of precipitation in the Big Chino Sub-Basin for the 2015 monsoon season. The precipitation values are the sum of the July, August and September monthly PRISM gridded data set. Monsoon precipitation ranged from just under 4.5” in the lower valley to over 7” in the higher elevations. An area of over 6” of precipitation occurred just above the Pine Creek monitoring location.

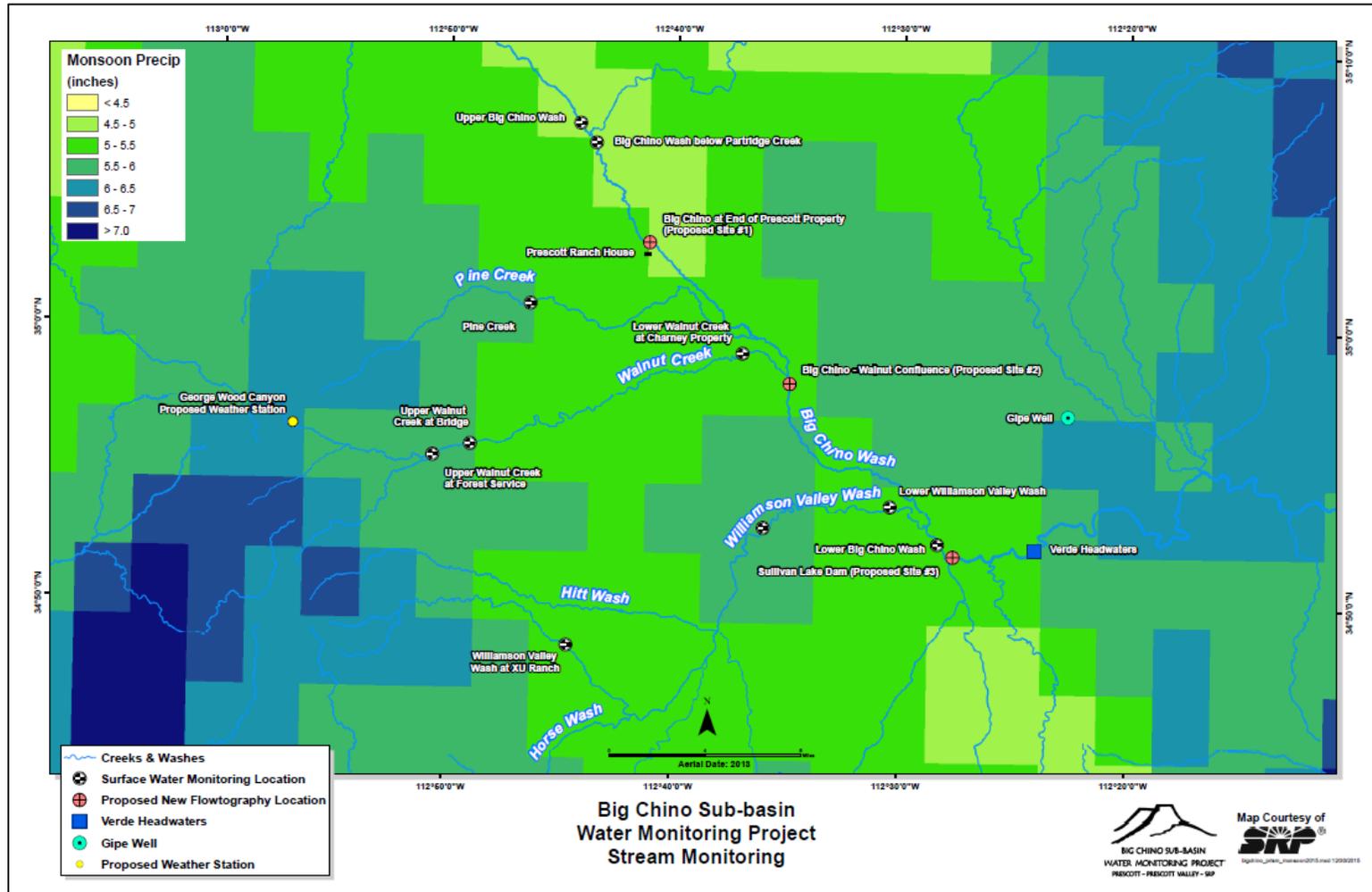


Figure 3. Precipitation data for the 2015 monsoon season. Source: PRISMS Climate Group, Oregon State University.

Seasonal Flow Events Summary

During the 2015 monsoon season a total of 17 days were observed with surface water flowing at one or more locations. The most widespread flow occurred early in the monsoon season, July 19, 2015. On that day, four of the seven locations indicated at least some surface water discharge. The largest single flow event was observed at Pine Creek on September 22-23, 2015. The total discharge for that one day was approximately 230 AF, which was greater than the season total of any other individual site. The monsoon season flow event totals (AF) at each location are outlined in Table 1 and Figure 4.

Start Date ¹	Upper Big Chino Wash	Big Chino Wash below Partridge Creek	Pine Creek	Upper Walnut Creek at Forest Service	Lower Walnut Creek at Charney Property	Williamson Valley Wash at XU Ranch	Lower Williamson Valley Wash	Lower Big Chino Wash
7/1/2015	0	0	0	0	0	0	0	0
7/3/2015	0	0	0.2	0	0	0	0	0
7/6/2015	7	0	22	0	0	0.6	0	0
7/7/2015	0.1	0	1	0	0	0	0	0
7/18/2015	0.2	0	3	0	0	0	73	0
7/19/2015	0.3	101	0	0	0	0	6	9
8/5/2015	0	0	0	0	0	0	24	0
8/6/2015	0	0	0	0	0	0	1	0
8/11/2015	4	7	0.1	0	0	0	0	0
8/12/2015	0.2	0	4	0	0	0	0	0
8/26/2015	6	54	0	0	0	0	0	0
8/30/2015	0.4	0	0	0	0	0	0	0
9/6/2015	0	0	4	0	0	0	0	0
9/10/2015	0.8	6	77	0	0	0	0	0
9/11/2015	0	0	2	0	0	0	0	0
9/14/2015	0.6	0	0	0	0	0	0	0
9/22/2015	0	0	230	0	0	0	0	0
9/23/2015	0	0	0.1	0	0	0	0	0
TOTAL AF	20	169	344	0	0	0.6	104	9

Table 1. Big Chino Sub-Basin Location – 2015 Monsoon Season Flow Event Totals in acre-feet (AF)

¹ Flow events may continue into the next day or start just prior to indicated date in some instances.

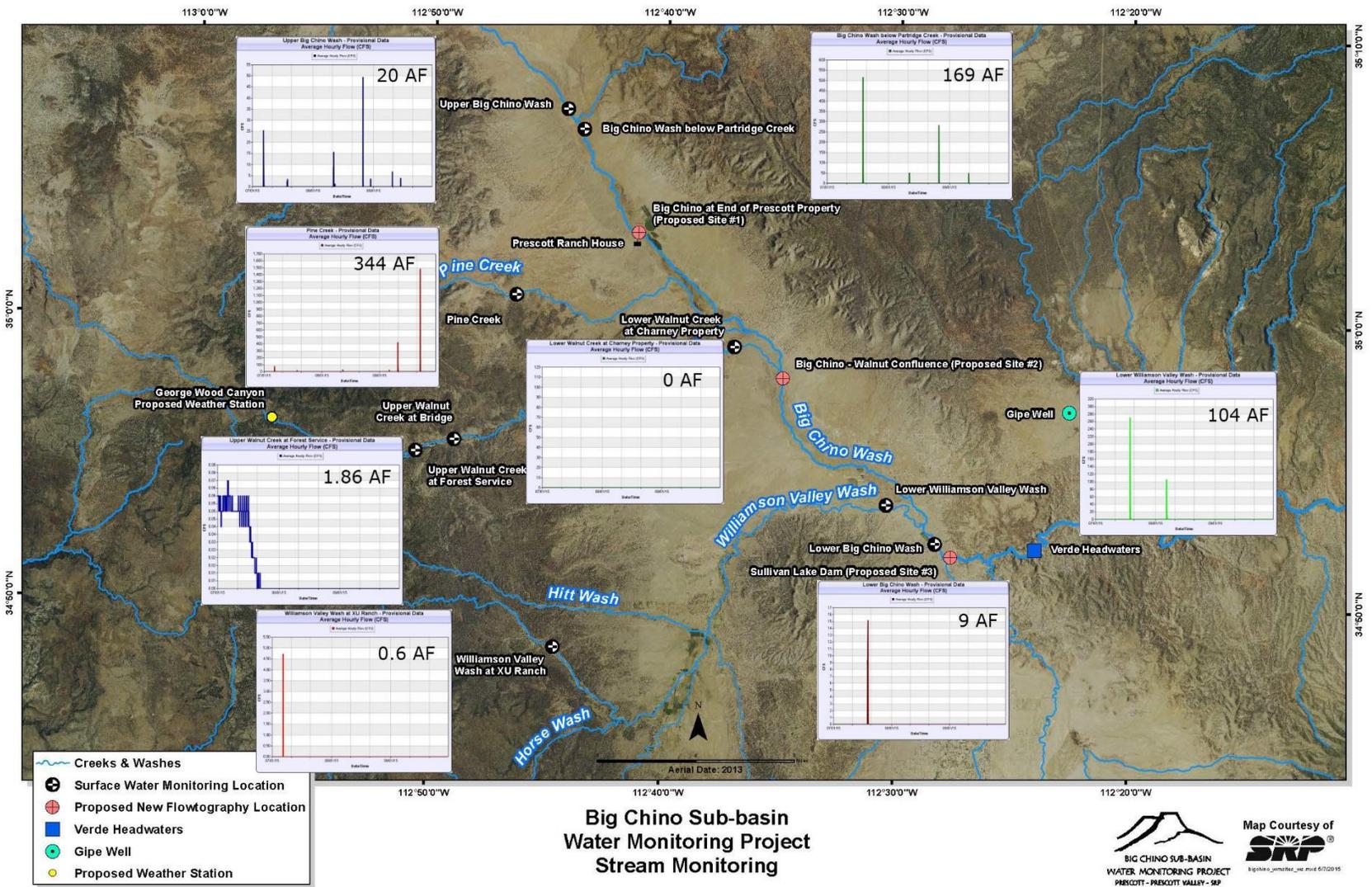


Figure 4. Hydrograph and total acre-feet discharge as it relates to the site and location in the Big Chino Sub-Basin.

Location Summaries

Upper Big Chino Wash (UBCW)

The Upper Big Chino Wash site experienced nine (9) flow events during the 2015 monsoon season (see Table 2 and Figure 5 for event data, hydrographs, and Flowtography images). The largest volumetric and duration of flow event was observed on 7/6/2015. The flow event lasted 11 hours and produced a volume of approximately 7 AF. The highest flow of the season occurred on 8/26/2015, with a peak estimate of 90 CFS. For the 2015 monsoon season, approximately 20 AF were observed at UBCW.

Table 2: Upper Big Chino Wash - 2015 Monsoon Flow Events

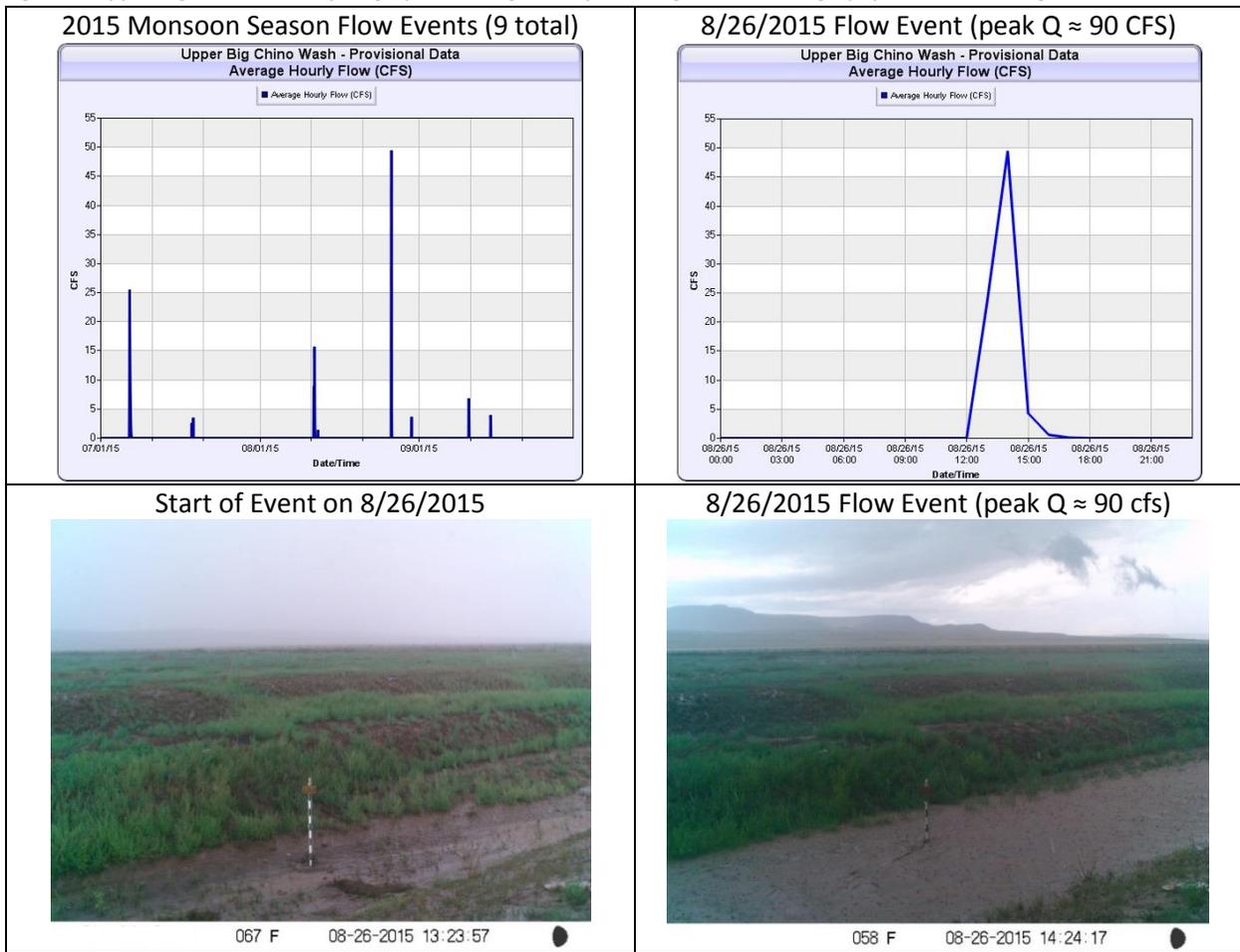
Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/6/2015	14:15	11	0.95	25	7
7/18/2015	17:30	2	0.35	7	0.2
7/19/2015	00:15	2	0.45	9	0.3
8/11/2015	11:30	9	1.00	30	4
8/12/2015	06:30	2	0.25	4	0.2
8/26/2015	13:15	5	1.90	90	6
8/30/2015	11:45	2	0.45	9	0.4
9/10/2015	15:45	3	0.85	23	0.8
9/14/2015	21:45	2	0.60	14	0.6
Total		38	1.90	90	20

* Start times are approximate within 15 minutes and events may continue into the next day

The UBCW location was visited two (2) times for the monsoon season. All site visits were routine for basic site maintenance and data collection. The monsoon season site visits are chronicled below:

- 7/8/2015: O&M site maintenance and data collection
- 10/7/2015 O&M site maintenance and data collection

Figure 5: Upper Big Chino Wash Hydrographs (average hourly discharge) and Flowtography Flow Event Images



Big Chino Wash below Partridge Creek (BCWPC)

The Big Chino Wash below Partridge Creek site experienced four (4) flow events during the 2015 monsoon season (see Table 3 and Figure 6 for event data, hydrographs, and Flowtography images). The largest flow event started on 7/18/2014 with an estimated peak stage of 6.15', and an approximate flow of 800 CFS. For the 2015 monsoon season, approximately 169 AF were observed at BCWPC.

The upstream and downstream event gages were damaged during the flow event on 7/19/2015. They were straightened out on 8/14/2015 and replaced with new event gages on 8/26/2015. A flow event on the evening of the 26th damaged the event gage. The flow for the entire monsoon time period was estimated using the Flowtography image data.

Table 3: Big Chino Wash below Partridge Creek – 2015 Monsoon Flow Events

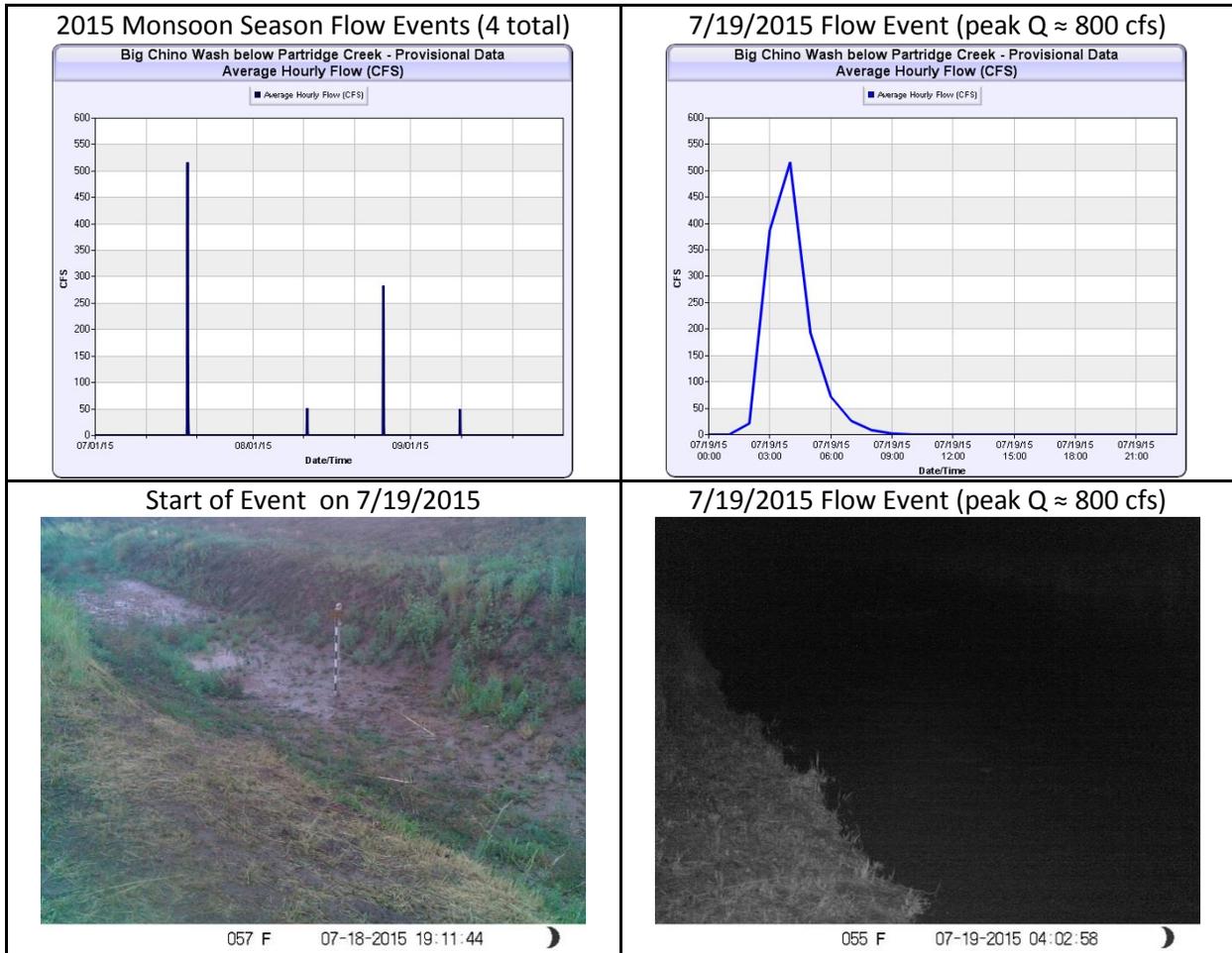
Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/19/2015	02:00	8	6.15	800	101
8/11/2015	14:30	4	2.25	58	7
8/26/2015	14:30	5	4.50	350	54
9/10/2015	16:00	4	2.50	80	6
Total		21	6.15	800	169

* Start times are approximate within 15 minutes and events may continue into the next day

The BCWPC location was visited four (4) times for the monsoon season. The site was visited twice for basic site maintenance and data collections, and two times to repair and/or replace damaged event gages. The monsoon season site visits are chronicled below:

- 7/8/2015: O&M site maintenance and data collection
- 8/14/2015: Repaired damaged event gauge
- 8/26/2015: Repaired damaged event gauge
- 10/7/2015 O&M site maintenance and data collection

Figure 6: Big Chino Wash below Partridge Creek Hydrographs (average hourly discharge) and Flowtography Flow Event Images



Pine Creek (PC)

The Pine Creek site experienced eight (8) flow events during the 2015 monsoon season (see Table 4 and Figure 7 for event data, hydrographs, and Flowtopography images). Two events in September (11th and 22nd) exceeded the original bank full survey (stages above 2.30'). In January 2016, a new survey cross-section was completed to extend the rating estimates for the observed September flow conditions. The largest flow event was recorded on 9/22/2015 with a peak discharge estimated around 2,350 CFS and a peak stage near 5.50'. The flow was great enough to remove the event gauge from the location. For the 2015 monsoon season, approximately 230 AF were observed at PC.

Table 4: Pine Creek - 2015 Monsoon Flow Events

Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/3/2015	18:00	1	0.20	5	0.2
7/6/2015	14:30	14	1.30	95	23
7/18/2015	17:00	4	0.65	25	3
8/11/2015	11:30	1	0.10	2	0.1
8/12/2015	06:30	5	0.75	33	4
9/6/2015	01:30	4	0.80	37	4
9/10/2015	16:00	15	3.15 ^a	725 ^a	78
9/22/2015	16:30	9	5.50 ^a	2,350 ^a	230
Total		53	5.50^a	2,350^a	344

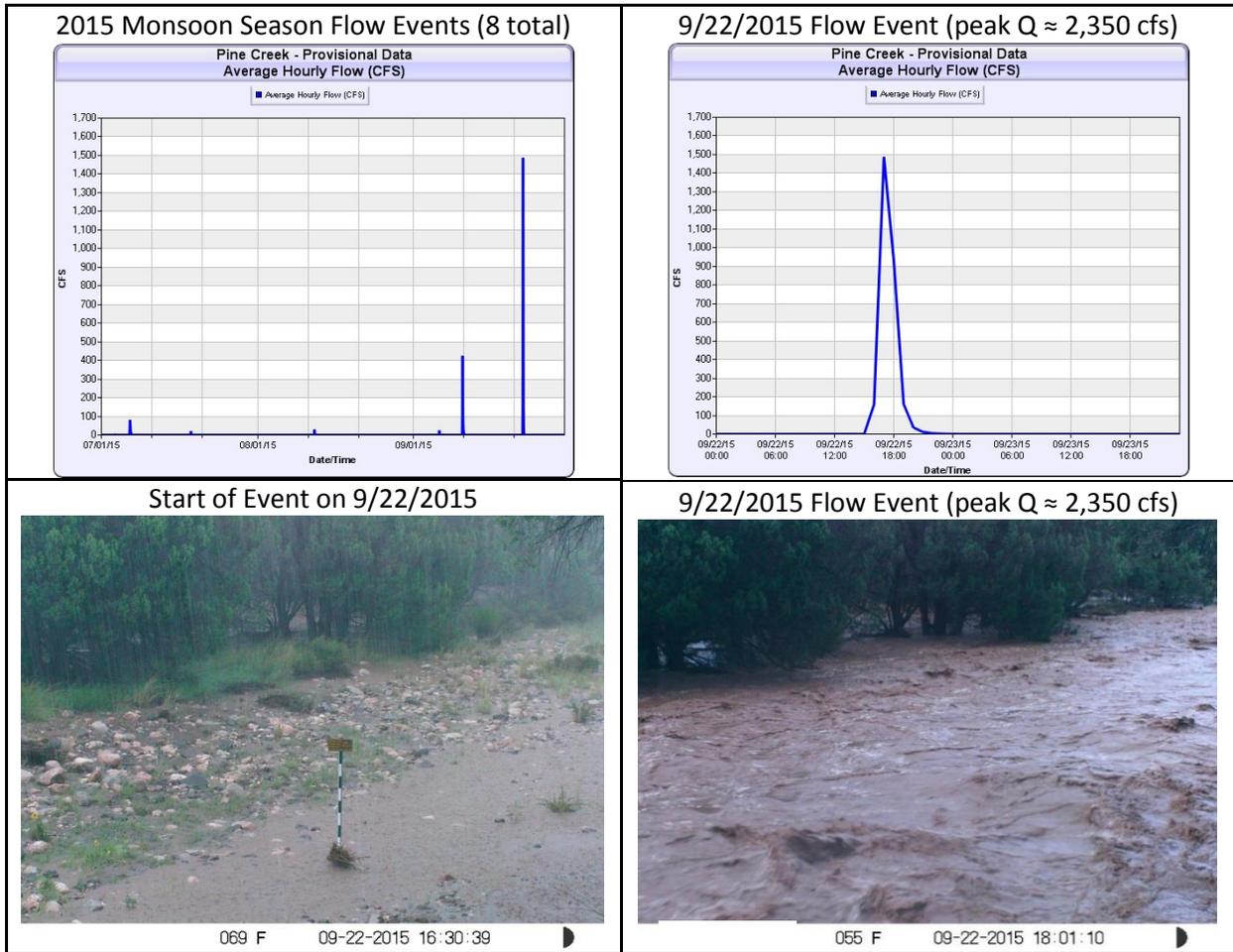
* Start times are approximate within 15 minutes and events may continue into the next day

^a Stage exceeded original survey bank full (stage = 2.30').

The PC location was visited four (4) times for the monsoon season. The site was visited twice for basic site maintenance and data collections and once to replace an inoperable camera. The monsoon season site visits are chronicled below:

- 7/8/2015: O&M site maintenance and data collection
- 8/14/2015: Replace camera
- 10/7/2015: O&M site maintenance and data collection
- 1/11/2016: Re-surveyed upstream cross-section to extend rating. The trip also included O&M site maintenance and data collection

Figure 7: Pine Creek Hydrographs (average hourly discharge) and Flowtography Flow Event Images



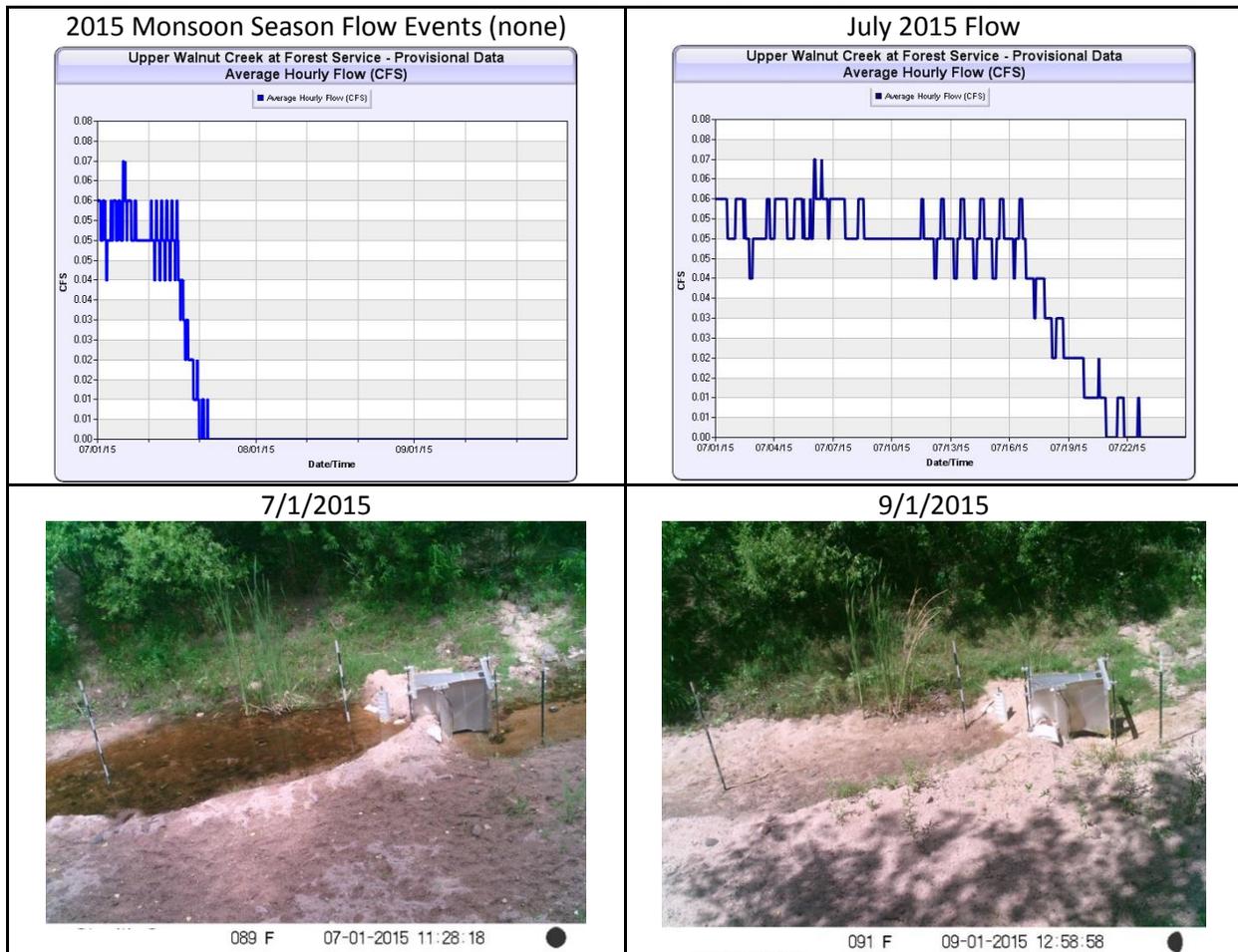
Upper Walnut Creek at Forest Service (UWCFS)

The Upper Walnut Creek at Forest Service site experienced no measureable monsoon flow events during the 2015 monsoon season (see Figure 8 for event hydrographs and Flowtography images). The pool of water behind the flume held steady until July 17, 2015. The pool and the channel became dry by July 22, 2015. On September 9, 2015, the Flowtography camera malfunctioned and stopped recording images. This site is not telemetered in, so the camera was serviced on the next scheduled service trip in October 2015. After September 9, 2015, the pressure transducer at the site continued to record no flow.

The UWCFS location was visited one (1) time for the monsoon season. The monsoon season site visits are chronicled below:

- 7/8/2015: O&M site maintenance and data collection

Figure 8: Upper Walnut Creek at Forest Service Hydrographs (average hourly discharge) and Flowtography Flow Event Images



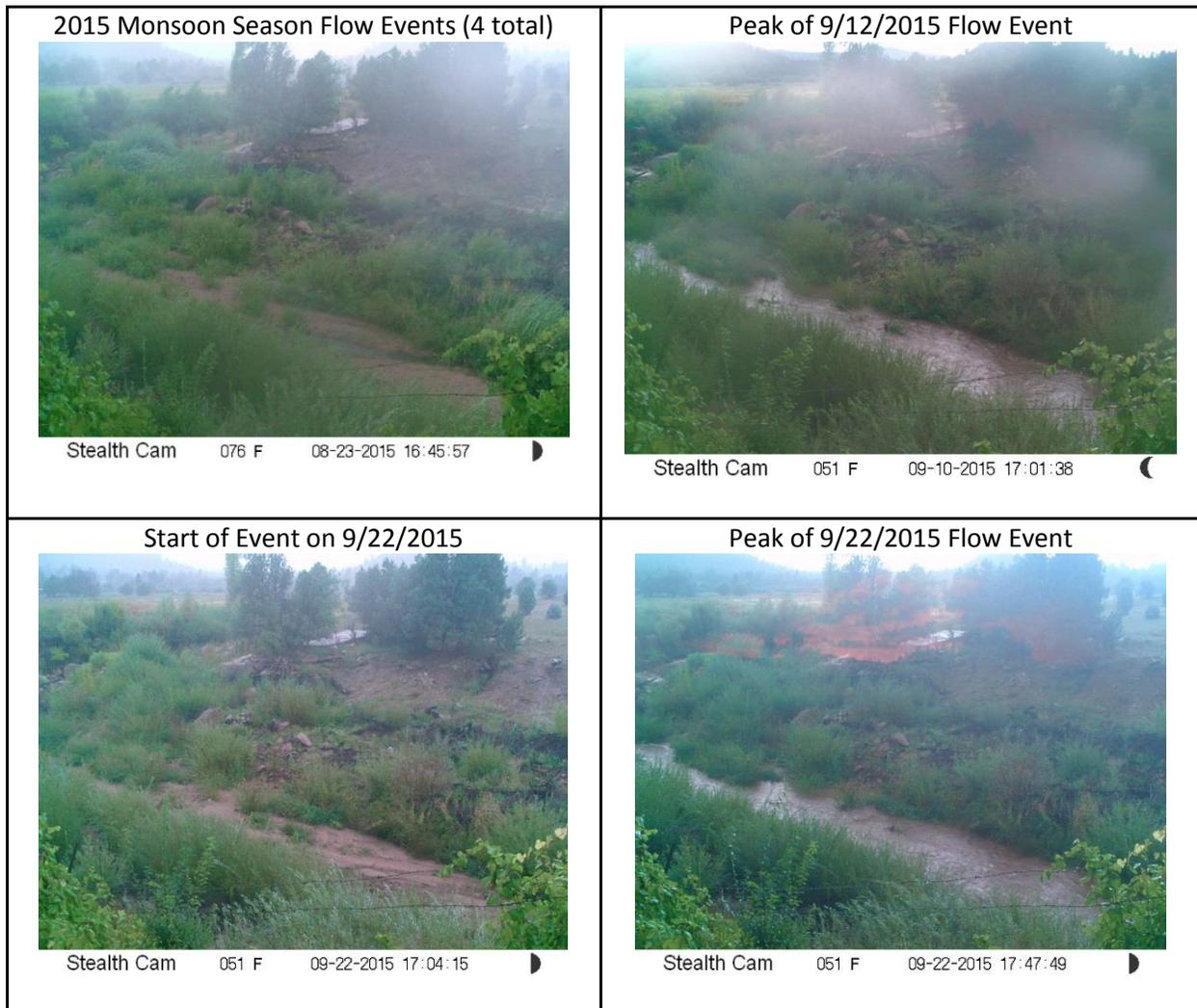
Upper Walnut Creek at Bridge (UWCB)

The Upper Walnut Creek at the Bridge site experienced four (4) flow events during the 2015 monsoon season (see Figure 9 for event Flowtography images). This site is equipped with a camera only, which documents flow events downstream of the UWCFE flume.

The UWCB location was visited one (1) time for the monsoon season. The monsoon season site visits are chronicled below:

- 7/8/2015: O&M site maintenance and data collection

Figure 9 – Upper Walnut Creek at Bridge Flow Event Flowtography Images



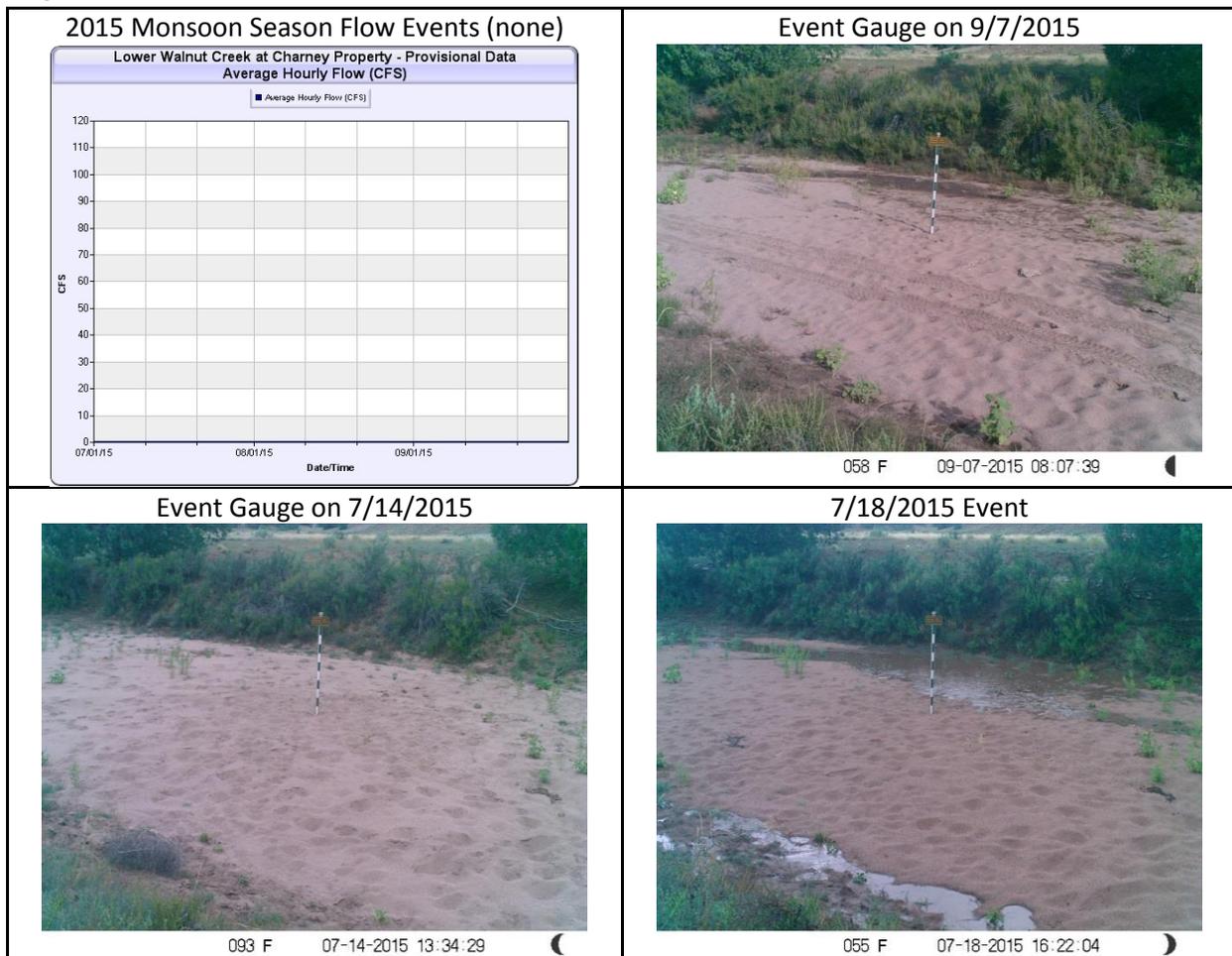
Lower Walnut Creek at Charney Property (LWCCP)

The Lower Walnut Creek at Charney Property site experienced no measureable flow events during the 2015 monsoon season (see Figure 10 for event hydrographs and Flowtography images). An event on 7/18/2015 resulted in a small trace of water pooling on the left bank of the channel, but this water did not reach the event gage nor did the pressure transducer register an increase in stage. For the 2015 monsoon season, 0 AF were observed at LWCCP.

The LWCCP location was visited two (2) times during the monsoon season. All site visits were routine for basic site maintenance and data collections. The monsoon season site visits are chronicled below:

- 7/8/2015: O&M site maintenance and data collection
- 10/7/2015 O&M site maintenance and data collection

Figure 10: Lower Walnut Creek at Charney Property Hydrographs (average hourly discharge) and Flowtography Flow Event Images



Williamson Valley Wash at XU Ranch (WVWXU)

The Williamson Valley Wash at XU Ranch site experienced one (1) flow event during the 2015 monsoon season (see Table 5 and Figure 11 for event data, hydrographs, and Flowtography images). The one flow event started on 7/6/2014 with an estimated peak stage of 0.25', and an approximate flow of 0.6 CFS. For the 2015 monsoon season, approximately 0.6 AF were observed at WVWXU.

Table 5: Williamson Valley Wash at XU Ranch – 2015 Monsoon Flow Events

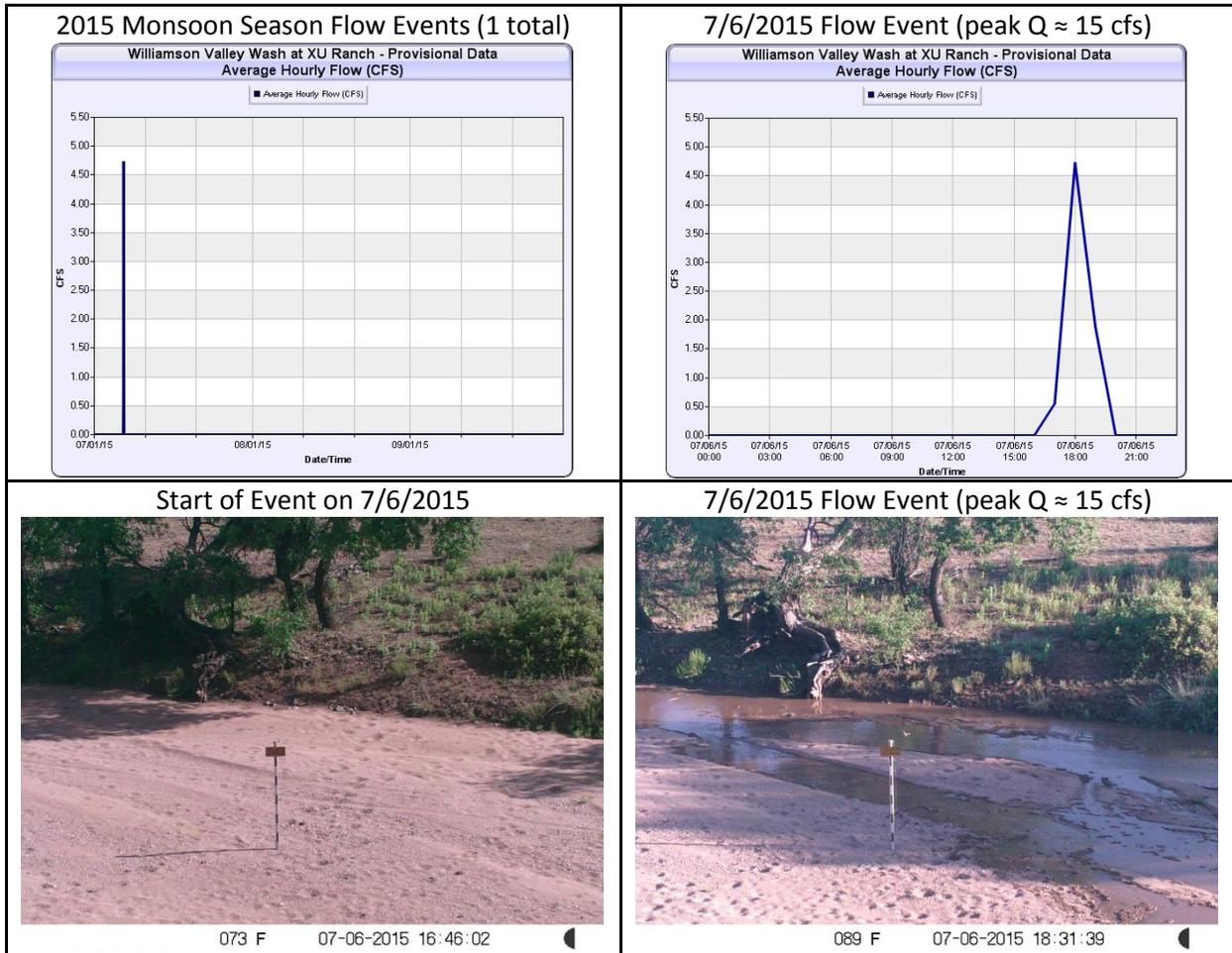
Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/6/2015	17:30	3	0.25	15	0.6
Total		3	0.25	15	0.6

* Start times are approximate within 15 minutes and events may continue into the next day

The WVWXU location was visited two (2) times for the monsoon season. All site visits were routine for basic site maintenance and data collections. The monsoon season site visits are chronicled below:

- 7/8/2015: O&M site maintenance and data collection
- 10/7/2015 O&M site maintenance and data collection

Figure 11: Williamson Valley Wash at XU Ranch Hydrographs (average hourly discharge) and Flowtography Flow Event Images



Lower Williamson Valley Wash (LWW)

The Lower Williamson Valley Wash site experienced two (2) flow events during the 2015 monsoon season (see Table 6 and Figure 12 for event data, hydrographs, and Flowtography images). The largest flow event started on 7/18/2015, with an estimated peak stage of 0.90', and an approximate flow of 300 CFS. For the 2015 monsoon season, approximately 104 AF were observed at WVVXU.

Table 6: Lower Williamson Valley Wash – 2015 Monsoon Flow Events

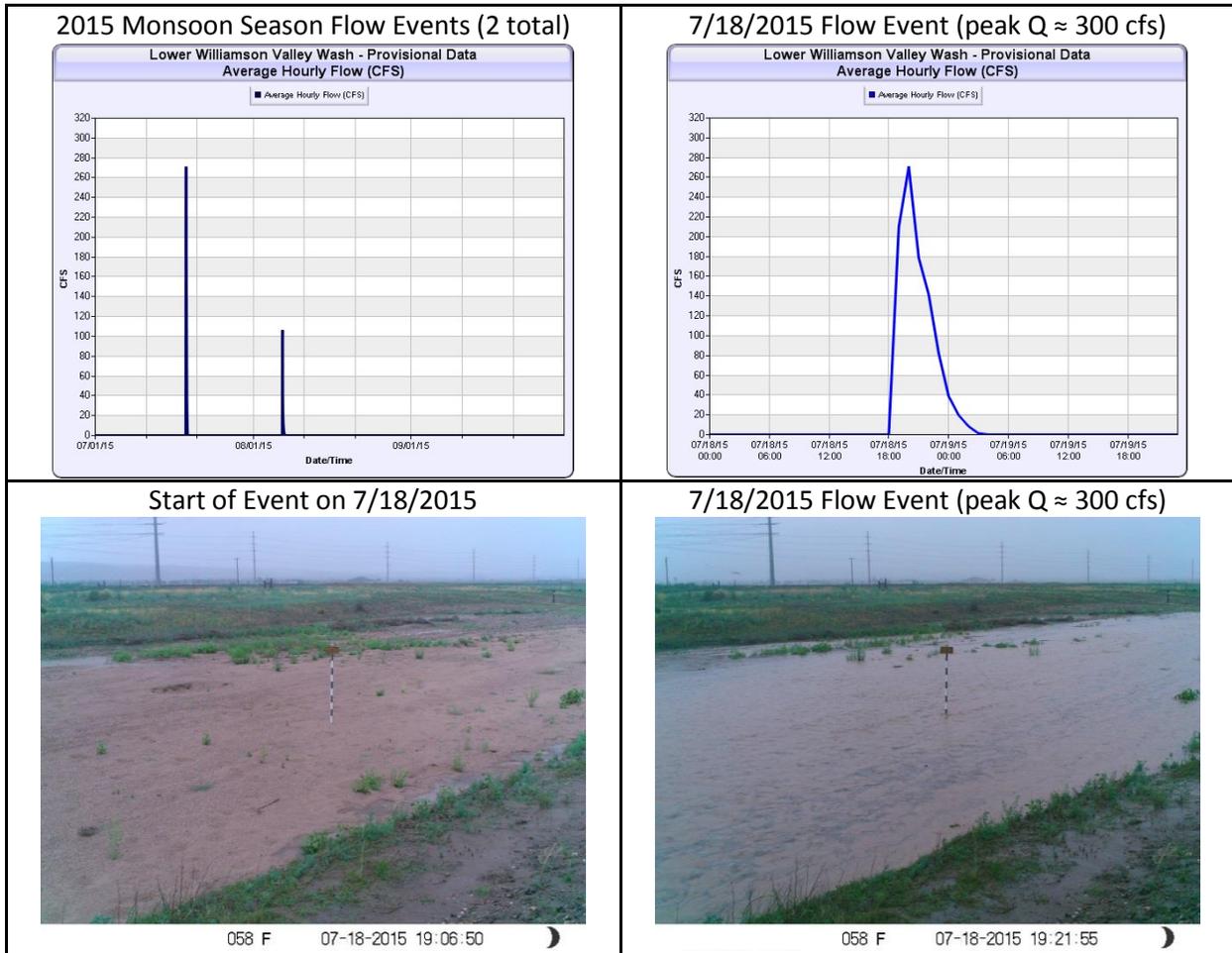
Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/18/2015	19:00	9	0.90	300	79
8/6/2015	17:30	11	0.70	190	25
Total		20	0.90	300	104

* Start times are approximate within 15 minutes and events may continue into the next day

The LWWV location was visited four (4) times for the monsoon season. The site was visited twice for basic site maintenance and data collections, and two times to repair and/or replace the inoperable camera. The monsoon season site visits are chronicled below:

- 7/8/2015: O&M site maintenance and data collection
- 8/14/2015: Replaced camera
- 8/26/2015: Repaired camera transmission issue
- 10/7/2015 O&M site maintenance and data collection

Figure 12: Lower Williamson Valley Wash Hydrographs (average hourly discharge) and Flowtopgraphy Flow Event Images



Lower Big Chino Wash (LBCW)

The Lower Big Chino site experienced one (1) flow event during the 2015 monsoon season (see Table 7 and Figure 13 for event data, hydrographs, and Flowtography images). The flow event on 7/19/2015, with an estimated peak stage of 1.4', had an approximate flow of 15 CFS. For the 2015 monsoon season, approximately 9 AF were observed at LBCW.

Table 7 - Lower Big Chino Wash - 2015 Monsoon Flow Events

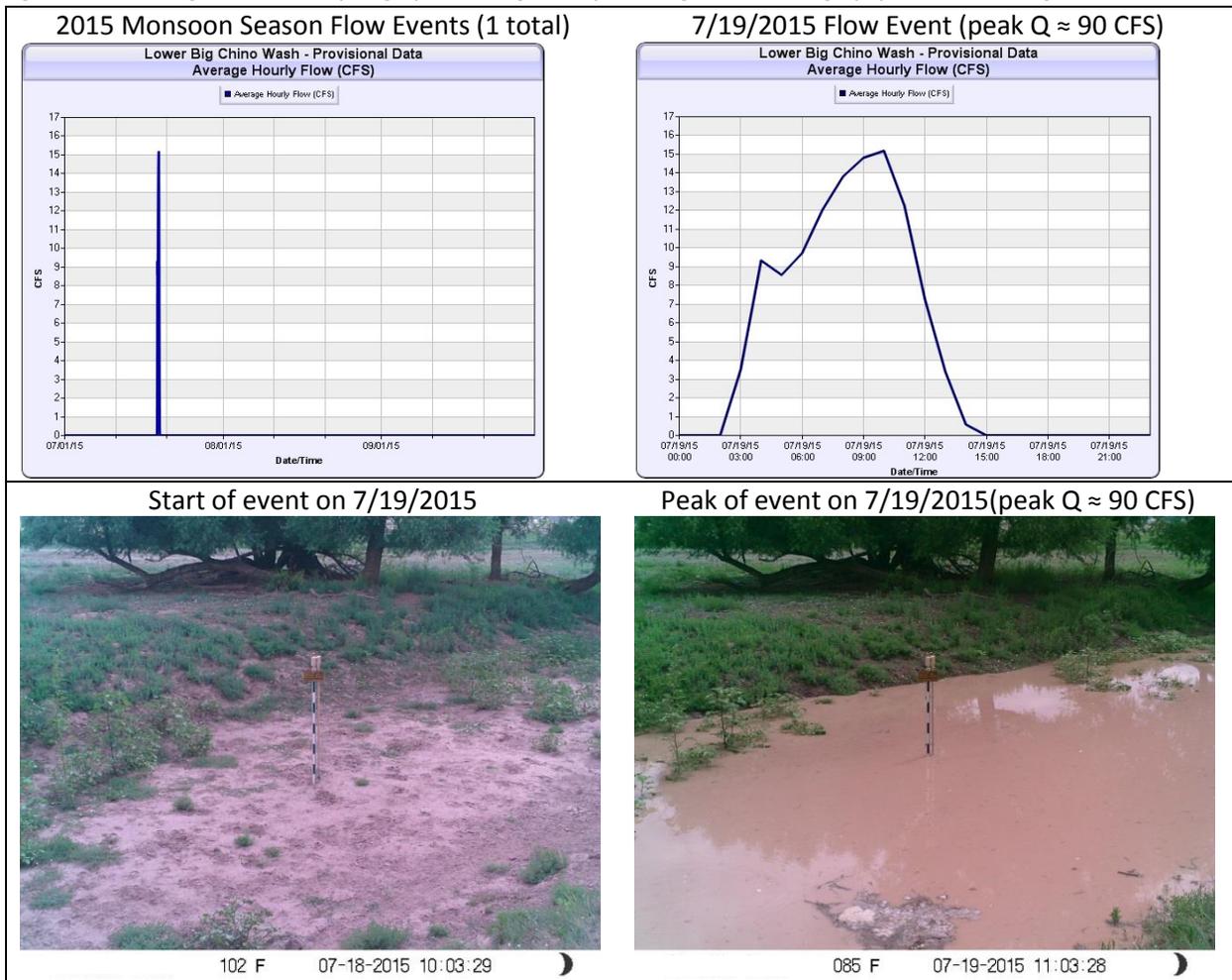
Start Date	Start Time*	Duration (hours)	Peak Stage (feet)	Peak Discharge (CFS)	Total Volume (AF)
7/19/2015	03:00	11	1.4	15	9
Total		11	1.4	15	9

* Start times are approximate within 15 minutes and events may continue into the next day

The LBCW location was visited two (2) times for the monsoon season. All site visits were routine for basic site maintenance and data collections. The monsoon season site visits are chronicled below:

- 7/8/2015: O&M site maintenance and data collection
- 10/7/2015 O&M site maintenance and data collection

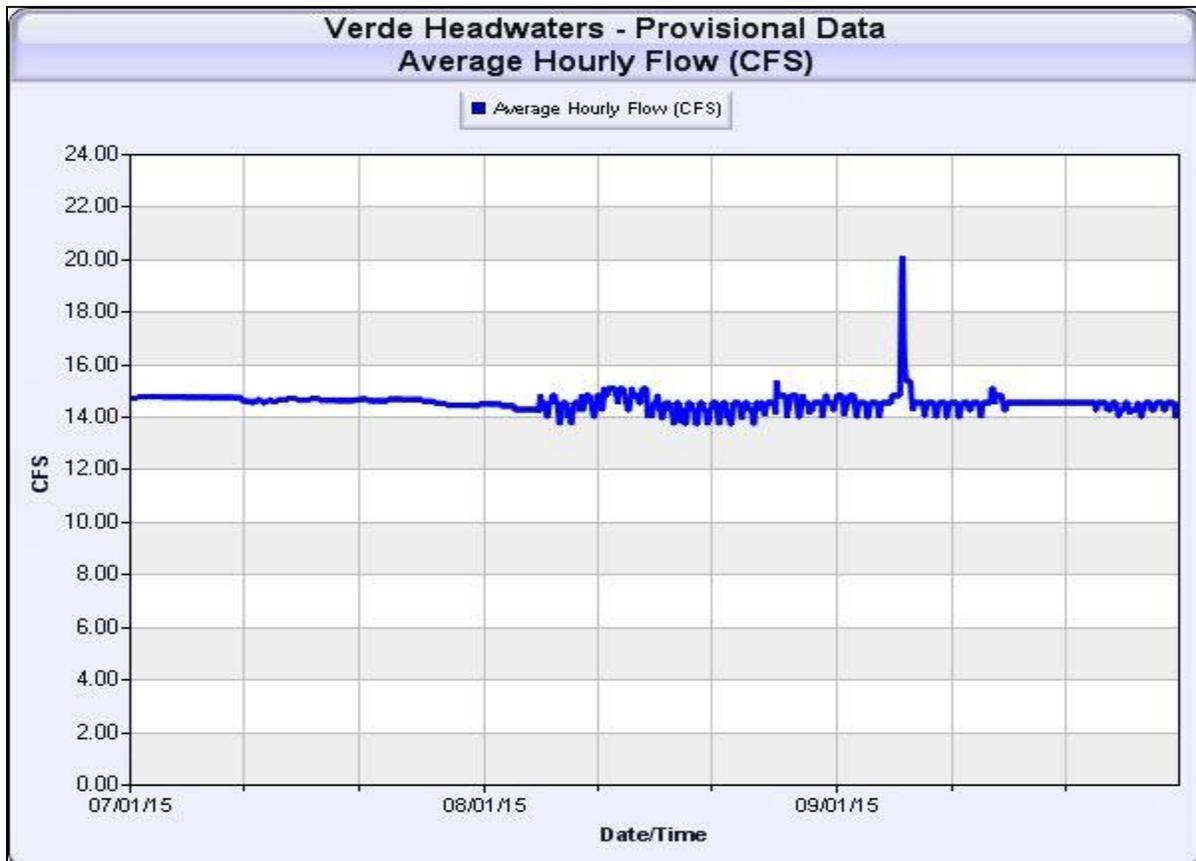
Figure 13: Lower Big Chino Wash Hydrographs (average hourly discharge) and Flowtography Flow Event Images



Verde Headwaters at Campbell Ranch

The Verde Headwaters at Campbell Ranch site experienced one (1) flow event during the monsoon season (see Figure 14 for a site hydrograph). The typical daily flow was approximately 15 CFS, with a peak flow 20.1 CFS observed on 9/6/2015. The Lower Big Chino Wash did not record a flow that day, so the water most likely originated downstream of the Big Chino Basin. The total discharge for the site for the monsoon period was approximately 2660 AF.

Figure 14 – Verde Headwaters at Campbell Ranch Hydrograph (average hourly discharge): 2015 Monsoon Season



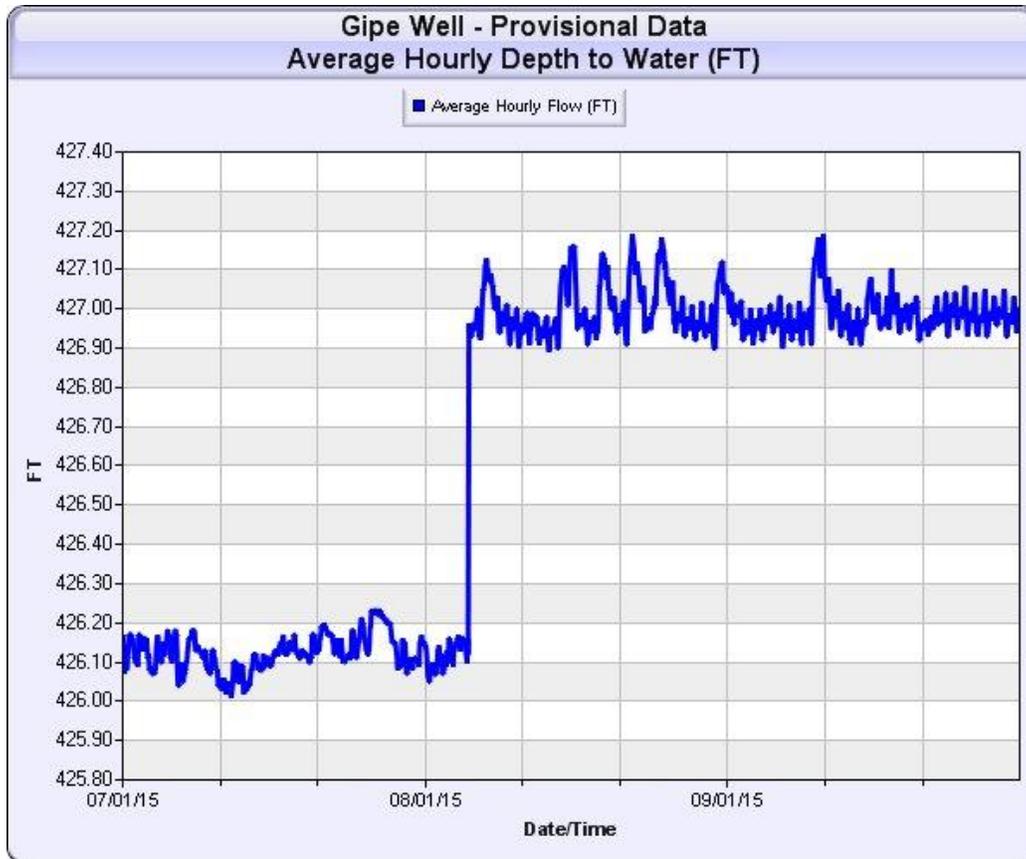
The Verde Headwaters location was visited one (1) time for the monsoon season on 8/5/2015 for routing quarterly site maintenance, data collection, and a current meter measurement. The monsoon season site visits are chronicled below:

- 8/5/2015: O&M site maintenance and data collection

Gipe Well

A faulty pressure transducer was replaced at Gipe Well on 8/5/2015. During calibration of the new pressure transducer the sounded well value was approximately one foot below the previous level (Figure 15). The step change in distance to water level is most likely due to the difficulties sounding the well. The well has an obstruction around 160' below the ground surface that ensnares the sounding tape.

Figure 15 – Gipe Well: 2015 Monsoon Season



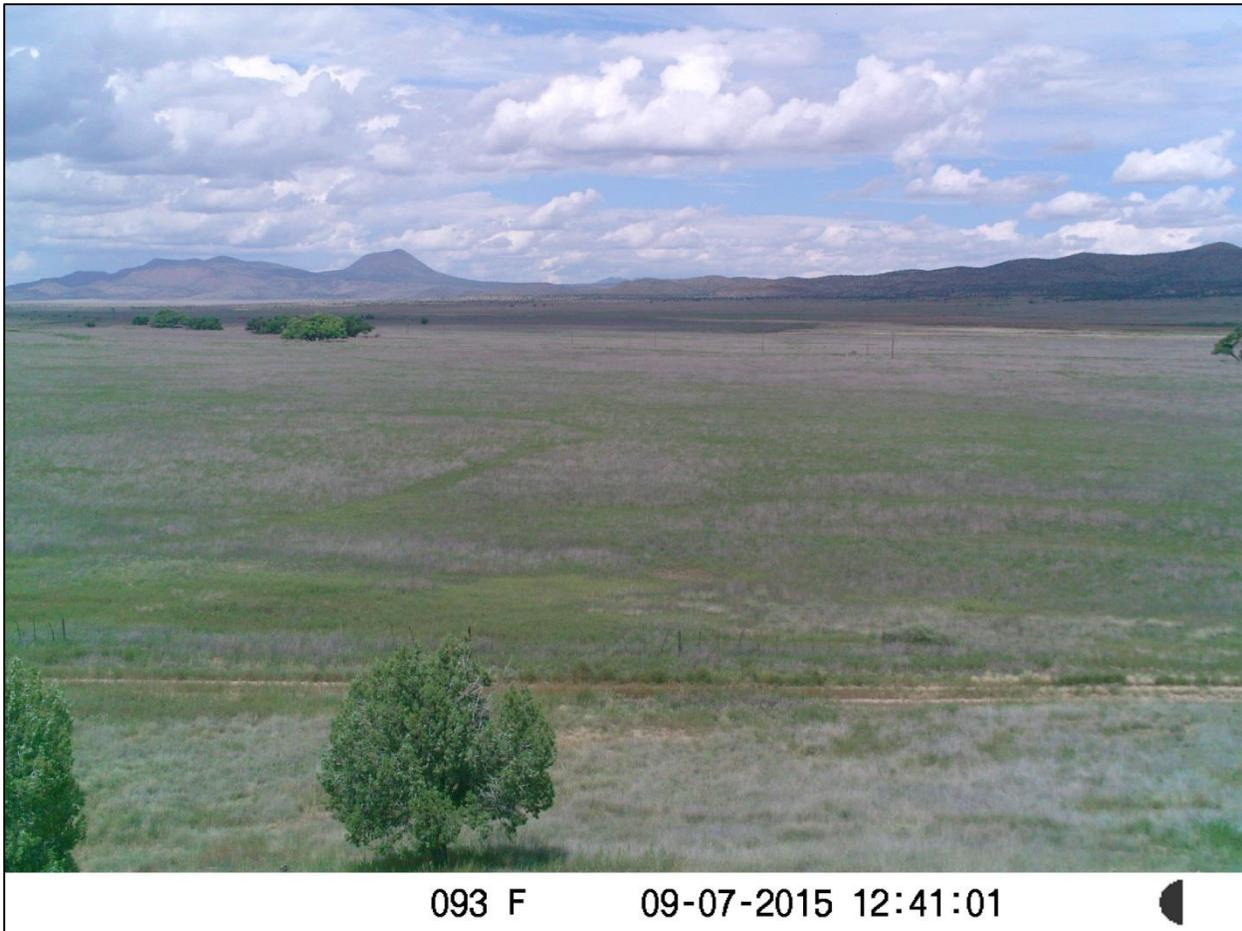
The Gipe Well location was visited two (2) times for the monsoon season. The faulty pressure transducer was replaced on the initial visit. The subsequent visit was to sound the well and verify the step change in the Depth to Water readings. The monsoon season site visits are chronicled below:

- 8/5/2015: Quarterly maintenance and replaced the pressure transducer
- 8/14/2015: Well sounding

Big Chino Wash at Prescott Ranch

On 8/26/2015, a camera was installed downstream of the Upper Big Chino Wash and Big Chino Wash below Partridge Creek monitoring sites on the City of Prescott Ranch property. The site is only equipped with a camera, and the goal of the site is to gain an understanding of what is going on in the sub-basin from a greater distance away, allowing the camera to capture more of the basin. See Figure 16 below for an image from the Prescott Ranch Flowtography Camera.

Figure 16 – Images from the Big Chino Wash at Prescott Ranch Camera only site: 2015 Monsoon Season



Other Activities in the Big Chino Sub-Basin

Sullivan Lake Siting Trip

Sullivan Lake was visited to identify the best location for a Flowtography camera. There were several areas identified for a possible camera placement (on the face of the bridge, near Old Highway 89 roadway and below the bridge). After review, the preferred camera location is on the embankment within the roadway right of way just northwest of the bridge. This will enable the camera to be out of sight from the roadway and to be in good position to take pictures of the Dam spillway.

Permitting for Sullivan Lake and Prescott Ranch

SRP completed and submitted the “Application & Permit for Construction in Public Right-of-way” to gain access to the right-of-way near Sullivan Dam, to install a camera only Flowtography assembly. The parcel is associated with the State of Arizona, and not the Town of Chino Valley, and there has been no further progress on completing and receiving permission to gain access to this land.

The camera only Flowtography assembly installed on the Prescott Ranch was installed on the City of Prescott property. Previous access was given to SRP at the start of the project.

Conclusion

The 2015 monsoon season was characterized by isolated storm and flow events. The largest event occurred late in the season at Pine Creek. The single September 22, 2015, event resulted in approximately the same volume as the remaining sites combined for the entire monsoon season. The Lower Big Chino Wash experienced only one small event during the monsoon season. That event did not correspond with an increase in flow at the Verde Headwaters flume. This would suggest that all of the 2015 monsoon precipitation was contained within the Big Chino Sub-Basin.