HYDROLOGIC DATA BRIEF FOR THE EDWARDS AQUIFER THROUGH SEPTEMBER 2016

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October 5, 2016

UVALDE COUNTY RAINFALL (in inches) for 2016

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Monthly Rainfall (2016)	0.86	1.60	0.68	1.99	7.21	3.01	1.48	7.37	2.85			
Historical Monthly Avg	1.13	1.24	1.32	2.36	3.16	2.83	1.95	2.16	2.60	2.57	1.41	1.34
Difference	**-0.27**	**0.36**	**-0.64**	**-0.37**	**4.05**	**0.18**	**-0.47**	**5.21**	**0.25**			

Historical Yearly Average	**24.07**
Total for January - September 2016	**27.05**
Historical Average January - September	**18.75**
Total Difference for Year to Date	**8.30**
Percent of Average Year to Date	**144%**

Data from EAA rain gauge UV033 located 4.4 miles south of the City of Uvalde.

MEDINA COUNTY RAINFALL (in inches) for 2016

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	* Aug.	Sept.	Oct.	Nov.	Dec.
Monthly Rainfall (2016)	0.54	1.42	1.51	2.87	6.95	1.74	1.56	6.35	1.65			
Historical Monthly Avg	1.43	1.94	1.53	2.66	3.79	3.38	1.88	2.76	3.00	3.03	1.73	1.43
Difference	**-0.89**	**-0.52**	**-0.02**	**0.21**	**3.16**	**-1.64**	**-0.32**	**3.59**	**-1.35**			

Historical Yearly Average	**28.56**
Total for January - September 2016	**24.59**
Historical Average January - September	**22.37**
Total Difference for Year to Date	**2.22**
Percent of Average Year to Date	**110%**

* ME003 data substituted for NWS rainfall station at Hondo Airport due to technical issues at Hondo Airport Gauge.

Data from National Weather Service (NWS) rainfall station at Hondo Airport.

BEXAR COUNTY RAINFALL (in inches) for 2016

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Monthly Rainfall (2016)	1.38	1.55	3.56	6.19	9.14	2.39	0.33	4.91	6.30			
Historical Monthly Avg	1.61	1.90	1.68	2.53	3.99	3.57	1.83	2.58	3.29	3.29	2.11	1.72
Difference	**-0.23**	**-0.35**	**1.88**	**3.66**	**5.15**	**-1.18**	**-1.50**	**2.33**	**3.01**			

Historical Yearly Average	**30.10**
Total for January - September 2016	**35.75**
Historical Average January - September	**22.98**
Total Difference for Year to Date	**12.77**
Percent of Average Year to Date	**156%**

Data from NWS rainfall station located at San Antonio International Airport.

COMAL COUNTY RAINFALL (in inches) for 2016

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Monthly Rainfall (2016)	1.00	1.01	2.76	4.42	5.60	2.00	3.12	5.31	3.35			
Historical Monthly Avg	2.36	2.09	1.92	2.68	4.86	4.64	2.02	2.16	3.39	3.84	2.79	2.75
Difference	**-1.36**	**-1.08**	**0.84**	**1.74**	**0.74**	**-2.64**	**1.10**	**3.15**	**-0.04**			

Historical Yearly Average	**35.50**
Total for January - September 2016	**28.57**
Historical Average January - September	**26.12**
Total Difference for Year to Date	**2.45**
Percent of Average Year to Date	**109%**

Data from NWS rainfall station located in New Braunfels.

HAYS COUNTY RAINFALL (in inches) for 2016

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	* Aug.	Sept.	Oct.	Nov.	Dec.
Monthly Rainfall (2016)	0.96	1.37	1.84	0.97	6.95	1.57	1.64	4.13	7.60			
Historical Monthly Avg	2.00	2.93	1.84	3.29	3.68	3.56	1.77	2.31	4.52	3.61	2.23	2.01
Difference	**-1.04**	**-1.56**	**0.00**	**-2.32**	**3.27**	**-1.99**	**-0.13**	**1.82**	**3.08**			

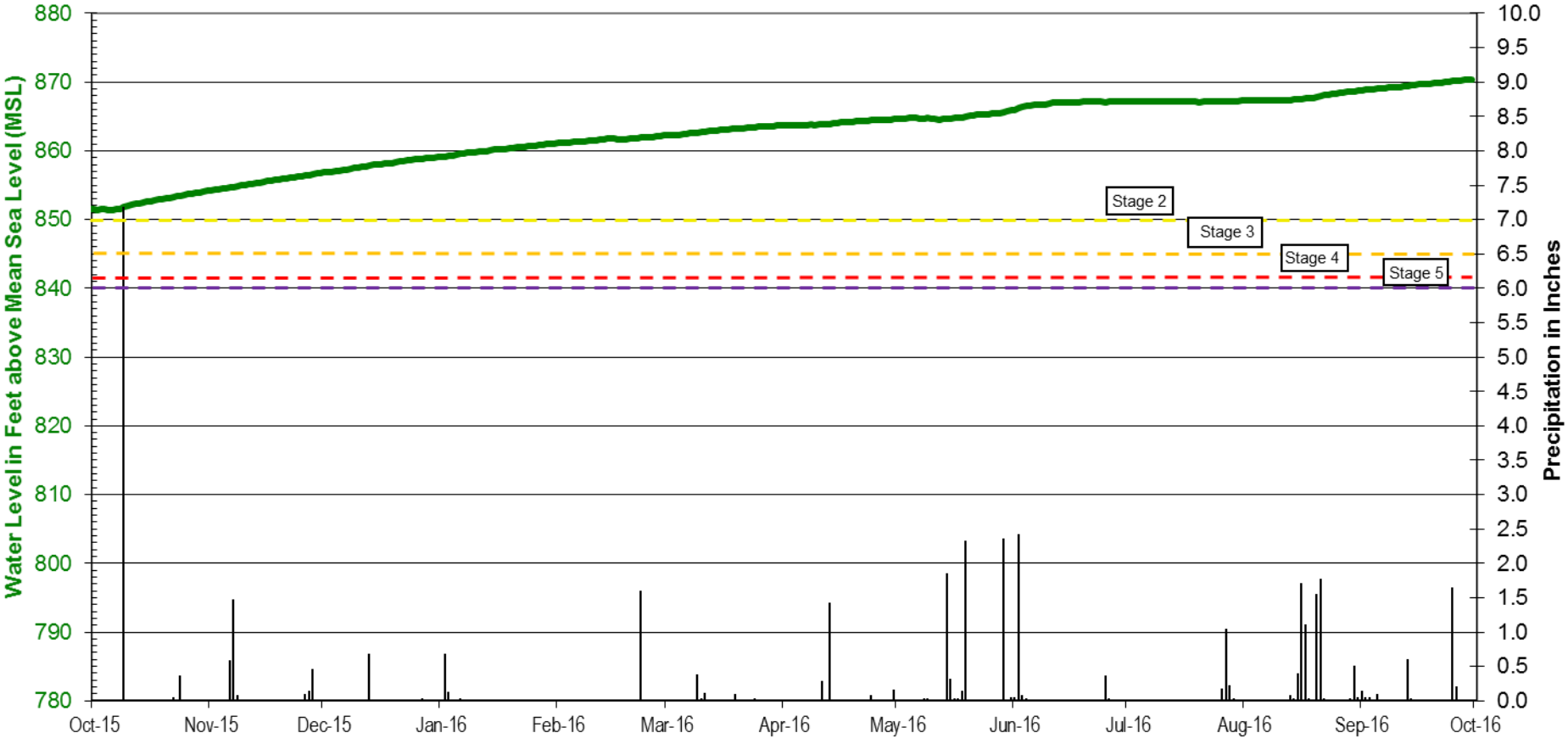
Historical Yearly Average	**33.75**
Total for January - September 2016	**27.03**
Historical Average January - September	**25.90**
Total Difference for Year to Date	**1.13**
Percent of Average Year to Date	**104%**

* HA157 data substituted for HA158 due to technical issues at HA158.

Data provided by EAA rain gauge HA158 located 0.25 miles west of Bobcat Stadium.
FAA Rainfall Station: San Marcos Airport - out of service.

Hydrograph of the Uvalde County Index Well (J-27) and Precipitation at Uvalde

(EAA Rain Gauge: UV033 located 4.4 miles south of the City of Uvalde)



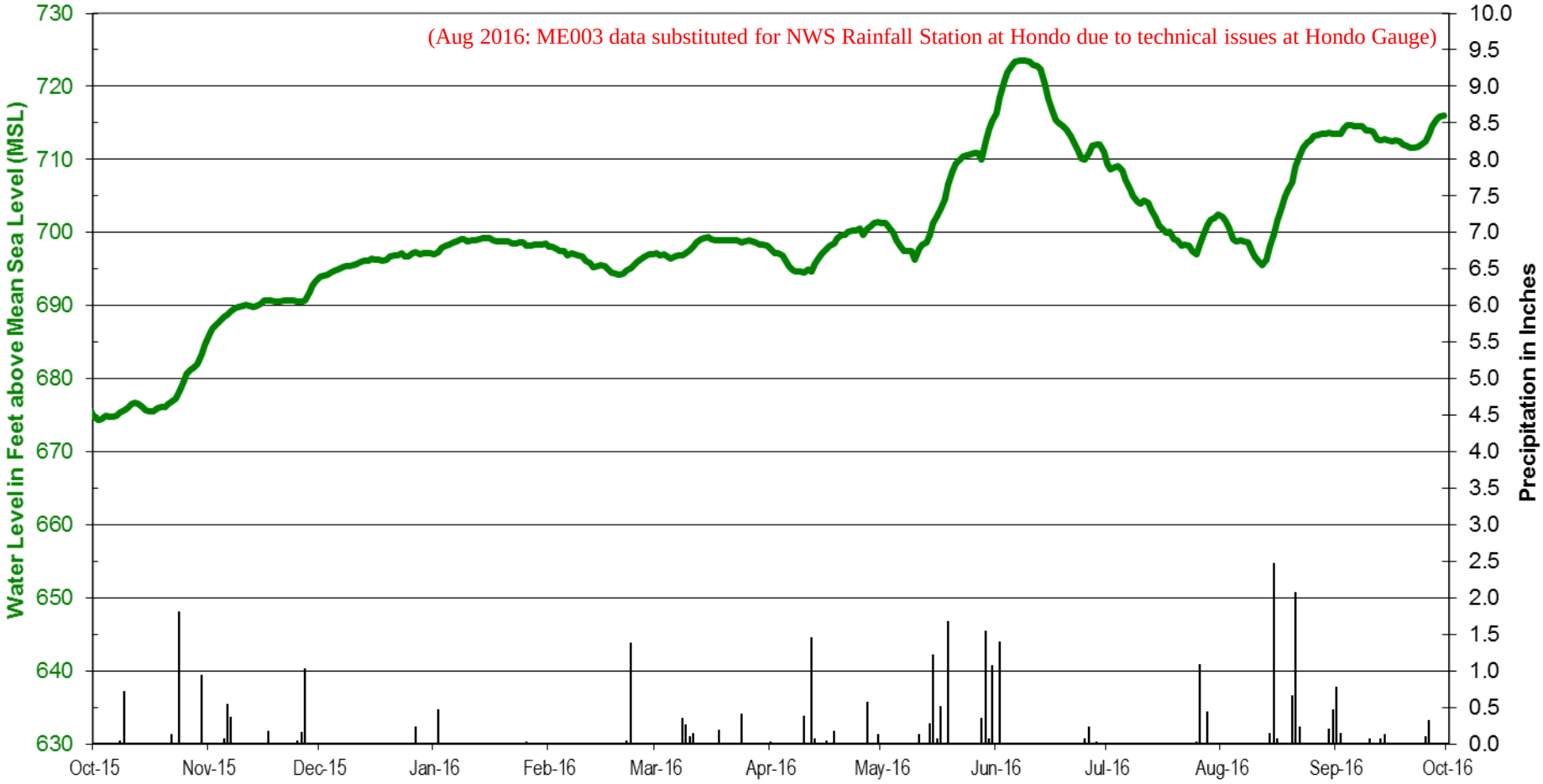
Stage 1 - None
Stage 2 - Critical Period - 10-day avg. < 850' MSL
Stage 3 - Critical Period - 10-day avg. < 845' MSL
Stage 4 - Critical Period - 10-day avg. < 842' MSL
Stage 5 - Critical Period - 10-day avg. < 840' MSL

Historical High - 889' MSL (6/15/87)
Historical Low - 811' MSL (4/13/57)

J-27 Water Level Precipitation at Uvalde

Hydrograph of the Medina County Hondo City Well and Precipitation at Hondo

(NWS Rainfall Station: Hondo)



CPM in Medina County is triggered by:
the10-day average water level at J-17 or
the10-day average springflow at Comal Springs or at San Marcos Springs

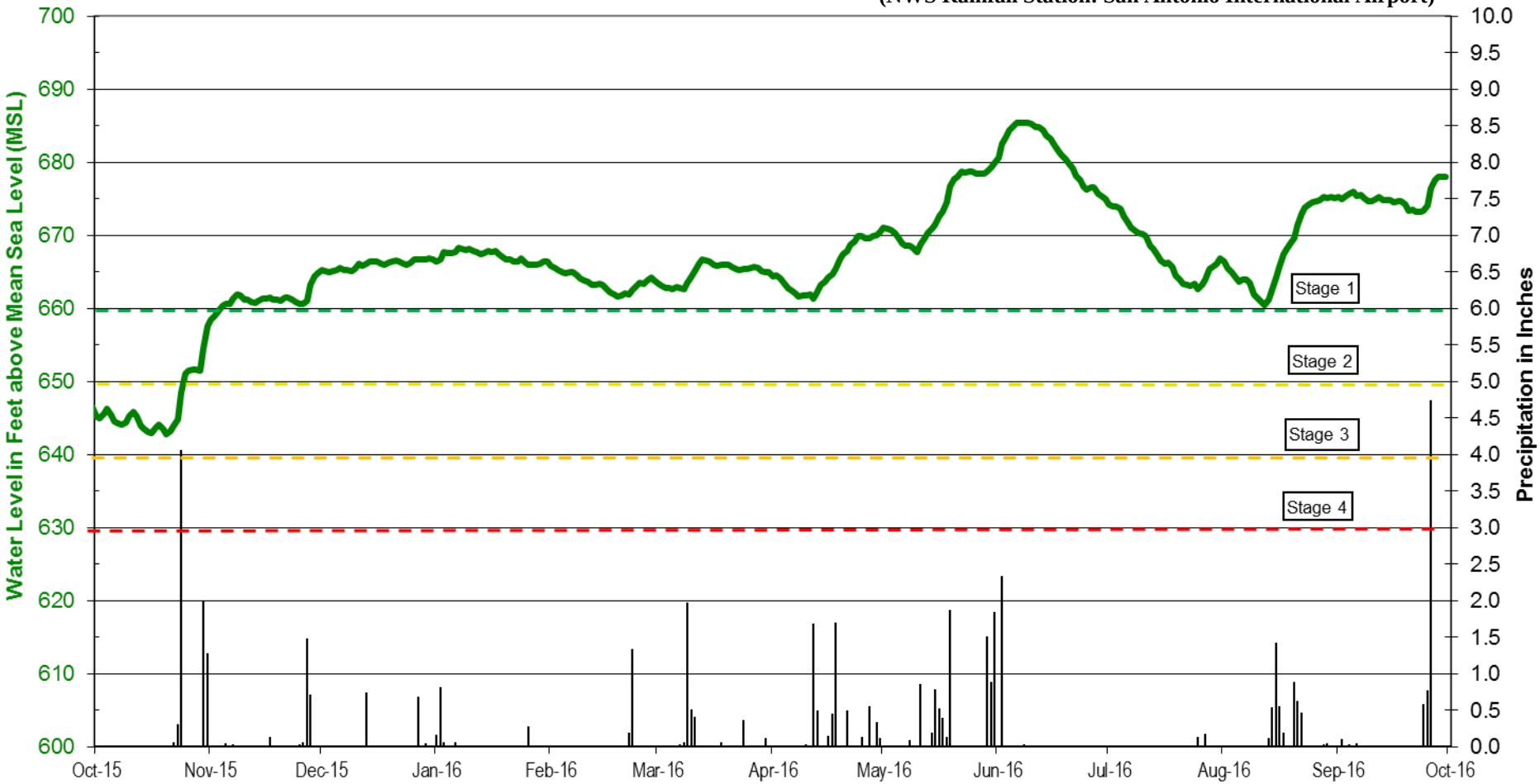
Date

Historical High - 779' MSL (6/15/92)
Historical Low - 651' MSL (6/30/90)

Hondo Water Level Precipitation at Hondo

Hydrograph of the Bexar County Index Well (J-17) and Precipitation at San Antonio

(NWS Rainfall Station: San Antonio International Airport)

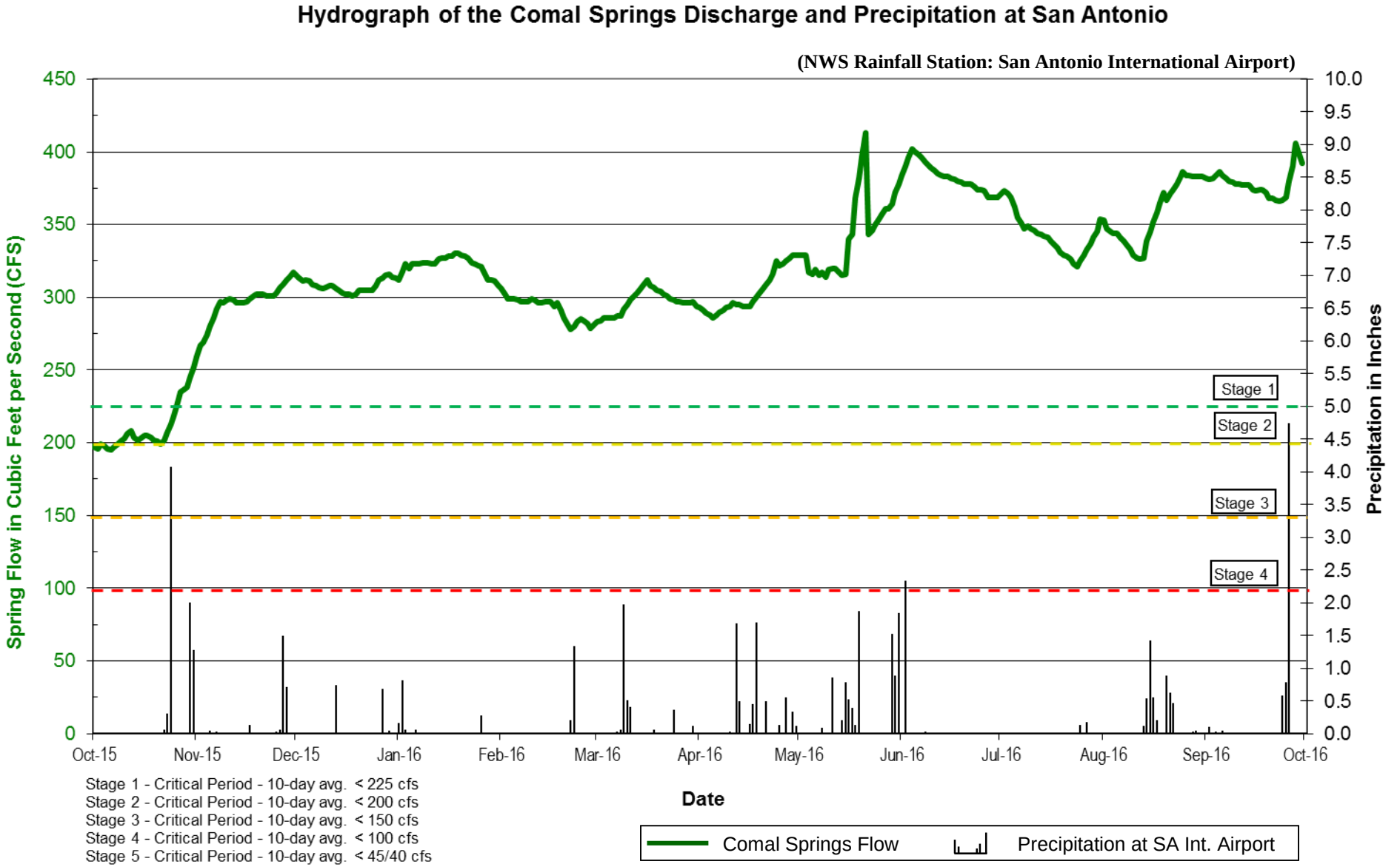


Stage 1 - Critical Period - 10-day avg. < 660' MSL
Stage 2 - Critical Period - 10-day avg. < 650' MSL
Stage 3 - Critical Period - 10-day avg. < 640' MSL
Stage 4 - Critical Period - 10-day avg. < 630' MSL
Stage 5 - Critical Period - 10-day avg. < 625' MSL

Historical High - 703.3' MSL (6/14/92)
Historical Low - 612.5' MSL (8/17/56)

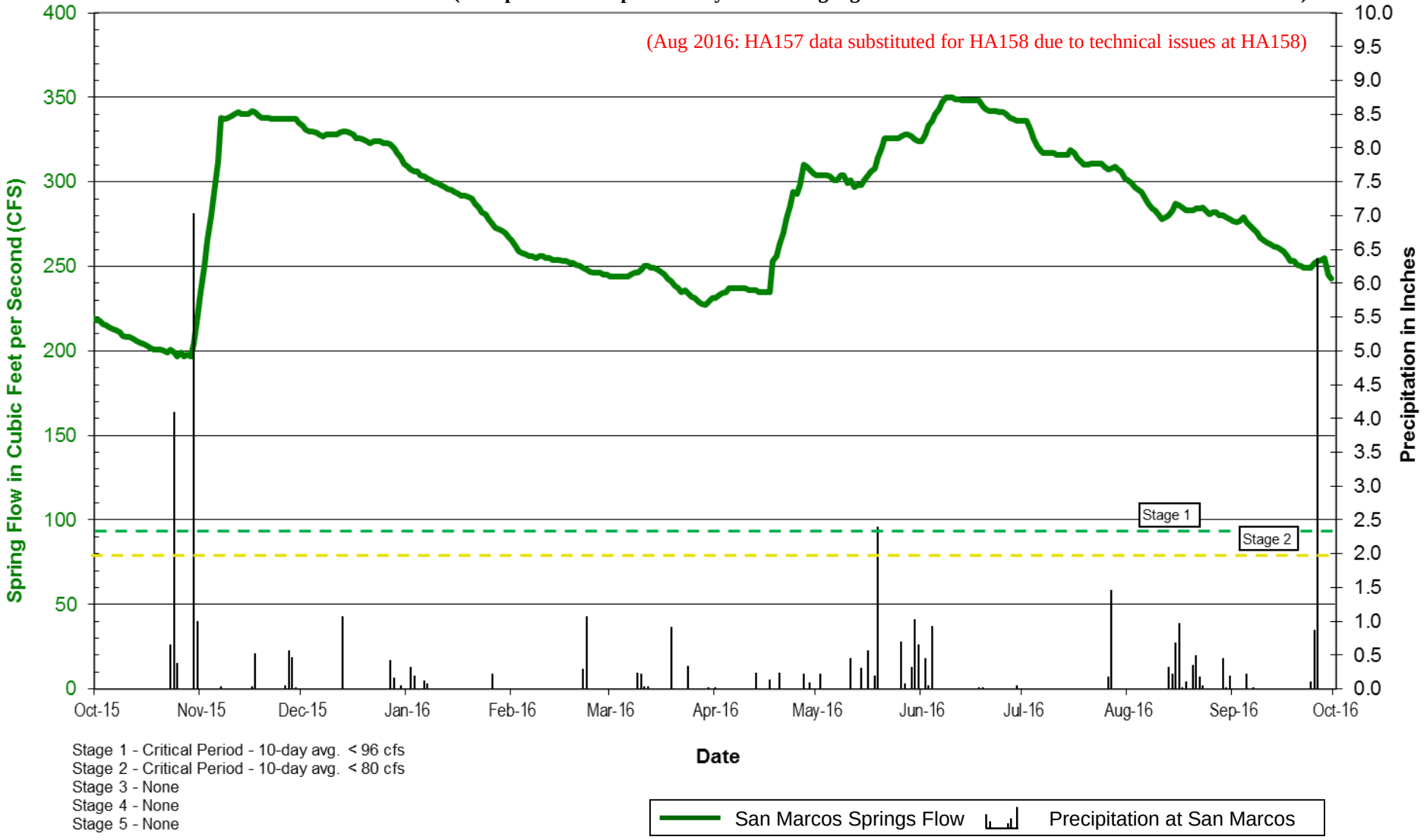
J-17 Water Level

Precipitation at SA Int. Airport

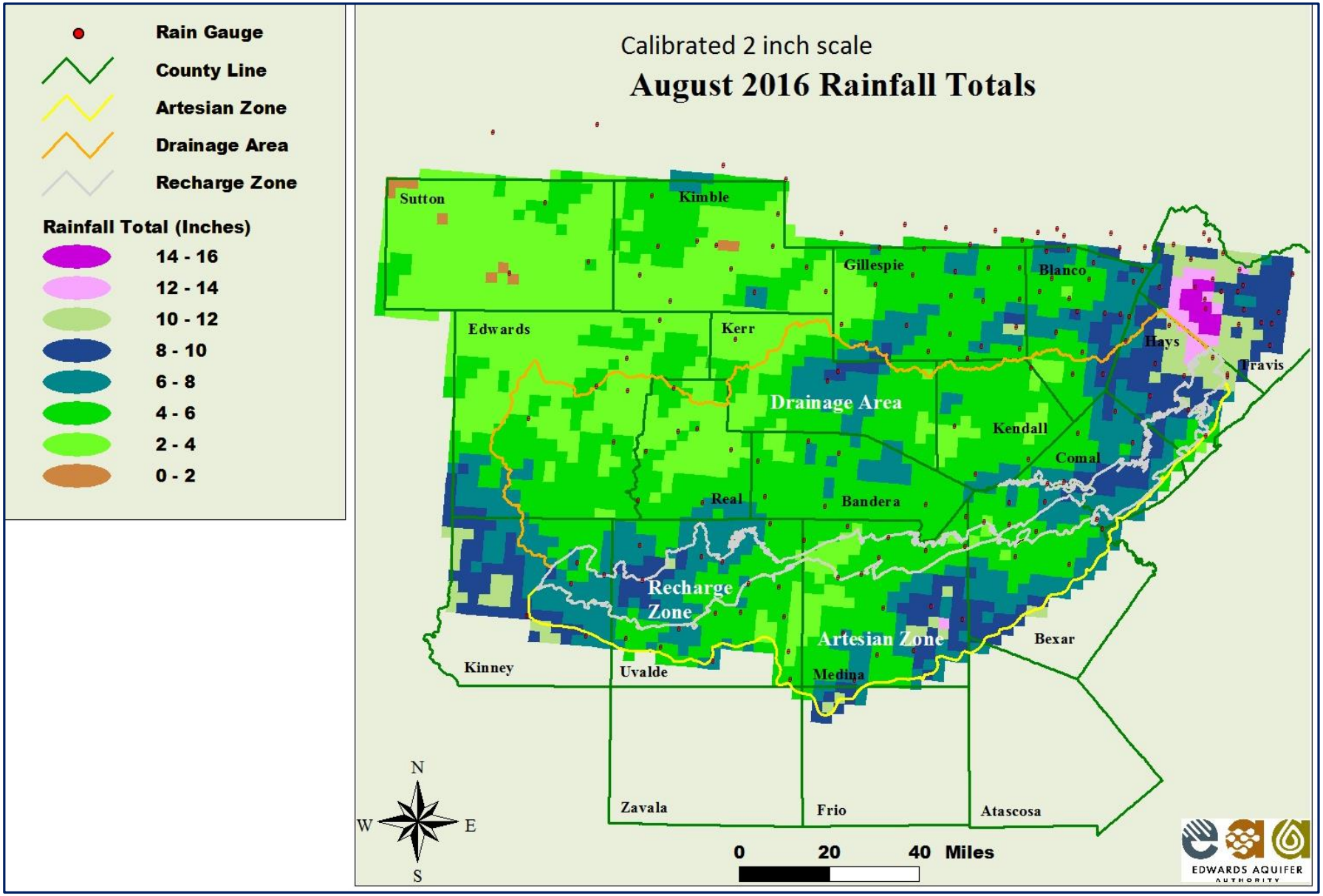

Hydrograph of the Comal Springs Discharge and Precipitation at San Antonio
(NWS Rainfall Station: San Antonio International Airport)
Spring Flow in Cubic Feet per Second (CFS)
Precipitation in Inches
450
400
350
300
250
200
150
100
50
0
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Stage 1
Stage 2
Stage 3
Stage 4
Oct-15
Nov-15
Dec-15
Jan-16
Feb-16
Mar-16
Apr-16
May-16
Jun-16
Jul-16
Aug-16
Sep-16
Oct-16
Date
Stage 1 - Critical Period - 10-day avg. < 225 cfs
Stage 2 - Critical Period - 10-day avg. < 200 cfs
Stage 3 - Critical Period - 10-day avg. < 150 cfs
Stage 4 - Critical Period - 10-day avg. < 100 cfs
Stage 5 - Critical Period - 10-day avg. < 45/40 cfs
Comal Springs Flow
Precipitation at SA Int. Airport

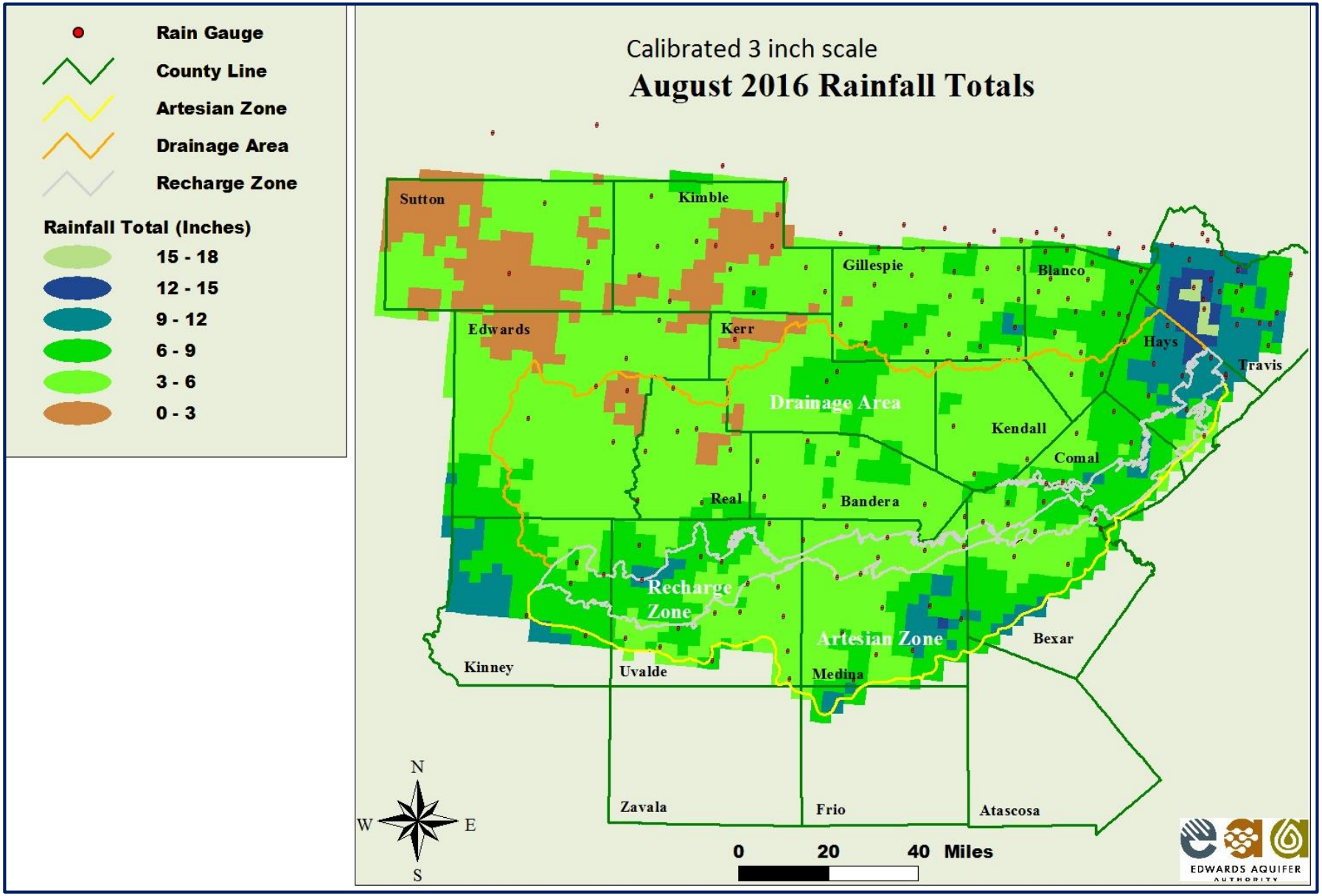
Hydrograph of the San Marcos Springs Discharge and Precipitation at San Marcos

(Precipitation data provided by EAA rain gauge HA158 located 0.25 miles west of Bobcat Stadium)



Stage 1 - Critical Period - 10-day avg. < 96 cfs
Stage 2 - Critical Period - 10-day avg. < 80 cfs
Stage 3 - None
Stage 4 - None
Stage 5 - None


Rain Gauge
County Line
Artesian Zone
Drainage Area
Recharge Zone
Rainfall Total (Inches)
14 - 16
12 - 14
10 - 12
8 - 10
6 - 8
4 - 6
2 - 4
0 - 2
Calibrated 2 inch scale
August 2016 Rainfall Totals
Sutton
Kimble
Gillespie
Blanco
Edwards
Kerr
Hays
Travis
Drainage Area
Kendall
Comal
Real
Bandera
Recharge Zone
Artesian Zone
Bexar
Kinney
Uvalde
Medina
Zavala
Frio
Atascosa
N
W
E
S
0 20 40 Miles
EDWARDS AQUIFER AUTHORITY


Rain Gauge
County Line
Artesian Zone
Drainage Area
Recharge Zone
Rainfall Total (Inches)
15 - 18
12 - 15
9 - 12
6 - 9
3 - 6
0 - 3
Calibrated 3 inch scale
August 2016 Rainfall Totals
Sutton
Kimble
Gillespie
Blanco
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Drainage Area
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Comal
Real
Bandera
Recharge Zone
Artesian Zone
Bexar
Kinney
Uvalde
Medina
Zavala
Frio
Atascosa
N
W
E
S
0 20 40 Miles
EDWARDS AQUIFER AUTHORITY

Real-time Precipitation Gauging System and Hydrologic Data Collection

The Edwards Aquifer Authority (EAA) operates 74 "real-time" precipitation gauges that record data on six-minute intervals and transmit these data to the EAA's office via a radio-telemetry system. Rain gauges are located on the Edwards Aquifer Contributing Zone, Recharge Zone, and Artesian Zone. Acquired data have many uses including aquifer recharge calculations, production of rainfall maps, and in a variety of research projects. The EAA also collects water level data from a series of aquifer monitor wells in the region, including two index wells: Well J-27, in Uvalde County and Well J-17, in Bexar County. Water level data from the Hondo City well in Medina County are also included in this data brief. Through a cooperative agreement with the U.S. Geological Survey, the EAA monitors the discharge at Comal Springs and San Marcos Springs.

Rainfall Evaluation – August 2016 Vieux & Associates Doppler Rainfall Map

The calibrated August 2016 Rainfall Totals Map was prepared by Vieux & Associates for the EAA using NEXRAD Doppler Radar and the EAA's precipitation gauge data. Calibrating the NEXRAD data with the EAA's precipitation gauge data improves the accuracy of the precipitation map and is calculated using a four-kilometer grid system. Rain gauge locations are indicated on the map.

In mid-August, the interaction of warm gulf moisture with cooler low pressure systems from the north produced rainfall across the region with some locally intense storms. While the entire Contributing Zone (Drainage Area) received between 2 and 12 inches, the heaviest rainfall totals occurred in only a few strategic locations across the Edwards Aquifer system. On the boarder of Kerr and southwest Gillespie Counties, recorded rainfall was between 4 and 10 inches while most of Hays and the adjoining Blanco/Comal County lines recorded rainfall in excess of between 6 and 12 inches. Strategic areas along the Recharge Zone / Contributing Zone boundary in northwest Uvalde and central Comal County recorded rainfall totals of between 6 and 12 inches. The entire Recharge Zone recorded between 2 and 12 inches of rainfall. The Artesian Zone received beneficial rainfall as between 2 and 14 inches was recorded (the most intense storm total occurred in southeast Medina into southwest Bexar County where 6 to 14 inches was recorded).

Rain Evaluation – September 2016 Precipitation Gauge Data

September events brought most areas above average rainfall with the exception of Medina County which was over an inch below. As such, the September 2016 maximum monthly total rainfall amounts in the EAA's gauges ranged from 0.58 to 9.17 inches. The highest reported 24-hour rainfall event from the EAA's precipitation gauge network in September, by county, were as follows: Bandera, 2.07 inches; Bexar, 2.19 inches; Blanco, 2.47 inches; Comal, 2.14 inches; Edwards, 4.20 inches; Hays, 6.37 inches; Kendall, 2.65 inches; Kinney, 4.41 inches; Medina, 3.70 inches; Real, 4.42 inches; and Uvalde County, 2.51 inches. The highest 24-hour rain event recorded in the region was 6.37 inches of rain that occurred on September 26 at a gauge located on the northwest side of Loop 82/ Branch 81 (Aquarena Springs Drive), about a 1/4 mile northeast from the intersection of Aquarena Springs Drive and Charles Austin Drive in Hays County.

Evaluation of September 2016 Aquifer Levels and Spring Discharge

With the exception of some areas, September rainfall was above average. As a result, aquifer levels and springflow discharges responded accordingly. The San Antonio Pool Index Well (J-17) *increased* 2.9 feet to 678.1 feet above mean sea level (msl) while the City of Hondo Well *increased* 2.5 feet to 716.0 feet msl. The Uvalde Pool Well (J-27), *increased* 1.8 feet to 870.5 feet msl.

The September daily average springflow for Comal Springs, *increased* 9 cubic feet per second (cfs) to 392 cfs, which is 126 cfs *above* the September monthly average discharge of 266 cfs. However, the daily average springflow for San Marcos Springs *decreased* 35 cfs to 243 cfs, which is still 81 cfs *above* the monthly average discharge of 162 cfs for September. Please note that the discharge amounts are estimates and may be adjusted up or down as more direct flow measurements are obtained.

Summary of Current Aquifer Levels and Spring Discharge

The official daily high water level for the Uvalde Pool Well (J-27) was 870.8 ft. msl on October 5, 2016, which is 4.1 ft. *above* the J-27 October monthly average of 866.7 ft. msl. The daily high water level at the San Antonio Pool Index Well (J-17) was 677.3 ft. msl on October 5, 2016; 14.2 ft. *above* the J-17 October monthly average of 663.1 ft. msl. The daily average discharge at Comal Springs on October 4, 2016, was estimated at 389 cfs, 110 cfs *above* the October average of 279 cfs while the daily average discharge at San Marcos Springs on October 4, 2016 was estimated at 242 cfs, 84 cfs *above* the October average of 158 cfs.

Summary of Current Regional Aquifer Conditions

The trend of above average rainfall in September managed to sustain the entire Edwards Aquifer system. Thus, the Edwards Aquifer Region continues to remain above Critical Period Management (CPM) thresholds. The U.S. Department of Agriculture - U.S. Drought Monitor indicated that active cool fronts produced moderate to heavy precipitation that caused improvements to the short term drought conditions across much of the state. As a result, only roughly 5% of Texas remained in some form of abnormally dry conditions. If the trend over the last two months continues, then drought improvements or removal is likely in south-central Texas.

The Climate Prediction Center (CPC) reports that, “ENSO-Neutral conditions were observed over the past month.” In addition, because “sea surface temperatures (SSTs) were below-average over the east-central equatorial Pacific Ocean, ENSO-Neutral conditions are slightly favored (between 55-60%) during the upcoming Northern Hemisphere fall and winter 2016-17.” The US Seasonal Drought Outlook shows drought conditions to remain status quo although drier areas may experience some form of short-term drought. In addition, the National Weather Service - Climate Prediction Center’s Long Range Outlook forecasts above normal temperatures and below normal precipitation for south central Texas into December 2016.