ILLINOIS STATE
WATER SURVEY
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February 8, 2012

Mr. Jeff Smith, Chairman
Imperial Valley Water Authority
25865 E. County Road 1000 N
Easton, IL 62633

Dear Chairman Smith:

The Illinois State Water Survey (ISWS), under contract to the Imperial Valley Water Authority (IVWA), has operated a network of rain gauges in Mason and Tazewell Counties since August 1992 and a network of groundwater observation wells since 1994. The purpose of the rain gauge and groundwater observation well networks is to collect long-term data to determine the impact of groundwater withdrawals during dry periods and during the growing season, and the rate at which the aquifer recharges. This letter serves as the year end report for Year 19 which covers the time period from September 1, 2010 through August 31, 2011.

The groundwater observation well network consists of thirteen wells, MTOW-01 through MTOW-13. The observation wells are drilled wells between 2 and 6 inches in diameter. With the exception of MTOW-05 and MTOW-09, these wells are equipped with pressure transducers that electronically log the groundwater level data.

In Year 15, a new well was drilled to replace MTOW-1. This new well, named Snicarte #2, or MTOW-1A has taken the place of the original well (MTOW-01 or Snicarte #1) within the monitoring well network.

In accordance with our agreement, each well, with the exception of MTOW-05 and MTOW-09, is visited by ISWS personnel during the first few days of the month during irrigation season and approximately bi-monthly during the non-irrigated portion of the year.

A 25-site rain gauge network (Figure 1) with approximately 5 miles between gauge was established in late August 1992. The network was reduced to 20 sites in September 1996. The rain gauge network is maintained by a Mason County resident, Bob Ranson, hired to visit each site monthly. During these visits the charts are changed, data downloaded and other routine services performed. Champaign-based ISWS personnel visit the rain gauge network to perform major maintenance and repairs as needed.

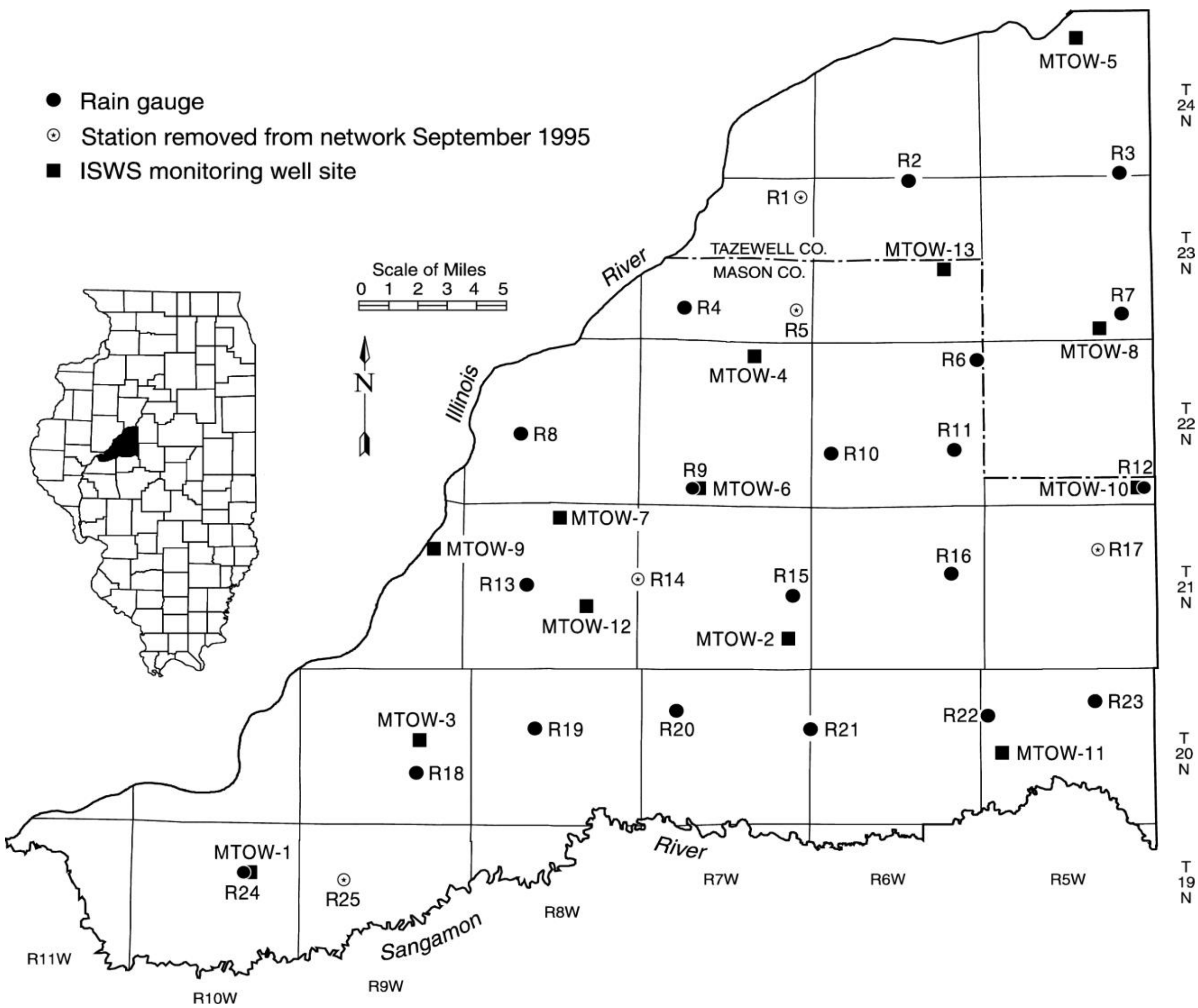


Figure 1. Configuration of the 13-site observation well and 25-site rain gauge networks.

Data reduction activities during Year Nineteen of network operation are similar to those performed during the previous eighteen years. Each month, hourly rainfall amounts are totaled from 10-minute digital data and are placed into an array of values for the 20 gauges. This data array is used to check for spatial and temporal consistency between gauges, and to divide the data into storm periods. If the digital data are missing, hourly rainfall amounts from the analog (paper) charts are used. In the rare event that data from both a data logger and the corresponding chart are missing, the hourly amounts are estimated based on an interpolation of values from the nearest surrounding gauges.

Groundwater levels for each well for the period of record (September 1, 2010-August 31, 2011) are presented in Appendix A. For MTOW-05, and -09 their entire period of record is shown because they do not have digital recorders and have only been measured periodically since 2005. These two wells have been shown to mimic stream gage in the Illinois River. Stage data from the Illinois River can be used, if necessary to recreate groundwater levels in those regions of the study area. Each hydrograph also contains the daily precipitation for the nearest rain gauge.

Since 1995, the IVWA has estimated irrigation pumpage from wells in the Imperial Valley based on electric power consumption. Menard Electric Cooperative provides the IVWA with electric power consumption data for the irrigation services they provide during the growing season (June-September). The pumpage estimate assumed that application rates for the irrigation wells with electric pumps in Menard Electric Cooperative also are representative of other utilities and other energy sources. Past estimates were based on the assumption that 33 percent of the irrigation wells were in Menard Electric Cooperative in 1995-1997, 40 percent in 1998-2001.

In 2002, the U.S. Geological Survey (USGS) updated the formula used to calculate pumpage by closely measuring the pumping rate at 77 irrigation systems serviced by Menard Electric. The updated formula provides estimates that are appreciably lower than the previous formula, by approximately 20 percent. Therefore, irrigation withdrawals for the years 1997 to the present were recalculated using the new formula, replacing earlier published estimates (reports through Year 11 use the original formula).

The Year Nineteen dataset was used to produce summaries for all storm data for each station and the network; monthly, seasonal, and annual rainfall totals; analysis of the rainfall and groundwater level fluctuations; the data obtained from the long-term monitoring well network; the database showing the individual storms in the Imperial Valley region; and an updated version of the irrigation pumpage data.

Precipitation Analysis

The Year Nineteen network precipitation of 34.17 inches was below average, 1.27 inches below the previous 18-year's average of 35.44 inches. It was the tenth wettest year in the 19 years of network operation. The fall, winter and spring seasons in Year Nineteen were slightly above average in seasonal total precipitation, and the summer was well below average, the fifth driest summer of 19 summers. Table 1 gives the monthly precipitation totals for each rain gauge within the network during Year 19.

Figure 2 presents the 19-year network average, excluding sites 16, 19, 21 during the period 1997-2002, and Figure 3 presents the annual precipitation pattern for Year Nineteen. During Year Nineteen, annual gauge totals varied from 29.33 inches at site 11 to 38.24 inches at site number 19 (Figure 3). Eleven inch gradients between gauges in annual precipitation are not unusual during any given year, as long as they are not replicated at the same gauges year after year, and are somewhat supported by surrounding gauges. During this year, a 6.5" gradiant was found between the gages at sites 2 and 6.

September and December of 2010 and February, April, and June of 2010 all received above average precipitation with June 2010 being the wettest month of the year. All other months of the year received below average precipitation (Figures 4-9). The network received 21.38 inches less precipitation than in the wettest year (1992-1993) and 8.87 inches more than in the driest year (1995-1996).

Table 1. Monthly Precipitation Amounts (inches), September 2010-August 2011

						Month							
Station	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Total*
2	2.97	9.27	3.2	4.25	1.73	1.8	3.4	3.15	7.79	8.71	5.74	2.63	54.64
3	1.61	8.11	3.14	2.6	1.55	1.37	2.59	3.32	4.52	8.18	3.48	2.84	43.31
4	2.79	7.85	3.78	3.65	1.35	1.51	2.71	2.92	7.77	8.81	6.91	2.04	52.09
6	1.9	7.06	2.72	2.05	1.2	1.31	2.41	2.99	6.08	8.48	3.81	2.04	42.05
7	1.75	7.41	3.06	2.91	1.21	1.27	2.39	3.28	5.26	8.67	2.77	1.94	41.92
8	2.88	7.81	3.9	3.97	1.62	1.4	2.2	2.94	7.45	8.24	5.39	3.03	50.83
9	2.63	8.56	3.58	3.38	1.57	1.35	2.29	2.07	6.3	7.99	4.98	3.07	47.77
10	2.09	8.31	3.77	3.14	1.49	1.33	2.18	2.7	6.65	8.77	7.08	3.41	50.92
11	2.11	7.5	3.18	3.09	1.26	1.37	2.1	2.76	6.2	7.75	3.85	2.78	43.95
12	2.55	7.74	3.34	3.28	1.24	1.41	2.45	3.84	5.99	7.02	2.44	2.6	43.9
13	3.15	6.98	3.66	3.14	1.35	1.75	2.12	2.73	5.69	6.63	7.18	3.43	47.81
15	3.01	7.81	3.77	3.37	1.36	1.45	2.1	2.52	7.41	5.34	4.68	2.58	45.4
16	3.02	7.78	3.42	2.69	1.17	1.42	1.77	2.39	6.24	5.75	3.31	2.72	41.68
18	3.2	9.33	3.3	4.24	1.2	1.49	2.15	2.61	6.86	6.02	8.46	3.43	52.29
19	3.93	9.7	3.48	3.87	1.29	1.9	2.32	2.84	6.61	6.07	7.91	4.16	54.08
20	2.83	8.28	3.5	3.48	1.2	1.54	2.11	2.63	6.39	6.55	8.29	3.98	50.78
21	2.24	7.78	3.27	2.68	1.19	1.32	2.21	2.42	6.36	6.73	6.76	4.17	47.13
22	2.14	8.22	3.94	3.38	1.04	1.39	2.18	2.6	7.39	7.11	5.13	3.52	48.04
23	2.12	7	3.26	2.94	0.98	1.28	2.45	3.17	5.82	7.31	4.4	2.86	43.59
24	4.16	9.06	3.19	3.98	1.38	1.55	2.02	2.91	6.49	7.87	10.3	3.19	56.1
Avg	2.65	8.08	3.42	3.3	1.32	1.46	2.31	2.84	6.46	7.4	5.64	3.02	47.91

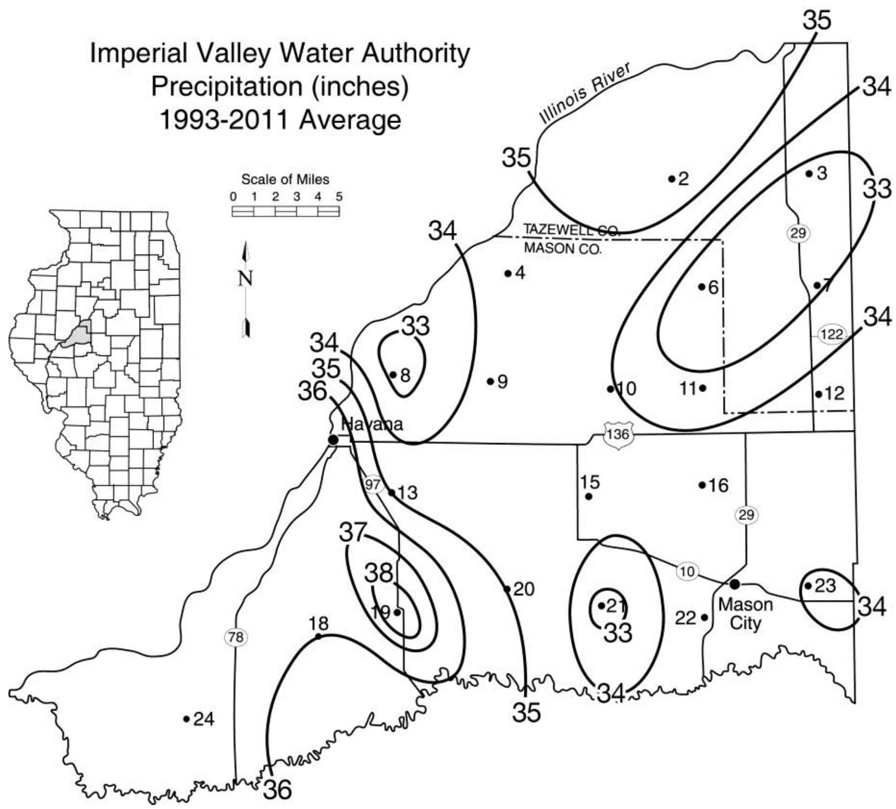


Figure 2. Network average annual precipitation (inches) for September 1993 - August 2011

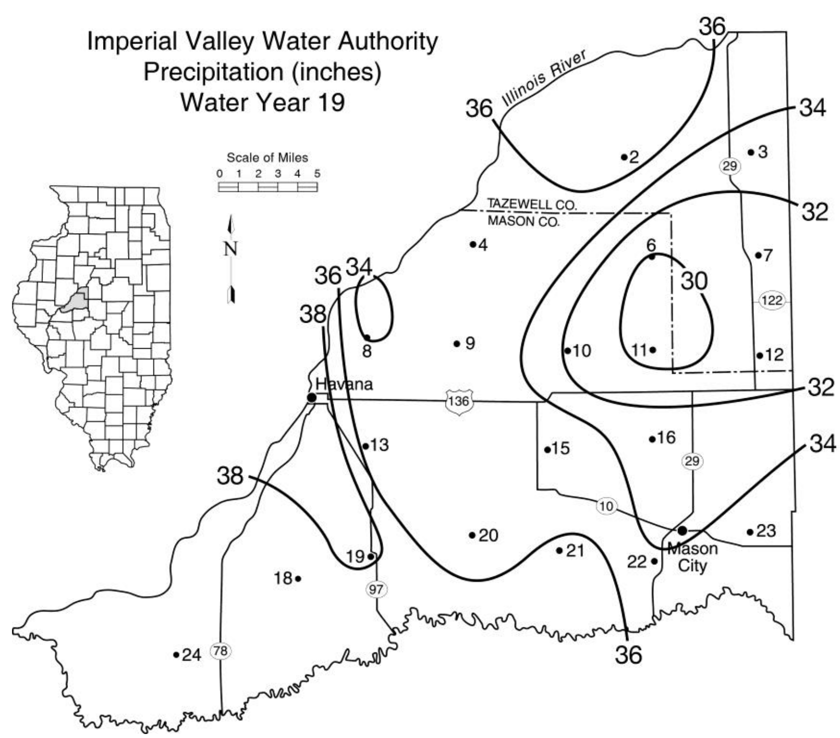


Figure 3. Total precipitation (inches) for September 2010- August 2011

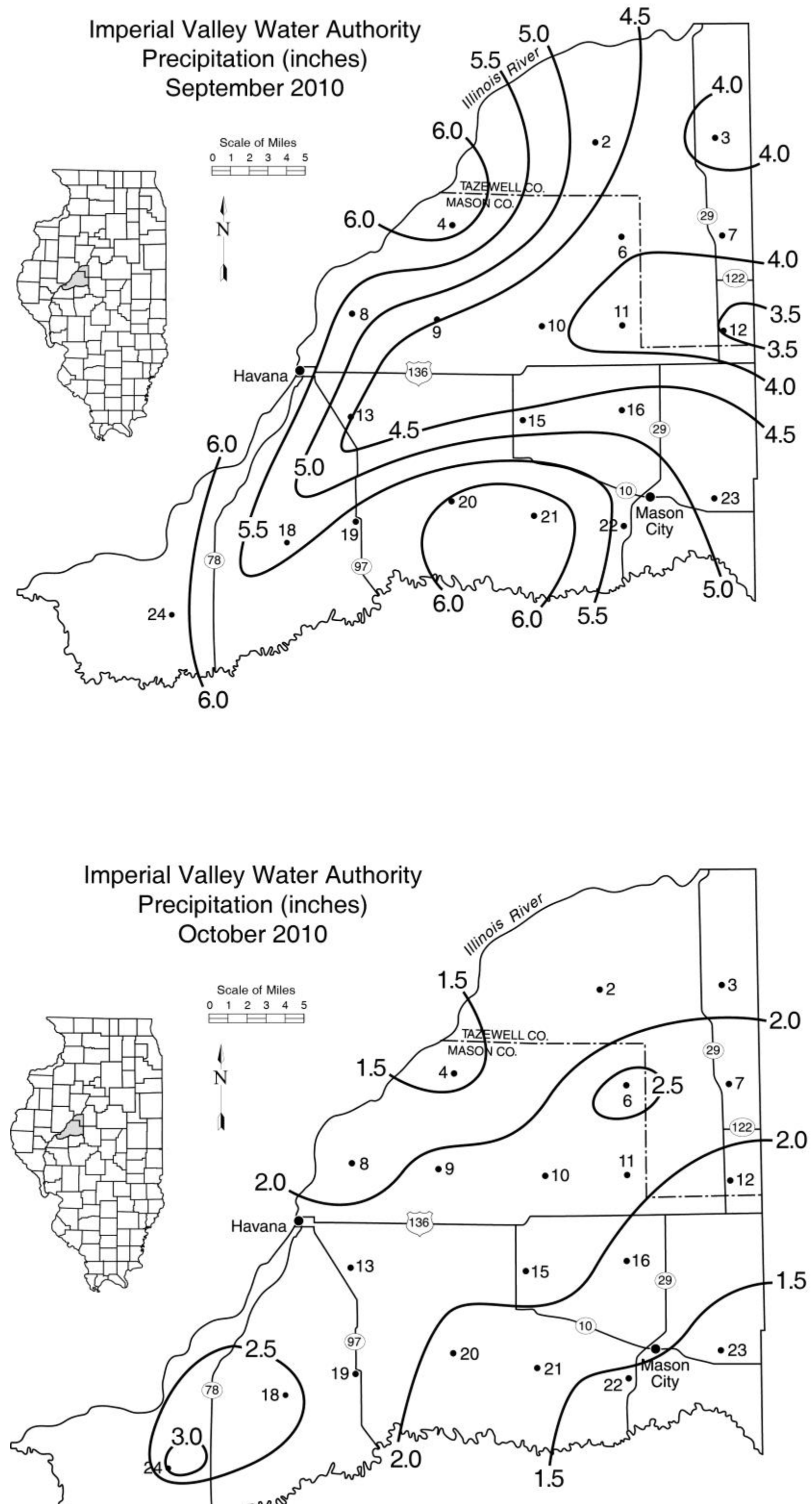
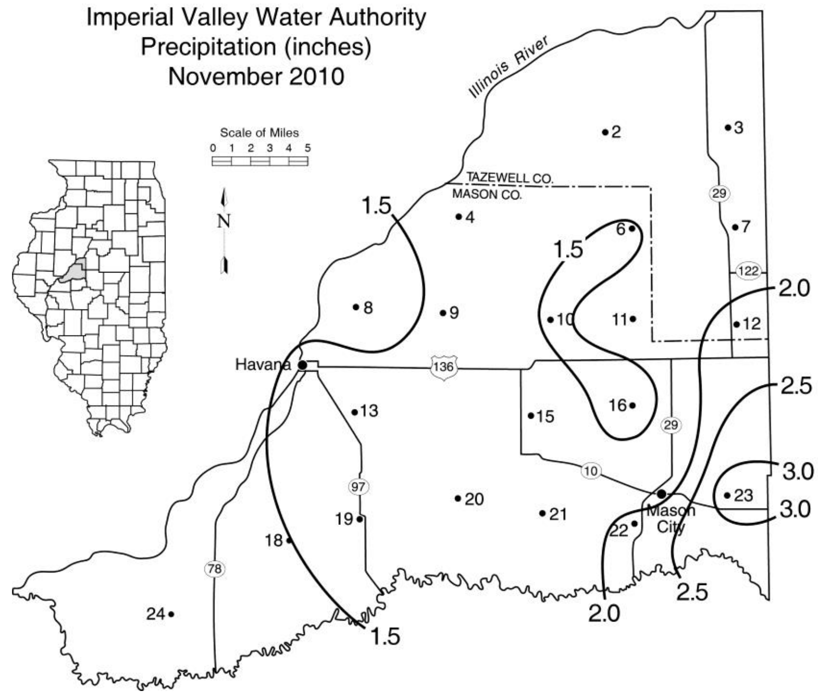


Figure 4. Precipitation (inches) for September 2010 and October 2010



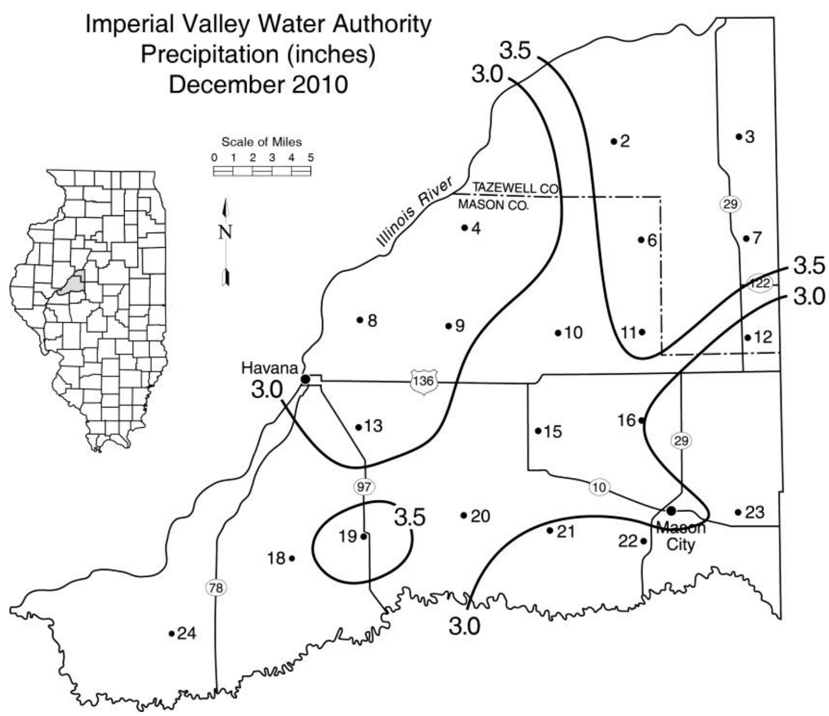
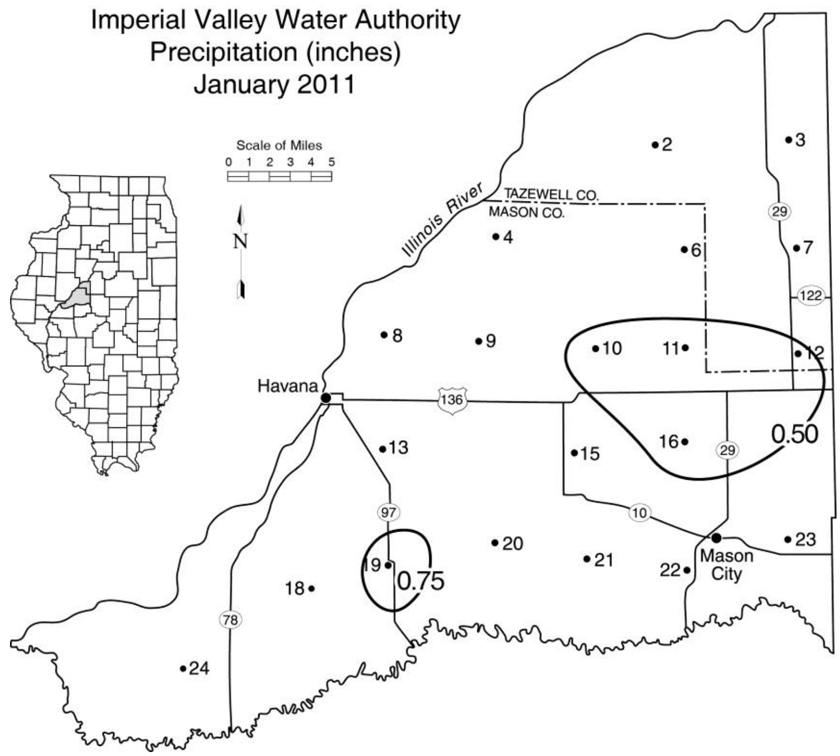


Figure 5. Precipitation (inches) for November 2010 and December 2010



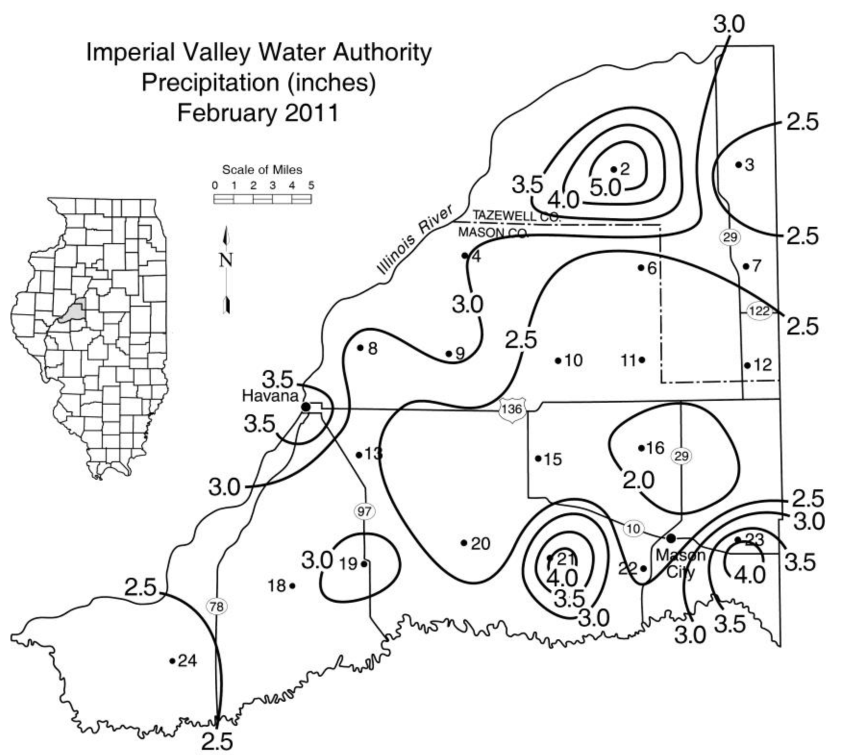


Figure 6. Precipitation (inches) for January 2011 and February 2011

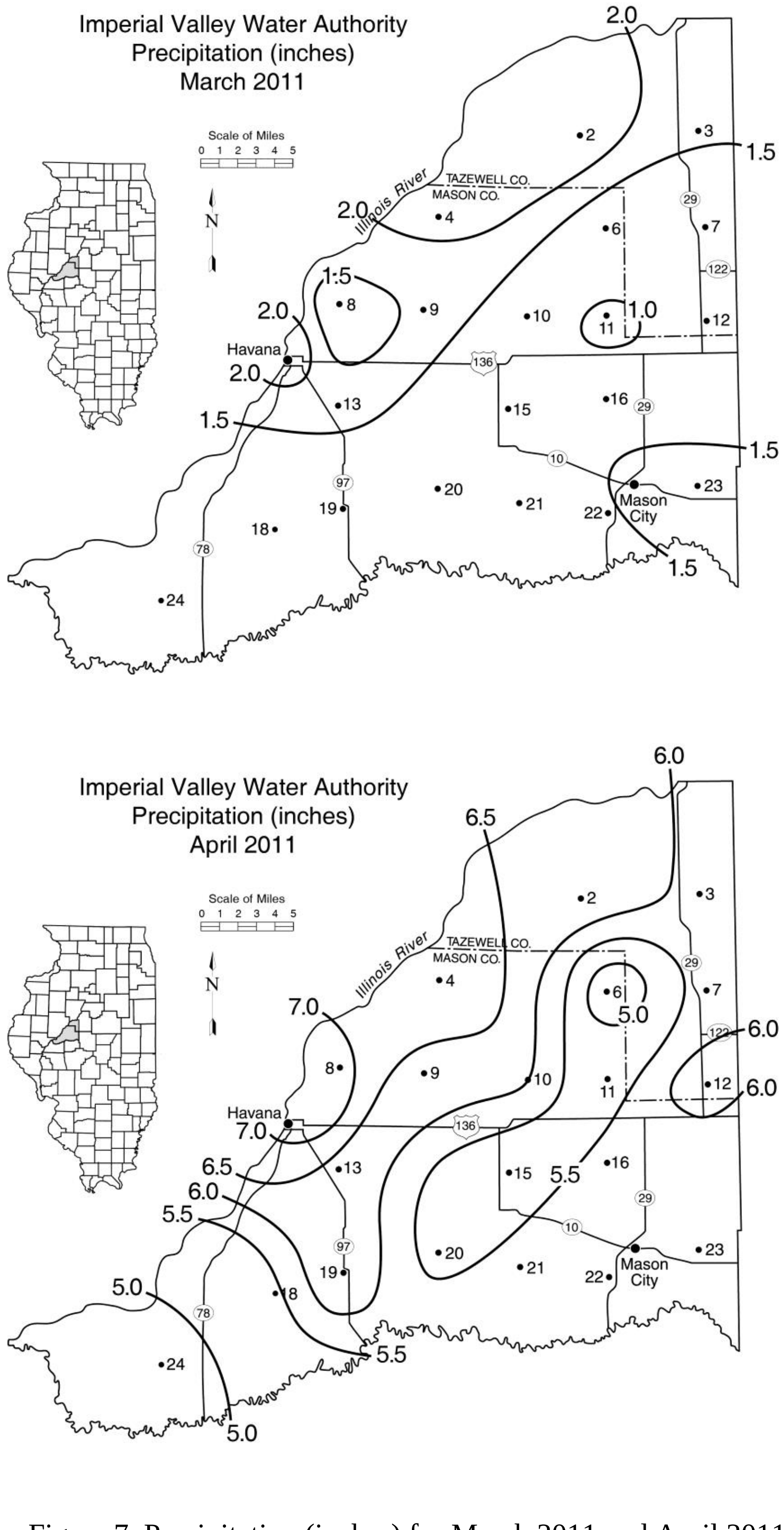
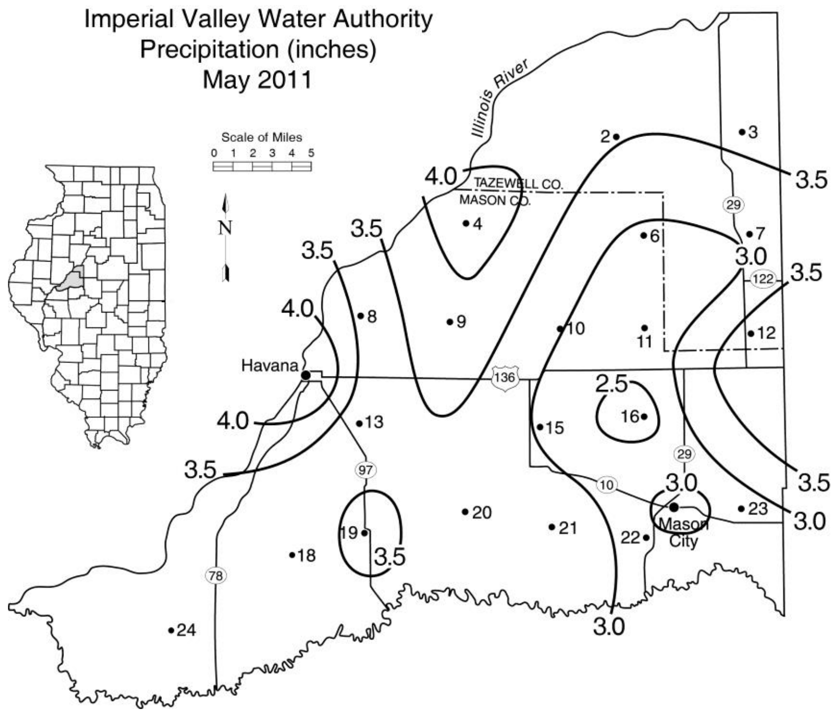


Figure 7. Precipitation (inches) for March 2011 and April 2011



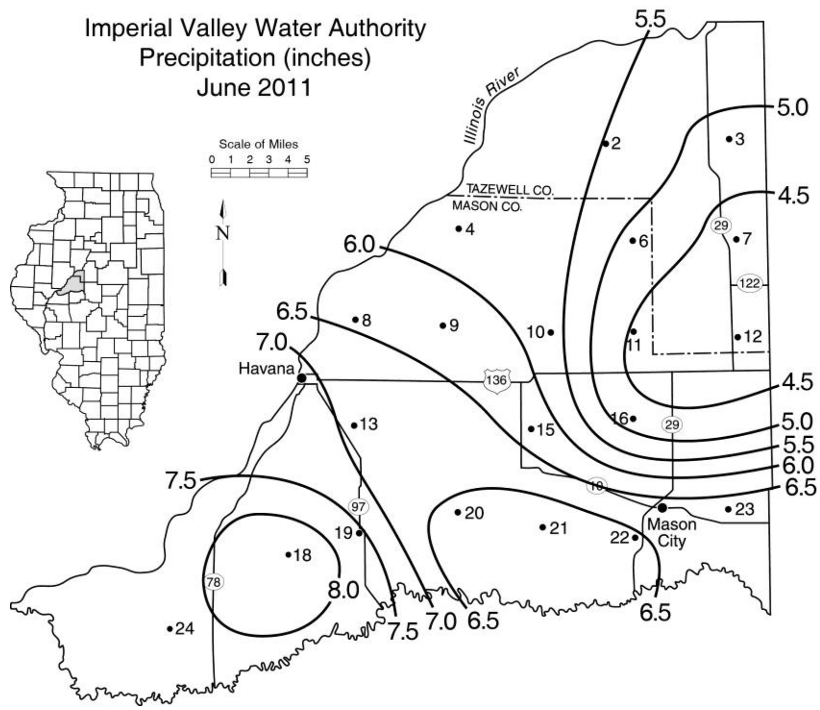
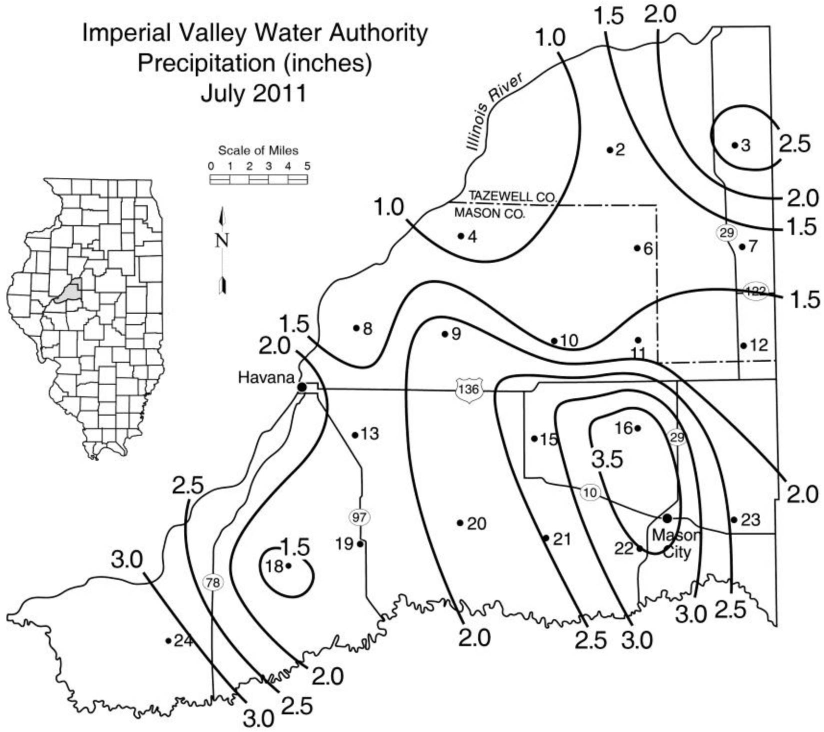


Figure 8. Precipitation (inches) for May 2011 and June 2011



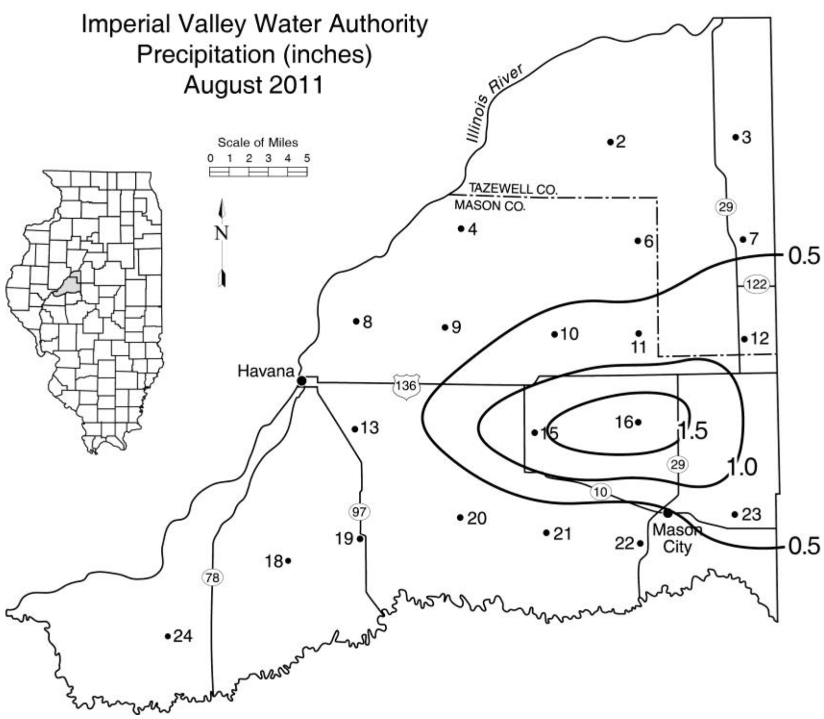


Figure 9. Precipitation (inches) for July 2011 and August 2011

Table 2. Comparison of Total Precipitation (inches), Number of Precipitation Events, and Average Precipitation per Event for Each Month and Season, 1992-2010 and 2010-2011

	1992-2010 18-yr average			*2010-2011 average*		
Period	*Precipitation*	*Events*	*Inches/event*	*Precipitation*	*Events*	*Inches/event*
Sep	2.93	7.3	0.40	4.87	11	0.44
Oct	2.71	8.8	0.31	2.01	5	0.40
Nov	2.69	9.3	0.29	1.72	8	0.22
Dec	1.79	9.3	0.19	3.19	10	0.32
Jan	2.07	9.2	0.23	0.59	7	0.08
Feb	1.70	7.7	0.22	2.80	10	0.28
Mar	2.32	8.7	0.27	1.37	5	0.27
Apr	3.47	11.2	0.31	5.85	12	0.49
May	4.22	14.1	0.30	3.22	9	0.36
Jun	4.07	12.3	0.33	5.98	13	0.46
Jul	4.00	11.1	0.36	2.06	7	0.29
Aug	3.47	12.2	0.29	0.51	6	0.09
Fall	8.33	25.0	0.33	8.60	24	0.36
Winter	5.56	26.3	0.21	6.58	27	0.24
Spring	10.01	33.7	0.30	10.44	26	0.40
Summer	11.54	34.5	0.33	8.55	26	0.33
Annual	35.44	121.1	0.29	34.17	103	0.33

The number of network precipitation periods was determined for the previous 18-year period. Mean monthly, seasonal, and annual number of these precipitation events are presented for 2010-2011 (Table 2). The monthly, seasonal, and annual number of precipitation events averaged over the 1992-2010 period also are presented (Table 2). A network storm period is defined as a precipitation event separated from proceeding and succeeding events at all network stations by at least three hours.

A total of 2282 storm periods occurred during the 19-year observation period, resulting in an average of 121 storm events per year. During Year 19, there were 103 precipitation events. Fewer events than average occurred in October 2010, March 2011, May, 2011 July 2011 and August 2011. A greater number of events than average occurred in September 2010 and February 2011. The spring and summer had many fewer events than average.

The plot of the network average monthly precipitation time series (Figure 10) shows the monthly variation of precipitation. From February 2005 through August 2008, a very dry period of record, only six months had precipitation of greater than 3.0 inches. During 2009-10, four months received 4 inches of precipitation or greater. In 2010-11, two months in the early part of the growing season, April and June had more than 5 inches of precipitation, but were followed by two summer months with 2 inches or less precipitation.

The storm recurrence frequency is the statistical probability of the recurrence of a storm with the reported precipitation (i.e., a 10-year storm would be expected to occur on average only once every 10 years at a given station, or have a 10 percent chance of occurring in any given year).

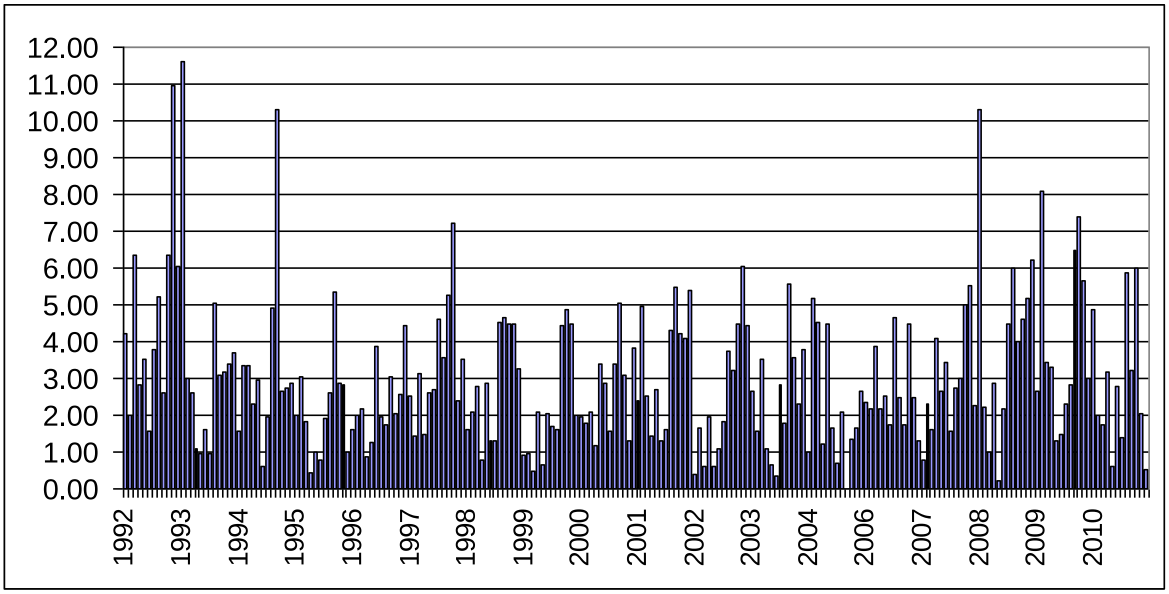


Figure 10. Network average monthly precipitation (inches), September 1992 - August 2011

The recurrence frequencies computed here are for each gage and are based upon the gage total storm precipitation and the total storm duration for the gages with precipitation.

In the first 19-years of network operation, 88 of 2282 storm events produced maximum precipitation at one or more gages with a recurrence frequency greater than one year: 50-yr (1 storm), 10-year (6 storms), 5-year (10 storms), 2-year (38 storms), and 1-year events (33 storms). The 50-year storm occurred on 13 September 1993, and the 10-year storms on 16 May 1995, 8 May 1996, 19 July 1997, and 30-31 March 2007, 11-14 September 2008. An average of 121 rain events and 5 heavy rain events occurred per year.

In Year 19, five of the 103 network storm periods exceeded the one-year or greater recurrence frequency. Year 19 had a below average number of storm periods but an average number of heavy rainfall events. One event exceeded the 2-year recurrence frequency and occurred on 31 December 2010. The four 1-year events occurred on 9-10 October 2010, 23 October 2010, 10-11 June 2011, and 24 July 2011.

Groundwater Levels

The long-term hydrograph at MTOW-01A (Snicarte) in Figure 11 provides a reference for comparison with the shorter records of the other network wells. The ISWS has a record of water levels at this site since 1958. Annual fluctuations from less than a foot to more than 8 feet have been observed. Based on the data we have available, these annual fluctuations often appear to be superimposed on longer term trends, perhaps 10 years or more.

A detailed look at water levels at the Snicarte site since 1990 is shown in Figure 12. During and shortly after the drought years of 1988 and 1989, the water level fell to 40.5 feet below land surface from September 1989 until April 1990, the only time in its 45-year history that the well went dry, until it did so again in 2006 and 2007. During the 1993 flood, groundwater levels rose around 8 feet and peaked at approximately 11 feet (depth to water) in September 1993.

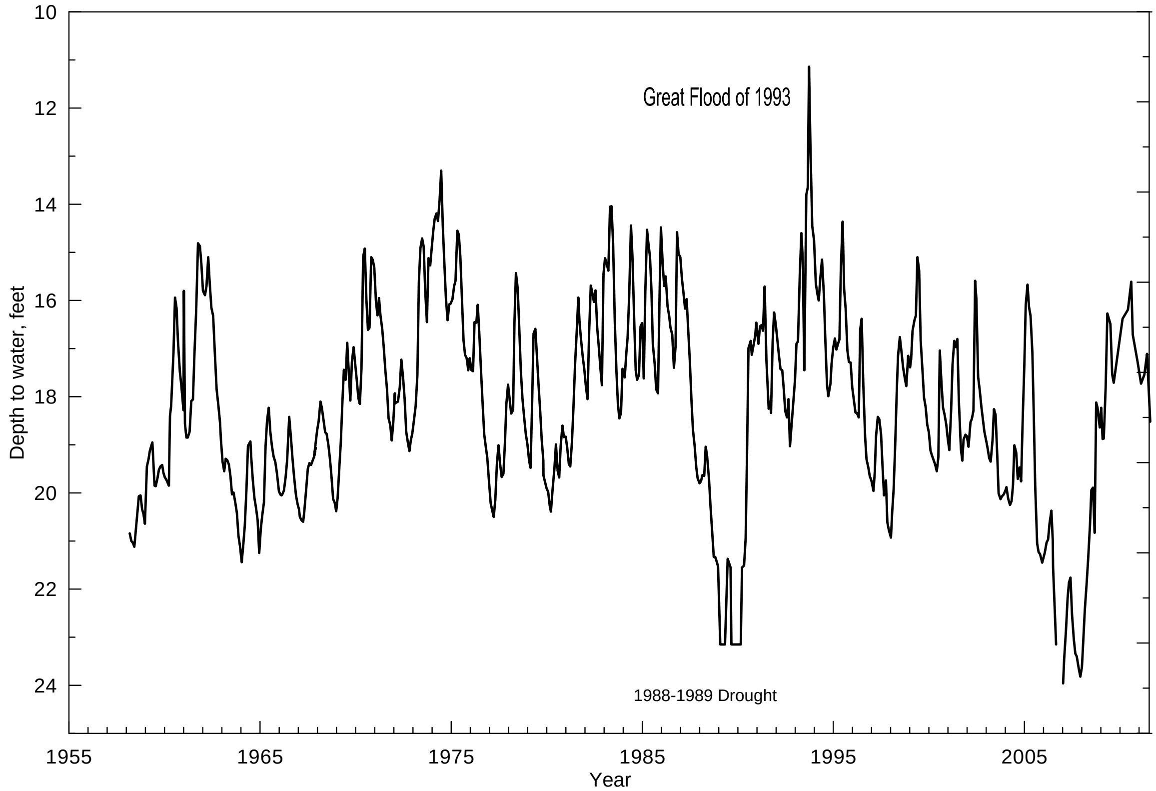


Figure 11. Groundwater levels at the Snicarte wells, 1958-2011

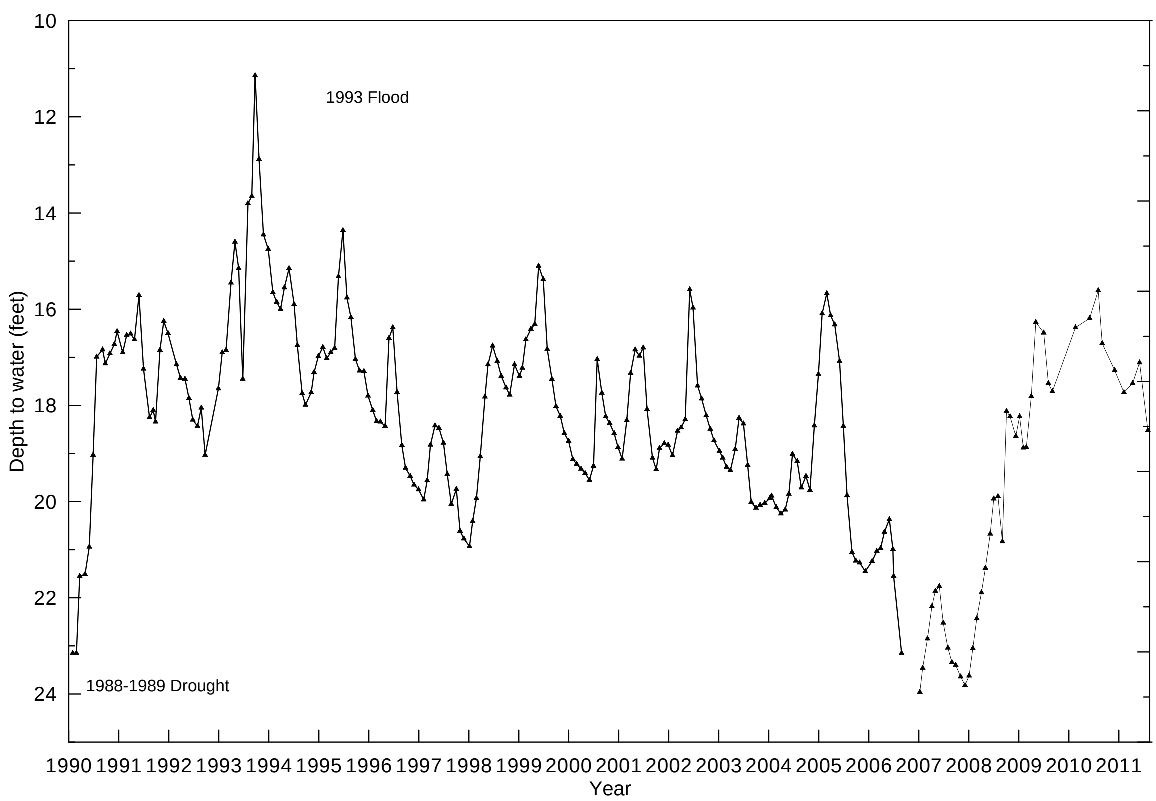


Figure 12. Groundwater levels at the Snicarte wells, 1990-2011

The dramatic drop in 1988-89 shows how significantly a major drought can impact the aquifer. Though we don't have irrigation data for 1988, based on data from the other parts of the state (Cravens, etal., 1989) it is likely that irrigation in 1988 was one of the highest amounts of any year. This is because summer precipitation was so low and summer temperatures were so high in 1988. Similarly, the irrigation amounts in 2005 (72 billion gallons) were 164 percent of average since 1995 and we saw similar dramatic declines in water levels. In Year 14 (2005-2006), temperatures were high and summer precipitation was low. Conversely, Year 17 (2008-2009), Year 18 (2009-2010) and most of Year 19 (2010-2011) were relatively wet years with low irrigation withdrawals and water levels rose. It is likely that local summer precipitation in future years will cause similar fluctuations in aquifer levels.

From late 2002 until 2008 the study area received below average rainfall. These below average precipitation totals in combination with irrigation withdrawals affected the groundwater elevations in the study area. Above average precipitation in Year 17 elevated groundwater levels to the point of near record highs since the observation well network was established in 1995. A second year of higher than average precipitation in Year 18 elevated groundwater levels to record highs in several of the network wells.

The above average precipitation continued until June of 2011. Because of the high precipitation totals over the last few years, the study area has experienced widespread Groundwater Flooding, Figures 13 and 14 show two areas experiencing groundwater flooding. The flooding subsided during the late summer and fall of 2011.

Figure 13. Groundwater flooding near Easton (Photo courtesy of Dr. George Roadcap)

Figure 14. Groundwater flooding of Sand Lake near Havana (Photo courtesy of Dr. George Roadcap)

Previous reports have shown hydrographs indicating recharge events in the aquifer occurring within a few days after a rainfall event. In other words, recharge occurs on a scale of days after a precipitation event, and so historical monthly measurements missed many such events. Based on these results, the IVWA purchased ten In-Situ data loggers that were installed in wells between December 30, 2004 and August 2005.

The hydrographs generated by the continuous water level measurements has already led to an increased understanding of the relationship between rainfall, irrigation, water levels, and recharge. Appendix A shows the hydrographs for all 13 wells with the observation well network. The hydrographs run from September 1, 2010 to August 31, 2011 and contain all groundwater elevation data and daily precipitation totals for nearby rain gauges. Looking at the figures from Appendix A, the rainfall/recharge relationship is evident as groundwater levels rise dramatically during periods of precipitation and how the lack of rain during July and August, along with pumpage, caused groundwater elevations to drop. Figures 15, 16, 17 and 18 show precipitation events during the summer, at Eason (MTOW-02), the Hahn Farm (MTOW-12), Rest Area (MTOW-07), and Wildlife Refuge wells (MTOW-03) producing over 1 foot of recharge within seven days. And while the hydrographs showing the recharge following precipitation for the Hahn Farm, Rest Area, and Wildlife Refuge wells are not as dramatic as at Easton, in general, the information they provide are just as vital.

Groundwater levels in the Pekin (MTOW-05) and Havana-IDOT (MTOW-09) wells, because of their proximity to the Illinois River, have been found to fluctuate largely in response to river stage. Since these two monitoring wells are so strongly influenced by the Illinois River, the wells are not outfitted with pressure transducers and in the future will be measured infrequently. The hydrographs for these two wells (MTOW-05 and MTOW-09) are located in Appendix A.

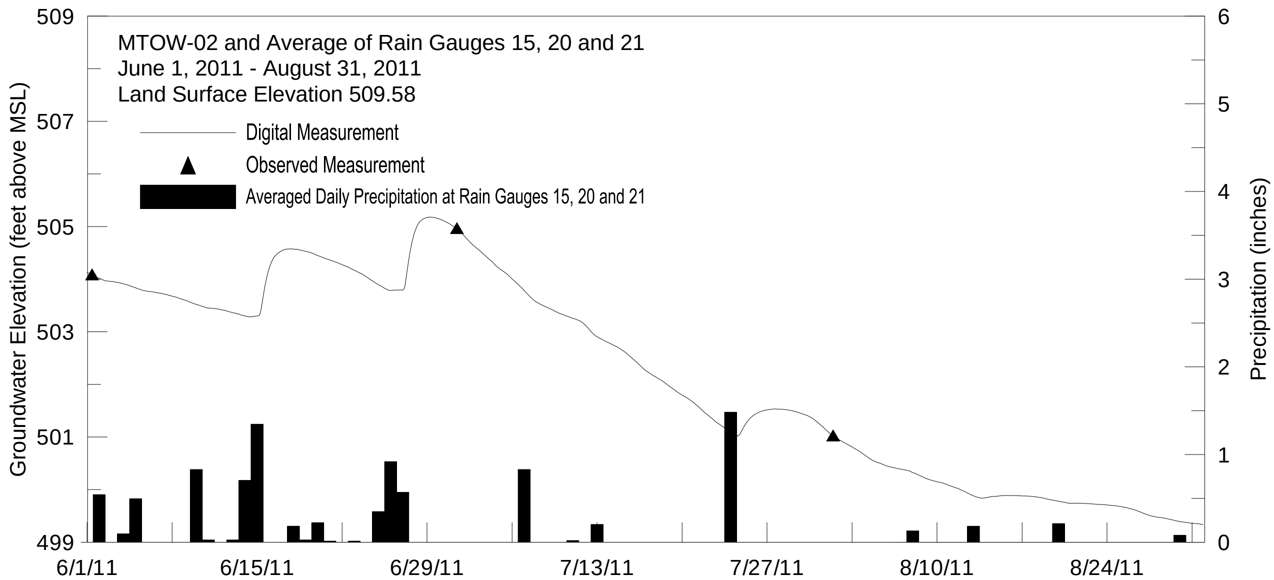


Figure 15. Groundwater elevations at the Easton well, MTOW-02,
June 1, 2011-August 31, 2011

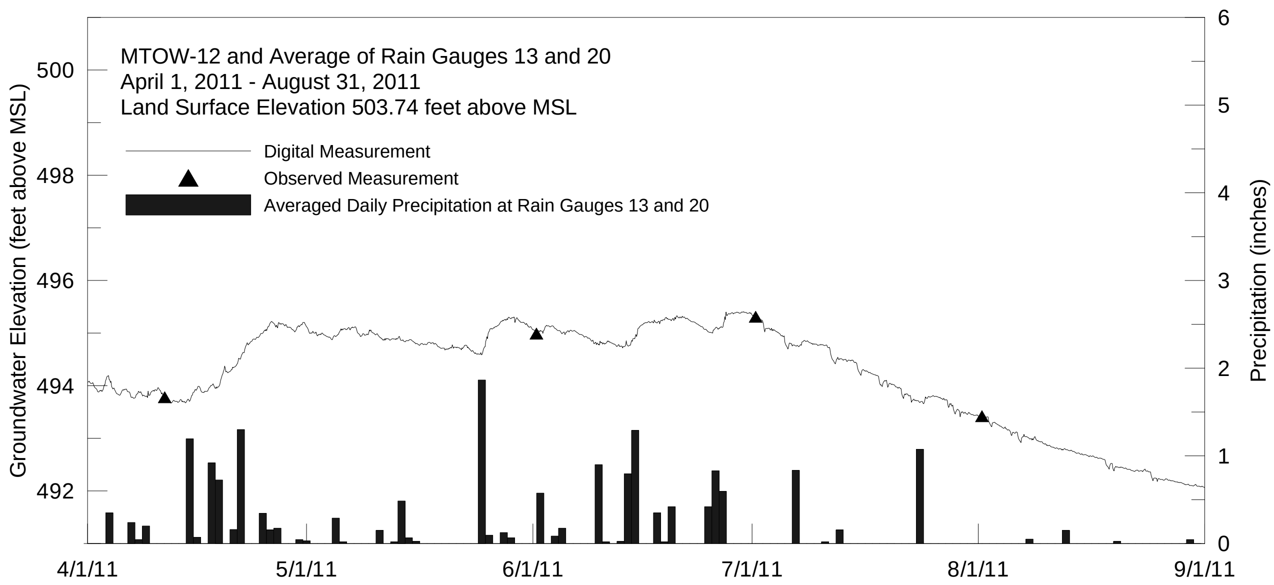


Figure 16. Groundwater elevations at the Hahn Farm well, MTOW-12,
April 1, 2011-August 31, 2011

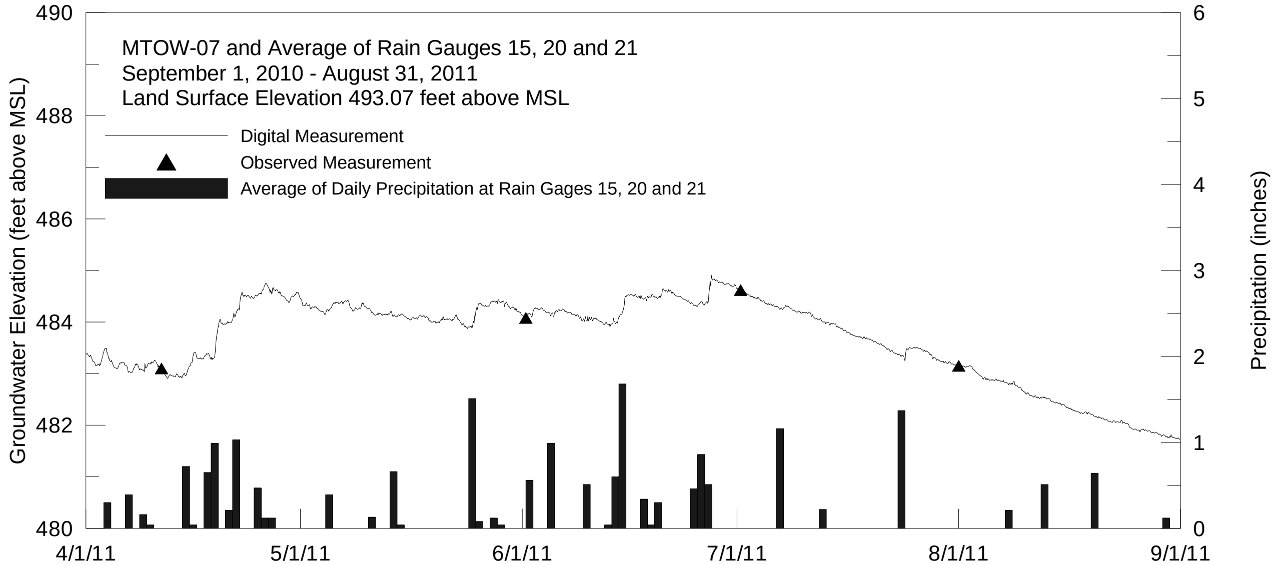


Figure 17. Groundwater elevations at the Rest Area well, MTOW-10,
April 1, 2011-August 31, 2011

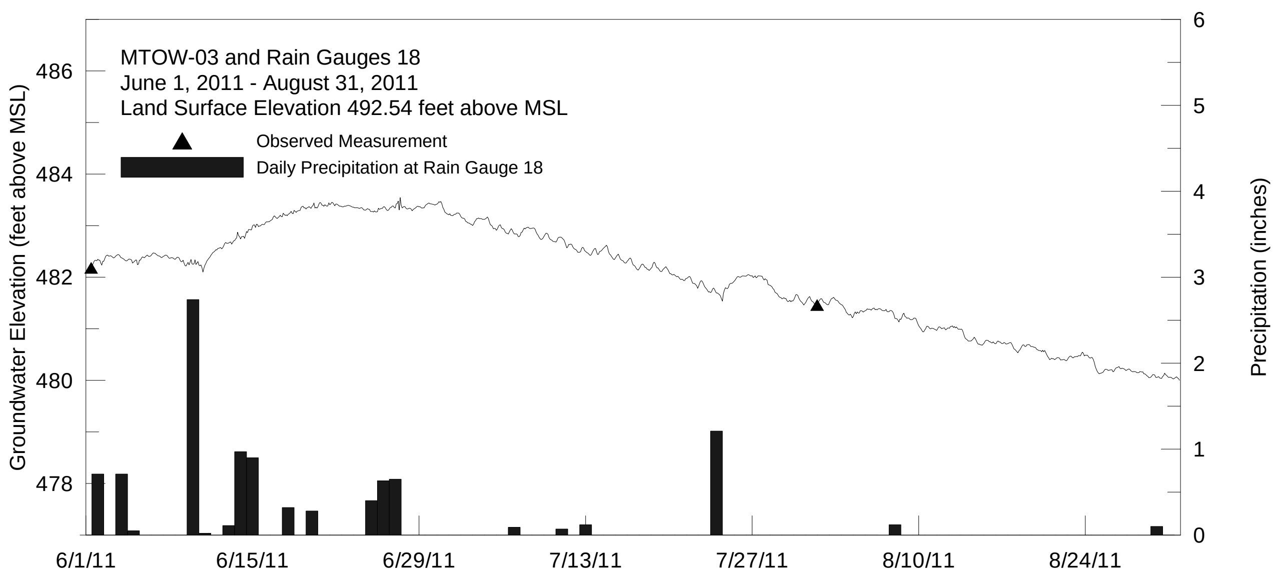


Figure 18. Groundwater elevations at the Wildlife Refuge well, MTOW-03,
June 1, 2011-August 31, 2011

Irrigation Water Use

The total irrigation pumpage in 2011 was approximately 52 billion gallons (bg), which is the third highest irrigation amount for the observation period, below the approximately 72 bg pumped in 2005 and the 57 bg pumped in 2007 and tied with 1996 pumpage of 52 bg. For Year Nineteen, the higher than normal precipitation in the spring and early summer of 2011 affected irrigation practices significantly. Irrigation in June was the lowest June for the length of the study, July the second lowest. Amazingly, only 3.2 bg of water was pumped during these two months. On average, approximately 19.4 bg of water is pumped from the study area during these two months. The months of August and September proved to be quite different. Irrigation pumpage in August was the highest on record as was the September pumpage. It should be noted that, as in previous years, the September total included pumpage from October. The hot and dry July and August clearly affected pumpage as 95% of total pumpage was during the months of August and September. September pumpage was almost 2.5 times higher than any other September on record. A wet spring may have led to later than normal planting, which coupled with the hot and dry weather, would have led to crops needing more water in September than usual.

The monthly and seasonal estimates of irrigation withdrawals are shown in Table 3. These data were calculated for the Imperial Valley by previously described methods. Total annual irrigation withdrawals, from highest to lowest, are as follows: 2005, 2007, 1996 and 2011 (equal), 2006; 2001 and 2002 (equal); 2003; 2004; 1999; 1995 and 1997 (equal); 2008, 1998 and 2000 (equal); 2010 and 2009. The three highest and two lowest irrigation withdrawals have occurred in the last 7 years. Typically, irrigation withdrawals are greatest in July and August, with September and June withdrawals being much less. Though more irrigation systems are added each year, suggesting that irrigation pumpage should keep increasing, it is clearly apparent that the timing and amount of rainfall received during the irrigation season (rather than throughout the whole year) are primary factors affecting the amount of irrigation.

The estimated monthly irrigation pumpage is displayed graphically in Figure 19 along with average monthly network precipitation. These pumpage values show a tendency for lower irrigation amounts during times of increasing precipitation and vice versa, but also show that irrigation is dependent on the timing of precipitation. For example, only 30 bg were pumped in 2000 (Year Eight), even though Year Eight showed a deficit of 9.5 inches (Table 4). This was because significant precipitation fell during the summer of 2000, reducing the need for irrigation. Similarly, Year Fifteen (summer 2007) was the ninth driest of network operation, but ranked number 2 for irrigation pumpage.

The influence of the abundant rainfall early in Year 19 is evident in both the decreased amount of water withdrawn for irrigation and in higher groundwater levels throughout the study area. However, during July and August, precipitation was deficient by 4.90 inches, allowing for the high irrigation withdrawals later in the year. Table 4 also shows that for 7 of the last 9 years and for 12 of the last 16 years, rainfall has been below the 30-year (1971-2000) historical average of 36.76 inches (average of Havana and Mason City). The influence of below average precipitation during July and August and accompanying high irrigation withdrawals has resulted in groundwater levels falling from the record highs experienced early in the year within much of the Imperial Valley.

Table 3. Estimated Monthly Irrigation Withdrawals (billion gallons), Number of Irrigation Systems, Withdrawal per System and Withdrawal Rank

Year	*June*	*July*	*August*	*September*	*Total*	*# Systems*	*BG/system*	*Rank*
1995	2.6	14	10	11	38			11
1996	2.0	20	18	12	52			3
1997	2.6	19	14	2.0	38			11
1998	2.1	7.8	13	6.9	30	1622	.018	14
1999	2.8	18	12	6.0	39	1771	.022	10
2000	6.4	6.0	12	5.6	30	1799	.017	14
2001	4.4	21	17	5.0	47	1818	.026	6
2002	3.4	24	16	3.7	47	1839	.026	6
2003	4.1	16	15	10	46	1867	.025	8
2004	5.3	12	19	5.7	42	1889	.022	9
2005	15	29	23	4.8	72	1909	.038	1
2006	7.2	22	16	5.2	50	1940	.026	5
2007	16	17	19	4.9	57	1971	.029	2
2008	1.2	10	14.5	7.1	33	2014	.016	13
2009	1.6	9.3	12.1	2.9	26	2054	.013	17
2010	1.8	2.4	11.7	10.6	27	2077	.013	16
2011	0.7	2.5	24.7	24.5	52	2100	.025	3
Average	4.9	15.5	15.1	6.5	42			

Note:

Total annual withdrawal may differ from sum of monthly withdrawals due to rounding error. Also, data regarding the number of systems in 1995-1997 are unavailable. Also, the BG/system was rounded incorrectly for 2009 and should be .013.

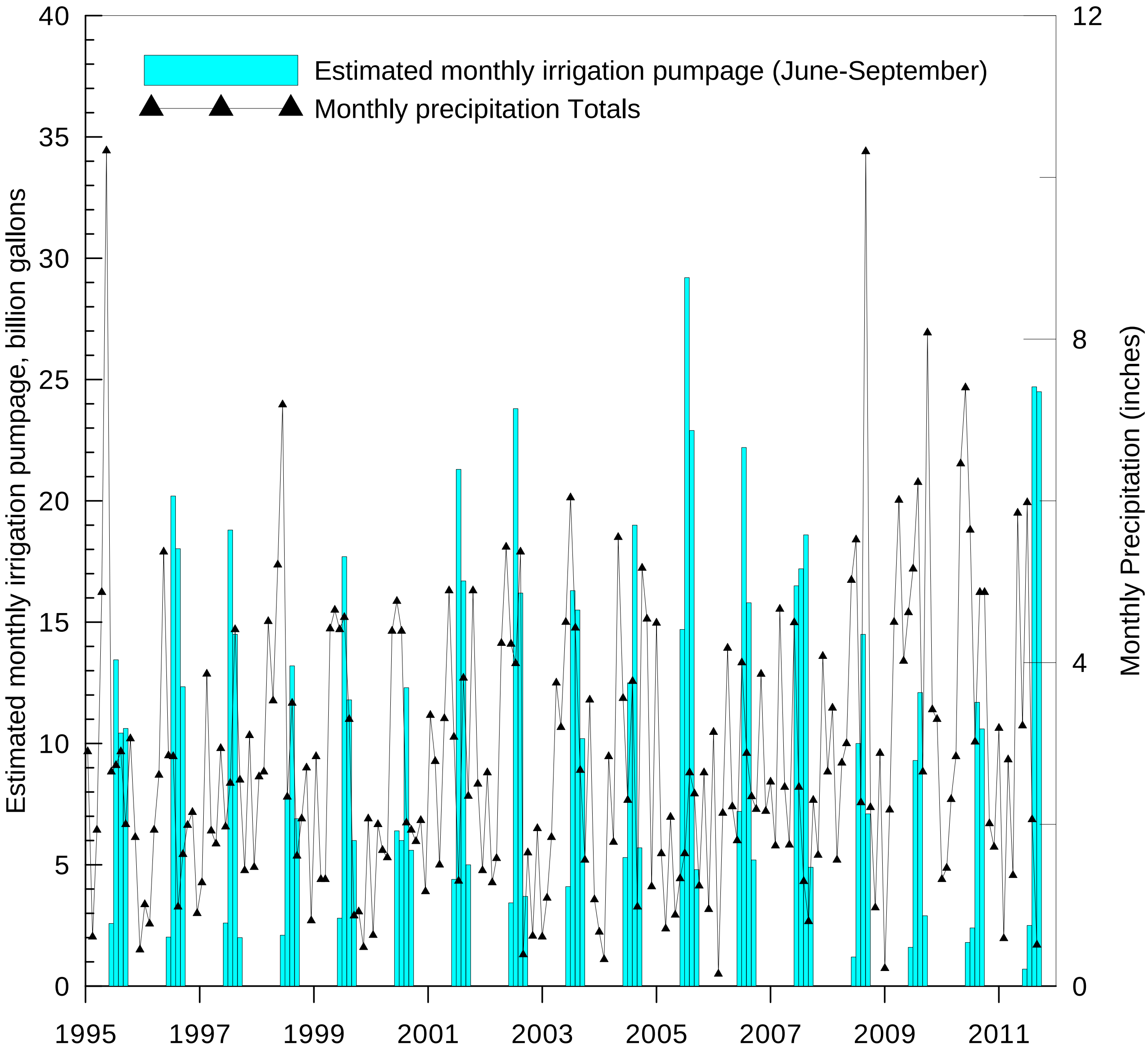


Figure 19. Estimated irrigation pumpage and average monthly precipitation, Imperial Valley

Table 4. Average Annual Precipitation, Annual Precipitation Surplus, Running Surplus, and Ranked Annual Precipitation and Irrigation, Imperial Valley Network

September-August period	*Network average precipitation (in.)*	*Annual surplus (in.)*	*Running surplus (in.)*	*Rank*	
				Precip.	*Irrigation*
1992 - 1993	55.55	+18.79	+18.79	1	-
1993 - 1994	40.21	+3.45	+22.24	4	-
1994 - 1995	39.42	+2.66	+24.90	7	11
1995 - 1996	25.70	-11.06	+13.84	19	3
1996 - 1997	27.31	-9.45	+4.39	17	11
1997 - 1998	40.06	+3.30	+7.69	5	14
1998 - 1999	34.02	-2.74	+4.95	9	10
1999 - 2000	25.81	-10.95	-6.00	18	14
2000 - 2001	30.97	-5.79	-11.79	12	6
2001 - 2002	39.91	+3.15	-8.64	6	6
2002 - 2003	30.06	-6.70	-15.34	13	8
2003 - 2004	29.64	-7.12	-22.46	14	9
2004 - 2005	27.34	-9.42	-31.88	16	1
2005 - 2006	27.74	-9.02	-40.90	15	5
2006 - 2007	31.94	-4.82	-45.72	11	2
2007 - 2008	35.02	-1.74	-47.46	8	13
2008 - 2009	49.34	+12.58	-34.88	2	17
2009- 2010	47.91	+11.15	-23.73	3	16
2010- 20101	34.17	-1.27	-25.00	10	3
1981 - 2000 30-yr average	39.80 (Havana)				
1981 - 2000 30-yr average	36.98 (Mason City)				
1981 - 2000 30-yr average	38.38 (average of Mason City and Havana used to determine surplus)				

Note: Site 16 was excluded from network average computations from 1996-1997 through 2001-2002.

Summary

In summary, for Year Nineteen of the rain gauge network operation (September 2010-August 2011), the network received an average of 34.17 inches of precipitation, 1.27 inches below the network's previous 18-year average precipitation of 35.44 inches, and 4.21 inches below the 30-year average for the study area. Year Eighteen was the third wettest year since the deployment of the precipitation network, and Year-Nineteen the tenth wettest year.

The timing and amount of rainfall was such that the need for irrigation in the early summer of 2011 was greatly reduced and then in August and September, when 29.2 bg was pumped for irrigation from the aquifer, pumpage was at an all time high. This late pumping of the aquifer for irrigation, along with below average precipitation, provided an opportunity groundwater levels to subside from the record and near record highs experienced throughout much of the region. In fact, much of the area that was under water at the beginning of the year due to groundwater flooding has been put back into service as agricultural lands.

The data collected over the last 19 years as part of this project have been invaluable to the ISWS in developing a better understanding of the groundwater system in the Havana Lowlands, as well as the Mahomet Aquifer as a whole. The ISWS is about to release a comprehensive report about the Mahomet Aquifer, based on the modeling work of Dr. Roadcap at the ISWS. His report, "Meeting East-Central Illinois Water Needs to 2050: Potential Impacts on the Mahomet Aquifer and Surface Reservoirs", was developed with funding from a number of sources, the Imperial Valley Water Authority being one of those funders. The report should be available on the ISWS website by December 19th, 2012. Hard copies are available to the IVWA upon request.

The report highlights the unique features of the aquifer in the IVWA area as well as the role it plays in being the discharge area for the Mahomet Aquifer. It specifically shows that the Illinois, Sangamon, and Mackinaw Rivers, along with Crane and Quiver Creek, are the final discharge points for the aquifer, all in the Havana Lowlands. It also discusses the Snicarte data in depth, using the long term record to help describe the hydrology of the area, and the Irrigation Test site, which taught us how significant groundwater recharge is in the area. Lastly, the report discusses the unusual depressions around Mason City and describes their likely cause and significance. What amazes many people who have looked at the data for the Havana Lowlands Region is the fact that water levels are basically unchanged from the 1960's even though there is now significant pumpage for irrigation in the area, a point made in the report.

Please contact Kevin Rennels, Steve Wilson or Nancy Westcott if you have any questions or comments.

Sincerely,

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Appendix A. Hydrographs, Imperial Valley Observation Well Network

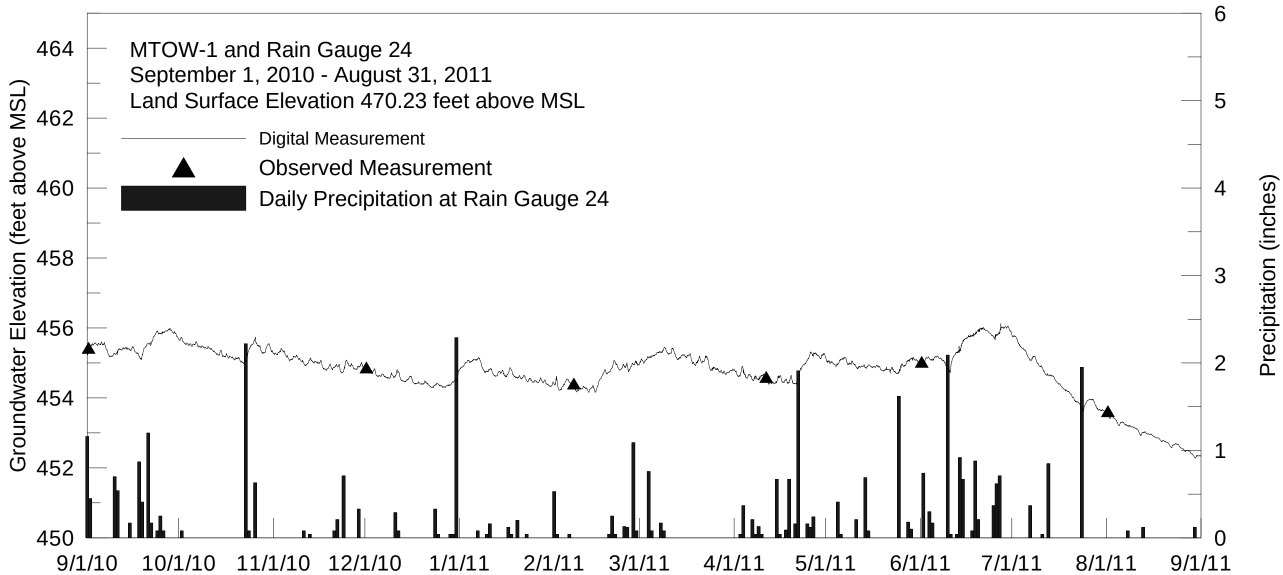

Figure A-1. Year 19 Groundwater depth and precipitation for MTOW-01

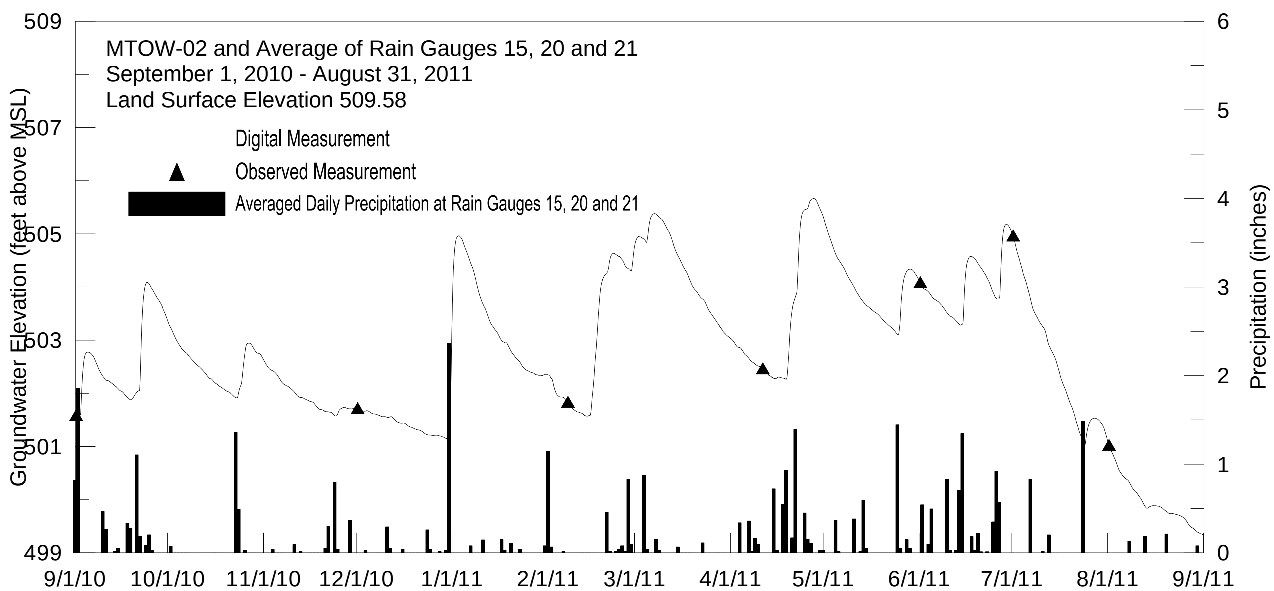

Figure A-2. Year 19 Groundwater depth and precipitation for MTOW-02

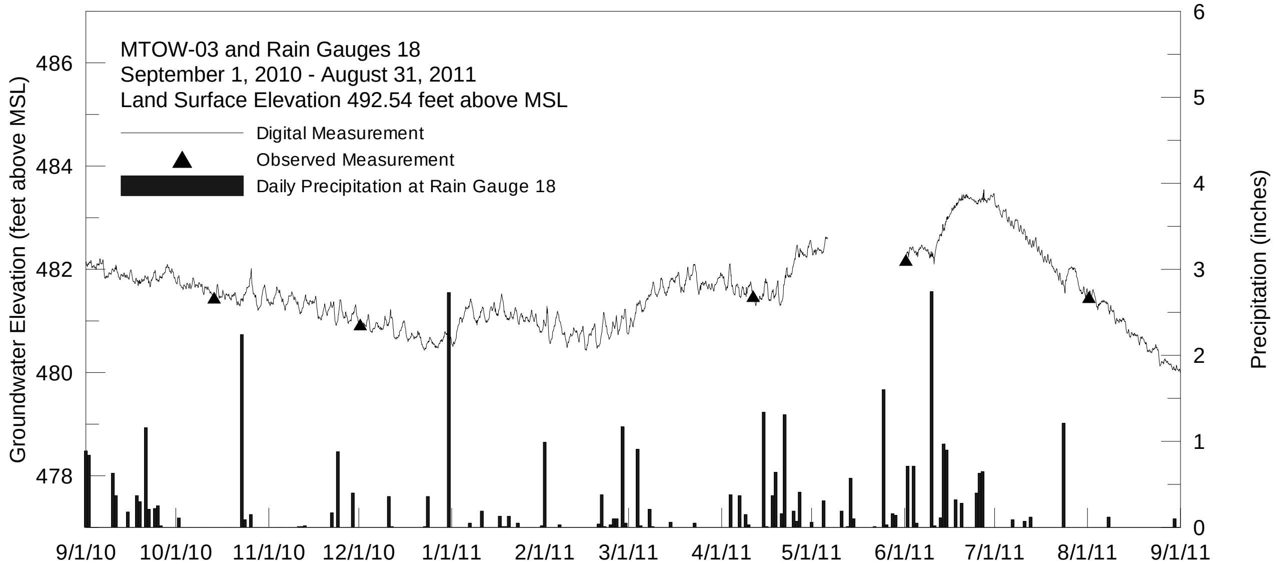

Figure A-3. Year 19 Groundwater depth and precipitation for MTOW-03

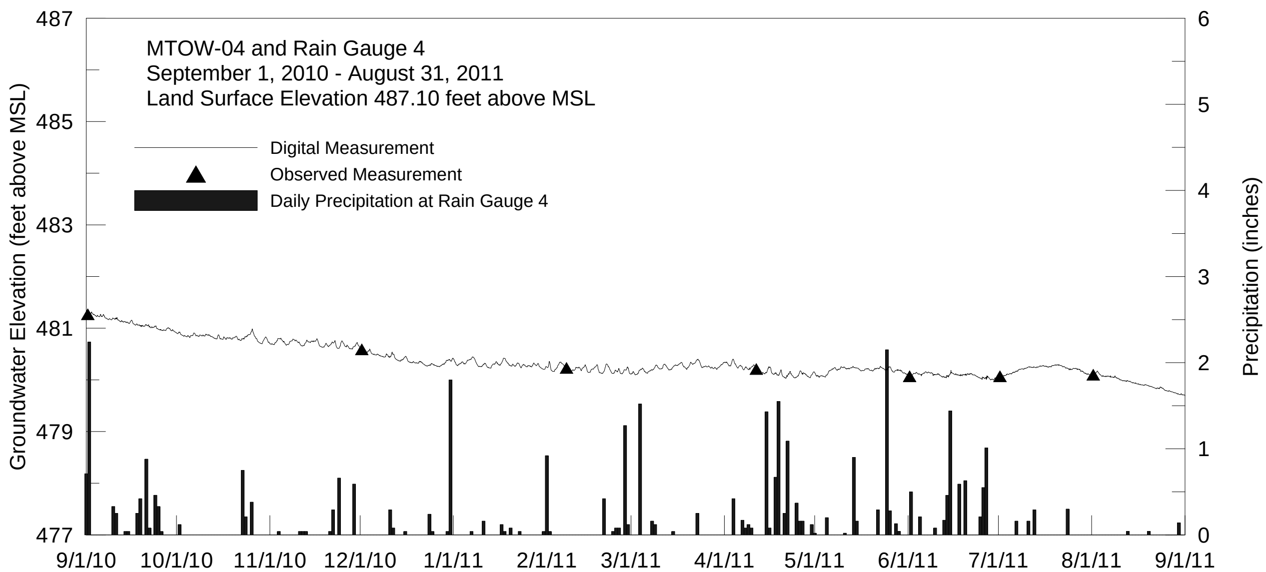

Figure A-4. Year 19 Groundwater elevation and precipitation for MTOW-04

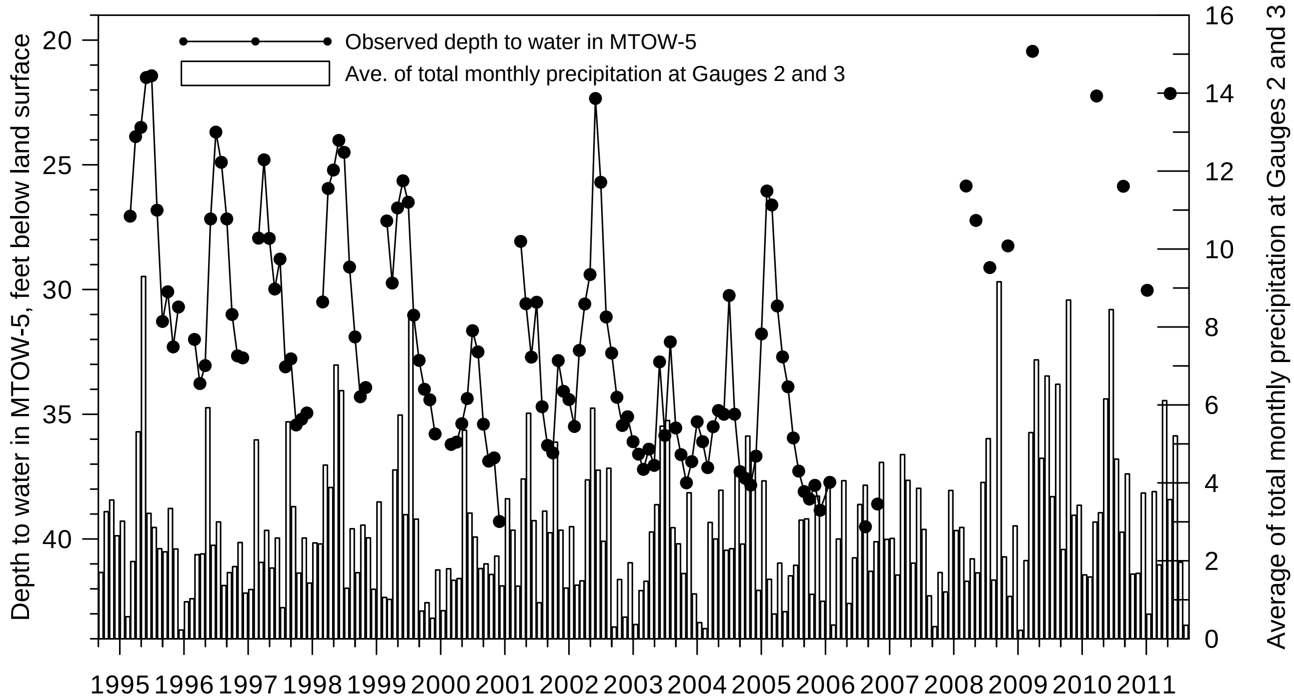

Figure A-5. Year 19 Groundwater depth and precipitation for MTOW-05 (not continuous recorder)

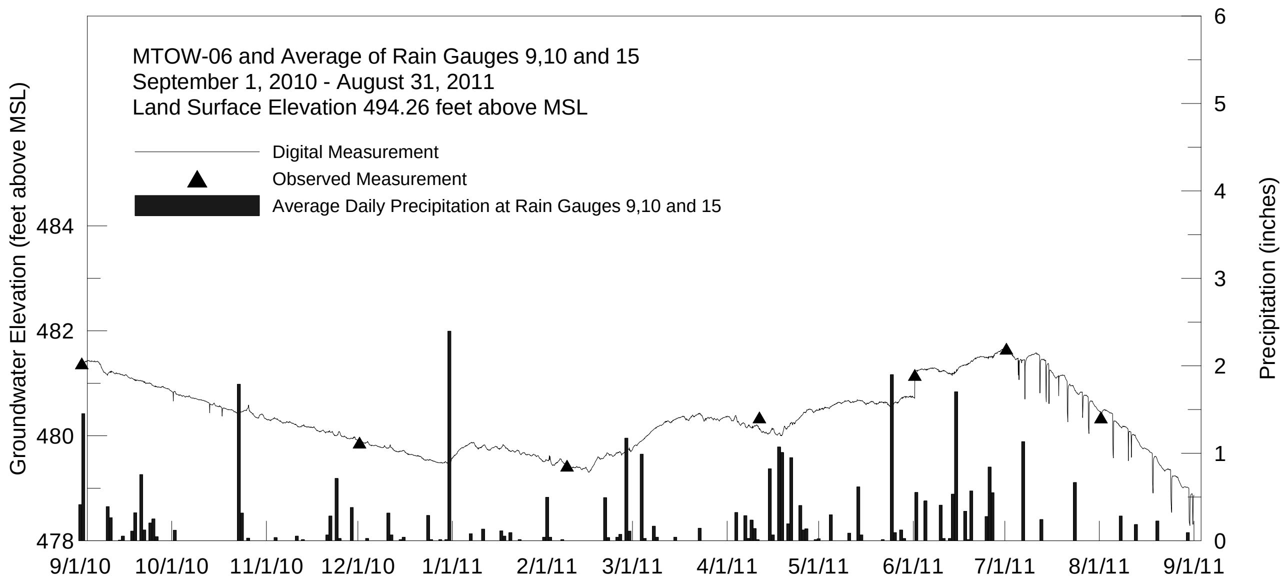

Figure A-6. Year 1 Groundwater elevation and precipitation for MTOW-06

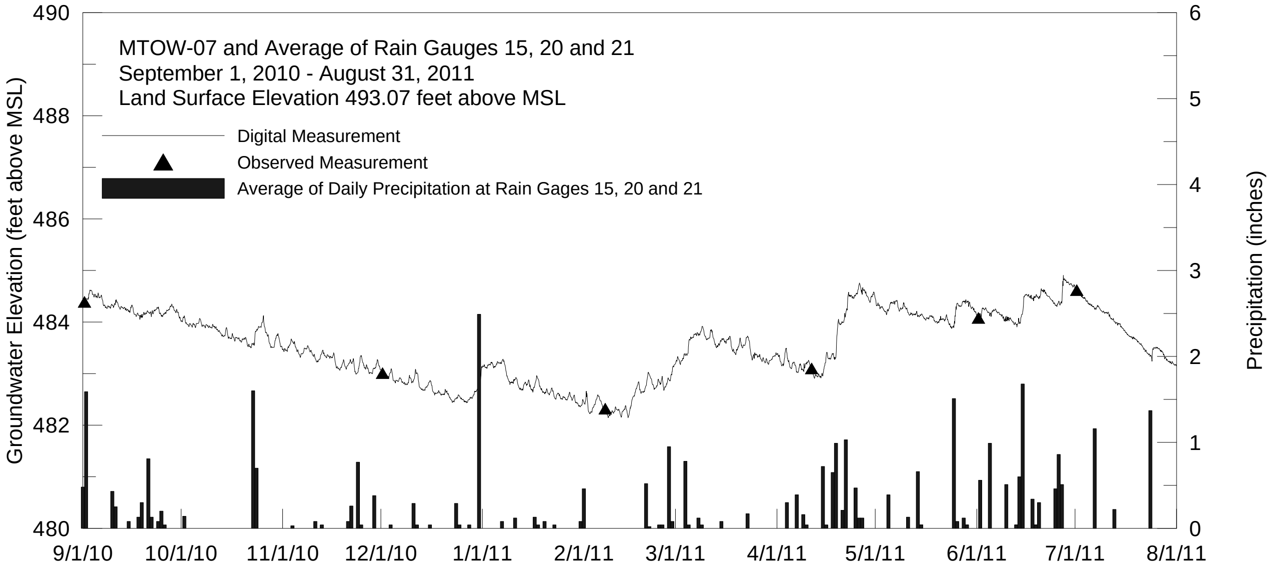

Figure A-7. Year 19 Groundwater elevation and precipitation for MTOW-07

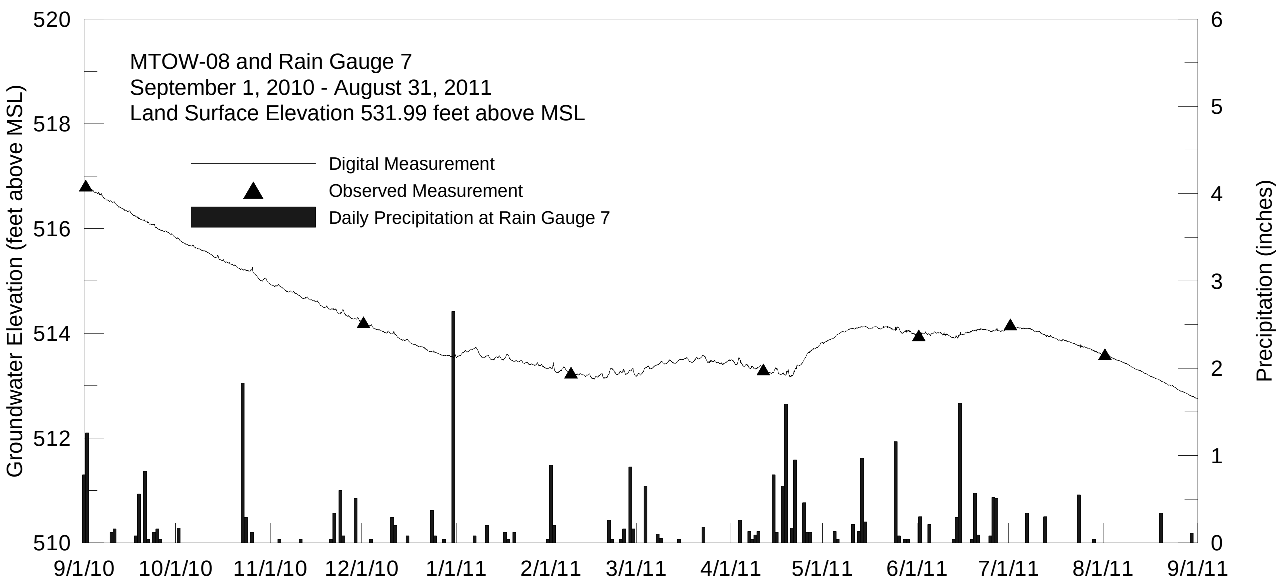

Figure A-8. Year 19 Groundwater elevation and precipitation for MTOW-08

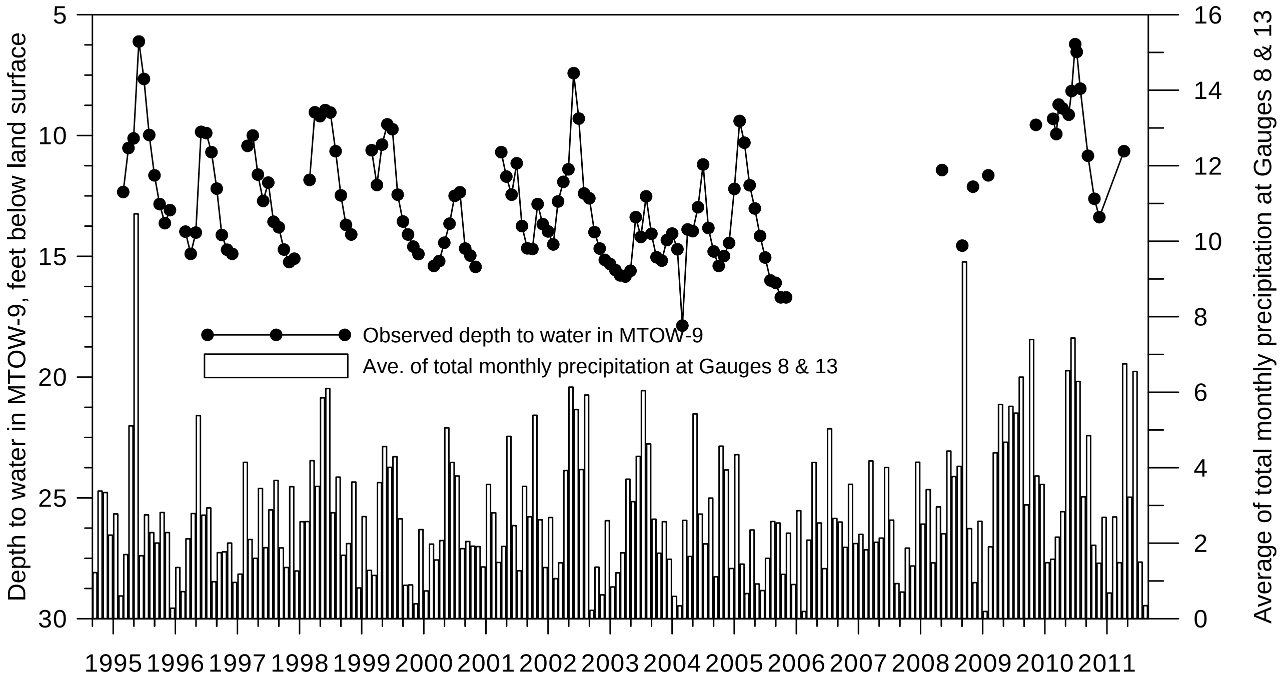

Figure A-9. Year 19 Groundwater depth and precipitation for MTOW-09 (not continuous recorder)

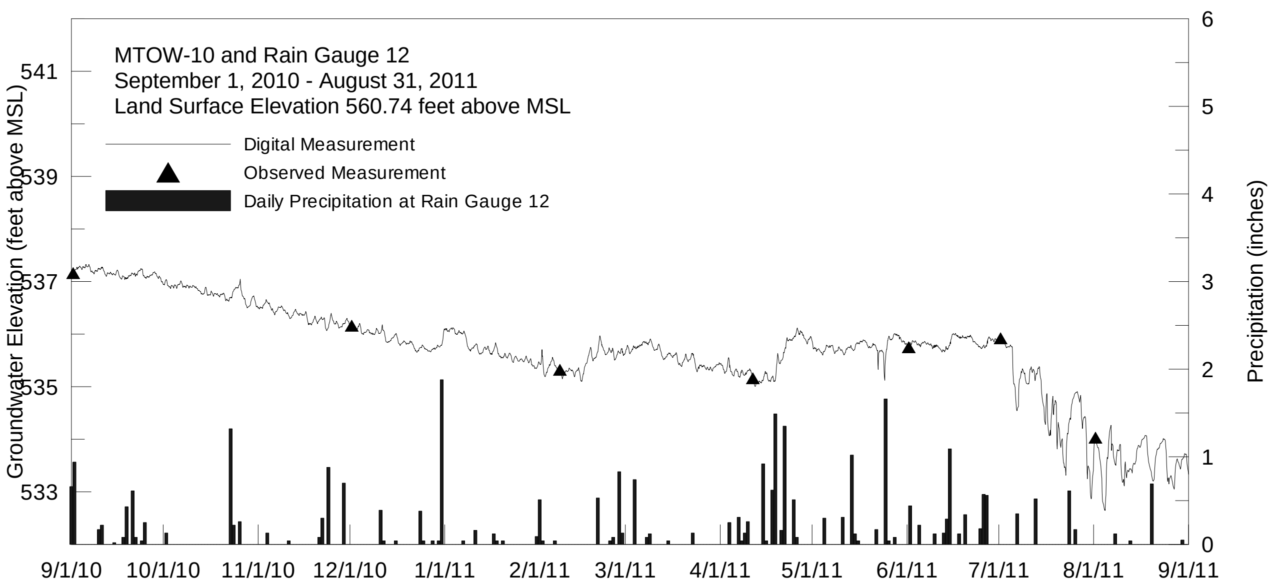

Figure A-10. Year 19 Groundwater depth and precipitation for MTOW-10

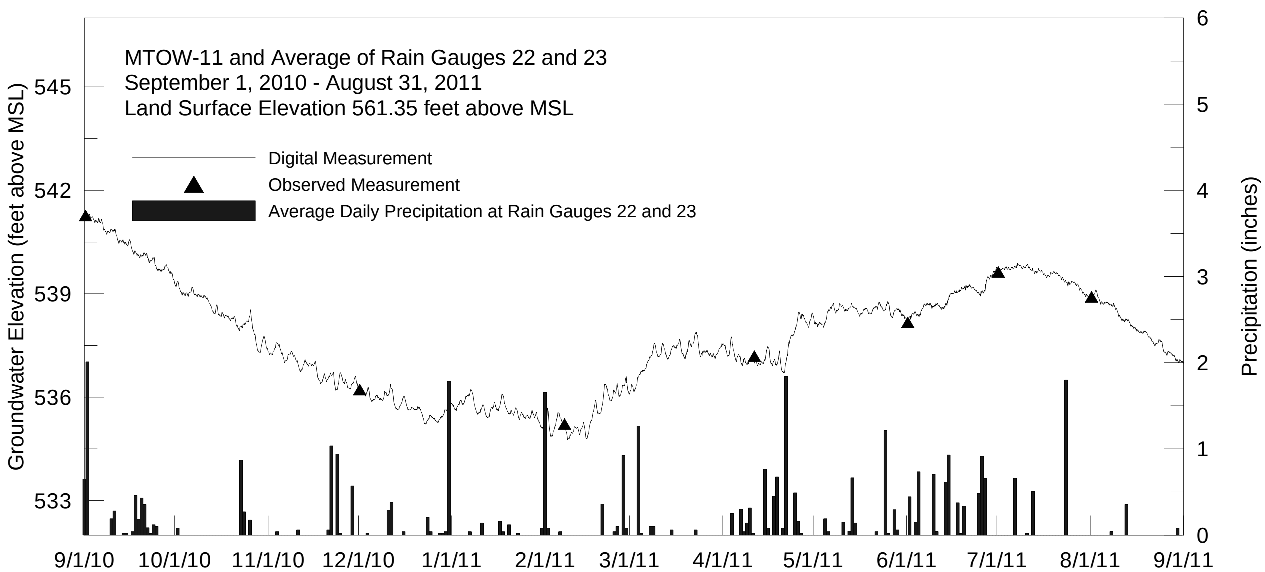

Figure A-11. Year 19 Groundwater elevation and precipitation for MTOW-11

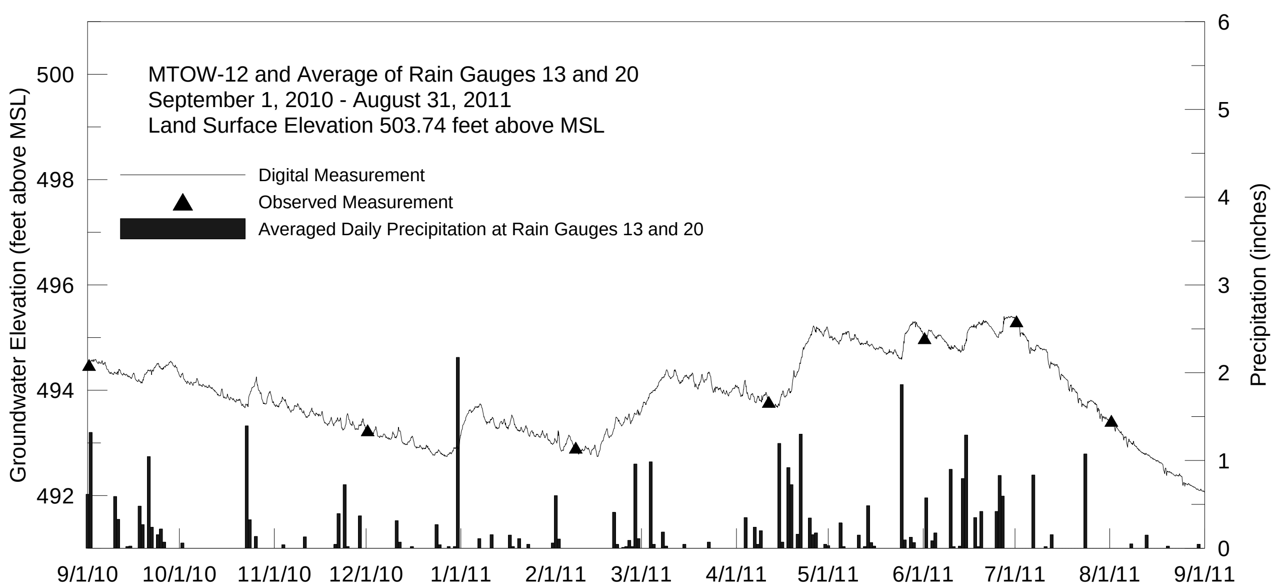

Figure A-12. Year 19 Groundwater elevation and precipitation for MTOW-12

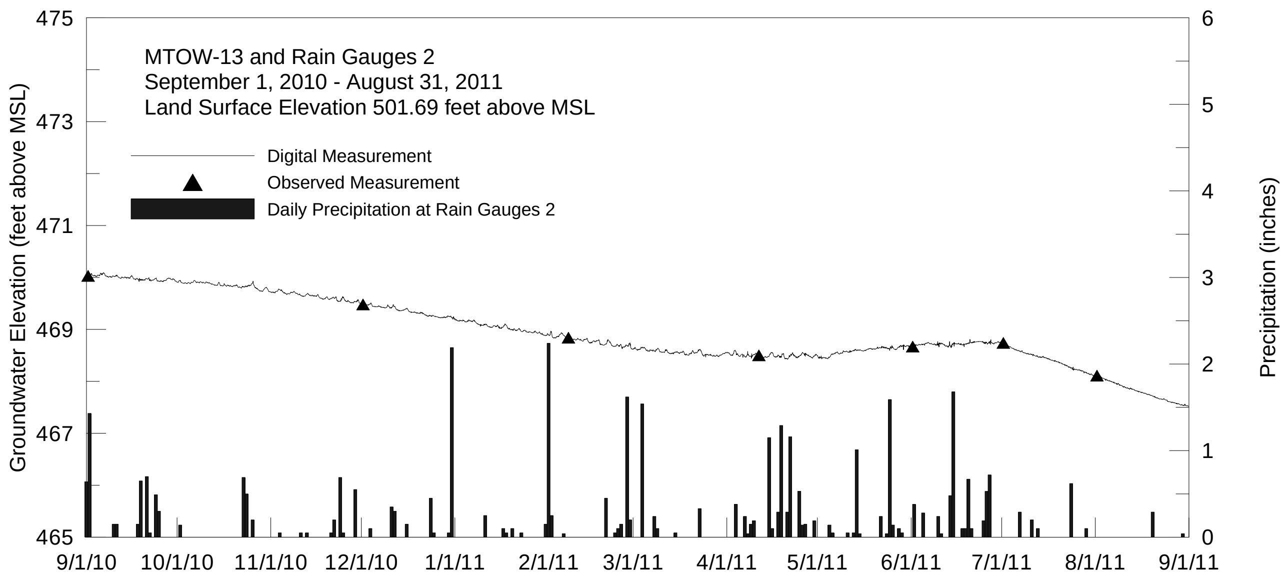

Figure A-13. Year 19 Groundwater depth and precipitation for MTOW-13