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September 27, 2011

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Planning & Development Services
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Subject: Hogan-Pancost Property: Neighborhood Event Timeline and Response to Specific Questions Raised by Adjacent Neighbors

Dear Mr. Arthur:

Through written surveys, neighborhood meetings, public hearings, and in a private meeting on May 16, 2011, neighbors adjacent to the Hogan-Pancost property have voiced concern regarding the coincidence of historical activities in the area and changes in local ground water levels. This concern has led to a concern that the currently proposed development could increase ground water levels. The purpose of this letter is to provide a clear timeline of neighborhood historical events and to respond to specific questions raised by adjacent neighbors regarding changes in ground water levels. For clarity, the information is presented herein is in a question/comment and response format.

Event Timeline

Based on both written and verbal information provided by neighbors adjacent to the Hogan-Pancost property, a timeline of relevant neighborhood events was compiled and is presented in Table 1. For reference, the locations of homes mentioned in the timeline are shown in Figure 1.

This timeline, and additional information provided by the adjacent neighbors regarding seasonal inflow rates to their sumps, were used to develop the conceptual model used in the "*Ground Water Evaluation*" Study previously submitted to the planning department.

Response to Specific Questions Raised by Adjacent Neighbors

Question: The homes along Cimmaron Way were built in 1966 without basement sumps. Why did the ground water rise in July of 1990 so that sumps needed to be installed and pumping had to begin at 220, 230 & 240 Cimmaron Way?

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The Short Response: Ground water levels increased in response to: 1) increased recharge from precipitation, and 2) increased recharge from lawn irrigation due to residential development in south Boulder. In 1990, the ground water levels reached a level that required basement sumps and pumping at these addresses.

The Long Response: The homes along Cimmaron Way were constructed in 1966 with basements and without basement sumps. From 1960 through 1968 the City of Boulder, and the South Boulder Creek watershed, had 6 of 9 years with below average precipitation (Figure 2). This is reflected in the spring flows (March-June) in South Boulder Creek which were 22% lower than average during the same period. At the time the homes were constructed, it is hypothesized that the ground water levels were low due to the multiple years of below average precipitation. In 1969, precipitation was significantly higher and South Boulder Creek flooded. Water from the flood recharged ground water but it was not enough to raise the ground water to a level that required sumps and pumping. Precipitation in 1970 was below average, 1971 and 1972 were near average and 1973 was above average. From 1974 through 1977 precipitation was below average and the ground water levels remained low. From 1978 to 1990 there was a trend of increasing precipitation with 8 of 13 years having higher than average precipitation.

Also, from the time the homes were constructed in 1966 through the 1980's, a significant amount of development occurred in Boulder south of Baseline Rd. By 1990, development in south Boulder covered approximately 3.7 square miles. With the change in land use, lawn irrigation increased and the amount of recharge to ground water also increased.

The combination of increased recharge from precipitation, and increased recharge from lawn watering caused ground water levels to rise. In 1990, the ground water level rise was enough to require basement sumps and pumping.

Question: Did the construction of the East Boulder Community Park soccer fields in 1989-1990 cause the ground water level to increase in July of 1990 so that pumping was now required at 220, 230 & 240 Cimmaron Way?

Response: No. Ground water levels rose in response to recharge increases in the South Boulder Creek watershed (increased precipitation and lawn watering). In 1990, the ground water was high enough to require basement sumps and pumping. Because pumping was required, the neighbors became aware of the ground water level relative to their basements.

Question: Could construction of the soccer fields compress the soils and create an "underground dam" that would cause the ground water level to rise significantly?

Short Response: No, the large lateral extent of ground water allows water to simply flow around any obstruction that may exist. This concept is similar to placing an obstruction such as a boulder in the middle of a stream. In this situation, water is simply diverted to either side of the boulder and water levels change only slightly.

This concept is supported by model simulations which demonstrate that even if ground water flow below the South Boulder Community Park was cut off completely, the ground water level below the adjacent homes would increase by only about 3 inches. This is small compared to ground water level changes observed on site of 40 to 44 inches (Figure 3, May 2011) and cannot account for a significant change in ground water level.

Question: Why did sump pumping begin at 250 Cimmaron Way in January 2002 and stop again in March 2002?

Short Response: January of 2002 was unseasonably warm and wet. Ground water levels rose in response to increased recharge and dropped when the recharge decreased in February and March of 2002.

Long Response: The ground water level rose in January of 2002 in response to an increase in recharge to ground water_from precipitation and snow melt. Records show that South Boulder Creek flows were 34% higher than average and precipitation was 57% higher than the 1950-2011 average. Anecdotal reports from the neighbors indicate that Dry Creek Ditch No. 2 was also running in January 2002 but dry in March 2002.

The 2002 drought began in February of 2002. Recharge to ground water from precipitation decreased as the precipitation decreased. For February, March and April of 2002 the South Boulder Creek flows were only 50%-60% of average. Precipitation was also below average during same time period and was 55% (February), 84% (March), and 8% (April).

Question: If a drought began in February of 2002, why did sump pumping begin at 260 Cimmaron Way and resume at 250 Cimmaron Way during May of 2002?

Response: With below average precipitation in April of 2002, lawn irrigation began earlier than normal to offset the lack of precipitation. In addition, seepage from irrigation ditches recharged ground water.

Question: Why did sump pumping increase at 260 Cimmaron Way in the spring of 2010 so that a second sump needed to be installed?

Short Response: The precipitation for February through July of 2010 was higher than average. As the water level rose in response to the above average precipitation, a second sump pump was needed to maintain the ground water level.

Long Answer: Above average monthly precipitation starting in February of 2010 (172% of average) and continuing through March and April (186% and 141% of average precipitation, respectively) caused the seasonal ground water rise to begin earlier than normal. Although precipitation for May of 2010 was slightly below average (86% of average precipitation), the

above average precipitation continued through both June and July of 2010 (162% and 129% of average precipitation, respectively). The above average precipitation caused ground water to rise higher than normal and a second sump pump was needed to maintain the ground water level.

Comment: In comments provided to the Planning Board, Mr. Ron Craig of 260 Cimmaron Way reported that he has experienced peak pumping rates greater than 14,000 gallons/day.

Short Response: Based on data measured for 2011 (Table 2), it is possible that Mr. Craig's sumps could pump at the reported rates. The data also show that pumping rates can both increase and decrease quickly and significantly in response to precipitation changes.

Long Response: The 2011 rates presented in Table 2 are based on: 1) pump cycle times provided by the neighbor located at 260 Cimmaron Way, and 2) pump cycle times and sump outflow volumes measured by Telesto Solutions, Inc.

For 2011, the estimated peak pumping rate of 11,726 gpd was measured on July 12th. Between June 23rd and July 12th the pumping rate doubled from 5,691 gpd to 11,726 gpd, a period of 19 days. This sudden increase was caused by the higher than average precipitation between June 23rd and July 12th (2.63 inches) that caused a corresponding rise in ground water levels. For reference, the 1971-2000 average precipitation for the months of June and July is 2.02 inches and 1.93 inches, respectively.

The pumping rate decreased slightly between July 12th and August 23rd and then decreased by nearly two-thirds between August 23rd and September 1st (10,001 gpd to 3,653 gpd), a period of 9 days. This sudden decrease was caused by the lower than average precipitation between July 12th and August 23rd (1.08 inches) that caused a corresponding decrease in ground water levels. For reference, the 1971-2000 average precipitation for the month of August is 1.62 inches.

Although the peak pumping rates measured for 2011 are somewhat lower than those reported by Mr. Craig for previous years, the 2011 flow data illustrates that sump pumping rates can both increase and decrease quickly and significantly in response to natural processes (i.e. precipitation changes).

Question: Is there evidence that Dry Creek Ditch No. 2 is leaking?

Short Answer: Yes, the neighbors conducted a dye tracer study in 1995 that demonstrated a connection between water in the ditch and water in the neighbor sumps.

Long Answer: On 9/9/95, Dennis Irwin (220 Cimmaron Way) wrote:

> "As the water flows continued into the summer we identified the water source and traced its movement through trace element fluorescence analysis. Immediately east (less than

> 10 feet) and parallel to the TCI cable trench is Dry Creek #2 irrigation ditch. Water in the irrigation ditch enters the TCI cable trench near the south east corner of 210 Cimmaron Way. From there it flows northward through the backfilled optic trench. This movement is shown by the presence of the trace elements in the cable vault in the backyard of 220 Cimmaron Way. They are then identifiable in the water in the sumps in the four basements [210, 220, 230, and 240]."

It is assumed that this hydraulic connection is still present.

Summary

The ground water system underneath the homes located on Cimmaron Way is part of a much larger alluvial ground water system that reacts in response to natural changes in recharge occurring throughout the South Boulder Creek Watershed.

Adjacent neighbor sump pumping rates may increase or decrease quickly and significantly in response to natural changes in recharge.

Construction of the East Boulder Community Park soccer fields coincided with, but is not related to, the ground water rise observed in July of 1990.

A dye tracer study conducted by the adjacent neighbors in 1995 demonstrated a connection between water in the ditch and water in the neighbor sumps. Piping the ditch will benefit the neighbors by reducing the local recharge to ground water and by removing the hydraulic connection between the ditch and the sumps.

If you have any questions, please feel free to give me a call.

Sincerely,

Telesto Solutions, Inc.

Terry Fairbanks
Senior Hydrologist

Enclosure:

Table 1	Timeline of Neighborhood Events
Table 2	2011 Estimated Sump Pumping Rates for 260 Cimmaron Way
Figure 1	Neighorhood Addresses
Figure 2	Precipitation and Event History

Figure 3 2011 Measred Depth to Ground Water

cc:

Leslie R. Ewy, PE, The Sanitas Group, LLC

Table 1 Timeline of Neighborhood Events

Date	Event	Reference
December, 1966	Homes built along Cimmaron Way	(1)
January, 1990	East Boulder Community Park soccer fields constructed	(2)
July, 1990	Seasonal sump pumping begins for first time at 230, 220 & 210 Cimmaron Way	(2)
August, 1990	Seasonal sump pumping ends at 230, 220 & 210 Cimmaron Way	(2)
September, 1993	TCI Installs a fiber optic cable in the easement behind homes on located on Cimmaron Way	(3)
May, 1995	Neighbors note that the Dry Creek Ditch No. 2 water level equals TCI vault water level	(3)
May, 1995	Flooding in basements: 240, 230, 220, 210 Cimmaron Way	(3)
August, 1995	Tracer study performed by neighbors shows that water flows from Dry Creek Ditch No. 2 to the TCI vault and then to the basement sumps	(3)
August, 1995	Seasonal sump pumping ends	(3)
January, 2002	Sump pumping begins at 250 Cimmaron Way	(4)
March, 2002	Sump pumping ends at 250 Cimmaron Way	(4)
May, 2002	Seasonal sump pumping begins 250 & 260 Cimmaron Way	(5)
June, 2010	Soccer fields are converted to artificial turf, contractor reports water problems	-
June, 2010	Second sump pump installed at 260 Cimmaron Way	(5)

References:

(1) Boulder County Assessor
(2) Dennis Irwin, 250 Cimmaron Way (5/9/92 letter)
(3) Dennis Irwin, 250 Cimmaron Way (9/9/95 letter)
(4) Ramon Jesch, 250 Cimmaron Way
(5) Ron Craig, 260 Cimmaron Way

Table 2: 2011 Estimated Sump Pumping Rates for 260 Cimmaron Way

Date (2011)	Sump 1[1] Cycle[3] (min)	Sump 1[1] Rate (gpm)	Sump 1[1] Rate (gpd)	Sump 2[2] Cycle[3] (min)	Sump 2[2] Rate (gpm)	Sump 2[2] Rate (gpd)	Total (gpd)	Source[4]	Incremental Precipitation (in)[5]
1/1	n/a	0	0	n/a	0	0	0	RC	0
4/7	n/a	0	0	n/a	0	0	0	RC	2.7
5/4	n/a	0	0	n/a	0	0	0	RC	2.09
5/5	4.0	1.1	1565	4.0	1.0	1418	2983	RC	0
5/6	1.75	2.5	3577	11.0	0.4	515	4093	RC	0
5/20	1.0	4.3	6260	4.0	1.0	1418	7678	RC	4.65
5/27	1.5	2.9	4173	3.0	1.3	1890	6063	RC	0.51
6/23	1.1	4.0	5691	n/a	n/a	n/a	5691	TF	1.29
7/12	1.1	4.0	5726	0.9	4.2	6000	11726	TF	2.63
8/23	0.9	5.1	7298	2.1	1.9	2703	10001	TF	1.28
9/1	2.2	2.0	2834	6.9	0.6	819	3653	TF	0.07
9/23	1.7	2.5	3587	4.5	0.9	1262	4850	TF	TBD

Notes:

(1) 4.35 gallons / cycle measured on 9/1/11
(2) 3.94 gallons / cycle measured on 9/1/11
(3) Cycle time is equal to the time between pumping.
(4) Rate is estimated by dividing the volume by the cycle time.
For example, 4.35 gal /cycle ÷ 4.0 min/cycle = 1.1 gal/min = 1565 gal/day.
(5) RC = Ron Craig, 260 Cimmaron Way. (TF) Terry Fairbanks, Telesto Solutions, Inc.
(6) Incremental precipitation is the total precipitation falling between the measurement dates.

PROJECT:	TASK
320-100	1

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FIGURE 1
NEIGHBORHOOD ADDRESSES

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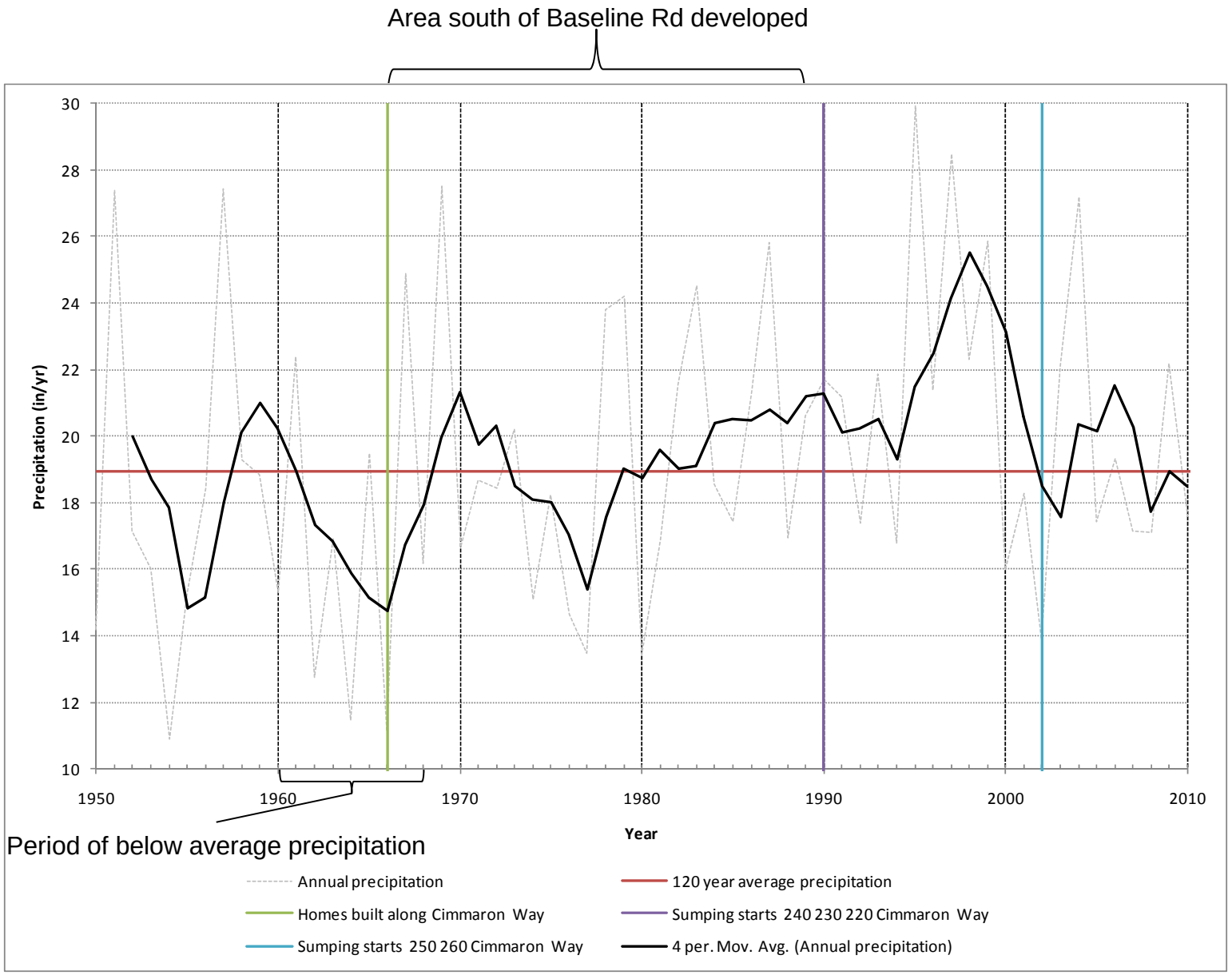

PROJECT:	TASK
320-100	1

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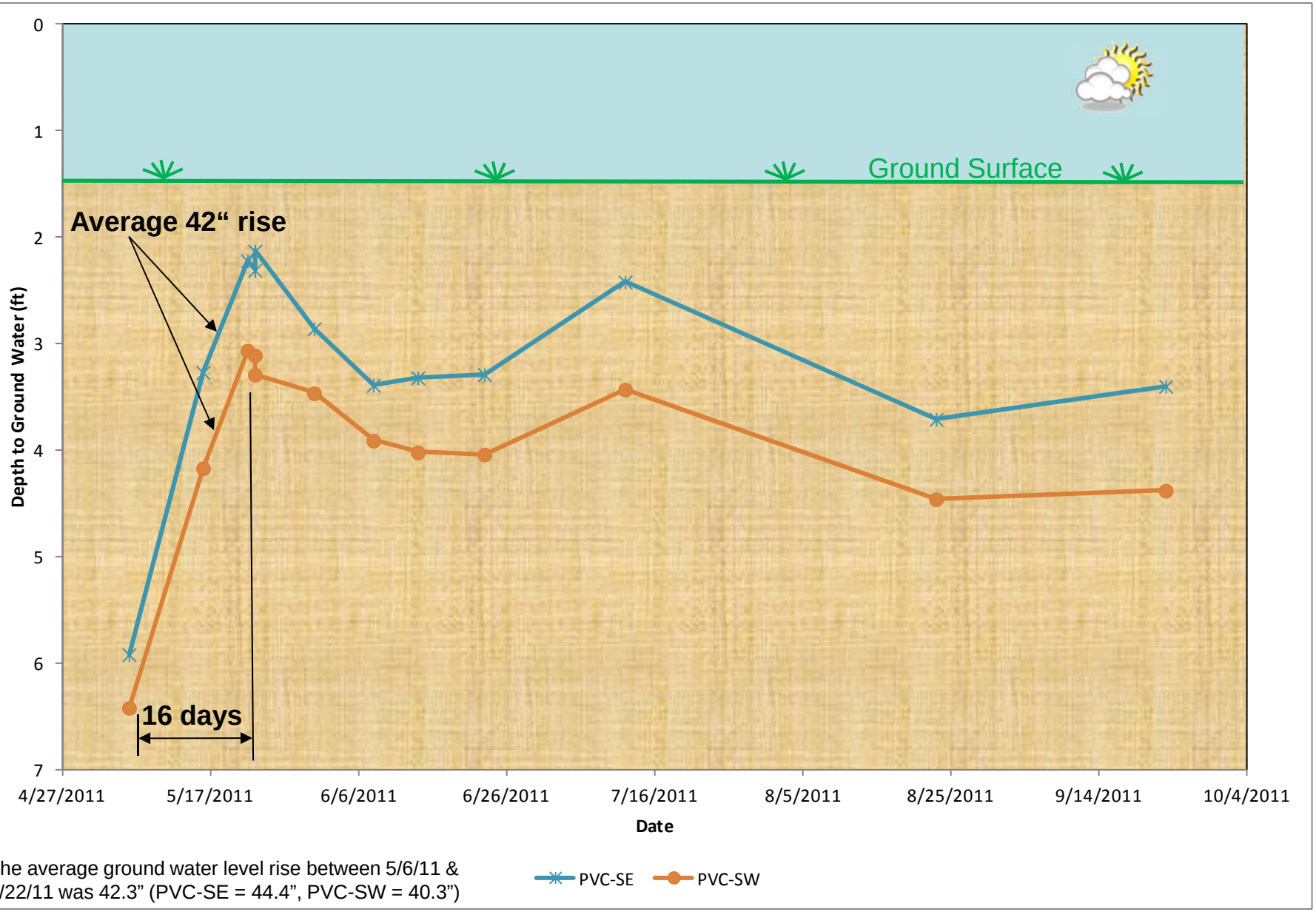
FIGURE 2
PRECIPITATION AND EVENT HISTORY

PREPARED FOR:
BOULDER CREEK COMMONS



The average ground water level rise between 5/6/11 & 5/22/11 was 42.3” (PVC-SE = 44.4”, PVC-SW = 40.3”)

PROJECT: 320-100	TASK: 1
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FIGURE 3
2011 MEASURED DEPTH TO GROUND WATER

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