Precipitation and Water Table Measurement Comparison Study for 2010 and 2011 for Brookings, South Dakota COOP (Co-operative Observer Program) Weather Station and AWDN (Automated Weather Data Network) Weather Station
Also a Look at How 2010 Was a Record Breaking Precipitation Year

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Abstract

This study used 2010 and 2011 COOP (Co-Operative Observer Program) and AWDN (Automated Weather Data Network) weather observations from Brookings, South Dakota. The study addressed 2010 as being a record breaking precipitation year for Brookings, South Dakota. Also addressed was how the rain events during 2010 and 2011 affected the water table depth through the comparisons of daily readings, to other time schedules and a comparison of two different types of metering sticks used to measure water table depth.

On a near daily basis during the time of year when the evaporation pan was in service (April 2010 to October 2011) the water table depth was measured as well as the daily amount of precipitation, evaporation and the snow depth for the entire year at the Brookings COOP station. At this station during 2010, the amount of precipitation was the highest recorded since records have been kept from 1894 to present.

The 2010 and 2011 daily precipitation amounts were compared to the daily water table depth data. What was found was that the water table depth responded within hours of a rain event. Without the water table depth being measured daily most of the details of this rain event and water table depth change interaction would not be seen. The comparison was extended to show that interaction with daily details would be lost if the observations were only taken once or twice a month or only the second day after a rain event as is the current practice at other water table depth monitoring sites. The last study compared two types of sticks used to measure the water table depth.

It was concluded that water table depth measurements should be made daily because of the interactive dynamics that occurred between rainfall events, snow melting, and water table depths that would otherwise lost. It also suggested that daily readings be made at other stations that measure water table depth, precipitation and snow depth to determine if Brookings was or was not unique in possessing this dynamic relationship

3. Results

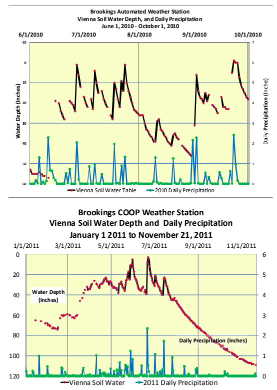


Fig 1 & 2 Daily Precipitation and Daily Water Table Depth Graphs

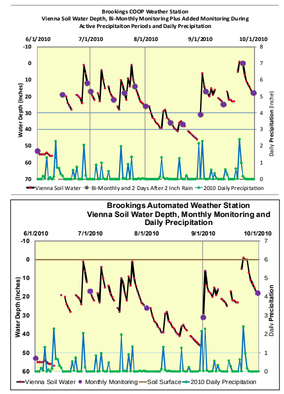


Fig. 3 & 4 Daily Precipitation and Different Water Table Monitoring Schedules Graphs

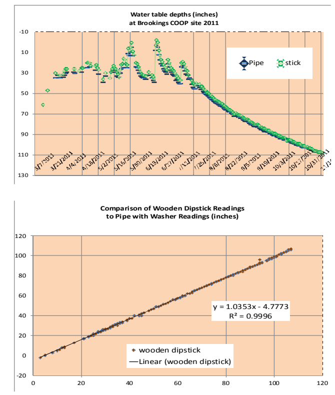


Fig 5 & 6 Comparisons between Dipstick and pipe for water table measurements graphs

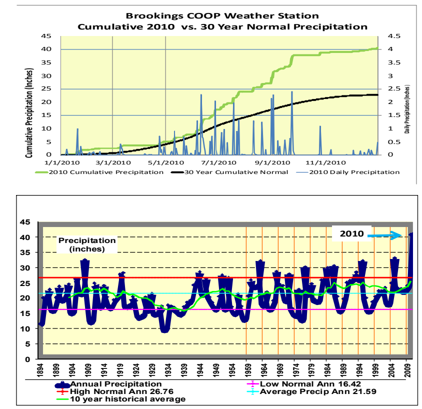
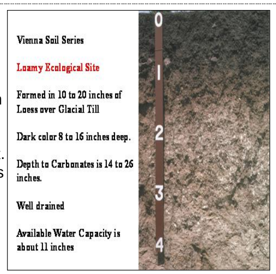


Fig. 5 & 6 2010 and historic Precipitation Graphs

Methods

A monitoring well was put in at the Brookings weather site October of 2009. The soil there was Vienna type soil that is well drained and does not have a water table within a depth of 60 inches during normal precipitation months and years The weather site is located on a high landscape position with a land slope of about one percent. The 120 inch long 1 1/2 inch diameter PVC pipe was inserted 111 inches into the ground with a 9 inch stickup above the ground. The bottom 36 inches of the pipe was slotted, wrapped with a woven plastic landscape fabric, and surrounded by a sand pack. The pipe from the top of the sand pack to the soil surface was sealed with Bentonite. There was also 2 inches of sand in the bottom of the pipe. This gave 109 inches of **pipe** measure inches of measurable well. Before water could come up in the well, it had to move through the soil to the sand pack and rise to equilibrium. A 10 foot long wooden dipstick with dimensions of 1/8 by 3/4 of inch was marked with one inch increments starting with 0 at the ground level and 107 inches at the bottom. This was inserted into the pipe and pulled out. The line at the top of the wet mark was the recorded measurement.



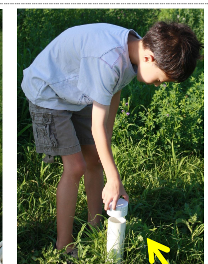
Starting April 17, 2011, an additional water table measuring devise was used. It consisted of a small pipe with a washer at the end which was slightly smaller than the well diameter. The observer could hear when the washer reached the water and the number on the small pipe was recorded. The measurements of the dipstick and pipe with the washer were compared. The advantage of the pipe over the dipstick was that it sat on top of the water and therefore did not raise the water level (up to three inches) in the well pipe like the dipstick. In addition, it could be read on rainy days. If the dipstick was already wet from rain it could not be used to find the water table depth in the well pipe. The advantage of the dipstick is that it is simpler to use and different users come up with the same reading with only a rounding error. The pipe readings among different users varied by as much as 2 inches and it took time to develop a consistent technique. (my 8 year old nephew got the same number as myself and my 2 youngest daughters with the dipstick, whereas him using the pipe was comical)

The precipitation was measured with an 8 inch diameter precipitation can, and the evaporation pan was at the site, both were measured in hundredths of an inch. Snow depth and water table were measured using whole inches.

The data collected was analyzed and put into graphs. Above is a sample of some of the graphs.

Precipitation Can

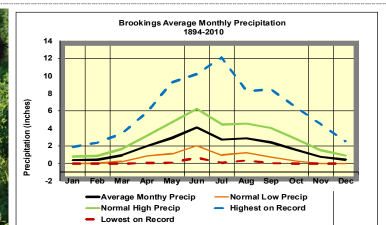
Evaporation Pan



Water Table Well Cap

Wooded Water Table Dipstick

Water Table Pipe with Washer Stick



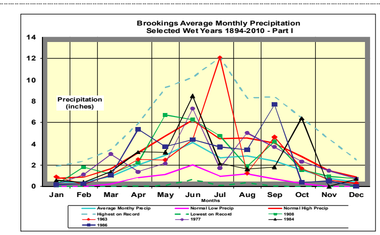


Fig. 7 & 8 Average Precipitation Graphs

Conclusion and Comments

2010 was a record breaking precipitation year. The total amount of precipitation was the highest for the record taking time period of 1894 to 2010. Even though 2010 was the first full year of water table observations, rare high soil water tables were recorded in the soil due to the record breaking precipitation amounts in 2010. Soil interpretations can be tailored for this and similar soils based on the frequency and depth of soil water. An example would be construction activities such as home basements

The combination of a higher than normal precipitation and the decision to take almost daily water table readings showed the interactive nature of rain events and melting snow with the water table. In 2011, we compared the pipe and stick for measuring the water table. 2011 was wet until mid-July and showed the quick response like 2010. Then for the rest of the year there was very little precipitation and the water table dropped to where the sticks could not longer reach the water table. This means that the two sticks could be compared over their entire usable length. As expected the difference between the two was due to the volume of the wooden stick displacing the water and raising the water table level recorded.

In 2012, a 20 foot PVC pipe was installed in order to measure this deeper water table depth. The pipe once, one has the technique down is more accurate, but the dipstick is easier. The dipstick provided a relative scale for the water table. In the future though, its markings should take into account the volume of the stick and put 0 inches where the wet line would be when the water table is at ground level . This would make both sticks read 0 at the ground level and they would then differ the most at the bottom of the well.

Additional studies of water tables at weather stations where daily precipitation and evaporation are measured would help confirm the relationship of water both above and below the soil surface. Daily water table monitoring would be important in obtaining the best quality of data and future reasearch.