Groundwater Level Measurements Using a Graduated Steel Tape

Introduction

Ground water level measurements are used to determine hydraulic gradients, directions of flow, rates of flow, locations of ground water recharge and discharge, the amount of water in storage, the change in storage over time, and aquifer hydraulic characteristics. Repeated measurements of water levels over time provide a history of water level fluctuations that aids interpretation of water quality and water quantity data. For example, seasonal variations in recharge induced by pumping can cause changes in hydraulic gradients that may correspond to changes in water quality and water quantity.

This fact sheet provides a method for measuring ground water levels using a graduated steel tape and a recommended format for documentation of data. It is not intended to replace American Society for Testing and Materials (ASTM) or other standards but to provide personnel with an overview of methodology and data requirements.

Materials

1. A hand-cranked steel tape graduated in feet, tenths of feet and hundredths of feet.
2. Blue carpenters' chalk.
3. Clean rags.
4. Pencil and eraser.
5. United States Geological Survey 7.5 minute quadrangle or county highway map.
6. This document requires Adobe Acrobat.
   Water Level Measurement Field Form. (59KB) This form is available for downloading.
7. Wrenches with adjustable jaws and other tools to remove well cap.
8. Common household chlorine bleach.

Data Accuracy and Limitations

1. A graduated steel tape is commonly accurate to 0.01 foot.
2. The water level should be within 500 feet of the land surface for steel tapes.
3. If the well casing is not plumb, the depth to water will have to be corrected.

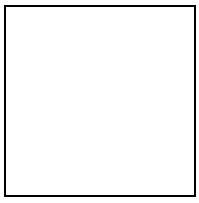
Advantages

1. The graduated steel tape method is considered to be the most accurate method for measuring the water level in non-flowing wells of moderate depth (less than 500 feet).
2. Ease of use.

Assumptions

1. An established measuring point (MP) exists. The MP is a permanent mark on the pump or well casing that is used as a reference point from which the tape readings are made.
2. The MP is clearly marked and described so that a person who has never measured the well will be able to easily locate it.
3. A water level measurement taken during the last field visit should be reviewed to estimate the length of tape that should be lowered into the well. If the water-level is being measured for the first time, several attempts may be necessary before the proper length of tape is established.
4. The well is free of obstructions. Well obstructions, if present, could cause errors in the measurement if the tape is not hanging vertical and straight.
5. Water level is stable. The pump has been shut down long enough to allow the water to recover to static levels (normally 2 or 3 hours).

Procedure



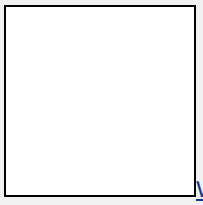
1. Verify that you are measuring the correct well.
2. Record the well location, well information, site location sketch, and measuring point sketch sections of the Water Level Measurement Field Form as completely as possible.
3. Chalk the lower few feet of the tape by pulling the tape across a piece of blue carpenter's chalk. The wetted chalk mark will identify that part of the tape that was submerged.
4. Lower the tape into the well until the lower end of the tape is submerged. Continue to lower the tape into the well until the next graduation (a whole foot mark) is opposite the MP (figure 1, click on picture to enlarge), record this reading in the *MP HOLD* column of the Water Level Measurement Field Form. The length of tape needed to reach the water

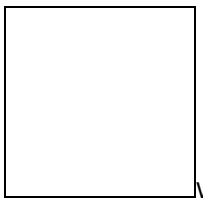
surface can be estimated from previous water level measurements. Otherwise, the length of tape needed to reach the water surface will have to be found by trial and error.

5. Rewind the tape and record the reading at the wetted chalk mark (sometimes referred to as the cut) in the *WETTED CHALK MARK* column of the Water Level Measurement Field Form.
6. Subtract the *WETTED CHALK MARK* reading from the *MP HOLD* reading, and record the result in the *DEPTH TO WATER FROM MP* (figure 1) column of the Water Level Measurement Field Form.
7. Apply the MP correction to get the depth to water below or above land surface datum. If the MP is above land surface, the distance between the MP and land surface datum (LSD) (figure 1) is subtracted from the *DEPTH TO WATER FROM MP* to obtain the *DEPTH TO WATER BELOW LSD*. If the MP is below land surface, add the distance between the MP and land surface datum (figure 1) to *DEPTH TO WATER FROM MP*. Record the result in the *DEPTH TO WATER FROM LSD* column of the Water Level Measurement Field Form. If the water level is above LSD, record the depth to water in feet above land surface as a negative number.
8. Make a check measurement by repeating steps 1 through 5. The check measurement should be made using a different MP hold value than that used for the original measurement. If the check measurement does not agree with the original measurement within 0.05 of a foot, continue to make check measurements until the reason for the lack of agreement is determined or until the results are shown to be reliable.
9. After completing the well measurement, disinfect the steel tape by pouring a small amount of common household chlorine bleach on a clean cloth and wiping down the part of the tape that was submerged below the water surface; this will avoid possible contamination of other wells.
10. Maintain the tape in good working condition by periodically checking the tape for rust, breaks, kinks and possible stretching.
11. In some pumped wells, a layer of oil may float on the water surface. If several feet of oil are present in the well, or if it is necessary to know the thickness of the oil layer, a commercially available water-detector paste can be used that will detect the presence of water in the oil. The paste is applied to the lower end of the tape and will show the top of the oil as a wet line; the top of the water beneath the oil will show as a distinct color change. Because the density of oil is about three-quarters that of water, the actual water level (i.e. the water level in a well without an overlying oil layer) can be estimated by adding the thickness of the oil layer times its density to the oil-water interface elevation.

Water Level Measurement Field Form

This form is available for downloading. This document requires Adobe Acrobat.

 Water Level Measurement Field Form (59 KB)

 When completing the Water Level Measurement Field Form, record as much information as possible. All requested information on this form is essential to the personnel entering these data into a groundwater database and to the personnel analyzing the water level data. Also, relocation of a well for the next water-level measurement is easier when the forms contain all requested information.

Well Location

Record the *State*, *County*, and *Owner* data on the field form. You may also need to record the owner's phone number if the owner requests to be notified before a water-level measurement is made. The *Land Net* and *Latitude* and *Longitude* data are the most important location data recorded for anyone attempting to analyze water-level data from multiple wells. When recording land net data, follow the naming convention illustrated in figure 2, (click on picture to enlarge). Record the *Altitude of Land Surface (LSD)* and the *Method of Location Measurement*. Finally, record the name and scale of the United States Geological Survey (USGS) quadrangle or county map you used to calculate the well location information in the *Location Map Name* and *Map Scale* portions of the form.

Well Information

Record the *Date of Construction*, *Well Depth*, *Primary Aquifer*, and *Use of Water* when initially contact with owners are made to gain permission to measure the water level in their wells.

Site Location Sketch and Directions

Sketch and note the well location as accurately and completely as possible. The sketch should include the location of the well and nearby roads and buildings. The sketch map and written directions to the well location will be the most important information on the field form for the next person measuring the water level at the well.

Measuring Point Sketch and Description

Sketch and describe the measuring point as accurately as possible. The sketch should include the well head and the measuring point location. Without a known measuring point the accuracy from one measurement to the next becomes questionable.

Conclusion

With the growing recognition that water is a vital natural resource, the need for accurate water data is increasing. Each accurately collected and recorded ground water- level measurement contributes important information, both locally and nationally, to the understanding of our nation's water resources.

References

ASTM D 4750-87 (93), 1993, Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well): American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

Lapham, W. W., Wilde, F. D., and Koterba, M.T., 1997, Guidelines and standard procedures for studies of ground-water quality: selection and installation of wells, and supporting documentation: U.S. Geological Survey, Water-Resources Investigations Report 96-4233, 110 p.

United States Geological Survey, Office of Ground Water, 1997, Water-level measurement using graduated steel tape, unpublished stand-alone procedure document, 5 p.