

GWPD 1—Measuring water levels by use of a graduated steel tape

VERSION: 2010.1

PURPOSE: To measure the depth to the water surface below land-surface datum using the graduated steel tape (wetted-tape) method.

Materials and Instruments

1. A steel tape graduated in feet, tenths and hundredths of feet. A black tape is preferred to a chromium-plated tape. If a chromium-plated tape is used, paint the back of the tape with a flat black paint to make reading the wetted chalk mark easier. A break-away weight should be attached to a ring on the end of the tape with wire strong enough to hold the weight, but not as strong as the tape, so that if the weight becomes lodged in the well the tape can still be pulled free. The weight should be made of brass, stainless steel, or iron. Lead weights are not acceptable.
 2. Blue carpenter's chalk.
 3. Clean rag.
 4. Pencil or pen, blue or black ink. Strikethrough, date, and initial errors; no erasures.
 5. Water-level measurement field form, or handheld computer for data entry.
 6. Two wrenches with adjustable jaws or other tools for removing well cap.
 7. Cleaning supplies for water-level tapes as described in the National Field Manual (Wilde, 2004).
 8. Key for well access.
3. The steel tape should be calibrated against another acceptable steel tape. An acceptable steel tape is one that is maintained in the office for use only for calibrating steel tapes, and this calibration tape never is used in the field.
 4. Oil, ice, or debris may interfere with a water-level measurement.
 5. Corrections are necessary for measurements made through angled well casings.
 6. When measuring deep water levels (greater than 500 feet), tape expansion and stretch is an additional consideration (Garber and Koopman, 1968).

Advantages

1. The graduated steel tape method is considered to be the most accurate method for measuring water levels in non-flowing wells of moderate depth.
2. Easy to use.
3. Small tape diameter allows access through small ports and provides little interference with pump wiring.

Disadvantages

1. Results may be unreliable if water is dripping into the well or condensing on the well casing.
2. Not recommended for measuring water levels while wells are being pumped.
3. Initial measurement is difficult if estimated water level is not known.

Data Accuracy and Limitations

1. A graduated steel tape is commonly accurate to 0.01 foot.
2. Most accurate for water levels less than 200 feet below land surface.

- Wetted chalk mark may dry before tape is retrieved under hot, dry conditions with large depths to water.

Assumptions

- An established measuring point (MP) exists and the distance from the MP to land-surface datum (LSD) is known (fig. 1). See GWPD 3 for the technical procedure document on establishing a permanent MP.
- The MP is clearly marked and described so that a person who has not measured the well will be able to recognize it.
- For established wells, a water-level measurement taken during the last field visit is available to estimate the length of tape that should be lowered into the well.
- The black sheen on the steel tape has been dulled so that the tape will retain the chalk.
- The well is free of obstructions that could affect the plumbness of the steel tape and cause errors in the measurement.
- The same field method is used for measuring depth below measuring point, or depth relative to vertical datum, but with a different datum correction.
- The graduated steel tape has been calibrated.

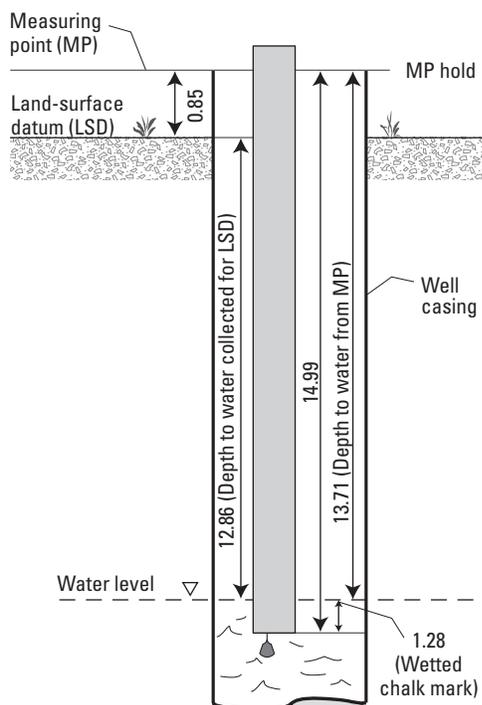


Figure 1. Water-level measurement using a graduated steel tape.

Instructions

- Open the well.
- Chalk the lower few feet of the tape by pulling the tape across a piece of blue carpenter's chalk. A wetted chalk mark will identify that part of the tape that was submerged.
- Review recent measurements from the well, if available, to estimate the hold point on the tape.
- Refer to figure 1 for an illustration of the elements of a steel tape measurement. Lower the weight and tape into the well until the lower end of the tape is submerged below the water. The weight and tape should be lowered into the water slowly to prevent splashing. Place the thumb and index finger on the tape graduation that is 0.01 less than the next whole foot mark (14.99 in figure 1). Continue to lower the end of the tape into the well until the thumb and index finger meet the MP. Record the graduation value (the HOLD) in the Hold column of the water-level measurement field form (fig. 2).
- Rapidly bring the tape to the surface before the wetted chalk mark dries and becomes difficult to read. Record the length of the wetted chalk (the CUT) in the Cut row of the water-level measurement field form (fig. 2). Record the time of the measurement in the "Time" row of the form.
- Subtract the CUT from the HOLD and record this number in the "WL below MP" column of the water-level measurement field form (fig. 2). The difference between the HOLD and the CUT is the depth to water below the MP.
- If the tape-calibration procedure indicates that a correction is needed at a given water-level depth or for a given water-level range, apply that correction to the "WL below MP" value by adding or subtracting the appropriate correction.
- Record the MP correction length on the "MP correction" row of the field form (fig. 2); the MP correction is positive if the MP is above land surface and is negative if the MP is below land surface (GWPD 3). Subtract the MP correction from the "WL below MP" value to get the depth to water below or above land-surface datum. Record the water level in the "WL below LSD" column of the water-level measurement field form (fig. 2). If the water level is above LSD, record the depth to water in feet below land surface as a negative number.
- Make a check measurement by repeating steps 1 through 5. The check measurement should be made using a different HOLD value than that used for the original measurement. If the check measurement does not agree

with the original measurement within 0.02 foot, continue to make measurements until the reason for lack of agreement is determined or the results are shown to be reliable. If more than two measurements are made, use best judgment to select the measurement most representative of field conditions.

10. Complete the “Final Measurement for GWSI” portion of the field form (fig. 2).
11. After completing the water-level measurement, disinfect and rinse that part of the tape that was submerged below the water surface, as described in the National Field Manual (Wilde, 2004). This will reduce the possibility of contamination of other wells from the tape.
12. Close the well.
13. Maintain the tape in good working condition by periodically checking the tape for rust, breaks, kinks, and possible stretch due to the suspended weight of the tape and the tape weight. The tape should be recalibrated annually and recorded in the calibration logbook.
14. In some pumped wells, a layer of oil may float on the water surface. If the oil layer is a foot or less thick, read the tape at the top of the oil mark and use this value for the water-level measurement instead of the wetted chalk mark. The measurement will differ slightly from the water level that would be measured were the oil not present. However, if several feet of oil are present in the well, or if it is necessary to know the thickness of the oil layer, an electronic “interface probe,” or 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, and the top of the water will show as a distinct color change. Because oil density is about three-quarters that of water, the water level can be estimated by adding the thickness of the oil layer times its density to the oil-water interface altitude.

Data Recording

All calibration and maintenance data associated with steel tape use are recorded in the calibration and maintenance equipment logbook.

All water-level data are recorded on the water-level measurement field form (fig. 2) or by using a handheld computer program such as MONKES. Field measurements are recorded to the nearest 0.01 foot or to the appropriate precision based on the judgment of the hydrographer. When using a handheld computer to record field measurements, the measurement procedure is the same as described in the “Instructions” section.

References

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