



Aquifer Testing for Improved Hydrogeologic Site Characterization

Checklist for the Execution of Pumping Tests

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1. What to do before you travel to the site

1. Design your test.
2. Provide for accurate measurements of elapsed time, distances between wells, drawdown, and pumping rate.

Reliable analyses of the data requires accurate measurements of elapsed time, distances between wells, drawdown, and pumping rate:

- Record time with a synchronized digital watches and a stopwatch;
- Measure distances twice;
- Make a manual water level measurement every time you download a transducer; and
- Measure pumping rates frequently and, if necessary, adjust the rates carefully.

3. Select transducers that cover the range of you anticipate.

A 10 psi transducer can measure up to 23.1 feet (7.04 m) of drawdown. If it is placed more than 23.1 feet below static water level, it will be off-scale and will register a constant reading. If a 10 psi transducer is placed more than 46.2 feet below static water level (twice the operating range) the transducer can be ruined. It is best to place the transducer at the midpoint of its range for maximum accuracy and to allow for rising water levels during the test. The total depth of a well equals the water level below top of casing plus the transducer output with the transducer at the bottom of the well.

4. Make sure that your water level tapes, transducers and dataloggers are working properly.
5. Know whether your transducers are vented or non-vented.

2. What to do when you arrive at the site

1. Check the calibration of your transducers in the field.

Make sure you know how to check the calibration of a transducer.

2. Perform pretest monitoring to determine the magnitude of water level variations in the monitoring network due to external influences.

To yield useful data the aquifer test must induce drawdowns of greater magnitude than the variations caused by external forces. Identify and quantify the external causes and, if possible, filter out their influence. It may be possible to time the aquifer test such that the external forces are either constant or not active. Some examples are: pumping in other wells; water level fluctuations in surface water bodies; barometric pressure changes; trains; and infiltration.

3. Locate the generator away from the wellhead.

If possible, have the generator located away from the wellhead to reduce the noise you have to work around.

3. Establish the pumping requirements

1. Make sure the pump intake is deep enough to allow adequate drawdown.
2. Induce the maximum stress possible on the aquifer, but avoid drawing the water level below the top of a confined aquifer, and avoid pumping sand.

The bigger the pump the better. An oversized pump that is throttled back will generally run at a higher rate than a pump running near capacity. A fully open valve is a horrifying sight when the pumping rate is declining.

3. Conduct a step test before the constant-rate test to identify a sustainable rate.
4. If you conduct a step test or start the pump to make sure it runs, allow the aquifer to stabilize before beginning the constant-rate test.
5. Choose pumping rates that can be monitored easily.

Have a stop watch available and estimate the range of acceptable times to pump a given volume of water. For example, if the target discharge rate is 30 gpm, at 28.5 gpm it will take 10 minutes and 32 seconds to pump 300 gallons, and at 31.5 gpm it will take 9 minutes and 32 seconds to pump 300 gallons. To be considered a constant-rate test, the pumping rate should not vary by more than 5 percent.

4. Measuring flow rates

1. Measure the flow rate carefully.

If you are going to deliberately change the pumping rate, make sure that you can measure the rate accurately throughout the test.

Measure the pumping rate with a totalizing flow meter, and control the rate with a valve and an in-line flowmeter. Install the valve downstream of the flow meter to reduce the turbulence through the meter. Have the meter and valve located close enough together so one person can adjust the valve and readily read the meter.

2. If a well does not produce sand, measure the pumping rate with a totalizing flow meter and control the rate with a valve and an in-line flowmeter.
3. For wells that produces sand, consider alternative approaches for measuring the pumping rate that may include orifice tube, weir box, measuring the profile of the falling water stream, or filling a container of known volume.

Totalizing flow meters work wonderfully unless the well produces "too much" sand. "Too much" sand is enough to jam the flow meter. This may not be much at all. Alternative measurement techniques include: orifice tube, weir box, measuring the profile of the falling water stream, or filling a container of known volume. These methods allow accurate instantaneous flow rate measurements but do not allow calculation of the cumulative average flow rate for the entire pumping period.

4. Make sure that there is a backflow-preventer (check valve) on the discharge pipe.

A check valve on the discharge pipe above the submersible pump will prevent backflow when the pump is shut off. If the discharge line discharges to a tank or surface water body, make sure that an air break exists so a siphon is not created when the pump is shut off.

5. Measuring water levels

1. Know where the bottom of a well is before you install a transducer.

Don't let the mud generally occupying the bottom of the well clog the ports on the transducer cap.

2. When setting transducers in wells, be extremely careful not to cut the transducer cable on the top of the riser.

If water gets inside the cable the transducer can be ruined. Use wire rope thimbles or duct tape to make a collar for the cable where it contacts the riser pipe and other sharp edges.

3. Be cautious when measuring the water level in a pumping well.

Know where the pump intake is and do not lower the water level indicator to that level. Never put the pressure transducer below or opposite the pump intake. Avoid placing a water level tape or transducer in a well with a pump installed in it that does not contain a drop pipe. A drop pipe will prevent the water level monitoring device from becoming snagged on the pump wires or other objects in the well.

4. Loosen well seals and vent the covers before taking any measurements and leave them loose throughout the testing period.

Airtight well seals and non-vented dust covers impede water level changes if the water level is above the well screen. Loosen seals and vent the covers before taking any measurements and leave them loose throughout the testing period.

5. Set the references on the dataloggers such that the output is equal to the manually measured water level.

Datalogger record water level changes relative to a reference value defined by the user. Set the references on the dataloggers such that the output is equal to the manually measured water level. Set the datalogger to record in length expressed relative the top of casing. Keep a log of manual measurements versus datalogger outputs. Dataloggers often drift during the early stages of a test, due to cable straightening and temperature equilibration. Be prepared to reset the reference if the datalogger drifts during the test. If the reference is reset while the test is underway, the previously collected data are automatically adjusted. If the data logger output continues to drift, check for other causes: slipping of the transducer; failing of the transducer; or kinking of the tape of the manual device.

6. Avoid immersing dataloggers.

Not all dataloggers are watertight. For some vented transducer designs, there is a vent on the instrument panel to keep the transducer in equilibrium with barometric pressure. The box can be exposed to rain, sleet, and snow but cannot be immersed.

7. Allow a few seconds for a datalogger to wake up if you are doing delayed starts.

If you are using delayed starts and stepping a test without stopping the previous step, you will not be able to synchronize the clocks of the datalogger(s). Read the time output from the datalogger to determine how much drift has occurred and allow for this drift when starting the next step of the test.

8. Increment the test number before adjusting the transducer parameters.

Changes to the transducer parameters are retroactive to the previous test if the test number is not incremented.

9. Avoid shocks.

Shocks erase data. During cold weather, make sure static electricity does not build up between you and the datalogger. When downloading data, touch the cable and your hands to the screws on the top of the data logger before connecting the cable.

10. Back up downloaded data. Back up backed-up downloaded data.

11. Always have enough manual measurements to suffice as a data set for analysis in case the datalogger fails, the data are lost, etc.

12. Assign the nightshift to the groundwater modellers.

6. What to do after the test

1. Measure recoveries for as long as you can.
2. Secure your transducers.

Transducers that are accessible are frequently stolen or vandalized.

3. Plot the pumping rate versus time.
4. Plot drawdowns versus time for all of the observation wells.