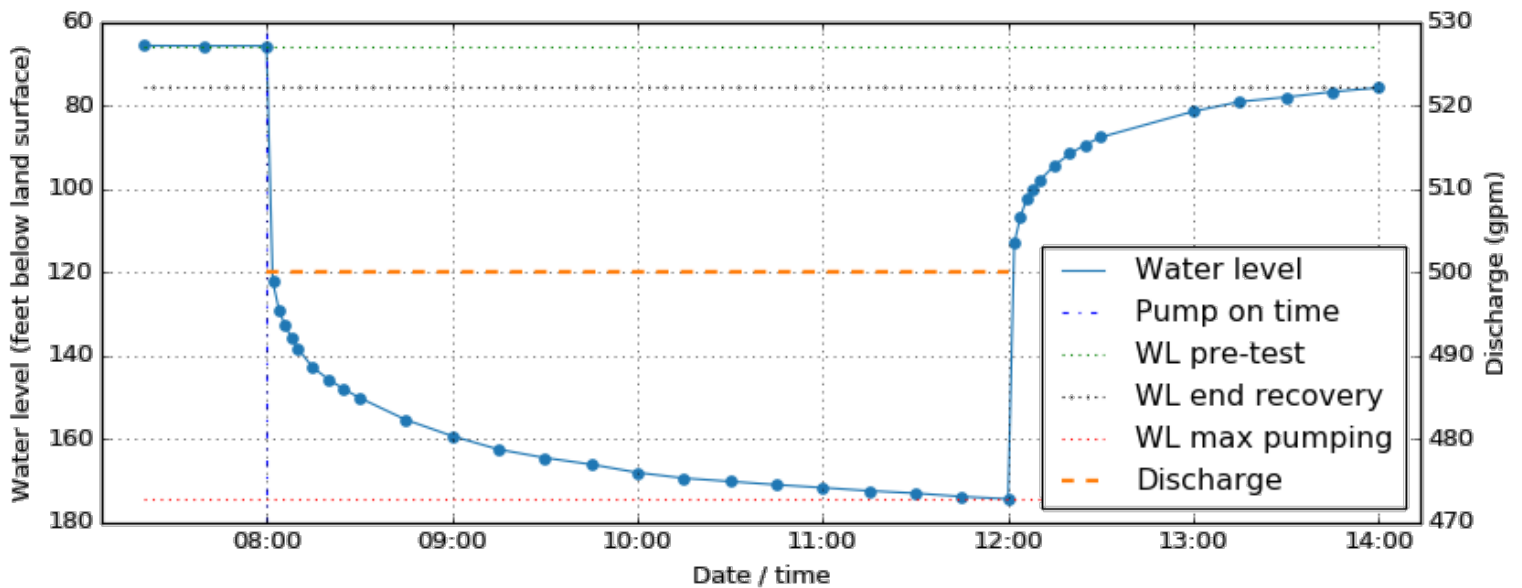


# 2019

## PUMP TEST REQUIREMENTS FOR GROUNDWATER RIGHT HOLDERS



OREGON



WATER RESOURCES  
DEPARTMENT

2019 REVISION

*Originally printed September 1995,*

*Revised March 2011*

STATE OF OREGON

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## Introduction

### Oregon Law Regarding Pump Tests

Oregon law requires permitted well owners in the state to conduct pump tests of their wells and submit the results to the Water Resources Department. This law (ORS 537.772) was enacted by the 1987 Legislature to provide important statewide information on groundwater resources. Wells which must be tested under this law are all those which are listed as a source of water on a groundwater right permit, certificate, or registration statement with priority dates on or after December 20, 1988.

As a condition of certification, a pump test must be submitted before the ten-year anniversary of the priority date whether or not a certificate is issued within that time. No pump tests are required for domestic wells, stock wells, or other permit exempt wells (see ORS 537.545). Requirements for pump tests are outlined in Oregon Administrative Rules Chapter 690, Division 217 ([OAR 690-217](#)).

This document is intended to act as a guide for groundwater right holders in determining which wells need to be tested and how to conduct a test in order to comply with the rules.

### What is a Pump Test?

A pump test, also known as a well test or an aquifer test, provides valuable information on the water-bearing earth materials (or groundwater aquifers) penetrated by a well. It also provides information on the performance of the well. **A pump test is not really a test of the pump, but rather a test of the well and aquifer.**

This information, combined with information the well driller provides on the associated Well

Report for the well, can be used to determine how easily water moves through the ground and how efficiently the well produces water from the aquifer. When a well develops a problem, a pump test can provide clues as to whether the problem is caused by the well itself, the pumping and distribution system, or depletion of the aquifer.

A pump test consists of three phases. The **pre-pumping phase** includes several depth-to-water measurements made prior to pumping the well to determine any natural fluctuations in aquifer water level. The **pumping phase** of the test consists of pumping the well at a constant rate for a period of at least four hours. As the well is pumped, the water level will drop. During pumping, the depth to water is periodically measured and recorded. The **post-pumping or recovery phase** of the test occurs after the pump is turned off. After pumping stops, depth-to-water measurements continue at periodic time intervals as the water rises, or recovers, in the well. Minimum measurement time intervals during the pumping and recovery phases are specified in rule.

## Definitions and Abbreviations

### Abbreviations

**OAR:** Oregon Administrative Rules

**ORS:** Oregon Revised Statutes

### Definitions Applying to OAR 690, Division 217 (OAR 690-217-0010)

(1) **“Air Line”:** A tube or pipe installed in a well specifically for the purpose of determining the water level by measuring the air pressure required to purge it of water.

(2) **“Commission”**: Water Resources Commission.

(3) **“Electric Water Level Measuring Tape”** [**“etape”**]: A device manufactured specifically for measuring depth to water in wells and consisting of a reel, electric cable with permanent depth markings, and an indicating buzzer, light or meter.

(4) **“Electronic Pressure Transducer”**: A submersible electronic pressure sensing device designed and constructed specifically for measuring water levels, usually connected to an electronic device to display or record pressure data.

(5) **“Flowing Artesian Well”**: A well which penetrates an aquifer with sufficient pressure to cause water to flow from the well without pumping.

(6) **“Pump Test”**: A controlled procedure in which water is withdrawn from a well at a constant rate for a specified period of time and in which the water level in the well is measured at [minimum] specified intervals before, during and after pumping.

(7) **“Pump Test Report”**: The form provided by the Water Resources Department for reporting the results of pump tests required by ORS 537.772.

(8) **“Static Water Level”**: The distance between the water level in a well and ground [surface] when no water is being withdrawn from the well and the effects of previous withdrawals are no longer noticeable.

## Which Wells Need Testing

### Wells That Need to be Tested

Any well that is listed as the source of water on a groundwater right permit or certificate or on a groundwater registration statement is subject

to these requirements. The pump test requirements do not apply to domestic wells, stock wells, or any other permit exempt wells that do not require a water right. Additional exceptions to the requirements are listed below.

## Wells That May be Exempted

Under certain circumstances, some wells may be exempt from part or all of the pump test requirements. Well owners must submit all requests for partial or full exemptions from the pump test rules in writing to the Water Resources Department. (OAR 690-217-0020(3)).

## Multiple Well Exemptions

If a landowner has two or more wells which are within five miles of each other and which produce from the same aquifer, only one of the wells may have to be tested. In order to test only one of the wells, the owner must request an exemption for the others from the Water Resources Department. The request must include specific documentation, such as well logs, which are used to verify that the wells are producing from the same aquifer. A multiple well exemption can only be granted once a test has been approved. (OAR 690-217-0020(3))

Multiple well exemption requests must be submitted using the Department’s form which can be obtained on the [Department’s website](#).

## Unreasonable Burden Exemptions

If a well is the source of irrigation water for land temporarily taken out of production under a government program, the owner may request an exemption from the pump test requirements until crop production on the land is resumed.

In some cases, it will be extremely difficult or inconvenient to conduct a pump test that meets all of the Water Resources Department's requirements. In such cases, well owners may request an exemption from part of the requirements and/or a time extension. The

Water Resources Department will not grant an exemption if only minor modifications are needed such as installing an access port for water level measurement. The Department may verify by field inspection any claims that a well cannot be pump tested. (OAR 690-217-0015(3) through (5)).

Unreasonable burden exemption requests must be submitted using the Department's form, which can be obtained on the [Department's website](#).

## Other Exemptions

If a well has a diameter of greater than 36 inches and a depth less than 30 feet, an exemption may be requested.

Exemptions may also be requested for excavations that produce water from horizontal screens embedded in a gravel pack (infiltration galleries) or vertical caissons that produce water from a radiating system of horizontal casings or screens (collection wells). (OAR 690-217-0015(6) and (7)).

Please contact the Department if any of these apply to your situation.

## Relevant Dates and Deadlines

The deadline to submit a pump test depends on the priority date of the water right. Generally, the priority date is the date on which the application for the water right was originally filed. If the water right for a well was applied for on or after December 20, 1988, the owner must submit the results of a pump test before a water right certificate will be issued (OAR 690-217-0020(1) and (2)).

## Qualifications to Conduct Pump Tests

Pump tests must be conducted by qualified individuals. The well owner may conduct the test, or may designate another person to do the test as long as that person meets certain qualifications. The following persons are eligible to conduct these pump tests:

1. The owner of the well to be tested.
2. A full-time employee of the well owner who routinely works with and is familiar with wells and pumps.
3. Individuals whose primary occupation involves well pump installation, service or testing.
4. Individuals within the following professional groups, provided they have significant experience conducting pump or aquifer tests:
  - Registered geologists or engineering geologists
  - Licensed well drillers
  - Certified water rights examiners
  - Registered professional engineers

Well owners who decide to conduct the pump tests themselves should become thoroughly familiar with all the test requirements. These requirements are described in the Water Resources Department's administrative rules [OAR 690-217](#) and are summarized in this guide. Some specialized equipment is needed to conduct pump tests.

**If a test is submitted which does not meet all the requirements, it may not be accepted by the Water Resources Department.**

# Pump Test Specifications and Forms

## Forms and Required Information

Pump test forms can be found online at <https://www.oregon.gov/OWRD/Forms/Pages/default.aspx>.

Relevant forms include:

- Pump Test Form Cover and Data Sheet
- Pump Test Multiple Well Exemption Request Form
- Pump Test Exemption Request Form (Cases of unreasonable burden)

The main pump test form is the Pump Test Form Cover and Data Sheet, which must be used to report information about the test. Pump test exemption forms are to be filled out when requesting either a [multiple well exemption](#) or an [exemption due to an unreasonable burden](#). The unreasonable burden exemption form may also be used to submit [other exemption requests](#).

Mail pump tests or requests for exemptions to the Department [attention of the Certificate Support](#), or email to [WRD\\_DL\\_pumptestsupport@oregon.gov](mailto:WRD_DL_pumptestsupport@oregon.gov).

## Test Procedures

### Pre-pumping Phase

The well to be tested cannot be pumped for at least sixteen hours before testing begins. The depth to water in the well must be measured at least three times within the hour before testing begins. These readings must be taken at 20-minute intervals.

### Pumping Phase

The well must be pumped continuously at a constant rate for at least four hours during the pumping phase of the test. During pumping, the depth to water must be measured at timed

intervals as close as possible to the following schedule:

- For the first ten minutes of pumping, water level readings must be no more than two minutes apart.
- From ten to thirty minutes of pumping, readings must be no more than five minutes apart.
- From thirty minutes to four hours of pumping, readings must be no more than fifteen minutes apart.

During pumping, the discharge rate must remain as constant as possible and as close to the normal pumping rate of the well as possible. Discharge must be recorded at the beginning of the test and once an hour during pumping. If the water discharged during the pump test is not put to its normal beneficial use, it should be disposed of in an appropriate manner and not allowed to accumulate on the ground around the well.

### Post-pumping (Recovery) Phase

After the pump is turned off, the depth to water in the well must be measured while the water level "recovers" from pumping. After pumping, water level measurements must be taken for a period of four hours or until only ten percent of the maximum drawdown remains, whichever occurs first. "Drawdown" is the distance the water level is lowered as a result of pumping. Maximum drawdown generally occurs at the very end of pumping, just before the pump is turned off.

After pumping is stopped, the depth to water must be measured at time intervals as close as possible to the following schedule:

- For the first ten minutes after pumping stops, water level readings must be no more than two minutes apart.

- From ten to thirty minutes after pumping stops, readings must be no more than five minutes apart.
- From thirty minutes to four hours after pumping stops, readings must be no more than fifteen minutes apart.

## Water Level and Flow Rate Measurement Methods

Only certain methods are allowed for measuring the depth to water and the pump discharge. The depth to water must be measured using one of the following methods (modified from OAR 690-217-0045(1)):

(a) An **electric water level measuring tape** (“etape”) specifically designed for this purpose. Depth markings on the tape shall be no more than five feet apart, and shall be accurate to 0.5 percent. All water level measurements shall be reported to a *precision of at least one-tenth of a foot*.

(b) A **calibrated electronic pressure transducer** coupled with an appropriate output device or data logger. The accuracy and precision of the transducer and output device or data logger shall be accurate to 0.5 percent. All water level measurements shall be reported to a *precision of at least one-tenth of a foot*. If an electronic pressure transducer is used for water level measurement, *the manufacturer’s name, the serial number and calibration date of the device must be supplied in the pump test report*. At least one concurrent static water level measurement made with an etape or airline during the pre-test period, and at least one concurrent measurement near the end of the pumping phase of the test, should be submitted along with pressure transducer data in order to tie transducer data to a depth below ground surface.

(c) An **airline and pressure gauge**. Airline measurements shall be accepted only where

water levels deeper than *300 feet* below ground level are encountered or expected. Airline accuracy shall be verified by *at least one water level measurement with an electric water level measuring tape*. Measurements of airline pressure of shut-in pressure of flowing artesian wells shall be with a calibrated pressure gauge with marked intervals of one PSI or less (OAR 690-217-0045(2)).

(d) An **acoustic sounding device** designed and manufactured specifically for measuring the depth to water in wells. The accuracy of the acoustic sounder should be verified by measuring the water level with an electric tape at least once before the test (not in the rules). . At least one concurrent static water level measurement made with an etape or airline during the pre-test period, and at least one concurrent measurement near the end of the pumping phase of the test, should be submitted along with acoustic sounder data in order to verify the accuracy of the sounder. *The manufacturer’s name, the serial number and calibration date of the device should be supplied in the pump test report*.

(e) The **wetted steel tape method**. This method may be used for *static water level* measurements only.

Other methods to measure depth to water may be approved by the Water Resources Department if requested in writing prior to the pump test.

Pump discharge must be measured by one of the following methods (modified from OAR 690-217-0045(3)):

(a) A properly installed **flow meter** which is functional and calibrated within reasonable limits. Permanently or temporarily installed mechanical flow meters may be used provided they are installed according to the



manufacturer's specifications and are properly calibrated.

(b) A properly installed **weir** or **flume**. The type of device must be specified and the methods used for calculations must be provided.

(c) A properly installed calibrated orifice plate and manometer.

(d) Known **volume/time calculations** (including calibrated bucket and stopwatch up to 60 gallons per minute). Determining the flow rate by measuring the amount of time it takes to fill a known volume is acceptable. A 5-gallon bucket may be used if the flow rate is 60 gallons per minute or less. A 55-gallon drum may be used if the flow rate is greater than 60 gallons per minute.

(e) Properly used **ultrasonic flow measuring devices** according to the manufacturer's specifications.

Other methods to measure pump discharge may be approved by the Water Resources Department if requested in writing **prior** to the pump test.

## Flowing Artesian Wells Pre-Pumping Phase

If the well to be tested is a flowing artesian well<sup>1</sup> with a pump (OAR 690-217-0030), the well must be shut in for at least 16 hours before testing begins. In addition, the shut-in pressure must be measured at least three times, at 20-minute intervals, within the hour before testing begins. For a flowing artesian well without a pump that is normally used in an open discharge fashion (OAR 690-217-0035), the well must be shut in for at least 16 hours prior to the

test and the shut-in pressure must be recorded within the hour prior to the test.

## Pumping/Flowing Phase

If the well to be tested is a flowing artesian well with a pump, the pumping phase should be conducted in the same manner as for non-flowing wells, however; the method of measurement for water levels above ground level need to be recorded using a pressure gauge. Results should be reported as pounds per square inch (PSI). If the water level drops below ground level (pressure drops below zero PSI), water levels must be measured by one of the methods listed above in the section on water level and flow rate measurement methods. Because flowing artesian wells require special testing procedures, the Water Resources Department encourages well owners to contact the Department for guidance in the testing of these wells.

If the well is a flowing artesian well without a pump, the well should be allowed to flow for at least four hours, during which time the flow rate should be measured and kept as constant as possible.

## Post-pumping (Recovery) Phase

If the well to be tested is a flowing artesian well with a pump, the well should be shut-in once the water level has recovered to ground level and before the well begins to flow freely again. After shut-in, several pressure readings should be taken at 15-minute intervals until the pressure stabilizes.

After the flowing period for a flowing artesian well without a pump, the well should be shut in and the pressure build-up recorded on the same schedule as water level recovery data collection in non-flowing well tests. Pressure

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<sup>1</sup> A flowing artesian well is a well that will freely flow water, without the use of a pump, when the well head is open to the atmosphere.

build-up must be recorded for four hours or until the pressure reaches 95 percent of the pre-test shut-in pressure.

## Nearby Wells and Streams

In order to determine the possible effects of surface water sources on pump test results, it is important to note nearby streams, lakes or ponds within one quarter of a mile of the tested well (OAR 690-217-0040(1)). The pump test form has a space to enter the approximate distance between the well and the surface water body and the approximate elevation difference between the surface water and the ground level at the well.

In order to determine the possible effects of the pumping of any nearby wells on the pump test, it is important to note any wells you are aware of within one thousand feet of the tested well that are pumping large amounts of water (OAR 690-217-0040(2)). This does not include domestic or stock wells, since they usually produce only small amounts of water. If pumping from a nearby well started or stopped during the test or within 24 hours prior to the test, the time the pumping started or stopped should be included on the pump test report if known or available. The pump test form has a place for you to enter any information you have about pumping of nearby wells during or immediately prior to the test.

## Submitting a Test Pre-Submittal Checklist

The following checklist can be used as a tool to evaluate the test for completeness and compliance under OAR 690-217 prior to submittal. It is important to note that this list is intended for information purposes only and does not guarantee a pump test approval. The Department reserves all authority pertaining to

the implementation of the rules under OAR 690-217.

- ✓ The discharge rate was held constant for the entire pumping phase.
- ✓ The pump was on during the entire pumping phase ( $\geq 4$  hours).
- ✓ The discharge was measured at the start of pumping and at least once every hour during the test.
- ✓ Water levels were measured to an accuracy of 0.1 feet or 0.5 percent.
- ✓ Pre-test static water levels were measured at least three times in the hour before pumping began at no less than 20 minutes apart.
- ✓ Water levels were measured at the specified intervals during the pumping phase of the test for at least four hours ( $\leq 2$  min for the first 10 minutes,  $\leq 5$  min for 10 – 30 minutes, and  $\leq 15$  min for the remainder of the test)
- ✓ Water levels were measured at the specified intervals (see above) during the recovery phase of the test for four hours or until 90 percent of the maximum drawdown has recovered.
- ✓ If using an airline, measurements were calibrated with an E-Tape and the depth to water was  $\geq 300$  feet.
- ✓ The pump test cover sheet was not completely filled out and signed.
- ✓ The pumping rate was as close as reasonably possible to the (anticipated) pumping rate during normal use of the well.
- ✓ The well was idle for at least 16 hours prior to the test.
- ✓ The pump test was completed by an acceptably qualified person (Oregon licensed water well constructors; Oregon registered professional geologists or certified engineering geologists; certified water rights examiners; Oregon registered professional engineers; and individuals

whose primary occupation involves, wholly or in significant part, pump installation, service, or testing).

## Submittal

Send hard copies of completed forms to:

Attn: Certificates Section  
Oregon Water Resources Department  
725 Summer St NE Suite A,  
Salem, OR 97301

Pump test forms may also be submitted electronically to [WRD\\_DL\\_pumptest.support@oregon.gov](mailto:WRD_DL_pumptest.support@oregon.gov).

## Technical Evaluation

Pump tests under OAR 690-217 are intended to provide aquifer and well information for groundwater resource characterization and to help solve well problems. Tests are evaluated based on compliance with the requirements defined in the rules, but each test is additionally evaluated for its ability to satisfy the intent of the rules.

Pump tests, or single-well aquifer tests, can be used to estimate the transmissivity of an aquifer. Transmissivity is a measure of the ease with which an aquifer can transmit water. Pump test information can also help to identify well interference with other wells and surface water bodies and to infer aquifer geometry and/or recharge sources.

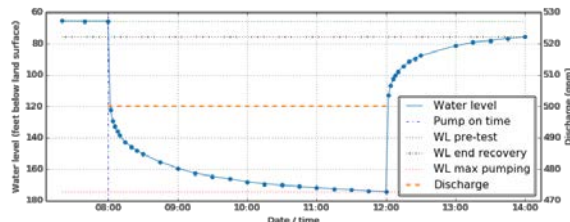
The Department uses pump test data in groundwater application reviews when evaluating for potential impact on surface water supplies and in evaluating for potential well or aquifer problems as a result of a submitted interference complaint. These tests are also used in groundwater modeling and basin studies. The results of these tests are useful for

making conjunctive groundwater/surface water management decisions.

Well owners can benefit from the results of pumping tests. Specific capacity, estimated by dividing pumping rate by drawdown, can be used to evaluate well performance. Changes in specific capacity can be diagnostic of performance deterioration due to sedimentation, collapse, corrosion, or biofouling of the well. Pump test information can also be useful in estimating the maximum potential pumping rate of a well given available drawdown and in estimating the duration of continued pumping under declining water level conditions.

## Test Examples

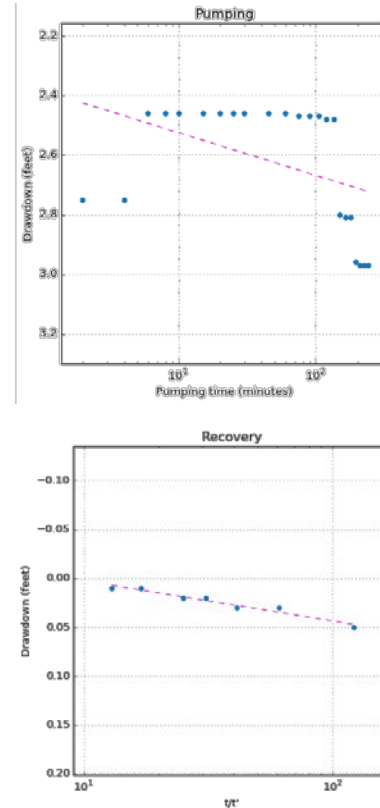
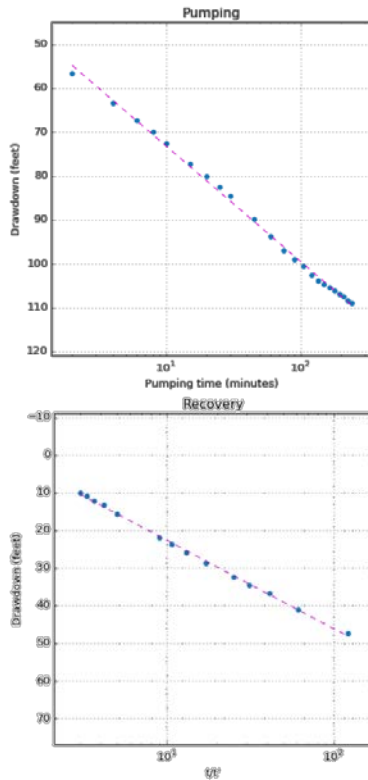
To estimate aquifer transmissivity at a well, time since the start of pumping is plotted against water level drawdown. The resultant plot generally looks something like this:



Note that the water level remains static prior to the start of pumping and then drops at a decreasing rate, forming a curve. This curve can be plotted as log time vs. drawdown to form a near-straight line. The slope of this line is used to estimate transmissivity using the Cooper-Jacob approximation of the Theis solution for non-steady flow in a confined aquifer.<sup>2</sup> The recovery-phase data is likewise plotted.

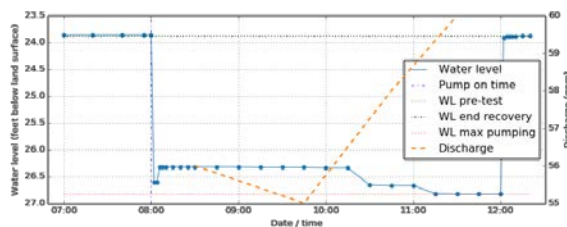
<sup>2</sup> Cooper, H.H. Jr. and C.E. Jacob, 1946. A generalized graphical method for evaluating formation constants and summarizing well-

field history. *Transactions, American Geophysical Union* 27:526-34.



Variations in these curves can be used in determining the type of aquifer (confined, unconfined) and any flow boundaries<sup>3</sup>. Transmissivity is calculated using the pumping rate and drawdown over one log-cycle. A poor-quality test may look something like the example below, where pumping rate was not held constant.

The water levels during the pumping phase show a sharp dip at the beginning of the test followed by a variable rate of drawdown. Although the recovery-phase curve looks relatively stable, the variable pumping rate does not allow for an accurate estimation of transmissivity.



## Bonus Reporting

Pump test data are of little value if well location and construction are unknown. The Department requests that as much information as possible is reported regarding well and water right information. Collecting and reporting the following information may aid in the processing of your pump test:

- Identify Well Log ID and Well Tag if possible
- If not, gather independent well construction information such as:

<sup>3</sup> Kruseman, G.P. and N.A. DeRidder, 1991. Analysis and Evaluation of Pumping Test Data, 2d ed., International Association for Land

Reclamation and Improvement, Publication 47, Wageningen, The Netherlands

- Sounded Depth
- Casing diameter
- Original owner
- Collect a GPS location
- Well history such as:
  - Does this owner have multiple wells?
  - Has this well ever been deepened or altered? By whom?
  - Does the owner have a name for this well?

The following methods are welcome as they generally provide higher-quality data that can be used in aquifer and well information.

- Collect water levels in multiple wells (multi-well aquifer test)
- Conduct test over a longer period than required
- Collect high-frequency water level data with a pressure transducer (in addition to manual data)
- Measure discharge on the same frequency as water levels, including both instantaneous rate and totalizer
- Record water level measurements with exact time of measurement (to the nearest second)
- Water level measurements taken with greater resolution < 2 minutes for the first ten minutes of both the pumping and recovery phases
- Water level measurements taken every 20 minutes within the 2-3 hours leading up to the test
- Measuring recovery water levels up to 95% or 100% recovery

## Additional Information

If you would like additional information about pump test requirements, would like to find out if and when you need to submit the results of a

test, or would like copies of the pump test form, please contact:

Attn: Certificate Support  
OREGON WATER RESOURCES DEPARTMENT  
725 Summer St NE, Suite A  
Salem, Oregon 97301-1271  
Phone: (503) 986-0900

Or email:  
WRD\_DL\_pumptestsupport@oregon.gov

## References and Links

### **Pump test forms:**

<https://www.oregon.gov/OWRD/Forms/Pages/default.aspx?wp9511=se:%22pump+test%22>

<https://www.oregon.gov/OWRD/programs/GW/WL/GW/Pages/PumpTestProgram.aspx>

### **Pump test administrative rules:**

<https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=3186>