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Australian Standard®

Test pumping of water wells

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- Association of Consulting Engineers Australia
- Australian Drilling Industry Association
- CSIRO, Division of Water Resources
- Department of Mines and Energy, South Australia
- Department of Water Resources, New South Wales
- Department of Water Resources, Victoria
- Geological Survey, Western Australia
- Hunter District Water Board
- Institution of Engineers Australia
- Rural Water Commission, Victoria
- University of New South Wales
- Water Authority of Western Australia
- Water Resources Commission, Queensland

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PREFACE

This Standard was prepared by the Standards Australia Committee on Test Pumping Water Wells. In preparing this Standard, the committee considered BS 6316:1983, *Code of practice for test pumping water wells*.

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FOREWORD

A pumping test is a means of obtaining quantitative information about groundwater systems and the wells which obtain water from them. The test is based on a period of pumping and recovery during which the pumping rate, water level in the well, and elapsed time, are measured.

The test can be used to —

(a) assess the hydraulic behaviour of a well and so determine its usefulness as a source of water, predict its performance under different pumping regimes, and enable determination of the most suitable pump and optimum intake depth; and

(b) determine the hydraulic properties of the groundwater system penetrated by the well, i.e. the transmissivity, storativity, and the presence, type, and distance of any hydraulic boundaries.

A pumping test also provides an opportunity to obtain information on water quality and its variation with time and perhaps with discharge rate.

When water is pumped from a well, the head in the well is lowered, creating a drawdown and setting up a localized hydraulic gradient which causes water to flow to the well from the surrounding aquifer. The head in the aquifer is also reduced and the effect spreads outwards from the well. A cone of depression of the potentiometric surface is thus formed around the well, and the shape and the manner of extension of this cone depends on the pumping rate and on the hydraulic properties of the aquifer. By recording the changes in the potentiometric head in observation wells located around the pumping well, it is possible to monitor the growth of the cone of depression and determine these hydraulic characteristics. Immediately around the well, the form of the cone of depression will generally be modified because additional head losses are incurred as the water crosses the well face. The drawdown in the well (head loss) may be considered to consist of the following two components:

(i) Head loss through the aquifer.

(ii) Head loss at the well.

Consequently there are two test objectives, viz an understanding of the characteristics of the well and of those of the aquifer.

A test may be performed to serve one or both of the main objectives. If both are satisfied it may be said that the hydraulic regime of the well and aquifer has been evaluated. It needs to be understood, however, that to predict the long-term effects of abstraction, other information will be required, particularly about factors affecting recharge to the groundwater system.

There are inherent difficulties involved in carrying out a pumping test, for example, wells drilled to investigate the hydraulic regime of an aquifer may disturb that regime by providing vertical connection between aquifers with different hydraulic head conditions. A second difficulty involves sampling. Only rarely will a cone of depression be circular and symmetrical; the relatively few observation wells which are usually available provide, in effect, a limited number of sampling points with which to determine the form of the cone. It is important that these limitations and difficulties are kept clearly in mind when designing and analyzing a pumping test and, in particular, when using the results.

A pumping test provides a basis from which quantitative information on aquifer properties can be obtained and proper decisions can be made for equipping and using a well as the source for a water supply. Wrong decisions can lead to the selection of incorrect pumps, less than optimum pumping schedules, and in the extreme, failure of the well to provide the expected quantity of water. Many well owners tend to save costs by skimping on the pumping test or even deciding not to have one. This is a risky course of action. Expenditure on the pump test will usually be a small proportion of the cost of construction and equipment of the well, and will be small compared with the cost of failure to deliver at the expected rate after it has been put into production. Well owners are encouraged to allocate sufficient funds for a comprehensive pumping test which can be used as a reliable basis for prediction of future performance.

STANDARDS AUSTRALIA

Australian Standard

Test pumping of water wells

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE. This Standard describes the factors which need to be considered and the measurements which need to be made when designing and performing a pumping test. It deals with the types of pumping tests carried out for water supply purposes, or aquifer parameter determinations in which water is abstracted from the entire screened, perforated, or unlined interval(s) of a well. Some guidance is also provided on slug tests and packer tests. Other specialized tests, such as drill-stem tests, and tests of strata for engineering purposes, are not considered in detail.

Interpretation of the data collected during a pumping test is referred to in this Standard only in a general way. For full details of the analysis and interpretation of test data, reference should be made to specialized texts.

1.2 REFERENCED DOCUMENTS. The following documents are referred to in this Standard:

ISO

1438/1 Water flow measurement in open channels using weirs and Venturi flumes
Part 1: Thin-plate weirs

5167 Measurement of fluid flow by means of orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full

BS

5930 Code of practice for site investigations

1.3 DEFINITIONS. For the purpose of this Standard, the definitions below apply (see also Figure 1.1).

1.3.1 Abstraction-removal of water from a well or aquifer.

1.3.2 Access tube—a pipe inserted into a well to permit installation of instruments, and to safeguard them from touching or becoming entangled with the pump or other equipment in the well.

1.3.3 Anisotropic—having some physical property that varies with direction.

1.3.4 Annulus—the space between the rising main and the casing, or between the casing and the wall of the well.

1.3.5 Aquiclude—a geologic formation, group of formations, or part of a formation through which virtually no water moves.

1.3.6 Aquifer—geologic formation, group of formations, or part of a formation capable of transmitting and yielding significant quantities of water.

1.3.7 Aquifer loss (formation loss)—the head loss at a pumped or flowing well associated with groundwater flow through the aquifer to the well face.

1.3.8 Aquifer properties—the characteristics of an aquifer that determine its hydraulic behaviour and its response to abstraction.

1.3.9 Aquitard—a saturated, but relatively poorly permeable bed, formation, or group of formations that does not transmit or yield water freely.

1.3.10 Boundary—a lateral discontinuity or change in the aquifer resulting in a significant change in hydraulic conductivity, storativity, or recharge.

1.3.11 Casing—a tube used as temporary or permanent lining for a well.

1.3.12 Confined aquifer—a completely saturated aquifer in which the upper and lower boundaries are relatively impermeable layers (aquitards or aquicludes). The groundwater is contained under sufficient pressure to cause it to rise above the aquifer if the top impermeable layer is breached.

1.3.13 Confining bed—a layer of relatively impermeable material underlying, overlying, or adjacent to one or more aquifers.