Aquifer Pumping Tests

Design, Field Procedures, Data Analysis and Sustainable Yield Assessment — a 2-Day Professional Training Programme

DATES	CPD POINTS	FORMAT
29–30 October 2026	2 CPD Points	Online or In-Person

O ATTEND REMOTELY — Live Online Training	R 8 999 per delegate
H IN-PERSON — Birchwood Hotel, Boksburg	R 9 999 per delegate

Course Overview

Aquifer pumping tests are among the most important investigations used to characterise groundwater systems, evaluate production-borehole performance and support groundwater-resource development. A properly designed and interpreted test reveals an aquifer's hydraulic behaviour, borehole efficiency, well losses, hydraulic boundaries and its response to abstraction.

In South Africa, **SANS 10299-4:2003** provides the standard framework for test-pumping of water boreholes. This course also draws on established South African research on fractured-rock aquifers and the Flow Characteristics (FC) method.

CONCEPTUALISE → DESIGN → TEST → PROCESS → ANALYSE → DIAGNOSE → ASSESS YIELD → REPORT

Run as a professional survey with guided analytical practice, the programme is theory-led, data-driven and application-focused, using realistic pumping-test datasets, worked examples and integrated case studies. No physical fieldwork is required.

Who Should Attend

- Hydrogeologists & Geohydrologists
- Groundwater Consultants
- Civil & Water-Supply Engineers
- Environmental Consultants
- Groundwater-Resource Managers
- Borehole Development Specialists
- Water-Use Licence Practitioners
- Pumping-Test Technicians

Course Objectives

- ✓ Understand groundwater occurrence, flow and storage across South Africa's principal fractured-rock and other aquifer systems
- ✓ Build a conceptual model of an aquifer before designing a test, and use it to select the right test type and analytical approach
- ✓ Design and justify a step-drawdown, constant-discharge and recovery test programme in line with SANS 10299-4:2003
- ✓ Recognise the field and instrumentation choices that determine data quality
- ✓ Assess borehole performance — specific capacity, well losses and efficiency — distinct from aquifer-parameter testing
- ✓ Process and quality-check a pumping-test dataset, and build and read standard diagnostic plots, including derivatives
- ✓ Apply Theis and Cooper-Jacob analysis, and know when their underlying assumptions do and don't hold
- ✓ Recognise the hydraulic behaviour of confined, unconfined, leaky and fractured-rock aquifers, and identify boundary effects
- ✓ Apply the Flow Characteristics (FC) method used in South African fractured-rock practice, and explain its limitations
- ✓ Distinguish tested, operational and sustainable yield, and translate results into a defensible technical recommendation

DAY 1: Design, Field Testing & Data Quality — Modules 1 to 7

1 Groundwater and Aquifer Fundamentals

- Groundwater occurrence, movement, recharge and discharge; hydraulic gradients and flow systems
- Groundwater–surface-water interaction; groundwater storage and abstraction
- Aquifer classification: unconfined, confined, leaky, perched, porous-media, fractured-rock, karst
- South African environments: Karoo, Basement, dolomite/karst, Table Mountain Group
- ★ *Key parameters: hydraulic conductivity, transmissivity, storativity, specific yield and specific capacity*

2 Conceptualising the Aquifer Before Testing

- Building a conceptual model: geological setting, aquifer geometry, lithology, water-bearing zones
- Recharge/discharge mechanisms, hydraulic boundaries, faults and fractures
- Using existing information: geological maps, borehole logs, drilling records, prior tests
- ★ *Core principle: the analytical method must fit the aquifer, not the other way around*

3 Principles and Objectives of Aquifer Pumping Tests

- Why conduct a pumping test: productivity, characterisation, parameter estimation, boundaries
- Borehole performance testing versus aquifer-parameter estimation — the key distinction
- Principal test types: step-drawdown, constant-discharge, recovery
- ★ *Brief overview of multi-well/interference testing and slug testing*

4 Pumping-Test Design and Planning

- Defining investigation objectives; reviewing hydrogeological and borehole records
- Establishing expected yield and selecting the test sequence, rates and duration
- Design factors: aquifer type, pump capacity, nearby boreholes, existing abstraction
- ★ *Designing the monitoring network: pumping borehole, observation boreholes, piezometers*

5 Equipment, Instrumentation & Field Data Quality

- Test-pump selection, sizing and installation; discharge pipework and flow control
- Water-level measurement: manual/electronic meters, pressure transducers, data loggers
- Discharge measurement; measurement frequency and reference-datum control
- ★ *Recognising field data-quality issues: calibration drift, timing errors, interference*

6 Step-Drawdown and Constant-Discharge Testing

- Step-drawdown: assessing productivity, specific capacity, well losses and efficiency
- Constant-discharge: selecting the rate and linking duration to the investigation objective
- Monitoring for delayed responses and boundary effects as the test matures
- ★ *SANS 10299-4:2003 step counts, durations and tolerances provided as a reference handout*

7 Recovery Testing

- Principles: residual drawdown, recovery monitoring, recovery duration and curves
- Recovery as an independent check on aquifer response
- Comparing pumping-phase and recovery-phase results
- ★ *Recognising incomplete recovery as a sign of boundary or storage effects*

DAY 2: Analysis, Diagnostics & Decision-Making — Modules 8 to 14

8 Pumping-Test Data Processing & Quality Control

- Assembling the dataset: water levels, drawdown, discharge, elapsed time, recovery
- Data-quality assessment: missing data, outliers, timing errors, background influences
- ★ *Building diagnostic plots: drawdown vs. time, semi-log, log-log and recovery plots*

9 Classical Analysis: Theis and Cooper-Jacob

- Theis type-curve method and its assumptions; Cooper-Jacob straight-line approximation
- Estimating transmissivity and storativity
- Cross-checking Theis versus Cooper-Jacob, and pumping- versus recovery-phase estimates
- ★ *Key principle: a mathematically correct calculation can still mislead if the aquifer doesn't satisfy the method's assumptions*

10 Diagnostic Interpretation and Flow Regimes

- Drawdown derivatives and log-log diagnostic plots; early-, intermediate- and late-time behaviour
- Recognising wellbore storage, skin effects, radial versus linear and fracture-controlled flow
- Recognising leakage, recharge/no-flow boundaries, heterogeneity and anisotropy
- ★ *Strong for boundary identification, risky if late-time behaviour is over-extrapolated*

11 Aquifer-Specific Interpretation

- Confined aquifers: radial flow and late-time response
- Unconfined aquifers: delayed drainage, specific yield, why confined solutions can mislead
- Leaky aquifers: aquitards and leakage signatures
- ★ *Fractured-rock aquifers: dual-porosity flow, discrete water strikes, non-radial behaviour*

12 Flow Characteristics (FC) Method & Its Limitations

- Background: purpose of the FC approach, South African development and application
- Applying FC: drawdown derivatives, flow-regime identification, long-term yield extrapolation
- Critical evaluation: assumed boundary conditions, distance and storativity uncertainty
- ★ *2024 Water SA review findings: FC is one line of evidence, not a stand-alone yield calculator*

Tested Yield vs Sustainable Yield

A recurring theme through Modules 13 and 14: **TESTED YIELD → OPERATIONAL YIELD → SUSTAINABLE ABSTRACTION**. A pumping test establishes the first two with confidence; sustainable abstraction also depends on recharge, boundaries, storage, interference and long-term monitoring that a single test cannot provide alone.

13 Borehole Yield, Available Drawdown & Sustainable Abstraction

- Distinguishing tested, maximum instantaneous, recommended operating and sustainable yield
- Available drawdown: static water level, pump setting, main water strike, minimum operating level
- What determines sustainable abstraction: recharge, boundaries, storage, interference, drought
- ★ *Why a pumping test alone doesn't determine long-term sustainability*

14 Integrated Case Studies and Reporting

- Case Study 1 – Production Borehole: specific capacity, efficiency, operating conditions
- Case Study 2 – Fractured-Rock Aquifer: derivative diagnostics, boundaries, FC application
- Case Study 3 – The Imperfect Dataset: what can and can't be concluded from incomplete data
- ★ *Folding findings into a professional report: methodology, parameters, yield, limitations*

Registration Form

Aquifer Pumping Tests | 29–30 October 2026 | Online or Birchwood Hotel, Boksburg

R 8 999 Online
R 9 999 In-Person

ATTENDANCE OPTION

☐ **LIVE ONLINE — Online Training — R 8 999 per delegate**

☐ **IN-PERSON — Birchwood Hotel, 44 Viewpoint Rd, Bartlett, Boksburg — R 9 999 per delegate**

ON COMPLETION, DELEGATES RECEIVE A CERTIFICATE OF ATTENDANCE AND 2 VERIFIABLE CPD POINTS

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