TECHNISCHE UNIVERSITÄT DRESDEN
INSTITUTE OF GROUNDWATER MANAGEMENT

TEACHING · RESEARCH · COLLABORATION

Groundwater Observatory

A digital, open-access groundwater test field for applied hydrogeology — where 18 years of monitoring, deep-to-shallow well infrastructure and interactive dashboards meet research, teaching and collaboration.

Pirna-Copitz • Saxony, Germany • Est. 2008

25+	50+	18+	100%
Digital dashboards	Monitoring points	Years of data	Free & open access

A field site of the Institute of Groundwater Management · TU Dresden

groundwater-observatory.com

Groundwater monitoring wells at the Teaching & Research Observatory in Pirna-Copitz, with the institute's external campus beyond.

WELCOME TO THE OBSERVATORY

An open field site for applied hydrogeology

Operated by TU Dresden's Institute of Groundwater Management since 2008 — and established together with the Helmholtz Centre for Environmental Research (UFZ) — the observatory is a working groundwater test field 20 km from the main campus. It demonstrates a broad range of established hydrogeological experiments and serves as a proving ground for new methods, strengthening international networking around the sustainable management of groundwater, the world's most important source of drinking water.

EXPERIMENT

Research

Digital tools for groundwater modelling, data visualisation, scenario evaluation and innovative groundwater-management research.

LEARN

Education

Interactive resources, training materials and hands-on tools for teaching, capacity development and course design.

CONNECT

Collaboration

Shared data and modelling platforms connecting researchers and professionals around groundwater research and innovation.

SITE CHARACTERISATION

The observatory sits on TU Dresden's external campus in Pirna-Copitz, directly bordering the river Elbe (50–150 m away). The instrumented area covers about 2.5 hectares — roughly 140 × 180 m — on terrain that falls toward the river from around 119 to 111 m above sea level. This riverside setting makes it a living laboratory for river–groundwater interaction, where the Elbe's stage governs local levels and can reverse the direction of flow.

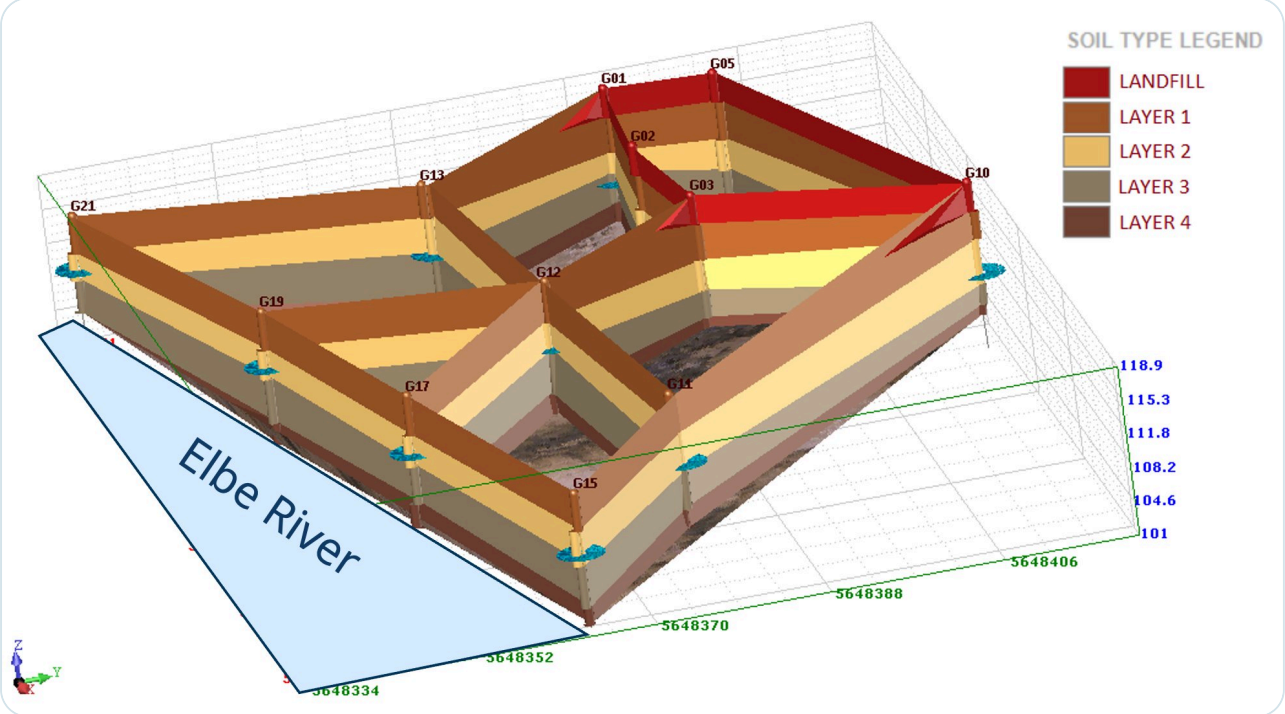
SITE AT A GLANCE

Location	Pirna-Copitz, Saxony
Operating since	2008
Distance to Elbe	50–150 m
Instrumented area	~2.5 ha
Footprint	≈140 × 180 m
Elevation	119 → 111 m a.s.l.
From TUD campus	20 km

THE GROUND BENEATH THE SITE

A heterogeneous aquifer shaped by the Elbe

The upper Quaternary unconsolidated aquifer consists of heterogeneous fluvial deposits. Beneath anthropogenic fill — up to about 2 m deep — highly conductive sands and gravels, threaded with silty lenses, reach depths of around 16 m. Below lies a 50–60 m clayey-silty aquitard of the upper Cretaceous (Pläner), and beneath that a confined chalk/sandstone aquifer (quartz/quartzitic sandstone) capped by a sealing Plenus-base claystone.



3D subsurface model across the monitoring-well grid (G01–G21): the capped landfill and four geological layers, with the Elbe River to the southwest. Elevation in metres above sea level.

Groundwater sits about 7 m below ground on average, fluctuating between 4 and 10 m. Because levels track the Elbe so closely, flow directions vary: once the river rises above 2.5 m (≈110.5 m a.s.l.), conditions reverse and groundwater flows from northeast to southwest — with velocities reaching up to 2 m per hour.

~7 m
Average depth to groundwater (range 4–10 m)

2 m/h
Peak groundwater flow velocity

~16 m
Thickness of the upper sand & gravel aquifer

WHY THIS SITE MATTERS

Few field sites combine a highly dynamic, river-coupled shallow aquifer with a deep confined system in one compact, fully instrumented footprint. That contrast lets researchers and students observe transport, mixing and recharge processes — and the absence of interaction across the aquitard — side by side.

FROM SHALLOW SENSORS TO DEEP WELLS

A fully instrumented test field

The observatory's installations span the full depth of the local aquifer system — from dense shallow direct-push sensors to production wells and a deep well reaching the Cretaceous, each enabling a distinct family of experiments.

41	7	2	1	100
1″ direct-push points	5″ multiparameter wells	10″ production wells	55 m deep well	m^3/h pump capacity

×41

1" direct-push points

26 points to 14 m with level sensors, plus 15 in the central area for tracer monitoring

ENABLES

- Flow-field characterisation in the upper aquifer
- Pump-free sampling demos (bailers, foot-valve pumps)
- Dense monitoring of tracer tests

×7

5" groundwater wells

14 m deep (screened 10–13 m); multiparameter probes: level, O_2, EC, pH

ENABLES

- Stable-isotope tracer tests (^{18}O, deuterium)
- Pneumatic slug tests for depth-resolved K
- Reactive transport & managed aquifer recharge

×2

10" production wells

Full aquifer thickness (screened 10–14 m); gravel vs. glass-bead filters; pumps to 100 m^3/h

ENABLES

- Pumping tests with analytical evaluation
- Comparative well-ageing & regeneration studies
- Elbe bank-filtrate abstraction & solute studies

×1

5" deep well — Cretaceous

To 55 m (screened 50–53 m) in the Pläner aquitard; semi-confined conditions

ENABLES

- Comparative water quality (ions, isotopes, temperature)
- Cross-aquifer (non-)interaction studies
- Pumping tests under semi-confined conditions

On-site weather station

Records air temperature, air pressure, relative humidity, precipitation, and wind speed & direction to characterise the site's climatic setting — and to link rainfall directly to groundwater response.

PUT TO WORK

Featured research projects

The infrastructure has underpinned competitively funded research spanning tracer hydrology, decision-support modelling and real-time control of managed aquifer recharge.

Rain as a groundwater tracer DFG

Using natural rainfall signals as a tracer to study recharge and transport through the unsaturated zone into the shallow aquifer.

Binder et al. (2019) · Tritschler et al. (2019)

INOWAS BMBF

An innovative web-based decision-support system for water sustainability under a changing climate, with groundwater-management modelling tools.

Barquero et al. (2019)

SMART CONTROL BMBF

A smart framework for real-time monitoring and control of subsurface processes in managed aquifer recharge applications.

Glass et al. (2022)

USE & COOPERATION OPPORTUNITIES

- **Training & CPD courses** — e.g. mine-hydrology monitoring and international summer schools.
- **Institutional partnerships** — collaboration with UFZ, HTW Dresden and others.
- **Hydrogeological experiments** — a broad range of field tests within research projects.
- **Student training** — hands-on demonstration of established and emerging methods.

EXPLORE THE DATA

25+ digital dashboards, free for everyone

Interactive dashboards turn historical and real-time monitoring into tools for research and learning — from groundwater levels and water quality to recharge, tracer tests and the live health of the sensor network.

1 **Hydrogeological monitoring**
Historical and real-time groundwater levels across the monitoring wells.

2 **Water quality monitoring**
Quality parameters in groundwater and nearby surface water (river Elbe).

3 **Vadose zone monitoring**
Soil moisture and related parameters measured in the unsaturated zone.

4 **River–groundwater interaction**
Compare groundwater levels against the Elbe's stage, live and historical.

5 **Climate vs. groundwater**
Weather-station and hydrogeological data: rainfall versus groundwater response.

6 **Groundwater modelling**
Results of modelling work at the test field, including MODFLOW and others.

7 **Managed aquifer recharge**
Infiltration rates, recharge volumes and groundwater response during events.

8 **Pumping & recovery tests**
Drawdown and recovery curves with observation-well responses.

9 **Direct-push injection logging**
Vertical profiles of hydraulic conductivity, with examples from the site.

10 **Tracer tests**
Concentrations, flow rates, breakthrough curves and inter-well travel times.

11 **Sensor & IoT infrastructure**
Health of the network: battery status, failure alerts and performance.

12 **Custom dashboards**
Cross-site comparisons, publication-ready reports, tables and analytics.

TAKE A VIRTUAL TOUR

Step onto the field site with an immersive 360° virtual tour — explore its features and monitoring techniques without leaving your desk.

OPEN & REUSABLE

All dashboards and datasets are 100% free and openly licensed (CC BY 4.0), ready to reuse in teaching, research and capacity-building.

FROM THE FIELD TO THE LITERATURE

Selected publications

A selection of peer-reviewed research grounded in work carried out at the observatory — from managed aquifer recharge to hydraulic characterisation and web-based modelling.

2022 Glass, J., Junghanns, R., Schlick, R. & Stefan, C. **The INOWAS platform: a web-based numerical groundwater modelling approach for groundwater management applications.** *Environmental Modelling & Software, 155, 105452.*

2019 Fichtner, T., Barquero, F., Sallwey, J. & Stefan, C. **Assessing managed aquifer recharge processes under three physical model concepts.** *Water, 11(1), 107.*

2019 Barquero, F., Fichtner, T. & Stefan, C. **Methods of in-situ assessment of infiltration rate reduction in groundwater recharge basins.** *Water, 11(4), 784.*

2018 Sallwey, J., Glass, J. & Stefan, C. **Utilizing unsaturated soil zone models for assessing managed aquifer recharge.** *Sustainable Water Resources Management, 4(2), 383–397.*

2016 Händel, F., Binder, M., Dietze, M., Liedl, R. & Dietrich, P. **Experimental recharge by small-diameter wells: the Pirna, Saxony, case study.** *Environmental Earth Sciences, 75(10), 1–8.*

2012 Dietze, M. & Dietrich, P. **Evaluation of vertical variations in hydraulic conductivity in unconsolidated sediments.** *Ground Water, 50(3), 450–456.*

VISIT · PARTNER · LEARN

Come and explore the observatory

Engage with the site through research collaboration, teaching partnerships or a guided visit. The test site is open to visitors by appointment.

groundwater-observatory.com →

FIND US

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