



**THE FIRST
MONITORING
CHANNEL**



PIEZOMETERS

— WHAT IS A PIEZOMETER?



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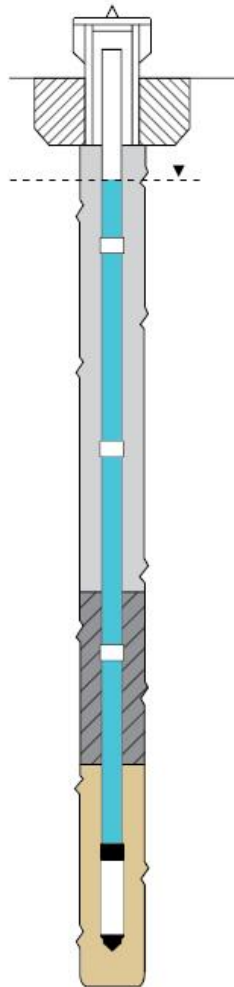
Piezometers are used extensively in the field of civil and foundation engineering to monitor groundwater level or pore water pressure in fully or partly saturated soils.

The main feature that characterizes a piezometer is the water quantity needed to obtain a measurement: the smaller the quantity, the faster the response time for measuring pore pressure variations in low permeability soil.

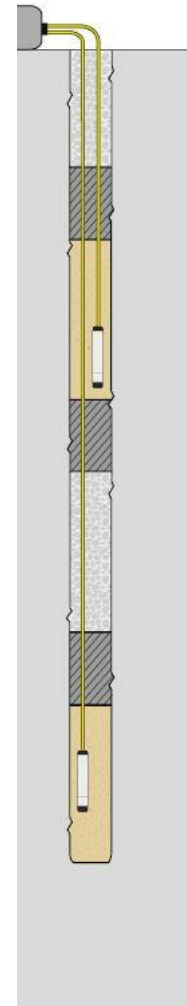
— WHAT IS A PIEZOMETER?

As a consequence, piezometers can be divided into two classes:

open circuit type



closed circuit type



— OPEN CIRCUIT PIEZOMETERS

Open circuit piezometers consist of:

- a porous cell, i.e. 200 mm long, connected to the surface by one or two open extension pipes;*
- a short length of slotted pipe connected to the surface by one open extension pipe;*

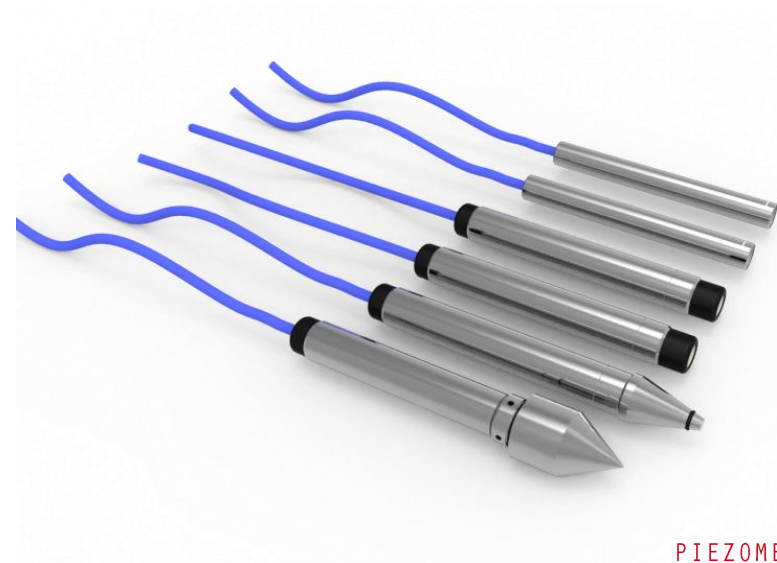
Open circuit piezometers are also known as
Casagrande Piezometers
or **Standpipe Piezometers.**



— CLOSED CIRCUIT PIEZOMETERS

Closed circuit piezometers consist of a filter, a saturated hydraulic chamber of minimum volume and a pressure sensitive elastic diaphragm.

*Water pressure transmitted through the filter causes a deflection of the diaphragm that is directly proportional to the pressure. The deflection of the diaphragm is usually measured by **vibrating wire** or **piezo-resistive** technologies.*



— CASAGRANDE AND STANDPIPE PIEZOMETERS



— CASAGRANDE AND STANDPIPE PIEZOMETERS

APPLICATIONS

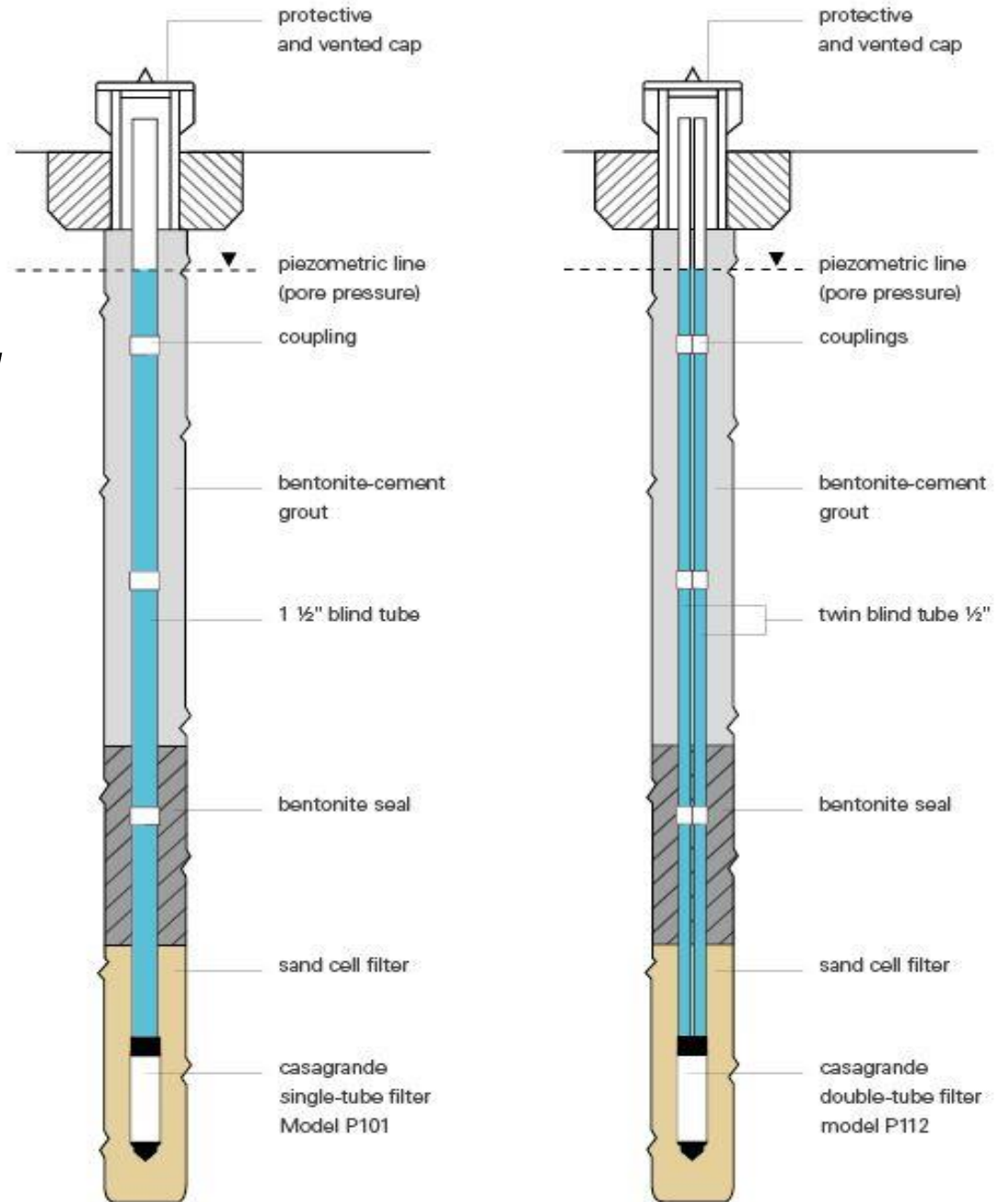
- *Control of ground water level*
- *Hydrological and water supply investigations*
- *Construction and stability control of rail and road embankments, earth dams and foundations*
- *Investigation of stability in natural and cut slopes*
- *Permeability tests for drainage and de-watering activities*

FEATURES

- *Filters available in different models for both single and twin tube*
- *Simple automation with resistive or vibrating wire pressure transducers*
- *Available conic-tip transducer that turns Casagrande piezometer in close circuit piezometer*

CASAGRANDE PIEZOMETERS

*Casagrande piezometers are used to detect, measure and monitor water pressure in medium-low permeable soils or rocks specifically **at the installed depth of the filter tip.***



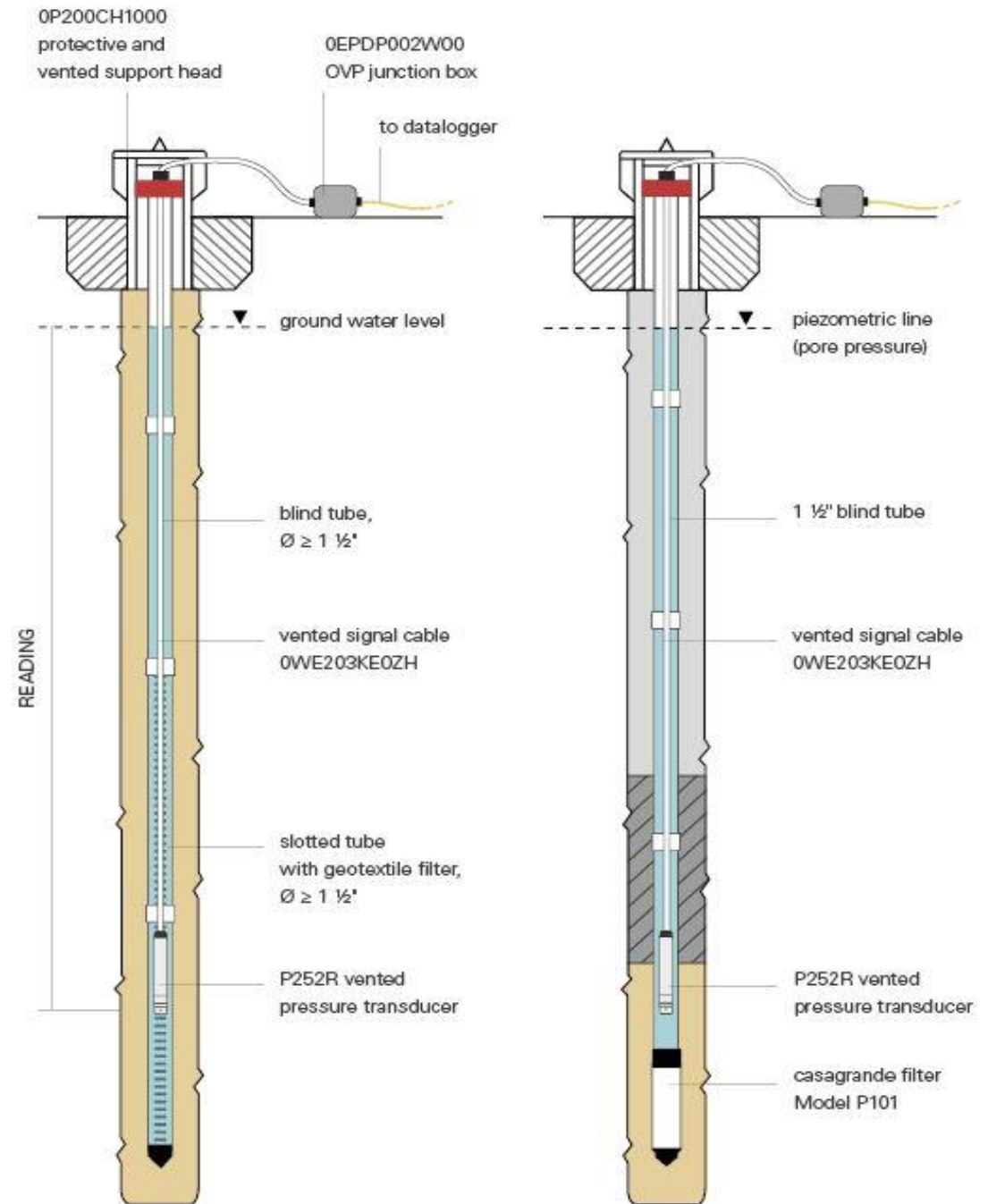
— CASAGRANDE PIEZOMETERS



STANDPIPE PIEZOMETERS

*The standpipe piezometers are used to detect, measure and monitor **ground water level** in permeable soils.*

The filter could be composed by a slotted PVC tube with external geotextile sock filter or a simple Casagrande filter unit.



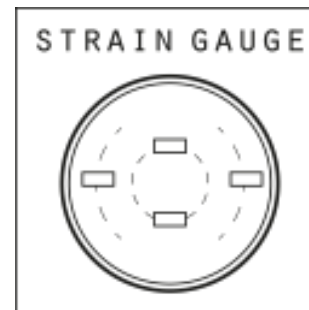
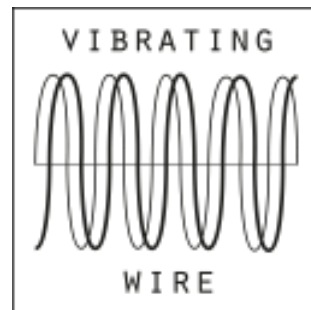
— STANDPIPE PIEZOMETERS



__ READING OF OPEN CIRCUIT PIEZOMETERS

Measurement are taken by :

- *a water level indicator (or dipmeter)*
- *an electric pressure transducer lowered into the piezometer tube. Electric pressure transducers could have vibrating wire or piezoresistive strain gauge technologies.*



— WATER LEVEL INDICATORS



— WATER LEVEL INDICATORS

APPLICATIONS

- *Casagrande and standpipe piezometers*
- *Water wells*
- *Water ground level measurement in landslides, tunnels, excavations and dams*
- *Water level indication in basins, lakes and canals*

FEATURES

- *Available also with water temperature probe*
- *Long life, inexpensive and compact*
- *Permanent and accurate cable markings*
- *Staff gauges available with special design for inclined installation or different marking colors*

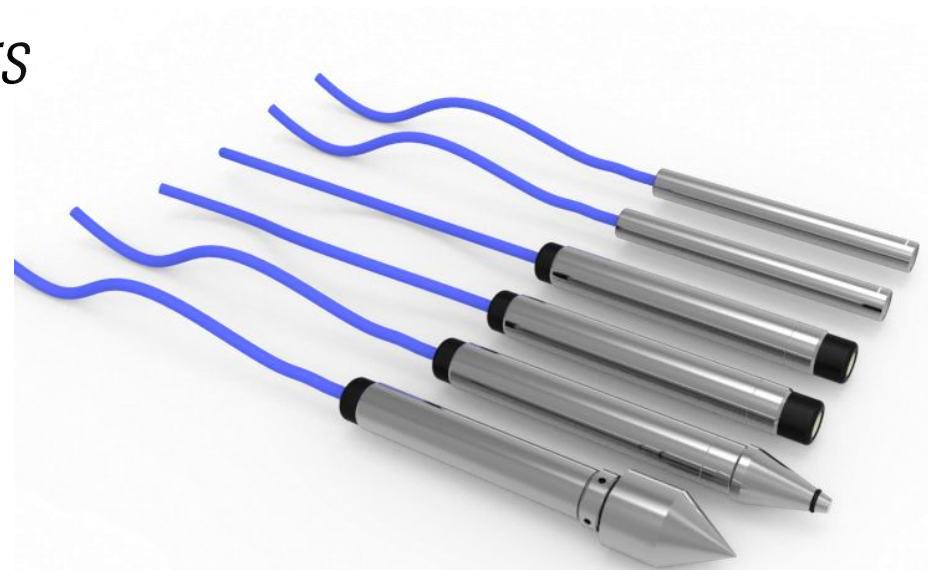
— WATER LEVEL INDICATORS

Reading of open circuit piezometer with water level indicator.

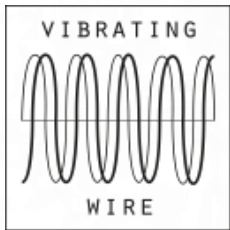


— ELECTRICAL PIEZOMETER

- *Vibrating wire piezometers*
- *Piezo-resistive piezometers*
- *Vibrating wire multipoint piezometers*
- *Vented pressure transducers*
- *Removable pressure transducers*
- *Titanium piezometers*
- *Drive-in piezometers*



— WIBRATING WIRE PIEZOMETERS



— WIBRATING WIRE PIEZOMETERS

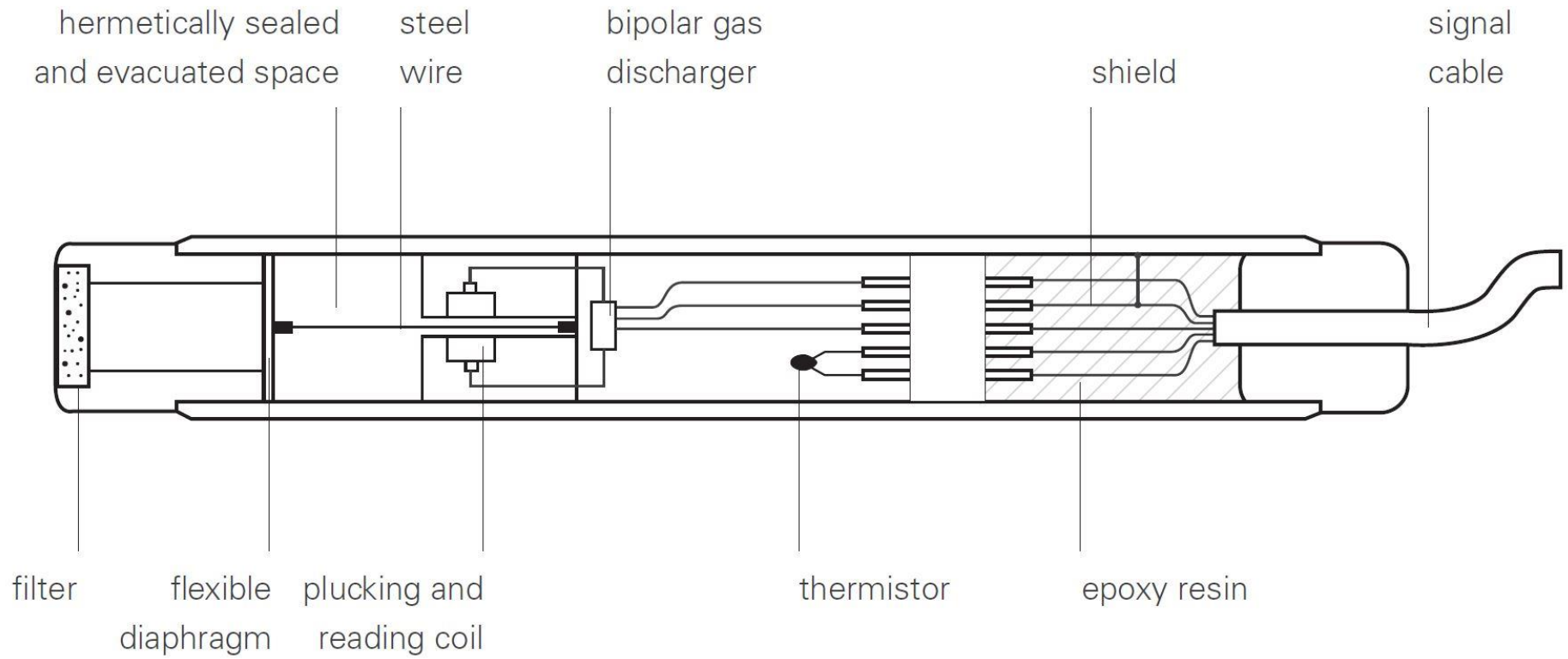
APPLICATIONS

- *Dams and fill embankments*
- *Measurement of ground water*
- *Dewatering activities*
- *Landslides monitoring*
- *Natural or cut slope sites*
- *Monitoring of up-lift pressure*

FEATURES

- *Long-term stability*
- *Cable length does not affect reading*
- *Long working life and reliability*
- *Built-in surge protection (overvoltage)*
- *Built-in temperature sensor*
- *Hermetically sealed*

— WORKING PRINCIPLE



__ MODELS

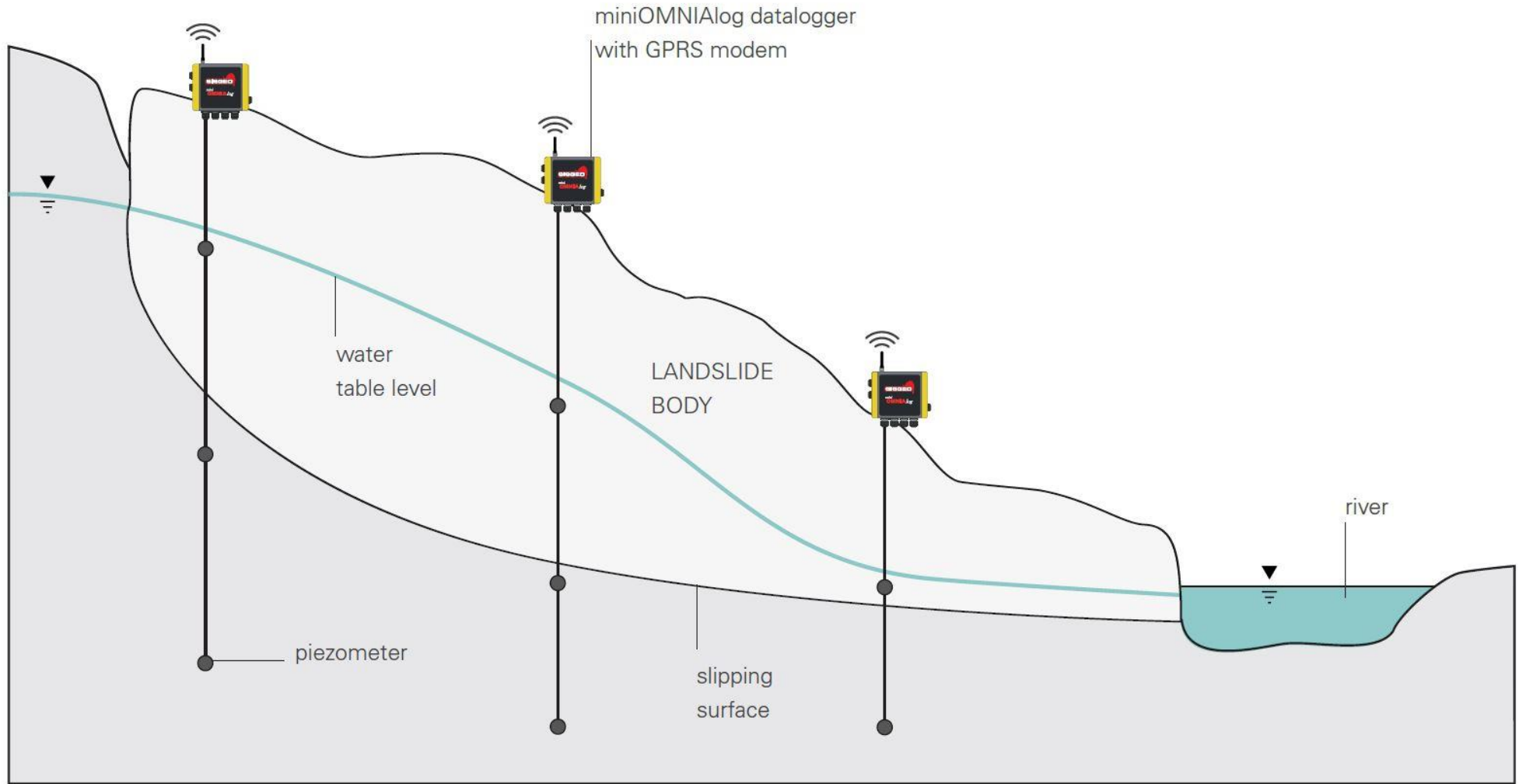
*Standard
piezometer*



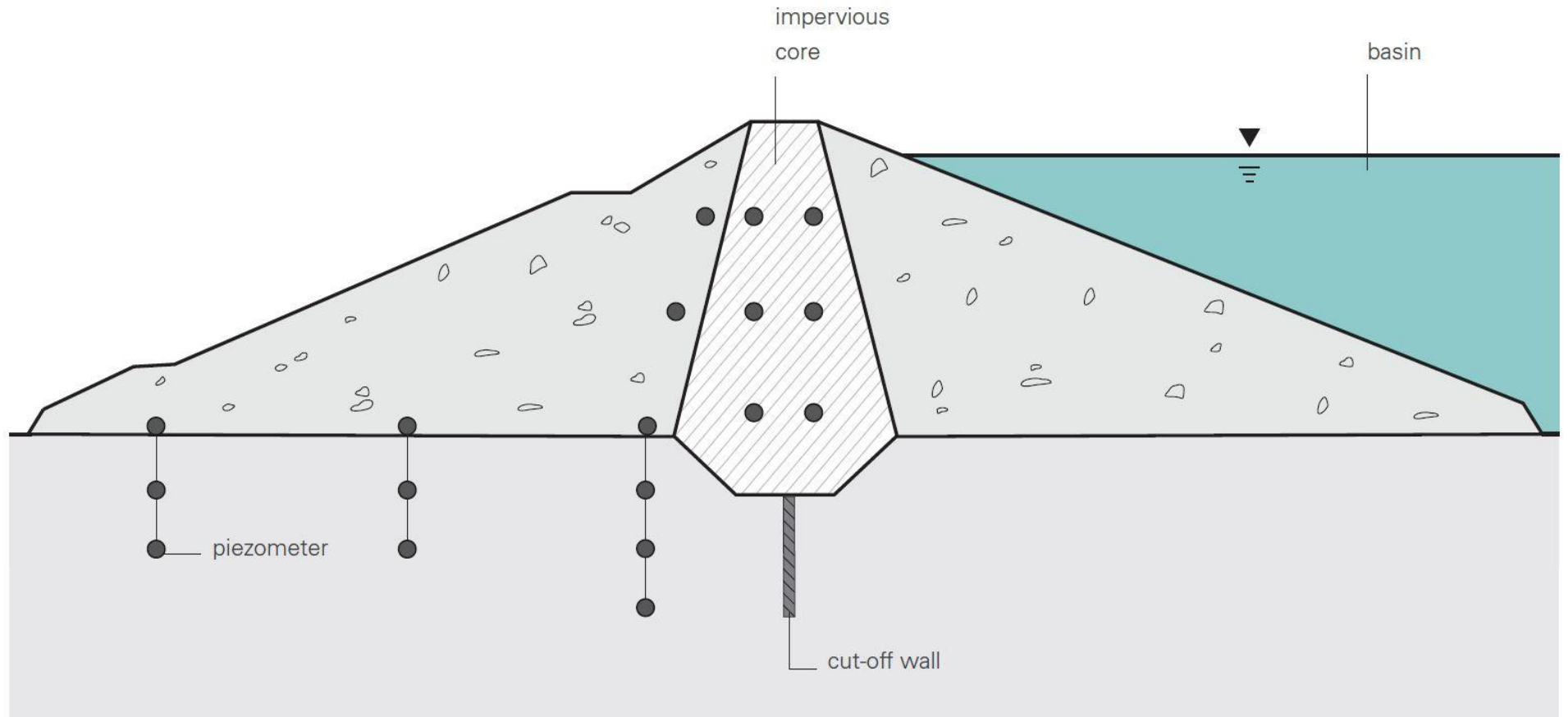
*Heavy duty
piezometer*



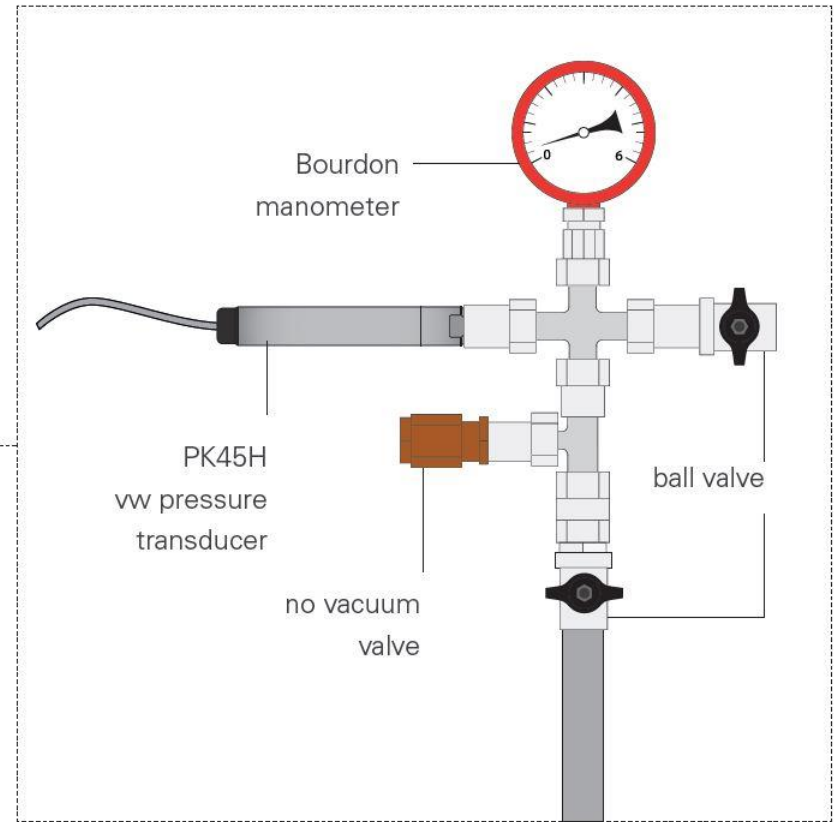
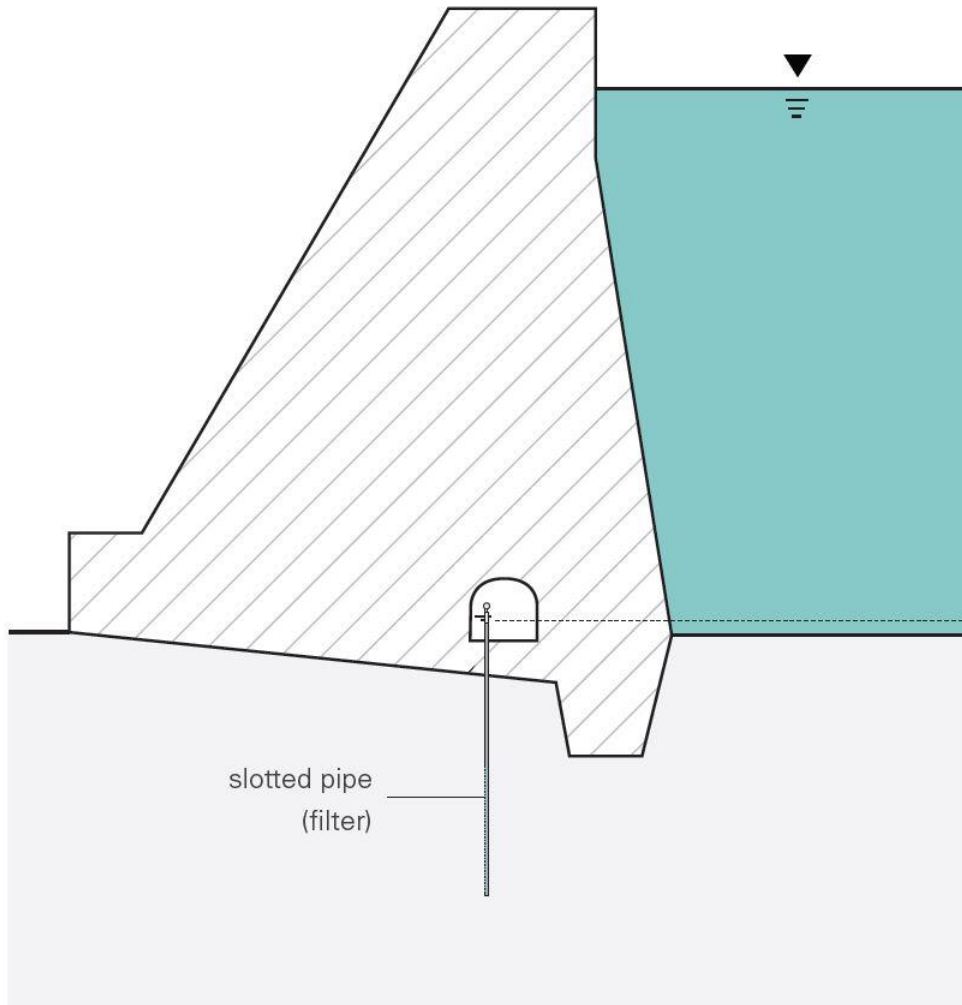
__ TYPICAL LANDSLIDE APPLICATION



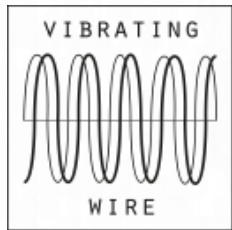
__ TYPICAL EMBANKMENT DAM APPLICATION



__ TYPICAL APPLICATION IN CONCRETE DAM



— VIBRATING WIRE MULTIPOINT PIEZOMETERS



— VIBRATING WIRE MULTIPOINT PIEZOMETERS

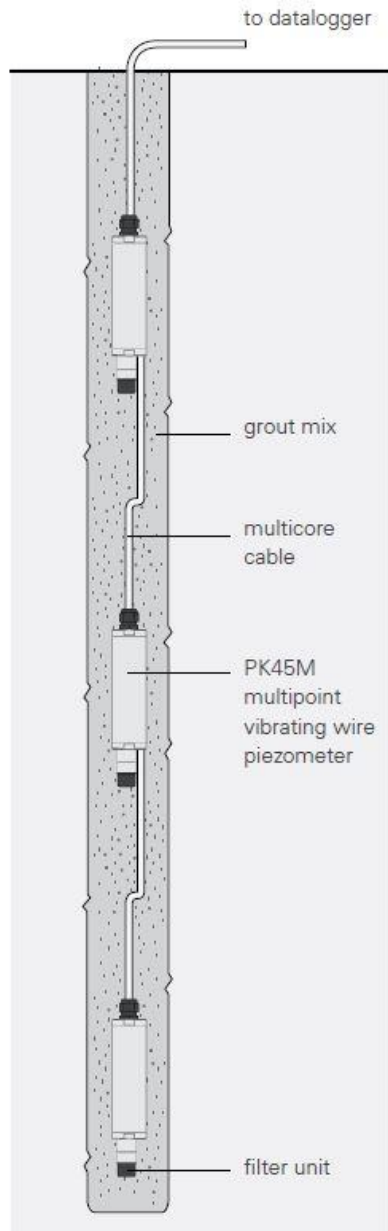
APPLICATIONS

- *Measurement of ground water pressure at different elevations*
- *Monitoring soil consolidation activities*
- *Dams and fill embankments*
- *Landslides monitoring*
- *Natural or cut slope sites*
- *Deep excavation*

FEATURES

- *Simple installation*
- *Long-term stability*
- *Cable length does not affect reading*
- *Long working life and reliability*
- *Built-in surge protection (overvoltage)*
- *Built-in temperature sensor*
- *Hermetically sealed*

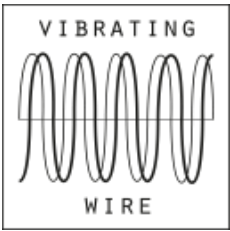
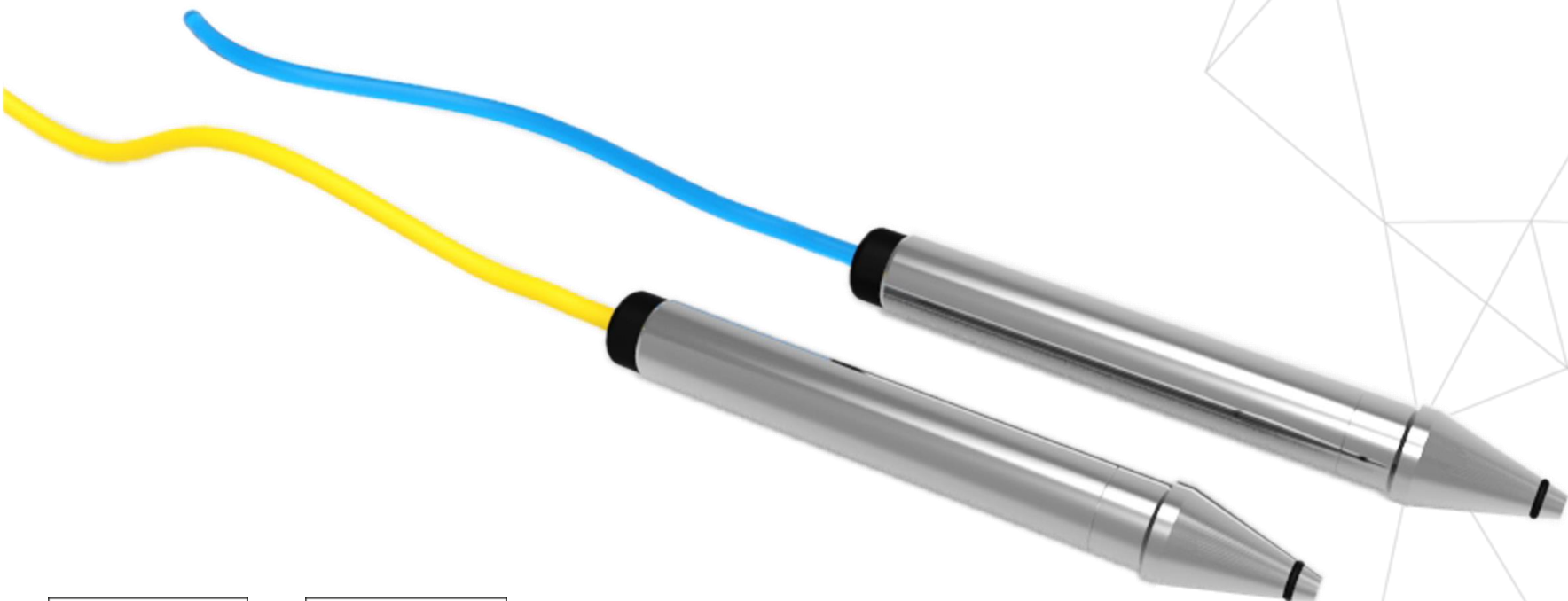
___ FULLY-GROUTED INSTALLATION METHOD



The fully-grouted installation method provides a reliable way to install piezometers in the same borehole, each measuring pore-water pressure at a different elevation. It eliminates problems with placing sand intake zones, bentonite seals, and channeling of water along signal cables.

The working principle is based on the idea that in a low permeability grout, radial pressure gradient around the piezometer tip is magnitudes higher than the vertical pressure gradient along the borehole, and that the response of the piezometer is controlled by the higher pressure gradient.

REMOVABLE PRESSURE TRANSDUCERS



REMOVABLE PRESSURE TRANSDUCERS

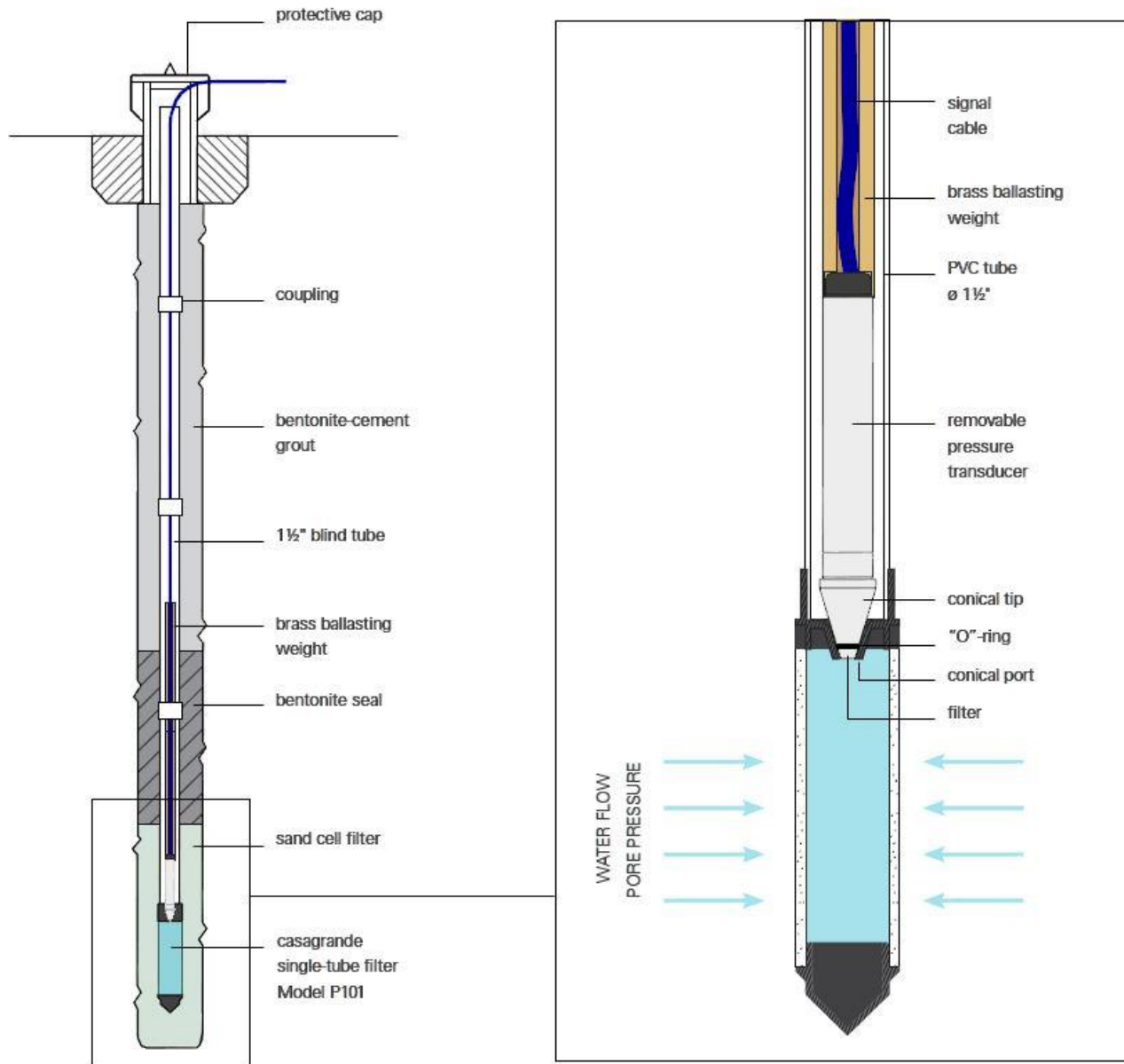
APPLICATIONS

- *Long term monitoring*
- *Suitable in lightning-prone areas (since it can be replaced)*
- *Dams and fill embankments*
- *Measurement of ground pore pressure*
- *Landslides monitoring*
- *Natural or cut slope sites*

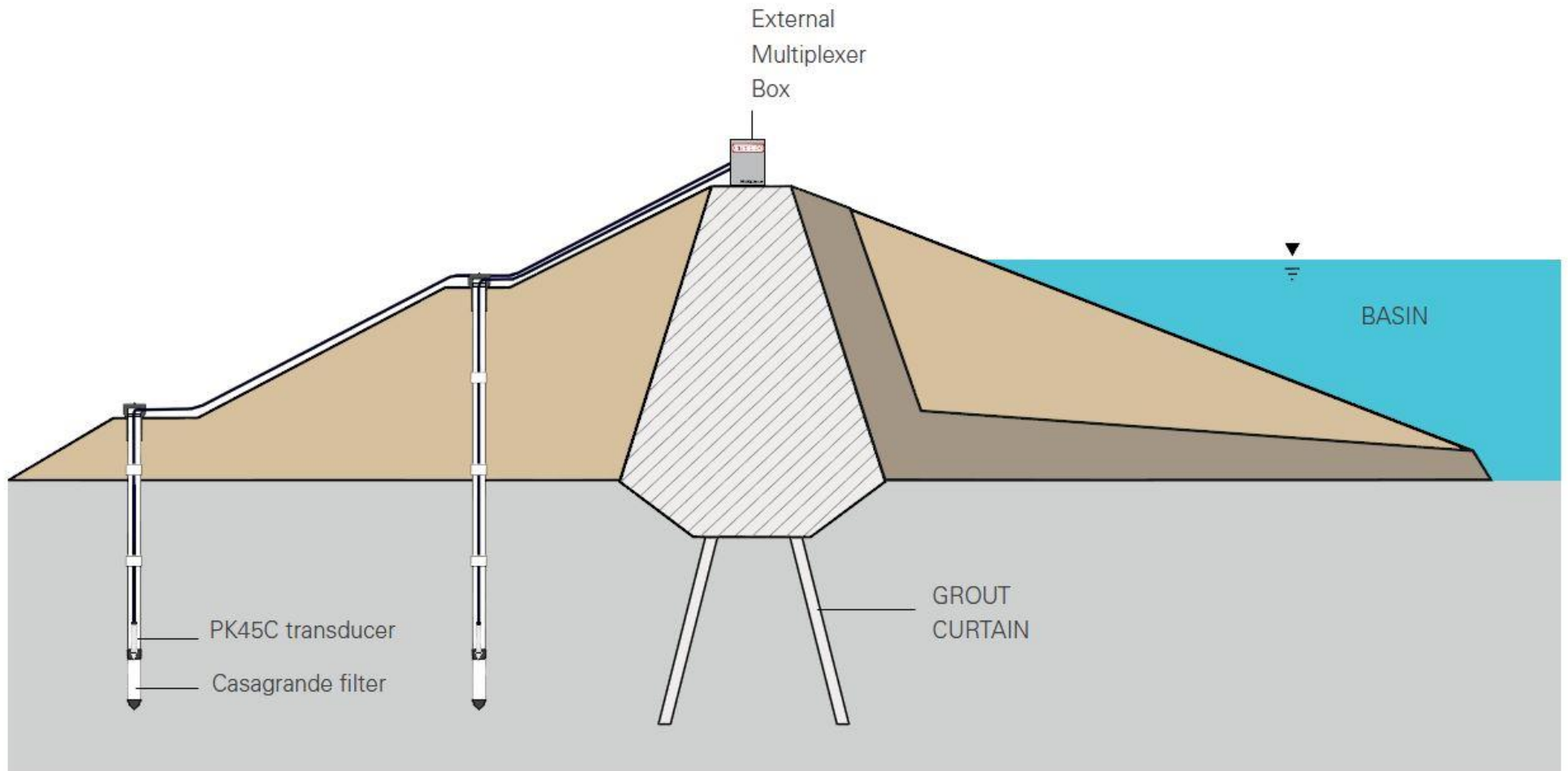
FEATURES

- *Removable for further calibration and check*
- *Cable length does not affect reading*
- *Built-in surge protection and temperature sensor (vibrating wire only)*
- *If removed, Casagrande continue to works with manual water level indicator*

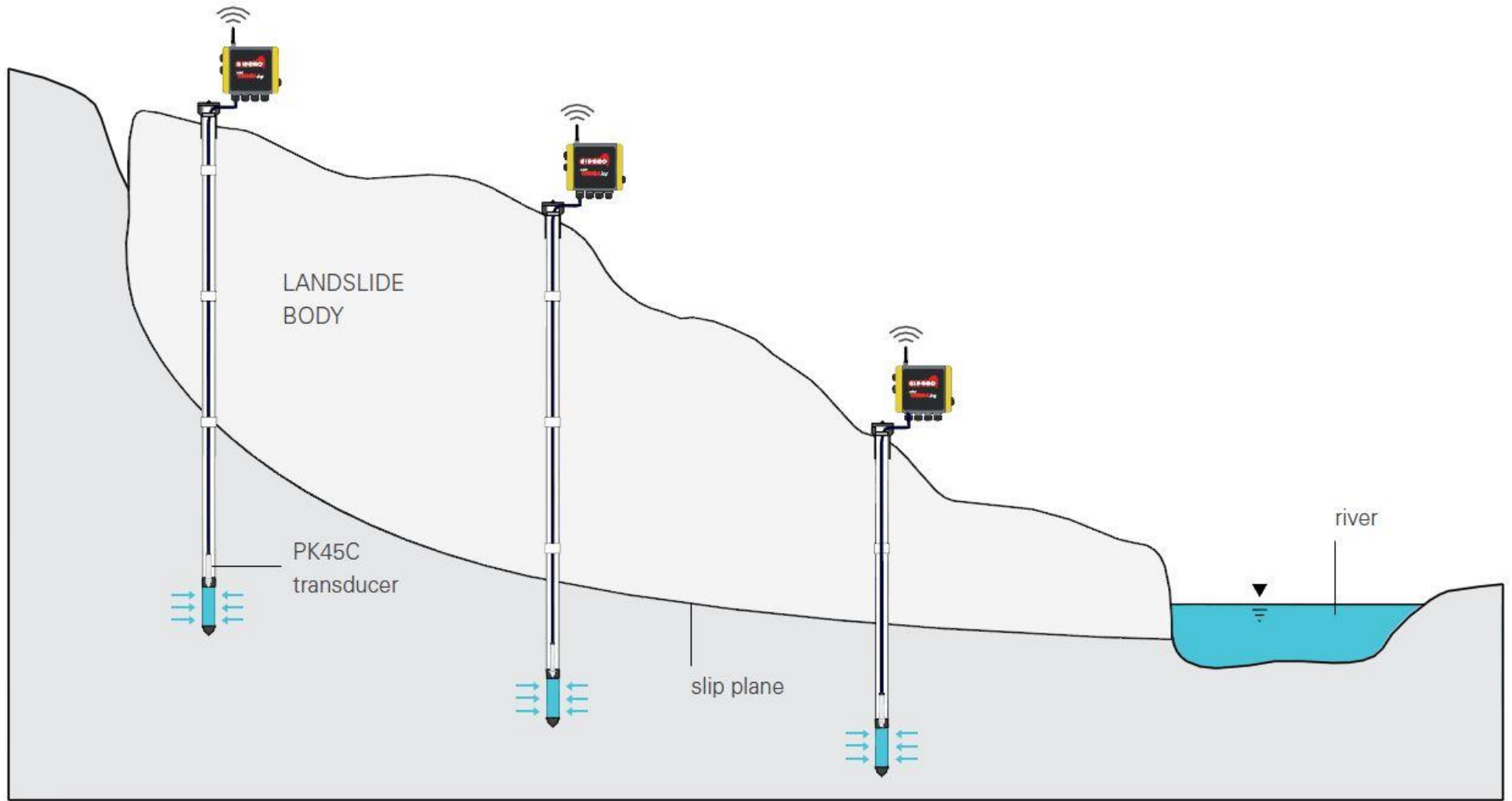
REMOVABLE TRANSDUCERS - WORKING PRINCIPLE



__ PORE PRESSURE MONITORING IN EMBANKMENT DAM'S FOUNDATION



UP-LIFT PRESSURE MONITORING IN LANDSLIDE APPLICATION



— PIEZO-RESISTIVE PIEZOMETERS



— PIEZO-RESISTIVE PIEZOMETERS

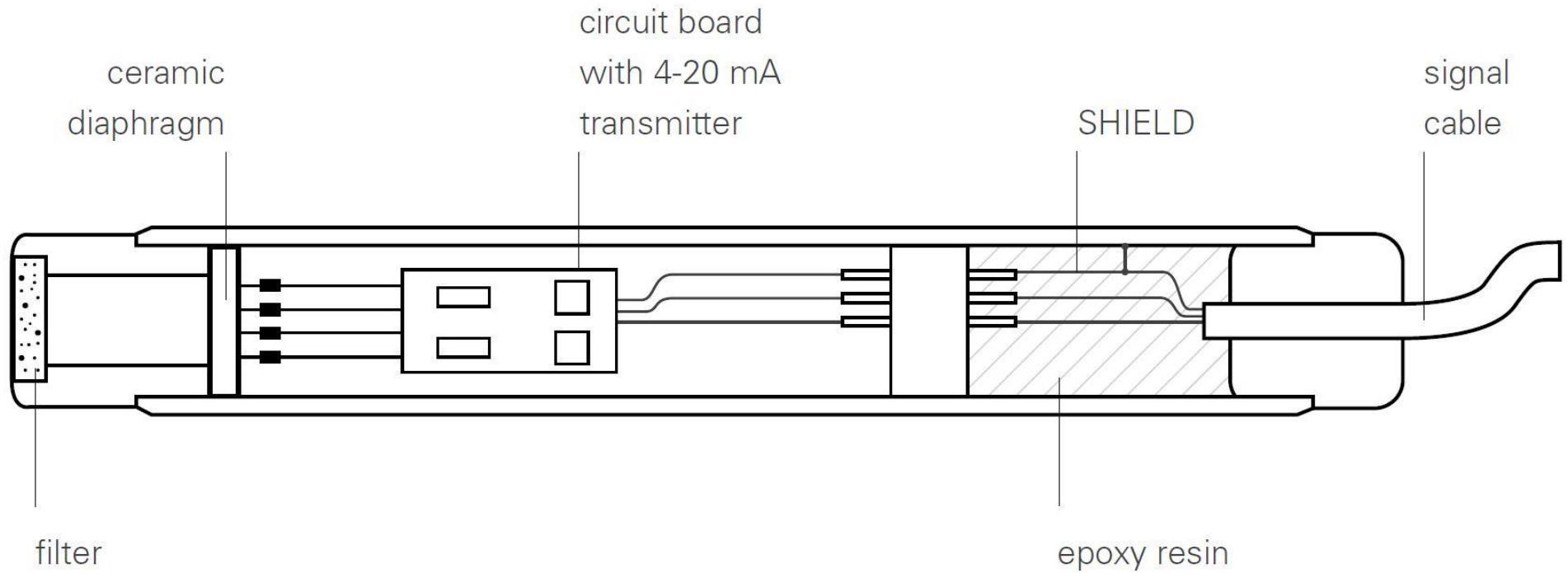
APPLICATIONS

- *Pore pressure in deep excavations*
- *Dynamic pore pressure monitoring*
- *Dewatering activities*
- *Hydraulic gradients in natural or cut slope*

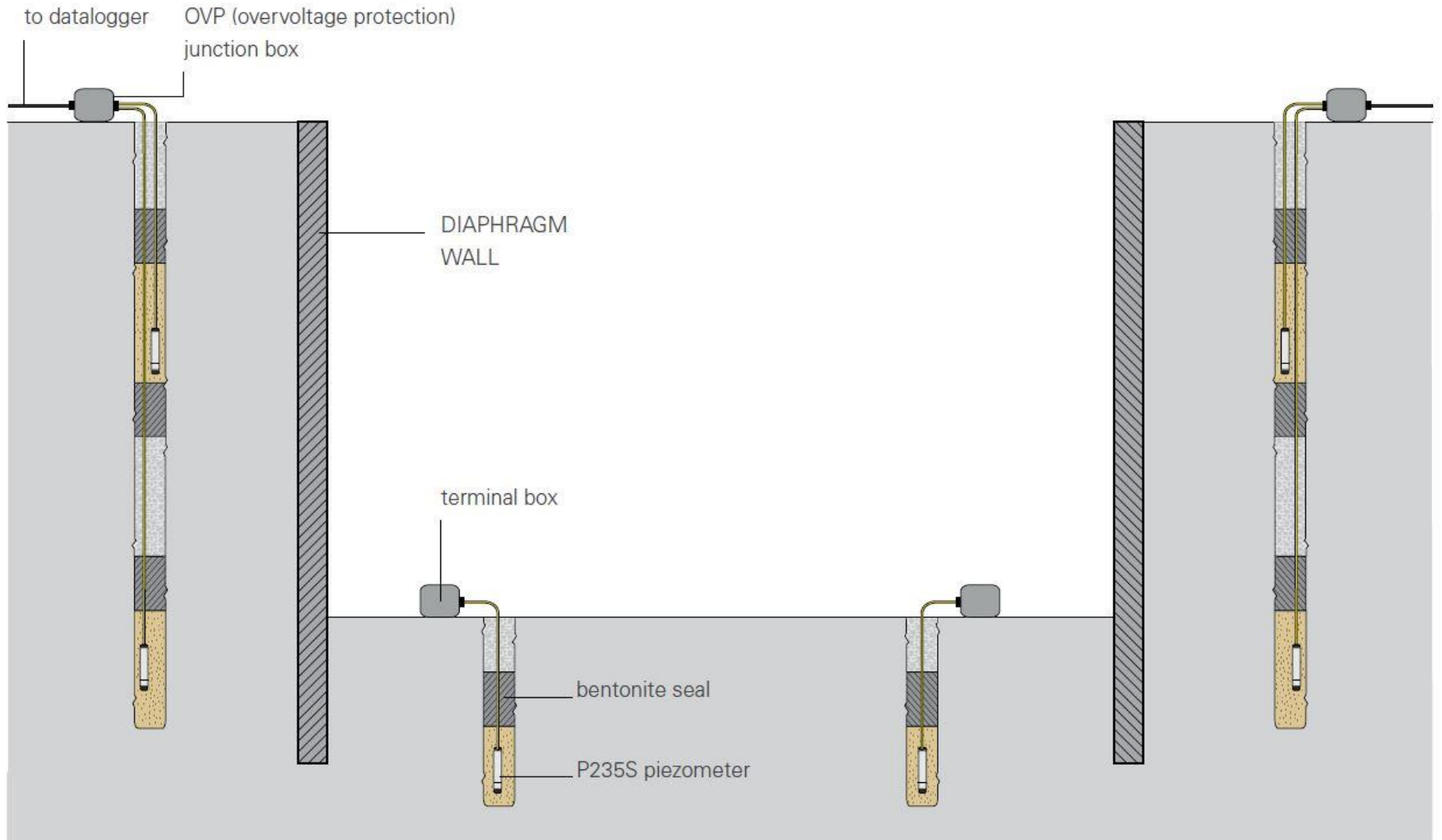
FEATURES

- *High accuracy and stability*
- *Compatible with most readout/logger in the market*
- *Built-in thermistor (on request)*
- *Capable of reading negative pressures*

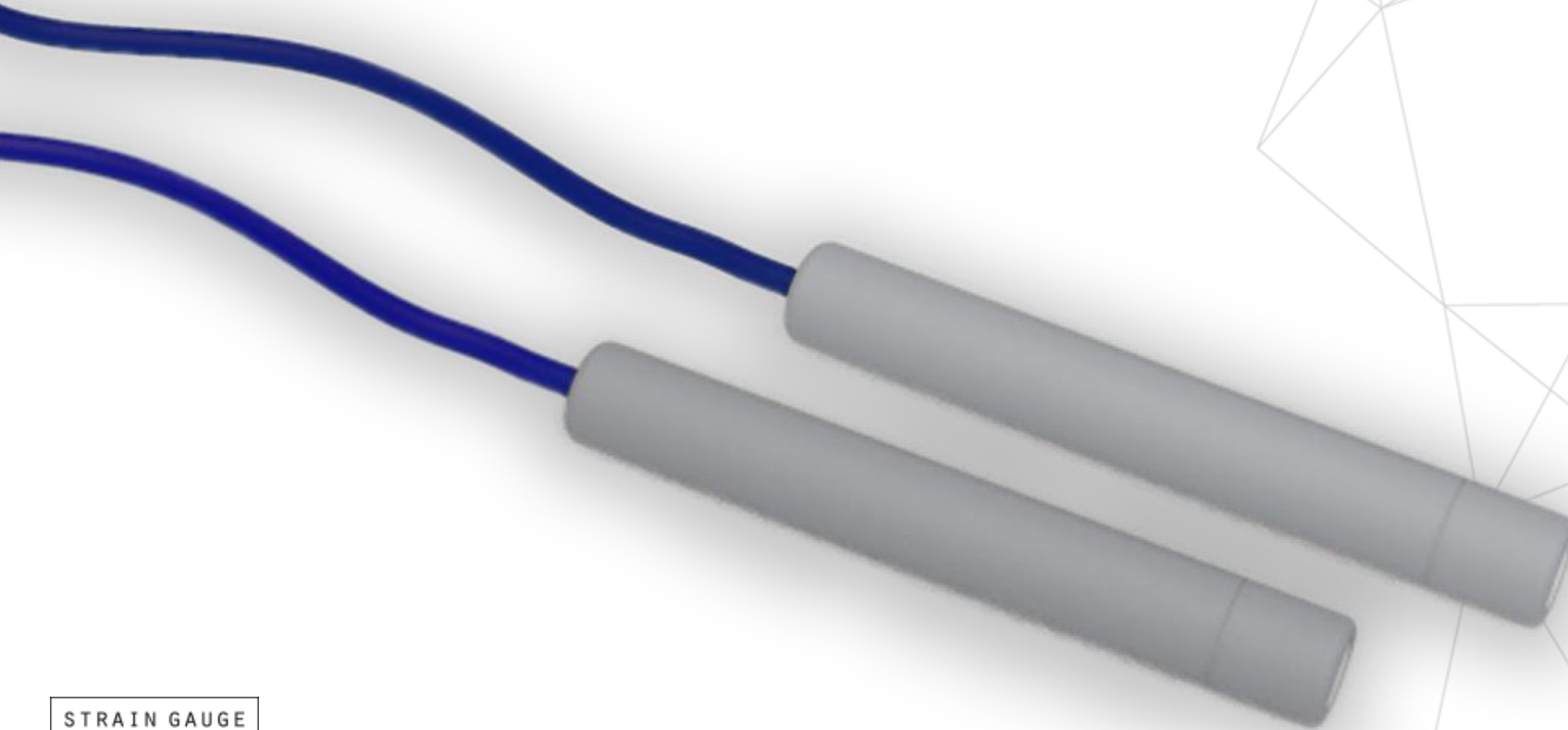
__ PIEZO RESISTIVE STRAIN GAUGE WORKING PRINCIPLE



APPLICATION IN DEEP EXCAVATION



— TITANIUM PIEZOMETERS



— TITANIUM PIEZOMETERS

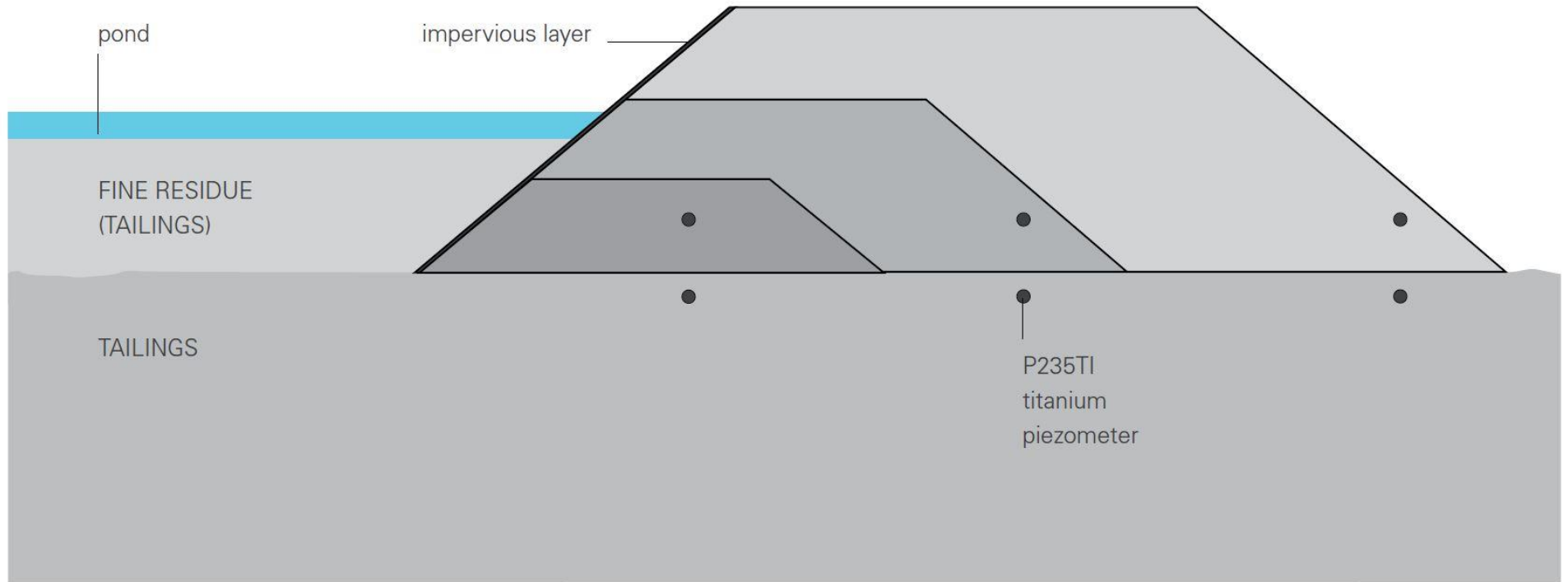
APPLICATIONS

- *Monitoring pore-water pressure under landfills*
- *Monitoring where brackish water or salt water is present*
- *Monitoring nuclear waste repositories*
- *Monitoring pore pressures in tailings*

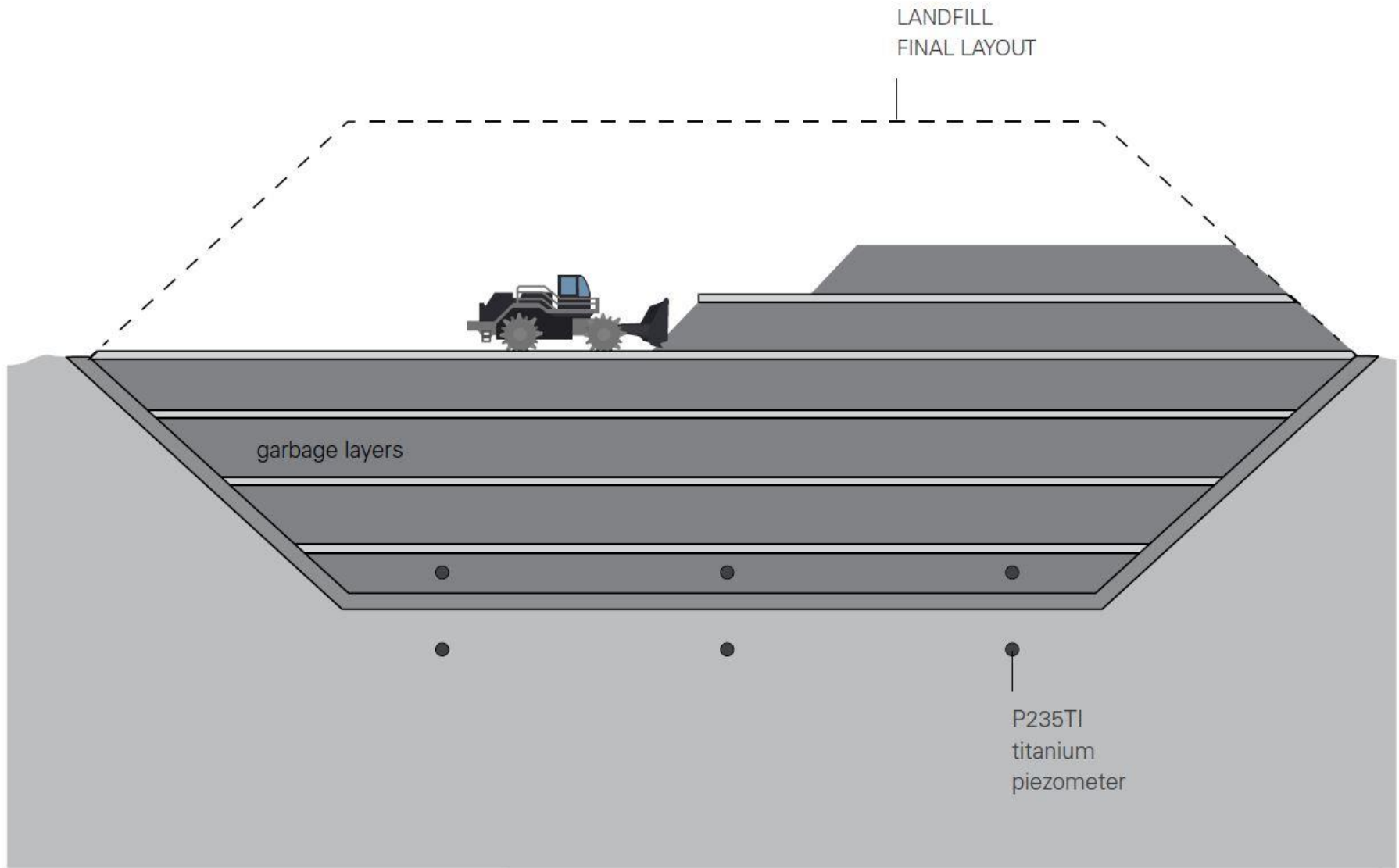
FEATURES

- *Corrosion-proof up to pH=1*
- *High accuracy and stability*
- *Compatible with most readouts and data loggers*
- *Built-in thermistor (on request)*
- *Suitable for dynamic measurements*

__ PORE PRESSURE MONITORING IN EMBANKMENT DAM'S FOUNDATION



APPLICATION IN LANDFILLS



— VENTED PRESSURE TRANSDUCER



— VENTED PRESSURE TRANSDUCER

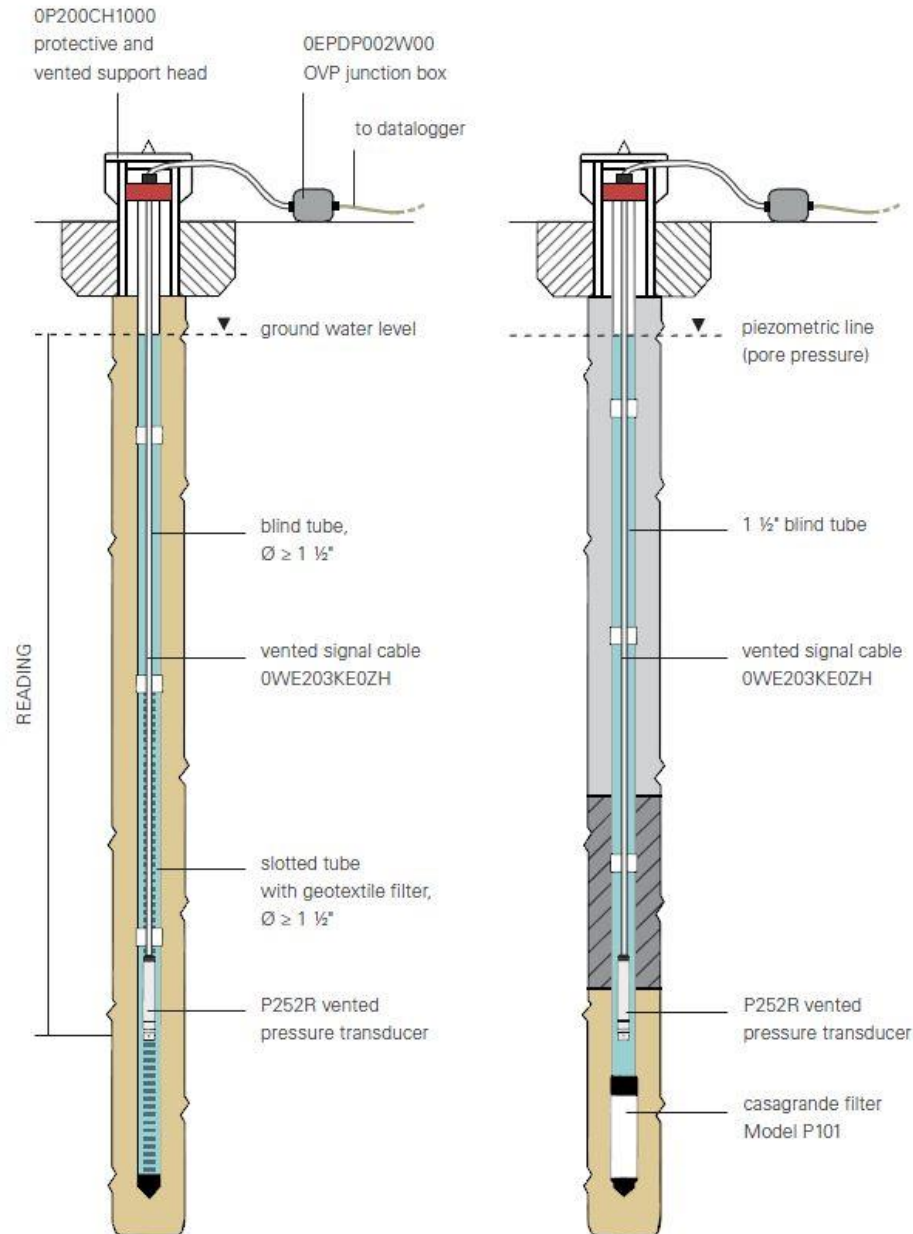
APPLICATIONS

- *Monitoring water levels in reservoirs*
- *Monitoring ground water tables*
- *Monitoring dewatering operations*
- *Monitoring landslide remediation*

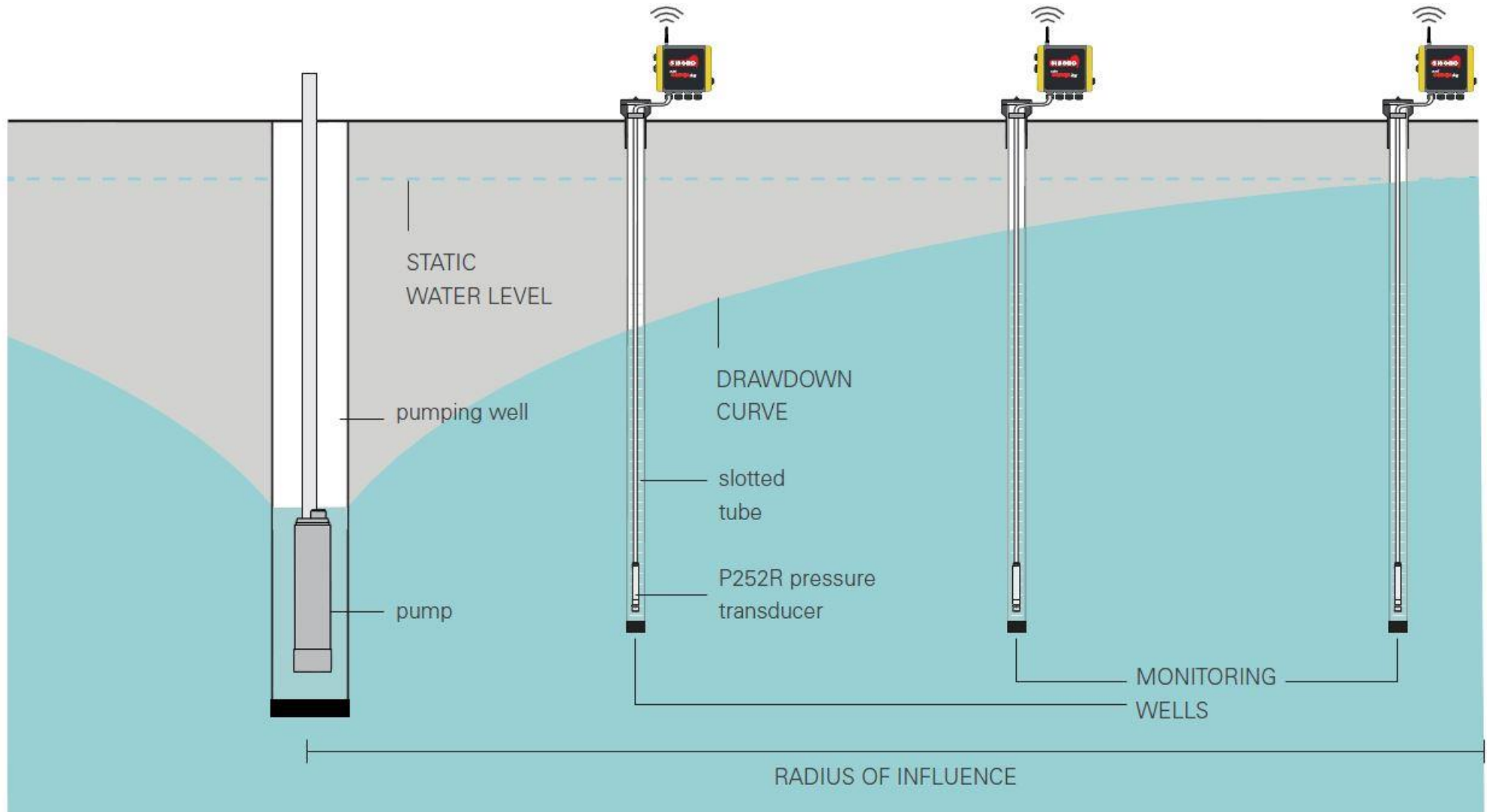
FEATURES

- *Automatic compensation for barometric changes*
- *High accuracy and reliability*
- *Robust 4-20mA signal*
- *Hermetically sealed*

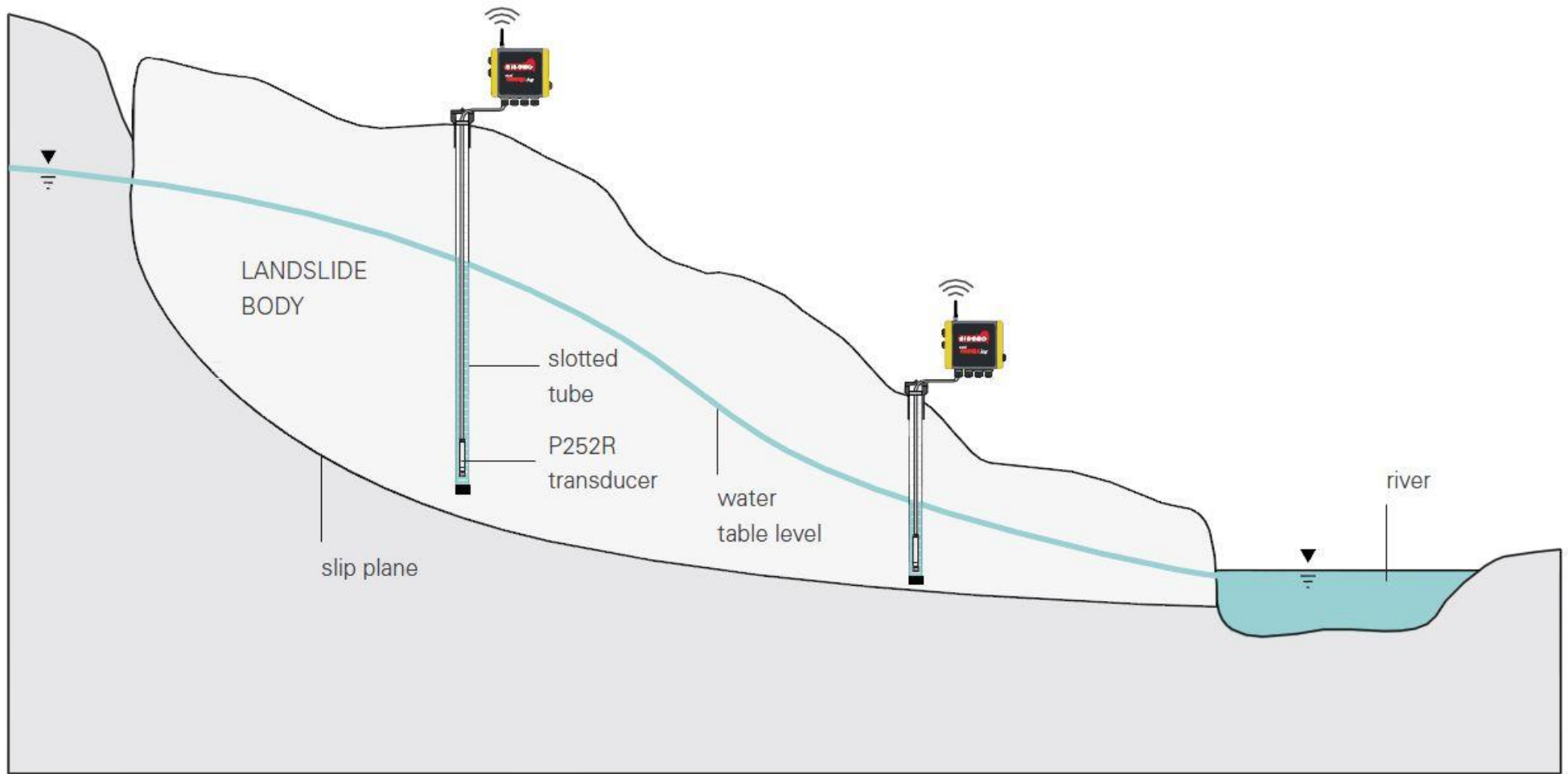
APPLICATION IN STANDPIPE AND CASAGRANDE PIEZO



APPLICATION IN PUMPING TEST



__ WATER TABLE LEVEL MONITORING LANDSLIDE



__ WLL - AUTOMATIC WATER TABLE LEVEL MONITORING



— WATER LEVEL LOGGER (WLL)

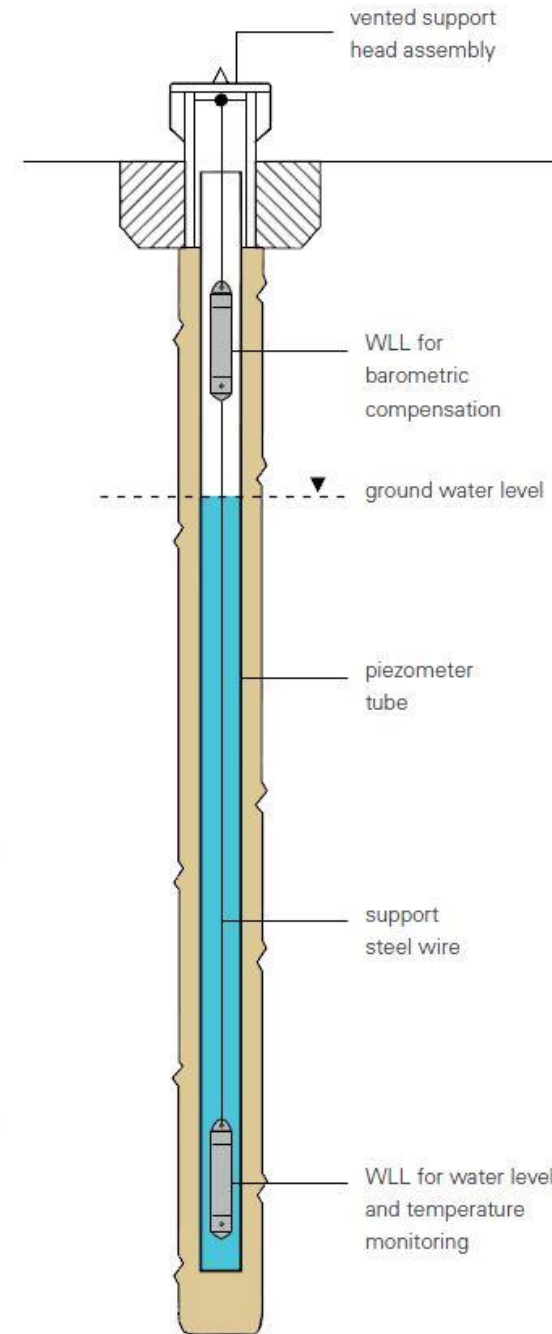
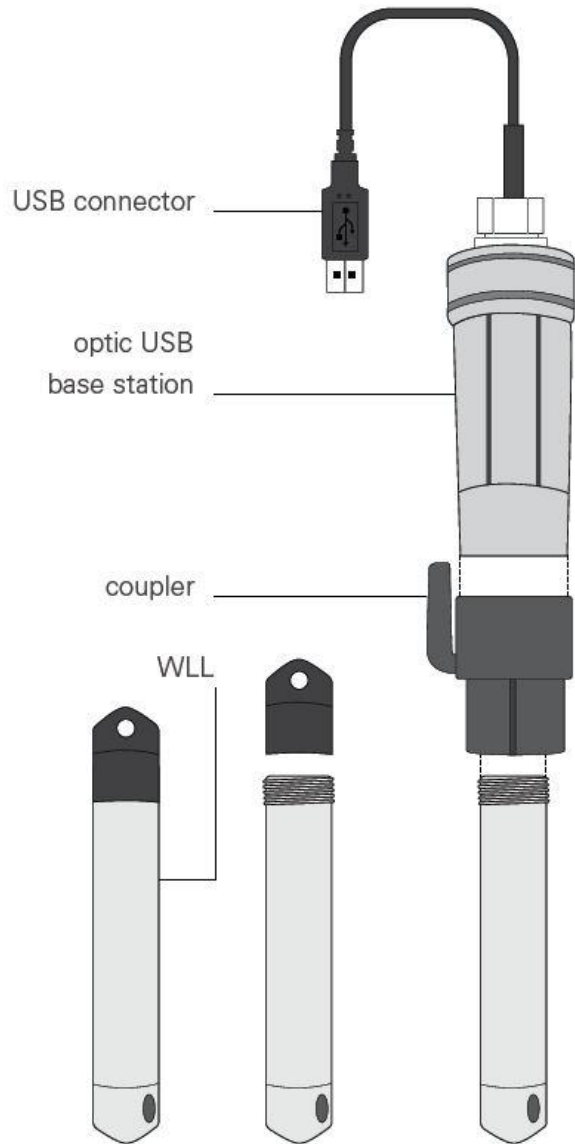
APPLICATIONS

- *Reservoirs and artificial lakes*
- *Water wells*
- *Freshwater wetlands*
- *Standpipe and Casagrande piezometers*

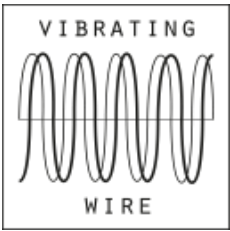
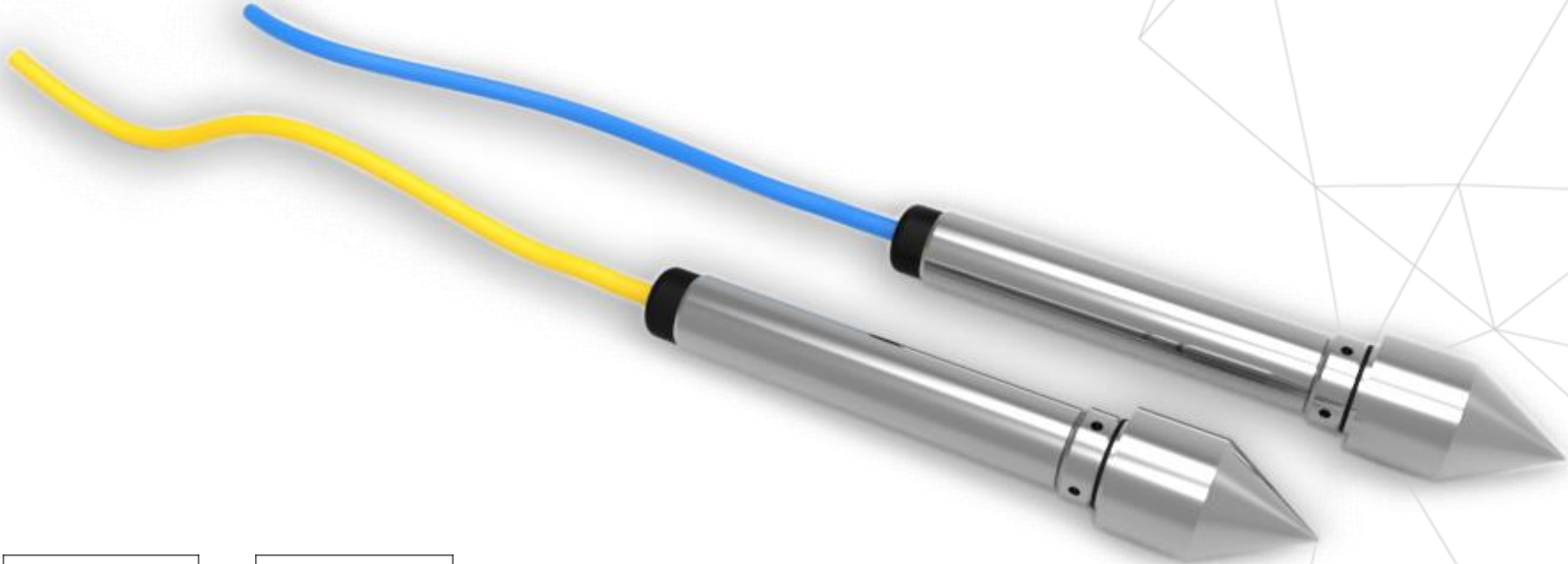
FEATURES

- *High accuracy*
- *Compact and rugged design*
- *User-friendly software*
- *Available also in titanium version for aggressive environment*

— WATER LEVEL LOGGER (WLL)



— DRIVE-IN PIEZOMETERS



— DRIVE-IN PIEZOMETERS

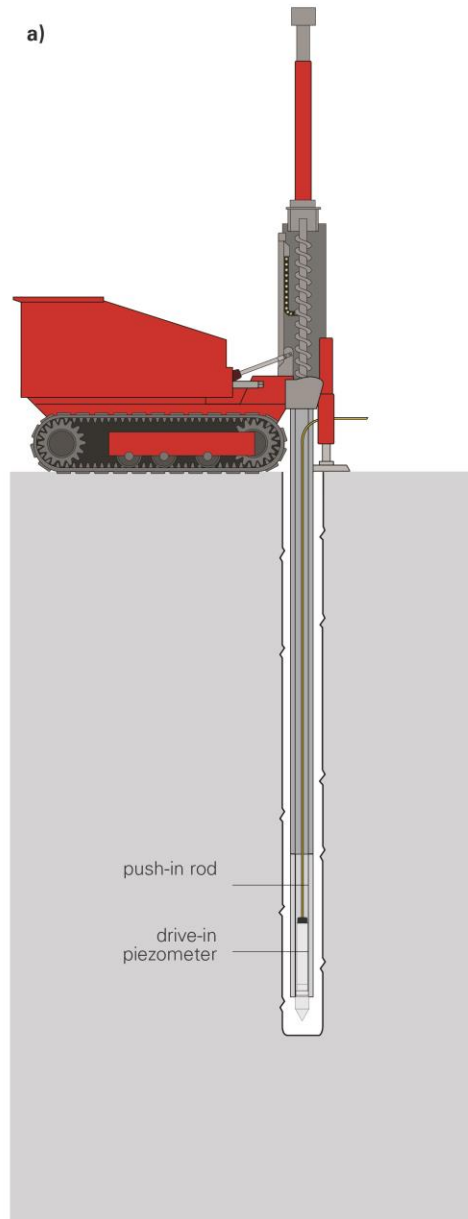
APPLICATIONS

- *Pore pressure in soft soils*
- *Dams and fill embankments*
- *Dewatering activities*
- *Natural or cut slope sites*
- *Deep excavations*
- *Diaphragm walls*

FEATURES

- *Cable length does not affect reading*
- *Long working life and reliability*
- *Built-in surge protection (vibrating wire only)*
- *Built-in temperature sensor*
- *Dynamic pore pressure monitoring (piezo-resistive only)*

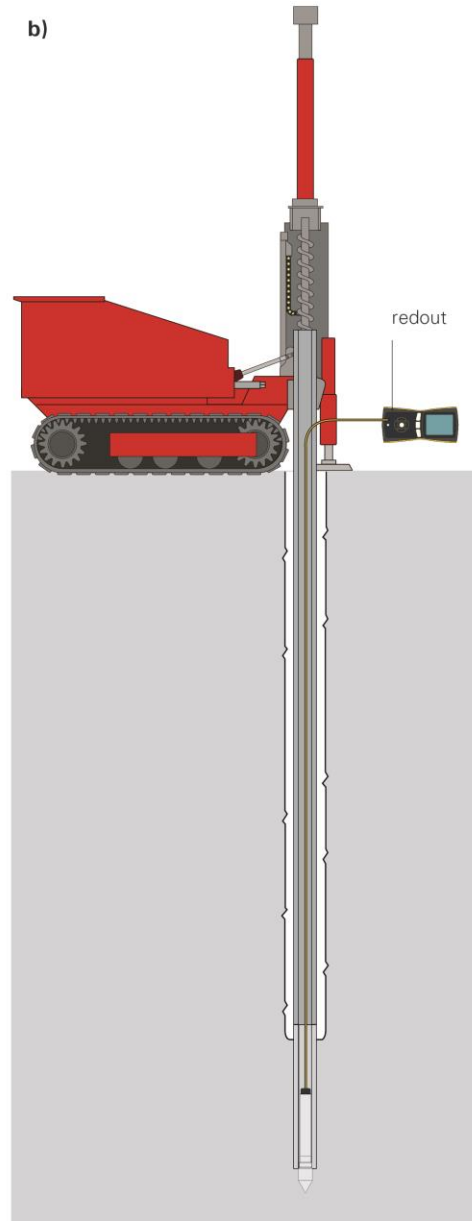
__ INSTALLATION METHODS – DEEPER INSTALLATIONS



For deeper installations, drill a borehole first and then push the piezometer into the soil at the bottom of the borehole.

(a) Insert rod over cable and onto piezo, add rods until piezo reaches bottom of borehole.

__ INSTALLATION METHODS – DEEPER INSTALLATIONS

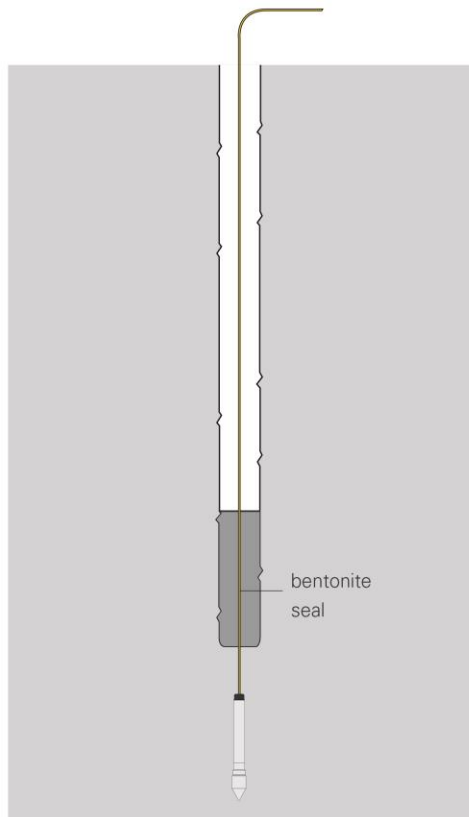


(b) Push piezo into soil at bottom of borehole. During the operations, the instrument shall be connected to a read-out unit to check that pressure generated by pushing does not exceed the allowed full-scale value.

__ INSTALLATION METHODS – DEEPER INSTALLATIONS

c)

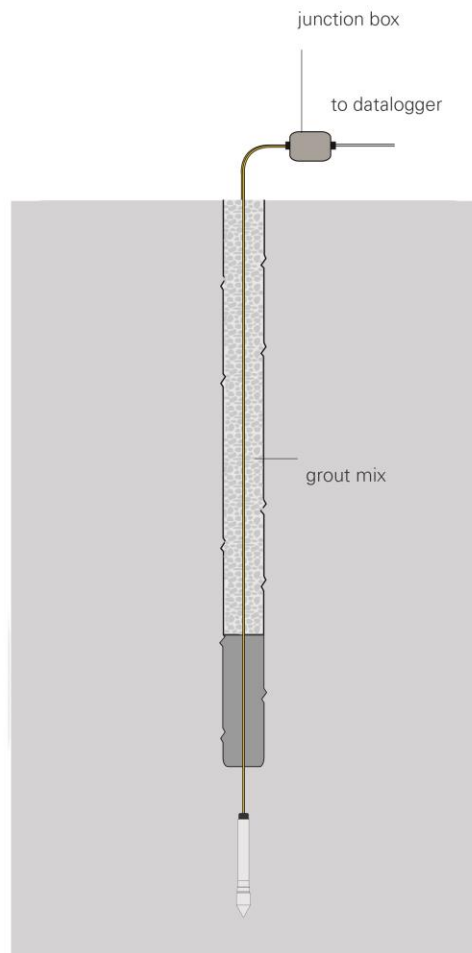
(c) Retrieve push rods and place a bentonite seal.



__ INSTALLATION METHODS – DEEPER INSTALLATIONS

d)

(d) Backfill the remainder of the hole with a bentonite-cement mix



__ INSTALLATION METHODS – SHALLOW INSTALLATIONS

For shallower installations in very soft ground, the piezometer can be pushed from the surface to the specified depth. Monitor for over pressure during the installation. Allow excess pressure to dissipate before continuing to push. Later, when the piezometers is at the specified depth, retrieve the push rods, being careful not to twist the cable.





Further information at:

<http://www.sisgeo.com/piezometer/>

Download piezometers datasheets:

<http://www.sisgeo.com/datasheets-products-piezometers/>





THANKS FOR WATCHING

*For any further clarification
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or email us: info@sisgeo.com*