Technology Data Sheet

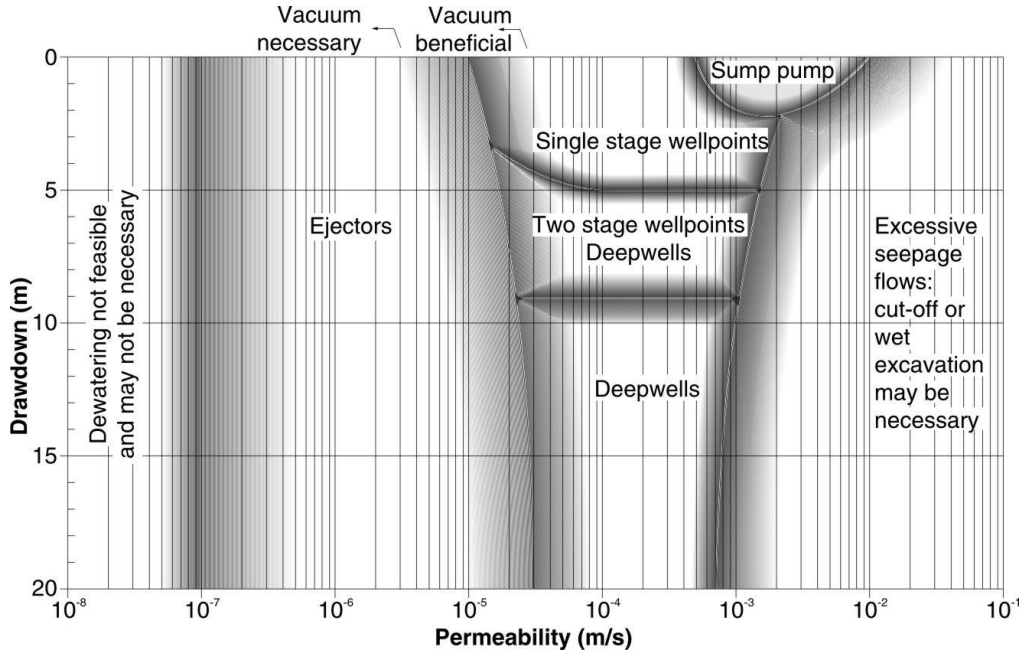
Construction Dewatering

Construction projects that extend below groundwater level present particular challenges. If groundwater is not adequately controlled then excavations may flood or become unstable, and the efficiency of construction operations will be reduced, wasting time and money.

Construction dewatering is the range of techniques used to control groundwater to allow excavations, shafts, tunnels and other structures to be constructed below groundwater level in workably dry, stable and safe conditions. If a planned programme of construction dewatering is implemented, a construction project will typically see several benefits, including:

- Improved geotechnical stability and safety, including allowing steeper side slopes and preventing the softening or disruption of the excavation formation level due to upward groundwater pressures or uncontrolled seepage.
- More efficient excavation and construction conditions, including firmer excavation conditions less prone to rutting or bogging down of plant and machinery. The drier working conditions created by dewatering will improve the efficiency of construction operations such as excavation, concreting or pipe laying.
- Less risk of adverse environmental impacts because correctly engineered dewatering systems produce 'clean' water with very little suspended solids, reducing the risk of water pollution.

Successful dewatering requires that the techniques used are appropriate to the type of excavation and hydrogeological conditions at the construction site. Dewatering techniques must be selected carefully, as the various techniques are not interchangeable and are only effective within certain conditions. The figure below provides useful initial guidance on the selection of dewatering techniques in relation to permeability (hydraulic conductivity) of the ground and the required drawdown of groundwater levels.



Range of application of pumped well groundwater control techniques (from CIRIA Report C515 Groundwater Control – Design and Practice (Preene et al., 2000), reproduced by permission of CIRIA, www.ciria.org)

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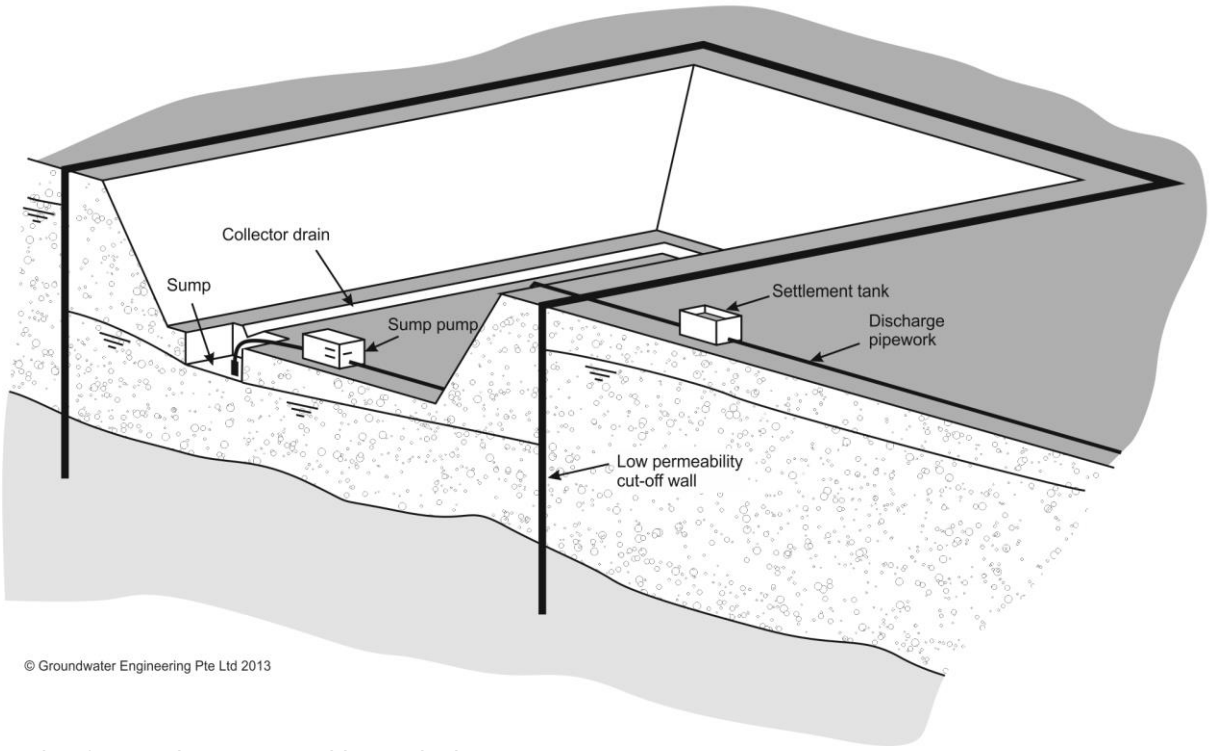
There are two main types of groundwater control techniques:

- Methods that use cut-off walls and other barriers to exclude water from the excavation (known as exclusion techniques).
- Methods that deal with groundwater by pumping.

Groundwater Control by Exclusion



Example of groundwater control by exclusion

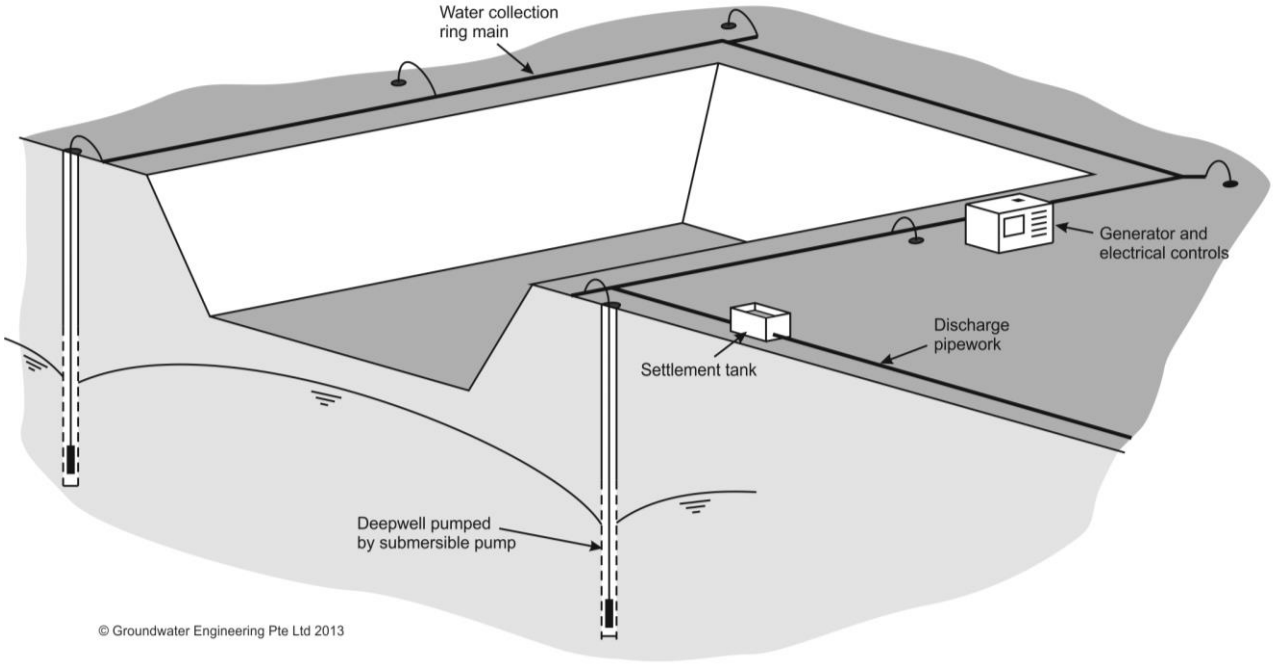
Groundwater can be excluded from the working area by a very low permeability physical cut-off wall or barrier installed around the perimeter of the excavation. Most commonly, the cut-off is vertical and ideally penetrates down to a very low permeability stratum (such as a clay or unfractured bedrock) that forms a basal seal for the excavation. There will still be a requirement for some groundwater pumping, to remove water trapped inside the area enclosed by the barrier, and to deal with any leakage through the wall.

Methods used to form cut-off walls include:

- Steel sheet-piling
- Slurry trench walls (soil-
- Concrete diaphragm walls
- Bored pile walls (secant pile walls, contiguous pile walls)
- Grout barriers (permeation grouting, rock grouting, jet grouting)
- Mix-in-place barriers
- Artificial ground freezing

The selection of the most appropriate exclusion method to form a cut-off barrier will depend on the conditions and constraints on a given project. Primary constraints are desired depth of wall, ground conditions, geometry of wall (some methods can be used horizontally or inclined to the vertical, while others are limited to vertical applications), and whether the barrier is intended to be permanent or temporary.

Groundwater Control by Pumping



Example of groundwater control by pumping using deep wells with submersible pumps

Pumping can locally lower groundwater levels in the vicinity of the excavation. It can be used as an alternative to, or in combination with, cut-off walls to exclude groundwater.

The simplest form of dewatering is **sump pumping**, where groundwater enters the excavation and is then collected in a sump and pumped away by robust solids handling pumps. This can be an effective method, but seepage into the excavation can create the risk of instability and other construction problems.

Alternatively 'pre-drainage' methods can be used to lower groundwater levels in advance of excavation. This will minimise groundwater seepage and ensure stability of excavation side slopes. Commonly used pre-drainage methods include:

Deep wells: These are bored wells pumped by submersible pumps; because it does not rely on the suction principle this technique can be used to generate large drawdowns for deep excavations. Wells are normally spaced around the perimeter of the excavation and work in combination to lower groundwater levels over a wide area.

Wellpoints: This method uses lines or rings of closely spaced shallow wells (known as 'wellpoints') installed around the excavation and connected to a common header pipe which is pumped by a wellpoint pump capable of pumping both air and water. This technique is very flexible and is widely used for pipeline trenches and shallow excavations. Suction limitations mean that the maximum drawdown that can generated by wellpoint systems is typically 5 to 6 m.

Eductors: This is a specialist technique used to depressurise and stabilise poorly draining fine-grained soils such as silts, silty sands and clays with permeable fabric. The system works by circulating high pressure water (from a tank and supply pumps at ground level) to a small-diameter nozzle and venturi located in the eductor in each well. This generates a vacuum directly in the well.

Horizontal wells: Specialist trenching machines can be used to lay a horizontal flexible perforated pipe, which is pumped by a wellpoint pump. This method can be very effective for dewatering long pipeline excavations. Horizontally directionally drilled (HDD) wells can also be used for dewatering below inaccessible areas or in areas where the disruption associated with surface drilling is undesirable.

COMPANY PROFILE

Groundwater Engineering is an international company specializing in dewatering, groundwater control and water well engineering for clients in the construction, mining and oil & gas industries. Backed by decades of industry experience and technical expertise we are committed to providing our clients with high quality and cost-effective solutions to their groundwater problems.

We pride ourselves on providing safe, technically sound and environmentally sensitive designs, and delivering them in the field, on time and on budget. Our teams combine geotechnical, hydrogeological, engineering and construction management skills, a strong supply chain, quality equipment and materials and skilled operatives to meet our client's needs.

Contracting

Groundwater Engineering provides a specialist contracting and construction service to design, install, commission, operate and maintain specialist groundwater, geotechnical and water supply systems, including:

- Construction dewatering and groundwater control
- Mine dewatering
- Water wells and water supply
- Geothermal systems

Consultancy

Groundwater Engineering offers a comprehensive design and consultancy service in the dewatering, groundwater control, water well, geothermal and groundwater remediation markets. We are able to provide robust, cost effective designs, and to innovate where it will benefit our clients.

Equipment sales and rental

Groundwater Engineering sells and rents a wide range of materials and equipment in the dewatering and water well fields:

- Dewatering pumps and equipment
- Pipework and pump controls
- Water well materials and pumps
- Well rehabilitation supplies

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