

# **GROUND IMPROVEMENT TECHNIQUES**

**By**

**Engr. Liaqat Ali**  
**MS Geotechnical Engineering**  
**Lecturer INU Peshawar**

**UNIT-3**  
**HYDRAULIC**  
**MODIFICATION**  
**N**

DEWATERING : Dewatering is a process in which groundwater contained within the site's soil is extracted , ensuring a stable foundation

Water is discharged Through

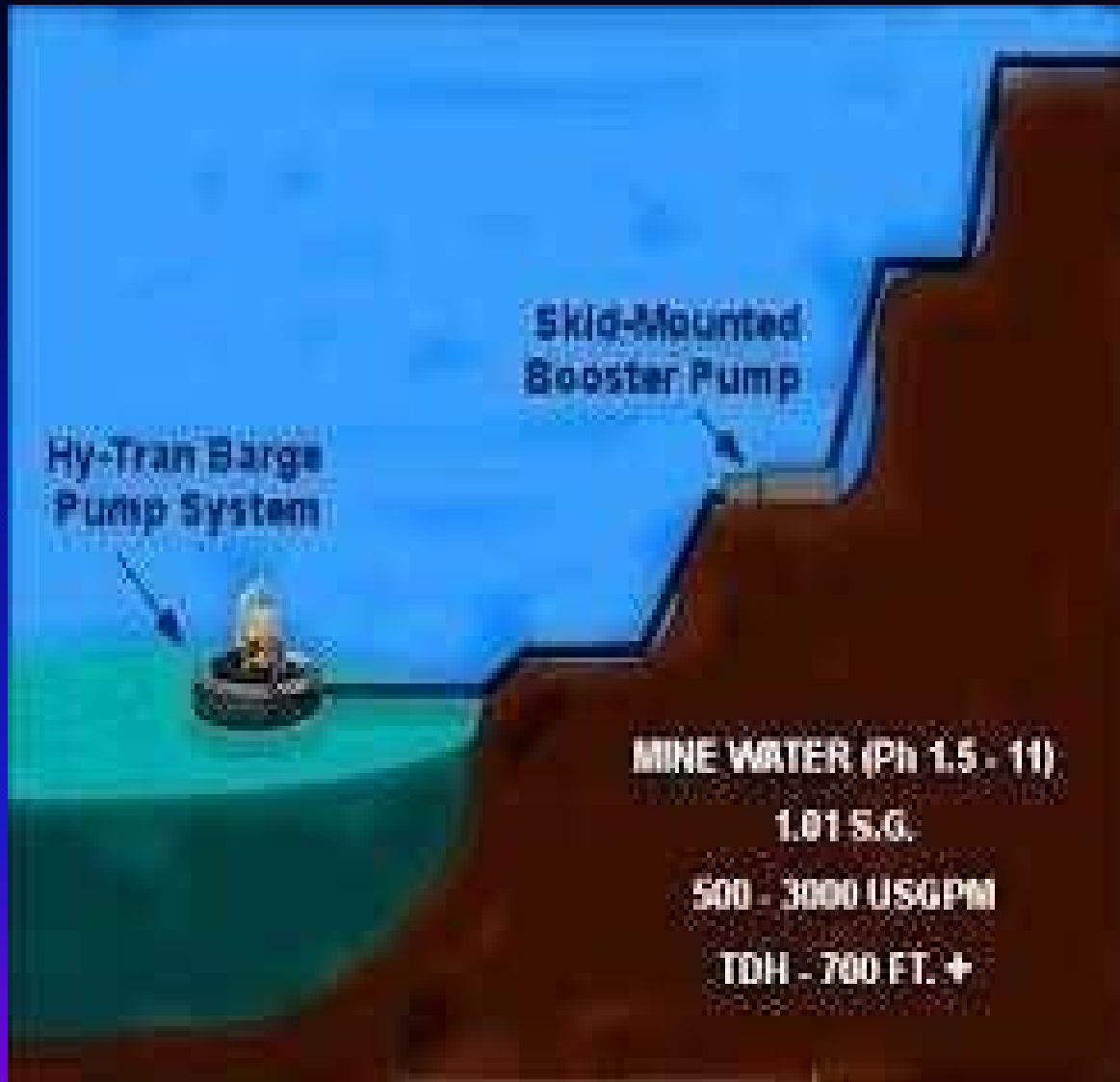
1. Storm drains
2. Municipal sewer System
3. Irrigation Purposes

Different methods of Dewatering are:

1. Open dewatering
2. Well point dewatering
3. Deep well dewatering
4. General Sump pumping

## **Open dewatering system:**

**It enable one to lower the groundwater table adequately in cohesive and low permeable soils. Water is pumped off directly from sumps (ditches) along the toes of the slopes of the excavation works.**



The suction hose with strainer is merely placed in the sump and the collected water is primed and discharged. This makes the open dewatering system easy to install and simple to operate. The open dewatering system utilizes

1. self priming
2. vacuum assisted centrifugal pumps,

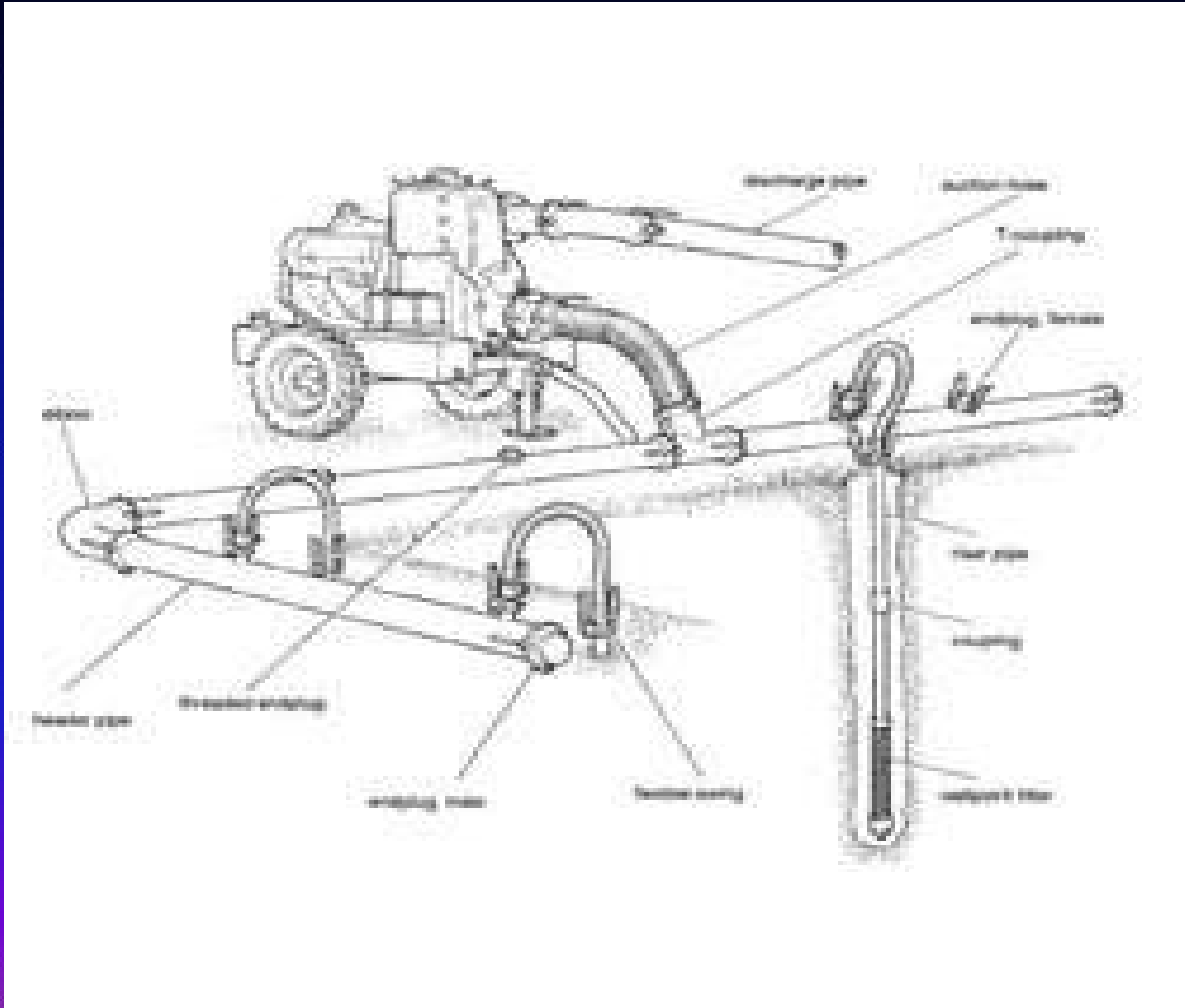
# Well point dewatering system

- 1. Well point dewatering systems enable one to lower the groundwater table adequately for deep and large construction sites.**
- 2. It has proven to be a very flexible system. The water from high permeable soils is pumped from well points, installed along the trench of the site.**
- 3. The well points are jetted and spaced to obtain an efficient drawdown against lowest capacity.**



4. The well points with integral strainers are joined to transparent flexible hoses, which are connected by quick release couplers to the ring main header pipeline.

5. Wellpoint dewatering is done either by gravity



## **Deep well dewatering :**

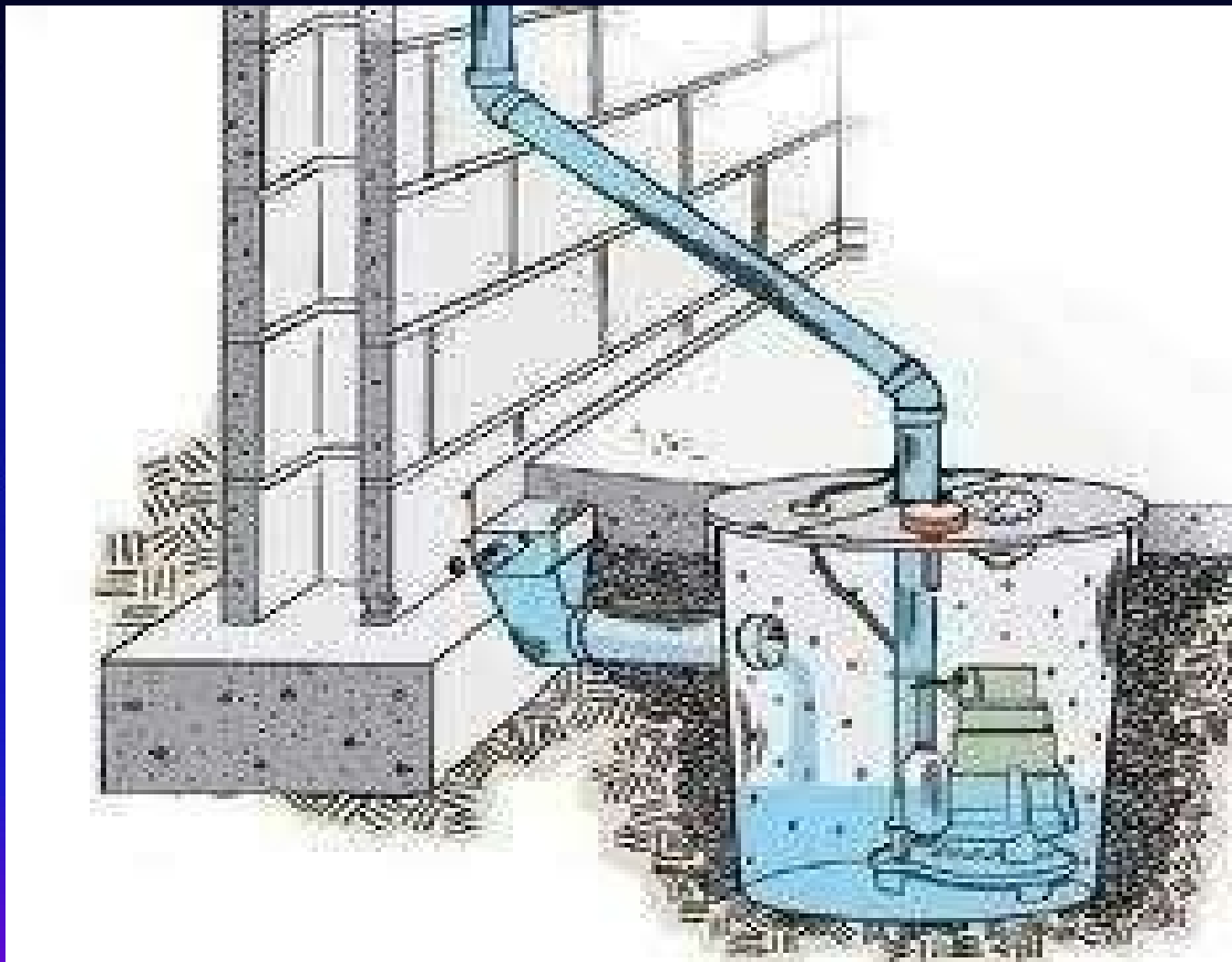
Deep well dewatering systems enable one to lower the groundwater table to a considerable depth. A submersible pump is installed at the bottom of the well, of which the casing generally has a minimum diameter of 150 mm. The discharge pipes from the submersible pumps of a number of adjacent wells are connected to a common delivery main. The water is raised from the well by a multi-staged pump



## General sump pumping:

Sump Pumps are used in applications where excess water must be pumped away from a particular area. They generally sit in a basin or sump that collects this excess water. This classification includes bilge and ballast pumps, centrifugal pumps, cantilever pumps, sewage pump pumps, submersible sump pumps and utility pumps, among others.



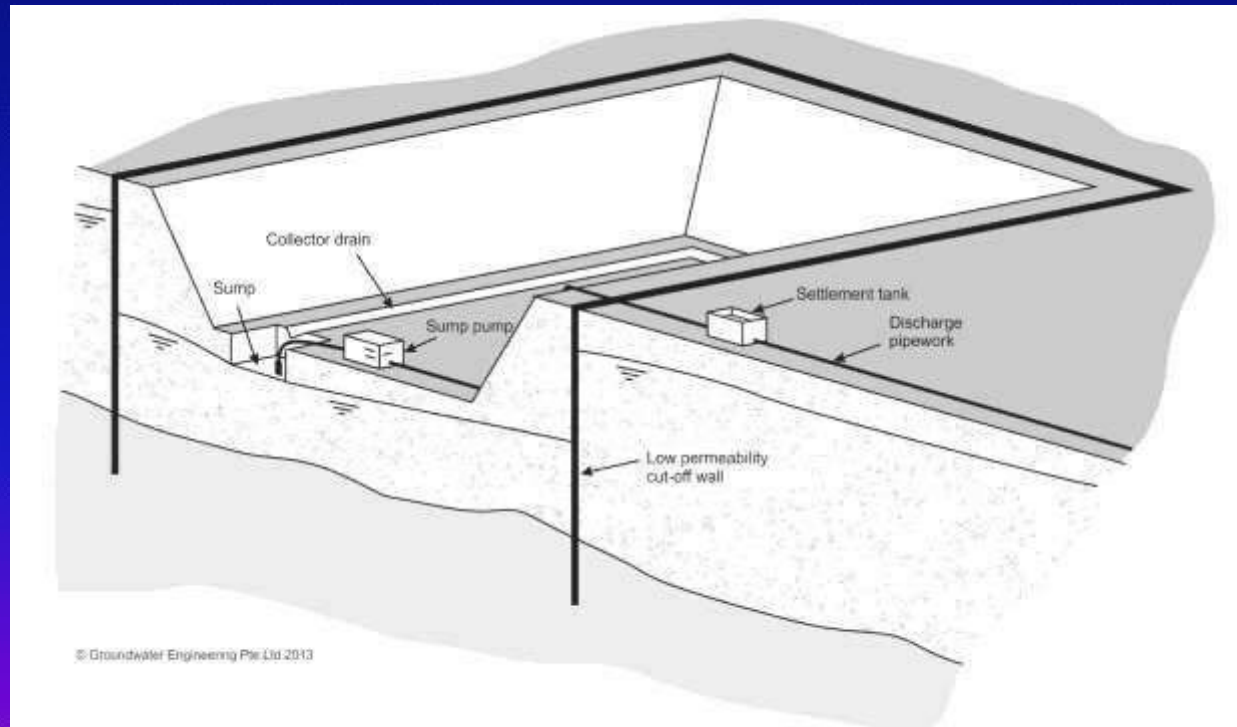


# Definition of Dewatering

- Dewatering is the term for the control of groundwater by pumping. On construction sites it may be known as '**construction dewatering**'. The method is also used on mine sites – '**mine dewatering**'
  - The process of dewatering can be defined as – *pumping from wells or sumps to temporarily lower groundwater levels, to allow excavations to be made in dry and stable conditions below natural groundwater level*
-

# Definition of Dewatering

As an alternative to groundwater control by pumping, physical cut-off walls can be installed around a site to exclude groundwater from the site





# Surface Water Control

Surface water must also be controlled:

## Sources of surface water

- Rainfall
- Construction operations (e.g. concreting, washing of plant)
- Seepage through cut-off walls

## Detrimental effects of poorly-managed surface water

- Risk of localised flooding
- Softening of soil exposed in excavation

# Methods of Surface Water Control

## Source control

- intercept run-off before it reaches the excavation
- prevent unnecessary generation of water in the excavation
- collect water as soon as it reaches the work area (or before!)

## Water collection

- French drains to intercept run off
- collector drains and sumps
- pumping systems (keep it simple!)

## Water treatment

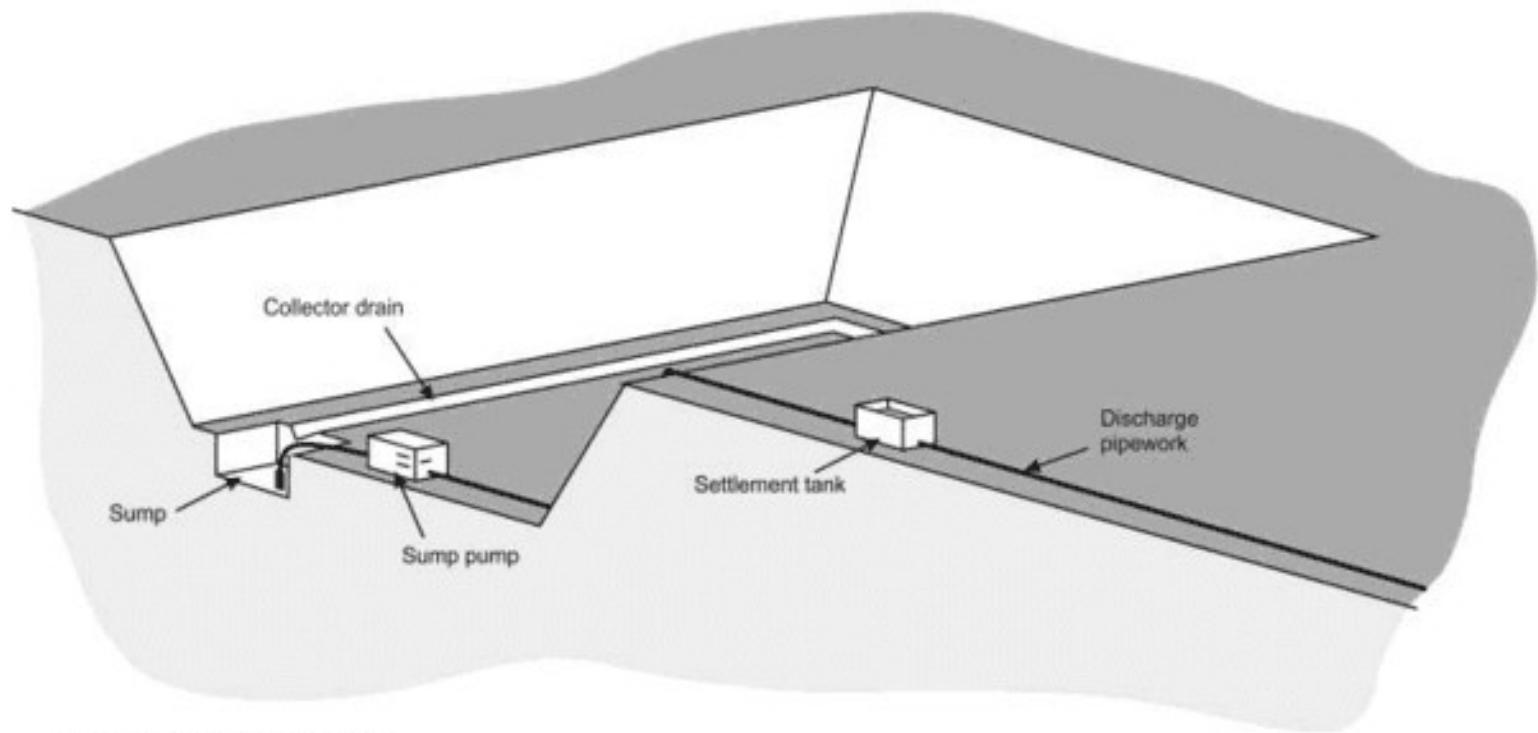
- solids removal (settlement tanks, Siltbusters)

# Dewatering Techniques

## Widely used dewatering techniques

- Sump Pumping
- Wellpoints
- Deepwells
- Ejector wells

# Sump Pumping

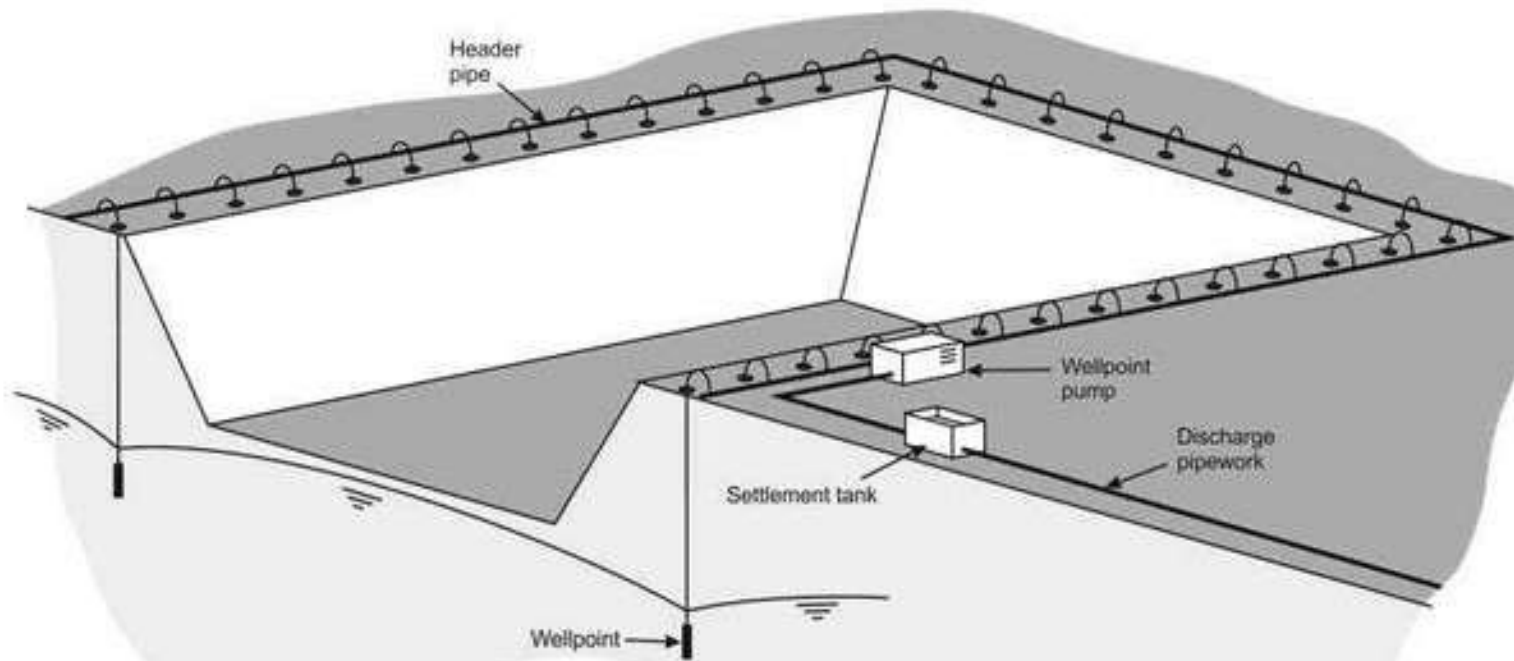


© Groundwater Engineering Pte Ltd 2013

# Sump Pumping

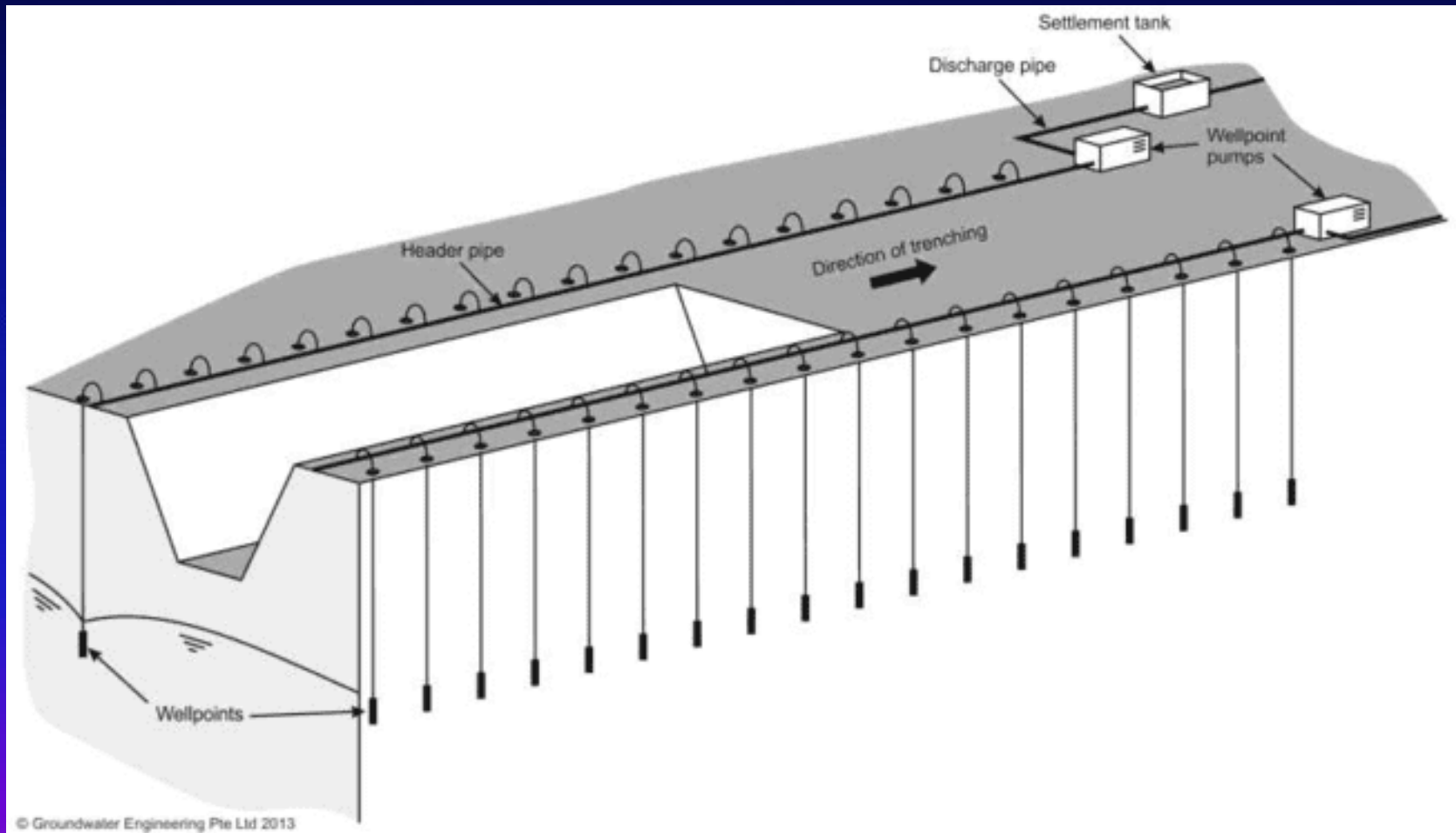
- Water is collected in deeper parts of the excavation (called sumps) and pumped away
- Simple and cheap method of dewatering in favourable ground conditions
- Limited to use in relatively coarse soils or fissured rock – if used in fine grained soils can lead to erosion and loss of fines with the risk of resulting instability
- The sump takes up space within an excavation
- Can lead to water pollution problems due to silt-laden water

# Wellpoints



© Groundwater Engineering Plc Ltd 2013

# Wellpoints

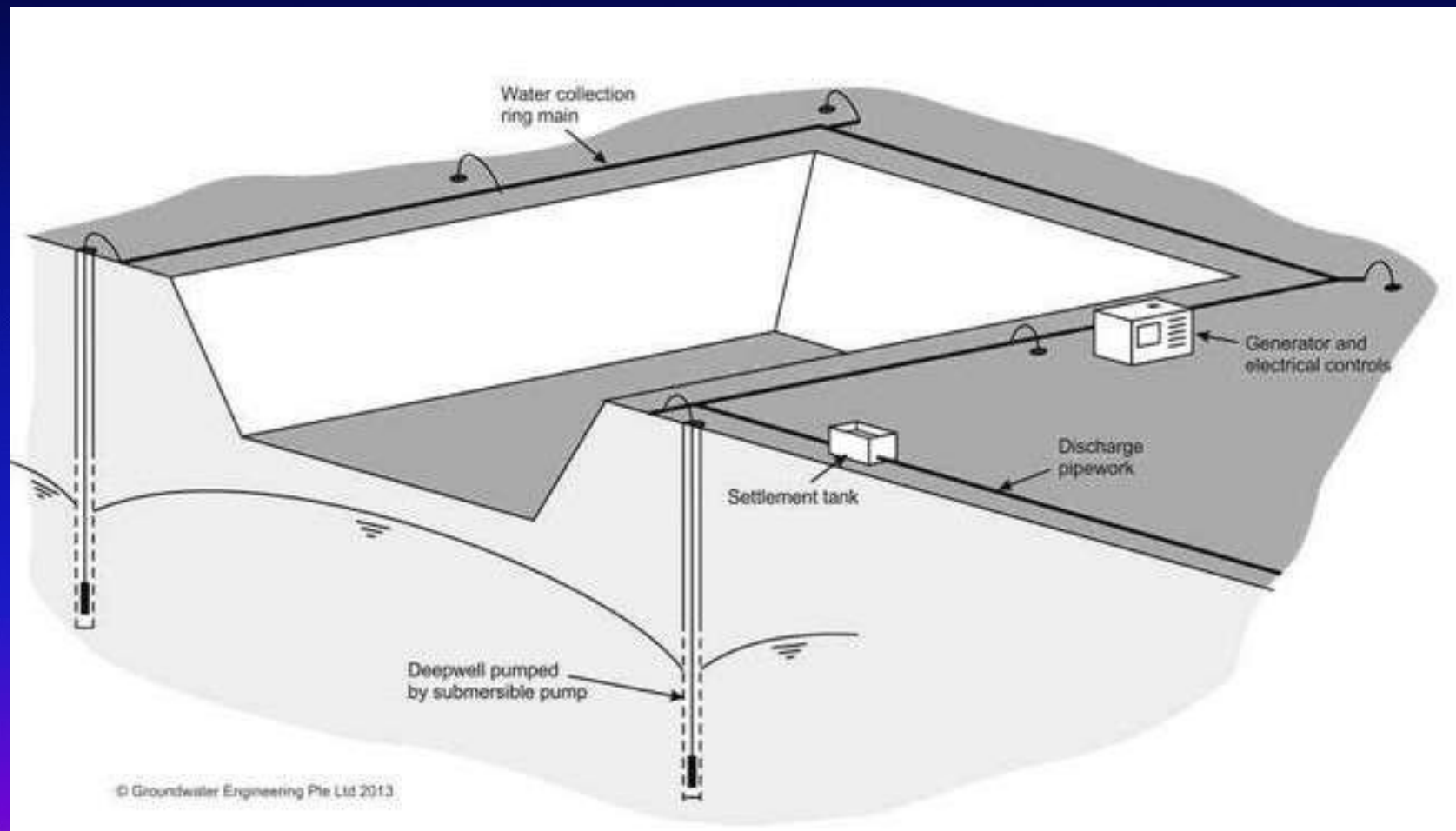


# Wellpoints

- A line or ring of small diameter shallow wells (called wellpoints) installed at close spacing (1 to 3 m centres) around the excavation.
- Commonly used for dewatering of pipeline trenches
- Can be a very flexible and effective method of dewatering in sands or sands and gravels
- Drawdown limited to 5 or 6 m below level of pump due to suction lift limits
- Individual wellpoints may need to be carefully adjusted (“trimming”)



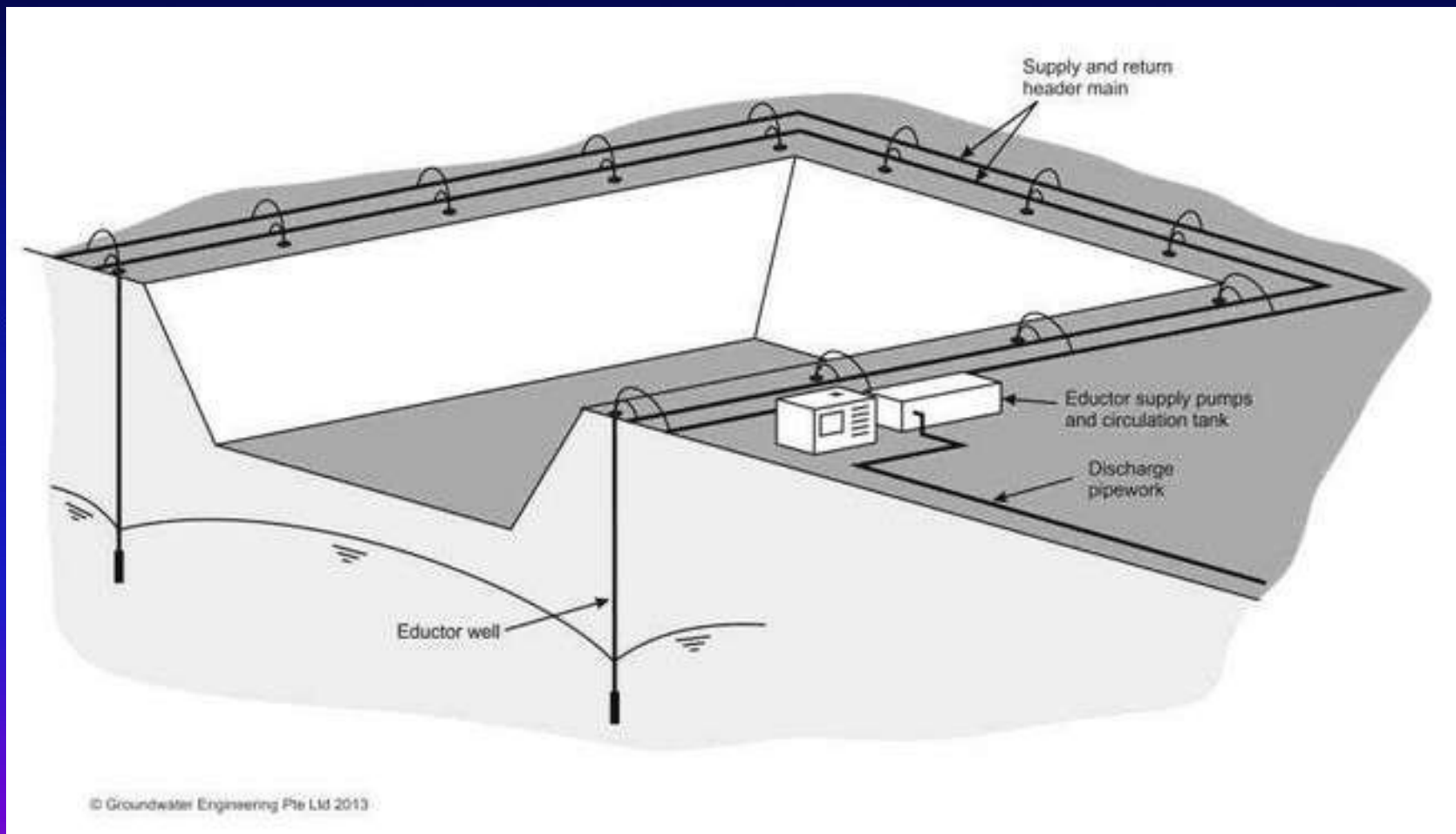
# Deepwells



# Deepwells

- Wells are drilled at wide spacing (10 to 60 m between wells) to form a ring around the outside of the excavation
- An electric submersible pump is installed in each well. Drawdown limited only by well depth and soil stratification
- Effective in a wide range of ground conditions, sands, gravels, fissured rocks

# Eductor Wells



# Eductor Wells

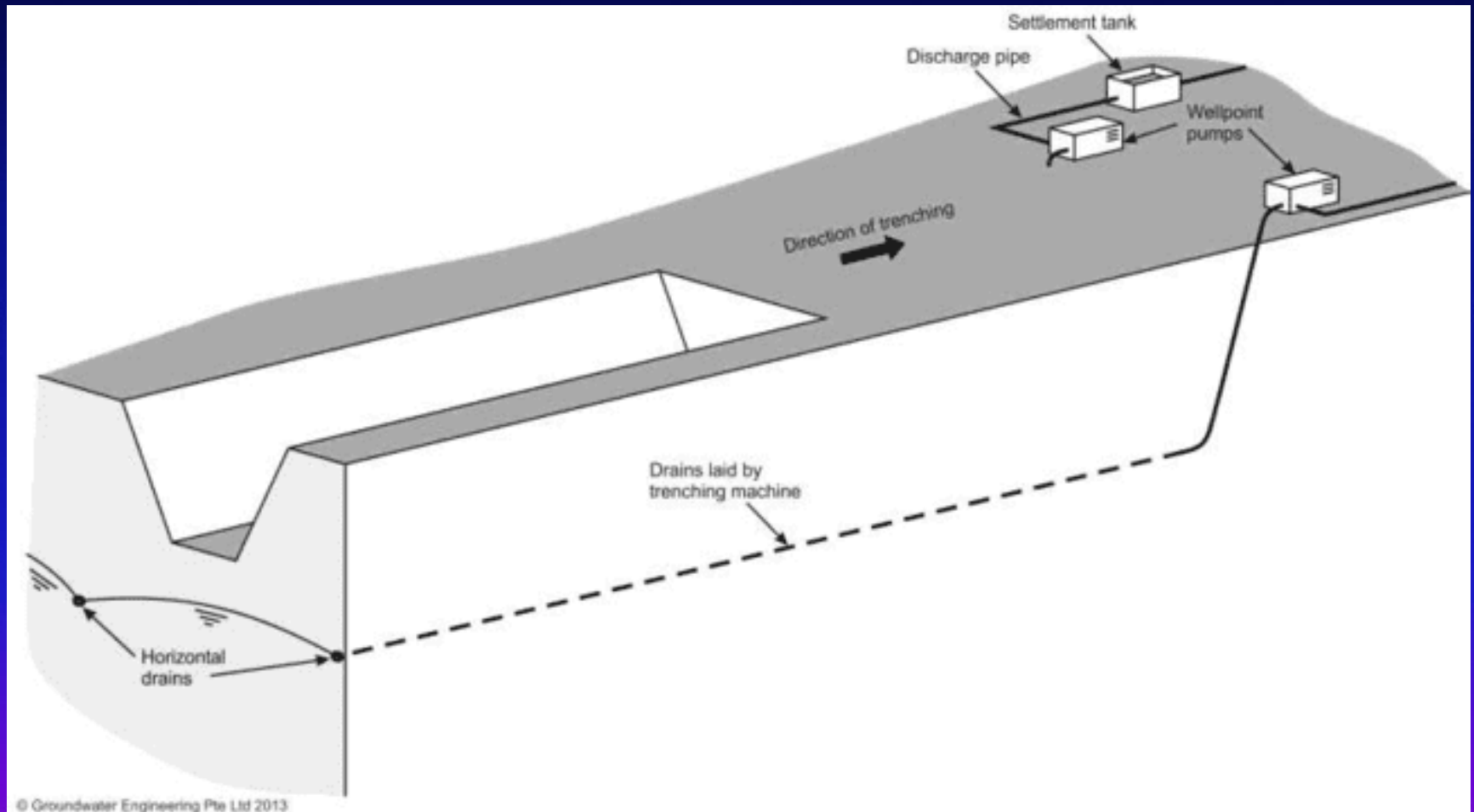
- Effective in stabilising fine soils (silts, silty sands) by reducing pore water pressures
- Wells are drilled around or alongside the excavation
- Suitable when well yields are low. Flow capacity 30 to 50 litres/min per well
- Drawdown generally limited to 25 to 30 m below pump level
- Vacuum of 0.95 Bar can be generated in the well, making this very effective in low permeability soils

# Dewatering Techniques

## Less commonly used dewatering techniques

- Horizontal wellpoints
- Relief wells
- Artificial recharge
- Groundwater remediation

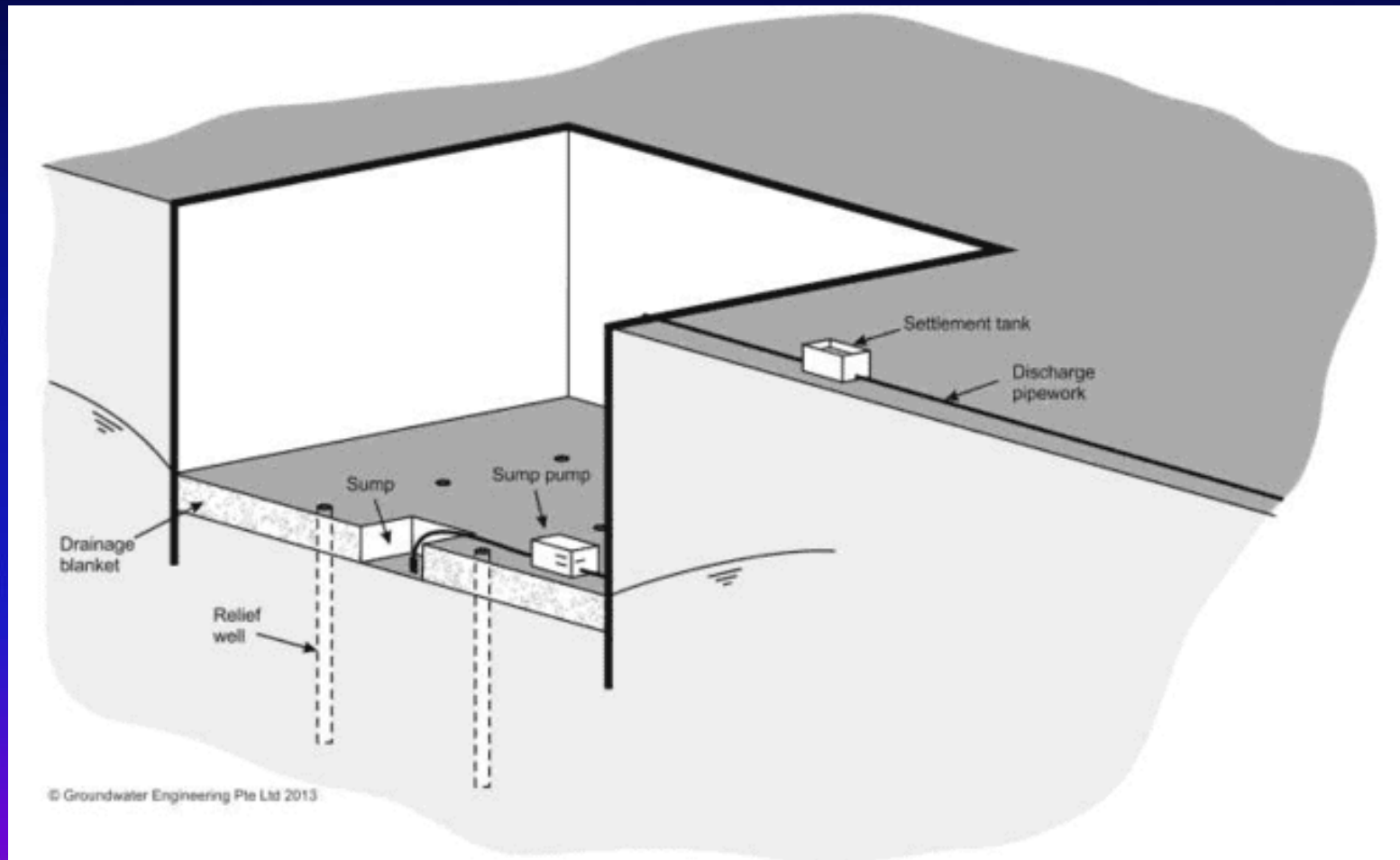
# Horizontal Wellpoints



# Horizontal Wellpoints

- Perforated drainage pipe, typically laid sub-horizontally by specialist trenching machine and surrounded by gravel filter media
- Used to dewater for pipeline trenches or to drain large shallow excavations
- Pumped by wellpointing pumps. Drawdown limited to 5 or 6 m below level of pump due to suction lift limits

# Relief Wells





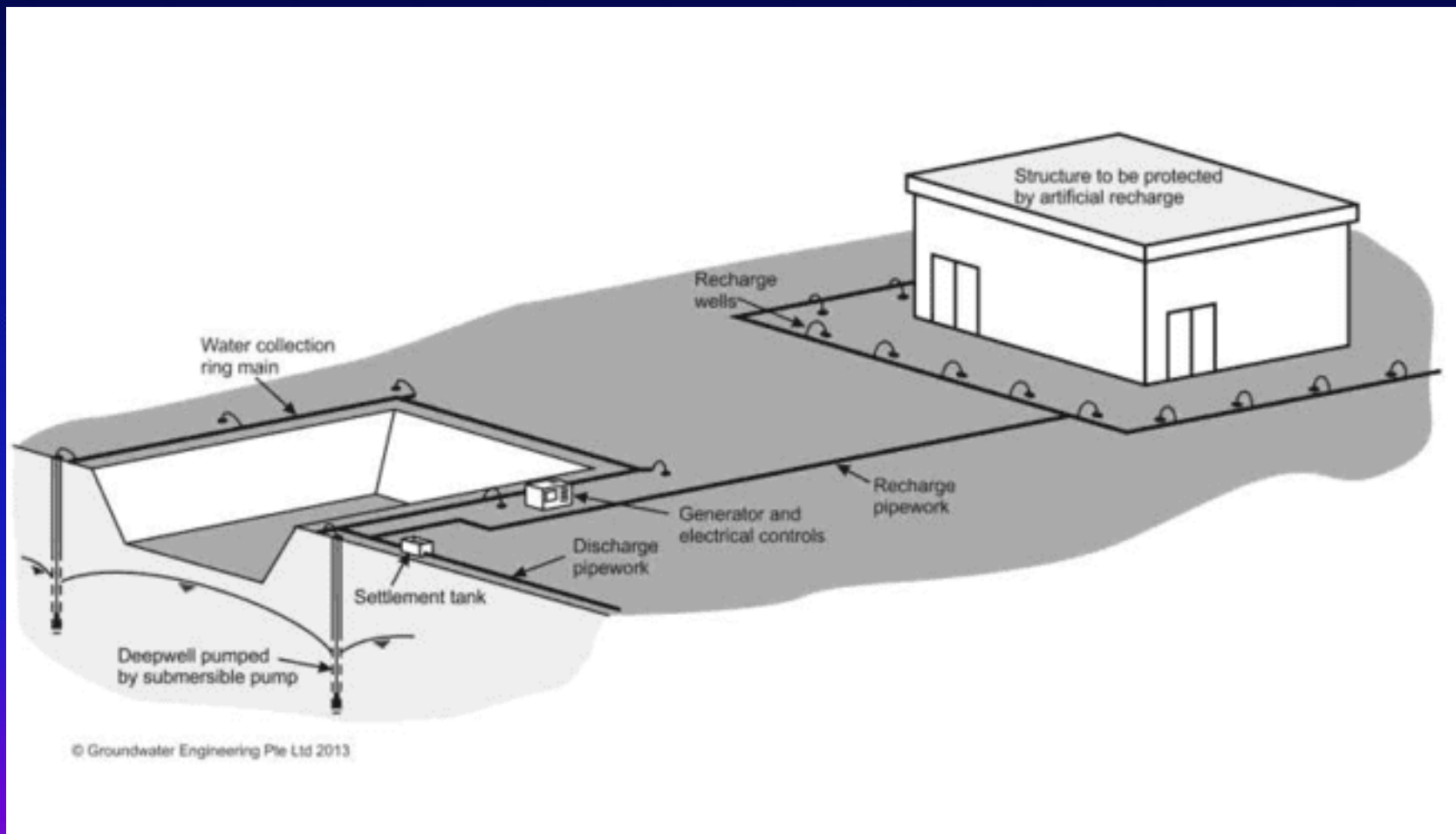
# Relief Wells

- Relief wells are used to form preferential vertical flow paths to relieve water pressures in confined aquifers beneath an excavation
- Water flows upward into the excavation and is collected in a drainage blanket and sumps and pumped away
- Commonly used to prevent heave or uplift of the base of excavations

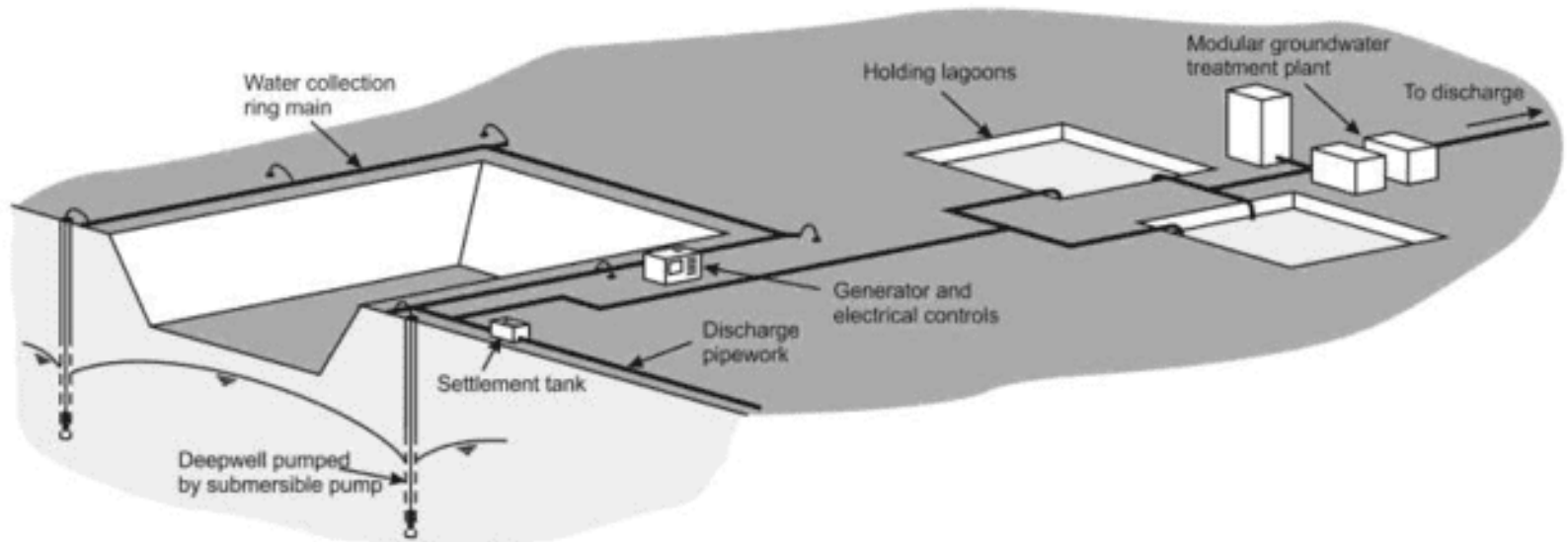
# Artificial Recharge

- Artificial recharge involves re-injecting or re-infiltrating the discharge water into the ground
- Can be used to reduce external drawdowns around a dewatering system. This is sometimes necessary to reduce ground settlements in compressible caused by effective stress increases
- Also sometimes used to help protect groundwater resources by reducing net abstraction from the aquifer – used in aquifers which are important sources of public or private water supply

# Artificial Recharge



# Groundwater Remediation



© Groundwater Engineering Plc Ltd 2013

# Groundwater Remediation

- Dewatering technologies may be used as part of the remediation strategy on contaminated sites
- Pumping from wells may be used to manipulate hydraulic gradients to control the migration of contaminated groundwater
- The pumped groundwater will require treatment to remove contamination prior to discharge