Assessment of Impacts from Groundwater Control Projects

Martin Preene
Technical Development Director, Golder Associates
Synopsis

- What is groundwater control?
- Potential impacts
- Case studies
- The future
- Conclusion
Groundwater control

Definition

“The process of temporarily dealing with groundwater, to allow excavations to be made in dry and stable conditions below natural groundwater level”
Groundwater control

- Exclusion: Physical cut-off walls
- Pumping: Arrays of wells or sumps (construction dewatering)
Groundwater control by exclusion

Cut-off walls penetrate into underlying low permeability stratum

Cut-off walls

Sump to aid draining of trapped water and to remove water leaking through cut-off

Very low permeability stratum
Groundwater control by pumping

Diagram showing pumped dewatering wells, original groundwater level, and lowered groundwater level.
Groundwater control is part of a wider picture

- Groundwater problems
  - Temporary
  - Permanent

Groundwater control by exclusion or pumping

Impacts
- Abstraction
- Pathways
- Barriers
- Discharge

Technology

Regulation
It is widely recognised that impacts can result from abstraction for groundwater control purposes.
Groundwater impacts

- It is widely recognised that impacts can result from abstraction for groundwater control purposes.
It is less widely recognised that groundwater impacts can result even where no abstraction is proposed.
Potential groundwater impacts

Impact 1: Abstraction
- e.g. settlement, impact on water sources

Impact 2: Pathways for groundwater flow
- e.g. increased risk of aquifer pollution

Impact 3: Barriers to groundwater flow
- e.g. changes in groundwater level

Impact 4: Discharges to groundwater
- e.g. risk of fuel spills, etc

Impact 5: Discharge to surface water
- e.g. risk of pollution of surface waters

Based on Preene and Brassington (2003)
Case studies

- Pathways
- Barriers
- Discharge to surface waters
Case studies - pathways

- Excavations through confining layers or through impermeable surfacing can create pathways for groundwater flow
- Example: pipeline construction through inner Source Protection Zone of Public Water Supply source
Excavations through confining layers or through impermeable surfacing can create pathways for groundwater flow.

Example: Cut and cover tunnel for river crossing portal penetrating into confined aquifer.
Excavations through confining layers or through impermeable surfacing can create pathways for groundwater flow.

Example: Cut and cover tunnel for river crossing portal penetrating into confined aquifer.
Case studies - barriers

- Example: Gravel extraction and formation of an inert landfill
- Alluvium and floodplain gravels over Clay
- Gravels have a high hydraulic conductivity and form an unconfined aquifer with a relatively shallow groundwater level
- There was a previous history of groundwater flooding in the area
- Concerns were raised at planning about the impacts of the inert landfill blocking groundwater flow
Case studies - barriers

- The site is located between two water supply reservoirs, where the gravel has been removed.
- The direction of groundwater flow is approximately north to south.
Case studies - barriers

- The hatched areas show where gravel has previously been removed.
- The new landfill may block groundwater flow in the remaining gap between the two reservoirs.
- Another landfill was proposed (by third parties) to the east of the site.
Case studies - barriers

- A 3-dimensional numerical model was constructed using MODFLOW
- The model was calibrated against monitoring data
- Various impact and mitigation scenarios were modelled
Case studies - barriers
Case studies - barriers

- Mitigation was proposed in the form of a groundwater drain around the site to allow natural flow to bypass the site and avoid groundwater flooding to the north of the site.
Case studies - discharges

Silt pollution of water course due to poorly-controlled sump pumping from chalk
Simple skip arrangement used as settlement tank
Case studies - discharges

Silt removal from discharge water using geotextile bags
Monitoring has a key role to play in determining baseline conditions and assessing impacts

- Groundwater levels in wells and boreholes
- Surface water levels in wetlands, streams, etc
- Flow from springs and in associated watercourses
- Water quality parameters at springs or boreholes
In the future we may need to assess ‘sustainability’ of groundwater control

We may be able to use wider sustainability assessment tools to compare methods

It will be interesting to directly compare active (i.e. pumping) methods with more passive (i.e. exclusion) methods
There is increasing awareness of the potential impacts that can result from groundwater control.

There is often a focus on direct impacts from abstraction.

But there are other categories of impact:
1. Abstraction
2. Pathways
3. Barriers
4. Discharges to groundwater
5. Discharges to surface water

In the future we may look at even wider impacts to compare the ‘sustainability’ of different groundwater control methods.
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mpreene@golder.com