International Association of Hydrogeologists

Strategic Overview Series

WATER UTILITIES & GROUNDWATER

KEY MESSAGES

- groundwater offers opportunities for water utilities to develop and operate water-supply sources that are more resilient to climate-change and more reliable in extended drought than surface-water sources
- the extensive distribution of aquifers means that groundwater can often be developed close to water-demand centres reducing capital and operational costs
- water utilities need to manage groundwater sources conjunctively with surface-water sources to optimize efficient service delivery and environmental benefits
- water utilities should be concerned about groundwater management beyond their own waterwells, since effective groundwater protection is in their long-term interest and needs broad collaboration

Why should water utilities pay more attention to groundwater resources ?

The very large natural storage of most aquifer systems results in groundwater resources being much less prone to decline in multi-annual drought and to offer greater resilience against climatic variation than surface-water sources. Thus groundwater nearly always represents a much more reliable source of public water-supply, which can be developed (within defined sustainable limits) at lower cost, because the water-treatment requirement is much less complex.

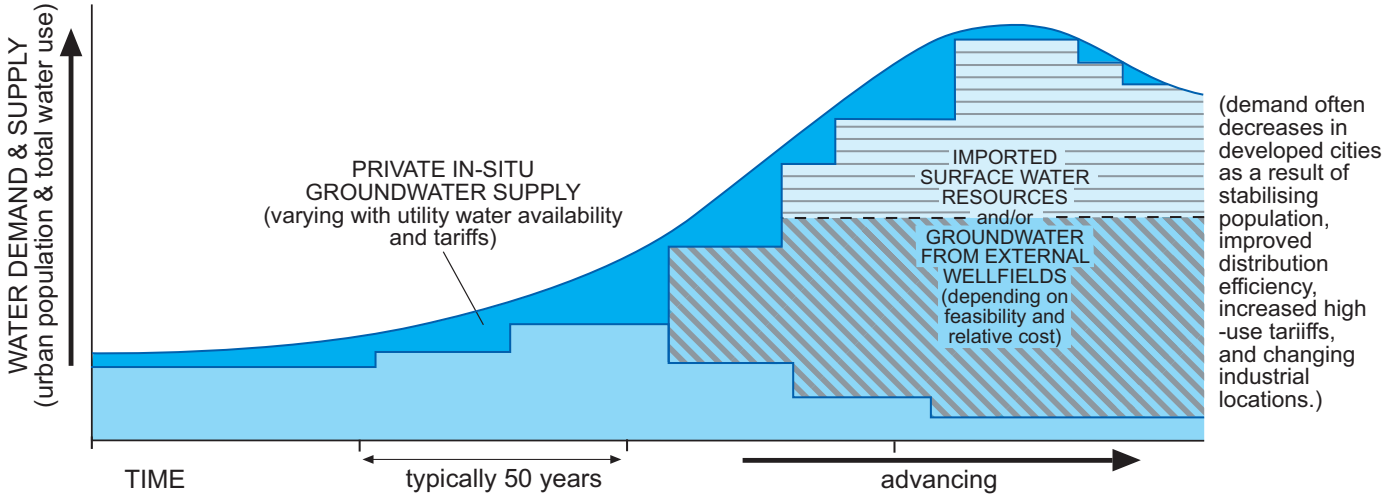
There will be variations on this position between developed and developing cities, since the situation evolves with time to greater dependence on external groundwater wellfields and/or imported surface-water sources in larger older cities.

The importance of developing local groundwater resources has been clearly demonstrated in some recent drought crises faced by water utilities, such as those in Cape Town (2016-18) and Chennai (2017-19). In these cases the water utility historically tended to ignore the possible development of local groundwater resources and was then confronted with desperate supply shortages from their surface-water reservoirs in extended drought.

GROUNDWATER SUPPLY DEVELOPMENT BY WATER UTILITY IN SUPHANBURI - THAILAND

This Series is designed both to inform professionals in other sectors of key interactions with groundwater resources and hydrogeological science, and to guide IAH members in their outreach to related sectors.

EVOLUTION OF GROUNDWATER USE AND DEPENDENCY WITH URBAN POPULATION GROWTH



Where water utilities have developed local groundwater rationally they have been much more able to cope in severe extended droughts.

The extensive distribution of many aquifers means that groundwater supplies can often be developed close to water-demand centres, avoiding the need for long-distance piped infrastructure and water transfer, reducing capital cost and operational vulnerability. Moreover, the development of groundwater also permits incremental water-supply expansion with phased expenditure, and can avoid the need to raise very large sums for the capital works of new sources.

Thus water utilities everywhere need to view and manage groundwater conjunctively with surface-water and other sources to allow better service delivery at lower cost to the community and to optimise the related benefits of environmental protection.

COMPARATIVE CAPITAL & RUNNING COSTS OF WATER SOURCES
(to expand London water-supply in water-stressed South-East England)

TYPE OF SUPPLY	CAPACITY (Ml/d)	CAPITAL COST (US$million per Ml/d)	RUNNING COST (US$ per Ml/d)
Conventional Groundwater	5	2	33
Groundwater MAR-Supplemented	10	4-6	45
Effluent Re-Use or Desalination	100	5-12	900

What risks to groundwater resource sustainability need to be addressed by water utilities ?

For waterwell use to be sustainable (and available at times of severe water-stress), groundwater resources need to be pro-actively managed to avoid :

- permanent depletion due to overexploitation, sometimes accompanied by saline-water intrusion or up-coning
- pollution from uncontrolled on-site sanitation, agricultural land-use and industrial activities.

Water utilities, being the major stakeholder in potable water-supplies, should formally recognise and embrace their co-responsibility for ground-water resource management and protection to avoid the above impacts. Inadequately designed and regulated groundwater development can also lead to serious degradation of groundwater-dependent ecosystems, and water utilities need to work with other groundwater stakeholders (notably the environment or water-resource regulator) to avoid or minimise such impacts.

In this context it will be helpful for water utilities to engage with their customer base so that their key involvement in environmental management is better understood, and a 'willingness to pay' for such services is generated.

What factors can facilitate or impede water-utility involvement with groundwater resources ?

The constitution and size of water utilities varies very widely both internationally and within some larger countries. The main organisational types are regulated private companies, publically-owned and operated corporations, and publically -owned corporations, operated in partnership with either a private company under a long-term concession or a public entity under an operational agreement. Water utilities can serve anywhere between 20,000 and 10 million customers.

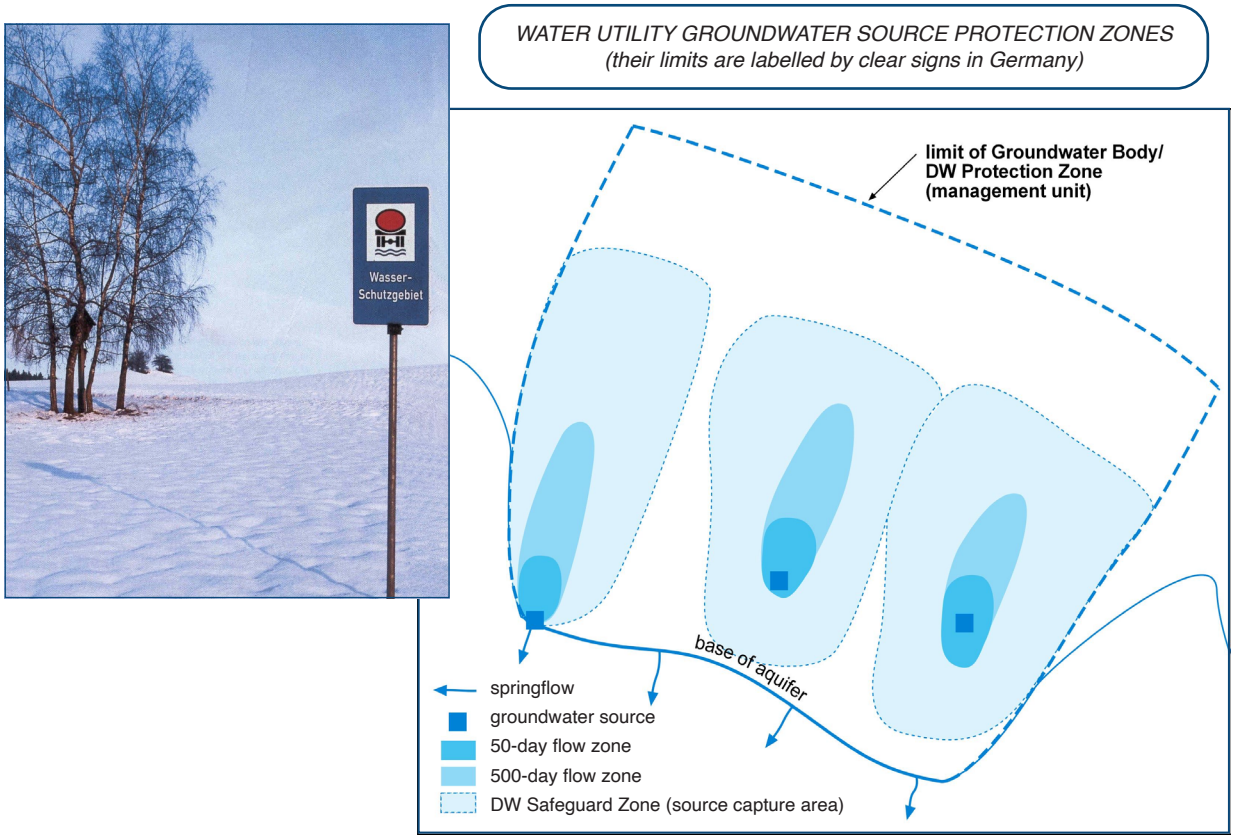
The factors impeding the wider involvement of some water utilities in groundwater resource management are the result of a combination of:

- restricted legal and regulatory mandate
- inadequate in-house capacity and knowledge of groundwater system behaviour.

The small size and aerial extension of some water utilities may mean that they have no operational role in the area of occurrence of relevant aquifers. This will inevitably affect how a water-utility interprets its role – as a mere 'service provider' or a 'co-resource custodian' with other groundwater stakeholders. But while the level of engagement will certainly vary with the size and constitution of water utilities, there are activities that even smaller utilities can very usefully undertake.

The factors that can facilitate greater water-utility involvement in groundwater resources include;

- an explicit regulatory mandate as a major stakeholder
- general social pressure to protect the water environment and develop greater supply resilience to global warming.



Water utilities need to promote debate on their water-resource role internally, and then clarify their position with the government water-service regulator so as to seek broader responsibility especially regarding groundwater catchment management and pollution protection. This will unquestionably pay-off in the longer run. Moreover, if a water utility takes on a major role in groundwater resource conservation this should be acknowledged by the water-service regulator at times of water-tariff determination.

How can hydrogeological knowledge and expertise improve water-utility source design and operation?

A better understanding of how available groundwater resources can best be used to support water-utility supplies is critical to improving urban water-supply security. The capacity of a water utility to act in this regard will vary quite widely on a geographic basis between the developed and developing world – but whether using in-house capacity or engaging appropriate hydrogeological or water-resource consultants, water utilities need to recognise the long-term benefits of getting sound advice in this regard.

The phased development of groundwater resources lowers considerably the capital development and operational costs of water-supply, and the application of 'advanced tools' like numerical groundwater modelling will help to optimize production waterwell operation and to understand interactions with groundwater-dependent ecosystems.

The delineation and implementation of groundwater source protection zones is of crucial importance for both reducing the risk of escalating water-treatment costs and increasing yield security. Moreover, understanding the factors that influence waterwell abstraction will serve to protect water-utility assets, and define their associated maintenance requirements more closely.

Why should water utilities be proactive on local groundwater resource management and protection?

Groundwater degradation is a slow process and action needs to be taken early to reduce insidious diffuse agricultural pollution, to curtail chemical contamination in industrial areas, and to avoid aquifer depletion especially in coastal areas. For

SOME EXAMPLES OF SPECIAL FUNCTIONS PERFORMED BY WATER UTILITIES

COUNTRY	LOCATION	SPECIAL FUNCTION
BRAZIL	Recife	empowered by state government to oversee, regulate and charge for private waterwell use, so as not to distort municipal water-supply tariff structure and revenue collection
ENGLAND	South-East	co-managing the control of groundwater impacts on the ecological status of Chalk streams
GERMANY	Munich	land-use management/co-stewardship for ecological farming scheme to maintain high natural groundwater quality for large urban water-supply wellfield
MEXICO	San Luis Potosi	acting as lead stakeholder in communal initiative for demand management measures (including wastewater re-use) to promote stabilization of a strategic aquifer
PERU	Lima	designing and implementing, on behalf of government ministry, major demand management and conjunctive use scheme to allow recovery of strategic urban aquifer in hyper-arid terrain

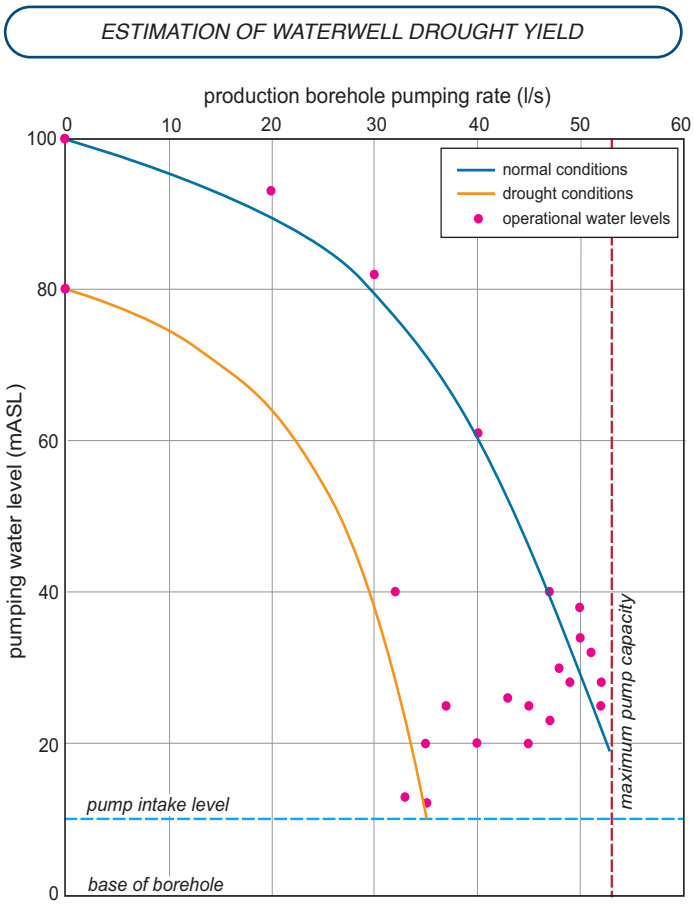
example the EU-Water Framework Directive strongly recommends 'pollution prevention rather than advanced water treatment' as a core philosophy, and groundwater source capture area protection must be seen as an integral part of this philosophy.

For this to happen water utilities need to take a clear lead on advocating to the water-resource regulator and local planning authorities that risks to groundwater must be incorporated into local planning procedures, and also seek agreement with local farmers to reduce or eliminate diffuse groundwater pollution from agricultural practices. Lack of timely action will risk escalating long-run water-supply costs.

Demand-side management is a basic pillar of sustainable groundwater management and one in which water utilities have a key role by promoting water-saving and rational water-use across their customer base.

Water utilities are also well placed to promote supply-side management through the enhancement of groundwater recharge by managed aquifer recharge (MAR) initiatives, including routing urban roof drainage to recharge soakaways. This will provide additional physical security to their groundwater supplies as well as being responsible stewardship of the water environment.

Unregulated (and often illegal) abstraction from private waterwells is commonplace in many developing cities. While groundwater use for self-supply can reduce the pressure on water-utilities supplies and in the short-term increases urban water security, it can also make the management of urban groundwater resources profoundly more complex, and have negative impacts on water-utility revenue and impact water-supply availability. As far as regulatory constraints allow, water-utilities need to make a greater effort to identify private waterwell use, offer monitoring services to improve its safety and where appropriate make a charge for related effluent discharge to the main sewerage system.



How can water utilities contribute to national and regional groundwater resource governance and management?

Water utilities hold large volumes of carefully-collected groundwater data, and some of this information needs to be shared with national and regional agencies and incorporated on national databases to improve hydrogeological understanding as a basis for improved groundwater management.

Water utilities are able to provide a valuable connection between the community and government. National or regional water-resource planning processes are top-down but require community facilitation and this role can be articulated by water utilities. The implementation

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acknowledging the collaboration of the International Water Association (IWA) at the corporate and individual member level for the production of this overview

of water-resource policies and strategies can be then be partly channelled through the water utilities (in coordination with others) as implementing agents.

The co-promotion of strategic groundwater management initiatives, such as recharge capture area protection, recharge enhancement practices,and monitoring private waterwell use can make a valuable contribution to national objectives, and will also aid the rapid extension of water-utility services.

GROUNDWATER PUMPING STATION OF SANTA CRUZ WATER UTILITY - BOLIVIA

PRIORITY ACTIONS

- **water utilities need to define and manage better the role of groundwater and its conservation in the long-term planning of climate-resilient water-supply operations**
- **water utilities need to undertake or to commission scientific definition of their groundwater source capture zones with systematic assessment of their possible pollution sources and appropriate mitigation measures**
- **water utilities need to engage actively with other stakeholders, notably the environment or water-resource regulator, to promote groundwater-friendly land-use practices**
- **water utilities need to consider seeking broader responsibility for stewardship of the groundwater-dependent environment, ensuring that water-supply operations are designed and monitored to avoid negative ecological impacts**

FURTHER READING

- *Cassim Z 2018 Cape Town could be the first major city in the world to run out of water. USA Today : 19 January 2019.*
- *DVGW 2008 Position paper on water resources protection German Association of Water Suppliers (DVGW) via: www.dvgw.de/english-pages/topics/water.*
- *Foster S & Sage R 2017 Groundwater science in water-utility operations : global reflections on current status and future needs, Hydrogeology Journal 25 : 1233-1236.*
- *Foster S et al, 2020 Urban water shortages - is groundwater the answer? CIWEM - The Environment February 2020: 32-35*
- *Foster S et al, 2020 Climate change : the utility groundwater role in supply security IWA -The Source April 2020 : 50-54*
- *Nagarajan G et al 2021 How one of the world's wettest major cities ran out of water. Bloomberg News : 3 February 2021.*
- *Olivier D W & Xu Y 2019 Making effective use of groundwater to avoid another water-supply crisis in Cape Town, South Africa. Hydrogeology Journal 27, 823–826.*
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- *US-EPA 2020 Adaptation actions for water utilities. US-Environmental Protection Agency (Washington DC) via:www.epa.gov/arc-x/adaption-actions-water-utilities.*
- *Yeung J et al, 2019 India's sixth biggest city is almost entirely out of water. CNN News Feature : 19 June 2019*

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