WE KNOW AQUIFERS
With over 80 years innovating subsurface exploration technologies, Schlumberger has become one of the most trusted service providers to managers of underground resources.

Schlumberger Water Services’ aquifer storage and recovery (ASR) systems offer a cost-effective, mass storage solution that lets you take back control of your water supply – naturally. Schlumberger Water Services offers a full range of services and technologies to help you grasp the full extent of your natural underground storage capacity. We help you use existing aquifers and reveal the ability to store billions of gallons of water underground at a fraction of the cost of conventional approaches.

ADVANTAGES OF ASR
- Ability to store billions of gallons of water
- Fraction of the cost of aboveground storage tanks
- No potential for in-tank fouling
- Reduced environmental footprint
- Does not have the evaporative losses of surface water reservoirs
- Very low risk of contamination

A BALANCED SOLUTION
Schlumberger Water Services provides a viable process for industrial and domestic clients to balance water supply against water demands. The aquifer’s storage capacity and hydraulic properties are critical to this balancing act.

We are helping stakeholders worldwide adopt ASR for:
- Seasonal storage of treated potable water (e.g. desalinated water)
- Storage of non-potable water
- Supplemental and emergency water sources
- Long term (inter-year) storage
- Capture and storage of surface water that would otherwise be lost
- Development of strategic water reserves
- Prevention of saline-water intrusion
- Improvement of surface water quality and reclaimed water quality
- Maintenance of environmental flows in streams

Our experts are developing ASR systems in some of the most arid climates in the world
APPRAISAL
Schlumberger Water Services’ approach to meeting the challenges of ASR is to provide superior team expertise and technology. Schlumberger is the global leader in sub-surface technology, giving Schlumberger Water Services access to a wealth of unmatched experience, knowledge, and advanced instrumentation. Many of our proven tools, originally developed for the oil and gas industry, can be applied directly to ASR and other water resources projects. In addition, Schlumberger Water Services has developed data analysis, modeling, and monitoring tools specifically for groundwater projects.

TECHNICAL CONSIDERATIONS
Our ASR systems are implemented in a phased approach, during which the feasibility, implementation plans, design, and economics of the project are re-evaluated as data is obtained. Go/No-Go decisions should be formally made after each project phase, in which the feasibility and cost-effectiveness of the ASR project at the investigated location(s) are objectively evaluated. The major advantage of a phased approach is that it affords early opportunities to change direction if an ASR project or location appears not to be feasible.

Our advanced aquifer modeling abilities can incorporate a variety of data sources, including:

- geophysical interpretation
- surface imaging and mapping
- log interpretation and well correlation
- complex fault and fracture modeling
- facies and geophysical modeling
- hydrodynamic test analysis
- uncertainty analysis
- surface and subsurface interaction
- upsampling processes and property population
- river and mass transport simulation
- surface geophysical surveys to assess the lateral extent and geometry of the aquifer

DESKTOP PRELIMINARY FEASIBILITY ASSESSMENT
Feasibility Study
Site Selection
Conceptual Design for Field Pilot Test

EXPLORATORY WELL PROGRAM
- Drilling and Evaluation of Test Wells
- 3D Hydrogeologic Dynamic Model and Simulation
- Geochromic modeling (incompatibility of injected water with ambient water and rocks)
- Conceptual Design for Phase III

DESIGN CONSIDERATIONS
We optimize efficiency, total recovery rate, the area of influence, and the area covered by the well field. Schlumberger Water Services has the technology and expertise to determine geologic and hydrogeologic heterogeneities in the pre-design stage of the project. Knowing these details minimizes the unknowns and maximizes certainty of success. Key design influences include:

- Native groundwater quality - less saline better mixing, desired water quality below 5000 mg/l TDS
- Hydraulic conductivity
- Water levels and pressures
- Aquifer heterogeneity
- Storage zone thickness
- Mixing due to hydrodynamic dispersion
- Confinement
- Regional flow gradient
- Geochemical – adverse water quality changes and plugging

IMPLEMENTATION
A successful ASR project requires excellent planning. Schlumberger Water Services increases the probability of success and reduces project costs by eliminating unexpected expenses during system construction, testing, and operation. Planning of ASR projects involves identifying, and giving due consideration to, the various factors that can impact the cost and success of an ASR project and proactively developing strategies for dealing with them.

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AR CAN BE USED FOR:
Domestic/public water supply
The most common application of ASR is public water supply. ASR systems can be used to manage seasonal imbalances in supply and demand, or to minimize the risk of drought occurring in years when normal water supply is disrupted.

Mining – aggregate, mineral, and precious gems
In many parts of the world, mining occurs in areas with limited or ephemeral supplies of water. ASR can be used to capture and store surface water for long-term storage or year-round mining operations. Water pumped during dewatering activities may also be stored for later beneficial uses.

Industry
ASR can be used by water intensive industries to provide seasonal or interyear water storage, which would help ensure a reliable year-round supply.

Energy – oil and gas
Oil and gas exploration and development activities may require large volumes of water for activities such as hydrofracturing and considerable quantities of water may be coproduced during oil and gas production. Treated oilfield waters may be stored in ASR systems for later use in oil and gas activities, reducing demands on local freshwater resources.

Agriculture
ASR can be a valuable drought management tool for agricultural operations. Seasonally or episodically available excess water can be stored for later use, when adequate water might not otherwise be available. ASR can also reduce or eliminate aquifer overdraws by balancing production and recharge.

Desalination Plants
Membrane desalination water treatment plants operate most efficiently when the membranes are being used continuously. Schlumberger Water Services provides the expertise to design, permit, and construct desalination plants, and reduce overall costs, by avoiding the construction of an underutilized treatment capacity.
Field data, analytical data and spatial data are all critical components of a successful groundwater management strategy. Schlumberger Water Services can help you to integrate, analyze, and report on these many data types.

- QA/QC functionality ensures data is accurate and within acceptable ranges
- GIS capabilities provide the spatial and temporal distribution of virtually any field parameter
- Cross-section interpretations of geologic and hydrogeologic data validates conceptual models
- Advanced borehole logs highlight geologic features critical to subsurface characterization
- Reports present project data to meet compliance guidelines and client needs

Advanced modeling programs address geologically complex site conditions that extend beyond traditional flow and transport modeling. Our programs provide the highest degree of accuracy necessary to minimize uncertainty.

- Hydrogeologic conceptual models are developed directly within the data management system to support input for various numeric models
- Model input incorporates multi-phase flow, density-dependent flow, air flow, discrete fractures, surface water and groundwater interactions
- Aqueous geochemical analysis and modeling predict changes to water quality
- Model results are optimized and calibrated to site conditions
- Finite element, finite difference, and finite volume gridding capabilities provide the numerical power to address any modeling project
- Three dimensional visualization tools reveal spatial and temporal trends

Merging advanced technologies with innovative solutions
About Schlumberger Water Services

Managing the world’s water resources is no small task. We tackle global water challenges with our worldwide network of hydrologists, geologists, and environmental experts. Combined with powerful and cost-effective technologies, we are successfully managing the world’s water resources, for now and the future.

Our people deliver your success.