Water Management for Coalbed Methane
Expertise, Technology, Solutions
Water Solutions for Coalbed Methane Projects

SCHLUMBERGER WATER SERVICES
Schlumberger Water Services has built a global organization providing groundwater resource management services. Through investment in water industry expertise and proprietary technology, Schlumberger has augmented its established leadership in reservoir evaluation and characterization with a dedicated team of hydrogeologists and engineers that use specialized tools to provide comprehensive assessment and management of aquifer systems. We deliver solutions to extensive water management challenges encountered during coalbed methane development projects.

SPECIALIZED CAPABILITIES
- Project management
- Preliminary groundwater assessment
- Baseline water well testing
- Regional hydrogeologic assessment
- Aquifer dewatering and management
- Drilling and pumping tests
- Water management planning
- Injection well design and drilling
- Reservoir engineering
- Geochemical evaluation
- Modeling and simulation
- Groundwater monitoring
- GIS integration and data management

Coalbed methane is a valuable resource that has become a major global energy source. Meeting demands requires careful evaluation and mitigating impacts to groundwater.
Coalbed Methane (CBM) projects produce gas from wells drilled into naturally fractured coal seams where gas is adsorbed within the coal matrix. The fracture system must first be dewatered to reduce pressure, allowing gas to diffuse from the bulk of the coal into the fractures. Effective management of the produced coalbed water and protection of fresh groundwater in adjacent aquifers are key challenges for successful CBM development. Schlumberger provides a full range of hydrogeological solutions to meet these challenges.

**PROJECT MANAGEMENT**

Schlumberger provides management services for a broad range of aquifer development applications and integrates proprietary technology, people, and experience to optimally achieve project goals.

**PRELIMINARY GROUNDWATER ASSESSMENT**

Regulations governing CBM development within a Groundwater Protection Zone will usually require, at an early stage, the preparation and submission of a Preliminary Groundwater Assessment (PGA). Preparation includes the integration of hydrogeological data from various data sources. Recognizing or anticipating water management issues early in the project enables the proactive development of appropriate solutions before potential problems arise. Further, preparation of the PGA helps to identify data gaps and provides a process for interfacing and responding to public concerns.

**BASELINE WATER WELL TESTING**

Baseline water well testing is a critical component of CBM development. The objective is to ensure the protection of groundwater resources by gathering baseline groundwater quantity and quality data from nearby wells prior to drilling.

To ensure that baseline testing data is generated according to rigorously developed and observed protocols, Schlumberger assembles a team of specialists for each element of the baseline testing procedure. Any public concerns will be evaluated and interpreted after the CBM development is in progress.

**REGIONAL HYDROGEOLOGICAL ASSESSMENT**

Understanding the hydrogeological regime in the area of a proposed CBM development is essential for evaluating the technical feasibility of CBM production and managing environmental stresses. A team of hydrogeologists, geochemists, modeling specialists, petrophysicists, and reservoir engineers will accurately assess a wide range of subsurface conditions using integrated technologies.

**AQUIFER DEWATERING AND MANAGEMENT**

Short-term dewatering issues include optimizing the locations and pumping rates of dewatering wells. Long-term issues include controlling regional drawdown and monitoring the impact on the environment. Schlumberger modeling experts are experienced in applying 3D flow and transport models while analyzing the short- and long-term effects of dewatering. Developing a groundwater model provides the ability to optimize water extraction schemes while minimizing extraction or drawdown. The model also represents a management tool that can be further refined and applied to manage water and wastewater management issues. Working directly with the reservoir engineers, Schlumberger develops dewatering systems that evolve over the life of the CBM project. Each system is designed to remove the appropriate amount of water by accurately characterizing the groundwater flow regime and producing site-specific water budgets.

**DRILLING AND PUMP TESTING**

Evaluating the hydraulic characteristics of an aquifer requires careful planning including well placement, drilling well design, pump selection, and water level data collection. Schlumberger provides a unique drilling and testing package that combines extensive field experience with advanced technological tools. Using data loggers and pumping test software, Schlumberger provides rapid and accurate analysis of data based on a range of hydraulic analysis techniques.

**WATER MANAGEMENT PLANNING**

The requirement to dewater coalbeds prior to the extraction of CBM represents a major additional challenge relative to conventional natural gas production. Effective production and disposal of the water is key to successful CBM development. De-pressuring the coal seam can generate large volumes of groundwater of varying quality. The preparation of a water management plan, consistent with regulatory guidelines, requires consideration of management options including reuse, treatment, deep well injection, and conjunctive use options for produced water. Schlumberger provides innovative solutions to help control water management costs.
INJECTION WELL DESIGN AND DRILLING
Re-injection of produced water into depleted coal seams often represents the most cost-effective method of disposal. Schlumberger offers well design solutions to optimize injection capacity, maximize well performance, and minimize risks. Comprehensive field tests and analysis are performed to evaluate vertical and lateral containment of injected water, the overall feasibility of water disposal, and impacts on local groundwater and surface water. Schlumberger offers regional expertise and local infrastructure which serve to mitigate hazards that exist within the sensitive environments in which CBM and unconventional gas sources are often found.

GROUNDWATER MONITORING
The Schlumberger suite of accurate and reliable groundwater monitoring equipment will optimize water resources management ensuring a long and productive lifespan with minimal impact to the aquifer system. Diver groundwater data loggers and the Westbay* multilevel groundwater characterization and monitoring systems acquire accurate representative data for all groundwater monitoring needs.

GIS AND DATA MANAGEMENT
Large-scale projects such as CBM commonly come with an abundance of data, collected over many years. Schlumberger has developed a suite of industry-standard and customized tools to help integrate and interpret vast amounts of data. Unorganized data can be converted into spatial data sets as part of an Environmental Data Model (EDM), which incorporates geologic, hydrogeologic, hydraulic, and contaminant information. Analysis of the EDM by Schlumberger GIS specialists can deliver specialized displays and maps such as:

- Aquifer vulnerability maps
- Hydrostratigraphic cross-sections
- Interpreted geological surfaces
- Groundwater recharge flux
- Potential contaminant sources

Beyond the GIS data assessment, Schlumberger uses EDMs to develop three-dimensional geological conceptual models to support groundwater flow and transport simulations. After model development, the EDM integrates wellhead protection areas, (WHPAs), contaminant plumes, and water balance information, which can be incorporated into reports, public presentations, or land-use policy.

RESERVOIR ENGINEERING
Schlumberger has a global network of experienced reservoir engineers and advanced oilfield and well-site technologies to complement the Schlumberger hydrogeological team and support specialist services such as perforating, fracturing, and sophisticated pumping systems.

GEOCHEMICAL EVALUATION
Characterizing the geochemical components of produced water is essential when considering water management options. Along with calculating groundwater flow and contaminant mass transport, computer models can be used to assess how aqueous geochemical interactions between the waste stream and the host rock might impact the formation and well integrity. Schlumberger geochemists provide reliable model predictions and a heightened understanding of the changes to water chemistry, thereby helping to mitigate risks and identify the most cost-effective strategies.

MODELING AND SIMULATION
Schlumberger leads in developing and applying advanced techniques to projects that extend beyond traditional modeling approaches. To find the most cost-effective and technically sound solution requires detailed understanding of a model’s limitations and strengths. Schlumberger takes the guesswork out of choosing the appropriate model for each specific CBM situation.

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SITE CHARACTERIZATION
Schlumberger offers a full suite of sophisticated geophysical well logging technologies, data acquisition instrumentation, and geological modeling software designed to characterize subsurface environments.

- Identify pore size distribution, hydraulic conductivity, and capillary pressure
- Estimate water-filled porosity
- Define total porosity and lithology
- Continuously measure upward and downward flow velocity and rate
- Log bulk matrix geochemistry and mineralogy
- Identify fracture orientation and aperture
- Receive a comprehensive view of the subsurface environment

FIELD MONITORING
Our high-quality field instrumentation is integrated with sophisticated data transfer and data management technologies. Qualified field technicians characterize, assess, and optimize injection zone and groundwater monitoring technologies for your site.

- Multilevel well systems monitor any number of zones in a single borehole
- Measure pressure under shut-in conditions
- Sample fluids without repeated purging
- Conduct pressure transient testing
- Frequent long-term measuring of conductivity, temperature, and depth
- Robust compact design to accommodate small diameter wells
- Ceramic housing offers corrosion-resistance in most environments
- Real-time, wireless data transfer to centralized information management systems

ADVANCED MODELING
Advanced modeling software address geologically complex site conditions that extend beyond traditional flow and transport modeling. Our software provide the highest degree of accuracy possible.

- 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
- 3D visualization tools reveal spatial and temporal trends

ANALYSIS AND MANAGEMENT
Field data, analytical data, and spatial data are all critical components of a successful groundwater management strategy. We can help you 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 field parameters
- Cross section interpretations of geologic and hydrogeologic data validate conceptual models
- Advanced borehole logs highlight geologic features critical to subsurface characterization
- Reports present project data to meet compliance guidelines and client needs
For over 25 years, Schlumberger Water Services has been providing leading-edge technical services to the mining industry, focusing on developing innovative technology solutions. With over 85 years of experience in technology applications related to subsurface characterization, drilling, and production optimization, Schlumberger is the only company that combines Oil and Gas technology and mine water management expertise and know-how. We have 125 dedicated research and engineering facilities and we invest resources in developing new tools and services to provide solutions to customer challenges. Schlumberger continues to invest in technologies and innovations to provide mining clients with solutions that can be successfully implemented at their mining sites.