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# GROUNDWATER REMEDIES:
## THE REVITALIZATION OF GEOLOGY

For some, wondering what lies beneath our feet might come as a passing thought — but for those responsible for groundwater remediation, understanding the layout of the subsurface is critical to successful remediation.

In the past, the development of subsurface conceptual site models relied on drilling wells to determine the extent of groundwater contamination, costing valuable time and money. Today, geology — more specifically an application called Environmental Sequence Stratigraphy (ESS) — is experiencing something of a renaissance in environmental consulting, offering remediation practitioners a more accurate way to determine the nature and extent of contamination, which benefits clients and the environment.

### Developing the Science

Geologists have a saying: "Whoever sees the most rocks wins." This holds particularly true in the practice of sequence stratigraphy, which, put simply, is the analyzing of rock outcroppings on the surface to better understand the depositional environment, thus informing the layout of the subsurface.

The process of focusing on stratigraphy to map the subsurface emerged in response to oil industry needs. In the early days of oil exploration and discovery, production was limited by a facility's capacity. As production began to decline in the 1950s, continued economic operations became increasingly reliant on the science of petroleum geology with a focus on stratigraphy to locate wells and control fluid flow.

Between the 1970s and 1990s, the science of sequence stratigraphy was developed and tested within the vacuum of the petroleum industry. Since that time, its use in other fields, such as environmental consulting, has been recognized, making it the new standard for evaluating sediments and sedimentary rocks.

### Applying the Practice

The use of sequence stratigraphy as an approach to groundwater remediation projects in the environmental industry was pioneered by Rick Cramer, a remediation department manager at Burns & McDonnell. With ESS, a stratigrapher's knowledge is applied to the data collected in the environmental industry. Results rely

Want to learn more about ESS and how it's applied?
Check out the U.S. EPA Technical Issue paper at
**burnsmcd.com/PracticalGuideESS**

## *The ESS Process*

Determine the depositional environment, which is the foundation of any ESS evaluation.

Leverage existing lithology data, formatting the information to emphasize vertical grain size distribution.

Map and predict in 3-D the subsurface conditions beyond the data points.

on the geologist's training, not the use of a formula or computer program.

"It's all about the practitioner," Cramer says. "It takes a geologist trained in sequence stratigraphy to gather and synthesize the data from regional studies and site observation to recognize the patterns and features that are the telltale signs of what the subsurface looks like."

This ability to recognize patterns, as well as a stratigrapher's encyclopedic knowledge of depositional systems and the geologic ingredients for the subsurface conditions, is what makes ESS so effective. Because each depositional environment has distinct features, a trained sequence stratigrapher can determine the condition of the subsurface and map out the subsurface contaminant migration pathways without the collection of additional data.

"The beauty of this process is in its simplicity," Cramer says. "It's all about using existing data — you don't have to collect anything new. Instead, it's about understanding and optimizing the data you already have to build better, predictive conceptual site models."

### Bringing Benefits to the Job Site

The subsurface provides the greatest uncertainty when addressing the extent of groundwater contaminated at job sites. In project delivery, this translates to potential delays or high-cost solutions that might go beyond what is required to meet remediation requirements.

"One of the most important things for a client is to reduce uncertainty and have a viable endpoint to their groundwater contamination liability," Cramer says. "Knowing that the remediation efforts they undertake will get their project to environmental compliancy means success without additional expenditures or delays. And unless the subsurface heterogeneity is adequately defined to show contaminant migration pathways, groundwater remediation of complex sites will continue to meet high failure rates."

The work of ESS — that of building improved, more representative conceptual site models — has the potential to inform the actions of a project's design team, ultimately affecting the outcomes of the construction phase. In this way, applying the practice of ESS to existing data today saves time and money throughout the project life cycle by guiding the most efficient groundwater remediation solution.