

SMART MONITORING WELL CONSTRUCTION

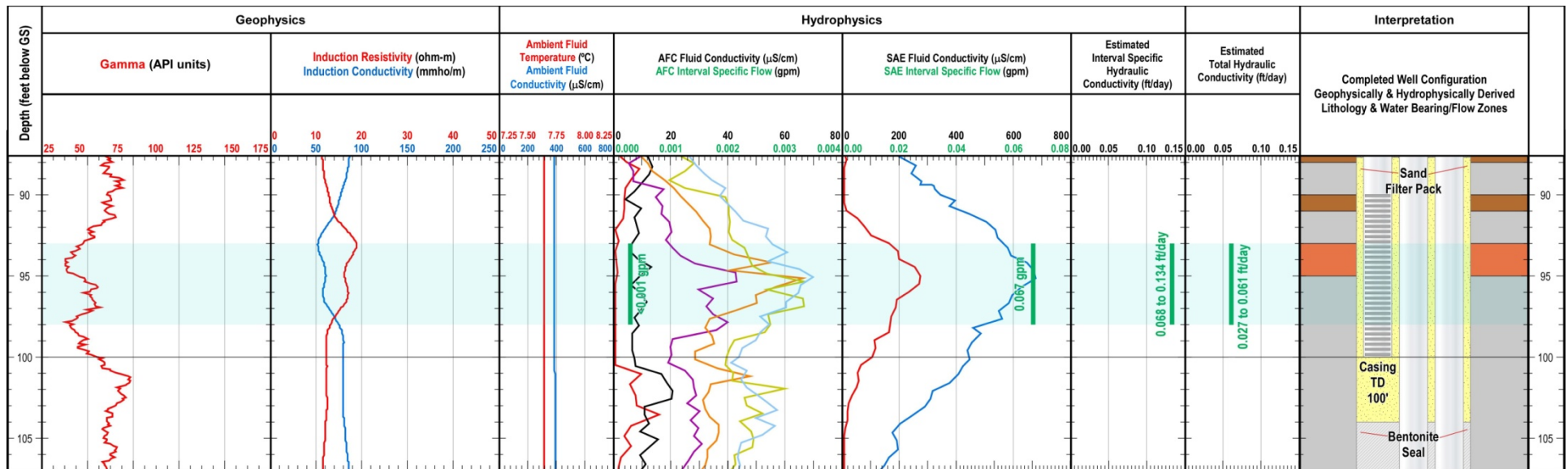
Optimizing borehole logs for effective monitoring

For accurate ground water monitoring, smart well construction is required. While open hole logging prior to completion is preferred, in environments where the open hole may collapse following drilling, temporary, fully-screened casing can be installed. This temporary screen may be constructed out of steel or PVC, but the screened zone should extend over the full saturated interval to allow for accurate identification of flowing groundwater intervals. If only selected depths are subsequently screened for long term monitoring, based on inaccurate data, identification of the flowing zones may not be correct, and the resulting completion may not allow for monitoring of the desired aquifer parameters. Subsequent groundwater monitoring data may be acquired; they just may not accurately represent those zones under study.

The illustration on the reverse side shows a well that was correctly completed – the zones of interest were screened and the monitoring over time was based on true groundwater results. In this well, the construction was designed *following* open hole hydrophysical logging. Therefore, the completion was based on field data which indicated the actual depths of the water bearing interval, and specified that the screened section should be longer than 10 ft. The result is that the aquifer to be monitored is accurately intersected by the screen, and therefore the sampling results will reflect the constituents from the flowing zones of interest.

When logging through the temporary casing, the casing material also has an impact on the types of borehole logs which can be collected. If the temporary casing is PVC, hydrophysical, natural gamma and induction resistivity measurements can be acquired. If steel is used, hydrophysical logging can be conducted, but the steel interferes with the induction response. Additional geophysical logs can be acquired for lithologic evaluation through steel casing, such as gamma-gamma density and neutron, however, these particular logs require use of a radioactive source, which has non-technical but nonetheless notable liability limitations.

As hydrophysical logging allows for direct identification of the groundwater flowing zones, this method can be applied in either PVC or steel which has been screened over the entire interval of interest. To optimize characterization of the flow regime, the longer the temporary screened section the better, because the method cannot detect flow in sections of blank casing which do not allow access to the formation and direct measurement of the in- or out-flowing zones. The example on the back is taken from a well in southeastern Wyoming where well construction was based on the results of logging through temporary casing. As evident in the montage, the hydraulically conductive zones are accurately screened. Therefore, subsequent monitoring will accurately reflect results from zones of interest.



PROPERLY-SCREENED MONITORING WELL - These data are from a chlorinated hydrocarbon plume monitoring well placed in the Ogallala formation of southeastern Wyoming. Multiple screens were placed into the well to monitor change in contaminant mass over time, within discrete conductive features that may be contributing to the rapid downgradient transport of TCE. In this case, a conductive feature was identified by hydrophysical logging at a depth of between 93 and 98 feet. While the interval-specific flow and transmissivity are not large, this interval is the dominant producing zone in this well, and is representative of the types of flow features in this portion of the formation. Based on the hydrophysical logging data, the screen was correctly placed to fully intersect the conductive feature, allowing accurate water quality measurements from this interval. Therefore, samples collected from within this screened interval are considered representative of the water quality in the conductive feature, and provide data supportive of more realistic consideration during plume flow modeling and monitoring.

- The flow was very low, and the formation was very tight, making flow zone identification difficult.
- The geophysical signature was not sufficiently distinct by itself to allow for identification of flow intervals.

Montage notes: KEN – remove the “estimated total hydraulic conductivity” column. Use standard symbols for lithology, Delete the blue induction conductivity profile (keep the red induction resistivity profile).

