
RISING FROM THE PLAINS: A STORY OF MONITORING WELL INSTALLATION IN A PRESSURED HYDROLOGIC SHALLOW GAS SYSTEM

By Ed Murphy

Fred Anderson's recent screening of wells for shallow gas in eastern North Dakota reminded me of an incident that occurred in 1984. The Geological Survey and the North Dakota Mining and Minerals Resources Research Institute (the precursor to the Energy and Environmental Research Center) were installing monitoring wells around an oil and gas brine pond in the Wylie Oil Field near Maxbass in Bottineau County. Brine ponds had been used since the discovery of oil in the 1950s as a means of disposing of saltwater produced by oil wells via evaporation. Later it was discovered that saltwater from these ponds was leaking into the groundwater system and they were outlawed in North Dakota. The purpose of our project was to determine how much saltwater from this old pond had infiltrated into the subsurface and how far it had migrated from the site.

We constructed our monitoring wells using two-inch PVC with a five-to-ten-foot slotted screen. The consultants that I have witnessed installing monitoring wells typically place the 10- or 20-foot-segments of pipe in the hole one at a time, using pipe rams to secure the pipe as it is lowered into the hole. We used a different approach. We would assemble the entire well and then try to thread it down the hole. It was a much quicker process, when all went well, but not without some element of danger. The key was to lift and throw the midpoint of the well into the air to cause the middle section to bow, making it easier to thread the base of the well into the hole. The person or persons guiding the base into the hole had the most difficult job and stood at the place (the screen) where the PVC was most likely to break, which it frequently did. The person at the other end had to know the precise time when to throw the top of the pipe into the air. If you timed it just right, the tension from the bowed portion of the pipe picked up the top end and the remaining sections of the well slid vertically into the hole. If you threw it too early, it could come back and strike you as Alan Kehew can attest. Alan (now with Western Michigan University) received several stitches in his forehead attempting this maneuver in the late 1970s.

Most of the monitoring wells that I helped thread into boreholes were less than 100 feet long. However, at this site we threaded a 220-foot well into the hole. Things went much smoother than we had anticipated, but we had trouble keeping the pipe from rising out of the hole. We assumed the well screen had plugged with mud and we filled the inside of the PVC with water as a counter balance, but the well continued to rise out of the hole unless several of us held it down. The driller, Gary Moe, suggested attaching a threaded

coupling to the top of the monitoring well connected to his mud pump so we could force air through the well screen to unplug it. It seemed like a good idea at the time, so five of us gathered around the well holding the pipe to keep it from rising out of the hole as he pumped in the air. At first nothing happened, so Gary steadily increased the air pressure being forced into the well. Then suddenly the increased pressure caused the PVC exposed above the ground to explode. PVC shrapnel flew throughout the area miraculously only injuring Gary (a minor cut on his side). I say miraculously because there was more space taken up by bodies than there was void space around the top of the well and yet only one piece of PVC hit anyone. We gave up our attempt at unplugging the well screen, replaced the damaged well casing, and anchored the well with bungee cords attached to fence posts that we drove around the well top.



A 40-foot monitoring well is assembled and ready to be snaked down a borehole on a reclaimed oil and gas pad in western North Dakota in this 1980 photograph.

We were installing another monitoring well about 600 feet south of the 220-footer when we looked up to see the casing from that deep well rising steadily out of the borehole. The pipe rose to a height of 100 feet or so before slowly falling over on its side without damaging the casing. We went back to the site and threaded the pipe back down the hole and secured it with additional fence posts and more weight. Later that day we cemented the pipe into the hole. It was not until we began checking water levels that we discovered the head (water level) in the well was three feet above the ground surface (a flowing well) and there were visible gas bubbles rising within the well casing. This monitoring well was screened across the base of glacial outwash and the top of the Fox Hills Formation (Cretaceous). This is the same stratigraphic interval that was the source of produced gas in the Mohall/Lansford/Maxbass area in the early 1900s. It was this gas pressure that had pushed the monitoring well out of the borehole. I was eager for Fred Anderson to test this well with the flame ionization detector while he was in Bottineau County this fall. Unfortunately, the well had been plugged and abandoned years ago.

I had an initial indication that this was going to be an unusual hole. We lost circulation in the glacial gravel and Gary Moe went through all of the bags of lost circulation material (a mixture of shredded cellophane and walnut hulls) that he had on hand with no success. Gary commented that he had been able to regain circulation in other problem holes by adding flax straw to the mud system. So I drove to the elevator at Westhope with hopes of obtaining some. The elevator had none bagged, but invited me to take whatever I wanted from the loose flax straw that had fallen off of railcars. I was driving a pickup and had to pack the straw in the cab with me because it would have blown out of the box of the truck. It was a hot day and I had the windows cracked to let in some air which served to blow the finer pieces of flax around the cab. Anyone who has been around flax straw knows what an itchy situation this was. Certainly those that worked at the elevator knew and had a good laugh at my expense. That miserable situation was made a little less so when the addition of flax straw to the mud system worked by sealing off the gravel layer and we were able to restart circulation and finish drilling the hole.



Gary Moe (Moe Drilling from Mott, North Dakota) holds pieces of pvc pipe that exploded from a monitoring well we had installed in the Wylie Field near Maxbass, ND. Photo taken in 1984.