HDD Extracts Dangerous Chemicals

Nestled in the hills 20 minutes southeast from downtown Seattle is Tukwila, WA. Named by the Duwamish Indians for the lush forests of hazelnuts trees, Tukwila's 8.6 square miles of land is home to Sea-Tac International Airport, the current corporate headquarters of Boeing and the Museum of Flight.

On the site of an old vanilla extract manufacturing plant, abandoned for the past 15 years, a horizontal remediation well system has been pumping out more than 5,000 gallons (38,000 pounds) of toluene over the last two years from a massive plume of contaminated ground.

The effectiveness and the relatively low cost of this remediation project could not have been possible without horizontal wellscreens installed by horizontal directional drilling.

Toluene is a colorless, flammable, poisonous liquid generally made from coal tar or petroleum and is instrumental in making dyes, paints, paint thinners and explosives. It is also used as a solvent. This chemical has been found in at least 869 of the 1,416 "National Priorities List" sites identified by the Environmental Protection Agency (EPA).

So much toluene was in the ground that it was leaching through this river delta in the fine, silty, sandy soil towards the Duwamish River.

When the landowner wanted to sell for development purposes, the EPA required that the site be cleaned up. The size of the plume on part of the old plant site measured 100 feet by 150 feet by 10 feet deep. The consulting engineers determined early that raw excavation could not be used to dig out this entire plume, as it would be cost-prohibitive to dig and haul to a hazardous waste landfill where disposal would cost hundreds of dollars per cubic yard.

The engineers brought in Jim Doesburg and his company, Directed Technologies Drilling Inc. (DTD), to install horizontal soil vapor extraction remediation wells. Based in Tacoma, WA, DTD has installed over 250 remediation wells of varying types on 60 different projects for chemical companies, refineries, the Department of Energy and the Department of Defense, along with numerous remediation projects dealing with underground storage tanks. In addition to horizontal remediation wells, the company also installs sewer utilities, electrical cable and telecommunication lines.

Viable alternative

Horizontal soil vapor extraction wells along with horizontal wells for ground water extraction, air sparging and air stripping are relatively new when compared to vertical wells. But as more engineers become aware of these methods, they have become a well-accepted alternative to vertical wells when cost and capture zones, or areas of influence, are taken into account.

The soil vapor extraction plan called for installing six wells, each 150 feet in length and two inches in diameter. The well location was 10 feet below the surface in the middle of the plume to provide a total installation of 900 feet of wellscreen. Once the wells were installed and connected with a single manifold, a single 600 SCFM blower system pulled the vapor out of the soil into a carbon filter extraction system. The

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well array was designed so that individual wells could be shut off depending on the extraction rate.

"Vertical wells were possible to install on this site, but it would have taken 200 vertical wells to reach the same area of influence covered by the horizontal wells," Doesburg said. "Plus, you would have to install multiple manifolds and blowers for the vertical wells. It would have been a nightmare of construction. So on all counts, horizontal wells are less expensive to install, and fewer of them collect contaminants from a wider capture zone. The horizontal wells are expected to clean up this site in three years. It would have taken four times that long for vertical wells to do the same on this large a site."

Complications

DTD brought their Vermeer D16x20 Navigator rig to the site in Tukwila to install the wells. But before any drilling was done, the crew had to plan around the existing foundation. Plenty of man-made obstructions existed when installing the screens.

Even though the plant was razed 15 years earlier, the underground concrete foundation for the building and pipelines from the storage tank presented logistical difficulties not only for the location of the machine but also for the location and placement of the wellscreens. The screens were to be installed 15 feet apart and over the 100-foot width of the plume. The drill itself was set up on the concrete foundation, which had to be cut through to get to the subsoil. There were different levels and depressions throughout the terrain, and the machine was elevated above the ground surface.

It was important for every one of the six bores to make significant steering corrections. "The 1.9-inch diameter drill stem came in handy," said Doesburg. "It had the flexibility we needed. With a bigger machine, we would have had a rougher time making the kind of steering corrections we did."

The drilling fluid used was CETCO Clean Drill. This fluid has some very special properties. When installing horizontal remediation wellscreens whether its for bioventing, air sparging, soil vapor extraction or groundwater extraction, the drilling fluid has to create the bore wall and suspend cuttings, but it also needs to break down and biodegrade so the air pressure can get through the wellscreen into the formation.

The wellscreens that were installed were Enviroflex screens - a two-inch perforated HDPE with a geo-fabric liner. Each of the wellscreens had to be developed. This is a careful, complicated process to make sure that when they are hooked up to the vacuum system that the air pressure will reach the contaminants in the plume and that the toluene (in this case) will be vacuumed into the well. After the horizontal well is in the ground, there should not be any barriers to proper flow in the ground.

To develop the well, the wellscreen first has to be cleaned and flushed to clean out the drilling fluid. All of the wellscreen areas are treated with an enzyme that will chemically break down any residual drilling mud that was left in the formation. Then, each well is pressurized and depressurized to force fine material through the screen and out of the perforations. When all of that is done, a final flush washes the wellscreen.

"When we first started the extraction process, we brought up a lot of water," said Doesburg. "Then it dried out, and the vacuum system brought up the vapor, which contained the contaminant."

Using electricity to power the vacuum system, the soil vapor extraction process vacuumed the vapor into a carbon filter. The toluene was absorbed by the granulated carbon. When the carbon was saturated, it started to break out. The crew then shut down the process, heated up the carbon filter and then condensed off the toluene.

"By 2002, the site should be clear," said Doesburg. "Horizontal directional drilling makes this a much more effective and efficient operation than any of the other known alternatives for remediation projects. We were able to save the owner of the property a lot of money and get it done a lot faster."