

In Their Back Yards



Jan Reis Photography

Graduate students Rachel Dunn, Veronica Morales, M. Ekrem Cakmak, Professor Tammo Steinhilber, and project leader Ian Toews worked with graduate students Adrian Harpold, Rachel Shannon, and Jennifer Smith, and junior Brianna Smith (not pictured) to be "another set of eyes" for a neighborhood troubled by TCE contamination.

By Glenn Scherer



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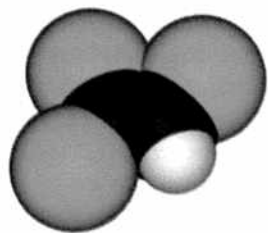
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Students help a neighborhood understand TCE pollution

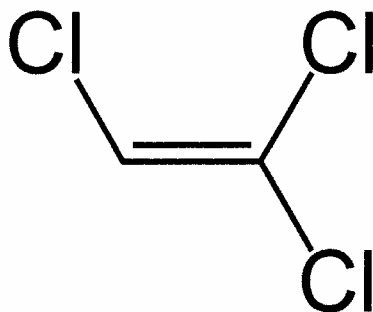
South Hill in Ithaca, New York, is a microcosm of urban America, a peaceful tree-shaded neighborhood that grew up in the shadow of industry in the late 19th and early 20th centuries. But just like thousands of other U.S. urban neighborhoods that flourished before the introduction of important environmental safeguards and regulations, South Hill is bedeviled by an Industrial Age relic: an unseen but potentially toxic chemical plume that runs beneath it, polluting its groundwater and seeping, as vapor, into home basements.

In the case of South Hill, the principle culprit is TCE, trichloroethylene, a potentially carcinogenic solvent used to clean metal machine parts by Ithaca's Morse Chain factory, now owned by Emerson Power Transmission. The health effects and economic fallout due to the TCE contamination are of major concern to South Hill's residents—a concern that has left them feeling vulnerable and unsupported.

So it was that in 2005 New York State assemblywoman Barbara Lifton responded to the fears of South Hill residents



Trichloroethylene or TCE is the most commonly reported organic groundwater contaminant in the nation. It's a probable human carcinogen, especially at higher concentrations.



The former Morse Chain factory, now owned by Emerson Power Transmission, is the source of TCE contamination that flows down into Ithaca's South Hill neighborhood.

"The students acted much like an environmental consulting firm, though an unusual one."

and went to Cornell University requesting its engineering students to provide "another set of eyes" to examine data related to the TCE contamination on behalf of community members. The result was a semester-long study in spring 2006, performed by the combined classes of Professor Tammo Steenhuis of the Department of Biological and Environmental Engineering and Professor Larry Cathles of the Department of Earth and Atmospheric Sciences. Their undergraduate and graduate students' hundred-page final report and oral presentation helped unravel some of the mysteries and uncertainties of South Hill's TCE contamination for local residents. (Click on "South Hill TCE report" at <http://soilandwater.bee.cornell.edu> for the full report.)

"The objective of our geohydrology class project was to understand the situation on South Hill in all its aspects, including technical, toxicological, geological, and economic concerns—the whole broad perspective," says Cathles. "The students acted much like an environmental consulting firm, though an unusual one."

Free of the preconceptions of the various parties involved in the TCE dispute, the students had the advantage of a fresh perspective, says Cathles. "Our client was the homeowners, and the students' job was to make a report to the residents

that explained the situation in lay language," he says.

The residents weren't the only ones to benefit from this unique collaboration. The students gained "years of consulting experience compressed for them into one term," Cathles says. The eight students "got to work with a real problem, in a real setting, not just on a textbook case," adds Jim Gillett, Cornell professor emeritus of toxicology who provided technical assistance to the project. "South Hill represents an awkward, awful, difficult case, complicated by fractured geology, the pollution of various types of industry over various time periods, with various attempted treatments."

Perhaps most useful for the students was their chance to work with or access work by many of the parties involved in the TCE case, including the New York State Department of Environmental Conservation, various environmental consultants, the principal responsible parties including Emerson, and the residents. "They got to see how different sets of people with different goals and problems cope with the same issue in very different ways," says Gillett. "They learned that there is no single right answer."

"Most valuable for me was participating with the community members while doing real research," agrees second-year grad student Veronica Morales. "We tried to give the residents some information they didn't have, and to explain technical information that some of them didn't understand up to that point. I feel like we definitely helped people in the community."

An Unseen Toxic Legacy

South Hill homeowner and activist Stan Scharf sums up the neighborhood's TCE toxic worries: "I am not happy living in a house with this contamination. It is always a threat. It is always on the mind. How dangerous it really is, is hard to say, but there has to be an increased risk of cancer here."

Trichloroethylene, or TCE, is a chlorinated solvent used extensively by industry in the 20th century as a degreasing agent to remove oils from metal parts. Ithaca's Morse Chain factory heavily utilized TCE in the 1960s and 1970s, discontinuing use by the 1980s when concerns arose about its health hazards. Unfortunately, TCE was deposited in large amounts in a Morse Chain underground concrete fire reservoir that then leaked into South Hill groundwater. It is also possible that TCE entered South Hill from a variety of other locations within the manufacturing plant.

In 1987, Emerson Power Transmission, the new owner of the Morse Chain facility, let NYSDEC know that they had discovered TCE leaking from the fire reservoir. Environmental consultants quickly learned that South Hill groundwater had been contaminated. In the 1990s, NYSDEC and Emerson began an attempted remediation process, extracting and treating groundwater from wells near the fire reservoir. Unfortunately, remediation didn't solve the problem. TCE remained inside South Hill.

In May 2004, Walter Hang, president of the Ithaca-based Toxics Targeting consulting firm held a press conference documenting the spread of TCE under South Hill. His work catalyzed community residents into action. "I got really involved then," notes South Hill resident Ken Deschere. "Residents became really concerned. We started a Yahoo Internet group of neighbors exchanging e-mail information, and we started working with local politicians to get public meetings." Testing of homes around South Hill found varying levels of TCE vapor, some in violation of state health standards. In those homes where violations were found, Emerson paid to install mitigation devices—pump and fan systems that remove TCE from the contaminated soils beneath the basements. Still many homes went untested, and fears and uncertainty plagued homeowners.

Residents like Ken and Regina Deschere and Stan Scharf participated actively in the Cornell geohydrology class. They wanted to know how far and wide the TCE had spread downhill from the Emerson plant, and what the risks were to neighborhood health. The student report attempted to answer those difficult questions.

Graduate student Jennifer Smith wrote the section

of the final report on TCE toxicology. She noted the alarming fact that "TCE is the most commonly reported organic groundwater contaminant" in the nation and that "between 9 and 34 percent of drinking water in the United States has TCE contamination." Smith also noted that TCE is a probable human carcinogen, especially at higher concentrations. "Humans occupationally exposed to TCE have increased incidence of liver, kidney, and cervical cancers as well as non-Hodgkin's lymphoma, Hodgkin's disease, and multiple myeloma," wrote Smith, "though these concentrations are many orders of magnitudes higher than air in homes measured on South Hill."

Research into the toxicological effects of the low levels of TCE vapor found in South Hill homes (in the range of parts per billion) was difficult to obtain, especially for long-term inhalation exposures. "In high concentrations TCE is a neurotoxin, but in the concentrations to which most people are exposed, we don't know of any real health problems," explains Gillett. "Carcinogenicity is not eliminated, but [TCE at low levels] is not a very potent carcinogen. The

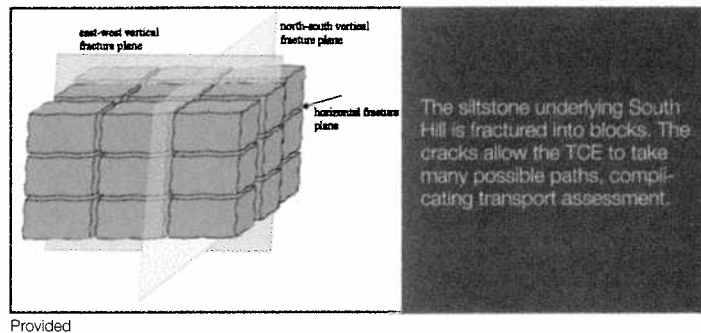
levels of TCE people are experiencing on South Hill may be one-tenth-thousandth the levels that workers can safely use in the workplace. But while it may not be enormously dangerous, the fact remains that it is a trespass, and people have a right to not have to worry about it. The residents are well within

their individual rights to try to get Emerson and whoever else is responsible to take care of it."

Puzzles in the Bedrock

Tracing TCE's course through the underground labyrinth beneath South Hill proved very difficult for the students. The problems begin with several odd qualities of TCE, which is classified as a dense nonaqueous phase liquid, with a specific gravity of 1.46. That means TCE is significantly heavier than water; it also has low solubility in water. These two facts "can potentially make assessments of transport difficult, since migration ... is dependent on water concentrations, water table depth and fluctuations, and temperature," says Jennifer Smith in the final report.

Add to these difficulties the convoluted geology of South Hill. Like the rest of Ithaca, the hill is underlain by a jumble of glacial till and highly weathered and fractured siltstone. A first set of siltstone vertical fractures runs approximately north-south, a second vertical set runs approximately east-west, while a third set runs horizontally. The result is that the bedrock is cut into variable-sized blocks, with each block surrounded by fractures. These fractures can range in size from small openings less than a millimeter wide to larger ones inches wide. "Because most of these fractures are deep underground, it is impossible to estimate where exactly all the fractures occur, or even how many there are," wrote



student Rachel Shannon in the report.

"I found the migration pathways for the TCE quite interesting," says Ian Toevs, a graduate student and the project team leader. "Because the TCE is denser than water, it sinks to the bottom [of cracks in the bedrock], though it can [also] rise as a vapor," entering through cracks in home basements. The odd behavior of trichloroethylene and the multitude of fracture paths that it might follow make the location, concentration, and migration of TCE pools below South Hill virtually unknowable by any science available today.

"The main thing our final report did was to clarify the difficulty of the geohydrology," says Steenhuis. "People had wanted Emerson to clean up the hill. But the students' report clearly showed that that isn't going to work. For now, we're stuck with the pollution in the hill. It is scattered all over, and you can't tell where it's been, or where it is going for all practical purposes. The students' study also demonstrated that straightforward mitigation methods—interrupting the flow or getting rid of the material from the source—were not going to be easy, would be very expensive, and maybe not even possible, whereas mitigation of individual homes is a temporary solution that may protect homeowners from the fleeing contaminant."

Nonetheless, recently released post-mitigation results have left South Hill residents displeased with the efficiency of the mitigation systems. Several homeowners have discovered that their indoor concentrations have not been reduced to the acceptable maximum concentrations required by the EAP, while others have found these new concentrations to be higher than what they had prior to mitigation.

A Winning Collaboration

Once their report was written, the students took a further step to help residents understand their TCE predicament. In May 2006, their project culminated with a very well received oral presentation to 40 South Hill residents at Ithaca's town hall.

"The report and presentation seemed to relieve a lot of the anxiety concerning unknowns that the residents had," says Cathles. "While I'm not sure the students found anything that wasn't already known, they were able to articulate in a clear fashion so residents could understand [what was happening under the hill and in their homes]. Essentially the students found that the movement of TCE contaminants in South Hill is so complicated through the fractured rock that the chemical's position and concentration is virtually unknowable." He adds, "I also think that one of the most important elements of the students' research was to look carefully at the toxicology, which found that while this level of TCE contamination certainly was not a desirable

thing to have in your backyard, it may not be as dangerous as it is believed to be."

"As both a city resident and an alum, I want to say what a wonderful example this is of Cornell's involvement in the community," concludes Ken Deschere, a South Hill resident who graduated from Cornell in 1971. "The level of sophistication of the students today with their computers, sampling devices, and other high tech equipment was far beyond what we had in our day. But the expertise the students brought to bear wasn't all just academic blackboard knowledge. They were really interested in using what they were learning in school to solve real-world problems. And it was marvelous to see their willingness to get involved with the residents. They made a very complicated scientific issue far more approachable. It was a great learning opportunity for the students and a great service to the community. I was delighted to be a part of it."

Still, notes Deschere, TCE concerns did not end with the Cornell project. "I worked 20 years in my basement [on South Hill], and in 2003 was diagnosed with an unexplained cancer. The only person I know of with this same type of cancer lives right down the street from me. People's kids played in their rec-room basements for years before we knew about the contamination. We still have big questions about what TCE has done and is doing to our health. We're hoping that continued efforts like the one with the Cornell class will get us more educated about toxicity and help us move forward."

Cornell students continue wrestling with the South Hill TCE problem. Grad student Veronica Morales is pursuing a yearlong project sampling TCE levels in South Hill basements through 2007. Also this year, the university is sponsoring a contest for teams of students who are

seeking to design a mathematical computer model explaining the sources and extent of TCE contamination under South Hill (more info at <http://www.math.cornell.edu/~mcm/>).

"The people who live on South Hill now have a much better understanding of what is known and what is not knowable about the TCE contamination, and what the risks are," says Steenhuis. "For the students this was an ideal project for teaching engineering design. They learned a great deal about what it is to go out in the field and practice engineering, and do design in an uncertain environment. When you are in the classroom, everything is very certain, the answers are always known, and they can be checked. On South Hill, the students were interacting with real citizens, taking their concerns into account, and dealing with those uncertainties." ■ ■ ■



Ken Deschere '71 and his wife Regina have lived on South Hill for more than 25 years.