

Community engaged scholarship in the physical sciences:

Using a contaminated EPA Superfund site to promote teaching, research, and community engagement

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Motivation

CTS of Asheville (North Carolina, USA) is an Environmental Protection Agency Superfund site, meaning it ranks as one of the most contaminated hazardous waste sites in the country. In 1999, residents living next to the facility noticed an oily substance in springs they had been using as a drinking-water source. Subsequent sampling of the springs revealed trichloroethylene (TCE) concentrations exceeding 20,000ppb, well above the federal drinking-water standard of 5 ppb. I first became aware of the site in 2007 through a local newspaper article and attended a public information session in early 2008. Shortly thereafter, I met the Rice family who lived next to the CTS plant and asked if I could bring my class to their property. Since then, over 200 students from the University of North Carolina Asheville (UNCA) have visited the Rice's property as a component of their coursework in the Environmental Studies and Chemistry departments. Several students have been so interested that they developed and conducted a variety of undergraduate research projects related to the CTS site. Perhaps just as importantly, students have had the opportunity to meet residents living near the site and see how they can apply their skills and knowledge in the community.



Teaching

As an educator, you can tell when you have the students' attention; this—a local environmental issue that they've seen in the news—gets their attention and has provided a fantastic real-world laboratory. The CTS site is about a 20-minute drive from the UNCA campus and can easily be visited during a typical three-hour lab. In ENVR 362 (Water Chemistry), students learn proper techniques for collecting and analyzing samples; in ENVR 338 (Hydrology and Hydrogeology), students interpret many of the publicly-available documents from the site and draw cross sections, water-table maps, and contaminant plumes. Both classes discuss how to be objective scientists while also showing empathy and treating residents with dignity and respect.



Photo: Students collect and test samples in ENVR 362 (Water Chemistry)

Community Engagement

UNC Asheville actively promotes community engagement, and activities related to the CTS site have been recognized and affirmed by the UNCA administration and the community. Last year, Ms. Annie Burton (Director of School and Community Outreach Programs in the Provost's office at UNCA) asked me to attend my first Engagement Scholarship Consortium meeting, and I was also recognized as a SENCER fellow (Science Education for New Civic Engagement and Responsibilities).

Over the years, I've met with residents living near the CTS site at public gatherings and in their homes. I've become particularly close with the Rice family—Mrs. Dot Rice, her husband, two sons, and great-grandsons; they've gotten to know my family too. Students have commented the impact of meeting the Rice family, and Mrs. Rice has stated on numerous occasions that despite the tragedy of living with contaminated water and air, they are hopeful some of the students who visit their property will be inspired to pursue careers in environmental science.



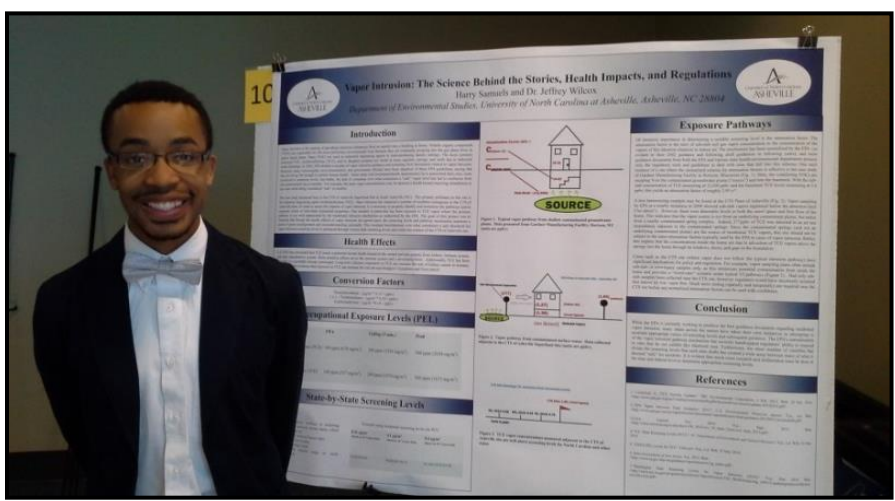
Left: Mrs. Dot Rice (resident and community partner) talks with UNCA students during a visit to her family's property.



Right: "Environmental refugee" Terry Rice and me after he was evacuated from his home due to unsafe TCE concentrations in the air.

Undergraduate Research

Several undergraduate research projects have arisen from the community partnership with residents living near the CTS site. Perhaps the most interesting project was where we were able to detect TCE in tree cores on the Rice property (map, top right) and delineate the underlying contaminant plume. More recently, one research student collected stream samples (photo, bottom right) and documented the shift from TCE- to DCE-dominated waters after CTS's contractor installed a vapor barrier in Fall 2014. Other projects have investigated public policy related to the health hazards of vapor intrusion (photo, middle right) and the economic impact of the CTS site on nearby property values. Students presented their work locally at the UNCA undergraduate research symposium as well as a regional chemistry and a national geology conference.



Top: Map showing trees (red) on the Rice property with detectable TCE. **Middle:** Harry Samuels (class of 2014) presents his research on vapor intrusion. **Bottom:** Luida Svetlova (class of 2015) collects samples for her research thesis.



Research presentations related to the CTS of Asheville site (*undergraduate research student)

- Svetlova, L.* , S. Wasileski, and J.D. Wilcox, 2015, Analysis of the effect of air sparging activity on trichloroethene and cis-1,2-dichloroethene in surface streams. UNCA Undergraduate Research Symposium.
- Samuels, H.* and J.D. Wilcox, 2014, Vapor intrusion: the science behind the stories, health impacts, and regulations. UNCA Undergraduate Research Symposium.
- Kanwisher, C.* and C. Bell, 2014, Environmental hazards and residential property values: evidence from the CTS Superfund site in Buncombe County, North Carolina. UNCA Undergraduate Research Symposium.
- Tryon, G.* , S. Wasileski, and J.D. Wilcox, 2013, Trace metal residues near the CTS Superfund site in Asheville, North Carolina. UNCA Undergraduate Research Symposium
- Svetlova, L.* , Wasileski, S. and Wilcox, J.D., 2012, Analysis of trichloroethene (TCE) accumulation by hybrid poplar trees planted in soil and grown hydroponically at a property contaminated with TCE. Southeastern meeting of the American Chemical Society.
- Wuttke, M.* and J.D. Wilcox, 2012, Using ArcGIS to help better understand the geology, hydrogeology, and contaminant transport of organic compounds around the CTS site in Asheville, NC: UNCA Undergraduate Research Symposium.
- Wilcox, J.D., K.M. Johnson*, and M.P. Wuttke*, 2011, Trichloroethylene (TCE) in tree cores collected at a contaminated spring complex in Asheville, NC. Geological Society of America Annual Meeting.
- Johnson, K.* and J.D. Wilcox, 2011, Trichloroethene (TCE) in tree rings near the CTS superfund site: UNCA Undergraduate Research Symposium.
- Wuttke, M.* and J.D. Wilcox, 2011, Trichloroethene (TCE) in surface water near the CTS site in south Asheville: UNCA Undergraduate Research Symposium.

Conclusions

1. Community engagement can enhance education in the physical sciences

Geology is a subject that tends to attract students and professionals who love learning about the earth and enjoy being outside (Manner, 1995). Recent studies of geology majors and successful practicing geologists have also identified connections with people (LaDue and Pacheco, 2013) and experiences in the community (Brock et al., 2006) with recruiting and retaining successful geoscientists. The *CTS of Asheville* site has enhanced the geology and chemistry curricula at UNC Asheville through field trips, hands-on learning, and interactions with the Rice family.

2. Community engagement can enhance scholarship in the physical sciences

Some physical scientists may view community engagement as a distraction that comes at the expense of scholarship. However, the *CTS* site has offered opportunities to engage with the community *and* conduct cutting-edge research.

3. Community engagement can (and should) be mutually beneficial in the physical sciences

"They're all just wonderful kids...it's good for me too, because my husband is sick and I enjoy people coming around." —Dot Rice, community partner, in the Asheville Citizen Times (article to the left).

Brock, L., M. Fuhman, R. Gonzalez, and R. Levine, 2006, Strategies for recruiting and retaining geoscience majors: voices from the field: Geological Society of America Abstracts with Programs, vol. 38, p. 461.

LaDue, N.L. and H.A. Pacheco, 2013, Critical experiences for field geologists: Emergent themes in interest development: Journal of Geoscience Education, vol. 61, no. 4, pp. 428-436.

Manner, B.M., 1995, Field studies benefit students and teachers: Journal of Geological Education, vol. 43, pp. 128-131.