

## **Camdenton, Missouri Site Visit**

By Lenny Siegel

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In early August I visited Camdenton, Missouri to conduct a workshop on vapor intrusion for neighbors and former employees of the Modine Manufacturing Company. The event was organized with the help of the Strong-Garner-Bauer law firm of Springfield. Since my visit, I have received comments on a draft version of this report from both regulators and responsible parties, and I have incorporated many of them.

The 120,000 square-foot former Modine plant, in the central Missouri town of Camdenton, sits empty on a 67-acre property in a quiet, wooded residential neighborhood, but pre-1990 releases of trichloroethylene (TCE) by a former owner still threaten the residents. The Missouri Department of Natural Resources (MDNR) is currently overseeing a robust, by-the-book vapor intrusion investigation. However, reviewing site documents after my visit, I found apparent shortcomings in the response. But, after sharing my draft with the regulators, I learned that they are already addressing those issues.



**Former Modine Manufacturing site**

Dawson Metal products built the original facility in 1967 to produce air conditioning coils and related parts. Sundstrand Tubular Products purchased the plant in 1974, continuing similar production. In 1990 Modine bought the plant, changing operations in 1997 to produce radiators. Sundstrand used TCE in its degreasing units, and according to former workers it was used casually and sloppily. MDNR reports that at one drum storage area as many as 4,500 gallons of TCE may have been released and at another 15 corroded 55-gallon drums leaked the solvent.

Modine used other solvents until 1997, when it removed the degreasers. It appears that United Technologies, the current owner of Sundstrand, has agreed to contribute to Modine's TCE cleanup costs.

Until 1986, the factory discharged untreated wastewater into the city-operated one-acre Hulett Lagoon, informally named after a nearby car dealership. The lagoon lay 1000 feet to the northeast, where toxic factory effluent mixed with other wastewater, but I have found no suggestion that TCE entered the lagoon from other sources. The city closed the lagoon in 1989, removed 2000 cubic yards of sludge, and re-graded the property. However, long before that time TCE from the lagoon had descended into the subsurface. MDNR believes that most of the contamination accumulated in a thin perched groundwater zone slightly more than 100 feet below the ground surface.



**Hulett Lagoon in the 1970s**

However, some TCE migrated down to the deep aquifer, perhaps through early monitoring wells, creating a deep groundwater plume that was pulled southward by the nearby Mulberry Well, at the time Camdenton's largest source of water. The 900-foot-below-surface well is 1000 feet south of the lagoon and 600 feet from Modine. In 1998, when TCE was found in well water above the 5 parts per billion (ppb) drinking water standard, the city of Camdenton took the well off line. While the lagoon plume is considered the primary source of Mulberry Well contamination, pumping there may also be pulling in TCE directly from the factory site.

While the Modine response is governed by MDNR's EPA-authorized Resource Conservation and Recovery Act (RCRA)-equivalent state Corrective Action program, the

lagoon cleanup is being addressed under the state Superfund program because the lagoon also accepted waste from sources other than the plant. Sundstrand/United Technologies has been the responsible party for the lagoon, and the lagoon and its plume are described in an entirely different set of documents than those covering the plant and its immediate neighbors. In 1999 MDNR scored the Hulett Lagoon high enough to qualify for the federal “Superfund” National Priorities List, but it was not listed because Sundstrand agreed to take responsibility for the response.

Most recently, earlier this year MDNR included the City of Camdenton and Modine, along with Sundstrand, in a Superfund order that addresses deep groundwater in the area. Sundstrand and its consultants continue to lead the investigation.

In 2002, Modine removed as much as 7,426 tons of contaminated soil outside the building footprint and backfilled with clean soil. In 2006 it sampled under the building and determined that the soil underneath was not a significant contributing source of groundwater contamination. In 2006 MDNR specialists conducted soil sampling along the sewer connecting the plant to the lagoon, finding at one location a TCE reading as high as 2570 mg/kg (milligrams per kilogram). This is above EPA’s *residential* soil screening level for TCE but reportedly below the screening level for *workers*.

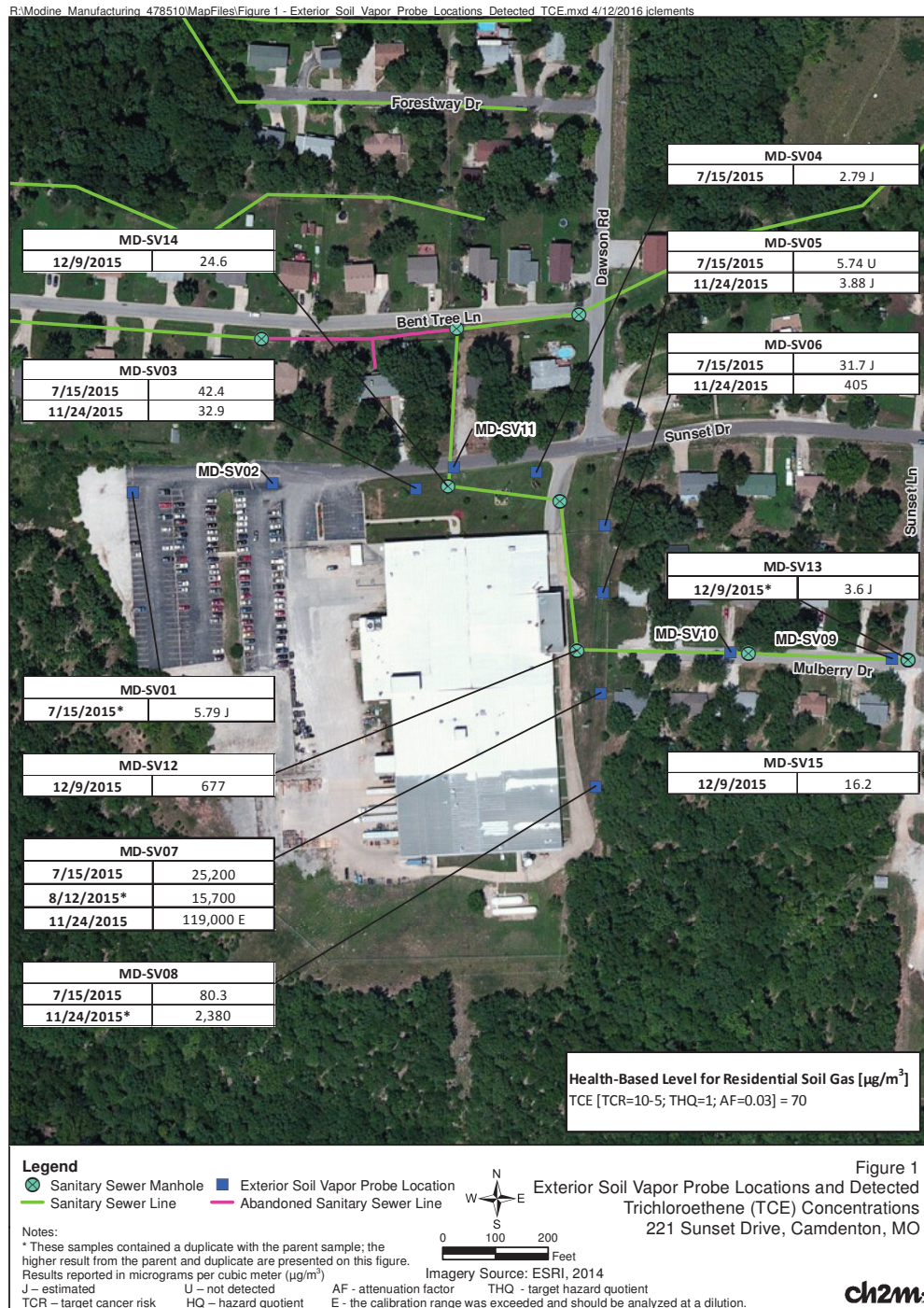
In 2003 Modine undertook its first Indoor Air Quality Assessment of the factory itself. To the credit of Modine and MDNR, they sampled indoor air rather than using a model to predict indoor air concentrations from soil gas readings. They found TCE at all six sampling locations, but MDNR later summarized Modine’s risk assessment conclusion: “Based upon further development of site-specific screening levels, the indoor air concentrations were within the acceptable incremental excess lifetime cancer risk range of  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$  and the non-cancer target hazard quotient of  $<1.0$ .”

However, in 2008, U.S. EPA Region 7 reviewed a draft RCRA Facility Investigation report. It noted that in 2003 TCE was detected in air inside the factory at levels as high as  $330 \mu\text{g}/\text{m}^3$  (micrograms per cubic meter). It observed:

While the risk assessment mentioned the significant uncertainties with using the J&E [Johnson and Ettinger] model for soil contamination, it fails to mention that the concentrations of contaminants detected in indoor air are significantly greater than (10-1000 times) the concentrations predicted by modeling.... Had the 2003 data been used in the risk assessment, health risks would exceed acceptable levels (i.e.  $>10^{-4}$  cancer risk).

Modine’s consultants measured TCE in the indoor air and subslab soil gas at the factory most recently in March 2015. To avoid worst-case results, they manually restarted the HVAC (heating, ventilation, and air conditioning) system. Nevertheless, indoor air levels were uniformly unacceptable, reaching  $121 \mu\text{g}/\text{m}^3$  at one sampling location. Under most of the building, the subslab soil gas is orders of magnitude above the screening level, reaching  $1,910,000 \mu\text{g}/\text{m}^3$  in the center. At the southeast corner of the plant, an outdoor “downwind” air sample registered  $0.15 \mu\text{g}/\text{m}^3$ , but the same spot was measured at  $0.74 \mu\text{g}/\text{m}^3$  in 2010. The building is not suitable for any occupants under current

conditions. Evaluation of remediation options for contaminant source material remaining beneath the former manufacturing building will be conducted and could be a source of highly variable contamination in the ambient air.



Source: CH2M HILL Engineers, Inc. (CH2M). 2015-2016 Residential Vapor Intrusion Investigation Technical Memorandum. Modine Manufacturing Facility. Camdenton, Missouri. April, 2016

The need for protective action is more than hypothetical. In August 2015 a potential purchaser reportedly began an environmental site assessment. Without remediation and mitigation, any new use could expose workers and others to toxic vapors well above health standards.

In late 2015 and 2016 Modine's consultants sampled indoor air, crawlspace air, outdoor air, soil gas, subslab soil gas, and sewer gas in the *residential* area just outside the plant. Both the sewer line and the gravel around it were considered possible TCE vapor pathways, because they connect the former factory to the homes along Mulberry Drive. I was pleased to see that they used U.S. EPA's default attenuation factor (the ratio of indoor air concentrations to soil gas concentrations) of .03, leading to a residential soil gas screening level of  $70 \mu\text{g}/\text{m}^3$ . There is no screening level for sewer gas, therefore the sewer gas results are being compared to the residential soil gas screening level of  $70 \mu\text{g}/\text{m}^3$ . In establishing the indoor air action level of  $2 \mu\text{g}/\text{m}^3$  for TCE, MDNR referenced EPA Region 9's 2014 memo describing the short-term risk that TCE may pose to the fetuses of pregnant women.

The three soil vapor samples and one sewer manhole sample directly east of the Modine plant exceeded the soil gas screening level. In fact, at  $119,000 \mu\text{g}/\text{m}^3$  one sample exceeded the instrument calibration range.

In December, 2015 the indoor air was sampled at 10 homes, and by March, 2016, 21 homes had been sampled on Mulberry Drive, Sunset Drive, and Bent Tree Lane. All homes in the program will be sampled for a total of four quarters.

Eight of the first ten homes tested have crawlspaces. The investigation report explains, "crawlspaces vents and exterior access points were shut (if not already closed or sealed) with plastic sheeting for the duration of the sampling." As I understand it, this creates a worst case. However, at least one homeowner told me that he left his vents closed throughout the summer. That's not a good idea, particularly if radon levels in the soil gas—not a subject of this investigation—are elevated. In general, I believe that vents should be opened soon after sampling is complete.

Of the two homes with slab-on-grade construction, one house registered sub-slab soil gas at  $72.1 \mu\text{g}/\text{m}^3$ . Summa canister indoor air samples from these same two homes collected from the breathing zone height were below indoor air action levels.

Within weeks, the consultants brought in a near-real-time Hazardous Air Pollutants Onsite (HAPSITE) gas chromatograph (GC)/mass spectrometer (MS) to measure TCE levels throughout the home. Several living spaces registered above  $1.0 \mu\text{g}/\text{m}^3$ , with  $2.31 \mu\text{g}/\text{m}^3$  found in a sump closet. They measured a whopping  $30.4 \mu\text{g}/\text{m}^3$  at the sump itself. A temporary plywood cover was placed on the sump, and a mitigation system was activated soon thereafter.



### **Looking down Mulberry Drive at the Former Modine plant**

When I talked to the homeowner, he said that his family was waiting to learn the results of subsequent testing. This is a familiar problem. The normal speed for verifying laboratory results often does not meet the needs of people who've been told that substances that may cause cancer, birth defects, and other diseases have intruded into their homes. In this case, the regulators say that the family was verbally given the results of confirmatory sampling "relatively quickly," and that they provided a written report soon after my August visit.

Of the other homes tested, two registered TCE indoors at  $1.0 \mu\text{g}/\text{m}^3$ , and one was right at the one-in-a-million excess lifetime cancer risk level of  $0.48 \mu\text{g}/\text{m}^3$ . These results are cause for concern, but not alarm.

TCE was detected beneath and inside the remaining homes, but at levels accepted by the regulators. I don't have enough information to be sure, but it appears in some cases that the source was TCE in the outdoor air. TCE is found outside in most major metropolitan areas at comparable levels, but I found its ambient presence in rural Camdenton puzzling. Outside one home near the plant it measured at  $1.49 \mu\text{g}/\text{m}^3$ . Outside another, it was  $0.87 \mu\text{g}/\text{m}^3$ .

It's generally difficult to pinpoint the source of variable outdoor contamination, because concentrations are a function of wind direction and speed. But I hypothesize two possible sources: First would be releases from vapors inside the former plant itself.

The other would be volatilized contamination from the permitted discharges from the Mulberry Well. In 1998 the city of Camdenton stopped using water from the well, which has produced water containing TCE as high as 68 parts per billion. However, the water is "pumped to waste." It took me a while to figure out what that meant, but the city continues to pump there because that prevents contaminated groundwater from

threatening other city wells and the tourist-attracting Lake of the Ozarks. But the city doesn't treat the contaminated water using sophisticated means. It releases the effluent into a spillway:

The water from the well flows through a series of corrugated troughs that channel the water down the hill before it is released to the ground surface. This agitates the water causing concentrations of TCE to quickly decrease to non-detect levels.

In 1999 MDNR initially issued the city a permit allowing a TCE maximum daily discharge concentration of 80 ppb and a monthly average of 80 ppb, but in 2009, when one sample reached 68 ppb, the daily limit was 60 ppb. MDNR notified the city about the exceedance. Since then, measured levels have gone down and the limits have risen. According to the regulators, the permit limits were derived from the Water Quality Standard for protection of fish consumption and other surface water pathways. The permit itself contains no discussion of the potential impact on ambient air, but MDNR tells me that it found that the releases to the atmosphere were *de minimis*

Moving contamination from groundwater to air doesn't make any sense to me. TCE in air has a half-life of three to seven days, so people are being protected from contaminated drinking water by the transfer of the contamination to outdoor air. While it's unlikely that outdoor air concentrations exceed health-based regulatory limits, TCE doesn't belong in the air and the emissions could easily be avoided. In a January 2009 press release the city of Camdenton promised to explore water treatment. It said, "The current aeration process will not and was never intended to be the final treatment method." But nothing was done for several years..

Finally, in February 2016 the City of Camdenton, Sundstrand, and Modine signed an Order with the MDNR's Superfund Program:

As part of the order the City of Camdenton began a series of pump tests on the Mulberry Well in September 2016. The ultimate goal is to isolate the contamination producing zones and implement a permanent system charcoal filtration system that will capture TCE vapors.

Meanwhile, the former factory has been empty since 2012. According to the 2009 Facility Investigation Report, an environmental covenant was to be prepared to prevent residential use, prohibit domestic groundwater use, and restrict soil disturbance. However, it has not yet been finalized. The same document suggested that no Corrective Measures (remediation) would be required for soil or vapor, given those restrictions. The report, prepared by Modine's consultant before the off-site vapor intrusion investigation, cited earlier Sundstrand reports suggesting that remediation of the perched groundwater zone was impractical and unnecessary, but groundwater remediation was beyond its scope. MDNR explains that the report "was not approved by the department due to additional uncertainties regarding indoor air in the building."

After my visit, I opined: "Modine, Hulett Lagoon, Mulberry Well, and the homes in the area need a current, complete Conceptual Site Model to guide further investigation

into the sources and pathways of TCE contamination. Is air contamination rising from groundwater more than 100 feet beneath the surface, or has TCE migrated directly as a soil gas? Is the Mulberry Well the source of outdoor TCE? Is outdoor TCE coming from the contaminated building? Is the pumping at the Mulberry Well spreading or containing the contamination? Are the sewer lines and surrounding gravel acting as preferential lateral pathways? Some of this work is going on, but as far as I could tell there is no holistic model for TCE spread throughout the area.”

Apparently the regulators were already asking many of the same questions.. According to DNR, in response to the findings from the manufacturing building and residential vapor sampling, the original conclusions regarding the lack of need for further remediation became outdated. Two months after my visit, in October 4, 2016. MDNR approved a Site-Wide Investigation Work Plan. “The purpose of this investigation is to further develop the Conceptual Site Model, and it is currently underway. The investigation includes site-wide investigation of soil, groundwater, and soil vapor at the facility to assess potential sources and migration pathways contributing to residential vapor intrusion. Offsite vapor intrusion pathways from the subsurface to residential properties are also being investigated under this work plan.”

The high levels of TCE inside the Modine Building should remind us of the unhealthy exposures suffered by workers there, during the use of TCE and even afterwards. A majority of the people at the August workshop were former employees at the plant. When one asked a state health official this March “if he should be worried because he worked at the manufacturing plant ... for 40 years,” she simply replied “yes.” This was reported in the local newspaper, and it’s what first caught my attention about the Camdenton contamination.

When Sundstrand operated the facility, workers were directly exposed to TCE, even dipping their hands in it, and even after Modine took over and started using other solvents, they continued to breathe high levels of TCE intruding from the subsurface. Those in attendance told me than many were sick, and that many more were dead. They were intensely interested in my presentation, staying long after the expected end of the workshop.

I was struck: Despite the extensive investigations that have been and continue to be carried out at and near the Modine site, there is no program in place to help the people whose health appears to have been impacted by the TCE exposures that they experienced during their years working there. Occupational exposures to workplace chemicals (by workers using those chemicals) fall under the jurisdiction of the Occupational Safety and Health Administration (OSHA), not MDNR or EPA. And while state and federal agencies often conduct health assessments in communities where people are or have been exposed to environmental contamination, there is no similar program to even study, let alone address, the health programs of former workers.