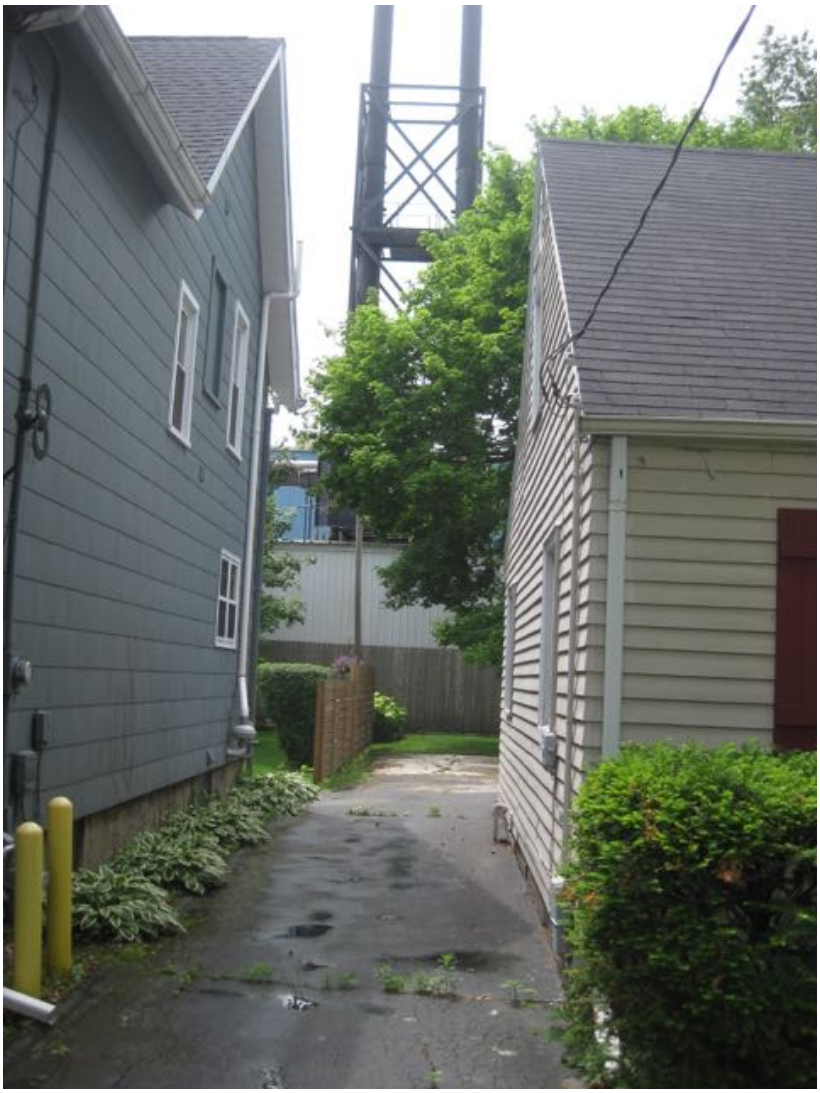
Under Wisconsin: Vapor Intrusion Issues in Madison

by Lenny Siegel
September, 2017

Madison, Wisconsin is well-known as the state capital and home of the University of Wisconsin, but it also has rich industrial history that has left behind a legacy of subsurface toxic contamination. The isthmus dividing Lake Mendota and Lake Monona contains a mix of homes and factories, separated in cases by nothing more than a wooden fence. Madison-Kipp Corporation's Waubesa Street aluminum diecasting factory is the most visible example of the health risks associated with that contamination, and the sluggish, reluctant environmental response there provides lessons that the environmentally conscious city government may be able to apply, particularly at properties in the area where redevelopment is expected.



The Kipp factory is just beyond the back fences of homes on Marquette Street.[1]

[1] All photos in this report were taken by Lenny Siegel on June 22, 2017.

The Kipp Case[2]

Madison-Kipp Corporation (MKC) has operated at the Waubesa Street location since 1902. Historically, the company manufactured parts for farm machinery, trains, and cars, and it produced munitions during World War I, World War II, the Korean War, and the Vietnam War. Today it manufactures precision metal parts for automobiles as well as recreational, lawn, and garden equipment. The 7.5-acre site is sandwiched between single-family homes on both Marquette Street to the east and Waubesa Street to the west. Over the decades it has released PCE (tetrachloroethylene), TCE (trichloroethylene), and PCBs,[3] among other contaminants, into the environment.

It appears that the first Kipp investigation began when low levels of chlorinated solvents were found in a monitoring well at Madison Brass Works, just across Waubesa Street. Soil and groundwater sampling from 1994 to1997 found significantly elevated levels of PCE, TCE, and their breakdown products.

In 2002, MKC notified the Wisconsin Department of Natural Resources (DNR) that PCE contamination had been found in Marquette Street backyards. In 2005, the company began treating contaminated soil in those backyards, and in 2008 it reported elevated levels of PCE in soil vapors near some of the homes. In 2011, MKC provided five homes with mitigation systems.

However, despite what became Wisconsin's largest vapor intrusion investigation site, both MKC and state agencies, including the Department of Health Services (DHS) as well as DNR, played down the risk to nearby residents and Kipp workers. DNR seemingly ignored its own guidance and required that the public be protected only after neighboring residents uncovered contamination data, publicized it through the media, and attracted attorneys willing to go to court.

In October 2011 two neighbors launched a class action lawsuit against MKC that ended up covering 33 homeowners adjacent to the plant. In November 2012 a second suit covering 52 residential properties a little further away was filed.

In 2012 DNR contracted for a vapor intrusion study that included indoor air, ambient air, and subslab soil gas sampling for 47 homes in a larger area. In that year, following U.S. EPA's PCE Toxicity Assessment, DNR raised (weakened) its indoor air action level for PCE to 6.2 parts per billion by volume (ppbV), equivalent to 42 $\mu g/m^3$, and its sub-slab soil gas screening level to 62 ppbV. These are based on a cancer target of one in 100,000 (10^{-5}) excess lifetime cancer risk. DNR reported, "All 47 homes tested are below the current (2012) PCE indoor air and sub-slab vapor screening levels." Still, a total of 26 vapor mitigation systems were installed, based on earlier screening levels, which were ten times as protective. That is, as DNR officials point out, residents were

[2] I would like to thank Maria Powell of the Midwest Environmental Justice Organization for collecting and annotating the documents I used in preparing this report.

[3] PCBs (Polychlorinated biphenyls) are also a serious risk at this site, but my report is focused on volatile contaminants and vapor intrusion.

provided more protection than required by state regulations. On the other hand, they were not provided the protection that my neighbors and I are provided in California, where PCE is believed to have the same cancer potential as TCE.

Though TCE was found in the soil vapor and indoor air in some homes, DNR ignored TCE in its December 2012 "Review of Vapor Sampling Results." TCE, according to EPA and DNR, causes cancer at much lower levels than PCE, and if a pregnant woman inhales TCE at low concentrations for a period that could be as short as one day to three weeks her child has an unacceptable risk of being born with heart malformations. Yet, there was no discussion of conducting more frequent sampling to determine if peak concentrations were unacceptably high.

In 2013 MKC, along with its insurance companies, reached a settlement with both plaintiff groups, finalizing documents in July. In the agreement, MKC agreed to pay the plaintiffs and their lawyers a total of $7.2 million. In addition to complying with DNR remediation requirements, Kipp promised to remove and replace contaminated soil and provide mitigation—subslab depressurization systems (SSDS)—to all participating households that didn't already have them. It stated:

> MKC shall, at its sole cost and expense, for a period of (5) years from installation 1) inspect these SSDS units once per year to ensure that they are operating as designed and installed, 2) repair and maintain these SSDS units to keep them in reasonable operating condition, provided however that, MKC is under no obligation to repair or maintain a SSDS which has been damaged, altered or destroyed… and 3) replace any SSDS which not operating as designed and installed and which cannot otherwise be quickly and cost effectively repaired…

Though pressure testing was conducted once mitigation systems were turned on, indoor air was sampled in few, if any, homes after the installation of mitigation systems. While it's possible that the homes continue to meet the weaker current standards, there is no data directly demonstrating the mitigation systems are serving their intended purpose:

preventing subsurface vapors from entering the homes. Lorne Everett, who served as an expert witness for the community members who sued Kipp, warns that typical pressure testing protocols—based on one measurement per home—are often insufficient to demonstrate that depressurization is consistent throughout the subslab.

Furthermore, five years ago, five years—the duration of Kipp's responsibility to monitor the systems, negotiated between the lawyers—may have seemed like a long time, but it may be decades before the potential for vapor intrusion dissipates. Residents are now becoming responsible for maintaining and monitoring systems about which they know little. The protection provided by those units may vanish into thin air. I do not believe that the change in exposure standards justifies a relaxation in protection. If indeed vapor intrusion is a threat, then DNR, DHS, or the company should be providing ongoing operation, maintenance, and monitoring of the vapor remedy.[4]

The Goodman Center Should Be Sampled

The Goodman Community Center, just across a popular bike path from the Madison-Kipp Waubesa Street factory, stands as an excellent model of adaptive reuse. The non-profit, publicly supported Center, housed in a former factory building itself, bustles every day with activities for a population diverse by ethnic background and age. Wisconsin DNR okayed the site for reuse in 2008 following the removal or encapsulation of PCBs on interior surfaces, excavation of contaminated soil, and the capping of residual soil contamination—all of which were designed to eliminate direct human contact with hazardous substances.

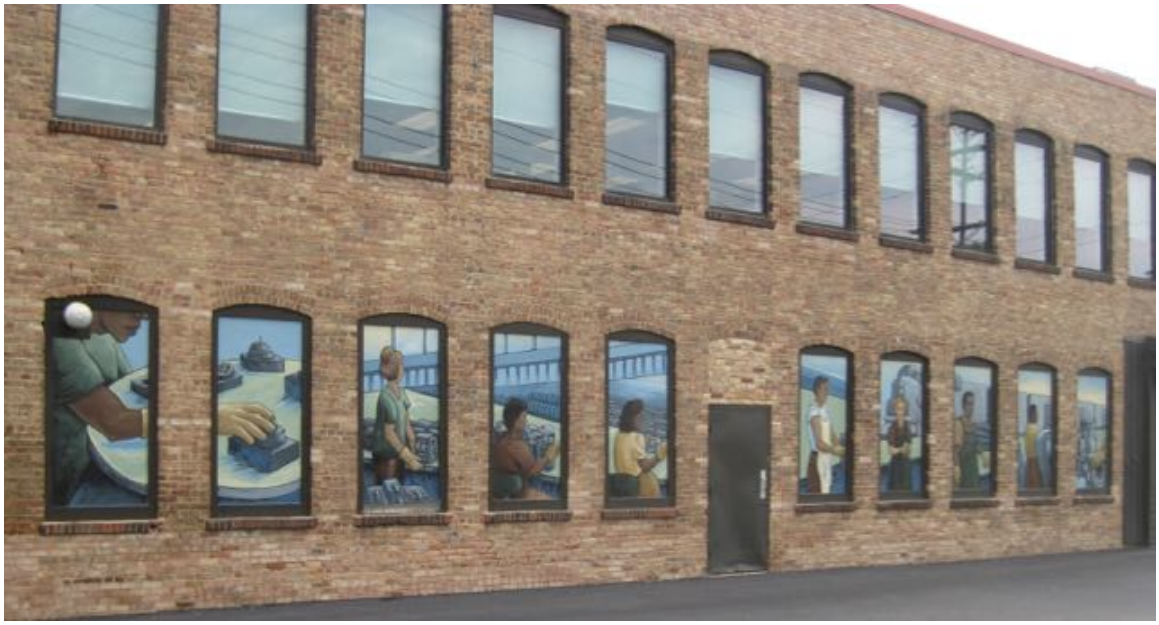
Goodman Community Center

[4] For examples of how this is done right at other sites, see "A Stakeholder's Guide to Long-Term Management at Vapor Intrusion Sites" at http://www.cpeo.org/pubs/VILTM.pdf .

Local residents have asked me whether the potential for vapor intrusion has adequately been evaluated. In summary, while there is no evidence of current indoor exposures to chlorinated solvents such as tetrachloroethylene and trichloroethylene, the presence of those highly toxic chemicals in the groundwater beneath and near the Goodman Center suggests the need for a comprehensive vapor intrusion investigation. Indeed, whenever redevelopment places people in industrial areas where solvents have been used, a vapor intrusion investigation should be routine.

The Goodman Center's web site describes the building, which was listed on the National Register of Historic Places in 2007:

> Four industrial manufacturers operated here over the last century, beginning with the American Shredder Company. In 1906 the Steinle Turret Lathe Machine Company took over and added [to] the building until it ran the entire length of the block. In 1940 the Theo Kupfer Iron Works purchased the building and a year later, erected the 320-foot long steel gantry that has become a neighborhood landmark. In 1990 Durline Scale Company moved in.



North-Facing Wall of Kipp Waubesa Street Factory

A series of environmental investigations beginning in 1987 identified petroleum, paint, metallic, and PCB contamination. A small number of groundwater tests found low levels of PCE and TCE at a number of locations on the property, the highest being a PCE reading of 14 parts per billion (ppb) in 2001[5] near the south end of the main Goodman building. Without presenting evidence, the Center's consultant/DNR concluded that the solvents had migrated onto the property from the active Madison-Kipp plant. In approving site closure in 2008, DNR agreed.

[5] The documents that I have reviewed do not say whether this result was found in the shallow "Water Table" aquifer.

During my June 2017 visit to the area I lunched at the Ironworks Café, an impressive teen employment and training program situated at the southern edge of the Goodman building. Looking out the window, I was struck how close the Madison-Kipp factory, with its mural-covered windows, appears across the Capital City Trail, the bike and pedestrian path that follows the former Union Pacific rail right-of-way. It's less than 100 feet away.

In March 2012 Kipp's lawyer asserted, "historic PCE use has been documented at the Goodman Center property…" But there is also enough evidence to consider whether PCE and TCE from Madison-Kipp have migrated onto the Goodman Center property. Based on groundwater, soil gas, and indoor air sampling, there is ample reason to conduct new sampling at Goodman before ruling out unacceptable risk from vapor intrusion. In fact, the first step should be to create a conceptual site model to describe the presence of solvents in both liquid and vapor form at both the Waubesa Street plant and the Goodman property.

1. Modeled plume maps from Kipp's investigation of the Waubesa Street plant show PCE above the drinking water standard of 5 ppb directly underneath the Goodman building, but not in the upper "Water Table" aquifer. For example, see the map below of the Lower Lone Rock formation (65-100 feet below ground surface). Deeper contours show the entire building above 50 ppb of PCE in the Upper Wonewoc aquifer (77-139 feet below ground surface). A similar map shows TCE above 5 ppb under much of the building in the same aquifer. It is striking that the consultants have drawn the boundaries with no nearby groundwater data.

   Deep groundwater contamination does not indicate a potential for vapor intrusion unless the upper aquifer or shallow soil gas is also contaminated. But no such sampling has been reported near the Goodman building, except perhaps for the 2001 groundwater sampling.

   Furthermore TCE has been found well above the drinking water standard at the same monitoring wells as PCE, but there are no TCE contour maps. Though TCE concentrations are lower than PCE concentrations, TCE is also a contaminant of concern because Wisconsin, as mentioned above, believes that TCE causes cancers at lower levels than PCE and that exposures as short as one day to three weeks may unacceptably raise the chance of babies being born with cardiac birth defects.

2. There appears to be no sampling data to confirm the shallow (Water Table) plume boundaries. Typically in such investigations, sampling is stepped out until no further contamination is found, or at least it remains below the drinking water standard. But the closest well to the Goodman Center, MW-1, over the last several years has often tested in the 20's and 30's of parts per billion for both PCE and TCE. The most recent samples are just above and below the 5 ppb standard.

Back in the mid-1990s, shallow groundwater sampling at and near MW-1 and at MW-2, on Waubesa Street, showed much higher levels of chlorinated VOCs.

DNR officials reminded me that a newer shallow groundwater monitoring well on the Goodman property, MW-26, shows lower levels of chlorinated VOCs than MW-1, but maps clearly show that it does not sit between MW-1 and the main Goodman building. Even if the area had consistent groundwater flows, MW-26 would not suffice as a sentry well for the Goodman Center.

Moreover, there is evidence that in this area that the groundwater flow direction changes, presumably due to water levels in the nearby lakes, precipitation, and groundwater extraction from nearby production and remediation wells. So it's possible that the contamination found on the Goodman property came, as the Goodman consultant suggested, from Madison-Kipp. Therefore Kipp's Water Table plume map, showing a plume that is conveniently distant from the Goodman Center main building, is questionable. If the shallow plume does indeed extend under the building, then that would be enough reason, by itself, to sample the indoor air there.

In June 2012, Kipp's consultants punched a temporary well adjacent to the northern tip of the Kipp plant, not far from the Goodman building. As far as I can tell, they did not measure CVOCs in the shallow aquifer, but given the concern about vapor intrusion I don't understand why not. Among other compounds, they found, apparently at 40 feet or more below ground surface:

Cis-1,2-DCE	2,000 ppb
PCE	1,500 ppb
TCE	500 ppb
Vinyl Chloride	890 ppb

Such data do not prove that the Goodman Center is likely to have vapor intrusion, but they are high enough to present a strong case for more sampling, which to the best of my knowledge was never conducted.

3. The closest soil vapor sampling point to the Goodman building (VP-6), on the Kipp property just across the trail from the Goodman kids' splash pool, repeatedly shows elevated, but variable levels of both PCE and TCE in soil gas. They are not flagged in the Kipp reports because the consultants use what I consider unrealistically permissive soil gas screening levels. In July 2015 PCE was measured at 470 parts per billion by volume (3188 $\mu g/m^3$) and TCE reached 700 ppbv (3762 $\mu g/m^3$). These are not the highest levels found over the past several years, but the TCE level in particular is high enough to cause unacceptable levels of TCE in indoor air.

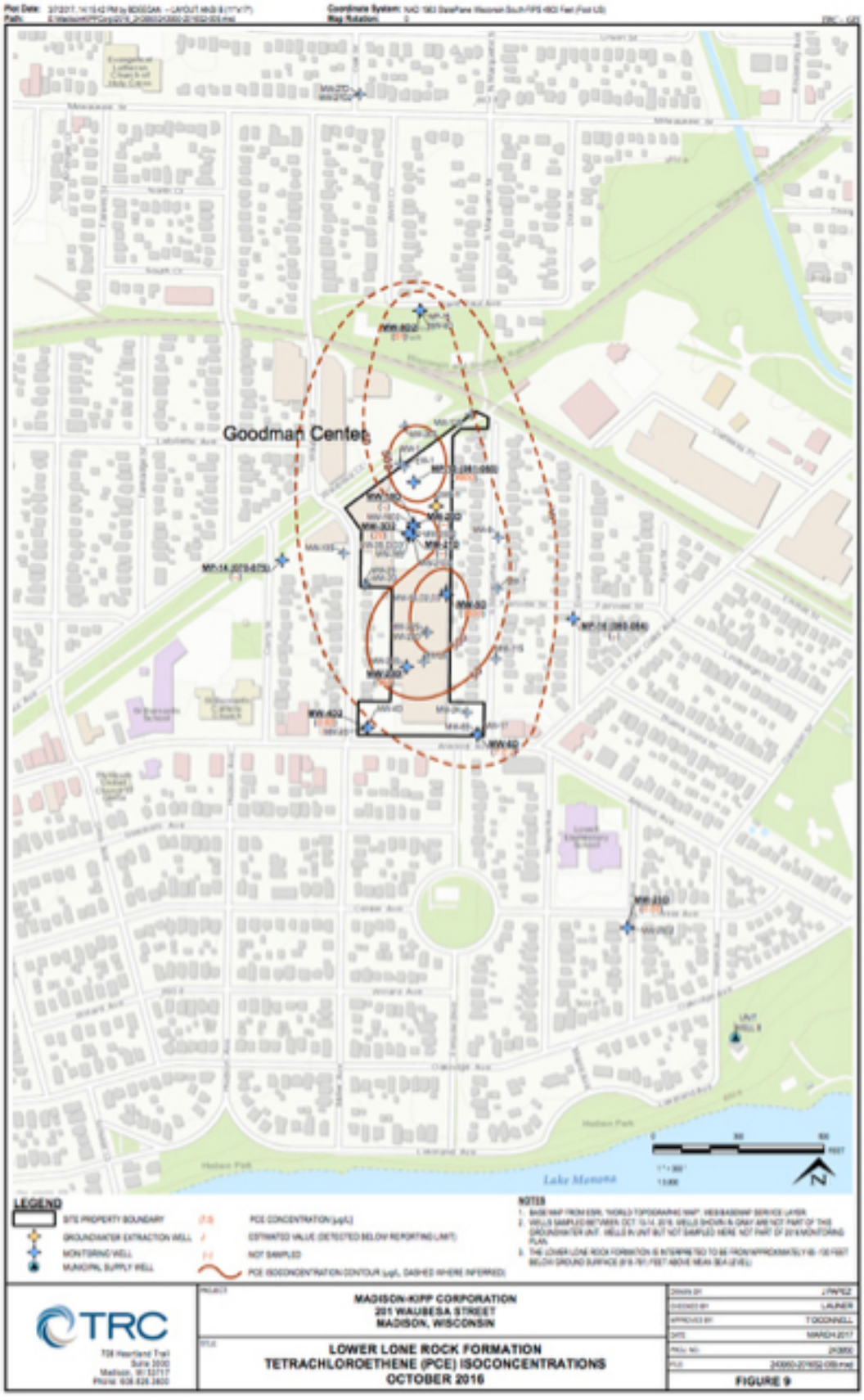
   As with groundwater, there are no sampling points that show clean soil gas between VP-6 and the Goodman Center, so Kipp's refusal to sample at Goodman is unjustified.

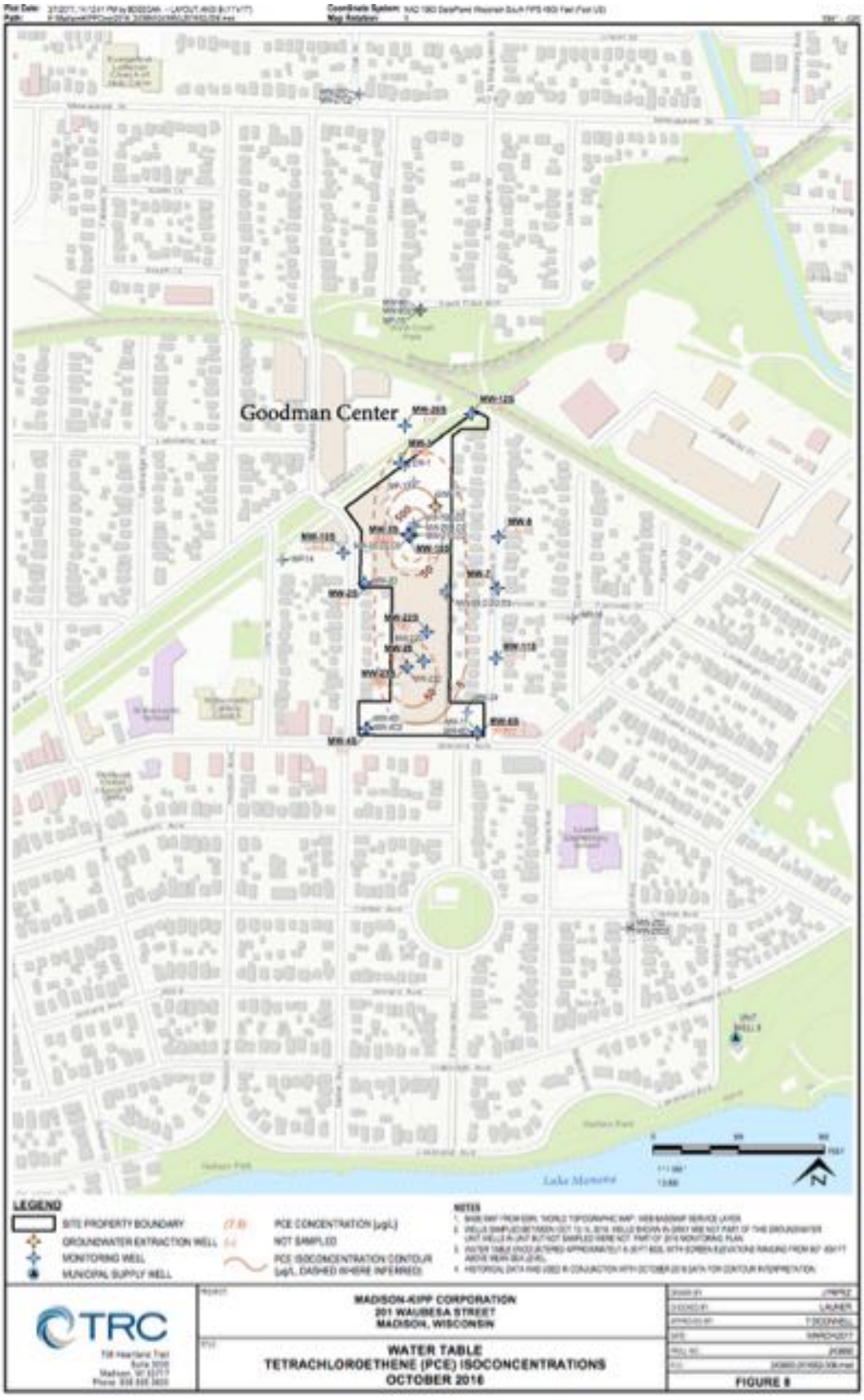
4. Finally, past indoor air sampling in the Kipp building across the trail from Goodman showed unacceptable levels of TCE in indoor air as well as PCE at higher levels. This seems to have been excused because the exceedances were found in file rooms not normally occupied. Nevertheless, in the absence of data showing non-detects within the Goodman building, these results suggest that vapor intrusion must be evaluated there.

Lorne Everett, the Class Action plaintiffs' expert, reached a similar conclusion in 2012:

> The conceptual site model in [Kipp's Site Investigation Report] does not discuss how the contamination was released and is generally incomplete. It disavows the high levels of PCE found north of the site in MW-15, which greatly distorts the depiction of the offsite extent of Madison-Kipp's contamination. Madison-Kipp's own consultant acknowledges a northern groundwater flow direction under the north part of the facility but dismisses the PCE contamination north of the facility as possibly coming from a dry cleaner. We trust WDNR will require more than this wishful thinking to relieve Madison-Kipp of its obligation to clean up its contamination north of the facility.

In summary, there is no reason for Goodman Center visitors and their families to panic. However, located on a former industrial site near other industrial sites—indeed, very close to some of the most contaminated portions of the Kipp Waubesa Street property—there is enough liquid and vapor TCE and PCE in the area to merit a realistic investigation. Such an investigation would include new groundwater, soil vapor, outdoor air, and most important, indoor air sampling at multiple locations and, particularly if TCE is found at any concentration, several times over the course of a year or more.


Goodman Center
Lake Monona
LEGEND
SITE PROPERTY BOUNDARY
GROUNDWATER EXTRACTION WELL
MONITORING WELL
MUNICIPAL SUPPLY WELL
PCE CONCENTRATION (µg/L)
ESTIMATED VALUE (DETECTED BELOW REPORTING LIMIT)
NOT SAMPLED
PCE ISOCONCENTRATION CONTOUR (µg/L, DASHED WHERE INFERRED)
NOTES
TRC
MADISON-KIPP CORPORATION
201 WAUBESA STREET
MADISON, WISCONSIN
LOWER LONE ROCK FORMATION
TETRACHLOROETHENE (PCE) ISOCONCENTRATIONS
OCTOBER 2016
FIGURE 9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NOTES
TRC
MADISON-KIPP CORPORATION
201 WAUBESA STREET
MADISON, WISCONSIN
WATER TABLE
TETRACHLOROETHENE (PCE) ISOCONCENTRATIONS
OCTOBER 2016
FIGURE 8

An Area-Wide Approach

The mixed-used areas of the Madison Isthmus, and likely other portions of this thriving city, are dotted with current or former industrial sites where volatile chlorinated compounds have been released into the subsurface. None of these sites seems to have affected an area as large as that associated with the Madison-Kipp Waubesa Street plant, but in many cases there is not enough data to rule out vapor intrusion, particularly if residential or public uses are planned for former industrial properties or adjacent to such properties.

DNR's 2010 Vapor Intrusion Guidance, now undergoing revision, states:

> **The vapor intrusion pathway should be investigated at all source properties where a release of CVOC [chlorinated volatile organic compound] has occurred.** The screening criteria listed here apply to developed properties as well as to undeveloped properties (where no buildings currently exist). In addition to CVOC source properties, the VI pathway should be investigated in the following situations, regardless of whether these conditions exist on or off the source property:
> · Any buildings overlying a CVOC soil source.
> · Any buildings within 100 feet of a CVOC soil source.
> · Any buildings overlying a CVOC groundwater plume located at the water table with groundwater concentrations above Wisconsin's groundwater enforcement standards (ES).
> · CVOC contaminated groundwater above Wisconsin's groundwater preventive action limit (PAL) is entering a building or in contact with the building's foundation, or is in water intercepted by the building's foundation drain system, including sumps.
> · CVOC vapors have the potential to enter preferential pathways (sewer lines, fractured bedrock, foundation cracks or openings, etc.) that connect contaminated areas to a building and migrate into that building.

But in practice, DNR does not have the data, resources, or will to fully carry out this policy.

In response, the city of Madison has the opportunity to further develop risk management policies that permit appropriate development while assuring future occupants of reused or redeveloped properties that they will be protected. Currently, though the city of Madison defers to DNR on direct cleanup oversight, it does screen some development projects for possible contamination problems. In a March, 2017 memorandum,[6] the City Engineer explained the city's approach:

> In the City of Madison, Engineering staff use the plan review process to screen proposed developments for contamination by reviewing all conditional use

[6] When I visited Madison in June, no one I met with knew about this memorandum. I only learned about it in August, when Mayor Soglin's office sent me a copy in response to my draft report.

> permits, plats/CSMs, and demolition projects. Approved uses do not receive an environmental screen. While the jurisdiction to enforce clean up of contamination lies solely with the Department of Natural Resources, the City of Madison assists the DNR by notifying it when a development is being proposed on a site with known contamination.

The city "also notifies developers when we suspect contamination may be encountered during redevelopment." It does not require developers to notify future building occupants that properties have been subject to environmental responses.

In general, these are good practices, but in areas where there are multiple known and potential sources of volatile organic compounds, I believe that they are not protective enough. Desktop screening should be routine for all developments, and intrusive sampling—as typically done for a Phase 2 Environmental Site Assessments—should be required near known sources of CVOCs. Associated documents should be easily accessible for public review.

Furthermore, to encourage DNR, developers, and property-owners to initiate vapor intrusion investigations where appropriate, the city of Madison could create a Web-accessible database that consolidates known information about CVOCs in industrial areas such as the Isthmus. Ideally, it would include plume maps where available, not just point identification of properties. Software for creating such data bases is commercially available. Such a system could also be used to identify data gaps to be filled before projects are approved.

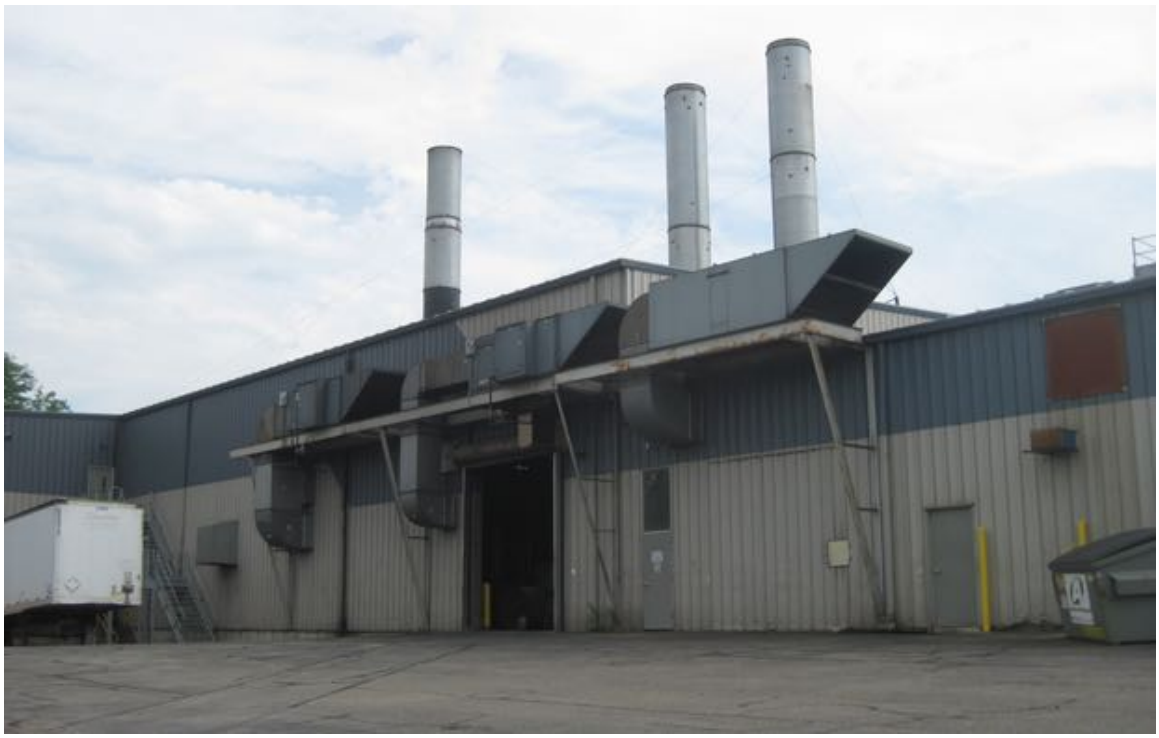
In late 2015 the Goodman Community Center acquired the historic Madison Brass Works property directly west of Kipp's Waubesa plant, with unspecified plans to locate some of its activities there. Recall that this is the site where the discovery of contaminated groundwater led to the Madison-Kipp investigation across Waubesa Street. A single set of subslab soil-gas samples in late 2014 found both PCE and TCE, but at levels well below DNR action levels. The results of groundwater sampling conducted at the same time showed PCE in shallow groundwater, at a single spot, just above the DNR's Preventive Action Limit of .5 ppb. MKC's deep plume maps show PCE and TCE at depth under the building.

Meanwhile, immediately northeast of its Waubesa factory, Madison-Kipp operates another plant on city-owned property on Fair Oaks Avenue. One housing proposal, across the street to the north of this plant, was denied a crucial piece of funding by the city council because of concerns about environmental pollution from this plant; the project is now in limbo. Another housing development, across the street just to the east of the Fair Oaks factory, has just been proposed and is moving forward through the city decision-making process. To my knowledge, there has been no sampling to determine if Kipp released hazardous volatile substances from the Fair Oaks site. Based on the company's record, one would expect such an investigation. But in the absence of a potential property transfer, there has been no requirement. Still one would think that, as property owner, the city could conduct or insist upon such sampling.

There is no evidence that there is an imminent risk of vapor intrusion at these sites, but recent studies in similar climates suggest that significant amounts of sampling—at multiple locations and at many times—must be done to rule out vapor intrusion in industrial areas where chlorinated solvents have been released or even are just known to have been used or stored.

Fortunately, there is a solution, particularly in new construction or major remodeling. Mitigation systems, such as vapor barriers and subslab depressurization systems, can be built into structures at less cost that a comprehensive sampling program. At sites where VOC concentrations in groundwater or soil gas are low, mitigation can be built as passive. At sites where soil gas or groundwater action levels are found to be exceeded during the planning phase, active systems should be installed during construction.

The housing developer who proposes to build across from Kipp's Fair Oaks Avenue plans passive mitigation. At least, that's what he said at a community meeting when a citizen asked about the potential for vapor intrusion at the project. To my knowledge, that plan is not yet written into any city or DNR document.



Madison-Kipp's Fair Oaks Avenue plant

If passive mitigation is installed at this housing, but post-installation indoor air monitoring shows elevated levels of VOCs, then passive venting can be transformed into active depressurization with the addition of blower fans. Such sampling and a contingency plan for exceedances should be built into city approval documents.

As a local elected official myself,[7] I take seriously decisions whether to allow development on contaminated property and on property near known contamination. While environmental regulatory agencies are responsible for overseeing environmental investigation and remediation, they must "chase after" polluters. Cities, as land-use jurisdictions, must approve projects. That is, the property owners or developers must come to us.

Madison has the opportunity to create a policy similar to that of Mountain View, California, in which construction on or near property contaminated with VOCs is required to include passive or active mitigation.[8] Furthermore, for properties subject to environmental oversight—for example, if PCE or TCE groundwater concentrations exceed action levels—we have also been requiring, as a condition of development, that future building occupants be notified about the environment response. People have a right to know such things, and some may decide not to work, live, or visit such properties, even if officials deem the environmental response sufficient.

[7] I currently serve as Vice-Mayor of Mountain View, California, where both residential and commercial developments have been built or are being built on Superfund sites and other contaminated property.

[8] Mountain View's policy is featured in U.S. EPA's 2015 Vapor Intrusion Guide, on page 164.

At a time when, across the country, environmental regulatory agencies lack the resources and often the will to address fully vapor intrusion risks, particularly where initial sampling does not show high levels of contamination, it is important that cities step up. I routinely state, from the Mountain View Council dais, that I have reviewed the environmental documents associated with development, and that we as a city are doing what we can to ensure that the people who live, work, study, or play in a building will be safe. Madison's officials can do the same.