Public Health Assessment

Evaluation of soil, groundwater, and vapor intrusion contamination at open and closed investigations on the Hartmeyer and Oscar Mayer sites in Madison, WI

Hartmeyer & Oscar Mayer Sites
2007 Roth St & 910 Mayer Ave
Madison, Wisconsin

BRRTS (Open):02-13-580721; 02-13-580723; 02-13-580328[1]

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Prepared by:

Wisconsin Department of Health Services
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[1] Open BRRTS site numbers are included here. Closed site investigations were also evaluated; BRRTS # information is located throughout the document.

Summary

In 1918, Oscar Mayer & Co. purchased the meat packing facility at 910 Mayer Ave. Throughout its history, the company used many chemicals on site in production and transportation, including solvents, petroleum products, and chemicals used in the manufacturing of plastics.

The Oscar Mayer site consists of east, central, and west portions. The majority of the buildings and processes were concentrated on the central portion of the site. The Hartmeyer property, located on the west side of the site, was leased to Oscar Mayer and is located next to the Wisconsin & Southern Railroad, which splits the central portion of the site from the western portion. Sites covered in this document include two open Oscar Mayer Sites (1,2-Dichloroethane (1,2-DCA) site and Building 43) at which remedial activities have recently been carried out. In addition, the Hartmeyer site, adjacent to Oscar Mayer, is also open and pending further potential investigation and/or remediation. Spills and closed sites were also evaluated per a request from the Sherman Neighborhood Association.

After review of open site investigations, closed site investigations, and spills, it was determined:

- **Building 43 on the Central Oscar Mayer site has a potentially completed exposure pathway to trichloroethylene (TCE) above health-related screening levels.**
- **On the Hartmeyer site, there is a potentially elevated cancer risk due to elevated levels of benzo[a]pyrene and arsenic in the soil. The current vegetative cap should effectively prevent any incidental exposures to contaminated soil, minimizing any risk in its current state.**
- **No health hazards were identified from other open sites, closed sites, or historic spills, given current site conditions. If site conditions change, (e.g., soil caps are disturbed or other potential exposure pathways are opened), there may be potential health risks.** DNR regulatory authority, in the form of site closure requirements or continuing obligations on closed sites, requires that any changes to site conditions are appropriately managed to prevent human health hazards.

The potentially completed exposure pathway in Building 43 consists of vapor intrusion of trichloroethylene (TCE) at levels exceeding the sub-slab vapor risk levels for the state of Wisconsin. Building 43 is currently undergoing remediation by soil vapor extraction (SVE) from 20 points in the building with the goal of reducing vapor intrusion exposure levels. As of Sep 2022, Building 43 is being used for storage and is rarely entered; we recommend susceptible populations (i.e., women of child-bearing years) do not enter the building, and that appropriate respiratory PPE is used by any workers entering the building.

While the Hartmeyer property does not currently pose any health risks due to the caps over contaminated soil, it is an open site. As such, any future development on the Hartmeyer site that opens exposure pathways to soil or groundwater would be required to be reviewed by DNR (and DHS if appropriate)

prior to approval, to ensure that any potential exposures during or after action are appropriately mitigated, and that all statutory requirements of NR 720 are met prior to land use.

Many closed sites have continuing obligations applied by DNR, such as yearly inspections, maintaining caps on sites, and notification in case of zoning changes, among others. DHS supports these continuing obligations, as they are implemented in a way to adequately protect public health. These continuing obligations prevent potential future exposures to contaminants remaining on sites after closure if changes to the site use occur. Additionally, per the DNR process, any open sites would need adequate mitigation to eliminate all public health hazards prior to the shift in land use.

There are limitations in this evaluation: no offsite sampling has occurred, and some data was old (10+ years) and potentially not reflective of current conditions at the site. This health assessment is only intended to evaluate current and potential health risks given the current state of the site; **future development or disruption of barriers on the property may open exposure pathways to contaminated groundwater or soil if appropriate precautions and mitigations are not implemented during development**. Per DNR regulations, statutory cleanup requirements, such as those in NR720, will need to be met prior to site closure and land use.

Due to spills, emissions, and site use, housing near or on industrial sites has the potential to pose environmental health risks to residents, which have historically been disproportionately minority and low-income populations across the country. These preventable exposures perpetuate generational harm. **Since a goal of the City of Madison's Oscar Mayer Special Area Plan is to encourage development of affordable housing to serve historically marginalized populations, ensuring appropriate review and mitigation of contamination on the Oscar Mayer and Hartmeyer properties is crucial to ensure adequate health for future residents.**

Acronyms

Below are the acronyms used in this assessment for reference. Some additional information about definitions can be found in Appendix B in the glossary at the end of this document.

- µg/L: microgram per liter
- µg: microgram
- 1,2-DCA: 1,2-Dichloroethane
- AST: Aboveground storage tank
- ATSDR: Agency for Toxic Substances and Disease Registry
- BRRTS: Bureau for Remediation and Redevelopment Tracking System
- cis-1,2-DCE: cis-1,2-dichloroethylene
- COC: Contaminant of concern
- CRA: Conestoga Rover & Associates (consultant)
- CREG: Cancer risk evaluation guide
- CV: Comparison value
- CVOC: Chlorinated volatile organic compounds
- DHS: Wisconsin Department of Health Services
- DNR: Wisconsin Department of Natural Resources
- DRO: Diesel Range Organics
- EPA: United States Environmental Protection Agency
- ERM: Environmental Resources Management (consultant)
- ES: Enforcement standard
- ESA: Environmental site assessment
- Fbgs: feet below ground surface
- GRO: Gas Range Organics
- mg/kg: milligram per kilogram
- MW: Monitoring well
- NIOSH: National Institute for Occupational Safety and Health
- OM: Oscar Mayer
- OSHA: Occupational Safety and Health Administration
- PAH: Polycyclic Aromatic Hydrocarbon
- PCE: Tetrachloroethylene (perchloroethylene)
- PFAS: Per- and polyfluoroalkyl substances
- PPE: Personal protective equipment
- PZ: Piezometer
- RCL: Residual contaminant level
- SB: Soil boring
- SVE: soil vapor extraction
- TCE: Trichloroethylene
- TMBs: Trimethylbenzenes
- UST: Underground Storage Tank
- VOC: Volatile organic compound
- VRSL: Sub-slab vapor risk screening level

Public Health Assessment Process

The public health assessment process involves two primary scientific evaluations: the exposure pathway evaluation and the health effects evaluation (Figure 1). The exposure assessment is when scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, DHS does not collect its own environmental sampling data but reviews information provided by federal and other state government agencies and/or their contractors, potentially responsible parties, and the public. When adequate environmental or exposure information is not available to evaluate exposure, DHS will indicate what limitations exist and what additional information is needed. If the exposure evaluation shows that people have or could come into contact with hazardous substances, DHS evaluates whether this contact may result in harmful health effects. DHS uses existing scientific information, which can include the results of medical, toxicological, and epidemiologic studies, to determine what health effects may result from exposures.

Identifying Exposure Pathways

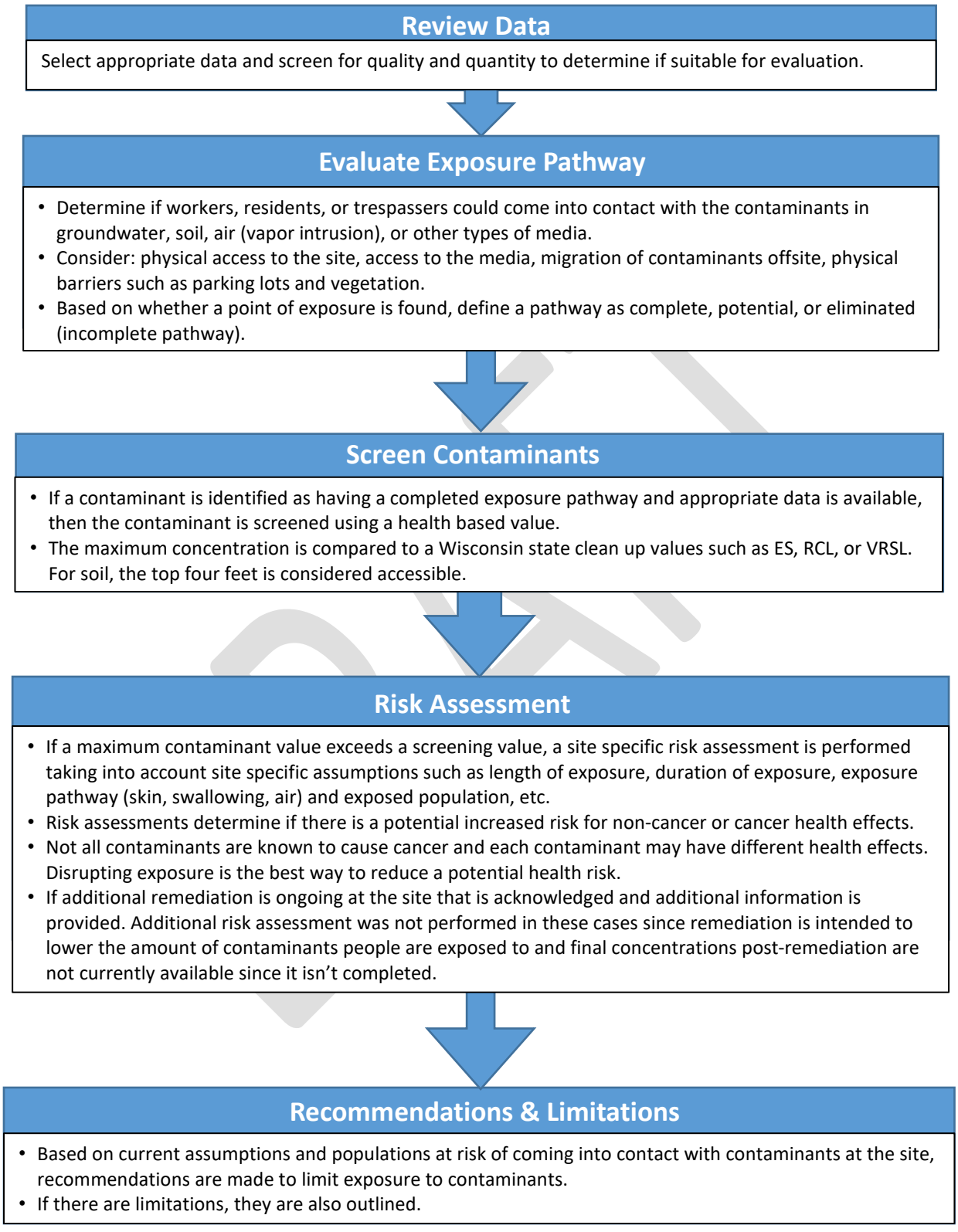
An evaluation of exposure pathways is performed to determine if an exposure or potential exposure to the contaminant is possible. In order for any contaminant to be a health concern, a completed exposure pathway must exist and the contaminant must be at a high enough concentration to cause potential harm to people. In order for a completed pathway to be present, all of the following elements must exist: a source of contamination,[2] media for the contaminant to travel, a point of exposure where people actually come into contact with contaminated material, a route of exposure for the contaminants to enter the body, and a receptor population or people who are exposed or potentially exposed to the contaminants.[3] Routes of exposure can include: ingestion (swallowing), inhalation (breathing) and dermal (skin contact) exposure. Contaminated media can include air, soil, and water (groundwater and/or drinking water). The glossary in Appendix B outlines defines the features of each of these pathways in relationship to media (water, soil, air) type.

Contaminants of Concern (COC)

If a maximum contaminant value associated with an area was associated with a completed exposure pathway and there is a known population coming into contact with the contaminated media (soil, air, water, etc.), then the contaminants are evaluated to determine if they are a contaminant of concern. To determine if a contaminant is of concern, the maximum contaminant level is compared to either a soil residual contaminant levels (RCLs), vapor risk screening levels (VRSL), or the groundwater enforcement standards (ES) to determine if it is above these Wisconsin State standards for contaminants.

[2] For example, for soil, this would be the top 4 feet of soil that would be considered accessible to residents or trespassers if it was uncovered (no parking lot and no dense vegetation) or loose. Workers may also have contact with it if they are remediating the area or disturbing the soil, even if there is a cap (parking lot or vegetation) present.

Figure 1. Human Health Risk Assessment Process



Overview of Oscar Mayer (OM) and Hartmeyer Sites

The Oscar Mayer site at 910 Mayer Avenue in Wisconsin is a mixed use area (industrial, commercial, recreational, and residential) (Appendix A, Figure 1). The site is approximately 70 acres divided into "Central", "East", and "West" Properties. The West Property is separated from the Central Property by the Wisconsin & Southern Railroad right-of-way, and the East Property is a single parcel separated from the Central Property by Packers Avenue. The Central Property is enclosed with a fence that limits access to the site by the general public and trespassers. The East Property and West Property have no open Bureau for Remediation and Redevelopment Tracking system (BRRTS)-related investigations and were not investigated as part of this assessment, due to there being no available data for evaluation.

The facility opened as a meat packing plant in 1916 before Oscar Mayer purchased the operating company in 1918. In 1981, Oscar Mayer was purchased by General Foods, which was subsequently acquired by Philip Morris in 1985. Under Philip Morris' ownership, the facility operated under the names Kraft General Foods, Inc., Kraft Foods, Inc., and finally Kraft Foods Group. H.J. Heinz Co. purchased Kraft Foods Group in 2015, and operated the facility as a meat processing and packaging plant under the Kraft Heinz name until closure in 2017. Three service stations existed on the east side of the Central Property between 1958 and 1967. By 1968, Packers Avenue was rerouted and expanded and subsequently the service stations were removed and the area was developed into employee parking areas for Oscar Meyer.

On the Central Property, there are currently two open investigations in BRRTS addressing two releases reported to DNR by Environmental Resources Management (ERM), on behalf of 910 Mayer LLC (the current owner), in a letter dated October 30, 2017. A third investigation, commonly referred to as the Oscar Mayer Former Filling Station East (02-13-580722) was recently closed (1/19/2021) and was considered a part of our evaluation.

The Phase II investigation of the Central Property included 63 soil borings throughout the Oscar Mayer site, numerous soil and groundwater samples (Appendix A, Figure 3), and 16 sub-slab vapor samples. The data provided in BRRTS are associated with the former Filling Station, the former 1,2-DCA tanks, and the spice room (Building 43) located on the Central Property (Appendix A, Figure 1). The former filling station is associated with the East parking lot where three gasoline filling/service stations were located on the eastern portion of the property between 1958 and 1967.[4] The presumed release from the former 1,2-DCA (also known as ethylene dichloride) aboveground storage tanks (AST) is located in the unpaved grassy area south of Building 59. In July 2017, ERM identified two 6,300-gallon ethylene dichloride tanks associated with an incinerator shown on the southern portion of the Central Property.[5] Historically, the spice room (Building 43) was used as an area to prepare, mix, and store spices used within the facility for food production. The Ramboll-Environ Phase I ESA indicated that chlorinated solvents may have been historically used in the vicinity of the spice room as part of an extraction process.[6]

Immediately south of the West Property portion of the Oscar Mayer site is the Hartmeyer site (Appendix A, Figure 2) which was previously leased to Kraft by the Hartmeyer family. The Hartmeyer site has been previously sampled and was considered as part of our assessment. The Hartmeyer site also has an open BRRTS investigation where 50 additional soil borings were analyzed for contaminants in 2020 for arsenic and benzo(a)pyrene. In 2019, 19 soil boring samples were analyzed. This contaminant data was used for evaluation of soil contamination (Appendix A, Figure 7).

[4] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=95806
[5] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=95809
[6] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=95808

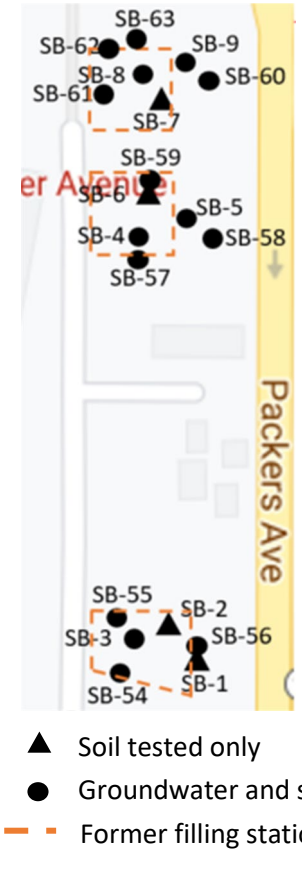
Closed spills and closed site investigations on BRRTS were also reviewed as part of this analysis. Please note that there were limitations for closed spills on site, since spills did not involve any testing and, depending on the contaminant (e.g., ammonia gas), released substances may not have been retrievable.[7] While some old sampling data collected from closed sites used outdated methods, some had updated sampling data from 2017 as part of the Phase II investigation for the central Oscar Mayer property. Data for closed sites were reviewed to determine:

1) If there were continuing obligations for the site,
2) Whether or not there was a completed exposure pathway for contaminants, and
3) Where applicable, data over time was evaluated to determine if contaminant levels were decreasing due to natural attenuation.[8]

In addition to the aforementioned data, we reviewed a report conducted for The Transparency Project by Midwest Environmental Advocates outlining the environmental contamination on the former Oscar Mayer property and surrounding areas in Madison, WI, which was provided to DHS by the Sherwood Neighborhood Association.

In 2020, the Oscar Mayer Special Area Plan was adopted by the City of Madison Planning Division, outlining an extensive rezoning and redevelopment vision in and around the Oscar Mayer and Hartmeyer properties. This effort would result in a significant disturbance of existing caps, leading to potentially completed exposure routes during construction. During this redevelopment project, ongoing assessment will be needed by DNR (and DHS as appropriate) to ensure there are no completed exposure pathways in the final constructions. Any future development conducted on open sites on the property would have this assessment done as a standard step, to ensure that all statutory requirements of NR700 are met. Existing continuing obligations at all closed sites means that review and approval are required before any development would occur.

Figure 2. Sampling and former filling station locations



Closed (2021) Site Investigation: Former Filling Station (East) Site (BRRTS# 02-13-580722)

The former gasoline filling station is located on the Central Property of the Oscar Mayer site, which contains former manufacturing complexes, business offices, and supporting infrastructure buildings. According to city directories, facility maps and aerial photographs, it appears that three gasoline filling and/or service stations were located on the eastern portion of the Central property between 1958 and 1967. By 1968, the east portion of the central site adjacent to Packers Avenue was expanded and reconfigured and several structures formerly located on the Central Property, including the gasoline stations, were razed and paved for a parking lot (Appendix A, Figure 1). Records regarding

[7] For example, if it was an ammonia gas release, retrieving the gas is impossible due to the nature of the release.
[8] The Environmental Protection Agency (EPA) defines **natural attenuation** as "a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater (https://toxics.usgs.gov/pubs/eos-v82-n5-2001-natural/#:~:text=The%20Environmental%20Protection%20Agency%20(EPA,contaminants%20in%20soil%20or%20groundwater.).

the number of underground storage tanks (USTs) and their contents are not available and no documentation of the UST removal is available for the former filling station properties. The Phase II site investigation indicated there were no USTs currently at the former filling station location on the central property. The soil and groundwater samples taken from the former filling station area included samples taken near the former filling station tanks' locations (Figure 2). For additional information about toxicity of specific contaminants, please see Appendix C. Chemical Toxicity Overview.

Soil Exposure Pathway

The main exposure pathway for a soil contaminant located outdoors is through touching or swallowing it, which includes accidental ingestion of soil due to hand-to-mouth behaviors. Currently, the soil in the vicinity of the former filling station is covered by a parking lot (Appendix A, Figure 6). The parking lot prevents direct contact with soil and serves as a cap, limiting access and exposure to the underlying soil. All soil borings samples from the top 4 feet of soil (or 5 feet if the boring was 4 to 5 feet in depth) were below their respective industrial direct contact values established by DNR. Two compounds analyzed in samples didn't currently have direct contact values, indicating that there isn't enough toxicological information to develop a standard (Benzo[g,h,i]perylene and phenanthrene). Therefore, there was not enough information to further evaluate these contaminants. Based on current exposure assumptions, these findings collectively indicate that the soil exposure pathway is incomplete (Table 1).

Table 1. Exposure Pathway Evaluation for Soil Contaminants at the Former Filling Station

Source (contaminant)	Point of Exposure	Potentially Exposed Population	Route of Exposure	Time Frame	Pathway Status
PAHs[1], Xylene, Naphthalene	None	Workers/ trespassers	Ingestion, dermal	Present	Incomplete
	None	Offsite residents	Ingestion, dermal	Present	Incomplete
Metals	None	Workers/ trespassers	Ingestion, dermal	Present	Incomplete
	None	Offsite residents	Ingestion, dermal	Present	Incomplete

[1]Polycyclic aromatic Hydrocarbons (PAHs) is a group of compounds (acenaphthene, acenaphthylene, anthracene, benz[a]anthracene, benzo[a]pyrene, benzo[e]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[j]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, fluoranthene, fluorine, indeno[1,2,3-c,d]pyrene, phenanthrene, and pyrene)[9]

Groundwater Exposure Pathway

The main exposure pathway for a groundwater contaminant is oral ingestion (drinking) and, depending on the contaminant and its chemical properties, dermal (skin) contact. Vapor intrusion or volatilization from household water (resulting in inhalation) can be another pathway depending on the contaminants and site conditions. Groundwater flow in this area of the site is inconsistent and varies depending upon geologic intervals, time of year, and amount of precipitation. Because of the shallow nature of the water table, direction of flow can be influenced by buried utility corridors, surface water bodies, groundwater pumping, and/or recharge from rain and snowmelt. Groundwater is a common source of drinking water, another potential exposure point. However, the municipal wells that serve the community are regularly monitored for contaminants, including heavy metals and volatile organic compounds (VOCs). For example, all VOCs and metals that were detected in municipal well 7 were below Wisconsin standards,

[9] https://www.atsdr.cdc.gov/ToxProfiles/tp69.pdf

and the Madison municipal wells are regularly tested for contaminants.[10] Furthermore, the continuing obligations and case closure letter for the site indicate that "there is no evidence that contamination exceeding a soil and/or groundwater standards extends beyond the site property boundary with respect to the investigation of the former filling (gasoline) stations."[11] Therefore, the groundwater pathway for this site was considered to be incomplete (Table 2). Furthermore, the monitoring well east of the site next to Packers Ave did not have any substances at levels exceeding groundwater standards.

At this site, the contaminated groundwater was located at depths varying from 3 feet to 19 feet below the surface, making direct contact with the groundwater unlikely, especially since the samples were taken beneath a parking lot separated from the residential community by a highway. Vapor intrusion and/or volatilization from groundwater was not considered a relevant exposure pathway because there are no buildings located over the contaminated portion of the site, and the area is served by the municipal water system, which is regularly monitored.

Table 2. Groundwater Exposure Pathway Evaluation for Contaminants near Former Filling Station

Source (contaminant)	Point of Exposure	Potentially Exposed Population	Route of Exposure	Time Frame	Pathway Status
PAHs, Xylene, Naphthalene	None	Workers	Ingestion, dermal	Present	Incomplete
	None	Offsite residents	Ingestion, dermal	Present	Incomplete
Metals	None	Workers	Ingestion, dermal	Present	Incomplete
	None	Offsite residents	Ingestion, dermal	Present	Incomplete

Continuing obligations

Activity on the site was closed in BRRTS on 1/19/2021[12] with the following continuing obligations put in place by DNR. These continuing obligations should protect people from potential future exposures to soil and groundwater contaminants at the site:

- Groundwater contamination is present at or above Ch. NR140, Wis. Adm. Code enforcement standards.
- Residual soil contamination exists that must be properly managed should it be excavated or removed.
- Pavement, an engineered cover or a soil cover must be maintained over contaminated soil and the DNR must be notified and approve any changes to this barrier.
- Remaining contamination could result in vapor intrusion if future construction activities occur.

Future construction includes expansion or partial removal of current buildings as well as construction of new buildings. Vapor control technologies will be required for occupied buildings, unless the property owner assesses the potential for vapor intrusion and the DNR agrees that vapor control technologies are

[10] Additional information and testing results on municipal wells in Madison can be found here.
[11] 20210119_56_CO_Packet (2).pdf
[12] 20210119_11_Closure_Final.pdf

not needed. During the construction process, any dewatering efforts would need to be appropriately permitted through DNR beforehand, which would involve identifying appropriate sites or treatment for discharge to not spread any residual groundwater contamination.

Limitations

Groundwater samples were not filtered at this location prior to analysis making it difficult to determine if lead contamination was associated with the groundwater or with the soil. However, the contamination has been well defined and appears to be confined to the former filling station tank area. These conclusions are based on on-site data available for review from BRRTS; to our knowledge, offsite sampling has not occurred at this time.

Conclusions & Recommendations[13]

Due to lack of access to the soil and groundwater located at the site, the exposure pathway is incomplete for groundwater and soil contaminants. The lack of access is primarily due to the soil being covered by a parking lot, and no indication of groundwater migration off site that would lead to an exposure. Furthermore, residential communities in the area rely on the municipal water system, which is regularly tested for contaminants and continues to provide water that meets Wisconsin state drinking water standards.

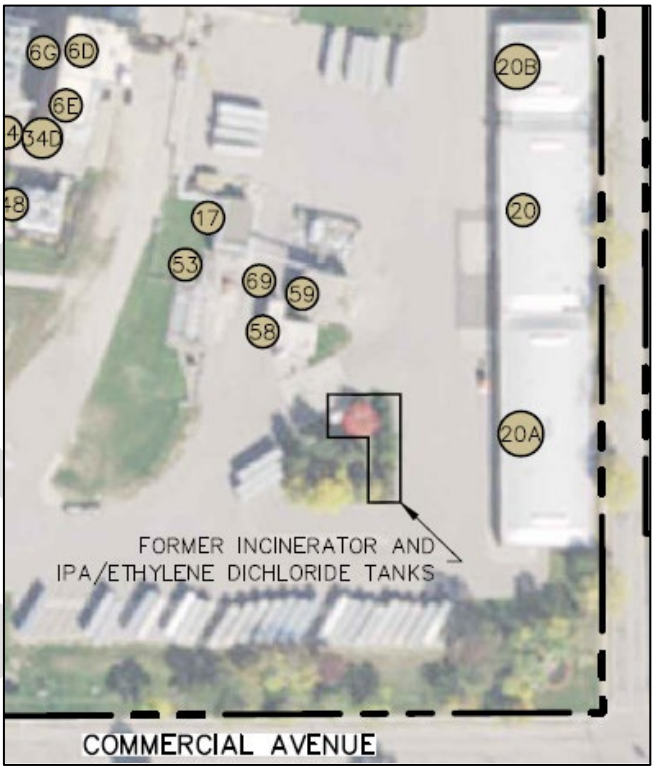
The continuing obligations imposed on this site offer protection from exposure to contaminants through barrier maintenance, and requires DNR notification should there be future construction. Beyond those obligations, basic guidance for handling any soil to limit accidental ingestion includes wearing gloves, avoiding hand to mouth contact with dirty hands, and maintaining proper hygiene by washing hands before eating. Additionally, workers should avoid tracking soil into their homes, by using work-specific clothing and shoes. Additional continuing obligations that are protective of human health now and for future use are outlined online. [14] **Therefore, there is no apparent public health public health hazard at this time.** If there are meaningful changes to the existing caps that would allow for access to soil or groundwater by workers or residents, that would create a potential exposure pathway, posing potential health risks. Any changes that impact a continuing obligation on the site would result in DNR review, including future DHS review if there are potential health risks.

[13] https://dnr.wi.gov/files/PDF/pubs/rr/RR819.pdf
[14] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=190613

1,2-DCA Above Ground Storage Tank Site (Open Site, BRRTS# 02-13-580721) & Closed Site #3 (BRRTS# 03-13-114831)

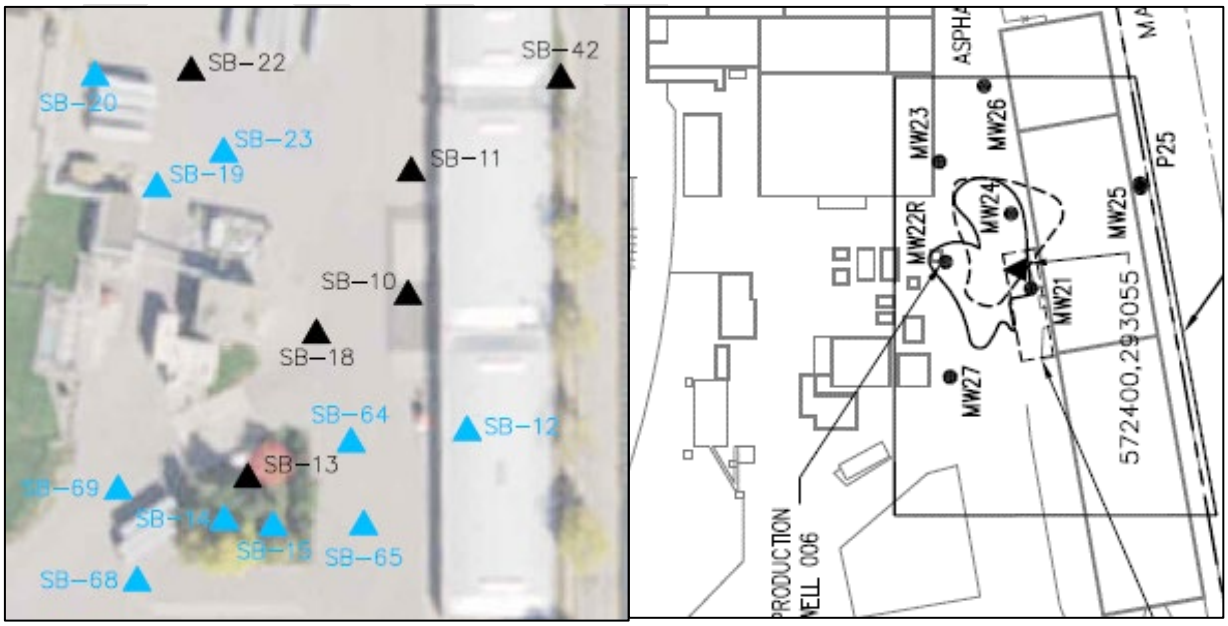
ERM, the consultant hired by 910 Mayer LLC, reviewed historical maps in 2017 and determined that there were two 6,300 gallon isopropanol tanks and two 6,300 gallon 1,2-DCA tanks associated with an incinerator on the southern portion of the central property of the Oscar Mayer site (Figure 3). The 1,2-DCA ASTs were originally located in the unpaved grassy area south of Building 59 but have since been removed. A release from the 1,2-DCA storage tanks had not been previously identified, but VOCs detected above Wisconsin DNR standards were reported as part of the due diligence investigation of the site by ERM in 2017 (BRRTS# 02-13-580721). Adjacent to the site are adjoined buildings 20, 20A, and 20B, collectively known as the Bodgery (a nonprofit makerspace in Madison). They offer access to the building for both members and for guests. Inside the building, there is an area reserved for child play.

Figure 3. Overview of the former 1,2-DCA site location on the Central Oscar Mayer Site



Closed Site #3 (BRRTS 03-13-114831) is located just west of The Bodgery building on the South side of the Central portion of the Oscar Mayer Property (Figure 4). An underground storage tank (UST), former diesel dispensers, and several former gasoline dispensers were excavated for removal from the site. Following excavation, the site was backfilled with clean fill and a new diesel UST. The former UST excavation for gasoline was also backfilled. Following the original excavation,

Figure 4. Closed Site #3 with 2017 data near site (left) and 1996 (right) extent of contamination.



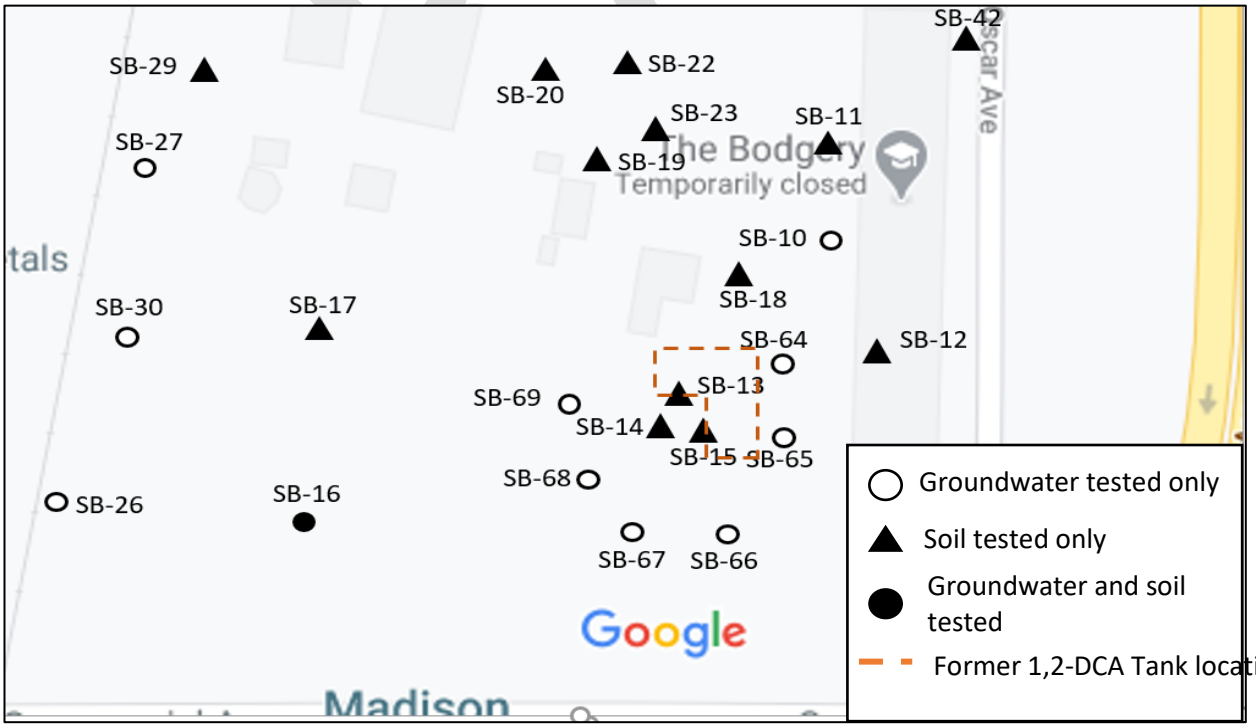
soil and groundwater analytical results were taken in 1996 and 1997 from the excavation to determine soil and groundwater contamination at the site. The cap is required to be maintained and inspected annually to determine its integrity. Sampling was also performed on this site as part of the 2017 Oscar Mayer investigation. Additional soil samples and groundwater samples were taken throughout Oscar Mayer property in 2017. The samples were also taken on the former 1,2-DCA tank site and from the area near Closed Site #3 (Figure 4 and Figure 5). Soil samples in the top 5 feet of soil (SB-11, SB-12, SB-18, SB-19, SB-23, SB-42) where the soil is most accessible, and groundwater samples (SB-10, SB-12, SB-18, SB-19, SB-23, SB-42, SB-64) were also taken near the former UST site behind the Bodgery.

1,2-DCA Site Exposure Pathway

The majority of this site is covered with parking lot material and dense vegetation coverage preventing access to both the soil and groundwater onsite (Figure 6). This portion of the site is also fenced-in (see Figure 7). The Bodgery building is located just east of the location, by the former 1,2-DCA tanks. While the southernmost section appears to have areas that aren't covered by pavement, there appears to be sufficient ground coverage and overgrowth which would limit exposure to the soil. This central portion of the site is located within a fenced-in area, but it is unclear if there is access to the area through the back of the Bodgery building.

The main contaminant of concern is 1,2-DCA, presumably from the former tanks. The groundwater has been tested, and remediation will be required to reduce the amount of 1,2-DCA and other related contaminants in the groundwater. The Bodgery is on the municipal well system, which is regularly monitored for contaminants, so exposure through drinking water is unlikely. Given that the ground is covered, direct exposure to groundwater is unlikely. Due to the direction of the plume and groundwater flow, DNR has indicated that vapor intrusion of 1,2-DCA and its degradation products is not a concern in the Bodgery building.

Figure 5. Approximate locations of soil and groundwater sampled on the 1,2-DCA above Ground Storage Tank site



Soil Exposure Pathway

To our knowledge and at the time of our site visit, there was no construction taking place in this area (In December 2020, an excavation to remove contaminated soil was carried out). It was also observed that access to this site appears to be limited due to a fence limiting access to a portion of the site. On the back of the Bodgery, there is a "garage door" type entrance to the building and a side door. Both appeared to not be in use (Figure 6). The fencing right outside this area does have a "No Trespassing" sign (Figure 7). A building at the back of the lot did appear to be in use with cars parked in the parking lot but it appeared to be for the building labeled "Nine-Ten" which is being leased out by a third party company. Upon further investigation, it was confirmed that several warehouse users have space onsite to store materials in buildings 71/72, 43, and 50. However, to our knowledge, these buildings are not actively being used as office or workspace, but only for storage. While the back of the Bodgery building does have garage-style doors (Figure 6) and a side door that are capable of opening to the fenced-in area, they do not appear to be easily opened and, therefore, it is unlikely that a child would be able to exit the Bodgery building by themselves. For these reasons, this pathway was considered to be incomplete (Table 3).

Figure 6. The former 1,2-DCA Tank location behind the Bodgery, which is a community building used as a makerspace for artists and community members.

Figure 7. Trepassing sign on the central Oscar Mayer Property near back of Bodgery building.

Table 3. Soil Exposure Pathway Evaluation at the 1,2-DCA site

Source (contaminant)	Point of Exposure	Potentially Exposed Population	Route of Exposure	Time Frame	Pathway Status
1,2-DCA, PAHs, vinyl chloride	Exposed soil	Trespassers, site-users	Ingestion, dermal	Present	Incomplete
Metals	Exposed soil	Trespassers, site-users	Ingestion, dermal	Present	Incomplete

Groundwater Exposure Pathway

Groundwater monitoring wells have been installed onsite to distinguish the contamination plume. In 2019, groundwater samples had contamination levels above Wisconsin Chapter NR 140 Groundwater ESs for benzene, vinyl chloride, naphthalene, 1,2-DCA, and 1,1,2-Trichloroethane. However, the groundwater was at depths of 3 feet to 8 feet below the surface with the samples taken from the capped area, which is covered by concrete, asphalt, or dense vegetation (Figure 6 and Figure 8). The Bodgery adjacent to the site is on the municipal well system that is regularly tested for contaminants, and the municipal well used for this building is located off the Oscar Mayer site, making exposure to contaminated water unlikely. Therefore, this pathway was considered to be incomplete (Table 4). Vapor intrusion was not a concern from groundwater or from soil given the location and extent of the contamination. This was confirmed to not be a concern after further communication with DNR.

Table 4. Groundwater Exposure Evaluation for Contaminants near former 1,2-DCA tanks

Source (contaminant)	Point of Exposure	Potentially Exposed Population	Route of Exposure	Time Frame	Pathway Status[1]
1,2-DCA and metabolites; Vinyl chloride	None	Trespassers/site users	Ingestion, dermal	Present	Incomplete
Metals	None	Trespassers/site users	Ingestion, dermal	Present	Incomplete

[1]Per ATSDR (https://www.atsdr.cdc.gov/hac/phamanual/ch6.html#6.6), a potential exposure pathway is when one or more of the elements are not present, but information is insufficient to eliminate or exclude the element. An eliminated exposure pathway is when one or more of the elements is absent.

Closed site #3 Soil and Groundwater Exposure Pathway

This area remains covered by pavement, limiting access to the soil and groundwater. Residential areas are located on the other side of Packers Ave and utilize the municipal well system which is regularly tested for contaminants. Contaminants (exceedances of gas range organics (GRO), diesel range organics (DRO), and benzene in 1997-1999) were found in the top 5.5 feet of soil where the UST was previously located. Benzene appeared to naturally attenuate over the duration of monitoring, with soil levels decreasing from 21 mg/kg in 1997-1999 to 2.18 mg/kg in 2017. The 2017 measurement was below DNR's current industrial direct contact value of 7.07 mg/kg.

1,2-DCA Tank Site Remedial Actions

On May 26, 2021, the DNR sent a letter approving the Remedial Action Design Report for the remediation of the 1,2-DCA site. Based on the Remediation Technology Screening performed by ERM, several remediation efforts were selected including:

- Soil excavation to mitigate source area vadose zone and saturated soils
- Enhanced biodegradation substrate injections to address elevated 1,2-DCA concentrations in shallow groundwater.
- For intermediate groundwater depths (up to 95 feet), quarterly groundwater monitoring will be conducted to evaluate if the remaining groundwater impacts will be successfully addressed by monitored natural attenuation.

To view details of the remediation action design report, please visit the report on BRRTS here.

Table 5. Soil and Groundwater Exposure Pathway Evaluations for Closed Site #3

Source (contaminant)	Environmental Medium	Point of Exposure	Potentially Exposed Population	Route of Exposure	Times Frame	Pathway Status
GRO (gasoline range organics), DRO (Diesel range organics)	Soil	None	Workers	Ingestion, dermal	Present (if undisturbed)	Incomplete
Benzene		None	offsite residents	Ingestion, dermal	Present (if undisturbed)	Incomplete
Benzene, ethylbenzene, toluene	Groundwater	None	workers	Ingestion, dermal	Present (if undisturbed)	Incomplete
Total xylenes, TMBs, naphthalene		None	offsite residents	Ingestion, dermal	Present (if undisturbed)	Incomplete

Closed Site #3 Continuing obligations

According to documents available in BRRTS in the site close-out information, there were continuing obligations listed for this site including:

1) Deed restrictions that require a surface barrier over the remaining soil contamination in order to prevent contamination from impacting human health through direct contact and to prevent contamination from impacting groundwater due to the infiltration of precipitation. The deed restriction also requires the property owner to investigate the degree and extent of residual contamination that is currently inaccessible if and when structural impediments that currently exist on the property are removed.
2) If contamination remains, all current and future owners and occupants of the property need to be aware that excavation of the contaminated soil may pose an inhalation or other direct contact

Figure 8. The south side of the Bodgery building adjacent to the former 1,2-DCA tank site

hazard at the time of excavation. Special precautions may need to be taken during excavation activities to prevent a direct contact health threat to humans.

1,2-DCA site and Closed Site #3 Limitations

There were several limitations at the 1,2-DCA site that may impact exposure and/or risk:

- Samples have not been taken offsite near the community east of the site. However, there is an asphalt barrier in place at the current location that prevents water from contacting the soil and potentially contributing to groundwater migrating offsite.[15] There is also a highway separating the site from the community, making groundwater and soil difficult to directly access for exposure. Contaminants are not suspected to have migrated offsite towards the residential area due to the location relative to the site and groundwater flow.
- A building named "Nine-Ten" was confirmed to be occupied (Building 27[16]) by the buildings' owner. This building is not located over the contaminant site and there is no known indication that there is contamination in the building. However, these individuals may have access to the area inside the fence of the central portion of the site.

Further remediation is planned and the extent to which this will lower contaminant levels is unknown. However, we support remediation actions which will reduce future exposures to contaminants and support any continuing obligations that DNR puts in place to prevent future exposure at the site. DHS also supports the proposed groundwater monitoring plan as outlined in the DNR-approved Remedial action design report with groundwater sampling occurring quarterly for two to three years[17].

There are also limitations for Closed Site #3. For example, over time, sampling sensitivity can change and improve. The samples taken in 2017 were not taken from the same groundwater wells or soil boring sites as samples taken in 1997-1999; therefore, they are not directly comparable. However, since the goal of the present assessment was to use the most recent data to look at specific health risk due to contaminant exposure, these samples were sufficient to get a more up-to-date interpretation of contaminants present in the soil and groundwater in relationship to Closed Site #3.

1,2-DCA Site and Closed Site #3 Conclusions

Both sites are covered by a cap (either thick vegetation or a parking lot) and are fenced in with limited access to the site through the parking lot and side buildings, making both soil and groundwater contamination inaccessible for dermal or incidental ingestion. Signage posted on areas of the site also indicate "No Trespassing." Groundwater has been well defined at both sites and appears to not be significantly migrating offsite at the water table level. The 1,2-DCA site will be remediated to reduce current site contamination (see "1,2-DCA Tank Site Remedial Actions"). The Eken Park neighborhood, located east of the site, receives its drinking water from municipal wells, which are regularly tested for drinking water contaminants. There is a deed restriction associated with Closed Site #3 indicating that:

- a surface barrier over the remaining soil contamination must be maintained
- the property owner is required to investigate the degree and extent of residual contamination that is currently inaccessible

[15] Engineering Controls on Brownfields Information Guide: How They Work with Institutional Controls; the Most Common Types Used; and an Introduction to Costs (epa.gov)
[16] See Appendix A, Figure 4 for layout of the central Oscar Mayer site with building numbers
[17] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=191952

As part of the deed restriction, the pavement barrier is required to be inspected annually and documentation kept noting said annual inspection. **Therefore, these sites have no apparent public health hazard at this time.** Future changes that impact or remove the existing barriers would require DNR approval, which would include an evaluation of potential health hazards by DHS.

In the interim, DHS also recommends that general precautions be taken for workers handling any soil in order to limit dermal exposure and incidental ingestion of soil. This includes:

- Wearing gloves when handling soil or site material during the remediation process
- Proper hand washing and hygiene prior to handling, preparing, and/or eating food
- Changing boots and/or clothing between the worksite and home to avoid cross contamination from the site and the home environment.

Open Site: Former Spice Room (Building 43, BRRTS# 02-13-580723)

Historically, the spice room (Building 43, BRRTS 02-13-580723) was used as an area to prepare, mix, and store spices used within the facility for food production. Chlorinated solvents may have historically been used in the vicinity of the spice room as part of the spice extraction process. During the Phase II investigation, chlorinated volatile organic compounds (CVOCs) were detected in the sub-slab soil gas samples collected around the former spice room located in Building 43. TCE was detected at concentrations that exceeded the Wisconsin sub-slab VRSL for industrial properties. Subsequently, six additional soil gas samples were collected in the vicinity of the spice room in an attempt to define the extent of CVOCs in sub-slab soil gas. The only CVOC detected in groundwater down-gradient of the former spice room was vinyl chloride (at SB-35), at concentrations that slightly exceeded the Wisconsin NR 140 ES. A release from the former spice room operations had not previously been reported; therefore, Ramboll-Environ notified the DNR of the release on behalf of Kraft Heinz.

Vapor Intrusion Exposure Pathway

To our knowledge, Building 43 is currently unoccupied and is located within a fenced-in area with "No Trespassing" signs posted on the central Oscar Mayer property. Workers have been accessing the site to take samples and to install and maintain the SVE remediation system that was recently installed on site[18] to reduce the high TCE levels. It's also important to note that the Occupational Safety and Health Administration (OSHA) requires employers to have health and safety plans on certain types of sites, including remediation of brownfield sites.[19] As part of their scope of work, ERM, the contractor for the Oscar Mayer site remediation, indicated in their work plan that they would prepare and implement a site-specific health and safety plan for the work including conducting daily health and safety tailgate briefings with all personnel prior to the initiation of the work each day in addition to implementing a site health and safety program.[20] DHS supports the implementation of this type of plan to protect workers entering Building 43 which has high TCE concentrations.

TCE data from Febuary of 2020 were used for human health risk evaluation since they represent the most recent values obtained from Building 43. The highest TCE value (99,700 µg/m^3) detected was in the sub-slab soil gas sampling in VP-30 on 2/21/2020. For a large commercial/industrial building in Wisconsin,

[18] A SVE system is a physical treatment process for remediation of volatile contaminants in the vadose zone (unsaturated) soil. The vadose zone is defined as the top of the ground surface to the water table. Extracted contaminants in the gas phase are treated in aboveground systems.

[19] https://www.osha.gov/sites/default/files/publications/OSHA-brownfield-cleanup.pdf

[20] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=171708&docName=20200812_148_RADR_received.pdf

the sub-slab VRSL is 880 µg/m^3. Of the 25 sub-slab soil gas and 2 vapor probes sampling TCE, 12 exceeded the sub-slab VRSL (see Appendix C for toxicity information on TCE). TCE concentrations have been monitored at Building 43 through sampling at 11 sub-slab soil gas sampling locations (VP-21 through VP-32), three soil vapor probes (SP-01 through SP-03, screen set from 4 to 4.5 fbgs), and three SVE wells (SVE-01 through SVE-03). Per a report submitted to and approved by DNR, the migration of VOCs off-site within sub-surface utilities present in Building 43 is not a concern based on the sampling data (see "Utilities corridor subsurface VOC assessment" section).[21] Therefore, the exposure pathway is completed for soil vapor gases if anyone is inside Building 43 without proper PPE (Table 6).

Table 6. TCE Exposure Pathway for soil gas vapors in the former Spice Room (Building 43)

Source Contaminant	Point of Exposure	Potentially Exposed	Route of Exposure	Time Frame	Pathway Status
Soil gas vapors (TCE)	Vapor Intrusion (air) from soil vapors	Workers/ Trespassers in Building 43	Ingestion	Present	Incomplete
			Dermal	Present	Incomplete
			inhalation	Present	Completed

Groundwater Exposure Pathway

Groundwater samples were taken in monitoring wells MW-14 through MW-16 (Figure 9) located just outside of Building 43 (north, south, and adjacent to Building 43) to determine the extent of TCE contamination. TCE concentrations were all below the Wisconsin ES of 5 µg/L[22], as defined in Chapter NR140, Wis. Admin Code. There was no indication of exposure to contaminated groundwater onsite or offsite (Table 7). However, groundwater levels of TCE could be contributing to vapor intrusion, which indicates the potential for the pathway to be completed if people enter the building without appropriate PPE.

Table 7. TCE in Groundwater Exposure Pathway for the former Spice Room (Building 43)

Source (contaminant)	Point of Exposure	Potentially Exposed	Route of Exposure	Time Frame	Pathway Status
Groundwater (TCE, 1,2-DCA)	Vapor Intrusion (air) from groundwater vapors	Workers/ Trespassers in building 43	Ingestion	Present	Incomplete
			dermal	Present	Incomplete
			inhalation	Present	Completed

Utilities corridor subsurface VOC assessment

ERM performed a subsurface utilities evaluation within Building 43. [23] The utilities of potential concern for VOC migration were found to be limited to the storm sewer. ERM tested the storm sewer system at 7 manholes in September 2020. No concentrations of VOCs were detected in exceedance of the DNR's standards for residential properties. Based on this sampling, the migration of VOCs off-site within sub-

[21] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=184369

[22] In June of 2019, Cycle 10 DHS recommended groundwater standards were released, including a recommendation to change the ES for TCE from 5 to 0.5 µg/L (https://www.dhs.wisconsin.gov/water/gws-cycle10.htm). The highest TCE concentration found in onsite monitoring wells was 2.2 µg/L, found in SR-MW-16A, but this area is outside of the spice room building is not directly accessible (located under a parking lot).

[23] 20201117_43_Status_report2 (1).pdf

surface utilities present in Building 43 was determined to not be a concern. Water lines and fire protection lines are enclosed and pressurized and therefore are not a concern for vapor migration. There is no subsurface connectivity of the process sewers outside of Building 43.

Remaining Site Action

SVE pilot testing was performed on August 24th, 2020 and a letter was sent from the DNR approving the installation of a SVE system to capture and remove VOC vapors. A pilot test was performed to evaluate the feasibility of the SVE technology to meet the remedial goal of reducing the vapor intrusion risk in Building 43 based on the presence of TCE and other VOCs. The sub-slab VRSL for TCE in non-residential settings (880 µg/m^3) was used to gauge feasibility. The SVE pilot test and sampling confirmed that SVE is the appropriate approach to remediating the VOC concentrations in the subsurface near Building 43. As of September 2021, the SVE system in Building 43 had been installed and was operational. Periodic system monitoring and maintenance ensure that the SVE system is working as intended. The first semi-annual report was released to DNR on 11/4/2021. The report indicated that the SVE was working appropriately and was lowering concentrations of TCE. See the report for more details.[24]

Recommendations and Conclusions

Because sub-slab levels of TCE exceed the WI sub-slab vapor risk screening level (VRSL), a SVE system was installed to remediate the hazardous vapors. According to OSHA and work plan documents by ERM, a health and safety plan was intended to be developed and implemented during the installation process to protect the health of workers installing the SVE system.

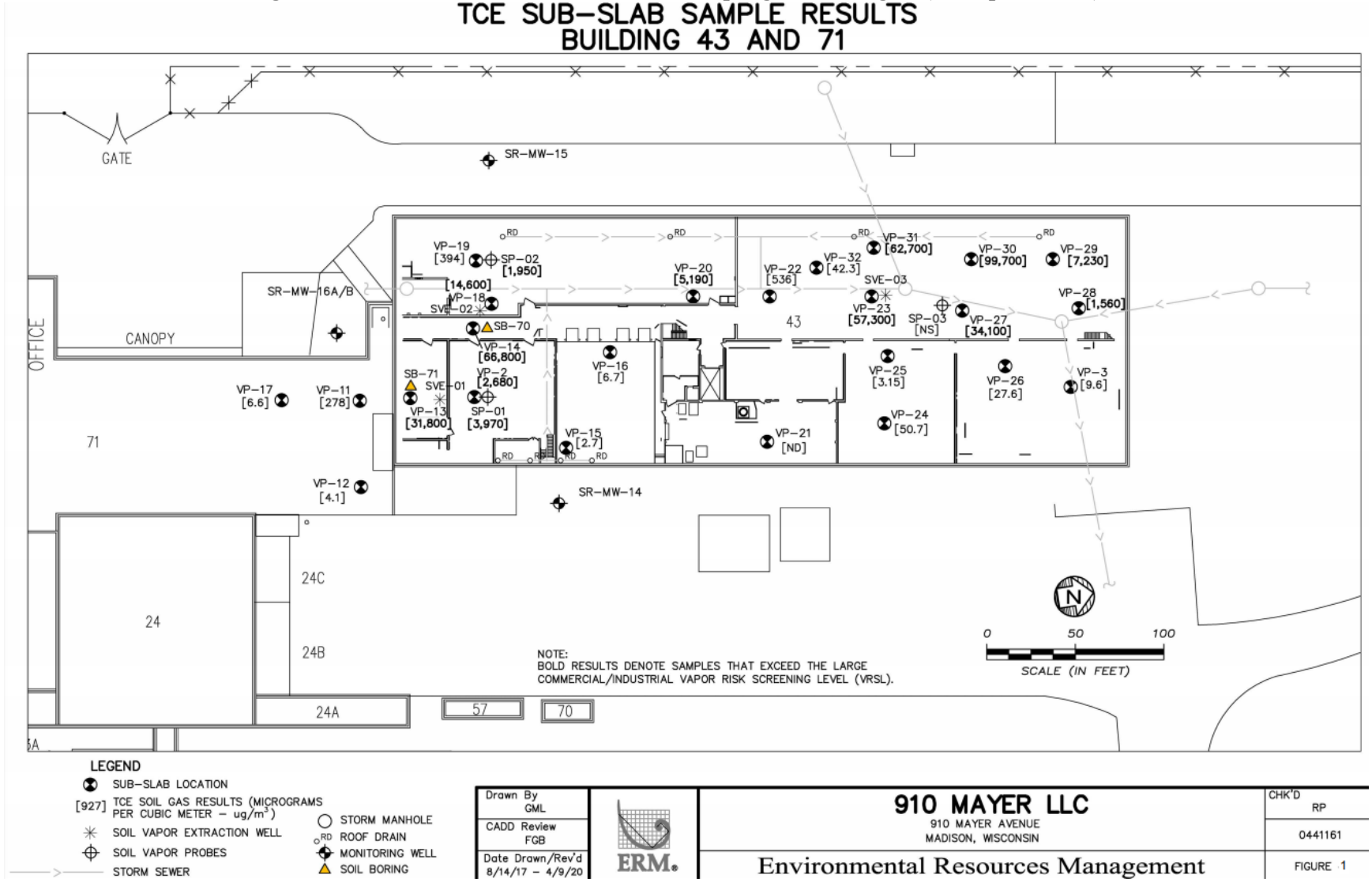
High levels of inhaled TCE may cause headaches, dizziness, and sleepiness; large amounts may cause coma or death. Exposure to high levels can also result in changes in the rhythm of the heartbeat, liver damage, and evidence of kidney damage. Some human studies indicate that TCE may cause developmental effects such as spontaneous abortion, congenital heart defects, central nervous system defects, and small birth weight. Therefore, the following recommendations are suggested to protect the health of workers:

- Workers actively in Building 43 should be wearing personal protective equipment (PPE), which includes proper respiratory equipment approved by NIOSH for TCE exposure unless sampling indicates that the SVE system has lowered levels below Wisconsin State values.
- If a worker is a woman of child-bearing age that is pregnant or trying to get pregnant, they should be particularly cautious since TCE exposure may cause heart defects in the fetus during pregnancy. It is recommended that workers fitting this profile not work in Building 43.
- Workers should also be wearing gloves to handle any soil at the site to avoid incidental ingestion of soil-borne contaminants. Proper hand hygiene is also recommended to avoid hand-to-mouth ingestion of soil contaminants.

Currently, TCE contamination at this site is considered to be an indeterminate public health hazard. The contamination at the site exceeds Wisconsin state standards but is currently undergoing remediation procedures (SVE) to reduce the level of TCE inside of Building 43 with the intention of eliminating the future exposure and thus lowering the future health risk. Following the above recommendations should protect the health of individuals working in the area. Any larger changes to the site are planned that would impact the current construction would require DNR review and approval.

[24] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=213426&docName=20211104_92_OM_Docs.pdf

Figure 9. Locations for the second round of sampling in Building 43 (The Spice Room).[25]



[25] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=163555

Hartmeyer Site (BRRTS 02-13-580328) & Closed Site #2 (BRRTS 03-13-000053)

The Hartmeyer site is located adjacent to the former Kraft Heinz Oscar Mayer facility, and was leased by Kraft Heinz from the John Hartmeyer Estate. In 2021, the Hartmeyer site was purchased by Kraft Heinz.

In anticipation of the pending lease termination, the environmental consultant Ramboll conducted an environmental assessment as required in the lease to "determine if any applicable State of Wisconsin soil cleanup standard is exceeded." Ramboll conducted a subsurface investigation in April and September of 2019 to evaluate soil conditions in areas of prior Kraft Heinz activities at the site (Appendix A, Figure 5), including the area that includes Closed Site #2. The site is located adjacent to a railway and had two aboveground fuel oil storage tanks; both have been removed.

Closed site #2, located within the Hartmeyer property, had residual fuel oil petroleum contamination originating from the distribution lines associated with the aboveground storage tank area located on the Hartmeyer property. These tanks have been removed and no indication of them can be seen on the Hartmeyer Site (Figures 10 and 11). The Wisconsin & Southern Railroad at the time was considered an adjoining property that was impacted by the contamination and they were notified. In 2006, the extent of the plume on the site was well defined and limited to the general area as defined by Figure 14. Because Closed Site #2 is part of the Hartmeyer property, we considered information from the 2019 investigation as well as the data from Closed Site #2 investigation when evaluating exposure pathways and health risks. For soil concentrations, we used the 2019 values as they were more up to date and distinguished individual compounds (e.g., benzo[a]pyrene). Some past samples were analyzed for "diesel range organic compounds" which is no longer tested for in site investigations since it measures the concentration of a mixture of compounds.

Figure 10. Hartmeyer site looking South to North (left photo) and looking north to South (right photo).

Hartmeyer Site Soil Exposure Pathway Soil

Currently, this site is easily accessible to the general public, is not enclosed by a fence, and there is no signage on the property. It also sits adjacent to businesses with parking lots. The northwestern portion of the site is partially capped with pavement. The site is also covered with dense vegetation (Figure 10 and 11) and there are railroad tracks to the east of the site that would limit access in that direction. As long as these features ensure sub-surface soils remain inaccessible, ingestion or dermal exposure to contaminated soil is unlikely and the exposure pathway for contaminated soil at the site is considered to be incomplete

(Table 8). Any change to the soil cap or property use may result in a potentially complete soil pathways, necessitating further evaluation at that time.

Table 8. Soil Exposure Pathway Evaluation at the Hartmeyer Site

Source (contaminant)	Point of Exposure	Potentially Exposed Population	Route of Exposure	Time Frame	Pathway Status
Arsenic	None; Thick vegetative coverage	Trespassers	Ingestion, dermal	Present	Incomplete
Benzo(a)pyrene	None; Thick vegetative coverage	Trespassers	Ingestion, dermal	Present	Incomplete

All soil samples considered for exposure pathway evaluation were taken from the top 5 feet of soil present on the Hartmeyer site. Sample results were evaluated against industrial direct contact residual contaminant levels (RCLs)[26], since the property is not located on residential property and is located adjacent to businesses. This indicates that the likelihood of someone regularly accessing the site and having high exposure to the soils at high levels each day is low. Please note that these values only apply to the top 5 feet of soil, since likelihood of any direct contact with soil more than 5 feet below the ground is unlikely.

Benzo(a)pyrene was detected at a concentration of 2,540 µg/kg at 1 to 2.5 feet (Sample boring B-5) below the surface near the area of historic coal storage. The maximum concentration for benzo(a)pyrene was detected at a concentration of 4,280 µg/kg at 4 to 5 feet below the surface and located in an area of known soil contamination (Closed Site #2). These values for benzo(a)pyrene (Appendix A, Figure 7) were above Wisconsin's direct industrial contact RCL (NR 720) of 2,110 µg/kg.[27] Additionally, the highest level of arsenic found was 137 mg/kg; however, arsenic values ranged from 1.9 to 137 mg/kg with an average of 15.6 mg/kg and a median[28] value of 9.6 mg/kg. Arsenic was above the Wisconsin state background threshold value (BTV) for arsenic (8.3 mg/kg). All other VOCs, PAHs, and metals were below Wisconsin RCL levels for industrial direct contact in soil.

Per the original request, a health assessment of arsenic and benzo(a)pyrene in surface soils was conducted. Given the number of samples, exposure point concentrations were chosen as the 95% upper confidence limit around the average: 23.37 mg/kg for arsenic and 569.7 µg/kg for benzo(a)pyrene for surface soil samples. Using a health-protective recreational use exposure scenario of 175 use days per year (5 days per week for 35 weeks per year) for 30 years, there was no risk of non-cancer related health effects.

We also investigated cancer risk from these concentrations. The cancer risk from benzo(a)pyrene assuming the same exposure above for children from birth to 21 was 5.3×10^{-6}, or 5 cases of cancer per 1,000,000 individuals, which just exceeds the cumulative carcinogenic PAH target excess cancer risk threshold of 1×10^{-6}.[29] The potential risk of cancer-related health effects due to exposure to arsenic was

[26] Wisconsin RCLs apply to the top 4 feet of soil, but because some soil was taken 4-5 feet below the surface, these values were included in our assessment.
[27] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=139608&docName=20191213_97_Tech_Review.pdf
[28] Median is the middle number in a sorted list of numbers. In this case, the 35 values of arsenic in the top 5 feet of soil were put in order from minimum to maximum with the value in the middle being 9.6 mg/kg.
[29] https://dnr.wisconsin.gov/topic/Brownfields/soil.html

$2.0x10^{-5}$, or 2 cases of cancer per 100,000 persons, for individuals exposed from birth to age 21, which is above the acceptable excess cancer risk of $1x10^{-6}$ outlined in NR 720.12(1)(a). With this risk being above the acceptable margin, it is important to follow safe recreation guidance, outlined below, to minimize direct contact with the soil—this will reduce exposure and decrease cancer risk.

Table 9. Hartmeyer Site Contaminants of Concern, Chronic Hazards and Cancer Risks

Contaminant	Age Group	EPC (mg/kg)[a]	Chronic Dose (mg/kg/day)	Chronic RfD[b] (mg/kg/day)	Chronic Hazard Quotient	Cancer Risk Threshold	Cancer Risk[c,d]
Benzo[a]pyrene	Birth to 21	0.57	0.000007	0.0003	0.023	$1.0x10^{-6}$	**$5.3x10^{-6}$**
Benzo[a]pyrene	Adult	0.57	0.0000005	0.0003	0.002	$1.0x10^{-6}$	$3.5x10^{-7}$
Arsenic	Birth to 21	23	0.00014	0.0003	0.48	$1.0x10^{-6}$	**$2.0x10^{-5}$**
Arsenic	Adult	23	0.00001	0.0003	0.034	$1.0x10^{-6}$	**$5.9x10^{-6}$**

[a] Exposure Point Concentration
[b] Reference Dose
[c] Cancer risk determined from chronic dose: (Dose * Cancer Slope Factor[d])*(Expected Duration/Lifetime)[30]
[d] Cancer Slope Factors: B[a]P: 1.7 $(mg/kg/day)^{-1}$; Arsenic: 1.5 $(mg/kg/day)^{-1}$

The current vegetative cap should effectively prevent any incidental exposures to contaminated soil, and visitors to the land should not be digging in the soil for any reason. Individuals should thoroughly wash their hands with soap and clean water if they come in direct contact with the soil. Any workers that may come into contact with the soil should also wear gloves and avoid contact with soil. Following these recommendations should eliminate the cancer risks outlined above. Any future development on the land that opens potential exposure pathways to soil or groundwater would be required to be reviewed by DNR and DHS prior to approval to ensure that any potential exposures during or after action are appropriately mitigated.

Closed Site #2 Exposure Pathway Evaluation

The information provided in BRRTS also indicates that the extent of petroleum product is not expanding, and that the groundwater contaminant plume is stable or receding and will eventually degrade over time. This process is known as natural attenuation and is acceptable for remediation for some types of contaminants. Per the EPA, many of the most environmentally significant components of petroleum hydrocarbons, such as benzene, toluene, ethyl benzene, and the xylenes and some PAHs, can biodegrade under the proper environmental conditions.[31]

Monitoring wells at the site continued to have samples analyzed for contaminants to confirm natural attenuation from 1999 to 2006. Monitoring Well-5 (MW-5) had the highest level of contamination and is located between the tracks of the Wisconsin & Southern Railroad right-of-way. MW-5 also had high levels of ethylbenzene (5,200 µg/L), benzene (210 µg/L), xylenes (14,000 µg/L) and TMBs (63,000 µg/L) in the second set of samples taken on Sept 7th in 2001 at the site. In subsequent years, benzene levels have ranged from 9.39 to 18 µg/L. MW-5 also appears to have had approximately 135.85 cumulative liters of petroleum product removed from the site from 1999 to 2006. A visit to the site indicated that the soil was inaccessible due to the railway and significant ground coverage by plants in the area (see Figures 10 and 11).

[30] https://www.epa.gov/iris/epas-approach-assessing-risks-associated-chronic-exposure-carcinogens
[31] Monitored Natural Attenuation of Petroleum Hydrocarbons US EPA Remedial Technology Fact sheet

Table 10. Exposure Pathway Evaluation for Groundwater at Closed Site #2

Contaminant Source	Point of Exposure	Potentially Exposed Population	Route of Exposure	Time Frame	Pathway Status
Benzene, TMBs, Naphthalene, 2-methylnaphthalene	None	workers	Ingestion, dermal	Present	Incomplete
Possibly Chrysene, benzo (a) anthracene	None	trespassers	Ingestion, dermal	Present	Incomplete

MW-5 also had a depth to water in feet below top of well casing of 3.13 feet in 2006, indicating that there was at least 3 feet of soil between the groundwater and the surface. Based on these factors, the groundwater exposure pathways at this site are considered incomplete (Table 10). As long as people don't have direct exposure to the contaminants, it will not pose an increased risk to health.

Remaining Site Actions

Plans for future remediation are unknown at this time. As an open site, the Hartmeyer property will be required to go through the NR726 closure requirements.

Hartmeyer & Closed Site #2 Limitations

The groundwater was routinely tested on the Hartmeyer site from 1999 to 2006 (see "Closed Site #2")[32], and there is no recent data to indicate the status of groundwater contamination on the site. However, since the contaminants of concern are subject to natural attenuation, this indicates that it is possible that there are lower concentrations of contaminants than were previously noted in the groundwater, especially due to the removal of petroleum product from MW-5. Soil samples taken in 2019 were limited to arsenic and benzo(a)pyrene, while samples from Closed Site #2 originally looked at DRO and GRO. DRO and GRO which measured the concentration of mixtures, are testing methods no longer used on sites. Therefore, these results were not directly comparable.

Recommendations, Conclusions, and Continuing obligations

The extent of vegetation and partial coverage by a parking lot at the site provide protection from exposure to arsenic and benzo(a)pyrene in the soil (Figure 11) and the associated cancer risks outlined above. In addition to vegetation and a partial parking lot/road, a railway is also present which creates a cap to any remaining contamination resulting from Closed Site #2. The conditions of case closure set out for Closed Site #2 required that the site be listed on the Remediation and Redevelopment Program's GIS Registry for the following reasons:

- Residual soil contamination exists that must be properly managed should it be excavated or removed.
- Groundwater contamination is present above Chapter NR 140 enforcement standards

Therefore, current information indicates soil contaminants on site do not represent a public health hazard. Given the open site status and continuing obligations, any future development that opens potential exposure pathways to soil or groundwater contamination would be required to be reviewed by DNR, with DHS consulted as needed.

[32] https://dnr.wi.gov/botw/DownloadBlobFile.do?docSeqNo=33967

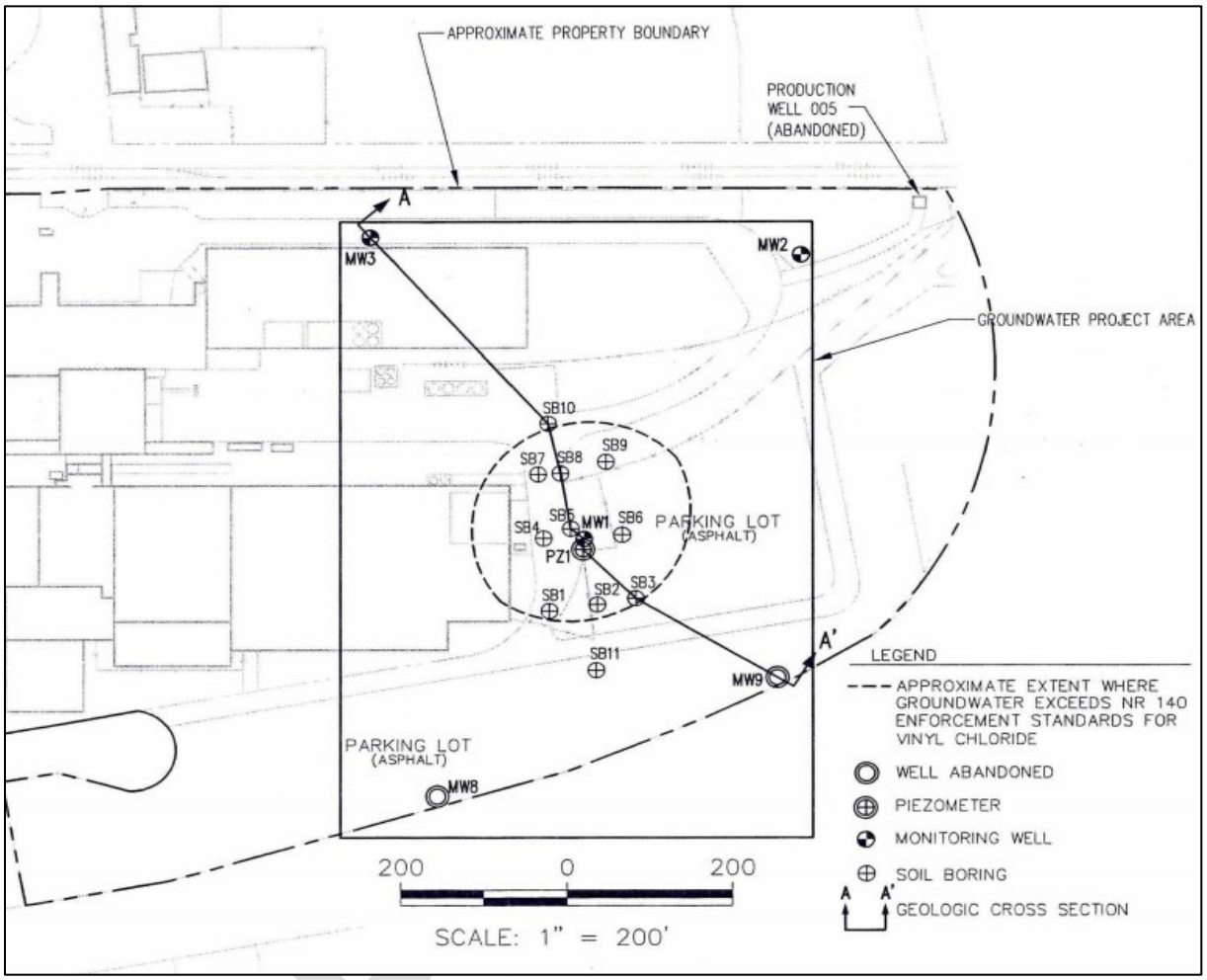
Currently, there are no known activities planned on the site that would result in disruption of the existing barriers (parking lot, vegetation, etc.). Several precautionary recommendations may be considered to ensure future exposures to soil-borne contaminants do not become a concern. The addition of fencing and/or signage would be beneficial for discouraging people from playing or accessing the site for recreational or other purposes that may cause them to come into direct contact with the soil. Maintenance of the vegetation to avoid contact to bare soil is important to minimize exposure.
As with any urban soils, background levels of PAHs are expected to be elevated, especially proximal to railways. To minimize exposure, anyone working with soil on site should follow best practices for avoiding exposures to contaminants in soil including wearing gloves, washing hands before eating, and avoid tracking potentially contaminated soil into homes following soil contact.

Figure 11. Images on ground coverage on the Hartmeyer Site

Closed Site #1 (BRRTS# 02-13-000895)

The Oscar Mayer groundwater project relates to the historical detection of trichloroethylene (TCE) and tetrachloroethylene (PCE) in production wells (high-capacity pumping wells) installed in the bedrock at the facility (Figure 12). The site is located under the Parking Lot North of Building 50. In response to these detections, Oscar Mayer hired Conestoga Rovers & Associates (CRA) in 1994 to investigate the source of the chlorinated solvents.

Figure 12. Closed Site #1 Sampling locations



Closed Site #1 Exposure Pathway Assessment

Groundwater sampling was conducted from 1997 to 2005 to monitor cis-1,2-dichloroethylene (cis-1,2-DCE) and vinyl chloride levels over time. Using the groundwater samples taken at this site over time, the groundwater plume (Figure 12) was determined to be sufficiently defined and the groundwater contaminants were only detectable above the Wisconsin ES for vinyl chloride in MW-1 and PZ-1, indicating that they are not migrating off-site and that natural attenuation over time is reducing this contamination on-site. Furthermore, monitoring of MW-1 from 1994 to 2005 and monitoring of PZ-1 from 2001 to 2005 has indicated that the vinyl chloride levels have decreased by 84% (from 90 µg/L to 14 µg/L) and 88% (from 5 µg/L to 0.58 µg/L), respectively. This site is also currently "capped" with a parking lot and thus direct access to the groundwater and soil is limited preventing direct exposure to the

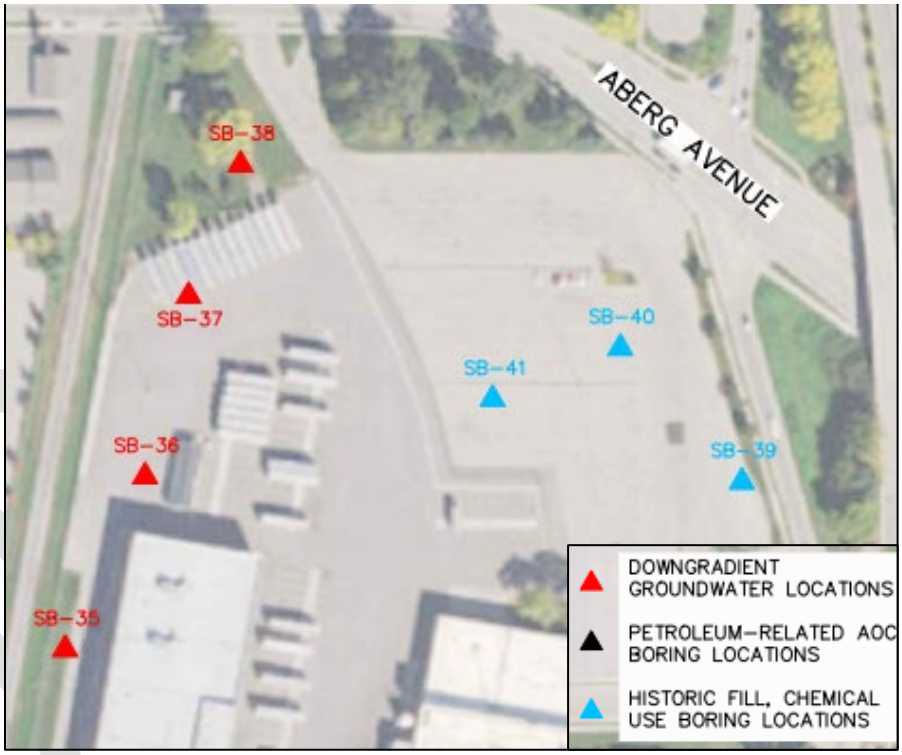
contaminants. The residual groundwater contamination identified in the area of monitoring well MW-1/PZ-1 has been investigated and remediated to the extent practicable under site conditions.[33]

In 2017, additional soil and groundwater samples were taken from the central Oscar Mayer property. Of the samples taken, several soil and groundwater samples were taken near Closed Site #1. These samples included SB-35, SB-36, SB-37, SB-38, SB-41, SB-39, and SB-40 (Figure 13). No soil samples in the top 5 feet of soil had vinyl chloride or cis-1,2-DCE levels above Wisconsin's Industrial Direct Contact values. Groundwater samples also had no detections of vinyl chloride or cis-1,2-DCE levels above Wisconsin's ESs. See Figure 14 for vertical extent of vinyl chloride contamination in MW-1 and PZ-1.

Closed Site #1 Conclusions & Continuing Obligations

Based on the most recent data from 2005 and reviewing data from previous years, ***residual contaminants at this site present no apparent public health hazard***. Furthermore, direct access to the soil and groundwater at the site is limited. Since the area is in a municipality and depends on municipal wells for drinking water that are regularly tested, there is no indication of a completed pathway.

Figure 13. Northern portion of Central Oscar Mayer site with 2017

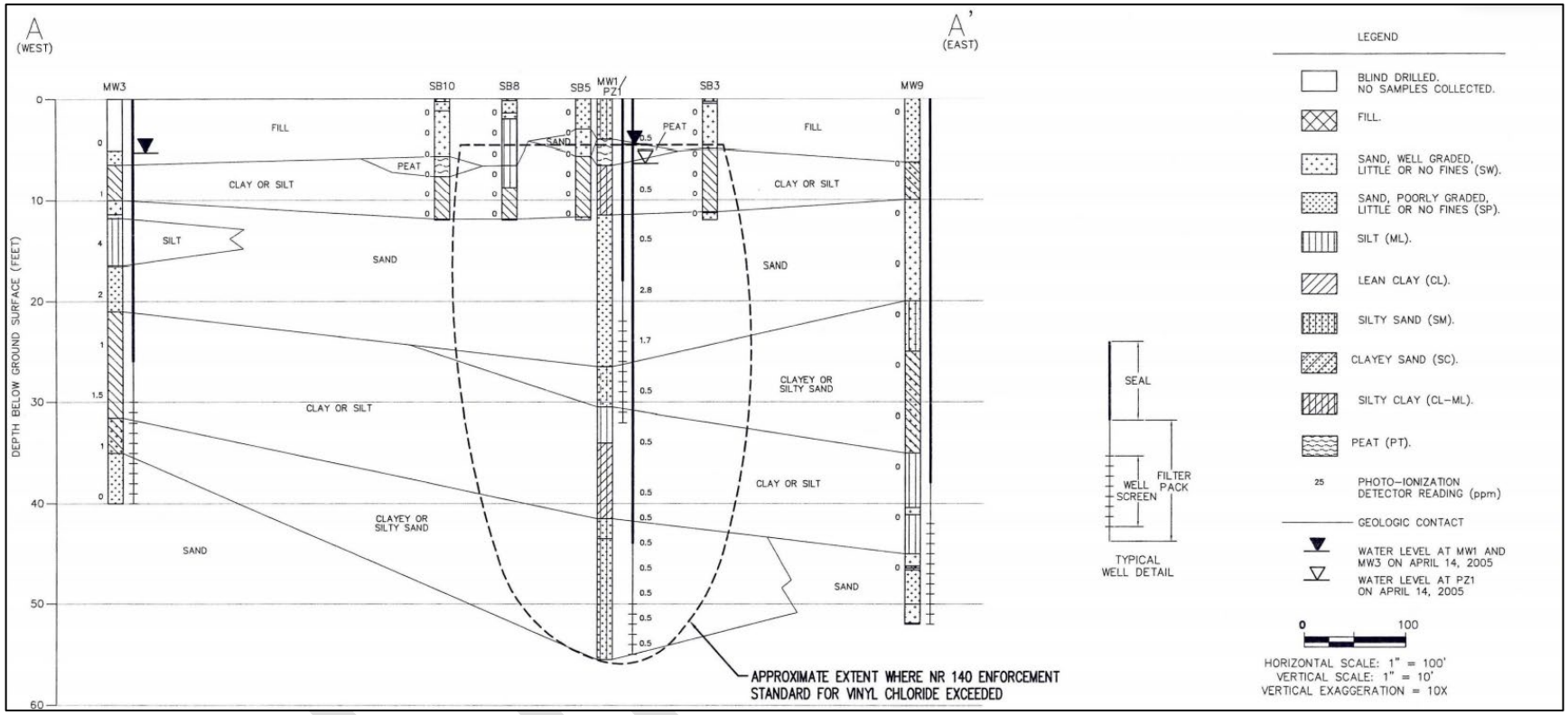


If the cap/parking lot is disturbed by workers during future construction, it would be our recommendation to properly handle soils and contaminants onsite with gloves to avoid hand-to-mouth exposure of contaminants at the site, per our general recommendations for handling any urban soil. Currently, there is a continuing obligation outlined by the DNR for this location:

- "If your property is listed on the GIS Registry because of remaining contamination and you intend to construct or reconstruct a well, you will need prior Department approval in accordance with s. NR 812.09(4) (w), Wis. Adm. Code."

[33] The primary removal process for vinyl chloride from surface waters is volatilization into the atmosphere. The hydrolytic half-life of vinyl chloride has been estimated to be <10 years at 25°C. Degradation of vinyl chloride generally occurs slowly in anaerobic groundwater and sediment (https://www.atsdr.cdc.gov/toxprofiles/tp20.pdf).

Figure 14. Closed Site #1 vertical extent of vinyl chloride at MW1/PZ1



Spills Associated with the Oscar Mayer Site

From 1992 to 2010, the Oscar Mayer site had 23 incidents characterized as spills and/or storage tank removals. Of these 23, there were 12 accidental ammonia releases into the air, 2 sodium hydroxide spills, 1 sulfuric acid spill, 8 petroleum or petroleum related product spills, and other spills included: sewage, bleach/chlorinated water, ethylene glycol, wastewater, and hydraulic oil from a freight elevator.

Ammonia[34] was used for refrigeration purposes, and is a liquid when under pressure but a gas at room temperature, and thus not recoverable following a leak. In the context of spills, precautions are taken by the individuals responding to the incident and the risk of these health effects is acute from being exposed to high ammonia concentrations in the air. However, in indoor air, ammonia will only last about a week. These spill incidents were resolved indicating that they were handled appropriately and do not require further remedial actions. Because of the nature of these spills as described above, they were not included on Tables 10, 11, or 12.

Spills involving sulfuric acid and sodium hydroxide are typically neutralized or diluted. Normally, with strong acids, the main concern is chemical burns and irritation in the lungs. After dilution or neutralization of acids, these solutions are not considered to be a contaminant and are suitable for disposal.

Bleach can also be a respiratory irritant and is typically diluted to reduce concentrations.

The wastewater and sewage contaminations mentioned in Table 11 were back-ups from drains. Once the drain blockage was resolved, the contaminants were disposed of appropriately using the proper drainage system.

Table 11. Wastewater, salt water, bleach, acid, base, and sewage spills on the Oscar Mayer Site

Contaminant	Spill Volume	BRRTS #	Cause	Remediation	Year Closed
Wastewater	10 Gal	04-13-548071	Power went out on pumps causing release of substance	Non-hazardous sludge, none recovered.	2006
Salt (Water)	7000 Gal	04-13-562776	Underground line leak	Cleanup method-absorbent; Recovered amount unknown	2014
Wastewater	Unknown	04-13-551001	Sump pump in wastewater treatment plant failed	Sump pump was repaired	2008
Bleach/chlorinated water	8000 Gal	04-13-529401	Reservoir was being filled with chlorinated water to sanitize it when manway hatch gasket failed	Monitor	2004
Sewage	475 Gal	04-13-264296	Sewage drain stoppage	Called City of Madison to clear stopped sewer drain	2000
Other	1000 Gal	04-13-229872	Plug in line causing reverse flow of the	Removed plug; cleanup method-absorbent	1998

[34] https://www.atsdr.cdc.gov/toxprofiles/tp126.pdf

			cooling water line to the storm sewer		
Wastewater	<1000 Gal	04-13-041208	Sewer was plugged		1986
Sodium hydroxide	35 Gal	04-13-270923	Cleaning pipe and broken flange	Monitor	2000
40% sodium hydroxide	1500 Gal	04-13-555058	Cleaning solution spilled from Ruan Trucking Delivery Service	Flushed: wash basin walls were cleaned and the pH was checked.	2010
Sulfuric Acid	12 Gal	04-13-241160	No additional info available on BRRTS		1999

Other contaminants appeared to be appropriately handled and monitored including bleach/chlorinated water, petroleum that was found in a container underneath the soil and was disposed of (Table 12), hydraulic oil, and ethylene glycol (Table 13). These were relatively small spills but were monitored in the wastewater drainage and determined to not have contaminated water.

Table 12. Petroleum/Petroleum-related products spills on the Oscar Mayer Site

Contaminant	Spill Volume	BRRTS #	Cause	Remediation	Year Closed
Petroleum	1 Gal	04-13-051030	Break in hose	Cleanup-method absorbent; storm sewer	1995
Petroleum products	N/A	02-13-221826	Storage tank found	Storage tank and soil removed from location.	1999
Hydraulic oil	140	02-13-221826	Freight elevator release in Building #43	64 gallons of oil recovered; soil and water removed to the extent possible	1999
Petroleum	15 cubic yards*	03-13-001744	Underground storage tank discovered during excavation	Tank believed to be used for storage of condensate water; Petroleum contaminated soil ~ 15 cubic yards was excavated, treated, and disposed.	1993
Petroleum (Hydraulic oil)	75 Gal	04-13-227043	Cylinder on elevator broke	Contractor was hired (BT2) to pick up soil	1998
Petroleum-unknown type	12 Gal	04-13-245306	Backpressure form filling underground storage tank	Sorbent pads were used to clean up the spill	1999
Hydraulic oil	3 Gal	04-13-049245	Tank froze	cleanup method-absorbent; oil dry; oil impacted snow removed	1994
Engine waste oil	Unknown	04-13-050780	Break in discharge line	Cleanup method-absorbent; storm sewer	1995

Ethylene glycol or antifreeze spills are listed in Table 13. In the air, ethylene glycol will break down in about 10 days and in water/soil it will breakdown within several days to a few weeks.[35]

Table 13. Antifreeze/Ethylene Glycol Spills on the Oscar Mayer Site

Contaminant	Spill Volume	BRRTS #	Cause	Remediation	Year Closed

[35] https://wwwn.cdc.gov/TSP/PHS/PHS.aspx?phsid=84&toxid=21

Ethylene glycol	5 Gal	04-13-550150	Overflowed while transferring ethylene glycol from one line to another.	A small amount made it to the storm sewer. The catch basin on the storm sewer was then pumped out; no indication that any glycol made it to the Yahara River.	2007
Antifreeze/Ethylene Glycol	30 Gal	04-13-051042	Mechanical failure	Sanitary sewer	1995
Ethylene glycol	3100 lb	04-13-560490	Equipment failure; system overheated causing coolant to overflow	coolant was vacuumed up; no material went into storm drain	2013
Antifreeze/Ethylene Glycol	30 Gal	04-13-048202	Broken pipe under the sidewalk	Cleanup method-absorbent; oil dry	1993
Freon (Freon 22)	22 lb	04-13-212337	Leaking pipe	Repaired pipe	1996

Spills Conclusion

All spills are closed as indicated in their respective tables. Most spills may pose a hazard at the time that they occur, but there was no indication, per the BRRTS database, that any of these spills resulted in serious injury. Most of the spills are resolved in a short period of time and are either diluted or neutralized to not pose a threat (acids and bases), break down in the environment over time (antifreeze/ethylene glycol), or are released into the air, preventing re-capturing of the contaminant. **Thus, we conclude that these spills are considered to not be a public health hazard.**

Appendix A. Maps and Images

Figure 1. Overview of the Oscar Mayer Releases and the Hartmeyer site.

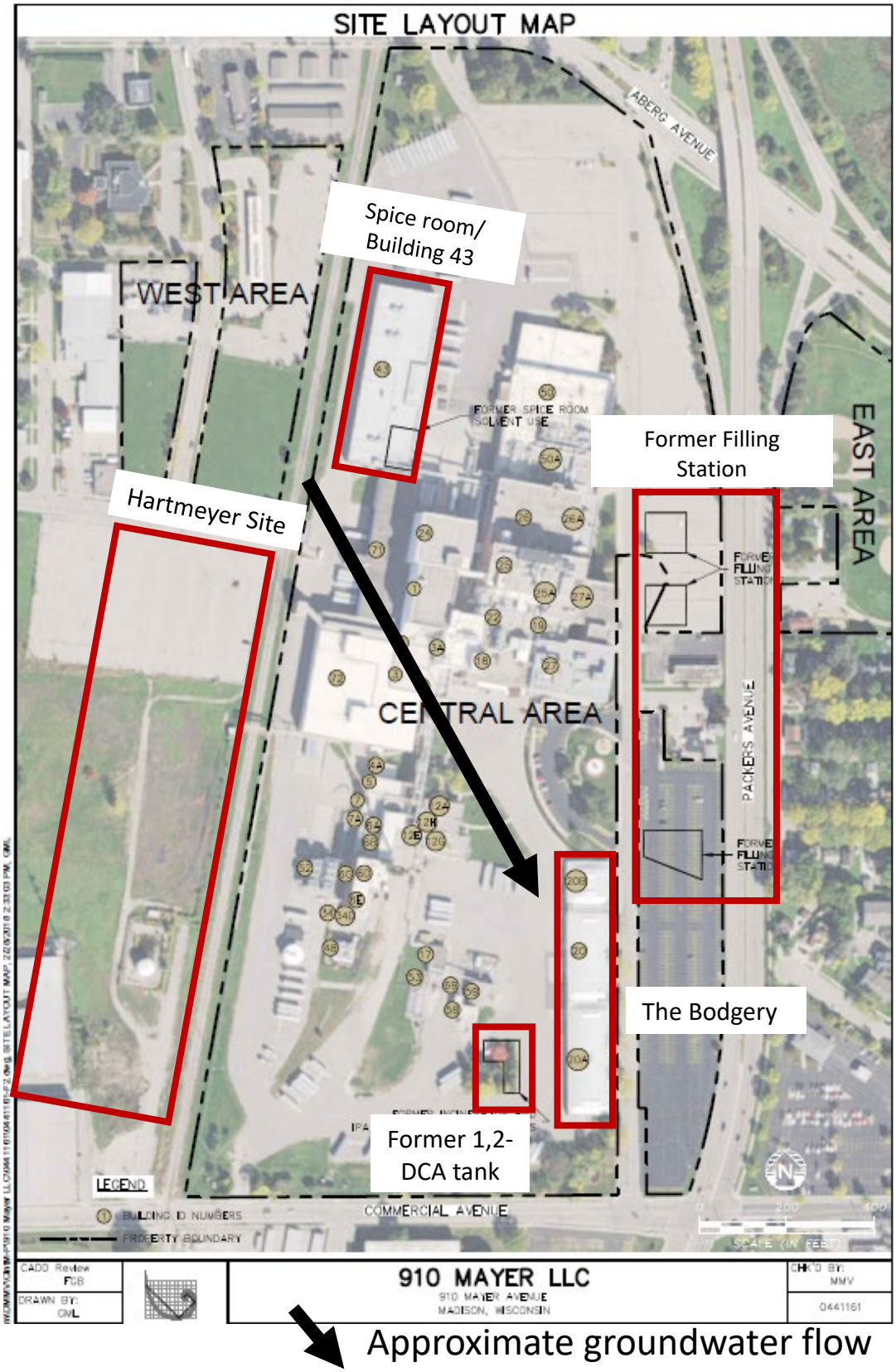


Figure 2. Overview of Central Oscar Mayer and Hartmeyer open sites and neighborhood.

Figure 3. Soil Boring Location Map on the Oscar Mayer Property, 2017

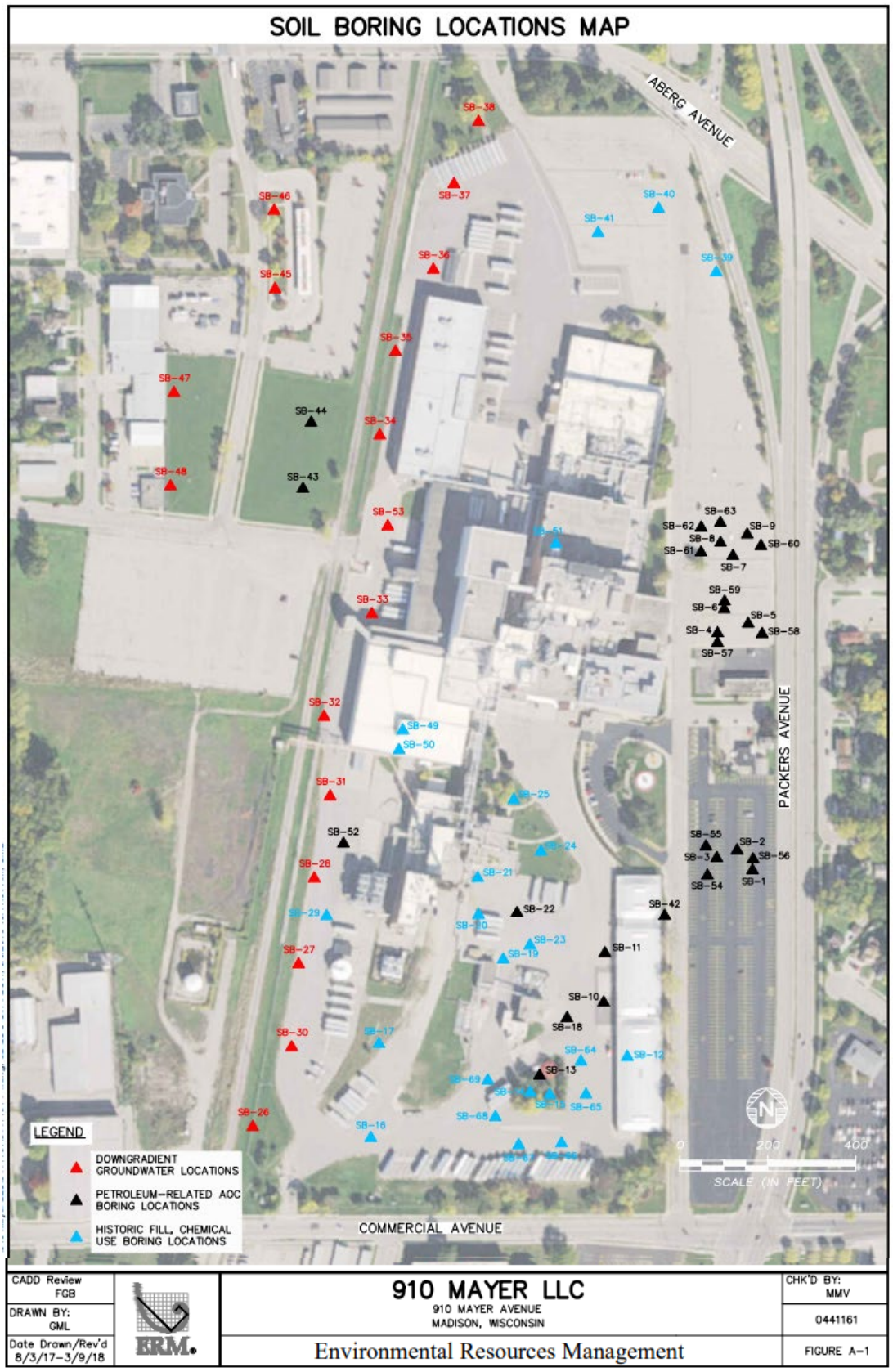


Figure 4. Site layout with building numbers on Central Oscar Mayer Site

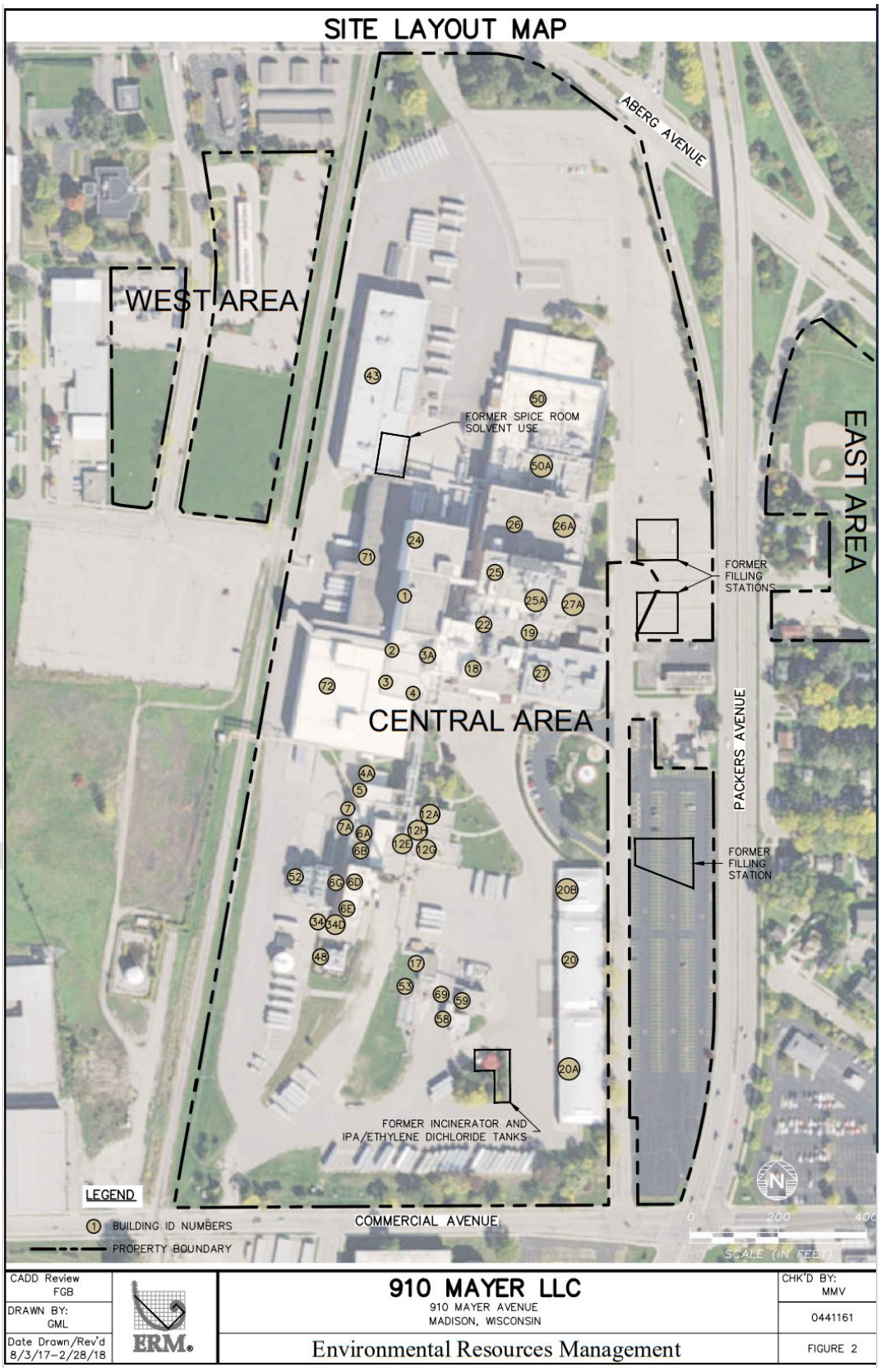
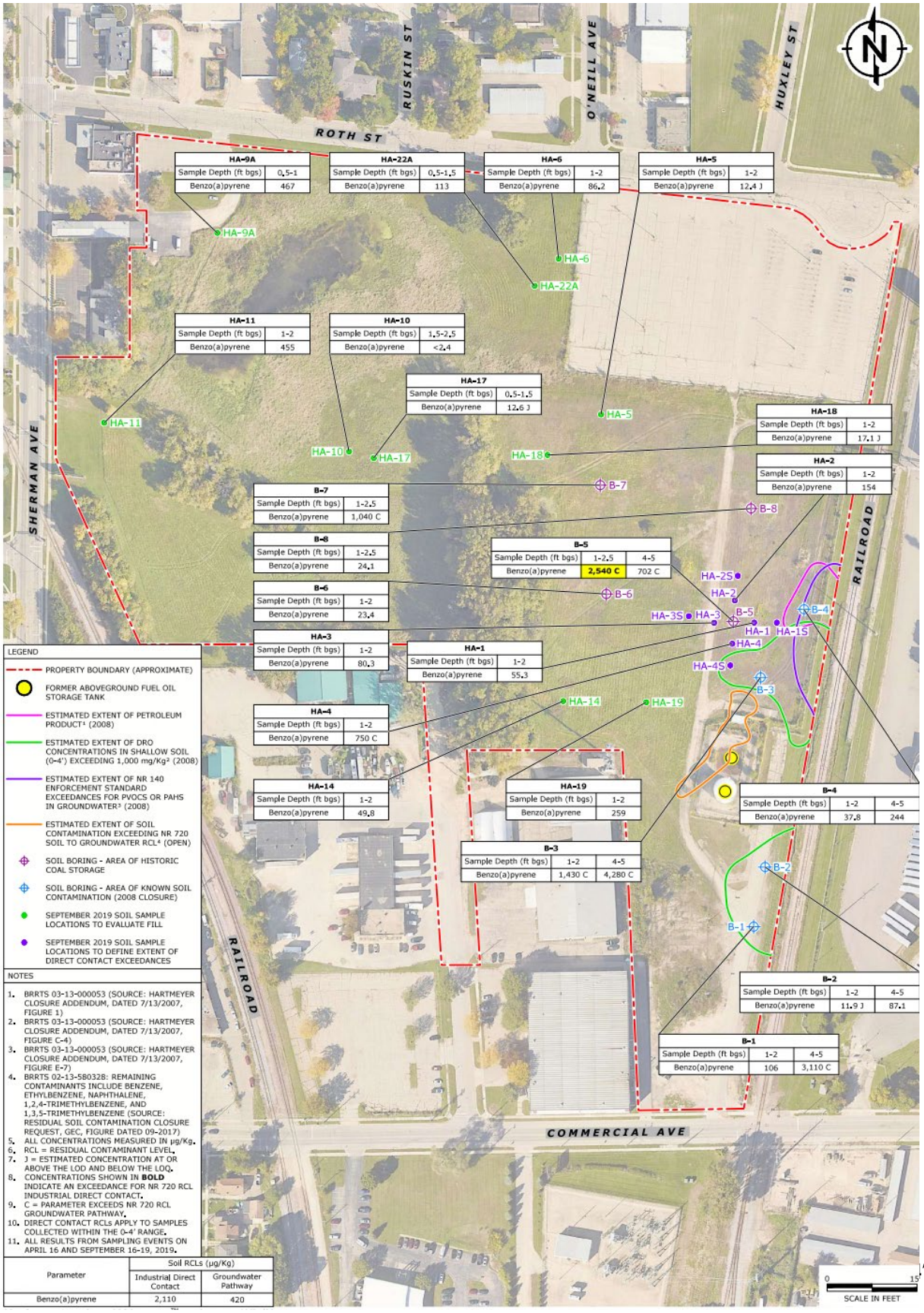


Figure 5. Soil Boring Location Map on the Oscar Mayer Property, 2020

Figure 6. Former Filling Station Site covered by Parking lot

Figure 7. 2019 Benzo(a)pyrene soil sampling results for the Hartmeyer site based on Closed Site #2 location



Appendix B. Glossary

Agency for Toxic Substances and Disease Registry (ATSDR)	The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.
Cancer Risk	A theoretical risk for developing cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.
Cancer Risk Evaluation Guide (CREG)	The concentration of a chemical in air, soil or water that is expected to cause no more than one excess cancer in a million persons exposed over a lifetime. The CREG is a comparison value used to select contaminants of potential health concern and is based on the cancer slope factor (CSF).
Cancer Slope Factor	A number assigned to a cancer causing chemical that is used to estimate its ability to cause cancer in humans.
Carcinogen	Any substance that causes cancer.
Comparison Value (CV)	Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.
Contaminant	A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.
Dermal Contact	Contact with (touching) the skin (see route of exposure).
Dermal exposure	Dirt particles that can adhere to the skin may cause additional exposure to contaminants through dermal absorption. Although human skin is an effective barrier for many environmental contaminants, some chemicals can move easily through the skin.
Dose (for chemicals that are not radioactive)	The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.
Wisconsin Enforcement Standard (ES)	Chapter NR 140 of Wisconsin State Statutes defines the enforcement standard as the means a numerical value expressing the concentration of a substance in groundwater which is s adopted under s. 160.07, Stats., and s. NR 140.10 or s. 160.09, Stats., and s. NR 140.12.
Environmental Media Evaluation Guide (EMEG)	A concentration in air, soil, or water below which adverse non-cancer health effects are not expected to occur. The EMEG is a comparison value used to select contaminants of potential health concern and is based on ATSDR's minimal risk level (MRL).
Environmental Protection Agency (EPA)	United States Environmental Protection Agency.
Exposure	Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Groundwater	Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].
Hazardous Substance	Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.
Ingestion	The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].
Ingestion exposure	Most people inadvertently swallow small amounts of sediments, soil and dust (and any contaminants they contain). Young children often put hands, toys, pacifiers, and other things in their mouths, and these may have dirt or dust on them that can be swallowed. Adults may ingest sediments, soil, and dust through activities such as gardening, mowing, construction work, dusting, and in this case, recreational activities.
Ingestion Rate	The amount of an environmental medium that could be ingested typically on a daily basis. Units for IR are usually liter/day for water, and mg/day for soil.
Inhalation	The act of breathing. A hazardous substance can enter the body this way [see route of exposure].
Inhalation exposure	Although people can inhale suspended sediment, soil or dust, airborne sediment usually consists of relatively large particles that are trapped in the nose, mouth, and throat and are then swallowed, rather than breathed into the lungs.
Inorganic	Compounds composed of mineral materials, including elemental salts and metals such as iron, aluminum, mercury, and zinc.
Lowest Observed Adverse Effect Level (LOAEL)	The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.
Maximum Contaminant Level (MCL)	A drinking water regulation established by the federal Safe Drinking Water Act. It is the maximum permissible concentration of a contaminant in water that is delivered to the free flowing outlet of the ultimate user of a public water system. MCLs are enforceable standards.
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.
Minimal Risk Level (MRL)	An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].
No apparent public health hazard	A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.
No Observed Adverse Effect Level (NOAEL)	The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.
Oral Reference Dose (RfD)	An amount of chemical ingested into the body (i.e., dose) below which health effects are not expected. RfDs are published by EPA.
Organic	Compounds composed of carbon, including materials such as solvents, oils, and pesticides that are not easily dissolved in water.

Parts per billion (ppb)/Parts per million (ppm)	Units commonly used to express low concentrations of contaminants. For example, 1 ounce of trichloroethylene (TCE) in 1 million ounces of water is 1 ppm. 1 ounce of TCE in 1 billion ounces of water is 1 ppb. If one drop of TCE is mixed in a competition size swimming pool, the water will contain about 1 ppb of TCE.
Pica	Pica behavior is a persistent eating of non-food substances (such as dirt or paper). In a small percentage of children, pica behavior has been found to result in the ingestion of relatively large amounts of soil (one or more grams per day). Compared to typical children, those who swallow large amounts of contaminated soil may have added risks from short-term exposure. Some adults may also exhibit pica behavior.
Plume	A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.
Reference Dose Media Evaluation guide (RMEG)	A concentration in air, soil, or water below which adverse non-cancer health effects are not expected to occur. The RMEG is a comparison value used to select contaminants of potential health concern and is based on EPA's oral reference dose (RfD).
Wisconsin Residual Contaminant Level (RCL)	Wisconsin statute indicates that residual contaminant levels for soil be based on protection of human health from direct contact and shall be developed using a certain criteria also defined in Wisconsin Chapter NR 720.12.
Route of exposure	The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].
Surface water	Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].
Time Weighted Approach (TWA)	The exposure concentration of a contaminant during a given period.
Volatile Organic Compound (VOC)	Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Appendix C. Chemical Toxicity Overview

All the following information was obtained from fact sheets provided by the Agency of Toxic Substances and Disease Agency of the CDC.

PVOCs

Benzene is a colorless liquid that evaporates into the air very quickly and dissolves slightly in water. Benzene is formed from both natural processes and human activities. Some industries use benzene to make other chemicals which are used to make plastics, resins, and nylons along with other synthetic fibers. Benzene can pass into the air from water and soil and reacts with other chemicals in the air and breaks down within a few days. Benzene breaks down more slowly in water and soil and can pass through the soil into underground water. It does not build up in plants or animals. Eating or drinking food

containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death.

Cis-1,2-dichloroethene is used to produce solvents and in chemical mixtures. Cis is one of two forms of 1,2-dichloroethene. Most 1,2-dichloroethene in the soil surface or bodies of water will evaporate into the air. 1,2-dichloroethene can travel through soil or dissolve in water in the soil. In groundwater, it takes 13 to 48 weeks to break down. 1,2-dichloroethene can break down into vinyl chloride. You can be exposed to 1,2-dichloroethene by breathing in 1,2-dichloroethene vapors or drinking contaminated water. In animal studies, low levels of cis-1,2-dichloroethene caused effects on the blood, such as decreased number of red blood cells, and also effects on the liver.

1,2-Dichloroethane (1,2-DCA) or ethylene dichloride, is a chemical not found naturally in the environment. 1,2-DCA is commonly used in the production of vinyl chloride which is used to make a variety of plastic and vinyl products. Most of the 1,2-DCA released in the environment is in the air and it can be broken down by reacting with other compounds formed by sunlight. In water, it breaks down very slowly and most of it will evaporate to the air. In soil, 1,2-DCA will either evaporate into the air or travel down through the soil and enter groundwater. Nervous system disorders, liver, and kidney diseases and lung effects have been reported in humans ingesting or inhaling large amounts of 1,2-DCA.

Trichloroethylene or TCE is a colorless, volatile liquid that quickly evaporates into the air. It is nonflammable and has a sweet odor. The two major uses of TCE are as a solvent to remove grease from metal parts and as a chemical that is used to make other chemicals. TCE is suspected to have been used as a solvent for extracting spices in Building 43. TCE is quickly broken down in the air and is removed from soil and water mainly through evaporation. TCE does not build up significantly in plants or animals. Exposure to TCE may cause headaches, dizziness, and sleepiness; large amounts may cause coma or death. Exposure to high levels can also result in changes in the rhythm of the heartbeat, liver damage, and evidence of kidney damage. Some human studies indicate that TCE may cause developmental effects such as spontaneous abortion, congenital heart defects, central nervous system defects, and small birth weight.

Tetrachloroethene (PCE) is a nonflammable colorless liquid used as a dry cleaning agent and metal degreasing solvent. It is also used as a starting material for making other chemicals and is used in some consumer products. PCE breaks down very slowly in the air but evaporates quickly from water into the air. It is generally slower to break down in water. PCE may evaporate quickly from shallow soils or may filter through the soil and into the groundwater below. It generally is slow to break down in soil. Breathing in high levels of PCE may cause dizziness, drowsiness, headaches, and higher levels causing unconsciousness and even death. Exposure for longer periods to low levels of PCE may cause changes in mood, memory, attention, reaction time, and vision.

Vinyl chloride is a colorless gas and is a manufactured substance that does not occur naturally. It can be formed when other substances such as trichloroethane, trichloroethylene, and tetrachloroethylene are broken down. Vinyl chloride is also used to make polyvinyl chloride which is used in a variety of plastic products. The effects of drinking high levels of vinyl chloride are unknown. Animal studies have shown that long-term exposure to vinyl chloride can damage the sperm and testes.

PAHs

PAHs are a class of over 100 chemicals which includes benzo(a)pyrene. PAHs are generated by the incomplete combustion of organic matter, including oil, wood, and coal. They are found in materials such as creosote, coal, coal tar, and motor oil. Based on structural similarities, metabolism, and toxicity, PAHs

are often grouped together when one is evaluating their potential adverse health effects. You may be exposed to PAHs by coming into contact with water, air or soil near a hazardous waste site or drinking contaminated water. Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people. The EPA has classified some PAHs—called cPAHs—as probable human carcinogens (B2) as a result of sufficient evidence of carcinogenicity in animals and inadequate evidence in humans.

Metals

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds. Many arsenic compounds can dissolve in water but most of the arsenic in water will ultimately end up in soil or sediment. Ingesting very high levels of arsenic can result in death and lower levels may result in nausea, vomiting, decreased red and white blood cell production, and darkening of the kind (inorganic arsenic). Skin contact with inorganic arsenic may cause redness and swelling. Almost nothing is known regarding health effects of organic arsenic compounds in humans but studies in animals suggest simple organic compounds are less toxic than inorganic forms. Ingestion to methyl or dimethyl compounds can cause diarrhea and damage to kidneys.

Appendix D: Public Comments