



# REMEDICATION AND REDEVELOPMENT DIVISION

# VAPOR INTRUSION

# RISK & REMEDIES

Volume 1, Issue 1, May 2010

*The Source for Part 201 and Part 213 Vapor Intrusion News*

## Intro to *VI Risk & Remedies*

*Frequently Asked Questions from RRD Cleanup Criteria Training Leads to the Development of VI R&R Newsletter*

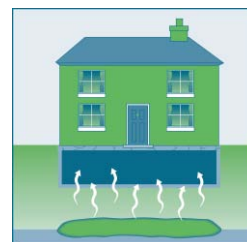
The Remediation and Redevelopment Division (RRD) provided Cleanup Criteria Training for RRD staff, the regulated community, and other interested parties in the summers of 2006 and 2007. Many questions related to the vapor intrusion to indoor air exposure pathway (VI) were raised during these trainings. The *VI Risk & Remedies (R&R)* newsletter was developed as a venue for restating and reviewing key concepts about VI presented at these trainings and to provide answers to some of the more frequently asked questions.

The RRD hopes that the information in *VI R&R* will provide a concise and convenient refresher for those in attendance at training and assist those that were unable to attend training by clearly identifying and prioritizing the key VI issues. This newsletter will also serve as a resource for updates in VI science. ♦

## Shallow Groundwater & VI

*Requirements for Addressing this Common Site Condition in Michigan*

Shallow groundwater is a site condition often assumed to add a layer of complexity to the already complicated process of VI investigation and assessment. However, despite the clear regulatory and technical limitations associated with cleanup criteria application, the shallow groundwater condition need not become an obstacle to VI evaluation, remediation, or redevelopment progress at VI sites in Michigan.



The Johnson and Ettinger (J&E) model (Johnson and Ettinger, 1991) is the fate and transport model used for development of the Part 201 generic groundwater volatilization to indoor air inhalation criteria/Part 213 Risk Based Screening Level (RBSL) (hereafter referred to as the GVIIC) to address human health risks resulting from volatile organic compounds (VOCs) volatilizing from groundwater to indoor air. The GVIIC were originally developed in 1998, and the GVIIC methodology (including the J&E model inputs and exposure assumptions) and resulting criteria were promulgated into Rule in 2002. The J&E model and its application limitations were discussed at the Cleanup Criteria Training in 2006 and 2007.

The J&E model's predicted outcomes become less reliable as groundwater depth becomes more shallow (i.e., closer to the basement foundation or building slab). Therefore, it becomes more critical to evaluate whether the J&E model is the

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appropriate tool for assessing VI risk when actual site conditions stray from the assumptions used in the model (such as depth to groundwater). To ensure the consideration of critical J&E assumptions, the Administrative Rules are specific with regard to the applicability of the GVIIC when shallow groundwater conditions exist at a VI site. Rule 714(2)(b) states that the GVIIC are not valid for assessing VI risk at a site if the highest water table is less than three meters from the ground surface, and a site-specific evaluation is required. This Rule requirement is intended to trigger an evaluation of the appropriateness of the GVIIC for assessing the VI pathway at sites where the GVIIC may not be protective because of facility-specific conditions (e.g., shallow groundwater).

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*...The shallow groundwater condition need not become an obstacle to VI evaluation, remediation, or redevelopment progress at VI sites...*

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A site-specific evaluation of the VI pathway must consider site-specific conditions. The party conducting the evaluation must be able to demonstrate to the department that the methods for evaluating the VI pathway are technically valid and appropriate to the site conditions. The proposal could include the use of a different version of the J&E model or a completely different risk assessment model; or soil gas sampling to demonstrate compliance with criteria [Rule 714(5)]. For a majority of facilities, a site-specific evaluation will include one or more of the following options:

1. Soil gas sampling may be conducted as part of a site-specific evaluation. The RRD Toxicology Unit has developed Acceptable Soil Gas Screening Concentrations (ASGSCs) for comparison to soil gas sampling data. For guidance on soil gas sampling and characterization, please refer to the Peer Review Draft Operational Memorandum #4, Attachment #4 – Soil Gas and Indoor Air Sampling, available upon request from RRD.
2. A site-specific evaluation may include the development of site-specific GVIIC using an

updated version of the J&E model that relies on site-specific inputs and exposure assumptions [see page 4 for a link to the United States Environmental Protection Agency's (EPA) online J&E model-based calculator]. **However, this will likely be the exception, as there are many limitations and technical considerations when applying the J&E model to groundwater that is very shallow.** Further, the site-specific data necessary for development of site-specific GVIIC are rarely available, and collection is often cost-prohibitive. Consultation with the RRD Toxicology Unit is recommended any time a responsible party proposes development of a site-specific GVIIC for addressing shallow groundwater. A detailed discussion of the development of site-specific GVIIC using alternative models, including EPA's online J&E model-based calculator, will be a future VI R&R topic.

3. The potential for VI risk may be assessed by comparing hazardous substance concentrations in shallow groundwater to the groundwater VI screening levels ( $GW_{VI}SLs$ ) available from the RRD Toxicology Unit. The  $GW_{VI}SLs$  are NOT criteria and are not required regulatory cleanup goals. The  $GW_{VI}SLs$  are intended to allow for screening for potential VI risk.

## SHALLOW GROUNDWATER AND SVIIC

As a reminder, Rule 724(2)(b) states that the Soil Volatilization to Indoor Air Inhalation Criteria (SVIIC) do not apply if there is a sump present (or will be in the future) in the building or structure being evaluated. A site-specific evaluation is required. The presence of a sump or another preferential pathway of vapor flow may allow for greater vapor infiltration rates than assumed under the current application of the J&E Model. Unfortunately, infiltration rates from sumps are not practically or reliably determined to allow for site-specific modification of the J&E model. See page 3 for more details on sumps. ♦

In the absence of preferential pathways of vapor migration to the indoor air space (e.g., groundwater entering a sump, see page 3), concentrations below the  $GW_{VI}SLs$  indicate that VI is likely not an issue. Concentrations exceeding the  $GW_{VI}SLs$  will require additional lines of evidence for a final risk determination, but do not, on their own, indicate an unacceptable risk.



As a note and caution: The  $GW_{VI}SLs$  are only acceptable for application if the groundwater is never in contact with the basement or

building slab, considering seasonal variation. VOCs in shallow groundwater may directly impact indoor air by entering a building's sump or drain system. See page 3 for more information on VOC contamination in sumps.

4. It may be assumed that an unacceptable VI risk exists and presumptive remedies may be explored and/or implemented to mitigate the exposure pathway.

**Note regarding Part 213 and Site Closure: Corrective actions at a site regulated by Part 213 are not considered complete if they include a presumptive remedy (e.g., sub-slab depressurization or other mitigation system) that requires continuing operation and maintenance.**

Other issues related to shallow groundwater will

## WHAT ABOUT SUMPS?

Rules 714(2)(c) and 724(2)(b) require a site-specific evaluation to address the VI pathway if there is a sump present in the structure at a facility under investigation.

The installation of sump pumps in building foundations, most commonly basements, is required under local building codes in many areas of Michigan to prevent the infiltration of shallow groundwater into the structure. If there is a sump present, even if only a room or portion of a building appears potentially affected by the sump, the sump is assumed to create a preferential pathway of vapor migration and impacts to indoor air quality cannot be quantified using the J&E model.

Although the isolation of a sump

and/or venting of vapors from the sump to the outdoors may effectively “seal” or “cap” the opening in a slab and eliminate a preferential pathway of vapor flow, these measures are not considered adequate to allow for the use of the J&E model. The J&E model assumes the presence of a concrete foundation and a fixed area available for vapor migration, much smaller than the typical area occupied by a sump. The presence of a sump and its associated drainage system may create pockets of vapor accumulation and areas of preferential vapor flow along fill materials surrounding drain tiles, also not consistent with the assumptions of the J&E model.

Capping does not eliminate vapor flow throughout the already established drain tile system nor prevent vapor accumulation in the area of the sump. A sump may also produce its own “zone of

influence,” particularly when vented to the outdoors where subsurface vapors may follow a path of least resistance toward the open sump. These factors may or may not cause or contribute to unacceptable VI risk; however, the impacts are not easily quantified and are not represented by the J&E model application.

The RRD Toxicology Unit has developed screening levels for assessing VI risk from volatile organic chemicals (VOCs) present in sump water under the authority of Rule 728(1). When VOCs are detected in the sump water at a given site, these screening levels may be used to assess potential human health risk from volatilization of VOCs from the sump water to indoor air. The use of these screening levels must be approved by the department prior to application as “site-specific” criteria, per Rule 728(1). ♦

likely be the subject of future VI R&R publications. For site-specific questions, please refer to the appropriate RRD district project manager. See the RRD District map to locate the district in which the site is located:

[http://www.michigan.gov/deq/0,1607,7-135-3306\\_3329-12306--,00.html](http://www.michigan.gov/deq/0,1607,7-135-3306_3329-12306--,00.html)

For criteria related questions:  
Amy Salisbury, Toxicologist Specialist  
RRD Toxicology Unit  
(517) 241-3584  
[salisburya@michigan.gov](mailto:salisburya@michigan.gov)

For sampling and characterization related questions:  
Matt Williams, VI Specialist  
RRD Superfund Section  
(517) 373-4821  
[williamsm13@michigan.gov](mailto:williamsm13@michigan.gov)



## Attention QCs!

The former Storage Tank Division (STD) Operational Memorandum No. 4, Attachment 8, titled “Part 213 Risk-Based Screening Levels (RBSLs) for Groundwater and Soil Volatilization to Indoor Air” was officially RESCINDED with the promulgation of the Part 201 Administrative Rules in December 2002. Qualified Consultants (QCs) may not cite this document as the source for development of Site Specific Target Levels (SSTLs) for the VI pathway. Please refer to the following Rules when addressing the vapor intrusion pathway:



- ◆ Rule 706a(4)
- ◆ Rule 706a(9)
- ◆ Rule 714
- ◆ Rule 724
- ◆ Rule 732

## VI RESOURCES

The primary VI resource for cleanups in Michigan is the Part 201 Administrative Rules, specifically Rules 714, 724, and Rules 732(3) and (4); found at <http://www.michigan.gov/deqrrd>.

The resources listed below are included for information purposes only. The content of these documents may not represent DNRE opinions, policy, or reflect Michigan regulatory requirements. Inclusion in this list of resources should not be interpreted to indicate DNRE endorsement.

- EPA’s Draft Subsurface Vapor Intrusion Guidance (2002)  
<http://www.epa.gov/osw/hazard/correctiveaction/eis/vapor.htm>
- EPA’s Johnson and Ettinger Spreadsheet for Calculating Site-Specific Criteria  
[http://www.epa.gov/athens/learn2model/part-two/onsite/JnE\\_lite.html](http://www.epa.gov/athens/learn2model/part-two/onsite/JnE_lite.html)
- The Interstate Technology Regulatory Council (ITRC) Vapor Intrusion Pathway: A Practical Guideline (2007).  
<http://www.itrcweb.org/guidancedocument.asp?TID=49>

- American Society for Testing and Materials (ASTM) Standard, ASTM E2600-08 Standard Practice for Assessment of Vapor Intrusion into Structures on Property Involved in Real Estate Transactions (2008). Available for purchase at:  
<http://www.astm.org/Standards/E2600.htm>  
For more information, please contact Amy Salisbury at [salisburya@michigan.gov](mailto:salisburya@michigan.gov)
- California Department of Toxic Substances Control Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air. Interim Final (2004).  
[http://www.dtsc.ca.gov/AssessingRisk/upload/HERD\\_POL\\_Eval\\_Subsurface\\_Vapor\\_Intrusion\\_interim\\_final.pdf](http://www.dtsc.ca.gov/AssessingRisk/upload/HERD_POL_Eval_Subsurface_Vapor_Intrusion_interim_final.pdf)
- New York State Department of Health Final Guidance for Evaluating Vapor Intrusion (2006).  
[http://www.health.state.ny.us/environmental/investigations/soil\\_gas/svi\\_guidance/](http://www.health.state.ny.us/environmental/investigations/soil_gas/svi_guidance/)
- For a more comprehensive listing of VI resources and useful websites, go to <http://www.envirogroup.com/links.php>

# MIOSHA & Part 201/213

## Frequently Asked Questions about MIOSHA Standards and VI in Michigan



*Are there regulations that address the use of occupational standards for environmental cleanups in Michigan?*

There are allowances in the Cleanup Program for the development of site-specific VI criteria that are based on the occupational standards developed pursuant to the Michigan Occupational Health and Safety Act (MIOSHA, 1974 PA 154, MCL 408.1001 *et seq.*). These allowances are found in Rules 714(6), 724(6), and 732(3) and (4). These rules shall apply only when all of the following three conditions are satisfied:

1. The risk being evaluated results from exposure to hazardous substances in the indoor air of an **active workplace that is currently regulated by the MIOSHA** [Rule 714(6)(a) and Rule 724(6)(a)].
2. The exposure to hazardous substances from subsurface environmental contamination is a portion of the exposure to which workers are otherwise exposed from **process-related sources of the same hazardous substance** [Rule 714(6)(b) and Rule 724(6)(b)].
3. The **risk to the non-worker population**, if any, from inhalation of indoor air at the property has been evaluated according to methods acceptable to the DNRE, and the **level of risk reduction meets the risk management objectives of Part 201**, Section 20120a [Rule 714(6)(c), Rule 724(6)(c), and Rules 732(3) and (4)].

The conditions identified in the Rules severely limit the application of MIOSHA standards as site-specific VI criteria. As a result, the MIOSHA standards are rarely applicable as site-specific cleanup criteria. These standards are primarily

intended for the protection of a healthy worker population based on limited durations of exposure in a controlled, workplace setting. The Rules allow consideration of MIOSHA applicability to reduce unnecessary regulatory duplicity when a cleanup site is an active workplace regulated by the MIOSHA; while ensuring that the cleanup goals of Part 201 and Part 213 are met. In other words, only under the conditions identified in Rules 714(6), 724(6), and 732(3) and (4), is the MIOSHA considered sufficiently protective of human health, safety, welfare, and the environment against unacceptable exposures to hazardous substances in environmental media.



*How do the MIOSHA standards differ from the soil and groundwater volatilization to indoor air cleanup criteria or the Acceptable Soil Gas or Indoor Air Screening Concentrations?*

Generally speaking, the MIOSHA standards are not intended for protection of the general population and are never appropriate for application at homes or schools. The MIOSHA standards are often based on empirical evidence of toxicity following workplace exposure to known chemicals. Some MIOSHA standards may be linked to acute human responses (e.g., dizziness, vomiting, fainting) instead of the potential to cause chronic or long-term toxicity.

Rules 714(6)(c), 724(6)(c) and Rules 732(3) and (4) allow for the application of MIOSHA standards only when “the level of risk reduction meets the risk management objectives of Part 201, Section 20120a”. However, the MIOSHA standards are not considered protective in many cases for application under Part 201 or Part 213 because they do not consider lifetime exposure, may not consider the most sensitive human health effects, do not protect for sensitive subgroups, and do not achieve the level of risk reduction [i.e., 1 in 100,000 ( $10^{-5}$ ) cancer risk, hazard quotient = 1] consistent with the requirements of Part 201, Section 20120a.



*Why can't I replace a cleanup criterion with a MIOSHA standard if I'm conducting a cleanup at an active workplace where exposures are occupational in nature?*

Per Rule 714(6)(a) and Rule 724(6)(a), the facility under investigation must be regulated by the MIOSHA if MIOSHA standards are to apply. In many instances, the MIOSHA standards would be impractical for application if the facility were not actively regulated by the MIOSHA. Certain hazardous substances may be subject to several MIOSHA standards. For example, if the occupational standards for a certain hazardous substance, "Substance A", include a time weighted average of 10 parts per million (ppm), a ceiling concentration of 25 ppm (10 minute allowable exposure), and a peak concentration of 50 ppm, then during an 8-hour work shift it is acceptable for an employee to be exposed to a concentration of Substance A above 25 ppm, but only for 10 minutes, and never above 50 ppm. Such exposure must be compensated by exposures to concentrations less than 10 ppm so that the cumulative exposure for the entire 8-hour work shift does not exceed a weighted average of 10 ppm.

Because exposure to environmental contaminants from vapor intrusion to indoor air cannot be controlled or monitored in such a manner, demonstrating compliance with these occupational standards is impractical and unreliable in the Part 201 and Part 213 programs unless the workplace is regulated by the MIOSHA.



*Are there examples of when the MIOSHA standards may apply at commercial and industrial facilities?*

The MIOSHA standards will only apply at a small subset of facilities. Application of a MIOSHA standard might be appropriate when addressing tetrachloroethylene, also called perchloroethylene (PCE), in the subsurface at an active dry cleaning facility, as long as part of a worker's exposure to PCE is from vapor intrusion as well as from the workplace use of PCE in the dry cleaning process



and all other Rule requirements are met [Rules 714(6), 724(6), and Rules 732(3) and (4)].

Even when all rule requirements are met, however, the MIOSHA would only apply to the active dry cleaning building. MIOSHA would not apply to other businesses or homes next to or immediately adjacent (e.g., strip mall) to the dry cleaner that may also be impacted by PCE.

The MIOSHA standards are not applicable at a commercial gas station per Rule 714(6)(a) and Rule 724(6)(a). As stated previously, these Rules require that the risk being evaluated results from inhalation exposure in an active workplace regulated by MIOSHA and the rules promulgated under that Act.

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***The MIOSHA standards are not applicable at a commercial gas station per Rule 714(6)(a) and Rule 724(6)(a).***

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The Part 311 Rules of the MIOSHA specifically address the occupational health standards for benzene. Part 311 of MIOSHA, Rule 1, states:

Rule 1. (1) These rules apply to all occupational exposures to benzene, chemical abstracts service registry number 71-43-2, except as provided in subrules (2) and (3) of this rule.

Subrule (2) is specific to benzene exposure at commercial gas stations:

Rule 1. (2) These rules do not apply to any of the following:

(a) The storage, transportation, distribution, dispensing, sale, or use of gasoline, motor fuels, or other fuels that contain benzene after its final discharge from bulk wholesale storage facilities..."

Because MIOSHA does not regulate occupational exposures to benzene at active gas station facilities, Rules 714(6)(a) and 724(6)(a) prohibit a demonstration of compliance using MIOSHA standards as site-specific cleanup criteria at active commercial gas stations. ♦