

## Vapor Intrusion Continuing Obligations Applied in DNR Closure Approvals

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This document is intended to help Remediation & Redevelopment staff determine which vapor intrusion continuing obligations to include in closure approval letters. Section NR 726.15(2)(h) through (L), Wis. Adm. Code, lists five continuing obligations that may be applicable at sites closed with residual contamination in order to protect the vapor intrusion pathway. This document discusses when to apply those continuing obligations. The continuing obligations are listed as Options 7A through 7E which parallels the closure template letter (RR-5351, Closure by Committee). Any combination of these conditions may be applicable to a given contaminated property.

An attachment to this document, “Considerations for Applying Vapor Intrusion Continuing Obligations”, summarizes certain recommended criteria for applying continuing obligations at sites with residual volatile organic chemical (VOC) contamination. The numbers in the “Considerations” attachment are only recommendations. All decisions for applying continuing obligations are made on a site-by-site basis using professional judgment.

### Template Letter RR-5351

#### Action Code 226, Protect Against Exposure or Potential Exposure to Contaminant Vapors

I. **Option 7A, Continuing Obligation : Where a vapor mitigation system is required due to sub-slab concentrations exceeding vapor risk screening levels**

A. Application

Before closure is considered at sites where the vapor pathway poses a risk to building occupants, s. NR 726.05(8)(b), Wis. Adm. Code, requires that remedial action has been conducted to reduce the mass and concentration of volatile compounds to the extent practicable and the vapor exposure pathway has been interrupted or mitigated. Having completed remedial action, continued operation and maintenance of a VMS may be needed post-closure to address vapors arising from residual contamination.

Option 7A is applied to buildings where sub-slab vapor risk screening levels (VRSL) are exceeded and an engineered vapor mitigation system (VMS) is needed to protect occupants from vapor intrusion. These systems may include the following:

1. *Passive venting systems* that can be converted to active systems. In general, passive venting systems are only appropriate at newly constructed buildings where the venting system is designed and installed beneath the building before construction<sup>1</sup>.
2. *Sub-slab depressurization systems (SSDS)*. These are the most commonly installed VMS. These systems actively remove vapors from beneath the building foundation and vent the vapors to the outdoors.

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<sup>1</sup> Criteria to determine when to require upgrading a passive system to an active system will be a topic of a future guidance.

3. *Sub-membrane depressurization systems.* These systems are most often installed over dirt floors and block walls. An impermeable membrane covers the entire surface to be depressurized and is sealed to the building foundation. Perforated PVC pipe underlies the membrane or a piping system depressurizes the block wall. The PVC piping extends outside the building and is connected to a fan which depressurizes the space between the membrane and the sealed area.
4. *Sub-slab pressurization systems.* Fans on these systems force air beneath the building foundation to create a positive pressure to displace vapors away from the building. These systems are rarely used due to problems surrounding system effectiveness and high energy costs.
5. *Building pressurization systems.* These systems rely on a building's heating, venting and air conditioning (HVAC) system to maintain positive indoor pressure relative to the outside and sub-slab pressures. Building pressurization systems are appropriate for certain commercial and industrial buildings but should not be relied upon for residential buildings. Proper operation of these systems requires regular maintenance and air balancing of the building on a periodic basis.
6. *Ventilated unoccupied parking garages.* Underground or first floor parking garages that meet the building codes and separate the occupied floor levels from the ground surface may be used to control vapor migration into the occupied space above.
7. *Other engineered VMS.* Any other engineered system, which may include building design, operations and existing engineering controls or HVAC systems that can be shown to protect the building occupants from vapor intrusion.

B. Documentation to accompany closure request

The responsible party (RP) provides documentation for the design, implementation, proper operation, and long-term operation, maintenance, monitoring, and inspection of the vapor control systems. Regardless of the vapor control system used at a building, the RP should provide the information required by NR 724 to the department before closure. A basic summary of the information needed includes:

1. *Documentation of system installation* and effective operation, including: as-built drawings; photographs; documentation of pressure field extension; post-installation indoor air sampling at residential buildings; system monitoring showing proper operation; alarm systems (if installed); etc.
2. *Operation and Maintenance (O&M) Plan*, including: actions necessary to maintain the system; frequency of inspection, monitoring, system adjustment, logs for recording all O&M efforts, etc. Refer to NR 724 for requirements related to operation, maintenance and monitoring.

C. Closure Letter Conditions

At minimum, the closure letter must include conditions imposed by NR 726.15(2)(h), including the following requirements:

1. That the property owner operate and maintain the VMS until it is no longer needed;
2. Immediate repair and replacement by the property owner of any portion of the VMS which fails;
3. That the property owner provides the operation and maintenance plan for the VMS to any occupant of the building who is responsible for continued operation of the VMS; and
4. Notification to the department at least 45 days prior to changing the use of the VMS, including all passive and active VMS.

Additional conditions may be imposed, depending on the circumstances of the specific site or facility. Examples of these conditions include:

5. Maintenance of certain structural features of the existing building, such as maintenance of the floor, to ensure proper operation of the VMS;
6. Maintain an inspection log of O&M activities required by the maintenance plan on the premises; and
7. Post-closure submittal of VMS operation, maintenance and monitoring records or logs on a periodic basis to the department. If this condition is imposed, the information should be submitted on Form 4400-305, Continuing Obligations Inspection and Maintenance Log.

**II. Option 7B, Continuing Obligation: Where compounds of concern are being used at the site or facility. Land use restricted to commercial/industrial use.**

A. Application

This condition may be applied alone or in conjunction with other vapor intrusion conditions; however, this condition should be applied if the contaminant of concern is present as a product in the building and sub-slab vapor concentrations exceed VRSL. Under Option 7B land use is restricted to commercial/industrial use. The closure condition requires that the property owner notify the department if land use changes from the current use to residential use. In addition, the closure letter may restrict occupancy or require notification of the department if occupancy changes to any other commercial or industrial use.

If the contaminant of concern is currently used in the building being tested for vapor intrusion, it may not be possible to fully assess the vapor intrusion pathway prior to closure. Reassessment of the vapor pathway post-closure may be necessary for several reasons. Buildings where solvents are used may have high concentrations of VOC beneath the foundation. Where very high sub-slab VOC concentrations exist, VMS must be closely controlled to ensure adequate pressure field extension in order to meet indoor air commercial/industrial screening levels. It is only anecdotal at this point, but there is some evidence that blower fans wear out more quickly in high VOC environments. Off-gassing from building materials is not technically "vapor intrusion." None the less, chemical exposures due to off-gassing may be unacceptable for the subsequent use of the building. Option 7B is applied at properties that may require more thorough reassessment regarding the vapor pathway when land or property uses change. Possible follow-up actions that may be considered if land use conditions change include:

1. *Evaluate the effectiveness of the mitigation system.* For instance, testing for pressure field extension and reassessment of the VMS to determine that it is functioning properly.
2. *Reassess the vapor intrusion pathway* if a VMS was not installed before site closure occurred.
3. *Indoor air testing, if necessary.* This should be determined by the PM based on the new land/property use.

A site requesting closure where contaminants of concern are in use at the facility and where a site investigation of the vapor pathway cannot be completed is not eligible to receive a Voluntary Party Liability Exemption (VPLE). If a structural impediment or other reason prevents the vapor intrusion conditions (and, in some cases soil or groundwater contamination) from being thoroughly investigated at a VPLE site, discuss the situation with the Team Supervisor and Brownfields Section Chief.

B. Documentation to accompany closure request

The closure request must document chemical use within the building; delineate type and location of residual contamination (paying particular attention to contaminant sources beneath the building); and, where necessary, documentation of the VMS (see Option 7A).

C. Closure letter conditions

Where sub-slab VRSL are exceeded at sites using compounds of concern in their daily operations, a VMS may be required prior to granting closure. See Option 7A for applicable continuing obligations.

Conditions of the closure letter may restrict the use or occupancy of the property to ensure public health is protected. In addition, the closure letter must include the following conditions:

1. Notification of the department at least 45 days prior to a change in current land use to a residential setting.
2. Evaluation of the vapor intrusion pathway prior to changing land use to a residential setting; and
3. A description of the type and location of the residual contamination on the property.

III. **Option 7C: Where operation of a dewatering system and vapor mitigation system were required due to site-specific hydrogeologic conditions.**

A. Application

Option 7C is applied at properties where groundwater must be controlled to allow effective operation of a vapor mitigation system. Option 7C is never used alone in a closure approval. It is applied as a continuing obligation in conjunction with Option 7A. All items discussed above in Option 7A, including as-built documentation, monitoring, inspection, O&M requirements, etc., must be submitted for the groundwater control system.

B. Documentation to accompany closure request

Because the discharged groundwater is usually contaminated, there may be wastewater discharge requirements or a wastewater discharge permit issued for these systems.

1. Discharge to a Publically Owned Treatment Works (POTW). The local wastewater treatment authority is responsible for approving discharge of contaminated water to a sanitary sewer. If a local wastewater discharge permit has been issued, the closure letter should include a continuing obligation that requires compliance with of the local wastewater discharge permit until the permit is no longer required by the municipality. The property owner is responsible for testing and analysis required for the discharged water.
2. Discharge to a location other than a POTW. Regional wastewater staff should be consulted before a discharge takes place to a location other than a POTW in order to determine the appropriate regulatory framework for these systems. Any department wastewater requirements (such as discharge location, monitoring and reporting requirements, etc.) should be documented in the closure approval by referring to or attaching the wastewater approval document with the closure letter.

C. Closure letter conditions

The closure letter must:

1. Identify the specific hydrogeologic conditions present at the site and include a description of the water control system or any other system necessary for the proper operation of the VMS;

2. Include all conditions applicable to the operation and maintenance of the VMS; and
3. Notification of the department at least 45 days prior to changing land use from non-residential to residential; and
4. Requirements necessary to maintain the wastewater discharge requirements and/or permits discussed in B. above.

**IV. Option 7D: Where site-specific (commercial or industrial) vapor exposure assumptions were used and land or property use is restricted to non-residential.**

**A. Application**

Option 7D is applied at buildings where commercial/industrial vapor risk screening levels are used to achieve site closure. The property use should be restricted to non-residential<sup>2</sup> uses. Option 7D may be used in conjunction with Option 7A – that is, vapor mitigation systems may be needed at these buildings. The requirements of Option 7A apply if a mitigation system is necessary. For the purpose of establishing land use classification as related to vapor risk, commercial/industrial land use is assumed wherever the current property use is not residential.

When Option 7D is applied to a property, land use is restricted to commercial/industrial uses. The property owner must notify department if land/property use changes to a residential setting in the future, in accordance with s. NR 727.07(5), Wis. Adm. Code. If such a land use change takes place, the VI pathway at the building should be reassessed, including indoor air testing, to determine if occupants are protected from chemical vapor exposure.

**B. Documentation to accompany closure request**

The closure request should document the following:

1. The exposure assumptions used to assess the VI pathway;
2. Current land use of the building (that is, residential, commercial or industrial); and
3. Expected future land use changes, if known.

**C. Closure letter conditions**

The closure letter must:

1. Include the specific exposure assumptions on which the closure decision is based;
2. Specifically state the restriction in use or occupancy of the property based on the site-specific exposure assumptions for vapor intrusion;
3. Land use must be consistent with the specific exposure assumptions used at closure. If land use changes to a residential setting in the future, the department must be notified at least 45 days prior to the change in use. Additional assessment of the VI pathway may be necessary at that time.

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<sup>2</sup> S. NR 700.03(49g), Wis. Adm. Code, states “residential setting” means any dwelling designed or used for human habitation, and includes educational, childcare, and elder care settings.

V. **Option 7E: Where residual contamination poses a vapor intrusion risk for new buildings or with a change in construction or expansion of existing buildings.**

A. Application

The purpose of Option 7E is to eliminate, to the extent possible, vapor intrusion risk to occupants of future buildings developed at properties with residual contamination. "Future construction activities" include construction of new buildings or expansion of existing buildings where the foundation is placed near or over residual contamination. Site specific conditions and professional judgment will determine whether a continuing obligation for future vapor risk is selected for a property. If the conditions discussed below are present at a property and an RP feels a CO for future vapor risk should NOT be applied, the RP/consultant should submit data and include a specific discussion of the potential for future vapor risk. That data may include multiple-lines of evidence to establish the magnitude (high to low) for risk of vapor intrusion to future buildings.

Redevelopment of contaminated properties requires that vapor control technologies be designed into the building prior to construction unless the risk of vapor intrusion is assessed and the department agrees that vapor control technologies are not needed. Regardless of the approach to vapor intrusion control, information must be provided showing the risk of vapor intrusion has been addressed through the proposed building design, in accordance with NR 727.07(6), Wis. Adm. Code.

Soil and/or groundwater contaminated with perchloroethylene (PCE) and/or trichloroethylene (TCE) can be the source of vapor migration onto an undeveloped, adjacent property where no building exists at the time of closure. The site investigation should establish that vapor migration onto the adjacent property is or is not a risk to a possible future building. This determination should consider contaminant concentration in soils and groundwater; distance between the source property contamination and the adjacent property; soil type; underground utilities and other relevant information.

B. Residual contaminant levels to be considered when selecting continuing obligations for future buildings

Consider the following when deciding to apply a continuing obligation for potential future exposure to vapors.

1. *NAPL presence.* Current or historical evidence of petroleum non-aqueous phase liquid (NAPL) in soil or at the groundwater table that has not been remediated and may pose a vapor risk to future buildings<sup>3</sup>. This includes soil staining, floating product, laser induced fluorescence (LIF) response, or similar indicators of petroleum NAPL.
2. *Soil.* Soil RCLs for the "indoor air" pathway are not available. Guidelines are provided below and in the attached table, "Considerations for Applying Vapor Intrusion Continuing Obligations," to help staff determine when to use Option 7E if residual soil contamination remains on a property. However, professional judgment should be used to determine when site-specific conditions require the application of Option 7E.

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<sup>3</sup> Expect highly weathered diesel NAPL to have low VOC content and to pose a low vapor risk.

3. *Groundwater.* Vapors arise from VOC contamination located at/near the water table. Contaminant concentrations from water table wells should be used to determine if there is a risk for vapor intrusion. Calculated groundwater VRSLs should not be used to rule out vapor intrusion at future development sites. Variation in groundwater elevation and contaminant concentration over time should be considered when determining whether to require a VMS at future buildings. Consider site geology and soil stratigraphy when applying the recommendations below and in the “Considerations” table. Staff should use their professional judgment in applying Option 7E when residual groundwater contamination remains on a property.
  
4. *Contaminant concentrations to be considered when applying Option 7E.* The following situations should be considered when selecting a continuing obligation for future exposure to vapors. Decisions to apply Option 7E are based on site-specific conditions and professional judgment.
  - a. Chlorinated VOCs
    - i. *Soil.* PCE or TCE (or other non-aerobically degradable VOC that presents a health risk) is present above a groundwater protective residual contaminant level (GW-RCL) anywhere within the vadose zone and a building can be placed above the soil contamination. Vadose zone soils include soils at the water table that are seasonally exposed due to water table fluctuations.
    - ii. *Groundwater.*
      - 1) Concentrations at or above ES for PCE or TCE (or other non-aerobically degradable VOC that presents a health risk) exist on a property.
      - 2) Groundwater contaminated with PCE or TCE (or other non-aerobically degradable VOC that presents a health risk) above PAL may come in contact with the foundation of a future building.
  - b. Petroleum VOCs (PVOC)
    - i. *Petroleum NAPL*<sup>4</sup> exists near any location where a building can be placed on the property (including the “smear zone”). Indicators of NAPL include any of the following:
      - 1) LNAPL floating on the water table, LIF survey results, etc.
      - 2) Soil
        - a. Benzene  $\geq 10$  mg/kg
        - b. Naphthalene<sup>5</sup>  $\geq 5$  mg/kg
        - c. Total PVOC<sup>6</sup>  $\geq 250$  mg/kg
      - 3) Groundwater
        - a. Benzene  $> 1$  mg/l
        - b. Total PVOC  $> 30$  mg/l
    - ii. *Soil.* Significant soil contamination less than NAPL indicators is located within five feet of a possible future building foundation.
    - iii. *Groundwater.*

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<sup>4</sup> See ITRC PVI Guidance, <http://www.itrcweb.org/PetroleumVI-Guidance/>, for more information on NAPL indicators.

<sup>5</sup> The naphthalene NAPL screening value is based on the non-industrial direct contact soil RCL. NAPL may exist at lower concentrations of naphthalene, based on site-specific conditions.

<sup>6</sup> Total PVOC = the sum of benzene, ethylbenzene, toluene, xylenes (BETX), MTBE, and all TMBs.

- 1) Significant dissolved petroleum VOCs are present at concentrations less than NAPL indicators and a future building foundation can be placed within five feet or less of the contaminated groundwater.
- 2) Dissolved petroleum VOCs at concentrations above PAL may come in contact with the foundation of a future building.

C. Documentation to accompany closure request

The closure request should document contaminant conditions that indicate a continuing obligation for future exposure to vapors is necessary. If there are no conditions that indicate the need for this continuing obligation, this should also be stated in the closure request.

D. Closure letter conditions

Additions or changes to an existing building located near residual contamination can affect vapor movement into that building. The closure letter should include the following:

1. Notification of the department at least 45 days prior to taking action to expand a current building or construct a new building on a contaminated property; and
2. A requirement that appropriate vapor control technologies be used in the construction of any building, unless an assessment is conducted and submitted to the department which shows that the residual contaminant levels do not pose a VI risk to the expanded building or new building.

Considerations for Applying Vapor Intrusion Continuing Obligations

(Numbers in this table are only recommendations. All decisions for applying continuing obligations are made on a site-by-site basis using professional judgment.)

Continuing Obligation Options Case Closure-GIS Registry Form 4400-202	Criteria for Application of VI Options	
	Chlorinated VOCs	Petroleum VOCs
(ix) O&M of VMS needed to protect VI pathway	Sub-slab > VRSL	Sub-slab (each compound, respectively): BETX, N, MTBE, TMBs > VRSL
(x) Hydrologic control for VMS to operate effectively	Sub-slab/sump air > VRSL At highest level, water table intersects building foundation	Sub-slab/sump air BETX, N, MTBE, TMBs > VRSL Water table intersects foundation
(xi) Compounds of Concern in use	Sub-slab > VRSL Solvent use in building at time of closure	Sub-slab: BETX, N, MTBE, TMBs > VRSL Petroleum products used within building
(xii) Commercial/Industrial Exposure Assumption	Sub-slab > Commercial/industrial VRSL Solvent NOT in use at time of closure	Sub-slab: BETX, N, MTBE, TMBs > Commercial/industrial VRSL
(xiii) Future Construction. Includes remodeling or additions on an existing building.  (assumes: 1) there are no preferential pathways between the new building and residual VOC source and 2) the groundwater plume is stable or receding)	<u>If any of the following exist:</u> <u>Soil:</u> GW-RCL for PCE/TCE met or exceeded anywhere in vadose zone on property <u>GW</u> ≥ ES on property <u>GW</u> ≥ PAL if contaminated groundwater may contact building foundation	<u>NAPL:</u> (any of the following indicators) near where a building can be placed on the property: 1. Soil: B > 10 mg/kg; N > 5 mg/kg; Total PVOC > 250 mg/kg 2. Groundwater: B > 1 mg/l; Total PVOC > 30 mg/l 3. Presence of petroleum product (e.g., floating product, LIF survey results) <u>Soil:</u> significant contamination less than NAPL indicators and a building foundation can be placed within 5 feet of the contamination <u>Groundwater:</u> (significant dissolved petroleum less than NAPL indicators) 1. Building foundation can be placed within 5 feet or less of contaminated groundwater 2. Dissolved petroleum VOC ≥ PAL if contaminated groundwater may contact building foundation

Notes:

1. Perform remedial action/source control prior to closure request when operation of a vapor mitigation system (VMS) in order to protect the vapor pathway, as required by NR 726.05(8).
2. If a VMS is installed and operating, documentation of the system installation and effectiveness is required by NR 724.15.
3. An O&M plan, including all requirements of NR 724.13(2)(k) must be submitted with the closure request. An O&M plan should have been provided to the property owner and DNR at the time of VMS installation.