DIVISION OF WASTE MANAGEMENT (DWM) VAPOR INTRUSION SCREENING LEVELS GUIDANCE DOCUMENT

APRIL 2014

DWM has developed Indoor Air Screening Levels (IASL), Groundwater Screening Levels (GWSL), and Soil Gas Screening Levels (SGSL) for residential and non-residential exposures to assist in the evaluation of potential VI impacts. Exceedances of the screening levels indicate that VI is possibly a concern and that further evaluation and/or potential remediation of the pathway is necessary. Consult the specific DWM Program providing oversight on a particular project when addressing exceedances of screening levels; there may be applicable program-specific guidance in addition to the DWM guidance. If a volatile contaminant is not listed in the tables, contact the specific DWM program with oversight of the project.

The screening levels are calculated using the U.S. Environmental Protection Agency (USEPA) Vapor Intrusion Screening Level Calculator Spreadsheets, available at: http://www.epa.gov/oswer/vaporintrusion/guidance.html.

The VISL spreadsheets use the USEPA Regional Screening Level (RSL) Table air values and chemical parameters to calculate indoor air, soil gas and groundwater screening concentrations for vapor intrusion. This information is available at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

USEPA revises the RSL tables twice a year based on new toxicity factor information and any changes in the exposure parameters or calculation procedures. DWM will modify the affected screening level values and associated tables based on updates to the RSL tables shortly after the information becomes available. DWM will also update the methodology used to develop the screening levels and the analytical reporting limits values as the state of the science advances. See the USEPA RSL table Users Guide for definitions, equations and assumptions used for the USEPA RSLs and subsequent DWM adjustments.

To allow for flexibility in updating the tables on a frequent basis, the screening level tables are separate from this document and can be found on the DWM website at http://portal.ncdenr.org/web/wm/. To ensure that the most current information is used, it is recommended that users refer to the DWM website directly rather than rely on printed versions of the tables.

Indoor Air Screening Levels (IASL)

The IASLs are calculated for residential and non-residential (industrial/commercial) exposure scenarios at a target cancer risk of 1.0E-06, 1.0E-05, and 1.0E-04 for carcinogens, and to account for multiple contaminants with the same adverse health effect, a hazard quotient (HQ) of 0.2 for non-carcinogens. If a contaminant has both carcinogenic and non-carcinogenic effects, the lower screening level is retained. DWM allows a maximum cumulative cancer risk for all carcinogens of 1.0E-04 from all routes of exposure, and a hazard index (HI) of 1.0 for all non-carcinogens. The HI is the sum of HQs. Additional information is available at: (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm).

DWM IASLs may be cancer-based or non-cancer based. The USEPA RSL for residential or industrial- commercial air at a target cancer risk of 1.0E-06 is multiplied by 10 or 100 to derive the DWM IASL corresponding to a target cancer risk of 1.0E-05 and 1.0E-04 respectively. For non-carcinogens the USEPA RSL at a target hazard quotient of 1.0 is divided by 5 to get a concentration corresponding to a target hazard quotient of 0.2. If a contaminant has both carcinogenic and non-carcinogenic health effects, the lower concentration is adopted as the screening level.

When site data are compared with the screening levels, the user should ensure that the concentrations and the screening levels are both in the same units (ug/m^3). If necessary, concentrations in parts per billion vapor (ppbv) should be converted to ug/m^3 for comparison to the screening levels.

DWM requires the use of the residential IASLs in the evaluation of residential properties, schools and day care centers. There may also be situations where other site-specific exposures may be considered residential exposure as determined by the appropriate DWM cleanup program.

The non-residential IASLs are applicable to commercial/industrial sites when a discharge to the environment has occurred and the facility is not currently handling or using the subsurface contaminants of concern associated with the discharge. **The evaluation of VI at facilities currently using the same chemicals present in the discharge-impacted media (e.g., groundwater) should include consideration of both the non-residential screening levels and the applicability of the OSHA PEL to the subject building.** In this circumstance, the use of the non-residential IASL and/or the OSHA PEL is generally contingent upon obtaining an institutional control at the affected structure(s) to address potential future changes in site use. The non-residential IASLs are applicable to industrial/commercial facilities where the adult is the receptor of concern. Non-residential settings with sensitive populations (such as pregnant workers) will be handled on a site-specific basis.

Background contaminant levels, particularly ambient air results, may supersede the IASLs when higher since DWM does not require remediation to levels below background concentrations. Background determinations are made on a site-specific basis in consultation with DWM and as part of the overall multiple lines of evidence approach.

Groundwater Screening Levels (GWSL)

DWM has developed screening levels for groundwater in order to protect against unacceptable inhalation exposures to volatiles resulting from the migration of chemicals from contaminated groundwater to indoor air. The DWM GWSLs are derived using the method described in the USEPA Draft Vapor Intrusion Guidance (USEPA 2002b). The GWSL corresponding to a contaminant's target indoor air concentration is calculated by dividing the target indoor air concentration by an appropriate attenuation factor and then converting the vapor concentration to an equivalent groundwater concentration, assuming equilibrium between the aqueous and vapor phases at the water table. Diffusion resistances across the capillary fringe are assumed to be accounted for in the value of the attenuation factor (α). The equilibrium partitioning is assumed to obey Henry's Law. The equation used to calculate GWSLs is:

$$GWSL\ (ug/L) = IASL\ (ug/m^3) * 0.001\ m^3/L * 1/H * 1/\alpha$$

Where: H = dimensionless Henry's Law Constant at 25C [(mg/L – vapor)/(mg/L – H_2o)]
α = attenuation factor (ratio of indoor air concentration to source vapor concentration)

GWSLs should not be applied where a building foundation is in direct contact with competent, massive bedrock containing discrete fractured zones if vertical fractures are very likely to act as preferential pathways for vapors (i.e., directly connecting contaminated groundwater with building foundations). For the calculation of GWSLs, DWM uses the IASL at a target cancer risk of 1.0E-05 or a hazard quotient of 0.2 and an attenuation factor (α) of 0.001 for residential and non-residential exposure.

Soil Gas Screening Levels (SGSL)

The DWM SGSLs are derived using the method described in the USEPA Draft Vapor Intrusion Guidance (USEPA 2002b). The target soil gas concentration corresponding to a chemical's target indoor air concentration is calculated by dividing the target indoor air concentration by an appropriate attenuation factor. The attenuation factor represents the factor by which subsurface vapor concentrations migrating into indoor air spaces are reduced due to diffusive, advective, and/or other attenuating mechanisms. The equation used to calculate SGSLs is:

$$SGSL\ (ug/m^3) = IASL\ (ug/m^3)/\alpha$$

Where: α = attenuation factor (ratio of indoor air concentration to source vapor concentration)

For the calculation of SGSLs, DWM uses the IASL associated with a target cancer risk of 1E-05 or a hazard quotient of 0.2 and an attenuation factor (α) of 0.03 for residential exposure and 0.01 for non-residential exposure.

Many industrial and commercial buildings have HVAC systems that increase air exchange rates and are typically constructed with thicker, more competent slabs than in residential settings. Increased air exchange rates result in a greater attenuation of contaminants in indoor air, and thicker, more competent slabs may provide an additional barrier to vapor intrusion. It is reasonable to assume a greater attenuation in non-residential settings, therefore; DWM uses a higher attenuation factor for non-residential SGSLs.

The results from sub-slab, near slab, and exterior soil gas samples (where appropriate) should be compared to the DWM SGSLs. Exterior soil gas sampling is not acceptable as the exclusive determinant in the assessment of the VI pathway. DWM prefers the collection of sub-slab over near slab soil gas samples.

Important: **For non-residential exposure/settings, the soil gas vapor attenuation factor of 0.03 (residential screening levels) must be used for structures that exhibit building characteristics similar to residential building characteristics (for example, presence of a basement or crawl space). Use a default soil gas vapor attenuation factor of 0.03 unless the property will be subject to Division-approved land use restrictions that control the uses and types of structures on the property. Alternatively, either an attenuation factor of 0.01 (non-residential screening levels) can be used or an attenuation factor derived through a site-specific vapor evaluation, but in either case, only if the site's remedy will include land use restrictions approved by the Division.**