



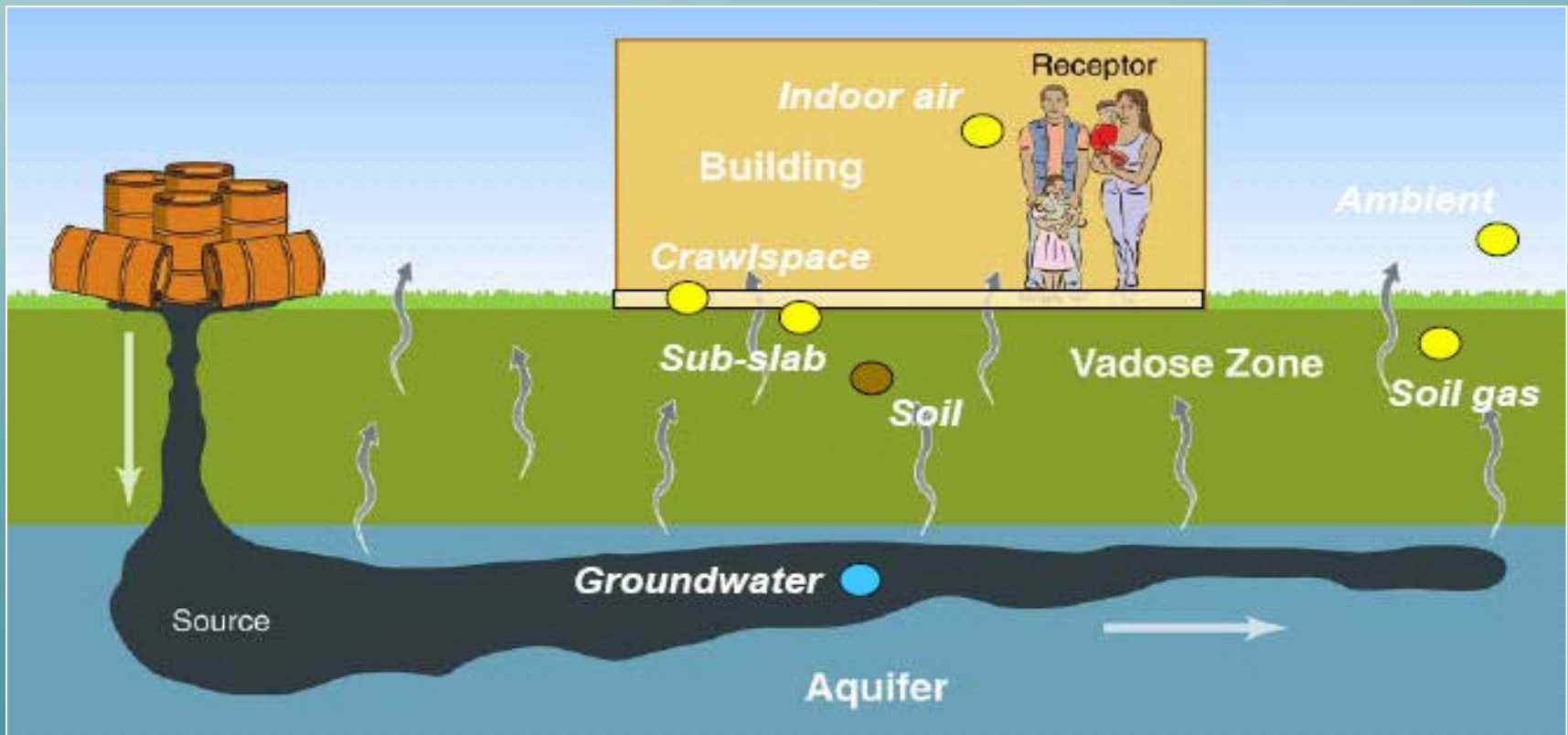
Remediation and Redevelopment Division Program Redesign 2009: New Vapor Intrusion Criteria and Immediate Response Activity Screening Levels

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Vapor Intrusion to Indoor Air

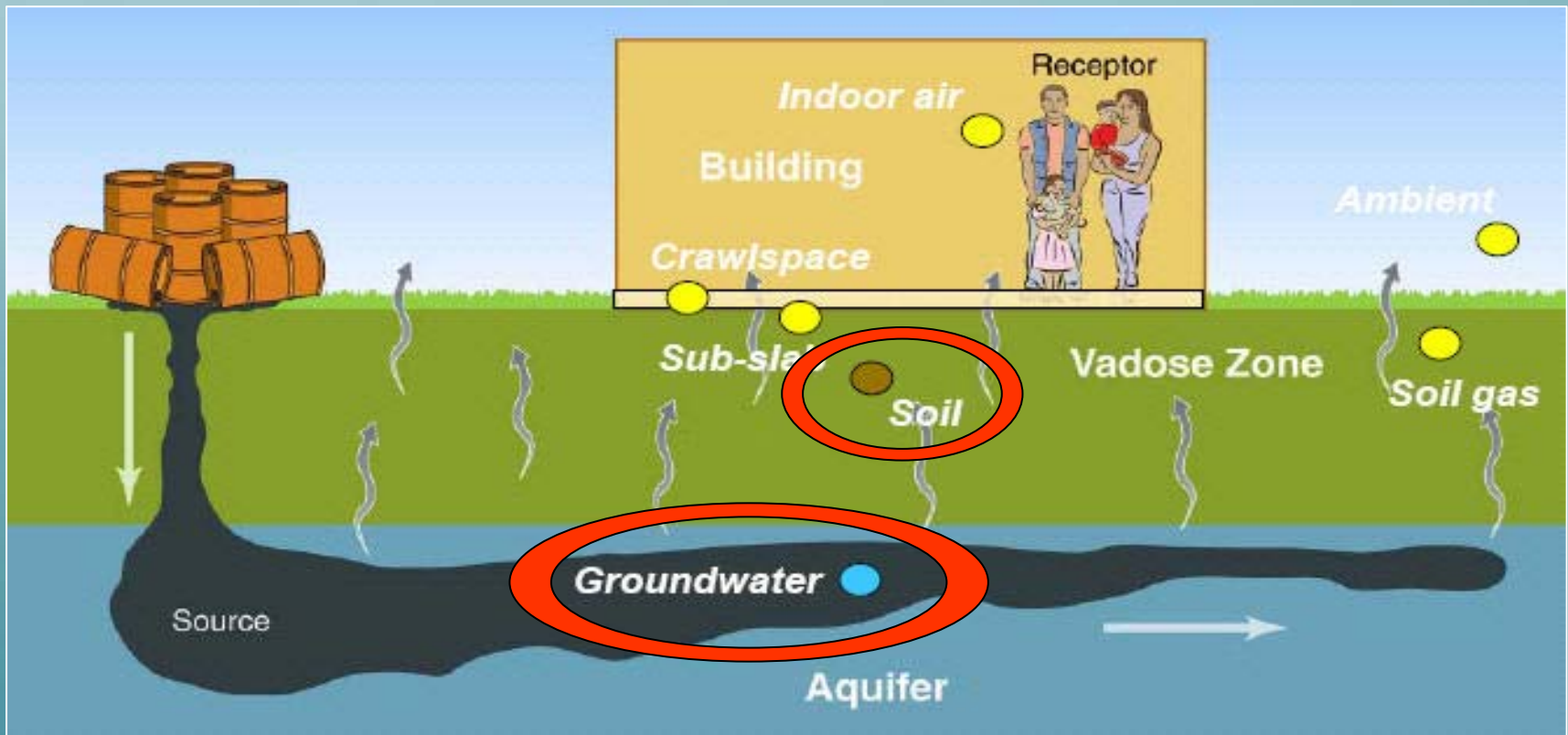
- VI one of most complex exposure pathways
- Various media used to evaluate VI risk
- Soil gas the preferred and most relevant medium for evaluating VI risk





Vapor Intrusion to Indoor Air

- Current approach dependant on soil and groundwater media
- SVIIC and GVIIC would no longer be used for compliance purposes or for facility determinations

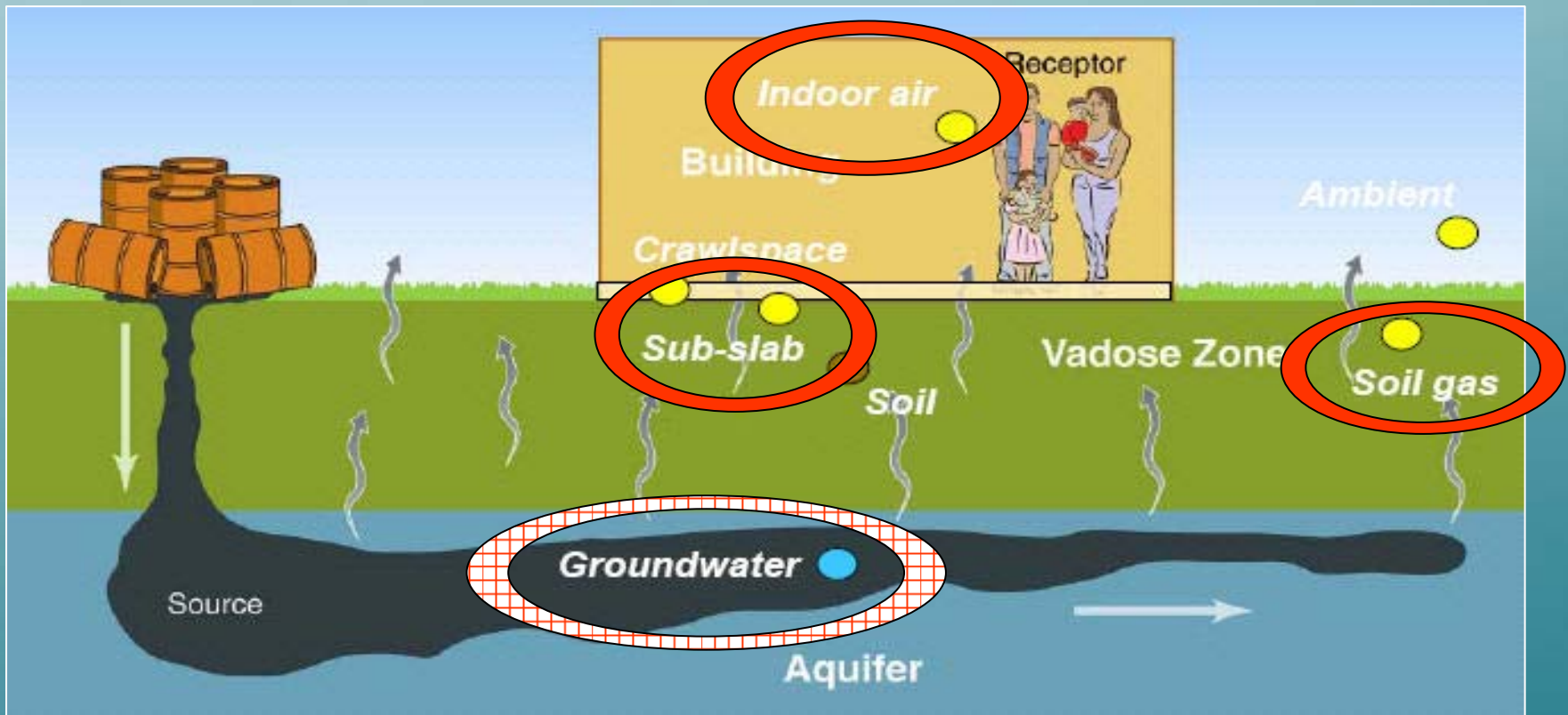


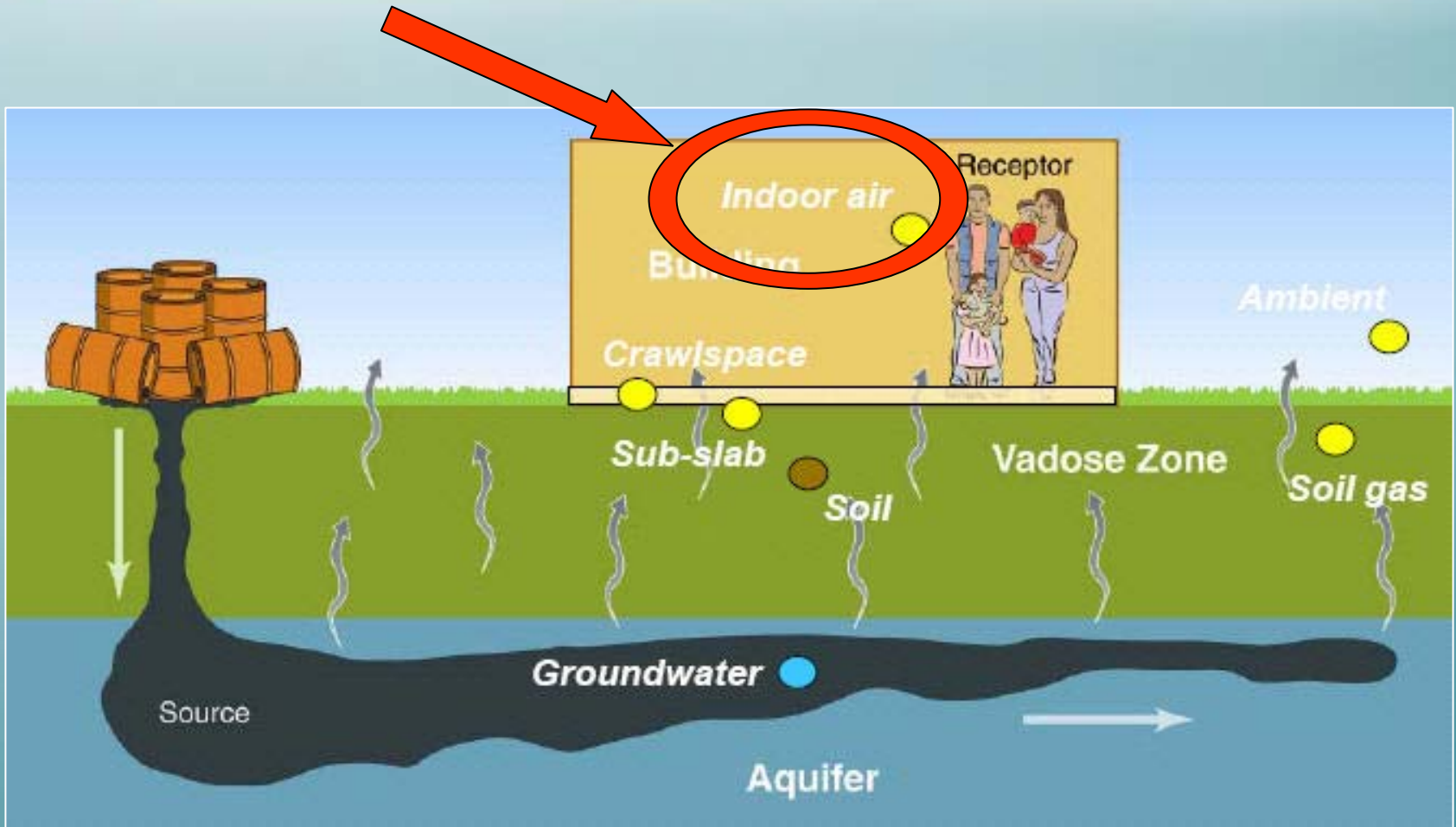


Vapor Intrusion to Indoor Air

New Cleanup Criteria to Address VI Pathway

- Soil Gas Criteria (SGC, Deep and Sub-slab)
- Indoor Air Criteria (IAC)
- Groundwater VI Screening Levels ($GW_{VI}SLs$)



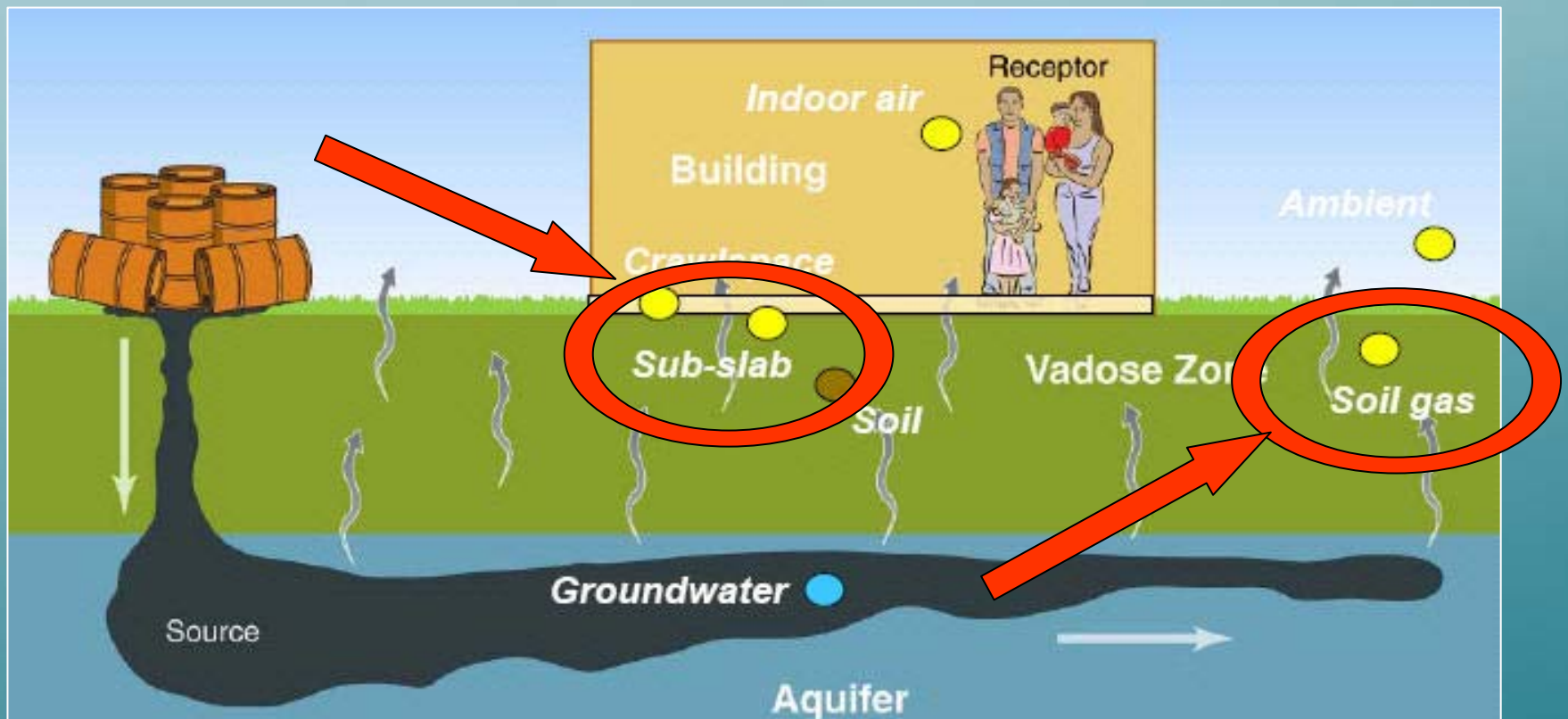




Indoor Air Criteria (IAC)

- For comparison to indoor air data (or crawl space)
- Calculation of the IAC equivalent to current methodology for calculating Acceptable Indoor Air Concentrations (AIACs)
- Chronic, risk-based, land use-specific exposure assumptions and chemical-specific toxicity characteristics
- Indoor air monitoring is generally not required for facility determinations or compliance demonstrations

- Calculation of SGC equivalent to current methodology for calculating the Acceptable Soil Gas Screening Concentrations (ASGSCs)
- For comparison to soil gas data (sub-slab and deep – 5')



Based on an attenuation coefficient, or alpha (α) value

- The α value represents a numerical constant derived empirically, modeled, or estimated to predict a concentration in soil gas that may cause impacts to indoor air above an acceptable health-based standard (e.g., IAC)
- The α value, as used in this context, is the ratio of contaminant vapor concentration in the building to the vapor concentration present at the source.



Basis of Attenuation Coefficient or α value:

- Attenuation coefficients for sub-slab to indoor air, deep soil gas to indoor air, and groundwater to indoor air were proposed in the draft U.S. EPA Subsurface Vapor Intrusion Guidance (2002).
- U.S. EPA (2002) recommended an attenuation coefficient of 0.1 (10%) for sub-slab to indoor air and 0.01 (1%) for deep soil gas to indoor air.



Basis of Attenuation Coefficient or α value (continued)

- Since the publication of the draft 2002 Guidance, the database has been significantly supplemented with new soil gas, indoor air, and groundwater data. These data suggest proposed α values (2002) are too conservative.
- The MDEQ has selected an α of 0.02 (2%) for sub-slab soil gas and 0.002 (0.2%) for deep soil gas for development of the SGC as a conservative and reasonable screening attenuation coefficient based on the latest empirical evidence.



Methodology:

$$SGC = \frac{IAC}{\alpha}$$

Where,

SGC = Soil Gas Criteria (sub-slab or deep), in ug/m³

IAC = Indoor Air Criteria (chemical-specific), in ug/m³

α = Attenuation Coefficient, unitless

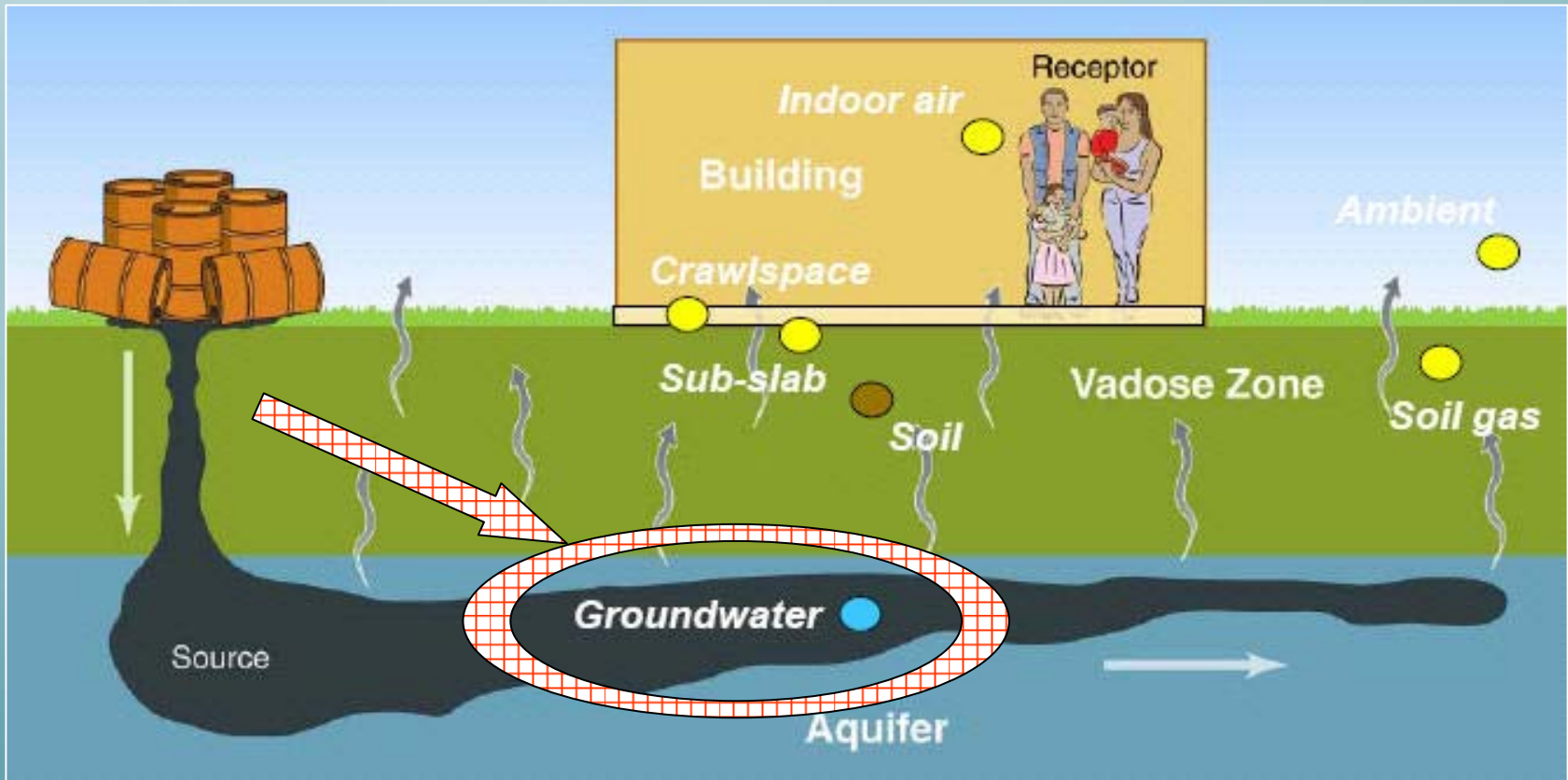
Sub-slab $\alpha = 0.02$

Deep $\alpha = 0.002$

Note: An appropriate bio-attenuation factor for petroleum hydrocarbons is under consideration



Groundwater VI Screening Level





Groundwater VI Screening Level

$GW_{VI}SL$

- Screening level for comparison to gw data
- Residential and non-residential screening levels
- Based on U.S. EPA (2002) methodology
- Uses empirically-derived attenuation coefficient of 0.001 (1/1000 or 0.1%)
- Unlike GVIIC, not dependant on modeling or consistency with a generic conceptual site model
- Applies to all groundwater beneath a structure (not in contact with a structure)
- Concentrations exceeding $GW_{VI}SL$ will require “facility” determination



Immediate Response Activity SLs

Specific conditions requiring immediate response activity are listed under another proposed section of the new statute titled, “Immediate Response Activities.” The new screening levels are intended to assist in identifying those conditions requiring immediate response under this proposed section



Immediate Response Activity SLs

- *Immediate Response Activity Screening Levels intended to facilitate self-implementation with limited MDEQ oversight or involvement*
- *Not intended to create a barrier to timely implementation of response action or to divert efforts from remedy selection or long-term compliance*
- *Absence of Immediate Response Activity Screening Level should not be interpreted as the absence of toxicity or physical hazard*



Immediate Response Activity SLs

Presentation Outline

- Purpose in Context of Program Redesign
- Introduction
- Acute Exposure
- Acute Inhalation Toxicity Values
- Immediate Response Activity Screening Levels
 - AIASLs
 - ASGSLs
 - EWSLS
 - FESLs
 - GW_{SUMP} SLs
- Draft Statutory Language



Purpose in Context of Program Redesign

- To identify exposure limits for various media, including air, soil gas, and groundwater, that are not expected to cause adverse health effects after a single or short-term exposure to an individual hazardous substance.
- To identify appropriate and necessary response actions and timeframes for response when exposure limits are exceeded in an environmental medium.

Definitions:

Definition of “Acute Exposure”

Acute exposure is generally defined as a single or repeated exposure over a 24-hour period.

Definition of “Acute Toxicity”

Acute toxicity is the ability of a hazardous substance to cause harmful, non-cancer effects in an organism through a single or short-term exposure.



Selection of Immediate Response Activity SLs

- Identification of acute effects or physical hazards resulting from inhalation, ingestion, and dermal exposures
- Limitation in available toxicity data for each exposure pathway
- Screening levels focused primarily on the inhalation route of exposure





May not protect populations with unique or increased exposure via a specific pathway (e.g., children and pica behavior via oral route)





Immediate Response Activity Screening Levels

Acute Indoor Air Screening Levels (AIASLs)

- Compared to indoor air data
- Same value for residential and non-residential land usage

Acute Soil Gas Screening Levels (ASGSLs)

- Screening levels for deep (5 feet) or sub-slab soil gas
- Same value for residential and non-residential land usage

Excavation Worker Screening Levels (EWSLs)

- Screening levels for deep (5 feet) soil gas
- Same value for residential and non-residential land usage

Fire and Explosion Screening Levels (FESLs)

- Compared to groundwater data
- Same methodology as current FESLs

Groundwater Sump Screening Levels ($GW_{\text{SUMP}}\text{SL}$)

- Compared to sump water data
- Same value for residential and non-residential land usage



Acute Inhalation Toxicity Values

Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRL)

- Preemptive in nature - Intended as an estimate of the daily human exposure to hazardous substance that is likely to be without appreciable risk of adverse non-cancer health effects over a specified duration of exposure [acute (1-14 days), intermediate (15-364 days) and chronic (365 days or more)]
- Rely on methodology similar to that of U.S. EPA's RfD and RfC methodology for deriving substance-specific health guidance levels for non-cancer endpoints (NOAEL/UF approach)
- MRLs undergo rigorous review process and are submitted for public comment.



Background

- Purpose of AIASLs to assist in the evaluation of the potential for acute inhalation toxicity in indoor air of an occupied structure and to identify appropriate response action
- **Not to be confused with Indoor Air Criteria (IAC) for addressing *chronic* inhalation toxicity as a result of vapor intrusion**
- Apply to indoor air data collected over 1-24 hour periods (averaging times)



Acute Indoor Air Screening Levels

Background (continued)

- AIASL equivalent to acute MRL
- Same AIASL for residential and non-residential
- Developed for a limited number of priority hazardous substances, including BTEX and PCE/TCE (total = 34)
- Used for back-calculating Acute Soil Gas Screening Levels (ASGSLs) and deriving Excavation Worker Screening Levels (EWSLs)
- May be used to evaluate crawl space air monitoring data



Immediate Response Obligations

- Requires only 1 exceedance to initiate accelerated evaluation/mitigation process
- Immediate response obligations include:
 - Initiation of response within 48 hours of discovery
 - Mitigation of acute inhalation hazard
 - Subsequent obligations may apply



Immediate Response Obligations (continued)

- NOTE: Indoor air monitoring not generally required; however, monitoring of indoor air may supplement an evaluation when discovery/inquiry shows an Acute Soil Gas Screening Level (ASGSL) is exceeded
- Demonstrating compliance with AIASL satisfies remedial obligations for addressing only acute inhalation hazards and due care requirements for the acute inhalation exposure pathway



Background

- Purpose of ASGSLs to assist in the evaluation of the potential for acute inhalation toxicity in indoor air and to identify appropriate response action
- **Not to be confused with Soil Gas Criteria (SGC) for addressing *chronic* inhalation toxicity as a result of vapor intrusion**
- Apply to appropriately collected deep (5 feet) or sub-slab soil gas data



Background (continued)

- Back-calculated from the acute MRL
- Developed for a limited number of priority hazardous substances, including BTEX and PCE/TCE (total = 34)
- Same ASGSL for residential and non-residential
- Methodology consistent with SGC
 - Deep ASGSL based on α of 0.002
 - Sub-slab ASGSL based on α of 0.02



Immediate Response Obligations

- Concentrations in deep or sub-slab soil gas do not necessarily indicate actual acute inhalation exposure indoors, but does indicate the need for further evaluation and an accelerated mitigation process
- Demonstrating compliance with ASGSL satisfies remedial obligations for addressing only acute inhalation hazards and due care requirements for the acute inhalation exposure pathway
- Evaluation may be supplemented with indoor air monitoring data (compared to AIASLs)



Immediate Response Obligations (continued)

- Exposure assessment, including initiation of conceptual site model to identify potential sources, receptors, and migration pathways
- Response actions may include, but are not limited to:
 - Source removal
 - Mitigation to address threatened receptors
 - Presumptive remedies
 - Further evaluation of indoor air quality. Indoor air data compared to AIASLs
- Subsequent obligations may ensue



Background

- For comparison to deep (5 feet) soil gas data ($\mu\text{g}/\text{m}^3$ or ppbv)
- Purpose of EWSLs to assist in the evaluation of the potential for acute inhalation toxicity during excavation or utility work and to identify appropriate response action
- EWSLs equivalent to acute MRL
- Developed for a limited number of priority hazardous substances, including BTEX and PCE/TCE (total = 34)
- Same EWSL for residential and non-residential land usage
- Note: If soil gas concentrations exceed a deep or sub-slab ASGSL, will also be exceeding an EWSL



Excavation Worker Screening Levels

Immediate Response Obligations

- ***Not intended to precede or preclude excavation work***
- No immediate response necessary unless current conditions or conceptual site model indicate current or on-going excavation work. If excavation work is being conducted at the site, remedial obligations include:
 - Immediate notice to excavation/utility workers
 - Mitigation of acute inhalation hazard
- If inquiry shows an exceedance of EWSL in soil gas, contingency to ensure protection required as part of response action if owner/operator/lessor engages in excavation activities
 - Notice to potentially affected parties
 - Example
- Subsequent obligations may apply



Fire and Explosion Screening Levels

Background

- Compared to groundwater data (ug/L)
- The purpose of the FESLs are to provide hazardous substance-specific screening concentrations that, when exceeded in groundwater, indicate a more detailed evaluation may be necessary to ensure protection against fires or explosion hazards
- FESL applicable to excavation work when groundwater may be intercepted and/or seeping into an excavation. Also applicable to contaminated groundwater in a sump or in an indoor trench, drain, or basin
- Relies on current FESL methodology
- Limited only to those hazardous substances with identified Lower Explosive Limit (NIOSH, ACGIH)



Immediate Response Obligations

- Exposure assessment, including initiation of conceptual site model to identify potential sources, receptors, and migration pathways
- Source removal
- Activity and use limitations preventing subsurface work
- NOTE: There are specific requirements to address methane. Technical Support Document specific to methane available.
- Subsequent obligations may apply



Immediate Response Obligations (continued)

- Response actions or presumptive remedies to address threatened receptors. Such measures include but are not limited to:
 - For active or operating facilities, development or modification to site Health and Safety Plan to address potential fire/explosion risks during excavation activities
 - Notification of potential threat to easement holders, utility workers or those conducting excavation
 - Venting of sump (capping alone is not an option as this may facilitate the accumulation of flammable or explosive vapors at the sump)
 - Presumptive mitigation of vapors beneath a structure
 - Soil gas evaluation. Soil gas data compared to 20% of LEL.



Groundwater Sump Screening Levels

Background

- The purpose of the GW_{SUMP} SLs are to provide hazardous substance-specific screening concentrations that, when exceeded in sump water, require immediate measures to presumptively mitigate potential volatilization to indoor air.
- Response action dependant upon presence of contaminated water in a sump. Occupancy may be considered.

Immediate Response Activities

- Approach not connected to a precise estimate of risk
- Initiate immediate measures (<48 hours) to cap or vent the sump.
- Subsequent obligations may ensue



Proposed Statutory Language

Subsection (1) - Authority

- Provides the department with the authority and ability to develop screening levels for the purpose of identifying environmental conditions that currently pose or may pose an immediate or imminent threat to human health, safety, or welfare, or the environment.

Subsection (2) – Methodology

- Identifies that the department may identify the methodology necessary for making a determination that an immediate or imminent response activity is necessary and for assigning specific obligations once that determination has been made.



Subsection (3) – Exposure Pathways

- To identify specific exposure pathways that are deemed by the department as relevant for the development of immediate response activity screening levels

Subsection (4) – Acute Inhalation

- Specific requirements for development of immediate response activity screening levels that are based on acute inhalation toxicity and exposure
- Provides options in the form of a hierarchy for selecting an appropriate acute inhalation toxicity endpoint



Subsection (5) – Fire and Explosion Hazards

- Identifies the fire and explosion screening levels as a separate category of the immediate response activity screening levels
- Specific requirements for response activities to address fire and explosion hazards are identified in the proposed section of the new statute titled “Immediate Response Activities”