



Designation: E2435 – 05 (Reapproved 2020)

## Standard Guide for Application of Engineering Controls to Facilitate Use or Redevelopment of Chemical-Affected Properties<sup>1</sup>

This standard is issued under the fixed designation E2435; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### INTRODUCTION

Environmental media, such as soil, groundwater, or air, are susceptible to impact by chemical releases associated with past property-use activities; or they may be affected by naturally occurring conditions. Previously developed properties may have been impacted by chemical releases associated with historical operations, chemical spill incidents, waste management practices, or other related sources of COCs. In some cases, such chemicals may remain in soil, groundwater, or other environmental media; and, depending on their toxicity, concentration, location, and migration potential in the environment, they can pose a potential health risk in the event of exposure of current or future property users. Similarly, in the absence of a chemical release caused by human activity, COCs that are naturally present in soils, groundwater, soil vapors, or other environmental media can pose an unacceptable risk to human health, depending on the chemical toxicity and exposure (e.g., radon gas emanation into indoor air space of overlying buildings). Under certain conditions, in the absence of exposure controls, human exposure to chemical-affected environmental media at residential, commercial, or industrial properties could occur via various exposure pathways, including but not limited to (1) surface soil direct contact, (2) ambient or indoor air vapor exposure, or (3) affected groundwater impact on subsurface structures or utilities. Other pathways or exposure mechanisms may exist, and if so, should be addressed in a similar manner to those addressed in the guide.

### 1. Scope

1.1 This guide presents general considerations for application of engineering controls to facilitate continued use or redevelopment of properties containing chemical-affected soil, groundwater, or other environmental media, due either to chemical releases or naturally-occurring conditions. This guide is not meant to be prescriptive but rather to present considerations for evaluating technologies capable of addressing potential human exposures associated with chemical-affected environmental media.

1.2 **Table 1** lists the considerations that should be taken into account when developing an engineering control in accordance with this guide.

1.3 This guide is intended for use by real estate developers, civil/structural designers, environmental regulators, industrial

parties, environmental consultants, and other persons concerned with residential, commercial, or industrial development of real properties where chemical-affected environmental media are present. The design process should involve the individuals and firms working on various aspects of the specifications for construction, operation, and maintenance. If the site is located on public property, then public participation should be considered during the design process.

1.4 This guide is directed toward properties where chemical-affected environmental media, associated with either human-influenced activities or naturally-occurring conditions, will remain in place and where active or passive engineering controls will be used to reduce or eliminate exposures that may otherwise pose an unacceptable risk to property users.

1.5 This guide identifies the exposure concerns associated with chemical-affected properties that may affect the property development plan, both in the construction phase and during the proposed use of the property; defines performance standards for control of applicable exposure pathways; and, for each exposure pathway, provides examples of engineering controls that may be applied for new or existing construction.

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.04 on Corrective Action.

Current edition approved Nov. 1, 2020. Published November 2020. Originally approved in 2005. Last previous edition approved in 2015 as E2435 – 05(2015). DOI: 10.1520/E2435-05R20.

**TABLE 1 Design Considerations for Engineering Controls<sup>4</sup>**

Task/Description	Reference <sup>B</sup>	Check	
		When Complete	If Not Applicable
<b>SITE CHARACTERIZATION</b>			
<b>1. Regulatory Framework</b>			
• <i>Regulations</i> : Identify federal, state, and local laws, rules, and ordinances applicable to site characterization and engineering controls. Ensure design and installation conform to technical standards specified in regulations.	6.3.9	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Guidance</i> : Identify relevant guidance documents.	4.6,6.3.9	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Risk Limits</i> : Define unacceptable risk per regulatory framework or other process.	5.2	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Permitting</i> : Complete permitting, notification, and activity and use limitations per regulatory requirements.	6.3.9	<input type="checkbox"/>	<input type="checkbox"/>
<b>2. Site Conceptual Model</b>			
• <i>Delineation</i> : Define extent of chemical-affected environmental media: soil, groundwater, air, other.	5.2.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Chemicals of Concern</i> : Identify COCs, toxicity, concentrations, locations, migration potential.	5.2.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Receptors</i> : Identify potential receptors, complete exposure pathways, define anticipated property use during design life of engineering control.	5.2.1	<input type="checkbox"/>	<input type="checkbox"/>
<b>SITE DEVELOPMENT PLAN</b>			
<b>1. Considerations for Site Development Plan</b>			
• <i>Human Contact</i> : Reduce or eliminate human contact with chemical-affected environmental media.	5.3.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Waste</i> : Limit generation of hazardous waste materials.	5.3.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>COC Migration</i> : Prevent off-site migration of COCs.	5.3.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Plume Expansion</i> : Prevent expansion of affected soil and groundwater zones.	5.3.1	<input type="checkbox"/>	<input type="checkbox"/>
<b>2. Limitations on Site Development Plan</b>			
• <i>Subsurface Construction</i> : Consider locations of structures and subsurface penetrations, consider direct contact with chemical-affected groundwater during construction.	5.3.2	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Existing Facilities</i> : Consider need to maintain existing engineering controls.	5.3.2	<input type="checkbox"/>	<input type="checkbox"/>
<b>DESIGN OF ENGINEERING CONTROLS</b>			
<b>1. Achievement of Performance Standard</b>			
• <i>Risk Limits</i> : Reduce or eliminate unacceptable risk by either or both of the following: a. By preventing direct contact with chemical-affected environmental media. b. By preventing migration of COCs from chemical-affected environmental media to point of exposure.	6.1.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Design Life</i> : Set design life of engineering control equal to lesser of the following: a. Expected duration of the exposure hazard. b. Expected duration of the site or structure for the specified property use.	6.1.2	<input type="checkbox"/>	<input type="checkbox"/>
<b>2. Application of Engineering Controls to Specific Exposure Pathways</b>			
• <i>Direct Contact</i> : Prevent surface soil direct contact by either or both of the following a. Obstructing human contact with chemical-affected soil. b. Impeding the release of wind-driven soil particulates into the air.	6.2.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Soil or Groundwater Vapors</i> : Prevent inhalation of vapors at concentrations exceeding unacceptable risk levels by inhibiting migration of vapors to ambient or indoor air.	6.2.2	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Groundwater Impacts</i> : Prevent impact of affected groundwater on subsurface structures or utilities by installing a barrier to flow.	6.2.3	<input type="checkbox"/>	<input type="checkbox"/>
<b>3. Design Specifications</b>			
• <i>Qualifications</i> : Prepare design specification by qualified persons having required professional or regulatory certifications.	4.5,6.3	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Participation</i> : Solicit, consider, and incorporate input from individuals and firms working on various aspects of the design, construction, operation, and maintenance specifications.	1.3	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Documentation</i> : Document design specifications in sufficient detail to evaluate compliance with performance criteria.	6.3	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Design Basis Information</i> : Develop design basis information sufficient to support engineering design of components of the engineering control.	6.3.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Effective Area</i> : Define effective area to address the full area or volume, or both, of the chemical-affected environmental media requiring exposure control.	6.3.2	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Defining Boundary</i> : Specify defining boundary to physically demarcate or document engineering control or area of chemical-affected media, or both.	6.3.2	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Components</i> : Specify design components of engineering control, including details of design, installation, and operation and maintenance.	6.3.3	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Dimensions and Material Specifications</i> : Evaluate the properties of each design component (e.g., material strength, durability, corrosion resistance, chemical compatibility) for capability to achieve the specified performance standard for the duration of the design life under anticipated site conditions.	6.3.4	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Treatment System</i> : Specify design for construction or installation of treatment system for soil or groundwater, including removal efficiency or required concentrations after treatment.	6.3.5	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Documentation</i> : Prepare record drawings, drawings conforming to construction records, or other written records to document installation of engineering control.	6.3.7	<input type="checkbox"/>	<input type="checkbox"/>
<b>INSTALLATION OF ENGINEERING CONTROLS</b>			
• <i>QA/QC Program</i> : Set up system of inspections, monitoring, or testing, or combination thereof, to confirm installation in accordance with design specifications.	7.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Qualifications</i> : Specify installation by persons qualified to complete work by reason of professional or regulatory certifications.	7.2	<input type="checkbox"/>	<input type="checkbox"/>

**TABLE 1** *Continued*

Task/Description	Reference <sup>B</sup>	Check	
		When Complete	If Not Applicable
<b>MONITORING AND MAINTENANCE OF ENGINEERING CONTROLS</b>			
• <i>Obligatory Requirements:</i> Ensure monitoring requirements comply with enforcement instruments for site (e.g., consent agreement, consent order, order, permit, etc.).	8.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Periodic Monitoring:</i> Specify type (e.g., visual inspection, physical measurements, sampling and testing) and frequency, of monitoring programs needed to assess performance of engineering control and fulfill regulatory requirements. Include triggers for non-routine monitoring.	8.2	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Maintenance:</i> Describe schedule and procedures for conducting repairs or replacements indicated by periodic monitoring.	8.3	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Assessment:</i> Describe procedures for assessing the performance of the engineering control and implementing changes as needed to address results of the periodic monitoring.	8.4	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Re-Evaluation:</i> Describe procedures for re-evaluating the performance of the engineering control and implementing changes as needed to address (1) a change in land use, regulatory criteria, or site development plan; or (2) a newly identified risk.	4.4,5.4,8.4	<input type="checkbox"/>	<input type="checkbox"/>
<b>USE OF ACTIVITY AND USE LIMITATIONS</b>			
• <i>Need for Activity and Use Limitations:</i> Identify the activity and use limitations to be implemented along with engineering controls in order to control risk.	9.1	<input type="checkbox"/>	<input type="checkbox"/>
• <i>Recordation:</i> File activity and use limitations in real property records of governmental entities having jurisdiction over the site in order to notify future owners and users of the site about the presence of engineering controls.	9.2	<input type="checkbox"/>	<input type="checkbox"/>

<sup>A</sup> Table presents design issues to be considered to demonstrate that the design of an engineering control for chemical-affected property has been developed in accordance with this guide. Consideration of the issues should be documented in accordance with the identified regulatory framework for the site.

<sup>B</sup> References indicate sections of this guide.

1.6 This guide will assist in identification of the optimal property development plan for a property with chemical-affected environmental media. Such a plan will address both short-term construction issues and long-term exposures of property users.

1.7 This guide does not address the broader range of environmental concerns that are not directly affected by construction measures and engineering controls (e.g., protection of water resources or ecological receptors).

1.8 Detailed specifications for site-specific application of engineering controls are not addressed in this guide. The user is referred to other related ASTM standards and technical guidelines regarding the implementation of the site evaluation and corrective action process, as well as the detailed design, installation, operation, and maintenance of these engineering controls.

1.9 The overall strategy for addressing unacceptable risks may employ either remedial actions or activity and use limitations, or both. Engineering controls are a subset of remedial actions given that (1) remedial actions involve cutting off the exposure pathway or reducing the concentration of COCs, or both and (2) that engineering controls only involve cutting off the exposure pathway. Engineering controls are briefly described in Guide E2091, which describes a broad range of options for managing risk. This guide covers implementation of engineering controls in a detailed manner, thereby providing a needed complement to the information provided in Guide E2091.

1.10 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.11 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the*

*responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.12 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 The pertinent ASTM standards for development of engineering controls at chemical-affected properties are listed below. Additional standards and other non-ASTM references related to the development of engineering controls at chemical-affected properties are provided in [Appendix X6](#).

### 2.2 ASTM Standards:<sup>2</sup>

[C1193 Guide for Use of Joint Sealants](#)

[C1299 Guide for Use in Selection of Liquid-Applied Sealants \(Withdrawn 2012\)<sup>3</sup>](#)

[E1689 Guide for Developing Conceptual Site Models for Contaminated Sites](#)

[E1745 Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs](#)

[E1984 Guide for Brownfields Redevelopment \(Withdrawn 2012\)<sup>3</sup>](#)

[E2081 Guide for Risk-Based Corrective Action](#)

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).