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Standard Guide for Developing Representative Sediment Background Concentrations at Sediment Sites—Selection of Background Reference Areas¹

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1. Scope

1.1 This guide focuses on the selection of sediment background reference areas from aquatic environments for the purpose of developing representative sediment background concentrations. These concentrations are typically used in contaminated sediment corrective actions performed under various regulatory programs, including the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Although many of the references cited in this guide are CERCLA-oriented, the guide is applicable to remedial actions performed under local, state, tribal, federal, and international cleanup programs. However, this guide does not describe the requirements for each jurisdiction.

1.1.1 The sediment background reference areas chosen using this guide will need to be approved by the regulatory agency having jurisdiction (or they should take no exception to the areas chosen), especially if the representative background sediment concentrations will potentially be used to develop sediment remedial criteria.

1.2 This guide provides a framework to select appropriate sediment background reference areas for the collection of sediment data in the development of representative sediment background concentrations. It is intended to inform, complement, and support, but not supersede, local, state, tribal, federal, or international guidelines.

1.2.1 This guide is designed to apply to contaminated sediment sites where sediment data have been collected and are readily available. Additionally, it assumes that risk assessments have been performed, so that the potential contaminants of concern (PCOCs) that exceed risk-based thresholds have been identified. This guide can be applied at multiple points within the project life cycle (such as site assessment and remedial design).

1.2.2 Furthermore, this guide presumes that the identified risk-based thresholds are low enough to pose corrective action implementation challenges or that the sediment site is subject to recontamination from ongoing anthropogenic or natural sources (or both) that are not controlled. In either case, representative sediment background concentrations are useful for determining the extent of corrective remedial actions (when used as remedial goals), evaluating risks posed by representative background concentrations, and establishing appropriate post-remedial monitoring plans.

1.2.3 A case study for selecting a background reference area using a tiered decision analysis approach is presented in [Appendix X1](#). It compares various characteristics of a hypothetical sediment site associated with a former upland manufactured gas plant (MGP) facility to three candidate background reference areas and identifies the background reference area that best satisfies the decision analysis objectives.

1.3 Methodologies used to develop representative background concentrations at contaminated sediment sites are not discussed in this guide—refer to Guide [E3242](#) for a discussion of these methodologies.

1.4 *Related ASTM Standards*—This guide is related to Guide [E3382](#), which provides the overarching framework for the development of representative background concentrations at contaminated sediment sites, including Conceptual Site Model (CSM) considerations. This guide is also related to Guide [E3242](#), which provides a detailed framework for developing representative sediment background concentrations, including statistical and geochemical considerations as well as background threshold values. This guide is also related to Guide [E3164](#), which addresses corrective action monitoring before, during, and after sediment remediation activities, as well as Guide [E3163](#), which concerns sediment sampling and analytical techniques used during sediment corrective action projects. Guide [D4823](#), which concerns sediment core sampling, is also related to this guide.

1.4.1 Specifically, this guide is intended to be used under the overarching framework of Guide [E3382](#), in conjunction with the detailed framework to develop representative background values outlined in Guide [E3242](#), to help ensure appropriate

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background reference areas are chosen for use in representative background concentration development.

1.5 *Units*—The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this guide.

1.6 *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.*

1.7 *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 ASTM Standards:²

- D4823** Guide for Core Sampling Submerged, Unconsolidated Sediments
- E178** Practice for Dealing With Outlying Observations
- E1689** Guide for Developing Conceptual Site Models for Contaminated Sites
- E3163** Guide for Selection and Application of Analytical Methods and Procedures Used during Sediment Corrective Action
- E3164** Guide for Contaminated Sediment Site Risk-Based Corrective Action – Baseline, Remedy Implementation and Post-Remedy Monitoring Programs
- E3240** Guide for Risk-Based Corrective Action for Contaminated Sediment Sites
- E3242** Guide for Determination of Representative Sediment Background Concentrations
- E3382** Guide for Developing Representative Background Concentrations at Sediment Sites — Framework Overview, Including Conceptual Site Model Considerations

3. Terminology

3.1 Definitions:

3.1.1 *background* (aka “reference”), *adj*—a term applied to substances, conditions, or locations that are similar to those found at a sediment site but not influenced by current or historical releases or activities from the sediment site; these are usually a combination of naturally occurring (consistently present in the environment but not influenced by human activity) and anthropogenic (influenced by human activity but not related to specific current or historical releases or activities at the sediment site) components. **E3382**

3.1.2 *background reference areas*, *n*—sediment areas that have similar physical, chemical, geological, biological, and

land-use characteristics as the site being investigated, but are not affected by site-related releases and/or activities. **E3242**

3.1.3 *candidate background data set*, *n*—a raw (that is, unprocessed) background data set obtained either by the collection of data from a background reference area(s), or by the extraction of background data from the sediment site data set, or a combination of both. **E3382**

3.1.3.1 *Discussion*—The candidate background data set must first be evaluated using the steps described in Guide **E3242** and Section 5 to obtain a representative background data set, which can then be used to develop representative background concentrations for the sediment site.

3.1.4 *cleanup level*, *n*—the prescribed average or point sediment concentration of a chemical that shall not be exceeded at the remediated site. **E3242**

3.1.5 *contaminant of concern (COC)*, *n*—substances identified as posing a risk based on a tiered risk assessment and that may warrant corrective action. **E3382**

3.1.5.1 *Discussion*—Typically, all PCOCs identified for a sediment site are evaluated in the risk assessment process. PCOCs that have sediment concentrations greater than risk-based thresholds identified in the risk assessment process are defined as COCs. Thus, the COCs identified for a sediment site are a subset of the PCOCs identified for that site.

3.1.6 *conceptual site model (CSM)*, *n*—the integrated representation of the physical and environmental context, the complete and potentially complete exposure pathways and the potential fate and transport of potential contaminants of concern at a site. **E3242**

3.1.6.1 *Discussion*—The CSM should include both the current understanding of the site and an understanding of the potential future conditions and uses for the site. It provides a method to conduct the exposure pathway evaluation, inventory the exposure pathways evaluated, and determine the status of the exposure pathways as incomplete, potentially complete, or complete.

3.1.7 *population*, *n*—in statistics, a comprehensive set of values consisting of all possible observations or measurements of a certain phenomenon from which a sample is to be drawn. **E3242**

3.1.8 *potential contaminant of concern (PCOC)*, *n*—a contaminant whose sediment concentrations at the site may exceed applicable screening levels; this includes chemicals of potential environmental concern (COPECs) and chemicals of potential concern (COPCs). **E3242**

3.1.9 *representative background data set*, *n*—a background data set obtained by evaluating candidate background data using the steps described in Guide **E3242**. **E3382**

3.1.9.1 *Discussion*—The evaluation determines if there are any data points in the candidate background data set that are not representative of sediment site background conditions. These data points are then removed from the candidate background data set (using technically justifiable rationale) to obtain a representative background data set, which is then used to develop representative background concentrations for the sediment site using methodologies described in Guide **E3242**.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

3.1.10 *representative background concentrations*, *n*—a chemical concentration that is inclusive of naturally occurring sources and anthropogenic sources similar to those present at a site, but not related to site releases and site-related activities.

3.1.11 *sediment(s)*, *n*—a matrix of porewater and particles including gravel, sand, silt, clay, and other natural and anthropogenic substances that have settled at the bottom of a tidal or non-tidal body of water. **E3163**

3.1.12 *sediment site*, *n*—the area(s) defined by the likely physical distribution of COC(s) from a source area and the adjacent areas required to implement the corrective action. A site could be an entire water body or a defined portion of a water body. **E3240**

3.1.13 *trace element*, *n*—an element defined as generally being present at less than 0.1 weight percent in the sediment sample; its natural concentrations are typically one or more orders of magnitude lower than those of the reference elements. **E3242**

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *anthropogenic background*, *n*—human-made substances present in the environment due to human activities, not specifically related to current or historical site-related releases or activities **(1)**.³

3.2.1.1 *Discussion*—The definition of “anthropogenic background” varies with jurisdiction. In some jurisdictions, the regulator defines anthropogenic background as having both human-made and naturally occurring substances. In this guide, the definition of anthropogenic background includes only the human-made substances.

3.2.2 *biological reference areas*, *n*—a location that is representative of background conditions resulting from localized and regional pollutant inputs but is not affected by site-related releases or activities, which is used to collect biological samples (such as fish and shellfish tissue, benthic community organisms) and sediment for laboratory bioassay testing (such as toxicity or bioaccumulation testing).

3.2.2.1 *Discussion*—A biological reference area can also serve as a background reference area, if sediment samples are also submitted for chemical analysis of PCOCs.

3.2.3 *natural background*, *n*—naturally occurring substances present in the environment in forms (and at concentrations) that have not been influenced by human activity **(1)**.

3.2.4 *urban runoff*, *n*—a non-point source of contaminants to the water body.

3.2.4.1 *Discussion*—Typically, this is stormwater from city streets and adjacent properties that carries contaminants into receiving waters directly, or indirectly via sewer systems **(2)**.

4. Significance and Use

4.1 *Intended Use*—This guide may be used by various parties involved in sediment corrective action programs, including regulatory agencies, project sponsors, environmental

consultants, toxicologists, risk assessors, site remediation professionals, environmental contractors, and other stakeholders.

4.2 *Importance of the CSM*—The CSM should be continuously updated and refined to describe the physical properties, chemical composition and occurrence, biologic features, and environmental conditions of the sediment corrective action project (Guide **E1689**).

4.3 *Reference Material*—This guide should be used in conjunction with other ASTM guides listed in **2.1** (especially Guides **E3242** and **E3382**); this guide should also be used in conjunction with the material in the References at the end of this guide (including **3**). Utilizing these reference materials will direct the user in developing representative sediment background concentrations.

4.4 *Flexible Site-Specific Implementation*—This guide provides a systematic but flexible framework to accommodate variations in approaches by regulatory agencies and by the user based on project objectives, site complexity, unique site features, regulatory requirements, newly developed guidance, newly published scientific research, changes in regulatory criteria, advances in scientific knowledge and technical capability, and unforeseen circumstances.

4.5 *Regulatory Frameworks*—This guide is intended to be applicable at a broad range of local, state, tribal, federal (such as CERCLA), or international jurisdictions, each with its own unique regulatory framework. As such, this guide does not provide a detailed discussion of the requirements or guidance associated with any of these regulatory frameworks, nor is it intended to supplant applicable regulations and guidance. The user of this guide will need to be aware of the regulatory requirements and guidance in the jurisdiction where the work is being performed.

4.6 *Systematic Project Planning and Scoping Process*—When applying this guide, the user should undertake a systematic project planning and scoping process to collect information to assist in making site-specific, user-defined decisions for a particular project, including assembling an experienced team of project professionals (that is, experienced practitioners familiar with current sediment site characterization and remediation techniques, as well as geochemistry and statistics). These practitioners should have the appropriate expertise to scope, plan, and execute a sediment data acquisition and analysis program. This team may include, but is not limited to, project sponsors, environmental consultants, toxicologists, site remediation professionals, analytical chemists, geochemists, and statisticians.

4.6.1 Depending on the regulatory requirements in a jurisdiction, the choice of background reference areas may need to consider critical habitats and ecological receptors.

4.6.2 In this guide, sediment (**3.1.11**) is defined as material being found at the bottom of a water body. Upland soils of sedimentary origin are excluded from consideration as sediment in this guide.

4.7 *Other Considerations*—This guide does not cover all components of a program to develop representative sediment background concentrations.

³ The boldface numbers in parentheses refer to the list of references at the end of this standard.